HYDROLOGY REPORT

This small watershed is steep, heavily wooded with almost no wetlands. Storm flows concentrate quickly and dissipate quickly resulting in large fluctuations between base flows and peak storm discharges. This watershed is at a mean elevation of 1815 feet, with an average slope of 17.5 percent. Annual precipitation is 42.9 inches. Soils are not well-drained with a mean basin percentage of only 9.25 of hydrologic soil group A. No open water is present and no sand and gravel aquifers are present. Rapid melting of snow-pack in the spring can amplify peak rates of runoff from rain storms.

Flood stage for the river was obtained from the National Weather Service website for the Roxbury station on the Swift River and was taken to be about 7 feet. Roxbury is the adjacent town to the south of Byron.

SUMMARY

Drainage Area	1.6	mi^2
Q1.1	41.4	ft^3/s
Q10	179.6	ft^3/s
Q50	278.3	ft^3/s
Q100	325.6	ft^3/s
Q500	445.1	ft^3/s

Reported by: Charles S. Hebson, PE
Date: February 19, 2019

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

Bank full width for Baldwin Brook has been determined to be 19’ with 1.2 bank-full width set at 23’. Discussions with the Maine DOT Environmental section indicate that a wide culvert barrel with 3 feet of special fill depth will be required to accommodate low-flow fish passage.

The resulting hydraulic opening of 23’ by 7’ is twice the area of the existing culvert with a more efficient cross section. Hydraulic capacity is not the primary driver in sizing this culvert.

HY8 hydraulic software was chosen to predict water surface elevations and flow velocities for this project. Since the culvert discharges directly into the Swift River, flood stage of 7’ above river bed elevation was assumed in the Swift River as a tailwater condition for the analysis. Also modelled was a lower tailwater elevation of 1’ above river bed elevation to attempt to capture the expected higher discharge velocities through the culvert barrel.

Input parameters for the existing culvert included a Manning’s n value of 0.024, a thin edge projecting inlet configuration and a culvert slope of 2.1 percent. Input parameters for the proposed culvert include a Manning’s n value of 0.012 for the sides and top and 0.05 for the cobble bottom, a thin edge projecting inlet configuration and a culvert slope of 5.45 percent.

Computed results from the HY8 analyses are shown in the charts below. See appendix E for more information.

	Low Tailwater 1 foot above Swift River bed			
	Exist 10' Dia CMP Pipe Culvert		Proposed 23' wide by 10' high Concrete Box Culvert with 3' of fill in Invert	
Storm Frequency	Headwater Elevation	Outlet Velocity fps	Headwater Elevation	Outlet Velocity fps
1.1	967.57	7.240	966.17	4.040
2	968.58	9.460	966.62	5.350
5	969.46	10.240	967.03	6.400
10	970.02	11.010	967.30	7.020
25	970.74	11.810	967.65	7.770
50	971.29	12.360	967.91	8.270
100	971.85	12.870	968.18	8.770
500	973.22	13.950	968.80	9.840

	High Tailwater 7 feet above Swift River bed			
	Exist 10' Dia CMP Pipe Culvert		Proposed 23' wide by 10' high Concrete Box Culvert with 3' of fill in Invert	
Storm Frequency	Headwater Elevation	Outlet Velocity fps	Headwater Elevation	Outlet Velocity fps
1.1	967.57	1.711	967.03	0.257
2	968.58	3.633	967.16	0.546
5	969.46	10.241	967.46	0.873
10	970.02	11.008	967.30	7.019
25	970.74	11.813	967.65	7.768
50	971.29	12.356	967.91	8.271
100	971.85	12.873	968.18	8.770
500	973.22	13.954	968.80	9.837

The inside roof elevation of the proposed box culvert on the upstream side is 972.5. Adequate clearance over the headwater elevation for the Q50 storm exists at over 4.5’.

The proposed culvert features great improvement over the existing culvert in outlet velocities for all storms. The net result may be a tendency toward a smaller plunge pool and easier passage for fish at higher flow regimes. Discharge velocities in the proposed culvert are not affected by the range of tailwater elevations modelled.

Since the culvert has been sized to provide low-flow fish passage, it is not surprising that the hydraulic capacity is generous. Elevations refer to NAVD88.

