PHASE II EXPANSION APPLICATION
JUNIPER RIDGE LANDFILL
NATURAL RESOURCES PROTECTION ACT AND SECTION 404 – CLEAN WATER ACT
VOLUME V

Prepared for

STATE OF MAINE BUREAU OF GENERAL SERVICES,
as Owner
and
NEWSME LANDFILL OPERATIONS, LLC
as Operator

November 2025

4 Blanchard Road
P.O. Box 85A
Cumberland, Maine 04021

Tel: 207.829.5016 sme-engineers.com

SME
SEVEE & MAHER
ENGINEERS

TABLE OF CONTENTS

Section No.	Title	Page No.
EXECUTIVE SUMMARY		**ES-1**
ATTACHMENT 1 ACTIVITY DESCRIPTION		**1-1**
1.1 Background		1-1
1.1.1 Original Landfill		1-1
1.1.2 Phase I Expansion		1-1
1.1.3 Phase II Expansion		1-2
1.2 Project Description		1-2
1.2.1 General Project Description		1-2
1.2.2 Wetlands Impacts		1-3
1.3 Adherence to NRPA Standards		1-4
1.4 Scenic, Aesthetic, Recreational, and Navigational Uses		1-4
1.4.1 Minimize Erosion		1-4
1.4.2 Protection of Wildlife Habitat		1-4
1.4.3 Natural Flow of Surface Water		1-5
1.4.4 Protection of Surface Water Classification		1-5
1.4.5 No Increase in Flooding		1-6
1.4.6 Historical and Archaeological Resources		1-6
1.5 Adherence to Maine Law		1-6
ATTACHMENT 2 ALTERNATIVES ANALYSIS		**2-1**
2.1 Examination of Need		2-1
2.1.1 Maine's Solid Waste Disposal Capacity and Needs		2-1
2.1.2 Landfill Siting Criteria		2-4
2.1.3 Operating Services Agreement (OSA)		2-5
2.2 Examination of Alternatives		2-6
2.2.1 No Build/Do Nothing		2-6
2.2.2 Use of Other Existing Waste Disposal Facilities		2-6
2.2.3 On-Site Avoidance and Minimization		2-7
2.2.4 Alternate Greenfield Sites		2-9
2.2.5 Alternative Locations on the JRL Property		2-10
2.2.6 Alternatives Analysis Conclusions		2-12
ATTACHMENT 3 USGS MAP		
ATTACHMENT 4 COLOR PHOTOS		
ATTACHMENT 5 OVERHEAD AND SITE VIEW DRAWINGS		
ATTACHMENT 6 ADDITIONAL PLANS		
ATTACHMENT 7 CONSTRUCTION PLANS		
ATTACHMENT 8 EROSION SEDIMENTATION CONTROL PLAN		
ATTACHMENT 9 SITE CONDITIONS (WETLAND DELINEATION REPORT)		
ATTACHMENT 10 NOTICE OF INTENT TO FILE AND CERTIFICATE OF GOOD CORPORATE STANDING		
ATTACHMENT 11 MAINE HISTORIC PRESERVATION COMMISSION AND TRIBAL CORRESPONDENCE		
ATTACHMENT 12 FUNCTIONS AND VALUES ASSESSMENT		
ATTACHMENT 13 WETLAND COMPENSATION PLAN		

LIST OF APPENDICES

APPENDIX A VISUAL EVALUATION FIELD SURVEY CHECKLIST AND VISUAL ASSESSMENT
APPENDIX B MAINE DEP PUBLIC BENEFIT DETERMINATION
APPENDIX C RIGHT, TITLE, OR INTEREST
APPENDIX D OPERATING SERVICES AGREEMENT (OSA)
APPENDIX E MATERIALS MANAGEMENT PLAN
APPENDIX F BIOSOLIDS REPORT

LIST OF FIGURES

(end of respective section)

Figure No.	Title	Page No.
1-1	SITE LOCATION MAP	1-7
1-2	SITE DEVELOPMENT PLAN	1-8
1-3	BASE LINER SYSTEM	1-9
1-4	IMPACTED WETLAND AREAS	1-10
2-1	ALTERNATIVE #1	2-13
2-2	ALTERNATIVE #2	2-14
2-3	ALTERNATIVE #3	2-15

LIST OF TABLES

Table No.	Title	Page No.
2-1	ALTERNATIVE LANDFILL VOLUMES AND IMPACTS	2-12

PHASE II EXPANSION APPLICATION
JUNIPER RIDGE LANDFILL
NATURAL RESOURCES PROTECTION ACT
AND
SECTION 404 – CLEAN WATER ACT
VOLUME V

EXECUTIVE SUMMARY

The Maine Bureau of General Services (BGS) and NEWSME Landfill Operations, LLC (NEWSME) have prepared this joint Application pursuant to both the Natural Resources Protection Act (NRPA), 38 M.R.S. §§ 480-A to 480-FF, and Section 404 of the Clean Water Act, 33 U.S.C. § 1344, in support of an application filed with the Maine Department of Environmental Protection (MEDEP) for a second expansion (Phase II Expansion) of the existing Juniper Ridge Landfill (JRL) onto an adjacent approximately 57-acre area immediately north of the existing 122-acre landfill facility. The MEDEP has already found in a Public Benefit Determination (PBD) granted on October 2, 2024, that the Phase II Expansion meets both the short- and long-term solid waste disposal capacity needs of Maine, as required in 38 M.R.S. § 1310-AA.

The Phase II Expansion will involve approximately 57 acres of additional landfill footprint, and approximately 13 acres of infrastructure, including access roads, electrical lines, and stormwater detention ponds. This development will result in unavoidable filling of 3.75 acres of freshwater wetlands. One of the impacted wetlands is designated as a Wetland of Special Significance (WOSS) (see Attachment 9, Natural Resources Report).

A total of nine potential vernal pools were identified in wetland areas in the vicinity of the proposed expansion area. One is a significant vernal pool (SVP) that was previously mapped and is included in Maine Department of Inland Fisheries and Wildlife (MDIF&W) mapping. Of the eight new potential vernal pool areas identified, six met the definition of a vernal pool as provided by the Programmatic General Permit of the U.S. Army Corp of Engineers (USACE) for Maine (Maine GP). The remaining two pools were small depressions located in upland areas which, when evaluated in the spring, did not contain egg masses or other vernal pool indicators. One of the new vernal pools met the criteria of a SVP. Two wetlands have been classified as WOSS because they contain SVPs. None of the vernal pools, potential vernal pools, or SVPs and their associated 250-foot critical terrestrial habitat, will be directly impacted as part of the Phase II Expansion.

The compensation plan includes the payment of an in-lieu fee of $763,103, representing $4.31 per square foot of non-WOSS wetland (149,670 square feet in total) and $8.62 per square foot of WOSS (13,692 square feet in total). The compensation fee will be paid upon final approval of the project prior to the start of construction. Details of the compensation plan are found in Attachment 13, Wetlands Compensation Plan.

The Phase II Expansion, totaling 11.9 million cubic yards (MCY) of waste, is anticipated to be needed by early 2028, based on current landfill utilization rates of the existing JRL. An analysis of need was done by the MEDEP as part of a PBD for the project, Order #S-020700-W5-CV-N, pursuant to the provisions of the Maine Hazardous Waste, Septage and Solid Waste Management Act, 38 M.R.S. §§ 1301 to 1319-Y; the Solid Waste Management Rules: General Provisions, 06-096 CMR 400; and Landfill Siting, Design, and Operations, 06-096 CMR 401. Based on that analysis, MEDEP determined that the Phase II Expansion is needed to ensure both the short-term and long-term waste disposal needs of the State.[1] The Phase II Expansion is expected to provide 10 to 12 years of additional solid waste disposal capacity once the existing facility is filled.

BGS and NEWSME have evaluated options to avoid and minimize wetland impacts, including off-site options and several alternate on-site development options for the Phase II Expansion. This evaluation determined that the proposed footprint is the least environmentally damaging practicable alternative to provide the capacity required by the State's landfill needs as approved by the MEDEP and avoid or minimize impacts to wetlands and other protected natural resources at the site to the maximum extent practicable.

[1] The PBD is included in Appendix A-8 of Volume I of the Expansion Application.

ATTACHMENT 1

ACTIVITY DESCRIPTION

SME
SEVEE & MAHER
ENGINEERS

ATTACHMENT 1 ACTIVITY DESCRIPTION

1.1 Background

BGS and NEWSME are proposing to expand the JRL located in Old Town, Maine (the Project). The JRL is located on a 780-acre parcel owned by the State of Maine southwest of Route 16 and north of Route 43 in Old Town (see Figure 1-1, Site Location Map and Appendix C for copy of deed). The existing JRL consists of a permitted 122-acre secure landfill with an administration building, maintenance buildings, leachate storage tank, leachate pump stations, stormwater detention ponds, landfill gas treatment facility and flare, renewable natural gas facility and flare, and access roads. The site also includes a permitted glacial till borrow pit and permitted clean wood waste storage and processing facility (see Figure 1-2, Site Development Plan).

1.1.1 Original Landfill

The JRL was initially constructed in 1996[2] for use by James River Corporation's papermill in Old Town, Maine. At that time, the Landfill was licensed by the MEDEP under the Maine Hazardous Waste, Septage and Solid Waste Management Act and Natural Resources Protection Act (MEDEP Permit #S-20700-7A-A-N). The license was transferred to the State of Maine in 2003 when the State acquired ownership of the facility (MEDEP Permit #S-20700-WR-M-T). JRL is operated by NEWSME pursuant to an Operating Services Agreement (OSA) that, among other things, grants NEWSME's ultimate parent, Casella Waste Systems, Inc., the exclusive right to occupy, operate, maintain, repair, design, construct, and utilize the landfill. These licenses were subsequently amended, including in 2004 (MEDEP Permit #S-20700-WD-N-A). In addition, the USACE issued a permit to James River for impacts to wetlands on the property under Section 404 of the Clean Water Act (USACE Permit #1991-01909).

1.1.2 Phase I Expansion

In 2006, NEWSME and the State of Maine filed a Preliminary Information Report (PIR) for an expansion of the Landfill. The purpose of the PIR was to present sufficient information on the proposed landfill expansion to enable the MEDEP to make a determination on the environmental feasibility of the proposed expansion and to outline the scope of study for development of a full solid waste licensing application. This 2006 PIR was for a 108-acre landfill with a total capacity of 22.9 MCY. The MEDEP determined the 108-acre landfill site to be environmentally feasible for landfill development and issued a Determination of Environmental Feasibility on April 13, 2007.

Subsequent to the determination that the entire 108-acre site was feasible for a landfill, BGS and NEWSME filed an application with the MEDEP for the full 22.9-MCY expansion for a PBD on September 15, 2011, as

[2] Since the initial construction occurred prior to September 1, 1996, the Phase II Expansion is an expansion of a facility that cannot practicably be located elsewhere because of the relation to the existing landfill, in accordance with Chapter 310, Section 5.A.1.d, of the Department's regulations.

a prerequisite to filing an application to build and operate the expansion, pursuant to 38 M.R.S. § 1310-AA. On January 31, 2012, the MEDEP issued a partial approval of the PBD, #S-020700-W5-AU-N, for 9.35 MCY of the 22.9 MCY that had been requested. An application relative to NRPA and Section 404 of the Clean Water Act was filed for the smaller 54-acre, 9.35 MCY expansion (the Phase I Expansion) in July 2015 and was approved by the MEDEP (S-020700-WD-BI-N and L-19015-TG-D-N) in June 2017 and by the USACE in November 2017 (NAE-1991-1909-MI).

1.1.3 Phase II Expansion

This application for the Phase II Expansion includes the remaining area that was included in the initial PIR in 2006, which comprised approximately 61 acres and represented 11.9 MCY of additional landfill volume. Even though this area had already been reviewed and found to be feasible under the initial PIR, a subsequent PIR was submitted in August 2023 for a second expansion and received approval from MEDEP in November 2023. The MEDEP issued an approval of the PBD for the Phase II Expansion, #S-020700-W5-CV-N on October 2, 2024.

This application addresses the unavoidable impacts to protected natural resources, as defined under NRPA, that will result from the proposed Phase II Expansion of the landfill.

1.2 Project Description

1.2.1 General Project Description

As shown in the final design, the proposed Phase II Expansion will increase the solid waste footprint of the landfill by approximately 57 acres (slightly smaller than the originally estimated 61 acres). The total developed area of the Phase II Expansion including the solid waste footprint, landfill perimeter dikes, access roads, electrical line, and stormwater detention ponds, is approximately 72 acres (see Figure 1-2, Site Development Plan). The overall waste disposal capacity will increase by 11.9 MCY. The Phase II Expansion is expected to ensure the State's long-term solid waste disposal needs for 10 to 12 years after it is constructed.

The Phase II Expansion is designed as a secure landfill with double-composite liners including HDPE geomembranes, geosynthetic clay liner, compacted barrier soil liners, and leak detection and leachate collection systems, as shown in Figure 1-3, Base Liner System. The design uses state-of-the-art gas management and odor control systems to manage gas and odors generated at the site. The Phase II Expansion will use the existing site access road from Route 16 and the existing facility infrastructure. It is anticipated that the facility will be developed in five discrete cells, with a new cell berm and liner system being constructed approximately every two years during the normal construction season. Waste will be spread and compacted in vertical lifts of 5 to 8 feet until the permitted elevation of 385 feet-Mean Sea Level is reached. The Phase II Expansion will also include approximately 4,530 lineal feet of access roads and associated ditches, and the addition of utility/communication lines. Three additional stormwater detention ponds will be constructed, and one existing detention pond will be relocated.

1.2.2 Wetlands Impacts

The development of the Phase II Expansion will result in filling a total of approximately 3.75 acres (163,360 square feet) of freshwater wetlands. A total of eight vernal pools were identified in the vicinity of the expansion area during the vernal pool assessment conducted by Biodiversity Research Institute of Portland, Maine (BRI) on May 3 and 16, 2023. One of these vernal pools meets the criteria to be considered a SVP. Additionally, one SVP was previously identified by others and is listed on the MDIFW website (https://maine.hub.arcgis.com/datasets/478a139603884f718651f21c9dbf318c/explore?location=44.984576%2C-68.713430%2C14.46, POOL ID 2,676). The two SVP depressions and their surrounding 250-foot critical terrestrial habitat areas will not be impacted by the Phase II Expansion. Because they contain SVPs, two of the wetlands have been classified as WOSS. None of the vernal pools or SVPs and their associated 250-foot critical terrestrial habitats will be directly impacted as part of the Phase II Expansion. Included in the 3.75 acres of impacted wetlands is a total of 13,692 square feet of WOSS. The impacted wetlands are shown on Figure 1-4, Impacted Wetland Areas.

Of the nine vernal pools identified, seven meet the definition of a vernal pool as provided by the USACE's Maine GP. The remaining two pools do not support one or more of the following obligate indicator species: wood frogs *(Rana sylvatica),* spotted salamanders *(Ambystoma maculatum),* blue-spotted salamanders *(Ambystoma laterale),* and fairy shrimp *(Eubranchipus* sp.) and, therefore, do not meet the Maine GP definition of vernal pools and are not regulated by the USACE. These two non-regulated vernal pools are contained within a larger wetland area that contains a SVP and, thus, the entire wetland area is considered a WOSS under state law, and is regulated by the USACE. None of the vernal pools will be directly impacted as part of the Phase II Expansion.

The locations of the wetlands, vernal pools, and the areas of wetlands that are impacted are described and shown in Attachment 9; their functions and values are described in Attachment 12. The 3.75 acres of wetlands that will be impacted will be compensated in accordance with the MEDEP in-lieu fee compensation schedule as outlined in Attachment 13A. As determined by the USACE and the MEDEP, 149,670 square feet of non-WOSS wetlands will be impacted and will be compensated at the Penobscot County rate of $4.31 per square foot. 13,692 square feet of WOSS will be impacted and will be compensated at the rate of two times $4.31 per square foot, or $8.62 per square foot, for a total wetlands compensation of $763,103.

Importantly, the general presumption that there are practicable alternatives to WOSS does not apply to this project for two reasons: (1) expansion of a landfill meets the definition of a health and safety project; and (2) the project is an expansion of an existing facility that, as will be demonstrated below, cannot practicably be located elsewhere because of its integral relation to the existing landfill, which was initially built before September 1, 1996. 06-096 CMR 310.5.A.1.a & d.

1.3 Adherence to NRPA Standards

This NRPA Application describes the project, its need, and includes a Project Description, Alternatives Analysis, Wetlands Delineation Report, Functions and Values Assessment Report, and a Wetland Compensation Plan, along with supporting information. As will be described in greater detail below, this Application demonstrates that BGS and NEWSME have satisfied each of the six applicable NRPA approval standards.

1.4 Scenic, Aesthetic, Recreational, and Navigational Uses

The activity will not unreasonably interfere with existing scenic, aesthetic, recreational, or navigational uses. The proposed expansion will be located adjacent to and abutting an existing landfill on a property that has been fenced for several years, where there are no recreational or navigational uses.

The project will have limited impact on scenic and aesthetic uses, as demonstrated in the visual assessment of the facility prepared by Viewshed of Yarmouth, Maine, included in Appendix A. The assessment was completed in accordance with the MEDEP Rules, Chapter 315, which state that "[a]n applicant is required to demonstrate that the proposed activity will not unreasonably interfere with existing scenic and aesthetic uses of a scenic resource," as defined. Section 5.H of Chapter 315 defines a scenic resource as "Public natural resources or public lands visited by the general public, in part for the use, observation, enjoyment, and appreciation of natural or cultural visual qualities." The Viewshed assessment concluded that there are no public viewing areas within 2,000 feet of the proposed project; and at an extended visual study area of seven miles, visibility is limited to a small handful of locations on Pushaw Lake, and potentially from limited extents of the Penobscot River and Stillwater River (Viewshed, 2024); therefore, the Phase II Expansion meets this standard.

1.4.1 Minimize Erosion

The design of the Phase II Expansion incorporates surface water management practices based on the "Maine Erosion and Sediment Control Best Management Practices" (BMP-MEDEP, 2016). The BMPs incorporated in the design to protect water quality include stormwater detention basins, low velocity ditches, level spreaders, use of erosion control mix or silt fence, culvert inlet and outlet protection, mulch, riprap channels, and stone check dams within on-site ditches, as presented in the Erosion and Sediment Control Plan (see Attachment 8). The proposed project will not cause unreasonable erosion or sedimentation or unreasonably inhibit the natural transfer of soil into a water environment.

1.4.2 Protection of Wildlife Habitat

State mapping and the assessment conducted by BRI (Attachment 9) determined, with the exception of the significant vernal pool habitat, that there is no significant wildlife habitat, threatened or endangered plant habitat, fisheries, aquatic habitat, travel corridor, or fisheries or other aquatic life. The bat survey conducted by Stantec of Topsham, Maine and included in Attachment 9, did not identify the presence of

federally endangered or threatened bats. As previously mentioned, the site is fenced, and thus there are no wildlife travel corridors.

A U.S. Fish and Wildlife Service Information for Planning and Consultation (IPaC) report was obtained for the project which documents the Endangered Species Act protected species and/or critical habitats that may exist in the project area. Specifically, the report documented potential presence of the following:

- Atlantic Salmon – an Endangered Species,
- Monarch Butterfly – a Candidate Species, and
- Tricolored Bat – Proposed Endangered Species.

Additionally, the IPaC identified that Critical Habitat for Atlantic Salmon may occur in the project area. The potential for critical habitat for Atlantic Salmon was reviewed within the project area and it was determined that there was no direct habitat since the expansion will occur within a fenced 72-acre area that does not contain waterbodies, or streams. Additionally, surface water from the project which could impact habitat will be controlled as discussed in the following sections of this application, further mitigating impacts to Atlantic Salmon habitat.

The IPaC also documents that there will be no effect on the Northern Long-Eared Bat (NLEB), which is a federally listed species. The report also documents that the Tricolored Bat species may be present at the project site. The previously-mentioned bat survey conducted by Stantec concluded with the probable absence of both the NLEB and Tricolored Bats in the proposed expansion area.

In addition to their efforts to avoid and minimize impacts to freshwater wetlands and significant wildlife habitat, BGS and NEWSME have proposed a wetland compensation plan (as described in Attachment 13) for the wetland impacts that will unavoidably occur. The activity will not unreasonably harm any significant wildlife habitat, freshwater wetland plant habitat, threatened or endangered plant habitat, aquatic or adjacent upland habitat, travel corridor, freshwater, estuarine or marine fisheries, or other aquatic life.

1.4.3 Natural Flow of Surface Water

No surface water bodies are disturbed by the site development. The drainage design for the project was completed to size the proposed detention ponds to manage stormwater flows such that there is no increase in flow rate to any of the existing streams at the site post-development. The proposed Project will not unreasonably interfere with the natural flow of any surface water bodies or subsurface waters.

1.4.4 Protection of Surface Water Classification

The Phase II Expansion design incorporates several features to protect the quality of surface water leaving the site. First, the design of the site requires that any precipitation that comes in contact with the waste

to be collected and treated as leachate. The leachate is then treated in a wastewater treatment plant subject to a waste discharge license from the MEDEP. Second, surface water management at the site addresses both construction practices and the management of clean surface water runoff from the covered portion of the landfill. The proposed project will meet State of Maine water quality standards, including those governing classification of the State's waters.

1.4.5 No Increase in Flooding

The stormwater design for the project was conducted to size the control measures such that the stormwater flows from the site are not increased beyond the pre-development condition. The activity will not unreasonably cause or increase flooding in the area. Proposed development on the site will be outside the 100-year floodplain as established by Federal Emergency Management Agency (FEMA) flood insurance rate map 23019C1926D. A Stormwater Management Plan comparing peak flows in pre and post development are included in Volume I of the Landfill Expansion Application.

1.4.6 Historical and Archaeological Resources

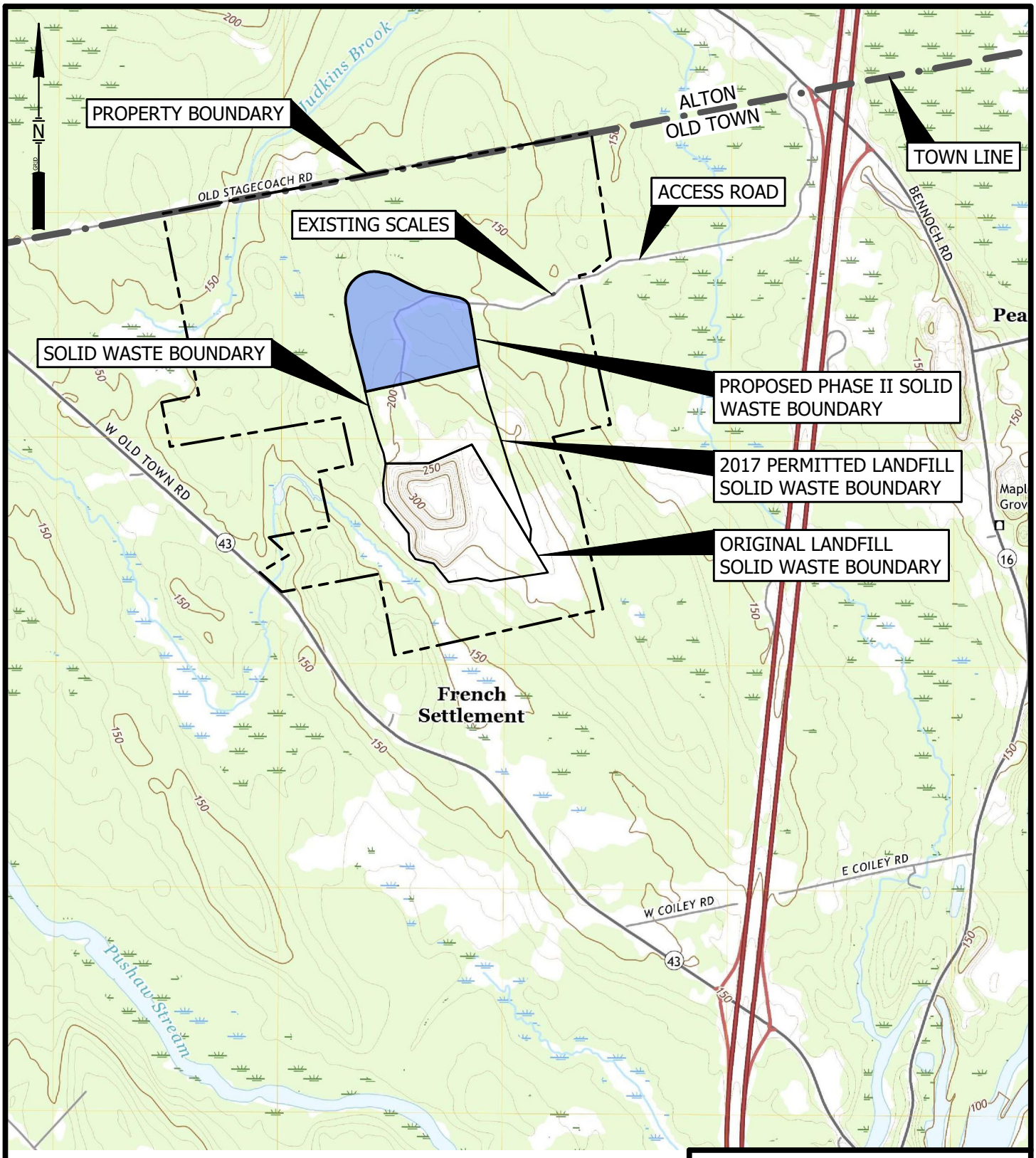
A Maine Historic Preservation Commission (MHPC) consultation was completed for the expansion and is documented in Attachment 11. The MHPC determined that there would be no impact on historic properties from the expansion.

Notification letters were sent to the five federally recognized tribes in Maine, including the Houlton Band of Maliseet Indians, Aroostook Band of the Mi'kmaq Nation, Passamaquoddy Tribe of Indians Pleasant Point Reservation, Passamaquoddy Tribe of Indians Indian Township Reservation, and Penobscot Nation. Notification letters and correspondence to the tribes are included in Attachment 11.

1.5 Adherence to Maine Law

During the development and operation of the Phase II Expansion, NEWSME will meet the goals set forth in 38 M.R.S. § 464.1 as follows:

- "The discharge of pollutants into the waters of the State will be eliminated where appropriate;
- No pollutants will be discharged into any waters of the State without first being given the degree of treatment necessary to allow those waters to attain their classification; and
- The water quality be sufficient to provide for the protection and propagation of fish, shellfish, and wildlife and provide for recreation in and on the water."



BASEMAP ADAPTED FROM 7.5 MIN USGS TOPO QUADS
OLD TOWN, ME - 2024

FIGURE 1-1
SITE LOCATION MAP
PHASE II EXPANSION
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS

DWG: SITELOC-EXPANSION LMN: NONE CTB: SME-STD.CTB JOB#: 240100.00 REV: 4/15/2025

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC-EXPANSION.dwg, A_FIG 1-1, 4/15/2025 7:47:55 AM, sjm

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.
6. SPECIAL FLOOD HAZARD ZONE PER FEMA PANEL 23019C1926D.

EXISTING SCALE HOUSE INFRASTRUCTURE AREA
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT (TYP)
BEDROCK OUTCROP (TYP)
END OF EXISTING LEACHATE FORCE MAIN
DETENTION POND 11R
PROPOSED SOLID WASTE LIMIT (TYP)
EXISTING OVERHEAD ELECTRIC LINE (TYP)
26'-WIDE PAVED ACCESS ROAD (TYP)
CELL 18 PUMP STATION
GRAVEL UTILITY ACCESS ROADS (TYP)
VERNAL POOL (TYP)
LFG KNOCKOUT STRUCTURE (TYP)
CELL 14 PUMP STATION
CELL 13 PUMP STATION
CELL 12 PUMP STATION
PRIMARY ACCESS ROAD (TYP)
FORCE MAIN VAULT (TYP)
CATCH BASIN AND CULVERT (TYP)
PERMITTED TILL BORROW PIT
PERMITTED WOOD WASTE HANDLING AREA
DETENTION POND 10
DETENTION POND 9
WOOD STORAGE FACILITY 2 ACRE
1 ACRE
PROPERTY LINE (TYP)
PROPOSED WOOD STORAGE LOT
SUBSURFACE WASTEWATER DISPOSAL FIELD
APPROXIMATE LOCATION OF PROPOSED PFAS TREATMENT PLANT
MAINTENANCE BUILDINGS
RNG TREATMENT FACILITY POND
LFG TREATMENT FACILITY
WATER SUPPLY WELL
RENEWABLE NATURAL GAS (RNG) FACILITY
LFG FLARE LOCATION
LEACHATE STORAGE TANK PUMP STATION
LEACHATE STORAGE TANK 1
PROPOSED LEACHATE STORAGE TANK 2
PROPOSED LEACHATE STORAGE TANK
LIMIT OF BRI WETLANDS DELINEATION (TYP) SEE NOTE 2
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT (TYP)
DETENTION POND 14
RIPRAP DITCH (TYP)
DETENTION POND 11
RIPRAP CB INLET
CELL 11 PUMP STATION
PROPOSED GUARDRAIL (TYP)
PROPOSED LANDFILL BASE GRADES (TYP) SEE NOTE 4
PROPOSED CELL LIMITS (TYP)
LIMIT OF PHASE I EXPANSION LINER (TYP)
24" LFG HEADER (TYP)
LFG KNOCKOUT STRUCTURE (TYP)
UTILITY MANHOLE (TYP)
DETENTION POND 6
CELL 8 PUMP STATION
EXISTING CELLS LINER LIMIT (TYP)
(2) 24" HDPE CULVERTS
PERMANENT LANDFILL ACCESS ROAD
100-YEAR FLOOD ZONE SPECIAL FLOOD HAZARD AREA (TYP) SEE NOTE 6
DETENTION POND 13
CELL 20 PUMP STATION
25-FOOT SETBACK FROM WOSS
FENCE (TYP)
8"x12" LEACHATE FORCEMAIN
PROPERTY LINE (TYP)
ELECTRICAL MANHOLE (TYP)
20'-WIDE GRAVEL ACCESS ROAD (TYP)
DEED RESTRICTION (TYP)
CELL 19 PUMP STATION
DETENTION POND 12
CELL 17 BASE GRADES (SEE NOTE 5)
CELL 16 PUMP STATION
EXISTING EMH (TYP)
EXISTING FORCEMAIN VAULT (TYP)
CELL 15 PUMP STATION
RIPRAP DITCH (TYP)
EXISTING 24" DIA LANDFILL GAS PIPE
25-FOOT STREAM SETBACK
WATER LOADING RACK
DETENTION POND 1
8" GRAVITY SEWER IS ABANDONED
DETENTION POND 2
UNDERGROUND ELECTRIC (TYP)
LFG KNOCKOUT STRUCTURE AND VALVES
CELL 5 PUMP STATION
CELL 4 PUMP STATION
DETENTION POND 1A

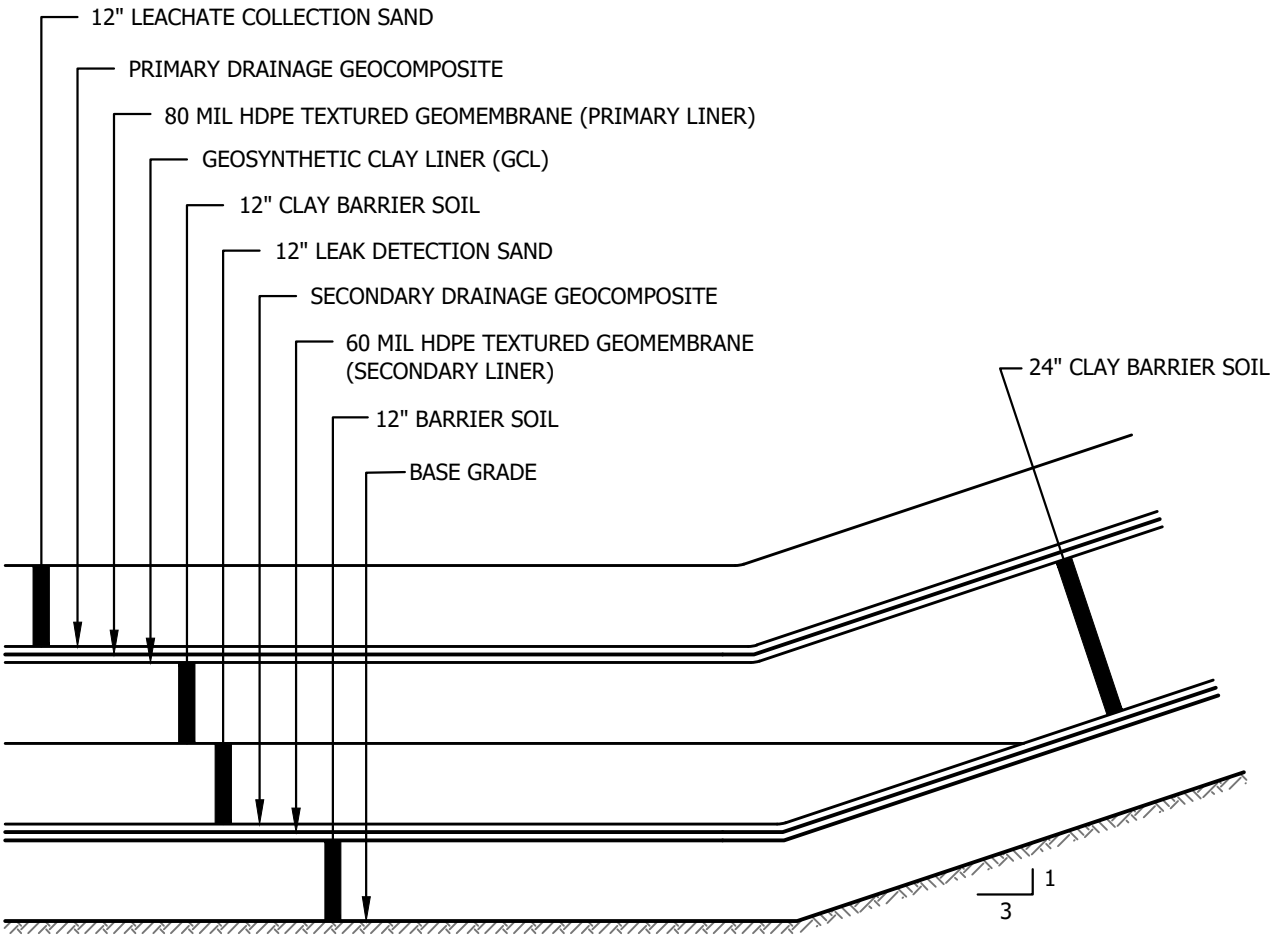
200 0 400 FEE

DWG: BASE LMN: SITE-DEV-FIG CTB: SME-STD-HALF.CTB JOB#: 240101 REV: 11/6/2025

FIGURE 1-2
SITE DEVELOPMENT PLAN
PHASE II EXPANSION
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS

\\Server\cds\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Plans\BASE.dwg, B_FIG 1-2, 11/6/2025 12:21:05 PM, sjm



BASE LINER SYSTEM

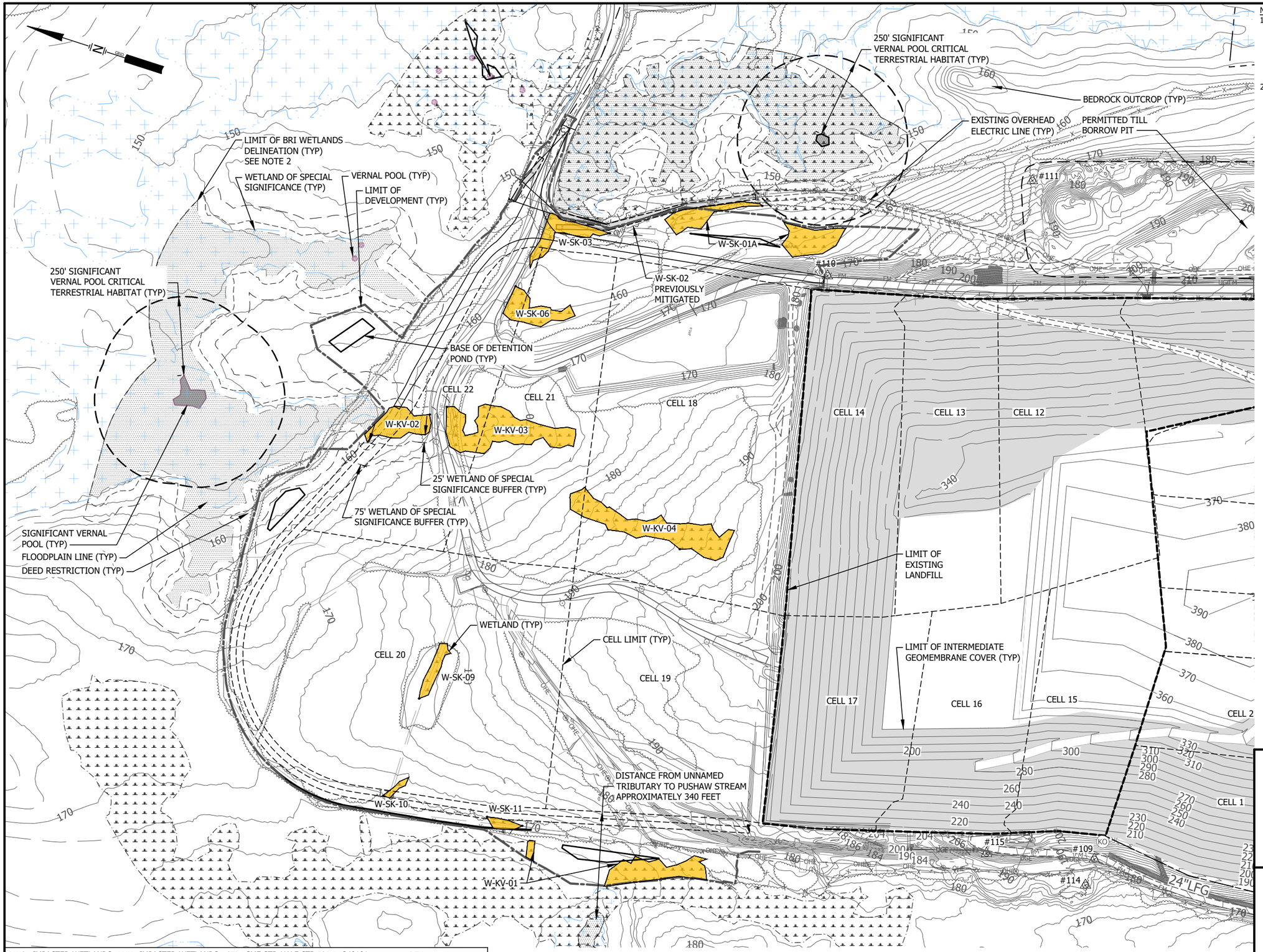
NTS

FIGURE 1-3
PROPOSED PHASE II
LANDFILL LINER SYSTEM
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

DWG: LINER LMN: NONE CTB: SME-STD.CTB JOB#: 240102.05 REV: 8/6/2025

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\LINER.dwg, A_ FIG 1-3, 8/6/2025 11:37:33 AM, sjm



NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. VERTICAL DATUM: BRASS PLUG AT PUMP STATION AT THE ADMINISTRATION BUILDING. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.

LEGEND

- WETLANDS
- WOSS WETLANDS
- W-KV-02 — IMPACTED WETLANDS AND ID
- FLOODPLAIN

WETLAND IMPACT TABLE

IMPACT ID	WETLAND IMPACT AREA	WOSS WETLAND IMPACT AREA
W-KV-01	±19,896 SF	N/A
W-SK-01A	±24,389 SF	N/A
W-KV-02	N/A	±13,692 SF
W-KV-03	±35,806 SF	N/A
W-KV-04	±35,720 SF	N/A
W-SK-03	±11,182 SF	N/A
W-SK-06	±12,993 SF	N/A
W-SK-09	±5,603 SF	N/A
W-SK-10	±1,431 SF	N/A
W-SK-11	±2,650 SF	N/A
TOTAL	±149,670 SF	±13,692 SF

150 0 300 FEET

FIGURE 1-4
IMPACTED WETLAND AREAS
PHASE II EXPANSION
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS

DWG: IMPACTED-WETLANDS LMN: IMPACTED-WETLANDS CTB: SME-STD-HALF.CTB JOB#: 240101 REV: 8/12/2025

\\Server\rds\Casella\OldTown\Landfill\Expansion\Phase II Expansion\Acad\Figures\IMPACTED-WETLANDS.dwg, B_FIGURE 1-4, 8/12/2025 2:08:48 PM, sjm

ATTACHMENT 2

ALTERNATIVES ANALYSIS

SME
SEVEE & MAHER
ENGINEERS

ATTACHMENT 2 ALTERNATIVES ANALYSIS

As required by Chapter 310.9 of the MEDEP's regulations pursuant to the NRPA, BGS and NEWSME have analyzed if a less environmentally damaging practicable alternative to the proposed expansion could be developed that would still meet the project purpose.

The purpose of the Phase II Expansion is to:

- Satisfy short- and long-term solid waste disposal needs of the State of Maine;[3]
- Utilize an environmentally suitable site that meets the MEDEP's stringent landfill siting criteria; and
- Comply with the provisions of the facility's Operating Services Agreement (OSA) between the State of Maine and NEWSME's parent company, Casella Waste Systems (CWS). The OSA is included in Appendix A-2 of Volume I of the Phase II Expansion application.

Additionally, this report evaluates both on- and off-site alternatives to the proposed impacts so as to avoid and minimize the impacts to wetlands by developing the smallest possible area while still meeting the three criteria listed above.

2.1 Examination of Need

In the Solid Waste Management Act, the Legislature found that "environmentally suitable sites for waste disposal are in limited supply and represent a critical natural resource." 38 M.R.S. § 1302. The following demonstrates the need for this site as a critical natural resource under the Solid Waste Management Act.

2.1.1 Maine's Solid Waste Disposal Capacity and Needs

The Phase II Expansion received a PBD from the MEDEP (#S-020700-W5-CV-N) on October 2, 2024 for 11.9 MCY of additional JRL capacity. In granting the PBD approval, the Commissioner determined, pursuant to 38 M.R.S. § 1310-AA, that the 11.9 MCY of capacity meets Maine's short- and long-term disposal capacity needs.

JRL provides disposal capacity for Maine-generated non-hazardous waste streams, including construction and demolition debris (CDD) and the associated processing residues, oversized bulky wastes (OBW), municipal solid waste (MSW) incinerator ash, multi-fuel boiler ash, bypassed MSW from waste-to-energy facilities (WTE) and solid waste processing facilities, municipal and industrial wastewater treatment plant (WWTP) sludge, contaminated soils, non-friable asbestos in demolition waste, catch basin and grit

[3] As a solid waste disposal project, the Phase II Expansion constitutes a "health or safety" project under Chapter 310.3.K and 310.5.A(1)(a).

screenings, oil spill debris, and a number of other, smaller waste streams. The proposed Phase II Expansion provides Maine municipalities with an immediate-, short-, and long-term cost-effective, environmentally secure disposal option for a wide variety of non-hazardous wastes.

In the "Maine Materials Management Plan: 2024 State Waste Management and Recycling Plan Update and 2022 Waste Generation and Disposal Capacity Report" (Materials Management Plan – Appendix E), the MEDEP stated that "the expansion of Juniper Ridge Landfill in Old Town will be necessary to ensure there is adequate capacity for the entire State of Maine over the next ten years" and that "[t]he loss of JRL as a disposal facility would create catastrophic capacity issues as it receives over 50 percent of all material landfilled in Maine annually."[4] Likewise, in a December 15, 2023 report prepared for the MEDEP regarding biosolids management in Maine, an "Evaluation of Biosolids Management in Maine and Recommendations for the Future" (Biosolids Report – Appendix F), consulting firm Brown and Caldwell concluded "[i]f JRL is not expanded, the State faces a dire situation for solid waste generated in Maine."[5] With respect to biosolids, the same report noted that "there is no current or proposed alternative outlet in the State that would be able to accept the tonnage currently handled at JRL," which it stated was nearly 90 percent of the biosolids generated in Maine.[5]

The remaining permitted capacity at JRL was approximately only 5.0 MCY based on the most recent aerial survey conducted in May 2024. As a result, the current capacity in the permitted landfill footprint is anticipated to run out in 2028, four years from now, assuming an annual waste acceptance rate similar to the 2021, 2022, and 2023 rates.

Customers from all sixteen counties in Maine utilize JRL. The proposed Phase II Expansion will allow JRL to continue to serve the entire State of Maine. In addition to the wastes that have traditionally been disposed of at JRL, there have been additional waste streams added since 2020, forcing many towns to rely on JRL for their waste and WWTP sludge disposal, as described below.

2.1.1.1 Wastewater Treatment Plant Sludge Disposal

The Maine State Legislature passed a law in April 2022 that prohibited the MEDEP from issuing new licenses or granting authorization to apply or spread sludge and septage at any location in the State. The law also allowed for the "disposal or placement at a solid waste landfill of any of the materials that are prohibited from application, spreading, sale, or distribution."

As a result, placement in a secure landfill like JRL is likely to be the preferred method for managing WWTP sludge for the immediate-, short-, and potentially long-term, since JRL has become Maine's most economical solution for handling emerging solid waste issues.[6] In 2023, JRL accepted nearly 90 percent of the biosolids generated in Maine[5] and "there is no current or proposed alternative outlet

[4] Materials Management Plan, page 3.
[5] Biosolids Report, page 2.
[6] Materials Management Plan, page 41.

in the State that would be able to accept the tonnage currently handled at JRL," according to the Biosolids Report.[5]

2.1.1.2 Alternative Waste Disposal Option

Two waste minimization facilities, one in Hampden and one in Orrington, have become inoperable in recent years. JRL provides an alternative disposal site for waste from the communities contracted to those facilities, as described below.

Capacity at JRL is needed to landfill bypass[7] MSW from the inoperable processing facility in Hampden, Maine. The facility was designed to accept and manage 650 tons of MSW per day, but it has been idle since May 2020, with bypass MSW being diverted to a combination of WTE facilities and landfills, including JRL.[8] Innovative Resource Recovery, a materials management company, plans to resume solid waste processing at the Hampden facility;[9] however, once operations resume, MSW will still be bypassed from the facility during maintenance and unscheduled outages.

Likewise, reduced operations at the WTE facility formerly known as PERC, which is located in Orrington, Maine, has caused additional towns to rely on waste disposal at JRL. PERC originally served nearly 200 municipalities and is permitted to accept 310,000 tons of MSW annually to produce electricity for sale on the electrical grid. PERC significantly reduced operations in May 2023 and shut down entirely in September 2023. Since the shutdown, all bypass MSW has been sent to JRL for disposal.[10] The new owner, EPEC, planned to resume waste processing by the end of 2023; however, as of the date of this submission, that has not occurred,[11] and the October 2024 fire within the facility will likely further slow the facility's return to active incineration. Even if the facility is able to reach full processing capacity, bypass MSW will continue to be disposed of at JRL during maintenance and unscheduled outages, just as with other WTE facilities.

---

[7] The term "bypass" means: "any solid waste that is destined for disposal, processing or beneficial use at an operating solid waste facility but that cannot be disposed of, processed or beneficially used at that facility because of the facility's temporary malfunction, temporary insufficient capacity, temporary inability to process or burn or temporary downtime." 38 M.R.S. § 1303-C(1-C). All incinerators and solid waste processing facilities have bypass plans in place as part of their MEDEP licenses to ensure that a waste stream can be diverted elsewhere when they are not operating.

[8] Materials Management Plan, page 35.

[9] Municipal Review Committee and Innovative Resource Recovery Join Forces as Co-Owners of Municipal Waste Solutions' Hampden Facility (June 30, 2023), https://www.mrcmaine.org/wp-content/uploads/2023/06/Innovative-Announcement-6.30.2023.pdf.

[10] JRL currently accepts swap tonnage as provided in an agreement between the MRC and Pine Tree Waste, Inc. ("Pine Tree") through which MRC member communities' bypass MSW is delivered to JRL while equivalent tonnage that otherwise would be delivered by Pine Tree to JRL is instead delivered by Pine Tree to Crossroads. This swap arrangement helps to lessen transportation costs to MRC member communities.

[11] Weidmayer, Marie, Orrington incinerator will restart by end of year with new name, Bangor Daily News, November 27, 2023.

2.1.2 Landfill Siting Criteria

The MEDEP Solid Waste Management Rules (Rules) set forth an extensive and stringent list of siting criteria, the application of which results in the elimination of many potential alternative facility locations. These siting criteria are described below.

2.1.2.1 Prohibitive Siting Criteria (Chapter 401)

The following Prohibitive Siting Criteria (06-096 CMR 401.1.C.2) were established to protect public health, safety, and the environment. Variances from the following criteria are not permitted:

- The solid waste handling area must be at least 1,000 feet from Class AA or Class SA waters;
- The area within the solid waste boundary must not lie over or be within 300 feet of a significant sand and gravel aquifer;
- The area within the solid waste boundary must not be located within 200 feet of a fault that has had displacement in Holocene time; and
- The facility must not be located on a coastal dune system, coastal wetland, or fragile mountain area.

2.1.2.2 Restrictive Siting Criteria (Chapter 401)

The Restrictive Siting Criteria (06-096 CMR 401.1.C.3) apply to new landfills and expansions of existing landfills and primarily address required setbacks, also to protect public health, safety, and the environment. Restrictive Siting Criteria include:

- A minimum 300-foot setback between the solid waste boundary and public roads;
- A minimum 300-foot setback between the solid waste boundary and the property boundary;
- A minimum 1,000-foot setback between the solid waste boundary and the nearest residence not owned by the applicant;
- A minimum 100-foot setback between the solid waste boundary and stratified sand and gravel deposits capable of providing sufficient water for domestic use or that would act as a contaminant migration pathway to a significant groundwater aquifer, a significant sand and gravel aquifer, a fractured bedrock aquifer, or a surface water body;
- A minimum 100-foot setback between the waste handling area and any classified surface water;
- A minimum 1,000-foot setback between the solid waste boundary and any water supply spring at the time the PIR is filed with the MEDEP;
- A minimum 1,000-foot setback between the solid waste boundary and any water supply well not owned by the applicant at the time the PIR is filed with the MEDEP;

- The area within the solid waste boundary must be located on soils that contain sufficient fines and clay-size particles to minimize infiltration of leachate. The in-situ soils must have an undisturbed hydraulic conductivity less than or equal to 1x10-5 cm/sec;
- The landfill and leachate storage ponds must be located so that site characterization monitoring, detection monitoring, and assessment monitoring can be conducted (see 06-096 CMR 405 for detailed monitoring requirements);
- The waste handling area may not be located on a 100-year floodplain;
- A waste handling area may not overlie an unstable area; and
- The facility site must not be located in, on, or over a significant wildlife habitat, as this term is defined in 38 M.R.S. § 480-B.

These landfill siting criteria define a specific geologic and environmental setting to protect the health, safety, and welfare of Maine's residents and the surrounding environment. Adherence to these siting criteria results in the selection of good landfill sites, but also significantly limits potential sites. Moreover, suitable landfill sites typically possess the same geologic and hydrogeologic conditions that promote the growth of hydrophytic vegetation; therefore, these areas often contain areas of wetlands.

2.1.3 Operating Services Agreement (OSA)

In February 2004, the State and CWS entered into an OSA for a term of thirty years, ending in 2034. Under the terms of the OSA, CWS is required to apply for an Expansion permit, which was intended to last for 20 years of operations. Initially an expansion of ten MCY was assumed, based on an annual usage rate of 500,000 cubic yards (CY). Because of the significant increases in waste disposal at the JRL over the last several years, the expansion, which was permitted for 9.35 MCY in 2017, is estimated to be full by early 2028, six years before the end of the term of the OSA. The proposed Phase II Expansion will provide the capacity necessary to meet the solid waste disposal needs of the current and anticipated customers of JRL for the remaining term of the initial OSA. Based on the aerial survey conducted in May 2024, JRL had 5.0 MCY of capacity remaining. At the anticipated consumption rate of about 1,050,000 CY/year, the first cell of the Phase II Expansion will need to be constructed in 2027 to be available for use in 2028. At projected fill rates, the Phase II Expansion will provide an additional 10 to 12 years of landfill life.

For the reasons stated above, the capacity proposed in the JRL Phase II Expansion application, and the timing of the application, are necessary to meet the future solid waste disposal needs of the State of Maine.

2.2 Examination of Alternatives

NEWSME and BGS examined practicable alternatives to the selected Project site and design, including development of alternate sites, development of an alternative area on the JRL property, a "no build" alternative, waste reduction/alternative waste management strategies, and alternate designs on site that would impact less wetland area. The alternative that was proposed was determined to present the least environmentally damaging practicable alternative while still meeting the project's purpose and need.

2.2.1 No Build/Do Nothing

As quoted above (Section 2.1), the MEDEP's Maine Materials Management Plan states that, "[t]he loss of JRL as a disposal facility would create catastrophic capacity issues as it receives over 50 percent of all material landfilled in Maine annually."[12] If no additional capacity were constructed in Maine, waste would need to be trucked to an out-of-state landfill. Some nearby states have laws similar to Maine and will not accept out-of-state waste, other nearby states are considering such laws, and there is a lack of capacity similar to Maine's in nearby states that still accept out-of-state waste. The nearest landfills that are likely to accept the million cubic yards of waste are located in Ohio. Trucking cost to these landfills would most likely double the cost of waste disposal for the affected Maine citizens. The option to do nothing does not meet the long-term waste disposal needs for the State of Maine as supported by the PBD and discussed previously in Section 2.1.

2.2.2 Use of Other Existing Waste Disposal Facilities

JRL currently takes 51.5 percent of the State's waste.[13] The next largest landfill, Crossroads Landfill in Norridgewock, takes 16.6 percent, and all remaining landfills (that are not restricted to only taking waste from certain towns) take 21.4 percent of the waste. For the waste that is sent to JRL to go to the other landfills, they would each need to increase their capacities by an additional 135 percent. If all of JRL's waste were sent to the Crossroads facility, it would need an additional capacity of 300 percent of its current annual volume. These facilities:

- Could not be permitted in time to meet the State's waste demands;
- Would face many challenges in scaling-up to manage the increase in waste, including purchase of additional equipment, hiring additional staff, potential changes in operating plans, sourcing additional daily cover material, and capital requirements to construct new cells on an accelerated time frame as opposed to what is currently planned;
- Would, in the case of landfills located on clay soils (e.g., at ecomaine's landfill in South Portland and Waste Management's landfill in Norridgewock), require a greater footprint because the reduced stability of clay soils necessitates a decrease in the height of waste as compared to JRL;

[12] Materials Management Plan, page 41.
[13] Materials Management Plan, page 32.

- May impact a greater amount of wetlands, especially for landfills located on high clay content soils; or
- Are located adjacent to residential areas, restrictive siting features, or lack the financial capability to expand.

Therefore, it is highly unlikely that these facilities could expand sufficiently to meet the State's needs, and redirecting the waste that is projected to go to JRL to one of these alternative facilities is not a viable option.

2.2.3 On-Site Avoidance and Minimization

The selection process conducted for the original siting of JRL, as described above, eliminated multiple alternative sites because they would have had greater natural resource impacts than an expansion at the existing JRL site, or failed to meet MEDEP's landfill siting criteria, and thus those potential impacts have been avoided. The following discussion explains how the Phase II Expansion avoids and minimizes on-site impacts to wetlands and other protected natural resources to the maximum extent practicable.

2.2.3.1 Waste Reduction and Alternative Waste Management

One potential way to avoid and minimize impacts would be to reduce the size of the project footprint required through waste reduction or by reducing the volume of waste. The wastes received at the JRL and proposed for disposal within the Phase II Expansion can be categorized into four primary groups:

- Residues from processing and waste reduction facilities, whose chemical or physical properties limit the possibility for recycling or reuse in non-secure landfill settings. Examples of these materials include incinerator ash and front-end process residue from incinerators or waste processing and recycling facilities;
- Waste for which the current best alternative is partial recycling or reuse, such as construction and demolition debris fines used as an alternative daily cover;
- WWTP sludge, for which landfilling is currently the only option as discussed in Section 2.1.1; and
- Special wastes, for which there are no waste management methods other than landfilling, such as sand blast grit.

Prior to their arrival at JRL, many of these waste streams are already minimized using waste management methods such as reuse, recycling, composting, processing, and incineration to the maximum extent practicable, as required for this project in 38 M.R.S. § 1310-N(1-D) to comply with Maine's solid waste management hierarchy. For example, construction and demolition debris disposed of at JRL has had some metal and wood removed at processing facilities prior to disposal at JRL and a large percentage of it has been recycled into beneficial use products. By-products and

residuals such as incinerator ashes and construction and demolition debris fines are currently used as the daily cover required by the Solid Waste Rules; thereby, reducing the amount of landfill capacity consumed by non-waste materials (e.g., virgin soil used as daily cover). Therefore, the need for the Phase II Expansion's disposal capacity will continue into the future even with initiatives to find alternate means of managing solid waste in Maine. For more information on how these waste streams are already being reduced to the maximum extent practicable, please see the Maine Department of Environmental Protection Public Benefit Determination included as Appendix B of this NRPA Application.

2.2.3.2 Avoidance

The Phase II Expansion design intentionally located the landfill, additional site access roads, and stormwater management ponds, in upland areas to the extent possible to avoid direct impacts to wetlands and vernal pools. All existing site infrastructure (scales, maintenance and office buildings, leachate storage tank, and landfill gas management structures) will continue to be used as is and will not need to be relocated and thus will not impact any additional wetlands. Landfill cell development requires a large contiguous parcel for the development of the disposal area, perimeter landfill berms, and associated roads and stormwater ponds. The stormwater ponds are designed to fill with water after a storm and slowly drain through the various ponds' outlets. This action of intermittent wetting and drying is similar to the natural action of stormwater in a wetland area and encourages the growth of wetland vegetation and use by various wetland species, as can be seen at several of the site's existing stormwater ponds. Access roads and utility poles were located to avoid wetland impacts in all but one small area (0.06 acres) located on the western edge of the cell.

The presence and configuration of wetlands on the proposed site, the need for a large tract of land to meet the State's long-term waste disposal needs, and the fact that the physical characteristics that make a site suitable for a landfill also tend to make it suitable for wetlands, which necessitates impacting some wetland areas within the proposed Phase II Expansion.[14] To meet the project purpose and waste disposal needs, it is not possible to completely avoid wetland impacts. The Phase II Expansion must meet minimum size requirements to provide the capacity to serve the State's solid waste needs and must also meet the MEDEP's siting criteria, including maintaining setbacks, as described in Section 2.2.2.

2.2.3.3 Minimization

The design of the Phase II Expansion minimizes unavoidable wetland impacts to the maximum extent practicable. The Phase II plan uses upland areas for the majority of the expansion development. The

[14] Good landfill sites typically possess the same geologic and hydrogeologic conditions that promote the growth of hydrophytic vegetation; therefore, these areas often contain areas of delineable wetlands. See USACE 1987 Wetland Delineation Manual and the 2012 Regional Supplement to the Manual for the Northcentral and Northeast (version 2.0).

cell development plan includes building the cells vertically, as much as allowed by State rules, thereby reducing the horizontal footprint and minimizing wetland acreage impacted, while meeting the State's capacity needs. Additional landfill capacity is obtained by using the in-fill area between the slopes of the existing landfill cells and the proposed expansion cells. As described in Section 2.2.4, if the expansion area were developed as a free-standing, separate landfill, approximately 2.8 MCY or 24 percent of the expansion volume would be lost due to the loss of the in-fill area. This would reduce the State's landfill capacity by approximately 2.6 years.

The exterior sideslopes of the access road will be graded to a slope of 2 horizontal to 1 vertical to minimize land use and wetland impacts. Level spreaders will be used whenever possible to reduce the area required for construction of detention ponds at the site. The routes for utility lines have been carefully selected to avoid wetland impacts.

2.2.4 Alternate Greenfield Sites

The JRL site was initially selected as the most suitable site to develop during the James River site search in the early 1990s, which identified 58 potential sites based primarily on favorable landfill soil conditions. A detailed screening of these 58 sites eliminated all but 18 of the sites from consideration because of surrounding land use, presence of streams and tributaries, potential wetland impacts, and proximity to ponds and lakes. On ten of these sites, on-site investigations were completed to evaluate the site conditions in terms of soil conditions and potential wetlands areas.[15]

After a complete analysis, the JRL site was ultimately selected for landfill development because of the following characteristics:

- Thick, dense, impermeable glacial till soils;
- Upward seepage gradients in the lower elevations of the site that are inherently protective of groundwater;
- Appropriate siting and setback distances;
- Sufficient parcel size to site a large landfill for long-term disposal capacity;
- Limited areas of relatively low value wetlands; and
- Site remoteness.

The site search study also determined that the limiting features that precluded selection of the other sites initially identified by the study will not change in the future. Each of the other sites investigated had more

[15] The location of the 10 sites where on-site investigations were completed is documented in the 1991 Application for a USACE 404 permit prepared for James River Corporation, Old Town Mill by Sevee & Maher Engineers, Inc., with assistance from Woodlot Alternatives, Inc. (SME 1991).

wetlands that would have been impacted by landfill development than the development impacts associated with the original JRL. Additionally, the other sites had characteristics that would have restricted and/or prohibited their use based upon the MEDEP siting criteria described above and thus likely would not have met the project purpose.

In contrast to the alternative sites assessed during previous site searches, an intensive hydrogeologic investigation of the State-owned property surrounding the existing JRL indicates that its location is well-suited to landfill development and satisfies applicable siting and engineering criteria. Site investigations conducted to date at the full JRL site include the installation of over 100 borings, 150 test pits, seismic refraction surveys (approximately 34,000 lineal feet of transects), photolineament mapping, bedrock outcrop mapping, in-situ hydraulic conductivity testing, groundwater measurements (wet- and dry-season), groundwater age-dating, groundwater tracer test analysis, numerous bedrock pumping tests, and water quality sampling and analysis.

Through the application of best engineering practices, it is possible to design an expansion of the existing JRL facility that both meets the long-term disposal capacity needs of the State and minimizes impacts to natural resources and the environment.

Developing a landfill at a new, alternative site that would provide the same disposal capacity as the proposed Phase II Expansion would require a larger landfill footprint for waste disposal because the new landfill would stand alone and 2.8 MCY of in-fill area between the expansion and the existing landfill, would not be available. Approximately 69 acres would be needed to accommodate that volume, rather than the proposed 57 acres. All new infrastructure would be required, including new access roads, scale houses, office and maintenance buildings, a leachate storage tank, and landfill gas management structures, which would comprise approximately 35 acres. By expanding the existing landfill, all the infrastructure that is already in-place at the JRL facility will continue to be used. In total, development in a new location could increase the developed footprint from approximately 72 acres to as much as 104 acres. Landfills should be sited on deep till or clay soils, and it is unlikely that a site with these conditions could be found that would not contain wetlands.

2.2.5 Alternative Locations on the JRL Property

2.2.5.1 Alternative #1 - Free-Standing Landfill on the JRL Property

The area within the existing property boundary was evaluated to determine if a free-standing landfill similar to that described in Section 2.2.4 could be placed elsewhere on the property. A location was selected for a free-standing landfill of similar volume (approximately 12.1 MCY) that would impact the least amount of wetlands for a comparably sized landfill, as shown on Figure 2-1, Alternative #1. The landfill footprint for this option would encompass 69 acres with an additional 14 acres required for the perimeter access road and stormwater ponds. Based on the 2022 wetland delineation surveys, this alternative would impact a total of 6.4 acres of wetlands and provide approximately 146,000 CY of landfill volume per acre of landfill footprint. It is typical to find wetlands in addition to the nationally

mapped wetlands when an on-site delineation is conducted, which skews the comparison of wetlands in areas that have field-delineated wetlands versus areas with large-scale mapping. This alternative was not selected because more wetlands would be impacted than would be impacted by the preferred alternative.

2.2.5.2 Alternative #2 - Alternative Location Adjacent to the Existing Landfill

One potential adjacent location was identified as shown on Figure 2-2, Alternative #2, which would provide approximately 5.1 MCY in a 40-acre landfill footprint, or about 108,000 CY of landfill volume per acre of landfill footprint. Based on NWI wetlands information this alternative, including the approximately 7 acres required for the access road, would impact about 0.4 acres of wetlands. A comprehensive hydrogeologic study has not been conducted for this location, and such an investigation may find the area to be unsuitable for development as a landfill. A current ground survey of wetlands has not been conducted for this site, and as such, additional wetlands are likely to be identified in this area, similarly to the additional wetlands identified within the area of the proposed Phase II Expansion. This option would provide a capacity of approximately only 5.1 MCY, or less than half the volume necessary to meet the long-term disposal needs of the State. This alternative was not selected because it does not meet the project purpose of providing the capacity of 11.9 MCY to expand to the current limits of the OSA in 2028, and more wetlands are likely to be found within the footprint that would be impacted.

2.2.5.3 Alternative #3 - Modify the Proposed Expansion Landfill Boundary/Design

The proposed JRL Phase II Expansion landfill footprint was designed specifically to provide the required 11.9 MCY of capacity within the suitable landfill development area (i.e., 57 acres) while impacting the smallest total acreage of wetlands, and was the basis for the MEDEP's Determination of Environmental Feasibility, dated November 6, 2023.[16]

An alternative layout within the proposed expansion area that would impact minimal wetlands at the site was evaluated. This option, shown on Figure 2-3 as Alternative #3, would encompass 30 acres for the landfill footprint, plus approximately an additional 9 acres for the access road for a total of 39 acres. This option would impact about 0.5 acres of delineated wetlands, while providing a capacity of approximately 3.3 MCY. This alternative was not selected because it provides only about one quarter of the 11.9 MCY of disposal capacity to expand to the current limits of the OSA in 2028.

[16] The 59 acres of suitable landfill area is located to the north of the existing JRL. Many other areas of the 780-acre site have landfill siting constraints due to setbacks, soil conditions, and wetland boundaries.

Table 2-1 lists each of the three options described above, including landfill volume, landfill footprint, and wetlands impacts. It can be seen from the table that the proposed Phase II Expansion is the preferred option because it is the only option that meets the necessary volume of waste disposal with the least amount of wetland impacts.

TABLE 2-1

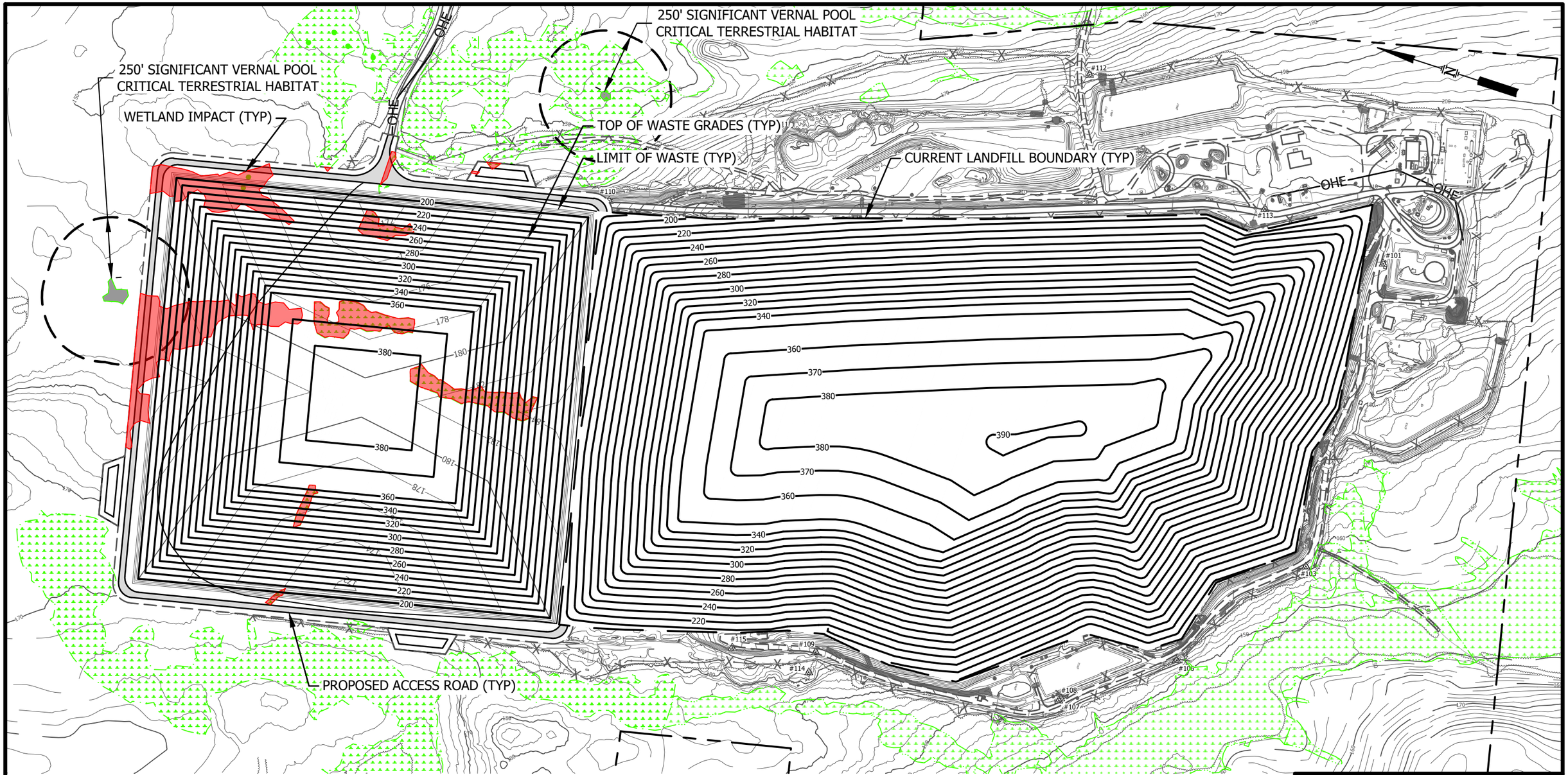
ALTERNATIVE LANDFILL VOLUMES AND IMPACTS

	Units	Alternative #1 Free-standing Landfill (Figure 2-1)	Alternative #2 Adjacent Option[1,2] (Figure 2-2)	Alternative #3 Minimal Impact Option (Figure 2-3)	Proposed Phase II Expansion (Figure 1-2)
Landfill volume	MCY	12.1	5.1	3.3	11.9
Percent of required volume	%	102%	43%	28%	100%
Landfill footprint	ac	69	40	30	57
Total landfill, access road, and stormwater detention pond area	ac	83	47	39	72
Landfill volume per developed acre	CY/ac	146,000	108,000	84,000	207,800
NWI Wetland impact	ac	0	0.4	0	0
Total Delineated Wetland impact	ac	6.4	Area not delineated	0.5	3.75

Notes:
1 This area has not had a full hydrogeologic investigation conducted and may not be suitable for development of a landfill.
2 This area has not had a recent wetlands survey. Additional wetlands or WOSS may be found in this area.

2.2.6 Alternatives Analysis Conclusions

The Phase II Expansion of JRL is the most practicable alternative available that provides necessary long-term disposal capacity for the State while minimizing impact to wetlands as much as possible. Expansion of the existing landfill facility is consistent with the site's current land use and with the preference to expand existing environmentally suitable disposal sites, which Maine law acknowledges are in short supply, instead of developing new "greenfield" sites. A no-build alternative is impractical because it does not meet the State's needs, even considering ongoing waste reduction/recycling efforts, and existing landfills cannot fully eliminate the future waste disposal needs of the State. In addition, once the site was selected, BGS and NEWSME designed the proposed landfill to avoid and minimize wetland impacts to the maximum extent practicable. BGS and NEWSME have chosen the least environmentally-damaging practicable alternative to meet the long-term disposal needs of the State.



NOTES:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. VERTICAL DATUM: BRASS PLUG AT PUMP STATION AT THE ADMINISTRATION BUILDING. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE.
2. PROPERTY LINE LOCATIONS ARE A RESULT OF FIELD SURVEY PERFORMED BY HERRICK AND SALSBURY, INC. LAND SURVEYORS, ELLSWORTH, MAINE FOR TRYTON TREE FARM PROJECT, PATTEN CORPORATION-DOWNEAST, OLD TOWN, MAINE, FEBRUARY 23, 1988, REVISED APRIL 7, 1988.
3. WETLAND DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
4. WETLAND BOUNDARIES AND VERNAL POOL LOCATIONS ARE APPROXIMATE AND SHOULD NOT BE USED FOR DESIGN, QUANTITY, TAKE-OFFS, GRADES ETC.

LEGEND

DELINEATED WETLAND

WETLAND IMPACT (6.4 ACRES)

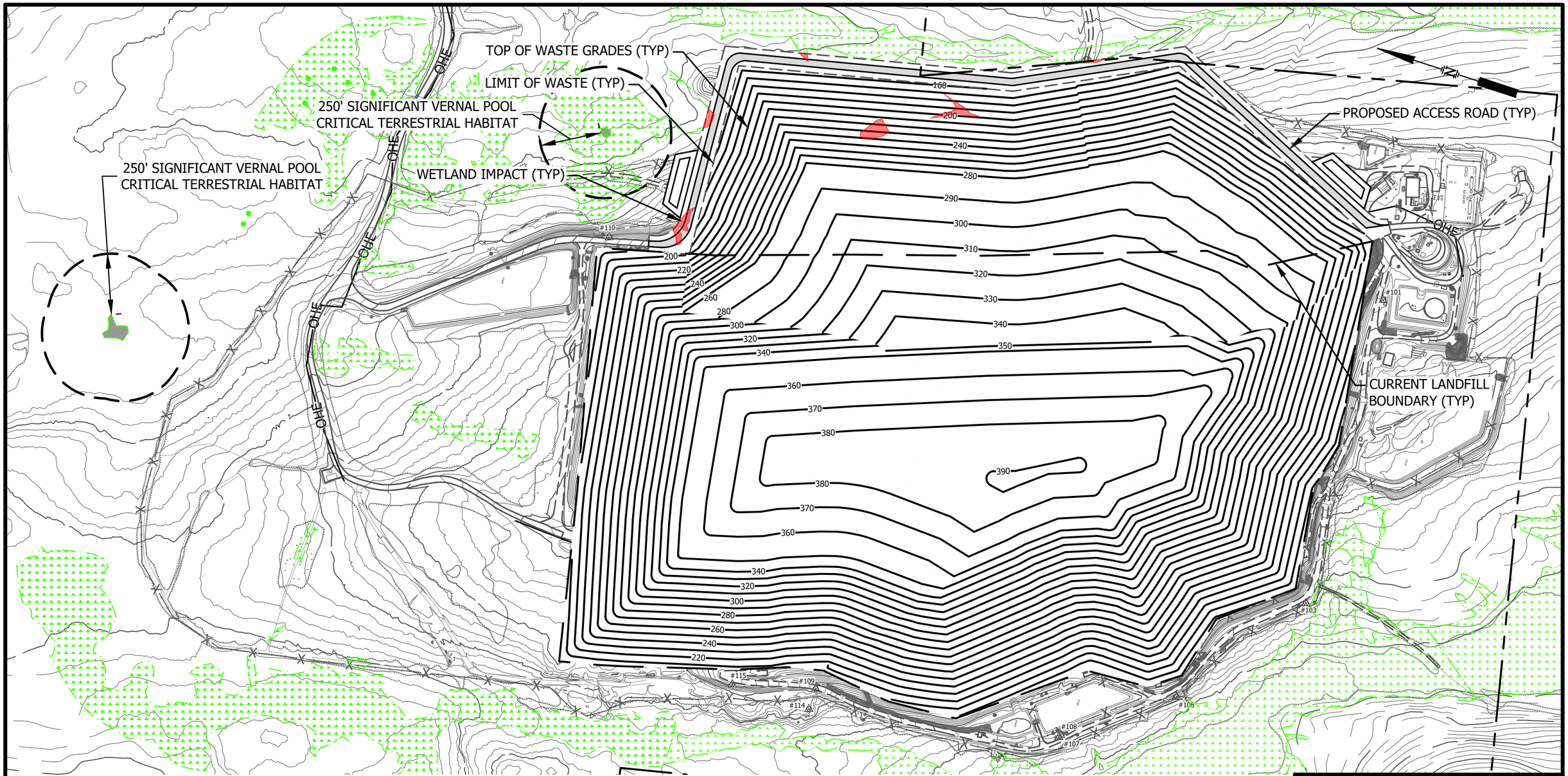
200 0 400 FEET

FIGURE 2-1
DEVELOPMENT CONCEPT
ALTERNATIVE 1
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS

DWG: CONCEPTS LMN: DEV CONCEPT ALT1 CTB: SME-STD.CTB JOB#: 240102.05 REV: 8/12/2025

\\Server\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\CONCEPTS.dwg, FIG 2-1, 8/12/2025 2:12:32 PM, sjm



NOTES:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. VERTICAL DATUM: BRASS PLUG AT PUMP STATION AT THE ADMINISTRATION BUILDING. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE.
2. PROPERTY LINE LOCATIONS ARE A RESULT OF FIELD SURVEY PERFORMED BY HERRICK AND SALSBURY, INC. LAND SURVEYORS, ELLSWORTH, MAINE FOR TRYTON TREE FARM PROJECT, PATTEN CORPORATION-DOWNEAST, OLD TOWN, MAINE, FEBRUARY 23, 1988, REVISED APRIL 7, 1988.
3. WETLAND DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
4. WETLAND BOUNDARIES AND VERNAL POOL LOCATIONS ARE APPROXIMATE AND SHOULD NOT BE USED FOR DESIGN, QUANTITY, TAKE-OFFS, GRADES ETC.

LEGEND

DELINEATED WETLAND

WETLAND IMPACT (0.4 ACRES)

200 0 400 FEET

FIGURE 2-2
DEVELOPMENT CONCEPT
ALTERNATIVE 2
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

DWG: CONCEPTS LMN: DEV CONCEPT ALT2 CTB: SME-STD.CTB JOB#: 240102.05 REV: 8/12/2025

\\Server\cfs\Casella\OldTown\LandfillExpansion\Phase II Expansion\Acad\Figures\CONCEPTS.dwg, FIG 2-2, 8/12/2025 2:11:46 PM, sjm

250' SIGNIFICANT VERNAL POOL
CRITICAL TERRESTRIAL HABITAT

250' SIGNIFICANT VERNAL POOL
CRITICAL TERRESTRIAL HABITAT

LIMIT OF WASTE (TYP)

TOP OF WASTE GRADES (TYP)

CURRENT LANDFILL BOUNDARY (TYP)

WETLAND IMPACT (TYP)

PROPOSED ACCESS ROAD (TYP)

OHE

#101 #103 #105 #106 #107 #108 #109 #110 #111 #112 #113 #114 #115

200 220 240 260 280 300 305 320 340 360 370 380 390

NOTES:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. VERTICAL DATUM: BRASS PLUG AT PUMP STATION AT THE ADMINISTRATION BUILDING. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE.
2. PROPERTY LINE LOCATIONS ARE A RESULT OF FIELD SURVEY PERFORMED BY HERRICK AND SALSBURY, INC. LAND SURVEYORS, ELLSWORTH, MAINE FOR TRYTON TREE FARM PROJECT, PATTEN CORPORATION-DOWNEAST, OLD TOWN, MAINE, FEBRUARY 23, 1988, REVISED APRIL 7, 1988.
3. WETLAND DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
4. WETLAND BOUNDARIES AND VERNAL POOL LOCATIONS ARE APPROXIMATE AND SHOULD NOT BE USED FOR DESIGN, QUANTITY, TAKE-OFFS, GRADES ETC.

LEGEND

DELINEATED WETLAND

WETLAND IMPACT (0.5 ACRES)

200 0 400 FEET

DWG: CONCEPTS LMN: DEV CONCEPT ALT3 CTB: SME-STD.CTB JOB#: 240102.05 REV: 8/12/2025

FIGURE 2-3
DEVELOPMENT CONCEPT
ALTERNATIVE 3
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

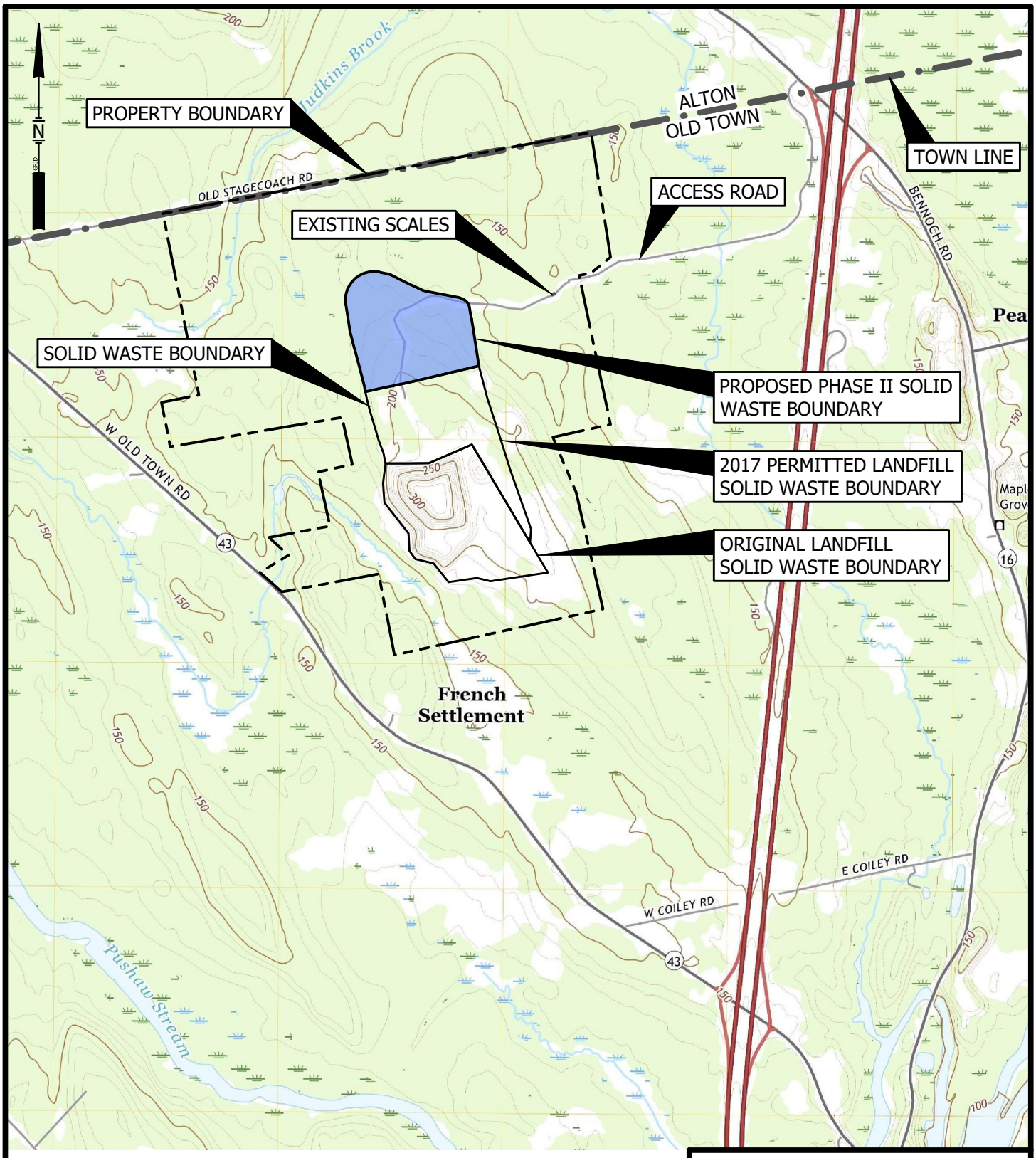
SME
SEVEE & MAHER
ENGINEERS

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\CONCEPTS.dwg, FIG 2-3, 8/12/2025 2:10:52 PM, sjm

ATTACHMENT 3

USGS MAP

SME
SEVEE & MAHER
ENGINEERS



BASEMAP ADAPTED FROM 7.5 MIN USGS TOPO QUADS
OLD TOWN, ME - 2024

FIGURE 1-1
SITE LOCATION MAP
PHASE II EXPANSION
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS

DWG: SITELOC-EXPANSION LMN: NONE CTB: SME-STD.CTB JOB#: 240100.00 REV: 4/15/2025

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC-EXPANSION.dwg, A_FIG 1-1, 4/15/2025 7:47:55 AM, sjm

ATTACHMENT 4

COLOR PHOTOS

Color photos of the wetlands to be impacted are contained in the Wetland Delineation Report (Attachment 9, Exhibit C).

SME
SEVEE & MAHER
ENGINEERS

ATTACHMENT 5

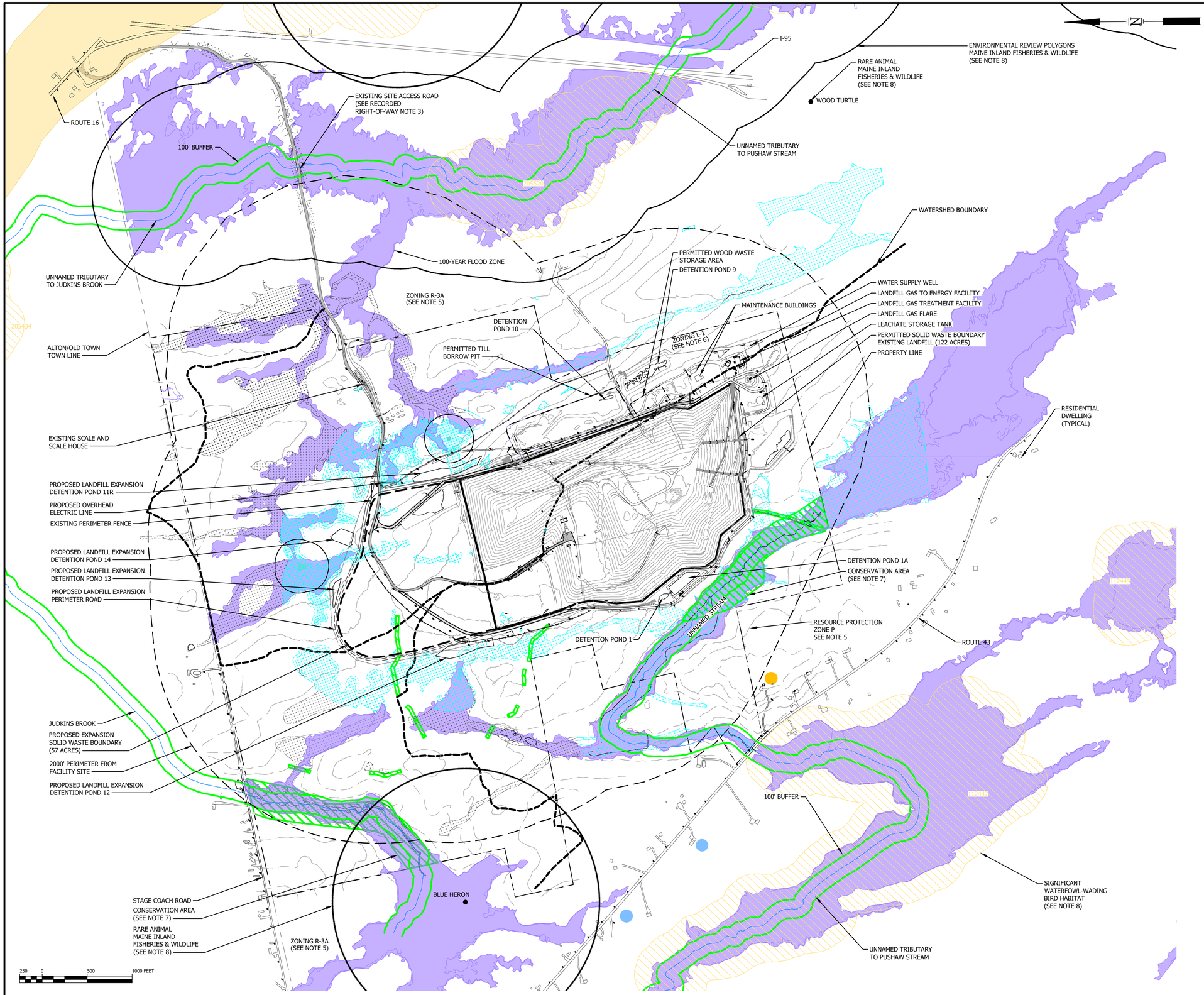
OVERHEAD AND SITE VIEW DRAWINGS

SME
SEVEE & MAHER
ENGINEERS

Overhead and side view plans drawn to scale show the project and the immediate surroundings in detail. These plans provide the following:

- The exact location of any lake, pond, river, stream, brook (perennial or intermittent) and/or wetland with the normal high-water line, low-water line, and/or wetland boundary shown. Show direction of flow for rivers, streams, and brooks. (See attached Site Surroundings Map.)
- The exact location and dimensions of the proposed activity on the lot or parcel, including areas of soil disturbance, fill, and vegetation removal and permanent structures. (See attached Drawing C-102, Site Development Plan.)
- The location and dimensions of all existing structures on the lot. Existing structures must all be shown on abutting lots, if they are located within 50 feet of any proposed structure. (See attached Drawing C-101, Anticipated Conditions Plan.)
- The location and dimension of any proposed seasonal or temporary structures. (Not applicable.)
- The location and type of all proposed erosion control measures. (See attached Drawings C-109, Final Grades and Site Drainage Plan, and C-308 and C-309 Sections and Details.)
- For piers, wharves, floats, etc., show the distance to abutting property lines from the proposed structure(s) and the distance to any existing structures (piers, wharves, etc.) on the abutting properties. (Not applicable.)
- Clearly identify resource boundaries and resource impact areas. (See Figure 1-4.)
- The location of all property lines and the names of all abutters. (See attached Tax Map of Property Abutters Figure.)
- For work in tidal waters the mean high and mean low water lines should be shown on all plans. (Not applicable.)
- The applicant's name, the scale of the drawings or plans, a north arrow, a legend, and the date. If drawings are not to scale they should be clearly dimensioned. (See attached Drawings and Figures.)
- Contour lines for significant regrading projects and large-scale projects that trigger pre-application meetings or that require a Site Location of Development Act Permit. (See attached Drawings C-101, C-102, and C-109.)

See design drawings included in Attachment 7 – Construction Plans.



NOTES:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. VERTICAL DATUM: BRASS PLUG AT PUMP STATION AT THE ADMINISTRATION BUILDING. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE.
2. LANDFILL EXPANSION 59+ ACRE FOOTPRINT BASED UPON CURRENT GRADING PLAN FOR THE JUNIPER RIDGE LANDFILL EXPANSION.
3. PROPERTY LINE LOCATIONS ARE A RESULT OF FIELD SURVEY PERFORMED BY HERRICK AND SALSBURY, INC. LAND SURVEYORS, ELLSWORTH, MAINE FOR TRYTON TREE FARM PROJECT, PATTEN CORPORATION-DOWNEAST, OLD TOWN, MAINE, FEBRUARY 23, 1988, REVISED APRIL 7, 1988.
4. RIGHT OF WAY FOR ALL PURPOSES OVER THE ACCESS ROAD (50) FOOT WIDE, AS DESCRIBED IN EXHIBIT A TO QUITCLAIM DEED WITH COVENANT (BOOK 9188, PAGE 154, #3751 - PENOBSCOT REGISTRY OF DEEDS).
5. THERE ARE NO HISTORICAL OR ARCHAEOLOGICAL PROPERTIES AFFECTED BY THE PROPOSED DEVELOPMENT OF THE JRL PHASE II EXPANSION. PER MAINE HISTORIC PRESERVATION COMMITTEE (JUNE 5, 2024).
6. ZONING, AS DESCRIBED BY THE CITY OF OLD TOWN CODE OF ORDINANCES, FOR PROPERTY OWNED BY THE STATE OF MAINE IS L-1 (LANDFILL ZONE). ALL OTHER PROPERTY SURROUNDING THE SITE IS R-3A (RESIDENCE AND FARMING). REFERENCE IS ZONING MAP OF CITY OF OLD TOWN (2010).
7. CONSERVATION AREAS SHOWN ARE WETLAND AREAS PREVIOUSLY PRESERVED AS DESCRIBED IN DECLARATIONS OF COVENANTS AND RESTRICTIONS BY JAMES RIVER PAPER COMPANY (REVISED PLAN AUGUST 10, 1995). LOCATIONS ARE APPROXIMATE.
8. THERE ARE NO RARE BOTANICAL FEATURES DOCUMENTED WITHIN THE PROJECT AREA BASED UPON A REVIEW OF THE NATURAL AREAS PROGRAM'S BIOLOGICAL AND CONSERVATION DATA SYSTEMS FILES BY THE MAINE DEPARTMENT OF AGRICULTURE CONSERVATION AND FORESTRY (DECEMBER 12, 2022 CORRESPONDENCE).
   THE MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE, WILDLIFE DIVISION, IDENTIFIED WOOD TURTLE, BAT SPECIES, AND SIGNIFICANT VERNAL POOLS, AND FISHERIES HABITAT NEAR THE SITE (DECEMBER 15, 2022 CORRESPONDENCE). THERE HAVE BEEN NO OTHER UNIQUE AREAS IDENTIFIED WITHIN THE GENERAL VICINITY OF THE SITE.
9. THERE ARE NO INDUSTRIAL OR PUBLIC WATER SUPPLY WELLS, PUBLIC WATER SUPPLY WATERSHED AREAS, WELLHEAD PROTECTION AREAS OR SIGNIFICANT SAND AND GRAVEL AQUIFERS LOCATED WITHIN 2000 FEET OF THE PROPOSED EXPANSION. ALL RESIDENTIAL DWELLINGS SHOWN ARE ASSUMED TO HAVE A DOMESTIC WATER SUPPLY WELL.

LEGEND

- MAINE INLAND FISHERIES AND WILDLIFE SIGNIFICANT WILDLIFE HABITAT SOURCE: NOVEMBER 5, 2014 CORRESPONDENCE WITH THE MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE
- 100 YEAR FLOOD ZONE (FEMA OLD TOWN QUAD PANEL NUMBER 23019C1926D AND 23019C1927D (EFFECTIVE 7/19/2023)
- WETLANDS DELINEATIONS AS PROVIDED IN NATURAL RESOURCES REPORT FOR JUNIPER RIDGE LANDFILL PROJECT BY BIODIVERSITY RESEARCH INSTITUTE (BRI) DATED, SEPTEMBER 2024.
- WETLANDS DELINEATED BY STANTEC (2004, 2008)
- GROUNDWATER YIELDS GREATER THAN 10 GPM SIGNIFICANT SAND & GRAVEL AQUIFER MGS SURVEY OPEN FILE NO. 01-188 DATED 2001.
- CONSERVATION AREAS
- RESOURCE PROTECTION ZONE P
- YIELD BETWEEN 5 AND 10 GALLONS PER MINUTE
- YIELD BETWEEN 10 AND 15 GALLONS PER MINUTE

} REFERENCE DRAWING: MAINE GEOLOGICAL SURVEY OPEN FILE NO. 02-25 2002 BANGOR 30x60 MINUTE QUADRANGLE

SITE SURROUNDINGS MAP
NRPA APPLICATION
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DWG: BUFFERPLAN LMN: SITE SURROUNDINGS CTB: SME-STD.CTB JOB#: 240102.05 REV: 3/6/2025

\\Server\Dk\Castle\JOs\Tom Landfill\Expansion\Phase II Expansion\Autof\Figures\BUFFERPLAN.dwg, SITE SURROUNDINGS, 3/6/2025 3:11:41 PM, sm

ATTACHMENT 6

ADDITIONAL PLANS

SME
SEVEE & MAHER
ENGINEERS

Additional plans, if applicable:

- Cross-sectional drawings for piers, roadways, stream crossings, dredging projects, retaining walls, riprap, gravel removal, pond construction, fill projects, and dams. (See attached Drawings C-109 and C-200 through C-205.)
- Profile drawing or plans for projects involving significant amounts of stream culverting or channelization work, roads involving steep embankments or inclines, and boat ramps. **(Not applicable.)**

See design drawings included in Attachment 7 – Construction Plans.

ATTACHMENT 7

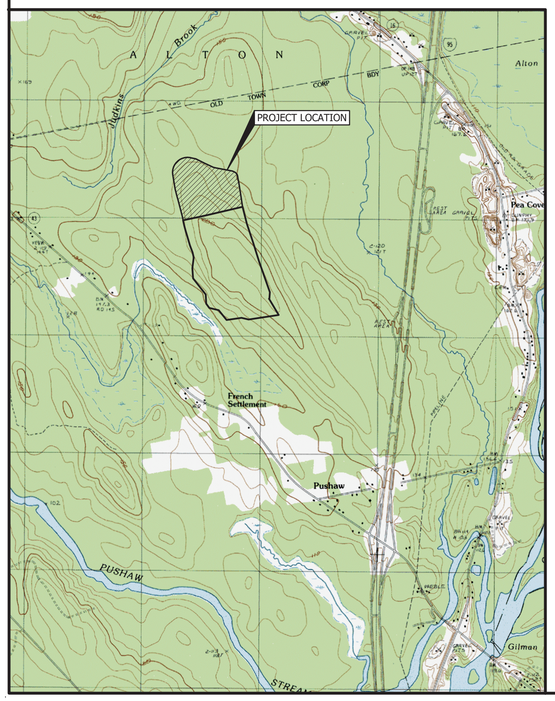
CONSTRUCTION PLANS

SME
SEVEE & MAHER
ENGINEERS

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS, LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

TITLE	DWG NO
COVER SHEET	
SYMBOLS & ABBREVIATIONS	C-100
ANTICIPATED CONDITIONS PLAN	C-101
SITE DEVELOPMENT PLAN	C-102
BASE GRADING PLAN	C-103
UNDERDRAIN PLAN	C-104
LEAK DETECTION PIPING PLAN	C-105
LEACHATE COLLECTION PIPING PLAN	C-106
LEACHATE STORAGE SYSTEM PLAN AND DETAILS	C-107
GAS COLLECTION PIPING PLAN	C-108
FINAL GRADES AND SITE DRAINAGE PLAN	C-109
SECTION LOCATION PLAN	C-110
PROPOSED SECTIONS TRAVERSE	C-200
PROPOSED SECTIONS TRAVERSE	C-201
PROPOSED SECTIONS TRAVERSE	C-202
PROPOSED SECTIONS LONGITUDINAL	C-203
PROPOSED SECTIONS LONGITUDINAL	C-204
PROPOSED SECTIONS LONGITUDINAL	C-205
SECTIONS AND DETAILS	C-300
SECTIONS AND DETAILS	C-301
SECTIONS AND DETAILS	C-302
SECTIONS AND DETAILS	C-303
SECTIONS AND DETAILS	C-304
SECTIONS AND DETAILS	C-305
SECTIONS AND DETAILS	C-306
SECTIONS AND DETAILS	C-307
SECTIONS AND DETAILS	C-308
SECTIONS AND DETAILS	C-309
SECTIONS AND DETAILS	C-310
SECTIONS AND DETAILS	C-311

LOCATION MAP



SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland Center, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • smemaine.com

STATE OF MAINE
BRIAN D PIERCE
9601
11/1/2023
REGISTERED PROFESSIONAL ENGINEER

\\Server-cdc\Data\ACTIVeLANRE\Expansion\Phase II Expansion\Asset\Plans\CIVIL\TER.dwg, C-000, 11/1/2023 8:29:43 AM, lyn

SYMBOLS

EXISTING	PROPOSED		EXISTING	PROPOSED		EXISTING	PROPOSED	
		NORTH ARROW (GRID)			DRAINAGE COURSE (WITH DIRECTION)	G	G	UNDERGROUND GAS MAIN
DATE		NORTH ARROW (MAGNETIC)			EDGE OF WATER	UCC	UCC	UNDERGROUND COMMUNICATIONS LINE
25	25	CONTOUR LINES			STREAM	UGE	UGE	UNDERGROUND ELECTRICAL LINE
	INV 25.56	SPOT ELEVATION (INVERT ELEVATION)			WATER ELEVATION (GROUND OR SURFACE)	OHE	OHE	OVERHEAD ELECTRICAL LINE
		SURVEY BASELINE WITH TRIANGULATION OR INTERSECTION POINT			FENCE LINE (STOCKADE)	OT	OT	OVERHEAD TELEPHONE LINE
		PROPERTY LINE OR RIGHT-OF-WAY	X X	X X	FENCE LINE (METAL/CHAIN LINK)	SS	SS	SANITARY SEWER
		DEED RESTRICTION BOUNDARY			STONE WALL	FM	FM	FORCE MAIN
N35°-10'-10"W 251.17'	N35°-10'-10"W 251.17'	PROPERTY LINE W/ BEARING AND DISTANCE			RETAINING WALL	W	W	WATER MAIN
1	20	CELL DESIGNATION			GUARD RAIL	SD	SD	STORM DRAIN
		BOUNDARY LINE (State, County, Municipality)			BUILDING AND STRUCTURES	UD	UD	UNDERDRAIN
⊡	■	SURVEY MONUMENT		2 1 OR 2:1	SLOPE RATIO (HORIZONTAL TO VERTICAL)	LFG	LFG	LANDFILL GAS
		SURVEY CONTROL	TOP OF SLOPE	TOP OF SLOPE	SLOPES (WITH SLOPE RATIO)	LT	LT	LEACHATE TRANSPORT
○	●	PROPERTY PIN, DRILL HOLE, PK, OR STAKE			EDGE OF PAVEMENT	LC	LC	LEACHATE COLLECTION
		WOODS OR BRUSH LINE			EDGE OF GRAVEL	LD	LD	LEAK DETECTION
		INDIVIDUAL TREE			CONCRETE	GC	GC	GAS COLLECTION
		WETLAND DELINEATED	B-12 MW-12 P-12	B-12 MW-12 P-12	TEST BORING, MONITORING WELL, OR PIEZOMETER AND NUMBER	GT	GT	GAS TRANSPORT
		WETLAND PHOTO INTERPRETED	TP-12	TP-12	TEST PIT AND NUMBER	▷	▶	REDUCER
		WETLAND TO BE IMPACTED	SW-12	SW-12	SURFACE WATER SAMPLE LOCATION			MECHANICAL CAP OR PLUG
		WETLAND OF SPECIAL SIGNIFICANCE (WOSS)			GAS EXTRACTION WELL			COUPLING
		WOSS SETBACK (25-FOOT)	C	C	GAS CONDENSATE TRAP			BEND
		WOSS SETBACK (75-FOOT)	KO	KO	LFG KNOCKOUT			TEE
	●	VERNAL POOL			GAS WELL HEAD			PIPE TO BE ABANDONED
		VERNAL POOL SETBACK			GAS VENT CAPPED			RISER PIPE & INLET GRATE
		NRPA STREAM		⊘	CLEANOUT STRUCTURE			STORM GRATE
		BEDROCK OUTCROP		●	MANHOLE			DRAINAGE INLET STRUCTURE
	♦	SAMPLE SUMP			CATCH BASIN		■	UNDERDRAIN SUMP
		SLOPE INCLINOMETER			CULVERT		LF	LITTER FENCE
		VIBRATING WIRE SETTLEMENT CELL			RIPRAP		SF	SILTATION FENCE
		VERTICAL/HORIZONTAL DISPLACEMENT MONUMENT			WATER OR GAS VALVE		LOW	LIMIT OF WORK LINE
		VERTICAL DISPLACEMENT MONUMENT			HYDRANT		CLL	CLEARING LIMIT LINE
				W	WELL (MAROOKA SUPPLY WELL)			100-YEAR FLOODPLAIN
					AIR RELEASE VALVE			WETLAND
				E	ELECTRICAL MANHOLE (EMH)			WETLAND OF SPECIAL SIGNIFICANCE (WOSS)
					UTILITY POLE			
					LIGHT POLE			

GENERAL NOTES

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC., NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLIGSA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC, CUMBERLAND, MAINE.

   SITE CONTROL POINTS INFORMATION:

POINT #	NORTHING	EASTING	ELEVATION (FT)	DESCRIPTION
1000	478242.06	925376.38	167.99	WET WELL-PLUG
1001	477837.90	925672.66	160.12	MH13-PK
1002	479259.38	925158.27	185.65	LEDGE-PK
1003	479589.83	925157.64	205.01	MH30-PK
1004	479820.27	925097.15	205.01	MH33-PK
1006	478246.50	925365.28	167.62	VALVE PIT-PK
1007	477451.45	926203.11	165.62	MH14-PK
1010	480071.86	926904.09	206.29	MH26-PK
1011	479669.08	927037.61	215.20	MH25-PK
1012	478065.49	927548.96	216.94	MH22-PK
1013	477534.13	927485.35	203.30	MH19-PK
1014	480638.39	926747.66	185.91	MH27-PK

2. LOCATIONS OF EXISTING UNDERGROUND UTILITIES INCLUDING ELECTRICAL AND PIPING BASED ON FIELD SURVEY DURING CONSTRUCTION OF CELLS 1 THROUGH 16, FORMER LEACHATE POND AND LANDFILL GAS HEADER AND FLARE RE-LOCATIONS.

3. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, AND 2015, AND BRI ENVIRONMENTAL IN 2024.

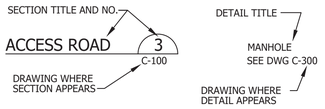
4. GRADES SHOWN WITHIN THE PERMITTED SOLID WASTE BOUNDARY REPRESENT ANTICIPATED GRADING AT THE BEGINNING OF PHASE II EXPANSION (CELL 18) CONSTRUCTION.

5. LIMIT OF INTERMEDIATE GEOMEMBRANE COVER AND FINAL COVER SHOWN REPRESENTS ANTICIPATED SITE CONDITIONS AT THE BEGINNING OF PHASE II EXPANSION (CELL 18) CONSTRUCTION.

TYPICAL ABBREVIATIONS:

ACCMP	ASPHALT COATED CMP
ACP	ASBESTOS CEMENT PIPE
AC	ACRE
AGG	AGGREGATE
ALUM	ALUMINUM
APPD	APPROVED
APPROX	APPROXIMATE
ARMH	AIR RELEASE MANHOLE
ASB	ASBESTOS
ASP	ASPHALT
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AZ	AZIMUTH
BCCMP	BITUMINOUS COATED CMP
BM	BENCH MARK
BIT	BITUMINOUS
BLDG	BUILDING
BOT	BOTTOM
BRG	BEARING
BV	BALL VALVE
CB	CATCH BASIN
CEN	CENTER
CEM LIN	CEMENT LINED
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CF	CUBIC FEET
CFS	CUBIC FEET PER SECOND
CI	CAST IRON
CL	CLASS
CONC	CONCRETE
CONST	CONSTRUCTION
CONTR	CONTRACTOR
CS	CURB STOP
CTR	CENTER
CU	COPPER
CY	CUBIC YARD
D	DEGREE OF CURVE
DBL	DOUBLE
DEG OR °	DEGREE
DEPT	DEPARTMENT
DI	DUCTILE IRON
DIA	DIAMETER
DIM	DIMENSION
DIST	DISTANCE
DN	DOWN
DR	DRAIN
DWG	DRAWING
EA	EACH
EG	EXISTING GROUND OR GRADE
ELEC	ELECTRIC
EL	ELEVATION
ELB	ELBOW
EOP	EDGE OF PAVEMENT
EQUIP	EQUIPMENT
EST	ESTIMATED
EXC	EXCAVATE
EXIST	EXISTING
FI	FIELD INLET
FG	FINISH GRADE
FBRGL	FIBERGLASS
FDN	FOUNDATION
FLEX	FLEXIBLE
FLG	FLANGE
FLR	FLOOR
FPS	FEET PER SECOND
FT OR '	FEET
FTG	FOOTING
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GPD	GALLONS PER DAY
GPM	GALLONS PER MINUTE
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
HP	HORSEPOWER
HYD	HYDRANT
ID	INSIDE DIAMETER
IN OR "	INCHES
INV	INVERT
INV EL	INVERT ELEVATION
LB	POUND
LC	LEACHATE COLLECTION
LD	LEAK DETECTION
LF	LINEAR FEET
LOC	LOCATION
LOW	LIMIT OF WORK
LT	LEACHATE TRANSPORT
MH	MANHOLE
MJ	MECHANICAL JOINT
MATL	MATERIAL
MAX	MAXIMUM
MFR	MANUFACTURE
MIN	MINIMUM
MISC	MISCELLANEOUS
MON	MONUMENT
NITC	NOT IN THIS CONTRACT
NTS	NOT TO SCALE
N/F	NOW OR FORMERLY
NO OR #	NUMBER
OC	ON CENTER
OD	OUTSIDE DIAMETER
PC	POINT OF CURVE
PD	PERIMETER DRAIN
PI	POINT OF INTERSECTION
PIV	POST INDICATOR VALVE
PT	POINT OF TANGENT
PERF	PERFORATED
PP	POWER POLE
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
QTY	QUANTITY
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT OF WAY
RAD	RADIUS
REQD	REQUIRED
RT	RIGHT
RTE	ROUTE
S	SLOPE
SCH	SCHEDULE
SF	SQUARE FEET
SFC	SLIPFORM CONCRETE CURB
SHT	SHEET
SMH	SANITARY MANHOLE
ST	STREET
STA	STATION
SY	SQUARE YARD
TAN	TANGENT
TDH	TOTAL DYNAMIC HEAD
TEMP	TEMPORARY
TYP	TYPICAL
UD	UNDERDRAIN
V	VOLTS
VA TEE	VALVE ANCHORING TEE
VERT	VERTICAL
VGC	VERTICAL GRANITE CURB
WG	WATER GATE
W/	WITH
W/O	WITHOUT
YD	YARD

VIEW MARKERS & IDENTIFICATION



REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE — BRIAN D. PERRY — 9600 — 11/11/2025 — REGISTERED PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SYMBOLS & ABBREVIATIONS

SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • smemaine.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB

JOB NO. 240101 DWG FILE SYMSHT

C-100

\\Server\CNCastle\CNTowLandfill\Expansion\Phase II Expansion\Xlab\Plans\SYMSHT.dwg, C-100, 11/10/2025 2:17:56 PM, jim

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. GRADES SHOWN WITHIN THE PERMITTED SOLID WASTE BOUNDARY REPRESENT ANTICIPATED GRADES AT THE BEGINNING OF PHASE II EXPANSION (CELL 18) CONSTRUCTION.
5. SPECIAL FLOOD HAZARD ZONE A IS 100-YEAR FLOOD ZONE WITHOUT BASE FLOOD ELEVATION (BFE) PER MAP PANEL 23019C1926D, EFFECTIVE DATE 7/19/2023.

SITE CONTROL POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION (FT)	DESCRIPTION
1000	478242.06	925376.38	167.99	WET WELL-PLUG
1001	477837.90	925672.66	160.12	MH13-PK
1002	479259.38	925158.27	185.65	LEDGE-PK
1003	479589.83	925157.64	205.01	MH30-PK
1004	479820.27	925097.15	205.01	MH33-PK
1006	478246.50	925365.28	167.62	VALVE PIT-PK
1007	477451.45	926203.11	165.62	MH14-PK
1010	480071.86	926904.09	206.29	MH26-PK
1011	479669.08	927037.61	215.20	MH25-PK
1012	478065.49	927548.96	216.94	MH22-PK
1013	477534.13	927485.35	203.30	MH19-PK
1014	480638.39	926747.66	185.91	MH27-PK

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PIERCE
9600
LICENSED PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

ANTICIPATED CONDITIONS PLAN

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	EXCN
CTB:	SME-STD.CTB
JOB NO.	240101.00
DWG FILE	BASE
	C-101

N:\Projects\Casella\Old Town Landfill\Expansion\Phase II Expansion\Acad\Plans\BASE.dwg C-101 11/10/2025 11:42:03 AM, sjm

EXISTING SCALE HOUSE INFRASTRUCTURE AREA
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT
BEDROCK OUTCROP (TYP)
SITE CONTROL POINT (TYP) SEE TABLE THIS DWG AND SEE NOTE 1 ON DWG C-100
LFG KNOCKOUT STRUCTURE (TYP)
END OF EXISTING LEACHATE FORCE MAIN
DETENTION POND 11R
PROPOSED SOLID WASTE LIMIT (TYP)
26'-WIDE PAVED ACCESS ROAD (TYP)
EXISTING OVERHEAD ELECTRIC LINE (TYP)
PERMITTED TILL BORROW PIT
PERMITTED WOOD WASTE HANDLING AREA
PROPOSED WOOD STORAGE LOT
SUBSURFACE WASTEWATER DISPOSAL FIELD
APPROXIMATE LOCATION OF PROPOSED PFAS TREATMENT PLANT
PROPERTY LINE (TYP)
VERNAL POOL (TYP)
GRAVEL UTILITY ACCESS ROADS (TYP)
OW-613A,B
OW-612A,B
LIMIT OF BRI WETLANDS DELINEATION (TYP) SEE NOTE 2
CELL 12 PUMP STATION
PRIMARY ACCESS ROAD (TYP)
DETENTION POND 10
DETENTION POND 9
MAINTENANCE BUILDINGS
RNG TREATMENT FACILITY POND
LFG TREATMENT FACILITY
WOOD STORAGE FACILITY 2 ACRE
WATER SUPPLY WELL
CELL 14 PUMP STATION
CELL 13 PUMP STATION
FORCE MAIN VAULT (TYP)
CATCH BASIN AND CULVERT (TYP)
1 ACRE
RENEWABLE NATURAL GAS (RNG) FACILITY
LFG FLARE LOCATION
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT
DETENTION POND 14
OW-614A,B
#1010
#1011
#1012
CELL 11 PUMP STATION
RIPRAP DITCH (TYP)
RIPRAP CB INLET
LEACHATE STORAGE TANK PUMP STATION
LEACHATE STORAGE TANK 1
PROPOSED LEACHATE STORAGE TANK 2
REMOVE AND RELOCATE EXISTING FENCE
DETENTION POND 11
EXISTING DETENTION POND INFRASTRUCTURE TO BE REMOVED
CELL 18 PUMP STATION
EXISTING PAVED ACCESS ROAD TO BE REMOVED
#1013
PROPOSED LEACHATE STORAGE TANK 3
PROPOSED GUARDRAIL (TYP)
OW-615A,B
STAGE 3 FINAL COVER
24" LFG HEADER (TYP)
LFG KNOCKOUT STRUCTURE (TYP)
EXISTING PAVED ACCESS ROAD TO BE REMOVED
PROPOSED LANDFILL BASE GRADES (TYP) SEE NOTE 4
PROPOSED CELL LIMITS (TYP)
100-YEAR FLOOD ZONE SPECIAL FLOOD HAZARD AREA (TYP) SEE NOTE 6
OW-616A,B
DETENTION POND 13
CELL 20 PUMP STATION
LIMIT OF PHASE I EXPANSION LINER (TYP)
STAGE 1 FINAL COVER
UTILITY MANHOLE (TYP)
DETENTION POND 6
CELL 8 PUMP STATION
EXISTING CELLS LINER LIMIT (TYP)
(2) 24" HDPE CULVERTS
PERMANENT LANDFILL ACCESS ROAD
FENCE (TYP)
EXISTING OVERHEAD UTILITIES TO BE REMOVED
STAGE 2 FINAL COVER
8"x12" LEACHATE FORCEMAIN
PROPERTY LINE (TYP)
20'-WIDE GRAVEL ACCESS ROAD (TYP)
OW-08-04A,B
DEED RESTRICTION (TYP)
#1007
ELECTRICAL MANHOLE (TYP)
DETENTION POND 2
UNDERGROUND ELECTRIC (TYP)
P-04-12A,B
CELL 19 PUMP STATION
CELL 16 PUMP STATION
EXISTING EMH (TYP)
#1004
#1003
#1002
#1001
#1000
#1006
DETENTION POND 1A
LFG KNOCKOUT STRUCTURE AND VALVES
CELL 5 PUMP STATION
CELL 4 PUMP STATION
OW-617A,B
REMOVE AND RELOCATE EXISTING FENCE
PROPOSED FENCE (TYP)
DETENTION POND 12
CELL 17 BASE GRADES (SEE NOTE 5)
25-FOOT STREAM SETBACK
EXISTING FORCEMAIN VAULT (TYP)
CELL 15 PUMP STATION
RIPRAP DITCH (TYP)
EXISTING 24" DIA LANDFILL GAS PIPE
8" GRAVITY SEWER IS ABANDONED
WATER LOADING RACK
DETENTION POND 1

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.
6. SPECIAL FLOOD HAZARD ZONE A IS ZONE WITHOUT BASE FLOOD ELEVATION (BFE) PER MAP PANEL 23019C1926D, EFFECTIVE DATE 7/19/2023.

100 0 200 400 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PIERCE
9601
LICENSED
PROFESSIONAL ENGINEER
11/17/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SITE DEVELOPMENT PLAN

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	SITE-DEV
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-102

N:\Server\Projects\2024\Juniper Ridge\Engineering\Phase II Expansion\Autocad\Plans\BASE.dwg, C-102, 11/17/2025 11:42:21 AM, sjm

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.

100-YEAR FLOOD ZONE
SPECIAL FLOOD
HAZARD AREA (TYP)
SEE NOTE 6 ON DWG C-101

GRAVEL UTILITY
ACCESS ROADS (TYP)

VERNAL POOL (TYP)

PROPOSED
FENCE (TYP)

DETENTION
POND 14

PROPOSED SOLID
WASTE LIMIT (TYP)

26'-WIDE PAVED
ACCESS ROAD (TYP)

END OF EXISTING
LEACHATE FORCE MAIN

DETENTION
POND 11R

250' SIGNIFICANT VERNAL POOL
CRITICAL TERRESTRIAL HABITAT

LFG KNOCKOUT
STRUCTURE (TYP)

EXISTING OVERHEAD
ELECTRIC LINE (TYP)

CELL 12 PUMP STATION

PRIMARY ACCESS ROAD (TYP)

CELL 11 PUMP STATION

CELL 13 PUMP STATION

CELL 14 PUMP STATION

EXISTING CATCH
BASIN AND CULVERT
TO BE REMOVED

LIMIT OF
AUGMENTED
LINER (TYP)

PROPOSED
GUARDRAIL (TYP)

250' SIGNIFICANT VERNAL POOL
CRITICAL TERRESTRIAL HABITAT

DETENTION
POND 13

C-300

PROPOSED LANDFILL
BASE GRADES (TYP)
SEE NOTE 4

PROPOSED CELL
LIMITS (TYP)

LIMIT OF PHASE I
EXPANSION LINER (TYP)

ANTICIPATED OPERATIONAL
WASTE GRADES (TYP)
SEE NOTE 4 ON DWG C-101

FENCE (TYP)

20'-WIDE GRAVEL
ACCESS ROAD (TYP)

DEED RESTRICTION (TYP)

LEAVE 12" OF NATIVE
SOIL IN PLACE ABOVE
BASE GRADE (TYP)
SEE NOTE 4

DETENTION
POND 12

25-FOOT STREAM SETBACK

CELL 17 BASE GRADES (TYP)
SEE NOTE 5

EXISTING
EMH (TYP)

EXISTING FORCEMAIN
VAULT (TYP)

CELL 16 PUMP
STATION

CELL 15 PUMP STATION

60 0 120 240 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN
PIERCE
9608
11/11/2025
LICENSED
PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

BASE GRADING PLAN

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	BASEGRADE
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-103

\\Server\cfs\Cwells\Old\Twin Law\MEExpansion\Phase II Expansion\Acad\Plans\BASE.dwg, C-103, 11/10/2025 11:42:47 AM, sjm

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PIERCE
9601
11/17/2025
PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

UNDERDRAIN PLAN

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	UNDERDRAIN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-104

60 0 120 240 FEET

\\server\sfs\Data\NOAH\Twin Landfill\Expansion\Phase II Expansion\Xcad\Plans\BASE.dwg, C-104, 11/17/2025 10:06:51 AM, sjm

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.

60 0 120 240 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PERRY
9601
PROFESSIONAL ENGINEER
11/7/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

LEAK DETECTION PIPING PLAN

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	LD-PIPE
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-105

\\Server\dk\Castle\2DTown\Landfill\Expansion\Phase II Expansion\Xdoll\Plans\BASE.dwg, C-105, 11/7/2025 11:43:30 AM, sjm

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. PIPE SDR RATING IS BASED ON OVERLYING WASTE DEPTH AT WHICH PIPE IS LOCATED. PIPE LATERALS LOCATED WITHIN CELL 18 AND PART OF CELL 21 WILL REQUIRE PIPE HDPE SDR 7.0 RATING
6. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.

PERMANENT COLLECTION SUMP AREA AND PUMP STATION (TYP) CELL 18 SEE DWG C-302
SMH #34 TIE-IN VAULT (TYP) SEE DWG C-307
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT
EXISTING OVERHEAD ELECTRIC LINE (TYP)
VERNAL POOL (TYP)
26'-WIDE PAVED ACCESS ROAD (TYP)
LFG KNOCKOUT STRUCTURE (TYP)
DETENTION POND 11R
CELL 12 PUMP STATION PRIMARY ACCESS ROAD (TYP)
CELL 13 PUMP STATION
SMH #27 CONNECTION AT EXISTING VAULT (TYP) SEE DWG C-307
CELL 14 PUMP STATION
6"x10" DUAL CONTAINMENT HDPE FORCE MAIN (TYP)
LEACHATE LEVEL TRANSDUCER AND CABLE (TYP)
DETENTION POND 14
6" DIA SDR 11 HDPE PERF LEACHATE COLLECTION LATERAL (TYP) SEE DWG C-300
PROPOSED GUARDRAIL (TYP)
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT
6" AND 8" DIA SDR 7 HDPE PERF LEACHATE COLLECTION LATERAL SEE DWG C-300 SEE NOTE 5
DETENTION POND 13
PROPOSED CELL LIMITS (TYP)
PROPOSED LANDFILL BASE GRADES (TYP) SEE NOTE 4
PERMANENT COLLECTION SUMP AREA AND PUMP STATION (TYP) CELL 20
SMH #39 TIE-IN VAULT SEE DWG C-307
LIMIT OF PHASE I EXPANSION LINER (TYP)
6" AND 8" DIA SDR 11 HDPE PERF LEACHATE COLLECTION LATERAL (TYP) SEE DWG C-300 SEE NOTE 5
INTERMEDIATE BERM BASE LINER CONNECTION (TYP) SEE DWG C-303
FENCE (TYP)
HDPE PIPE END CAP (TYP)
LINER SYSTEM TIE-IN CONNECTION TO ADJACENT CELL (TYP) SEE DWG C-300
SMH #38 IN-LINE VAULT SEE DWG C-307
PROPOSED SOLID WASTE LIMIT (TYP)
20'-WIDE GRAVEL ACCESS ROAD (TYP)
8" DIA SDR 17 HDPE PERF HEADER PIPE (TYP)
LEACHATE COLLECTION AND LEAK DETECTION CLEANOUTS (TYP) SEE DWG C-301
SMH #33 TIE-IN CONNECTION VAULT SEE DWG C-307
DEED RESTRICTION (TYP)
CELL 17 BASE GRADE SEE NOTE 6
CELL 16 PUMP STATION
EXISTING EMH (TYP)
EXISTING FORCEMAIN VAULT (TYP)
CLEARING LIMIT LINE (LIMIT OF WORK) (TYP)
SMH #37 IN-LINE VAULT SEE DWG C-307
PERMANENT COLLECTION SUMP AREA AND PUMP STATION (TYP) CELL 19
PIPING AT PERIMETER BERM (TYP) SEE DWG C-300
DETENTION POND 12
SMH #36 TIE-IN VAULT SEE DWG C-307
25-FOOT STREAM SETBACK
SMH #35 IN-LINE VAULT SEE DWG C-307
6"x10" DUAL CONTAINMENT HDPE FORCE MAIN (TYP)

60 0 120 240 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE BRIAN D. PIERCE 9601 LICENSED PROFESSIONAL ENGINEER 11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

LEACHATE COLLECTION PIPING PLAN

SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	LC-PIPE
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-106

\\Netwrok\SME\Data\2024\Juniper\Engineering\Phase II Expansion\Acad\Plans\BASE.dwg, C-106, 11/11/2025 11:43:51 AM, sjm

SMH #19
SMH #17
12"/18" DUAL CONTAINMENT FORCE MAIN
PROPOSED CONTAINMENT AREA PERIMETER
EXISTING GRAVITY LEACHATE DRAIN PIPE
FUTURE PFAS POST-TREATMENT STORAGE TANK ±500,000 GALLONS (PRIOR TO EXPANSION)
FROM PFAS TREATMENT PLANT
SMH #18 MODIFICATION SEE DWG C-311
12"/16" DUAL CONTAINMENT FORCE MAIN
EXISTING 921,000 GALLON LEACHATE STORAGE TANK
TANK INLET SEE DWG C-310
TANK OUTLET SEE DWG C-310
LEACHATE STORAGE TANK FOUNDATION DRAIN CONNECT TO EXISTING TANK FOUNDATION DRAIN
EXISTING STORAGE BUILDING
RIPRAP DITCH (TYP) SEE DWG C-309
FUTURE POST TREATMENT LEACHATE PIPING (PRIOR TO EXPANSION)
DETENTION POND 6
LEACHATE STORAGE TANK SYSTEM SECTION SEE DWG C-310
(2) 24" DIA HDPE CULVERTS INV IN 192.0 INV OUT 189.0
RIPRAP OUTLET APRON (TYP) SEE DWG C-308
PROPOSED±921,000 GALLON LEACHATE STORAGE TANK
LEACHATE STORAGE TANK AREA CATCH BASIN INLET
12" DIA IPS HDPE STORM DRAIN OUTLET PIPE
INV OUT 197.5
BOLLARD (TYP)
POST INDICATOR VALVE
BOLLARD (TYP)
POST INDICATOR VALVE (CLOSED POSITION)
8"/12" DUAL CONTAINMENT FORCE MAIN
4" FOUNDATION DRAIN SOLID WALL CORRUGATED POLYETHYLENE PIPE
REMOVE EXISTING CATCH BASIN AND INSTALL END CAP ON 12" DRAIN CORE
ABANDON EXISTING 12" DRAIN LINE IN PLACE
8"/12" DUAL CONTAINMENT FORCE MAIN TO PFAS TREATMENT
8'x12' TANK DISCHARGE VALVE PIT SEE DWG C-311
8"/12" DUAL CONTAINMENT FORCE MAIN
6' DIA LOADING RACK VALVE PIT SEE DWG C-311
8"/12" DUAL CONTAINED HDPE LONG RADIUS ELBOW
CB-02 4' DIAMETER RIM 208.00 INV OUT 199.00
LEACHATE STORAGE TANK SYSTEM SECTION SEE DWG C-310
EXISTING PIPING TO LOADING RACK
LEACHATE STORAGE TANK PUMP STATION
8" SDR 11 HDPE PIPE
2" SDR 11 HDPE PIPE
DUAL CONTAINMENT PUMP STATION
8" SDR 11 HDPE PIPE
2"/4" DUAL CONTAINMENT FORCE MAIN
24"LFG
N
10 0 20 40 FEET

NOTE:
1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE BRIAN D PIERCE 9601 LICENSED PROFESSIONAL ENGINEER 11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

LEACHATE STORAGE SYSTEM PLAN

SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	LC-STOR
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-107

\\Warren\Civil\Data\Civil\Juniper\Engineering\Phase II Expansion\Final\Plan\BASE.dwg, C-107, 11/7/2025 11:44:17 AM, kjm

NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE. THE BASE LINER SYSTEM SHALL BE CONSTRUCTED ON THE RESULTING GRADE ABOVE THE UNDERDRAIN, AUGMENTED LINER, OR ONE FOOT OF NATIVE SOILS.
5. PIPE SDR RATING IS BASED ON OVERLYING WASTE DEPTH AT WHICH PIPE IS LOCATED. PIPE LATERALS LOCATED WITHIN CELL 18 AND PART OF CELL 21 WILL REQUIRE PIPE HDPE SDR 7.0 RATING
6. CELL 17 BASE GRADES REPRESENT PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE LINER SYSTEM WITHIN THE LANDFILL LINER LIMITS. CELL 17 BASE GRADE SHOWN OUTSIDE THE LANDFILL REPRESENT THE PREPARED SUBGRADE PRIOR TO CONSTRUCTING THE ACCESS ROAD. CELL 17 HAS NOT BEEN CONSTRUCTED AT THE TIME THESE DRAWINGS WERE PREPARED.
7. GAS COLLECTION PIPING FROM LFG SYSTEM DESIGN REPORT FOR THE PHASE II EXPANSION AT JUNIPER RIDGE LANDFILL, PREPARED BY SANBORN, HEAD & ASSOCIATES, INC., DATED NOVEMBER 2025.

GRAVEL UTILITY ACCESS ROADS (TYP)
VERNAL POOL (TYP)
CELL 18 CONDENSATE PUMP STATION (TEMPORARY)
PERMANENT COLLECTION SUMP AREA AND PUMP STATION (TYP) CELL 18
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT
26'-WIDE PAVED ACCESS ROAD (TYP)
6"x10" DUAL CONTAINMENT HDPE FORCE MAIN (TYP)
LFG KNOCKOUT STRUCTURE (TYP)
EXISTING OVERHEAD ELECTRIC LINE (TYP)
DETENTION POND 11R
CELL 14 PUMP STATION
CELL 13 PUMP STATION
CELL 12 PUMP STATION
PRIMARY ACCESS ROAD (TYP)
DETENTION POND 14
CELL 22 CONDENSATE PUMP STATION
PROPOSED GUARDRAIL (TYP)
250' SIGNIFICANT VERNAL POOL CRITICAL TERRESTRIAL HABITAT
DETENTION POND 13
CELL 20 CONDENSATE PUMP STATION (TEMPORARY)
PERMANENT COLLECTION SUMP AREA AND PUMP STATION (TYP) CELL 20
FENCE (TYP)
PROPOSED SOLID WASTE LIMIT (TYP)
20'-WIDE GRAVEL ACCESS ROAD (TYP)
DEED RESTRICTION (TYP)
CLEARING LIMIT LINE (LIMIT OF WORK) (TYP)
PERMANENT COLLECTION SUMP AREA AND PUMP STATION (TYP) CELL 19
CELL 19 CONDENSATE PUMP STATION
DETENTION POND 12
25-FOOT STREAM SETBACK
CELL 17 BASE GRADE SEE NOTE 6
6"x10" DUAL CONTAINMENT HDPE FORCE MAIN (TYP)
CELL 16 PUMP STATION
PROPOSED LANDFILL FINISH WASTE GRADES (TYP) SEE NOTE 4

60 0 120 240 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE BRIAN D. PERRY 9600 PROFESSIONAL ENGINEER 11/12/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

GAS COLLECTION PIPING PLAN

SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	GC-PIPE
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-108

\\Narwin\CAD\Cadd\COT\Twn\Land\RE\Expansion\Phase II Expansion\Xdoh\Plans\BASE.dwg, C-108, 11/7/2025 12:42:43 PM, sjm

DETENTION POND 10
OUTLET CONTROL
STRUCTURES TO REMAIN

DETENTION POND 10

EMERGENCY SPILLWAY (TYP)
SEE DWG C-309

CB 4G AND SD 4G
SEE DWG C-309

TOE DITCH
SEE DWG C-309

OUTLET CONTROL
STRUCTURE DP-11R
SEE DWG C-309

PLUNGE POOL
SEE DWG C-309

LEVEL SPREADER DP-11R
SEE DWG C-308

DETENTION POND 11R

CB 4H AND SD 4H
SEE DWG C-309

EXISTING
CULVERT PS-14

EXISTING
CULVERT PS-11B-2

EXISTING
CULVERT PS-13

EXISTING CB 4I
AND CULVERT 4I

EXISTING
CULVERT PS-11

EXISTING
CULVERT 4IA

EXISTING CB 4JA-3
AND SD 4JA-3

EXISTTING CULVERTS
4JB AND 4JC

EXISTING CB 4JA
AND SD 4JA

LEVEL SPREADER DP-14
SEE DWG C-309

EMERGENCY
SPILLWAY (TYP)
SEE DWG C-309

PLUNGE POOL
SEE DWG C-309

OUTLET CONTROL
STRUCTURE DP-14
SEE DWG C-309

DETENTION POND 14

CB 4D AND SD 4D
SEE DWG C-309

EMERGENCY
SPILLWAY (TYP)
SEE DWG C-309

DETENTION
POND 13

OUTLET CONTROL
STRUCTURE DP-13
SEE DWG C-309

LEVEL SPREADER
DP-13
SEE DWG C-308

PLUNGE POOL
SEE DWG C-309

CB 4C AND SD 4C
SEE DWG C-309

TOE DITCH
SEE DWG C-309

FINAL COVER RIPRAP
DOWNSPOUT (TYP)
SEE DWG C-309

FINAL COVER SURFACE
TERRACE (TYP)
SEE DWG C-309

FINAL LANDFILL
ACCESS ROAD (TYP)

FINAL WASTE GRADES (TYP)

7.5% MIN (TYP)

10H:1V (TYP)

2H:1V (TYP)

CB 2B AND SD 2B
SEE DWG C-309

CB 2E AND SD 2E
SEE DWG C-309

OUTLET CONTROL
STRUCTURE DP-12
SEE DWG C-309

LEVEL SPREADER DP-12
SEE DWG C-308

DETENTION POND 12

EMERGENCY SPILLWAY (TYP)
SEE DWG C-309

PLUNGE POOL
SEE DWG C-309

CB 2D AND SD 2D
SEE DWG C-309

EXISTING DITCH 2D
SEE DWG C-309

FINAL COVER SYSTEM
SEE DWG C-309

NOTE:
1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.

2. WETLAND BOUNDARIES DELINEATED BY BRI ENVIRONMENTAL IN 2024.

3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.

60 0 120 240 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D PIERCE
9608
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

FINAL GRADES AND SITE DRAINAGE PLAN

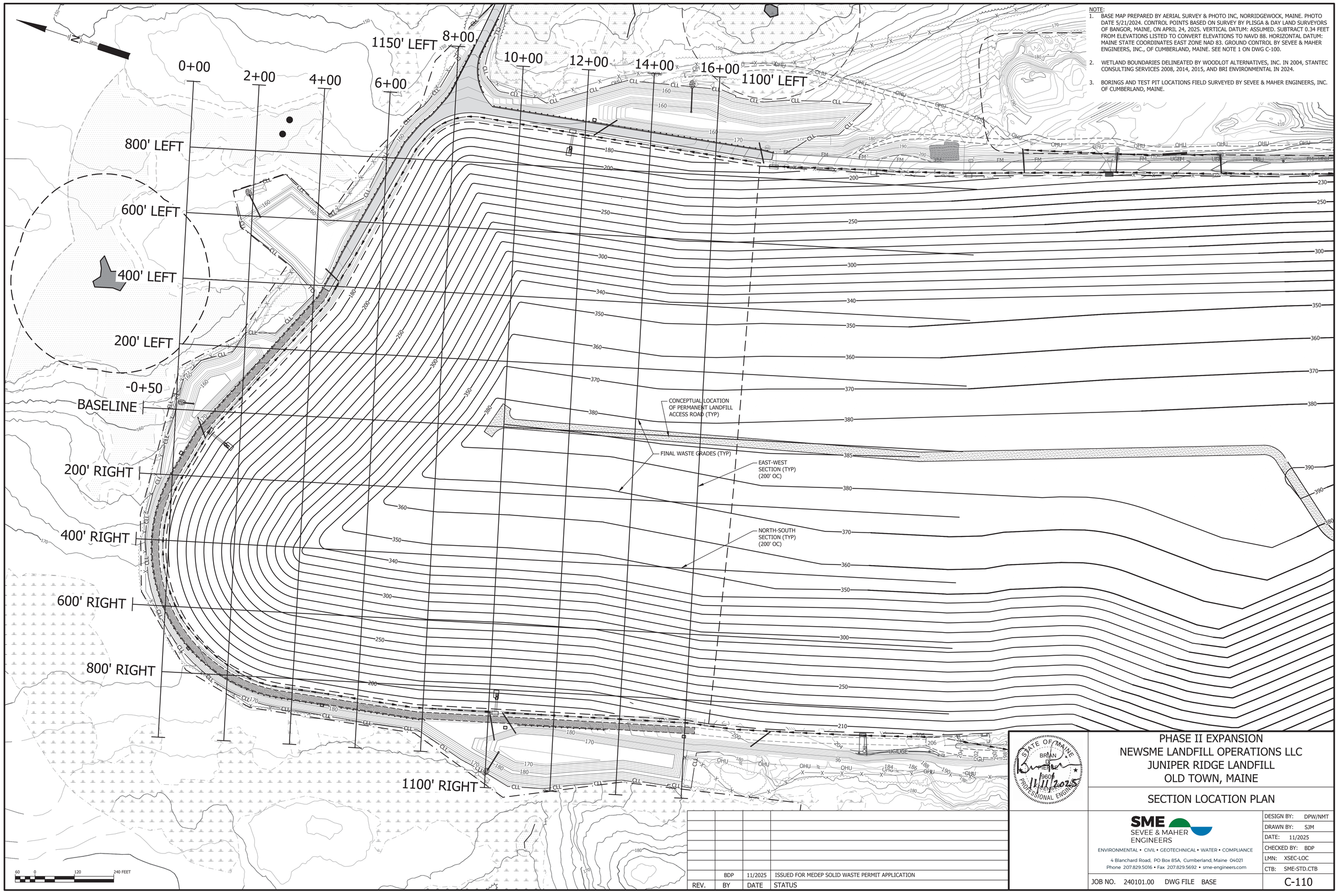
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	FINAL-DRAIN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-109

\\Server\Jobs\Casella\DAT\Twin Landfill\Expansion\Phase II Expansion\Acad\Plans\BASE.dwg C-109, 11/11/2025 10:07:24 AM, sjm



NOTE:

1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.
2. WETLAND BOUNDARIES DELINEATED BY WOODLOT ALTERNATIVES, INC. IN 2004, STANTEC CONSULTING SERVICES 2008, 2014, 2015, AND BRI ENVIRONMENTAL IN 2024.
3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PERRY
9601
11/11/2025
PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

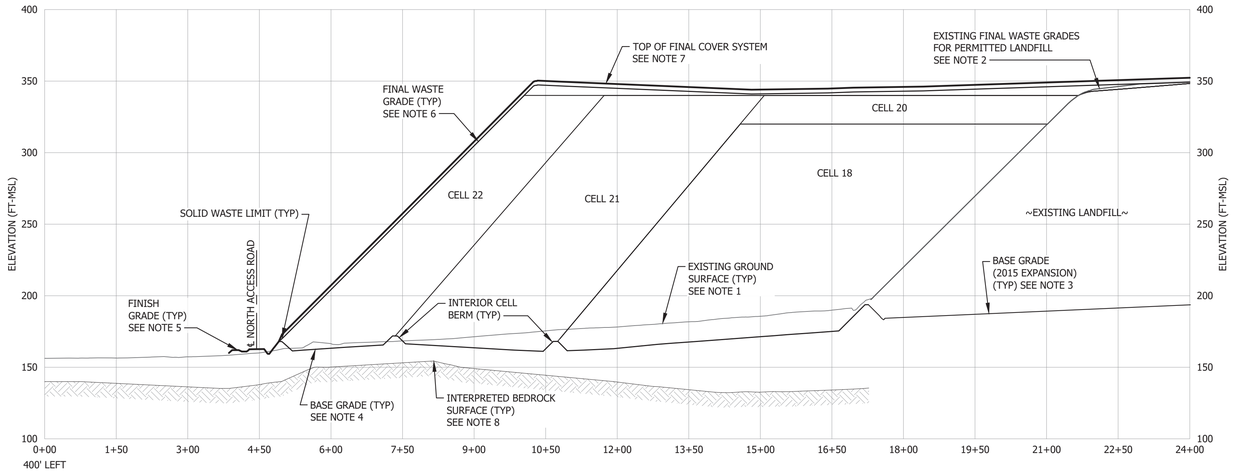
SECTION LOCATION PLAN

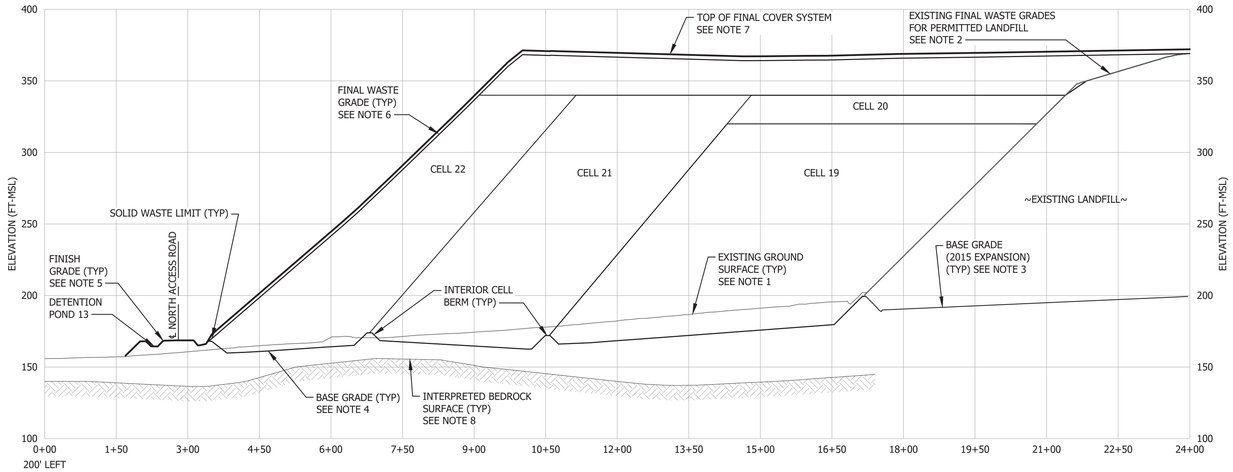
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

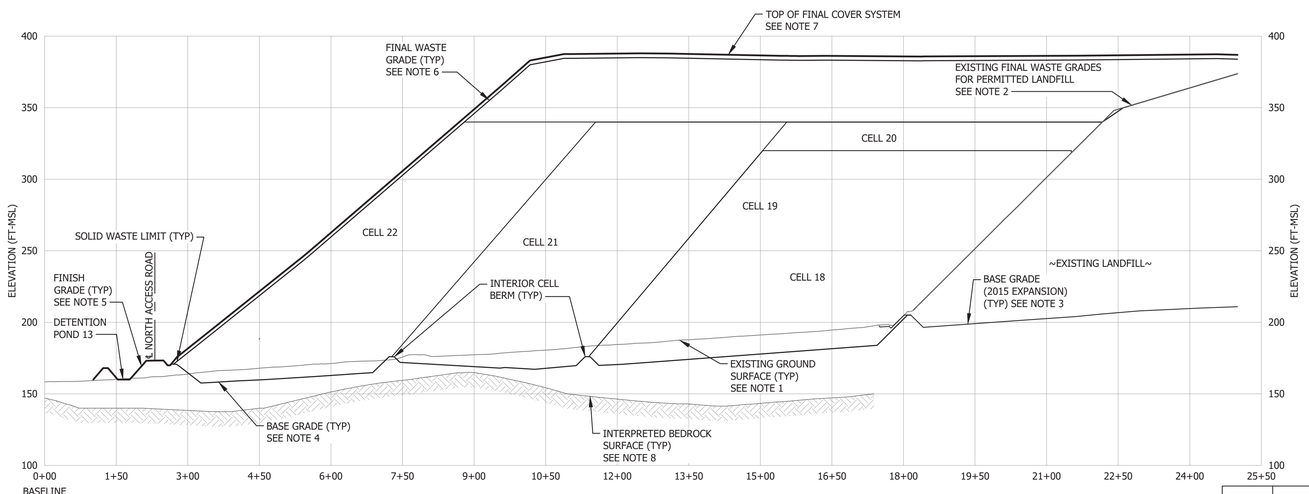
DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	XSEC-LOC
CTB:	SME-STD.CTB
JOB NO.	240101.00
DWG FILE	BASE

C-110

\\Newnet\VA\Castle\2\Twr\Land\Bl\Expansion\Phase II Expansion\Xsec\Plans\BASE.dwg, C-110, 11/11/2025 10:24:29 AM, vjm







NOTES:

1. EXISTING GROUND SURFACE INTERPRETED FROM TOPOGRAPHIC BASE MAP PREPARED BY AERIAL SURVEY AND PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATED 5/21/2024.
2. GRADES SHOWN REPRESENT THE EXISTING PERMITTED LANDFILL FINAL WASTE GRADES (TOP OF WASTE).
3. GRADES SHOWN AT THE BOTTOM OF THE EXISTING LANDFILL REPRESENT THE DESIGN BASE GRADES OF THE EXISTING PERMITTED LANDFILL (2015 EXPANSION).
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE SHOWN.
5. GRADES SHOWN BEYOND THE SOLID WASTE LIMIT REPRESENT THE PROPOSED FINISH GRADE ELEVATIONS (I.E. TOP OF PAVEMENT, GRAVEL, OR VEGETATIVE SUPPORT SOIL).
6. FINAL WASTE GRADES SHOWN REPRESENT THE PROPOSED TOP OF WASTE ELEVATIONS FOR THE PHASE II LANDFILL EXPANSION.
7. TOP OF FINAL COVER SYSTEM GRADES REPRESENT THE FINAL ELEVATION OF THE PHASE II EXPANSION INCLUDING THE FINAL COVER SYSTEM AS SHOWN ON DWGS C-109 AND C-306.
8. BEDROCK SUFACE ELEVATION IS INTERPRETED FROM SECTION 4.3 VOLUME II SITE ASSESSMENT REPORT FOR JUNIPER RIDGE LANDFILL PHASE II EXPANSION, DATED NOVEMBER, 2025.

75 0 150 300 FEET (HORZ)
25 0 50 100 FEET(VERT)

STATE OF MAINE
BRIAN D. PIERCE
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

PROPOSED SECTIONS TRANSVERSE

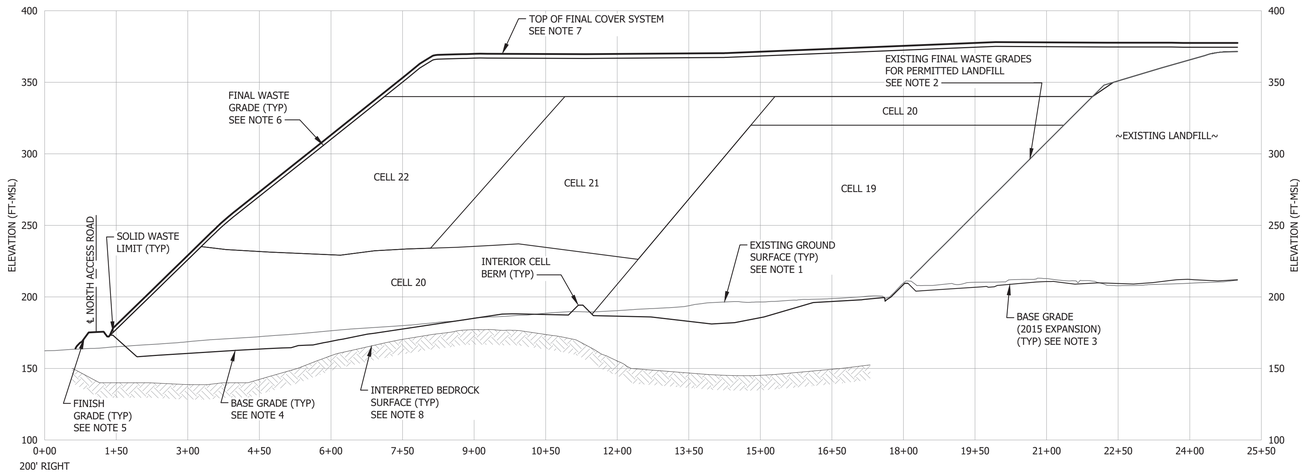
REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

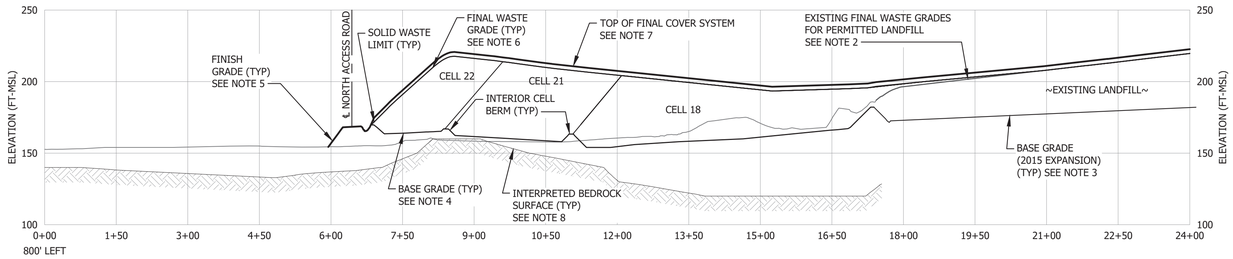
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

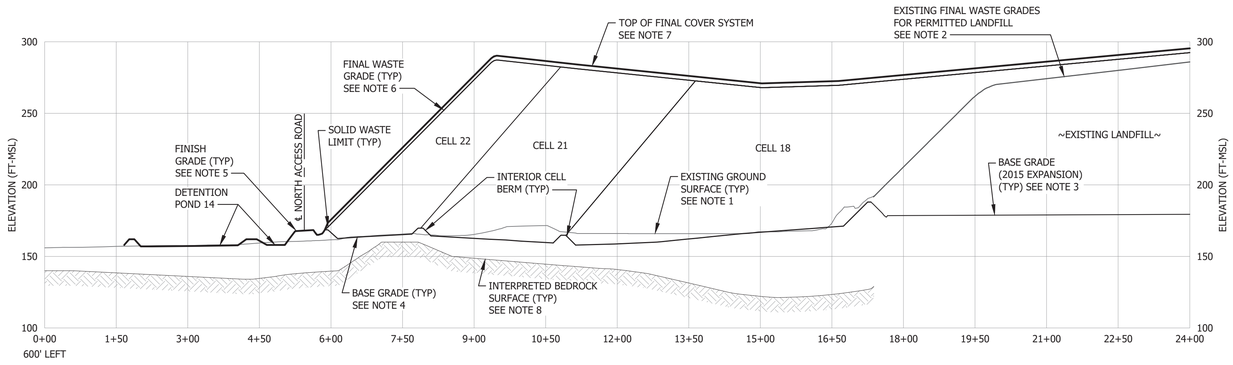
DESIGN BY:	DPW
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB
JOB NO.	240101.00
DWG FILE	SECTIONS

C-200

\\Warren\Civil\Create\Civil\Twin Lake\BFE Expansion\Phase II Expansion\Acad\Plans\SECTIONS.dwg, C-200, 11/10/2025 2:05:20 PM, sjm







NOTES:

1. EXISTING GROUND SURFACE INTERPRETED FROM TOPOGRAPHIC BASE MAP PREPARED BY AERIAL SURVEY AND PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATED 5/21/2024.
2. GRADES SHOWN REPRESENT THE EXISTING PERMITTED LANDFILL FINAL WASTE GRADES (TOP OF WASTE).
3. GRADES SHOWN AT THE BOTTOM OF THE EXISTING LANDFILL REPRESENT THE DESIGN BASE GRADES OF THE EXISTING PERMITTED LANDFILL (2015 EXPANSION).
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE SHOWN.
5. GRADES SHOWN BEYOND THE SOLID WASTE LIMIT REPRESENT THE PROPOSED FINISH GRADE ELEVATIONS (I.E. TOP OF PAVEMENT, GRAVEL, OR VEGETATIVE SUPPORT SOIL).
6. FINAL WASTE GRADES SHOWN REPRESENT THE PROPOSED TOP OF WASTE ELEVATIONS FOR THE PHASE II LANDFILL EXPANSION.
7. TOP OF FINAL COVER SYSTEM GRADES REPRESENT THE FINAL ELEVATION OF THE PHASE II EXPANSION INCLUDING THE FINAL COVER SYSTEM AS SHOWN ON DWGS C-109 AND C-306.
8. BEDROCK SUFACE ELEVATION IS INTERPRETED FROM SECTION 4.3 VOLUME II SITE ASSESSMENT REPORT FOR JUNIPER RIDGE LANDFILL PHASE II EXPANSION, DATED NOVEMBER, 2025.

75 0 150 300 FEET (HORZ)
25 0 50 100 FEET(VERT)

STATE OF MAINE
BRIAN D. PERRY
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

PROPOSED SECTIONS TRANSVERSE

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

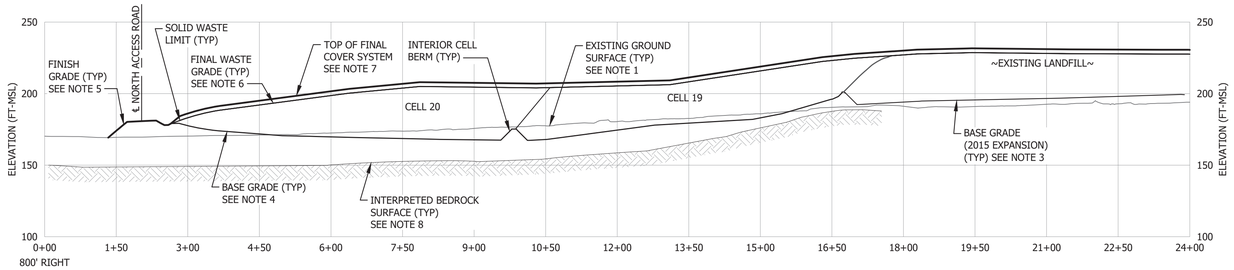
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

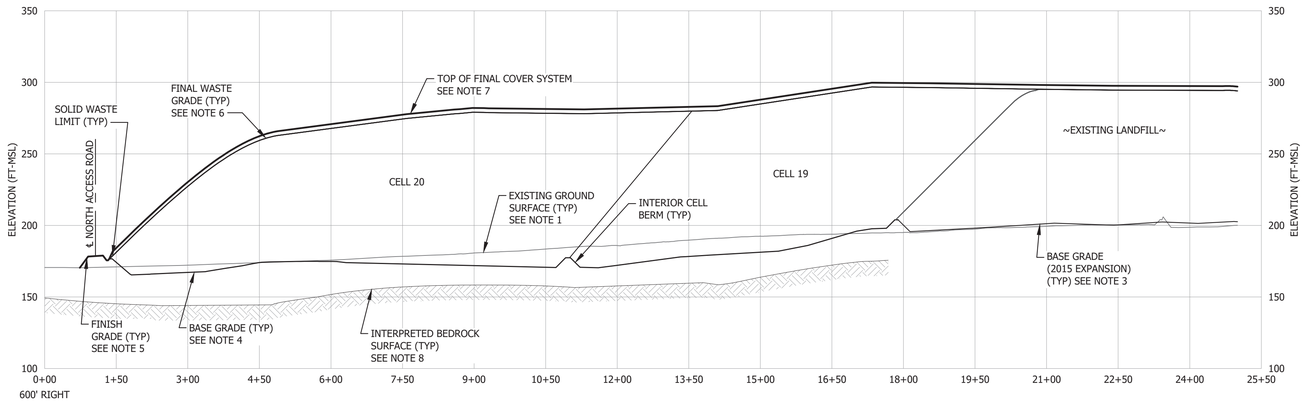
DESIGN BY:	DPW
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB

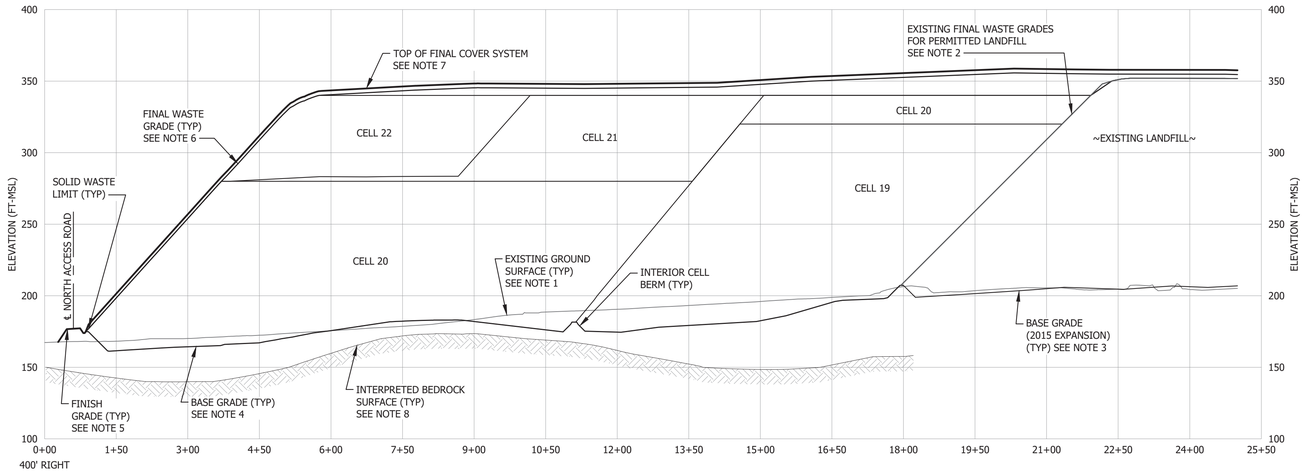
JOB NO. 240101.00 DWG FILE SECTIONS

C-201

X:\Name\Civil Cadd\AD\Town Land\JRE\Expansion\Autol\Plans\SECTIONS.dwg C-201, 11/10/2025 2:28:21 PM, sjm

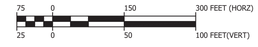






NOTES:

1. EXISTING GROUND SURFACE INTERPRETED FROM TOPOGRAPHIC BASE MAP PREPARED BY AERIAL SURVEY AND PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATED 5/21/2024.
2. GRADES SHOWN REPRESENT THE EXISTING PERMITTED LANDFILL FINAL WASTE GRADES (TOP OF WASTE).
3. GRADES SHOWN AT THE BOTTOM OF THE EXISTING LANDFILL REPRESENT THE DESIGN BASE GRADES OF THE EXISTING PERMITTED LANDFILL (2015 EXPANSION).
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE SHOWN.
5. GRADES SHOWN BEYOND THE SOLID WASTE LIMIT REPRESENT THE PROPOSED FINISH GRADE ELEVATIONS (I.E. TOP OF PAVEMENT, GRAVEL, OR VEGETATIVE SUPPORT SOIL).
6. FINAL WASTE GRADES SHOWN REPRESENT THE PROPOSED TOP OF WASTE ELEVATIONS FOR THE PHASE II LANDFILL EXPANSION.
7. TOP OF FINAL COVER SYSTEM GRADES REPRESENT THE FINAL ELEVATION OF THE PHASE II EXPANSION INCLUDING THE FINAL COVER SYSTEM AS SHOWN ON DWGS C-109 AND C-306.
8. BEDROCK SUFACE ELEVATION IS INTERPRETED FROM SECTION 4.3 VOLUME II SITE ASSESSMENT REPORT FOR JUNIPER RIDGE LANDFILL PHASE II EXPANSION, DATED NOVEMBER, 2025.



PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

PROPOSED SECTIONS TRANSVERSE

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

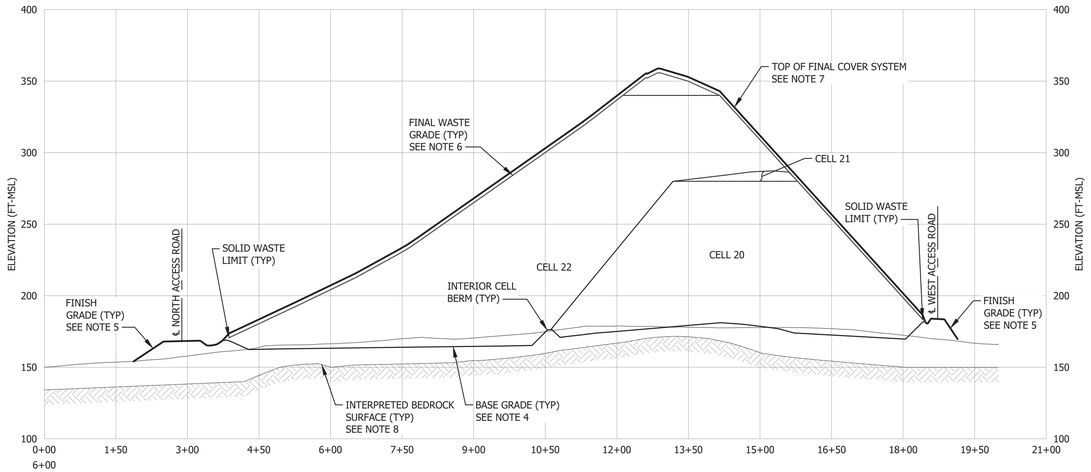
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

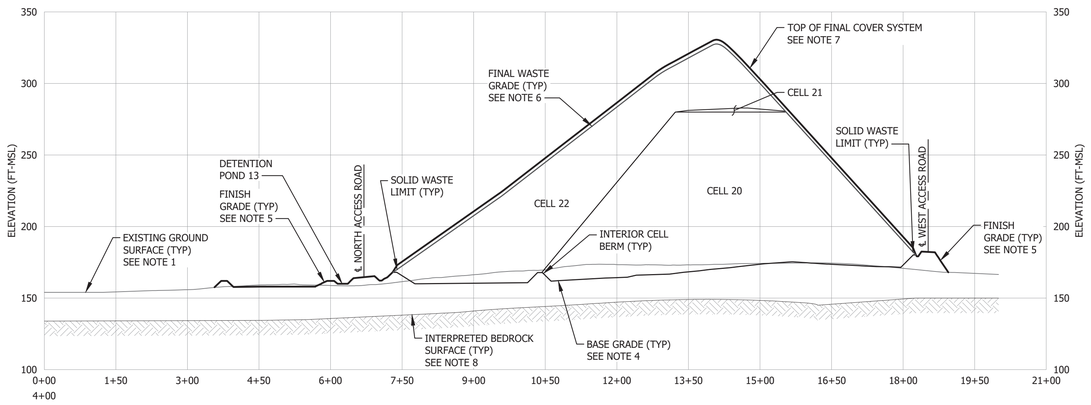
DESIGN BY:	DPW
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB

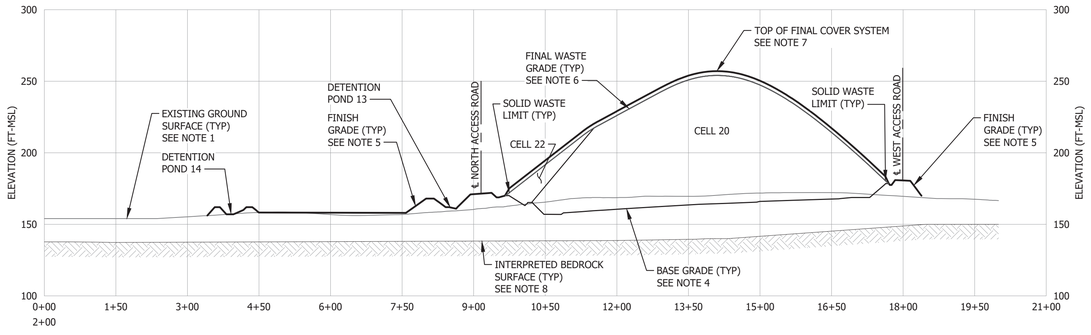
JOB NO. 240101.00 DWG FILE SECTIONS

C-202

\\Server\dfs\Data\JobToDo\JuniperRidgeExpansion\Phase II Expansion\Acad\Plans\SECTIONS.dwg, C-202, 11/10/2025 2:26:21 PM, sjm

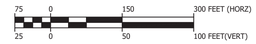






NOTES:

1. EXISTING GROUND SURFACE INTERPRETED FROM TOPOGRAPHIC BASE MAP PREPARED BY AERIAL SURVEY AND PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATED 5/21/2024.
2. GRADES SHOWN REPRESENT THE EXISTING PERMITTED LANDFILL FINAL WASTE GRADES (TOP OF WASTE).
3. GRADES SHOWN AT THE BOTTOM OF THE EXISTING LANDFILL REPRESENT THE DESIGN BASE GRADES OF THE EXISTING PERMITTED LANDFILL (2015 EXPANSION).
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE SHOWN.
5. GRADES SHOWN BEYOND THE SOLID WASTE LIMIT REPRESENT THE PROPOSED FINISH GRADE ELEVATIONS (I.E. TOP OF PAVEMENT, GRAVEL, OR VEGETATIVE SUPPORT SOIL).
6. FINAL WASTE GRADES SHOWN REPRESENT THE PROPOSED TOP OF WASTE ELEVATIONS FOR THE PHASE II LANDFILL EXPANSION.
7. TOP OF FINAL COVER SYSTEM GRADES REPRESENT THE FINAL ELEVATION OF THE PHASE II EXPANSION INCLUDING THE FINAL COVER SYSTEM AS SHOWN ON DWGS C-109 AND C-306.
8. BEDROCK SUFACE ELEVATION IS INTERPRETED FROM SECTION 4.3 VOLUME II SITE ASSESSMENT REPORT FOR JUNIPER RIDGE LANDFILL PHASE II EXPANSION, DATED NOVEMBER, 2025.



REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

PROPOSED SECTIONS LONGITUDINAL

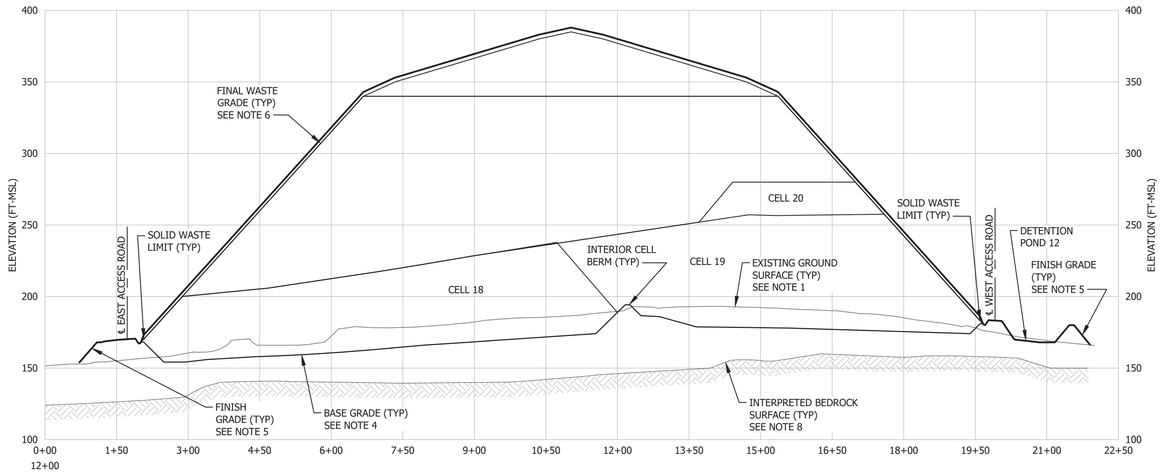
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

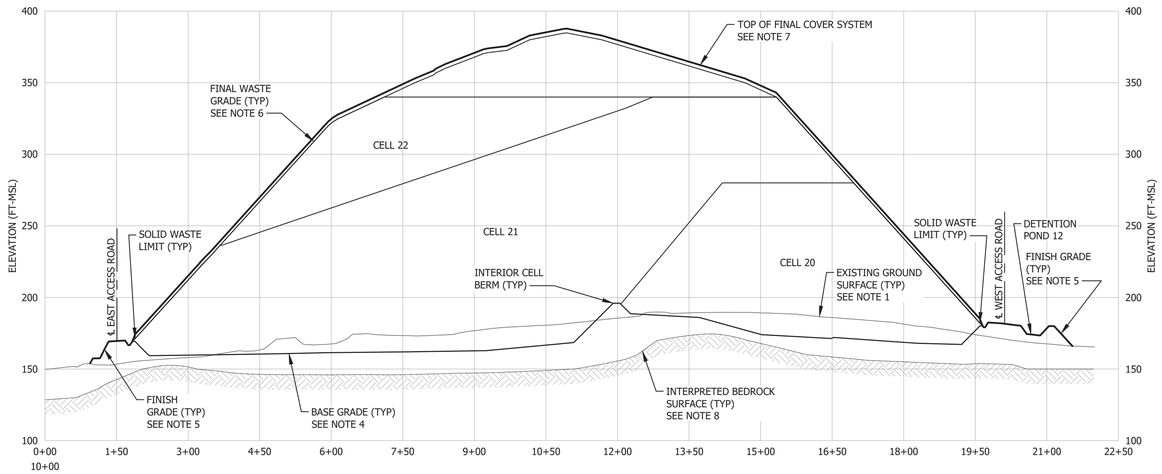
DESIGN BY:	DPW
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB

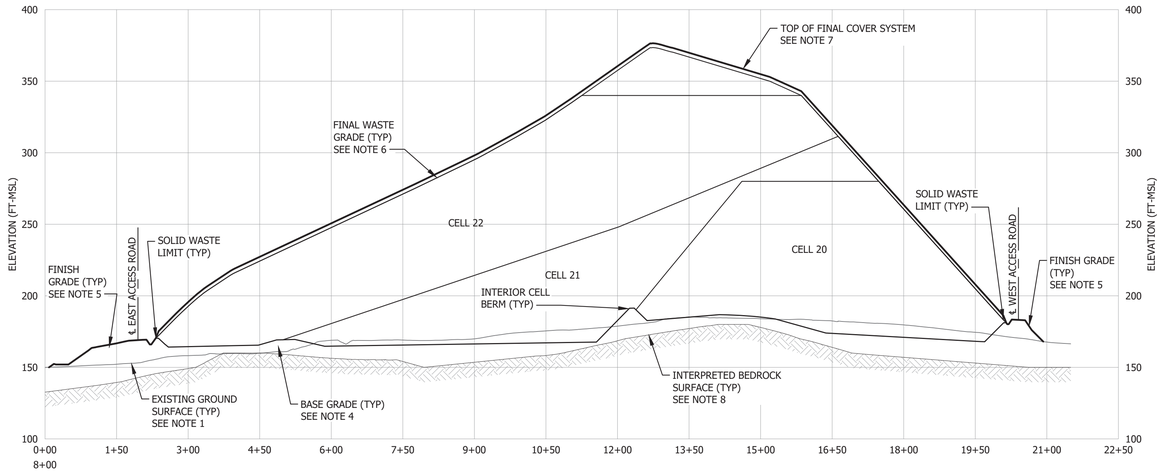
JOB NO. 240101.00 DWG FILE SECTIONS

C-203

I:\Warner\Civil\Cadd\Civil\Twn\Land\Fill\Expansion\Phase II Expansion\Acad\Plans\SECTIONS.dwg, C-203, 11/10/2025 2:59:22 PM, sjm







NOTES:

1. EXISTING GROUND SURFACE INTERPRETED FROM TOPOGRAPHIC BASE MAP PREPARED BY AERIAL SURVEY AND PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATED 5/21/2024.
2. GRADES SHOWN REPRESENT THE EXISTING PERMITTED LANDFILL FINAL WASTE GRADES (TOP OF WASTE).
3. GRADES SHOWN AT THE BOTTOM OF THE EXISTING LANDFILL REPRESENT THE DESIGN BASE GRADES OF THE EXISTING PERMITTED LANDFILL (2015 EXPANSION).
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE SHOWN.
5. GRADES SHOWN BEYOND THE SOLID WASTE LIMIT REPRESENT THE PROPOSED FINISH GRADE ELEVATIONS (I.E. TOP OF PAVEMENT, GRAVEL, OR VEGETATIVE SUPPORT SOIL).
6. FINAL WASTE GRADES SHOWN REPRESENT THE PROPOSED TOP OF WASTE ELEVATIONS FOR THE PHASE II LANDFILL EXPANSION.
7. TOP OF FINAL COVER SYSTEM GRADES REPRESENT THE FINAL ELEVATION OF THE PHASE II EXPANSION INCLUDING THE FINAL COVER SYSTEM AS SHOWN ON DWGS C-109 AND C-306.
8. BEDROCK SUFACE ELEVATION IS INTERPRETED FROM SECTION 4.3 VOLUME II SITE ASSESSMENT REPORT FOR JUNIPER RIDGE LANDFILL PHASE II EXPANSION, DATED NOVEMBER, 2025.

75 0 150 300 FEET (HORZ)
25 0 50 100 FEET(VERT)

STATE OF MAINE
BRIAN D PIERCE
9601
11/17/2025
LICENSED PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

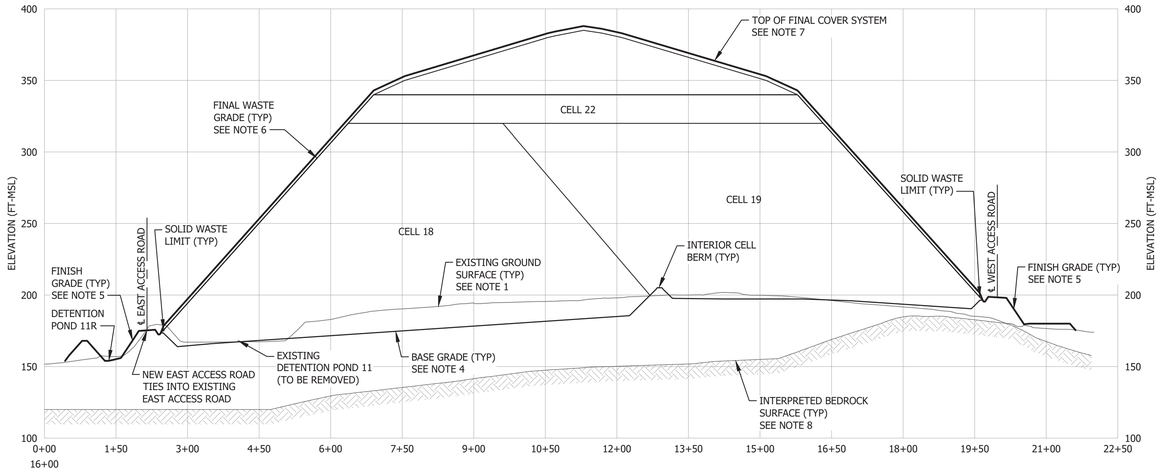
PROPOSED SECTIONS LONGITUDINAL

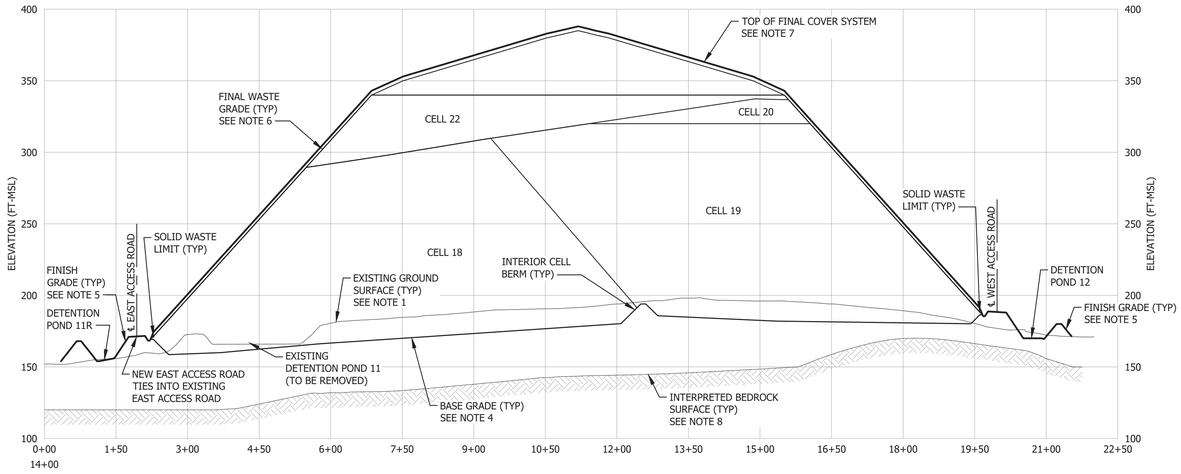
REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB
JOB NO. 240101.00	DWG FILE SECTIONS
	C-204

\\sme-nas\vfs\Data\JOAT\work\Landfill\Expansion\Phase II Expansion\Acad\Plans\SECTIONS.dwg, C-204, 11/17/2025 2:59:22 PM, sjm





NOTES:

1. EXISTING GROUND SURFACE INTERPRETED FROM TOPOGRAPHIC BASE MAP PREPARED BY AERIAL SURVEY AND PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATED 5/21/2024.
2. GRADES SHOWN REPRESENT THE EXISTING PERMITTED LANDFILL FINAL WASTE GRADES (TOP OF WASTE).
3. GRADES SHOWN AT THE BOTTOM OF THE EXISTING LANDFILL REPRESENT THE DESIGN BASE GRADES OF THE EXISTING PERMITTED LANDFILL (2015 EXPANSION).
4. BASE GRADES REPRESENT THE PREPARED SUBGRADE SURFACE BELOW THE UNDERDRAIN OR AUGMENTED LAYER. IN LOCATIONS THAT ARE NOT IDENTIFIED TO RECEIVE UNDERDRAIN OR AUGMENTED LINER, ONE FOOT OF NATIVE SOILS SHALL REMAIN IN PLACE ABOVE THE BASE GRADE SHOWN.
5. GRADES SHOWN BEYOND THE SOLID WASTE LIMIT REPRESENT THE PROPOSED FINISH GRADE ELEVATIONS (I.E. TOP OF PAVEMENT, GRAVEL, OR VEGETATIVE SUPPORT SOIL).
6. FINAL WASTE GRADES SHOWN REPRESENT THE PROPOSED TOP OF WASTE ELEVATIONS FOR THE PHASE II LANDFILL EXPANSION.
7. TOP OF FINAL COVER SYSTEM GRADES REPRESENT THE FINAL ELEVATION OF THE PHASE II EXPANSION INCLUDING THE FINAL COVER SYSTEM AS SHOWN ON DWGS C-109 AND C-306.
8. BEDROCK SUFACE ELEVATION IS INTERPRETED FROM SECTION 4.3 VOLUME II SITE ASSESSMENT REPORT FOR JUNIPER RIDGE LANDFILL PHASE II EXPANSION, DATED NOVEMBER, 2025.

25 0 150 300 FEET (HORZ)
25 0 50 100 FEET(VERT)

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PIERCE
9608
11/11/2025
LICENSED PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

PROPOSED SECTIONS LONGITUDINAL

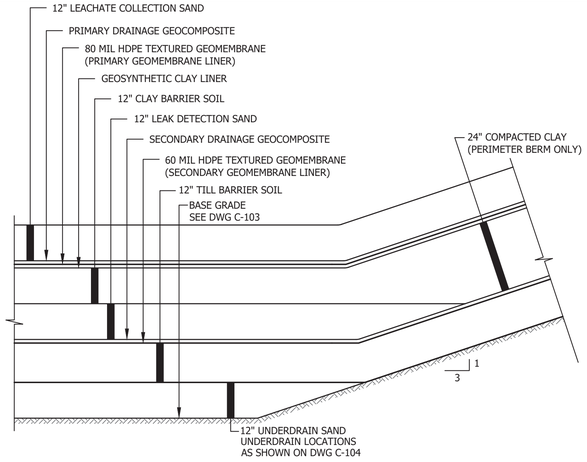
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	NONE
CTB:	SME-STD.CTB

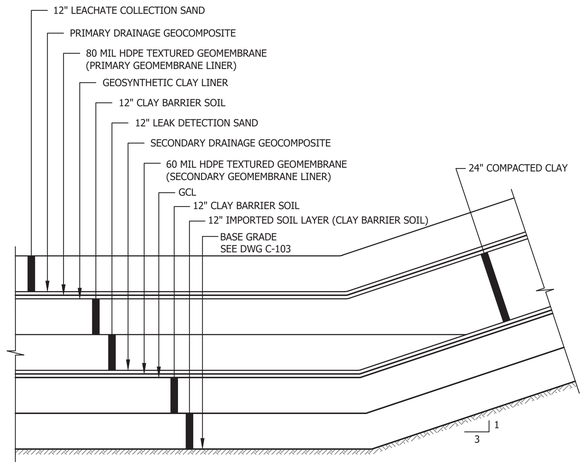
JOB NO. 240101.00 DWG FILE SECTIONS

C-205

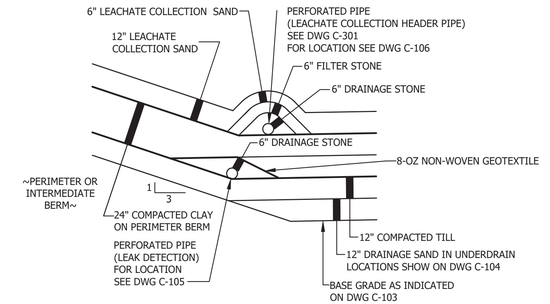
\\Server\cfs\Create\247\wrt\Landfill\Expansion\Phase II Expansion\Acad\Plans\SECTIONS.dwg, C-205, 11/10/2025 2:09:23 PM, sjm



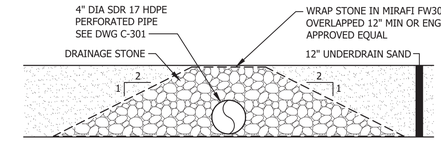
BASE LINER SYSTEM
NTS



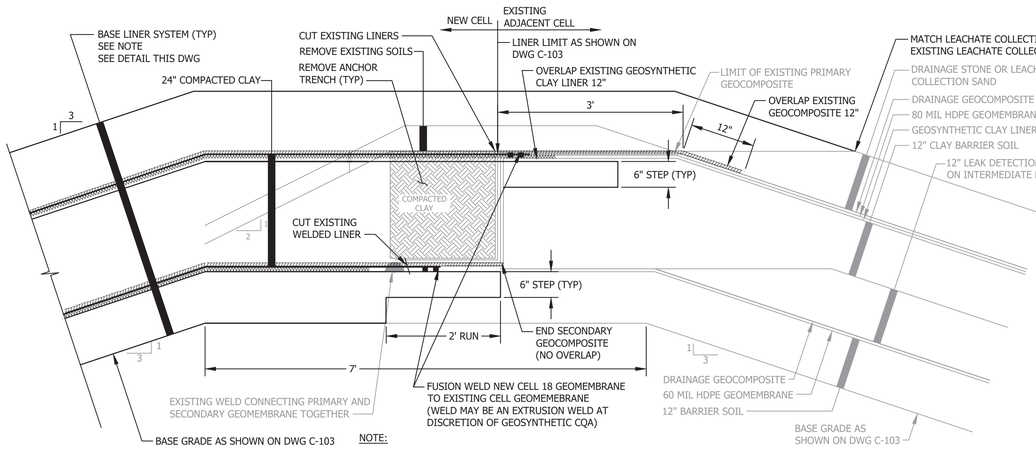
AUGMENTED LINER SYSTEM
NTS



PIPING AT PERIMETER BERM
NTS

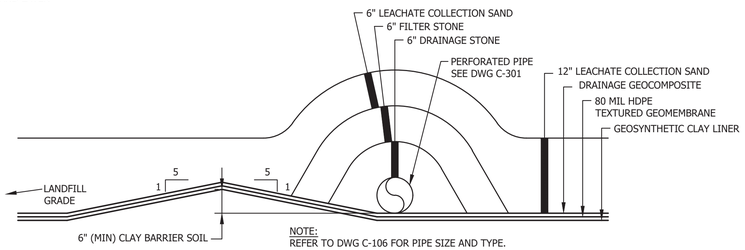


UNDERDRAIN PIPING
NTS



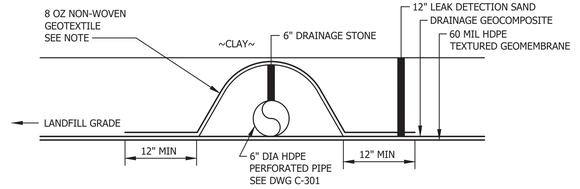
NOTE:
AREAS WITH BASE LINER SYSTEM DO NOT INCLUDE GCL UNDER THE SECONDARY GEOMEMBRANE OR THE CLAY BARRIER SOIL.

LINER SYSTEM TIE-IN CONNECTION TO ADJACENT CELLS
NTS



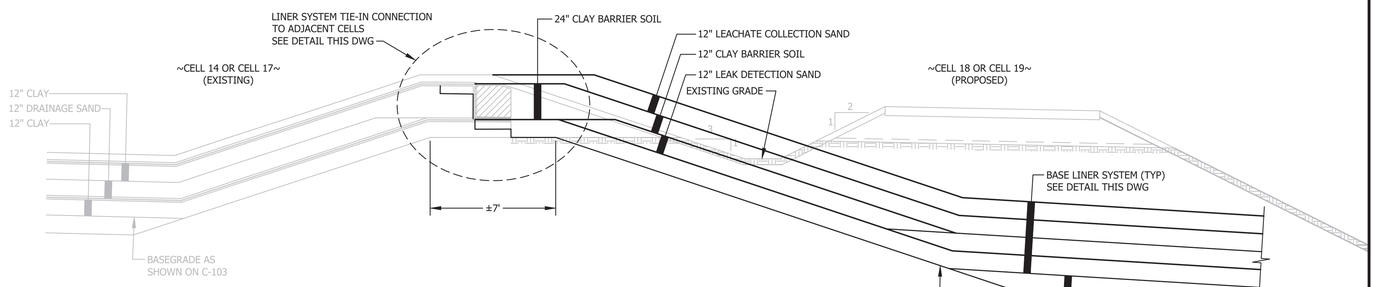
NOTE:
REFER TO DWG C-106 FOR PIPE SIZE AND TYPE.

LEACHATE COLLECTION LATERAL
NTS



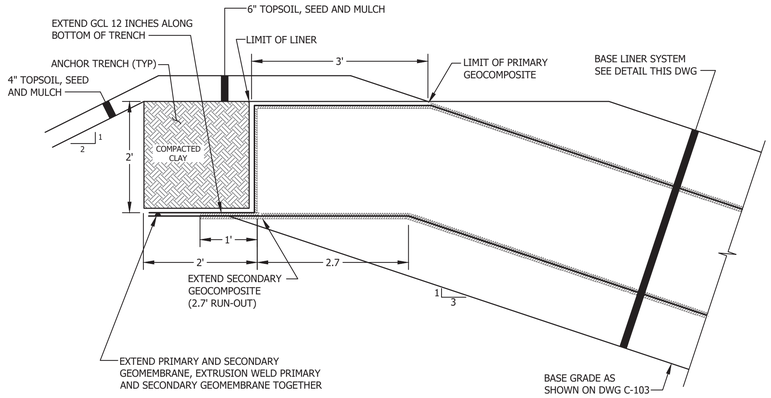
NOTE:
PLACE 8 OZ NON-WOVEN GEOTEXTILE OVER DRAINAGE STONE. EXTEND FABRIC ONE FOOT BEYOND LIMITS OF STONE ALONG THE ENTIRE LENGTH OF THE PIPE.

LEAK DETECTION LATERAL
NTS



LINER SYSTEM CONNECTION TO EXISTING CELLS (1)
NTS

C-102
C-103
C-104
C-105
C-106



ANCHOR TRENCH/LINER TERMINATION
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D PIERCE
9609
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

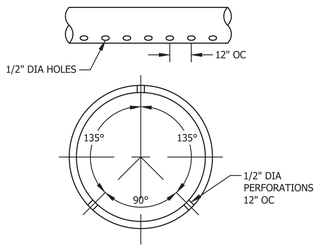
SME
SEVEE & MAHER
ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

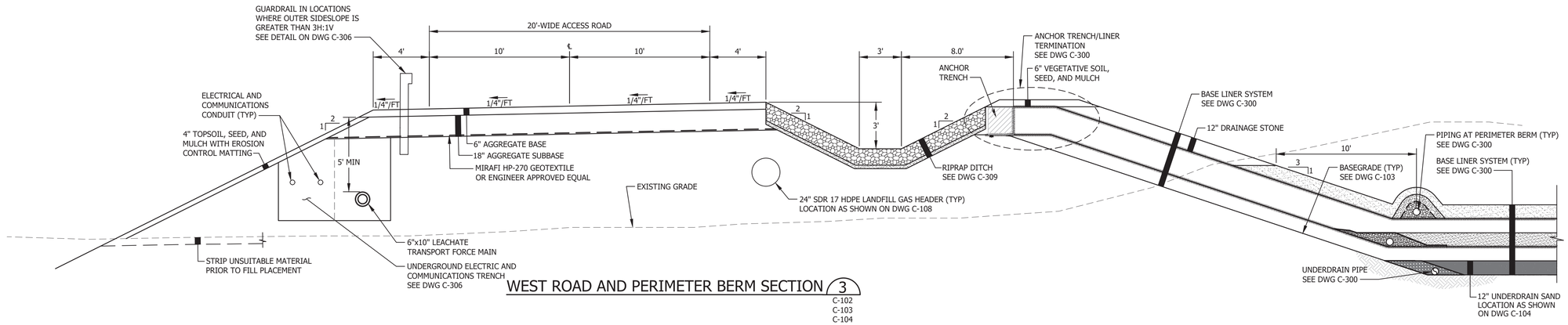
C-300

X:\Kenan\Dc\Cad\Dd\Twd\Jan\Mtl\Expansion\Phase II Expansion\Acad\Plans\C300_DETAILS.dwg, C-300, 11/10/2025 11:02:00 AM, kjm



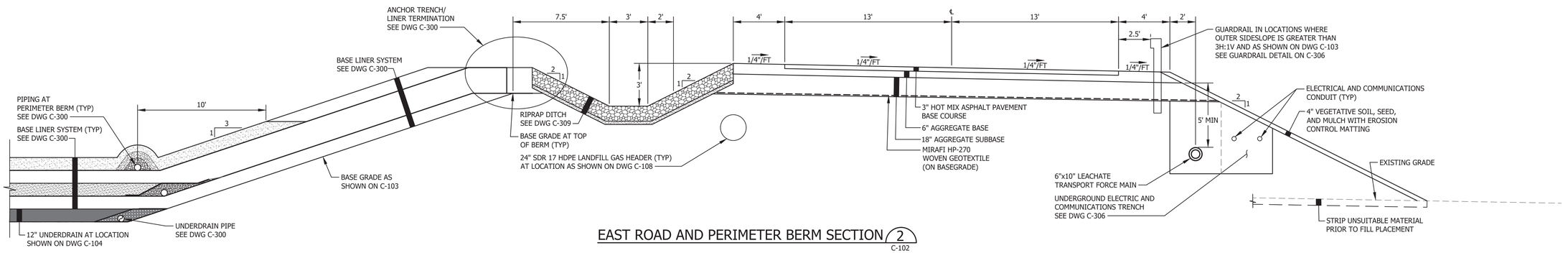
PERFORATED PIPE

NTS



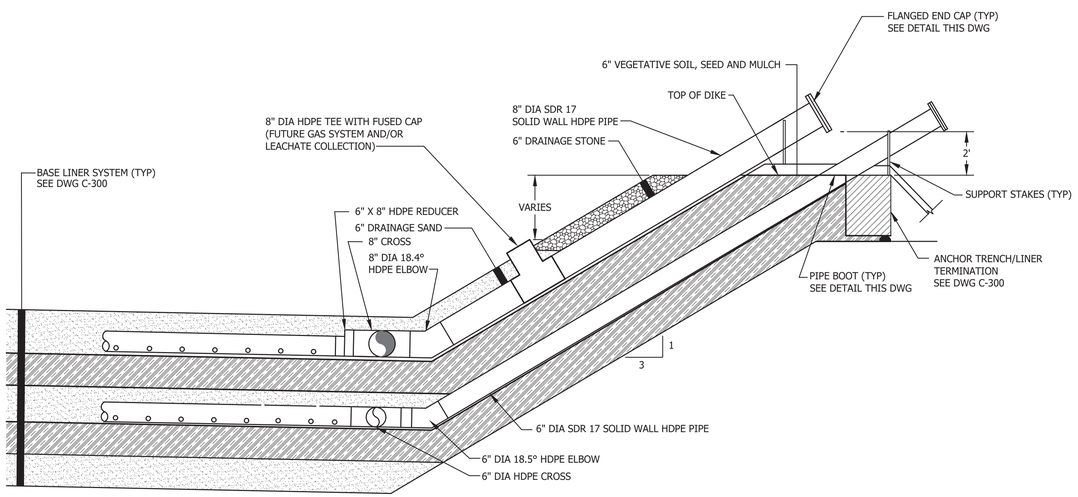
WEST ROAD AND PERIMETER BERM SECTION 3

C-102
C-103
C-104
C-105



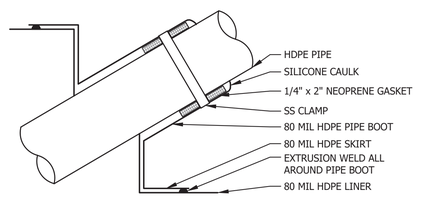
EAST ROAD AND PERIMETER BERM SECTION 2

C-102
C-103
C-104
C-105



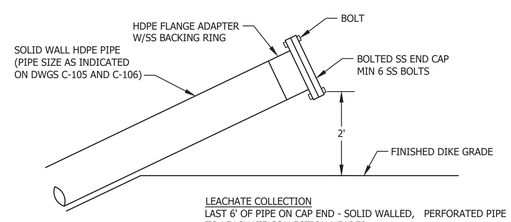
LEACHATE COLLECTION & LEAK DETECTION CLEANOUTS

NTS



PIPE BOOT

NTS



LEACHATE COLLECTION
LAST 6' OF PIPE ON CAP END - SOLID WALLED, PERFORATED PIPE
TO LEACHATE COLLECTION HEADER

LEAK DETECTION CLEANOUT
SOLID WALLED ENTIRE LENGTH TO HEADER

FLANGED END CAP

NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D PIERCE
9609
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

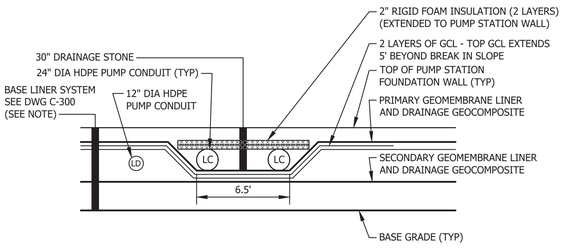
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

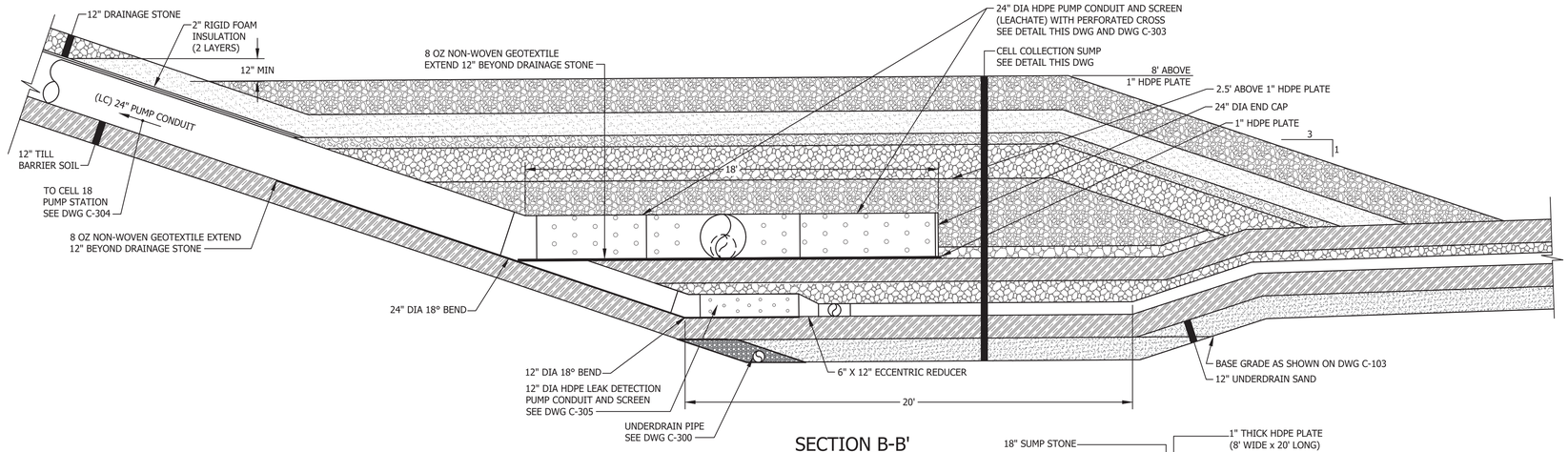
JOB NO. 240101.00 DWG FILE DETAILS

C-301

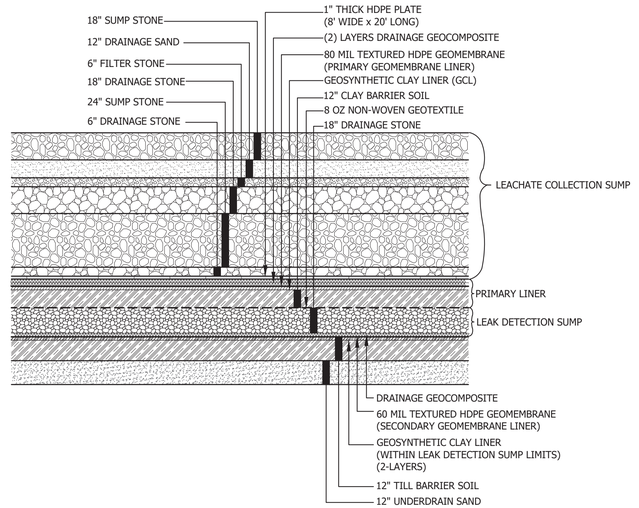
V:\Harvest\Civil\Cad\Cad\Cad Files\Landfill\Expansion\Phase II Expansion\Autocad\Plans\DETAILS.dwg C-301 11/10/2025 11:02:08 AM lyn



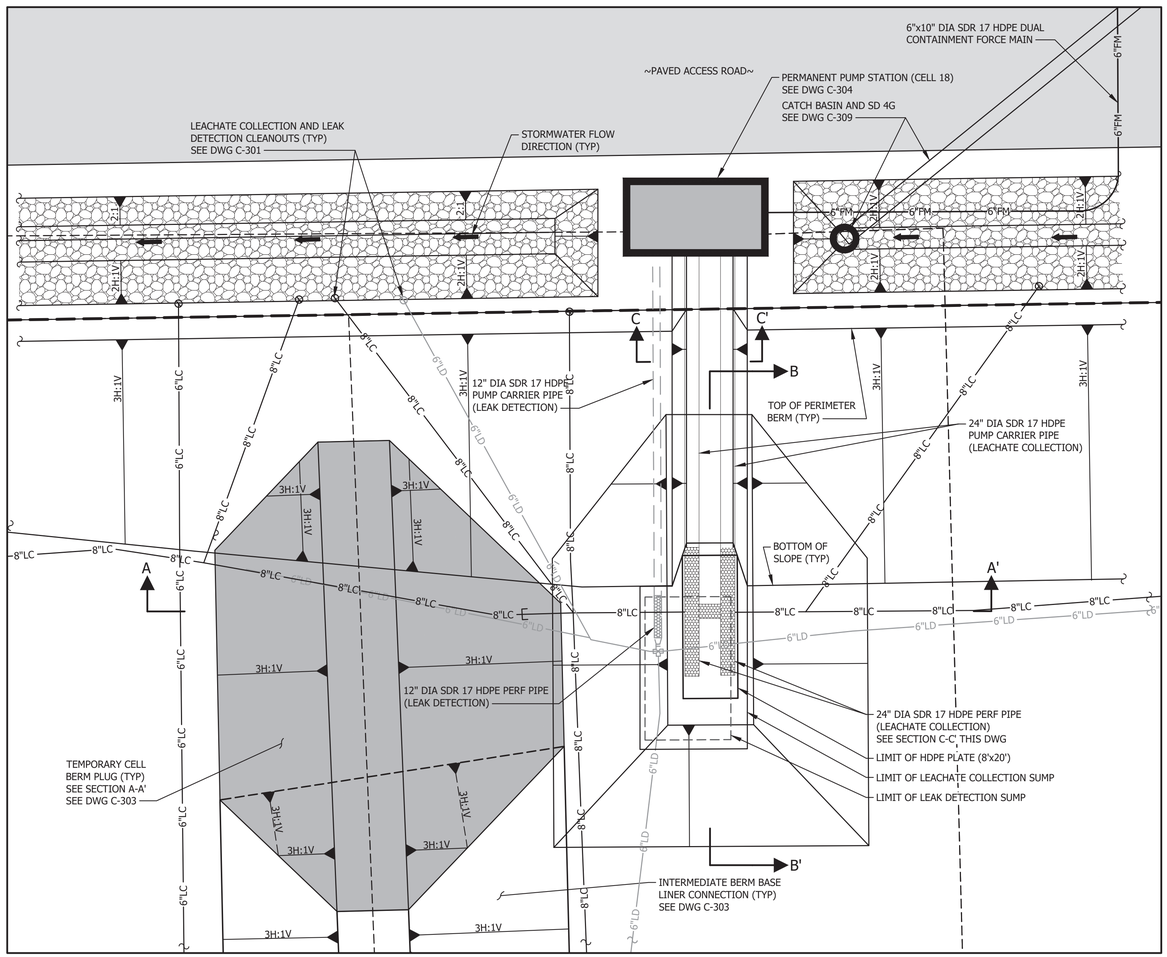
SECTION C-C'
NTS



SECTION B-B'
NTS



CELL COLLECTION SUMP
NTS



PERMANENT COLLECTION SUMP AREA AND PUMP STATION PLAN - CELL 18

5 0 10 20 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PIERCE
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

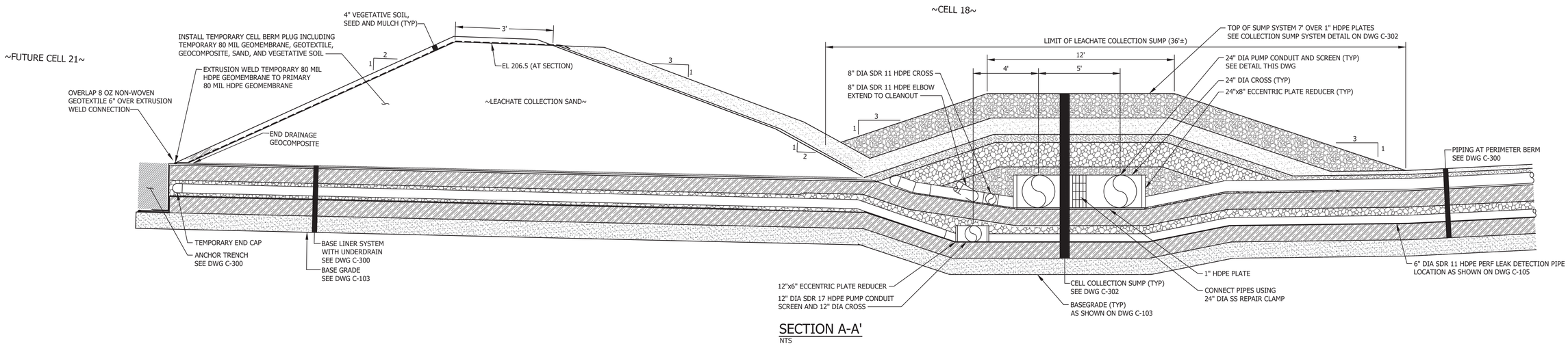
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	PERM-PUMP
CTB:	SME-STD.CTB

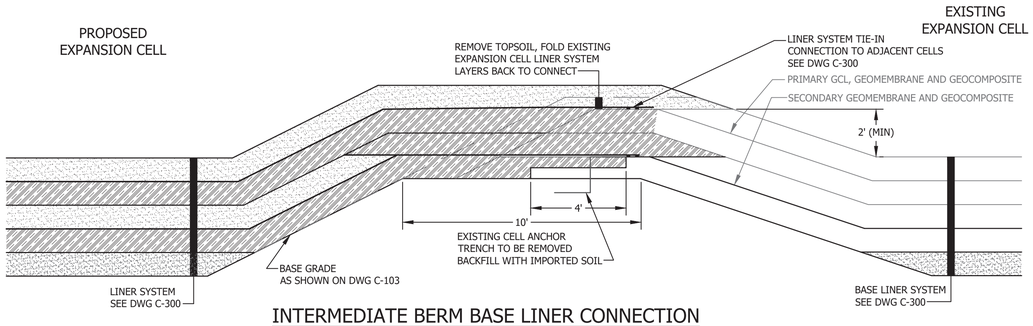
JOB NO. 240101.00 DWG FILE BASE

C-302

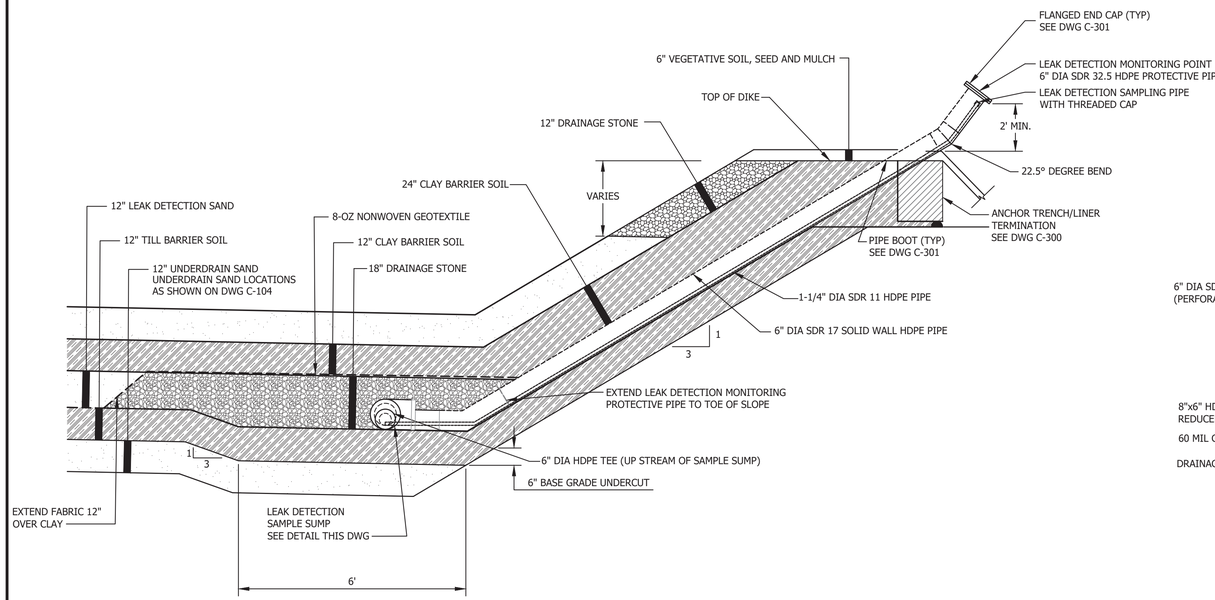
\\Server\Civil\Create\Old Town Landfill\Expansion\Phase II Expansion\Acad\Plans\BASE.dwg, C-302, 11/7/2025 11:46:16 AM, sjm



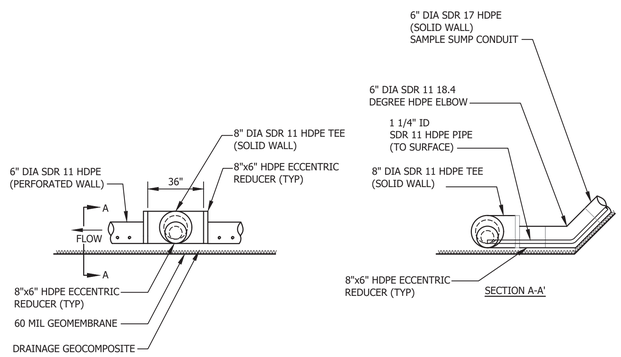
SECTION A-A'
NTS



INTERMEDIATE BERM BASE LINER CONNECTION
NTS



CELL 20, 21, AND 22 LEAK DETECTION SAMPLE SUMP
NTS



LEAK DETECTION SAMPLE SUMP
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE BRIAN D. EMERY 9601 11/11/2025 PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

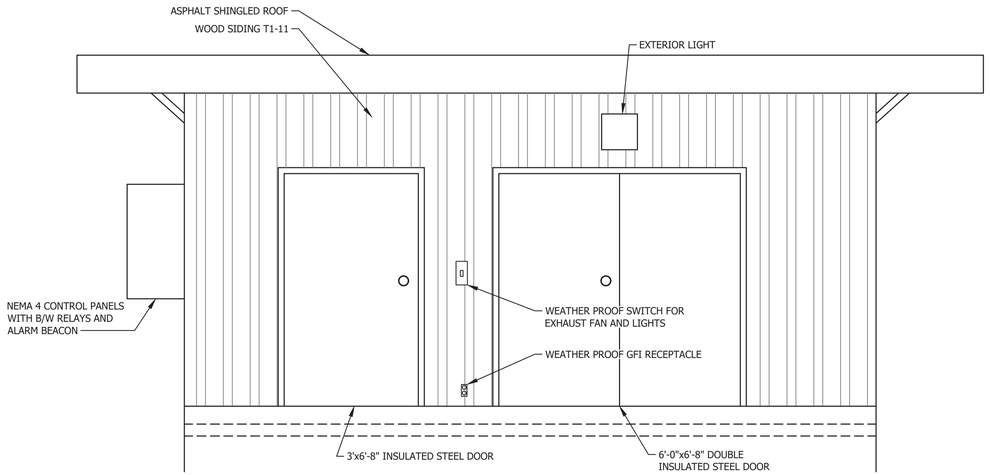
SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/11/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

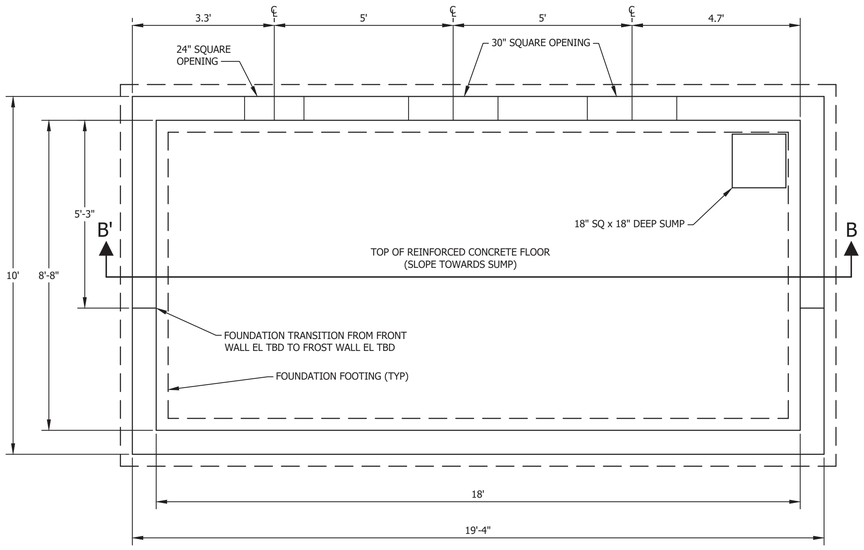
JOB NO. 240101.00 DWG FILE DETAILS

C-303

\\Server\VK\Cadd\JOT\newLandfill\Expansion\Phase II Expansion\Aslp\Plans\DETAILS.dwg, C-303, 11/11/2025 12:48:53 PM, sjm

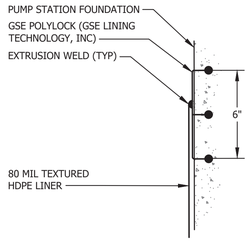


PERMANENT PUMP STATION (CELL 18) - FRONT ELEVATION
NTS

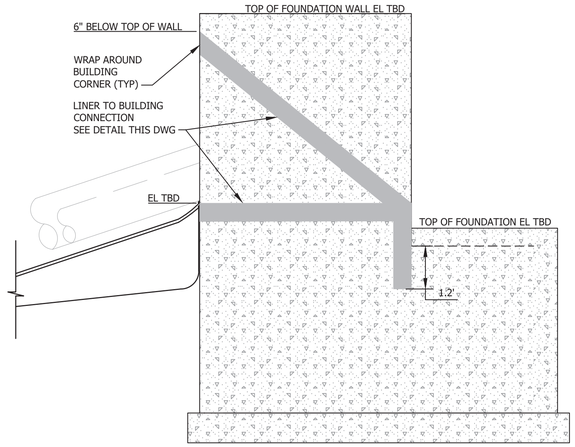


PLAN VIEW

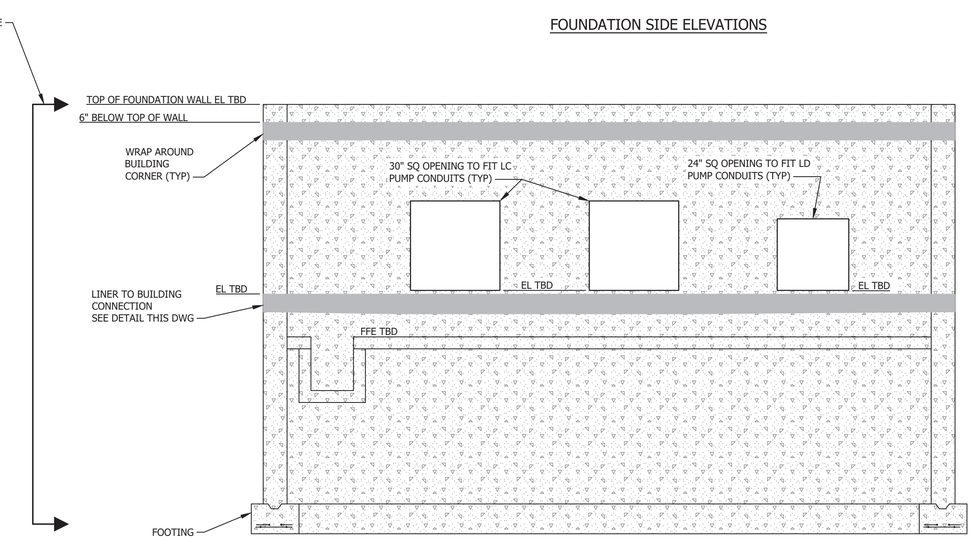
PERMANENT PUMP STATION (CELL 18) - FOUNDATION PLAN
NTS



LINER TO BUILDING CONNECTION
NTS



FOUNDATION SIDE ELEVATIONS



FOUNDATION REAR ELEVATION

LINER TO PERMANENT PUMP STATION CONNECTION
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D PIERCE
9601
11/11/2025
LICENSED PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

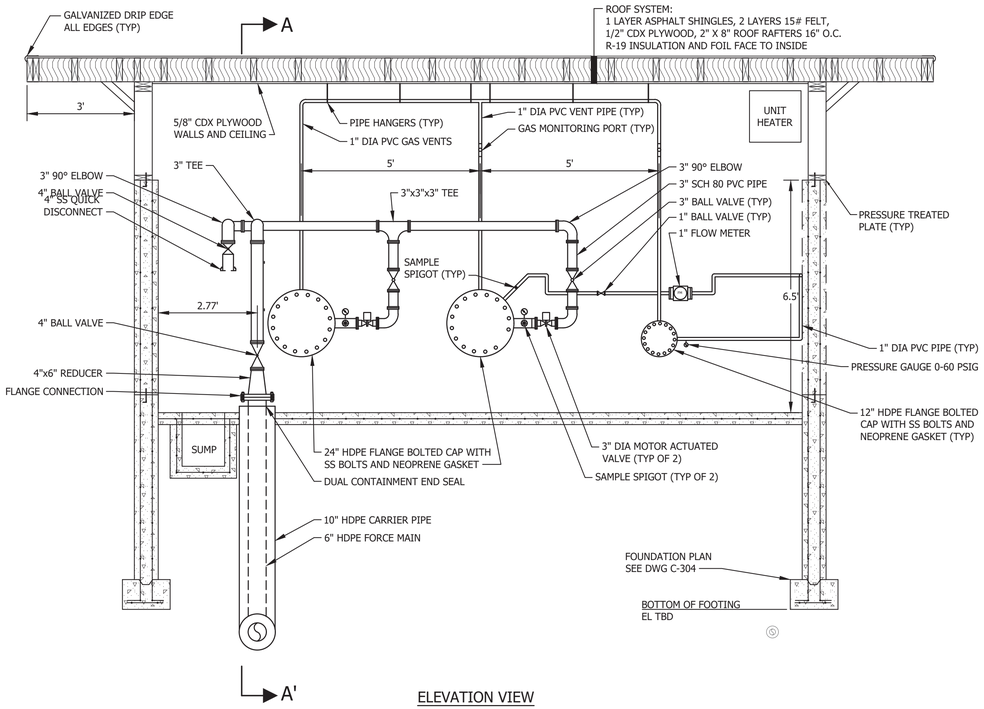
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

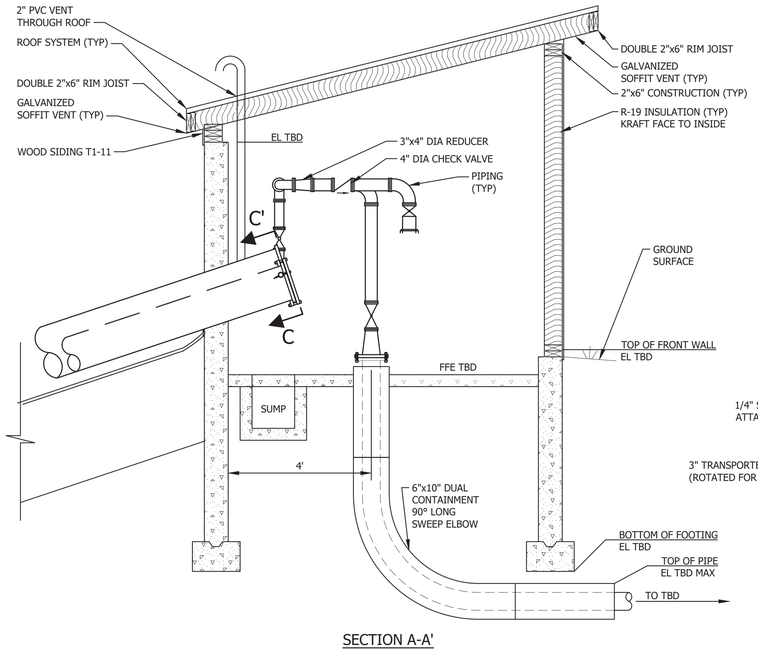
JOB NO. 240101.00 DWG FILE DETAILS

C-304

\\Server\Vol\Create\247\Twn\Juni\MEExpansion\Phase II Expansion\Acad\Plans\DETAILS.dwg, C-304, 11/10/2025 11:07:19 AM, sjm

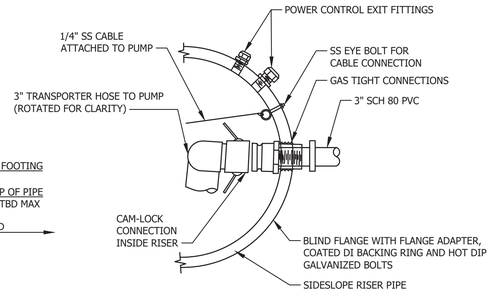


ELEVATION VIEW

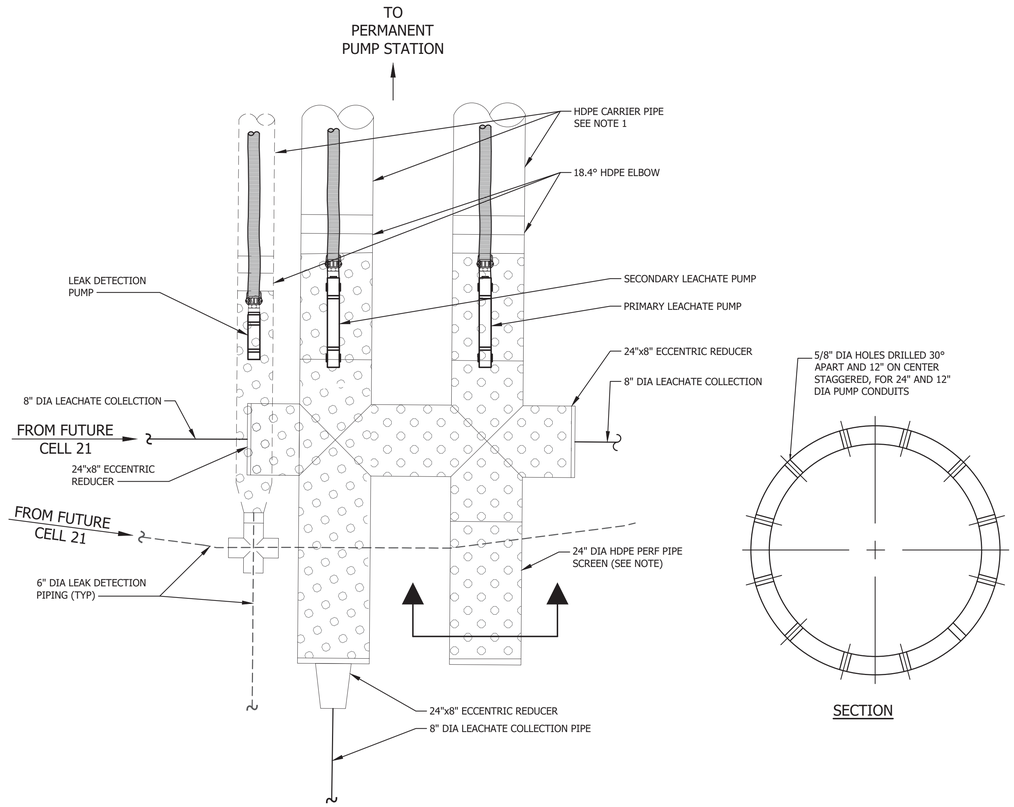


SECTION A-A'

PERMANENT PUMP STATION (CELL 18)
NTS



DISCHARGE CONNECTION - SECTION C-C'
NTS



SECTION

NOTES:
1. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF PUMP HDPE PUMP CONDUITS TO THE ENGINEER FOR REVIEW AND APPROVAL.
2. DIAMETER OF PUMP CONDUIT AND SCREEN IS 12" FOR LEAK DETECTION SYSTEM, 24" FOR PRIMARY LEACHATE COLLECTION SYSTEM AND SECONDARY LEACHATE COLLECTION SYSTEM.
3. PRIMARY AND SECONDARY LEACHATE PUMPS SHALL BE AT THE BOTTOM OF SUMP AND SIT HORIZONTALLY ON SUMP FLOOR. PRIMARY LEACHATE PUMP DISCHARGE HOSE IS 3-INCH DIAMETER.
4. LEAK DETECTION PUMP SHALL BE POSITIONED AT THE BOTTOM OF THE LEAK DETECTION SUMP AND SIT HORIZONTALLY ON SUMP FLOOR. LEAK DETECTION DISCHARGE HOSE IS 2-INCH DIAMETER.

