Appendix 7

Proposed Upstream Fishway Final Design Plans submitted to FERC

a) Shawmut Final Fish Lift Design Plans Submittal to FERC under 2013 ISPP (December 31, 2019)
b) Re-submittal to FERC of Shawmut Fish Lift Final Design Plans as Relicensing Proposal (July 30, 2020)

Brookfield

Brookfield Renewable
150 Main Street
Lewiston, ME 04240

Tel 207.755.5600
Fax 207.755.5655
www.brookfieldrenewable.com

CEII/CUI

December 31, 2019

VIA FEDERAL EXPRESS

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N. E.
Washington, DC 20426

Submittal for the Shawmut Hydroelectric Project (FERC No. 2322) Upstream Fish Passage Facility

Dear Ms. Bose:

Brookfield White Pine Hydro, LLC (BWPH), licensee for the Shawmut Hydroelectric Project (FERC No. 2322) (Project), herein provides Final Design Drawings, Operation and Maintenance Plan and Consultation Records for the Shawmut Upstream Fish Passage Facility. The Project is located on the Kennebec River in the Towns of Fairfield and Benton, Kennebec County, Maine.

On September 16, 1998 the Federal Energy Regulatory Commission (FERC or Commission) issued an order approving the Lower Kennebec River Comprehensive Hydropower Settlement Agreement (Settlement). The 1998 Settlement and corresponding 1998 Water Quality Certificate (WQC) # L-19751-33-A-M amended the Project's 1986 FERC license to include permanent upstream fish passage requirements (Condition D and F). Both the Settlement and WQC stipulate that installation of permanent upstream fish passage at the Lockwood Project (FERC No. 2574).

Since the 1998 Settlement, Atlantic salmon have been listed as an endangered species under the Endangered Species Act and Atlantic salmon runs have increased within the Kennebec River. BWPH consulted with fisheries agencies and subsequently filed with the FERC an Interim Species Protection Plan (Interim SPP) for Atlantic Salmon. Under the FERC approved Interim SPP, BWPH is required to construct a permanent upstream fish passage facility at the Shawmut Project so as to provide volitional passage for upstream migration of Atlantic salmon and other anadromous species.

In compliance with 155 FERC 61,185(D), upstream fish passage design was developed in close consultation with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Maine Department of Marine Resources (MDMR), and the Maine Department of Inland Fisheries and Wildlife (MDIFW). Agencies provided comments that were addressed at every stage of design – 30%, 60% and 90% (consultation attached). As required by 155 FERC 61,185(I-43,F-51,F-52), NMFS provided concurrence with the final design package via email on Dec. 17, 2019.

Please contact me should you have any questions.

Sincerely,

Kelly Maloney
Manager, Compliance - Northeast

cc: Kelly Maloney, BWPH
Gerry Mitchell, BWPH

Enclosures: Exhibit A – Final Design Drawings
Exhibit B – Operation & Maintenance Plan
Exhibit C – Agency Consultation Documentation

Exhibit A – Final Design Drawings

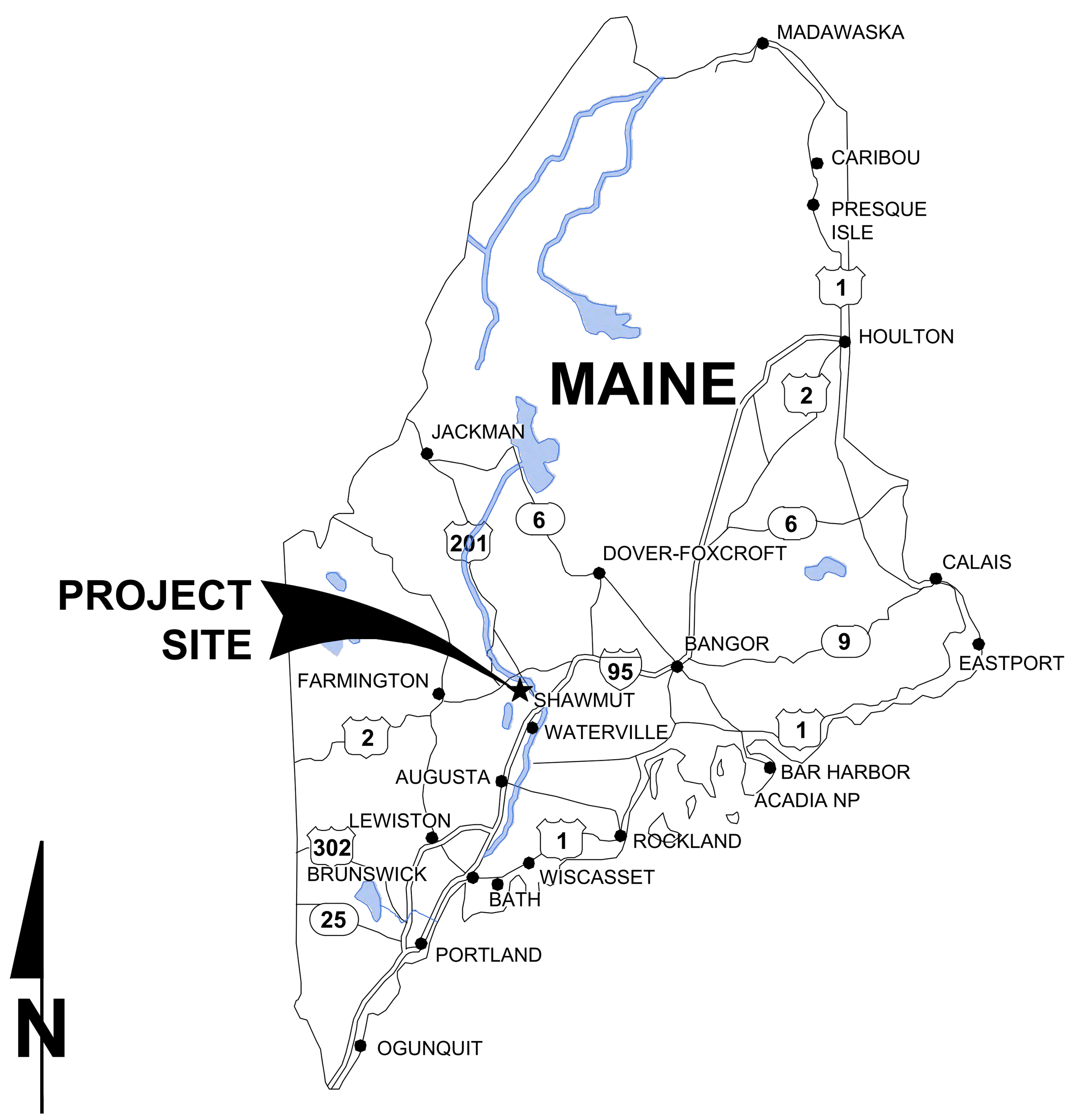
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE

PREPARED FOR

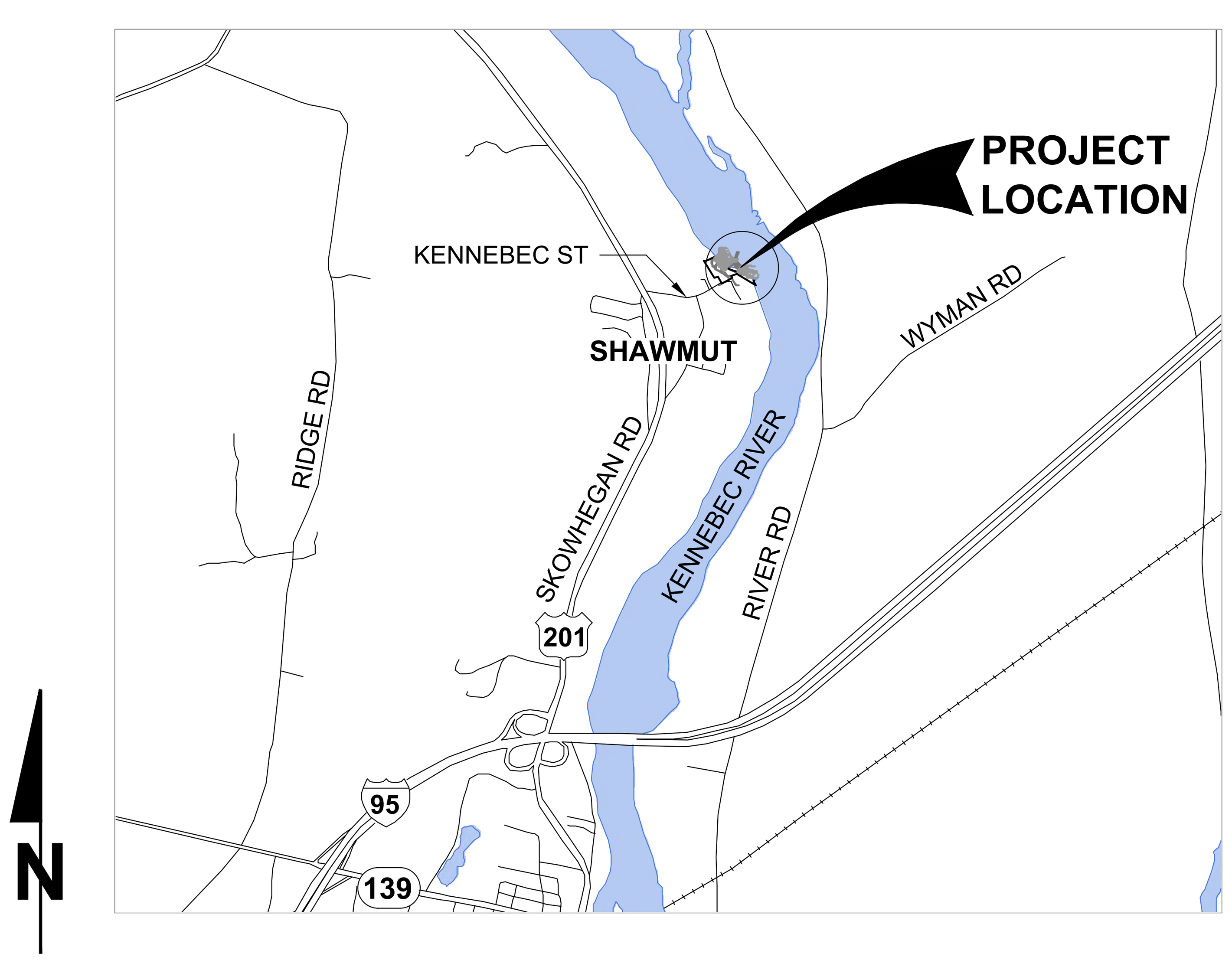
BROOKFIELD WHITE PINE HYDRO, LLC

PREPARED BY

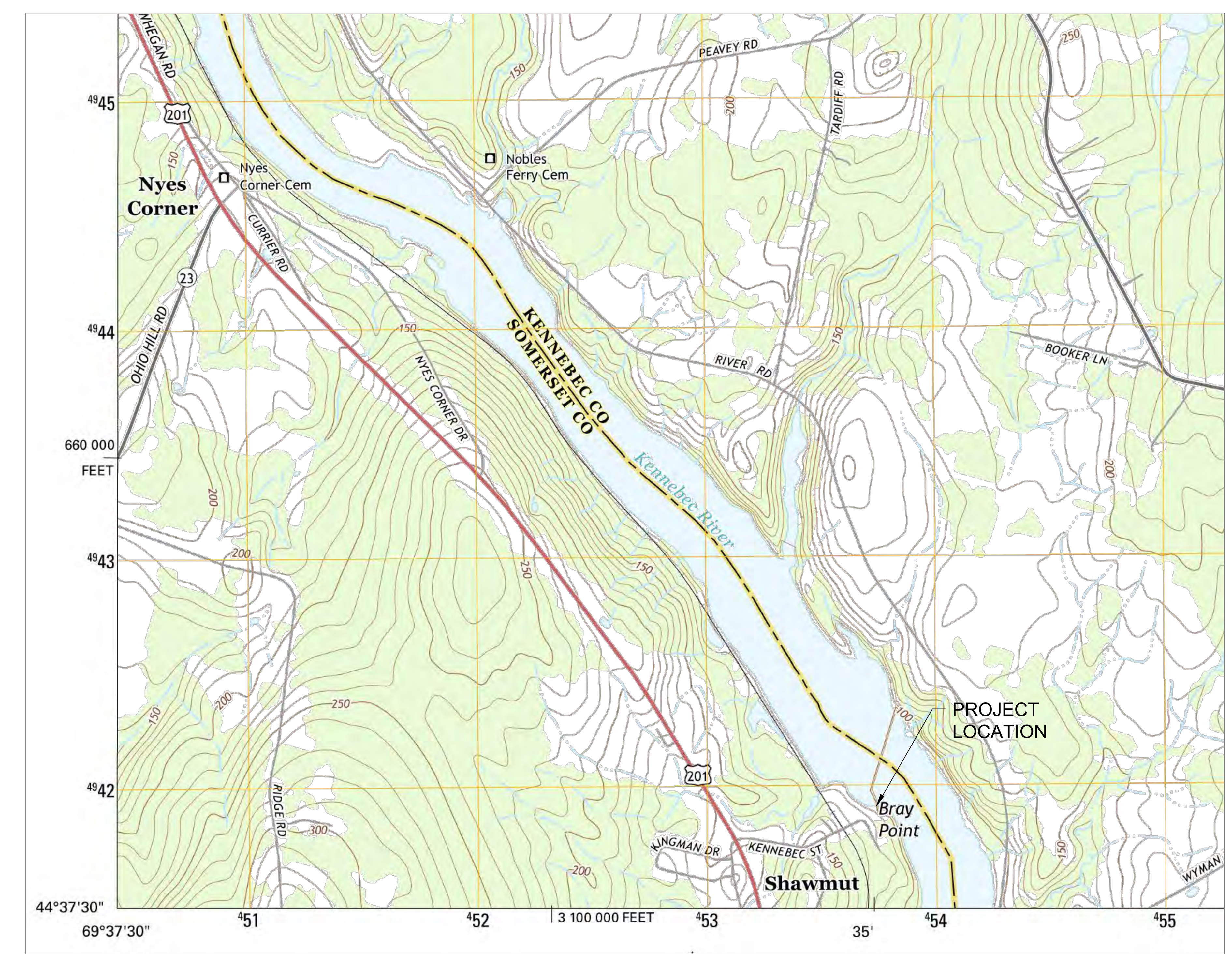
ALDEN RESEARCH LABORATORY, INC



LOCATION MAP
SCALE: NTS



VICINITY MAP
SCALE: NTS



LOCATION MAP
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

COVER SHEET, LOCATION MAP, AND VICINITY MAP

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	1 OF 176
DRAWING:	G-001

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden msa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\G\G-001.dwg USER: Agrogan
DATE: Dec 13, 2019 2:32pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP MAINE-PE-STAMP-MDG IMAGES:

DRAWING LIST

SHEET	DRAWING	DESCRIPTION
GENERAL		
1	G-001	COVER SHEET, LOCATION MAP, AND VICINITY MAP
2	G-002	DRAWING LIST
3	G-003	GENERAL NOTES AND ABBREVIATIONS
4	G-004	EXISTING CONDITIONS OVERALL SITE PLAN
5	G-005	SITE ACCESS, CONSTRUCTION LIMITS, GEOTECHNICAL BORINGS, AND SURVEY CONTROL
6	G-006	STAGING AREAS, EROSION CONTROL, & DEWATERING PLAN
7	G-007	EROSION CONTROL & DEWATERING PLAN - FISH LIFT
8	G-008	EROSION CONTROL & DEWATERING PLAN - UNIT 7 & 8 FISH PASSAGE
9	G-009	EROSION CONTROL & DEWATERING DETAILS
CIVIL (GENERAL)		
10	C-001	OVERALL SITE PLAN
CIVIL (FISH LIFT)		
11	C-101	EXISTING CONDITIONS PLAN - FISH LIFT
12	C-102	DEMOLITION AND ROCK EXCAVATION PLAN - FISH LIFT
13	C-103	DEMOLITION & EXCAVATION SECTIONS - FISH LIFT
14	C-104	FISH LIFT GENERAL ARRANGEMENT PLAN
15	C-105	FISH LIFT ENTRANCE FLUME GENERAL PLAN & SECTION
16	C-106	AWS SPILLWAY GENERAL ARRANGEMENT SECTION
17	C-107	FISH LIFT TRANSITION FLUME AND EXIT PIPING
18	C-108	FISH LIFT TRANSITION FLUME SUPPORT FRAME & EQUIPMENT
CIVIL (UNIT 7 & 8 FISH PASSAGE)		
19	C-301	EXISTING CONDITIONS PLAN - UNIT 7 & 8 FISH PASSAGE
20	C-302	DEMOLITION AND EXCAVATION PLAN - UNIT 7 & 8 FISH PASSAGE
21	C-303	DEMOLITION AND EXCAVATION SECTIONS - UNIT 7 & 8 FISH PASSAGE
22	C-304	UNIT 7 & 8 FISH PASSAGE GENERAL PLAN
23	C-305	UNIT 7 & 8 FISH PASSAGE PLAN AND SECTION
24	C-306	UNIT 7 & 8 FISH PASSAGE SECTIONS
25	C-307	UNIT 7 & 8 FISH PASSAGE SECTIONS
26	C-308	UNIT 7 & 8 FISH PASSAGE DUCT BANK RELOCATION
STRUCTURAL (GENERAL)		
27	S-001	STRUCTURAL NOTES
28	S-002	STRUCTURAL DESIGN CRITERIA
STRUCTURAL (FISH LIFT)		
29	S-101	AWS SPILLWAY & FISH LIFT - STRUCTURAL CONCRETE PLAN AT EL 94.00
30	S-102	AWS SPILLWAY & FISH LIFT - STRUCTURAL CONCRETE PLAN AT EL 118.00
31	S-103	AWS SPILLWAY & FISH LIFT - ENLARGED PLANS & DETAILS
32	S-104	AWS SPILLWAY & FISH LIFT - ENLARGED PLAN, DETAILS, & SECTIONS
33	S-105	AWS SPILLWAY STRUCTURAL CONCRETE SECTION
34	S-106	AWS SPILLWAY STRUCTURAL CONCRETE SECTIONS
35	S-107	AWS SPILLWAY STRUCTURAL CONCRETE SECTION
36	S-108	AWS SPILLWAY & FISH LIFT STRUCTURAL CONCRETE SECTION
37	S-109	AWS SPILLWAY & FISH LIFT STRUCTURAL CONCRETE SECTION
38	S-110	FISH LIFT STRUCTURAL CONCRETE SECTIONS
39	S-111	FISH LIFT STRUCTURAL CONCRETE SECTIONS
40	S-112	FISH LIFT STRUCTURAL CONCRETE SECTIONS & DETAILS
41	S-113	FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT
42	S-114	FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT ELEVATION
43	S-115	FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT DETAILS
44	S-116	FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT DETAILS
45	S-117	FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT DETAILS
46	S-118	ELECTRICAL ENCLOSURE
STRUCTURAL (TOWER)		
47	S-201	GENERAL STEEL FRAMING PLAN AT EL 118.00
48	S-202	TOWER LOWER LEVEL STEEL FRAMING PLAN
49	S-203	TOWER STEEL FRAMING SECTIONS
50	S-204	TOWER STEEL FRAMING SECTIONS
51	S-205	TOWER STEEL FRAMING SECTIONS
52	S-206	TOWER STEEL FRAMING STAIR SECTIONS
53	S-207	TOWER STEEL FRAMING PLATFORM PLANS
54	S-208	TOWER STEEL FRAMING PLATFORM PLANS
55	S-209	TOWER STEEL FRAMING SECTIONS AND DETAILS
56	S-210	TOWER STEEL FRAMING SECTIONS AND DETAILS
57	S-211	TOWER STEEL FRAMING SECTIONS AND DETAILS
58	S-212	TOWER STEEL FRAMING SECTIONS AND DETAILS
59	S-213	TOWER STEEL FRAMING SECTIONS AND DETAILS
60	S-214	STAIR SECTIONS AND DETAILS
61	S-215	TRANSITION FLUME AND FISH EXIT PIPE FRAMING PLANS
62	S-216	TRANSITION FLUME PLAN & SECTIONS
63	S-217	TRANSITION FLUME DETAILS
64	S-218	TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS
65	S-219	TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS
66	S-220	TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS
67	S-221	TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS
68	S-222	TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS
69	S-223	FISH EXIT PIPE SUPPORT DETAILS
70	S-224	FISH EXIT PIPE SUPPORT DETAILS
STRUCTURAL (UNIT 7 & 8 FISH PASSAGE)		
71	S-301	UNIT 7 & 8 FISH PASSAGE STRUCTURAL CONCRETE PLAN
72	S-302	UNIT 7 & 8 FISH PASSAGE STRUCTURAL ENLARGED CONCRETE PLAN
73	S-303	UNIT 7 & 8 FISH PASSAGE CONCRETE SECTIONS & DETAILS
74	S-304	UNIT 7 & 8 FISH PASSAGE CONCRETE SECTIONS
75	S-305	UNIT 7 & 8 FISH PASSAGE CONCRETE SECTIONS & DETAILS
76	S-306	UNIT 7 & 8 FISH PASSAGE STEEL GRATING AND STAIR PLAN
77	S-307	UNIT 7 & 8 FISH PASSAGE STEEL, SECTIONS & DETAILS
STRUCTURAL (STANDARD DETAILS)		
78	S-501	STRUCTURAL STANDARD DETAILS
79	S-502	STRUCTURAL STANDARD DETAILS
80	S-503	STRUCTURAL STANDARD DETAILS
81	S-504	STRUCTURAL STANDARD DETAILS
82	S-505	STRUCTURAL STANDARD DETAILS
MECHANICAL (FISH LIFT)		
83	M-101	ATTRACTION WATER INTAKE HEADGATE REQUIREMENTS
84	M-102	WEDGE WIRE AWS INTAKE SCREEN
85	M-103	FISH LIFT ENTRANCE ISOLATION GATE REQUIREMENTS
86	M-104	FISH LIFT ENTRANCE GATE ELEVATIONS AND STEM DETAILS
87	M-105	FISH LIFT ENTRANCE GATE STEEL SECTIONS & DETAILS
88	M-106	FISH LIFT ENTRANCE GATE STEEL DETAILS
89	M-107	FISH LIFT ENTRANCE GATE STEEL DETAILS
90	M-108	FISH LIFT V-GATE GENERAL PLAN, ELEVATIONS, AND DETAILS
91	M-109	FISH LIFT V-GATE OPERATOR SUPPORT DETAILS
92	M-110	FISH LIFT V-GATE DETAILS
93	M-111	FISH LIFT V-GATE STEEL FRAMING PLANS
94	M-112	FISH LIFT V-GATE BEARING DETAILS
95	M-113	FISH LIFT HOPPER - GENERAL LAYOUT AND INFORMATION
96	M-114	FISH LIFT HOPPER DETAILS
97	M-115	FISH LIFT HOPPER - HOPPER GATE AND BRAIL DETAILS
98	M-116	FISH LIFT HOPPER - GENERAL LAYOUT AND INFORMATION
99	M-117	FISH LIFT HOPPER - STEEL COMPONENTS
100	M-118	FISH LIFT HOPPER - STEEL COMPONENTS
101	M-119	FISH LIFT UPSTREAM TOWER SCREEN ELEVATION AND DETAILS
102	M-120	FISH LIFT BAFFLE ELEVATIONS AND DETAILS
103	M-121	FISH LIFT WEIR PANEL PLAN
104	M-122	FISH LIFT WEIR PANEL ELEVATION AND DETAILS
MECHANICAL (UNIT 7 & 8 FISH PASSAGE)		
105	M-301	UNIT 7 & 8 FISH PASSAGE U/S ISOLATION GATE REQUIREMENTS
106	M-302	UNIT 7 & 8 FISH PASSAGE FLAP GATE ELEVATIONS AND STEM DETAILS
107	M-303	UNIT 7 & 8 FISH PASSAGE FLAP GATE STEEL SECTION AND DETAILS
108	M-304	UNIT 7 & 8 FISH PASSAGE FLAP GATE STEEL DETAILS
109	M-305	UNIT 7 & 8 FISH PASSAGE FLAP GATE STEEL DETAILS
110	M-306	UNIT 7 & 8 FISH PASSAGE D/S ISOLATION GATE REQUIREMENTS
ELECTRICAL		
111	EE-AA-001	COVER SHEET
112	EE-AB-001	INDEX SHEET
113	EE-AD-001	SYMBOL, LEGEND & NOTES
114	EE-AE-001	BILL OF MATERIAL
115	EE-AG-001	CABLE SCHEDULES
116	EE-AG-002	CABLE SCHEDULES
117	EE-BA-001	AC POWER 1-LINE DIAGRAM
118	EE-BB-001	SYSTEM ARCHITECTURE
119	EE-CA-001	SITE PLAN
120	EE-CD-001	LIGHTING & POWER OUTLETS LAYOUT
121	EE-CE-001	FLCP EXTERIOR LAYOUT - FRONT VIEW
122	EE-CE-002	FLCP INTERIOR LAYOUT - FRONT VIEW
123	EE-CE-003	FPCP EXTERIOR LAYOUT - FRONT VIEW
124	EE-CE-004	FPCP INTERIOR LAYOUT - FRONT VIEW
125	EE-CE-005	FPMS EXTERIOR LAYOUT - FRONT
126	EE-CE-006	FPMS INTERIOR LAYOUT - FRONT
127	EE-CE-007	HOIST CONTROL STATION EXTERIOR LAYOUT
128	EE-CE-008	HOIST CONTROL STATION INTERIOR LAYOUT
129	EE-CE-009	MAINE POWERHOUSE DUCT BANK JUNCTION BOXES
130	EE-CE-010	UNITS 7 & 8 POWERHOUSE DUCT BANK JUNCTION BOXES
131	EE-DB-001	AWS GATE AT INTAKE ELEMENTARY
132	EE-DB-002	AWS INTAKE FLOW CONTROL GATE
133	EE-DB-003	HOPPER HOIST - CONTROL SCHEMATIC
134	EE-DB-004	EXIT FLUME WATER SUPPLY VALVE
135	EE-DB-005	EXIT FLUME WATER SUPPLY PUMP ELEMENTARY
136	EE-DB-006	U/S FISH LIFT ENTEREANCE GATE (HINGED GATE)
137	EE-DB-007	U/S FISH LIFT ENTERANCE GATE
138	EE-DB-008	NORTH V-GATE - ELEMENTARY DIAGRAM
139	EE-DB-009	SOUTH V-GATE - ELEMENTARY DIAGRAM
140	EE-DB-010	UPSTREAM CROSSOVER ISOLATION GATE
141	EE-DB-011	DOWNSTREAM CROSSOVER ISOLATION GATE
142	EE-DB-012	CROSSOVER ENTERANCE CONTROL GATE
143	EE-DC-001	FLCP PLC PANEL POWER DISTRIBUTION
144	EE-DC-002	FPCP PLC PANEL POWER DISTRIBUTION
145	EE-DD-001	PLC RACK 0, SLOT 0 & 1 POWER SUPPLY & CPU
146	EE-DD-002	PLC RACK 0, SLOT 2 DISCRETE OUTPUT MODULE
147	EE-DD-003	PLC RACK 0, SLOT 3 DISCRETE OUTPUT MODULE
148	EE-DD-004	PLC RACK 0, SLOT 4 DISCRETE INPUT MODULE
149	EE-DD-005	PLC RACK 0, SLOT 5 DISCRETE INPUT MODULE
150	EE-DD-006	PLC RACK 0, SLOT 6 DISCRETE INPUT MODULE
151	EE-DD-007	PLC RACK 0, SLOT 7 ANOLOG INPUT MODULE
152	EE-DD-008	PLC RACK 0, SLOT 8 ANOLOG INPUT MODULE
153	EE-DD-009	PLC RACK 0, SLOT 9 SPARE
154	EE-DD-010	PLC RACK 0, SLOT 10 ANOLOG OUTPUT MODULE
155	EE-DD-011	PLC RACK 0, SLOT 11 HIGH SPEED COUNTER MODULE
156	EE-DD-021	PLC RACK 1, SLOT 0 & 1 POWER SUPPLY AND CPU
157	EE-DD-022 SH1	PLC RACK 1, SLOT 2 DISCRETE MIXED INPUT / OUTPUT MODULE
158	EE-DD-022 SH2	PLC RACK 1, SLOT 2 DISCRETE MIXED INPUT / OUTPUT MODULE
159	EE-DD-023 SH1	PLC RACK 1, SLOT 3 ANALOG INPUT MODULE, CHANNELS 1-4
160	EE-DD-023 SH2	PLC RACK 1, SLOT 3 ANALOG INPUT MODULE, CHANNELS 5-8
161	EE-DD-024	PLC RACK 1, SLOT 4 ANALOG MIXED I/O MODULE
162	EE-ED-001	FLCP PANEL DOOR WIRING DIAGRAM
163	EE-ED-002	FLCP PANEL BACK PANEL WIRING DIAGRAM
164	EE-ED-003	FLCP PANEL LEFT SIDE TERMINALS WIRING DIAGRAM
165	EE-ED-004	FLCP PANEL RIGHT SIDE TERMINALS WIRING DIAGRAM
166	EE-EF-001	FPCP PANEL DOOR WIRING DIAGRAM
167	EE-EF-002	FPCP PANEL BACK PANEL WIRING DIAGRAM
168	EE-EG-001	FPCP LOCAL CONTROL PANEL WIRING DIAGRAM
169	EE-EH-001	HOPPER HOIST MANUAL STATION WIRING DIAGRAMS
170	EE-EJ-001	AC PANEL SCHEDULES
171	EE-EK-001	NORTH V-GATE WIRING DIAGRAM
172	EE-EK-002	SOUTH V-GATE WIRING DIAGRAM
173	EE-EK-003	HOPPER HOIST WIRING DIAGRAM
174	EE-EK-004	ATTRACTION WATER SUPPLY VALVE WIRING DIAGRAM
175	EE-EL-001	MAIN POWERHOUSE DUCT BANK JUNCTION BOXES WIRING DIAGRAM
176	EE-EL-002	UNITS 7 & 8 POWERHOUSE DUCT BANK JUMCTION BOXES WIRING DIAGRAM

100 SERIES = FISH LIFT

200 SERIES = TOWER

300 SERIES = UNIT 7 & 8 FISH PASSAGE

500 SERIES = STANDARD DETAILS

FINAL FOR BID

NOT FOR CONSTRUCTION

DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE · MARK DANIEL GRAESER · No.39328 · 12/13/2019 · LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

DRAWING LIST

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 2 OF 176
DRAWING: G-002

GENERAL NOTES:

1. LOCATIONS, ELEVATIONS, AND DIMENSIONS OF EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES ARE SHOWN ACCORDING TO THE BEST INFORMATION AVAILABLE AT THE TIME OF THE PREPARATION OF THESE DRAWINGS, BUT DO NOT PURPORT TO BE ABSOLUTELY CORRECT OR ACCURATE. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES AFFECTING THE WORK. SHOULD THE CONTRACTOR IDENTIFY ANY UTILITIES, STRUCTURES OR FEATURES NOT SHOWN ON THE PLANS, THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE IMMEDIATELY.
2. ALL UTILITIES SHALL BE KEPT IN OPERATION EXCEPT WITH THE EXPRESS WRITTEN CONSENT OF THE UTILITY OWNER. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PRESERVE EXISTING UTILITIES. ANY AND ALL DAMAGE TO EXISTING UTILITIES AS A RESULT OF THE CONTRACTOR'S ACTIONS, SHALL BE REPAIRED IMMEDIATELY AT THE CONTRACTOR'S EXPENSE.
3. REMOVE, REPLACE OR RELOCATE ALL OVERHEAD INTERFERENCE WHICH MAY AFFECT OPERATION DURING CONSTRUCTION AND TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD OR UNDERGROUND POWER, GAS OR OTHER UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS AND LIABILITY IN CONNECTION THEREWITH.
4. COORDINATE UNDERGROUND UTILITY MARKING WITH THE EXISTING UTILITIES BY CONTACTING DIGSAFE AT 1-888-344-7233 OR 811. DIGSAFE MUST BE CONTACTED A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION OR GROUND DISTURBANCE.
5. THE CONTRACTOR SHALL REVIEW THE SITE TO DETERMINE EXISTING CONDITIONS. ANYTHING NOT SHOWN ON THESE DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND SHALL NOT CONSTITUTE AN EXTRA, UNLESS RECOMMENDED BY THE ENGINEER AND APPROVED BY THE OWNER.
6. CONTACT THE OWNER'S REPRESENTATIVE IMMEDIATELY OF ANY CONFLICTS ARISING DURING THE CONSTRUCTION OF ANY IMPROVEMENTS SHOWN ON THESE DRAWINGS.
7. PRESERVE ALL SURVEY MARKERS AND MONUMENTATION WHEREVER POSSIBLE. THOSE REQUIRING REMOVAL SHALL BE RE-ESTABLISHED IN ACCORDANCE WITH THE LOCAL, STATE, OR FEDERAL GOVERNING AUTHORITY.
8. ALL DRAWINGS AND DETAILS INCLUDED IN THE CONTRACT DOCUMENTS SHALL FULLY APPLY TO THE WORK WHETHER SPECIFICALLY REFERENCED OR NOT.
9. LIMIT CONSTRUCTION OPERATIONS TO WITHIN THE RIGHT-OF-WAY, EASEMENTS, AND DESIGNATED WORK AREAS AS INDICATED. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR ANY DAMAGES OUTSIDE THE DESIGNATED WORK AREAS SHOWN ON THE DRAWINGS.
10. RESTORE ALL AREAS DISTURBED BY CONSTRUCTION ACTIVITIES. REFER TO RECLAMATION OF DISTURBED AREAS IN SPECIFICATIONS.
11. THE CONTRACTOR SHALL REPLACE ALL ROADS, STABILIZED EARTH, FENCES, AND DRIVEWAYS, ETC., WITH THE SAME TYPE OF MATERIAL THAT WAS REMOVED DURING CONSTRUCTION.
12. SHORING REQUIRED FOR THE STABILITY OF THE UNCOMPLETED STRUCTURE OR FOR INSTALLATION OR MODIFICATION OF STRUCTURAL MEMBERS SHALL BE THE CONTRACTOR'S RESPONSIBILITY.
13. DIMENSIONS OF VALVES, FITTINGS AND OTHER EQUIPMENT MAY VARY DEPENDING UPON MANUFACTURER. CONTRACTOR SHALL REVIEW SHOP DRAWINGS BEFORE SETTING BASES, SUPPORTS, ETC.
14. EXISTING FENCING DISTURBED OR REMOVED SHALL BE REPLACED IN-KIND.
15. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE A SECURE PROJECT SITE. BROOKFIELD WHITE PINE HYDRO, LLC. WILL NOT BE RESPONSIBLE FOR STOLEN OR VANDALIZED PROPERTY.
16. AT THE CLOSE OF EACH WORKING SHIFT, WHERE THE NEXT SHIFT WILL NOT IMMEDIATELY FOLLOW, PROTECT AND SECURE OPEN EXCAVATION.
17. VERTICAL DATUM IS BASED ON PLANT DATUM.

GENERAL FISH PASSAGE DESIGN CRITERIA NOTES:

1. FISHWAY DESIGN POPULATIONS (NOAA DECEMBER 23, 2016 LETTER TO BROOKFIELD):
   a. BLUEBACK HERRING: 1,535,000
   b. ALEWIVES: 134,000
   c. AMERICAN SHAD: 177,000
   d. ATLANTIC SALMON: 12,000
2. FISH PASSAGE STRUCTURE LOCATIONS:
   a. FISH LIFT: NORTH OF POWERHOUSE 1-6
   b. FISHWAY CHANNEL: NORTH OF POWERHOUSE 7 & 8 TO PROVIDE PASSAGE FROM POWERHOUSE 7-8 TAILRACE TO POWERHOUSE 1-6 TAILRACE
   c. DOWNSTREAM PASSAGE CHANNEL: NORTH OF POWERHOUSE 7-8 TO PROVIDE PASSAGE FROM POWERHOUSE 7-8 FOREBAY TO POWERHOUSE 7-8 TAILRACE
3. WATER ELEVATIONS:

   HEAD POND ELEVATIONS
   - MIN 108
   - NORMAL 112
   - MAX 122 (100 YR)

   TAILWATER ELEVATIONS
   UNITS 1 TO 6
   - DESIGN LOW 88.6 (95% EXCEEDANCE)
   - NORMAL 89.1
   - DESIGN HIGH 91.5 (5% EXCEEDANCE)

   TAILWATER ELEVATIONS
   UNIT 7 & 8
   - DESIGN LOW 87.1 (95% EXCEEDANCE)
   - NORMAL 87.6
   - DESIGN HIGH 90.0 (5% EXCEEDANCE)
4. AUXILIARY WATER SYSTEM (AWS)- DESIGN TO MINIMIZE TURBULENCE AND AIR ENTRAINMENT.
5. FISH PASSAGE FACILITIES DESIGN RANGE: RIVER FLOW BETWEEN 2,540 CFS (95% EXCEEDANCE) AND 20,270 CFS (5% EXCEEDANCE).
6. FISHWAY ENTRANCE
   - 6 TO 12 INCHES HEAD DROP
   - HINGED FLAP GATE TO MAINTAIN HEAD DROP AND VELOCITY
   - INVERT EL. 79.6
   - 8 FT WIDTH
7. FISHWAY ATTRACTION WATER SYSTEM
   - TOTAL ATTRACTION FLOW - 340 CFS (5% STATION CAPACITY)
   - FISH LIFT ENTRANCE - UP TO 225 CFS
   - AWS AUXILIARY SPILLWAY UP TO 225 CFS
   - 1/4-INCH OPENING OR LESS WEDGE WIRE SCREEN
8. FISH LIFT CYCLE TIME OF 15 MIN.
9. TWO SIDED BRAIL, 9.5 DEGREE SLOPE, SMOOTH ALUMINUM WITH 50% POROSITY.
10. EXIT FLUME
    - EXIT FLUME 20 INCH SMOOTH FIBERGLASS PIPE WITH ACCESS PORTS
    - 74 ± FT LONG
    - 5% SLOPE
11. UNIT 7&8 FISHWAY
    - 100 TO 140 CFS FLOW CAPACITY
    - SINGLE 42 INCH VERTICAL SLOT BAFFLE
    - 6.8 FT ENTRANCE WIDTH
    - HINGED ENTRANCE FLAP GATE TO MAINTAIN HEAD DROP
    - 6 TO 12 INCH ENTRANCE HEAD DROP

ABBREVIATIONS:

'	FEET
"	INCHES
&	AND
@	AT
100 FP	100 YEAR FLOOD PLAIN
ACI	AMERICAN CONCRETE INSTITUTE
ACSE	AMERICAN SOCIETY OF CIVIL ENGINEERS
ADD'L	ADDITIONAL
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AL	ALUMINUM
APPROX	APPROXIMATE
ASTM	AMERICAN SOCIETY OF TESTING MATERIALS
AWS	AUXILIARY WATER SYSTEM
B.O.	BOTTOM OF
B/O	BOTTOM OF
BC	BOLT CENTERLINE
BOC	BOTTOM OF CONCRETE
BTM	BOTTOM
C/C	CENTER TO CETNER
C/L	CENTER LINE
CF	CUBIC FEET
CFS	CUBIC FEET PER SECOND
CL	CENTER LINE
CONC	CONCRETE
CONST	CONSTRUCTION
R	CONSTRUCTION
CONT	CONTINUOUS
CTR	CENTER
D/S	DOWNSTREAM
DEMO	DEMOLISH
DIA	DIAMETER
DIMS	DIMENSIONS
DWG	DRAWING
EA	EACH
EF	EACH FACE
EL, ELEV	ELEVATION
ELF	EQUIVALENT LATERAL FORCES
EMBED	EMBEDMENT
ETC	ETCETERA
EW	EACH WAY
f'c	COMPRESSIVE STRENGTH OF CONCRETE
FLG	FLANGE
FLGS	FLANGES
FP	FLOOD PLAIN
FT	FOOT
fy	YIELD STRENGTH
GA	GAUGE
GALV	GALVANIZED
GP	GUSSET PLATE
HAS	HEADED ANCHOR STUDS
HORIZ	HORIZONTAL
HSS	HOLLOW STRUCTURE SECTION
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IN	INCH
INV	INVERT
JT	JOINT
L	ANGLE/LENGTH
LB	POUND
LBS	POUNDS
Ld	DEVELOPMENT LENGTH
LOC	LOCATIONS
MAX	MAXIMUM
MFR	MANUFACTURE/MANUFACTURER
MIN	MINIMUM
MIN.	MINUTES
MIN.	MINIMUM
MISC	MISCELLANEOUS
MPH	MILES PER HOUR
NHW	NORMAL HIGH WATER
NOAA	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NTS	NOT TO SCALE
NWE	NORMAL WATER ELEVATION
NWL	NORMAL WATER LEVEL
OC	ON CENTERS
OCBF	ORDINARY CONCENTRICALLY BRACED FRAME
OD	OUTSIDE DIAMETER
OPNG	OPENING
PL	PLATE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
R	RISERS/RADIUS
RD	ROAD
REINF	REINFORCING
REQ'D	REQUIRED
SCH	SCHEDULE
SF	SILT FENCE
SIM	SIMILAR
SPEC	SPECIFICATION
SQ	SQUARE
SS	STAINLESS STEEL
SST	STAINLESS STEEL
ST	STREET
STA	STATION
STD	STANDARD
STRUC	STRUCTURAL
SYM	SYMMETRICAL
T&B	TOP AND BOTTOM
T.O.	TOP OF
T/O	TOP OF
TC	TURBIDITY CURTAIN
THK	THICK
THRU	THROUGH
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOS	TOP OF STEEL
TOW	TOP OF WALL
TPI	THREADS PER INCH
TYP	TYPICAL
U/S	UPSTREAM
UNO	UNLESS NOTED OTHERWISE
UON	UNLESS OTHERWISE NOTED
US	UNITED STATES
VERT	VERTICAL
W	WIDTH/WIDE FLANGE SECTION
W/	WITH
WLS	WATER LEVEL SENSOR
WP	WORKING POINT
WSEL	WATER SURFACE ELEVATION
WSL	WATER SURFACE LEVEL
YR	YEAR

LEGEND & SYMBOLS:

- APPROXIMATE PROPERTY LINE
- NHW — NORMAL HIGH WATER LINE
- 100 FP — 100 YEAR FLOOD PLAIN
- SF — SILT FENCE
- TC — TURBIDITY CURTAIN
- COFFERDAM / BULKHEAD / DEWATERING STRUCTURE
- GRATING SPAN DIRECTION
- RAILING
- CHAIN
- B-X — GEOTECHNICAL BORING (3 ½" BORING)
- GEOTECHNICAL BORING (2 ½" BORING)
- 45° ANGLED BORING DRILLED IN DIRECTION INDICATED
- FLOW
- UNDISTURBED SOIL
- FLOW FILL
- GROUT
- CONCRETE
- GRATING
- BEDROCK
- CONCRETE DEMOLITION
- EXCAVATE BEDROCK

REFERENCE DRAWINGS		
FILE DRAWING NO.	DATE	DESCRIPTION
182-1	MAY 1912	GENERAL PLAN AND SECTIONS OF HEADGATES
182-11	JULY 1912	DETAIL PLAN AND SECTION OF PULP MILL FOUNDATIONS
182-22	FEBURARY 1913	GENERAL PLATE OF FORE BAY AND POWER HOUSE
183-77	AUGUST 1941	GENERAL ARRANGEMENT PROVISION FOR FUTURE UNIT RECONSTRUCTION FOREBAY WALL
183-81	AUGUST 1941	GATE PLUGS NORTH OF POWERHOUSE AND BUTTRESS SOUTH OF POWERHOUSE
183-142	SEPTEMBER 1962	FOREBAY AREA PLAN - SECTIONS
183-1-505	JUNE 1981	SITE LOCATION PLAN
183-1-506	JUNE 1981	GENERAL SITE PLAN
183-1-508	JUNE 1981	SITE GRADING PLAN
183-42-501	JUNE 1981	TAILRACE PLAN AND PROFILE
183-42-502	JUNE 1981	TAILRACE CROSS SECTIONS
183-42-503	JUNE 1981	TAILRACE CROSS SECTIONS
183-42-507	JUNE 1981	POWERHOUSE EAST ELEVATION
183-42-508	JUNE 1981	POWERHOUSE DOWNSTREAM ELEVATION
183-42-509	JUNE 1981	POWERHOUSE WEST ELEVATION
183-42-510	JUNE 1981	EXISTING HEADWORKS PLAN
183-42-523	JUNE 1981	POWERHOUSE CROSS SECTIONS
183-42-524	JUNE 1981	POWERHOUSE REINFORCEMENT & ANCHOR BOLT CROSS SECTIONS
183-42-525	JUNE 1981	POWERHOUSE CROSS SECTIONS
183-42-526	JUNE 1981	POWERHOUSE CROSS SECTIONS
183-42-527	JUNE 1981	POWERHOUSE CROSS SECTIONS
183-42-539	JUNE 1981	POWERHOUSE ROOF PLAN
183-42-562	OCTOBER 1981	ELECTRICAL DUCT BANK TO EXISTING POWERHOUSE
183-234	OCTOBER 1982	POWERHOUSE AND TAILRACE PLANS AND SECTIONS 1982 DEVELOPMENT
183-235	OCTOBER 1982	POWERHOUSE PLANS AND SECTIONS 1982 DEVELOPMENTS
183-236	OCTOBER 1982	POWERHOUSE ELEVATIONS 1982 DEVELOPMENTS
183-42-2	OCTOBER 1984	REFERENCE ANCHOR POINT CONC. GROWTH MONITORING ELEVATION 109'
183-31-1	FEBURARY 1999	BAYS 1, 2, & 3 ABANDONED WATER PASSAGE BAY CLOSURES PLAN, ELEVATION, AND SECTIONS
183-31-3	JANURARY 2001	BAYS 4, 5, & 6 ABANDONED WATER PASSAGE BAY CLOSURES PLAN, ELEVATION, AND SECTIONS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

GENERAL NOTES AND ABBREVIATIONS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	G. ALLEN
APPROVED BY:	M. GRAESER
SHEET:	3 OF 176
DRAWING:	G-003

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden msa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\G\G-003.dwg USER: Agrogan
DATE: Dec 13, 2019 2:32pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

NOTES:

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES AND STRUCTURES.
2. NORMAL HIGH WATER LINE; EL. 112 FT UPSTREAM OF THE DAM; EL. 89.1 FT DOWNSTREAM OF THE DAM; AND EL 87.6 FT IN THE UNIT 7 & 8 TAILRACE.

SITE PLAN
SCALE: 1"=30'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

EXISTING CONDITIONS OVERALL SITE PLAN

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. COLEMAN
APPROVED BY:	M. GRAESER
SHEET:	4 OF 176
DRAWING:	G-004

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden msa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\G\G-004.dwg USER: Agrogan
DATE: Dec 13, 2019 2:32pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP MAINE-PE-STAMP-MDG IMAGES:

SITE PLAN
SCALE: 1"=30'

NOTES:

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES AND STRUCTURES.
2. NORMAL HIGH WATER LINE; EL. 112 FT UPSTREAM OF THE DAM; EL. 89.1 FT DOWNSTREAM OF THE DAM; AND EL 87.6 FT IN THE UNIT 7 & 8 TAILRACE.
3. VERTICAL DATUM IS BASED ON PLANT DATUM.
4. GEOTECHNICAL INVESTIGATION WAS PROVIDED BY GZA GEOENVIRONMENTAL, INC. AND SUMMARIZED IN THE GEOTECHNICAL EVALUATION MEMORANDUM, DATED JULY 12, 2018.

LEGEND:

- B-X — GEOTECHNICAL BORING (3 ½" BORING)
- GEOTECHNICAL BORING (2 ½" BORING)
- 45° ANGLED BORING DRILLED IN DIRECTION INDICATED

BORING TABLE (GEOTECHNICAL REPORT MARCH 25, 1981)

BORING	NORTHING	EASTING	DESCRIPTION
B-1	655044.2927	3104617.3848	3 1/2" BORING
B-2	655076.7896	3104630.5497	3 1/2" BORING
B-3	655032.3555	3104661.1033	3 1/2" BORING
B-4	655067.1176	3104686.6711	3 1/2" BORING
B-5	655049.2582	3104673.9852	3 1/2" BORING
B-6	655025.2211	3104605.1923	2 1/2" BORING
B-7	655014.2703	3104667.3810	2 1/2" BORING
B-8	655026.3636	3104716.6369	2 1/2" BORING
B-8A	655028.7351	3104717.9940	2 1/2" BORING

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

SITE ACCESS, CONSTRUCTION LIMITS, GEOTECHNICAL BORINGS, AND SURVEY CONTROL

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	5 OF 176
DRAWING:	G-005

SITE PLAN
SCALE: 1"=30'

NOTES:

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES AND STRUCTURES.
2. NORMAL HIGH WATER LINE; EL. 112 FT UPSTREAM OF THE DAM; EL. 89.1 FT DOWNSTREAM OF THE DAM; AND EL 87.6 FT IN THE UNIT 7 & 8 TAILRACE.
3. SEE DRAWING G-009 FOR TYPICAL DETAILS.

LEGEND:

- —SF——SF— SILT FENCE
- —TC——TC— TURBIDITY CURTAIN
- — — — — COFFERDAM/BULKHEAD/DEWATERING STRUCTURE
- ——NHW—— NORMAL HIGH WATER LINE

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

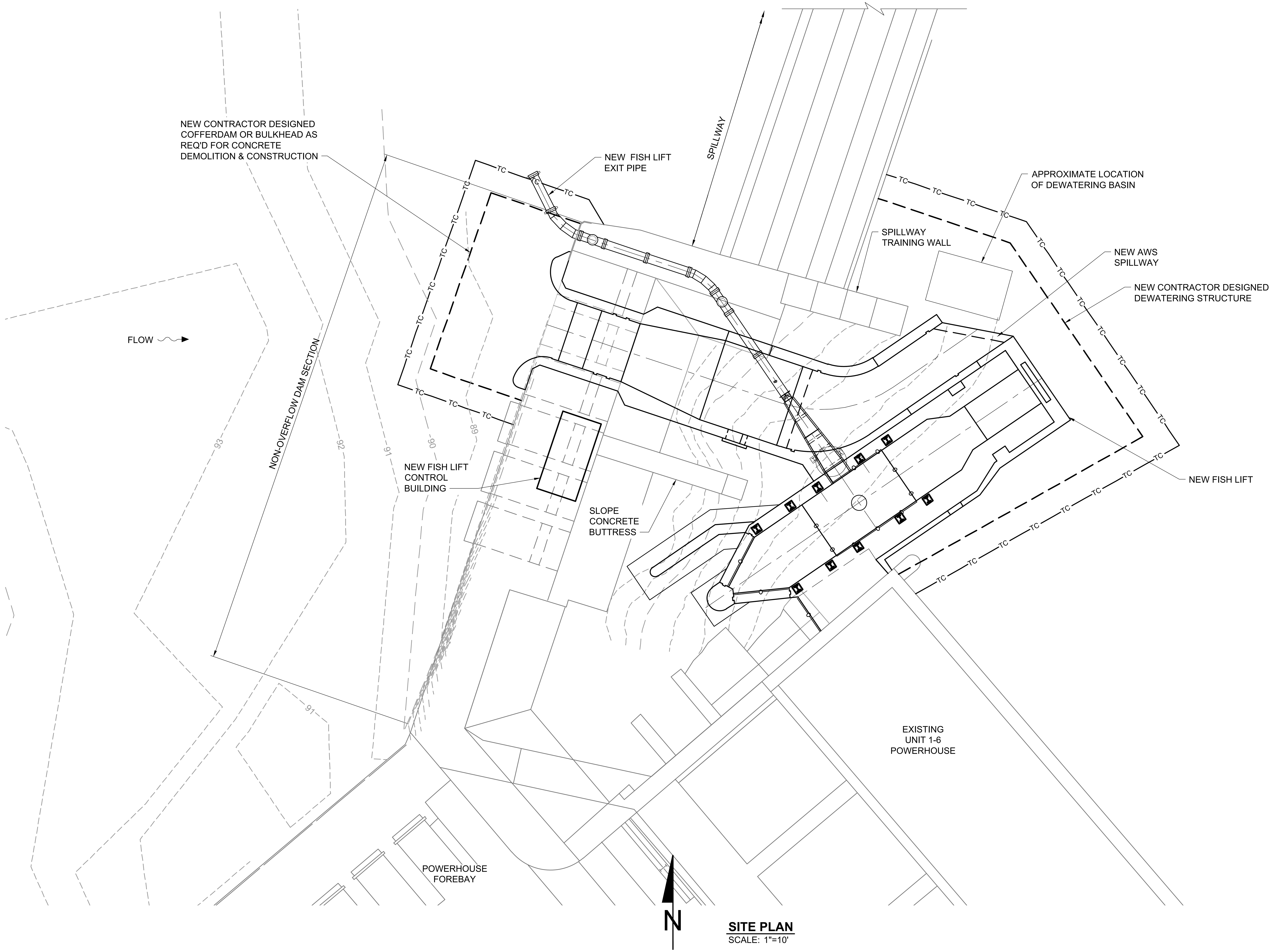
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STAGING AREAS, EROSION CONTROL, & DEWATERING PLAN

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	6 OF 176
DRAWING:	G-006



SITE PLAN
SCALE: 1"=10'

NOTE:

1. SEE DRAWING G-009 FOR TYPICAL DETAILS.

LEGEND:

—TC—TC— TURBIDITY CURTAIN

— — — — COFFERDAM/BULKHEAD/DEWATERING STRUCTURE

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

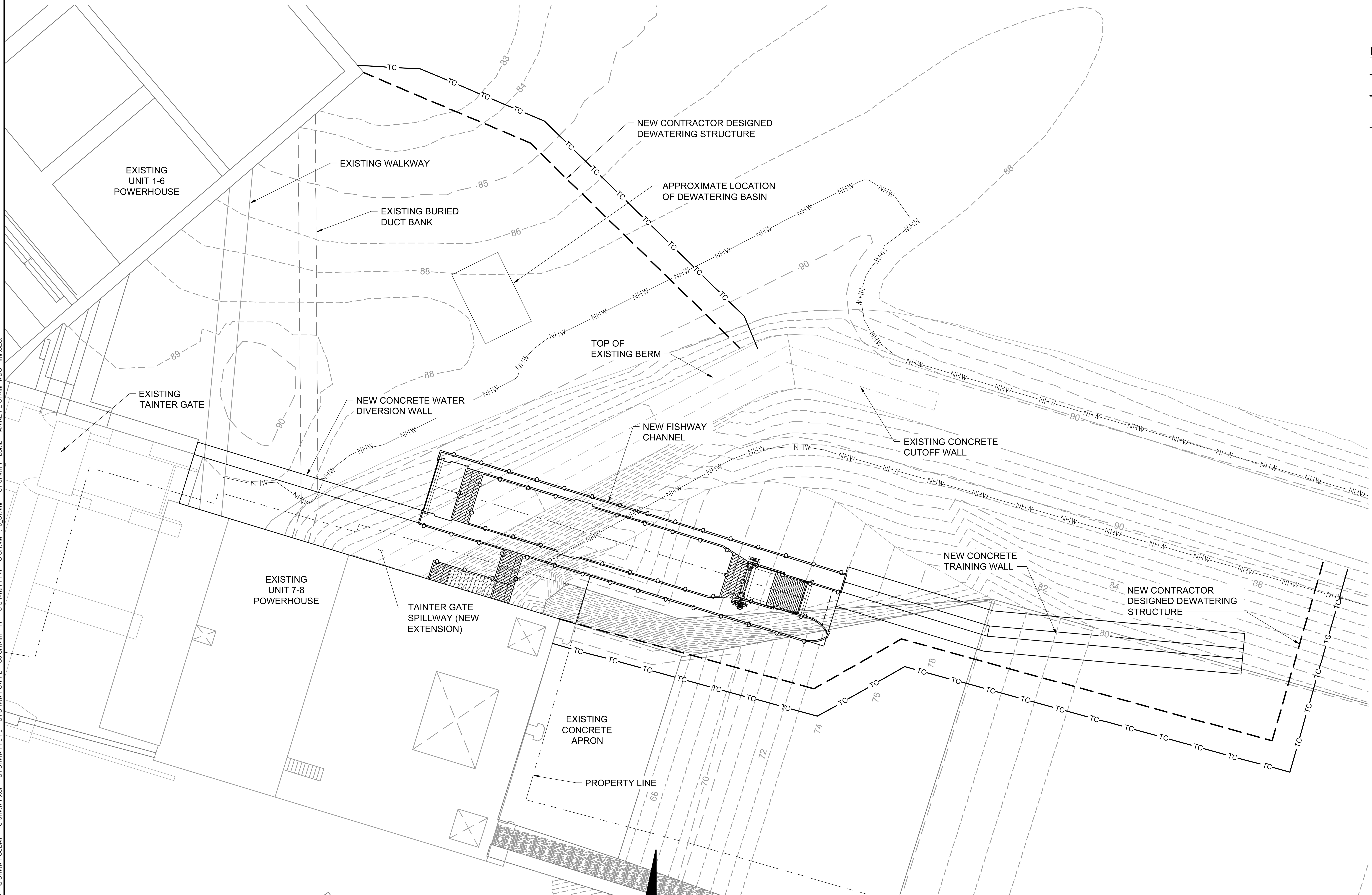
STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

EROSION CONTROL & DEWATERING PLAN - FISH LIFT

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	7 OF 176
DRAWING:	G-007

DWG: C:\Users\agroga\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\G\G-007.dwg USER: Agrogan
DATE: Dec 13, 2019 2:32pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP C-SHWMT-PFW S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:



SITE PLAN
SCALE: 1"=10'

NOTE:

1. SEE DRAWING G-009 FOR TYPICAL DETAILS.

LEGEND:

- —TC—TC— TURBIDITY CURTAIN
- — — — COFFERDAM/BULKHEAD/DEWATERING STRUCTURE
- —NHW—NHW— NORMAL HIGH WATER LINE

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

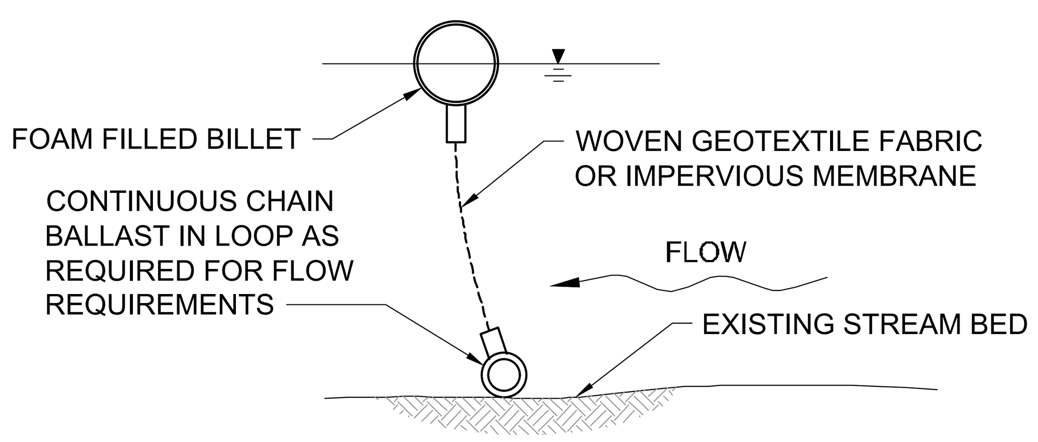
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED — PROFESSIONAL ENGINEER — 12/13/2019

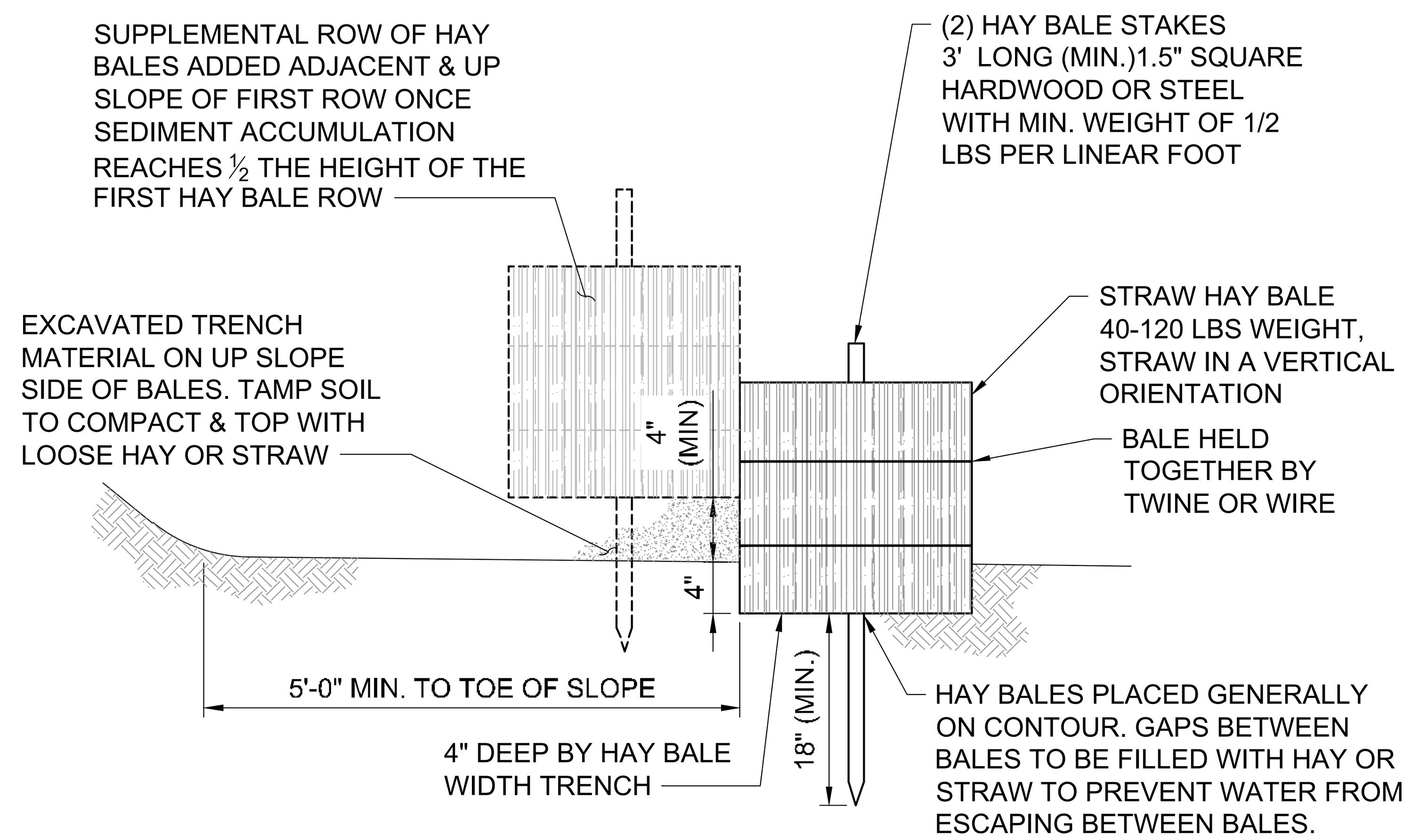
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

EROSION CONTROL & DEWATERING PLAN - UNIT 7 & 8 FISH PASSAGE

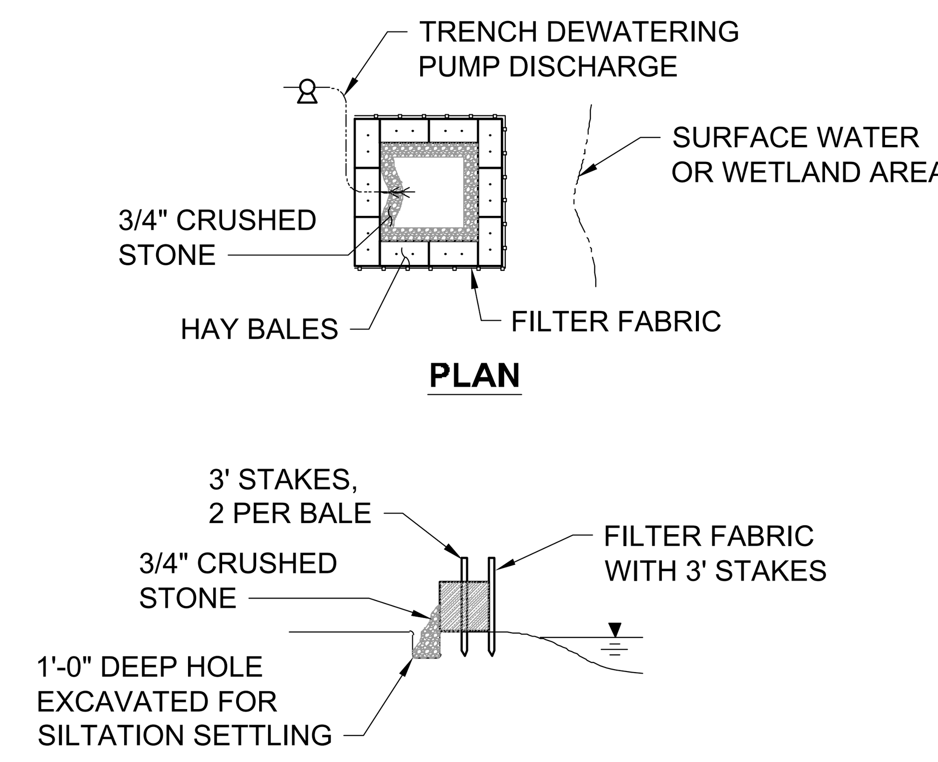
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	8 OF 176
DRAWING:	G-008



1 **TURBIDITY CURTAIN**
SCALE: NTS



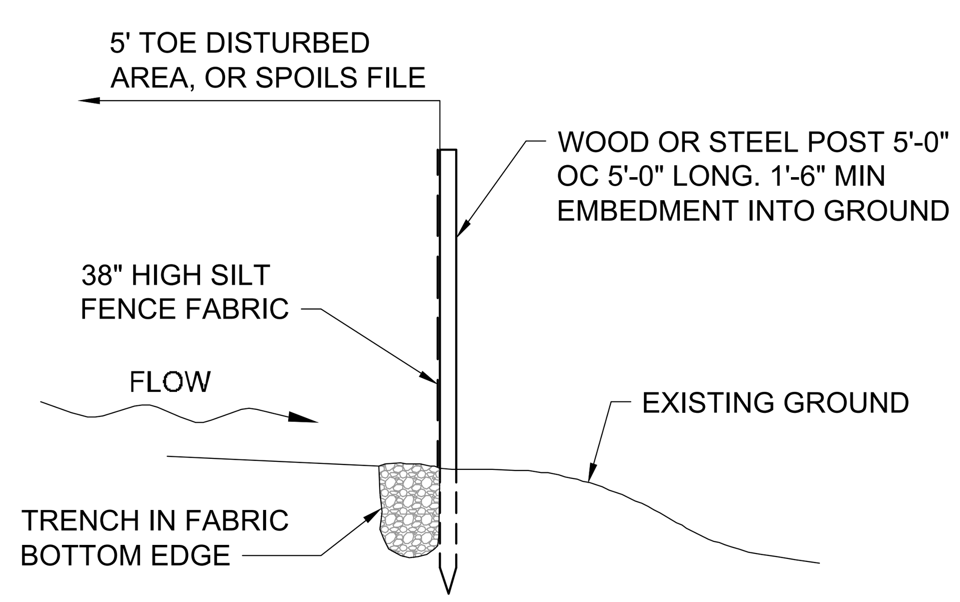
2 **HAY BALE BARRIER**
SCALE: NTS

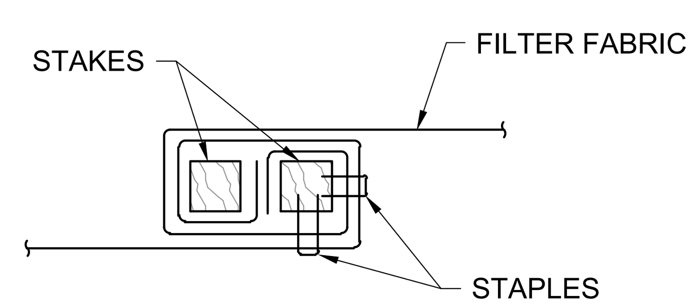


3 **DEWATERING/SETTLING BASIN**
SCALE: NTS

SOIL EROSION & SEDIMENT CONTROL NOTES:

1. SEDIMENTATION BASIN: SEDIMENT LADEN WATER SHALL NOT BE RELEASED INTO ANY WATERWAY. CONTRACTOR SHALL PROVIDE APPROPRIATE SIZED SEDIMENTATION BASIN, WATER FILTERING BAGS OR OTHER APPROVED SEDIMENT REMOVAL DEVICES FOR ALL DEWATERING OR WATER DIVERSION ACTIVITIES.
2. SILT FENCE: IF NEEDED TO CONTROL WATER CONTAMINATION. PROVIDE SILT FENCE CONFORMING TO THE FOLOWING:
   - EQUIVALENT OPENING - SIZE OF A US STANDARD SIEVE SIZED 40 (MAX), 70 (MIN).
   - MULLEN BURST STRENGTH - 200 PSI.
   - GRAB STRENGTH - 120 LBS MIN.
   - SPUN-BONDED NYLON FABRIC - REINFORCED WITH POLYESTER NETTING, OR POLYPROPYLENE FABRIC WITH 2" x 4" 12 GA WOVEN WIRE BACKING FENCE.
3. DE-SILTING BASINS OR WATER FILTERING BAGS OR OTHER APPROVED SEDIMENT REMOVAL DEVICES ON SHORE SHALL HAVE A VEGETATIVE BUFFER FOR THE DISCHARGE. BASINS NEED TO BE ACCESSIBLE FOR MAINTENANCE BUT OUT OF THE WAY OF LAYDOWN AND CONSTRUCTION ACTIVITIES.





JOINING FENCE DETAIL

NOTES:

1. PROVIDE SILT FENCE ON DOWNSLOPE SIDE OF SOIL DISTURBANCES OR ALL STOCKPILES UNTIL PERMANENT VEGETATION IS ESTABLISHED.
2. FILTER FABRIC FENCE MUST BE INSTALLED AT EXISTING LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST BE EXTENDED AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.
3. SEDIMENT MUST BE REMOVED WHERE ACCUMULATIONS REACH ⅓ THE ABOVE GROUND HEIGHT OF THE FENCE.
4. SILT FENCE TO BE INSPECTED AFTER EACH RUNOFF EVENT AND AT LEAST WEEKLY.

4 **SILT FENCE**
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

EROSION CONTROL & DEWATERING DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	9 OF 176
DRAWING:	G-009

NOTE:

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES AND STRUCTURES.