WIN:	23559.00	**Project Name:**	
Town:	Byron	**Stream Name:**	Baldwin Brook
Route No.	ME-17	**Bridge Name:**	Dugway Bridge
Asset ID:	2236	**Analysis by:**	CSH
Lat:	44.73379 **Long:** -70.6599	**Date:**	2/19/2019

Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015)

Enter data in blue cells only!

ver. 2018 Jul 09

	km²	mi²	ac	*Enter data in [mi²]*
A	4.14	1.60	1024.0	Watershed Area *DRNAREA*
W	0.07	0.0	18.4	Wetlands area (by NWI)
P_c	366928	4955731		watershed centroid (E, N; UTM 19N; meters)
County	Oxford W			*choose county from drop-down menu*
pptA				mean annual precipitation (inches; by look-up)
A (km²)	4.14	**Conf Lvl**	0.67	
W (%)	1.80			NWI Wetlands % *STORNWI*

Worksheet prepared by:
Charles S. Hebson, PE
Environmental Office
Maine Dept. Transportation
Augusta, ME 04333-0016
207-557-1052
Charles.Hebson@maine.gov

References:

Hodgkins, G.A., 1999.
Estimating the magnitude of peak flows for streams in Maine for selected recurrence intervals
WRIR 99-4008, USGS Augusta, ME

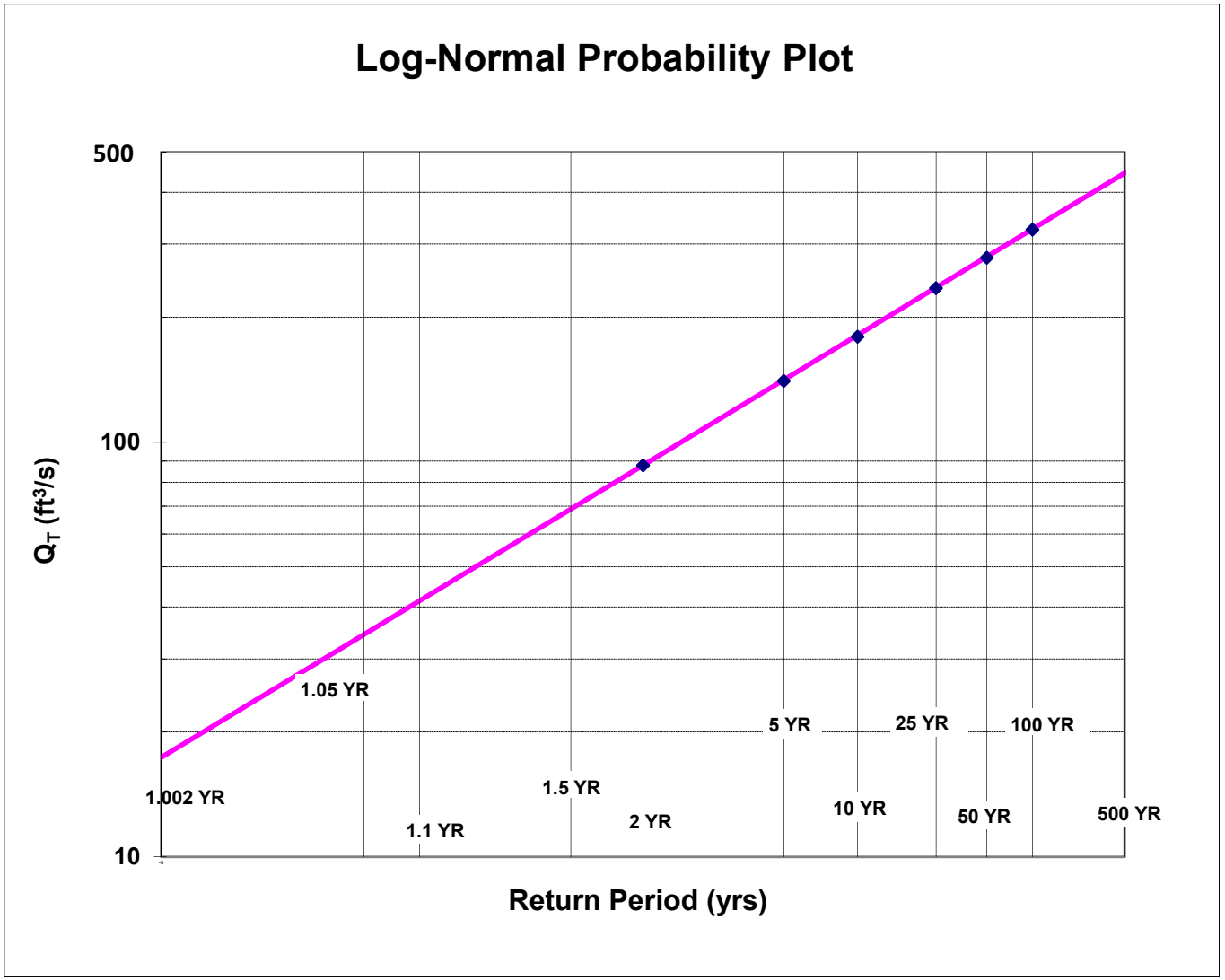
Watershed Characteristics for Monthly & Daily Flows