HDPE PUMP CONDUIT AND SCREEN
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN
D
PIERCE
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

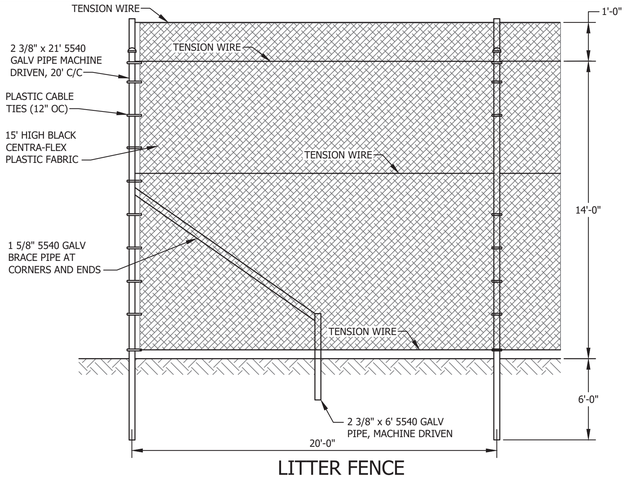
SME
SEVEE & MAHER
ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

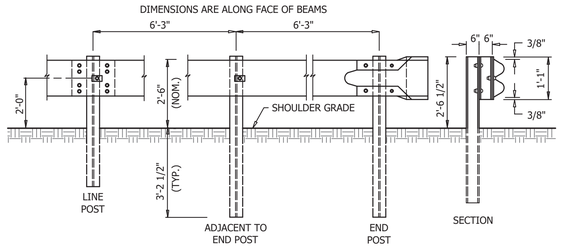
JOB NO. 240101.00 DWG FILE DETAILS

C-305

C:\Users\nmcowell\Documents\Revit Local Files\240101.00_Juniper Ridge Landfill_Phase II Expansion_nmcowell.rvt 11/10/2025 11:02:11 AM

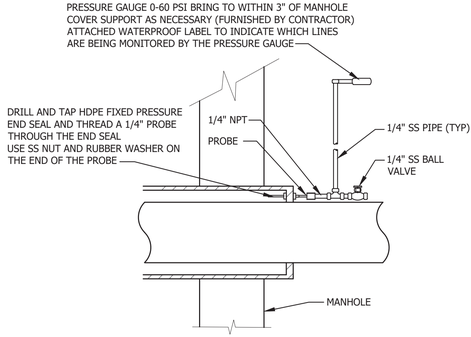


LITTER FENCE
NTS

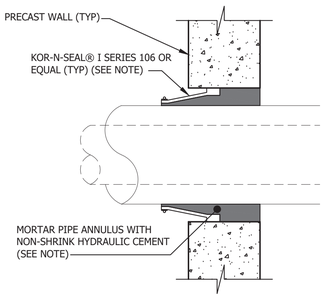


NOTES:
1. INTERMEDIATE POST SPACING SHALL BE 6'-3" UNLESS OTHERWISE SHOWN.
2. POST AND OFFSET BRACKETS SHALL BE 4"x 6" I-BEAM 8.5 OR 9.0 LBS/FT. LENGTH OF 5'-9" ATTACHED WITH 5/8" DIA HOT DIP GALVANIZED BOLTS WITH HEX NUTS.
3. ALL HOLES IN BEAM TO BE SHOP-PUNCHED PRIOR TO GALVANIZING.
4. RAIL PANELS AND END SECTIONS TO BE 12 GAUGE STEEL.
5. BACK-UP PLATE TO BE PLACED BEHIND RAIL ELEMENTS AT INTERMEDIATE STEEL POSTS (NON-SPLICE POSTS).
6. ALL PARTS SHALL CONFORM TO CURRENT MAINE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.
7. WHEN GUARDRAIL IS CONSTRUCTED AT UP TO FOUR FEET FROM THE EDGE OF PAVEMENT, THE GUARDRAIL WILL BE SET FROM THE GRADE AT THE FACE OF RAIL.
8. END SECTIONS TO BE IN ACCORDANCE WITH MAINE DEPARTMENT OF TRANSPORTATION STANDARDS.
9. GUARDRAIL SET ON A RADIUS OF 150 FEET OR LESS TO BE CIRCULAR.

GUARDRAIL
NTS



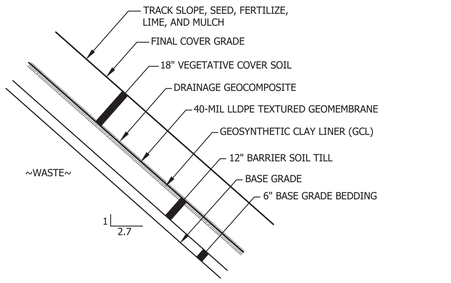
PRESSURE GAUGE AND TRANSMITTER
NTS



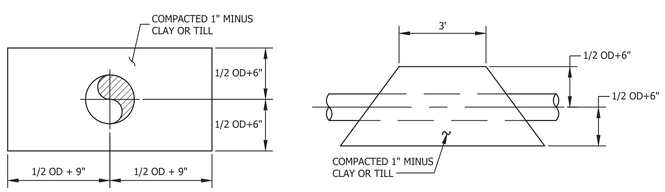
NOTE:

THE JOINTS FOR THE PIPES THROUGH PRECAST WALLS SHALL BE WEDGE STYLE KOR-N-SEAL® I SERIES 106 AS MANUFACTURED BY TRELLEBORG OR EQUAL. THE ANNULUS SHALL BE FILLED WITH NON-SHRINK HYDRAULIC CEMENT. THE CONTRACTOR SHALL FOLLOW THE MANUFACTURERS INSTRUCTIONS TO MIX AND APPLY THE CEMENT. THE FINAL PLUG SHALL YIELD A STRONG AND RIGID SEAL BETWEEN THE PIPE AND STRUCTURE. COMPLETE VACUUM TESTING PRIOR TO THE INSTALLATION OF CEMENT.

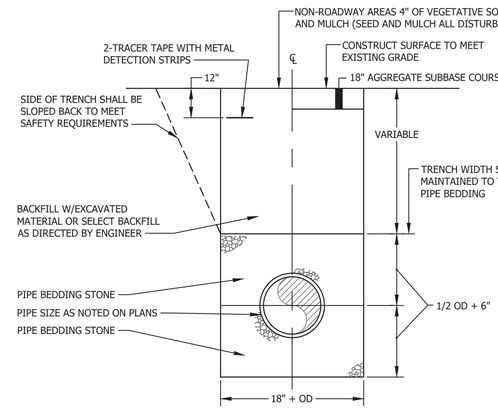
PRECAST WALL PENETRATION
NTS



FINAL COVER SYSTEM
NTS

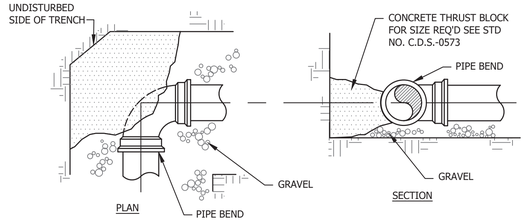


PIPE DAM
NTS

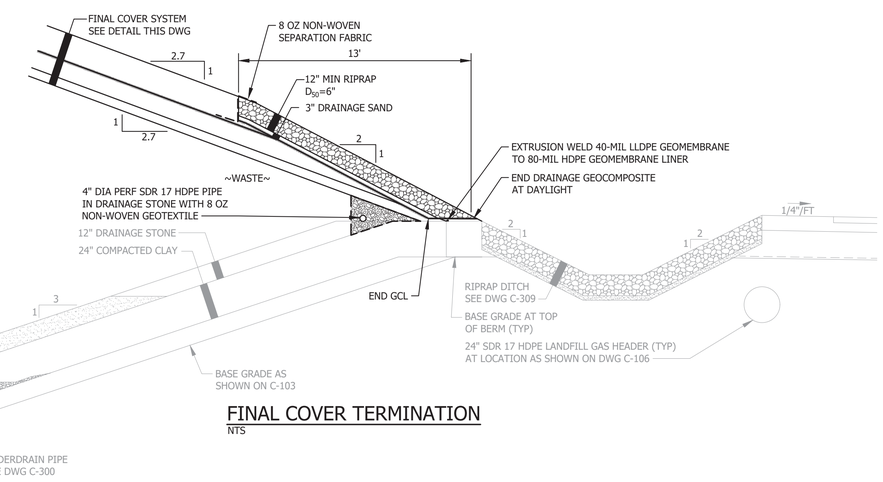


PIPE TRENCH
NTS

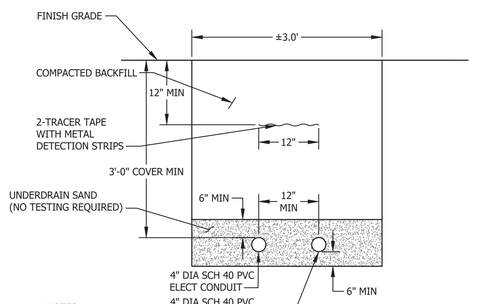
SIZE REQUIREMENTS FOR CONCRETE THRUST BLOCKS					
		BEARING ON UNDISTURBED SOIL (SQ FT)			
FITTINGS		90° BENDS	45° BENDS	TEES & PLUGS	HYDRANTS
PIPE SIZE	4"	2.0	1.0	1.0	N/A
	6"	3.0	2.0	2.0	6.0
	8"	5.0	3.0	4.0	N/A
	10"	7.0	4.0	5.0	N/A
	12"	10.0	6.0	7.0	N/A
	14"	13.0	7.0	10.0	N/A
	16"	17.0	9.0	12.0	N/A



TYPICAL THRUST BLOCK PLACEMENT ON BENDS
NTS

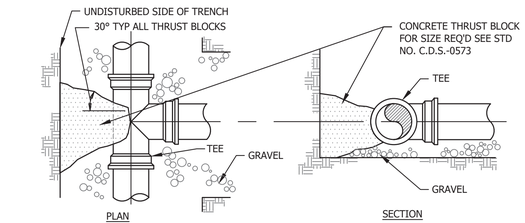


FINAL COVER TERMINATION
NTS



NOTES:
1. FROM POWER POLE TO PUMP STATION INSTALL TWO ELECTRICAL CONDUITS.
2. FROM PUMP STATION TO CLEANING/TIE-IN VAULT TWO ELECTRICAL CONDUITS AND ONE COMMUNICATION CONDUIT.
3. FIELD FIT AND MODIFY AS NECESSARY.

UNDERGROUND ELECTRIC AND COMMUNICATION TRENCH
NTS



TYPICAL THRUST BLOCK PLACEMENT ON TEES
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE — BRIAN D. PIERCE — 9608 — 11/11/2025 — LICENSED PROFESSIONAL ENGINEER

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

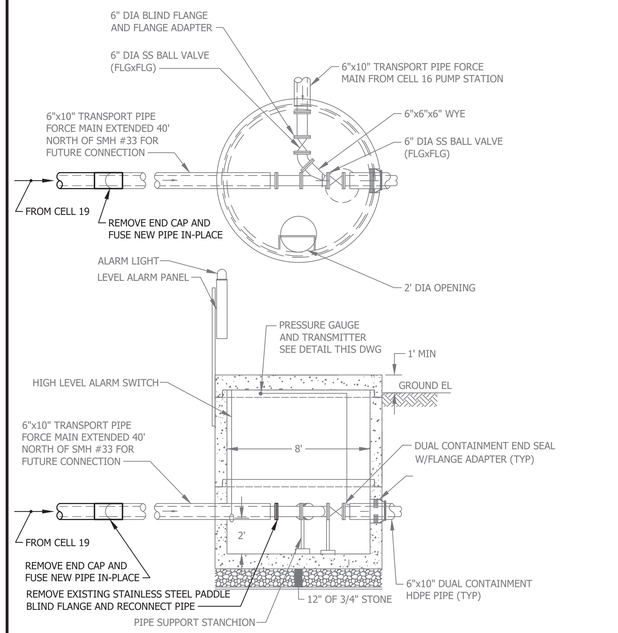
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

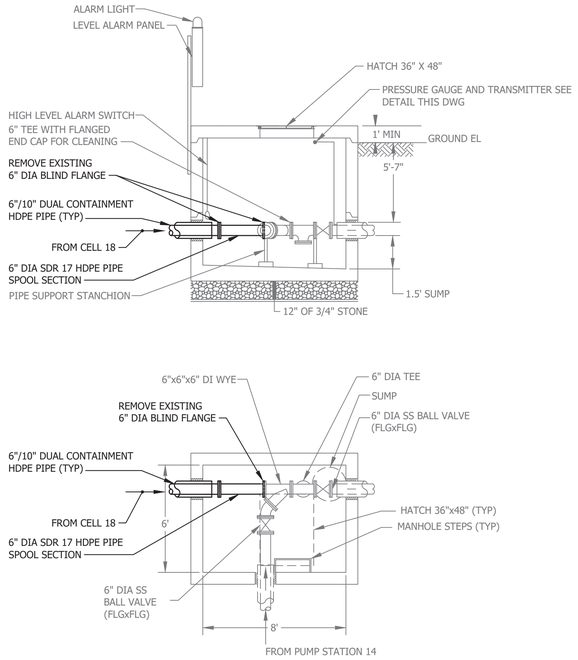
C-306

I:\Newsme\05-Civil\04-Drawings\Phase II Expansion\Autodesk\Plans\C306_11102025 11:02:12 AM.dwg

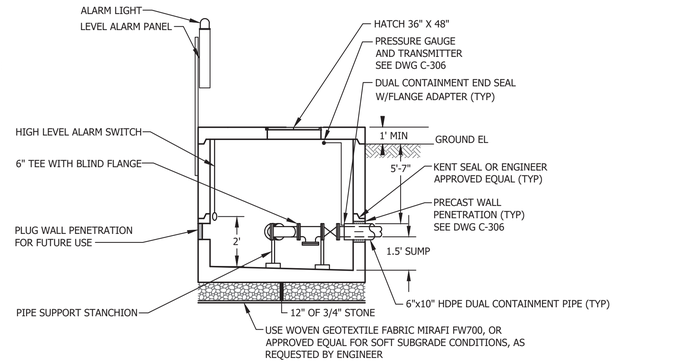


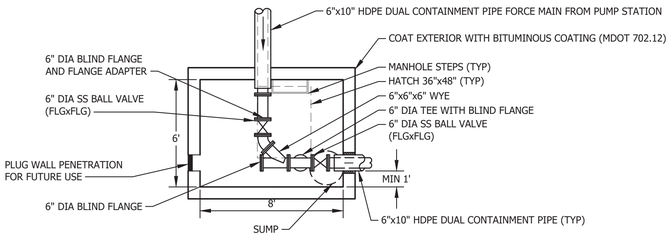
NOTE: ALL PIPE FITTINGS TO BE DUCTILE IRON UNLESS OTHERWISE NOTED.

SMH #33 CONNECTION
NTS



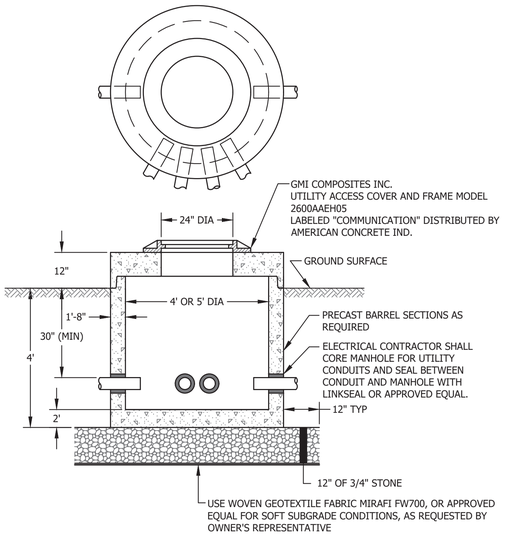
SMH #27 CONNECTION
NTS





NOTE: ALL PIPE FITTINGS TO BE DUCTILE IRON UNLESS OTHERWISE NOTED.

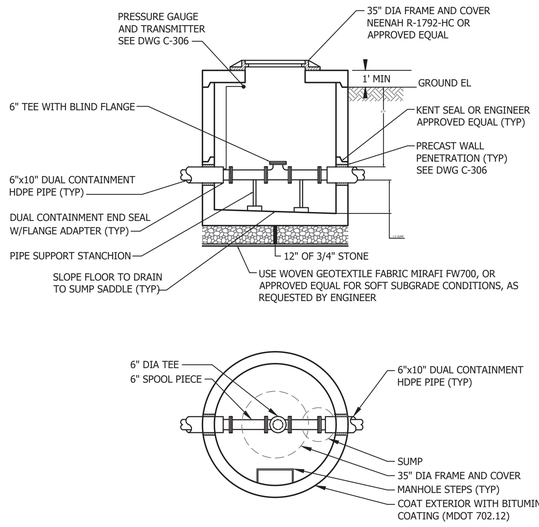
SMH TIE-IN VAULT (SMH #34, #36 & #39)
NTS



NOTES:

1. 4' DIA MANHOLE AS MANUFACTURED BY AMERICAN CONCRETE INDUSTRIES OR ENGINEER APPROVED EQUAL.
2. 4000 PSI CONCRETE AT 28 DAYS.
3. DESIGNED FOR H-20 WHEEL LOADING.
4. CONFORMS TO ASTM C-478 SPECIFICATIONS.
5. REINFORCED TO 0.12 IN SQ/LF.
6. SHIPLAP JOINTS SEALED WITH BUTYL RUBBER.
7. EXTERIOR COATED WITH ASPHALTIC PROTECTIVE DAMPROOFING.
8. BOTTOM MIN 5'-0" BELOW FINISH GRADE.
9. PRECAST CONCRETE VAULT MANUFACTURER TO PROVIDE ANTI-FLOATATION EXTENDED BASE SLAB AS NECESSARY. ANTI-FLOATATION DESIGN AND SHOP DRAWINGS SHALL BE PREPARED BY THE MANUFACTURER AND SUBMITTED TO THE ENGINEER FOR APPROVAL.

ELECTRIC AND COMMUNICATIONS MANHOLE (EMH)
NTS



NOTE: ALL PIPE FITTINGS TO BE DUCTILE IRON UNLESS OTHERWISE NOTED.

SMH IN-LINE VAULT (SMH #35, #37 & #38)
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. PIERCE
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

C-307

\\Server\cfs\Castle\2kTown\Landfill\Expansion\Phase II Expansion\Acad\Plans\DETAILS.dwg, C-307, 11/10/2025 11:13:14 AM, lgm

A. GENERAL

1. All soil erosion and sediment control will be done in accordance with: (1) the Maine Erosion and Sediment Control Handbook: Best Management Practices, Maine Department of Environmental Protection (MEDEP), October 2016; (2) the project specific stormwater pollution prevention plan.

2. The site contractor (to be determined) will be responsible for the repair/replacement/maintenance of all erosion control measures until all disturbed areas are stabilized.

3. Disturbed areas will be permanently stabilized within 7 days of final grading. Disturbed areas not to be worked upon within 14 days of disturbance will be temporarily stabilized within 7 days of the disturbance.

4. In all areas, removal of trees, bushes and other vegetation, as well as disturbance of topsoil will be kept to a minimum while allowing proper site operations.

5. Any suitable topsoil will be stripped and stockpiled for reuse as directed by the owner. Topsoil will be stockpiled in a manner such that natural drainage is not obstructed and no off-site sediment damage will result. In any event, stockpiles will not be located within 100 feet of wetlands and will be at least 50 feet upgradient of the stockpile's perimeter silt fence. The sideslopes of the topsoil stockpile will not exceed 2:1. Silt fence will be installed around the perimeter of all topsoil stockpiles. Topsoil stockpiles will be surrounded with siltation fencing and will be temporarily seeded with Aroostook rye, annual or perennial ryegrass within 7 days of formation, or temporarily mulched.

B. TEMPORARY MEASURES

1. STABILIZED CONSTRUCTION ENTRANCE/EXIT

A crushed stone stabilized construction entrance/exit will be placed at any point of vehicular access to the site.

2. SILT FENCE

a. Silt fence will be installed prior to all construction activity, where soil disturbance may result in erosion. Silt fence will be erected at locations shown on the plans and/or downgradient of all construction activity.

b. Silt fences will be removed when they have served their useful purpose, but not before the upgradient areas have been permanently stabilized.

c. Silt fences will be inspected immediately after each rainfall and at least daily during prolonged rainfall. They will be inspected if there are any signs of erosion or sedimentation below them. Any required repairs will be made immediately. If there are signs of undercutting at the center or the edges, or impounding of large volumes of water behind them, they will be replaced with a temporary crushed stone check dam.

d. Sediment deposits will be removed after each storm event if significant build-up has occurred or if deposits exceed half the height of the barrier.

3. STONE CHECK DAMS

Stone check dams will be installed in grass-lined swales and ditches during construction.

4. BARK MULCH SEDIMENT BARRIER

a. Where approved, bark mulch sediment barriers may be used as a substitute for silt fence. See the details in this drawing set for specifications.

b. Rock Filter Berms: To provide more filtering capacity or to act as a velocity check dam, a berm's center can be composed of clean crushed rock ranging in size from the french drain stone to riprap.

5. TEMPORARY SEEDING

Stabilize disturbed areas that will not be brought to final grade for a year or less and reduce problems associated with mud and dust production from exposed soil surface during construction with temporary vegetation.

6. TEMPORARY MULCHING

Use temporary mulch in the following locations and/or circumstances:

- In sensitive areas (within 100 feet of streams, wetlands and in lake watersheds) temporary mulch will be applied within 7 days of exposing spill or prior to any storm event.
- Apply temporary mulch within 14 days of disturbance or prior to any storm event in all other areas.
- Areas which have been temporarily or permanently seeded will be mulched immediately following seeding.
- Areas which cannot be seeded within the growing season will be mulched for over-winter protection and the area will be seeded at the beginning of the growing season.
- Mulch can be used in conjunction with tree, shrub, vine, and ground cover plantings.
- Mulch anchoring will be used on slopes greater than 5 percent in late fall (past September 1), and over-winter (September 1 - April 25).

The following materials may be used for temporary mulch:

a. Hay or Straw material shall be air-dried, free of seeds and coarse material. Apply 2-3 tons/acre or 3 bales (90-130 lbs per 1,000 sf).

b. Erosion Control Mix: It can be used as a stand-alone reinforcement:
- on slopes 2 horizontal to 1 vertical or less;
- on frozen ground or forested areas; and
- at the edge of gravel parking areas and areas under construction.

c. Erosion control mix alone is not suitable:
- on slopes with groundwater seepage;
- at low points with concentrated flows and in gullies;
- at the bottom of steep perimeter slopes exceeding 100 feet in length;
- below culvert outlet aprons; and around catch basins and closed storm systems.

d. Chemical Mulches and Soil Binders: Wide ranges of synthetic spray-on materials are marketed to protect the soil surface. These are emulsions that are mixed with water and applied to the soil. They may be used alone, but most often are used to hold wood fiber, hydro-mulches or straw to the soil surface.

e. Erosion Control Blankets and Mats: Mats are manufactured combinations of mulch and netting designed to retain soil moisture and modify soil temperature. During the growing season (April 25 to August 31) use mats indicated on drawings or North American Green (NAG) C125 BN (or mulch and netting) on:
- the base of grassed waterways;
- steep slopes (15 percent or greater); and
- any disturbed soil within 100 feet of lakes, streams, or wetlands.

During the late fall and winter (September 1 to April 25) use heavy grade mats indicated on drawings for NAG SC250 on all areas noted above plus use lighter grade mats NAG C125BN (or mulch and netting) on:
- sideslopes of grassed waterways; and
- moderate slopes (between 8 and 15 percent).

7. TEMPORARY DUST CONTROL

To prevent the blowing and movement of dust from exposed soil surfaces, and reduce the presence of dust, use water to control dusting by preserving the moisture level in the road surface materials. The use of calcium chloride or any other chemicals for dust control is prohibited

8. CONSTRUCTION DE-WATERING

a. Water from construction de-watering operations shall be cleaned of sediment before reaching wetlands, water bodies, streams or site boundaries. Utilize temporary sediment basins, erosion control soil filter berms backed by staked hay bales, or other approved Best Management Practices (BMP's).

b. In sensitive areas near streams or ponds, discharge the water from the de-watering operation into a temporary sediment basin created by a surrounding filter berm of uncompacted erosion control mix immediately backed by staked hay bales (see the site details). Locate the temporary sediment basin at lease 100 feet from the nearest water body, such that the filtered water will flow through undisturbed vegetated soil areas prior to reaching the water body or property line.

A. PERMANENT MEASURES

1. Riprapped Aprons: All storm drain pipe outlets and the inlet and outlet of culverts will have riprap aprons to protect against scour and deterioration.

2. Topsoil, Seed, and Mulch: All areas disturbed during construction, but not subject to other restoration (paving, riprap, etc.) will be loamed, limed, fertilized, seeded, and mulched.

a. Seeded Preparation: Use stockpiled materials spread to the depths shown on the plans, if available. Approved topsoil substitutes may be used. Grade the site as needed.

b. Seeding will be completed by August 31 of each year. Late season seeding may be done between September 1 and April 25. Areas not seeded or which do not obtain satisfactory growth by August 31, will be seeded with Aroostook Rye or mulched. After November 1, or the first killing frost, disturbed areas will be seeded at double the specified application rates, mulched, and anchored.

PERMANENT SEEDING SPECIFICATIONS

Mixture:	Grassed areas (lbs/acre)
Tall Fescue	54
Creeping Red Fescue	25
Red Top	5
Ladino Clover	13
Annual Ryegrass	8
Birdsfoot Trefoil	5
Timothy	10

c. Mulch in accordance with specifications for temporary mulching.

d. If permanent vegetated stabilization cannot be established due to the season of the year, all exposed and disturbed areas not to undergo further disturbance are to have dormant seeding applied and be temporarily mulched to protect the site.

3. Ditches and Channels: All ditches on-site will be lined with North American Green S75 erosion control mesh (or an approved equal) upon installation of loam and seed.

B. WINTER CONSTRUCTION AND STABILIZATION

1. Winter excavation and earthwork will be completed so as to minimize exposed areas while satisfactorily completing the project. Limit exposed areas to those areas in which work is to occur during the following 15 days and that can be mulched in one day prior to any snow event. All areas will be considered denuded until the subbase gravel is installed in roadway areas or the areas of future loam and seed have been loamed, seeded, and mulched.

Install any added measures necessary to control erosion/sedimentation. The particular measure used will be dependent upon site conditions, the size of the area to be protected, and weather conditions.

To minimize areas without erosion control protection, continuation of earthwork operations on additional areas will not begin until the exposed soil surface on the area being worked has been stabilized.

2. Natural Resource Protection: During winter construction, or within 100-feet of a natural resource (i.e., wetland) a double-row of sediment barriers (i.e., silt fence backed with hay bales or erosion control mix) will be placed between any natural resource and the disturbed area. Projects crossing the natural resource will be protected a minimum distance of 100 feet on either side from the resource.

3. Sediment Barriers: During frozen conditions, sediment barriers may consist of erosion control mix berms or any other recognized sediment barriers as frozen soil prevents the proper installation of hay bales or silt fences.

4. Mulching: All areas will be considered to be denuded until seeded and mulched. Hay and straw mulch will be applied at a rate of twice the normal accepted rate.

Mulch will not be spread on top of snow.

After each day of final grading, the area will be properly stabilized with anchored hay or straw or erosion control matting.

Between the dates of September 1 and April 25, all mulch will be anchored by either mulch netting, emulsion chemical, tracking or wood cellulose fiber.

5. Soil Stockpiling: Stockpiles of soil or subsoil will be mulched for over-winter protection with hay or straw at twice the normal rate or with a 4-inch layer of erosion control mix. This will be done within 24 hours of stocking and re-established prior to any rainfall or snowfall. Any soil stockpiles shall not be placed (even covered with mulch) within 100 feet from any natural resources.

6. Seeding: Dormant seeding may be placed prior to the placement of mulch or erosion control blankets. If dormant seeding is used for the site, all disturbed areas will receive 4 inches of loam and seed at an application rate of three times the rate for permanent seeding. All areas seeded during the winter will be inspected in the spring for adequate catch. All areas insufficiently vegetated (less than 85 percent catch) will be revegetated by replacing loam, seed, and mulch.

If dormant seeding is not used for the site, all disturbed areas will be revegetated in the spring.

7. Maintenance: Maintenance measures will be applied as needed during the entire construction season. After each rainfall, snow storm, or period of thawing and runoff, the site contractor will perform a visual inspection of all installed erosion control measures and perform repairs as needed to ensure their continuous function.

Following the temporary and/or final seeding and mulching, the contractor will, in the spring, inspect and repair any damages and/or bare spots. An established vegetative cover means a minimum of 90 percent of areas vegetated with vigorous growth.

A. OVER-WINTER CONSTRUCTION EROSION CONTROL MEASURES

1. Stabilization of Disturbed Soil: By August 31, all disturbed soils on areas having a slope less than 15 percent will be seeded and mulched. If the contractor fails to stabilize these soils by this date, then the contractor shall stabilize the soil for late fall and winter, by using either temporary seeding or mulching.

2. Stabilization of Disturbed Slopes: All slopes to be vegetated will be completed by August 31. The owner will consider any area having a grade greater than 15 percent (6.5H:1V) to be a slope. Slopes not vegetated by August 31 will receive one of the following actions to stabilize the slope for late fall and winter:

a. Stabilize the soil with temporary vegetation and erosion control mesh.
b. Stabilize the slope with erosion control mix.
c. Stabilize the slope with stone riprap.

3. Stabilization of Ditches and Channels: All stone-lined ditches and channels to be used to convey runoff through the winter will be constructed and stabilized by November 15. Grass-lined ditches and channels will be complete by September 15. Grass-lined ditches not stabilized by September 15 shall be lined with either sod or riprap.

E. MAINTENANCE PLAN

1. Routine Maintenance: Inspection will be performed as outlined in the project's Erosion Control Plan. Inspection will be by a qualified person during wet weather to ensure that the facility performs as intended. Inspection priorities will include checking erosion controls for accumulation of sediments.

A. Housekeeping

1. Spill prevention. Controls must be used to prevent pollutants from being discharged from materials on site, including storage practices to minimize exposure of the materials to stormwater, and appropriate spill prevention, containment, and response planning and implementation.

2. Groundwater protection. During construction, liquid petroleum products and other hazardous materials with the potential to contaminate groundwater may not be stored or handled in areas of the site draining to an infiltration area. An "infiltration area" is any area of the site that by design or as a result of soils, topography and other relevant factors accumulates runoff that infiltrates into the soil. Dikes, berms, sumps, and other forms of secondary containment that prevent discharge to groundwater may be used to isolate portions of the site for the purposes of storage and handling of these materials.

3. Fugitive sediment and dust. Actions must be taken to ensure that activities do not result in noticeable erosion of soils or fugitive dust emissions during or after construction. Oil may not be used for dust control.

4. Debris and other materials. Litter, construction debris, and chemicals exposed to stormwater must be prevented from becoming a pollutant source.

5. Trench or foundation de-watering. Trench de-watering is the removal of water from trenches, foundations, coffer dams, ponds, and other areas within the construction area that retain water after excavation. In most cases the collected water is heavily silted and hinders correct and safe construction practices. The collected water must be removed from the ponded area, either through gravity or pumping, and must be spread through natural wooded buffers or removed to areas that are specifically designed to collect the maximum amount of sediment possible, like a cofferdam sedimentation basin. Avoid allowing the water to flow over disturbed areas of the site. Equivalent measures may be taken if approved by the department.

6. Non-stormwater discharges. Identify and prevent contamination by non-stormwater discharges.

7. Additional requirements. Additional requirements may be applied on a site-specific basis.

B. CONSTRUCTION SEQUENCE

It is anticipated that construction will commence upon receipt of all necessary permits and approvals. The following outlines the preliminary construction sequence:

a. Install silt fence and other temporary erosion control measures for the construction of Cell and accessory facilities such as berms, and service roads;

b. Construct upslope stormwater diversion berms, ditches, culvert outlets, and control structures:

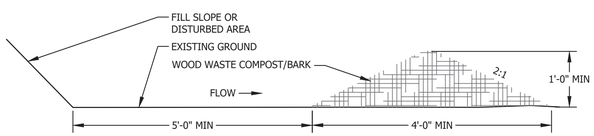
c. Perform stormwater upgrades;

d. Construct service road;

e. Construct Cell base grade;

f. Construct Cell liner system;

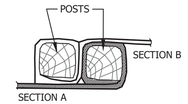
g. As permanent erosion control measures become stabilized, remove temporary measures (e.g., silt fence, stone check dams).



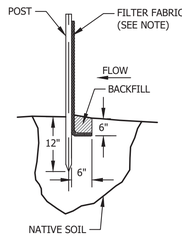
NOTE:
BARK MULCH SEDIMENT BARRIERS MAY BE USED AS AN ALTERNATE TO SILT FENCE WHEN APPROVED BY THE ENGINEER.

EROSION CONTROL MIX BERM
NTS

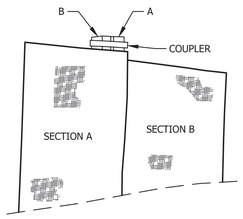
NOTE: SILTATION FENCE SHALL BE ENVIROFENCE AS MANF. BY MIRAFI INC., PROPEX SILT STOP AS MANF. BY AMOCO FABRICS CO. OR EQUAL



TOP VIEW

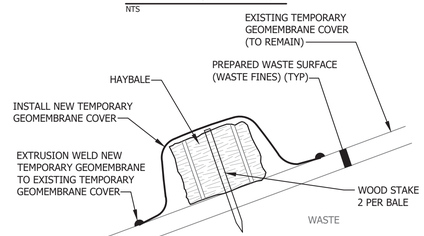


TOE-IN DETAIL

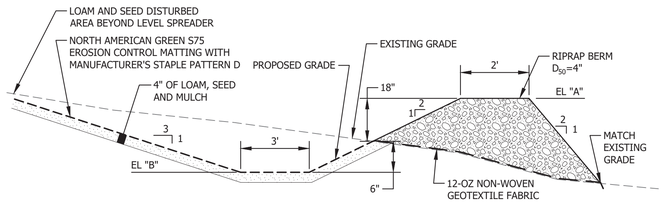


JOINING SECTIONS

SILTATION FENCE
NTS



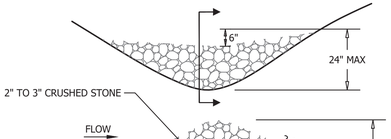
INTERMEDIATE COVER STORMWATER DIVERSION BERM
NTS



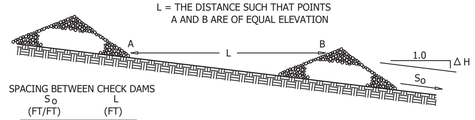
NOTES:
1. CONSTRUCT LEVEL LIP AND SPREADER ON ZERO PERCENT GRADE.
2. STORM RUNOFF CONVERTED TO SHEET FLOW SHALL OUTLET ONTO STABILIZED AREA. WATER SHALL NOT BE CHANNELIZED IMMEDIATELY BELOW POINT OF DISCHARGE.

LEVEL SPREADER NO.	EL "A"	EL "B"	LENGTH (FT)
DP-11R	151.5	150.0	15.0
DP-12	165.8	164.3	15.0
DP-13	158.0	156.5	15.0
DP-14	154.0	152.5	25.0

LEVEL SPREADER
NTS



SECTION

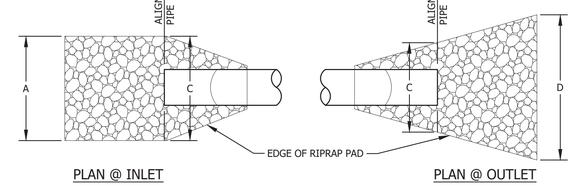


SPACING BETWEEN CHECK DAMS

So (FT/FT)	L (FT)
0.020	75
0.030	50
0.040	40
0.050	30
0.080	20
0.100	10

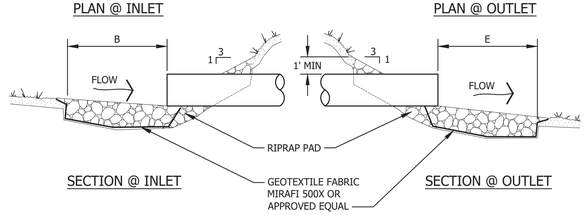
STONE CHECK DAM
NTS

CROSS SECTION



PLAN @ INLET

PLAN @ OUTLET



SECTION @ INLET

SECTION @ OUTLET

RIPRAP PAD MUST BE INSTALLED WITHIN 48 HOURS OF INSTALLING NEW PIPE OR CULVERT.

PIPE	PIPE DIA (IN)	C (FT)	D (FT)	E (FT)	PAD DEPTH (IN)	D50 (IN)
DP-11R	24	6	15	20	20	10
DP-12	24	6	15	20	20	10
DP-13	24	6	15	20	20	10
DP-14	24	6	15	20	20	10
SC-2D	24	6	15	20	20	10
UNDERDRAIN DISCHARGE STRUCTURE	4	4	4	4	8	4

PIPE INLET/OUTLET DETAILS
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. EMERY
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

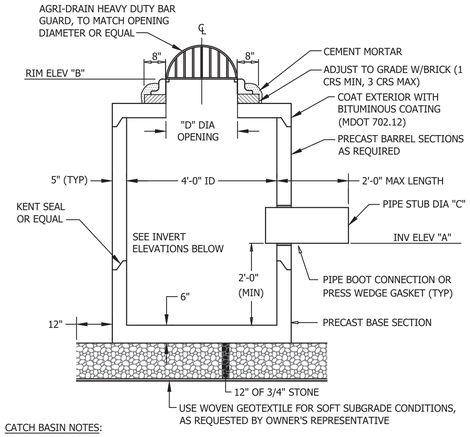
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

C-308

\\Banner\shCivil\Old\Tom Lee\BE\Expansion\Phase II Expansion\Acad\Plans\SETTAILS.dwg C:\BB, 11/10/2025 2:32:32 PM, rgh



CATCH BASIN NOTES:

THE CONTRACTOR SHALL PROVIDE SUBMITTALS TO THE ENGINEER FOR APPROVAL. SUBMITTALS SHALL INCLUDE BUT NOT LIMITED TO THE FOLLOWING:

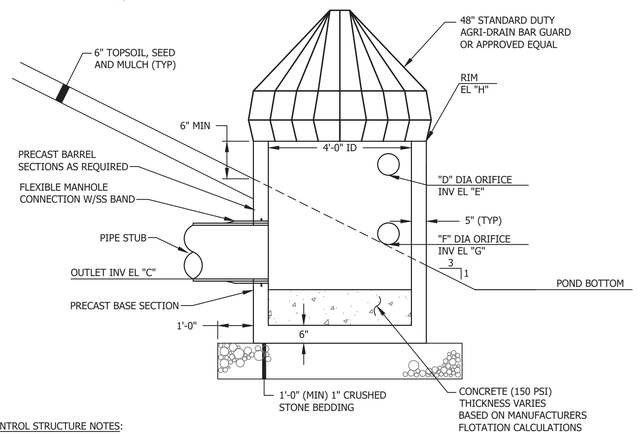
PRODUCT DATA: SUBMIT PRODUCT DATA FOR ALL MATERIALS USED ON THE JOB FOR REVIEW FOR LIMITED PURPOSE OF CHECKING FOR CONFORMANCE WITH INFORMATION GIVEN AND DESIGN CONCEPT EXPRESSED IN CONTRACT DOCUMENTS.

SHOP DRAWINGS: SUBMIT FOR REVIEW SHOP DRAWINGS OF ALL PRECAST UNITS. MANUFACTURER'S INFORMATION SHALL BE SUBMITTED FOR JOINT SEALANTS AND WATERPROOFING. MANUFACTURER SHALL PROVIDE ANTI-FLOTATION DESIGN SHOP DRAWINGS AND CALCULATIONS, INCLUDING ANY EXTENDED BASE SLABS AS NECESSARY, FOR PROPOSED MANHOLES. MANUFACTURER SHALL ASSUME GROUNDWATER LEVELS EQUAL TOP OF GROUND ELEVATIONS AND PROVIDE FOR A 1.2 FACTOR OF SAFETY AGAINST FLOTATION.

CATCH BASIN SCHEDULE A

CATCH BASIN DESIGNATION	PIPE INV EL	RIM EL	PIPE DIA	TOP OPENING
	"A" (FT)	"B" (FT)	"C" (IN)	DIA "D" (IN)
CB-2B	173.0	179.0	24	30
CB-2G	173.0	179.0	24	30
CB-2D	192.0	201.0	24	30
CB-4C	167.0	171.0	24	30
CB-4D	158.00	160.5	24	30
CB-4G	161.00	167.0	24	30
CB-4H	174.0	181.0	24	30

CATCH BASIN
NTS



OUTLET CONTROL STRUCTURE NOTES:

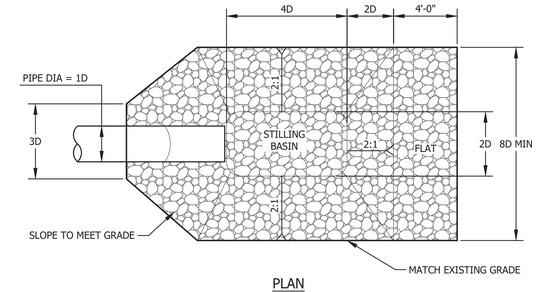
THE CONTRACTOR SHALL PROVIDE SUBMITTALS TO THE ENGINEER FOR APPROVAL. SUBMITTALS SHALL INCLUDE BUT NOT LIMITED TO THE FOLLOWING:

PRODUCT DATA: SUBMIT PRODUCT DATA FOR ALL MATERIALS USED ON THE JOB FOR REVIEW FOR LIMITED PURPOSE OF CHECKING FOR CONFORMANCE WITH INFORMATION GIVEN AND DESIGN CONCEPT EXPRESSED IN CONTRACT DOCUMENTS.

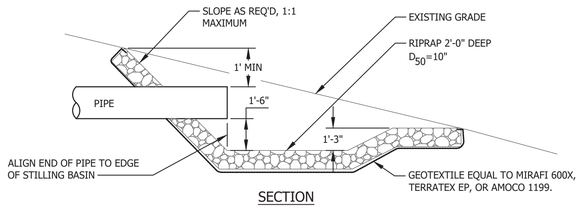
SHOP DRAWINGS: SUBMIT FOR REVIEW SHOP DRAWINGS OF ALL PRECAST UNITS. MANUFACTURER'S INFORMATION SHALL BE SUBMITTED FOR JOINT SEALANTS AND WATERPROOFING. MANUFACTURER SHALL PROVIDE ANTI-FLOTATION DESIGN SHOP DRAWINGS AND CALCULATIONS, INCLUDING ANY EXTENDED BASE SLABS AS NECESSARY, FOR PROPOSED MANHOLES. MANUFACTURER SHALL ASSUME GROUNDWATER LEVELS EQUAL TOP OF BERM ELEVATION AND PROVIDE FOR A 1.2 FACTOR OF SAFETY AGAINST FLOTATION.

STRUCTURE DESIGNATION	OUTLET INV EL	ORIFICE DIA	ORIFICE INV EL	ORIFICE DIA	ORIFICE INV EL	RIM EL	OUTLET (C) CULVERT	CULVERT	CULVERT SLOPE
	"C" (FT)	"D" (IN)	"E" (FT)	"F" (IN)	"G" (FT)	"H" (FT)	DIAMETER (IN)	LENGTH (FT)	(FT/FT)
DP-11R	155.3	6.0	159.0	4.0	156.50	161.00	24 (CORR PE)	55.00	0.02
DP-12	168.9	6.0	174.0	4.0	171.50	175.00	24 (CORR PE)	66.00	0.01
DP-13	160.3	6.0	163.0	4.0	160.50	163.80	24 (CORR PE)	30.00	0.04
DP-14	157.0	6.0	159.0	4.0	158.00	159.80	24 (CORR PE)	55.00	0.02

OUTLET CONTROL STRUCTURE
NTS



PLAN

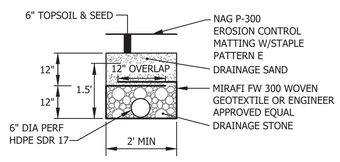


SECTION

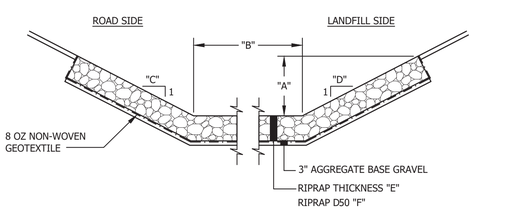
NOTES:

1. INSTALL SILT FENCE DOWNSTREAM PRIOR TO EXCAVATION.
2. LOAM AND SEED ALL AREAS DISTURBED BY CONSTRUCTION OF PLUNGE POOL.

STANDARD PLUNGE POOL
NTS



POND UNDERDRAIN
NTS

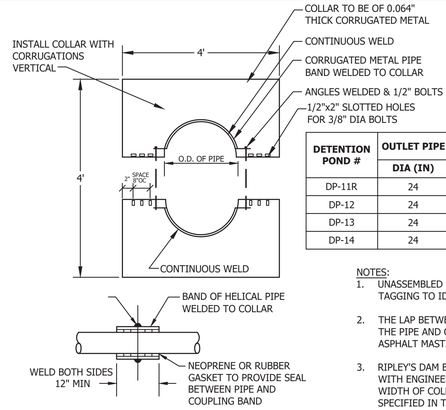


DITCH	A	B	C	D	E	F
	(FT)	(FT)			(IN)	(IN)
TOE DITCH	3	3	2	2	22	10
DITCH 2D	3	3	2	2	22	10

RIPRAP DITCH
NTS

STORM DRAIN	DIAMETER	MATERIAL	LENGTH	SLOPE	INV IN	INV OUT
	(in.)		(ft.)	(%)		
SD-2B	24	CORR PE	90.0	0.010	173.00	172.00
SD-2E	24	CORR PE	80.0	0.010	173.00	172.00
SD-2D	24	CORR PE	30.0	0.020	192.00	191.50
SD-4C	24	CORR PE	52.0	0.009	167.00	166.50
SD-4D	24	CORR PE	54.5	0.009	158.00	157.50
SD-4G	24	CORR PE	115.0	0.008	161.00	160.00
SD-4H	24	CORR PE	65.0	0.030	174.00	172.00

STORM DRAIN PIPES
NTS

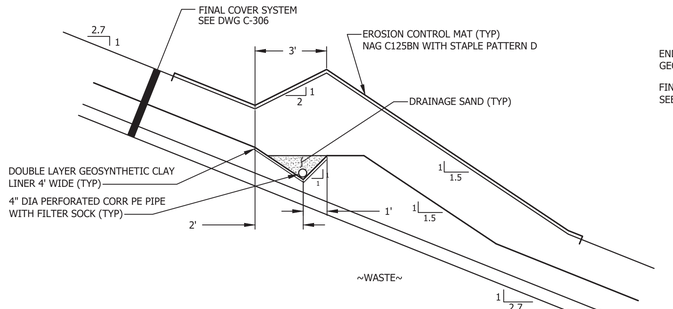


DETENTION POND #	OUTLET PIPE	PIPE LENGTH	SATURATED LENGTH	# OF	SPACING
	DIA (IN)	(FT)	(FT)	COLLARS	(FT)
DP-11R	24	55	46.2	2	15
DP-12	24	66	35.2	2	12
DP-13	24	30	42.5	2	14
DP-14	24	55	22.8	2	8

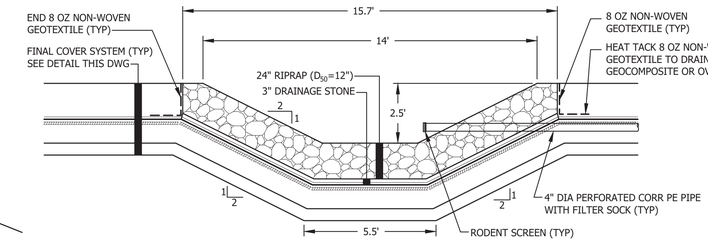
NOTES:

1. UNASSEMBLED COLLAR SHALL BE MARKED BY PAINTING OR TAGGING TO IDENTIFY MATCHING PARTS.
2. THE LAP BETWEEN THE TWO HALF SECTIONS AND BETWEEN THE PIPE AND CONNECTING BAND SHALL BE CAULKED WITH ASPHALT MASTIC AT TIME OF INSTALLATION.
3. RIPLEY'S DAM BY MCRIP MANUFACTURING MAY BE USED WITH ENGINEERS APPROVAL PROVIDING THAT LENGTH AND WIDTH OF COLLAR IS EQUAL TO OR GREATER THAN THAT SPECIFIED IN THE DETAIL.

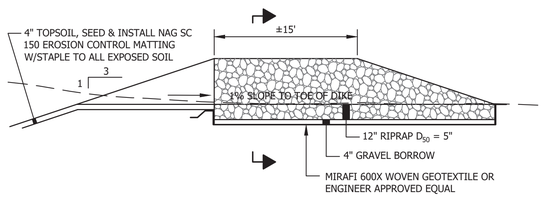
ANTI-SEEP COLLAR
NTS



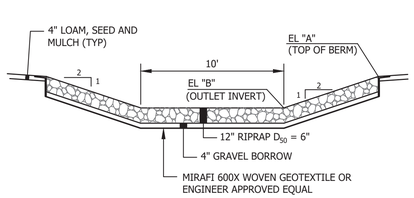
FINAL COVER SURFACE TERRACE
NTS



FINAL COVER RIPRAP DOWNSPOUT
NTS



ELEVATION



SECTION

STRUCTURE DESIGNATION	BOTTOM WIDTH (FT)	LENGTH (FT)	EL "A" (FT)	D_{50} (IN)	THICKNESS (IN)	EL "B" (FT)
DP-11R	10	±15	168.0	6	12	166.5
DP-12	10	±15	180.0	6	12	178.5
DP-13	10	±15	168.0	6	12	166.5
DP-14	10	±15	162.0	6	12	160.5

EMERGENCY SPILLWAY
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE — BRIAN D. PERRY — 9600 — LICENSED PROFESSIONAL ENGINEER — 11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

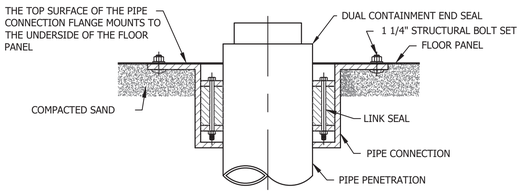
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

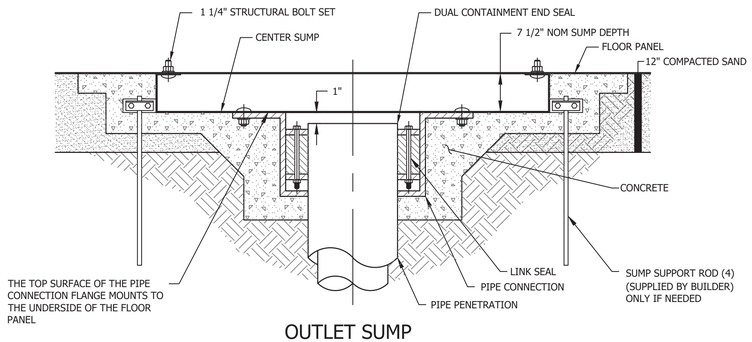
JOB NO. 240101.00 DWG FILE DETAILS

C-309

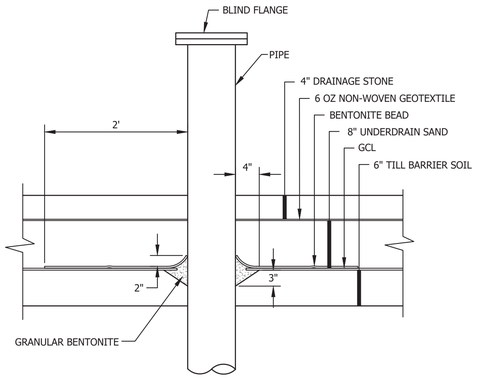
\\Server\Dk\Castle\Dk\Town Land\RE Expansion\Phase 1 Expansion\Acad\Plans\DETAILS.dwg, C-309, 11/7/2025 2:34:04 PM, sjm



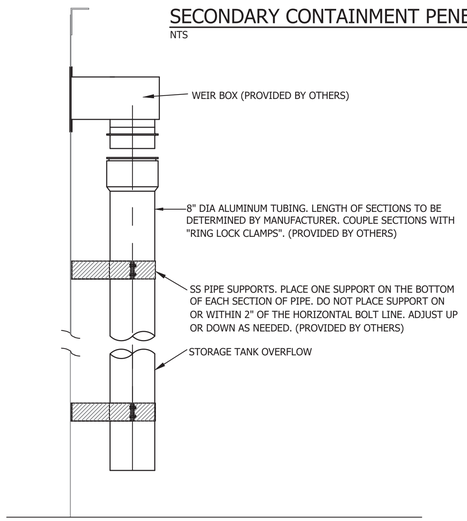
TANK INLET
NTS



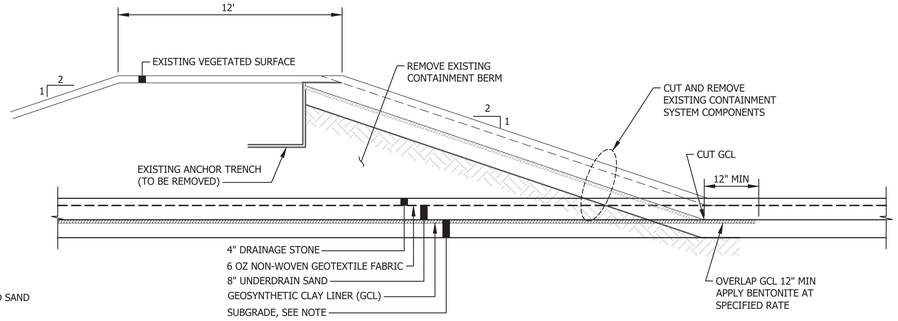
OUTLET SUMP
NTS



SECONDARY CONTAINMENT PENETRATION
NTS

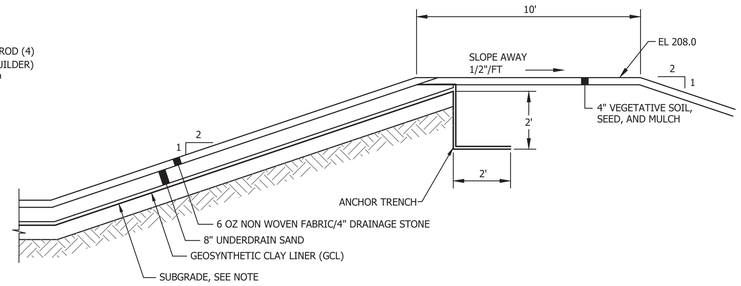


GRAVITY SEWER TERMINATION
NTS



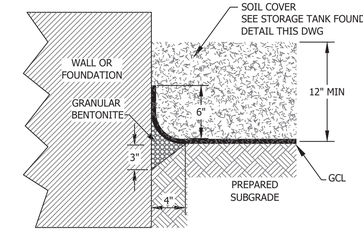
NOTE:
TOP 6 INCHES OF SUBGRADE TO BE SCARIFIED.
REMOVE ROCKS GREATER THAN 1" AND RECOMPACT.

CONTAINMENT AREA LINER CONNECTION
NTS

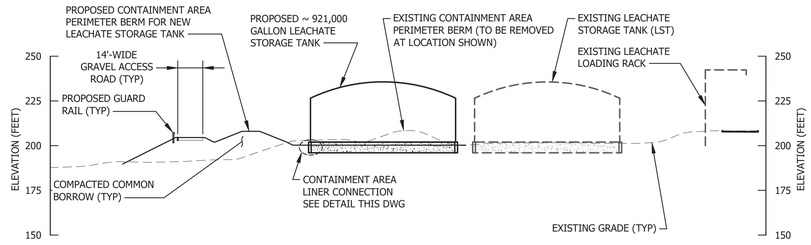


NOTE:
TOP 6 INCHES OF SUBGRADE TO BE SCARIFIED. REMOVE ROCKS GREATER THAN 1" AND RECOMPACT.

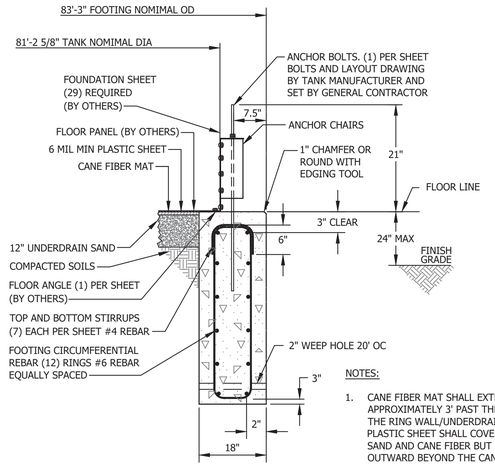
CONTAINMENT AREA AND PERIMETER BERM
NTS



GCL WALL SEAL
NTS

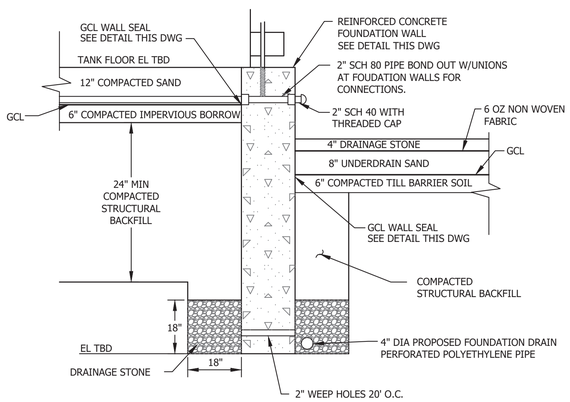


LEACHATE STORAGE SYSTEM SECTION
20 0 40 80 FEET (HORZ)
20 0 40 80 FEET (VERT)



NOTES:
1. CANE FIBER MAT SHALL EXTEND INWARD APPROXIMATELY 3' PAST THE INTERSECTION OF THE RING WALL/UNDERDRAIN SAND. SIX MIL PLASTIC SHEET SHALL COVER THE UNDERDRAIN SAND AND CANE FIBER BUT SHALL NOT EXTEND OUTWARD BEYOND THE CANE FIBER.
2. TANK INSTALLER TO FILLET INTERSECTION OF RING WALL/FLOOR ANGLE WITH TANK SEALANT.

REINFORCED CONCRETE FOUNDATION WALL
NTS



STORAGE TANK FOUNDATION
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE BRIAN D. PHELPS 9601 REGISTERED PROFESSIONAL ENGINEER 11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

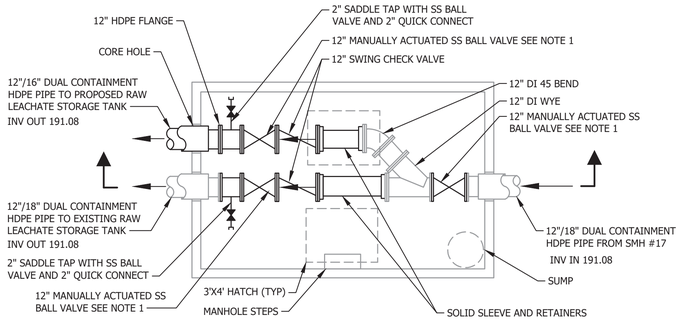
SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

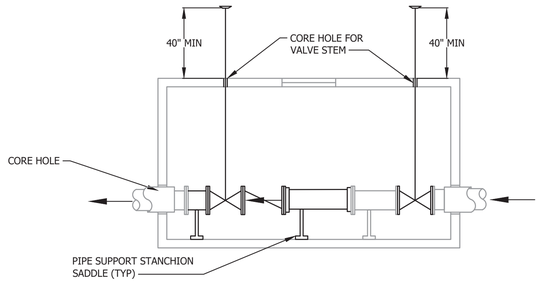
C-310

\\Server\d\Castle\2oTherLandfill\Expansion\Phase II Expansion\Cad\Plans\DETAILS.dwg, C-310, 11/10/2025 11:02:18 AM, sjm



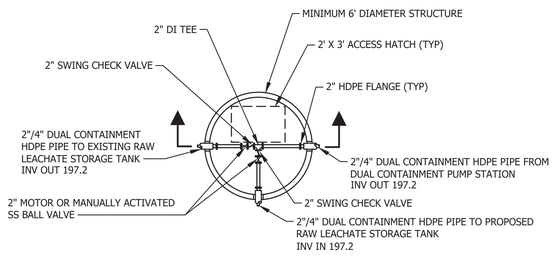
PLAN VIEW

NOTES:
1. BALL VALVE TO BE MANUALLY ACTUATED WITH HANDWHEEL AND EXTEND A MINIMUM OF 40" ABOVE THE STRUCTURE

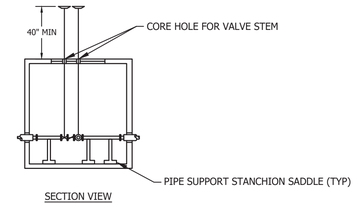


SECTION VIEW

SMH #18 MODIFICATIONS
NTS

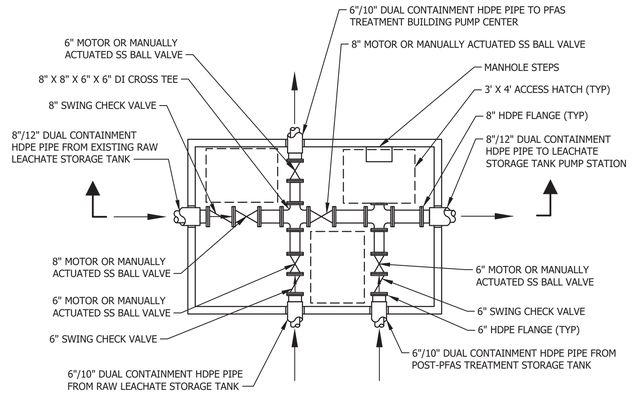


PLAN VIEW



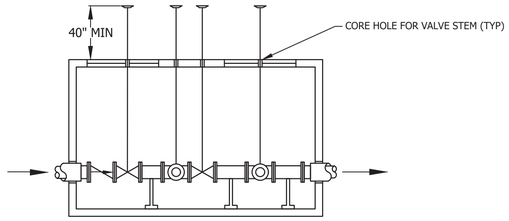
SECTION VIEW

LOADING RACK VALVE PIT
NTS



PLAN VIEW

NOTES:
1. DRAIN EXISTING LEACHATE STORAGE TANK PRIOR TO COMMENCING TIE-IN OPERATIONS
2. BYPASS LEACHATE PUMPING REQUIRED FROM EXISTING LEACHATE STORAGE TANK TO EXISTING LEACHATE STORAGE TANK PUMP STATION DURING TIE-IN OPERATIONS



SECTION VIEW

TANK DISCHARGE VALVE PIT
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D PIERCE
9608
LICENSED PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

C-311

N:\Documents\Civil\Projects\240101.00 NewSME Landfill Operations\Phase II Expansion\Autocad\Plans\DETAILS.dwg, C-311, 11/10/2025 11:02:29 AM, sjm

The anticipated general project development and construction schedule is shown below. Generally, construction is expected to begin in June 2027 with tree clearing and placement of erosion control measures. Construction of the Phase II Expansion is anticipated to end in September 2028, with Cell Development occurring biannually.

Preliminary Construction Schedule:

- October/November 2025 – Application Submittal
- June 2027 – Cell 18 Base Grading, PFAS Treatment System, and Additional Leachate Storage Tank Construction Begins
- September 2028 – Cell 18 Construction Ends
- 2030 – Cell 19 Construction
- 2032 – Cell 20 Construction
- 2034 – Cell 21 Construction
- 2036 – Cell 22 Construction

A complete set of Expansion Plans are contained in this section.

ATTACHMENT 8

EROSION SEDIMENTATION CONTROL PLAN

SME
SEVEE & MAHER
ENGINEERS

PHASE II EXPANSION APPLICATION
JUNIPER RIDGE LANDFILL
EROSION AND SEDIMENTATION CONTROL PLAN

Prepared for

STATE OF MAINE BUREAU OF GENERAL SERVICES
as Owner
and
NEWSME LANDFILL OPERATIONS, LLC
as Operator

November 2025

4 Blanchard Road
P.O. Box 85A
Cumberland, Maine 04021

Tel: 207.829.5016 sme-engineers.com

SME
SEVEE & MAHER
ENGINEERS

TABLE OF CONTENTS

Section No.	Title	Page No.
1.0	**INTRODUCTION**	**1-1**
2.0	**SITE DESCRIPTION**	**2-1**
3.0	**SITE SETTING**	**3-1**
4.0	**EXISTING AND PROPOSED DRAINAGE FACILITIES**	**4-1**
4.1	Existing Detention Ponds	4-1
4.2	Proposed Drainage Facilities	4-2
5.0	**TIMING AND SEQUENCE OF LAND DISTURBANCE ACTIVITIES**	**5-1**
6.0	**EROSION CONTROL MEASURES**	**6-1**
6.1	Temporary Erosion Control	6-1
6.2	Permanent Erosion Control	6-1
6.3	Standard Erosion Control Procedures	6-2
6.4	Additional Erosion Control Procedures (Project Specific)	6-4
7.0	**MAINTENANCE**	**7-1**
7.1	Routine Maintenance	7-1
7.2	Grassed Areas	7-1
8.0	**INSPECTIONS**	**8-1**
9.0	**CONCLUSION**	**9-1**

LIST OF APPENDICES

APPENDIX A	POST-DEVELOPMENT STORMWATER ANALYSIS DRAWING D-101 AND FINAL SITE DRAINAGE PLAN DRAWING C-109
APPENDIX B	EROSION CONTROL DESIGN
	B-1 GRASS DITCH LINING DESIGN
	B-2 RIPRAP DITCH LINING DESIGN
	B-3 CULVERT INLET/OUTLET DESIGN
	B-4 LEVEL SPREADER DESIGN
	B-5 PLUNGE POOL DESIGN
	B-6 EMERGENCY SPILLWAY DESIGN
APPENDIX C	TYPICAL CONSTRUCTION EROSION AND SEDIMENTATION CONTROL SPECIFICATIONS AND DRAWINGS C-308 AND C-309

LIST OF FIGURES

(end of respective section

Figure No.	Title	Page No.
2-1	SITE LOCATION MAP	2-2
3-1	MEDIUM INTENSITY SOIL TYPES	3-3

LIST OF TABLES

Table No.	Title	Page No.
3-1	SITE SURFICIAL SOIL SUMMARY	3-2
4-1	SUMMARY OF STORMWATER STORM DRAINS, CATCH BASINS, AND CHANNELS	4-3
6-1	SEEDING SPECIFICATIONS	6-2

PHASE II EXPANSION APPLICATION
JUNIPER RIDGE LANDFILL
EROSION AND SEDIMENTATION CONTROL PLAN

1.0 INTRODUCTION

This erosion and sedimentation control plan (ESCP) for the Juniper Ridge Landfill (JRL) Phase II Expansion located in Old Town, Maine was designed to comply with the requirements of 06-096 CMR Chapter 400, Section 4.J of the Maine Solid Waste Management Rules.

This plan has been prepared to address the standards and submission requirements, including the following:

- That the facility be located on soils suitable for their intended purpose;
- That the facility does not cause unreasonable sedimentation or erosion of soil; and
- That the facility is not located in a Federal Flood Insurance Administration 100-year frequency floodplain.

2.0 SITE DESCRIPTION

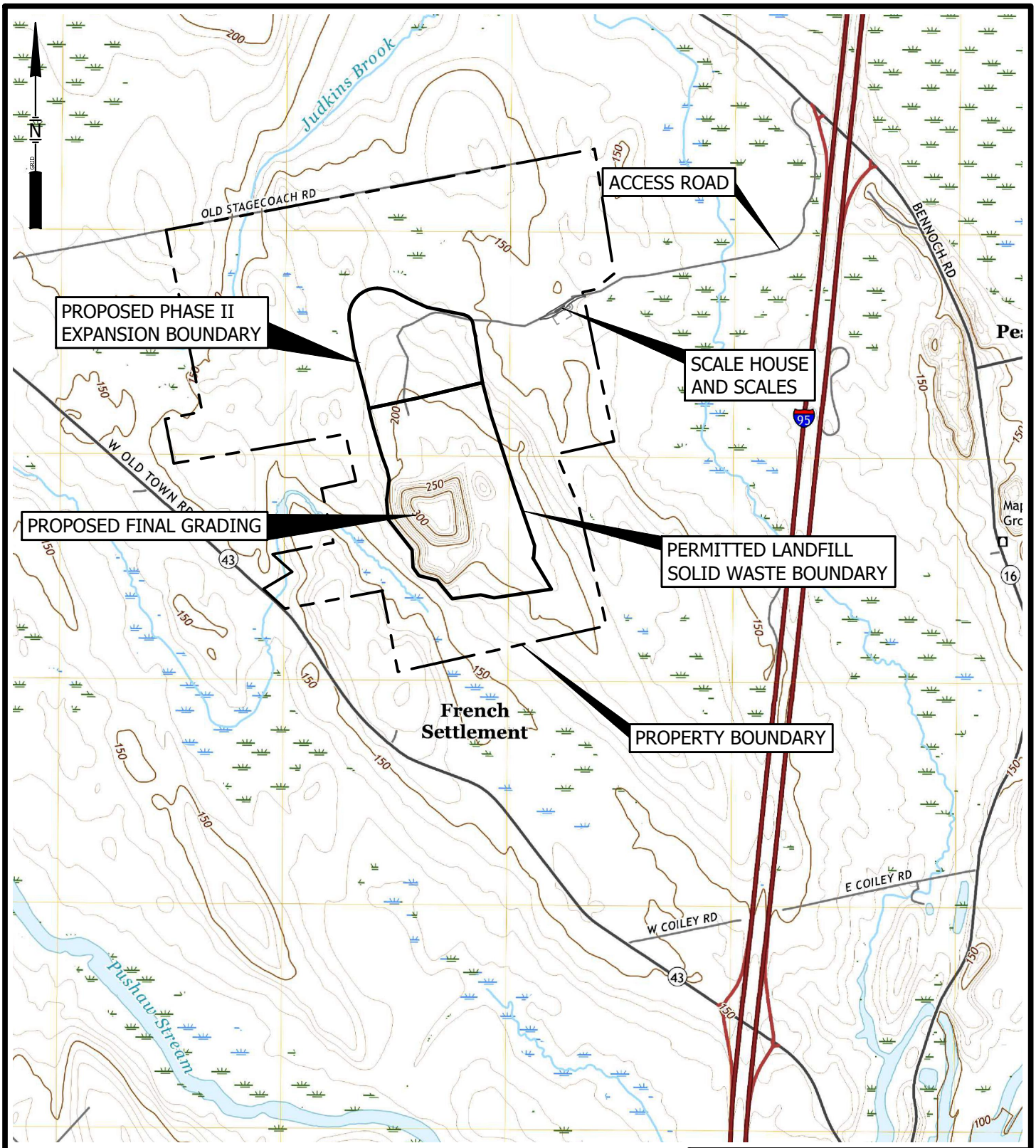
The existing landfill and the Phase II Expansion are located on an approximately 780-acre parcel of land located approximately one mile west of Interstate 95 in Old Town, Maine (see Figure 2-1).

The existing landfill consists of the previously permitted 122-acre solid waste footprint (of which approximately 115 acres are currently developed). The existing landfill infrastructure also includes a 2-mile primary access road, a maintenance/administration building, several storage buildings, a dual-scale house, a former leachate storage pond now used for stormwater detention, a leachate storage tank, five primary leachate pump stations, one leachate haul truck loading rack, one water truck loading rack, multiple detention/sedimentation ponds, soil borrow areas, construction material laydown/soil stockpile areas, parking areas and other grassed areas (i.e., berm slopes etc.), Thiopaq and Sulfa Treat gas scrubbing systems, a storage/processing pad for clean wood debris and railroad ties, a perimeter access road, a Renewable Natural Gas (RNG) Processing Facility, and two landfill gas flares (one belonging to the JRL, and the other to the owners of the RNG Processing Facility).

The Phase II Expansion will be located adjacent to and generally north of the existing landfill and will expand the solid waste footprint by approximately 57 acres. The total area of development for Phase II, including supporting site infrastructure (e.g., access roads, stormwater management ponds, etc.), will be approximately 72 acres.

The development of the Phase II Expansion is anticipated to begin in 2027 and will be constructed in a phased fashion over an approximate 10-year period. As the project progresses, subsequent landfill cells will be constructed, and intermediate or final cover will be placed on cells as they reach capacity. Development of the Phase II Expansion will also include the construction of additional site infrastructure, including stormwater management and erosion control structures, an additional leachate tank, leachate pump stations, force mains, landfill gas system infrastructure, and overhead and buried utilities.

Detention ponds will be used primarily for detention (peak stormwater flow control), but will also serve as a means of sediment control. Stormwater discharge from the ponds will be spread using level spreaders to limit erosion associated with the point discharges.



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
OLD TOWN, MAINE - 2021
GREENBUSH, MAINE - 2021

1000 0 2000 FEET

DWG: SITELOC LMN: USGS MAP CTB: SME-STD REV: 5/30/2025

FIGURE 2-1
SITE LOCATION MAP
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, A_FIG 2-1, 5/30/2025 2:33:46 PM, sjm

3.0 SITE SETTING

The majority of the northern portion of the 780-acre parcel is wooded, with hardwoods predominating in the upper elevations, and softwoods predominating in the lower elevations. The parcel is irregularly shaped and the existing landfill is positioned in the southern portion of the parcel. A drumlin oriented in a northwest to southeast direction effectively divides the parcel into four watersheds, east, northeast, northwest, and southwest. The northeast and the northwest watersheds both contribute to Judkins Brook and eventually Birch Stream. These watersheds will not be influenced by the Phase II Expansion. The southwest watershed contributes to an unnamed tributary to Pushaw Stream, and the east watershed drains to an unnamed and unmapped tributary to Judkins Brook. Both Birch Stream and Pushaw Stream are tributaries to the Stillwater River, which flows to the Penobscot River.

This project is not within the direct watershed of lakes most at risk for new development or an urban impaired stream, as listed in Appendices A and B of the Maine Department of Environmental Protection (MEDEP) Rules, 06-096 CMR, Chapter 502: *Direct Watersheds of Lakes Most At Risk from New Development and Urban Impaired Streams.*

The ground elevation within the Phase II Expansion area currently ranges from approximately 152 to 200 feet-MSL. The Phase II Expansion area is mostly wooded with a mixed stand of hardwood and softwood overlying underbrush along the forest floor. The existing ground within the Phase II Expansion area slopes radially from the top of the drumlin toward the property boundary at grades varying from 1 to 20 percent. Surface drainage within the Phase II Expansion area consists of sheet and shallow concentrated flow with some channelization occurring in existing roadside ditches.

The surficial soils at the site are primarily Plaisted and Howland series along with some Monarda, Buxton, and Scantic, as shown on Figure 3-1. Surficial soils at the site were delineated based on mapping shown on the Soil Conservation Service Medium Intensity Soils Survey for Penobscot County. Table 3-1 shows the hydrologic soil group (HSG) for the various soil series at the site.

TABLE 3-1

SITE SURFICIAL SOIL SUMMARY

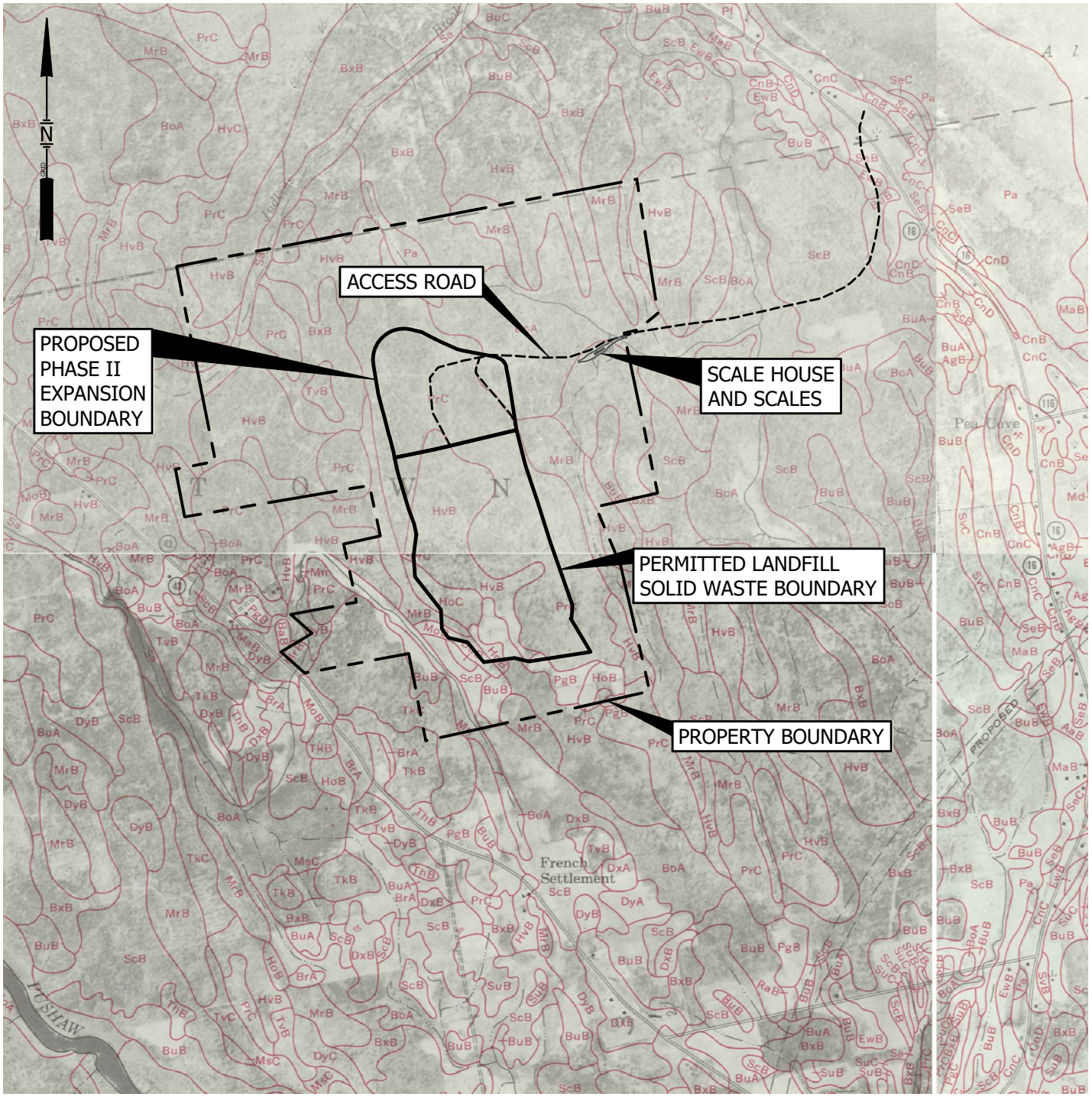
Soil Series	Hydrologic Soil Group
Plaisted	C
Howland	C
Monarda	D
Buxton	C
Scantic	D
Landfill Cover	C
Gravel Surfaces	C/D
Buildings/Roofs/Pond/Paved Surfaces	Impervious Surface

On-site observations within the landfill site have not identified areas that would be considered highly susceptible to erosion (i.e., exposed eroded sideslopes); however, US Department of Agriculture Natural Resources Conservation Services (2002) indicates that Plaisted and Howland soils with slopes greater than 15 percent should be considered highly erodible. Given the presence of these soils on-site, design and implementation of suitable erosion control practices (timing and sequence of land disturbance, temporary measures , permanent measures, inspection, and maintenance) are critical to project development.

The Phase II Expansion area and proposed detention ponds were located outside the limits of the Federal Emergency Management Agency (FEMA) 100-year floodplain shown on D-100 in Appendix A.

An emergent marsh area that forms the headwaters to an unnamed tributary that feeds Pushaw Stream is downgradient and to the southwest of the Phase II Expansion. The marsh can be classified as in good condition and stable with a heavy growth of marsh grasses and no apparent signs of erosion problems. A minimum 100-foot wooded buffer will be maintained between any site development and the emergent wetland marsh to the southwest of the existing landfill.

Design of the proposed facility was performed with a major consideration being to minimize impacts to wetland areas. Existing drainage courses will be utilized where feasible to convey stormwater from the developed site. All the runoff from the developed site will be conveyed through detention basins that attenuate peak flow rates to the unnamed tributaries feeding Pushaw Stream and Judkins Brook. Level spreaders will be installed on all detention basin outlets to disperse flows and keep surface water velocities low.



MAPPING SOURCE

NATURAL RESOURCES CONSERVATION SERVICE, WEB SOIL SURVEY OF PENOBSCOT COUNTY, MAINE, 2014. SOIL CONSERVATION SERVICE MEDIUM INTENSITY SOIL MAPS FOR PENOBSCOT COUNTY, SHEETS 203 & 213 COMPILED IN 1962.

LEGEND

BoA	BIDDEFORD MUCKY PEAT
BuB	BUXTON SILT LOAM
HoC	HOWLAND GRAVELLY LOAM
HvB	HOWLAND VERY STONY LOAM
MoB	MONARDA SILT LOAM
MrB	MONARDA-BURNHAM COMPLEX
PgB	PLAISTED GRAVELLY LOAM
PrC	PLAISTED VERY STONY LOAM
ScB	SCANTIC SILT LOAM

1000 0 2000 FEET

FIGURE 3-1
MEDIUM INTENSITY SOIL TYPES
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER ENGINEERS

DWG: SITELOC LMN: SOILS CTB: SME-STD JOB#: 240101.00 REV: 10/9/2025

\\Nserver\CFS\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, A_FIG 3-1, 10/9/2025 11:38:46 AM, sjm

4.0 EXISTING AND PROPOSED DRAINAGE FACILITIES

4.1 Existing Detention Ponds

There are several existing drainage structures within the existing landfill project site. The locations of these drainage structures are shown on Drawing C-109 in Appendix A. Design considerations for each of the ponds are included in the facility's Phase II Stormwater Management Plan.

Detention Pond 1

Detention Pond 1 is located to the west of the existing landfill cells and will remain in operation throughout the Phase II Expansion development and operation. This detention pond also served as a sedimentation pond during the site's initial years of development. Detention Pond 1 currently functions as a detention and sedimentation basin and will not require any additional modifications and can adequately accommodate the peak flow both during and after the Phase II Expansion development.

Detention Pond 1A

Detention Pond 1A is located west of the existing landfill cells and adjacent to Detention Pond 1. It is used to temporarily store stormwater runoff from the developed portions of the landfill. The water collected in Pond 1A is discharged into Detention Pond 1 by way of a pipe that connects the two ponds. There are no proposed modifications to Detention Pond 1A as part of the Phase II Expansion.

Detention Ponds 2 and 6

Detention Ponds 2 and 6 are located to the south of the existing landfill and will remain in place for the life of the facility. There are no proposed modifications to either Pond 2 or Pond 6 as part of the Phase II Expansion.

Detention Pond 9

Detention Pond 9 is located in the eastern watershed, east of the permitted wood waste handling areas, and receives stormwater flow from the wood waste handling area, the maintenance/administrative building and parking area, the landfill gas treatment facility, the RNG processing facility, and the construction material laydown/soil stockpile areas. There are no proposed modifications to Pond 9 as a result of the Phase II Expansion.

Detention Pond 10

Detention Pond 10 is located in the eastern watershed. There are no proposed modifications to the detention pond as part of the Phase II Expansion.

Detention Pond 11

Detention Pond 11 is in the eastern watershed and within the footprint of future Cell 18. This detention pond will be replaced with Detention Pond 11R as part of Cell 18 Construction.

4.2 Proposed Drainage Facilities

Proposed drainage facilities used to manage stormwater associated with the Phase II Expansion will include grass-lined and riprap-lined channels, catch basins, culverts, storm drains, detention ponds, riprap aprons, riprap plunge pools, and level spreaders.

Stormwater runoff from the developed areas of the Phase II Expansion will be conveyed by a series of drainage structures including channels, catch basins, and culverts as summarized on Table 4-1. Locations of the proposed permanent channels, catch basins, and culverts are shown on Drawing C-109 included in Appendix A. The post-development stormwater analysis, provided in Drawing D-101 in Appendix A, shows the drainage area for each of the above-mentioned structures. A printout of the post-development stormwater analysis is included in Appendix B of the Phase II Expansion Stormwater Management Plan. These structures were sized to handle the peak flows from the 25-year/24-hour rainfall event.

TABLE 4-1

SUMMARY OF STORMWATER STORM DRAINS, CATCH BASINS, AND CHANNELS

Culverts	Diameter (in.)	Material	Length (ft.)	Slope (%)	Inv. In.	Inv. Out
P-1G	24	HDPE	36	0.13	335.5	331
P-1H	24(2)	CMP	56	0.017	183	182
P-1I	24	HDPE	38	0.12	290.5	286
P-1J-1	24(2)	HDPE	37	0.01	190	189.6
P-1J-2	18	HDPE	40	0.02	186.8	186
P-1K	24	HDPE	33	0.075	254.5	252
1P	24(2)	HDPE	76	0.013	206	205
12P	24(2)	HDPE	98	0.025	197.9	195.5
15P	12	HDPE	121	0.06	197.4	189.9
C-2B	24	HDPE	90	0.01	173	172
C-2E	24	HDPE	80	0.01	173	172
C-2D	24	HDPE	30	0.02	192	191.5
C-4C	24	HDPE	52	0.009	167	166.5
C-4D	24	HDPE	54.5	0.009	158	157.5
C-4G	24	HDPE	115	0.008	161	160
C-4H	24	HDPE	65	0.03	174	172
C-4IA	24	HDPE	40	0.023	213	212.2
C-4JA	18	HDPE	56	0.01	213	212.2
C-4JA3	24	HDPE	60	0.02	204.9	204
C-4JC	24	HDPE	73	0.021	211.5	210
C-4K	24	HDPE	51	0.043	216.5	214.3
C-4L	18	HDPE	121	0.017	213	211
C-4N	18	HDPE	33	0.03	184	183

Catch Basin	Basin Dia. (ft)	Grate Opening (in.)	Depth (ft)	Dia. (in.)
CB-2B	4	30	8	24
CB-2E	4	30	8	24
CB-2D	4	30	11	24
CB-4C	4	30	6	24
CB-4D	4	30	4.5	24
CB-4G	4	30	8	24
CB-4H	4	30	9	24
CB-4I	4	30	9.6	24
CB-4JA	4	30	7	18
CB-4JA3	4	30	10	24
CB-4K	4	30	4.5	24
CB-4L	4	24	4	18

Channels	Base Width (ft.)	Depth (ft.)	Sideslope Z-Value ('/')	Lining
Detention Pond 11R Emergency Spillway	10	2	2	Riprap (D50=6", t=12")
Perimeter (toe) PH II	3'	3'	2 '/'	Riprap (D50=10", t=22")
Terrace Drain	0' - V-ditch	1.5’	2 '/'	NAG C125BN erosion mat
Downspouts	4'	2'	2 '/'	Riprap (D50=12" and t=24”)

Notes:
1 Existing culverts and storm drains to remain for Post-Development condition.
2 Location of structures shown on Drawing C-109 contained in Appendix D.

Peak flows to each of the stormwater drainage structures was based on SCS TR20 methodology. Culverts and catch basins were sized using *HydroCAD* computer stormwater modeling system by Applied Microcomputer Systems of Chocorua, New Hampshire. Ditches were sized using the *Hydraulic Design Series No. 4, Design of Roadside Drainage Channels*. Channel linings and culvert inlet/outlet protection was designed using SCS guidance found in the *Maine Erosion and Sediment Control Best Management Practices (BMPs)* (SCS, 10/2016). These calculations are attached in Appendix B. Calculations for the proposed pond level spreaders, plunge pools, and emergency spillways are included in the Phase II Expansion Stormwater Management Plan.

Proposed culverts will be corrugated polyethylene pipe (CPE) with smooth interior and have diameters of 24 inches. The culverts were designed with riprap inlet aprons and riprap-lined aprons or plunge pools at their perimeter outlet. Riprap for culvert inlet and outlet protection has a D_{50} rating (i.e., 50 percent of riprap) that ranges from 4 to 10 inches. Culvert outflows will be routed through level spreaders to limit the potential for erosion.

The Phase II Expansion perimeter drainage channels will be riprap-lined channels (D_{50} of 10 inches) with a minimum base width of 3 feet, depth of 3 feet, and sideslopes of 2 horizontal to 1 vertical (2H:1V).

Riprap downspouts on the landfill cover will be lined with riprap (D_{50} of 12 inches) and have a base width of 4 feet, depth of two feet, and maximum sideslopes of 2H:1V. Riprap downspout sizing was based on the maximum longitudinal slope. Riprap downspouts were uniformly sized for capacity based on the largest contributing drainage area and riprap size based on contributing area and slope.

Surface terrace channels on the sideslopes of the landfill cover will be grass-lined 'v'-channels with a depth of 1.5 feet, longitudinal pitch of 7 percent (typical), and maximum sideslopes of 2H:1V. Surface terrace channel linings were uniformly sized based on the largest contributing drainage area and maximum expected slope.

HYDRAIN 6.01 (1996), Integrated Drainage Design Computer System, from the Federal Highway Administration (FHWA) was used to evaluate size of the riprap for downspouts and channels.

Erosion Control Materials Design Software (ECMDS) Version 4.2 (2002) from the North American Green Co. (N.A.G.) was used to evaluate temporary erosion matting for grass-lined and vegetated channels.

The HYCHL Module of the FHWA HYDRAIN 6.01 software and the ECMDS software are designed to provide recommendations for effective temporary and permanent erosion protection of stormwater ditches and channels conveying intermittent, concentrated, uniform water flows. The channel lining analysis and performance evaluations are conducted using the maximum shear stress (tractive force) method as outlined in the Federal Highway Administration's HEC-15. The stability check for channel lining materials

is based on its capability to physically survive and effectively control soil loss on the channel surface under the calculated shear stresses for a specified flow period.

The proposed detention ponds for the Phase II Expansion (Detention Ponds 11R, 12, 13, and 14) were designed to provide flow control and sedimentation during construction. Proposed Detention Ponds 11R, 12, 13, and 14 will each have a composite outlet structure consisting of a 4-foot-diameter drop inlet with side-mounted orifices which will discharge to a 24-inch-diameter HDPE outlet culvert. Each outlet culvert will have anti-seep collars to minimize "piping" of water along the outside of the outlet pipe. Each culvert outlet discharges to a riprap-lined plunge pool. From this plunge pool, stormwater discharges will flow to level spreaders that discharge to the adjacent wooded buffer areas. Plunge pools and level spreaders were designed to meet the requirements of *Maine Erosion and Sediment Control BMPs* (SCS 10/2016). Detention Ponds 11R, 12, 13, and 14 will have a riprap-lined channel emergency spillway designed to pass the 100-year/24-hour storm event with at least one foot of freeboard.

Each detention pond will include an underdrain installed in the bottom of the pond that is independently routed to the pond's exterior. This underdrain system will allow the pond to drain completely during dry times of the year.

Design calculations for the ponds, including riprap plunge pools, level spreaders, anti-seep collars, and emergency spillways, are included in the Phase II Expansion Stormwater Management Plan.

5.0 TIMING AND SEQUENCE OF LAND DISTURBANCE ACTIVITIES

The proposed timing and sequence of land disturbance activities associated with the Phase II Expansion construction activities (cell construction, cover construction, etc.) be as follows:

- Submittal of a notice of intent to comply, Maine Construction General Permit at least 14 calendar days prior to project start;
- Install silt fence and other temporary erosion control measures for the construction activities and accessory facilities such as stormwater pumping systems, detention ponds, berms, and service roads;
- Clear and grub area (if necessary);
- Construct upslope stormwater diversion berms, ditches, culvert outlets, and outlet control structures (if necessary);
- Construct service road(s) (if necessary);
- Perform construction activities;
- As permanent erosion control measures become stabilized, remove temporary measures (e.g., silt fence, stone check dams); and
- Submittal of Maine Construction General Permit notice of termination, after project completion and permanent control measures have been established.

Site construction activities will follow the landfill construction drawings and specifications that will contain detailed requirements for erosion and sedimentation control. These requirements are as discussed in Section 6.0 of this plan.

6.0 EROSION CONTROL MEASURES

To minimize erosion during Phase II Expansion cell construction, operations, and cover placement, temporary and permanent erosion control measures will be implemented. Temporary measures (e.g., silt fences, temporary seeding, mulching, and stone check dams) and permanent measures (e.g., downspouts, detention basins, permanent seeding, mulching, and culvert inlet and outlet protection) will be monitored on a regular basis. The Contractor and/or landfill operator (whichever entity is performing the construction activity) will ensure that structures are functioning properly and will perform necessary maintenance as required. Construction project technical specifications will contain an erosion and sedimentation control section. A typical specification that will be used on the project is contained in Appendix C.

6.1 Temporary Erosion Control

Temporary erosion control measures will be implemented during the Phase II Expansion cell construction, operation, and cover placement. The greatest potential for erosion to occur is during grubbing and grading operations. This is when stumps and topsoil are removed from the site, the base grades prepared, and perimeter dikes constructed. Before beginning the grubbing phase, or any other project that requires erosion control measures, a siltation fence will be placed and stone check dams will be installed in surface water drainage channels, as necessary. Once the perimeter dikes, culverts, channels, and roadway embankments are completed, they will be mulched and seeded within seven days of final grading. Areas that are disturbed and cannot be completed for periods of more than 14 days will receive temporary seeding. The seeding specifications are included on Table 6-1.

6.2 Permanent Erosion Control

Permanent erosion control measures will be implemented during the Phase II Expansion cell construction, operation, and cover placement. During landfill operations, stormwater falling within the open area of the landfill cell will be collected internally and treated as leachate. Surface water within the active cell will be collected internally within the cells and directed to the cell's leachate sump.

Upon reaching final grade, topsoil, seed, lime, fertilizer, and mulch will be applied to disturbed areas in accordance with the seeding specifications listed in Table 6-1.

TABLE 6-1

SEEDING SPECIFICATIONS

Seed Type	Permanent Seeding (120 lbs/acre)	Temorary Seeding (120 lbs/acre)
Tall Fescue	54	Winter Rye
Creeping Red Fescue	25	
Red Top	5	
White Clover (Ladino)	13	
Annual Ryegrass	8	
Birdsfoot Trefoil	5	
Timothy	10	
Fertilizer: Apply 1,300 pounds per acre of 10-10-10 fertilizer or equivalent per acre (29.8 lbs/1,000 sq. ft). Lime: Apply liquid limestone at a rate of 3 tons per acre (138-lbs/1,000 sq. ft.). Mulch: Mulch with weed-free hay or straw at 2.0 – 3.0 tons per acre with tack or 4,000 lb/acre fiber mulch. Tackifier: Use engineer approved non-asphaltic tackifier at rates specified by manufacturer or 4,000 lbs/acre of fiber mulch		

Permanent seeding operations typically occur between April 26 and August 31, at which time the soil shall be protected with mulch consisting of either hay or straw, a temporary seed mixture, and an erosion control blanket, as necessary in accordance with the Maine Erosion and Sediment Control BMPs. The mulch may be required to be secured with either netting or twine. Seeding operations shall be done on 100-by-100-foot blocks. Problem areas and continually eroding areas shall be repaired immediately and, in these areas, temporary erosion control blankets shall be used. The blankets shall conform and be installed in accordance with the manufacturer's recommendations. Silt fence shall also be installed at the toe of slopes of greater than 100 feet in length. Ditches constructed to convey water off the intermediate cover shall be protected with stone check dams. Details of erosion control fencing, stone check dams and other erosion control measures are shown on the typical erosion control drawing included in Appendix C. The detention ponds and drainage channels shall be cleaned and repaired, as necessary.

6.3 Standard Erosion Control Procedures

In addition to the measures listed in the section above, the following erosion control procedures will be implemented during the Phase II Expansion cell construction, cover placement, and operations:

- Soil erosion and sedimentation control measures will be performed in accordance with procedures outlined in the Maine Erosion and Sediment Control Best Management Practices (BMPs) (2016).
- The removal of trees, brush, and other vegetation, as well as disturbance of soil, will be kept to a minimum during site development.

- Usable topsoil will be stripped and stockpiled for reuse. Excess topsoil will be removed from the project site and disposed of or reused in an approved manner. Topsoil needed for on-site reuse will be stockpiled on-site within the permitted till borrow pit area for use in final grading. Topsoil will be stockpiled such that natural drainage is not obstructed and no off-site sedimentation will result. Sideslopes of the stockpiled topsoil will not exceed 2 horizontal to 1 vertical (2H:1V), and the stockpile will be surrounded with a siltation fence if needed to control sediment runoff. Soil Stockpiles shall be temporarily mulched as necessary, in accordance with the Maine Erosion and Sediment Control BMPs if seeding cannot be done within the recommended seeding dates.
- The site will be brought to approximate finish grades and stabilized without extended delays. This includes the application of mulch to surfaces designated for revegetation and placement of riprap where shown. Erosion and sedimentation control measures, such as bark mulch sediment barriers, stone check dams, and siltation fences, will be installed as shown, and/or adjusted to suit construction after a cut or fill slope has been created.
- The siltation fences and/or sediment barriers will be inspected after each rainfall that exceeds one (1) inch in 24 hours and at least daily during prolonged rainfall. Required repairs will be made. Sediment deposits will be removed periodically from the upstream side of the silt barriers and will be spread and stabilized in site areas not subject to erosion. The siltation fences will be replaced, as necessary, to provide proper filtering action.
- Riprap required at culverts will consist of fieldstone or rough unhewn quarry stone of approximately rectangular shape. Stones will be of a size as noted on the Construction Drawings.
- Following final grading, all graded or disturbed areas, not to be used as gravel roadways, parking areas or landfill structures, will be spread with a minimum compacted depth of four (4) inches of vegetative soil and seeded to provide a permanent vegetative cover.
- All areas receiving vegetative soil will be seeded. Permanent seeding will normally occur between April 26 and August 31. For winter construction, permanent seeding will occur after April 26 the following spring. Surface water runoff control measures (e.g., drainage ditches, berms, and culverts) will be constructed before seeding; all grading also will be performed before seeding. The top layer of soil will be loosened by tracking, raking, discing, or other acceptable means before seeding. Application rates for the lime, fertilizer, seed, and mulch are as presented in Table 6-1. The seed will be applied uniformly with a hydroseeder, drill, or cultipack seeder. Seed will not be planted if there is danger of frost shortly after seed germination. Maximum seeding depth is one-quarter-inch when using methods other than hydroseeding.
- Wood fiber, cellulose mulch or hay mulch will be spread uniformly upon completion of the seedbed preparation, liming, fertilization, and seeding. The mulch may be anchored in-place by uniformly applying an acceptable mulch binder such as Geltac or Terratac. During winter construction and on sideslopes greater than 5H:1V, hay mulch shall be anchored with mulch netting.

- If germination is unsuccessful (i.e., less than 90 percent catch) or there is unsatisfactory growth in the next year, the area will be reseeded in accordance with seeding specifications described herein.

6.4 Additional Erosion Control Procedures (Project Specific)

Expansion-related construction projects that include a disturbed area of greater than one acre will be required to obtain a Construction General Permit (CGP) that requires creation of a project-specific Stormwater Pollution Prevention Plan (SWPPP). The CGP SWPPP will contain a site plan; provide project-specific erosion and sedimentation controls; and include inspection, maintenance, and housekeeping requirements. In the case of large construction activities (greater than 5 acres of disturbed area), the SWPPP will also include a construction sequence, setbacks, temporary sedimentation basins (if necessary), stump dumps (if applicable), minimum required on-site mulch storage, soil testing requirements, identify elevated erosion risk subcatchments, require a MEDEP-certified contractor perform the work, require inspection and documentation by MEDEP Certified Erosion Control Inspector, and provide calculations supporting design of the items listed in the sections above. A project-specific CGP SWPPP will be created and submitted with the CGP prior to each individual phase of development.

7.0 MAINTENANCE

7.1 Routine Maintenance

Inspection shall be performed annually by a qualified person during wet weather to ensure that the stormwater control structures and the erosion and sediment control systems perform as intended. Inspection priorities shall include checking erosion controls for accumulation of sediments, functioning of inlet/outlet structures of the ponds, and the integrity of the ponds' earthen berms.

Maintenance of the detention ponds will be an ongoing process, consisting of routine inspections of the inlet structures, containment dikes, and outlet structures. Periodically (every two years), sediment will be removed from the ponds and deposited within the limits of the landfill where future erosion of the sediment is unlikely.

7.2 Grassed Areas

Routine maintenance of grassed areas shall consist of:

- Applying lime according to a soil test as necessary; and
- Topdressing with fertilizer in the early spring (before May 15) one year after planting, with a balanced fertilizer, applying 50 pounds of nitrogen/acre (500 pounds of 10-20-20 per acre).

8.0 INSPECTIONS

Inspections will be undertaken by the Landfill Operator or a qualified person to assure that temporary and permanent erosion and sedimentation controls are properly installed and correctly functioning, and that additional erosion control measures are installed if needed. Such inspections will occur bi-weekly and after each significant rainfall event (1 inch or more within a 24-hour period) during construction until permanent erosion control measures have been properly installed and the site is stabilized.

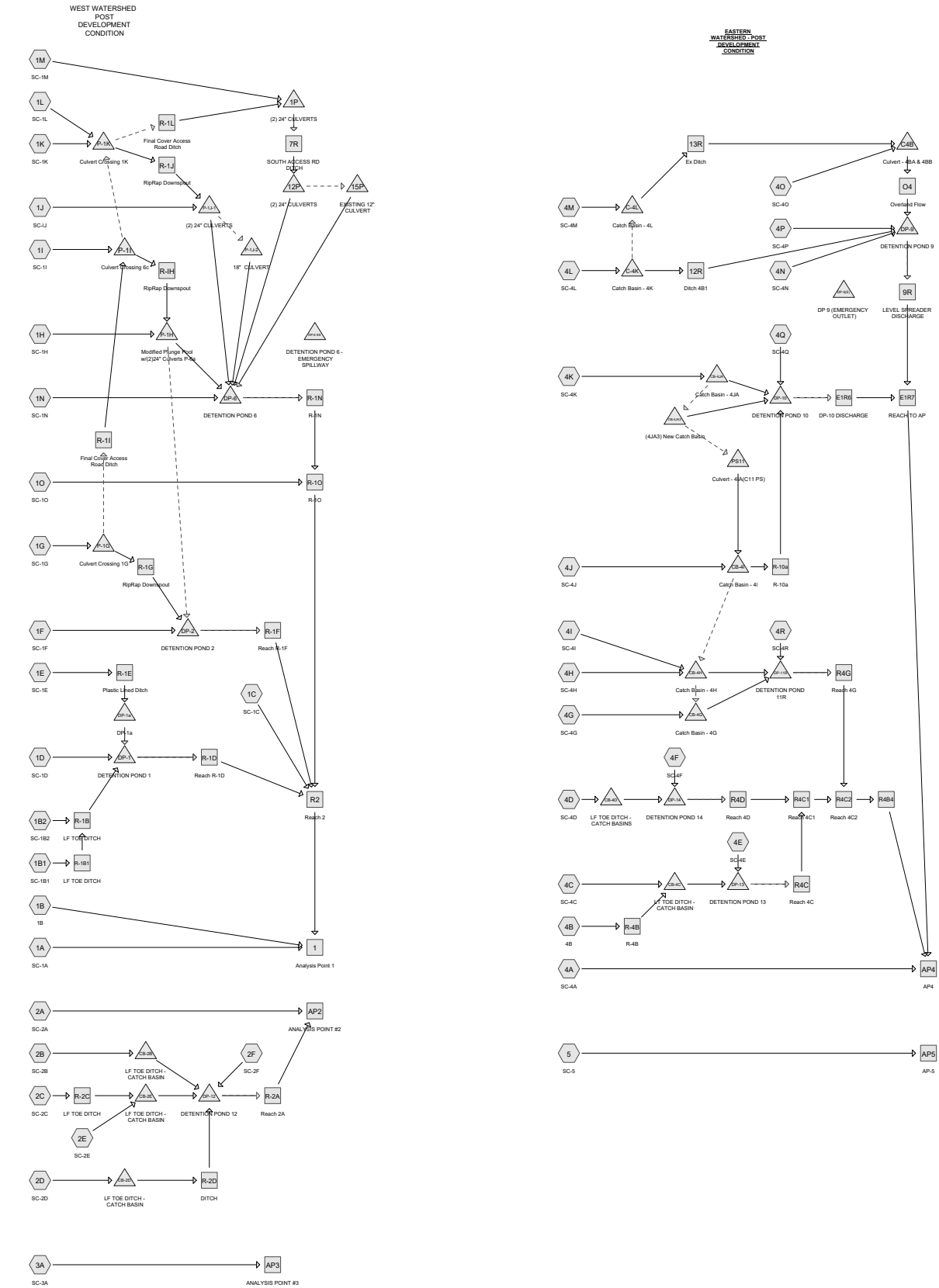
9.0 CONCLUSION

The Phase II Expansion is located on soils suitable for landfill development, and that will not cause unreasonable sedimentation or erosion of soil if constructed, inspected, and maintained in accordance with this plan.

APPENDIX A

POST-DEVELOPMENT STORMWATER ANALYSIS DRAWING D-101 AND FINAL SITE DRAINAGE PLAN DRAWING C-109

SME
SEVEE & MAHER
ENGINEERS



Routing Diagram for Post-Development_20250312

Prepared by Sevee & Maher Engineers, Printed 5/29/2025

HydroCAD® 10.20-7a s/n 01260 © 2025 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr Storm	Type II 24-hr		Default	24.00	1	2.70	2
2	10-yr Storm	Type II 24-hr		Default	24.00	1	3.90	2
3	25-yr Storm	Type II 24-hr		Default	24.00	1	4.90	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.393	79	50-75% Grass cover, Fair, HSG C (4Q)
14.519	74	>75% Grass cover, Good, HSG C (2F, 4N, 4O, 4P, 4Q, 4R)
1.074	70	Brush, Fair, HSG C (4O)
0.338	98	Building/Concrete Slabs (4N)
3.930	98	Existing Waterbody (2A, 3A)
0.032	91	Fallow, bare soil, HSG C, rip rap (1H)
6.452	91	Gravel (1F, 1J, 4A, 4N, 4P)
2.122	96	Gravel Surface (1A, 1C, 1D, 1E, 1G, 1N, 1O)
2.329	89	Gravel roads, HSG C (1K, 1L, 4A, 4O, 4P)
2.879	98	Impervious Surface (1A, 1O, 4A, 4O)
168.865	71	Landfill Final Cover (1B, 1B2, 1D, 1E, 1F, 1G, 1I, 1J, 1K, 1L, 1M, 2B, 2C, 2D, 2E, 4B, 4C, 4D, 4G, 4H, 4I, 4J, 4K, 4L, 4M)
17.694	78	Meadow HSG D (1A, 1C, 1N, 1O)
50.348	71	Meadow, non-grazed, HSG C (1A, 1B1, 1C, 1H, 1O, 2A, 3A, 4A, 4E, 4F, 4N)
5.359	98	Paved Area (1O, 2A, 3A, 4A, 4N, 4O, 4P)
0.283	92	Paved roads w/open ditches, 50% imp, HSG C (1M)
2.758	93	Paved roads w/open ditches, 50% imp, HSG D (2F, 4Q, 4R, 5)
3.819	98	Pond (1N, 4P, 4Q)
0.800	78	Pond, Meadow HSG D (1D)
5.663	98	Riprap (1B1, 1B2, 1D, 1E, 1I, 1K, 2B, 2C, 2D, 2E, 4B, 4C, 4D, 4G, 4H, 4I, 4J, 4K, 4L, 4M)
0.007	98	Roofs, HSG C (1F)
255.568	70	Woods, Good, HSG C (1A, 1C, 1N, 1O, 2A, 3A, 4A, 5)
307.674	77	Woods, Good, HSG D (1A, 1C, 1O, 2A, 3A, 4A, 5)
855.906	**74**	**TOTAL AREA**

Summary for Subcatchment 1A: SC-1A

Runoff = 5.44 cfs @ 13.15 hrs, Volume= 1.359 af, Depth= 0.72"
Routed to Reach 1 : Analysis Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	11.084	70	Woods, Good, HSG C
*	7.750	77	Woods, Good, HSG D
*	1.540	71	Meadow, non-grazed, HSG C
*	1.760	78	Meadow HSG D
*	0.070	96	Gravel Surface
*	0.330	98	Impervious Surface
	22.534	74	Weighted Average
	22.204		98.54% Pervious Area
	0.330		1.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	150	0.0200	0.04		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
20.4	1,840		1.50		**Direct Entry, Segment ID: B-C**
16.4	260		0.26		**Direct Entry, Segment ID: C-D**
93.1	2,250	Total			

Summary for Subcatchment 1B: 1B

Runoff = 0.39 cfs @ 11.94 hrs, Volume= 0.017 af, Depth= 0.59"
Routed to Reach 1 : Analysis Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	0.344	71	Landfill Final Cover
	0.344		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, Segement A-B**

Summary for Subcatchment 1B1: SC-1B1

Runoff = 6.76 cfs @ 12.06 hrs, Volume= 0.451 af, Depth= 0.64"
Routed to Reach R-1B1 : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	8.111	71	Meadow, non-grazed, HSG C
*	0.400	98	Riprap
	8.511	72	Weighted Average
	8.111		95.30% Pervious Area
	0.400		4.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	140	0.1000	4.74		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.4	240	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	482	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.8	1,012	Total			

Summary for Subcatchment 1B2: SC-1B2

Runoff = 8.63 cfs @ 12.07 hrs, Volume= 0.583 af, Depth= 0.64"
Routed to Reach R-1B : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	10.600	71	Landfill Final Cover
*	0.403	98	Riprap
	11.003	72	Weighted Average
	10.600		96.34% Pervious Area
	0.403		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.6	75	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	403	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	554	0.3300	19.66	314.62	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.050 Mountain streams w/large boulders
13.1	1,182	Total			

Summary for Subcatchment 1C: SC-1C

Runoff = 4.26 cfs @ 12.90 hrs, Volume= 0.872 af, Depth= 0.82"
Routed to Reach R2 : Reach 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	6.100	77	Woods, Good, HSG D
*	0.690	70	Woods, Good, HSG C
*	3.100	78	Meadow HSG D
*	2.580	71	Meadow, non-grazed, HSG C
*	0.310	96	Gravel Surface
	12.780	76	Weighted Average
	12.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.7	200	0.0350	0.06		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
1.6	170	0.0133	1.73		**Shallow Concentrated Flow, Segment ID: B-C** Grassed Waterway Kv= 15.0 fps
16.7					**Direct Entry, Segment ID: C-D**
75.0	370	Total			

Summary for Subcatchment 1D: SC-1D

Runoff = 9.74 cfs @ 12.06 hrs, Volume= 0.647 af, Depth= 0.64"
Routed to Pond DP-1 : DETENTION POND 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	11.000	71	Landfill Final Cover
*	0.110	96	Gravel Surface
*	0.800	78	Pond, Meadow HSG D
*	0.300	98	Riprap
	12.210	72	Weighted Average
	11.910		97.54% Pervious Area
	0.300		2.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
0.8	110	0.1000	2.21		**Shallow Concentrated Flow, Segment ID: B-C** Short Grass Pasture Kv= 7.0 fps
0.3	241	0.0700	12.78	172.52	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.025
0.3	556	0.3300	28.09	449.46	**Trap/Vee/Rect Channel Flow, Segment ID: D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.035
12.7	1,057	Total			

Summary for Subcatchment 1E: SC-1E

Runoff = 7.89 cfs @ 12.05 hrs, Volume= 0.508 af, Depth= 0.64"
Routed to Reach R-1E : Plastic Lined Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	9.100	71	Landfill Final Cover
*	0.200	96	Gravel Surface
*	0.280	98	Riprap
	9.580	72	Weighted Average
	9.300		97.08% Pervious Area
	0.280		2.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	146	0.1000	0.22		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	296	0.0700	16.72	200.67	**Trap/Vee/Rect Channel Flow, Segment ID: B-C** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.025
0.3	537	0.3300	28.09	449.46	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.035
0.3	186	0.0700	10.28	57.82	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=0.00' D=1.50' Z= 3.0 & 2.0 '/' Top.W=7.50' n= 0.030 Earth, grassed & winding
11.9	1,165	Total			

Summary for Subcatchment 1F: SC-1F

Runoff = 8.89 cfs @ 11.97 hrs, Volume= 0.429 af, Depth= 0.64"
Routed to Pond DP-2 : DETENTION POND 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	7.747	71	Landfill Final Cover
*	0.349	91	Gravel
	0.007	98	Roofs, HSG C
	8.103	72	Weighted Average
	8.096		99.91% Pervious Area
	0.007		0.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	100	0.3800	0.51		**Sheet Flow, Segment A-B** Grass: Short n= 0.150 P2= 2.70"
1.2	293	0.0700	3.97		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.2	300	0.3800	29.77	669.83	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.50' Z= 2.0 '/' Top.W=14.00' n= 0.040 Earth, cobble bottom, clean sides
4.7	693	Total			

Summary for Subcatchment 1G: SC-1G

Runoff = 1.55 cfs @ 12.06 hrs, Volume= 0.100 af, Depth= 0.68"
Routed to Pond P-1G : Culvert Crossing 1G

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	1.625	71	Landfill Final Cover
*	0.147	96	Gravel Surface
	1.772	73	Weighted Average
	1.772		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.9	142	0.1500	2.71		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.3	154	0.0700	8.95	60.43	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.035 Earth, dense weeds

12.5 446 Total

Summary for Subcatchment 1H: SC-1H

Runoff = 3.09 cfs @ 11.95 hrs, Volume= 0.138 af, Depth= 0.59"
Routed to Pond P-1H : Modified Plunge Pool w/(2)24" Culverts P-6a

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	0.032	91	Fallow, bare soil, HSG C, rip rap
	2.759	71	Meadow, non-grazed, HSG C
	2.791	71	Weighted Average
	2.791		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	66	0.3900	0.47		**Sheet Flow, Segment A-B** Grass: Short n= 0.150 P2= 2.70"
0.3	140	0.0800	9.12	27.13	**Trap/Vee/Rect Channel Flow, Segment B-C** Bot.W=0.00' D=1.15' Z= 2.5 & 2.0 '/' Top.W=5.17' n= 0.030 Earth, grassed & winding
0.2	190	0.1430	16.62	49.46	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.15' Z= 2.5 & 2.0 '/' Top.W=5.17' n= 0.022 Earth, clean & straight
2.8	396	Total			

Summary for Subcatchment 1I: SC-1I

Runoff = 3.66 cfs @ 12.02 hrs, Volume= 0.207 af, Depth= 0.64"
Routed to Pond P-1I : Culvert Crossing 6c

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	3.829	71	Landfill Final Cover
*	0.077	98	Riprap
	3.906	72	Weighted Average
	3.829		98.03% Pervious Area
	0.077		1.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	150	0.1000	0.32		**Sheet Flow, Segment AB** Grass: Short n= 0.150 P2= 2.70"
0.4	106	0.1000	4.74		**Shallow Concentrated Flow, Segment BC** Grassed Waterway Kv= 15.0 fps
0.4	260	0.0700	10.44	70.50	**Trap/Vee/Rect Channel Flow, Segment C - D** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.030 Earth, grassed & winding
0.1	140	0.3300	39.33	629.24	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.025 Rubble masonry, cemented
8.7	656	Total			

Summary for Subcatchment 1J: SC-IJ

Runoff = 2.13 cfs @ 11.95 hrs, Volume= 0.096 af, Depth= 0.64"
Routed to Pond P-1J-1 : (2) 24" CULVERTS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	1.763	71	Landfill Final Cover
*	0.046	91	Gravel
	1.809	72	Weighted Average
	1.809		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	67	0.5000	0.52		**Sheet Flow, SEGMENT AB** Grass: Short n= 0.150 P2= 2.70"
0.8	325	0.1900	6.54		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.4	325	0.0300	12.44	149.28	**Trap/Vee/Rect Channel Flow, C-D** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
3.3	717	Total			

Summary for Subcatchment 1K: SC-1K

Runoff = 3.34 cfs @ 11.95 hrs, Volume= 0.148 af, Depth= 0.68"
Routed to Pond P-1K : Culvert Crossing 1K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	2.350	71	Landfill Final Cover
	0.163	89	Gravel roads, HSG C
*	0.111	98	Riprap
	2.624	73	Weighted Average
	2.513		95.77% Pervious Area
	0.111		4.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	68	0.3300	0.44		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 2.70"
0.4	93	0.0700	3.97		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.3	249	0.3300	12.60	201.68	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.078 Riprap, 12-inch
3.3	410	Total			

Summary for Subcatchment 1L: SC-1L

Runoff = 1.95 cfs @ 11.95 hrs, Volume= 0.089 af, Depth= 0.64"
Routed to Pond P-1K : Culvert Crossing 1K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	1.607	71	Landfill Final Cover
	0.064	89	Gravel roads, HSG C
	1.671	72	Weighted Average
	1.671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	67	0.4000	0.48		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
1.2	442	0.1000	6.15	49.59	**Trap/Vee/Rect Channel Flow, B-C** Bot.W=2.00' D=1.50' Z= 2.0 & 2.5 '/' Top.W=8.75' n= 0.069 Riprap, 6-inch
3.5	509	Total			

Summary for Subcatchment 1M: SC-1M

Runoff = 4.52 cfs @ 12.06 hrs, Volume= 0.299 af, Depth= 0.64"
Routed to Pond 1P : (2) 24" CULVERTS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	5.368	71	Landfill Final Cover
	0.283	92	Paved roads w/open ditches, 50% imp, HSG C
	5.651	72	Weighted Average
	5.509		97.50% Pervious Area
	0.141		2.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	73	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.3	174	0.0700	11.06	265.40	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=2.00' Z= 2.0 & 10.0 '/' Top.W=24.00' n= 0.035 Earth, dense weeds
0.5	413	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.6	810	Total			

Summary for Subcatchment 1N: SC-1N

Runoff = 7.05 cfs @ 12.30 hrs, Volume= 0.754 af, Depth= 1.03"
Routed to Pond DP-6 : DETENTION POND 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	2.942	70	Woods, Good, HSG C
*	3.662	78	Meadow HSG D
*	0.572	96	Gravel Surface
*	1.607	98	Pond
	8.783	80	Weighted Average
	7.176		81.70% Pervious Area
	1.607		18.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.8	100	0.0400	0.05		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
1.7	123	0.0569	1.19		**Shallow Concentrated Flow, Segment ID: B-C** Woodland Kv= 5.0 fps
0.5	370	0.0189	12.43	801.88	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=2.00' D=3.00' Z= 10.0 & 3.0 '/' Top.W=41.00' n= 0.022 Earth, clean & straight
33.0	593	Total			

Summary for Subcatchment 1O: SC-1O

Runoff = 17.81 cfs @ 12.39 hrs, Volume= 2.246 af, Depth= 0.87"
Routed to Reach R-1O : R-1O

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	13.230	77	Woods, Good, HSG D
*	5.712	70	Woods, Good, HSG C
*	9.172	78	Meadow HSG D
*	1.195	71	Meadow, non-grazed, HSG C
*	0.713	96	Gravel Surface
*	0.515	98	Impervious Surface
*	0.494	98	Paved Area
	31.031	77	Weighted Average
	30.022		96.75% Pervious Area
	1.009		3.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0100	0.07		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
15.1	1,875	0.0190	2.07		**Shallow Concentrated Flow, Segment BC** Grassed Waterway Kv= 15.0 fps
12.8	856	0.0500	1.12		**Shallow Concentrated Flow, Segment CD** Woodland Kv= 5.0 fps
39.7	2,781	Total			

Summary for Subcatchment 2A: SC-2A

Runoff = 8.33 cfs @ 13.94 hrs, Volume= 2.898 af, Depth= 0.72"
Routed to Reach AP2 : ANALYSIS POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	24.340	70	Woods, Good, HSG C
	15.830	77	Woods, Good, HSG D
*	5.898	71	Meadow, non-grazed, HSG C
*	0.380	98	Paved Area
	1.600	98	Existing Waterbody
	48.048	74	Weighted Average
	46.068		95.88% Pervious Area
	1.980		4.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
91.1	150	0.0060	0.03		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
42.6	534	0.0070	0.21		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
10.6	1,213		1.90		**Direct Entry, Segment C-D (STWC, 0.008)**
144.3	1,897	Total			

Summary for Subcatchment 2B: SC-2B

Runoff = 6.91 cfs @ 12.09 hrs, Volume= 0.493 af, Depth= 0.64"
Routed to Pond CB-2B : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	9.090	71	Landfill Final Cover
*	0.218	98	Riprap
	9.308	72	Weighted Average
	9.090		97.66% Pervious Area
	0.218		2.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.3	178	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	252	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	455	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
0.8	136	0.0100	3.00	81.02	**Trap/Vee/Rect Channel Flow, Segment E-F** Bot.W=3.00' D=3.00' Z= 2.0 '/' Top.W=15.00' n= 0.069 Riprap, 6-inch
14.4	1,171	Total			

Summary for Subcatchment 2C: SC-2C

Runoff = 7.41 cfs @ 12.08 hrs, Volume= 0.516 af, Depth= 0.64"
Routed to Reach R-2C : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	9.383	71	Landfill Final Cover
*	0.357	98	Riprap
	9.740	72	Weighted Average
	9.383		96.33% Pervious Area
	0.357		3.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.2	158	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.6	308	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	474	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.7	1,090	Total			

Summary for Subcatchment 2D: SC-2D

Runoff = 7.14 cfs @ 12.07 hrs, Volume= 0.493 af, Depth= 0.64"
Routed to Pond CB-2D : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	8.931	71	Landfill Final Cover
*	0.366	98	Riprap
	9.297	72	Weighted Average
	8.931		96.06% Pervious Area
	0.366		3.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.2	157	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	248	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	475	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.6	1,030	Total			

Summary for Subcatchment 2E: SC-2E

Runoff = 0.80 cfs @ 11.94 hrs, Volume= 0.035 af, Depth= 0.77"
Routed to Pond CB-2E : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	0.466	71	Landfill Final Cover
*	0.073	98	Riprap
	0.539	75	Weighted Average
	0.466		86.46% Pervious Area
	0.073		13.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 2F: SC-2F

Runoff = 4.93 cfs @ 11.94 hrs, Volume= 0.211 af, Depth= 0.97"
Routed to Pond DP-12 : DETENTION POND 12

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

Area (ac)	CN	Description
1.947	74	>75% Grass cover, Good, HSG C
0.655	93	Paved roads w/open ditches, 50% imp, HSG D
2.602	79	Weighted Average
2.274		87.41% Pervious Area
0.327		12.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 3A: SC-3A

Runoff = 29.28 cfs @ 15.25 hrs, Volume= 15.029 af, Depth= 0.68"
Routed to Reach AP3 : ANALYSIS POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	158.900	70	Woods, Good, HSG C
	102.800	77	Woods, Good, HSG D
	1.000	71	Meadow, non-grazed, HSG C
*	0.564	98	Paved Area
*	2.330	98	Existing Waterbody
	265.594	73	Weighted Average
	262.700		98.91% Pervious Area
	2.894		1.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	150	0.0200	0.04		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
105.2	1,116	0.0050	0.18		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
78.7	3,093		0.66		**Direct Entry, Segment C-D (STWC, 0.001)**
240.2	4,359	Total			

Summary for Subcatchment 4A: SC-4A

Runoff = 22.65 cfs @ 16.26 hrs, Volume= 14.143 af, Depth= 0.82"
Routed to Reach AP4 : AP4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	130.444	77	Woods, Good, HSG D
	44.640	70	Woods, Good, HSG C
*	23.410	71	Meadow, non-grazed, HSG C
*	3.300	98	Paved Area
*	2.520	91	Gravel
	1.000	89	Gravel roads, HSG C
*	2.000	98	Impervious Surface
	207.314	76	Weighted Average
	202.014		97.44% Pervious Area
	5.300		2.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
91.1	150	0.0060	0.03		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
200.8	1,905	0.0040	0.16		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
17.7	1,592		1.50		**Direct Entry, Segment C-D (STWC, 0.0031)**
7.9	760		1.60		**Direct Entry, Segment D-E (STWC, 0.005)**
6.7	963		2.40		**Direct Entry, Segment E-F (STWC, 0.0125)**
324.2	5,370	Total			

Summary for Subcatchment 4B: 4B

Runoff = 4.35 cfs @ 12.06 hrs, Volume= 0.278 af, Depth= 0.72"
Routed to Reach R-4B : R-4B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	4.150	71	Landfill Final Cover
*	0.452	98	Riprap
	4.602	74	Weighted Average
	4.150		90.18% Pervious Area
	0.452		9.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	32	0.0500	1.57		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	240	0.0700	8.81	49.56	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 3.0 '/' Top.W=7.50' n= 0.035 Earth, dense weeds
0.4	342	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.5	764	Total			

Summary for Subcatchment 4C: SC-4C

Runoff = 6.23 cfs @ 12.02 hrs, Volume= 0.353 af, Depth= 0.72"
Routed to Pond CB-4C : LT TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	0.566	98	Riprap
*	5.290	71	Landfill Final Cover
	5.856	74	Weighted Average
	5.290		90.33% Pervious Area
	0.566		9.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	101	0.1000	0.20		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.8	442	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment B-C** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 Earth, dense weeds
0.4	365	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
9.4	908	Total			

Summary for Subcatchment 4D: SC-4D

Runoff = 11.18 cfs @ 12.02 hrs, Volume= 0.641 af, Depth= 0.64"
Routed to Pond CB-4D : LF TOE DITCH - CATCH BASINS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	11.800	71	Landfill Final Cover
*	0.295	98	Riprap
	12.095	72	Weighted Average
	11.800		97.56% Pervious Area
	0.295		2.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	100	0.1000	0.20		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.2	117	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	504	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
9.0	721	Total			

Summary for Subcatchment 4E: SC-4E

Runoff = 1.09 cfs @ 11.95 hrs, Volume= 0.049 af, Depth= 0.59"
Routed to Pond DP-13 : DETENTION POND 13

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

Area (ac)	CN	Description
0.992	71	Meadow, non-grazed, HSG C
0.992		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	300		1.67		**Direct Entry, Segment A-B**

Summary for Subcatchment 4F: SC-4F

Runoff = 1.53 cfs @ 11.94 hrs, Volume= 0.068 af, Depth= 0.59"
Routed to Pond DP-14 : DETENTION POND 14

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

Area (ac)	CN	Description
1.366	71	Meadow, non-grazed, HSG C
1.366		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	500		4.17		**Direct Entry, Segment A-B**

Summary for Subcatchment 4G: SC-4G

Runoff = 8.57 cfs @ 12.08 hrs, Volume= 0.597 af, Depth= 0.64"
Routed to Pond CB-4G : Catch Basin - 4G

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	11.040	71	Landfill Final Cover
*	0.220	98	Riprap
	11.260	72	Weighted Average
	11.040		98.05% Pervious Area
	0.220		1.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.1	143	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	390	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	497	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.7	1,180	Total			

Summary for Subcatchment 4H: SC-4H

Runoff = 8.50 cfs @ 12.09 hrs, Volume= 0.617 af, Depth= 0.59"
Routed to Pond CB-4H : Catch Basin - 4H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	12.330	71	Landfill Final Cover
*	0.135	98	Riprap
	12.465	71	Weighted Average
	12.330		98.92% Pervious Area
	0.135		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	232	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	464	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	440	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.3	1,286	Total			

Summary for Subcatchment 4I: SC-4I

Runoff = 2.90 cfs @ 11.95 hrs, Volume= 0.130 af, Depth= 0.59"
Routed to Pond CB-4H : Catch Basin - 4H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	2.595	71	Landfill Final Cover
*	0.036	98	Riprap
	2.631	71	Weighted Average
	2.595		98.63% Pervious Area
	0.036		1.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, A-B**

Summary for Subcatchment 4J: SC-4J

Runoff = 9.80 cfs @ 12.08 hrs, Volume= 0.692 af, Depth= 0.64"
Routed to Pond CB-4I : Catch Basin - 4I

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	12.590	71	Landfill Final Cover
*	0.462	98	Riprap
	13.052	72	Weighted Average
	12.590		96.46% Pervious Area
	0.462		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	223	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	386	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.4	376	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.1	1,135	Total			

Summary for Subcatchment 4K: SC-4K

Runoff = 6.51 cfs @ 12.19 hrs, Volume= 0.618 af, Depth= 0.64"
Routed to Pond CB-4JA : Catch Basin - 4JA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	11.234	71	Landfill Final Cover
*	0.429	98	Riprap
	11.663	72	Weighted Average
	11.234		96.32% Pervious Area
	0.429		3.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
10.3	432	0.0100	0.70		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	432	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	392	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
22.9	1,406	Total			

Summary for Subcatchment 4L: SC-4L

Runoff = 10.40 cfs @ 12.10 hrs, Volume= 0.765 af, Depth= 0.64"
Routed to Pond C-4K : Catch Basin - 4K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	14.000	71	Landfill Final Cover
*	0.437	98	Riprap
	14.437	72	Weighted Average
	14.000		96.97% Pervious Area
	0.437		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
2.6	242	0.0500	1.57		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.9	476	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	406	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
15.3	1,274	Total			

Summary for Subcatchment 4M: SC-4M

Runoff = 0.88 cfs @ 11.93 hrs, Volume= 0.038 af, Depth= 0.68"
Routed to Pond C-4L : Catch Basin - 4L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	0.633	71	Landfill Final Cover
*	0.046	98	Riprap
	0.679	73	Weighted Average
	0.633		93.23% Pervious Area
	0.046		6.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 4N: SC-4N

Runoff = 6.78 cfs @ 12.13 hrs, Volume= 0.515 af, Depth= 1.03"
Routed to Pond DP-9 : DETENTION POND 9

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	2.512	74	>75% Grass cover, Good, HSG C
*	0.245	98	Paved Area
*	0.338	98	Building/Concrete Slabs
*	1.404	91	Gravel
	1.497	71	Meadow, non-grazed, HSG C
	5.996	80	Weighted Average
	5.413		90.28% Pervious Area
	0.583		9.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	61	0.0200	1.14		**Sheet Flow, Segment A-B** Smooth surfaces n= 0.011 P2= 2.70"
10.5	61	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.70"
7.9	955	0.0180	2.01		**Shallow Concentrated Flow, Grassed waterway** Grassed Waterway Kv= 15.0 fps
19.3	1,077	Total			

Summary for Subcatchment 4O: SC-4O

Runoff = 3.16 cfs @ 12.06 hrs, Volume= 0.197 af, Depth= 0.97"
Routed to Pond C4B : Culvert - 4BA & 4BB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	1.074	70	Brush, Fair, HSG C
*	0.034	98	Impervious Surface
	0.687	89	Gravel roads, HSG C
	0.387	74	>75% Grass cover, Good, HSG C
*	0.240	98	Paved Area
	2.422	79	Weighted Average
	2.148		88.69% Pervious Area
	0.274		11.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	24	0.0200	0.95		**Sheet Flow, Segment AB** Smooth surfaces n= 0.011 P2= 2.70"
0.8	19	0.5000	0.41		**Sheet Flow, Segment BC** Grass: Short n= 0.150 P2= 2.70"
11.9	584	0.0137	0.82		**Shallow Concentrated Flow, Segment CD** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0250	7.14	85.66	**Trap/Vee/Rect Channel Flow, Segment DE** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.035
13.2	667	Total			

Summary for Subcatchment 4P: SC-4P

Runoff = 7.66 cfs @ 12.29 hrs, Volume= 0.800 af, Depth= 1.48"
Routed to Pond DP-9 : DETENTION POND 9

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	0.415	89	Gravel roads, HSG C
*	2.133	91	Gravel
	2.304	74	>75% Grass cover, Good, HSG C
*	1.500	98	Pond
*	0.136	98	Paved Area
	6.488	87	Weighted Average
	4.852		74.78% Pervious Area
	1.636		25.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	125	0.0216	0.12		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	25	0.0520	0.78		**Sheet Flow, Segment B-C** n= 0.023 P2= 2.70"
2.0	270	0.0190	2.22		**Shallow Concentrated Flow, Segment C-D** Unpaved Kv= 16.1 fps
0.2	44	0.3300	4.02		**Shallow Concentrated Flow, Segment D-E** Short Grass Pasture Kv= 7.0 fps
2.0	102	0.0150	0.86		**Shallow Concentrated Flow, Segment E-F** Short Grass Pasture Kv= 7.0 fps
11.2	258	0.0030	0.38		**Shallow Concentrated Flow, Segment F-G** Short Grass Pasture Kv= 7.0 fps
33.9	824	Total			

Summary for Subcatchment 4Q: SC-4Q

Runoff = 16.86 cfs @ 11.99 hrs, Volume= 0.831 af, Depth= 0.97"
Routed to Pond DP-10 : DETENTION POND 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
	3.393	79	50-75% Grass cover, Fair, HSG C
	1.056	93	Paved roads w/open ditches, 50% imp, HSG D
*	0.712	98	Pond
	5.073	74	>75% Grass cover, Good, HSG C
	10.234	79	Weighted Average
	8.994		87.88% Pervious Area
	1.240		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	150	0.0500	0.59		**Sheet Flow, AB** Fallow n= 0.050 P2= 2.70"
0.2	85	0.1600	6.44		**Shallow Concentrated Flow, Segment BC** Unpaved Kv= 16.1 fps
2.5	625	0.0800	4.24		**Shallow Concentrated Flow, CD** Grassed Waterway Kv= 15.0 fps
6.9	860	Total			

Summary for Subcatchment 4R: SC-4R

Runoff = 4.24 cfs @ 12.04 hrs, Volume= 0.248 af, Depth= 0.97"
Routed to Pond DP-11R : DETENTION POND 11R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

Area (ac)	CN	Description
0.757	93	Paved roads w/open ditches, 50% imp, HSG D
2.296	74	>75% Grass cover, Good, HSG C
3.053	79	Weighted Average
2.674		87.60% Pervious Area
0.378		12.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	37	0.0200	1.04		**Sheet Flow, AB** Smooth surfaces n= 0.011 P2= 2.70"
0.4	215	0.3300	9.25		**Shallow Concentrated Flow, Segment BC** Unpaved Kv= 16.1 fps
10.4	338	0.0060	0.54		**Shallow Concentrated Flow, CD** Short Grass Pasture Kv= 7.0 fps
11.4	590	Total			

Summary for Subcatchment 5: SC-5

Runoff = 6.25 cfs @ 14.50 hrs, Volume= 2.665 af, Depth= 0.82"
Routed to Reach AP5 : AP-5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

Area (ac)	CN	Description
7.260	70	Woods, Good, HSG C
31.520	77	Woods, Good, HSG D
0.290	93	Paved roads w/open ditches, 50% imp, HSG D
39.070	76	Weighted Average
38.925		99.63% Pervious Area
0.145		0.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.9	150	0.0130	0.04		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
122.7	1,930	0.0110	0.26		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
2.5	275		1.80		**Direct Entry, Segment C-D (STWC, 0.007)**
192.1	2,355	Total			

Summary for Reach 1: Analysis Point 1

Inflow Area = 145.103 ac, 3.22% Impervious, Inflow Depth > 0.66" for 2-yr Storm event
Inflow = 26.41 cfs @ 12.90 hrs, Volume= 7.921 af
Outflow = 26.41 cfs @ 12.90 hrs, Volume= 7.921 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach 7R: SOUTH ACCESS RD DITCH

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 4.35 cfs @ 12.09 hrs, Volume= 0.299 af
Outflow = 4.21 cfs @ 12.12 hrs, Volume= 0.299 af, Atten= 3%, Lag= 1.7 min
Routed to Pond 12P : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.27 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 3.4 min

Peak Storage= 266 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 4.14'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 173.05 cfs

3.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 262.0' Slope= 0.0271 '/'
Inlet Invert= 205.00', Outlet Invert= 197.90'

Summary for Reach 9R: LEVEL SPREADER DISCHARGE

Inflow Area = 30.022 ac, 9.91% Impervious, Inflow Depth > 0.10" for 2-yr Storm event
Inflow = 0.05 cfs @ 24.71 hrs, Volume= 0.259 af
Outflow = 0.04 cfs @ 28.29 hrs, Volume= 0.254 af, Atten= 1%, Lag= 214.7 min
Routed to Reach E1R7 : REACH TO AP

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Max. Velocity= 0.05 fps, Min. Travel Time= 84.1 min
Avg. Velocity = 0.05 fps, Avg. Travel Time= 98.9 min

Peak Storage= 226 cf @ 26.89 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 20.81'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 11.46 cfs

20.00' x 1.00' deep channel, n= 0.800 Sheet flow: Woods+dense brush
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 273.0' Slope= 0.0623 '/'
Inlet Invert= 180.00', Outlet Invert= 163.00'

‡

Summary for Reach 12R: Ditch 4B1

Inflow Area = 14.437 ac, 3.03% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 10.52 cfs @ 12.10 hrs, Volume= 0.764 af
Outflow = 10.00 cfs @ 12.15 hrs, Volume= 0.764 af, Atten= 5%, Lag= 3.1 min
Routed to Pond DP-9 : DETENTION POND 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.53 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.30 fps, Avg. Travel Time= 4.5 min

Peak Storage= 1,019 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.80' , Surface Width= 5.21'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 70.02 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 352.0' Slope= 0.0085 '/'
Inlet Invert= 213.50', Outlet Invert= 210.50'

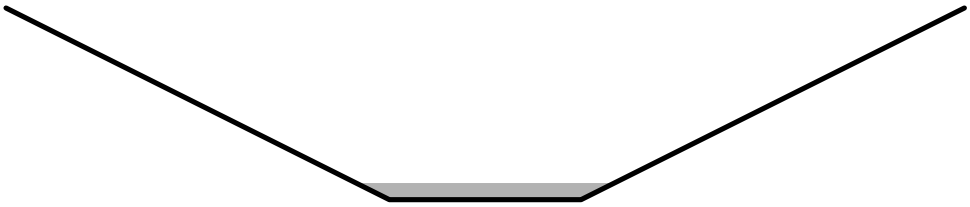
Summary for Reach 13R: Ex Ditch

Inflow Area = 0.679 ac, 6.77% Impervious, Inflow Depth = 0.18" for 2-yr Storm event
Inflow = 0.78 cfs @ 11.93 hrs, Volume= 0.010 af
Outflow = 0.67 cfs @ 11.99 hrs, Volume= 0.010 af, Atten= 14%, Lag= 3.5 min
Routed to Pond C4B : Culvert - 4BA & 4BB

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 5.5 min

Peak Storage= 91 cf @ 11.95 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 2.69'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 81.05 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 225.0' Slope= 0.0164 '/'
Inlet Invert= 209.70', Outlet Invert= 206.00'



Summary for Reach AP2: ANALYSIS POINT #2

Inflow Area = 79.534 ac, 4.18% Impervious, Inflow Depth = 0.70" for 2-yr Storm event
Inflow = 9.00 cfs @ 13.96 hrs, Volume= 4.639 af
Outflow = 9.00 cfs @ 13.96 hrs, Volume= 4.639 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP3: ANALYSIS POINT #3

Inflow Area = 265.594 ac, 1.09% Impervious, Inflow Depth = 0.68" for 2-yr Storm event
Inflow = 29.28 cfs @ 15.25 hrs, Volume= 15.029 af
Outflow = 29.28 cfs @ 15.25 hrs, Volume= 15.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP4: AP4

Inflow Area = 326.605 ac, 3.82% Impervious, Inflow Depth > 0.70" for 2-yr Storm event
Inflow = 23.89 cfs @ 16.55 hrs, Volume= 19.005 af
Outflow = 23.89 cfs @ 16.55 hrs, Volume= 19.005 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP5: AP-5

Inflow Area = 39.070 ac, 0.37% Impervious, Inflow Depth = 0.82" for 2-yr Storm event
Inflow = 6.25 cfs @ 14.50 hrs, Volume= 2.665 af
Outflow = 6.25 cfs @ 14.50 hrs, Volume= 2.665 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach E1R6: DP-10 DISCHARGE

Inflow Area = 34.949 ac, 6.10% Impervious, Inflow Depth > 0.56" for 2-yr Storm event
Inflow = 0.78 cfs @ 19.76 hrs, Volume= 1.643 af
Outflow = 0.78 cfs @ 19.94 hrs, Volume= 1.641 af, Atten= 0%, Lag= 10.5 min
Routed to Reach E1R7 : REACH TO AP

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.98 fps, Min. Travel Time= 6.1 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 9.0 min

Peak Storage= 283 cf @ 19.84 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 20.78'
Bank-Full Depth= 2.00' Flow Area= 80.0 sf, Capacity= 827.94 cfs

20.00' x 2.00' deep channel, n= 0.045
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 357.0' Slope= 0.0672 '/'
Inlet Invert= 178.00', Outlet Invert= 154.00'

‡

Summary for Reach E1R7: REACH TO AP

Inflow Area = 64.971 ac, 7.86% Impervious, Inflow Depth > 0.35" for 2-yr Storm event
Inflow = 0.78 cfs @ 20.01 hrs, Volume= 1.895 af
Outflow = 0.78 cfs @ 21.09 hrs, Volume= 1.882 af, Atten= 0%, Lag= 65.2 min
Routed to Reach AP4 : AP4

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.00 fps, Min. Travel Time= 36.3 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 57.4 min

Peak Storage= 1,690 cf @ 20.49 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 3.65'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 48.12 cfs

2.00' x 2.00' deep channel, n= 0.045 Winding stream, pools & shoals
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 2,170.0' Slope= 0.0074 '/'
Inlet Invert= 158.00', Outlet Invert= 142.00'

Summary for Reach O4: Overland Flow

Inflow Area = 3.101 ac, 10.32% Impervious, Inflow Depth = 0.80" for 2-yr Storm event
Inflow = 3.60 cfs @ 12.06 hrs, Volume= 0.207 af
Outflow = 3.56 cfs @ 12.06 hrs, Volume= 0.207 af, Atten= 1%, Lag= 0.5 min
Routed to Pond DP-9 : DETENTION POND 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.99 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 9.99 fps, Avg. Travel Time= 0.3 min

Peak Storage= 60 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 119.87 cfs

Custom stage-perimeter table, n= 0.035 Earth, dense weeds
100 Intermediate values determined by Multi-point interpolation
Length= 168.0' Slope= 0.0554 '/'
Inlet Invert= 201.30', Outlet Invert= 192.00'

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
2.00	12.0	12.0	2,016	119.87

Summary for Reach R-10a: R-10a

Inflow Area = 13.052 ac, 3.54% Impervious, Inflow Depth = 0.63" for 2-yr Storm event
Inflow = 9.33 cfs @ 12.07 hrs, Volume= 0.683 af
Outflow = 8.84 cfs @ 12.16 hrs, Volume= 0.683 af, Atten= 5%, Lag= 5.7 min
Routed to Pond DP-10 : DETENTION POND 10

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.85 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 8.1 min

Peak Storage= 1,477 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.43' , Surface Width= 6.61'
Bank-Full Depth= 3.00' Flow Area= 39.0 sf, Capacity= 437.98 cfs

4.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 641.0' Slope= 0.0137 '/'
Inlet Invert= 194.00', Outlet Invert= 185.25'

‡

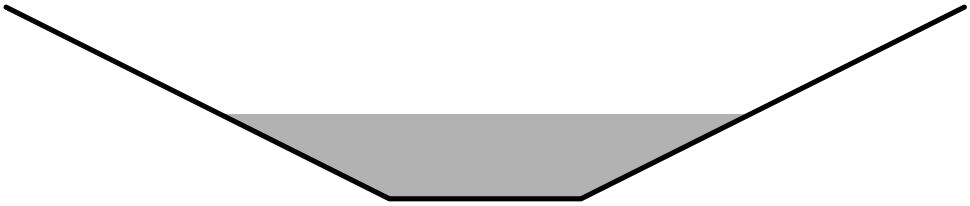
Summary for Reach R-1B: LF TOE DITCH

Inflow Area = 19.514 ac, 4.11% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 14.45 cfs @ 12.09 hrs, Volume= 1.034 af
Outflow = 13.81 cfs @ 12.16 hrs, Volume= 1.034 af, Atten= 4%, Lag= 3.9 min
Routed to Pond DP-1 : DETENTION POND 1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.19 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.48 fps, Avg. Travel Time= 6.1 min

Peak Storage= 1,805 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.89' , Surface Width= 5.55'
Defined Flood Depth= 2.00' Flow Area= 12.0 sf, Capacity= 79.00 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 79.00 cfs

2.00' x 2.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 540.0' Slope= 0.0278 '/'
Inlet Invert= 181.00', Outlet Invert= 166.00'



Summary for Reach R-1B1: LF TOE DITCH

Inflow Area = 8.511 ac, 4.70% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 6.76 cfs @ 12.06 hrs, Volume= 0.451 af
Outflow = 6.36 cfs @ 12.13 hrs, Volume= 0.451 af, Atten= 6%, Lag= 3.7 min
Routed to Reach R-1B : LF TOE DITCH

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.95 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 5.9 min

Peak Storage= 791 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.54' , Surface Width= 4.15'
Defined Flood Depth= 2.00' Flow Area= 12.0 sf, Capacity= 96.96 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 96.96 cfs

2.00' x 2.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 478.0' Slope= 0.0418 '/'
Inlet Invert= 204.00', Outlet Invert= 184.00'

Summary for Reach R-1D: Reach R-1D

Inflow Area = 41.304 ac, 3.35% Impervious, Inflow Depth > 0.55" for 2-yr Storm event
Inflow = 1.11 cfs @ 17.26 hrs, Volume= 1.882 af
Outflow = 1.11 cfs @ 17.45 hrs, Volume= 1.881 af, Atten= 0%, Lag= 11.6 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.94 fps, Min. Travel Time= 6.5 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 14.1 min

Peak Storage= 436 cf @ 17.34 hrs
Average Depth at Peak Storage= 0.11' , Surface Width= 12.13'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 67.93 cfs

10.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 370.0' Slope= 0.0324 '/'
Inlet Invert= 159.00', Outlet Invert= 147.00'

‡

Summary for Reach R-1E: Plastic Lined Ditch

Inflow Area = 9.580 ac, 2.92% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 7.89 cfs @ 12.05 hrs, Volume= 0.508 af
Outflow = 7.77 cfs @ 12.06 hrs, Volume= 0.508 af, Atten= 2%, Lag= 0.5 min
Routed to Pond DP-1a : DP-1a

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.39 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.24 fps, Avg. Travel Time= 1.0 min

Peak Storage= 168 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 4.77'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 1,302.19 cfs

4.00' x 3.00' deep channel, n= 0.011
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0500 '/'
Inlet Invert= 176.00', Outlet Invert= 166.00'

Summary for Reach R-1F: Reach R-1F

Inflow Area = 9.875 ac, 0.07% Impervious, Inflow Depth = 0.60" for 2-yr Storm event
Inflow = 1.94 cfs @ 12.35 hrs, Volume= 0.496 af
Outflow = 1.93 cfs @ 12.44 hrs, Volume= 0.496 af, Atten= 0%, Lag= 5.5 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.08 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 9.6 min

Peak Storage= 377 cf @ 12.38 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 21.72'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 140.14 cfs

20.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 210.0' Slope= 0.0524 '/'
Inlet Invert= 158.00', Outlet Invert= 147.00'

‡

Summary for Reach R-1G: RipRap Downspout

Inflow Area = 1.772 ac, 0.00% Impervious, Inflow Depth = 0.68" for 2-yr Storm event
Inflow = 1.47 cfs @ 12.09 hrs, Volume= 0.100 af
Outflow = 1.41 cfs @ 12.17 hrs, Volume= 0.100 af, Atten= 4%, Lag= 4.8 min
Routed to Pond DP-2 : DETENTION POND 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.87 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 7.3 min

Peak Storage= 242 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.12' , Surface Width= 4.46'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 368.81 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 493.0' Slope= 0.3428 '/'
Inlet Invert= 333.00', Outlet Invert= 164.00'

Summary for Reach R-1I: Final Cover Access Road Ditch

Inflow = 0.02 cfs @ 12.09 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 12.49 hrs, Volume= 0.000 af, Atten= 84%, Lag= 23.5 min
Routed to Pond P-1I : Culvert Crossing 6c

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.46 fps, Min. Travel Time= 19.2 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 19.2 min

Peak Storage= 4 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.00' , Surface Width= 2.02'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 80.08 cfs

2.00' x 2.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 524.0' Slope= 0.0849 '/'
Inlet Invert= 335.00', Outlet Invert= 290.50'

Summary for Reach R-1J: RipRap Downspout

Inflow Area = 4.295 ac, 2.58% Impervious, Inflow Depth = 0.66" for 2-yr Storm event
Inflow = 4.97 cfs @ 11.97 hrs, Volume= 0.237 af
Outflow = 4.80 cfs @ 11.98 hrs, Volume= 0.237 af, Atten= 3%, Lag= 1.1 min
Routed to Pond P-1J-1 : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.59 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 2.0 min

Peak Storage= 174 cf @ 11.98 hrs
Average Depth at Peak Storage= 0.24' , Surface Width= 4.95'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 387.31 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 164.0' Slope= 0.3780 '/'
Inlet Invert= 252.00', Outlet Invert= 190.00'

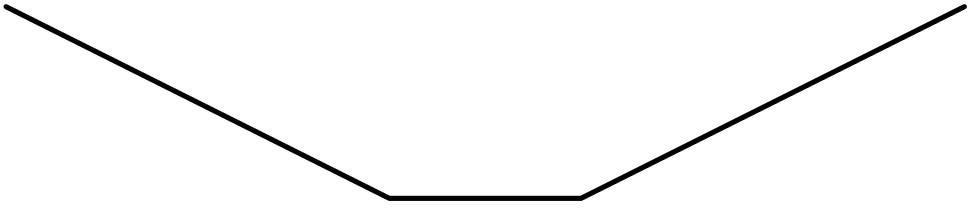
Summary for Reach R-1L: Final Cover Access Road Ditch

Inflow = 0.01 cfs @ 11.95 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 12.37 hrs, Volume= 0.000 af, Atten= 88%, Lag= 25.0 min
Routed to Pond 1P : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.44 fps, Min. Travel Time= 21.2 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 21.2 min

Peak Storage= 1 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.00' , Surface Width= 2.00'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 77.46 cfs

2.00' x 2.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 560.0' Slope= 0.0795 '/'
Inlet Invert= 254.50', Outlet Invert= 210.00'



Summary for Reach R-1N: R-1N

Inflow Area = 27.235 ac, 7.11% Impervious, Inflow Depth = 0.46" for 2-yr Storm event
Inflow = 0.63 cfs @ 19.70 hrs, Volume= 1.051 af
Outflow = 0.63 cfs @ 20.37 hrs, Volume= 1.051 af, Atten= 0%, Lag= 40.3 min
Routed to Reach R-1O : R-1O

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.63 fps, Min. Travel Time= 24.8 min
Avg. Velocity = 0.27 fps, Avg. Travel Time= 58.0 min

Peak Storage= 939 cf @ 19.95 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 11.83'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 49.97 cfs

10.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 940.0' Slope= 0.0176 '/'
Inlet Invert= 168.00', Outlet Invert= 151.50'

‡

Summary for Reach R-1O: R-1O

Inflow Area = 58.266 ac, 5.06% Impervious, Inflow Depth = 0.68" for 2-yr Storm event
Inflow = 17.81 cfs @ 12.39 hrs, Volume= 3.297 af
Outflow = 16.43 cfs @ 12.66 hrs, Volume= 3.297 af, Atten= 8%, Lag= 15.9 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.39 fps, Min. Travel Time= 8.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 44.1 min

Peak Storage= 8,670 cf @ 12.51 hrs
Average Depth at Peak Storage= 0.70' , Surface Width= 23.91'
Bank-Full Depth= 2.00' Flow Area= 60.0 sf, Capacity= 151.21 cfs

10.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 10.0 '/' Top Width= 50.00'
Length= 735.0' Slope= 0.0020 '/'
Inlet Invert= 151.50', Outlet Invert= 150.00'

‡

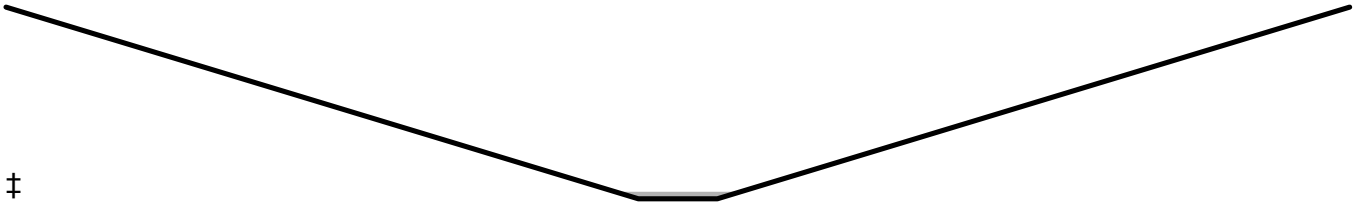
Summary for Reach R-2A: Reach 2A

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 0.66" for 2-yr Storm event
Inflow = 1.08 cfs @ 15.98 hrs, Volume= 1.741 af
Outflow = 1.08 cfs @ 18.39 hrs, Volume= 1.741 af, Atten= 0%, Lag= 144.4 min
Routed to Reach AP2 : ANALYSIS POINT #2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.44 fps, Min. Travel Time= 61.2 min
Avg. Velocity = 0.31 fps, Avg. Travel Time= 87.0 min

Peak Storage= 3,970 cf @ 17.37 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 39.95'
Bank-Full Depth= 2.00' Flow Area= 450.0 sf, Capacity= 1,332.75 cfs

25.00' x 2.00' deep channel, n= 0.050 Scattered brush, heavy weeds
Side Slope Z-value= 100.0 '/' Top Width= 425.00'
Length= 1,630.0' Slope= 0.0092 '/'
Inlet Invert= 166.00', Outlet Invert= 151.00'



‡

Summary for Reach R-2C: LF TOE DITCH

Inflow Area = 9.740 ac, 3.67% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 7.41 cfs @ 12.08 hrs, Volume= 0.516 af
Outflow = 6.99 cfs @ 12.17 hrs, Volume= 0.516 af, Atten= 6%, Lag= 5.5 min
Routed to Pond CB-2E : LF TOE DITCH - CATCH BASIN

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.42 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.48 fps, Avg. Travel Time= 9.3 min

Peak Storage= 1,307 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.99' , Surface Width= 6.96'
Defined Flood Depth= 2.00' Flow Area= 14.0 sf, Capacity= 29.12 cfs
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 70.39 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 265.0' Slope= 0.0075 '/'
Inlet Invert= 181.00', Outlet Invert= 179.00'

Summary for Reach R-2D: DITCH

Inflow Area = 9.297 ac, 3.94% Impervious, Inflow Depth = 0.63" for 2-yr Storm event
Inflow = 7.13 cfs @ 12.07 hrs, Volume= 0.489 af
Outflow = 6.88 cfs @ 12.11 hrs, Volume= 0.489 af, Atten= 4%, Lag= 2.4 min
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.82 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.97 fps, Avg. Travel Time= 3.9 min

Peak Storage= 563 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.60' , Surface Width= 5.39'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 183.17 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 225.0' Slope= 0.0511 '/'
Inlet Invert= 191.50', Outlet Invert= 180.00'

Summary for Reach R-4B: R-4B

Inflow Area = 4.602 ac, 9.82% Impervious, Inflow Depth = 0.72" for 2-yr Storm event
Inflow = 4.35 cfs @ 12.06 hrs, Volume= 0.278 af
Outflow = 2.44 cfs @ 12.46 hrs, Volume= 0.278 af, Atten= 44%, Lag= 24.0 min
Routed to Pond CB-4C : LT TOE DITCH - CATCH BASIN

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.05 fps, Min. Travel Time= 16.0 min
Avg. Velocity = 0.32 fps, Avg. Travel Time= 53.1 min

Peak Storage= 2,361 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.57' , Surface Width= 5.27'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 69.96 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,006.0' Slope= 0.0075 '/'
Inlet Invert= 178.50', Outlet Invert= 171.00'

Summary for Reach R-IH: RipRap Downspout

Inflow Area = 3.906 ac, 1.97% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 3.72 cfs @ 12.01 hrs, Volume= 0.207 af
Outflow = 3.50 cfs @ 12.05 hrs, Volume= 0.207 af, Atten= 6%, Lag= 2.1 min
Routed to Pond P-1H : Modified Plunge Pool w/(2)24" Culverts P-6a

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.14 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 3.4 min

Peak Storage= 226 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.20' , Surface Width= 4.80'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 385.75 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 256.0' Slope= 0.3750 '/'
Inlet Invert= 286.00', Outlet Invert= 190.00'

Summary for Reach R2: Reach 2

Inflow Area = 122.225 ac, 3.55% Impervious, Inflow Depth > 0.64" for 2-yr Storm event
Inflow = 22.27 cfs @ 12.67 hrs, Volume= 6.546 af
Outflow = 21.46 cfs @ 12.88 hrs, Volume= 6.545 af, Atten= 4%, Lag= 12.4 min
Routed to Reach 1 : Analysis Point 1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 6.8 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 28.1 min

Peak Storage= 8,721 cf @ 12.77 hrs
Average Depth at Peak Storage= 0.72' , Surface Width= 24.46'
Bank-Full Depth= 2.00' Flow Area= 60.0 sf, Capacity= 183.33 cfs

10.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 10.0 '/' Top Width= 50.00'
Length= 700.0' Slope= 0.0030 '/'
Inlet Invert= 148.40', Outlet Invert= 146.30'

‡

Summary for Reach R4B4:

Inflow Area = 54.320 ac, 3.83% Impervious, Inflow Depth = 0.66" for 2-yr Storm event
Inflow = 2.40 cfs @ 24.25 hrs, Volume= 2.980 af
Outflow = 2.39 cfs @ 24.97 hrs, Volume= 2.980 af, Atten= 0%, Lag= 43.1 min
Routed to Reach AP4 : AP4

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.65 fps, Min. Travel Time= 24.8 min
Avg. Velocity = 0.23 fps, Avg. Travel Time= 69.8 min

Peak Storage= 3,558 cf @ 24.56 hrs
Average Depth at Peak Storage= 0.25' , Surface Width= 17.08'
Bank-Full Depth= 2.00' Flow Area= 64.0 sf, Capacity= 131.94 cfs

12.00' x 2.00' deep channel, n= 0.080
Side Slope Z-value= 10.0 '/' Top Width= 52.00'
Length= 963.0' Slope= 0.0094 '/'
Inlet Invert= 142.00', Outlet Invert= 132.96'

‡

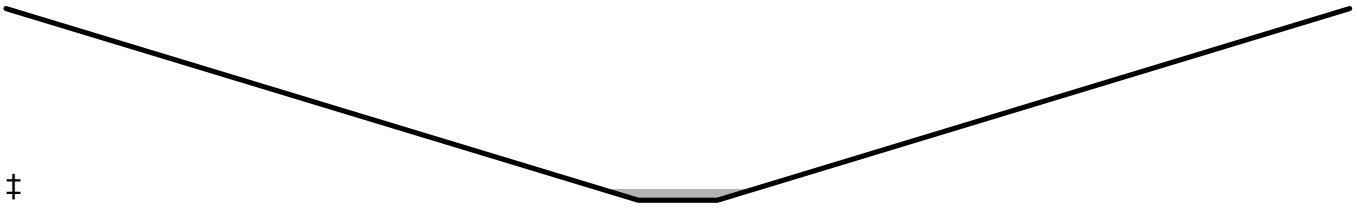
Summary for Reach R4C: Reach 4C

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 0.71" for 2-yr Storm event
Inflow = 1.38 cfs @ 13.06 hrs, Volume= 0.678 af
Outflow = 1.25 cfs @ 15.27 hrs, Volume= 0.678 af, Atten= 9%, Lag= 132.5 min
Routed to Reach R4C1 : Reach 4C1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.29 fps, Min. Travel Time= 56.4 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 114.4 min

Peak Storage= 4,223 cf @ 14.33 hrs
Average Depth at Peak Storage= 0.12' , Surface Width= 48.63'
Bank-Full Depth= 2.00' Flow Area= 450.0 sf, Capacity= 669.12 cfs

25.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 425.00'
Length= 970.0' Slope= 0.0093 '/'
Inlet Invert= 159.00', Outlet Invert= 150.00'



‡

Summary for Reach R4C1: Reach 4C1

Inflow Area = 24.911 ac, 5.27% Impervious, Inflow Depth = 0.67" for 2-yr Storm event
Inflow = 2.12 cfs @ 15.40 hrs, Volume= 1.386 af
Outflow = 1.48 cfs @ 23.02 hrs, Volume= 1.386 af, Atten= 30%, Lag= 457.7 min
Routed to Reach R4C2 : Reach 4C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.16 fps, Min. Travel Time= 239.0 min
Avg. Velocity = 0.07 fps, Avg. Travel Time= 526.5 min

Peak Storage= 21,267 cf @ 19.04 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 117.45'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 562.82 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 2,240.0' Slope= 0.0031 '/'
Inlet Invert= 150.00', Outlet Invert= 143.00'

‡

Summary for Reach R4C2: Reach 4C2

Inflow Area = 54.320 ac, 3.83% Impervious, Inflow Depth = 0.66" for 2-yr Storm event
Inflow = 2.42 cfs @ 22.97 hrs, Volume= 2.980 af
Outflow = 2.40 cfs @ 24.25 hrs, Volume= 2.980 af, Atten= 1%, Lag= 76.7 min
Routed to Reach R4B4 :

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.17 fps, Min. Travel Time= 44.5 min
Avg. Velocity = 0.07 fps, Avg. Travel Time= 106.2 min

Peak Storage= 6,407 cf @ 23.51 hrs
Average Depth at Peak Storage= 0.13' , Surface Width= 125.52'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 477.27 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 445.0' Slope= 0.0022 '/'
Inlet Invert= 143.00', Outlet Invert= 142.00'

‡

Summary for Reach R4D: Reach 4D

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 0.63" for 2-yr Storm event
Inflow = 0.89 cfs @ 13.36 hrs, Volume= 0.707 af
Outflow = 0.88 cfs @ 16.16 hrs, Volume= 0.707 af, Atten= 1%, Lag= 168.2 min
Routed to Reach R4C1 : Reach 4C1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.19 fps, Min. Travel Time= 54.2 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 76.2 min

Peak Storage= 2,856 cf @ 15.26 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 109.02'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 1,002.64 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 605.0' Slope= 0.0099 '/'
Inlet Invert= 156.00', Outlet Invert= 150.00'

‡

Summary for Reach R4G: Reach 4G

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 0.65" for 2-yr Storm event
Inflow = 1.13 cfs @ 15.41 hrs, Volume= 1.595 af
Outflow = 1.12 cfs @ 15.76 hrs, Volume= 1.595 af, Atten= 0%, Lag= 21.2 min
Routed to Reach R4C2 : Reach 4C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.47 fps, Min. Travel Time= 12.9 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 16.8 min

Peak Storage= 871 cf @ 15.54 hrs
Average Depth at Peak Storage= 0.11' , Surface Width= 22.27'
Bank-Full Depth= 2.00' Flow Area= 80.0 sf, Capacity= 199.54 cfs

20.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 363.0' Slope= 0.0193 '/'
Inlet Invert= 150.00', Outlet Invert= 143.00'

‡

Summary for Pond 1P: (2) 24" CULVERTS

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 4.52 cfs @ 12.06 hrs, Volume= 0.299 af
Outflow = 4.35 cfs @ 12.09 hrs, Volume= 0.299 af, Atten= 4%, Lag= 1.9 min
Primary = 4.35 cfs @ 12.09 hrs, Volume= 0.299 af
Routed to Reach 7R : SOUTH ACCESS RD DITCH
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 7R : SOUTH ACCESS RD DITCH

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 206.65' @ 12.09 hrs Surf.Area= 1,195 sf Storage= 686 cf
Flood Elev= 210.00' Surf.Area= 3,240 sf Storage= 7,740 cf

Plug-Flow detention time= 7.6 min calculated for 0.299 af (100% of inflow)
Center-of-Mass det. time= 7.7 min (892.3 - 884.6)

Volume	Invert	Avail.Storage	Storage Description
#1	206.00'	7,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
206.00	900	0	0
208.00	1,800	2,700	2,700
210.00	3,240	5,040	7,740

Device	Routing	Invert	Outlet Devices
#1	Primary	206.00'	**24.0" Round 24"Culvert (X2) X 2.00** L= 76.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 206.00' / 205.00' S= 0.0132 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	209.60'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.29 cfs @ 12.09 hrs HW=206.65' (Free Discharge)
1=24"Culvert (X2) (Inlet Controls 4.29 cfs @ 2.42 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=206.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 12P: (2) 24" CULVERTS

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 4.21 cfs @ 12.12 hrs, Volume= 0.299 af
Outflow = 4.13 cfs @ 12.15 hrs, Volume= 0.299 af, Atten= 2%, Lag= 1.5 min
Primary = 4.13 cfs @ 12.15 hrs, Volume= 0.299 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 15P : EXISTING 12" CULVERT

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 198.54' @ 12.15 hrs Surf.Area= 933 sf Storage= 375 cf
Flood Elev= 200.50' Surf.Area= 2,548 sf Storage= 3,866 cf

Plug-Flow detention time= 1.5 min calculated for 0.299 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (897.2 - 895.6)

Volume	Invert	Avail.Storage	Storage Description
#1	198.00'	3,866 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
198.00	464	0	0
200.00	2,212	2,676	2,676
200.50	2,548	1,190	3,866

Device	Routing	Invert	Outlet Devices
#1	Primary	197.90'	**24.0" Round 24"Culvert (X2) X 2.00** L= 98.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 197.90' / 195.47' S= 0.0248 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Secondary	200.00'	**14.0' long x 11.0' breadth Broad-Crested Rectangular Weir-Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.53 2.59 2.70 2.68 2.67 2.68 2.66 2.64

Primary OutFlow Max=4.11 cfs @ 12.15 hrs HW=198.54' (Free Discharge)
1=24"Culvert (X2) (Inlet Controls 4.11 cfs @ 2.39 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
2=Broad-Crested Rectangular Weir-Overflow(Controls 0.00 cfs)

Summary for Pond 15P: EXISTING 12" CULVERT

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-6 : DETENTION POND 6

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 198.00' @ 0.00 hrs Surf.Area= 464 sf Storage= 0 cf
Flood Elev= 200.50' Surf.Area= 2,212 sf Storage= 2,676 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	198.00'	2,676 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
198.00	464	0	0
200.00	2,212	2,676	2,676

Device	Routing	Invert	Outlet Devices
#1	Primary	197.40'	**12.0" Round 24"Culvert (X2)** L= 121.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 197.40' / 189.90' S= 0.0620 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Secondary	198.00'	**10.0' long x 50.0' breadth Broad-Crested Rectangular Weir**

Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
1=24"Culvert (X2) (Passes 0.00 cfs of 1.02 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond C-4K: Catch Basin - 4K

Inflow Area = 14.437 ac, 3.03% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 10.40 cfs @ 12.10 hrs, Volume= 0.765 af
Outflow = 10.52 cfs @ 12.10 hrs, Volume= 0.764 af, Atten= 0%, Lag= 0.1 min
Primary = 10.52 cfs @ 12.10 hrs, Volume= 0.764 af
Routed to Reach 12R : Ditch 4B1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond C-4L : Catch Basin - 4L

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 218.55' @ 12.10 hrs Surf.Area= 13 sf Storage= 51 cf

Plug-Flow detention time= 1.0 min calculated for 0.764 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (887.4 - 887.1)

Volume	Invert	Avail.Storage	Storage Description
#1	214.50'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	216.50'	**24.0" Round Culvert - 4K** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 216.50' / 214.50' S= 0.0392 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	218.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	220.00'	**2.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=10.45 cfs @ 12.10 hrs HW=218.55' (Free Discharge)
1=Culvert - 4K (Passes 10.45 cfs of 15.49 cfs potential flow)
2=Orifice/Grate (Weir Controls 10.45 cfs @ 2.42 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=214.50' (Free Discharge)
3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond C-4L: Catch Basin - 4L

Inflow Area = 0.679 ac, 6.77% Impervious, Inflow Depth = 0.68" for 2-yr Storm event
Inflow = 0.88 cfs @ 11.93 hrs, Volume= 0.038 af
Outflow = 0.78 cfs @ 11.93 hrs, Volume= 0.010 af, Atten= 12%, Lag= 0.0 min
Primary = 0.78 cfs @ 11.93 hrs, Volume= 0.010 af
Routed to Reach 13R : Ex Ditch
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 214.61' @ 11.93 hrs Surf.Area= 13 sf Storage= 43 cf

Plug-Flow detention time= 3.7 min calculated for 0.010 af (27% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	210.50'	43 cf	**4.00'D x 3.40'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	212.50'	**18.0" Round Culvert 4L** L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 212.50' / 210.50' S= 0.0165 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	214.50'	**24.0" Horiz. Orifice-Top of catch basin** C= 0.600 Limited to weir flow at low heads
#3	Secondary	215.00'	**15.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.72 cfs @ 11.93 hrs HW=214.61' (Free Discharge)
└**1=Culvert 4L** (Passes 0.72 cfs of 9.91 cfs potential flow)
└**2=Orifice-Top of catch basin** (Weir Controls 0.72 cfs @ 1.07 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=210.50' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C4B: Culvert - 4BA & 4BB

Inflow Area = 3.101 ac, 10.32% Impervious, Inflow Depth = 0.80" for 2-yr Storm event
Inflow = 3.62 cfs @ 12.04 hrs, Volume= 0.207 af
Outflow = 3.60 cfs @ 12.06 hrs, Volume= 0.207 af, Atten= 1%, Lag= 0.8 min
Primary = 3.60 cfs @ 12.06 hrs, Volume= 0.207 af
Routed to Reach O4 : Overland Flow

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 205.03' @ 12.06 hrs Surf.Area= 510 sf Storage= 160 cf

Plug-Flow detention time= 0.7 min calculated for 0.207 af (100% of inflow)
Center-of-Mass det. time= 0.7 min (852.6 - 851.9)

Volume	Invert	Avail.Storage	Storage Description
#1	204.40'	11,690 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
204.40	0	0	0
206.00	1,300	1,040	1,040
208.00	4,200	5,500	6,540
209.00	6,100	5,150	11,690

Device	Routing	Invert	Outlet Devices
#1	Primary	204.40'	**24.0" Round Culvert - 4B X 2.00** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 204.40' / 203.70' S= 0.0152 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf

Primary OutFlow Max=3.56 cfs @ 12.06 hrs HW=205.02' (Free Discharge)
└**1=Culvert - 4B** (Inlet Controls 3.56 cfs @ 2.12 fps)

Summary for Pond CB-2B: LF TOE DITCH - CATCH BASIN

Inflow Area = 9.308 ac, 2.34% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 6.91 cfs @ 12.09 hrs, Volume= 0.493 af
Outflow = 7.01 cfs @ 12.07 hrs, Volume= 0.491 af, Atten= 0%, Lag= 0.0 min
Primary = 7.01 cfs @ 12.07 hrs, Volume= 0.491 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 179.42' @ 12.07 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 3.4 min calculated for 0.491 af (100% of inflow)
Center-of-Mass det. time= 1.3 min (887.6 - 886.3)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	173.00'	**24.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=6.71 cfs @ 12.07 hrs HW=179.41' (Free Discharge)
└**2=Culvert** (Passes 6.71 cfs of 35.18 cfs potential flow)
└**1=Orifice/Grate** (Weir Controls 6.71 cfs @ 2.09 fps)

Summary for Pond CB-2D: LF TOE DITCH - CATCH BASIN

Inflow Area = 9.297 ac, 3.94% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 7.14 cfs @ 12.07 hrs, Volume= 0.493 af
Outflow = 7.13 cfs @ 12.07 hrs, Volume= 0.489 af, Atten= 0%, Lag= 0.1 min
Primary = 7.13 cfs @ 12.07 hrs, Volume= 0.489 af
Routed to Reach R-2D : DITCH

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 201.42' @ 12.07 hrs Surf.Area= 13 sf Storage= 138 cf
Flood Elev= 200.65' Surf.Area= 13 sf Storage= 134 cf

Plug-Flow detention time= 4.8 min calculated for 0.489 af (99% of inflow)
Center-of-Mass det. time= 1.2 min (886.7 - 885.5)

Volume	Invert	Avail.Storage	Storage Description
#1	190.00'	138 cf	**4.00'D x 11.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	201.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	192.00'	**24.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 192.00' / 191.50' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=6.92 cfs @ 12.07 hrs HW=201.42' (Free Discharge)
↑**2=Culvert** (Passes 6.92 cfs of 34.65 cfs potential flow)
↑**1=Orifice/Grate** (Weir Controls 6.92 cfs @ 2.11 fps)

Summary for Pond CB-2E: LF TOE DITCH - CATCH BASIN

Inflow Area = 10.279 ac, 4.18% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 7.11 cfs @ 12.17 hrs, Volume= 0.551 af
Outflow = 7.18 cfs @ 12.16 hrs, Volume= 0.549 af, Atten= 0%, Lag= 0.0 min
Primary = 7.18 cfs @ 12.16 hrs, Volume= 0.549 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 179.43' @ 12.16 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 3.2 min calculated for 0.548 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (894.0 - 893.0)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#2	Primary	173.00'	**24.0" Round Culvert** L= 80.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=6.97 cfs @ 12.16 hrs HW=179.42' (Free Discharge)
↑—**2=Culvert** (Passes 6.97 cfs of 35.21 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 6.97 cfs @ 2.12 fps)

Summary for Pond CB-4C: LT TOE DITCH - CATCH BASIN

Inflow Area = 10.458 ac, 9.73% Impervious, Inflow Depth = 0.72" for 2-yr Storm event
Inflow = 6.24 cfs @ 12.02 hrs, Volume= 0.631 af
Outflow = 6.35 cfs @ 12.03 hrs, Volume= 0.629 af, Atten= 0%, Lag= 0.6 min
Primary = 6.35 cfs @ 12.03 hrs, Volume= 0.629 af
Routed to Pond DP-13 : DETENTION POND 13

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.39' @ 12.03 hrs Surf.Area= 13 sf Storage= 80 cf
Flood Elev= 174.00' Surf.Area= 13 sf Storage= 88 cf

Plug-Flow detention time= 2.5 min calculated for 0.629 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (895.9 - 895.4)

Volume	Invert	Avail.Storage	Storage Description
#1	165.00'	88 cf	**4.00'D x 7.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	171.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	167.00'	**24.0" Round Culvert** L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 167.00' / 166.50' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=6.07 cfs @ 12.03 hrs HW=171.38' (Free Discharge)
↑—**2=Culvert** (Passes 6.07 cfs of 27.82 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 6.07 cfs @ 2.02 fps)

Summary for Pond CB-4D: LF TOE DITCH - CATCH BASINS

Inflow Area = 12.095 ac, 2.44% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 11.18 cfs @ 12.02 hrs, Volume= 0.641 af
Outflow = 11.20 cfs @ 12.02 hrs, Volume= 0.640 af, Atten= 0%, Lag= 0.0 min
Primary = 11.20 cfs @ 12.02 hrs, Volume= 0.640 af
Routed to Pond DP-14 : DETENTION POND 14

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 160.86' @ 12.02 hrs Surf.Area= 13 sf Storage= 57 cf
Flood Elev= 162.00' Surf.Area= 13 sf Storage= 57 cf

Plug-Flow detention time= 1.5 min calculated for 0.640 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (881.7 - 881.2)

Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	160.50'	**30.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	158.00'	**24.0" Round Culvert X 2.00** L= 54.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 158.00' / 157.50' S= 0.0092 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=10.79 cfs @ 12.02 hrs HW=160.85' (Free Discharge)
└**2=Culvert** (Passes 10.79 cfs of 39.73 cfs potential flow)
└**1=Orifice/Grate** (Weir Controls 10.79 cfs @ 1.94 fps)

Summary for Pond CB-4G: Catch Basin - 4G

Inflow Area = 11.260 ac, 1.95% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 8.57 cfs @ 12.08 hrs, Volume= 0.597 af
Outflow = 8.62 cfs @ 12.08 hrs, Volume= 0.596 af, Atten= 0%, Lag= 0.3 min
Primary = 8.62 cfs @ 12.08 hrs, Volume= 0.596 af
Routed to Pond DP-11R : DETENTION POND 11R

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 162.32' @ 12.08 hrs Surf.Area= 13 sf Storage= 42 cf
Flood Elev= 170.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 0.8 min calculated for 0.596 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (885.9 - 885.6)

Volume	Invert	Avail.Storage	Storage Description
#1	159.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	161.00'	**24.0" Round Culvert** L= 115.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 161.00' / 160.00' S= 0.0087 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 3.14 sf
#2	Primary	167.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.40 cfs @ 12.08 hrs HW=162.30' (Free Discharge)
└**1=Culvert** (Inlet Controls 8.40 cfs @ 3.88 fps)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond CB-4H: Catch Basin - 4H

Inflow Area = 15.096 ac, 1.13% Impervious, Inflow Depth = 0.60" for 2-yr Storm event
Inflow = 9.67 cfs @ 12.07 hrs, Volume= 0.753 af
Outflow = 9.69 cfs @ 12.07 hrs, Volume= 0.751 af, Atten= 0%, Lag= 0.0 min
Primary = 9.69 cfs @ 12.07 hrs, Volume= 0.751 af
Routed to Pond DP-11R : DETENTION POND 11R
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond CB-4G : Catch Basin - 4G

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 181.52' @ 12.07 hrs Surf.Area= 13 sf Storage= 113 cf
Flood Elev= 183.00' Surf.Area= 13 sf Storage= 113 cf

Plug-Flow detention time= 2.6 min calculated for 0.751 af (100% of inflow)
Center-of-Mass det. time= 0.7 min (888.0 - 887.3)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	113 cf	**4.00'D x 9.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	**24.0" Round Culvert** L= 65.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.00' S= 0.0308 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	181.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	183.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=9.46 cfs @ 12.07 hrs HW=181.51' (Free Discharge)
└**1=Culvert** (Passes 9.46 cfs of 38.61 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 9.46 cfs @ 2.34 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=172.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond CB-4I: Catch Basin - 4I

Inflow Area = 13.052 ac, 3.54% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 9.80 cfs @ 12.08 hrs, Volume= 0.692 af
Outflow = 10.00 cfs @ 12.07 hrs, Volume= 0.689 af, Atten= 0%, Lag= 0.0 min
Primary = 9.33 cfs @ 12.07 hrs, Volume= 0.683 af
Routed to Reach R-10a : R-10a
Secondary = 0.67 cfs @ 12.07 hrs, Volume= 0.006 af
Routed to Pond CB-4H : Catch Basin - 4H

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 208.09' @ 12.07 hrs Surf.Area= 13 sf Storage= 102 cf
Flood Elev= 209.90' Surf.Area= 13 sf Storage= 121 cf

Plug-Flow detention time= 2.4 min calculated for 0.689 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (886.6 - 886.0)

Volume	Invert	Avail.Storage	Storage Description
#1	200.00'	121 cf	**4.00'D x 9.60'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	200.00'	**24.0" Round NEW 24-INCH** L= 67.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 194.00' S= 0.0896 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	207.58'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	208.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=9.01 cfs @ 12.07 hrs HW=208.08' (Free Discharge)
└**1=NEW 24-INCH** (Passes 9.01 cfs of 40.24 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 9.01 cfs @ 2.31 fps)

Secondary OutFlow Max=0.50 cfs @ 12.07 hrs HW=208.08' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 0.50 cfs @ 0.65 fps)

Summary for Pond CB-4JA: Catch Basin - 4JA

Inflow Area = 11.663 ac, 3.68% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 6.51 cfs @ 12.19 hrs, Volume= 0.618 af
Outflow = 6.74 cfs @ 12.20 hrs, Volume= 0.616 af, Atten= 0%, Lag= 0.3 min
Primary = 6.74 cfs @ 12.20 hrs, Volume= 0.616 af
Routed to Pond DP-10 : DETENTION POND 10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond CB-4JA3 : (4JA3) New Catch Basin

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 219.11' @ 12.20 hrs Surf.Area= 13 sf Storage= 88 cf

Plug-Flow detention time= 2.5 min calculated for 0.616 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (895.2 - 894.1)

Volume	Invert	Avail.Storage	Storage Description
#1	211.00'	88 cf	**4.00'D x 7.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	213.00'	**18.0" Round Culvert - 4JA** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 213.00' / 212.20' S= 0.0143 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	218.70'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	220.00'	**2.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=6.68 cfs @ 12.20 hrs HW=219.11' (Free Discharge)
└**1=Culvert - 4JA** (Passes 6.68 cfs of 19.69 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 6.68 cfs @ 2.09 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=211.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Pond CB-4JA3: (4JA3) New Catch Basin

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-10 : DETENTION POND 10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond PS11 : Culvert - 4IA(C11 PS)

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 202.90' @ 0.00 hrs Surf.Area= 0.000 ac Storage= 0.000 af
Flood Elev= 215.00' Surf.Area= 0.000 ac Storage= 0.003 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	202.90'	0.003 af	**4.00'D x 10.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	204.90'	**18.0" Round NEW 24-INCH** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 204.90' / 204.00' S= 0.0150 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	212.90'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	212.90'	**2.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=202.90' (Free Discharge)
└**1=NEW 24-INCH** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=202.90' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-1: DETENTION POND 1

Inflow Area = 41.304 ac, 3.35% Impervious, Inflow Depth > 0.60" for 2-yr Storm event
Inflow = 21.44 cfs @ 12.12 hrs, Volume= 2.064 af
Outflow = 1.11 cfs @ 17.26 hrs, Volume= 1.882 af, Atten= 95%, Lag= 308.2 min
Primary = 1.11 cfs @ 17.26 hrs, Volume= 1.882 af
Routed to Reach R-1D : Reach R-1D
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-1D : Reach R-1D

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 163.74' @ 17.26 hrs Surf.Area= 16,618 sf Storage= 50,977 cf
Flood Elev= 166.00' Surf.Area= 21,310 sf Storage= 93,390 cf

Plug-Flow detention time= 1,290.1 min calculated for 1.881 af (91% of inflow)
Center-of-Mass det. time= 1,118.4 min (2,212.0 - 1,093.6)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	115,245 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	10,750	0	0
162.00	13,540	24,290	24,290
164.00	17,070	30,610	54,900
165.00	19,300	18,185	73,085
166.00	21,310	20,305	93,390
167.00	22,400	21,855	115,245

Device	Routing	Invert	Outlet Devices
#1	Primary	159.80'	**30.0" Round Culvert** L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 159.80' / 159.35' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf
#2	Device 1	160.60'	**3.0" Vert. Orifice on side** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.70'	**72.0" Horiz. Orifice-Top of drop inlet** C= 0.600 Limited to weir flow at low heads
#4	Secondary	166.30'	**40.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.97 cfs @ 17.26 hrs HW=163.74' (Free Discharge)
└─**1=Culvert** (Passes 0.97 cfs of 30.62 cfs potential flow)
  ├─**2=Orifice on side** (Orifice Controls 0.41 cfs @ 8.37 fps)
  └─**3=Orifice-Top of drop inlet** (Weir Controls 0.56 cfs @ 0.68 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-10: DETENTION POND 10

Inflow Area = 34.949 ac, 6.10% Impervious, Inflow Depth = 0.73" for 2-yr Storm event
Inflow = 22.81 cfs @ 12.02 hrs, Volume= 2.131 af
Outflow = 0.78 cfs @ 19.76 hrs, Volume= 1.643 af, Atten= 97%, Lag= 464.8 min
Primary = 0.17 cfs @ 19.76 hrs, Volume= 0.117 af
Routed to Reach E1R6 : DP-10 DISCHARGE
Secondary = 0.61 cfs @ 19.76 hrs, Volume= 1.525 af
Routed to Reach E1R6 : DP-10 DISCHARGE
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach E1R6 : DP-10 DISCHARGE

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 186.25' @ 19.76 hrs Surf.Area= 38,562 sf Storage= 69,558 cf
Flood Elev= 189.00' Surf.Area= 77,500 sf Storage= 239,860 cf

Plug-Flow detention time= 2,088.8 min calculated for 1.642 af (77% of inflow)
Center-of-Mass det. time= 1,992.4 min (2,871.6 - 879.2)

Volume	Invert	Avail.Storage	Storage Description
#1	180.00'	320,610 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	10	0	0
182.00	2,300	2,310	2,310
184.00	11,000	13,300	15,610
186.00	34,000	45,000	60,610
188.00	71,000	105,000	165,610
190.00	84,000	155,000	320,610

Device	Routing	Invert	Outlet Devices
#1	Device 3	187.00'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 3	186.00'	**6.0" Vert. 6-in Orifice** C= 0.600 Limited to weir flow at low heads
#3	Primary	181.00'	**24.0" Round 18-in Primary Culvert** L= 96.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 181.00' / 180.00' S= 0.0104 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#4	Secondary	177.50'	**5.8" Round 6-in Culvert** L= 220.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 177.50' / 174.00' S= 0.0159 '/' Cc= 0.900

n= 0.011, Flow Area= 0.18 sf

#5	Device 4	186.00'	**5.8" Horiz. Orifice Top** C= 0.600 Limited to weir flow at low heads
#6	Device 4	184.00'	**1.5" Vert. Orifice Side** X 2 rows with 0.5" cc spacing C= 0.600 Limited to weir flow at low heads
#7	Tertiary	188.00'	**10.0' long x 26.0' breadth E-Spillway Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.16 cfs @ 19.76 hrs HW=186.25' (Free Discharge)
└**3=18-in Primary Culvert** (Passes 0.16 cfs of 31.17 cfs potential flow)
  ├**1=Orifice/Grate** (Controls 0.00 cfs)
  └**2=6-in Orifice** (Orifice Controls 0.16 cfs @ 1.69 fps)

Secondary OutFlow Max=0.61 cfs @ 19.76 hrs HW=186.25' (Free Discharge)
└**4=6-in Culvert** (Passes 0.61 cfs of 1.31 cfs potential flow)
  ├**5=Orifice Top** (Orifice Controls 0.44 cfs @ 2.39 fps)
  └**6=Orifice Side** (Orifice Controls 0.17 cfs @ 7.08 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=180.00' (Free Discharge)
└**7=E-Spillway Weir** (Controls 0.00 cfs)

Summary for Pond DP-11R: DETENTION POND 11R

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 0.65" for 2-yr Storm event
Inflow = 22.31 cfs @ 12.07 hrs, Volume= 1.595 af
Outflow = 1.13 cfs @ 15.41 hrs, Volume= 1.595 af, Atten= 95%, Lag= 200.4 min
Primary = 0.15 cfs @ 15.41 hrs, Volume= 0.044 af
  Routed to Reach R4G : Reach 4G
Secondary = 0.98 cfs @ 15.41 hrs, Volume= 1.551 af
  Routed to Reach R4G : Reach 4G
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 156.64' @ 15.41 hrs Surf.Area= 21,446 sf Storage= 34,924 cf

Plug-Flow detention time= 411.3 min calculated for 1.594 af (100% of inflow)
Center-of-Mass det. time= 411.4 min (1,293.8 - 882.4)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	499,354 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,440	0	0
156.00	19,408	21,848	21,848
158.00	25,775	45,183	67,031
160.00	32,395	58,170	125,201
162.00	39,360	71,755	196,956
164.00	46,635	85,995	282,951
166.00	54,090	100,725	383,676
168.00	61,588	115,678	499,354

Device	Routing	Invert	Outlet Devices
#1	Primary	155.30'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.30' / 154.00' S= 0.0236 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	156.50'	**4.0" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	161.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	152.20'	**6.0" Round Culvert** L= 118.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 152.20' / 151.80' S= 0.0034 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.16 cfs @ 15.41 hrs HW=156.64' (Free Discharge)
└**1=Culvert** (Passes 0.16 cfs of 8.82 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.16 cfs @ 1.80 fps)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.98 cfs @ 15.41 hrs HW=156.64' (Free Discharge)
└**5=Culvert** (Barrel Controls 0.98 cfs @ 4.99 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-12: DETENTION POND 12

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 0.66" for 2-yr Storm event
Inflow = 20.74 cfs @ 12.13 hrs, Volume= 1.741 af
Outflow = 1.08 cfs @ 15.98 hrs, Volume= 1.741 af, Atten= 95%, Lag= 231.2 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R-2A : Reach 2A
Secondary = 1.08 cfs @ 15.98 hrs, Volume= 1.741 af
  Routed to Reach R-2A : Reach 2A
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R-2A : Reach 2A

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 169.89' @ 15.98 hrs Surf.Area= 33,302 sf Storage= 38,655 cf

Plug-Flow detention time= 422.3 min calculated for 1.740 af (100% of inflow)
Center-of-Mass det. time= 422.3 min (1,308.2 - 885.9)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	537,379 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	7,544	0	0
170.00	34,762	42,306	42,306
172.00	40,454	75,216	117,522
174.00	46,283	86,737	204,259
176.00	52,328	98,611	302,870
178.00	58,583	110,911	413,781
180.00	65,015	123,598	537,379

Device	Routing	Invert	Outlet Devices
#1	Primary	168.90'	**24.0" Round Culvert** L= 66.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 168.90' / 168.50' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	171.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	174.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	175.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	166.00'	**6.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 166.00' / 165.50' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	178.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
  ├**2=Orifice** (Controls 0.00 cfs)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.08 cfs @ 15.98 hrs HW=169.89' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.08 cfs @ 5.52 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-13: DETENTION POND 13

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 0.71" for 2-yr Storm event
Inflow = 6.68 cfs @ 12.02 hrs, Volume= 0.678 af
Outflow = 1.38 cfs @ 13.06 hrs, Volume= 0.678 af, Atten= 79%, Lag= 62.7 min
Primary = 0.29 cfs @ 13.06 hrs, Volume= 0.057 af
  Routed to Reach R4C : Reach 4C
Secondary = 1.08 cfs @ 13.06 hrs, Volume= 0.621 af
  Routed to Reach R4C : Reach 4C
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R4C : Reach 4C

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 161.15' @ 13.06 hrs Surf.Area= 8,690 sf Storage= 8,606 cf
Flood Elev= 166.00' Surf.Area= 17,062 sf Storage= 71,548 cf

Plug-Flow detention time= 59.2 min calculated for 0.678 af (100% of inflow)
Center-of-Mass det. time= 59.2 min (954.0 - 894.8)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	109,546 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	6,224	0	0
162.00	10,498	16,722	16,722
164.00	13,633	24,131	40,853
166.00	17,062	30,695	71,548
168.00	20,936	37,998	109,546

Device	Routing	Invert	Outlet Devices
#1	Primary	160.30'	**24.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 160.30' / 159.00' S= 0.0433 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	160.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	164.30'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	158.00'	**6.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 158.00' / 157.70' S= 0.0055 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.29 cfs @ 13.06 hrs HW=161.15' (Free Discharge)
└**1=Culvert** (Passes 0.29 cfs of 4.03 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.29 cfs @ 3.36 fps)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.08 cfs @ 13.06 hrs HW=161.15' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.08 cfs @ 5.52 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-14: DETENTION POND 14

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 0.63" for 2-yr Storm event
Inflow = 11.86 cfs @ 12.01 hrs, Volume= 0.707 af
Outflow = 0.89 cfs @ 13.36 hrs, Volume= 0.707 af, Atten= 93%, Lag= 81.1 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R4D : Reach 4D
Secondary = 0.89 cfs @ 13.36 hrs, Volume= 0.707 af
Routed to Reach R4D : Reach 4D
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 157.72' @ 13.36 hrs Surf.Area= 26,310 sf Storage= 11,692 cf

Plug-Flow detention time= 129.3 min calculated for 0.707 af (100% of inflow)
Center-of-Mass det. time= 129.3 min (1,010.7 - 881.4)

Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	176,567 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	6,253	0	0
158.00	34,183	20,218	20,218
160.00	38,909	73,092	93,310
162.00	44,348	83,257	176,567

Device	Routing	Invert	Outlet Devices
#1	Primary	157.00'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 157.00' / 156.00' S= 0.0182 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.80'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	155.00'	**6.0" Round Culvert** L= 76.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 155.00' / 154.70' S= 0.0039 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#5	Device 1	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Tertiary	160.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=157.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Controls 0.00 cfs)
└**3=Grate** (Controls 0.00 cfs)
└**5=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.89 cfs @ 13.36 hrs HW=157.72' (Free Discharge)
└**4=Culvert** (Barrel Controls 0.89 cfs @ 4.53 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=157.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-1a: DP-1a

Inflow Area = 9.580 ac, 2.92% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 7.77 cfs @ 12.06 hrs, Volume= 0.508 af
Outflow = 0.22 cfs @ 18.99 hrs, Volume= 0.383 af, Atten= 97%, Lag= 415.8 min
Primary = 0.22 cfs @ 18.99 hrs, Volume= 0.383 af
Routed to Pond DP-1 : DETENTION POND 1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-1 : DETENTION POND 1

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Starting Elev= 163.00' Surf.Area= 34,985 sf Storage= 146,410 cf
Peak Elev= 163.42' @ 18.99 hrs Surf.Area= 36,006 sf Storage= 161,235 cf (14,825 cf above start)
Flood Elev= 166.00' Surf.Area= 43,000 sf Storage= 263,046 cf (116,636 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 1,101.3 min (1,986.4 - 885.1)

Volume	Invert	Avail.Storage	Storage Description
#1	158.00'	263,046 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
158.00	24,139	0	0
160.00	27,981	52,120	52,120
162.00	32,544	60,525	112,645
163.00	34,985	33,765	146,410
164.00	37,429	36,207	182,617
166.00	43,000	80,429	263,046

Device	Routing	Invert	Outlet Devices
#1	Primary	163.10'	**113.0 deg Sharp-Crested Vee/Trap Weir** Cv= 2.49 (C= 3.11)
#2	Secondary	165.60'	**18.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=0.21 cfs @ 18.99 hrs HW=163.42' (Free Discharge)
1=Sharp-Crested Vee/Trap Weir (Weir Controls 0.21 cfs @ 1.40 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=163.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond DP-2: DETENTION POND 2

Inflow Area = 9.875 ac, 0.07% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 9.03 cfs @ 11.97 hrs, Volume= 0.530 af
Outflow = 1.94 cfs @ 12.35 hrs, Volume= 0.496 af, Atten= 79%, Lag= 22.7 min
Primary = 1.94 cfs @ 12.35 hrs, Volume= 0.496 af
Routed to Reach R-1F : Reach R-1F

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2

Starting Elev= 162.30' Surf.Area= 1,330 sf Storage= 630 cf
Peak Elev= 164.75' @ 12.35 hrs Surf.Area= 4,507 sf Storage= 7,257 cf (6,627 cf above start)
Flood Elev= 167.80' Surf.Area= 17,700 sf Storage= 36,993 cf (36,363 cf above start)

Plug-Flow detention time= 114.7 min calculated for 0.481 af (91% of inflow)
Center-of-Mass det. time= 60.0 min (941.1 - 881.1)

Volume	Invert	Avail.Storage	Storage Description
#1	162.00'	36,993 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
162.00	1,000	0	0
164.00	3,200	4,200	4,200
165.00	4,940	4,070	8,270
166.00	7,860	6,400	14,670
167.00	12,570	10,215	24,885
167.80	17,700	12,108	36,993

Device	Routing	Invert	Outlet Devices
#1	Primary	162.80'	**24.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 162.80' / 162.20' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	164.20'	**8.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	165.40'	**2.4' long x 0.30' rise Sharp-Crested Rectangular Weir** 1 End Contraction(s)
#5	Device 1	166.60'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.94 cfs @ 12.35 hrs HW=164.75' (Free Discharge)
└**1=Culvert** (Passes 1.94 cfs of 14.84 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 1.16 cfs @ 5.90 fps)
  ├**3=Orifice** (Orifice Controls 0.78 cfs @ 2.53 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**5=Grate** (Controls 0.00 cfs)

Summary for Pond DP-6: DETENTION POND 6

Inflow Area = 27.235 ac, 7.11% Impervious, Inflow Depth = 0.76" for 2-yr Storm event
Inflow = 15.20 cfs @ 12.01 hrs, Volume= 1.729 af
Outflow = 0.63 cfs @ 19.70 hrs, Volume= 1.051 af, Atten= 96%, Lag= 461.0 min
Primary = 0.63 cfs @ 19.70 hrs, Volume= 1.051 af
Routed to Reach R-1N : R-1N
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-1N : R-1N

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 174.51' @ 19.70 hrs Surf.Area= 35,172 sf Storage= 52,033 cf
Flood Elev= 180.00' Surf.Area= 130,159 sf Storage= 496,644 cf

Plug-Flow detention time= 748.0 min calculated for 1.051 af (61% of inflow)
Center-of-Mass det. time= 615.1 min (1,496.3 - 881.3)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	783,647 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	3,635	0	0
174.00	25,931	29,566	29,566
176.00	62,168	88,099	117,665
178.00	93,326	155,494	273,159
180.00	130,159	223,485	496,644
182.00	156,844	287,003	783,647

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**24.0" Round Outlet Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 178.00' / 168.00' S= 0.1429 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	174.00'	**5.8" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Secondary	179.00'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.63 cfs @ 19.70 hrs HW=174.51' (Free Discharge)
└**1=Outlet Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Orifice Controls 0.63 cfs @ 3.44 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=172.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-6 ES: DETENTION POND 6 - EMERGENCY SPILLWAY

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Starting Elev= 178.00' Surf.Area= 93,326 sf Storage= 273,159 cf
Peak Elev= 178.00' @ 0.00 hrs Surf.Area= 93,326 sf Storage= 273,159 cf
Flood Elev= 180.00' Surf.Area= 130,159 sf Storage= 496,644 cf (223,485 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	783,647 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	3,635	0	0
174.00	25,931	29,566	29,566
176.00	62,168	88,099	117,665
178.00	93,326	155,494	273,159
180.00	130,159	223,485	496,644
182.00	156,844	287,003	783,647

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**24.0" Round Outlet Culvert X 0.00** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 178.00' / 168.00' S= 0.1429 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	174.00'	**5.8" Horiz. Orifice X 0.00** C= 0.600 Limited to weir flow at low heads
#3	Secondary	179.00'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=178.00' (Free Discharge)
└**1=Outlet Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=178.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-9: DETENTION POND 9

Inflow Area = 30.022 ac, 9.91% Impervious, Inflow Depth = 0.91" for 2-yr Storm event
Inflow = 25.56 cfs @ 12.15 hrs, Volume= 2.286 af
Outflow = 0.05 cfs @ 24.71 hrs, Volume= 0.259 af, Atten= 100%, Lag= 753.8 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 9R : LEVEL SPREADER DISCHARGE
Secondary = 0.05 cfs @ 24.71 hrs, Volume= 0.259 af
Routed to Reach 9R : LEVEL SPREADER DISCHARGE
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 188.51' @ 24.71 hrs Surf.Area= 80,385 sf Storage= 98,824 cf
Flood Elev= 191.00' Surf.Area= 91,210 sf Storage= 312,840 cf

Plug-Flow detention time= 3,035.2 min calculated for 0.259 af (11% of inflow)
Center-of-Mass det. time= 2,873.1 min (3,739.6 - 866.5)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	404,050 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	35,200	0	0
188.00	78,220	56,710	56,710
190.00	86,700	164,920	221,630
192.00	95,720	182,420	404,050

Device	Routing	Invert	Outlet Devices
#1	Primary	189.50'	**12.0" Round 12-In Outlet Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 189.50' / 180.50' S= 0.1875 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Secondary	184.21'	**5.8" Round 6-In Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 184.21' / 180.50' S= 0.0618 '/' Cc= 0.900 n= 0.011, Flow Area= 0.18 sf
#3	Device 2	188.70'	**5.8" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	188.30'	**1.5" Vert. Orifice X 2.00** C= 0.600 Limited to weir flow at low heads
#5	Tertiary	190.50'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=187.00' (Free Discharge)
└**1=12-In Outlet Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.05 cfs @ 24.71 hrs HW=188.51' (Free Discharge)
└**2=6-In Culvert** (Passes 0.05 cfs of 1.41 cfs potential flow)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Orifice** (Orifice Controls 0.05 cfs @ 1.85 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=187.00' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-9(E): DP 9 (EMERGENCY OUTLET)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	404,050 cf	**Detention Pond (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	35,200	0	0
188.00	78,220	56,710	56,710
190.00	86,700	164,920	221,630
192.00	95,720	182,420	404,050

Device	Routing	Invert	Outlet Devices
#1	Tertiary	190.50'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond P-1G: Culvert Crossing 1G

Inflow Area = 1.772 ac, 0.00% Impervious, Inflow Depth = 0.68" for 2-yr Storm event
Inflow = 1.55 cfs @ 12.06 hrs, Volume= 0.100 af
Outflow = 1.49 cfs @ 12.09 hrs, Volume= 0.100 af, Atten= 4%, Lag= 1.8 min
Primary = 1.47 cfs @ 12.09 hrs, Volume= 0.100 af
Routed to Reach R-1G : RipRap Downspout
Secondary = 0.02 cfs @ 12.09 hrs, Volume= 0.000 af
Routed to Reach R-1I : Final Cover Access Road Ditch

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 336.03' @ 12.09 hrs Surf.Area= 507 sf Storage= 242 cf

Plug-Flow detention time= 8.3 min calculated for 0.100 af (100% of inflow)
Center-of-Mass det. time= 8.3 min (888.7 - 880.4)

Volume	Invert	Avail.Storage	Storage Description
#1	335.50'	1,200 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
335.50	400	0	0
337.50	800	1,200	1,200

Device	Routing	Invert	Outlet Devices
#1	Primary	335.50'	**24.0" Round 24" Culvert** L= 36.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 335.50' / 331.00' S= 0.1250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	336.00'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=1.45 cfs @ 12.09 hrs HW=336.03' (Free Discharge)
1=24" Culvert (Inlet Controls 1.45 cfs @ 2.18 fps)

Secondary OutFlow Max=0.02 cfs @ 12.09 hrs HW=336.03' (Free Discharge)
2=Stone Check Dam Weir (Weir Controls 0.02 cfs @ 0.52 fps)

Summary for Pond P-1H: Modified Plunge Pool w/(2)24" Culverts P-6a

Inflow Area = 6.697 ac, 1.15% Impervious, Inflow Depth = 0.62" for 2-yr Storm event
Inflow = 5.07 cfs @ 11.99 hrs, Volume= 0.345 af
Outflow = 5.00 cfs @ 12.00 hrs, Volume= 0.343 af, Atten= 1%, Lag= 0.4 min
Primary = 5.00 cfs @ 12.00 hrs, Volume= 0.343 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-2 : DETENTION POND 2

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 183.75' @ 12.00 hrs Surf.Area= 302 sf Storage= 275 cf
Flood Elev= 186.00' Surf.Area= 869 sf Storage= 1,551 cf

Plug-Flow detention time= 6.3 min calculated for 0.343 af (99% of inflow)
Center-of-Mass det. time= 2.6 min (889.1 - 886.5)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	5,714 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
182.00	37	0	0
183.00	163	100	100
184.00	348	256	356
185.00	587	468	823
186.00	869	728	1,551
188.00	1,067	1,936	3,487
190.00	1,160	2,227	5,714