SITE PLAN
SCALE: 1"=30'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\C\C-001.dwg USER: Agrogan
DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP C-SHWMT-PFW S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

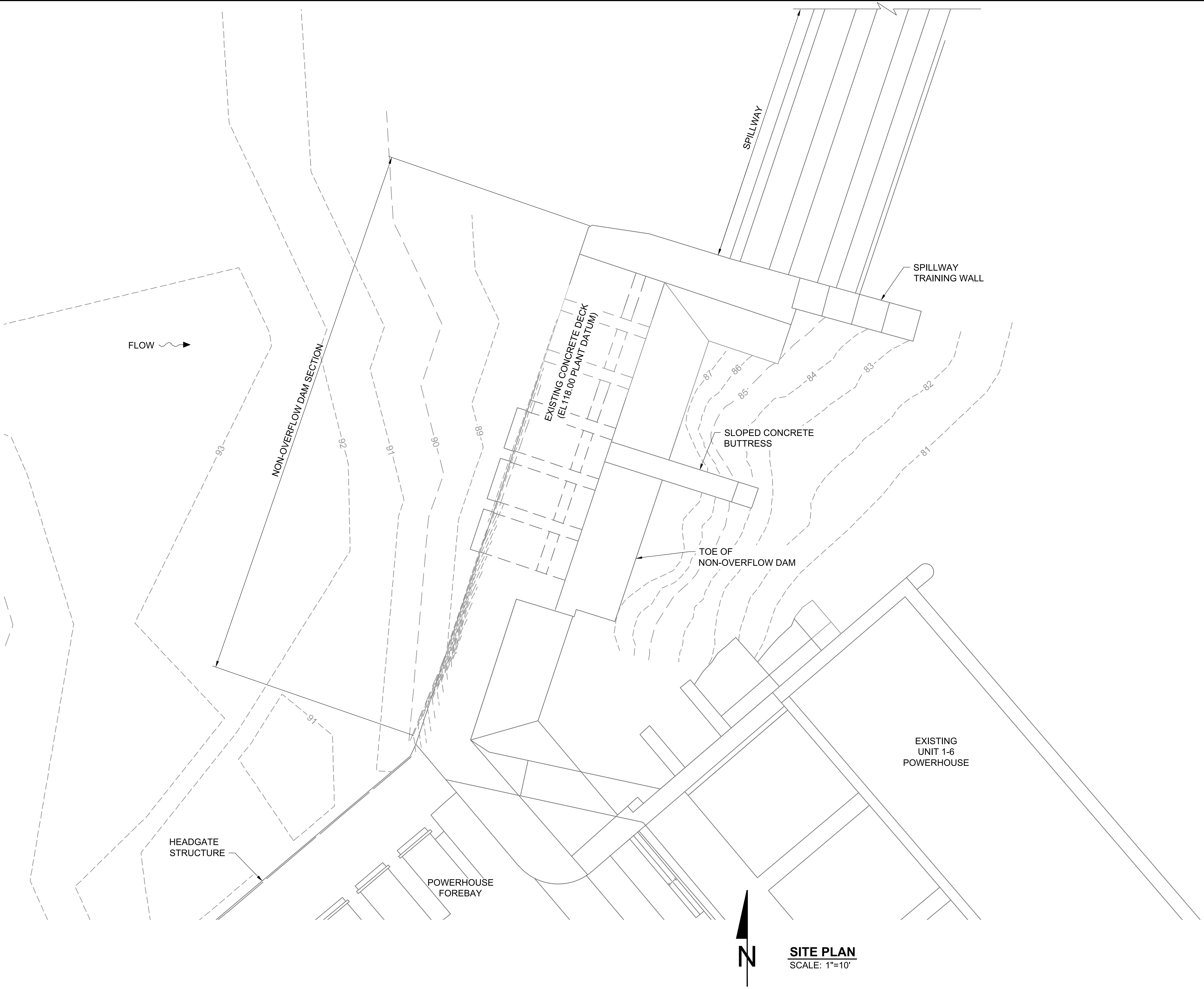
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

OVERALL SITE PLAN

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	10 OF 176
DRAWING:	C-001

NOTE:

1. VERTICAL DATUM IS BASED ON PLANT DATUM.



SITE PLAN
SCALE: 1"=10'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

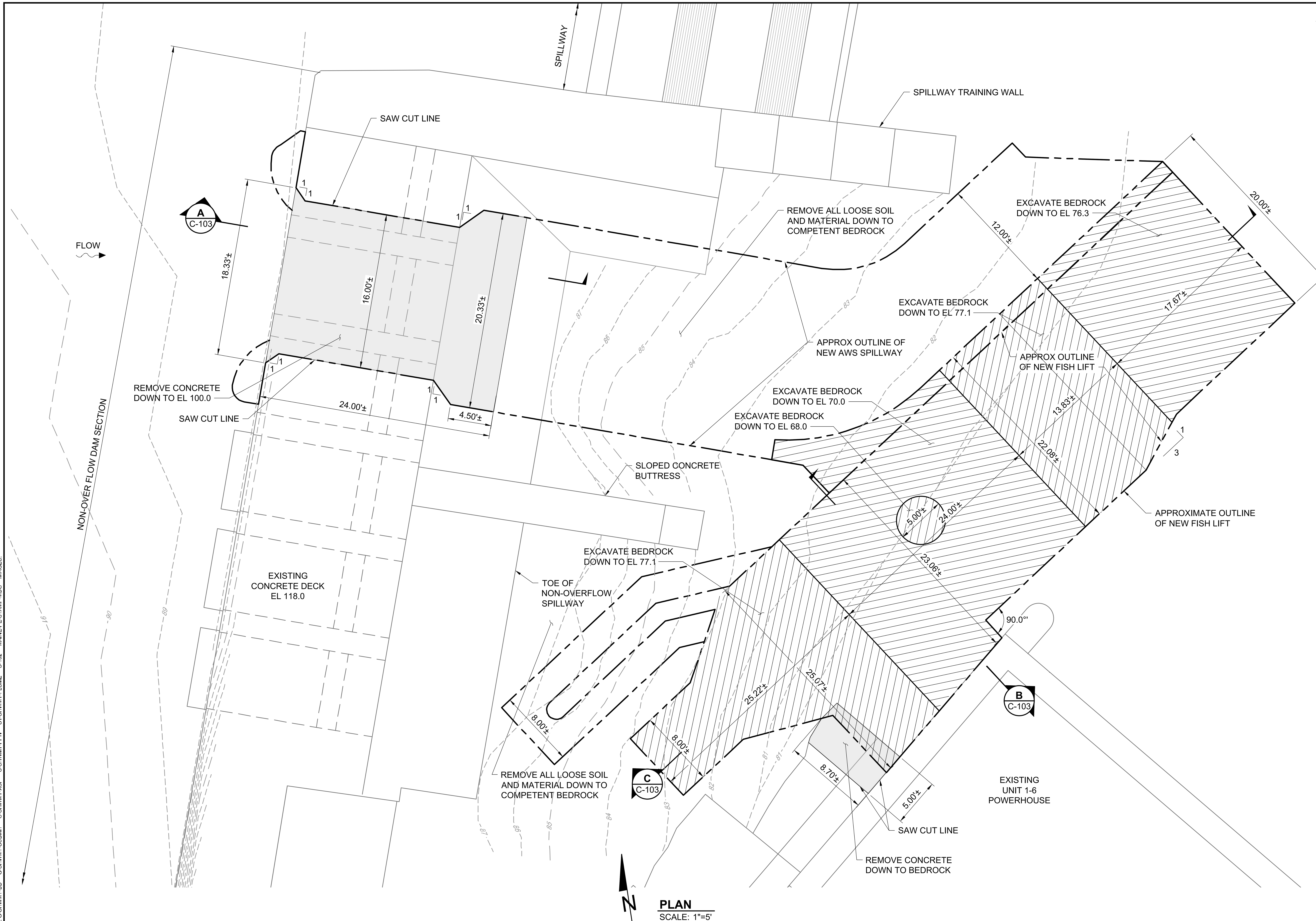
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

EXISTING CONDITIONS
PLAN - FISH LIFT

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	11 OF 176
DRAWING:	C-101



NOTE:

1. EXCAVATION LIMITS SHOWN ARE APPROXIMATE. ACTUAL EXCAVATION LIMITS WILL VARY BASED ON CONTRACTOR'S COMPLIANCE WITH APPLICABLE SAFETY REQUIREMENTS.

LEGEND:

- CONCRETE DEMOLITION
- EXCAVATE BEDROCK (SEE PLAN FOR ELEVATION)
- APPROX OUTLINE OF NEW STRUCTURES

FLOW

KENNEBEC RIVER

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

DEMOLITION AND ROCK EXCAVATION PLAN - FISH LIFT

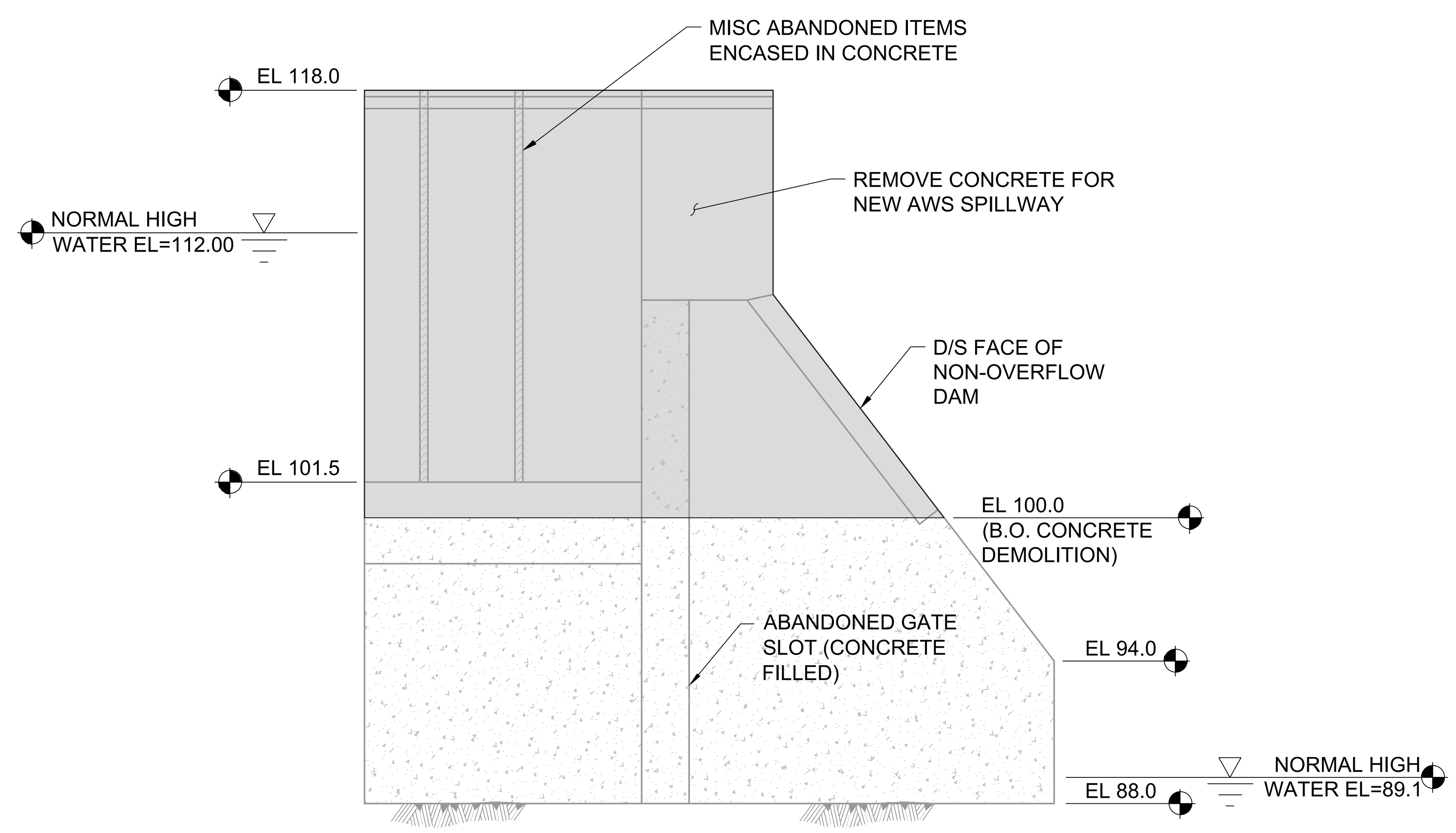
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	12 OF 176
DRAWING:	C-102

EXCAVATION NOTE:

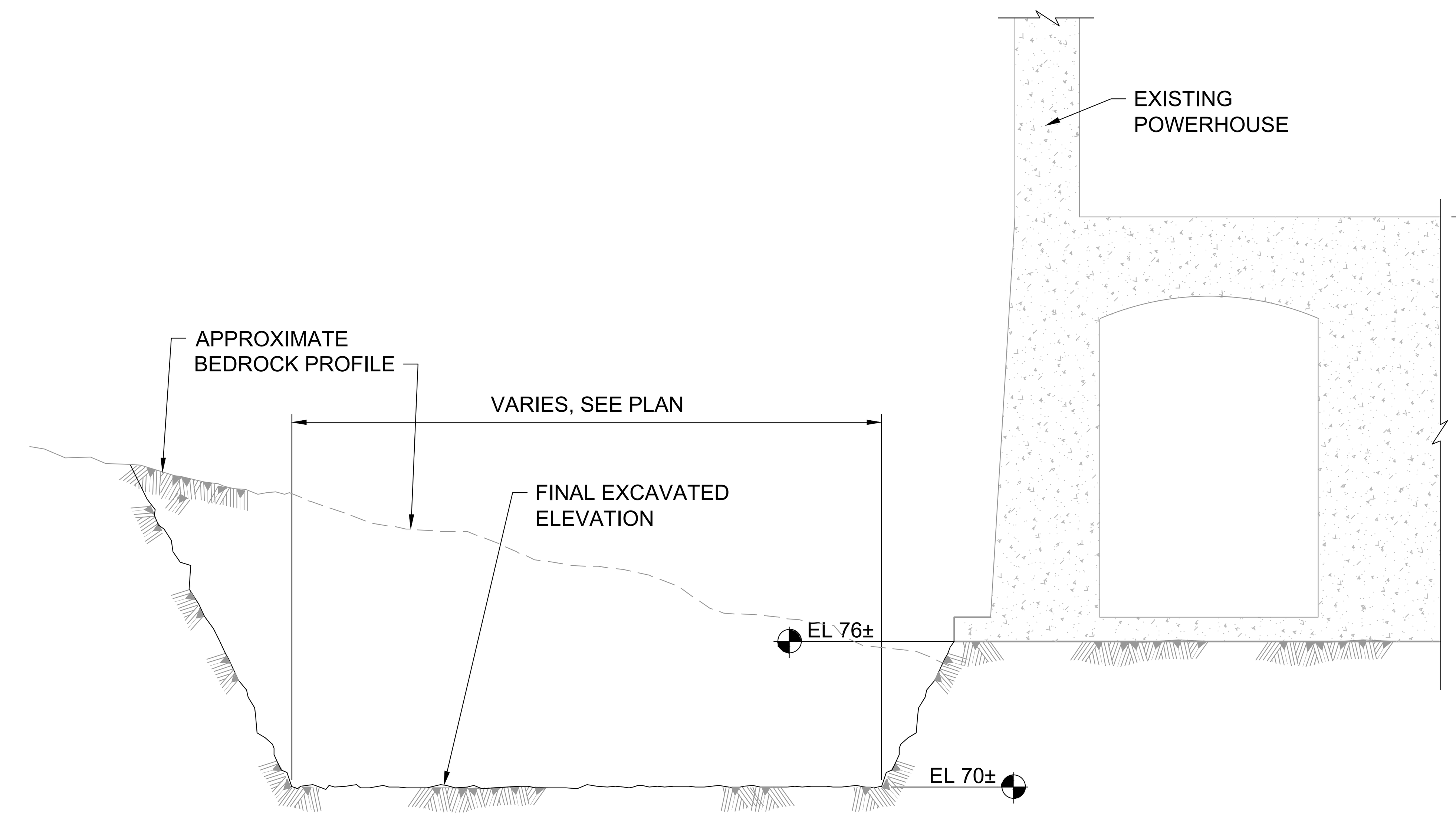
1. SLOPES SHOWN ARE APPROXIMATE. ACTUAL SLOPES WILL VARY BASED ON CONTRACTORS COMPLIANCE WITH APPLICABLE SAFETY REQUIREMENTS.

LEGEND:

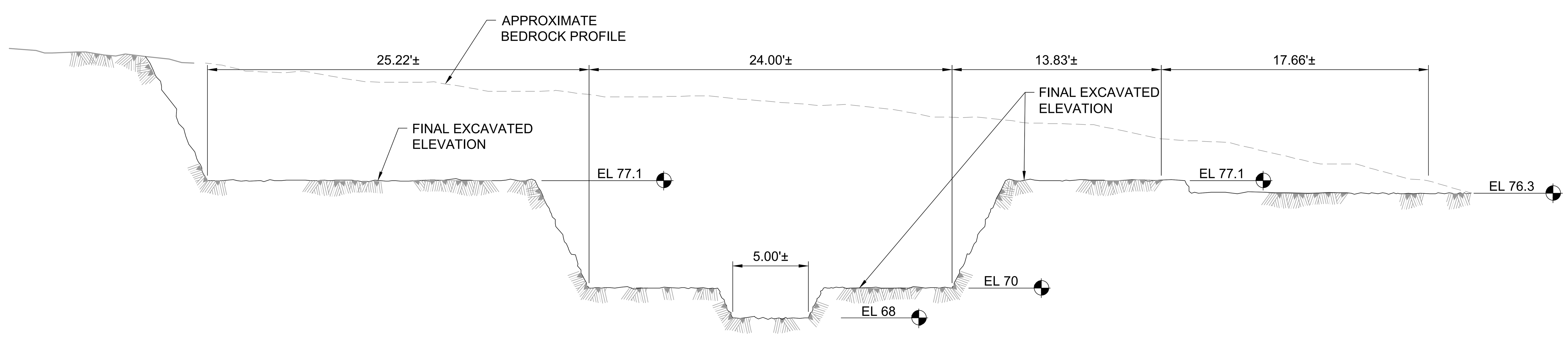
CONCRETE DEMOLITION



A SECTION
C-102 SCALE: 1"=5'



B SECTION
C-102 SCALE: 1"=5'



C SECTION
C-102 SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

DEMOLITION & EXCAVATION
SECTIONS - FISH LIFT

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 13 OF 176
DRAWING: C-103

DWG: C:\Users\agroga\documents\autocad sheet sets\31009-alden mss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\C\C-104.dwg USER: Agrogan IMAGES:
DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP C-SHWMT-PFW S1-SHWMT-FLUME MAINE-PE-STAMP-MDG

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

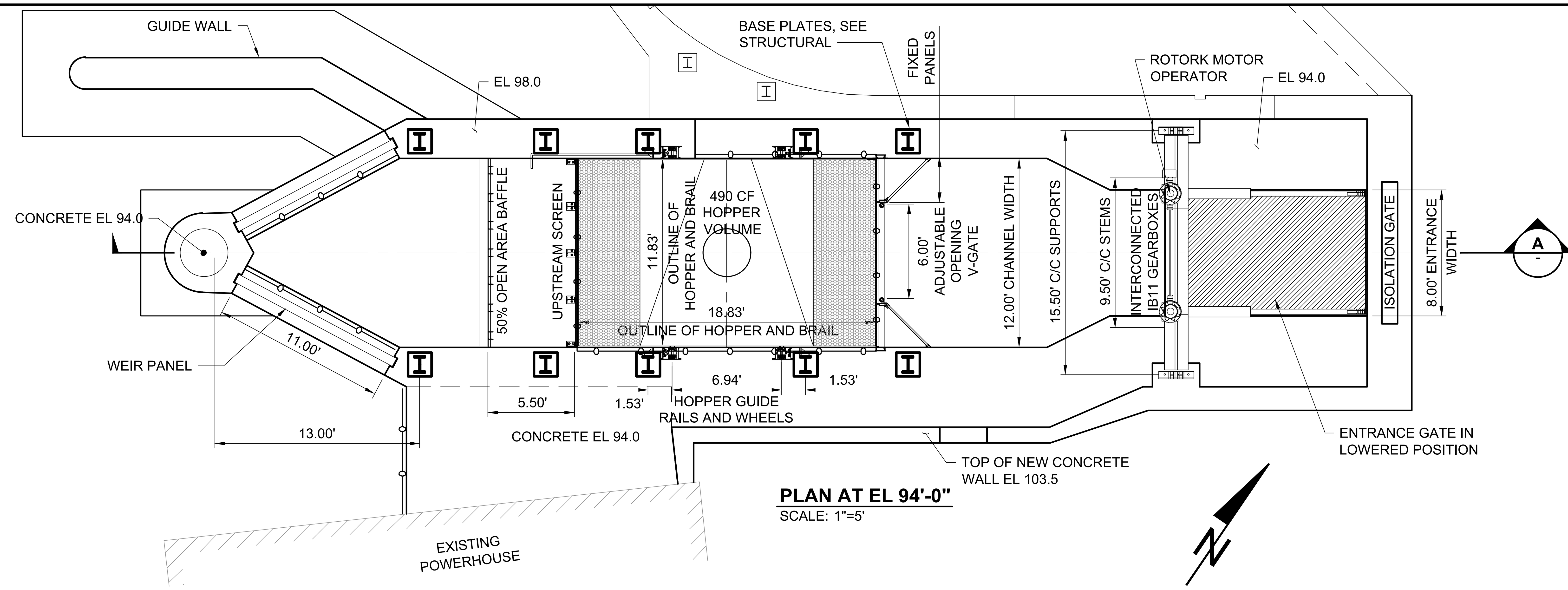
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT GENERAL ARRANGEMENT PLAN

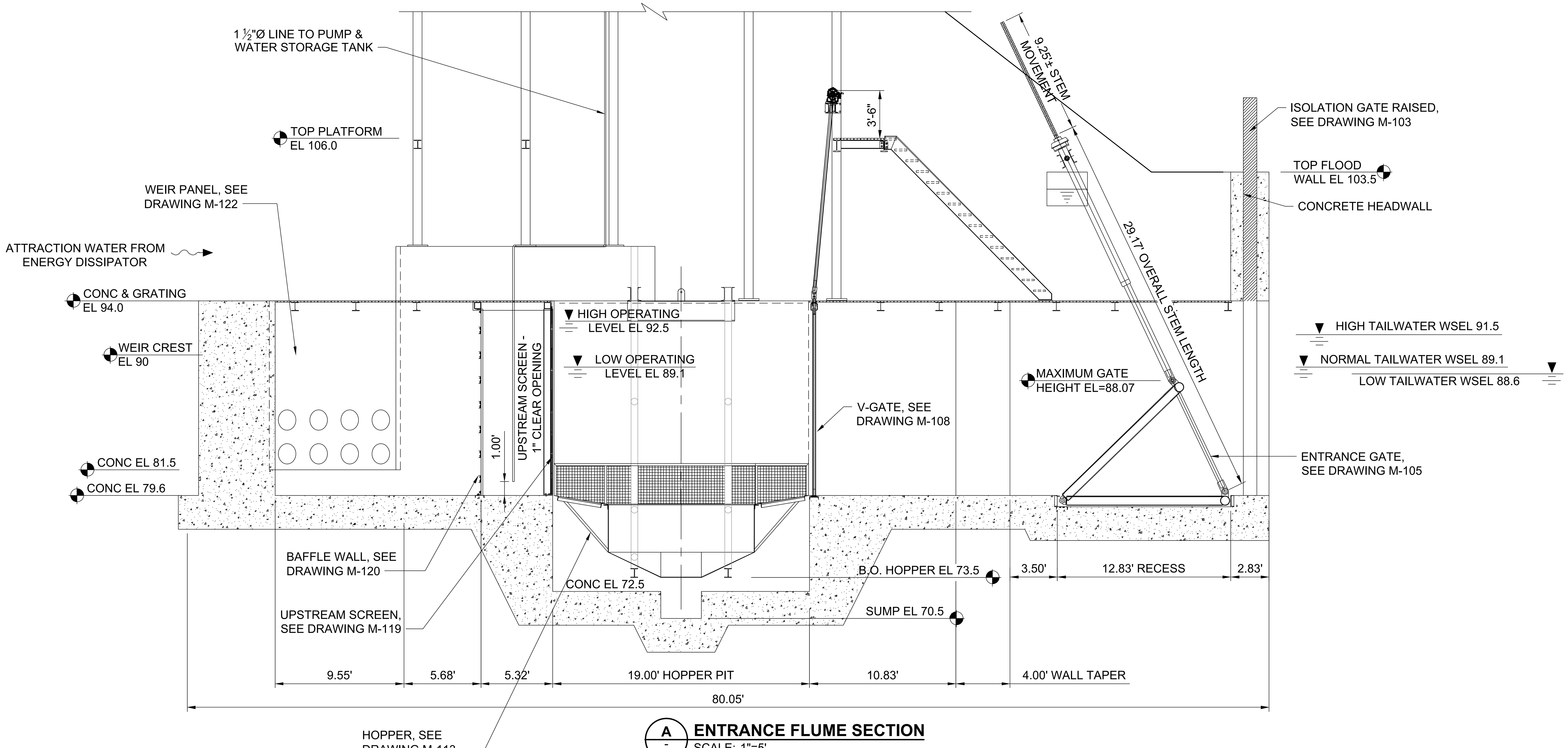
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 14 OF 176
DRAWING: C-104

NOTES:

1. SEE DRAWING S-113 FOR CONCRETE ENTRANCE FLUME EMBEDMENTS.
2. SEE MECHANICAL (M) DRAWINGS FOR GATE DETAILS AND REQUIREMENTS.



PLAN AT EL 94'-0"
SCALE: 1"=5'



A ENTRANCE FLUME SECTION
SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

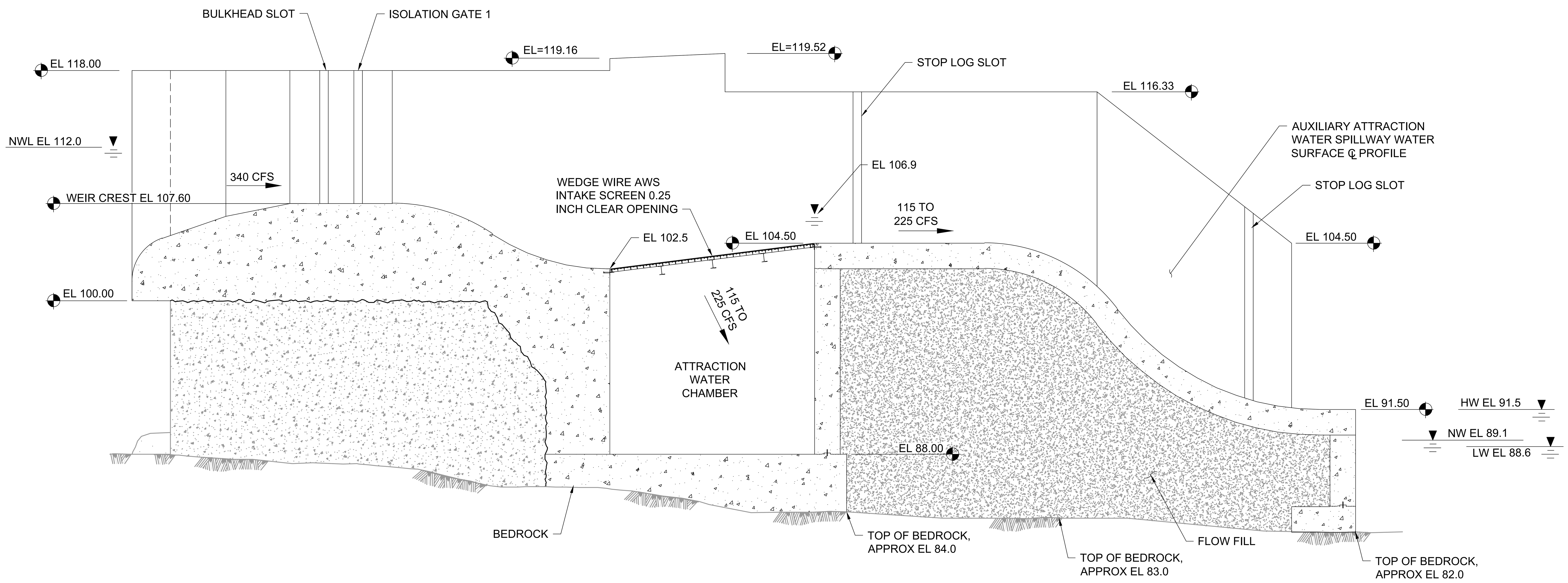
STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT ENTRANCE FLUME
GENERAL PLAN & SECTION

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	15 OF 176
DRAWING:	C-105

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nass and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\C-105.dwg USER: Agrogan
DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD S1-SHWMT-SC S1-SHWMT-FL-PL G-SHWMT-SUBMIT C-SHWMT-PFW S3-SHWMT-PFP S1-SHWMT-SW-PL S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:



A C-104 **SECTION**
SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

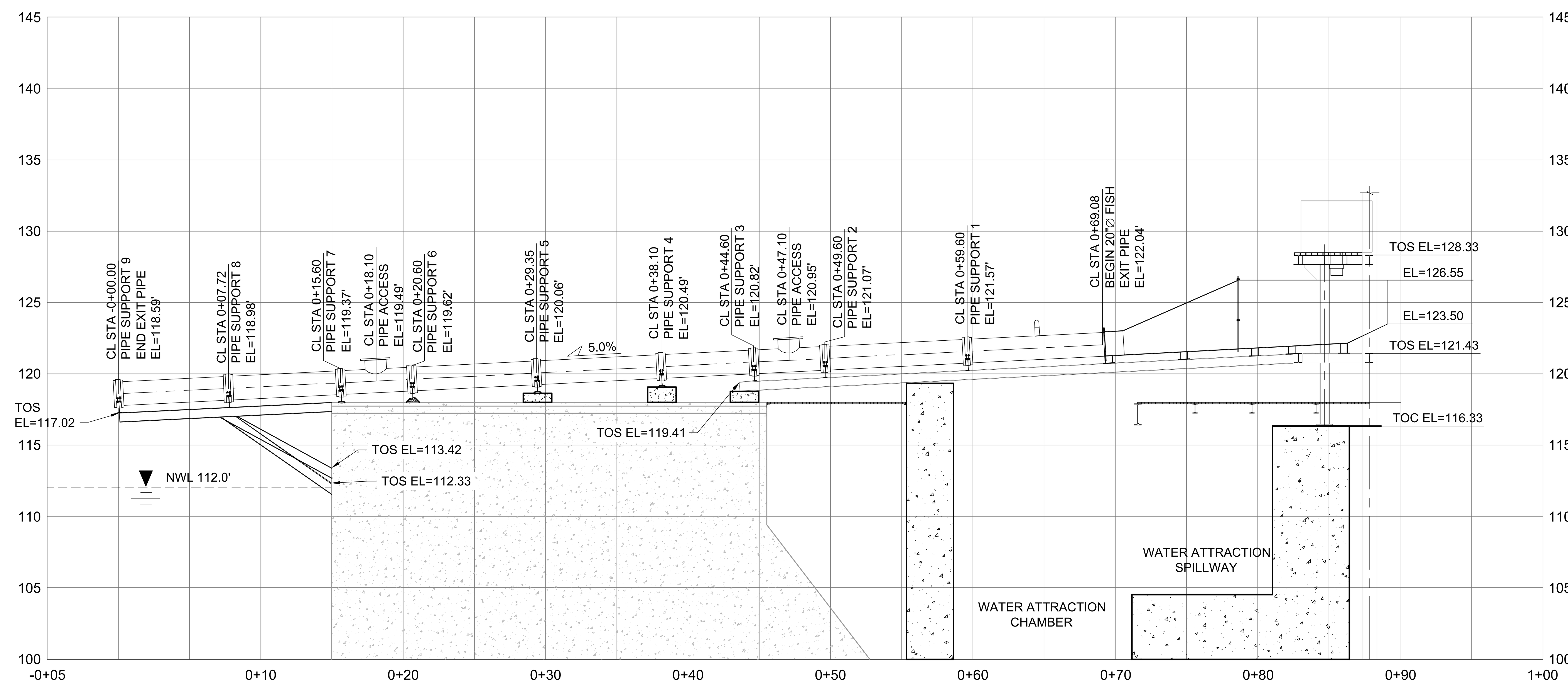
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY GENERAL ARRANGEMENT SECTION

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 16 OF 176
DRAWING: C-106

PLAN

SCALE: 1"=5'



CENTERLINE PROFILE

SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE – MARK DANIEL GRAESER – No.39328 – 12/13/2019 – LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

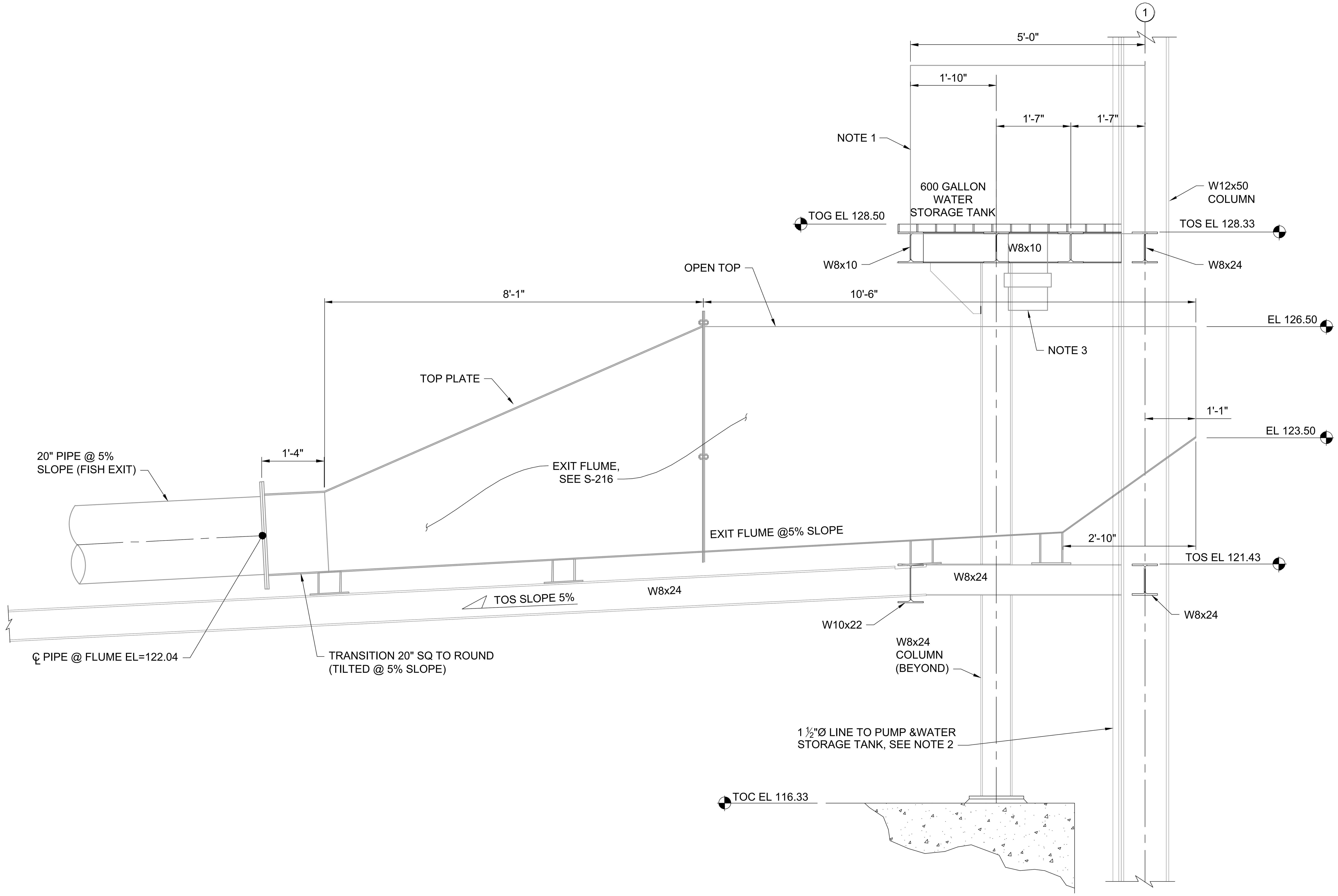
FISH LIFT TRANSITION FLUME AND EXIT PIPING

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	17 OF 176
DRAWING:	C-107

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nsa and projects\holden office projects\SHAWMUT1900 CAD\02-sheets\C\C-107.dwg USER: Agrogan
DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP S1-SHWMT-CR118 C-SHWMT-PFW S3-SHWMT-PFP S1-SHWMT-SW-PL S1-SHWMT-FL-PL S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

NOTES:

1. PROVIDE 600 GALLON FIBERGLASS STORAGE TANK.
2. WATER SUPPLY PUMP FOR STORAGE TANK TO BE MOUNTED AT EL 98.
3. PROVIDE 10" BUTTERFLY VALVE BOLTED TO TANK FLANGE.
4. SEE SPECIFICATION 33 16 00 FOR DETAILS.



A – **TRANSITION FLUME SUPPORT FRAME - ELEVATION**
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

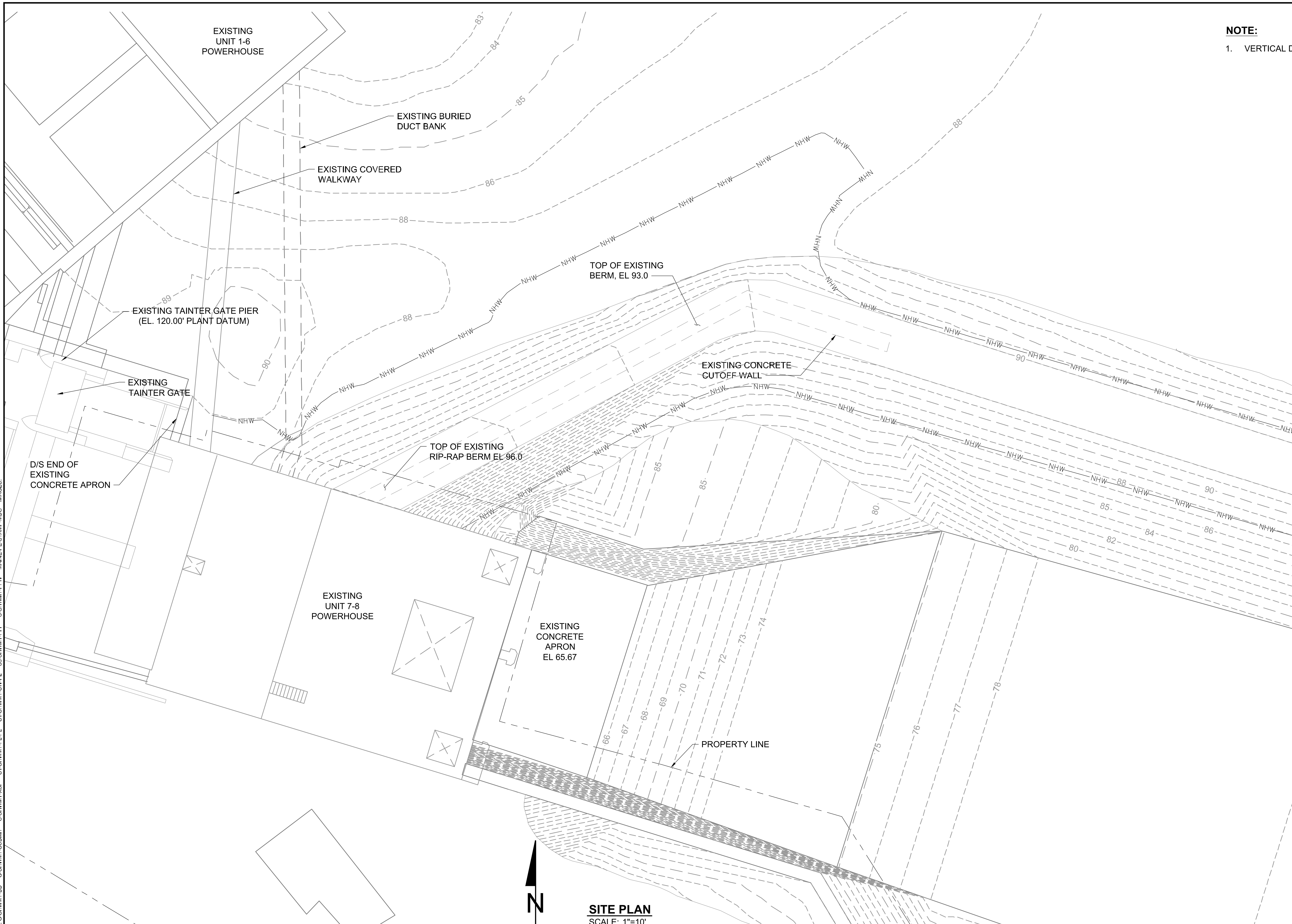
STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT TRANSITION FLUME
SUPPORT FRAME & EQUIPMENT

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	18 OF 176
DRAWING:	C-108

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mas and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\C\C-108.dwg USER: Agrogan
DATE: Dec 13, 2019 2:34pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:



SITE PLAN
SCALE: 1"=10'

NOTE:

1. VERTICAL DATUM IS BASED ON PLANT DATUM.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
PROFESSIONAL ENGINEER LICENSED

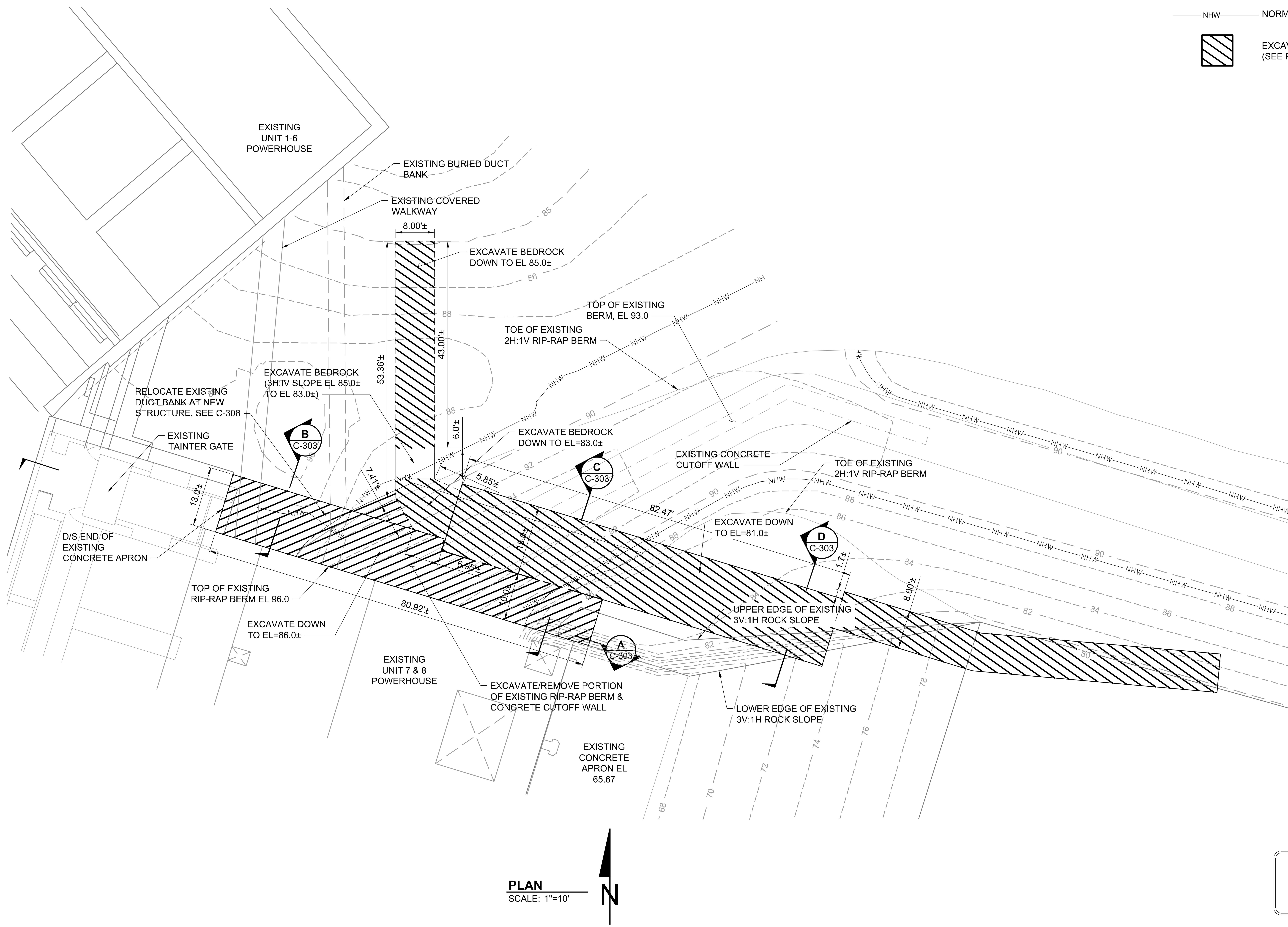
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

EXISTING CONDITIONS PLAN - UNIT 7 & 8 FISH PASSAGE

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	19 OF 176
DRAWING:	C-301

LEGEND:

- — — — APPROX OUTLINE OF NEW STRUCTURES
- —NHW— NORMAL HIGH WATER LINE
- (hatched box) EXCAVATED BEDROCK (SEE PLAN FOR ELEVATION)



PLAN
SCALE: 1"=10'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

DEMOLITION AND EXCAVATION PLAN - UNIT 7 & 8 FISH PASSAGE

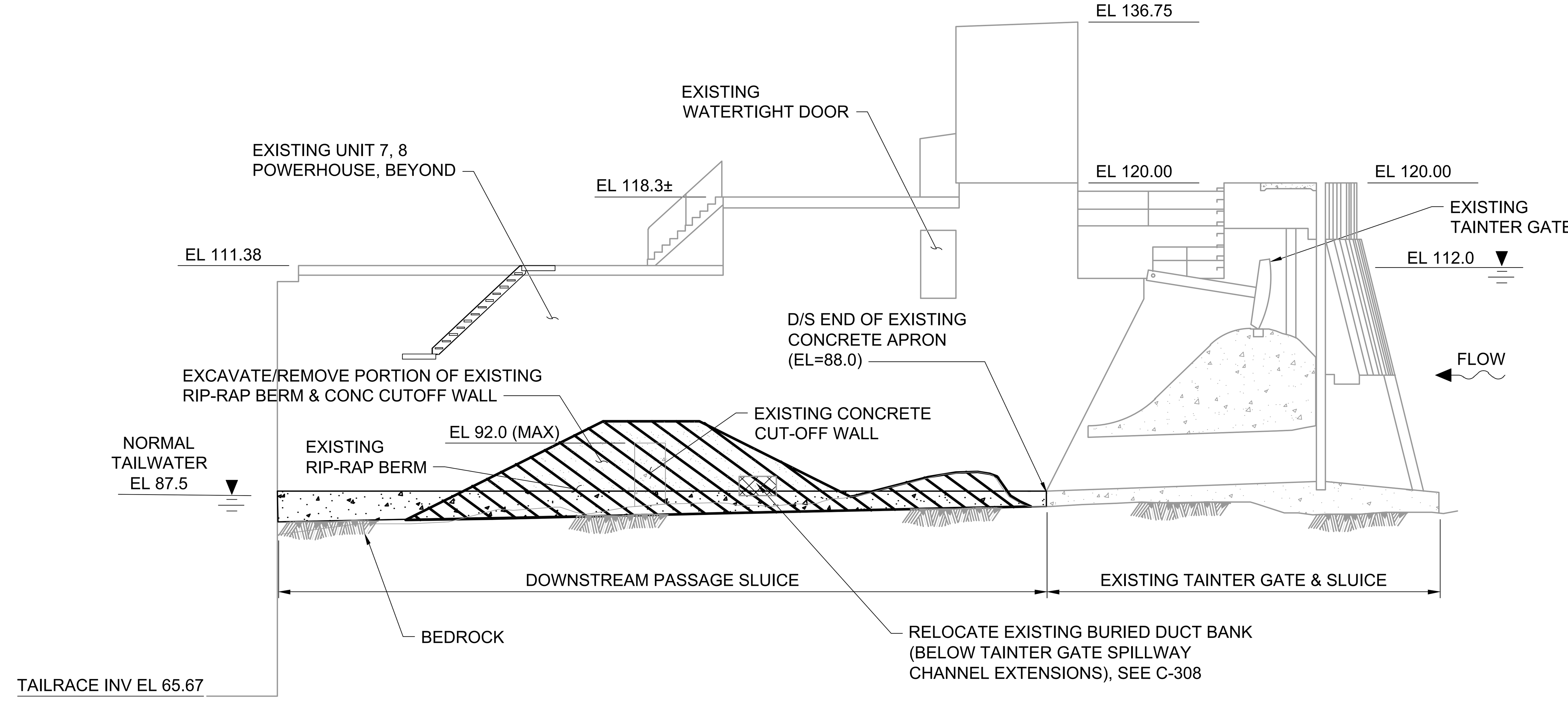
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	20 OF 176
DRAWING:	C-302

NOTE:

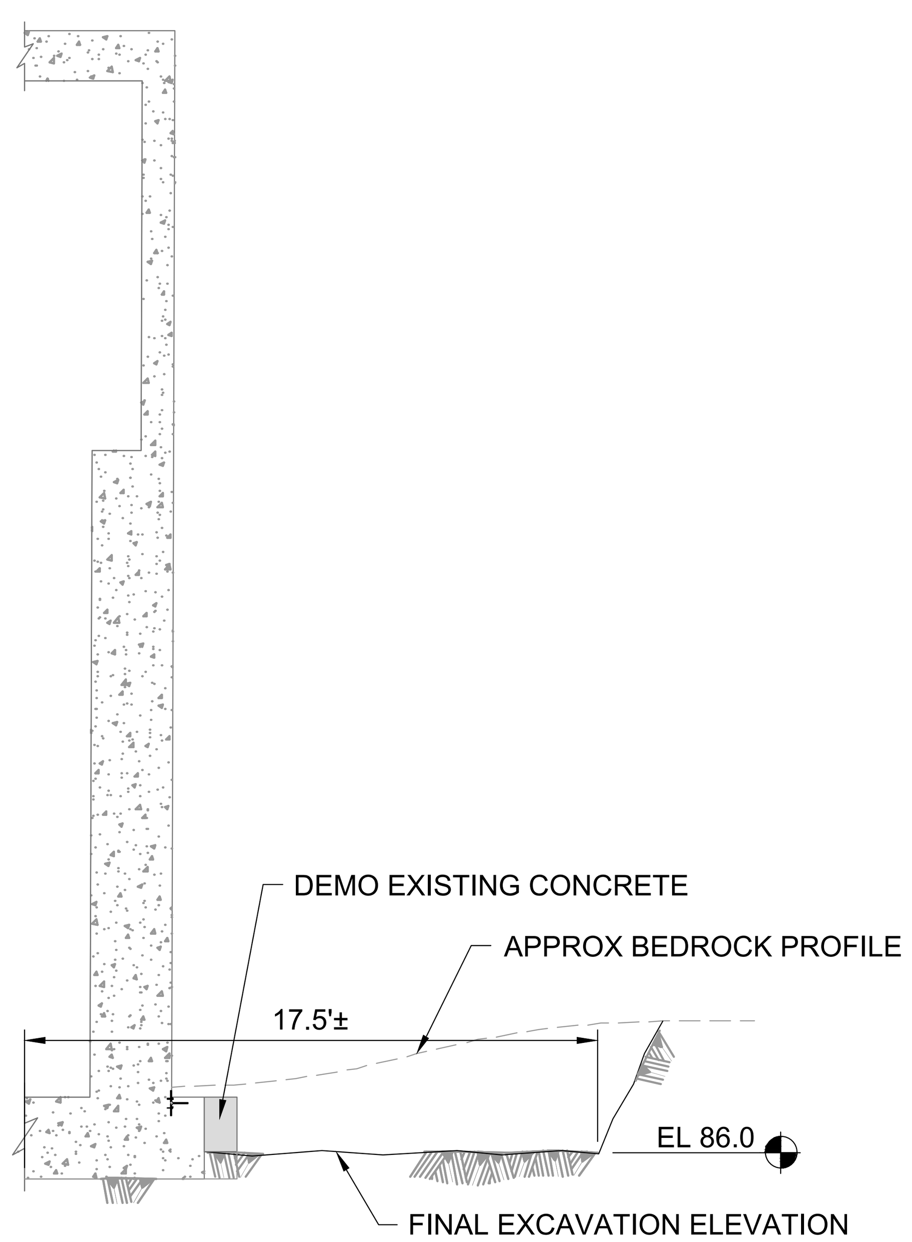
1. SLOPES SHOWN ARE APPROXIMATE. ACTUAL SLOPES WILL VARY BASED ON CONTRACTORS COMPLIANCE WITH APPLICABLE SAFETY REQUIREMENTS.

LEGEND:

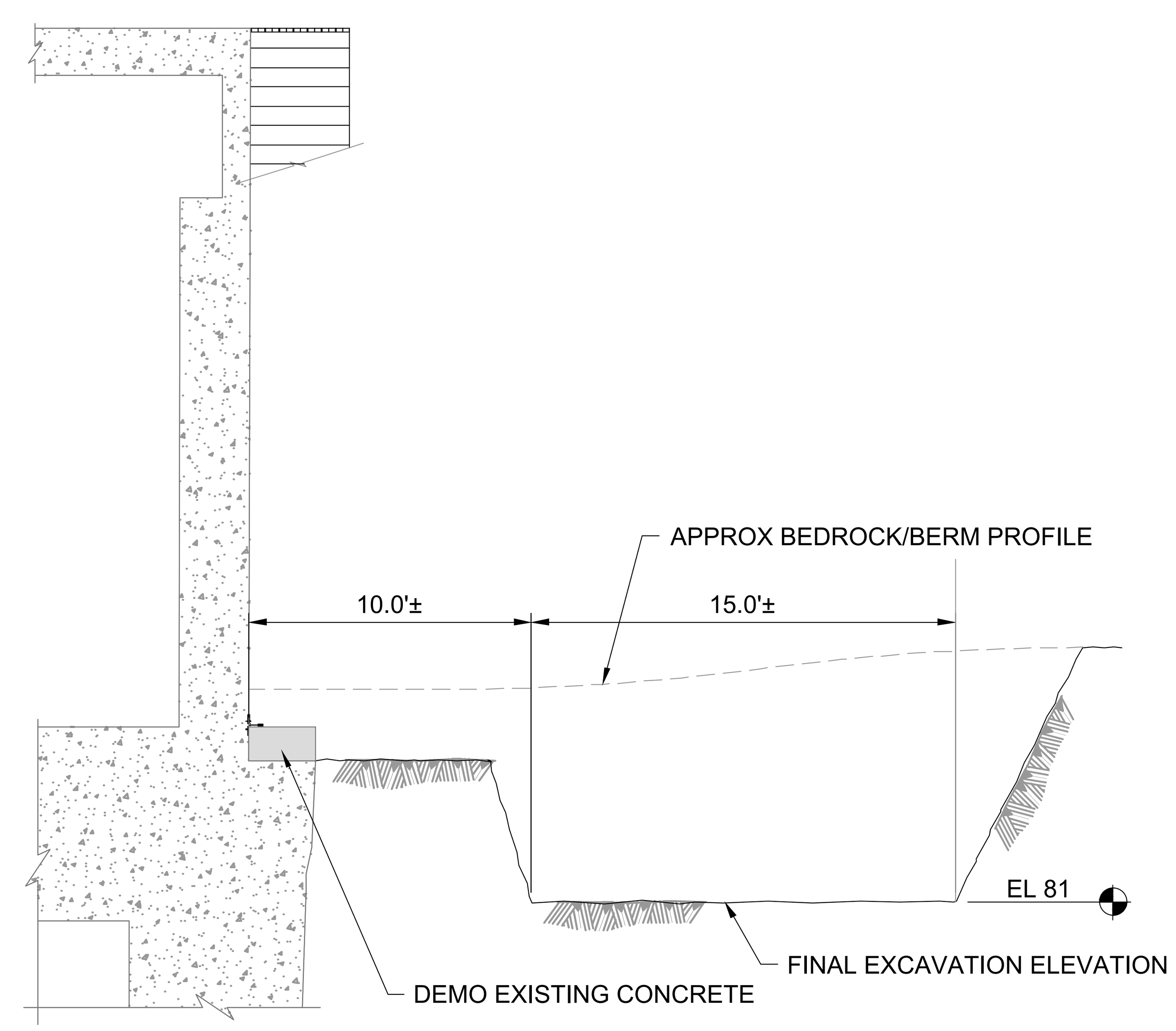
- EXCAVATE/REMOVE PORTION OF EXISTING RIP-RAP BERM & CONC CUT-OFF-WALL
- RELOCATE EXISTING BURIED DUCT BANK (BELOW NEW TAINTER GATE SPILLWAY CHANNEL EXTENSIONS), SEE C-308.
- CONCRETE DEMOLITION



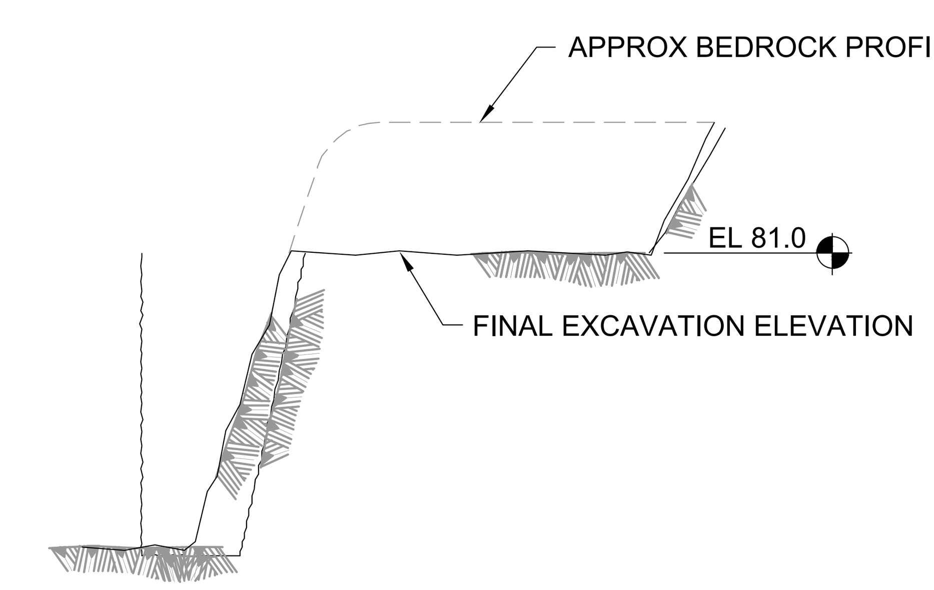
A / C-302 **DEMOLITION SECTION**
SCALE: 1"=10'



B / C-302 **EXCAVATION SECTION**
SCALE: 1"=5'



C / C-302 **EXCAVATION SECTION**
SCALE: 1"=5'



D / C-302 **EXCAVATION SECTION**
SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

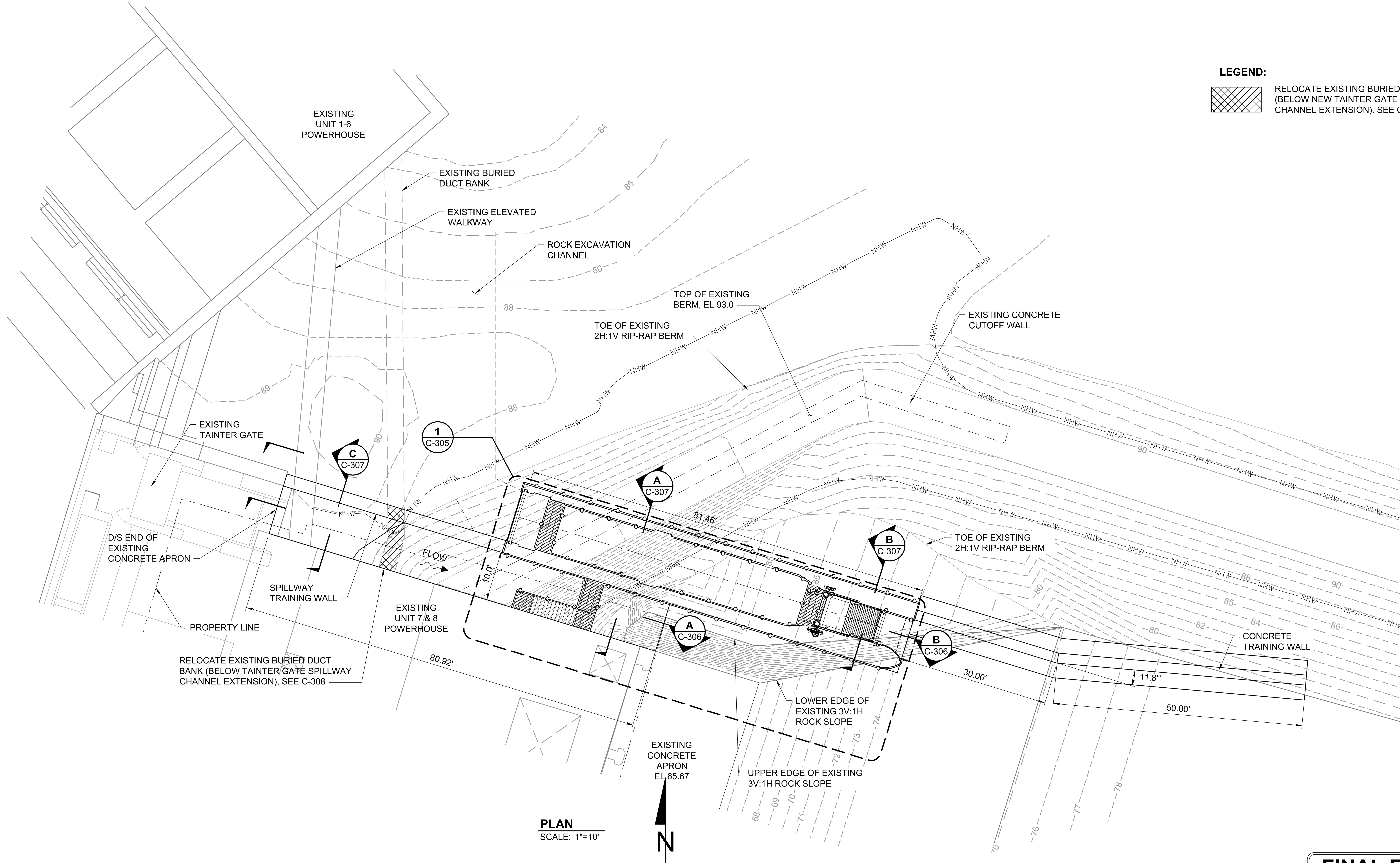
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

DEMOLITION AND EXCAVATION SECTIONS - UNIT 7 & 8 FISH PASSAGE

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	21 OF 176
DRAWING:	C-303



LEGEND:

RELOCATE EXISTING BURIED DUCT BANK (BELOW NEW TAINTER GATE SPILLWAY CHANNEL EXTENSION). SEE C-308.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

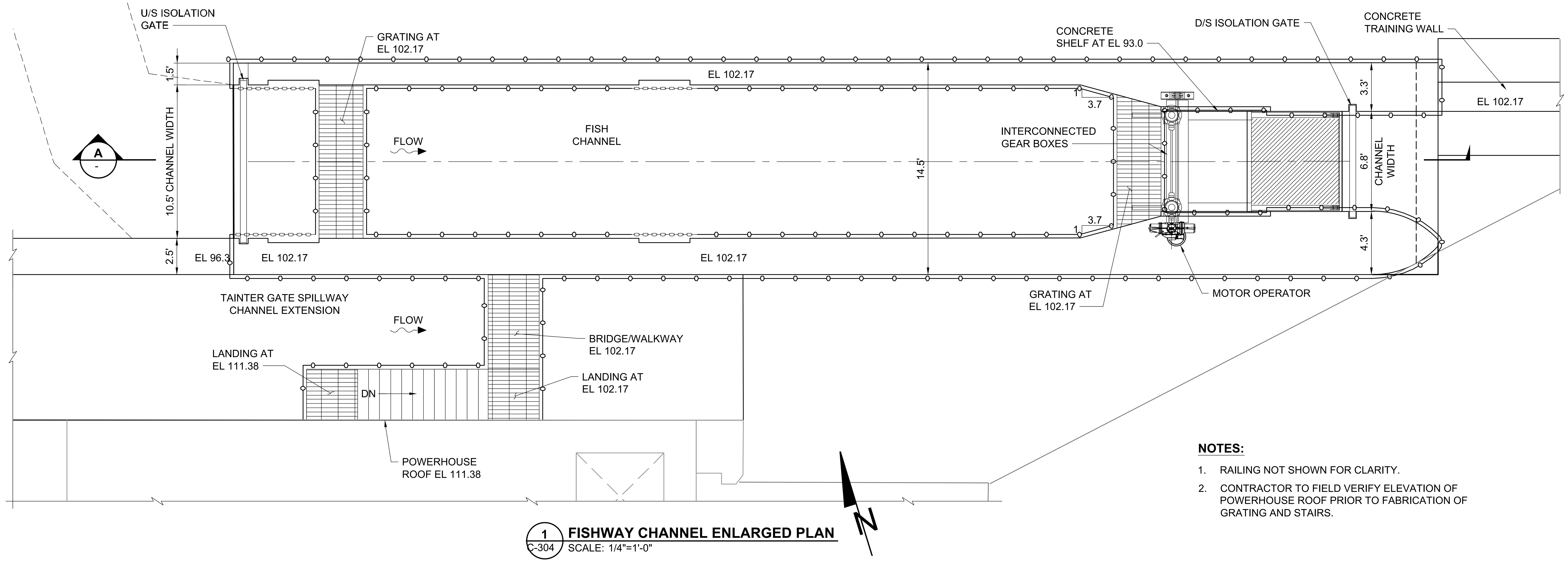
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
GENERAL PLAN

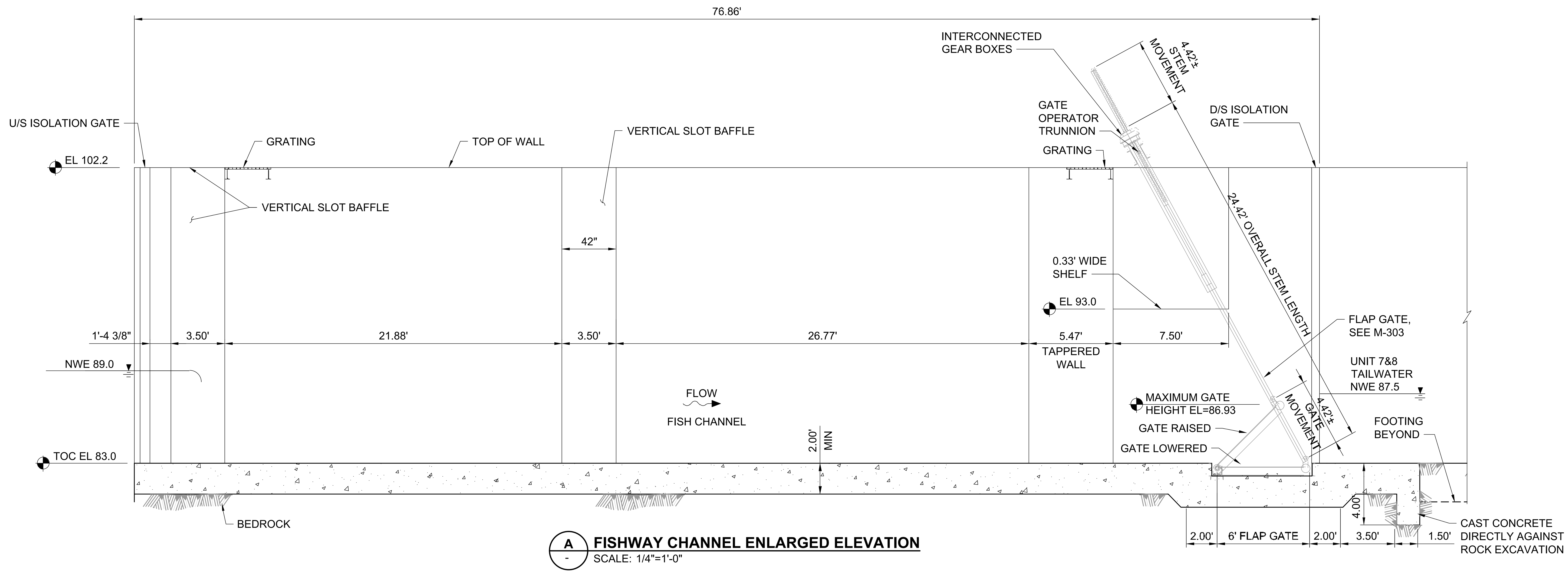
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	22 OF 176
DRAWING:	C-304



1 C-304 **FISHWAY CHANNEL ENLARGED PLAN**
SCALE: 1/4"=1'-0"

NOTES:

1. RAILING NOT SHOWN FOR CLARITY.
2. CONTRACTOR TO FIELD VERIFY ELEVATION OF POWERHOUSE ROOF PRIOR TO FABRICATION OF GRATING AND STAIRS.