EAVG	1815	mean basin elevation (ft)
SLOPE	17.5	mean basin slope (%)
EMAX	2472	maximum basin elevation (ft)
WATER	0	percent of drainage basin land cover classified as open water
PRECIP	42.9	mean annual precipitation
SG	0.00	sand & gravel aquifer as decimal fraction of watershed A
HGA	9.25	mean basin percentage of hydrological soil group A
DIST	109.00	distance from the coast (mi)

Ret Pd T (yr)	Peak Flow Estimate Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		1.17		41.4
2		2.49		87.9
5		3.98		140.5
10		5.09		179.6
25		6.65		234.9
50		7.88		278.3
100		9.22		325.6
500		12.61		445.1

Lombard, P.J. & G.A. Hodgkins, 2015.
Peak flow regression equations for small, ungaged streams in Maine - Comparing map-based to field-based variables
SIR 2015-4059, USGS, Augusta, ME

$Q_T = b \times A^a \times 10^{-wW}$


Log-Normal Probability Plot
500
100
10
Q_T (ft³/s)
1.002 YR
1.05 YR
1.1 YR
1.5 YR
2 YR
5 YR
10 YR
25 YR
50 YR
100 YR
500 YR
Return Period (yrs)

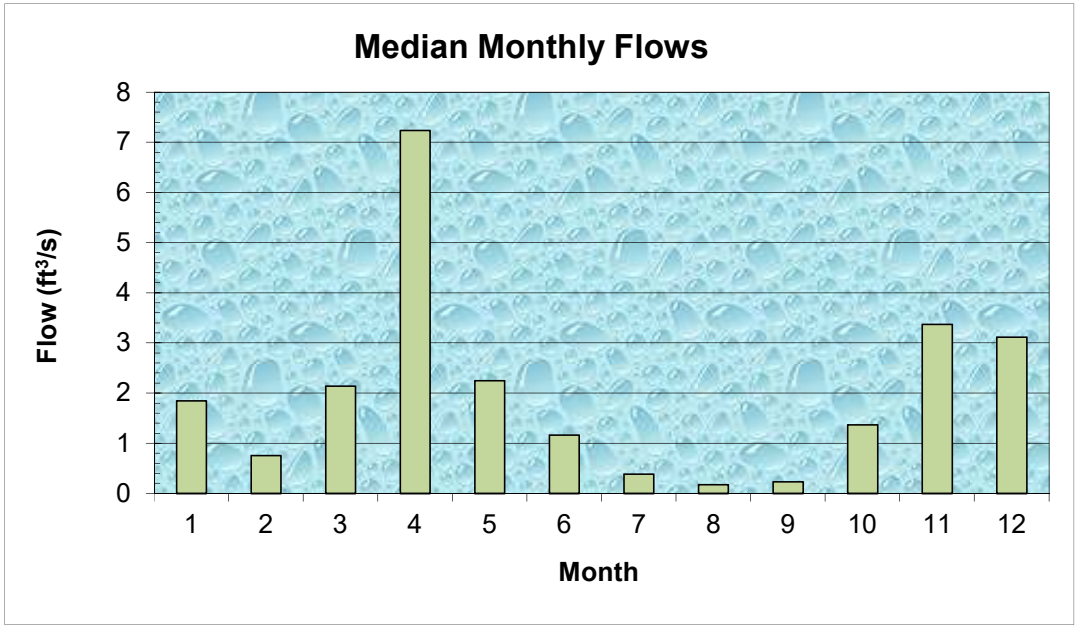
WIN:	23559.00	**Project Name:**	0
Town:	Byron	**Stream Name:**	Baldwin Brook
Route No.	ME-17	**Bridge Name:**	Dugway Bridge
Asset ID:	2236	**Analysis by:**	CSH
Lat:	44.73379 **Long:** -70.65986	**Date:**	2/19/2019

DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED

MAINE MONTHLY MEDIAN FLOWS and HYDRAULIC GEOMETRY BY USGS REGRESSION EQUATIONS (2004, 2013, 2015)

	Value	Variable	Explanation
	1.60	*A*	Area (mi^2)
366927.5	4955731	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	108.53	*DIST*	Distance from Coastal reference line (mi)
	42.9	*pptA*	Mean Annual Precipitation (inches)
	0.00	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**1.85**	0.0523
Feb	**0.76**	0.0215
Mar	**2.14**	0.0608
Apr	**7.24**	0.2051
May	**2.25**	0.0637
Jun	**1.16**	0.0330
Jul	**0.39**	0.0110
Aug	**0.18**	0.0050
Sep	**0.24**	0.0067
Oct	**1.37**	0.0387
Nov	**3.37**	0.0955
Dec	**3.12**	0.0883