Device	Routing	Invert	Outlet Devices
#1	Primary	183.00'	**24.0" Round (2)24"-Culvert X 2.00** L= 56.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 183.00' / 182.00' S= 0.0179 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Secondary	185.00'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=5.00 cfs @ 12.00 hrs HW=183.75' (Free Discharge)
↑—**1=(2)24"-Culvert** (Barrel Controls 5.00 cfs @ 3.43 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=182.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P-1I: Culvert Crossing 6c

Inflow Area = 3.906 ac, 1.97% Impervious, Inflow Depth = 0.64" for 2-yr Storm event
Inflow = 3.66 cfs @ 12.02 hrs, Volume= 0.207 af
Outflow = 3.72 cfs @ 12.01 hrs, Volume= 0.207 af, Atten= 0%, Lag= 0.0 min
Primary = 3.72 cfs @ 12.01 hrs, Volume= 0.207 af
Routed to Reach R-IH : RipRap Downspout
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond P-1K : Culvert Crossing 1K

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 291.38' @ 12.01 hrs Surf.Area= 800 sf Storage= 300 cf

Plug-Flow detention time= 6.8 min calculated for 0.207 af (100% of inflow)
Center-of-Mass det. time= 6.5 min (887.4 - 880.9)

Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	300 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	400	0	0
291.00	800	300	300

Device	Routing	Invert	Outlet Devices
#1	Primary	290.50'	**24.0" Round 24" Culvert** L= 38.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 290.50' / 286.00' S= 0.1184 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	291.50'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=3.59 cfs @ 12.01 hrs HW=291.36' (Free Discharge)
↑—**1=24" Culvert** (Inlet Controls 3.59 cfs @ 2.78 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=290.50' (Free Discharge)
↑—**2=Stone Check Dam Weir** (Controls 0.00 cfs)

Summary for Pond P-1J-1: (2) 24" CULVERTS

Inflow Area = 6.104 ac, 1.82% Impervious, Inflow Depth = 0.65" for 2-yr Storm event
Inflow = 6.69 cfs @ 11.97 hrs, Volume= 0.333 af
Outflow = 6.68 cfs @ 11.98 hrs, Volume= 0.333 af, Atten= 0%, Lag= 0.4 min
Primary = 6.68 cfs @ 11.98 hrs, Volume= 0.333 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond P-1J-2 : 18" CULVERT

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 190.88' @ 11.98 hrs Surf.Area= 182 sf Storage= 84 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (876.2 - 875.9)

Volume	Invert	Avail.Storage	Storage Description
#1	190.00'	410 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
190.00	10	0	0
192.00	400	410	410

Device	Routing	Invert	Outlet Devices
#1	Primary	190.00'	**24.0" Round Culvert X 2.00** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 190.00' / 189.60' S= 0.0108 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	191.20'	**170.0 deg x 1.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.46 (C= 3.08)

Primary OutFlow Max=6.38 cfs @ 11.98 hrs HW=190.86' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 6.38 cfs @ 2.49 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=190.00' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Summary for Pond P-1J-2: 18" CULVERT

Inflow	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af

Routed to Pond DP-6 : DETENTION POND 6

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 187.00' @ 0.00 hrs Surf.Area= 10 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	32,056 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	10	0	0
188.00	1,367	689	689
190.00	3,000	4,367	5,056
192.00	6,000	9,000	14,056
194.00	12,000	18,000	32,056

Device	Routing	Invert	Outlet Devices
#1	Primary	186.80'	**18.0" Round 18" Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 186.80' / 185.97' S= 0.0208 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=187.00' (Free Discharge)
↑—**1=18" Culvert** (Passes 0.00 cfs of 0.17 cfs potential flow)

Summary for Pond P-1K: Culvert Crossing 1K

Inflow Area = 4.295 ac, 2.58% Impervious, Inflow Depth = 0.66" for 2-yr Storm event
Inflow = 5.29 cfs @ 11.95 hrs, Volume= 0.237 af
Outflow = 4.98 cfs @ 11.97 hrs, Volume= 0.237 af, Atten= 6%, Lag= 1.0 min
Primary = 4.97 cfs @ 11.97 hrs, Volume= 0.237 af
Routed to Reach R-1J : RipRap Downspout
Secondary = 0.01 cfs @ 11.95 hrs, Volume= 0.000 af
Routed to Reach R-1L : Final Cover Access Road Ditch

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 255.53' @ 11.97 hrs Surf.Area= 506 sf Storage= 241 cf

Plug-Flow detention time= 0.3 min calculated for 0.237 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (873.7 - 873.5)

Volume	Invert	Avail.Storage	Storage Description
#1	255.00'	1,200 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
255.00	400	0	0
257.00	800	1,200	1,200

Device	Routing	Invert	Outlet Devices
#1	Primary	254.50'	**24.0" Round 24" Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.50' / 252.00' S= 0.0758 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	255.50'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=4.76 cfs @ 11.97 hrs HW=255.51' (Free Discharge)
↑—**1=24" Culvert** (Inlet Controls 4.76 cfs @ 3.01 fps)

Secondary OutFlow Max=0.01 cfs @ 11.95 hrs HW=255.52' (Free Discharge)
↑—**2=Stone Check Dam Weir** (Weir Controls 0.01 cfs @ 0.41 fps)

Summary for Pond PS11: Culvert - 4IA(C11 PS)

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond CB-4I : Catch Basin - 4I

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 212.90' @ 0.00 hrs Surf.Area= 5 sf Storage= 0 cf
Flood Elev= 215.10' Surf.Area= 1,133 sf Storage= 1,237 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	212.90'	1,353 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
212.90	5	0	0
213.04	63	5	5
215.20	1,185	1,348	1,353

Device	Routing	Invert	Outlet Devices
#1	Primary	213.05'	**24.0" Round Culvert - 4IA(C11 PS)** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 213.05' / 212.15' S= 0.0225 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.90' (Free Discharge)
↑—**1=Culvert - 4IA(C11 PS)** (Controls 0.00 cfs)

Summary for Subcatchment 1A: SC-1A

Runoff = 12.59 cfs @ 13.12 hrs, Volume= 2.861 af, Depth= 1.52"
Routed to Reach 1 : Analysis Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	11.084	70	Woods, Good, HSG C
*	7.750	77	Woods, Good, HSG D
*	1.540	71	Meadow, non-grazed, HSG C
*	1.760	78	Meadow HSG D
*	0.070	96	Gravel Surface
*	0.330	98	Impervious Surface
	22.534	74	Weighted Average
	22.204		98.54% Pervious Area
	0.330		1.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	150	0.0200	0.04		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
20.4	1,840		1.50		**Direct Entry, Segment ID: B-C**
16.4	260		0.26		**Direct Entry, Segment ID: C-D**
93.1	2,250	Total			

Summary for Subcatchment 1B: 1B

Runoff = 0.89 cfs @ 11.93 hrs, Volume= 0.038 af, Depth= 1.33"
Routed to Reach 1 : Analysis Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	0.344	71	Landfill Final Cover
	0.344		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, Segement A-B**

Summary for Subcatchment 1B1: SC-1B1

Runoff = 16.03 cfs @ 12.06 hrs, Volume= 0.986 af, Depth= 1.39"
Routed to Reach R-1B1 : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	8.111	71	Meadow, non-grazed, HSG C
*	0.400	98	Riprap
	8.511	72	Weighted Average
	8.111		95.30% Pervious Area
	0.400		4.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	140	0.1000	4.74		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.4	240	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	482	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.8	1,012	Total			

Summary for Subcatchment 1B2: SC-1B2

Runoff = 20.51 cfs @ 12.06 hrs, Volume= 1.275 af, Depth= 1.39"
Routed to Reach R-1B : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	10.600	71	Landfill Final Cover
*	0.403	98	Riprap
	11.003	72	Weighted Average
	10.600		96.34% Pervious Area
	0.403		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.6	75	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	403	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	554	0.3300	19.66	314.62	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.050 Mountain streams w/large boulders
13.1	1,182	Total			

Summary for Subcatchment 1C: SC-1C

Runoff = 9.30 cfs @ 12.86 hrs, Volume= 1.770 af, Depth= 1.66"
Routed to Reach R2 : Reach 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	6.100	77	Woods, Good, HSG D
*	0.690	70	Woods, Good, HSG C
*	3.100	78	Meadow HSG D
*	2.580	71	Meadow, non-grazed, HSG C
*	0.310	96	Gravel Surface
	12.780	76	Weighted Average
	12.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.7	200	0.0350	0.06		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
1.6	170	0.0133	1.73		**Shallow Concentrated Flow, Segment ID: B-C** Grassed Waterway Kv= 15.0 fps
16.7					**Direct Entry, Segment ID: C-D**
75.0	370	Total			

Summary for Subcatchment 1D: SC-1D

Runoff = 23.10 cfs @ 12.05 hrs, Volume= 1.415 af, Depth= 1.39"
Routed to Pond DP-1 : DETENTION POND 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	11.000	71	Landfill Final Cover
*	0.110	96	Gravel Surface
*	0.800	78	Pond, Meadow HSG D
*	0.300	98	Riprap
	12.210	72	Weighted Average
	11.910		97.54% Pervious Area
	0.300		2.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
0.8	110	0.1000	2.21		**Shallow Concentrated Flow, Segment ID: B-C** Short Grass Pasture Kv= 7.0 fps
0.3	241	0.0700	12.78	172.52	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.025
0.3	556	0.3300	28.09	449.46	**Trap/Vee/Rect Channel Flow, Segment ID: D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.035
12.7	1,057	Total			

Summary for Subcatchment 1E: SC-1E

Runoff = 18.64 cfs @ 12.05 hrs, Volume= 1.110 af, Depth= 1.39"
Routed to Reach R-1E : Plastic Lined Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	9.100	71	Landfill Final Cover
*	0.200	96	Gravel Surface
*	0.280	98	Riprap
	9.580	72	Weighted Average
	9.300		97.08% Pervious Area
	0.280		2.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	146	0.1000	0.22		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	296	0.0700	16.72	200.67	**Trap/Vee/Rect Channel Flow, Segment ID: B-C** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.025
0.3	537	0.3300	28.09	449.46	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.035
0.3	186	0.0700	10.28	57.82	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=0.00' D=1.50' Z= 3.0 & 2.0 '/' Top.W=7.50' n= 0.030 Earth, grassed & winding
11.9	1,165	Total			

Summary for Subcatchment 1F: SC-1F

Runoff = 20.48 cfs @ 11.96 hrs, Volume= 0.939 af, Depth= 1.39"
Routed to Pond DP-2 : DETENTION POND 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	7.747	71	Landfill Final Cover
*	0.349	91	Gravel
	0.007	98	Roofs, HSG C
	8.103	72	Weighted Average
	8.096		99.91% Pervious Area
	0.007		0.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	100	0.3800	0.51		**Sheet Flow, Segment A-B** Grass: Short n= 0.150 P2= 2.70"
1.2	293	0.0700	3.97		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.2	300	0.3800	29.77	669.83	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.50' Z= 2.0 '/' Top.W=14.00' n= 0.040 Earth, cobble bottom, clean sides
4.7	693	Total			

Summary for Subcatchment 1G: SC-1G

Runoff = 3.55 cfs @ 12.05 hrs, Volume= 0.215 af, Depth= 1.46"
Routed to Pond P-1G : Culvert Crossing 1G

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	1.625	71	Landfill Final Cover
*	0.147	96	Gravel Surface
	1.772	73	Weighted Average
	1.772		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.9	142	0.1500	2.71		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.3	154	0.0700	8.95	60.43	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.035 Earth, dense weeds

12.5 446 Total

Summary for Subcatchment 1H: SC-1H

Runoff = 7.21 cfs @ 11.94 hrs, Volume= 0.308 af, Depth= 1.33"
Routed to Pond P-1H : Modified Plunge Pool w/(2)24" Culverts P-6a

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	0.032	91	Fallow, bare soil, HSG C, rip rap
	2.759	71	Meadow, non-grazed, HSG C
	2.791	71	Weighted Average
	2.791		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	66	0.3900	0.47		**Sheet Flow, Segment A-B** Grass: Short n= 0.150 P2= 2.70"
0.3	140	0.0800	9.12	27.13	**Trap/Vee/Rect Channel Flow, Segment B-C** Bot.W=0.00' D=1.15' Z= 2.5 & 2.0 '/' Top.W=5.17' n= 0.030 Earth, grassed & winding
0.2	190	0.1430	16.62	49.46	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.15' Z= 2.5 & 2.0 '/' Top.W=5.17' n= 0.022 Earth, clean & straight
2.8	396	Total			

Summary for Subcatchment 1I: SC-1I

Runoff = 8.56 cfs @ 12.01 hrs, Volume= 0.453 af, Depth= 1.39"
Routed to Pond P-1I : Culvert Crossing 6c

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	3.829	71	Landfill Final Cover
*	0.077	98	Riprap
	3.906	72	Weighted Average
	3.829		98.03% Pervious Area
	0.077		1.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	150	0.1000	0.32		**Sheet Flow, Segment AB** Grass: Short n= 0.150 P2= 2.70"
0.4	106	0.1000	4.74		**Shallow Concentrated Flow, Segment BC** Grassed Waterway Kv= 15.0 fps
0.4	260	0.0700	10.44	70.50	**Trap/Vee/Rect Channel Flow, Segment C - D** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.030 Earth, grassed & winding
0.1	140	0.3300	39.33	629.24	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.025 Rubble masonry, cemented
8.7	656	Total			

Summary for Subcatchment 1J: SC-IJ

Runoff = 4.85 cfs @ 11.94 hrs, Volume= 0.210 af, Depth= 1.39"
Routed to Pond P-1J-1 : (2) 24" CULVERTS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	1.763	71	Landfill Final Cover
*	0.046	91	Gravel
	1.809	72	Weighted Average
	1.809		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	67	0.5000	0.52		**Sheet Flow, SEGMENT AB** Grass: Short n= 0.150 P2= 2.70"
0.8	325	0.1900	6.54		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.4	325	0.0300	12.44	149.28	**Trap/Vee/Rect Channel Flow, C-D** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
3.3	717	Total			

Summary for Subcatchment 1K: SC-1K

Runoff = 7.38 cfs @ 11.94 hrs, Volume= 0.318 af, Depth= 1.46"
Routed to Pond P-1K : Culvert Crossing 1K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	2.350	71	Landfill Final Cover
	0.163	89	Gravel roads, HSG C
*	0.111	98	Riprap
	2.624	73	Weighted Average
	2.513		95.77% Pervious Area
	0.111		4.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	68	0.3300	0.44		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 2.70"
0.4	93	0.0700	3.97		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.3	249	0.3300	12.60	201.68	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.078 Riprap, 12-inch
3.3	410	Total			

Summary for Subcatchment 1L: SC-1L

Runoff = 4.45 cfs @ 11.95 hrs, Volume= 0.194 af, Depth= 1.39"
Routed to Pond P-1K : Culvert Crossing 1K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	1.607	71	Landfill Final Cover
	0.064	89	Gravel roads, HSG C
	1.671	72	Weighted Average
	1.671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	67	0.4000	0.48		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
1.2	442	0.1000	6.15	49.59	**Trap/Vee/Rect Channel Flow, B-C** Bot.W=2.00' D=1.50' Z= 2.0 & 2.5 '/' Top.W=8.75' n= 0.069 Riprap, 6-inch
3.5	509	Total			

Summary for Subcatchment 1M: SC-1M

Runoff = 10.72 cfs @ 12.05 hrs, Volume= 0.655 af, Depth= 1.39"
Routed to Pond 1P : (2) 24" CULVERTS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	5.368	71	Landfill Final Cover
	0.283	92	Paved roads w/open ditches, 50% imp, HSG C
	5.651	72	Weighted Average
	5.509		97.50% Pervious Area
	0.141		2.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	73	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.3	174	0.0700	11.06	265.40	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=2.00' Z= 2.0 & 10.0 '/' Top.W=24.00' n= 0.035 Earth, dense weeds
0.5	413	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.6	810	Total			

Summary for Subcatchment 1N: SC-1N

Runoff = 13.88 cfs @ 12.29 hrs, Volume= 1.434 af, Depth= 1.96"
Routed to Pond DP-6 : DETENTION POND 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	2.942	70	Woods, Good, HSG C
*	3.662	78	Meadow HSG D
*	0.572	96	Gravel Surface
*	1.607	98	Pond
	8.783	80	Weighted Average
	7.176		81.70% Pervious Area
	1.607		18.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.8	100	0.0400	0.05		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
1.7	123	0.0569	1.19		**Shallow Concentrated Flow, Segment ID: B-C** Woodland Kv= 5.0 fps
0.5	370	0.0189	12.43	801.88	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=2.00' D=3.00' Z= 10.0 & 3.0 '/' Top.W=41.00' n= 0.022 Earth, clean & straight
33.0	593	Total			

Summary for Subcatchment 1O: SC-1O

Runoff = 37.78 cfs @ 12.38 hrs, Volume= 4.484 af, Depth= 1.73"
Routed to Reach R-1O : R-1O

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	13.230	77	Woods, Good, HSG D
*	5.712	70	Woods, Good, HSG C
*	9.172	78	Meadow HSG D
*	1.195	71	Meadow, non-grazed, HSG C
*	0.713	96	Gravel Surface
*	0.515	98	Impervious Surface
*	0.494	98	Paved Area
	31.031	77	Weighted Average
	30.022		96.75% Pervious Area
	1.009		3.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0100	0.07		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
15.1	1,875	0.0190	2.07		**Shallow Concentrated Flow, Segment BC** Grassed Waterway Kv= 15.0 fps
12.8	856	0.0500	1.12		**Shallow Concentrated Flow, Segment CD** Woodland Kv= 5.0 fps
39.7	2,781	Total			

Summary for Subcatchment 2A: SC-2A

Runoff = 19.04 cfs @ 13.82 hrs, Volume= 6.099 af, Depth= 1.52"
Routed to Reach AP2 : ANALYSIS POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	24.340	70	Woods, Good, HSG C
	15.830	77	Woods, Good, HSG D
*	5.898	71	Meadow, non-grazed, HSG C
*	0.380	98	Paved Area
	1.600	98	Existing Waterbody
	48.048	74	Weighted Average
	46.068		95.88% Pervious Area
	1.980		4.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
91.1	150	0.0060	0.03		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
42.6	534	0.0070	0.21		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
10.6	1,213		1.90		**Direct Entry, Segment C-D (STWC, 0.008)**
144.3	1,897	Total			

Summary for Subcatchment 2B: SC-2B

Runoff = 16.53 cfs @ 12.07 hrs, Volume= 1.078 af, Depth= 1.39"
Routed to Pond CB-2B : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	9.090	71	Landfill Final Cover
*	0.218	98	Riprap
	9.308	72	Weighted Average
	9.090		97.66% Pervious Area
	0.218		2.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.3	178	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	252	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	455	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
0.8	136	0.0100	3.00	81.02	**Trap/Vee/Rect Channel Flow, Segment E-F** Bot.W=3.00' D=3.00' Z= 2.0 '/' Top.W=15.00' n= 0.069 Riprap, 6-inch
14.4	1,171	Total			

Summary for Subcatchment 2C: SC-2C

Runoff = 17.76 cfs @ 12.06 hrs, Volume= 1.129 af, Depth= 1.39"
Routed to Reach R-2C : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	9.383	71	Landfill Final Cover
*	0.357	98	Riprap
	9.740	72	Weighted Average
	9.383		96.33% Pervious Area
	0.357		3.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.2	158	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.6	308	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	474	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.7	1,090	Total			

Summary for Subcatchment 2D: SC-2D

Runoff = 17.01 cfs @ 12.06 hrs, Volume= 1.077 af, Depth= 1.39"
Routed to Pond CB-2D : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	8.931	71	Landfill Final Cover
*	0.366	98	Riprap
	9.297	72	Weighted Average
	8.931		96.06% Pervious Area
	0.366		3.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.2	157	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	248	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	475	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.6	1,030	Total			

Summary for Subcatchment 2E: SC-2E

Runoff = 1.67 cfs @ 11.94 hrs, Volume= 0.072 af, Depth= 1.59"
Routed to Pond CB-2E : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	0.466	71	Landfill Final Cover
*	0.073	98	Riprap
	0.539	75	Weighted Average
	0.466		86.46% Pervious Area
	0.073		13.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 2F: SC-2F

Runoff = 9.48 cfs @ 11.94 hrs, Volume= 0.408 af, Depth= 1.88"
Routed to Pond DP-12 : DETENTION POND 12

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

Area (ac)	CN	Description
1.947	74	>75% Grass cover, Good, HSG C
0.655	93	Paved roads w/open ditches, 50% imp, HSG D
2.602	79	Weighted Average
2.274		87.41% Pervious Area
0.327		12.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 3A: SC-3A

Runoff = 68.13 cfs @ 15.21 hrs, Volume= 32.228 af, Depth= 1.46"
Routed to Reach AP3 : ANALYSIS POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	158.900	70	Woods, Good, HSG C
	102.800	77	Woods, Good, HSG D
	1.000	71	Meadow, non-grazed, HSG C
*	0.564	98	Paved Area
*	2.330	98	Existing Waterbody
	265.594	73	Weighted Average
	262.700		98.91% Pervious Area
	2.894		1.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	150	0.0200	0.04		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
105.2	1,116	0.0050	0.18		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
78.7	3,093		0.66		**Direct Entry, Segment C-D (STWC, 0.001)**
240.2	4,359	Total			

Summary for Subcatchment 4A: SC-4A

Runoff = 48.86 cfs @ 16.22 hrs, Volume= 28.718 af, Depth= 1.66"
Routed to Reach AP4 : AP4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	130.444	77	Woods, Good, HSG D
	44.640	70	Woods, Good, HSG C
*	23.410	71	Meadow, non-grazed, HSG C
*	3.300	98	Paved Area
*	2.520	91	Gravel
	1.000	89	Gravel roads, HSG C
*	2.000	98	Impervious Surface
	207.314	76	Weighted Average
	202.014		97.44% Pervious Area
	5.300		2.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
91.1	150	0.0060	0.03		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
200.8	1,905	0.0040	0.16		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
17.7	1,592		1.50		**Direct Entry, Segment C-D (STWC, 0.0031)**
7.9	760		1.60		**Direct Entry, Segment D-E (STWC, 0.005)**
6.7	963		2.40		**Direct Entry, Segment E-F (STWC, 0.0125)**
324.2	5,370	Total			

Summary for Subcatchment 4B: 4B

Runoff = 9.69 cfs @ 12.05 hrs, Volume= 0.584 af, Depth= 1.52"
Routed to Reach R-4B : R-4B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	4.150	71	Landfill Final Cover
*	0.452	98	Riprap
	4.602	74	Weighted Average
	4.150		90.18% Pervious Area
	0.452		9.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	32	0.0500	1.57		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	240	0.0700	8.81	49.56	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 3.0 '/' Top.W=7.50' n= 0.035 Earth, dense weeds
0.4	342	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.5	764	Total			

Summary for Subcatchment 4C: SC-4C

Runoff = 13.75 cfs @ 12.01 hrs, Volume= 0.743 af, Depth= 1.52"
Routed to Pond CB-4C : LT TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	0.566	98	Riprap
*	5.290	71	Landfill Final Cover
	5.856	74	Weighted Average
	5.290		90.33% Pervious Area
	0.566		9.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	101	0.1000	0.20		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.8	442	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment B-C** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 Earth, dense weeds
0.4	365	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
9.4	908	Total			

Summary for Subcatchment 4D: SC-4D

Runoff = 26.16 cfs @ 12.01 hrs, Volume= 1.401 af, Depth= 1.39"
Routed to Pond CB-4D : LF TOE DITCH - CATCH BASINS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	11.800	71	Landfill Final Cover
*	0.295	98	Riprap
	12.095	72	Weighted Average
	11.800		97.56% Pervious Area
	0.295		2.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	100	0.1000	0.20		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.2	117	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	504	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
9.0	721	Total			

Summary for Subcatchment 4E: SC-4E

Runoff = 2.55 cfs @ 11.94 hrs, Volume= 0.110 af, Depth= 1.33"
Routed to Pond DP-13 : DETENTION POND 13

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

Area (ac)	CN	Description
0.992	71	Meadow, non-grazed, HSG C
0.992		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	300		1.67		**Direct Entry, Segment A-B**

Summary for Subcatchment 4F: SC-4F

Runoff = 3.55 cfs @ 11.93 hrs, Volume= 0.151 af, Depth= 1.33"
Routed to Pond DP-14 : DETENTION POND 14

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

Area (ac)	CN	Description
1.366	71	Meadow, non-grazed, HSG C
1.366		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	500		4.17		**Direct Entry, Segment A-B**

Summary for Subcatchment 4G: SC-4G

Runoff = 20.53 cfs @ 12.06 hrs, Volume= 1.305 af, Depth= 1.39"
Routed to Pond CB-4G : Catch Basin - 4G

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	11.040	71	Landfill Final Cover
*	0.220	98	Riprap
	11.260	72	Weighted Average
	11.040		98.05% Pervious Area
	0.220		1.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.1	143	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	390	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	497	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.7	1,180	Total			

Summary for Subcatchment 4H: SC-4H

Runoff = 21.06 cfs @ 12.07 hrs, Volume= 1.378 af, Depth= 1.33"
Routed to Pond CB-4H : Catch Basin - 4H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	12.330	71	Landfill Final Cover
*	0.135	98	Riprap
	12.465	71	Weighted Average
	12.330		98.92% Pervious Area
	0.135		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	232	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	464	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	440	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.3	1,286	Total			

Summary for Subcatchment 4I: SC-4I

Runoff = 6.77 cfs @ 11.94 hrs, Volume= 0.291 af, Depth= 1.33"
Routed to Pond CB-4H : Catch Basin - 4H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	2.595	71	Landfill Final Cover
*	0.036	98	Riprap
	2.631	71	Weighted Average
	2.595		98.63% Pervious Area
	0.036		1.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, A-B**

Summary for Subcatchment 4J: SC-4J

Runoff = 23.44 cfs @ 12.07 hrs, Volume= 1.512 af, Depth= 1.39"
Routed to Pond CB-4I : Catch Basin - 4I

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	12.590	71	Landfill Final Cover
*	0.462	98	Riprap
	13.052	72	Weighted Average
	12.590		96.46% Pervious Area
	0.462		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	223	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	386	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.4	376	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.1	1,135	Total			

Summary for Subcatchment 4K: SC-4K

Runoff = 15.93 cfs @ 12.17 hrs, Volume= 1.351 af, Depth= 1.39"
Routed to Pond CB-4JA : Catch Basin - 4JA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	11.234	71	Landfill Final Cover
*	0.429	98	Riprap
	11.663	72	Weighted Average
	11.234		96.32% Pervious Area
	0.429		3.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
10.3	432	0.0100	0.70		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	432	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	392	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
22.9	1,406	Total			

Summary for Subcatchment 4L: SC-4L

Runoff = 24.84 cfs @ 12.08 hrs, Volume= 1.673 af, Depth= 1.39"
Routed to Pond C-4K : Catch Basin - 4K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	14.000	71	Landfill Final Cover
*	0.437	98	Riprap
	14.437	72	Weighted Average
	14.000		96.97% Pervious Area
	0.437		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
2.6	242	0.0500	1.57		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.9	476	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	406	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
15.3	1,274	Total			

Summary for Subcatchment 4M: SC-4M

Runoff = 1.94 cfs @ 11.93 hrs, Volume= 0.082 af, Depth= 1.46"
Routed to Pond C-4L : Catch Basin - 4L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
*	0.633	71	Landfill Final Cover
*	0.046	98	Riprap
	0.679	73	Weighted Average
	0.633		93.23% Pervious Area
	0.046		6.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 4N: SC-4N

Runoff = 13.24 cfs @ 12.12 hrs, Volume= 0.979 af, Depth= 1.96"
Routed to Pond DP-9 : DETENTION POND 9

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	2.512	74	>75% Grass cover, Good, HSG C
*	0.245	98	Paved Area
*	0.338	98	Building/Concrete Slabs
*	1.404	91	Gravel
	1.497	71	Meadow, non-grazed, HSG C
	5.996	80	Weighted Average
	5.413		90.28% Pervious Area
	0.583		9.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	61	0.0200	1.14		**Sheet Flow, Segment A-B** Smooth surfaces n= 0.011 P2= 2.70"
10.5	61	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.70"
7.9	955	0.0180	2.01		**Shallow Concentrated Flow, Grassed waterway** Grassed Waterway Kv= 15.0 fps
19.3	1,077	Total			

Summary for Subcatchment 4O: SC-4O

Runoff = 6.22 cfs @ 12.05 hrs, Volume= 0.380 af, Depth= 1.88"
Routed to Pond C4B : Culvert - 4BA & 4BB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	1.074	70	Brush, Fair, HSG C
*	0.034	98	Impervious Surface
	0.687	89	Gravel roads, HSG C
	0.387	74	>75% Grass cover, Good, HSG C
*	0.240	98	Paved Area
	2.422	79	Weighted Average
	2.148		88.69% Pervious Area
	0.274		11.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	24	0.0200	0.95		**Sheet Flow, Segment AB** Smooth surfaces n= 0.011 P2= 2.70"
0.8	19	0.5000	0.41		**Sheet Flow, Segment BC** Grass: Short n= 0.150 P2= 2.70"
11.9	584	0.0137	0.82		**Shallow Concentrated Flow, Segment CD** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0250	7.14	85.66	**Trap/Vee/Rect Channel Flow, Segment DE** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.035
13.2	667	Total			

Summary for Subcatchment 4P: SC-4P

Runoff = 13.18 cfs @ 12.29 hrs, Volume= 1.376 af, Depth= 2.55"
Routed to Pond DP-9 : DETENTION POND 9

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	0.415	89	Gravel roads, HSG C
*	2.133	91	Gravel
	2.304	74	>75% Grass cover, Good, HSG C
*	1.500	98	Pond
*	0.136	98	Paved Area
	6.488	87	Weighted Average
	4.852		74.78% Pervious Area
	1.636		25.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	125	0.0216	0.12		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	25	0.0520	0.78		**Sheet Flow, Segment B-C** n= 0.023 P2= 2.70"
2.0	270	0.0190	2.22		**Shallow Concentrated Flow, Segment C-D** Unpaved Kv= 16.1 fps
0.2	44	0.3300	4.02		**Shallow Concentrated Flow, Segment D-E** Short Grass Pasture Kv= 7.0 fps
2.0	102	0.0150	0.86		**Shallow Concentrated Flow, Segment E-F** Short Grass Pasture Kv= 7.0 fps
11.2	258	0.0030	0.38		**Shallow Concentrated Flow, Segment F-G** Short Grass Pasture Kv= 7.0 fps
33.9	824	Total			

Summary for Subcatchment 4Q: SC-4Q

Runoff = 32.71 cfs @ 11.98 hrs, Volume= 1.606 af, Depth= 1.88"
Routed to Pond DP-10 : DETENTION POND 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

	Area (ac)	CN	Description
	3.393	79	50-75% Grass cover, Fair, HSG C
	1.056	93	Paved roads w/open ditches, 50% imp, HSG D
*	0.712	98	Pond
	5.073	74	>75% Grass cover, Good, HSG C
	10.234	79	Weighted Average
	8.994		87.88% Pervious Area
	1.240		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	150	0.0500	0.59		**Sheet Flow, AB** Fallow n= 0.050 P2= 2.70"
0.2	85	0.1600	6.44		**Shallow Concentrated Flow, Segment BC** Unpaved Kv= 16.1 fps
2.5	625	0.0800	4.24		**Shallow Concentrated Flow, CD** Grassed Waterway Kv= 15.0 fps
6.9	860	Total			

Summary for Subcatchment 4R: SC-4R

Runoff = 8.32 cfs @ 12.03 hrs, Volume= 0.479 af, Depth= 1.88"
Routed to Pond DP-11R : DETENTION POND 11R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

Area (ac)	CN	Description
0.757	93	Paved roads w/open ditches, 50% imp, HSG D
2.296	74	>75% Grass cover, Good, HSG C
3.053	79	Weighted Average
2.674		87.60% Pervious Area
0.378		12.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	37	0.0200	1.04		**Sheet Flow, AB** Smooth surfaces n= 0.011 P2= 2.70"
0.4	215	0.3300	9.25		**Shallow Concentrated Flow, Segment BC** Unpaved Kv= 16.1 fps
10.4	338	0.0060	0.54		**Shallow Concentrated Flow, CD** Short Grass Pasture Kv= 7.0 fps
11.4	590	Total			

Summary for Subcatchment 5: SC-5

Runoff = 13.69 cfs @ 14.32 hrs, Volume= 5.412 af, Depth= 1.66"
Routed to Reach AP5 : AP-5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Storm Rainfall=3.90"

Area (ac)	CN	Description
7.260	70	Woods, Good, HSG C
31.520	77	Woods, Good, HSG D
0.290	93	Paved roads w/open ditches, 50% imp, HSG D
39.070	76	Weighted Average
38.925		99.63% Pervious Area
0.145		0.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.9	150	0.0130	0.04		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
122.7	1,930	0.0110	0.26		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
2.5	275		1.80		**Direct Entry, Segment C-D (STWC, 0.007)**
192.1	2,355	Total			

Summary for Reach 1: Analysis Point 1

Inflow Area = 145.103 ac, 3.22% Impervious, Inflow Depth > 1.46" for 10-yr Storm event
Inflow = 72.63 cfs @ 12.71 hrs, Volume= 17.639 af
Outflow = 72.63 cfs @ 12.71 hrs, Volume= 17.639 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach 7R: SOUTH ACCESS RD DITCH

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 1.45" for 10-yr Storm event
Inflow = 12.24 cfs @ 12.08 hrs, Volume= 0.682 af
Outflow = 11.96 cfs @ 12.10 hrs, Volume= 0.682 af, Atten= 2%, Lag= 1.3 min
Routed to Pond 12P : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.92 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.57 fps, Avg. Travel Time= 2.8 min

Peak Storage= 540 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.51' , Surface Width= 5.05'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 173.05 cfs

3.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 262.0' Slope= 0.0271 '/'
Inlet Invert= 205.00', Outlet Invert= 197.90'

Summary for Reach 9R: LEVEL SPREADER DISCHARGE

Inflow Area = 30.022 ac, 9.91% Impervious, Inflow Depth > 0.85" for 10-yr Storm event
Inflow = 0.82 cfs @ 24.20 hrs, Volume= 2.133 af
Outflow = 0.82 cfs @ 24.83 hrs, Volume= 2.125 af, Atten= 0%, Lag= 38.2 min
Routed to Reach E1R7 : REACH TO AP

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Max. Velocity= 0.16 fps, Min. Travel Time= 28.2 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 51.1 min

Peak Storage= 1,379 cf @ 24.36 hrs
Average Depth at Peak Storage= 0.23' , Surface Width= 24.54'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 11.46 cfs

20.00' x 1.00' deep channel, n= 0.800 Sheet flow: Woods+dense brush
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 273.0' Slope= 0.0623 '/'
Inlet Invert= 180.00', Outlet Invert= 163.00'

‡

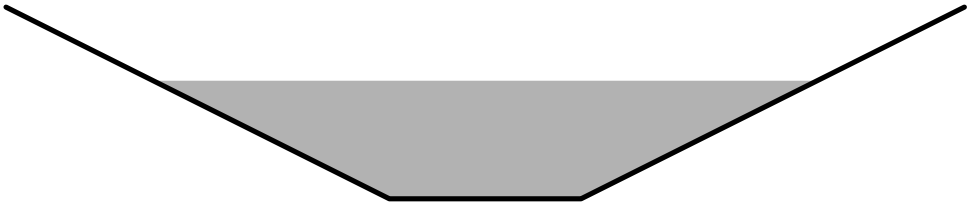
Summary for Reach 12R: Ditch 4B1

Inflow Area = 14.437 ac, 3.03% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 24.63 cfs @ 12.08 hrs, Volume= 1.671 af
Outflow = 24.01 cfs @ 12.12 hrs, Volume= 1.671 af, Atten= 3%, Lag= 2.5 min
Routed to Pond DP-9 : DETENTION POND 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.46 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 3.7 min

Peak Storage= 1,938 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.23' , Surface Width= 6.93'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 70.02 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 352.0' Slope= 0.0085 '/'
Inlet Invert= 213.50', Outlet Invert= 210.50'



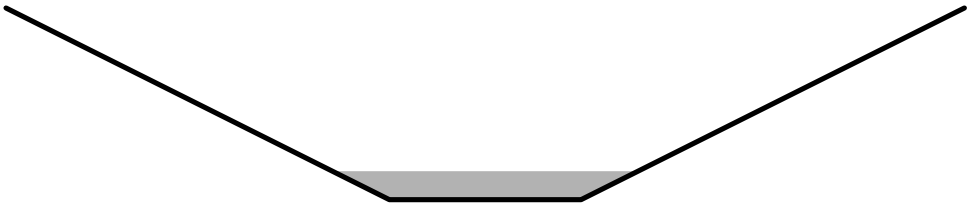
Summary for Reach 13R: Ex Ditch

Inflow Area = 0.679 ac, 6.77% Impervious, Inflow Depth = 1.38" for 10-yr Storm event
Inflow = 1.93 cfs @ 11.93 hrs, Volume= 0.078 af
Outflow = 1.73 cfs @ 11.97 hrs, Volume= 0.078 af, Atten= 11%, Lag= 2.3 min
Routed to Pond C4B : Culvert - 4BA & 4BB

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.40 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 5.9 min

Peak Storage= 175 cf @ 11.94 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 3.19'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 81.05 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 225.0' Slope= 0.0164 '/'
Inlet Invert= 209.70', Outlet Invert= 206.00'



Summary for Reach AP2: ANALYSIS POINT #2

Inflow Area = 79.534 ac, 4.18% Impervious, Inflow Depth = 1.49" for 10-yr Storm event
Inflow = 19.98 cfs @ 13.90 hrs, Volume= 9.856 af
Outflow = 19.98 cfs @ 13.90 hrs, Volume= 9.856 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP3: ANALYSIS POINT #3

Inflow Area = 265.594 ac, 1.09% Impervious, Inflow Depth = 1.46" for 10-yr Storm event
Inflow = 68.13 cfs @ 15.21 hrs, Volume= 32.228 af
Outflow = 68.13 cfs @ 15.21 hrs, Volume= 32.228 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP4: AP4

Inflow Area = 326.605 ac, 3.82% Impervious, Inflow Depth > 1.51" for 10-yr Storm event
Inflow = 54.33 cfs @ 16.22 hrs, Volume= 41.205 af
Outflow = 54.33 cfs @ 16.22 hrs, Volume= 41.205 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP5: AP-5

Inflow Area = 39.070 ac, 0.37% Impervious, Inflow Depth = 1.66" for 10-yr Storm event
Inflow = 13.69 cfs @ 14.32 hrs, Volume= 5.412 af
Outflow = 13.69 cfs @ 14.32 hrs, Volume= 5.412 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach E1R6: DP-10 DISCHARGE

Inflow Area = 34.949 ac, 6.10% Impervious, Inflow Depth > 1.32" for 10-yr Storm event
Inflow = 3.63 cfs @ 14.10 hrs, Volume= 3.849 af
Outflow = 3.62 cfs @ 14.20 hrs, Volume= 3.847 af, Atten= 0%, Lag= 5.7 min
Routed to Reach E1R7 : REACH TO AP

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.77 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 7.9 min

Peak Storage= 733 cf @ 14.14 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 21.96'
Bank-Full Depth= 2.00' Flow Area= 80.0 sf, Capacity= 827.94 cfs

20.00' x 2.00' deep channel, n= 0.045
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 357.0' Slope= 0.0672 '/'
Inlet Invert= 178.00', Outlet Invert= 154.00'

‡

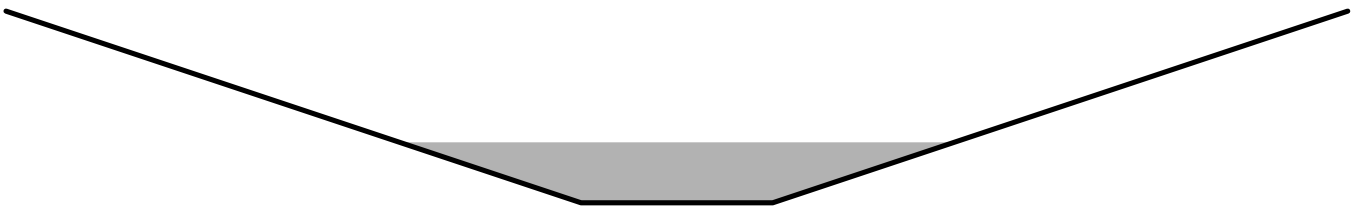
Summary for Reach E1R7: REACH TO AP

Inflow Area = 64.971 ac, 7.86% Impervious, Inflow Depth > 1.10" for 10-yr Storm event
Inflow = 3.89 cfs @ 14.49 hrs, Volume= 5.972 af
Outflow = 3.83 cfs @ 15.27 hrs, Volume= 5.957 af, Atten= 2%, Lag= 46.8 min
Routed to Reach AP4 : AP4

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.56 fps, Min. Travel Time= 23.1 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 44.4 min

Peak Storage= 5,312 cf @ 14.89 hrs
Average Depth at Peak Storage= 0.63' , Surface Width= 5.78'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 48.12 cfs

2.00' x 2.00' deep channel, n= 0.045 Winding stream, pools & shoals
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 2,170.0' Slope= 0.0074 '/'
Inlet Invert= 158.00', Outlet Invert= 142.00'



Summary for Reach O4: Overland Flow

Inflow Area = 3.101 ac, 10.32% Impervious, Inflow Depth = 1.77" for 10-yr Storm event
Inflow = 7.26 cfs @ 12.05 hrs, Volume= 0.458 af
Outflow = 7.21 cfs @ 12.05 hrs, Volume= 0.458 af, Atten= 1%, Lag= 0.5 min
Routed to Pond DP-9 : DETENTION POND 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.99 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 9.99 fps, Avg. Travel Time= 0.3 min

Peak Storage= 122 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 119.87 cfs

Custom stage-perimeter table, n= 0.035 Earth, dense weeds
100 Intermediate values determined by Multi-point interpolation
Length= 168.0' Slope= 0.0554 '/'
Inlet Invert= 201.30', Outlet Invert= 192.00'

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
2.00	12.0	12.0	2,016	119.87

Summary for Reach R-10a: R-10a

Inflow Area = 13.052 ac, 3.54% Impervious, Inflow Depth = 1.30" for 10-yr Storm event
Inflow = 17.93 cfs @ 12.07 hrs, Volume= 1.416 af
Outflow = 17.28 cfs @ 12.14 hrs, Volume= 1.416 af, Atten= 4%, Lag= 4.1 min
Routed to Pond DP-10 : DETENTION POND 10

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.73 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.63 fps, Avg. Travel Time= 6.6 min

Peak Storage= 2,375 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.63' , Surface Width= 7.78'
Bank-Full Depth= 3.00' Flow Area= 39.0 sf, Capacity= 437.98 cfs

4.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 641.0' Slope= 0.0137 '/'
Inlet Invert= 194.00', Outlet Invert= 185.25'

‡

Summary for Reach R-1B: LF TOE DITCH

Inflow Area = 19.514 ac, 4.11% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 34.92 cfs @ 12.08 hrs, Volume= 2.261 af
Outflow = 33.52 cfs @ 12.13 hrs, Volume= 2.261 af, Atten= 4%, Lag= 3.1 min
Routed to Pond DP-1 : DETENTION POND 1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.32 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.77 fps, Avg. Travel Time= 5.1 min

Peak Storage= 3,493 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.37' , Surface Width= 7.47'
Defined Flood Depth= 2.00' Flow Area= 12.0 sf, Capacity= 79.00 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 79.00 cfs

2.00' x 2.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 540.0' Slope= 0.0278 '/'
Inlet Invert= 181.00', Outlet Invert= 166.00'

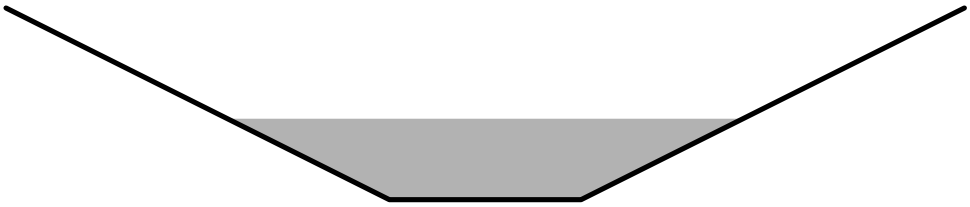
Summary for Reach R-1B1: LF TOE DITCH

Inflow Area = 8.511 ac, 4.70% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 16.03 cfs @ 12.06 hrs, Volume= 0.986 af
Outflow = 15.31 cfs @ 12.10 hrs, Volume= 0.986 af, Atten= 5%, Lag= 2.9 min
Routed to Reach R-1B : LF TOE DITCH

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.00 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 4.8 min

Peak Storage= 1,487 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.84' , Surface Width= 5.38'
Defined Flood Depth= 2.00' Flow Area= 12.0 sf, Capacity= 96.96 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 96.96 cfs

2.00' x 2.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 478.0' Slope= 0.0418 '/'
Inlet Invert= 204.00', Outlet Invert= 184.00'



Summary for Reach R-1D: Reach R-1D

Inflow Area = 41.304 ac, 3.35% Impervious, Inflow Depth > 1.30" for 10-yr Storm event
Inflow = 22.23 cfs @ 12.32 hrs, Volume= 4.476 af
Outflow = 21.25 cfs @ 12.41 hrs, Volume= 4.475 af, Atten= 4%, Lag= 5.5 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.45 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 12.2 min

Peak Storage= 3,226 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.56' , Surface Width= 21.19'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 67.93 cfs

10.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 370.0' Slope= 0.0324 '/'
Inlet Invert= 159.00', Outlet Invert= 147.00'

‡

Summary for Reach R-1E: Plastic Lined Ditch

Inflow Area = 9.580 ac, 2.92% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 18.64 cfs @ 12.05 hrs, Volume= 1.110 af
Outflow = 18.46 cfs @ 12.05 hrs, Volume= 1.110 af, Atten= 1%, Lag= 0.4 min
Routed to Pond DP-1a : DP-1a

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.67 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.73 fps, Avg. Travel Time= 0.9 min

Peak Storage= 294 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.32' , Surface Width= 5.27'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 1,302.19 cfs

4.00' x 3.00' deep channel, n= 0.011
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0500 '/'
Inlet Invert= 176.00', Outlet Invert= 166.00'

Summary for Reach R-1F: Reach R-1F

Inflow Area = 9.875 ac, 0.07% Impervious, Inflow Depth = 1.35" for 10-yr Storm event
Inflow = 6.22 cfs @ 12.15 hrs, Volume= 1.110 af
Outflow = 6.21 cfs @ 12.21 hrs, Volume= 1.110 af, Atten= 0%, Lag= 3.8 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.66 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 8.3 min

Peak Storage= 784 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 23.44'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 140.14 cfs

20.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 210.0' Slope= 0.0524 '/'
Inlet Invert= 158.00', Outlet Invert= 147.00'

‡

Summary for Reach R-1G: RipRap Downspout

Inflow Area = 1.772 ac, 0.00% Impervious, Inflow Depth = 1.38" for 10-yr Storm event
Inflow = 2.75 cfs @ 12.06 hrs, Volume= 0.205 af
Outflow = 2.66 cfs @ 12.13 hrs, Volume= 0.205 af, Atten= 3%, Lag= 3.9 min
Routed to Pond DP-2 : DETENTION POND 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.64 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.21 fps, Avg. Travel Time= 6.8 min

Peak Storage= 364 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 4.68'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 368.81 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 493.0' Slope= 0.3428 '/'
Inlet Invert= 333.00', Outlet Invert= 164.00'

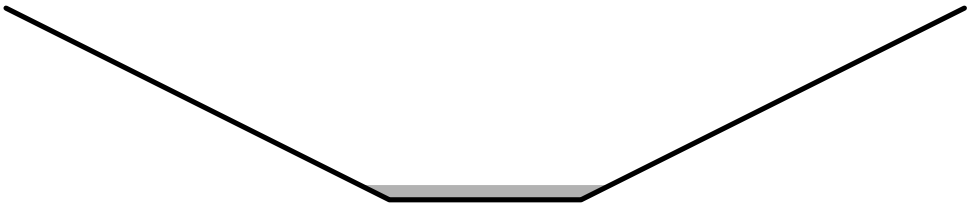
Summary for Reach R-1I: Final Cover Access Road Ditch

Inflow = 0.78 cfs @ 12.06 hrs, Volume= 0.011 af
Outflow = 0.56 cfs @ 12.21 hrs, Volume= 0.011 af, Atten= 28%, Lag= 9.1 min
Routed to Pond P-1I : Culvert Crossing 6c

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.60 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 15.0 min

Peak Storage= 185 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.15' , Surface Width= 2.61'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 80.08 cfs

2.00' x 2.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 524.0' Slope= 0.0849 '/'
Inlet Invert= 335.00', Outlet Invert= 290.50'



Summary for Reach R-1J: RipRap Downspout

Inflow Area = 4.295 ac, 2.58% Impervious, Inflow Depth = 1.38" for 10-yr Storm event
Inflow = 9.02 cfs @ 11.96 hrs, Volume= 0.495 af
Outflow = 8.80 cfs @ 11.97 hrs, Volume= 0.495 af, Atten= 2%, Lag= 0.8 min
Routed to Pond P-1J-1 : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.72 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.63 fps, Avg. Travel Time= 1.7 min

Peak Storage= 257 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 5.34'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 387.31 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 164.0' Slope= 0.3780 '/'
Inlet Invert= 252.00', Outlet Invert= 190.00'

Summary for Reach R-1L: Final Cover Access Road Ditch

Inflow = 3.11 cfs @ 11.96 hrs, Volume= 0.027 af
Outflow = 2.01 cfs @ 12.06 hrs, Volume= 0.027 af, Atten= 35%, Lag= 6.3 min
Routed to Pond 1P : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.45 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 15.2 min

Peak Storage= 502 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.34' , Surface Width= 3.34'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 77.46 cfs

2.00' x 2.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 560.0' Slope= 0.0795 '/'
Inlet Invert= 254.50', Outlet Invert= 210.00'

Summary for Reach R-1N: R-1N

Inflow Area = 27.235 ac, 7.11% Impervious, Inflow Depth = 1.28" for 10-yr Storm event
Inflow = 1.19 cfs @ 19.28 hrs, Volume= 2.901 af
Outflow = 1.19 cfs @ 19.82 hrs, Volume= 2.901 af, Atten= 0%, Lag= 32.5 min
Routed to Reach R-1O : R-1O

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.79 fps, Min. Travel Time= 19.8 min
Avg. Velocity = 0.37 fps, Avg. Travel Time= 42.4 min

Peak Storage= 1,412 cf @ 19.49 hrs
Average Depth at Peak Storage= 0.13' , Surface Width= 12.65'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 49.97 cfs

10.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 940.0' Slope= 0.0176 '/'
Inlet Invert= 168.00', Outlet Invert= 151.50'

‡

Summary for Reach R-1O: R-1O

Inflow Area = 58.266 ac, 5.06% Impervious, Inflow Depth = 1.52" for 10-yr Storm event
Inflow = 37.78 cfs @ 12.38 hrs, Volume= 7.385 af
Outflow = 35.67 cfs @ 12.59 hrs, Volume= 7.385 af, Atten= 6%, Lag= 12.8 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.73 fps, Min. Travel Time= 7.1 min
Avg. Velocity = 0.35 fps, Avg. Travel Time= 34.8 min

Peak Storage= 15,244 cf @ 12.47 hrs
Average Depth at Peak Storage= 1.02' , Surface Width= 30.49'
Bank-Full Depth= 2.00' Flow Area= 60.0 sf, Capacity= 151.21 cfs

10.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 10.0 '/' Top Width= 50.00'
Length= 735.0' Slope= 0.0020 '/'
Inlet Invert= 151.50', Outlet Invert= 150.00'

‡

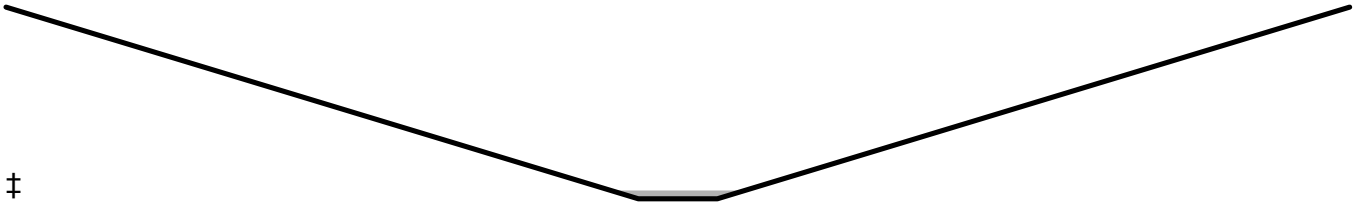
Summary for Reach R-2A: Reach 2A

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 1.43" for 10-yr Storm event
Inflow = 1.43 cfs @ 18.64 hrs, Volume= 3.756 af
Outflow = 1.42 cfs @ 20.22 hrs, Volume= 3.756 af, Atten= 0%, Lag= 95.2 min
Routed to Reach AP2 : ANALYSIS POINT #2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.48 fps, Min. Travel Time= 56.2 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 76.1 min

Peak Storage= 4,798 cf @ 19.29 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 42.41'
Bank-Full Depth= 2.00' Flow Area= 450.0 sf, Capacity= 1,332.75 cfs

25.00' x 2.00' deep channel, n= 0.050 Scattered brush, heavy weeds
Side Slope Z-value= 100.0 '/' Top Width= 425.00'
Length= 1,630.0' Slope= 0.0092 '/'
Inlet Invert= 166.00', Outlet Invert= 151.00'



‡

Summary for Reach R-2C: LF TOE DITCH

Inflow Area = 9.740 ac, 3.67% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 17.76 cfs @ 12.06 hrs, Volume= 1.129 af
Outflow = 16.84 cfs @ 12.14 hrs, Volume= 1.129 af, Atten= 5%, Lag= 4.5 min
Routed to Pond CB-2E : LF TOE DITCH - CATCH BASIN

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.81 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 7.7 min

Peak Storage= 2,503 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.55' , Surface Width= 9.20'
Defined Flood Depth= 2.00' Flow Area= 14.0 sf, Capacity= 29.12 cfs
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 70.39 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 265.0' Slope= 0.0075 '/'
Inlet Invert= 181.00', Outlet Invert= 179.00'

Summary for Reach R-2D: DITCH

Inflow Area = 9.297 ac, 3.94% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 16.93 cfs @ 12.07 hrs, Volume= 1.074 af
Outflow = 16.49 cfs @ 12.10 hrs, Volume= 1.074 af, Atten= 3%, Lag= 1.8 min
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.60 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.21 fps, Avg. Travel Time= 3.1 min

Peak Storage= 1,045 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.95' , Surface Width= 6.80'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 183.17 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 225.0' Slope= 0.0511 '/'
Inlet Invert= 191.50', Outlet Invert= 180.00'

Summary for Reach R-4B: R-4B

Inflow Area = 4.602 ac, 9.82% Impervious, Inflow Depth = 1.52" for 10-yr Storm event
Inflow = 9.69 cfs @ 12.05 hrs, Volume= 0.584 af
Outflow = 6.58 cfs @ 12.35 hrs, Volume= 0.584 af, Atten= 32%, Lag= 18.2 min
Routed to Pond CB-4C : LT TOE DITCH - CATCH BASIN

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.39 fps, Min. Travel Time= 12.0 min
Avg. Velocity = 0.37 fps, Avg. Travel Time= 45.7 min

Peak Storage= 4,758 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.96' , Surface Width= 6.84'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 69.96 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,006.0' Slope= 0.0075 '/'
Inlet Invert= 178.50', Outlet Invert= 171.00'

Summary for Reach R-IH: RipRap Downspout

Inflow Area = 3.906 ac, 1.97% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 7.21 cfs @ 12.02 hrs, Volume= 0.453 af
Outflow = 7.22 cfs @ 12.03 hrs, Volume= 0.453 af, Atten= 0%, Lag= 0.7 min
Routed to Pond P-1H : Modified Plunge Pool w/(2)24" Culverts P-6a

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.34 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.48 fps, Avg. Travel Time= 2.9 min

Peak Storage= 354 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 5.20'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 385.75 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 256.0' Slope= 0.3750 '/'
Inlet Invert= 286.00', Outlet Invert= 190.00'

Summary for Reach R2: Reach 2

Inflow Area = 122.225 ac, 3.55% Impervious, Inflow Depth > 1.45" for 10-yr Storm event
Inflow = 64.41 cfs @ 12.52 hrs, Volume= 14.741 af
Outflow = 62.80 cfs @ 12.69 hrs, Volume= 14.741 af, Atten= 2%, Lag= 10.0 min
Routed to Reach 1 : Analysis Point 1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.31 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 23.4 min

Peak Storage= 19,061 cf @ 12.60 hrs
Average Depth at Peak Storage= 1.22' , Surface Width= 34.48'
Bank-Full Depth= 2.00' Flow Area= 60.0 sf, Capacity= 183.33 cfs

10.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 10.0 '/' Top Width= 50.00'
Length= 700.0' Slope= 0.0030 '/'
Inlet Invert= 148.40', Outlet Invert= 146.30'

‡

Summary for Reach R4B4:

Inflow Area = 54.320 ac, 3.83% Impervious, Inflow Depth = 1.44" for 10-yr Storm event
Inflow = 4.31 cfs @ 23.80 hrs, Volume= 6.530 af
Outflow = 4.31 cfs @ 24.39 hrs, Volume= 6.530 af, Atten= 0%, Lag= 34.9 min
Routed to Reach AP4 : AP4

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.78 fps, Min. Travel Time= 20.5 min
Avg. Velocity = 0.29 fps, Avg. Travel Time= 56.1 min

Peak Storage= 5,292 cf @ 24.05 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 19.07'
Bank-Full Depth= 2.00' Flow Area= 64.0 sf, Capacity= 131.94 cfs

12.00' x 2.00' deep channel, n= 0.080
Side Slope Z-value= 10.0 '/' Top Width= 52.00'
Length= 963.0' Slope= 0.0094 '/'
Inlet Invert= 142.00', Outlet Invert= 132.96'

‡

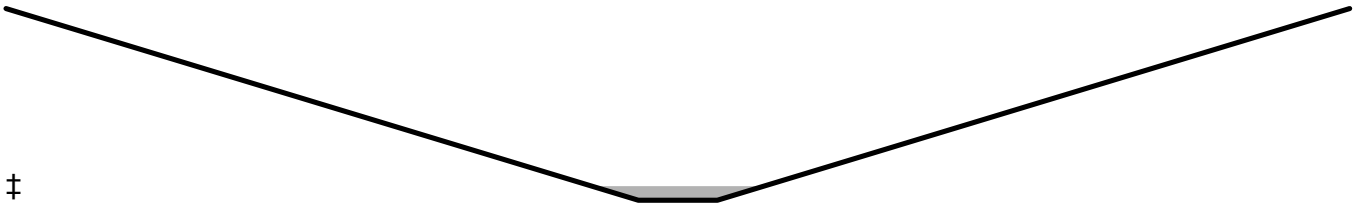
Summary for Reach R4C: Reach 4C

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 1.50" for 10-yr Storm event
Inflow = 1.97 cfs @ 13.29 hrs, Volume= 1.435 af
Outflow = 1.91 cfs @ 15.45 hrs, Volume= 1.435 af, Atten= 3%, Lag= 129.9 min
Routed to Reach R4C1 : Reach 4C1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.32 fps, Min. Travel Time= 49.8 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 99.5 min

Peak Storage= 5,697 cf @ 14.62 hrs
Average Depth at Peak Storage= 0.15' , Surface Width= 54.50'
Bank-Full Depth= 2.00' Flow Area= 450.0 sf, Capacity= 669.12 cfs

25.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 425.00'
Length= 970.0' Slope= 0.0093 '/'
Inlet Invert= 159.00', Outlet Invert= 150.00'



‡

Summary for Reach R4C1: Reach 4C1

Inflow Area = 24.911 ac, 5.27% Impervious, Inflow Depth = 1.44" for 10-yr Storm event
Inflow = 3.10 cfs @ 15.58 hrs, Volume= 2.987 af
Outflow = 2.58 cfs @ 23.02 hrs, Volume= 2.987 af, Atten= 17%, Lag= 446.9 min
Routed to Reach R4C2 : Reach 4C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.19 fps, Min. Travel Time= 196.5 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 467.5 min

Peak Storage= 30,413 cf @ 19.75 hrs
Average Depth at Peak Storage= 0.12' , Surface Width= 124.22'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 562.82 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 2,240.0' Slope= 0.0031 '/'
Inlet Invert= 150.00', Outlet Invert= 143.00'

‡

Summary for Reach R4C2: Reach 4C2

Inflow Area = 54.320 ac, 3.83% Impervious, Inflow Depth = 1.44" for 10-yr Storm event
Inflow = 4.32 cfs @ 22.76 hrs, Volume= 6.530 af
Outflow = 4.31 cfs @ 23.80 hrs, Volume= 6.530 af, Atten= 0%, Lag= 62.4 min
Routed to Reach R4B4 :

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.20 fps, Min. Travel Time= 36.4 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 88.8 min

Peak Storage= 9,414 cf @ 23.20 hrs
Average Depth at Peak Storage= 0.18' , Surface Width= 135.87'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 477.27 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 445.0' Slope= 0.0022 '/'
Inlet Invert= 143.00', Outlet Invert= 142.00'

‡

Summary for Reach R4D: Reach 4D

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 1.38" for 10-yr Storm event
Inflow = 1.21 cfs @ 14.17 hrs, Volume= 1.551 af
Outflow = 1.20 cfs @ 16.05 hrs, Volume= 1.551 af, Atten= 1%, Lag= 112.4 min
Routed to Reach R4C1 : Reach 4C1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.21 fps, Min. Travel Time= 48.3 min
Avg. Velocity = 0.15 fps, Avg. Travel Time= 66.3 min

Peak Storage= 3,482 cf @ 15.24 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 110.90'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 1,002.64 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 605.0' Slope= 0.0099 '/'
Inlet Invert= 156.00', Outlet Invert= 150.00'

‡

Summary for Reach R4G: Reach 4G

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 1.45" for 10-yr Storm event
Inflow = 1.86 cfs @ 15.94 hrs, Volume= 3.543 af
Outflow = 1.86 cfs @ 16.23 hrs, Volume= 3.543 af, Atten= 0%, Lag= 17.6 min
Routed to Reach R4C2 : Reach 4C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.56 fps, Min. Travel Time= 10.7 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 14.4 min

Peak Storage= 1,194 cf @ 16.06 hrs
Average Depth at Peak Storage= 0.15' , Surface Width= 23.06'
Bank-Full Depth= 2.00' Flow Area= 80.0 sf, Capacity= 199.54 cfs

20.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 363.0' Slope= 0.0193 '/'
Inlet Invert= 150.00', Outlet Invert= 143.00'

‡

Summary for Pond 1P: (2) 24" CULVERTS

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 1.45" for 10-yr Storm event
Inflow = 12.73 cfs @ 12.06 hrs, Volume= 0.682 af
Outflow = 12.24 cfs @ 12.08 hrs, Volume= 0.682 af, Atten= 4%, Lag= 1.4 min
Primary = 12.24 cfs @ 12.08 hrs, Volume= 0.682 af
Routed to Reach 7R : SOUTH ACCESS RD DITCH
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 7R : SOUTH ACCESS RD DITCH

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 207.16' @ 12.08 hrs Surf.Area= 1,422 sf Storage= 1,348 cf
Flood Elev= 210.00' Surf.Area= 3,240 sf Storage= 7,740 cf

Plug-Flow detention time= 5.1 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 5.2 min (858.8 - 853.6)

Volume	Invert	Avail.Storage	Storage Description
#1	206.00'	7,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
206.00	900	0	0
208.00	1,800	2,700	2,700
210.00	3,240	5,040	7,740

Device	Routing	Invert	Outlet Devices
#1	Primary	206.00'	**24.0" Round 24"Culvert (X2) X 2.00** L= 76.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 206.00' / 205.00' S= 0.0132 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	209.60'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=11.91 cfs @ 12.08 hrs HW=207.14' (Free Discharge)
↑—**1=24"Culvert (X2)** (Inlet Controls 11.91 cfs @ 3.21 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=206.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 12P: (2) 24" CULVERTS

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 1.45" for 10-yr Storm event
Inflow = 11.96 cfs @ 12.10 hrs, Volume= 0.682 af
Outflow = 11.64 cfs @ 12.12 hrs, Volume= 0.682 af, Atten= 3%, Lag= 1.3 min
Primary = 11.64 cfs @ 12.12 hrs, Volume= 0.682 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 15P : EXISTING 12" CULVERT

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 199.03' @ 12.12 hrs Surf.Area= 1,362 sf Storage= 939 cf
Flood Elev= 200.50' Surf.Area= 2,548 sf Storage= 3,866 cf

Plug-Flow detention time= 1.6 min calculated for 0.682 af (100% of inflow)
Center-of-Mass det. time= 1.6 min (862.9 - 861.3)

Volume	Invert	Avail.Storage	Storage Description
#1	198.00'	3,866 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
198.00	464	0	0
200.00	2,212	2,676	2,676
200.50	2,548	1,190	3,866

Device	Routing	Invert	Outlet Devices
#1	Primary	197.90'	**24.0" Round 24"Culvert (X2) X 2.00** L= 98.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 197.90' / 195.47' S= 0.0248 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Secondary	200.00'	**14.0' long x 11.0' breadth Broad-Crested Rectangular Weir-Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.53 2.59 2.70 2.68 2.67 2.68 2.66 2.64

Primary OutFlow Max=11.35 cfs @ 12.12 hrs HW=199.01' (Free Discharge)
1=24"Culvert (X2) (Inlet Controls 11.35 cfs @ 3.17 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
2=Broad-Crested Rectangular Weir-Overflow(Controls 0.00 cfs)

Summary for Pond 15P: EXISTING 12" CULVERT

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-6 : DETENTION POND 6

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 198.00' @ 0.00 hrs Surf.Area= 464 sf Storage= 0 cf
Flood Elev= 200.50' Surf.Area= 2,212 sf Storage= 2,676 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	198.00'	2,676 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
198.00	464	0	0
200.00	2,212	2,676	2,676

Device	Routing	Invert	Outlet Devices
#1	Primary	197.40'	**12.0" Round 24"Culvert (X2)** L= 121.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 197.40' / 189.90' S= 0.0620 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Secondary	198.00'	**10.0' long x 50.0' breadth Broad-Crested Rectangular Weir**

Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
└**1=24"Culvert (X2)** (Passes 0.00 cfs of 1.02 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C-4K: Catch Basin - 4K

Inflow Area = 14.437 ac, 3.03% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 24.84 cfs @ 12.08 hrs, Volume= 1.673 af
Outflow = 24.78 cfs @ 12.08 hrs, Volume= 1.672 af, Atten= 0%, Lag= 0.0 min
Primary = 24.63 cfs @ 12.08 hrs, Volume= 1.671 af
Routed to Reach 12R : Ditch 4B1
Secondary = 0.17 cfs @ 12.10 hrs, Volume= 0.001 af
Routed to Pond C-4L : Catch Basin - 4L

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 220.15' @ 12.08 hrs Surf.Area= 13 sf Storage= 57 cf

Plug-Flow detention time= 0.5 min calculated for 1.672 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (861.6 - 861.5)

Volume	Invert	Avail.Storage	Storage Description
#1	214.50'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	216.50'	**24.0" Round Culvert - 4K** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 216.50' / 214.50' S= 0.0392 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	218.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	220.00'	**2.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=24.24 cfs @ 12.08 hrs HW=220.07' (Free Discharge)
└**1=Culvert - 4K** (Inlet Controls 24.24 cfs @ 7.72 fps)
└**2=Orifice/Grate** (Passes 24.24 cfs of 34.00 cfs potential flow)

Secondary OutFlow Max=0.17 cfs @ 12.10 hrs HW=220.10' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.80 fps)

Summary for Pond C-4L: Catch Basin - 4L

Inflow Area = 0.679 ac, 6.77% Impervious, Inflow Depth = 1.47" for 10-yr Storm event
Inflow = 1.94 cfs @ 11.93 hrs, Volume= 0.083 af
Outflow = 1.93 cfs @ 11.93 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min
Primary = 1.93 cfs @ 11.93 hrs, Volume= 0.078 af
Routed to Reach 13R : Ex Ditch
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 214.71' @ 11.93 hrs Surf.Area= 13 sf Storage= 43 cf

Plug-Flow detention time= 24.4 min calculated for 0.078 af (94% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	210.50'	43 cf	**4.00'D x 3.40'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	212.50'	**18.0" Round Culvert 4L** L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 212.50' / 210.50' S= 0.0165 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	214.50'	**24.0" Horiz. Orifice-Top of catch basin** C= 0.600 Limited to weir flow at low heads
#3	Secondary	215.00'	**15.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.81 cfs @ 11.93 hrs HW=214.70' (Free Discharge)
└**1=Culvert 4L** (Passes 1.81 cfs of 10.24 cfs potential flow)
└**2=Orifice-Top of catch basin** (Weir Controls 1.81 cfs @ 1.46 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=210.50' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C4B: Culvert - 4BA & 4BB

Inflow Area = 3.101 ac, 10.32% Impervious, Inflow Depth = 1.77" for 10-yr Storm event
Inflow = 7.30 cfs @ 12.03 hrs, Volume= 0.458 af
Outflow = 7.26 cfs @ 12.05 hrs, Volume= 0.458 af, Atten= 0%, Lag= 1.0 min
Primary = 7.26 cfs @ 12.05 hrs, Volume= 0.458 af
Routed to Reach O4 : Overland Flow

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 205.32' @ 12.05 hrs Surf.Area= 747 sf Storage= 343 cf

Plug-Flow detention time= 0.7 min calculated for 0.458 af (100% of inflow)
Center-of-Mass det. time= 0.7 min (840.4 - 839.7)

Volume	Invert	Avail.Storage	Storage Description
#1	204.40'	11,690 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
204.40	0	0	0
206.00	1,300	1,040	1,040
208.00	4,200	5,500	6,540
209.00	6,100	5,150	11,690

Device	Routing	Invert	Outlet Devices
#1	Primary	204.40'	**24.0" Round Culvert - 4B X 2.00** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 204.40' / 203.70' S= 0.0152 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf

Primary OutFlow Max=7.21 cfs @ 12.05 hrs HW=205.32' (Free Discharge)
└**1=Culvert - 4B** (Inlet Controls 7.21 cfs @ 2.57 fps)

Summary for Pond CB-2B: LF TOE DITCH - CATCH BASIN

Inflow Area = 9.308 ac, 2.34% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 16.53 cfs @ 12.07 hrs, Volume= 1.078 af
Outflow = 16.60 cfs @ 12.07 hrs, Volume= 1.076 af, Atten= 0%, Lag= 0.0 min
Primary = 16.60 cfs @ 12.07 hrs, Volume= 1.076 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 179.75' @ 12.07 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 1.7 min calculated for 1.076 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (861.2 - 860.6)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	173.00'	**24.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=16.16 cfs @ 12.07 hrs HW=179.73' (Free Discharge)
└**2=Culvert** (Passes 16.16 cfs of 36.22 cfs potential flow)
└**1=Orifice/Grate** (Weir Controls 16.16 cfs @ 2.80 fps)

Summary for Pond CB-2D: LF TOE DITCH - CATCH BASIN

Inflow Area = 9.297 ac, 3.94% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 17.01 cfs @ 12.06 hrs, Volume= 1.077 af
Outflow = 16.93 cfs @ 12.07 hrs, Volume= 1.074 af, Atten= 0%, Lag= 0.1 min
Primary = 16.93 cfs @ 12.07 hrs, Volume= 1.074 af
Routed to Reach R-2D : DITCH

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 201.76' @ 12.07 hrs Surf.Area= 13 sf Storage= 138 cf
Flood Elev= 200.65' Surf.Area= 13 sf Storage= 134 cf

Plug-Flow detention time= 2.3 min calculated for 1.074 af (100% of inflow)
Center-of-Mass det. time= 0.6 min (860.5 - 859.9)

Volume	Invert	Avail.Storage	Storage Description
#1	190.00'	138 cf	**4.00'D x 11.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	201.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	192.00'	**24.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 192.00' / 191.50' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=16.58 cfs @ 12.07 hrs HW=201.75' (Free Discharge)
↑**2=Culvert** (Passes 16.58 cfs of 35.32 cfs potential flow)
↑**1=Orifice/Grate** (Weir Controls 16.58 cfs @ 2.83 fps)

Summary for Pond CB-2E: LF TOE DITCH - CATCH BASIN

Inflow Area = 10.279 ac, 4.18% Impervious, Inflow Depth = 1.40" for 10-yr Storm event
Inflow = 17.07 cfs @ 12.14 hrs, Volume= 1.200 af
Outflow = 17.07 cfs @ 12.14 hrs, Volume= 1.198 af, Atten= 0%, Lag= 0.0 min
Primary = 17.07 cfs @ 12.14 hrs, Volume= 1.198 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 179.76' @ 12.14 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 1.7 min calculated for 1.198 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (866.1 - 865.7)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#2	Primary	173.00'	**24.0" Round Culvert** L= 80.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=16.80 cfs @ 12.14 hrs HW=179.75' (Free Discharge)
↑—**2=Culvert** (Passes 16.80 cfs of 36.28 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 16.80 cfs @ 2.84 fps)

Summary for Pond CB-4C: LT TOE DITCH - CATCH BASIN

Inflow Area = 10.458 ac, 9.73% Impervious, Inflow Depth = 1.52" for 10-yr Storm event
Inflow = 14.38 cfs @ 12.02 hrs, Volume= 1.328 af
Outflow = 14.39 cfs @ 12.02 hrs, Volume= 1.326 af, Atten= 0%, Lag= 0.0 min
Primary = 14.39 cfs @ 12.02 hrs, Volume= 1.326 af
Routed to Pond DP-13 : DETENTION POND 13

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.68' @ 12.02 hrs Surf.Area= 13 sf Storage= 84 cf
Flood Elev= 174.00' Surf.Area= 13 sf Storage= 88 cf

Plug-Flow detention time= 1.7 min calculated for 1.326 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (867.3 - 867.0)

Volume	Invert	Avail.Storage	Storage Description
#1	165.00'	88 cf	**4.00'D x 7.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	171.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	167.00'	**24.0" Round Culvert** L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 167.00' / 166.50' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=13.97 cfs @ 12.02 hrs HW=171.67' (Free Discharge)
↑—**2=Culvert** (Passes 13.97 cfs of 28.96 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 13.97 cfs @ 2.67 fps)

Summary for Pond CB-4D: LF TOE DITCH - CATCH BASINS

Inflow Area = 12.095 ac, 2.44% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 26.16 cfs @ 12.01 hrs, Volume= 1.401 af
Outflow = 26.17 cfs @ 12.01 hrs, Volume= 1.400 af, Atten= 0%, Lag= 0.0 min
Primary = 26.17 cfs @ 12.01 hrs, Volume= 1.400 af
Routed to Pond DP-14 : DETENTION POND 14

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 161.14' @ 12.01 hrs Surf.Area= 13 sf Storage= 57 cf
Flood Elev= 162.00' Surf.Area= 13 sf Storage= 57 cf

Plug-Flow detention time= 0.7 min calculated for 1.400 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (855.8 - 855.6)

Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	160.50'	**30.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	158.00'	**24.0" Round Culvert X 2.00** L= 54.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 158.00' / 157.50' S= 0.0092 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=25.52 cfs @ 12.01 hrs HW=161.13' (Free Discharge)
↑**2=Culvert** (Passes 25.52 cfs of 43.57 cfs potential flow)
↑**1=Orifice/Grate** (Weir Controls 25.52 cfs @ 2.59 fps)

Summary for Pond CB-4G: Catch Basin - 4G

Inflow Area = 11.260 ac, 1.95% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 20.53 cfs @ 12.06 hrs, Volume= 1.305 af
Outflow = 20.52 cfs @ 12.07 hrs, Volume= 1.304 af, Atten= 0%, Lag= 0.0 min
Primary = 20.52 cfs @ 12.07 hrs, Volume= 1.304 af
Routed to Pond DP-11R : DETENTION POND 11R

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 163.84' @ 12.07 hrs Surf.Area= 13 sf Storage= 61 cf
Flood Elev= 170.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 0.4 min calculated for 1.304 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (860.1 - 860.0)

Volume	Invert	Avail.Storage	Storage Description
#1	159.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	161.00'	**24.0" Round Culvert** L= 115.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 161.00' / 160.00' S= 0.0087 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 3.14 sf
#2	Primary	167.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=20.09 cfs @ 12.07 hrs HW=163.76' (Free Discharge)
↑**1=Culvert** (Inlet Controls 20.09 cfs @ 6.40 fps)
2=Orifice/Grate (Controls 0.00 cfs)

Summary for Pond CB-4H: Catch Basin - 4H

Inflow Area = 15.096 ac, 1.13% Impervious, Inflow Depth = 1.40" for 10-yr Storm event
Inflow = 27.85 cfs @ 12.06 hrs, Volume= 1.762 af
Outflow = 27.74 cfs @ 12.06 hrs, Volume= 1.760 af, Atten= 0%, Lag= 0.1 min
Primary = 27.74 cfs @ 12.06 hrs, Volume= 1.760 af
Routed to Pond DP-11R : DETENTION POND 11R
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond CB-4G : Catch Basin - 4G

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 182.38' @ 12.06 hrs Surf.Area= 13 sf Storage= 113 cf
Flood Elev= 183.00' Surf.Area= 13 sf Storage= 113 cf

Plug-Flow detention time= 1.2 min calculated for 1.759 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (854.7 - 854.3)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	113 cf	**4.00'D x 9.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	**24.0" Round Culvert** L= 65.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.00' S= 0.0308 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	181.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	183.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=27.45 cfs @ 12.06 hrs HW=182.35' (Free Discharge)
↑└**1=Culvert** (Passes 27.45 cfs of 41.01 cfs potential flow)
↑└**2=Orifice/Grate** (Orifice Controls 27.45 cfs @ 5.59 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=172.00' (Free Discharge)
↑└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond CB-4I: Catch Basin - 4I

Inflow Area = 13.052 ac, 3.54% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 23.44 cfs @ 12.07 hrs, Volume= 1.512 af
Outflow = 23.46 cfs @ 12.07 hrs, Volume= 1.510 af, Atten= 0%, Lag= 0.0 min
Primary = 17.93 cfs @ 12.07 hrs, Volume= 1.416 af
Routed to Reach R-10a : R-10a
Secondary = 5.53 cfs @ 12.07 hrs, Volume= 0.094 af
Routed to Pond CB-4H : Catch Basin - 4H

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 208.37' @ 12.07 hrs Surf.Area= 13 sf Storage= 105 cf
Flood Elev= 209.90' Surf.Area= 13 sf Storage= 121 cf

Plug-Flow detention time= 1.2 min calculated for 1.509 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (860.7 - 860.3)

Volume	Invert	Avail.Storage	Storage Description
#1	200.00'	121 cf	**4.00'D x 9.60'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	200.00'	**24.0" Round NEW 24-INCH** L= 67.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 194.00' S= 0.0896 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	207.58'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	208.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=17.58 cfs @ 12.07 hrs HW=208.36' (Free Discharge)
└**1=NEW 24-INCH** (Passes 17.58 cfs of 41.03 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 17.58 cfs @ 2.88 fps)

Secondary OutFlow Max=5.26 cfs @ 12.07 hrs HW=208.36' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 5.26 cfs @ 1.47 fps)

Summary for Pond CB-4JA: Catch Basin - 4JA

Inflow Area = 11.663 ac, 3.68% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 15.93 cfs @ 12.17 hrs, Volume= 1.351 af
Outflow = 15.90 cfs @ 12.18 hrs, Volume= 1.349 af, Atten= 0%, Lag= 0.1 min
Primary = 15.90 cfs @ 12.18 hrs, Volume= 1.349 af
Routed to Pond DP-10 : DETENTION POND 10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond CB-4JA3 : (4JA3) New Catch Basin

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 219.43' @ 12.18 hrs Surf.Area= 13 sf Storage= 88 cf

Plug-Flow detention time= 1.2 min calculated for 1.349 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (868.8 - 868.5)

Volume	Invert	Avail.Storage	Storage Description
#1	211.00'	88 cf	**4.00'D x 7.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	213.00'	**18.0" Round Culvert - 4JA** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 213.00' / 212.20' S= 0.0143 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	218.70'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	220.00'	**2.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=15.71 cfs @ 12.18 hrs HW=219.42' (Free Discharge)
└**1=Culvert - 4JA** (Passes 15.71 cfs of 20.26 cfs potential flow)
└**2=Orifice/Grate** (Weir Controls 15.71 cfs @ 2.78 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=211.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Pond CB-4JA3: (4JA3) New Catch Basin

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-10 : DETENTION POND 10
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond PS11 : Culvert - 4IA(C11 PS)

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 202.90' @ 0.00 hrs Surf.Area= 0.000 ac Storage= 0.000 af
Flood Elev= 215.00' Surf.Area= 0.000 ac Storage= 0.003 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	202.90'	0.003 af	**4.00'D x 10.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	204.90'	**18.0" Round NEW 24-INCH** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 204.90' / 204.00' S= 0.0150 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	212.90'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	212.90'	**2.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=202.90' (Free Discharge)
└**1=NEW 24-INCH** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=202.90' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-1: DETENTION POND 1

Inflow Area = 41.304 ac, 3.35% Impervious, Inflow Depth > 1.35" for 10-yr Storm event
Inflow = 53.86 cfs @ 12.10 hrs, Volume= 4.659 af
Outflow = 22.23 cfs @ 12.32 hrs, Volume= 4.476 af, Atten= 59%, Lag= 13.5 min
Primary = 22.23 cfs @ 12.32 hrs, Volume= 4.476 af
Routed to Reach R-1D : Reach R-1D
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-1D : Reach R-1D

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 164.20' @ 12.32 hrs Surf.Area= 17,516 sf Storage= 58,540 cf
Flood Elev= 166.00' Surf.Area= 21,310 sf Storage= 93,390 cf

Plug-Flow detention time= 596.4 min calculated for 4.474 af (96% of inflow)
Center-of-Mass det. time= 514.0 min (1,503.7 - 989.6)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	115,245 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	10,750	0	0
162.00	13,540	24,290	24,290
164.00	17,070	30,610	54,900
165.00	19,300	18,185	73,085
166.00	21,310	20,305	93,390
167.00	22,400	21,855	115,245

Device	Routing	Invert	Outlet Devices
#1	Primary	159.80'	**30.0" Round Culvert** L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 159.80' / 159.35' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf
#2	Device 1	160.60'	**3.0" Vert. Orifice on side** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.70'	**72.0" Horiz. Orifice-Top of drop inlet** C= 0.600 Limited to weir flow at low heads
#4	Secondary	166.30'	**40.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=21.61 cfs @ 12.32 hrs HW=164.19' (Free Discharge)
└**1=Culvert** (Passes 21.61 cfs of 33.07 cfs potential flow)
  ├**2=Orifice on side** (Orifice Controls 0.44 cfs @ 8.96 fps)
  └**3=Orifice-Top of drop inlet** (Weir Controls 21.17 cfs @ 2.29 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-10: DETENTION POND 10

Inflow Area = 34.949 ac, 6.10% Impervious, Inflow Depth = 1.50" for 10-yr Storm event
Inflow = 51.38 cfs @ 12.01 hrs, Volume= 4.371 af
Outflow = 3.63 cfs @ 14.10 hrs, Volume= 3.849 af, Atten= 93%, Lag= 125.2 min
Primary = 2.49 cfs @ 14.10 hrs, Volume= 1.384 af
Routed to Reach E1R6 : DP-10 DISCHARGE
Secondary = 1.14 cfs @ 14.10 hrs, Volume= 2.465 af
Routed to Reach E1R6 : DP-10 DISCHARGE
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach E1R6 : DP-10 DISCHARGE

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 187.11' @ 14.10 hrs Surf.Area= 54,592 sf Storage= 109,916 cf
Flood Elev= 189.00' Surf.Area= 77,500 sf Storage= 239,860 cf

Plug-Flow detention time= 1,133.6 min calculated for 3.847 af (88% of inflow)
Center-of-Mass det. time= 1,076.2 min (1,934.6 - 858.4)

Volume	Invert	Avail.Storage	Storage Description
#1	180.00'	320,610 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	10	0	0
182.00	2,300	2,310	2,310
184.00	11,000	13,300	15,610
186.00	34,000	45,000	60,610
188.00	71,000	105,000	165,610
190.00	84,000	155,000	320,610

Device	Routing	Invert	Outlet Devices
#1	Device 3	187.00'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 3	186.00'	**6.0" Vert. 6-in Orifice** C= 0.600 Limited to weir flow at low heads
#3	Primary	181.00'	**24.0" Round 18-in Primary Culvert** L= 96.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 181.00' / 180.00' S= 0.0104 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#4	Secondary	177.50'	**5.8" Round 6-in Culvert** L= 220.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 177.50' / 174.00' S= 0.0159 '/' Cc= 0.900

n= 0.011, Flow Area= 0.18 sf

#5	Device 4	186.00'	**5.8" Horiz. Orifice Top** C= 0.600 Limited to weir flow at low heads
#6	Device 4	184.00'	**1.5" Vert. Orifice Side** X 2 rows with 0.5" cc spacing C= 0.600 Limited to weir flow at low heads
#7	Tertiary	188.00'	**10.0' long x 26.0' breadth E-Spillway Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.44 cfs @ 14.10 hrs HW=187.11' (Free Discharge)
└**3=18-in Primary Culvert** (Passes 2.44 cfs of 34.20 cfs potential flow)
  ├**1=Orifice/Grate** (Weir Controls 1.56 cfs @ 1.10 fps)
  └**2=6-in Orifice** (Orifice Controls 0.88 cfs @ 4.47 fps)

Secondary OutFlow Max=1.14 cfs @ 14.10 hrs HW=187.11' (Free Discharge)
└**4=6-in Culvert** (Passes 1.14 cfs of 1.35 cfs potential flow)
  ├**5=Orifice Top** (Orifice Controls 0.93 cfs @ 5.08 fps)
  └**6=Orifice Side** (Orifice Controls 0.21 cfs @ 8.38 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=180.00' (Free Discharge)
└**7=E-Spillway Weir** (Controls 0.00 cfs)

Summary for Pond DP-11R: DETENTION POND 11R

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 1.45" for 10-yr Storm event
Inflow = 56.32 cfs @ 12.06 hrs, Volume= 3.543 af
Outflow = 1.86 cfs @ 15.94 hrs, Volume= 3.543 af, Atten= 97%, Lag= 233.0 min
Primary = 0.65 cfs @ 15.94 hrs, Volume= 0.853 af
  Routed to Reach R4G : Reach 4G
Secondary = 1.21 cfs @ 15.94 hrs, Volume= 2.690 af
  Routed to Reach R4G : Reach 4G
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 158.89' @ 15.94 hrs Surf.Area= 28,727 sf Storage= 91,332 cf

Plug-Flow detention time= 621.8 min calculated for 3.542 af (100% of inflow)
Center-of-Mass det. time= 622.0 min (1,476.4 - 854.4)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	499,354 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,440	0	0
156.00	19,408	21,848	21,848
158.00	25,775	45,183	67,031
160.00	32,395	58,170	125,201
162.00	39,360	71,755	196,956
164.00	46,635	85,995	282,951
166.00	54,090	100,725	383,676
168.00	61,588	115,678	499,354

Device	Routing	Invert	Outlet Devices
#1	Primary	155.30'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.30' / 154.00' S= 0.0236 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	156.50'	**4.0" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	161.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	152.20'	**6.0" Round Culvert** L= 118.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 152.20' / 151.80' S= 0.0034 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.65 cfs @ 15.94 hrs HW=158.89' (Free Discharge)
└**1=Culvert** (Passes 0.65 cfs of 24.35 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.65 cfs @ 7.45 fps)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.21 cfs @ 15.94 hrs HW=158.89' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.21 cfs @ 6.15 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-12: DETENTION POND 12

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 1.43" for 10-yr Storm event
Inflow = 50.07 cfs @ 12.10 hrs, Volume= 3.756 af
Outflow = 1.43 cfs @ 18.64 hrs, Volume= 3.756 af, Atten= 97%, Lag= 392.2 min
Primary = 0.11 cfs @ 18.64 hrs, Volume= 0.061 af
  Routed to Reach R-2A : Reach 2A
Secondary = 1.32 cfs @ 18.64 hrs, Volume= 3.696 af
  Routed to Reach R-2A : Reach 2A
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R-2A : Reach 2A

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.74' @ 18.64 hrs Surf.Area= 39,716 sf Storage= 107,124 cf

Plug-Flow detention time= 897.1 min calculated for 3.755 af (100% of inflow)
Center-of-Mass det. time= 897.4 min (1,757.4 - 860.1)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	537,379 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	7,544	0	0
170.00	34,762	42,306	42,306
172.00	40,454	75,216	117,522
174.00	46,283	86,737	204,259
176.00	52,328	98,611	302,870
178.00	58,583	110,911	413,781
180.00	65,015	123,598	537,379

Device	Routing	Invert	Outlet Devices
#1	Primary	168.90'	**24.0" Round Culvert** L= 66.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 168.90' / 168.50' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	171.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	174.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	175.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	166.00'	**6.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 166.00' / 165.50' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	178.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.11 cfs @ 18.64 hrs HW=171.74' (Free Discharge)
└**1=Culvert** (Passes 0.11 cfs of 18.93 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.11 cfs @ 1.67 fps)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.32 cfs @ 18.64 hrs HW=171.74' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.32 cfs @ 6.70 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-13: DETENTION POND 13

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 1.50" for 10-yr Storm event
Inflow = 15.85 cfs @ 12.00 hrs, Volume= 1.435 af
Outflow = 1.97 cfs @ 13.29 hrs, Volume= 1.435 af, Atten= 88%, Lag= 76.9 min
Primary = 0.62 cfs @ 13.29 hrs, Volume= 0.314 af
  Routed to Reach R4C : Reach 4C
Secondary = 1.36 cfs @ 13.29 hrs, Volume= 1.121 af
  Routed to Reach R4C : Reach 4C
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R4C : Reach 4C

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 162.83' @ 13.29 hrs Surf.Area= 11,800 sf Storage= 25,985 cf
Flood Elev= 166.00' Surf.Area= 17,062 sf Storage= 71,548 cf

Plug-Flow detention time= 139.9 min calculated for 1.435 af (100% of inflow)
Center-of-Mass det. time= 139.9 min (1,006.1 - 866.2)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	109,546 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	6,224	0	0
162.00	10,498	16,722	16,722
164.00	13,633	24,131	40,853
166.00	17,062	30,695	71,548
168.00	20,936	37,998	109,546

Device	Routing	Invert	Outlet Devices
#1	Primary	160.30'	**24.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 160.30' / 159.00' S= 0.0433 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	160.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	164.30'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	158.00'	**6.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 158.00' / 157.70' S= 0.0055 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.62 cfs @ 13.29 hrs HW=162.83' (Free Discharge)
└**1=Culvert** (Passes 0.62 cfs of 18.72 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.62 cfs @ 7.08 fps)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.36 cfs @ 13.29 hrs HW=162.83' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.36 cfs @ 6.91 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-14: DETENTION POND 14

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 1.38" for 10-yr Storm event
Inflow = 27.78 cfs @ 12.00 hrs, Volume= 1.551 af
Outflow = 1.21 cfs @ 14.17 hrs, Volume= 1.551 af, Atten= 96%, Lag= 130.2 min
Primary = 0.21 cfs @ 14.17 hrs, Volume= 0.110 af
Routed to Reach R4D : Reach 4D
Secondary = 1.00 cfs @ 14.17 hrs, Volume= 1.441 af
Routed to Reach R4D : Reach 4D
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 158.41' @ 14.17 hrs Surf.Area= 35,143 sf Storage= 34,295 cf

Plug-Flow detention time= 350.6 min calculated for 1.550 af (100% of inflow)
Center-of-Mass det. time= 350.6 min (1,206.1 - 855.4)

Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	176,567 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	6,253	0	0
158.00	34,183	20,218	20,218
160.00	38,909	73,092	93,310
162.00	44,348	83,257	176,567

Device	Routing	Invert	Outlet Devices
#1	Primary	157.00'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 157.00' / 156.00' S= 0.0182 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.80'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	155.00'	**6.0" Round Culvert** L= 76.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 155.00' / 154.70' S= 0.0039 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#5	Device 1	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Tertiary	160.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.21 cfs @ 14.17 hrs HW=158.41' (Free Discharge)
└**1=Culvert** (Passes 0.21 cfs of 9.53 cfs potential flow)
├**2=Orifice** (Controls 0.00 cfs)
├**3=Grate** (Controls 0.00 cfs)
└**5=Orifice/Grate** (Orifice Controls 0.21 cfs @ 2.36 fps)

Secondary OutFlow Max=1.00 cfs @ 14.17 hrs HW=158.41' (Free Discharge)
└**4=Culvert** (Barrel Controls 1.00 cfs @ 5.11 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=157.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-1a: DP-1a

Inflow Area = 9.580 ac, 2.92% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 18.46 cfs @ 12.05 hrs, Volume= 1.110 af
Outflow = 1.09 cfs @ 13.70 hrs, Volume= 0.983 af, Atten= 94%, Lag= 98.7 min
Primary = 1.09 cfs @ 13.70 hrs, Volume= 0.983 af
Routed to Pond DP-1 : DETENTION POND 1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-1 : DETENTION POND 1

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Starting Elev= 163.00' Surf.Area= 34,985 sf Storage= 146,410 cf
Peak Elev= 163.71' @ 13.70 hrs Surf.Area= 36,712 sf Storage= 171,743 cf (25,333 cf above start)
Flood Elev= 166.00' Surf.Area= 43,000 sf Storage= 263,046 cf (116,636 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 601.8 min (1,461.0 - 859.2)

Volume	Invert	Avail.Storage	Storage Description
#1	158.00'	263,046 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
158.00	24,139	0	0
160.00	27,981	52,120	52,120
162.00	32,544	60,525	112,645
163.00	34,985	33,765	146,410
164.00	37,429	36,207	182,617
166.00	43,000	80,429	263,046

Device	Routing	Invert	Outlet Devices
#1	Primary	163.10'	**113.0 deg Sharp-Crested Vee/Trap Weir** Cv= 2.49 (C= 3.11)
#2	Secondary	165.60'	**18.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=1.08 cfs @ 13.70 hrs HW=163.71' (Free Discharge)
1=Sharp-Crested Vee/Trap Weir (Weir Controls 1.08 cfs @ 1.94 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=163.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond DP-2: DETENTION POND 2

Inflow Area = 9.875 ac, 0.07% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 21.60 cfs @ 11.96 hrs, Volume= 1.143 af
Outflow = 6.22 cfs @ 12.15 hrs, Volume= 1.110 af, Atten= 71%, Lag= 11.2 min
Primary = 6.22 cfs @ 12.15 hrs, Volume= 1.110 af
Routed to Reach R-1F : Reach R-1F

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2

Starting Elev= 162.30' Surf.Area= 1,330 sf Storage= 630 cf
Peak Elev= 166.08' @ 12.15 hrs Surf.Area= 8,250 sf Storage= 15,517 cf (14,887 cf above start)
Flood Elev= 167.80' Surf.Area= 17,700 sf Storage= 36,993 cf (36,363 cf above start)

Plug-Flow detention time= 75.7 min calculated for 1.096 af (96% of inflow)
Center-of-Mass det. time= 48.6 min (904.5 - 856.0)

Volume	Invert	Avail.Storage	Storage Description
#1	162.00'	36,993 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
162.00	1,000	0	0
164.00	3,200	4,200	4,200
165.00	4,940	4,070	8,270
166.00	7,860	6,400	14,670
167.00	12,570	10,215	24,885
167.80	17,700	12,108	36,993

Device	Routing	Invert	Outlet Devices
#1	Primary	162.80'	**24.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 162.80' / 162.20' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	164.20'	**8.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	165.40'	**2.4' long x 0.30' rise Sharp-Crested Rectangular Weir** 1 End Contraction(s)
#5	Device 1	166.60'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.22 cfs @ 12.15 hrs HW=166.08' (Free Discharge)
└**1=Culvert** (Passes 6.22 cfs of 22.86 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 1.59 cfs @ 8.10 fps)
  ├**3=Orifice** (Orifice Controls 2.09 cfs @ 5.99 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Orifice Controls 2.54 cfs @ 3.57 fps)
  └**5=Grate** (Controls 0.00 cfs)

Summary for Pond DP-6: DETENTION POND 6

Inflow Area = 27.235 ac, 7.11% Impervious, Inflow Depth = 1.58" for 10-yr Storm event
Inflow = 35.27 cfs @ 12.00 hrs, Volume= 3.580 af
Outflow = 1.19 cfs @ 19.28 hrs, Volume= 2.901 af, Atten= 97%, Lag= 436.7 min
Primary = 1.19 cfs @ 19.28 hrs, Volume= 2.901 af
Routed to Reach R-1N : R-1N
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-1N : R-1N

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 175.82' @ 19.28 hrs Surf.Area= 58,872 sf Storage= 109,652 cf
Flood Elev= 180.00' Surf.Area= 130,159 sf Storage= 496,644 cf

Plug-Flow detention time= 999.1 min calculated for 2.901 af (81% of inflow)
Center-of-Mass det. time= 915.4 min (1,772.8 - 857.4)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	783,647 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	3,635	0	0
174.00	25,931	29,566	29,566
176.00	62,168	88,099	117,665
178.00	93,326	155,494	273,159
180.00	130,159	223,485	496,644
182.00	156,844	287,003	783,647

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**24.0" Round Outlet Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 178.00' / 168.00' S= 0.1429 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	174.00'	**5.8" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Secondary	179.00'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.19 cfs @ 19.28 hrs HW=175.82' (Free Discharge)
└**1=Outlet Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Orifice Controls 1.19 cfs @ 6.49 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=172.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-6 ES: DETENTION POND 6 - EMERGENCY SPILLWAY

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Starting Elev= 178.00' Surf.Area= 93,326 sf Storage= 273,159 cf
Peak Elev= 178.00' @ 0.00 hrs Surf.Area= 93,326 sf Storage= 273,159 cf
Flood Elev= 180.00' Surf.Area= 130,159 sf Storage= 496,644 cf (223,485 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	783,647 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	3,635	0	0
174.00	25,931	29,566	29,566
176.00	62,168	88,099	117,665
178.00	93,326	155,494	273,159
180.00	130,159	223,485	496,644
182.00	156,844	287,003	783,647

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**24.0" Round Outlet Culvert X 0.00** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 178.00' / 168.00' S= 0.1429 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	174.00'	**5.8" Horiz. Orifice X 0.00** C= 0.600 Limited to weir flow at low heads
#3	Secondary	179.00'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=178.00' (Free Discharge)
└**1=Outlet Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=178.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-9: DETENTION POND 9

Inflow Area = 30.022 ac, 9.91% Impervious, Inflow Depth = 1.79" for 10-yr Storm event
Inflow = 53.20 cfs @ 12.13 hrs, Volume= 4.484 af
Outflow = 0.82 cfs @ 24.20 hrs, Volume= 2.133 af, Atten= 98%, Lag= 724.1 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 9R : LEVEL SPREADER DISCHARGE
Secondary = 0.82 cfs @ 24.20 hrs, Volume= 2.133 af
Routed to Reach 9R : LEVEL SPREADER DISCHARGE
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 189.33' @ 24.20 hrs Surf.Area= 83,859 sf Storage= 166,368 cf
Flood Elev= 191.00' Surf.Area= 91,210 sf Storage= 312,840 cf

Plug-Flow detention time= 1,571.3 min calculated for 2.132 af (48% of inflow)
Center-of-Mass det. time= 1,446.0 min (2,294.1 - 848.1)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	404,050 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	35,200	0	0
188.00	78,220	56,710	56,710
190.00	86,700	164,920	221,630
192.00	95,720	182,420	404,050

Device	Routing	Invert	Outlet Devices
#1	Primary	189.50'	**12.0" Round 12-In Outlet Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 189.50' / 180.50' S= 0.1875 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Secondary	184.21'	**5.8" Round 6-In Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 184.21' / 180.50' S= 0.0618 '/' Cc= 0.900 n= 0.011, Flow Area= 0.18 sf
#3	Device 2	188.70'	**5.8" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	188.30'	**1.5" Vert. Orifice X 2.00** C= 0.600 Limited to weir flow at low heads
#5	Tertiary	190.50'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=187.00' (Free Discharge)
└**1=12-In Outlet Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.82 cfs @ 24.20 hrs HW=189.33' (Free Discharge)
└**2=6-In Culvert** (Passes 0.82 cfs of 1.54 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 0.70 cfs @ 3.82 fps)
  └**4=Orifice** (Orifice Controls 0.12 cfs @ 4.74 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=187.00' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-9(E): DP 9 (EMERGENCY OUTLET)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	404,050 cf	**Detention Pond (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	35,200	0	0
188.00	78,220	56,710	56,710
190.00	86,700	164,920	221,630
192.00	95,720	182,420	404,050

Device	Routing	Invert	Outlet Devices
#1	Tertiary	190.50'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond P-1G: Culvert Crossing 1G

Inflow Area = 1.772 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-yr Storm event
Inflow = 3.55 cfs @ 12.05 hrs, Volume= 0.215 af
Outflow = 3.53 cfs @ 12.06 hrs, Volume= 0.215 af, Atten= 1%, Lag= 0.7 min
Primary = 2.75 cfs @ 12.06 hrs, Volume= 0.205 af
Routed to Reach R-1G : RipRap Downspout
Secondary = 0.78 cfs @ 12.06 hrs, Volume= 0.011 af
Routed to Reach R-1I : Final Cover Access Road Ditch

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 336.24' @ 12.06 hrs Surf.Area= 549 sf Storage= 352 cf

Plug-Flow detention time= 5.7 min calculated for 0.215 af (100% of inflow)
Center-of-Mass det. time= 5.7 min (861.7 - 855.9)

Volume	Invert	Avail.Storage	Storage Description
#1	335.50'	1,200 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
335.50	400	0	0
337.50	800	1,200	1,200

Device	Routing	Invert	Outlet Devices
#1	Primary	335.50'	**24.0" Round 24" Culvert** L= 36.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 335.50' / 331.00' S= 0.1250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	336.00'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=2.71 cfs @ 12.06 hrs HW=336.24' (Free Discharge)
1=24" Culvert (Inlet Controls 2.71 cfs @ 2.58 fps)

Secondary OutFlow Max=0.74 cfs @ 12.06 hrs HW=336.24' (Free Discharge)
2=Stone Check Dam Weir (Weir Controls 0.74 cfs @ 1.33 fps)

Summary for Pond P-1H: Modified Plunge Pool w/(2)24" Culverts P-6a

Inflow Area = 6.697 ac, 1.15% Impervious, Inflow Depth = 1.36" for 10-yr Storm event
Inflow = 12.69 cfs @ 11.96 hrs, Volume= 0.761 af
Outflow = 12.41 cfs @ 11.97 hrs, Volume= 0.759 af, Atten= 2%, Lag= 0.3 min
Primary = 12.41 cfs @ 11.97 hrs, Volume= 0.759 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-2 : DETENTION POND 2

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 184.25' @ 11.97 hrs Surf.Area= 409 sf Storage= 452 cf
Flood Elev= 186.00' Surf.Area= 869 sf Storage= 1,551 cf

Plug-Flow detention time= 3.4 min calculated for 0.758 af (100% of inflow)
Center-of-Mass det. time= 1.7 min (860.5 - 858.8)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	5,714 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
182.00	37	0	0
183.00	163	100	100
184.00	348	256	356
185.00	587	468	823
186.00	869	728	1,551
188.00	1,067	1,936	3,487
190.00	1,160	2,227	5,714

Device	Routing	Invert	Outlet Devices
#1	Primary	183.00'	**24.0" Round (2)24"-Culvert X 2.00** L= 56.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 183.00' / 182.00' S= 0.0179 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Secondary	185.00'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=12.03 cfs @ 11.97 hrs HW=184.23' (Free Discharge)
1=(2)24"-Culvert (Barrel Controls 12.03 cfs @ 4.25 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=182.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond P-1I: Culvert Crossing 6c

Inflow Area = 3.906 ac, 1.97% Impervious, Inflow Depth = 1.42" for 10-yr Storm event
Inflow = 8.56 cfs @ 12.01 hrs, Volume= 0.463 af
Outflow = 8.24 cfs @ 12.02 hrs, Volume= 0.463 af, Atten= 4%, Lag= 0.7 min
Primary = 7.21 cfs @ 12.02 hrs, Volume= 0.453 af
Routed to Reach R-IH : RipRap Downspout
Secondary = 1.03 cfs @ 12.02 hrs, Volume= 0.011 af
Routed to Pond P-1K : Culvert Crossing 1K

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 291.78' @ 12.02 hrs Surf.Area= 800 sf Storage= 300 cf

Plug-Flow detention time= 4.3 min calculated for 0.463 af (100% of inflow)
Center-of-Mass det. time= 4.3 min (857.0 - 852.6)

Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	300 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	400	0	0
291.00	800	300	300

Device	Routing	Invert	Outlet Devices
#1	Primary	290.50'	**24.0" Round 24" Culvert** L= 38.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 290.50' / 286.00' S= 0.1184 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	291.50'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=7.14 cfs @ 12.02 hrs HW=291.77' (Free Discharge)
↑—**1=24" Culvert** (Inlet Controls 7.14 cfs @ 3.39 fps)

Secondary OutFlow Max=0.97 cfs @ 12.02 hrs HW=291.77' (Free Discharge)
↑—**2=Stone Check Dam Weir** (Weir Controls 0.97 cfs @ 1.41 fps)

Summary for Pond P-1J-1: (2) 24" CULVERTS

Inflow Area = 6.104 ac, 1.82% Impervious, Inflow Depth = 1.39" for 10-yr Storm event
Inflow = 13.51 cfs @ 11.96 hrs, Volume= 0.705 af
Outflow = 13.43 cfs @ 11.96 hrs, Volume= 0.705 af, Atten= 1%, Lag= 0.3 min
Primary = 13.26 cfs @ 11.96 hrs, Volume= 0.704 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.17 cfs @ 11.95 hrs, Volume= 0.001 af
Routed to Pond P-1J-2 : 18" CULVERT

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 191.30' @ 11.96 hrs Surf.Area= 264 sf Storage= 178 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.2 min (853.9 - 853.7)

Volume	Invert	Avail.Storage	Storage Description
#1	190.00'	410 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
190.00	10	0	0
192.00	400	410	410

Device	Routing	Invert	Outlet Devices
#1	Primary	190.00'	**24.0" Round Culvert X 2.00** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 190.00' / 189.60' S= 0.0108 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	191.20'	**170.0 deg x 1.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.46 (C= 3.08)

Primary OutFlow Max=12.96 cfs @ 11.96 hrs HW=191.28' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 12.96 cfs @ 3.04 fps)

Secondary OutFlow Max=0.16 cfs @ 11.95 hrs HW=191.29' (Free Discharge)
↑—**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.16 cfs @ 0.84 fps)

Summary for Pond P-1J-2: 18" CULVERT

Inflow = 0.17 cfs @ 11.95 hrs, Volume= 0.001 af
Outflow = 0.15 cfs @ 11.96 hrs, Volume= 0.001 af, Atten= 12%, Lag= 0.3 min
Primary = 0.15 cfs @ 11.96 hrs, Volume= 0.001 af
Routed to Pond DP-6 : DETENTION POND 6

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 187.04' @ 11.96 hrs Surf.Area= 58 sf Storage= 1 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.5 min (717.9 - 717.4)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	32,056 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	10	0	0
188.00	1,367	689	689
190.00	3,000	4,367	5,056
192.00	6,000	9,000	14,056
194.00	12,000	18,000	32,056

Device	Routing	Invert	Outlet Devices
#1	Primary	186.80'	**18.0" Round 18" Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 186.80' / 185.97' S= 0.0208 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.23 cfs @ 11.96 hrs HW=187.03' (Free Discharge)
↑—**1=18" Culvert** (Inlet Controls 0.23 cfs @ 1.30 fps)

Summary for Pond P-1K: Culvert Crossing 1K

Inflow Area = 4.295 ac, 2.58% Impervious, Inflow Depth = 1.46" for 10-yr Storm event
Inflow = 12.41 cfs @ 11.95 hrs, Volume= 0.523 af
Outflow = 12.13 cfs @ 11.96 hrs, Volume= 0.523 af, Atten= 2%, Lag= 0.4 min
Primary = 9.02 cfs @ 11.96 hrs, Volume= 0.495 af
Routed to Reach R-1J : RipRap Downspout
Secondary = 3.11 cfs @ 11.96 hrs, Volume= 0.027 af
Routed to Reach R-1L : Final Cover Access Road Ditch

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 255.97' @ 11.96 hrs Surf.Area= 594 sf Storage= 482 cf

Plug-Flow detention time= 0.3 min calculated for 0.522 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (846.3 - 846.0)

Volume	Invert	Avail.Storage	Storage Description
#1	255.00'	1,200 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
255.00	400	0	0
257.00	800	1,200	1,200

Device	Routing	Invert	Outlet Devices
#1	Primary	254.50'	**24.0" Round 24" Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.50' / 252.00' S= 0.0758 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	255.50'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=8.89 cfs @ 11.96 hrs HW=255.96' (Free Discharge)
↑—**1=24" Culvert** (Inlet Controls 8.89 cfs @ 3.63 fps)

Secondary OutFlow Max=2.95 cfs @ 11.96 hrs HW=255.96' (Free Discharge)
↑—**2=Stone Check Dam Weir** (Weir Controls 2.95 cfs @ 1.79 fps)

Summary for Pond PS11: Culvert - 4IA(C11 PS)

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond CB-4I : Catch Basin - 4I

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 212.90' @ 0.00 hrs Surf.Area= 5 sf Storage= 0 cf
Flood Elev= 215.10' Surf.Area= 1,133 sf Storage= 1,237 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	212.90'	1,353 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
212.90	5	0	0
213.04	63	5	5
215.20	1,185	1,348	1,353

Device	Routing	Invert	Outlet Devices
#1	Primary	213.05'	**24.0" Round Culvert - 4IA(C11 PS)** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 213.05' / 212.15' S= 0.0225 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=212.90' (Free Discharge)
↑—**1=Culvert - 4IA(C11 PS)** (Controls 0.00 cfs)

Summary for Subcatchment 1A: SC-1A

Runoff = 19.42 cfs @ 13.10 hrs, Volume= 4.290 af, Depth= 2.28"
Routed to Reach 1 : Analysis Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	11.084	70	Woods, Good, HSG C
*	7.750	77	Woods, Good, HSG D
*	1.540	71	Meadow, non-grazed, HSG C
*	1.760	78	Meadow HSG D
*	0.070	96	Gravel Surface
*	0.330	98	Impervious Surface
	22.534	74	Weighted Average
	22.204		98.54% Pervious Area
	0.330		1.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	150	0.0200	0.04		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
20.4	1,840		1.50		**Direct Entry, Segment ID: B-C**
16.4	260		0.26		**Direct Entry, Segment ID: C-D**
93.1	2,250	Total			

Summary for Subcatchment 1B: 1B

Runoff = 1.37 cfs @ 11.93 hrs, Volume= 0.059 af, Depth= 2.04"
Routed to Reach 1 : Analysis Point 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	0.344	71	Landfill Final Cover
	0.344		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, Segement A-B**

Summary for Subcatchment 1B1: SC-1B1

Runoff = 24.87 cfs @ 12.05 hrs, Volume= 1.504 af, Depth= 2.12"
Routed to Reach R-1B1 : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	8.111	71	Meadow, non-grazed, HSG C
*	0.400	98	Riprap
	8.511	72	Weighted Average
	8.111		95.30% Pervious Area
	0.400		4.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	140	0.1000	4.74		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.4	240	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	482	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.8	1,012	Total			

Summary for Subcatchment 1B2: SC-1B2

Runoff = 31.82 cfs @ 12.05 hrs, Volume= 1.945 af, Depth= 2.12"
Routed to Reach R-1B : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	10.600	71	Landfill Final Cover
*	0.403	98	Riprap
	11.003	72	Weighted Average
	10.600		96.34% Pervious Area
	0.403		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.6	75	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	403	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	554	0.3300	19.66	314.62	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.050 Mountain streams w/large boulders
13.1	1,182	Total			

Summary for Subcatchment 1C: SC-1C

Runoff = 14.02 cfs @ 12.84 hrs, Volume= 2.613 af, Depth= 2.45"
Routed to Reach R2 : Reach 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	6.100	77	Woods, Good, HSG D
*	0.690	70	Woods, Good, HSG C
*	3.100	78	Meadow HSG D
*	2.580	71	Meadow, non-grazed, HSG C
*	0.310	96	Gravel Surface
	12.780	76	Weighted Average
	12.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.7	200	0.0350	0.06		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
1.6	170	0.0133	1.73		**Shallow Concentrated Flow, Segment ID: B-C** Grassed Waterway Kv= 15.0 fps
16.7					**Direct Entry, Segment ID: C-D**
75.0	370	Total			

Summary for Subcatchment 1D: SC-1D

Runoff = 35.81 cfs @ 12.05 hrs, Volume= 2.158 af, Depth= 2.12"
Routed to Pond DP-1 : DETENTION POND 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	11.000	71	Landfill Final Cover
*	0.110	96	Gravel Surface
*	0.800	78	Pond, Meadow HSG D
*	0.300	98	Riprap
	12.210	72	Weighted Average
	11.910		97.54% Pervious Area
	0.300		2.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
0.8	110	0.1000	2.21		**Shallow Concentrated Flow, Segment ID: B-C** Short Grass Pasture Kv= 7.0 fps
0.3	241	0.0700	12.78	172.52	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.025
0.3	556	0.3300	28.09	449.46	**Trap/Vee/Rect Channel Flow, Segment ID: D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.035
12.7	1,057	Total			

Summary for Subcatchment 1E: SC-1E

Runoff = 28.86 cfs @ 12.04 hrs, Volume= 1.693 af, Depth= 2.12"
Routed to Reach R-1E : Plastic Lined Ditch

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	9.100	71	Landfill Final Cover
*	0.200	96	Gravel Surface
*	0.280	98	Riprap
	9.580	72	Weighted Average
	9.300		97.08% Pervious Area
	0.280		2.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	146	0.1000	0.22		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	296	0.0700	16.72	200.67	**Trap/Vee/Rect Channel Flow, Segment ID: B-C** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.025
0.3	537	0.3300	28.09	449.46	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.035
0.3	186	0.0700	10.28	57.82	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=0.00' D=1.50' Z= 3.0 & 2.0 '/' Top.W=7.50' n= 0.030 Earth, grassed & winding
11.9	1,165	Total			

Summary for Subcatchment 1F: SC-1F

Runoff = 31.43 cfs @ 11.96 hrs, Volume= 1.432 af, Depth= 2.12"
Routed to Pond DP-2 : DETENTION POND 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	7.747	71	Landfill Final Cover
*	0.349	91	Gravel
	0.007	98	Roofs, HSG C
	8.103	72	Weighted Average
	8.096		99.91% Pervious Area
	0.007		0.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	100	0.3800	0.51		**Sheet Flow, Segment A-B** Grass: Short n= 0.150 P2= 2.70"
1.2	293	0.0700	3.97		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.2	300	0.3800	29.77	669.83	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.50' Z= 2.0 '/' Top.W=14.00' n= 0.040 Earth, cobble bottom, clean sides
4.7	693	Total			

Summary for Subcatchment 1G: SC-1G

Runoff = 5.44 cfs @ 12.05 hrs, Volume= 0.325 af, Depth= 2.20"
Routed to Pond P-1G : Culvert Crossing 1G

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	1.625	71	Landfill Final Cover
*	0.147	96	Gravel Surface
	1.772	73	Weighted Average
	1.772		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.9	142	0.1500	2.71		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.3	154	0.0700	8.95	60.43	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.035 Earth, dense weeds

12.5 446 Total

Summary for Subcatchment 1H: SC-1H

Runoff = 11.12 cfs @ 11.94 hrs, Volume= 0.475 af, Depth= 2.04"
Routed to Pond P-1H : Modified Plunge Pool w/(2)24" Culverts P-6a

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	0.032	91	Fallow, bare soil, HSG C, rip rap
	2.759	71	Meadow, non-grazed, HSG C
	2.791	71	Weighted Average
	2.791		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	66	0.3900	0.47		**Sheet Flow, Segment A-B** Grass: Short n= 0.150 P2= 2.70"
0.3	140	0.0800	9.12	27.13	**Trap/Vee/Rect Channel Flow, Segment B-C** Bot.W=0.00' D=1.15' Z= 2.5 & 2.0 '/' Top.W=5.17' n= 0.030 Earth, grassed & winding
0.2	190	0.1430	16.62	49.46	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.15' Z= 2.5 & 2.0 '/' Top.W=5.17' n= 0.022 Earth, clean & straight
2.8	396	Total			

Summary for Subcatchment 1I: SC-1I

Runoff = 13.20 cfs @ 12.00 hrs, Volume= 0.690 af, Depth= 2.12"
Routed to Pond P-1I : Culvert Crossing 6c

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	3.829	71	Landfill Final Cover
*	0.077	98	Riprap
	3.906	72	Weighted Average
	3.829		98.03% Pervious Area
	0.077		1.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	150	0.1000	0.32		**Sheet Flow, Segment AB** Grass: Short n= 0.150 P2= 2.70"
0.4	106	0.1000	4.74		**Shallow Concentrated Flow, Segment BC** Grassed Waterway Kv= 15.0 fps
0.4	260	0.0700	10.44	70.50	**Trap/Vee/Rect Channel Flow, Segment C - D** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.030 Earth, grassed & winding
0.1	140	0.3300	39.33	629.24	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.025 Rubble masonry, cemented
8.7	656	Total			

Summary for Subcatchment 1J: SC-IJ

Runoff = 7.41 cfs @ 11.94 hrs, Volume= 0.320 af, Depth= 2.12"
Routed to Pond P-1J-1 : (2) 24" CULVERTS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	1.763	71	Landfill Final Cover
*	0.046	91	Gravel
	1.809	72	Weighted Average
	1.809		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	67	0.5000	0.52		**Sheet Flow, SEGMENT AB** Grass: Short n= 0.150 P2= 2.70"
0.8	325	0.1900	6.54		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.4	325	0.0300	12.44	149.28	**Trap/Vee/Rect Channel Flow, C-D** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
3.3	717	Total			

Summary for Subcatchment 1K: SC-1K

Runoff = 11.15 cfs @ 11.94 hrs, Volume= 0.482 af, Depth= 2.20"
Routed to Pond P-1K : Culvert Crossing 1K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	2.350	71	Landfill Final Cover
	0.163	89	Gravel roads, HSG C
*	0.111	98	Riprap
	2.624	73	Weighted Average
	2.513		95.77% Pervious Area
	0.111		4.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	68	0.3300	0.44		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 2.70"
0.4	93	0.0700	3.97		**Shallow Concentrated Flow, Segment B-C** Grassed Waterway Kv= 15.0 fps
0.3	249	0.3300	12.60	201.68	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.078 Riprap, 12-inch
3.3	410	Total			

Summary for Subcatchment 1L: SC-1L

Runoff = 6.81 cfs @ 11.94 hrs, Volume= 0.295 af, Depth= 2.12"
Routed to Pond P-1K : Culvert Crossing 1K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	1.607	71	Landfill Final Cover
	0.064	89	Gravel roads, HSG C
	1.671	72	Weighted Average
	1.671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	67	0.4000	0.48		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 2.70"
1.2	442	0.1000	6.15	49.59	**Trap/Vee/Rect Channel Flow, B-C** Bot.W=2.00' D=1.50' Z= 2.0 & 2.5 '/' Top.W=8.75' n= 0.069 Riprap, 6-inch
3.5	509	Total			

Summary for Subcatchment 1M: SC-1M

Runoff = 16.63 cfs @ 12.05 hrs, Volume= 0.999 af, Depth= 2.12"
Routed to Pond 1P : (2) 24" CULVERTS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	5.368	71	Landfill Final Cover
	0.283	92	Paved roads w/open ditches, 50% imp, HSG C
	5.651	72	Weighted Average
	5.509		97.50% Pervious Area
	0.141		2.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	73	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.3	174	0.0700	11.06	265.40	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=2.00' Z= 2.0 & 10.0 '/' Top.W=24.00' n= 0.035 Earth, dense weeds
0.5	413	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.6	810	Total			

Summary for Subcatchment 1N: SC-1N

Runoff = 20.01 cfs @ 12.28 hrs, Volume= 2.054 af, Depth= 2.81"
Routed to Pond DP-6 : DETENTION POND 6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	2.942	70	Woods, Good, HSG C
*	3.662	78	Meadow HSG D
*	0.572	96	Gravel Surface
*	1.607	98	Pond
	8.783	80	Weighted Average
	7.176		81.70% Pervious Area
	1.607		18.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.8	100	0.0400	0.05		**Sheet Flow, Segment ID: A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
1.7	123	0.0569	1.19		**Shallow Concentrated Flow, Segment ID: B-C** Woodland Kv= 5.0 fps
0.5	370	0.0189	12.43	801.88	**Trap/Vee/Rect Channel Flow, Segment ID: C-D** Bot.W=2.00' D=3.00' Z= 10.0 & 3.0 '/' Top.W=41.00' n= 0.022 Earth, clean & straight
33.0	593	Total			

Summary for Subcatchment 1O: SC-1O

Runoff = 56.18 cfs @ 12.37 hrs, Volume= 6.567 af, Depth= 2.54"
Routed to Reach R-1O : R-1O

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	13.230	77	Woods, Good, HSG D
*	5.712	70	Woods, Good, HSG C
*	9.172	78	Meadow HSG D
*	1.195	71	Meadow, non-grazed, HSG C
*	0.713	96	Gravel Surface
*	0.515	98	Impervious Surface
*	0.494	98	Paved Area
	31.031	77	Weighted Average
	30.022		96.75% Pervious Area
	1.009		3.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0100	0.07		**Sheet Flow, Segment ID: A-B** Grass: Dense n= 0.240 P2= 2.70"
15.1	1,875	0.0190	2.07		**Shallow Concentrated Flow, Segment BC** Grassed Waterway Kv= 15.0 fps
12.8	856	0.0500	1.12		**Shallow Concentrated Flow, Segment CD** Woodland Kv= 5.0 fps
39.7	2,781	Total			

Summary for Subcatchment 2A: SC-2A

Runoff = 29.38 cfs @ 13.79 hrs, Volume= 9.148 af, Depth= 2.28"
Routed to Reach AP2 : ANALYSIS POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	24.340	70	Woods, Good, HSG C
	15.830	77	Woods, Good, HSG D
*	5.898	71	Meadow, non-grazed, HSG C
*	0.380	98	Paved Area
	1.600	98	Existing Waterbody
	48.048	74	Weighted Average
	46.068		95.88% Pervious Area
	1.980		4.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
91.1	150	0.0060	0.03		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
42.6	534	0.0070	0.21		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
10.6	1,213		1.90		**Direct Entry, Segment C-D (STWC, 0.008)**
144.3	1,897	Total			

Summary for Subcatchment 2B: SC-2B

Runoff = 25.70 cfs @ 12.07 hrs, Volume= 1.645 af, Depth= 2.12"
Routed to Pond CB-2B : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	9.090	71	Landfill Final Cover
*	0.218	98	Riprap
	9.308	72	Weighted Average
	9.090		97.66% Pervious Area
	0.218		2.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.3	178	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	252	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	455	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
0.8	136	0.0100	3.00	81.02	**Trap/Vee/Rect Channel Flow, Segment E-F** Bot.W=3.00' D=3.00' Z= 2.0 '/' Top.W=15.00' n= 0.069 Riprap, 6-inch
14.4	1,171	Total			

Summary for Subcatchment 2C: SC-2C

Runoff = 27.58 cfs @ 12.06 hrs, Volume= 1.722 af, Depth= 2.12"
Routed to Reach R-2C : LF TOE DITCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	9.383	71	Landfill Final Cover
*	0.357	98	Riprap
	9.740	72	Weighted Average
	9.383		96.33% Pervious Area
	0.357		3.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.2	158	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.6	308	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	474	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.7	1,090	Total			

Summary for Subcatchment 2D: SC-2D

Runoff = 26.42 cfs @ 12.06 hrs, Volume= 1.643 af, Depth= 2.12"
Routed to Pond CB-2D : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	8.931	71	Landfill Final Cover
*	0.366	98	Riprap
	9.297	72	Weighted Average
	8.931		96.06% Pervious Area
	0.366		3.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.2	157	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	248	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	475	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.6	1,030	Total			

Summary for Subcatchment 2E: SC-2E

Runoff = 2.47 cfs @ 11.94 hrs, Volume= 0.106 af, Depth= 2.37"
Routed to Pond CB-2E : LF TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	0.466	71	Landfill Final Cover
*	0.073	98	Riprap
	0.539	75	Weighted Average
	0.466		86.46% Pervious Area
	0.073		13.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 2F: SC-2F

Runoff = 13.50 cfs @ 11.94 hrs, Volume= 0.589 af, Depth= 2.72"
Routed to Pond DP-12 : DETENTION POND 12

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

Area (ac)	CN	Description
1.947	74	>75% Grass cover, Good, HSG C
0.655	93	Paved roads w/open ditches, 50% imp, HSG D
2.602	79	Weighted Average
2.274		87.41% Pervious Area
0.327		12.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 3A: SC-3A

Runoff = 105.89 cfs @ 15.20 hrs, Volume= 48.744 af, Depth= 2.20"
Routed to Reach AP3 : ANALYSIS POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	158.900	70	Woods, Good, HSG C
	102.800	77	Woods, Good, HSG D
	1.000	71	Meadow, non-grazed, HSG C
*	0.564	98	Paved Area
*	2.330	98	Existing Waterbody
	265.594	73	Weighted Average
	262.700		98.91% Pervious Area
	2.894		1.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	150	0.0200	0.04		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
105.2	1,116	0.0050	0.18		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
78.7	3,093		0.66		**Direct Entry, Segment C-D (STWC, 0.001)**
240.2	4,359	Total			

Summary for Subcatchment 4A: SC-4A

Runoff = 73.65 cfs @ 16.21 hrs, Volume= 42.385 af, Depth= 2.45"
Routed to Reach AP4 : AP4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	130.444	77	Woods, Good, HSG D
	44.640	70	Woods, Good, HSG C
*	23.410	71	Meadow, non-grazed, HSG C
*	3.300	98	Paved Area
*	2.520	91	Gravel
	1.000	89	Gravel roads, HSG C
*	2.000	98	Impervious Surface
	207.314	76	Weighted Average
	202.014		97.44% Pervious Area
	5.300		2.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
91.1	150	0.0060	0.03		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
200.8	1,905	0.0040	0.16		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
17.7	1,592		1.50		**Direct Entry, Segment C-D (STWC, 0.0031)**
7.9	760		1.60		**Direct Entry, Segment D-E (STWC, 0.005)**
6.7	963		2.40		**Direct Entry, Segment E-F (STWC, 0.0125)**
324.2	5,370	Total			

Summary for Subcatchment 4B: 4B

Runoff = 14.68 cfs @ 12.05 hrs, Volume= 0.876 af, Depth= 2.28"
Routed to Reach R-4B : R-4B

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	4.150	71	Landfill Final Cover
*	0.452	98	Riprap
	4.602	74	Weighted Average
	4.150		90.18% Pervious Area
	0.452		9.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.3	32	0.0500	1.57		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.5	240	0.0700	8.81	49.56	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 3.0 '/' Top.W=7.50' n= 0.035 Earth, dense weeds
0.4	342	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
12.5	764	Total			

Summary for Subcatchment 4C: SC-4C

Runoff = 20.76 cfs @ 12.01 hrs, Volume= 1.115 af, Depth= 2.28"
Routed to Pond CB-4C : LT TOE DITCH - CATCH BASIN

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	0.566	98	Riprap
*	5.290	71	Landfill Final Cover
	5.856	74	Weighted Average
	5.290		90.33% Pervious Area
	0.566		9.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	101	0.1000	0.20		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.8	442	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment B-C** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 Earth, dense weeds
0.4	365	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
9.4	908	Total			

Summary for Subcatchment 4D: SC-4D

Runoff = 40.38 cfs @ 12.01 hrs, Volume= 2.138 af, Depth= 2.12"
Routed to Pond CB-4D : LF TOE DITCH - CATCH BASINS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	11.800	71	Landfill Final Cover
*	0.295	98	Riprap
	12.095	72	Weighted Average
	11.800		97.56% Pervious Area
	0.295		2.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	100	0.1000	0.20		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.2	117	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	504	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
9.0	721	Total			

Summary for Subcatchment 4E: SC-4E

Runoff = 3.94 cfs @ 11.94 hrs, Volume= 0.169 af, Depth= 2.04"
Routed to Pond DP-13 : DETENTION POND 13

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

Area (ac)	CN	Description
0.992	71	Meadow, non-grazed, HSG C
0.992		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	300		1.67		**Direct Entry, Segment A-B**

Summary for Subcatchment 4F: SC-4F

Runoff = 5.46 cfs @ 11.93 hrs, Volume= 0.232 af, Depth= 2.04"
Routed to Pond DP-14 : DETENTION POND 14

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

Area (ac)	CN	Description
1.366	71	Meadow, non-grazed, HSG C
1.366		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	500		4.17		**Direct Entry, Segment A-B**

Summary for Subcatchment 4G: SC-4G

Runoff = 31.88 cfs @ 12.06 hrs, Volume= 1.990 af, Depth= 2.12"
Routed to Pond CB-4G : Catch Basin - 4G

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	11.040	71	Landfill Final Cover
*	0.220	98	Riprap
	11.260	72	Weighted Average
	11.040		98.05% Pervious Area
	0.220		1.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.1	143	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	390	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.6	497	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
13.7	1,180	Total			

Summary for Subcatchment 4H: SC-4H

Runoff = 33.16 cfs @ 12.07 hrs, Volume= 2.120 af, Depth= 2.04"
Routed to Pond CB-4H : Catch Basin - 4H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	12.330	71	Landfill Final Cover
*	0.135	98	Riprap
	12.465	71	Weighted Average
	12.330		98.92% Pervious Area
	0.135		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	232	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	464	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	440	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.3	1,286	Total			

Summary for Subcatchment 4I: SC-4I

Runoff = 10.45 cfs @ 11.94 hrs, Volume= 0.448 af, Depth= 2.04"
Routed to Pond CB-4H : Catch Basin - 4H

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	2.595	71	Landfill Final Cover
*	0.036	98	Riprap
	2.631	71	Weighted Average
	2.595		98.63% Pervious Area
	0.036		1.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry, A-B**

Summary for Subcatchment 4J: SC-4J

Runoff = 36.42 cfs @ 12.07 hrs, Volume= 2.307 af, Depth= 2.12"
Routed to Pond CB-4I : Catch Basin - 4I

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	12.590	71	Landfill Final Cover
*	0.462	98	Riprap
	13.052	72	Weighted Average
	12.590		96.46% Pervious Area
	0.462		3.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	223	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.7	386	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.4	376	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.1	1,135	Total			

Summary for Subcatchment 4K: SC-4K

Runoff = 24.96 cfs @ 12.17 hrs, Volume= 2.062 af, Depth= 2.12"
Routed to Pond CB-4JA : Catch Basin - 4JA

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	11.234	71	Landfill Final Cover
*	0.429	98	Riprap
	11.663	72	Weighted Average
	11.234		96.32% Pervious Area
	0.429		3.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
10.3	432	0.0100	0.70		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	432	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	392	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
22.9	1,406	Total			

Summary for Subcatchment 4L: SC-4L

Runoff = 38.63 cfs @ 12.08 hrs, Volume= 2.552 af, Depth= 2.12"
Routed to Pond C-4K : Catch Basin - 4K

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	14.000	71	Landfill Final Cover
*	0.437	98	Riprap
	14.437	72	Weighted Average
	14.000		96.97% Pervious Area
	0.437		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
2.6	242	0.0500	1.57		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.9	476	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	406	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
15.3	1,274	Total			

Summary for Subcatchment 4M: SC-4M

Runoff = 2.92 cfs @ 11.93 hrs, Volume= 0.125 af, Depth= 2.20"
Routed to Pond C-4L : Catch Basin - 4L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	0.633	71	Landfill Final Cover
*	0.046	98	Riprap
	0.679	73	Weighted Average
	0.633		93.23% Pervious Area
	0.046		6.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, Segment A-B**

Summary for Subcatchment 4N: SC-4N

Runoff = 19.00 cfs @ 12.12 hrs, Volume= 1.402 af, Depth= 2.81"
Routed to Pond DP-9 : DETENTION POND 9

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	2.512	74	>75% Grass cover, Good, HSG C
*	0.245	98	Paved Area
*	0.338	98	Building/Concrete Slabs
*	1.404	91	Gravel
	1.497	71	Meadow, non-grazed, HSG C
	5.996	80	Weighted Average
	5.413		90.28% Pervious Area
	0.583		9.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	61	0.0200	1.14		**Sheet Flow, Segment A-B** Smooth surfaces n= 0.011 P2= 2.70"
10.5	61	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.70"
7.9	955	0.0180	2.01		**Shallow Concentrated Flow, Grassed waterway** Grassed Waterway Kv= 15.0 fps
19.3	1,077	Total			

Summary for Subcatchment 4O: SC-4O

Runoff = 8.97 cfs @ 12.05 hrs, Volume= 0.548 af, Depth= 2.72"
Routed to Pond C4B : Culvert - 4BA & 4BB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	1.074	70	Brush, Fair, HSG C
*	0.034	98	Impervious Surface
	0.687	89	Gravel roads, HSG C
	0.387	74	>75% Grass cover, Good, HSG C
*	0.240	98	Paved Area
	2.422	79	Weighted Average
	2.148		88.69% Pervious Area
	0.274		11.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	24	0.0200	0.95		**Sheet Flow, Segment AB** Smooth surfaces n= 0.011 P2= 2.70"
0.8	19	0.5000	0.41		**Sheet Flow, Segment BC** Grass: Short n= 0.150 P2= 2.70"
11.9	584	0.0137	0.82		**Shallow Concentrated Flow, Segment CD** Short Grass Pasture Kv= 7.0 fps
0.1	40	0.0250	7.14	85.66	**Trap/Vee/Rect Channel Flow, Segment DE** Bot.W=2.00' D=2.00' Z= 2.0 '/' Top.W=10.00' n= 0.035
13.2	667	Total			

Summary for Subcatchment 4P: SC-4P

Runoff = 17.88 cfs @ 12.28 hrs, Volume= 1.878 af, Depth= 3.47"
Routed to Pond DP-9 : DETENTION POND 9

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	0.415	89	Gravel roads, HSG C
*	2.133	91	Gravel
	2.304	74	>75% Grass cover, Good, HSG C
*	1.500	98	Pond
*	0.136	98	Paved Area
	6.488	87	Weighted Average
	4.852		74.78% Pervious Area
	1.636		25.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	125	0.0216	0.12		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
0.5	25	0.0520	0.78		**Sheet Flow, Segment B-C** n= 0.023 P2= 2.70"
2.0	270	0.0190	2.22		**Shallow Concentrated Flow, Segment C-D** Unpaved Kv= 16.1 fps
0.2	44	0.3300	4.02		**Shallow Concentrated Flow, Segment D-E** Short Grass Pasture Kv= 7.0 fps
2.0	102	0.0150	0.86		**Shallow Concentrated Flow, Segment E-F** Short Grass Pasture Kv= 7.0 fps
11.2	258	0.0030	0.38		**Shallow Concentrated Flow, Segment F-G** Short Grass Pasture Kv= 7.0 fps
33.9	824	Total			

Summary for Subcatchment 4Q: SC-4Q

Runoff = 46.82 cfs @ 11.98 hrs, Volume= 2.316 af, Depth= 2.72"
Routed to Pond DP-10 : DETENTION POND 10

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
	3.393	79	50-75% Grass cover, Fair, HSG C
	1.056	93	Paved roads w/open ditches, 50% imp, HSG D
*	0.712	98	Pond
	5.073	74	>75% Grass cover, Good, HSG C
	10.234	79	Weighted Average
	8.994		87.88% Pervious Area
	1.240		12.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	150	0.0500	0.59		**Sheet Flow, AB** Fallow n= 0.050 P2= 2.70"
0.2	85	0.1600	6.44		**Shallow Concentrated Flow, Segment BC** Unpaved Kv= 16.1 fps
2.5	625	0.0800	4.24		**Shallow Concentrated Flow, CD** Grassed Waterway Kv= 15.0 fps
6.9	860	Total			

Summary for Subcatchment 4R: SC-4R

Runoff = 11.97 cfs @ 12.03 hrs, Volume= 0.691 af, Depth= 2.72"
Routed to Pond DP-11R : DETENTION POND 11R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

Area (ac)	CN	Description
0.757	93	Paved roads w/open ditches, 50% imp, HSG D
2.296	74	>75% Grass cover, Good, HSG C
3.053	79	Weighted Average
2.674		87.60% Pervious Area
0.378		12.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	37	0.0200	1.04		**Sheet Flow, AB** Smooth surfaces n= 0.011 P2= 2.70"
0.4	215	0.3300	9.25		**Shallow Concentrated Flow, Segment BC** Unpaved Kv= 16.1 fps
10.4	338	0.0060	0.54		**Shallow Concentrated Flow, CD** Short Grass Pasture Kv= 7.0 fps
11.4	590	Total			

Summary for Subcatchment 5: SC-5

Runoff = 20.73 cfs @ 14.31 hrs, Volume= 7.988 af, Depth= 2.45"
Routed to Reach AP5 : AP-5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

Area (ac)	CN	Description
7.260	70	Woods, Good, HSG C
31.520	77	Woods, Good, HSG D
0.290	93	Paved roads w/open ditches, 50% imp, HSG D
39.070	76	Weighted Average
38.925		99.63% Pervious Area
0.145		0.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.9	150	0.0130	0.04		**Sheet Flow, Segment A-B** Woods: Dense underbrush n= 0.800 P2= 2.70"
122.7	1,930	0.0110	0.26		**Shallow Concentrated Flow, Segment B-C** Forest w/Heavy Litter Kv= 2.5 fps
2.5	275		1.80		**Direct Entry, Segment C-D (STWC, 0.007)**
192.1	2,355	Total			

Summary for Reach 1: Analysis Point 1

Inflow Area = 145.103 ac, 3.22% Impervious, Inflow Depth = 2.22" for 25-yr Storm event
Inflow = 123.36 cfs @ 12.71 hrs, Volume= 26.874 af
Outflow = 123.36 cfs @ 12.71 hrs, Volume= 26.874 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach 7R: SOUTH ACCESS RD DITCH

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 2.30" for 25-yr Storm event
Inflow = 21.68 cfs @ 12.07 hrs, Volume= 1.084 af
Outflow = 21.20 cfs @ 12.09 hrs, Volume= 1.084 af, Atten= 2%, Lag= 1.1 min
Routed to Pond 12P : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.98 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.75 fps, Avg. Travel Time= 2.5 min

Peak Storage= 806 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.70' , Surface Width= 5.80'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 173.05 cfs

3.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 262.0' Slope= 0.0271 '/'
Inlet Invert= 205.00', Outlet Invert= 197.90'

Summary for Reach 9R: LEVEL SPREADER DISCHARGE

Inflow Area = 30.022 ac, 9.91% Impervious, Inflow Depth > 1.63" for 25-yr Storm event
Inflow = 1.83 cfs @ 19.49 hrs, Volume= 4.089 af
Outflow = 1.83 cfs @ 20.08 hrs, Volume= 4.082 af, Atten= 0%, Lag= 35.5 min
Routed to Reach E1R7 : REACH TO AP

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Max. Velocity= 0.21 fps, Min. Travel Time= 21.3 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 41.6 min

Peak Storage= 2,336 cf @ 19.73 hrs
Average Depth at Peak Storage= 0.36' , Surface Width= 27.24'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 11.46 cfs

20.00' x 1.00' deep channel, n= 0.800 Sheet flow: Woods+dense brush
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 273.0' Slope= 0.0623 '/'
Inlet Invert= 180.00', Outlet Invert= 163.00'

‡

Summary for Reach 12R: Ditch 4B1

Inflow Area = 14.437 ac, 3.03% Impervious, Inflow Depth = 2.03" for 25-yr Storm event
Inflow = 29.87 cfs @ 12.08 hrs, Volume= 2.446 af
Outflow = 29.57 cfs @ 12.12 hrs, Volume= 2.446 af, Atten= 1%, Lag= 2.2 min
Routed to Pond DP-9 : DETENTION POND 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.69 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.73 fps, Avg. Travel Time= 3.4 min

Peak Storage= 2,235 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.35' , Surface Width= 7.40'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 70.02 cfs

2.00' x 2.00' deep channel, n= 0.025
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 352.0' Slope= 0.0085 '/'
Inlet Invert= 213.50', Outlet Invert= 210.50'

Summary for Reach 13R: Ex Ditch

Inflow Area = 0.679 ac, 6.77% Impervious, Inflow Depth = 3.94" for 25-yr Storm event
Inflow = 8.74 cfs @ 12.08 hrs, Volume= 0.223 af
Outflow = 8.21 cfs @ 12.11 hrs, Volume= 0.223 af, Atten= 6%, Lag= 1.6 min
Routed to Pond C4B : Culvert - 4BA & 4BB

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 4.9 min

Peak Storage= 519 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.68' , Surface Width= 4.74'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 81.05 cfs

2.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 225.0' Slope= 0.0164 '/'
Inlet Invert= 209.70', Outlet Invert= 206.00'

Summary for Reach AP2: ANALYSIS POINT #2

Inflow Area = 79.534 ac, 4.18% Impervious, Inflow Depth = 2.24" for 25-yr Storm event
Inflow = 30.74 cfs @ 13.81 hrs, Volume= 14.846 af
Outflow = 30.74 cfs @ 13.81 hrs, Volume= 14.846 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP3: ANALYSIS POINT #3

Inflow Area = 265.594 ac, 1.09% Impervious, Inflow Depth = 2.20" for 25-yr Storm event
Inflow = 105.89 cfs @ 15.20 hrs, Volume= 48.744 af
Outflow = 105.89 cfs @ 15.20 hrs, Volume= 48.744 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP4: AP4

Inflow Area = 326.605 ac, 3.82% Impervious, Inflow Depth > 2.29" for 25-yr Storm event
Inflow = 82.47 cfs @ 16.20 hrs, Volume= 62.372 af
Outflow = 82.47 cfs @ 16.20 hrs, Volume= 62.372 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach AP5: AP-5

Inflow Area = 39.070 ac, 0.37% Impervious, Inflow Depth = 2.45" for 25-yr Storm event
Inflow = 20.73 cfs @ 14.31 hrs, Volume= 7.988 af
Outflow = 20.73 cfs @ 14.31 hrs, Volume= 7.988 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Summary for Reach E1R6: DP-10 DISCHARGE

Inflow Area = 34.949 ac, 6.10% Impervious, Inflow Depth > 2.03" for 25-yr Storm event
Inflow = 15.90 cfs @ 12.62 hrs, Volume= 5.911 af
Outflow = 15.85 cfs @ 12.68 hrs, Volume= 5.910 af, Atten= 0%, Lag= 3.5 min
Routed to Reach E1R7 : REACH TO AP

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.04 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 7.5 min

Peak Storage= 1,864 cf @ 12.65 hrs
Average Depth at Peak Storage= 0.23' , Surface Width= 24.67'
Bank-Full Depth= 2.00' Flow Area= 80.0 sf, Capacity= 827.94 cfs

20.00' x 2.00' deep channel, n= 0.045
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 357.0' Slope= 0.0672 '/'
Inlet Invert= 178.00', Outlet Invert= 154.00'

‡

Summary for Reach E1R7: REACH TO AP

Inflow Area = 64.971 ac, 7.86% Impervious, Inflow Depth > 1.85" for 25-yr Storm event
Inflow = 15.86 cfs @ 12.68 hrs, Volume= 9.992 af
Outflow = 13.83 cfs @ 13.28 hrs, Volume= 9.977 af, Atten= 13%, Lag= 36.1 min
Routed to Reach AP4 : AP4

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.19 fps, Min. Travel Time= 16.5 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 40.0 min

Peak Storage= 13,716 cf @ 13.01 hrs
Average Depth at Peak Storage= 1.16' , Surface Width= 8.94'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 48.12 cfs

2.00' x 2.00' deep channel, n= 0.045 Winding stream, pools & shoals
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 2,170.0' Slope= 0.0074 '/'
Inlet Invert= 158.00', Outlet Invert= 142.00'

Summary for Reach O4: Overland Flow

Inflow Area = 3.101 ac, 10.32% Impervious, Inflow Depth = 2.98" for 25-yr Storm event
Inflow = 16.05 cfs @ 12.10 hrs, Volume= 0.771 af
Outflow = 15.83 cfs @ 12.11 hrs, Volume= 0.771 af, Atten= 1%, Lag= 0.5 min
Routed to Pond DP-9 : DETENTION POND 9

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.99 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 9.99 fps, Avg. Travel Time= 0.3 min

Peak Storage= 269 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 119.87 cfs

Custom stage-perimeter table, n= 0.035 Earth, dense weeds
100 Intermediate values determined by Multi-point interpolation
Length= 168.0' Slope= 0.0554 '/'
Inlet Invert= 201.30', Outlet Invert= 192.00'

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
2.00	12.0	12.0	2,016	119.87

Summary for Reach R-10a: R-10a

Inflow Area = 13.052 ac, 3.54% Impervious, Inflow Depth = 1.90" for 25-yr Storm event
Inflow = 23.94 cfs @ 12.07 hrs, Volume= 2.071 af
Outflow = 23.39 cfs @ 12.13 hrs, Volume= 2.071 af, Atten= 2%, Lag= 3.6 min
Routed to Pond DP-10 : DETENTION POND 10

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.16 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.80 fps, Avg. Travel Time= 5.9 min

Peak Storage= 2,938 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.74' , Surface Width= 8.43'
Bank-Full Depth= 3.00' Flow Area= 39.0 sf, Capacity= 437.98 cfs

4.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 641.0' Slope= 0.0137 '/'
Inlet Invert= 194.00', Outlet Invert= 185.25'

‡

Summary for Reach R-1B: LF TOE DITCH

Inflow Area = 19.514 ac, 4.11% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 54.70 cfs @ 12.07 hrs, Volume= 3.449 af
Outflow = 52.68 cfs @ 12.12 hrs, Volume= 3.449 af, Atten= 4%, Lag= 2.7 min
Routed to Pond DP-1 : DETENTION POND 1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.97 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.94 fps, Avg. Travel Time= 4.6 min

Peak Storage= 4,876 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.68' , Surface Width= 8.73'
Defined Flood Depth= 2.00' Flow Area= 12.0 sf, Capacity= 79.00 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 79.00 cfs

2.00' x 2.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 540.0' Slope= 0.0278 '/'
Inlet Invert= 181.00', Outlet Invert= 166.00'

Summary for Reach R-1B1: LF TOE DITCH

Inflow Area = 8.511 ac, 4.70% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 24.87 cfs @ 12.05 hrs, Volume= 1.504 af
Outflow = 23.83 cfs @ 12.09 hrs, Volume= 1.504 af, Atten= 4%, Lag= 2.6 min
Routed to Reach R-1B : LF TOE DITCH

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.64 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.81 fps, Avg. Travel Time= 4.4 min

Peak Storage= 2,063 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.05' , Surface Width= 6.21'
Defined Flood Depth= 2.00' Flow Area= 12.0 sf, Capacity= 96.96 cfs
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 96.96 cfs

2.00' x 2.00' deep channel, n= 0.040 Winding stream, pools & shoals
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 478.0' Slope= 0.0418 '/'
Inlet Invert= 204.00', Outlet Invert= 184.00'

Summary for Reach R-1D: Reach R-1D

Inflow Area = 41.304 ac, 3.35% Impervious, Inflow Depth > 2.03" for 25-yr Storm event
Inflow = 38.56 cfs @ 12.29 hrs, Volume= 6.990 af
Outflow = 38.48 cfs @ 12.36 hrs, Volume= 6.990 af, Atten= 0%, Lag= 4.0 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.91 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 0.53 fps, Avg. Travel Time= 11.6 min

Peak Storage= 4,902 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.75' , Surface Width= 25.10'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 67.93 cfs

10.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 370.0' Slope= 0.0324 '/'
Inlet Invert= 159.00', Outlet Invert= 147.00'

‡

Summary for Reach R-1E: Plastic Lined Ditch

Inflow Area = 9.580 ac, 2.92% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 28.86 cfs @ 12.04 hrs, Volume= 1.693 af
Outflow = 28.64 cfs @ 12.05 hrs, Volume= 1.693 af, Atten= 1%, Lag= 0.3 min
Routed to Pond DP-1a : DP-1a

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.66 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.16 fps, Avg. Travel Time= 0.8 min

Peak Storage= 394 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.41' , Surface Width= 5.63'
Bank-Full Depth= 3.00' Flow Area= 30.0 sf, Capacity= 1,302.19 cfs

4.00' x 3.00' deep channel, n= 0.011
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 200.0' Slope= 0.0500 '/'
Inlet Invert= 176.00', Outlet Invert= 166.00'

Summary for Reach R-1F: Reach R-1F

Inflow Area = 9.875 ac, 0.07% Impervious, Inflow Depth = 2.06" for 25-yr Storm event
Inflow = 13.32 cfs @ 12.08 hrs, Volume= 1.693 af
Outflow = 12.89 cfs @ 12.14 hrs, Volume= 1.693 af, Atten= 3%, Lag= 3.7 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.20 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 7.6 min

Peak Storage= 1,292 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 25.42'
Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 140.14 cfs

20.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 40.00'
Length= 210.0' Slope= 0.0524 '/'
Inlet Invert= 158.00', Outlet Invert= 147.00'

‡

Summary for Reach R-1G: RipRap Downspout

Inflow Area = 1.772 ac, 0.00% Impervious, Inflow Depth = 2.00" for 25-yr Storm event
Inflow = 3.63 cfs @ 12.06 hrs, Volume= 0.296 af
Outflow = 3.52 cfs @ 12.12 hrs, Volume= 0.296 af, Atten= 3%, Lag= 3.5 min
Routed to Pond DP-2 : DETENTION POND 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.28 fps, Avg. Travel Time= 6.4 min

Peak Storage= 436 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.20' , Surface Width= 4.80'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 368.81 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 493.0' Slope= 0.3428 '/'
Inlet Invert= 333.00', Outlet Invert= 164.00'

Summary for Reach R-1I: Final Cover Access Road Ditch

Inflow = 1.79 cfs @ 12.06 hrs, Volume= 0.030 af
Outflow = 1.49 cfs @ 12.17 hrs, Volume= 0.030 af, Atten= 17%, Lag= 6.7 min
Routed to Pond P-1I : Culvert Crossing 6c

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.25 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 12.9 min

Peak Storage= 361 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 3.08'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 80.08 cfs

2.00' x 2.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 524.0' Slope= 0.0849 '/'
Inlet Invert= 335.00', Outlet Invert= 290.50'

Summary for Reach R-1J: RipRap Downspout

Inflow Area = 4.295 ac, 2.58% Impervious, Inflow Depth = 2.07" for 25-yr Storm event
Inflow = 12.70 cfs @ 11.96 hrs, Volume= 0.740 af
Outflow = 12.52 cfs @ 11.98 hrs, Volume= 0.740 af, Atten= 1%, Lag= 0.8 min
Routed to Pond P-1J-1 : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.37 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 1.5 min

Peak Storage= 322 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.41' , Surface Width= 5.63'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 387.31 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 164.0' Slope= 0.3780 '/'
Inlet Invert= 252.00', Outlet Invert= 190.00'

Summary for Reach R-1L: Final Cover Access Road Ditch

Inflow = 6.72 cfs @ 11.96 hrs, Volume= 0.085 af
Outflow = 6.00 cfs @ 12.04 hrs, Volume= 0.085 af, Atten= 11%, Lag= 4.8 min
Routed to Pond 1P : (2) 24" CULVERTS

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.30 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 12.9 min

Peak Storage= 1,034 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.58' , Surface Width= 4.33'
Bank-Full Depth= 2.00' Flow Area= 12.0 sf, Capacity= 77.46 cfs

2.00' x 2.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 10.00'
Length= 560.0' Slope= 0.0795 '/'
Inlet Invert= 254.50', Outlet Invert= 210.00'

Summary for Reach R-1N: R-1N

Inflow Area = 27.235 ac, 7.11% Impervious, Inflow Depth > 2.05" for 25-yr Storm event
Inflow = 1.45 cfs @ 20.00 hrs, Volume= 4.663 af
Outflow = 1.45 cfs @ 20.52 hrs, Volume= 4.663 af, Atten= 0%, Lag= 31.4 min
Routed to Reach R-1O : R-1O

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.85 fps, Min. Travel Time= 18.4 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 34.0 min

Peak Storage= 1,608 cf @ 20.21 hrs
Average Depth at Peak Storage= 0.15' , Surface Width= 12.98'
Bank-Full Depth= 1.00' Flow Area= 20.0 sf, Capacity= 49.97 cfs

10.00' x 1.00' deep channel, n= 0.060
Side Slope Z-value= 10.0 '/' Top Width= 30.00'
Length= 940.0' Slope= 0.0176 '/'
Inlet Invert= 168.00', Outlet Invert= 151.50'

‡

Summary for Reach R-1O: R-1O

Inflow Area = 58.266 ac, 5.06% Impervious, Inflow Depth = 2.31" for 25-yr Storm event
Inflow = 56.24 cfs @ 12.37 hrs, Volume= 11.230 af
Outflow = 53.78 cfs @ 12.56 hrs, Volume= 11.230 af, Atten= 4%, Lag= 11.4 min
Routed to Reach R2 : Reach 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.93 fps, Min. Travel Time= 6.4 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 29.0 min

Peak Storage= 20,558 cf @ 12.45 hrs
Average Depth at Peak Storage= 1.25' , Surface Width= 34.91'
Bank-Full Depth= 2.00' Flow Area= 60.0 sf, Capacity= 151.21 cfs

10.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 10.0 '/' Top Width= 50.00'
Length= 735.0' Slope= 0.0020 '/'
Inlet Invert= 151.50', Outlet Invert= 150.00'

‡

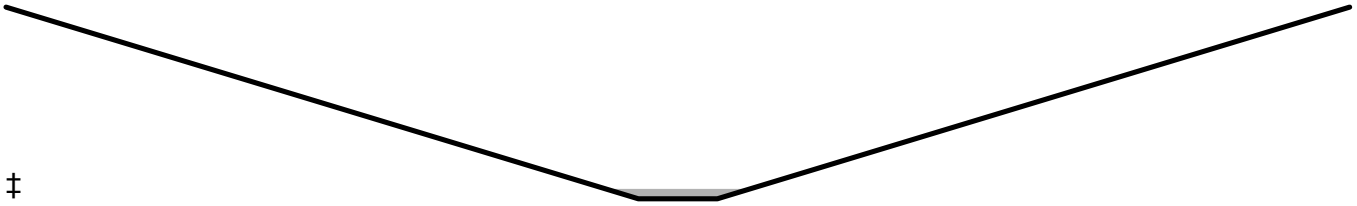
Summary for Reach R-2A: Reach 2A

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 2.17" for 25-yr Storm event
Inflow = 1.99 cfs @ 18.63 hrs, Volume= 5.698 af
Outflow = 1.99 cfs @ 20.06 hrs, Volume= 5.698 af, Atten= 0%, Lag= 86.2 min
Routed to Reach AP2 : ANALYSIS POINT #2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.53 fps, Min. Travel Time= 50.8 min
Avg. Velocity = 0.38 fps, Avg. Travel Time= 70.6 min

Peak Storage= 6,062 cf @ 19.22 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 45.93'
Bank-Full Depth= 2.00' Flow Area= 450.0 sf, Capacity= 1,332.75 cfs

25.00' x 2.00' deep channel, n= 0.050 Scattered brush, heavy weeds
Side Slope Z-value= 100.0 '/' Top Width= 425.00'
Length= 1,630.0' Slope= 0.0092 '/'
Inlet Invert= 166.00', Outlet Invert= 151.00'



‡

Summary for Reach R-2C: LF TOE DITCH

Inflow Area = 9.740 ac, 3.67% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 27.58 cfs @ 12.06 hrs, Volume= 1.722 af
Outflow = 26.18 cfs @ 12.13 hrs, Volume= 1.722 af, Atten= 5%, Lag= 4.0 min
Routed to Pond CB-2E : LF TOE DITCH - CATCH BASIN

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 7.0 min

Peak Storage= 3,482 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.92' , Surface Width= 10.68'
Defined Flood Depth= 2.00' Flow Area= 14.0 sf, Capacity= 29.12 cfs
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 70.39 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 265.0' Slope= 0.0075 '/'
Inlet Invert= 181.00', Outlet Invert= 179.00'

Summary for Reach R-2D: DITCH

Inflow Area = 9.297 ac, 3.94% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 26.51 cfs @ 12.06 hrs, Volume= 1.640 af
Outflow = 25.66 cfs @ 12.09 hrs, Volume= 1.640 af, Atten= 3%, Lag= 1.8 min
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.07 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 2.8 min

Peak Storage= 1,442 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.19' , Surface Width= 7.77'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 183.17 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 225.0' Slope= 0.0511 '/'
Inlet Invert= 191.50', Outlet Invert= 180.00'

Summary for Reach R-4B: R-4B

Inflow Area = 4.602 ac, 9.82% Impervious, Inflow Depth = 2.28" for 25-yr Storm event
Inflow = 14.68 cfs @ 12.05 hrs, Volume= 0.876 af
Outflow = 10.48 cfs @ 12.32 hrs, Volume= 0.876 af, Atten= 29%, Lag= 16.2 min
Routed to Pond CB-4C : LT TOE DITCH - CATCH BASIN

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.59 fps, Min. Travel Time= 10.6 min
Avg. Velocity = 0.40 fps, Avg. Travel Time= 41.8 min

Peak Storage= 6,724 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.23' , Surface Width= 7.90'
Bank-Full Depth= 3.00' Flow Area= 27.0 sf, Capacity= 69.96 cfs

3.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,006.0' Slope= 0.0075 '/'
Inlet Invert= 178.50', Outlet Invert= 171.00'

Summary for Reach R-IH: RipRap Downspout

Inflow Area = 3.906 ac, 1.97% Impervious, Inflow Depth = 2.06" for 25-yr Storm event
Inflow = 9.43 cfs @ 12.01 hrs, Volume= 0.672 af
Outflow = 9.32 cfs @ 12.03 hrs, Volume= 0.672 af, Atten= 1%, Lag= 1.1 min
Routed to Pond P-1H : Modified Plunge Pool w/(2)24" Culverts P-6a

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.81 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 2.6 min

Peak Storage= 417 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 5.39'
Bank-Full Depth= 2.50' Flow Area= 22.5 sf, Capacity= 385.75 cfs

4.00' x 2.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 2.0 '/' Top Width= 14.00'
Length= 256.0' Slope= 0.3750 '/'
Inlet Invert= 286.00', Outlet Invert= 190.00'

Summary for Reach R2: Reach 2

Inflow Area = 122.225 ac, 3.55% Impervious, Inflow Depth = 2.21" for 25-yr Storm event
Inflow = 109.28 cfs @ 12.56 hrs, Volume= 22.526 af
Outflow = 107.85 cfs @ 12.69 hrs, Volume= 22.525 af, Atten= 1%, Lag= 7.6 min
Routed to Reach 1 : Analysis Point 1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.66 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 20.6 min

Peak Storage= 28,389 cf @ 12.61 hrs
Average Depth at Peak Storage= 1.57' , Surface Width= 41.50'
Bank-Full Depth= 2.00' Flow Area= 60.0 sf, Capacity= 183.33 cfs

10.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 10.0 '/' Top Width= 50.00'
Length= 700.0' Slope= 0.0030 '/'
Inlet Invert= 148.40', Outlet Invert= 146.30'

‡

Summary for Reach R4B4:

Inflow Area = 54.320 ac, 3.83% Impervious, Inflow Depth = 2.21" for 25-yr Storm event
Inflow = 6.22 cfs @ 21.54 hrs, Volume= 10.010 af
Outflow = 6.22 cfs @ 22.08 hrs, Volume= 10.010 af, Atten= 0%, Lag= 32.0 min
Routed to Reach AP4 : AP4

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.88 fps, Min. Travel Time= 18.2 min
Avg. Velocity = 0.33 fps, Avg. Travel Time= 49.3 min

Peak Storage= 6,810 cf @ 21.77 hrs
Average Depth at Peak Storage= 0.43' , Surface Width= 20.66'
Bank-Full Depth= 2.00' Flow Area= 64.0 sf, Capacity= 131.94 cfs

12.00' x 2.00' deep channel, n= 0.080
Side Slope Z-value= 10.0 '/' Top Width= 52.00'
Length= 963.0' Slope= 0.0094 '/'
Inlet Invert= 142.00', Outlet Invert= 132.96'

‡

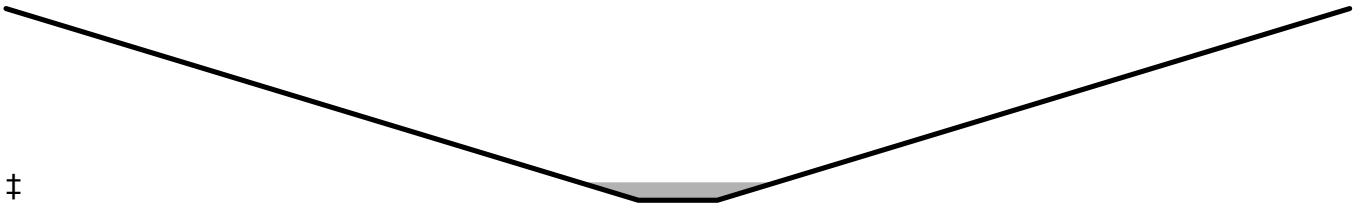
Summary for Reach R4C: Reach 4C

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 2.26" for 25-yr Storm event
Inflow = 3.15 cfs @ 13.11 hrs, Volume= 2.158 af
Outflow = 2.97 cfs @ 14.85 hrs, Volume= 2.158 af, Atten= 6%, Lag= 104.1 min
Routed to Reach R4C1 : Reach 4C1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.37 fps, Min. Travel Time= 43.9 min
Avg. Velocity = 0.18 fps, Avg. Travel Time= 91.8 min

Peak Storage= 7,838 cf @ 14.11 hrs
Average Depth at Peak Storage= 0.19' , Surface Width= 62.08'
Bank-Full Depth= 2.00' Flow Area= 450.0 sf, Capacity= 669.12 cfs

25.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 425.00'
Length= 970.0' Slope= 0.0093 '/'
Inlet Invert= 159.00', Outlet Invert= 150.00'



‡

Summary for Reach R4C1: Reach 4C1

Inflow Area = 24.911 ac, 5.27% Impervious, Inflow Depth = 2.18" for 25-yr Storm event
Inflow = 4.44 cfs @ 14.95 hrs, Volume= 4.527 af
Outflow = 3.42 cfs @ 21.64 hrs, Volume= 4.527 af, Atten= 23%, Lag= 401.2 min
Routed to Reach R4C2 : Reach 4C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.21 fps, Min. Travel Time= 177.8 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 429.7 min

Peak Storage= 36,520 cf @ 18.67 hrs
Average Depth at Peak Storage= 0.14' , Surface Width= 128.53'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 562.82 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 2,240.0' Slope= 0.0031 '/'
Inlet Invert= 150.00', Outlet Invert= 143.00'

‡

Summary for Reach R4C2: Reach 4C2

Inflow Area = 54.320 ac, 3.83% Impervious, Inflow Depth = 2.21" for 25-yr Storm event
Inflow = 6.24 cfs @ 20.57 hrs, Volume= 10.011 af
Outflow = 6.22 cfs @ 21.54 hrs, Volume= 10.010 af, Atten= 0%, Lag= 58.4 min
Routed to Reach R4B4 :

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.23 fps, Min. Travel Time= 32.2 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 79.5 min

Peak Storage= 12,014 cf @ 21.01 hrs
Average Depth at Peak Storage= 0.22' , Surface Width= 144.22'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 477.27 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 445.0' Slope= 0.0022 '/'
Inlet Invert= 143.00', Outlet Invert= 142.00'

‡

Summary for Reach R4D: Reach 4D

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 2.11" for 25-yr Storm event
Inflow = 1.50 cfs @ 14.89 hrs, Volume= 2.369 af
Outflow = 1.50 cfs @ 16.21 hrs, Volume= 2.369 af, Atten= 0%, Lag= 79.1 min
Routed to Reach R4C1 : Reach 4C1

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.23 fps, Min. Travel Time= 44.7 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 61.6 min

Peak Storage= 4,015 cf @ 15.46 hrs
Average Depth at Peak Storage= 0.06' , Surface Width= 112.48'
Bank-Full Depth= 2.00' Flow Area= 600.0 sf, Capacity= 1,002.64 cfs

100.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 100.0 '/' Top Width= 500.00'
Length= 605.0' Slope= 0.0099 '/'
Inlet Invert= 156.00', Outlet Invert= 150.00'

‡

Summary for Reach R4G: Reach 4G

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 2.24" for 25-yr Storm event
Inflow = 3.26 cfs @ 15.01 hrs, Volume= 5.483 af
Outflow = 3.25 cfs @ 15.25 hrs, Volume= 5.483 af, Atten= 0%, Lag= 14.4 min
Routed to Reach R4C2 : Reach 4C2

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.69 fps, Min. Travel Time= 8.7 min
Avg. Velocity = 0.46 fps, Avg. Travel Time= 13.1 min

Peak Storage= 1,708 cf @ 15.11 hrs
Average Depth at Peak Storage= 0.21' , Surface Width= 24.25'
Bank-Full Depth= 2.00' Flow Area= 80.0 sf, Capacity= 199.54 cfs

20.00' x 2.00' deep channel, n= 0.100 Heavy timber, flow below branches
Side Slope Z-value= 10.0 '/' Top Width= 60.00'
Length= 363.0' Slope= 0.0193 '/'
Inlet Invert= 150.00', Outlet Invert= 143.00'

‡

Summary for Pond 1P: (2) 24" CULVERTS

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 2.30" for 25-yr Storm event
Inflow = 22.61 cfs @ 12.05 hrs, Volume= 1.084 af
Outflow = 21.68 cfs @ 12.07 hrs, Volume= 1.084 af, Atten= 4%, Lag= 1.4 min
Primary = 21.68 cfs @ 12.07 hrs, Volume= 1.084 af
Routed to Reach 7R : SOUTH ACCESS RD DITCH
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach 7R : SOUTH ACCESS RD DITCH

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 207.66' @ 12.07 hrs Surf.Area= 1,649 sf Storage= 2,122 cf
Flood Elev= 210.00' Surf.Area= 3,240 sf Storage= 7,740 cf

Plug-Flow detention time= 4.2 min calculated for 1.084 af (100% of inflow)
Center-of-Mass det. time= 4.2 min (841.0 - 836.7)

Volume	Invert	Avail.Storage	Storage Description
#1	206.00'	7,740 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
206.00	900	0	0
208.00	1,800	2,700	2,700
210.00	3,240	5,040	7,740

Device	Routing	Invert	Outlet Devices
#1	Primary	206.00'	**24.0" Round 24"Culvert (X2) X 2.00** L= 76.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 206.00' / 205.00' S= 0.0132 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	209.60'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=21.09 cfs @ 12.07 hrs HW=207.63' (Free Discharge)
↑—**1=24"Culvert (X2)** (Inlet Controls 21.09 cfs @ 3.84 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=206.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 12P: (2) 24" CULVERTS

Inflow Area = 5.651 ac, 2.50% Impervious, Inflow Depth = 2.30" for 25-yr Storm event
Inflow = 21.20 cfs @ 12.09 hrs, Volume= 1.084 af
Outflow = 20.53 cfs @ 12.11 hrs, Volume= 1.084 af, Atten= 3%, Lag= 1.4 min
Primary = 20.53 cfs @ 12.11 hrs, Volume= 1.084 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond 15P : EXISTING 12" CULVERT

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 199.50' @ 12.11 hrs Surf.Area= 1,777 sf Storage= 1,684 cf
Flood Elev= 200.50' Surf.Area= 2,548 sf Storage= 3,866 cf

Plug-Flow detention time= 1.6 min calculated for 1.084 af (100% of inflow)
Center-of-Mass det. time= 1.6 min (844.7 - 843.1)

Volume	Invert	Avail.Storage	Storage Description
#1	198.00'	3,866 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
198.00	464	0	0
200.00	2,212	2,676	2,676
200.50	2,548	1,190	3,866

Device	Routing	Invert	Outlet Devices
#1	Primary	197.90'	**24.0" Round 24"Culvert (X2) X 2.00** L= 98.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 197.90' / 195.47' S= 0.0248 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Secondary	200.00'	**14.0' long x 11.0' breadth Broad-Crested Rectangular Weir-Overflow** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.53 2.59 2.70 2.68 2.67 2.68 2.66 2.64

Primary OutFlow Max=20.17 cfs @ 12.11 hrs HW=199.48' (Free Discharge)
1=24"Culvert (X2) (Inlet Controls 20.17 cfs @ 3.78 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
2=Broad-Crested Rectangular Weir-Overflow(Controls 0.00 cfs)

Summary for Pond 15P: EXISTING 12" CULVERT

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-6 : DETENTION POND 6

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 198.00' @ 0.00 hrs Surf.Area= 464 sf Storage= 0 cf
Flood Elev= 200.50' Surf.Area= 2,212 sf Storage= 2,676 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	198.00'	2,676 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
198.00	464	0	0
200.00	2,212	2,676	2,676

Device	Routing	Invert	Outlet Devices
#1	Primary	197.40'	**12.0" Round 24"Culvert (X2)** L= 121.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 197.40' / 189.90' S= 0.0620 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Secondary	198.00'	**10.0' long x 50.0' breadth Broad-Crested Rectangular Weir**

Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
└**1=24"Culvert (X2)** (Passes 0.00 cfs of 1.02 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=198.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond C-4K: Catch Basin - 4K

Inflow Area = 14.437 ac, 3.03% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 38.63 cfs @ 12.08 hrs, Volume= 2.552 af
Outflow = 38.65 cfs @ 12.08 hrs, Volume= 2.551 af, Atten= 0%, Lag= 0.0 min
Primary = 29.87 cfs @ 12.08 hrs, Volume= 2.446 af
Routed to Reach 12R : Ditch 4B1
Secondary = 8.79 cfs @ 12.08 hrs, Volume= 0.105 af
Routed to Pond C-4L : Catch Basin - 4L

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 221.40' @ 12.08 hrs Surf.Area= 13 sf Storage= 57 cf

Plug-Flow detention time= 0.4 min calculated for 2.551 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (849.0 - 848.9)

Volume	Invert	Avail.Storage	Storage Description
#1	214.50'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	216.50'	**24.0" Round Culvert - 4K** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 216.50' / 214.50' S= 0.0392 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	218.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	220.00'	**2.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=29.64 cfs @ 12.08 hrs HW=221.34' (Free Discharge)
└**1=Culvert - 4K** (Inlet Controls 29.64 cfs @ 9.43 fps)
└**2=Orifice/Grate** (Passes 29.64 cfs of 43.19 cfs potential flow)

Secondary OutFlow Max=8.30 cfs @ 12.08 hrs HW=221.34' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 8.30 cfs @ 3.10 fps)

Summary for Pond C-4L: Catch Basin - 4L

Inflow Area = 0.679 ac, 6.77% Impervious, Inflow Depth = 4.06" for 25-yr Storm event
Inflow = 9.22 cfs @ 12.08 hrs, Volume= 0.229 af
Outflow = 9.22 cfs @ 12.08 hrs, Volume= 0.226 af, Atten= 0%, Lag= 0.0 min
Primary = 8.74 cfs @ 12.08 hrs, Volume= 0.223 af
Routed to Reach 13R : Ex Ditch
Secondary = 0.49 cfs @ 12.09 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 215.07' @ 12.08 hrs Surf.Area= 13 sf Storage= 43 cf

Plug-Flow detention time= 7.4 min calculated for 0.226 af (98% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	210.50'	43 cf	**4.00'D x 3.40'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	212.50'	**18.0" Round Culvert 4L** L= 121.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 212.50' / 210.50' S= 0.0165 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	214.50'	**24.0" Horiz. Orifice-Top of catch basin** C= 0.600 Limited to weir flow at low heads
#3	Secondary	215.00'	**15.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=8.31 cfs @ 12.08 hrs HW=215.05' (Free Discharge)
└**1=Culvert 4L** (Passes 8.31 cfs of 11.41 cfs potential flow)
└**2=Orifice-Top of catch basin** (Weir Controls 8.31 cfs @ 2.42 fps)

Secondary OutFlow Max=0.41 cfs @ 12.09 hrs HW=215.05' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 0.41 cfs @ 0.56 fps)

Summary for Pond C4B: Culvert - 4BA & 4BB

Inflow Area = 3.101 ac, 10.32% Impervious, Inflow Depth = 2.98" for 25-yr Storm event
Inflow = 16.44 cfs @ 12.09 hrs, Volume= 0.771 af
Outflow = 16.05 cfs @ 12.10 hrs, Volume= 0.771 af, Atten= 2%, Lag= 1.0 min
Primary = 16.05 cfs @ 12.10 hrs, Volume= 0.771 af
Routed to Reach O4 : Overland Flow

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 205.87' @ 12.10 hrs Surf.Area= 1,191 sf Storage= 872 cf

Plug-Flow detention time= 0.8 min calculated for 0.771 af (100% of inflow)
Center-of-Mass det. time= 0.8 min (817.3 - 816.6)

Volume	Invert	Avail.Storage	Storage Description
#1	204.40'	11,690 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
204.40	0	0	0
206.00	1,300	1,040	1,040
208.00	4,200	5,500	6,540
209.00	6,100	5,150	11,690

Device	Routing	Invert	Outlet Devices
#1	Primary	204.40'	**24.0" Round Culvert - 4B X 2.00** L= 46.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 204.40' / 203.70' S= 0.0152 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf

Primary OutFlow Max=15.91 cfs @ 12.10 hrs HW=205.86' (Free Discharge)
└**1=Culvert - 4B** (Inlet Controls 15.91 cfs @ 3.24 fps)

Summary for Pond CB-2B: LF TOE DITCH - CATCH BASIN

Inflow Area = 9.308 ac, 2.34% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 25.70 cfs @ 12.07 hrs, Volume= 1.645 af
Outflow = 25.75 cfs @ 12.07 hrs, Volume= 1.643 af, Atten= 0%, Lag= 0.0 min
Primary = 25.75 cfs @ 12.07 hrs, Volume= 1.643 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 180.18' @ 12.07 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 1.2 min calculated for 1.642 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (848.5 - 848.1)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	173.00'	**24.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=25.20 cfs @ 12.07 hrs HW=180.14' (Free Discharge)
└**2=Culvert** (Passes 25.20 cfs of 37.47 cfs potential flow)
└**1=Orifice/Grate** (Orifice Controls 25.20 cfs @ 5.13 fps)

Summary for Pond CB-2D: LF TOE DITCH - CATCH BASIN

Inflow Area = 9.297 ac, 3.94% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 26.42 cfs @ 12.06 hrs, Volume= 1.643 af
Outflow = 26.51 cfs @ 12.06 hrs, Volume= 1.640 af, Atten= 0%, Lag= 0.0 min
Primary = 26.51 cfs @ 12.06 hrs, Volume= 1.640 af
Routed to Reach R-2D : DITCH

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 202.25' @ 12.06 hrs Surf.Area= 13 sf Storage= 138 cf
Flood Elev= 200.65' Surf.Area= 13 sf Storage= 134 cf

Plug-Flow detention time= 1.6 min calculated for 1.640 af (100% of inflow)
Center-of-Mass det. time= 0.5 min (847.8 - 847.3)

Volume	Invert	Avail.Storage	Storage Description
#1	190.00'	138 cf	**4.00'D x 11.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	201.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	192.00'	**24.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 192.00' / 191.50' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=26.10 cfs @ 12.06 hrs HW=202.22' (Free Discharge)
↑**2=Culvert** (Passes 26.10 cfs of 36.26 cfs potential flow)
↑**1=Orifice/Grate** (Orifice Controls 26.10 cfs @ 5.32 fps)

Summary for Pond CB-2E: LF TOE DITCH - CATCH BASIN

Inflow Area = 10.279 ac, 4.18% Impervious, Inflow Depth = 2.13" for 25-yr Storm event
Inflow = 26.52 cfs @ 12.13 hrs, Volume= 1.828 af
Outflow = 26.55 cfs @ 12.13 hrs, Volume= 1.826 af, Atten= 0%, Lag= 0.1 min
Primary = 26.55 cfs @ 12.13 hrs, Volume= 1.826 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 180.26' @ 12.13 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 1.1 min calculated for 1.825 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (852.8 - 852.4)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

#2	Primary	173.00'	**24.0" Round Culvert** L= 80.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=26.04 cfs @ 12.13 hrs HW=180.21' (Free Discharge)
↑—**2=Culvert** (Passes 26.04 cfs of 37.71 cfs potential flow)
↑—**1=Orifice/Grate** (Orifice Controls 26.04 cfs @ 5.31 fps)

Summary for Pond CB-4C: LT TOE DITCH - CATCH BASIN

Inflow Area = 10.458 ac, 9.73% Impervious, Inflow Depth = 2.28" for 25-yr Storm event
Inflow = 22.47 cfs @ 12.02 hrs, Volume= 1.991 af
Outflow = 22.48 cfs @ 12.02 hrs, Volume= 1.989 af, Atten= 0%, Lag= 0.0 min
Primary = 22.48 cfs @ 12.02 hrs, Volume= 1.989 af
Routed to Pond DP-13 : DETENTION POND 13

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.92' @ 12.02 hrs Surf.Area= 13 sf Storage= 87 cf
Flood Elev= 174.00' Surf.Area= 13 sf Storage= 88 cf

Plug-Flow detention time= 0.9 min calculated for 1.989 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (853.5 - 853.3)

Volume	Invert	Avail.Storage	Storage Description
#1	165.00'	88 cf	**4.00'D x 7.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	171.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	167.00'	**24.0" Round Culvert** L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 167.00' / 166.50' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=22.04 cfs @ 12.02 hrs HW=171.90' (Free Discharge)
↑—**2=Culvert** (Passes 22.04 cfs of 29.88 cfs potential flow)
↑—**1=Orifice/Grate** (Weir Controls 22.04 cfs @ 3.11 fps)

Summary for Pond CB-4D: LF TOE DITCH - CATCH BASINS

Inflow Area = 12.095 ac, 2.44% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 40.38 cfs @ 12.01 hrs, Volume= 2.138 af
Outflow = 40.40 cfs @ 12.01 hrs, Volume= 2.137 af, Atten= 0%, Lag= 0.0 min
Primary = 40.40 cfs @ 12.01 hrs, Volume= 2.137 af
Routed to Pond DP-14 : DETENTION POND 14

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 161.35' @ 12.01 hrs Surf.Area= 13 sf Storage= 57 cf
Flood Elev= 162.00' Surf.Area= 13 sf Storage= 57 cf

Plug-Flow detention time= 0.5 min calculated for 2.136 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (843.2 - 843.1)

Volume	Invert	Avail.Storage	Storage Description
#1	156.00'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	160.50'	**30.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	158.00'	**24.0" Round Culvert X 2.00** L= 54.5' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 158.00' / 157.50' S= 0.0092 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=39.65 cfs @ 12.01 hrs HW=161.34' (Free Discharge)
└**2=Culvert** (Passes 39.65 cfs of 46.29 cfs potential flow)
└**1=Orifice/Grate** (Weir Controls 39.65 cfs @ 3.00 fps)

Summary for Pond CB-4G: Catch Basin - 4G

Inflow Area = 11.260 ac, 1.95% Impervious, Inflow Depth = 2.24" for 25-yr Storm event
Inflow = 42.04 cfs @ 12.06 hrs, Volume= 2.099 af
Outflow = 42.30 cfs @ 12.06 hrs, Volume= 2.098 af, Atten= 0%, Lag= 0.0 min
Primary = 42.30 cfs @ 12.06 hrs, Volume= 2.098 af
Routed to Pond DP-11R : DETENTION POND 11R

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 167.44' @ 12.06 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 170.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 0.3 min calculated for 2.098 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (841.1 - 841.0)

Volume	Invert	Avail.Storage	Storage Description
#1	159.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	161.00'	**24.0" Round Culvert** L= 115.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 161.00' / 160.00' S= 0.0087 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 3.14 sf
#2	Primary	167.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=41.29 cfs @ 12.06 hrs HW=167.39' (Free Discharge)
└**1=Culvert** (Inlet Controls 35.11 cfs @ 11.18 fps)
└**2=Orifice/Grate** (Weir Controls 6.18 cfs @ 2.03 fps)

Summary for Pond CB-4H: Catch Basin - 4H

Inflow Area = 15.096 ac, 1.13% Impervious, Inflow Depth = 2.23" for 25-yr Storm event
Inflow = 47.70 cfs @ 12.06 hrs, Volume= 2.805 af
Outflow = 47.76 cfs @ 12.06 hrs, Volume= 2.803 af, Atten= 0%, Lag= 0.0 min
Primary = 37.59 cfs @ 12.06 hrs, Volume= 2.694 af
Routed to Pond DP-11R : DETENTION POND 11R
Secondary = 10.17 cfs @ 12.06 hrs, Volume= 0.108 af
Routed to Pond CB-4G : Catch Basin - 4G

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 183.53' @ 12.06 hrs Surf.Area= 13 sf Storage= 113 cf
Flood Elev= 183.00' Surf.Area= 13 sf Storage= 113 cf

Plug-Flow detention time= 0.8 min calculated for 2.803 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (838.5 - 838.2)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	113 cf	**4.00'D x 9.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	**24.0" Round Culvert** L= 65.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 174.00' / 172.00' S= 0.0308 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	181.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	183.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=37.50 cfs @ 12.06 hrs HW=183.52' (Free Discharge)
└**1=Culvert** (Passes 37.50 cfs of 44.15 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 37.50 cfs @ 7.64 fps)

Secondary OutFlow Max=9.77 cfs @ 12.06 hrs HW=183.52' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 9.77 cfs @ 1.89 fps)

Summary for Pond CB-4I: Catch Basin - 4I

Inflow Area = 13.052 ac, 3.54% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 36.42 cfs @ 12.07 hrs, Volume= 2.311 af
Outflow = 36.45 cfs @ 12.07 hrs, Volume= 2.309 af, Atten= 0%, Lag= 0.0 min
Primary = 23.94 cfs @ 12.07 hrs, Volume= 2.071 af
Routed to Reach R-10a : R-10a
Secondary = 12.52 cfs @ 12.06 hrs, Volume= 0.237 af
Routed to Pond CB-4H : Catch Basin - 4H

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 208.60' @ 12.06 hrs Surf.Area= 13 sf Storage= 108 cf
Flood Elev= 209.90' Surf.Area= 13 sf Storage= 121 cf

Plug-Flow detention time= 0.8 min calculated for 2.309 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (847.9 - 847.6)

Volume	Invert	Avail.Storage	Storage Description
#1	200.00'	121 cf	**4.00'D x 9.60'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	200.00'	**24.0" Round NEW 24-INCH** L= 67.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 194.00' S= 0.0896 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	207.58'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	208.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=23.69 cfs @ 12.07 hrs HW=208.58' (Free Discharge)
↑—**1=NEW 24-INCH** (Passes 23.69 cfs of 41.66 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 23.69 cfs @ 4.83 fps)

Secondary OutFlow Max=12.06 cfs @ 12.06 hrs HW=208.59' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Weir Controls 12.06 cfs @ 2.06 fps)

Summary for Pond CB-4JA: Catch Basin - 4JA

Inflow Area = 11.663 ac, 3.68% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 24.96 cfs @ 12.17 hrs, Volume= 2.062 af
Outflow = 24.96 cfs @ 12.17 hrs, Volume= 2.060 af, Atten= 0%, Lag= 0.0 min
Primary = 22.32 cfs @ 12.17 hrs, Volume= 2.034 af
Routed to Pond DP-10 : DETENTION POND 10
Secondary = 2.64 cfs @ 12.17 hrs, Volume= 0.026 af
Routed to Pond CB-4JA3 : (4JA3) New Catch Basin

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 220.63' @ 12.17 hrs Surf.Area= 13 sf Storage= 88 cf

Plug-Flow detention time= 0.9 min calculated for 2.060 af (100% of inflow)
Center-of-Mass det. time= 0.3 min (856.2 - 856.0)

Volume	Invert	Avail.Storage	Storage Description
#1	211.00'	88 cf	**4.00'D x 7.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	213.00'	**18.0" Round Culvert - 4JA** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 213.00' / 212.20' S= 0.0143 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	218.70'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	220.00'	**2.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=22.25 cfs @ 12.17 hrs HW=220.59' (Free Discharge)
└**1=Culvert - 4JA** (Inlet Controls 22.25 cfs @ 12.59 fps)
└**2=Orifice/Grate** (Passes 22.25 cfs of 32.50 cfs potential flow)

Secondary OutFlow Max=2.43 cfs @ 12.17 hrs HW=220.59' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 2.43 cfs @ 2.06 fps)

Summary for Pond CB-4JA3: (4JA3) New Catch Basin

Inflow = 2.64 cfs @ 12.17 hrs, Volume= 0.026 af
Outflow = 3.10 cfs @ 12.16 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min
Primary = 2.60 cfs @ 12.16 hrs, Volume= 0.020 af
Routed to Pond DP-10 : DETENTION POND 10
Secondary = 0.50 cfs @ 12.16 hrs, Volume= 0.004 af
Routed to Pond PS11 : Culvert - 4IA(C11 PS)

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 213.11' @ 12.15 hrs Surf.Area= 0.000 ac Storage= 0.003 af
Flood Elev= 215.00' Surf.Area= 0.000 ac Storage= 0.003 af

Plug-Flow detention time= 1.2 min calculated for 0.024 af (93% of inflow)
Center-of-Mass det. time= 0.8 min (731.0 - 730.2)

Volume	Invert	Avail.Storage	Storage Description
#1	202.90'	0.003 af	**4.00'D x 10.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Primary	204.90'	**18.0" Round NEW 24-INCH** L= 60.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 204.90' / 204.00' S= 0.0150 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	212.90'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	212.90'	**2.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=2.23 cfs @ 12.16 hrs HW=213.10' (Free Discharge)
↑—**1=NEW 24-INCH** (Passes 2.23 cfs of 23.22 cfs potential flow)
↑—**2=Orifice/Grate** (Weir Controls 2.23 cfs @ 1.45 fps)

Secondary OutFlow Max=0.42 cfs @ 12.16 hrs HW=213.10' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Weir Controls 0.42 cfs @ 1.08 fps)

Summary for Pond DP-1: DETENTION POND 1

Inflow Area = 41.304 ac, 3.35% Impervious, Inflow Depth = 2.08" for 25-yr Storm event
Inflow = 85.57 cfs @ 12.09 hrs, Volume= 7.174 af
Outflow = 38.56 cfs @ 12.29 hrs, Volume= 6.990 af, Atten= 55%, Lag= 12.1 min
Primary = 38.56 cfs @ 12.29 hrs, Volume= 6.990 af
Routed to Reach R-1D : Reach R-1D
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-1D : Reach R-1D

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 165.32' @ 12.29 hrs Surf.Area= 19,943 sf Storage= 79,584 cf
Flood Elev= 166.00' Surf.Area= 21,310 sf Storage= 93,390 cf

Plug-Flow detention time= 397.4 min calculated for 6.990 af (97% of inflow)
Center-of-Mass det. time= 340.9 min (1,285.5 - 944.6)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	115,245 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	10,750	0	0
162.00	13,540	24,290	24,290
164.00	17,070	30,610	54,900
165.00	19,300	18,185	73,085
166.00	21,310	20,305	93,390
167.00	22,400	21,855	115,245

Device	Routing	Invert	Outlet Devices
#1	Primary	159.80'	**30.0" Round Culvert** L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 159.80' / 159.35' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf
#2	Device 1	160.60'	**3.0" Vert. Orifice on side** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.70'	**72.0" Horiz. Orifice-Top of drop inlet** C= 0.600 Limited to weir flow at low heads
#4	Secondary	166.30'	**40.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=38.53 cfs @ 12.29 hrs HW=165.31' (Free Discharge)
└**1=Culvert** (Inlet Controls 38.53 cfs @ 7.85 fps)
  └**2=Orifice on side** (Passes < 0.51 cfs potential flow)
  └**3=Orifice-Top of drop inlet** (Passes < 126.40 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-10: DETENTION POND 10

Inflow Area = 34.949 ac, 6.10% Impervious, Inflow Depth = 2.21" for 25-yr Storm event
Inflow = 76.39 cfs @ 12.01 hrs, Volume= 6.441 af
Outflow = 15.90 cfs @ 12.62 hrs, Volume= 5.911 af, Atten= 79%, Lag= 36.7 min
Primary = 14.61 cfs @ 12.62 hrs, Volume= 3.278 af
Routed to Reach E1R6 : DP-10 DISCHARGE
Secondary = 1.29 cfs @ 12.62 hrs, Volume= 2.633 af
Routed to Reach E1R6 : DP-10 DISCHARGE
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach E1R6 : DP-10 DISCHARGE

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 187.48' @ 12.62 hrs Surf.Area= 61,319 sf Storage= 130,989 cf
Flood Elev= 189.00' Surf.Area= 77,500 sf Storage= 239,860 cf

Plug-Flow detention time= 779.9 min calculated for 5.911 af (92% of inflow)
Center-of-Mass det. time= 736.2 min (1,584.5 - 848.3)

Volume	Invert	Avail.Storage	Storage Description
#1	180.00'	320,610 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
180.00	10	0	0
182.00	2,300	2,310	2,310
184.00	11,000	13,300	15,610
186.00	34,000	45,000	60,610
188.00	71,000	105,000	165,610
190.00	84,000	155,000	320,610

Device	Routing	Invert	Outlet Devices
#1	Device 3	187.00'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Device 3	186.00'	**6.0" Vert. 6-in Orifice** C= 0.600 Limited to weir flow at low heads
#3	Primary	181.00'	**24.0" Round 18-in Primary Culvert** L= 96.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 181.00' / 180.00' S= 0.0104 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#4	Secondary	177.50'	**5.8" Round 6-in Culvert** L= 220.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 177.50' / 174.00' S= 0.0159 '/' Cc= 0.900

n= 0.011, Flow Area= 0.18 sf

#5	Device 4	186.00'	**5.8" Horiz. Orifice Top** C= 0.600 Limited to weir flow at low heads
#6	Device 4	184.00'	**1.5" Vert. Orifice Side** X 2 rows with 0.5" cc spacing C= 0.600 Limited to weir flow at low heads
#7	Tertiary	188.00'	**10.0' long x 26.0' breadth E-Spillway Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=14.54 cfs @ 12.62 hrs HW=187.48' (Free Discharge)
└**3=18-in Primary Culvert** (Passes 14.54 cfs of 35.40 cfs potential flow)
  ├**1=Orifice/Grate** (Weir Controls 13.49 cfs @ 2.26 fps)
  └**2=6-in Orifice** (Orifice Controls 1.05 cfs @ 5.33 fps)

Secondary OutFlow Max=1.29 cfs @ 12.62 hrs HW=187.48' (Free Discharge)
└**4=6-in Culvert** (Passes 1.29 cfs of 1.37 cfs potential flow)
  ├**5=Orifice Top** (Orifice Controls 1.07 cfs @ 5.85 fps)
  └**6=Orifice Side** (Orifice Controls 0.22 cfs @ 8.87 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=180.00' (Free Discharge)
└**7=E-Spillway Weir** (Controls 0.00 cfs)

Summary for Pond DP-11R: DETENTION POND 11R

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 2.24" for 25-yr Storm event
Inflow = 91.57 cfs @ 12.05 hrs, Volume= 5.483 af
Outflow = 3.26 cfs @ 15.01 hrs, Volume= 5.483 af, Atten= 96%, Lag= 177.6 min
Primary = 1.91 cfs @ 15.01 hrs, Volume= 2.139 af
  Routed to Reach R4G : Reach 4G
Secondary = 1.35 cfs @ 15.01 hrs, Volume= 3.345 af
  Routed to Reach R4G : Reach 4G
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 160.52' @ 15.01 hrs Surf.Area= 34,204 sf Storage= 142,499 cf

Plug-Flow detention time= 644.3 min calculated for 5.481 af (100% of inflow)
Center-of-Mass det. time= 644.6 min (1,485.0 - 840.4)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	499,354 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,440	0	0
156.00	19,408	21,848	21,848
158.00	25,775	45,183	67,031
160.00	32,395	58,170	125,201
162.00	39,360	71,755	196,956
164.00	46,635	85,995	282,951
166.00	54,090	100,725	383,676
168.00	61,588	115,678	499,354

Device	Routing	Invert	Outlet Devices
#1	Primary	155.30'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.30' / 154.00' S= 0.0236 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	156.50'	**4.0" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	161.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	152.20'	**6.0" Round Culvert** L= 118.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 152.20' / 151.80' S= 0.0034 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.91 cfs @ 15.01 hrs HW=160.52' (Free Discharge)
└─**1=Culvert** (Passes 1.91 cfs of 31.07 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.84 cfs @ 9.65 fps)
  ├─**3=Orifice** (Orifice Controls 1.07 cfs @ 5.43 fps)
  └─**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.35 cfs @ 15.01 hrs HW=160.52' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.35 cfs @ 6.86 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-12: DETENTION POND 12

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 2.17" for 25-yr Storm event
Inflow = 78.37 cfs @ 12.09 hrs, Volume= 5.698 af
Outflow = 1.99 cfs @ 18.63 hrs, Volume= 5.698 af, Atten= 97%, Lag= 392.2 min
Primary = 0.52 cfs @ 18.63 hrs, Volume= 0.713 af
  Routed to Reach R-2A : Reach 2A
Secondary = 1.47 cfs @ 18.63 hrs, Volume= 4.985 af
  Routed to Reach R-2A : Reach 2A
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R-2A : Reach 2A

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 173.19' @ 18.63 hrs Surf.Area= 43,913 sf Storage= 167,588 cf

Plug-Flow detention time= 1,058.3 min calculated for 5.696 af (100% of inflow)
Center-of-Mass det. time= 1,058.7 min (1,906.2 - 847.5)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	537,379 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	7,544	0	0
170.00	34,762	42,306	42,306
172.00	40,454	75,216	117,522
174.00	46,283	86,737	204,259
176.00	52,328	98,611	302,870
178.00	58,583	110,911	413,781
180.00	65,015	123,598	537,379

Device	Routing	Invert	Outlet Devices
#1	Primary	168.90'	**24.0" Round Culvert** L= 66.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 168.90' / 168.50' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	171.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	174.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	175.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	166.00'	**6.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 166.00' / 165.50' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	178.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.52 cfs @ 18.63 hrs HW=173.19' (Free Discharge)
└─**1=Culvert** (Passes 0.52 cfs of 27.42 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.52 cfs @ 5.94 fps)
  ├─**3=Orifice** (Controls 0.00 cfs)
  └─**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.47 cfs @ 18.63 hrs HW=173.19' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.47 cfs @ 7.50 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-13: DETENTION POND 13

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 2.26" for 25-yr Storm event
Inflow = 24.69 cfs @ 12.00 hrs, Volume= 2.158 af
Outflow = 3.15 cfs @ 13.11 hrs, Volume= 2.158 af, Atten= 87%, Lag= 66.4 min
Primary = 1.62 cfs @ 13.11 hrs, Volume= 0.698 af
  Routed to Reach R4C : Reach 4C
Secondary = 1.53 cfs @ 13.11 hrs, Volume= 1.460 af
  Routed to Reach R4C : Reach 4C
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R4C : Reach 4C

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 164.06' @ 13.11 hrs Surf.Area= 13,728 sf Storage= 41,613 cf
Flood Elev= 166.00' Surf.Area= 17,062 sf Storage= 71,548 cf

Plug-Flow detention time= 174.2 min calculated for 2.157 af (100% of inflow)
Center-of-Mass det. time= 174.1 min (1,026.6 - 852.5)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	109,546 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	6,224	0	0
162.00	10,498	16,722	16,722
164.00	13,633	24,131	40,853
166.00	17,062	30,695	71,548
168.00	20,936	37,998	109,546

Device	Routing	Invert	Outlet Devices
#1	Primary	160.30'	**24.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 160.30' / 159.00' S= 0.0433 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	160.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	164.30'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	158.00'	**6.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 158.00' / 157.70' S= 0.0055 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.62 cfs @ 13.11 hrs HW=164.06' (Free Discharge)
└**1=Culvert** (Passes 1.62 cfs of 25.11 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.77 cfs @ 8.86 fps)
  ├**3=Orifice** (Orifice Controls 0.85 cfs @ 4.32 fps)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.53 cfs @ 13.11 hrs HW=164.06' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.53 cfs @ 7.77 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-14: DETENTION POND 14

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 2.11" for 25-yr Storm event
Inflow = 42.95 cfs @ 12.00 hrs, Volume= 2.369 af
Outflow = 1.50 cfs @ 14.89 hrs, Volume= 2.369 af, Atten= 97%, Lag= 173.3 min
Primary = 0.40 cfs @ 14.89 hrs, Volume= 0.386 af
Routed to Reach R4D : Reach 4D
Secondary = 1.10 cfs @ 14.89 hrs, Volume= 1.983 af
Routed to Reach R4D : Reach 4D
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 159.04' @ 14.89 hrs Surf.Area= 36,650 sf Storage= 57,194 cf

Plug-Flow detention time= 465.9 min calculated for 2.368 af (100% of inflow)
Center-of-Mass det. time= 465.9 min (1,308.8 - 842.8)

Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	176,567 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	6,253	0	0
158.00	34,183	20,218	20,218
160.00	38,909	73,092	93,310
162.00	44,348	83,257	176,567

Device	Routing	Invert	Outlet Devices
#1	Primary	157.00'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 157.00' / 156.00' S= 0.0182 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.80'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	155.00'	**6.0" Round Culvert** L= 76.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 155.00' / 154.70' S= 0.0039 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#5	Device 1	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Tertiary	160.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.40 cfs @ 14.89 hrs HW=159.04' (Free Discharge)
└**1=Culvert** (Passes 0.40 cfs of 15.46 cfs potential flow)
├**2=Orifice** (Orifice Controls 0.01 cfs @ 0.71 fps)
├**3=Grate** (Controls 0.00 cfs)
└**5=Orifice/Grate** (Orifice Controls 0.39 cfs @ 4.51 fps)

Secondary OutFlow Max=1.10 cfs @ 14.89 hrs HW=159.04' (Free Discharge)
└**4=Culvert** (Barrel Controls 1.10 cfs @ 5.59 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=157.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-1a: DP-1a

Inflow Area = 9.580 ac, 2.92% Impervious, Inflow Depth = 2.12" for 25-yr Storm event
Inflow = 28.64 cfs @ 12.05 hrs, Volume= 1.693 af
Outflow = 2.83 cfs @ 12.72 hrs, Volume= 1.566 af, Atten= 90%, Lag= 40.4 min
Primary = 2.83 cfs @ 12.72 hrs, Volume= 1.566 af
Routed to Pond DP-1 : DETENTION POND 1
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-1 : DETENTION POND 1

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Starting Elev= 163.00' Surf.Area= 34,985 sf Storage= 146,410 cf
Peak Elev= 163.99' @ 12.72 hrs Surf.Area= 37,410 sf Storage= 182,319 cf (35,910 cf above start)
Flood Elev= 166.00' Surf.Area= 43,000 sf Storage= 263,046 cf (116,636 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 435.3 min (1,281.8 - 846.5)

Volume	Invert	Avail.Storage	Storage Description
#1	158.00'	263,046 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
158.00	24,139	0	0
160.00	27,981	52,120	52,120
162.00	32,544	60,525	112,645
163.00	34,985	33,765	146,410
164.00	37,429	36,207	182,617
166.00	43,000	80,429	263,046

Device	Routing	Invert	Outlet Devices
#1	Primary	163.10'	**113.0 deg Sharp-Crested Vee/Trap Weir** Cv= 2.49 (C= 3.11)
#2	Secondary	165.60'	**18.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=2.83 cfs @ 12.72 hrs HW=163.99' (Free Discharge)
↑**1=Sharp-Crested Vee/Trap Weir** (Weir Controls 2.83 cfs @ 2.35 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=163.00' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-2: DETENTION POND 2

Inflow Area = 9.875 ac, 0.07% Impervious, Inflow Depth = 2.10" for 25-yr Storm event
Inflow = 33.38 cfs @ 11.96 hrs, Volume= 1.728 af
Outflow = 13.32 cfs @ 12.08 hrs, Volume= 1.693 af, Atten= 60%, Lag= 7.4 min
Primary = 13.32 cfs @ 12.08 hrs, Volume= 1.693 af
Routed to Reach R-1F : Reach R-1F

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2

Starting Elev= 162.30' Surf.Area= 1,330 sf Storage= 630 cf
Peak Elev= 166.85' @ 12.08 hrs Surf.Area= 11,842 sf Storage= 23,305 cf (22,675 cf above start)
Flood Elev= 167.80' Surf.Area= 17,700 sf Storage= 36,993 cf (36,363 cf above start)

Plug-Flow detention time= 65.1 min calculated for 1.678 af (97% of inflow)
Center-of-Mass det. time= 45.7 min (889.7 - 844.0)

Volume	Invert	Avail.Storage	Storage Description
#1	162.00'	36,993 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
162.00	1,000	0	0
164.00	3,200	4,200	4,200
165.00	4,940	4,070	8,270
166.00	7,860	6,400	14,670
167.00	12,570	10,215	24,885
167.80	17,700	12,108	36,993

Device	Routing	Invert	Outlet Devices
#1	Primary	162.80'	**24.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 162.80' / 162.20' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	164.20'	**8.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	165.40'	**2.4' long x 0.30' rise Sharp-Crested Rectangular Weir** 1 End Contraction(s)
#5	Device 1	166.60'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=13.09 cfs @ 12.08 hrs HW=166.84' (Free Discharge)
└**1=Culvert** (Passes 13.09 cfs of 26.37 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 1.79 cfs @ 9.12 fps)
  ├**3=Orifice** (Orifice Controls 2.55 cfs @ 7.31 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Orifice Controls 3.96 cfs @ 5.56 fps)
  └**5=Grate** (Weir Controls 4.79 cfs @ 1.60 fps)

Summary for Pond DP-6: DETENTION POND 6

Inflow Area = 27.235 ac, 7.11% Impervious, Inflow Depth = 2.35" for 25-yr Storm event
Inflow = 54.55 cfs @ 12.01 hrs, Volume= 5.342 af
Outflow = 1.45 cfs @ 20.00 hrs, Volume= 4.663 af, Atten= 97%, Lag= 479.1 min
Primary = 1.45 cfs @ 20.00 hrs, Volume= 4.663 af
  Routed to Reach R-1N : R-1N
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
  Routed to Reach R-1N : R-1N

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 176.71' @ 20.00 hrs Surf.Area= 73,177 sf Storage= 172,607 cf
Flood Elev= 180.00' Surf.Area= 130,159 sf Storage= 496,644 cf

Plug-Flow detention time= 1,277.0 min calculated for 4.663 af (87% of inflow)
Center-of-Mass det. time= 1,215.0 min (2,060.1 - 845.1)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	783,647 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	3,635	0	0
174.00	25,931	29,566	29,566
176.00	62,168	88,099	117,665
178.00	93,326	155,494	273,159
180.00	130,159	223,485	496,644
182.00	156,844	287,003	783,647

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**24.0" Round Outlet Culvert** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 178.00' / 168.00' S= 0.1429 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	174.00'	**5.8" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Secondary	179.00'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.45 cfs @ 20.00 hrs HW=176.71' (Free Discharge)
└**1=Outlet Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Orifice Controls 1.45 cfs @ 7.92 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=172.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-6 ES: DETENTION POND 6 - EMERGENCY SPILLWAY

Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Starting Elev= 178.00' Surf.Area= 93,326 sf Storage= 273,159 cf
Peak Elev= 178.00' @ 0.00 hrs Surf.Area= 93,326 sf Storage= 273,159 cf
Flood Elev= 180.00' Surf.Area= 130,159 sf Storage= 496,644 cf (223,485 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	783,647 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
172.00	3,635	0	0
174.00	25,931	29,566	29,566
176.00	62,168	88,099	117,665
178.00	93,326	155,494	273,159
180.00	130,159	223,485	496,644
182.00	156,844	287,003	783,647

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**24.0" Round Outlet Culvert X 0.00** L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 178.00' / 168.00' S= 0.1429 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	174.00'	**5.8" Horiz. Orifice X 0.00** C= 0.600 Limited to weir flow at low heads
#3	Secondary	179.00'	**20.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=178.00' (Free Discharge)
└**1=Outlet Culvert** (Controls 0.00 cfs)
└**2=Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=178.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-9: DETENTION POND 9

Inflow Area = 30.022 ac, 9.91% Impervious, Inflow Depth = 2.60" for 25-yr Storm event
Inflow = 77.99 cfs @ 12.13 hrs, Volume= 6.497 af
Outflow = 1.83 cfs @ 19.49 hrs, Volume= 4.089 af, Atten= 98%, Lag= 441.5 min
Primary = 0.68 cfs @ 19.49 hrs, Volume= 0.589 af
Routed to Reach 9R : LEVEL SPREADER DISCHARGE
Secondary = 1.15 cfs @ 19.49 hrs, Volume= 3.501 af
Routed to Reach 9R : LEVEL SPREADER DISCHARGE
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 189.98' @ 19.49 hrs Surf.Area= 86,597 sf Storage= 219,623 cf
Flood Elev= 191.00' Surf.Area= 91,210 sf Storage= 312,840 cf

Plug-Flow detention time= 1,376.3 min calculated for 4.089 af (63% of inflow)
Center-of-Mass det. time= 1,264.4 min (2,102.4 - 837.9)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	404,050 cf	**Detention Pond (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	35,200	0	0
188.00	78,220	56,710	56,710
190.00	86,700	164,920	221,630
192.00	95,720	182,420	404,050

Device	Routing	Invert	Outlet Devices
#1	Primary	189.50'	**12.0" Round 12-In Outlet Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 189.50' / 180.50' S= 0.1875 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Secondary	184.21'	**5.8" Round 6-In Culvert** L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 184.21' / 180.50' S= 0.0618 '/' Cc= 0.900 n= 0.011, Flow Area= 0.18 sf
#3	Device 2	188.70'	**5.8" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 2	188.30'	**1.5" Vert. Orifice X 2.00** C= 0.600 Limited to weir flow at low heads
#5	Tertiary	190.50'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.68 cfs @ 19.49 hrs HW=189.98' (Free Discharge)
└**1=12-In Outlet Culvert** (Inlet Controls 0.68 cfs @ 1.85 fps)

Secondary OutFlow Max=1.15 cfs @ 19.49 hrs HW=189.98' (Free Discharge)
└**2=6-In Culvert** (Passes 1.15 cfs of 1.64 cfs potential flow)
  ├**3=Orifice** (Orifice Controls 1.00 cfs @ 5.44 fps)
  └**4=Orifice** (Orifice Controls 0.15 cfs @ 6.12 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=187.00' (Free Discharge)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-9(E): DP 9 (EMERGENCY OUTLET)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	404,050 cf	**Detention Pond (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	35,200	0	0
188.00	78,220	56,710	56,710
190.00	86,700	164,920	221,630
192.00	95,720	182,420	404,050

Device	Routing	Invert	Outlet Devices
#1	Tertiary	190.50'	**10.0' long x 22.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond P-1G: Culvert Crossing 1G

Inflow Area = 1.772 ac, 0.00% Impervious, Inflow Depth = 2.20" for 25-yr Storm event
Inflow = 5.44 cfs @ 12.05 hrs, Volume= 0.325 af
Outflow = 5.42 cfs @ 12.06 hrs, Volume= 0.325 af, Atten= 0%, Lag= 0.5 min
Primary = 3.63 cfs @ 12.06 hrs, Volume= 0.296 af
Routed to Reach R-1G : RipRap Downspout
Secondary = 1.79 cfs @ 12.06 hrs, Volume= 0.030 af
Routed to Reach R-1I : Final Cover Access Road Ditch

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 336.36' @ 12.06 hrs Surf.Area= 573 sf Storage= 420 cf

Plug-Flow detention time= 4.7 min calculated for 0.325 af (100% of inflow)
Center-of-Mass det. time= 4.8 min (848.5 - 843.8)

Volume	Invert	Avail.Storage	Storage Description
#1	335.50'	1,200 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
335.50	400	0	0
337.50	800	1,200	1,200

Device	Routing	Invert	Outlet Devices
#1	Primary	335.50'	**24.0" Round 24" Culvert** L= 36.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 335.50' / 331.00' S= 0.1250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	336.00'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=3.60 cfs @ 12.06 hrs HW=336.36' (Free Discharge)
1=24" Culvert (Inlet Controls 3.60 cfs @ 2.79 fps)

Secondary OutFlow Max=1.75 cfs @ 12.06 hrs HW=336.36' (Free Discharge)
2=Stone Check Dam Weir (Weir Controls 1.75 cfs @ 1.60 fps)

Summary for Pond P-1H: Modified Plunge Pool w/(2)24" Culverts P-6a

Inflow Area = 6.697 ac, 1.15% Impervious, Inflow Depth = 2.05" for 25-yr Storm event
Inflow = 18.71 cfs @ 11.95 hrs, Volume= 1.147 af
Outflow = 18.27 cfs @ 11.96 hrs, Volume= 1.144 af, Atten= 2%, Lag= 0.3 min
Primary = 18.27 cfs @ 11.96 hrs, Volume= 1.144 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Pond DP-2 : DETENTION POND 2

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 184.60' @ 11.96 hrs Surf.Area= 491 sf Storage= 606 cf
Flood Elev= 186.00' Surf.Area= 869 sf Storage= 1,551 cf

Plug-Flow detention time= 3.0 min calculated for 1.144 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (848.9 - 847.5)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	5,714 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
182.00	37	0	0
183.00	163	100	100
184.00	348	256	356
185.00	587	468	823
186.00	869	728	1,551
188.00	1,067	1,936	3,487
190.00	1,160	2,227	5,714

Device	Routing	Invert	Outlet Devices
#1	Primary	183.00'	**24.0" Round (2)24"-Culvert X 2.00** L= 56.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 183.00' / 182.00' S= 0.0179 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.14 sf
#2	Secondary	185.00'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=17.99 cfs @ 11.96 hrs HW=184.58' (Free Discharge)
1=(2)24"-Culvert (Inlet Controls 17.99 cfs @ 3.38 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=182.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond P-1I: Culvert Crossing 6c

Inflow Area = 3.906 ac, 1.97% Impervious, Inflow Depth = 2.21" for 25-yr Storm event
Inflow = 13.36 cfs @ 12.01 hrs, Volume= 0.720 af
Outflow = 13.17 cfs @ 12.01 hrs, Volume= 0.720 af, Atten= 1%, Lag= 0.1 min
Primary = 9.43 cfs @ 12.01 hrs, Volume= 0.672 af
Routed to Reach R-IH : RipRap Downspout
Secondary = 3.75 cfs @ 12.01 hrs, Volume= 0.048 af
Routed to Pond P-1K : Culvert Crossing 1K

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs

Peak Elev= 292.01' @ 12.01 hrs Surf.Area= 800 sf Storage= 300 cf

Plug-Flow detention time= 3.4 min calculated for 0.720 af (100% of inflow)
Center-of-Mass det. time= 3.5 min (841.7 - 838.3)

Volume	Invert	Avail.Storage	Storage Description
#1	290.50'	300 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
290.50	400	0	0
291.00	800	300	300

Device	Routing	Invert	Outlet Devices
#1	Primary	290.50'	**24.0" Round 24" Culvert** L= 38.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 290.50' / 286.00' S= 0.1184 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	291.50'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=9.33 cfs @ 12.01 hrs HW=292.00' (Free Discharge)
↑—**1=24" Culvert** (Inlet Controls 9.33 cfs @ 3.68 fps)

Secondary OutFlow Max=3.62 cfs @ 12.01 hrs HW=292.00' (Free Discharge)
↑—**2=Stone Check Dam Weir** (Orifice Controls 3.62 cfs @ 1.89 fps)

Summary for Pond P-1J-1: (2) 24" CULVERTS

Inflow Area = 6.104 ac, 1.82% Impervious, Inflow Depth = 2.08" for 25-yr Storm event
Inflow = 19.41 cfs @ 11.96 hrs, Volume= 1.060 af
Outflow = 19.32 cfs @ 11.96 hrs, Volume= 1.060 af, Atten= 0%, Lag= 0.2 min
Primary = 17.08 cfs @ 11.96 hrs, Volume= 1.042 af
Routed to Pond DP-6 : DETENTION POND 6
Secondary = 2.25 cfs @ 11.96 hrs, Volume= 0.018 af
Routed to Pond P-1J-2 : 18" CULVERT

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 191.53' @ 11.96 hrs Surf.Area= 308 sf Storage= 242 cf

Plug-Flow detention time= 0.2 min calculated for 1.059 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (842.6 - 842.4)

Volume	Invert	Avail.Storage	Storage Description
#1	190.00'	410 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
190.00	10	0	0
192.00	400	410	410

Device	Routing	Invert	Outlet Devices
#1	Primary	190.00'	**24.0" Round Culvert X 2.00** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 190.00' / 189.60' S= 0.0108 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	191.20'	**170.0 deg x 1.0' long Sharp-Crested Vee/Trap Weir** Cv= 2.46 (C= 3.08)

Primary OutFlow Max=16.82 cfs @ 11.96 hrs HW=191.51' (Free Discharge)
└**1=Culvert** (Inlet Controls 16.82 cfs @ 3.30 fps)

Secondary OutFlow Max=2.07 cfs @ 11.96 hrs HW=191.51' (Free Discharge)
└**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 2.07 cfs @ 1.45 fps)

Summary for Pond P-1J-2: 18" CULVERT

Inflow	=	2.25 cfs @	11.96 hrs, Volume=	0.018 af
Outflow	=	1.76 cfs @	11.99 hrs, Volume=	0.019 af, Atten= 22%, Lag= 1.9 min
Primary	=	1.76 cfs @	11.99 hrs, Volume=	0.019 af

Routed to Pond DP-6 : DETENTION POND 6

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 187.49' @ 11.99 hrs Surf.Area= 672 sf Storage= 166 cf

Plug-Flow detention time= 1.3 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (719.0 - 717.5)

Volume	Invert	Avail.Storage	Storage Description
#1	187.00'	32,056 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
187.00	10	0	0
188.00	1,367	689	689
190.00	3,000	4,367	5,056
192.00	6,000	9,000	14,056
194.00	12,000	18,000	32,056

Device	Routing	Invert	Outlet Devices
#1	Primary	186.80'	**18.0" Round 18" Culvert** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 186.80' / 185.97' S= 0.0208 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=1.66 cfs @ 11.99 hrs HW=187.47' (Free Discharge)
└**1=18" Culvert** (Inlet Controls 1.66 cfs @ 2.19 fps)

Summary for Pond P-1K: Culvert Crossing 1K

Inflow Area = 4.295 ac, 2.58% Impervious, Inflow Depth = 2.31" for 25-yr Storm event
Inflow = 20.38 cfs @ 11.95 hrs, Volume= 0.825 af
Outflow = 19.42 cfs @ 11.96 hrs, Volume= 0.825 af, Atten= 5%, Lag= 0.7 min
Primary = 12.70 cfs @ 11.96 hrs, Volume= 0.740 af
Routed to Reach R-1J : RipRap Downspout
Secondary = 6.72 cfs @ 11.96 hrs, Volume= 0.085 af
Routed to Reach R-1L : Final Cover Access Road Ditch

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 256.39' @ 11.96 hrs Surf.Area= 677 sf Storage= 747 cf

Plug-Flow detention time= 0.4 min calculated for 0.825 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (829.9 - 829.5)

Volume	Invert	Avail.Storage	Storage Description
#1	255.00'	1,200 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
255.00	400	0	0
257.00	800	1,200	1,200

Device	Routing	Invert	Outlet Devices
#1	Primary	254.50'	**24.0" Round 24" Culvert** L= 33.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.50' / 252.00' S= 0.0758 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Secondary	255.50'	**160.0 deg x 1.0' long x 0.50' rise Stone Check Dam Weir** Cv= 2.47 (C= 3.09)

Primary OutFlow Max=12.40 cfs @ 11.96 hrs HW=256.35' (Free Discharge)
↑—**1=24" Culvert** (Inlet Controls 12.40 cfs @ 4.09 fps)

Secondary OutFlow Max=6.46 cfs @ 11.96 hrs HW=256.35' (Free Discharge)
↑—**2=Stone Check Dam Weir** (Orifice Controls 6.46 cfs @ 3.37 fps)

Summary for Pond PS11: Culvert - 4IA(C11 PS)

Inflow = 0.50 cfs @ 12.16 hrs, Volume= 0.004 af
Outflow = 0.39 cfs @ 12.20 hrs, Volume= 0.004 af, Atten= 22%, Lag= 2.5 min
Primary = 0.39 cfs @ 12.20 hrs, Volume= 0.004 af
Routed to Pond CB-4I : Catch Basin - 4I

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 213.33' @ 12.20 hrs Surf.Area= 216 sf Storage= 46 cf
Flood Elev= 215.10' Surf.Area= 1,133 sf Storage= 1,237 cf

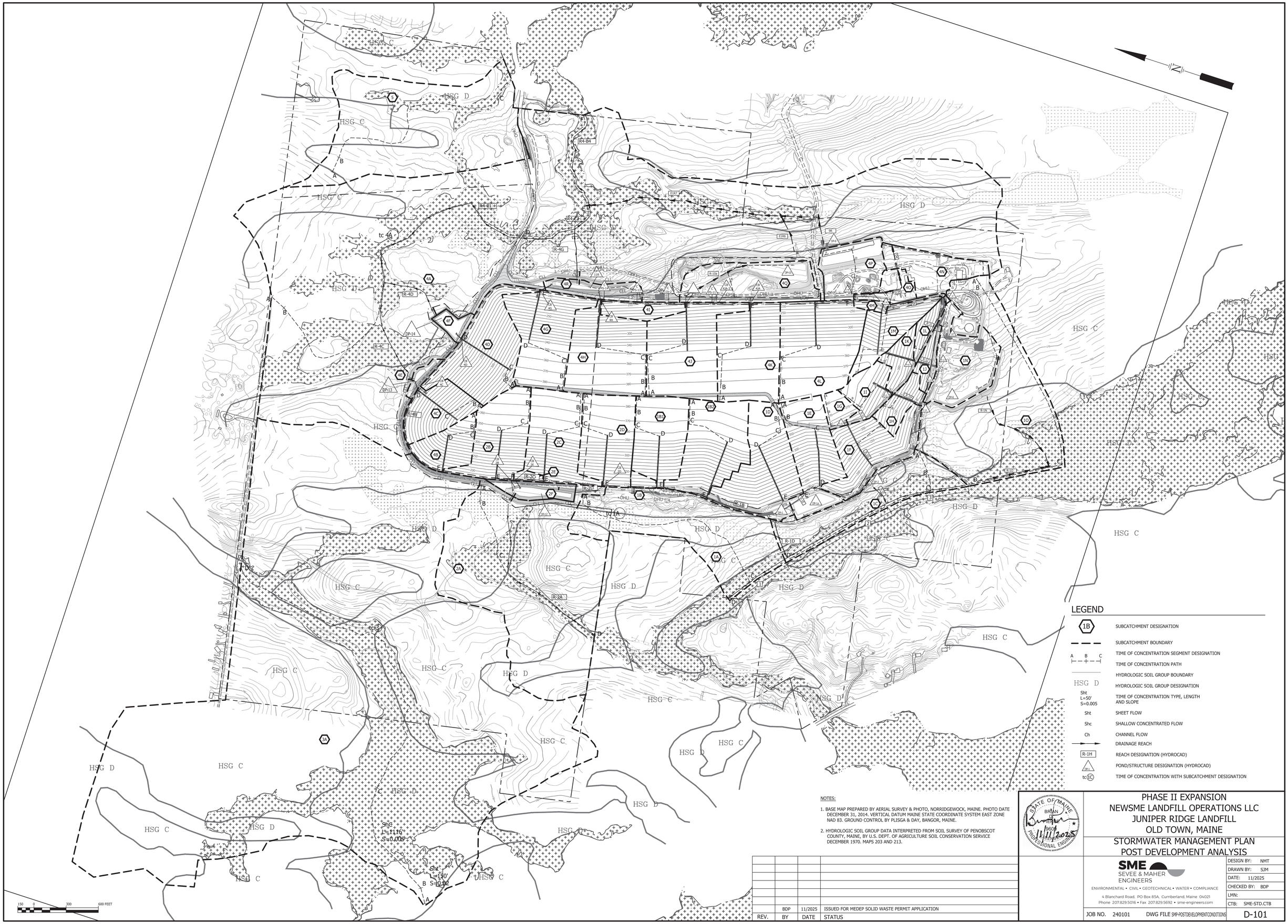
Plug-Flow detention time= 2.4 min calculated for 0.004 af (97% of inflow)
Center-of-Mass det. time= 2.3 min (733.3 - 731.0)

Volume	Invert	Avail.Storage	Storage Description
#1	212.90'	1,353 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
212.90	5	0	0
213.04	63	5	5
215.20	1,185	1,348	1,353

Device	Routing	Invert	Outlet Devices
#1	Primary	213.05'	**24.0" Round Culvert - 4IA(C11 PS)** L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 213.05' / 212.15' S= 0.0225 '/' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf

Primary OutFlow Max=0.38 cfs @ 12.20 hrs HW=213.33' (Free Discharge)
↑—**1=Culvert - 4IA(C11 PS)** (Inlet Controls 0.38 cfs @ 1.42 fps)


N
HSG C
HSG D
R4-B4
R4-B3
R-4G
R-4D
R-4C
R-4B
R-2C
R-2B
R-2A
R-1B
R-1D
R-1H
R-1G
R-1F
R-1E
R-1C
R-1A
R-10J
DP-14
DP-13
DP-1
DP-2
DP-3
DP-4
DP-5
DP-6
DP-7
DP-8
DP-9
DP-10
DP-11
DP-12
DP-15
DP-16
DP-17
DP-18
DP-19
DP-20
DP-21
DP-22
DP-23
DP-24
DP-25
DP-26
DP-27
DP-28
DP-29
DP-30
DP-31
DP-32
DP-33
DP-34
DP-35
DP-36
DP-37
DP-38
DP-39
DP-40
DP-41
DP-42
DP-43
DP-44
DP-45
DP-46
DP-47
DP-48
DP-49
DP-50
DP-51
DP-52
DP-53
DP-54

DETENTION POND 10
OUTLET CONTROL
STRUCTURES TO REMAIN

DETENTION POND 10

EMERGENCY SPILLWAY (TYP)
SEE DWG C-309

CB 4G AND SD 4G
SEE DWG C-309

TOE DITCH
SEE DWG C-309

OUTLET CONTROL
STRUCTURE DP-11R
SEE DWG C-309

PLUNGE POOL
SEE DWG C-309

LEVEL SPREADER DP-11R
SEE DWG C-308

DETENTION POND 11R

CB 4H AND SD 4H
SEE DWG C-309

EXISTING
CULVERT PS-14

EXISTING
CULVERT PS-11B-2

EXISTING
CULVERT PS-13

EXISTING CB 4I
AND CULVERT 4I

EXISTING
CULVERT PS-11

EXISTING
CULVERT 4IA

EXISTING CB 4JA-3
AND SD 4JA-3

EXISTTING CULVERTS
4JB AND 4JC

EXISTING CB 4JA
AND SD 4JA

LEVEL SPREADER DP-14
SEE DWG C-309

EMERGENCY
SPILLWAY (TYP)
SEE DWG C-309

PLUNGE POOL
SEE DWG C-309

OUTLET CONTROL
STRUCTURE DP-14
SEE DWG C-309

DETENTION POND 14

CB 4D AND SD 4D
SEE DWG C-309

EMERGENCY
SPILLWAY (TYP)
SEE DWG C-309

DETENTION
POND 13

OUTLET CONTROL
STRUCTURE DP-13
SEE DWG C-309

LEVEL SPREADER
DP-13
SEE DWG C-308

PLUNGE POOL
SEE DWG C-309

CB 4C AND SD 4C
SEE DWG C-309

TOE DITCH
SEE DWG C-309

FINAL COVER RIPRAP
DOWNSPOUT (TYP)
SEE DWG C-309

FINAL COVER SURFACE
TERRACE (TYP)
SEE DWG C-309

FINAL LANDFILL
ACCESS ROAD (TYP)

FINAL WASTE GRADES (TYP)

7.5% MIN (TYP)

10H:1V (TYP)

2H:1V (TYP)

CB 2B AND SD 2B
SEE DWG C-309

CB 2E AND SD 2E
SEE DWG C-309

OUTLET CONTROL
STRUCTURE DP-12
SEE DWG C-309

LEVEL SPREADER DP-12
SEE DWG C-308

DETENTION POND 12

EMERGENCY SPILLWAY (TYP)
SEE DWG C-309

PLUNGE POOL
SEE DWG C-309

CB 2D AND SD 2D
SEE DWG C-309

EXISTING DITCH 2D
SEE DWG C-309

FINAL COVER SYSTEM
SEE DWG C-309

NOTE:
1. BASE MAP PREPARED BY AERIAL SURVEY & PHOTO INC, NORRIDGEWOCK, MAINE. PHOTO DATE 5/21/2024. CONTROL POINTS BASED ON SURVEY BY PLISGA & DAY LAND SURVEYORS OF BANGOR, MAINE, ON APRIL 24, 2025. VERTICAL DATUM: ASSUMED. SUBTRACT 0.34 FEET FROM ELEVATIONS LISTED TO CONVERT ELEVATIONS TO NAVD 88. HORIZONTAL DATUM: MAINE STATE COORDINATES EAST ZONE NAD 83. GROUND CONTROL BY SEVEE & MAHER ENGINEERS, INC., OF CUMBERLAND, MAINE. SEE NOTE 1 ON DWG C-100.