A - **FISHWAY CHANNEL ENLARGED ELEVATION**
SCALE: 1/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

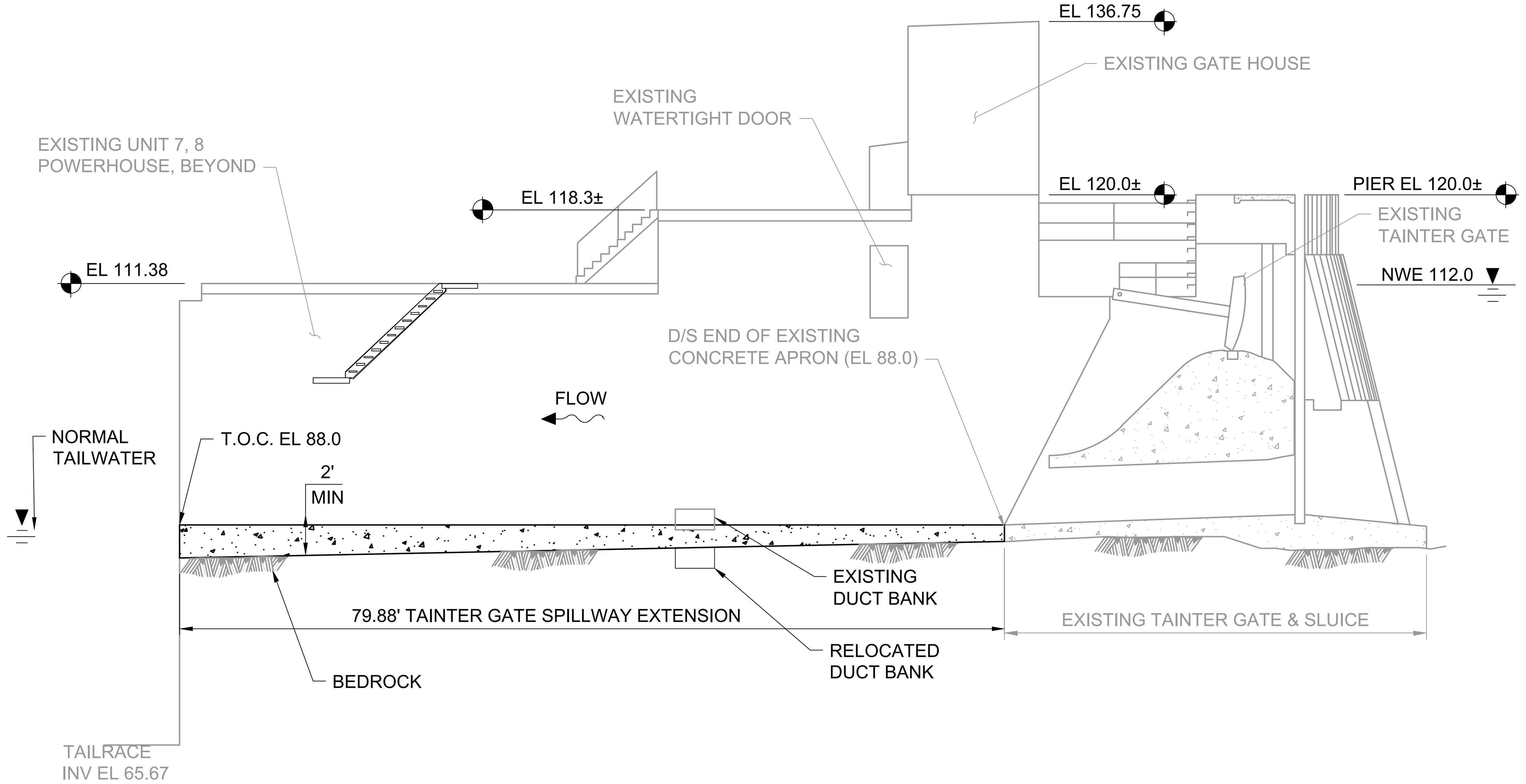
STATE OF MAINE
MARK DANIEL GRAESER
No. 39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

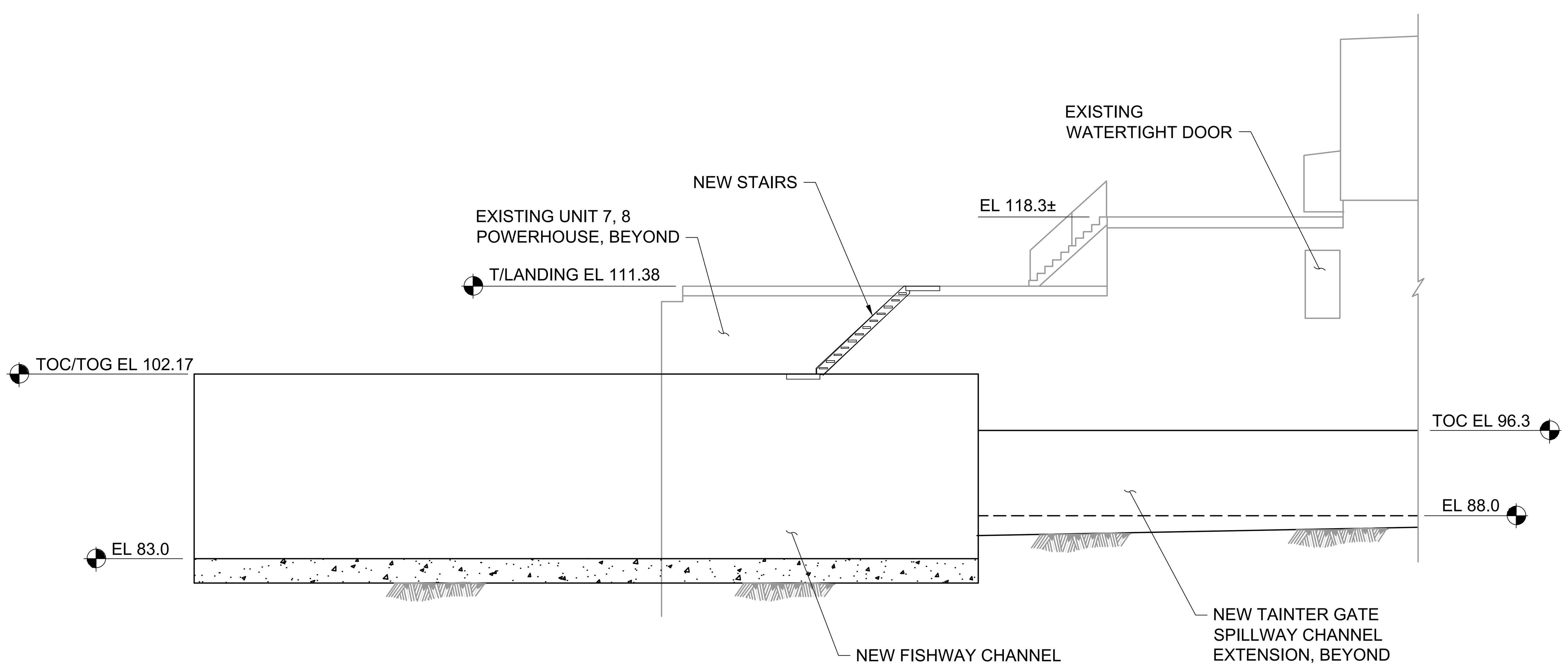
UNIT 7 & 8 FISH PASSAGE
PLAN AND SECTION

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 23 OF 176
DRAWING: C-305

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nas and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\C\C-305.dwg USER: Agrogan IMAGES:
DATE: Dec 13, 2019 2:34pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S-SHWMT-FISHWAY-SC S3-SHWMT-FFP S3-SHWMT-EFP MAINE-PE-STAMP-MDG



A
C-304
DOWNSTREAM PASSAGE SECTION
SCALE: 1"=10'



B
C-304
DOWNSTREAM PASSAGE ELEVATION
SCALE: 1"=10'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

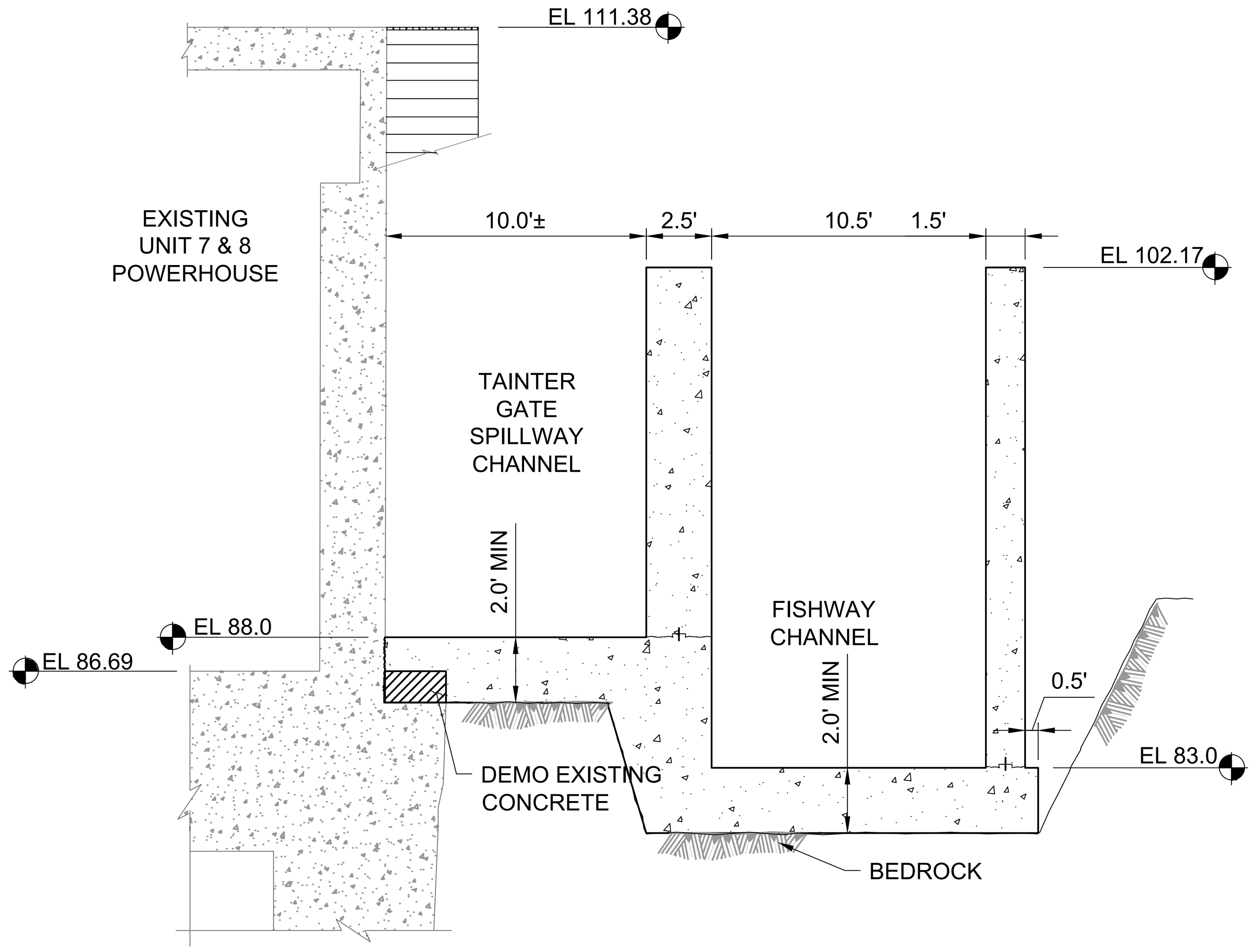
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

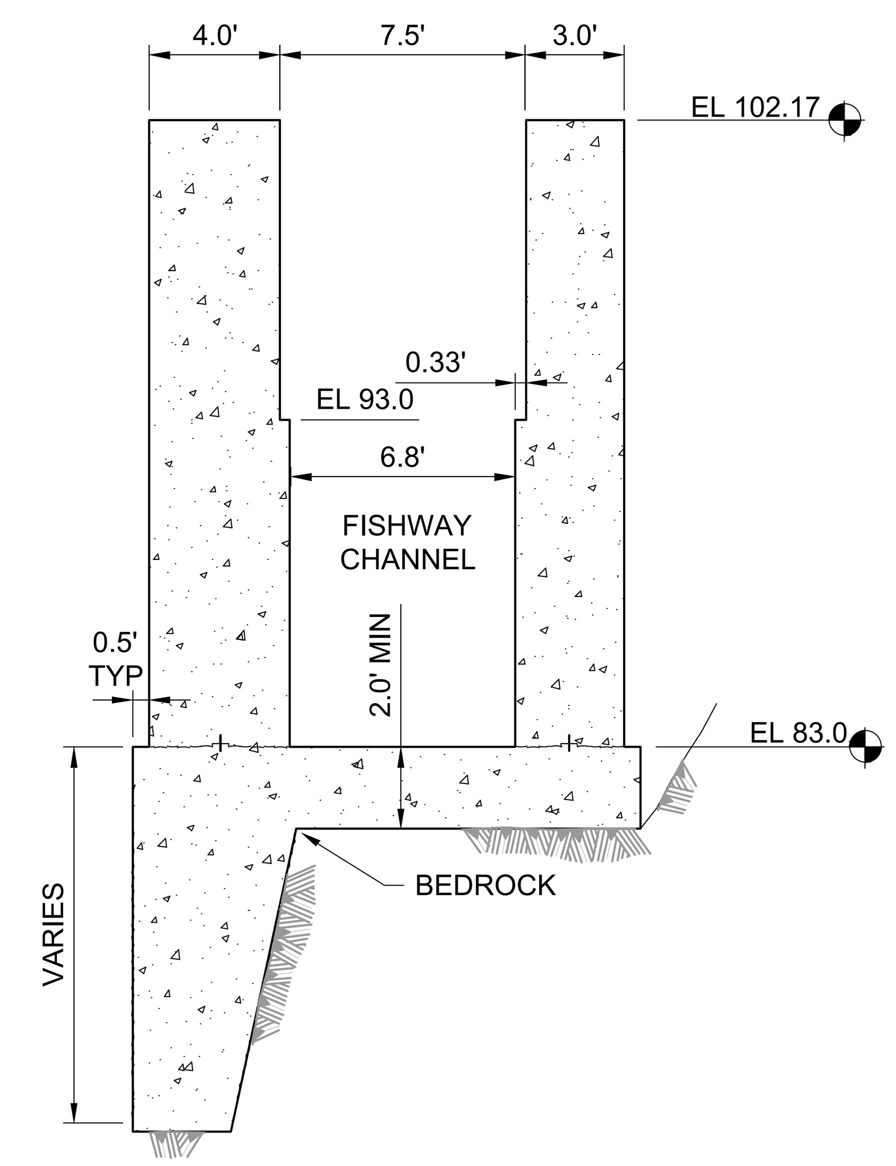
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
SECTIONS

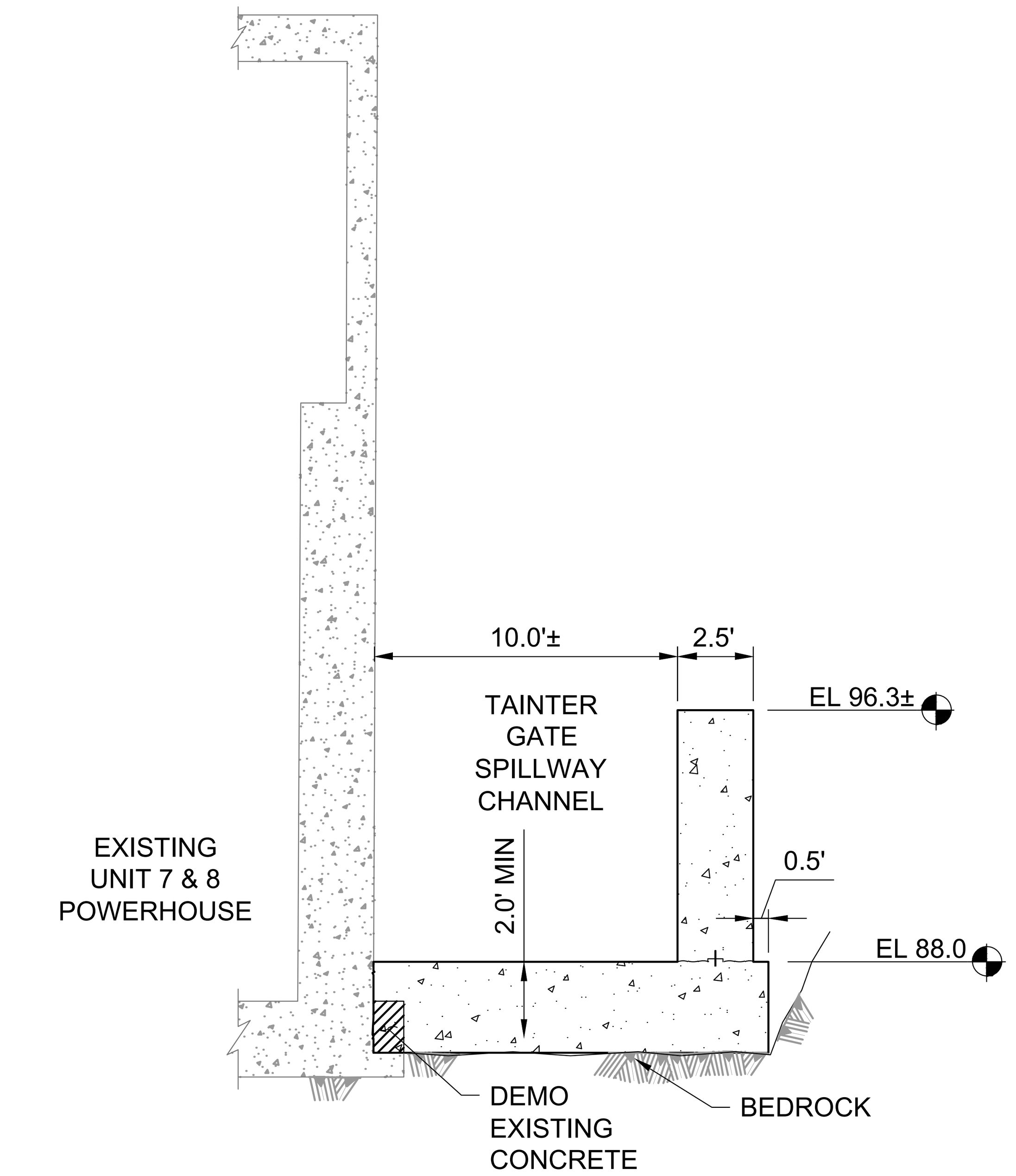
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	24 OF 176
DRAWING:	C-306



A CHANNEL SECTION
C-304 SCALE: 1"=5'



B FISHWAY CHANNEL SECTION
C-304 SCALE: 3"=1'-0"



C TAINTER GATE SPILLWAY CHANNEL SECTION
C-304 SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

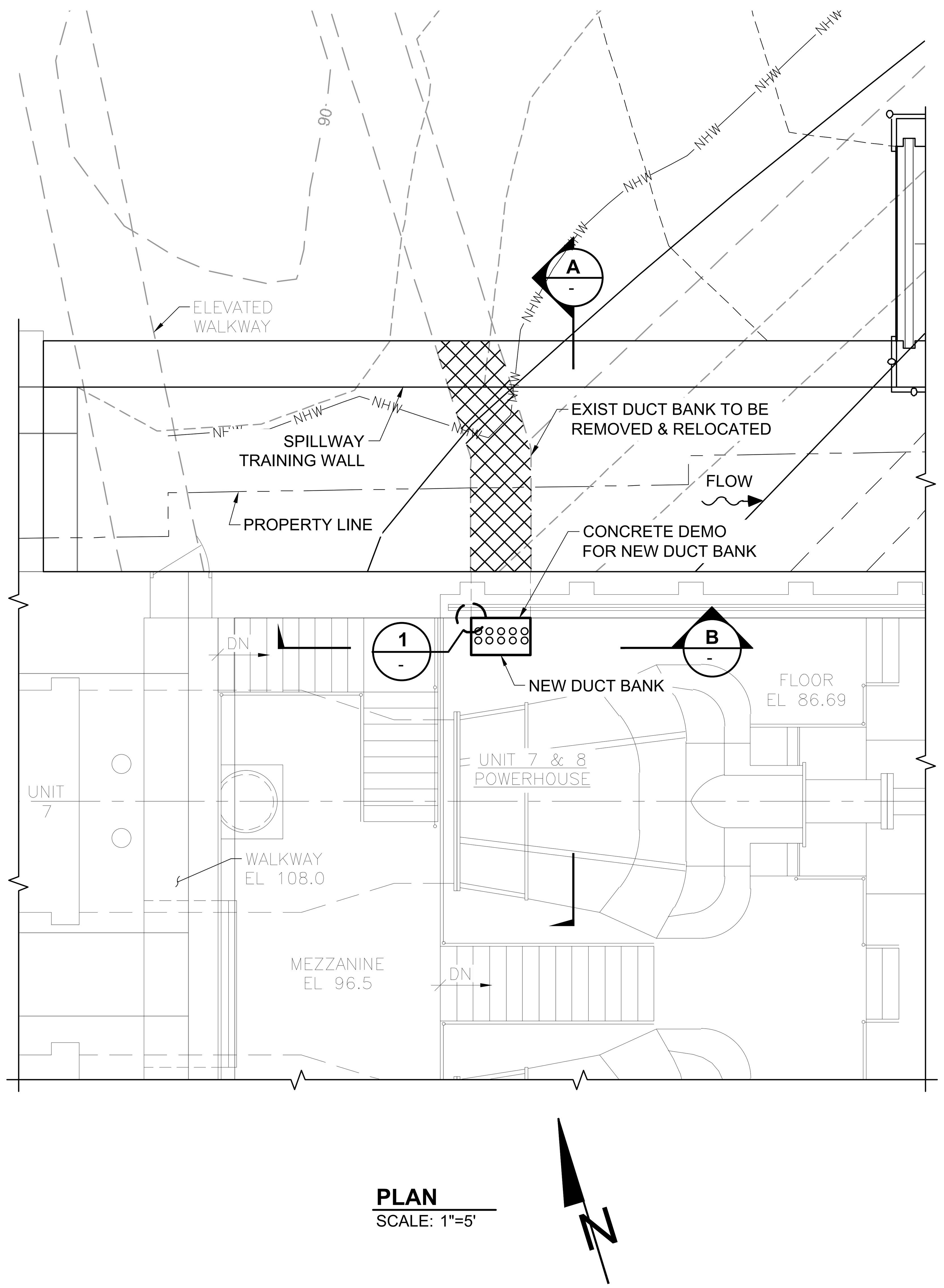
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
SECTIONS

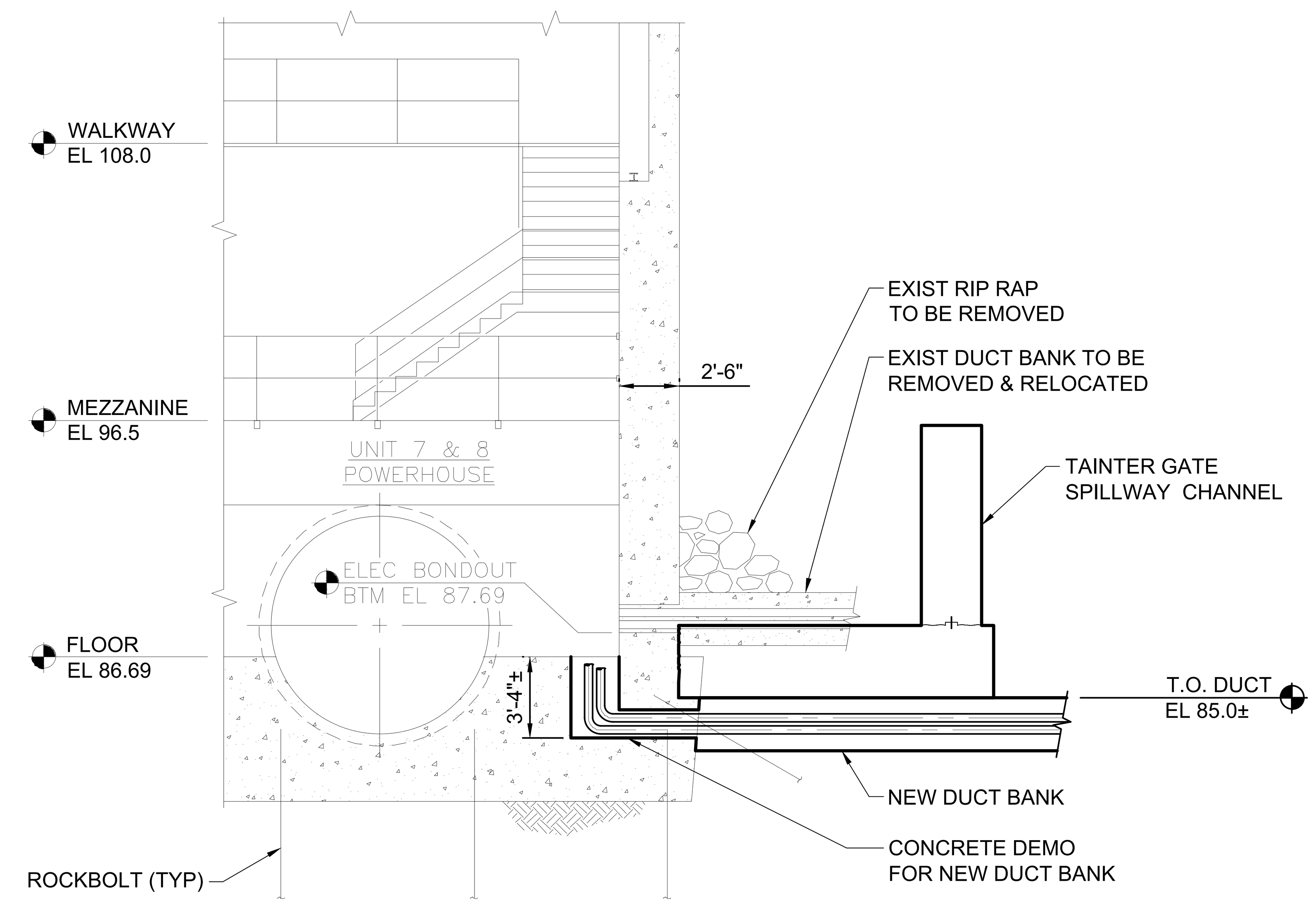
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	25 OF 176
DRAWING:	C-307

LEGEND:

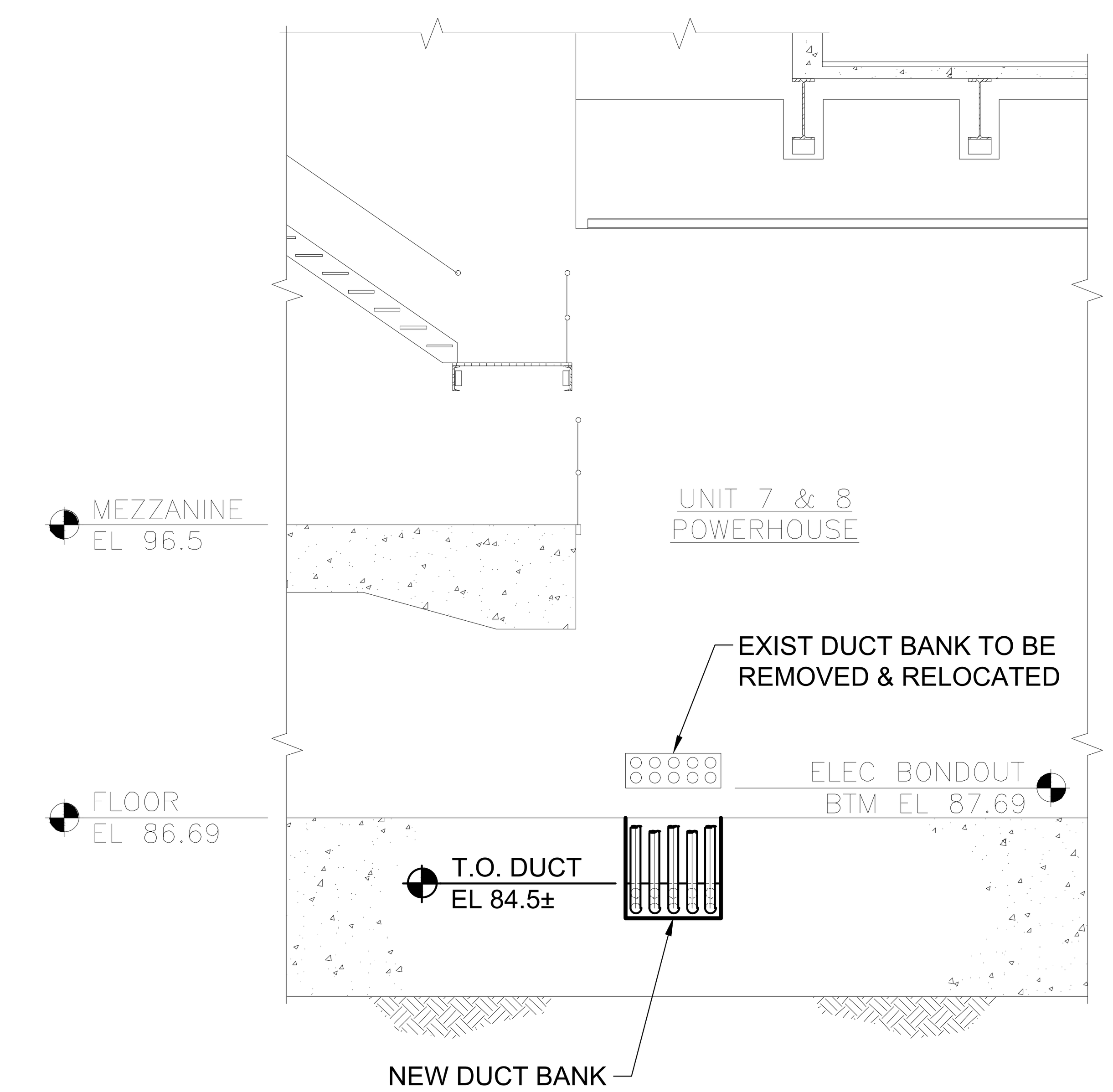
- RELOCATE EXISTING BURIED DUCT BANK (BELOW NEW TAINTER GATE SPILLWAY CHANNEL EXTENSION).
- CONCRETE DEMOLITION



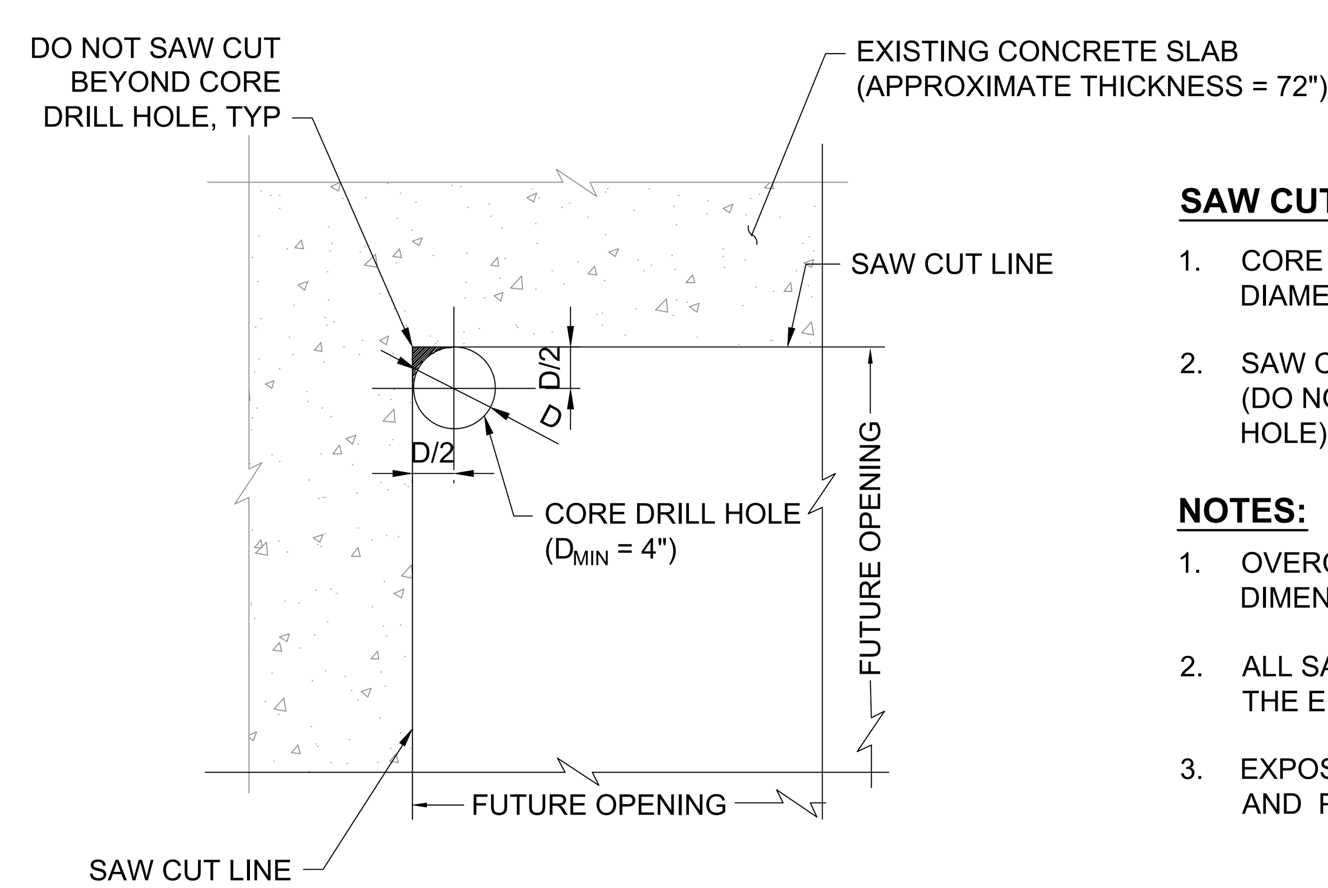
PLAN
SCALE: 1"=5'



A SECTION
SCALE: 1"-5'



B SECTION
SCALE: 1"-5'



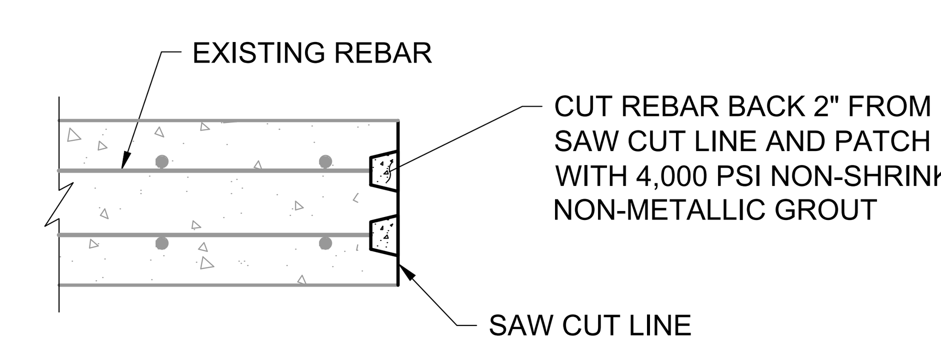
1 SAW CUT / DEMO DETAIL AT NEW OPENING
SCALE: NTS

SAW CUT / DEMO SEQUENCE:

1. CORE DRILL HOLE NEAR CORNER, MIN DIAMETER, D = 4".
2. SAW CUT TANGENT TO CORE DRILL HOLE (DO NOT SAW CUT BEYOND CORE DRILL HOLE).

NOTES:

1. OVERCUTTING BEYOND THE OPENING DIMENSIONS IS NOT PERMITTED.
2. ALL SAW CUTS SHALL BE MADE THROUGH THE ENTIRE DEPTH OF CONCRETE.
3. EXPOSED REBAR SHALL BE CUT BACK AND PATCHED PER 2/-



2 CUT REBAR
SCALE: 1"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED — PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE DUCT BANK RELOCATION

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 26 OF 176
DRAWING: C-308

GENERAL NOTES:

1. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR CONFLICTS FOUND IN THE CONTRACT DOCUMENTS AND/OR FIELD CONDITIONS.
2. ALL STRUCTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH THE OTHER PROJECT DRAWINGS AND SPECIFICATIONS.
3. REFER TO CIVIL, MECHANICAL, ELECTRICAL, AND OTHER DISCIPLINES DRAWINGS FOR ANCHORS, PIPE SLEEVES, CONDUITS OR OTHER ITEMS TO BE EMBEDDED IN OR THAT PASS THROUGH THE STRUCTURE. IN GENERAL, EMBEDMENTS AND PENETRATIONS LESS THAN 12 INCHES IN DIAMETER ARE NOT SHOWN ON THE STRUCTURAL DRAWINGS.
4. STANDARD DETAILS SHALL BE USED AT ALL APPLICABLE LOCATIONS, UNLESS OTHERWISE NOTED ON THE DRAWINGS.
5. PLANS ON THESE DRAWINGS ARE TREATED AS HORIZONTAL SECTIONS (I.E. “PLANS AT ELEVATION 100.00” SHOW ITEMS BELOW 100.00).
6. DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS.
7. CONTRACTOR TO VERIFY ALL EXISTING CONDITIONS, DIMENSIONS, AND ELEVATIONS PRIOR TO CONSTRUCTION. NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR CONFLICTS FOUND IN THE CONTRACT DOCUMENTS AND/OR FIELD CONDITIONS.
8. SHOP DRAWINGS SHALL BE FURNISHED FOR REVIEW BEFORE ANY FABRICATION AND ERECTION IS STARTED. POORLY EXECUTED SHOP DRAWINGS SHALL BE REJECTED AND RESUBMITTED.

CONCRETE NOTES:

1. SPECIFIED MINIMUM COMPRESSIVE STRENGTH OF CLASS A STRUCTURAL CONCRETE SHALL BE 4500 PSI AT 28 DAYS UNLESS OTHERWISE NOTED. REFER TO THE SPECIFICATIONS.
2. CONCRETE WORK SHALL CONFORM TO ACI 301 AND ACI 318.
3. REINFORCEMENT STEEL SHALL BE DEFORMED BARS CONFORMING IN QUALITY TO THE REQUIREMENTS OF ASTM A615 OR A706, "SPECIFICATIONS FOR DEFORMED BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT", GRADE 60.
4. ALL DETAILING, FABRICATION AND PLACING OF REINFORCING BARS, UNLESS OTHERWISE INDICATED, SHALL BE IN ACCORDANCE WITH ACI-315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", LATEST EDITION.
5. REINFORCING BARS AND ACCESSORIES SHALL NOT BE IN CONTACT WITH PIPE, PIPE FLANGE OR METAL PARTS EMBEDDED IN CONCRETE, A MINIMUM OF 2 INCHES CLEARANCE SHALL BE PROVIDED AT ALL TIMES.
6. UNLESS OTHERWISE SHOWN ON THE DRAWINGS CONCRETE COVER FOR REINFORCING BARS SHALL BE 3" UNO.
7. UNLESS OTHERWISE NOTED, WALLS AND SLABS SHOWN WITH A SINGLE LAYER OF REINFORCEMENT SHALL HAVE THAT REINFORCEMENT CENTERED.
8. CHAMFER EDGES OF PERMANENTLY EXPOSED CONCRETE SURFACES WITH A 45 DEGREE BEVEL AS SHOWN IN THE STANDARD DETAILS.
9. ALL REINFORCEMENT BENDS, LAPS AND SPLICES UNLESS OTHERWISE NOTED, SHALL SATISFY THE MINIMUM REQUIREMENTS SHOWN IN THE STANDARD DETAILS.
10. DIMENSIONS ARE TO THE CENTERLINES OF THE BARS UNLESS SHOWN OTHERWISE.
11. BARS SHOWN WITH BENDS NOT DIMENSIONED SHALL BE ASSUMED TO END WITH A STANDARD HOOK AS SHOWN IN THE STANDARD DETAILS.
12. REINFORCEMENT PARALLEL TO ANCHOR BOLTS OR OTHER EMBEDDED MATERIAL SHALL BE PLACED TO MAINTAIN A CLEAR DISTANCE OF AT LEAST 1-1/3 TIMES THE MAXIMUM AGGREGATE SIZE.
13. THE FIRST AND LAST BARS IN STRUCTURAL MEMBERS ARE TO START AND END AT A MAXIMUM OF ONE HALF OF THE ADJACENT BAR SPACING.
14. CONTRACTOR SHALL NOT BACKFILL AGAINST STRUCTURAL CONCRETE UNTIL CONCRETE HAS REACHED ITS DESIGN STRENGTH UNLESS OTHERWISE APPROVED IN WRITING BY ENGINEER. SEE SPECIFICATIONS.
15. PLACE BACKFILL EQUALLY ON ALL SIDES OF STRUCTURES. SEE SPECIFICATIONS.
16. LOCATE CONSTRUCTION JOINTS WHERE SHOWN OR NOTED ON DRAWINGS. CONTRACTOR SHALL SUBMIT FOR REVIEW AND APPROVAL THE LOCATION OF PROPOSED CONSTRUCTION JOINTS.
17. MAXIMUM JOINT SPACING SHALL BE NO MORE THAN 30'.
18. MINIMUM TIME BETWEEN ADJACENT POURS SHALL BE 5 DAYS.

INSPECTION TESTING AND QUALITY ASSURANCE NOTES:

1. SPECIAL INSPECTIONS AND TESTING IN ACCORDANCE WITH CHAPTER 17 OF THE IBC ARE REQUIRED AS PART OF THIS PROJECT. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE COMPLIANCE WITH THESE OVERSIGHT AND QUALITY ASSURANCE REQUIREMENTS.
2. THE OWNER OR THE REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE, ACTING AS THE OWNERS AGENT WILL BE PROVIDING SPECIAL INSPECTIONS IN ACCORDANCE WITH CHAPTER 17 OF THE IBC. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING ADEQUATE TIME AND ACCESS FOR COMPLETION OF SPECIAL INSPECTIONS BY THE OWNER OR OWNER'S AGENT PRIOR TO COVERING THE WORK TO BE INSPECTED WITH NEW WORK.
3. AS A MINIMUM, SPECIAL INSPECTIONS ARE TO BE COMPLETED FOR THE FOLLOWING AREAS OF CONSTRUCTION.

CONSTRUCTION TYPE	APPLICABLE CODE TABLE(S)
SOILS / FOUNDATIONS	IBC 1705.6
CONCRETE	IBC 1705.3
STRUCTURAL STEEL	AISC 360
STEEL CONSTRUCTION OTHER THAN STRUCTURAL STEEL	IBC 1705.2.2

4. THE CONTRACTOR SHALL PROVIDE A “STATEMENT OF RESPONSIBILITY” TO THE OWNER OR OWNER'S AGENT, IN ACCORDANCE WITH SECTION 1706 OF THE IBC.
5. SPECIAL INSPECTORS SHALL SUBMIT THEIR QUALIFICATIONS TO THE BUILDING OFFICIAL AND BE APPROVED BY THE BUILDING OFFICIAL PRIOR TO BEGINNING WORK.

DEFERRED SUBMITTAL ITEMS:

1. THE FOLLOWING PORTIONS OF THE PROJECT ARE DEFERRED SUBMITTAL ITEMS AND HAVE NOT BEEN DESIGNED BY THE ENGINEER OF RECORD.

   ANCHORAGE OF EQUIPMENT AND APPURTENANCES
   GRATING
   HYDRAULIC GATES
   LADDERS
   PRE-ENGINEERED BUILDING
   RAILING

2. DEFERRED SUBMITTAL ITEMS SHALL NOT BE INSTALLED UNTIL THE ENGINEER OF RECORD HAS REVIEWED THE SUBMITTAL DOCUMENTS AND INDICATED AS A MINIMUM THAT THEY HAVE BEEN REVIEWED AND FOUND TO BE IN GENERAL CONFORMANCE WITH THE DESIGN OF THE STRUCTURE.
3. DEFERRED SUBMITTAL ITEMS SHALL BE PREPARED AND STAMPED BY A LICENSED CIVIL OR STRUCTURAL PROFESSIONAL ENGINEER UNLESS OTHERWISE NOTED ELSEWHERE IN THESE DOCUMENTS.

STRUCTURAL STEEL AND STAINLESS STEEL NOTES:

1. MATERIALS SHALL CONFORM TO THE STANDARDS LISTED:

- STEEL HSS	ASTM A500, GRADE C
- STEEL CHANNELS	ASTM A36 (UNO)
- STEEL PLATE	ASTM A36
- STEEL ANGLES	ASTM A36
- STEEL BEAMS	ASTM A992
- STEEL BOLTS	ASTM A325
- STEEL ANCHOR BOLTS	ASTM F1554, GR 36
- STEEL HEADED ANCHOR STUDS (HAS)	TYPE A108
- STEEL WT	ASTM A992
- STAINLESS STEEL ANGLES	ASTM A276, TYPE 304L
- STAINLESS STEEL PLATE	ASTM A240, TYPE 304L
- STAINLESS STEEL HEADED ANCHOR STUDS (HAS)	TYPE 304L
- STAINLESS STEEL BOLTS	ASTM F593
- STAINLESS STEEL ANCHOR BOLTS	ASTM A193
- STAINLESS STEEL NUTS	ASTM F594

2. ALL WELDING SHALL BE DONE BY CERTIFIED WELDERS AND SHALL BE IN ACCORDANCE WITH THE LATEST STANDARDS OF THE AWS AND AISC. INSPECT ALL WELDING IN ACCORDANCE WITH THE SPECIFICATIONS.
3. DO NOT FIELD CUT OR ALTER STRUCTURAL MEMBERS WITHOUT ENGINEER'S WRITTEN APPROVAL.
4. ALL STRUCTURAL STEEL MEMBERS AND MISCELLANEOUS ITEMS SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.

EXCAVATION AND ROCK TRIMMING:

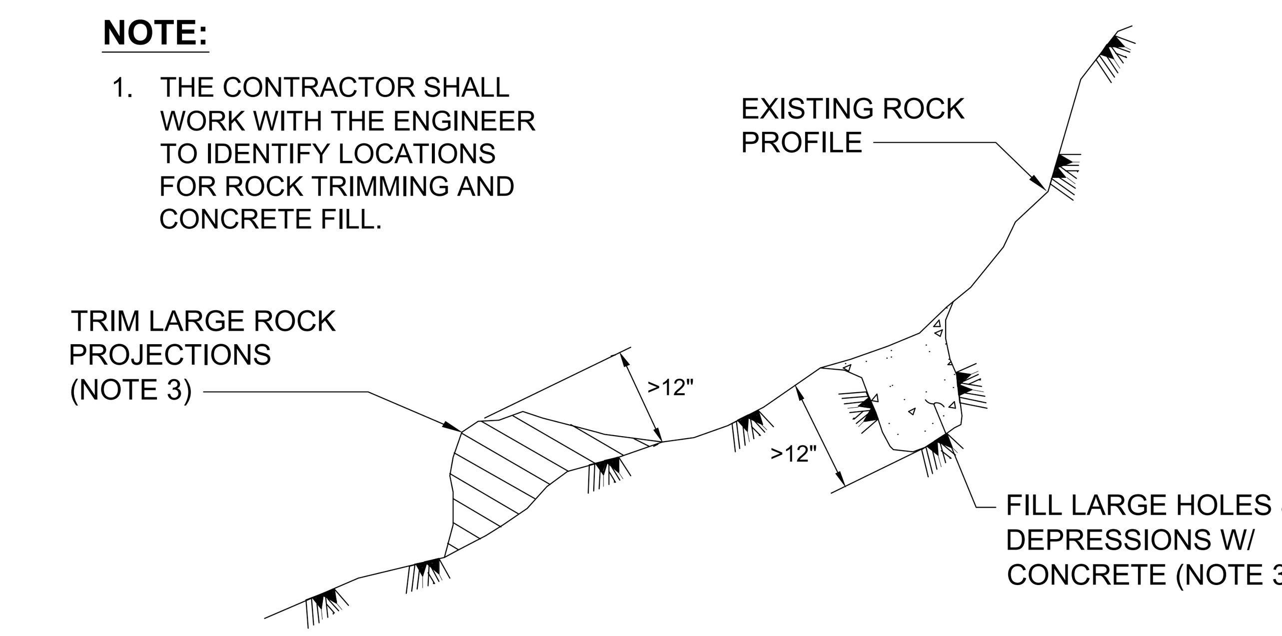
1. PROVIDE ADEQUATE SURVEY CONTROL TO AVOID UNAUTHORIZED OVEREXCAVATION.
2. REMOVE THE ORGANIC AND LOOSE/WEATHERED MATERIAL DOWN TO SOUND ROCK.
3. EXCAVATE TO LINES, GRADES, AND DIMENSIONS SHOWN AND AS NECESSARY TO ACCOMPLISH WORK.
4. TRIM TO NEAT LINES WHERE CONCRETE IS TO BE PLACED AGAINST FOUNDATION MATERIAL.
5. EXCAVATION MATERIALS SHALL BE DISPOSED OF OFFSITE IN ACCORDANCE WITH APPLICABLE LAWS AND REGULATIONS AND AT A LOCATION DETERMINED BY THE CONTRACTOR.

ROCK SURFACE PREPARATION:

1. SUBMIT A ROCK SURFACE PREPARATION PLAN FOR REVIEW.
2. PREPARE A TEST SECTION FOR REVIEW BY THE ENGINEER PRIOR TO COMMENCEMENT OF PRODUCTION ROCK SURFACE PREPARATION.
3. ROCK SHALL BE PREPARED BY A COMBINATION OF ROCK TRIMMING AND CONCRETE FILL TO A SMOOTHNESS AND UNIFORMITY SUITABLE FOR CONCRETE PLACEMENT. REFER TO STANDARD DETAIL 1.
4. ROCK SURFACES AGAINST WHICH CONCRETE ARE TO BE PLACED SHALL BE CLEAN, FREE OF LOOSE MATERIAL, AND FREE FROM STANDING OR RUNNING WATER.
5. ROCK SURFACES SHALL BE CLEAN AND SATURATED SURFACE DRY (SSD) DURING CONCRETE PLACEMENT.
6. ROCK SURFACES TO BE IN CONTACT WITH NEW CONCRETE SHALL BE REVIEWED BY THE ENGINEER PRIOR TO CONCRETE PLACEMENT.

NOTE:

1. THE CONTRACTOR SHALL WORK WITH THE ENGINEER TO IDENTIFY LOCATIONS FOR ROCK TRIMMING AND CONCRETE FILL.



1 / - ROCK SURFACE PREPARATION DETAIL
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STRUCTURAL NOTES

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	27 OF 176
DRAWING:	S-001

GENERAL DESIGN CRITERIA:

1. THE FOLLOWING, DESIGN CODES, DESIGN CRITERIA AND STRUCTURE LOADS WERE USED TO COMPLETE THE STRUCTURAL DESIGN.
   - 2009 INTERNATIONAL BUILDING CODE
   - 2005 ASCE7 - MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES
   - AISC MANUAL OF STEEL CONSTRUCTION, THIRTEENTH EDITION.
   - ACI 318-11, BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE, BY THE AMERICAN CONCRETE INSTITUTE.

LOAD	DETAIL	MAGNITUDE	UNITS	NOTES
LIVE LOADS	FLOOR	150	PSF	
	WALKWAYS/PLATFORMS	150	PSF	
SNOW	GROUND SNOW LOAD (Pg)	80	PSF	
	EXPOSURE FACTOR (Ce)	0.9		FULLY EXPOSED
	IMPORTANCE FACTOR (Is)	1.0		
	THERMAL FACTOR (Ct)	1.0		
ICE	NOMINAL ICE THICKNESS	1	IN	
	IMPORTANCE FACTOR (I:)	1.0		
	STRUCTURE CATEGORY	II		
WIND	BASIC WIND SPEED	90	MPH	3 SECOND GUST
	IMPORTANCE FACTOR (Iw)	1.0		
	BUILDING OCCUPANCY CATEGORY	II		
	EXPOSURE	C		
EARTHQUAKE	IMPORTANCE FACTOR (Ie)	1.5		STEEL TOWER STRUCTURE
	BUILDING OCCUPANCY CATEGORY	II		
	Ss	22.2	%g	
	S1	7.9	%g	
	SITE CLASS	B		
	SDS	14.8	%g	
	SD1	5.3	%g	
	SEISMIC DESIGN CATEGORY	B		
	BASIC FORCE RESISTING SYSTEM	OCBF		
	BASE SHEAR	11.0K		
	CS	0.11		
	R	2.00		
	ANALYSIS PROCEDURE	ELF		

GEOTECHNICAL DESIGN CRITERIA:

REFERENCE GEOTECHNICAL EVALUATION MEMORANDUM BY GZA GEO ENVIRONMENTAL, INC. DATED JULY 12, 2018 REGARDING GEOTECHNICAL DATA.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

DATE	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

REVISION | DESCRIPTION OF ISSUE / REVISION | REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STRUCTURAL DESIGN CRITERIA

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 28 OF 176
DRAWING: S-002

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT - STRUCTURAL CONCRETE PLAN AT EL 94.00

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	29 OF 176
DRAWING:	S-101

NOTES:

1. GENERAL STEEL FRAMING, SEE S-201.
2. LOWER LEVEL STEEL FRAMING PLAN, SEE S-202.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

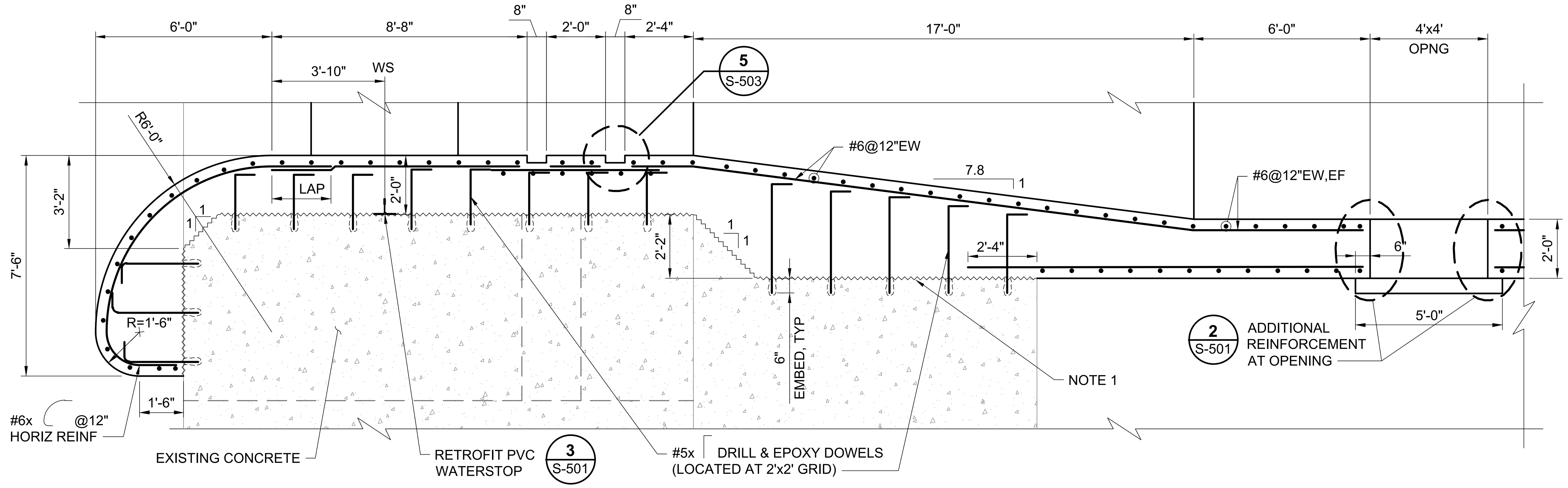
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT - STRUCTURAL CONCRETE PLAN AT EL 118.00

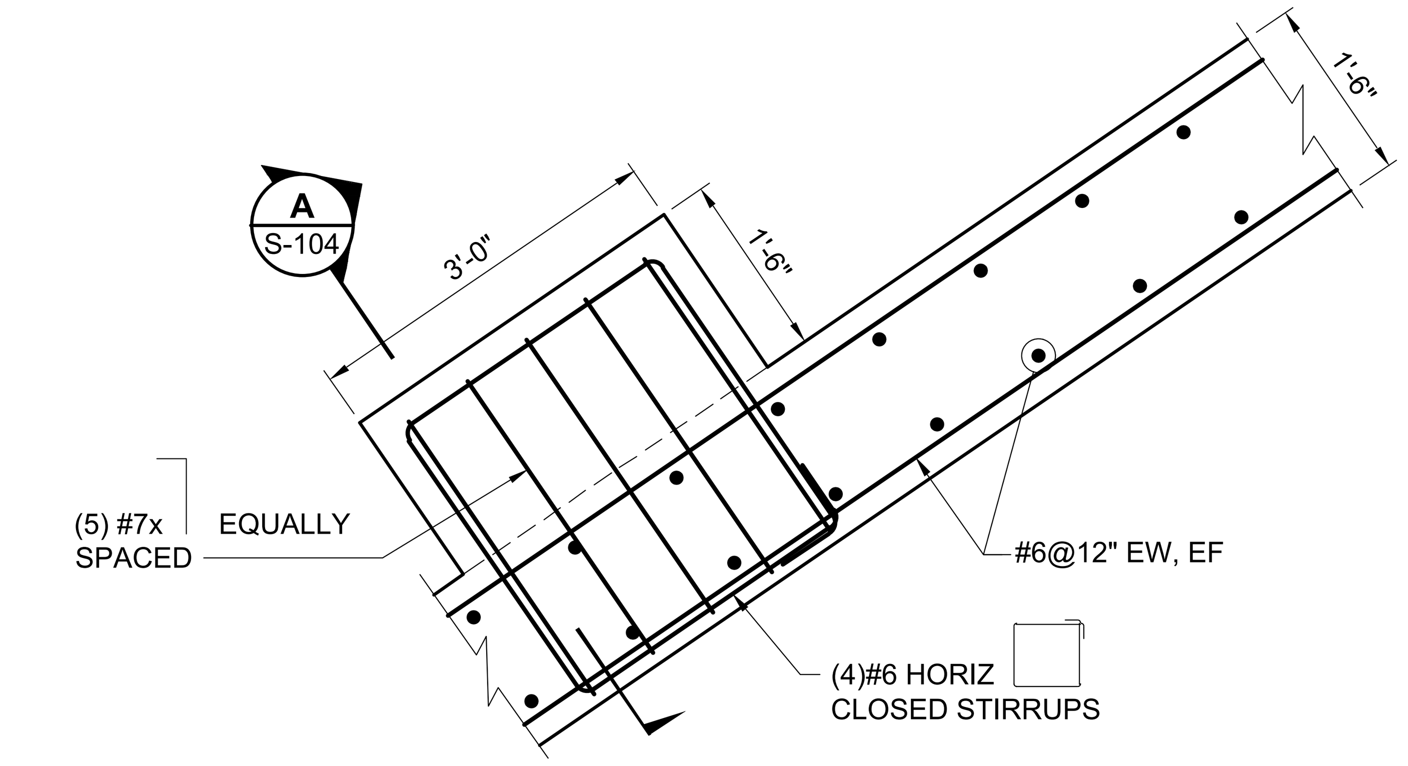
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	30 OF 176
DRAWING:	S-102

NOTE:

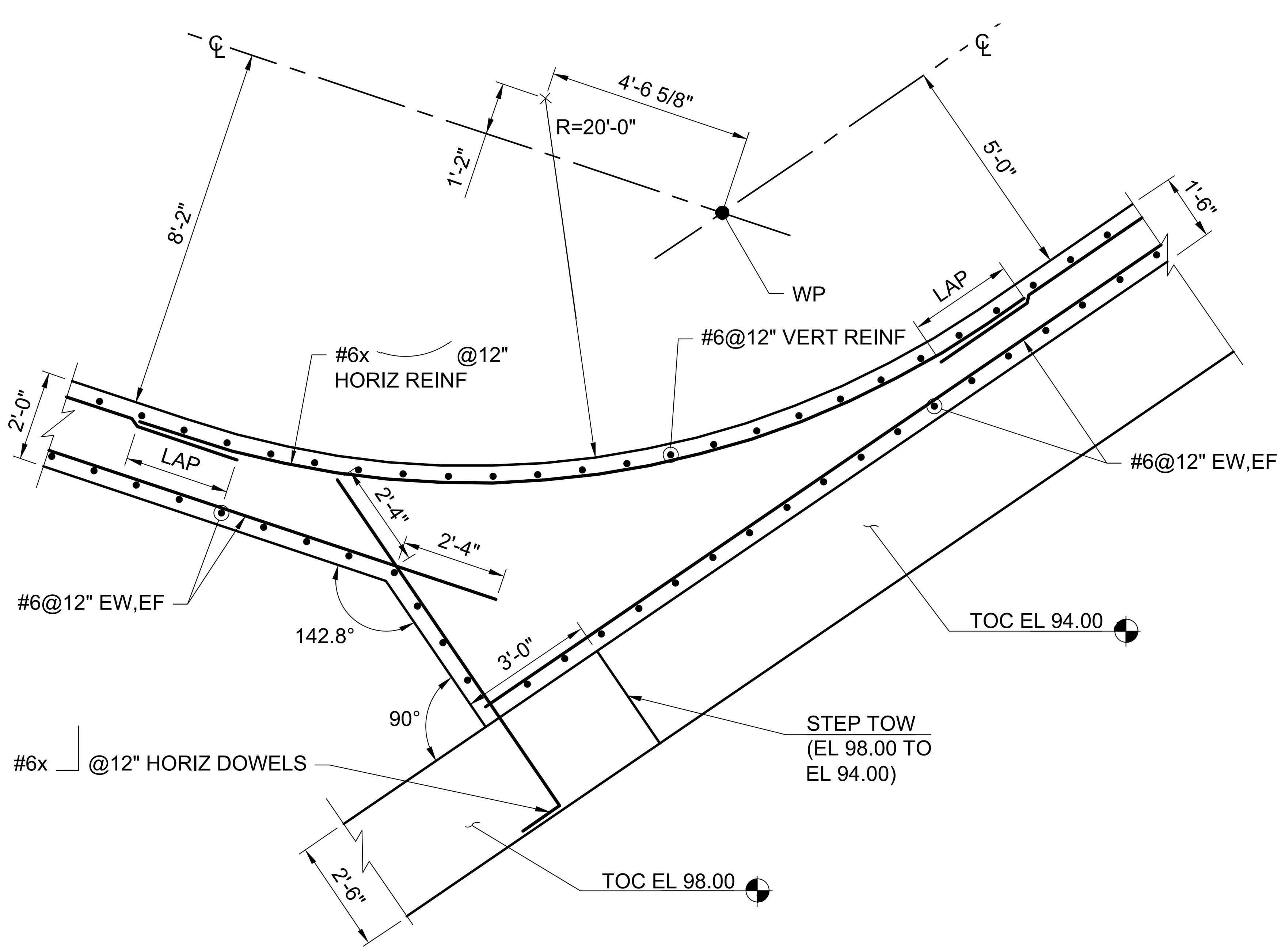
1. MECHANICALLY ROUGHEN EXISTING CONCRETE SURFACE TO ¼" MINIMUM AMPLITUDE.



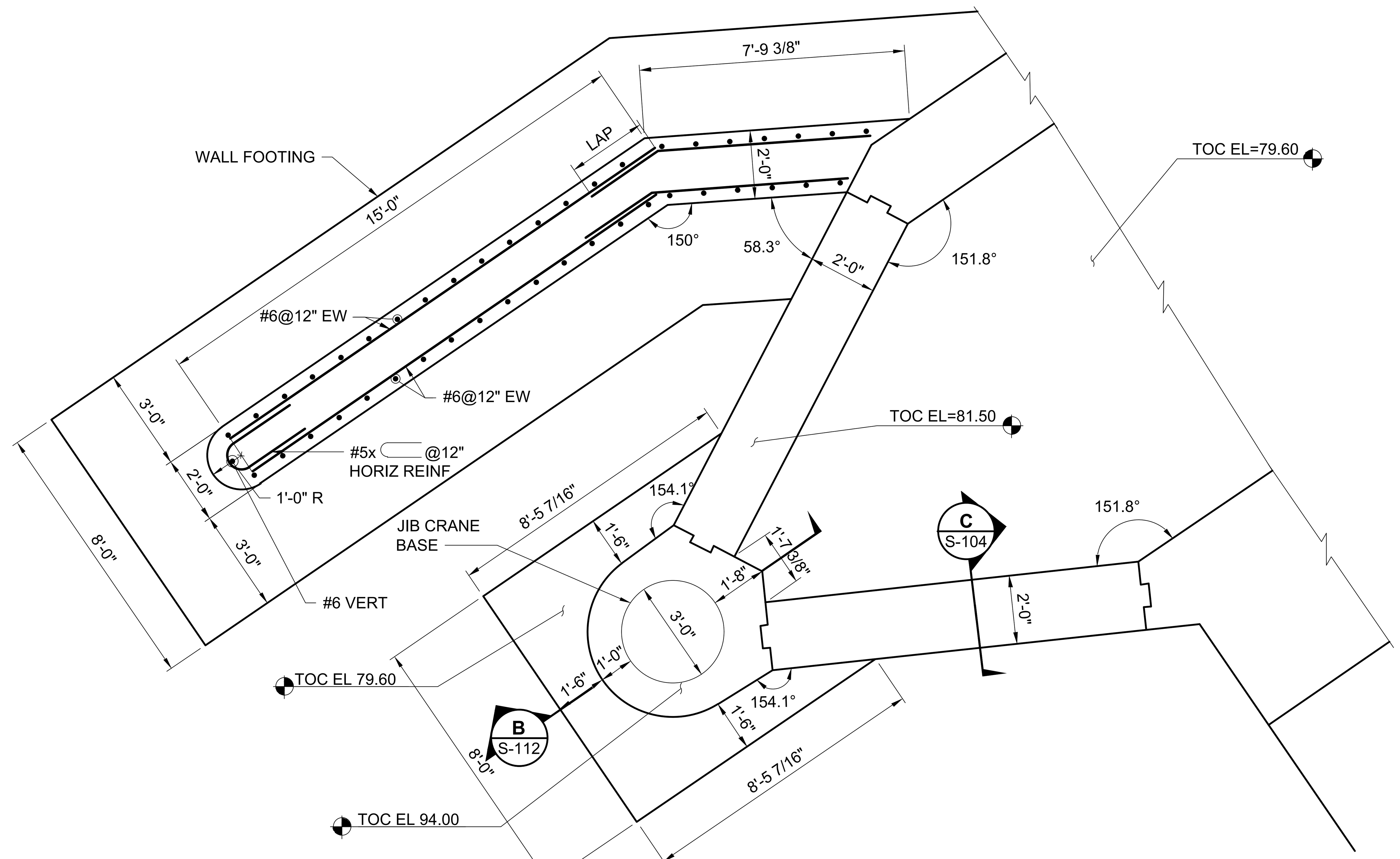
1 S-101 S-102 **ENLARGED VIEW**
SCALE: 3/8"=1'-0"



4 S-102 **CORBEL DETAIL**
SCALE: 3/4"=1'-0"



2 S-101 S-102 **ENLARGED VIEW REINFORCED SECTION (ABOVE EL 98.00)**
SCALE: 3/8"=1'-0"



3 S-101 S-102 **ENLARGED VIEW**
SCALE: 3/8"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

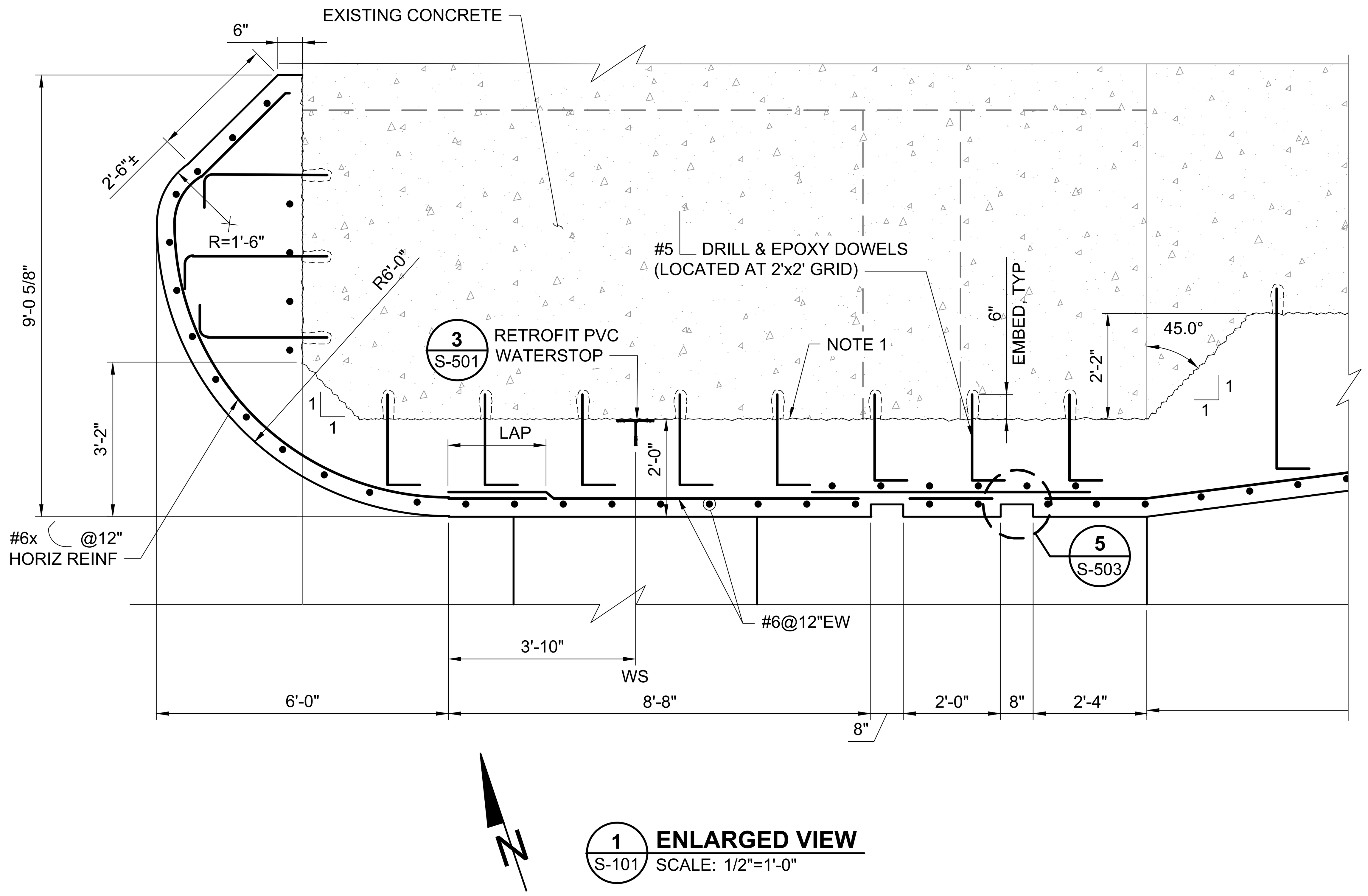
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT - ENLARGED PLANS & DETAILS

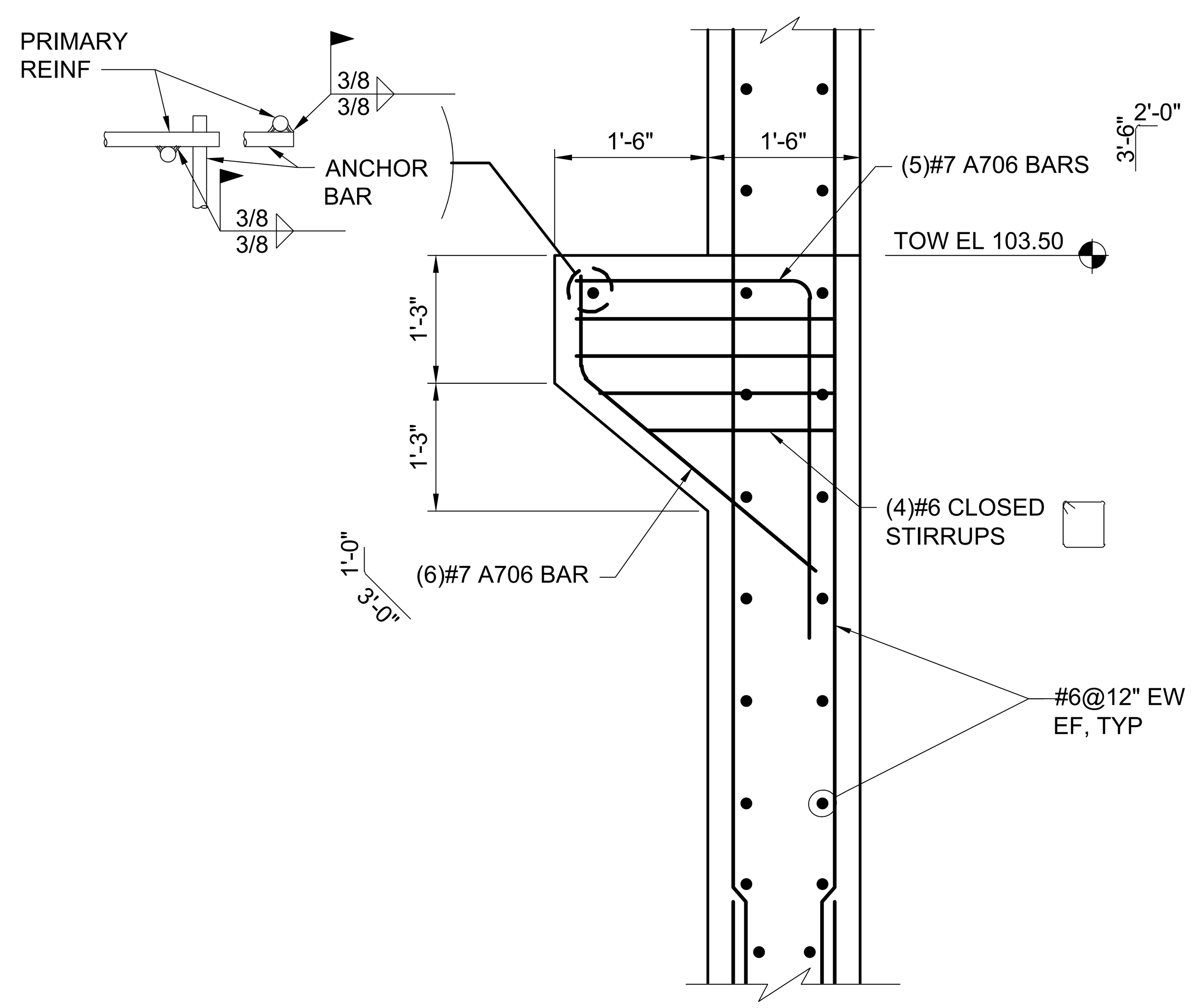
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 31 OF 176
DRAWING: S-103

NOTE:

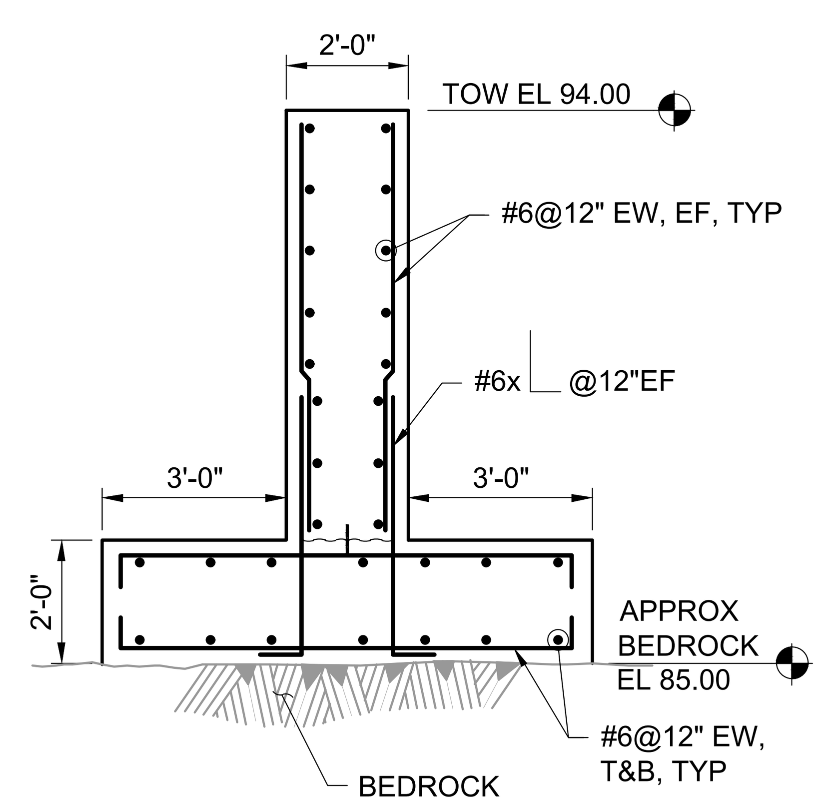
1. MECHANICALLY ROUGHEN EXISTING CONCRETE SURFACE TO ¼" MINIMUM AMPLITUDE.



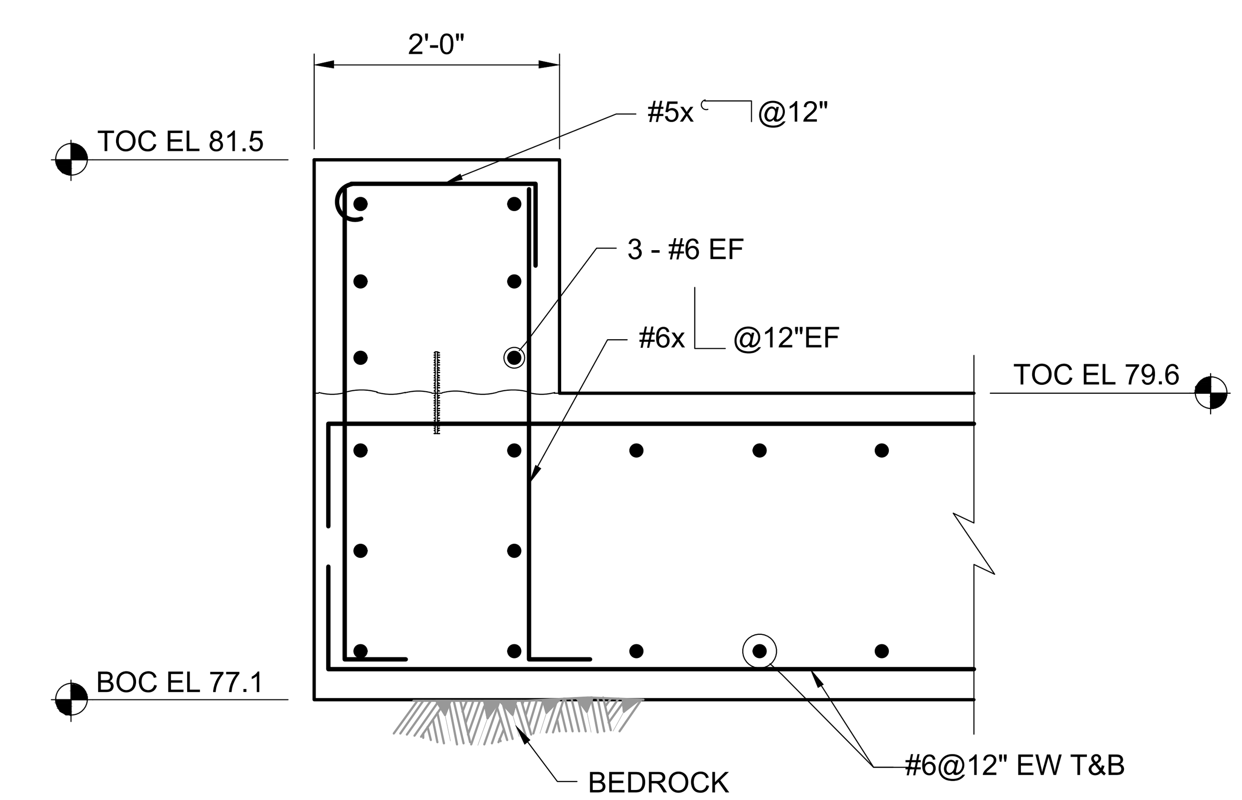
1 S-101 **ENLARGED VIEW**
SCALE: 1/2"=1'-0"



A S-102 **CORBEL DETAIL**
SCALE: NTS
S-103
S-202



B S-101 **SECTION**
SCALE: 3/8"=1'-0"
S-102



C S-103 **WEIR PANEL BASE**
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden risa and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-104.dwg USER: Agrogan
DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S3-SHWMT-PFW S1-SHWMT-SW-PL S1-SHWMT-FL-PL S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

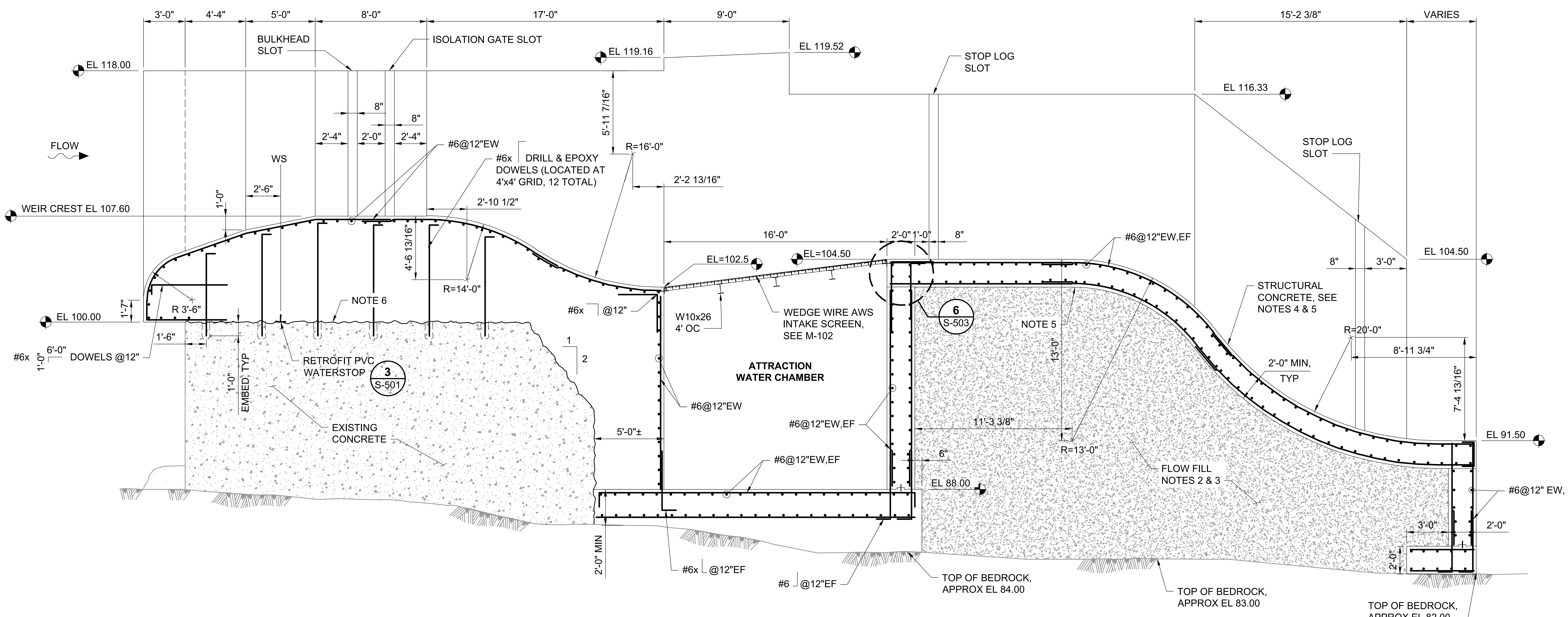
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT - ENLARGED PLAN, DETAILS, & SECTIONS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	32 OF 176
DRAWING:	S-104

NOTES:

1. CONCRETE SLAB MUST HAVE MINIMUM THICKNESS OF 2'-0".
2. CONTRACTOR MAY USE LEAN CONCRETE OR STRUCTURAL CONCRETE INSTEAD OF FLOW FILL.
3. MAXIMUM HEIGHT OF FLOW FILL LIFT IS 4'-0".
4. MINIMUM STRUCTURAL CONCRETE THICKNESS AND REINFORCEMENT ARE SHOWN.
5. LOWER STRUCTURAL CONCRETE SURFACE CAN BE ALTERED (STEPPED, SLOPED, ETC.) TO ACCOMMODATE CONTRACTOR'S MEANS AND METHODS. CONTRACTOR SHALL SUBMIT PROPOSED CONSTRUCTION APPROACH FOR REVIEW BY ENGINEER.
6. MECHANICALLY ROUGHEN EXISTING CONCRETE SURFACE TO ¼" MINIMUM AMPLITUDE.