Q_{bf}	**8.5**	
ann avg	**4.6**	
ann med	**1.8**	
$Q_{1.002}$	**17.4**	
$Q_{1.01}$	**23.6**	
$Q_{1.05}$	**34.3**	
Q_{bf}	**36.1**	assume v = 4ft/s

W_{bf}	**12.9**	estimated bankfull width (ft)
d_{bf}	**0.7**	estimated bankfull depth (ft)
A_{bf}	**6.8**	estimated bankfull flow area (ft^2)

References

Dudley, R.W., 2013. FY2013 Progress Report - Phase 1 …, USFWS QRP Project

Dudley, R.W., 2004. Estimating Monthly Streamflows … , SIR 2004-5026

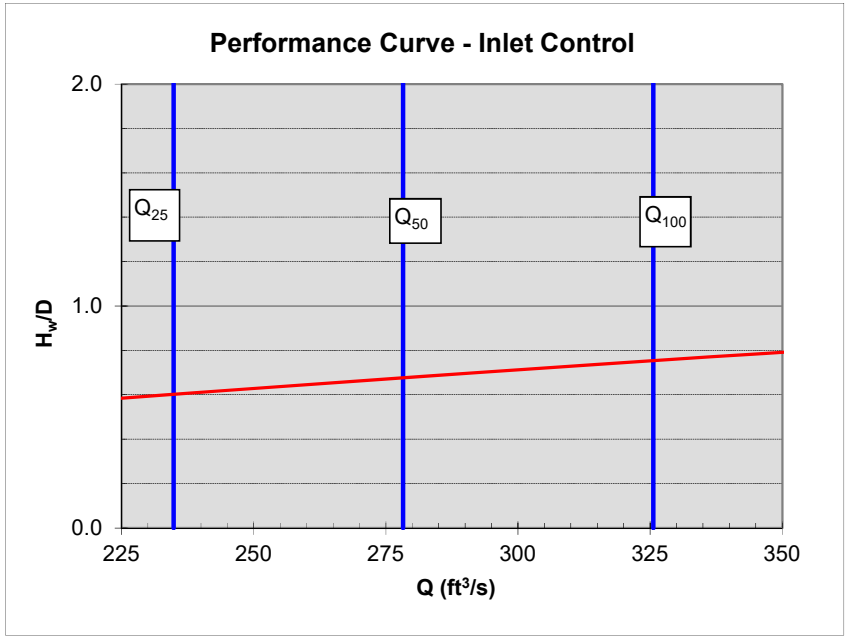
Dudley, R.W., 2015. Regression Equations for Monthly and Annual Mean..., USGS SIF

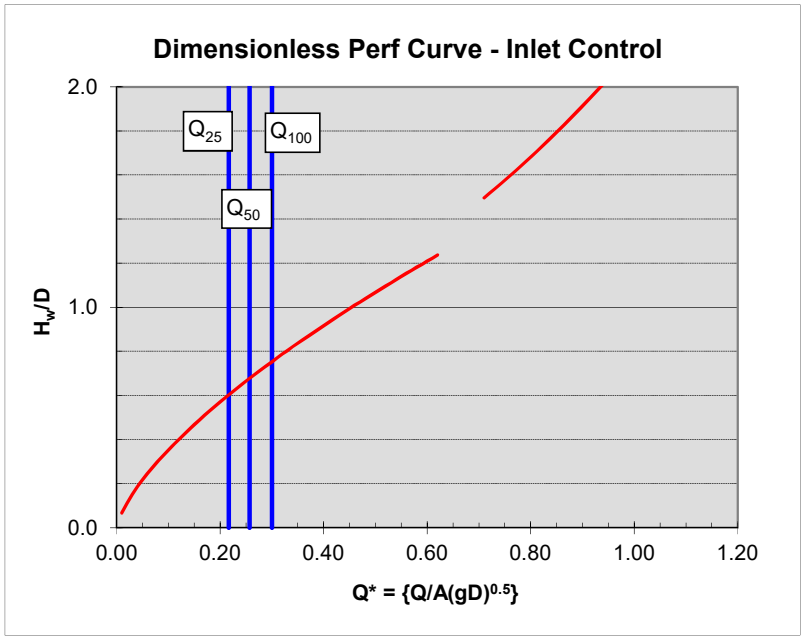
NOTE: ***This page is for preliminary sizing only.***
Final design should be done with HY8, HDS-5 or HEC-RAS