2. WETLAND BOUNDARIES DELINEATED BY BRI ENVIRONMENTAL IN 2024.

3. BORINGS AND TEST PIT LOCATIONS FIELD SURVEYED BY SEVEE & MAHER ENGINEERS, INC. OF CUMBERLAND, MAINE.

60 0 120 240 FEET

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D PIERCE
9608
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

FINAL GRADES AND SITE DRAINAGE PLAN

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/2025
CHECKED BY:	BDP
LMN:	FINAL-DRAIN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE BASE

C-109

\\Server\Jobs\Casella\DAT\Twin Landfill\Expansion\Phase II Expansion\Acad\Plans\BASE.dwg C-109, 11/11/2025 10:07:24 AM, sjm

APPENDIX B

EROSION CONTROL DESIGN

B-1 GRASS DITCH LINING DESIGN
B-2 RIPRAP DITCH LINING DESIGN
B-3 CULVERT INLET/OUTLET DESIGN
B-4 LEVEL SPREADER DESIGN
B-5 PLUNGE POOL DESIGN
B-6 EMERGENCY SPILLWAY DESIGN

SME
SEVEE & MAHER
ENGINEERS

B-1

GRASS DITCH LINING DESIGN

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

FINAL COVER SURFACE TERRACE

Project Name: Juniper Ridge Landfill Phase II Expansion
Project Location: Old Town, Maine
Project No.: 240101
By: NMT
Date: 11/7//2025
Checked By: BDP
Date: 11/7/2025

OBJECTIVE

Design channel with adequate lining to convey stormwater flows from 25-year, 24-hour storm event assuming full grass cover and 2-year, 24-hour storm event assuming bare ditch condition.

REFERENCES

1. Maine Department of Environmental Protection, Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices, October 2016.
2. Applied Microcomputer Systems, HydroCAD Stormwater Modeling System, Version 10.10-4a, Chocorua, New Hampshire.
3. North American Green Erosion Control Material Design Software.

ANALYSIS

1. Evaluate temporary channel lining using peak stormwater flows from 2-year and 25-year, 24-hour storm event using TR-20.
2. Use ditch subcatchment from Top, Middle, and Bottom terrace dtiches with the largest peak flow as basis of design (conservative).
3. All terrace ditch grass line channels assumed to be grass lined and have a longitudinal slope of 7%.

CONCLUSION

(in)

Grassed Ditch	Flow From	Slope (Max.) (ft/ft)	Q_2 (cfs)	Q_{25} (cfs)	Bottom Width (feet)	Side Slopes (H:1V)	Temp. Lining	Permanent Lining
Top	4J	0.07	3.3	12.6	0	10:1,2:1	C125BN	GRASS
Middle	4L	0.07	1.5	5.4	0	3:1,2:1	C125BN	GRASS
Bottom	1D	0.07	1.1	4.8	0	3:1,2:1	C125BN	GRASS

North American Green
5401 St. Wendel-Cynthiana Rd.
Poseyville, Indiana 47633
Tel. 800.772.2040
>Fax 812.867.0247
www.nagreen.com
ECMDS v7.0

CHANNEL ANALYSIS

> > > 4J TOP

Name	4J TOP
Discharge	12.64
Channel Slope	0.07
Channel Bottom Width	0
Left Side Slope	10
Right Side Slope	2
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Mix (Sod and Bunch)
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

C125BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
C125BN Unvegetated	Straight	12.64 cfs	6.43 ft/s	0.57 ft	0.026	2.8 lbs/ft2	2.5 lbs/ft2	1.12	STABLE	D
Underlying Substrate	Straight	12.64 cfs	6.43 ft/s	0.57 ft	0.026	2.05 lbs/ft2	1.22 lbs/ft2	1.68	STABLE	D

S150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S150BN Unvegetated	Straight	12.64 cfs	5.56 ft/s	0.62 ft	0.032	1.9 lbs/ft2	2.69 lbs/ft2	0.71	UNSTABLE	D
Underlying Substrate	Straight	12.64 cfs	5.56 ft/s	0.62 ft	0.032	1.39 lbs/ft2	1.31 lbs/ft2	1.06	STABLE	D

SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	12.64 cfs	5.56 ft/s	0.62 ft	0.032	2 lbs/ft2	2.69 lbs/ft2	0.74	UNSTABLE	D
Underlying Substrate	Straight	12.64 cfs	5.56 ft/s	0.62 ft	0.032	1.47 lbs/ft2	1.31 lbs/ft2	1.12	STABLE	D

Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	12.64 cfs	4.62 ft/s	0.67 ft	0.041	4 lbs/ft2	2.94 lbs/ft2	1.36	STABLE	--
Underlying Substrate	Straight	12.64 cfs	4.62 ft/s	0.67 ft	0.041	1.8 lbs/ft2	1.44 lbs/ft2	1.25	STABLE	--

S75BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S75BN Unvegetated	Straight	12.64 cfs	5.93 ft/s	0.6 ft	0.029	1.6 lbs/ft2	2.6 lbs/ft2	0.62	UNSTABLE	D

Underlying Substrate	Straight	12.64 cfs	5.93 ft/s	0.6 ft	0.029	1.17 lbs/ft2	1.27 lbs/ft2	0.92	UNSTABLE	D

North American Green
5401 St. Wendel-Cynthiana Rd.
Poseyville, Indiana 47633
Tel. 800.772.2040
>Fax 812.867.0247
www.nagreen.com
ECMDS v7.0

CHANNEL ANALYSIS

> > > 4L Middle

Name	4L Middle
Discharge	5.4
Channel Slope	0.07
Channel Bottom Width	0
Left Side Slope	3
Right Side Slope	2
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Mix (Sod and Bunch)
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

C125BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
C125BN Unvegetated	Straight	5.4 cfs	6.28 ft/s	0.59 ft	0.026	2.8 lbs/ft2	2.56 lbs/ft2	1.09	STABLE	D
Underlying Substrate	Straight	5.4 cfs	6.28 ft/s	0.59 ft	0.026	2.05 lbs/ft2	1.19 lbs/ft2	1.73	STABLE	D

S150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S150BN Unvegetated	Straight	5.4 cfs	5.42 ft/s	0.63 ft	0.032	1.9 lbs/ft2	2.76 lbs/ft2	0.69	UNSTABLE	D
Underlying Substrate	Straight	5.4 cfs	5.42 ft/s	0.63 ft	0.032	1.39 lbs/ft2	1.28 lbs/ft2	1.09	STABLE	D

SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	5.4 cfs	5.42 ft/s	0.63 ft	0.032	2 lbs/ft2	2.76 lbs/ft2	0.73	UNSTABLE	D
Underlying Substrate	Straight	5.4 cfs	5.42 ft/s	0.63 ft	0.032	1.47 lbs/ft2	1.28 lbs/ft2	1.15	STABLE	D

Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	5.4 cfs	4.5 ft/s	0.69 ft	0.041	4 lbs/ft2	3.03 lbs/ft2	1.32	STABLE	--
Underlying Substrate	Straight	5.4 cfs	4.5 ft/s	0.69 ft	0.041	1.83 lbs/ft2	1.4 lbs/ft2	1.31	STABLE	--

S75BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S75BN Unvegetated	Straight	5.4 cfs	5.8 ft/s	0.61 ft	0.029	1.6 lbs/ft2	2.67 lbs/ft2	0.6	UNSTABLE	D

Underlying Substrate	Straight	5.4 cfs	5.8 ft/s	0.61 ft	0.029	1.17 lbs/ft2	1.23 lbs/ft2	0.95	UNSTABLE	D

North American Green
5401 St. Wendel-Cynthiana Rd.
Poseyville, Indiana 47633
Tel. 800.772.2040
>Fax 812.867.0247
www.nagreen.com
ECMDS v7.0

CHANNEL ANALYSIS

> > > 1D Bottom Terrace

Name	1D Bottom Terrace
Discharge	4.79
Channel Slope	0.07
Channel Bottom Width	0
Left Side Slope	3
Right Side Slope	2
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Mix (Sod and Bunch)
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

C125BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
C125BN Unvegetated	Straight	4.79 cfs	6.04 ft/s	0.56 ft	0.026	2.8 lbs/ft2	2.45 lbs/ft2	1.14	STABLE	D
Underlying Substrate	Straight	4.79 cfs	6.04 ft/s	0.56 ft	0.026	2.05 lbs/ft2	1.13 lbs/ft2	1.81	STABLE	D

S150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S150BN Unvegetated	Straight	4.79 cfs	5.22 ft/s	0.61 ft	0.032	1.9 lbs/ft2	2.65 lbs/ft2	0.72	UNSTABLE	D
Underlying Substrate	Straight	4.79 cfs	5.22 ft/s	0.61 ft	0.032	1.39 lbs/ft2	1.23 lbs/ft2	1.14	STABLE	D

SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	4.79 cfs	5.22 ft/s	0.61 ft	0.032	2 lbs/ft2	2.65 lbs/ft2	0.76	UNSTABLE	D
Underlying Substrate	Straight	4.79 cfs	5.22 ft/s	0.61 ft	0.032	1.47 lbs/ft2	1.23 lbs/ft2	1.2	STABLE	D

Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	4.79 cfs	4.31 ft/s	0.67 ft	0.042	4 lbs/ft2	2.91 lbs/ft2	1.38	STABLE	--
Underlying Substrate	Straight	4.79 cfs	4.31 ft/s	0.67 ft	0.042	1.89 lbs/ft2	1.35 lbs/ft2	1.41	STABLE	--

S75BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S75BN Unvegetated	Straight	4.79 cfs	5.6 ft/s	0.58 ft	0.029	1.6 lbs/ft2	2.55 lbs/ft2	0.63	UNSTABLE	D

Underlying Substrate	Straight	4.79 cfs	5.6 ft/s	0.58 ft	0.029	1.17 lbs/ft2	1.18 lbs/ft2	0.99	UNSTABLE	D

Summary for Subcatchment 1-D: Bottom Terrace

Runoff = 1.34 cfs @ 11.94 hrs, Volume= 0.059 af, Depth= 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	1.200	71	Landfill Cover
	1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, A-B**

Summary for Subcatchment 4-J: Top Terrace

Runoff = 3.26 cfs @ 12.07 hrs, Volume= 0.229 af, Depth= 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (ac)	CN	Description
*	4.620	71	Landfill Cover
	4.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
1.3	241	0.2000	3.13		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.9	476	0.0700	9.08	81.69	**Trap/Vee/Rect Channel Flow, C-D** Bot.W=0.00' D=1.50' Z= 5.0 & 3.0 '/' Top.W=12.00' n= 0.035 Earth, dense weeds
13.5	867	Total			

Summary for Subcatchment 4-L: Middle Terrace

Runoff = 1.47 cfs @ 11.99 hrs, Volume= 0.076 af, Depth= 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Storm Rainfall=2.70"

	Area (sf)	CN	Description
*	66,530	71	Landfill Cover
	66,530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	100	0.3300	0.33		**Sheet Flow, A-B**
					Grass: Dense n= 0.240 P2= 2.70"
0.4	103	0.3300	4.02		**Shallow Concentrated Flow, B-C**
					Short Grass Pasture Kv= 7.0 fps
0.7	376	0.0700	8.95	60.43	**Trap/Vee/Rect Channel Flow, C-D**
					Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00'
					n= 0.035 Earth, dense weeds
6.2	579	Total			

Summary for Subcatchment 1-D: Bottom Terrace

Runoff = 4.79 cfs @ 11.93 hrs, Volume= 0.204 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	1.200	71	Landfill Cover
	1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry, A-B**

Summary for Subcatchment 4-J: Top Terrace

Runoff = 12.64 cfs @ 12.06 hrs, Volume= 0.786 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	4.620	71	Landfill Cover
	4.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 2.70"
1.3	241	0.2000	3.13		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.9	476	0.0700	9.08	81.69	**Trap/Vee/Rect Channel Flow, C-D** Bot.W=0.00' D=1.50' Z= 5.0 & 3.0 '/' Top.W=12.00' n= 0.035 Earth, dense weeds
13.5	867	Total			

Summary for Subcatchment 4-L: Middle Terrace

Runoff = 5.40 cfs @ 11.98 hrs, Volume= 0.260 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (sf)	CN	Description
*	66,530	71	Landfill Cover
	66,530		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	100	0.3300	0.33		**Sheet Flow, A-B**
					Grass: Dense n= 0.240 P2= 2.70"
0.4	103	0.3300	4.02		**Shallow Concentrated Flow, B-C**
					Short Grass Pasture Kv= 7.0 fps
0.7	376	0.0700	8.95	60.43	**Trap/Vee/Rect Channel Flow, C-D**
					Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00'
					n= 0.035 Earth, dense weeds
6.2	579	Total			

B-2

RIPRAP DITCH LINING DESIGN

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

WEST DITCH RIPRAP CHANNEL DESIGN

Project Name: Juniper Ridge Landfill Phase II Expansion
Project Location: Old Town, Maine
Project No.: 240101
By: NMT
Date: 11/7//2025
Checked By: BDP
Date: 11/7/2025

OBJECTIVE

Design riprap channel with adequate lining to convey stormwater flows from 25-year, 24-hour storm event assuming stable cover conditions

REFERENCES

1. Maine Department of Environmental Protection, Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices, October 2016
2. Applied Microcomputer Systems, HydroCAD Stormwater Modeling System,Version 7.0, Chocorua, New Hampshire, 2001
3. Channel Design Program HYCHL Version 6.1

ANALYSIS

1.Determine peak stormwater flows for 25-year, 24-hour storm events using TR-20. (See Attached Hydrocad Printouts). Evaluate permanent channel lining using maximum flow rate.
2. Use peak stormwater inflow for CB-2E which represents the channel with greatest slope and greatest flow.

CONCLUSION

						Riprap	
Riprap Ditch	Flow From	Slope (Max.) (ft/ft)	Q_{25} (cfs)	Bottom Width (feet)	Side Slopes (H:1V)	D_{50} (in)	Thickness (in)
West Ditch Between CB 2D and CB 2E	2C and 2E	0.05	26.6	3	2	10	20

```
          ******  HYCHL  ****** (Version 6.1) ******          Date 11-
07-2025
 Commands Read From File: C:\WESTDITCH.CHL

       JOB WESTDITCH
       UNI 0
 ** UNITS PARAMETER = 0 (ENGLISH)
       CHL .05    26.6
       TRP 3      2      2
 ** LEFT SIDE SLOPE    2.0 AND RIGHT SIDE SLOPE    2.0
 ** THE BASE WIDTH OF THE TRAPEZOID (ft)    3.00
       LRR .83    2 42     2.65   0.047
 ** D50 (ft)    .83
 ** ANGLE OF REPOSE (DEGREES)   42.00
 ** SPECIFIC GRAVITY    2.65
 ** SHIELDS PARAMETER    .047
       END
***************END OF COMMAND FILE************

 WESTDITCH
 ------------
 INPUT REVIEW
 ------------
   DESIGN PARAMETERS:
       DESIGN DISCHARGE (ft^3/s):           26.60
       CHANNEL SHAPE:                  TRAPEZOIDAL
       CHANNEL SLOPE (ft/ft):               .050
 -------------------------------------
 HYDRAULIC CALCULATIONS USING BATHURST
 -------------------------------------

 FLOW (cfs)                26.60
 MAX DEPTH (ft)             1.09
 AREA (ft^2)                5.67
 WETTED PERIMETER (ft)      7.89
 HYDRAULIC RADIUS (ft)       .72
 AVG VELOCITY (ft/s)        4.69
 MANNINGS EQUIVALENT        .060
 Davg / D50                  .93
 FROUDE NUMBER               .79
 REYNOLDS NUMBER (10^5)      .97
 ------------------
 STABILITY ANALYSIS
 ------------------

                      LINING    PERMIS SHR   CALC. SHR  STAB.
     CONDITION        TYPE      (LB/FT^2)    (LB/FT^2)  FACTOR   REMARKS
     ---------         ------    ----------   ---------  ------   ------
-
   BOTTOM; STRAIGHT   RIPRAP          4.02      3.41      1.18   STABLE
   SIDE; STRAIGHT     RIPRAP          2.99      2.60      1.15   STABLE

 *** NORMAL END OF HYCHL ***
```

Summary for Pond CB-2E: LF TOE DITCH - CATCH BASIN

Inflow Area = 10.279 ac, 4.18% Impervious, Inflow Depth = 2.13" for 25-yr Storm event
Inflow = 26.52 cfs @ 12.13 hrs, Volume= 1.828 af
Outflow = 26.55 cfs @ 12.13 hrs, Volume= 1.826 af, Atten= 0%, Lag= 0.1 min
Primary = 26.55 cfs @ 12.13 hrs, Volume= 1.826 af
Routed to Pond DP-12 : DETENTION POND 12

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 180.26' @ 12.13 hrs Surf.Area= 13 sf Storage= 101 cf
Flood Elev= 182.00' Surf.Area= 13 sf Storage= 101 cf

Plug-Flow detention time= 1.1 min calculated for 1.825 af (100% of inflow)
Center-of-Mass det. time= 0.4 min (852.8 - 852.4)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	101 cf	**4.00'D x 8.00'H Vertical Cone/Cylinder**

Device	Routing	Invert	Outlet Devices
#1	Device 2	179.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	173.00'	**24.0" Round Culvert** L= 80.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 173.00' / 172.00' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=26.04 cfs @ 12.13 hrs HW=180.21' (Free Discharge)
└**2=Culvert** (Passes 26.04 cfs of 37.71 cfs potential flow)
└**1=Orifice/Grate** (Orifice Controls 26.04 cfs @ 5.31 fps)

SME
SEVEE & MAHER
ENGINEERS
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

RIPRAP DOWNSPOUT DESIGN

Project Name: Juniper Ridge Landfill Phase II Expansion
Project Location: Old Town, Maine
Project No.: 240101
By: NMT
Date: 11/7/2025
Checked By: BDP
Date: 11/7/2025

OBJECTIVE

Design riprap channel with adequate freeboard and lining to convey stormwater flows from 25-year, 24-hour storm event assuming full grass cover.

REFERENCES

1. Applied Microcomputer Systems, HydroCAD Stormwater Modeling System, Version 10.10.
2. Channel Design Program HYCHL Version 6.1.
3. USDOT, FHA, Design of Roadside Channels with Flexible Linings, HEC 15, September 2005.

ASSUMPTIONS

1. This evaluation includes anticipated stormwater flows from landfill final cover.
2. This evaluation is worst case.

ANALYSIS

Determine peak stormwater flows for the 25-year, 24-hour storm event (assuming full grass growth) using TR-20. (See Attached HydroCAD Printouts). Evaluate channel stability based on peak flows.

CONCLUSION

Note: Riprap sizing for downspouts for final cover conditions.

Downspout	R-4H Final Cover Downspout
Q25 Vegetated (ft3/sec)	33.16
Qdesign	33.16
Downspout Geometry	
Maximum Slope (ft/ft)	0.37
Bottom Width (ft)	4
Side slope left (H:1V)	2
Side slope right (H:1V)	2
Depth (ft) =	2.5
D50 (in) =	12
Minimum Thickness (in) =	24
Mannings n =	0.045
Velocity (ft/sec) =	12.65
Flow Depth (ft) =	0.52

D50 riprap size checked using HYCHL Program. (See Attachment)

```
          ******  HYCHL  ****** (Version 6.1) ******          Date 11-
07-2025
 Commands Read From File: C:\4H.CHL

       JOB 4H
       UNI 0
 ** UNITS PARAMETER = 0 (ENGLISH)
       CHL .37    33.16
       TRP 4      2      2
 ** LEFT SIDE SLOPE    2.0 AND RIGHT SIDE SLOPE    2.0
 ** THE BASE WIDTH OF THE TRAPEZOID (ft)    4.00
       LRR 1      2 42     2.65   .1500
 ** D50 (ft)   1.00
 ** ANGLE OF REPOSE (DEGREES)   42.00
 ** SPECIFIC GRAVITY    2.65
 ** SHIELDS PARAMETER    .150
       END
***************END OF COMMAND FILE************

 4H
 ------------
 INPUT REVIEW
 ------------
   DESIGN PARAMETERS:
       DESIGN DISCHARGE (ft^3/s):           33.16
       CHANNEL SHAPE:                  TRAPEZOIDAL
       CHANNEL SLOPE (ft/ft):               .370
 -------------------------------------
 HYDRAULIC CALCULATIONS USING BATHURST
 -------------------------------------

 FLOW (cfs)                33.16
 MAX DEPTH (ft)              .53
 AREA (ft^2)                2.72
 WETTED PERIMETER (ft)      6.40
 HYDRAULIC RADIUS (ft)       .43
 AVG VELOCITY (ft/s)       12.19
 MANNINGS EQUIVALENT        .043
 Davg / D50                  .44
 FROUDE NUMBER              2.94
 REYNOLDS NUMBER (10^5)     2.28
 ------------------
 STABILITY ANALYSIS
 ------------------

                      LINING    PERMIS SHR   CALC. SHR  STAB.
     CONDITION        TYPE      (LB/FT^2)    (LB/FT^2)  FACTOR   REMARKS
     ---------         ------    ----------   ---------  ------   ------
-
   BOTTOM; STRAIGHT   RIPRAP          15.44     12.33      1.25   STABLE
   SIDE; STRAIGHT     RIPRAP          11.49      9.53      1.21   STABLE

 *** NORMAL END OF HYCHL ***
```

Summary for Subcatchment 4-H: SC-4H

Runoff = 33.16 cfs @ 12.07 hrs, Volume= 2.120 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Storm Rainfall=4.90"

	Area (ac)	CN	Description
*	12.330	71	Landfill Final Cover
*	0.135	98	Riprap
	12.465	71	Weighted Average
	12.330		98.92% Pervious Area
	0.135		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	150	0.1000	0.22		**Sheet Flow, Segment A-B** Grass: Dense n= 0.240 P2= 2.70"
1.7	232	0.1000	2.21		**Shallow Concentrated Flow, Segment B-C** Short Grass Pasture Kv= 7.0 fps
0.8	464	0.0700	9.13	123.23	**Trap/Vee/Rect Channel Flow, Segment C-D** Bot.W=0.00' D=1.50' Z= 2.0 & 10.0 '/' Top.W=18.00' n= 0.035 High grass
0.5	440	0.3300	14.25	227.99	**Trap/Vee/Rect Channel Flow, Segment D-E** Bot.W=4.00' D=2.00' Z= 2.0 '/' Top.W=12.00' n= 0.069 Riprap, 6-inch
14.3	1,286	Total			

B-3

CULVERT INLET/OUTLET DESIGN

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

RIPRAP APRON DESIGN

Project Name: Juniper Ridge Landfill Phase II Expansion
Project Location: Old Town, Maine
Project No.: 240101
By: NMT
Date: 3/24/2025
Checked By: TJM
Date: 4/3/2025

OBJECTIVE

Design culvert outlet protection to protect the outlet of culverts from scour and deterioration.

REFERENCES

Maine Department of Environmental Protection, Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices, October 2016.

ANALYSIS

Evaluate required riprap apron dimensions for full pipe with low tail water.

CONCLUSION

Riprap Apron Designation	Flow From	Culvert Dia. (in)	D_{50} (in)	Thickness (in)	Min. Length (ft)	Min. Width (ft)
11R	Pond DP-11R	24	10	20	20	8
12	Pond DP-12	24	10	20	20	8
13	Pond DP-13	24	10	20	20	8
14	Pond DP-14	24	10	20	20	8

B-4

LEVEL SPREADER DESIGN

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER ENGINEERS
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

STANDARD LEVEL SPREADER DESIGN

Project Name: Juniper Ridge Landfill Phase II Expansion
Project Location: Old Town, Maine
Project No.: 240101
By: NMT
Date: 3/24/2025
Checked By: TJM
Date: 4/3/2025

OBJECTIVE

Design level spreaders in accordance with Erosion and Sediment Control Standards.

REFERENCES

1. Maine Department of Environmental Protection, Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices, October 2016.
2. Applied Microcomputer Systems, HydroCAD Stormwater Modeling System,Version 7.0, Chocorua, New Hampshire, 2001.

ANALYSIS

1. Level Spreader Length shall be such that flow from the spreader during the 10-year storm event does not exceed 0.25 cfs per linear foot of spreader. (Minimum Length= 15')

CONCLUSION

Level Spreader Designation	Discharge From	Q_{10} (cfs)	Rqd Rate (cfs/ft)	Min. Rqd. Length (ft)	Specified Length (ft)
11R	Pond DP-11R	1.9	0.25	7.6	15
12	Pond DP-12	1.4	0.25	5.6	15
13	Pond DP-13	1.8	0.25	7.2	15
14	Pond DP-14	1.3	0.25	5.2	15

Summary for Pond DP-11R: DETENTION POND 11R

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 1.45" for 10-yr Storm event
Inflow = 56.32 cfs @ 12.06 hrs, Volume= 3.543 af
Outflow = 1.86 cfs @ 15.94 hrs, Volume= 3.543 af, Atten= 97%, Lag= 233.0 min
Primary = 0.65 cfs @ 15.94 hrs, Volume= 0.853 af
Routed to Reach R4G : Reach 4G
Secondary = 1.21 cfs @ 15.94 hrs, Volume= 2.690 af
Routed to Reach R4G : Reach 4G
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 158.89' @ 15.94 hrs Surf.Area= 28,727 sf Storage= 91,332 cf

Plug-Flow detention time= 621.8 min calculated for 3.542 af (100% of inflow)
Center-of-Mass det. time= 622.0 min (1,476.4 - 854.4)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	499,354 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,440	0	0
156.00	19,408	21,848	21,848
158.00	25,775	45,183	67,031
160.00	32,395	58,170	125,201
162.00	39,360	71,755	196,956
164.00	46,635	85,995	282,951
166.00	54,090	100,725	383,676
168.00	61,588	115,678	499,354

Device	Routing	Invert	Outlet Devices
#1	Primary	155.30'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.30' / 154.00' S= 0.0236 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	156.50'	**4.0" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	161.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	152.20'	**6.0" Round Culvert** L= 118.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 152.20' / 151.80' S= 0.0034 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.65 cfs @ 15.94 hrs HW=158.89' (Free Discharge)
└─**1=Culvert** (Passes 0.65 cfs of 24.35 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.65 cfs @ 7.45 fps)
  ├─**3=Orifice** (Controls 0.00 cfs)
  └─**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.21 cfs @ 15.94 hrs HW=158.89' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.21 cfs @ 6.15 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-12: DETENTION POND 12

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 1.43" for 10-yr Storm event
Inflow = 50.07 cfs @ 12.10 hrs, Volume= 3.756 af
Outflow = 1.43 cfs @ 18.64 hrs, Volume= 3.756 af, Atten= 97%, Lag= 392.2 min
Primary = 0.11 cfs @ 18.64 hrs, Volume= 0.061 af
Routed to Reach R-2A : Reach 2A
Secondary = 1.32 cfs @ 18.64 hrs, Volume= 3.696 af
Routed to Reach R-2A : Reach 2A
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-2A : Reach 2A

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.74' @ 18.64 hrs Surf.Area= 39,716 sf Storage= 107,124 cf

Plug-Flow detention time= 897.1 min calculated for 3.755 af (100% of inflow)
Center-of-Mass det. time= 897.4 min (1,757.4 - 860.1)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	537,379 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	7,544	0	0
170.00	34,762	42,306	42,306
172.00	40,454	75,216	117,522
174.00	46,283	86,737	204,259
176.00	52,328	98,611	302,870
178.00	58,583	110,911	413,781
180.00	65,015	123,598	537,379

Device	Routing	Invert	Outlet Devices
#1	Primary	168.90'	**24.0" Round Culvert** L= 66.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 168.90' / 168.50' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	171.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	174.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	175.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	166.00'	**6.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 166.00' / 165.50' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	178.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.11 cfs @ 18.64 hrs HW=171.74' (Free Discharge)
└**1=Culvert** (Passes 0.11 cfs of 18.93 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.11 cfs @ 1.67 fps)
  ├**3=Orifice** (Controls 0.00 cfs)
  └**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.32 cfs @ 18.64 hrs HW=171.74' (Free Discharge)
└**5=Culvert** (Barrel Controls 1.32 cfs @ 6.70 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-13: DETENTION POND 13

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 1.50" for 10-yr Storm event
Inflow = 15.85 cfs @ 12.00 hrs, Volume= 1.435 af
Outflow = 1.97 cfs @ 13.29 hrs, Volume= 1.435 af, Atten= 88%, Lag= 76.9 min
Primary = 0.62 cfs @ 13.29 hrs, Volume= 0.314 af
Routed to Reach R4C : Reach 4C
Secondary = 1.36 cfs @ 13.29 hrs, Volume= 1.121 af
Routed to Reach R4C : Reach 4C
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R4C : Reach 4C

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 162.83' @ 13.29 hrs Surf.Area= 11,800 sf Storage= 25,985 cf
Flood Elev= 166.00' Surf.Area= 17,062 sf Storage= 71,548 cf

Plug-Flow detention time= 139.9 min calculated for 1.435 af (100% of inflow)
Center-of-Mass det. time= 139.9 min (1,006.1 - 866.2)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	109,546 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	6,224	0	0
162.00	10,498	16,722	16,722
164.00	13,633	24,131	40,853
166.00	17,062	30,695	71,548
168.00	20,936	37,998	109,546

Device	Routing	Invert	Outlet Devices
#1	Primary	160.30'	**24.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 160.30' / 159.00' S= 0.0433 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	160.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	164.30'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	158.00'	**6.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 158.00' / 157.70' S= 0.0055 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.62 cfs @ 13.29 hrs HW=162.83' (Free Discharge)
└─**1=Culvert** (Passes 0.62 cfs of 18.72 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.62 cfs @ 7.08 fps)
  ├─**3=Orifice** (Controls 0.00 cfs)
  └─**4=Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.36 cfs @ 13.29 hrs HW=162.83' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.36 cfs @ 6.91 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-14: DETENTION POND 14

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 1.38" for 10-yr Storm event
Inflow = 27.78 cfs @ 12.00 hrs, Volume= 1.551 af
Outflow = 1.21 cfs @ 14.17 hrs, Volume= 1.551 af, Atten= 96%, Lag= 130.2 min
Primary = 0.21 cfs @ 14.17 hrs, Volume= 0.110 af
Routed to Reach R4D : Reach 4D
Secondary = 1.00 cfs @ 14.17 hrs, Volume= 1.441 af
Routed to Reach R4D : Reach 4D
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 158.41' @ 14.17 hrs Surf.Area= 35,143 sf Storage= 34,295 cf

Plug-Flow detention time= 350.6 min calculated for 1.550 af (100% of inflow)
Center-of-Mass det. time= 350.6 min (1,206.1 - 855.4)

Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	176,567 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	6,253	0	0
158.00	34,183	20,218	20,218
160.00	38,909	73,092	93,310
162.00	44,348	83,257	176,567

Device	Routing	Invert	Outlet Devices
#1	Primary	157.00'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 157.00' / 156.00' S= 0.0182 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.80'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	155.00'	**6.0" Round Culvert** L= 76.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 155.00' / 154.70' S= 0.0039 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#5	Device 1	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Tertiary	160.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.21 cfs @ 14.17 hrs HW=158.41' (Free Discharge)
└─**1=Culvert** (Passes 0.21 cfs of 9.53 cfs potential flow)
  ├─**2=Orifice** (Controls 0.00 cfs)
  ├─**3=Grate** (Controls 0.00 cfs)
  └─**5=Orifice/Grate** (Orifice Controls 0.21 cfs @ 2.36 fps)

Secondary OutFlow Max=1.00 cfs @ 14.17 hrs HW=158.41' (Free Discharge)
└─**4=Culvert** (Barrel Controls 1.00 cfs @ 5.11 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=157.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

B-5

PLUNGE POOL DESIGN

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

PLUNGE POOL DESIGN

Project Name: Juniper Ridge
Project Location: Old Town, ME
240101
NMT
4/4/2025
TJM

OBJECTIVE: Design plunge pool to protect the outlet of culverts from scour and deterioration.

REFERENCES:

1. Maine Department of Environmental Protection, Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices, March 2003
2. Applied Microcomputer Systems, HydroCAD Stormwater Modeling System, Version 7.0, Chocorua, New Hampshire, 2001

DESIGN PROCEDURE:

1. Use design flows for 25-year, 24-hour storm event and attached Outlet Plunge Pool table to determine plunge pool dimensions and riprap size.

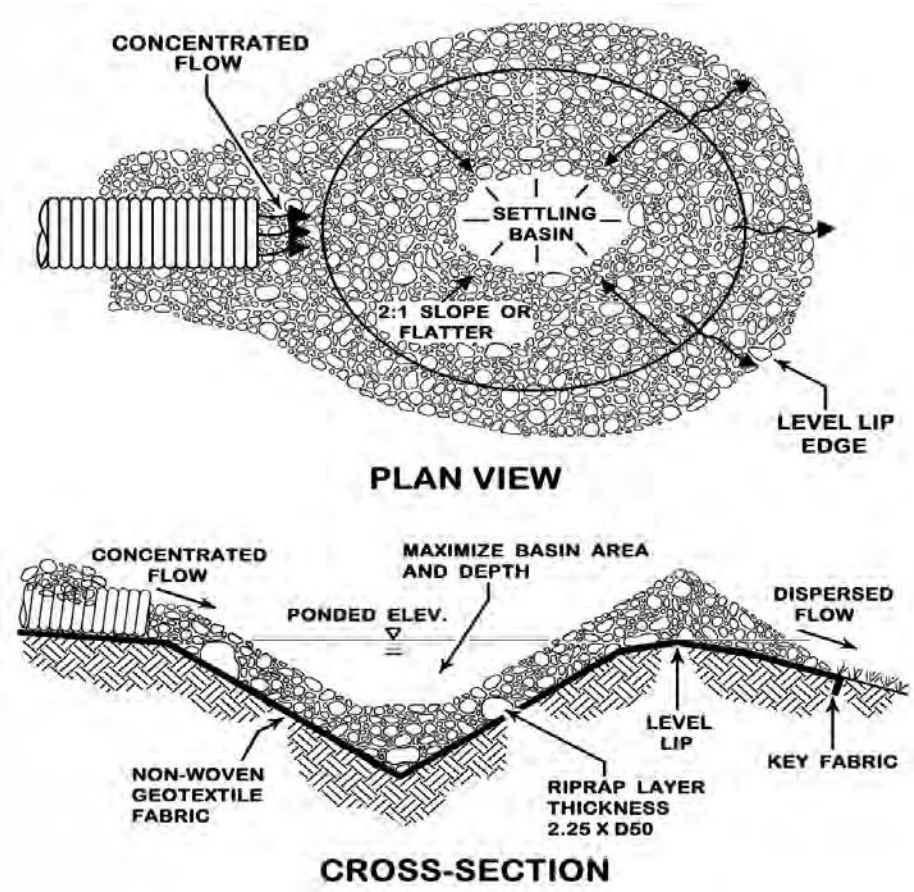
SUMMARY OF RESULTS:

				Riprap			
Plunge Pool Designation	Flow From	Q_{25} (cfs)	Culvert Dia. (in)	D_{50} (in)	Thickness (in)	Length (ft)	Width (ft)
11R	Pond DP-11R	3.3	24	6	14	8	8
12	Pond DP-12	2.0	24	4	9	8	8
13	Pond DP-13	3.3	24	6	14	8	8
14	Pond DP-14	1.5	24	4	9	8	8

PLUNGE POOL SIZING (minimum)				
SIZE	***RIPRAP SIZING (D_{50})***	***WIDTH At the narrow end of pipe***	***LENGTH For slow flows (no pressure head)***	***LENGTH For high flows (with pressure head)***
12”	5”	3-4’	4-6’	8-10’
18”	8”	4-6’	6-8’	12-18’
24”	10”	6-8’	8-10’	18-22’
30”	12”	8-10’	12-14’	22-28’
36”	14”	10-12’	14-16’	28-32’
The diameter of the largest stone size in the mix should be about 1.5 times the D_{50} and the smallest one about one half the size. The thickness of riprap should never be less than 2 times the rock D_{50}.				

CONSTRUCTION SPECIFICATIONS

- If the pipe discharges onto a flat area, the apron should have a width that is three times the outlet pipe’s diameter. If the pipe flows have the potential of causing a gully, a level spreader should be provided.
- The channel side slopes should be no steeper than 2:1. Riprap on the sides of the plunge pool should extend to the top of the channel.
- The plunge pool sizing and the median sized riprap can be determined from the following table. The thickness of riprap should not be less than 2 times the rock D_{50}.
- A geotextile or appropriate gravel filter should be used to protect against piping of soil fines from beneath the rock.
- In a channel that can be revegetated, seed and mulch should be applied within 7 days from final construction.



B-6

EMERGENCY SPILLWAY DESIGN

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 / Fax: 207.829.5692
smemaine.com

RIPRAP CHANNEL DESIGN

Project Name: Juniper Ridge Landfill Phase II Expansion
Project Location: Old Town, Maine
Project No.: 240101
By: NMT
Date: 3/24/2025
Checked By: BDP
Date: 5/29/2025

OBJECTIVE

Design riprap channel with adequate lining to convey stormwater flows from 25-year or 100-year, 24-hour storm event assuming vegetative conditions.

REFERENCES

1. Maine Department of Environmental Protection, Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices, October 2016
2. Applied Microcomputer Systems, HydroCAD Stormwater Modeling System,Version 7.0, Chocorua, New Hampshire, 2001.
3. Channel Design Program HYCHL Version 6.1

ANALYSIS

Determine peak stormwater flows for 25-year and 100-year, 24-hour storm events using TR-20. (See Attached Hydrocad Printouts). Evaluate permanent channel lining using maximum flow rate. Assume normal outlets are clogged for 25-year storm and all outlets working during 100-year event.

CONCLUSION

							Riprap	
Riprap Ditch	Flow From	Slope (Max.) (ft/ft)	Q_{25} (cfs)	Q_{100} (cfs)	Bottom Width (feet)	Side Slopes (H:1V)	D_{50} (in)	Thickness (in)
DP-11R Emergency Spillway	DP-11R	0.33	NA	NA	10	2	4	9
DP-12 Emergency Spillway	DP-12	0.33	NA	NA	10	2	4	9
DP-13 Emergency Spillway	DP-13	0.33	0.94	NA	10	2	4	9
DP-14 Emergency Spillway	DP-14	0.33	0.57	NA	10	2	4	9

Note: No discharge during 100-year storm event.

```
          ******  HYCHL  ****** (Version 6.1) ******          Date 05-
29-2025
 Commands Read From File: C:\DP13ES.CHL
       JOB DP13 ES
       UNI 0
 ** UNITS PARAMETER = 0 (ENGLISH)
       CHL .40    .94
 ** LEFT SIDE SLOPE    2.0 AND RIGHT SIDE SLOPE    2.0
 ** THE BASE WIDTH OF THE TRAPEZOID (ft)   10.00
       LRR .33    2 42     2.65   .15
 ** D50 (ft)    .33
 ** ANGLE OF REPOSE (DEGREES)   42.00
 ** SPECIFIC GRAVITY    2.65
 ** SHIELDS PARAMETER    .150
       END
***************END OF COMMAND FILE************

 DP13 ES
 ------------
 INPUT REVIEW
 ------------
   DESIGN PARAMETERS:
       DESIGN DISCHARGE (ft^3/s):             .94
       CHANNEL SHAPE:                  TRAPEZOIDAL
       CHANNEL SLOPE (ft/ft):               .400

 *** WARNING:  DEPTH DID NOT CONVERGE. PROGRAM WILL CONTINUE
                 WITH MOST RECENT VALUE
 -------------------------------------
 HYDRAULIC CALCULATIONS USING BATHURST
 -------------------------------------

 FLOW (cfs)                   .94
 MAX DEPTH (ft)               .04
 AREA (ft^2)                  .56
 WETTED PERIMETER (ft)      10.25
 HYDRAULIC RADIUS (ft)        .06
 AVG VELOCITY (ft/s)         1.66
 MANNINGS EQUIVALENT         .446
 Davg / D50                   .17
 FROUDE NUMBER               1.49
 REYNOLDS NUMBER (10^5)       .43
 ------------------
 STABILITY ANALYSIS
 ------------------

                      LINING    PERMIS SHR   CALC. SHR  STAB.
    CONDITION         TYPE      (LB/FT^2)    (LB/FT^2)  FACTOR   REMARKS
    ---------          ------    ----------   ---------  ------   ------
  BOTTOM; STRAIGHT   RIPRAP          5.10       .97      5.27   STABLE
  SIDE; STRAIGHT     RIPRAP          3.79       .75      5.03   STABLE

 *** NORMAL END OF HYCHL ***
```

Summary for Pond DP-11R: DETENTION POND 11R

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 2.24" for 25-yr Storm event
Inflow = 91.57 cfs @ 12.05 hrs, Volume= 5.483 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R4G : Reach 4G

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 163.02' @ 24.90 hrs Surf.Area= 43,058 sf Storage= 238,848 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	499,354 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,440	0	0
156.00	19,408	21,848	21,848
158.00	25,775	45,183	67,031
160.00	32,395	58,170	125,201
162.00	39,360	71,755	196,956
164.00	46,635	85,995	282,951
166.00	54,090	100,725	383,676
168.00	61,588	115,678	499,354

Device	Routing	Invert	Outlet Devices
#1	Primary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond DP-11R: DETENTION POND 11R

Inflow Area = 29.409 ac, 2.62% Impervious, Inflow Depth = 3.89" for 100-yr Storm event
Inflow = 166.60 cfs @ 12.05 hrs, Volume= 9.537 af
Outflow = 37.67 cfs @ 12.34 hrs, Volume= 9.537 af, Atten= 77%, Lag= 17.5 min
Primary = 36.21 cfs @ 12.34 hrs, Volume= 5.725 af
Routed to Reach R4G : Reach 4G
Secondary = 1.47 cfs @ 12.34 hrs, Volume= 3.812 af
Routed to Reach R4G : Reach 4G
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 162.03' @ 12.34 hrs Surf.Area= 39,466 sf Storage= 198,102 cf

Plug-Flow detention time= 472.9 min calculated for 9.533 af (100% of inflow)
Center-of-Mass det. time= 473.4 min (1,296.2 - 822.8)

Volume	Invert	Avail.Storage	Storage Description
#1	154.00'	499,354 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.00	2,440	0	0
156.00	19,408	21,848	21,848
158.00	25,775	45,183	67,031
160.00	32,395	58,170	125,201
162.00	39,360	71,755	196,956
164.00	46,635	85,995	282,951
166.00	54,090	100,725	383,676
168.00	61,588	115,678	499,354

Device	Routing	Invert	Outlet Devices
#1	Primary	155.30'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.30' / 154.00' S= 0.0236 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	156.50'	**4.0" Horiz. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	161.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	152.20'	**6.0" Round Culvert** L= 118.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 152.20' / 151.80' S= 0.0034 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=36.20 cfs @ 12.34 hrs HW=162.03' (Free Discharge)
└─**1=Culvert** (Inlet Controls 36.20 cfs @ 11.52 fps)
  ├─**2=Orifice** (Passes < 0.99 cfs potential flow)
  ├─**3=Orifice** (Passes < 1.58 cfs potential flow)
  └─**4=Grate** (Passes < 42.77 cfs potential flow)

Secondary OutFlow Max=1.47 cfs @ 12.34 hrs HW=162.03' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.47 cfs @ 7.47 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=154.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-12: DETENTION POND 12

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 2.17" for 25-yr Storm event
Inflow = 78.37 cfs @ 12.09 hrs, Volume= 5.698 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 174.92' @ 34.65 hrs Surf.Area= 49,069 sf Storage= 248,202 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	537,379 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	7,544	0	0
170.00	34,762	42,306	42,306
172.00	40,454	75,216	117,522
174.00	46,283	86,737	204,259
176.00	52,328	98,611	302,870
178.00	58,583	110,911	413,781
180.00	65,015	123,598	537,379

Device	Routing	Invert	Outlet Devices
#1	Primary	178.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond DP-12: DETENTION POND 12

Inflow Area = 31.486 ac, 4.26% Impervious, Inflow Depth = 3.64" for 100-yr Storm event
Inflow = 133.74 cfs @ 12.08 hrs, Volume= 9.546 af
Outflow = 6.57 cfs @ 14.18 hrs, Volume= 9.546 af, Atten= 95%, Lag= 125.6 min
Primary = 4.90 cfs @ 14.18 hrs, Volume= 3.046 af
Secondary = 1.66 cfs @ 14.18 hrs, Volume= 6.499 af
Routed to Reach R-2A : Reach 2A
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R-2A : Reach 2A

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 175.18' @ 14.18 hrs Surf.Area= 49,848 sf Storage= 260,943 cf

Plug-Flow detention time= 1,062.2 min calculated for 9.542 af (100% of inflow)
Center-of-Mass det. time= 1,062.9 min (1,895.2 - 832.4)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	537,379 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
168.00	7,544	0	0
170.00	34,762	42,306	42,306
172.00	40,454	75,216	117,522
174.00	46,283	86,737	204,259
176.00	52,328	98,611	302,870
178.00	58,583	110,911	413,781
180.00	65,015	123,598	537,379

Device	Routing	Invert	Outlet Devices
#1	Primary	168.90'	**24.0" Round Culvert** L= 66.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 168.90' / 168.50' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	171.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	174.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	175.00'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	166.00'	**6.0" Round Culvert** L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 166.00' / 165.50' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	178.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.82 cfs @ 14.18 hrs HW=175.18' (Free Discharge)
└─**1=Culvert** (Passes 4.82 cfs of 34.76 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.79 cfs @ 9.02 fps)
  ├─**3=Orifice** (Orifice Controls 0.91 cfs @ 4.64 fps)
  └─**4=Grate** (Weir Controls 3.12 cfs @ 1.38 fps)

Secondary OutFlow Max=1.66 cfs @ 14.18 hrs HW=175.18' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.66 cfs @ 8.48 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=168.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-13: DETENTION POND 13

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 2.26" for 25-yr Storm event
Inflow = 24.69 cfs @ 12.00 hrs, Volume= 2.158 af
Outflow = 0.94 cfs @ 16.81 hrs, Volume= 0.516 af, Atten= 96%, Lag= 288.2 min
Primary = 0.94 cfs @ 16.81 hrs, Volume= 0.516 af
Routed to Reach R4C : Reach 4C

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 166.10' @ 16.81 hrs Surf.Area= 17,264 sf Storage= 73,336 cf
Flood Elev= 166.00' Surf.Area= 17,062 sf Storage= 71,548 cf

Plug-Flow detention time= 486.8 min calculated for 0.515 af (24% of inflow)
Center-of-Mass det. time= 343.0 min (1,195.4 - 852.5)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	109,546 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	6,224	0	0
162.00	10,498	16,722	16,722
164.00	13,633	24,131	40,853
166.00	17,062	30,695	71,548
168.00	20,936	37,998	109,546

Device	Routing	Invert	Outlet Devices
#1	Primary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.90 cfs @ 16.81 hrs HW=166.10' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.90 cfs @ 0.87 fps)

Summary for Pond DP-13: DETENTION POND 13

Inflow Area = 11.450 ac, 8.89% Impervious, Inflow Depth = 3.75" for 100-yr Storm event
Inflow = 42.15 cfs @ 12.00 hrs, Volume= 3.581 af
Outflow = 23.86 cfs @ 12.32 hrs, Volume= 3.581 af, Atten= 43%, Lag= 19.3 min
Primary = 22.29 cfs @ 12.32 hrs, Volume= 1.848 af
Routed to Reach R4C : Reach 4C
Secondary = 1.57 cfs @ 12.32 hrs, Volume= 1.733 af
Routed to Reach R4C : Reach 4C
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach R4C : Reach 4C

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 164.43' @ 12.32 hrs Surf.Area= 14,366 sf Storage= 46,837 cf
Flood Elev= 166.00' Surf.Area= 17,062 sf Storage= 71,548 cf

Plug-Flow detention time= 131.7 min calculated for 3.580 af (100% of inflow)
Center-of-Mass det. time= 131.7 min (967.8 - 836.1)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	109,546 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	6,224	0	0
162.00	10,498	16,722	16,722
164.00	13,633	24,131	40,853
166.00	17,062	30,695	71,548
168.00	20,936	37,998	109,546

Device	Routing	Invert	Outlet Devices
#1	Primary	160.30'	**24.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 160.30' / 159.00' S= 0.0433 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	160.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	163.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#4	Device 1	163.80'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	158.00'	**6.0" Round Culvert** L= 55.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 158.00' / 157.70' S= 0.0055 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#6	Tertiary	166.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=22.07 cfs @ 12.32 hrs HW=164.42' (Free Discharge)
└─**1=Culvert** (Passes 22.07 cfs of 26.73 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.81 cfs @ 9.33 fps)
  ├─**3=Orifice** (Orifice Controls 1.02 cfs @ 5.22 fps)
  └─**4=Grate** (Weir Controls 20.23 cfs @ 2.58 fps)

Secondary OutFlow Max=1.57 cfs @ 12.32 hrs HW=164.42' (Free Discharge)
└─**5=Culvert** (Barrel Controls 1.57 cfs @ 8.01 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=160.00' (Free Discharge)
└─**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DP-14: DETENTION POND 14

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 2.11" for 25-yr Storm event
Inflow = 42.95 cfs @ 12.00 hrs, Volume= 2.369 af
Outflow = 0.57 cfs @ 23.49 hrs, Volume= 0.227 af, Atten= 99%, Lag= 689.8 min
Primary = 0.57 cfs @ 23.49 hrs, Volume= 0.227 af
Routed to Reach R4D : Reach 4D

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 160.07' @ 23.49 hrs Surf.Area= 39,113 sf Storage= 96,233 cf

Plug-Flow detention time= 713.1 min calculated for 0.227 af (10% of inflow)
Center-of-Mass det. time= 559.9 min (1,402.8 - 842.8)

Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	176,567 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	6,253	0	0
158.00	34,183	20,218	20,218
160.00	38,909	73,092	93,310
162.00	44,348	83,257	176,567

Device	Routing	Invert	Outlet Devices
#1	Primary	160.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.55 cfs @ 23.49 hrs HW=160.07' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.55 cfs @ 0.73 fps)

Summary for Pond DP-14: DETENTION POND 14

Inflow Area = 13.461 ac, 2.19% Impervious, Inflow Depth = 3.56" for 100-yr Storm event
Inflow = 72.37 cfs @ 11.99 hrs, Volume= 3.997 af
Outflow = 4.97 cfs @ 12.95 hrs, Volume= 3.997 af, Atten= 93%, Lag= 57.1 min
Primary = 3.74 cfs @ 12.95 hrs, Volume= 1.453 af
Routed to Reach R4D : Reach 4D
Secondary = 1.22 cfs @ 12.95 hrs, Volume= 2.544 af
Routed to Reach R4D : Reach 4D
Tertiary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 159.95' @ 12.95 hrs Surf.Area= 38,791 sf Storage= 91,376 cf

Plug-Flow detention time= 463.0 min calculated for 3.995 af (100% of inflow)
Center-of-Mass det. time= 463.2 min (1,290.9 - 827.7)

Volume	Invert	Avail.Storage	Storage Description
#1	157.00'	176,567 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
157.00	6,253	0	0
158.00	34,183	20,218	20,218
160.00	38,909	73,092	93,310
162.00	44,348	83,257	176,567

Device	Routing	Invert	Outlet Devices
#1	Primary	157.00'	**24.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 157.00' / 156.00' S= 0.0182 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Device 1	159.00'	**6.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	159.80'	**48.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	155.00'	**6.0" Round Culvert** L= 76.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 155.00' / 154.70' S= 0.0039 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#5	Device 1	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Tertiary	160.00'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.74 cfs @ 12.95 hrs HW=159.95' (Free Discharge)
└**1=Culvert** (Passes 3.74 cfs of 21.12 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.79 cfs @ 4.03 fps)
  ├**3=Grate** (Weir Controls 2.39 cfs @ 1.27 fps)
  └**5=Orifice/Grate** (Orifice Controls 0.56 cfs @ 6.43 fps)

Secondary OutFlow Max=1.22 cfs @ 12.95 hrs HW=159.95' (Free Discharge)
└**4=Culvert** (Barrel Controls 1.22 cfs @ 6.22 fps)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=157.00' (Free Discharge)
└**6=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX C

TYPICAL CONSTRUCTION EROSION AND SEDIMENTATION CONTROL SPECIFICATIONS AND DRAWINGS C-308 AND C-309

SME
SEVEE & MAHER
ENGINEERS

SECTION 02220

EROSION CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements (if any) apply to the work specified in this Section.

B. Requirements set forth by the Quality Assurance/Quality Control Plan shall apply to the work specified in this Section.

C. The Project Site-Specific Maine Construction General Permit.

D. All work performed under this specification shall be performed in general accordance with the most recent edition of the Maine Department of Environmental Protection (MEDEP) Maine Erosion and Sediment Control Practices Best Management Practices.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

A. Measurement and Payment: Section 01025

B. Project Coordination: Section 01041

C. Site Preparation: Section 02100

D. Earthwork: Section 02200

E. Riprap: Section 02261

F. Seeding and Mulching: Section 02800

1.03 DESCRIPTION OF WORK:

A. Prevention: Take every reasonable precaution and do whatever is necessary to avoid any erosion and to prevent sedimentation of rivers, streams, lakes, reservoirs, impoundments, and drainage ditches and swales.

B. Exposure: The exposure of uncompleted cut slopes, embankments, trench excavations, and site-graded areas shall be kept as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.

C. Temporary Protection: Should it become necessary to suspend construction for seven days, shape all excavated and graded areas in such a manner that runoff will be intercepted and diverted to points where sediment control structures have been installed. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, sedimentation basins, sediment traps, mulching, temporary seeding, stone check dams, and filter berms until permanent drainage facilities or erosion control features have been completed and are operative. The Contractor shall provide temporary seeding, mulching, or other protective coverings to exposed earth surfaces and stockpiles outside of the landfill cell that are susceptible to erosion and which will be exposed to rain or wind elements for a period of greater than seven days.

D. Handling of Erodible Soils: Erodible soils placed or exposed during the work shall be so handled and treated as to minimize the possibility of its reaching any surface waters. Use diversion channels, dikes, sediment traps, or any other effective control measures.

E. Off-site Erosion Control: The requirements of this Section also apply to Project-related construction activities away from the Project site, such as at borrow pits, off-site storage areas, and haul and work roads.

F. Remedial Action: Should any protective measures employed indicate any deficiencies or erosion taking place, immediately repair erosion control measures or employ different techniques to correct the situation and to prevent subsequent erosion and sedimentation.

G. Discontinuation: Continue temporary erosion and sedimentation control measures until the permanent measures have been sufficiently established and are capable of controlling erosion and sedimentation on their own.

H. Permanent Seeding: At the completion of landfill construction activities, the Contractor shall provide permanent seeding, mulching, or other protective landscape coverings to exposed earth surfaces affected by construction activities, and as shown on the Contact Drawings, and as specified in Section 02800.

I. Inspection: The Contractor shall perform all inspections and documentation required by the project's MEDEP Maine General Construction Permit.

J. Maintenance and Repair: The Contractor shall be responsible for maintenance, and/or repair of all temporary and permanent erosion and sedimentation control measures during construction, including temporary or permanent erosion and sedimentation control measures installed by other subcontractors and used during this project. Inspections will be undertaken by the Contractor's qualified personnel to ensure that controls are correctly functioning, and that additional erosion control measures are installed if needed. Such inspections will occur bi-weekly and after each significant rainfall event (1 inch or more within a 24-hour period) during construction and until permanent erosion and sediment control measures have been properly installed and the site is stabilized. Sediment within sediment control structures shall be removed when the height of the sediment is greater than one-half the depth of the erosion control measure.

1.04 SEDIMENT CONTROL GUIDELINES:

A. Maine Erosion and Sediment Control BMPs (most recent version).

B. Maine Erosion and Sediment Control Practices Field Guide for Contractors (most recent version).

C. MEDEP Natural Resources Protection Act Permit by Rule Standards, Chapter 305.

D. MEDEP – Maine Construction General Permit requirements.

1.05 SUBMITTALS:

A. The Contractor shall furnish to the Engineer, in writing, his plan for dewatering excavations and diverting surface water before beginning the construction work for which the dewatering or diversion is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

B. Manufacturer's product data sheets, material certifications, and standard manufacturing quality control test data for products listed in Part 2 of this specification.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Handle material in accordance with manufacturer's recommendations. Protect materials from deterioration during delivery, and while stored at the site.

1.07 JOB CONDITIONS: Contractor must examine the subgrade, verify the elevations, observe the conditions under which work is to be performed and notify the Engineer of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

Proceed with and complete the erosion and sedimentation work as rapidly as portions of the site become available, working within the required seasonal limitations.

A. Seeding Seasons: Unless variance is requested in writing and approved by the Engineer, seeding shall be done within the following dates:

Permanent Seeding: April 26 – September 15

Temporary Seeding: September 16 until April 25

Dormant Seeding: At the Contractor's risk, from September 16 until April 25

1.08 QUALITY CONTROL:

A. Source Quality Control:
   1. General: Ship erosion control materials with certificates of inspection as required by governmental authorities. Comply with governing regulations applicable to landscape materials.
   2. Analysis and Standards: Package standard products with the manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agricultural Chemist, wherever applicable or as further specified.
   3. Inspection: The Engineer reserves the right to request manufacturers materials (bags, tags, etc.) of any and all materials to confirm material quality and quantity.

B. Installation Quality Control:
   1. Provide at least one person who shall be present at all times during erosion control installation and who shall be thoroughly familiar with the types of materials being installed and the best methods for their installation and who shall direct all work performed under this Section.
   2. Material manufacturers and vendors shall be reputable, qualified firms regularly engaged in producing the required types of materials.
   3. Protect and maintain all areas disturbed by the work, such that erosion is controlled and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

PART 2 - MATERIALS AND PRODUCTS

2.01 GENERAL:

A. Materials incorporated in erosion control shall be specified in other sections or included herein.

2.02 GRUBBINGS:

A. The top 14 inches of soil removed from areas shown on the Drawings shall be segregated into piles, cleaned sufficiently, and reused in accordance with Section 02200, Earthwork. Any of this soil that is used as vegetative soil shall be tested by a qualified laboratory for the requirements listed for vegetative soil. If the quantity of stockpiled vegetative soil is insufficient, or quality is not in accordance with the requirements for vegetative soil, the Contractor shall provide additional new vegetative soil from an Engineer-approved off-site source as required to complete the work.

2.03 VEGETATIVE SOIL:

A. Vegetative Soil shall be as specified in Seeding and Mulching Specification Section 02800.

2.04 SILTATION FENCE:

A. Siltation fence shall be preassembled fence consisting of synthetic filter fabric reinforced with a supporting mesh and mounted on wood or metal stakes.

B. The fence shall be Envirofence as manufactured by Mirafi, Spun Bond as manufactured by Trevira, or Propex Silt Stop as manufactured by Amoco or approved equal.

2.05 RIPRAP STONE:

A. Riprap shall be as shown on the Drawings.

B. Bedding Stone: Material for bedding shall be drainage stone conforming to Specification 02200, Earthwork.

C. Riprap Geotextile: The nonwoven geotextile used in the construction of riprap-lined swales, the final cover downspout, plunge pool, and the gas collection trench shall meet Specification 02272.

2.06 STONE CHECK DAMS:

A. Stone for check dams shall consist of a mixture of angular stones having a particle size of between 2 and 6 inches and faced with 6 inches of drainage stone. The check dams shall be installed at locations as indicated on the Drawings and shall be constructed as detailed on the Drawings.

B. Exposed Stone: The exposed stones for the check dams shall be angular and as nearly rectangular in cross-section as practicable. Rounded stone will not be permitted. The stone shall consist of durable stones that will not disintegrate by exposure to the action of water or weather.

2.07 EROSION CONTROL MATTING:

A. Shall be placed on newly loamed and seeded areas as indicated on the Contract Drawings.

B. During fall and winter (see Section 1.07.A) use heavy-grade mats or as recommended by the Engineer on all channel bottoms and slopes greater than 4H:1V. Install mats according to manufacturer's recommendation.

2.08 MULCH:

A. Mulch shall be in accordance with Seeding and Mulching Specification Section 02800.

2.09 HAY BALES:

A. Rectangular-shaped bales of hay or straw weighing at least 40 lbs. free from primary noxious weed seeds and rough or woody materials.

2.10 EROSION CONTROL MIX:

A. Erosion Control Mix shall contain a well-graded mixture of particle-sizes and may contain rocks smaller than 4” diameter. Erosion control mix shall be free of refuse, physical contaminants, and material toxic to plant growth such as ash and yard scrapings. Large portions of silts, clays, or fine sands are not acceptable in the mix. The mix composition should meet the following standards:
   1. The organic matter content should be between 80% and 100% on a dry weight basis;

2. Particle size by weight should be 100% passing a 4-inch screen and 70% to 85% passing a 0.75” screen;
3. The organic portion needs to be fibrous and elongated;
4. Soluble salt content shall be < 4.0 mmhos/cm; and
5. The pH shall be between 5.0 and 8.0.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall provide for the diversion of clean surface water from the construction areas and install siltation and erosion control structures as shown on the Contract Drawings or as directed by the Engineer or QARE.

B. The Contractor shall provide all materials, equipment, and labor necessary (for the duration of the Contract) for the dewatering of excavations and the removal and/or diversion of surface water from the construction area, and installation of erosion and sedimentation control structures as shown on the Contract Drawings and according to these Specifications, and in accordance with the MEDEP BMPs. The Contractor shall maintain a dewatering and stormwater control system so that no sediment-impacted waters are discharged from the site.

C. The Contractor shall build all drains, dikes, and sediment basins, install all siltation fencing, mulches, grasses, seeding, ditches, channels, riprap, grading, and all other work necessary to control water pollution, surface runoff, and soil erosion.

D. The Contractor shall provide temporary seeding, mulching, or other protective coverings to exposed earth surfaces or stockpiles which will be exposed to rain or wind elements through the fall and winter seasons.

E. The Contractor shall maintain all facilities necessary to control water pollution, surface runoff, and soil erosion until permission is given by the Engineer to discontinue the use of the facilities.

F. It shall be the Contractor’s responsibility to restore any eroded or damaged surfaces to the design grade with approved material and to keep topsoiled areas in acceptable condition until a sufficient vegetated surface is established and accepted by the Engineer.

3.02 EROSION CONTROL PROVISIONS:

A. The discharge from pumping operations during dewatering operations shall be contained by a dike so constructed as to prevent siltation, and the area at the outlet pipe shall be protected against erosion by the construction of a riprap apron.

B. Prior to removal of sediment control dikes, all retained silt or other materials shall be removed and placed in areas not susceptible to erosion as directed by the Engineer, at no additional cost to the Owner.

3.03 REMOVAL OF TEMPORARY WORKS:

A. After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required to present a sightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

3.04 PLACEMENT OF EROSION CONTROL BLANKET: Erosion control blanket shall be placed at locations indicated on Contract Drawings. The anchoring of the blanket shall be in accordance with manufacturer’s recommendations, as shown on the Contract Drawings, or as directed by the Engineer or QARE.

3.05 PLACEMENT OF RIPRAP: Placement of riprap shall be in accordance with Riprap Specification Section 02261.

3.06 MAINTENANCE AND ACCEPTANCE:

A. The Contractor shall be responsible for inspection and maintenance of all temporary erosion and sedimentation control measures during construction. Inspections will be undertaken by qualified personnel to ensure that controls are correctly functioning, and that additional erosion control measures are installed if needed. Such inspections will occur bi-weekly and after each significant rainfall event (1 inch or more within a 24-hour period) during construction until permanent erosion control measures have been properly installed and the site is stabilized. Trapped sediment shall be removed when the height of the sediment is greater than one-half the depth of the erosion control measure.

B. The Contractor shall continue to maintain erosion and sedimentation controls until vegetation is suitably established (Seeding and Mulching Specification Section 02800) and the Engineer deems the site stable, at which time all temporary erosion and sediment controls may be removed from the site.

END OF SECTION

A. GENERAL

1. All soil erosion and sediment control will be done in accordance with: (1) the Maine Erosion and Sediment Control Handbook: Best Management Practices, Maine Department of Environmental Protection (MEDEP), October 2016; (2) the project specific stormwater pollution prevention plan.

2. The site contractor (to be determined) will be responsible for the repair/replacement/maintenance of all erosion control measures until all disturbed areas are stabilized.

3. Disturbed areas will be permanently stabilized within 7 days of final grading. Disturbed areas not to be worked upon within 14 days of disturbance will be temporarily stabilized within 7 days of the disturbance.

4. In all areas, removal of trees, bushes and other vegetation, as well as disturbance of topsoil will be kept to a minimum while allowing proper site operations.

5. Any suitable topsoil will be stripped and stockpiled for reuse as directed by the owner. Topsoil will be stockpiled in a manner such that natural drainage is not obstructed and no off-site sediment damage will result. In any event, stockpiles will not be located within 100 feet of wetlands and will be at least 50 feet upgradient of the stockpile's perimeter silt fence. The sideslopes of the topsoil stockpile will not exceed 2:1. Silt fence will be installed around the perimeter of all topsoil stockpiles. Topsoil stockpiles will be surrounded with siltation fencing and will be temporarily seeded with Aroostook rye, annual or perennial ryegrass within 7 days of formation, or temporarily mulched.

B. TEMPORARY MEASURES

1. STABILIZED CONSTRUCTION ENTRANCE/EXIT

A crushed stone stabilized construction entrance/exit will be placed at any point of vehicular access to the site.

2. SILT FENCE

a. Silt fence will be installed prior to all construction activity, where soil disturbance may result in erosion. Silt fence will be erected at locations shown on the plans and/or downgradient of all construction activity.

b. Silt fences will be removed when they have served their useful purpose, but not before the upgradient areas have been permanently stabilized.

c. Silt fences will be inspected immediately after each rainfall and at least daily during prolonged rainfall. They will be inspected if there are any signs of erosion or sedimentation below them. Any required repairs will be made immediately. If there are signs of undercutting at the center or the edges, or impounding of large volumes of water behind them, they will be replaced with a temporary crushed stone check dam.

d. Sediment deposits will be removed after each storm event if significant build-up has occurred or if deposits exceed half the height of the barrier.

3. STONE CHECK DAMS

Stone check dams will be installed in grass-lined swales and ditches during construction.

4. BARK MULCH SEDIMENT BARRIER

a. Where approved, bark mulch sediment barriers may be used as a substitute for silt fence. See the details in this drawing set for specifications.

b. Rock Filter Berms: To provide more filtering capacity or to act as a velocity check dam, a berm's center can be composed of clean crushed rock ranging in size from the french drain stone to riprap.

5. TEMPORARY SEEDING

Stabilize disturbed areas that will not be brought to final grade for a year or less and reduce problems associated with mud and dust production from exposed soil surface during construction with temporary vegetation.

6. TEMPORARY MULCHING

Use temporary mulch in the following locations and/or circumstances:

- In sensitive areas (within 100 feet of streams, wetlands and in lake watersheds) temporary mulch will be applied within 7 days of exposing spill or prior to any storm event.
- Apply temporary mulch within 14 days of disturbance or prior to any storm event in all other areas.
- Areas which have been temporarily or permanently seeded will be mulched immediately following seeding.
- Areas which cannot be seeded within the growing season will be mulched for over-winter protection and the area will be seeded at the beginning of the growing season.
- Mulch can be used in conjunction with tree, shrub, vine, and ground cover plantings.
- Mulch anchoring will be used on slopes greater than 5 percent in late fall (past September 1), and over-winter (September 1 - April 25).

The following materials may be used for temporary mulch:

a. Hay or Straw material shall be air-dried, free of seeds and coarse material. Apply 2-3 tons/acre or 3 bales (90-130 lbs per 1,000 sf).

b. Erosion Control Mix: It can be used as a stand-alone reinforcement:
- on slopes 2 horizontal to 1 vertical or less;
- on frozen ground or forested areas; and
- at the edge of gravel parking areas and areas under construction.

c. Erosion control mix alone is not suitable:
- on slopes with groundwater seepage;
- at low points with concentrated flows and in gullies;
- at the bottom of steep perimeter slopes exceeding 100 feet in length;
- below culvert outlet aprons; and around catch basins and closed storm systems.

d. Chemical Mulches and Soil Binders: Wide ranges of synthetic spray-on materials are marketed to protect the soil surface. These are emulsions that are mixed with water and applied to the soil. They may be used alone, but most often are used to hold wood fiber, hydro-mulches or straw to the soil surface.

e. Erosion Control Blankets and Mats: Mats are manufactured combinations of mulch and netting designed to retain soil moisture and modify soil temperature. During the growing season (April 25 to August 31) use mats indicated on drawings or North American Green (NAG) C125 BN (or mulch and netting) on:
- the base of grassed waterways;
- steep slopes (15 percent or greater); and
- any disturbed soil within 100 feet of lakes, streams, or wetlands.

During the late fall and winter (September 1 to April 25) use heavy grade mats indicated on drawings for NAG SC250 on all areas noted above plus use lighter grade mats NAG C125BN (or mulch and netting) on:
- sideslopes of grassed waterways; and
- moderate slopes (between 8 and 15 percent).

7. TEMPORARY DUST CONTROL

To prevent the blowing and movement of dust from exposed soil surfaces, and reduce the presence of dust, use water to control dusting by preserving the moisture level in the road surface materials. The use of calcium chloride or any other chemicals for dust control is prohibited

8. CONSTRUCTION DE-WATERING

a. Water from construction de-watering operations shall be cleaned of sediment before reaching wetlands, water bodies, streams or site boundaries. Utilize temporary sediment basins, erosion control soil filter berms backed by staked hay bales, or other approved Best Management Practices (BMP's).

b. In sensitive areas near streams or ponds, discharge the water from the de-watering operation into a temporary sediment basin created by a surrounding filter berm of uncompacted erosion control mix immediately backed by staked hay bales (see the site details). Locate the temporary sediment basin at lease 100 feet from the nearest water body, such that the filtered water will flow through undisturbed vegetated soil areas prior to reaching the water body or property line.

A. PERMANENT MEASURES

1. Riprapped Aprons: All storm drain pipe outlets and the inlet and outlet of culverts will have riprap aprons to protect against scour and deterioration.

2. Topsoil, Seed, and Mulch: All areas disturbed during construction, but not subject to other restoration (paving, riprap, etc.) will be loamed, limed, fertilized, seeded, and mulched.

a. Seeded Preparation: Use stockpiled materials spread to the depths shown on the plans, if available. Approved topsoil substitutes may be used. Grade the site as needed.

b. Seeding will be completed by August 31 of each year. Late season seeding may be done between September 1 and April 25. Areas not seeded or which do not obtain satisfactory growth by August 31, will be seeded with Aroostook Rye or mulched. After November 1, or the first killing frost, disturbed areas will be seeded at double the specified application rates, mulched, and anchored.

PERMANENT SEEDING SPECIFICATIONS

Mixture:	Grassed areas (lbs/acre)
Tall Fescue	54
Creeping Red Fescue	25
Red Top	5
Ladino Clover	13
Annual Ryegrass	8
Birdsfoot Trefoil	5
Timothy	10

c. Mulch in accordance with specifications for temporary mulching.

d. If permanent vegetated stabilization cannot be established due to the season of the year, all exposed and disturbed areas not to undergo further disturbance are to have dormant seeding applied and be temporarily mulched to protect the site.

3. Ditches and Channels: All ditches on-site will be lined with North American Green S75 erosion control mesh (or an approved equal) upon installation of loam and seed.

B. WINTER CONSTRUCTION AND STABILIZATION

1. Winter excavation and earthwork will be completed so as to minimize exposed areas while satisfactorily completing the project. Limit exposed areas to those areas in which work is to occur during the following 15 days and that can be mulched in one day prior to any snow event. All areas will be considered denuded until the subbase gravel is installed in roadway areas or the areas of future loam and seed have been loamed, seeded, and mulched.

Install any added measures necessary to control erosion/sedimentation. The particular measure used will be dependent upon site conditions, the size of the area to be protected, and weather conditions.

To minimize areas without erosion control protection, continuation of earthwork operations on additional areas will not begin until the exposed soil surface on the area being worked has been stabilized.

2. Natural Resource Protection: During winter construction, or within 100-feet of a natural resource (i.e., wetland) a double-row of sediment barriers (i.e., silt fence backed with hay bales or erosion control mix) will be placed between any natural resource and the disturbed area. Projects crossing the natural resource will be protected a minimum distance of 100 feet on either side from the resource.

3. Sediment Barriers: During frozen conditions, sediment barriers may consist of erosion control mix berms or any other recognized sediment barriers as frozen soil prevents the proper installation of hay bales or silt fences.

4. Mulching: All areas will be considered to be denuded until seeded and mulched. Hay and straw mulch will be applied at a rate of twice the normal accepted rate.

Mulch will not be spread on top of snow.

After each day of final grading, the area will be properly stabilized with anchored hay or straw or erosion control matting.

Between the dates of September 1 and April 25, all mulch will be anchored by either mulch netting, emulsion chemical, tracking or wood cellulose fiber.

5. Soil Stockpiling: Stockpiles of soil or subsoil will be mulched for over-winter protection with hay or straw at twice the normal rate or with a 4-inch layer of erosion control mix. This will be done within 24 hours of stocking and re-established prior to any rainfall or snowfall. Any soil stockpiles shall not be placed (even covered with mulch) within 100 feet from any natural resources.

6. Seeding: Dormant seeding may be placed prior to the placement of mulch or erosion control blankets. If dormant seeding is used for the site, all disturbed areas will receive 4 inches of loam and seed at an application rate of three times the rate for permanent seeding. All areas seeded during the winter will be inspected in the spring for adequate catch. All areas insufficiently vegetated (less than 85 percent catch) will be revegetated by replacing loam, seed, and mulch.

If dormant seeding is not used for the site, all disturbed areas will be revegetated in the spring.

7. Maintenance: Maintenance measures will be applied as needed during the entire construction season. After each rainfall, snow storm, or period of thawing and runoff, the site contractor will perform a visual inspection of all installed erosion control measures and perform repairs as needed to ensure their continuous function.

Following the temporary and/or final seeding and mulching, the contractor will, in the spring, inspect and repair any damages and/or bare spots. An established vegetative cover means a minimum of 90 percent of areas vegetated with vigorous growth.

A. OVER-WINTER CONSTRUCTION EROSION CONTROL MEASURES

1. Stabilization of Disturbed Soil: By August 31, all disturbed soils on areas having a slope less than 15 percent will be seeded and mulched. If the contractor fails to stabilize these soils by this date, then the contractor shall stabilize the soil for late fall and winter, by using either temporary seeding or mulching.

2. Stabilization of Disturbed Slopes: All slopes to be vegetated will be completed by August 31. The owner will consider any area having a grade greater than 15 percent (6.5H:1V) to be a slope. Slopes not vegetated by August 31 will receive one of the following actions to stabilize the slope for late fall and winter:

a. Stabilize the soil with temporary vegetation and erosion control mesh.
b. Stabilize the slope with erosion control mix.
c. Stabilize the slope with stone riprap.

3. Stabilization of Ditches and Channels: All stone-lined ditches and channels to be used to convey runoff through the winter will be constructed and stabilized by November 15. Grass-lined ditches and channels will be complete by September 15. Grass-lined ditches not stabilized by September 15 shall be lined with either sod or riprap.

E. MAINTENANCE PLAN

1. Routine Maintenance: Inspection will be performed as outlined in the project's Erosion Control Plan. Inspection will be by a qualified person during wet weather to ensure that the facility performs as intended. Inspection priorities will include checking erosion controls for accumulation of sediments.

A. Housekeeping

1. Spill prevention. Controls must be used to prevent pollutants from being discharged from materials on site, including storage practices to minimize exposure of the materials to stormwater, and appropriate spill prevention, containment, and response planning and implementation.

2. Groundwater protection. During construction, liquid petroleum products and other hazardous materials with the potential to contaminate groundwater may not be stored or handled in areas of the site draining to an infiltration area. An "infiltration area" is any area of the site that by design or as a result of soils, topography and other relevant factors accumulates runoff that infiltrates into the soil. Dikes, berms, sumps, and other forms of secondary containment that prevent discharge to groundwater may be used to isolate portions of the site for the purposes of storage and handling of these materials.

3. Fugitive sediment and dust. Actions must be taken to ensure that activities do not result in noticeable erosion of soils or fugitive dust emissions during or after construction. Oil may not be used for dust control.

4. Debris and other materials. Litter, construction debris, and chemicals exposed to stormwater must be prevented from becoming a pollutant source.

5. Trench or foundation de-watering. Trench de-watering is the removal of water from trenches, foundations, coffer dams, ponds, and other areas within the construction area that retain water after excavation. In most cases the collected water is heavily silted and hinders correct and safe construction practices. The collected water must be removed from the ponded area, either through gravity or pumping, and must be spread through natural wooded buffers or removed to areas that are specifically designed to collect the maximum amount of sediment possible, like a cofferdam sedimentation basin. Avoid allowing the water to flow over disturbed areas of the site. Equivalent measures may be taken if approved by the department.

6. Non-stormwater discharges. Identify and prevent contamination by non-stormwater discharges.

7. Additional requirements. Additional requirements may be applied on a site-specific basis.

B. CONSTRUCTION SEQUENCE

It is anticipated that construction will commence upon receipt of all necessary permits and approvals. The following outlines the preliminary construction sequence:

a. Install silt fence and other temporary erosion control measures for the construction of Cell and accessory facilities such as berms, and service roads;

b. Construct upslope stormwater diversion berms, ditches, culvert outlets, and control structures:

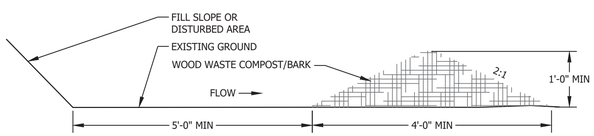
c. Perform stormwater upgrades;

d. Construct service road;

e. Construct Cell base grade;

f. Construct Cell liner system;

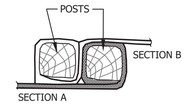
g. As permanent erosion control measures become stabilized, remove temporary measures (e.g., silt fence, stone check dams).



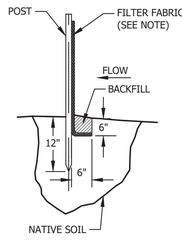
NOTE:
BARK MULCH SEDIMENT BARRIERS MAY BE USED AS AN ALTERNATE TO SILT FENCE WHEN APPROVED BY THE ENGINEER.

EROSION CONTROL MIX BERM
NTS

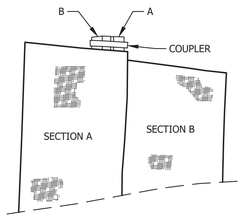
NOTE: SILTATION FENCE SHALL BE ENVIROFENCE AS MANF. BY MIRAFI INC., PROPEX SILT STOP AS MANF. BY AMOCO FABRICS CO. OR EQUAL



TOP VIEW

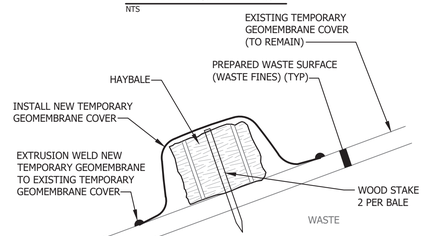


TOE-IN DETAIL

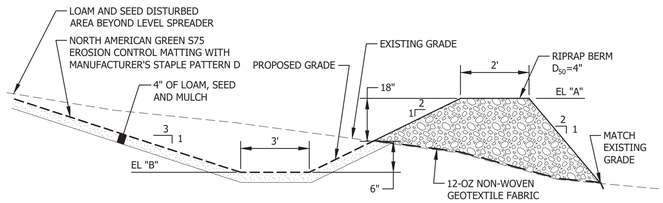


JOINING SECTIONS

SILTATION FENCE
NTS



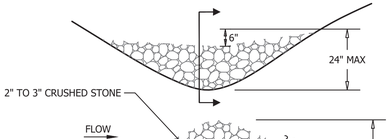
INTERMEDIATE COVER STORMWATER DIVERSION BERM
NTS



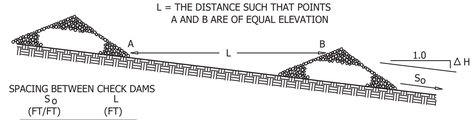
NOTES:
1. CONSTRUCT LEVEL LIP AND SPREADER ON ZERO PERCENT GRADE.
2. STORM RUNOFF CONVERTED TO SHEET FLOW SHALL OUTLET ONTO STABILIZED AREA. WATER SHALL NOT BE CHANNELIZED IMMEDIATELY BELOW POINT OF DISCHARGE.

LEVEL SPREADER NO.	EL "A"	EL "B"	LENGTH (FT)
DP-11R	151.5	150.0	15.0
DP-12	165.8	164.3	15.0
DP-13	158.0	156.5	15.0
DP-14	154.0	152.5	25.0

LEVEL SPREADER
NTS



SECTION

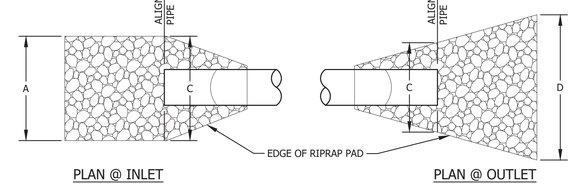


SPACING BETWEEN CHECK DAMS

So (FT/FT)	L (FT)
0.020	75
0.030	50
0.040	40
0.050	30
0.080	20
0.100	10

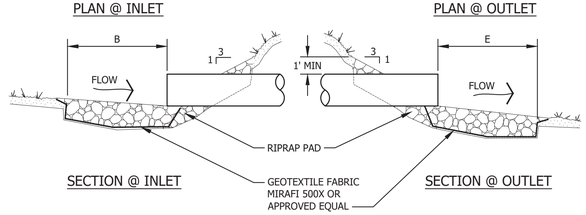
STONE CHECK DAM
NTS

CROSS SECTION



PLAN @ INLET

PLAN @ OUTLET



SECTION @ INLET

SECTION @ OUTLET

RIPRAP PAD MUST BE INSTALLED WITHIN 48 HOURS OF INSTALLING NEW PIPE OR CULVERT.

PIPE	PIPE DIA (IN)	C (FT)	D (FT)	E (FT)	PAD DEPTH (IN)	D50 (IN)
DP-11R	24	6	15	20	20	10
DP-12	24	6	15	20	20	10
DP-13	24	6	15	20	20	10
DP-14	24	6	15	20	20	10
SC-2D	24	6	15	20	20	10
UNDERDRAIN DISCHARGE STRUCTURE	4	4	4	4	8	4

PIPE INLET/OUTLET DETAILS
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE
BRIAN D. EMERY
9601
LICENSED
PROFESSIONAL ENGINEER
11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

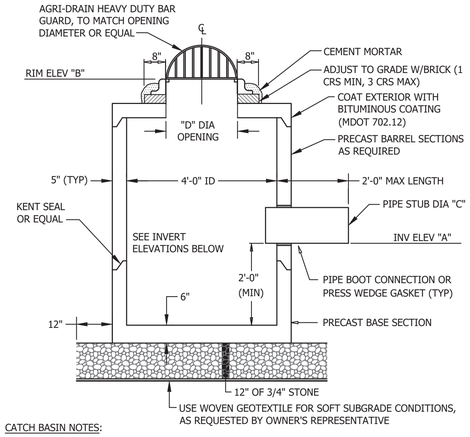
SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

C-308

\\Banner\shCivil\Old\Tom Lee\BE\Expansion\Phase II Expansion\Acad\Plans\SETTAILS.dwg C:\BB, 11/10/2025 2:32:32 PM, rgh



CATCH BASIN NOTES:

THE CONTRACTOR SHALL PROVIDE SUBMITTALS TO THE ENGINEER FOR APPROVAL. SUBMITTALS SHALL INCLUDE BUT NOT LIMITED TO THE FOLLOWING:

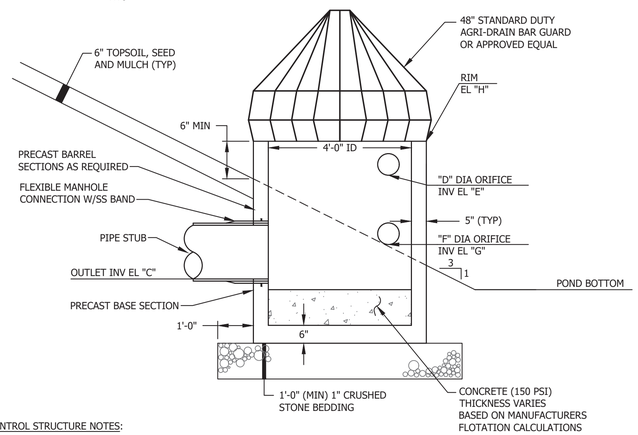
PRODUCT DATA: SUBMIT PRODUCT DATA FOR ALL MATERIALS USED ON THE JOB FOR REVIEW FOR LIMITED PURPOSE OF CHECKING FOR CONFORMANCE WITH INFORMATION GIVEN AND DESIGN CONCEPT EXPRESSED IN CONTRACT DOCUMENTS.

SHOP DRAWINGS: SUBMIT FOR REVIEW SHOP DRAWINGS OF ALL PRECAST UNITS. MANUFACTURER'S INFORMATION SHALL BE SUBMITTED FOR JOINT SEALANTS AND WATERPROOFING. MANUFACTURER SHALL PROVIDE ANTI-FLOTATION DESIGN SHOP DRAWINGS AND CALCULATIONS, INCLUDING ANY EXTENDED BASE SLABS AS NECESSARY, FOR PROPOSED MANHOLES. MANUFACTURER SHALL ASSUME GROUNDWATER LEVELS EQUAL TOP OF GROUND ELEVATIONS AND PROVIDE FOR A 1.2 FACTOR OF SAFETY AGAINST FLOTATION.

CATCH BASIN SCHEDULE A

CATCH BASIN DESIGNATION	PIPE INV EL	RIM EL	PIPE DIA	TOP OPENING
	"A" (FT)	"B" (FT)	"C" (IN)	DIA "D" (IN)
CB-2B	173.0	179.0	24	30
CB-2G	173.0	179.0	24	30
CB-2D	192.0	201.0	24	30
CB-4C	167.0	171.0	24	30
CB-4D	158.00	160.5	24	30
CB-4G	161.00	167.0	24	30
CB-4H	174.0	181.0	24	30

CATCH BASIN
NTS



OUTLET CONTROL STRUCTURE NOTES:

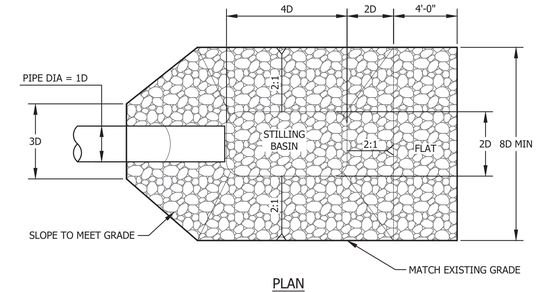
THE CONTRACTOR SHALL PROVIDE SUBMITTALS TO THE ENGINEER FOR APPROVAL. SUBMITTALS SHALL INCLUDE BUT NOT LIMITED TO THE FOLLOWING:

PRODUCT DATA: SUBMIT PRODUCT DATA FOR ALL MATERIALS USED ON THE JOB FOR REVIEW FOR LIMITED PURPOSE OF CHECKING FOR CONFORMANCE WITH INFORMATION GIVEN AND DESIGN CONCEPT EXPRESSED IN CONTRACT DOCUMENTS.

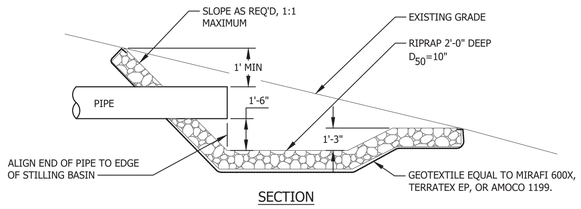
SHOP DRAWINGS: SUBMIT FOR REVIEW SHOP DRAWINGS OF ALL PRECAST UNITS. MANUFACTURER'S INFORMATION SHALL BE SUBMITTED FOR JOINT SEALANTS AND WATERPROOFING. MANUFACTURER SHALL PROVIDE ANTI-FLOTATION DESIGN SHOP DRAWINGS AND CALCULATIONS, INCLUDING ANY EXTENDED BASE SLABS AS NECESSARY, FOR PROPOSED MANHOLES. MANUFACTURER SHALL ASSUME GROUNDWATER LEVELS EQUAL TOP OF BERM ELEVATION AND PROVIDE FOR A 1.2 FACTOR OF SAFETY AGAINST FLOTATION.

STRUCTURE DESIGNATION	OUTLET INV EL	ORIFICE DIA	ORIFICE INV EL	ORIFICE DIA	ORIFICE INV EL	RIM EL	OUTLET (C) CULVERT	CULVERT	CULVERT SLOPE
	"C" (FT)	"D" (IN)	"E" (FT)	"F" (IN)	"G" (FT)	"H" (FT)	DIAMETER (IN)	LENGTH (FT)	(FT/FT)
DP-11R	155.3	6.0	159.0	4.0	156.50	161.00	24 (CORR PE)	55.00	0.02
DP-12	168.9	6.0	174.0	4.0	171.50	175.00	24 (CORR PE)	66.00	0.01
DP-13	160.3	6.0	163.0	4.0	160.50	163.80	24 (CORR PE)	30.00	0.04
DP-14	157.0	6.0	159.0	4.0	158.00	159.80	24 (CORR PE)	55.00	0.02

OUTLET CONTROL STRUCTURE
NTS



PLAN

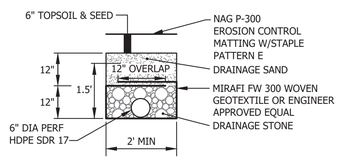


SECTION

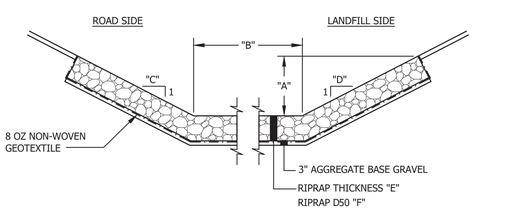
NOTES:

1. INSTALL SILT FENCE DOWNSTREAM PRIOR TO EXCAVATION.
2. LOAM AND SEED ALL AREAS DISTURBED BY CONSTRUCTION OF PLUNGE POOL.

STANDARD PLUNGE POOL
NTS



POND UNDERDRAIN
NTS

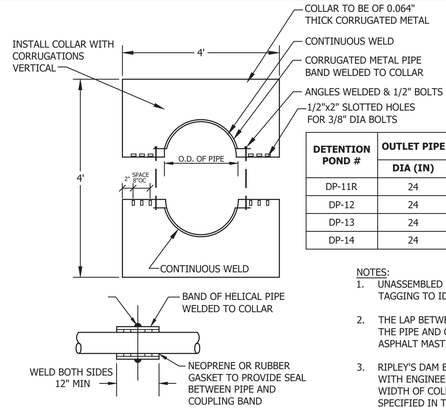


DITCH	A	B	C	D	E	F
	(FT)	(FT)			(IN)	(IN)
TOE DITCH	3	3	2	2	22	10
DITCH 2D	3	3	2	2	22	10

RIPRAP DITCH
NTS

STORM DRAIN	DIAMETER	MATERIAL	LENGTH	SLOPE	INV IN	INV OUT
	(in.)		(ft.)	(%)		
SD-2B	24	CORR PE	90.0	0.010	173.00	172.00
SD-2E	24	CORR PE	80.0	0.010	173.00	172.00
SD-2D	24	CORR PE	30.0	0.020	192.00	191.50
SD-4C	24	CORR PE	52.0	0.009	167.00	166.50
SD-4D	24	CORR PE	54.5	0.009	158.00	157.50
SD-4G	24	CORR PE	115.0	0.008	161.00	160.00
SD-4H	24	CORR PE	65.0	0.030	174.00	172.00

STORM DRAIN PIPES
NTS

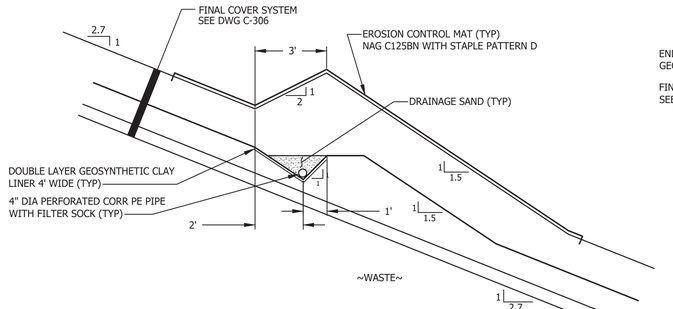


DETENTION POND #	OUTLET PIPE	PIPE LENGTH	SATURATED LENGTH	# OF	SPACING
	DIA (IN)	(FT)	(FT)	COLLARS	(FT)
DP-11R	24	55	46.2	2	15
DP-12	24	66	35.2	2	12
DP-13	24	30	42.5	2	14
DP-14	24	55	22.8	2	8

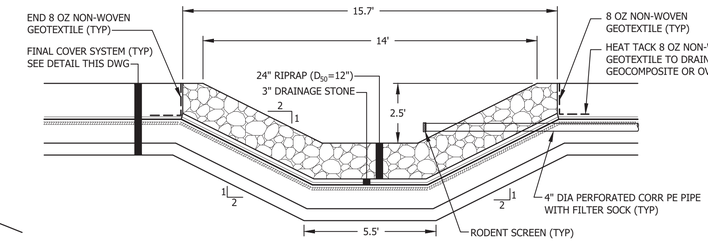
NOTES:

1. UNASSEMBLED COLLAR SHALL BE MARKED BY PAINTING OR TAGGING TO IDENTIFY MATCHING PARTS.
2. THE LAP BETWEEN THE TWO HALF SECTIONS AND BETWEEN THE PIPE AND CONNECTING BAND SHALL BE CAULKED WITH ASPHALT MASTIC AT TIME OF INSTALLATION.
3. RIPLEY'S DAM BY MCRIP MANUFACTURING MAY BE USED WITH ENGINEERS APPROVAL PROVIDING THAT LENGTH AND WIDTH OF COLLAR IS EQUAL TO OR GREATER THAN THAT SPECIFIED IN THE DETAIL.

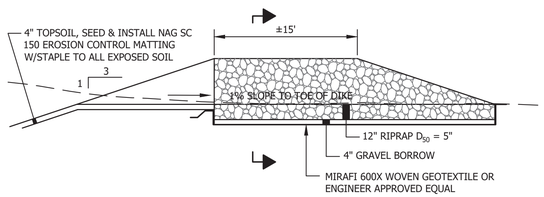
ANTI-SEEP COLLAR
NTS



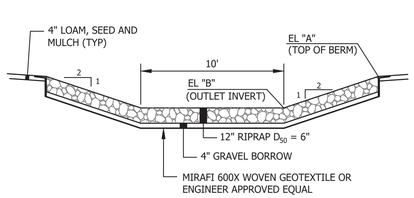
FINAL COVER SURFACE TERRACE
NTS



FINAL COVER RIPRAP DOWNSPOUT
NTS



ELEVATION



SECTION

STRUCTURE DESIGNATION	BOTTOM WIDTH (FT)	LENGTH (FT)	EL "A" (FT)	D_{50} (IN)	THICKNESS (IN)	EL "B" (FT)
DP-11R	10	±15	168.0	6	12	166.5
DP-12	10	±15	180.0	6	12	178.5
DP-13	10	±15	168.0	6	12	166.5
DP-14	10	±15	162.0	6	12	160.5

EMERGENCY SPILLWAY
NTS

REV.	BY	DATE	STATUS
	BDP	11/2025	ISSUED FOR MEDEP SOLID WASTE PERMIT APPLICATION

STATE OF MAINE — BRIAN D. PERRY — 9600 — LICENSED PROFESSIONAL ENGINEER — 11/11/2025

PHASE II EXPANSION
NEWSME LANDFILL OPERATIONS LLC
JUNIPER RIDGE LANDFILL
OLD TOWN, MAINE

SECTIONS AND DETAILS

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY:	DPW/NMT
DRAWN BY:	SJM
DATE:	11/10/2025
CHECKED BY:	BDP
LMN:	LMN
CTB:	SME-STD.CTB

JOB NO. 240101.00 DWG FILE DETAILS

C-309

\\Server\Dk\Castle\Dk\Town Land\RE Expansion\Phase 1 Expansion\Acad\Plans\DETAILS.dwg, C-309, 11/7/2025 2:34:04 PM, sjm

ATTACHMENT 9

SITE CONDITIONS
(WETLAND DELINEATION REPORT)

SME
SEVEE & MAHER
ENGINEERS

Natural Resources Report

Juniper Ridge Landfill Project

Prepared by BRI Environmental

September 2024

Contents

Table of Contents

1.0 Introduction 3
2.0 Geographic Setting 3
3.0 Methods 4
3.1 Wetland Delineation 4
3.2 Stream Identification 4
3.3 Vernal Pool Survey 4
4.0 Results 6
4.1 Upland Habitats 6
4.2 Wetland Habitats 7
4.3 Streams and Aquatic Habitats 10
4.4 Vernal Pools 10
5.0 Agency Consultation 11
6.0 Discussion 11

Exhibits

Exhibit A: Location Map

Exhibit B: Natural Resources Map

Exhibit C: Natural Resources Photographs

Exhibit D: NRCS Soils Map

Exhibit E: USACE Wetland Determination Forms

Exhibit F: Vernal Pool Survey Forms

Exhibit G: Agency Consultation

1.0 Introduction

Biodiversity Research Institute (BRI) was retained by Sevee & Maher Engineers (SME) to complete regulated natural resource delineations on an approximately 144-acre survey area located at the Juniper Ridge Landfill in Old Town, Maine (Site). The Site is bisected by Juniper Ridge Landfill Road, which is located just south of Bennoch Road. The Site is located approximately two miles west of the Stillwater River on the parcel known as Tax Map 3, Lot 1 in Old Town, Maine. The survey area is shown in **Exhibit A**.

2.0 Geographic Setting

The Site is characterized by areas of large palustrine forested and scrub-shrub wetlands and a few palustrine emergent wetlands. Uplands are primarily forested with a mix of deciduous and coniferous tree species typical of the region. The Site is surrounded by undeveloped forestland and some residential buildings. A portion of the site is within a protective conservation deed restriction (**Exhibit A**).

The Site falls within the US Environmental Protection Agency's (EPA) Eco-region of the Penobscot Lowlands within the Acadian Plains and Hills. The EPA's description of the region is as follows:

The Penobscot Lowlands ecoregion is lower and flatter than surrounding ecoregions. A distinguishing characteristic is its deep fine sediments and many areas of wet flats with swamp and bog deposits. Glaciomarine sediments of silt, clay, sand, and gravel cover many of the flatter lower elevations, deposits formed from marine submergence of lowland areas, or where glacial meltwater streams entered the sea. Some alluvial deposition of deep, coarser sediments occurs along the Penobscot River. Fine and fine-silty, frigid Inceptisols, loamy Spodosols, and Histosols are typical. The region has a relatively moderate climate and diverse flora and fauna. Northern hardwoods and northern hardwoods-spruce forests are major forest types. Second-growth hemlock forests are common with scattered sugar maples, big-tooth aspen, paper birch, and white pine. Areas of red pine occur on some low ridges. Settlement and road patterns are less dense than in Central Maine Embayment to the west. The many open wetlands provide breeding habitat for wetland-dependent birds.[1]

[1] Ecoregions of New England http://ecologicalregions.info/data/vt/new_eng_front.pdf

3.0 Methods

Prior to the initial Site visit, BRI conducted a desktop review of publicly available data, which included the National Wetlands Inventory (NWI)[2], Natural Resources Conservation Service (NRCS) Soil Survey[3], Beginning with Habitat data (BWH)[4], topographic maps, and aerial photos. A natural resources survey was completed to formally map resources on Site using the methodologies described below. These methods represent the current standard of practice for the delineation of regulated natural resources.

3.1 Wetland Delineation

Wetlands on the Site were delineated according to the survey techniques described in the *1987 US Army Corps of Engineers Wetland Delineation Manual*[5] and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, v2.0*[6]. In areas where evidence of hydrology or hydrophytic plants were observed, samples of the soil profile were observed to further investigate evidence of saturated conditions within the upper part of the soil profile. Survey flags were hung along the wetland-upland boundaries. The flags were labeled with a unique alpha-numeric code and sequence denoting the resource type, delineator initials, wetland identification number, and flag number (e.g., W-KV-01-1, W-KV-01-02 etc.).

3.2 Stream Identification

The survey area was reviewed for conditions that meet the definition of river, stream, or brook. Mapped streams meet the definition described in Article 5-A of the Natural Resource Protection Act (NRPA)[7]. Where streams less than 6 feet in bank width were identified, survey flags were hung along the centerline of the stream. For streams with bank width equal to or greater than 6 feet, both banks (i.e., the ordinary high-water mark) of the stream were flagged. Flags were labeled with a unique alpha-numeric code and sequence denoting the resource type, delineator initials, stream identification number, and flag number (e.g., S-KV-01-1, S-KV-01-2 etc.).

3.3 Vernal Pool Survey

During the natural resources survey, potentially significant vernal pool surveys were completed based on methodologies described in detail in the *April 2014 Maine Association of Wetland Scientists Vernal Pool Technical Committee Vernal Pool Survey Protocol*[8]. Chapter 335 of the Maine Department of Environmental Protection (MDEP) NRPA includes the following definition of a vernal pool:

---

[2] U.S. Fish and Wildlife Service National Wetland Inventory Mapper https://www.fws.gov/wetlands/data/mapper.html

[3] U.S NRCS Web Soil Survey https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

[4] Maine Beginning with Habitat Online Mapper https://webapps2.cgis-solutions.com/beginningwithhabitat/

[5] US Army Corps of Engineers Wetland Delineation Manual (1987) https://www.nae.usace.army.mil/Portals/74/docs/regulatory/JurisdictionalLimits/wlman87.pdf

[6] US Army Corps of Engineers *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, v2.0* https://www.nae.usace.army.mil/Portals/74/docs/regulatory/JurisdictionalLimits/RegionalSupplement2012.pdf

[7] Natural Resource Protection Act, Maine Statute Title 38, Chapter 3, subchapter 1, Article 5-A, §480-B http://www.mainelegislature.org/legis/statutes/38/title38sec480-B.html

[8] Maine Association of Wetland Scientist 2014 Vernal Pool Survey Protocol http://mainewetlands.org/vptc

*"A vernal pool, also referred to as a seasonal forest pool, is a natural, temporary to semi-permanent body of water occurring in a shallow depression that typically fills during the spring or fall and may dry during the summer. Vernal pools have no permanent inlet or outlet and no viable populations of predatory fish. A vernal pool may provide the primary breeding habitat for wood frogs (*Rana [Lithobates] sylvatica*), spotted salamanders (*Ambystoma maculatum*), blue-spotted salamanders (*Ambystoma laterale*), and fairy shrimp (*Eubranchipus *sp.), as well as valuable habitat for other plants and wildlife including several rare, threatened, and endangered species. A vernal pool intentionally created for the purposes of compensatory mitigation is included in this definition."*

The criteria for identifying a Significant Vernal Pool are described in detail in the April 2014 Maine Association of Wetland Scientists Vernal Pool Technical Committee Vernal Pool Survey Protocol[9]. This survey effort focuses on the requirements to meet Maine regulations[10] relating to vernal pools.

The first round of vernal pool surveys was initiated approximately two weeks following reports of full wood frog chorusing (as reported by local area wetland scientists). The Project site is located within the MDIFW Central Region which has a target window for vernal pool surveys conducted for salamander egg masses from April 25 to May 10. Potentially Significant Vernal Pools received a subsequent round of vernal pool surveys (i.e., secondary visits to surveyed pools to assess later breeding or emergence of vernal pool indicator species in naturally occurring pools) approximately two to three weeks after an appropriately timed first visit, depending on weather and reports from proximal field efforts regarding vernal pool activity. The MDIFW target window for secondary egg mass surveys will be between May 5 and May 25, depending on the timing of findings in the first survey.

If pools that appear to meet the definition of a potentially Significant Vernal Pool were encountered, scientists collected GPS points at the edge of the pool (during spring high water conditions). Pools were waded to search for vernal pool indicator species egg masses, presence of fairy shrimp, and/or associated rare, threatened, and endangered (RTE) species. The second round of vernal pools surveys were conducted to assess for later breeding vernal pool indicator species, the presence of fairy shrimp (which often do not emerge until late spring), and/or associated RTE species.

For vernal pools that extended beyond the Project boundary, efforts were made to visually survey the pool for the presence of egg masses to an approximate distance of no greater than 30 feet from the Project boundary. Photographs and notes regarding the potential full extent of these vernal pools (as much as can be ascertained in this manner) were collected. All vernal pools were

[9] MAWS 2014. Maine Association of Wetland Scientists Vernal Pool Technical Committee Vernal Pool Survey Protocol Available online at: http://mainewetlands.org/s/Complete-MAWS-2014-VP-Survey-Protocol v3 05142014-6zs7.pdf

[10] Maine Department of Environmental Protection Natural Resources Protection Act (38 M.R.S.A. §§480-A et seq.) and the Maine Significant Wildlife Habitat Rules (Chapter 335), available at: http://www.maine.gov/dep/land/nrpa/index.html

photographed from various angles. Representative photos of egg masses were taken. Shapefiles of the delineated vernal pool spring high water boundaries will be provided to SME upon completion of the work.

4.0 Results

Field surveys were completed on November 30 and December 1 and 6, 2022. Weather at the time of the survey ranged from sunny to partly cloudy. Temperatures ranged from 35°-45° F. Vernal pool surveys were completed in May of 2023. Wetland areas within the proposed development area were field verified during the growing season on May 24, 2024. **Exhibit B** includes the natural resources identified and mapped on the Site and **Exhibit C** includes representative photographs of mapped natural resources. The NRCS soil survey is included as **Exhibit D**.

4.1 Upland Habitats

Upland habitats on the Site are dominated by forestland that is characteristic of the Penobscot Lowland region. The overstory vegetation was dominated by red maple (*Acer rubrum*), Balsam fir (*Abies balsamea*), eastern hemlock (*Tsuga canadensis*), paper birch (*Betula papyrifera),* red oak (Q*uercus rubra*), white pine (*Pinus strobus*), bigtooth aspen (*Populus grandidentata*), and red spruce (*Picea rubens*). Shrub layer vegetation consisted of primarily overstory species as well as American beech (*Fagus grandifolia*). Herbaceous vegetation includes bracken fern (*Pteridium aquilinum*), Sheep laurel (*Kalmia angustifolia*), American wintergreen (*Gaultheria procumbens*), and bunchberry (*Cornus canadensis*).

There are three common soils on Site: Telos-Chesuncook complex, Monarda-Telos complex, and Pushaw-Swanville complex. Telos-Chesuncook complex ranges from poorly to moderately well-drained soils on till plains, hills, ridges, and mountains. They are shallow and very deep to bedrock. These soils formed in till and dense glacial till. The Monarda-Telos complex consists of poorly drained soils formed in dense till on lower slopes or in slight depressions on till plains, hills, and ridges. They are very deep to bedrock and shallow to dense till. The Pushaw-Swanville complex consists of very deep, somewhat poorly drained soils that formed in glaciolacustrine or glaciomarine deposits on lake plains and marine terraces. Representative upland soils on Site are characterized generally by 0-2” of 10YR 3/2 organic, 2-24” of 10YR 5/3 silt loam. Photo 1 show representative views of upland habitats on the Site.

Photo 1. Representative view of the uplands in the Site (November 30, 2022).

4.2 Wetland Habitats

Thirteen wetlands were delineated on the Site. Wetland W-KV-01 is the largest wetland on Site and is predominantly forested with scrub-shrub and emergent portions. The site is characterized by forested wetlands along the perimeter of the survey area. Within the central portion of the survey area, several smaller pockets of wetland are present.

The scrub-shrub wetlands are dominated by speckled alder (*Alnus* incana), winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), balsam fir, maleberry (*Lyonia ligustrina*), witch hazel (*Hamamelis virginiana*), red spruce (*Picea rubens*), cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea* sensibilis), swamp dewberry (*Rubus hispidus*), woolgrass (*Scirpus cyperinus*), hop sedge (*Carex lupulina*), fringed sedge (*Carex crinita*), cattail (*Typha latifolia*), and Sphagnum moss. Emergent wetlands are dominated by cattail, white meadowsweet (*Spiraea alba*), steeplebush (*Spiraea tomentosa*), hop sedge, fringed sedge, fringed brome (*Bromus ciliatus*), wool grass, cinnamon fern, sensitive fern, swamp dewberry and the presence of random shrubs and trees including alder, paper birch, balsam fir and red maple.

Forested portions of the wetlands are characterized by eastern hemlock (*Tsuga canadensis*), balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), red spruce, paper birch (*Betula papyrifera*), gray birch (*Betula populifolia*), northern white-cedar (*Thuja occidentalis*) and white pine (*Pinus strobus*). The hydric soil indicator within these forested wetlands is typically a

depleted matrix. Photo 3 and 4 show representative views of wetland habitats identified on the Site. USACE Wetland Determination Forms are provided in **Exhibit E**.

Photo 2. Representative view of a scrub-shrub wetland on Site (W-KV-02) (December 1, 2022).

Photo 3. Representative view of a forested wetland on Site (W-KV-01) (December 1, 2022).

Table 1. Juniper Ridge Wetland Summary

Wetland ID	Wetland Type[11]	Wetland of Special Significance	Acreage
W-SK-01	PFO/PEM	Yes, includes a significant vernal pool	5.9
W-SK-01A	PEM*	No	1.7
W-SK-02	PFO*	No	0.08
W-SK-03	PEM*	No	0.27
W-SK-04	PFO/PSS	No	4.17
W-SK-06	PFO*	No	0.30
W-SK-09	PEM*	No	0.13
W-SK-10	PEM*	No	0.03
W-SK-11	PEM*	No	0.06
W-KV-01	PFO/PSS/PEM	Those portions of wetland within 25' of a stream	14.64
W-KV-02	PFO/PSS	Yes, includes a significant vernal pool	9.61
W-KV-03	PEM*	No	0.82
W-KV-04	PEM*	No	0.82
Total			**37.00**

*Wetland is either the result of historic landuse (i.e., created within an old road) or impacted by historic ground disturbance.

[11] PFO-Palustrine Forested Wetland, PSS-Palustrine Scrub-Shrub Wetland, PEM-Palustrine Emergent Wetland, PUB-Palustrine Unconsolidated Bottom Wetland

4.3 Streams and Aquatic Habitats

Three MDEP jurisdictional stream segments were identified on Site. Stream S-KV-01 is a small stream within the forested portions of Wetland W-KV-01. The other two streams, S-SK-01 and S-SK-02, are in wetland W-SK-01 and are small stream segments. These streams are the result of concentrated flows in areas with slightly more gradient allowing for the formation of scoured channels. Both streams segments originate in the forested portions of W-SK-01 and terminate prior to leaving the Site.

Photo 4. Representative view of stream S-SK-01 (November 30, 2022).

4.4 Vernal Pools

During the wetland delineation completed on November 30 and December 1 and 6, 2022, some potential pools were observed. These pools were identified outside of the amphibian breeding season and were subsequently surveyed during the 2023 breeding season. A total of eight (8) vernal pools were identified and one was recommended as significant. In addition, the MDIFW agency inquiry (Section 6.0) identified a pervious significant vernal pool which was identified by others during previous resource work. Vernal pools were visited on two separate occasions to capture potential breeding by both wood frogs and salamanders. Initial visits were made on May 3, 2023 and follow up visits on May 16, 2023. Table 2 includes a summary of the vernal pools identified on site. Vernal pool survey forms and MEDEP responses are included as **Exhibit F**. In the MDEP response, dated July 31, 2023, the MDIFW concurred with determinations made during

the field work completed in 2023 which identified one new significant vernal pool (SVP-KV-01) in addition to the significant pool identified by others (associated with wetland W-SK-01).

Table 2. Juniper Ridge Vernal Pool Summary

Vernal Pool ID	First Visit[12]					Second Visit					State Significant
	WF	YSS	BSS	Egg Mass Maturity [13]	Tadpoles	WF	YSS	BSS	Egg Mass Maturity	Tadpoles	
VP-SK-01	16	14	0	M/A/H	No	0	18	0	A	No	No
VP-SK-02	2	25	0	A/H	Yes	0	8	0	A	Yes	No
VP-SK-03	0	12	0	M/A	No	0	1	0	A	No	No
VP-SK-04	0	4	0	M/A	No	0	2	0	A	No	No
VP-SK-05	4	10	0	M/A	No	0	8	0	A	Yes	No
VP-SK-06	0	0	0	-	No	0	0	0	-	No	No
VP-SK-07	0	0	0	-	No	0	0	0	-	No	No
SVP-KV-01	0	35	0	-	No	-	-	-	-	No	Yes

5.0 Agency Consultation

Inquiry letters were sent to the Maine Natural Areas Program (MNAP) on December 12, 2022 and the Maine Department of Inland Fisheries and Wildlife (MDIFW) on December 13, 2022, to identify any rare, threatened, or endangered species that may occur within the Site. MNAP responded on December 12, 2022 and stated there are no rare botanical features documented specifically within the Project Site. The MDIFW responded on December 15, 2022 and specified that they have not mapped any Essential Habitats that would be directly affected by the Juniper Ridge Landfill expansion project. There was one previously identified significant vernal pool from previous resource work completed by others. They recommend formal vernal pool surveys since a significant Wildlife Habitat occurs within the project review area, this was done in the spring of 2023 and results are included in Section 4.4, and vernal pool data forms and MEDEP certification of vernal pools are included in **Exhibit F**. MNAP and MDIFW responses are included in **Exhibit G**.

6.0 Discussion

The center of the Site is dominated by uplands, with some small wetlands present. Within the Site there are also pre-existing gravel roads and historic haul roads which cross wetlands in a number of locations. The uplands in the central portions of the Site are mostly level terrain and consist of early successional forest or open manicured lawn. The largest wetland areas are located along the perimeter of the proposed expansion area and include expansive forested wetlands. The majority of the wetlands located within the central portion of the survey area are isolated and very disturbed by historic land-use activities. Within these smaller wetlands there is

[12] WF-Wood Frog Egg Masses, YSS- Yellow Spotted Salamander Egg Masses, BSS-Blue Spotted Salamander Egg Masses
[13] M – Mature egg mass; A- Advanced egg mass; H – Hatching egg mass

evidence of rutting, moving of soils, and placement of fill. In addition, some wetlands appear to be the direct result of old construction roads or haul roads. Wetlands W-SK-09 and W-SK-10 occur within upland areas and wetland indicators were only observed within the linear portion of the old haul road, it is likely that these wetlands are a direct result of that activity and therefore offer limited functions (Photo 5). Two wetlands and a portion of a third wetland identified on Site are wetlands considered Wetlands of Special Significance (WOSS), which have additional protections under NRPA. The wetland complex W-KV-02, containing significant pool VP-KV-01, as well as wetland W-SK-01, including the significant vernal pool identified in the MDIFW response, are both considered WOSS as they contain Essential Habitat. A small portion (within 25' of the stream) of W-KV-01 is also considered a WOSS. As is described below there was significant work completed on the Juniper Ridge landfill around 2004. Part of this work included construction of a fence and associated ground disturbance. During this work, portions of wetland W-SK-01 were cleared of trees and the topsoil was bladed off in order to install the project perimeter fence. The result of this work resulted in a habitat break as well as modifications to hydrology associated with the fence installation and a utility right-of-way (ROW) (Photo 6).

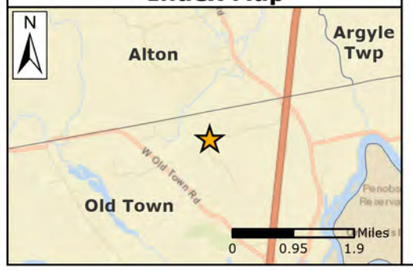
Photo 6. View of W-SK-09 which occurs entirely within an old access road (May 34, 2024).

Photo 7. View of habitat break associated with installed fence and utility line in W-SK-01A (November 30, 2022).

Exhibit A:

Location Map

Index Map



Legend

- Potentially Developable Area
- Proposed Survey Area (500-ft Buffer off Potentially Developable Area)

BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science

Scale

0 — 495 — 990 Feet

1:6,000 when printed on 11 inch by 17 inch media

Project Overview Map

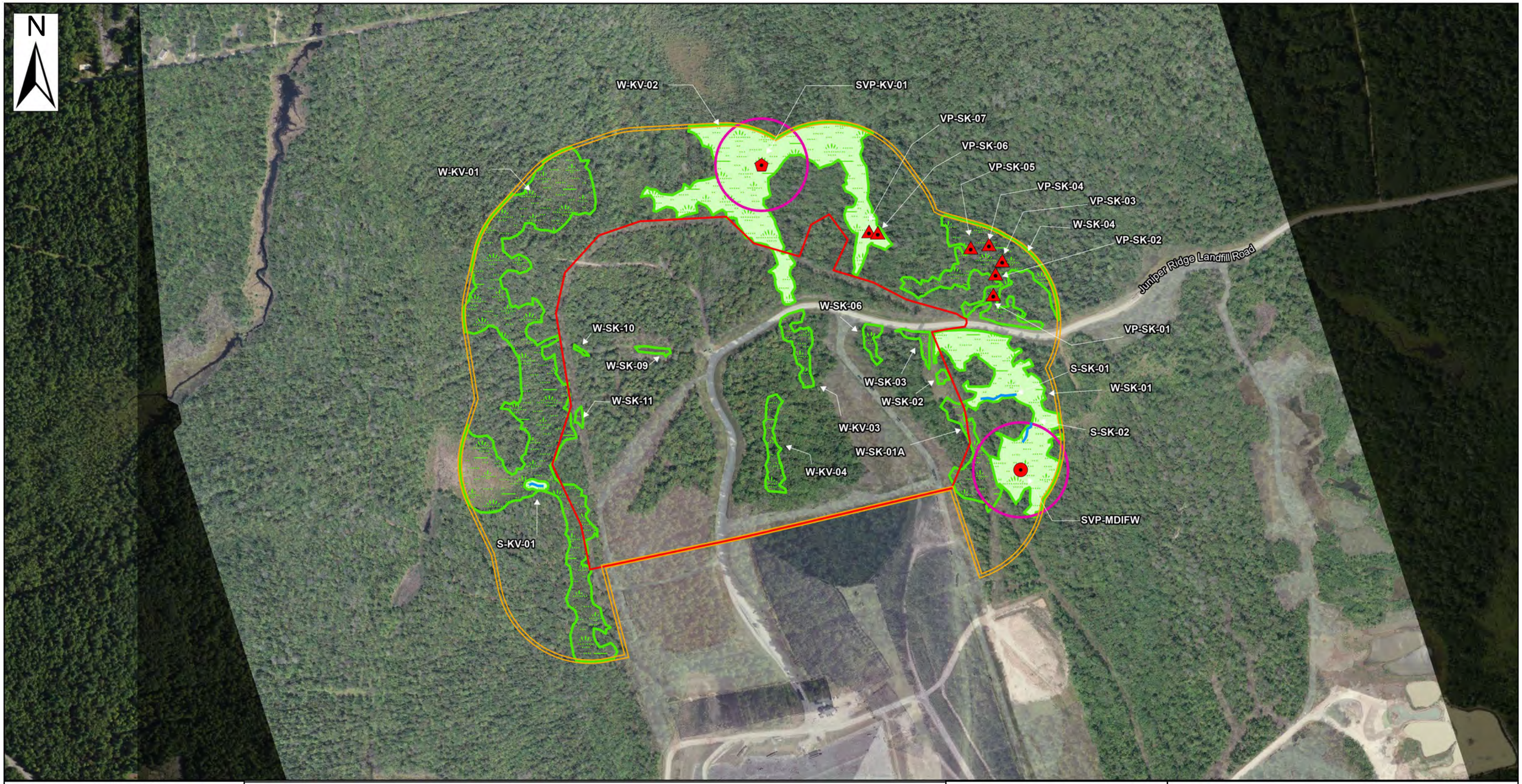
Juniper Ridge Landfill | Old Town, Maine

September 11, 2024

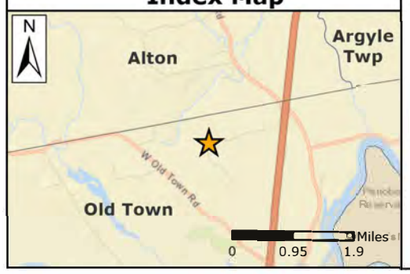
BIODIVERSITY RESEARCH INSTITUTE

Exhibit B:

Natural Resources Map



Index Map



Legend

- Survey Area (Excluding Previously Permitted Areas)
- Potentially Developable Area
- Wetland of Special Significance (WOSS)
- Wetland
- SVP 250ft Buffer
- SVP mapped by others
- Vernal Pool
- Significant Vernal Pool
- Stream

BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science

Scale

0 495 990 Feet

1:6,000 when printed on 11 inch by 17 inch media

Natural Resources Map

Juniper Ridge Landfill | Old Town, Maine

September 11 2024

BIODIVERSITY RESEARCH INSTITUTE

Exhibit C:

Natural Resources Photographs

Photo 1. View of Wetland W-KV-01 (December 1, 2022)

Photo 2. View of Wetland W-KV-02 (December 1, 2022)

Photo 3. View of Wetland W-KV-03 (December 1, 2022)

Photo 4. View of Wetland W-KV-04 (December 6, 2022)

Photo 5. View of Wetland W-SK-01 (November 30, 2022)

Photo 6. View of Wetland W-SK-03 (November 30, 2022)

Photo 7. View of Wetland W-SK-04 (December 6, 2022)

Photo 8. View of Wetland W-SK-06 (December 6, 2022)

Photo 9. View of Wetland W-SK-09 (December 6, 2022)

Photo 10. View of Wetland W-SK-10 (December 6, 2022)

Photo 11. View of Wetland W-SK-11 (December 6, 2022)

Photo 12. View of Stream S-KV-01 (November 30, 2022)

Photo 13. View of Stream S-SK-01 (November 30, 2022).

Exhibit D:

NRCS Soil Map

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Penobscot County, Maine, Southern Part

Juniper Ridge

December 7, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface..... 2
How Soil Surveys Are Made.....5
Soil Map..... 8
Soil Map.....9
Legend.....10
Map Unit Legend..... 11
Map Unit Descriptions.....11
Penobscot County, Maine, Southern Part.....13
CDB—Colonel-Peru-Brayton complex, 0 to 8 percent slopes, very stony.. 13
MXA—Monarda-Burnham complex, 0 to 3 percent slopes, very stony.....15
SWB—Pushaw-Swanville complex, 0 to 8 percent slopes.....17
TcB—Telos-Chesuncook complex, 0 to 8 percent slopes, very stony..... 18
TmB—Monarda-Telos complex, 0 to 8 percent slopes, very stony..... 20
TRB—Telos-Chesuncook-Ragmuff association, 0 to 8 percent slopes, very stony.....22
References.....25

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Penobscot County, Maine, Southern Part
Survey Area Data: Version 8, Aug 30, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 11, 2021—Oct 29, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CDB	Colonel-Peru-Brayton complex, 0 to 8 percent slopes, very stony	2.4	1.3%
MXA	Monarda-Burnham complex, 0 to 3 percent slopes, very stony	17.5	9.9%
SWB	Pushaw-Swanville complex, 0 to 8 percent slopes	29.4	16.7%
TcB	Telos-Chesuncook complex, 0 to 8 percent slopes, very stony	63.1	35.8%
TmB	Monarda-Telos complex, 0 to 8 percent slopes, very stony	56.9	32.3%
TRB	Telos-Chesuncook-Ragmuff association, 0 to 8 percent slopes, very stony	7.0	4.0%
Totals for Area of Interest		**176.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Penobscot County, Maine, Southern Part

CDB—Colonel-Peru-Brayton complex, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: szrs
Elevation: 50 to 1,000 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Colonel and similar soils: 45 percent
Peru and similar soils: 30 percent
Brayton and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Colonel

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till

Typical profile

Oa - 0 to 3 inches: highly decomposed plant material
E - 3 to 5 inches: fine sandy loam
Bs - 5 to 19 inches: fine sandy loam
BC - 19 to 22 inches: sandy loam
Cd - 22 to 65 inches: sandy loam

Properties and qualities

Slope: 2 to 6 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 14 to 23 inches to densic material
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 6 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144BY502ME - Loamy Till Toeslope, F144BY503ME - Loamy Flat
Hydric soil rating: No

Description of Peru

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till

Typical profile

Oa - 0 to 2 inches: highly decomposed plant material
E - 2 to 3 inches: fine sandy loam
Bs - 3 to 11 inches: fine sandy loam
BC - 11 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 5 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 21 to 33 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 16 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Ecological site: F144BY501ME - Loamy Slope (Northern Hardwoods)
Hydric soil rating: No

Description of Brayton

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy lodgment till

Typical profile

Oa - 0 to 5 inches: muck
Eg - 5 to 10 inches: gravelly fine sandy loam
Bg - 10 to 16 inches: fine sandy loam
BC - 16 to 23 inches: fine sandy loam
Cd - 23 to 65 inches: fine sandy loam

Properties and qualities

Slope: 0 to 4 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent

Depth to restrictive feature: 16 to 25 inches to densic material
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144BY502ME - Loamy Till Toeslope, F144BY503ME - Loamy Flat
Hydric soil rating: Yes

MXA—Monarda-Burnham complex, 0 to 3 percent slopes, very stony

Map Unit Setting

National map unit symbol: t1bm
Elevation: 50 to 750 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Monarda and similar soils: 45 percent
Burnham and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monarda

Setting

Landform: Ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy lodgment till

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 8 inches: cobbly silt loam
Bg - 8 to 16 inches: gravelly silt loam
BC - 16 to 19 inches: loam
Cd - 19 to 65 inches: channery silt loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 15 to 24 inches to densic material
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144BY301ME - Loamy Till Swamp
Hydric soil rating: Yes

Description of Burnham

Setting

Landform: Ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Organic material over loamy lodgment till

Typical profile

Oe - 0 to 13 inches: mucky peat
Eg - 13 to 16 inches: channery silt loam
Bg - 16 to 24 inches: channery loam
Cdg - 24 to 65 inches: gravelly loam

Properties and qualities

Slope: 0 to 2 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 14 to 35 inches to densic material
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144BY301ME - Loamy Till Swamp
Hydric soil rating: Yes

SWB—Pushaw-Swanville complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: szrm
Elevation: 20 to 300 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Pushaw and similar soils: 50 percent
Swanville and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pushaw

Setting

Landform: Marine terraces, river valleys
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Base slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Fine-silty glaciomarine deposits

Typical profile

Oe - 0 to 2 inches: mucky peat
Bw - 2 to 15 inches: silt loam
BCg - 15 to 18 inches: silt loam
C - 18 to 65 inches: silty clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 6 to 17 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D
Ecological site: F144BY401ME - Clay Flat
Hydric soil rating: No

Description of Swanville

Setting

Landform: Marine terraces, river valleys
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Fine-silty glaciomarine deposits

Typical profile

Oe - 0 to 2 inches: mucky peat
Bg - 2 to 10 inches: silt loam
BCg - 10 to 20 inches: silt loam
C - 20 to 65 inches: silty clay loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: F144BY001ME - Marine Terrace Flat, F144BY304ME - Wet Clay Flat, F144BY401ME - Clay Flat
Hydric soil rating: Yes

TcB—Telos-Chesuncook complex, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2rk0c
Elevation: 50 to 750 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Telos and similar soils: 45 percent
Chesuncook and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Telos

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy lodgment till

Typical profile

Oa - 0 to 3 inches: highly decomposed plant material
E - 3 to 5 inches: silt loam
Bs - 5 to 11 inches: silt loam
BC - 11 to 16 inches: gravelly loam
Cd - 16 to 65 inches: gravelly loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 14 to 23 inches to densic material
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 6 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144BY501ME - Loamy Slope (Northern Hardwoods), F144BY502ME - Loamy Till Toeslope
Hydric soil rating: No

Description of Chesuncook

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
E - 2 to 5 inches: silt loam
Bs - 5 to 18 inches: gravelly silt loam
BC - 18 to 24 inches: cobbly silt loam
Cd - 24 to 65 inches: cobbly loam

Properties and qualities

Slope: 5 to 8 percent

Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 21 to 31 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 16 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Ecological site: F144BY501ME - Loamy Slope (Northern Hardwoods)
Hydric soil rating: No

TmB—Monarda-Telos complex, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 1ls63
Elevation: 50 to 750 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Telos and similar soils: 45 percent
Monarda and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Telos

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy lodgment till

Typical profile

Oa - 0 to 3 inches: highly decomposed plant material
E - 3 to 5 inches: silt loam
Bs - 5 to 11 inches: silt loam
BC - 11 to 16 inches: gravelly loam
Cd - 16 to 65 inches: gravelly loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 14 to 23 inches to densic material
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 6 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144BY502ME - Loamy Till Toeslope
Hydric soil rating: No

Description of Monarda

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy lodgment till

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 8 inches: cobbly silt loam
Bg - 8 to 16 inches: gravelly silt loam
BC - 16 to 19 inches: loam
Cd - 19 to 65 inches: channery silt loam

Properties and qualities

Slope: 0 to 5 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 15 to 24 inches to densic material
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144BY502ME - Loamy Till Toeslope, F144BY503ME - Loamy Flat

Hydric soil rating: Yes

TRB—Telos-Chesuncook-Ragmuff association, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 1ls9c
Elevation: 50 to 750 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Telos and similar soils: 40 percent
Chesuncook and similar soils: 30 percent
Ragmuff and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Telos

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy lodgment till

Typical profile

Oa - 0 to 3 inches: highly decomposed plant material
E - 3 to 5 inches: silt loam
Bs - 5 to 11 inches: silt loam
BC - 11 to 16 inches: gravelly loam
Cd - 16 to 65 inches: gravelly loam

Properties and qualities

Slope: 0 to 6 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 14 to 23 inches to densic material
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 6 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144BY501ME - Loamy Slope (Northern Hardwoods), F144BY503ME - Loamy Flat
Hydric soil rating: No

Description of Chesuncook

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
E - 2 to 5 inches: silt loam
Bs - 5 to 18 inches: gravelly silt loam
BC - 18 to 24 inches: cobbly silt loam
Cd - 24 to 65 inches: cobbly loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 21 to 31 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.14 in/hr)
Depth to water table: About 16 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Ecological site: F144BY501ME - Loamy Slope (Northern Hardwoods)
Hydric soil rating: No

Description of Ragmuff

Setting

Landform: Ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till

Typical profile

Oa - 0 to 4 inches: highly decomposed plant material
E - 4 to 9 inches: gravelly very fine sandy loam
Bs - 9 to 20 inches: gravelly loam

BC - 20 to 31 inches: gravelly loam
Cd - 31 to 34 inches: gravelly loam
R - 34 to 79 inches: bedrock

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.5 percent
Depth to restrictive feature: 21 to 37 inches to densic material; 23 to 45 inches to lithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: About 16 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Ecological site: F144BY501ME - Loamy Slope (Northern Hardwoods), F144BY702ME - Shallow and Moderately-deep Till
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

BIODIVERSITY RESEARCH INSTITUTE

Exhibit E:

USACE Wetland Determination Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Juniper Ridge Landfill City/County: Old Town Sampling Date: 12/01/2022

Applicant/Owner: MidCoast Solar State: ME Sampling Point: PLOT-W-KV

Investigator(s): Korik Vargas Section, Township, Range: Old Town

Landform (hillside, terrace, etc.): Hillslope Local relief (concave, convex, none): concave Slope (%): 5

Subregion (LRR or MLRA): LRR R Lat: 44.984946° N Long: 68.730759° W Datum: Maine State Plane

Soil Map Unit Name: Telos-Chesuncook-Ragmuff association NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**		
Hydric Soil Present?	Yes ____	No X	**within a Wetland?**	**Yes** ____	**No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID:		

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ____ Surface Water (A1)
- ____ High Water Table (A2)
- ____ Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- ____ Sparsely Vegetated Concave Surface (B8)
- ____ Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15)
- ____ Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tilled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required

- ____ Surface Soil Cracks (B6)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Stunted or Stressed Plants (D1)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ Microtopographic Relief (D4)
- ____ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____		
Water Table Present?	Yes ____	No X	Depth (inches): ____		
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): 0	**Wetland Hydrology Present?**	**Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No Hydrology

VEGETATION – Use scientific names of plants.

Sampling Point: LOT-W-KV-01-U

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	15	No	FAC
2. *Betula papyrifera*	7	No	FACU
3. *Pinus strobus*	7	No	FACU
4. *Abies balsamea*	25	Yes	FAC
5. *Fagus grandifolia*	3	No	FACU
6. *Populus grandidentata*	25	Yes	FACU
7. *Fraxinus pennsylvanica*	5	No	FACW
	87	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Tsuga canadensis*	5	No	FAC
2. *Fagus grandifolia*	10	Yes	FACU
3. *Pinus strobus*	15	Yes	FACU
4.			
5.			
6.			
7.			
	30	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Pteridium aquilinum*	20	Yes	FAC
2. *Cornus canadensis*	15	Yes	FACW
3. *Coptis trifolia*	5	No	FACU
4. *Dendrolycopodium dendroideum*	3	No	FACU
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	43	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.3% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	20	x 2 =	40
FAC species	45	x 3 =	135
FACU species	75	x 4 =	300
UPL species	0	x 5 =	0
Column Totals:	140 (A)		475 (B

Prevalence Index = B/A = 3.39

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportin data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must b present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamete at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH ar greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: LOT-W-KV-01

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 3/2							Organic
2-4	10YR 6/2							Silt Loam
4-9	7.5YR 5/4							Silt Loam
9-14	5Y 5/2							Silt Loam
14-21	5Y 6/2		10YR 8/6	3				Silty Clay Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils versio 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Juniper Ridge Landfill City/County: Old Town Sampling Date: 11/30/22

Applicant/Owner: Sevee & Maher State: ME Sampling Point: PLOT-W-KV-

Investigator(s): Korik Vargas Section, Township, Range: Old Town

Landform (hillside, terrace, etc.): Flood plain basin Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR or MLRA): LRR R Lat: 44.985857° N Long: 68.732251° W Datum: Maine State Plane

Soil Map Unit Name: Monarda-Telos complex NWI classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**		
Hydric Soil Present?	Yes X	No ____	**within a Wetland?**	**Yes** X	**No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID:	W-KV-01	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- ____ High Water Table (A2)
- X Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- X Inundation Visible on Aerial Imagery (B7)
- ____ Sparsely Vegetated Concave Surface (B8)
- ____ Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15)
- ____ Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tilled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required

- ____ Surface Soil Cracks (B6)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Stunted or Stressed Plants (D1)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ Microtopographic Relief (D4)
- ____ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches):	0	
Water Table Present?	Yes X	No ____	Depth (inches):	6	
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches):	0	**Wetland Hydrology Present?** **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: OT-W-KV-01-W

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	10	Yes	FAC
2. *Abies balsamea*	7	Yes	FAC
3. *Betula papyrifera*	10	Yes	FACU
4.			
5.			
6.			
7.			
	27	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Pinus strobus*	5	No	FAC
2. *Alnus incana*	25	Yes	FACW
3.			
4. *Betula papyrifera*	5	No	FACU
5.			
6.			
7.			
	35	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Scirpus cyperinus*	10	No	FAC
2. *Bromus diandrus*	15	Yes	FACW
3. *Spiraea alba*	20	Yes	FACW
4. *Carex crinita*	10	No	OBL
5. *Carex lupulina*	10	No	OBL
6. *Spiraea tomentosa*	20	Yes	FACW
7.			
8.			
9.			
10.			
11.			
12.			
	85	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 85.7% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	80	x 2 =	160
FAC species	22	x 3 =	66
FACU species	15	x 4 =	60
UPL species	0	x 5 =	0
Column Totals:	137 (A)		306 (B

Prevalence Index = B/A = 2.23

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportin data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must b present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamete at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH ar greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: OT-W-KV-01-

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
1-3	10YR 2/1							Sandy Loam
3-6	5Y 7/2							Silt Loam
6-24	5Y 5/3		10YR 5/6	5				Silt Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils versio 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Juniper Ridge Landfill Project City/County: Old Town Sampling Date: 11/30/2022

Applicant/Owner: Sevee & Maher State: ME Sampling Point: PLOT-W-KV

Investigator(s): Korik Vargas Section, Township, Range: Old Town

Landform (hillside, terrace, etc.): Hillslope Local relief (concave, convex, none): concave Slope (%): 5

Subregion (LRR or MLRA): LRR R Lat: 44.986606° N Long: 68.720204° W Datum: Maine State Plane

Soil Map Unit Name: Pushaw-Swanville complex NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**		
Hydric Soil Present?	Yes ____	No X	**within a Wetland?**	**Yes** ____	**No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID:		

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ____ Surface Water (A1)
- ____ High Water Table (A2)
- ____ Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- ____ Sparsely Vegetated Concave Surface (B8)
- ____ Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15)
- ____ Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tilled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required

- ____ Surface Soil Cracks (B6)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Stunted or Stressed Plants (D1)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ Microtopographic Relief (D4)
- ____ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____		
Water Table Present?	Yes ____	No X	Depth (inches): ____		
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): 0	**Wetland Hydrology Present?**	**Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No Hydrology

VEGETATION – Use scientific names of plants.

Sampling Point: LOT-W-KV-01-U

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	30	Yes	FAC
2. *Abies balsamea*	20	Yes	FAC
3. *Fagus grandifolia*	10	No	FACU
4.			
5.			
6.			
7.			
	60	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4. *Picea rubens*	10	Yes	FACU
5.			
6.			
7.			
	10	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Pteridium aquilinum*	20	Yes	FAC
2. *Cornus canadensis*	10	Yes	FACW
3. *Pinus strobus*	5	No	FACU
4. *Fagus grandifolia*	5	No	FACU
5. *Abies balsamea*	5	No	FAC
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	45	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60.0% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	10	x 2 =	20
FAC species	55	x 3 =	165
FACU species	30	x 4 =	120
UPL species	0	x 5 =	0
Column Totals:	95 (A)		305 (B

Prevalence Index = B/A = 3.21

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportin data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must b present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamete at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH ar greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: LOT-W-KV-01

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 3/2							Organic
2-24	10YR 5/3							Silt Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils versio 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Juniper Ridge Landfill Project City/County: Old Town Sampling Date: 11/30/22

Applicant/Owner: Sevee & Maher State: ME Sampling Point: PLOT-W-SK-

Investigator(s): Korik Vargas Section, Township, Range: Old Town

Landform (hillside, terrace, etc.): Flood plain basin Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR or MLRA): LRR R Lat: 44.986770° N Long: 68.720084° W Datum: Maine State Plane

Soil Map Unit Name: Pushaw-Swanville complex NWI classification: PFO/PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No ____	**within a Wetland?** **Yes** X **No** ____
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: W-SK-01

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- ____ High Water Table (A2)
- X Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- ____ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15)
- ____ Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tilled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required

- ____ Surface Soil Cracks (B6)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Stunted or Stressed Plants (D1)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ Microtopographic Relief (D4)
- ____ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X No ____	Depth (inches):	1
Water Table Present?	Yes X No ____	Depth (inches):	0
Saturation Present? (includes capillary fringe)	Yes X No ____	Depth (inches):	0

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: OT-W-SK-01-W

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	85	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	85	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2. *Acer rubrum*	20	Yes	FAC
3. *Ilex verticillata*	10	Yes	FACW
4.			
5.			
6.			
7.			
	30	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Scirpus cyperinus*	40	Yes	FAC
2. *Onoclea sensibilis*	30	Yes	FACW
3. *Glyceria striata*	10	No	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80.0% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	40	x 2 =	80
FAC species	105	x 3 =	315
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	155 (A)		405 (B

Prevalence Index = B/A = 2.61

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportin data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must b present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamete at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH ar greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: OT-W-SK-01-

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/1							Organic
4-18	10YR 5/2		10YR 5/6					Silty Clay Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils versio 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

Exhibit F:

Vernal Pool Data Forms

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-KV-01 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☑ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ◉ Natural ○ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom sparse pool vegetation with predominantly mineral/leaf litter substrate-pit and mound topography within much larger wetland complex.

■ Maximum depth at survey: ○ 0-12" (0-1 ft.) ◉ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 100 ○ m ◉ ft Length: 84 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ○ Mineral soil (sphagnum moss present)
- ◉ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☑ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ◉ No inlet or outlet
- ○ Intermittent inlet or outlet
- ○ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ○ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	0			3											
Spotted Salamander	35			3			M/A								
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy shrimp: X = present
4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☑ SVP ☐ Potential SVP ☐ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool VP-KV-01

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-01 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ◉ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☑ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ○ Natural ◉ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

Existing wetland which has been ditched in the past, wetland is associated with a culverted road crossing and it appears that the area was ditched to enhance drainage within the wetland.

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom with muck in the deeper portions. Majority of the pool is vegetated with herbaceous species such as sensitive fern.

■ Maximum depth at survey: ○ 0-12" (0-1 ft.) ◉ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 65 ○ m ◉ ft Length: 91 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ○ Mineral soil (sphagnum moss present)
- ◉ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☑ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ○ No inlet or outlet
- ○ Intermittent inlet or outlet
- ◉ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ◉ No
- Was the entire pool surveyed for egg masses? ○ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	16	0					M/H						2		
Spotted Salamander	14	18					M	A					3	3	
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy shrimp: X = present
4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Vernal pool is within a larger complex, several pools are interconnected by a dug channel that extends from the roadway culvert through the pools to enhance flow into the wetland. This feature did not meet the definition of a stream, but does maintain flow. Photos of the pool and inlet/outlet have been included.

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool inlet into VP-SK-01 (Road with culvert in the photo background)

Photo 2: View of pool inlet into VP-SK-01 (looking toward the VP depression)

Photo 3: View of pool outlet from VP-SK-01 (looking toward the VP depression)

Photo 4: View of pool VP-SK-01 (5/3/23)

Photo 4: View of pool VP-SK-01 (5/16/23)

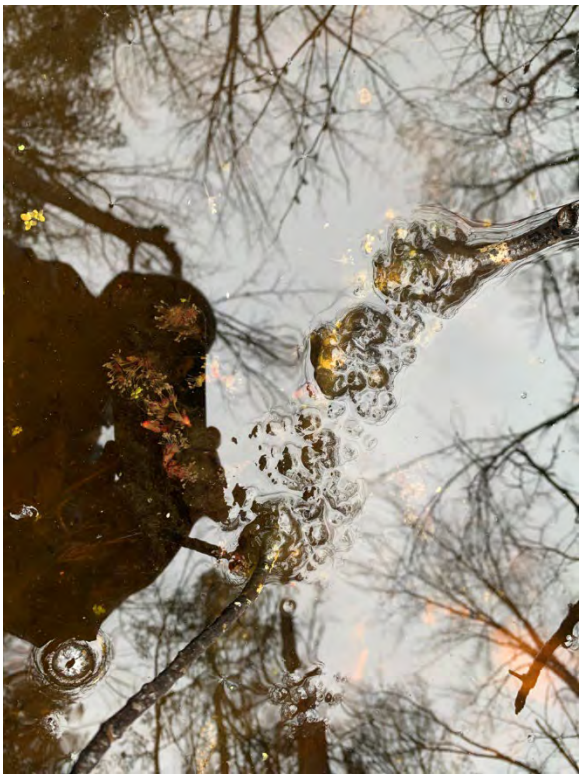


Photo 4: Yellow spotted salamander egg masses (5/3/23)

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-02 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ◉ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): _____

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☑ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ○ Natural ◉ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

Existing wetland which has been ditched in the past, wetland is associated with a culverted road crossing and it appears that the area was ditched to enhance drainage within the wetland.

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ○ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom with muck in the deeper portions. Majority of the pool is vegetated with herbaceous species such as sensitive fern.

■ Maximum depth at survey: ○ 0-12" (0-1 ft.) ◉ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 40 ○ m ◉ ft Length: 60 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ○ Mineral soil (sphagnum moss present)
- ◉ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☑ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ○ No inlet or outlet
- ○ Intermittent inlet or outlet
- ◉ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ○ Yes ◉ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	2	0		2	2		H			X	X		3	3	
Spotted Salamander	25	8		3	3		M/A	A							
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy shrimp: X = present
4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Pool contains significant numbers of salamander egg masses, however this pool has both a perennial inlet and outlet which interconnects with adjacent pools. The channel appears to have been excavated to enhance flow from a culvert.

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool inlet into VP-SK-02 (looking upgradient toward VP-SK-01)

Photo 2: View of pool outlet (looking downgradient toward VP-SK-03)

Photo 3: View of pool VP-SK-02 (5/3/23)

Photo 4: View of pool VP-SK-02 (5/16/23)

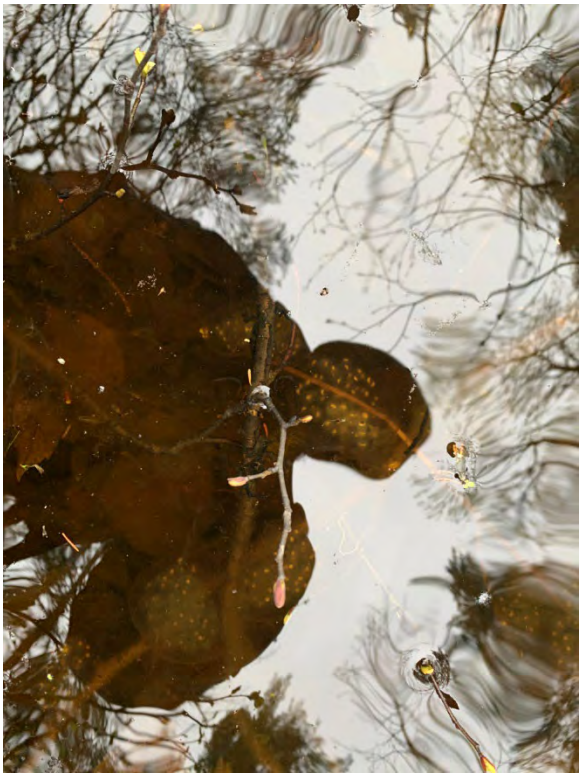


Photo 4: Yellow spotted salamander egg masses (5/3/23)

Photo 4: Wood frog egg mass (5/3/23)

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-03 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Agusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☑ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ○ Natural ◉ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

Existing wetland which has been ditched in the past, wetland is associated with a culverted road crossing and it appears that the area was ditched to enhance drainage within the wetland.

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom with muck in the deeper portions. Majority of the pool is vegetated with herbaceous species such as sensitive fern.

■ Maximum depth at survey: ○ 0-12" (0-1 ft.) ◉ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 42 ○ m ◉ ft Length: 40 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ○ Mineral soil (sphagnum moss present)
- ◉ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☑ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ○ No inlet or outlet
- ○ Intermittent inlet or outlet
- ◉ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ○ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	0	0		2	2										
Spotted Salamander	12	1		3	3		M/A	A							
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy shrimp: X = present
4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Vernal pool is within a larger complex, several pools are interconnected by a dug channel that extends from the roadway culvert through the pools to enhance flow into the wetland.

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool inlet into VP-SK-03 (looking upgradient toward VP-SK-02)

Photo 2: View of pool inlet into VP-SK-03 (looking upgradient toward VP-SK-02)

Photo 3: View of pool VP-SK-03 (5/3/23)

Photo 4: View of pool VP-SK-02 (5/16/23)

Photo 4: Yellow spotted salamander egg masses (5/3/23)

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-04 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☐ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ◉ Natural ○ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom sparse pool vegetation with predominantly mineral/leaf litter substrate

■ Maximum depth at survey: ◉ 0-12" (0-1 ft.) ○ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 20 ○ m ◉ ft Length: 20 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ◉ Mineral soil (sphagnum moss present)
- ○ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☐ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ◉ No inlet or outlet
- ○ Intermittent inlet or outlet
- ○ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ○ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	0	0		2	2										
Spotted Salamander	4	2		3	3		M/A	A							
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%
2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching
3-Fairy shrimp: X = present
4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen
**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool VP-SK-04 (5/3/23)

Photo 2: View of pool VP-SK-04 (5/16/23)

Photo 3: Yellow spotted salamander eggs in VP-SK-04 (5/3/23)

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-05 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☐ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ◉ Natural ○ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom sparse pool vegetation with predominantly mineral/leaf litter substrate

■ Maximum depth at survey: ◉ 0-12" (0-1 ft.) ○ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 30 ○ m ◉ ft Length: 35 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ◉ Mineral soil (sphagnum moss present)
- ○ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☐ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ◉ No inlet or outlet
- ○ Intermittent inlet or outlet
- ○ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ○ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	4	0		3	3		A				X			3	
Spotted Salamander	10	8		3	3		M/A	A							
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%

2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching

3-Fairy shrimp: X = present

4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen

**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool VP-SK-05 (5/3/23)

Photo 2: View of pool VP-SK-05 (5/16/23)

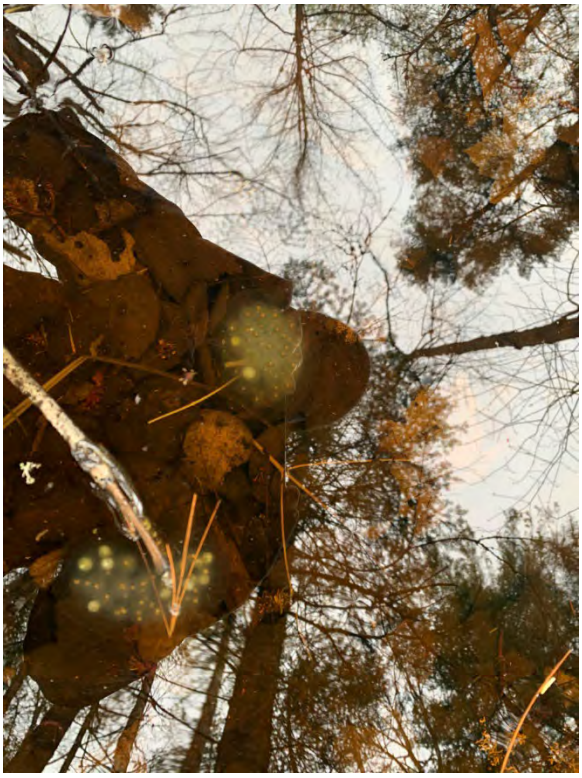


Photo 3: Yellow spotted salamander eggs in VP-SK-05 (5/3/23)

Photo 4: Wood frog egg masses in VP-SK-05 (5/3/23)

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-06 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☑ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ◉ Natural ○ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom sparse pool vegetation with predominantly mineral/leaf litter substrate

■ Maximum depth at survey: ◉ 0-12" (0-1 ft.) ○ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 10 ○ m ◉ ft Length: 20 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ◉ Mineral soil (sphagnum moss present)
- ○ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☐ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ◉ No inlet or outlet
- ○ Intermittent inlet or outlet
- ○ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ○ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	0	0		3	3										
Spotted Salamander	0	0		3	3										
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%

2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching

3-Fairy shrimp: X = present

4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen

**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool VP-SK-06 (5/3/23)

Photo 2: View of pool VP-SK-06 (5/16/23)

Maine State Vernal Pool Assessment Form

INSTRUCTIONS:

- **Complete all 3 pages of form thoroughly. Most fields are required for pool registration.**
- **Clear photographs of a) the pool AND b) the indicators (one example of each species egg mass) are required for all observers.**

Observer's Pool ID: VP-SK-07 **MDIFW Pool ID:** _____

1. PRIMARY OBSERVER INFORMATION

a. Observer name: Steve Knapp

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

2. PROJECT CONTACT INFORMATION

a. Contact name: ◉ same as observer ○ other _____

b. Contact and credentials previously provided? ○ No (submit Addendum 1) ◉ Yes

c. Project Name: Juniper Ridge Landfill

3. LANDOWNER CONTACT INFORMATION

a. Are you the landowner? ○ Yes ◉ No If no, was landowner permission obtained for survey? ○ Yes ○ No

b. Landowner's contact information (required)

Name: Bureau of General Services Phone: (207) 624-7345 E-mail: wallace.giakas@maine.gov

Street Address: 77 State House Station City: Augusta State: ME Zip: 04333

c. ☐ Large Projects: check if separate project landowner data file submitted

The Maine Department of Environmental Protection will e-mail official status letters to the project contact and landowner. Please check these data for completeness and accuracy to prevent delay in mailings. E-mail is the preferred method of notification; please provide e-mail addresses for the project contact and the landowner when available.

4. VERNAL POOL LOCATION INFORMATION

a. Location Township: Old Town

Brief site directions to the pool (using mapped landmarks):

Drive down the Juniper Ridge Access Road, vernal pool is located within a large wetland complex north of the access road and just after the gate weight station.

b. Mapping Requirements

i. USGS topographic map OR aerial photograph with pool clearly marked.

ii. GPS location of vernal pool (use Datum NAD83 / WGS84)

Longitude/Easting: _____ Latitude/Northing: _____

Coordinate system: _____

Check one:

◉ GIS shapefile
- send to VernalPool.MDIFW@maine.gov; observer has reviewed shape accuracy

○ (Best) The pool perimeter is delineated by multiple GPS points. (Excellent)
- Include map or spreadsheet with coordinates.

○ The above GPS point is at the center of the pool. (Good)

5. VERNAL POOL HABITAT INFORMATION

a. Habitat survey date (only if different from indicator survey dates on page 3): 5/3/23

b. Wetland habitat characterization

■ Choose the best descriptor for the landscape setting:

- ○ Isolated depression
- ○ Floodplain depression
- ◉ Pool associated with larger wetland complex
- ○ Other: _____

■ Check all wetland types that best apply to this pool:

- ☑ Forested swamp
- ☑ Shrub swamp
- ☐ Peatland (fen or bog)
- ☐ Emergent marsh
- ☐ Wet meadow
- ☐ Lake or pond cove
- ☐ Abandoned beaver flowage
- ☐ Active beaver flowage
- ☐ Slow stream
- ☐ Floodplain
- ☐ Mostly unvegetated pool
- ☐ ATV or skidder rut
- ☐ Dug pond or borrow pit
- ☐ Roadside ditch
- ☐ Other: _____

c. Vernal pool status under the Natural Resources Protection Act (NRPA)

i. Pool Origin: ◉ Natural ○ Natural-Modified ○ Unnatural ○ Unknown

If modified, unnatural or unknown, describe any modern or historic human impacts to the pool (**required**):

ii. Pool Hydrology

■ Select the pool's estimated hydroperiod AND provide rationale in box (**required**):

- ○ Permanent
- ○ Semi-permanent (drying partially in all years and completely in drought years)
- ◉ Ephemeral (drying out completely in most years)
- ○ Unknown

Explain:

Pools have leaf litter bottom sparse pool vegetation with predominantly mineral/leaf litter substrate

■ Maximum depth at survey: ◉ 0-12" (0-1 ft.) ○ 12-36" (1-3 ft.) ○ 36-60" (3-5 ft.) ○ >60" (>5 ft.)

■ Approximate size of pool (at spring highwater): Width: 10 ○ m ◉ ft Length: 15 ○ m ◉ ft

■ Predominate substrate in order of increasing hydroperiod:

- ○ Mineral soil (bare, leaf-litter bottom, or upland mosses present)
- ◉ Mineral soil (sphagnum moss present)
- ○ Organic matter (peat/muck) shallow or restricted to deepest portion
- ○ Organic matter (peat/muck) deep and widespread

■ Pool vegetation indicators in order of increasing hydroperiod (check all that apply):

- ☐ Terrestrial nonvascular spp. (e.g. haircap moss, lycopodium spp.)
- ☐ Dry site ferns (e.g. spinulose wood fern, lady fern, bracken fern)
- ☑ Moist site ferns (e.g. sensitive fern, cinnamon fern, interrupted fern, New York fern)
- ☐ Moist site vasculars (e.g. skunk cabbage, jewelweed, blue flag iris, swamp candle)
- ☐ Sphagnum moss (anchored or suspended)
- ☐ Wet site ferns (e.g. royal fern, marsh fern)
- ☑ Wet site shrubs (e.g. highbush blueberry, maleberry, winterberry, mountain holly)
- ☐ Wet site graminoids (e.g. blue-joint grass, tussock sedge, cattail, bulrushes)
- ☐ Aquatic vascular spp. (e.g. pickerelweed, arrowhead)
- ☐ Floating or submerged aquatics (e.g. water lily, water shield, pond weed, bladderwort)
- ☐ No vegetation in pool

■ Faunal indicators (check all that apply):

- ☐ Fish
- ☐ Bullfrog or Green Frog tadpoles
- ☐ Other: _____

iii. Inlet/Outlet Flow Permanency

Type of inlet or outlet (a seasonal or permanent channel providing water flowing into or out of the pool):

- ◉ No inlet or outlet
- ○ Intermittent inlet or outlet
- ○ Permanent inlet or outlet (channel with well-defined banks and permanent flow)
- ○ Other or Unknown (explain): _____

6. VERNAL POOL INDICATOR INFORMATION

a. Indicator survey dates: 5/3/23; 5/16/23

b. Indicator abundance criteria and pool survey effort

- Is pool depression bisected by 2 ownerships (straddler pool)? ◉ Yes ○ No
- Was the entire pool surveyed for egg masses? ◉ Yes ○ No; what % of entire pool surveyed? _____
- For each indicator species, indicate the exact number of egg masses, confidence level for species determination, and egg mass maturity. Separate cells are provided for separate survey dates.

INDICATOR SPECIES	Egg Masses (or adult Fairy Shrimp)									Tadpoles/Larvae[4]					
	Visit #1	Visit #2	Visit #3	Confidence Level[1]			Egg Mass Maturity[2]			Observed			Confidence Level[1]		
Wood Frog	0	0		3	3										
Spotted Salamander	0	0		3	3										
Blue-spotted Salamander															
Fairy Shrimp[3]															

1-Confidence level: 1 = <60%, 2 = 60-95%, 3 = >95%

2-Egg mass maturity: F= Fresh (<24 hrs), M= Mature (round embryos), A= Advanced (loose matrix, curved embryos), H= Hatched or Hatching

3-Fairy shrimp: X = present

4-Tadpoles/larvae: X = present

c. Rarity criteria

- Note any rare species associated with vernal pools. Observations should be accompanied by photographs.

SPECIES	Method of Verification*			CL**	SPECIES	Method of Verification*			CL**
	P	H	S			P	H	S	
Blanding's Turtle	☐	☐	☐		Wood Turtle	☐	☐	☐	
Spotted Turtle	☐	☐	☐		Ribbon Snake	☐	☐	☐	
Ringed Boghaunter	☐	☐	☐		Other:	☐	☐	☐	

*Method of verification: P = Photographed, H = Handled, S = Seen

**CL - Confidence level in species determination: 1= <60%, 2= 60-95%, 3= >95%

d. Optional observer recommendation:

☐ SVP ☐ Potential SVP ☑ Non Significant VP ☐ Indicator Breeding Area

e. General vernal pool comments and/or observations of other wildlife:

Send completed form and supporting documentation to: VernalPool.MDIFW@maine.gov

NOTE: Digital submissions are preferred but if not possible, please mail to: Maine Department of Inland Fisheries and Wildlife
Attn: Vernal Pools
106 Hogan Road, Suite 1
Bangor, ME 04401

For MDIFW use only Reviewed by MDIFW Date: _____ Initials: _____

This pool is: ☐ **Significant** ☐ **Potentially Significant** but lacking critical data ☐ **Not Significant** due to: ○ does not meet biological criteria. ○ does not meet MDEP vernal pool criteria.

Comments:

Photo 1: View of pool VP-SK-07 (5/3/23)

Photo 2: View of pool VP-SK-07 (5/16/23)

Exhibit G:

Agency Correspondence

JANET T. MILLS
GOVERNOR

STATE OF MAINE
DEPARTMENT OF
INLAND FISHERIES & WILDLIFE
353 WATER STREET
41 STATE HOUSE STATION
AUGUSTA ME 04333-0041

JUDITH CAMUSO
COMMISSIONER

December 15, 2022

Steve Knapp
Biodiversity Research Institute
276 Canco Road
Portland, ME 04103

RE: Information Request – Juniper Ridge Landfill Expansion Project, Old Town

Dear Steve:

Per your request received on December 13, 2022, we have reviewed current Maine Department of Inland Fisheries and Wildlife (MDIFW) information for known locations of Endangered, Threatened, and Special Concern species; designated Essential and Significant Wildlife Habitats; and inland fisheries habitat concerns within the vicinity of the *Juniper Ridge Landfill Expansion* project in Old Town.

Our Department has not mapped any Essential Habitats that would be directly affected by your project.

Endangered, Threatened, and Special Concern Species

Bat Species – Of the eight species of bats that occur in Maine, the three *Myotis* species are protected under Maine's Endangered Species Act (MESA) and are afforded special protection under 12 M.R.S §12801 - §12810. The three *Myotis* species include little brown bat (State Endangered), northern long-eared bat (State Endangered), and eastern small-footed bat (State Threatened). The five remaining bat species are listed as Special Concern: big brown bat, red bat, hoary bat, silver-haired bat, and tri-colored bat. While a comprehensive statewide inventory for bats has not been completed, based on historical evidence it is likely that several of these species occur within the project area during migration and/or the breeding season. However, our Agency does not anticipate significant impacts to any of the bat species as a result of this project.

Wood Turtle - Occurrences of wood turtle, a State Species of Special Concern, have been documented within the vicinity of the search area of the proposed project. Wood turtles use a mix of aquatic and terrestrial habitats throughout the year including riparian meadows, shrub thickets, farmland, and deciduous forests as well as bogs, forested wetlands, vernal pools, and streams. If these habitats are present in the project area, we recommend that they be avoided and adequately buffered with a 300-foot undisturbed, intact vegetative cover.

Significant Wildlife Habitat

Significant Vernal Pools - A mapped Significant Vernal Pool, a Significant Wildlife Habitat under Maine's Natural Resources Protection Act, occurs within the project review area; however, it is unclear if formal surveys for vernal pools have been conducted for the entire project area. If not, we recommend that surveys for vernal pools be conducted within the project boundary by qualified wetland scientists prior to final project design to determine whether there are other Significant Vernal Pools present in the area. These surveys should extend up to 250 feet beyond the anticipated project footprint because of

potential performance standard requirements for off-site Significant Vernal Pools, assuming such pools are located on land owned or controlled by the applicant. Once surveys are completed, survey forms should be submitted to our Agency for review well before to the submission of any necessary permits. Our Department will need to review and verify any vernal pool data prior to final determination of significance.

Fisheries Habitat

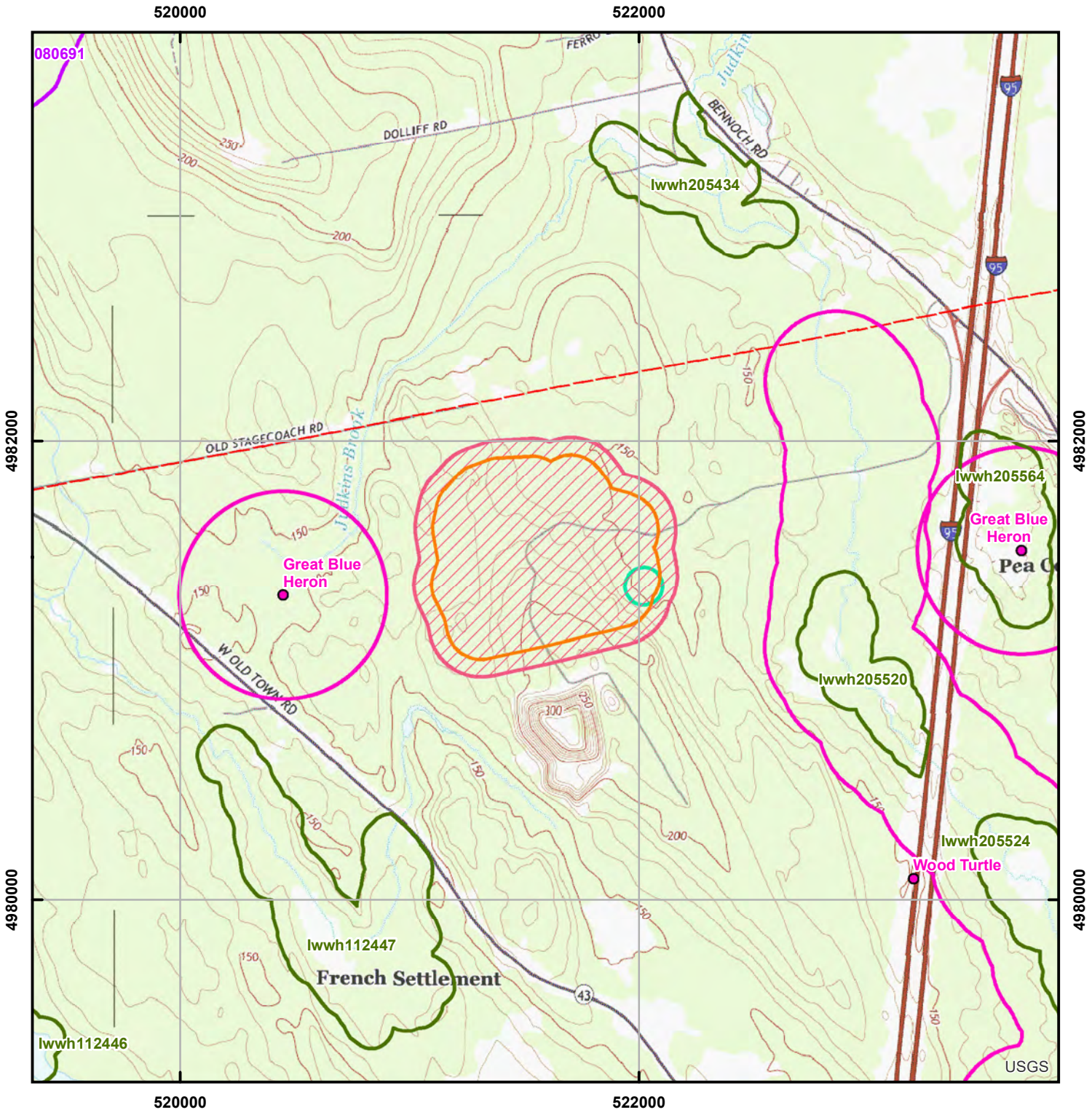
We generally recommend maintaining 100-foot undisturbed vegetated buffers from the upland edge of all intermittent and perennial streams and any contiguous wetlands. Maintaining and enhancing buffers along these resources is critical to the protection of water temperatures, water quality, natural inputs of coarse woody debris, and various forms of aquatic life necessary to support fish and other aquatic species. Riparian buffers also provide critical habitat and important travel corridors for a variety of wildlife species. Stream crossings should be avoided, but if a stream crossing is necessary, or an existing crossing needs to be modified, it should be designed to provide for full aquatic passage. Small streams, including intermittent streams, can provide crucial rearing habitat, cold water for thermal refugia, and abundant food for juvenile salmonids on a seasonal basis. Undersized crossings may inhibit these functions and become a frequent maintenance problem that causes reoccurring damage to the resource. Generally, MDIFW recommends that all new, modified, and replacement stream crossings be sized to span at least 1.2 times the bankfull width of the stream. In addition, we generally recommend that stream crossings be open bottomed (i.e. natural bottom), although embedded structures which are backfilled with representative streambed material have been shown to be effective in providing habitat connectivity for fish and other aquatic organisms. Construction Best Management Practices should be closely followed to avoid erosion, sedimentation, alteration of stream flow, and other impacts as eroding soils can travel significant distances as well as transport other pollutants resulting in direct impacts to fish, other aquatic life, and their habitats. In addition, we recommend that any necessary instream work occur between July 15 and October 1.

This consultation review has been conducted specifically for known MDIFW jurisdictional features and should not be interpreted as a comprehensive review for the presence of other regulated features that may occur in this area. Prior to the start of any future site disturbance we recommend additional consultation with the municipality, and other state resource agencies including the Maine Natural Areas Program, Maine Department of Marine Resources, and Maine Department of Environmental Protection in order to avoid unintended protected resource disturbance.

Please feel free to contact my office if you have any questions regarding this information, or if I can be of any further assistance.

Best regards,

Becca Settele
Wildlife Biologist



Environmental Review of Fish and Wildlife Observations and Priority Habitats

Project Name: Juniper Ridge Landfill Expansion, Old Town (Version 1)

Miles

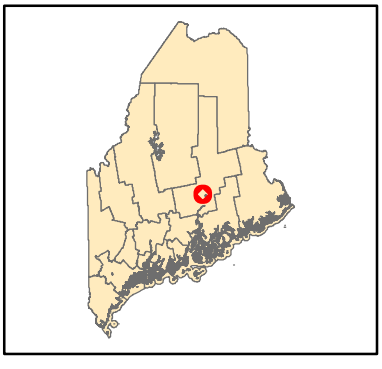
0 0.1250.25 0.5 0.75 1

Projection: UTM, NAD83, Zone 19N

Date: 12/15/2022

Maine Department of Inland Fisheries and Wildlife

- ProjectSearchAreas - All Versions
- Maine Cliff and Talus Areas
- Deer Winter Area
- LUPC p-fw
- Cooperative DWAs
- Seabird Nesting Islands
- Shorebird Areas
- Inland Waterfowl and Wading Bird
- 2008 lwwh - Shoreland Zoning
- Tidal Waterfowl and Wading Bird
- Significant Vernal Pools
- Environmental Review Polygons
- Roseate Tern
- Piping Plover and Least Tern
- Aquatic ETSc - 2.5 mi review
- Rare Mussels - 5 mi review
- Maine Heritage Fish Waters
- Arctic Charr Habitat
- Redfin Pickerel and Swamp Darter Habitats - buffer100ft
- Special Concern occupied habitats - 100ft buffer
- Wild Lake Trout Habitats



STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

July 31, 2023

Steve Knapp
Biodiversity Research Institute
30 Danforth Street, Suite 213
Portland, ME 04101

Re: Vernal Pool Significance Determination, Pool ID #s 5200, 5203, 5204, 5205, 5206, 5201, 5202–Old Town

Dear Steve Knapp:

Vernal pools are temporary to semi-permanent wetlands occurring in shallow depressions that typically fill during the spring and dry during the summer or in drought years. They provide important breeding and foraging habitat for a wide variety of specialized wildlife species including several rare, threatened, and endangered species.

Based on your field surveys, it has been determined that the vernal pools identified above on the property of Bureau of General Services are NOT SIGNIFICANT because either: 1. the features do not meet the definition of a vernal pool under the Significant Wildlife Habitat rules, 06-096 CMR 335(9) or 2. the vernal pools do not meet the biological standards for exceptional wildlife use of the Significant Wildlife Habitat rules, 06-096 CMR 335(9)(B). Therefore, activities within 250 feet of the pools are not regulated under the Natural Resources Protection Act (NRPA) unless there are other protected natural resources nearby such as streams or freshwater wetlands. I have attached a copy of the database printout that verifies the State's findings with respect to your surveys.

I want to also advise you that the pool areas on the property can be considered freshwater wetlands and therefore direct pool alterations may require permitting under the NRPA.

The Department will notify the landowner of the pool status under separate cover. If you have any questions or need further clarification, please contact Mark Stebbins at 207-592-4810 or email at: Mark.N.Stebbins@maine.gov

Sincerely,

Robert Wood
Director, Bureau of Land Resources

cc. town file

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
207-941-4570 FAX: (207) 941-4584

PORTLAND
312 CANCO ROAD
PORTLAND, MAINE 04103
(207) 822-6300 FAX: (207) 822-6303

PRESQUE ISLE
1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, MAINE 04769
(207) 764-0477 FAX: (207) 760-3143

WEBSITE: www.maine.gov/dep

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

July 31, 2023

Steve Knapp
Biodiversity Research Institute
30 Danforth Street, Suite 213
Portland, ME 04101

Re: Vernal Pool Significance Determination, Pool ID # 5199–Old Town

Dear Steve Knapp:

Vernal pools are temporary to semi-permanent wetlands occurring in shallow depressions that typically fill during the spring and dry during the summer or in drought years. They provide important breeding and foraging habitat for a wide variety of specialized wildlife species including several rare, threatened, and endangered species.

Based on your field survey, it has been determined that the vernal pool identified above on the property of Bureau of General Services is SIGNIFICANT. I have attached a copy of the database printout that verifies the State's findings with respect to our survey.

As a significant vernal pool, all areas on the Bureau of General Services property within 250 feet of the vernal pool depression, known as the "critical terrestrial habitat", will be subject to the requirements of the Natural Resources Protection Act, 38 M.R.S.A. §§480-A to 480-FF, and the Significant Wildlife Habitat rules, 06-096 CMR 335.

The Department will ensure that the vernal pool's location and status is entered and mapped in the State's vernal pool database. Note that if the pool depression (only) crosses two or more property boundaries the abutter(s) are similarly subject to the requirements of the Natural Resources Protection Act and the Significant Wildlife Habitat rules.

The Department will notify the landowner of the pool status under separate cover. If you have any questions or need further clarification, please contact Mark Stebbins at 207-592-4810 or email at: Mark.N.Stebbins@maine.gov

Sincerely,

Robert Wood
Director, Bureau of Land Resources

cc. town file

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
207-941-4570 FAX: (207) 941-4584

PORTLAND
312 CANCO ROAD
PORTLAND, MAINE 04103
(207) 822-6300 FAX: (207) 822-6303

PRESQUE ISLE
1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, MAINE 04769
(207) 764-0477 FAX: (207) 760-3143

WEBSITE: www.maine.gov/dep

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Monday, July 31, 2023

IFW's Pool ID: 5199 Twp: Old Town
Observer's ID: VP-KV-01
UTM Coordinates of Pool Center: 521590 E, 4981869 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023
IFW's Recommendation: GREEN: SIGNIFICANT
IFW Comments: Pool provides significant habitat for spotted salamanders.

IFW's Pool ID: 5200 Twp: Old Town
Observer's ID: VP-SK-01
UTM Coordinates of Pool Center: 521974 E, 4981657 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool provides some habitat for wood frogs and spotted salamanders but does not meet biological criteria for significance.

IFW's Pool ID: 5201 Twp: Old Town
Observer's ID: VP-SK-02
UTM Coordinates of Pool Center: 521977 E, 4981691 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition
IFW Comments: Pool provides some habitat for wood frogs and significant habitat for spotted salamanders but does not meet MDEP vernal pool definition (permanent inlet and outlet)

IFW's Pool ID: 5202 Twp: Old Town
Observer's ID: VP-SK-03
UTM Coordinates of Pool Center: 521988 E, 4981713 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the vernal pool definition
IFW Comments: Pool provides some habitat for spotted salamanders but does not meet biological criteria for significance. Pool also does not meet MDEP vernal pool definition (permanent inlet and outlet).

IFW's Pool ID: 5203 Twp: Old Town
Observer's ID: VP-SK-04
UTM Coordinates of Pool Center: 521966 E, 4981740 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool provides some habitat for spotted salamanders but does not meet biological criteria for significance.

IFW Recommendations for Significant Vernal Pool Determinations

The following is a list of pools and IFW's recommendations for whether or not they qualify as Significant Vernal Pools, one of Maine's Significant Wildlife Habitats.

Data current as of: Monday, July 31, 2023

IFW's Pool ID: 5204 Twp: Old Town
Observer's ID: VP-SK-05
UTM Coordinates of Pool Center: 521936 E, 4981734 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments: Pool provides some habitat for wood frogs and spotted salamanders but does not meet biological criteria for significance.

IFW's Pool ID: 5205 Twp: Old Town
Observer's ID: VP-SK-06
UTM Coordinates of Pool Center: 521783 E, 4981758 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments:

IFW's Pool ID: 5206 Twp: Old Town
Observer's ID: VP-SK-07
UTM Coordinates of Pool Center: 521768 E, 4981760 N
ProjectType: Juniper Ridge Landfill

Landowner:	Contact:
Bureau of General Services	Steve Knapp - Biodiversity Research Institute
77 State House Station	30 Danforth Street, Suite 213
Augusta, ME 04333	Portland, ME 04101
(207) 624-7345 wallace.giakas@maine.gov	(207) 570-9462 steve.knapp@brienvironmental.org

Survey Date: 5/3/2023 Additional Survey Dates: 05/16/2023
IFW's Recommendation: RED: NOT SIGNIFICANT, does not meet the biological criteria
IFW Comments:

STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY
177 STATE HOUSE STATION
AUGUSTA, MAINE 04333

JANET T. MILLS
GOVERNOR

AMANDA E. BEAL
COMMISSIONER

December 12, 2022

Steve Knapp
BRI Environmental
30 Danforth Street, Suite 213
Portland, ME 04101

Via email: steve.knapp@brienvironmental.org

Re: Rare and exemplary botanical features in proximity to: #0921, Juniper Ridge Landfill Expansion, Old Town, Maine

Dear Mr. Knapp:

I have searched the Maine Natural Areas Program's Biological and Conservation Data System files in response to your request received December 12, 2022 for information on the presence of rare or unique botanical features documented from the vicinity of the project in Old Town, Maine. Rare and unique botanical features include the habitat of rare, threatened, or endangered plant species and unique or exemplary natural communities. Our review involves examining maps, manual and computerized records, other sources of information such as scientific articles or published references, and the personal knowledge of staff or cooperating experts.

Our official response covers only botanical features. For authoritative information and official response for zoological features you must make a similar request to the Maine Department of Inland Fisheries and Wildlife, 284 State Street, Augusta, Maine 04333.

According to the information currently in our Biological and Conservation Data System files, there are no rare botanical features documented specifically within the project area. This lack of data may indicate minimal survey efforts rather than confirm the absence of rare botanical features. You may want to have the site inventoried by a qualified field biologist to ensure that no undocumented rare features are inadvertently harmed.

If a field survey of the project area is conducted, please refer to the enclosed supplemental information regarding rare and exemplary botanical features documented to occur in the vicinity of the project site. The list may include information on features that have been known to occur historically in the area as well as recently field-verified information. While historic records have not been documented in several years, they may persist in the area if suitable habitat exists. The enclosed list identifies features with potential to occur in the area, and it should be considered if you choose to conduct field surveys.

This finding is available and appropriate for preparation and review of environmental assessments, but it is not a substitute for on-site surveys. Comprehensive field surveys do not exist for all natural areas in Maine, and in the absence of a specific field investigation, the Maine Natural Areas Program cannot provide a definitive statement on the presence or absence of unusual natural features at this site.

MOLLY DOCHERTY, DIRECTOR
MAINE NATURAL AREAS PROGRAM
BLOSSOM LANE, DEERING BUILDING

DEPARTMENT OF Agriculture Conservation & Forestry

PHONE: (207) 287-804490
WWW.MAINE.GOV/DACF/MNAP

The Maine Natural Areas Program (MNAP) is continuously working to achieve a more comprehensive database of exemplary natural features in Maine. We would appreciate the contribution of any information obtained should you decide to do field work. MNAP welcomes coordination with individuals or organizations proposing environmental alteration or conducting environmental assessments. If, however, data provided by MNAP are to be published in any form, the Program should be informed at the outset and credited as the source.

The Maine Natural Areas Program has instituted a fee structure of $75.00 an hour to recover the actual cost of processing your request for information. You will receive an invoice for $150.00 for two hours of our services.

Thank you for using MNAP in the environmental review process. Please do not hesitate to contact me if you have further questions about the Natural Areas Program or about rare or unique botanical features on this site.

Sincerely,

Lisa St. Hilaire

Lisa St. Hilaire | Information Manager | Maine Natural Areas Program
207-287-8044 | lisa.st.hilaire@maine.gov

Rare and Exemplary Botanical Features within 4 miles of
Project: #0921, Juniper Ridge Landfill Expansion, Old Town, ME

Common Name	State Status	State Rank	Global Rank	Date Last Observed	Occurrence Number	Habitat
Awned Flatsedge						
	SC	S2	G5	1942-09-09	1	Non-tidal rivershore (non-forested, seasonally wet)
	SC	S2	G5	1899-09-18	7	Non-tidal rivershore (non-forested, seasonally wet)
Button Sedge						
	SC	S2	G5	1983-08-12	1	
Domed Bog						
		S3	GNR	2014-08-26	6	
Dwarf Shrub Bog						
		S5	G5	2008-09-09	50	
Fall Fimbry						
	SC	S2S3	G5	1899-09-18	14	Open wetland, not coastal nor rivershore (non-forested,
Long-leaved Bluet						
	SC	S2S3	G5TNR	2010-07-13	4	Non-tidal rivershore (non-forested, seasonally wet)
MacGregor's Rye						
	SC	S2	G5	2014-08-19	7	
New England Violet						
	SC	S2	G4	1916-07-01	9	Non-tidal rivershore (non-forested, seasonally wet)
	SC	S2	G4	2010-07-13	10	Non-tidal rivershore (non-forested, seasonally wet)
	SC	S2	G4	1934-10-24	11	Non-tidal rivershore (non-forested, seasonally wet)
Orono Sedge						
	T	S3	G3	1997-07-17	4	Old field/roadside (non-forested, wetland or upland)
	T	S3	G3	1987-06-08	9	Old field/roadside (non-forested, wetland or upland)
	T	S3	G3	2011-07-25	33	Old field/roadside (non-forested, wetland or upland)
	T	S3	G3	1916-07-01	65	Old field/roadside (non-forested, wetland or upland)

Pale Green Orchis					
SC	S2	G4?T4Q	1933-07-06	5	Non-tidal rivershore (non-forested, seasonally wet),Open
Raised Level Bog Ecosystem					
	S4	GNR	2009-07-09	14	
Ram's-head Lady's-slipper					
E	S1	G3	1886-05-30	5	Forested wetland,Hardwood to mixed forest (forest,
Rivershore Outcrop					
	S2	G3	2010-07-13	1	
Shining Ladies'-tresses					
T	S1	G4	1946-07-08	8	Non-tidal rivershore (non-forested, seasonally wet),Open
Showy Lady's-slipper					
SC	S3	G4G5	1943-07-09	22	Forested wetland,Open wetland, not coastal nor
Silver Maple Floodplain Forest					
	S3	GNR	2010-07-13	37	
	S3	GNR	2014-06-16	46	
	S3	GNR	2014-06-16	46	
	S3	GNR	2014-09-03	51	
Sparse-flowered Sedge					
SC	S3	G5	1982-08-30	3	Forested wetland,Open wetland, not coastal nor
Swarthy Sedge					
E	S2	G5	1916-07-01	1	Rocky coastal (non-forested, upland)
Unpatterned Fen Ecosystem					
	S5	GNR	2009	8	

Date Exported: 2022-12-12 17:27

Conservation Status Ranks

State and Global Ranks: This ranking system facilitates a quick assessment of a species' or habitat type's rarity and is the primary tool used to develop conservation, protection, and restoration priorities for individual species and natural habitat types. Each species or habitat is assigned both a state (S) and global (G) rank on a scale of critically imperiled (1) to secure (5). Factors such as range extent, the number of occurrences, intensity of threats, etc., contribute to the assignment of state and global ranks. The definitions for state and global ranks are comparable but applied at different geographic scales; something that is state imperiled may be globally secure.

The information supporting these ranks is developed and maintained by the Maine Natural Areas Program (state ranks) and NatureServe (global ranks).

Rank	Definition
S1 **G1**	**Critically Imperiled** – At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.
S2 **G2**	**Imperiled** – At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
S3 **G3**	**Vulnerable** – At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
S4 **G4**	**Apparently Secure** – At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
S5 **G5**	**Secure** – At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
SX **GX**	**Presumed Extinct** – Not located despite intensive searches and virtually no likelihood of rediscovery.
SH **GH**	**Possibly Extinct** – Known from only historical occurrences but still some hope of rediscovery.
S#S# **G#G#**	**Range Rank** – A numeric range rank (e.g., S2S3 or S1S3) is used to indicate any range of uncertainty about the status of the species or ecosystem.
SU **GU**	**Unrankable** – Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
GNR **SNR**	**Unranked** – Global or subnational conservation status not yet assessed.
SNA **GNA**	**Not Applicable** – A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities (e.g., non-native species or ecosystems.
Qualifier	**Definition**
S#? **G#?**	**Inexact Numeric Rank** – Denotes inexact numeric rank.
Q	**Questionable taxonomy that may reduce conservation priority** – Distinctiveness of this entity as a taxon or ecosystem type at the current level is questionable. The "Q" modifier is only used at a global level.
T#	**Infraspecific Taxon (trinomial)** – The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank.

State Status: Endangered and Threatened are legal status designations authorized by statute. Please refer to MRSA Title 12, §544 and §544-B.

Status	Definition
E	**Endangered** – Any native plant species in danger of extinction throughout all or a significant portion of its range within the State or Federally listed as Endangered.
T	**Threatened** – Any native plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range in the State or Federally listed as Threatened.
SC	**Special Concern** – A native plant species that is rare in the State, but not rare enough to be considered Threatened or Endangered.
PE	**Potentially Extirpated** – A native plant species that has not been documented in the State in over 20 years, or loss of the last known occurrence.

Element Occurrence (EO) Ranks: Quality assessments that designate viability of a population or integrity of habitat. These ranks are based on size, condition, and landscape context. Range ranks (e.g., AB, BC) and uncertainty ranks (e.g., B?) are allowed. The Maine Natural Areas Program tracks all occurrences of rare plants and natural communities/ecosystems (S1-S3) as well as exemplary common natural community types (S4-S5 with EO ranks A/B).

Rank	Definition
A	**Excellent** – Excellent estimated viability/ecological integrity.
B	**Good** – Good estimated viability/ecological integrity.
C	**Fair** – Fair estimated viability/ecological integrity.
D	**Poor** – Poor estimated viability/ecological integrity.
E	**Extant** – Verified extant, but viability/ecological integrity not assessed.
H	**Historical** – Lack of field information within past 20 years verifying continued existence of the occurrence, but not enough to document extirpation.
X	**Extirpated** – Documented loss of population/destruction of habitat.
U	**Unrankable** – Occurrence unable to be ranked due to lack of sufficient information (e.g., possible mistaken identification).
NR	**Not Ranked** – An occurrence rank has not been assigned.

Visit the Maine Natural Areas Program website for more information
http://www.maine.gov/dacf/mnap

maine DEPARTMENT OF Agriculture Conservation & Forestry
NATURAL AREAS

Stantec

Memo

To:	Peter Maher and Lisa Turner Sevee and Maher Engineers 4 Blanchard Road Cumberland, ME 04021 lisa.turner@smemaine.com	From:	Laura Berube Stantec Consulting 30 Park Drive Topsham ME 04086 laura.berube@stantec.com
File:	195603227	Date:	August 7, 2024

Reference: Rare Bat Acoustic Survey for the Phase II Expansion of the Juniper Ridge Landfill in Old Town, Maine

BACKGROUND AND PROJECT DESCRIPTION

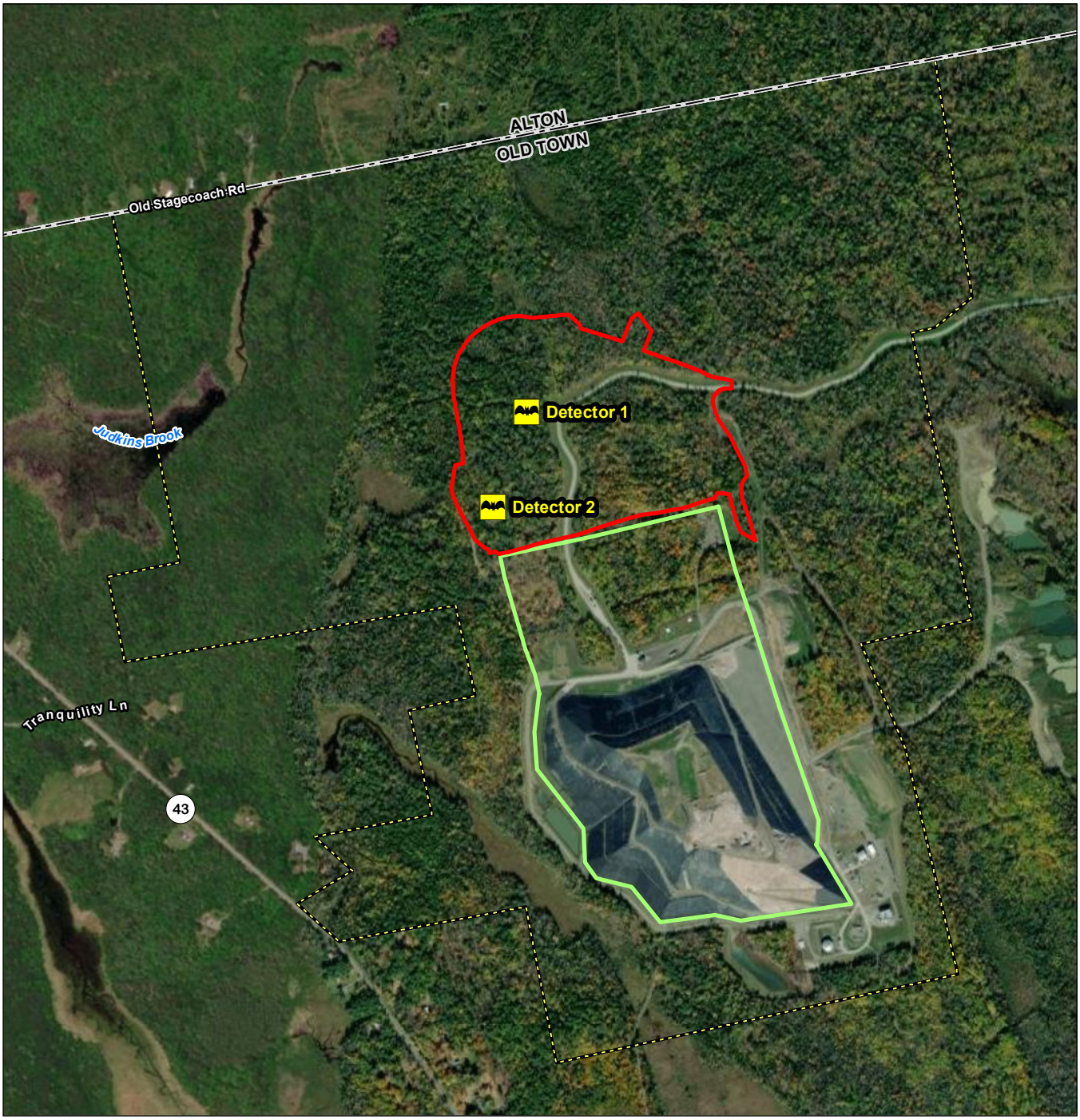
Stantec Consulting Services Inc. (Stantec) conducted a rare bat acoustic survey for the Phase II Expansion of the Juniper Ridge Landfill in Old Town, Maine, targeting northern long-eared bat (NLEB; *Myotis septentrionalis*), federally listed under the Endangered Species Act, and tricolored bat (*Perimyotis subflavus*), a species proposed for federal listing under the Endangered Species Act. The expansion project will require vegetation clearing of approximately 61 acres, which may include clearing of trees considered suitable habitat by the United States Fish and Wildlife (USFWS) for NLEB and tricolored bat[1].

Stantec conducted the rare bat acoustic survey following the 2024 US Fish and Wildlife Service (USFWS) Range-wide Indiana Bat & Northern Long-eared Bat Survey Guidelines (USFWS Guidelines).[2] USFWS Guidelines are followed to evaluate presence or probable absence of federally listed and other bat species. Stantec provided the USFWS Study Plan Form for Bat Surveys and Monitoring (Study Plan; Attachment A) to the USFWS on July 15, 2024. This memorandum is a summary of the acoustic bat survey findings based on Stantec's field survey conducted in summer 2024.

SURVEY METHODS

The objective of the survey was to determine the presence/probable absence of federally listed NLEB, and tricolored bat, a candidate species for federal listing. Based on the USFWS Guidelines, acoustic surveys for a non-linear project such as the Phase II Expansion of the Juniper Ridge Landfill require a survey effort of 14 detector-nights per 123 acres of suitable summer habitat, with at least two survey sites located more than 200 meters apart. We selected two survey sites within the proposed expansion area (Figure 1), each to be surveyed for seven nights to attain the USFWS's required 14 detector-nights per 123 acres[3]. To be counted as a valid survey night, suitable weather conditions must occur during the first five hours past sunset including temperatures above 50 degrees Fahrenheit, wind speeds not exceeding 9 miles per hour for more than 30 minutes, and no more than 30 minutes of precipitation.

[1] The USFWS considers forested habitat with trees greater than 3 inches in diameter at breast height to be potentially suitable summer habitat for NLEB.
[2] U.S. Fish and Wildlife Service. 2024. Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines. U.S. Fish and Wildlife Service, Region 3, Bloomington, MN. 76 pp.
[3] Even though the Project is less than 123 acres this is the minimum survey effort allowed for small project sites.



Notes
1. Coordinate System: USA/NAD83(2011)/Maine (East)-csref
2. Data Sources: MEGIS, Sevee and Maher Engineers, Inc., Stantec
3. Background: Aerial imagery provided by ArcGIS Online World Imagery Mapping Service.

Legend
- Bat Detector Location
- Expansion
- Existing Landfill
- Property Boundary
- Municipal Boundary

0 1,500 Feet

(At original document size of 8.5x11)
1" = 1,167'

N

Stantec

Project Location
Old Town, Maine

Prepared by PWB on 2024-08-28
TR Review by KWH on 2024-08-28
IR Review by LB on 2024-08-28

Client/Project 195603227
Sevee & Maher Engineers, Inc.
Juniper Ridge Landfill Expansion

Figure No.
1

Title
Rare Bat Survey Map

Revised: 2024-09-05 By: pbarbera

U:\195619560322703_data\gis_cad\gis\MXD s\3227_01_Juniper_Site.mxd

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Reference: **Rare Bat Acoustic Survey for the Phase II Expansion of the Juniper Ridge Landfill in Old Town, Maine**

We determined the final location of each survey site while in the field based on potential bat habitat availability. Detector 1 was deployed near the proposed location in a small clearing, and Detector 2 was deployed approximately 210 meters west of the location proposed in the Study Plan (and ~240 meters from Detector 1) to survey what appeared to be more suitable foraging habitat. At each survey site, we deployed one full-spectrum acoustic bat detector (Wildlife Acoustics SM4BAT) with an omnidirectional microphone (SMM-U1). We deployed detectors based on preferred criteria identified within the USFWS Guidelines. We deployed the detector microphones 3 meters above the ground on extendable poles and, to the extent possible, more than 10 meters from vegetation that could obstruct or reflect bat calls. Detectors were programmed using default settings, including a 12-decibel gain, 256 kilohertz (kHz) sample rate, 16 kHz minimum trigger frequency, 3-second trigger window, and 15-second maximum file length. The detectors were powered by internal alkaline batteries and equipped with an SD card with a capacity of 128 gigabytes. We recorded detector and habitat conditions data for each detector deployed, and we collected a series of photographs of each detector site. We noted bat roosting, traveling, and foraging habitat at each detector site. Datasheets including photographs and brief habitat descriptions for each survey site are provided in Attachment B.

We programmed detectors to record bat activity from 30 minutes before sunset until 30 minutes after sunrise as determined by the latitude and longitude of the site. Detectors were deployed on July 18, 2024. Once deployed, we monitored weather conditions at a nearby weather station (Station ID: KMEOLDTO34[4]) in Old Town, Maine. We removed detectors from the field after they operated for at least 7 nights with suitable weather conditions, according to records at that weather station.

We processed data from the first seven nights with suitable weather conditions for each survey location using a USFWS approved version of Kaleidoscope Pro (KPro) software (Version 5.6.6) using autoclassifier version 5.4.0 (S/A: -1) with the species set selected for Maine. The automated analysis provides results for each bat species potentially recorded during the survey. We manually vetted each pass classified as NLEB and tricolored bat by KPro for those nights with nightly maximum likelihood estimations (MLEs) indicating presence (i.e., nightly MLE of <0.05). We also reviewed the high frequency bat passes recorded on those nights to verify if any NLEB or tricolored bat passes may have been misclassified on those nights.

Species presence each night was based on a nightly MLE of 0.05 or less, as calculated by KPro, and/or based on visual vetting by experts in acoustic bat identification (Laura Berube and Trevor Peterson, resumes in Attachment C).

SURVEY RESULTS

Acoustic survey nights with suitable weather conditions were collected on July 18–24, 2024. A total of 14 detector-nights were collected, with 7 detector-nights per survey site. KPro did not classify any files as NLEB and did not have any nights at either of the survey sites that had a significant nightly MLE (i.e., nightly MLE of <0.05), indicating unlikely presence of this species at the sampling sites (Table 1). KPro did classify two files as tricolored bats but no nights had a significant nightly MLE, indicating unlikely presence of this species at the sampling sites. Although the USFWS Guidelines did not require manual review of the two files classified by KPro as tricolored bat, Stantec did view these files and determined that one was likely produced by an

[4] Weather Underground, Runaway Weather Station, KMEOLDTO34, https://www.wunderground.com/dashboard/pws/KMEOLDTO34

Reference: **Rare Bat Acoustic Survey for the Phase II Expansion of the Juniper Ridge Landfill in Old Town, Maine**

eastern red bat (*Lasiurus borealis*) and that the other contained only three bat pulses produced by a high frequency bat but did not contain enough call characteristic information to be identified to species.

Although not the targeted species in this study, auto-classification results from KPro found the probable presence of big brown bat (*Eptesicus fuscus*), eastern red bat, hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*; Table 1). Surveys determined presence of eastern small-footed bat (*Myotis leibii*) and little brown bat (*Myotis lucifugus*) to be unlikely based on no nights with nightly MLE values of less than 0.05.

Table 1. Number of nights with significant nightly MLE results (i.e., nightly MLE of <0.05) calculated by KPro automated analysis software by species and site.

Site	Number of Nights with Significant Nightly MLE (<0.05) / Percent of Total Surveyed Nights							
	Target Species[1]		Non-Target Species					
	NLEB	Tricolored	Big Brown	Eastern Red	Hoary	Silver-haired	Eastern Small-footed	Little Brown
1	0 / 0%	0 / 0%	6 / 86%	6 / 86%	3 / 43%	7 / 100%	0 / 0%	0 / 0%
2	0 / 0%	0 / 0%	7 / 100%	5 / 71%	3 / 43%	5 / 71%	0 / 0%	0 / 0%
Project Total	**0 / 0%**	**0 / 0%**	**13 / 93%**	**11 / 79%**	**3 / 43%**	**12 / 86%**	**0 / 0%**	**0 / 0%**

1. Target species include NLEB, federally listed under the Endangered Species Act, and tricolored bat, a species proposed for federal listing under the Endangered Species Act.

SUMMARY AND CONCLUSIONS

The acoustic survey conducted for the Project in summer 2024 followed USFWS Guidelines and resulted in the findings of probable absence of NLEB and tricolored bat at the proposed expansion area of the Phase II Expansion of the Juniper Ridge Landfill in Old Town, Maine at the time of survey. KPro did not calculate a nightly MLE indicating presence at either detector for NLEB or tricolored bat, indicating unlikely presence of both species at the sampling sites pr USFWS Guidelines.

If you have any questions about our survey efforts or results, please feel free to contact me.

Stantec Consulting Services Inc.

Laura Berube

Laura Berube
Project Scientist

Mobile: 207.713.0462
Laura.berube@stantec.com

Cc: Doug Stewart, Stantec Consulting Services Inc.

Reference: **Rare Bat Acoustic Survey for the Phase II Expansion of the Juniper Ridge Landfill in Old Town, Maine**

Attachments: Attachment A – USFWS Study Plan Form
Attachment B – Acoustic Bat Detector Datasheets
Attachment C – Resume for Bat Analysis

Electronic Deliverable: USFWS Bat Reporting Spreadsheet

Attachment A – USFWS Study Plan Form

U.S. Fish and Wildlife Service

Study Plan Form for Bat Surveys and Monitoring (v. 2.1)[1]

PROJECT & SURVEY INFORMATION

Project Name: Juniper Ridge Landfill Phase II Expansion

Proposed Survey Start Date: July 15, 2024

Project Proponent's Name (e.g., client/company/institution): Juniper Ridge Landfill, Phase 2 Expansion

Project Location: State(s): Old Town and Alton, ME

County(s): Penobscot

Latitude: 44.986940°

Longitude: -68.726840°

REQUIRED: Attach or provide links to Google Earth® KMZ files (preferred) and/or shapefiles (mapping must show project boundaries, impacted forest habitat (if known) and all proposed survey sites)
Files are attached: Yes ☑ No ☐
File Links: _____

Project Summary. In the space provided below, please provide a description of the proposed action, including any activities that will permanently or temporarily alter the current environment and existing habitat features.