A S-101 SECTION AT CENTERLINE

SCALE: 1/4"=1'-0"

S-102

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

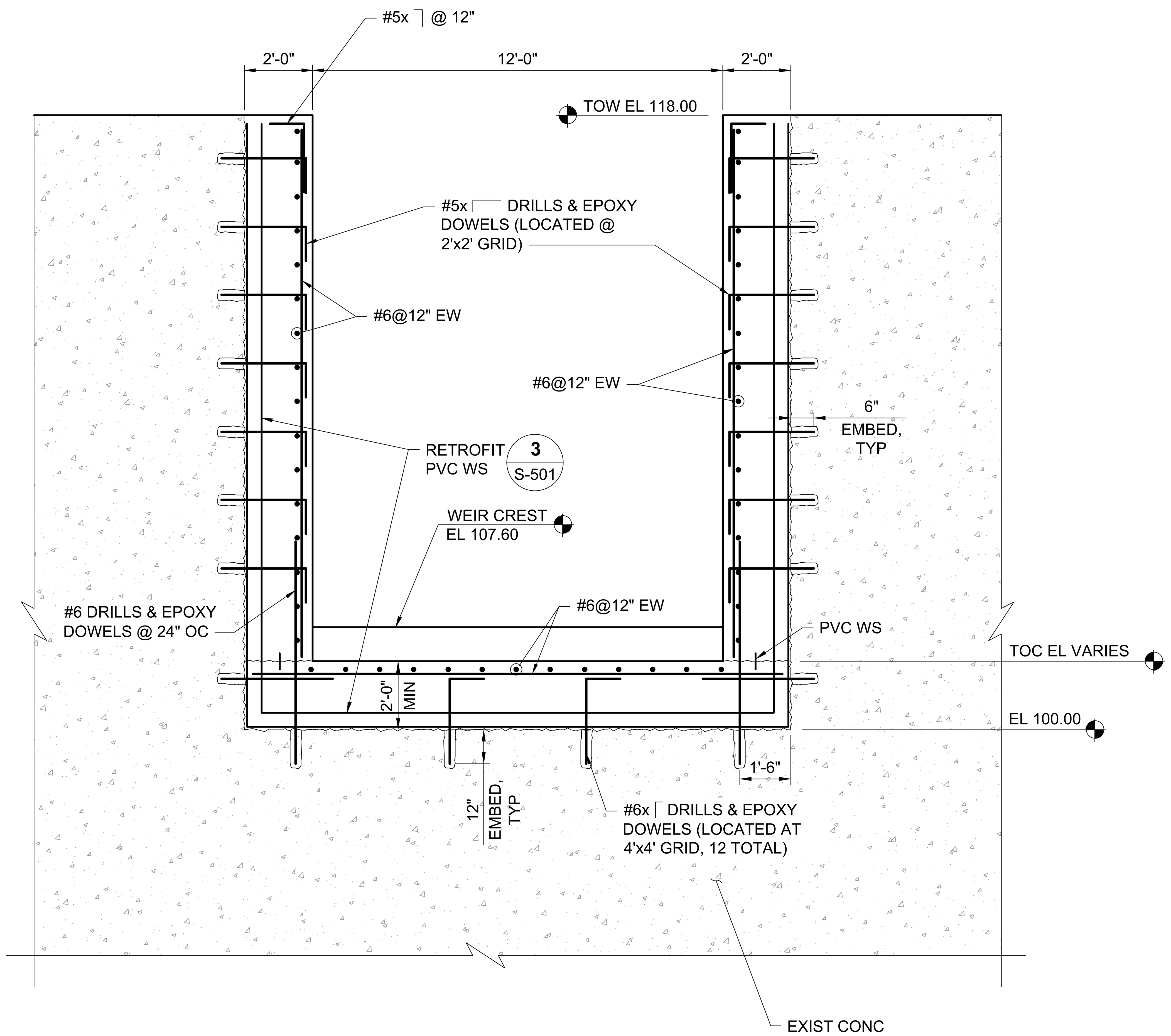
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY STRUCTURAL CONCRETE SECTION

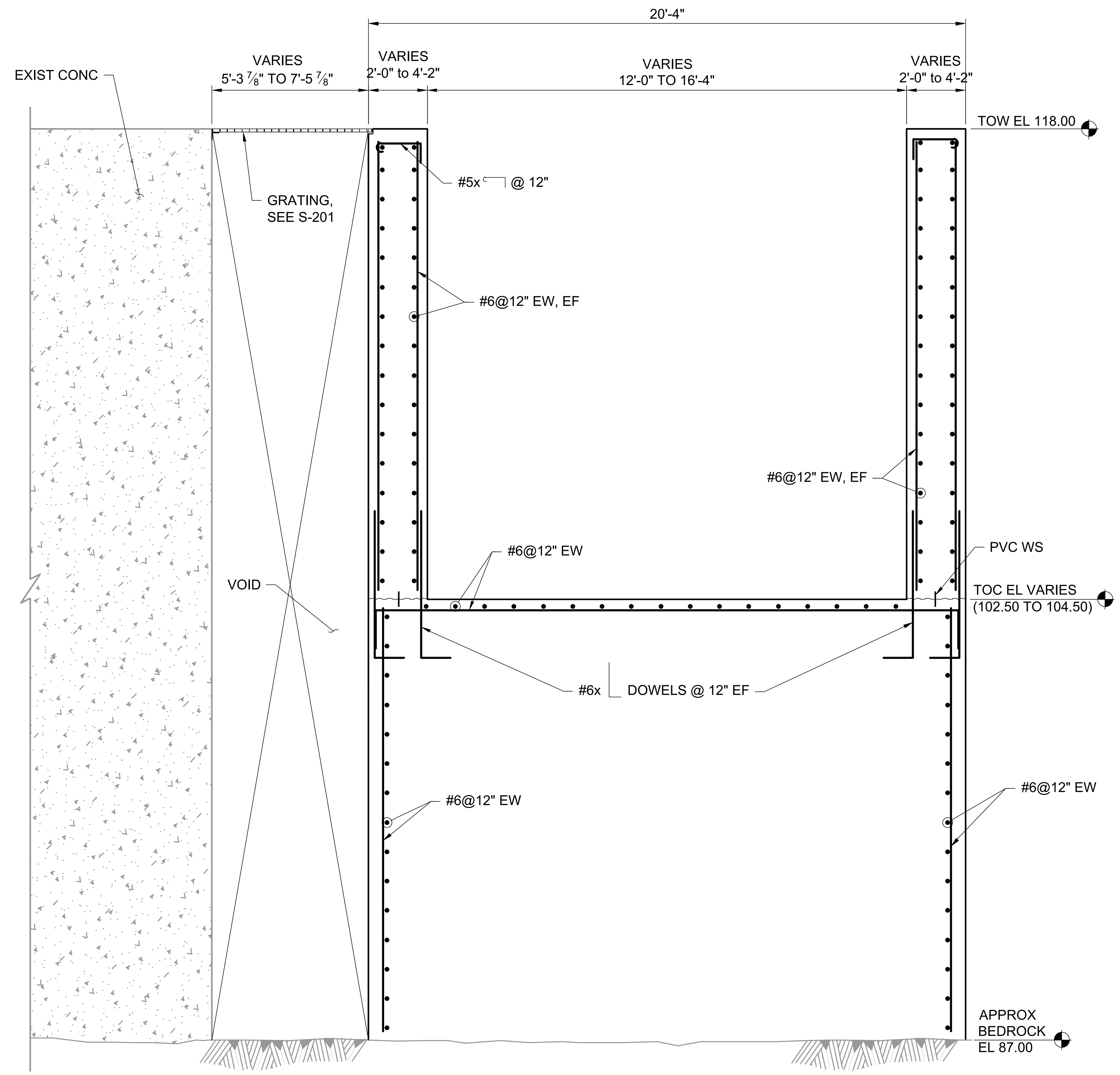
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	33 OF 176
DRAWING:	S-105

NOTES:

1. CONCRETE SLAB MUST HAVE MINIMUM THICKNESS OF 2'-0".
2. MAXIMUM HEIGHT OF FLOW FILL LIFT IS 4'-0".



A SECTION
S-101 SCALE: 3/8"=1'-0"
S-102



B SECTION
S-101 SCALE: 3/8"=1'-0"
S-102

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

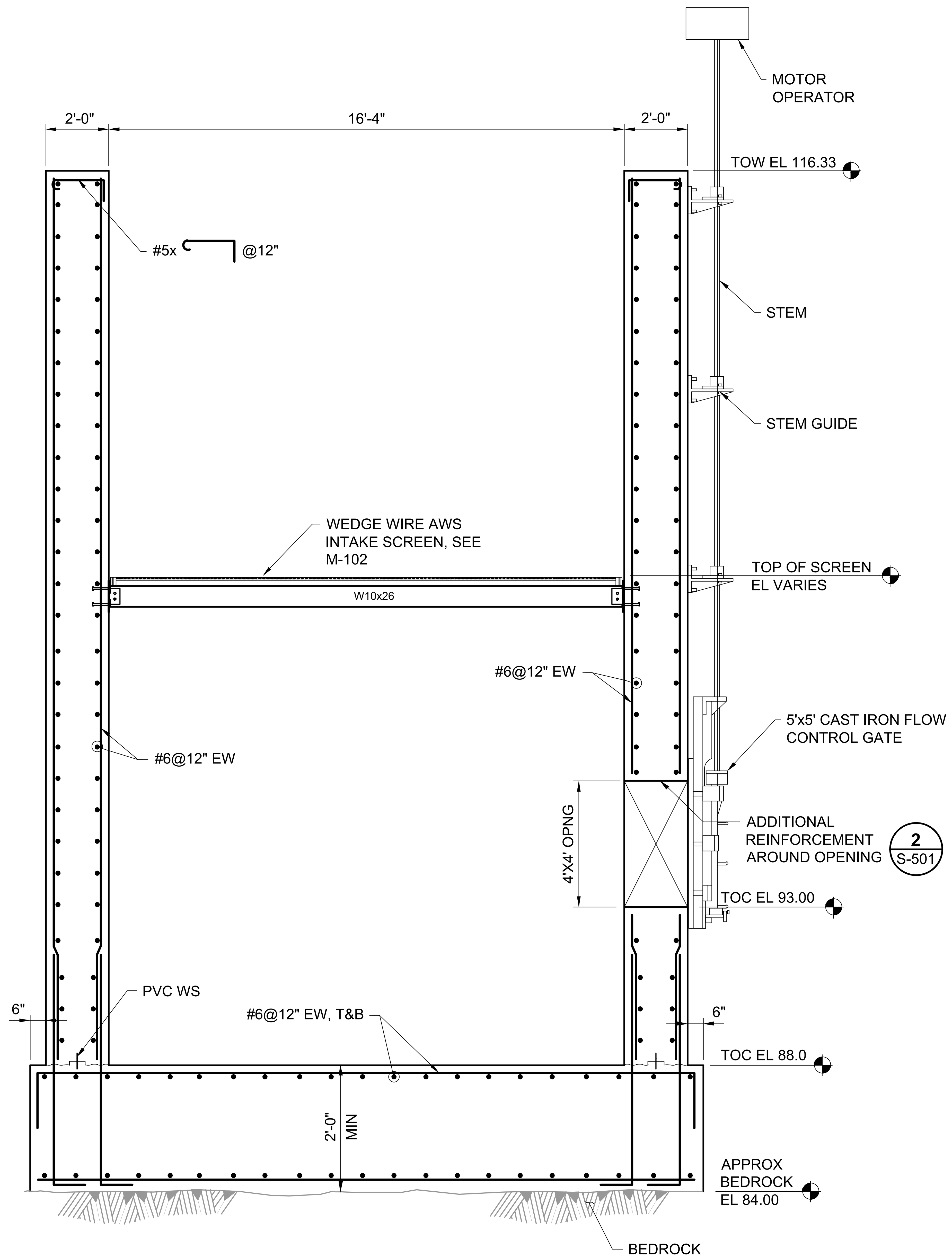
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE MARK DANIEL GRAESER No.39328 12/13/2019 LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY STRUCTURAL CONCRETE SECTIONS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 34 OF 176
DRAWING: S-106



C
S-101
S-102

SECTION
SCALE: 3/8"=1'-0"

CONTROL GATE NOTES:

AWS FLOW CONTROL:

1. OPERATION: ADJUSTABLE FOR FLOW CONTROL PCL CONTROL POSITION MONITORING.
2. OPENING: W4' x H4'
3. HEAD: 21'
4. UPWARD OPENING

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

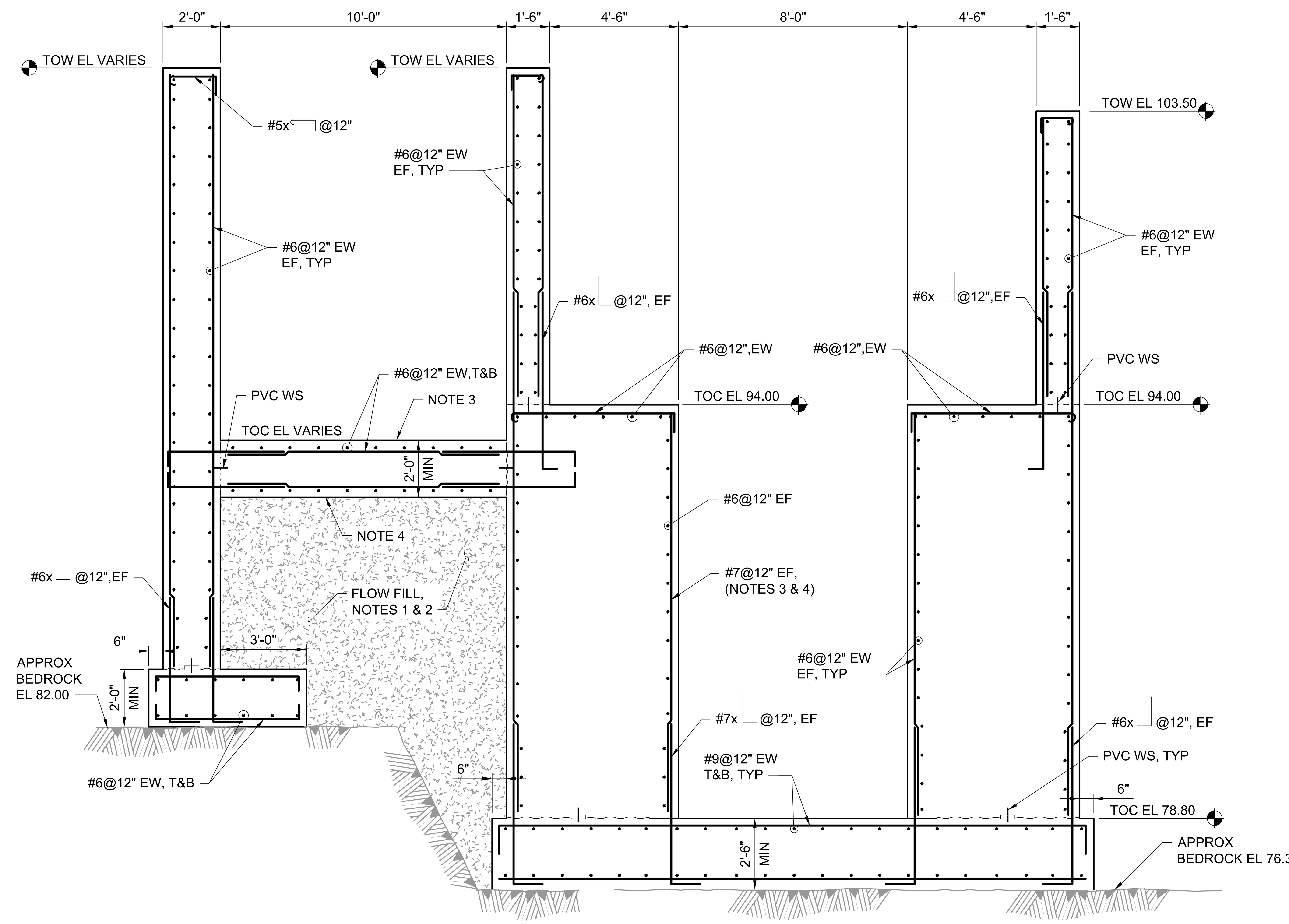
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY STRUCTURAL CONCRETE SECTION

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	35 OF 176
DRAWING:	S-107

NOTES:

1. CONTRACTOR MAY USE LEAN CONCRETE OR STRUCTURAL CONCRETE INSTEAD OF FLOW FILL.
2. MAXIMUM HEIGHT OF FLOW FILL LIFT IS 4'-0".
3. MINIMUM STRUCTURAL CONCRETE THICKNESS AND REINFORCEMENT ARE SHOWN.
4. LOWER STRUCTURAL CONCRETE SURFACE CAN BE ALTERED (STEPPED, SLOPED, ETC.) TO ACCOMMODATE CONTRACTOR'S MEANS AND METHODS. CONTRACTOR SHALL SUBMIT PROPOSED CONSTRUCTION APPROACH FOR REVIEW BY ENGINEER.



C
S-101
SECTION
SCALE: 3/8"=1'-0"
S-102

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

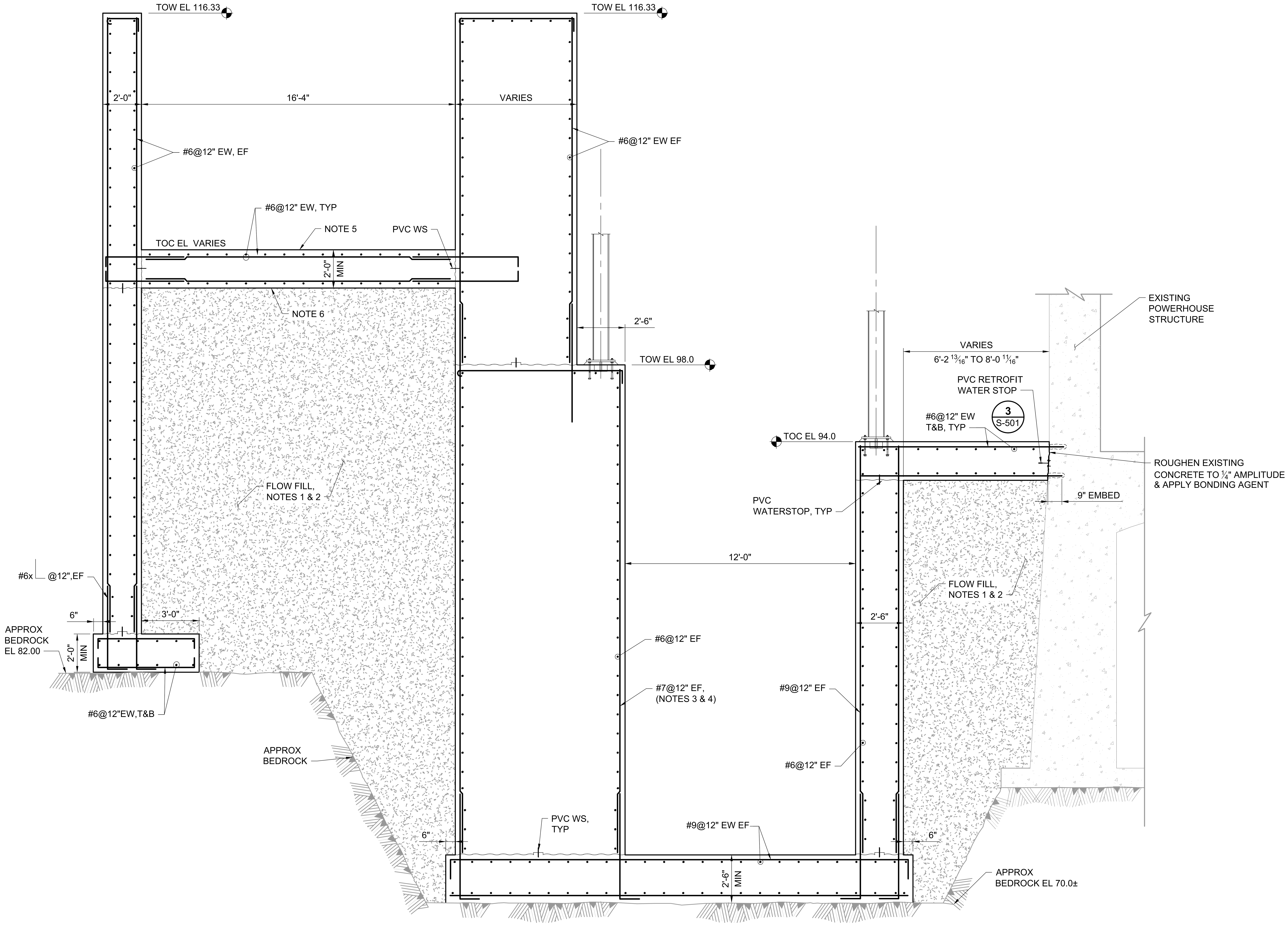
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT
STRUCTURAL CONCRETE SECTION

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	36 OF 176
DRAWING:	S-108



D
S-101
SECTION
SCALE: 3/8"=1'-0"
S-102

NOTES:

1. CONTRACTOR MAY USE LEAN CONCRETE OR STRUCTURAL CONCRETE INSTEAD OF FLOW FILL.
2. MAXIMUM HEIGHT OF FLOW FILL LIFT IS 4'-0".
3. #9@12" EF VERTICAL REINFORCEMENT FOR LOCATIONS WITH 2'-6" THICK WALL.
4. #9@12" EF VERTICAL REINFORCEMENT FOR LOCATIONS WITH WALLS THICKER THAN 2'-6".
5. MINIMUM STRUCTURAL CONCRETE THICKNESS AND REINFORCEMENT ARE SHOWN.
6. LOWER STRUCTURAL CONCRETE SURFACE CAN BE ALTERED (STEPPED, SLOPED, ETC.) TO ACCOMMODATE CONTRACTOR'S MEANS AND METHODS. CONTRACTOR SHALL SUBMIT PROPOSED CONSTRUCTION APPROACH FOR REVIEW BY ENGINEER.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

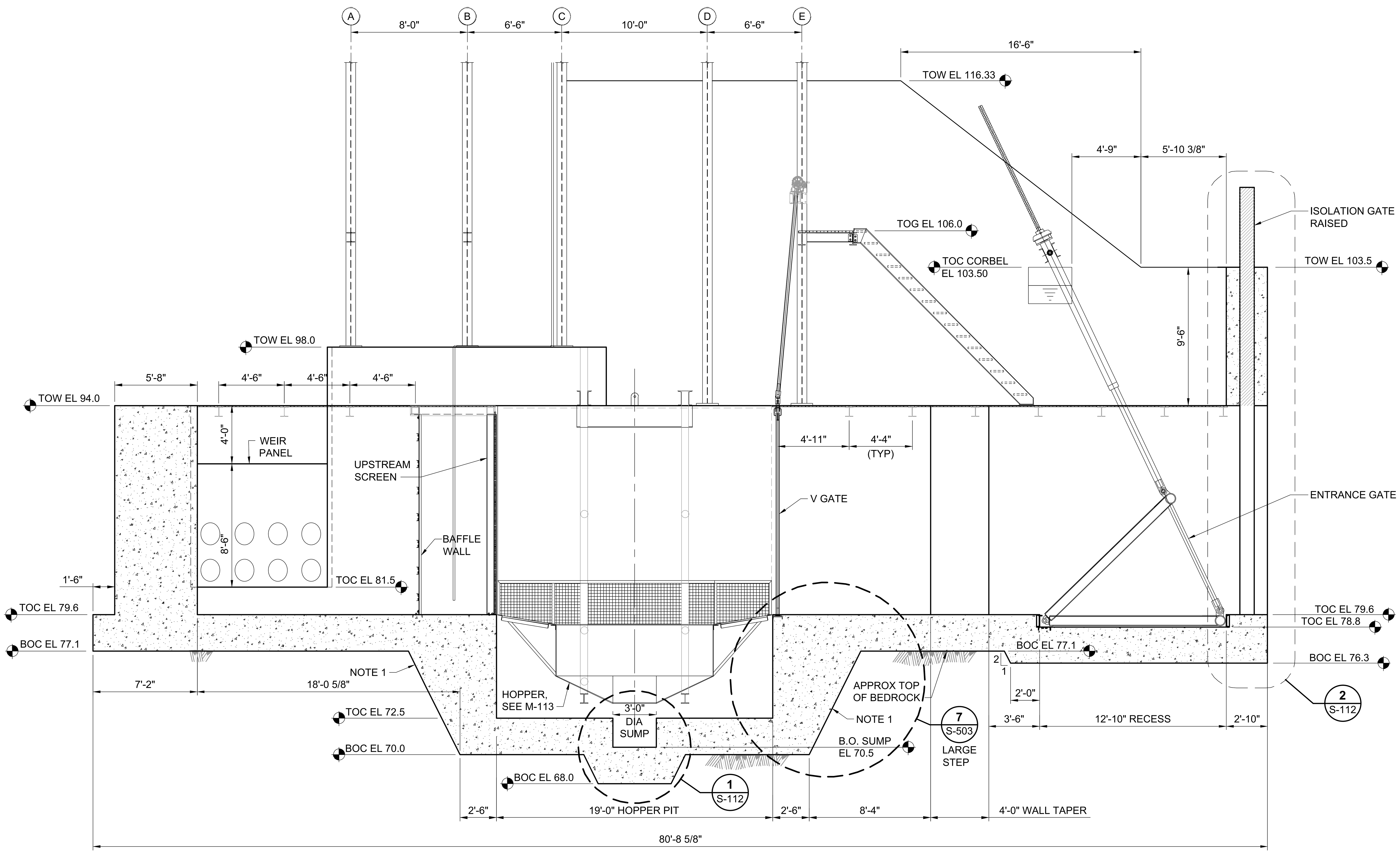
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
LICENSED PROFESSIONAL ENGINEER
12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT
STRUCTURAL CONCRETE SECTION

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	37 OF 176
DRAWING:	S-109



EXCAVATION NOTE:

1. SLOPES SHOWN ARE APPROXIMATE. ACTUAL SLOPES WILL VARY BASED ON CONTRACTORS COMPLIANCE WITH APPLICABLE SAFETY REQUIREMENTS.

A SECTION (S-101, S-102)
SCALE: 1/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

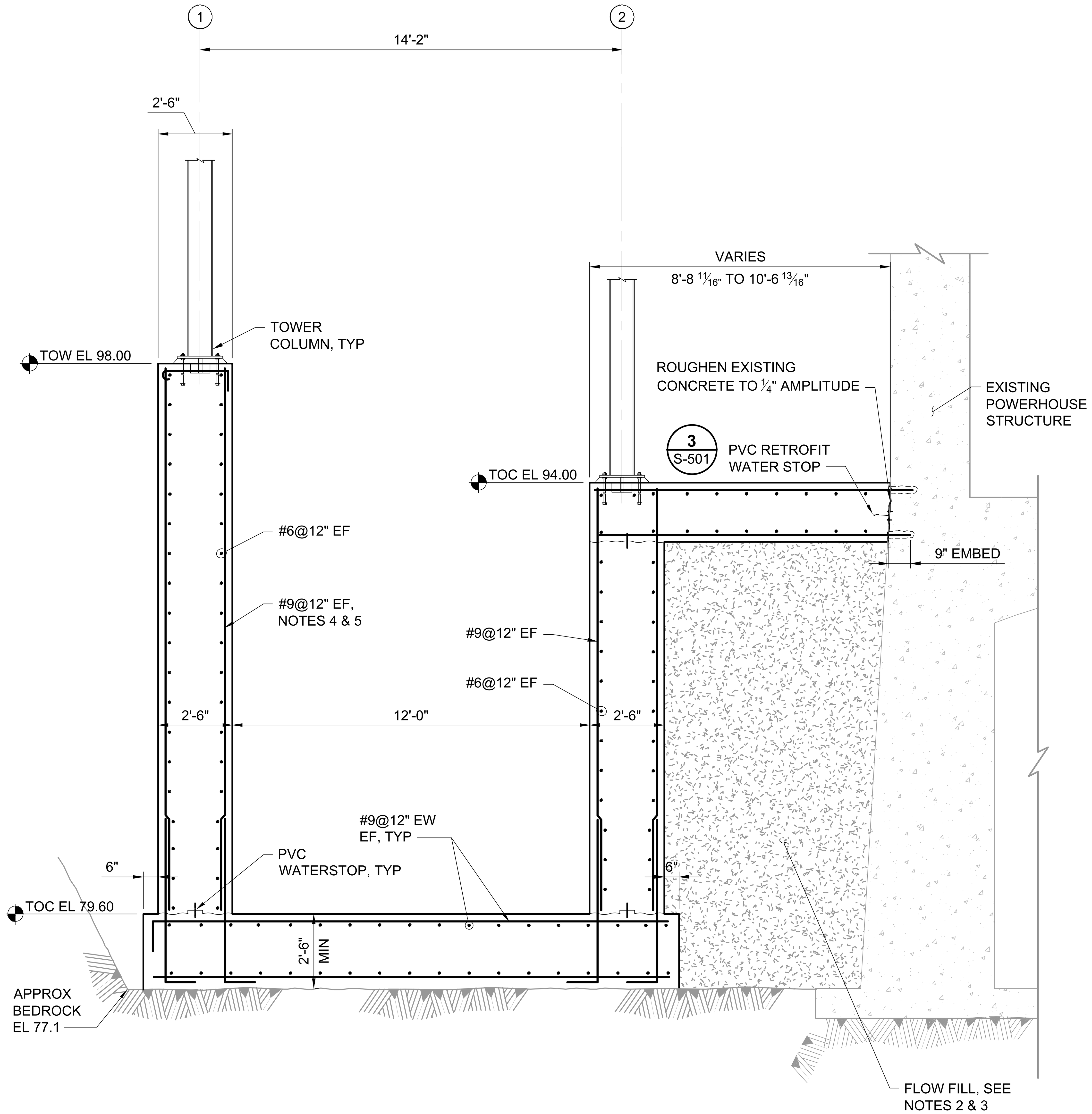
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT STRUCTURAL CONCRETE SECTIONS

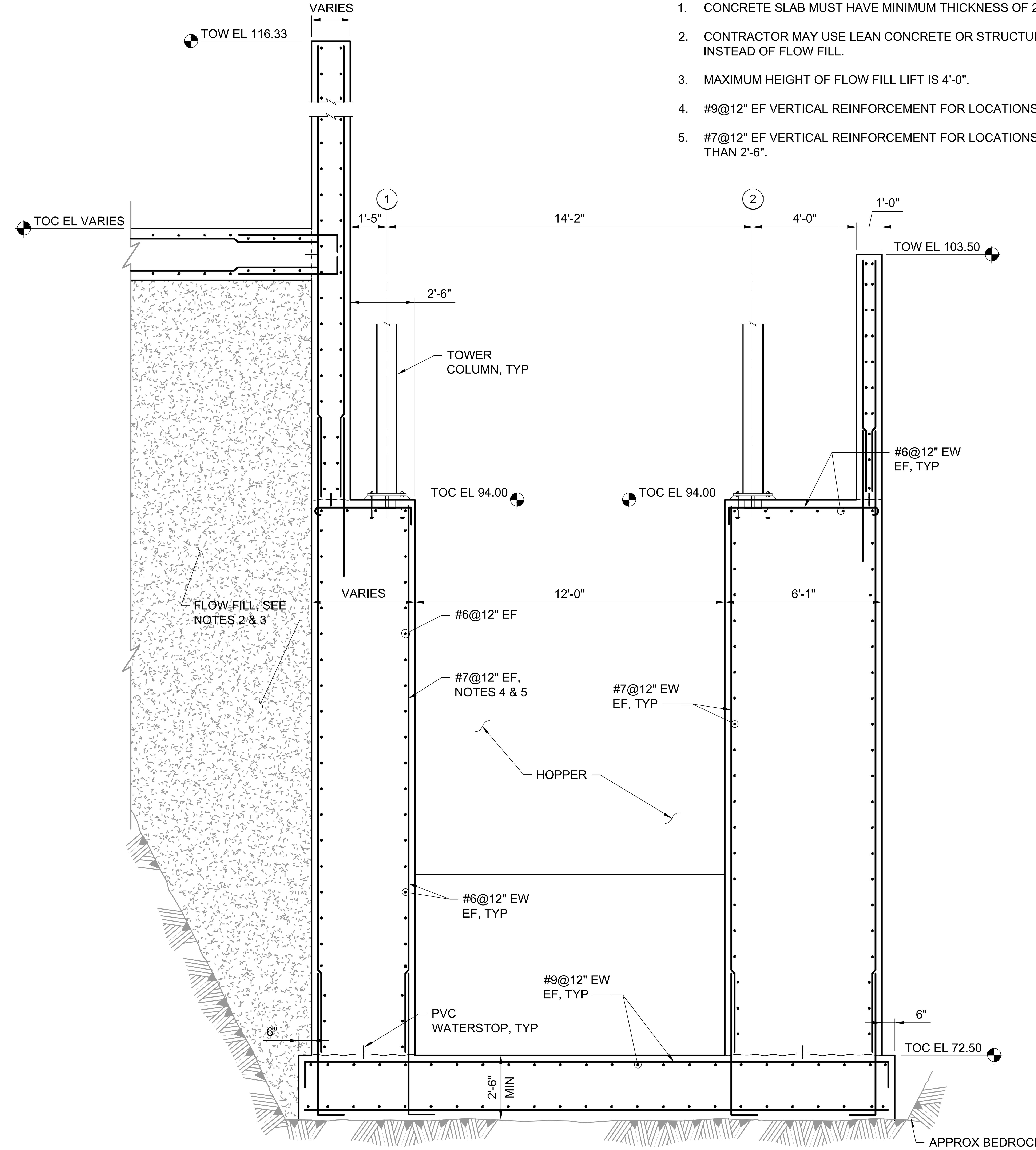
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	38 OF 176
DRAWING:	S-110

NOTES:

1. CONCRETE SLAB MUST HAVE MINIMUM THICKNESS OF 2'-6".
2. CONTRACTOR MAY USE LEAN CONCRETE OR STRUCTURAL CONCRETE INSTEAD OF FLOW FILL.
3. MAXIMUM HEIGHT OF FLOW FILL LIFT IS 4'-0".
4. #9@12" EF VERTICAL REINFORCEMENT FOR LOCATIONS WITH 2'-6" THICK WALL.
5. #7@12" EF VERTICAL REINFORCEMENT FOR LOCATIONS WITH WALLS THICKER THAN 2'-6".



A SECTION
S-101 SCALE: 3/8"=1'-0"
S-102



B SECTION
S-101 SCALE: 3/8"=1'-0"
S-102

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

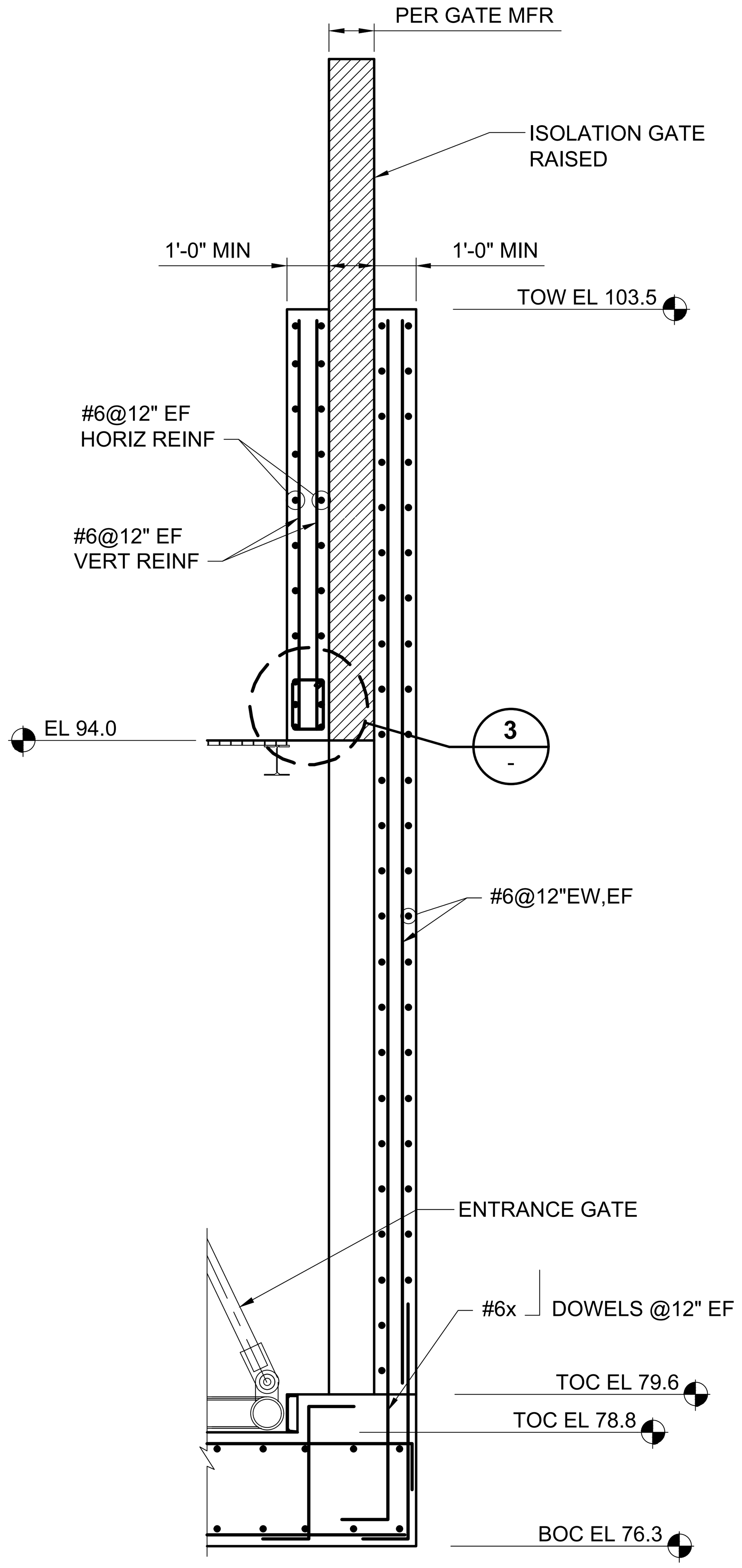
STATE OF MAINE MARK DANIEL GRAESER No.39328 12/13/2019 LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

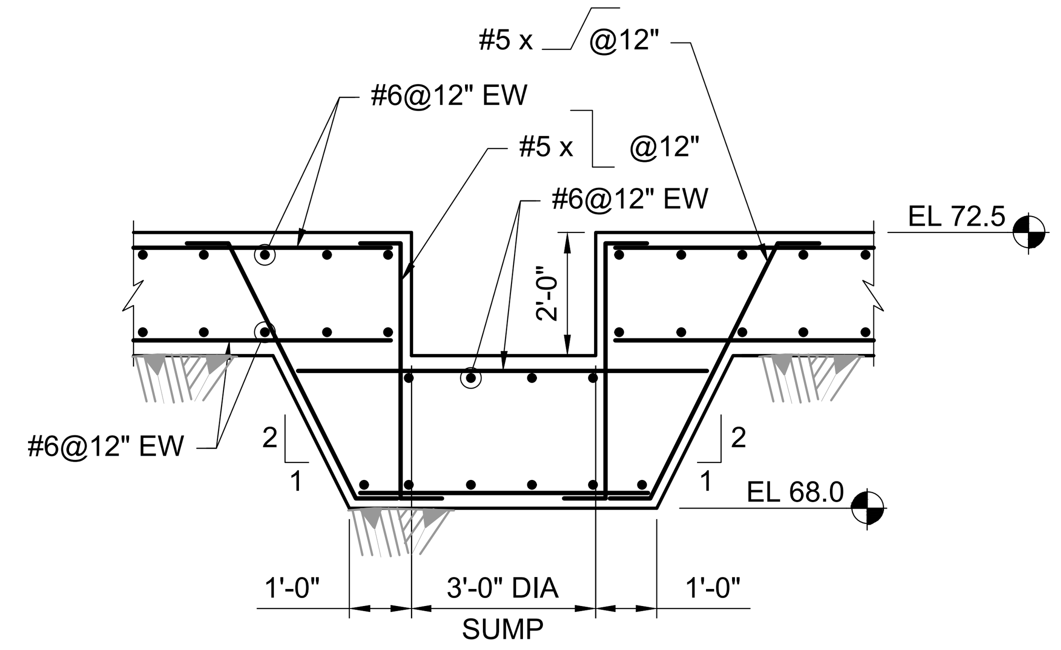
FISH LIFT STRUCTURAL CONCRETE SECTIONS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 39 OF 176
DRAWING: S-111

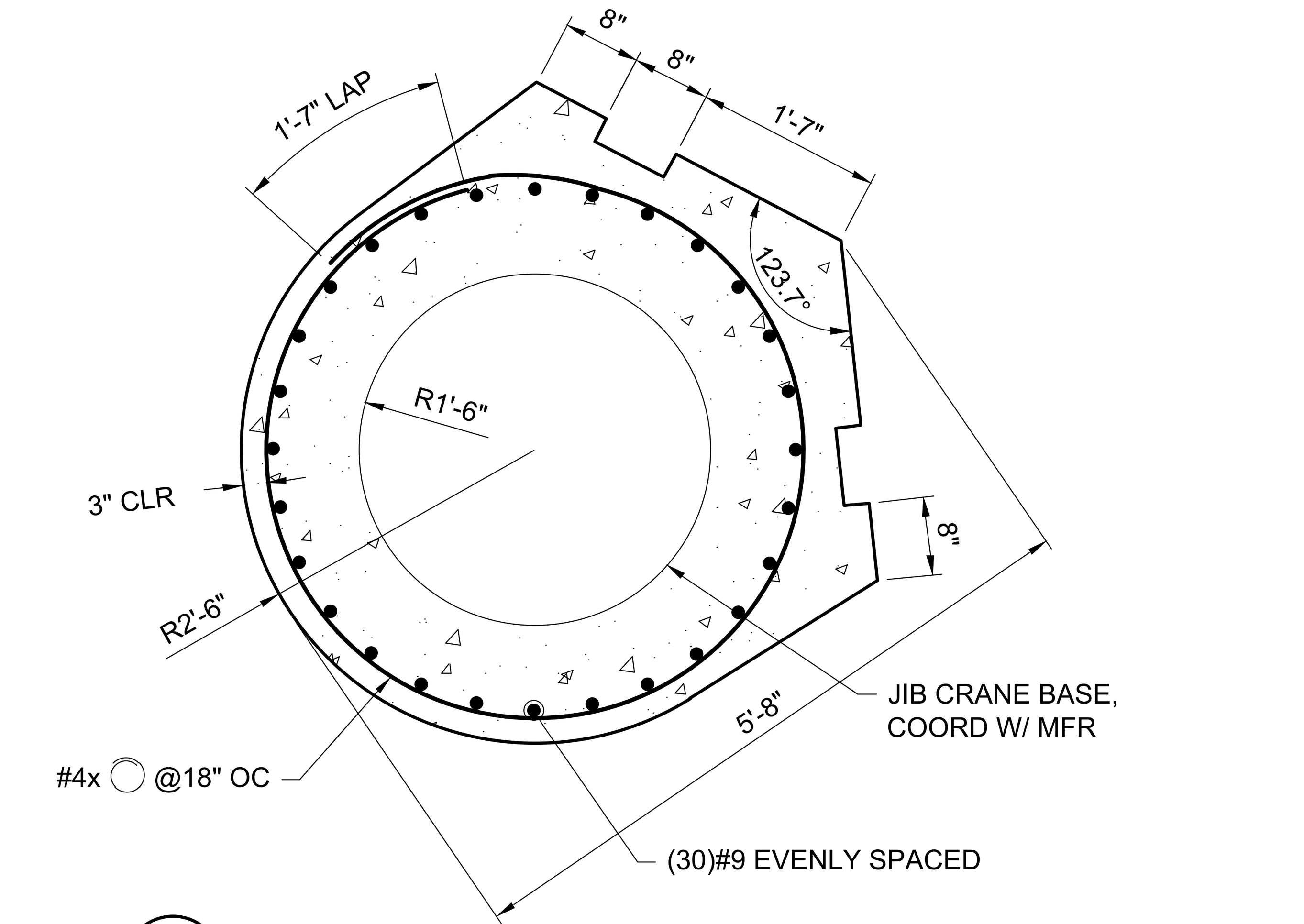
DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden misc and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-111.dwg USER: Agrogan
DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S-SHWMT-LIFT-SC MAINE-PE-STAMP-MDG IMAGES:



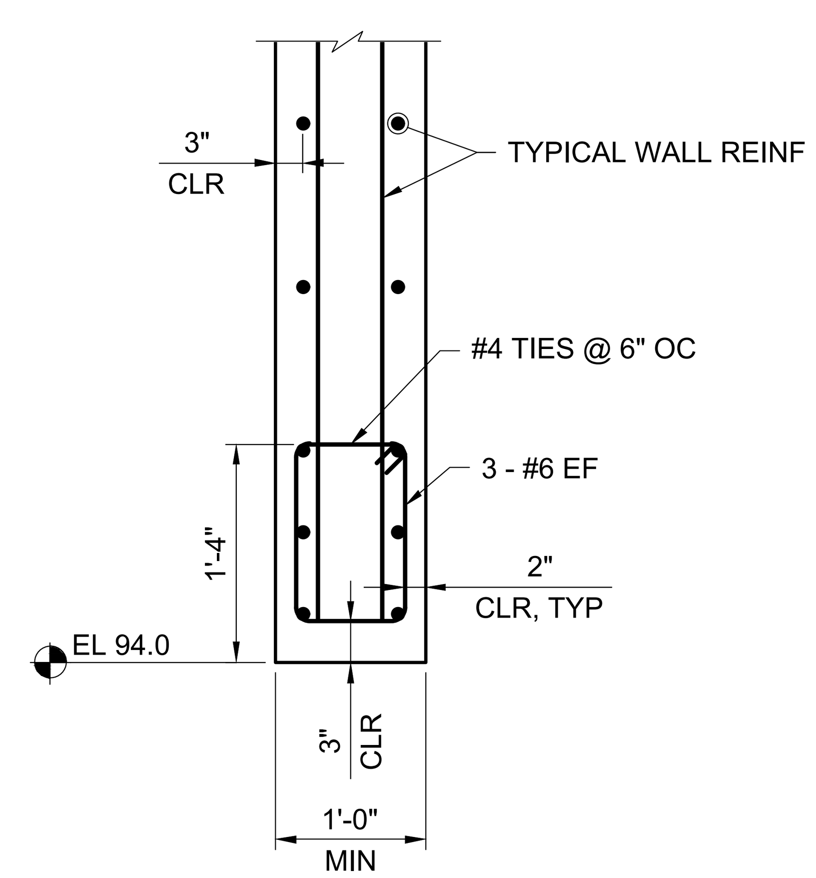
2 S-110 **DETAIL**
SCALE: 3/8"=1'-0"



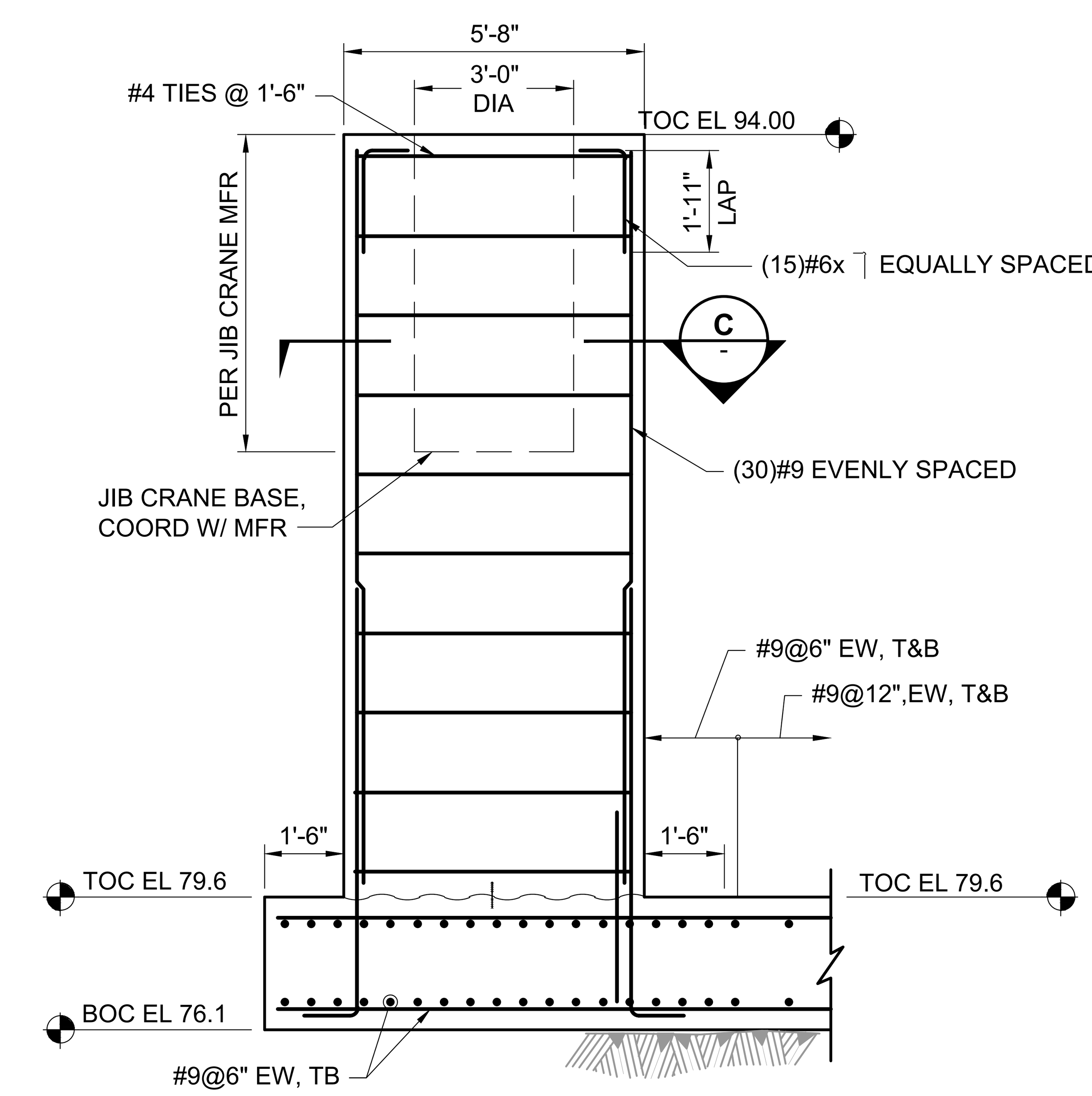
1 S-110 **SUMP PIT DETAIL**
SCALE: 3/8"=1'-0"



C - **SECTION**
SCALE: 3/4"=1'-0"



3 - **BEAM DETAIL (AT BOTTOM OF WALL)**
SCALE: 1"=1'-0"



B S-103 **JIB CRANE BASE**
SCALE: 3/8"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

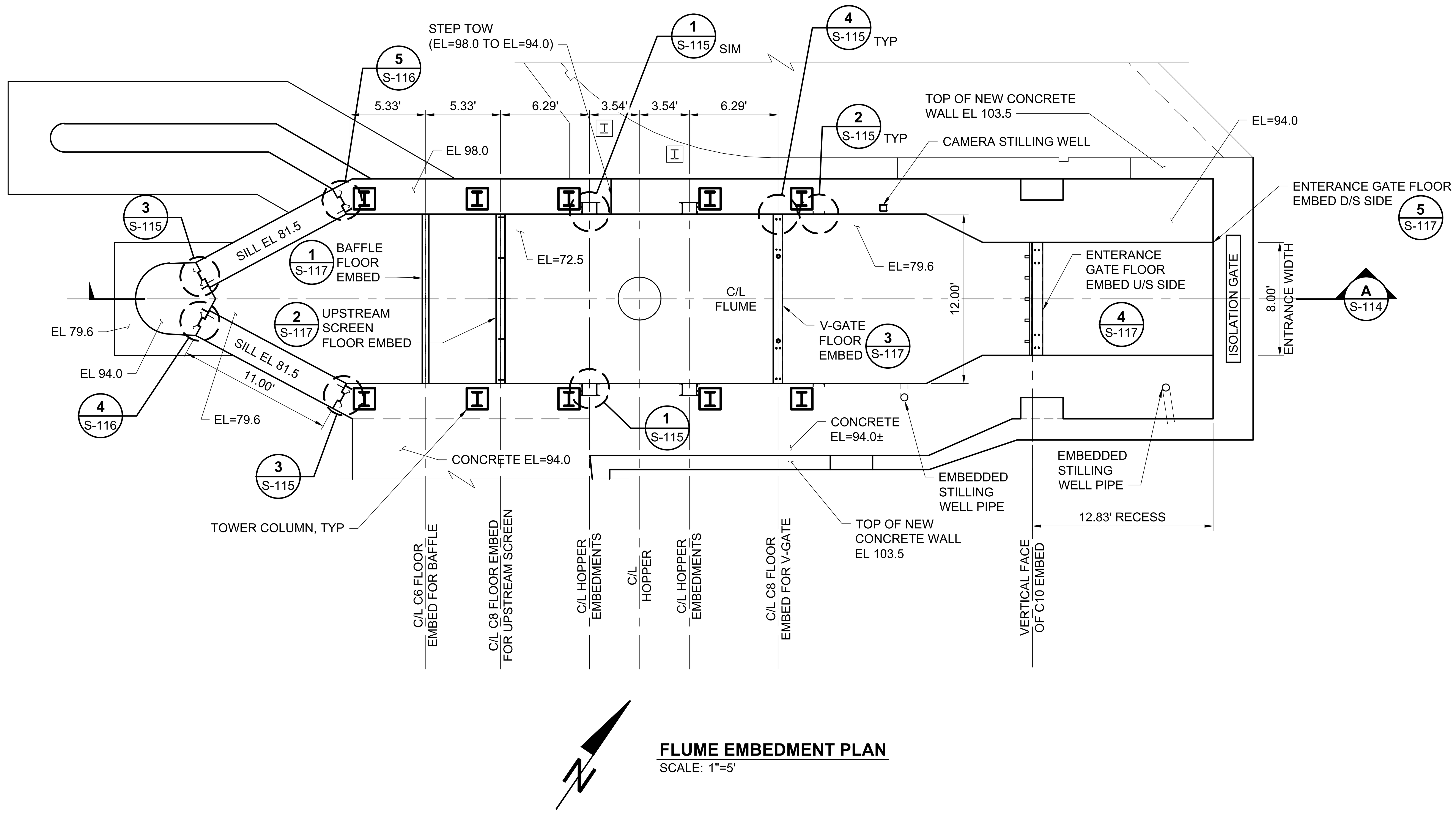
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT STRUCTURAL
CONCRETE SECTIONS & DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	40 OF 176
DRAWING:	S-112

EMBEDMENT NOTES:

1. WELDS FOR ¼" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE ¾" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.



FLUME EMBEDMENT PLAN

SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

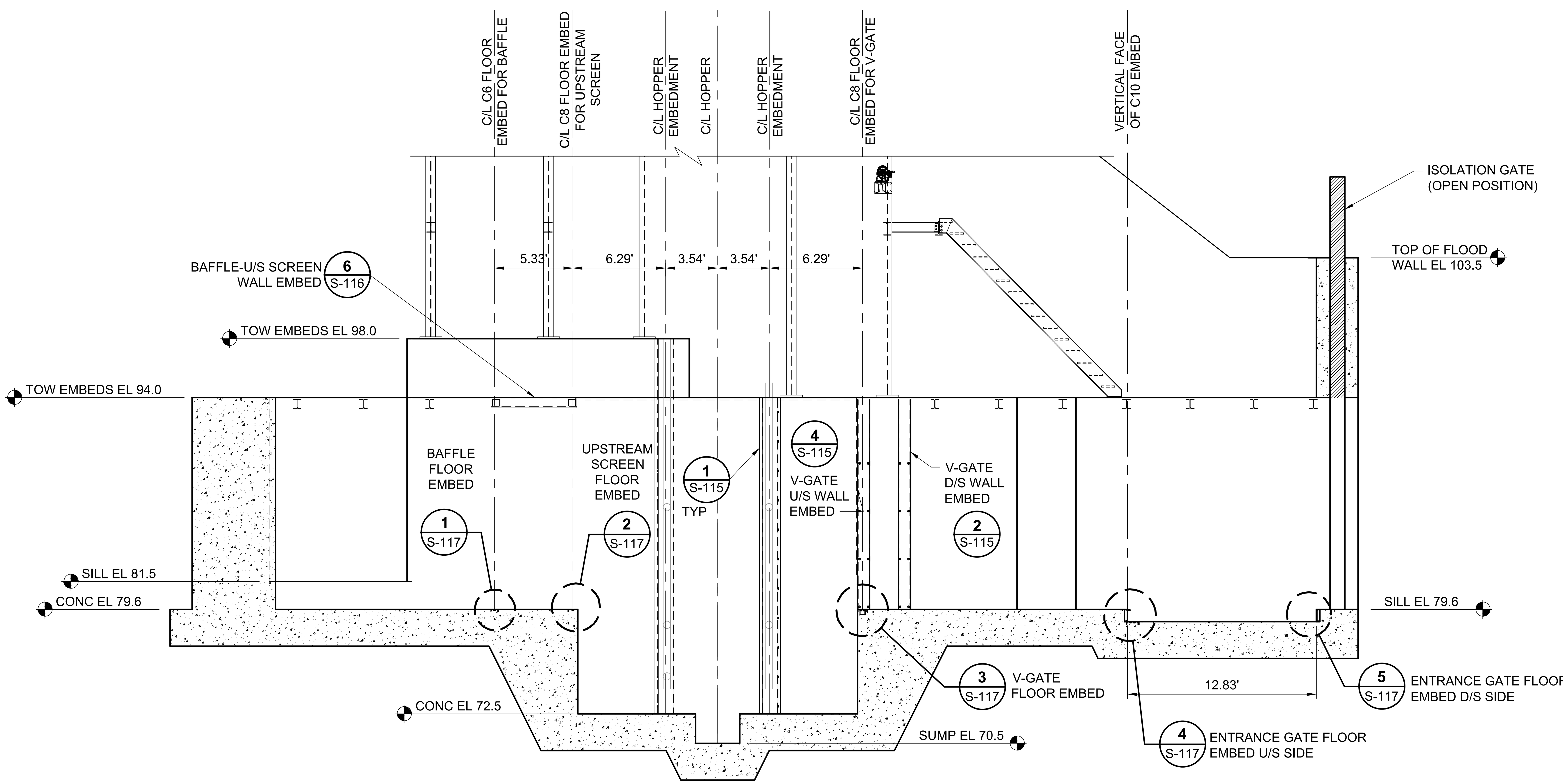
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT CONCRETE ENTRANCE
FLUME EMBEDMENT

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	41 OF 176
DRAWING:	S-113

EMBEDMENT NOTES:

1. WELDS FOR ¼" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE ¾" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.



A S-113 **FLUME EMBEDMENT ELEVATION**
SCALE: 1"=5'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

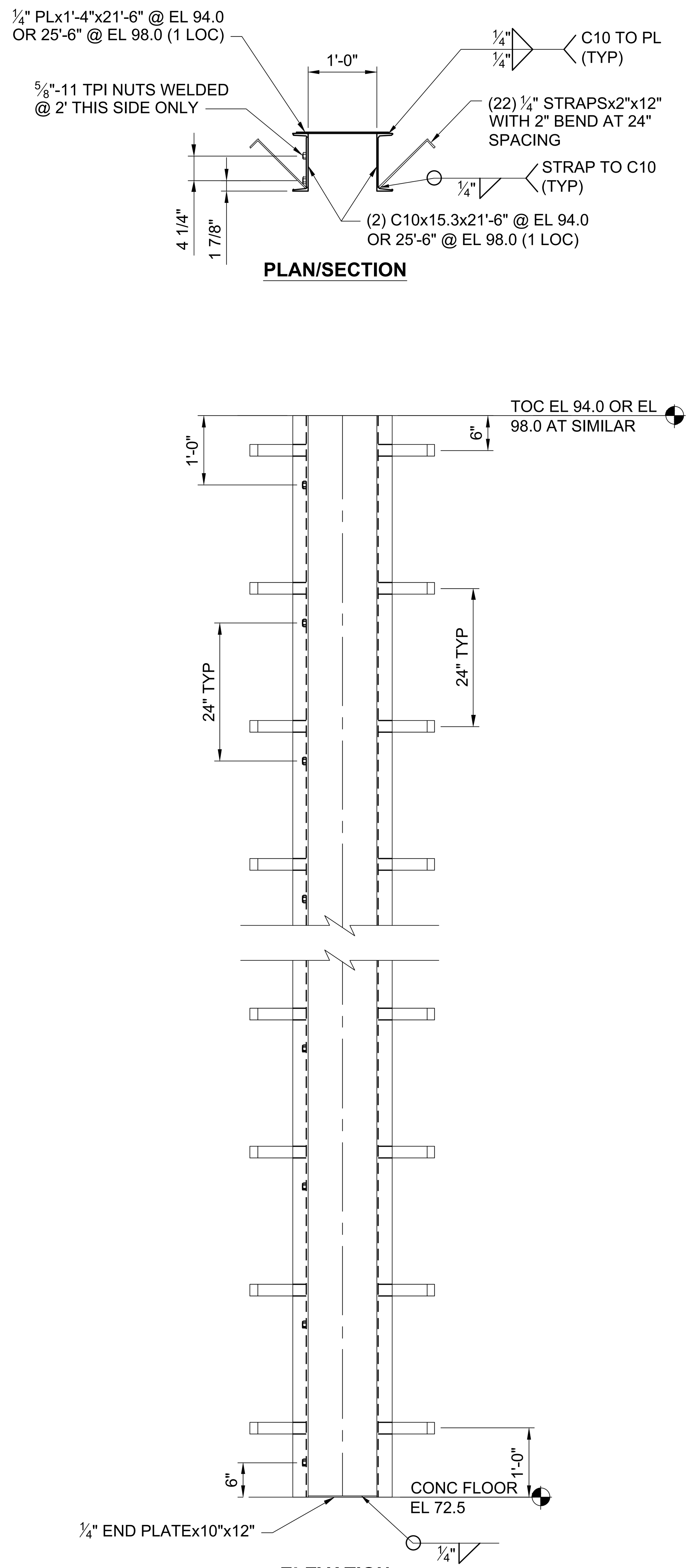
FISH LIFT CONCRETE ENTRANCE
FLUME EMBEDMENT ELEVATION

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	42 OF 176
DRAWING:	S-114

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nsa and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-114.dwg USER: Agrogan
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S1-SHWMT-SC C-SHWMT-PFW S3-SHWMT-PFP S1-SHWMT-SW-PL S1-SHWMT-FL-PL S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

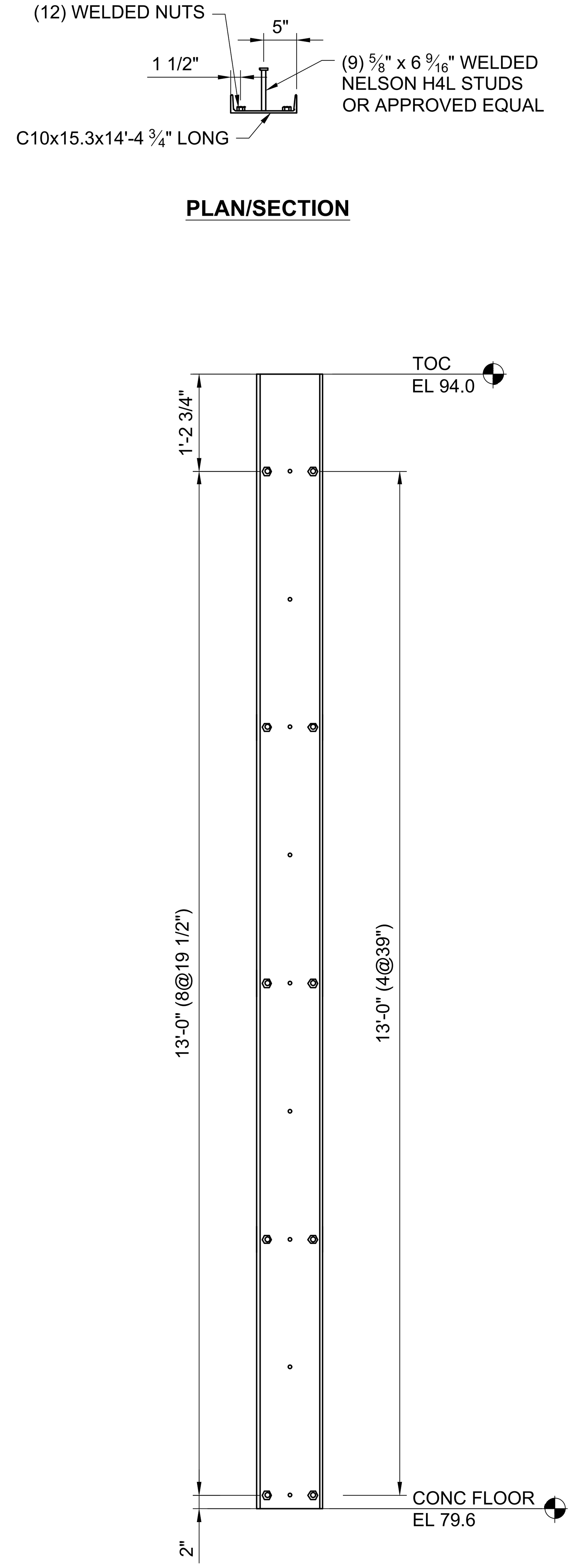
EMBEDMENT NOTES:

1. WELDS FOR ¼" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE ¾" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.



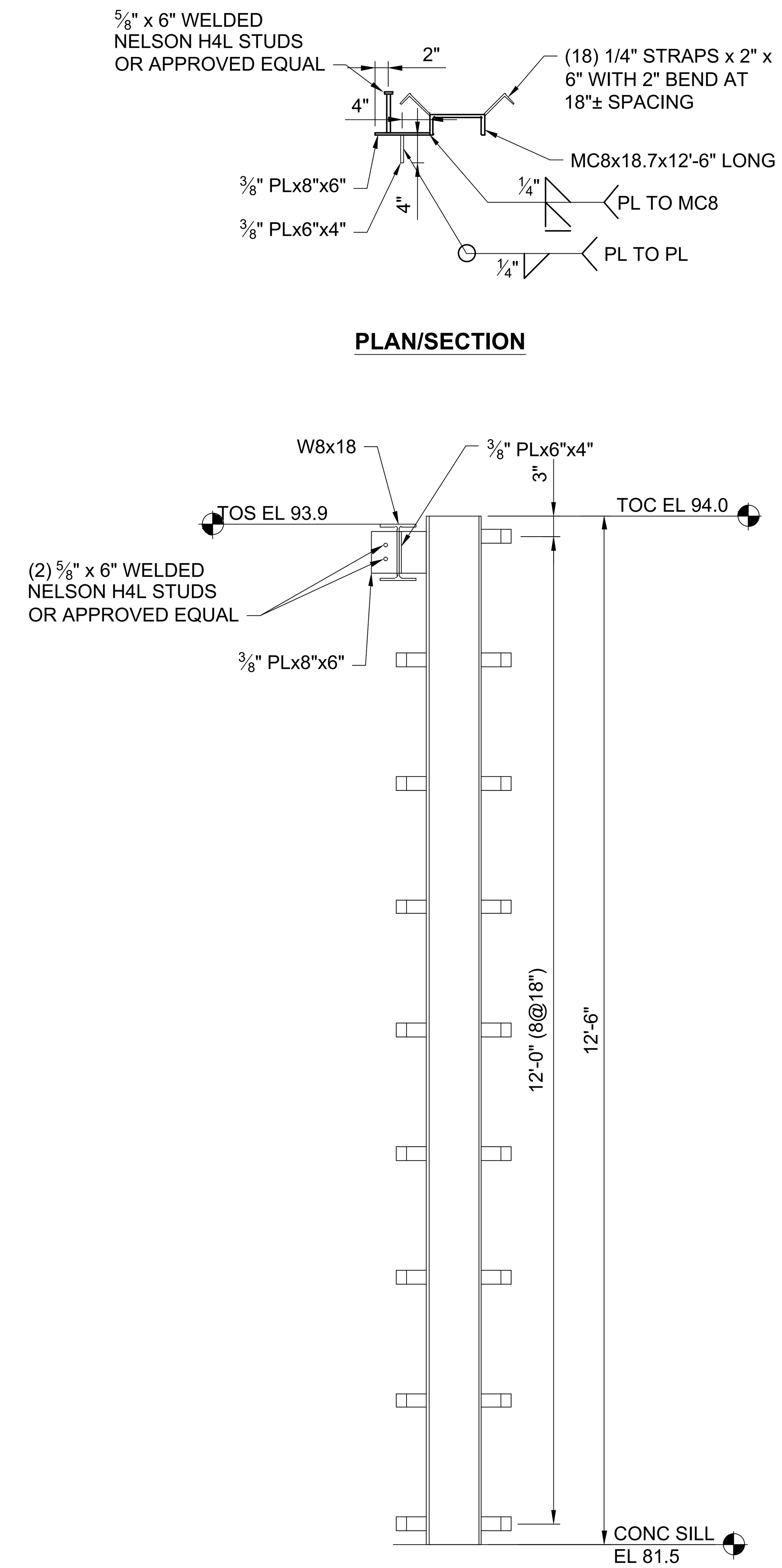
ELEVATION

1 HOPPER RAIL WALL EMBEDMENTS (4 LOC)
S-113 SCALE: 3/4"=1'-0"
S-114



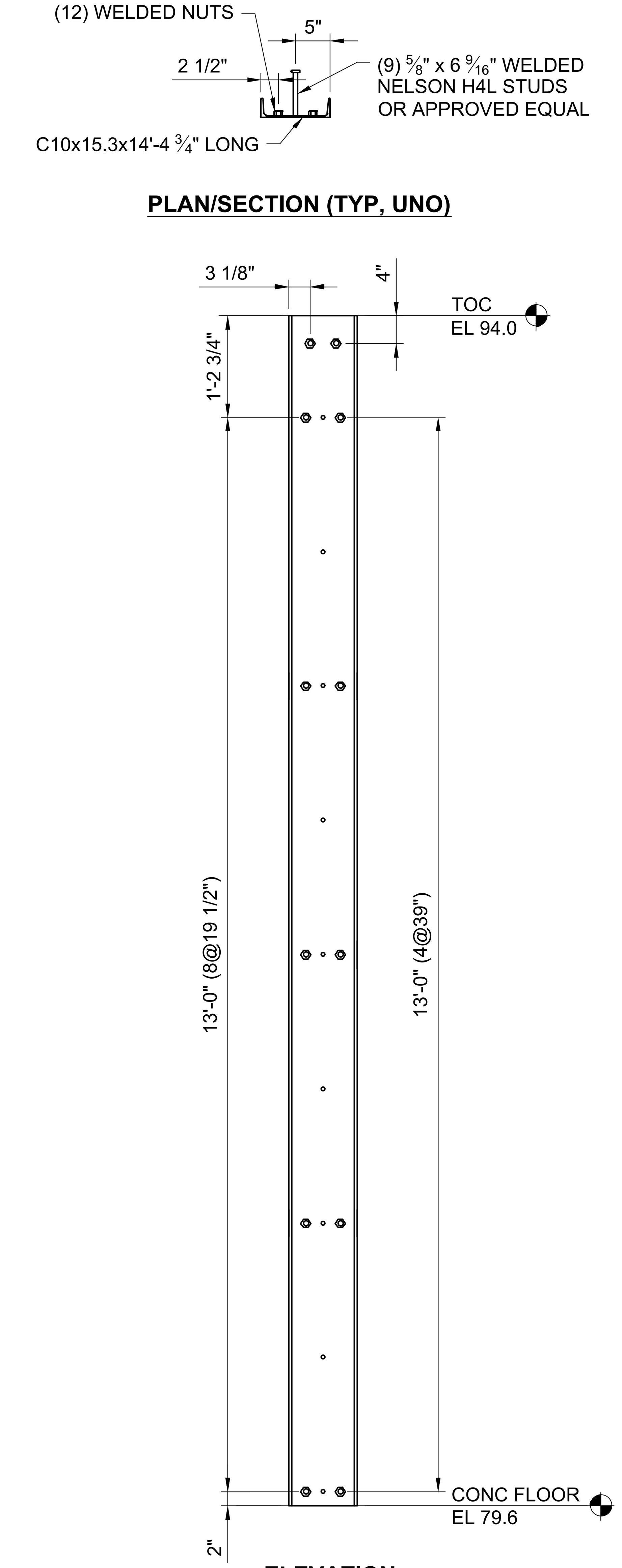
ELEVATION

2 D/S V-GATE WALL EMBEDMENTS (2 LOC)
S-113 SCALE: 3/4"=1'-0"
S-114



ELEVATION

3 FISH LIFT WEIR WALL EMBEDMENTS (2 LOC)
S-113 SCALE: 3/4"=1'-0"



ELEVATION

4 U/S V-GATE WALL EMBEDMENTS (2 LOC)
S-113 SCALE: 3/4"=1'-0"
S-114

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

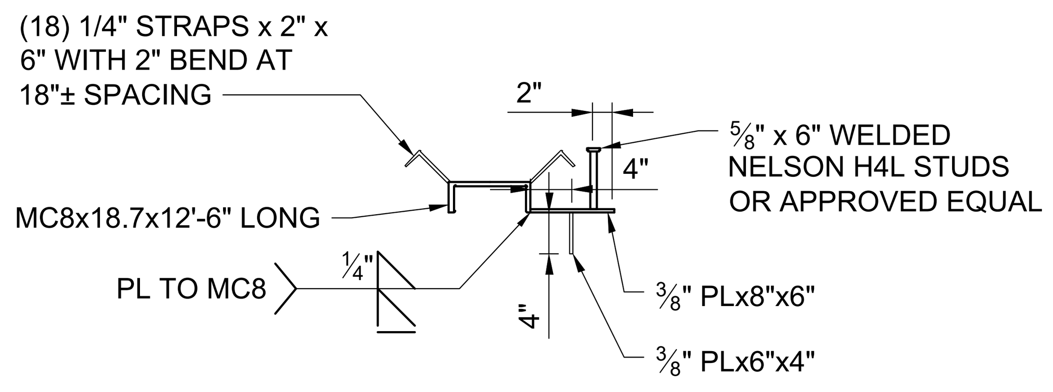
FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	43 OF 176
DRAWING:	S-115

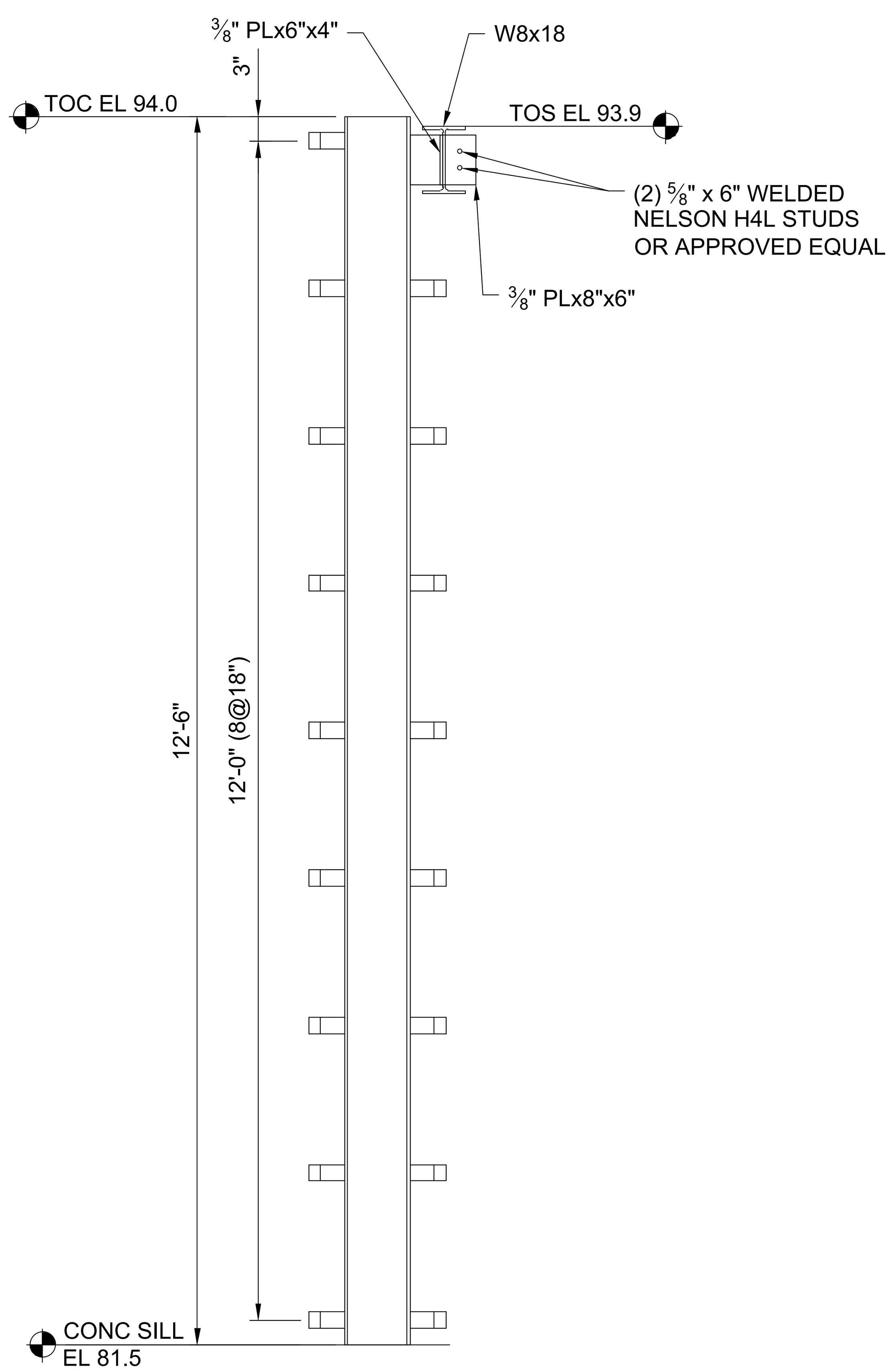
DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden mss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-115.dwg USER: Agrogan
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

EMBEDMENT NOTES:

1. WELDS FOR ¼" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE ¾" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.