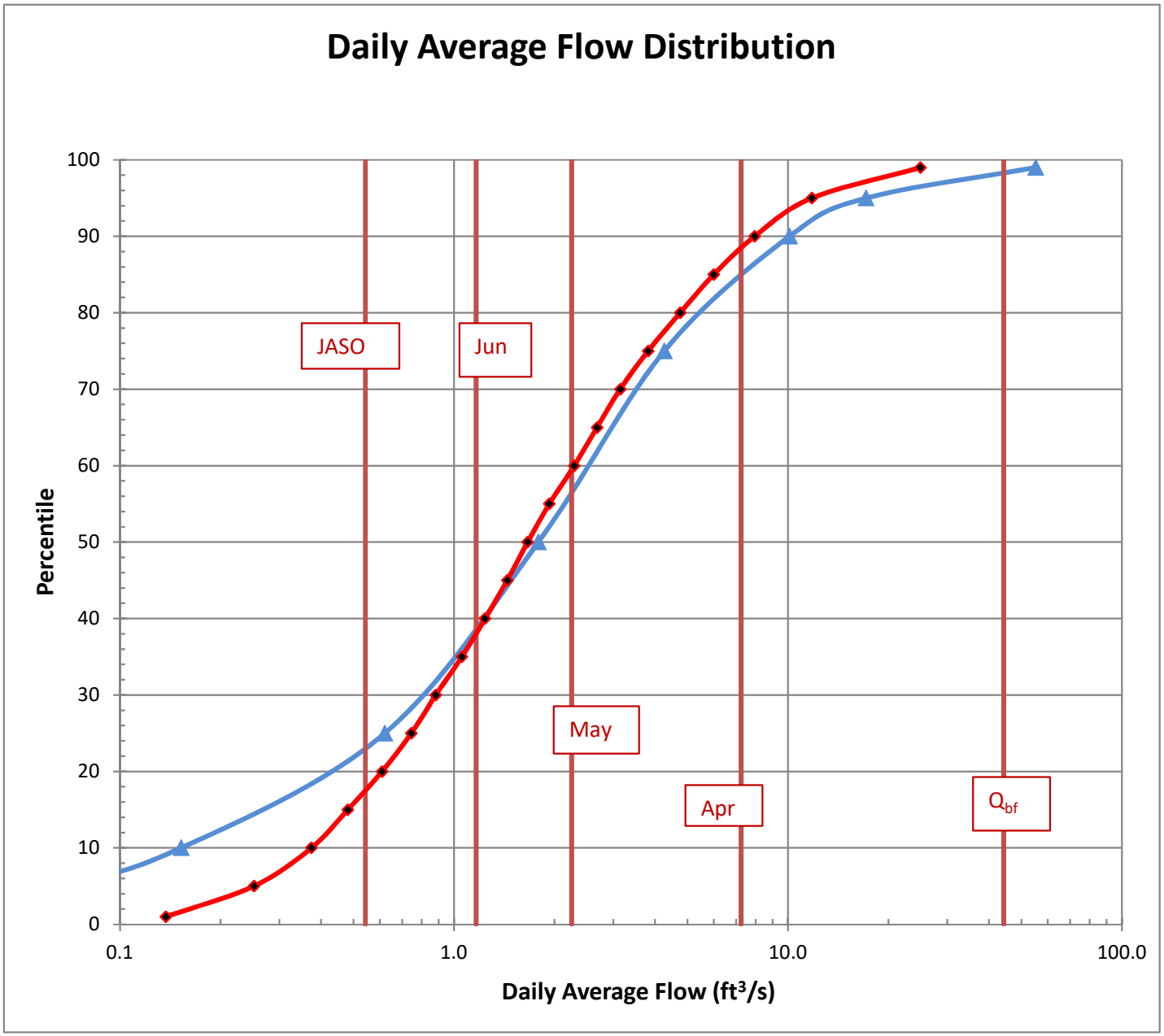
Preliminary Culvert Sizing - Round & Box Culverts

Shape:	Box						
Type:	Box 0 ww		Q_{25}	234.9			
D or R (ft)	6		Q_{50}	278.3	trial D / R =	7.9	
w (ft)	*13*	*box width*	Q_{100}	325.6	trial w: BFW =	12.9	
Slope (ft/ft)	0.02						
A (ft^2)	78.00						
g (ft/s^2)	32.2						

Note:
culvert dimensions are for open flow area; adjust for lost capacity due to embedding / backfilling (min {2' / 25% rise} embedment)