The Juniper Ridge Landfill is a secure landfill located on a 780-acre parcel in Old Town and Alton. It is owned by the Maine Department of Administrative and Financial Services' Bureau of General Services and is operated by NEWSME Landfill Operations, LLC. On behalf of the owners and operators, Sevee & Maher Engineers is proposing the clearing of up to 61 acres of vegetation which may include clearing of trees considered suitable habitat for the federally listed northern long-eared bat and tr-colored bat recently proposed for listing. This tree clearing is necessary for the expansion of the Juniper Ridge Landfill in Old Town and Alton, Maine.

CONTACT INFORMATION

Project Manager/Primary Point of Contact (POC): Doug Stewart

Phone: 207 406-5471

Field Survey Crew Leader (if different from POC): Gabe Pelletier

Cell Phone: 207-720-0171

Institution/Company Name: Stantec Consulting Services Inc.

Mailing Address: 30 Park Drive, Topsham, ME 04086

POC Email Address: Stantec, 30 Park Drive, Topsham, ME 04086

USFWS Sec. 10(a)(1)(A) Permit No.(s) (if applicable): not applicable

State Permit No.(s) (if applicable): not applicable

[1] Unless otherwise directed by the Service, surveyors may complete this fillable form, in lieu of a traditional narrative format, and submit it (and supporting files) to the Ecological Services Field Office in the state(s) where the work is to be completed (https://www.fws.gov/our-facilities). Use of this form is not a requirement at this time. Our goal is to improve pre-survey coordination and to expedite the Field Office review and approval process. Please submit your study plan at least 15 working days in advance of your proposed survey start date. Suggestions for improving this document may be sent to R4_Bat_Survey_Guidance@fws.gov.

Have project proponents been informed that abiding by protective time-of-year restrictions (where available) may be sufficient to avoid take of federally listed bats and (in some cases) may negate the need for a bat survey? Yes☑ No☐

Have project proponents been informed that the Service does not require presence/probable absence surveys for federally listed species and that presence can be assumed in a project area containing suitable habitat? Yes☑ No☐

Will this survey be conducted on private or public lands? *(Check both if applicable)*: Private☐ Public☑

Has permission of all necessary landowners/managing agencies been obtained? Yes☑ No☐

If no, explain: _____

Does this project have a federal nexus[2]? Yes☑ No☐ Unsure☐

If yes, explain: _____

IPaC[3] Consultation Code (if applicable): _____

Purpose of Survey: Official P/A Survey ☑ Research ☐ Monitoring ☐
Educational Outreach/Training Other: _____

Survey Target Species: Indiana bat (IBAT) ☐ Northern long-eared bat (NLEB) ☑
Tricolored bat (TCB) ☑ Other: _____

Has a Phase-1 Habitat Assessment* of the project area been conducted? Yes☐ No☑
If yes, how was the habitat assessment conducted? Field☐ Desktop☐ Combo☐
*(*if available, attach a written report)*

Is suitable habitat[4] present (or assumed present) for all "target" species? Yes☑ No☐

If no, explain: _____

Does this project fall within the outer-tier[5] of any "target" species known home range? Yes☐ No☐ Unsure☑

If yes, which species: _____

Project Configuration

Is this project **linear** (>1 km in total length)? Yes☐ No☑ Combo☐ Unsure☐

If yes, how many 1-km sections containing suitable IBAT/NLEB habitat will be impacted? _____

Is this project **non-linear**? Yes☑ No☐ Combo☐ Unsure☐

If yes, how many acres of suitable IBAT/NLEB habitat is in the overall project area? 61

If yes, how many acres of suitable IBAT/NLEB habitat will be directly impacted/cleared? 61

PROPOSED METHODS & SURVEY LEVEL OF EFFORT[6]

ACOUSTICS

Total number of detector sites proposed to be surveyed: 2 Number of detector nights/site: 7

[2] A project or action that is carried out, authorized, funded, and/or permitted by a federal agency.
[3] https://ipac.ecosphere.fws.gov/
[4] See Appendix A of the Guidelines regarding suitable habitat definitions.
[5] See Appendix G of the Guidelines if you are unclear what the out-tier of a known range includes.
[6] Survey level of effort (acoustic or netting) must be spread over at least two calendar nights/survey site.

Total number of detector nights for entire survey: 14

Total proposed number of calendar nights to complete the entire survey: 7

Detector(s) (Brand, Model): Wildlife Acoustics SM4BAT or BatMini Microphone(s): directional ☐ omnidirectional ☑

Recording Format: Full Spectrum ☑ Zero-Crossing ☐

FWS-Approved[7] Acoustic Bat ID Software: KPro vers. 5.6.6 KPro Classifier, NA vers. 5.4.0 BCID vers.____
Other Candidate Programs (e.g., Sonobat) vers.: _____

Species to be included for automatic software ID classification analysis:

EPFU☑ CORA☐ COTO☐ LABO☑ LACI☑ LANO☑ LASE☐ TABR☐ MYCI☐ MYEV☐ MYGR☐ MYLU☑
MYLE☑ MYSE☑ MYSO☐ MYTH☐ MYVO☐ NYHU☐ PESU☑ Others:_____

Will qualitative analysis (i.e., manual vetting) be used? Yes☑ No☐ Unsure☐

Name(s) of qualified biologist(s) conducting qualitative/manual identifications (attach resume or link with qualifications):
Laura Berube, Caroline Byrne, Trevor Peterson

MIST-NETTING

Total number of net sites to be surveyed: 0 Total number of net nights/site: _____

Total number of net nights for entire survey (No. of sites X No. of net nights/site): _____

Total proposed number of calendar nights to complete the entire survey: _____

A) Maximum number of net set-ups that will be operated/checked (10-min interval) on a given calendar night at a given survey site: _____
B) Minimum Number of personnel present to operate/check X (see A) net set-ups on a given site: _____
C) Proposed Staffing Rate (A divided by B): _____

Staffing Rate

Number of Section 10-permitted biologists per net site (or state-permitted in USFWS R5): _____

Do you propose to band bats? Yes☐ No☐

If yes, please answer the following:

What species will be banded? COTO☐ MYGR☐ MYLU☑ MYSE☑ MYSO☐ PESU☑
Others:_____ All captured bats:
If banding *Myotis* sp. or PESU, specify band size: _____
Describe your proposed bands (color and letter-numbers) and banding scheme: _____
Will banding pliers be used? Yes☐ No☐

Will any biological samples be collected from captured bats (e.g., guano, hair, swab, wing punch)? Yes☐ No☐

If yes, explain: _____

Name of institution or facility to conduct DNA analysis: _____

RADIO-TRACKING

Will any bats be radio-tagged and tracked? Yes☐ No☑

[7] https://www.fws.gov/media/automated-acoustic-bat-id-software-programs

If yes, please answer following:

Which species will be radio-tagged? _____

Name of USFWS Section 10 permitted biologist(s) who will apply transmitter(s): _____

Make/model and approximate weight of transmitter(s) to be used: _____

Manufacturer date and estimated life-span of transmitters to be used: _____

Frequency range (MHz) of transmitters (e.g., 150.xxx or 172.xxx): _____

If radio-tracking multiple targeted bats/species, what criteria will be used in selecting which bats will be tracked?

_____

Will all radio-tagged bats be tracked (min. of 4-hrs. search effort/day) to their diurnal roosts for the minimum recommended period of 7 days? Yes☐ No☐

If no, explain: _____

Will night-time foraging data/telemetry be collected? Yes☐ No☐

Glue used for attaching transmitters: Type: Silicone-based Surgical Adhesive Name: Uro-Bond III 5000

Manufacturer: 3M Other: _____

EMERGENCE SURVEYS

After diurnal roost sites of radio-tagged bats are identified, will emergence surveys be conducted at each identified roost (assuming landowner permission is obtained)? Yes☐ No☐

If yes, how many emergence surveys/roost? _____

Have you identified a small number (e.g., ≤10) of potentially suitable roost trees* that you propose to conduct emergence surveys for? Yes☐ No☐

*(*If yes, provide photographs of each tree documenting that all of the tree can be observed by the surveyor along with coordinates (lat/long and/or KML/shapefile) of all trees to be surveyed.)*

POTENTIAL HIBERNACULA SURVEYS

Are you aware of any known hibernacula used by the target species within the project area itself or nearby?

Yes☐ No☑ Unknown☐

If yes or unknown, list sites or explain: _____

Has your desktop analysis identified any natural or man-made features that could be used as a hibernaculum by any of the target bat species? Yes☐ No☐ Unknown☐

If yes, underground features (e.g., caves, mines, tunnels, bunkers, cisterns) present: Yes☐ No☐

If yes, above-ground features* (e.g., crawl spaces) present: Yes☐ No☐

If unknown, explain: _____

Are you requesting approval of a field survey for potential hibernacula at this time? Yes*☐ No☐

*(*If yes, attach a separate narrative explaining how the project area(s) will be surveyed for potential hibernacula.)*

Are you submitting the results of a Phase 1 Habitat Assessment of potentially suitable hibernacula identified from field surveys? Yes*☐ No☐

*(*If yes, provide a Phase 1 Habitat Assessment Data Sheet for each potential hibernaculum/portal(s)[8] identified to be surveyed.)*

BRIDGE & CULVERT ASSESSMENTS

Will any bridges or culverts be surveyed for bat presence? Yes☐ No☑

If yes, please answer the following:

[8] If multiple cave entrances/portals, please list all locations.

Structure type(s) (check all that apply): Bridge☐ Culvert☐ Other☐
If "other", explain: _____

Survey methodology for structure(s) (check all that apply):
Visual inspection☐ Guano collection☐ Emergence survey☐ Acoustics*☐
Mist-net*☐ Harp-trap*☐ Other _____
*(*Due to site-specific conditions of structures, coordination with the local USFWS Field Office and appropriate state agency(ies) is necessary before proceeding with these survey methodologies)*

Will guano be collected and analyzed to confirm species ID? Yes☐ No☐
If "yes", name of institution/entity performing analysis: _____

ADDITIONAL SURVEY INFORMATION[9]

Will the proposed bat survey deviate from the current version of the USFWS Survey Guidelines?[10] Yes☐ No☑

If yes, provide justification for any departures or modifications to the guidelines (if applicable) below:

Proposed detector locations are >200 m from one another. Potentially suitable habitat occurs throughout the parcel to be surveyed, but potentially suitable detector sites are limited. Should proposed survey points need to be moved to meet suitable criteria outlined in the USFWS guidelines, Stantec will determine final detector locations in the field based on field conditions and document their position.

I hereby acknowledge that the information being provided to the Service is accurate and complete as of today's date.

Signature: Stewart, Doug (Topsham) Digitally signed by Stewart, Doug (Topsham) Date: 2024.07.15 14:01:51 -04'00' Date: _____

[9] Attach additional pages to this form, if needed.

[10] Proposed surveys deviating from the current Range-wide IBAT & NLEB Survey Guidelines will only be accepted with a thoroughly described justification. Coordinate with your local USFWS Field Office (https://www.fws.gov/our-facilities) for acceptable modifications.

*********FOR U.S. FISH AND WILDLIFE SERVICE USE ONLY**********

United States Department of the Interior

Fish and Wildlife Service

Generic ES Field Office

Street Address

General Office Phone:

SITE-SPECIFIC AUTHORIZATION - BAT WORK

Our Field Office has reviewed your study plan and found it to contain sufficient information for our approval. When signed, this statement serves as your site-specific authorization to conduct the proposed activities at the specified locations included in the attached Study Plan Form and supporting files and must be carried with your federal permit when conducting work for this project. All activities must be carried out with strict adherence to permit conditions and authorizations specified in your federal permit as well as your state permit(s) (if needed). The section 10(a)(1)(A) permit authorizing the activities must remain with the surveyor at all times. This authorization is not valid if you have not obtained permission from the owner of the lands where activities will occur.

For federal permit reporting purposes, please use the appropriate USFWS bat survey data spreadsheet, available on the IBAT and NLEB Summer Survey Guidance website[1]. To mitigate the risk of humans transmitting viruses (e.g., SARS-CoV-2) to bats or viral transmission from bats to humans, the U.S. Fish and Wildlife Service requests anyone directly handling or working in close proximity to bats follow current guidelines prepared by the CDC[2] and IUCN Bat Specialist Group[3] in addition to the following the standard WNS decontamination protocols[4].

If the work expands beyond the scope of your original study plan or if there are adverse effects to bats that were not anticipated, cease all survey and/or research activities, and contact this office prior to continuing. Additionally, if a federally listed bat is captured, this USFWS Field Office must be notified within 48 hours with information regarding species, sex, age, and whether or not the bat has a transmitter attached.

Field Office POC: _____

email: _____ phone:_____

☐ **Authorized as Proposed**

☐ **Authorized with Conditions** (see below)

You are authorized to proceed provided that the following adjustment(s) and/or conditions are met.

☐ **Not Authorized.**

Comments:

Signature & Date:

NOTE: Please check the appropriate box above before signing/locking the document.

[1] https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines
[2] https://www.cdc.gov/healthypets/covid-19/wildlife.html
[3] https://www.iucnbsg.org/uploads/6/5/0/9/6509077/amp_recommendations_for_researchers_final.pdf
[4] https://www.whitenosesyndrome.org/mmedia-education/national-wns-decontamination-protocol-u-s

Attachment B – Acoustic Bat Detector Datasheets

Stantec Ground-Based Acoustic Bat Detector Datasheet

Site ID: 1	**Project Number:** 195603227	**Project Name:** Juniper Ridge Landfill	
	State: ME	**County:** Penobscot	**Acoustic Survey Type**
Site Selector: Laura Berube	**Lat:**44.98705171642082	**Long:**-68.72812682274099	Summer - Acoustic
Deployer: Laura Berube	**Notes:**		
Date Deployed: July 18, 2024			
Deploy Duration: 7			
Detector #: S4U12628			

Detector Setup

Detector Make:	Wildlife Acoustics	**Detector Model:**	SM4BAT FS	**Dist to Obstruct (m):**	10
Microphone Model:	SMM-U1	**Directionality:**	Omnidirectional	**Mic Height (AGL; m):**	3
Weatherproofing:	None	**Mic Angle:**	0 (parallel w/ ground)	**Call Data Type:**	Full Spectrum
Mic Direction (deg):	340	**In-Field Calibration:**	PASS	**Notes:**	

HABITAT DESCRIPTION

VEGETATION CHARACTERISTICS

Habitat Type: Other

Canopy Closure (%): Open

Habitat Description: Small clear cut with wet woods road running through it, within mixed forest adjacent to Landfill Road. Clear cut made up of regenerating hardwoods.

Habitat Use:	Roosting, Foraging, Traveling

Habitat Notes: See above.

STREAM CHARACTERISTICS

Est. Distance to Water Source (m):	900
Type of Water:	Pond

Detector Startup Notes:

Detector Startup:

Memory A:	0/128
Memory B:	0/NA
Battery:	6.3
Mic 0:	U1
Cal Ch 0:	PASS
Going to Sleep Until:	July 18, 2024 7:46 PM

Additional Site Notes:

Stantec Ground-Based Acoustic Bat Detector Datasheet

Site ID: 2	**Project Number:** 195603227	**Project Name:** Juniper Ridge Landfill	
	State: ME	**County:** Penobscot	**Acoustic Survey Type**
Site Selector: Laura Berube	**Lat:**44.98506104699033	**Long:**-68.72911184864148	Summer - Acoustic
Deployer: Laura Berube	**Notes:**		
Date Deployed: July 18, 2024			
Deploy Duration: 7			
Detector #: S4U00671			

Detector Setup

Detector Make:	Wildlife Acoustics	**Detector Model:**	SM4BAT FS	**Dist to Obstruct (m):**	10
Microphone Model:	SMM-U1	**Directionality:**	Omnidirectional	**Mic Height (AGL; m):**	3
Weatherproofing:	None	**Mic Angle:**	0 (parallel w/ ground)	**Call Data Type:**	Full Spectrum
Mic Direction (deg):	80	**In-Field Calibration:**	PASS	**Notes:** Tons of eagles and crows scavenging here, near the landfill	

HABITAT DESCRIPTION

VEGETATION CHARACTERISTICS

Habitat Type: Other

Canopy Closure (%): Open

Habitat Description: Clear cut between dirt road and mixed forest, next to the landfill. Ferns, gramminoids, and some regenerating hardwoods in clear cut.

Habitat Use:	Roosting, Foraging, Traveling

Habitat Notes: See above.

STREAM CHARACTERISTICS

Est. Distance to Water Source (m):	700
Type of Water:	Pond

Detector Startup Notes:

Detector Startup:

Memory A:	0/128
Memory B:	0/NA
Battery:	6.3
Mic 0:	U1
Cal Ch 0:	PASS
Going to Sleep Until:	July 18, 2024 7:46 PM

Additional Site Notes:

Attachment C – Resumes for Bat Analysis

Laura Berube

Project Environmental Scientist
13 years of experience ·Topsham, Maine

Laura is a Project Environmental Scientist for projects involving avian and bat studies for pre- and post-construction projects in eastern United States and Canada. Laura is a wildlife biologist and is proficient in acoustic bat analysis including manual vetting of rare and threatened species and the use of automated analysis programs: Kaleidoscope, BCID, EchoClass, and Sonobat. She has performed acoustic bat data analysis for projects ranging from West Virginia, United States, north to Newfoundland, Canada. Laura also has strong bird identification skills and the ability to identify bird species by both sight and sound. She has recently performed diverse avian studies for a number of renewable energy projects in the Northeastern United States, with field work including visual raptor surveys, eagle point count surveys, nocturnal migrant radar surveys, breeding bird surveys, and acoustic bat surveys. Laura is proficient in data management, analysis, summary, and vigorous QAQC for a variety of avian wildlife surveys.

Laura is also responsible for conducting vernal pool surveys and natural resource assessments and supporting wetland delineations to assist with the preparation of local, state, and federal permit applications. She has worked on a variety of natural community and rare plant surveys and projects ranging from general reconnaissance observations to quantitative community- and species-specific surveys. These projects have involved natural community mapping and analysis for transportation projects, utility corridors, and development sites.

PROFESSIONAL EXPERIENCE

• Stantec Consulting. 2010-present. Project Environemntal Scientist.
• University of Maine. 2009. Wildlife Department Field Assistant.

EDUCATION

Bachelor of Science, Wildlife Ecology, University of Maine, Orono, Maine, 2010

Bat Conservation and Management - Acoustic Data Management Workshop, Bat Survey Solutions, LLC - Janet Tyburec and John Chenger, Fairfield, Maine, 2015

Wilderness First Aid Certified, SOLO, Topsham, Maine, 2014

40-Hour HAZWOPER Certification, Topsham, Maine, 2014

OSHA 10-Hour Construction Certification, ClickSafety, Topsham, Maine, 2012

MEMBERSHIPS

Secretary/Treasurer, 2014-2019, The Wildlife Society, Maine

PROJECT EXPERIENCE

NATURAL RESOURCE SERVICES

Hand Analysis of Acoustic Bat Data | Topsham, Maine

Over ten years of experience conducting analysis of bat detector data to determine species of bats for multiple project sites in eastern United States and Canada. Analysis results were then provided to clients to assist with their project planning and permit applications in compliance with applicable local, state, and federal natural resource regulations.

Automated Program Analysis of Acoustic Bat Data | Topsham, Maine

Conducted analysis of bat detector data using Kaleidoscope, BCID, and Sonabat software to determine species of bats for multiple project sites for both passive acoustic bat surveys and presence/absence acoustic bat surveys targetting northern long-eared bat (*Myotis septentrionalis*) and Indiana bat (*Myotis sodalis*). Analysis results were provided to clients to assist with their project planning and permit applications in compliance with applicable state and federal natural resource regulations.

Proposed Solar and Infrastructure Update Projects | Vermont | Project Manager

Wrote the proposals and was Project Manager for proposed projects requiring northern long-eared bat surveys. Responsible for client and agency communication, managing of field staff and field survey completion, and the completion of final reports and delivery to client to assist with their project planning and permit applications in compliance with applicable state and federal natural resource regulations.

Post-construction Avian Fatality Monitoring at a Developed Wind Project | New Hampshire | Project Manager

Project Manager of the post-construction monitoring survey conducted at a developed wind project in New Hampshire. Responsible for client and agency communication, managing of field staff and field survey completion, and the completion of final reports and delivery to client and applicable state and federal natural resource agencies to assist with the compliance of the permit.

Ichthyoplankton Sampling | Field Technician

Assisted in ichtyoplankton field sampling to characterize the marine egg and larvae community present and potentially susceptible to impingement and entrainment at the cooling water intake structure of a facility withdrawing cooling water from Penobscot Bay, in support of the Clean Water Act 316(b) for a confidential client. The results of the sampling will be included in 316b report and would be used to inform the design of the impingement control system to be eventually installed.

Proposed Wind Project | Maine | Project Manager

Project Manager for proposed wind project requiring pre-construction avian and wildlife surveys. Responsible for client and agency communication, managing of field staff and field survey completion, and the completion of final reports and delivery to client to assist with their project planning and permit applications in compliance with applicable state and federal natural resource regulations.

Proposed Wind Projects | Maine | Task Manager

Responsible for the staffing and scheduling of field surveys including visual raptor surveys, eagle point count surveys, breeding bird surveys, and acoustic bat surveys. Also responsible for task managing the completion of sections of the final reports to be delivered to clients to assist with their project planning and permit applications in compliance with applicable state and federal natural resource regulations.

Orangeville, Marsh Hill, and Sheldon Wind Projects, Post-Construction Monitoring | Western New York | Technician Supervisor

Supervised four post-construction monitoring technicians. Responsible for timecard and expense approval, tracking completion of safety trainings, and communicating with staff about needs while in the field.

Proposed Wind Project, Down East Maine

Conducted pre-construction wind project development surveys and impact assessments for a proposed wind project in Maine. These assessments included raptor surveys, eagle point count surveys, acoustic bat surveys, nocturnal radar surveys, and breeding bird surveys. Analyzed and reported on data for reporting purposes related to impact assessment and permitting efforts.

Agency Meeting and Site Visit for Proposed Wind Project, Down East Maine

Attended a pre-application agency consultation meeting for a proposed wind project in Down East Maine. Attended a site visit at proposed project area with client and agency representatives. Provided information on pre-construction wildlife field surveys conducted by Stantec at proposed wind project.

Rollins Wind Project Invasive Species Monitoring | Lincoln, Maine

Conducted invasive species surveys along a recently constructed transmission line right-of-way according to the standards and methods developed in the Invasive Species Management Plan.

Schedule Coordinator | Topsham, Maine

Proposed Linear Project | New Brunswick, Canada

Conducted surveys for rare, threatened, and endangered species of plants and wildlife, assessments of existing wildlife habitat values, and mapping of wetland and stream resources.

Proposed Wind Project, Western New York

Conducted eagle point count surveys to determine eagle locations and behavior in relation to proposed wind turbines. Assisted in survey design, mapping, and implementation. Preformed quality assurance and control on data to inform potential collision risk of eagles as a result of the project.

Bull Hill Wind Farm Post-Construction Monitoring, Maine

Conducted bird and bat mortality ground searches (a requirement of utility-scale wind power developments in Maine). Responsible for scavenger surveys, which involved the placement and monitoring of carcasses and use of game cameras. Responsible for searcher efficiency trials, which involved the placement and monitoring of carcass retrieval by other surveyors.

Groton Wind Farm, Raptor Surveys, Breeding Bird Surveys, Nocturnal Migrant Radar Surveys | Grafton County, New Hampshire | Task Manager

Responsible for the staffing and scheduling of field surveys. Also responsible for task managing the completion of sections of the final report to be delivered to the client. Conducted raptor, breeding bird, and nocturnal migrant radar surveys.. Analyzed data for reporting purposes related to impact assessment and permitting efforts.

Record Hill Wind Farm Raptor Surveys, Roxbury, Maine

Conducted raptor surveys to determine species, locations, and behavior in relation to proposed wind turbines. Analyzed data for reporting purposes related to impact assessment and permitting efforts.

Rollins Wind Farm Post-Construction Mortality Monitoring and Raptor Surveys, Maine

Conducted bird and bat mortality ground searches (a requirement of utility-scale wind power developments in Maine). Evaluated as having high searcher efficiency scores for the on-the-ground trials. Responsible for scavenger surveys, which involved the placement and monitoring of carcasses and use of game cameras. Also conducted raptor surveys to determine species, locations, and behavior in relation to proposed wind turbines. Analyzed data for reporting purposes related to impact assessment and permitting efforts.

Proposed Wind Project Bird and Bat Surveys, Coye Hill, Connecticut

Conducted pre-construction wind project development surveys and impact assessments for a proposed wind project in Connecticut. These assessments included raptor surveys, acoustic bat surveys, and breeding bird surveys.

Eastern Box Turtle Protection Plan and Construction, Brewster, Massachusetts

Conducted regular fence inspection in accordance with and NHESP-approved Eastern Box Turtle Protection Plan designed to protect box turtles in compliance with MESA during construction of a pump station development project. Responsible for documenting the presence of any box turtles in the vicinity of the fencing and reporting deficiencies in the fencing to appropriate personnel.

Stetson I and II Wind Farms Post-Construction Monitoring, Maine

Conducted bird and bat mortality ground searches (a requirement of utility-scale wind power developments in Maine). Evaluated as having high searcher efficiency scores for the on-the-ground trials. Responsible for scavenger surveys, which involved the placement and monitoring of carcasses and use of game cameras.

Oakfield Wind Project Avian Studies | Maine

Conducted raptor surveys to determine species, locations, and behavior in relation to proposed wind turbines. Analyzed data for reporting purposes related to impact assessment and permitting efforts.

Ecological Characterizations | Coos County, New Hampshire

Conducted surveys for rare, threatened, and endangered species of plants and wildlife, assessments of existing wildlife habitat values, and mapping of wetland and stream resources in a remote area of New Hampshire.

Data Manager | Topsham, Maine

Responsible for managing data related to bird and bat studies conducted by the office. Responsible for the retrieval, and placement of data to assist in effective report writing and limiting of possible liability.

Wind Project | Eastern Maine

Project scientist responsible for organization, progress, and safety of field staff through the field work phase (wetland delineations, vernal pool surveys, and other natural resource mapping) of large-scale wind power development. Responsible for data management and associated reporting of findings to accompany state and federal permit applications.

Beech Hill Wind Project | Aroostook County, Maine

Assisted in wetland delineations, vernal pool surveys, and Global Positioning System surveys for a proposed 34-turbine wind project and associated 67-mile transmission line. Identified streams and Wetlands of Special Significance based on the criteria in the Maine Department of Environmental Protection's Natural Resource Protection Act. Characterized wetland and waterbody resources based the U.S. Fish and Wildlife Service Classification of Wetlands and Deep Water Habitats of the United States (Cowardin et. al 1979). Documented the biological and physical characteristics of potential vernal pool habitat based on the criteria of the Maine Department of Inland Fisheries and Wildlife.

Proposed Wind Project | Northern California

Analyzed crepuscular radar data targeting federally threatened and state endangered marbled murrelets (*Brachyramphus marmoratus)* and reviewed and managed acoustic bat survey data for reporting purposes related to impact assessment and permitting efforts.

Proposed Wind Project | Central Maine

Conducted wetland delineations, vernal pool surveys, and Global Positioning System surveys over an area totaling approximately 6,800 acres for a proposed 55-turbine wind project in Central Maine. Determined wetland boundaries using the technical criteria described in the U.S. Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Identified streams and Wetlands of Special Significance based on the criteria in the Maine Department of Environmental Protection's Natural Resource Protection Act. Characterized wetland and waterbody resources based the U.S. Fish and Wildlife Service Classification of Wetlands and Deep Water Habitats of the United States (Cowardin et. al 1979). Documented the biological and physical characteristics of potential vernal pool habitat based on the criteria of the Maine Department of Inland Fisheries and Wildlife.

Block Island Wind Farm, Offshore | Rhode Island

Conducted analysis of bat detector data using Kaleidoscope software and provided quality review of bat call determinations by the software to determine species of bats. Analysis results were provided to the client to assist with the project’s compliance of applicable state and federal natural resource regulations.

Natural Resource Advisory Role in Oil Spill Response | Large Interstate Oil Spill in Gulf of Mexico | 2010-present | Natural Resource Advisor

Natural Resource Advisor (NRA) conducting environmental oversight of oil spill cleanup activities in compliance with an emergency consultation under Section 7 of the Endangered Species Act. NRAs worked directly with operational cleanup crews to implement Best Management Practices (BMPs). These BMPs served as the formal technical guidance issued under the emergency consultation. The objective of this work was to minimize secondary impacts of the cleanup activities on protected resources, including sea turtles, migratory and nesting shorebirds, beach mice, mangrove wetlands, estuaries, coastal wetlands, and dune systems. Implemented BMPs and conducted surveys for piping plover and sea turtles within designated critical habitats. Conducted training and oversight of cleanup crews and prepared daily reports documenting NRA activities. Worked closely with cleanup operations to provide education on BMPs and documenting daily compliance for use in USFWS consultation process and evaluation of secondary impacts to protected resources as part of the Natural Resources Damage Assessment (NRDA).

Proposed Wind Project, Offshore | Northeast and Mid-Atlantic US

Conducted analysis of bat detector data using Kaleidoscope software and provided quality review of bat call determinations by the software to determine species of bats. Analysis results were provided to the client to assist with planning and permit applications in compliance with applicable state and federal natural resource regulations.

Trevor Peterson PhD

Project Manager, Senior Wildlife Biologist
26 years of experience · Topsham, Maine

Dr. Peterson is a senior wildlife biologist and project manager specializing in renewable energy projects, bird and bat migration, and rare species assessments. He focuses on solutions to quantify and manage turbine-related wildlife impacts at terrestrial and offshore commercial wind projects. Since joining the company in 2003, Trevor's project experience has included a wide range of wide range of wildlife surveys at proposed and existing wind projects, rare bat surveys, breeding bird surveys, raptor surveys, nocturnal radar surveys, vernal pool water quality and ecological monitoring, rare turtle telemetry and demographic studies, natural community characterization, and vegetation monitoring. He earned his PhD in Ecology and Environmental Sciences from the University of Maine for his research on the use of long-term acoustic bat data to study bat migration and predict and manage potential impacts from land-based and offshore wind projects. Before working at Stantec, Trevor worked seasonally for the National Park Service at Acadia National Park and Isle Royale National Park and as an island caretaker for the Maine Island Trail Association. Dr. Peterson serves as Stantec's technical lead for acoustic bat surveys, responsible for updating equipment, survey methods, and data analysis/reporting methods.

EDUCATION

AB, Biology/Environmental Studies, Summa cum Laude, Phi Beta Kappa, Bowdoin College, Brunswick, Maine, US, 2002

Semester Program in Costa Rica, Tropical Field Biology, Environmental Studies, and Spanish, Duke University, Durham, North Carolina, US, 2000

PhD Ecology and Environmental Sciences , University of Maine, Orono, ME, 2020

CERTIFICATIONS & TRAINING

Habitat Conservation Plan Training, US Fish and Wildlife Service National Conservation Training Center, Shepherdstown, WV, United States, 2010

MEMBERSHIPS

Member, Northeast Regional Migration Monitoring Network

Member, Northeast Bat Working Group

Member, The Wildlife Society, Maine, May 2011-present

PROJECT EXPERIENCE

RENEWABLE ENERGY, OFFSHORE

Tracking Bats using Nanotag Telemetry in the Gulf of Maine

Senior Biologist and Project Manager. Developed and implemented survey techniques to track bats along the Maine coast using nanotag technology. Constructed and installed 5 telemetry receivers along the coast to supplement an existing network of monitoring stations. Project was funded by Stantec and supported by federal, state, academic, and NGO partners.

Regional Offshore Acoustic Bat Monitoring | Gulf of Maine, mid-Atlantic, Great lakes

Senior Biologist and Project Manager. Developed and implemented survey techniques and data analysis for long-term (2009–2014) acoustic bat monitoring in the Gulf of Maine, mid-Atlantic, and Great Lakes. Surveys included long-term monitoring at over 40 locations including remote islands, offshore weather buoys, ships, and coastal sites. Project was funded by Stantec, the US Department of Energy, and supported by federal, state, academic, and NGO partners.

RENEWABLE ENERGY

Activity-based Informed Curtailment: Using Acoustics to Design and Validate Smart Curtailment at Wind Farms | US Department of Energy | 2019 - 2022 | Prinicipal Investigator

Dr. Peterson serves as the principal investigator for this multi-year study of the use of acoustic bat data recorded at wind turbines to design and evaluate activity-based informed curtailment alternatives designed to manage risk to bats with minimal loss of renewable energy generation.

Avian and Bat Surveys at New Creek Wind Energy Project | Grant County, West Virginia

Project Manager, Field Supervisor, Expert Witness. Managed pre-construction agency consultation and bird and bat surveys, and coordinated field efforts, including breeding bird surveys, raptor surveys, bat mist-netting surveys, bat telemetry surveys, acoustic bat surveys, carcass monitoring, and curtailment studies. Managed post-construction fatality monitoring and nacelle-height acoustic monitoring to design activity-based informed curtailment programs to reduce impacts to bats.

Avian and Bat Surveys at Laurel Mountain Wind Energy Project | AES | Randolph and Barbour Counties, West Virginia

Project Manager, Field Supervisor, Expert Witness. Conducted bird and bat field surveys within proposed wind project. Coordinated pre-construction and post-construction field efforts, including breeding bird surveys, raptor surveys, bat mist-netting surveys, acoustic bat surveys, carcass monitoring, and curtailment studies. Managed correspondence between the developer, operator, and state and federal wildlife agencies. Prepared survey reports, avian bird and bat risk assessment, testimony, and a site-specific Avian and Bat Protection Plan.

Pre-construction Avian and Bat Surveys at Proposed Wind Energy Project | Texas

Project Manager and Field Supervisor. Developed an innovative work scope to conduct a variety of field surveys focusing on assessing potential impacts to Mexican free-tailed bats and managed a variety of field surveys including nocturnal radar surveys, NEXRAD data analysis, acoustic bat monitoring, and visual night-vision surveys. Mr. Peterson also coordinated discussions between project developers, state wildlife agencies, and non-profit groups.

Avian and Bat Surveys at Armenia Mountain Wind Energy Project | AES | Tioga and Bradford Counties, Pennsylvania

Project Manager and Field Supervisor. Conducted bird and bat field surveys within proposed wind project. Coordinated field efforts, including breeding bird surveys, raptor surveys, bat mist-netting surveys, and acoustic bat surveys. Managed correspondence between the developer and state and federal wildlife agencies. Prepared survey reports and a site-specific bird and bat risk assessment for the project. Managed two years of post-construction monitoring according to Pennsylvania Game Commission protocols.

Post-construction Avian and Bat Mortality Monitoring at Forward and Lookout Wind Projects | Edison-Mission Energy | Somerset County, Pennsylvania

Project Manager and Field Supervisor. As the Project Manager for post-construction bird and bat mortality surveys at two of the first operational wind projects to participate in Pennsylvania's Voluntary Cooperative Wind Energy agreement, Mr. Peterson developed survey work scopes, and coordinated fieldwork for multiple years of monitoring, including daily mortality surveys, acoustic bat surveys, and diurnal raptor surveys. Mr. Peterson also coordinated project-related agency communications with state and federal wildlife agencies.

NATURAL RESOURCE SERVICES

Acoustic Bat Surveys: Proposed Road Corridors | Tennessee Department of Transportation | Tennessee

Technical and Field Supervisor. Conducted acoustic bat surveys in a variety of habitats within 67-kilometer long segments of multiple potential highway corridors within a National Forest for the Tennessee Department of Transportation. Completed data analysis and prepared survey reports.

Indiana Bat and Rare Bird Surveys at Proposed Wind Energy Project | Jefferson and Oswego Counties, New York

Project Manager and Field Supervisor. Coordinated multiple years of habitat evaluations, acoustic bat surveys, and radio telemetry surveys for Indiana bats at a proposed wind project in northwestern New York. Mr. Peterson also coordinated and conducted field surveys for breeding birds and rare birds within the area.

PUBLICATIONS & WHITEPAPERS

Peterson, T.. *Predicting and managing risk to bats at commercial wind farms using acoustics. A dissertation submitted in partial fulfillment of the requirements for the degree of doctor of philosophy, University of Maine.*, 2020.

Peterson, T.S., A. Uesugi, and J. Lichter. Tree recruitment limitation by introduced snowshoe hares, Lepus americanus, on Kent Island, New Brunswick. *Canadian Field Naturalist 119 (4). 569-572*, 2005.

Peterson, T.S., B. Mcgill, C.D. Hein, and A. Rusk. Acoustic exposure to turbine operation quantifies risk to bats at commercial wind energy facilities. . *Wildlife Society Bulletin*, 2021, pp. 552-565.

Johnson, J.S., J.D. Kiser, K.S. Watrous, and T.S. Peterson. Day-roosts of Myotis leibii in the Appalachian Ridge and Valley of West Virginia. *Northeastern Naturalist 18 (1): 95-106.*, 2011.

Peterson, T.S., S.K. Pelletier and M. Giovanni. Long-term bat monitoring on islands, offshore structures, and coastal Sites in the Gulf of Maine, mid-Atlantic, and Great Lakes - final report. *Prepared for the US Department of Energy*, 2016.

Peterson, T.S., S.K. Pelletier, S.A. Boyden, and K.S. Watrous. Offshore acoustic monitoring of bats in the Gulf of Maine. *Northeastern Naturalist 21(1): 86-107*, 2014.

LAT (decimal degree)	LONG (decimal degree)	Positional Accuracy	Month	Day	Year	Start Time (military)	End Time (military)	Project Name	Site	State	County	Survey Type
44.98705172	-68.72812682	GPS with submete	7	18	2024	19:46	5:37	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	19	2024	19:45	5:38	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	20	2024	19:44	5:39	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	21	2024	19:43	5:40	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	22	2024	19:42	5:41	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	23	2024	19:41	5:42	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	24	2024	19:40	5:43	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	18	2024	19:46	5:37	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	19	2024	19:45	5:38	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	20	2024	19:44	5:39	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	21	2024	19:43	5:40	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	22	2024	19:42	5:41	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	23	2024	19:41	5:42	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	24	2024	19:40	5:43	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic

Detector Brand	Detector Model	Microphone Brand & Model	Directional, Omnidirectional, or Hemispherical Microphone	Weatherproofing type	Microphone Height (m)	Horizontal Orientation of Directional Microphone (1-360 degrees)	Vertical Orientation of Directional Microphone (approx. degrees)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)

Sensitivity Setting	Audio Division (if applicable)	Data Division (if applicable)	Were calls collected in Full Spectrum or Zero Crossing?	Habitat Type or Feature being Surveyed	Name of Person who Selected Acoustic Site	Name of Person who Deployed Detector	Email Address of Primary Surveyor	Comments
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	

LAT (decimal degree)	LONG (decimal degree)	Positional Accuracy	Month	Day	Year	Start Time (military)	End Time (military)	Project Name	Site	State	County	Survey Type
44.98705172	-68.72812682	GPS with submete	7	18	2024	19:46	5:37	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	19	2024	19:45	5:38	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	20	2024	19:44	5:39	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	21	2024	19:43	5:40	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	22	2024	19:42	5:41	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	23	2024	19:41	5:42	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98705172	-68.72812682	GPS with submete	7	24	2024	19:40	5:43	Juniper Ridge Lar	1	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	18	2024	19:46	5:37	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	19	2024	19:45	5:38	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	20	2024	19:44	5:39	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	21	2024	19:43	5:40	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	22	2024	19:42	5:41	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	23	2024	19:41	5:42	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic
44.98506105	-68.72911185	GPS with submete	7	24	2024	19:40	5:43	Juniper Ridge Lar	2	Maine	Penobscot	Summer - Acoustic

Detector Brand	Detector Model	Microphone Brand & Model	Directional, Omnidirectional, or Hemispherical Microphone	Weatherproofing type	Microphone Height (m)	Horizontal Orientation of Directional Microphone (1-360 degrees)	Vertical Orientation of Directional Microphone (approx. degrees)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	340	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)
Wildlife Acoustics	SM4BAT	SMM-U1	Omnidirectional	None	3	80	0 (parallel with ground)

Sensitivity Setting	Audio Division (if applicable)	Data Division (if applicable)	Were calls collected in Full Spectrum or Zero Crossing?	Habitat Type or Feature being Surveyed	Name of Person who Selected Acoustic Site	Name of Person who Deployed Detector	Email Address of Primary Surveyor	Comments
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	
			Full spectrum	Upland forest	Laura Berube	Laura Berube	laura.berube@stantec.com	

October 21, 2024

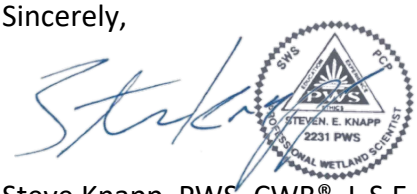
Lisa Turner, P.E., L.S.S
Project Manager
Sevee & Maher Engineers
4 Blanchard Road
Cumberland, ME 04021

RE: Juniper Ridge Landfill Rare, Threatened, and Endangered Species

In 2022, Biodiversity Research Institute (BRI) was retained by Sevee & Maher Engineers (SME) to complete regulated natural resource delineations on an approximately 144-acre survey area located at the Juniper Ridge Landfill in Old Town, Maine. As part of the site due diligence, inquiry letters were sent to the Maine Natural Areas Program (MNAP) on December 12, 2022 and the Maine Department of Inland Fisheries and Wildlife (MDIFW) on December 13, 2022, to identify any state listed rare, threatened, or endangered species that may occur within the Site. MNAP responded on December 12, 2022 and stated there are no rare botanical features documented specifically within the Project Site. The MDIFW responded on December 15, 2022 and specified that they have not mapped any Essential Habitats that would be directly affected by the Juniper Ridge Landfill expansion project.

Field surveys were completed on November 30 and December 1 and 6, 2022. Vernal pool surveys were completed in May of 2023. Wetland areas within the proposed development area were field verified during the growing season on May 24, 2024. While a targeted survey for rare, threatened, or endangered species was not included in our scope of work, BRI staff did not observe any rare or listed species during extensive survey work which occurred throughout the survey area. Information provided by the MNAP and MDIFW was reviewed and informed field crews on possible species that may occur based on habitat. None of these possible species were observed during field work completed in 2022, 2023, or 2024.

Sincerely,



Steve Knapp, PWS, CWB®, L.S.E
Senior Scientist
Biodiversity Research Institute

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Maine Ecological Services Field Office
P. O. Box A
East Orland, ME 04431
Phone: (207) 469-7300 Fax: (207) 902-1588

In Reply Refer To: 09/17/2024 18:34:45 UTC
Project code: 2024-0145257
Project Name: Juniper Ridge Landfill Expansion Project

Federal Action Agency (if applicable): Army Corps of Engineers

Subject: Record of project representative's no effect determination for 'Juniper Ridge Landfill Expansion Project'

Dear CHRIS VONDERWEIDT:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on September 17, 2024, for 'Juniper Ridge Landfill Expansion Project' (here forward, Project). This project has been assigned Project Code 2024-0145257 and all future correspondence should clearly reference this number. **Please carefully review this letter.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species' determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into IPaC must accurately represent the full scope and details of the Project.

Failure to accurately represent or implement the Project as detailed in IPaC or the Northern Long-eared Bat Rangewide Determination Key (Dkey), invalidates this letter. ***Answers to certain questions in the DKey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid.***

Determination for the Northern Long-Eared Bat

Based upon your IPaC submission and a standing analysis, your project has reached the determination of "No Effect" on the northern long-eared bat. To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative), to a federally listed species or designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed

action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no consultation with the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13].

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination for the northern long-eared bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Atlantic Salmon *Salmo salar* Endangered
- Monarch Butterfly *Danaus plexippus* Candidate
- Tricolored Bat *Perimyotis subflavus* Proposed Endangered

Critical Habitats:

- Atlantic Salmon Salmo salar Endangered

You may coordinate with our Office to determine whether the Action may affect the animal species listed above and, if so, how they may be affected.

Next Steps

Based upon your IPaC submission, your project has reached the determination of “No Effect” on the northern long-eared bat. If there are no updates on listed species, no further consultation/ coordination for this project is required with respect to the northern long-eared bat. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional coordination with the Service should take place to ensure compliance with the Act.

If you have any questions regarding this letter or need further assistance, please contact the Maine Ecological Services Field Office and reference Project Code 2024-0145257 associated with this Project.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

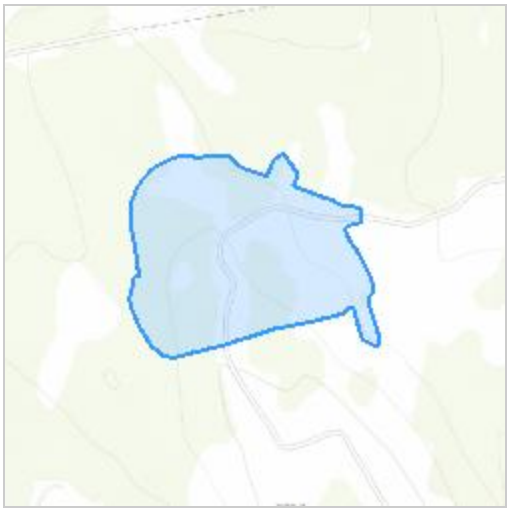
Juniper Ridge Landfill Expansion Project

2. Description

The following description was provided for the project 'Juniper Ridge Landfill Expansion Project':

> Expansion of the Juniper Ridge Landfill in Old Town, Maine.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@44.9865896,-68.726113042305,14z



DETERMINATION KEY RESULT

Based on the information you provided, you have determined that the Proposed Action will have no effect on the Endangered northern long-eared bat (Myotis septentrionalis). Therefore, no consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required for those species.

QUALIFICATION INTERVIEW

1. Does the proposed project include, or is it reasonably certain to cause, intentional take of the northern long-eared bat or any other listed species?

   Note: Intentional take is defined as take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species?

   No

2. The proposed action does not intersect an area where the northern long-eared bat is likely to occur, based on the information available to U.S. Fish and Wildlife Service as of the most recent update of this key. If you have data that indicates that northern long-eared bats are likely to be present in the action area, answer "NO" and continue through the key.

   Do you want to make a no effect determination?

   Yes

PROJECT QUESTIONNAIRE

IPAC USER CONTACT INFORMATION

Agency: Private Entity
Name: CHRIS VONDERWEIDT
Address: 30 PARK DRIVE
City: TOPSHAM
State: ME
Zip: 04086
Email christopher.vonderweidt@stantec.com
Phone: 2072407466

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Army Corps of Engineers

ATTACHMENT 10

NOTICE OF INTENT TO FILE
AND CERTIFICATE OF GOOD CORPORATE STANDING

SME
SEVEE & MAHER
ENGINEERS

State of Maine

Department of the Secretary of State

I, the Secretary of State of Maine, certify that according to the provisions of the Constitution and Laws of the State of Maine, the Department of the Secretary of State is the legal custodian of the Great Seal of the State of Maine which is hereunto affixed and of the records of formation, amendment, and cancellation of limited liability companies and annual reports filed by the same.

I further certify that NEWSME LANDFILL OPERATIONS LLC is a duly formed limited liability company under the laws of the State of Maine and that the date of formation is September 18, 2003.

I further certify that said limited liability company has filed annual reports due to this Department, and that no action is now pending by or on behalf of the State of Maine to forfeit the certificate of formation and that according to the records in the Department of the Secretary of State, said limited liability company is a legally existing limited liability company in good standing under the laws of the State of Maine at the present time.

In testimony whereof, *I have caused the Great Seal of the State of Maine to be hereunto affixed, given under my hand at Augusta, Maine, this thirty-first day of January 2025.*

Shenna Bellows

Shenna Bellows
Secretary of State

Authentication: 8009774

ATTACHMENT 11

MAINE HISTORIC PRESERVATION COMMISSION AND TRIBAL CORRESPONDENCE

SME
SEVEE & MAHER
ENGINEERS

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

RECEIVED
MAY 21 2024
By 0975-24

May 20, 2023

VIA EMAIL

Kirk F. Mohney, Director
Maine Historic Preservation Commission

Email: kirk.mohney@maine.gov

Subject: Juniper Ridge Landfill Expansion, Old Town, Maine

Dear Kirk:

The State of Maine acting through the Bureau of General Services is seeking approval for expansion of Juniper Ridge Landfill (JRL) in Old Town, Maine under a Maine Department of Environmental Protection (MEDEP) Secure Landfill Permit. We are requesting a review by the Maine Historic Preservation Commission to support the MEDEP permit application.

PROJECT DESCRIPTION

The Bureau of General Services is proposing a 61-acre expansion on the existing parcel of land in Old Town, Maine. The proposed construction area is primarily undeveloped forested land with an existing access road surrounding the proposed work area. The existing landfill and proposed work area is accessed off Bennoch Road (Route 16). It is understood that the intention is to clear, stump, and grub the entire proposed area for installation of the landfill expansion. The project location is outlined in the attached Figure 1 – Site Location Map.

HISTORICAL FINDINGS

A search of the National Register of Historic Places online maps did not identify any historic places within 2 miles of the parcel.

In addition to searching the National Register of Historic Places, records of neighboring properties within 1,000 feet were searched for any buildings over fifty (50) years old. Five properties were identified. All properties with such buildings and year built are listed below. Historic Building Survey Forms and photographs of the structures are attached to this letter.

- 549 West Old Town Road (1950)
- 584 West Old Town Road (1940)
- 631 West Old Town Road (1950)

SME
SEVEE & MAHER
ENGINEERS

- 649 West Old Town Road (1950)
- 655 West Old Town Road (1973)

Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachments:

Figure 1 – Site Location Map
Historic Building Survey Forms

Based on the information submitted, I have concluded that there will be no historic properties affected by the proposed undertaking, as defined by Section 106 of the National Historic Preservation Act. Consequently, pursuant to 36 CFR 800.4(d)(1), no further Section 106 consultation is required unless additional resources are discovered during project implementation pursuant to 36 CFR 800.13.

Kirk F. Mohney, 6/5/24
Kirk F. Mohney, Date
State Historic Preservation Officer
Maine Historic Preservation Commission

MHPC # 0975-24

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

July 17, 2024

VIA EMAIL
Chris Sockalexis, Tribal Historic Preservation Officer
Penobscot Nation
Cultural and Historic Preservation Department
12 Wabanaki Way
Indian Island, ME 04468

Email: Chris.Sockalexis@penobscotnation.org

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Chris:

The purpose of this letter is to request information on any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill.

Please review the attached map and let me know if there are any known or suspected cultural or historic resources associated with this potential development area.

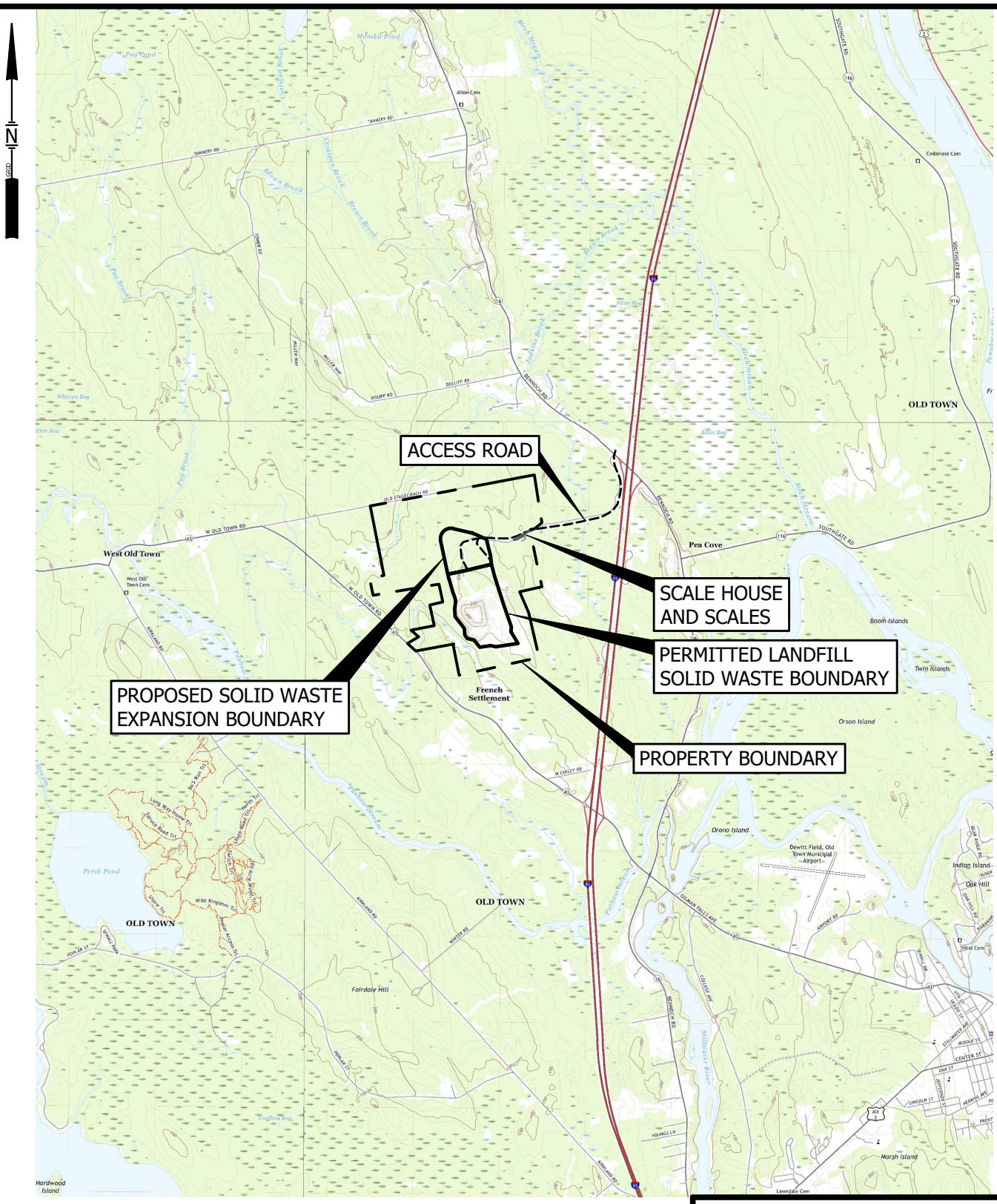
Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Site Location Map



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
OLD TOWN, MAINE-2021

SITE LOCATION MAP
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

NOT TO SCALE

DWG: SITELOC LMN: SITELOC-EXPANSION CTB: SME-STD.CTB REV: 7/1/2024

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, MAP, 7/1/2024 3:47:42 PM, sjm

Outlook

FW: JRL Penobscot Nation Correspondence

From Stewart, Doug (Topsham) <doug.stewart@stantec.com>
Date Thu 11/21/2024 2:53 PM
To Lisa Turner <Lisa.Turner@smemaine.com>
Cc Pelletier, Gabriel <Gabriel.Pelletier@stantec.com>

3 attachments (738 KB)

1-27-2017 Jake Riley - Juniper Ridge Landfill.pdf; RE: JRL Applications - follow up to yesterday's call; Juniper Ridge Landfill Expansion Project - Old Town, Maine .pdf;

Thanks Gabe-

Lisa, attached provides the correspondence from the Penobscot's on the least expansion project. Hope this helps!

From: Pelletier, Gabriel <Gabriel.Pelletier@stantec.com>
Sent: Thursday, November 21, 2024 2:39 PM
To: Stewart, Doug (Topsham) <doug.stewart@stantec.com>
Subject: JRL Penobscot Nation Correspondence

Hi Doug,

See the attached memo from the Penobscot Nation dated January 27, 2017.

"This project appears to have no impact on a structure or site of historic, architectural or archaeological significance to the Penobscot Nation as defined by the National Historic Preservation Act of 1966, as amended."

Chris Sockalexis' email to Jake (attached) suggests that there will be further dialog but we don't have any record of further dialog. I've attached two relevant correspondence.

Hope this is helpful. Do we have a date when the expansion scope was minimized?

Gabe Pelletier (he/him), AWB®
Environmental Scientist

Mobile: 207-607-0596
Gabriel.Pelletier@stantec.com

Stantec
30 Park Drive
Topsham ME 04086-1737

Stantec

PENOBSCOT NATION
CULTURAL & HISTORIC PRESERVATION
12 WABANAKI WAY, INDIAN ISLAND, ME 04468

CHRIS SOCKALEXIS – TRIBAL HISTORIC PRESERVATION OFFICER
E-MAIL: chris.sockalexis@penobscotnation.org

NAME	Lisa Turner
ADDRESS	Sevee & Maher Engineers, Inc. 4 Blanchard Road, P.O. Box 85A Cumberland, ME 04021
OWNER'S NAME	NEWSME Landfill Operations, LLC
TELEPHONE	207.829.5016
EMAIL	Lisa.Turner@smemaine.com
PROJECT NAME	Juniper Ridge Landfill Expansion
PROJECT SITE	Old Town, ME
DATE OF REQUEST	July 17, 2024
DATE REVIEWED	February 28, 2025

Thank you for the opportunity to comment on the above referenced project. This project appears to have no impact on a structure or site of historic, architectural or archaeological significance to the Penobscot Nation as defined by the National Historic Preservation Act of 1966, as amended.

If there is an inadvertent discovery of Native American cultural materials during the course of the project, please contact my office at (207) 817-7471. Thank you for consulting with the Penobscot Nation Tribal Historic Preservation Office with this project.

Chris Sockalexis, THPO
Penobscot Nation

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

December 18, 2024

Charles Loring
Penobscot Nation
Cultural and Historic Preservation Department
12 Wabanaki Way
Indian Island, ME 04468

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Mr. Loring:

The purpose of this letter is to request information on any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill. We have previously emailed Mr. Sockalexis but have not received an answer (see attached letter sent via email). We have been told that you may be able to provide us with an answer.

Please review the attached map and let me know if there are any known or suspected cultural or historic resources associated with this potential development area.

Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Letter to Mr. Sockalexis, dated July 17, 2024

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

July 17, 2024

VIA EMAIL
Chris Sockalexis, Tribal Historic Preservation Officer
Penobscot Nation
Cultural and Historic Preservation Department
12 Wabanaki Way
Indian Island, ME 04468

Email: Chris.Sockalexis@penobscotnation.org

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Chris:

The purpose of this letter is to request information on any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill.

Please review the attached map and let me know if there are any known or suspected cultural or historic resources associated with this potential development area.

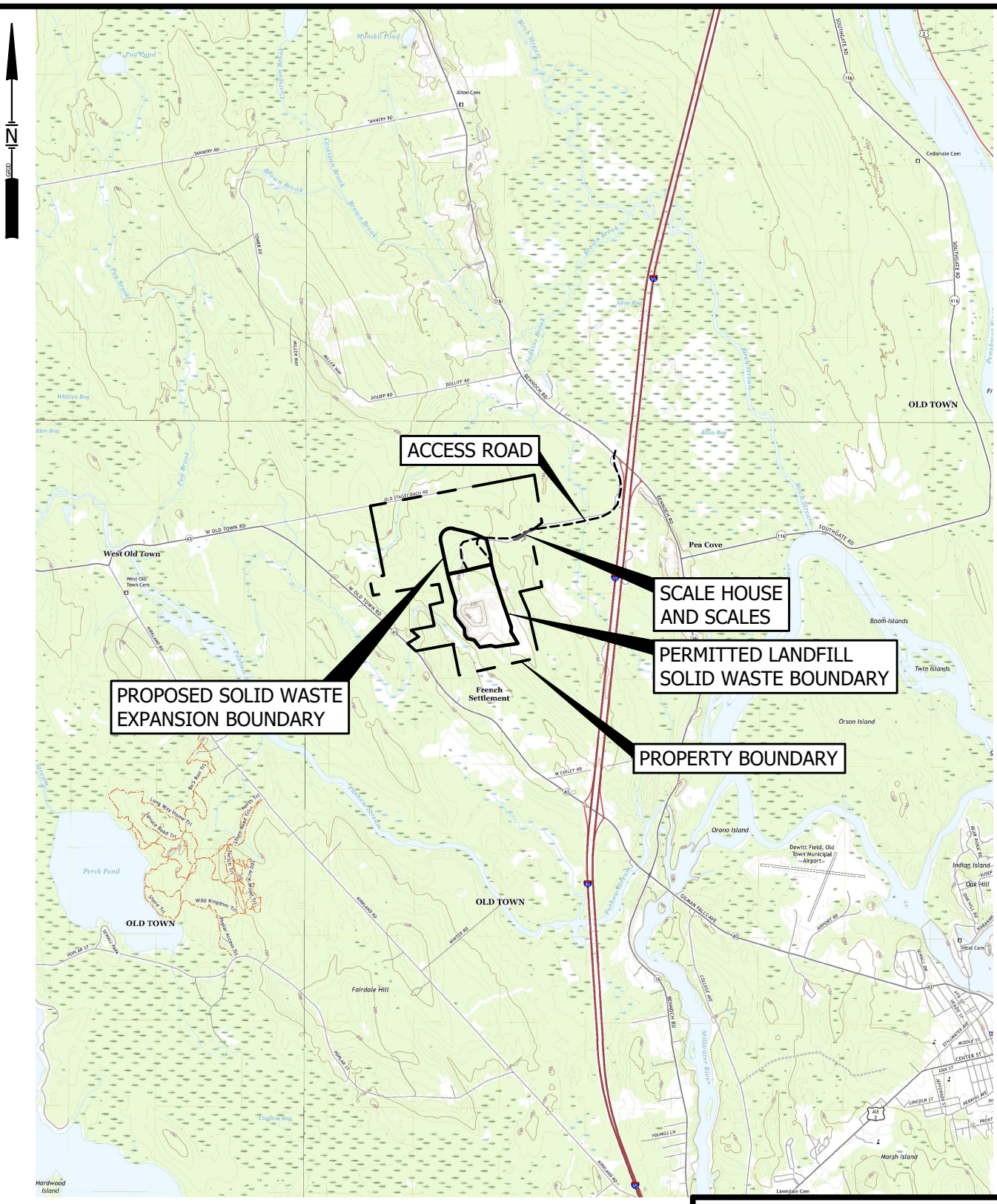
Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Site Location Map



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
OLD TOWN, MAINE-2021

SITE LOCATION MAP
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

NOT TO SCALE

DWG: SITELOC LMN: SITELOC-EXPANSION CTB: SME-STD.CTB REV: 7/1/2024

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, MAP, 7/1/2024 3:47:42 PM, sjm

Outlook

Significant Cultural/Historic Resources Information Request for Juniper Ridge Landfill Expansion

From Charlie Loring, Jr. <Charlie.Loring.JR@penobscotnation.org>
Date Fri 1/10/2025 4:19 PM
To Lisa Turner <Lisa.Turner@smemaine.com>

1 attachment (1 MB)
Penobscot Nation_Declaration.pdf;

Greetings,

I am writing in response to a letter I received around Christmas asking about cultural and/or historic resources that are associated with the current location of Juniper Ridge Landfill expansion area. In short, the landfill area is surrounded by two tributaries to the Penobscot River which our ancestors used to thrive on for thousands of years prior to any colonial presence. The River and her tributaries were not only a lifeline to obtain fish and medicines from; they were also a means of transportation to reach lands that had other medicines, and items such as birch bark or brown ash for containers and baskets, but also furbearers for food and warmth as well as more food and medicines for subsistence. Wetlands in many regions are diverse ecosystems which hold dense populations of subsistence species, medicines and forest products that are utilized by native people, so that holds some real significance, but also know, Western science has also backed up their importance by exposing wetlands as ecological marvels that filter water. These areas, however, can lose their benefits by altering hydrology and creating a potential avenue for landfill-derived pollutants to enter groundwater ultimately, which would have adverse effects on all life, be it aquatic, plant or terrestrial life near the areas affected. We have been experiencing the degradation of our River and wetlands for a very long time, exacerbated in no small part by Juniper Ridge Landfill and its leachate. We are continuously trying to stop this mounting harm and restore the River's health.

In addition to this brief summary, the Penobscot Nation issued a signed declaration which presents more details related to our on-going cultural and historic resource concerns associated with Juniper Ridge Landfill.

Respectfully,

Chuck Loring

Office of the Chief and Council
Kirk E. Francis
Chief
Mark Sockbeson
Vice-Chief
Maulian Dana
Tribal Ambassador

Penobscot Nation
12 Wabanaki Way
Indian Island, Maine 04468
Phone: (207) 817-7349
Fax: (207) 827-6042

DECLARATION OF THE PENOBSCOT NATION

I, Chief Kirk Francis declare as follows:

1. I am the Chief of the Pαnawάhpskewi – the Penobscot Nation – and I am competent to testify to all facts contained in this declaration.
2. The Penobscot Nation is a sovereign entity that has inhabited Pαnawάhpskek since time immemorial. Today the Penobscot Nation consists of well over 2,000 citizens.
3. The Penobscot Nation is working with the Conservation Law Foundation ("CLF") because of our concerns about the proposed expansion of the Juniper Ridge Landfill ("JRL"). It is the Penobscot Nation's understanding that CLF is active throughout New England and frequently works on waste-related issues, which includes involvement in waste facility proposals in environmental justice communities.
4. The Penobscot Nation Reservation includes islands that are 1.5 miles from JRL. The Penobscot Nation also has a school, daycare, youth program, administrative buildings, a health center, and elder facilities including assisted living and elderly apartments located on Indian Island all 6.4 miles from JRL. The Alton Fee land is 5 miles away from JRL and the Argyle Trust land is 5.25 miles away from JRL. The Penobscot Nation also includes additional land less than 10 miles away from JRL. The original homelands of the Penobscot Nation include the present-date site where JRL is located and operates.
5. The Penobscot Nation is involved in this process with CLF because our rights and sovereignty are violated by an expansion that threatens our people, our land, and the Penobscot River, which are our kin. The Penobscot River is a citizen of our tribe, and the environment is full of fish, wildlife and plants that are our relatives.
6. The Penobscot Nation is deeply concerned that an expansion of JRL will worsen the negative impacts of the landfill on our people and the environment that we have stewarded for centuries. The tribe has worked tirelessly to invest in the restoration of salmon and other sea-run fish including river herring, striped bass, American shad, rainbow smelts, American eel, sea lamprey, and more. The efforts have not been limited to reservation land as we work throughout the region to restore and protect our relatives.
7. The Penobscot Nation lives in concert with the Penobscot River Watershed and strives to be life giving as opposed to destroying. JRL is located between Pushaw and Birch streams, two significant streams that flow into the Penobscot River – directly into reservation waters. The Penobscot Nation believes our people have the right to continue to live in the cultural way of our ancestors. We are concerned that an expansion of JRL will further threaten that way of life.
8. We have long been involved in trying to protect ourselves from JRL's pollution. We have had a citizen of Penobscot Nation on the JRL Advisory Committee for decades.
9. The Penobscot Nation is already overburdened by pollution. Our people experience cancer at a much higher rate than other Mainers and we believe this is related to the proximity to pollution both historically and present-day. The proposed expansion of JRL wants to build out the landfill by half its existing acreage. JRL is a business, and Casella brings trash in and dumps it in our backyard.

10. JRL is a state-owned landfill that accepts waste from not only around Maine but also from out of state as well. The placement of JRL in Penobscot County is purposeful. This situation is one where powerful people dump waste in a place where people do not have the capacity to fight against it. The Penobscot Nation bears the brunt as people who still use the land and the waterways to sustain ourselves. It is certainly an environmental justice concern.
11. This concern is not a new one. Maine has denied the Penobscot Nation environmental justice since statehood. Our culture has been threatened countless times from the clear cutting of trees to pay a war debt to the constant disregard for agreements made with the Penobscot Nation time and time again. Our people have had to fight to protect the Penobscot River before, and we are committed to doing it again to protect our way of life and our relatives.
12. The Penobscot Nation is very worried about the impact of a JRL expansion on our people's sustenance hunting and fishing rights. Many of our citizens still practice our traditional way of life and regularly eat turtle, muskrat, duck, deer, and moose. The ability to hunt these animals is protected as part of our tribe's sovereignty. Fishing, too, is a large concern as our citizens consume sea-run fish, alewives, and resident fish populations. Now, the threats posed by pollution make this way of life less safe. The ability to eat traditional diets and to hunt, fish, and gather is already challenged by pollution in the Penobscot River and waterways throughout the watershed. The Penobscot Nation is concerned that a JRL expansion will further impede these rights as pollution of the air and water makes traditional diets less safe.
13. The known presence of PFAS in leachate that is discharged into the Penobscot River is deeply concerning. Our people are riverine based. Our culture relies on wild foods, and when our traditional food sources are contaminated, we are forced to choose between being true to our traditions while risking the health of our tribe or moving away from our centuries-old culture. It is a denial of environmental justice to put our people in the position of choosing between exercising our cultural rights and caring for our health and wellbeing.
14. The Penobscot Nation is also fearful for our relatives in the Penobscot watershed. Our fisheries are impacted and so are the fish themselves. The plants and the very water are negatively impacted by JRL's operations. The Penobscot River, as the oldest citizen of our tribe, suffers and the Penobscot Nation speaks on its behalf and on the behalf of our relatives. We are worried about the health and safety of all of our citizens including our nonhuman relatives that are a part of our creation story.
15. The expansion of JRL also threatens our restoration work. Even as the Penobscot Nation works to restore salmon and other sea-run fish to the area, there will be significant risks to consuming the fish. Further pollution to our waterways also threatens the salmon and other species directly. The expansion also changes our landscape, moving us further away from the land our ancestors experienced. JRL already towers over the landscape, and the contamination of water and land impacts our people's ceremonies.
16. The Penobscot Nation water ceremonies are deeply significant to our people. The consequences on our people of discharging polluted leachate into the Penobscot River and the watershed broadly is much like asking someone who is Catholic to go into church and receive a blessing that uses holy water contaminated with PFAS and other toxins from landfill leachate. The toxins change our waters, and the water loses its ability to heal and to sustain life. These waters are part of our culture and the expansion of JRL would further threaten our healing spiritual relationship with our waters.
17. The Penobscot Nation has seen ash rain down following a fire at JRL. As our people struggled to breathe, there were also very serious concerns for Penobscot people growing food in their yards, collecting fiddleheads, and spending time near the riverbeds. The proposed JRL expansion will increase the size of the landfill significantly and will increase the risk of landfill fires.

18. Our citizens already must live with the smells of the landfill. If the proposed expansion were to occur, we are worried that the odors will get stronger and more prevalent. The Penobscot Nation is also very concerned about what the odors contain. Our people are worried the odors contain toxins released from the decomposition of waste at the landfill. There are children with respiratory problems and parents are worried about the health of their families. Landfill gas contains hydrogen sulfide which gives off an odor of rotten eggs. It is amongst our biggest concerns that an expansion of JRL would cause an increase in landfill gases and hazardous air pollutants.
19. The Penobscot Nation has fears about water quality as well. We have citizens that have experienced significant health impacts, and we believe it is related to poor water quality. Casella itself provides water to the homes surrounding the landfill, and we view this as an admission of the dangers the landfill poses to water sources in the area. Some citizens complain that their water smells and is undrinkable. Our people wonder what we are inhaling and consuming, and we fear a JRL expansion will only worsen this problem. The Penobscot Nation feels we are in the bullseye of facing the negative impacts of JRL.
20. The Penobscot Nation is also concerned that an expansion of JRL will increase the amount of leachate that the landfill will produce. JRL uses barriers to prevent leachate leaks, but Casella told us that the liners last up to 100 years. In response, former Penobscot Nation Chief Jim Sappier, said it best; "we've been here for several hundred years, and we still plan to be here for several hundred more." A JRL expansion will be a problem our grandchildren will have to deal with as well. The health of our people now and in the future is at risk.
21. The Penobscot Nation has witnessed the sky glow red as JRL burns off methane. It is a very scary experience, and our people always worry the glow could be from fires that we are not told about. This is the reality we must deal with and in its current state, a JRL expansion is unconscionable. Doubling the size will double the impacts and increase fear – our people are living in fear.
22. The Penobscot Nation is also concerned about the lack of due process for our people. Casella and MEDEP have not engaged or cooperated with the Penobscot Nation in a meaningful way. Our people are in a constant state of vigilance, and yet we are not given the time necessary to respond to plans that significantly impact us. Especially for our people who are less privileged, it is difficult to have to deal with so many problems and have the time and energy to engage with a process that is not designed to allow for meaningful involvement. Time marches on, and even as we want to be a part of the solution, we are always up against systems that do not want to include us.
23. The Penobscot Nation does not feel that MEDEP and Casella adequately consulted our people as part of the Public Benefit Determination ("PBD") process. We received a letter and a couple of binders with hundreds of pages of highly technical information. Our citizens are supposed to be able to get involved based on that information alone. A letter and a binder are not adequate consultation, especially when that information is difficult to understand. This is also not sufficient consultation given the lack of time available to engage with the process. We also believe this decision could make or break effective and genuine environmental justice processes in Maine.
24. The Penobscot Nation is concerned that the decision does not set a proper environmental justice standard. Our people live with environmental injustice and deal with it every day, but there is not always the education available for people to name it or to fight it. The PBD process could have slowed down so that our people could consider the options and make an informed decision. The communication about when meetings are happening is also insufficient and we often learn about events only a couple of days before they happen, which leaves us little time to prepare to participate.

25. Casella also offers very little information about the operations of the landfill and its effects on the community. There is not enough communication about leaks or spills, and there have been times when we see firetrucks go to the landfill without ever being told that there is a fire. The lack of information leads to doubt and suspicion.
26. The people of the Penobscot Nation and our relatives already suffer the negative impacts of JRL and the pollution it creates. This is yet another injustice in our history, but it is one that Maine has the chance to correct and improve. A JRL expansion would threaten our very way of life as well as the health and safety of our people and our kin.

I swear, under penalty of perjury, that the foregoing is true and correct to the best of my knowledge.

Executed on: November 7, 2024

/s/ _____
Chief Kirk Francis

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

July 17, 2024

VIA EMAIL
Donald Soctomah, Tribal Historic Preservation Officer
Passamaquoddy Tribe of Indians
Indian Township Reservation
P.O. Box 301
Princeton, ME 04668

Email: soctomah@gmail.com

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Donald:

The purpose of this letter is to request information on any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill.

Please review the attached map and let me know if there are any known or suspected cultural or historic resources associated with this potential development area.

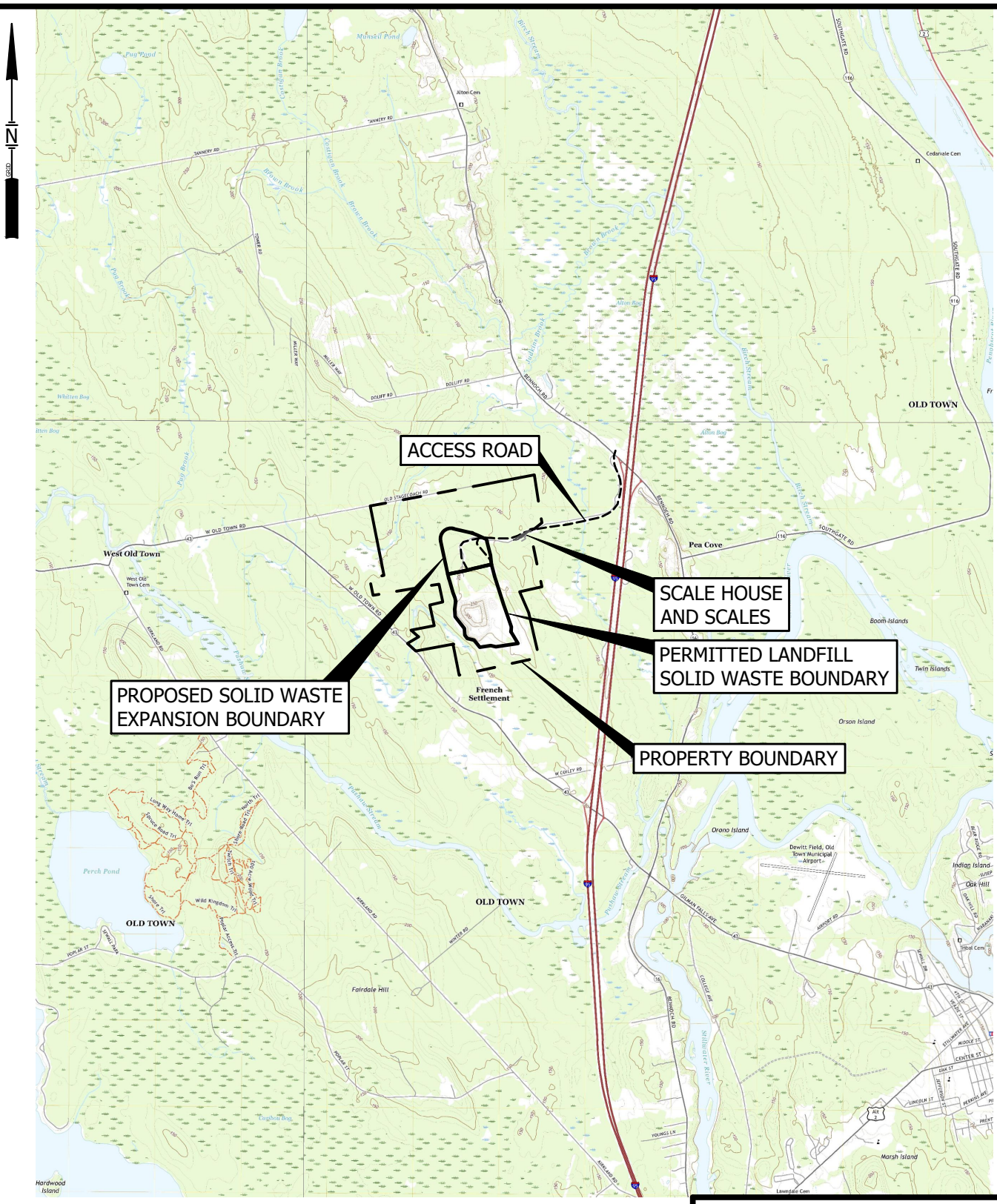
Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Site Location Map



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
OLD TOWN, MAINE-2021

SITE LOCATION MAP
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

NOT TO SCALE

DWG: SITELOC LMN: SITELOC-EXPANSION CTB: SME-STD.CTB REV: 7/1/2024

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, MAP, 7/1/2024 3:47:42 PM, sjm

Tribal Historic Preservation Office
Passamaquoddy Tribe
PO Box 159 Princeton, Me. 04668
207-214-4051

July 18, 2024

Lisa Turner, P.E., L.S.S.

Project Manager

SME

- Re: Juniper Ridge Landfill Expansion

Dear ***Lisa*** ;

The Passamaquoddy THPO has reviewed the following application regarding the historic properties and significant religious and cultural properties in accordance with NHPA, NEPA, AIRFA, NAGPRA, ARPA, Executive Order 13007 Indian Sacred Sites, Executive Order 13175 Consultation and Coordination with Indian Tribal Governments, and Executive Order 12898 Environmental Justice.

We are in support of the Penobscot THPO comments on this project.

Sincerely;

Donald Soctomah
Soctomah@gmail.com
THPO
Passamaquoddy Tribe

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

August 20, 2024

VIA EMAIL
Donald Soctomah, Tribal Historic Preservation Officer
Pleasant Point Tribe of Indians
Indian Township Reservation
P.O. Box 301
Princeton, ME 04668

Email: soctomah@gmail.com

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Donald:

On July 17, 2024 Sevee & Maher Engineers, Inc. sent a letter asking you if the Passamaquoddy Tribe of *Indian Township Reservation* knew of any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill. You very quickly responded by deferring to the Penobscot Nation.

At the risk of being redundant, we would like to ask if the Passamaquoddy Tribe of *Pleasant Point Reservation* know of any significant cultural or historic resources associated with the same location. The attached map depicts the potential development area.

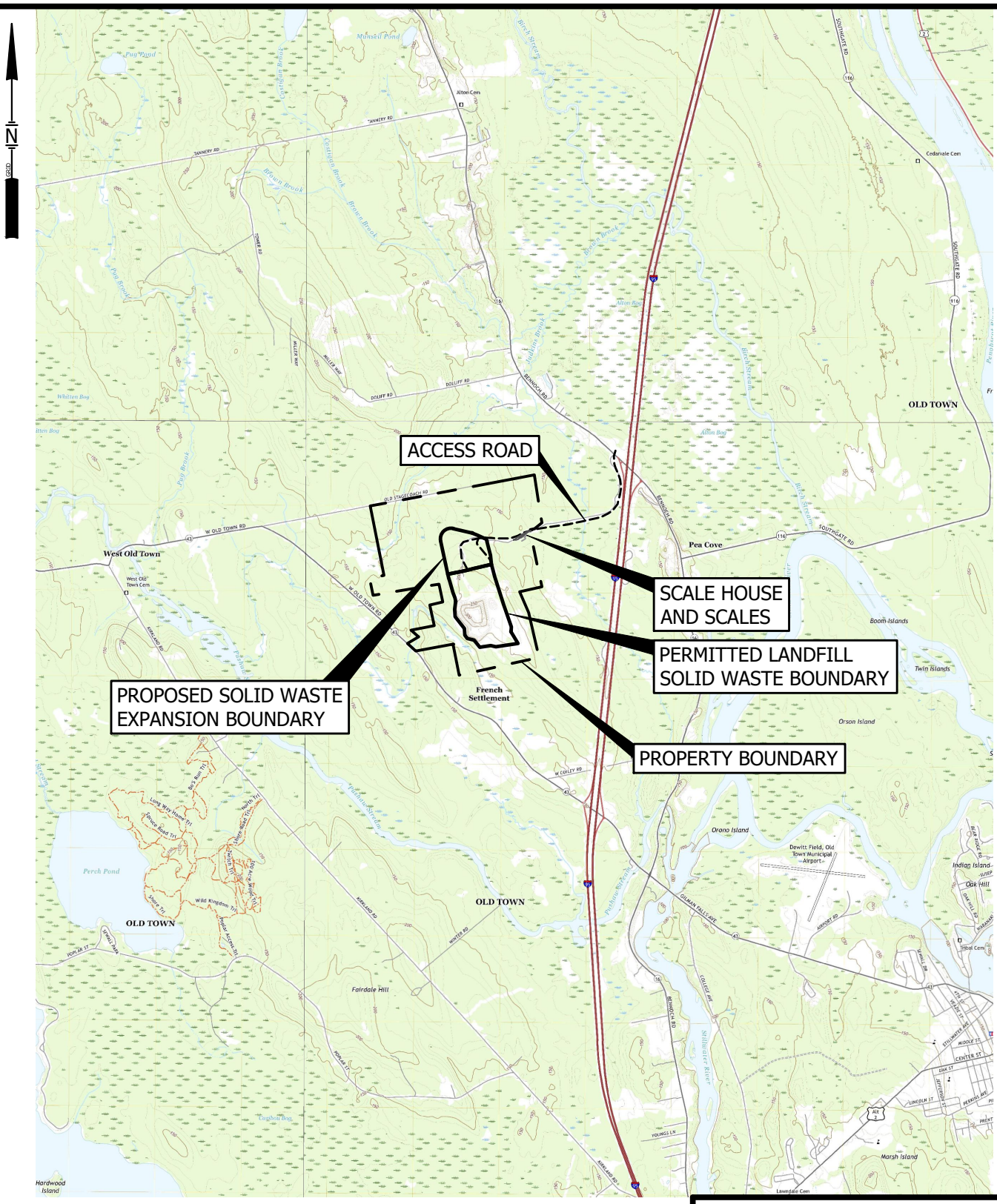
Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information, and my apologies if it was unnecessarily time consuming for you to respond to two requests.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Site Location Map



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
OLD TOWN, MAINE-2021

SITE LOCATION MAP
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

NOT TO SCALE

DWG: SITELOC LMN: SITELOC-EXPANSION CTB: SME-STD.CTB REV: 7/1/2024

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, MAP, 7/1/2024 3:47:42 PM, sjm

Tribal Historic Preservation Office
Passamaquoddy Tribe
PO Box 159 Princeton, Me. 04668
207-214-4051

August 22, 2024

Sevee & Maher Engineers, Inc.

4 Blanchard Road, P.O. Box 85A

Cumberland, ME 04021

- Re: Significant Cultural/ Historic Resources Juniper Ridge Landfill Expansion

Dear ***Lisa*** ;

The Passamaquoddy THPO has reviewed the following application regarding the historic properties and significant religious and cultural properties in accordance with NHPA, NEPA, AIRFA, NAGPRA, ARPA, Executive Order 13007 Indian Sacred Sites, Executive Order 13175 Consultation and Coordination with Indian Tribal Governments, and Executive Order 12898 Environmental Justice.

The Project listed above we follow the Penobscot Nations concerns on cultural and historical issues within their Nations homelands.

Sincerely;

Donald Soctomah
Soctomah@gmail.com
THPO
Passamaquoddy Tribe

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

July 17, 2024

VIA EMAIL
Jenny Gaenzle, Tribal Historic Preservation Officer
Aroostook Band of Micmacs
7 Northern Road
Presque Isle, ME 04769

Email: jgaenzle@micmac-nsn.gov

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Ms. Gaenzle:

The purpose of this letter is to request information on any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill.

Please review the attached map and let me know if there are any known or suspected cultural or historic resources associated with this potential development area.

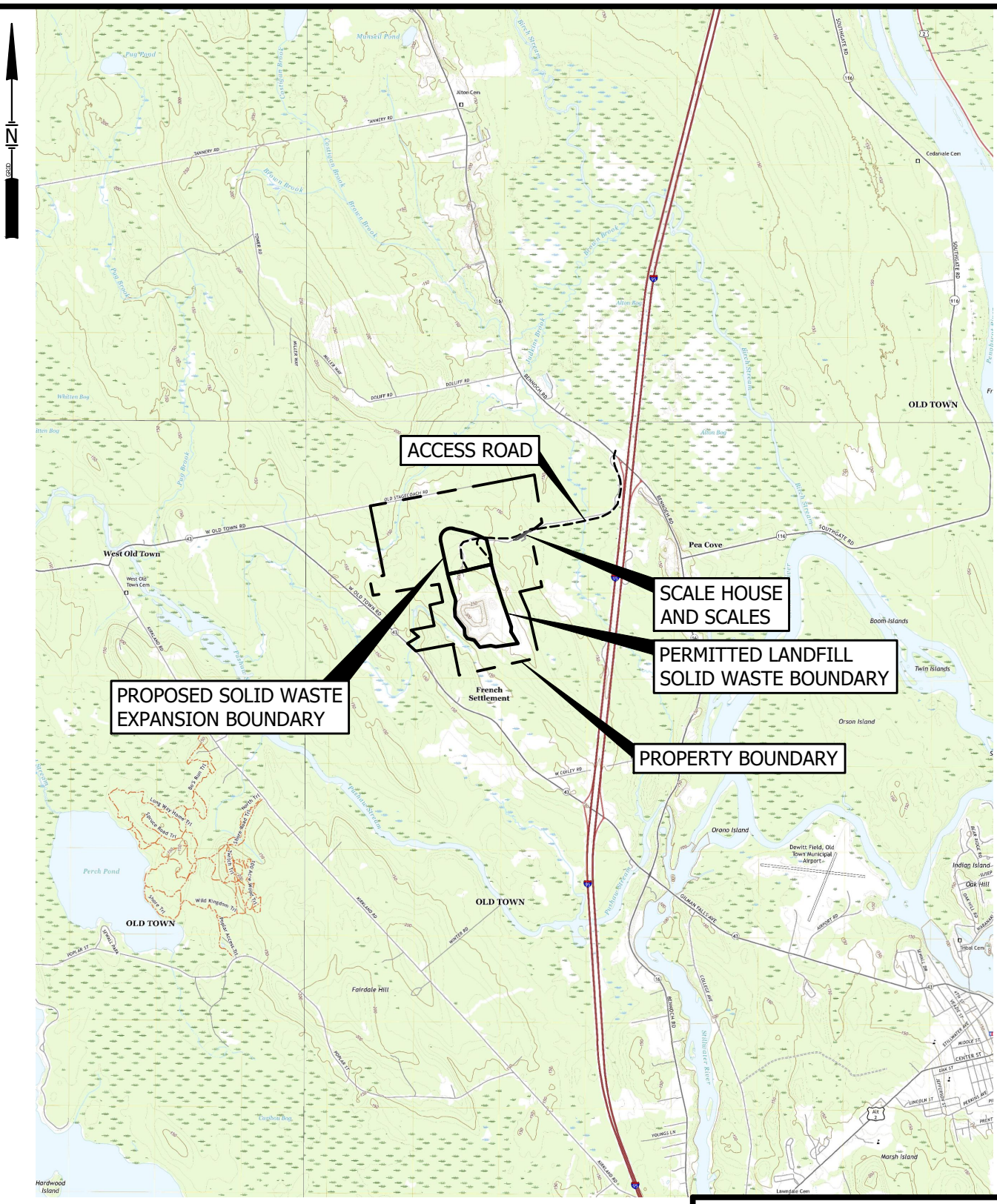
Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Site Location Map



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
OLD TOWN, MAINE-2021

SITE LOCATION MAP
JUNIPER RIDGE LANDFILL EXPANSION
OLD TOWN, MAINE

SME
SEVEE & MAHER
ENGINEERS

NOT TO SCALE

DWG: SITELOC LMN: SITELOC-EXPANSION CTB: SME-STD.CTB REV: 7/1/2024

\\Nserver\cfs\Casella\OldTownLandfill\Expansion\Phase II Expansion\Acad\Figures\SITELOC.dwg, MAP, 7/1/2024 3:47:42 PM, sjm

Tribal Historic Preservation Office
Mi'kmaq Nation
7 Northern Road
Presque Isle, ME 04769
Phone: (207)764-1972 ext. 161
jgaenzle@micmac-nsn.gov

Mi'kmaq Nation

August 20, 2024

To: Lisa Turner – Sevee & Maher Engineers 4 Blanchard Road, Cumberland, ME 04021
Owner: NEWSME Landfill Operations, LLC
Project Location: Juniper Ridge Landfill Expansion 2828 Bennoch Rd, Alton, ME 04468

Based on the project descriptions, we do not have knowledge of any specific sites or cultural features of significance to the Mi'kmaq Nation that exist at the proposed project location(s) listed above. However, this geographic area does constitute traditional areas that were historically utilized by members of the Mi'kmaq Nation and the other Wabanaki Tribes. As such, any future activities at the location would require a new consultation.

Therefore, we respectfully request that if evidence of Native American presence is discovered during the course of the current project location activities such as, human remains, artifacts, or any other potentially sensitive or culturally significant items, that site activities in the vicinity of the discovery immediately cease, pending notification to us.

In addition, if this project results in wetland disturbances requiring mitigation, we are requesting that black ash (*Fraxinus nigra*) be used as the principal wetland species for wetland restoration activities. The black ash tree has special significance in the culture of the northeastern Tribes and is used extensively for weaving baskets and other Native American crafts. The black ash tree also provides valuable food and habitat for migratory waterfowl and other wildlife. Unfortunately, however, this species is rarely selected by foresters and landowners who favor other tree species. As a result of this, and other environmental factors, the black ash tree is in serious decline in Maine. The Mi'kmaq Nation has completed several black ash wetland restoration projects and have a dependable source for highly-quality seedlings, and the experience and expertise to assist you with black ash wetland restoration projects.

On the subject of human remains, artifacts, or any other evidence of Native American presence, if discovered, the human remains will be reburied with the appropriate respect for the remains, at a distinctive and respectable location on tribal lands. The artifacts and other evidence of Native American discovery will be documented with appropriate detail, analyzed for the precise period of the items by the Tribal Historic Preservation Officer for the Mi'kmaq Nation, and retained for preservation or interred with the ancestor remains.

If you have any questions or comments, please feel free to contact me.

Sincerely,

Jenny Gaenzle
Tribal Historic Preservation Officer

SME
SEVEE & MAHER
ENGINEERS

4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Tel: 207.829.5016 • Fax: 207.829.5692
info@smemaine.com
smemaine.com

September 18, 2024

VIA EMAIL
Issac St. John, Tribal Historic Preservation Officer
Houlton Band of Maliseet Indians
88 Bell Road
Littleton, ME 04730

Email: istjohn@maliseets.com

Subject: Significant Cultural/ Historic Resources Information Request
Juniper Ridge Landfill Expansion

Dear Isaac:

The purpose of this letter is to request information on any significant cultural or historic resources associated with the location depicted on the attached figure. We are assisting NEWSME Landfill Operations, LLC with evaluating this site for the proposed expansion of the Juniper Ridge Landfill.

Please review the attached map and let me know if there are any known or suspected cultural or historic resources associated with this potential development area.

Please feel free to contact me at 207.829.5016 or Lisa.Turner@smemaine.com if you have any questions or need additional information. Thank you for your assistance in obtaining this information.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Lisa Turner, P.E., L.S.S.
Project Manager

Attachment: Site Location Map

Outlook

RE: Historical Information Request

From Isaac St John <istjohn@maliseets.com>
Date Tue 10/22/2024 9:01 AM
To Lisa Turner <Lisa.Turner@smemaine.com>

Good morning,

We do not have an immediate concern with your project or project site, and do not currently have the resources to fully investigate same. Should any human remains, archaeological properties or other items of historical importance be unearthed while working on this project, we recommend that you stop your project and report your findings to the appropriate authorities including the Houlton Band of Maliseet Indians.

Thank you,

Isaac St. John
Tribal Historic Preservation Officer
Houlton Band of Maliseet Indians
88 Bell Road
Littleton, ME 04730

From: Lisa Turner [mailto:Lisa.Turner@smemaine.com]
Sent: Wednesday, September 18, 2024 10:13 AM
To: istjohn@maliseets.com
Subject: Historical Information Request

Dear Mr. St. John,

Please see the attached information request. Let us know if you have any questions.

Sincerely,

Lisa Turner, P.E., L.S.S.
Project Manager

SME
SEVEE & MAHER
ENGINEERS

Sevee & Maher Engineers, Inc.
4 Blanchard Road, P.O. Box 85A
Cumberland, ME 04021
Office: 207.829.5016
Cell: 207.841.8385
Fax: 207.829.5692

ATTACHMENT 12

FUNCTIONS AND VALUES ASSESSMENT

SME
SEVEE & MAHER
ENGINEERS

Wetland Functions and Values Assessment

Juniper Ridge Landfill

Prepared by BRI Environmental

September 2024

BIODIVERSITY RESEARCH INSTITUTE

Contents

Table of Contents

1.0 Introduction 2
3.0 Methods 2
4.0 Results 3
5.0 Discussion 8

Exhibits

Exhibit A: Draft Site Plan

Exhibit B: Functions and Values Worksheets

1.0 Introduction

Biodiversity Research Institute (BRI) was retained by Sevee & Maher Engineers (SME) to complete regulated natural resource delineations on an approximately 144-acre survey area located at the Juniper Ridge Landfill in Old Town, Maine (Site). The Site is bisected by Juniper Ridge Landfill Road, which is located just south of Bennoch Road. The Site is located approximately two miles west of the Stillwater River on the parcel known as Tax Map 3, Lot 1 in Old Town, Maine. Following the wetland delineation, completed in 2022, and a follow-up site walk completed on May 24, 2024, SME requested that BRI complete a functional analysis of wetlands anticipated to be impacted as a result of the proposed project development.

2.0 Methods

All wetlands were evaluated using the U.S. Army Corps of Engineers (USACE) Highway Methodology[1]. Functions and values are assessed based on a descriptive approach and characteristics observed within the field as well as a review of pertinent desktop and publicly available information. Wetlands are assigned either a principal or secondary function based on the assessment of the wetland. Based on a review of the proposed Site plan, BRI analyzed the functions and values provided by those wetlands that are proposed to be altered by the Project. The functions and values assessed are based on those found in the USACE Highway Methodology. A brief description of the functions and values being assessed is provided below. Each of these were assessed using field and desktop data.

Groundwater Recharge/Discharge

This function considers the potential for a wetland to serve as a groundwater recharge and/or discharge area. It refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

Flood-flow Alteration

This function considers the effectiveness of the wetland in reducing flood damage by water retention for prolonged periods following precipitation events and the gradual release of floodwaters. It adds to the stability of the wetland ecological system or its buffering characteristics and provides social or economic value relative to erosion and/or flood prone areas.

Fish and Shellfish Habitat

This function considers the effectiveness of seasonal or permanent watercourses associated with the wetland in question for fish and shellfish habitat.

Sediment/Toxicant Retention

This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants, or pathogens in runoff water from surrounding uplands or upstream eroding wetland areas.

[1] USACE Highway Methodology
https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Forms/HighwaySupplement6Apr2015.pdf

Nutrient Removal

This function considers the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands and the ability of the wetland to process these nutrients into other forms or trophic levels. One aspect of this function is to prevent ill effects of nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.

Production Export

This function evaluates the effectiveness of the wetland to produce food or usable products for humans or other living organisms.

Sediment/Shoreline Stabilization

This function considers the effectiveness of a wetland to stabilize streambanks and shorelines against erosion.

Wildlife Habitat

This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered. Species lists of observed and potential animals should be included in the wetland assessment report.

Recreation

This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting, and other active or passive recreational activities. Consumptive opportunities consume or diminish the plants, animals, or other resources that are intrinsic to the wetland. Non-consumptive opportunities do not consume or diminish these resources of the wetland.

Educational/Scientific Value

This value considers the suitability of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.

Uniqueness/Heritage

This value considers the effectiveness of the wetland or its associated waterbodies to provide certain special values. These may include archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, its relative importance as a typical wetland class for this geographic location. These functions are clearly valuable wetland attributes relative to aspects of public health, recreation, and habitat diversity.

Visual Quality/Aesthetics

This value considers the visual and aesthetic quality or usefulness of the wetland.

Endangered Species Habitat

This value considers the suitability of the wetland to support threatened or endangered species.

3.0 Results

As part of the wetland delineation, BRI evaluated wetland functions and values using the USACE Highway Methodology during fieldwork. Functions and values are assessed based on characteristics observed within the field as well as a review of pertinent desktop and publicly available information. Important functions provided by all wetlands proposed to be impacted on the Site include wildlife habitat, as evidenced by wildlife signs (i.e., tracks and scat) as well as direct observations of wildlife. In addition, water quality improvements (i.e., sediment and

toxicant retention and sediment stabilization) are provided by all wetlands. **Table 1** contains a summary of pre-construction functions and values for each of the wetlands proposed to be impacted based on BRI's understanding of the project design as of June 12, 2024. **Exhibit B** includes the functions and values sheets that have been completed for each wetland proposed to be impacted (shown in Table 1).

Table 1. Proposed Impact to Delineated Wetlands

Wetland ID	Proposed Wetland Impact (Sq. Ft.)	Total Area of Wetland (Sq. Ft.)	Percentage of Wetland Impacted
W-KV-01	17,145	705,672	2
W-KV-02	22,787	418,612	5
W-KV-03	35,806	35,806	100
W-KV-04	35,720	35,720	100
W-SK-01A	25,995	25,7076	10
W-SK-02	841	3,485	24
W-SK-03	10,354	10,354	100
W-SK-06	12,993	12,993	100
W-SK-09	5,603	5,603	100
W-SK-10	1,431	1,431	100
W-SK-11	2,650	3,049	87
Total	**171,315**	**1,563,781**	**11**

At the time of the wetland delineation there were three common soils on Site: Telos-Chesuncook complex, Monarda-Telos complex, and Pushaw-Swanville complex. Telos-Chesuncook complex ranges from poorly to moderately well-drained soils on till plains, hills, ridges, and mountains. They are shallow to very deep to bedrock. These soils are formed in till and dense glacial till. The Monarda-Telos complex consists of poorly drained soils formed in dense till on lower slopes or in slight depressions on till plains, hills, and ridges. They are very deep to bedrock and shallow to dense till. The Pushaw-Swanville complex consists of very deep, somewhat poorly drained soils that formed in glaciolacustrine or glaciomarine deposits on lake plains and marine terraces. Representative upland soils on Site were characterized generally by 0-2" of 10YR 3/2 organic, 2-24" of 10YR 5/3 silt loam.

Upland habitats on the Site were dominated by forestland that is characteristic of the Penobscot Lowland region. The overstory vegetation was dominated by red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), eastern hemlock (*Tsuga canadensis*), paper birch (*Betula papyrifera),* red oak (Q*uercus rubra*), white pine (*Pinus strobus*), bigtooth aspen (*Populus grandidentata*), and red spruce (*Picea rubens*). Shrub layer vegetation consisted of primarily overstory species as well as American beech (*Fagus grandifolia*). Herbaceous vegetation includes bracken fern (*Pteridium aquilinum*), sheep laurel (*Kalmia angustifolia*), American wintergreen (*Gaultheria procumbens*), and bunchberry (*Cornus canadensis*).

Based on a review of the proposed project layout, a total of eleven (11) wetlands will be impacted. These wetlands are summarized below and functions of the existing conditions are included in Table 2.

W-KV-01

This wetland is a large wetland complex which includes forested, scrub-shrub, and emergent wetland habitats. Impacts within this wetland are only proposed for a portion of the wetland (17,145 sq. ft.). Soils within this wetland were all dominated by a depleted matrix and reduced conditions. Some organic accumulation is present within areas of deeper ponding. Much of this wetland is forested with a mix of deciduous species along with eastern hemlock and balsam fir. A small section of this wetland within 25 feet of the mapped intermittent stream is considered a Wetland of Special Significance (WOSS) proposed impacts do not occur within the WOSS portion of the wetland.

W-KV-02

This wetland is a large wetland complex which includes forested, scrub-shrub, and emergent wetland habitats. Impacts within this wetland are only proposed for a portion of the wetland (22,787 sq. ft.). Soils within this wetland were dominated by a depleted matrix and in some cases organic accumulation (within interior wetland areas). Common species within this wetland were eastern hemlock, balsam fir, red maple, and occasional northern white-cedar (*Thuja occidentalis*). The shrub layer vegetation was dominated by speckled alder (*Alnus incana*) and winterberry (*Ilex verticillata*). Herbaceous vegetation was diverse and includes species such as cinnamon fern (*Osmundastrum cinnamomeum*), sensitive fern (*Onoclea sensibilis*), swamp dewberry (*Rubus hispidus*), wool grass (*Scripus cyperinus*), hop sedge (*Carex lupulina*), fringed sedge (*Carex crinite*), cattail (*Typha latifolia*). Several vernal pools, including one State Significant Vernal Pool, were identified within this wetland complex (proposed impacts avoid the vernal pool and associated 250-foot buffer).

W-KV-03

This wetland is a smaller wetland adjacent to the project access road. There is some evidence of historic ground disturbance within this wetland which includes placement of boulders and historic rutting. These disturbances appear to be quite old as they appear naturalized (i.e., trees and shrubs are present within them). Forested vegetation within this wetland was dominated by softwood species such as balsam fir and red spruce with a shrubby understory which was dominated by speckled alder and yellow birch (*Betula alleghaniensis*) saplings. Soils were depleted and shallow ponding of water was present during the wetland delineation.

W-KV-04

This wetland is very similar to wetland W-KV-03. As was observed in W-KV-03, there is evidence of historic ground disturbance, which includes historic rutting and side-cast (i.e., old fill piles) adjacent to the wetland. These disturbances appear to be quite old as they appear naturalized

(i.e., trees and shrubs are present within them). Forested vegetation within this wetland was also dominated by softwood species such as balsam fir and red spruce with a shrub understory that was dominated by speckled alder and yellow birch saplings. Soils are depleted and shallow ponding was present during the wetland delineation.

W-SK-01A

Wetland W-SK-01 is a forested wetland complex located within the eastern portion of the proposed development area. A portion of this wetland has been identified as WOSS based on the presence of a significant vernal pool that was mapped during previous work. The forested portion of this wetland included mostly deciduous species such as red maple and green ash (*Fraxinus pennsylvanica*). Proposed impacts to this wetland are not located within the portion of the wetland that is considered WOSS. Impacts have been restricted to the portion, W-SK-01A, of the wetland which has been previously impacted by earth moving and development activities related to the clearing of a pre-existing right-of-way, and installation of a perimeter project fence. This portion of the wetland is predominantly wet meadow and dominated by species including wool grass, cattail and other herbaceous species. Impacts within wetland W-SK-01A are only proposed for a portion of the wetland (25,995 sq. ft.).

W-SK-02

Wetland W-SK-02 is a smaller isolated wet meadow depression that is located within the area previously developed for the perimeter fence and right-of-way. Based on field observations this wetland appears to be unnatural in origin and may have resulted from subsequent grading after the installation of the fence line. This wetland was dominated by primarily wool grass and cattail, proposed impacts include 841 sq ft.

W-SK-03

Wetland W-SK-03 is a small pocket wetland that has formed as a result of roadside ditches associated with the land fill access road as well as clearing associated with the perimeter fence and a utility line. This wetland was dominated by cattail along with white meadowsweet (*Spiraea alba*), and steeplebush (*Spiraea tomentosa*).

W-SK-06

Wetland W-SK-06 is a small pocket wetland that is directly adjacent to the primary access road. There is evidence of historic ground disturbance, and hydrology within this wetland has likely been influenced by the roadside ditch which is associated with the access road. The wetland was dominated by soft wood species, primarily balsam fir and red spruce with a component of shrub vegetation including speckled alder and willow (*Salix* Spp) saplings. Herbaceous vegetation included cattail, cinnamon fern, and sensitive fern, along with white meadowsweet and steeplebush.

W-SK-09, W-SK-10, W-SK-11

These wetlands are all very similar in composition. In all cases these wetlands have been disturbed by historic land use practices. These wetlands are likely the result of altered drainage related to the construction of the original access road. Soils within these features were hydric (i.e., depleted matrix), but were similar in texture to fill which is commonly used for roads beds. Vegetation within these areas was dominated by meadow species, or in some cases (e.g., W-SK-10) are devoid of significant vegetation due to shading and the fact that the wetlands formed within historic skid trails. Dominant species include cattail, white meadowsweet, steeplebush, hop sedge, fringed sedge, fringed brome (*Bromus ciliatus*), wool grass, cinnamon fern, sensitive fern, reed canary-grass (*Phalaris arundinacea*), and swamp dewberry. A representative photo of W-SK-10 is shown to illustrate the historic disturbance within these wetland areas (Photo 1). It is likely that these wetlands formed because of rutting, which ponded water and led to the development of hydric soil conditions and wetland vegetation. Proposed impacts include the entirety (i.e., fill) of wetland W-SK-09 and W-SK-10 and only a portion (2,650 sq. ft.) of wetland W-SK-11.

Photo 1: Representative view of historic disturbance within W-SK-10.

Table 2. Pre-Construction Wetland Functions and Values Table

Wetland ID	Groundwater Recharge/Discharge	Flood-flow Alteration	Fish and Shellfish Habitat	Sediment/Toxicant Retention	Nutrient Removal	Production Export	Sediment/Shoreline Stabilization	Wildlife Habitat	Recreation	Educational/Scientific Value	Uniqueness/Heritage	Visual Quality/Aesthetics	Endangered Species Habitat
W-KV-01		**P**		**P**	**P**	S		**P**					
W-KV-02		**P**		**P**	**P**	S		**P**					
W-KV-03				**P**	**P**			S					
W-KV-04				**P**	**P**			S					
W-SK-01A		**S**		**P**	**P**			**P**					
W-SK-02				**P**	**P**			S					
W-SK-03				**P**	**P**			S					
W-SK-06				**P**	**P**			S					
W-SK-09				**P**	**P**			S					
W-SK-10				**P**	**P**			S					
W-SK-11				**P**	**P**			S					

P=Principal function or value; S=Secondary function or value (i.e., present but not at a principal level)

4.0 Discussion

Field observations and subsequent desktop analysis were used to review wetlands within the proposed project area in relation to the functional assessment. After reviewing, it is clear that wetlands within this area have been significantly impacted by historic land use. Around 2004, the Juniper Ridge Landfill underwent significant permitted expansion. Between 2015 and 2018, additional perimeter fencing with associated impacts was erected around larger portions of the landfill. This permitted activity has reduced functions of adjacent wetlands in two ways. First, the fence line not only creates a barrier to wildlife, but it also creates a break in contiguous habitat by creating a clearing, which creates habitat "islands" within the fenced area. These areas, while still forested, do not provide high quality habitat, as they are functionally separated from surrounding resources from a wildlife standpoint. Second, ground disturbance associated with managing water for roadside drainages and similar from permitted fences and access roads have impacted the historic hydrology of these wetlands. While these interior wetlands meet the three parameters required for delineation, the historic connection to adjacent wetlands has been altered by decades of active permitted work associated with the landfill.

Based on the current design proposal, the project will impact a total of eleven wetlands. Eight of the impacted wetlands will be completely filled to complete the landfill expansion, resulting in a

loss of functions and values within those wetlands. For three of the wetlands, only a small portion of the wetland will be filled. For these wetlands, functions within the direct impact area will be lost (shown in red in Table 2) but functions provided by the larger wetland complex (associated with W-KV-02) will remain. It should be noted that most of the wetlands that are proposed for impacts occur within the central portion of the site and are therefore disconnected from larger intact habitats by cleared fence lines, roadways, or ground disturbance. In addition, several of these wetlands show signs of historic ground disturbance and/or have resulted from human activities (e.g., rutting within old roads which have established wetland parameters).

The most intact and functionally important wetland with proposed impacts is wetland W-KV-02, which will be partially impacted by proposed activities within a portion of the wetland. Based on the current design, fill impacts are proposed within a portion of this wetland, which will result in a loss of function in the filled area. However, overall wetland functions and values within the larger wetland complex will not be lost entirely. Table 3 includes a summary of anticipated post-construction functions provided by impacted wetlands. Cells shown in red represent functions or values that will be lost (i.e., fill) and cells shown in orange represent functions and values that will remain but may be reduced. In some instances, only a small portion of the entire wetland will be lost or modified (e.g., W-KV-01) as a result of the proposed project. In these cases, functions and values may remain intact within the majority of the wetland.

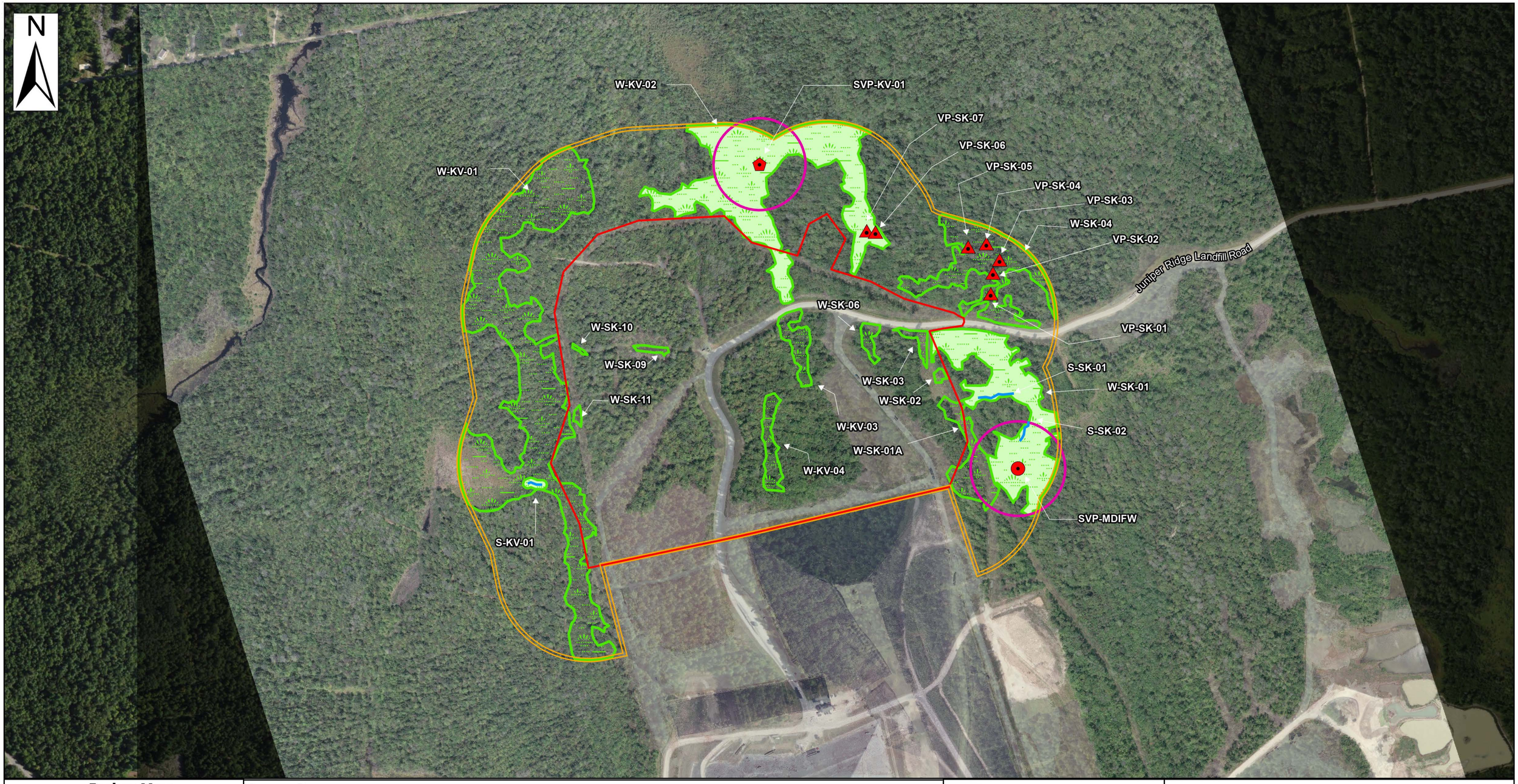
Table 3. Post Construction Wetland Functions and Values Table

Wetland ID	Percent of Wetland Impacted	Groundwater Recharge/Discharge	Flood-flow Alteration	Fish and Shellfish Habitat	Sediment/Toxicant Retention	Nutrient Removal	Production Export	Sediment/Shoreline Stabilization	Wildlife Habitat	Recreation	Educational/Scientific Value	Uniqueness/Heritage	Visual Quality/Aesthetics	Endangered Species Habitat
W-KV-01	2		**P**		**P**	**P**	S		**P**					
W-KV-02	5		**P**		**P**	**P**	S		**P**					
W-KV-03	100				**P**	**P**			S					
W-KV-04	100				**P**	**P**			S					
W-SK-01A	10		**P**		**P**	**P**			**P**					
W-SK-02	24				**P**	**P**			S					
W-SK-03	100				**P**	**P**			S					
W-SK-06	100				**P**	**P**			S					
W-SK-09	100				**P**	**P**			S					
W-SK-10	100				**P**	**P**			S					
W-SK-11	87				**P**	**P**			S					

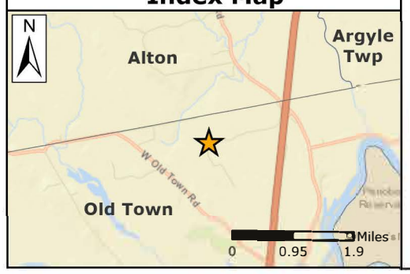
P=Principal function or value; S=Secondary function or value (i.e., present but not at a principal level)

Exhibit A:

Draft Site Plan



Index Map



Legend

- Survey Area (Excluding Previously Permitted Areas)
- Potentially Developable Area
- Wetland of Special Significance (WOSS)
- Wetland
- SVP 250ft Buffer
- SVP mapped by others
- Vernal Pool
- Significant Vernal Pool
- Stream

BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science

Scale

0 — 495 — 990 Feet

1:6,000 when printed on 11 inch by 17 inch media

Natural Resources Map

Juniper Ridge Landfill | Old Town, Maine

September 11 2024

Exhibit B:

Functions and Values Worksheets

Wetland Function-Value Evaluation Form

Total area of wetland 16.1 acres Human made? No Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PFO/PSS/PEM Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-KV-01

Latitude 44°59'21.18"N Longitude 68°43'32.78"W

Prepared by: BRI Date 8/20/2024

Wetland Impact:
Type Clearing/Shading Area 17,145

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N	7		
Floodflow Alteration	Y	1,5,6,7,8,9,13,18	X	Watercourses are present outside of the survey area.
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,3,4,5,8	X	
Nutrient Removal	Y	1,3,4,5,6,7,8,9,10	X	
Production Export	Y	1,2,7,8,12		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	4,5,6,7,8,9,11,13,14,15,16,20	X	See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 9.6 acres Human made? No Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PFO/PSS/PEM Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-KV-02

Latitude 44.990210° Longitude -68.726516°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Clearing/Shading Area

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N	7		
Floodflow Alteration	Y	1,5,6,7,8,9,13,18	X	Watercourses are present outside of the survey area.
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,3,4,5,8	X	
Nutrient Removal	Y	1,3,4,5,6,7,8,9,10	X	
Production Export	Y	1,2,7,8,12		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	4,5,6,7,8,9,11,13,14,15,16,20	X	See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 1.6 acres Human made? No Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PFO Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-KV-03

Latitude 44.987298° Longitude -68.725298°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Fill Area 1.6

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,4	X	
Nutrient Removal	Y	4,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 1.3 acres Human made? No Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development 200 Feet

Dominant wetland systems present PFO Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-KV-04

Latitude 44.986119° Longitude -68.725906°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Fill Area 1.3

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,4	X	
Nutrient Removal	Y	4,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 1.7 acres Human made? No Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PFO Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-01A

Latitude 44°59'11.56"N Longitude 68°43'14.72"W

Prepared by: BRI Date 8/20/24

Wetland Impact:
Type clearing Area 25,995 sq ft

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	Y	1,4,5,6,9		
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,3,4,5,8,10,14	X	Associated with a small intermittent stream, however this stream does not continue off of of the survey area.
Nutrient Removal	Y	1,3,4,5,6,7,8,9,10	X	
Production Export	N	1,4,7		
Sediment/Shoreline Stabilization	N	2,3		
Wildlife Habitat	Y	8,10,12,13,14,16,17,18,20	X	See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 0.08 acres Human made? Yes Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill/ROW Distance to nearest roadway or other development Adjacent

Dominant wetland systems present Emergent Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-02

Latitude 44°59'12.28"N Longitude 68°43'20.71"W

Prepared by: BRI Date 8/20/24

Wetland Impact:
Type Fill Area 831 sq ft

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,3,4,5	X	
Nutrient Removal	Y	3,4,5,6,9,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,13,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 0.3 acres Human made? Yes Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PFO Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-03

Latitude 44.987443° Longitude -68.722650°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Fill Area 0.3

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,3,4,5	X	
Nutrient Removal	Y	3,4,5,6,9,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,13,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 0.3 acres Human made? No Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PFO Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-06

Latitude 44.987440° Longitude -68.723746°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Fill Area 0.3

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,4	X	
Nutrient Removal	Y	4,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 0.13 acres Human made? Yes Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PEM (Wet Meadow) Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-09

Latitude 44.987170° Longitude -68.728182°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Fill Area 0.13

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,4	X	
Nutrient Removal	Y	4,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 0.03 acres Human made? Yes Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development Adjacent

Dominant wetland systems present PEM (Wet Meadow) Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-10

Latitude 44.987142° Longitude -68.729745°

Prepared by: BRI Date 11/14/2023

Wetland Impact:
Type Fill Area 0.03

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,4	X	
Nutrient Removal	Y	4,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland 0.06 acres Human made? Yes Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Forested/Land Fill Distance to nearest roadway or other development 200 FT

Dominant wetland systems present PEM (Wet Meadow) Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Lower

How many tributaries contribute to the wetland? 0 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. W-SK-11

Latitude 44.983157° Longitude -68.728955°

Prepared by: BRI Date 11/21/2023

Wetland Impact:
Type Fill Area 0.06

Evaluation based on:
Office YES Field YES

Corps manual wetland delineation completed? Y YES N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N			
Floodflow Alteration	N			
Fish and Shellfish Habitat	N	1		
Sediment/Toxicant Retention	Y	1,2,4	X	
Nutrient Removal	Y	4,10	X	
Production Export	N	1		
Sediment/Shoreline Stabilization	N			
Wildlife Habitat	Y	8,17		See resource report for wildlife
Recreation	N			Subject area is within a closed landfill-public access is not permitted
Educational/Scientific Value	N			Subject area is within a closed landfill-public access is not permitted
Uniqueness/Heritage	N			Subject area is within a closed landfill-public access is not permitted
Visual Quality/Aesthetics	N			Subject area is within a closed landfill-public access is not permitted
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

ATTACHMENT 13

WETLAND COMPENSATION PLAN

SME
SEVEE & MAHER
ENGINEERS

As discussed with the MEDEP at JRL on October 2, 2024, NEWSME will compensate for unavoidable impact to 3.75 acres of wetlands in the proposed Phase II Expansion by payment of an in-lieu fee. A total of $763,103, representing $4.31 per square foot of non-WOSS wetland (149,670 square feet in total) and $8.62 per square foot of WOSS (13,692 square feet in total).

The impacted wetlands areas are depicted on Figure 1-4, with the delineation label for each impacted area noted. Table 1 lists each area and the square footage of impacted wetland.

TABLE 1

Impacted Wetlands Areas (square feet)			**Fee ($)**
Non-WOSS Wetlands	W-KV-01	19,896	$4.31
	W-KV-03	35,806	
	W-KV-04	35,720	
	W-SK-01A	24,389	
	W-SK-03	11,182	
	W-SK-06	12,993	
	W-SK-09	5,603	
	W-SK-10	1,431	
	W-SK-11	2,650	
TOTAL Non-WOSS		**149,670**	**$645,078**
WOSS Wetlands	W-KV-02	13.692	$8.62
TOTAL WOSS		**13,692**	**$118,025**
TOTAL ALL WETLANDS		**163,360**	**$763,103**

REFERENCES

Maine Department of Environmental Projection, January 2015. Maine Solid Waste Generation and Disposal Capacity Report: for Calendar Year 2013: Report to the Joint Standing Committee on Environmental and Natural Resources 127th Legislature, First Session.

Sevee & Maher Engineers, Inc. (SME), 1991. James River Corporation Old Town Mill Secure Landfill Site Old Town Maine, Application for an Army Corp of Engineers SS404 Permit April 1991.

APPENDIX A

VISUAL EVALUATION FIELD SURVEY CHECKLIST AND VISUAL ASSESSMENT

SME
SEVEE & MAHER
ENGINEERS

Visual Impact Assessment

JUNIPER RIDGE LANDFILL PHASE II EXPANSION

Old Town, Maine

Prepared By:

VIEWSHED

Landscape Architecture | GIS | Planning

121 West Main Street, Yarmouth, ME 04096

March 2025

1 Table of Contents

1 INTRODUCTION 4
1.1 Background 4
1.2 Overview of Methodology 4
2 REGULATORY REQUIREMENTS 5
2.1 NRPA Chapter 315: *Assessing and Mitigating Impacts to Scenic and Aesthetic Uses* 5
2.2 Chapter 400: Maine Solid Waste Management Rules – *General Provisions* 6
2.3 City of Old Town Code Chapter 24: *Solid Waste Facilities* 6
3 METHODOLOGY 7
3.1 Visual Study Area Determination 7
3.2 Scenic Resource Inventory 7
3.3 Computer-Based Viewshed Analysis 7
3.4 Field Investigations 9
3.5 Photosimulations 9
3.6 Study Area Photographs 10
4 PROJECT DESCRIPTION 10
4.1 Landfill Operation 10
4.2 Cover System 10
5 PROJECT VISUAL STUDY AREA (VSA) 10
5.1 Site Context 10
5.2 Landform and Vegetative Patterns 11
5.3 Water Resources 11
5.4 Cultural Characteristics 11
6 EVALUATION OF VISUAL IMPACTS TO SCENIC RESOURCES 12
6.1 Distance Zones 12
6.2 Geographic Extent of Project Visibility 13
6.3 Impacts to Scenic Resources: MDEP Visual Evaluation Field Survey Checklist 14
7 CONCLUSION 23

Attachments

Attachment 1: Study Area and Viewshed Mapping

Attachment 2: Pushaw Lake Photosimulation

Attachment 3: Study Area Photographs

1 INTRODUCTION

1.1 Background

Viewshed, a Landscape Architecture, GIS, and Planning firm in Yarmouth, Maine, was retained by Sevee & Maher Engineers (SME) to prepare this Visual Impact Assessment (VIA) on behalf of NEWSME Landfill Operations, LLC and the Maine Bureau of General Services ('Applicant'), , to assess the visual impacts associated with the proposed Juniper Ridge Landfill Phase II Expansion (Project). This VIA has been developed to address the State of Maine Department of Environmental Protection (MDEP) and City of Old Town permitting requirements as they relate to solid waste development and impacts to natural resources.

Juniper Ridge Landfill (JRL) is a secure landfill located on a 780-acre parcel in Old Town and Alton. It is owned by the State of Maine and managed of behalf of the state by the Maine Department of Administrative and Financial Services' Bureau of General Services (BGS), and is operated by NEWSME Landfill Operations, LLC (NEWSME) under a 30-year Operating Services Agreement (OSA).

JRL is located southwest of Route 16 and north of Route 43 (See Maps in **Attachment 1**). It was originally permitted in 1993, constructed in 1996, and operated by James River Paper Company, Inc. as a papermill landfill. The original permit was for approximately 68 acres and provided 3.3 million cubic yards (MCY) of capacity. The State of Maine purchased JRL in 2004 from the Fort James Operating Company, the successor of James River Paper Company. On February 5, 2004, the State of Maine, and Casella Waste Systems (CWS), through its wholly owned subsidiary, NEWSME, entered into an OSA for operation of the Site.

The most recent expansion at the Site was approved in 2017 to provide an additional 9.35 MCY of disposal capacity to meet the State of Maine's long-term solid waste disposal needs. This increased JRL's permitted solid waste footprint by 54 acres to 122 acres. In 2024, JRL's capacity is expected to run out in approximately five years. In the *Maine Materials Management Plan: 2024 State Waste Management and Recycling Plan Update and 2022 Waste Generation and Disposal Capacity Report*, the MDEP stated that "the expansion of Juniper Ridge Landfill in Old Town will be necessary to ensure there is adequate capacity for the entire State of Maine over the next ten years". The Project aims to meet the short-term and long-term solid waste disposal needs of the State of Maine by expanding JRL's current permitted solid waste footprint by approximately 57acres, as depicted in **Attachment 1**.

1.2 Overview of Methodology

The methodology for assessing the potential visual impacts of the Project involves the judgment of experienced landscape architects in the selection of factors chosen to evaluate scenic quality and determine the magnitude of visual impact. This approach, widely used in permitting work in Maine and elsewhere throughout the country, is based upon current studies and statutes of what constitutes scenic landscapes and visual impacts. Specifically, this report was guided by MDEP Chapter 315: *Assessing and Mitigating Impacts to Scenic and Aesthetic Uses,* MDEP Chapter 400.4 F: *No Unreasonable Adverse Effect on Existing Uses and Scenic Character,* and the City of Old Town Code Chapter 24: *Solid Waste Facilities.* These regulatory requirements are discussed further in Section 2. The VIA report and its conclusions are grounded on the completion of the following:

- Determination of the Visual Study Area
- Research, Inventory, and Mapping of Scenic Resources
- Computer-based Viewshed Mapping Analysis
- Fieldwork Studies and Image Collection
- 3D Modeling and Photosimulation Analysis

The Visual Study Area (VSA) is the geographic area around the Project that is assessed for potential visual impacts. The VSA includes all land and water located within a 7-mile radius around the Project, including a total of 10 towns, unorganized territories, and tribal lands. Located within Penobscot County, communities within the VSA include Old Town where the landfill is located, Penobscot Nation Tribal lands on Indian Island and Orson Island, Glenburn, Hudson, Alton, Argyle, Greenbush, Milford, Bradley, and Orono.

The Report is supported by the following Attachments:

- Attachment 1: Study Area and Viewshed Mapping
- Attachment 2: Push Lake Photosimulation
- Attachment 3: Study Area Photographs

2 REGULATORY REQUIREMENTS

The Project will trigger permitting requirements related to visual resources in Chapter 315 of the MDEP Natural Resources Protection Act (NRPA), as well as Chapter 400 of the Maine Solid Waste Management Rules.

2.1 NRPA Chapter 315: *Assessing and Mitigating Impacts to Scenic and Aesthetic Uses*

The guidelines in Chapter 315 require the Applicant to provide evidence that allows MDEP to determine whether the Project will have an unreasonable adverse impact on existing uses and scenic character by identifying and assessing the potential impacts to scenic resources. MDEP defines scenic resources as:

> *Public natural resources or public lands visited by the general public, in part for the use, observation, enjoyment, and appreciation of natural or cultural visual qualities. The attributes, characteristics, and features of the landscape of a scenic resource provide varying responses from, and varying degrees of benefits to, humans.*

Furthermore, Chapter 315.10 classifies scenic resources in the following six categories.

A. *National Natural Landmarks and other outstanding natural and cultural features (e.g., Orono Bog, Meddybemps Heath)*

B. *State or National Wildlife Refuges, Sanctuaries, or Preserves and State Game Refuges (e.g., Rachael Carson Salt Pond Preserve in Bristol, Petit*

Manan National Wildlife Refuge, the Wells National Estuarine Research Reserve)

C. *A State or federally designated trail (e.g., the Appalachian Trail, East Coast Greenway)*

D. *A property on or eligible for inclusion in the National Register of Historic Places pursuant to the National Historic Preservation Act of 1966, as amended (e.g., the Rockland Breakwater Light, Fort Knox)*

E. *National or State Parks (e.g., Acadia National Park, Sebago Lakes State Park)*

F. *Public natural resources or public lands visited by the general public, in part for the use, observation, enjoyment and appreciation of natural or cultural visual qualities. (e.g., great ponds, the Atlantic Ocean).*

Scenic resources identified within the VSA are described in more detail in Section 6 and presented on Maps in **Attachment 1.**

2.2 Chapter 400: Maine Solid Waste Management Rules – *General Provisions*

Chapter 400.4(F) entitled: *No Unreasonable Adverse Effect on Existing Uses and Scenic Character*, provides standards for assessing impacts to "public viewing areas" within 2,000 feet of the Project (400.4(F)(3)(b).

MDEP defines public viewing areas as:

> *"Public viewing area" means an area designated for the public to view scenic areas, historical sites, unusual natural features, or public monuments. These areas include, but are not limited to, scenic highways; public easements; scenic turnouts; public monuments; and national, state or municipal parks.*

Chapter 400.4(F)(3) states that applications must provide evidence that demonstrates that there will be no unreasonable adverse impacts to existing uses and scenic character in relation to these public viewing areas.

2.3 City of Old Town Code Chapter 24: *Solid Waste Facilities*

The City of Old Town's solid waste ordinance largely mirrors the standards in Chapter 400 as they pertain to visual resources. Section 24-8(M) entitled: *Impact on Existing Uses and Scenic Character,* and Section 24-12 (K) entitled: *Criteria for Approving a Solid Waste Facility Permit or Permit Amendment,* provide similar requirements of the assessment of 'established Public Viewing Areas' within 2,000 feet of the Project (§24-12(K)(c).

As stated in Section 1, this VIA Report and supporting attachments are meant to be a comprehensive assessment that meets the standards of all State and local regulations as they apply to visual resources.

3 METHODOLOGY

The following describes the methodology used to assess the visual impacts of the Project.

3.1 Visual Study Area Determination

As noted in Section 1.2, the VSA is the geographic area around the Project in which scenic resources are identified and potential visual impacts are assessed. Both Chapter 400 and Old Town Code Chapter 24 guidance require the applicant to look at public viewing areas within a 2,000 foot radius of the Project.

The Juniper Ridge Landfill has been expanded in both height and area periodically over the last three decades, each time requiring a regulatory permitting process similar to that required by the Phase II Expansion. During the most recent effort to expand the landfill spanning the period from 2014 to 2017, a VIA was completed by SMRT Inc[1]. While initially only required to assess public viewing areas within 2,000 feet of the landfill, public input helped to shed light on the importance of assessing potential views from Pushaw Lake, where the existing landfill is currently visible from some locations. Due to this feedback, the VSA used by SMRT was conservatively expanded to 6-miles, covering much of the lake. Additionally, NRPA Chapter 315.7 states:

> *"The radius of the impact area to be analyzed must be based on the relative size and scope of the proposed activity given the specific location."*

A 7-mile radius around the Project was used to define the extent of this assessment. This determination was based on precedent set in the previous SMRT VIA, existing regulatory statutes, and the current geographic extent of visibility of the existing landfill (particularly on Pushaw Lake).

3.2 Scenic Resource Inventory

Scenic resources were inventoried within the 7-mile VSA using State Geographical Information Systems (GIS) databases, municipal Comprehensive Plans and documents, and online research. As noted in Section 2.1, scenic resources are typically defined as publicly owned and/or accessible places visited by the public, in part for the enjoyment of visual quality. Scenic resources are places that include, but are not limited to parks, conservation lands, trails, scenic byways, elevated viewpoints and overlooks, water bodies, and historic resources. NRPA Chapter 315 provides a framework for evaluating impacts on scenic resources. Section 6 of this report provides an evaluation of visibility from scenic resources. Map 1 in **Attachment 1** displays an inventory of scenic resources found within the VSA**.**

3.3 Computer-Based Viewshed Analysis

A computer-based viewshed analysis is a predictive screening tool to determine areas with potential Project visibility within the VSA. The viewshed analysis was conducted using ESRI ArcGIS Pro software. The analysis relied on a Digital Terrain Model (DTM) to represent topography as well as a Digital Surface Model (DSM) to represent features in the landscape (vegetation and structures). For the majority of the

[1] SMRT Engineers, *Visual Assessment Report – Juniper Ridge Landfill.* Appendix G. 2015

VSA, the DTM and DSM were derived from LiDAR point cloud data, which was taken from The National Map produced by the U.S. Geological Survey (USGS)[2]. LiDAR point cloud data is typically considered to be the most accurate form of surface data that is publicly available. The point cloud data was processed to create 3-foot resolution surface raster models.

For an area covering approximately 21,400 acres (19.6% of the VSA), there was no publicly available LiDAR point cloud data. This data is owned by the Penobscot Nation and there was no obvious way to include the data in this analysis. Within this area, the DSM was created using a combination of the Maine Land Cover Database (2004) and the Maine CCAP High Resolution Impervious and Forest Resource Data (2021)[3], as well as building footprints for the area. The area that was processed with land cover data is identified on Map 2 in **Attachment 1**. These datasets assign an average height to both natural and human created features in the landscape to generate a reasonably accurate digital surface. The following heights were assigned to features in the landscape.

- Forest: 40 Feet
- Low Forest: 20 Feet
- Scrub Shrub: 10 Feet
- Buildings: 30 Feet
- Cleared Ground/Agricultural, Water, Wetlands, and Impervious: 0 Feet

While surface data produced with land cover represents a reasonably accurate dataset, absent the presence of LiDAR point cloud data, the heights used for landscape features are averages. Forest cover exceeding 40 feet was observed within the area substituted with land cover data; especially along the banks of the Penobscot River and Stillwater Rivers, as well as other waterbodies. This method produced a less accurate surface model than using LiDAR data, but does provide a better understanding of the vegetative and human crated surface than just using ground surface data.

Using the LiDAR and landcover datasets described above, a computer-based viewshed analysis was completed relying on both DTM and DSM models. The viewshed analysis is based on a viewer elevation 5.9 ft above the topography, representing visibility from the approximate height of a viewer in the landscape. The viewshed analysis represents potential visibility from the maximum height of the Project, which is expected to have a maximum height of approximately 180 feet above the high point of the existing ground surface, or approximately 380 to 385 feet above sea level. As an initial screening tool, the viewshed analysis was used to determine the geographic extent of Project visibility, identify visually sensitive resources with potential visibility, and select places to conduct field investigations to better understand potential Project visibility.

There are some technological shortcomings to the viewshed analysis. It does not determine the degree of visibility based on distance, weather, or other atmospheric conditions. It also does not determine how much of the landfill would be seen from any one viewpoint, or whether any part of the landfill would be seen silhouetted against the sky. Other visualization techniques, such as 3D modeling and photosimulation analysis, help to create a clearer picture of visual impacts. The results of the viewshed analysis are displayed on Map 2 in **Attachment 1**.

---

[2] The National Map produced by the U.S. Geological Survey is available at: https://viewer.nationalmap.gov/basic/

[3] Both land cover datasets are available for download from the Maine Office of GIS at: https://www.maine.gov/geolib/catalog.html

3.4 Field Investigations

Field studies began with an evaluation of the viewshed analysis to determine areas where the Project will be visible in the landscape and from scenic resources. Field investigations were conducted during site visits on May 22 and 23, 2024. Fieldwork concentrated on evaluating and photographing scenic resources and other components of the visible landscape within the VSA, 7-miles of the Project. Fieldwork was conducted by automobile, kayak, and on foot. It was limited to lands, roads, and waterbodies that are considered public or allow for public access.

Photographs were primarily taken with a Nikon D750 camera set to record at the highest resolution (fine). The Nikon D750 (a full-frame camera) was equipped with a 50mm lens. GPS coordinates of the photographs were recorded with a camera-mounted GPS unit. Full-frame photographs were used in the preparation of a photosimulation from Pushaw Lake in **Attachment 2**. An annotated selection of representative views within the VSA are included in **Attachment 3: Study Area Photographs** to provide additional context for the Project and scenic resources.

3.5 Photosimulations

Photosimulations are photo-realistic images of the proposed Project, generated through a combination of field photography aligned to a 3D model of the Project. Photosimulations are prepared for visual impact assessments to help illustrate the anticipated changes in views from scenic resources due to Project visibility.

Photosimulations are prepared by 1) creating digital landscape model (using the same DTM and DSM surfaces described in Section 3.3); 2) creating a 3D digital model of the Project, based on Project data provided by the Applicant, and digitally inserting the Project model into the landscape model; 3) aligning the digital models with GPS-located photograph (the elevation, latitude, and longitude data), matching the lens focal length and aligning existing visible elements in the landscape (e.g., vegetation, ridgelines, roads, buildings) to register the photographs to actual ground conditions; 5) rendering a simulated perspective of the Project using 3D model rending software, taking into consideration date and time of photograph, digital resolution, and lighting conditions of the original photograph. The result of these steps results in highly accurate rendering of the Project that aligns to the scale, lighting, and colors of the original image.

Post-production editing involved eliminating parts of the Project that would be blocked by terrain or vegetation. Images were then modified in Adobe Photoshop to fine tune adjustments that accounted for the time of day, weather conditions, haze, and other environmental factors.

The photosimulation was also merged with adjacent photographs of existing conditions in Adobe Photoshop to create a panorama that gives a more contextual view of the broader landscape as seen from the viewpoint. The legend in the 'panoramic' image provides the latitude and longitude of the viewpoint, view direction, date/time when the photograph was taken, camera make and model and lens focal length, description of view, distance to the Project, and relevant Project specifications. The photosimulation also includes a Project context map and location map. The 'normal view' image describes the distance that the viewer should hold the photosimulation from the eye to accurately replicate real-world conditions. **See Attachment 2**.

3.6 Study Area Photographs

Representative photographs of the VSA are included in **Attachment 3**. The locations of the photographs are indicated on the Visual Study Area Map in **Attachment 1**. The photographs were selected to document the field investigations, give VIA reviewers additional information on the existing character of the surrounding area, and provide context for the photosimulation.

4 PROJECT DESCRIPTION

The following section describes the visible Project components and activities within the Project that may influence visibility.

4.1 Landfill Operation

As previously described, the landfill consists of the originally permitted 68 acres of landfill, the initial 54-acre expansion, and the current project, which is the 57-acre Phase II Expansion. Within the 57 acres, individual cells will be constructed approximately every two years, comprising approximately seven to fifteen acres each. Each cell will have a double composite liner, including (from top to bottom) a leachate collection system consisting of a 12-inch-thick layer of sand over a drainage geocomposite; a primary liner, consisting of a an 80-mil high density polyethylene (HDPE) geomembrane, a geosynthetic clay liner, and a 12-inch-thick compacted barrier soil. The primary liner system overlies the leak detection system, which is constructed like the leachate collection system. The secondary liner underlies the leak detection system and consists of a 60-mil HDPE geomembrane over a 12-inch-thick compacted barrier soil layer.

4.2 Cover System

Once a cell liner is constructed, the cell will be filled with waste to an interim elevation below the final waste grade, at which time it will be covered with a temporary LLDPE geomembrane until the waste can be placed to final grades and the final landfill cover constructed. The Phase II Expansion is expected to last for approximately ten to twelve years.

The final cover system (from top to bottom) consists of 18 inches of vegetative cover soil, 250-mil drainage geocomposite, 40-mil linear low-density polyethylene (LLDPE) textured geomembrane, GCL, and a 12-inch compacted till barrier layer. Slope terraces with a minimum berm height of 1.5 feet will be constructed every 75 feet (horizontally) on the final cover slope to control stormwater and convey runoff to riprap-lined downspouts and ultimately to the stormwater detention ponds.

5 PROJECT VISUAL STUDY AREA (VSA)

5.1 Site Context

The VSA includes all land and water area within a 7-mile radius of the Project, illustrated on maps in **Attachment 1**. The regional context and character can be described by the existing landforms, vegetative patterns, water resources, and cultural characteristics.

5.2 Landform and Vegetative Patterns

Most of the VSA falls within the Central Maine Interior Ecoregion of Maine.[4] This region is defined by mostly flat landforms with occasional rolling hills as well as large wetland and bog systems, lakes and ponds, and the rivers and streams the make up the Penobscot River Watershed. An approximately 14.5 mile long section of the Penobscot River runs through the eastern half of the VSA. Vegetation in the region is primarily made up of large areas of mixed second growth hardwoods and softwoods broken up by lower scrub shrub species inhabiting wetlands and bogs.

5.3 Water Resources

At over 5,000 acres[5], Pushaw Lake is the largest waterbody within the VSA, located approximately 4 miles southwest of the Project. The lake has several public access points allowing recreational use for power boating, canoeing, kayaking, swimming, fishing, and ice fishing. Just east of Pushaw Lake is Perch Pond, located 3 miles southwest of the Project. The undeveloped pond is surrounded by conserved lands and trails and can be accessed via Old Town's Sewall Park. As mentioned above, the Penobscot River, in addition to the Stillwater River, Pushaw Stream, and Birch Stream, are among the most notable linear water features within the VSA.

In addition to lakes and rivers, there are several bog and wetland areas within the VSA that are unique to this area of Maine, including Orono Bog, Sunkhaze Meadows Wildlife Management Area, and Caribou Bog. These publicly accessible protected areas contain trails and educational opportunities that serve as important local and recreational tourism destinations.

5.4 Cultural Characteristics

5.4.1 Population Centers

Population in the VSA is primarily concentrated in the towns of Orono (pop. 11,179) and Old Town (pop. 7,430) located in the central and southern portions of the VSA[6]. Outside of these towns, the majority of the VSA is characterized by woodlands mixed with pockets of small communities and rural residential development.

5.4.2 Cultural and Historic Influences

Many of the communities within the VSA carry rich cultural and historic influences that shape their identity today. One of the most significant historical influences is the presence of the Penobscot Nation,

---

[4] Schlawin & Cutko *A Conservation Vision for Maine Using Ecoregions*, Maine Natural Areas Program, Maine Department of Agriculture, Conservation and Forestry. 2014.

[5] Maine IFW Lake Survey: https://www.maine.gov/ifw/docs/lake-survey-maps/penobscot/pushaw_lake.pdf.

[6] Based on 2020 U.S. Census data (https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-cities-and-towns.html)

whose ancestors have inhabited the region for thousands of years. The Penobscot people have a deep connection to the land and waters around the Penobscot River. Their cultural traditions, including language, crafts, and spiritual practices, continue to influence the local community and are celebrated through events and collaborations with the broader region.

The establishment of the University of Maine in Orono in 1865 has had a significant impact on the area's cultural landscape. The University brings youthful energy and diverse perspectives to the region. It serves as a center for education, research, and cultural activities, fostering intellectual engagement and contributing to the community's vibrancy. The University's influence can be seen in the arts, music, and academic events that enrich the cultural life in the area.

5.4.3 Outdoor Recreation

The Central Maine region in the vicinity of the Project VSA is known for its abundant outdoor recreational opportunities for visitors and residents alike. This includes activities such as hiking, biking, snowmobiling, and wildlife viewing in places like the Orono Bog Boardwalk and the Hirundo Wildlife Refuge. Water activities like canoeing, kayaking, and fishing on the Penobscot River, Stillwater River, and Pushaw Lake are also popular.

The City of Old Town Comprehensive Plan, titled *2016 Comprehensive Plan Update* [7], discusses goals to preserve local scenery, and lists scenic viewpoints identified by the community that hold both recreational and visual importance. Existing conditions images from a selection of these locations are included in **Attachment 3** and are shown in the 'Resources Identified by Viewshed' layer on maps in **Attachment 1**. These viewpoints are further discussed in Section 6.

6 EVALUATION OF VISUAL IMPACTS TO SCENIC RESOURCES

This section describes the geographic extent of potential visibility and evaluates the visual impact at the identified scenic resources using the *Appendix A – Maine Department Visual Evaluation Field Survey Checklist (Natural Resources Protection Act, 38 M.R.S. §§ 480 A - Z)*.

6.1 Distance Zones

The concept of distance zones is used as a frame of reference to discuss the characteristics of the visible landscape and the scenic effects of human activities in the surrounding landscape. The concept is based upon the USDA Forest Service visual analysis criteria for forested landscapes and addresses the amount of detail that an observer can differentiate at varying distances.[8] The evaluation of foreground, midground, and background, as defined below, provides a useful framework for evaluating the visual significance of the Project in the larger landscape. The distance zones used for the Project are defined as:

- **Foreground**: 0 to 1/2 mile from the observer. Within the foreground, observers can detect surface textures, details, and a full spectrum of color. The details of the landfill (operations

[7] *2016 Comprehensive Plan Update*. City of Old Town. 2016

[8] Landscape Aesthetics: A Handbook for Scenery Management. USDA Forest Service. Agricultural Handbook Number 701. December 1995.

vehicles and equipment, colors and textures associated with solid waste deposits), and other Project components will be readily apparent.

- **Midground**: 1/2 mile to 3-5 miles from the observer. The midground is a critical part of the natural landscape. Within this zone, the details found in the landscape become subordinate to the whole: individual trees lose their identities and become forests; buildings are seen as simple geometric forms; roads and rivers become lines. Edges define patterns on the ground and hillsides. Development patterns are readily apparent, especially where there is noticeable contrast in scale, form, texture, or line. Colors of structures become somewhat muted, and the details become subordinate to the whole. This effect is intensified in hazy weather conditions, which tend to mute colors and de-sharpen outlines even further. In panoramic views, the midground landscape is the most important element in determining visual impact.
- **Background**: greater than 3–5 miles.[9] Background distances provide the setting for panoramic views that give the observer the greatest sense of the larger landscape. However, the effects of distance and atmospheric haze will obliterate the surface textures, detailing, and form of Project components. Objects in the background will be highly visible only if they present a noticeable contrast in form or line, and when weather and lighting conditions are favorable.

6.2 Geographic Extent of Project Visibility

The landscape within the 7-mile VSA is characterized by largely flat and gently rolling landforms, bogs and wetland areas, lakes and rivers, and low-density rural development. The presence of the Penobscot River running north to south through the eastern portion of VSA influences many of the natural systems that shape the landscape, as well as the scale and density of human development. Compared to other parts of central and western Maine, there are fewer pronounced peaks and ridgelines offering distant views. This relatively flat, mostly wooded landscape works to screen and limit opportunities for Project visibility throughout the VSA.

The Viewshed Analysis displayed on Map 2 in **Attachment 1** indicates that potential Project visibility is mostly limited to a handful of cleared areas and water features in the central and southwestern portions of the VSA. Based on the viewshed analysis, areas of potential visibility account for less than one percent (0.7% of the total area within the VSA).

The largest areas of potential visibility are located in Alton Bog in the vicinity of Interstate 95 located 1.5 miles northeast of the Project, and from the southwest end of Pushaw Lake located approximately 5.2 miles southwest of the Project. Near Orson Island, located approximately 2 miles southeast of the Project in Old Town, the viewshed analysis indicates intermittent pockets of visibility along the Stillwater River to the north and east of Orson Island and along the Penobscot River to the west of Indian Island. Little to no visibility was identified from any of the village and town centers within the VSA. Visibility from local roads was limited to brief openings in vegetation along Route 16 and Route 43 in Old Town. Section 6.3 further discusses visibility from the areas mentioned above. Beyond the lands owned by the Juniper Ridge Landfill itself, there was minimal potential visibility observed from private residential property and commercial businesses within the VSA.

[9] For purposes of this visual impact assessment, the background viewing distance is limited to the extent of the 7-mile VSA.

6.3 Impacts to Scenic Resources: MDEP Visual Evaluation Field Survey Checklist

In order to evaluate visibility from identified scenic resources within the VSA, this assessment was guided by the *MDEP Visual Evaluation Field Survey Checklist (Natural Resources Protection Act, 38 M.R.S. §§ 480 A - Z).*

MDEP Visual Evaluation Field Survey Checklist

Name of Applicant: State of Maine, Bureau of General Services

Application Type: Natural Resources Protection Act

Activity Type: Expansion of Landfill Footprint

Activity Location: Old Town, ME

County: Penobscot

GIS Coordinates, if known: 44.985533°, -68.726147°

Date of Survey: July 23, 2024

Observer: Steve Thompson

Phone: 207-846-0757

6.3.1 Would the activity be visible from:

A. A National Natural Landmark or other outstanding natural feature?

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource			
	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
Orono Bog	**X**			

1. Orono Bog

The northern end of Orono Bog is located at the edge of the VSA, approximately 7-miles south of the Project. Managed by the University of Maine, the bog is federally recognized as a National Natural Landmark and includes a popular ADA accessible boardwalk that runs for nearly a mile. The Project will not be visible from the boardwalk, or any lands considered part of the bog due to intervening terrain and vegetation on Kelley Hill, just north of the bog in Orono.

There are no other designated National Natural Landmarks or comparable natural areas with potential Project visibility within the VSA. Alton Bog, located 1.5 miles northeast of the Project, was identified as having potential Project visibility. However, the bog is bisected by Interstate 95, contains no formal trails or access points, and is not considered a scenic resource.

B. A State or National Wildlife Refuge, Sanctuary, or Preserve or a State Game Refuge?

There will be no Project visibility from any State or National Wildlife Refuges, Sanctuaries, Preserves, or State Game Refuges. The most notable scenic resources within the VSA under this category include the following:

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource			
	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
Sunkhaze Meadows National Wildlife Refuge (NWR)	**X**			
Caribou Bog Wildlife Management Area (WMA)	**X**			
Hirundo Wildlife Refuge	**X**			

2. Sunkhaze Meadows National Wildlife Refuge (NWR)

The Sunkhaze Meadows NWR is an expansive protected area in Milford of over 10,000 acres that supports a variety of ecosystems, habitats, and wildlife communities.[10] The NWR is located approximately 5.5 miles east of the Project. Managed by the U.S. Fish and Wildlife Service, the NWR contains opportunities for hiking, hunting, scenery, and wildlife viewing. There will be no Project visibility from the NWR due to intervening vegetation and terrain.

3. Caribou Bog Wildlife Management Area (WMA)

Caribou Bog WMA is located 3.7 miles southwest of the Project in Orono and Old Town and is managed by the Maine Department of Inland Fisheries and Wildlife. The bog covers over 2,000 acres of upland and wetland habitat, and while access is limited to foot traffic only, the WMA is open to hikers, hunters, and wildlife observers[11]. The WMA is bordered by several conservation parcels managed by the Orono Land Trust, which include trail networks and access points into the lands within the Caribou Bog. There will be no Project visibility from the WMA due to intervening vegetation and terrain. (For general context photos, see **Attachment 3** *Photo 15 & 18*.)

4. Hirundo Wildlife Refuge

While privately managed by the Hirundo Land Trust, this wildlife refuge is open to the public and borders lands connected to the Caribou Bog WMA. Located 2.4 miles west of the Project in Old Town and Alton, the refuge is an important haven for wildlife, as well as a recreational and educational resource for the region. There will be no Project visibility from the Hirundo Wildlife

[10] https://www.fws.gov/refuge/sunkhaze-meadows

[11] https://www.maine.gov/ifw/blogs/mdifw-blog/caribou-bog-wildlife-management-area

Refuge due to intervening vegetation and terrain. (For general context photos, see **Attachment 3** *Photo 12, 13, & 14*.)

C. *A state or federal trail?*

There will be no Project visibility from State or Federal trail systems within the VSA. Details on ITS 84 are provided below.

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource			
	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
ITS 84	**X**			

5. ITS 84

The Maine Interconnected Trail System (ITS) is a snowmobile trail system that covers the State of Maine and is managed in part by the Maine Bureau of Parks and Lands. ITS 84 runs for approximately 3.7 miles within the eastern portion of the VSA approximately 5 miles from the Project. ITS 84 then connects to a network of local snowmobile trails managed by private community clubs. Local snowmobile trails are typically located on private land, and access is granted by private property owners. These local trails are not typically considered scenic resources.

D. *A public site or structure listed on the National Register of Historic Places (NRHP)?*

There are no listed or eligible structures, districts, or other places with potential Project visibility within the VSA.

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource			
	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
All Structures and Districts listed below	**X**			

A total of 10 listed structures, 19 eligible structures, and two listed historic districts were identified within the 7-mile VSA. The 10 structures and two historic districts listed on the National Register of Historic Places include:

Structures

- St Anne's Church and Mission Site (4 miles southeast of the Project in Old Town) (For general context photos, see **Attachment 3** *Photo 24*.)
- Milford Congregational Church (4.1 miles southeast of the Project in Milford) (For general context photos, see **Attachment 3** *Photo 26*.)
- Bodwell Water Power Company Plant (4.1 miles southeast of the Project in Milford) (For general context photos, see **Attachment 3** *Photo 30*.)

- US Post Office (4.5 miles southeast of the Project in Old Town) (For general context photos, see **Attachment 3** *Photo 32*.)
- St. James Episcopal Church (4.6 miles southeast of the Project in Old Town) (For general context photos, see **Attachment 3** *Photo 31*.)
- Patch, Edith Marion House (5 miles southeast of the Project in Old Town)
- Maine Experiment Station Barn (6 miles southeast of the Project in Orono)
- Phi Gamma Delta House (6.3 miles south of the Project in Orono)
- Colburn, William House (6.4 miles south of the Project in Orono)
- Old Fire Engine House (6.8 miles southeast of the Project in Orono)

Districts

- University of Maine Historic District (5.4 miles southeast of the Project in Orono)
- Orono Main Street Historic District (6.9 miles south of the Project in Orono)

E. A National or State Park?

There are no National or State Parks within the VSA.

F. Public natural resources or public lands visited by the general public, in part for the use, observation, enjoyment and appreciation of natural or cultural visual qualities.

1. A municipal park or public open space?

There are no municipal parks or similar public open spaces with potential visibility of the Project within the VSA.

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource			
	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
All municipal sites listed below	**X**			

Municipal parks and public open spaces within the VSA mostly consist of small parks and playgrounds near village and town centers, water access points and picnic areas along the region's lakes and rivers, as well as nature preserves and recreation areas. Notable parks and open spaces managed locally include, but are not limited to:

- **Gould's Landing** (6.3 miles southwest of the Project in Orono) includes park space and water access to Pushaw Lake. (For general context photos, see **Attachment 3** *Photo 36 & 37*.)
- **Lakeside Landing Park** (5.1 miles southwest of the Project in Glenburn) includes park space and water access to Pushaw Lake. (For general context photos, see **Attachment 3** *Photo 34 & 35*.)

- **Sewall Park** (3.4 miles southwest of the Project in Old Town) includes park space and water access to Perch Pond. (For general context photos, see **Attachment 3** *Photo 16 & 17*.)
- **4th Street Park** (3.7 miles southeast of the Project in Old Town) includes park space and water access to the Penobscot River and Stillwater River. (For general context photos, see **Attachment 3** *Photo 22 & 23*.)
- **Greenfield Boat Ramp** (4.4 miles northeast of the Project in Milford) includes water access to the Penobscot River. (For general context photos, see **Attachment 3** *Photo 3 & 4*.)
- **Greenbush Public Landing** (5.8 miles northeast of the Project in Greenbush) includes water access to the Penobscot River. (For general context photos, see **Attachment 3** *Photo 1 & 2*.)

None of the places listed above, as well as any of the other parks and open spaces identified within the VSA will have Project visibility due to intervening vegetation, structures, and terrain.

2. A publicly owned land visited, in part, for the use, observation, enjoyment, and appreciation of natural or man-made visual qualities?

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource			
	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
All established local scenic roads	**X**			

Established Local Scenic Views

The City of Old Town Comprehensive Plan, titled *2016 Comprehensive Plan Update* describes goals related to the preservation of scenic resources and notes scenic views important to the City. The following scenic views were identified in the Plan:

- View from the Milford Dam in the Downtown (For general context photos, see **Attachment 3** *Photo 28 & 29*.)
- View from the Gilman Falls Dam on Route 43 (For general context photos, see **Attachment 3** *Photo 20 & 21*.)
- View from the Stillwater Dam on the Stillwater River (For general context photos, see **Attachment 3** *Photo 40*.)
- View from "high head" (South Main Street heading north from Orono) of the paper mill and site of the former Great Works Dam
- View of Katahdin from outer Kirkland Road
- View of the Stillwater River from Route 116 at Birch Stream
- View from Poplar Street at the bog
- Sewall Park on Mud/Perch Pond (For general context photos, see **Attachment 3** *Photo 16 & 17*.)
- View of the Stillwater River from Bennoch Road (For general context photos, see **Attachment 3** *Photo 10*.)

- View of the Stillwater River from College Road through the University Forest

None of the scenic view locations listed above will have visibility of the Project due to intervening vegetation, structures, and terrain. Photos from several of these scenic view locations are available in **Attachment 3** and identified in the list**.**

Interstate 95

Visibility was identified in the vicinity of Alton Bog along the Interstate 95 highway in Alton. For an approximately 4,200 ft stretch of highway, motorists traveling southbound will have intermittent views of the Project through pockets of roadside vegetation. The posted speed limit in this area is 75 miles per hour, which would allow account for less than a second of interment views along the stretch of highway with potential visibility.

Northbound motorists would have to turn nearly 180 degrees to see potential views of the Project through foreground elements including a vegetated median, the southbound lanes of travel, and roadside vegetation along the southbound lanes. Visibility of the Project from northbound motorists is highly unlikely.

Local Roads

The viewshed analysis and fieldwork confirmed intermittent Project visibility from Route 16 (Bennoch Road) and Route 43 (W Old Town Road). Both public roads serve as linear features from which to enjoy the scenic quality of the lands they traverse. Neither Route 16 or Route 43 have been designated as part of any local, state, or national scenic route or byway. While the City of Old Town Comprehensive Plan does mention scenic views of the Stillwater River from points along Route 16, there are no views of the Stillwater River from locations on the roadway where views of the Project would also be visible (See Map 2 in **Attachment 1**).

All potential Project visibility locations along Route 16 and Route 43 currently have views of the existing Juniper Ridge Landfill. Visibility from most of these locations is brief and intermittent in nature, often seen through small gaps in vegetation and structures. From a stretch of Route 43 (approximately 1,300 foot long) located just south of the Project, arborvitae planted along the road over a decade ago to mitigate views of the existing landfill have now grown to be an effective visual screen. These plantings will continue to mitigate any potential Project views from motorists travelling northbound. Overall, Project visibility from local roads is likely to be minimal and would not cause an unreasonable adverse visual impact to motorists and other users traversing the area. Areas of potential Project visibility are mapped as viewshed analysis in **Attachment 1**. Photographs from areas with Project visibility along Route 16 and Route 43 are presented in **Attachment 3.**

3. A public resource, such as the Atlantic Ocean a great pond or a navigable river?

SCENIC RESOURCE(S)	VISIBILITY TABLE Distance Between the Proposed Visible Activity and Resource

	No Visibility	0 – ¼ mile	¼ - 1 mile	1+ miles
Pushaw Lake, Penobscot River, Stillwater River				**X**
Perch Pond, Pickerel Pond, Holland Pond, Birch Stream, Pushaw Stream	**X**			

Pushaw Lake is the largest Great Pond within the VSA. Other large waterbodies considered Great Ponds in the VSA include Perch Pond, Pickerel Pond, and Holland Pond. The Penobscot River, Stillwater River, Pushaw Stream, and Birch Stream are among the most notable river and stream systems within the VSA. The potential visual impact on public waterbodies is described below.

Pushaw Lake

Pushaw Lake is a Great Pond of over 5,000 acres partially located within the boundaries of four municipalities, including Old Town, Hudson, Glenburn, and Orono. As the largest lake in the Project VSA, and one of the largest lakes in the greater Bangor region, the lake is a vital recreational, environmental, and commercial resource for surrounding communities, visitors, and wildlife. Though the lake is not rated for scenic resources in the *Maine's Finest Lakes Assessment.* The lake is rated for having significant or outstanding physical, fishery, and wildlife characteristics[12].

The computer-based viewshed analysis indicated potential Project visibility from areas in the southwestern corner of the lake, covering approximately 2% of the lake's surface (See Map 2 in **Attachment 1**). According to this analysis, the Project would be seen at distances between 5.2 and 6.7 miles away, within the background viewing distance zone.

In addition to viewshed analysis, a thorough assessment of Pushaw Lake was conducted to understand the potential magnitude of visual effects on the lake. This assessment included fieldwork, 3D modeling, and photosimulation development. The photosimulation from a viewpoint on Pushaw Lake in **Attachment 2** illustrates how the Project at its maximum size (reaching a height of approximately 180 feet above the current high point, or approximately 380 to 385 feet above sea level) might appear from an area of visibility located approximately 6 miles away from the Project. From viewpoints in the southwestern area of Pushaw Lake at distances beyond 5 miles, the Project would be visible in the background. The Project would introduce minimal contrasts in scale, form, line, and color. During the majority of the landfill's operation, once the expansion reaches heights visible above tree line, the Project would appear as a grayish/brownish color. As the Project reaches its final permitted elevations, dark gray/black capping membranes will be applied before a vegetative cap is installed. Though the form and color of the Project will change as it develops over time, these gradual changes will remain inconspicuous to the human eye;

[12] Parkin, Lortie, Humphrey, DiBello; *Maine's Finest Lakes – The Results of the Maine Lakes Study.* Maine State Planning Office Critical Areas Program. 1989

visible just above the foreground and midground tree line of the lake's eastern side. As boaters, swimmers, and other recreational users move closer to the eastern side of the lake, the Project will disappear behind elements in the foreground.

The Project is expected to have little to no spatial dominance in the landscape, when looking east from the lake due to the effects of distance and visual acuity. The Project will appear subordinate to the colors, textures, and other physical landscape characteristics visible in the foreground and midground of the lake. As illustrated in the Pushaw Lake photosimulation, the Project will remain low on the horizon reducing contrasts in form and color against the sky. While overall landscape contrasts will be limited, Project visibility and visual contract with the surrounding landscape will vary as light and weather patterns shift throughout the day. As the seasons change, the surrounding colors and textures of the landscape will act to further subdue or accentuate the Project's appearance.

Ultimately, upon reaching its full size and completed vegetative capping, the Project is expected to align with the natural features of surrounding landscape visible from the lake. As discussed in Section 5.2, the landscape within the VSA is characterized by mostly flat wooded and wetland areas mixed with occasional low, rolling hills that are often visible in the distance from open areas such as Pushaw Lake. For these reasons, the Project is unlikely to have an unreasonable adverse visual impact on those recreating, enjoying scenery, or engaged in other activities on Pushaw Lake.

Perch Pond

Formerly called Mud Pond, Perch Pond is located approximately 2.8 miles southwest of the Project in Old Town. The pond is surrounded by protected lands containing trails and other recreation opportunities, including Sewall Park that allows water access to the pond. There will be no Project visibility from the pond due to intervening vegetation and terrain.

Pickerel Pond and Holland Pond

These two ponds are both located approximately 4.1 miles north of the Project in Alton. There is little evidence to suggest a high degree of recreational use of these ponds. Access appears to be limited and may require permission to cross private land. There will be no Project visibility from either pond due to intervening vegetation and terrain.

Penobscot River

The Penobscot River is the largest river system in the VSA, running north to south for approximately 14.5 miles within the VSA. The river is a major ecological, recreational, cultural, and historical influence on the communities and wildlife that inhabit the region. The portion of the Penobscot River within the VSA is listed as a "C" river and is not rated for scenic quality in the *Maine Rivers Study*[13].

In the Maine Rivers Study, river segments are rated according to the number and significance of overlapping resources. Resource categories included unique natural rivers,

[13] Maine Department of Conservation, et al.; *Maine Rivers Study – Final Report*. 1982

geologic/hydrologic features, scenic/recreational, historic, and ecologic. Classifications range from A – D, with A being the highest ranked. Rivers considered under category C of the Study are those that have received at least three unique/significant river resources ratings such as ecological, fishery, recreational, scenic, etc.

The viewshed analysis indicated potential visibility from the main stem of the Penobscot River in two primary areas. One area is located between Milford and Old Town located approximately 5.1 miles southeast of the Project. Fieldwork and 3D modeling analysis determined that the Project would not be visible due to the mature riparian vegetation along the banks of the river, in addition to man-made structures in the foreground (see photo 33 on page 11 in **Attachment 3**). The viewshed analysis also indicated visibility from an area approximately 3.7 miles southeast of the Project on a stretch of the river that passes the Old Town Municipal Airport. Visibility of the Project in the midground and background viewing distance for this area is not expected to unreasonably interfere with the experience of boaters and paddlers on the river, who are typically focused on foreground elements.

As discussed in Section 3.3, the surface modeling used to generate the viewshed analysis map in the vicinity of the Penobscot River and Stillwater River was based on land cover data. This data does not account for the micro changes and variations in vegetation and structure heights to the degree that LiDAR does. As a result, visibility shown in the viewshed analysis is likely to be somewhat conservative, as vegetation above 40 feet (the average used in the land cover data along most of river's edge) was observed along much of the Penobscot River's edge.

Stillwater River

The Stillwater River is an 11.5 mile long side channel of the Penobscot River, that begins at the east side of Orson Island in Old Town and continues south where it rejoins the main stem of the Penobscot River in Orono. Considered part of the Penobscot River system, the Stillwater River was also listed as a "C" river in the *Maine Rivers Study* and was not rated for having unique scenic quality.

The viewshed analysis indicated potential Project visibility from intermittent areas 2.3 to 3.5 miles east and southeast of the Project (See Map 2 in **Attachment 1**). Visibility was further investigated during fieldwork and 3D modeling exercises, however, due to the presence of mature forest vegetation along the banks of the river, Project visibility from the Stillwater River is expected to be highly limited or negligible from most areas.

Birch Stream and Pushaw Stream

Birch Stream and Pushaw Stream are both part of the greater Penobscot river watershed and are notable recreational resources within the VSA. Though both streams are within 1.5 to 2 miles of the Project, there will be no visibility from either stream due to intervening vegetation and terrain.

Based on the analysis above, the Project is unlikely to have an unreasonable adverse visual impact on the scenic character to users of these waterbodies within the VSA.

6.3.2 What is the closest estimated distance to a similar activity?

There are several solid waste and landfill facilities in this region of Maine[14]. There are three closed landfills within the 7 mile VSA, these include:

- Old Town Landfill (2.2 mi to the southeast)
- Glenburn Municipal C & D Landfill (6.2 mi to the southwest)
- Orono Municipal C & D Debris Landfill (5.2 mi to the south)

The closest active solid waste facility is the Pinetree Landfill and Transfer Station in Hampden (16.3 mi to the south).

6.3.3 Are any of the resources checked in Question 1 used by the public during the time of year during which the activity will be visible?

Yes - Pushaw Lake is used by the public recreationally throughout the year, and the Project is expected to be visible at varying degrees during all seasons.

7 CONCLUSION

In determining whether the Project will have an unreasonable adverse visual impact on public viewing areas, as well as on the scenic and aesthetic character and uses of the surrounding area, the assessment can conclude the following.

- **Geographic Extent of Visibility** – The viewshed analysis has indicated that there will be potential Project visibility from approximately 0.7% of the 7-mile VSA, with some of the largest areas of potential visibility being from places that are inaccessible and/or not considered scenic resources. Other than the Juniper Ridge Landfill property, there are no areas where the Project will be visible in the foreground distance zone. Fieldwork, 3D modeling, and photosimulation analysis has shown that intermittent visibility indicated in the computer viewshed analysis may potentially be overstated due to intervening vegetation, especially from areas of visibility identified along the Penobscot River and Stillwater River due to intervening vegetation. See Map 2 in **Attachment 1**.

- **Visibility from Identified Scenic Resources** – There are no "public viewing areas" within 2,000 feet of the Project as defined in the Maine Chapter 400 and Old Town Chapter 24 rules regulating solid waste management. At a 7-mile VSA, it should be noted that the scope and scale of review in this VIA far exceeds what is required under these rules. Visibility from scenic resources identified under the guidance of NRPA Chapter 315 is limited to a small handful of locations on Pushaw Lake, and potentially from the Penobscot River and Stillwater River.

---

[14] *Maine Department of Environmental Protection, EGAD (Environmental and Geographic Analysis Database), https://www.maine.gov/dep/maps-data/egad/, (Accessed August 15, 2024).*

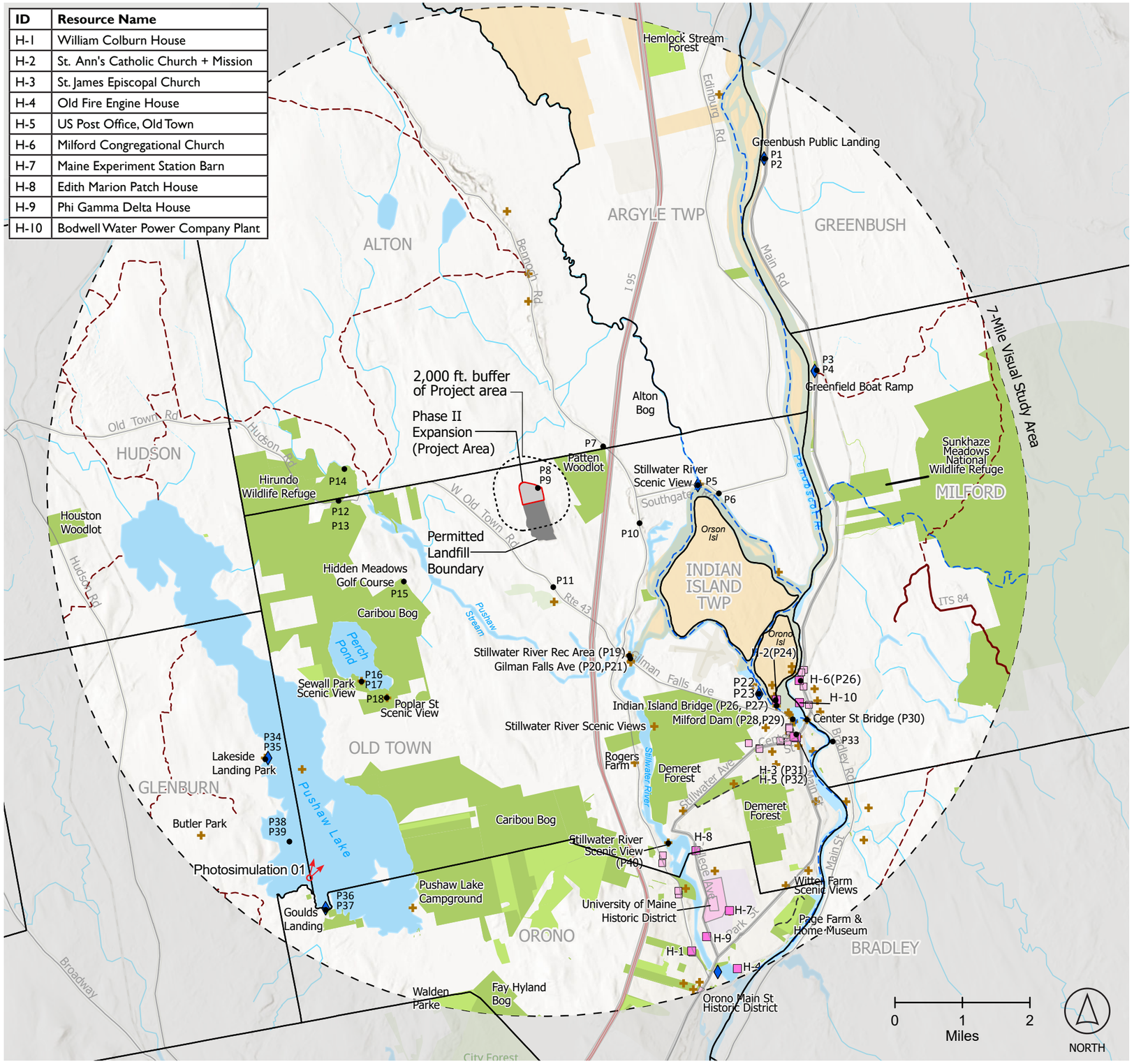
- **Landscape Compatibility** – With all potential Project visibility from scenic resources located within the midground and background viewing distance zones, the Project is expected to have minimal contrasts in color, form, line, and texture. The Project is unlikely to be perceived as a significant change in how the site has been used for nearly three decades. The Project will take on different elements of form and color contrasts as it develops, but once it has reached its final elevations and receives vegetative capping, it is likely be relatively consistent with other elevated landscape features within the VSA when viewed from midground and background distances.

Pursuant to Chapter 400.4(F) of the Maine Solid Waste Rules, and similar language in the City of Old Town Code Chapter 24, the Project will not have an unreasonable adverse impact on existing uses and scenic character related to public viewing areas.

Pursuant to Chapter 315.9 and 38 M.R.S.A. § 480-D of the Natural Resources Protection Act, the Project will not have an unreasonable adverse impact on existing scenic and aesthetic uses.

MAP 01. Visual Study Area Overview

ID	Resource Name
H-1	William Colburn House
H-2	St. Ann's Catholic Church + Mission
H-3	St. James Episcopal Church
H-4	Old Fire Engine House
H-5	US Post Office, Old Town
H-6	Milford Congregational Church
H-7	Maine Experiment Station Barn
H-8	Edith Marion Patch House
H-9	Phi Gamma Delta House
H-10	Bodwell Water Power Company Plant



LEGEND

- Municipal Boundary

Project Data

- Project Study Area (7 mi)
- Project Area (Landfill Phase II Expansion)
- Extent of Existing Juniper Ridge Landfill
- P# Study Area Photo Location
- Photosimulation Location

Lands & Conservation Areas

- Public Conserved Land
- Private Conserved Land
- Tribal Territory

Historic Resources

- Listed NRHP Structure (labeled H1-H10 and identified in Resource Table)
- Eligible NRHP Structure

Other Resources

- Local Resource
- Boating Access Site

Roads and Trails

- Water Trail
- Interconnected Trail System (ITS)
- Local Snowmobile Trail

MAP NOTES

Map shows the extent and context of the 7-Mile Visual Study Area, identified scenic and recreational resources, photograph locations, and photosimulation location.

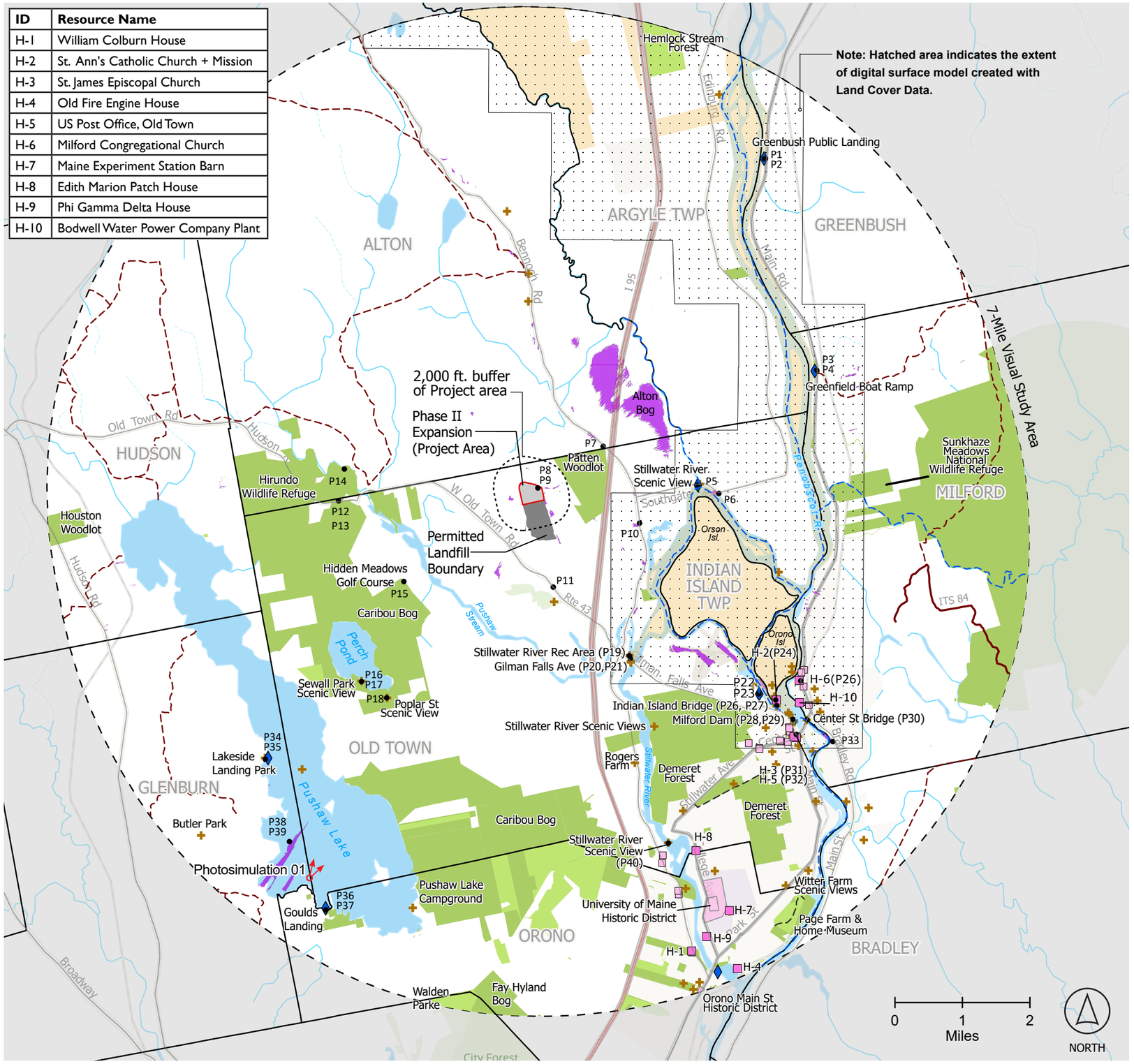
JUNIPER RIDGE LANDFILL

VIEWSHED

August 2024
Attachment 1

MAP 02. Viewshed Analysis of Phase II Expansion Based On Topography & Surface Data

ID	Resource Name
H-1	William Colburn House
H-2	St. Ann's Catholic Church + Mission
H-3	St. James Episcopal Church
H-4	Old Fire Engine House
H-5	US Post Office, Old Town
H-6	Milford Congregational Church
H-7	Maine Experiment Station Barn
H-8	Edith Marion Patch House
H-9	Phi Gamma Delta House
H-10	Bodwell Water Power Company Plant



LEGEND

- Municipal Boundary

Project Data

- Project Study Area (7 mi)
- Project Area (Landfill Phase II Expansion)
- Extent of Existing Juniper Ridge Landfill
- P# Study Area Photo Location
- Photosimulation Location

Lands & Conservation Areas

- Public Conserved Land
- Private Conserved Land
- Tribal Territory

Historic Resources

- Listed NRHP Structure (labeled H1-H10 and identified in Resource Table)
- Eligible NRHP Structure

Other Resources

- Local Resource
- Boating Access Site

Roads and Trails

- Water Trail
- Interconnected Trail System (ITS)
- Local Snowmobile Trail

Viewshed Analysis Based On Topography & Surface Data

- Potential Visibility of Landfill Phase II Expansion

MAP NOTES

Map shows the potential visibility of the landfill expansion within the Visual Study Area based on the screening effects of topography and surface features (structures and vegetation).

The analysis relies on a Digital Terrain Model (DTM) and a Digital Surface Model (DSM), processed at 3 ft. resolution from LiDAR data acquired from USGS. A portion of the DSM was developed using landcover data because LiDAR data was not available. This area is noted in a hatch on the map.

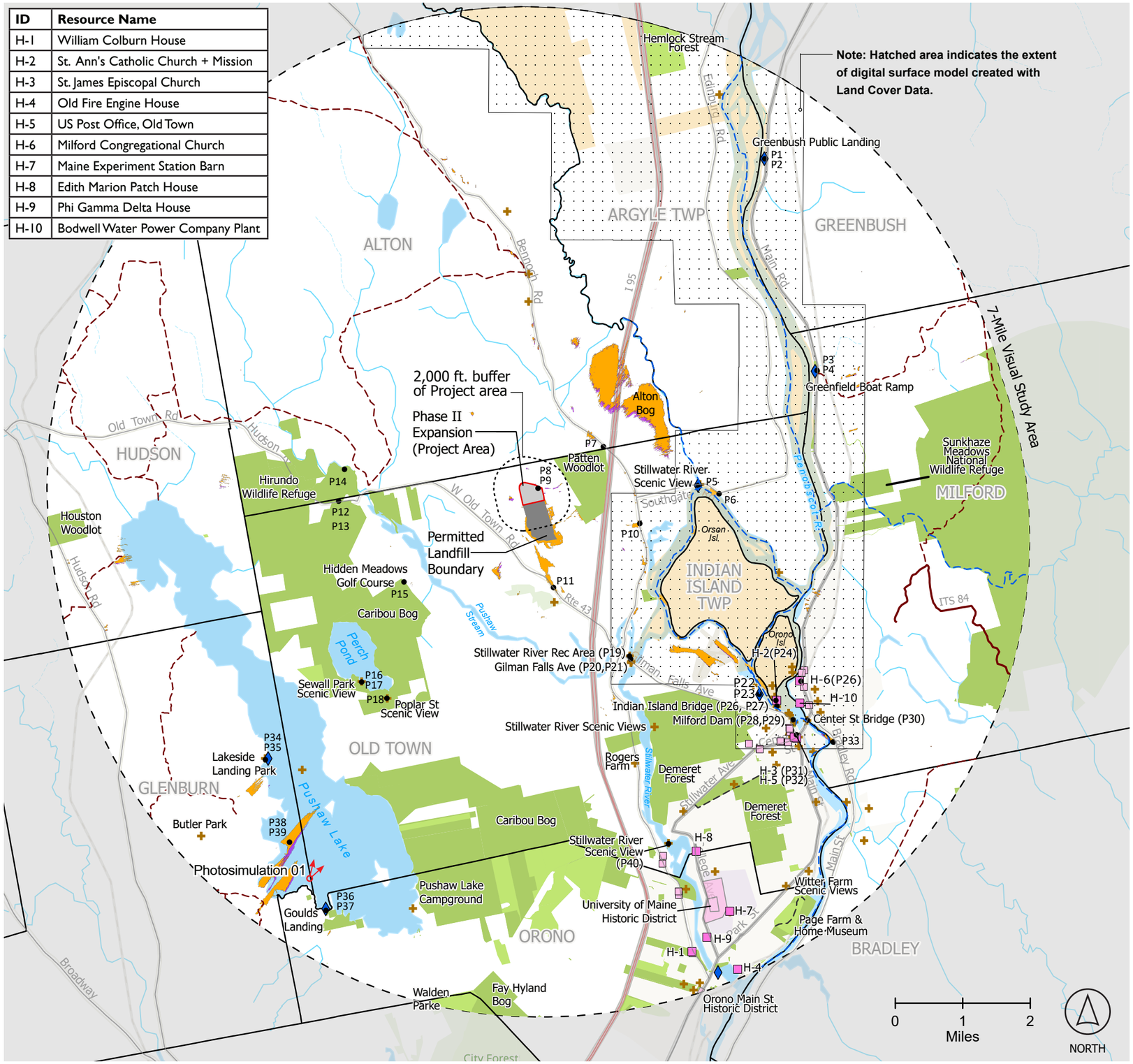
The viewshed represents where a viewer, with an eye level of 5.9ft, may see any portion of the landfill expansion area, accounting for the screening effects of both topography and surface features.

JUNIPER RIDGE LANDFILL

VIEWSHED

August 2024
Attachment 1

ID	Resource Name
H-1	William Colburn House
H-2	St. Ann's Catholic Church + Mission
H-3	St. James Episcopal Church
H-4	Old Fire Engine House
H-5	US Post Office, Old Town
H-6	Milford Congregational Church
H-7	Maine Experiment Station Barn
H-8	Edith Marion Patch House
H-9	Phi Gamma Delta House
H-10	Bodwell Water Power Company Plant



MAP 03. Viewshed Analysis of Phase II Expansion & Permitted Landfill Based On Topography & Surface Data

LEGEND

- Municipal Boundary

Project Data

- Project Study Area (7 mi)
- Project Area (Landfill Phase II Expansion)
- Extent of Existing Juniper Ridge Landfill
- P# Study Area Photo Location
- Photosimulation Location

Lands & Conservation Areas

- Public Conserved Land
- Private Conserved Land
- Tribal Territory

Historic Resources

- Listed NRHP Structure (labeled H1-H10 and identified in Resource Table)
- Eligible NRHP Structure

Other Resources

- Local Resource
- Boating Access Site

Roads and Trails

- Water Trail
- Interconnected Trail System (ITS)
- Local Snowmobile Trail

Viewshed Analysis Based On Topography & Surface Data

- Potential Visibility of Landfill Phase II Expansion
- Potential Visibility of Permitted Landfill

MAP NOTES

Map shows the potential visibility of the landfill expansion and the current permitted landfill within the Visual Study Area based on the screening effects of topography and surface features (structures and vegetation).

The analysis relies on a Digital Terrain Model (DTM) and a Digital Surface Model (DSM), processed at 3 ft. resolution from LiDAR data acquired from USGS. A portion of the DSM was developed using landcover data because LiDAR data was not available. This area is noted in a hatch on the map.

The viewshed represents where a viewer, with an eye level of 5.9ft, may see any portion of the landfill expansion area, accounting for the screening effects of both topography and surface features.

JUNIPER RIDGE LANDFILL

VIEWSHED

August 2024
Attachment 1

Juniper Ridge Landfill
Pushaw Lake, Glenburn
Panoramic Photosimulation

VIEWSHED

VIEWPOINT

Juniper Ridge Landfill (the Project) would be visible directly across the lake from the viewpoint. The Project would be seen projecting slightly above the tree line at a distance of six miles.

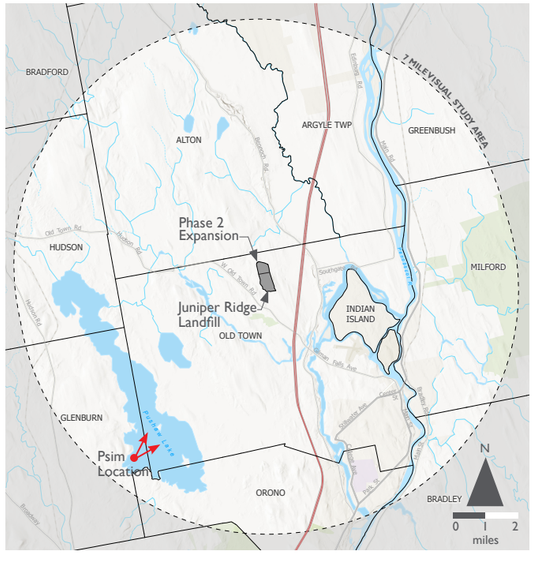
PROJECT VIEW

Size of Project Area	61 Acres
Distance to Project	6.0 Miles
Horizontal Field of View of the visible portion of the Project	1.5°

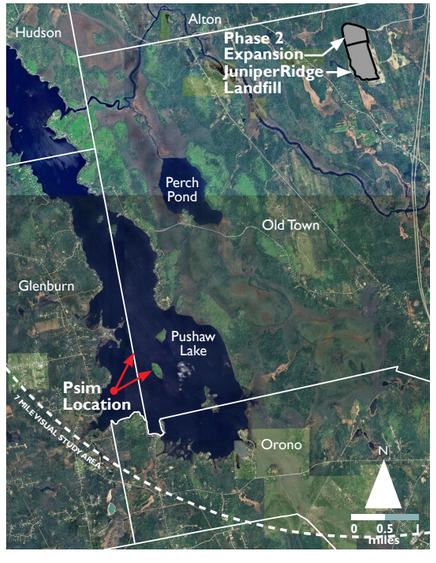
IMAGE DATA

Location Coordinates	44.907475°N, -68.801707°W
Date	05/22/2024
Time	1:13 pm
Viewer Elevation	119 ft
Direction of View	Northeast
Focal Length	50mm
Camera Model	NIKON D750
Image Resolution	300 ppi
Weather Conditions	Clear

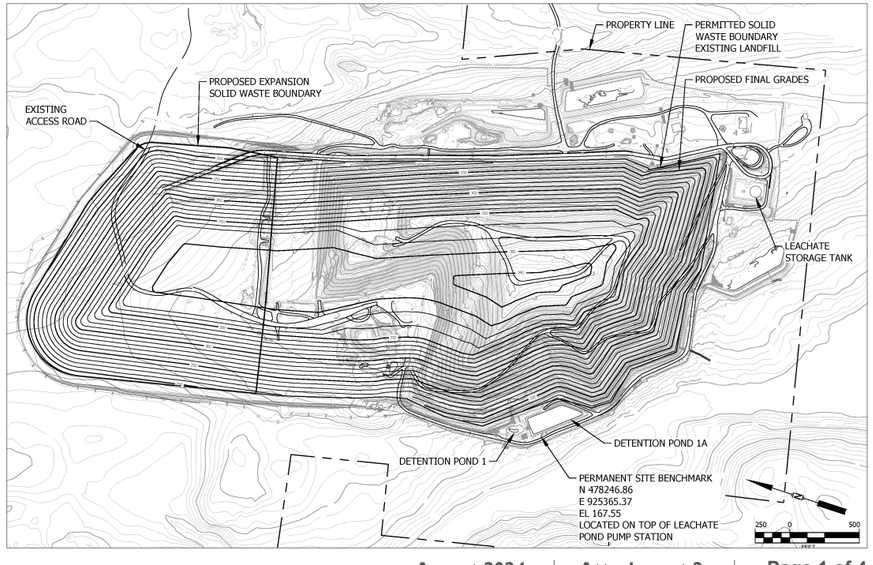
CONTEXT MAP



LOCATION MAP



PROJECT SITE PLAN



Juniper Ridge Landfill
Pushaw Lake, Glenburn

VIEWSHED

NORMAL VIEW
EXISTING CONDITIONS

VIEWING DISTANCE

To replicate the actual view, position your eyes at a distance of 1.5 times the full width of the image.

Printed View:
Print on 11x17 inch (tabloid) paper. The image will be 14 inches wide. Hold image 21 inches from eyes. (14 inches x 1.5=21 inches).

Screen View:
To replicate the printed viewing distance (described above), make the line below measure to 1 inch on screen.

1 INCH LINE

Juniper Ridge Landfill
Pushaw Lake, Glenburn

VIEWSHED

NORMAL VIEW PHOTOSIMULATION

VIEWING DISTANCE

To replicate the actual view, position your eyes at a distance of 1.5 times the full width of the image.

Printed View:
Print on 11x17 inch (tabloid) paper. The image will be 14 inches wide. Hold image 21 inches from eyes. (14 inches x 1.5=21 inches).

Screen View:
To replicate the printed viewing distance (described above), make the line below measure to 1 inch on screen.

1 INCH LINE

Juniper Ridge Landfill
Pushaw Lake, Glenburn

VIEWSHED

NORMAL VIEW PHOTOSIMULATION (4X ZOOM)

VIEWING DISTANCE

To replicate the actual view, position your eyes at a distance of 1.5 times the full width of the image.

Printed View:
Print on 11x17 inch (tabloid) paper. The image will be 14 inches wide. Hold image 21 inches from eyes. (14 inches x 1.5=21 inches).

Screen View:
To replicate the printed viewing distance (described above), make the line below measure to 1 inch on screen.

1 INCH LINE

P1 - View looking southwest across the Penobscot River from the Greenbush Public Landing in Greenbush. The Project is located 5.8 miles away and will not be visible from this location due to intervening vegetation and terrain.

P2 - Parking area at the Greenbush Public Landing.

P3 - View looking west across the Penobscot River from the Greenfield Boat Ramp in Milford. The Project is located 4.8 miles away and will not be visible from this location due to intervening vegetation and terrain.

P4 - Informational kiosk at Greenfield Boat Ramp.

P5 - View looking southeast from the Birch Stream Paddle Access on Route 116 (Southgate Road) toward the Stillwater River in Old Town. The Project is 2.5 miles away and will not be visible from this location due to intervening vegetation and terrain.

P6 - View looking west from the Stillwater River off of Route 116 (Southgate Road), 0.33 miles upstream of where the Stillwater River intersects with Birch Stream. The Project is located 2.8 miles away from this location and will not be visible due to intervening vegetation and terrain.

P7 - Sign at the entrance of the Juniper Ridge Landfill, located off of Route 16 (Bennoch Road) in Old Town.

P8 - View from an on-site access road looking south toward the existing Juniper Ridge Landfill showing a portion of the site where a capping membrane has been installed.

P9 - View from an on-site access road looking southwest toward the existing Juniper Ridge Landfill showing landfill deposit operations vehicles at work, as well as capping membranes in the foreground.

P10 - View looking west from Route 16 (Bennoch Road) toward the existing Juniper Ridge Landfill. The Project is located 1.4 miles away from this location and may be partially visible behind foreground vegetation and structures.

P11 - View looking north from Route 43 (W Old Town Road) toward the existing Juniper Ridge Landfill. Though the previously installed tree plantings show some signs of damage, they continue to provide an adequate screening from views of the existing landfill.

P12 - Entry signage and kiosk at the Hirundo Wildlife Refuge, located off of Route 43 (W Old Town Road) in Old Town. The Project is located 2.6 miles east of this location and will not be visible from anywhere within the refuge due to intervening vegetation and terrain.

P13 - Trails bring visitors through fields and forests within the Hirundo Wildlife Refuge.

P14 - Pushaw Stream, viewed from the Hirundo Wildlife Refuge.

P15 - Entrance at the Perch Pond Recreational Trails on Kirkland Road in Old Town. The Project is located 2 miles north of this location and will not be visible due to intervening vegetation and terrain.

P16 - Entrance to Sewall Park on Poplar Street in Old Town. The Project is located 3.3 miles away from this location and will not be visible due to intervening vegetation and terrain.

P17 - View looking north from Sewall Park toward Perch Pond. The Project is located 2.8 miles away from the pond and will not be visible due to intervening vegetation and terrain. This view is noted as a scenic in the Old Town Comprehensive Plan.

P18 - View looking northeast from Poplar Street in Old Town, across Caribou Bog. The Project is located 3.3 miles from this location and will not be visible due to intervening vegetation and terrain. Views of the bog from this section of Poplar Street are noted as scenic in the Old Town Comprehensive Plan.

P19 - View looking north from the Stillwater River Recreation Facility in Old Town. The Project is 2.3 miles from this location and will not be visible due to intervening vegetation and terrain.

P20 - View looking northeast of the Gilman Falls Dam from Route 43 (Gilman Falls Avenue) in Old Town. The Project is located 2.4 miles away from this location and will not be visible due to intervening vegetation and terrain.

P21 - View looking southwest across the Stillwater River from Route 43 (Gilman Falls Avenue) in Old Town. The Project is located 2.4 miles away from this location and will not be visible due to intervening vegetation and terrain. Views like this from Gilman Falls Dam are listed as scenic in the Old Town Comprehensive Plan.

P22 - Kiosk at the Fourth Street Park boat launch on the Penobscot River in Old Town. The Project is 4 miles from this location and there will be no visibility due to intervening vegetation and terrain.

P23 - View of the Penobscot River looking north from Fourth Street Park in Old Town.

P24- View looking southeast at St. Ann's Catholic Church on Down Street in Indian Island. The Project is located 4.3 miles from this location and will not be visible due to intervening vegetation and terrain. St. Ann's Catholic Church is listed on the National Register of Historic Places.

P25 - View looking southwest at the Milford First Congregational Church on U.S. Route 2. The Project is 4.5 miles away and will not be visible from this location due to intervening vegetation and terrain. The Milford First Congregational Church is listed on the National Register of Historic Places.

P26 - View looking southeast across the Penobscot River from the West Street Bridge in Old Town. The Project is 4.4 miles away from this location and will not be visible due to intervening vegetation and terrain. Views from this bridge are noted as scenic views in the Old Town Comprehensive Plan.

P27 - View looking northwest across the Penobscot River from the West Street Bridge in Old Town. The Project is 4.4 miles away from this location and will not be visible due to intervening vegetation and terrain. Views from this bridge are noted as scenic views in the Old Town Comprehensive Plan.

P28 - View looking northeast toward the Penobscot River from Old Town Park in Old Town. The Project is located 4.7 miles from this location and is and will not be visible due to intervening vegetation and terrain. Views from this area are designated as scenic in the Old Town Comprehensive Plan.

P29 - View looking south at Old Town Park. The Project is located 4.7 miles from this location and is and will not be visible due to intervening vegetation and terrain.

P30 - View looking southeast across the Penobscot River toward the Milford Dam from the Center Street Bridge in Old Town. The Project is located 4.8 miles from this location and is and will not be visible due to intervening vegetation and terrain. Views from this bridge are listed as scenic in the Old Town Comprehensive Plan.

P31 - View looking northwest toward Old Town City Hall from Main Street in Old Town. The Project is 4.9 miles away from this location and will not be visible due to intervening vegetation, structures, and terrain.

P 32 - View looking southeast toward Main Street in downtown Old Town. The Project is 4.9 miles away from this location and will not be visible due to intervening vegetation, structures, and terrain.

P 33 - View looking northwest from the Penobscot River off of Bradley Road in Milford. The Project is located 5.1 miles away and will not be visible from this location due to intervening vegetation and terrain.

P34 - View looking southeast across Pushaw Lake from the boat launch at Lakeside Landing Park in Glenburn. The Project is 5.2 miles away and will not be visible from this location due to intervening vegetation and terrain.

P35 - View looking east across Lakeside Landing Park in Glenburn. The Project is 5.2 miles away and will not be visible from this location due to intervening vegetation and terrain.

P36 - View looking east at Gould's Landing in Orono. The Project is 6.4 miles away and will not be visible from this location due to intervening vegetation and terrain.

P37 - View looking north across Pushaw Lake from Gould's Landing in Orono. The Project is 6.4 miles away and will not be visible from this location due to intervening vegetation and terrain.

P38 - View looking northeast from Pushaw Lake in Glenburn toward the Project (center of photo). The Project is located 6 miles away from this location and will be minimally visible. See photosimulation in Attachment 2.

P39 - View looking southeast from the water on the southwestern corner of Pushaw Lake in Glenburn showing the typical development pattern of camps and year round homes on the Lake. The Project is located 6 miles away from this location and will be minimally visible when facing northeast (this view is represented above in P38).

P40 - View looking northwest from the Stillwater Avenue Bridge across the Stillwater River. The Project is 5 miles away and will not be visible from this location due to intervening vegetation and terrain. Views from the Stillwater Avenue Bridge are noted as scenic in the Old Town Comprehensive Plan.

APPENDIX B

MAINE DEP PUBLIC BENEFIT DETERMINATION

SME
SEVEE & MAHER
ENGINEERS

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
17 STATE HOUSE STATION AUGUSTA, MAINE 04333-0017

DEPARTMENT ORDER

IN THE MATTER OF

STATE OF MAINE,	)	PUBLIC BENEFIT
DEPARTMENT OF ADMINISTRATIVE AND FINANCIAL	)	DETERMINATION
SERVICES, BUREAU OF GENERAL SERVICES	)	
OLD TOWN, PENOBSCOT COUNTY, MAINE	)	
JUNIPER RIDGE LANDFILL EXPANSION	)	
S-020700-W5-CV-N	)	
(APPROVAL WITH CONDITIONS)	)	

Pursuant to the provisions of the *Maine Hazardous Waste, Septage, and Solid Waste Management Act*, 38 M.R.S. §§ 1301 through 1319-Y; *Solid Waste Management and Recycling*, 38 M.R.S. §§ 2101 through 2236; the *Maine Solid Waste Management Rules: General Provisions*, 06-096 C.M.R. ch. 400 (last amended February 9, 2021); and the *Maine Solid Waste Management Rules: Landfill Siting, Design, and Operation,* 06-096 C.M.R. ch. 401 (last amended April 12, 2015), the Department of Environmental Protection ("Department") has considered the application of the STATE OF MAINE, acting through the Department of Administrative and Financial Services, Bureau of General Services ("BGS" or "the applicant") with its supportive data, staff summary, agency review comments, and other related materials on file and FINDS THE FOLLOWING FACTS:

1. APPLICATION SUMMARY

A. Application: BGS has applied for a determination of public benefit for a proposed expansion of the Juniper Ridge Landfill in Old Town.

B. History: The following history is a summary and does not include all licensing actions:

(1) On July 28, 1993, James River Paper Company, Inc. was issued a license to construct and operate a 68-acre secure landfill, known as the West Old Town Landfill, to dispose of the James River Paper Company's pulp and papermaking residuals (Department Order S-020700-7A-A-N).

(2) On August 25, 1997, James River Paper Company, Inc. changed its legal name to Fort James Operating Company; this name change did not necessitate a license transfer. On October 21, 2003, the Department issued conditional approval for the transfer of licenses for the West Old Town Landfill, from the Fort James Operating Company to the State of Maine, State Planning Office ("SPO") (Department Orders S-020700-WR-M-T

and L-019015-TH-C-T), with the transfer effective on the sale date of February 5, 2004.

(3) On February 5, 2004, the State of Maine, acting by and through the SPO, and Casella Waste Systems, Inc. ("Casella") entered into an Operating Services Agreement ("OSA") for the operation of the West Old Town Landfill.

(4) On April 9, 2004, the Department approved an amendment application (Department Order S-020700-WD-N-A) for a vertical increase in the final elevation of the landfill and the disposal of additional waste streams. The license was subsequently affirmed by the Board of Environmental Protection ("Board") on October 21, 2004.

(5) In 2006, the West Old Town Landfill became known as the Juniper Ridge Landfill ("JRL").

(6) On January 31, 2012, the Department issued a partial approval of SPO's application for determination of public benefit for an expansion. The Department approved a 9.35-million-cubic-yard expansion finding that the entire proposed 21.9-million-cubic-yard expansion was not needed to meet the immediate or short-term solid waste disposal capacity needs of the State.

(7) Pursuant to P.L. 2011, ch. 655, § GG-69, on July 1, 2012, BGS, within the Department of Administrative and Financial Services ("DAFS") became the state agency acting as the owner and licensee of JRL. The Department of Economic and Community Development was the manager of JRL, although BGS assumed the manager role in 2020. NEWSME Landfill Operations, LLC ("NEWSME"), a wholly owned subsidiary of Casella, operated the landfill for the State of Maine, acting through BGS.

(8) On June 1, 2017, the Board approved the construction and operation of a 9.35-million-cubic-yard expansion at JRL (Board Order S-020700-WD-BI-N, hereafter "expansion license") in a phased manner, designated as Cells 11 through 16.

(9) Cells 11, 12, 13, 14, and 15 of the expansion have been constructed and are operational. Department approval for the specific design of Cell 11

was incorporated in the expansion license. The approval of the design specifics of Cell 12 was issued April 30, 2020 (Department Order S-020700-WD-CB-C). During the design of Cell 12, the expansion cell layout was changed; initially, the expansion was to be constructed in 6 cells, 11-16, but it was revised to be constructed in 7 cells, 11-17, with no change to the overall expansion footprint or fill height. Approval of the subsequent cell design specifics occurred as follows: Cell 13 was approved May 25, 2021 (Department Order S-020700-WD-CL-C), Cell 14 was approved April 15, 2022 (Department Order S-020700-WD-CP-C), Cell 15 was approved April 27, 2023 (Department Order S-020700-WD-CR-C); and Cell 16 (Department Order S-020700-WD-CU-C) was approved June 26, 2024. Cell 16 is currently under construction.

C. Summary of Proposal: BGS proposes to expand JRL by approximately 61 acres, to provide 11.9 million cubic yards of additional capacity. At the most recent 5-year fill rate average of 860,771 tons or 1,049,721 cubic yards, this would provide approximately 11.3 additional years of use. The expansion would continue to accept construction and demolition debris ("CDD"), oversized bulky waste ("OBW"), residue from CDD processing facilities located in Maine, bypass municipal solid waste ("MSW") from Maine incinerators and the Municipal Waste Solutions ("MWS") waste processing facility in Hampden, wastewater treatment plant sludge, ash, and a variety of other in-state non-hazardous solid wastes.

The application for a determination of public benefit ("Application") was submitted to the Department on June 10, 2024 and was accepted for processing on June 24, 2024. Pursuant to 38 M.R.S. § 1310-AA(2) and 06-096 C.M.R. ch. 400, § 5(G), the Department shall issue a decision within 60 days of receipt of the Application. In an August 13, 2024 letter, the Department requested a 30-day extension to this timeframe. The Department's request was granted in an August 13, 2024 letter from the applicant. The Department requested additional information on the Application in a July 30, 2024 letter. In an August 8, 2024 letter, the applicant provided a response to the Department's request.

2. APPLICABLE LAW

38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5 establish the process and standards to be used in determining whether a proposed new or expanded solid waste

disposal facility provides a substantial public benefit. The process and relevant standards follow.

A. Process: The law requires the Commissioner to consider the state waste management and recycling plan required under 38 M.R.S. § 2122 ("State Plan"), written information submitted in support of the Application and any other written information the Commissioner considers relevant. The most recent version of the State Plan is the *Maine Materials Management Plan: 2024 State Waste Management and Recycling Plan Update and 2022 Waste Generation and Disposal Capacity Report*, dated January 2024. The law also requires the Commissioner to hold a public meeting in the vicinity of the proposed facility to take public comments, to consider those comments in making the determination, and to accept written public comment during the course of processing the Application.

B. Standards: In order for the Commissioner to find that the proposed landfill expansion provides a substantial public benefit, the applicant must demonstrate to the Commissioner that the proposed facility:

- Meets the immediate, short-term, or long-term capacity needs of the state. "Immediate" is defined as within the next 3 years; "short-term" is within the next 5 years; and "long-term" is within the next 10 years. The Commissioner shall consider relevant local and regional needs as appropriate and the regional nature of the development and use of disposal capacity due to transportation distances and other factors;
- Is consistent with the state waste management and recycling plan and promotes the solid waste management hierarchy ("waste hierarchy");
- Is not inconsistent with local, regional, or state waste collection, storage, transportation, processing, or disposal; and
- Is not inconsistent with ensuring environmental justice for the community in which the facility or expansion is proposed.

3. TITLE, RIGHT OR INTEREST

06-096 C.M.R. ch. 400, § 4(A) requires an applicant to demonstrate to the Department's satisfaction sufficient title, right or interest in all of the property which is proposed for development or use. The Application includes a copy of the deed for the property, which is recorded in Book 9188, Page 152 of the Penobscot County Registry of Deeds. Casella Waste Systems' subsidiary, NEWSME Landfill Operations, operates the landfill under

the terms of the OSA with the State of Maine. The Department finds that BGS has demonstrated sufficient evidence of title, right or interest in the property, as required by 06-096 C.M.R. ch. 400, § 4(A).

4. PUBLIC PARTICIPATION

A. Notice of Intent to File: 06-096 C.M.R. ch. 400, § 5(F)(1) requires public notification prior to filing an application for determination of public benefit. A notice of Intent to File the Application was published in the Bangor Daily News on June 7, 2024. A copy of the notice was sent by certified mail to abutters, the Town of Alton, the City of Old Town, the Penobscot Indian Nation, and the Juniper Ridge Landfill Advisory Committee members. The Department finds that the public notifications complied with the requirements in 06-096 C.M.R. ch. 400, § 5(F)(1).

B. Public Meetings: 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(F)(1) require that the Commissioner hold a public meeting in the vicinity of the proposed expansion to receive public comments regarding the Application. The Commissioner held an in-person public meeting in Orono, Maine on July 16, 2024, from 1:00 pm to 3:00 pm and 5:30 pm to 7:30 pm with the option to attend, but not give comment, virtually. Notice of the meeting was published in the Bangor Daily News on July 3, 2024, and posted on the Department's website, with interested parties notified by electronic mail. Comments were received orally and in writing at the meeting. The meeting was recorded, and a video and transcript posted on the Department's website. Based on a request from a commenter, a virtual-only public meeting was held on July 26, 2024, at 9:00 am, to accept remote public comments. Notice of the virtual meeting was published in the Bangor Daily News on July 12, 2024, posted on the Department's website, and sent to interested parties by electronic mail. The virtual meeting was also recorded, and the video and transcript posted on the Department's website. The Department finds that a public meeting was held as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(F)(1).

C. Public Comment: 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(F)(1) require that the Department accept public comments during the course of processing the Application. Public comments have been received throughout the course of processing the Application. In addition to comments received at the public meetings, comments were submitted to the Department by electronic mail. The comments received in writing and by electronic mail have been posted on the

Department's website. Those commenting include people living near the project site, people living elsewhere in Maine, members of the Penobscot Indian Nation, local legislators, the City of Old Town, and people representing or associated with the following organizations: Conservation Law Foundation, Slingshot, Maine Climate Action Now, Maine Water Environment Association, Community Water Justice, Don't Waste ME, Defend Our Health, Friends of the Harriet L. Hartley Conservation Area, Upstream Watch, the Sierra Club, First Light, ecomaine, and the Houlton Water Company.

Issues raised by commenters included, but were not limited to, the following concerns: the Department's review may not be objective, considering statements in the State Plan, dated January 2024; landfill expansion does not support the waste hierarchy and encourages disposal; landfill space has been consumed by out-of-state waste; it is premature to expand landfill capacity with the future of the Orrington waste-to-energy incinerator, Hampden waste processing facility, and treatment plant sludge management options being unclear; the State has failed to provide non-landfill options for waste management; there is insufficient incentive for people to reduce, reuse, or recycle waste and a financial incentive to landfill it; landfill leachate receives insufficient treatment prior to discharge; exposure of the public to odors, pollutants released during landfill fires, and leachate constituents discharged to the Penobscot River are inconsistent with environmental justice; the facility has changed from a landfill supporting residual disposal from a local pulp and paper mill to a facility accepting a wide variety of wastes from the entire State and other New England states with limited input from the host community and others; the application process does not provide for meaningful public involvement; duration and quantity of MSW bypass should be limited; it makes sense to expand an existing landfill rather than to place one in an unspoiled location elsewhere; and, the landfill expansion is needed to provide time for development and funding of infrastructure to support policies developed by the State.

The Department finds that public comments have been accepted and considered as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(F)(1).

D. Draft License Decision Comment Period: In accordance with 06-096 C.M.R. ch. 2, § 18,[1] a draft Public Benefit Determination was made available for a five-

[1] 06-096 C.M.R. ch. 2, § 2(B) does not apply to this public benefit determination. To the extent the Department consulted the rule, it did so for guidance only.

working-day comment period on September 13, 2024, through notification to the applicant, the Town of Alton, the City of Old Town, the Penobscot Indian Nation, Juniper Ridge Landfill Advisory Committee members, and interested persons. The draft Public Benefit Determination was also posted on the Department's website. In response to a request from the public, the Department sought concurrence from the applicant, on September 17, 2024, to provide an additional week for public comment and an additional 3 business days for Department review. The applicant agreed to this request on September 19, 2024. In addition to the topics described in Finding of Fact 4.C above, issues raised included, but were not limited to, the following: Casella should be required to install a sludge dryer at the landfill; there should be a limit on annual capacity used; there should be a limit on the quantity of CDD processing fines accepted; MSW bypass that has been continuing for a lengthy period of time should no longer be considered bypass; JRL should use tarps, biologically active soil, or soil from agronomic sludge utilization sites as daily cover material instead of alternative daily cover ("ADC") or virgin soil; additional continuous air monitors should be installed in the vicinity of JRL and Indian Island; a public alert warning system or siren should be established; and landfill capacity for sludge is needed because the few solutions that might marginally lower municipal sludge volumes would require financial investments out of reach of small utility districts.

5. CAPACITY NEEDS

38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(1) require the applicant to demonstrate that the proposed facility meets immediate, short-term, or long-term capacity needs of the State. 38 M.R.S. § 2124-A requires the Department to report to the Legislature regarding statewide generation of solid waste, statewide recycling rates, and available disposal capacity for solid waste. The State's capacity needs are projected in the most recent update of the State Plan.