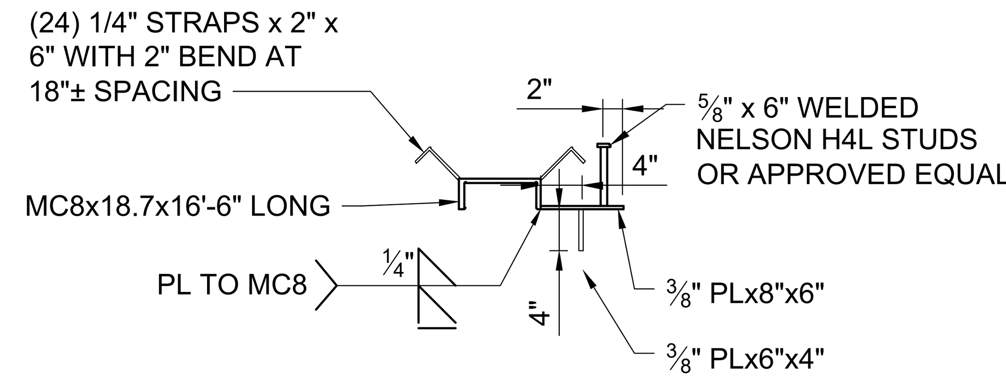


PLAN/SECTION

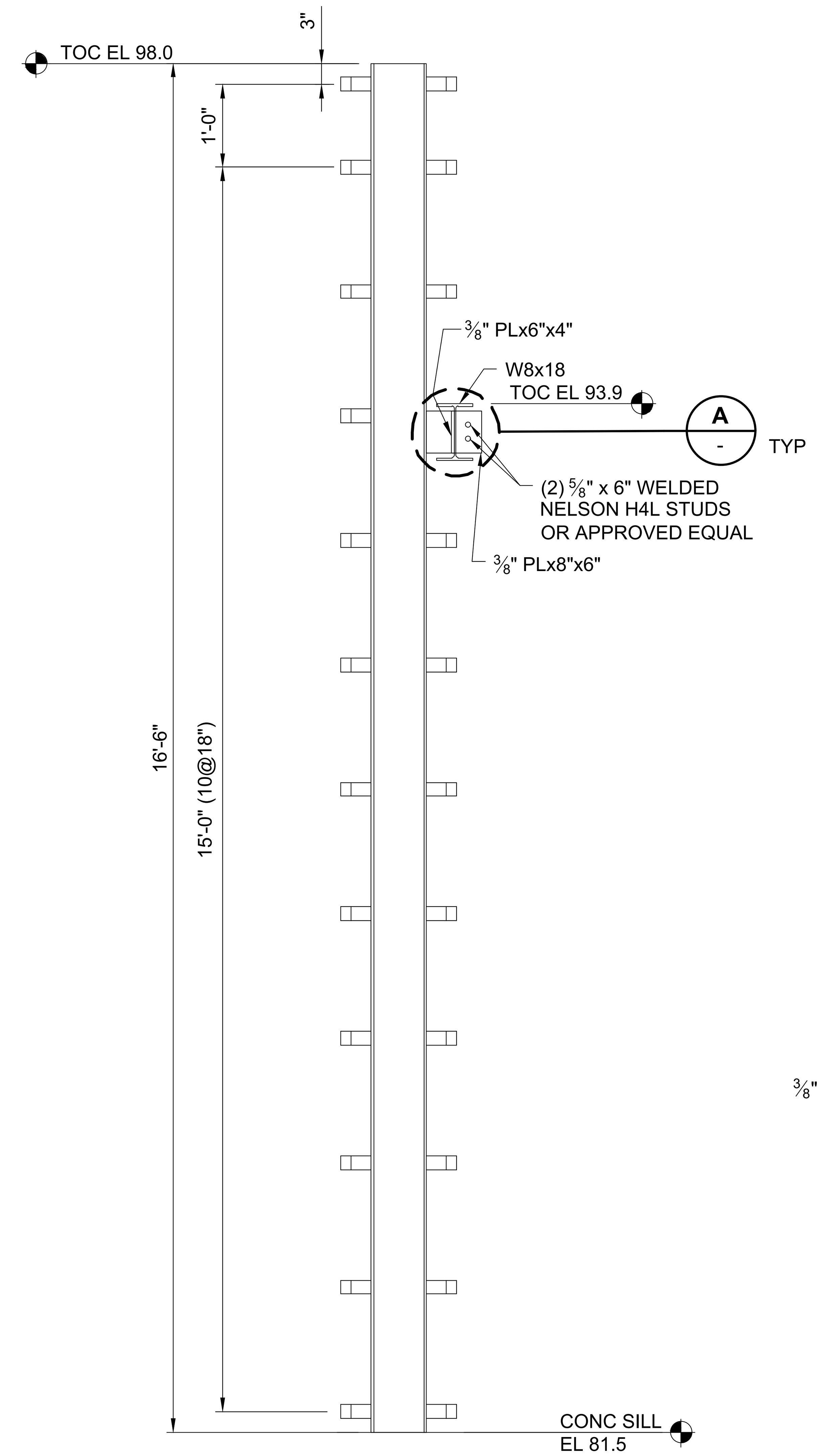


ELEVATION

4 FISH LIFT WEIR WALL EMBEDMENTS (1 LOC)
S-113 SCALE: 3/4"=1'-0"

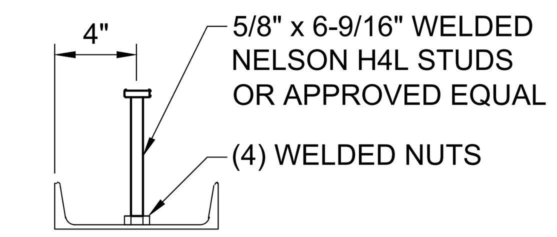


PLAN/SECTION

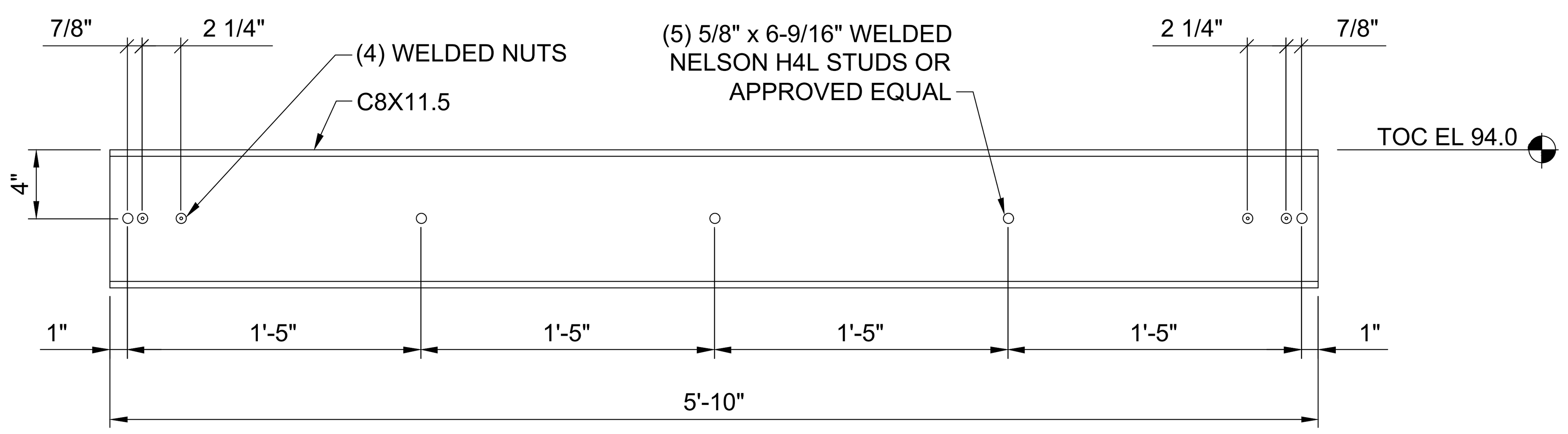


ELEVATION

5 FISH LIFT WEIR WALL EMBEDMENTS (1 LOC)
S-113 SCALE: 3/4"=1'-0"

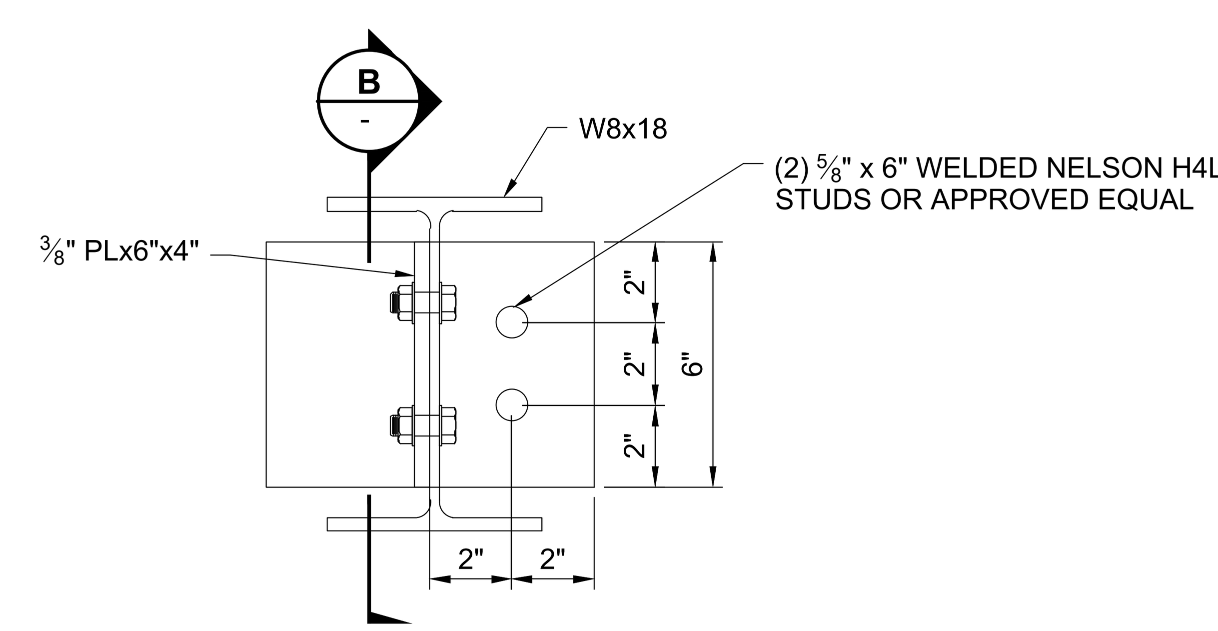


PLAN/SECTION

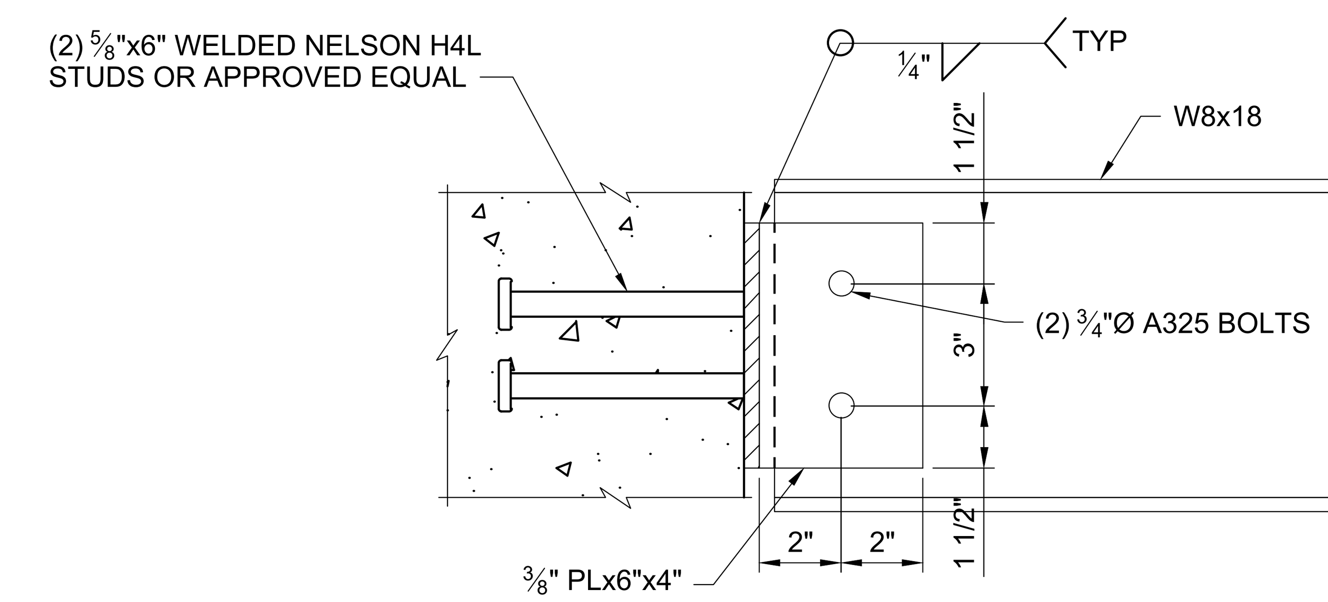


ELEVATION

6 U/S SCREEN-BAFFLE WALL EMBENDMENT (2 LOC)
S-114 SCALE: 1 1/2"=1'-0"



A CONNECTION DETAIL
- SCALE: 3"=1'-0"
S-202



B CONNECTION DETAIL
- SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agregoire\documents\autocad sheet sets\31009-alden rms and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-116.dwg USER: Agregoire
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

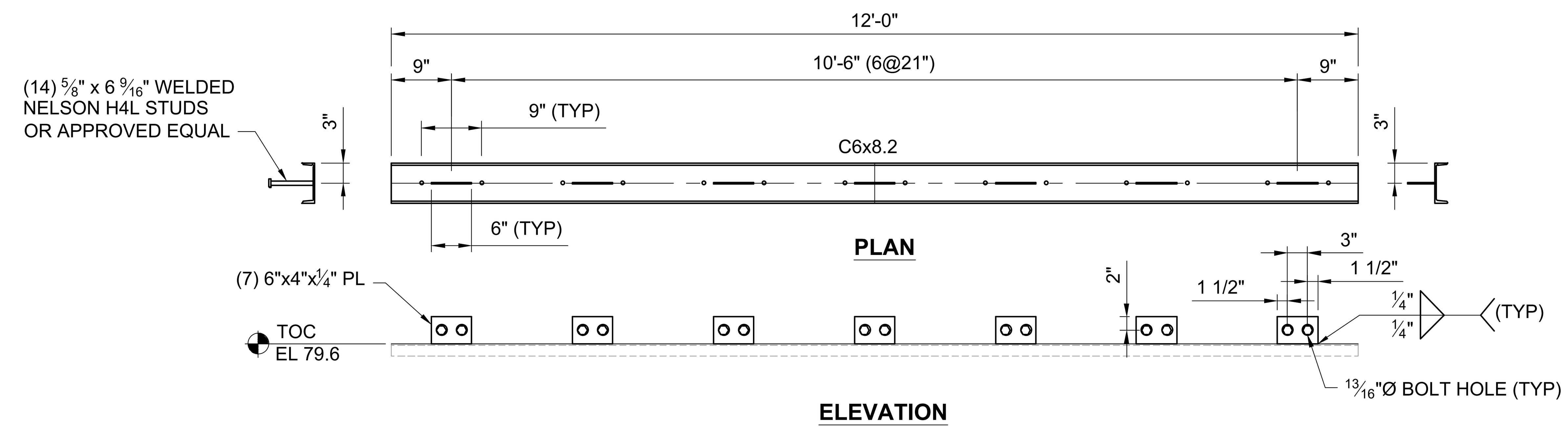
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

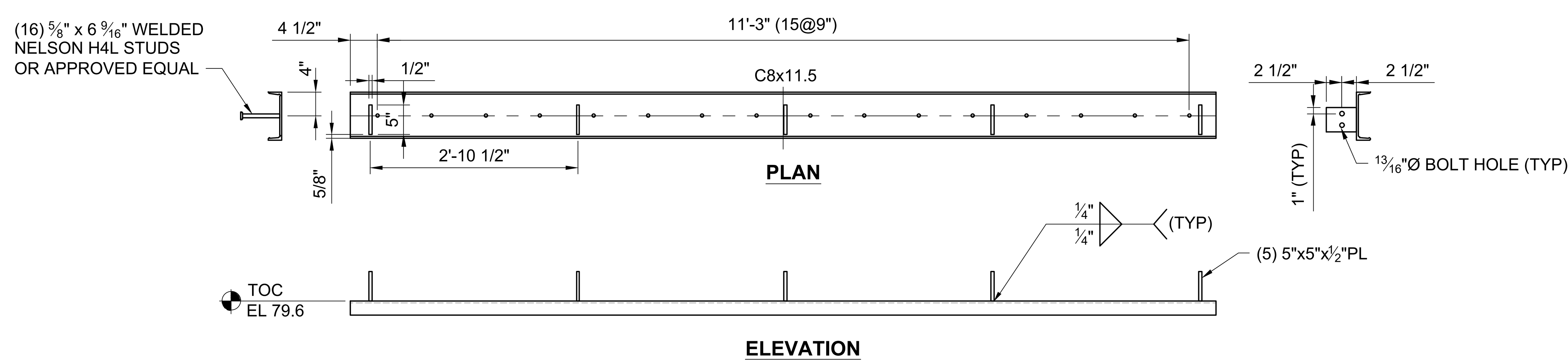
FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	44 OF 176
DRAWING:	S-116



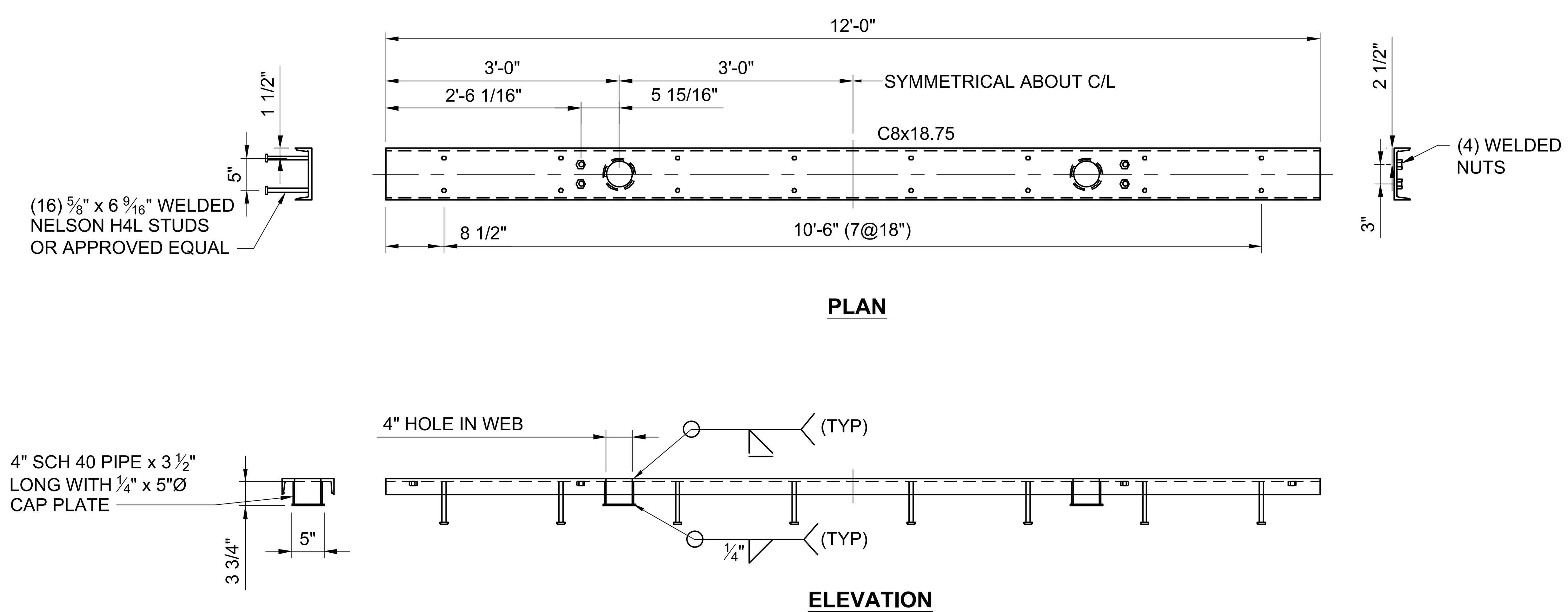
1 BAFFLE FLOOR EMBEDMENT (1 LOC)

S-113 SCALE: 3/4"=1'-0"
S-114



2 UPSTREAM SCREEN FLOOR EMBEDMENT (1 LOC)

S-113 SCALE: 3/4"=1'-0"
S-114

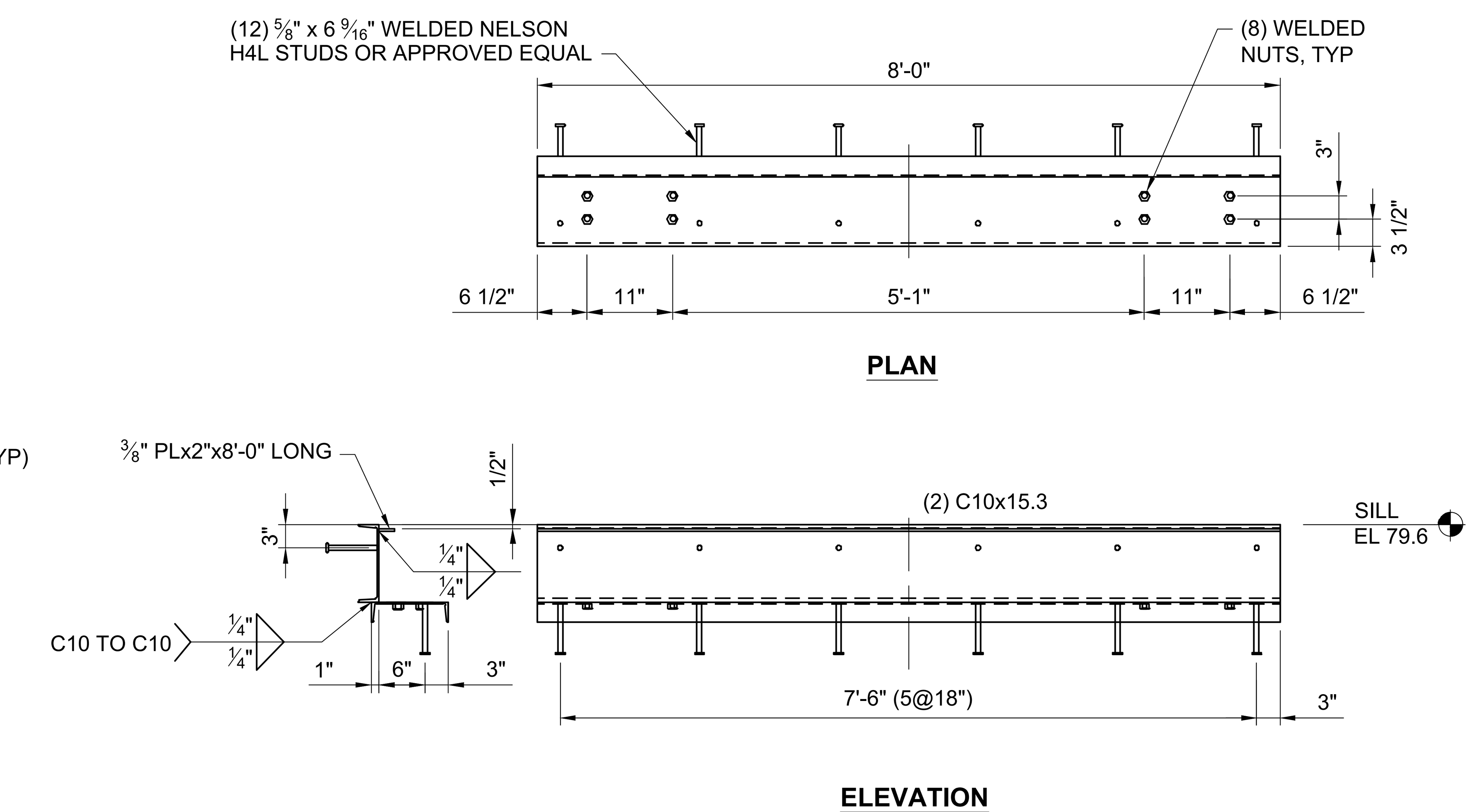


3 V-GATE FLOOR EMBEDMENT (1 LOC)

S-113 SCALE: 3/4"=1'-0"
S-114

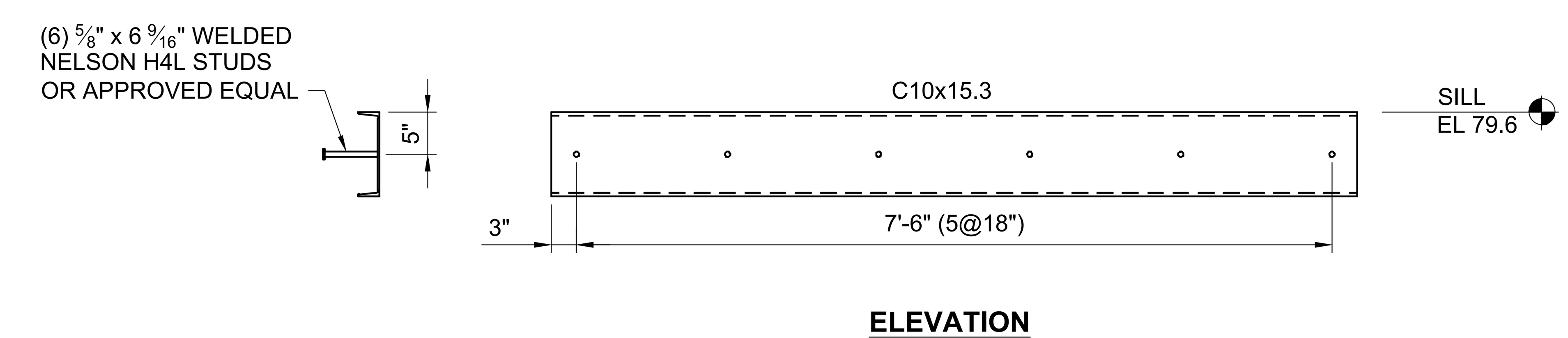
EMBEDMENT NOTES:

1. WELDS FOR 1/4" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE 3/4" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.



4 ENTRANCE GATE FLOOR EMBEDMENT, UPSTREAM SIDE (1 LOC)

S-113 SCALE: 3/4"=1'-0"
S-114



5 ENTRANCE GATE FLOOR EMBEDMENT, DOWNSTREAM SIDE (1 LOC)

S-113 SCALE: 3/4"=1'-0"
S-114

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED — PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

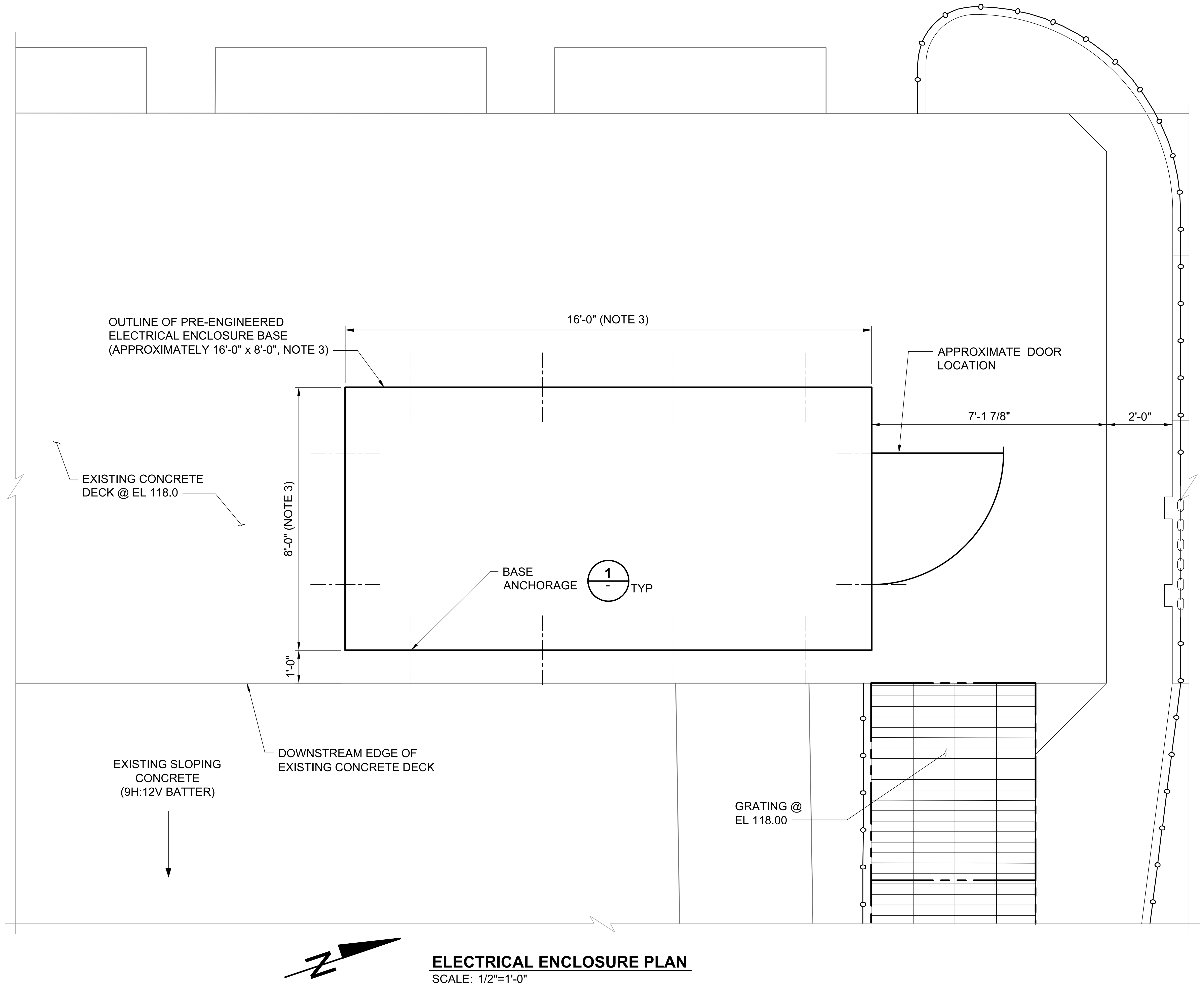
FISH LIFT CONCRETE ENTRANCE FLUME EMBEDMENT DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 45 OF 176
DRAWING: S-117

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-117.dwg USER: Agrogan
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

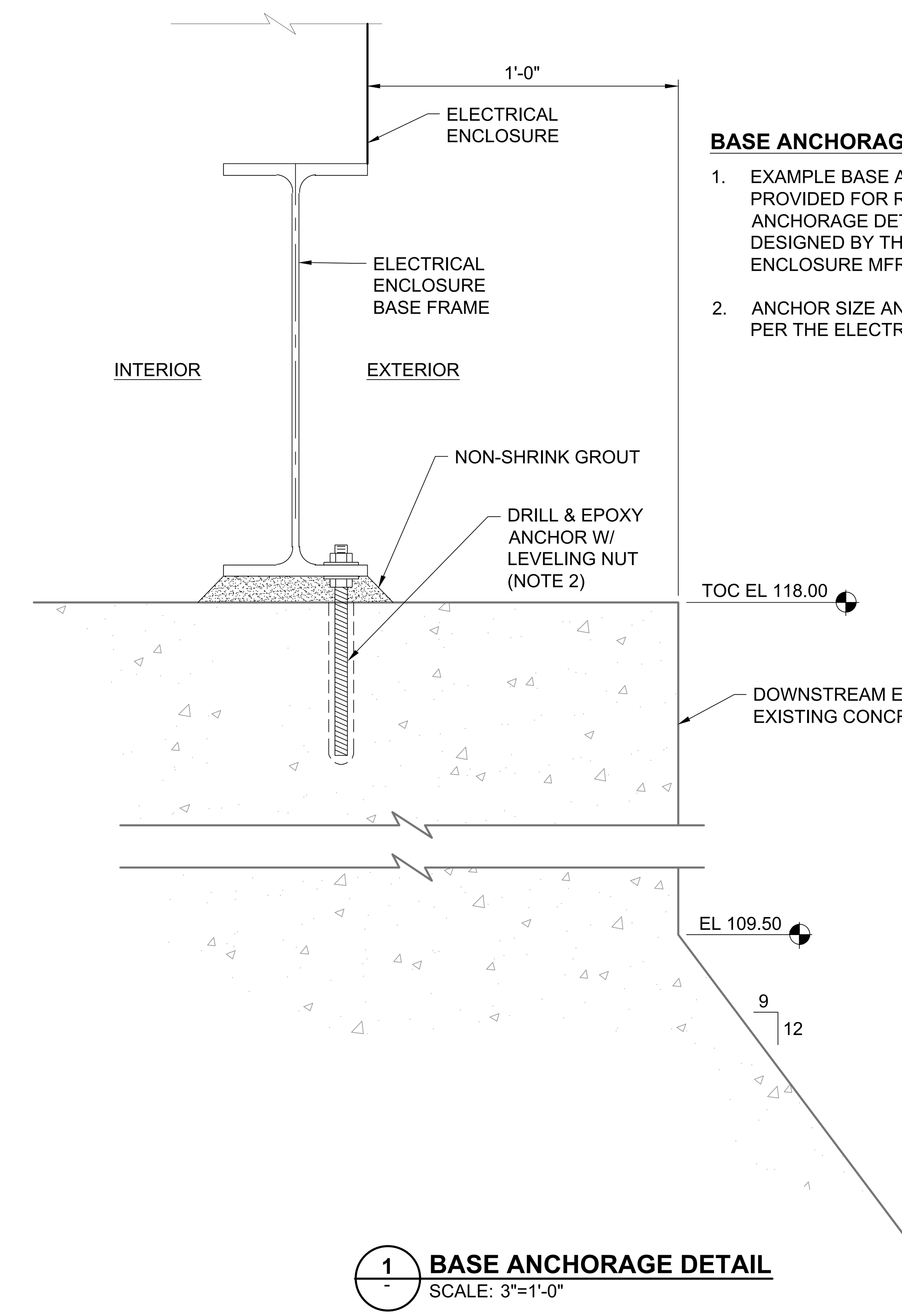
NOTES:

1. SEE SPECIFICATION SECTION 01 81 10 FOR STRUCTURAL DESIGN CRITERIA.
2. SEE SPECIFICATIONS 26 27 16 FOR PRE-ENGINEERED ELECTRICAL ENCLOSURE.
3. BASE DIMENSIONS SHALL BE VERIFIED WITH THE ACTUAL ELECTRICAL ENCLOSURE SUPPLIED.



ELECTRICAL ENCLOSURE PLAN

SCALE: 1/2"=1'-0"



BASE ANCHORAGE NOTES:

1. EXAMPLE BASE ANCHORAGE DETAIL PROVIDED FOR REFERENCE ONLY. BASE ANCHORAGE DETAIL INSTALLED SHALL BE DESIGNED BY THE ELECTRICAL ENCLOSURE MFR.
2. ANCHOR SIZE AND LOCATION SHALL BE PER THE ELECTRICAL ENCLOSURE MFR.

1 BASE ANCHORAGE DETAIL

SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

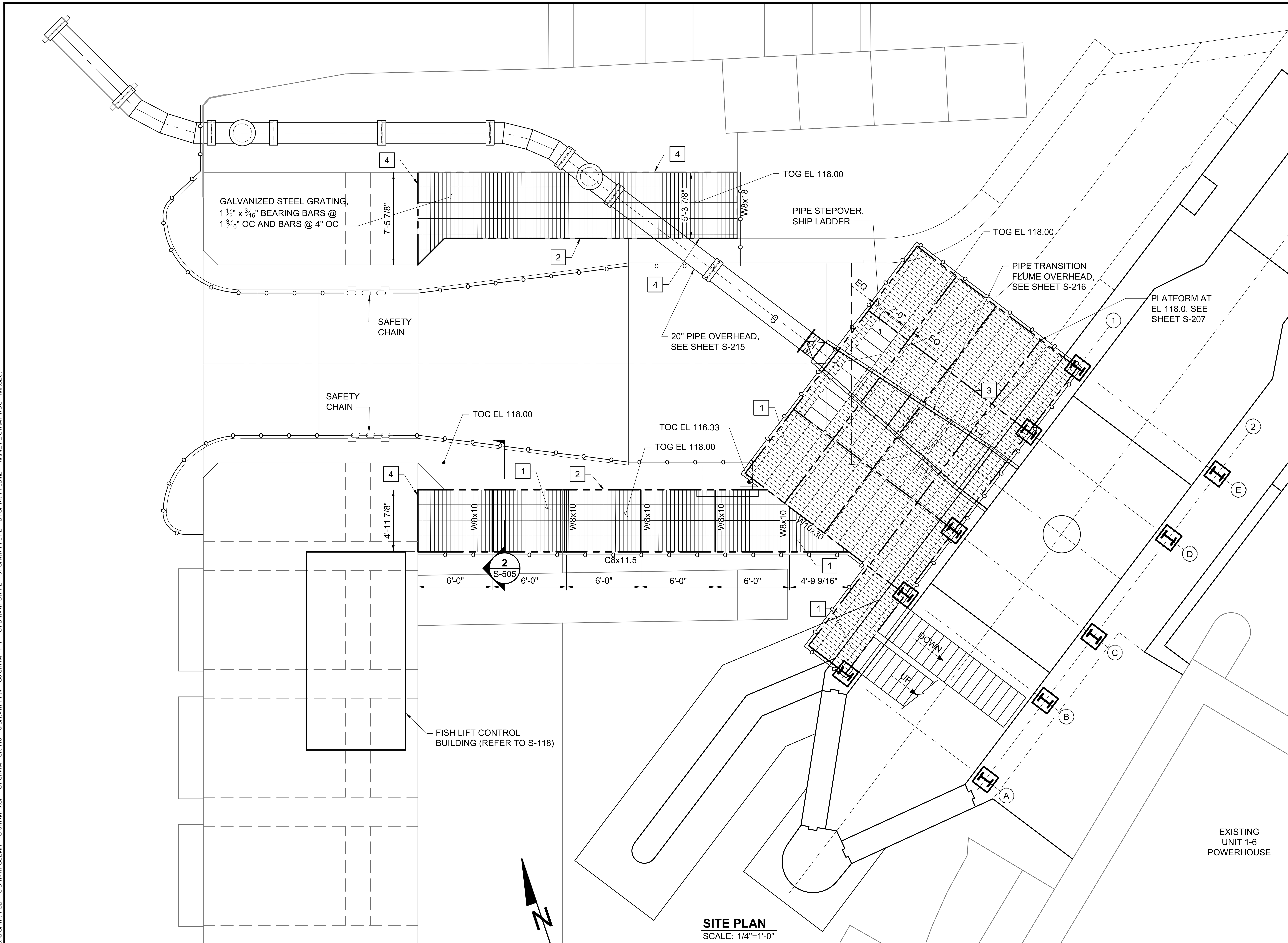
STATE OF MAINE — MARK DANIEL GRAESER — No. 39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

ELECTRICAL ENCLOSURE

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	46 OF 176
DRAWING:	S-118

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nass and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-118.dwg USER: Agrogan IMAGES: MAINE-PE-STAMP-MDG
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-PFW S3-SHWMT-PFP S1-SHWMT-SW-PL C-SHWMT-XSP S1-SHWMT-GR-118 S1-SHWMT-FL-PL S1-SHWMT-FLUME



NOTES:

1. ALL RAILING IS SIDE MOUNTED UNLESS OTHERWISE NOTED.
2. REMOVE EXISTING RAILING AS NECESSARY.

KEYED NOTES:

1. GALVANIZED STEEL GRATING, 1 1/4" x 3/16" BEARING BARS @ 1 3/16" OC. AND CROSS BARS @ 4" OC. BAND ALL EDGES OF GRATING. USE SADDLE TYPE CLIPS, MINIMUM 4 PER PANEL.
2. GRATING SUPPORT TYPE 1 (1 / S-504)
3. LOCATE SHIPS LADDER AT LOWER PART OF PIPE. SHIP LADDERS W/ ELEVATED PLATFORM OVER 20" HOBAS PIPE. COORDINATE BEAM SUPPORT LOCATIONS W/ LADDER MFR. TOP OF PLATFORM EL 126'-0".
4. GRATING SUPPORT TYPE 2 (2 / S-504)

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

STATE OF MAINE MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

GENERAL STEEL FRAMING PLAN AT EL 118.00

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	47 OF 176
DRAWING:	S-201

NOTES:

1. GALVANIZED STEEL GRATING, 1 ½" x $^3/_{16}$" BEARING BARS @ 1 $^3/_{16}$" OC. AND CROSS BARS @ 4" OC. BAND ALL EDGES OF GRATING. USE SADDLE TYPE CLIPS, MINIMUM 4 PER PANEL.
2. ALL RAILING IS SIDE MOUNTED UNLESS OTHERWISE NOTED.

KEYED NOTES:

[1] GRATING SUPPORT TYPE 1 (1/S-504)

STEEL TOWER LOWER PLAN

SCALE: 3/8"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

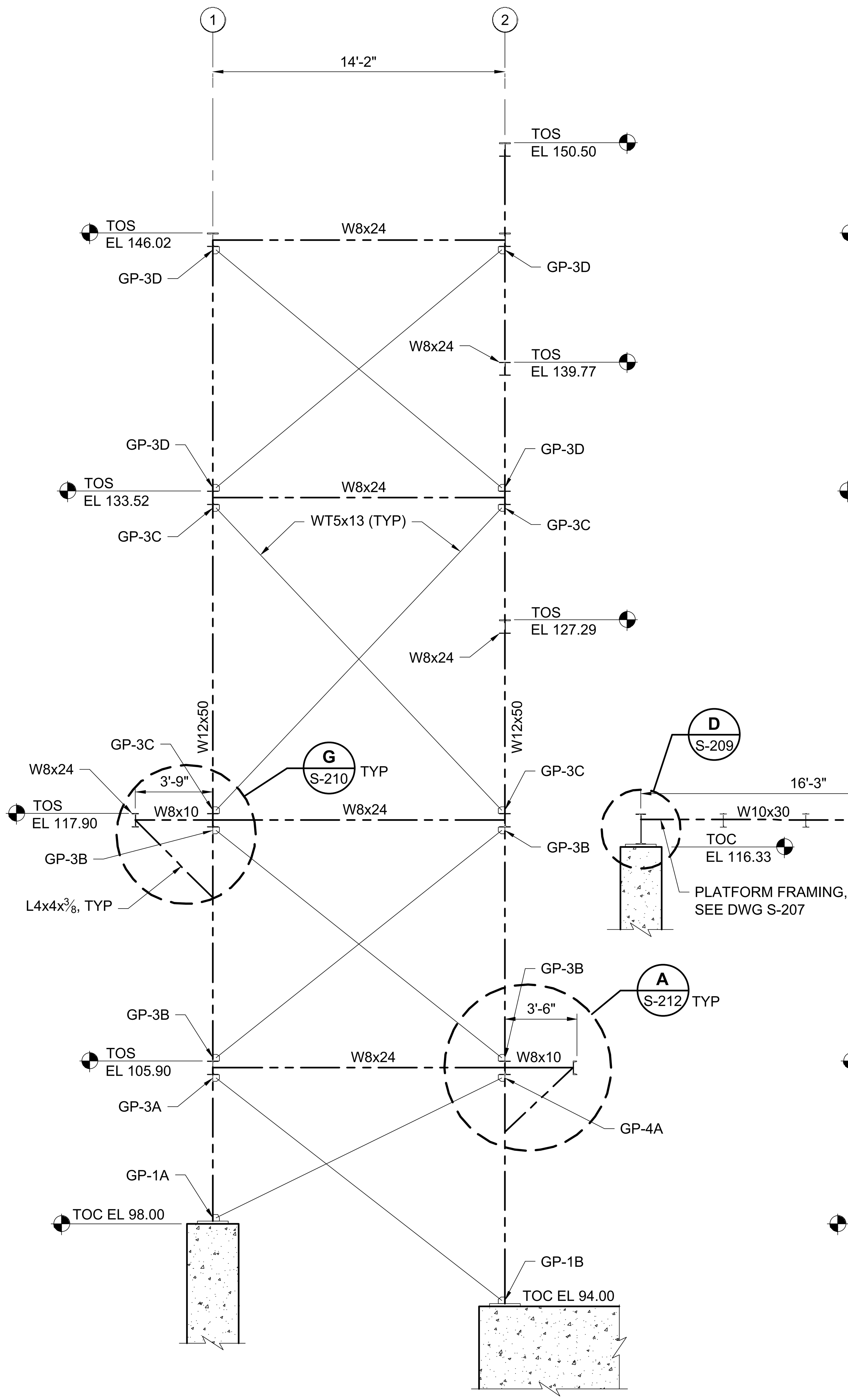
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

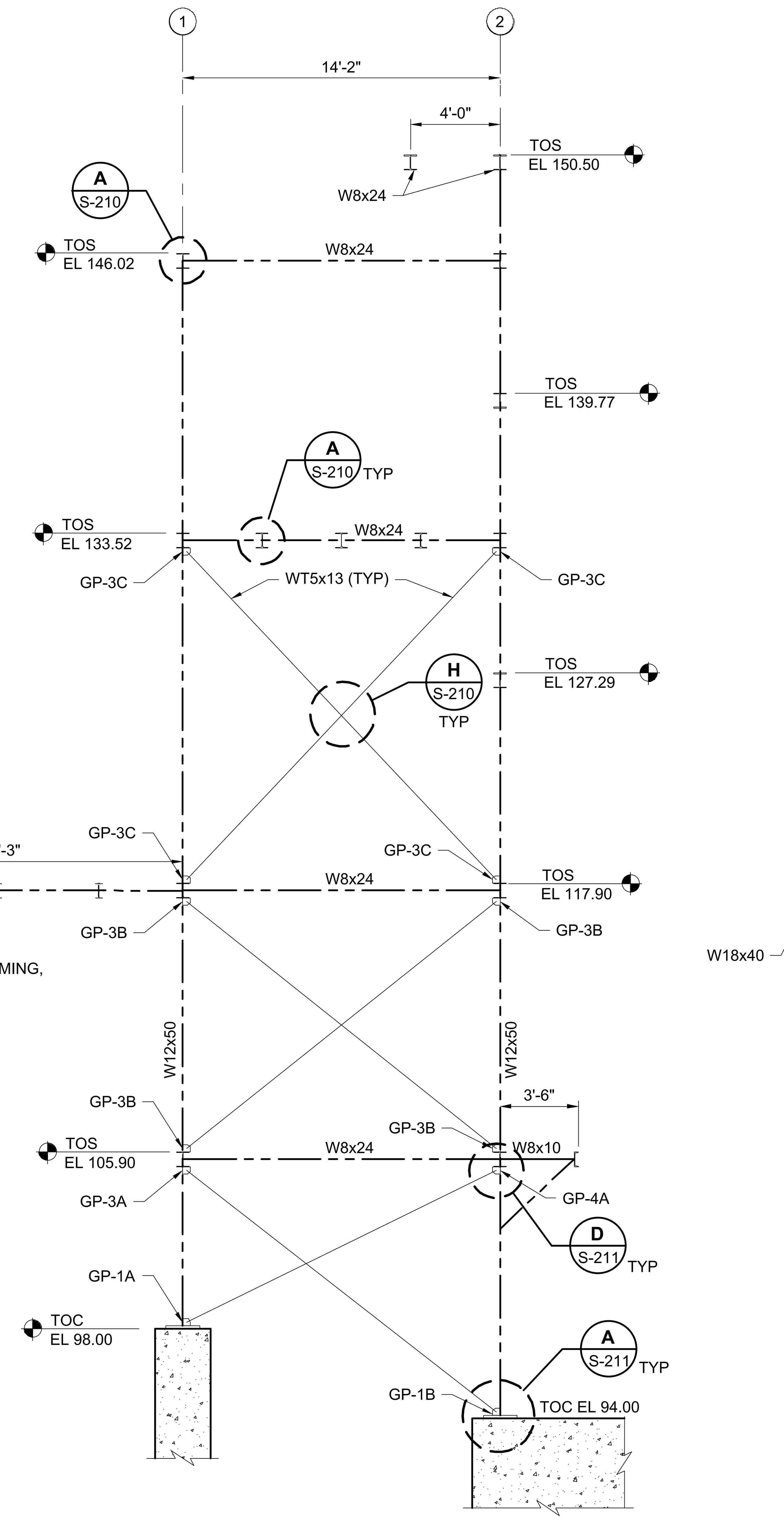
TOWER LOWER LEVEL STEEL FRAMING PLAN

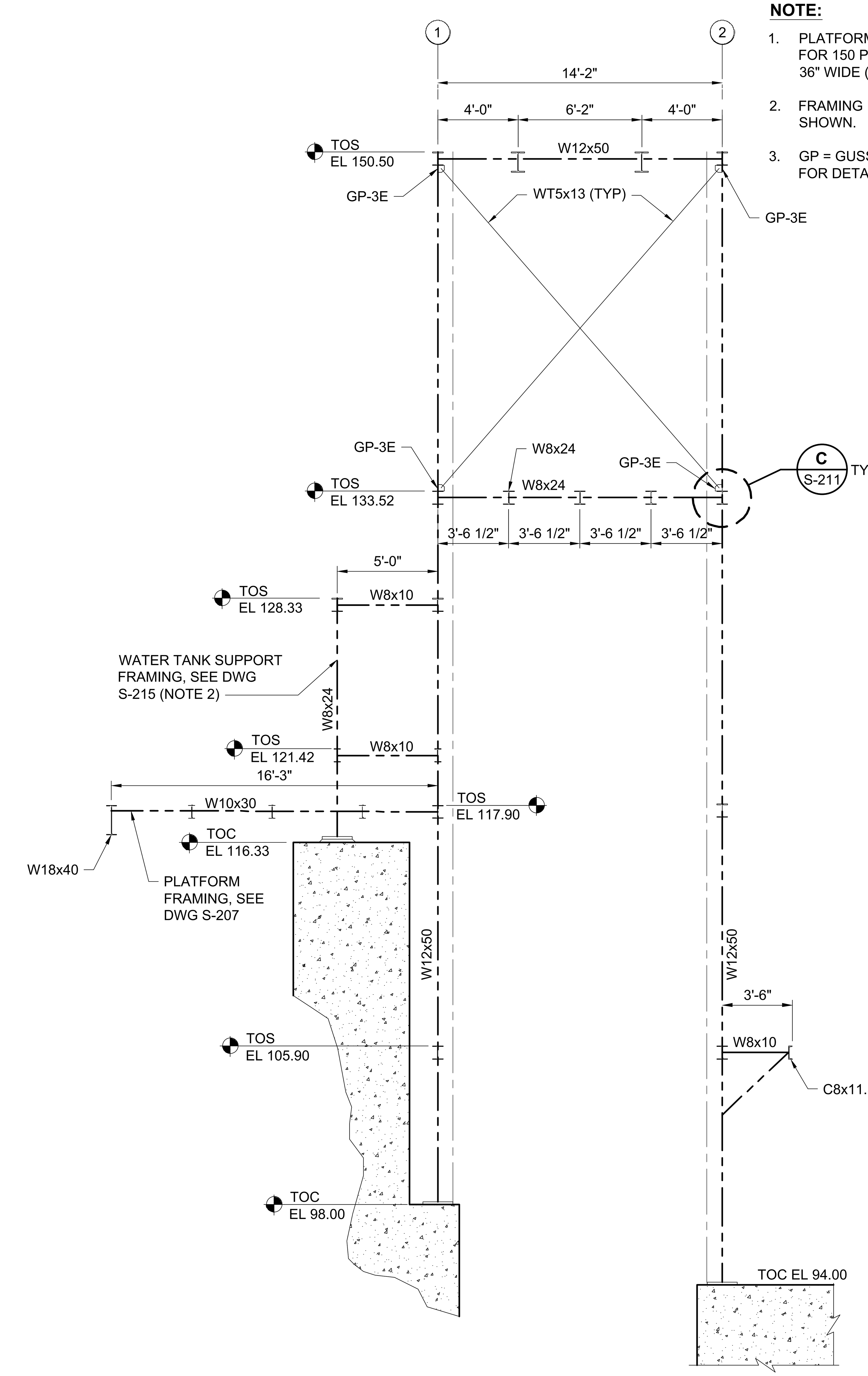
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	48 OF 176
DRAWING:	S-202

NOTE:

1. PLATFORMS AND WALKWAYS DESIGNED FOR 150 PSF (UNO) STAIR TREADS TO BE 36" WIDE (UNO).
2. FRAMING FOR FISH EXIT PIPING NOT SHOWN.
3. GP = GUSSET PLATE. REFER TO S-211 FOR DETAILS.







A S-202 **SECTION GRID A** SCALE: 1/4"=1'-0"

B S-202 **SECTION GRID B** SCALE: 1/4"=1'-0"

C S-202 **SECTION GRID C** SCALE: 1/4"=1'-0"

FINAL FOR BID

NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

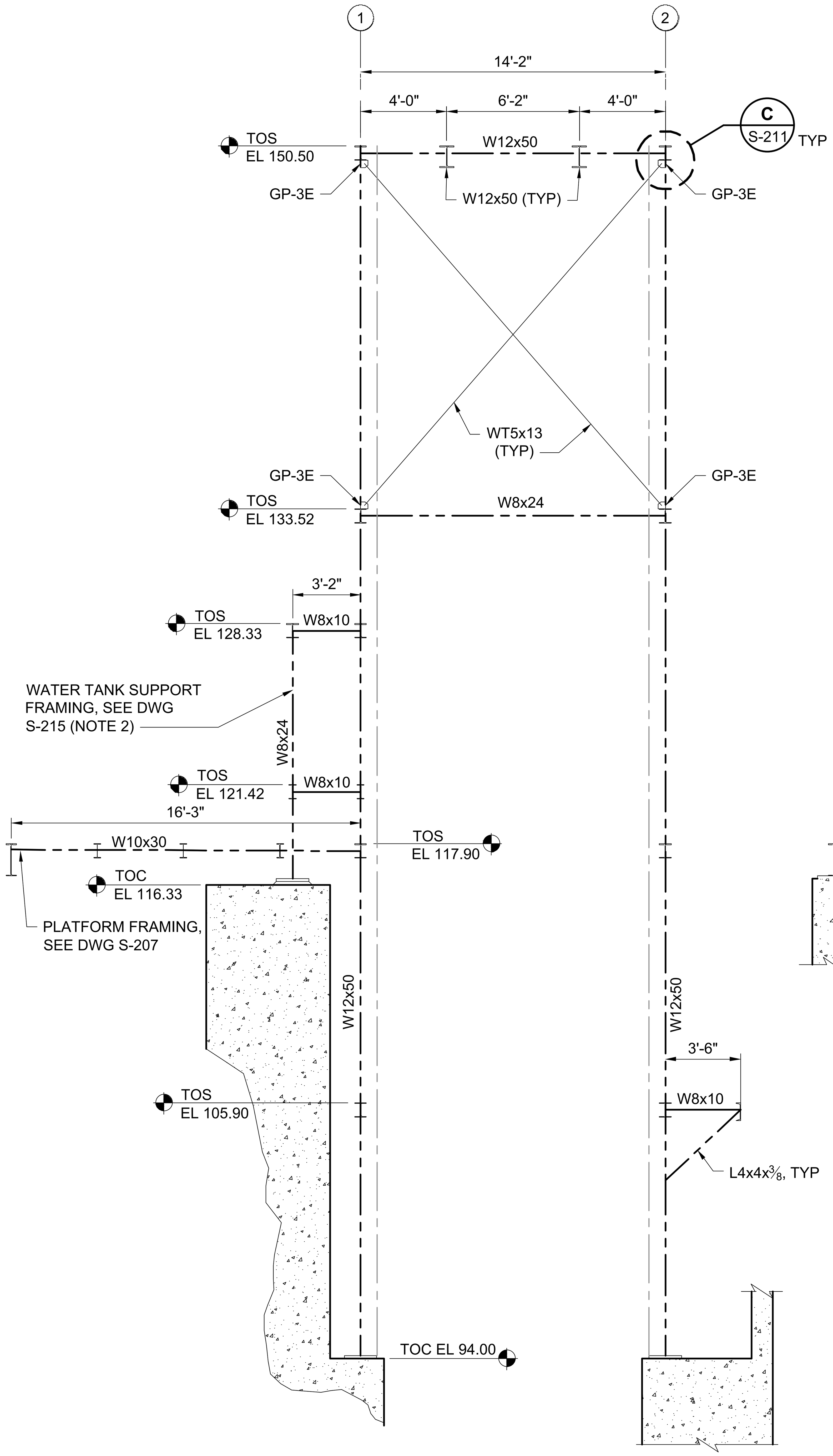
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS

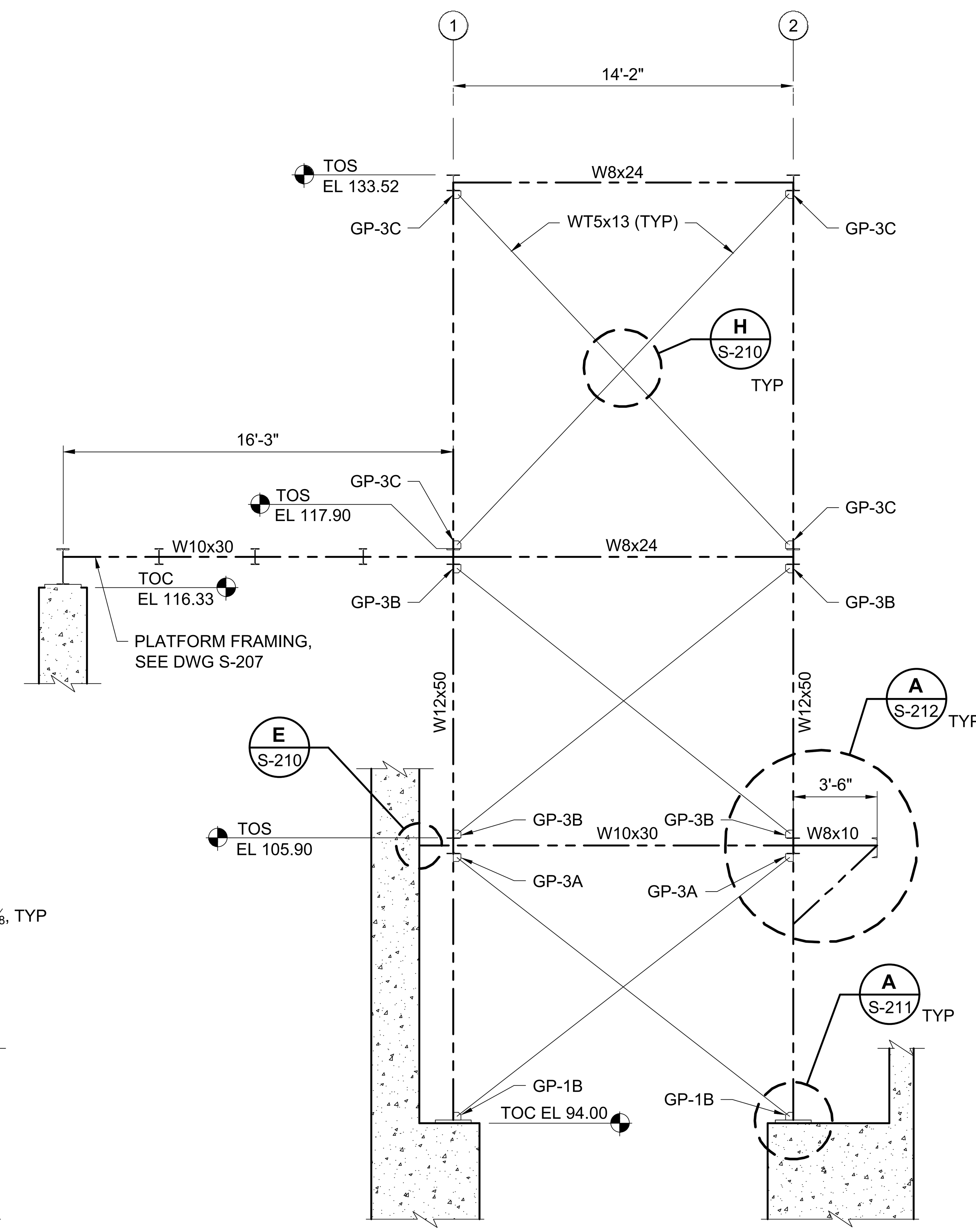
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	49 OF 176
DRAWING:	S-203

NOTE:

1. PLATFORMS AND WALKWAYS DESIGNED FOR 150 PSF (UNO) STAIR TREADS TO BE 36" WIDE (UNO).
2. FRAMING FOR FISH EXIT PIPING NOT SHOWN.
3. GP = GUSSET PLATE. REFER TO S-211 FOR DETAILS.