Daily Avg Flow Dist		
A_{ws} = (mi^2)		1.6
Q (ft^3/s)		
Pctl	Median	84th pctl
1	0.14	0.24
5	0.25	0.41
10	0.37	0.56
15	0.48	0.70
20	0.61	0.85
25	0.74	1.00
30	0.88	1.14
35	1.06	1.30
40	1.24	1.49
45	1.44	1.69
50	1.66	2.00
55	1.93	2.32
60	2.29	2.73
65	2.68	3.18
70	3.15	3.70
75	3.81	4.46
80	4.76	5.32
85	6.00	6.82
90	7.95	9.15
95	11.80	14.23
99	24.95	32.84

Q_{bf}	8.5
$Q_{1.002}$	17.4
$Q_{1.1}$	41.4
Q_2	87.9


Swift River
Swift River

Byron 23559 Dugway Brook @ ME17

Region ID: ME
Workspace ID: ME20190219142009982000
Clicked Point (Latitude, Longitude): 44.73390, -70.65992
Time: 2019-02-19 09:20:25 -0500

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.6	square miles
STORNWI	Percentage of storage (combined water bodies and wetlands) from the National Wetlands Inventory	1.77	percent
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0	dimensionless
ELEV	Mean Basin Elevation	1815	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	17.5	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	366927.51	feet
CENTROIDY	Basin centroid vertical (y) location in state plane units	4955731.23	feet
COASTDIST	Shortest distance from the coastline to the basin centroid	109	miles
ELEVMAX	Maximum basin elevation	2471.8	feet
LC06WATER	Percent of open water, class 11, from NLCD 2006	0	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	0.13	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.0544	percent
PRECIP	Mean Annual Precipitation	42.9	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	0	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	9.25	percent

Bankfull Statistics Parameters [Central and Coastal Bankfull 2004 5042]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.6	square miles	2.92	298

Bankfull Statistics Disclaimers [Central and Coastal Bankfull 2004 5042]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [Central and Coastal Bankfull 2004 5042]

Statistic	Value	Unit
Bankfull Streamflow	8.5	ft^3/s
Bankfull Width	9.79	ft
Bankfull Depth	0.697	ft
Bankfull Area	6.82	ft^2

Bankfull Statistics Citations

Dudley, R.W.,2004, Hydraulic-Geometry Relations for Rivers in Coastal and Central Maine: U.S. Geological Survey Scientific Investigations Report 2004-5042, 30 p (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)

Peak-Flow Statistics Parameters [Statewide Peak Flow DA LT 12sqmi 2015 5049]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.6	square miles	0.31	12
STORNWI	Percentage of Storage from NWI	1.77	percent	0	22.2

Peak-Flow Statistics Flow Report [Statewide Peak Flow DA LT 12sqmi 2015 5049]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp
1.01 Year Peak Flood	25.6	ft^3/s	38
2 Year Peak Flood	87.9	ft^3/s	34

Statistic	Value	Unit	SEp
5 Year Peak Flood	141	ft^3/s	35
10 Year Peak Flood	180	ft^3/s	37
25 Year Peak Flood	235	ft^3/s	39
50 Year Peak Flood	278	ft^3/s	41
100 Year Peak Flood	326	ft^3/s	42
250 Year Peak Flood	374	ft^3/s	44
500 Year Peak Flood	445	ft^3/s	47

Peak-Flow Statistics Citations

Lombard, P.J., and Hodgkins, G.A.,2015, Peak flow regression equations for small, ungaged streams in Maine— Comparing map-based to field-based variables: U.S. Geological Survey Scientific Investigations Report 2015–5049, 12 p. (http://dx.doi.org/10.3133/sir20155049)

Flow-Duration Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.6	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0	dimensionless	0	0.212
ELEV	Mean Basin Elevation	1815	feet	239	2120

Flow-Duration Statistics Disclaimers [Statewide Annual SIR 2015 5151]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report [Statewide Annual SIR 2015 5151]

Statistic	Value	Unit
1 Percent Duration	0.0115	ft^3/s
5 Percent Duration	0.061	ft^3/s
10 Percent Duration	0.152	ft^3/s
25 Percent Duration	0.621	ft^3/s
50 Percent Duration	1.79	ft^3/s
75 Percent Duration	4.26	ft^3/s
90 Percent Duration	10.1	ft^3/s
95 Percent Duration	17.1	ft^3/s
99 Percent Duration	55.2	ft^3/s

Flow-Duration Statistics Citations

Dudley, R.W.,2015, Regression equations for monthly and annual mean and selected percentile streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2015–5151, 35 p. (http://dx.doi.org/10.3133/sir20155151)

Annual Flow Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.6	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0	dimensionless	0	0.212
ELEV	Mean Basin Elevation	1815	feet	239	2120

Annual Flow Statistics Disclaimers [Statewide Annual SIR 2015 5151]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report [Statewide Annual SIR 2015 5151]