A. Requested Capacity: JRL is expected to exhaust its permitted capacity in 2028, if disposal continues at current rates. BGS requests an expansion providing additional capacity of 11.9 million cubic yards, which would add 11.3 years of landfill life, using JRL's annual waste acceptance average over the most recent 5-year period, and assuming a compaction rate of 0.82 tons of waste per cubic yard. JRL currently accepts waste from all areas of the State of Maine, and disposes of approximately 52% of the waste landfilled in Maine. JRL also accepts nearly 90% of the wastewater treatment plant sludge disposed in Maine. The landfill provides a disposal location for residues from the Orrington waste-to-energy

incinerator, bypass MSW from all three Maine waste-to-energy incinerators, and bypass MSW from some of the municipalities under contract with the Municipal Waste Solutions (MWS) waste processing facility under a waste swap agreement with the Crossroads Landfill in Norridgewock. The landfill is located between an active commercial landfill in Norridgewock and an active landfill in Fort Fairfield licensed to accept MSW, CDD, and some special wastes.

The proposed expansion would provide for acceptance of the same types of wastes that are currently accepted, which include in-state CDD, OBW, residues from processing CDD, front end processing residue from waste-to-energy incinerators, bypass MSW, wastewater treatment plant sludge, and various non-hazardous special wastes. Based on waste volume information in the JRL annual reports, the average quantities of the major categories of waste received at JRL from 2020 through 2023 were: 38% CDD, 25% bypass MSW, 10% wastewater treatment plant sludge (both municipal and industrial), 9% OBW, 9% CDD processing fines, 4% miscellaneous waste, and 3% ash. In response to a question from the Department, the applicant calculated that if the Maine Regional Conversion Facility, LLC sludge dryer and the anticipated Brunswick AD, LLC anaerobic digester expansion projects are successful, sludge deliveries to the landfill may be reduced by 90%, in which case the proposed expansion would provide approximately 13 years of capacity.

Because the landfill accepts nearly 90% of the municipal wastewater treatment plant sludge disposed in Maine, and the licensed capacity is expected to be filled in 2028, the Application references a conclusion in the *Analysis of Sludge and State-Owned Landfills as Public Utilities Report*, dated January 2024 ("Biosolids Report") that additional disposal capacity will be needed for wastewater treatment plant sludge as soon as 2028, and thus the expansion would meet Maine's short-term need for capacity for wastewater treatment plant sludge.

The Application further concludes that an expansion of JRL is necessary to prevent a shortfall of disposal capacity for all wastes in less than 10 years based on a set of assumptions: the State's recycling rate is consistent; waste generation continues to increase at approximately 5.6% per year; the quantity of waste exported from Maine remains consistent; the Maine Waste to Energy and ecomaine waste-to-energy incinerators continue operation at the current rates; the MWS waste processing facility in Hampden sends 30% of its contracted waste to landfills; the Orrington facility incinerates 50% of its contracted waste in 2025 and 60% thereafter; municipally operated landfills do not change significantly;

and the Crossroads Landfill in Norridgewock could not handle all of the State's landfill needs. With these assumptions and based on calculations presented by the applicant a shortfall of landfill disposal capacity for all wastes will occur in less than 10 years, and therefore the expansion is needed to meet Maine's long-term capacity needs for all wastes.

B. Department Review: The Department considered the State Plan, the *Maine Solid Waste Generation and Disposal Capacity Report for Calendar Years 2020 & 2021*, dated January 2023 ("Biennial Report"), the Biosolids Report, the Application and other supporting information, recent facility annual reporting information, and public comments during review of the Application.

As noted in the Application, there are currently eight licensed landfills in Maine, in addition to JRL, that accept MSW, bypassed MSW, CDD and special waste. Four of these landfills (Bath, Hatch Hill in Augusta, Tri-Community in Fort Fairfield, and Presque Isle[2]) are municipally owned and primarily accept waste from the area municipalities. As stated in the Biennial Report, these landfills had 2,303,572 cubic yards of capacity remaining as of December 31, 2021, about two-thirds of which is capacity in Aroostook County. Two landfills, ecomaine (in Scarborough and South Portland) and Lewiston, accept primarily ash from associated or nearby waste-to-energy incinerators. These landfills had 1,328,969 cubic yards of capacity as of December 31, 2021. The Crossroads Landfill in Norridgewock is a commercial landfill accepting waste from a wide service area, and had 8,533,231 cubic yards of capacity available as of December 31, 2021. The remaining licensed landfill is the State-owned Carpenter Ridge Landfill, which has not yet been developed. Carpenter Ridge Landfill has a licensed capacity of 1,800,000 cubic yards and is licensed to accept only special waste. Nineteen additional municipally owned small landfills accept wood wastes and CDD, and seven generator-owned landfills accept wastes only from the generators. As stated in the JRL annual report, the landfill had 6,332,172 cubic yards of capacity remaining as of December 31, 2021. By the end of 2022, available capacity of the nine landfills combined was approximately 17,792,907 cubic yards. Based on 2023 annual reports, available capacity of the nine landfills combined at the end of 2023 was 15,951,479 cubic yards.

[2] The Presque Isle Landfill is currently inactive as its owner, Aroostook Waste Solutions, has transitioned operations to its landfill in Fort Fairfield; however, available capacity remains in Presque Isle and will be used once operations in Fort Fairfield have ceased.

The State Plan reported that 1,547,594 tons of MSW and CDD (including CDD used as ADC) was placed in landfills in 2022, including the 8 currently licensed and operating landfills described above and 19 smaller municipally owned landfills. Review of annual report information for 2023 for only the 8 currently licensed and operating landfills described above showed 1,507,497 tons of waste received (assuming ecomaine's ash landfill received waste at its 5-year average rate). Over the time period from 2018 to 2022, JRL accepted approximately 52% of the landfilled waste; Crossroads Landfill accepted approximately 27%, Hatch Hill Landfill in Augusta accepted approximately 5%, two Aroostook County landfills (in Presque Isle and Fort Fairfield) accepted approximately 5%, and municipally owned landfills accepted the remaining 11%. The 2024 State Plan analyzed licensed disposal capacity at the three waste-to-energy incinerators and licensed landfill capacity for the larger landfills in the State. The waste-to-energy incinerators accepted approximately 44% of the MSW disposed in Maine; the remaining 56% was landfilled. A minor percentage of CDD generated in Maine is disposed at small municipally owned facilities, but the majority must be managed at a processing facility or landfilled.

In addition to receiving bypass MSW, waste-to-energy incinerator residue, processing facility residue, and wastewater treatment plant sludge, JRL accepts CDD and special waste from sources that include: municipal transfer stations; municipal bulky waste collection events; commercial waste haulers providing disposal services; construction debris from new developments; remediation projects; disaster cleanups; and individuals who generate waste such as debris from home renovations. JRL's location meets local and regional needs for a disposal location for these wastes. With the exception of Crossroads Landfill, the other existing landfills are either not available for use by the generators currently using JRL or, in the case of the Aroostook County landfills, not a viable option due to transportation distances. JRL has been used as the location for disposal of some of the bypass MSW from the MWS processing facility in Hampden because of transportation distances, efficiency, and logistical challenges. MWS contracted with Crossroads Landfill for disposal of waste generated by its members from the effective date of contracts until facility startup ("bridge waste"), bypass, and residue, but the location of Crossroads Landfill made it difficult for some municipalities utilizing curbside collection to complete a collection route and still have time to travel to Crossroads Landfill for disposal before it closed for the day. Other municipalities would have travelled past JRL to go to Crossroads Landfill.

Regarding available licensed capacity, the information in the Application is consistent with the State Plan. As noted in the Application, the State Plan concluded that expansion of JRL would be needed to ensure adequate disposal capacity for the entire State for the next 10 years. The Department determined, after review of the State Plan and landfill annual reports, that the State Plan's conclusion is still valid.

Uncertainties regarding the quantity of bypass MSW needing landfill disposal (depending on future status of the Orrington waste-to-energy incinerator and MWS processing facility), quantity of municipal wastewater treatment plant sludge needing disposal (depending on startup of and sources of sludge for the new Maine Regional Conversion Facility, LLC sludge dryer, possible restart of the Brunswick AD, LLC anaerobic digester in Brunswick, and availability of bulking material for sludge at JRL) and possibility of legislative initiatives make prediction of future disposal capacity needs challenging. Many of the public comments received stated that too much landfill space has been consumed by waste originating in other states. Others commented that the amount of CDD should be reduced or more should be recycled. Current statute allows placement of a certain amount of waste from a processing facility located in Maine that accepts waste from out-of-state. Unless the statute is revised, JRL may legally accept a certain amount of residues from in-state CDD processing facilities. The Application states that JRL needs OBW from CDD processing facilities to bulk the increased quantity of wastewater treatment plant sludge being landfilled, and needs the processing fines in order to avoid using virgin soil material for daily cover. Casella has used more virgin soil in 2022 and 2023, when the quantity of processing fines decreased. The Department notes that JRL's daily cover, as a percentage of the total waste received, appears reasonable in comparison to similar landfills in Maine. Discounting the space consumed by CDD processing fines used as ADC, since the space would otherwise be consumed mostly by virgin soil (the other materials approved as ADC are a small percentage of the total waste received, and are not always available), approximately 6% of landfill space (average from 2020 through 2023) has been used by OBW that originated out-of-state. In contrast, approximately 38% of landfill space (average from 2020-2023) has been used for disposal of CDD originating in Maine. Data from the two CDD processing facilities operating in Maine are an indication that the recyclable content of the mixed CDD they receive is very low. Reducing the amount of CDD generated in Maine and requiring generators to separate CDD components at the site of generation is beyond the ability of the operator of JRL to control. Commenters expressed the concern that, if the landfill capacity is

increased, the incentive to find ways to reduce the volume of waste being disposed will disappear until the next capacity shortfall. Licensing and construction of landfill capacity can take three years or more to complete, so planning must begin well in advance of when capacity is needed. During this time, changes in waste management methods, pricing, and availability of alternatives to landfills can change, but it would be irresponsible to ignore the current projected capacity need. Moreover, the Department has already begun working toward alternative methods for diverting waste from landfills through its numerous product stewardship programs including the new extended producer responsibility for packaging program anticipated to be in full implementation in 2027. The State Plan acknowledges that, even with an expansion of JRL, waste disposal capacity will be limited in 15 years.

C. Findings: The Department finds that in consideration of the State Plan, expansion of JRL meets short-term and long-term capacity needs of the State, as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(1). The Department further finds that adding 11.9 million cubic yards of capacity is reasonable, considering the amount of time it takes to license new or expanded disposal capacity or waste processing facilities, uncertainty surrounding waste management options in the Eastern Maine region, uncertainty surrounding the future municipal wastewater treatment plant sludge management options, the fact that waste generation rates fluctuate but as noted in the State Plan, per capita waste generation appears to be increasing, the need to support waste-to-energy incinerators and disposal needs of the Eastern Maine region, and the lack of existing infrastructure to increase waste diversion.

6. CONSISTENCY WITH STATE WASTE MANAGEMENT PLAN AND HIERARCHY

38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(2) require the applicant to demonstrate that the proposed expansion is consistent with the State Waste Management and Recycling Plan and to promote the Solid Waste Management Hierarchy. The State Plan is based on the waste hierarchy established in 38 M.R.S. § 2101 and the State's goals for recycling, composting, and waste reduction established in 38 M.R.S. § 2132. The waste management hierarchy establishes priorities for the State to use when making solid waste management decisions. The hierarchy, from highest to lowest priority is as follows: reduction of waste (in amount and toxicity) at the source; reuse of waste; recycling of waste; composting of biodegradable waste; processing of waste to reduce the volume needing land disposal, including incineration; and land disposal of waste. The State's goals are to recycle or compost at least 50% of the MSW tonnage by January 1,

2021; to reduce the per capita disposal rate to 0.55 tons per person per year by January 1, 2019, with further reduction of 5% every 5 years thereafter; and for municipalities to demonstrate reasonable progress toward these goals. The State Plan described several studies that have been or are being undertaken to understand and characterize waste streams; the results will be used for future solid waste management planning. In the meantime, the State Plan includes some strategies for consideration, including but not limited to the following: use of subsidies, tax incentives, low-interest loans, and "pay as you throw" programs to increase waste diversion; increasing participation in product stewardship programs; encouraging municipal efforts through education, cooperative work, and publicizing waste diversion grant opportunities and future extended producer responsibility reimbursement; and encouraging regionalization.

A. Application Discussion: The Application and supporting documents describe a number of actions and programs to demonstrate that expansion of the landfill is consistent with the State Plan and promotes the waste management hierarchy.

(1) Landfill gas at JRL has been flared, but Casella, with an energy partner, developed a renewable natural gas facility that converts landfill gas to biogas. The biogas will eventually be directed to a natural gas pipeline; currently the gas is compressed and trucked, while awaiting extension of the gas line.

(2) Casella operates a single sort recycling facility in Lewiston and a commercial recycling facility in Scarborough, and provides brokerage operations; over 93,000 tons per year of recyclables are managed through these programs. JRL's 2023 annual report states that 101 tons of residue from the Casella operated single sort recycling facility was delivered to the Maine Waste to Energy waste-to-energy incinerator. Additional residue and trash from the Casella operated single sort recycling facility disposed at JRL totaled 8,239 tons. Casella provides recycling capability for traditional recyclable materials (paper, plastics, glass, cans) at 11 out of 15 Casella-owned or operated transfer stations and provides curbside collection of or drop-off locations for recyclables in 39 municipalities. Casella states that 3,251 businesses in Maine participate in its single sort recycling program.

(3) Casella also collects and manages universal waste, electronic waste, and tires at most of its owned or managed transfer stations. Metals are accepted for recycling at all of its owned or operated transfer stations.

Four of its transfer stations collect wood separately; wood waste processed from two of them is used for alternative daily cover or other landfill use, and the other two send wood waste to other processors.

(4) Casella manages 15,000 to 30,000 tons per year of residuals for agronomic utilization, including seaweed residual, wood-fired boiler ash, and paper mill lime wastes.

(5) Casella provides education and outreach for recycling customers through its website, at schools, businesses, and community events; with student internships focused on recycling education; and with a mobile recycling application ("app") that it has deployed to six communities so far, with plans to deploy to additional municipalities. Casella worked with one large municipality to perform recycling audits and bin tagging to reduce contamination in recycling, and is willing to work with other interested towns.

(6) Casella's August 9, 2024 response to the Department states that it intends to initiate a mattress recycling program in Maine in 2025.

B. Department Review: A solid waste disposal facility must show that waste has been reduced, reused, recycled, composted, and/or processed to the maximum extent practicable prior to landfilling. The greatest amount of waste must be handled through means as high on the hierarchy as possible without causing unreasonable increases in facility operating costs or unreasonable impacts on other aspects of facility operation.

The Application demonstrates that Casella has existing programs in place to reduce and reuse waste and to encourage recycling at the facilities it owns and, to a lesser extent, facilities it operates for municipalities, including single sort recycling, commercial recycling, universal waste and electronic waste recycling, metal recycling, tire recycling, agronomic utilization of residuals, wood waste recycling, and converting landfill gas to renewable natural gas. The categories of waste accepted by the landfill in the greatest volumes in recent years have been bypass MSW, CDD, residue from CDD processing facilities, and wastewater treatment plant sludge. Casella cannot control the amount of MSW that is bypassed from waste-to-energy incinerators or the Hampden waste processing facility. The volumes of CDD delivered to the landfill from non-Casella haulers or transfer stations not owned or operated by Casella similarly are beyond

Casella's control to sort or reduce. The Department anticipates that the volume of CDD processing residue from Maine's largest CDD processing facility delivered to JRL for disposal will be reduced in accordance with 38 M.R.S. § 1310-N(5-A) which requires this processing facility to reuse or recycle at least 50% of its processing debris through methods other than placement in a solid waste landfill by July 1, 2028. The quantities of wastewater treatment plant sludge delivered to the landfill are generated by municipalities and industries after passing through the treatment plants' dewatering processes. If Casella were to refuse to accept the treatment plant sludge due to its moisture content, or to require the generators to dry it further, this would increase the burden on municipalities and require time to develop and implement a solution. As noted in the Application, landfill space will still be required for sludge when drying or anaerobic digestion facilities are not operating due to planned maintenance or malfunction events. However, the Department recognizes that new facilities may become operational in the future to reduce the volume of wastewater treatment plant sludge either by drying or anaerobic digestion. For example, Maine Regional Conversion Facility, LLC expects to have their proposed sludge dryer operational in late 2025. This facility is expected to reduce sludge volumes by approximately 75%. Reduction in volume of waste is one of the priorities in Maine's solid waste management hierarchy.

The Department finds that expansion of the JRL as proposed by BGS is consistent with the State Plan and promotes the solid waste management hierarchy as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(2), provided:

- Casella submits a report to the Department detailing its plans and schedule for implementing the mattress recycling program within six months of the date of this Order;
- Casella continues to expand deployment of its mobile recycling app, and includes information in each landfill annual report regarding where the app has been deployed;
- Casella includes a discussion in each landfill annual report regarding Casella's work to encourage and assist towns to engage in all possible recycling and diversion activities; and
- Casella evaluates, and submits the evaluation in each annual report, the availability and capacity of regional facilities in Maine to reduce the volume of municipal wastewater treatment plant sludge prior to landfilling at JRL. The evaluation should include recommendations to further reduce the volume of sludge prior to landfilling.

7. NOT INCONSISTENT WITH LOCAL, REGIONAL, OR STATE WASTE COLLECTION, STORAGE, TRANSPORTATION, PROCESSING, OR DISPOSAL

38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(3) require the applicant to demonstrate that the proposed expansion is not inconsistent with local, regional, or state waste management.

Casella provides collection and/or recycling services to approximately 60 municipalities, including curbside collection, drop-off locations, transfer stations, and brokerage services for recyclables, consistent with local, regional, and statewide collection practices. JRL is located centrally and is accessible to many municipalities. Vehicles performing curbside collection have time to complete their route and go to the landfill on the same day. A large part of Maine is within 50 miles of the landfill; it is close to Bangor, the second largest city in the state, and nearly the entire state is within 150 miles, so the landfill meets local, regional, and statewide needs. Tipping fees at the landfill are capped in accordance with the OSA, and are subject to annual adjustment in accordance with the consumer price index. The not-to-exceed tipping fees for bypass MSW are slightly above the average and median cost of MSW disposal stated in the State Plan. The CDD tipping fees are a little lower than the average and median cost stated in the State Plan. The landfill provides a disposal location for special wastes that require disposal in a secure landfill. The landfill supports existing processing facilities and waste-to-energy incinerators in the state by providing a disposal location for bypassed waste and residues that require landfilling.

The landfill has existed as a State-owned landfill for 20 years, and was purchased by the State to provide for disposal capacity for nonhazardous waste generated within the state. The landfill continues to accept wastes similar to those it has accepted over the past 20 years, although the 2017 expansion limited acceptance of MSW to bypass from Maine waste-to-energy incinerators and the MWS processing facility, and the quantity of sludge accepted as a percentage of the waste stream has increased in recent years. Continued operation of the landfill in a manner similar to which it has been operated is consistent with past waste management practices in the state.

The Department finds that the proposed expansion is not inconsistent with local, regional, or state waste collection, storage, transportation, processing, or disposal, as required by 38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(3).

8. NOT INCONSISTENT WITH ENSURING ENVIRONMENTAL JUSTICE

38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(5) require the applicant to demonstrate that the proposed project is not inconsistent with ensuring environmental justice for the community in which the facility is proposed. Environmental justice is defined as the right to be protected from environmental pollution and to live in and enjoy a clean and healthful environment regardless of ancestry, class, disability, ethnicity, income, national origin, or religion. Environmental justice includes the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of waste management laws, regulations, and licensing decisions.

Based on EPA's Environmental Justice Screening and Mapping Tool (Version 2.3), Indian Island and the Penobscot River to just above the Mattaseunk Dam is part of a block group identified as a Designated Disadvantaged Community according to EPA Justice40 criteria (designated for energy, health, and American Indian Reservation Lands) and EPA Inflation Reduction Act ("IRA") Data 2.0 criteria. The tract of land where JRL is located is identified as disadvantaged according to EPA IRA Data 1.0. There are 20 disadvantaged tracts in Penobscot County and 127 disadvantaged tracts in Maine according to EPA Justice40 criteria.

Based on environmental justice indicators, the block group that includes Indian Island is above the 95th percentile when compared to state data for several indexes including wastewater discharge,[3] hazardous waste proximity,[4] underground storage tanks,[5] and toxic releases to air.[6] Within the 19.36-square-mile block, 7 regulated sites (1 water discharger and 6 brownfields) report data to EPA. For the block group that includes JRL, there are 2 environmental justice indexes (toxic releases to air and wastewater discharge)

[3] The environmental burden indicator for wastewater discharge measures how much relative risk there is of being exposed to pollutants from wastewater that flows into rivers or other bodies of water downstream.
[4] The environmental burden indicator for hazardous waste proximity measures how close people might live to a facility that handles hazardous waste.
[5] The environmental burden indicator for underground storage tanks measures how many underground storage tanks and release sites are near where people live. This indicator is based on the sum of tanks and releases within a 1,500-foot buffered block group.
[6] The environmental burden indicator for toxic releases to air measures the average annual chemical concentrations in air weighted by the toxicity of each chemical. This indicator includes chemicals covered by EPA's Toxics Release Inventory (TRI) Program.

that are in the 50th to 80th percentile range when compared to state data. There are no environmental justice indicators at higher percentiles. As part of this block group, there is one regulated water discharger and two regulated air polluters that are required to report data to EPA.

The Penobscot River Basin is the longest river system located entirely within Maine and is New England's second largest river basin located entirely within the region. The Penobscot Indian Nation, a federally recognized tribe, which is based on Indian Island near Old Town, has deep connections to the land and waterways of the Penobscot River. The Penobscot River is considered the heart of the Penobscot culture and is relied on for food, drinking water, transportation, and other cultural facets. The West Branch and mainstem receive wastewater discharges from five pulp and paper mill outfalls, one of which is ND OTM, LLC in Old Town. ND OTM, LLC is licensed under Maine Pollutant Discharge Elimination System permit #ME0002020 and Maine Discharge License #W002226-5N-S-M. In 2023, 26,531,525 gallons of landfill leachate from JRL were generated and hauled off-site for treatment at the ND OTM, LLC wastewater treatment facility.

Based on the Department's draft *2024 Integrated Water Quality Report*, a total of seven segments on the mainstem of the Penobscot River from the confluence of the East and West Branches to Reeds Brook in Hampden and the West Branch Penobscot River between Millinocket Stream and East Branch Penobscot River are listed as impaired for aquatic life. Maine has established safe eating guidelines for fish from the Penobscot River below Lincoln of no more than one to two meals per month of any fish species based on testing for PCBs, dioxins, and DDT.

A. Per- and Polyfluoroalkyl Substances: Per- and Polyfluoroalkyl Substances ("PFAS") are a group of manufactured chemicals that have been used in industry and consumer products since the 1940s. There are thousands of different PFAS, some of which have been more widely used and studied than others. Many PFAS are known to break down very slowly and can bioaccumulate in people, animals, and the environment over time. Several commenters expressed concern over PFAS in JRL's landfill leachate and in the discharge from ND OTM, LLC's wastewater treatment facility, where JRL leachate is treated, to the Penobscot River.

Based on data reported to the Department pursuant to P.L. 2021, ch. 641, the Sum of 6 PFAS[7] (PFOA, PFOS, PFHxS, PFNA, PFHpA, and PFDA) from samples taken at Outfall 001-A at ND OTM, LLC ranged from a low of 11 parts per trillion ("ppt") in March 2023 to a high of 311 ppt in September 2023. The Sum of 6 PFAS from an October 2023 landfill leachate sample from JRL was approximately 2,920 ppt. The lowest Sum of 6 PFAS concentration was 410 ppt from a December 2021 sample. ND OTM, LLC's wastewater treatment facility does not specifically include treatment for PFAS.

B. Environmental Monitoring at JRL: As part of the facility's environmental monitoring plan, the applicant monitors 50 groundwater monitoring wells, 5 surface water monitoring locations, 5 pore-water monitoring locations, 2 stormwater monitoring locations, 13 underdrain monitoring locations, 7 leak detection monitoring locations, and 1 leachate monitoring location. The applicant also conducts monitoring for landfill gas within manholes and groundwater monitoring wells, and at underdrain, leak detection, and leachate collection locations. Four locations just beyond the property boundary are also monitored for hydrogen sulfide. The facility operates a sulfur removal system to remove total reduced sulfur compounds, primarily hydrogen sulfide, from the landfill gas prior to flaring.

Based on the Department's most recent review of JRL's annual monitoring report, the Department concluded that "[g]roundwater, surface water, porewater, underdrain and leak detection monitoring results continue to show minimal evidence of impact from landfill leachate." Further, the Department noted that groundwater monitoring locations that exhibit low concentrations of certain landfill indicator parameters (i.e., chloride) appear to be affected by site-related maintenance and construction activities rather than leachate from the landfill.

C. Air Quality and Landfill Odor: As part of landfill operations, the applicant conducts daily odor surveys around the active waste areas, continuous hydrogen sulfide monitoring with stationary monitors, and quarterly methane emission surface scans on the landfill intermediate cover. Through surface scan monitoring, improvements are made to ensure the effectiveness of the intermediate cover and active gas collection and control system. If a hydrogen

[7] The Department reported the Sum of 6 PFAS in its November 2023 wastewater effluent monitoring summary report which includes the compounds used in Maine's current interim drinking water standards. However, Maine does not have any standards or screening levels for wastewater effluent or landfill leachate. The use of the Sum of 6 PFAS in this paragraph is for ease of reference only.

sulfide monitor detects hydrogen sulfide over 15 parts per billion ("ppb"), the scale house is automatically alerted, and scale house staff report the detection to landfill supervisory staff. If there is a detection over 30 ppb, the Old Town code enforcement officer is to be notified. These action levels were established during licensing of the landfill expansion in 2017, based on the recommendation of Old Town's consultant. For comparison purposes, the Department's acute ambient air guidelines include a level of 30 ppb (30-minute rolling average) for hydrogen sulfide. Based on JRL's 2023 Annual Report, JRL received a total of 49 odor complaints; 44 were confirmed as likely coming from the landfill. During 2023, there were 20 hydrogen sulfide readings from the monitors that were above 15 ppb. Of these, none were above 30 ppb. While the odor threshold for hydrogen sulfide is variable, hydrogen sulfide can become noticeable at approximately 10 ppb. Several comments were received about odor from JRL and impacts to the enjoyment of property.

JRL's Operations Manual includes an Odor Control Plan and Odor Complaint Management and Response Plan. The Odor Control Plan outlines specific provisions to control and mitigate the off-site migration of odors associated with landfill operations including the placement of daily cover, minimizing the active waste area, use of an odor neutralizer spray at the working face and on waste within incoming waste loads, and the use of a perimeter odor misting system during warmer months. As each landfill cell is filled and cover is placed, a series of lateral gas collection pipes is installed to control fugitive landfill gas emissions which could result in landfill odors. Vertical landfill gas extraction wells are installed once certain waste grades are reached. Once extracted, landfill gas is either compressed and trucked off-site while awaiting extension of a natural gas pipeline or combusted with on-site flares.

Based on air quality complaints received pertaining to the landfill, the Department's Bureau of Air Quality installed a dedicated hazardous air pollutant sampler in November 2023 to collect 24-hour samples and a particulate matter sensor at a residence near the entrance to JRL in Old Town. Data evaluated to date do not show any exceedances of the Department's acute ambient air guidelines. The Department will be installing a dedicated continuous hydrogen sulfide monitor in the near future. It is the Department's understanding that the Penobscot Indian Nation received funding from the U.S. Environmental Protection Agency to purchase a hazardous air pollutant sampler to operate on Indian Island.

D. Community Notification: The Department received several comments relating to the lack of real-time information available to the public during events such as the May 2023 landfill fire. The applicant maintains a dedicated website devoted to State-owned landfills and JRL which includes notices of public meetings, information about PFAS, various monthly reports, annual reports, and operating services agreements. Monthly reports include information about significant construction and operational activities; licenses applied for, received, or renewed; volume of leachate transported for disposal; volume of landfill gas flared; and quantity and origin of wastes received. A summary of complaints received including the nature and location of the complaint, wind direction and speed at the time of the complaint, hydrogen sulfide monitoring data, and information about whether the complaint was confirmed to be landfill related and its resolution is also provided on a monthly basis and posted on the applicant's website. Reports for the current month are posted in the following month.

E. Department Finding: The Department finds that expansion of JRL is not inconsistent with ensuring environmental justice for the community in which the facility is proposed, as required by 38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(5), provided that if a license is issued for the construction and operation of the expansion:

(1) Casella designs and installs a Department-approved system for the treatment of landfill leachate for PFAS prior to expansion operations and submits an implementation schedule with tasks to the Department for review and approval to meet this timeframe. The schedule should be submitted to the Department within 90 days of issuance of this public benefit determination;

(2) Casella pays for all applicable costs associated with a third-party odor consultant, working on behalf of the Department, to complete an odor analysis of the landfill and surrounding area, including evaluation of historical air quality sampling results, odor complaint history, field investigation, and recommended actions, to be submitted to the Department for review;

(3) Casella conducts two additional surface scans per year, during periods of low barometric pressure, if possible, of the landfill intermediate cover using a Department-approved method, to determine if there are fugitive

landfill gas emissions and conducts repairs of the cover material accordingly; and

(4) The applicant establishes a system to inform the public about significant landfill events in near real time such as through a website or other means as approved by the Department.

BASED on the above Findings of Fact and subject to the Conditions listed below, the Department makes the following CONCLUSIONS:

1. BGS has demonstrated sufficient evidence of title, right or interest in the property, as required by 06-096 C.M.R. ch. 400, § 4(A).

2. A public meeting was held and public comments were accepted and considered as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(F)(1).

3. Expansion of JRL as proposed by BGS meets short-term and long-term capacity needs of the State, as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(1).

4. Expansion of JRL as proposed by BGS is consistent with the State Plan and promotes the solid waste management hierarchy as required by 38 M.R.S § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(2), provided that Casella submits a report to the Department detailing its plans and schedule for implementing the mattress recycling program within 6 months of the date of this Order and, if a license is issued for the construction and operation of the expansion:

   - Casella continues to expand deployment of its mobile recycling app, and includes information in each landfill annual report regarding where the app has been deployed;
   - Each landfill annual report includes a discussion regarding Casella's work to encourage and assist towns to engage in all possible recycling and diversion activities; and
   - Casella evaluates, and submits the evaluation in each annual report, the availability and capacity of regional facilities in Maine to reduce the volume of municipal wastewater treatment plant sludge prior to landfilling at JRL. The evaluation should include recommendations to further reduce the volume of sludge prior to landfilling.

5. The proposed expansion is not inconsistent with local, regional, or state waste collection, storage, transportation, processing, or disposal, as required by 38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(3).

6. The proposed expansion is not inconsistent with ensuring environmental justice for the community in which the expansion is proposed, as required by 38 M.R.S. § 1310-AA and 06-096 C.M.R. ch. 400, § 5(E)(5), provided that if a license is issued for the construction and operation of the expansion:

- Casella designs and installs a Department-approved system for the treatment of landfill leachate for PFAS prior to expansion operations and submits an implementation schedule with tasks to the Department for review and approval to meet this timeframe. The schedule should be submitted to the Department within 90 days of issuance of this public benefit determination;
- Casella pays for all applicable costs associated with a third-party odor consultant, working on behalf of the Department, to complete an odor analysis of the landfill and surrounding area, including evaluation of historical air quality sampling results, odor complaint history, field investigation, and recommended actions, to be submitted to the Department for review;
- Casella conducts two additional surface scans per year during periods of low barometric pressure, if possible, of the landfill intermediate cover, using a Department-approved method to determine if there are fugitive landfill gas emissions and conducts repairs of the cover material accordingly; and
- The applicant establishes a system to inform the public about significant landfill events in near real time such as through a website or other means as approved by the Department.

THEREFORE, the Department APPROVES the above noted application of the STATE OF MAINE, acting through the Department of Administrative and Financial Services, Bureau of General Services, SUBJECT TO THE FOLLOWING CONDITIONS, and all applicable standards and regulations.

1. The Standard Conditions of Approval, a copy attached as Appendix A.

2. The invalidity or unenforceability of any provision, or part thereof, of this Order shall not affect the remainder of the provisions or any other provisions. This Order shall be

construed and enforced in all respects as if such invalid or unenforceable provision or part thereof had been omitted.

3. Within 6 months of the date of this Order, Casella shall submit a report to the Department detailing its plans and a schedule for implementing the mattress recycling program.

4. If a license is issued for the construction and operation of the expansion:

   A. Casella shall continue to expand deployment of its mobile recycling app, and include information in each landfill annual report regarding where the app has been deployed;

   B. Casella shall include in each landfill annual report a discussion regarding their work to encourage and assist towns to engage in all possible recycling and diversion activities; and

   C. Casella evaluates, and submits the evaluation in each annual report, the availability and capacity of regional facilities in Maine to reduce the volume of municipal wastewater treatment plant sludge prior to landfilling at JRL and, include recommendations to further reduce the volume of sludge prior to landfilling;

   D. Casella designs and installs a Department-approved system for the treatment of landfill leachate for PFAS prior to expansion operations;

   E. Casella pays for all applicable costs associated with a third-party odor consultant, working on behalf of the Department, to complete an odor analysis of the landfill and surrounding area, including evaluation of historical air quality sampling results, odor complaint history, field investigation, and recommended actions, to be submitted to the Department for review and approval;

   F. Casella conducts two additional surface scans per year during periods of low barometric pressure, if possible, of the landfill intermediate cover, using a Department-approved method to determine if there are fugitive landfill gas emissions and conduct repairs of the cover material accordingly; and

   G. The applicant establishes a system to inform the public about significant landfill events in near real time such as through a website or other means as approved by the Department.

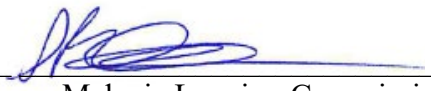
STATE OF MAINE	25	PUBLIC BENEFIT
DEPARTMENT OF ADMINISTRATIVE AND FINANCIAL	)	DETERMINATION
SERVICES, BUREAU OF GENERAL SERVICES	)	
OLD TOWN, PENOBSCOT COUNTY, MAINE	)	
JUNIPER RIDGE LANDFILL EXPANSION	)	
S-020700-W5-CV-N	)	
(APPROVAL WITH CONDITIONS)	)	

5. Within 90 days of the issuance of this public benefit determination, Casella shall submit an implementation schedule with tasks to detail how they intend to design and install a Department-approved system for the treatment of landfill leachate for PFAS prior to expansion operations, if a license approval is issued for the expansion.

DONE AND DATED AT AUGUSTA, MAINE, THIS 2nd DAY

OF October, 2024.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY:  *for*
Melanie Loyzim, Commissioner

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURE

Date of initial receipt of application: June 10, 2024
Date of application acceptance: June 24, 2024

Date filed with the Board of Environmental Protection:

XKK92656

FILED

OCT 2, 2024

State of Maine
Board of Environmental Protection

STANDARD CONDITIONS TO ALL SOLID WASTE FACILITY LICENSES

STRICT CONFORMANCE WITH THE STANDARD AND SPECIAL CONDITIONS OF THIS APPROVAL IS NECESSARY FOR THE PROJECT TO MEET THE STATUTORY CRITERIA FOR APPROVAL. VIOLATIONS OF THE CONDITIONS UNDER WHICH A LICENSE IS ISSUED SHALL CONSTITUTE A VIOLATION OF THAT LICENSE AGAINST WHICH ENFORCEMENT ACTION MAY BE TAKEN, INCLUDING REVOCATION.

1. **Approval of Variations from Plans.** The granting of this approval is dependent upon and limited to the proposals and plans contained in the application and supporting documents submitted and affirmed by the license. Any consequential variation from these plans, proposals, and supporting documents is subject to review and approval prior to implementation.

2. **Compliance with All Applicable Laws.** The licensee shall secure and comply with all applicable federal, state, and local licenses, permits, authorizations, conditions, agreements, statutes, regulations, and orders prior to or during construction and operation, as appropriate.

3. **Compliance with All Terms and Conditions of Approval.** The licensee shall submit all reports and information requested by the Department demonstrating that the licensee has complied or will comply with all terms and conditions of this approval. All preconstruction terms and conditions must be met before construction begins.

4. **Transfer of License.** The licensee may not transfer the solid waste facility license or any portion thereof without approval of the Department.

5. **Initiation of Construction or Development Within Two Years.** If the construction or operation of the solid waste facility is not begun within two years of issuance or within 2 years after any administrative and judicial appeals have been resolved, the license lapses and the licensee must reapply to the Department for a new license unless otherwise approved by the Department.

6. **Approval Included in Contract Bids.** A copy of the approval must be included in or attached to all contract bid specifications for the solid waste facility.

7. **Approval Shown to Contractors.** Contractors must be shown the license by the licensee before commencing work on the solid waste facility.

8. **Background of key individuals.** A licensee may not knowingly hire as an officer, director or key solid waste facility employee, or knowingly acquire an equity interest or debt interest in, any person convicted of a felony or found to have violated a State or federal environmental law or rule without first obtaining the approval of the Department.

STANDARD CONDITIONS TO ALL SOLID WASTE FACILITY LICENSES

9. **Fees.** The licensee must comply with annual license and annual reporting fee requirements of the Department's rules.

ADDITIONAL STANDARD CONDITIONS FOR SOLID WASTE DISPOSAL FACILITIES

10. **Recycling and Source Reduction Determination for Solid Waste Disposal Facilities.** This condition does not apply to the expansion of a commercial solid waste disposal facility that accepts only special waste for landfilling.

The solid waste disposal facility shall only accept solid waste that is subject to recycling and source reduction programs, voluntary or otherwise, at least as effective as those imposed by State law.

11. **Deed Requirements for Solid Waste Disposal Facilities.** Whenever any lot of land on which an active, inactive, or closed solid waste disposal facility is located is being transferred by deed, the following information must be recorded in the Registry of Deeds:

A. The type of facility located on the lot and the dates of its establishment and closure.
B. A description of the location and the composition, extent, and depth of the waste deposited.
C. The disposal location coordinates of asbestos wastes must be identified.

DEP INFORMATION SHEET

Appealing a Department Licensing Decision

Dated: August 2021 **Contact: (207) 314-1458**

SUMMARY

This document provides information regarding a person's rights and obligations in filing an administrative or judicial appeal of a licensing decision made by the Department of Environmental Protection's (DEP) Commissioner.

Except as provided below, there are two methods available to an aggrieved person seeking to appeal a licensing decision made by the DEP Commissioner: (1) an administrative process before the Board of Environmental Protection (Board); or (2) a judicial process before Maine's Superior Court. An aggrieved person seeking review of a licensing decision over which the Board had original jurisdiction may seek judicial review in Maine's Superior Court.

A judicial appeal of final action by the Commissioner or the Board regarding an application for an expedited wind energy development (35-A M.R.S. § 3451(4)) or a general permit for an offshore wind energy demonstration project (38 M.R.S. § 480-HH(1)) or a general permit for a tidal energy demonstration project (38 M.R.S. § 636-A) must be taken to the Supreme Judicial Court sitting as the Law Court.

I. ADMINISTRATIVE APPEALS TO THE BOARD

LEGAL REFERENCES

A person filing an appeal with the Board should review Organization and Powers, 38 M.R.S. §§ 341-D(4) and 346; the Maine Administrative Procedure Act, 5 M.R.S. § 11001; and the DEP's *Rule Concerning the Processing of Applications and Other Administrative Matters* (Chapter 2), 06-096 C.M.R. ch. 2.

DEADLINE TO SUBMIT AN APPEAL TO THE BOARD

Not more than 30 days following the filing of a license decision by the Commissioner with the Board, an aggrieved person may appeal to the Board for review of the Commissioner's decision. The filing of an appeal with the Board, in care of the Board Clerk, is complete when the Board receives the submission by the close of business on the due date (5:00 p.m. on the 30th calendar day from which the Commissioner's decision was filed with the Board, as determined by the received time stamp on the document or electronic mail). Appeals filed after 5:00 p.m. on the 30th calendar day from which the Commissioner's decision was filed with the Board will be dismissed as untimely, absent a showing of good cause.

HOW TO SUBMIT AN APPEAL TO THE BOARD

An appeal to the Board may be submitted via postal mail or electronic mail and must contain all signatures and required appeal contents. An electronic filing must contain the scanned original signature of the appellant(s). The appeal documents must be sent to the following address.

Chair, Board of Environmental Protection
c/o Board Clerk
17 State House Station
Augusta, ME 04333-0017
ruth.a.burke@maine.gov

The DEP may also request the submittal of the original signed paper appeal documents when the appeal is filed electronically. The risk of material not being received in a timely manner is on the sender, regardless of the method used.

At the time an appeal is filed with the Board, the appellant must send a copy of the appeal to: (1) the Commissioner of the DEP (Maine Department of Environmental Protection, 17 State House Station, Augusta, Maine 04333-0017); (2) the licensee; and if a hearing was held on the application, (3) any intervenors in that hearing proceeding. **Please contact the DEP at 207-287-7688 with questions or for contact information regarding a specific licensing decision.**

REQUIRED APPEAL CONTENTS

A complete appeal must contain the following information at the time the appeal is submitted.

1. *Aggrieved status*. The appeal must explain how the appellant has standing to bring the appeal. This requires an explanation of how the appellant may suffer a particularized injury as a result of the Commissioner's decision.
2. *The findings, conclusions, or conditions objected to or believed to be in error.* The appeal must identify the specific findings of fact, conclusions of law, license conditions, or other aspects of the written license decision or of the license review process that the appellant objects to or believes to be in error.
3. *The basis of the objections or challenge.* For the objections identified in Item #2, the appeal must state why the appellant believes that the license decision is incorrect and should be modified or reversed. If possible, the appeal should cite specific evidence in the record or specific licensing criteria that the appellant believes were not properly considered or fully addressed.
4. *The remedy sought.* This can range from reversal of the Commissioner's decision on the license to changes in specific license conditions.
5. *All the matters to be contested*. The Board will limit its consideration to those matters specifically raised in the written notice of appeal.
6. *Request for hearing.* If the appellant wishes the Board to hold a public hearing on the appeal, a request for hearing must be filed as part of the notice of appeal, and it must include an offer of proof regarding the testimony and other evidence that would be presented at the hearing. The offer of proof must consist of a statement of the substance of the evidence, its relevance to the issues on appeal, and whether any witnesses would testify. The Board will hear the arguments in favor of and in opposition to a hearing on the appeal and the presentations on the merits of an appeal at a regularly scheduled meeting. If the Board decides to hold a public hearing on an appeal, that hearing will then be scheduled for a later date.
7. *New or additional evidence to be offered.* If an appellant wants to provide evidence not previously provided to DEP staff during the DEP's review of the application, the request and the proposed supplemental evidence must be submitted with the appeal. The Board may allow new or additional evidence to be considered in an appeal only under limited circumstances. The proposed supplemental evidence must be relevant and material, and (a) the person seeking to add information to the record must show due diligence in bringing the evidence to the DEP's attention at the earliest possible time in the licensing process; or (b) the evidence itself must be newly discovered and therefore unable to have been presented earlier in the process. Requirements for supplemental evidence are set forth in Chapter 2 § 24.

OTHER CONSIDERATIONS IN APPEALING A DECISION TO THE BOARD

1. *Be familiar with all relevant material in the DEP record.* A license application file is public information, subject to any applicable statutory exceptions, and is made accessible by the DEP. Upon request, the DEP will make application materials available to review and photocopy during normal working hours. There may be a charge for copies or copying services.

2. *Be familiar with the regulations and laws under which the application was processed, and the procedural rules governing the appeal.* DEP staff will provide this information upon request and answer general questions regarding the appeal process.
3. *The filing of an appeal does not operate as a stay to any decision.* If a license has been granted and it has been appealed, the license normally remains in effect pending the processing of the appeal. Unless a stay of the decision is requested and granted, a licensee may proceed with a project pending the outcome of an appeal, but the licensee runs the risk of the decision being reversed or modified as a result of the appeal.

WHAT TO EXPECT ONCE YOU FILE A TIMELY APPEAL WITH THE BOARD

The Board will acknowledge receipt of an appeal, and it will provide the name of the DEP project manager assigned to the specific appeal. The notice of appeal, any materials admitted by the Board as supplementary evidence, any materials admitted in response to the appeal, relevant excerpts from the DEP's administrative record for the application, and the DEP staff's recommendation, in the form of a proposed Board Order, will be provided to Board members. The appellant, the licensee, and parties of record are notified in advance of the date set for the Board's consideration of an appeal or request for a hearing. The appellant and the licensee will have an opportunity to address the Board at the Board meeting. The Board will decide whether to hold a hearing on appeal when one is requested before deciding the merits of the appeal. The Board's decision on appeal may be to affirm all or part, affirm with conditions, order a hearing to be held as expeditiously as possible, reverse all or part of the decision of the Commissioner, or remand the matter to the Commissioner for further proceedings. The Board will notify the appellant, the licensee, and parties of record of its decision on appeal.

II. JUDICIAL APPEALS

Maine law generally allows aggrieved persons to appeal final Commissioner or Board licensing decisions to Maine's Superior Court (see 38 M.R.S. § 346(1); 06-096 C.M.R. ch. 2; 5 M.R.S. § 11001; and M.R. Civ. P. 80C). A party's appeal must be filed with the Superior Court within 30 days of receipt of notice of the Board's or the Commissioner's decision. For any other person, an appeal must be filed within 40 days of the date the decision was rendered. An appeal to court of a license decision regarding an expedited wind energy development, a general permit for an offshore wind energy demonstration project, or a general permit for a tidal energy demonstration project may only be taken directly to the Maine Supreme Judicial Court. See 38 M.R.S. § 346(4).

Maine's Administrative Procedure Act, DEP statutes governing a particular matter, and the Maine Rules of Civil Procedure must be consulted for the substantive and procedural details applicable to judicial appeals.

ADDITIONAL INFORMATION

If you have questions or need additional information on the appeal process, for administrative appeals contact the Board Clerk at 207-287-2811 or the Board Executive Analyst at 207-314-1458 bill.hinkel@maine.gov, or for judicial appeals contact the court clerk's office in which the appeal will be filed.

Note: This information sheet, in conjunction with a review of the statutory and regulatory provisions referred to herein, is provided to help a person to understand their rights and obligations in filing an administrative or judicial appeal. The DEP provides this information sheet for general guidance only; it is not intended for use as a legal reference. Maine law governs an appellant's rights.

APPENDIX C

RIGHT, TITLE, OR INTEREST

SME
SEVEE & MAHER
ENGINEERS

Bk 9188 Pg152 #3751
02-05-2004 @ 03:12p

QUITCLAIM DEED WITH COVENANT

KNOW ALL BY THESE PRESENTS, that Fort James Operating Company, "**GRANTOR(S),**" a Virginia corporation with a place of business at Old Town, Penobscot County, Maine, for consideration paid, grants to the State of Maine, acting by and through its Executive Department, State Planning Office "**GRANTEE**", and pursuant to Resolves, 2003, ch. 93, with Quitclaim Covenant, the land and buildings described in Exhibit A attached hereto and incorporated herein by reference, located in Old Town, Penobscot County, Maine (the "Premises"). The Premises are conveyed subject to the restrictive covenants and right of reverter set forth in Exhibit B attached hereto and incorporated herein by reference.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

IN WITNESS WHEREOF, the said Fort James Operating Company has caused this instrument to be sealed with its corporate seal and signed in its corporate name by Michael C. Burandt, its Executive Vice President this 3rd day of February, 2004.

FORT JAMES OPERATING COMPANY

By: _____
Its: Executive Vice President
Printed Name: Michael C. Burandt

SEAL

STATE OF
COUNTY OF Fulton, ss.

On February 3, 2004, personally appeared the above-named Michael C. Burandt, Executive Vice Pres of said corporation in his said capacity, and acknowledged the foregoing to be his free act and deed and the free act and deed of said corporation.

Before me,

_____
Notary Public
Printed Name: A. CLAIRE SHERWOOD
Notary Public, Fulton Cty, Georgia
Commission Expires June 16, 2007

SEAL

Exhibit A
To
Quitclaim Deed with Covenant

Parcel Description

Four parcels located at Old Town, Penobscot County, Maine, and described as follows (individually referred to as "Parcel" and collectively referred to as "Parcels"):

PARCEL ONE: A certain parcel of land with any buildings thereon, situated on the northeast side of Route 43, 3.4 + miles west of the intersection of Route 43 and Route 95, in the city of Old Town, County of Penobscot, State of Maine and being more particularly described as follows:

1) BEGINNING at a 3/4 inch rebar located on the northeast side of Route 43, at the northwest corner of land now or formerly of Scott E. Bergquist as described in deed recorded at the Penobscot County Registry of Deeds in Book 3608, Page 247. Said rebar is also located at the southwest corner of the "Cadorette Parcel" as shown on plan entitled "Perkins & Cadorette Parcels, Standard Boundary Survey (with exceptions)" by Squaw Bay Corp. of Cumberland, Maine, June, 1995, Ronald M. Carpentier, PLS #2042, recorded at the Penobscot County Registry of Deeds, Plan Book D46-95, to which reference is hereby made;

2) THENCE South 82° 12' 30" East, 1445.38 feet along the land of said Bergquist to a cedar post and the land now or formerly of James River Paper Company, Inc. as described in the deed recorded at the Penobscot County Registry of Deeds in Book 4870, Page 200;

3) THENCE North 4° 27' 20" East, 809.31 feet along the land of said James River Paper Company, Inc. to a point;

4) THENCE North 5° 59' 05" East, 15.69 feet along the land of said James River Paper Company, Inc. to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the land now or formerly of Alfred Perkins and Florine Perkins as described in the deed recorded at the Penobscot County Registry of Deeds in Book 1448, Page 22;

5) THENCE North 82° 46' 26" West, 2014.87 feet along the land of said Perkins to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the sideline of Route 43;

6) THENCE South 29° 43' 31" East, 1013.29 feet along Route 43 to a 3/4 inch rebar and point of beginning.

The above-described parcel contains 32.4 acres.

Being the same premises described in a Warranty Deed given by Francis R. Cadorette and Rhonda B. Cadorette to James River Paper Company, Inc., dated June 13, 1995, and recorded in said Registry in Book 5878, Page 272.

PARCEL TWO: A certain parcel of land with any buildings thereon situated on the northeast side of Route 43, 3.4+ miles west of the intersection of Route 43 and Route 95, in the City of Old Town, County of Penobscot, State of Maine, and being more particularly described as follows:

COMMENCING at a 5/8 inch rebar with survey cap marked "RMC NO. 2042" located at the intersection of the northeast sideline of Route 43, and the southerly boundary line of land now or formerly of Alfred Perkins and Florine Perkins as described in deed recorded at the

Penobscot County Registry of Deeds in Book 1448, Page 22. Said rebar is also located at the northwest corner of the "Cadorette Parcel" as shown on plan entitled "Perkins & Cadorette Parcels, Standard Boundary Survey (with exceptions)" by Squaw Bay Corp. of Cumberland, Maine, June, 1995, Ronald M. Carpentier, PLS #2042. to be recorded at the Penobscot County Registry of Deeds to which reference is hereby made. Thence South 82° 46' 26" East, 1485.52 feet along the Cadorette parcel to the point of Beginning.

1) THENCE from the Point of Beginning South 82°46'26" East, 529.45 feet along the Cadorette Parcel to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the land now or formerly of James River Paper Company, Inc., as described in the deed recorded at the Penobscot County Registry of Deeds in Book 4870, Page 200;

2) THENCE North 5° 59' 05" East, 828.72 feet along the land of said James River Paper Company, Inc. to a cedar post and the land of Alfred J. Meister as described in the deed recorded at the Penobscot County Registry of Deeds in Book 3738, Page 197;

3) THENCE North 84° 06' 52" West, 529.33 feet along the land of said Meister to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the land now or formerly of said Perkins;

4) THENCE South 5° 59' 05" West, 816.33 feet along the land of said Perkins to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the Point of Beginning.

The above-described parcel contains 10 acres.

Being the same premises described in a Warranty Deed given by Alfred K. Perkins and Florine J. Perkins to James River Paper Company, Inc. dated June 13, 1995, and recorded in said Registry of Deeds in Book 5878, Page 278.

PARCEL THREE: Lots 1 through 9 and 14 through 22, inclusive, as shown on the survey "Tyron Tree Farm" dated February 23, 1988, recorded in the Penobscot County Registry of Deeds in Plan file C26-88, together with a strip of land fifty (50) feet wide leading from Bennoch Road to the northerly line of Lot 11 on said plan, which strip was conveyed to Patten Corporation – Downeast by deed of Lyman B. Feero and Rosalita Feero, dated June 4, 1988, and recorded in said Registry in Book 4244, Page 5, and together with a right of way for all purposes over the roads fifty (50) feet wide, the centerlines of which are shown on said plan, leading from the northerly line of Lot 11 to the lots hereby conveyed. This right of way includes, but is not limited to, the right to install, use, maintain, repair and replace utility lines, poles and cables.

Together with all right, title and interest in and to that portion of the discontinued roadway lying northerly of the above described Parcel Three and southerly of the Town of Alton southerly line.

Being the same premises described in a Warranty Deed given by James River Corporation to James River Paper Company, Inc. dated July 10, 1991, and recorded in said Registry in Book 4870, Page 200.

Exceptions

The Parcels are conveyed subject to the following exceptions:

ALL PARCELS:

1. State of Maine, Department of Environmental Protection, Site Location Findings of Fact and Order, dated August 24, 1995, and recorded in the Penobscot County Registry of Deeds in Book 5939, Page 147.

2. Declarations of Covenants and Restrictions by James River Paper Company, Inc., dated December 20, 1993, recorded in said Registry in Book 5518, Page 67; Corrected Declaration of Covenants and Restrictions, dated January 20, 1994, recorded in said Registry in Book 5549, Page 162; and Amendment to Declaration of Covenants and Restrictions, dated November 30, 1995, recorded in said Registry in Book 6044, Page 118.

PARCELS ONE AND TWO ONLY:

1. Such state of facts as shown on the plan entitled "Cadorette House Lots, Route 43, Old Town, Maine," prepared by Squaw Bay Corp., dated June 1995, and recorded in said Registry in Plan 1996-59.

2. Such statement of facts as shown on the plan entitled "Perkins & Cadorette Parcels, Route 43, Old Town, Maine," prepared by Squaw Bay Corp., dated June 1995, recorded in said Registry in Plan D46-95.

PARCEL THREE ONLY:

1. Rights of way acquired by the University of Maine System by deeds dated July 27, 1989, and recorded in said Registry in Book 4490, Page 322 and Book 4490, Page 325.

2. Restrictions and conditions set forth in the deed from Pattern Corporation to James River Corporation recorded in said Registry in Book 4654, Page 310.

3. Rights of way reserved in the deed form Camillis G. Kidder to Napoleon Parady, dated January 10, 1910, and recorded in said Registry in Book 750, Page 407.

4. Order of the Grantee of Maine, Department of Environmental Protection, dated October 3, 1988, recorded in said Registry in Book 4345, Page 19.

5. Such statement of facts, including easements and rights of way, as shown on the plan entitled "Tryon Tree Farm, Patten Corporation-Downeast," prepared by Raymond S. Silsby, dated February 23, 1988, and recorded in said Registry in C26-88.

NOTICE OF SOLID WASTE DISPOSAL FACILITY

Pursuant to Maine Department of Environmental Protection Solid Waste Management Regulation, Chapter 400 Appendix C.11, Grantor provides the following notice:

The Premises contains an active secure solid waste disposal facility (the "Facility"). The Facility was licensed by the Maine Board of Environmental Protection on July 28, 1993. The Facility began operations on December 2, 1996. The Facility is 68 acres and is located southern quadrant of Parcel Three of the Premises. The following non-hazardous wastes have been placed in the Facility to a maximum depth of approximately 30 feet:

- pulp and papermill wastewater treatment plant sludge,
- lime wastes and grit,
- woodwastes and inert debris,
- small quantities of soil and sawdust contaminated with process chemicals that are non-hazardous,
- virgin oily contaminated debris,
- soil rags, oil filters, absorbent materials, crushed grease drums and waste grease,

- sand from sand filters,
- non-hazardous sand from sand blasting,
- multifuel fly ash and bottom ash from the Lincoln Pulp and Papermills, and
- wood ash from the City of Old Town

BK 7188 P9158 #3751

Exhibit B
To
Quitclaim Deed with Covenant

Use Restrictions. So long as Grantee is obligated to provide disposal capacity to Grantor pursuant to Section 5.1 of the Amendment and Restatement of Agreement Regarding Solid Waste Disposal Facility Acquisition and Operation between Fort James Operating Company and State of Maine, acting by and through its Executive Department, State Planning Office, as it may be amended from time to time ("Acquisition Agreement") dated on or about the date of this Quitclaim Deed with Covenant the Premises will not be used in any manner that would prohibit or impair, in any way, the construction and operation of a solid waste landfill of sufficient size, nature, scope and location as is required to satisfy the Grantee's capacity commitment to Grantor under Section 5.1 of the Acquisition Agreement. The Grantee is prohibited from constructing any facility or improvement at the Premises that would prohibit or impair, in any way, the construction and operation of a solid waste landfill of sufficient size, nature, scope and location as is required to satisfy the Grantee's capacity commitment to Grantor under Section 5.1 of the Acquisition Agreement. In addition to the foregoing, the Premises shall not be developed for any uses unrelated to use as a solid waste landfill that creates any undue risk of harm to public health resulting from the use of a portion of the Premises as a solid waste landfill.

Transfer Restrictions The Grantee is restricted from selling, assigning, transferring or otherwise disposing of any interest in, granting any rights to, mortgaging or otherwise encumbering all or any portion of the Premises, during the term of the capacity commitment under Section 5.1 of the Acquisition Agreement, without the transferee or successor explicitly assuming the Grantee's capacity commitments under Section 5.1 of the Acquisition Agreement in a written document reasonably acceptable to Grantor, provided, however, that the Grantee may collaterally assign its rights under any operating agreement and, on notice to Grantor, may dispose of an interest in, or grant rights to, the Premises so long as such disposition or grant does not prohibit or impair, in any way, the construction and operation of a solid waste landfill of sufficient size, nature, scope and location as is required to satisfy the Grantee's capacity commitment to Grantor under Section 5.1 of the Acquisition Agreement. Any sale, assignment, transfer or other disposition of the Premises, whether with or without assumption of the Section 5.1 capacity commitments, will not discharge the Grantee from its responsibilities to satisfy those commitments except to the extent specifically released by Grantor in writing.

Covenants Running with the Land. The foregoing terms and conditions constitute covenants running with the land and shall touch and concern the land during the term of their applicability. Such terms and conditions are binding upon the Grantee, its successors and assigns, as well as all transferees, lessees or future owners of the Premises or any portion thereof.

Reverter Option.

(a) The Grantor reserves the option to cause reversion of title to the Premises to Grantor in the event the Grantee fails to perform, in any material respect, any of its material obligations under the Acquisition Agreement. Grantor will provide the Grantee with prompt written notice of the alleged default or breach, specifying in reasonable detail the facts relative to the breach and the related obligation under the Acquisition Agreement. Grantee shall have

ninety (90) days to cure such default or breach, or if such default or breach, by its nature, cannot be cured within such period, such additional time as may be necessary to cure the default (not to exceed one hundred eighty (180) days), provided Grantee has exercised its reasonable commercial efforts and taken reasonable steps to begin a cure within the initial ninety (90) day period. A delay in performance caused by a Force Majeure (as defined in the Acquisition Agreement) is not a basis for exercise of Grantor's right of reverter. The right of reverter expires if it is not exercised on or before the thirtieth (30th) anniversary of the recording of this Quitclaim Deed with Covenant.

(b) Upon expiration of the cure period referenced above, Grantor may, at its option but subject to the terms hereof, exercise the reverter on thirty (30) days prior written notice to the Grantee and thereby cause immediate and automatic fee simple title to the Premises to revert to Grantor, or any affiliate thereof specified as the entity taking title under this reverter, upon recordation of a certificate executed by a duly authorized officer of Grantor certifying that:

(i) The conditions required to give rise to Grantor's rights under this reverter clause have been satisfied;

(ii) Grantor is thereby exercising its right to cause reversion of the fee simple title to the Premises to Grantor, or an affiliate of Grantor named in the certificate as the entity to receive reversionary title to the Premises;

(iii) The cure periods referenced above have expired and Grantor has given Grantee thirty (30) days prior written notice of Grantor's intent to exercise reverter and (A) the Grantee has not disputed Grantor's right to exercise the reverter following the expiration of the cure periods referenced above or (B) if Grantee has disputed Grantor's right to exercise the reverter, a court of competent jurisdiction has determined that Grantor is authorized to exercise its reverter, and such decision shall not be subject to further appeal; and

(iv) Upon recordation of the certificate, title automatically and irrevocably shall revert to Grantor, or it designated affiliate, without any action required by or of the Grantee or any other party.

(c) The Grantee may, at its option, terminate the reverter upon recordation of a certificate executed by a duly authorized officer of the Grantee certifying that:

(i) the conditions required to give rise to the Grantee's rights to terminate the reverter have been satisfied;

(ii) the Grantee has given Grantor notice of breach of the terms of the Acquisition Agreement by Grantor, and the Grantee has given Grantor thirty (30) days prior written notice of the Grantee's intent to terminate the reverter following the expiration of the cure periods referenced above and (A) the Grantor has not disputed the Grantee's right to terminate the reverter or (B) if it has disputed the Grantee's right to terminate the reverter, a court of competent jurisdiction has determined that the Grantee is authorized to terminate the reverter, and such decision shall not be subject to further appeal; or

(iii) Grantor has ceased to operate both its papermaking and commercial pulping operations at the Old Town Mill for a period of one (1) year.

(iv) Upon recordation of the certificate, the right of reverter contained herein shall automatically and irrevocably be deemed to be terminated, without any action required by or of the Grantor or any other party.

(d) The Grantee may seek judicial relief to enjoin the reversion provided for hereunder or seek a declaratory judgment on the issue of whether such conditions to exercise or terminate the right of reverter have been satisfied. Grantor may seek injunctive or other equitable relief to enforce the reversion provided for hereunder or seek a declaratory judgment on the issue of whether the conditions to exercise or terminate the right of reverter have been satisfied. If a party elects to seek an injunction and a court fails to enjoin the reversion or permit the termination of the reversion, as the case may be, such party may pursue all other legal remedies available to it to challenge a party's right to exercise or terminate the right of reversion. After the final resolution of any dispute, or if the Grantee does not dispute the reverter, if it is determined that exercise of the right of reverter by Grantor was authorized, the Grantee will cooperate fully with Grantor and exercise its reasonable commercial efforts to assist Grantor in transferring any and all necessary Governmental Approvals relating to the ownership and operation of the Facility (as defined in the Acquisition Agreement) provided, however, that Grantor acknowledges that the Grantee's commitment for cooperation is not a guaranty of issuance of any permit or approval of transfer because the Department of Environmental Protection is an independent permitting authority.

"Maine Real Estate Transfer Tax Paid"

PENOBSCOT COUNTY, MAINE
Susan F. Bulay
Register of Deeds

(W0208216.1)

PROTECTED AREA DESCRIPTION
JUNIPER RIDGE LANDFILL TRACT
OLD TOWN, MAINE

A certain lot or parcel of land with the improvements thereon situate in the City of Old Town, County of Penobscot, State of Maine, more particularly described as follows:

Tract One: Beginning at a wood post found marking the southeasterly corner of lot numbered one (1) as shown on a plan titled, Final Plan Tyron Tree Farm ..." dated February 23, 1988, recorded in Penobscot County Registry of Deeds, Plan File C26-88; thence on an easterly prolongation of the southerly line of said lot numbered one, North 80 degrees, 46 minutes, 40 seconds East, a distance of 183.6 feet to an iron rod set; thence North 11 degrees, 21 minutes West a distance of 539.2 feet to an angle; thence North 25 degrees, 18 minutes West a distance of 364.6 feet to an iron rod set; thence North 18 degrees, 00 minutes East a distance of 332.9 feet to an angle; thence North 9 degrees, 11 minutes West a distance of 507.9 feet to an iron rod set; thence North 12 degrees, 32 minutes East a distance of 225.9 feet to an angle; thence North 42 degrees, 32 minutes East a distance of 273.9 feet; thence North 71 degrees, 8 minutes East a distance of 234.3 feet to an iron rod set; thence North 87 degrees, 3 minutes East a distance of 468.2 feet to an angle; thence South 45 degrees, 47 minutes East a distance of 206.3 feet to an iron rod set; thence South 73 degrees, 48 minutes East a distance of 258.5 feet to and angle; thence North 20 degrees, 16 minutes East a distance of 183.6 feet to an angle; thence North 60 degrees, 28 minutes East a distance of 112.4 feet to an iron rod set; thence South 36 degrees, 11 minutes East a distance of 169.7 feet to an angle; thence South 25 degrees, 18 minutes West a distance of 183.3 feet to an iron rod set; thence South 72 degrees, 57 minutes East a distance of 224.8 feet to an angle; thence South 62 degrees, 35 minutes East a distance of 204.8 feet to an angle; thence North 89 degrees, 59 minutes East a distance of 149.1 feet to an iron rod set; thence South 62 degrees, 23 minutes East a distance of a distance of 247.3 feet to an angle; thence South 74 degrees, 1 minute East a distance of 202.5 feet to an angle; thence South 87 degrees, 17 minutes East a distance of 251.3 feet to an angle; thence North 67 degrees, 45 minutes East a distance of 194.3 feet to an iron rod set; thence North 21 degrees, 8 minutes West a distance of 2,319.0 feet to an iron rod set on the municipal boundary between the City of Old Town and the Town of Alton; thence along said municipal boundary line, South 79 degrees, 44 minutes West, a distance of 3347.5 feet to a point on the southeasterly boundary of Lot 12 of "Preservation Wetlands" as described in Exhibit B of a Declaration of Covenants and Restrictions made by James River Paper Company recorded in Penobscot County Registry of Deeds, Book 5518, Page 67; thence following the southeasterly boundary of Lot 12 of "Preservation Wetlands", South 6 degrees, 33 minutes West, a distance of 479.3 feet; thence continuing along the southeasterly boundary of Lot 12 of "Preservation Wetlands", South 28 degrees, 18 minutes West, a distance of 446.9 feet; thence continuing along the southeasterly boundary of Lot 12 of "Preservation Wetlands", South 2 degrees, 35 minutes East, a distance of 604.7 feet; thence continuing along the southeasterly boundary of Lot 12 of "Preservation Wetlands", South 47 degrees, 39 minutes West, a distance of 961.3 feet to the westerly

boundary of lot numbered two (2) as shown on the aforementioned plan of Tryon Tree Farm recorded in Penobscot County Registry of Deeds, Plan File C26-88; thence along the westerly boundary of lot numbered two (2), as shown by said plan, South 10 degrees, 50 minutes East, a distance of 792.5 feet to the northerly boundary line of lot numbered one (1) as shown on the aforementioned plan of Tryon Tree Farm; thence along the northerly boundary line of lot numbered one (1), South 79 degrees, 19 minutes West a distance of 554.7 feet to the northwesterly corner of said lot numbered one (1); thence along the westerly boundary of lot numbered one (1), South 10 degrees, 33 minutes East, a distance of 661.4 feet to the southwesterly corner of said lot numbered one (1); thence following the southerly boundary line of lot numbered one (1), North 80 degrees, 46 minutes, 40 seconds East, a distance of 2,553.5 feet to the point of beginning, enclosing 247.4 acres.

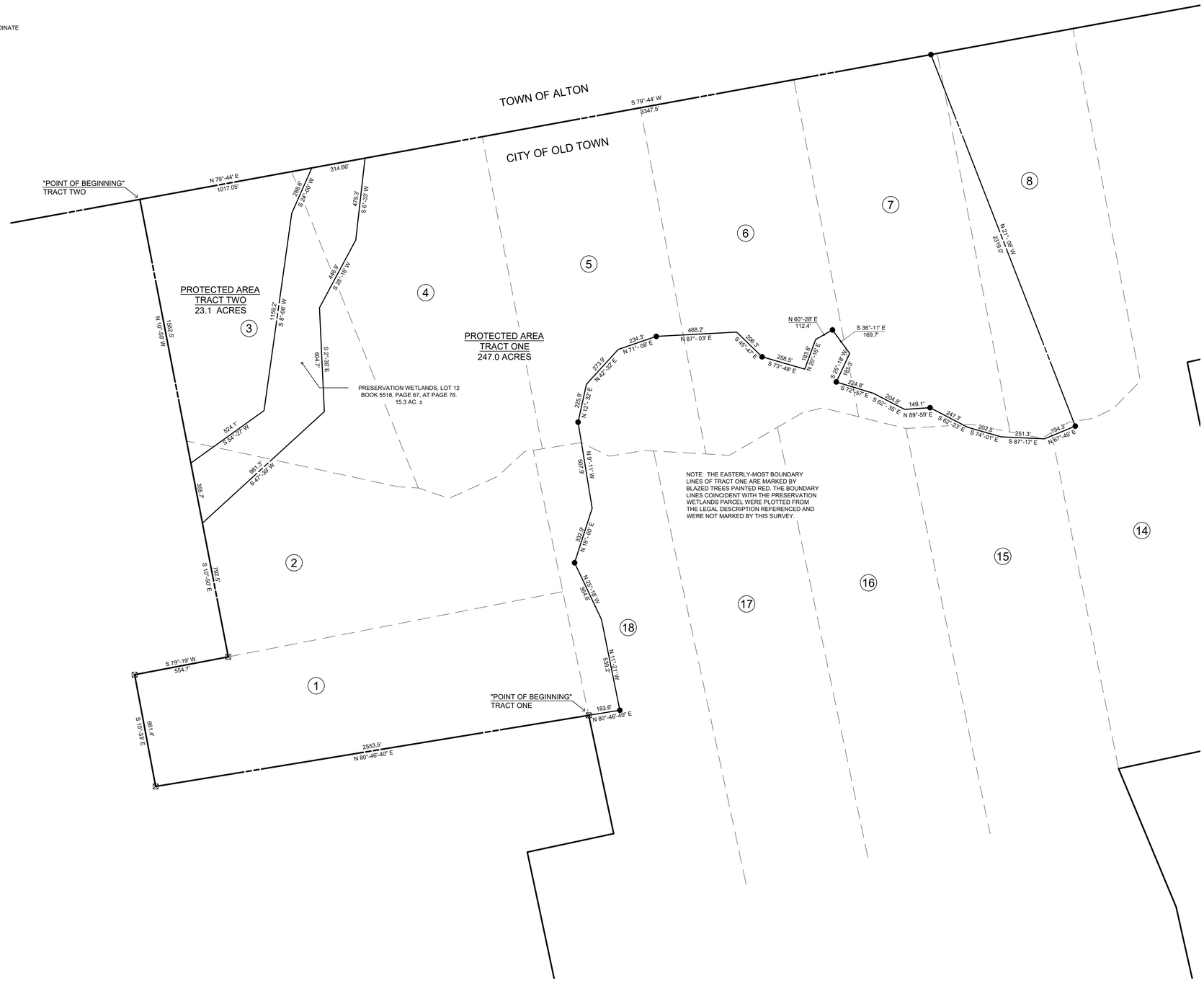
Tract Two: Beginning at the point of intersection formed by the northerly prolongation of the westerly boundary of lot numbered three (3) as shown on the plan of Tryon Tree Farm recorded in Penobscot County Registry of Deeds, Plan File C26-88, with the municipal boundary between the City of Old Town and the Town of Alton; thence following the municipal boundary, North 79 degrees, 44 minutes East, a distance of 1,017.05 feet to the northwesterly boundary of Lot 12 of "Preservation Wetlands" as described in Exhibit B of a Declaration of Covenants and Restrictions made by James River Paper Company recorded in Penobscot County Registry of Deeds, Book 5518, Page 67; thence following the northwesterly boundary of Lot 12 of "Preservation Wetlands", South 24 degrees, 0 minutes West, a distance of 288.6 feet; thence continuing along the northwesterly boundary of Lot 12 of "Preservation Wetlands", South 8 degrees, 6 minutes West, a distance of 1,159.2 feet; thence continuing along the northwesterly boundary of Lot 12 of "Preservation Wetlands", South 54 degrees, 27 minutes West, a distance of 524.1 feet to the westerly boundary of lot numbered two (2) as shown on the aforementioned plan of Tryon Tree Farm recorded in Penobscot County Registry of Deeds, Plan File C26-88; thence following the westerly boundary of lot numbered two (2) and the westerly boundary of lot numbered three (3), as shown by said plan, North 10 degrees, 50 minutes West, a distance of 1,562.5 feet to the point of beginning, enclosing 23.1 acres

Bearings referenced herein are oriented to magnetic north, July 1992, as determined by a survey conducted by Plisga & Day, Land Surveyors.

For the Grantor's source of title reference is made to Parcel Three in a deed from Fort James Operating Company to State of Maine dated February 3, 2004, recorded in Penobscot County Registry of Deeds, Book 9188, Page 152.

Richard A. Day
12-19-2017
Revised to 12-21-2017

GRID NORTH, MAINE STATE COORDINATE SYSTEM OF 1983, EAST ZONE.



NOTE: THE EASTERLY-MOST BOUNDARY LINES OF TRACT ONE ARE MARKED BY BLAZED TREES PAINTED RED. THE BOUNDARY LINES COINCIDENT WITH THE PRESERVATION WETLANDS PARCEL WERE PLOTTED FROM THE LEGAL DESCRIPTION REFERENCED AND WERE NOT MARKED BY THIS SURVEY.

SCALE: 1"= 300'

300' 0 300' 600' 900' 1,200'

NOTES

(1) DOCUMENTS REFERENCED ON THIS PLAN ARE RECORDED IN PENOBSCOT COUNTY REGISTRY OF DEEDS UNLESS OTHERWISE NOTED.

LEGEND

BOUNDARY SYMBOLS

- ● NO. 6 REBAR, SET
- ○ IRON PIPE FOUND
- ⊙ IRON ROD/BOLT FOUND
- ⊠ WOOD POST
- (15) LOT NUMBERING AS SHOWN ON PLAN OF TYRON TREE FARM, PLAN FILE C26-88.

LINE TYPE LEGEND

- EXISTING PROPERTY LINE
- EASEMENT BOUNDARY
- ADJOINING PROPERTY LINE
- INTERIOR PARCEL LINE

SURVEY STANDARD

BEARINGS AND DISTANCES SHOWN ON THIS PLAN WERE DETERMINED FROM OBSERVATIONS MADE BY "C/A-CODE" GPS INSTRUMENTATION WITH A MANUFACTURER'S SPECIFICATION FOR ACCURACY OF LESS THAN ONE METER UNDER OPTIMAL CONDITIONS.

STATE OF MAINE
RICHARD A. DAY
NO. 1151
PROFESSIONAL LAND SURVEYOR

RICHARD A. DAY, MAINE LICENSED PROFESSIONAL LAND SURVEYOR No. 1151

SHEET TITLE

PROTECTED AREA BOUNDARY SURVEY

PROPERTY OF
STATE OF MAINE
PENOBSCOT COUNTY REGISTRY OF DEEDS
BOOK 9188, PAGE 152
JUNIPER RIDGE LAND FILL - OLD TOWN, MAINE

PLISGA & DAY
LAND SURVEYORS
72 MAIN STREET
BANGOR, ME 04401
(207) 947-0019

PROJECT:	SHEET:
06248	1 of 1
DATE: 12-21-2017	
SCALE: 1"=300'	

APPENDIX D

OPERATING SERVICES AGREEMENT (OSA)

SME
SEVEE & MAHER
ENGINEERS

OPERATING SERVICES AGREEMENT

This OPERATING SERVICES AGREEMENT (this "Agreement") is made as of this 5th day of February, 2004, by and between CASELLA WASTE SYSTEMS, INC., a Delaware corporation with a place of business at 25 Greens Hill Lane, Rutland, Vermont 05702 ("Casella"), and the STATE OF MAINE, acting by and through its Executive Department, State Planning Office (the "State").

WITNESSETH:

WHEREAS, the State has contemporaneously with the execution and delivery hereof and payment of the amounts due hereunder acquired the solid waste landfill located in Old Town, Maine and more fully described below, previously owned by Fort James Operating Company, a Delaware corporation ("FJ"); and

WHEREAS, the State desires that Casella operate and develop the Landfill pursuant to the terms and conditions contained herein;

NOW, THEREFORE, in consideration of the mutual promises and agreements hereinafter contained, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Casella and the State agree as follows:

SECTION 1 DEFINITIONS

Capitalized words and phrases used but not otherwise defined herein shall have the following meanings:

1.1 "Affiliates" shall mean any corporation or other business entity controlling, controlled by, or under common control with the subject corporation, business enterprise or person.

1.2 "Acceptable Waste" shall mean such material as may from time to time be legally

accepted at the Landfill in accordance with applicable MDEP permits and other applicable laws and regulations, excluding, however, all Excluded Waste.

1.3 "Biomass Ash" shall mean the ash resulting from the operation of the Biomass Generating Facility to the extent the same is disposable at the Landfill under the Existing Permit and meets the definition of "special waste" as defined under Maine Environmental Law.

1.4 "Biomass Generating Facility" shall mean the electric generating facility fueled principally with biomass fuel, to be installed at the Old Town Mill.

1.5 "Capacity Credit" is defined in Section 2.8(d).

1.6 "Cash Application" is defined in Section 2.8(d).

1.7 "CERCLA" means the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. §§ 9602 et seq.

1.8 "Closure" shall mean those acts and activities required by applicable law and regulations which result in a permanent cessation of use of a solid waste landfill or portion thereof, as those requirements and regulations may be amended or modified from time to time, and which result in a stabilized solid waste Landfill which is not in active use, excluding those acts and activities which are required for Post-Closure Care.

1.9 "Damages" shall mean liability, loss, costs and expenses of every nature and type and howsoever arising that a Person may incur (including, without limitation, costs of investigation and defense and reasonable attorneys', paralegals and other professionals' fees and expenses).

1.10 "Disposal Application" is defined in Section 2.8(d).

1.11 "Effective Date" shall mean the date hereof.

1.12 "Environmental Law" shall mean any federal, state or local law, statute, rule,

order, directive, judgment, Governmental Approval or regulation or the common law relating to the environment (including the ambient air, surface water, groundwater, land surface or subsurface strata), or exposure of persons or property to Materials of Environmental Concern, including any statute, regulation, administrative decision or order pertaining to: (i) the presence of or the treatment, storage, disposal, generation, transportation, handling, distribution, manufacture, processing, use, or recycling, of Materials of Environmental Concern or documentation related to the foregoing; (ii) air, water and noise pollution; (iii) groundwater and soil contamination; (iv) the release, threatened release, or accidental release into the environment, or other areas of Materials of Environmental Concern, including emissions, discharges, injections, spills, escapes or dumping of Materials of Environmental Concern; (v) transfer of interests in or control of real property; (vi) land use, subdivision and zoning; (vii) community or worker right-to-know disclosures with respect to Materials of Environmental Concern; (viii) the protection of wild life, aquatic and marine life and wetlands, and endangered and threatened species; and (ix) storage tanks, vessels, containers, abandoned or discarded barrels and other open or closed receptacles. As used above, the term "release" shall have the meaning set forth in CERCLA, and to the extent it is more extensive or comprehensive, as defined in Maine Environmental Law. Without limiting the foregoing, the term "Environmental Law" shall include the Maine Forest Practices Act, 12 M.R.S.A. §§8867-A et seq.

1.13 "Environmental Matters" shall mean any liability or obligation arising under Environmental Law, whether arising under theories of contract, tort, negligence, successor or enterprise liability, strict liability or other legal or equitable theory, including (i) any failure to comply with an applicable Environmental Law and (ii) any liability or obligation arising from the presence of, release or threatened release of, or exposure of persons or property to, Materials

of Environmental Concern at the Premises or associated with the Premises. As used above, the term "release" shall have the meaning set forth in CERCLA, and to the extent it is more extensive or comprehensive, as defined in Maine Environmental Law.

1.14 "Escrow Agent" means Lawyers Title Insurance Corporation, appointed as escrow agent to hold and administer the Improvement Fund under Section 2.2(b) of the Acquisition Agreement pursuant to a separate Escrow Agreement between FJ and the State.

1.15 "Existing Permit" means Maine Department of Environmental Protection Permit # S 020700 7A-A-N, issued July 28, 1993, as amended or revised.

1.16 "Expansion Permit" shall mean any and all federal, state, local and other governmental permits, permit modifications, operation plan modifications, other modifications, statutory amendments and legislation, licenses, approvals, authorizations or amendments necessary for the expansion of the Landfill beyond the licensed footprint as of the date hereof.

1.17 "Excluded Waste" shall mean (a) any Acceptable Waste or any other waste of any nature generated outside of the State of Maine, (b) any waste as of the date of Casella's response to the RFP under contract for delivery to another disposal facility or processing facility unless agreed to in writing by such facility's waste generator or responsible party, and (c) any other waste or material excluded from disposal in the Landfill by applicable laws or regulations, or excluded by any of the terms and conditions of any permits, licenses, authorizations or approvals obtained with respect to the construction or operation of the Landfill, provided that Excluded Waste shall not include any waste that would otherwise constitute Excluded Waste hereunder if such category of waste is accepted at another disposal facility in the State of Maine owned or operated by the State, subject in all instances to the prior receipt of any and all required licenses or permits for such category of waste. Notwithstanding the foregoing, the parties acknowledge

and agree that, subject to applicable laws and regulations and such certifications as the State may reasonably require, Casella may bring construction and demolition waste generated outside the State of Maine for processing within the State of Maine solely for purposes of allowing Casella to generate biomass fuel required in connection with the provision of biomass fuel to FJ or its successor or assigns under the C&D Fuel Agreement in the form attached hereto as Exhibit B. Casella agrees to use its best efforts to ensure that any such construction and demolition waste generated outside the State of Maine and processed in the State of Maine is free of putrescible waste. This term shall also include such other wastes and materials as Casella determines, in the reasonable exercise of its commercial judgment, pose a risk or danger to the operation or safety of the Landfill or to the human or natural environment or are otherwise reasonably unacceptable to Casella provided, however, that in no event may FJ Waste be excluded or otherwise deemed Excluded Waste unless such exclusion is required by applicable law, regulation, permit, license, authorization or approval.

1.18 Intentionally omitted.

1.19 Intentionally omitted.

1.20 "FJ Waste" is defined in Section 2.8(a).

1.21 "Force Majeure" shall mean any act, event or condition affecting the Landfill or to the extent that it materially and adversely affects the ability of either party to perform or comply with any obligation, duty or agreement required of the party under this Agreement, provided such act, event or condition is beyond the reasonable control of the party or its agents relying thereon and is not the result of the willful or negligent act or omission of the party relying thereon. Force Majeure includes, without limitation but by way of illustrating the actions, events and conditions constituting a Force Majeure hereunder: (a) an act of God, epidemic, landslide,

lightning, earthquake, fire, explosion, storm, flood or similar occurrence; (b) an act of the public enemy, war, blockage, insurrection, riot, general arrest or restraint of government and people, civil disturbance or disobedience, sabotage or similar occurrence; or (c) a strike, work slowdown, or similar industrial or labor action.

1.22 "Governmental Approval" means any and all approvals, licenses, permits, authorizations (or the transfer thereof) required by any Governmental Authority for the design, construction, improvement, alteration, ownership or operation of the Landfill and all related projects, improvements or land use or the transfer thereof.

1.23 "Governmental Authority" means any federal, state or local governmental subdivision, board, body or regulatory authority.

1.24 "Hazardous Waste" shall mean any pollutant, contaminant, chemical, industrial, toxic or other waste or material that constitutes hazardous waste or material as defined pursuant to the Resource Conservation and Recovery Act, 42 U.S.C. §9601, et seq., or similar Maine laws, or the regulations adopted thereunder, or any successor laws regulating the same or similar substances, and Materials of Environmental Concern.

1.25 "Landfill" shall mean the solid waste landfill located in Old Town, Maine, that the State proposes to acquire from FJ pursuant to the Acquisition Agreement and all of the assets and properties acquired by the State from FJ in connection with said landfill, including any expansion of the solid waste landfill located at the Premises, whether such expansion is effected under the Existing Permit or under a new, amended or additional Governmental Approval, and any associated land, buildings, appurtenances, equipment and fixtures, the full benefit of all utility arrangements, licenses, approvals and permits to the extent transferable, including rights of assignment to the extent any such licenses and permits are assignable (but subject to any third

party consents, when required).

1.26 "Letter of Credit" means an irrevocable, unconditional, direct pay letter of credit in the form of Exhibit E attached to the Acquisition Agreement issued by a financial institution acceptable to FJ, in its discretion, (i) issued to FJ in the face amount of $12,500,000 under Section 2.2(a)(ii) of the Acquisition Agreement, and (ii) issued to the Escrow Agent in the face amount of $1,000,000 under Section 2.2(a)(iii) of the Acquisition Agreement.

1.27 "License Amendment" shall mean any and all federal, state, local and other governmental permits, permit modifications, operation plan modifications, other modifications, statutory amendments and legislation, licenses, approvals, authorizations or amendments necessary for the development of the Landfill within the currently permitted footprint for an additional 7 million cubic yards.

1.28 "License Application" shall mean the application for License Amendment submitted to the MDEP on October 30, 2003.

1.29 "Lincoln" shall mean Lincoln Pulp & Paper Co., Inc.

1.30 "Lincoln Agreement" means the Biomass Ash Disposal Agreement between FJ and Lincoln Pulp and Paper, Co., Inc. dated September 30, 2003.

1.31 "Lincoln's Biomass Ash" means the ash resulting from the operation of the Lincoln biomass boiler located in Lincoln, Maine.

1.32 "Leachate" shall mean the liquid or semi-solid residue from waste deposited at the Landfill and either collected within a liner system to be installed at the Landfill, or otherwise collected for disposal.

1.33 "Materials of Environmental Concern" shall mean any: pollutants, contaminants or hazardous substances (as such terms are defined under CERCLA, the Maine Protection and

Improvement of Waters Act, 38 M.R.S.A. § 361-A, or the Maine Uncontrolled Hazardous Substances Sites Law, 38 M.R.S.A. § 1362.1), pesticides (as such term is defined under the Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S.C. §§ 136 et seq.), solid wastes and hazardous wastes (as such terms are defined under the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 et seq., and Maine's Hazardous Waste, Septage and Solid Waste Management Act, 38 M.R.S.A. §§ 1301 et seq.), chemicals, other hazardous, radioactive or toxic materials, oil, petroleum and petroleum products (and fractions thereof), asbestos and asbestos-containing materials, polychlorinated biphenyls ("PCBs") or PCB-containing materials, or any other material (or article containing such material) listed or subject to regulation under any law, statute, rule, regulation, order, Governmental Approval, or directive due to its potential, directly or indirectly, to harm the environment or the health of humans or other living beings.

1.34 "MDEP" shall mean the Maine Department of Environmental Protection, and any successor agency or department of the State of Maine.

1.35 "Mill Waste" shall mean waste from the Old Town Mill of a composition consistent with the waste FJ (or its successors or assigns) is permitted to dispose of at the Landfill under the Existing Permit, provided it meets the definition of "special waste" as currently defined by Maine Environmental Law.

1.36 "Old Town Mill" shall mean the pulp and paper mill owned and operated by FJ located in Old Town, Maine, and all related facilities and improvements.

1.37 "Post-Closure Care" shall include those acts and activities which are required under applicable laws, regulations and permits for post-closure care of a solid waste landfill or portion thereof, including monitoring, reporting and maintenance for the time set forth in the relevant laws, regulations and permits.

1.38 "Premises" means the real estate, together with all buildings and improvements thereon, situated in Alton and Old Town, Maine and more particularly described in Exhibit A attached hereto and incorporated herein by reference, including the Landfill.

1.39 "Prime Rate" means the fluctuating interest rate per annum equal to the rate of interest published in The Wall Street Journal as the Prime Rate or the base rate on corporate loans posted by at least 75% of the nation's thirty (30) largest banks, as it may vary. In the event The Wall Street Journal ceases to publish the Prime Rate, the parties shall select a comparable substitute interest rate index.

1.40 "RFP" means the 'Request For Proposals: Contract for Landfill Operations', as issued on June 13, 2003, by the Maine State Planning Office, Waste Management & Recycling Program.

1.41 "Special Waste" shall mean any discarded waste and solid material, other than those which are typically found in household, commercial or municipal refuse, including, without limitation, materials such as industrial waste (but not including Mill Waste or Biomass Ash), institutional waste, animal manure, petroleum contaminated soil of a nonhazardous nature, ash, residue from incineration, waste treatment plant sludge, food processing wastes, dredging wastes, asbestos, or waste which requires special or exceptional handling or approval from MDEP, but only to the extent the foregoing is permitted for disposal in the Landfill under applicable MDEP permits, and shall not include any Excluded Waste, any solid waste generated by sources other than household and typical commercial establishments that exists in such an unusual quantity or in such a chemical or physical state, or any combination thereof, that may disrupt or impair effective waste management or threaten the public health, human safety or the environment and requires special handling, transportation and disposal procedures. Special

Waste includes, but is not limited to: (a) ash; (b) industrial and industrial process waste; (c) sludge and dewatered septage; (d) debris from nonhazardous chemical spills and cleanup of those spills; (e) contaminated soils and dredge materials; (f) asbestos and asbestos-containing waste; (g) sand blast grit and non-liquid paint waste; (h) high and low pH waste; (i) spent filter media residue; and (j) shredder residue.

1.42 "Shut-Down Period" is defined in Section 2.8(d).

1.43 "SPO" means the State Planning Office, an Executive Department of the State.

1.44 "State/FJ Agreement" or the "Acquisition Agreement" means the Agreement Regarding Solid Waste Disposal Facility Acquisition and Operation between the State and FJ pursuant to which the State has acquired the Landfill.

1.45 "Term" shall mean that period of time commencing on the Effective Date and ending on the earlier to occur of (i) thirty (30) years after the Effective Date, or (ii) the date this Agreement is terminated by one or more of the parties as provided for herein.

1.46 "Tipping Fees" shall mean the aggregate of all fees, charges, levies and assessments charged by Casella for the disposal of waste at the Landfill, including any contractors, subcontractors or other service providers employed by Casella, excluding any transportation costs associated with delivery of waste to the Landfill.

SECTION 2 LANDFILL OPERATION AND MANAGEMENT

2.1 Operation, Management and Exclusive Use—General. The State grants to Casella during the Term and subject to the terms and conditions hereof and all applicable laws, regulations and permits, the exclusive right, license and privilege to occupy, operate, maintain, repair, design, redesign, construct and utilize the Landfill, including, without limitation, the right to take possession of, occupy and have the exclusive use of the Landfill, subject to the terms and conditions of this Agreement. Without limiting the generality of the foregoing and subject in all

instances to the terms and conditions hereof, these rights include the following:

2.1.1 The right to take possession of and use all of the Landfill. Casella shall prominently post the hours of operation and other limitations and conditions of access at the entrance to the Landfill. Casella shall have the right to post additional signage at the Landfill indicating its operation of the Landfill and any other information it deems necessary or desirable, subject in all instances to applicable laws and regulations.

2.1.2 The exclusive right to operate and dispose of Acceptable Waste at the Landfill and, subject to the terms hereof, to create and implement rules and policies pertaining to disposal at, and operation of, the Landfill, provided that in no event shall such rules and policies cause a default by the State of its obligations under the State/FJ Agreement or otherwise violate or restrict Casella's obligations under Section 2.8.

2.1.3 To the extent permitted by applicable law, the right to use the permits, licenses, approvals and authorizations issued in the State's name and the right, with the consent of the State (which consent will not be unreasonably withheld), to seek any modifications, transfers or renewals of the same, consistent with this Agreement.

2.1.4 The right to take and use any landfill gas generated at the Landfill, all in accordance with applicable laws and regulations.

2.2 Construction.

(a) Subject to the terms of all applicable laws, regulations and permits, Casella shall have the right to design, locate, permit, construct and remove at the Landfill such buildings and fixed resources as it deems necessary for the operation of the Landfill, including, without limitation, garages, office

buildings, recycling facilities and other structures, fixtures, appurtenances, and improvements, provided that Casella's actions shall in no event impair or limit Casella's obligation to satisfy the capacity commitment to FJ under Section 2.8. The use of the Landfill shall be restricted to development and operation of a solid waste landfill, or other facilities providing for the disposal or recycling of solid waste or other management of solid waste or, with the prior written consent of the State which may be granted or withheld in the State's sole discretion, other uses that do not prohibit or impair the operation of a solid waste landfill of sufficient size, nature, scope and limitation as is required to satisfy Casella's capacity commitment to FJ under Section 2.8 during the term hereof. Casella shall be prohibited from constructing any facility or improvement at the Landfill that would prohibit or impair the construction and operation of a solid waste landfill of sufficient size, nature, scope and location as is required to satisfy Casella's capacity commitment to FJ under Section 2.8. Any capital improvements to or at the Landfill shall be and remain the property of the State upon termination of this Agreement without any compensation to Casella.

(b) Subject to the issuance of all necessary State and local licenses permits and approvals, Casella shall construct a new sewer line to convey leachate to the Old Town Waste Water Treatment Plant on or before five years from the Effective Date.

2.3 Operation.

2.3.1 Casella shall have full control, both physical and managerial, of the

Landfill, subject in all instances to the terms and conditions of this Agreement.

2.3.2 Subject in all instances to the terms and conditions hereof and all applicable laws, regulations, licenses and permits, Casella shall be responsible for, and shall have sole authority over, the day-to-day operation of the Landfill, including weighing of waste pursuant to Section 2.4, testing of waste, preparation of waste for disposal, Landfill construction as provided in Section 2.2, establishment of Tipping Fees pursuant to Section 2.11, acceptance and disposal of Acceptable Waste, preparation and application of daily interim and final cover, construction of temporary roads and other temporary access, and installation and monitoring of groundwater wells. Notwithstanding the foregoing or anything to the contrary herein, Casella agrees to operate the Landfill gate and scale house in such manner, and on such terms so as to provide no price or entry discrimination or benefit (consistent with Section 2.11) in favor of its affiliated haulers or otherwise as to disadvantage haulers that are not Affiliates or who do not have business relations with Casella or its Affiliates.

2.3.3 Subject in all instances to the terms and provisions hereof and all applicable laws, regulations, licenses and permits, Casella shall be responsible for providing at its own cost and expense and shall have sole authority regarding:

(a) all engineering and other services necessary for the design, permitting, construction and operation of the Landfill (with the exception of those construction services for those portions of the Landfill which have already been constructed); and

(b) the employment of all personnel needed to operate the Landfill; and

(c) all services incidental to the business of the Landfill, including security,

accounting, legal, fire prevention and pollution control.

2.3.4 Without limiting the foregoing, Casella shall have the right to detain and inspect the contents of all vehicles delivering waste to the Landfill. Casella shall have the right to refuse or reject any Excluded Waste in its sole discretion or, if not detected prior to entering the Landfill, and Casella becomes aware that Excluded Waste has been disposed of at the Landfill, Casella shall immediately notify MDEP and manage the treatment of such Excluded Waste as MDEP may require. In addition, Casella may proceed against the hauler and/or generator for removal and proper disposal costs and other costs incurred by Casella. Subject in all instances to its obligations under Section 2.8 and Subsection 2.3.2, Casella shall have the right to ban haulers from disposing at the Landfill until such time as the expenses for reimbursement for the removal of any such Excluded Waste are paid to Casella. Subject in all instances to its obligations under Section 2.8 and Subsection 2.3.2, Casella shall have the right to ban any and all haulers which violate any of the rules and policies it establishes for the Landfill. Casella shall not allow members of the general public access to the Landfill for the discharge of solid waste.

2.3.5 Casella shall have the right to operate the Landfill during hours of its selection in accordance with any relevant permits, approvals, licenses, orders or agreements, and shall not discriminate against haulers who do not have business relations with Casella or its Affiliates.

2.3.6 Casella shall not accept any Excluded Waste at the Landfill.

2.4 Weighing. In connection with Casella's operation of the Landfill hereunder, Casella shall weigh all vehicles containing waste to be delivered to the Landfill pursuant to this

Agreement. Casella shall utilize scales approved by the State to weigh all waste delivered to the Landfill. The State or its authorized representative shall have the right at the State's expense to test the accuracy of scales used by Casella in the performance of its obligations hereunder, provided that such tests are conducted at reasonable times and do not unreasonably interfere with Casella's operation of the scales or the Landfill.

2.5 Revenues. Subject in all instances to payment of all governmental taxes, fees and charges and without limiting its payment obligations hereunder, all revenue, income and other financial benefits generated by, at, or related to operation of, the Landfill during the Term, shall be collected by Casella and shall be the property of Casella.

2.6 Inspection. The State shall have the right to inspect the Landfill during reasonable business hours to confirm compliance with the provisions of this Agreement, that policies are in place to provide that only Acceptable Waste will be received at the Landfill, and that the Landfill is being operated in conformity with state and federal environmental laws and regulations and other applicable laws.

2.7 Maintenance Responsibilities. Casella shall be responsible for, and shall have the sole authority regarding, all necessary maintenance of the Landfill.

2.8 FJ Waste Disposal Capacity. Casella agrees to provide FJ with the following waste disposal capacity at the Landfill during the Term:

(a) Casella will provide disposal capacity at the Landfill to FJ for all Mill Waste and all Biomass Ash (excluding for purposes of clarification and the avoidance of doubt, Lincoln's Biomass Ash) (collectively "FJ Waste"). Casella further hereby assumes FJ's and/or the State's responsibilities to provide for the disposal of Lincoln's Biomass Ash at the Facility under and in

accordance with the terms and provisions of the Lincoln Agreement.

(b) The Tipping Fees charged to FJ for disposal of FJ Waste will be fixed at the following levels:

(i) For the first 50,000 tons per year of FJ Waste, Tipping Fees will be fixed at a maximum of $10 per ton for the first five (5) years of the Term. On the sixth anniversary of this Agreement, and thereafter on each anniversary of this Agreement throughout the Term, Tipping Fees shall be adjusted upward or downward annually by a percentage equal to the percentage change in the Consumer Price Index (U.S.-national) ("CPI") from the date of the immediately preceding anniversary of this Agreement through the then current anniversary of this Agreement. In no event shall the CPI adjustment be less than one percent (1%) per year or in excess of five percent (5%) per year.

(ii) For FJ Waste in excess of 50,000 tons per year, but less than 75,000 tons per year, Tipping Fees shall be fixed at a maximum of $40.00 per ton for the first 5 years of the Term. On the sixth anniversary of this Agreement, and thereafter on each anniversary of the Agreement throughout the Term, the Tipping Fees shall be adjusted upward or downward annually by a percentage equal to the percentage change in the CPI from the immediately preceding anniversary of this Agreement through the then current anniversary of this Agreement. In no event shall the CPI adjustment be less than one percent (1%) per year or in excess of five percent (5%) per year.

(iii) Tipping Fees for FJ Waste in excess of 75,000 tons per year will be assessed at the then prevailing market rate.

For purposes of this Section 2.8, reference to a year means the period of twelve (12) months extending from the Effective Date to the first anniversary thereof, or from one anniversary of the Effective Date of this Agreement to another, as applicable.

(c) Casella shall provide for the disposal of up to six thousand (6,000) tons per year of Lincoln's Biomass Ash at the Landfill for four (4) years from the Effective Date at no cost, and thereafter shall provide for the disposal at the Landfill of Lincoln's Biomass Ash at the same pricing and on the same terms as for FJ Waste.

(d) Casella shall provide FJ with a "Capacity Credit" for unused disposal capacity during the Term in the event FJ Waste disposed of at the Landfill is less than 50,000 tons in any year during which the Mill has operated its commercial pulping facility. The Capacity Credit will be at the rate of one (1) ton of future disposal at the Tipping Fee in effect for the first 50,000 tons of FJ Waste for the year in which the Capacity Credit is utilized by FJ. This Capacity Credit will be provided to FJ by allowing FJ to choose, at its option, one of the following alternatives:

(i) During any year when FJ disposes of more than 50,000 tons of FJ Waste, apply any Capacity Credit accumulated during the preceding three (3) years to FJ Waste in excess of the first 50,000 tons disposed of that year ("Disposal Application"); or

(ii) Payment in cash by Casella to FJ of an amount equal to the

monetary value of the Capacity Credit accumulated over the previous three (3) years and not applied to actual disposal under subsection (i) above. In determining the monetary value of the Capacity Credit, each ton of Capacity Credit shall be valued at the Tipping Fee per ton applicable during the year in which the Capacity Credit is cashed out (the "Cash Application"). Cash Application amounts shall be paid to FJ in cash within thirty (30) days following the date of exercise of the Cash Application option.

FJ may exercise its option to apply Capacity Credits through Disposal Application at any time during a year when the volume of FJ Waste disposal exceeds 50,000 tons. FJ may exercise its option to apply Capacity Credits through Cash Application at any time following the end of the year in which the Capacity Credit has been generated. FJ shall exercise its option by written notice to Casella with a copy to the State. In the event FJ has not provided written notice of its choice of option by the end of the third year following the year in which a Capacity Credit is earned, then FJ shall be deemed to have exercised its option to receive the Capacity Credit through Cash Application as of the last day of such year.

For purposes of calculation of the Capacity Credit, the 50,000 ton per year threshold shall be adjusted downward to account for any period in which the Old Town Mill is not operated for a period of fifty-three (53) or more days during any calendar year (a "Shut-Down Period"). The adjustment shall be a reduction in the 50,000 ton threshold by a per diem of 135 tons per day for each day the Old Town Mill is not operated in excess of the initial fifty-three (53) days in a calendar year.

(e) Notwithstanding anything to the contrary herein, if, despite the best efforts of

Casella in preparing, amending, submitting, resubmitting and prosecuting the same, the Expansion Permit does not issue as a direct result of a material change in law, made after the date hereof, that is generally applicable to landfills in the State of Maine and that by its terms prohibits the expansion and/or permitting of landfills for a period of more than two consecutive years, and if as a result thereof disposal capacity at the Landfill is thereby limited to the 10,000,000 cubic yards available under the Existing Permit and, when issued, the License Amendment (a "Capacity Limiting Event"), then (i) Casella's obligation to provide disposal capacity for FJ Waste under subsections (a), (b) and (d) above shall be limited to a period of fifteen (15) years unless and until such law is repealed (in which case, if Casella or any of its Affiliates is still the operator at the Landfill, its disposal capacity obligation shall be reinstated for the balance of this Agreement) ("Reduced Capacity Commitment"); and (ii) FJ shall, subject to the provisions of this Subsection 2.8(e), forfeit its disposal capacity (including any claim for Capacity Credits and Cash Application) in excess of the Reduced Capacity Commitment (that is, disposal capacity otherwise available to FJ hereunder on and after the fifteenth (15^{th}) anniversary hereof) to the extent necessary to allow Casella to operate the Landfill at a level of five hundred thousand (500,000) tons of waste disposal per year through the twentieth (20^{th}) anniversary of the Effective Date hereof.

Casella agrees that regardless of the occurrence of a Capacity Limiting Event,

it shall be obligated to accept the FJ Waste at the Landfill, at the price and on the terms specified herein, for a period of at least fifteen (15) years and thereafter until the disposal capacity at the Landfill is exhausted. Upon exhaustion of the disposal capacity at the Landfill as aforesaid, Casella will make available to FJ disposal capacity for FJ Waste for a price and on the terms specified above at any other landfill in the State of Maine owned and/or operated by Casella or any Affiliate that is licensed to accept FJ Waste for up to an additional fifteen (15) years (for a total commitment of thirty (30) years) or such earlier time as disposal capacity at such landfill(s) is exhausted; provided, however, that FJ shall pay any and all costs of transporting FJ Waste to such site.

In the event of a Capacity Limiting Event and if Casella or any Affiliate is not able to satisfy the thirty (30) year commitment to FJ (or its successors or assigns) as aforesaid at the Landfill or any alternative landfills in the State of Maine, the State will make available to FJ disposal capacity for FJ Waste for the price and on the terms specified above at any other landfill in the State of Maine owned and/or operated by the State that is licensed to accept FJ Waste until the first to occur of the thirtieth (30^{th}) anniversary of the date hereof or when disposal capacity at such landfill(s) for FJ Waste has been exhausted; provided, however, that FJ shall pay any and all costs of transporting FJ Waste to such site.

The parties and FJ intend the provisions of this subsection (e) to be construed

narrowly and to apply only to the specific and generally applicable laws enacted after the Effective Date that by their terms prohibit the expansion of landfills and thereby the issuance of the Expansion Permit and leave Casella only with the disposal capacity at the Landfill provided under the Existing Permit and License Amendment . For purposes of clarification and illustration, a moratorium prohibiting the licensing of an expansion of landfills in the State of Maine for in excess of two (2) years represents the type of change in law triggering the application of this subsection (e), while a change in law that modifies operating requirements for landfills, the qualifications or requirements for operators, the expense of operating landfills or other requirements associated with the operation, management or permitting of landfills would not excuse performance of Casella's obligations under this Agreement.

(f) Casella's commitment to provide disposal capacity described in this Section 2.8 shall apply to FJ, its successors and assigns, including without limiting the generality of the foregoing any subsequent owner, lessor or operator of the Old Town Mill.

(g) The foregoing Tipping Fees are exclusive of any fees, charges, levies or assessments ("Waste Disposal Fees") which may be imposed by the State after the date hereof for the disposal of waste at landfills. The parties acknowledge that Section 5.2 of the Acquisition Agreement exempts FJ from Waste Disposal Fees. However, in the event FJ Waste is subjected to Waste Disposal Fees notwithstanding the Section 5.2 exemption, (i) Casella shall not

be obligated to pay any such Waste Disposal Fees, and (ii) FJ shall have exclusive liability for such Waste Disposal Fees.

2.9 Other Tipping Fees on FJ Waste. Other than as specifically provided in Section 2.8 hereof, Casella will not charge or assess any Tipping Fees on FJ Waste, or Lincoln's Biomass Ash, whether related to disposal in existing built Landfill space or space constructed in the future.

2.10 Maintenance of Capacity for FJ Waste. Casella agrees throughout the Term that it will maintain fully permitted/licensed, fully constructed, unused capacity at the Landfill in the amount sufficient to satisfy the obligation of the State to FJ regarding disposal capacity under the Acquisition Agreement and Casella's obligations to FJ and with respect to Lincoln Biomass Ash under Section 2.8 hereof, including without limitation at all times after October 1, 2004 (which date shall be extended to the final resolution of any appeals with respect to the License Amendment) , one million five hundred thousand (1,500,000) tons of fully constructed available capacity at the Landfill dedicated to and reserved for FJ Waste minus fifty thousand (50,000) tons on each anniversary of the Effective Date This capacity shall be reserved by Casella solely to satisfy its obligations under Section 2.8 with respect to FJ Waste and Lincoln Biomass Ash and the corresponding obligation of the State to FJ under the Acquisition Agreement. Upon request from the State, executive officers of Casella shall periodically certify to the State Casella's compliance with this subsection and the State may inspect the Landfill to confirm the same. Casella's agreement to satisfy the State's obligation to FJ as per Subsection 2.8 and the Acquisition Agreement represent a material condition of the State's agreement to enter into this Agreement.

2.11 Tipping Fees on Non-FJ Waste.

(a) Casella shall charge Tipping Fees for disposal of waste that is not FJ Waste or Lincoln's Biomass Ash according to the following schedule:

• Certain Special Wastes, including without limitation bottom ash / fly from municipal solid waste incinerators and sandblast grit.	$48.00 / Ton
• Oversized, bulky waste from municipal solid waste incinerators, that are unacceptable at municipal solid waste incinerators.	$58.00 / Ton
• Front-end residue from municipal solid waste incinerators.	$48.00 / Ton
• Municipal solid waste, including municipal solid waste designated as "by pass" on an infrequent basis.	$58.00 / Ton
• Construction and demolition debris, free of putresible waste.	$58.00 / Ton

Subject in all instances to Casella's obligations under Section 2.3.2 hereof, the foregoing Tipping Fees are "not to exceed" fees (it being understood that Casella may, in its sole discretion charge lower fees), are exclusive of any Tipping Fees which may be imposed by the State under laws enacted or regulations promulgated after the Effective Date, and shall be subject to annual adjustment in accordance with changes in the CPI and changes in law which materially affect the cost of landfill design, construction, operations or closure. The fee schedule above is inclusive

of all charges, including the Host Community Benefit Package costs referred to in Casella's response to the RFP.

(b) The State reserves the right to direct solid waste to the Landfill, as may be required by changes in State law or in MDEP rules and regulations. The Tipping Fees established by Casella for the waste stream most closely matching these directed wastes shall apply. Prior to redirection of these wastes, the State shall notify Casella as to the reason for the redirection and an estimate of the expected volume/tonnage of wastes. In no event shall the State's exercise of its rights under this subsection restrict or impair the capacity reserved for FJ under Section 2.8.

2.12 Costs. Casella shall bear all costs, expenses, and liabilities associated with the operation and maintenance of the Landfill and the fulfillment of Casella's other responsibilities hereunder during the term of this Agreement including, without limitation, any liabilities for claims of employees performing activities under this Agreement that arise out of any provision of the workers' compensation law or otherwise.

2.13 Waste Management Hierarchy. Casella agrees to use its best efforts to achieve the following goals:

(a) to operate the Landfill following the State's solid waste management hierarchy (reduce, reuse, recycle, compost, incinerate, landfill);

(b) to implement the Public/Private Partnership agreement with the Municipal Review Committee (MRC);

(c) to draw upon Casella's FCR Division to analyze and develop the best collection, processing and marketing options for all MRC member

communities;

(d) to implement Green Mountain Glass's technology for recovery and recycling of all color glass containers;

(e) to work with the MRC to analyze and help develop organics recycling programs that enhance or expand current practices of MRC communities;

(f) to work with the MRC members in developing program to collect, store and process (where applicable) Universal Wastes and mercury containing products;

(g) to work with MRC members in developing programs to identify, collect and properly dispose of household hazardous wastes;

(h) to work with the MRC and appropriate research facilities to assess the viability of using Maine developed ablation technology as a source of air emission control for biomass boilers combusting up to 50% clean C&D wood as a fuel source, such as being proposed by GP;

(i) to expand C&D processing capability of Casella and its Affiliates to achieve an increase in C&D waste volume requiring disposal with a focus on recovering the clean C&D wood waste that would assist in meeting the biomass fuel commitment to FJ. Other recyclable materials would be separated and utilized in other applications, including aggregate and metals.

2.14 Real and Personal Property Taxes. Casella shall be responsible for the payment of all real and personal property taxes with respect to the Landfill during the Term.

SECTION 3 CONTRACTS WITH THIRD PARTIES

3.1

(a) During the Term hereof, but after the issuance of the License Amendment,

Casella shall, subject to the terms and conditions hereof, have the exclusive right and authority to negotiate and enter into various contracts regarding the Landfill. These contracts may include, among others, (i) long-term contracts for the disposal of waste at the Landfill, (ii) a long-term contract for the disposal of Leachate generated at the Landfill, (iii) long-term contracts for the disposal of local municipal solid waste at the Landfill, and (iv) long-term host community agreement with the City of Old Town, all on terms and conditions reasonably acceptable to Casella. Casella shall provide the State with notice of and adequate time to review and comment on such contracts and agreements prior to their execution. These contracts will not bind State without the State's prior written consent, and shall be expressly subject to the Unwind Provisions described in Section 5.3 (a).

(b) Casella agrees to assume the leachate trucking agreement between FJ and Thornton's Construction and the Landfill operations agreement between FJ and J.A. Buchanan, or, if such contracts cannot be assumed without the consent of the other contract party, to use its best efforts to secure such consents. If Casella is unable to secure such consents, Casella shall use its best efforts to negotiate the termination of such agreements with no impact on FJ or the State. Casella shall further be solely responsible for any liabilities associated with assignment or termination of such contracts, including any contract buyout obligations or termination fees or damages arising from the termination or breach thereof, and hereby indemnifies and holds the State and FJ harmless for any liabilities arising from or relating to the assumption or

termination of such contracts.

SECTION 4 PERMITTING MODIFICATIONS AND COOPERATION

4.1 Cooperation. The State agrees (a) to cooperate reasonably with Casella in obtaining and, where applicable, in maintaining in the State's name (i) the Existing Permit and License Amendment, and (ii) all permits, licenses, statutory amendments and legislation, approvals and authorizations reasonably requested by Casella and agreed to by the State for the operation of the Landfill in accordance with the terms hereof, including without limitation the Expansion Permit, but at no cost or expense to the State and (b) to provide reasonable assistance to Casella but at no cost to the State, in dealing with all federal, state and local agencies to obtain the issuance, modification, transfer or amendment of all permits reasonably requested by Casella and agreed to by the State. The parties shall diligently pursue in good faith the acquisition of all such permits, licenses, approvals and authorizations, and any modifications or amendments thereto, for the Landfill as contemplated by and subject to the terms of this Agreement. The parties, however, recognize that the MDEP is an independent permitting authority before which the State must appear as any other person. Therefore, the parties acknowledge that any commitment of the State to cooperate with and seek a governmental approval is not a guaranty of issuance of such approval or the terms of such approval.

4.2 Permit Responsibility.

(a) Casella shall use its best and most diligent efforts to maintain in full force and effect the Existing Permit and, when issued, License Amendment. Casella shall not take any action or suffer any omission that causes, or provides a basis for, the revocation, suspension or restriction of the Existing Permit and, when issued, License Amendment, or limit or restrict Casella's or the State's ability to operate the Landfill.

(b) Casella shall use its best and most diligent efforts to, at its own cost and expense, apply for, seek and maintain in full force and effect (i) the License Amendment, (ii) the Expansion Permit, and (iii) such other federal, state and local permits, licenses and authorizations as otherwise required in connection with Casella's obligations under this Agreement, including, without limitation, any required zoning, subdivision and site plan approval. Without limiting the generality of the foregoing, Casella shall prepare on or before the third anniversary of the Effective Date an application for the Expansion Permit and shall conduct geologic and engineering studies and bear the cost of any consulting services related to all such permit/license and approval efforts. Subject to the foregoing, Casella shall determine the timing of the submission and the content of any such applications to the appropriate regulatory entities. Casella currently contemplates an application for the Expansion Permit for ten million (10,000,000) cubic yards of additional capacity, but, following exhaustion of all appeals of any approval of the Expansion Permit authorizing a lesser disposal capacity, Casella hereby agrees to accept any such approval so issued in connection with any application for the Expansion Permit, provided that, taken together, the initial application so submitted by Casella for the Expansion Permit shall provide that the Existing Permit, the License Amendment and the Expansion Permit will collectively provide sufficient capacity to dispose of at least 500,000 tons of waste per year over twenty (20) years of operation. If issued, Casella shall not take any action or suffer any omission that causes, or provides a basis for the revocation, suspension or

restriction of the Expansion Permit, or limit or restrict Casella's or the State's ability to operate the Landfill.

SECTION 5 PAYMENT AND BONDS; UNWIND PROVISIONS

5.1 Payments to the State. Contemporaneously with the execution of this Agreement, Casella shall pay to the State, and the State directs Casella to pay FJ, a total of Twenty-six Million Dollars ($26,000,000) as follows: (a) $12,500,000 in cash or by certified or bank cashier's check or by wire transfer to an account designated by the State; (b) $12,500,000 by issuance of a Letter of Credit in such amount; and (c) $1,000,000 by issuance of a Letter of Credit in such amount to the Escrow Agent for deposit into the Improvement Fund (as defined in the Acquisition Agreement). The aforesaid Letters of Credit may be fully drawn by FJ and the Escrow Agent, as applicable, in the event that, within five (5) business days following the receipt of the License Amendment that is materially consistent with the License Application, Casella fails to pay the amounts of the Letters of Credit to FJ and the Escrow Agent, respectively, in cash or by certified or bank cashier's check or by wire transfer. In the event that Casella pays the amounts of the Letters of Credit to the respective beneficiaries as aforesaid, the State shall cause the Letters of Credit to be immediately revoked and returned to Casella. There shall be no requirement that any appeal period expire or that any appeal of the issuance of the License Amendment be resolved prior to drawing under the Letters of Credit.

5.2 Bonds.

(a) Casella's obligation to perform its obligations hereunder shall be secured by a Four Million Dollar ($4,000,000) payment and performance bond in the form attached hereto as Exhibit C, which shall be delivered within five (5) business days from the date hereof.

(b) On the Effective Date Casella shall post, and thereafter shall maintain, closing and post-closing bonds in substitution for those provided by FJ in such amounts and on such terms as MDEP and federal law may require. Copies of the proposed closing and post-closing bonds shall be provided to the State within ten (10) business days of the Effective Date.

5.3 (a) Unwind Provisions. In the event that the License Amendment is (i) not received by June 30, 2004, or (ii) received by June 30, 2004 but is materially inconsistent with the License Application, or (iii) received by June 30, 2004 but successfully challenged on appeal such that a final judgment or court order either invalidates the License Amendment or results in the License Amendment being materially inconsistent with the License Application, Casella shall have the right to terminate this Agreement and rescind the transaction, at a simultaneous closing complying with the terms of Section 2.10 of the Acquisition Agreement. The closing shall occur within thirty (30) days of the exercise by Casella of its right to terminate and rescind hereunder, or such later date when the parties obtain MDEP authority to transfer the Existing Permit. At the closing, FJ shall promptly refund the $12,500,000 paid by Casella pursuant to Section 5.1, and FJ shall return or cause to be returned the cash or the Letters of Credit (as the case may be) described in Section 5.1. Appropriate provision shall be made for the closure and post-closure bonds identified in Section 5.2(b) in accordance with applicable law, and Casella shall undertake any remedial action as a result of its activities hereunder required by applicable regulatory authorities. Casella agrees to cooperate with the State and FJ in connection with the reconveyance of the Landfill described in Section 2.10 of the Acquisition Agreement, including filing necessary applications for transfer of all federal, state and local permits and approvals for operation of the Landfill as a generator-owned landfill (provided that FJ shall have the option to

assume the License Amendment, if any, and to the extent allowable under applicable law and so long as Casella and the State are released from any liability for post-assignment activities), and undertaking all other actions required to unwind the transaction described in the Acquisition Agreement and place the parties as nearly as reasonably possible in the same positions they were in prior to said transaction, with the exception that each party shall be responsible for its own out-of-pocket costs associated with said transaction and effecting the foregoing unwind provisions. Casella's right to terminate this Agreement and rescind the transaction hereunder must by exercised within thirty (30) days after the last to occur of the three events described in the first sentence of this Section 5.3(a). Any dispute regarding rights or obligations under this Section 5.3 shall be resolved by binding arbitration in accordance with the Commercial Arbitration Rules of the American Arbitration Association, provided that the arbitrators shall be directed to make an arbitration award within ninety (90) days, and that Casella shall continue to operate the Landfill pursuant to the terms hereof until the issuance of a final arbitration award.

(b) The State shall have no liability or obligation to Casella with respect to the repayment of the cash or return of the Letters of Credit as described in Section 5.3(a), and Casella agrees to look solely to FJ for the repayment of such cash and return of the Letters of Credit and hereby waives and releases the State of any liability arising thereunder or relating thereto, howsoever arising.

SECTION 6 EQUIPMENT

Casella shall be responsible for all operating, repair and maintenance costs associated with any equipment used in the operation of the Landfill, and shall maintain and replace such equipment as it deems necessary.

SECTION 7 COMPLIANCE WITH LAW

Except as otherwise provided in this Agreement, and subject to Section 8 hereof, Casella shall be responsible for all costs and expenses related to Landfill regulatory compliance. Notwithstanding the foregoing, Casella shall have the right, at its own cost and expense, to contest or review by legal or administrative proceedings the validity or legality of any law, order, ordinance, rule, regulation, direction or certificate of occupancy, and, to the extent permitted by law, during such contest Casella may refrain from complying therewith, subject, however, to the terms and conditions hereof.

SECTION 8 INDEMNIFICATION

8.1 Indemnification.

(a) Casella will indemnify, defend, and hold the State and FJ, their respective Affiliates and their respective officers, directors, employees, agents and Affiliates harmless from and against any and all Damages that arise from or related to any past, current or future design, construction, improvement, ownership or operation of the Landfill or any other activities associated therewith, or any breach of Casella's obligations under this Agreement, including without limiting the generality of the foregoing, any and all Damages resulting from:

(i) groundwater or surface water contamination caused by the Landfill, whether or not such liability results from operation of the

Landfill by FJ or any third parties;

(ii) on-Premises or off-Premises contamination;

(iii) violation of any Environmental Law at or in connection with the Landfill or Premises;

(iv) any fine, penalty, judgment, award, or settlement of any legal or administrative proceeding relating in any way to Environmental Matters relating to the Landfill or the Premises;

(v) any compliance, corrective or remedial measure required under any Environmental Law or other requirement including any clean-up, removal, containment or other remediation or response actions associated with the Landfill or the Premises; and

(vi) any and all Environmental Matters.

8.2 Limitations. Anything in this Section 8 to the contrary notwithstanding, in the event that this Agreement is terminated pursuant to Section 15 below, Casella's indemnity obligations hereunder shall survive termination hereof and the unwind of the transaction described in Section 5.3 (a) but shall be limited to Environmental Matters and other Damages arising from or relating to breaches, conditions, events, transactions or occurrences which occurred at any time prior to the termination of this Agreement or the unwind of the transaction but regardless of when the same shall be discovered or become manifest. Furthermore, Casella's indemnity obligations hereunder shall not extend to Damages arising from breaches of FJ's representations and warranties under Article 3 of the Acquisition Agreement.

SECTION 9 SUBCONTRACTING

In the performance of its obligations hereunder, Casella shall have the unrestricted right to subcontract those services that it deems appropriate in its sole discretion, including, without

limitation, construction, engineering, design, permitting, operation, maintenance, management and administration; provided, that Casella shall remain fully responsible for the performance of any and all obligations subcontracted hereunder.

SECTION 10 RECORDS, AUDITS AND CONFIDENTIALITY

10.1 Annual Report; Inspection Rights. In addition to other reports that Casella may be required to maintain under applicable law, Casella shall prepare and provide to the State an annual report summarizing in reasonable detail the business and technical operation of the Landfill during the preceding calendar year or portion thereof and such other records and information as the State may reasonably require, including certifications regarding the as built and available disposal capacity reserved for FJ (or its successor or assign). Casella shall maintain accurate records, books and data with respect to the amount of all Acceptable Waste disposed of at the Landfill during any period that Casella is the operator of the Landfill. The State shall have the right at reasonable times and upon not less than three (3) business days prior notice to inspect and examine Casella's books and records related to the operation of the Landfill to confirm Casella's compliance with this Agreement and applicable permits and environmental laws and regulations. The State shall further have the right to visit and enter upon the Landfill to confirm, among other matters, satisfaction by Casella of its obligations under Sections 2.8 and 2.10 hereof. The parties shall cooperate in good faith to develop a list of the books, records and data which shall be available for such inspection and examination by the State. Casella shall maintain any such books, records or other data for so long as Casella's indemnity obligations under Section 8 shall continue in effect. Upon termination of this Agreement, the State shall have the right to review and copy, and shall have a permanent, irrevocable, exclusive license to make use of all of Casella's technical information, data, studies, engineering, operational records and other materials and information of any nature related to the Landfill and/or the design,

construction, licensing or operation of the Landfill, including without limitation, all testing results, design materials, engineering studies and other engineering work, all applications for Governmental Approvals related to the Landfill and any and all such other data and materials as relate in any way to the premises and/or the development of the Landfill.

SECTION 11 NO JOINT VENTURE

Without limiting Casella's obligations hereunder (including the obligation to satisfy the State's obligation to FJ under the Acquisition Agreement), the parties acknowledge and agree that nothing contained in this Agreement is intended to nor shall be construed to create a partnership or joint venture between Casella and the State or make Casella and the State partners or joint venturers, or make either party in any way liable or otherwise responsible for the debts, actions, obligations or losses of the other party.

SECTION 12 SPECIAL PROVISIONS CONCERNING THE STATE

12.1 Appropriations. The State's obligations and liabilities hereunder are subject to available budgetary appropriations and shall not create any obligation of payment on behalf of the State in excess of such appropriations and other funds and assets available to the State for the performance of its obligations. Notwithstanding any other provision of this Agreement, if the State does not receive sufficient funds to fund this Agreement and the State's obligations hereunder and other obligations of the State, if funds are deappropriated, or if the State does not receive legal authority to expend funds from the Maine State Legislature or Maine courts, then the State is not obligated to make any payment otherwise due under this Agreement. The SPO hereby represents that it reasonably believes that funds will be made available through appropriation by the Legislature to make all payments required hereunder and to fund all obligations of performance hereunder by the State. Without limiting the foregoing, the SPO hereby covenants and agrees that it will exercise all reasonable efforts to obtain, maintain and

properly request and pursue appropriation of funds and other revenue sources from which all payments to be made hereunder shall be satisfied, and through which all obligations of performance will be funded, including, without limitation, making provisions for such payments in any and all budgets submitted for the purposes of obtaining appropriations and/or funding, using all reasonable efforts to have such portion of the budget approved. Without limiting the foregoing, it is the State's intent to make all payments required hereunder and perform all of its obligations hereunder if funds are legally available therefor.

12.2 No Waiver of Sovereign Immunity. Casella acknowledges and agrees that the Legislative Resolve authorizing this Agreement specifically provides that nothing in this Agreement, or the execution and delivery of this Agreement, or the agreement by the State to perform its obligations hereunder constitutes or is intended to constitute abrogation of the sovereign immunity of the State with respect to each and every term of this Agreement. In this regard, the State expressly reserves its right of sovereign immunity with respect to its obligations hereunder, and the execution and delivery of this Agreement by the State, and its undertakings herein in no way waive, partially waive, imply a waiver, limit or restrict the State's unconditional right to exercise its right of, or to assert sovereign immunity with respect to any matter, term or issue arising under or relating to this Agreement.

SECTION 13 CERTAIN REPRESENTATIONS, WARRANTIES AND COVENANTS OF CASELLA

Casella represents and warrants to the State as follows:

13.1 Casella is a corporation duly organized and existing under the laws of the State of Delaware with the full legal right, power and authority to enter into and fully and timely perform its obligations under this Agreement.

13.2 Casella has duly authorized, executed and delivered this Agreement, and this

Agreement constitutes a legal, valid and binding obligation, enforceable against Casella in accordance with its terms, subject to bankruptcy, insolvency and other laws affecting creditors' rights generally.

13.3 Neither the execution or delivery by Casella of this Agreement nor the performance by Casella of its obligations in connection with the transactions contemplated hereby or Casella's fulfillment of the terms and conditions hereof conflicts with, violates or results in a breach of any law or governmental regulation applicable to Casella or materially conflicts with, violates or results in a breach of, any term or condition of any order, judgment or decree or any agreement or instrument to which Casella is a party or by which Casella or any of its properties or assets is bound, or otherwise constitutes a default thereunder.

13.4 No approval, authorization, order, consent, declaration, registration or filing with any federal, state or local governmental authority or agency is required for the valid execution and delivery by Casella of this Agreement or the performance by Casella of its obligations hereunder.

13.5 Casella covenants and agrees to operate Landfill and otherwise conduct all aspects of its business at the Landfill in compliance with all applicable laws and regulations and permits. Casella further agrees to maintain, and not to take any action or fail to take any action that would cause denial or revocation of the Existing Permit or the License Amendment, or, if issued, the Expansion Permit or any other license or permit issued during the Term relating to the Landfill. Casella further agrees to assume responsibility for all closure and post-closure aspects of the Landfill arising during the Term and to close those portions of the Landfill which reach final grade in accordance with approved plans and specifications.

13.6 Casella agrees to make all contributions to the State of Maine's Solid Waste

Management Fund (or any successor fund) or other payments required under applicable laws and regulations as if the Landfill were a commercial landfill under applicable law.

13.7 Casella shall maintain in full force and effect throughout the Term and for one year following termination, the $4,000,000 payment and performance bond in the form attached hereto as Exhibit C during the term hereof and the closure and post-closure bonds required hereunder upon closure of the Landfill with financially sound and reputable sureties and/or insurers qualified to issue sureties and bonds in the State, reasonably acceptable to the State. The State acknowledges that Evergreen National Indemnity Company is a financially sound and reputable surety as of the date hereof.

13.8 Casella agrees that all improvements to the Landfill of every nature and type shall be the property of and ownership of the same shall vest in the State on termination of this Agreement.

13.9 Throughout the term hereof, Casella agrees to participate in, and support to the best of its ability, the joint citizen advisory committee, comprised of representatives from the City of Old Town and the Town of Alton, as created by the Legislative Resolve permitting the State Planning Office to purchase the Landfill and cause it to be operated, all at no cost or expense to the State.

13.10 Casella shall perform its obligations under the C&D Fuel Agreement and shall not amend the same without the prior written consent of the State, which consent will not be unreasonably withheld

SECTION 14 SURVIVAL OF REPRESENTATIONS, WARRANTIES AND COVENANTS

All representations and warranties and covenants made herein or in any schedules attached hereto, or in any instruments or documents delivered by or on behalf of either party

pursuant to this Agreement, shall remain in effect during the Term and shall survive termination hereof to the extent specifically contemplated herein. The indemnity commitment described in Section 8 hereof shall continue until the expiration of the longest of the statutes of limitations applicable to Environmental Matters subject to the indemnification thereunder.

SECTION 15 TERMINATION

15.1 Events. This Agreement may be terminated at any time:

(a) By mutual written agreement of the parties;

(b) By either party if, prior to the Effective Date, litigation is filed or threatened, or any governmental authority institutes an action or investigation, intended to prohibit or prevent consummation of any of the transactions contemplated hereby or by the Acquisition Agreement, or any governmental authority does anything by the Effective Date which in a party's reasonable commercial judgment renders such consummation imprudent.

(c) By Casella if:

(i) Casella exercises its right to terminate under Section 5.3, subject to the limitations and qualifications set forth in said Section 5.3.

(ii) an Expansion Permit has not issued as a result of a Capacity Limiting Event and the licensed and permitted capacity of the Landfill (in excess of the capacity reserved for FJ Waste pursuant to Section 2.8) has been exhausted, provided that Casella cannot exercise its right to terminate under this clause (i) until on or after the fifteenth (15^{th}) anniversary hereof.

(iii) An Event of Default by the State occurs as set forth in Section 16, which default remains uncured beyond any applicable period for cure

thereof;

Without in any respect limiting the foregoing or affecting other terms and provisions hereof, and solely for purposes of illustration, Casella shall not have the right to terminate this Agreement in the event:

(A) The application for the Expansion Permit is denied under State law in effect as of the date of this Agreement;

(B) The construction, engineering, design, permitting, licensing, operation, maintenance, management and administration of the Landfill is more expensive under the terms of the Expansion Permit as granted than as anticipated by Casella;

(C) The application for the Expansion Permit is granted but restricted such that the new capacity, when added to the then permitted capacity, is insufficient to allow Casella to dispose of 500,000 tons of waste a year for a period of twenty (20) years;

(D) Casella is unable or fails to comply with the terms and conditions under which the Landfill is permitted and licensed;

(E) There is a change in Federal or State law after the Effective Date of this Agreement that increases the cost of the construction, engineering, design, permitting, licensing, operation, maintenance, management and administration of the Landfill; or

(F) The Expansion Permit is revoked or modified.

(d) By the State if:

(i) an Event of Default by Casella occurs as defined in Section 16.1,

which default remains uncured beyond any applicable period for cure thereof; or

(ii) any of the conditions to closing in the Acquisition Agreement for either the State's or FJ's benefit shall not have been satisfied or waived and such Agreement shall have been terminated in accordance with terms thereof; or

(iii) any representation or warranty made by Casella hereunder is not true, accurate and complete in any material respect when made or becomes untrue, inaccurate or incomplete in any material respect during Term; or

(iv) FJ exercises its right of reverter under Article 10 of the Acquisition Agreement and the underlying breach is not cured within the applicable cure period or Casella breaches its obligations under the C&D Fuel Agreement and the underlying breach is not cured within the applicable cure period; or

(v) if the State reasonably determines that the issuer of the payment and performance bond attached hereto as Exhibit C is not financially sound or reputable, notifies Casella of the same and Casella fails to secure an alternative bond in form and content reasonably satisfactory to the State issued by a financially sound and reputable surety reasonably acceptable to the State and licensed to issue surety bonds and/or insurance policies within ninety (90) days.

15.2 Effects of Termination.

(a) If this Agreement is terminated pursuant to Subsections 15.1(a) or (b), this Agreement shall terminate and neither party shall have any further or continuing obligation hereunder.

(b) If the State terminates this Agreement pursuant to subsection 15.1(d), in addition to whatever other rights or remedies it may have (none of which are waived), the State (a) may remove Casella and its agents from, and on demand Casella and its agents shall, vacate the Landfill, and (b) and/or make demand under the payment and performance bond.

(c) Upon termination of this Agreement for any reason, the State shall own all fixed capital improvements to the Landfill and all other buildings, fixtures and other improvements without any obligation to pay Casella.

(d) Termination of this Agreement for any reason shall not relieve a party of its obligations arising prior to the termination date or those obligations that survive termination, including certain of Casella payment obligations under Section 5.2 and Casella's obligations under Section 8.

SECTION 16 DEFAULT AND REMEDIES

16.1 Notice/Cure. If either party fails to perform a material obligation under this Agreement, then the other party shall give notice of such alleged material failure, describing the alleged material failure and the action required to cure such material failure, if any. If the party receiving such notice fails to cure any such material failure to perform pursuant to Section 17 hereof, then an "Event of Default" shall be deemed to have occurred and the other party shall have the rights and remedies set forth in subsection 15.1 above and 16.2 below.

16.2 Remedies. If any Event of Default occurs (as defined in subsection 16.1 above), then (i) this Agreement may be terminated by the non-defaulting party by giving notice of

termination to the defaulting party, and/or (ii) the non-defaulting party shall have the right to take whatever action at law or in equity it deems necessary or desirable to collect any amounts then due or thereafter to become due under this Agreement or to enforce performance of any covenant or obligation of the defaulting party under this Agreement, including as to the State the right to make demand on the payment and performance bond securing Casella's obligations under this Agreement.

SECTION 17 RIGHT TO CURE BREACH

Upon its receipt of a notice of alleged material failure to perform a material obligation under this Agreement issued under subsection 16.1 hereof, the receiving party shall either:

17.1 Cure the material failure to perform within thirty (30) days of receipt of the written notice from the other party, provided that there shall be no cure period for a breach by Casella of its obligations under section 13.7 and 21.2; or

17.2 Continuously demonstrate, for those defaults for which cure periods exist, within such thirty (30) day cure period that it is actively pursuing a course of action which reasonably can be expected to lead to a cure of the material failure to perform (and the cure period shall be extended for so long as the curing party is actively and continuously pursuing such course of action) within a commercially reasonable period of time not to exceed ninety (90) days; provided, however, that with respect to a default by Casella under Section 2.10, the aforesaid period of time shall be extended to one (1) year on the condition that Casella has established and is maintaining a capital improvement plan designed to bring Casella into compliance with and maintain Casella's compliance with the requirements of Section 2.10; alternatively, Casella shall have the right to cure such a default by posting a performance bond in the amount of the insufficient capacity, calculated at the rate of $2.90 per ton; provided further that, in the event of the failure of either party to pay the other party any amount required to be paid hereunder when

due, cure shall consist of payment in full which shall be made within ten (10) business days of written demand from the party entitled to the payment, together with interest accruing from the date the payment was due at a per annum rate equal to the Prime Rate, unless said sums are being contested.

SECTION 18 NON-BINDING MEDIATION

18.1 Non-Binding Mediation. The parties agree that in the event of any dispute, controversy or claim arising under or relating to this Agreement or any alleged breach thereof, other than a breach by Casella of its payment obligations or its obligations under Sections 13.7, 21.1 or 21.2 hereof, the parties shall attempt to come to a reasonable settlement of any dispute (i) by having their authorized representatives attempt to negotiate a resolution of the dispute for a period of thirty (30) days, and, if not resolved by the authorized representatives (ii) by having other more senior members of each party's management, who have no previous involvement in the dispute, but who have the authority to resolve the dispute, attempt to negotiate a resolution of the dispute for an additional fifteen (15) days.

18.2 Waiver of Jury Trial. THE STATE AND CASELLA AGREE THAT NEITHER OF THEM NOR ANY ASSIGNEE OR SUCCESSOR SHALL (A) SEEK A JURY TRIAL IN ANY LAWSUIT, PROCEEDING, COUNTERCLAIM OR ACTION ARISING UNDER OR RELATING TO THIS AGREEMENT, OR (B) SEEK TO CONSOLIDATE ANY SUCH ACTION WITH ANY OTHER ACTION IN WHICH A JURY TRIAL CANNOT BE OR HAS NOT BEEN WAIVED. THE PROVISIONS OF THIS PARAGRAPH HAVE BEEN FULLY DISCUSSED BY THE STATE AND CASELLA, AND THESE PROVISIONS SHALL BE SUBJECT TO NO EXCEPTIONS. NEITHER THE STATE NOR CASELLA HAS AGREED WITH OR REPRESENTED TO THE OTHER THAT THE PROVISIONS OF THIS SECTION WILL NOT BE FULLY ENFORCED IN ALL INSTANCES.

18.3 Consent to Jurisdiction. The parties and their assigns submit to the jurisdiction of any state or federal court located in the State of Maine in connection with any proceeding or action arising from or relating to this Agreement or the agreements referred to herein. The parties consent to the jurisdiction and venue of any such court and waive any argument that venue in such forums is not convenient. In the event a party commences any action in another jurisdiction or venue under any tort or contract theory arising directly or indirectly from the relationship created by this Agreement, the other party at its option shall be entitled to have the case transferred to one of the jurisdictions and venues above-described, or if such transfer cannot be accomplished under applicable law, to have such case dismissed without prejudice.

SECTION 19 FORCE MAJEURE

If either party hereto is rendered unable, in whole or in part, to perform any of its obligations under this Agreement (other than an obligation to pay money when due) as a result of the occurrence of an event of Force Majeure, then the obligations of the affected party shall be suspended and its non-performance thereof excused during the continuation of the event of Force Majeure. At any time that a party intends to rely upon an event of Force Majeure to suspend its obligations or excuse its non-performance as provided in this Section 19, the affected parties shall notify the other party as soon as reasonably practicable (but in no event later than 72 hours following such event) describing in reasonable detail the circumstances of the event of Force Majeure and its ongoing efforts to mitigate the effects of such event of Force Majeure. Notice shall again be given when the effect of the event of Force Majeure has ceased. As a condition of invoking the protection afforded by this Section 19, the party relying upon an event of Force Majeure shall be required to exercise its best and most diligent efforts to eliminate the Force Majeure or devise a means of performance notwithstanding the Force Majeure and re-establish performance hereunder as rapidly as possible

Notwithstanding anything to the contrary herein, upon the occurrence of a force majeure, Casella will make available to FJ disposal capacity for FJ Waste and Lincoln Biomass Ash at the then prevailing market rate at any other landfill in the State of Maine owned and/or operated by Casella or any Affiliate that is licensed to accept FJ Waste and Lincoln Biomass Ash for a total commitment of thirty (30) years or such earlier time as disposal capacity at such landfill(s) is exhausted; provided, however, that FJ or Lincoln, as applicable, shall pay any and all costs of transporting FJ Waste and Lincoln Biomass Ash to such site. Except as aforesaid, Casella's obligations to provide disposal capacity for FJ Waste and Lincoln Biomass Ash shall be suspended during the pendency of any Force Majeure.

SECTION 20 EMINENT DOMAIN

The State agrees to cooperate with Casella in opposing any effort by any governmental authority to exercise its rights of eminent domain. In the event an eminent domain award is made, the amount of the award, after deducting amounts due FJ resulting from any breach of the Acquisition Agreement or Casella's obligations to FJ hereunder shall be apportioned between the State and Casella on the basis of the value of Casella's contractual and other interests under this Agreement, including without limitation, the value of any capital improvements made by Casella hereunder, and the value of lost revenue under any Landfill waste disposal capacity otherwise available to Casella hereunder.

SECTION 21 INSURANCE

21.1 General Insurance Requirements. Casella shall maintain liability, fire and workers' compensation insurance insuring both the State and Casella in the amounts set forth in Schedule 21 attached hereto, issued by financially sound and reputable insurance companies reasonably acceptable to the State that are authorized and licensed to issue such policies in the

State of Maine. Casella shall pay any premiums with respect to such policies as they come due. If Casella fails to pay any such premiums when due, the State shall have the right and option to pay any such premiums, whereupon the amount of any such premiums paid by the State shall be reimbursed by Casella to the State upon demand therefor. Upon request from the State, Casella shall promptly provide copies of such policies to the State.

21.2 Environmental Impairment. During the Term hereof, and annually thereafter for a period equal to the longest applicable statute of limitations (so long as such insurance is commercially available) for claims (including governmental actions) under Environmental Laws, Casella shall cause the Landfill to be insured for third party environmental impairment under a claims made policy carried by Casella. The policy shall provide a limit of not less than the greater of (a) the amount required under applicable laws and regulations from time to time in effect or required in connection with license and permits, or (b) $1,000,000 primary coverage and a $10,000,000 umbrella, increased annually by Two Hundred Twenty-five Thousand Dollars ($225,000) on each anniversary date of the Effective Date. Such policies shall name the State and FJ as additional insureds and shall be reasonably acceptable to the State and FJ.

SECTION 22 COVENANT OF QUIET ENJOYMENT

The State covenants and agrees that Casella, upon its performance of its obligations hereunder, shall lawfully, peacefully and quietly hold, occupy and enjoy the Landfill during the Term without hindrance, objection or disturbance, subject in all instances to the terms and provisions hereof.

SECTION 23 THIRD-PARTY BENEFICIARY

23.1 Third Party Benefit to FJ. FJ is an intended third-party beneficiary of all agreements, commitments and promises of Casella under this Agreement that provide benefit to FJ, including without limiting the generality of the foregoing, the provisions of Sections 2.8, 2.9,

2.10, 3.1, 4.1, 4.2, 8, 13, 14, 19, 20, 21 and 23.2 hereof, including related definitions from Section 1 and Exhibits (collectively, the "FJ Commitments"). The parties acknowledge and agree that FJ has provided consideration for its status as a third-party beneficiary hereunder through the sale of the Landfill to the State contemporaneously herewith, and that FJ's status as a third-party beneficiary under this Agreement was a material inducement to FJ selling the Landfill to the State. FJ's status hereunder shall be fully vested and shall be absolute as of the date hereof and FJ shall be entitled to take whatever action, in law or in equity, as may be available to enforce FJ's rights hereunder against Casella or any Affiliate operating the Landfill. FJ's status hereunder as a direct, intended, fully vested, absolute third-party beneficiary shall not in any way limit, restrict, abrogate or otherwise alter its rights against the State under the Acquisition Agreement.

23.2 Third Party Benefit to Casella. Casella is an intended third party beneficiary of the Unwind Provisions set forth in Section 2.10, the Representations and Warranties of FJ set forth in Article 3, and the Reverter Option set forth in Section 10.1, of the Acquisition Agreement. The parties acknowledge that Casella has provided consideration for its status as a third party beneficiary through its undertakings hereunder, and that such status shall be fully vested and absolute as of the date hereof and that Casella shall be entitled to take whatever action, in law or equity, as may be available to enforce Casella's rights as a third party beneficiary.

23.3 Successors and Assigns. The provisions of this Section 23 shall inure to the benefit of, and be binding upon FJ and its respective successors and assigns. Casella shall not assign or otherwise transfer its obligations under the FJ Commitments without the express written consent of FJ.

SECTION 24 MISCELLANEOUS PROVISIONS

24.1 Assignment. This Agreement may not be assigned by either party without the prior written consent of the other, which consent may be granted or withheld by such party in its sole discretion; notwithstanding the foregoing, Casella shall have the right to assign this Agreement to any Affiliate provided that Casella remains fully liable hereunder and provides reasonable assurances of the same to State in connection with any such assignment; furthermore, until such time as the License Amendment is received and is substantially consistent with the terms and conditions of the License Application, Casella shall have the right to delegate or subcontract the operation of the Landfill to J.A. Construction, Inc., subject to the terms and conditions of this Agreement. Each party further agrees not to unreasonably withhold its consent to a collateral assignment of this Agreement by the other party of such party's rights under this Agreement.

24.2 Cumulative Remedies. The specified remedies available to a party under this Agreement are not exclusive of any other remedies or means of redress to which such party may be lawfully entitled in the event of any breach or threatened breach by the other party of any provision(s) of this Agreement.

24.3 Captions and Headings. Captions and headings contained in this Agreement are inserted for convenience and reference only and the words contained therein shall in no way be held or deemed to define, limit, describe, explain, modify, amplify or add to the interpretation, construction or meaning of any provision or of the scope or intent of this Agreement, nor in any way to affect this Agreement.

24.4 Amendments and Modifications. This Agreement shall not be amended, modified or changed, except pursuant to an agreement in writing signed by or on behalf of the party against whom enforcement of the amendment, modification or change is sought.

24.5 Notices. All notices or other communications required or permitted hereunder shall be in writing and may be given by personal delivery, by overnight express delivery, or by registered or certified U.S. mail, postage prepaid, return receipt requested, properly addressed as follows:

To the State:

Executive Department
State Planning Office
38 State House Station
Augusta, Maine 04333-0038
Attention: Director

With a copy to:

William H. Laubenstein III Esq.
Assistant Attorney General
State of Maine
Office of the Attorney General
6 State House Station
Augusta, ME 04333-0006

To Casella:

c/o Casella Waste Systems, Inc.
25 Greens Hill Lane
Rutland, VT 05702-0866

With a copy to:

Gordon F. Grimes, Esq.
Bernstein, Shur, Sawyer & Nelson, P.A.
100 Middle Street, P.O. Box 9729
Portland, Maine 04104

Either party may change the address to which notices are required to be sent by giving notice of such change in the manner provided in this Section 24.5. All notices shall be deemed to have been received on the date of delivery if service is made in person, on the day after sent by

overnight express delivery service, or on the third (3rd) business day after mailing in accordance with this Section 24.5, except that any notice of a change of address shall be effective only upon actual receipt.

24.6 Strict Performance. The failure of either party to insist on the strict performance of any of the terms, covenants and provisions of this Agreement or to exercise any right, remedy or option herein contained shall not be construed as a waiver or a relinquishment for the future of such term, covenant, condition, provision, right, remedy or option.

24.7 Severability. In the event that any one or more of the terms or provisions of this Agreement shall for any reason he held by a court or other tribunal of competent jurisdiction to be invalid, illegal or unenforceable in any respect, in whole or in part, such invalidity, illegality or unenforceability shall not affect any other terms or provisions of this Agreement, and this Agreement shall be construed as if such invalid, illegal or unenforceable term or provision had never been contained herein, provided that it is the intention of the parties that, in lieu of such term or provision held to be invalid, illegal or unenforceable, there shall be added by mutual agreement as a part of this Agreement a term or provision as similar in terms to such illegal, invalid or unenforceable term or provision as may be possible, valid, legal and enforceable.

24.8 Construction. Words connoting the singular number shall include the plural in each case, and vice versa, and words connoting persons shall include corporations, companies, firms or other entities. The terms "herein", "hereunder", "hereby", "hereof" and any similar terms shall refer to this Agreement; the term "heretofore" shall mean before the date of execution of this Agreement. This Agreement is the result of joint negotiations and drafting and no part of this Agreement shall be construed as the product of any one of the parties hereto.

24.9 Entire Agreement. This Agreement, including covenants in the Acquisition

Agreement incorporated or referred to herein and the other agreements contemplated hereby, the covenants of Casella in the C&D Fuel Agreement and all exhibits and schedules attached hereto and thereto, constitute the entire agreement between the State and Casella with respect to the subject matter hereof, and supersede all prior or contemporaneous negotiations, representations, understandings and agreements, whether written or oral, between the parties with respect to the subject matter hereof.

24.10 Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original for all purposes, but all of which together shall constitute one and the same agreement.

24.11 Governing Law. This Agreement shall be governed by and construed and enforced in accordance with the laws of the State of Maine, without regard to the conflicts of law principles of such State.

24.12 Binding Effect; No Third Party Rights. This Agreement shall be binding upon and shall inure to the benefit of the parties hereto and their respective legal representatives, successors (whether by sale, assignment, transfer, merger, other acquisition, operation of law, or court ruling) and/or permitted assigns without releasing Casella of its obligations herein and shall be binding on any entity or entities that acquire all or substantially all of the assets or business of Casella and/or its Affiliates, in one or more transactions, whether by sale of assets, stock, merger or otherwise. Subject to the foregoing, and except as otherwise expressly provided herein (including Subsections 23.1 and 25), nothing in this Agreement shall be construed to confer any benefit on, or create any obligation, duty or liability to, or create any standard of care with respect to, any person, firm or entity not a party to this Agreement.

24.13 Authority of Parties. Each party hereto represents and warrants that the individual

who has executed this Agreement on its behalf has the full and complete authority to sign on behalf of such party for the purpose of duly binding such party to this Agreement.

24.14 State Special Services Agreement. This Agreement is subject to certain provisions of Rider B to the State's standard form of Agreement for Special Services, which provisions are attached hereto as Exhibit D.

SECTION 25 C&D FUEL COMMITMENT

Contemporaneously with the execution of this Agreement, Casella and FJ shall enter into a C&D Fuel Agreement in the form attached hereto as Exhibit B.

IN WITNESS WHEREOF, the parties have executed and delivered this Agreement as of the date first above written.

CASELLA WASTE SYSTEMS, INC.

Witness

Name:

By:
Name: James W. Bohlig
Its President

STATE OF MAINE, Acting by and Through its Executive Department, State Planning Office

Witness

Name: George M. MacDonald

By: Martha E. Freeman
Name: Martha E. Freeman
Its Director

EXHIBITS

Exhibit A	Alton and Old Town, Maine real estate
Exhibit B	C&D Fuel Agreement
Exhibit C	Performance Bond
Exhibit D	Agreement for Special Services

Exhibit A

Parcel Description

Four parcels located at **Old Town, Penobscot County, Maine,** and described as follows (individually referred to as "Parcel" and collectively referred to as "Parcels"):

PARCEL ONE: A certain parcel of land with any buildings thereon, situated on the northeast side of Route 43, 3.4 + miles west of the intersection of Route 43 and Route 95, in the city of Old Town, County of Penobscot, State of Maine and being more particularly described as follows:

1) BEGINNING at a 3/4 inch rebar located on the northeast side of Route 43, at the northwest corner of land now or formerly of Scott E. Bergquist as described in deed recorded at the Penobscot County Registry of Deeds in Book 3608, Page 247. Said rebar is also located at the southwest corner of the "Cadorette Parcel" as shown on plan entitled "Perkins & Cadorette Parcels, Standard Boundary Survey (with exceptions)" by Squaw Bay Corp. of Cumberland, Maine, June, 1995, Ronald M. Carpentier, PLS #2042, recorded at the Penobscot County Registry of Deeds, Plan Book D46-95, to which reference is hereby made;

2) THENCE South 82° 12' 30" East, 1445.38 feet along the land of said Bergquist to a cedar post and the land now or formerly of James River Paper Company, Inc. as described in the deed recorded at the Penobscot County Registry of Deeds in Book 4870, Page 200;

3) THENCE North 4° 27' 20" East, 809.31 feet along the land of said James River Paper Company, Inc. to a point;

4) THENCE North 5° 59' 05" East, 15.69 feet along the land of said James River Paper Company, Inc. to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the land now or formerly of Alfred Perkins and Florine Perkins as described in the deed recorded at the Penobscot County Registry of Deeds in Book 1448, Page 22;

5) THENCE North 82° 46' 26" West, 2014.87 feet along the land of said Perkins to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the sideline of Route 43;

6) THENCE South 29° 43' 31" East, 1013.29 feet along Route 43 to a 3/4 inch rebar and point of beginning.

The above-described parcel contains 32.4 acres.

Being the same premises described in a Warranty Deed given by Francis R. Cadorette and Rhonda B. Cadorette to James River Paper Company, Inc., dated June 13, 1995, and recorded in said Registry in Book 5878, Page 272.

PARCEL TWO: A certain parcel of land with any buildings thereon situated on the northeast side of Route 43, 3.4+ miles west of the intersection of Route 43 and Route 95, in the City of Old Town, County of Penobscot, State of Maine, and being more particularly described as follows:

COMMENCING at a 5/8 inch rebar with survey cap marked "RMC NO. 2042" located at the intersection of the northeast sideline of Route 43, and the southerly boundary line of land now or formerly of Alfred Perkins and Florine Perkins as described in deed recorded at the Penobscot County Registry of Deeds in Book 1448, Page 22. Said rebar is also located at the northwest corner of the "Cadorette Parcel" as shown on plan entitled "Perkins & Cadorette Parcels, Standard Boundary Survey (with exceptions)" by Squaw Bay Corp. of Cumberland, Maine, June, 1995, Ronald M. Carpentier, PLS #2042. to be recorded at the Penobscot County Registry of Deeds to which reference is hereby made. Thence South 82° 46' 26" East, 1485.52 feet along the Cadorette parcel to the point of Beginning.

1) THENCE from the Point of Beginning South 82°46'26" East, 529.45 feet along the Cadorette Parcel to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the land now or formerly of James River Paper Company, Inc., as described in the deed recorded at the Penobscot County Registry of Deeds in Book 4870, Page 200;

2) THENCE North 5° 59' 05" East, 828.72 feet along the land of said James River Paper Company, Inc. to a cedar post and the land of Alfred J. Meister as described in the deed recorded at the Penobscot County Registry of Deeds in Book 3738, Page 197;

3) THENCE North 84° 06' 52" West, 529.33 feet along the land of said Meister to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the land now or formerly of said Perkins;

4) THENCE South 5° 59' 05" West, 816.33 feet along the land of said Perkins to a 5/8 inch rebar with plastic survey cap marked "RMC NO. 2042" and the Point of Beginning.

The above-described parcel contains 10 acres.

Being the same premises described in a Warranty Deed given by Alfred K. Perkins and Florine J. Perkins to James River Paper Company, Inc. dated June 13, 1995, and recorded in said Registry of Deeds in Book 5878, Page 278.

PARCEL THREE: Lots 1 through 9 and 14 through 22, inclusive, as shown on the survey "Tyron Tree Farm" dated February 23, 1988, recorded in the Penobscot County Registry of Deeds in Plan file C26-88, together with a strip of land fifty (50) feet wide leading from Bennoch Road to the northerly line of Lot 11 on said plan, which strip was conveyed to Patten Corporation – Downeast by deed of Lyman B. Feero and Rosalita Feero, dated June 4, 1988, and recorded in said Registry in Book 4244, Page 5, and together with a right of way for all purposes over the roads fifty (50) feet wide, the centerlines of which are shown on said plan, leading from the northerly line of Lot 11 to the lots hereby conveyed. This right of way includes, but is not limited to, the right to install, use, maintain, repair and replace utility lines, poles and cables.

Together with all right, title and interest in and to that portion of the discontinued roadway lying northerly of the above described Parcel Three and southerly of the Town of Alton southerly line.

Being the same premises described in a Warranty Deed given by James River Corporation to James River Paper Company, Inc. dated July 10, 1991, and recorded in said Registry in Book 4870, Page 200.

Exceptions

The Parcels are conveyed subject to the following exceptions:

ALL PARCELS:

1. State of Maine, Department of Environmental Protection, Site Location Findings of Fact and Order, dated August 24, 1995, and recorded in the Penobscot County Registry of Deeds in Book 5939, Page 147.

2. Declarations of Covenants and Restrictions by James River Paper Company, Inc., dated December 20, 1993, recorded in said Registry in Book 5518, Page 67; Corrected Declaration of Covenants and Restrictions, dated January 20, 1994, recorded in said Registry in Book 5549, Page 162; and Amendment to Declaration of Covenants and Restrictions, dated November 30, 1995, recorded in said Registry in Book 6044, Page 118.

PARCELS ONE AND TWO ONLY:

1. Such state of facts as shown on the plan entitled "Cadorette House Lots, Route 43, Old Town, Maine," prepared by Squaw Bay Corp., dated June 1995, and recorded in said Registry in Plan 1996-59.

2. Such statement of facts as shown on the plan entitled "Perkins & Cadorette Parcels, Route 43, Old Town, Maine," prepared by Squaw Bay Corp., dated June 1995, recorded in said Registry in Plan D46-95.

PARCEL THREE ONLY:

1. Rights of way acquired by the University of Maine System by deeds dated July 27, 1989, and recorded in said Registry in Book 4490, Page 322 and Book 4490, Page 325.

2. Restrictions and conditions set forth in the deed from Pattern Corporation to James River Corporation recorded in said Registry in Book 4654, Page 310.

3. Rights of way reserved in the deed form Camillis G. Kidder to Napoleon Parady, dated January 10, 1910, and recorded in said Registry in Book 750, Page 407.

4. Order of the Grantee of Maine, Department of Environmental Protection, dated October 3, 1988, recorded in said Registry in Book 4345, Page 19.

5. Such statement of facts, including easements and rights of way, as shown on the plan entitled "Tryon Tree Farm, Patten Corporation-Downeast," prepared by Raymond S. Silsby, dated February 23, 1988, and recorded in said Registry in C26-88.

NOTICE OF SOLID WASTE DISPOSAL FACILITY

Pursuant to Maine Department of Environmental Protection Solid Waste Management Regulation, Chapter 400 Appendix C.11, Grantor provides the following notice:

The Premises contains an active secure solid waste disposal facility (the "Facility"). The Facility was licensed by the Maine Board of Environmental Protection on July 28, 1993. The Facility began operations on December 2, 1996. The Facility is 68 acres and is located southern quadrant of Parcel Three of the Premises. The following non-hazardous wastes have been placed in the Facility to a maximum depth of approximately 30 feet:

- pulp and papermill wastewater treatment plant sludge,
- lime wastes and grit,
- woodwastes and inert debris,
- small quantities of soil and sawdust contaminated with process chemicals that are non-hazardous,
- virgin oily contaminated debris,
- soil rags, oil filters, absorbent materials, crushed grease drums and waste grease,
- sand from sand filters,

- non-hazardous sand from sand blasting,
- multifuel fly ash and bottom ash from the Lincoln Pulp and Papermills, and
- wood ash from the City of Old Town

EXHIBIT B
FUEL SUPPLY AGREEMENT

This C&D FUEL AGREEMENT (this "Agreement") is made as of this _____day of February, 2004, by and between CASELLA WASTE SYSTEMS, INC., a Maine corporation with a place of business at 25 Green Hill Lane, Rutland, Vermont 05702 ("Casella"), and the FORT JAMES OPERATING COMPANY, a Delaware corporation ("FJ").

Recitals

1. The State of Maine, acting by and through its Executive Department, State Planning Office ("State") and FJ entered into an Agreement Regarding Solid Waste Disposal Facility Acquisition and Operation dated November 20, 2003 ("Landfill P&S").

2. The State and Casella entered into an Operating Services Agreement dated _____, 2003 ("Operating Agreement").

3. Both the Landfill P&S and the Operating Agreement contemplate that FJ and Casella will formalize and agreement regarding the C&D fuel commitments described herein.

Agreement

In consideration of the foregoing, and the promises set forth herein, the parties agree as follows:

1. **Definitions.** Capitalized terms used but not defined herein shall have the meanings assigned to those terms in the Landfill P&S. Capitalized terms used but not defined herein or in the Landfill P&S shall have the meanings assigned to those terms in the Operating Agreement.

"C&D Fuel" means processed construction and demolition debris, which shall meet the following criteria:

(a) Provides a minimum of at least 4,000 BTUs per pound (HHV) and an average of 6,800 BTUs per pound (HHV);

(b) Meets such specifications as the DEP may require for legitimate fuel substitution;

(c) Constitute "processed" C&D Fuel, in a form ready to burn in FJ's Biomass Generation Facility;

(d) Restricted to the type of waste which the FJ's Biomass Generation Facility is licensed to burn; and

(e) In no event shall C&D Fuel constitute or contain pentachlorophenol, arsenic or creosote-treated wood waste, except in such trace amounts as are consistent within the

DEP's current or future definition of "clean" C&D waste fuel and within the allowances for such substances set forth in the DEP permit for the Biomass Generation Facility.

2. **C&D Fuel Commitment.** (a) Casella hereby grants to FJ an option to purchase from Casella or its Affiliates, all or any portion of FJ's requirements for C&D Fuel ("C&D Fuel Option") for FJ's proposed Biomass Generating Facility in excess of any requirements satisfied by burning all available bark from FJ's pulping operations (estimated at a minimum of 100,000 tons per year) under the terms and conditions set forth below.

(b) The terms and conditions of the option be as follows:

(i) The term of the C&D Fuel Option shall extend for the shorter of: (x) the term, or any extended term, of the Operating Agreement or (y) a period of thirty (30) years following the date of commencement of operation of the Biomass Generation Facility ("Biomass Commencement Date").

(ii) The price charged to FJ for C&D Fuel will be fixed for the entire term of the C&D Fuel Option at the following levels:

(A) The price shall be fixed at the lesser of (x) market price or (y) $4 per ton for the first five (5) years following the Biomass Commencement Date.

(B) On the sixth anniversary of the Biomass Commencement Date, the price shall be the lesser of (x) market price or (y) $4 per ton, adjusted as set forth below. On the sixth anniversary of the Biomass Commencement Date, and thereafter on each anniversary of the Biomass Commencement Date throughout the remaining term of the C&D Fuel Option, the $4 per ton shall be adjusted upward or downward annually by a percentage equal to the percentage change in the Consumer Price Index (U.S.-national) ("CPI") from the immediately preceding anniversary through the then current anniversary of the Biomass Commencement Date. In no event shall the CPI adjustment be less than one percent (1%) per year or in excess of five percent (5%) per year.

For purposes of this section, reference to a "year" means the period of twelve (12) months extending from the Biomass Commencement Date to the first anniversary thereof, or from one anniversary of the Biomass Commencement Date to another, as applicable.

(iii) The volume of C&D Fuel available at the pricing set forth above is 75,000 tons in the first year of operation of the Biomass Generating Facility, 90,000 tons in the second year, and 100,000 tons in the third year and thereafter for the remainder of the term of this C&D Fuel Option.

3. **Chip Fuel Option.** Casella hereby grants to FJ an option to purchase from Casella, or its Affiliates, all or any portion of FJ's requirements for green wood chip fuel for FJ's proposed Biomass Generating Facility in excess of any requirements satisfied by burning all available bark

from FJ's pulping operations and C&D Fuel under the terms and conditions set forth below ("Chip Fuel Option").

(i) In the event FJ is not able to obtain all necessary Governmental Approvals to burn C&D Fuel at the Biomass Generating Facility, and during any period in which such Governmental Approvals have not yet been obtained, lapse or are otherwise not in force, Casella will provide to FJ up to 75,000 tons of green wood chip fuel at a price of $9 per ton for the first year following the Biomass Commencement Date, and thereafter adjusted upward or downward on each anniversary of the Biomass Commencement Date throughout the remaining term of this Chip Fuel Option by a percentage equal to the percentage change in the CPI from the date of the previous adjustment through the then current anniversary of the Biomass Commencement Date. In no event shall the CPI adjustment be less than one percent (1%) per year or in excess of five percent (5%) per year.

(ii) During the first year following the Biomass Commencement Date, Casella will provide FJ with up to 25,000 tons green wood chip fuel, if any, required by the Biomass Generating Facility to operate in normal mode to produce approximately 15 megawatts of electricity after utilization of FJ's available bark fuel and the C&D Fuel at a cost of $9 per ton for the first year following the Biomass Commencement Date, and thereafter adjusted upward or downward on each anniversary of the Biomass Commencement Date throughout the remaining term of this Chip Fuel Option by a percentage equal to the percentage change in the CPI from the date of the previous adjustment through the then current anniversary of the Biomass Commencement Date. In no event shall the CPI adjustment be less than one percent (1%) per year or in excess of five percent (5%) per year. The foregoing obligation will be reduced to 18,000 tons during the second year following the Biomass Commencement Date, and 9,000 tons in the third and each successive year thereafter until the end of the thirty-year term of this Chip Fuel Option. FJ agrees to utilize all green wood chip fuel provided by the operator as fuel for the Biomass Generating Facility.

4. **Alternative Fuel Source.** For any period during which the combination of FJ's available bark fuel, the C&D Fuel provided under Section 2 and the green wood chip fuel provided under Section 3 do not result in a fuel mixture that enables the Biomass Generating Facility to produce 15 megawatts of power on a sustained basis, Casella and its Affiliates shall exercise their best and most diligent efforts to provide FJ with other more efficient sources of fuel that will enable the Biomass Generation Facility to produce at the level specified above at prevailing market rates.

5. **Terms of Payment.** Payment shall be made by FJ to Casella net 30 days from date of invoice for each delivery.

6. **Supply Terms.**

(a) Timing and Volume. FJ and Casella acknowledge and agree that they shall work cooperatively and in good faith to establish a supply schedule that will provide consistent supply

of fuel hereunder as required to meet FJ's requirements for efficient Biomass Generating Facility operation. FJ and Casella shall meet not less often than once per month to review FJ's projected supply requirements for the ensuing three (3) months and establish a mutually acceptable delivery schedule. The delivery schedule shall represent a firm order for the fuel designated therein for the first [month/weeks/week] reflected in the delivery schedule. The remainder of the schedule will be advisory only. FJ and Casella agree to periodically adjust the schedule between monthly meetings, as required to reflect FJ's actual requirements.

(b) All sales will be FOB FJ's Old Town Mill. Title and risk of loss shall pass to FJ upon delivery and acceptance of each shipment.

(c) FJ shall have a period of [10] days to inspect and test each delivery for conformity to specifications. FJ may reject all or any portion of a delivery that does not meet the specifications described herein by notification to Casella stating the reason for rejection. Casella shall cure any defect or remove any non-conforming delivery and promptly provide conforming product. Rejection of any individual delivery shall not constitute a termination of this Agreement. The foregoing is not intended to limit FJ's remedies at law for dealing with non-conforming deliveries.

7. **Miscellaneous Provisions.**

(a) This Agreement may not be assigned by either party without the prior written consent of the other, which consent may be granted or withheld by such party in its sole discretion; not withstanding the foregoing, Casella shall have the right to assign this Agreement to any Affiliate provided that Casella remains fully liable hereunder.

(b) Captions and headings contained in this Agreement are inserted for convenience and reference only and the words contained therein shall in no way be held or deemed to define, limit, describe, explain, modify, amplify or add to the interpretation, construction or meaning of any provision or of the scope or intent of this Agreement, nor in any way to affect this Agreement.

(c) This Agreement shall not be amended, modified or changed, except pursuant to an agreement in writing signed by or on behalf of the party against whom enforcement of the amendment, modification or change is sought.

(d) Notices. All notices or other communications required or permitted hereunder shall be in writing and may be given by personal delivery, by overnight express delivery, or by registered or certified U.S. mail, postage prepaid, return receipt requested, properly addressed as follows:

To Casella:

Casella Waste Systems, Inc.
25 Green Hill Lane

Rutland, VT 05702-0866

To FJ:

Georgia-Pacific Corporation
Attention: General Counsel
133 Peachtree Street, N.E.
Atlanta, Georgia 30303

Either party may change the address to which notices are required to be sent by giving notice of such change in the manner provided in this Section 7(d). All notices shall be deemed to have been received on the date of delivery if service is made in person, on the day after sent by overnight express delivery service, or on the third (3rd) business day after mailing in accordance with this Section, except that any notice of a change of address shall be effective only upon actual receipt.

(e) The failure of either party to insist on the strict performance of any of the terms, covenants and provisions of this Agreement or to exercise any right, remedy or option herein contained shall not be construed as a waiver or a relinquishment for the future of such term, covenant, condition, provision, right, remedy or option.

(f) This Agreement, including provisions of the Landfill P&S and Operating Agreement incorporated herein constitute the entire agreement between the parties with respect to the subject matter hereof, and supersedes all prior or contemporaneous negotiations, representations, understandings and agreements, whether written or oral, between the parties with respect to the subject matter hereof.

(g) This Agreement may be executed in one or more counterparts, each of which shall be deemed an original for all purposes, but all of which together shall constitute one and the same agreement.

(h) This Agreement shall be governed by and construed and enforced in accordance with the laws of the State of Maine, without regard to the conflicts of law principles of such State.

(i) This Agreement shall be binding upon and shall inure to the benefit of the parties hereto and their respective legal representatives, successors (whether by sale, assignment, transfer, merger, other acquisition, operation of law, or court ruling) and/or permitted assigns. Subject to the foregoing, nothing in this Agreement shall be construed to confer any benefit on, or create any obligation, duty or liability to, or create any standard of care with respect to, any person, firm or entity not a party to this Agreement.

(j) Each party hereto represents and warrants that the individual who has executed this Agreement on its behalf has the full and complete authority to sign on behalf of such party for the purpose of duly binding such party to this Agreement.

(k) FJ and Casella agree that a breach of Casella's obligations under this Agreement shall constitute a failure to perform a material obligation under the Operating Agreement and shall be treated as such for purposes of declaring default and exercising remedies under Section 16 thereof.

IN WITNESS WHEREOF, the parties have executed and delivered this Agreement as of the date first above written.

FORT JAMES OPERATING COMPANY

Witness

_____
Name:

By:_____
Name:_____
Its _____

CASELLA WASTE SYSTEMS, INC.

Witness

_____
Name:

By:_____
Name:_____
Its _____

EXHIBIT C

PAYMENT AND PERFORMANCE BOND

Bond No.: _____

KNOW ALL MEN BY THESE PRESENTS, that we **CASSELLA WASTE SYSTEMS, INC.**, having a place of business at 25 Green Hills Lane, Rutland, Vermont 05702, (the "Principal"), and **EVERGREEN NATIONAL INDEMNITY COMPANY**, having a place of business at 6140 Parkland Boulevard, Suite 300, Cleveland, OH 44124, (the "Surety"), are held and firmly bound unto the **STATE OF MAINE**, acting by and through its Executive Department, State Planning Office, (the "Obligee"), in the penal sum of Four Million Dollars ($4,000,000) for the payment of which we bind ourselves, our heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Operating Services Agreement for the operation and maintenance of the solid waste landfill located in Old Town, Maine (the "Landfill") with the above mentioned Obligee, dated the _____ day of February, 2004, which agreement, as amended from time to time, is hereby incorporated herein by reference as if fully rewritten (the "Contract").

WHEREAS, it is a condition of the agreement of the Obligee to enter into the Contract that the Principal provide Obligee with a payment and performance bond in form and content satisfactory to Obligee to secure Principal's obligations thereunder;

NOW, THEREFORE, the condition of the above obligation is such that if the Principal shall promptly and faithfully perform this Contract, then this obligation shall be null and void; otherwise, it shall remain in full force and effect and Surety covenants to perform its obligations hereunder, subject, however, to and on the following conditions:

1. This Bond shall be maintained, in full force and effect throughout the Term (as defined in the Contract) and for one (1) year following Termination (as defined in the Contract). Notwithstanding the foregoing, if the Contract is terminated for any reason other than breach by Obligee prior to the date which is thirty (30) years after the Effective Date (as defined in the Contract) of the Contract, and Obligee makes a demand for payment and performance under this Bond prior to or within one (1) year following such Termination, the Bond shall continue to be maintained in full force and effect until the date which is thirty (30) years after the Effective Date (as defined in the Contract) as security for ongoing losses, liabilities and damages Obligee may incur.

2. If there is no material breach or default on the part of the Obligee, then the Surety's payment and performance obligation under this Bond shall arise as follows:

   a. The Obligee shall notify the Principal and the Surety in writing at their respective addresses of the alleged breach with a reasonably detailed description thereof. The parties shall attempt to arrange a conference with the Principal and the Surety to be held not later than fifteen (15) days after receipt of such notice to discuss methods of performing the Contract. During the notice period Obligee shall make available to Surety all books, records, and accounts relevant to the Contract which may be reasonably requested by the Principal or Surety, subject to such reasonable confidentiality undertaking as Obligee may require.

   b. The Principal shall be allowed time to cure the breach during the cure periods referenced in the Contract, if any; but such an agreement shall not waive the Obligee's right, if any, to subsequently declare a Principal default.

   c. If the Principal does not cure such breach or default within the cure periods referenced in the Contract, if any, Obligee may perform or arrange for the performance of Principal's duties under the Contract for the balance of the Term and make a demand for payment and performance under this Bond, and Surety hereby irrevocably covenants to pay Obligee any and all Adverse Consequences of every nature and type that Obligee may incur arising from or relating to Principal's failure to perform its obligations under the Contract, including, without limitation, the costs and expenses of any substitute contractor or any costs and expenses associated with the satisfaction of any obligations owed by the Principal to Fort James Operating Company or Georgia Pacific, Inc. or their successors and assigns. Obligee may make multiple demands for payment and performance under this Bond according to the procedures stated above, and may make demand at one time for all Adverse Consequences it anticipates arising from or relating to Principal's breach of its obligations under the Contract, provided that in no event shall Surety's obligations hereunder exceed $4,000,000. For purposes of this Bond, "Adverse Consequences" means all actions, suits, proceedings, hearings, investigations, charges, complaints, claims, demands, injunctions, judgments, orders, decrees, rulings, damages, dues, penalties, fines, costs, amounts paid in settlement, liabilities, obligations, taxes, liens, losses, expenses, and fees,

including court costs and reasonable attorneys' fees and expenses.

d. The parties acknowledge that under the terms of the Contract, Principal may assign its obligations under the Contract to a wholly-owned subsidiary, without, however, releasing Principal of its obligations under the Contract. Surety acknowledges that its obligations hereunder survive regardless of whether the obligations of Principal under the Contract are or were to be performed by Principal or its successors or assigns.

3. No claim, action, suit or proceeding, except as herein set forth, shall be had or maintained against the Surety pursuant to this Bond unless the same be brought or instituted and process served upon the Surety within one (1) year after the completion or termination of the Contract.

4. The Bond may be extended for additional terms at the option of the Surety, by Continuation Certificate executed by the Surety.

5. Neither non-renewal by the Surety, nor failure, nor inability of the Principal to file a replacement bond shall constitute loss to the Obligee recoverable under this bond.

6. In no event shall the liability of the Surety hereunder exceed the penal sum hereof (namely, $4,000,000).

7. Surety further acknowledges and agrees that (i) Obligee is independent of any agency of the State of Maine with regulatory authority over any aspect of the Landfill or performance of the Contract (an "Agency") such that, among other things, any act or inaction by any such Agency shall not be attributable to Obligee and shall not under any circumstances limit or excuse performance by Surety under this Bond and (ii) any approval, disapproval or conditioned approval by an Agency of a contractor tendered by Surety to perform the Contract is an act independent of the Obligee and shall not limit or excuse performance by Surety under this Bond and (iii) any security held or procured by any Agency with respect to the operation or closure of the Landfill shall not reduce or limit the obligation of Surety hereunder.

8. Surety agrees that the Contract may be amended from time to time without notice to or approval by the Surety.

9. The obligations of Surety and Principal hereunder are joint and several. No past or future act or omission of Principal shall excuse or limit the obligation of Surety to perform under this Bond.

10. Any claim or controversy relating in any way to this Bond shall be governed and interpreted exclusively in accordance with the laws of the State of Maine.

11. Surety's obligation under this Bond may not be assigned without obtaining the prior written consent of the Principal, the Surety and the Obligee.

12. The Bond shall not be amended, modified or changed in any way without obtaining the prior written consent of the Obligee, which consent may be granted or withheld in the sole discretion of Obligee.

13. Without limiting the terms of Section 11 hereof, this Bond shall be binding upon and shall inure to the benefit of the parties hereto and their respective legal representatives, successors (whether by sale, assignment, transfer, merger, other acquisition, operation of law, or court ruling) and/or permitted assigns.

14. Except as otherwise specified herein, Surety hereby waives any and all suretyship defenses.

(The remainder of this page is intentionally left blank.
The signature page follows this page.)

Signed, sealed and executed this _____ day of February, 2004.

Witness

_____
Name:

CASELLA WASTE SYSTEMS, INC.

By:_____

Name:_____
Its _____

EVERGREEN NATIONAL SURETY COMPANY

By: _____
Name:

By: _____

Name:_____
Its _____

SEEN AND AGREED TO

STATE PLANNING OFFICE

By: _____

Its: _____

EXHIBIT D

10. EQUAL EMPLOYMENT OPPORTUNITY. During the performance of this Agreement, Casella (hereinafter, the "Provider") agrees as follows:

a. The Provider shall not discriminate against any employee or applicant for employment relating to this Agreement because of race, color, religious creed, sex, national origin, ancestry, age, physical or mental disability, unless related to a bona fide occupational qualification. The Provider shall take affirmative action to ensure that applicants are employed and employees are treated during employment, without regard to their race, color, religion, sex, age, national origin, or physical or mental disability.

Such action shall include but not be limited to the following: employment, upgrading, demotions, or transfers; recruitment or recruitment advertising; layoffs or terminations; rates of payor other forms of compensation; and selection for training including apprenticeship. The Provider agrees to post in conspicuous places available to employees and applicants for employment notices setting forth the provisions of this nondiscrimination clause.

b. The Provider shall, in all solicitations or advertising for employees placed by or on behalf of the Provider relating to this Agreement, state that all qualified applicants shall receive consideration for employment without regard to race, color, religious creed, sex, national origin, ancestry, age, physical or mental disability.

c. The Provider shall send to each labor union or representative of the workers with which it has a collective bargaining agreement, or other agreement or understanding, whereby it is furnished with labor for the performance of this Agreement a notice to be provided by the contracting agency, advising the said labor union or workers' representative of the Provider's commitment under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Provider shall inform the contracting Department's Equal Employment Opportunity Coordinator of any discrimination complaints brought to an external regulatory body (Maine Human Rights Commission, EEOC, Office of Civil Rights) against their agency by any individual as well as any lawsuit regarding alleged discriminatory practice.

e. The Provider shall comply with all aspects of the Americans with Disabilities Act (ADA) in employment and in the provision of service to include accessibility and reasonable accommodations for employees and clients.

f. Contractors and subcontractors with contracts in excess of $50,000 shall also pursue in good faith affirmative action programs.

g. The Provider shall cause the foregoing provisions to be inserted in any subcontract for any work covered by this Agreement so that such provisions shall be binding upon each subcontractor, provided that the foregoing provisions shall not apply to contracts or subcontracts for standard commercial supplies or raw materials.

11. EMPLOYMENT AND PERSONNEL. The Provider shall not engage any person in the employ of any State Department or Agency in a position that would constitute a violation of 5 M.R.S.A. § 18 or 17 M.R.S.A. § 3104. The Contractor shall not engage on a full-time, part-time or other basis during the period of this Agreement, any other personnel who are or have been at any time during the period of this Agreement in the employ of any State Department or Agency, except regularly retired employees, without the written consent of the State Purchases Review Committee. Further, the Provider shall not engage on this project on a full-time, part-time or other basis during the period of this Agreement any retired employee of the Department who has not been retired for at least one year, without the written consent of the State Purchases Review Committee. The Provider shall cause the foregoing provisions to be inserted in any subcontract for any work covered by this Agreement so that such provisions shall be binding upon each subcontractor, provided that the foregoing provisions shall not apply to contracts or subcontracts for standard commercial supplies or raw materials.

12. STATE EMPLOYEES NOT TO BENEFIT. No individual employed by the State at the time this Agreement is executed or any time thereafter shall be admitted to any share or part of this Agreement or to any benefit that might arise there from directly or indirectly that would constitute a violation of 5 M.R.S.A. § 18 or 17 M.R.S.A. § 3104. No other individual employed by the State at the time this Agreement is executed or any time thereafter shall be admitted to any share or part of this Agreement or to any benefit that might arise there from directly or indirectly due to his employment by or financial interest in the Provider or any affiliate of the Provider, without the written consent of the State Purchases Review Committee. The Provider shall cause the foregoing provisions to be inserted in any subcontract for any work covered by this Agreement so that such provisions shall be binding upon each subcontractor, provided that the foregoing provisions shall not apply to contracts or subcontracts for standard commercial supplies or raw materials.

14. ACCESS TO RECORDS. The Provider shall maintain all books, documents, payrolls, papers, accounting records and other evidence pertaining to this Agreement and make such materials available at its offices at all reasonable times during the period of this Agreement and for such subsequent period as specified under Maine Uniform Accounting and Auditing Practices for Community Agencies (MAAP) rules. The Provider shall allow inspection of pertinent documents by the Department or any authorized representative of the State of Maine or Federal Government, and shall furnish copies thereof, if requested.

FIRST AMENDMENT
TO
OPERATING SERVICES AGREEMENT
BETWEEN
CASELLA WASTE SYSTEMS, INC
AND
STATE OF MAINE, ACTING BY AND THROUGH ITS EXECUTIVE DEPARTMENT, STATE PLANNING OFFICE

This is the First Amendment to the Operating Services Agreement ("Agreement") between Casella Waste Systems, Inc. ("Casella") and State of Maine, State Planning Office ("State"), which was entered into on February 5, 2004.

1. Section 4.2 (b) is amended to read:

Casella shall use its best and most diligent efforts to, at its own cost and expense, apply for, seek and maintain in full force and effect (i) the License Amendment, (ii) the Expansion Permit, and (iii) such other federal, state and local permits, licenses and authorizations as otherwise required in connection with Casella's obligations under this Agreement, including, without limitation, any required zoning, subdivision and site plan approval. Without limiting the generality of the foregoing, Casella shall prepare on or before the fifth anniversary of the Effective Data an application for the Expansion Permit and shall conduct geologic and engineering studies and bear the cost of any consulting services related to all such permit/license and approval efforts. Subject to the foregoing, Casella shall determine the timing of the submission and the content of any such applications to the appropriate regulatory entities. Casella currently contemplates and application for the Expansion Permit of ten million (10,000,000) cubic yards of additional capacity, but, following exhaustion of all appeals of any approval of the Expansion Permit authorizing a lesser disposal capacity, Casella hereby agrees to accept any such approval so issued in connection with any application for the Expansion Permit, provided that, taken together, the initial application so submitted by Casella for the Expansion Permit shall provide that the Existing Permit, the License Amendment and the Expansion Permit will collectively provide sufficient capacity to dispose of at least 500,000 tons of waste per year over twenty (20) years of operation. If issued, Casella shall not take any action or suffer any omission that causes, or provides a basis for the revocation, suspension or restriction of the Expansion Permit, or limit or restrict Casella's or the State's ability to operate the landfill.

2. Except as expressly provided in this First Amendment, the Agreement remains in full force and effect.

Dated: 7/28/06

CASELLA WASTE SYSTEMS, INC

By: _____

Name: Brian Oliver

Its: Vice President, Casella Northeast Region

WITNESS:

_____
(name)

Dated: July 24, 2006

STATE OF MAINE, Acting by and through
its Executive Department, State Planning Office

By: Martha E. Freeman

Name: Martha E. Freeman

Its: Director

WITNESS:

_____
(name)

SECOND AMENDMENT TO OPERATING SERVICES AGREEMENT

This Second Amendment to the Operating Services Agreement ("Amendment") is made as of this 2nd day of November, 2006, by and between CASELLA WASTE SYSTEMS, INC., a Delaware corporation with a place of business at 25 Greens Hill Lane, Rutland, Vermont 05702 ("Casella"), and the STATE OF MAINE, acting by and through its Executive Department, State Planning Office (the "State").

WITNESSETH:

WHEREAS, Casella and the State are parties to an Operating Services Agreement, dated as of February 5, 2004, as amended by the First Amendment to Operating Services Agreement, dated as of July 28, 2006 (the "Agreement"); and

WHEREAS, in connection with the contemplated change in the ownership of and the manner of operating the paper manufacturing facility and the biomass electric generating facility located in Old Town, Maine, FJ proposes to assign to, and Red Shield Environmental, LLC, a Delaware limited liability company ("Red Shield") proposes to assume, the FJ Commitments (as defined in the "Agreement"); and

WHEREAS, the parties wish to amend the Agreement;

NOW, THEREFORE, in consideration of the mutual promises and agreements hereinafter contained, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Casella and the State agree as follows:

1. The recitals and identification of the parties to this Amendment are incorporated by reference as though fully set forth herein. Capitalized terms not defined herein shall have the meaning given to them in the Agreement. Effective upon the consummation of the transactions described in the second recital above, all FJ Commitments, as defined in Section 23 of the Agreement, that refer to "FJ" or "Fort James" are hereby amended to refer to Red Shield.

2. Effective upon the consummation of the transactions described in the second recital above, Section 1 of the Agreement shall be amended as follows:

(a) The definition of "Biomass Ash" is hereby restated as follows: "Biomass Ash" shall mean the ash resulting from the operation of any Biomass Generating Facility installed and operated at the Old Town Facility to the extent the same is disposable at the Landfill under the Existing Permit and meets the definition of "special waste" as defined under Maine Environmental Law.

(b) The definition of "Old Town Mill" is hereby restated as follows: "Old Town Facility" shall mean the pulp and paper mill previously operated by FJ located in Old Town and Orono, Maine, including, without limitation, all industrial operations

conducted by any entity thereon, irrespective of the entity that owns or operates any industrial operation thereon, and all related facilities and improvements.

3. All references to "Old Town Mill" in the Agreement are hereby amended to refer to the "Old Town Facility."

4. All references to "Mill Waste" in the Agreement are hereby amended to refer to "Old Town Facility Waste."

5. Effective upon the consummation of the transactions described in the second recital above, Section 2.8(d) of the Agreement, and all cross-references thereto in the Agreement, are hereby deleted in their entirety.

6. In consideration for (i) Casella's willingness to enter into this Amendment and the Fuel Supply Agreement (the "FSA"), dated of near or even date herewith, between Casella and Red Shield, and (ii) Casella's agreement to cease accepting waste for disposal at the Pine Tree Landfill located in Hampden, Maine, on or prior to December 31, 2009, in accordance with the closure plan submitted to MDEP, and in recognition of Casella's loss of disposal capacity at the Pine Tree Landfill and its need to enter into long-term, binding commitments to accept construction and demolition waste ("C&D") and to develop and construct or expand, or otherwise gain access to one or more processing facilities within the State of Maine in order to assure its ability to produce or obtain C&D Fuel sufficient to fulfill its potential obligations hereunder and under the FSA, the State agrees that, anything to the contrary set forth in the Agreement notwithstanding, and in order to clarify the parties' understanding of the intent of the relevant provisions of the Agreement:

(a) Casella shall be entitled to source from within or outside the State of Maine sufficient quantity of C&D (as defined in the FSA) to produce, at one or more processing facilities located within the State of Maine, C&D Fuel (as defined in the FSA) to meet its delivery obligation under the FSA, and shall be entitled to dispose at the Landfill any and all residue produced in the processing of C&D, at one or more processing facilities located within the State of Maine. In accordance with Section 2.13 of the Agreement, Casella agrees to exercise commercially reasonable efforts to utilize C&D generated within the State of Maine in fulfilling its obligations under the FSA.

(b) Casella shall be entitled to dispose at the Landfill any C&D (up to 20,000 tons in any calendar year) that would have been processed, at a processing facility located within the State of Maine, in the ordinary course to produce C&D Fuel, as contemplated by Section 6(a) or Section 6(c) hereof, but for the fact that such processing facility was shut down for planned or unplanned maintenance or repair.

(c) In the event and to the extent that Red Shield fails to accept delivery of C&D Fuel that was processed at a processing facility located within the State of Maine at the maximum volumes contemplated by Section 2(b)(iii) of the FSA, or in the event that the FSA does not take effect, or the C&D Fuel Option (as defined in the FSA) is

terminated prior to thirty (30) years after the Biomass Commencement Date (as defined in the FSA), Casella shall be entitled to dispose at the Landfill any and all C&D processing residue should Casella elect to continue to produce, at one or more processing facilities located within the State of Maine, C&D Fuel to supply to alternate users.

(d) For purposes of clarification and the avoidance of doubt, no portion of any C&D sourced by Casella or any C&D residue created in the processing of C&D Fuel, in each case, as contemplated by this Section 6, shall be considered Excluded Waste, provided that such C&D and C&D residue does not contain Hazardous Waste.

This Section 6 shall be binding upon the parties irrespective of whether the transactions involving Red Shield contemplated by the second recital above are consummated.

7. Effective upon the consummation of the transactions described in the second recital above, Section 5.3 of the Agreement and all cross-references thereto in the Agreement are hereby deleted in their entirety.

8. Notwithstanding anything in the Agreement to contrary, Red Shield shall have the unrestricted right to mortgage and pledge its rights under the Agreement without Casella's consent, and encumber its rights under the Agreement with any type of security interest to secure debt, or other similar instrument creating a lien or other encumbrance on Red Shield's interest in the Agreement, regardless of the priority thereof (hereinafter, "Security Interest," and each lender with a Security Interest, a "Lender"), any assignment thereof and any modification or amendment of any of the terms thereof, including, without limitation, any extension, renewal or refinancing of any indebtedness secured thereby or an additional advance secured by any Security Interest or any additional Security Interest given to secure the same. A Lender, or its designee, or any purchaser in foreclosure proceedings (including, without limitation, an entity formed by a Lender) may become a legal owner of Red Shield's interest under the Agreement through such foreclosure proceedings or by assignment of Red Shield's interest under the Agreement in lieu of foreclosure. A Lender may enforce its rights under its Security Interest and acquire title to Red Shield's interest in the Agreement in any lawful way. The parties agree that nothing in the Agreement shall be deemed to impose any liability or obligation on (i) any mortgagee or secured party that may at any time hold a mortgage lien on or a security interest in the Agreement, or (ii) any party that becomes a mortgagee in possession, secured party in possession or receiver with respect to the Agreement. With respect to a party that is assigned the rights under the Agreement through a mortgage foreclosure, secured party sale or deed or bill of sale in lieu thereof, such party shall assume the obligations and liabilities under the Agreement first arising as of the date of such assignment.

9. In all other respects, the Agreement shall remain in full force and effect in accordance with its terms. The obligations of the State hereunder shall survive, and shall not be affected by, any termination of the FSA or closure of or cessation of operations at the Biomass Generating Facility.

IN WITNESS WHEREOF, the parties have caused this Amendment to be executed and delivered by their duly authorized representatives as of the day and year first above written.

Witness

CASELLA WASTE SYSTEMS, INC.

By: _____
Name: Brian Olivo
Title: Authorized Agent

Witness

STATE OF MAINE, acting by and through Its Executive Department, State Planning Office

By: _____
Name: Martha Freeman
Title: Director

SEEN AND AGREED TO:

RED SHIELD ENVIRONMENTAL, LLC

By: _____
Name: EDWARD T. PACZKOWSKI
Title: CHAIRMAN

THIRD AMENDMENT TO OPERATING SERVICES AGREEMENT

This Third Amendment to the Operating Services Agreement is made as of this 21st day of December, 2015, by and between Casella Waste Systems, Inc., a Delaware corporation with a place of business at 25 Greens Hill Lane, Rutland, Vermont 065702 ("Casella") and State of Maine, Department of Administrative and Financial Services, Bureau of General Services (the "State").

WITNESSETH:

WHEREAS, by Resolves 2003, ch. 93 (the "Resolve"), the State was authorized to acquire, own and cause to be operated an existing solid waste disposal facility in the City of Old Town now known as the Juniper Ridge Landfill (the "Landfill"), under such terms and conditions as are revenue-neutral and the State determines are advisable and in the public interest; and

WHEREAS, the State of Maine, acting by and through the Department of Administrative and Financial Services, Bureau of General Services, is the owner of the Landfill; and

WHEREAS, the State entered into an Operating Services Agreement (the "OSA") with Casella dated February 5, 2004, as amended by the First Amendment dated July 28, 2006 and the Second Amendment dated November 2, 2006, whereby the State granted to Casella the "...right, license and privilege to occupy, operate, maintain, repair, design, redesign, construct and utilize the Landfill..."; and

WHEREAS, the OSA provides that "the use of the Landfill shall be restricted to development and operation of a solid waste landfill, or other facilities providing for the disposal or recycling of solid waste or other management of solid waste or, with the prior written consent of the State...other uses that do not prohibit or impair the operation of a solid waste landfill..."; and

WHEREAS, the OSA provides that any capital improvements of any nature or type to or at the Landfill shall be and remain the property of the State upon termination of the OSA without any compensation to Casella; and

WHEREAS, under the OSA the State granted to Casella the right "to take and use any landfill gas generated at the Landfill, all in accordance with applicable laws and regulations"; and

WHEREAS, under the OSA the State granted to Casella the right to collect and retain all revenue, income and other financial benefits generated by, at, or related to the operation of the Landfill during the term of the OSA; and

WHEREAS, Casella now wishes to exercise its right under the OSA to take and use the landfill gas ("LFG") generated at the Landfill and the parties wish to amend and clarify the OSA in order to enable Casella to do so as provided herein and in the other agreements and instruments referred to herein; and

WHEREAS, Casella, through its subsidiary, NEWSME Landfill Operations, LLC, has entered into the Landfill Gas Rights Agreement for the Juniper Ridge Landfill dated December 29, 2014, as amended by an amendment dated of near or even date herewith (the "LGRA"), with Juniper Ridge Energy, LLC, a Delaware limited liability company doing business at 46280 Dylan Drive, Suite 200, Novi, MI 48377 ("LES") pursuant to which Casella purported to grant to LES, among other rights, "...the exclusive rights to all LFG collected by NEWSME from the Juniper Ridge Landfill, and any contiguous expansions, and all Environmental Attributes[,]" as the term is defined in the LGRA; and

WHEREAS, Casella has requested the State's consent to the LES landfill gas to energy project being located at and operating at JRL pursuant to Sections 2.1.4 and 2.2(a) of the OSA; and

WHEREAS, the State is not a party to the LGRA; and

WHEREAS, the State recognizes that the use of recovered LFG is of environmental and economic benefit; and

WHEREAS, LFG will continue to be generated by the Landfill, and will need to be collected and managed, beyond the term of OSA; and

WHEREAS, pursuant to the OSA, Casella is responsible for all closure and post-closure aspects of the Landfill arising during the term of the OSA and for closing those portions of the Landfill that reach final grade; and

WHEREAS, pursuant to the OSA, Casella is responsible for the posting of closure and post-closure bonds; and

WHEREAS, Casella acknowledges that the interests and obligations of the State as owner and co-licensee of the Landfill need to be recognized and addressed with regard to any contract or other arrangement for the location and operation of a LFG utilization project ("LFGTE") at the Landfill pursuant to the LGRA; and

WHEREAS, Casella acknowledges that the interests and obligations of the State as owner and co-licensee of the Landfill need to be recognized and addressed with regard to any subordination or collateral access agreement that may be requested in connection with Casella's financing arrangements; and

WHEREAS, Casella may request that the State consent to certain collateral access rights and the subordination of any State interests in machinery or equipment employed by Casella in the operation of the Landfill and to certain collateral access rights and the subordination of any State interests in machinery or equipment employed by LES in the operation of the LFGTE at the Landfill; and

WHEREAS, the State and Casella desire to amend the OSA to address the rights and obligations of the parties with regard to the location and operation of a LFGTE at the Landfill; and

WHEREAS, the State and Casella desire to amend the OSA to address the rights and obligations of the parties with regard to certain collateral access rights and the subordination of any State interests in machinery or equipment employed by Casella in the operation of the Landfill.

NOW THEREFORE, in consideration of the premises and the mutual covenants and obligations set forth herein, the Parties agree as follows:

1. The State hereby consents to the LGRA, subject to the following terms and conditions, including certain amendments to the LGRA agreed to in writing by both Casella and LES and described below in Sections 1.1 – 1.10:

1.1. Section 1.23 of the LGRA shall be amended by deleting the last sentence and replacing it with the following: "The LFGTE Facility Site shall be at the site identified on Exhibit A attached hereto, or such other location at the Landfill mutually agreed to by NEWSME and LES and consented to in writing by the State, which consent shall not be unreasonably withheld, delayed or conditioned, subject in all cases to the receipt of all necessary permits, licenses and approvals, including but not limited to a minor revision of the JRL landfill license, an air license and site plan approval by the City of Old Town. No such change of location may occur without the agreement of NEWSME and LES and the written consent of the State."

1.2. Section 1.25 of the LGRA shall be deleted and replaced with the following: "License shall mean that license to be issued by the State, which will provide for construction of the LFGTE Facility at the Landfill by LES, its contractors or agents and grants access over and across the Landfill for the operation, service and maintenance by LES of the LFGTE Facility for the Term of the OSA, or as may be otherwise agreed to in writing by NEWSME, LES and the State".

1.3. Casella agrees to notify the State of any adverse regulatory action relating to LES's compliance with applicable permits, rules and regulations, including but not limited to air emissions, noise levels related to or associated with the operation and maintenance of the LFGTE Facility and/or the OSA, all as more specifically addressed in Section 4.4 of the LGRA.

1.4. Section 7 of the LGRA shall be deleted and replaced with the following:

"(a) NEWSME acknowledges that LES may, at its sole option, secure financing for some or all of the machineryor equipment owned by LES and that LES requires to perform under this Agreement and hereby consents to any encumbrance or lien on such machineryor equipment that make up the LFGTE Facility listed on Exhibit B hereto (together with any replacements thereof or additions thereto) (the "LES Equipment") and hereby consents to a collateral assignment by LES of the LES Equipment and its rights under this Agreement as required from time to time by any such financing.

"(b) LES acknowledges that NEWSME may, at its sole option, secure financing for some or all of the machinery or equipment owned by NEWSME at the Landfill, including the LFG Management System and the Cameron H2S System. LES hereby consents to any encumbrance or lien thereon and hereby consents to a collateral assignment by NEWSME of its assets and its rights under this Agreement as required from time to time by any such financing."

1.5. Section 9.1 of the LGRA shall be amended to extend to the State (a) LES's indemnity obligations for any and all suits, actions, liabilities, legal proceedings, claims, demands, losses, costs and expenses arising from LES's negligence or willful misconduct in connection with LES's performance under the LGRA; and (b) LES's indemnity obligations arising from LES's violation of any law, regulation, code, judgment, order, permit, license or governmental approval, including but not limited to a violation of the OSA and/or the permit regarding the ownership, operation and maintenance of the Landfill.

1.6. Section 9.2 of the LGRA shall be amended to extend to the State (a) Casella's indemnity obligations for any and all suits, actions, liabilities, legal proceedings, claims, demands, losses, costs and expenses arising from Casella's negligence or willful misconduct in connection with Casella's performance under the LGRA; and (b) Casella's indemnity obligations arising from Casella's violation of any law, regulation, code, judgment, order, permit, license or governmental approval, including but not limited to a violation of the OSA and/or the permit regarding the ownership, operation and maintenance of the Landfill.

1.7. Section 11.1 of the LGRA shall be amended to require Casella and LES to name the State as an additional insured with respect to general liability and automobile coverages. In the event LES and Casella purchase additional insurance, the State shall be named as an additional insured.

1.8. Section 12 of the LGRA shall be amended by adding a new sentence at the end of subsection 12.2 to read: "Notwithstanding the foregoing or the provisions of Section 12.1, any capital improvements to or at the Landfill, including without limitation any capital improvements made by LES, shall be and remain the property of the State without any compensation to

Casella or LES. The parties agree and acknowledge that the LES Equipment does not constitute capital improvements."

1.9. Section 14 of the LGRA shall be amended by deleting the last sentence of subsection 14.3 and replacing it with the following: "In the event of a default which results in termination by LES, LES may remove, without the consent of the State, the LES Equipment, but may not remove any capital improvements made by LES, which capital improvements shall be and remain the property of the State without any compensation to Casella or LES.\ Notwithstanding the foregoing, LES shall notify Casella and the State prior to the removal of the LES Equipment. Such removal shall be conducted in a manner reasonably acceptable to Casella and the State and undertaken in a manner that does not unreasonably interfere with the operation of the Landfill."

1.10 Section 16 of the LGRA shall be amended by adding the words "(except in connection with a collateral assignment to third parties in connection with secured financing)" after the words "provided that" in the two instances where it occurs in the second sentence of Section 16.

1.11. Notwithstanding any provision to the contrary in the LGRA, concurrently with the execution of the Agreement and the effectiveness of the amendment to the LGRA contemplated hereby, the State will enter into a license agreement with LES (the "LES License"), upon terms acceptable to Casella and LES, to permit the construction of the LFGTE Facility at the Landfill by LES or its agents and to grant access over and across the Landfill for the operation, service and maintenance by LES of the LFGTE Facility for the Term of the OSA and thereafter for so long as Casella continues to provide closure and post-closure services at the Landfill. The LES License shall contain provisions reflecting the provisions of this Third Amendment relating to the LES Equipment, including without limitation those confirming that such LES Equipment does not constitute capital improvements for purposes of the OSA.

1.12. Casella shall promptly notify the State of any material operating or regulatory compliance deficiencies relating to the LFGTE Facility and applicable permits, rules and regulations, including but not limited to air emissions, noise levels related to or associated with the operation and maintenance of the LFGTE Facility and/or relating to the OSA, of which

Casella becomes aware, including those coming to Casella's attention pursuant to Section 4.4 of the LGRA. Casella agrees to promptly notify LES of the receipt by Casella of any notice of breach by Casella under the OSA given by the State, and to keep LES promptly informed of any further material actions or proceedings taken or initiated by the State in connection therewith.

2. The OSA is amended by amending Section 2.1.4 to read in its entirety as follows:

"During the Term of the OSA and coterminous with the fulfillment, termination or discharge of Casella's closure and post closure obligations and its rights and obligations under this Agreement with respect to the Landfill, the right to take and use any landfill gas at the Landfill, all in accordance with applicable laws and regulations."

3. The OSA is amended by adding a new subsection 2.1.5 to read as follows:

"2.1.5. The State grants to Casella the right of access over and across the Landfill, upon terms and conditions agreed to by the Parties in writing, to meet Casella's closure and post-closure obligations with respect to the Landfill. The term of the right of access granted in this subsection 2.1.5 shall be coterminous with the fulfillment, termination or discharge of Casella's closure and post-closure obligations and its rights and obligations under this Agreement with respect to the operation of the Landfill."

4. The OSA is amended by adding a new subsection 2.1.6 to read as follows:

"2.1.6. The State grants to Casella the right of access over and across the Landfill, upon terms and conditions agreed to by the Parties in writing, to operate, service and maintain the LFG Management System, as that term is defined in the LGRA. The State agrees and acknowledges that, notwithstanding any other provision to the contrary in this Agreement, the assets listed on Exhibit C hereto, whether or not included in the LFG Management System, together with any replacements thereof and any additions thereto, do not constitute fixed capital improvements, buildings, fixtures or other improvements for purposes of this Agreement. The term of the right of access granted in this subsection 2.1.6 shall be coterminous with the rights granted to Casella pursuant to Section 2.1.5 of this Agreement."

5. Section 10.1 of the OSA is amended by deleting from the last sentence thereof the word "exclusive" and replacing it with the word "non-exclusive".

6. The OSA is amended by adding a new sentence at the end of Section 13.5 to read as follows:

"Casella's responsibility for closure and post-closure of the Landfill, including without limitation the posting of closing and post-closing bonds, shall survive termination of the OSA."

7. The OSA is amended by adding a new subsection 15.1 (d)(vi) to read as follows:

"15.1 (d)(vi) if Casella seeks protection under any bankruptcy, receivership, trust deed, creditors arrangement, composition or comparable proceeding, or if any such proceeding is instituted against Casella and not dismissed within 60 days thereafter; or"

8. The OSA is amended by adding a new subsection 15.1(d) (vii) to read as follows:

"15.1 (d) (vii) if the State has received a written notice from Casella's senior lender that the obligations under Casella's senior secured credit facility (in excess of $15 million) have been accelerated prior to its stated maturity and that such senior lender intends to assert its rights under a written collateral access agreement with the State and to foreclose upon or otherwise dispose of Casella's or its subsidiaries' assets that are located on the Landfill, and such notice is not withdrawn or rescinded within ninety (90) days; or"

9. The OSA is amended by adding a new subsection 15.1 (d) (viii) to read as follows:

"15.1 (d)(viii) if Casella defaults in its obligation in Section 7 hereof to be responsible for all costs and expenses related to Landfill regulatory compliance, including but not limited to Casella's obligation to provide financial assurance for conducting post-closure care and maintenance of the Landfill for at least 30 years after closure of the facility."

10. The OSA is amended by adding a new subsection 15.2 (e) to read as follows:

"15.2 (e) Upon request of the State at or following termination of this Agreement (other than upon expiration of the term of this Agreement or a termination arising from the breach hereof by the State), subject to the rights of Casella's senior lenders, Casella shall assign to the State all its interests in the LGRA upon terms and conditions agreed to by the parties."

11. The OSA is amended by adding the following text at the end of Section 24.1 thereof:

"The State agrees that, upon the request of Casella from time to time, the State will execute and deliver subordination and collateral access agreements in favor of Casella's senior secured lenders, in form and substance reasonably acceptable to the State. The parties agree that a subordination and collateral access agreement substantially in the form attached hereto as Exhibit D is deemed reasonably acceptable to the State."

12. Except as provided in this Third Amendment, the OSA shall remain in full force and effect in accordance with its terms.

IN WITNESS WHEREOF, the parties have caused this Third Amendment to Operating Services Agreement to be executed and delivered by their duly authorized representatives as of the day and year first above written.

Witness

CASELLA WASTE SYSTEMS, INC.

By: _____

Name: Brian Oliver

Title: Vice President

Witness

STATE OF MAINE, Department of Administrative and Financial Services, Bureau of General Services

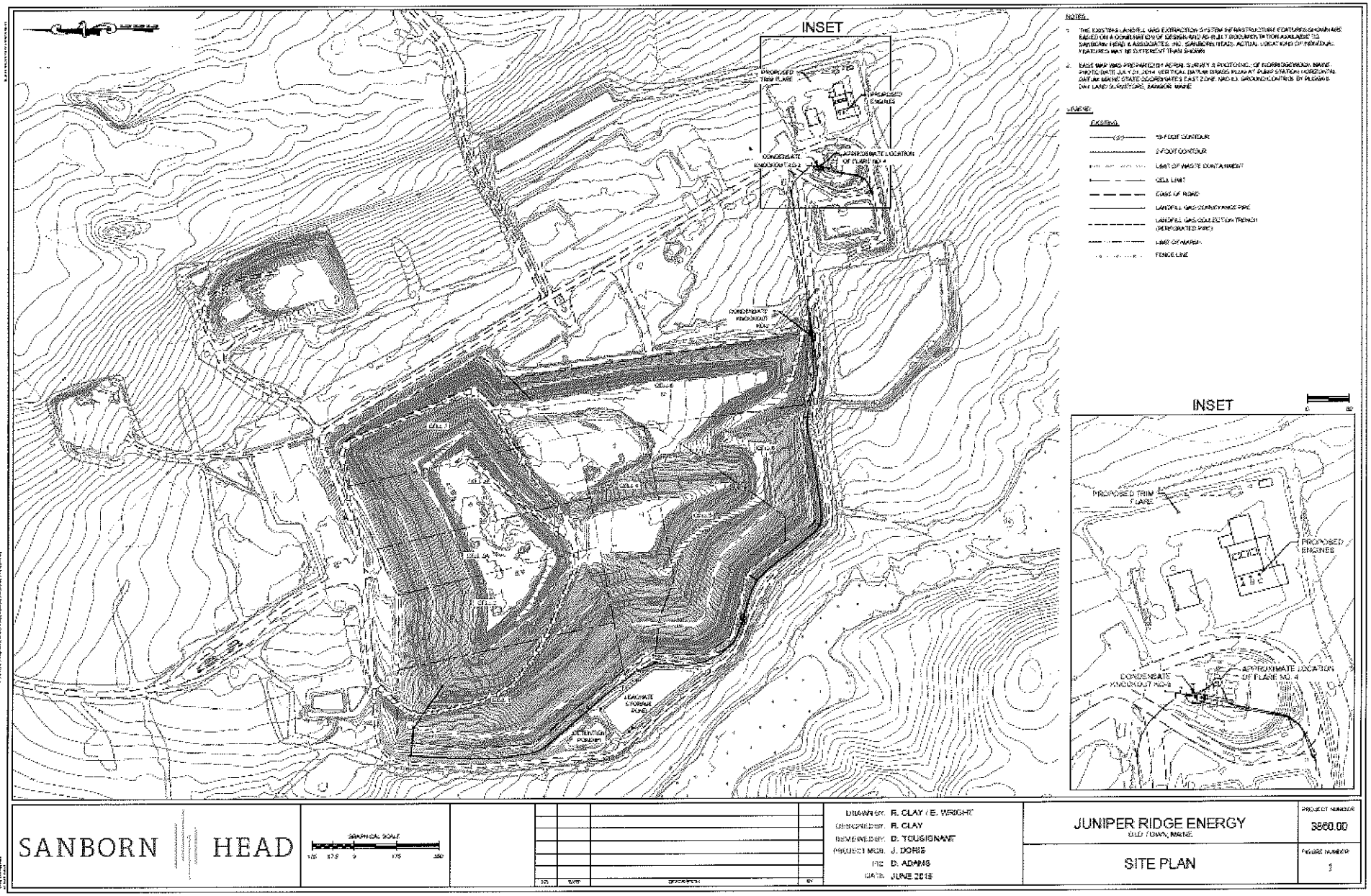
By: _____

Name: Edward A. Dahl

Title: Director

EXHIBIT A

(See Attached)



SANBORN HEAD

GRAPHICAL SCALE

NO.	DATE	DESCRIPTION	BY

DRAWN BY: R. CLAY / E. WRIGHT
DESIGNED BY: R. CLAY
REVIEWED BY: D. TOUSIGNANT
PROJECT MGR.: J. DORIS
PIC: D. ADAMS
DATE: JUNE 2015

JUNIPER RIDGE ENERGY
OLD TOWN, MAINE

SITE PLAN

PROJECT NUMBER: 3660.00

FIGURE NUMBER: 1

EXHIBIT B

Initial LES Equipment

Processing equipment will include the following equipment (together with any replacements thereof and additions thereto):

- Gas Compression
- Gas Treatment components
- Engine-Generators and associated ancillary equipment
- Generation Switchgear
- Generation substation equipment
- Controls and Motor Control Centers associated with above equipment
- Plant office equipment, spare parts inventory

[**NOTE**: Equipment is on order; serial number, etc., not yet available]

EXHIBIT C

Casella/NEWSME Equipment
(non-Capital Improvements)

Asset #	Description	Unit Number	Serial Number
11029	Pickup, 2000 Chevrolet	6252	2GCEK19V7Y1103176
11575	Ford Ranger Pickup, 2000	6355	1FTYR14U0XTB02797
16473	Trailer, 1987 Fruehauf	70831	1H2V04825HH060718
25713	Trailer 8X20 Hydraulicdeckover	71034	434DC25237C062321
2348	Bulldozer, Cat 91 D4H	9923	4664
6224	Auto, Chevy 97 Tahoe	1100	1GNEK13ROVJ378943
10161	Wheel Loader, Cat 966F Ii	9127	1SL02282
12908	Pickup, Chevrolet 1500 1997	6367	1GCEC14W9VZ152430
13029	Dump Truck 97 Intl Tri Axle	6369	1HTGLAET1VH481550
15969	Svc Truck, Ford 97 F450 4X2	6404	3FELF47F6VMA68019
21445	Plow Truck, 1987 Ford L8000	6517	QFDYK8OU7HVA67526
25566	Fuel Truck	9930	1FV6HFBB1SL653608
25569	Fuel Truck	9928	JW6HCFIB4JK000246
27648	Truck, 2008 Ford F350 Pickup	6719	1FTWF31548ED41761
28276	Truck, 2009 Toyota Tundra	6737	5TFBT541X9X015142
30320	Jd 400 Articulating Dump Truck	9855	DW400DT604831
30958	2008 Ford F250	6659	1FTSW215X8EC69134
32545	2007 International 4300	6807	1HTMMAAN67H422908
32789	2006 Toyota Corolla	1527	2TIBR32E36C692844
21444	H2S Analyzer		2249
22202	Gas Pod For Analyzer		
22203	Sander		4685
22846	Jerome H2S Analyzer Model631-X		2312
23130	Honda Pressure Washer On Trlr		4K1PT4C155K000439
24069	Isuzu Diesel Generator 120/240		
24985	Pressure Washer		
24986	Compressor		
24987	Welder-Power Mig 350Mp Package		V1061107395
24988	Welder 225A Dc Welder		LG078260

Asset #	Description	Unit Number	Serial Number
24989	Plasma Cutter		3821963
25142	Shop Tools		
25143	5Hp Light Duty Compressor		6004096
25144	2Hp 24Gal Compressor Irss3R2Gm		
25452	Chain Hoist-5 Ton Electric		
26331	Portable Litter Fence		
26686	Fisher Plow-Extreme V Plow		
30673	Hydraulic Jack		
30674	10' Swanson Sander		
34160	2007 Jd 850J Dozer	9901*	T0850JX128632
34827	Sulfa Treat System		
904764	Forklift-1998 Cat Gp25Lphp	9699	5AM92524
4442	Skid Steer, Bobcat 96 763	9025	512220170
6351	Articulated Truck, Dumptruck	9013	5TN00433
11003	All Terrain Vehicle, 95 Polaris	9212	2587809
12880	Wheel Loader, Cat 01 966G	9469	35W735
13821	Articulated Truck, Cat 95 D250	9013A	
14304	Grapple Bondine 3/2 Tines		
15449	Gas Blower		
16650	Welder On Service Truck #6404		
18069	D6R 1997 Caterpillar Dozer	9654	9PN00663
23680	Excavator, John Deere 270	9846	FF270CX702558
24008	Loader, John Deere 744	9854	DW744JX586551
24009	Crawler Dozer John Deere 850J	9837	T0850JX123883
24071	Trailer Mounted Dav System		
24670	Trimble Gcs900V10 Dual Ms980		T716/T605
24992	Emergency Response Trailer	71033	
25120	966 Bucket 5.25Cy	9469*	
25145	Confined Space Trailer	71035	4U01C10176A029589
27067	80' Portable Spray Unit Trlr		
27793	Jack		
27966	2000 Cat 826G Compactor	9926	7LN552
27987	Somatex Bridge Crane		
27988	Gps System Trimble Sn B900		
28385	Pro Heat Unit X3		
28480	Gideon Air Cleaner		
29668	2007 Fusion Machine		
30288	Bench Press		
30338	Radio Control System For Crane		

Asset #	Description	Unit Number	Serial Number
30367	Track Loader Cat 299C		JSP01105
30666	John Deere 850J Crawler Dozer	90131	1T0850JXJA0190710
30715	Plow/Forks For Track Loader		
30716	Gps System For Jd850	90131*	
30934	Winter Tracks For Skidsteer		
30935	Gps Upgrade	90131**	
31705	2001 Johnston J4000 Sp St Swee	90165	1J9VM4H351C172058
31706	Receiver Board Assembly	90131***	
32069	Skidsteer Attachments		
34942	Gps Receiver Antennas	90131*****	
35554	Sulfa Treat Can X4		
36875	Thiopaq		
36743	Gps Upgrade Trimble		
8335	20Yd, Ro Open Top		
19922	Router, Wan Interface Card		S32396059
22681	Kronos Time Clock		
30339	Tables/Chairs-Conference Room		
	Gem Landfill Gas Monitor		
	Scale System		
29835	Block Heater		

EXHIBIT D

EXECUTION VERSION

AGREEMENT

This **AGREEMENT** ("Agreement") is made and entered into as of this 20th day of August, 2015, by and among the State of Maine, acting by and through its Department of Administrative and Financial Services, Bureau of General Services ("Owner"), Casella Waste Systems, Inc., a Delaware corporation ("Operator"), and BANK OF AMERICA, N.A., as agent ("Agent") for the lenders (collectively, "Lenders") from time to time party to the Loan Agreement described below.