D S-202 SECTION GRID D
SCALE: 1/4"=1'-0"



E S-202 SECTION GRID E
SCALE: 1/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\3173\009-alden nea and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-204.dwg USER: Agrogan
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No. 39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

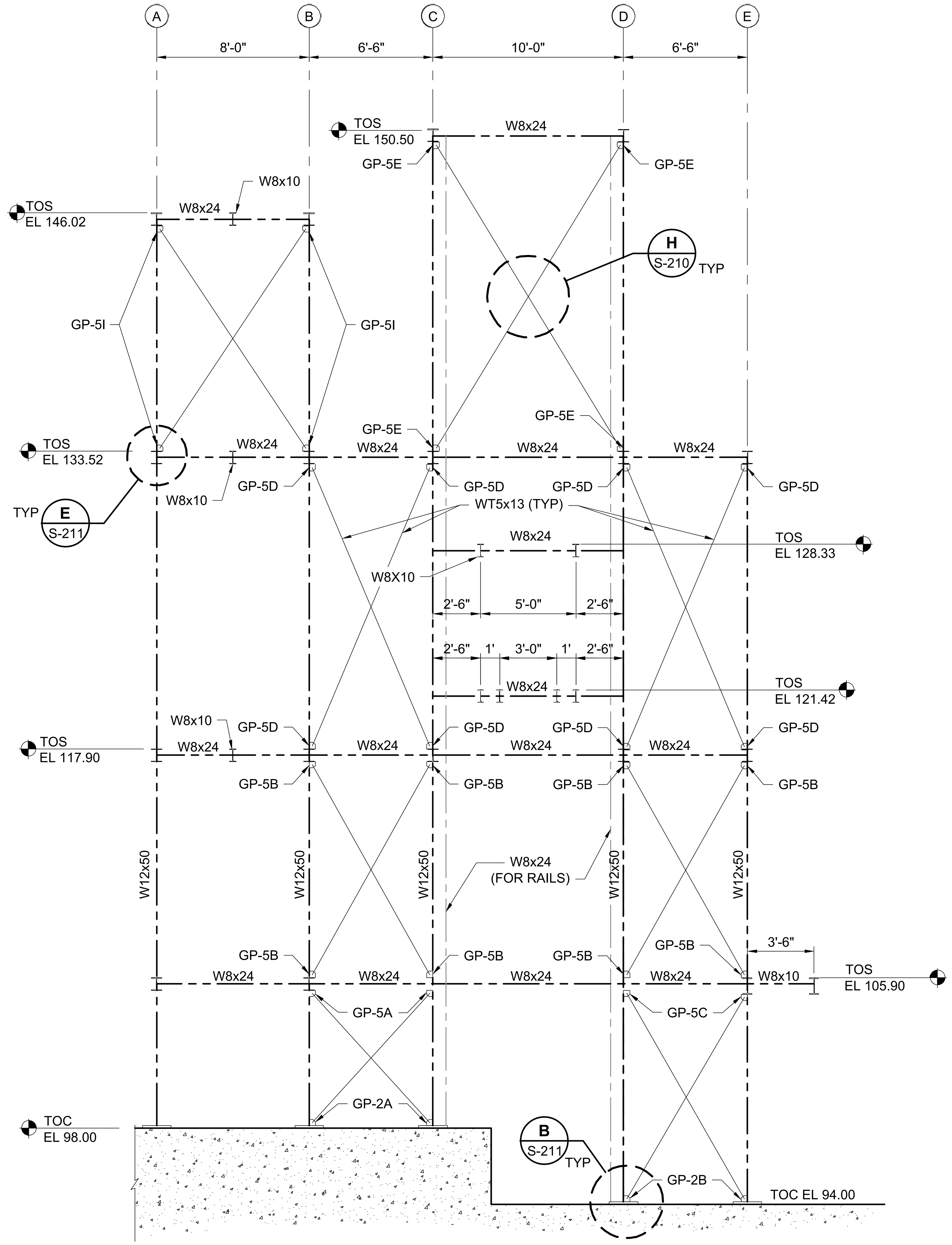
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS

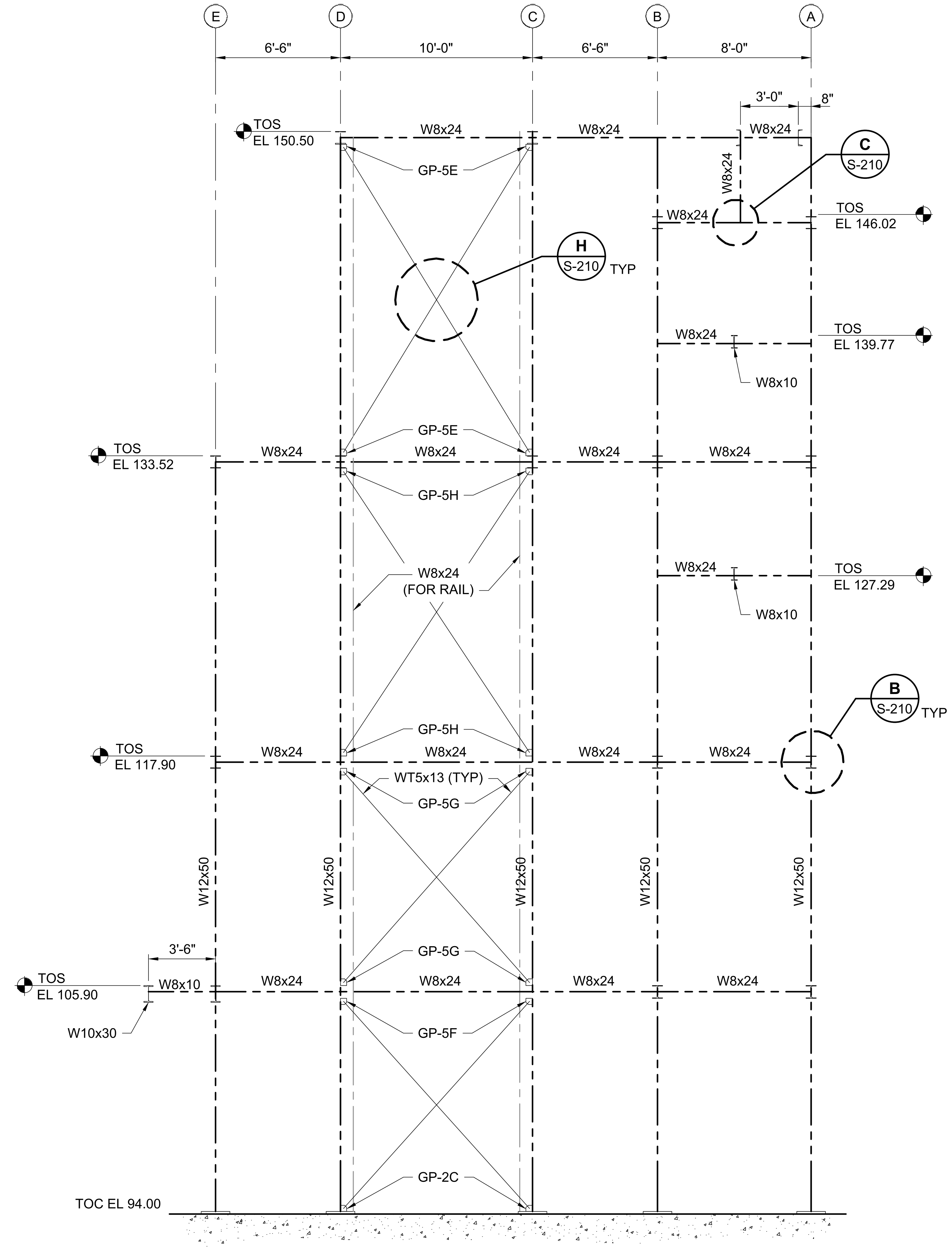
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 50 OF 176
DRAWING: S-204

NOTE:

1. STAIR STRINGERS NOT SHOWN FOR CLARITY.
2. GP = GUSSET PLATE. REFER TO S-211 FOR DETAILS.



E SECTION GRID 1 (S-202)
SCALE: 1/4"=1'-0"



F SECTION GRID 2 (S-202)
SCALE: 1/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

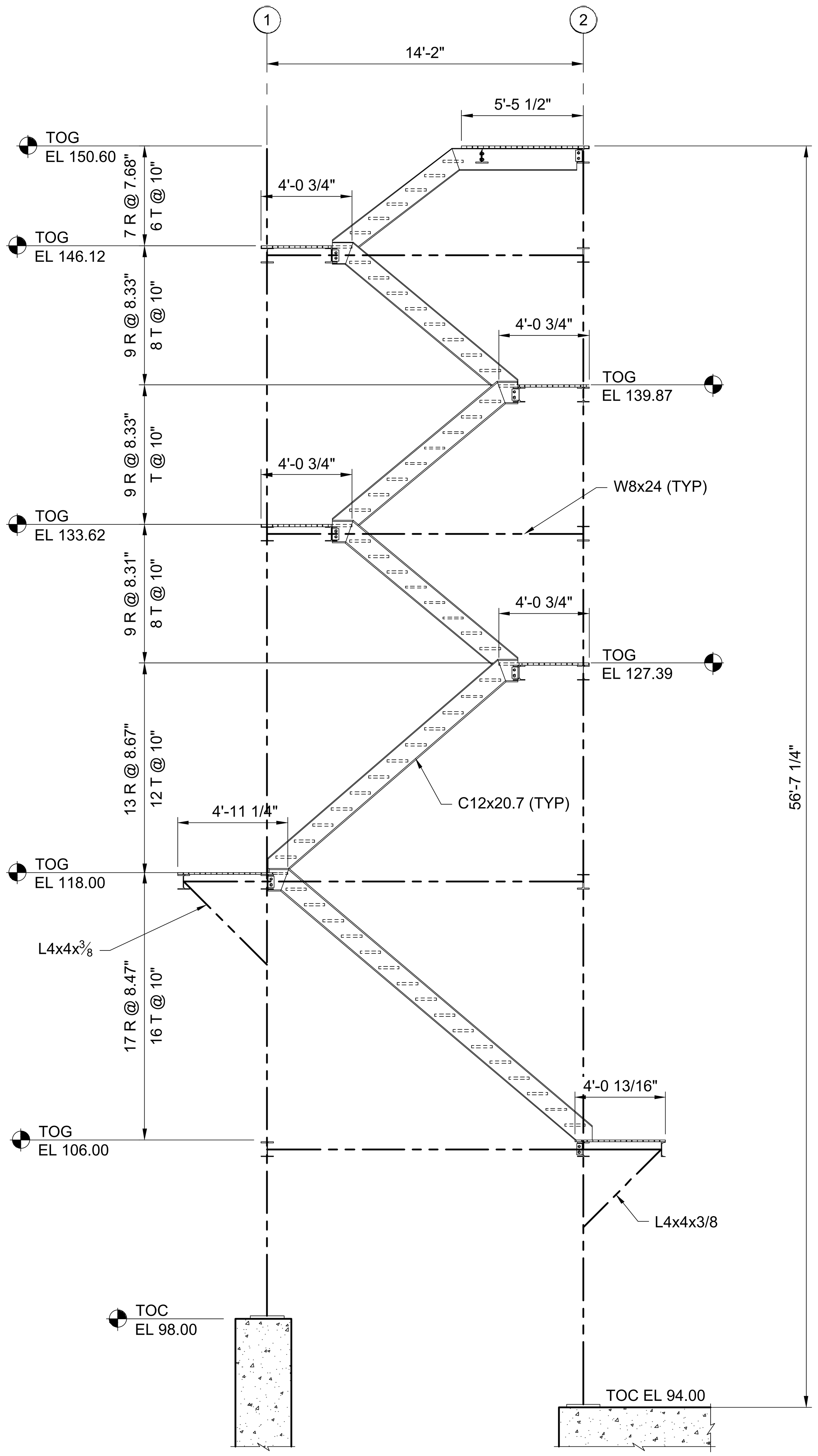
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

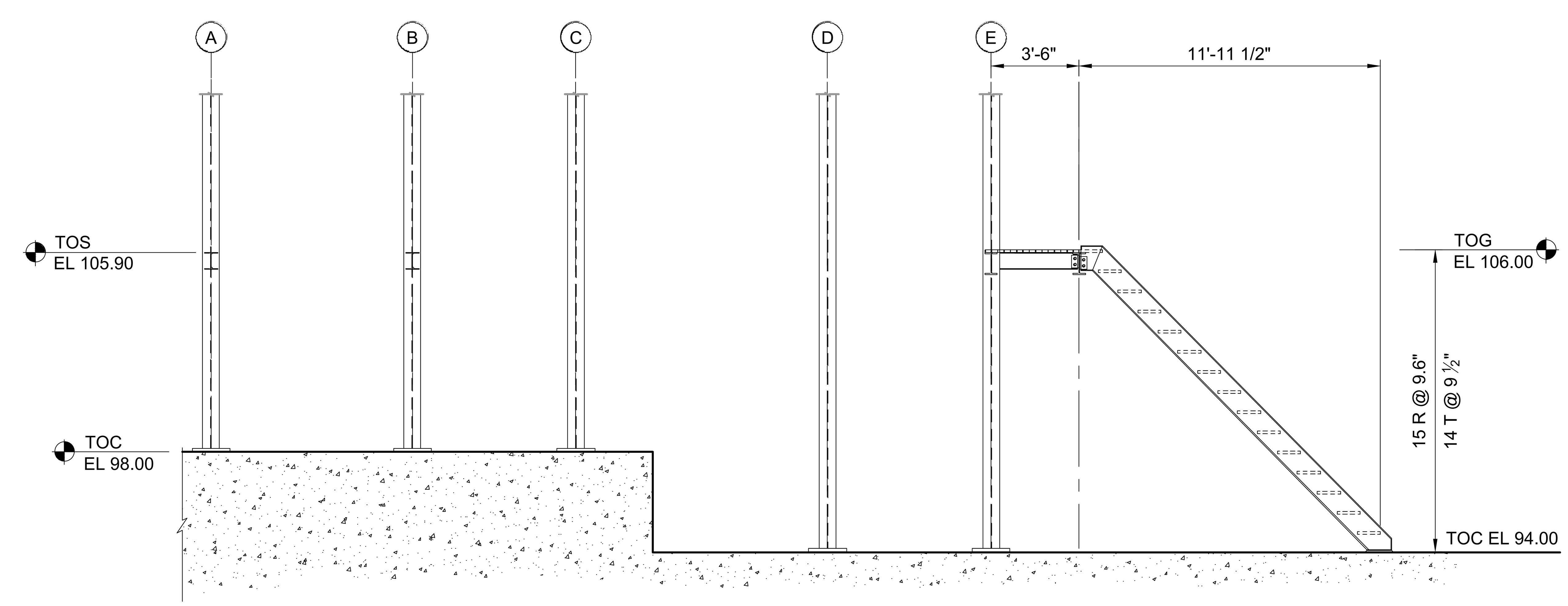
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 51 OF 176
DRAWING: S-205



A **SECTION GRID A**
S-202 SCALE: 1/4"=1'-0"



B **SECTION GRID 1**
S-202 SCALE: 1/4"=1'-0"

NOTES:

1. PLATFORMS AND WALKWAYS DESIGNED FOR 150 PSF (UNO) STAIR TREADS TO BE 36" WIDE (UNO).
2. TOP OF GRATING (TOG) IS 1 1/4" HIGHER THAN TOP OF STEEL (TOS).
3. RAILING NOT SHOWN FOR CLARITY.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING
STAIR SECTIONS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	52 OF 176
DRAWING:	S-206

DWG: C:\Users\agroga\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-206.dwg USER: Agrogan
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

NOTES:

1. TOP OF GRATING (TOG) IS 1 ¼" HIGHER THAN TOP OF STEEL (TOS).
2. ALL RAILING IS SIDE MOUNTED UNLESS OTHERWISE NOTED.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

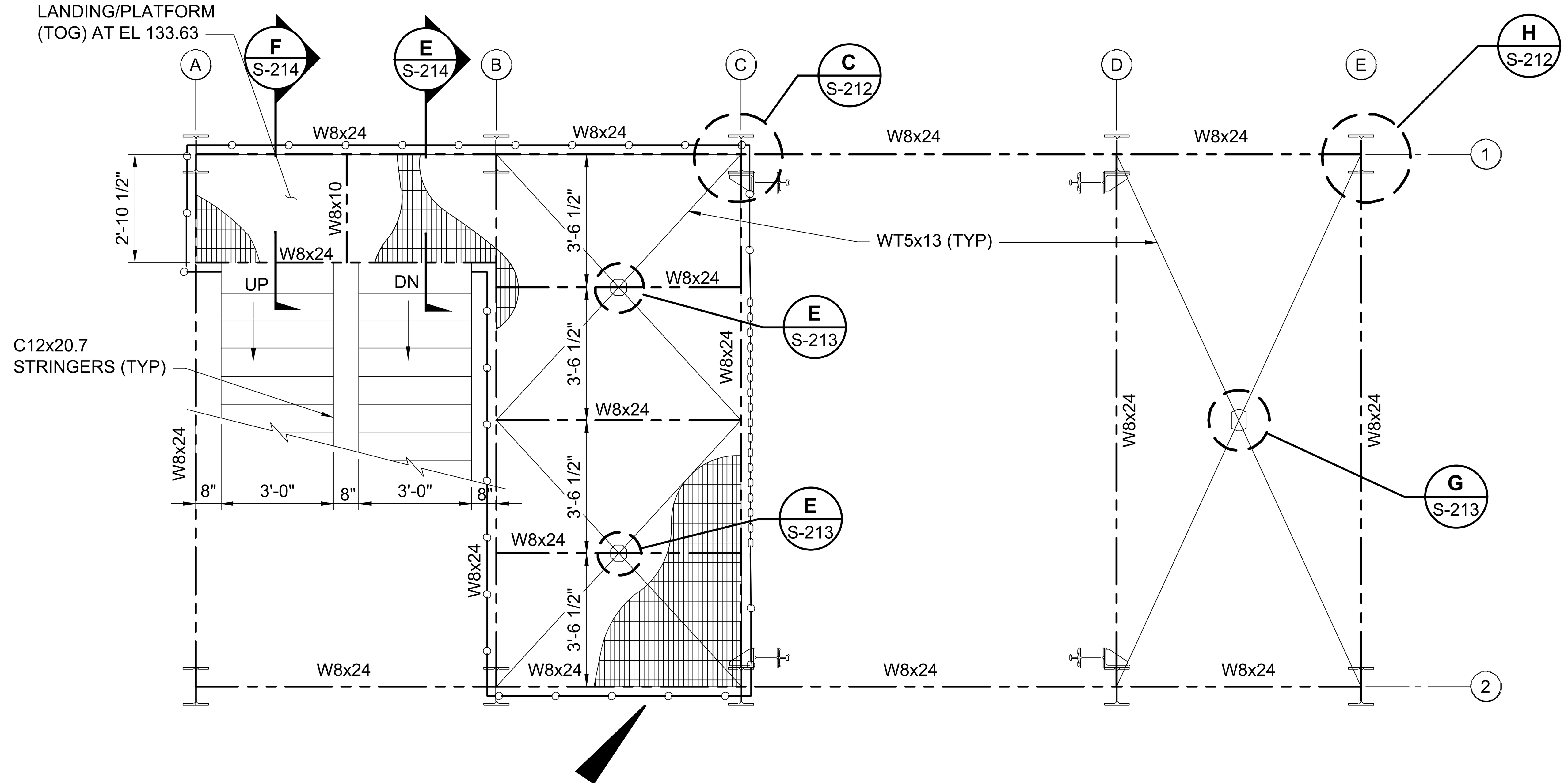
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING
PLATFORM PLANS

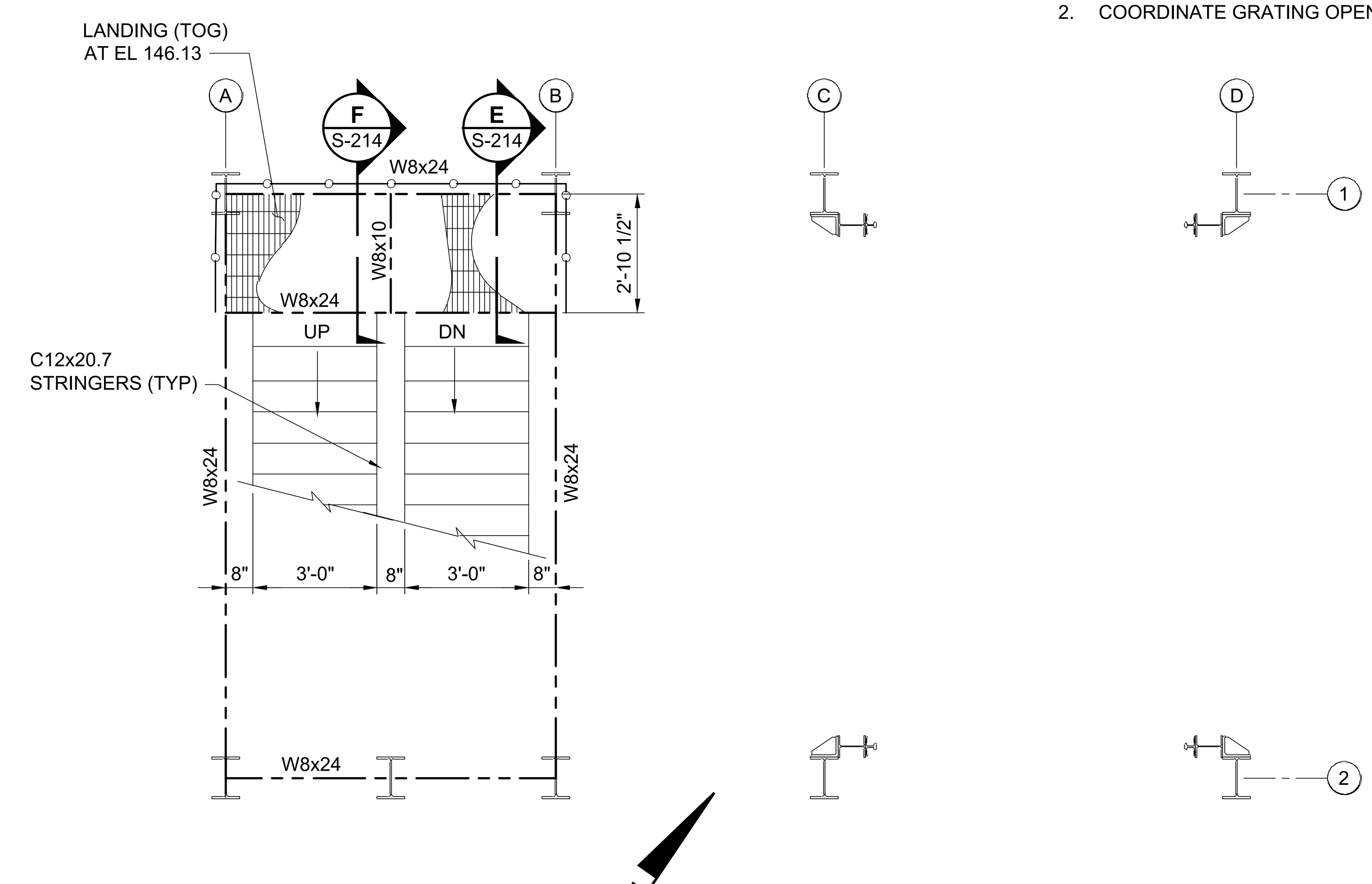
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	53 OF 176
DRAWING:	S-207

NOTES:

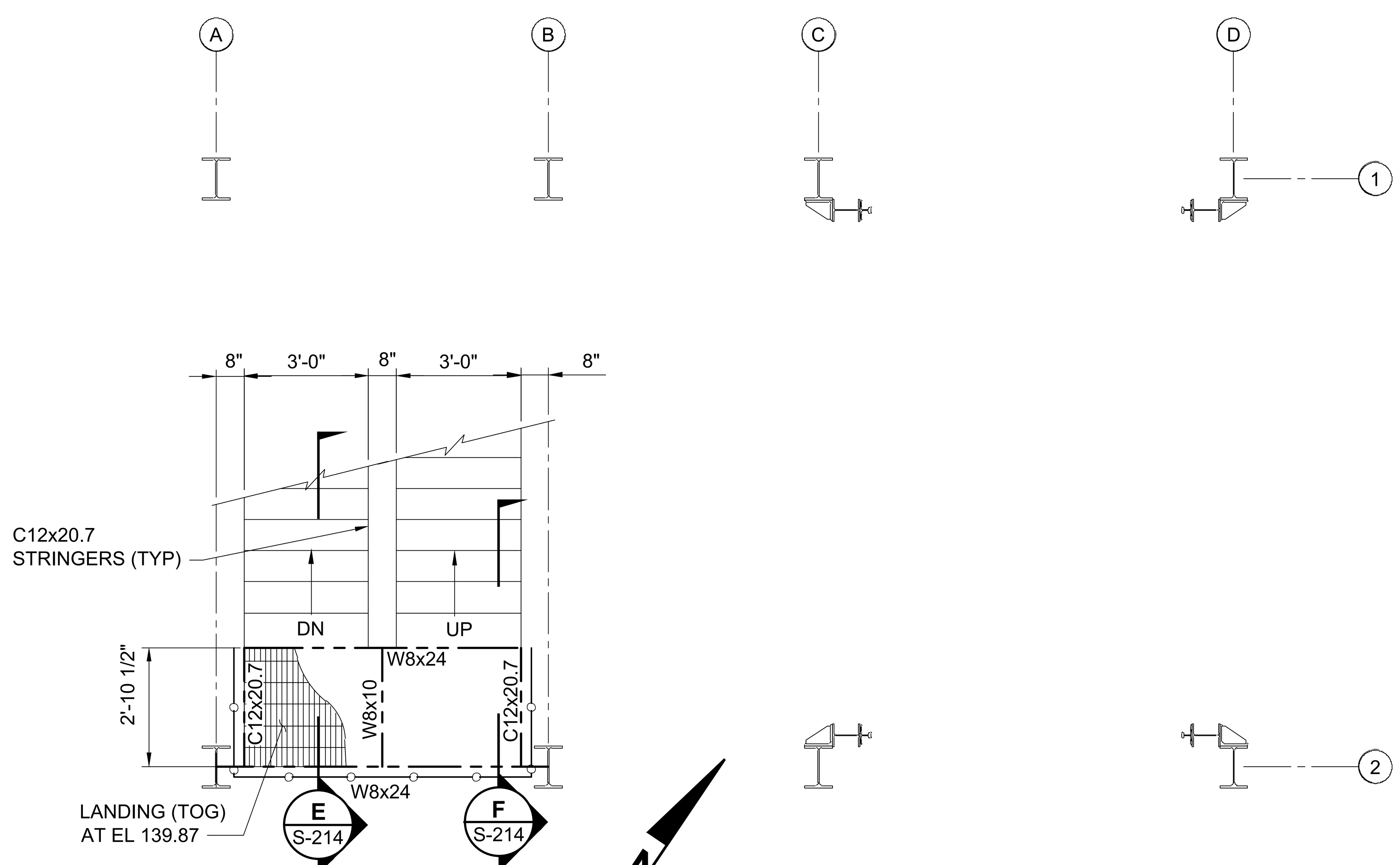
1. TOP OF GRATING (TOG) IS 1 ¼" HIGHER THAN TOP OF STEEL (TOS).
2. COORDINATE GRATING OPENING WITH HOIST MFR.



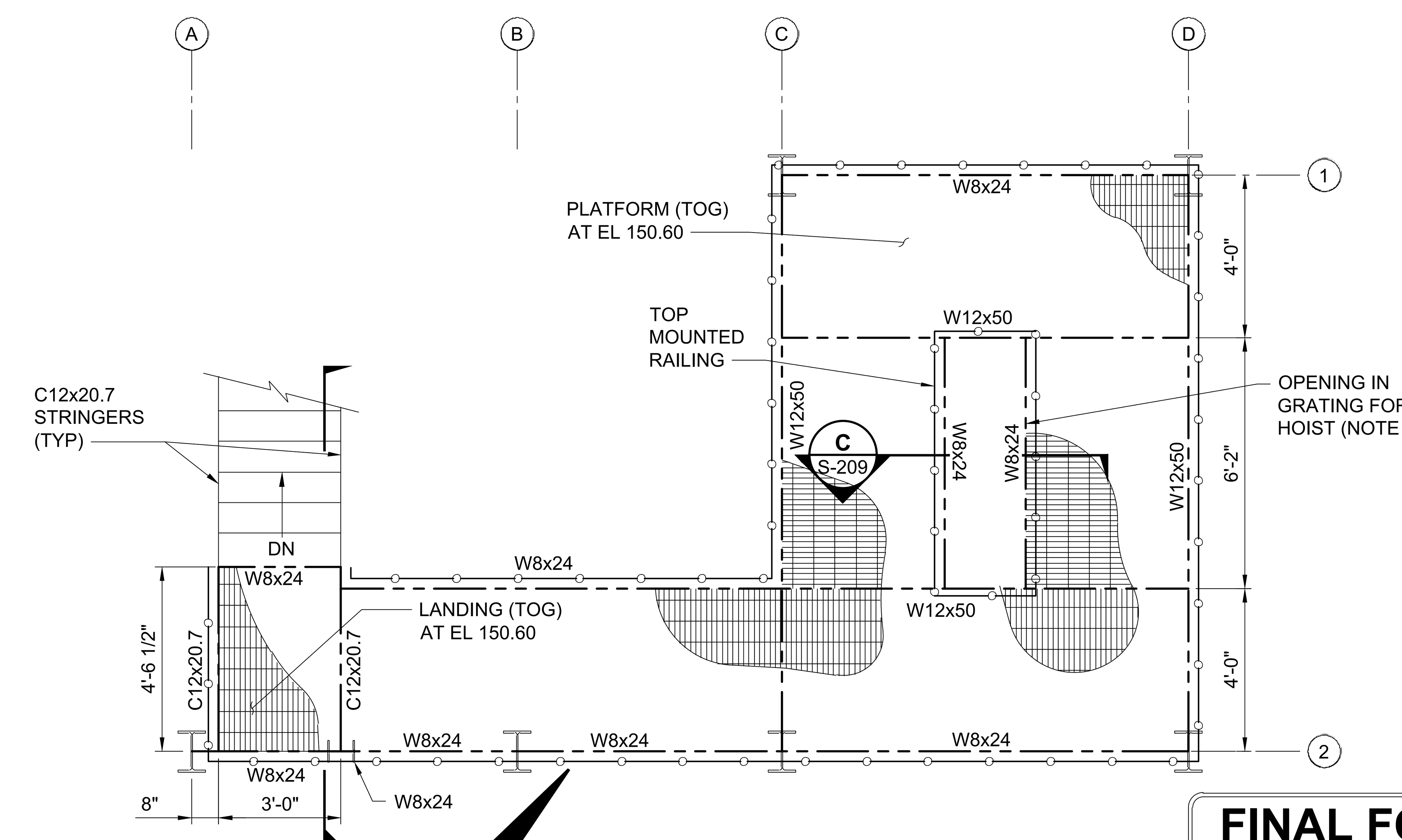
PLAN AT TOG EL 133.62 (TOS EL 133.52)
SCALE: 3/8"=1'-0"



PLAN AT TOG EL 146.12 (TOS EL 146.02)
SCALE: 3/8"=1'-0"



PLAN AT TOG EL 139.87 (TOS EL 139.77)
SCALE: 3/8"=1'-0"



PLAN AT TOG EL 150.60 (TOS EL 150.50)
SCALE: 3/8"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING
PLATFORM PLANS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 54 OF 176
DRAWING: S-208

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden rsss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-208.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

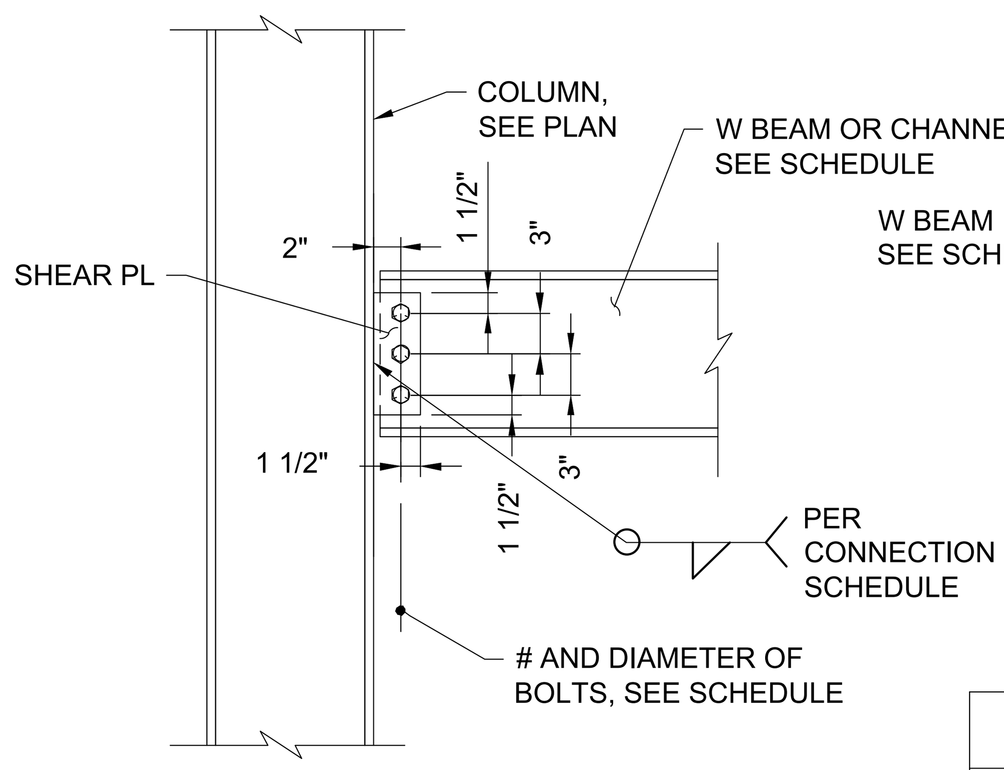
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS
AND DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	55 OF 176
DRAWING:	S-209

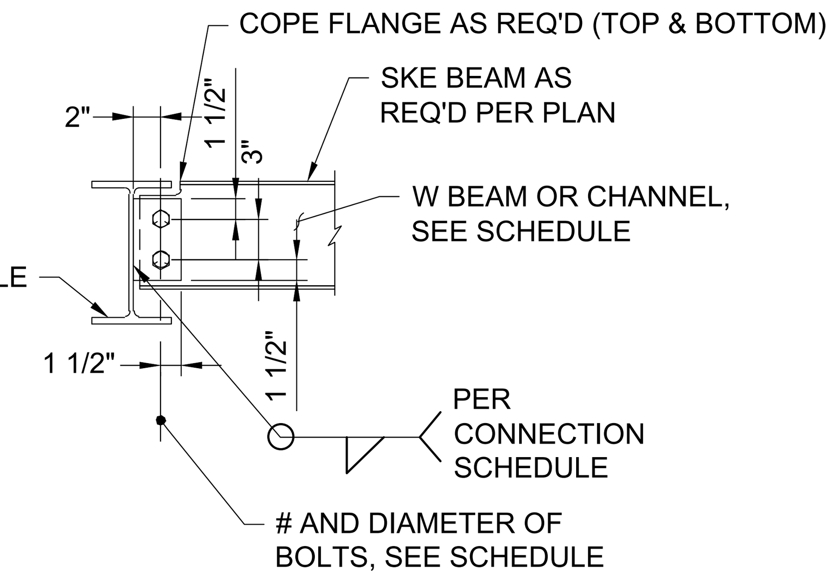
DWG: C:\Users\agrogan\documents\autocad sheet sets\3173\1009-alden miss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-209.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

AT COLUMN FLG



A SECTION
SCALE: 1"=1'-0"
S-203
S-212
S-215

AT BEAM

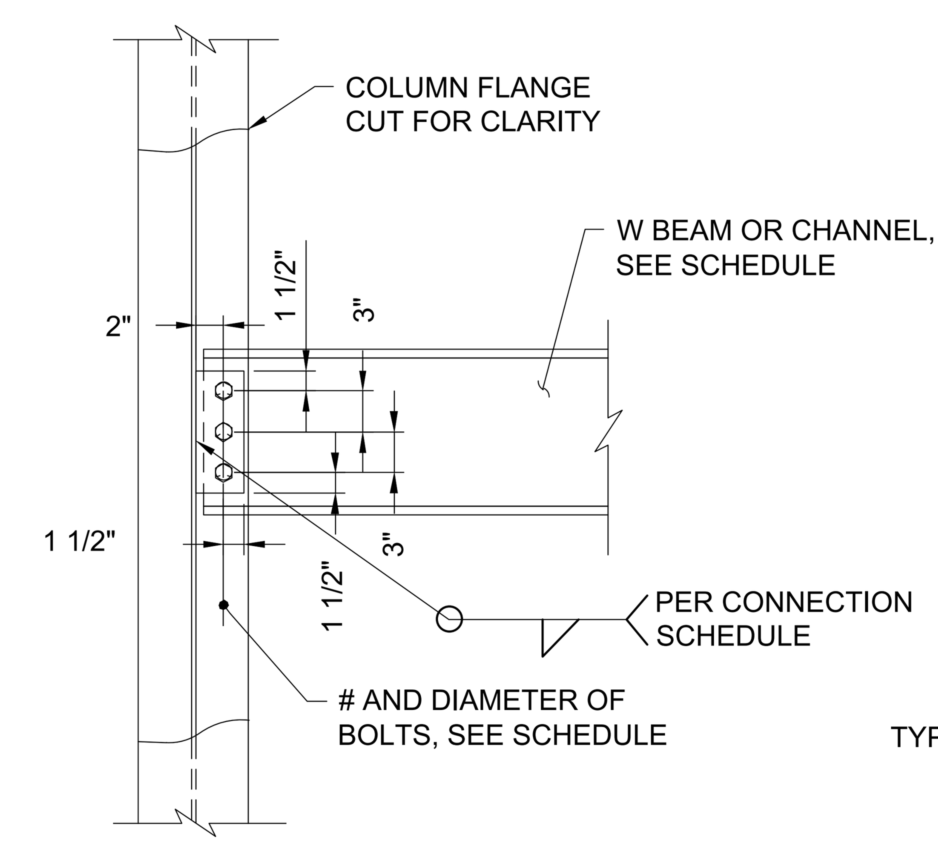


CONNECTION SCHEDULE

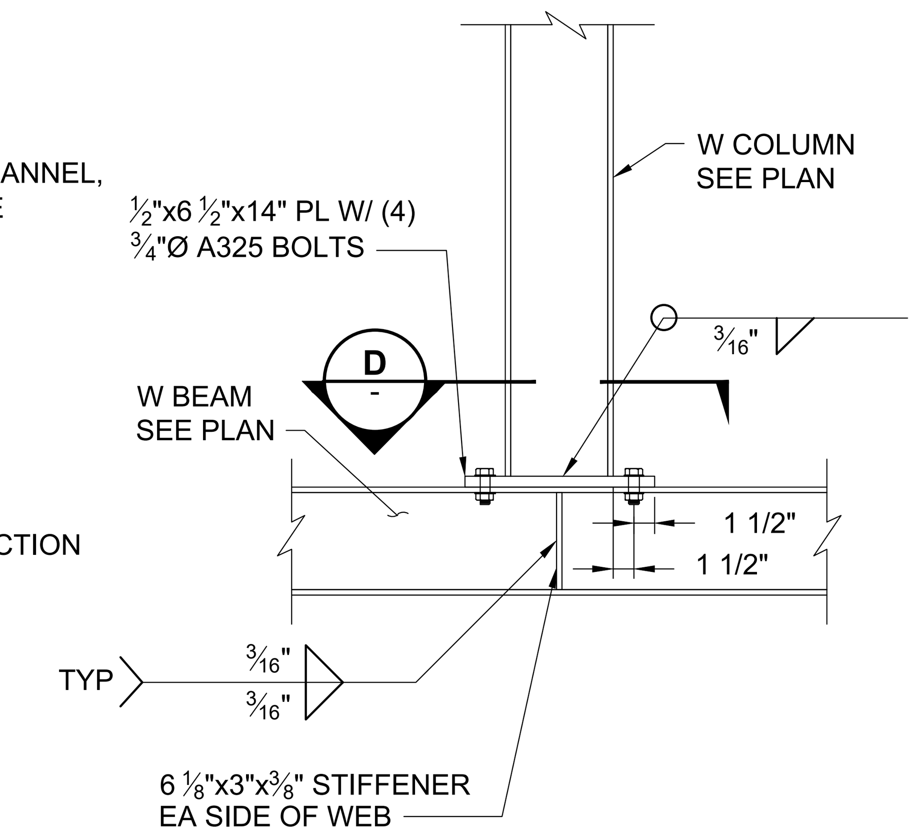
BEAM	# AND BOLT DIA	SHEAR PL DIMS	WELD SIZE
W or C 8	(2) ¾"Ø	⅜"x6"x3 ½"	¼"
W or C 10	(2) ¾"Ø	⅜"x6"x3 ½"	¼"
W or C 12	(3) ¾"Ø	⅜"x9"x3 ½"	¼"

NOTE: BOLTS ARE SSLT, THREADS EXCLUDED ASTM A325 BOLTS.

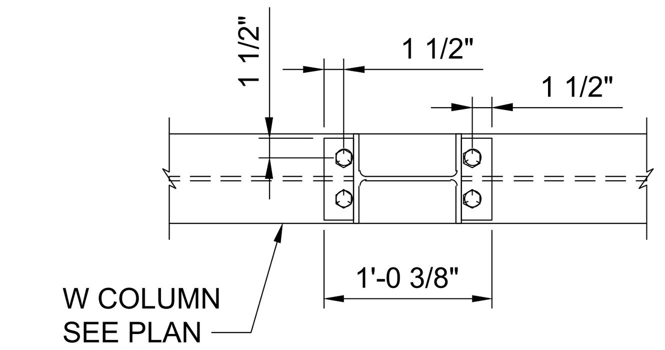
AT COLUMN WEB



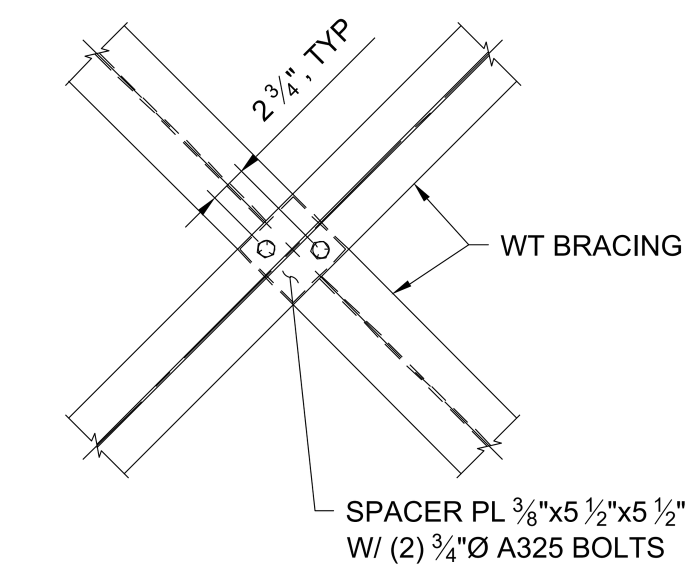
B SECTION
S-205
SCALE: 1"=1'-0"
S-211
S-215



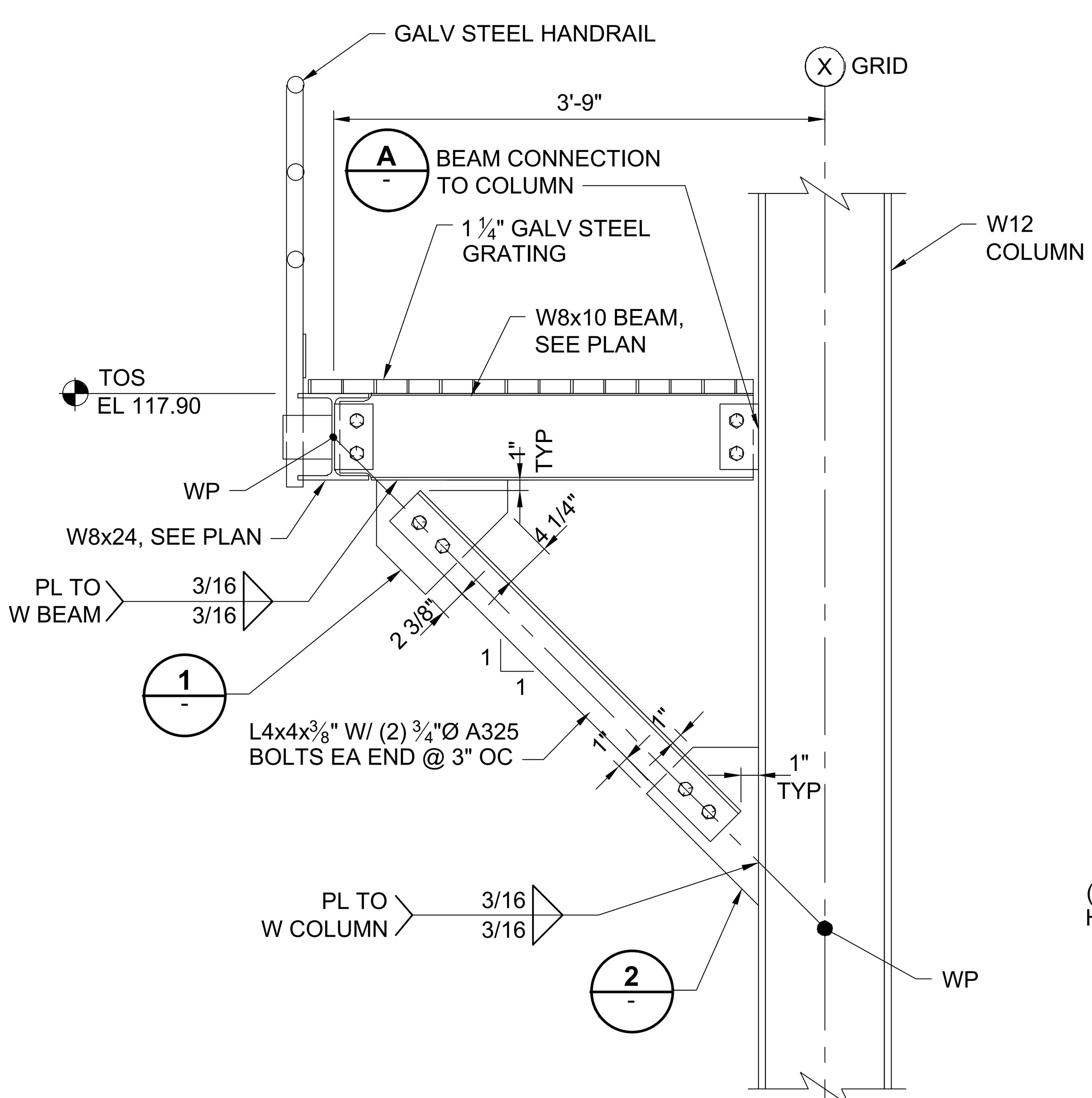
C SECTION
S-205
SCALE: 1"=1'-0"



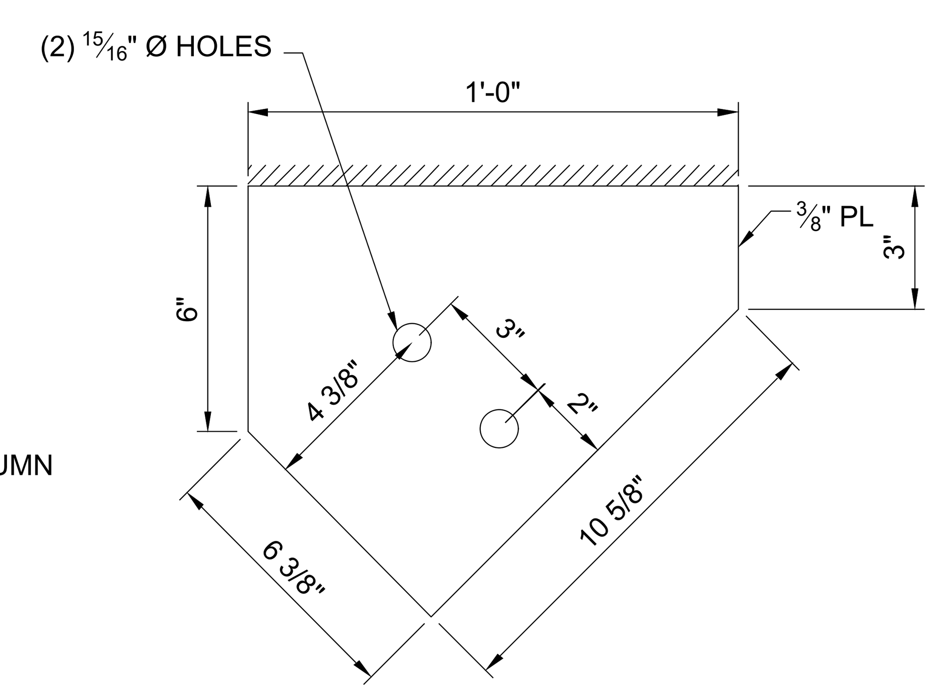
D SECTION
SCALE: 1"=1'-0"



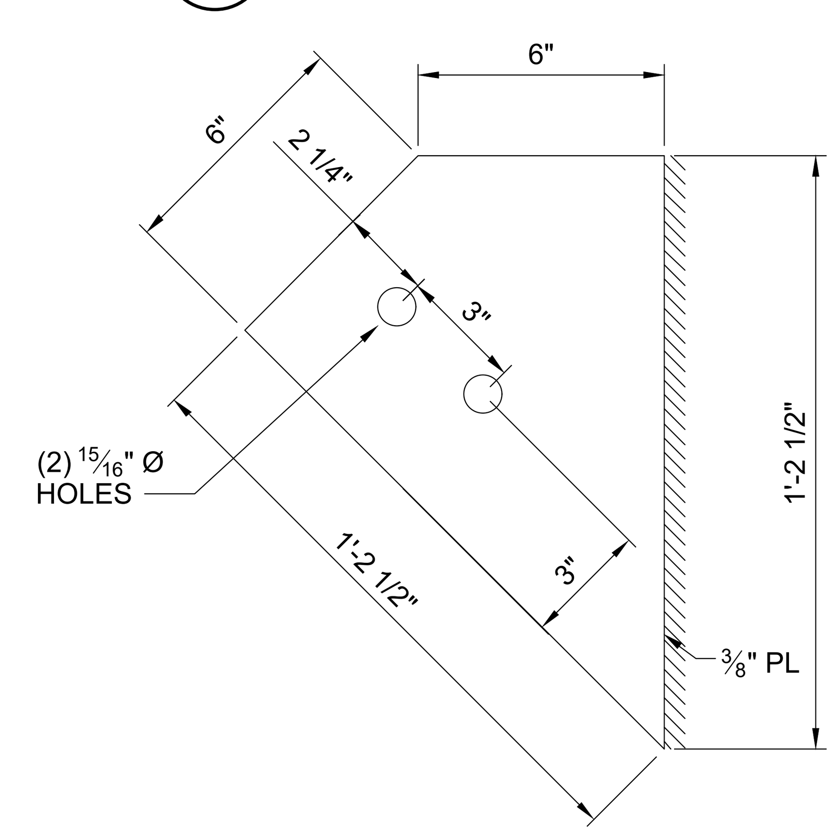
H SECTION
S-203
SCALE: 1"=1'-0"
S-204
S-205



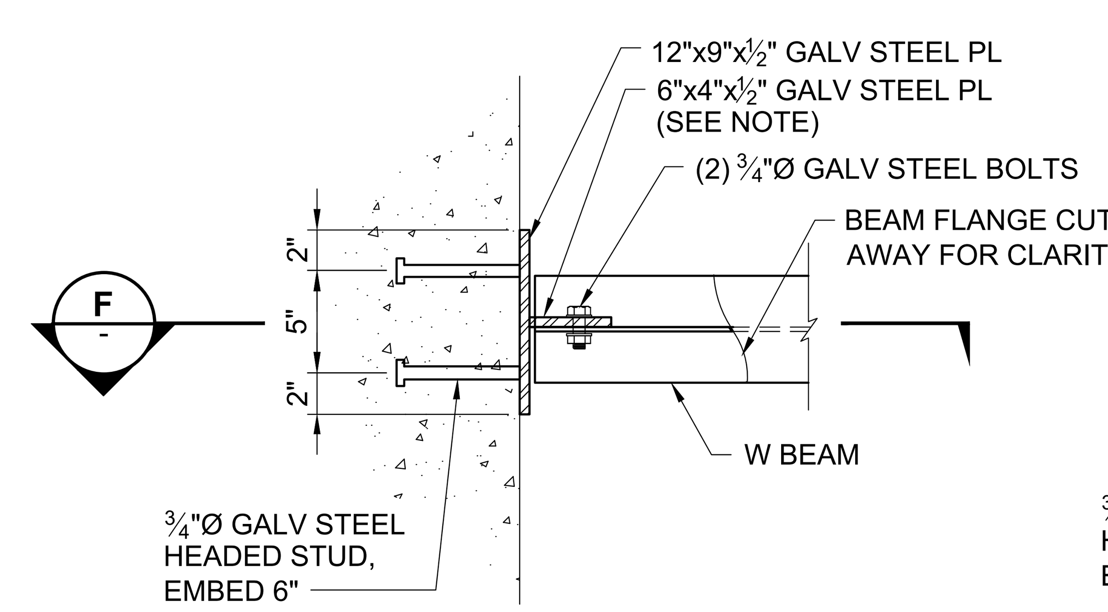
G SECTION
S-203
SCALE: 1"=1'-0"



1 GUSSET PLATE DETAIL
SCALE: 3"=1'-0"

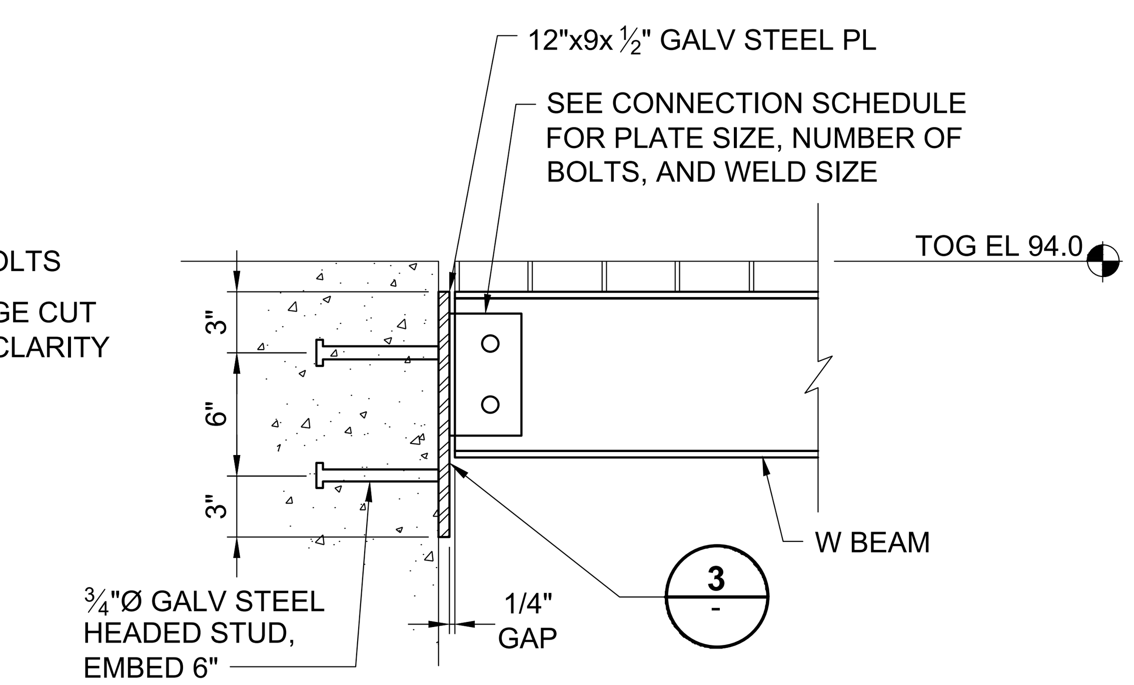


2 GUSSET PLATE DETAIL
SCALE: 3"=1'-0"

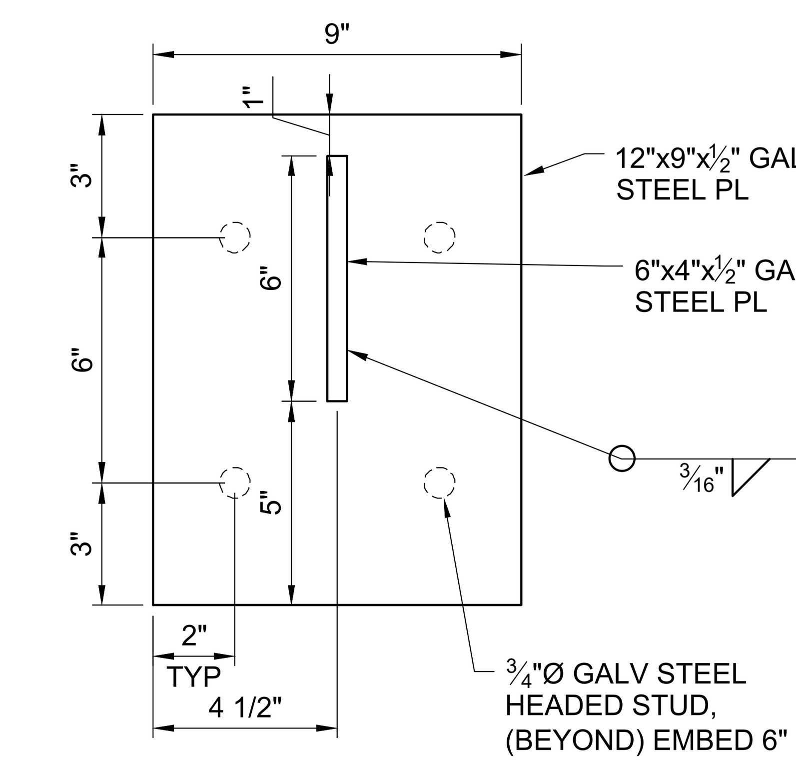


NOTE:
ANGLE THE SS PL AT SIM.

E CONNECTION DETAIL
S-202
SCALE: 1-1/2"=1'-0"



F CONNECTION SECTION
SCALE: 1-1/2"=1'-0"



3 CONNECTION PLATE DETAIL
SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

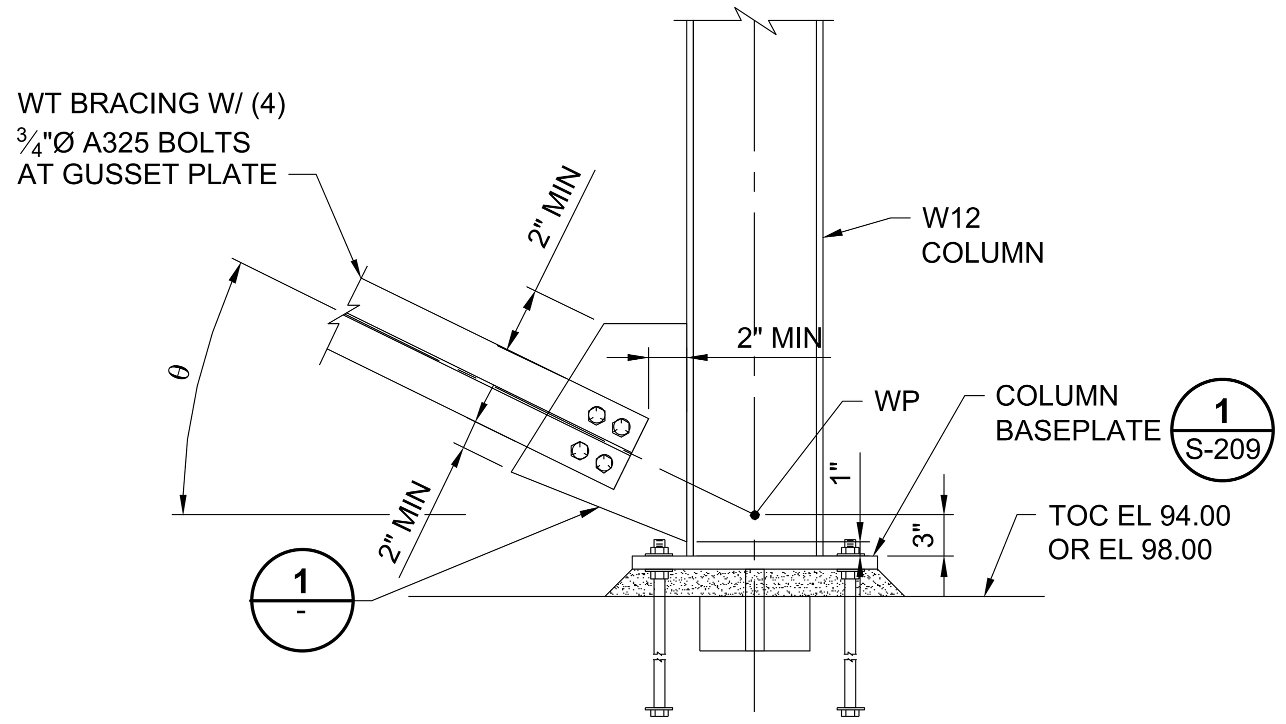
TOWER STEEL FRAMING SECTIONS
AND DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 56 OF 176
DRAWING: S-210

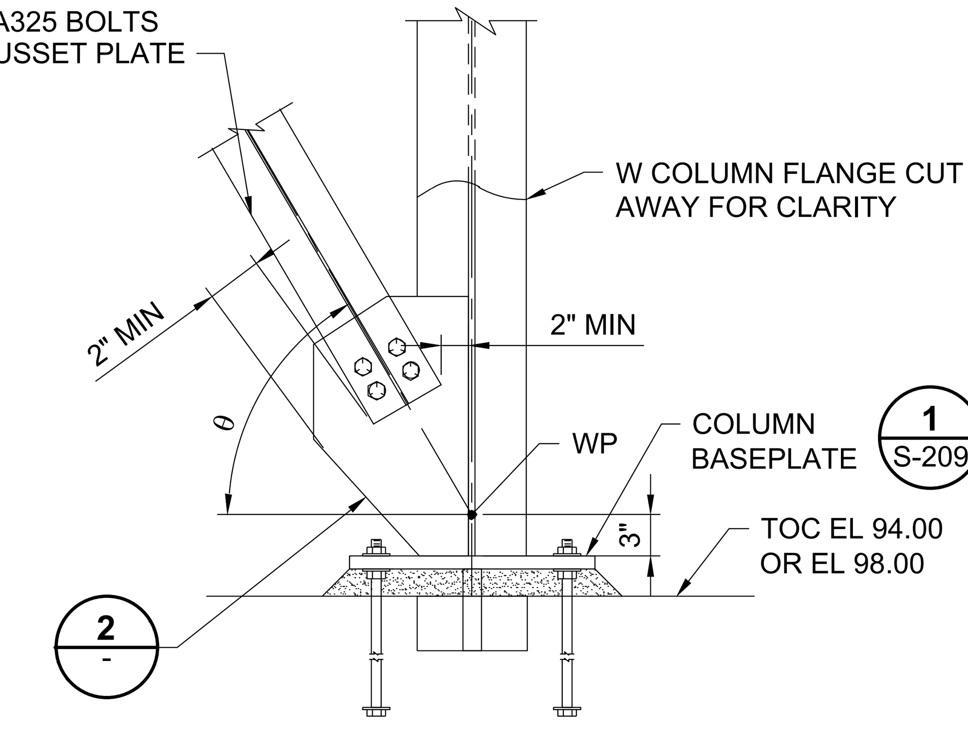
DWG: C:\users\agrogan\documents\autocad sheet sets\31009-alden rsss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-210.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

NOTE:

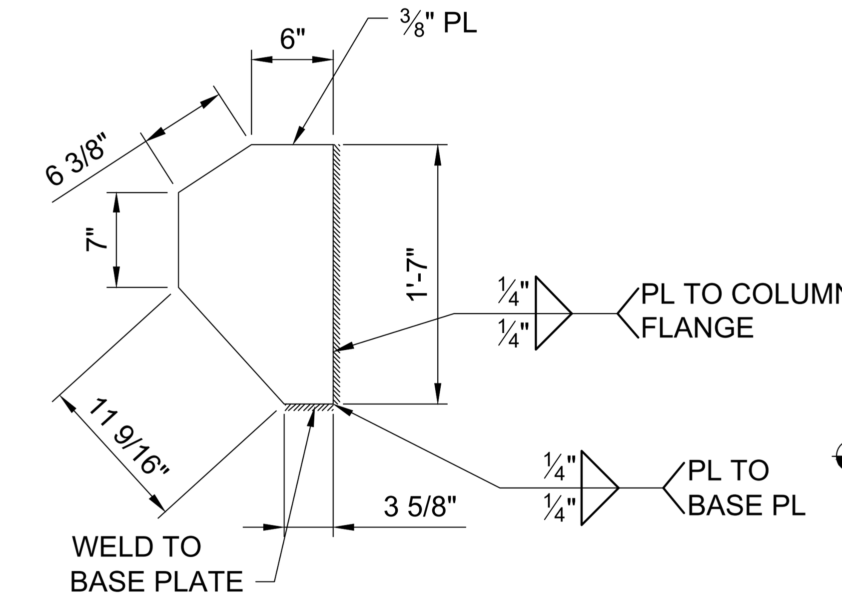
1. FIELD DRILL HOLES IN GUSSET PLATE.
2. GUSET PLATE WILL BE CENTERED ON BEAM OR COLUMN.



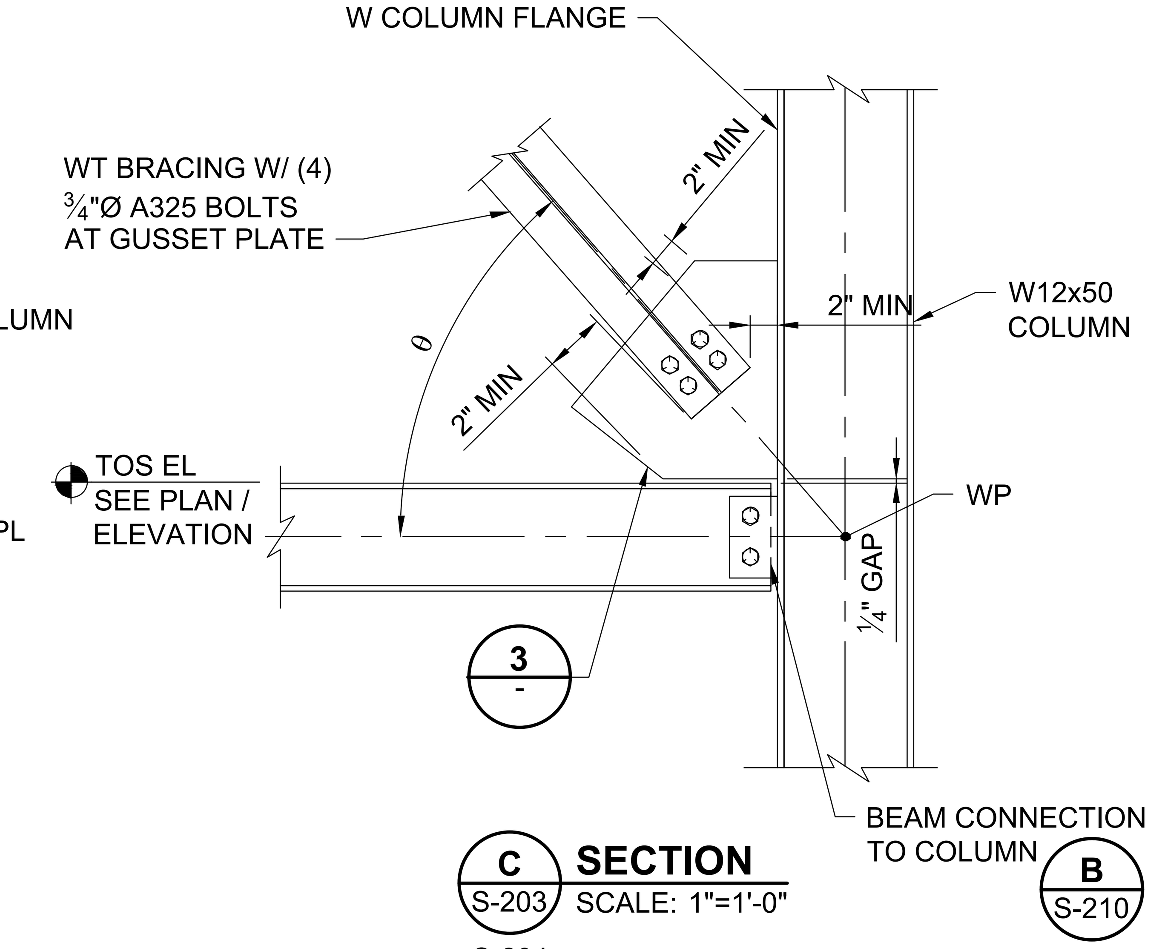
A SECTION
S-203 SCALE: 1"=1'-0"
S-204



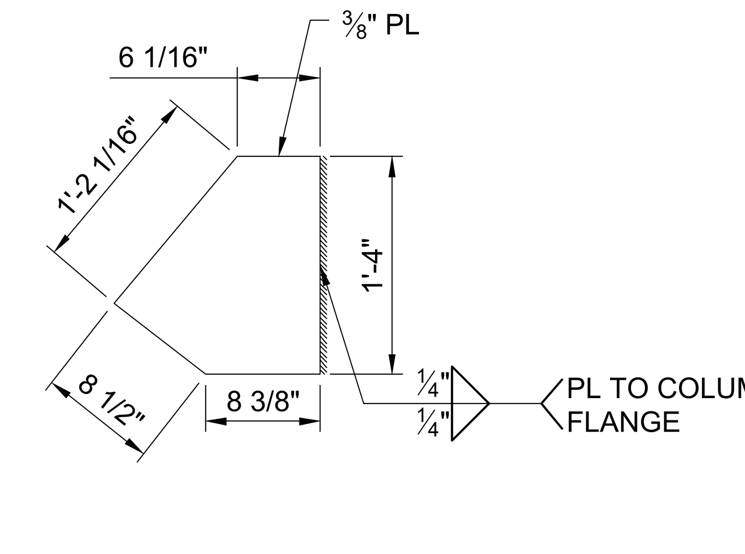
B SECTION
S-205 SCALE: 1"=1'-0"



2 GUSSET PLATE 2 DETAIL
SCALE: 1"=1'-0"

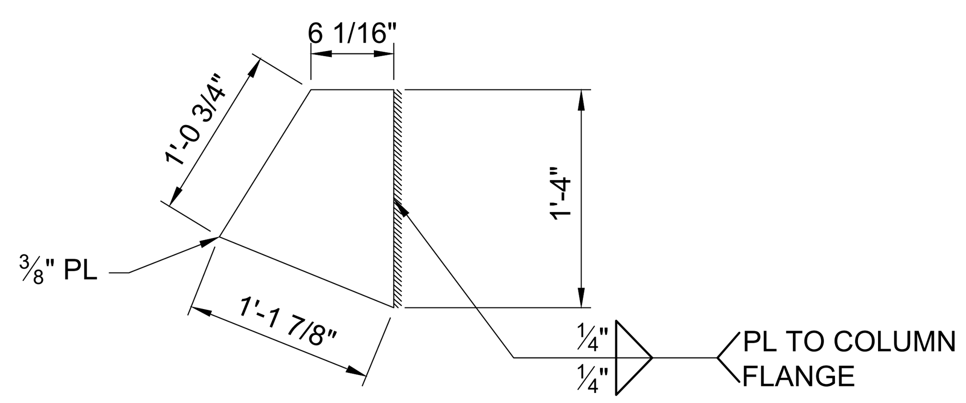


C SECTION
S-203 SCALE: 1"=1'-0"
S-204

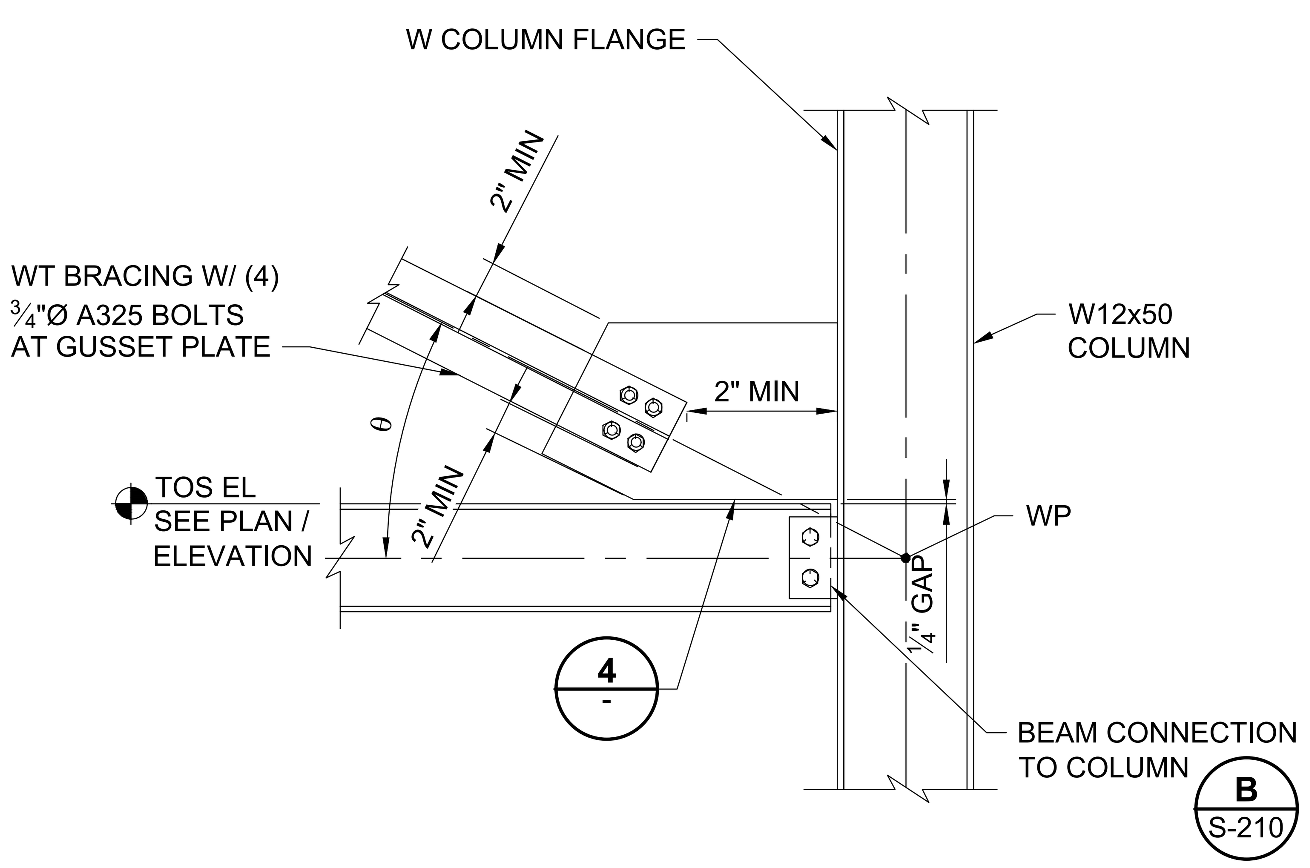


3 GUSSET PLATE 3 DETAIL
SCALE: 1"=1'-0"

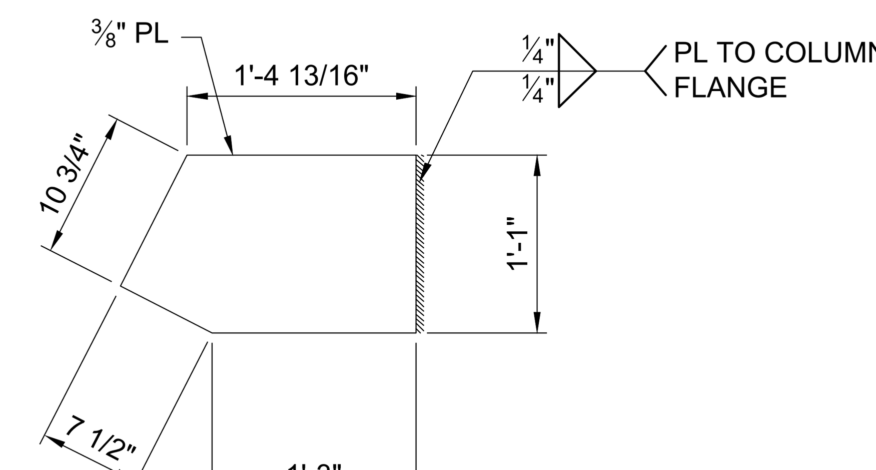
Connection Name	GUSSET PLATE	θ	NUMBER OF CONNECTIONS
GP-1A	1	26.1°	2
GP-1B	1	37.9°	4
GP-2A	2	47.7°	2
GP-2B	2	59.7°	2
GP-2C	2	48.1°	2
GP-3A	3	37.9°	4
GP-3B	3	38.5°	12
GP-3C	3	46.6°	12
GP-3D	3	39.8°	4
GP-3E	3	48.9°	8
GP-4A	4	26.1°	2
GP-5A	5	47.7°	2
GP-5B	5	60.7°	8
GP-5C	5	60.2°	2
GP-5D	5	67.1°	8
GP-5E	5	58.7°	8
GP-5F	5	48.1°	2
GP-5G	5	48.6°	4
GP-5H	5	56.5°	4
GP-5I	5	57.4°	4



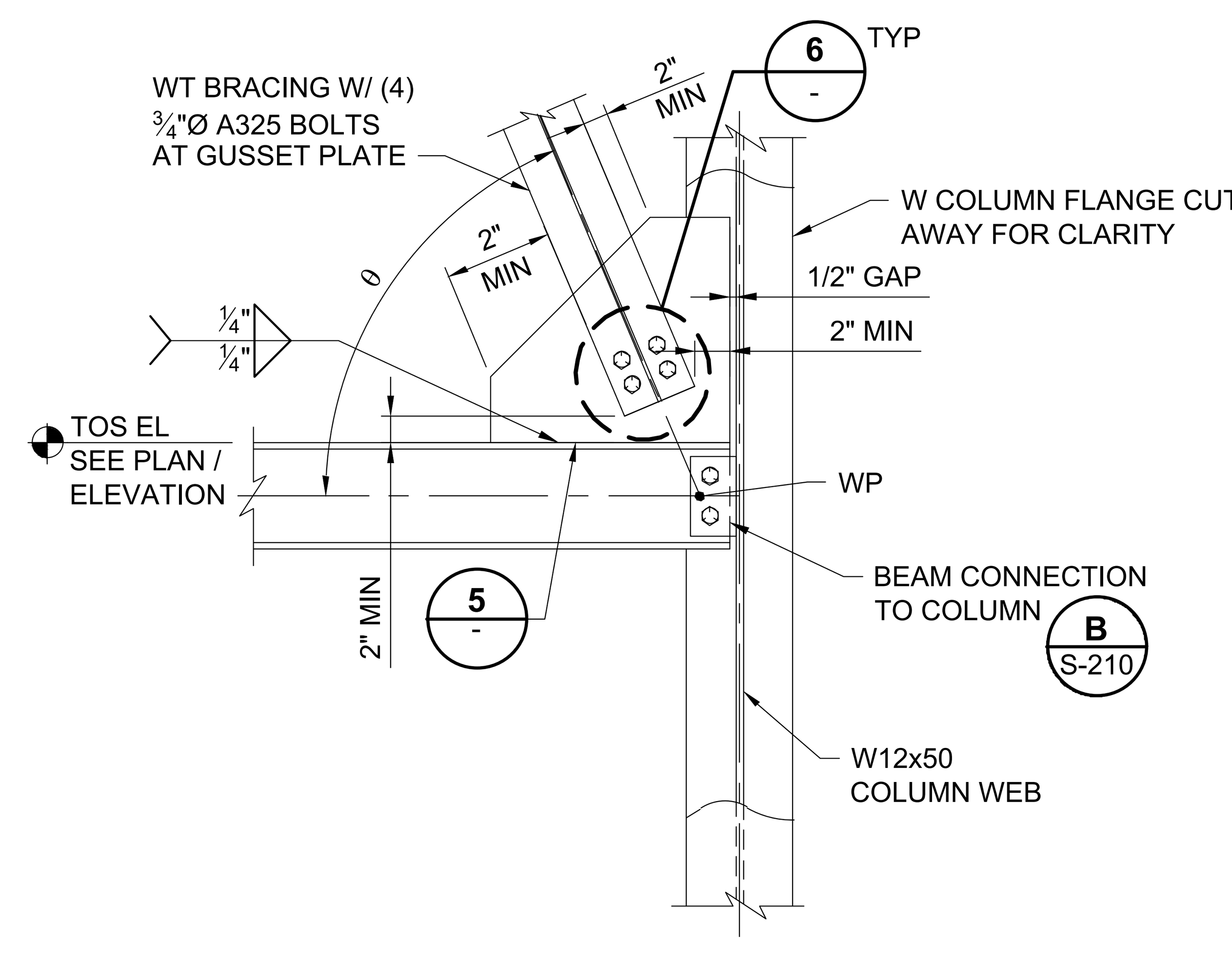
1 GUSSET PLATE 1 DETAIL
SCALE: 1"=1'-0"



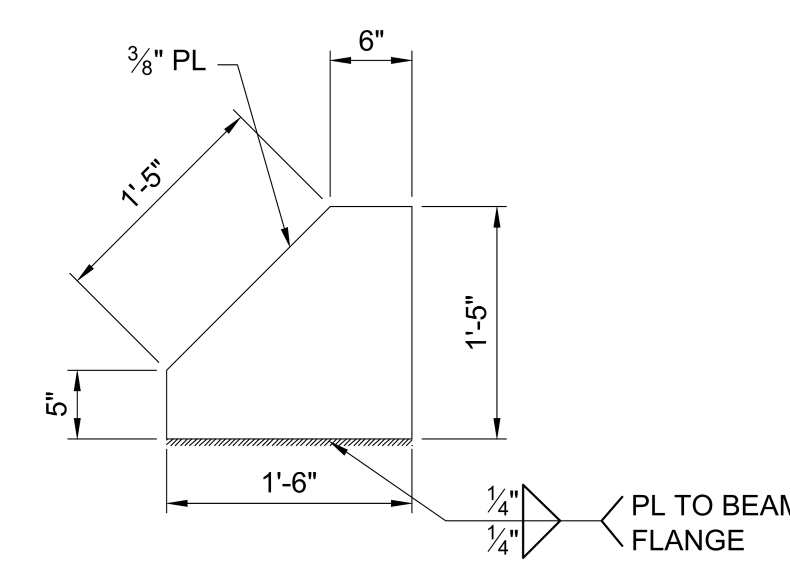
D SECTION
S-203 SCALE: 1"=1'-0"