Statistic	Value	Unit
Mean Annual Flow	4.55	ft^3/s

Annual Flow Statistics Citations

Dudley, R.W.,2015, Regression equations for monthly and annual mean and selected percentile streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2015–5151, 35 p. (http://dx.doi.org/10.3133/sir20155151)

Application Version: 4.3.0

HY-8 Culvert Analysis Report

Prepared by

Mark Gray

6-4-2019

Assumed Swift River at flood stage (constant tailwater at elevation 967)

Existing 10’ diameter Corrugated Steel Culvert

Proposed 23’ wide by 10’ Concrete Box Culvert With 3’ submergence (23’ x 7” hydraulic opening)

Return to: Swift River Point Selection Page

Important Note: Book-marking page saves current search criteria

Jump to Location

Swift River At Roxbury (ROXM1)

Return to Top

Flood Stage: 7 Feet Latest Stage: 2.12

Current Warnings/Statements/Advisories: None currently.

Complete information about the Swift River at Roxbury available from NWS Gray, ME

NOTE: Forecasts for the Swift River at Roxbury are issued routinely year-round.

Flood Categories (in feet)

Major Flood Stage:	14
Moderate Flood Stage:	12
Flood Stage:	7
Action Stage:	5

Historic Crests

(1) 12.87 ft on 10/24/1959
(2) 12.58 ft on 09/17/1932
(3) 12.54 ft on 04/01/1987
(4) 12.42 ft on 06/15/1942
(5) 11.60 ft on 05/12/1989

Show More Historic Crests

(P): Preliminary values subject to further review.

Recent Crests

(1) 8.97 ft on 06/03/2012
(2) 9.04 ft on 12/02/1996
(3) 8.17 ft on 07/05/1996
(4) 8.52 ft on 01/27/1996
(5) 10.84 ft on 01/19/1996

Show More Recent Crests

(P): Preliminary values subject to further review.

Low Water Records
Currently none available.

Collaborative Agencies Collapse

The National Weather Service prepares its forecasts and other services in collaboration with agencies like the US Geological Survey, US Bureau of Reclamation, US Army Corps of Engineers, Natural Resource Conservation Service, National Park Service, ALERT Users Group, Bureau of Indian Affairs, and many state and local emergency managers across the country. For details, please click here.

NWS Information

National Weather Service
Gray Weather Forecast Office
P.O. Box 1208, 1 Weather Lane, Route 231
Gray, ME 04039
(207) 688-3216

Culvert Analysis Report

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1 year	41.40	41.40	967.57	2.121	0.0*	1-S2n	1.185	1.474	1.224	1.000	7.238	0.000
2 year	87.90	87.90	968.58	3.133	0.379	1-S2n	1.711	2.164	1.711	1.000	9.462	0.000
5 year	140.50	140.50	969.46	4.010	1.042	1-S2n	2.158	2.756	2.249	1.000	10.241	0.000
10 year	179.60	179.60	970.02	4.573	1.485	1-S2n	2.442	3.126	2.543	1.000	11.008	0.000
25 year	234.90	234.90	970.74	5.294	2.089	1-S2n	2.802	3.595	2.930	1.000	11.813	0.000
50 year	278.30	278.30	971.29	5.836	2.550	1-S2n	3.059	3.926	3.206	1.000	12.356	0.000
100 year	325.60	325.60	971.85	6.404	3.053	1-S2n	3.321	4.261	3.491	1.000	12.873	0.000
500 year	445.10	445.10	973.22	7.774	4.352	1-S2n	3.928	5.020	4.151	1.000	13.954	0.000

Table 1 - Culvert Summary Table: Existing 10' Dia CMP Low TW

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 965.45 ft, Outlet Elevation (invert): 963.62 ft

Culvert Length: 87.02 ft, Culvert Slope: 0.0210

****

Site Data - Existing 10' Dia CMP Low TW

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 965.45 ft

Outlet Station: 87.00 ft

Outlet Elevation: 963.62 ft

Number of Barrels: 1

Culvert Data Summary - Existing 10' Dia CMP Low TW

Barrel Shape: Circular

Barrel Diameter: 10.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 2 - Culvert Summary Table: Prop 23' x 7' Box Low TW