WHEREAS, the Owner and the Operator are party to an operating services agreement (the "Operating Services Agreement") providing for the operation by the Operator of a facility on the Owner's real property commonly known as the solid waste landfill located in Old Town, Maine ("Owner's Property"); and

WHEREAS, Owner is informed that Agent and Lenders have previously entered into a Loan and Security Agreement (the "Loan Agreement") and other loan documents with Operator, and certain of its affiliates, and to secure the obligations arising under such Loan Agreement, Operator has granted to Agent, for its own benefit and the ratable benefit of Lenders, a security interest in and lien upon certain personal property, including without limitation, those assets described on Schedule 1 attached hereto, and replacements thereof, that are owned by Operator and located or to be located in and upon said Premises (the property listed on Schedule 1, collectively, the "Collateral"). For the avoidance of doubt, in no event shall the term "Collateral" include any fixed capital improvements to the Owner's Property or any other buildings, fixtures or other improvements.

NOW, THEREFORE, in consideration of One Dollars ($1.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereby agree as follows:

1. **Acknowledgement**. Owner acknowledges that (a) the Operating Services Agreement is in full force and effect, and (b) to Owner's knowledge, without investigation or inquiry, Operator is not in default under the Operating Services Agreement.

2. **Subordination of Owner's Lien**. Owner agrees that until such time as the obligations of Operator to Agent and Lenders are indefeasibly paid in full and all commitments to lend thereunder have terminated, Owner subordinates any interest of Owner in the Collateral to the interests of the Agent and the Lenders, and agrees not to distrain or levy upon any Collateral or assert any lien, right of distraint or other claim against the Collateral for any reason.

3. **Notices**.

(a) Agent will use reasonable efforts to notify Owner in the event Operator is in monetary default under the Loan Agreement and when Operator has paid in full and all commitments to lend have been terminated provided, however, Agent shall have no liability to Owner for failing to so notify Owner.

(b) Owner will use reasonable efforts to provide Agent (at the same time Owner sends such a notice to Operator) with (i) written notice of the termination of the Operating

Services Agreement as a result of any default or failure to perform by Operator under the Operating Services Agreement (a "Termination Notice"), and (ii) any other notice given by the Owner to the Operator of a default or failure to perform a material obligation under the Operating Services Agreement; provided, however, Owner shall have no liability to Agent for failing to provide any such notice to Agent. Operator shall provide Agent with a copy of any Termination Notice or any other notice given by the Owner to the Operator of a default or failure to perform a material obligation under the Operating Services Agreement within two (2) business days of receipt.

(c) All notices required hereunder to be given shall be in writing, sent by certified mail, return receipt requested, or overnight delivery by a reputable overnight courier, to the respective parties at the addresses set forth below, or at such other addresses as the receiving party shall designate in writing:

Owner: State of Maine

Department Administrative & Financial Services
Bureau of General Services
77 State House Station
Augusta, ME 04333-0077
Attention: Director of Bureau of General Services

Operator: Casella Waste Systems, Inc.

25 Greens Hill Lane
Rutland, VT 05701
Attn: Office of General Counsel

Agent: Bank of America, N.A.
225 Franklin Street
MA1 225 02 05
Boston, MA 02110
Attention: Jolanta Bialek

4. Agreements.

(a) Agent may, after the occurrence of an event of default and acceleration of the obligations under the Loan Agreement, give notice (a "Disposition Period Notice") to the Owner and the Operator of the Agent's election to commence a Disposition Period. The "Disposition Period" shall commence on the earlier to occur of (i) the effective date of the termination of the Operating Services Agreement designated by the Owner in a Termination Notice that has been delivered by the Owner to Agent (or if later, 90 days after the date of notice given by the Owner to the Operator (a copy of which has been delivered to the Agent before the effective date of a termination under the Termination Notice) of a default or failure to perform a material obligation under the Operating Services Agreement which default or failure to perform has not been cured and has resulted in the termination specified in the Termination Notice), or (ii) the 90th day following receipt by Owner of a Disposition Period Notice (such time, a "Disposition Period

Commencement Date") and shall end on the Disposition Period End Date. The "Disposition Period End Date" shall be the earlier of (i) 90 days following the Disposition Period Commencement Date and (ii) the date on which the Collateral has been removed from the Premises. Notwithstanding the foregoing, with respect to the Delayed Removal Collateral (defined below), the Disposition Period Commencement Date may be postponed for a period of up to 275 days in a written election of the Owner, if the Owner in its reasonable discretion determines that it is necessary to maintain such Delayed Removal Collateral for an additional period of time to ensure that there is no interruption in the operation and maintenance of the landfill operated at the Owner's Property. The "Delayed Removal Collateral" means the Collateral identified on Schedule 2.

(b) During any Disposition Period, upon at least 48 hours notice, Agent and its representatives may enter into and be present upon the Premises and inspect, repossess, and/or remove the Collateral, and Agent may conduct private sales of the Collateral at the Premises. If Agent conducts a private sale of the Collateral at the Premises, Agent shall notify Owner prior to such sale. Such sale shall be conducted in a manner reasonably acceptable to Owner and undertaken in a manner that does not unreasonably interfere with the operation of the landfill. The Agent will provide information reasonably requested by the Owner regarding the disposition of the Collateral during the Disposition Period.

(c) Agent shall promptly repair, at Agent's expense, or, at Owner's request, immediately reimburse Owner for any physical damage to the Premises caused by the conduct of such private sale and any removal of Collateral by or through Agent (ordinary wear and tear excluded). Subject to the foregoing, neither Agent nor any Lender shall be liable for any diminution in value of the Premises caused by the absence of Collateral removed, and neither Agent nor any Lender shall have any duty or obligation to remove or dispose of any Collateral or any other property left on the Premises by Operator.

(d) After the Owner's receipt of a Disposition Period Notice, Owner may enter into and be present upon the Premises and inspect (or cause to be inspected) the Collateral.

(e) After the Owner's receipt of a Disposition Period Notice and until the Disposition Period End Date, if the Operating Services Agreement has been terminated, or if the Owner has given Casella a notice of Casella's default or failure to perform under the Operating Services Agreement, and such default or failure to perform has not been cured, Owner may use and/or operate (or cause to be used or operated) any Collateral on the Premises as Owner deems necessary in its reasonable discretion, subject to the rights of the Agent under Section 4(b) hereof during a Disposition Period.

(f) No action by Agent or any Lender pursuant to this Agreement shall be deemed to be an assumption by Agent or such Lender of any obligation under the Operating Agreement and/or an assignment of the Operating Agreement to Agent or Lender.

5. **Miscellaneous**.

Section headings are for convenience of reference only and in no way shall be used to construe or modify the provisions set forth in this Agreement. Operator hereby agrees that Owner shall

have no duty or obligation to inquire into the accuracy or validity of any default by Operator with respect to the security agreements, and Operator hereby agrees that nothing contained in this Agreement nor Owner's acts or failures to act in connection herewith shall be deemed a default by Owner under the Operating Services Agreement, and Operator hereby waives all claims of whatever nature or kind Operator may have against Owner in connection with this Agreement and/or Owner's acts or failures to act in connection with herewith. This Agreement shall be governed by and construed in accordance with the laws of the State of Maine. It is specifically understood and agreed that this Agreement shall not be binding in any manner upon any present or future mortgagee of the aforesaid real estate. This Agreement may be executed in any number of several counterparts and shall inure to the benefit of Agent and its successors and assigns provided Owner receives written notice of such transfer and/or assignment and shall be binding upon Owner and its successors and assigns (including any transferees of the Premises). Owner agrees and consents to the filing of this document for recording in the land records of the county in which the Premises is located provided Owner incurs no additional cost in connection therewith.

[Signatures Appear on Following Page]

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

Owner: State of Maine, Dept of Administrative and Financial Services
By: R W Rosen
Name: Richard W. Rosen
Title: Commissioner

Agent: Bank of America, N.A., as Agent
By: _____
Name: _____
Title: _____

Operator: _____
By: _____
Name: _____
Title: _____

[Corporate Seal]

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

Owner: _____

By: _____

Name: _____

Title: _____

Agent: Bank of America, N.A., as Agent

By: _____

Name: Christopher M. O'Halloran

Title: Senior Vice President

Operator: _____

By: _____

Name: _____

Title: _____

[Corporate Seal]

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

Owner: _____

By: _____

Name: _____

Title: _____

Agent: Bank of America, N.A., as Agent

By: _____

Name: _____

Title: _____

Operator: _____

By: _____

Name: JOHN W. CASEKA

Title: Chairman & CEO

[Corporate Seal]

SCHEDULE 1

Asset #	Description	Unit Number	Serial Number
11029	Pickup, 2000 Chevrolet	6252	2GCEK19V7Y1103176
11575	Ford Ranger Pickup, 2000	6355	1FTYR14U0XTB02797
16473	Trailer, 1987 Fruehauf	70831	1H2V04825HH060718
25713	Trailer 8x20 HydraulicDeckover	71034	434DC25237C062321
2348	Bulldozer, Cat 91 D4H	9923	4664
6224	Auto, Chevy 97 Tahoe	1100	1GNEK13ROVJ378943
10161	Wheel Loader, Cat 966F II	9127	1SL02282
12908	PICKUP, CHEVROLET 1500 1997	6367	1GCEC14W9VZ152430
13029	DUMP TRUCK 97 INTL TRI AXLE	6369	1HTGLAET1VH481550
15969	Svc Truck, Ford 97 F450 4x2	6404	3FELF47F6VMA68019
21445	Plow Truck, 1987 Ford L8000	6517	QFDYK8OU7HVA67526
25566	Fuel Truck	9930	1FV6HFBB1SL653608
25569	Fuel Truck	9928	JW6HCFIB4JK000246
27648	Truck, 2008 Ford F350 Pickup	6719	1FTWF31548ED41761
28276	Truck, 2009 Toyota Tundra	6737	5TFBT541X9X015142
30320	JD 400 Articulating Dump Truck	9855	DW400DT604831
30958	2008 Ford F250	6659	1FTSW215X8EC69134
32545	2007 International 4300	6807	1HTMMAAN67H422908
32789	2006 Toyota Corolla	1527	2TIBR32E36C692844
21444	H2S Analyzer		2249
22202	Gas Pod for Analyzer		

22203	Sander		4685
22846	Jerome H2S Analyzer Model631-X		2312
23130	Honda Pressure Washer on trlr		4K1PT4C155K000439
24069	Isuzu Diesel Generator 120/240		
24985	Pressure Washer		
24986	Compressor		
24987	Welder-Power MIG 350MP package		V1061107395
24988	Welder 225A DC Welder		LG078260
24989	Plasma Cutter		3821963
25142	Shop Tools		
25143	5HP Light Duty Compressor		6004096
25144	2HP 24Gal Compressor IRSS3R2GM		
25452	Chain Hoist-5 ton Electric		
26331	Portable Litter Fence		
26686	Fisher plow-Extreme V plow		
30673	Hydraulic Jack		
30674	10' Swanson Sander		
34160	2007 JD 850J Dozer	9901*	T0850JX128632
34827	Sulfa Treat System		
904764	Forklift-1998 Cat GP25LPHP	9699	5AM92524
4442	Skid Steer, Bobcat 96 763	9025	512220170
6351	Articulated Truck, DumpTruck	9013	5TN00433
11003	All Terrain Vehicle, 95 Polaris	9212	2587809

12880	Wheel Loader, Cat 01 966G	9469	35W735
13821	Articulated Truck, CAT 95 D250	9013A	
14304	Grapple Bondine 3/2 Tines		
15449	Gas Blower		
16650	Welder on Service Truck #6404		
18069	D6R 1997 Caterpillar Dozer	9654	9PN00663
23680	Excavator, John Deere 270	9846	FF270CX702558
24008	Loader, John Deere 744	9854	DW744JX586551
24009	Crawler Dozer John Deere 850J	9837	T0850JX123883
24071	Trailer Mounted DAV System		
24670	Trimble GCS900v10 Dual MS980		T716/T605
24992	Emergency Response Trailer	71033	
25120	966 Bucket 5.25CY	9469*	
25145	Confined Space Trailer	71035	4U01C10176A029589
27067	80' Portable Spray Unit Trlr		
27793	Jack		
27966	2000 Cat 826G Compactor	9926	7LN552
27987	Somatex Bridge Crane		
27988	GPS System Trimble SN B900		
28385	Pro Heat Unit x3		
28480	Gideon Air Cleaner		
29668	2007 Fusion Machine		
30288	Bench Press		

30338	Radio Control System for Crane		
30367	Track Loader Cat 299c		JSP01105
30666	John Deere 850J Crawler Dozer	90131	1T0850JXJA0190710
30715	Plow/Forks for Track Loader		
30716	GPS System for JD850	90131*	
30934	Winter Tracks for Skidsteer		
30935	GPS Upgrade	90131**	
31705	2001 Johnston J4000 SP ST Swee	90165	1J9VM4H351C172058
31706	Receiver Board Assembly	90131***	
32069	Skidsteer Attachments		
34942	GPS Receiver Antennas	90131*****	
35554	Sulfa Treat Can x4		
36875	Thiopaq		
36743	GPS Upgrade Trimble		
8335	20YD, RO OPEN TOP		
19922	Router, WAN Interface card		S32396059
22681	Kronos Time Clock		
30339	Tables/Chairs-Conference Room		
	GEM Landfill Gas Monitor		
	Scale System		
29835	Block Heater		

SCHEDULE 2

34827 Sulfa Treat System
15449 Gas Blower
35554 Sulfa Treat Can x4

APPENDIX E

MATERIALS MANAGEMENT PLAN

SME
SEVEE & MAHER
ENGINEERS

Report to the Joint Standing Committee on Environment and Natural Resources
131st Legislature, Second Session

Maine Materials Management Plan:

2024 State Waste Management and Recycling Plan Update and 2022 Waste Generation and Disposal Capacity Report

January 2024

Contacts

Carla Hopkins
Director, Division of Materials Management
207-446-4366
Carla.J.Hopkins@maine.gov

Brian Beneski
Supervisor, Recycling Programs
207-592-0248
Brian.Beneski@maine.gov

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
17 State House Station | Augusta, Maine 04333-0017
www.maine.gov/dep

Table of Contents

Executive Summary 3
I. Introduction 5
II. Waste Generation and Characterization 6
A. Waste Generation 6
B. Waste Characterization 8
1. Studying Waste in Maine 8
a. General/All Waste Stream Study 9
b. Food Waste Stream Study 11
c. Sludge/Biosolids Waste Stream Study 11
d. Packaging Material Waste Stream / Recycling Needs Assessment Study 13
2. Current Understanding of Maine's Waste Streams 14
a. Construction and Demolition Debris ("CDD") 14
b. Problematic Material 17
i. Producer Responsibility Programs 18
ii. Beverage Redemption Container Program 18
iii. Household Hazardous Waste ("HHW") and Waste Pesticides 18
iv. Consumer Electronic Products and Batteries 19
III. Waste Reduction, Diversion, and Recycling Assessment 19
A. Laws Addressing Recycling and Diversion Goals 19
B. Reducing the Amount of Waste Generated 20
1. Recycling Assessment 23
2. Current Diversion Programs 24
3. Steps to Assist with Waste Reduction and Increase Recycling Opportunities 25
IV. Determination of Existing and Potential Disposal Capacity 25
A. Increasing Need for Disposal Capacity 25
B. Current Waste Disposal and MSW Processing Facilities 29
1. Waste-to-Energy Facilities 29
2. Landfills 30
a. Hatch Hill, Augusta 33
b. Presque Isle and Fort Fairfield Landfills 33
c. Bath Landfill 33
d. Lewiston Landfill 33

e. Crossroads Landfill, Norridgewock 34
f. Juniper Ridge Landfill, Old Town 34
g. ecomaine Landfill, Portland 34
3. MSW Processing Facility 35
4. Materials Recovery Facilities 35
C. Juniper Ridge Landfill's Role in Maine's Waste Disposal Arena 36
D. Projected Demand for Capacity 41
V. Stakeholder Input Summary 43
A. General Concerns of Maine's Waste Management System 43
B. Solutions Suggested to Maine's Waste Management System 44
VI. Future Strategies 47
VII. Conclusions 49

Executive Summary

38 M.R.S. § 2122, requires the Department of Environmental Protection ("Department") to update a Statewide Waste Management and Recycling Plan ("Plan") every five years. This update includes an analysis of, and a plan for, the management, reduction, and recycling of solid waste for Maine. While not required, this year's Plan also includes information about existing disposal capacity in order to plan for projected capacity needs. Information in this Plan includes the 2022 data normally included in the Waste Generation and Disposal Capacity Report (38 M.R.S. § 2124-A) which is not due again until January 15, 2026. While this Plan includes the key elements required by statute, many additional elements are included in this Plan to paint a broader picture of how solid waste is managed, handled, and disposed of in Maine. All of these factors combined are complicated and intertwined with geography, transportation and logistics, business and economics, and policy. This report evaluates some of those intertwined factors and also highlights steps that are being taken to better understand these complexities, and what the Department can do to enhance management of waste streams in Maine.

Maine is currently faced with difficult challenges regarding waste management, ranging from the sufficiency of long-term disposal capacity to infrastructure gaps and inconsistent access by Maine communities to programs such as recycling or composting. All of these challenges play an important role in Maine's ability to meet statutory goals of the solid waste management hierarchy including waste reduction and waste diversion. As a path forward to finding solutions to these challenges, multiple comprehensive assessments are currently underway that will provide significant insight into Maine's waste streams, the results of which will lend certainty and credibility to future planning efforts. These studies are described in greater detail within the Plan and include a comprehensive analysis of food loss and waste, the components of municipal solid waste and construction and demolition debris, and sludge capacity and management solutions. It is critical the comprehensive data from these studies allow for appropriate solutions to be identified for Maine's challenges.

The key takeaways from this Plan include the following:

- Maine is currently grappling with a shortage of waste disposal options for the Eastern Maine Region.
- The expansion of Juniper Ridge Landfill ("JRL") in Old Town will be necessary to ensure there is adequate capacity for the entire State of Maine over the next 10 years.
- Assuming an expansion of JRL takes place, Maine has between 15-20 years of capacity left for its statewide waste disposal (with the exception of Aroostook County which has about 40 years capacity remaining).
- To best manage the waste disposal capacity concerns the Department will plan for enhanced waste reduction and diversion programs as well as evaluate key infrastructure needs for waste disposal.
- Increases in waste disposal capacity for Maine will likely need to include expanding landfill space, full operation of incineration and waste processing facilities, and/or implementing new technologies to treat waste streams to either reduce volume or prevent the need for landfilling.

- Current assessments underway will help inform the Department of how to best enhance waste reduction and diversion programs. One of these assessments is complete, while the others are anticipated to be completed in 2024, 2025 and 2026.
- Implementation of the product stewardship program for packaging materials will play an important role likely beginning in 2026 in waste reduction and reuse, while simultaneously supporting recycling efforts at municipalities by 2027.

This Plan is based on the best available data at the time of its release, including input provided by the public, and other publicly available information. Prior to development of this Plan, the Department hosted a series of five regional stakeholder meetings seeking input for updating this Plan. The meetings were held from late June to early August of 2023 in Presque Isle, Machias, Orono, Augusta, and Portland. Meetings were accessible both in-person and remotely, ensuring all interested parties were able to participate. As a result, the Department received valuable feedback that is discussed in this Plan.

I. Introduction

This 5-year update to Maine's Materials Management Plan has been prepared in accordance with 38 M.R.S. § 2122, which states: "The department shall prepare an analysis of, and a plan for, the management, reduction and recycling of solid waste for the State." 38 M.R.S. § 2123-A requires that, "[t]he State Plan [to] include the following elements:

1. Waste characterization. The state plan must be based on a comprehensive analysis of solid waste generated, recycled and disposed of in the State. Data collected must include, but not be limited to, the source, type and amount of waste currently generated; and the costs and types of waste management employed including recycling, composting, landspreading, incineration or landfilling.

2. Waste reduction and recycling assessment. The state plan must include an assessment of the extent to which waste generation could be reduced at the source and the extent to which recycling can be increased.

3. Determination of existing and potential disposal capacity. The state plan must identify existing solid waste disposal and management capacity within the State and the potential for expansion of that capacity.

4. Projected demand for capacity. The state plan must identify the need in the State for current and future solid waste disposal capacity by type of solid waste, including identification of need over the next 5-year, 10-year and 20-year periods."

38 M.R.S. § 2122 also requires that each plan update must be based on the priorities and recycling goals established in 38 M.R.S. §§ 2101 and 2132 and must provide guidance and direction to municipalities in planning and implementing waste management and recycling programs at the state, regional and local levels. The Department published its initial statewide Materials Management Plan in January 2014, and updates it every 5 years to incorporate changes in waste generation trends, changes in waste recycling and disposal technologies, development of new waste generating activities and other factors affecting solid waste management.

The Department views this Plan as an opportunity to comprehensively evaluate and provide information regarding materials management throughout the state. Stakeholder meetings were convened in Presque Isle, Machias, Orono, Augusta, and Portland to assist in this Plan's development and content. Recordings and transcripts for the stakeholder meetings are available on the Department's Materials Management Plan for Solid Waste and Recycling webpage. The Department thanks all stakeholders who attended these meetings virtually or in person for their participation and input to this Plan.

Based on an analysis of current waste management practices in Maine and guided by Maine's Solid Waste Management and Food Recovery Hierarchies (see Appendix A), this 5-year update includes strategies and actions focused on:

1. Increasing waste reduction, food rescue, goods repair (electronics, clothing, furniture, etc.), and reuse initiatives;

2. Continued focus on increasing the diversion of organics from disposal;

3. Diverting materials from landfill disposal;

4. Exploring potential pathways to broaden the economic feasibility and appeal of materials recovery such as green jobs training programs or small business opportunities not yet widely developed in Maine; and

5. Evaluating strategic needs for expansion of waste disposal capacity (landfilling and incineration) and waste processing technologies.

This Plan highlights key challenges with meeting Maine's statutory solid waste disposal reduction and diversion goals and suggests areas of potential exploration and action to determine their suitability for implementation in Maine. Such action will require investments in additional waste management and recycling infrastructure.

II. Waste Generation and Characterization

A. Waste Generation

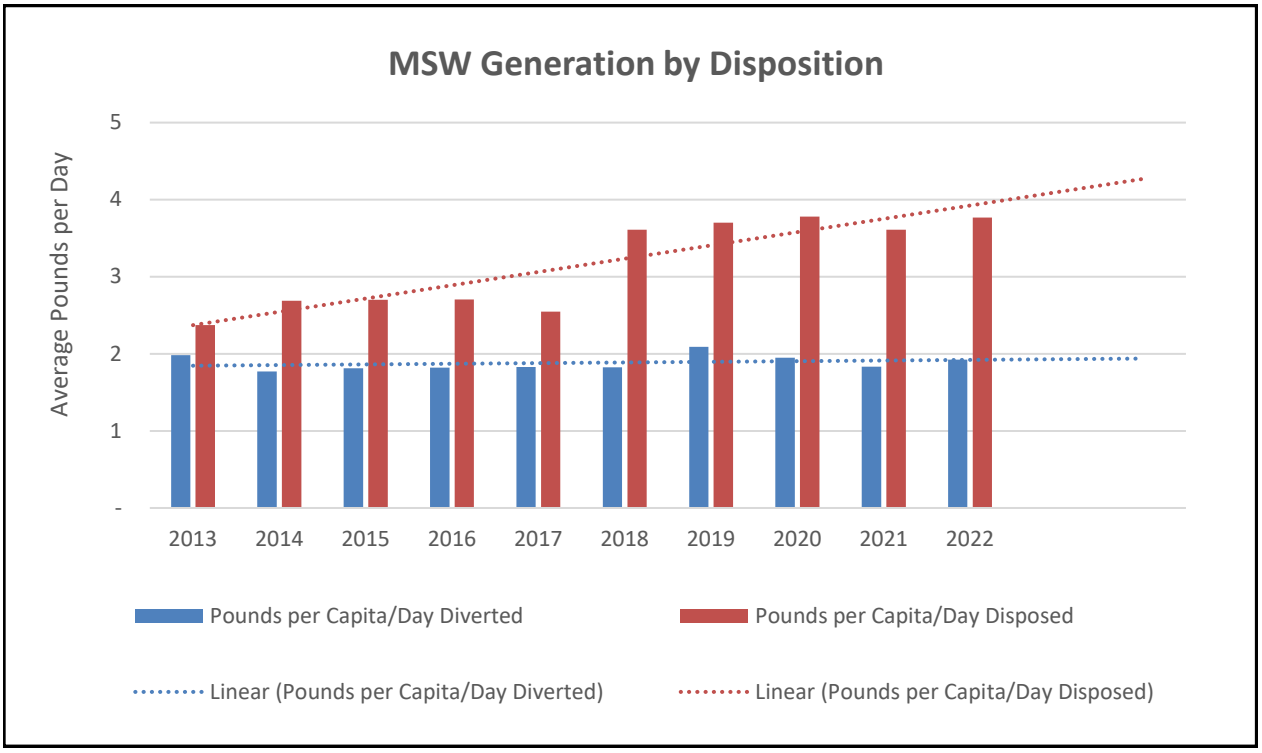
Solid waste, defined by 38 M.R.S. § 1303-C(29) as "useless, unwanted or discarded solid material with insufficient liquid content to be free-flowing," is generated by Maine's households and industrial, commercial, and institutional sectors. 38 M.R.S. § 1305 assigns responsibility for the management of the municipal solid waste ("MSW") to each municipality specifying that "[e]ach municipality shall provide solid waste disposal services for domestic and commercial solid waste generated within the municipality." As there is no specific guidance provided, each municipality chooses how to meet its own responsibility by managing MSW through a combination of municipal and commercial waste handling services, facilities, and systems. Industrial and institutional generators manage the solid waste they generate through their own privately-owned facilities or through contracting with commercial services. While this market-based approach has provided municipalities and other entities with control over how to manage their waste materials, it has become increasingly clear that market failures are contributing to systemic issues such as increased disposal; limited competition among service providers that can increase costs for municipalities; underdeveloped infrastructure, particularly for waste diversion programs; and pricing structures that strongly favor disposal over diversion across much of the state.

Every two years, the Department develops and submits a Waste Generation and Disposal Capacity Report ("WGDC Report") to the Joint Standing Committee on Environment and Natural Resources pursuant to 38 M.R.S. § 2124-A. The WGDC Report provides an overview of Maine's solid waste generation, diversion, and disposal activities during the previous two calendar years, and an evaluation of Maine's progress toward our waste reduction and recycling goals, some of the same reporting requirements for this Plan. It also includes a projection of the solid waste disposal needs of Maine for the next 5, 10, and 20 years, and how the fill rate at each solid waste landfill could affect the expected lifespan of that landfill. Recent years' WGDC reports can be found online at https://www.maine.gov/dep/publications/reports/index.html.

For the past several years, the WGDC report has been a biennial report. However, 38 M.R.S. § 2124-A was amended in 2023[1] to modify the frequency for the WGDC Report to an annual basis. Since reporting requirements for both reports are similar, the Department has combined the 2024 WGDC Report for the 2022 reporting year with this Plan.

Review of the WGDC Reports from the past several years shows that the amount of MSW disposed in Maine has been trending up, while diversion (including all tracked food rescue, animal feed, repair and reuse, recycling, composting, anaerobic digestion, etc., for which data is available[2]) has remained roughly constant although this data is limited. The per capita disposal and diversion rates are depicted in Figure 1 below.

Figure 1. Municipal Solid Waste Generation Per Capita

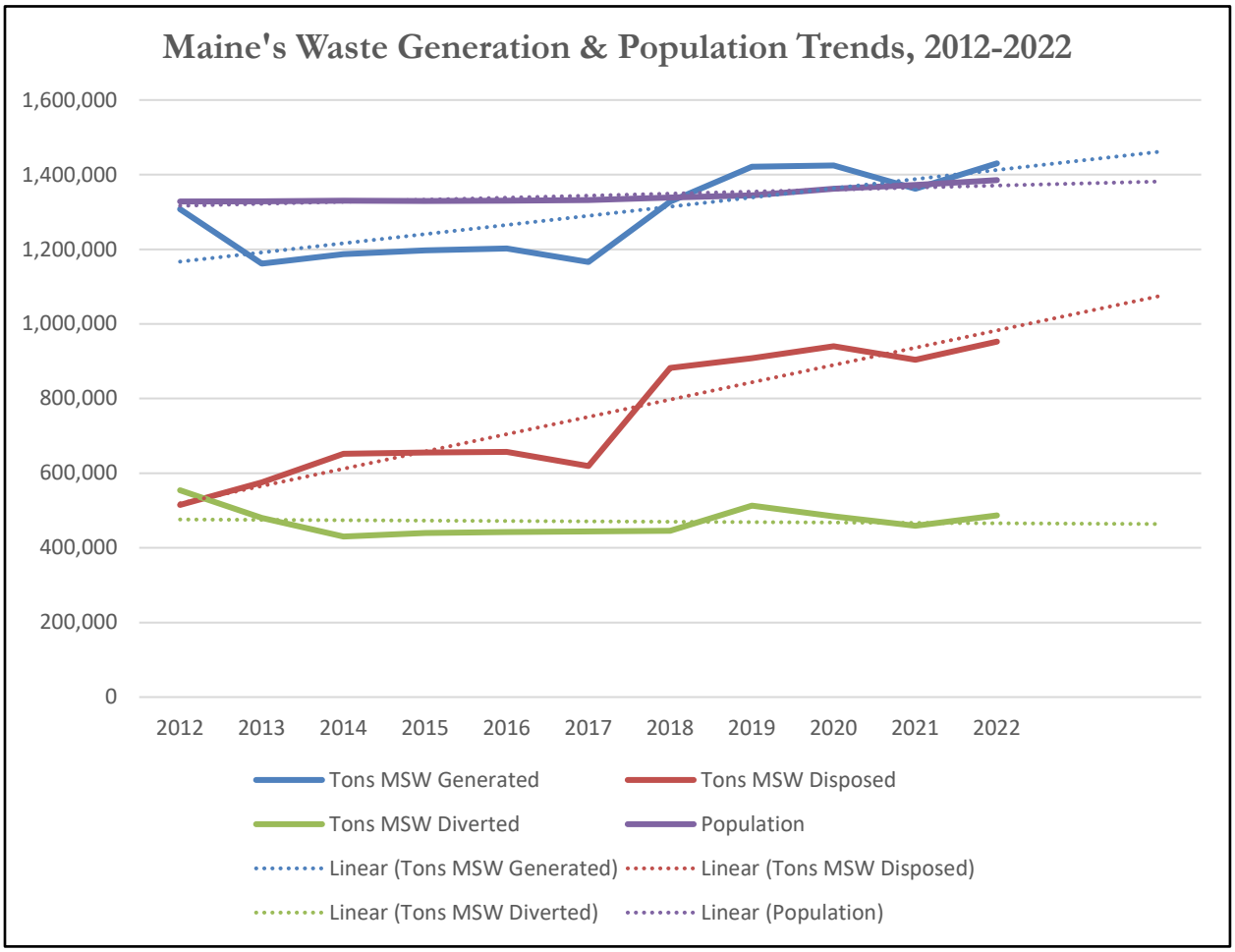


Maine's population is growing but the per capita data suggests that the increase in disposal tonnage is not simply a factor of increased population. As shown in Figure 2 below, Maine's disposal tonnage is trending upward faster than the population is growing, while tracked diversion activities remains flat. Subsequently, additional waste disposal capacity will be needed in the long-term, unless there is additional infrastructure in place as well as robust implementation of statewide diversion programs to recover recyclables and organics, and other materials that could

[1] 38 M.R.S. § 2124-A was amended in 2023 by L.D. 1172 – *An Act to Reestablish Annual Reporting on Solid Waste in Maine.* This law requires submittal of the WGDC Report on or before January 1, 2026 and annually thereafter.
[2] Data for food rescue, animal feed, and repair and reuse is extremely limited; this likely represents only a small subsection of the total quantity of material diverted through such activities.

be diverted from waste disposal. Systemic changes and infrastructure investments will be necessary to reverse this trend.

Figure 2. Waste Management and Population Trends 2012-2022[3]



B. Waste Characterization

1. Studying Waste in Maine

As described in more detail below, the Department is in the process of moving forward with several different studies to better characterize and understand waste streams in Maine. These studies will be utilized by the Department to assist in long-term waste management planning by providing a comprehensive understanding of the composition of waste currently being disposed. This will allow the Department to target majority components of the waste stream

[3] MSW disposed includes MSW incinerated, landfilled, and exported for disposal. It does not include MSW incinerator ash, which is a special waste that was included with MSW totals until 2018, when the Department decided to include that material with special waste totals. While incinerator ash is a residue of incinerating MSW, it is classified as a special waste ("SPW") in Maine.

for future reduction, diversion, recycling, composting, and anaerobic digestion, and reduce the overall amount of material requiring disposal. It will also aid in planning for the best management of the available space in our landfills and the capacity of Maine's other waste management facilities. Below is a discussion of each of the studies that will be providing critical information that will be necessary in the next phase of solid waste management planning for Maine.

a. General/All Waste Stream Study

The composition of waste generated in Maine and disposed in Maine's facilities can be quite varied. As an example, Table 1 presents the waste types disposed at the Juniper Ridge Landfill ("JRL") in Old Town. The sort categories for a waste characterization study being conducted (discussed later in this Report) on behalf of the Department in 2024 can be found in Appendix B.

Although the Department has not conducted a formal waste characterization study, the Department has evaluated the data provided by various waste management facilities in annual reports submitted to the Department. To supplement this evaluation, the Department is also in the process of contracting a comprehensive statewide audit called a Waste Characterization Study ("WC Study") to begin in 2024. The data gathered from this statewide WC Study will provide a baseline of data for Maine's waste streams and by sector to include the types, amounts and sources of materials generated and destined for disposal. In addition, the WC Study will provide the state with an improved understanding of the sources, content, and condition of construction and demolition debris ("CDD"). It is anticipated that this WC Study will be completed by the beginning of 2025. Funding for the WC Study was provided by the United States Environmental Protection Agency ("USEPA") Solid Waste Infrastructure for Recycling ("SWIFR") grant. This SWIFR grant program includes funding specifically to states for waste characterization studies. Once the WC Study is completed, it will be appended to this Plan and will include additional recommendations based on the study's findings.

Table 1. Summary of Wastes Accepted at Juniper Ridge Landfill in 2022

MSW & CDD Wastes	**Total (tons)**
Bypass MSW	276,619
CDD/MSW Processing Residue - OBW (Disposed of in the Original 2004 Permitted Footprint)	4,222
CDD/MSW Processing Residue - OBW (Disposed of in the Expansion Permitted Footprint)	74,950
CDD Processing Residue - Fines	73,689
Mixed CDD	332,290
Wood from CDD	147
Residue/Trash from Single Stream	7,064
Total MSW & CDD	**768,981**[4]
Special Wastes (SPW)	**Total (tons)**
Burn Pile Ash and/or Hot Loads Area Ash	239
Burnt Structure Debris/Ash	1,828
Catch Basin Grit & Street Sweeping	680
Coal, Oil & Multi-fuel Boiler Ash	4,259
Contaminated Soil & Debris	20,977
Industrial (Miscellaneous)	525
Industrial WWTP Sludge	15,888
Leather Scraps	70
Lime Mud/Grit	4,784
MSW Incinerator Ash	29,502
Municipal WWTP/POTW Sludge	78,383
Non-Friable Asbestos	561
Non-Hazardous Chemical Related	1,033
Oil Spill Debris	1,037
Polyethylene & Cellulose Trimmings	1,917
Pulp Mill Waste	751
Sandblast Grit	533
Spoiled Foods	458
Sulfur Scrubbing Residues	545
Water/Air Filtration Media	10
WWTP Grit Screenings	692
Total SPW	**164,672**

[4] Totals for Waste Types (MSW, CDD, and SPW) in Table 1 are based on adding the individual tonnages by material type and vary slightly from the table provided within Juniper Ridge Landfill's annual report most likely due to rounding.

b. Food Waste Stream Study

In addition to the WC Study, the Department is also conducting a Food Loss and Waste Generation Study ("FLWG Study") funded by a Climate Pollution Reduction Grant from USEPA[5], which will provide extensive insight into the locations, types, and quantity of food loss and waste, as well as the quality of that food, across the state. Information gathered from studies in other states and municipalities have shown that food scraps, food-related wastes, and other organic materials may comprise roughly 40% of Maine's solid waste stream and are for the most part suitable for diverting into higher and better uses in a range of activities from feeding hungry people or animals to being transformed into valuable soil amendments that may improve the health and vitality of agricultural land and soils.

To strategically plan for addressing food loss and waste, it is imperative that the Department gather reliable data on how much food is generated and wasted and how that waste is currently managed, as well as characterizing the quality of the surplus food to identify higher and better uses. The FLWG Study will provide comprehensive data on the quantity, quality, types, and sources of surplus food and food scraps currently generated by geographic location. Additionally, data collected will be broken down by generating sector and geographic location, providing a robust source of information about surplus food generation by entities such as grocers, farmers, restaurants, food pantries, schools and universities, prisons, hospitals, and other businesses generating food-related wastes. The data collected from this study will allow the Department to prepare an informed analysis, and a plan for moving food up the food recovery hierarchy within the entire State in an effort to mitigate hunger as well as reduce greenhouse gas emissions and conserve the energy, water and financial capital embedded in wasted food, with an added benefit of improving soil health by recovering nutrients and returning them to agricultural land and soils.

This assessment is the first phase in the state's movement towards developing a comprehensive plan for addressing food loss and waste in Maine. Initially, the results of this assessment will be used as the basis for an assessment of the greenhouse gas emissions impact from food loss and waste. This assessment will also be used as the baseline for an initial assessment of the current waste management infrastructure's ability to meet Maine's greenhouse gas emissions reduction goals and waste reduction and diversion goals and provide recommendations for infrastructure improvements.

c. Sludge/Biosolids Waste Stream Study

A significant issue that has come to the forefront in recent years which will likely influence multiple aspects of materials management from recycling to landfilling to organics management in the future is the presence of per- and polyfluoroalkyl substances ("PFAS"). Used in household products, industrial settings, and firefighting foam since

[5] In collaboration with the Governor's Office of Policy Innovation and the Future ("GOPIF"), which is passing grant funding through to the Department to conduct the FLWG Study.

the early 1950s, these chemicals are persistent and bioaccumulative in the environment.[6] The Maine Legislature has enacted a number of laws relating to PFAS including a ban on the land application, distribution or sale of sludge and sludge-derived products, effective August 2022[7], a ban on carpets, rugs, and fabric treatments with intentionally added PFAS, effective January 2023, as well as a ban on products with intentionally added PFAS effective January 2030.[8] Rulemaking is currently underway to prohibit PFAS in certain food service packaging.[9]

With the passage of the ban on the land application of sludge and sludge-derived products, this material is being almost exclusively driven toward Maine's landfills because there is a dearth of other options for economically viable disposal in both the state and region.[10] The physical nature of this material complicates landfill operations requiring the use of bulking material, sometimes at a high ratio, to provide landfill stability. The use and type of sludge bulking material is generally landfill-specific and can consist of various types of wastes like CDD (including bulky wastes), ash, and soil, although bulky wastes are preferred. Adding more wastes in the form of both sludge and bulking materials increases the overall rate at which Maine landfills will reach maximum capacity.

In response to the marked increase in municipal Wastewater Treatment Plant ("WWTP") sludge and associated bulking materials disposed in Maine starting in 2022, as well as challenges to landfill operations that occurred in early 2023, the Department, in collaboration with the Maine Water Environment Association ("MWEA"), commissioned a study to evaluate sludge management practices in Maine and make recommendations for the future. It is intended that this study will provide important information that may be useful for policy decisions moving forward. This study, An Evaluation of Biosolids Management in Maine and Recommendations for the Future, was completed on December 15, 2023. The study assesses current sludge generation rates, limiting factors at landfills (for example, limits on wet wastes and the need for bulking agents), uncertainty of future landfill capacity in Maine, and different types of sludge management strategies. The strategies recommended include volume reduction by dewatering, anaerobic digestion, thermal drying, as well as PFAS destruction technologies for piloting in Maine. The study also provides information relating to both costs and feasibility of each of the recommendations.

---

[6] See EPA's guide to PFAS for more information: https://www.epa.gov/pfas/pfas-explained.

[7] See 38 M.R.S. § 1306(7).

[8] See 38 M.R.S. § 1614.

[9] See 32 M.R.S. § 1733(3-B).

[10] In March 2023, the Department investigated alternative outlets other than in-state landfill disposal for sludge generated from municipal WWTPs. It became clear that Maine had no other alternatives available within the state for disposal of this waste stream. Operators of Sewage Sludge Incinerators ("SSIs") and landfills in the entire northeast region had no additional capacity to take Maine's sludge. As a result, options remaining were to ship the waste stream to a company in New Brunswick, Canada to use to make sludge derived compost or to ship the waste to landfills as far away as Ohio or South Carolina. Sending to Canada proved to be the most economically viable outcome despite a steep rise in costs to WWTPs. More background information is available in this report An Evaluation of Biosolids Management in Maine and Recommendations for the Future.

As volume reduction and PFAS destruction strategies are developed and implemented for managing sludge, the need to rely solely on landfills for disposal will shift. Across the country, researchers are working on technologies that will allow for treatment and destruction of PFAS in several types of media including sludges.[11] Should any of these technologies become feasible to scale up and deploy in a cost-effective manner, the door might be reopened for a cautious return to agronomic utilization, with proper sampling and monitoring to ensure that the treated materials are safe for such use. Because these technologies are still in pilot phase, the return to agronomic utilization is likely several years in the future and will not provide a short-term solution for Maine's landfill capacity challenges. Until these technologies become economically viable and scaled to work in Maine, landfill capacity will need to be managed to include disposal of sludges and necessary bulking materials.

d. Packaging Material Waste Stream / Recycling Needs Assessment Study

38 M.R.S. § 2146 enacted in 2021, requires the Department to establish a new product stewardship program for packaging materials. The overall intent of the program is to reduce the amount of packaging from consumer products that go into the landfill and to provide a mechanism to compensate municipalities for handling these packaging materials. The legislature determined that a significant volume of waste going into landfills is in part due to the amount of packaging materials that are used in consumer products (and that are used in shipping of products by third party sellers). The intent of this new law was to create a new program using a producer responsibility model to incentivize producers to reduce the generation and use of unnecessary packaging materials, and thus lower the overall volume of these materials needing a place for waste disposal. Rules for this new program are currently being developed. As part of this program a statewide needs assessment for recycling will be conducted. This assessment will not be completed until the new program is in place and will likely be completed sometime after 2026. This study, which will be funded by producers of packaging, will provide valuable information regarding gaps in Maine's recycling programs with respect to packaging.

[11] See PFAS Disposal and Destruction Research | US EPA and DEP's website on Treatment and Disposal for PFAS - PFOA and PFOS, Maine Department of Environmental Protection.

2. Current Understanding of Maine's Waste Streams

This section of the report will focus on Maine's current understanding of its waste streams. As explained in Section 1, the Department is looking forward to amassing new information about its waste streams so that it can better plan into the future. Until information is obtained from the completed studies, the Department is relying on other sources of existing information including Annual Reports from waste disposal and waste processing facilities, Recycling Establishment Reports, and Municipal Recycling Progress Reports submitted to the Department.

a. Construction and Demolition Debris ("CDD")

Using the existing information listed above, the Department prepares a biennial WGDC Report outlining the waste generated and ultimately disposed of in Maine. Providing a delineation of waste by type and sector is beyond the statutory scope of the WGDC Report, however, the report provides a basic analysis of the following waste streams: MSW, CDD and similar material, SPW, and wood wastes. As shown in Figure 3 below, MSW comprises the majority of waste generated in Maine, followed by CDD, with other materials making up a smaller proportion of the overall waste managed. Also illustrated in the figure is the amount of material that landfill owners received for cover material and other uses by the landfill, which may include a wide variety of permitted materials, including CDD, processing residues from CDD, and other special wastes. As CDD is the second largest category of waste, this Plan will focus on its generation and disposal in more detail. Future addendums to this Plan will incorporate the results and recommendations of the WC Study and the FLWG Study once completed. Figure 3 below includes total Maine-generated wastes disposed within Maine landfills and incinerators, and wastes generated within Maine and exported to out-of-state landfills for disposal. Waste tonnage used as cover material is included as this material also takes up valuable space within landfills.

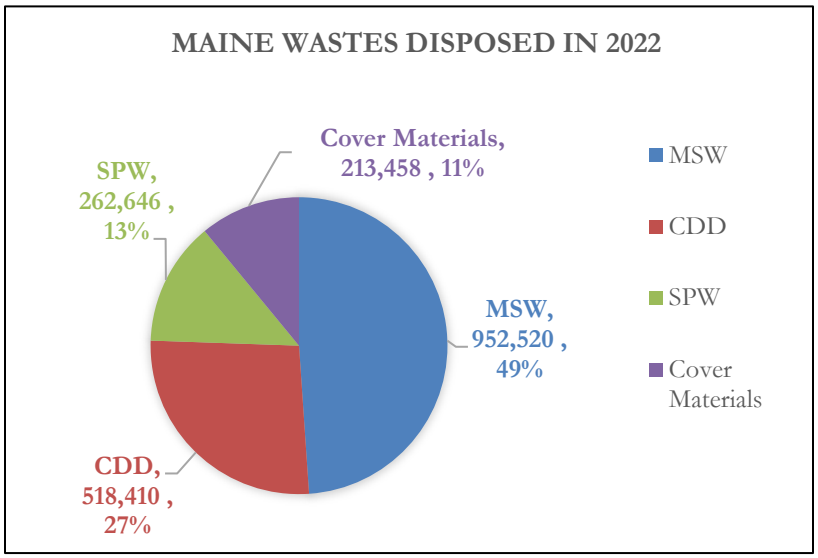
For comparison, while CDD makes up nearly 30% of Maine's waste stream, not including the significant amounts of cover material comprised of CDD, Vermont's 2018 waste characterization study showed that CDD makes up just 16% of its waste.[12] Like Maine, New Hampshire and Vermont are both in the process of conducting waste characterization studies that will be available in the beginning of 2025. Study results from Vermont and New Hampshire will provide a valuable and interesting comparison to the composition of Maine's waste stream.

Several facilities in Maine receive CDD or other wastes and process them to recover materials such as metal, wood chips, or plastics. After processing, much of the residue or waste that cannot be recovered is then sent to disposal facilities. Some of these

[12] See: https://dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/2018-VT-Waste-Characterization.pdf.

processing residues can be used for landfill cover and shaping, while some materials are not suitable for an alternate use within the landfill and must be managed as waste.

Figure 3. Maine Generated Wastes Disposed in 2022



Once processed by a Maine facility, any outgoing material from the facility is considered to be a waste generated within the state.[13] Processing facilities are required to be licensed by the Department. As permitted, these facilities may receive material from both within and outside of Maine as well as send disposal material to facilities within or outside of Maine.

As an example, Table 2 depicts the origin of material received by ReSource Waste Services of Lewiston LLC ("ReSource Lewiston") and WIN Waste Innovations in Eliot (formerly Aggregate Recycling Corporation), the two largest processing facilities in Maine by volume for 2022. The total amount of material sent to Maine landfills from these facilities in 2022 was 130,580 tons. Tables 3 and 4 specify the destinations of the materials leaving these facilities after processing. There are other smaller processing facilities that operate in a similar manner but are not highlighted here.

[13] Waste generated within the state is defined at 38 M.R.S. § 1303-C(40-A)(C).

Table 2. Origin of Materials Received at Large Maine CDD Processing Facilities in 2022

Facility	ME	MA	NH	CT	RI	Unknown[14]	Total
ReSource Lewiston (Tons)	36,563	87,991	40,123	-	-	-	164,677
% of Total	22%	53%	24%	-	-	-	-
WIN Waste Innovations (Tons)	11,586	6,279	18,552	2	501	20,083	57,003
% of Total	20%	11%	33%	0.004%	1%	35%	-
Total Tons by State	**48,149**	**94,270**	**58,675**	**2**	**501**	**20,083**	**221,680**
Overall % of Total	**22%**	**43%**	**26%**	**0%**	**0%**	**9%**	-

Table 3. ReSource Lewiston Material Disposition

	Recycling (Non-Landfill Use)	Landfill Use (shaping, grading, cover, etc.)	Maine Landfill Disposal	Total to Maine Landfill	Total Tons
Percent of Total Tons by Disposition	9%	44%	47%	91%	-
Amount from Maine[15] (Tons)	3,470	16,331	17,519	33,850	37,320
Proportional Amount from OOS[16] (Tons)	12,158	57,222	61,385	118,607	130,765
Total Tons	**15,628**	**73,553**	**78,904**	**152,457**	**168,085**

[14] These materials were received prior to when the facility began tracking the origin of received material.

[15] The proportional amount for Maine is based on the percent of waste materials received at the facility originally generated in Maine. For example, approximately 22% of the materials received at ReSource Lewiston was from Maine in 2022.

[16] The proportional amount for OOS ("Out-of-State") is based on the percent of waste materials received at the facility originally generated in another state. For example, approximately 78% of the materials received at ReSource Lewiston was from Massachusetts and New Hampshire in 2022.

Table 4. WIN Waste Innovations Material Disposition

	Recycling (Non-Landfill Uses)	Ash Landfill (Ground Cover) - Exported to MA	Maine Landfill Disposal	Total Tons
Percent of Total Tons by Disposition	3%	15%	81%	-
Proportional Amount from Maine[17] (Tons)	429	1,925	10,335	12,689
Proportional Amount from OOS[18] (Tons)	1,716	7,701	41,341	50,758
Total Tons	**2,145**	**9,626**	**51,676**	**63,447**

Materials diverted from a landfill by ReSource Lewiston's processing included 11,572 tons of various materials including CDD wood chips sent for particle board production, plastics, sheetrock, tires, and aggregate sent for fill or further processing. According to the Annual Report submitted to the Department by Resource Lewiston, 73,553 tons were sent to the JRL for shaping, grading, cover, or use in landfill venting systems in 2022. WIN Waste Innovations similarly accepted a larger quantity of materials from other states than from within Maine and sent a larger quantity of waste to Maine landfills than it received from within Maine, as shown in Tables 2 and 4. For example, WIN Waste Innovations received approximately 11,586 tons of waste from Maine in 2022, during which time the facility received approximately 25,334 tons from other New England states, and, prior to tracking the state from which material was received, took in about 19,235 tons of mixed construction and demolition debris and 848 tons of ground asphalt shingles for which the origins are unknown. WIN Waste Innovations took in approximately 57,003 tons of material in total and sent just over 50,000 tons of debris to Maine landfills, with the majority (46,457 tons) going to JRL. In some cases, the amount of outgoing waste or recyclable material reported for a calendar year may be greater than the amount accepted by a facility during that year due to materials that had been stored on-site from the previous year's activity.

b. Problematic Material[19]

Some wastes that are not present in the waste stream in large quantities are still challenging for waste handling, processing, and disposal facilities. These wastes are

[17] The proportional amount for Maine is based on the percent of waste materials received at the facility originally generated in Maine; for example, approximately 20% of the materials received at WIN Waste Innovations was from Maine in 2022.

[18] The proportional amount for OOS is based on the percent of waste materials received at the facility originally generated in another state; for example, approximately 80% of the materials received at WIN Waste Innovations was from Massachusetts and New Hampshire in 2022.

[19] Problematic materials are unwanted materials that are difficult to manage in household and commercial waste such as mercury-containing auto switches, thermostats, and bulbs; rechargeable batteries; and paint. These materials can be challenging to manage due, in part, to their chemical composition, fire potential, or detriment to the environment if spilled.

described in more detail in this section. Some of these waste types are managed through product stewardship programs in Maine, as described in the Department's Annual Product Stewardship Report. Other waste types in this category require more robust handling, processing and disposal measures. Once the WC Study has been completed, the Department may evaluate further whether any special measures should be taken for wastes that fall into this category.

i. Producer Responsibility Programs

Maine currently has product stewardship programs, which aid in diverting the following materials from disposal:

- Mercury auto switches (38 M.R.S. § 1665-A);
- Specific electronic devices (38 M.R.S. § 1610);
- Cell phones (38 M.R.S. § 2143);
- Mercury thermostats (38 M.R.S. § 1665-B);
- Mercury-added lamps (38 M.R.S. § 1672);
- Paint (38 M.R.S. § 2144);
- Rechargeable batteries (38 M.R.S. § 2165); and
- Pharmaceuticals (38 M.R.S. § 1612).

Maine is currently in the process of establishing an Extended Producer Responsibility Program for Packaging ("EPR Packaging Program") to meet the requirements set forth in 38 M.R.S. § 2146. It is anticipated that this program will begin operation in 2026 with municipalities receiving reimbursements for some of the costs related to handling packaging materials in 2027.

ii. Beverage Redemption Container Program

Maine has a returnable beverage container program pursuant to 38 M.R.S. §§ 3101 - 3119, which is a type of product stewardship program as it places some responsibility on entities other than consumers and municipalities to recover materials. All material collected as part of the returnable beverage container program is required to be recycled.

iii. Household Hazardous Waste ("HHW") and Waste Pesticides

In recent years, Department staff have noticed an increase in inquiries about Household Hazardous Waste ("HHW") and Waste Pesticides. HHW is a term used to describe any hazardous waste material excluded from identification as a hazardous waste by 06-096 C.M.R. ch. 850, § 3(A)(4)(vii) because it is generated by households, including single and multi-family residences, hotels and motels, bunkhouses, picnic grounds, and day-use recreational facilities. These materials are exempt from the precautionary handling requirements that apply to commercially generated hazardous waste. Many waste pesticides are banned from landfilling while some are not, meaning that some may be disposed of in a landfill.

Options to manage pesticides and other types of HHW are extremely limited in many regions of Maine. This results in more items being disposed of in Maine's landfills that could be diverted.

For waste pesticides, the Maine Board of Pesticides Control conducts a program each October to collect and properly dispose of banned and unusable pesticides from homeowners and farms. Pre-registration is required, registration numbers are limited, and collections are held at just four sites across the state one day per year, so the program, while important, is limited in scope and capacity.

For HHW, there are only two permanent collection sites open to all Maine residents; however, they are only open on a seasonal basis (not in winter) and are both located in the Southern part of the State (Lewiston and Portland). Disposal at these facilities is expensive and often inconvenient for many Maine residents.[20] While some municipalities provide one-day collection events for HHW, these are not consistent or routine, and due to the costs, many municipalities have ceased holding HHW collection events altogether.

iv. Consumer Electronic Products and Batteries

With the proliferation of consumer electronics, more electronic devices and batteries are making their way into the municipal waste stream, from laptop computers and tablets to vape pens. Many of these products are recycled through Maine's product stewardship program for electronic wastes. Non-covered products are likely to end up in the landfill or to be managed at a waste processing facility. The Department anticipates further information about these types of wastes in the upcoming WC Study and will also be addressing these wastes in the 2024 Product Stewardship Report.

III. Waste Reduction, Diversion, and Recycling Assessment

A. Laws Addressing Recycling and Diversion Goals

Maine has several relevant laws addressing recycling and waste diversion. 38 M.R.S § 2101 establishes a Solid Waste Management Hierarchy to be used as guiding principles in decision-making for the management of solid waste. 38 M.R.S. § 2101 sets forth an integrated approach to solid waste management with waste reduction as the highest priority, followed by reuse, recycling, composting, waste processing to reduce waste volume including waste-to-energy, and landfilling as the management option of last resort. 38 M.R.S. § 2101-B, the Food Recovery Hierarchy, provides additional guidance on the management of food waste within the context of the Solid Waste Management Hierarchy. It prioritizes reducing surplus food generation at the source, donating surplus food to feed hungry people, diverting food scraps for use as animal

[20] Fee structures vary from $3.50 per pound or $6.50 per gallon to $33-$40 per unit, depending on the facility and whether the person dropping materials off is part of a municipality that has arranged for reduced fees.

feed, composting of food scraps and diversion to waste utilization technologies to create fuels and recover energy, and finally, incineration or land disposal.

Additionally, Maine's laws have established specific recycling and waste reduction goals including:

- 38 M.R.S. § 2132(1) A goal to recycle or compost50% of the MSW tonnage generated each year within the State by January 1, 2021.

- 38 M.R.S. § 2132(1-B) A goal to reduce the statewide per capita disposal rate of MSW tonnage to 0.55 tons disposed per capita by January 1, 2019 and to further reduce the statewide per capita disposal rate by an additional 5% every 5 years thereafter. This incremental goal of reducing waste by 5% every 5 years provides a mechanism to measure progress at the municipal level.

- 38 M.R.S. § 2133(1-A) Municipal responsibilities for meeting the goals above. Municipalities are not required to meet the state recycling goal in 38 M.R.S. § 2132, but they must *demonstrate* reasonable progress toward that goal, and the Department shall *determine* reasonable progress. While reasonable progress is not specifically defined in statute, the Department notes that the goals set in statute are used as criteria for determining progress.

It is important to clarify that composting, anaerobic digestion, and any waste reduction, reuse, or recovery of materials to prevent them from becoming waste is considered a municipal diversion effort. For example, communities hosting repair cafés or annual yard sales may use the estimated diversion amounts from such events to support their traditional recycling program or other established municipal programs to divert materials from disposal. This information may be reported by a municipality in their Municipal Recycling Report.

38 M.R.S. § 2133(7) outlines reporting requirements for municipalities to provide data to the State for evaluating progress toward the goals outlined above. Municipalities are required to report biennially on forms provided by the Department, on their solid waste management and recycling practices. The biennial report must identify the options available to residents and businesses within the municipality for managing solid waste, including any provisions for the separate management of reportable recyclable materials and organic waste and the disposal of other MSW, including CDD.

B. Reducing the Amount of Waste Generated

The Department's 2019 Plan identified that market conditions for solid waste management in Maine created significant drivers that worked against managing wastes higher up Maine's Solid Waste Management Hierarchy. Today this is still true. Simply put, it is expensive to start up a program where specific waste materials are separated out from other waste streams for recovery, even if such a program has the potential to save money and conserve disposal capacity in the long run. Additionally, given the constraints for the Department as discussed later, landfilling material is still currently the less expensive option. Table 5 below outlines Maine's progress toward waste reduction goals.

Table 5. Assessment of Progress Towards Per Capita Waste Reduction Goal

Maine MSW Disposal vs. Goal	2022
Tons MSW Generated and Disposed	952,520
Pounds MSW Generated and Disposed	1,905,039,782
Population	1,385,340
Tons per Capita	0.69
Pounds per capita	1,375
Tons per Capita Disposal Reduction Goal	0.55
Tons per Capita Short of Goal	(0.138)
Pounds per Capita Short of Goal	(275)
Per Capita Pounds Disposed per Week	26
Per Capita Pounds Disposed per Day	3.8

It is important to distinguish between waste generation and waste disposal. Waste generation includes the generation of all waste materials, even materials that are diverted from disposal and managed through an alternate pathway such as recycling or composting. These materials are still a waste that has been generated and requires management, but there is significant potential to improve processes and provide economic incentives to recover the resources in waste. Managing waste sustainably reduces the extraction of virgin natural resources, and often the energy use and other impacts related to extraction, processing, and transport of natural resources to produce new products.[21]

When we dispose of an item, we may not consider the waste that was generated in that item's production, or the resources that were consumed to produce the item. A way to better grasp the complete impacts of our waste is to consider the full lifecycle of goods, from resource extraction, processing and energy and water use to emissions. For example, disposing of food is a waste of the resources that go into producing food, including agricultural land, water, pesticides, fertilizers, and energy. The production, transport, storage, and other management of food generates significant greenhouse gas emissions that are wasted when the food goes uneaten. Surplus food or food scraps that end up in landfills generate methane, a potent greenhouse gas.

Capturing surplus food and food scraps prior to entry into the disposal pathway provides an opportunity to reduce reliance on disposal options while providing Maine's communities with an opportunity to prevent hunger or reuse these valuable nutrients to enrich soil while reducing greenhouse gas emissions.

EPA's Waste Reduction Model ("WARM")[22] is a tool designed to compare waste management scenarios, such as landfill or incineration of materials versus recycling, composting, or anaerobic digestion, to determine the potential greenhouse gas emissions reductions, energy savings, and economic impacts from different waste management practices. The WARM tool can also be

[21] https://www.epa.gov/warm/basic-information-about-waste-reduction-model-warm.
[22] The WARM tool may be accessed online at https://www.epa.gov/warm.

used to compare diversion activities higher up the waste and food recovery hierarchies, including food rescue, reuse, and waste reduction. Using Maine-specific data and a high-level summary of 2022's diversion activities, Table 6 provides an estimate of the greenhouse gas emissions reductions related to Maine's statewide food rescue, recycling, composting, and anaerobic digestion activities.

The WARM tool provides the estimated greenhouse gas emissions reductions in Metric Tons of Carbon Dioxide Equivalents ("MTCO2E"), along with a simple equivalent measure to understand the environmental impact by translating the metric tons of carbon dioxide into the equivalent avoided emissions of passenger vehicles[23] driven for a year.[24]

Table 6. Estimated Greenhouse Gas Reductions Based on 2022 Diversion Activities

Diversion Pathway (Compared to Landfill Disposal)	Greenhouse Gas Emissions (MTCO2E) Reduction[25]	Equivalent Annual Passenger Vehicle Emissions	Tons of Material Diverted from Disposal	Greenhouse Gas Emissions (MTCO2E) Reduction Per Ton Diverted
Food Rescue[26]	16,082.26	3,414.49	3,829.75	4.20
Traditional Recyclables	526,858.83	111,859.62	188,061.20	2.80
Scrap Metal Recycling	1,110,367.07	235,746.72	251,975.14	4.41
Compost (Food/Yard Waste)	2,742.26	582.22	7,663.77	0.36
Anaerobic Digestion	11,561.46	2,454.66	21,520.57	0.54
Total/Average (per Ton)	**1,667,611.87**	**354,057.72**	**473,050.43**	**3.53**

Traditional recyclables included in the scenario above include typical household packaging and paper, such as cardboard, paper, glass, beverage containers, plastic jugs, tubs, and film, and metal cans. The "food waste" and "yard trimmings" categories were used to calculate emissions reductions related to composting. The "food waste" category was also used to model food rescue, with a 1-3% (used 2% as the average) loss rate factored in, as per the EPA WARM tool guidance. The food rescue tonnage data sources are limited, and this tonnage data comes from just a few large chain retailers for which information was readily accessible by the Department. It is likely the actual food rescue quantities are significantly greater. The food wastes diverted via

[23] Passenger vehicles are defined as 2-axle 4-tire vehicles, including passenger cars, vans, pickup trucks, and sport/utility vehicles. The WARM tool is based on average U.S. vehicle mileage of 11,520 miles per year and a weighted average fuel economy of 22.9 across all vehicle types. See EPA's reference page for details: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references#vehicles.

[24] The WARM tool is not intended to be used as a Greenhouse Gas Emissions annual inventory tool as it reflects the full lifecycle of a waste. See the EPA Life-Cycle GHG Accounting Versus GHG Emissions Inventories fact sheet for details: https://www.epa.gov/sites/default/files/2016-03/documents/life-cycle-ghg-accounting-versus-ghg-emission-inventories10-28-10.pdf.

[25] Modeling in WARM is comparing diversion to landfill disposal.

[26] This includes food donation as well as animal feed donated to farms; uses that still resulted in the food being consumed rather than managed as waste.

anaerobic digestion include milk and brewery wastes, food waste, and other source-separated organics; the food waste category was also used to model their diversion in the WARM tool.

1. Recycling Assessment

Table 7 presents Maine's current recycling rate, including a breakdown of CDD and MSW disposition during 2022.

Table 7. MSW and CDD Disposition During 2022

Maine MSW Disposition	**Tons**
Maine MSW landfilled in state	515,474
Maine MSW disposed via waste-to-energy	382,609
Maine MSW disposed of out-of-state	54,437
Subtotal Maine MSW (exclusive of CDD) Disposed	**952,520**
Paper; cardboard; plastic, metal, and glass containers, textiles; and white goods recycled	188,061
Other MSW recycled (ferrous and non-ferrous scrap metal, and vehicle batteries)	255,142
Estimates for MSW reused (textiles, packaging, etc.)	9,523
Reported food rescue (food donation for human consumption)	3,565
Reported food rescue (animal feed)	1,223
Reported MSW composted (includes yard waste and food scraps, food processing waste; does not include backyard composting and <60 yds^3/month)	7,664
Anaerobic digestion (not including non-food commercial wastes such as de-icer, distillate or fats, oils, and grease)	21,521
Subtotal Maine MSW Reused, Rescued, Recycled & Composted/Digested	**486,698**
Total Maine MSW (exclusive of CDD)	**1,439,218**
Maine's MSW Recycling Rate (exclusive of CDD)	**33.8%**
Maine CDD Disposition	**Tons**
Mixed CDD disposed of in-state	505,282
Mixed CDD disposed of out-of-state	13,128
Processed CDD sent to a landfill for daily cover, shaping, and grading	76,664
Processed CDD recycled into new wood products	7,589
Processed CDD beneficially used as fuel	6,842
Subtotal Maine CDD recycled & beneficially used as fuel	14,431
Total CDD generated	609,506
Maine's CDD Recycling Rate (all non-landfill uses)	**2.37%**
Total MSW & CDD generated	2,048,723
Total MSW & CDD disposed (includes materials used in landfill for cover, shaping, and grading)	1,547,594
Total MSW, CDD, and organics recycled and composted (including wood waste used as fuel chips)	501,129
Maine's Combined MSW, CDD & Organics Recycling Rate	**24.46%**

The global economic impacts from changes in recycling policies discussed in our 2019 Plan[27] continue to have a lingering effect on recycling in the United States and across the world. Generally, recycling outlets continue to require higher quality bale specifications than in years past, which results in materials recovery facilities needing to invest more time and labor in sorting single-stream recycling to create bales of materials acceptable to available markets.[28]

The changed economics of recycling have caused many municipalities in Maine to consider curtailing or eliminating their programs. Some communities have faced steep increases in costs for recycling services from private sector companies. When these costs are greater than the cost of disposal some are opting to suspend recycling services, at least until recycling is less costly than disposal. As shown in Table 8 below, there is much greater variability and higher costs associated with recycling than with disposal fees for MSW or CDD.

Decreased market values have caused some towns that operate facilities which collect source-separated materials to stop collecting mixed plastics, redirecting this recycling stream to disposal. For example, in 2022 only 176 municipalities out of nearly 500 submitted recycling progress reports. Approximately 130 indicated that they offer some form of recycling program, but these vary greatly in terms of what materials can be recycled from a cardboard-only drop-off program to curbside recycling for commingled materials.

Table 8. Municipal Costs Reported for Recycling and Disposal

Cost Comparison Per Ton - Recycling vs. Disposal[29]				
	Recycling (Hauling)	**Recycling (Processing)**	**Disposal (MSW)**	**Disposal (CDD)**
Min	$55.00	$ -	$0.50	$17.00
Max	$900.00	$384.00	$225.00	$225.00
Median	$391.43	$85.00	$82.70	$95.86
Average	$440.80	$99.25	$86.90	$96.64

2. Current Diversion Programs

Maine has two programs that are specifically designed to assist with waste diversion; the Solid Waste Diversion Grant Program ("Waste Diversion Grant Program"), and the recently enacted EPR Packaging Program.

The Waste Diversion Grant Program provides grants to public and private entities to assist in the development, implementation or improvement of programs, projects, initiatives or activities designed to increase the diversion of solid waste from disposal in the State. The

[27] See the 2019 Plan update for additional information: https://www.maine.gov/dep/publications/reports/index.html.
[28] See: https://resource-recycling.com/plastics/2022/04/06/study-national-sword-increased-us-landfilled-plastic/.
[29] The majority of municipalities specified the tip fee per ton. For municipalities that did not specify, it is assumed that the amount they provided is the tip fee rather than the total cost.

Department offers these grants twice annually. The Department seeks proposals that will take advantage of regional economies of scale to increase organics management and recycling infrastructure in underserved areas of the state; promote waste reduction through reuse, repair and sharing economy initiatives (i.e., tool lending libraries or other equipment sharing programs); reduce wasted food through donation or other sharing initiatives; expand the types of materials managed through composting, recycling, and reuse; and address a statewide need.

The EPR Packaging Program's goal is to divert packaging material from disposal towards recycling and reuse. Producers of products will pay into a fund based on the amount and recyclability of packaging associated with their products. These funds will be used to reimburse municipalities for eligible recycling and waste management costs, make investments in recycling infrastructure, and help Maine citizens understand how to recycle. This program is currently in development and is expected to be operational in 2026 with the first payments to municipalities anticipated in 2027.

Aside from Maine's new EPR Packaging Program, most of the other product stewardship programs the Department administers handle waste materials that pose challenges for disposal rather than materials that make up a large portion of the waste stream. Not counting the EPR Packaging Program, there are currently eight active product stewardship programs administered by the Department.

Generally, the Department would benefit from a better understanding of municipal roadblocks to diversion programs and welcomes public feedback on the items below, which include comments received during the course of stakeholder meetings and written comments received for consideration in this Plan.

3. Steps to Assist with Waste Reduction and Increase Recycling Opportunities

The Department currently lacks in-depth knowledge about precisely what is in Maine's municipal solid waste stream, which makes it challenging to come up with an effective and comprehensive plan to divert waste materials by type. The statewide WC Study and FLWG Study will provide a great level of detail regarding what materials are being managed as waste, which will in turn allow the Department to prioritize materials for diversion.

IV. Determination of Existing and Potential Disposal Capacity

A. Increasing Need for Disposal Capacity

Over the past five years since the previous Plan update, Maine residents, businesses, and institutions have generated roughly 1,700,000 to nearly 1,900,000 total tons of waste per year, averaging approximately 1,790,000 tons for the five-year period. This accounts for all types of waste generated within the state, such as MSW, CDD, SPW, and cover materials that are often comprised of processed waste materials, and while necessary, still take up valuable landfill space (see Table 9). This total also includes waste generated within the state that was exported outside of Maine for disposal.

Table 9. Maine Generated Wastes

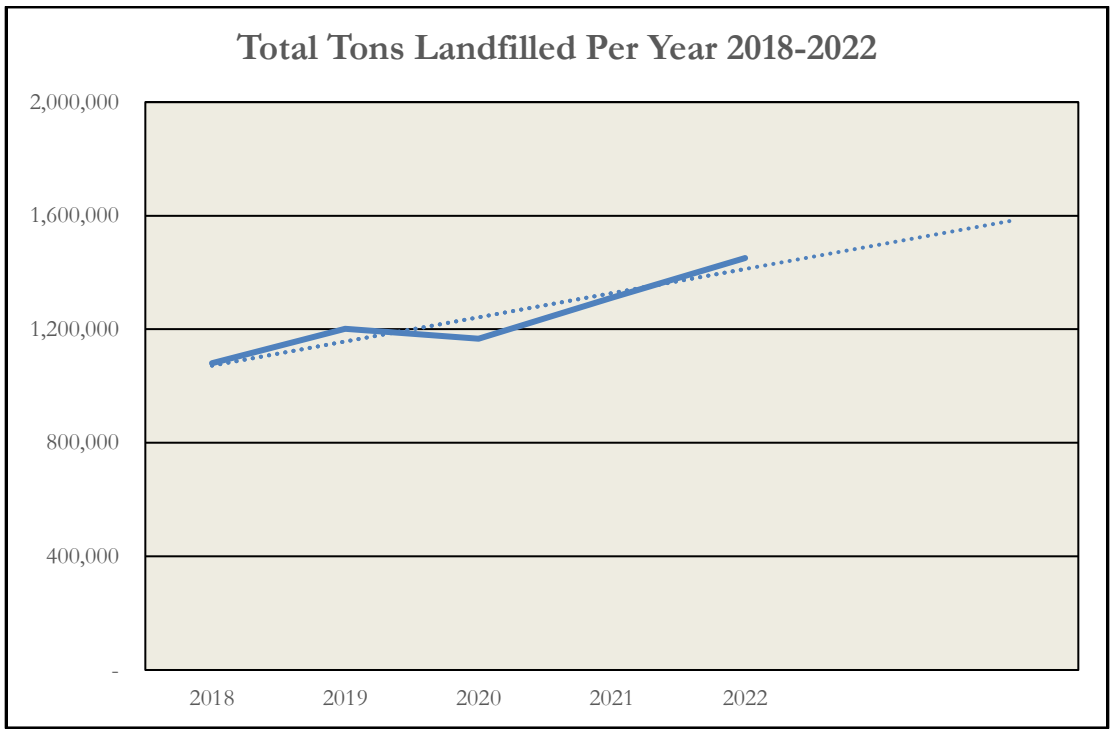
Year	MSW Landfilled[30]	MSW Incinerated	CDD Landfilled	SPW Landfilled	Cover Landfilled	Total Disposed
2018	388,629	434,652	485,362	244,706	145,128	1,698,477
2019	423,408	420,687	446,135	257,216	217,679	1,765,126
2020	498,013	441,804	461,299	308,309	153,665	1,863,089
2021	535,648	365,941	474,805	284,866	161,113	1,822,373
2022	569,911	382,609	518,410	262,646	213,458	1,785,505

The annual amount of waste generated within the state has increased by an average rate of 1.3% per year in the past five years, with a change of 5.1% when comparing 2018 to 2022. Using the year with the highest amount of waste generated during the past five years (2020) and the current rate of increase in waste generation (5.1%), the Department estimates that Maine will generate approximately 1,960,000 tons of waste in 2029, 2,060,000 tons in 2034, 2,160,000 tons in 2039, and 2,270,000 tons in 2049.

Since 2018, the total amount of waste landfilled, including the minimal amount of waste shipped to out-of-state landfills, has grown even more significantly by 34.28%. When comparing 2018 to 2022, the rate of increase was 7.8% annually. This is most likely due to several factors including: the idling of the waste-to-energy facility in Orrington; the idling of the Hampden waste processing facility, and the resultant shift of waste and recycling from those communities (as is discussed later in the report); the increase in WWTP sludge being landfilled due to the sludge land application ban; and the increase in CDD and other similar wastes being generated. Figure 4 reflects Maine-generated waste disposed in Maine landfills only.[31]

[30] This total includes Maine-generated MSW exported to landfills located in other states or Canada.
[31] This figure does not include out-of-state waste accepted at the Crossroads Landfill.

Figure 4. Total Tons of Material Landfilled in Maine from 2018-2022



Maine has eight landfills currently accepting MSW, three waste-to-energy incinerators, and one MSW waste processing facility (now called Municipal Waste Solutions). These facilities are briefly described below, including the average amount of waste received over the five-year period since the previous Plan was published.

Since generators and haulers will seek to find the most cost-effective disposal facility for their material, MSW is treated as a commodity by waste disposal facilities (including landfills and incinerators). Landfill operators will take into account market conditions for various wastes and their ability to use waste as cover material. Therefore, estimates of capacity or life beyond 5 to 10 years may not be accurate, as the volume of material accepted at a given facility can vary significantly from year to year as generators and haulers seek more cost-effective facilities and landfills change their operations. As transportation of waste is a significant factor in the overall cost of waste management, the locations and size of waste management facilities should be considered as a part of statewide waste management decision making. Figure 5 provides the location of these waste disposal facilities.

Figure 5. Landfills and Waste-to-Energy Facilities Accepting MSW in Maine

B. Current Waste Disposal and MSW Processing Facilities

1. Waste-to-Energy Facilities

There are three waste-to-energy incinerators in Maine: ecomaine in Portland, Mid-Maine Waste Action Corporation ("MMWAC") in Auburn, and the Garbage Recycling and Clean Energy facility ("GRACE")[32] in Orrington. However, the Orrington waste-to-energy facility hasn't incinerated waste since May 2023 and has bypassed significant amounts of waste due to maintenance issues over the past several years. It has instead been sending its waste for landfilling or storing it on-site. The GRACE facility will likely require significant investment to restart operations. All three waste-to-energy incinerators are licensed to accept both in-state and out-of-state waste. The total amount of waste accepted by these facilities in 2022 is shown in Table 10, and their annual licensed capacity in Table 11. The two operational waste-to-energy facilities are currently meeting their air quality emission standards and are being operated and maintained in accordance with applicable State laws, rules and Department licenses. Future capacity of these facilities is expected to remain stable, as currently licensed and constructed. As can be seen when comparing the charts, the two currently operating waste-to-energy facilities are operating at levels near their licensed capacity.

Table 10. 2022 Solid Wastes Managed by Maine's Waste-to-Energy Facilities by Origin

Facility	Maine MSW	Recycling Residue	Other Waste	Total Maine Tons	Out-of-State Waste (NH & MA)	Total Tons
ecomaine	183,654	3,2789	4,962	191,894	1,879	193,774
MMWAC	83,603	-	4,004	87,607	-	87,607
GRACE	98,162	-	4,946	103,108	547	103,655
Totals	**365,419**	**3,2789**	**13,912**	**382,609**	**2,426**	**385,035**

[32] GRACE purchased the Orrington Waste-to-Energy facility (formerly called Penobscot Energy Recycling Corporation) in November 2023.

Table 11. Available Licensed MSW Disposal Capacity at Maine's Waste-to-Energy Facilities

Waste-to-Energy Facilities	Annual Capacity	2020	2025	2030	2035
Tons/year					
MMWAC	70,000	70,000	70,000	70,000	70,000
ecomaine	170,000	170,000	170,000	170,000	170,000
GRACE[33]	310,000	210,000	210,000	210,000	210,000
Total Capacity	**550,000**	**450,000**	**450,000**	**450,000**	**450,000**

With the waste-to-energy facility in Orrington not currently operating, approximately 210,000 tons of capacity has been lost. The majority of this material has been diverted to the JRL. As will be discussed in more detail further in this Plan, efforts to restart the Orrington waste-to-energy facility are currently underway, which would reduce the volume of waste going to Maine landfills.

2. Landfills

There are eight landfills that are licensed and currently operating that accept MSW or "MSW bypass," which is defined as MSW originally destined for a facility but diverted due to temporary capacity issues (i.e., during maintenance activities). Of these eight, six are municipally owned, one is owned by the State but managed by a contracted operator, and one is commercially owned and operated (Waste Management Disposal Services of Maine, or "Crossroads Landfill"). Also, there are 19 smaller landfills operated by municipalities that accept wood waste and CDD, and a small secure landfill that in addition to wood waste and CDD accepts WWTP sludge and other special wastes. Additionally, two municipal landfills (Rockland and Mid-Coast Solid Waste Corporation landfill in Rockport) accepted MSW during their operational history but now only accept nominal amounts of CDD, and one (Rockland) is in the process of closing and will soon no longer accept any material.

There are approximately eight generator-owned landfills that are associated with a specific manufacturing facility which are licensed to take waste only from that facility. Since the wastes disposed at these generator-owned landfills are specific to those facilities, they are not discussed in the Plan.

The amount of material each landfill accepted annually since the previous Plan was published is detailed in Table 12. The eight landfills that accept MSW or MSW bypass are

[33] GRACE's original design capacity was 310,000 tons per year which is the capacity of its two boilers operating full time. In 2020, GRACE changed its boilers' operating time, resulting in an operational reduction in waste incineration capacity to 210,000 tons annually. It is unknown whether the new owners will operate at the design capacity of 310,000 tons/year once the facility is restarted and fully operational.

discussed below, with an average amount of material the landfill received annually during the last five years. It should be noted that of the eight landfills, two, JRL and Crossroads Landfill, receive the majority of material, JRL accepting 52% and Crossroads Landfill accepting 27% of the total amount of waste landfilled in Maine. Additionally, Crossroads Landfill, as a privately owned and operated commercial landfill, can and does accept waste from out of state. The total amount of waste managed at Maine's landfills for the past five years is shown in Table 12 and illustrated in the pie chart that is Figure 5. The amount of material disposed in these landfills since the 2018 report has grown by 34.28%.

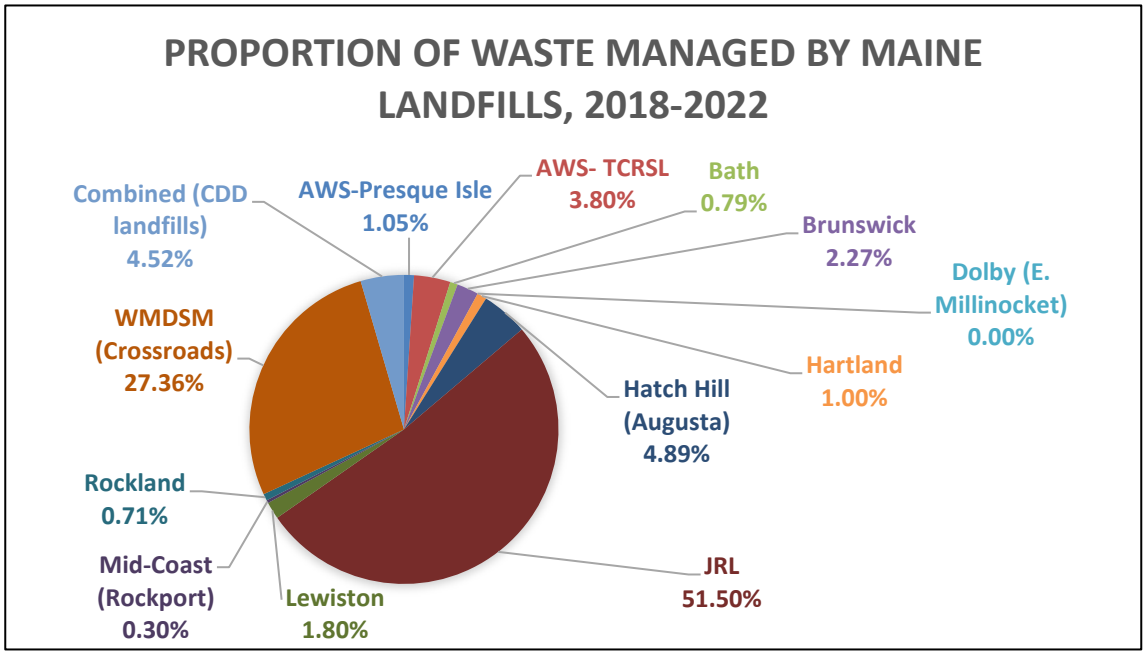
In most cases, the landfill capacity used and capacity remaining is calculated by the facility from annual physical surveys of the landfill. Therefore, capacity estimates include capacity that may have been gained by the landfill through settlement of previously disposed waste as well as capacity used by waste that was utilized as daily cover.

Landfills are frequently licensed to use a specific waste material as alternative daily cover ("ADC"). As examples, in 2020, 2021, and 2022, Crossroads Landfill used the following wastes as ADC: processed utility poles, crushed glass, CDD wood chips, ashes, contaminated soil, WWTP sludge, auto shredder fluff and some other special wastes. During the same three-year period, JRL used CDD fines and processing residues and wood as ADC. JRL is also licensed to use other wastes as ADC including ashes and contaminated soils. Some of the wastes suitable for cover, and other types of waste such as bulky wastes, are also utilized for stabilizing material like sludge. Table 12 outlines the total amount of all material that was received by these landfills for either disposal, use as ADC, or other useful purpose by the landfill. However, the ability to use material for landfill operations and for stabilizing sludge does require a more nuanced view of waste disposal. Since JRL received over 50% of material landfilled in Maine, JRL will be discussed later in more detail.

Table 12. Total Amount of Material Landfilled

Total Amount of Material Landfilled in Tons at Municipal, Commercial and State-Owned Landfills Includes MSW, CDD, and SPW (and ADC)					
	2018	2019	2020	2021	2022
AWS - Presque Isle	11,320	23,604	25,699	32,111	15,502
AWS - Fort Fairfield	41,087	29,139	37,080	31,079	47,381
Bath	8,585	7,578	5,389	15,859	23,412
Brunswick	24,580	25,062	3,966	458	-
Dolby (East Millinocket)[34]	-	-	-	416	-
Hartland	10,797	12,166	17,622	10,861	4,336
Hatch Hill (Augusta)	52,819	51,211	53,745	52,289	53,723
JRL (Old Town)	556,446	624,121	672,570	726,192	933,653
Lewiston	19,419	559	17,419	17,000	17,445
Mid-Coast (Rockport)	3,283	2,910	4,694	2,006	2,629
Rockland	7,642	1,712	6,069	18,260	1,288
WM Crossroads (Norridgewock)	295,621	370,203	263,265	332,038	301,175
Combined (CDD Landfills)	48,856	52,922	59,508	72,450	50,307
TOTAL	**1,080,456**	**1,201,187**	**1,167,026**	**1,311,015**	**1,450,850**

Figure 6. Maine Landfill Tonnage by Percent Managed



[34] Dolby is a state acquired landfill that served the papermills in Millinocket and East Millinocket that stopped accepting waste in 2021.

a. Hatch Hill, Augusta

The Hatch Hill Landfill is owned and operated by the City of Augusta. In addition to the landfill, the City of Augusta also operates a transfer station at the facility and operates as a regional solid waste facility for eight other communities. Over the past five years, Hatch Hill has received an average of approximately 52,757 tons of waste per year and is expected to reach its currently licensed capacity in approximately four to five years at current fill rates. The City of Augusta plans to apply for a vertical increase, which, at current fill rates, would provide an additional 12 to 15 years of capacity for approximately 500,000 tons of material. The City plans to submit this application to the Department in 2024 and hopes to begin construction in 2026. The City has also discussed the possibility of putting a cap on how much waste is landfilled annually if the vertical increase is constructed.

b. Presque Isle and Fort Fairfield Landfills

The Presque Isle and Fort Fairfield (formerly called Tri-Community Recycling & Sanitary Landfill) Landfills are both owned and operated by Aroostook Waste Solutions ("AWS"). AWS is operating the landfills in a manner that will reduce redundancy and provide AWS with waste disposal options for the next 40 years. Over the past five years, both landfills have received an average of approximately 29,400 tons of waste per year. The Presque Isle Landfill stopped receiving waste in 2023 and will be temporarily closed with an interim cover while AWS diverts all waste intended for landfilling to Fort Fairfield. At current waste generation rates, the Fort Fairfield Landfill is expected to provide AWS with disposal capacity until approximately 2041. After the Fort Fairfield Landfill reaches capacity, it will be permanently closed and AWS will reopen the Presque Isle Landfill, which is expected to provide an additional 17 years of disposal capacity.

c. Bath Landfill

The Bath Landfill is owned and operated by the City of Bath. It receives waste from Bath and 15 to 20 surrounding municipalities. It has received an average of 12,165 tons of material annually over the past five years, and at current fill rates is expected to reach capacity in approximately 21 years.

d. Lewiston Landfill

The Lewiston Landfill is owned and operated by the City of Lewiston. Although licensed to accept MSW, currently the Lewiston Landfill has chosen to only accept ash from the MMWAC in Auburn and smaller amounts of special waste such as grit and screenings from various sewage treatment facilities, crushed glass, and CDD. It has received an average of 14,368 tons of material annually over the past five years, and at current fill rates is expected to reach capacity in 33 years. The City of Lewiston has recently approached the Department to discuss the potential landfilling of sludge from

the Lewiston-Auburn Water Pollution Control Authority. The City intends this to be a contingency plan in case other disposal outlets are not available or feasible.

e. Crossroads Landfill, Norridgewock

The Crossroads Landfill in Norridgewock is owned and operated by Waste Management, a private company. As a privately owned and operated commercial landfill, it receives waste from outside Maine in addition to in-state waste. Over the past five years, Crossroads has received an average of approximately 312,460 tons of waste per year and was previously expected to reach constructed capacity in 2024. However, an expansion has recently been approved and Waste Management began using the expanded area in 2023. This expansion is expected to add approximately 7,757,000 cubic yards of additional capacity and expand the life of the landfill by 17 years.

f. Juniper Ridge Landfill, Old Town

The Juniper Ridge Landfill ("JRL") is owned by the State's Department of Administrative and Financial Services Bureau of General Services ("BGS") and is operated by Casella Waste Systems, a private company. JRL is licensed to accept MSW when it is bypassed ("MSW bypass") from the three Maine waste-to-energy incinerators and the Municipal Waste Solutions MSW waste processing facility in Hampden (discussed later in this report) and front-end processing waste generated by a waste-to-energy incinerator. It also accepts a variety of special wastes such as sludge, CDD and CDD processing residue, some of which it utilizes as daily cover and as a bulking agent for other wastes as discussed later in the report. It has received an average of 702,597 tons of material annually over the past five years. JRL has approximately five years of remaining capacity and has just initiated the licensing process for a proposed future expansion by submitting a Preliminary Information Report ("PIR").[35] JRL's history and waste disposal trends will be discussed in greater detail in Section IV(C) of this report.

g. ecomaine Landfill, Portland

In addition to its waste-to-energy incinerator, ecomaine operates a landfill for disposal of its incinerator ash. It previously received baled MSW before the incinerator began operation. A small portion of the landfill is used to temporarily store MSW during summer periods of higher waste generation, and the stockpiled MSW is then incinerated during periods of lower incoming waste volume. ecomaine occasionally sends MSW bypass to Crossroads or to JRL. The ash landfill has received an average of 46,832 tons of material over the past five years and is estimated to have over 50 years of capacity at current disposal rates.

[35] Required under 06-096 C.M.R. ch. 401, § 1(E).

3. MSW Processing Facility

Municipal Waste Solutions, LLC ("MWS") and the Municipal Review Committee, Inc. ("MRC") own an MSW processing facility in Hampden which is designed to process 650 tons per day of MSW from 115 municipalities that are part of the MRC. However, due to financial and technical issues that developed during construction and start-up, the facility only operated for a short period of time and has been idle since May of 2020, requiring the waste to be bypassed.

Until April 2018, MSW from the MRC municipalities was disposed at the waste-to-energy incinerator in Orrington. When construction of the waste processing facility was not completed by April 2018, MRC redirected the MSW from its member communities to the privately-owned Crossroads Landfill. MRC had negotiated an exclusive contract with Crossroads Landfill for the disposal of "bridge capacity" and bypass waste during construction, start-up, and initial operation of the facility, as applicable. Through a waste swap agreement that addressed logistical waste handling constraints to minimize waste transportation distances, some waste from the MRC communities was also diverted to JRL. Subsequent to this, some of this waste destined to be landfilled was also diverted to the waste-to-energy facility in Orrington to promote higher priority uses on the state's waste management hierarchy.

The waste from the MRC communities is still being bypassed to Crossroads Landfill or to JRL. Since April 2019 when the processing facility began accepting waste, some of the municipalities contracted to deliver their MSW to the Hampden waste processing facility began altering their recycling methods to utilize the Hampden facility's sorting process, reducing or eliminating recycling programs that separated out recyclable material from household trash. Since the recyclable portion of the waste was not collected separately or sorted out from the trash, it has been landfilled, although a small portion of recyclable material delivered to the Orrington waste-to-energy facility was pulled out from the mixed MSW before incineration.

The MRC formed Municipal Waste Solutions, LLC ("MWS") in 2022 for the purpose of purchasing the processing facility. It purchased the processing facility in 2022, and in 2023, sold 90% of the membership interest in MWS to Innovative Resource Recovery. MWS has been working on a plan for facility improvements and currently expects to restart the facility by early 2025. Until the MWS facility is fully operational for a complete calendar year, it will not be possible to assess whether the amount of bypass and processing residue resulting from its operations will significantly alter the amounts of solid waste destined for landfilling.

4. Materials Recovery Facilities

It should be noted that two materials recovery facilities ("MRFs") operate in Maine. A MRF is a facility that processes single stream recycling materials to be sold to end buyers. ecomaine operates a MRF in Portland, and Casella operates a MRF in Lewiston. These facilities are also an integral part of Maine's solid waste infrastructure.

C. Juniper Ridge Landfill's Role in Maine's Waste Disposal Arena

As shown in Figure 5 above, the State-owned Juniper Ridge Landfill has received slightly over 50% of all waste material landfilled in Maine since 2018. Given its significant role in waste management in Maine and the fact that it is a State-owned resource, the Department has provided the following information regarding its history and role in waste management for the State to assist with decision making.

P.L. 1989, Chapter 585, *An Act to Promote Reduction, Recycling and Integrated Management of Solid Waste and Sound Environmental Regulation* established a comprehensive framework for solid waste management in Maine. Included were provisions that established the Solid Waste Management Hierarchy, a ban on new commercial disposal facilities, public sector responsibility for ensuring disposal capacity for MSW, and state authority to develop and operate state-owned solid waste disposal facilities. These provisions were intended to provide the State with tools to encourage diversion of solid waste from landfilling and minimize the need for the development of additional landfill capacity.

Since the enactment of this law, the State has established ownership of three licensed landfills: the yet-to-be-developed Carpenter Ridge Landfill with a design capacity of 1.8 million cubic yards, the inactive Dolby Landfill in East Millinocket which is in the process of final closure, and JRL in Old Town. When obtained by the State, the licenses for each of these landfills were focused on providing disposal capacity for special wastes associated with the paper mills that operated them at the time. In April 2004, the State, acting through the State Planning Office, received a license amendment (Department License #S-020700-WD-N-A) that provided for the acceptance of additional waste types at JRL (then known as the "West Old Town Landfill" or "WOTL"), including: front-end process residue ("FEPR") from the then-owned PERC and the Maine Energy Recovery Company ("MERC") waste-to-energy incinerator in Biddeford (now closed); oversized bulky wastes ("OBW"); MSW bypass from any waste-to-energy incinerator located in Maine; CDD; ash from any waste-to-energy incinerator located in Maine; and water/wastewater treatment sludge. Finding of Fact 13 in that license states that "[t]he yearly quantity of solid waste to be accepted at the landfill is not expected to exceed 540,000 tons per year." This amount is inclusive of up to 50,000 tons per year of mill wastes from the Old Town papermill, 120,000 tons of FEPR and 70,000 tons of ash from two waste-to-energy incinerators (then operating PERC and MERC), and 190,000 tons of CDD. In December 2013, WOTL (now known as JRL) was licensed (Department License #S-020700-WD-BC-A) to accept up to 81,800 tons of non-bypass MSW generated in Maine into its existing permitted landfill area. This amendment was sought to provide a temporary alternative (through March 31, 2018) for disposal of MSW generated in municipalities that had been sending their MSW to the MERC facility in Biddeford prior to it ceasing operations in December 2012. In June 2017, the State, acting through BGS received approval for a 9.35-million-cubic-yard expansion. In 2018, the approval to accept up to 81,000 tons of non-bypass, in-state MSW was extended through March 31, 2020, to account for the near-term uncertainty in disposal capacity due to operational adjustments at the Orrington waste-to-energy facility and the delay of operations of the MSW waste processing facility in Hampden.

The data show significant changes in the types of waste being landfilled at JRL in 2022 compared with 2012. There has been a substantial drop in FEPR and MSW incinerator ash due

to the closure of the MERC facility and the curtailing of operation at the Orrington Waste-to-Energy facility, as well as industrial WWTP sludges and papermill wastes due to the closure of the papermills in Old Town and Lincoln. However, the fill rate at JRL has climbed due to significant increases in the disposal of MSW and more recently municipal WWTP sludge. For example, MSW increased from 729 tons in 2012 to 283,683 tons in 2022 and CDD[36] increased from 369,069 tons in 2012 to 485,298 tons in 2022. Likewise, the disposal of municipal WWTP sludge from 53,023 tons in 2018 to 94,271 tons in 2022 has also increased the fill rate at JRL. Although waste volumes fluctuate year-by-year, the overall trend is a marked increase in material accepted for disposal.

Much of the large volume of CDD landfilled at JRL comes from processing facilities located in Maine. Although 38 M.R.S § 1310-N(11) prohibits the disposal of waste generated from out of state directly into state-owned waste disposal facilities, it allows "waste generated within the State" to include "residue and bypass generated by incineration, processing and recycling facilities within the State," all of which may include waste originating from locations out of state before it gets to the processing/recycling/incineration facilities. Notably a significant amount of Maine's CDD originates in Massachusetts due to a ban on the disposal of CDD in Massachusetts.[37] This has resulted in a large volume of out-of-state CDD being processed by waste processing facilities in Maine with the processed fines being placed in the landfill as shaping, grading or alternative daily cover materials, and residual CDD being disposed of into JRL as in-state waste.

To better address the issue of JRL using up capacity to accept wastes that are not originally generated in Maine, the legislature enacted several requirements for processing facilities. First, the definition of "waste generated within the state" under 38 M.R.S. § 1303-C(40-A) was modified. Under this definition, the total weight of residue generated in a calendar year by a solid waste processing facility that is disposed of or otherwise placed in a solid waste landfill in that calendar year cannot exceed the total weight of the solid waste initially generated in state for processing at the facility. Any excess residue generated by that facility is not considered waste generated within the State. In addition, 38 M.R.S. § 1310-N(5-A)(B)(2) requires that all processing facilities that generate residue for disposal must recycle at least 50% of the CDD they accept. In doing so these facilities are allowed to count the following toward recycling: "reuse of waste as shaping, grading or alternative daily cover materials at landfills; aggregate material in construction; and boiler fuel substitutes." Once this 50% goal is met, the processing facility is then required to demonstrate that of the material characterized as recycled, at least 50% of it must have been recycled or reused "other than being placed in a solid waste landfill," unless the processing facility qualifies for specialized criteria allowing for alternative percentages under 38 M.R.S. § 1310-N(5-A)(B)(2)(a-e).

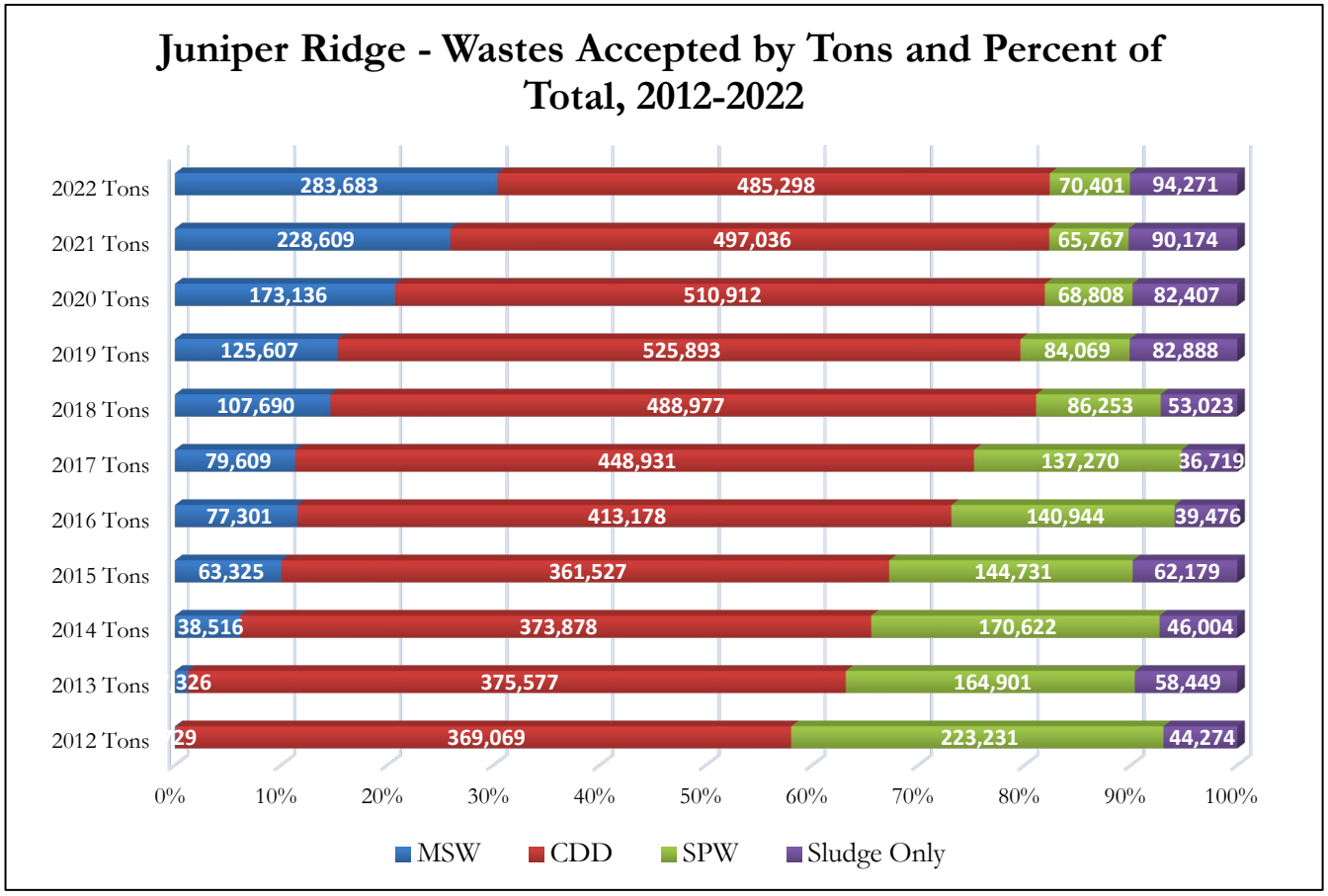
[36] These numbers may be higher than those reported in the past as they include a more complete array of construction and demolition debris and processing residues: OBW, wood, mixed CDD, CDD processing residue and fines, mixed MSW/CDD processing residue, and crushed glass.
[37] https://www.mass.gov/doc/frequently-asked-questions-construction-demolition-materials-waste-ban/download.

The discovery of PFAS in municipal WWTP sludges and other sludge-derived products banned from land application in Maine have made JRL the landfill of choice for final disposition of this material, which has had a significant impact in recent years on its capacity. Beginning in August 2022, most municipal WWTP sludge generated in Maine was disposed of at JRL. The physical nature of sludge makes landfill disposal challenging and can affect both the short-term and long-term stability of a landfill. Stabilizing materials need to be mixed with the sludge, adding an additional volume of material for disposal and taking up valuable landfill space. CDD, CDD residue and other similar material, and OBW have been utilized as bulking material for stabilization. These additional bulking materials compounded by sludge volumes have shortened the timeframe by which JRL is expected to reach its maximum capacity.

While Crossroads Landfill also takes sludge from Maine's WWTPs (albeit a smaller volume), it also has concerns about the quantity of sludge it takes in relation to moisture and the need for operational stability. As a result, Crossroads Landfill has determined the best path forward to maximizing capacity is to invest in sludge drying. Sludge can be dried to reduce its volume and its need for bulking agents for stability. On September 15, 2023, Crossroads Landfill submitted an application to the Department for a waste processing (sludge drying) facility which, if approved, will be licensed to receive approximately 200 tons of municipal WWTP sludge daily, greatly reducing the overall volume of this waste stream for disposal down to roughly 50 tons. The dried material will then be landfilled without the need for significant bulking materials. The proposed new facility is planned to run on heat pump technology and utilize the biogas generated at the nearby landfill, reducing the energy demand needed for processing sludge. This model, if successful could serve as a model or prototype for other facilities accepting WWTP sludge including other landfills. Investing in sludge dewatering facilities and/or focusing on PFAS treatment and destruction technology as identified in the Bureau of General Service's Study to Assess Treatment Alternatives for Reducing PFAS in Leachate from State Owned Landfills may be a far more sustainable option in the long run than continuing to landfill larger amounts of CDD in order to accommodate landfilling of sludge. The current trajectory of sludge and CDD disposal encourages the expansion and use of landfilling, and without alternative options, Maine's landfills will likely fill up more quickly than originally planned for.

The following figures provide an overview of waste material types received at JRL and how they have changed over the past 10 years. Figure 7 provides an outline of waste material types as a percentage of total waste received per year since 2012, Figure 8 provides an outline by tonnage received per year since 2012, and Figure 9 provides an overview of total amount of waste received by tonnage and percentage since 2012.

Figure 7 – Wastes Accepted at Juniper Ridge Landfill by Percent of the Total Accepted[38]



[38] While sludge is a special waste, this graph depicts it as its own category pulled out from the rest of the special waste (SPW) to show the sludge as a percent of the incoming wastes over time.

Figure 8. Wastes Accepted at Juniper Ridge by Tons and Type

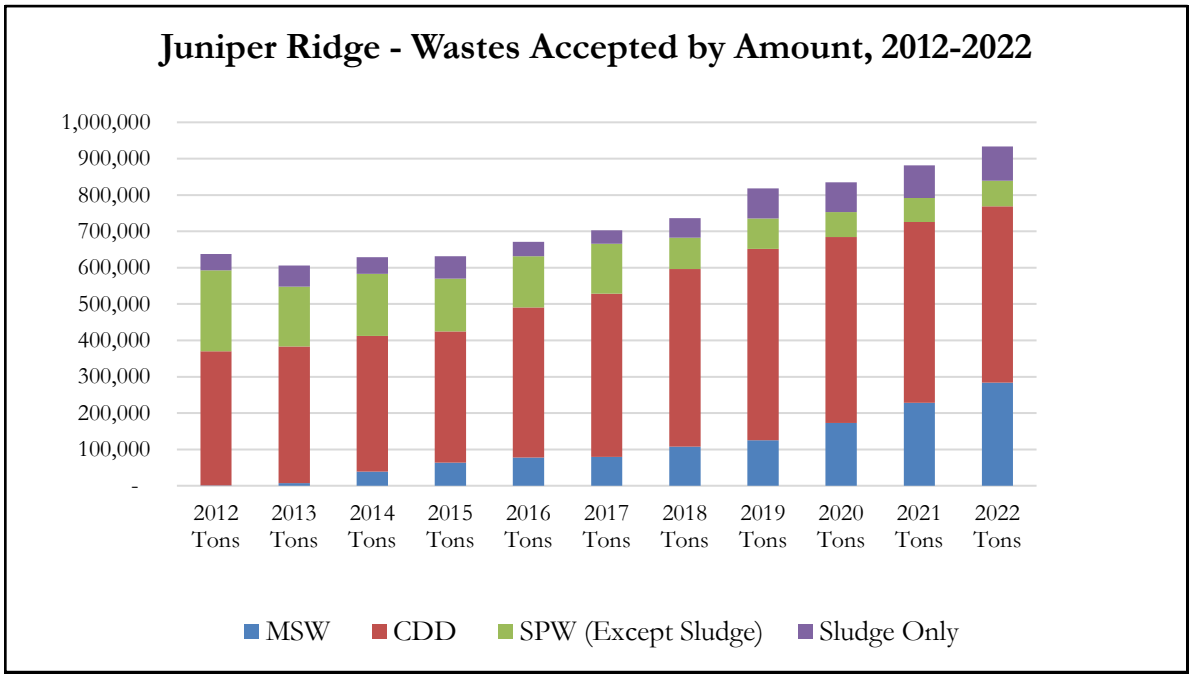
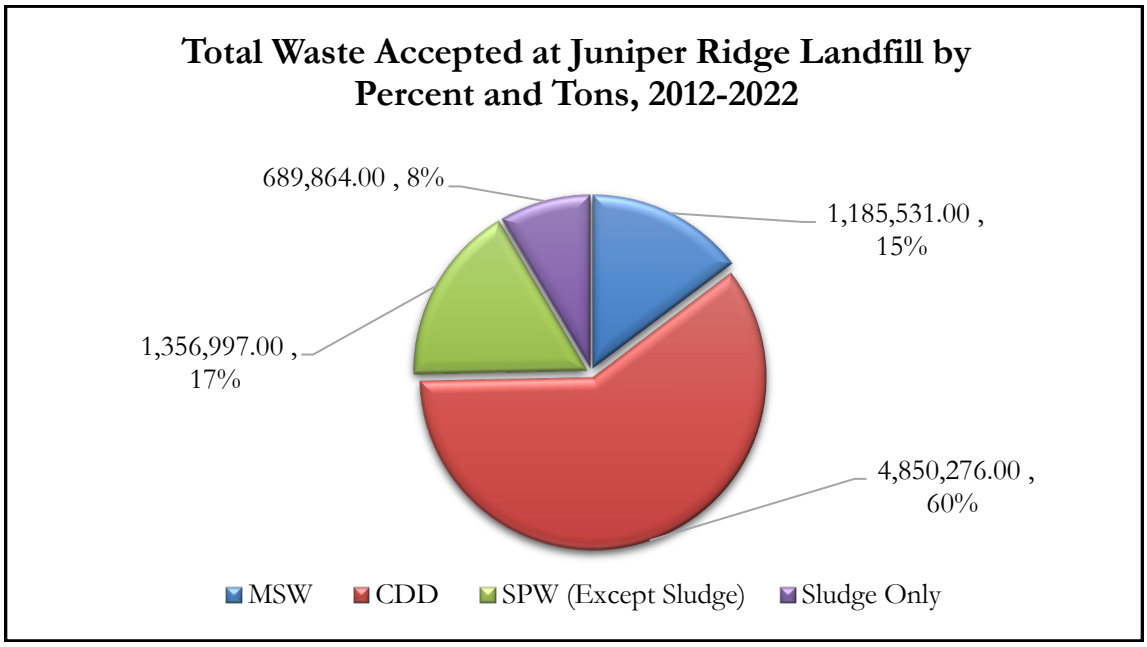


Figure 9. Total Tons Accepted at Juniper Ridge by Percent 2012-2022



While not intentional, JRL has in effect become Maine's fastest and most economical solution for handling emerging solid waste issues. Given the increasing quantities of wastes being landfilled at JRL, expansion of this landfill is a critical solution that will be necessary in addition to proactive steps to increase waste infrastructure options as well as enhancing efforts toward meeting statutory waste reduction, diversion, and recycling goals. Difficult decisions will need to be made about the overall purpose and use of this state-owned landfill, how to maximize its capacity and lifespan, whether to invest in alternative infrastructure for waste disposal at other locations, and how market pressures can be modified to encourage waste diversion programs.

D. Projected Demand for Capacity

Currently, there are significant gaps in Maine's Eastern Maine region for managing MSW. Investment activity[39] focused on restarting both the idled Orrington waste-to-energy incinerator and the Hampden solid waste processing facility are underway, but uncertainties remain with regard to, operating timeframes, financial barriers, and long-term capacity. Should either of these facilities begin operations, the concerns about how to cost effectively manage MSW in the region should ease. However, at the current time MSW is bypassing from both facilities going directly to landfills. JRL will likely continue to be the recipient of most of this MSW stream over the next few years as it is closest in proximity to the region impacted (logistics and transportation make this more cost effective). It should be mentioned that both of these facilities while currently operating do fall higher up on Maine's solid waste management hierarchy.

Statewide, other than the issue specific to Maine's Eastern Maine region, Maine appears to have adequate capacity for at least 10 years before several landfill facilities reach their capacity. This assumes however that an expansion license application is both received by and approved by the Department for the JRL facility. As of the date of this report, the Department has received a PIR from JRL for a future expansion.[40] The loss of JRL as a disposal facility would create catastrophic capacity issues as it receives over 50% of all material landfilled in Maine annually. If JRL moves forward with its application for an expansion, the projected capacity at current fill rates would most likely add an additional 15 to 20 years, which at the earliest brings it to being at capacity once again in 2042.

Even with capacity available statewide for the next 10 years, unless significant progress is made in ensuring that the state has existing or new infrastructure for waste processing and disposal, as well as enhancing waste diversion programs, landfill capacity will become an even more pressing issue in 15 years. For example:

- If the application for expansion for the Hatch Hill Landfill is approved, Hatch Hill will reach its estimated capacity in 12 to 15 years. This means that as early as 2035, Maine will lose approximately 50,000 tons of waste disposal capacity.

[39] The new operators taking over the Orrington waste-to-energy incinerator have renamed the facility, "Garbage Recycling and Clean Energy" or "GRACE" and plan to resume full operation of the facility. See: https://www.bangordailynews.com/2023/11/27/news/bangor/orrington-trash-incinerator-restart-operations-joam40zk0w/.

[40] In the past licensing for the JRL facility from start to finish has taken approximately six years.

- Crossroads Landfill is expected to reach the capacity of its recent expansion in 17 years, putting its operations until about 2040. This will substantially impact Maine's waste disposal capacity as this landfill accepts on average about 300,000 tons annually (although some of this comes from out-of-state).

- Bath Landfill is expected to reach capacity in 21 years, allowing its operations until 2044. The loss of the Bath Landfill will have a relatively minor impact to Maine's overall waste disposal capacity, as that landfill receives only approximately 12,000 tons of material annually.

- The loss of the Hatch Hill and Bath landfills, in particular, will impact disposal options for the Central Maine region in about 15-20 years.

As with all of these landfills, landfill operators can extend the life span of their landfill by turning away or not accepting wastes. This will pose additional challenges to generators of solid waste who may need to seek alternative disposal outlets which may be farther away and cost more to access. These costs likely will be passed on to municipalities in most cases, which in turn will pass costs on to Maine residents.

To extend operating time to Maine's existing landfills, it is important not just to evaluate landfill expansions, but also to consider how to bring new or licensed but non-operating facilities online more quickly. This is a critical need as it currently takes several years from the beginning of the licensing process to the end when construction and operation are allowed to take place. Long-term disposal capacity is a significant and valid concern. With the exception of Aroostook County, which appears to have landfill capacity for a minimum of 40 years, it is clear that if considerable reduction in the amount of material going to landfills is not achieved, or unless new technology and infrastructure is brought online in multiple locations in Maine, a sizeable portion of Maine's landfill capacity will be gone within 20 years. Maine's increases in waste generation as discussed in Sections III and IV above, indicate that this timeframe could be even shorter. Costs related to hauling MSW, CDD, recycling material, salvageable material, compostable food waste, and other waste streams are a significant portion of the overall cost for the management of this material, in addition to its greenhouse gas emissions impacts. These costs will likely be passed on to Maine residents and communities.

As Maine evaluates adding new infrastructure and enhancing existing waste diversion programs, it is important to consider locating facilities near areas where waste material is generated, utilizing regionalization, and implementing "hub and spoke" models for transferring waste material to make hauling more efficient and cost effective. In addition to practical issues associated with managing an increased amount of waste over time and maximizing existing and new infrastructure, it is important to recognize that many waste streams that could be diverted are being disposed of because disposal is often the lowest cost option. There is a clear need for a market readjustment to incentivize more sustainable materials management to maximize long-term disposal capacity and increase efficiencies in our management of materials.

V. Stakeholder Input Summary

The Department has encouraged public input on the contents of this Plan update as well as the direction of future materials management efforts by holding five public meetings across the State in Aroostook, Washington, Penobscot, Kennebec, and Cumberland counties. The meetings were held both in person and online to encourage participation. Meeting recordings were posted on the Department's website and written comments were accepted by email. Attendance at each of the meetings ranged from five to approximately twenty participants. The Department received nine written comments submitted through email.

Discussion was encouraged by a series of prepared questions specific to current materials management practices as well as broadly scoped questions regarding desired improvements. Not surprisingly, discussion ranged from logistical issues of a more local or regional nature to issues common to the State at large. Issues identified as common across the State included lack of drop-off locations for materials covered by current producer responsibility programs, lack of feedback on municipal reporting, and inconsistent availability of public information regarding programs and best practices to manage various discarded materials. Reliance of the state on meeting waste capacity needs through disposal rather than diversion efforts was a common concern. Additionally, participants discussed a desire for the Department to increase its efforts in communication in many of the aspects of waste management, from increasing information availability on individual facilities to providing information on recycling opportunities and handling problematic materials.

A. General Concerns of Maine's Waste Management System

Overall, a consensus emerged supporting greater effort in the top two tiers of Maine's Solid Waste Management Hierarchy; reduce and reuse. While waste reduction may be the hardest to measure, it remains the highest priority. Reuse is more tangible and yields a myriad of positive impacts. Examples of reuse candidates mentioned by attendees included pellet bags (deposit), refillable beverage containers, water dispensers in lieu of bottled water, 1-lb. propane canisters (refillable in CA, MA, RI), repair cafés (already emerging around the state), tool libraries (sharing), and reuse stores.

In each of the five public forums held, the Maine Waste Management Agency (and after 1995, the State Planning Office) ("MWMA/SPO") were both mentioned for the fact that they no longer exist, and the bulk of their tasks were not picked up by the Department or other agencies. Attendees discussed how the MWMA/SPO was a driving force in bringing "reduce, reuse and recycle" into common parlance throughout the state from the late 1980s on. It not only administered a robust grant funding program for waste infrastructure throughout the state, but it also tracked progress toward overall waste reduction goals set by the Legislature through staff providing a high level of assistance to municipalities in filing annual reports to MWMA/SPO. Staff were tasked with not only seeing that each individual facility's recordkeeping was adequate and reports were filed on time but, perhaps most importantly, providing feedback to the facility managers regarding shortfalls and best management practices.

A significant number of those attending stakeholder meetings expressed a degree of angst regarding the future of JRL, the incinerator in Orrington, and the long-delayed waste processing facility in Hampden. It was recognized that currently, landfilling and waste-to-energy

incinerators are the foundation on which all else in waste management rests. A concern was expressed that materials diverted from landfilling by successful recycling and other diversion efforts will be replaced at JRL with wastes sourced from out-of-state.

The different levels of waste management services provided by the municipalities throughout the State was another topic of concern. Rural Maine has become a mosaic of differing collection programs from one town to the next. While all municipalities and unorganized areas have some sort of household waste disposal option, not all municipalities have a robust recycling program, and some offer no recycling at all. As a result, many communities do not have the necessary infrastructure to participate in longstanding producer responsibility programs to allow for free or reduced-cost collection of e-waste, mercury-containing light bulbs and thermostats, architectural paint and rechargeable batteries. Further, some rural communities have signed onto expensive curbside collection programs with little consideration for collaboration with neighboring towns. Without collaboration, duplicative efforts within a region lead to less-than-optimal costs and greater vulnerability to market changes. It also makes determining whether a program is successful in terms of recycling and waste diversion difficult.

Concern was expressed that vertically integrated private companies have gained disproportionate control of waste management and recycling services, particularly in rural areas. This appears to be a common issue when municipalities approach such services on an individual rather than a regional manner, as there is less leverage to negotiate contract terms and prices. When opting out of collaborative regional transfer stations, municipal flexibility, control, and choice are more limited. Attendees also expressed concerns that small, independent towns are forced into restrictive or predatory-appearing contracts for transport, recycling, processing, and disposal due to lack of true competition for such services.

B. Solutions Suggested to Maine's Waste Management System

Attendees at the public meetings proposed several recommendations for addressing waste management issues, as discussed below.

1. Promote regionalization for new, more efficient waste transfer and recycling facilities.

Whether at the county level or as a result of nearby municipalities working together, it was discussed that regional facilities could provide more sophisticated governance over service contracts as well as offering expanded services to residents that curbside programs cannot manage and small municipalities may struggle to offer on their own.

2. Facilitate universal waste and other problematic waste collection in new regions.

E-waste, mercury-containing items, paint, and rechargeable batteries have long been collected in some areas of the State, but due to lack of collection locations, these programs are not readily available to all. Municipalities could be collection points, but many choose not to. In place of developing a collection facility in each rural municipality, a central collection facility for neighboring rural communities would be more efficient and could be as simple as placing one or more properly sized shipping containers (or a similarly sized storage container) in a host community, with oversight and controlled access to ensure the site is used for its intended

purpose. Oversight of a collection location could be under a fire department, town office, or public works department. Such programs could be developed with funds dispersed through the State's Waste Diversion Grant Program. Program creativity could expand such a collection system to include other recyclables or organics, as well as offering information kiosks regarding programs and opportunities for sustainably managing wastes.

3. Clearly prioritize regionalization and boost funding for Maine's Waste Diversion Grant Program.

While the current grant program has been quite successful at awarding organics diversion grants up to $40,000 per grantee, there was a concern expressed that there have been few proposals to fund regional solutions in rural areas. It was also suggested to consider streamlining grant applications for regional organizations, which, along with municipalities, are designated as the highest priority in the awarding of funds under 38 M.R.S. § 2201-B.

4. Phase in mandatory food waste recycling with incremental requirements.

A strong desire was expressed to start phasing in a mandatory food waste recycling program. While sufficient infrastructure is not currently in place for collection, transportation, and processing of organics, a phased approach to preventing wasted food and recycling food scraps will allow for planning, investment, and implementation over a period of time that would allow successful regional programs to develop. Attendees noted that participation in such diversion programs needs encouragement beyond simply being informed of its benefits. It was also noted that Vermont, New Hampshire, Massachusetts, Rhode Island, and Connecticut all have some sort of mandatory organics recycling or food waste disposal bans in place.

5. Broaden battery collection to include a larger array of batteries.

Attendees pointed out that the market is moving towards electric powered tools and yard equipment, reducing use of fuel and the related GHG emissions from combustion-powered tools. However, lower quality tools may be treated as "disposable" (rather than repairable) and often end up, batteries attached, in landfills or at recycling facilities where they can cause fires, endanger workers, and waste valuable resources. Attendees suggested that a deposit at the point of purchase or an expansion of the current rechargeable battery stewardship program would be a reasonable starting point to address this important safety risk and improve the recovery of critical minerals contained within batteries and the devices and tools they power.

6. Promote deconstruction of buildings over demolition.

To address the concern regarding the amount of CDD being placed in landfills, attendees discussed incentivizing salvaging and reuse. Attendees noted that CDD consumes a lot of landfill space. Utilizing salvageable materials from construction and demolition sites has the potential to lower demand for virgin materials, conserve higher quality materials, make affordable recovered materials available for reuse, and create local jobs. Deconstruction

provides a significant tax benefit when a property is correctly appraised,[41] and could be further encouraged through educational material for property owners, local ordinances, municipal tax credit programs, or the establishment of a directory for services and purchasable salvaged materials.

7. Discourage single-use food service ware and promote reusable alternatives.

Attendees discussed a desire to develop a grant program or a revolving loan fund specific for commercial and institutional reuse programs, such as washing equipment to scale up reuse programs on a regional basis. Restaurants and schools utilize large quantities of single-use food service ware, mostly made of plastics, for takeout and cafeterias. The useful lifespan of single-use plastic items averages just 15 minutes,[42] and its carbon footprint is significant for such a limited use item. If a school with 500 students (the average school size in the U.S.) replaced what is perceived to be a more sustainable option, such as compostable food containers with reusable food service ware, it would prevent 6,786 pounds of waste annually and the corresponding reduction in carbon dioxide emissions would be equivalent to taking nearly 800 cars off the road.[43]

8. Develop a field task force for materials management.

It was noted that the former MWMA/SPO employed a trained team that would review commercial and industrial facilities and institutions to make informed, situation-specific recommendations on waste reduction, reuse, and recycling. Attendees expressed interest in rekindling a similar program that would also train any interested and qualified parties to conduct such reviews. The data collected by this team could be used to develop a directory to post no longer needed materials generated in northern New England that could add value to another process, identifying and expanding the potential for industrial symbiosis.[44]

9. Right to Repair to encourage industry to produce repairable, durable goods.

Many attendees lamented that durable goods are not so durable anymore, and that greater public education focused on purchasing repairable, durable goods has significant potential to reduce how much waste is generated through the consumption and disposal of poor-quality goods. Possible steps identified to tackle this issue included use of a repair rating for durable products, or the development of an income-based rebate system for purchases of long-lasting, durable goods that are repairable. Such an index exists in France[45] and provides an existing baseline, although certain products available in the U.S. may not be rated by the French repairability index.

---

[41] See: https://www.thegreenmissioninc.com/assets/deconstruction-material-and-property-appraisal-issues-in-22.pdf and https://www.thegreenmissioninc.com/assets/appraiser-appraisal%20updated-article.pdf.
[42] See: https://www.qld.gov.au/environment/circular-economy-waste-reduction/reduction/plastic-pollution/single-use-plastics-guide#:~:text=Single%2Duse%20plastics%20have%20helped,usable%20lifespan%20of%2015%20minutes.
[43] Vanderlip, C. (2023, January 3). School cafeterias use tons of single-use containers that go to landfill. Here's how to change that. *Fast Company*. https://www.fastcompany.com/90828505/school-cafeterias-single-use-packaging-waste-circular-economy-reuse.
[44] See: https://nordregio.org/nordregio-magazine/issues/industrial-symbiosis/what-is-industrial-symbiosis/.
[45] See: https://www.indicereparabilite.fr/.

10. Education of youth to instill environmental awareness around waste management, recycling, and reuse.

It was discussed that many people do not understand how the waste management system works, even though everyone contributes waste to it. Education in schools about such systems and the environmental impacts of materials management would be useful. The Maine Climate Hub already provides multiple relevant lessons.[46] To help support further development and inclusion of materials management curriculum for K through 12, attendees suggested providing funding or grants for continued development of grade-appropriate environmental science material related to waste management.

11. Improve collection of household hazardous waste statewide.

Lack of HHW collection was a major concern and attendees would like to see permanent collection points in each county for HHW. It was mentioned that Vermont recently passed a stewardship program for household hazardous waste and suggested that Maine should consider a similar program.

12. Streamline municipal reporting.

Several attendees discussed that, from the municipal perspective, the current transfer station and municipal recycling progress reports and reporting systems are repetitive and inefficient. Streamlining reporting will allow for more efficient data collection, management and analyses and streamline the process of making data available to the public to aid in decision making for waste management.

13. Citizen input and participation.

Several attendees articulated a desire for the State to create and fund staff for a Citizens Advisory Group to act as a review and information outlet for waste management issues.

VI. Future Strategies

The Department is looking forward to evaluating data once its comprehensive assessments are completed. The Department anticipates these studies will provide the data necessary to target the components of the waste stream that will be most impactful toward reaching Maine's recycling and waste diversion goals. The Department will then be able to make recommendations regarding Maine's infrastructure for recycling, composting, diversion efforts, processing and disposal, and also for appropriately managing municipal WWTP sludge.

The strategies below are based on the information available at the time of the publication of this Plan and include input from the public. While the Department does not have enough information at this time to provide recommendations, the Department has observed some strategies that are worth considering right away. These include:

[46] See: https://maineclimatehub.org/.

1. Evaluating the concept of subsidies for waste-to-energy incinerators, anaerobic digestion facilities, or other facilities/processes that can reduce the volume of waste requiring landfilling. Subsidies could be structured either to incentivize construction or expansion of facilities or to subsidize the cost of managing materials/processes other than landfill disposal.

2. Coordinating or partnering with the Finance Authority of Maine for tax incentives or low-interest loans, as available, to develop infrastructure for waste diversion.

3. Considering statewide unit-based pricing, also known as "pay as you throw" to make disposal costs more equitable and provide a financial incentive to reduce waste and increase recycling.

4. Creating subsidies or assistance for food rescue for businesses and other generators or food scrap collection for municipalities.

5. Strengthening participation in existing product stewardship programs for safer, more affordable materials management across the state.

Maine-specific concepts identified by the Department during the stakeholder meetings:

1. Provide additional assistance to municipalities in meeting recycling and waste diversion goals by highlighting reimbursement to municipalities and funding for infrastructure development through the EPR Packaging Program as well as existing opportunities through the Waste Diversion Grant Program.

2. Incentivize reuse, repair, refill, in reducing overall waste generation and the need for prioritizing these actions to conserve resources and reduce emissions while acknowledging the need for and importance of continuing to support and build out infrastructure for recycling and composting.

3. Increase education efforts and cooperative work on reuse, refill, waste reduction, recycling, organics management.

4. Encourage regionalization between municipalities and counties through subsidies. Regional systems could form a "hub and spoke" model for more efficient handling and transportation. Regional facilities could receive subsidies to accept all recyclables, universal waste, and take responsibility for one collection event for HHW, electronics, and other problematic material.

5. Encourage or make requirements for lessors of multifamily housing to provide for the collection of recyclable waste and not force renters to just dispose of wastes.

6. Encourage expansion of "right to repair" to increase the life span of consumer products. Since December 2022, New York, Minnesota, Colorado, and California have passed right to repair bills covering electronics, appliances, and agricultural equipment.

Future planning must also take into account the rural nature of much of Maine. Waste management costs are dependent on economies of scale, whether it be hauling material, processing, or disposal. The more material collected, and the more people serviced, the lower per capita costs will be. The relatively low population density of portions of the state generally drives up the per capita costs for

providing services to those areas. The State may need to provide incentives in order to entice waste facilities and operators to locate in and provide services to portions of the state with lower population densities. Not doing so will create underserved areas of the state compared to more populous areas.

VII. Conclusions

As shown by the data presented in this report and in the Waste Generation and Disposal Capacity Reports published by the Department since the previous Plan update in 2019, Maine has not been making progress towards reaching its waste diversion and recycling goals. The amount of MSW and CDD Maine generates annually has increased, the amount of waste material Maine is landfilling has increased, and the rates of recycling and waste diversion has remained, at best, stagnant in some areas of the state and has decreased in others.

Additionally, Maine has lost capacity in regard to waste-to-energy options due to the idling of one of its three waste-to-energy incinerators. If the facility is not successfully restarted, the permanent loss of that facility would further limit disposal options in Maine. Although Maine's landfill capacity appears adequate for the next 15 years (assuming that the JRL facility is licensed for expansion), after that time period landfill capacity will be quite limited. The only secure spot in Maine's waste arena in terms of capacity is the Northern Maine area, in which AWS appears to have adequate landfill capacity for its regional population for at least 40 years.

The Department anticipates a significantly improved understanding of Maine's waste stream once the aforementioned WC Study, FLWG Study, and Biosolids Study are completed and evaluated. As an example, the Department anticipates that textiles, which have been identified as the fastest growing waste stream in the country,[47] will also be noted as a material of concern in the composition of Maine's MSW stream. The WC Study will provide clear data regarding how much of Maine's waste stream is comprised of such material currently, and target diversion efforts. While it is clear that further action is needed to ensure that Maine's waste reduction and recycling goals are met, and that Maine maintains long-term disposal capacity for waste that needs to be disposed, gathering and analyzing the data being generated by these studies is imperative for sound and economically driven decision making moving forward.

One issue that is apparent from the currently available data is that approximately one-third of the volume of material landfilled in Maine is CDD, CDD residue, wood waste, and other similar material. While some of this material is utilized by the landfill as cover material and other uses such as bulking material for municipal WWTP sludge, much is also being landfilled. Steps should be taken to further reduce the amount of CDD being generated, increase diversion and recycling, and assure when landfilling is necessary that advantageous use of this material at the facility is maximized (i.e., as cover and bulking), minimizing the amount placed in landfills merely as waste. Repurposing of CDD also holds significant economic opportunity, with the potential to support new education pathways, as well as job growth and a new avenue for small businesses.

[47] See: https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-207.pdf.

The cost of transportation has been mentioned in stakeholder meetings as a major factor in materials management around the state for both waste disposal and diversion programs such as recycling and organics management. It is clear that more regionalization is needed and determining how to best foster such regional partnerships is an ongoing process for the Department.

APPENDICES

Appendix A: Maine's Solid Waste Management and Food Recovery Hierarchies

§ 2101. Solid Waste Management Hierarchy

1. Priorities. It is the policy of the State to plan for and implement an integrated approach to solid waste management for solid waste generated in this State and solid waste imported into this State, which must be based on the following order of priority:

   A. Reduction of waste generated at the source, including both amount and toxicity of the waste;

   B. Reuse of waste;

   C. Recycling of waste;

   D. Composting of biodegradable waste;

   E. Waste processing that reduces the volume of waste needing land disposal, including incineration; and

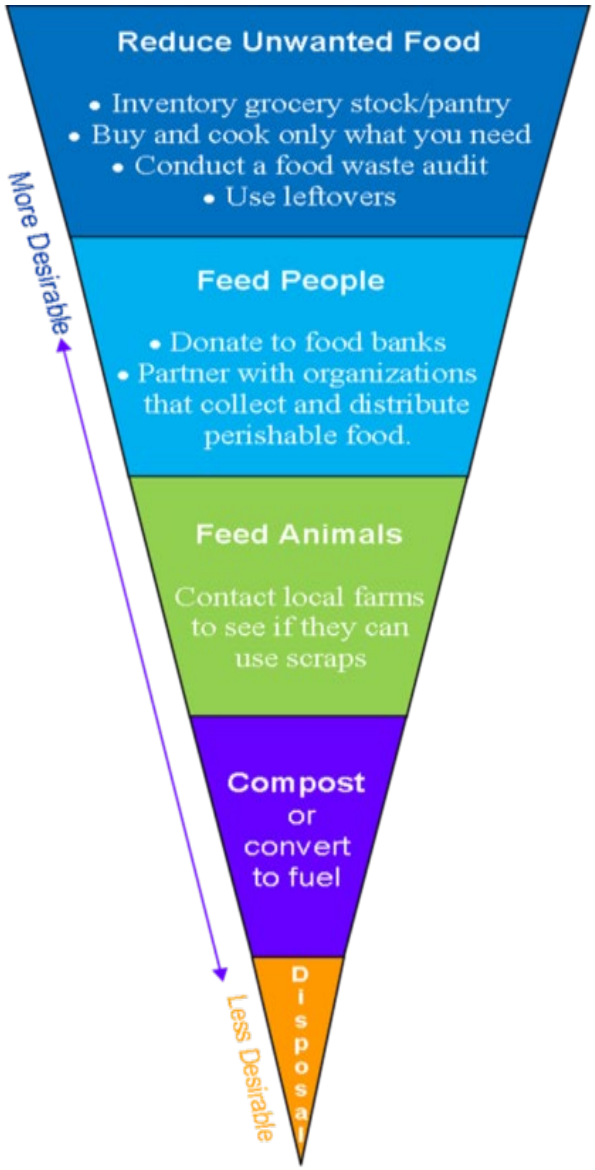
   F. Land disposal of waste.

It is the policy of the State to use the order of priority in this subsection as a guiding principle in making decisions related to solid waste management.

2. Waste reduction and diversion. It is the policy of the State to actively promote and encourage waste reduction measures from all sources and maximize waste diversion efforts by encouraging new and expanded uses of solid waste generated in this State as a resource.

§ 2101-B. Food Recovery Hierarchy

1. **Priorities.** It is the policy of the State to support the solid waste management hierarchy in section 2101 by preventing and diverting surplus food and food scraps from land disposal or incineration in accordance with the following order of priority:



A. Reduction of the volume of surplus food generated at the source;

B. Donation of surplus food to food banks, soup kitchens, shelters and other entities that will use surplus food to feed hungry people;

C. Diversion of food scraps for use as animal feed;

D. Utilization of waste oils for rendering and fuel conversion, utilization of food scraps for digestion to recover energy, other waste utilization technologies and creation of nutrient-rich soil amendments through the composting of food scraps; and

E. Land disposal or incineration of food scraps.

2. Guiding principle. It is the policy of the State to use the order of priority in this section, in conjunction with the order of priority in section 2101, as a guiding principle in making decisions related to solid waste and organic materials management.

Appendix B: List of MSW and CDD Categories and Sub-sorts for a Statewide Waste Audit

Category		Sub-sorts
Paper	1	Books
	2	Boxboard (chipboard)
	3	Compostable Paper
	4	High Grade Office Paper
	5	Magazines/Catalogs
	6	Mixed Recyclable Paper
	7	Newsprint
	8	Non-Recyclable R/C Paper
	9	OCC (Old Corrugated Containers)
	10	Polycoated/Aseptic/Multi-Material Containers
Glass	11	Glass Beverage Bottles - BB
	12	Glass Beverage or Food Containers - NBB
	13	Other Glass (Non-Container)
Metal	14	Aluminum Cans - BB
	15	Aluminum Foil, Pans, and Containers - NBB
	16	Ferrous Containers
	17	Other Ferrous
	18	Other Non-Ferrous
Plastic	19	#1 PET Bottles - BB
	20	#1 PET Food and Dairy Bottles and Jars -NBB
	21	#2 HDPE Bottles - BB
	22	#2 HDPE Food, Dairy & Other NBB
	23	#3-7 Bottles - BB
	24	#3-7 Bottles, Non-BB
	25	#5 PP Food Containers
	26	#6 PS Rigid Food and Beverage Containers
	27	#6 EPS Foam Food and Beverage Containers
	28	Bulky Rigids >1 Gallons
	29	Film, Agricultural and Marine Shrink Wrap
	30	Film, Garbage Bags
	31	Film, Other Bags or Non-Bags
	32	Film, Retail Bags
	33	Thermoforms
	41	Clean Wood
	42	Other Organics
	43	Pet Waste
Electronics	45	Non-CED Electronics
	46	CEDs - CRTs
	47	CEDs - Desktop Computers
	48	CEDs - Laptops and Tablets
	49	CEDs - Printers
	50	CEDs - Television and Monitors (non-CRT)
	51	CEDs - Other
	52	Computer Peripherals
	53	Products with Embedded Batteries
	54	Small Appliances
	55	White Goods
	56	Solar/PV Panels/Components
CDD	57	Asphalt Brick and Concrete (ABC)
	58	Asphalt Shingles
	59	CDD Metal
	60	Ceramic Fixtures
	61	Drywall/Gypsum Board
	62	Oriented Strand Board (OSB)/Plywood
	63	Other/Residual CDD
	64	Painted/Treated Wood
Batteries	65	Batteries - Primary
	66	Batteries – Rechargeable, Li-ion
	67	Batteries – Rechargeable, Other
UW/HHW	68	Mercury-Containing Products - Lamps
	69	Mercury-Containing Products - Thermostats
	70	Mercury-Containing Products - Other
	71	Architectural Paint
	72	Non-Architectural Paint
	73	Household Hazardous Waste
All	74	Carpet/Padding

Category		Sub-sorts
	34	Remainder/Other Plastic
Ceramics	35	Ceramic Bottles - BB
	36	Other Ceramics
Organics	37	Food Waste - Packaged
	38	Food Waste - Unpackaged
	39	Branches and Stumps >1" Diameter
	40	Mixed Yard Waste

Category		Sub-sorts
Other Wastes	75	Diapers/Sanitary Products
	76	Furniture/Bulky Items
	77	Supplements/Pharmaceuticals/Medicines
	78	Textiles/Leather
	79	Rubber/Tires
	80	Mattresses
	81	Miscellaneous Household Waste

CDD Categories and Sub-sorts

Category		Sub-Sorts
Paper	1	OCC Cardboard/Kraft Paper
	2	Other/Composite Paper
Plastic	3	Clean Film
	4	HDPE Buckets
	5	Other Plastic
Metal	6	Ferrous
	7	Non-Ferrous
Glass	8	Glass
CDD	9	Asphalt Paving
	10	Asphalt Shingles
	11	Concrete/Brick/Masonry
	12	Insulation
	13	Carpet/Padding
	14	Ceiling Tiles
	15	Ceramic Fixtures
	16	Gypsum Wall Board
	17	Pallets & Crates
	18	Oriented Strand Board (OSB)
	19	Plywood
	20	Other Engineered Wood
	21	Clean Wood
	22	Painted/Treated Wood
	23	Other CDD
Organics	24	Mixed Yard Waste
	25	Branches and Stumps >1" Diameter
	26	Other Organics
Batteries	27	Batteries - Primary
	28	Batteries – Wet-Cell
	29	Batteries – Rechargeable, Li-ion
	30	Batteries – Rechargeable, Other
UW/Haz Waste	31	Mercury-Containing Products - Lamps
	32	Mercury-Containing Products - Thermostats
	33	Mercury-Containing Products - Other
	34	Architectural Paint
	35	Non-Architectural Paint
	36	Other Hazardous Waste
Electronics	37	CED Electronics
	38	Non-CED Electronics
	39	Products with Embedded Batteries
	40	Solar/PV Panels/ Components
Special/Other	41	White Goods
	42	Mattresses
	43	Furniture/Other Bulky Items
	44	Tires
	45	Soil/Sand/Gravel
	46	Fines/Mixed Residue
	47	All Other Waste

APPENDIX F

BIOSOLIDS REPORT

SME
SEVEE & MAHER
ENGINEERS

An Evaluation of Biosolids Management in Maine and Recommendations for the Future

PREPARED FOR THE MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

December 15, 2023 // **FINAL REPORT**

PREPARED BY:

Brown AND Caldwell

IN COLLABORATION WITH:

MEWEA

Technical Memorandum

200 Brickstone Square
Suite 403
Andover, MA 01810
T: 978.794.0336

Prepared for: Maine Department of Environmental Protection (DEP)

Project Title: Study for Sustainable Management of Wastewater Solids, Septage & Leachate in the State of Maine

Project No.: 169895

Final Report

Subject: **An Evaluation of Biosolids Management in Maine and Recommendations for the Future**

Date: December 15, 2023

To: Commissioner Melanie Loyzim, DEP

From: Bill Brower, Brown and Caldwell (BC)

Copy to: Maine Department of Environmental Protection:

Brian W. Kavanah, Director, Bureau of Water Quality

Susanne Miller, Director, Bureau of Remediation and Waste Management

Victoria Eleftheriou, P.E., Deputy Director, Bureau of Remediation and Waste Management

Carla J. Hopkins, Director, Division of Materials Management

Tim A. MacMillan, P.E., Environmental Engineering Services Manager

Maine Water Environment Association representatives:

Travis Peaslee, P. E., General Manager, Lewiston Auburn Water Pollution Control Authority

Emily Cole-Prescott, City Planner, City of Saco

André Brousseau, Superintendent, Sanford Sewerage District

Prepared by: _____
Bill Brower, Northeast Practice Leader for Solids and Energy, BC

Prepared by: _____
Persephone Ma, Senior Staff, BC

Prepared by: _____
Jessica Nekowitsch, Staff Environmental Engineer, BC

Reviewed by: _____
Natalie Sierra, National Practice Leader for Solids and Energy, BC

Limitations:

This document was prepared solely for the Maine Department of Environmental Protection (DEP) in accordance with professional standards at the time the services were performed and in accordance with the contract between DEP and Brown and Caldwell dated May 2, 2023. This document is governed by the specific scope of work authorized by DEP; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by DEP and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Figures iv
List of Tables v
Abbreviation List vi
Executive Summary 1
Section 1: Project Introduction and Background 5
1.1 Biosolids Generation in Maine 5
1.2 Biosolids PFAS Sampling Results 6
Section 2: Current Issues Impacting Biosolids Management 7
2.1 State Legislation and Regulations 7
2.1.1 Ban on Sludge and Sludge-derived Products Land Application, Sale, and Distribution 8
2.1.2 Out-of-State Waste and Recycling Targets 8
2.1.3 Temporary Revision of Out-of-State Waste and Recycling Targets 9
2.1.4 Air Quality Statutes, Regulation, and Permitting 9
2.2 Other Relevant Regulations 10
2.2.1 Federal PFAS Regulations 10
2.2.2 Regulations in Nearby States 10
2.2.3 Regulations in Canada 11
2.3 Limiting Factors at Landfills 11
2.3.1 Limits on Wet Wastes 11
2.3.2 Bulking Agents 12
2.3.3 Other Issues 12
Section 3: Future Drivers for Biosolids Management 13
3.1 Uncertain Future Landfill Capacity 13
3.2 Septage Land Application Restrictions 14
3.3 Effluent PFAS Limits at Publicly Owned Treatment Works 15
3.4 Climate Action 15
3.5 PFAS Source Control Laws 15
Section 4: Regional Facilities 18
4.1 Governance Structures 18
4.2 Financing 18
4.3 Materials Handling 19
4.4 Proposed Regional Facilities 19
4.5 Proposed BioHub 20
Section 5: Technology Alternatives Analysis 22
5.1 Overview of Selected Technologies 22
5.1.1 Dewatering 22
5.1.2 Anaerobic Digestion 22

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.1.3 Thermal Drying 23
5.2 Selection of Representative POTW Sizes 25
5.3 Cost Evaluation Methodology 27
5.3.1 Operations and Maintenance Costs 27
5.3.2 Capital Costs 27
5.3.3 Life-cycle Cost Analysis 28
5.3.4 Sensitivity Analysis 29
5.4 Cost Evaluation Results: Small POTW 29
5.4.1 Operations and Maintenance Costs 29
5.4.2 Capital Costs 30
5.4.3 Life-cycle Cost Analysis 30
5.4.4 Sensitivity Analysis 31
5.5 Cost Evaluation Results: Medium POTW 31
5.5.1 Operations and Maintenance Costs 32
5.5.2 Capital Costs 32
5.5.3 Life-cycle Cost Analysis 32
5.5.4 Sensitivity Analysis 33
5.6 Cost Evaluation Results: Large POTW 34
5.6.1 Operations and Maintenance Costs 34
5.6.2 Capital Costs 35
5.6.3 Life-cycle Cost Analysis 35
5.6.4 Sensitivity Analysis 36
5.7 Cost Evaluation Results: Regional Facility 37
5.7.1 Operations and Maintenance Costs 37
5.7.2 Capital Costs 38
5.7.3 Life-cycle Cost Analysis 39
5.7.4 Sensitivity Analysis 39
5.8 Summary of Cost Evaluation Results 40
Section 6: Piloting PFAS Treatment Technologies 41
6.1 Siting Considerations 41
6.2 Logistical Considerations 41
6.3 Pilot Location 42
6.4 Suggested Criteria for Selecting Pilots 42
6.5 Roles and Responsibilities During Piloting 43
6.5.1 Technology Vendor 43
6.5.2 Utility 43
6.5.3 State of Maine 43
6.6 PFAS Sampling Protocol 44
6.7 Pilot Outputs 44
6.8 Pilot Costs 44
Section 7: Recommendations 45

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

7.1 Biosolids Beneficial Use Screening Levels 45
7.2 Landfill Capacity for Biosolids 46
7.3 Bulking Agents 46
7.4 Piloting of PFAS Treatment Technologies 47
7.5 Volume Reduction and Dryer Projects 47
7.6 Biosolids Production Reporting 48
Section 8: Conclusion 49
References 50
Attachment A: Innovative Technology Provider Survey A-1
Attachment B: Process Flow Diagrams for Technology Alternatives B-1
Attachment C: Capital Cost Estimates C-1
Attachment D: Net Present Cost Calculations D-1
Attachment E: Suggested Sampling Protocol for Pilots of PFAS Treatment Technologies E-1

List of Figures

Figure 21. Historical biosolids disposal at Maine landfills 8
Figure 3-1. Estimated biosolids management capacity in Maine 13
Figure 3-2. Blood levels of the most common PFAS in people in the U.S. over time 17
Figure 51. Distribution of POTWs by size 26
Figure 52. Net present cost for small-scale POTW alternatives 30
Figure 53. Sensitivity analysis for small-scale POTW alternatives 31
Figure 54. Net present costs for medium-scale POTW alternatives 33
Figure 5-5: Sensitivity analysis for medium-scale POTW alternatives 34
Figure 56. Net present costs for large-scale POTW alternatives 36
Figure 57. Sensitivity analysis of large-scale POTW alternatives 37
Figure 58. Net present costs for regional-scale alternatives 39
Figure 59. Sensitivity analysis for regional-scale POTW alternatives 40

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

List of Tables

Table ES-1. Levers Available to Maine State Government to Address Biosolids Challenges 2
Table 1-1. Biosolids Managed Out of State 5
Table 1-2. PFAS Concentrations for Maine Biosolids 6
Table 1-3. Biosolids Screening Levels in Other States 6
Table 3-1. Landfill Owners Indicating a Willingness to Discuss Starting to Accept Biosolids 14
Table 4-1. Regional Facility Survey Results 19
Table 5-1. Size and Count of Maine POTWs 25
Table 5-3. Construction Cost-estimating Markups 28
Table 5-4. Interest Rate Assumptions 28
Table 5-5. List of Small (0.5 mgd) POTW Alternatives 29
Table 5-6. O&M Costs for Small-scale POTW Alternatives 29
Table 5-7. Class 5 Capital Cost Estimates for Small-scale POTWs 30
Table 5-8. List of Medium-scale (2.5 mgd) POTW Alternatives 31
Table 5-9. O&M Costs for Medium-scale POTW Alternatives 32
Table 5-10. Class 5 Capital Costs for Medium-scale POTW Alternatives 32
Table 5-11. List of Large-scale (7.0 mgd) POTW Alternatives 34
Table 5-12. O&M Costs for Large-scale POTW Alternatives 35
Table 5-13. Class 5 Capital Costs for Large-scale POTW Alternatives 35
Table 5-14. List of Regional-scale (20 MGD) POTW Alternatives 37
Table 5-15. O&M Costs for Regional-scale Alternatives 38
Table 5-16. Class 5 Capital Cost Estimates for Regional-scale POTW Alternatives 38
Table 6-1. Suggested Pass/Fail Criteria for Screening Pilot Proposals 42
Table A-1. Technology Provider Survey Results A-2

Abbreviation List

AACE	Association for the Advancement of Cost Engineering International
BC	Brown and Caldwell
CDD	construction and demolition debris
CFR	Code of Federal Regulations
DEP	Department of Environmental Protection
EGLE	Environmental, Great Lakes, and Energy
EPA	U.S. Environmental Protection Agency
GHG	greenhouse gas
JRL	Juniper Ridge Landfill
L.D.	Legislative Document
MAD	mesophilic anaerobic digestion
mgd	million gallons per day
NEBRA	North East Biosolids and Residuals Association
NG	natural gas
NPC	net present cost
O&M	operations and maintenance
PBD	Public Benefit Determination
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
P.L.	Public Law
POTW	publicly owned treatment works
ppb	parts per billion
R&R	repair and rehabilitation
RFP	request for proposal
SCWO	supercritical water oxidation
SWEET	Solids-Water-Energy Evaluation Tool
THP	thermal hydrolysis process
TS	total solids

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Executive Summary

Several factors have made the current situation for managing biosolids very challenging and uncertain for the Publicly Owned Treatment Works (POTW) who treat municipal wastewater and generate biosolids in Maine. Effective August 8, 2022, 38 M.R.S. §1306(7) banned the land application, sale, and distribution of "sludge and sludge-derived products" in Maine. POTWs were left with one option within the state to manage biosolids: disposal at landfills. Three landfills have provided for nearly all the biosolids disposal in the state, with the state-owned Juniper Ridge Landfill (JRL) in Old Town handling the vast majority. Not long after the ban took effect (February 2023), 38 M.R.S. §1310-N(5-A)(B) (Public Law 2021, Chapter 626) also went into effect, which set recycling deadlines that further exacerbated impacts to the overall management of sludge generated in Maine. Specifically, the operator of JRL asserted that there was consequently an insufficient amount of bulking agents—bulky materials that landfills mix with biosolids to achieve needed landfill stability—available to manage biosolids being added to the landfill and began turning away municipal biosolids. This left POTWs in a challenging situation in which they struggled to find a cost-effective outlet to remove and manage the biosolids generated from the continued treatment of incoming wastewater flows. In some cases, this led to sludge piling up on site, which in turn placed some of the POTWs at risk of being out of compliance with their wastewater discharge permits.

Due to swift action from the POTW community, the Department of Environmental Protection (DEP), and Hawk Ridge Composting Facility, emergency measures were put in place to store and transport sludge to a vendor in Canada. While this was intended as an emergency operation, it should be noted that hauling biosolids hundreds of miles out of the country resulted in greatly increased costs to POTWs (and ultimately ratepayers), and also increased greenhouse gas emissions. Virtually overnight, biosolids management costs for many POTWs doubled, which caused severe and unexpected strains on public utility budgets.

Definition of terms as used in this document:

Biosolids: While neither Maine law nor DEP rule defines the term "biosolids", it is a commonly understood term. Here it is used to refer generally to the treated or untreated solids residual resulting from wastewater treatment at publicly owned treatment works (POTWs).

Septage: The residual removed from septic tanks, cesspools, portable toilets, and similar facilities. When septage is managed at POTWs, much of it is converted via treatment to biosolids.

The root cause of this challenge was, at its heart, a solid waste management issue—having too much biosolids and too few outlets. **The following table shows suggested "levers"—tangible actions to address the underlying issues— available to Maine government to address the key challenges impacting biosolids management in Maine and help avoid similar situations in the future.** In particular, DEP, which oversees both wastewater treatment and sludge management, and the Bureau of General Services within the Department of Administrative and Financial Services, which is charged with administering state-owned landfills, will be integral in developing solutions.

Following the table is a graphic showing the projected biosolids management capacity in the state compared with the amount of biosolids currently generated. The graphic discusses the impact of key regulations, estimated landfill closures and regional biosolids facilities. **The key takeaway from this graphic is that as soon as 5 years from now there could be a drastic shortfall in capacity to accept biosolids in the state unless some of the actions in the table are implemented.**

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Table ES-1. Levers Available to Maine State Government to Address Biosolids Challenges		
Issue	**Details**	**Lever to Address**
SHORT TERM (2024-2025)		
Landfill Capacity	The state-owned Juniper Ridge Landfill (JRL) in Old Town was the outlet for nearly 90% of biosolids generated in Maine in 2022. The current permitted capacity of this facility is estimated to be fully used by 2028. The last time JRL was expanded it took nearly 6 years between submittal of the Public Benefit Determination and final approval, with additional time then needed to construct the new area. If JRL is not expanded, the state faces a dire situation for solid waste generally in the state. For biosolids, there is no current or proposed alternative outlet in the state that would be able to accept the tonnage currently handled at JRL (see the following figure). Out-of-state options would be very costly—with POTWs likely facing significantly higher costs than even those seen during 2022.	It is Brown and Caldwell's understanding that the next step in the process to expand JRL is for the current operator to submit a Public Benefit Determination application to DEP for approval (38 M.R.S. §1310-AA). Given the severity of the implications if the facility is not expanded, it is recommended that **the State work with the current operator to ensure that an application is submitted as soon as possible** to ensure sufficient time to pursue alternatives if the expansion is not pursued by the current operator. In a questionnaire sent to landfill operators in the state as part of this project, four facilities expressed interest in discussing with DEP the possibility of starting to accept biosolids (see Section 3.1). While smaller than JRL**, DEP should coordinate discussions with these regulated facilities** to provide supplemental or contingency capacity.
Bulking Agents	Biosolids are typically mixed with bulking agents when landfilled to ensure slope stability. Much of the bulking agent that was used at JRL originated from a single solid waste processing facility that handled a large amount of waste that originated from out of state. P.L. 2021, ch. 626 limited the ability of this facility to process out-of-state wastes as it prevented the facility from meeting its mandated recycling goals (which prioritized in-state waste generation over out-of-state waste generation). When the provisions of this law went into effect in February 2023, the operator of JRL claimed this resulted in insufficient availability of bulking agent necessary to manage the increased tonnages of biosolids being brought to the landfill, and JRL stopped accepting some biosolids. With very few other options available, biosolids management costs for many POTWs doubled virtually overnight, which caused severe strains on public utility budgets. During the 131st legislature, P.L. 2023, ch. 283 (codified at 38 M.R.S. §1310-N(5-A)(B)) delayed the recycling deadlines that the facility needed to meet and also allowed the facility to increase the overall quantity of out-of-state oversized bulky wastes until July 2025. The practical effect of this change provided some temporary relief in that a larger quantity of bulking agents would be able to come from out of state for 2 additional years; however, this change did not address the longer-term availability of bulking agents. From legislative testimony in 2023, it appeared that part of the challenge was not only a lack of bulking agents from out of state, but also that construction and demolition debris—the source of much of the bulking agent—is generally at a low generation rate during certain times of year, notably late spring, which coincides with spring runoff and increased precipitation, when bulking agent is needed most at a landfill. In a questionnaire sent to landfill operators in the state as part of this project, several landfills listed the lack of bulking agents as a limitation to accepting more biosolids.	**Fund an independent study evaluating the availability of bulking agents**. Restrictions impacting the availability of bulking agents go into effect in 2024 and 2025, so this study should be completed as soon as possible. If the study finds that insufficient quantities of bulking agents are available, then the extension on the restrictions in P.L. 2021, ch. 626 may need to be extended (see Sections 2.1.2, 2.1.3 and 7.3).

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Table ES-1. Levers Available to Maine State Government to Address Biosolids Challenges		
Issue	Details	Lever to Address
Pilot Treatment Technologies for Per- and Polyfluoroalkyl Substances (PFAS)	The full fate of PFAS through biosolids treatment technologies is not known. By funding pilots, Maine can advance the understanding of the potential for cost-effective destruction of PFAS in biosolids and inform future permitting.	**Issue a Request for Proposals to select pilots of these technologies for the state to fund**. Within this request, identify necessary data collection to facilitate future permitting of full-scale facilities (see Section 6).
MEDIUM TERM (2024-2034)		
Support Volume Reduction and Dryer Projects	Current drivers in Maine lead to the need for fewer biosolids and/or biosolids dried to no longer fall under wet waste restrictions at landfills.	As Clean Water State Revolving Funds are already stretched, it is recommended to **issue a bond to provide state grants for volume reduction and drying projects** (similar to the Wastewater Treatment Facility Planning and Construction Grants Program the state undertook in 2019-2020) (see Section 7.5). This should include promising regional projects (see Section 4). The economic analysis in Section 5 shows the value in economies of scale.
Biosolids Beneficial Use Screening Levels	The current lack of management options for biosolids in Maine is not sustainable. Leaving landfill disposal as the sole outlet for biosolids in the state exacerbates landfill capacity issues, runs counter to the state's waste management hierarchy and climate goals, and leaves POTWs (and ultimately ratepayers) at the risk of drastic and sudden increases in biosolids management costs. The three landfills currently handling nearly all the biosolids generated in the state are all estimated to close in the next 20 years. There are several proposals being developed to install biosolids dryers or thermal treatment technologies in the state (Section 4.4), but under the ban on land application of sludge and sludge-derived products pursuant to 38 M.R.S. § 1306(7), the resulting products—even those that have been treated to reduce PFAS—would have essentially no outlet in the state once the major landfills are closed. This would leave POTWs with only options in other states or provinces—and beholden to their tightening regulations.	Maine should consider establishing revised screening levels to allow for a return to land application, provided that levels are consistent with U.S. Environmental Protection Agency (EPA) goals of being protective of human health and the environment. It may be determined that some land application is safe for both human health and the environment, and as such may provide an additional outlet for some of the biosolids generated in Maine. The EPA is conducting a very thorough risk assessment of PFAS in biosolids, scheduled to be completed in late 2024. **It is recommended that the State Legislature consider reevaluating the ban on land application to determine if DEP ought to adopt the federal biosolids PFAS limits once established.**
LONG TERM (2035 and beyond)		
Support PFAS Treatment Projects	Build on the results of the pilot and other research efforts to support the deployment of technologies that have been proven to provide cost-effective PFAS destruction.	**Issue a bond to provide state grants for PFAS treatment projects.**

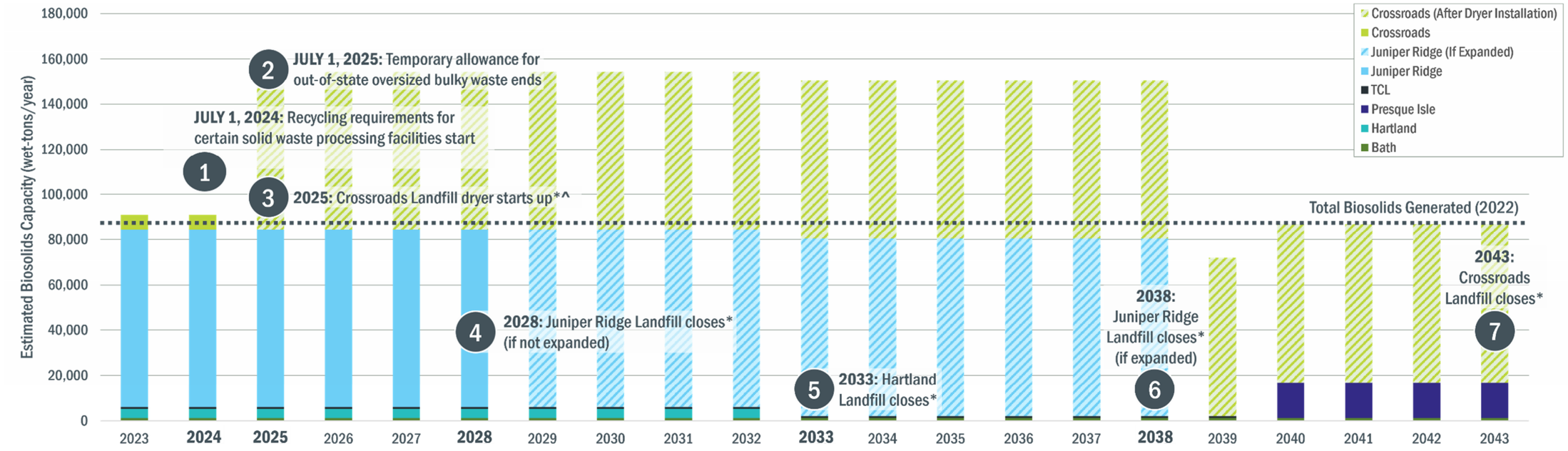
Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

An Overview of the Uncertain Future for Biosolids Management in Maine

To illustrate the urgency to implement effective solutions, the figure below shows the projected capacity to manage biosolids in Maine in the coming years—compared with the amount of biosolids generated in 2022 (horizontal dotted line)—and key events impacting that capacity.

Maine is facing a biosolids management challenge with too much biosolids and too few outlets.

The next two years present complications with bulking agent availability, which could limit the use of in-state landfills for biosolids. Looking towards the next twenty years, landfill closures will severely reduce outlets for biosolids. The challenge ahead is implementing a sustainable and functioning solution to manage biosolids while continuing to protect the environment.



1 July 1, 2024	2 July 1, 2025	3 2025	4 2028	5 2033	6 2038	7 2043
Recycling requirements for certain solid waste processing facilities start	Temporary allowance for out-of-state oversized bulky waste ends	Crossroads Landfill dryer starts up*^	Juniper Ridge Landfill closes* (if not expanded)	Hartland Landfill closes*	Juniper Ridge Landfill closes* (if expanded)	Crossroads Landfill closes*
IMPACT + SIGNIFICANCE: With this requirement, solids processing facilities will have to recycle more of the waste they receive through methods other than use as a bulking agent or alternative daily cover at a landfill—potentially decreasing the amount of material available to mix with biosolids at landfills.	**IMPACT + SIGNIFICANCE:** When the temporary measure allowing oversized bulky waste derived from waste generated out of state to be placed in a state-owned landfill ends, there may be a further shortage of bulking agents to mix with biosolids. Similar to spring 2023, this could result in increased costs to POTWs if biosolids must be sent out of the state.	**IMPACT + SIGNIFICANCE:** After drying, biosolids can be introduced to the landfill without the need for bulking agents. When this dryer is fully operational, it will increase the capacity of the Crossroads Landfill for biosolids.	**IMPACT + SIGNIFICANCE:** The current permitted capacity of JRL is estimated to be used by 2028. If it isn't expanded, there will be no Maine landfill with enough capacity to meet solid waste needs and much of the biosolids produced will need to be sent out of state at greatly increased cost for utilities and ratepayers.	**IMPACT + SIGNIFICANCE:** When Hartland Landfill closes, the biosolids currently disposed there (historically about 5% of the biosolids generated annually) will need to be diverted to an alternate site.	**IMPACT + SIGNIFICANCE:** Even if expanded, JRL is estimated to use all available capacity by 2038. When JRL closes, Maine's available landfill capacity for biosolids (and solid waste generally) will be severely curtailed. Most biosolids would need to be managed in other states or provinces at greatly increased cost.	**IMPACT + SIGNIFICANCE:** Under current regulations, when the Crossroads Landfill uses its remaining permitted capacity, there will be nearly no outlets for biosolids—dried or not—in Maine.

**Estimated dates*
^While other biosolids facilities have been proposed in Maine, including those discussed in Section 3.2, this is the only facility for which permit applications have been formally submitted to DEP and so is the only one included in this graphic.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 1: Project Introduction and Background

The generation of biosolids is an unavoidable part of treating and cleaning wastewater before it is reintroduced into the environment. Biosolids management is covered under the discharge permit for Publicly Owned Treatment Works (POTWs), as well as state and federal laws specifically pertaining to biosolids management in landfills and beneficial use on land (Section 2.1).

POTWs are not active producers or users of per- and polyfluoroalkyl substances (PFAS) but are passive receivers of products containing these materials that are used by homeowners, businesses, and industry and find their way into public sewers. Biosolids represent a small fraction of the PFAS cycling in the environment but have generated concerns in Maine as a potential source of PFAS to soils, surface water, and groundwater (Maine PFAS Task Force, 2020).

This report looks at current and future issues impacting biosolids in Maine (Sections 2 and 3). Section 4 looks at the impact that regional facilities could have on the capacity within the state to manage biosolids. Current Maine regulations leave landfilling as essentially the only management option for biosolids, which exacerbates the need for fewer, drier biosolids. Section 5 provides a general economic analysis of installing anaerobic digestion and thermal dryers at various scales—two proven technologies for volume reduction and producing dryer material. Technologies for treating PFAS in biosolids are not yet ready for statewide adoption, and the research on the extent of destruction is still developing. Section 6 details the suggested approach to supporting pilots of PFAS treatment technologies in the state to further the research, inform the permitting approach for these technologies, and determine which would be worthwhile to fund at full scale. Sections 7 and 8 provide recommendations for concrete actions that Maine state government can take to help address the challenges for biosolids management in the state, and provides conclusions.

1.1 Biosolids Generation in Maine

Brown and Caldwell (BC) estimated that the State of Maine currently manages a total of 88,500 wet-tons of biosolids per year, or approximately 19,600 dry-tons of biosolids at 22 percent total solids (%TS). To estimate the total, tonnage values were pulled from multiple data sources, including Maine Department of Environmental Protection's (DEP) compiled data for generators permitted for agronomic utilization and composting, survey data compiled by the North East Biosolids and Residuals Association (NEBRA), and hauling data from biosolids management companies, as well as a compilation of data BC has from previous work for biosolids production at POTWs in southern Maine. For any facility for which data was not available, estimates for solids production were calculated based on estimated average wastewater flow.

This estimate was also verified by comparing it against the amount of biosolids accepted at landfills. In a technical memorandum produced as part of another part of this project (Batiste, 2023), it was shown that around 87,000 wet-tons of biosolids were landfilled in 2021 and 2022. Nearly all biosolids were landfilled in these years, so the estimated production correlates well with the known landfill acceptance data.

Biosolids managed out of state were primarily sent to a compost facility in Canada. Quantities of biosolids sent out of state are presented in Table 1-1. Note that this only includes tonnage from facilities with an Agronomic Utilization Program License.

Table 1-1. Biosolids Managed Out of State (wet-tons per year)

2017	2018	2019	2020	2021	2022	2023 (through July)
0	500	708	155	275	230	4,145

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

1.2 Biosolids PFAS Sampling Results

In March 2019, DEP issued a memorandum requiring all agronomic utilization licensees and biosolids compost facilities to test for three PFAS compounds. DEP has subsequently obtained additional PFAS sampling data for biosolids in the state. Data from the DEP Environmental and Geographic Analysis Database (EGAD) for the three PFAS compounds in the Screening Levels for Beneficial Use (06-096 C.M.R. Chapter 418, Appendix A, *Solid Waste Management Rules: Beneficial Use of Solid Wastes*) are presented in Table 1-2 as minimum, average, and maximum concentrations by year. It is anticipated that additional PFAS compounds will be added to the screening levels list, but these updates have not been published at the time of the report's drafting.

Table 1-2. PFAS Concentrations for Maine Biosolids[a], (parts per billion)

Compound	Acronym	Value	2019	2020	2021	2022
Perfluorooctanoic Acid	PFOA	Minimum	Non-detect	0.6	0.3	0.8
		Average	9.4	8.2	5.3	6.6
		Maximum	46	63	25	38.9
Perfluorooctane Sulfonic Acid	PFOS	Minimum	2.2	2.5	2.1	1.2
		Average	27.2	16.6	22.7	19.3
		Maximum	120	51.9	111	66
Perfluorobutane Sulfonic Acid	PFBS	Minimum	0.8	0.2	0.5	0.4
		Average	3.3	1.4	2.7	21.7
		Maximum	10	3.9	7.3	86

[a] *Data available in EGAD at time of analysis only. Excludes biosolids compost.*

As of this report's drafting, Maine's soil beneficial use screening levels—which were applied to biosolids destined for agronomic utilization prior to the 2022 prohibition on the land application of biosolids and biosolids-derived products—were 5.2 parts per billion (ppb) for PFOS, 2.5 ppb for PFOA and 1,900 ppb for PFBS.

For reference, regulatory limits from other states are shown in Table 1-3. In 2022, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) updated the threshold value, defining "industrially impacted" biosolids as those with PFOS levels greater than 125 ppb. The average PFOS and PFOA concentrations for Maine biosolids in 2022 are at levels that would be allowed to be land applied without remedial action (e.g., source control to reduce concentrations) under the interim guidelines finalized by New York in 2023—the most stringent numerical standards specifically for biosolids in the country.

Table 1-3. Biosolids Screening Levels in Other States

State	Limit Requiring Remedial Action	Limit Prohibiting Beneficial Reuse
Michigan (Interim Strategy)	PFOS: 50 ppb	PFOS: 125 ppb
New York (Interim Guidelines)	PFOS: 20 ppb PFOA: 20 ppb	PFOS: 50 ppb PFOA: 50 ppb

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 2: Current Issues Impacting Biosolids Management

The following sections discuss the legislation and regulations in Maine and elsewhere that impact biosolids management in the state, as well as other factors that limit the ability of landfills to accept biosolids.

2.1 State Legislation and Regulations

Modern biosolids management authority in Maine was established in 1973 by the Maine Hazardous Waste, Septage, and Solid Waste Management Act, 38 M.R.S. 13. These statutes establish the authority of the state and Maine DEP to regulate waste management to protect the health and safety of its citizens and the environment. Residuals management in Maine is managed by the Material Management Program Division in the Bureau of Remediation and Waste Management of DEP. Biosolids are also regulated under Chapter 40 Part 503 of the Code of Federal Regulations (40 CFR 503); within this regulation is embedded the right for states to pass regulations more stringent than 40 CFR 503.

In 2016, milk from a Maine dairy farm was found to have high levels of PFOS, one of the more prevalent PFAS compounds, which led to a statewide effort to test and monitor PFAS concentrations in the environment. After investigation by multiple state agencies, two additional dairy farms were identified to have high levels of PFOS in milk, which supported a link between land application of municipal and industrial sludge and agricultural impacts from PFAS. To address concerns about food supply and drinking water, the state established a task force in March 2019 to develop a path forward for tackling PFAS contamination. The top two task force recommendations were to ensure provision of safe drinking water and to protect the food supply from PFAS contamination.

Also in March 2019, DEP issued a memorandum stating that biosolids agronomic utilization licensees and licensed sludge composters must first sample for three PFAS compounds (those identified in the recently updated 06-096 C.M.R. Chapter 418, Appendix A, *Solid Waste Management Rules: Beneficial Use of Solid Wastes)* prior to conducting any land application activity. Any PFAS samples above the screening concentrations and/or site-specific soil loading rate calculations would then result in restricted or no land application. In 2019, biosolids from only one POTW met the screening limits for all three PFAS compounds (without consideration of loading rate calculations), which either severely restricted the land application rate or, more commonly, pushed biosolids into landfill (see Figure 2-1).

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

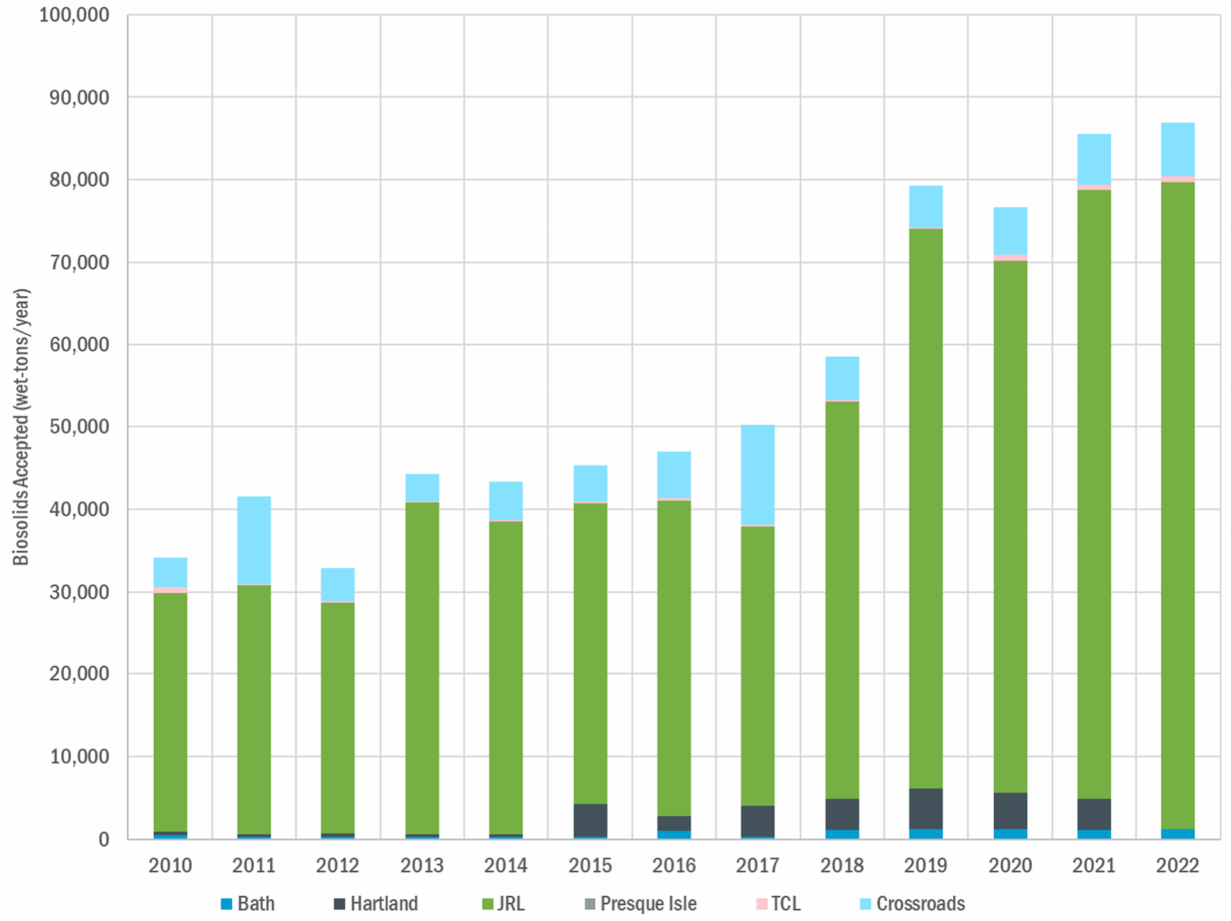


Figure 21. Historical biosolids disposal at Maine landfills

2.1.1 Ban on Sludge and Sludge-derived Products Land Application, Sale, and Distribution

In April 2022, the 130th Maine legislature passed Public Law (P.L.) 2021, ch. 641, "An Act to Prevent the Further Contamination of the Soils and Waters of the State with So-called Forever Chemicals" (often referred to by the name of the original bill, Legislative Document (L.D.) 1911, and codified at 38 M.R.S. § 1306 (7)). This legislation banned the land application, sales, and distribution of any products made with or mixed with biosolids and commercial and industrial sludges.

This legislation drove the little remaining agronomic utilization in the state (via land application and distribution as compost) to landfill disposal. In 2022, nearly all biosolids generated in the state were sent to in-state landfills, primarily the state-owned Juniper Ridge Landfill (JRL), which is operated by NEWSME Landfill Operations LLC, a wholly owned subsidiary of Casella Waste Systems, Inc. This was the culmination of a trend toward landfilling over the past few years as concerns about PFAS grew in the state (as shown previously on Figure 21).

2.1.2 Out-of-State Waste and Recycling Targets

At the same time as the biosolids land application, sale, and distribution ban the legislature passed P.L. 2021, ch. 626 (L.D. 1639), "An Act to Protect the Health and Welfare of Maine Communities and Reduce Harmful Solid Waste." This law became effective in February 2023 and limited the tonnage that solid waste

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

processing facilities could send to landfills in Maine to no more than what the facility accepted from in-state sources, with the goal of preserving landfill space for waste generated in Maine. The law also required that at least 50% of the material that certain solid waste processing facilities (those that accepted more than 200,000 tons in 2018) accepted be reused or recycled through methods other than placement in a landfill, with a gradually increasing percentage of the recycled amount going to outlets other than landfills (as a bulking agent or alternate daily cover).

As is discussed in further detail in Section 2.3.2, biosolids are typically mixed with bulking agents when landfilled to ensure slope stability. Much of the bulking agent that was used at JRL (construction and demolition debris (CDD), including oversized bulky waste) originated from a processing facility that handled a large amount of waste that originated from out of state. When the provisions of P.L. 2021, ch. 626 restricting out-of-state waste went into effect in February 2023, the operator of JRL claimed that there was insufficient bulking agent available, particularly with the increased tonnages of biosolids being landfilled due to the ban, and began turning away trucks with municipal biosolids.

As a result of the confluence of these events, POTWs were left with little to no outlets for the biosolids that are a byproduct of wastewater treatment. On-site sludge storage at POTWs filled up quickly, and several utilities were at risk of being out of compliance with their wastewater discharge permits. In March 2023, Casella sought temporary approval from the Maine DEP to use a backup alternative to manage the increasing need to store biosolids by collecting and sending the material for temporary storage at the Hawk Ridge Compost Facility, and within a prescribed turnaround, sending these materials to a compost facility in New Brunswick, Canada. This was all done at a significantly increased cost. Virtually overnight, biosolids management costs for many POTWs doubled, which caused severe strains on public utility budgets.

Historically, around 150 to 700 wet-tons per year of biosolids were managed out of state (see Section 1.1). During the March to early July 2023 timeframe, approximately 4,100 wet-tons of biosolids were sent to Canada for management—equivalent to approximately 14% of the biosolids generated in the state in a typical four-month period.

2.1.3 Temporary Revision of Out-of-State Waste and Recycling Targets

In June 2023, the Maine legislature passed P.L. 2023, ch. 283 (codified at 38 M.R.S. §1310-N(5-A)(B)), which allows solid waste processing facilities to continue sending up to 25,000 tons per 12-month period of oversized bulky waste that was originally generated out of state to state-owned landfills (i.e., JRL) until July 1, 2025. This was to ensure that enough bulky waste could be obtained throughout the year until better solutions were available for managing biosolids in Maine. The law also delays until July 1, 2024, the start date for when certain large solid waste processing facilities are required to ensure a portion of recycled material goes to an outlet other than landfills. These temporary measures helped alleviate the immediate challenge, but the underlying issues still need to be addressed.

2.1.4 Air Quality Statutes, Regulation, and Permitting

POTWs, project developers, and technology vendors have reported a lack of clarity in the requirements for air permitting for biosolids technologies in Maine, including thermal dryers and potential PFAS treatment technologies. There are no current PFAS limits for air emissions in Maine, though DEP anticipates there very likely will be in the future, likely based on federal guidance when it becomes available. In the interim, DEP has provided guidance that it will require a Best Available Control Technology analysis for new sources or major or minor modifications to existing licenses (as defined in 06-096 C.M.R. Chapter 115, *"Major and Minor Source Air Emission License Regulations"*). License renewals of minor sources will require Best Practical Treatment analysis.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

2.2 Other Relevant Regulations

Separate and apart from Maine's actions, the federal government, Canadian provincial and federal governments, and other states within the region have been pursuing regulatory actions around PFAS and biosolids management that are distinct from Maine's approach.

2.2.1 Federal PFAS Regulations

In October 2021, U.S. Environmental Protection Agency (EPA) Administrator Michael S. Regan announced the agency's PFAS Strategic Roadmap, which lays out a whole-of-agency approach to addressing PFAS. The roadmap sets timelines by which EPA plans to take specific actions and commit to new policies. For wastewater, the Roadmap emphasizes the role of source control—keeping PFAS from entering sewer systems in the first place. For example, EPA plans to issue updated effluent limitation guidelines for several key industrial categories in the coming years. This pretreatment-based approach was further expanded in a December 2022 memorandum from EPA Assistant Administrator Radhika Fox, which emphasized the importance of industrial pretreatment for utilities land applying biosolids.

In 2020, the EPA began its risk assessment process to evaluate the need for PFOA and PFOS limits in biosolids under 40 CFR 503, the federal regulatory mechanism for biosolids management oversight. The results of this risk assessment are expected to be published in late 2024 and could result in regulatory limits for PFOA and PFOS in land-applied biosolids. Other PFAS compounds have been identified for further study, including potential future risk assessment.

2.2.2 Regulations in Nearby States

In general, biosolids management has been challenging in New England in recent years, particularly in Massachusetts, where the largest volumes of biosolids are generated due to higher population density. These management constraints mean there is limited opportunity to manage Maine biosolids in nearby states, primarily due to:

- Limited sites for Class B land application: Relative to the volumes generated, there is insufficient acreage for management of Class B biosolids on land. Short growing seasons in New England, as compared to other parts of the country, exacerbate this constraint.
- PFAS concerns and regulations under development: While Maine was the first New England state to regulate PFAS in biosolids, New Hampshire, Massachusetts, and Vermont have all begun the process of developing regulations related to PFAS in land-applied biosolids. New Hampshire, in coordination with the U.S. Geological Survey, is conducting a scientifically rigorous process for establishing biosolids screening standards, which could be informative for Maine.
- Limited landfill capacity.
- Vermont and New Hampshire have regulations stating that biosolids brought into those states for certain uses must meet the pollutant limits or chemical contaminant concentrations of that state or the state in which they were generated, whichever is more stringent.
- Exhausted regional incineration capacity: In southern New England, regional incinerators provide additional biosolids management capacity. The facilities are largely at capacity, with some older facilities experiencing higher downtime for maintenance. Many sewage sludge incinerators in the region have closed and new ones are difficult to develop due to more stringent air emissions controls necessary per new source performance standards and emission guidelines rules finalized by the EPA in 2016. Incinerators are also facing scrutiny as potential sources of PFAS air emissions. Connecticut, a state in

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

which incineration dominates as a biosolids management option, has begun a PFAS monitoring program with the potential for future regulation.

These constraints are a key reason why biosolids management companies have sought to manage Maine biosolids elsewhere, particularly in Canada.

Biosolids dried to U.S. EPA Class A standards (meaning they can be used in a wide variety of horticultural applications, as well as agricultural) would be easier to manage outside of Maine, as would the biochar produced by pyrolysis or partial gasification units.

2.2.3 Regulations in Canada

In Canada, biosolids are generally regulated at the provincial level; there is no federal equivalent to 40 CFR 503. Previously, biosolids from New England had been hauled to Canada, specifically Quebec and New Brunswick, for reuse. However, on March 2, 2023, the Quebec provincial government issued a temporary moratorium on the importation of land-applied biosolids from the U.S. while the Ministry of the Environment of Quebec works to develop PFAS standards in biosolids. The provincial government of Quebec is expected to issue a regulation on the land application of biosolids, including limits for certain PFAS compounds, in 2024. While biosolids are still accepted in New Brunswick, the Canadian Food Inspection Agency is expected in early 2024 to implement a PFOS limit (purported to be around 50 ppb) for biosolids that would impact beneficial use across all provinces.

Agronomically utilizing biosolids in Canada had been crucial in managing biosolids in New England for some time. Quebec and New Brunswick have historically been routine outlets for biosolids in northern Maine. The New Brunswick facility is often the backup option listed on many Casella contracts. In 2023, when biosolids land application in Maine was banned and landfills had insufficient bulking agent to accept biosolids, a facility in New Brunswick was an essential alternative outlet. The movement of biosolids to Canada has garnered significant negative press in the past year; thus, even biosolids that could be managed under the new federal and provincial laws may be challenged to find receivers.

2.3 Limiting Factors at Landfills

While landfills have generally had the capacity to manage nearly all biosolids generated in the state in recent years (see Figure 21), landfill capacity to receive biosolids is constrained by several key factors pertinent to this study. The importance of these factors was reinforced in a survey of landfills conducted as part of this project.

2.3.1 Limits on Wet Wastes

While landfills are currently managing essentially all of the biosolids produced in the state, the events of spring 2023 highlighted how dependent biosolids management is on a handful of landfill operations in Maine and in particular to Maine's state-owned landfill, JRL. A separate report published as part of this project (Batiste, 2023) examined the potential for landfills currently permitted to accept biosolids to accept additional tonnage. A main limiting factor to biosolids acceptance is the proportion of "high-moisture content waste" or "wet waste" that landfill owners are permitted or willing to accept per internal operating guidelines. Wet waste is typically defined as materials having a moisture content greater than 60% (Georgia Department of Natural Resources, 2021); most biosolids have a moisture content of 75% or higher and thus fall into this category. If added in too great a proportion, wet wastes can affect the stability of landfill side slopes, leading to unsafe operating conditions, including slope failures. The maximum amount of wet waste

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

accepted is typically no more than 10% of the total amount of waste accepted, and all other wet wastes (e.g., industrial sludges, industrial wastes) accepted at the landfill count toward this overall limit.

Based on historical data and the responses to a questionnaire sent to landfill operators in the state as part of this project (Batiste, 2023), there appears to be limited ability of landfills currently accepting biosolids to accept more due to limits on the acceptance of wet wastes.

It is important to note that biosolids that have been dried to a moisture content below 60% would no longer fall under this limitation. There are multiple POTWs in other states sending dried biosolids to landfill, either as a component of alternative daily cover or for direct burial, without issue. As with many materials, consideration would need to be given to how dried biosolids are placed in a landfill to avoid stability or heating issues.

2.3.2 Bulking Agents

As the challenges in finding outlets for biosolids in the spring of 2023 made clear, the acceptance of biosolids at landfills is heavily reliant on the availability of bulking agents to mix with the biosolids to provide needed stability (see Sections 2.1.2 and 2.1.3). The ratio of bulking agent to biosolids is typically 4:1 or more, depending on the moisture content of the biosolids, the bulking agent properties, and the workability goals of the landfill operator. Some bulking agents require a higher ratio, which reduces the number of biosolids trucks that can be accepted per hour.

From legislative testimony in 2023, it appeared that part of the challenge was not only a lack of bulking agents from out of state, but also that CDD—the source of much of the bulking agent—is generally at a low generation rate during certain times of year, notably late spring, which coincides with spring runoff and increased precipitation, when bulking agent is needed most at a landfill.

2.3.3 Other Issues

In addition to limits on the proportion of wet waste and the need for sufficient quantities of bulking agents (see Section 2.3.2), there are several other logistical factors that in practice limit the amount of biosolids that can or will be accepted at a landfill, including:

- Biosolids arriving for disposal at a landfill need to be promptly mixed with other solid waste and covered to minimize the potential for odors. Operators try to coordinate biosolids acceptance with the availability of sufficient waste available for mixing so trucks are able to enter and exit the facility as quickly as possible.
- Landfill gas and leachate production both have the potential to increase with the addition of biosolids to a landfill; therefore, additional attention to these systems is generally needed.
- Landfilling of biosolids has the potential to impact leachate quality, which may affect options for treating and managing the leachate.
- Landfills may at times be undergoing restrictions due to inclement weather (such as the heavy precipitation of summer 2023) or operational issues such as location and size of the working face that reduce the volume of biosolids that can be accepted.
- The potential requirement for PFAS treatment in leachate has made some landfill operators reluctant to accept biosolids.

Finally, a nationwide shortage of truck drivers and volatile fuel prices add uncertainty to the process of transporting biosolids to the landfill in the first place.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

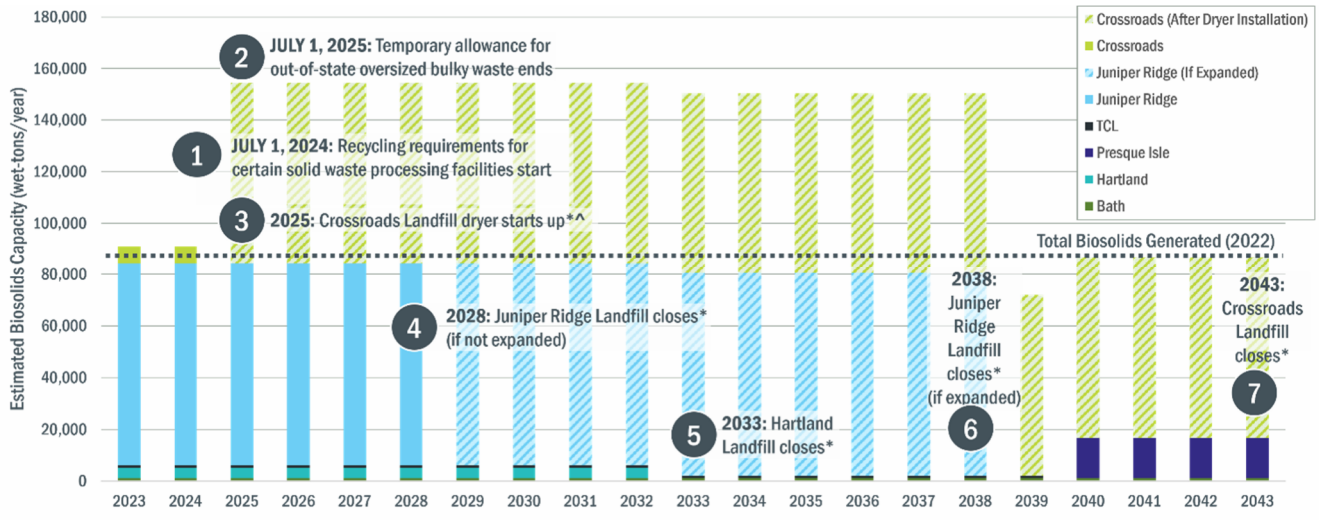
Section 3: Future Drivers for Biosolids Management

While biosolids management in Maine remains precarious today, uncertainty around future landfill capacity, the development of alternative management outlets, and competing state goals all impact available management options in the future.

3.1 Uncertain Future Landfill Capacity

Another report published as part of this project (Batiste, 2023) estimated when the permitted capacity at landfills accepting biosolids would be completely used (see Figure 3-1). At current consumption rates, it is estimated that the current permitted capacity for the two facilities accepting the vast majority of biosolids in the state, JRL and Crossroads, would be exhausted in 2028 and 2043, respectively. A proposed expansion at JRL, the permitting process for which has just formally begun, is estimated to extend the operating life by an estimated 10 years to 2038 (see Figure 3-1). Figure 3-1 additionally shows the potential impact of a planned thermal dryer for biosolids at the Crossroads Landfill.

This obviously presents a solid waste management challenge in the state well beyond biosolids, but after 2043, given the current legislation and these anticipated landfill closures, POTWs in Maine will be left with no in-state (and likely few out-of-state) options for managing biosolids. As will be discussed in Section 4.4, there are several proposals being developed to install biosolids dryers or thermal treatment technologies in the state so that the resulting material is no longer subject to wet waste restrictions. However, these options are only a near-term fix, as the two landfills will not be able to accept biosolids of any kind when they have reached capacity. Given the restrictions of Maine's biosolids land application ban, once landfills reach maximum capacity, there will be no outlet in the state even for dried material.



**Estimated dates*
^While other biosolids facilities have been proposed in Maine, including those discussed in Section 3.2, this is the only facility for which permit applications have been formally submitted to DEP and so is the only one included in this graphic.

Figure 3-1. Estimated biosolids management capacity in Maine (wet-tons/year)

In the questionnaire responses, a few landfill owners not currently permitted to accept biosolids (City of Augusta, City of Lewiston, and Twin Rivers Paper Company LLC) expressed interest in discussing with DEP the possibility of accepting biosolids in the future. In addition, the Pixelle Androscoggin facility, which includes a landfill, is in the process of being sold. While the proposed plan for the facility is to close the

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

landfill, the possibility of using the remaining permitted capacity at the site for biosolids disposal could be explored with the new owners as an alternative action if the proposed activity complies with state statutes and rules.

While additional restrictions on the amount of biosolids that could be accepted at these "additional" facilities are likely, an approximate maximum tonnage that each facility could accept was calculated based on questionnaire responses and annual reports (Table 3-1). Collectively it is estimated that these facilities could accept a maximum of almost 10,000 wet-tons/year, or around 11% of all the biosolids currently generated in the state. These facilities could provide another outlet for biosolids, particularly for POTWs located nearby. They could also provide contingency backup in the event issues arise at the landfills currently accepting biosolids.

Table 3-1. Landfill Owners Indicating a Willingness to Discuss Starting to Accept Biosolids[a]

Owner	Landfill	Public/Private	Location (city/town)	Typical Waste Acceptance Rate (wet-tons/year)	Estimated Maximum Biosolids Acceptance[b] (wet-tons/year)
City of Augusta	Hatch Hill Landfill	Public	Augusta	71,000	7,100
City of Lewiston	Lewiston Landfill	Public	Lewiston	11,000	1,100
Pixelle Androscoggin LLC	Pixelle Androscoggin Landfill	Private	Jay	7,000	700
Twin Rivers Paper Company LLC	Frenchville Landfill	Private	Madawaska	8,600	860
				TOTAL:	**9,760**

[a] *In study questionnaire response*

[b] *10% of total waste accepted based on questionnaire responses or annual reports*

It is not anticipated that new landfills will be constructed in Maine over the planning period of this study (20 years). Maine has had a moratorium on new commercial landfills since 1989, and BC was not made aware of any plans for new or expanded state landfills (with the exception of the possible JRL expansion).

3.2 Septage Land Application Restrictions

P.L. 2021, ch. 641 suspended issuance of new septage land application licenses, restricted land application of septage at existing sites based on whether groundwater concentrations exceeded the state's interim drinking water standards for PFAS, and tasked DEP with evaluating alternatives to the land application of septage. Maine DEP submitted the "Report on the Land Application of Septage" to the legislature on January 13, 2023, to provide information to the legislature on whether it was advisable to enact a similar ban on the land application of septage.

Another, separate, report produced as part of this project (Rebodos, 2023) provided further evaluation on management options other than land application of septage. That report estimated that if a septage land application ban were to be enacted in Maine and most of the septage currently land applied in the state were to be transferred to POTWs for treatment, an additional 3,000 wet-tons per year of biosolids (as dewatered cake) would be produced in the state, roughly a 3% increase. This additional material would require increased bulking agent at the landfill. At a biosolids management cost of $140/wet-ton, this represents an annual cost of $420,000 to the POTWs accepting this septage, a cost likely to be passed along to septage haulers and ultimately septage system owners. POTWs are not required to accept septage

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

and may choose not to do so if management costs increase and as POTWs come under increasing PFAS regulation—leaving septage system owners with few management options.

3.3 Effluent PFAS Limits at Publicly Owned Treatment Works

According to a DEP presentation (Crowley, 2023), it is likely that the state will regulate PFAS concentrations in POTW effluent in the future. The intent would be to regulate PFAS compounds in Maine Pollutant Discharge Elimination System (MEPDES) permits (also known as Waste Discharge Licenses) held by the POTWs in the same manner as other regulated compounds.

This focus on PFAS in effluent will likely cause POTWs to work with industrial sewer users, through Industrial Pretreatment Programs or other means, to reduce PFAS entering the wastewater collection system. As discussed in Section 2.2.1, source control is one of the primary recommendations from the EPA for reducing PFAS at POTWs. Other states, including Michigan (EGLE, 2022), have had great success using pretreatment programs to reduce PFAS in POTW effluent and biosolids. Therefore, effluent PFAS limits will likely lead to reduced PFAS concentrations in biosolids.

Note that POTW effluent limits will be a disincentive for these facilities to accept materials such as landfill leachate and septage, which have few other outlets.

3.4 Climate Action

Maine has adopted ambitious climate goals:

- Decrease greenhouse gas (GHG) emissions by 45% by 2030 and 80% by 2050
- Achieve carbon neutrality by 2045

Disposing of organics in landfills generates a significant amount of methane, a potent GHG, a large percentage of which is released to the atmosphere in even modern landfills with methane capture systems. Most organics diversion legislation in the U.S. has focused on food waste; however, any organics degrading in anaerobic conditions like those of a landfill will emit methane—including biosolids. California has implemented a comprehensive organics recycling plan in an effort to reduce methane emissions, including a severe reduction in the amount of biosolids that can be landfilled.

Maine does not currently have an organic waste landfill ban or food waste recycling law; however, in recent years, several proposed legislative bills have been introduced to address concerns about GHGs and landfill capacity. In 2023, L.D. 1009 (“An Act Regarding the Reduction and Recycling of Food Waste”) was introduced and carried over to the next legislative session for further discussion by the Environment and Natural Resources Committee. Moreover, the Governor’s Office of Policy Innovation and the Future is embarking on a statewide study of food waste generation as part of its overall climate and waste management activity toward mitigating climate change.

Should Maine decide to adopt food waste recycling and reduction programming (including a landfill ban), it should be noted that the practical impact of continuing to enforce the sludge land application ban will run contrary to this movement toward reducing GHGs at landfills. As climate action goals get greater traction, the state may decide to reevaluate the ban on biosolids land application as a means of reducing methane emissions and preserving landfill capacity.

3.5 PFAS Source Control Laws

In 2021, Maine was the first state to pass a sweeping law to monitor and ultimately eliminate products that contain PFAS: P.L. 2021, ch. 477, “An Act To Stop Perfluoroalkyl and Polyfluoroalkyl Substances Pollution.”

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

The timeframes for this law were amended in 2023 by P.L. 2023, ch. 138, "An Act to Support Manufacturers Whose Products Contain Perfluoroalkyl and Polyfluoroalkyl Substances." Starting in 2025, this legislation requires any manufacturer who intentionally adds PFAS to a product for sale in Maine to submit a description of the product, its use, and its PFAS concentration. There are exemptions for businesses smaller than 25 people and for products regulated at the federal level.

Starting at the beginning of 2023, carpets, rugs, and fabric treatments with intentionally added PFAS were banned from sale in Maine. The legislation allows DEP to add additional categories or product uses to this list and calls on the department to prioritize products that are most likely to cause environmental contamination. In 2030, this measure expands to all products not specifically designated as a "currently unavoidable use" by DEP.

This is similar to the approach used in addressing lead contamination in drinking water. The current focus is on removing lead service lines so lead is not in drinking water in the first place, rather than trying to remove lead after contamination.

This type of source control—reducing concentrations of a pollutant in the environment by avoiding its production in the first place—has shown to be very effective. In the U.S., PFOS was voluntarily phased out of production in 2002, and most uses of PFOA were phased out by the mid-2000s, completing the phase out in 2015. Figure 3-1 shows the results of the National Health and Nutrition Examination Survey blood PFAS sampling results in people in the U.S. The correlation between the phase outs and the blood serum levels is apparent in the graph, with PFOS and PFOA concentrations falling nearly an order of magnitude in a decade. PFAS source control laws should be expected to reduce the concentration of PFAS in the environment, in soils, and in biosolids.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

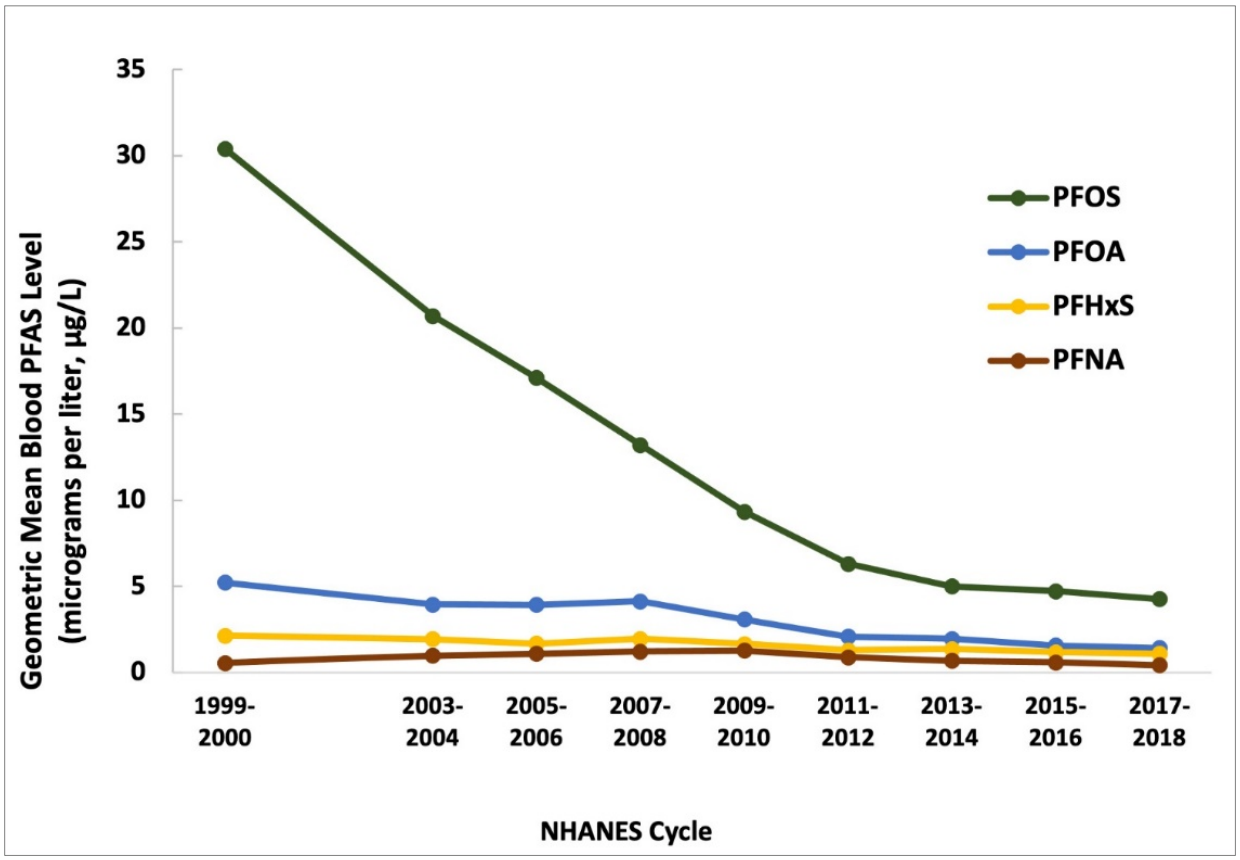


Figure 3-2. Blood levels of the most common PFAS in people in the U.S. over time

Source: Agency for Toxic Substances and Disease Registry, 2022

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 4: Regional Facilities

As is discussed in the economic analysis in Section 5, regional facilities for biosolids treatment are able to benefit from economies of scale. While an appealing approach in theory, there are governance, finance, and basic materials handling challenges that need to be thoroughly addressed for such a facility to be successful.

4.1 Governance Structures

There are generally four options for a governance structure to undertake a regional biosolids project. Two options have two levels of participation, depending on the desires of the individual agencies regarding their method of participation. The selection of a governance option may limit the delivery method or process selection for the project.

- Private Entity Contracts: Each individual alliance member contracts directly with a company(s) that owns, designs, builds, and/or operates the biosolids facility.
- Lead Agency Contract: One agency takes the lead to deliver the project, and each individual alliance member contracts with the lead agency for use of the facility.
- Joint Powers Agreement: Alliance members enter into a joint agreement to deliver the project within the power and authority of one identified alliance member agency. A core of alliance members could enter into the joint contract, and the remaining alliance members would contract with the core group for use of the facility.
- Joint Powers Agency: Alliance members form a new joint powers agency that functions independently with the power and authority required. A core of alliance members could form the joint powers agency, and the remaining alliance members would contract with the core group for use of the facility.

One important aspect in choosing the right governance structure will involve determining which structure helps to best define, communicate, and agree upon expectations of and between all parties. Understanding what each agency seeks to achieve and is willing to contribute will shape the relationships between agencies, the relationship between the alliance and a merchant, and whether a lead agency or core leadership structure is necessary.

4.2 Financing

There are several factors agencies may be able to leverage that have the potential to reduce the capital expenditures and operating costs of the biosolids facility, and thereby reduce associated tipping fees. However, it is worth bearing in mind that while these factors may reduce the cost of processing biosolids at a regional facility, agencies may incur increased internal costs. The primary factor to consider is whether an agency within the alliance has available land or space within its existing plants or has abandoned or underused buildings or existing infrastructure.

Considerations in determining a member agency's appropriateness to serve as a host facility include:

- Existing transportation corridors.
- Physical boundaries with an existing level of staff presence or oversight.
- On-site or nearby utilities.
- Available heat, energy, steam, and process water.

Additional cost savings may be achieved by:

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

- Operational know-how and other existing skills agency staff possess, such as communications, finance, and legal or business skills.
- The ability to secure capital at a fraction of the cost to the private sector.
- Traditionally strong creditworthiness.
- Homogeneity of material delivered to the regional plant.

4.3 Materials Handling

Some regional biosolids facilities that have been constructed in other parts of the country have failed or been significantly challenged by seemingly straightforward solids handling issues. The methods for accepting biosolids with varying characteristics coming at an unsteady rate and conveying the material in and out of various treatment steps must be carefully designed. For instance, an inability by the facility to accept hauled material at a rate at least as fast as the rate at which haulers are accustomed to at landfills has the potential to strain agency relationships with their haulers. When used as a conditioning step ahead of pyrolysis or gasification, a thermal dryer must be selected that is able to handle the characteristics of the incoming biosolids and is well matched to the needs of the thermal treatment step.

4.4 Proposed Regional Facilities

There are several entities considering or actively pursuing projects that would serve as a regional biosolids processing facility. To understand these efforts, BC developed an 11-question survey that included questions regarding planned location, volume, design and permitting progress, and partnerships. This survey was not comprehensive, but rather was designed to illuminate the high-level landscape of PFAS solutions under discussion. DEP sent the survey to 16 contacts, and eight companies responded. A summary of the responses is shown in Table 4-1.

Table 4-1. Regional Facility Survey Results

Company Name	Planned Location	Estimated/Planned Capacity (dry tons/day)	Design Phase	Permitting Status	Technology	Confirmed Partners
ecomaine	Scarborough	Unknown	Exploration	None	Unknown	None
Heartland Water Technology	Various	>1	Preliminary Planning	None	Dewatering, Drying, Gasification, Pyrolysis	Confidential
Synagro	Portland	40	Preliminary Planning	In discussion with DEP	Digestion, Dewatering, Drying, Pyrolysis	Andritz, CHAR
374Water	Various	2-25	Preliminary Planning	None	Supercritical Water Oxidation	In discussion
Waste Management (WM)	Norridgewock	44	30% Design	Permit applications submitted	Drying	None
Kiewit	Various	Unknown	Preliminary Planning	None	Digestion, Dewatering, Drying, others	None

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Table 4-1. Regional Facility Survey Results						
Company Name	Planned Location	Estimated/Planned Capacity (dry tons/day)	Design Phase	Permitting Status	Technology	Confirmed Partners
Viridi RNG	Brunswick	46	60% Design	Existing permit; updates will be required	Digestion, Dewatering, Drying, Pyrolysis	None
NORESCO	Sanford	22	Preliminary Planning	None	Drying, potentially pyrolysis/gasification	None

The facility that is furthest along in the permitting process is for a thermal dryer at the Waste Management Crossroads Landfill in Norridgewock. Waste Management is at the preliminary design stage (30%) for a 200-wet-tons/day belt dryer. They report that the facility will have three independent dryer trains and operate every day of the year, so they anticipate uptime to be 96%, for an annual throughput of 70,000 wet-tons per year. Their proposal includes using existing landfill biogas power generation to power three heat pump belt dryers. A permit application for this facility has been submitted to, and approved by, the Town of Norridgewock Planning Board; the permit application has been submitted to DEP and is being reviewed.

Viridi RNG reports that it is at the intermediate design stage (60%) of its to upgrade the digestion facility in Brunswick that was previously operated by Village Green Ventures but is not currently operating. Viridi RNG reports that the upgraded facility—which is permitted to accept septage, food waste, and biosolids—could process up to 46 dry-tons per day. The facility would include digestion, dewatering, drying, and pyrolysis. DEP is in receipt of an application for the transfer of licenses from the current owner. Updates would be required for the new facilities. As of the writing of this report, DEP has not been contacted about permitting the additional equipment. When the facility was in operation, there were reportedly issues with off-site odors, ability to accept hauled material, and nutrient loading to the Brunswick Sewer District Wastewater Treatment Facility. These issues would need to be addressed to ensure this was a consistent outlet for biosolids in southern Maine.

While the Crossroads dryer will provide a welcome alternative in the state if completed and be able to handle a significant portion of the biosolids generated, other options need to be developed to ensure reliable and redundant biosolids management options in the state.

4.5 Proposed BioHub

In 2022, NEIWPCC, NEBRA, and the Maine Water Environment Association led a group of Northeast stakeholders proposing the long-term placement of a PFAS/Biosolids Bio-Technology Hub (BioHub) in Maine. The BioHub concept started as a research facility to prove destruction technologies' effectiveness for emerging contaminants for fast-paced deployment throughout the U.S. The BioHub concept was developed to address the current lack of approved, proven, or established methods to treat PFAS in biosolids on a large scale.

On behalf of the stakeholders from Northeast states' health and environment departments, numerous POTWs, environmental consulting and law firms, E2Tech, universities, and national environmental organizations, NEIWPCC submitted a Congressionally Directed Spending Request through Senator Angus King's office for the BioHub project. With much demand for funding in this highly competitive process, the BioHub project was not selected for inclusion in the Senate's appropriations bill for Fiscal Year 2024.

Unfortunately, seeking and securing funding and then studying, locating, permitting, and constructing the BioHub project would take many years, possibly a decade. And as each year passes, information has become more critical for POTW financial budgeting, planning, and assessment to support their fiscal responsibility to ratepayers. Therefore, the stakeholders pivoted from a physical facility to an information

clearinghouse concept. The BioHub clearinghouse's goal is to serve as a resource of information on research and funding for piloting, planning, and permitting treatment of PFAS in municipal biosolids. This information will be available publicly for other entities to inform proof of concept, demonstration, testing, design and construction at physical facilities. Once available, this will be a valuable resource for those wishing to pursue regional facilities.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 5: Technology Alternatives Analysis

Current drivers in Maine lead to the need for less material and/or material dried to no longer fall under wet waste restrictions at landfills. There are mature technologies for these purposes: anaerobic digestion and drying. This section provides a generalized economic analysis of a series of alternatives employing these technologies at different scales of POTWs. While the exact economics of a project are site-specific, this analysis is provided to give POTWs across the state an idea of the level of capital and annual costs associated with reasonable approaches to reducing biosolids generation.

PFAS treatment technologies have gotten a lot of attention in the past few years and the market offerings are maturing; however, there are only a handful of current installations running at commercial scale, most for less than a year. The long-term reliability and operations and maintenance (O&M) costs associated with these technologies is not yet known. An estimate from Minnesota put the total cost to install PFAS treatment at POTWs around that state at $1.6 billion to $3.3 billion (Barr, 2023). These technologies are not yet ready for statewide adoption. It is also not fully known what the full PFAS destruction potential is through these units, although data to support such claims is being collected at the few operational facilities. Section 6 lays out a piloting effort that Maine could fund to help answer these questions.