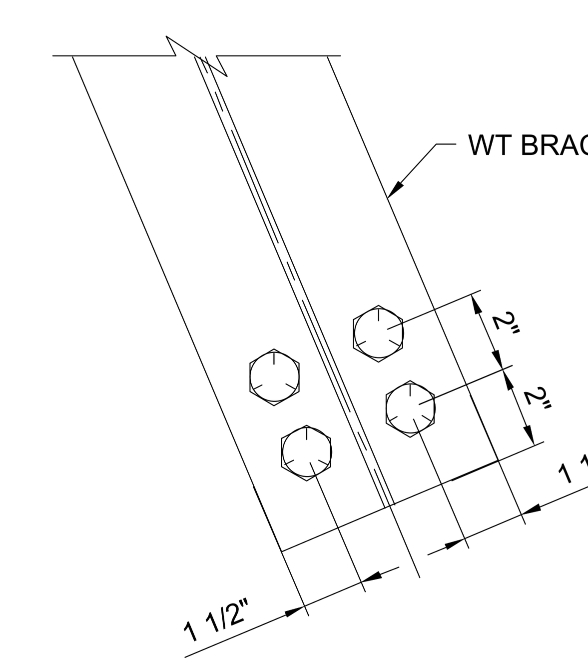
4 GUSSET PLATE 4 DETAIL
SCALE: 1"=1'-0"



E SECTION
S-205 SCALE: 1"=1'-0"



5 GUSSET PLATE 5 DETAIL
SCALE: 1"=1'-0"



6 DETAIL
SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden rsss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-211.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

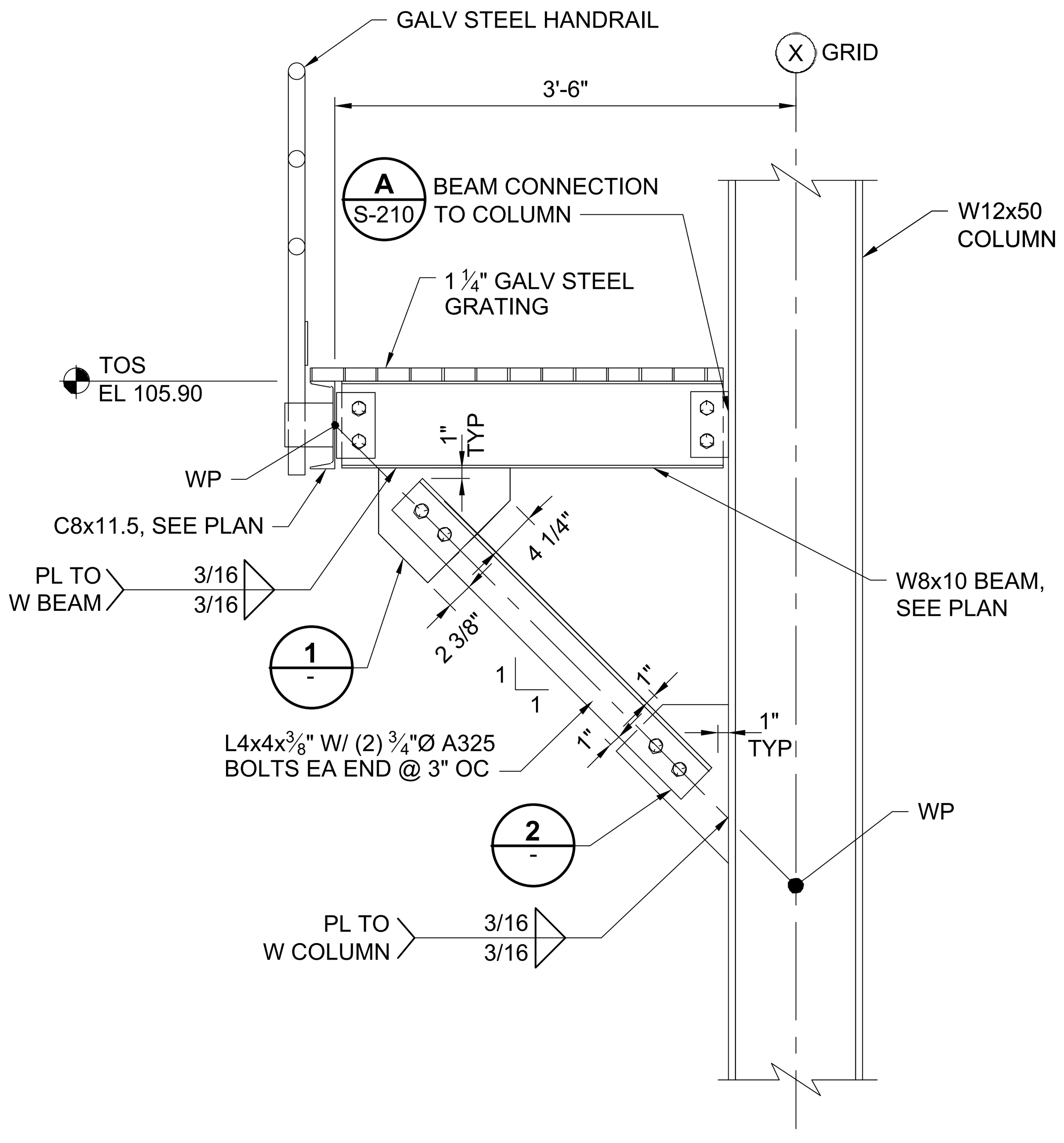
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

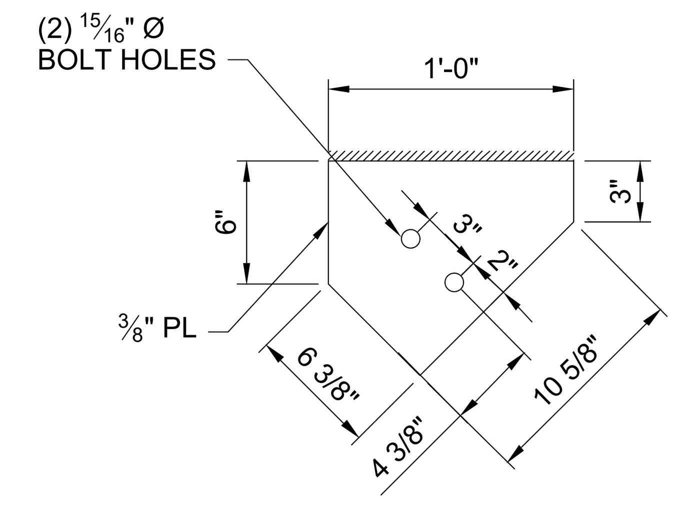
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS AND DETAILS

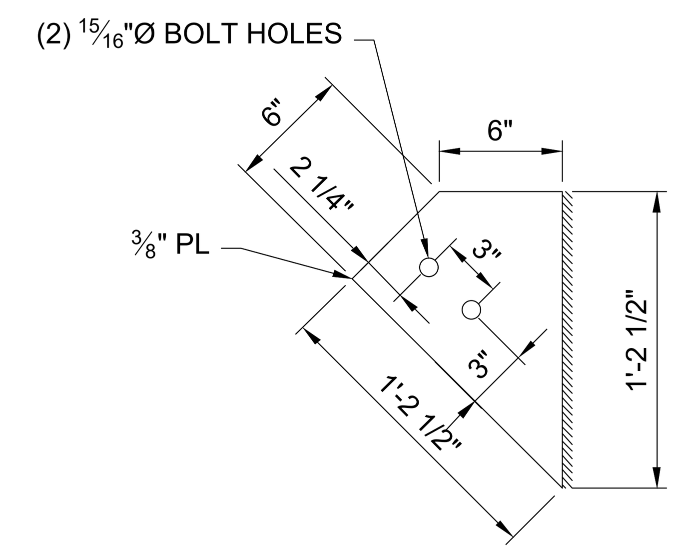
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 57 OF 176
DRAWING: S-211



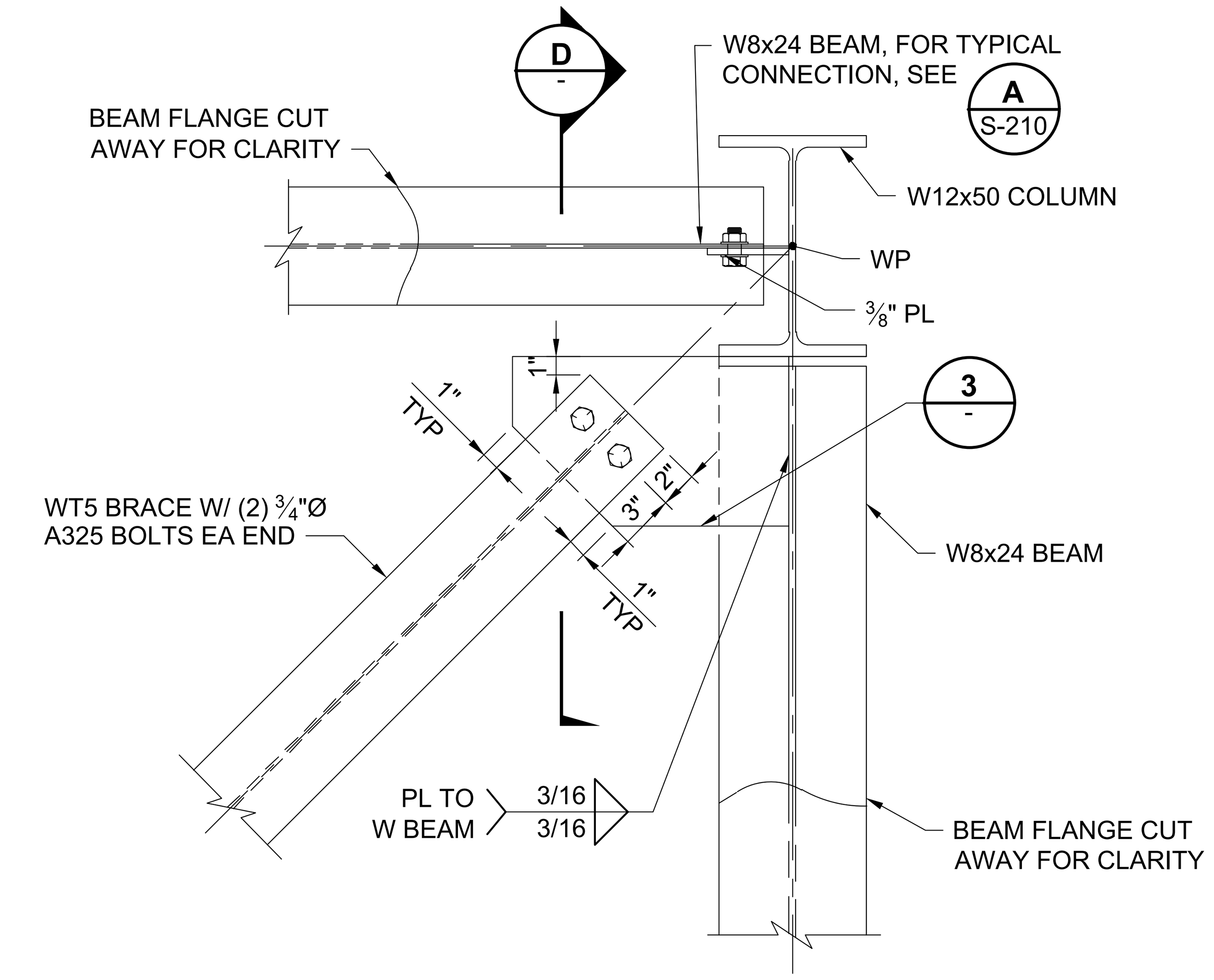
SECTION A (S-203)
SCALE: 1"=1'-0"
S-204
S-207



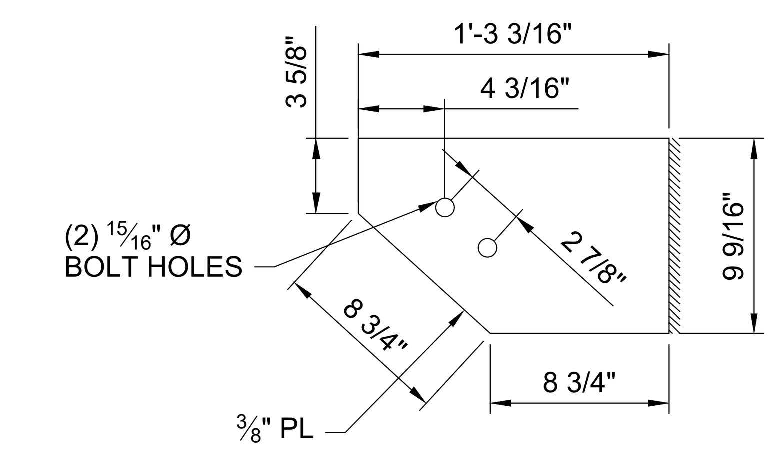
1 GUSSET PLATE DETAIL
SCALE: 1-1/2"=1'-0"



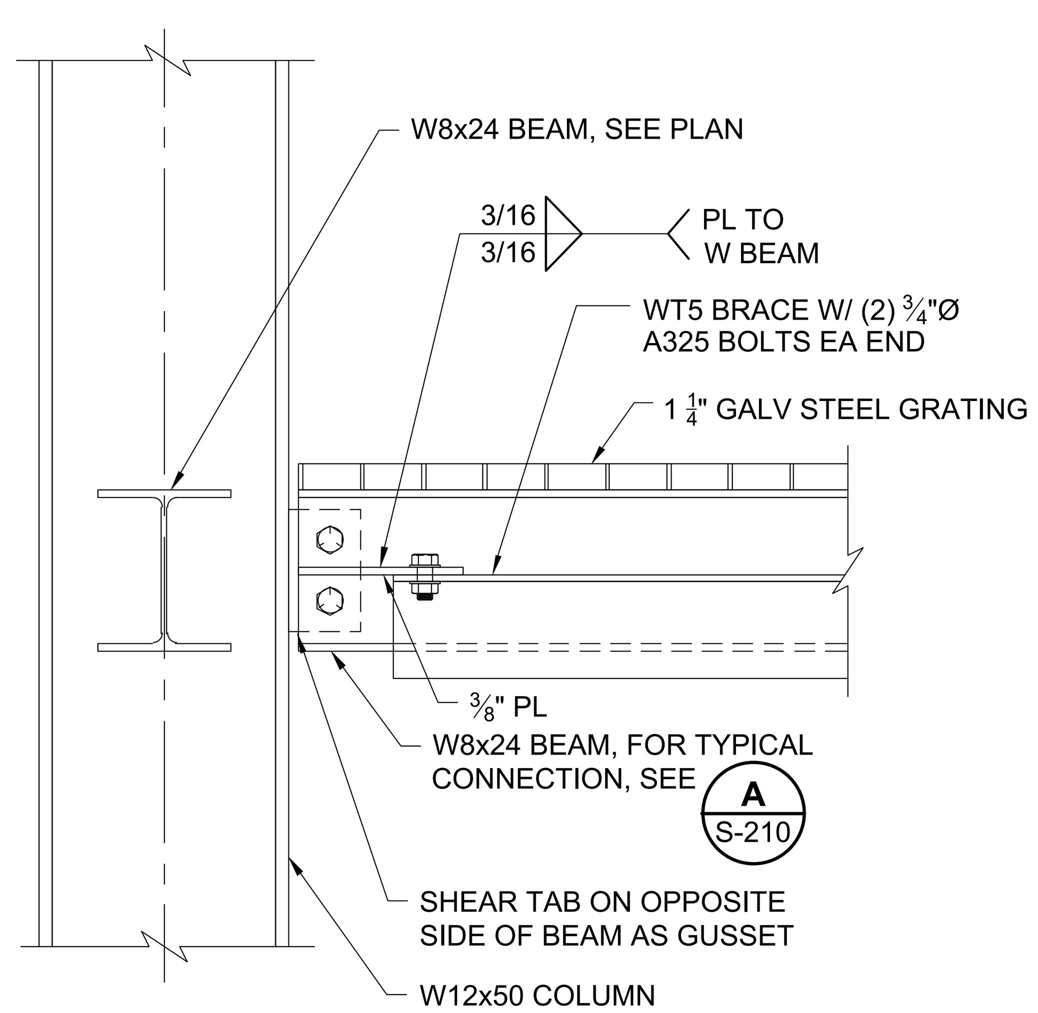
2 GUSSET PLATE DETAIL
SCALE: 1-1/2"=1'-0"



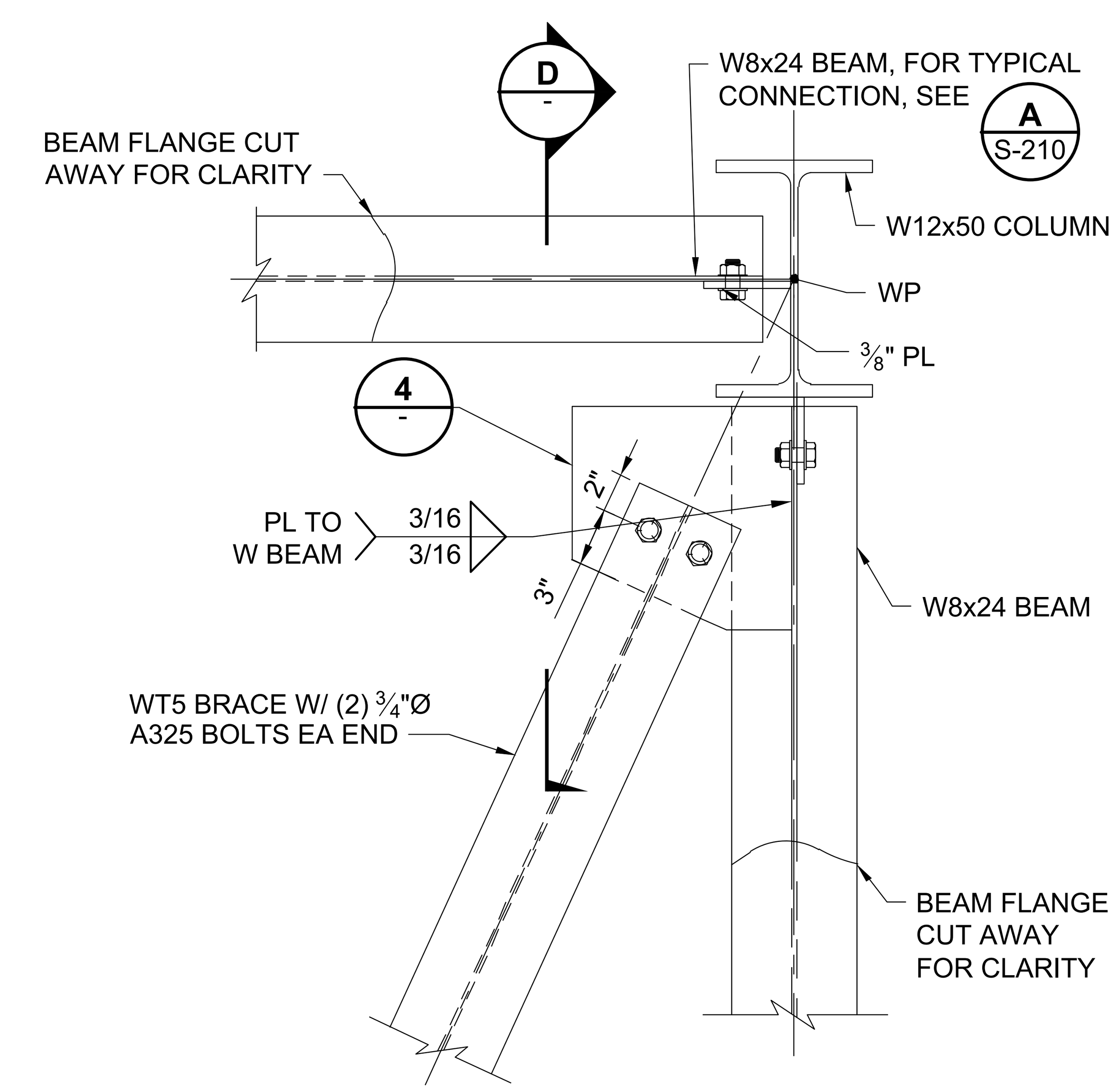
SECTION C (S-208)
SCALE: 1 1/2"=1'-0"



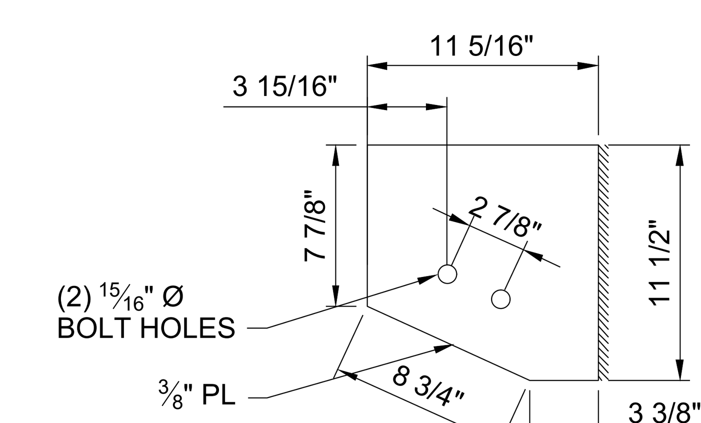
3 GUSSET PLATE DETAIL
SCALE: 1 1/2"=1'-0"



SECTION D
SCALE: 1 1/2"=1'-0"



SECTION H (S-208)
SCALE: 1 1/2"=1'-0"



4 GUSSET PLATE DETAIL
SCALE: 1 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

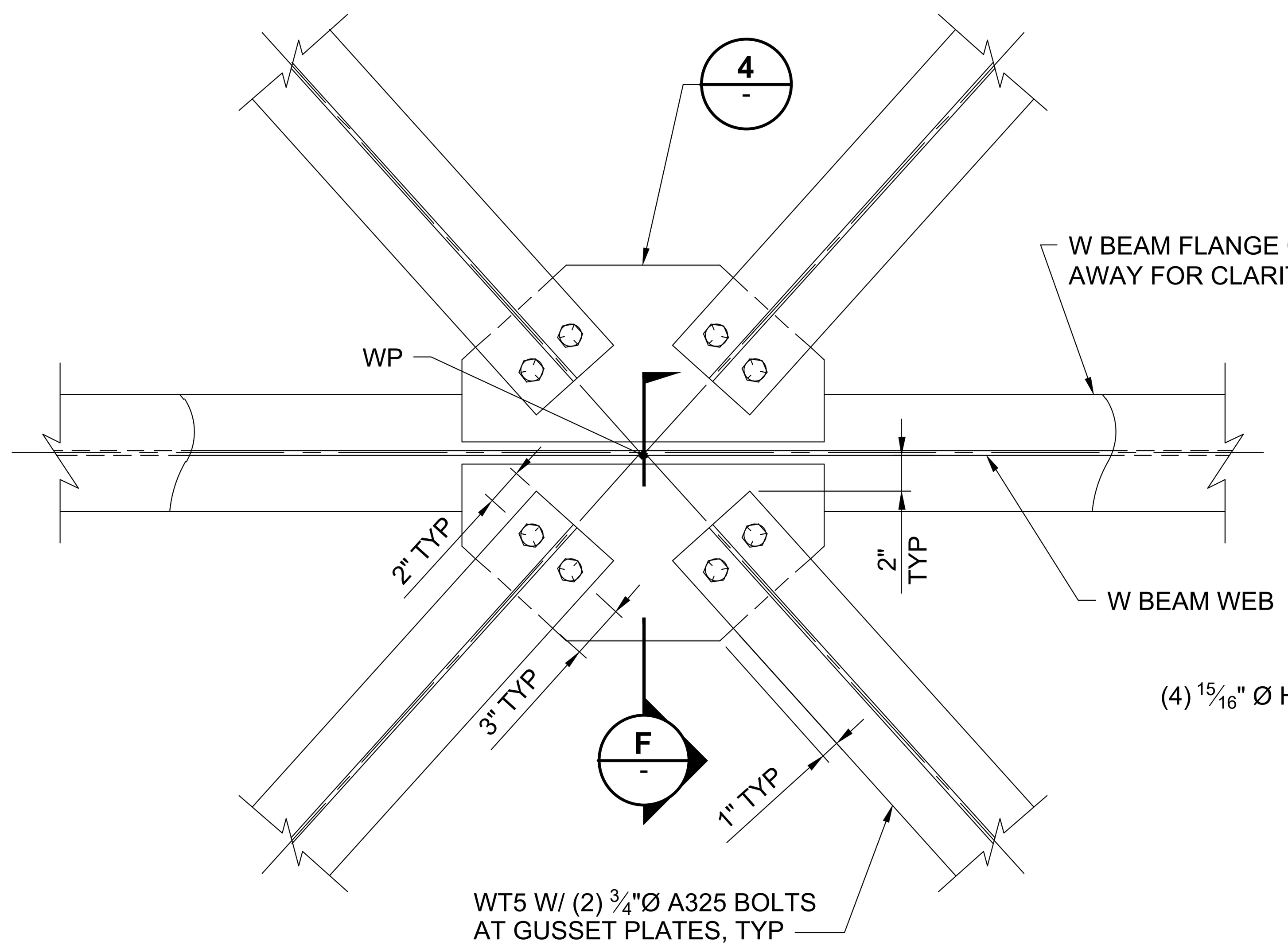
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE MARK DANIEL GRAESER No.39328 12/13/2019 LICENSED PROFESSIONAL ENGINEER

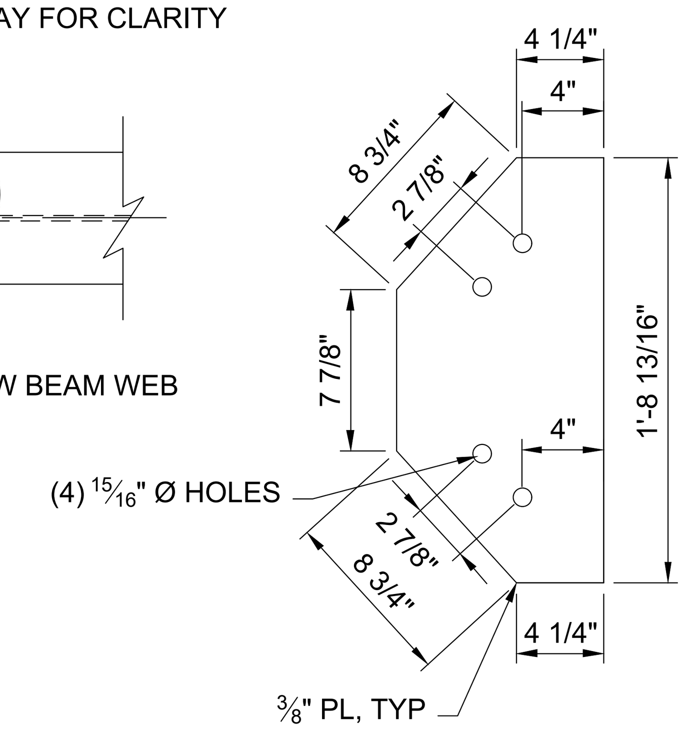
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS AND DETAILS

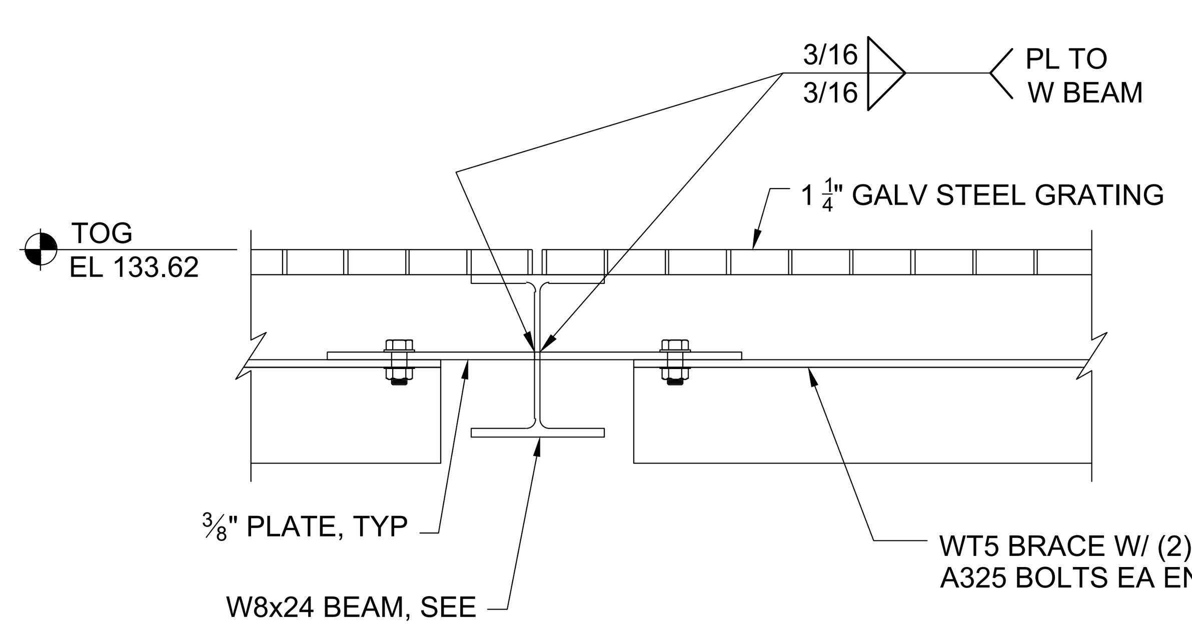
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 58 OF 176
DRAWING: S-212



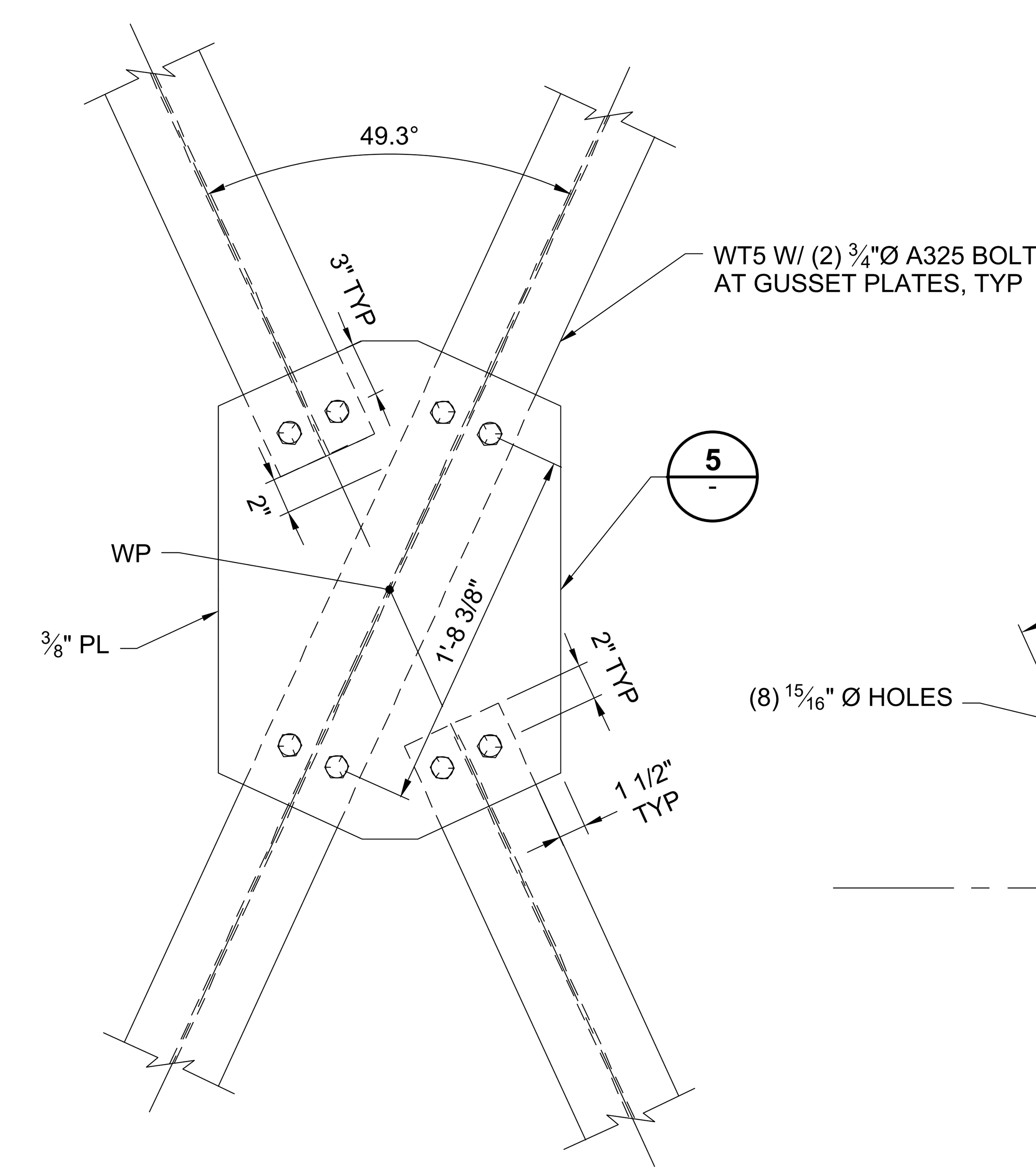
E
S-208
PLAN
SCALE: 1-1/2"=1'-0"



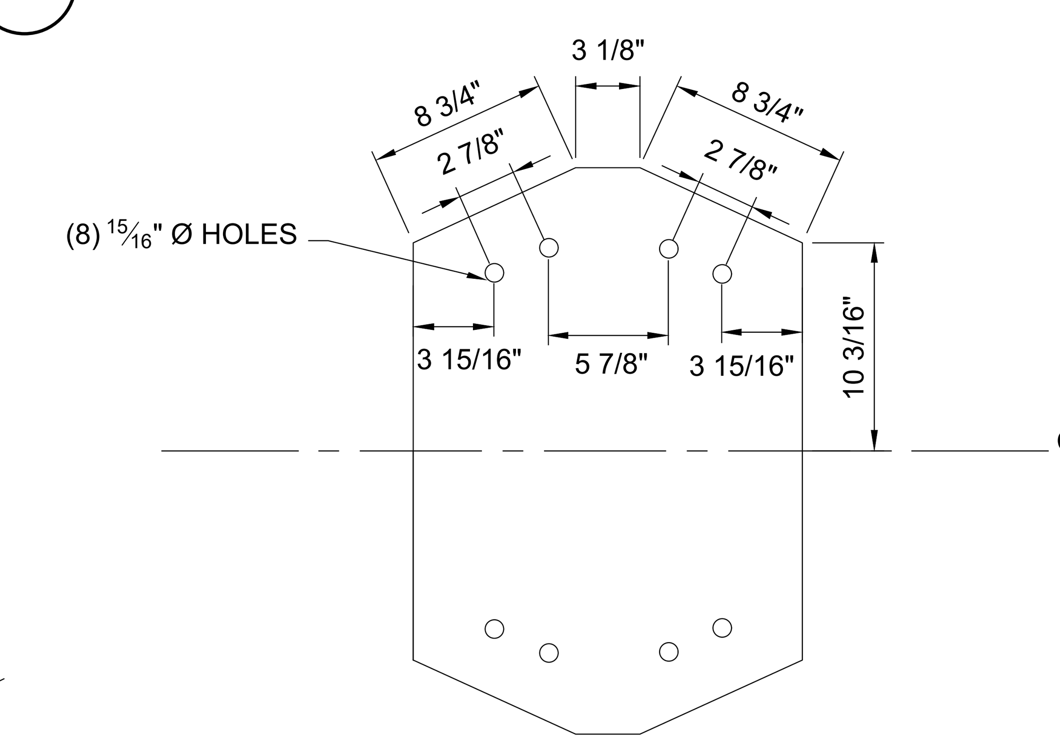
4
-
GUSSET PLATE DETAIL
SCALE: 1-1/2"=1'-0"



F
-
SECTION
SCALE: 1-1/2"=1'-0"



G
S-208
PLAN
SCALE: 1-1/2"=1'-0"



5
-
GUSSET PLATE DETAIL
SCALE: 1-1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

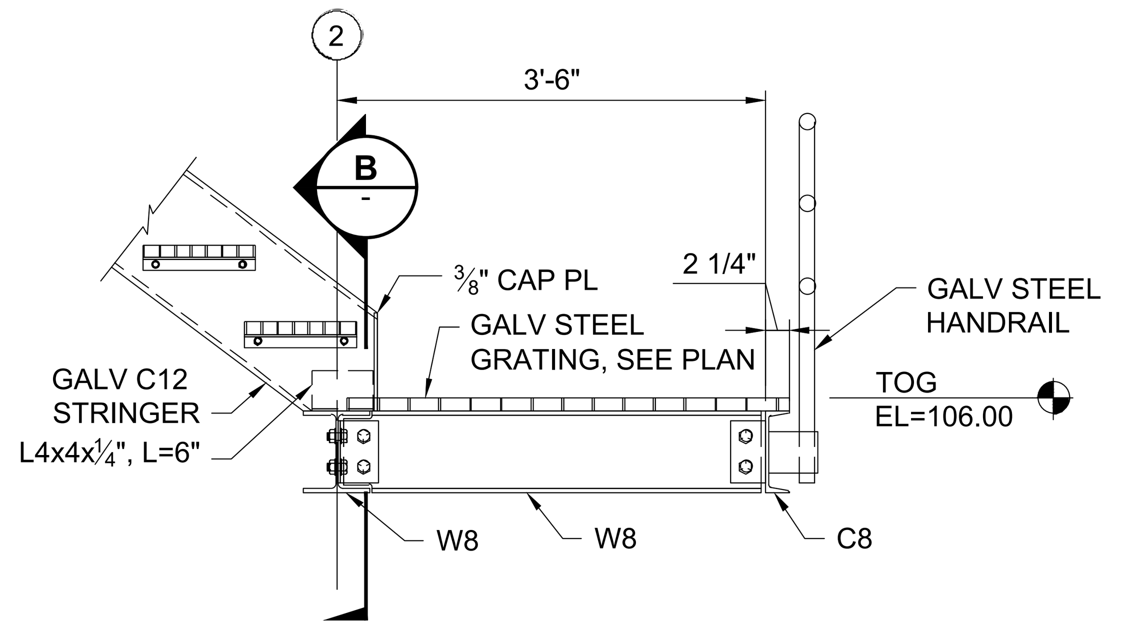
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

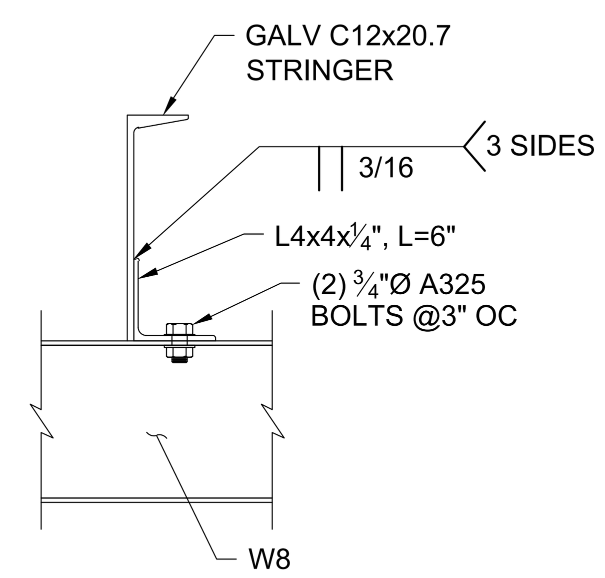
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS AND DETAILS

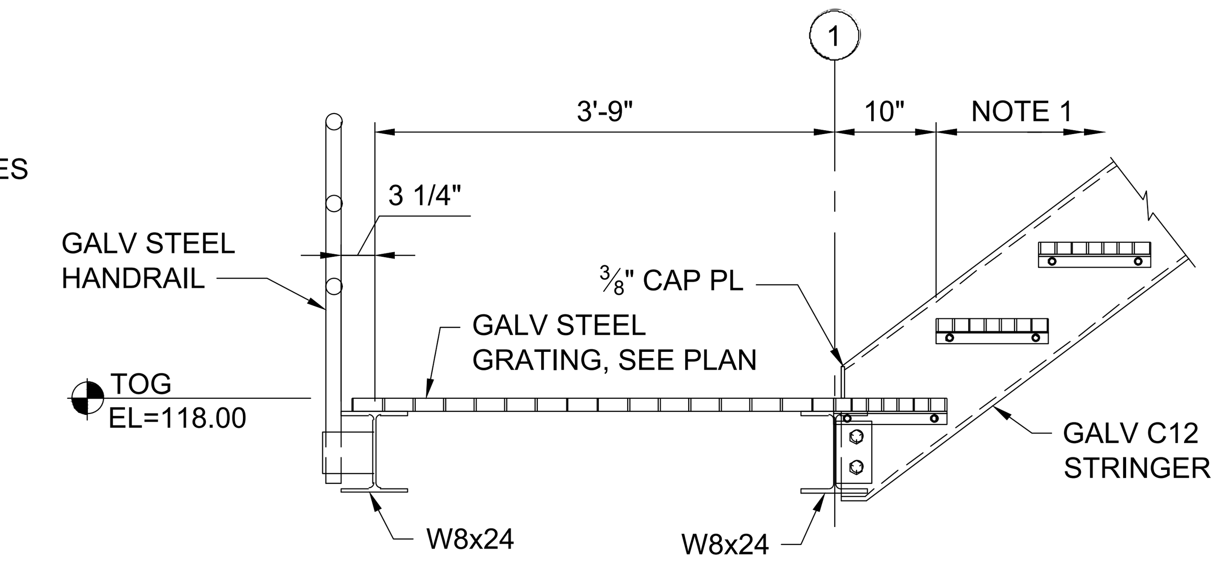
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	59 OF 176
DRAWING:	S-213



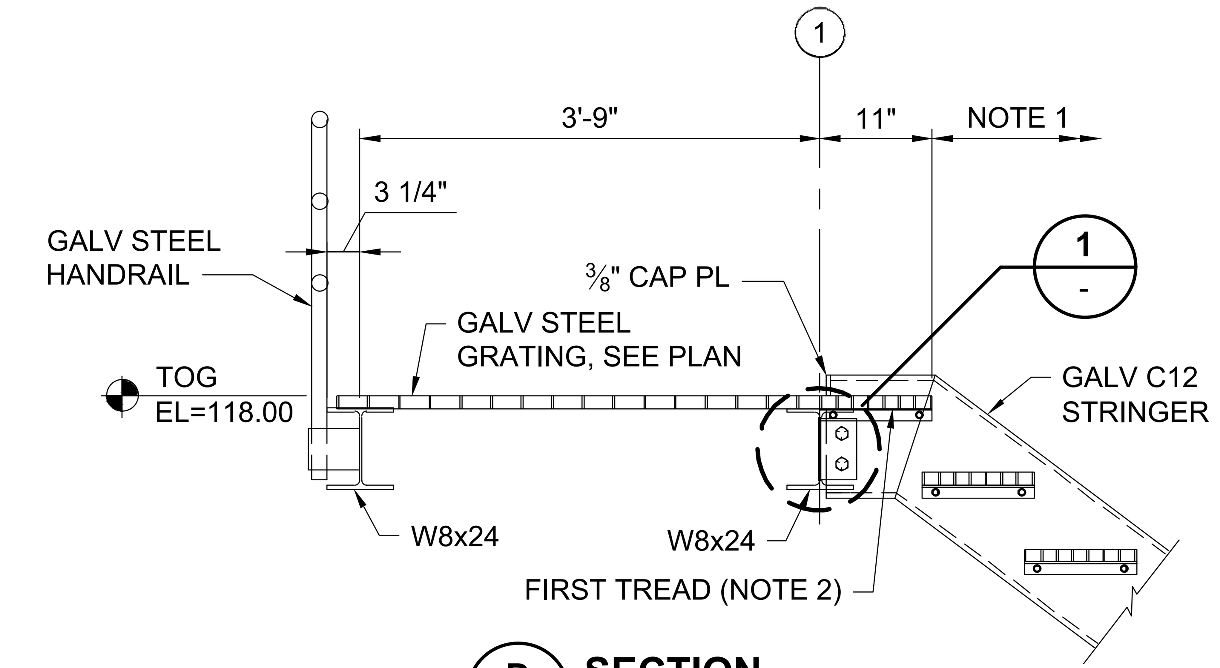
A S-207 **SECTION** SCALE: 3/4"=1'-0"



B - **SECTION** SCALE: 1 1/2"=1'-0"



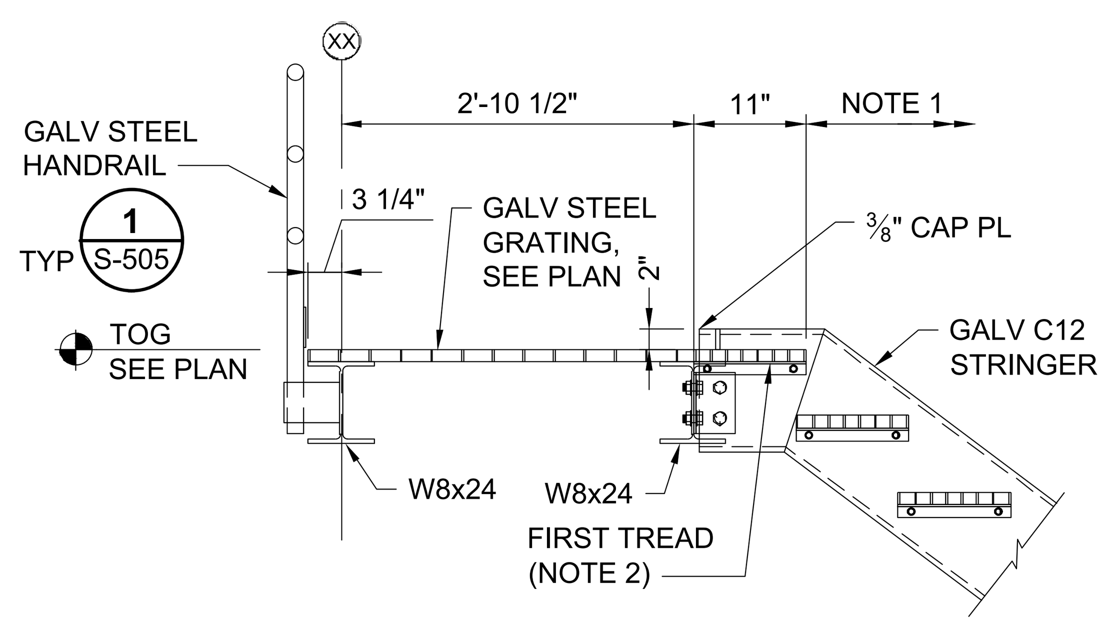
C S-207 **SECTION** SCALE: 3/4"=1'-0"



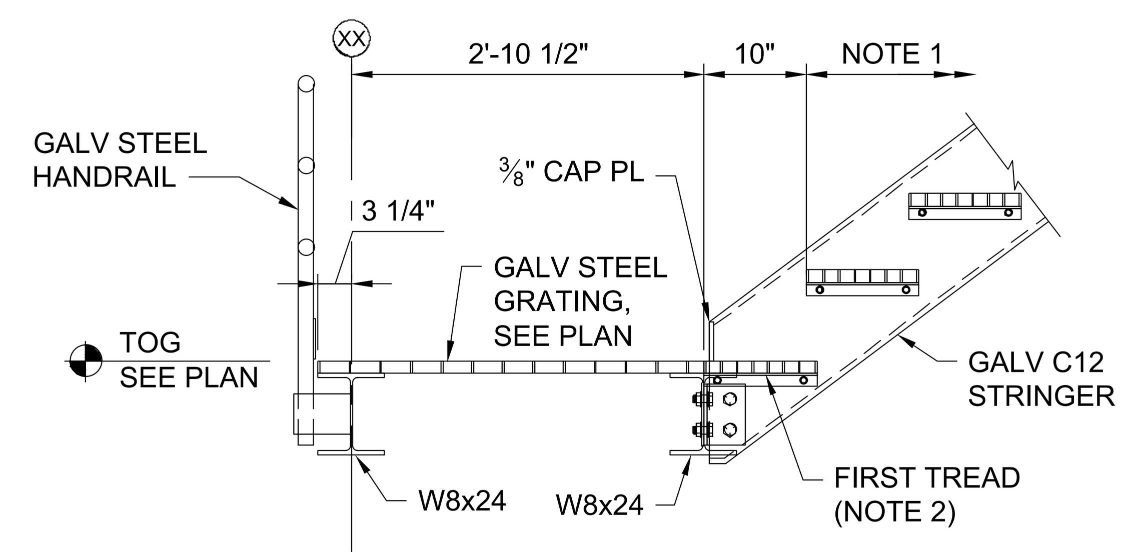
D S-207 **SECTION** SCALE: 3/4"=1'-0"

NOTES:

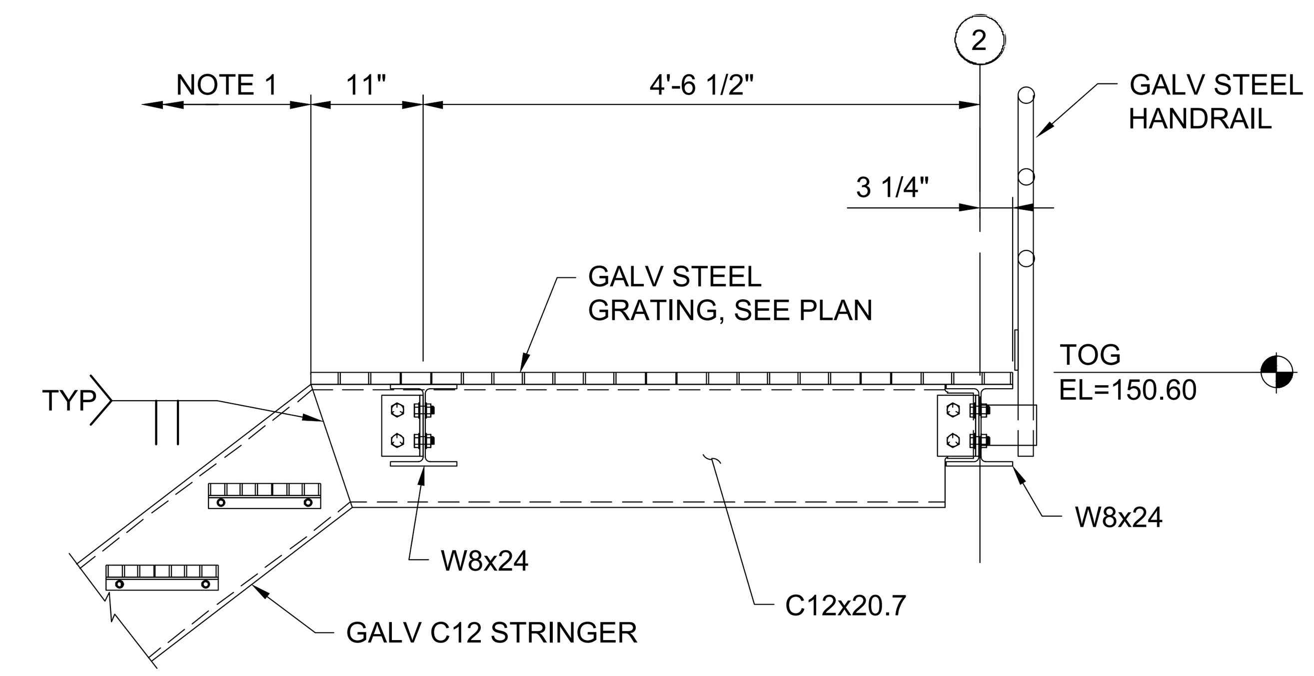
1. FOR TREAD SPACING, SEE STAIR SECTIONS A/S-206 B/S-206
2. FIRST TREAD SHALL BE AT SAME ELEVATION AS ADJACENT GRATING UNLESS OTHERWISE NOTED.



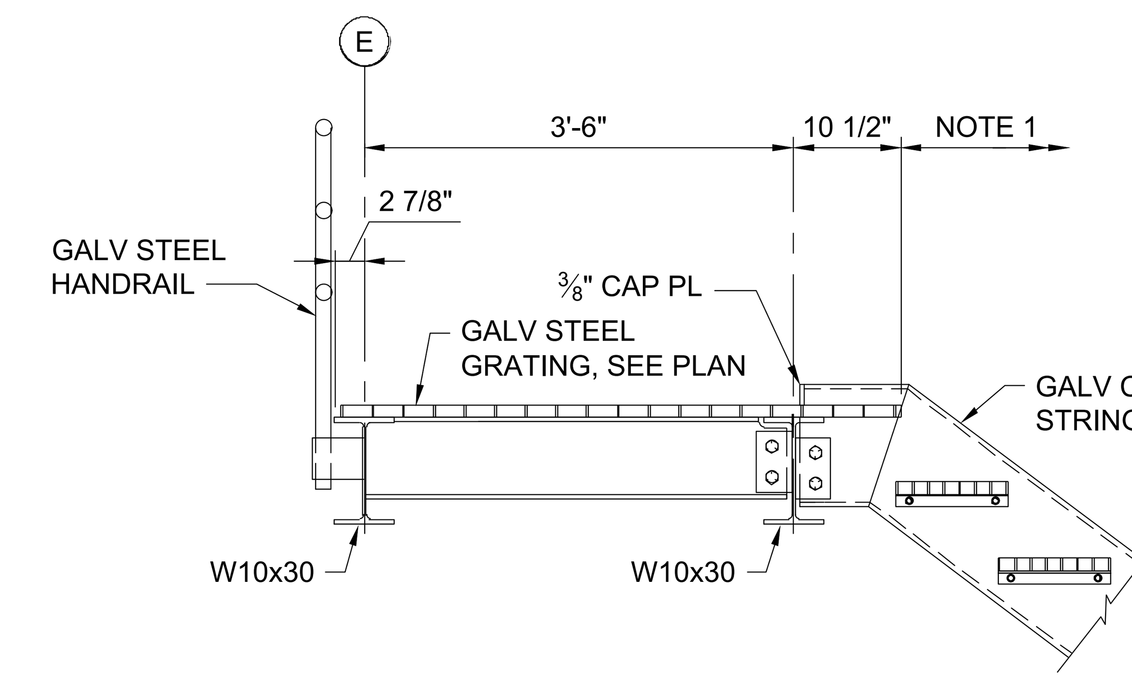
E S-207 **SECTION** SCALE: 3/4"=1'-0"
S-208



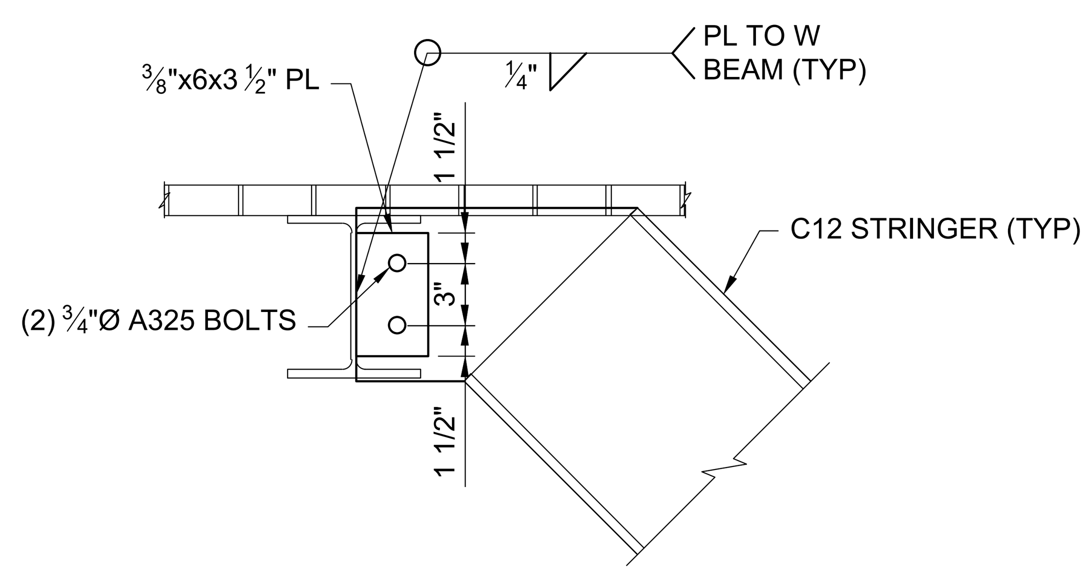
F S-207 **SECTION** SCALE: 3/4"=1'-0"
S-208



G S-208 **SECTION** SCALE: 3/4"=1'-0"



H S-207 **SECTION** SCALE: 3/4"=1'-0"



1 - **CONNECTION DETAIL** SCALE: 1-1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden rnss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-214.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

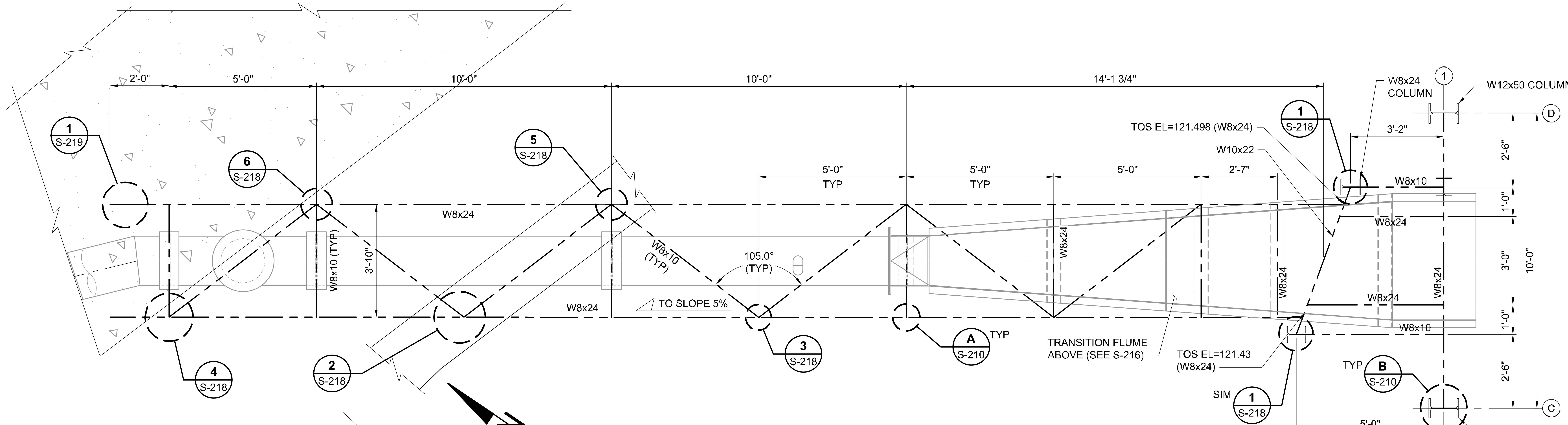
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

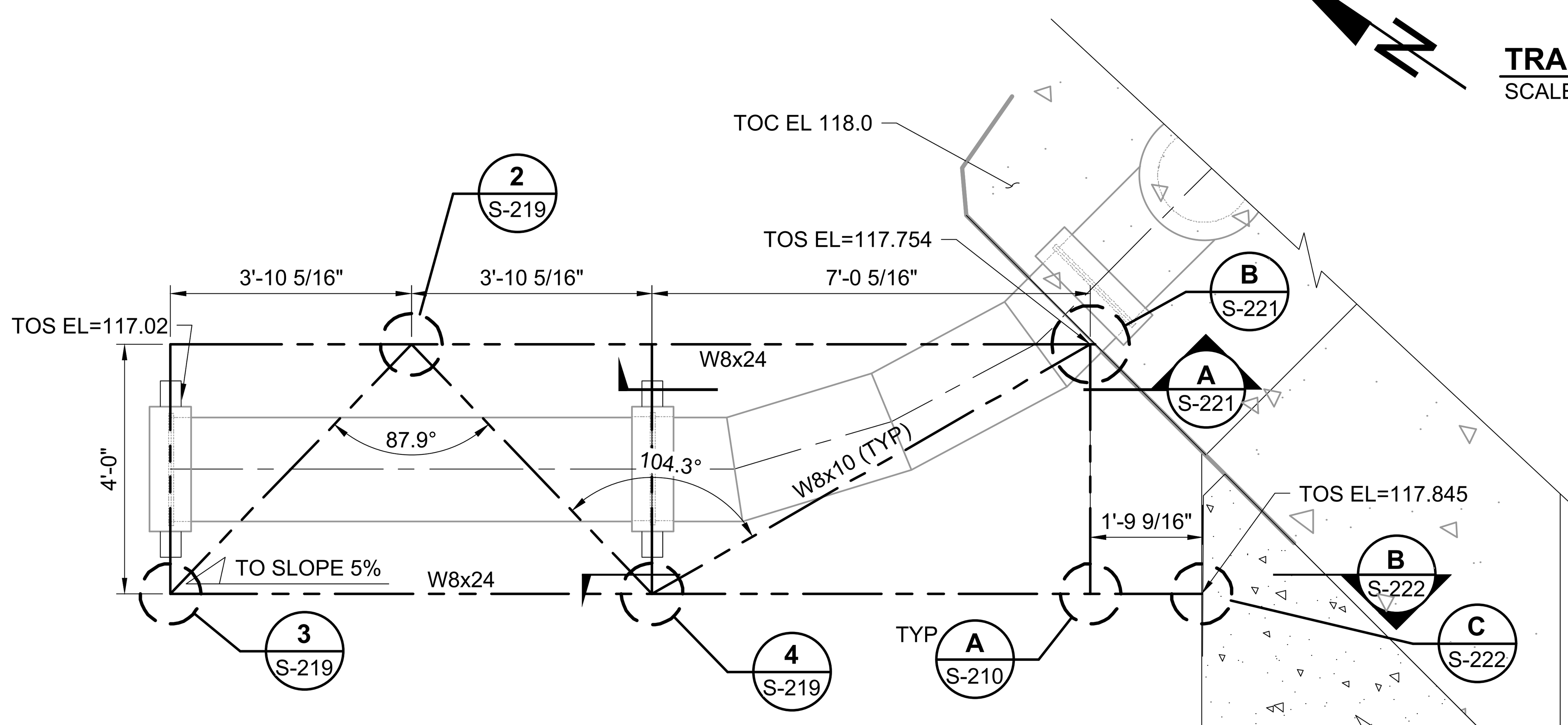
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STAIR SECTIONS AND DETAILS

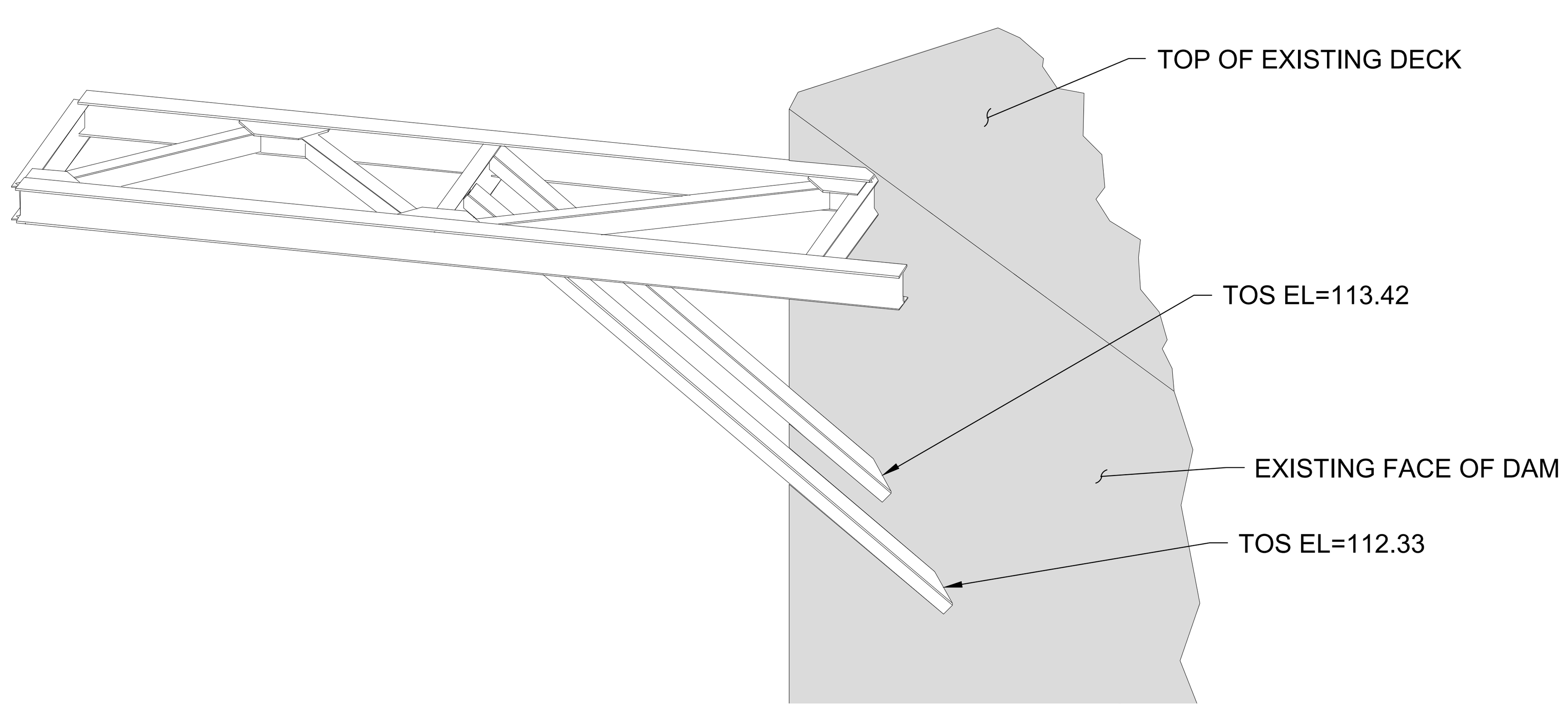
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	60 OF 176
DRAWING:	S-214



TRANSITION FLUME SUPPORT FRAME - PLAN AT TOS EL 121.42
SCALE: 1/2"=1'-0"



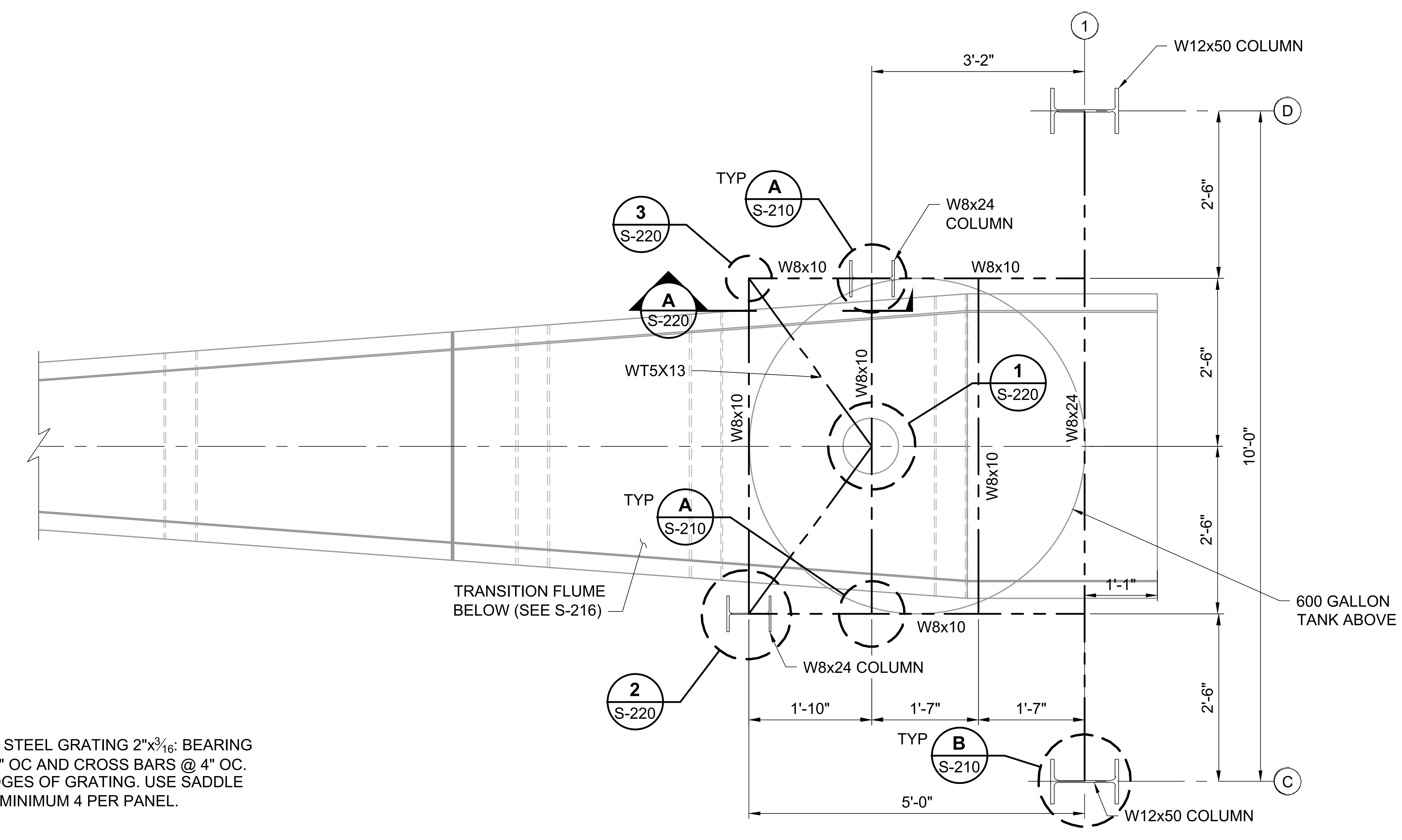
TRANSITION FLUME SUPPORT FRAME - PLAN AT TOS EL 118.00
SCALE: 1/2"=1'-0"



TRANSITION FLUME SUPPORT FRAME ISOMETRIC
SCALE: 3/8"=1'-0"

NOTE:

1. GALVANIZED STEEL GRATING 2"x3/16: BEARING BARS @ 1 3/16" OC AND CROSS BARS @ 4" OC. BAND ALL EDGES OF GRATING. USE SADDLE TYPE CLIPS, MINIMUM 4 PER PANEL.