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1 year	41.40	41.40	966.17	0.669	0.0*	1-S2n	0.434	0.458	0.434	1.000	4.038	0.000
2 year	87.90	87.90	966.62	1.117	0.0*	1-S2n	0.696	0.759	0.696	1.000	5.353	0.000
5 year	140.50	140.50	967.03	1.527	0.0*	1-S2n	0.930	1.042	0.930	1.000	6.403	0.000
10 year	179.60	179.60	967.30	1.799	0.0*	1-S2n	1.084	1.232	1.084	1.000	7.019	0.000
25 year	234.90	234.90	967.65	2.153	0.0*	1-S2n	1.281	1.487	1.281	1.000	7.768	0.000
50 year	278.30	278.30	967.91	2.411	0.0*	1-S2n	1.425	1.664	1.425	1.000	8.271	0.000
100 year	325.60	325.60	968.18	2.677	0.0*	1-S2n	1.573	1.845	1.573	1.000	8.770	0.000
500 year	445.10	445.10	968.80	3.297	0.0*	1-S2n	1.917	2.273	1.917	1.000	9.837	0.000

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 965.50 ft, Outlet Elevation (invert): 960.00 ft

Culvert Length: 101.15 ft, Culvert Slope: 0.0545

****

Site Data - Prop 23' x 7' Box Low TW

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 962.50 ft

Outlet Station: 101.00 ft

Outlet Elevation: 957.00 ft

Number of Barrels: 1

Culvert Data Summary - Prop 23' x 7' Box Low TW

Barrel Shape: Concrete Box

Barrel Span: 23.00 ft

Barrel Rise: 10.00 ft

Barrel Material: Concrete

Embedment: 36.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0500 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Culvert Summary Table: Existing 10' Dia CMP High TW

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1 year	41.40	41.40	967.57	2.121	1.560	1-JS1t	1.185	1.474	3.380	7.000	1.711	0.000
2 year	87.90	87.90	968.58	3.133	1.595	1-JS1t	1.711	2.164	3.380	7.000	3.633	0.000
5 year	140.50	140.50	969.46	4.010	1.666	1-S2n	2.158	2.756	2.249	7.000	10.241	0.000
10 year	179.60	179.60	970.02	4.573	1.739	1-S2n	2.442	3.126	2.543	7.000	11.008	0.000
25 year	234.90	234.90	970.74	5.294	2.089	1-S2n	2.802	3.595	2.930	7.000	11.813	0.000
50 year	278.30	278.30	971.29	5.836	2.550	1-S2n	3.059	3.926	3.206	7.000	12.356	0.000
100 year	325.60	325.60	971.85	6.404	3.053	1-S2n	3.321	4.261	3.491	7.000	12.873	0.000
500 year	445.10	445.10	973.22	7.774	4.352	1-S2n	3.928	5.020	4.151	7.000	13.954	0.000

****

Straight Culvert

Inlet Elevation (invert): 965.45 ft, Outlet Elevation (invert): 963.62 ft

Culvert Length: 87.02 ft, Culvert Slope: 0.0210

****

Site Data - Existing 10' Dia CMP High TW

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 965.45 ft

Outlet Station: 87.00 ft

Outlet Elevation: 963.62 ft

Number of Barrels: 1

Culvert Data Summary - Existing 10' Dia CMP High TW

Barrel Shape: Circular

Barrel Diameter: 10.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 4 - Culvert Summary Table: Prop 23' x 7' Box High TW

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1 year	41.40	41.40	967.03	0.669	1.535	1-S1f	0.434	0.458	7.000	7.000	0.257	0.000
2 year	87.90	87.90	967.16	1.117	1.663	1-S1f	0.696	0.759	7.000	7.000	0.546	0.000
5 year	140.50	140.50	967.46	1.527	1.958	1-S1f	0.930	1.042	7.000	7.000	0.873	0.000
10 year	179.60	179.60	967.30	1.799	1.542	1-S2n	1.084	1.232	1.084	7.000	7.019	0.000
25 year	234.90	234.90	967.65	2.153	1.577	1-S2n	1.281	1.487	1.281	7.000	7.768	0.000
50 year	278.30	278.30	967.91	2.411	1.611	1-S2n	1.425	1.664	1.425	7.000	8.271	0.000
100 year	325.60	325.60	968.18	2.677	1.656	1-S2n	1.573	1.845	1.573	7.000	8.770	0.000
500 year	445.10	445.10	968.80	3.297	1.798	1-S2n	1.917	2.273	1.917	7.000	9.837	0.000

****

Straight Culvert

Inlet Elevation (invert): 965.50 ft, Outlet Elevation (invert): 960.00 ft

Culvert Length: 101.15 ft, Culvert Slope: 0.0545

****

Site Data - Prop 23' x 7' Box High TW

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 962.50 ft

Outlet Station: 101.00 ft

Outlet Elevation: 957.00 ft

Number of Barrels: 1

Culvert Data Summary - Prop 23' x 7' Box High TW

Barrel Shape: Concrete Box

Barrel Span: 23.00 ft

Barrel Rise: 10.00 ft

Barrel Material: Concrete

Embedment: 36.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0500 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None