5.1 Overview of Selected Technologies

5.1.1 Dewatering

Dewatering technologies are often used at wastewater treatment facilities to separate solids and water to make processing and hauling more efficient. For the alternatives used in this analysis, centrifuge dewatering technologies were used. In addition to centrifuge dewatering, belt filter presses and screw presses are often used and have been installed throughout New England. Centrifuge dewatering is a process that uses centrifugal forces to separate water from sludge particles conditioned with polymer. These forces are generated by rapidly rotating a cylindrical bowl, which causes suspended solids to move outward, away from the rotation axis and towards the bowl's walls. As the sludge enters the centrifuge, a scroll conveyor inside the cylinder continuously conveys it from the inlet to the outlet, while simultaneously liquid drains out from the opposite end of the centrifuge. The resulting "dewatered cake" typically has a total solids content of 15% to 30% (the remaining 70% to 85% being water).

POTWs that do not have dewatering are typically unable to send their (thickened) liquid sludge to a landfill as it will not pass the required paint filter liquids test. The crucial role dewatering can play in biosolids management was highlighted in 2019 when some smaller POTWs in the state that did not have on-site dewatering were left with no options for biosolids management when restrictions on land application due to PFAS concerns went into effect. The state supported a number of these facilities with Emergency Sludge Dewatering State Wastewater Infrastructure Planning and Construction Grants to offset the cost of one-time contracted dewatering.

5.1.2 Anaerobic Digestion

Mesophilic anaerobic digestion (MAD) is the most common solids stabilization technology in the U.S. Digestion breaks down a significant portion of the organic matter in the biosolids into biogas, thereby reducing the amount of solids to manage and producing a valuable fuel source. Digesters operate continuously and result in fewer solids downstream, which opens the possibility for smaller dewatering and drying equipment and storage. When coupled with drying, the biogas produced from digestion can be used to offset some of the dryer's fuel requirements.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

MAD employs operating temperatures of 35° to 39°Celsius (95° to 102°Farenheit) and solids are digested under anaerobic conditions. This stabilization process has the longest operational history of all the processes under consideration, with the most supporting operational data to date. Digestion reduces odors and pathogens but has the most significant benefit in plants that produce primary solids, which degrade more readily in anaerobic digesters. MAD is relatively easy to operate and maintain, but it is capital intensive and requires significant ancillary equipment and instrumentation.

5.1.2.1 Pre-digestion Thermal Hydrolysis

The thermal hydrolysis process (THP) is an anaerobic digestion pretreatment system that enhances wastewater solids processing and energy production, even achieving Class A biosolids standards in certain configurations. THP is generating interest for regional digestion facilities because the process typically requires feed solids at 15% to 18%TS, which is similar to the solids concentration of typical dewatered cake produced by most POTWs. THP ahead of digestion at regional facilities facilitates the acceptance of biosolids hauled to the facility for processing from POTWs. It is therefore included in one of the regional alternatives (see Section 5.7).

THP is a mature technology in Europe, dating back to 1995, and has been adopted in the U.S. since late 2014. THP uses medium-pressure steam to create high-temperature and high-pressure conditions that break down bacterial cells and solubilize organic material in wastewater solids, thus making them more digestible. This process accelerates digestion, reduces digester residence time, increases gas production by 10% to 20%, lowers sludge viscosity, allows for higher solids concentrations to digestion (9% to 12%), and improves dewaterability and odor control in the digested solids.

5.1.3 Thermal Drying

For traditional thermal dryers, there are three main types used for biosolids applications in the U.S.: belt, indirect, and rotary drum. Belt and rotary drum technologies advance product through the dryer vessel via a rotating belt or drum, respectively, while hot gases are passed through the product to facilitate evaporation. Indirect dryers use metal discs or paddles to advance product while transferring heat to the product through the disc or paddle surface using thermal oil or steam to heat the metal surfaces. Each dryer technology has unique operational characteristics.

A primary differentiator between technologies is product throughput. Rotary drum dryers have a substantially higher throughput than the other two technologies, which makes them most efficient at large facilities and limits their applications at small- to medium-sized facilities. For this reason, rotary drum dryers were only considered for regional alternatives, and not at smaller scales.

Because belt and indirect dryers are both commonly installed at POTWs of a range of sizes at least one was included for further analysis at all scales. Thin film dryers are indirect dryers that are widely used internationally and in a variety of industries but have not been used as frequently in the U.S. for wastewater solids. Thin film dryers have fewer issues with processing undigested solids and so were included in this analysis as a representative technology for indirect dryers. Thermal dryers work best when paired with anaerobic digestion. The anaerobic digestion process produces a stabilized sludge, which is less likely to cause mechanical issues in dryers and results in a better-quality solids product. In Maine, most biosolids will be sent to landfill, so a 90% TS end product, as could be achieved with the highest quality of drying in order to meet EPA Class A pathogen reduction requirements, will not be necessary. A lesser percentage of total solids will significantly reduce the risk of dust and dust-related issues. Paddle dryers, another type of indirect dryer, were not considered in this analysis because the sole current paddle dryer vendor will not supply a unit for un-stabilized solids because paddle dryers have a more turbulent dryer chamber, which leads to more dust generation, particularly with un-stabilized primary sludge. There are a limited number of dryer

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

installations in the U.S. processing un-stabilized primary sludge, which may pose a challenge for use of dryers on un-stabilized sludge in Maine.

5.1.3.1 Belt Dryer

Belt dryer installations are common in both in the U.S. and Europe. They can be either direct or indirect. Indirect and direct thermal dryers are established technologies. Heat is typically supplied by a fuel-burning furnace that serves to heat a thermal fluid, water, or flue gas. Belt dryers can be fueled by natural gas (NG), biogas, propane, thermal oil, or electricity. Because of the lower temperature operation, (lower grade, i.e., lower temperature) waste heat from other POTW processes can be used. Dewatered biosolids are distributed via nozzles or perforated plates onto a slow-moving porous belt that provides a large surface area exposed to the hot heat exchanger fluid or process air. Belt dryers shape and distribute dewatered solids into noodle or granule shaped particles onto a slow-moving porous belt. Warm process gases are circulated through the belt chamber to evaporate the water content in the feed solids. The material's shape provides a large surface for exposure to the warm process gas, and the slow-moving belt provides contact time and generates minimal dust and fines. Belt dryers without further processing generate a product with irregular size distribution and low density. The resulting TS concentration after belt drying is typically higher than 90%. This product typically has a limited market but is acceptable for landfilling purposes. The low density can mean more trucking as well, since vehicles that are full of product are below the truck's weight limit. Pelletizers can be added following the dryer to obtain a more dense and uniform product, but these systems are typically expensive to buy and operate, and the added complexity may not be balanced by additional sales revenue.

Wastewater solids with high amounts of fibrous and stringy materials can plug some types of extruders and may need to be screened for use with these types of extrusion systems. The slow-moving belts provide contact time and generate minimal dust and fines in the dryer cabinet. Belt dryer exhaust is commonly dehumidified with a condenser, then reheated and mixed with incoming air to minimize exhaust volume and reuse waste heat. Alternatively, some belt dryers use an air-to-water heat exchanger in the exhaust to capture waste heat and return it to the dryer inlet to heat the incoming process gas stream. Most belt dryers are operated automatically and only require roughly half a full-time employee for the first shift. To maintain this equipment, weekly and quarterly cleaning is recommended, as is replacing limited-wear items every 1 to 5 years. The footprint required for belt dryers is relatively large and operating complexity is moderate. Additionally, the end product is dependent on the belt dryer manufacturer.

5.1.3.2 Thin Film Dryer

Thin film dryers are indirect dryers that are widely used internationally and in a variety of industries but are not yet established in the U.S. for biosolids. These dryers can be used with a wide variety of sludge, including digested or undigested, high-strength waste, fibrous, and blended sludges. The thin film dryer allows partial to full drying operations for TS concentrations between 30% and 95%. Typical operation of a thin film dryer pumps sludge into the rotating blades within the dryer where the sludge is pressed into a thin film across the dryer's outer heating surface. Thin film dryers evenly distribute the solids above the heated zone and over the unit's inner surface. The material is then transferred to the thermal surface. The solids are pushed by the dryer blades to the discharge section. The resulting dried biosolids can be Class A, used for landfilling, or be processed further through incineration, gasification, and pyrolysis. Moisture released from the sludge flows out of the dryer to a condenser where an exhaust fan extracts the moisture. Thin film dryers generate a particle that is more uniform and dense than a belt-dried product, but not as high quality as a rotary drum dryer.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

These dryers can be heated by steam, hot water, or thermal oil that flows on the outside of the heating surface. The thermal efficiency of thin film dryers depends on the heating fuel and is typically higher than 85%. Approximately half of the installations in Europe run unattended because the controls are set up with interlocks that can shut down the equipment if there is an issue with the system.

5.1.3.3 Rotary Drum Dryer

Rotary drum dryers are an established technology in the U.S. and internationally, particularly at large-scale facilities. Drum dryers operate by heating sludge using process air at roughly 1,100°Fahrenheit in a large drum. This is the highest temperature drying equipment; therefore, these dryers have the highest throughput compared to other drying technologies, which makes them the most efficient for large-scale facilities. In addition, they have a moderately sized footprint for their capacity, and relatively high operations and maintenance complexity. They typically require 1 to 2 full-time employees on all three shifts with hourly sampling and checks while the equipment is running to ensure smooth execution.

5.2 Selection of Representative POTW Sizes

To determine the four facility sizes to be evaluated as representative POTWs in this study, the total number of facilities in the state was determined, and sizing categories were developed based on Maine POTW Waste Discharge License Type codes, as shown in Table 5-1. In addition to this analysis, a map of the POTW sizes in the state of Maine was developed to gain a better understanding of where these facilities are located in relation to one another, as well as their potential hauling and disposal routes. The map of POTWs is shown in Figure 5-1.

Table 5-1. Size and Count of Maine POTWs

Size of POTW (gpd)	Type Code	Number of POTWs
More than 5 million	5M[a]	13
1 to 5 million	6D	35
100,000 to 1 million	6C	62
10,000 to 100,000	6B	32
Less than 10,000	6A	10

[a] *Or any size with significant industrial waste*

mgd = million gallons per day

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

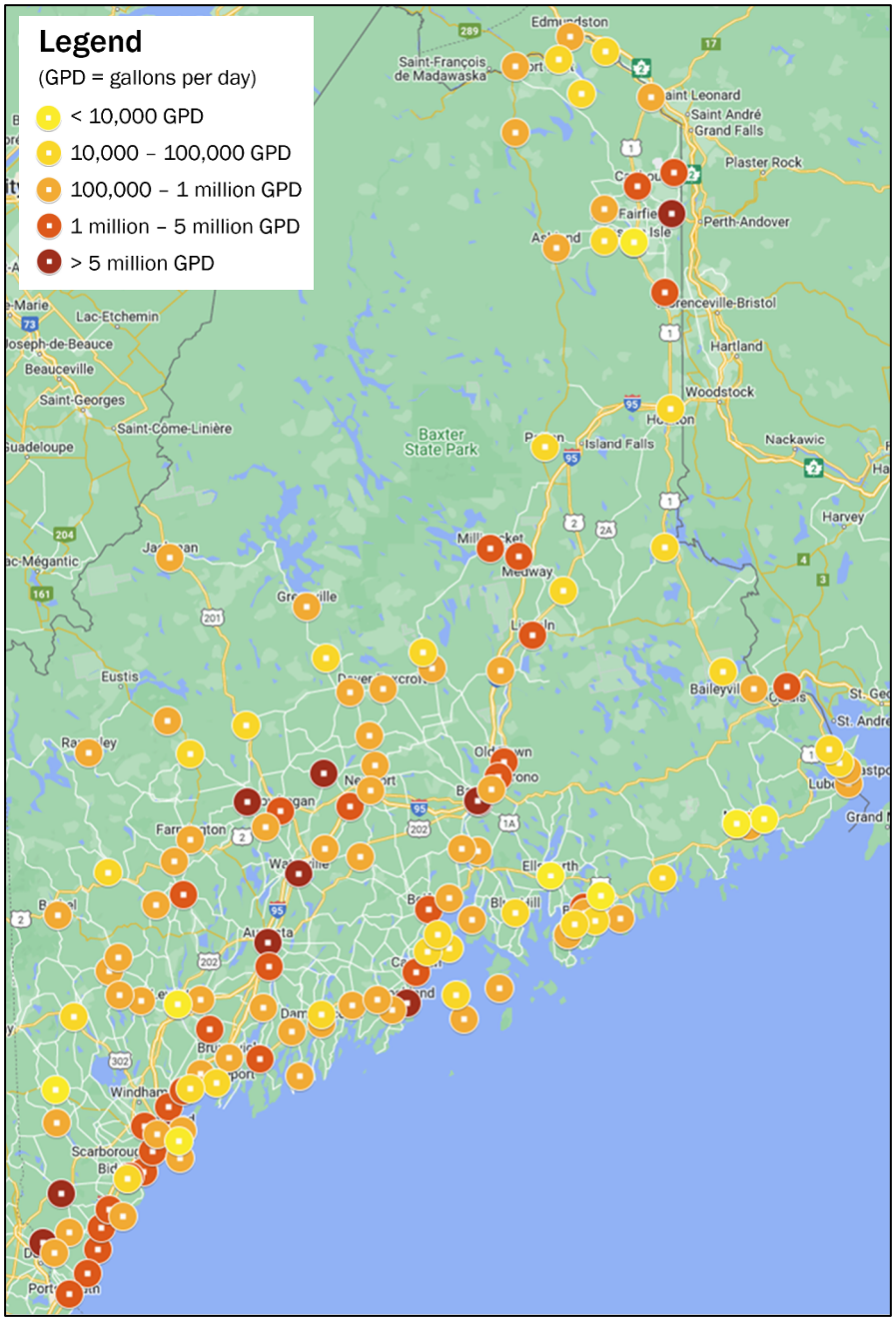


Figure 51. Distribution of POTWs by size

Based on the distribution of POTW sizes in Maine, the following were chosen as the conceptual facility sizes (in million gallons per day, [mgd]) for the alternatives analysis portion of this study:

- Small: 0.5 mgd
- Medium: 2.5 mgd
- Large: 7.0 mgd
- Regional: 20 mgd

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.3 Cost Evaluation Methodology

5.3.1 Operations and Maintenance Costs

Annual O&M costs were estimated for each alternative. General assumptions, along with their reasoning, are shown in Table 5-2; assumptions specific to each alternative are shown in tables in the following sections. Costs in the following sections are shown for the estimated solids production and costs in 2026, which is assumed to be the earliest year by which a project of this sort could be implemented. All operating costs are escalated annually by 4.2% for the life-cycle cost analysis (see Section 5.3.3).

Table 5-2. General Operation and Maintenance Cost Assumptions (2023)

Cost	Units	Value in Model	Basis
Electricity	$/kWh	$0.14	maine.gov
Natural gas	$/mmBtu	$14.78	maine.gov
Polymer	$/lb	$1.25	Typical value
Labor	$/hour	$36.53	ziprecruiter.com
Major equipment repair and rehabilitation (R&R)	%	2% of capital cost	Cost factor based on similar projects
Dewatered biosolids hauling and landfilling	$/wet-ton	$140	Typical current rate
Dried product hauling and management	$/wet-ton	$100	Assumption based on discussion with biosolids management companies
Hauling cost to regional facility	$/wet-ton	$15	Typical value

kWh = kilowatt hour

mmBtu = million British thermal units

It was assumed that biogas generated was used only for digester heating and offsetting energy needs for the dryer (if applicable). No additional value was assumed for the gas. There are incentive programs for renewable power and renewable fuel generation from beneficial use of biogas that could help the economics of projects like the ones under consideration in these alternatives.

5.3.2 Capital Costs

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, Class 5 capital estimates were developed as a means of comparing costs for the different alternatives. In a Class 5 estimate, engineering is typically 0% to 2% complete. Class 5 estimates are used to prepare planning-level cost scopes or to evaluate alternatives in design conditions and form the base work for the Class 4 project budget or funding estimate. Development of Class 4 estimates would be recommended if a project were advanced for inclusion in a capital plan.

Expected accuracy for Class 5 estimates typically range from -50 to +100%, depending on the project's technological complexity, appropriate reference information, and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

The factors in Table 5-3 were used to estimate total project cost for each alternative. Major equipment costs were developed based on vendor budgetary estimates and comparable recent project costs. These are purely planning numbers that should be vetted as part of a more complete design assessment. Detailed cost

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

estimate calculations for each alternative are shown in Appendix C. These assumptions are based on historical cost factors; recent price instabilities could have a disproportionate impact on certain factors. More analysis would be needed in further design.

Table 5-3. Construction Cost-estimating Markups

Markup	%	Basis
Installation	20%	of equipment cost
Electrical, Instrumentation & Controls	30%	of major mechanical equipment
Misc. Demolition	5%	of equipment installed in existing areas
Site Civil	10%	of equipment cost
Piping	15%	of equipment cost
Shipping and Handling	2%	of materials and equipment
General Conditions, Contractor Overhead and Profit	30%	of subtotal of items above
Sales Tax	5.5%	
Bonds and Insurance	2.5%	
Construction Management	10%	
Contingency	30%	
Engineering	10%	

5.3.3 Life-cycle Cost Analysis

BC created a process and cost model in its Solids-Water-Energy Evaluation Tool (BC:SWEET) to evaluate the technical performance and economic viability of installing the different alternatives. The economic analysis considered capital and operating costs and produced a 20-year net present cost (NPC) life-cycle cost analysis of the alternatives.

For NPC calculations, the interest rates in Table 5-4 were used. These values were obtained from the most recent version of the United States Office of Management and Budget Circular A-94, Appendix C (December 2022). All operating costs are escalated by 4.2% per year to account for inflation and other price increases. Future costs are brought back to 2023 dollars via a 2.2% discount rate. These calculations assume capital, construction, and operation costs start in 2026, and operation continues for 20 years to 2046. Appendix D shows the NPC calculations for each alternative.

Table 5-4. Interest Rate Assumptions

Escalation Rate	4.2%
Discount Rate	2.2%

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.3.4 Sensitivity Analysis

The effect of a change in one of three cost factors that can vary significantly was used to determine the sensitivity of the results obtained in the life-cycle analysis. These factors are:

- Dewatered biosolids management cost (increase to $190/wet-ton): As discussed, there is significant uncertainty about the future management options in Maine and nearby states and provinces. Under some scenarios (e.g., JRL is not expanded), biosolids management costs would likely increase far more, but $190/wet-ton is in the range of the increased cost many utilities were paying during the challenges of spring 2023.
- NG cost (+50%): A non-renewable resource, for which supply and demand heavily influence prices, and which is predicted to increase in price over time.
- Funding (-30% in capital cost): State and federal grants and no- or low-interest loans can have a significant impact on the overall project payback, but funds are limited.

5.4 Cost Evaluation Results: Small POTW

The small-scale (0.5 mgd) alternatives are listed in Table 5-5. The first alternative at this scale is considered the baseline alternative, which assumes the addition of dewatering. The second and third alternatives add a raw sludge belt dryer or raw sludge thin film dryer. Digestion is unlikely to be feasible for small facilities. Thin film dryers and belt dryers have been proven to be effective at processing undigested sludge, so they were chosen as the best equipment to achieve sludge volume reduction for these alternatives.

Table 5-5. List of Small (0.5 mgd) POTW Alternatives

Alternative	Major Solids Processing Equipment
1-A (Baseline)	Dewatering
1-B	Dewatering + Raw Sludge Belt Dryer
1-C	Dewatering + Raw Sludge Thin Film Dryer

5.4.1 Operations and Maintenance Costs

O&M costs for small-scale facilities were analyzed based on biosolids hauling and landfill tip fees, electricity, NG, polymer, labor, and repair and rehabilitation (R&R) costs. The total costs for each of these factors and their given alternatives are shown in Table 5-6.

Table 5-6. O&M Costs for Small-scale POTW Alternatives ($ thousands)

Alternative ID	Description	Biosolids Management	Electric	NG	Polymer	Labor	R&R	TOTAL
1-A (Baseline)	Dewatering Only	$122k	$7k	--	$14k	--	$16k	$160k
1-B	Raw Sludge Belt Dryer	$29k	$210k	$36k	$14k	$76k	$42k	$408k
1-C	Raw Sludge Thin Film Dryer	$29k	$210k	$36k	$14k	$76k	$42k	$408k

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.4.2 Capital Costs

Capital costs for the small-scale POTW alternatives were estimated using AACE Class 5 estimating standards. Budgetary quotes from vendors as well as recent project data and the markup assumptions shown in Section 5.3.2 were used to estimate capital costs for these alternatives. It was assumed that new buildings would be needed for new equipment.

Table 5-7. Class 5 Capital Cost Estimates for Small-scale POTWs ($ millions)

Alternative ID	Description	Major Equipment Cost	Capital Cost Estimate[a]	Estimating Range
1-A (Baseline)	Dewatering Only	Dewatering Centrifuge: $0.8M	$2.9M	$1.5M to $6M
1-B	Raw Sludge Belt Dryer	Dewatering Centrifuge: $0.8M Belt Dryer: $1.3M	$10.3M	$5M to $21M
1-C	Raw Sludge Thin Film Dryer	Dewatering Centrifuge: $0.8M Thin Film Dryer: $1.3M	$10.3 M	$5M to $21M

a. *AACE Class 5 Capital Cost Estimate*

5.4.3 Life-cycle Cost Analysis

Results of a 20-year life-cycle cost analysis of the small-scale facility alternatives are shown in Figure 5-2. These life-cycle costs are based on NPCs in 2023-equivalent dollar values. Figure 5-2 shows that for smaller facilities, the most economically feasible alternative is the baseline dewatering alternative, which will have the least overall capital costs and O&M costs compared to the other two alternatives. The belt drying and thin film drying options (1-B and 1-C) are closer in terms of NPC, but still double that of the baseline alternative, 1-A.

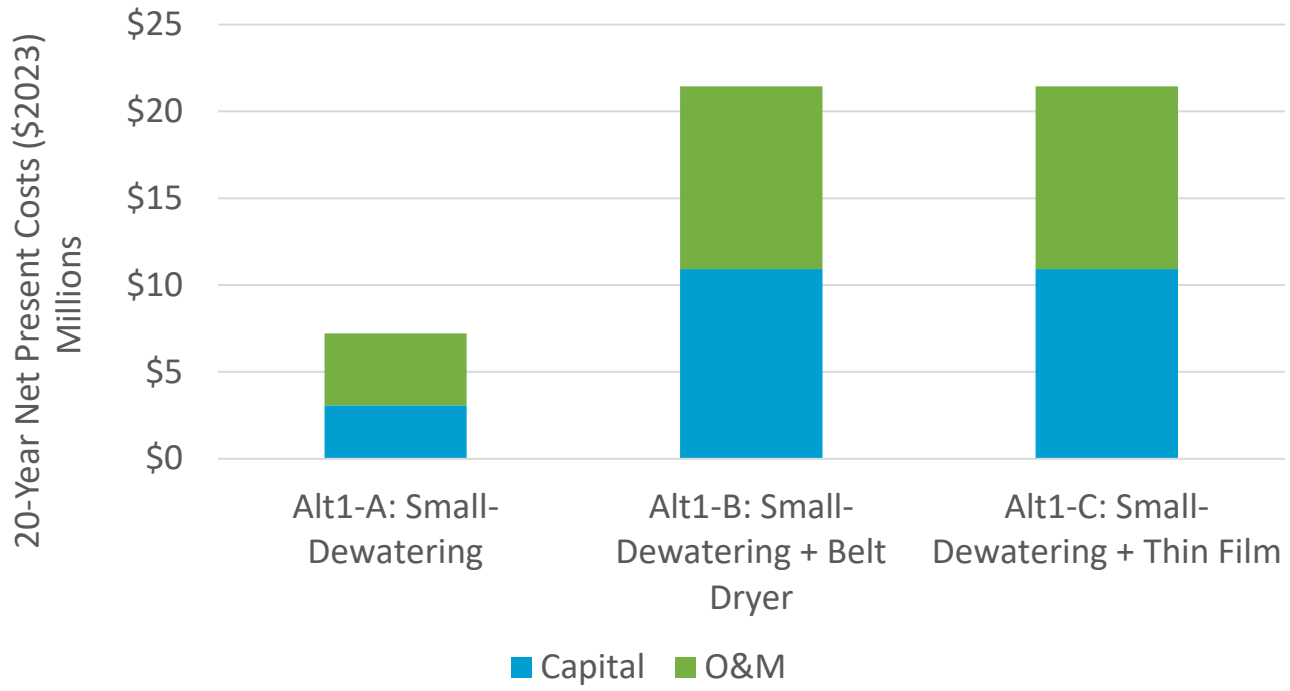


Figure 52. Net present cost for small-scale POTW alternatives

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.4.4 Sensitivity Analysis

The results of a sensitivity analysis on the small-scale alternatives' NPCs are shown in Figure 5-3. None of the variables changes the overall result. This matches with previous experience; dryers typically do not have a sufficient payback at this scale to make up for the capital cost within the dryer's life cycle.

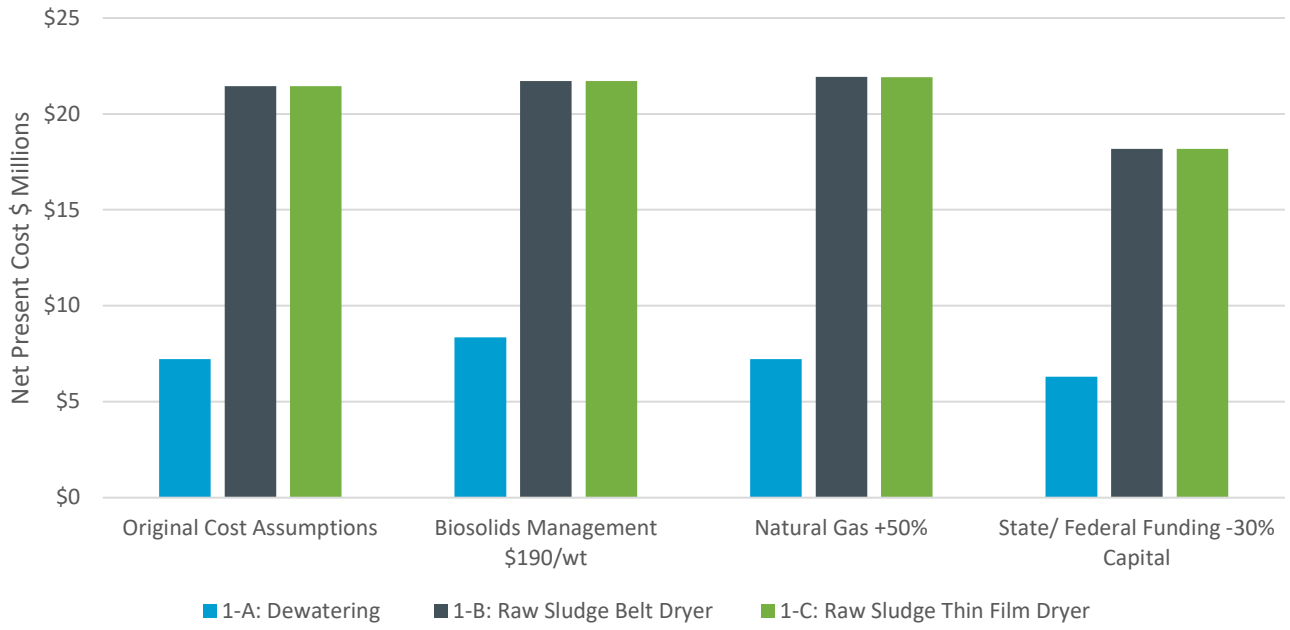


Figure 53. Sensitivity analysis for small-scale POTW alternatives

5.5 Cost Evaluation Results: Medium POTW

The medium-scale (2.5 mgd) alternatives are listed in Table 5-8. All alternatives assume that the facility already has dewatering. The first alternative at this scale is the baseline alternative, which assumes no new equipment is added. Alternative 2-A includes the addition of a raw sludge (i.e., undigested) thin film dryer. Alternative 2-B adds mesophilic anaerobic digestion for volume reduction, and assumes the existing dewatering will be used after digestion. Alternative 2-C adds a belt dryer to the equipment from 2-B.

Table 5-8. List of Medium-scale (2.5 mgd) POTW Alternatives

Alternative	Major Solids Processing Equipment
2-Baseline	No new equipment
2-A	Raw Sludge Thin Film Dryer
2-B	Mesophilic Anaerobic Digestion (MAD)
2-C	MAD + Belt Dryer

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.5.1 Operations and Maintenance Costs

O&M costs for medium-scale facilities were analyzed based on biosolids hauling and landfilling, electricity, NG, polymer, labor, and repair and rehabilitation (R&R) costs. The total costs for each of these factors and their given alternatives are shown in Table 5-9. Dewatering power and polymer costs are calculated for all alternatives, including the baseline, since digestion upstream has an impact on dewatering (fewer solids and typically higher polymer usage). It should be noted that the O&M cost for the baseline scenarios (continued landfilling of dewatered biosolids) is predominantly driven by volatile biosolids management costs. There is an advantage to the alternatives that are more distributed to several, more stable costs (e.g., electricity, NG, polymer, and maintenance).

Table 5-9. O&M Costs for Medium-scale POTW Alternatives ($ thousands)

Alternative ID	Description	Biosolids Management	Electric	NG	Polymer	Labor	R&R	TOTAL
2-Baseline	Dewatering Only	$610k	$35k	--	$75k	--	--	$720k
2-A	Raw Sludge Thin Film Dryer	$151k	$239k	$169k	$75k	$76k	$37k	$747k
2-B	MAD	$387k	$234k	--	$46k	$153k	$75k	$895k
2-C	MAD + Belt Dryer	$91k	$437k	$62k	$46k	$229k	$104k	$968k

5.5.2 Capital Costs

Capital costs for the medium-scale POTW alternatives were estimated using AACE Class 5 estimating standards. Budgetary quotes from vendors as well as recent project data and the markup assumptions shown in Section 5.3.2 were used to estimate capital costs for these alternatives. It was assumed that new buildings would be needed for new equipment.

Table 5-10. Class 5 Capital Costs for Medium-scale POTW Alternatives ($ millions)

Alternative ID	Description	Major Equipment Cost	Capital Cost Estimate[a]	Estimating Range
2-A	Raw Sludge Thin Film Dryer	Thin Film Dryer: $2M	$10M	$5M to $20M
2-B	MAD	Digesters: $4M	$12M	$6M to $24M
2-C	MAD + Belt Dryer	Digesters: $4M Belt Dryer: $4M	$22M	$11M to $44M

[a]*AACE Class 5 Capital Cost Estimate*

5.5.3 Life-cycle Cost Analysis

The results of a 20-year lifecycle cost analysis of the medium-scale facility alternatives are shown in Figure 5-4. These life-cycle costs are based on NPCs in 2023-equivalent dollar values. Figure 5-4 shows that for medium-sized facilities, the most economically feasible alternative is the baseline dewatering alternative, which will have the least overall capital and O&M costs compared to the other two alternatives. The raw sludge thin film drying alternative (2-A) is the second most economically feasible alternative for medium-

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

scale facilities, with O&M costs that are roughly the same as the baseline O&M costs. Alternatives 2-B and 2-C are the most-costly alternatives, with the addition of anaerobic digestion.

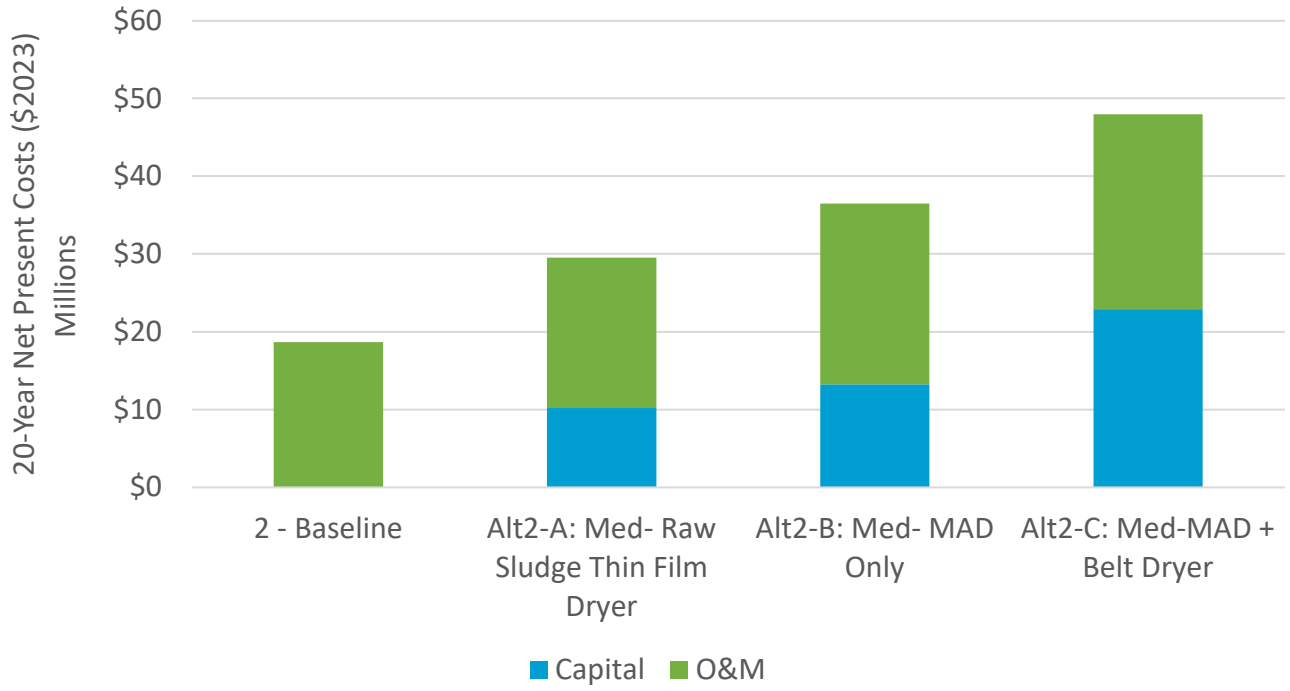


Figure 54. Net present costs for medium-scale POTW alternatives

5.5.4 Sensitivity Analysis

The results of a sensitivity analysis on the medium-scale alternatives' NPCs are shown in Figure 5-5. For these alternatives, the NG increasing by 50% or the biosolids hauling costs increasing to $190/wet ton had minimal impact on their NPCs compared to the original cost assumptions. The most impactful variable on these relative costs is funding from the state, which in this case was assumed to be 30% of the overall capital cost. Higher rates of funding could make dryer projects economically feasible. The value to the state in supporting dryer projects is that dryer projects free up landfill capacity for biosolids from other POTWs.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

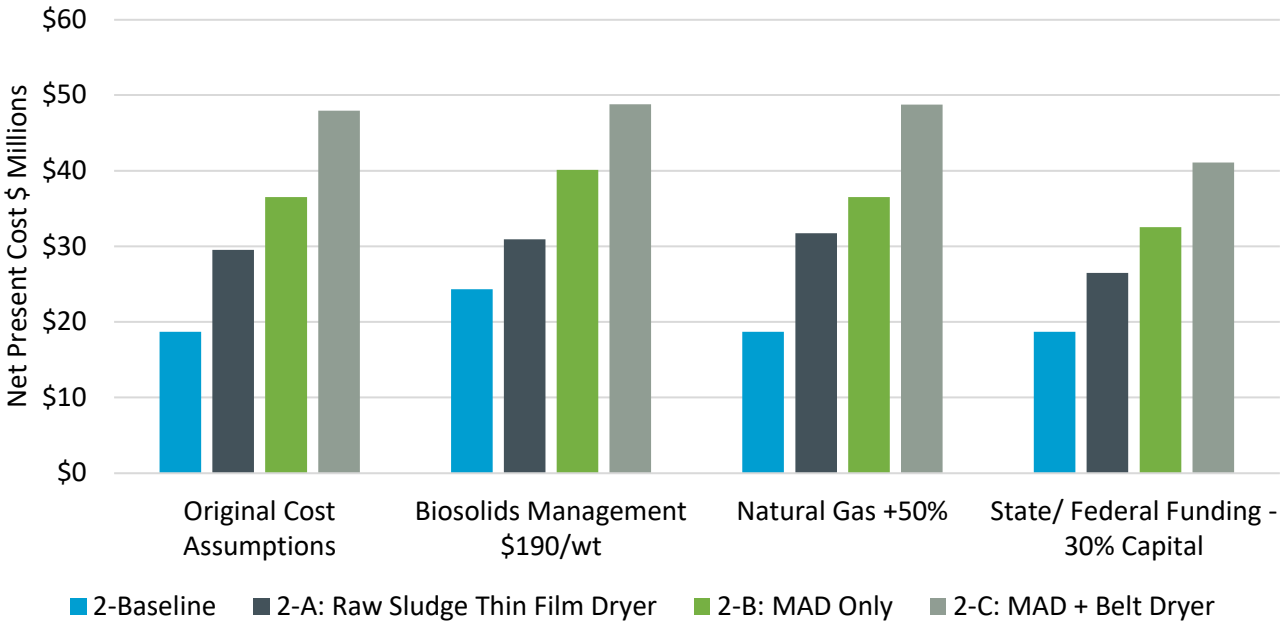


Figure 5-5: Sensitivity analysis for medium-scale POTW alternatives

5.6 Cost Evaluation Results: Large POTW

The large-scale (7.0 mgd) alternatives are listed in Table 5-11. All alternatives assume that the facility already has dewatering. The first alternative at this scale is the baseline alternative, which assumes no new equipment is added. Alternative 3-A includes the addition of a raw sludge belt dryer. Alternative 3-B adds mesophilic anaerobic digestion for volume reduction and assumes the existing dewatering will be used after digestion. Alternative 3-C adds a belt dryer to the equipment from 3-B.

Table 5-11. List of Large-scale (7.0 mgd) POTW Alternatives

Alternative	Major Solids Processing Equipment
3-Baseline	No new equipment
3-A	Raw Sludge Belt Dryer
3-B	MAD
3-C	MAD + Belt Dryer

5.6.1 Operations and Maintenance Costs

O&M costs for large-scale facilities were analyzed using the BC:SWEET model based on biosolids hauling and landfilling, electricity, NG, polymer, labor, and R&R costs. The total costs for each of these factors and their given alternatives are shown in Table 5-12.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Table 5-12. O&M Costs for Large-scale POTW Alternatives								
Alternative ID	Description	Biosolids Management	Electric	NG	Polymer	Labor	R&R	TOTAL
3-Baseline	Dewatering Only	$1.7M	$99k	--	$201k	--	--	$2.0M
3-A	Raw Sludge Belt Dryer	$423k	$303k	$472k	$201k	$153k	$126k	$1.8M
3-B	MAD	$1.1M	$297k	--	$127k	$153k	$107k	$1.8M
3-C	MAD + Belt Dryer	$255k	$500k	$207k	$127k	$305k	$210k	$1.6M

5.6.2 Capital Costs

Capital costs for the large-scale POTW alternatives were estimated using AACE Class 5 estimating standards. Budgetary quotes from vendors as well as recent project data and the markup assumptions shown in Section 5.3.2 were used to estimate capital costs for these alternatives. It was assumed that new buildings would be needed for new equipment.

Table 5-13. Class 5 Capital Costs for Large-scale POTW Alternatives ($ millions)				
Alternative ID	Description	Major Equipment Cost	Capital Cost Estimate[a]	Estimating Range
3-A	Raw Sludge Belt Dryer	Belt Dryer: $5.6M	$29M	$15M to $58M
3-B	MAD	Digesters: $5M	$18M	$9M to $36M
3-C	MAD + Belt Dryer	Belt Dryer: $5.6M Digesters: $5M	$42M	$21M to $84M

[a] *AACE Class 5 Estimate*

Note that privately developed projects do not typically have the same redundancy and materials of construction as municipal facilities, which are constructed for reliability and longevity. In addition, some private owners or operators may be able to realize further capital and operational savings via management decisions, including use of landfill gas or maintenance of backup outlets to manage cake in case of process upset or shutdown.

5.6.3 Life-cycle Cost Analysis

The results of a 20-year life-cycle cost analysis of the large-scale facility alternatives are shown in Figure 5-6. These life-cycle costs are based on NPCs in 2023-equivalent dollar values. Figure 5-6 shows that for large-sized facilities, the most economically feasible alternative is digestion only (3-B), which is slightly above the baseline dewatering costs.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

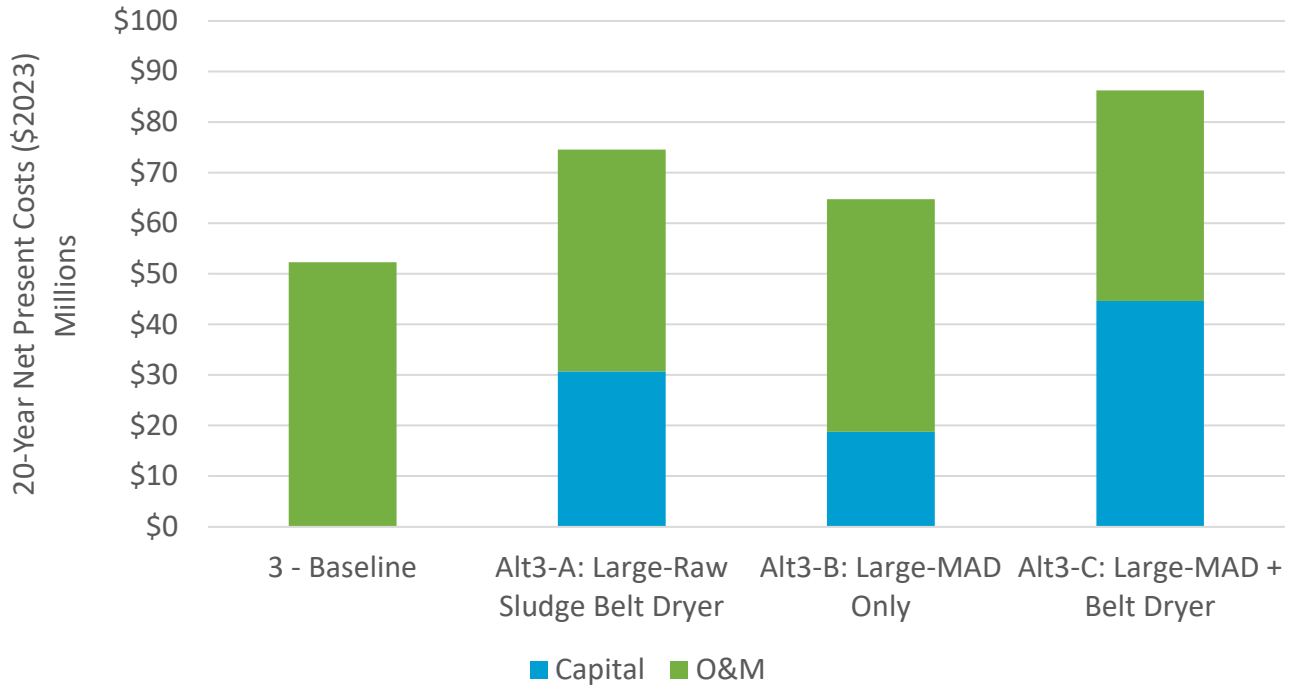


Figure 56. Net present costs for large-scale POTW alternatives

5.6.4 Sensitivity Analysis

The results of a sensitivity analysis on the large-scale alternatives' NPCs are shown in Figure 5-7. For these alternatives, the NG increasing by 50% or the biosolids hauling costs increasing to $190/wet ton had minimal impacts on their NPCs compared to the original cost assumptions. The most impactful variable on these relative costs is funding from the state, which in this case was assumed to be 30% of the overall capital cost. Higher rates of funding could make dryer or digestion projects economically feasible.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

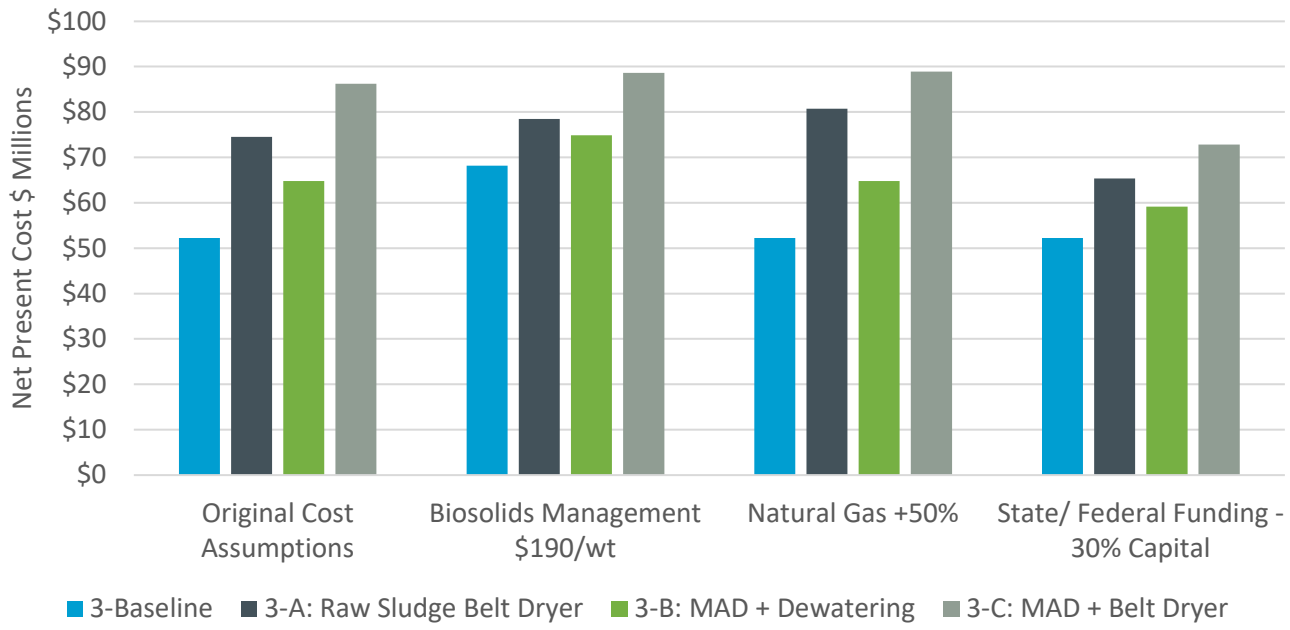


Figure 57. Sensitivity analysis of large-scale POTW alternatives

5.7 Cost Evaluation Results: Regional Facility

The regional-scale (20 mgd) alternatives are listed in Table 5-14. The first alternative at this scale is considered the baseline alternative, which assumes that the facility in question has a dewatering process in place. Alternative 4-A includes the addition of a raw sludge belt dryer. Alternative 4-B pairs dewatering with a raw sludge belt dryer, and Alternative 4-C is the most complex alternative, with thermal hydrolysis, anaerobic digestion, dewatering, and a belt dryer.

Table 5-14. List of Regional-scale (20 MGD) POTW Alternatives

Alternative	Major Solids Processing Equipment
4-Baseline	No new equipment
4-A	Raw Sludge Belt Dryer
4-B	Raw Sludge Drum Dryer
4-C	Thermal Hydrolysis Process + Anaerobic Digestion + Dewatering + Belt Dryer

5.7.1 Operations and Maintenance Costs

O&M costs for regional-scale facilities were analyzed using the BC:SWEET model based on biosolids hauling and landfilling, electricity, NG, polymer, labor, R&R, and cake hauling costs to the regional facility. The total costs for each of these factors and their given alternatives are shown in Table 5-15.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Note that for a facility like the dryer proposed at the Crossroads Landfill that has access to very-low-cost power (in that case from on-site landfill gas power generation) the operating costs would be significantly reduced from what is shown in the table.

Table 5-15. O&M Costs for Regional-scale Alternatives

Alternative ID	Description	Biosolids Management	Electric	NG	Polymer	Labor	R&R	Hauling Cake to Regional Facility	TOTAL
4-Baseline	Dewatering Only	$4.7M	--	--	--	--	--	--	$4.7M
4-A	Raw Sludge Belt Dryer	$1.2M	$203k	$1.3M	--	$305k	$190k	$498k	$3.8M
4-B	Raw Sludge Drum Dryer	$1.2M	$203k	$1.2M	--	$381k	$302k	$498k	$3.8M
4-C	THP + MAD + Dewatering + Belt Dryer	$543k	$629k	$138k	$271k	$517k	$1.1M	$498k	$3.7M

5.7.2 Capital Costs

Capital costs for the regional-scale POTW alternatives were estimated using AACE Class 5 estimating standards. Budgetary quotes from vendors as well as recent project data and the markup assumptions shown in Section 5.3.2 were used to estimate capital costs for these alternatives. It was assumed that new buildings would be needed for new equipment.

Table 5-16. Class 5 Capital Cost Estimates for Regional-scale POTW Alternatives ($ millions)

Alternative ID	Description	Major Equipment Cost Estimate	Capital Cost Estimate[a]	Estimating Range
4-A	Raw Sludge Belt Dryer	Cake Receiving: $4.1M Belt Dryer: $5.5M	$44M	$22M to $88M
4-B	Raw Sludge Drum Dryer	Cake Receiving: $4.1M Drum Dryer: $11M	$71M	$36M to $142M
4-C	THP + MAD + Dewatering + Belt Dryer	Cake Receiving: $4.1M THP: $30M Digesters: $9M Centrifuges: $3.5M Belt Dryer: $3M	$199M	$100M to $398M

[a] *AACE Class 5 Capital Cost Estimate*

Note that privately developed projects do not typically have the same redundancy and materials of construction as municipal facilities, which are constructed for reliability and longevity. In addition, some private owners or operators may be able to realize further capital and operational savings via management decisions, including use of landfill gas or maintenance of backup outlets to manage cake in case of process upset or shutdown.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

5.7.3 Life-cycle Cost Analysis

The results of a 20-year life-cycle cost analysis of the regional-scale facility alternatives are shown in Figure 5-8. These life-cycle costs are based on NPCs in 2023-equivalent dollar values. Figure 5-8 shows that for regional-sized facilities, the most economically feasible alternative is the raw sludge belt dryer alternative (4-A); however, it is still higher than the baseline of individual POTWs continuing to dewater and send biosolids cake to the landfill directly.

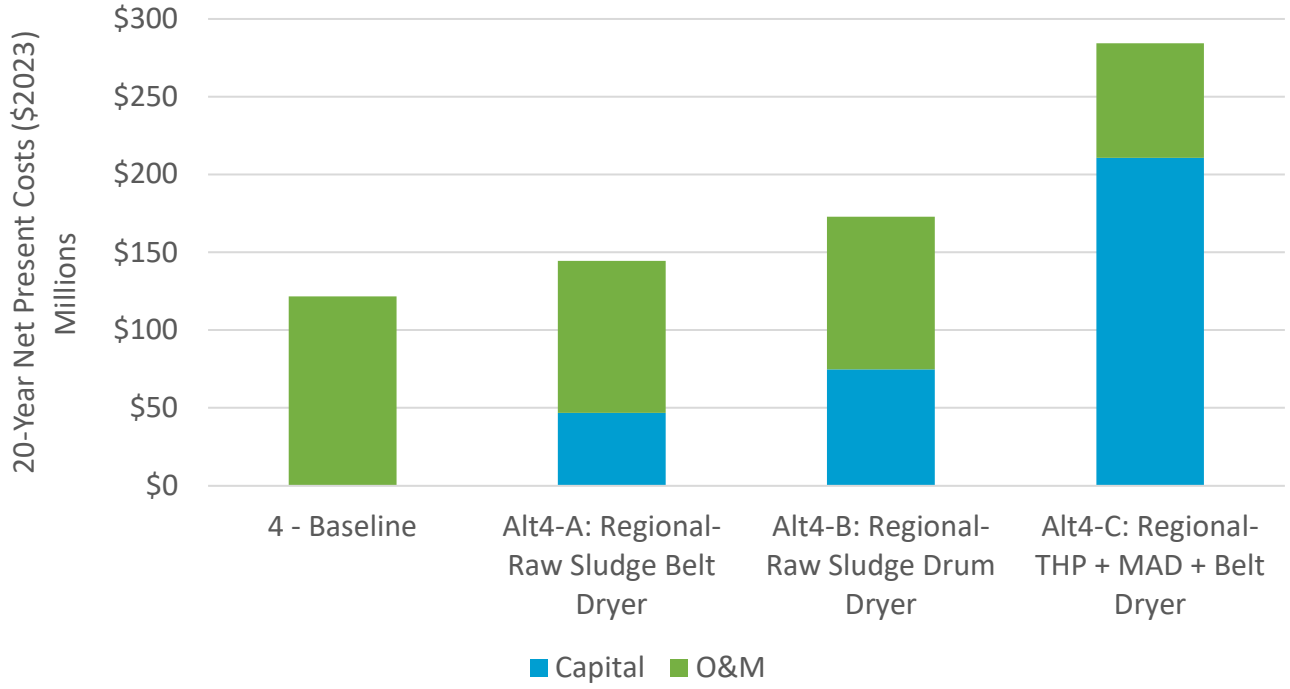


Figure 58. Net present costs for regional-scale alternatives

5.7.4 Sensitivity Analysis

The results of a sensitivity analysis on the regional-scale alternatives' NPCs are shown in Figure 5-9. For these alternatives, the NG increasing by 50% had minimal impacts on the relative NPC compared to the original cost assumptions. The most impactful variable on these costs is increasing biosolids management costs. If biosolids costs were to return to the levels seen in spring 2023 ($190/wet-ton), regional drying alternatives would be competitive with individual POTWs continuing to dewater and landfill biosolids cake directly. State or federal funding also brings the NPC closer to parity with the baseline.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

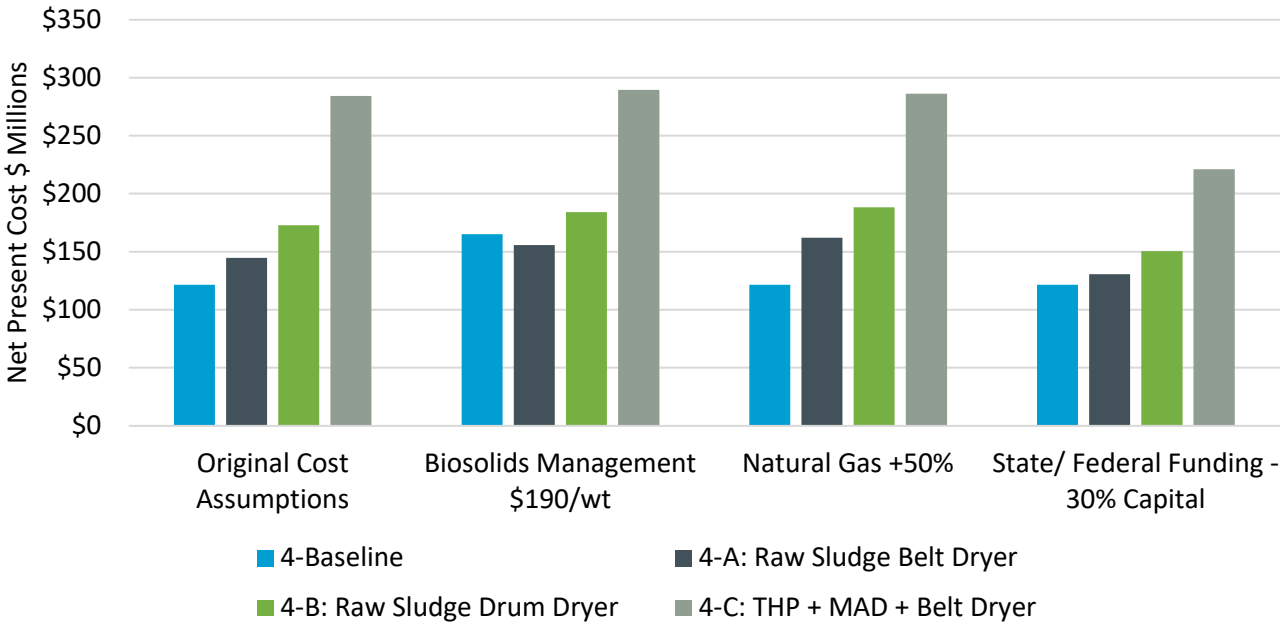


Figure 59. Sensitivity analysis for regional-scale POTW alternatives

5.8 Summary of Cost Evaluation Results

This analysis shows the importance of economies of scale for the technologies under consideration. Dryers and digestion typically do not make sense economically at small facilities, but can have a payback at larger facilities, particularly with state or federal support to offset some of the construction costs. Economies of scale are especially apparent for regional-scale facilities, which have the benefit of managing more material and hence having a more meaningfully impact on the overall state of biosolids capacity in the state. If biosolids costs increase to the levels seen in spring 2023 or if sufficient funding is provided, regional drying facilities appear to be cost effective according to the assumptions in this analysis.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 6: Piloting PFAS Treatment Technologies

Across the U.S. there is a need to identify cost-effective technologies to reduce the levels of PFAS in biosolids. While several technologies have shown promising results in reducing PFAS in biosolids, this is an emerging area of research (Winchel, 2020). Using knowledge gained from other studies, Maine can develop a pilot study that matches the specific needs of utilities in the state and answers questions still remaining regarding the fate of PFAS in these treatment processes. The pilot project will contribute to the advancement of scientific knowledge and the development of best practices for PFAS treatment in biosolids. The results of the study, as well as results of studies elsewhere in the U.S., can be used to determine if these technologies are able to provide levels of PFAS reduction that the state would want to support for full-scale development in the state, and inform the required regulatory approach.

To select a pilot(s), BC recommends that the state of Maine authorize funding for and issue a request for proposal (RFP) from interested vendors. Sections 6.1 and 6.2 discuss some of the particular considerations for this type of piloting, which will be significantly more involved than pilots of more traditional wastewater treatment equipment. Vendors of the technologies under consideration reportedly can charge hundreds of thousands of dollars for on-site pilots lasting 2 to 3 months. Costs can be less for shorter-term piloting at out-of-state demonstration facilities or existing installations. Section 6.4 provides the suggested screening criteria for selecting proposals that are eligible for funding. Also presented are suggested responsibilities during piloting for the vendor, the host POTW (if applicable) and the state (Section 6.5; PFAS sampling protocols specific to these technologies (Section 6.6); and intended pilot outputs (Section 6.7).

As one of the state's piloting goals would be to determine which technologies could provide significant PFAS reduction in biosolids and be worth supporting for full-scale development, if funding allows, it is recommended that DEP select at least one pilot from at least two technologies. If possible, for consistency, the biosolids used in the multiple pilots should come from the same POTW at the same time. For instance, if one pilot were being performed on site at a POTW and one at a remote site, the biosolids sent to the remote facility should be collected and sent at the same time as the biosolids were fed to the on-site pilot.

These technologies and vendors are not as mature as traditional processing equipment so there is the possibility that one pilot could fail. Funding more than one pilot would help ensure some results were obtained, even if one of the pilots should fail.

6.1 Siting Considerations

Siting considerations for the pilot study are important to ensure that the treatment technologies are tested under conditions where results are reliable and meaningful. Ideally, the pilot study will be located at a facility that accepts landfill leachate and/or septage. This will allow the pilot study to demonstrate the potential for disrupting the PFAS cycle, as landfill leachate and septage are common sources of PFAS contamination in wastewater and biosolids. Another siting option to consider would be to process solids from a facility with consistent, moderately elevated levels of a range of PFAS. This will ensure the treatment technologies are evaluated against elevated concentrations of PFAS so the impact of treatment is more apparent in the results.

6.2 Logistical Considerations

Piloting pyrolysis, gasification, and supercritical water oxidation (SCWO) is different from piloting other technologies, such as centrifuges, and thus requires several logistical considerations. Firstly, most PFAS reduction technologies require NG or another fuel source. This means that the pilot site should have access to a reliable and sufficient supply of NG or other suitable fuel source. For pyrolysis and gasification

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

specifically, dewatered solids typically must be dried to less than 20% moisture content first. Each treatment technology will produce various solid and liquid residues that need to be monitored, collected, and disposed of properly, and air emissions that need to be monitored, collected, and treated properly. Maine DEP should work with host locations and technology vendors to establish a plan to handle these emissions prior to pilot startup.

6.3 Pilot Location

As many of these vendors do not have mobile pilot units, treatment technologies may not be readily available or transportable to the pilot site. Vendors should be evaluated on their readiness and availability to install technology at the selected host site. Some of the vendors may only have demonstration facilities or existing installations in other locations. These vendors should be considered if it is not feasible or economically viable to install the technology at a host plant in Maine.

6.4 Suggested Criteria for Selecting Pilots

BC recommends limiting piloting to the following technologies, which have commercially available units and have shown promising results for PFAS removal: pyrolysis, gasification, and SCWO. BC has published several literature reviews (e.g., Ross, et al., 2022) that show strong support for the significant reduction of PFAS in biosolids through pyrolysis and gasification units. For SCWO, the EPA showed a greater than 99% reduction of the PFAS compounds identified in a targeted analysis (Krause, 2022). Other technologies can be considered if peer-reviewed scientific literature showing significant PFAS reduction (i.e., >90%) in all phases (solid, liquid and air) is provided.

Table 6-1 shows suggested criteria that a proposer must meet to be considered for pilot funding.

Table 6-1. Suggested Pass/Fail Criteria for Screening Pilot Proposals

Category	Criteria
Willingness to Share Data	Is the respondent willing to share all operating, cost, PFAS, and other data associated with the pilot?
Technology with Proven Ability to Reduce PFAS	Is the respondent proposing one of the following technologies? • Pyrolysis • Gasification • SCWO • Others showing an overall destruction removal efficiency >90% as supported by submitted peer-reviewed scientific literature
Vendor Maturity	Has the respondent operated a full-scale unit (>3 wet-tons/day capacity) within the last 3 years that is functionally equivalent to the one proposed?
Availability of a Unit for Piloting	Does the vendor have a full-scale unit meeting one of the criteria below available for this pilot in the timeframe indicated in the RFP? • Mobile pilot unit • Demonstration facility • Existing installation

Respondents should also provide:

- A list of other installations, current and in development
- Life-cycle cost estimates

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

- Prior PFAS fate and transport research for their proposed pilot
- Staff qualifications to operate all aspects of the pilot, including relevant sampling of waste streams
- Information pertaining to the pilot's ability to handle other materials (e.g., PFAS treatment residuals)
- All-in costs per month (shipping, mobilization, interconnections, utilities, staff time, sampling)

In addition, if the pilot will be on site at a POTW in Maine, the respondent should also provide:

- Identification of a host site
- Required utilities
- Footprint size requirements
- Requirements for feedstock solids (e.g., is drying or slurrying of dewatered cake required before feeding?)

6.5 Roles and Responsibilities During Piloting

6.5.1 Technology Vendor

The vendor would be responsible for the following aspects of the pilot:

- Arranging all shipping and setup (for mobile units)
- Running all aspects of the pilot
- For out-of-state pilots, performing PFAS sampling per established protocol (Appendix E and send all samples as directed to an approved lab

6.5.2 Utility

The host plant of the pilot project plays a vital role in providing the necessary resources and support for the successful implementation and evaluation of the treatment technologies for PFAS in biosolids. The host plant will allocate a suitable area within its premises for pilot equipment installation and operation. The host plant will also supply the biosolids that will be used as the treatment technologies' feedstock. The biosolids should have a consistent quality and should be representative of the typical biosolids produced by the host plant. The host plant will collect and share the relevant operating data from the plant (e.g., total and volatile solids of dewatered cake) at the time of the pilot. The operability of the technology should also be evaluated, and feedback should be based on the experience and observations of the plant staff who are trained on the use of the pilot equipment. The overall ease of the technology's use is an important aspect in evaluating the feasibility on a larger scale.

6.5.3 State of Maine

State government is a key partner and stakeholder of the pilot project, as it provides support and resources for evaluating treatment technologies for PFAS in biosolids. Maine will fund the pilot project, covering the equipment installation costs and disposal costs for the end product.

Additionally, for in-state pilots, the state will provide personnel (staff or contractors) to conduct PFAS sampling and will cover the cost of laboratory analysis. Data associated with the pilot study will be compiled and analyzed by the state unless otherwise agreed. The state will grant the necessary regulatory approval for the pilot project.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

6.6 PFAS Sampling Protocol

BC's research to date indicated that all inputs and outputs must be measured to ensure the full fate and transport of PFAS through the technology is determined. To truly understand what happens to the thousands of PFAS compounds, detailed analyses must be performed. A suggested PFAS sampling protocol, provided in Appendix F, includes the following items:

- All inputs and outputs, including stack emissions: This will involve collecting representative samples of the biosolids before and after treatment, as well as the air emissions from the treatment process. The samples will be stored and transported according to standard procedures and quality assurance/quality control measures.
- Targeted PFAS analysis: This will involve measuring the concentrations of specific PFAS compounds in the samples using validated analytical methods.
- Targeted byproducts analysis: This will involve measuring the concentrations of byproducts of the treatment technologies.
- Non-targeted analysis: This will involve identifying and characterizing unknown or emerging PFAS and byproducts in the samples using advanced analytical techniques.
- Total organic fluorine balance: This will involve measuring the total amount of organic fluorine in the samples. The total organic fluorine balance will help in evaluating the mass balance and removal efficiency of the treatment technologies for PFAS and byproducts.

6.7 Pilot Outputs

The pilot project aims to test the performance and feasibility of different treatment technologies for reducing PFAS in biosolids. To evaluate the effectiveness of these technologies, the pilot output should include publishing PFAS fate and transport data, which will show PFAS levels before and after treatment. Additionally, the pilot operating parameters and costs should be published, including energy usage and any added chemicals. Such considerations will provide information on the technical and economic aspects of the treatment technologies. This information will help to compare the advantages and disadvantages of each technology and to identify the most cost-effective and sustainable options for PFAS management in biosolids. Ideally, the data collected is sufficient to allow DEP to develop a regulatory and permitting strategy around these technologies and determine which could be beneficial to support for full-scale development.

6.8 Pilot Costs

Vendors of the technologies under consideration reportedly can charge hundreds of thousands of dollars for on-site pilots lasting 2 to 3 months. Costs can be less for shorter-term piloting at out-of-state demonstration facilities or existing installations.

Comprehensive PFAS treatment testing will add considerable cost as well, particularly air emissions testing. BC recommends running these studies on 3 consecutive days at the same operating parameters to have triplicate results. In the research projects BC is performing on pyrolysis units and incinerators, vendors have charged $50,000 for a 3-day test (4 hours each day). A targeted PFAS sample analysis for solids and liquid is around $500 per sample. Four sampling points (incoming cake, dryer exhaust, condensate, dried biosolids) over 3 days is an additional $6,000. One comprehensive round of sampling and analysis would, therefore, total approximately $56,000 to pilot.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 7: Recommendations

7.1 Biosolids Beneficial Use Screening Levels

The current situation for biosolids management in Maine is not sustainable. Leaving landfill disposal as the sole outlet for biosolids in the state exacerbates landfill capacity issues, runs counter to the state's solid waste management hierarchy as well as the state's climate goals, and leaves POTWs (and ultimately ratepayers) at the risk of drastic and sudden increases in biosolids management costs (as seen during the "sludge crisis" in 2023). The three landfills currently handling nearly all the biosolids generated in the state are all estimated to be exhausted in, at best, the next 20 years, with JRL (which handled nearly 90% of biosolids disposal in 2022) exhausted as soon as 2028. There are several proposals being developed to install biosolids dryers or thermal treatment technologies in the state (Section 4.4) but under the absolute restrictions on land application of biosolids and biosolids-derived products in Maine, the resulting dried biosolids, biochar, or other products would also have no outlet in the state when landfills are exhausted.

In the coming years, the state may, therefore, want to consider establishing screening levels to allow the use of biosolids and biosolids-derived products outside of landfills in a manner that protects human health and the environment. This is the approach being pursued by the EPA and every other state that has regulated PFAS in biosolids.

While some pushback to reversing the ban on the agronomic utilization of biosolids should be expected, several important factors have changed since the passing of Maine's biosolids land application ban:

- Maine has conducted significant sampling of biosolids and land application sites, which has shown that the significant impacts to particular dairy farms that ultimately led to the ban appear to be the exception rather than the rule. In particular, while the Department of Agriculture, Conservation, and Forestry has noted that about 70 farms have had varying levels of impacts from PFAS, there are almost 800 farms in Maine. At least four dairy farms that have had annual applications of biosolids for 30 years or more showed no detectable PFAS in their milk (NEBRA, 2019).
- The significant biosolids management challenges in 2023 have exposed the risk to utilities and ultimately ratepayers to having only one outlet for biosolids available in the state.
- As the requirements for reporting and restricting products containing PFAS (see Section 3.5) take effect in Maine (and elsewhere), the amount of PFAS in the state and consequently in biosolids should dramatically decrease in line with previous PFAS phase-outs. The Maine PFAS Task Force final report envisioned this reduction, stating "reduc[ing] uses of PFAS is expected to reduce concentrations of PFAS in residuals [biosolids] so that utilization can resume" (2020).
- The EPA is conducting a very thorough risk assessment of PFAS in biosolids, scheduled to be completed in late 2024, which is evaluating 18 human and ecological exposure pathways based on the latest research (Tobias, 2023). The anticipated result is the establishment of science-based PFAS limits for beneficially reused biosolids consistent with EPA' s mission to protect human health and the environment.

It is therefore recommended that the State Legislature consider reevaluating the ban on land application to determine if DEP ought to adopt the federal biosolids PFAS limits once established. Many other states are deferring to this comprehensive federal process for regulating PFAS in biosolids (Hughes, 2023). For instance, the New York interim strategy for controlling PFAS in recycled biosolids (i.e., those that are not landfilled) explicitly states that the state will incorporate federal standards when available (pending state review of the federal standards).

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

7.2 Landfill Capacity for Biosolids

The state-owned Juniper Ridge Landfill in Old Town was the outlet for nearly 90% of biosolids generated in Maine in 2022. This facility's current permitted capacity is estimated to be fully used by 2028. It is BC's understanding that the next step in the JRL expansion process is for the current JRL operator to submit a Public Benefit Determination (PBD) application (38 M.R.S. § 1310-AA) to DEP for approval. The last time JRL was expanded it took nearly 6 years between PBD submittal and final approval, with additional time needed to then construct the new area. For another state-owned landfill, the former Maine State Planning Office estimated 7 years would be needed to prepare the PBD and expansion applications, have them reviewed by DEP, address legal challenges, and construct the expansion. Using these timelines and to meet landfill expansion needs, the PBD should have been submitted by 2021 at the latest.

If JRL is not expanded, the state faces a dire situation for solid waste generally in the state. For biosolids, there is no current or proposed alternative outlet in the state that would be able to accept the tonnage currently handled at JRL. Regional facilities (Sections 4 and 5.7) and installation of digesters and dryers at POTWs (Section 5) will help, but it is unlikely more than one or two of these facilities will be operational by 2028. Out-of-state options would be very costly, with POTWs likely facing significantly higher costs than even those seen during mid-2023.

Given the severity of the implications if the facility is not expanded, it is recommended that **the State work with the current operator to ensure that an application is submitted as soon as possible** to ensure sufficient time to pursue alternatives if the expansion is not pursued by the current operator.

In a questionnaire sent to landfill operators in the state as part of this project, three additional landfill facilities expressed interest in discussing with DEP the possibility of obtaining authorization to accept biosolids (see Section 3.1). While these facilities are significantly smaller than JRL, **DEP should coordinate discussions with the owners of these facilities to provide supplemental or contingency capacity for biosolids.** Possibilities for future use at the facility in Jay, which is currently in the process of a real estate transfer, should also be discussed with the new owners once closing has occurred.

7.3 Bulking Agents

To avoid another "sludge crisis" in the coming 2 years when the restrictions on out-of-state waste and recycling requirements for certain large solid waste processing facilities go back into effect (as described in Sections 2.1.2 and 2.1.3), the state can take several immediate and longer-term actions. Most pressing, the state needs to verify that ReSource Lewiston (the solid waste processing facility producing much of the bulking agent for JRL) and Casella anticipate having sufficient and consistent amounts of bulking agent available to support continued acceptance of the current levels of biosolids (and other wet wastes). **BC recommends that the state fund an independent study evaluating the availability of traditional and alternative bulking agents.** If the study finds that insufficient quantities of bulking agent are available, then the extension on the restrictions in P.L. 2021, ch. 626 may need to be extended until reliable alternatives are secured.

Given the current state of development, design, and permitting (Section 4), the only new facility that could reasonably be operational by July 1, 2025, when the restriction on out-of-state oversized bulky waste goes back into effect is the Crossroads Landfill biosolids dryer. BC is not aware of any digestion or drying projects at individual POTWs in Maine that are scheduled to be operational by this time. These projects take several years to develop. Many dryers, for instance, currently have manufacturing lead times of 12 to 18 months—which does not include the installation and ramp-up time needed for full-scale operation.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

In the longer term, it is recommended that the state incentivize increased recycling of CDD produced in the state, including by supporting increased processing capacity in the state. This will also help extend the available landfill capacity generally in the state.

7.4 Piloting of PFAS Treatment Technologies

The full fate of PFAS through biosolids treatment technologies is not known. By funding pilots, Maine can advance the understanding of the potential for cost-effective destruction of PFAS in biosolids and inform future permitting. **It is recommended that the state issue an RFP to select pilots of these technologies for the state to fund.** Within this RFP, the state should identify necessary data collection to facilitate future permitting of full-scale facilities (see Section 6 for more details).

7.5 Volume Reduction and Dryer Projects

Current drivers in Maine lead to the need for less material and/or material dried to no longer fall under wet waste restrictions at landfills. There are mature technologies for these purposes: anaerobic digestion and drying. Section 5 provided a generalized economic analysis of a series of alternatives employing these technologies at different scales of POTWs and for regional facilities. This analysis showed that using generalized cost factors for Maine, thermal drying and anaerobic digestion can be economically viable at sufficient scale. It should also be noted that the O&M cost for baseline scenarios (continued landfilling of dewatered biosolids) is predominantly driven by volatile biosolids management costs. Alternatives with similar overall O&M costs to the baseline would have the advantage of being less risky as the overall O&M costs for the alternatives are made up of a more even distribution of several relatively more stable costs (e.g., electricity, NG, polymer and maintenance).

According to the members of the Maine Water Environment Association who were involved in this project (representatives of three wastewater utilities), the Clean Water State Revolving Fund (CWSRF), which is the typical method for providing state support to wastewater infrastructure projects, is stretched each year to support the basic capital improvement projects that POTWs need to repair and replace aging infrastructure and keep plants meeting discharge limits. The Bipartisan Infrastructure Law (BIL) provides additional funding allocations to CWSRF for fiscal years 2022-2026; however, for FY23, the base CWSRF plus supplement BIL funding was insufficient to fund approximately two-thirds of projects that applied for funding (Maine DEP, 2023).BIL also provides Emerging Contaminant funding specifically for treatment of PFAS and other contaminants of emerging concern; however, the funds are, again, limited. For FY23 there was $1.5M allocated for these projects.

It is therefore recommended to create a separate program to fund the capital projects recommended in this report to address biosolids challenges through volume reduction and the production of drier material. Similar to the Wastewater Treatment Facility Planning and Construction Grants Program for state FY19-20, a bond could be issued to provide funding for these projects, including regional solutions. Under this previous program, up to 80% of the construction costs of wastewater infrastructure projects were eligible for grant funding.

As the market matures, the research improves, and the state feels confident in PFAS treatment technologies, a similar program could be set up to fund these projects. Having a fund dedicated to PFAS treatment would facilitate the separate tracking of PFAS expenditures.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

7.6 Biosolids Production Reporting

DEP does not currently have readily available comprehensive data on biosolids production in the state. These data would provide needed context for legislators, regulators, and solutions providers, particularly in uncertain times, for biosolids management. POTWs with an Agronomic Utilization Program License are required to report annual tonnages by destination, but this only covers around one-third of the approximately 150 POTWs in the state. With the ban on biosolids agronomic utilization under P.L. 2021, ch. 641, this reporting will gradually phase out as licenses that are no longer able to be used are surrendered. While landfills are required to report the annual amount of biosolids received, this data is not always broken out by generator.

The reporting form provided by the state (DEP Form 49) to aid with submitting Discharge Monitoring Reports (DMRs) required of all POTWs in Maine (Section D.1.d of the standard permit conditions) includes "sludge disposal," including the site used. It is recommended that DEP evaluate the structure and purpose of this form and how it is currently being used and **develop a tool for mining biosolids management data from existing DMR submittals.**

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Section 8: Conclusion

While the situation for biosolids management in Maine is challenging and uncertain, there are several actions the state can take to provide more options for POTWs responsible for managing the biosolids generated by treating the wastewater from homes, businesses, and industry. In the short term, the state needs to support efforts to provide additional, reliable landfill capacity for biosolids—by prioritizing the landfill application process for the expansion at JRL, discussing accepting biosolids with landfills not currently accepting biosolids, and helping to ensure bulking agents are available.

The state can also make POTWs less reliant on landfills by supporting projects to reduce the quantity of biosolids produced as well as opening up additional outlets. It is recommended that the state adopt the federal biosolids limits for PFAS when available and reevaluate whether the land application of biosolids can once again become an option for Maine.

While source control has often proven to be the most effective approach to reducing environmental pollutants, the state can also support the deployment of new technologies to reduce PFAS in biosolids. These technologies are not yet widely proven, and the level of PFAS destruction is an open area of research. Maine can contribute to filling knowledge gaps, determine permitting pathways, and select technologies to support full-scale deployment by funding pilots that include comprehensive PFAS testing. Maine can become a leader in implementing some of these new technologies, which in turn could help local businesses and create jobs.

By taking these recommended actions, the State of Maine can play a more proactive role in managing its biosolids capacity.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

References

Agency for Toxic Substances and Disease Registry. *PFAS in the U.S. Population*. https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html (Accessed October 22, 2023).

Barr. *Evaluation of Current Alternatives and Estimated Cost Curves for PFAS Removal and Destruction from Municipal Wastewater, Biosolids, Landfill Leachate, and Compost Contact Water*. May 2023. https://www.pca.state.mn.us/sites/default/files/c-pfc1-26.pdf (Access November 15, 2023).

Batiste, Stephen; et al. *Assessment of Landfill Capacity for Biosolids and Initial Evaluation of Leachate Treatment Approaches in Maine*. 2023.

Beecher, Ned. *PFAS Update September 2019*. North East Biosolids & Residuals Association, Sept. 26, 2019, www.nebiosolids.org/pfas-update-september-2019. (Accessed November 10, 2023).

Crowley, Jim. *PFAS Testing Update*. Maine Water Environment Association Fall Conference. Sept. 21, 2023.

Department of Energy. *Standard Review Plan, Technology Readiness Assessment Report*. Mar. 2010. https://www.energy.gov/sites/prod/files/em/Volume_I/O_SRP.pdf (Accessed October 15, 2023).

Georgia Department of Natural Resources. *High Moisture Content Waste Management Plans at Solid Waste Facilities Guidance Document.* July 2021, https://epd.georgia.gov/document/document/hmcw-guidance-72021pdf/download (Accessed July 15, 2023).

Hughes, Sarah G. *PFAS in Biosolids: A Review of State Efforts & Opportunities for Action*, ECOS, Jan. 2023. https://www.ecos.org/wp-content/uploads/2023/01/PFAS-in-Biosolids-A-Review-of-State-Efforts-and-Opportunities-for-Action.pdf (Accessed September 12, 2023).

Krause, Max J., et al. *Supercritical Water Oxidation as an Innovative Technology for PFAS Destruction*. Journal of Environmental Engineering, vol. 148, no. 2, Feb. 2022, https://doi.org/10.1061/(asce)ee.1943-7870.0001957. (Accessed October 17, 2023).

Maine Department of Environmental Protection. *Report on the Land Application of Septage*. January 13, 2023.

Maine Department of Environmental Protection. *Clean Water State Revolving Fund Federal Fiscal Year 2023 Intended Use Plan*, Sep. 2023. https://www.maine.gov/dep/water/grants/SRF/cwsrf/Final%20FFY%202023%20IUP.pdf (Accessed November 10, 2023).

Maine PFAS Task Force. *Managing PFAS in Maine: Final Report from the Maine PFAS Task Force*. Jan. 2020. https://static1.squarespace.com/static/54806478e4b0dc44e1698e88/t/5e2b15d84e43bc1f2fe5a4ef/1579881955942/Maine-PFAS-Task-Force-Report-FINAL-Jan2020.pdf (Accessed November 15, 2023).

Michigan Department of Environment, Great Lakes, and Energy. *Land Application of Biosolids Containing PFAS: Interim Strategy*, Apr. 2022. p. 6.

Rebodos, Robert. *Maine Septage Management Evaluation*. 2023.

Ross, John, et al. *Biosolids Pyrolysis and Gasification: Technology Advancements and an Updated Assessment.* Water Environment Federation, Residuals and Biosolids Conference Proceedings, May 2022. https://www.accesswater.org/publications/proceedings/-10082009/biosolids-pyrolysis-and-gasification--technology-advancements-and-an-updated-assessment (Accessed November 3, 2023).

Tobias, David. EPA Tools and Resources Webinar: *Chemical Risk Assessment for PFOA/PFOS in Biosolids*. United States Environmental Protection Agency Office of Water. June 21, 2023. https://www.epa.gov/system/files/documents/2023-07/508%20Compliant%20-%20PFAS%20in%20Biosolids_Tobias%20%28final%29.pdf.

United States Office of Management and Budget. *Circular A-94, Appendix C*. Dec. 2022.

Winchell, Lloyd; et al. P*er- and polyfluoroalkyl substances thermal destruction at water resource recovery facilities: A state of the science review*. Nov. 15, 2020. Water Environment Federation, Water Environment Research.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Attachment A: Innovative Technology Provider Survey

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Several technologies on the market seek to address the issue of PFAS in the environment. To understand the state of the technology and the options available to Maine as they move forward, BC sent out a survey to twenty-three high-temperature technology companies. The survey was comprised of 10 questions and asked companies to assess their own Technology Readiness Level (TRL), as defined by the Department of Energy (2023), and to discuss the technological impacts on PFAS concentrations on the processing stream. For both of these pieces, BC requested supporting documents, with a preference for peer-reviewed publications supporting the claims. Of the twenty-three who received the survey, thirteen responded. Responses are summarized below.

Table A-1. Technology Provider Survey Results

Company	Company Age (years)	Technology Description	TRL (1-9)	Operating Parameters	PFAS Destruction (as reported by company)	Supporting Info
SoniQ Force	4	Supersonic drying	3		No/unknown	
SoMax Circular Solutions	6	Hydrothermal carbonization	7		Yes, per operating parameters	General literature*
C-Green/ Next Rung	7	Hydrothermal carbonization and wet oxidation	7		Unconfirmed, testing in progress	
374 Water	5	Supercritical water oxidation	7	374˚C, 218 atm (H2O supercritical conditions)	Yes, per internal tests	Verbal/Conference data
Stircor Services	4	Gasification, drying	9		Drying – no Gasification – yes	Publicly available PFAS results
Aries Clean Technologies	12	Gasification (fluidized bed)	7	Gasifier: 675˚C Thermal oxidizer: 980˚C	Yes, per operating parameters	General literature*
CTEC Energy	13	Gasification	9	1400˚C	Yes, per operating parameters	General literature*
Heartland Water	15	Gasification (ultra-high-temperature ionic)	7	5000˚C	Yes, per operating parameters	General literature*
Biowaste Pyrolysis Solutions	8	Pyrolysis	6	850˚C, 15 sec	Reduction	
Green Waste Energy	8	Pyrolysis	6	> 900˚C	Yes, per operating parameters	General literature*
Aquagreen	8	Pyrolysis, steam drying	8	Pyrolysis: 650˚C, 10 min Burner: 900˚C, 2 sec	Yes	Public pilot study data
CharTech	10	Pyrolysis	6	> 850˚C	Yes	Public pilot study data
Bioforcetech	11	Pyrolysis, bio drying	7	Pyrolysis: 450-750˚C Burner: 900-1100˚C	Reduction	Public pilot study data

** PFAS destruction has been observed for a particular technology broadly but not tested on a company's specific unit and operating parameters.*

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Attachment B: Process Flow Diagrams for Technology Alternatives

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

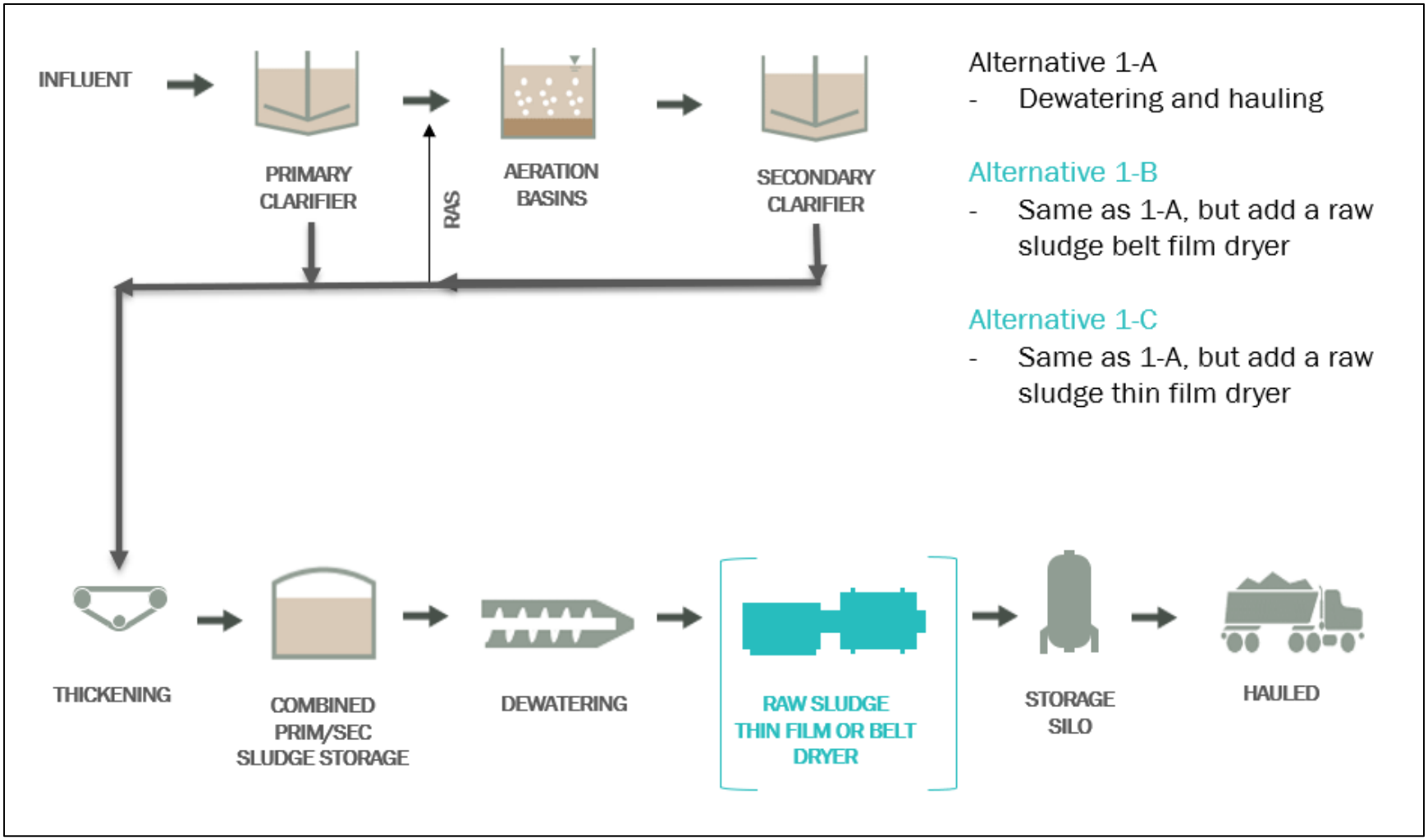


Figure 1: Alternative 1-A, 1-B, and 1-C Process Flow Diagrams

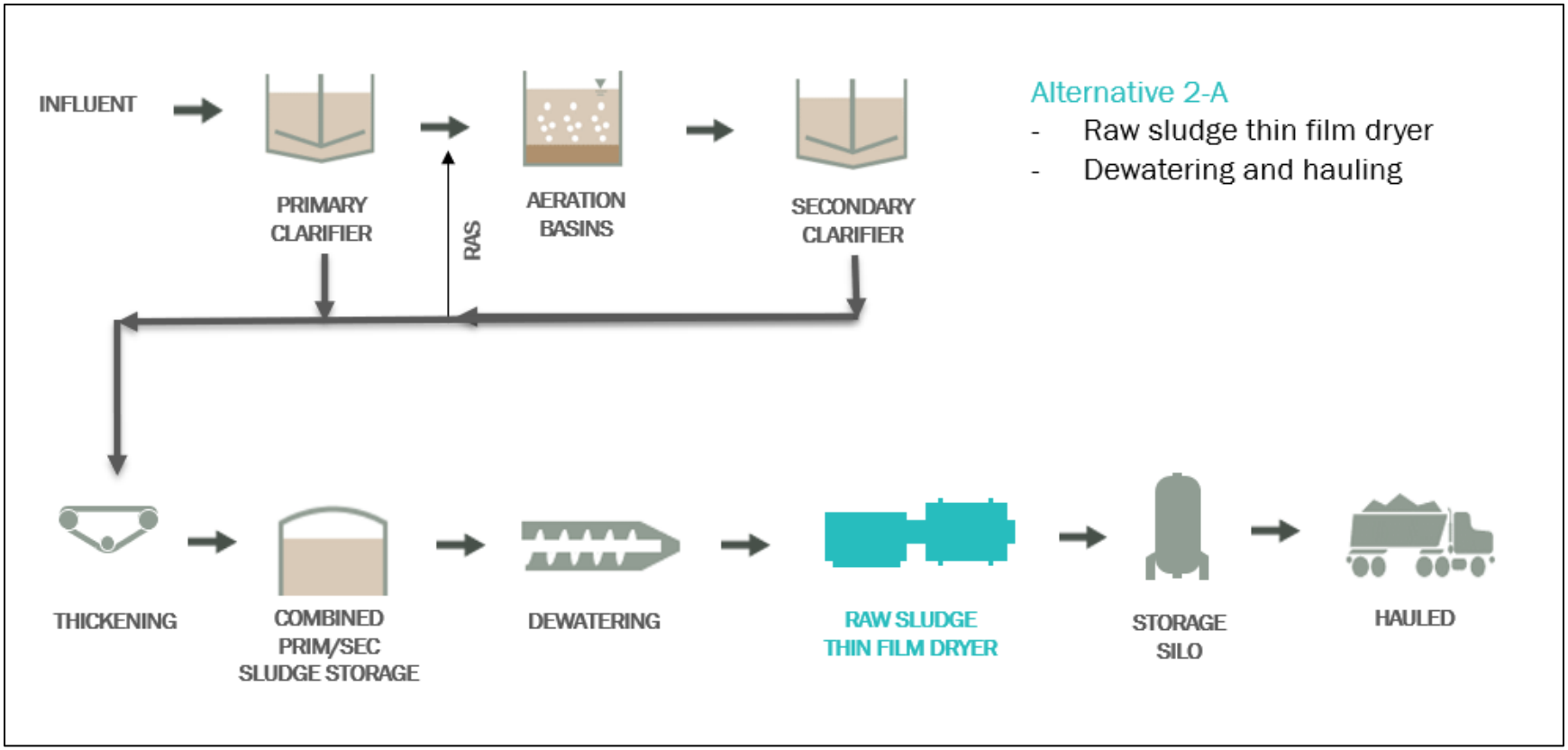


Figure 2: Alternative 2-A Process Flow Diagram

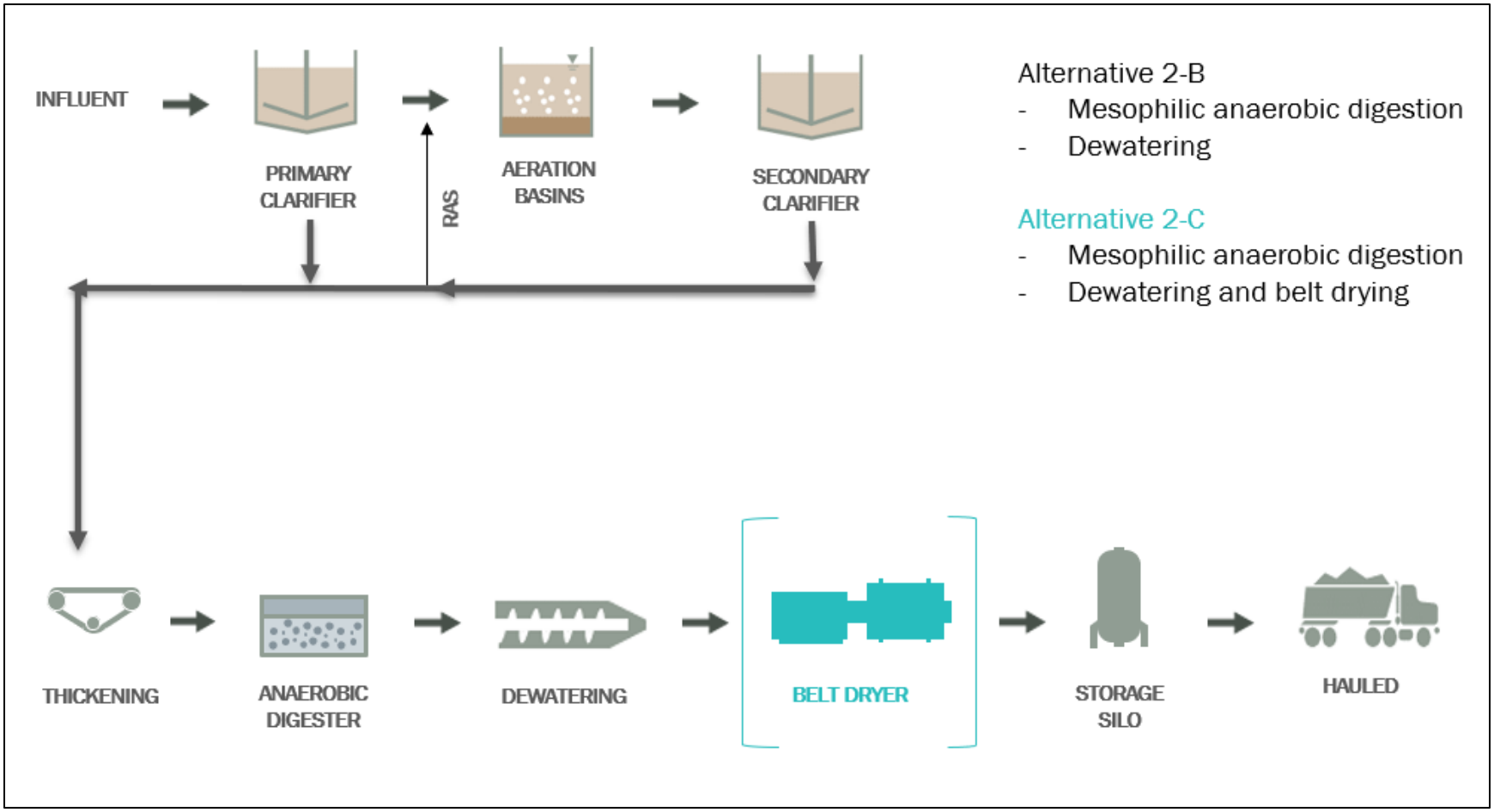


Figure 3: Alternatives 2-B and 2-C Process Flow Diagrams

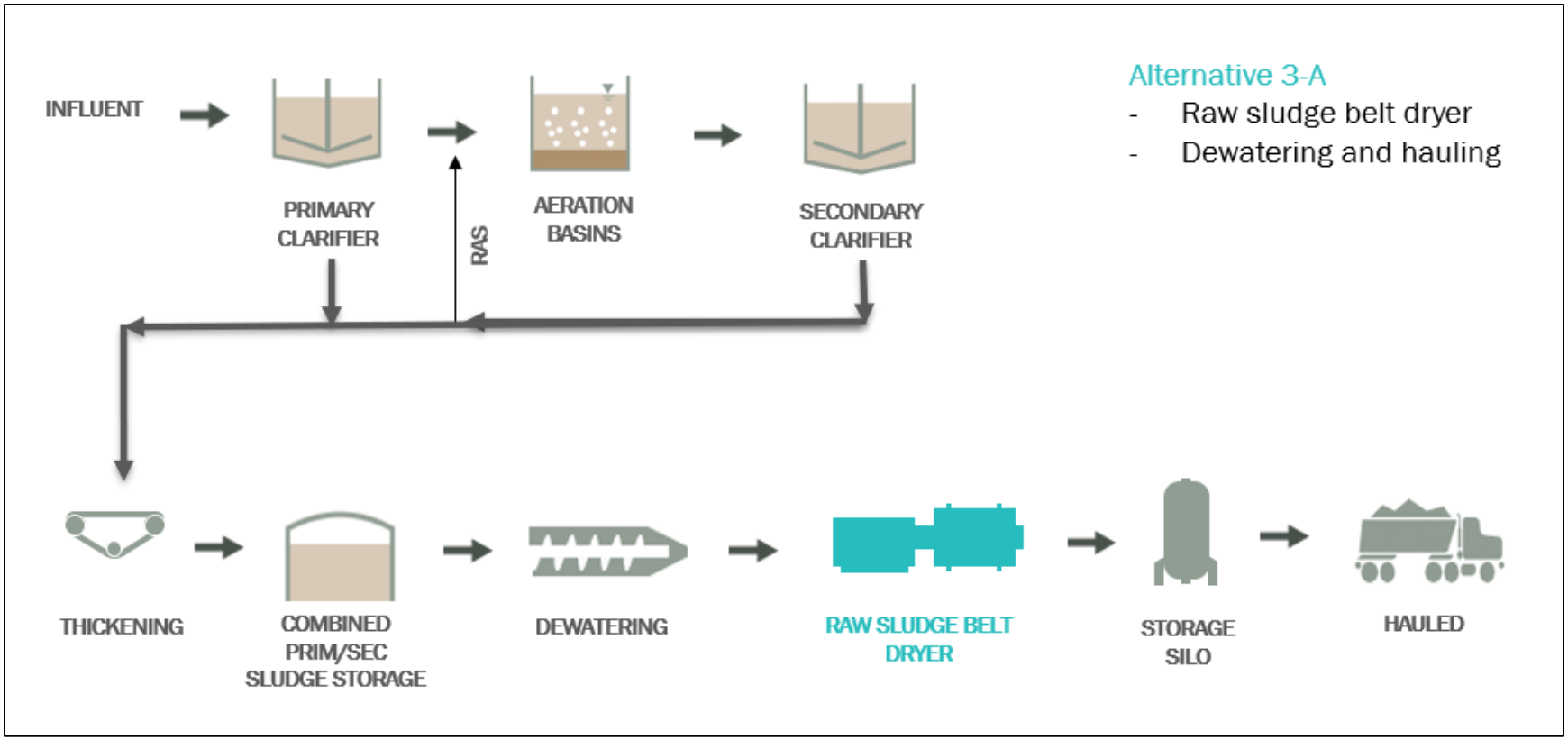


Figure 4: Alternative 3-A Process Flow Diagram

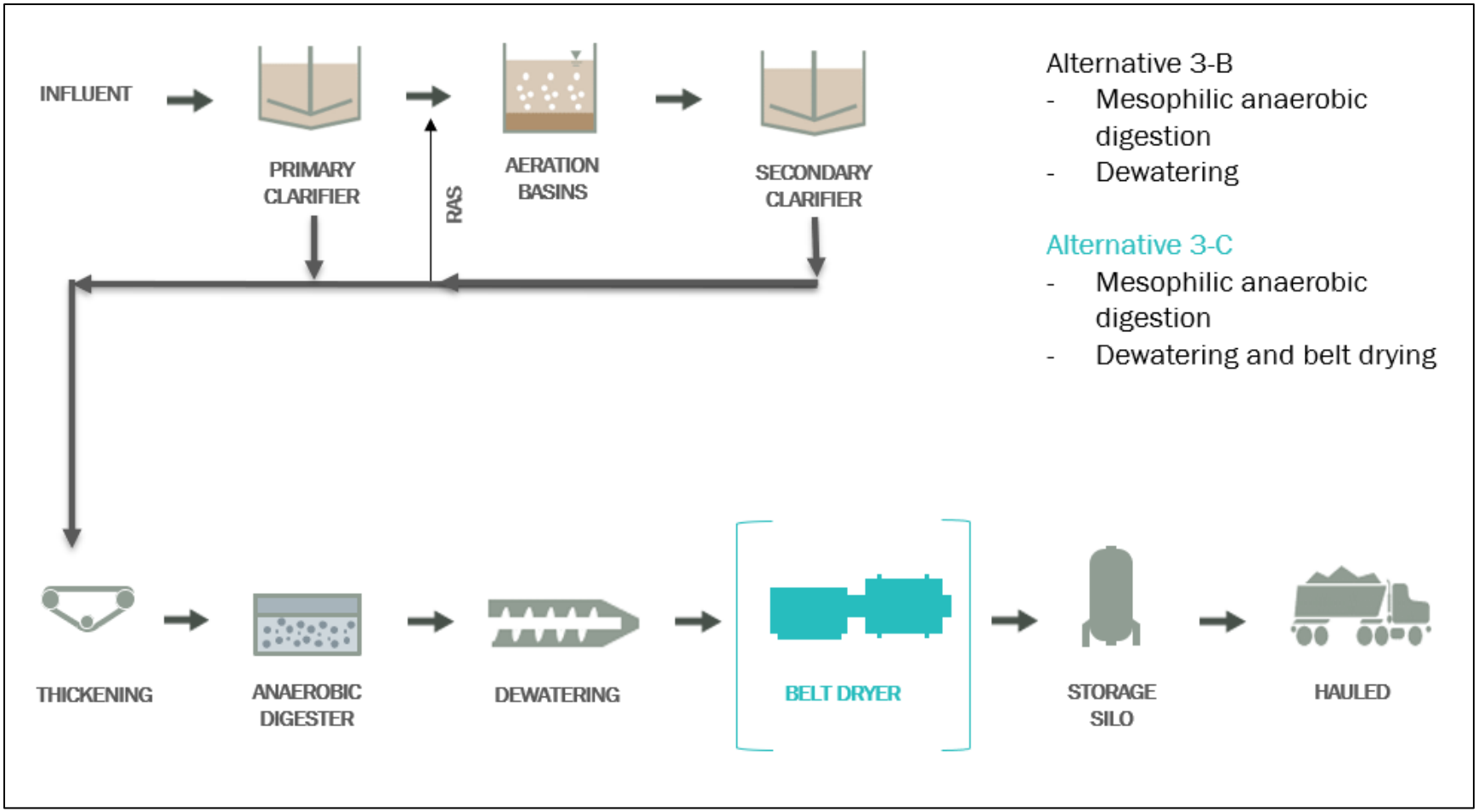


Figure 5: Alternatives 3-B and 3-C Process Flow Diagrams

Alternative 4-A

- Accepting undigested primary and secondary dewatered cake and digested dewatered cake
- Belt dryer

Alternative 4-B

- Same as 4-A, but using a drum dryer

Figure 6: Alternatives 4-A and 4-B Process Flow Diagrams

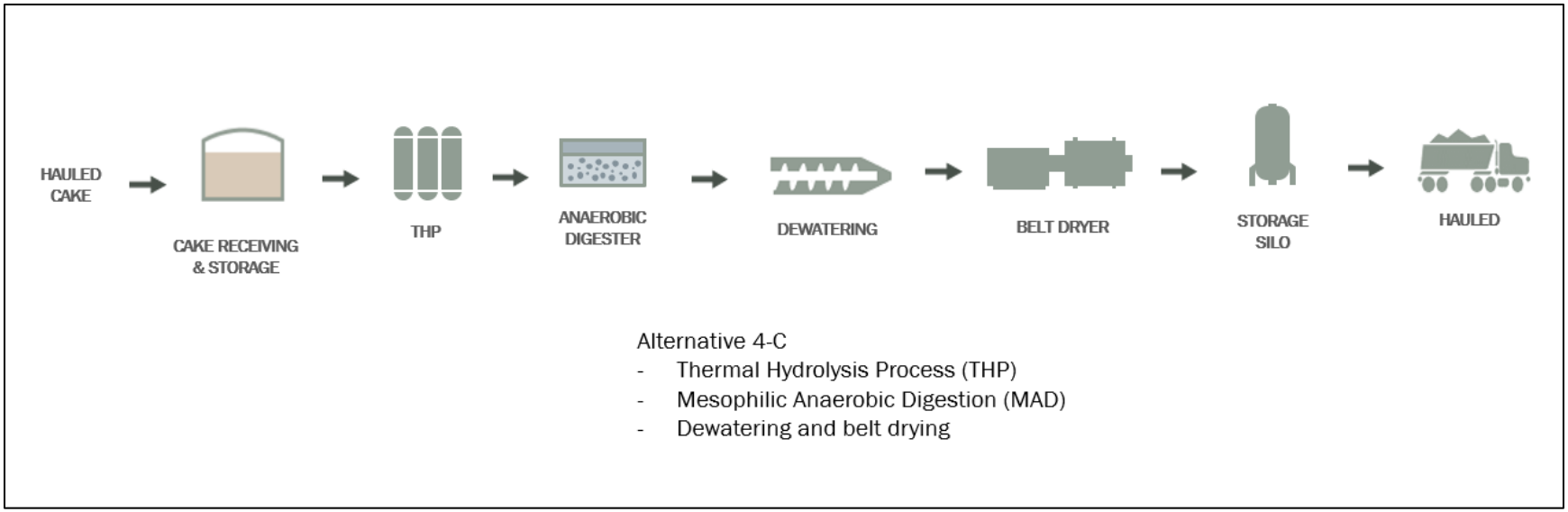


Figure 7: Alternative 4-C Process Flow Diagram

Attachment C: Capital Cost Estimates

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

DISCLAIMERS AND ASSUMPTIONS TO PROVIDE ON THE COVER PAGE FOR THE COST ESTIMATING APPENDIX:

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 5 estimate. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.
Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Major equipment costs are based on both vendor supplied price quotes obtained by the project design team and/or estimators, and on historical pricing of like equipment.
4. There is sufficient electrical power to feed the specified equipment. The local power company will supply power and transformers suitable for this facility.
5. Soils are of adequate nature to support the structures. No piles have been included in this estimate.
6. The Estimating Contingency line item does not include changed conditions or large scope changes.

The following estimating exclusions were assumed in the development of this estimate.

1. Hazardous materials remediation and/or disposal.
2. Utility agency costs for incoming power modifications.
3. Permits beyond those normally needed for the type of project and project conditions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 1-A: Dewatering Only						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
1-A: Dewatering Only						
Sludge Storage	$3	/gallon	1,766	gallon	$5,298	assumes 4 hrs of storage for each tank, n+1
Dewatering	$810,000	/unit	1	unit	$810,000	
Subtotal A					**$820,000**	
Piping	15%	of "A"			$123,000	
Site Civil	10%	of "A"			$82,000	
Misc. Demolition	5%	of "A"			$41,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$246,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$106	
Subtotal B					**$1,310,000**	
Startup and Construction Sequencing	2%	of "B"			$26,200	
General Conditions	15%	of "B"			$196,500	
Contractor Overhead and Profit	15%	of "B"			$196,500	
Sales Tax	5.50%	of "B"			$72,050	
Bonds and Insurance	2.5%	of "B"			$32,750	
Subtotal C Construction Costs					**$1,830,000**	
Engineering	10%	of total construction costs			$183,000	
Construction Management	10%	of total construction costs			$183,000	
Subtotal Project Costs					**$2,200,000**	
Estimating Contingency	30%	of subtotal Project Costs			$660,000	
Total Project Cost					**$2,900,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 1-B: Dewatering + Raw Sludge Belt Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
1-B: Dewatering + Raw Sludge Belt Dryer						
Sludge Storage	$3	/gallon	1,766	gallon	$5,298	assumes 4 hrs of storage for each tank, n+1
Dewatering	$810,000	/unit	1	unit	$810,000	
Dryer Equipment						
Huber Belt Dryer	$1,290,439	/package	1	package	$1,290,439	Vendor Quote, assuming this includes conveyance
Installation of dryers	20%	percent			$258,088	
Dryer Building	$325	/sf	2000	sf	$650,000	
Subtotal A					**$3,010,000**	
Piping	15%	of "A"			$451,500	
Site Civil	10%	of "A"			$301,000	
Misc. Demolition	5%	of "A"			$150,500	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$708,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$42,115	
Subtotal B					**$4,700,000**	
Startup and Construction Sequencing	2%	of "B"			$94,000	
General Conditions	15%	of "B"			$705,000	
Contractor Overhead and Profit	15%	of "B"			$705,000	
Sales Tax	5.50%	of "B"			$258,500	
Bonds and Insurance	2.5%	of "B"			$117,500	
Subtotal C Construction Costs					**$6,600,000**	
Engineering	10%	of total construction costs			$660,000	
Construction Management	10%	of total construction costs			$660,000	
Subtotal Project Costs					**$7,900,000**	
Estimating Contingency	30%	of subtotal Project Costs			$2,370,000	
Total Project Cost					**$10,300,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 1-C: Dewatering + Raw Sludge Thin Film Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
1-C: Dewatering + Raw Sludge Thin Film Dryer						
Sludge Storage	$3	/gallon	1,766	gallon	$5,298	assumes 4 hrs of storage for each tank, n+1
Dewatering	$810,000	/unit	1	unit	$810,000	
Dryer Equipment						
Thin Film Dryer	$1,286,214	/package	1	package	$1,286,214	Scaled based on vendor quote, package includes conveyance and hopper
Installation of dryers	20%	percent			$257,243	
Dryer Building	$325	/sf	1800	sf	$585,000	
Subtotal A					**$2,940,000**	
Piping	15%	of "A"			$441,000	
Site Civil	15%	of "A"			$441,000	
Misc. Demolition	5%	of "A"			$147,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$706,500	
Shipping and Handling	2%	of Materials and Processing Equipment			$42,030	
Subtotal B					**$4,700,000**	
Startup and Construction Sequencing	2%	of "B"			$94,000	
General Conditions	15%	of "B"			$705,000	
Contractor Overhead and Profit	15%	of "B"			$705,000	
Sales Tax	5.50%	of "B"			$258,500	
Bonds and Insurance	2.5%	of "B"			$117,500	
Subtotal C Construction Costs					**$6,600,000**	
Engineering	10%	of total construction costs			$660,000	
Construction Management	10%	of total construction costs			$660,000	
Subtotal Project Costs					**$7,900,000**	
Estimating Contingency	30%	of subtotal Project Costs			$2,370,000	
Total Project Cost					**$10,300,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 2-A: Dewatering + Raw Sludge Thin Film Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
2-A: Dewatering + Raw Sludge Thin Film Dryer						
Sludge Storage	$3	/gallon	4,320	gallon	$12,960	assumes 4 hrs of storage for each tank, 18gpm
Dryer Equipment						
Thin Film Dryer	$1,827,310	/package	1	package	$1,827,310	Vendor Quote, assumes dried product conveyance and silos are included
Installation of dryers	20%	percent			$365,462	
Dryer Building	$325	/sf	2000	sf	$650,000	
Subtotal A					**$2,860,000**	
Piping	15%	of "A"			$429,000	
Site Civil	10%	of "A"			$286,000	
Misc. Demolition	5%	of "A"			$143,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$663,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$36,805	
Subtotal B					**$4,400,000**	
Startup and Construction Sequencing	2%	of "B"			$88,000	
General Conditions	15%	of "B"			$660,000	
Contractor Overhead and Profit	15%	of "B"			$660,000	
Sales Tax	5.50%	of "B"			$242,000	
Bonds and Insurance	2.5%	of "B"			$110,000	
Subtotal C Construction Costs					**$6,200,000**	
Engineering	10%	of total construction costs			$620,000	
Construction Management	10%	of total construction costs			$620,000	
Subtotal Project Costs					**$7,400,000**	
Estimating Contingency	30%	of subtotal Project Costs			$2,220,000	
Total Project Cost					**$9,600,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 2-B: Dewatering + MAD						
Item	Unit Costs		Quantity		Class 5 Total	Notes
2-B: Dewatering + MAD						
Digester						
Digesters	$3	/gal	400,000	unit	$1,200,000	
Control Building & Ancillary Equipment	$3	/gal	400,000	unit	$1,200,000	
Digested Sludge Storage	$3	/gal	400,000	unit	$1,200,000	
Waste Gas Burner						
Waste Gas Burner	$50,000	/unit	1	unit	$50,000	scaled off of the cost for a new flare (1500 scfm)
Gas flare concrete, assumes 18in thick slab	$800	/cy	0.22	cy	$178	Assumed 18 inch slab, costs from Dan Goddard, includes installation
Gas Conditioning	$3,583	/scfm	30	scfm	$107,503	assumes Hydrogen Sulfide removal and moisture
Subtotal A					**$3,760,000**	
Piping	15%	of "A"			$564,000	
Site Civil	10%	of "A"			$376,000	
Misc. Demolition	5%	of "A"			$188,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$768,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$51,150	
Subtotal B					**$5,700,000**	
Startup and Construction Sequencing	2%	of "B"			$114,000	
General Conditions	15%	of "B"			$855,000	
Contractor Overhead and Profit	15%	of "B"			$855,000	
Sales Tax	5.50%	of "B"			$313,500	
Bonds and Insurance	2.5%	of "B"			$142,500	
Subtotal C Construction Costs					**$8,000,000**	
Engineering	10%	of total construction costs			$800,000	
Construction Management	10%	of total construction costs			$800,000	
Subtotal Project Costs					**$9,600,000**	
Estimating Contingency	30%	of subtotal Project Costs			$2,880,000	
Total Project Cost					**$12,500,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 2-C: MAD + Dewatering + Belt Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
2-C: MAD + Dewatering + Belt Dryer						
Digester						
Digesters	$3	/gal	400,000	unit	$1,200,000	
Control Building & Ancillary Equipment	$3	/gal	400,000	unit	$1,200,000	
Digested Sludge Storage	$3	/gal	400,000	unit	$1,200,000	
Waste Gas Burner						
Waste Gas Burner	$50,000	/unit	1	unit	$50,000	scaled off of the cost for a new flare (1500 scfm)
Gas flare concrete, assumes 18in thick slab	$800	/cy	0.22	cy	$178	Assumed 18 inch slab, costs from Dan Goddard, includes installation
Gas Conditioning	$3,583	/scfm	30	scfm	$107,503	assumes Hydrogen Sulfide removal and moisture
Dryer Equipment						
Huber Belt Dryer	$1,422,870	/package	1	package	$1,422,870	Vendor Quote, assumes dried product conveyance and silos are included
Installation of dryers	20%	percent			$284,574	
Dryer Building	$325	/sf	2500	sf	$812,500	
Subtotal A					**$6,280,000**	
Piping	15%	of "A"			$942,000	
Site Civil	10%	of "A"			$628,000	
Misc. Demolition	5%	of "A"			$314,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$1,640,250	
Shipping and Handling	2%	of Materials and Processing Equipment			$79,607	
Subtotal B					**$9,900,000**	
Startup and Construction Sequencing	2%	of "B"			$198,000	
General Conditions	15%	of "B"			$1,485,000	
Contractor Overhead and Profit	15%	of "B"			$1,485,000	
Sales Tax	5.50%	of "B"			$544,500	
Bonds and Insurance	2.5%	of "B"			$217,500	
Subtotal C Construction Costs					**$13,800,000**	
Engineering	10%	of total construction costs			$1,380,000	
Construction Management	10%	of total construction costs			$1,380,000	
Subtotal Project Costs					**$16,600,000**	
Estimating Contingency	30%	of subtotal Project Costs			$4,980,000	
Total Project Cost					**$21,600,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 3-A: Raw Sludge Belt Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
3-A: Raw Sludge Belt Dryer						
Sludge Storage	$3	/gallon	216,480	gallon	$649,440	assumes 4 hrs of storage for each tank
Dryer Equipment						
Huber BT8 Belt Dryer	$5,651,865	/package	1	package	$5,651,865	Vendor Quote, conveyance and pumps included
Installation of dryers	20%	percent			$1,130,373	
Dryer Building	$325	/sf	3000	sf	$975,000	
Subtotal A					**$8,410,000**	
Piping	15%	of "A"			$1,261,500	
Site Civil	10%	of "A"			$841,000	
Misc. Demolition	5%	of "A"			$420,500	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$2,230,500	
Shipping and Handling	2%	of Materials and Processing Equipment			$126,026	
Subtotal B					**$13,300,000**	
Startup and Construction Sequencing	2%	of "B"			$266,000	
General Conditions	15%	of "B"			$1,995,000	
Contractor Overhead and Profit	15%	of "B"			$1,995,000	
Sales Tax	5.50%	of "B"			$731,500	
Bonds and Insurance	2.5%	of "B"			$332,500	
Subtotal C Construction Costs					**$18,600,000**	
Engineering	10%	of total construction costs			$1,860,000	
Construction Management	10%	of total construction costs			$1,860,000	
Subtotal Project Costs					**$22,300,000**	
Estimating Contingency	30%	of subtotal Project Costs			$6,690,000	
Total Project Cost					**$29,000,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 3-B: Dewatering + MAD						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
3-B: Dewatering + MAD						
Digester						
Lipp Digesters	$2	/gal	1100000	unit	$1,650,000	
Control Building & Ancillary Equipment	$2	/gal	1100000	unit	$1,650,000	
Digested Sludge Storage	$2	/gal	1100000	unit	$1,650,000	
Waste Gas Burner						
Waste Gas Burner	$100,000	/unit	1	unit	$100,000	assumes to be the same cost of new flare
Gas flare concrete, assumes 18in thick slab	$800	/cy	0.22	cy	$178	Assumed 18 inch slab, costs from Dan Goddard, includes installation
Gas Conditioning	$3,583	/scfm	83	scfm	$295,634	assumes Hydrogen Sulfide removal and moisture
Subtotal A					**$5,350,000**	
Piping	15%	of "A"			$802,500	
Site Civil	10%	of "A"			$535,000	
Misc. Demolition	5%	of "A"			$267,500	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$1,110,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$73,913	
Subtotal B					**$8,100,000**	
Startup and Construction Sequencing	2%	of "B"			$162,000	
General Conditions	15%	of "B"			$1,215,000	
Contractor Overhead and Profit	15%	of "B"			$1,215,000	
Sales Tax	5.50%	of "B"			$445,500	
Bonds and Insurance	2.5%	of "B"			$202,500	
Subtotal C Construction Costs					**$11,300,000**	
Engineering	10%	of total construction costs			$1,130,000	
Construction Management	10%	of total construction costs			$1,130,000	
Subtotal Project Costs					**$13,600,000**	
Estimating Contingency	30%	of subtotal Project Costs			$4,080,000	
Total Project Cost					**$17,700,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 3-C: Dewatering + MAD + Belt Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
3-C: Dewatering + MAD + Belt Dryer						
Digester						
Digesters	$2	/gal	1100000	unit	$2,200,000	
Control Building & Ancillary Equipment	$2	/gal	1100000	unit	$2,200,000	
Digested Sludge Storage	$2	/gal	1100000	unit	$2,200,000	
Waste Gas Burner						
Waste Gas Burner	$100,000	/unit	1	unit	$100,000	assumes to be the same cost of new flare
Gas flare concrete, assumes 18in thick slab	$800	/cy	0.22	cy	$178	Assumed 18 inch slab, costs from Dan Goddard, includes installation
Gas Conditioning	$3,583	/scfm	83	scfm	$295,634	assumes Hydrogen Sulfide removal and moisture
Dryer Equipment						
Huber BT8 Belt Dryer	$3,485,290	/package	1	package	$3,485,290	Vendor Quote includes conveyance and pumps
Installation of dryers	20%	percent			$697,058	
Dryer Building	$325	/sf	3000	sf	$975,000	
Subtotal A					**$12,150,000**	
Piping	15%	of "A"			$1,822,500	
Site Civil	15%	of "A"			$1,822,500	
Misc. Demolition	5%	of "A"			$607,500	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$2,692,500	
Shipping and Handling	2%	of Materials and Processing Equipment			$165,618	
Subtotal B					**$19,300,000**	
Startup and Construction Sequencing	2%	of "B"			$386,000	
General Conditions	15%	of "B"			$2,895,000	
Contractor Overhead and Profit	15%	of "B"			$2,895,000	
Sales Tax	5.50%	of "B"			$1,061,500	
Bonds and Insurance	2.5%	of "B"			$482,500	
Subtotal C Construction Costs					**$27,000,000**	
Engineering	10%	of total construction costs			$2,700,000	
Construction Management	10%	of total construction costs			$2,700,000	
Subtotal Project Costs					**$32,400,000**	
Estimating Contingency	30%	of subtotal Project Costs			$9,720,000	
Total Project Cost					**$42,100,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 4-A: Dewatering + Belt Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
4-A: Dewatering + Belt Dryer						
Sludge Storage	$3	/gallon	5,520	gallon	$16,560	assumes 4 hrs of storage for each tank
Cake Receiving	$4,129,500	/package	1	package	$4,129,500	
Installation	20%	percent			$825,900	
Dryer Equipment						
Andritz Belt Dryers BDS40	$5,390,543	/package	1	package	$5,390,543	Vendor Quote, cake pump, silos, hoppers and conveyance included
Installation of dryers	20%	percent			$1,078,109	
Dryer Building	$325	/sf	4000	sf	$1,300,000	
Subtotal A					**$12,740,000**	
Piping	15%	of "A"			$1,911,000	
Site Civil	10%	of "A"			$1,274,000	
Misc. Demolition	5%	of "A"			$637,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$3,432,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$190,732	
Subtotal B					**$20,200,000**	
Startup and Construction Sequencing	2%	of "B"			$404,000	
General Conditions	15%	of "B"			$3,030,000	
Contractor Overhead and Profit	15%	of "B"			$3,030,000	
Sales Tax	5.50%	of "B"			$1,111,000	
Bonds and Insurance	2.5%	of "B"			$505,000	
Subtotal C Construction Costs					**$28,300,000**	
Engineering	10%	of total construction costs			$2,830,000	
Construction Management	10%	of total construction costs			$2,830,000	
Subtotal Project Costs					**$34,000,000**	
Estimating Contingency	30%	of subtotal Project Costs			$10,200,000	
Total Project Cost					**$44,200,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 4-B: Dewatering + Drum Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
4-B: Dewatering + Drum Dryer						
Sludge Storage	$3	/gallon	5,520	gallon	$16,560	assumes 4 hrs of storage for each tank
Cake Receiving	$4,129,500	/package	1	package	$4,129,500	
Installation	40%	percent			$1,651,800	
Dryer Equipment						
Andritz DDS80 Drum Dryers	$10,966,215	/package	1	package	$10,966,215	Vendor Quote, cake pump, silos, hoppers and conveyance included
Installation of dryers	20%	percent			$2,193,243	
Dryer Building	$325	/sf	4000	sf	$1,300,000	
Subtotal A					**$20,260,000**	
Piping	15%	of "A"			$3,039,000	
Site Civil	10%	of "A"			$2,026,000	
Misc. Demolition	5%	of "A"			$1,013,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$5,688,000	
Shipping and Handling	2%	of Materials and Processing Equipment			$302,246	
Subtotal B					**$32,300,000**	
Startup and Construction Sequencing	2%	of "B"			$646,000	
General Conditions	15%	of "B"			$4,845,000	
Contractor Overhead and Profit	15%	of "B"			$4,845,000	
Sales Tax	5.50%	of "B"			$1,776,500	
Bonds and Insurance	2.5%	of "B"			$807,500	
Subtotal C Construction Costs					**$45,200,000**	
Engineering	10%	of total construction costs			$4,520,000	
Construction Management	10%	of total construction costs			$4,520,000	
Subtotal Project Costs					**$54,200,000**	
Estimating Contingency	30%	of subtotal Project Costs			$16,260,000	
Total Project Cost					**$70,500,000**	

Note: Refer to title sheet for additional assumptions.

Class 5 Capital Cost Estimate for Biosolids Management Alternative 4-C: THP + MAD + Belt Dryer						
Item	**Unit Costs**		**Quantity**		**Class 5 Total**	**Notes**
4-C: THP + MAD + Belt Dryer						
Sludge Storage	$3	/gallon	5,520	gallon	$16,560	assumes 4 hrs of storage for each tank
Digester						
Digesters	$3	/gal	990000	unit	$2,970,000	
Control Building & Ancillary Equipment	$3	/gal	990000	unit	$2,970,000	
Digested Sludge Storage	$3	/gal	990000	unit	$2,970,000	
Waste Gas Burner						
Waste Gas Burner	$285,000	/unit	1	unit	$285,000	assumes to be the same cost of new flare
Gas flare concrete, assumes 18in thick slab	$800	/cy	0.50	cy	$400	Assumed 18 inch slab, costs from Dan Goddard, includes installation, 3x3 ft
Gas Conditioning	$3,583	/scfm	588	scfm	$2,107,068	assumes Hydrogen Sulfide removal and moisture
Cake Receiving	$4,129,500	/package	1	package	$4,129,500	
Installation	20%	percent			$825,900	
Cambi THP	$29,500,000	/package	1	package	$29,500,000	Vendor quote
Dewatering Units						
Dewatering Centrifuges	$864,000	/unit	4	unit	$3,456,000	assumes n+1
Installation of dewatering centrifuges	20%	percent			$691,200	
Polymer units	$420,895	/unit	4	unit	$1,683,580	assumes 1 system per centrifuge
Installation of polymer	20%	percent			$336,716	
Cake Conveyance	$1,080	/lf	100	lf	$108,000	assumes 100 lf for regional facilities
Dryer Equipment						
Andritz BDS 40 Belt Dryers	$3,057,730	/package	1	package	$3,057,730	Vendor Quote, cake pump, silos, hoppers and conveyance included
Installation of dryers	20%	percent			$611,546	
Dryer Building	$325	/sf	4300	sf	$1,397,500	
Subtotal A					**$57,120,000**	
Piping	15%	of "A"			$8,568,000	
Site Civil	10%	of "A"			$5,712,000	
Misc. Demolition	5%	of "A"			$2,856,000	
Electrical, Instrumentation & Controls	30%	of Subtotal A minus building construction			$15,825,750	
Shipping and Handling	2%	of Materials and Processing Equipment			$900,717	
Subtotal B					**$91,000,000**	
Startup and Construction Sequencing	2%	of "B"			$1,820,000	
General Conditions	15%	of "B"			$13,650,000	
Contractor Overhead and Profit	15%	of "B"			$13,650,000	
Sales Tax	5.50%	of "B"			$5,005,000	
Bonds and Insurance	2.5%	of "B"			$2,275,000	
Subtotal C Construction Costs					**$127,400,000**	
Engineering	10%	of total construction costs			$12,740,000	
Construction Management	10%	of total construction costs			$12,740,000	
Subtotal Project Costs					**$152,900,000**	
Estimating Contingency	30%	of subtotal Project Costs			$45,870,000	
Total Project Cost					**$198,800,000**	

Note: Refer to title sheet for additional assumptions.

Attachment D: Net Present Cost Calculations

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt1-A
Life Cycle Alternative Cost Analysis ($)

Alternative 1-A: Dewatering Only

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	2,900,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**2,900,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
23 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
24 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
25 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
26 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
27 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
28 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
29 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
30 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
34 Hauled solids	$121,927	$122,115	$122,303	$122,491	$122,679	$122,867	$123,056	$123,244	$123,432	$123,620	$123,808	$123,996	$124,184	$124,372	$124,560	$124,749	$124,937	$125,125	$125,313	$125,501
35 electrical demand	$7,099	$7,110	$7,121	$7,132	$7,143	$7,154	$7,165	$7,176	$7,187	$7,198	$7,209	$7,220	$7,231	$7,241	$7,252	$7,263	$7,274	$7,285	$7,296	$7,307
36 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
37 polymer use	$14,324	$14,346	$14,368	$14,390	$14,413	$14,435	$14,457	$14,479	$14,501	$14,523	$14,545	$14,567	$14,589	$14,611	$14,634	$14,656	$14,678	$14,700	$14,722	$14,744
38 Labor	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
39 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
40 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
41 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**143,350**	**143,571**	**143,792**	**144,014**	**144,235**	**144,456**	**144,677**	**144,898**	**145,119**	**145,341**	**145,562**	**145,783**	**146,004**	**146,225**	**146,446**	**146,667**	**146,889**	**147,110**	**147,331**	**147,552**
Annual Risk Costs (optional):																				
45 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
46 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
47 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
48 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
49 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
53 R&R 1	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306	$16,306
54 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
55 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
56 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
57 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
58 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
59 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
60 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**	**16,306**
Net Benefit/(cost)	**(3,059,656)**	**(159,877)**	**(160,098)**	**(160,319)**	**(160,541)**	**(160,762)**	**(160,983)**	**(161,204)**	**(161,425)**	**(161,646)**	**(161,868)**	**(162,089)**	**(162,310)**	**(162,531)**	**(162,752)**	**(162,973)**	**(163,195)**	**(163,416)**	**(163,637)**	**(163,858)**

Expressed in escalated dollars with sensitivity adjustments 195,877

Capital Outlays																				
Capital outlay 1	3,280,962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**3,280,962**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	137,944	143,959	150,237	156,787	163,623	170,757	178,201	185,969	194,076	202,535	211,363	220,575	230,188	240,219	250,687	261,610	273,009	284,903	297,316	310,268
electrical demand	8,032	8,382	8,747	9,129	9,527	9,942	10,376	10,828	11,300	11,792	12,306	12,843	13,402	13,987	14,596	15,232	15,896	16,588	17,311	18,065
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	16,206	16,913	17,650	18,420	19,223	20,061	20,935	21,848	22,800	23,794	24,831	25,913	27,043	28,221	29,451	30,734	32,073	33,471	34,929	36,451
Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**162,181**	**169,254**	**176,634**	**184,336**	**192,373**	**200,760**	**209,512**	**218,645**	**228,176**	**238,122**	**248,501**	**259,331**	**270,633**	**282,427**	**294,734**	**307,576**	**320,978**	**334,962**	**349,556**	**364,784**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	18,448	19,223	20,030	20,871	21,748	22,661	23,613	24,605	25,638	26,715	27,837	29,006	30,225	31,494	32,817	34,195	35,631	37,128	38,687	40,312
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**18,448**	**19,223**	**20,030**	**20,871**	**21,748**	**22,661**	**23,613**	**24,605**	**25,638**	**26,715**	**27,837**	**29,006**	**30,225**	**31,494**	**32,817**	**34,195**	**35,631**	**37,128**	**38,687**	**40,312**
Net escalated benefit/(cost)	**(3,461,591)**	**(188,477)**	**(196,664)**	**(205,207)**	**(214,121)**	**(223,421)**	**(233,125)**	**(243,250)**	**(253,815)**	**(264,837)**	**(276,338)**	**(288,337)**	**(300,858)**	**(313,921)**	**(327,551)**	**(341,771)**	**(356,609)**	**(372,090)**	**(388,243)**	**(405,096)**
Life cycle cost analysis																				
PVs in 2023	(3,242,822)	(172,764)	(176,389)	(180,089)	(183,867)	(187,723)	(191,660)	(195,679)	(199,782)	(203,971)	(208,247)	(212,612)	(217,069)	(221,618)	(226,263)	(231,004)	(235,844)	(240,786)	(245,830)	(250,979)
NPV as of 2023	**(7,224,998)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt1-B
Life Cycle Alternative Cost Analysis ($)

Alternative 1-B: Raw Sludge Belt Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	10,300,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**10,300,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
80 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
81 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
82 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
83 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
84 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
85 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
86 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
87 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
91 Hauled solids	$28,689	$28,733	$28,777	$28,821	$28,866	$28,910	$28,954	$28,998	$29,043	$29,087	$29,131	$29,176	$29,220	$29,264	$29,308	$29,353	$29,397	$29,441	$29,485	$29,530
92 electrical demand	$210,409	$210,420	$210,431	$210,442	$210,453	$210,464	$210,475	$210,486	$210,497	$210,508	$210,518	$210,529	$210,540	$210,551	$210,562	$210,573	$210,584	$210,595	$210,606	$210,617
93 NG demand (lhv)	$36,381	$36,437	$36,493	$36,549	$36,605	$36,661	$36,718	$36,774	$36,830	$36,886	$36,942	$36,998	$37,054	$37,110	$37,167	$37,223	$37,279	$37,335	$37,391	$37,447
94 polymer use	$14,324	$14,346	$14,368	$14,390	$14,413	$14,435	$14,457	$14,479	$14,501	$14,523	$14,545	$14,567	$14,589	$14,611	$14,634	$14,656	$14,678	$14,700	$14,722	$14,744
95 Labor	$76,325	$76,443	$76,561	$76,679	$76,796	$76,914	$77,032	$77,150	$77,267	$77,385	$77,503	$77,621	$77,738	$77,856	$77,974	$78,092	$78,209	$78,327	$78,445	$78,563
96 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
97 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
98 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**366,128**	**366,379**	**366,630**	**366,881**	**367,133**	**367,384**	**367,635**	**367,886**	**368,137**	**368,389**	**368,640**	**368,891**	**369,142**	**369,393**	**369,645**	**369,896**	**370,147**	**370,398**	**370,649**	**370,901**
Annual Risk Costs (optional):																				
102 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
103 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
104 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
105 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
106 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
110 R&R 1	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115	$42,115
111 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
112 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
113 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
114 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
115 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
116 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
117 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**	**42,115**
Net Benefit/(cost)	**(10,708,243)**	**(408,494)**	**(408,745)**	**(408,996)**	**(409,247)**	**(409,499)**	**(409,750)**	**(410,001)**	**(410,252)**	**(410,503)**	**(410,755)**	**(411,006)**	**(411,257)**	**(411,508)**	**(411,759)**	**(412,011)**	**(412,262)**	**(412,513)**	**(412,764)**	**(413,015)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	11,653,071	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**11,653,071**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	32,457	33,873	35,350	36,891	38,500	40,178	41,930	43,758	45,665	47,655	49,732	51,900	54,162	56,522	58,985	61,555	64,237	67,036	69,957	73,004
electrical demand	238,050	248,061	258,493	269,363	280,691	292,495	304,796	317,614	330,971	344,890	359,394	374,508	390,257	406,669	423,772	441,593	460,164	479,516	499,681	520,695
NG demand (lhv)	41,160	42,955	44,828	46,783	48,822	50,951	53,172	55,490	57,909	60,433	63,067	65,816	68,684	71,677	74,800	78,060	81,461	85,010	88,714	92,578

polymer use	16,206	16,913	17,650	18,420	19,223	20,061	20,935	21,848	22,800	23,794	24,831	25,913	27,043	28,221	29,451	30,734	32,073	33,471	34,929	36,451
Labor	86,352	90,117	94,047	98,148	102,427	106,893	111,553	116,415	121,490	126,786	132,312	138,078	144,096	150,375	156,928	163,766	170,901	178,347	186,117	194,225
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**414,225**	**431,918**	**450,367**	**469,604**	**489,663**	**510,578**	**532,386**	**555,125**	**578,835**	**603,558**	**629,336**	**656,215**	**684,242**	**713,465**	**743,936**	**775,708**	**808,837**	**843,380**	**879,398**	**916,954**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	47,647	49,648	51,734	53,906	56,170	58,530	60,988	63,549	66,218	69,000	71,898	74,917	78,064	81,343	84,759	88,319	92,028	95,893	99,921	104,118
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**47,647**	**49,648**	**51,734**	**53,906**	**56,170**	**58,530**	**60,988**	**63,549**	**66,218**	**69,000**	**71,898**	**74,917**	**78,064**	**81,343**	**84,759**	**88,319**	**92,028**	**95,893**	**99,921**	**104,118**
Net escalated benefit/(cost)	**(12,114,942)**	**(481,566)**	**(502,101)**	**(523,511)**	**(545,833)**	**(569,107)**	**(593,373)**	**(618,674)**	**(645,054)**	**(672,557)**	**(701,234)**	**(731,132)**	**(762,305)**	**(794,807)**	**(828,695)**	**(864,027)**	**(900,865)**	**(939,273)**	**(979,319)**	**(1,021,071)**
Life cycle cost analysis																				
PVs in 2023	(11,349,289)	(441,421)	(450,336)	(459,431)	(468,709)	(478,175)	(487,832)	(497,683)	(507,734)	(517,987)	(528,447)	(539,117)	(550,004)	(561,109)	(572,439)	(583,998)	(595,789)	(607,819)	(620,091)	(632,610)
NPV as of 2023	**(21,450,019)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt1-C
Life Cycle Alternative Cost Analysis ($)

Alternative 1-C: Raw Sludge Thin Film Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	10,300,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**10,300,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
137 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
138 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
139 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
140 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
141 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
142 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
143 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
144 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
148 Hauled solids	$28,689	$28,733	$28,777	$28,821	$28,866	$28,910	$28,954	$28,998	$29,043	$29,087	$29,131	$29,176	$29,220	$29,264	$29,308	$29,353	$29,397	$29,441	$29,485	$29,530
149 electrical demand	$210,409	$210,420	$210,431	$210,442	$210,453	$210,464	$210,475	$210,486	$210,497	$210,508	$210,518	$210,529	$210,540	$210,551	$210,562	$210,573	$210,584	$210,595	$210,606	$210,617
150 NG demand (lhv)	$36,381	$36,437	$36,493	$36,549	$36,605	$36,661	$36,718	$36,774	$36,830	$36,886	$36,942	$36,998	$37,054	$37,110	$37,167	$37,223	$37,279	$37,335	$37,391	$37,447
151 polymer use	$14,324	$14,346	$14,368	$14,390	$14,413	$14,435	$14,457	$14,479	$14,501	$14,523	$14,545	$14,567	$14,589	$14,611	$14,634	$14,656	$14,678	$14,700	$14,722	$14,744
152 Labor	$76,325	$76,443	$76,561	$76,679	$76,796	$76,914	$77,032	$77,150	$77,267	$77,385	$77,503	$77,621	$77,738	$77,856	$77,974	$78,092	$78,209	$78,327	$78,445	$78,563
153 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
154 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
155 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**366,128**	**366,379**	**366,630**	**366,881**	**367,133**	**367,384**	**367,635**	**367,886**	**368,137**	**368,389**	**368,640**	**368,891**	**369,142**	**369,393**	**369,645**	**369,896**	**370,147**	**370,398**	**370,649**	**370,901**
Annual Risk Costs (optional):																				
159 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
160 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
161 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
162 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
163 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
167 R&R 1	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030	$42,030
168 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
169 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
170 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
171 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
172 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
173 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
174 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**	**42,030**
Net Benefit/(cost)	**(10,708,158)**	**(408,409)**	**(408,660)**	**(408,912)**	**(409,163)**	**(409,414)**	**(409,665)**	**(409,916)**	**(410,168)**	**(410,419)**	**(410,670)**	**(410,921)**	**(411,172)**	**(411,424)**	**(411,675)**	**(411,926)**	**(412,177)**	**(412,428)**	**(412,680)**	**(412,931)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	11,653,071	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**11,653,071**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	32,457	33,873	35,350	36,891	38,500	40,178	41,930	43,758	45,665	47,655	49,732	51,900	54,162	56,522	58,985	61,555	64,237	67,036	69,957	73,004
electrical demand	238,050	248,061	258,493	269,363	280,691	292,495	304,796	317,614	330,971	344,890	359,394	374,508	390,257	406,669	423,772	441,593	460,164	479,516	499,681	520,695
NG demand (lhv)	41,160	42,955	44,828	46,783	48,822	50,951	53,172	55,490	57,909	60,433	63,067	65,816	68,684	71,677	74,800	78,060	81,461	85,010	88,714	92,578

polymer use	16,206	16,913	17,650	18,420	19,223	20,061	20,935	21,848	22,800	23,794	24,831	25,913	27,043	28,221	29,451	30,734	32,073	33,471	34,929	36,451
Labor	86,352	90,117	94,047	98,148	102,427	106,893	111,553	116,415	121,490	126,786	132,312	138,078	144,096	150,375	156,928	163,766	170,901	178,347	186,117	194,225
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**414,225**	**431,918**	**450,367**	**469,604**	**489,663**	**510,578**	**532,386**	**555,125**	**578,835**	**603,558**	**629,336**	**656,215**	**684,242**	**713,465**	**743,936**	**775,708**	**808,837**	**843,380**	**879,398**	**916,954**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	47,552	49,549	51,630	53,798	56,058	58,412	60,866	63,422	66,086	68,861	71,753	74,767	77,907	81,179	84,589	88,142	91,844	95,701	99,720	103,909
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**47,552**	**49,549**	**51,630**	**53,798**	**56,058**	**58,412**	**60,866**	**63,422**	**66,086**	**68,861**	**71,753**	**74,767**	**77,907**	**81,179**	**84,589**	**88,142**	**91,844**	**95,701**	**99,720**	**103,909**
Net escalated benefit/(cost)	**(12,114,847)**	**(481,467)**	**(501,997)**	**(523,402)**	**(545,720)**	**(568,990)**	**(593,251)**	**(618,547)**	**(644,921)**	**(672,419)**	**(701,089)**	**(730,982)**	**(762,149)**	**(794,644)**	**(828,525)**	**(863,850)**	**(900,680)**	**(939,081)**	**(979,118)**	**(1,020,862)**
Life cycle cost analysis																				
PVs in 2023	(11,349,200)	(441,329)	(450,243)	(459,336)	(468,613)	(478,076)	(487,731)	(497,581)	(507,629)	(517,880)	(528,338)	(539,007)	(549,891)	(560,994)	(572,322)	(583,878)	(595,667)	(607,694)	(619,964)	(632,481)
NPV as of 2023	**(21,447,853)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt2-A
Life Cycle Alternative Cost Analysis ($)

Alternative 2-A: Raw Sludge Thin Film Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	9,600,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**9,600,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
194 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
195 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
196 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
197 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
198 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
199 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
200 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
201 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
205 Hauled solids	$150,993	$151,226	$151,459	$151,692	$151,925	$152,158	$152,391	$152,624	$152,857	$153,090	$153,323	$153,556	$153,788	$154,021	$154,254	$154,487	$154,720	$154,953	$155,186	$155,419
206 electrical demand	$238,805	$238,860	$238,915	$238,970	$239,024	$239,079	$239,134	$239,189	$239,243	$239,298	$239,353	$239,408	$239,462	$239,517	$239,572	$239,627	$239,681	$239,736	$239,791	$239,846
207 NG demand (lhv)	$168,715	$168,975	$169,235	$169,496	$169,756	$170,016	$170,277	$170,537	$170,797	$171,057	$171,318	$171,578	$171,838	$172,099	$172,359	$172,619	$172,879	$173,140	$173,400	$173,660
208 polymer use	$75,390	$75,506	$75,623	$75,739	$75,855	$75,972	$76,088	$76,204	$76,321	$76,437	$76,553	$76,670	$76,786	$76,902	$77,018	$77,135	$77,251	$77,367	$77,484	$77,600
209 Labor	$76,325	$76,443	$76,561	$76,679	$76,796	$76,914	$77,032	$77,150	$77,267	$77,385	$77,503	$77,621	$77,738	$77,856	$77,974	$78,092	$78,209	$78,327	$78,445	$78,563
210 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
211 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
212 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**710,228**	**711,010**	**711,792**	**712,575**	**713,357**	**714,139**	**714,921**	**715,703**	**716,485**	**717,267**	**718,049**	**718,831**	**719,613**	**720,395**	**721,178**	**721,960**	**722,742**	**723,524**	**724,306**	**725,088**
Annual Risk Costs (optional):																				
216 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
217 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
218 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
219 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
220 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
224 R&R 1	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805	$36,805
225 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
226 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
227 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
228 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
229 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
230 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
231 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**	**36,805**
Net Benefit/(cost)	**(10,347,034)**	**(747,816)**	**(748,598)**	**(749,380)**	**(750,162)**	**(750,944)**	**(751,726)**	**(752,508)**	**(753,290)**	**(754,072)**	**(754,855)**	**(755,637)**	**(756,419)**	**(757,201)**	**(757,983)**	**(758,765)**	**(759,547)**	**(760,329)**	**(761,111)**	**(761,893)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	10,861,114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**10,861,114**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	170,828	178,278	186,052	194,164	202,630	211,464	220,683	230,303	240,342	250,818	261,750	273,158	285,062	297,485	310,448	323,975	338,091	352,821	368,193	384,233
electrical demand	270,176	281,588	293,482	305,878	318,798	332,264	346,298	360,926	376,171	392,059	408,619	425,879	443,867	462,616	482,156	502,521	523,747	545,869	568,925	592,955
NG demand (lhv)	190,878	199,202	207,888	216,953	226,412	236,283	246,584	257,333	268,550	280,256	292,471	305,218	318,519	332,400	346,885	362,000	377,772	394,231	411,407	429,329

polymer use	85,294	89,013	92,895	96,945	101,172	105,583	110,186	114,989	120,001	125,232	130,690	136,386	142,330	148,533	155,005	161,759	168,807	176,162	183,837	191,846
Labor	86,352	90,117	94,047	98,148	102,427	106,893	111,553	116,415	121,490	126,786	132,312	138,078	144,096	150,375	156,928	163,766	170,901	178,347	186,117	194,225
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**803,528**	**838,198**	**874,363**	**912,088**	**951,439**	**992,486**	**1,035,303**	**1,079,966**	**1,126,554**	**1,175,151**	**1,225,842**	**1,278,719**	**1,333,875**	**1,391,408**	**1,451,421**	**1,514,021**	**1,579,319**	**1,647,431**	**1,718,479**	**1,792,588**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	41,640	43,389	45,212	47,111	49,089	51,151	53,299	55,538	57,870	60,301	62,834	65,473	68,222	71,088	74,073	77,185	80,426	83,804	87,324	90,992
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**41,640**	**43,389**	**45,212**	**47,111**	**49,089**	**51,151**	**53,299**	**55,538**	**57,870**	**60,301**	**62,834**	**65,473**	**68,222**	**71,088**	**74,073**	**77,185**	**80,426**	**83,804**	**87,324**	**90,992**
Net escalated benefit/(cost)	**(11,706,283)**	**(881,588)**	**(919,575)**	**(959,198)**	**(1,000,528)**	**(1,043,637)**	**(1,088,602)**	**(1,135,504)**	**(1,184,424)**	**(1,235,452)**	**(1,288,676)**	**(1,344,191)**	**(1,402,097)**	**(1,462,496)**	**(1,525,494)**	**(1,591,205)**	**(1,659,745)**	**(1,731,235)**	**(1,805,803)**	**(1,883,580)**
Life cycle cost analysis																				
PVs in 2023	(10,966,457)	(808,094)	(824,770)	(841,789)	(859,158)	(876,884)	(894,975)	(913,439)	(932,282)	(951,514)	(971,140)	(991,171)	(1,011,614)	(1,032,477)	(1,053,769)	(1,075,499)	(1,097,676)	(1,120,310)	(1,143,409)	(1,166,982)
NPV as of 2023	**(29,533,408)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt2-B
Life Cycle Alternative Cost Analysis ($)

Alternative 2-B: MAD + Dewatering

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	12,500,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**12,500,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
251 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
252 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
253 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
254 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
255 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
256 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
257 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
258 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
262 Hauled solids	$387,423	$388,020	$388,618	$389,216	$389,813	$390,411	$391,009	$391,607	$392,204	$392,802	$393,400	$393,998	$394,595	$395,193	$395,791	$396,388	$396,986	$397,584	$398,182	$398,779
263 electrical demand	$233,908	$234,175	$234,441	$234,708	$234,975	$235,242	$235,508	$235,775	$236,042	$236,309	$236,576	$236,842	$237,109	$237,376	$237,643	$237,909	$238,176	$238,443	$238,710	$238,977
264 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
265 polymer use	$45,515	$45,585	$45,655	$45,726	$45,796	$45,866	$45,936	$46,006	$46,077	$46,147	$46,217	$46,287	$46,358	$46,428	$46,498	$46,568	$46,638	$46,709	$46,779	$46,849
266 Labor	$152,651	$152,886	$153,122	$153,357	$153,593	$153,828	$154,064	$154,299	$154,535	$154,770	$155,006	$155,241	$155,477	$155,712	$155,948	$156,183	$156,419	$156,654	$156,890	$157,125
267 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
268 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
269 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**819,496**	**820,666**	**821,836**	**823,006**	**824,177**	**825,347**	**826,517**	**827,687**	**828,858**	**830,028**	**831,198**	**832,368**	**833,539**	**834,709**	**835,879**	**837,049**	**838,220**	**839,390**	**840,560**	**841,730**
Annual Risk Costs (optional):																				
273 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
274 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
275 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
276 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
277 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
281 R&R 1	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150
282 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
283 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
284 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
285 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
286 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
287 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
288 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**
Net Benefit/(cost)	**(13,394,646)**	**(895,816)**	**(896,986)**	**(898,157)**	**(899,327)**	**(900,497)**	**(901,667)**	**(902,837)**	**(904,008)**	**(905,178)**	**(906,348)**	**(907,518)**	**(908,689)**	**(909,859)**	**(911,029)**	**(912,199)**	**(913,370)**	**(914,540)**	**(915,710)**	**(916,880)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	14,142,076	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**14,142,076**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	438,317	457,431	477,377	498,192	519,913	542,580	566,234	590,918	616,676	643,556	671,606	700,877	731,421	763,295	796,557	831,266	867,485	905,280	944,720	985,876
electrical demand	264,635	276,065	287,987	300,424	313,398	326,931	341,048	355,775	371,137	387,162	403,878	421,316	439,505	458,480	478,273	498,920	520,457	542,924	566,360	590,806
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	51,494	53,740	56,083	58,528	61,080	63,743	66,522	69,422	72,448	75,606	78,901	82,340	85,928	89,673	93,580	97,658	101,913	106,353	110,987	115,822
Labor	172,704	180,235	188,094	196,295	204,854	213,785	223,105	232,831	242,980	253,571	264,623	276,156	288,191	300,750	313,856	327,532	341,803	356,695	372,235	388,451
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**927,150**	**967,470**	**1,009,541**	**1,053,439**	**1,099,245**	**1,147,039**	**1,196,910**	**1,248,946**	**1,303,241**	**1,359,895**	**1,419,008**	**1,480,688**	**1,545,046**	**1,612,199**	**1,682,266**	**1,755,375**	**1,831,658**	**1,911,252**	**1,994,302**	**2,080,955**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	85,022	88,593	92,314	96,191	100,231	104,441	108,828	113,398	118,161	123,124	128,295	133,683	139,298	145,149	151,245	157,597	164,216	171,113	178,300	185,789
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**85,022**	**88,593**	**92,314**	**96,191**	**100,231**	**104,441**	**108,828**	**113,398**	**118,161**	**123,124**	**128,295**	**133,683**	**139,298**	**145,149**	**151,245**	**157,597**	**164,216**	**171,113**	**178,300**	**185,789**
Net escalated benefit/(cost)	**(15,154,248)**	**(1,056,063)**	**(1,101,855)**	**(1,149,631)**	**(1,199,476)**	**(1,251,480)**	**(1,305,737)**	**(1,362,344)**	**(1,421,402)**	**(1,483,019)**	**(1,547,303)**	**(1,614,372)**	**(1,684,344)**	**(1,757,347)**	**(1,833,511)**	**(1,912,972)**	**(1,995,874)**	**(2,082,366)**	**(2,172,602)**	**(2,266,744)**
Life cycle cost analysis																				
PVs in 2023	(14,196,514)	(968,024)	(988,257)	(1,008,911)	(1,029,995)	(1,051,518)	(1,073,489)	(1,095,917)	(1,118,812)	(1,142,183)	(1,166,041)	(1,190,395)	(1,215,255)	(1,240,633)	(1,266,538)	(1,292,982)	(1,319,977)	(1,347,532)	(1,375,661)	(1,404,374)
NPV as of 2023	**(36,493,009)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt2-C
Life Cycle Alternative Cost Analysis ($)

Alternative 2-C: MAD + Belt Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	21,600,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**21,600,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
251 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
252 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
253 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
254 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
255 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
256 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
257 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
258 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
262 Hauled solids	$387,423	$388,020	$388,618	$389,216	$389,813	$390,411	$391,009	$391,607	$392,204	$392,802	$393,400	$393,998	$394,595	$395,193	$395,791	$396,388	$396,986	$397,584	$398,182	$398,779
263 electrical demand	$233,908	$234,175	$234,441	$234,708	$234,975	$235,242	$235,508	$235,775	$236,042	$236,309	$236,576	$236,842	$237,109	$237,376	$237,643	$237,909	$238,176	$238,443	$238,710	$238,977
264 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
265 polymer use	$45,515	$45,585	$45,655	$45,726	$45,796	$45,866	$45,936	$46,006	$46,077	$46,147	$46,217	$46,287	$46,358	$46,428	$46,498	$46,568	$46,638	$46,709	$46,779	$46,849
266 Labor	$152,651	$152,886	$153,122	$153,357	$153,593	$153,828	$154,064	$154,299	$154,535	$154,770	$155,006	$155,241	$155,477	$155,712	$155,948	$156,183	$156,419	$156,654	$156,890	$157,125
267 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
268 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
269 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**819,496**	**820,666**	**821,836**	**823,006**	**824,177**	**825,347**	**826,517**	**827,687**	**828,858**	**830,028**	**831,198**	**832,368**	**833,539**	**834,709**	**835,879**	**837,049**	**838,220**	**839,390**	**840,560**	**841,730**
Annual Risk Costs (optional):																				
273 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
274 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
275 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
276 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
277 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
281 R&R 1	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150	$75,150
282 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
283 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
284 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
285 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
286 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
287 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
288 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**	**75,150**
Net Benefit/(cost)	**(22,494,646)**	**(895,816)**	**(896,986)**	**(898,157)**	**(899,327)**	**(900,497)**	**(901,667)**	**(902,837)**	**(904,008)**	**(905,178)**	**(906,348)**	**(907,518)**	**(908,689)**	**(909,859)**	**(911,029)**	**(912,199)**	**(913,370)**	**(914,540)**	**(915,710)**	**(916,880)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	24,437,508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**24,437,508**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	438,317	457,431	477,377	498,192	519,913	542,580	566,234	590,918	616,676	643,556	671,606	700,877	731,421	763,295	796,557	831,266	867,485	905,280	944,720	985,876
electrical demand	264,635	276,065	287,987	300,424	313,398	326,931	341,048	355,775	371,137	387,162	403,878	421,316	439,505	458,480	478,273	498,920	520,457	542,924	566,360	590,806
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	51,494	53,740	56,083	58,528	61,080	63,743	66,522	69,422	72,448	75,606	78,901	82,340	85,928	89,673	93,580	97,658	101,913	106,353	110,987	115,822
Labor	172,704	180,235	188,094	196,295	204,854	213,785	223,105	232,831	242,980	253,571	264,623	276,156	288,191	300,750	313,856	327,532	341,803	356,695	372,235	388,451
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**927,150**	**967,470**	**1,009,541**	**1,053,439**	**1,099,245**	**1,147,039**	**1,196,910**	**1,248,946**	**1,303,241**	**1,359,895**	**1,419,008**	**1,480,688**	**1,545,046**	**1,612,199**	**1,682,266**	**1,755,375**	**1,831,658**	**1,911,252**	**1,994,302**	**2,080,955**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	85,022	88,593	92,314	96,191	100,231	104,441	108,828	113,398	118,161	123,124	128,295	133,683	139,298	145,149	151,245	157,597	164,216	171,113	178,300	185,789
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**85,022**	**88,593**	**92,314**	**96,191**	**100,231**	**104,441**	**108,828**	**113,398**	**118,161**	**123,124**	**128,295**	**133,683**	**139,298**	**145,149**	**151,245**	**157,597**	**164,216**	**171,113**	**178,300**	**185,789**
Net escalated benefit/(cost)	**(25,449,679)**	**(1,056,063)**	**(1,101,855)**	**(1,149,631)**	**(1,199,476)**	**(1,251,480)**	**(1,305,737)**	**(1,362,344)**	**(1,421,402)**	**(1,483,019)**	**(1,547,303)**	**(1,614,372)**	**(1,684,344)**	**(1,757,347)**	**(1,833,511)**	**(1,912,972)**	**(1,995,874)**	**(2,082,366)**	**(2,172,602)**	**(2,266,744)**
Life cycle cost analysis																				
PVs in 2023	(23,841,283)	(968,024)	(988,257)	(1,008,911)	(1,029,995)	(1,051,518)	(1,073,489)	(1,095,917)	(1,118,812)	(1,142,183)	(1,166,041)	(1,190,395)	(1,215,255)	(1,240,633)	(1,266,538)	(1,292,982)	(1,319,977)	(1,347,532)	(1,375,661)	(1,404,374)
NPV as of 2023	**(46,137,779)**																			

Year of analysis	2023
Start of NPV	2026
Escalation rate	4.20%
Discount rate	2.20%

Risk adjustments (+/- percent):

Benefits	0%
Capital costs	0%
Running costs	0%

Alt2-D
Life Cycle Alternative Cost Analysis ($)

Alternative 2-D: Baseline

Expressed in 2023 dollars, unescalated -- dollars

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Capital Outlays																				
Capital outlay 1																				
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																				
365 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
366 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
367 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
368 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
369 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
370 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
371 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
372 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Running Costs:																				
376 Hauled solids	$609,634	$610,575	$611,515	$612,456	$613,396	$614,337	$615,278	$616,218	$617,159	$618,099	$619,040	$619,980	$620,921	$621,861	$622,802	$623,743	$624,683	$625,624	$626,564	$627,505
377 electrical demand	$35,495	$35,550	$35,605	$35,660	$35,714	$35,769	$35,824	$35,879	$35,934	$35,988	$36,043	$36,098	$36,153	$36,207	$36,262	$36,317	$36,372	$36,426	$36,481	$36,536
378 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
379 polymer use	$71,621	$71,731	$71,842	$71,952	$72,063	$72,173	$72,284	$72,394	$72,505	$72,615	$72,726	$72,836	$72,947	$73,057	$73,168	$73,278	$73,389	$73,499	$73,610	$73,720
380 Labor	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
381 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
382 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
383 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	716,750	717,856	718,962	720,068	721,173	722,279	723,385	724,491	725,597	726,703	727,808	728,914	730,020	731,126	732,232	733,337	734,443	735,549	736,655	737,761
Annual Risk Costs (optional):																				
387 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
388 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
389 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
390 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
391 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R Costs:																				
395 R&R 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
396 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
397 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
398 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
399 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
400 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
401 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
402 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Benefit/(cost)	(716,750)	(717,856)	(718,962)	(720,068)	(721,173)	(722,279)	(723,385)	(724,491)	(725,597)	(726,703)	(727,808)	(728,914)	(730,020)	(731,126)	(732,232)	(733,337)	(734,443)	(735,549)	(736,655)	(737,761)

Expressed in escalated dollars with sensitivity adjustments

Capital Outlays																				
Capital outlay 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Running Costs:																				
Hauled solids	689,719	719,796	751,183	783,937	818,117	853,785	891,006	929,847	970,380	1,012,677	1,056,815	1,102,874	1,150,938	1,201,094	1,253,433	1,308,050	1,365,043	1,424,517	1,486,578	1,551,340
electrical demand	40,158	41,909	43,737	45,644	47,634	49,711	51,878	54,140	56,499	58,962	61,532	64,214	67,012	69,933	72,980	76,160	79,478	82,941	86,555	90,325
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	81,029	84,563	88,250	92,098	96,113	100,304	104,676	109,240	114,001	118,970	124,156	129,567	135,214	141,106	147,255	153,671	160,367	167,354	174,645	182,253
Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**810,907**	**846,269**	**883,170**	**921,679**	**961,864**	**1,003,799**	**1,047,560**	**1,093,226**	**1,140,881**	**1,190,609**	**1,242,503**	**1,296,655**	**1,353,164**	**1,412,133**	**1,473,668**	**1,537,881**	**1,604,889**	**1,674,812**	**1,747,778**	**1,823,918**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Net escalated benefit/(cost)	**(810,907)**	**(846,269)**	**(883,170)**	**(921,679)**	**(961,864)**	**(1,003,799)**	**(1,047,560)**	**(1,093,226)**	**(1,140,881)**	**(1,190,609)**	**(1,242,503)**	**(1,296,655)**	**(1,353,164)**	**(1,412,133)**	**(1,473,668)**	**(1,537,881)**	**(1,604,889)**	**(1,674,812)**	**(1,747,778)**	**(1,823,918)**
Life cycle cost analysis																				
PVs in 2023	(759,658)	(775,719)	(792,118)	(808,862)	(825,957)	(843,412)	(861,234)	(879,430)	(898,008)	(916,977)	(936,345)	(956,119)	(976,309)	(996,922)	(1,017,969)	(1,039,457)	(1,061,397)	(1,083,797)	(1,106,668)	(1,130,019)
NPV as of 2023	**(18,666,377)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt3-A
Life Cycle Alternative Cost Analysis ($)

Alternative 3-A: Raw Sludge Belt Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	29,000,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**29,000,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
422 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
423 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
424 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
425 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
426 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
427 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
428 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
429 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
433 Hauled solids	$422,780	$423,433	$424,085	$424,737	$425,389	$426,042	$426,694	$427,346	$427,999	$428,651	$429,303	$429,955	$430,608	$431,260	$431,912	$432,565	$433,217	$433,869	$434,521	$435,174
434 electrical demand	$302,697	$302,850	$303,004	$303,157	$303,310	$303,464	$303,617	$303,770	$303,924	$304,077	$304,230	$304,384	$304,537	$304,690	$304,844	$304,997	$305,150	$305,304	$305,457	$305,610
435 NG demand (lhv)	$472,401	$473,130	$473,859	$474,588	$475,317	$476,045	$476,774	$477,503	$478,232	$478,961	$479,690	$480,418	$481,147	$481,876	$482,605	$483,334	$484,063	$484,791	$485,520	$486,249
436 polymer use	$211,092	$211,418	$211,744	$212,069	$212,395	$212,721	$213,046	$213,372	$213,698	$214,023	$214,349	$214,675	$215,000	$215,326	$215,652	$215,977	$216,303	$216,629	$216,954	$217,280
437 Labor	$152,651	$152,886	$153,122	$153,357	$153,593	$153,828	$154,064	$154,299	$154,535	$154,770	$155,006	$155,241	$155,477	$155,712	$155,948	$156,183	$156,419	$156,654	$156,890	$157,125
438 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
439 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
440 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**1,561,621**	**1,563,717**	**1,565,813**	**1,567,908**	**1,570,004**	**1,572,099**	**1,574,195**	**1,576,291**	**1,578,386**	**1,580,482**	**1,582,578**	**1,584,673**	**1,586,769**	**1,588,865**	**1,590,960**	**1,593,056**	**1,595,152**	**1,597,247**	**1,599,343**	**1,601,438**
Annual Risk Costs (optional):																				
444 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
445 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
446 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
447 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
448 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
452 R&R 1	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026	$126,026
453 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
454 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
455 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
456 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
457 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
458 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
459 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**	**126,026**
Net Benefit/(cost)	**(30,687,647)**	**(1,689,743)**	**(1,691,839)**	**(1,693,934)**	**(1,696,030)**	**(1,698,126)**	**(1,700,221)**	**(1,702,317)**	**(1,704,412)**	**(1,706,508)**	**(1,708,604)**	**(1,710,699)**	**(1,712,795)**	**(1,714,891)**	**(1,716,986)**	**(1,719,082)**	**(1,721,178)**	**(1,723,273)**	**(1,725,369)**	**(1,727,465)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	32,809,617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**32,809,617**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	478,319	499,178	520,944	543,659	567,363	592,098	617,911	644,848	672,957	702,290	732,899	764,842	798,174	832,957	869,254	907,131	946,655	987,900	1,030,940	1,075,852
electrical demand	342,461	357,025	372,209	388,038	404,540	421,744	439,679	458,377	477,870	498,191	519,377	541,464	564,490	588,494	613,520	639,609	666,808	695,163	724,723	755,541
NG demand (lhv)	534,459	557,765	582,087	607,467	633,953	661,592	690,434	720,532	751,940	784,716	818,918	854,609	891,854	930,720	971,277	1,013,599	1,057,762	1,103,848	1,151,939	1,202,122

polymer use	238,823	249,237	260,105	271,446	283,281	295,632	308,520	321,969	336,004	350,650	365,933	381,882	398,524	415,891	434,014	452,926	472,660	493,254	514,743	537,167
Labor	172,704	180,235	188,094	196,295	204,854	213,785	223,105	232,831	242,980	253,571	264,623	276,156	288,191	300,750	313,856	327,532	341,803	356,695	372,235	388,451
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**1,766,765**	**1,843,440**	**1,923,439**	**2,006,906**	**2,093,991**	**2,184,851**	**2,279,649**	**2,378,557**	**2,481,751**	**2,589,418**	**2,701,751**	**2,818,953**	**2,941,233**	**3,068,813**	**3,201,921**	**3,340,796**	**3,485,689**	**3,636,859**	**3,794,579**	**3,959,133**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	142,582	148,570	154,810	161,312	168,087	175,147	182,503	190,168	198,155	206,478	215,150	224,186	233,602	243,413	253,636	264,289	275,389	286,956	299,008	311,566
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**142,582**	**148,570**	**154,810**	**161,312**	**168,087**	**175,147**	**182,503**	**190,168**	**198,155**	**206,478**	**215,150**	**224,186**	**233,602**	**243,413**	**253,636**	**264,289**	**275,389**	**286,956**	**299,008**	**311,566**
Net escalated benefit/(cost)	**(34,718,964)**	**(1,992,010)**	**(2,078,249)**	**(2,168,218)**	**(2,262,078)**	**(2,359,998)**	**(2,462,152)**	**(2,568,725)**	**(2,679,906)**	**(2,795,896)**	**(2,916,901)**	**(3,043,139)**	**(3,174,835)**	**(3,312,226)**	**(3,455,557)**	**(3,605,085)**	**(3,761,078)**	**(3,923,815)**	**(4,093,587)**	**(4,270,699)**
Life cycle cost analysis																				
PVs in 2023	(32,524,757)	(1,825,946)	(1,863,988)	(1,902,819)	(1,942,456)	(1,982,916)	(2,024,216)	(2,066,373)	(2,109,404)	(2,153,328)	(2,198,164)	(2,243,930)	(2,290,645)	(2,338,329)	(2,387,002)	(2,436,685)	(2,487,398)	(2,539,163)	(2,592,001)	(2,645,935)
NPV as of 2023	**(74,555,457)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt3-B
Life Cycle Alternative Cost Analysis ($)

Alternative 3-B: MAD + Dewatering

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	17,700,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**17,700,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
479 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
480 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
481 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
482 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
483 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
484 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
485 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
486 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
490 Hauled solids	$1,084,783	$1,086,457	$1,088,130	$1,089,804	$1,091,478	$1,093,151	$1,094,825	$1,096,498	$1,098,172	$1,099,846	$1,101,519	$1,103,193	$1,104,867	$1,106,540	$1,108,214	$1,109,888	$1,111,561	$1,113,235	$1,114,908	$1,116,582
491 electrical demand	$296,984	$297,349	$297,713	$298,077	$298,441	$298,805	$299,169	$299,533	$299,897	$300,261	$300,625	$300,989	$301,354	$301,718	$302,082	$302,446	$302,810	$303,174	$303,538	$303,902
492 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
493 polymer use	$127,442	$127,638	$127,835	$128,031	$128,228	$128,425	$128,621	$128,818	$129,015	$129,211	$129,408	$129,604	$129,801	$129,998	$130,194	$130,391	$130,588	$130,784	$130,981	$131,177
494 Labor	$152,651	$152,886	$153,122	$153,357	$153,593	$153,828	$154,064	$154,299	$154,535	$154,770	$155,006	$155,241	$155,477	$155,712	$155,948	$156,183	$156,419	$156,654	$156,890	$157,125
495 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
496 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
497 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**1,661,860**	**1,664,330**	**1,666,799**	**1,669,269**	**1,671,739**	**1,674,209**	**1,676,679**	**1,679,149**	**1,681,619**	**1,684,088**	**1,686,558**	**1,689,028**	**1,691,498**	**1,693,968**	**1,696,438**	**1,698,908**	**1,701,377**	**1,703,847**	**1,706,317**	**1,708,787**
Annual Risk Costs (optional):																				
501 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
502 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
503 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
504 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
505 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
509 R&R 1	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913	$106,913
510 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
511 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
512 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
513 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
514 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
515 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
516 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**	**106,913**
Net Benefit/(cost)	**(19,468,772)**	**(1,771,242)**	**(1,773,712)**	**(1,776,182)**	**(1,778,652)**	**(1,781,122)**	**(1,783,592)**	**(1,786,061)**	**(1,788,531)**	**(1,791,001)**	**(1,793,471)**	**(1,795,941)**	**(1,798,411)**	**(1,800,881)**	**(1,803,350)**	**(1,805,820)**	**(1,808,290)**	**(1,810,760)**	**(1,813,230)**	**(1,815,700)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	20,025,180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**20,025,180**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	1,227,287	1,280,806	1,336,656	1,394,937	1,455,757	1,519,225	1,585,456	1,654,570	1,726,694	1,801,957	1,880,496	1,962,454	2,047,980	2,137,227	2,230,359	2,327,544	2,428,958	2,534,785	2,645,217	2,760,454
electrical demand	335,998	350,539	365,709	381,535	398,045	415,269	433,238	451,983	471,539	491,940	513,223	535,426	558,589	582,753	607,961	634,259	661,693	690,314	720,171	751,318
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	144,183	150,471	157,032	163,879	171,024	178,480	186,261	194,381	202,854	211,696	220,923	230,551	240,599	251,084	262,025	273,443	285,357	297,790	310,763	324,301
Labor	172,704	180,235	188,094	196,295	204,854	213,785	223,105	232,831	242,980	253,571	264,623	276,156	288,191	300,750	313,856	327,532	341,803	356,695	372,235	388,451
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**1,880,172**	**1,962,051**	**2,047,491**	**2,136,647**	**2,229,680**	**2,326,759**	**2,428,060**	**2,533,765**	**2,644,067**	**2,759,164**	**2,879,265**	**3,004,588**	**3,135,359**	**3,271,814**	**3,414,201**	**3,562,777**	**3,717,811**	**3,879,583**	**4,048,385**	**4,224,524**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	120,957	126,038	131,331	136,847	142,595	148,584	154,824	161,327	168,102	175,163	182,520	190,185	198,173	206,497	215,169	224,206	233,623	243,435	253,660	264,313
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**120,957**	**126,038**	**131,331**	**136,847**	**142,595**	**148,584**	**154,824**	**161,327**	**168,102**	**175,163**	**182,520**	**190,185**	**198,173**	**206,497**	**215,169**	**224,206**	**233,623**	**243,435**	**253,660**	**264,313**
Net escalated benefit/(cost)	**(22,026,309)**	**(2,088,088)**	**(2,178,822)**	**(2,273,494)**	**(2,372,275)**	**(2,475,343)**	**(2,582,884)**	**(2,695,092)**	**(2,812,169)**	**(2,934,327)**	**(3,061,785)**	**(3,194,774)**	**(3,333,532)**	**(3,478,311)**	**(3,629,371)**	**(3,786,984)**	**(3,951,434)**	**(4,123,018)**	**(4,302,045)**	**(4,488,837)**
Life cycle cost analysis																				
PVs in 2023	(20,634,267)	(1,914,015)	(1,954,192)	(1,995,209)	(2,037,083)	(2,079,832)	(2,123,473)	(2,168,027)	(2,213,510)	(2,259,944)	(2,307,348)	(2,355,741)	(2,405,145)	(2,455,580)	(2,507,068)	(2,559,631)	(2,613,291)	(2,668,071)	(2,723,994)	(2,781,084)
NPV as of 2023	**(64,756,503)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt3-C
Life Cycle Alternative Cost Analysis ($)

Alternative 3-C: MAD + Belt Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	42,100,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**42,100,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
593 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
594 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
595 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
596 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
597 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
598 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
599 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
600 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
604 Hauled solids	$255,243	$255,637	$256,031	$256,424	$256,818	$257,212	$257,606	$258,000	$258,393	$258,787	$259,181	$259,575	$259,969	$260,362	$260,756	$261,150	$261,544	$261,938	$262,331	$262,725
605 electrical demand	$500,294	$500,658	$501,023	$501,387	$501,751	$502,115	$502,479	$502,843	$503,207	$503,571	$503,935	$504,299	$504,663	$505,028	$505,392	$505,756	$506,120	$506,484	$506,848	$507,212
606 NG demand (lhv)	$207,077	$207,396	$207,715	$208,035	$208,354	$208,674	$208,993	$209,313	$209,632	$209,952	$210,271	$210,591	$210,910	$211,230	$211,549	$211,869	$212,188	$212,508	$212,827	$213,147
607 polymer use	$127,442	$127,638	$127,835	$128,031	$128,228	$128,425	$128,621	$128,818	$129,015	$129,211	$129,408	$129,604	$129,801	$129,998	$130,194	$130,391	$130,588	$130,784	$130,981	$131,177
608 Labor	$305,301	$305,772	$306,243	$306,714	$307,185	$307,656	$308,127	$308,598	$309,069	$309,540	$310,011	$310,482	$310,953	$311,424	$311,895	$312,366	$312,838	$313,309	$313,780	$314,251
609 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
610 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
611 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**1,395,357**	**1,397,102**	**1,398,847**	**1,400,592**	**1,402,337**	**1,404,082**	**1,405,827**	**1,407,572**	**1,409,317**	**1,411,062**	**1,412,807**	**1,414,552**	**1,416,297**	**1,418,042**	**1,419,787**	**1,421,532**	**1,423,277**	**1,425,022**	**1,426,767**	**1,428,512**
Annual Risk Costs (optional):																				
615 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
616 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
617 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
618 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
619 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
623 R&R 1	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618	$209,618
624 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
625 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
626 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
627 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
628 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
629 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
630 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**	**209,618**
Net Benefit/(cost)	**(43,704,975)**	**(1,606,720)**	**(1,608,465)**	**(1,610,210)**	**(1,611,955)**	**(1,613,700)**	**(1,615,445)**	**(1,617,190)**	**(1,618,935)**	**(1,620,680)**	**(1,622,425)**	**(1,624,170)**	**(1,625,915)**	**(1,627,660)**	**(1,629,405)**	**(1,631,150)**	**(1,632,895)**	**(1,634,640)**	**(1,636,385)**	**(1,638,130)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	47,630,512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**47,630,512**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	288,773	301,366	314,507	328,221	342,531	357,465	373,048	389,311	406,281	423,990	442,470	461,754	481,878	502,877	524,790	547,657	571,520	596,420	622,404	649,519
electrical demand	566,016	590,218	615,454	641,769	669,209	697,822	727,658	758,769	791,210	825,037	860,310	897,091	935,444	975,436	1,017,137	1,060,620	1,105,961	1,153,241	1,202,541	1,253,948
NG demand (lhv)	234,279	244,496	255,157	266,283	277,892	290,008	302,651	315,844	329,612	343,979	358,972	374,617	390,943	407,980	425,758	444,310	463,669	483,870	504,951	526,949

polymer use	144,183	150,471	157,032	163,879	171,024	178,480	186,261	194,381	202,854	211,696	220,923	230,551	240,599	251,084	262,025	273,443	285,357	297,790	310,763	324,301
Labor	345,407	360,470	376,188	392,591	409,708	427,570	446,210	465,662	485,960	507,142	529,246	552,313	576,383	601,501	627,712	655,063	683,605	713,389	744,469	776,901
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**1,578,659**	**1,647,020**	**1,718,338**	**1,792,742**	**1,870,365**	**1,951,345**	**2,035,829**	**2,123,967**	**2,215,917**	**2,311,845**	**2,411,921**	**2,516,326**	**2,625,246**	**2,738,877**	**2,857,422**	**2,981,093**	**3,110,112**	**3,244,710**	**3,385,128**	**3,531,618**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	237,155	247,116	257,495	268,309	279,578	291,321	303,556	316,306	329,590	343,433	357,857	372,887	388,549	404,868	421,872	439,591	458,054	477,292	497,338	518,226
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**237,155**	**247,116**	**257,495**	**268,309**	**279,578**	**291,321**	**303,556**	**316,306**	**329,590**	**343,433**	**357,857**	**372,887**	**388,549**	**404,868**	**421,872**	**439,591**	**458,054**	**477,292**	**497,338**	**518,226**
Net escalated benefit/(cost)	**(49,446,327)**	**(1,894,136)**	**(1,975,833)**	**(2,061,052)**	**(2,149,943)**	**(2,242,666)**	**(2,339,385)**	**(2,440,272)**	**(2,545,508)**	**(2,655,278)**	**(2,769,779)**	**(2,889,213)**	**(3,013,795)**	**(3,143,745)**	**(3,279,294)**	**(3,420,684)**	**(3,568,166)**	**(3,722,002)**	**(3,882,466)**	**(4,049,844)**
Life cycle cost analysis																				
PVs in 2023	(46,321,365)	(1,736,231)	(1,772,131)	(1,808,771)	(1,846,166)	(1,884,332)	(1,923,285)	(1,963,041)	(2,003,616)	(2,045,028)	(2,087,293)	(2,130,429)	(2,174,454)	(2,219,387)	(2,265,245)	(2,312,048)	(2,359,815)	(2,408,567)	(2,458,323)	(2,509,104)
NPV as of 2023	**(86,228,629)**																			

Year of analysis	2023
Start of NPV	2026
Escalation rate	4.20%
Discount rate	2.20%

Risk adjustments (+/- percent):

Benefits	0%
Capital costs	0%
Running costs	0%

Alt3-D
Life Cycle Alternative Cost Analysis ($)

Alternative 3-D: Baseline

Expressed in 2023 dollars, unescalated -- dollars

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Capital Outlays																				
Capital outlay 1																				
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																				
536 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
537 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
538 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
539 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
540 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
541 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
542 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
543 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Running Costs:																				
547 Hauled solids	$1,706,976	$1,709,609	$1,712,243	$1,714,876	$1,717,510	$1,720,144	$1,722,777	$1,725,411	$1,728,044	$1,730,678	$1,733,311	$1,735,945	$1,738,578	$1,741,212	$1,743,846	$1,746,479	$1,749,113	$1,751,746	$1,754,380	$1,757,013
548 electrical demand	$99,387	$99,540	$99,694	$99,847	$100,000	$100,154	$100,307	$100,460	$100,614	$100,767	$100,920	$101,074	$101,227	$101,381	$101,534	$101,687	$101,841	$101,994	$102,147	$102,301
549 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
550 polymer use	$200,538	$200,847	$201,156	$201,466	$201,775	$202,085	$202,394	$202,703	$203,013	$203,322	$203,632	$203,941	$204,250	$204,560	$204,869	$205,178	$205,488	$205,797	$206,107	$206,416
551 Labor	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
552 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
553 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
554 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	2,006,900	2,009,997	2,013,093	2,016,189	2,019,286	2,022,382	2,025,478	2,028,574	2,031,671	2,034,767	2,037,863	2,040,960	2,044,056	2,047,152	2,050,249	2,053,345	2,056,441	2,059,537	2,062,634	2,065,730
Annual Risk Costs (optional):																				
558 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
559 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
560 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
561 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
562 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R Costs:																				
566 R&R 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
567 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
568 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
569 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
570 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
571 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
572 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
573 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Benefit/(cost)	(2,006,900)	(2,009,997)	(2,013,093)	(2,016,189)	(2,019,286)	(2,022,382)	(2,025,478)	(2,028,574)	(2,031,671)	(2,034,767)	(2,037,863)	(2,040,960)	(2,044,056)	(2,047,152)	(2,050,249)	(2,053,345)	(2,056,441)	(2,059,537)	(2,062,634)	(2,065,730)

Expressed in escalated dollars with sensitivity adjustments

Capital Outlays																				
Capital outlay 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Running Costs:																				
Hauled solids	1,931,214	2,015,430	2,103,313	2,195,023	2,290,727	2,390,597	2,494,816	2,603,572	2,717,063	2,835,495	2,959,082	3,088,048	3,222,627	3,363,064	3,509,613	3,662,540	3,822,121	3,988,647	4,162,418	4,343,751
electrical demand	112,443	117,347	122,464	127,803	133,376	139,190	145,258	151,591	158,199	165,094	172,290	179,799	187,635	195,811	204,344	213,248	222,540	232,235	242,353	252,911
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	226,881	236,775	247,100	257,874	269,117	280,850	293,094	305,871	319,204	333,117	347,636	362,788	378,598	395,097	412,314	430,280	449,027	468,591	489,006	510,309
Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**2,270,539**	**2,369,552**	**2,472,877**	**2,580,701**	**2,693,220**	**2,810,638**	**2,933,169**	**3,061,034**	**3,194,466**	**3,333,706**	**3,479,008**	**3,630,634**	**3,788,860**	**3,953,973**	**4,126,271**	**4,306,067**	**4,493,688**	**4,689,473**	**4,893,777**	**5,106,971**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Net escalated benefit/(cost)	**(2,270,539)**	**(2,369,552)**	**(2,472,877)**	**(2,580,701)**	**(2,693,220)**	**(2,810,638)**	**(2,933,169)**	**(3,061,034)**	**(3,194,466)**	**(3,333,706)**	**(3,479,008)**	**(3,630,634)**	**(3,788,860)**	**(3,953,973)**	**(4,126,271)**	**(4,306,067)**	**(4,493,688)**	**(4,689,473)**	**(4,893,777)**	**(5,106,971)**
Life cycle cost analysis																				
PVs in 2023	(2,127,043)	(2,172,014)	(2,217,931)	(2,264,812)	(2,312,680)	(2,361,553)	(2,411,454)	(2,462,403)	(2,514,423)	(2,567,536)	(2,621,765)	(2,677,133)	(2,733,664)	(2,791,382)	(2,850,313)	(2,910,481)	(2,971,912)	(3,034,633)	(3,098,671)	(3,164,052)
NPV as of 2023	**(52,265,855)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt4-A
Life Cycle Alternative Cost Analysis ($)

Alternative 4-A: Raw Sludge Belt Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	44,200,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**44,200,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
650 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
651 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
652 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
653 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
654 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
655 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
656 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
657 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
661 Hauled solids	$1,207,944	$1,209,808	$1,211,671	$1,213,535	$1,215,398	$1,217,262	$1,219,126	$1,220,989	$1,222,853	$1,224,717	$1,226,580	$1,228,444	$1,230,308	$1,232,171	$1,234,035	$1,235,899	$1,237,762	$1,239,626	$1,241,490	$1,243,353
662 electrical demand	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310
663 NG demand (lhv)	$1,349,718	$1,351,800	$1,353,883	$1,355,965	$1,358,047	$1,360,130	$1,362,212	$1,364,294	$1,366,377	$1,368,459	$1,370,542	$1,372,624	$1,374,706	$1,376,789	$1,378,871	$1,380,954	$1,383,036	$1,385,118	$1,387,201	$1,389,283
664 polymer use	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
665 Labor	$305,301	$305,772	$306,243	$306,714	$307,185	$307,656	$308,127	$308,598	$309,069	$309,540	$310,011	$310,482	$310,953	$311,424	$311,895	$312,366	$312,838	$313,309	$313,780	$314,251
666 transferred cake	$500,042	$500,813	$501,585	$502,356	$503,128	$503,899	$504,671	$505,442	$506,214	$506,985	$507,756	$508,528	$509,299	$510,071	$510,842	$511,614	$512,385	$513,157	$513,928	$514,700
667 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
668 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**3,566,314**	**3,571,503**	**3,576,691**	**3,581,880**	**3,587,068**	**3,592,257**	**3,597,446**	**3,602,634**	**3,607,823**	**3,613,011**	**3,618,200**	**3,623,388**	**3,628,577**	**3,633,765**	**3,638,954**	**3,644,142**	**3,649,331**	**3,654,519**	**3,659,708**	**3,664,896**
Annual Risk Costs (optional):																				
672 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
673 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
674 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
675 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
676 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
680 R&R 1	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401	$190,401
681 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
682 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
683 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
684 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
685 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
686 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
687 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**	**190,401**
Net Benefit/(cost)	**(47,956,715)**	**(3,761,904)**	**(3,767,092)**	**(3,772,281)**	**(3,777,469)**	**(3,782,658)**	**(3,787,846)**	**(3,793,035)**	**(3,798,223)**	**(3,803,412)**	**(3,808,601)**	**(3,813,789)**	**(3,818,978)**	**(3,824,166)**	**(3,829,355)**	**(3,834,543)**	**(3,839,732)**	**(3,844,920)**	**(3,850,109)**	**(3,855,297)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	50,006,381	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**50,006,381**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	1,366,627	1,426,222	1,488,413	1,553,311	1,621,036	1,691,710	1,765,460	1,842,422	1,922,734	2,006,542	2,093,998	2,185,262	2,280,497	2,379,877	2,483,583	2,591,802	2,704,730	2,822,572	2,945,542	3,073,862
electrical demand	230,018	239,679	249,745	260,234	271,164	282,553	294,420	306,786	319,671	333,097	347,087	361,665	376,855	392,683	409,176	426,361	444,268	462,927	482,370	502,630
NG demand (lhv)	1,527,025	1,593,615	1,663,105	1,735,621	1,811,294	1,890,262	1,972,669	2,058,663	2,148,401	2,242,046	2,339,767	2,441,741	2,548,154	2,659,199	2,775,076	2,895,996	3,022,179	3,153,852	3,291,254	3,434,635

polymer use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labor	345,407	360,470	376,188	392,591	409,708	427,570	446,210	465,662	485,960	507,142	529,246	552,313	576,383	601,501	627,712	655,063	683,605	713,389	744,469	776,901
transferred cake	565,730	590,400	616,145	643,010	671,046	700,302	730,832	762,691	795,937	830,630	866,834	904,613	944,037	985,177	1,028,107	1,072,905	1,119,653	1,168,435	1,219,339	1,272,459
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**4,034,807**	**4,210,386**	**4,393,595**	**4,584,768**	**4,784,248**	**4,992,397**	**5,209,592**	**5,436,224**	**5,672,704**	**5,919,458**	**6,176,933**	**6,445,594**	**6,725,926**	**7,018,436**	**7,323,653**	**7,642,127**	**7,974,435**	**8,321,175**	**8,682,974**	**9,060,487**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	215,413	224,460	233,888	243,711	253,947	264,613	275,726	287,307	299,374	311,948	325,049	338,701	352,927	367,750	383,195	399,289	416,060	433,534	451,743	470,716
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**215,413**	**224,460**	**233,888**	**243,711**	**253,947**	**264,613**	**275,726**	**287,307**	**299,374**	**311,948**	**325,049**	**338,701**	**352,927**	**367,750**	**383,195**	**399,289**	**416,060**	**433,534**	**451,743**	**470,716**
Net escalated benefit/(cost)	**(54,256,601)**	**(4,434,846)**	**(4,627,483)**	**(4,828,479)**	**(5,038,195)**	**(5,257,010)**	**(5,485,318)**	**(5,723,531)**	**(5,972,077)**	**(6,231,405)**	**(6,501,982)**	**(6,784,295)**	**(7,078,853)**	**(7,386,186)**	**(7,706,848)**	**(8,041,417)**	**(8,390,494)**	**(8,754,709)**	**(9,134,717)**	**(9,531,202)**
Life cycle cost analysis																				
PVs in 2023	(50,827,634)	(4,065,135)	(4,150,404)	(4,237,454)	(4,326,321)	(4,417,043)	(4,509,660)	(4,604,209)	(4,700,733)	(4,799,271)	(4,899,865)	(5,002,559)	(5,107,395)	(5,214,419)	(5,323,676)	(5,435,212)	(5,549,074)	(5,665,312)	(5,783,973)	(5,905,110)
NPV as of 2023	**(144,524,458)**																			

Year of analysis	2023	Risk adjustments (+/- percent):	
Start of NPV	2026	Benefits	0%
Escalation rate	4.20%	Capital costs	0%
Discount rate	2.20%	Running costs	0%

Alt4-B
Life Cycle Alternative Cost Analysis ($)

Alternative 4-B: Raw Sludge Drum Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	70,500,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**70,500,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
707 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
708 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
709 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
710 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
711 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
712 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
713 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
714 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
718 Hauled solids	$1,207,944	$1,209,808	$1,211,671	$1,213,535	$1,215,398	$1,217,262	$1,219,126	$1,220,989	$1,222,853	$1,224,717	$1,226,580	$1,228,444	$1,230,308	$1,232,171	$1,234,035	$1,235,899	$1,237,762	$1,239,626	$1,241,490	$1,243,353
719 electrical demand	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310	$203,310
720 NG demand (lhv)	$1,181,003	$1,182,825	$1,184,647	$1,186,469	$1,188,291	$1,190,114	$1,191,936	$1,193,758	$1,195,580	$1,197,402	$1,199,224	$1,201,046	$1,202,868	$1,204,690	$1,206,512	$1,208,334	$1,210,156	$1,211,979	$1,213,801	$1,215,623
721 polymer use	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
722 Labor	$381,626	$382,215	$382,804	$383,393	$383,981	$384,570	$385,159	$385,748	$386,337	$386,925	$387,514	$388,103	$388,692	$389,281	$389,869	$390,458	$391,047	$391,636	$392,224	$392,813
723 transferred cake	$500,042	$500,813	$501,585	$502,356	$503,128	$503,899	$504,671	$505,442	$506,214	$506,985	$507,756	$508,528	$509,299	$510,071	$510,842	$511,614	$512,385	$513,157	$513,928	$514,700
724 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
725 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**3,473,925**	**3,478,971**	**3,484,017**	**3,489,063**	**3,494,109**	**3,499,155**	**3,504,201**	**3,509,247**	**3,514,293**	**3,519,339**	**3,524,385**	**3,529,431**	**3,534,477**	**3,539,523**	**3,544,569**	**3,549,615**	**3,554,661**	**3,559,707**	**3,564,753**	**3,569,799**
Annual Risk Costs (optional):																				
729 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
730 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
731 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
732 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
733 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
737 R&R 1	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246	$302,246
738 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
739 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
740 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
741 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
742 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
743 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
744 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**	**302,246**
Net Benefit/(cost)	**(74,276,170)**	**(3,781,216)**	**(3,786,262)**	**(3,791,308)**	**(3,796,354)**	**(3,801,400)**	**(3,806,446)**	**(3,811,492)**	**(3,816,538)**	**(3,821,584)**	**(3,826,630)**	**(3,831,676)**	**(3,836,722)**	**(3,841,768)**	**(3,846,814)**	**(3,851,860)**	**(3,856,906)**	**(3,861,952)**	**(3,866,998)**	**(3,872,044)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	79,761,309	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**79,761,309**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	1,366,627	1,426,222	1,488,413	1,553,311	1,621,036	1,691,710	1,765,460	1,842,422	1,922,734	2,006,542	2,093,998	2,185,262	2,280,497	2,379,877	2,483,583	2,591,802	2,704,730	2,822,572	2,945,542	3,073,862
electrical demand	230,018	239,679	249,745	260,234	271,164	282,553	294,420	306,786	319,671	333,097	347,087	361,665	376,855	392,683	409,176	426,361	444,268	462,927	482,370	502,630
NG demand (lhv)	1,336,147	1,394,413	1,455,217	1,518,668	1,584,882	1,653,980	1,726,085	1,801,330	1,879,851	1,961,790	2,047,296	2,136,524	2,229,635	2,326,799	2,428,192	2,533,997	2,644,406	2,759,620	2,879,847	3,005,305

polymer use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labor	431,759	450,587	470,235	490,739	512,135	534,463	557,763	582,077	607,450	633,928	661,558	690,391	720,479	751,876	784,640	818,829	854,507	891,737	930,587	971,127
transferred cake	565,730	590,400	616,145	643,010	671,046	700,302	730,832	762,691	795,937	830,630	866,834	904,613	944,037	985,177	1,028,107	1,072,905	1,119,653	1,168,435	1,219,339	1,272,459
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**3,930,281**	**4,101,301**	**4,279,754**	**4,465,963**	**4,660,263**	**4,863,007**	**5,074,561**	**5,295,307**	**5,525,643**	**5,765,988**	**6,016,774**	**6,278,454**	**6,551,503**	**6,836,412**	**7,133,696**	**7,443,894**	**7,767,564**	**8,105,291**	**8,457,685**	**8,825,383**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	341,950	356,312	371,277	386,871	403,120	420,051	437,693	456,076	475,231	495,191	515,989	537,660	560,242	583,772	608,291	633,839	660,460	688,199	717,104	747,222
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**341,950**	**356,312**	**371,277**	**386,871**	**403,120**	**420,051**	**437,693**	**456,076**	**475,231**	**495,191**	**515,989**	**537,660**	**560,242**	**583,772**	**608,291**	**633,839**	**660,460**	**688,199**	**717,104**	**747,222**
Net escalated benefit/(cost)	**(84,033,540)**	**(4,457,613)**	**(4,651,032)**	**(4,852,834)**	**(5,063,383)**	**(5,283,058)**	**(5,512,254)**	**(5,751,382)**	**(6,000,874)**	**(6,261,178)**	**(6,532,762)**	**(6,816,115)**	**(7,111,745)**	**(7,420,184)**	**(7,741,987)**	**(8,077,732)**	**(8,428,024)**	**(8,793,490)**	**(9,174,789)**	**(9,572,605)**
Life cycle cost analysis																				
PVs in 2023	(78,722,699)	(4,086,004)	(4,171,525)	(4,258,828)	(4,347,950)	(4,438,929)	(4,531,804)	(4,626,614)	(4,723,400)	(4,822,201)	(4,923,061)	(5,026,021)	(5,131,126)	(5,238,420)	(5,347,948)	(5,459,757)	(5,573,894)	(5,690,407)	(5,809,346)	(5,930,761)
NPV as of 2023	**(172,860,696)**																			

Year of analysis	2023
Start of NPV	2026
Escalation rate	4.20%
Discount rate	2.20%

Risk adjustments (+/- percent):

Benefits	0%
Capital costs	0%
Running costs	0%

Alt4-C
Life Cycle Alternative Cost Analysis ($)

Alternative 4-C: THP + MAD + Belt Dryer

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Expressed in 2023 dollars, unescalated -- dollars																				
Capital Outlays																				
Capital outlay 1	198,800,000																			
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	**198,800,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
764 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
765 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
766 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
767 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
768 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
769 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
770 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
771 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
775 Hauled solids	$4,667,056	$4,674,256	$4,681,457	$4,688,657	$4,695,858	$4,703,058	$4,710,259	$4,717,459	$4,724,660	$4,731,860	$4,739,060	$4,746,261	$4,753,461	$4,760,662	$4,767,862	$4,775,063	$4,782,263	$4,789,464	$4,796,664	$4,803,865
776 electrical demand	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
777 NG demand (lhv)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
778 polymer use	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
779 Labor	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
780 transferred cake	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
781 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
782 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	**4,667,056**	**4,674,256**	**4,681,457**	**4,688,657**	**4,695,858**	**4,703,058**	**4,710,259**	**4,717,459**	**4,724,660**	**4,731,860**	**4,739,060**	**4,746,261**	**4,753,461**	**4,760,662**	**4,767,862**	**4,775,063**	**4,782,263**	**4,789,464**	**4,796,664**	**4,803,865**
Annual Risk Costs (optional):																				
786 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
787 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
788 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
789 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
790 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
794 R&R 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
795 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
796 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
797 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
798 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
799 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
800 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
801 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Net Benefit/(cost)	**(203,467,056)**	**(4,674,256)**	**(4,681,457)**	**(4,688,657)**	**(4,695,858)**	**(4,703,058)**	**(4,710,259)**	**(4,717,459)**	**(4,724,660)**	**(4,731,860)**	**(4,739,060)**	**(4,746,261)**	**(4,753,461)**	**(4,760,662)**	**(4,767,862)**	**(4,775,063)**	**(4,782,263)**	**(4,789,464)**	**(4,796,664)**	**(4,803,865)**
Expressed in escalated dollars with sensitivity adjustments																				
Capital Outlays																				
Capital outlay 1	224,915,578	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	**224,915,578**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Annual Running Costs:																				
Hauled solids	5,280,149	5,510,404	5,750,685	6,001,431	6,263,094	6,536,151	6,821,097	7,118,448	7,428,745	7,752,549	8,090,448	8,443,056	8,811,011	9,194,981	9,595,662	10,013,779	10,450,092	10,905,391	11,380,502	11,876,284
electrical demand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NG demand (lhv)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

polymer use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
transferred cake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**5,280,149**	**5,510,404**	**5,750,685**	**6,001,431**	**6,263,094**	**6,536,151**	**6,821,097**	**7,118,448**	**7,428,745**	**7,752,549**	**8,090,448**	**8,443,056**	**8,811,011**	**9,194,981**	**9,595,662**	**10,013,779**	**10,450,092**	**10,905,391**	**11,380,502**	**11,876,284**
Annual Risk Costs (optional):																			
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																			
R&R 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Net escalated benefit/(cost)	**(230,195,727)**	**(5,510,404)**	**(5,750,685)**	**(6,001,431)**	**(6,263,094)**	**(6,536,151)**	**(6,821,097)**	**(7,118,448)**	**(7,428,745)**	**(7,752,549)**	**(8,090,448)**	**(8,443,056)**	**(8,811,011)**	**(9,194,981)**	**(9,595,662)**	**(10,013,779)**	**(10,450,092)**	**(10,905,391)**	**(11,380,502)**	**(11,876,284)**
Life cycle cost analysis																			
PVs in 2023	(215,647,571)	(5,051,029)	(5,157,808)	(5,266,832)	(5,378,147)	(5,491,803)	(5,607,847)	(5,726,330)	(5,847,303)	(5,970,817)	(6,096,926)	(6,225,685)	(6,357,148)	(6,491,372)	(6,628,415)	(6,768,336)	(6,911,194)	(7,057,052)	(7,205,972)	(7,358,018)
NPV as of 2023	**(332,245,605)**																		

Year of analysis	2023
Start of NPV	2026
Escalation rate	4.20%
Discount rate	2.20%

Risk adjustments (+/- percent):

Benefits	0%
Capital costs	0%
Running costs	0%

Alt4-D
Life Cycle Alternative Cost Analysis ($)

Alternative 4-D: Baseline

Expressed in 2023 dollars, unescalated -- dollars

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Capital Outlays																				
Capital outlay 1																				
Capital outlay 2																				
Capital outlay 3																				
Capital outlay 4																				
Capital outlay 5																				
Capital outlay 6																				
Capital outlay 7																				
Capital outlay 8																				
Total capital outlays	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																				
821 Benefits 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
822 Benefits 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
823 Benefits 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
824 Benefits 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
825 Benefits 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
826 Benefits 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
827 Benefits 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
828 Benefits 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Running Costs:																				
832 Hauled solids	$543,363	$544,202	$545,040	$545,878	$546,717	$547,555	$548,393	$549,232	$550,070	$550,908	$551,747	$552,585	$553,423	$554,261	$555,100	$555,938	$556,776	$557,615	$558,453	$559,291
833 electrical demand	$628,910	$629,049	$629,188	$629,327	$629,466	$629,605	$629,744	$629,883	$630,022	$630,162	$630,301	$630,440	$630,579	$630,718	$630,857	$630,996	$631,135	$631,274	$631,413	$631,552
834 NG demand (lhv)	$137,810	$138,023	$138,236	$138,448	$138,661	$138,874	$139,086	$139,299	$139,511	$139,724	$139,937	$140,149	$140,362	$140,574	$140,787	$141,000	$141,212	$141,425	$141,638	$141,850
835 polymer use	$271,299	$271,717	$272,136	$272,554	$272,973	$273,392	$273,810	$274,229	$274,647	$275,066	$275,484	$275,903	$276,321	$276,740	$277,159	$277,577	$277,996	$278,414	$278,833	$279,251
836 Labor	$516,610	$486,221	$455,832	$425,443	$395,054	$364,666	$334,277	$303,888	$273,499	$243,110	$212,722	$182,333	$151,944	$121,555	$91,166	$60,778	$30,389	$0	($30,389)	($60,778)
837 Annual O&M 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
838 Annual O&M 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
839 Annual O&M 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total running costs	2,097,992	2,069,212	2,040,431	2,011,651	1,982,871	1,954,091	1,925,311	1,896,530	1,867,750	1,838,970	1,810,190	1,781,409	1,752,629	1,723,849	1,695,069	1,666,288	1,637,508	1,608,728	1,579,948	1,551,168
Annual Risk Costs (optional):																				
843 Annual Risk Costs 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
844 Annual Risk Costs 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
845 Annual Risk Costs 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
846 Annual Risk Costs 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
847 Annual Risk Costs 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total risk costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R Costs:																				
851 R&R 1	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909	$1,062,909
852 R&R 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
853 R&R 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
854 R&R 4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
855 R&R 5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
856 R&R 6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
857 R&R 7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
858 R&R 8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total refurbishments	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909	1,062,909
Net Benefit/(cost)	(3,160,901)	(3,132,120)	(3,103,340)	(3,074,560)	(3,045,780)	(3,017,000)	(2,988,219)	(2,959,439)	(2,930,659)	(2,901,879)	(2,873,098)	(2,844,318)	(2,815,538)	(2,786,758)	(2,757,977)	(2,729,197)	(2,700,417)	(2,671,637)	(2,642,857)	(2,614,076)

Expressed in escalated dollars with sensitivity adjustments

Capital Outlays																				
Capital outlay 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital outlay 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total capital outlays	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																				
Benefits 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Running Costs:																				
Hauled solids	614,743	641,550	669,525	698,718	729,183	760,973	794,148	828,767	864,894	902,593	941,933	982,985	1,025,825	1,070,528	1,117,178	1,165,857	1,216,655	1,269,663	1,324,978	1,382,700
electrical demand	711,527	741,575	772,892	805,532	839,550	875,004	911,956	950,468	990,606	1,032,439	1,076,039	1,121,480	1,168,840	1,218,200	1,269,644	1,323,261	1,379,142	1,437,382	1,498,082	1,561,346
NG demand (lhv)	155,914	162,713	169,808	177,212	184,939	193,002	201,416	210,196	219,359	228,920	238,898	249,309	260,175	271,513	283,344	295,690	308,574	322,018	336,047	350,687

polymer use	306,938	320,323	334,291	348,867	364,077	379,950	396,514	413,800	431,837	450,660	470,302	490,800	512,189	534,510	557,801	582,107	607,470	633,937	661,555	690,375
Labor	584,475	573,198	559,942	544,563	526,903	506,800	484,078	458,554	430,032	398,305	363,155	324,349	281,643	234,778	183,479	127,457	66,405	0	(72,100)	(150,257)
Annual O&M 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual O&M 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total running costs	**2,373,597**	**2,439,359**	**2,506,459**	**2,574,892**	**2,644,652**	**2,715,729**	**2,788,112**	**2,861,785**	**2,936,728**	**3,012,917**	**3,090,327**	**3,168,924**	**3,248,672**	**3,329,528**	**3,411,446**	**3,494,372**	**3,578,246**	**3,663,001**	**3,748,563**	**3,834,851**
Annual Risk Costs (optional):																				
Annual Risk Costs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Risk Costs 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total risk costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R&R Costs:																				
R&R 1	1,202,539	1,253,046	1,305,673	1,360,512	1,417,653	1,477,195	1,539,237	1,603,885	1,671,248	1,741,440	1,814,581	1,890,793	1,970,207	2,052,955	2,139,179	2,229,025	2,322,644	2,420,195	2,521,843	2,627,761
R&R 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&R 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total refurbishments	**1,202,539**	**1,253,046**	**1,305,673**	**1,360,512**	**1,417,653**	**1,477,195**	**1,539,237**	**1,603,885**	**1,671,248**	**1,741,440**	**1,814,581**	**1,890,793**	**1,970,207**	**2,052,955**	**2,139,179**	**2,229,025**	**2,322,644**	**2,420,195**	**2,521,843**	**2,627,761**
Net escalated benefit/(cost)	**(3,576,136)**	**(3,692,405)**	**(3,812,132)**	**(3,935,404)**	**(4,062,305)**	**(4,192,924)**	**(4,327,349)**	**(4,465,670)**	**(4,607,976)**	**(4,754,358)**	**(4,904,908)**	**(5,059,717)**	**(5,218,878)**	**(5,382,484)**	**(5,550,626)**	**(5,723,397)**	**(5,900,890)**	**(6,083,196)**	**(6,270,406)**	**(6,462,612)**
Life cycle cost analysis																				
PVs in 2023	(3,350,127)	(3,384,588)	(3,419,113)	(3,453,694)	(3,488,320)	(3,522,977)	(3,557,655)	(3,592,342)	(3,627,023)	(3,661,686)	(3,696,317)	(3,730,901)	(3,765,423)	(3,799,867)	(3,834,217)	(3,868,457)	(3,902,568)	(3,936,533)	(3,970,332)	(4,003,947)
NPV as of 2023	**(73,566,087)**																			

Attachment E: Suggested Sampling Protocol for Pilots of PFAS Treatment Technologies

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Suggested Sampling Protocol for Pilots of PFAS Treatment Technologies

1.1 Introduction

To better understand the fate and transport of PFAS through each of these technologies, it is recommended that a PFAS sampling plan be developed. Typically, a sampling plan is developed to investigate PFAS levels at key inputs and outputs to a system, which are considered individual sampling locations. At each sampling location, samples are taken in triplicate, meaning that four samples should be taken per sampling run, with a total of 3 runs. It is important that the samples taken capture the PFAS levels in all phases, gas, solid, and liquid, of emissions and end products. If there are multiple phases to test at each sampling location, three samples should be taken of each phase of end product or emission. For PFAS sampling, it is recommended that these be 4-hour composite samples, and that field and proof blanks be taken on ten percent of the samples collected. An example of sampling procedures for pyrolysis systems is included in section 1.3. Although this is specific to pyrolysis, the PFAS sampling protocol for other equipment follows a similar process, with minor changes to sampling locations.

There are several publicly available sources which include a more involved description PFAS sampling and general guidance, including:

- ASTM D4448-01. "Standard Guide for Sampling Ground-Water Monitoring Wells"
- ASTM D6452-99. "Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations"
- EGLE, Groundwater Perfluoroalkyl and Polyfluoroalkyl (PFAS) Sampling Guidance
- EGLE, MDEQ PFAS Sampling Quick Reference Field Guide
- EGLE, Residential Well Perfluoroalkyl and Polyfluoroalkyl (PFAS) Sampling Guidance
- Interstate Regulatory Technology Council (ITRC). "Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)."

PFAS sampling is an expensive process. Each sample analysis of solid or liquid substances costs roughly $500, for a total of (3 x 4 x $500) $6,000 per sampling location. Air emissions is even more cost prohibitive. One round of air emissions testing costs roughly $50,000 for a three-run sampling event. Therefore, it is important to follow PFAS sampling methods and protocols as closely as possible, so as not to waste any samples.

1.2 General Guidelines

Sample contamination presents a real concern given the ubiquity of PFAS in the environment and consumer products, but also because of the low levels being measured. The list below includes basic guidance.

- Samples should be stored in coolers with ice in zip lock style bags. Use of synthetic cooling packs is prohibited.
- Field documentation should be restricted to plain paper and ball point pens. Waterproof paper, felt tip markers, sticky notes, or other components suspect of containing PFAS should not be used.
- Sampling personnel should not wear water resistant clothing.
- Nitrile gloves are acceptable and should always be worn during sample collection.
- Food or beverages should not be consumed while sampling, other than water. Sampling staff should thoroughly wash hands after meal breaks.
- Personal care products should not be used on the day of sampling.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

1.3 Pyrolysis Sampling Procedure

Sampling protocols for both full-scale and laboratory-scale pyrolysis systems are similar to each other. First, the sampling points of the system are identified. These include the inputs and output locations of the system in all of their phases, gas, solid, and liquid. For a typical pyrolysis system, this includes five locations. PFAS exist in volatile, semi-volatile, and non-volatile forms so the sampling approach aims to characterize these classes in the specific phases.

1. Dewatered biosolids
2. Dryer combustion air
3. Dried biosolids
4. Biochar
5. Pyrolysis combustion air
6. Flue gas emissions

1.3.1 Dewatered Biosolids

The main PFAS load to the pyrolysis systems will enter with the dewatered biosolids, or cake. During a full-scale sampling event, three composite dewatered biosolids samples are collected. Because the dryers operate as a batch system and require a multi-day processing time, dewatered biosolids samples should be taken several days in advance of the main sampling event. One of the larger pyrolysis suppliers (BFT) has indicated that a single dryer's worth of biosolids can feed the pyrolysis system for 28–34 hours, and possibly up to 48 hours if dewatering achieves 20 percent TS. Dewatered biosolids are sampled during the loading of the dryer which generally takes 3–4 hours.

1.3.2 Dryer Combustion Air

Combustion processes require oxygen, usually supplied from an air stream. Dryer furnaces combust natural gas fuel to directly heat a process airstream (consisting of leak air and recycled, conditioned dryer exhaust) drawn through the drum dryer system to convey heat and product through downstream separation devices. Combustion air to the furnace represents a small fraction of the process airstream (5 – 10%) and likely contains little to no PFAS but requires sampling as an input for confirmation. The sampling location should be assumed to be representative for the dryer system leak air as well.

1.3.3 Cooling Water (Plant Water and Potable)

Some dryers, such as drum dryer systems, use cooling water in a saturator and venturi scrubber to remove evaporated water and pollutants from the process airstream. At typical testing sites, the majority of the cooling water is provided by secondary effluent from the WRRF process, or plant water, which provides a practically free supply of water. This water will contain some PFAS as the WRRF liquid stream processes do not significantly transform the PFAS content. Plant water exists as a two-phase sample, containing some, but likely less than 30 mg/L TSS depending on the liquid stream and dedicated screening system performance. A small fraction of potable, or protected, water is used in the venturi scrubber for fine misting nozzles.

1.3.4 Saturator and Scrubber Drain

The cooling water supply, condensate, and captured particulate drains from the saturator and venturi scrubber to a plant drain for discharge to the local WRRF. This drain may contain several thousand milligrams per liter of TSS due to captured particulates. The drain from the venturi scrubber will have less

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

particulates as most are expected to be removed in the saturator upstream. Each drain will contain PFAS from the cooling water but also potentially PFAS escaping the dryer in moisture droplets entrained in the dryer exhaust that would be captured by the scrubbing process.

1.3.5 Exhaust Emissions

Airstream exhaust emissions are arguably the most critical output to be evaluated as there is no published data on whether PFAS can be transferred to the gas-phase and consequently be discharged to the environment. In a drum drying WRRF study example, exhaust emissions were studied at two points: (1) dryer exhaust directly after the dried product is separated in the pre-separator and poly-cyclone to identify whether PFAS are present in the direct gas-phase discharge and (2) after the saturator, venturi scrubber, and RTO to determine whether the APC train can remove the PFAS that may exist in the direct exhaust stream.

1.3.6 Dried Biosolids

The drying step removes the bulk of water from the dewatered biosolids. The drying step targets roughly 80 percent TS for a full-scale operation for a relatively single-phase matrix. Samples from the system are taken on the same day as the gas-phase and biochar sampling. The sampling site should aim to dedicate a single dryer for feeding the pyrolysis reactors during the sampling event. At 20 percent TS, technology providers expect 48 hours of operation possible which would cover the sampling schedule necessary for gas phase sampling. These samples shall represent the dried dewatered biosolids sampled several days prior. Three samples of the laboratory dried dewatered biosolids should be taken associated with each experimental run.

1.3.7 Biochar

The pyrolysis process intentionally leaves a portion of the combustible matter present in the biosolids as a solid residual along with the non-combustible fraction, known as biochar. The biochar differs from ash generated during a combustion process by the combustible fraction still present. Biochar sampling from the system should occur on the same day as gas-phase and dried biosolid sample collection. The short retention time, roughly 20 minutes, of pyrolysis reactors allows coincidental sampling. A sample should be collected from each experimental run.

1.3.8 Combustion Air

Combustion processes require oxygen, usually supplied from an air stream. While air likely contains little to no PFAS, the load to the thermal oxidizer warrants sampling. Both full-scale and laboratory-scale sampling events would collect combustion air samples in concert with each flue gas emission sample.

1.3.9 Flue Gas Emissions

Flue gas emissions are arguably the most critical output of the process because they are directly discharged to the environment. Samples should be taken of flue gas after the thermal oxidizer and prior to the wet scrubber.

1.3.10 Solid-Phase Samples

Samples of dewatered biosolids, dried biosolids, and biochar should be collected by taking representative samples of the material fed to, or resulting from, the process run. Samples should be stored at 4°C.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Subsequent laboratory extraction should occur within 14 days and subsequent analysis within 28 days, or up to one year if extracts are frozen.

1.3.11 Gas-Phase

Gas phase sampling should include flue gas and combustion air. Flue gas sampling should include Modified Method OTM-45 for semi-volatile and non-volatile compounds and Fourier-transform infrared spectroscopy (FTIR) for specific volatile compounds. All sampling should be conducted in triplicate.

1.3.12 Quality Assurance and Control

A series of duplicates and blanks should be taken to provide quality control for the sampling process. A total of three field duplicates should be collected, one each of the dewatered biosolids, dried biosolids, and biochar. Blind field duplicates should be subjected to the polar targeted analysis. The collected samples should represent roughly 20 percent of the samples taken. The duplicate samples should be prepared in the same way as the base samples. Extracts should be held for additional analyses if results warrant.

Use of contents on this sheet is subject to the limitations specified at the beginning of this document.
Maine DEP Biosolids Management Final Report

Boston

200 Brickstone Square, Suite 403
Andover, MA, 01810

T 978.794.0336