TRANSITION FLUME SUPPORT FRAME - PLAN AT TOS EL 128.33 (TOG EL 128.50)
SCALE: 3/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

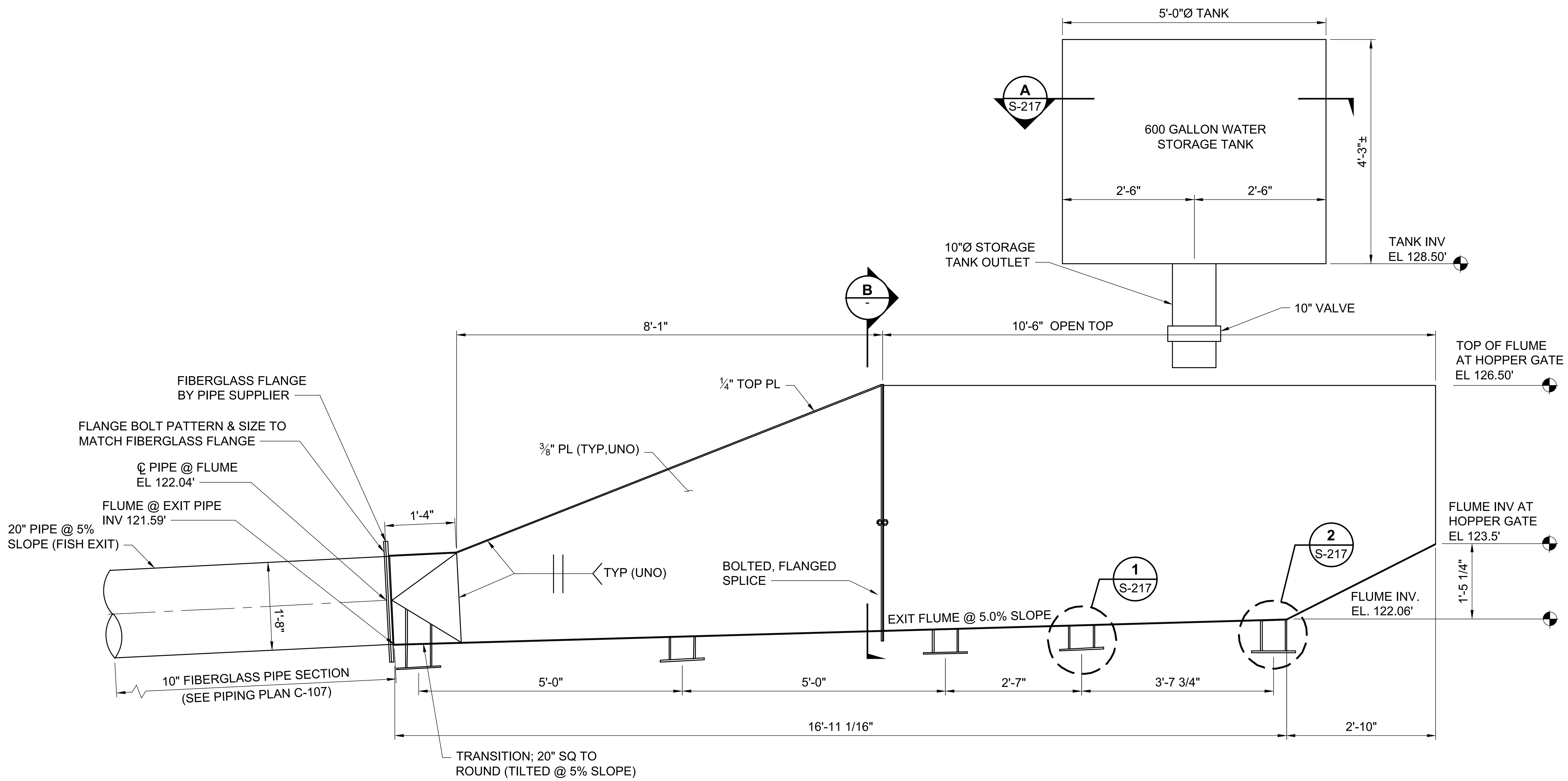
TRANSITION FLUME AND FISH EXIT PIPE FRAMING PLANS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 61 OF 176
DRAWING: S-215

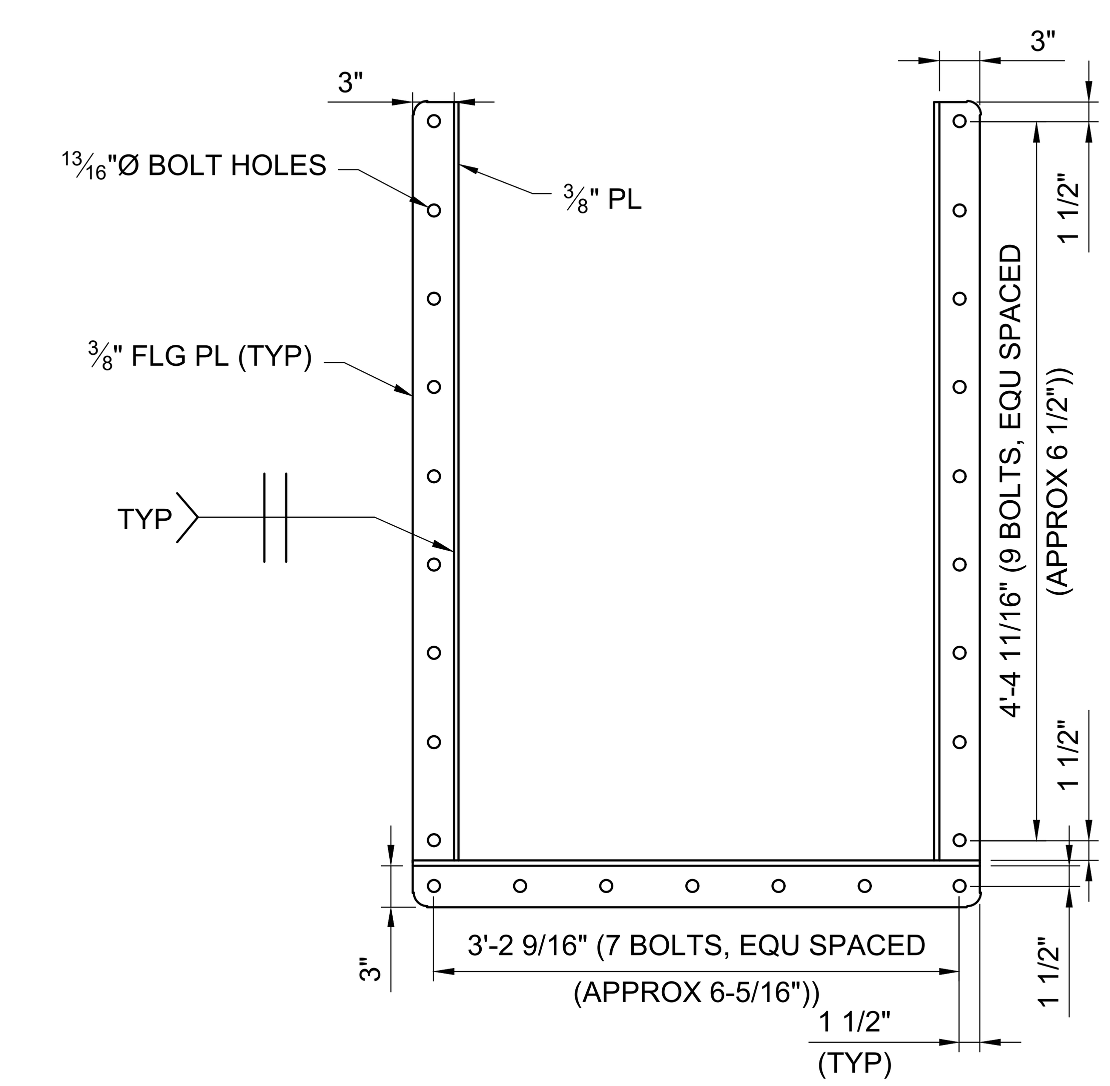
DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nsa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-215.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S1-SHWMT-FLUME C-SHWMT-XSP MAINE-PE-STAMP-MDG IMAGES:

NOTE:

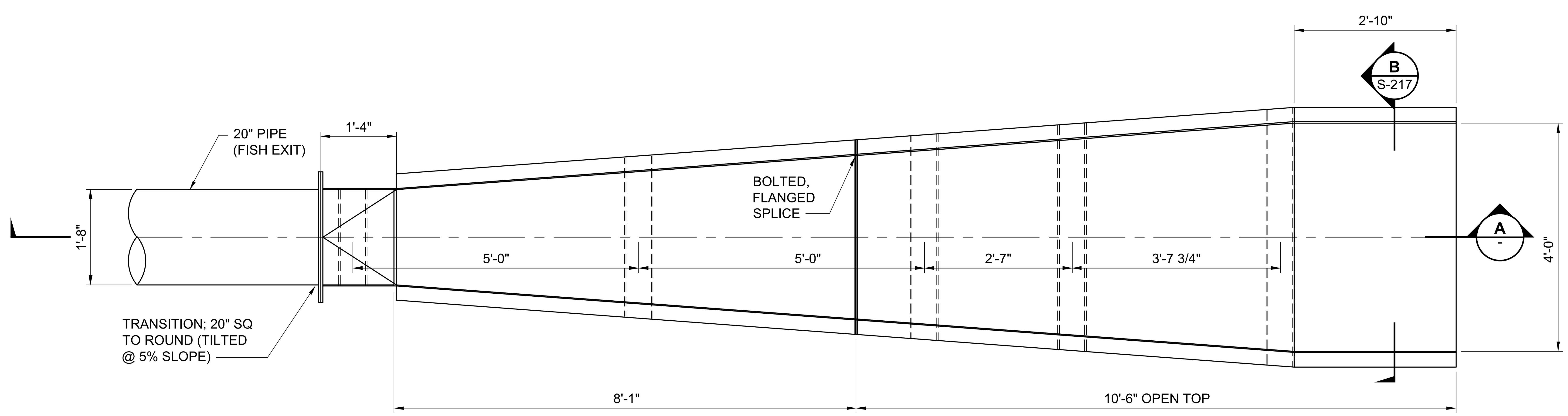
1. STEEL FRAME NOT SHOWN FOR CLARITY.



A - **FISH EXIT TRANSITION FLUME - ELEVATION**
SCALE: 3/4"=1'-0"



B - **BOLTED FLANGE DETAIL (N&F)**
SCALE: 1"=1'-0"



FISH EXIT TRANSITION FLUME - PLAN
SCALE: 3/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

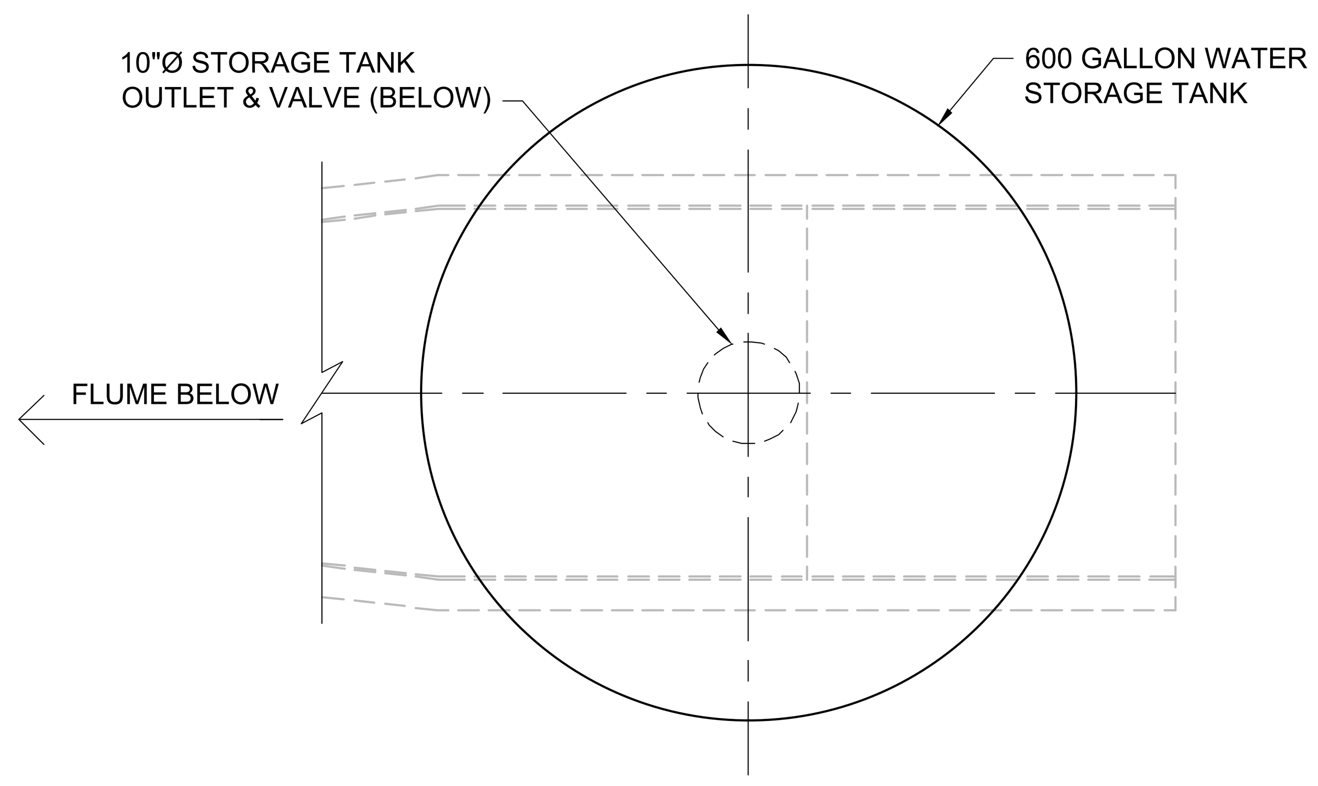
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

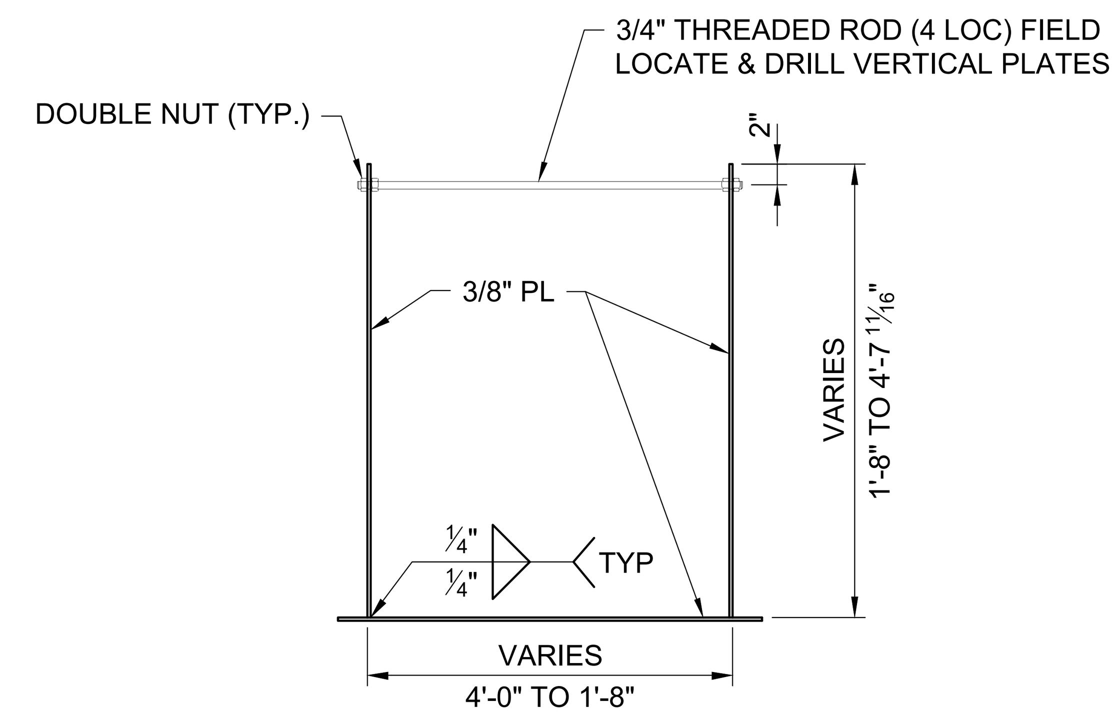
TRANSITION FLUME PLAN & SECTIONS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	62 OF 176
DRAWING:	S-216

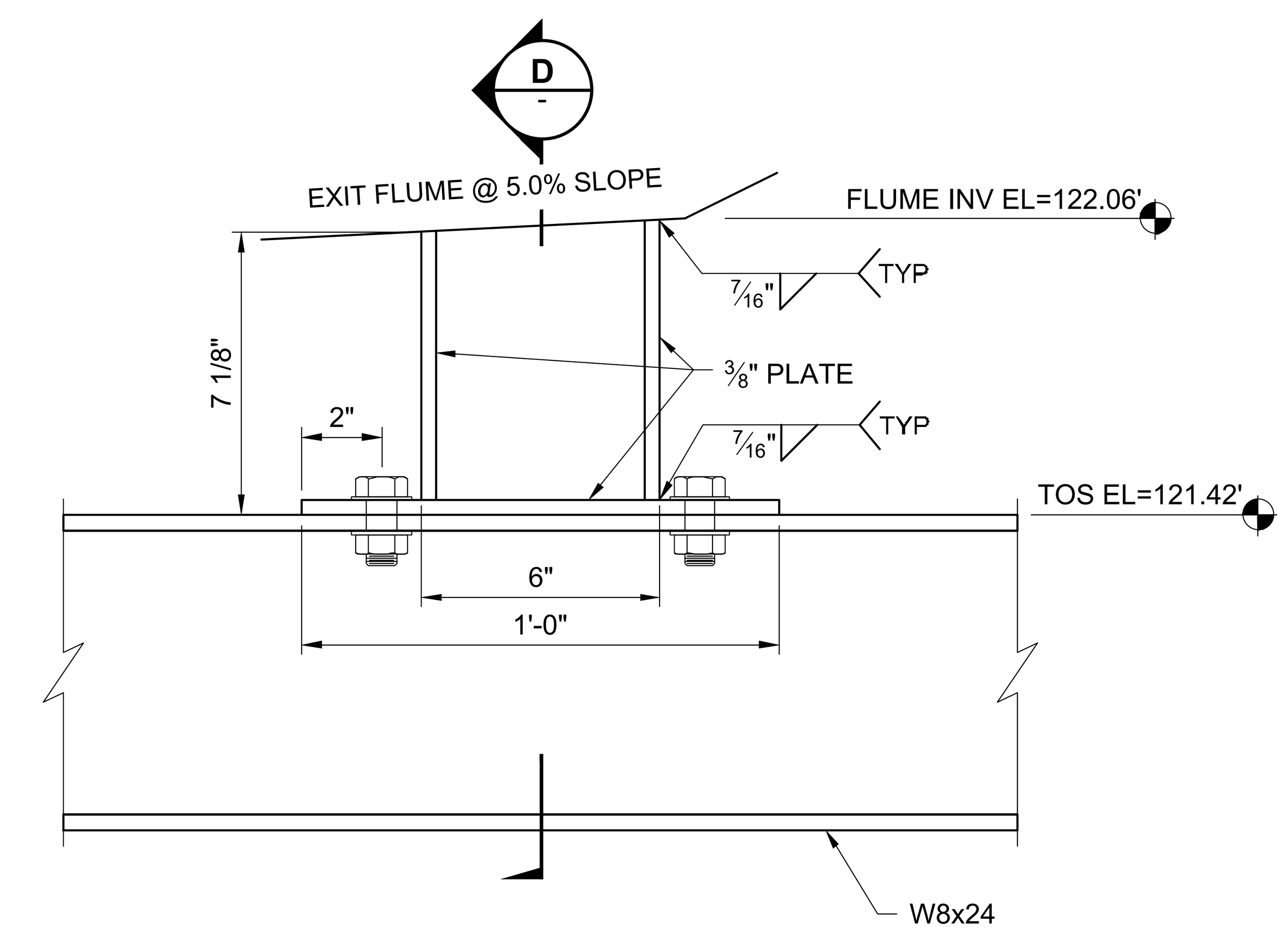
DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden nas and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-216.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES



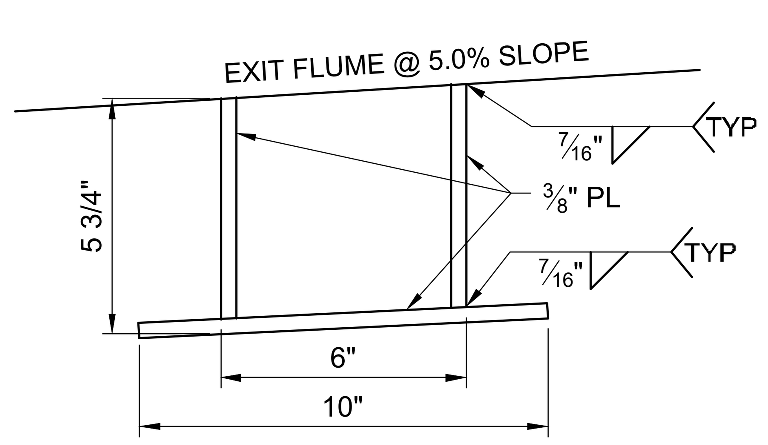
A S-216 **STORAGE TANK PLAN**
SCALE: 3/4"=1'-0"

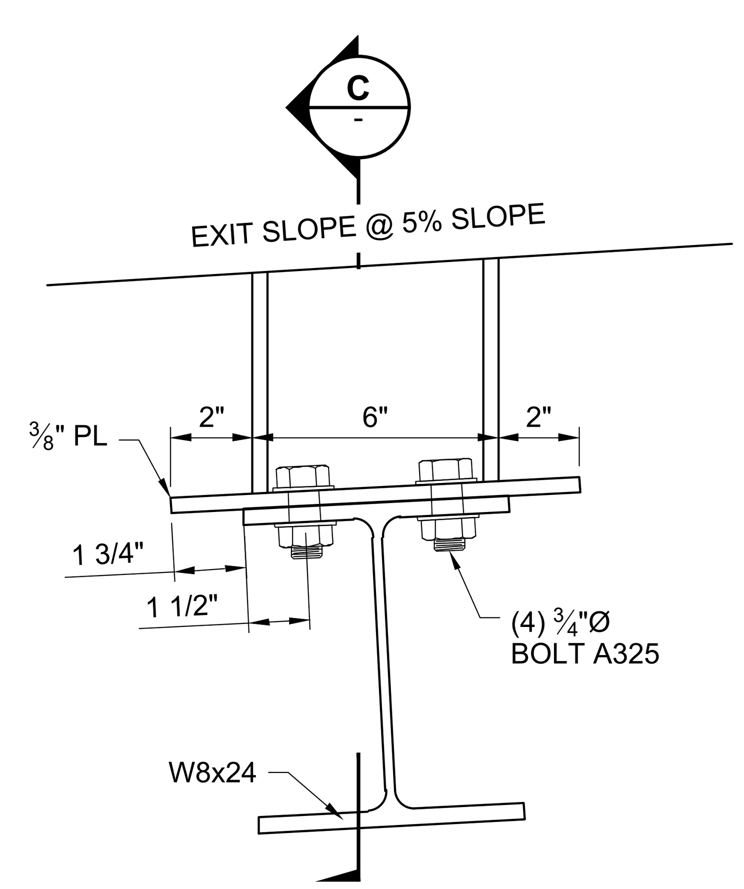


B S-216 **FISH EXIT TRANSITION FLUME TYPICAL SECTION**
SCALE: 3/4"=1'-0"

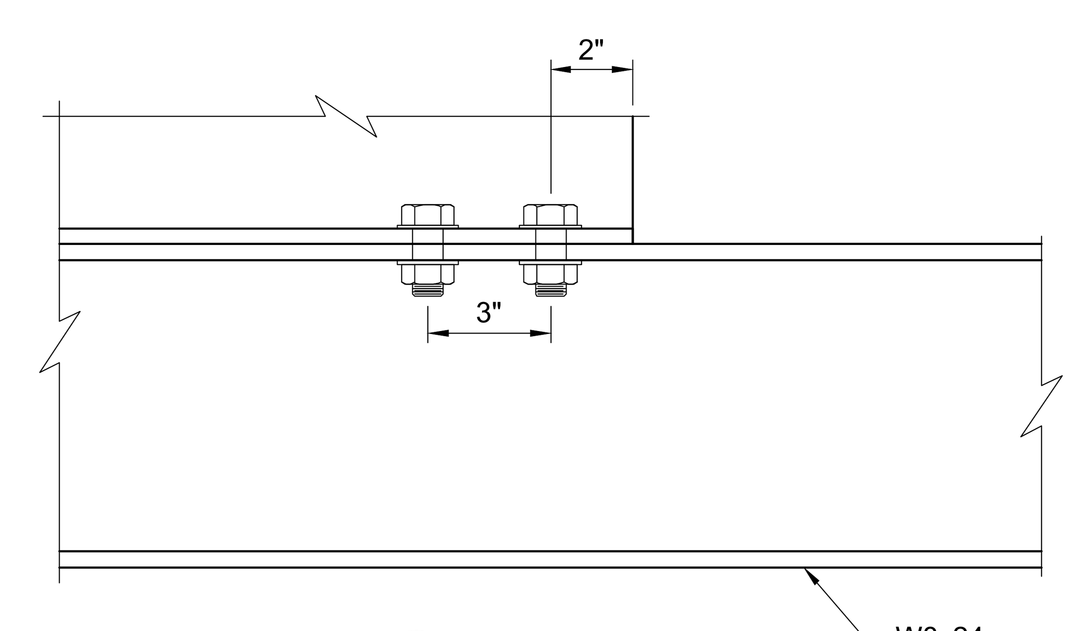


2 S-216 **TRANSITION FLUME FOOT DETAIL AND CONNECTION**
SCALE: 3"=1'-0"

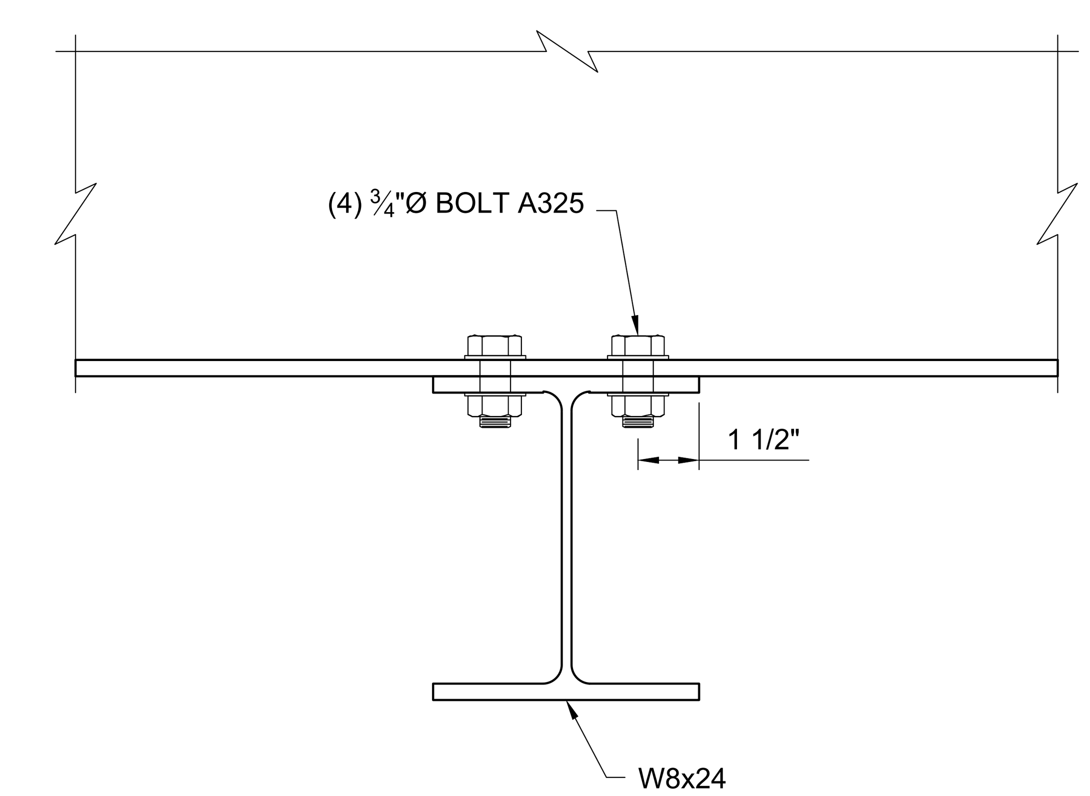




1 S-216 **TRANSITION FLUME FOOT DETAIL AND CONNECTION**
SCALE: 3"=1'-0"



C - **SECTION**
SCALE: 3"=1'-0"



D - **SECTION**
SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	63 OF 176
DRAWING:	S-217

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden ress and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-217.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

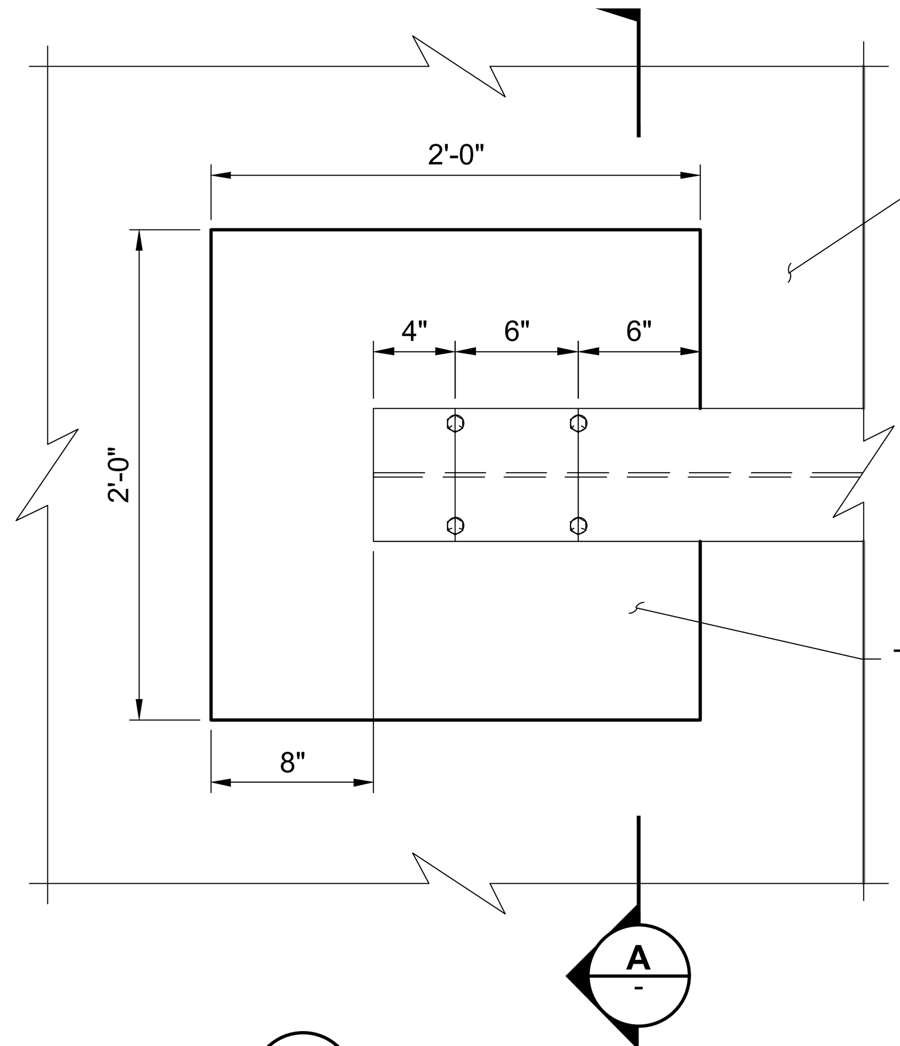
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

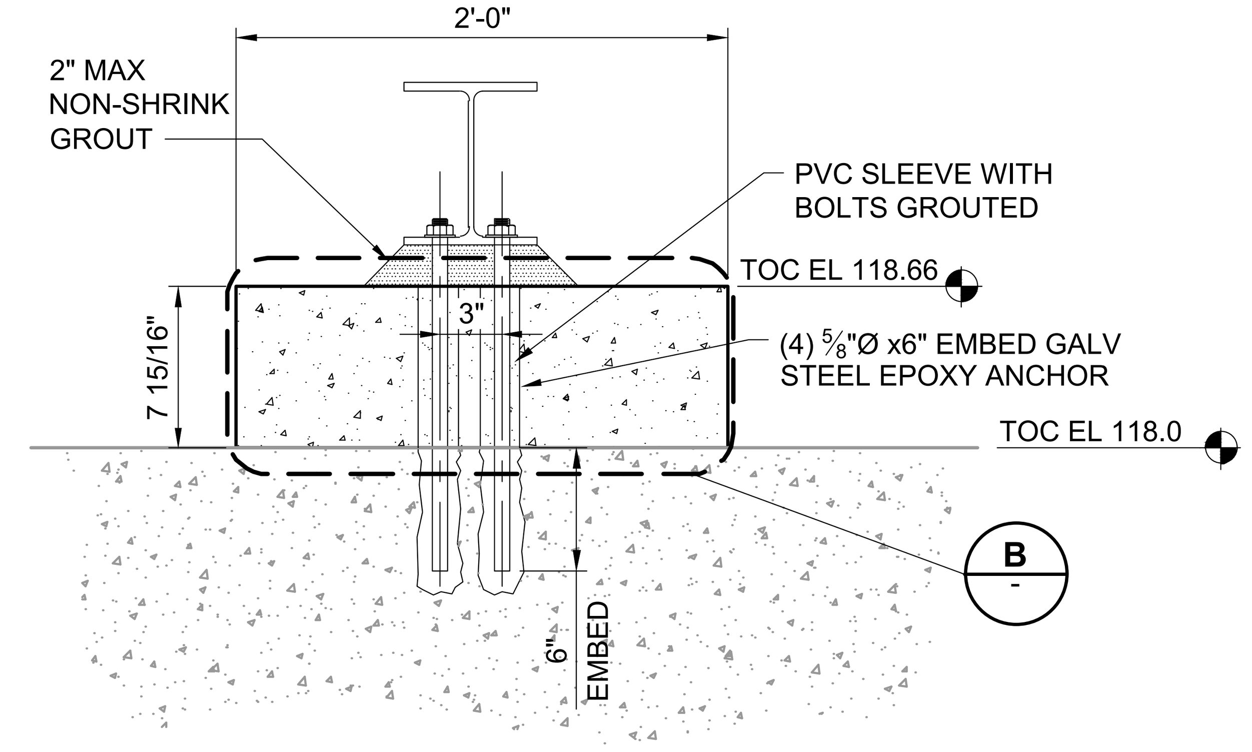
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	64 OF 176
DRAWING:	S-218



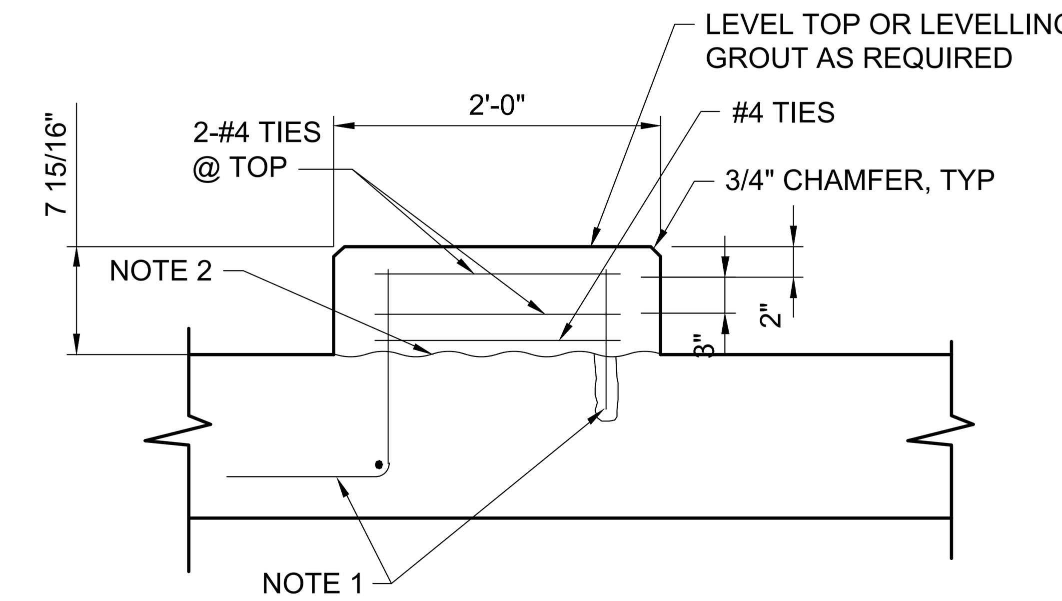
1 DETAIL
S-215 SCALE: 1 1/2"=1'-0"



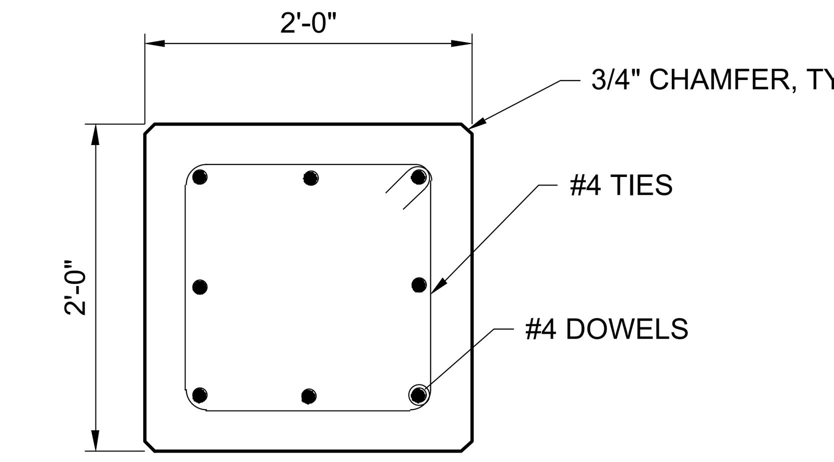
A SECTION
SCALE: 1 1/2"=1'-0"

NOTES:

1. AT NEW CONCRETE FLOOR: #4 x — @ 12" OC (MINIMUM 4 DOWELS PER SUPPORT). AT EXISTING CONCRETE FLOOR: #4 DRILL & EPOXY DOWELS @ 12" OC (TYP, UNO) W/ 4" EMBED (MINIMUM 4 DOWELS PER SUPPORT).
2. ROUGHEN CONCRETE TO ¼" AMPLITUDE & APPLY BONDING AGENT.

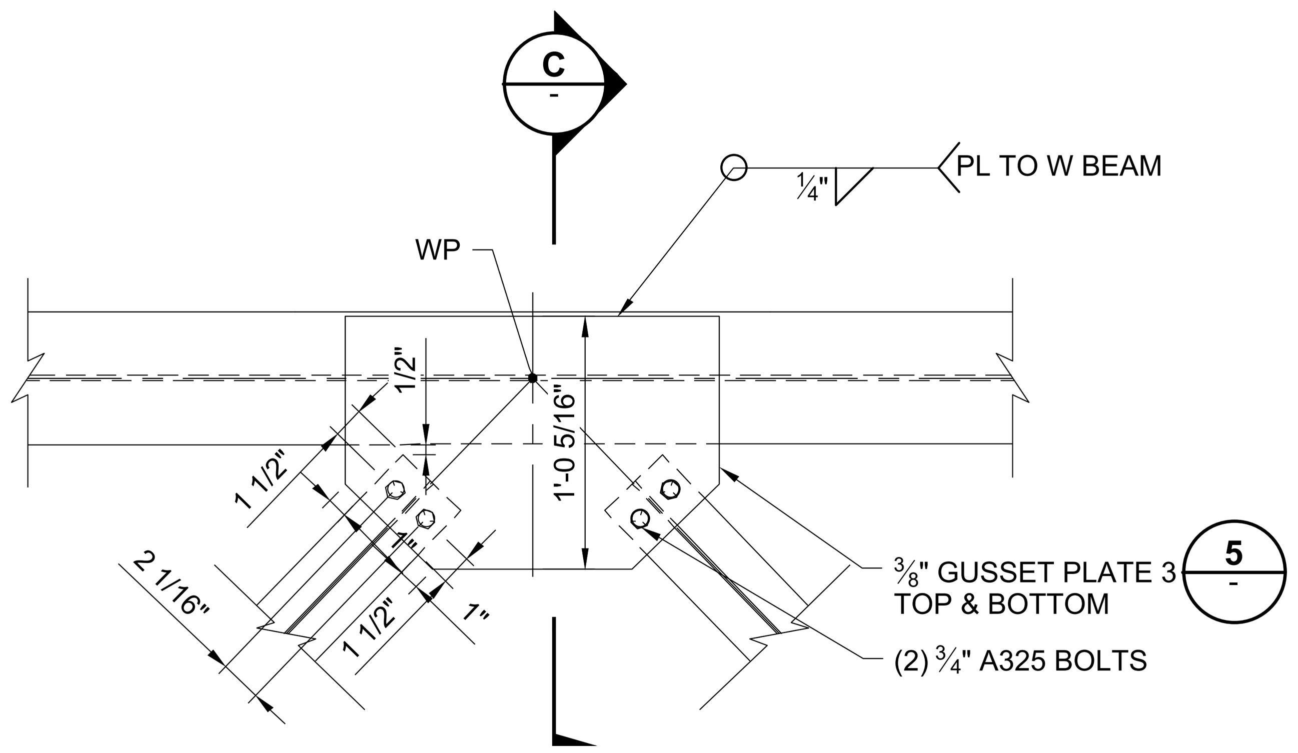


SECTION

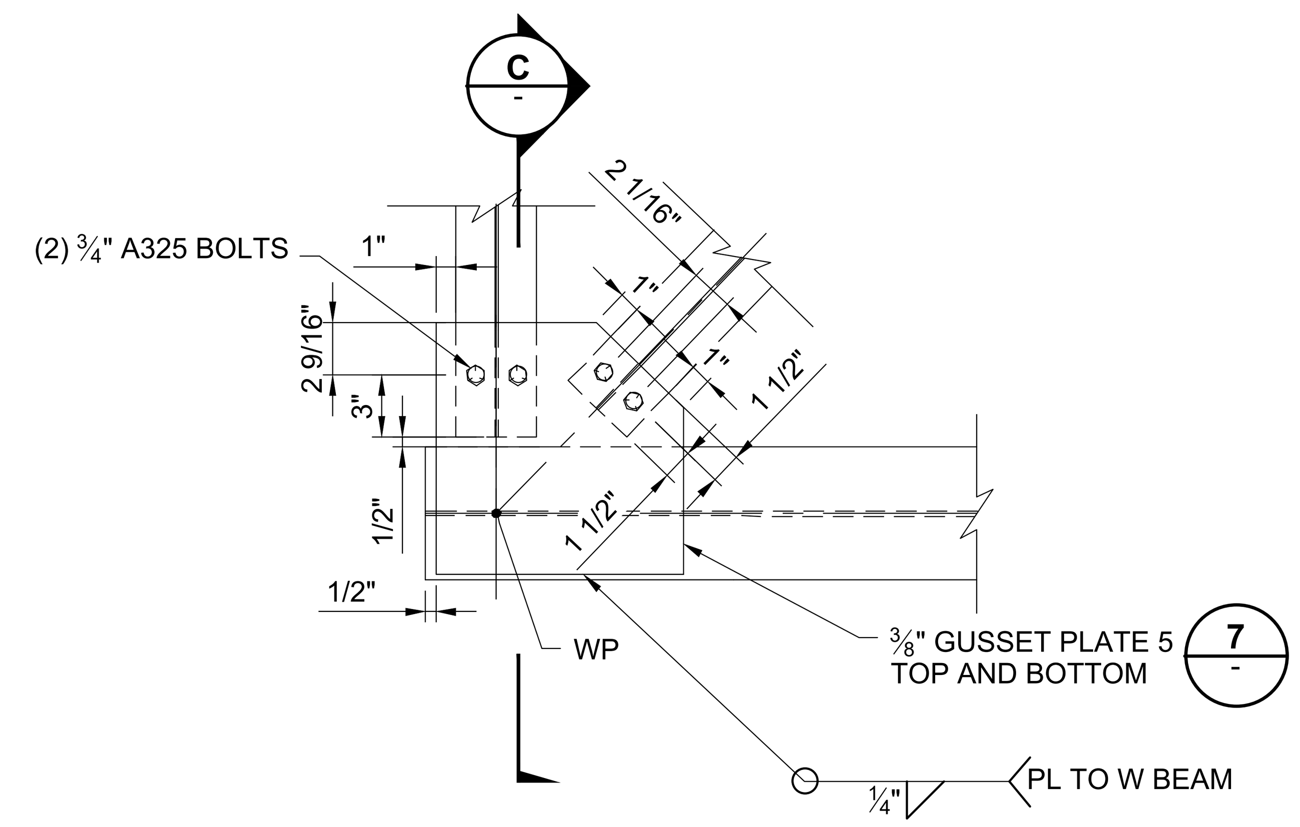


PLAN

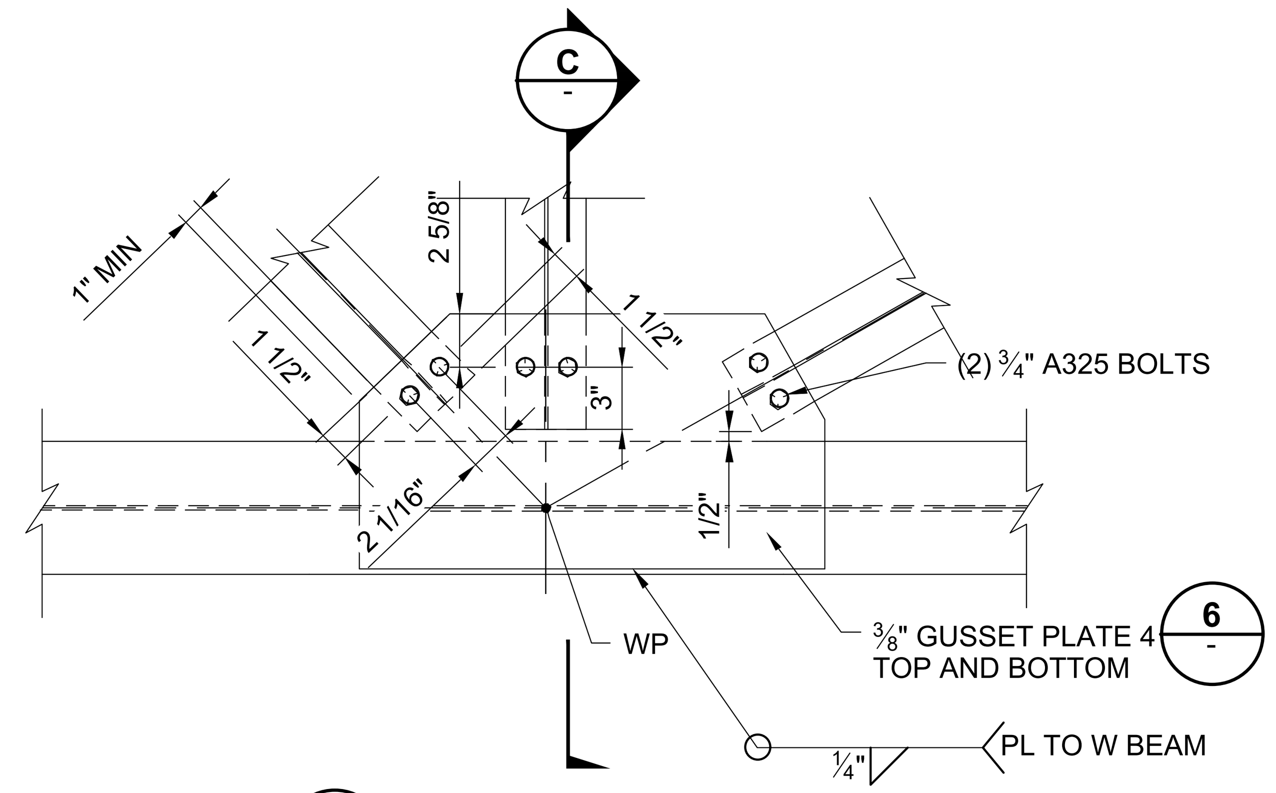
B DETAIL
SCALE: 1"=1'-0"



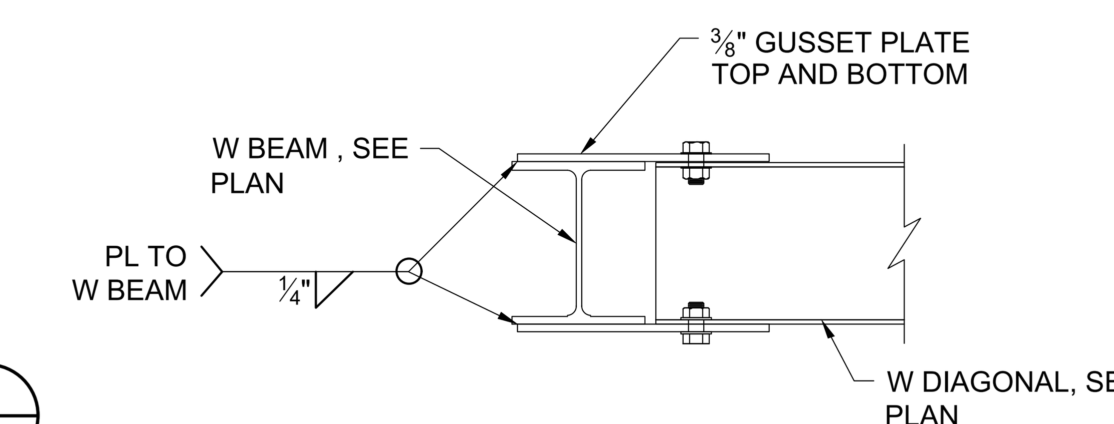
2 DETAIL
S-215 SCALE: 1 1/2"=1'-0"



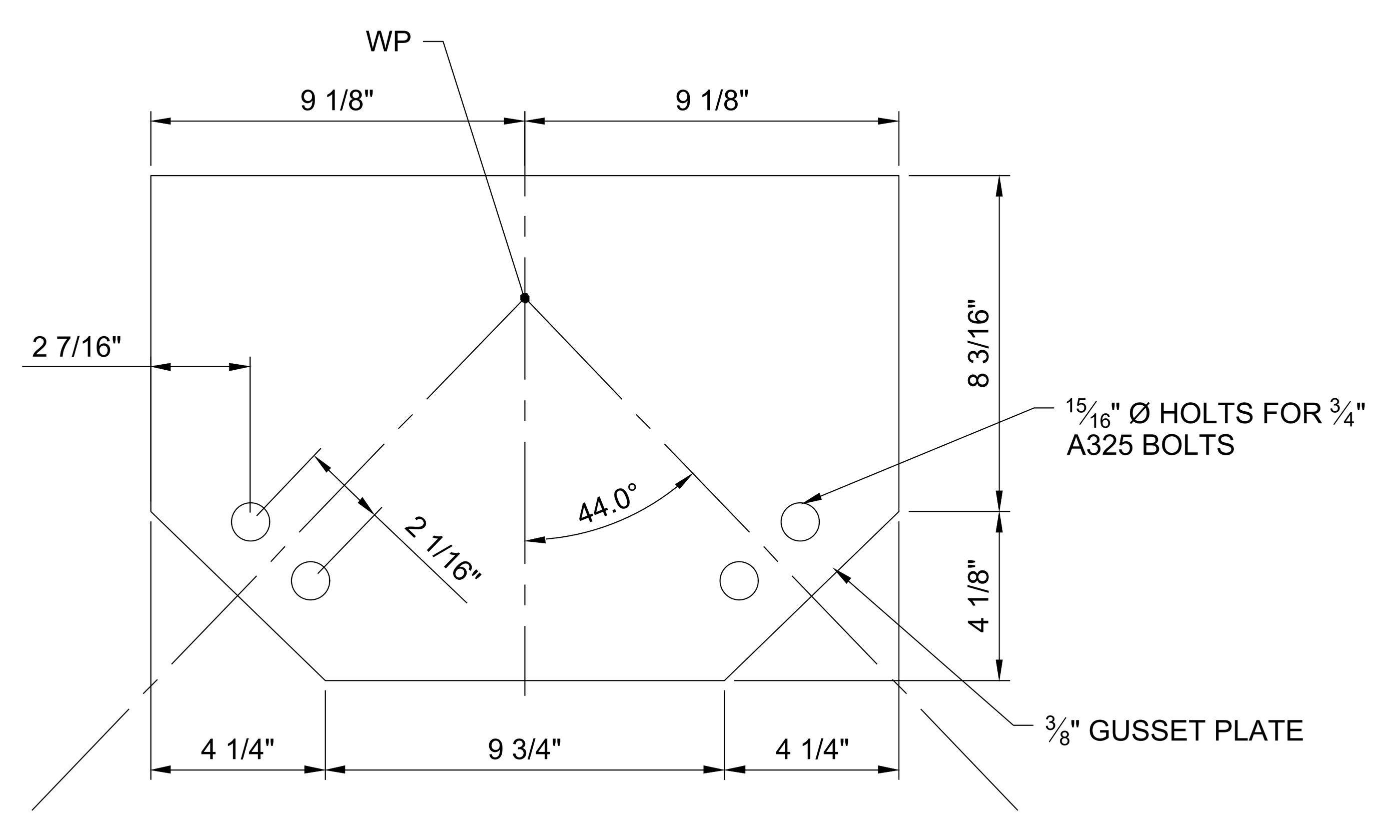
3 DETAIL
S-215 SCALE: 1 1/2"=1'-0"



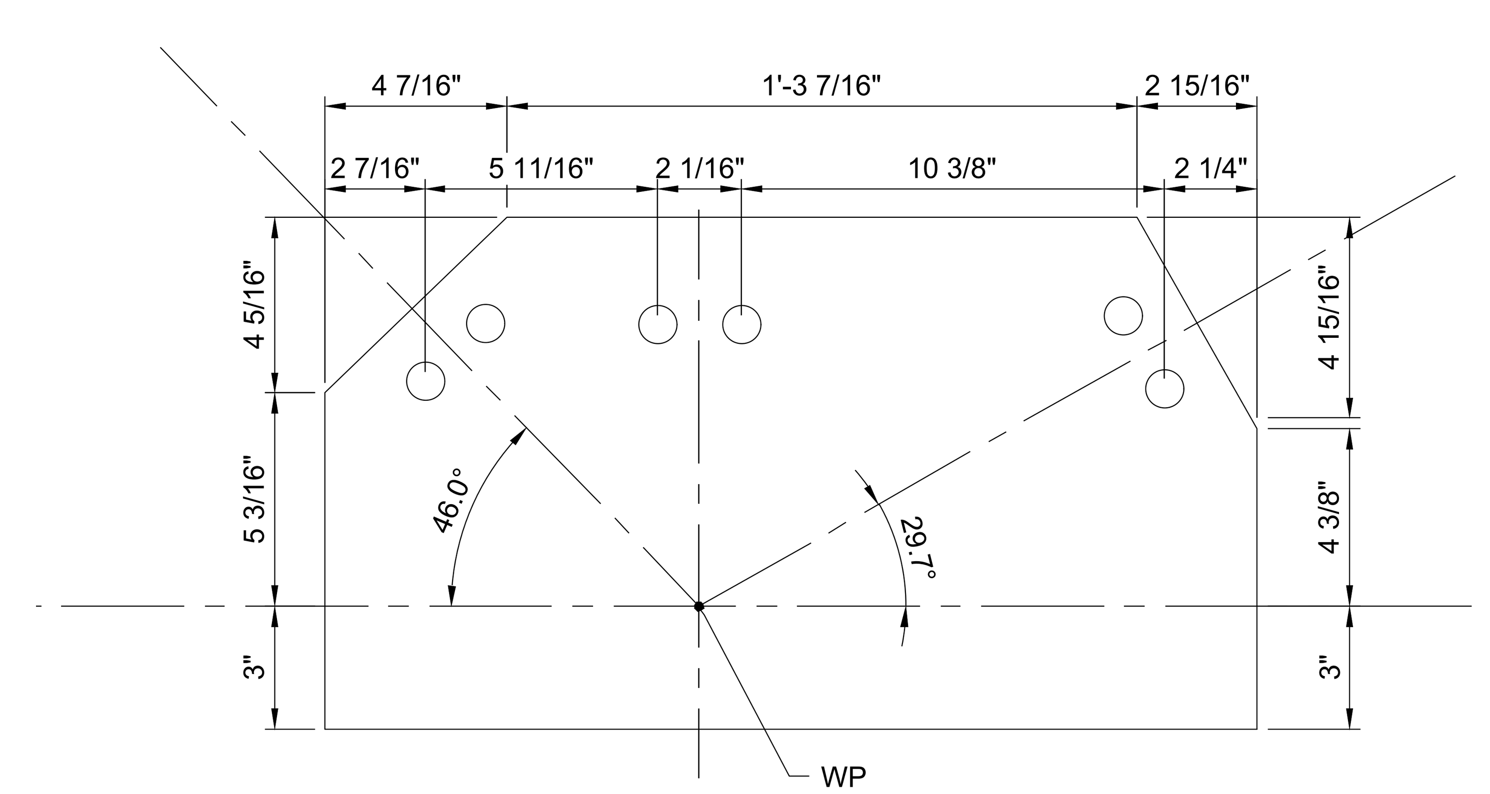
4 DETAIL
SCALE: 1 1/2"=1'-0"



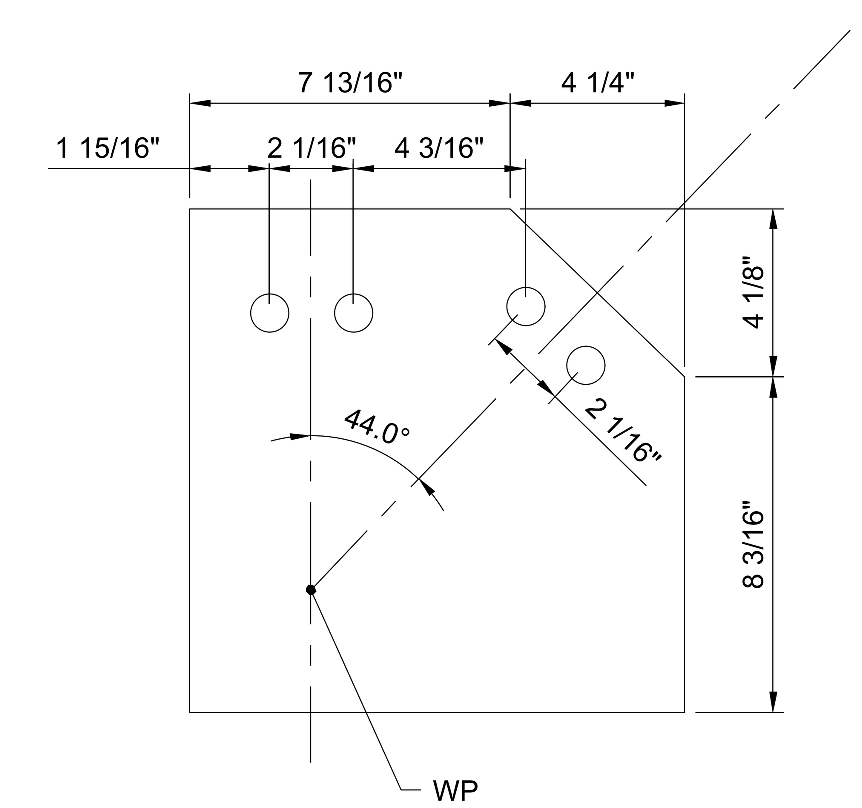
C SECTION
SCALE: 1 1/2"=1'-0"



5 GUSSET PLATE 3 DETAIL
SCALE: 3"=1'-0"



6 GUSSET PLATE 4 DETAIL
SCALE: 3"=1'-0"



7 GUSSET PLATE 5 DETAIL
SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

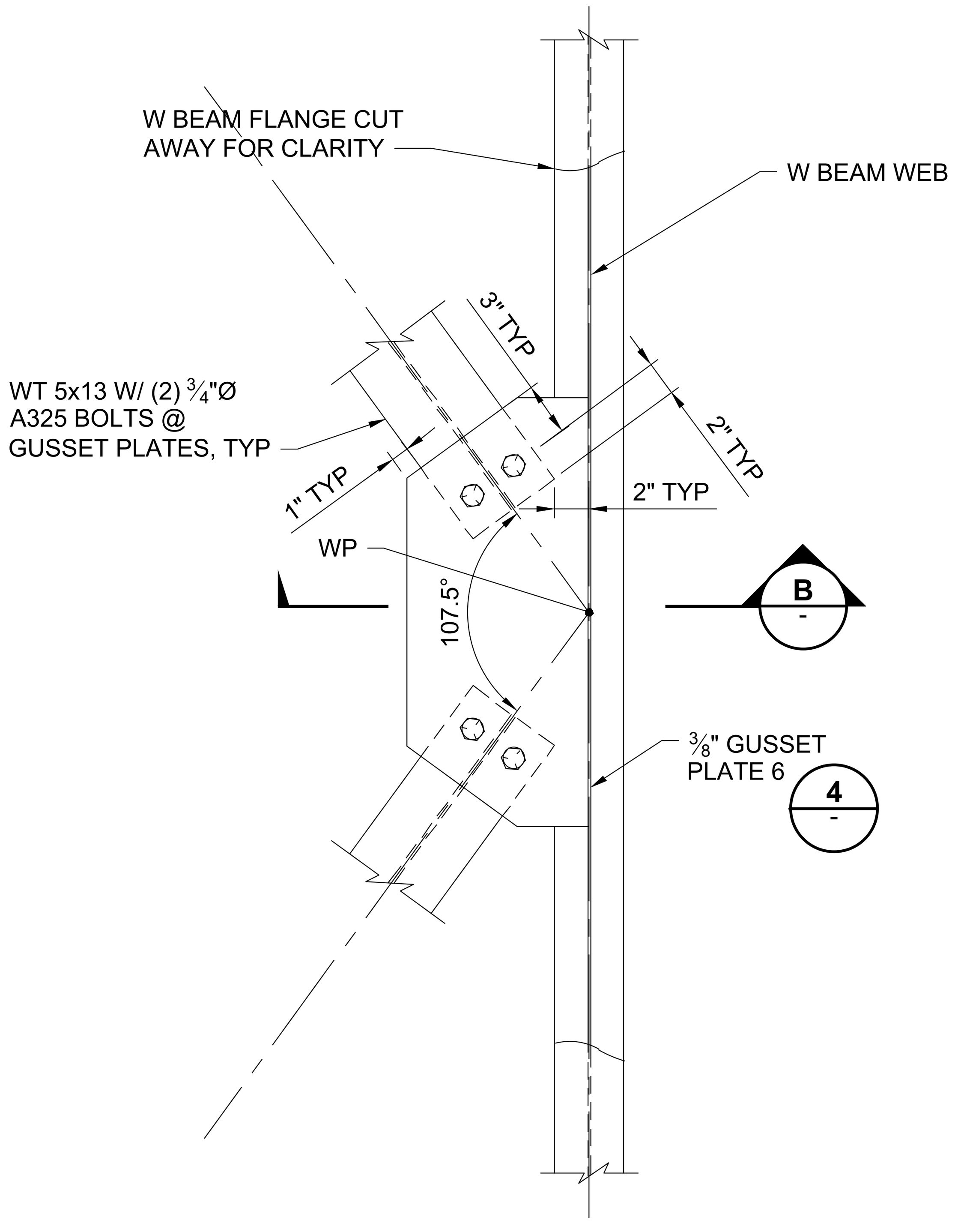
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

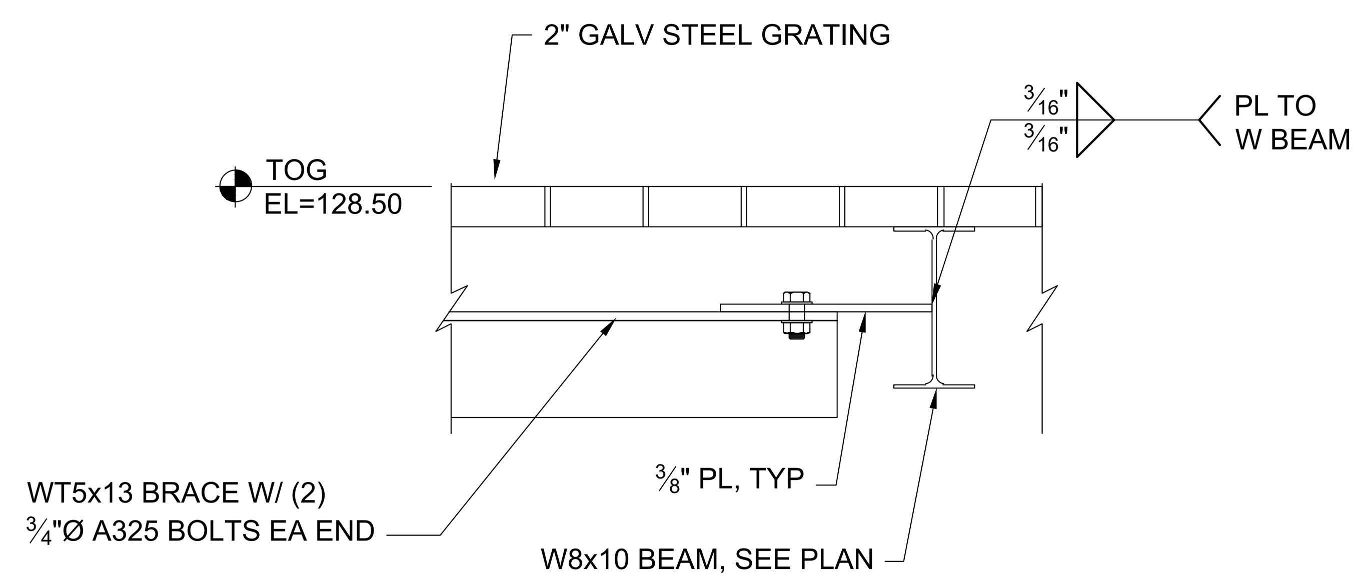
TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 65 OF 176
DRAWING: S-219

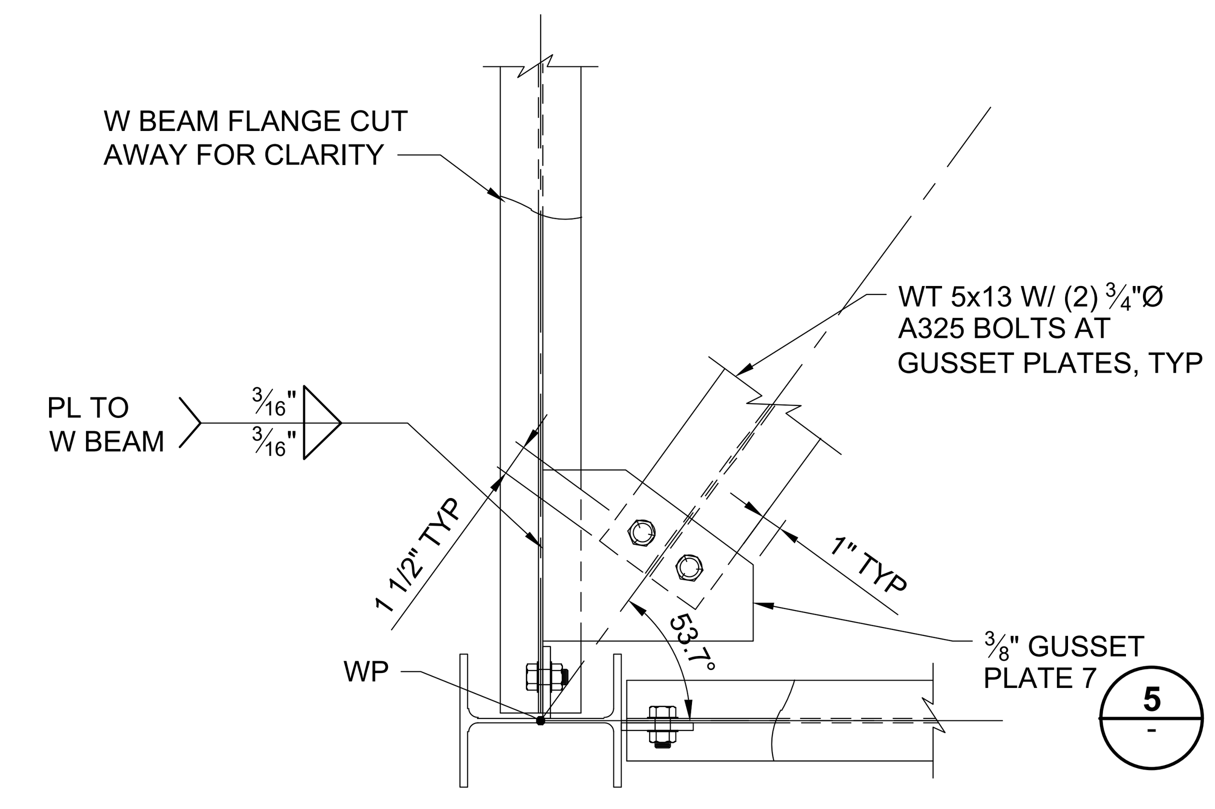
DATE: Dec 13, 2019 2:35pm USER: Agrogan



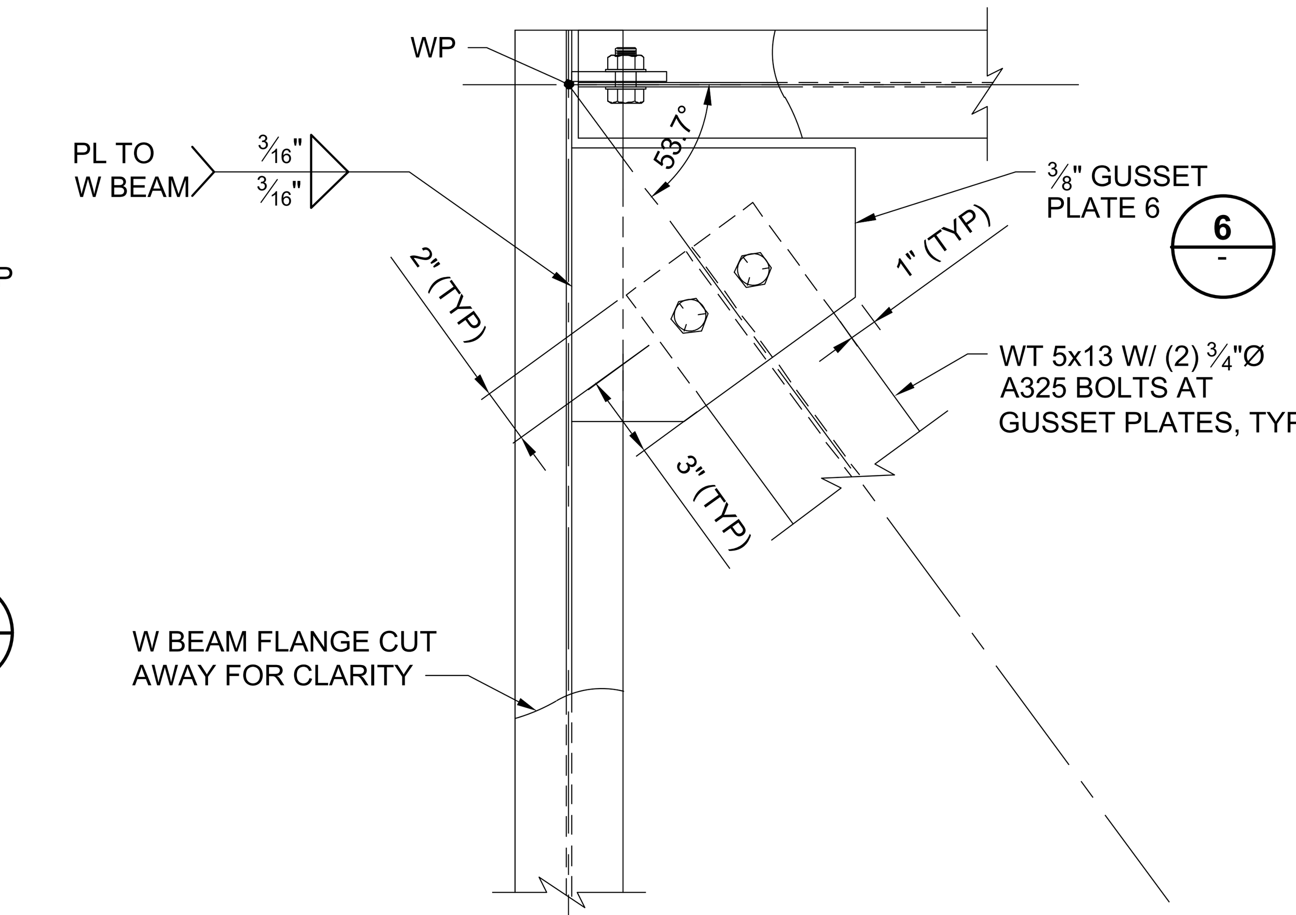
1 PLAN
S-215
SCALE: 1"=1'-0"



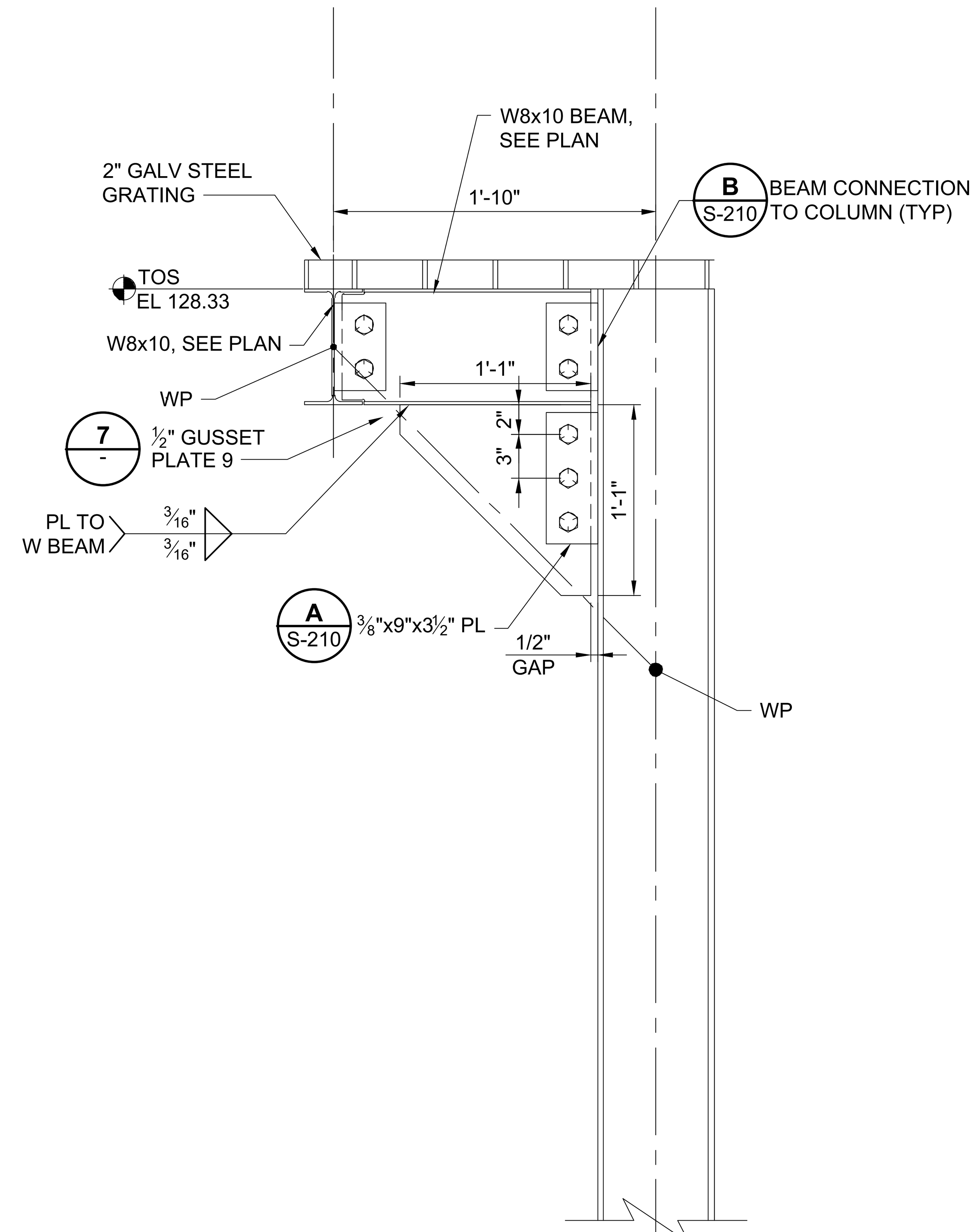
B SECTION
-
SCALE: 1"=1'-0"



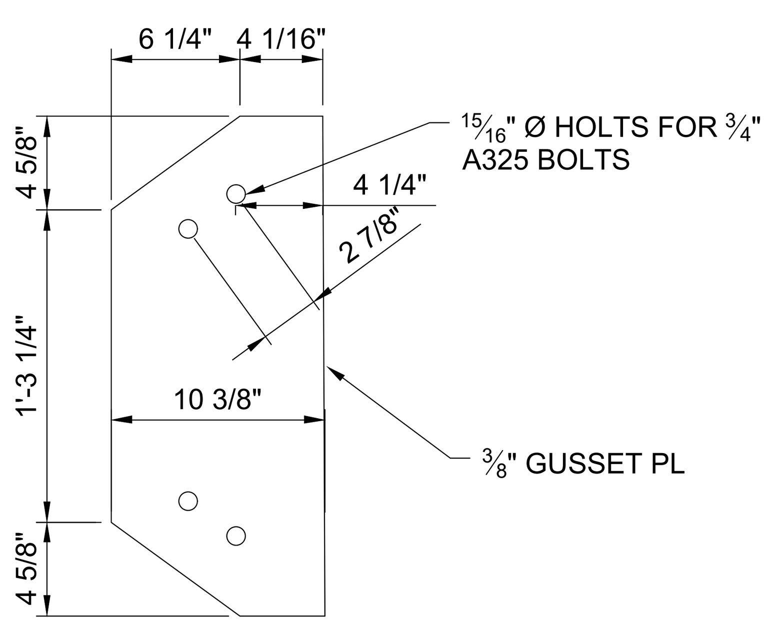
2 PLAN
S-215
SCALE: 1"=1'-0"



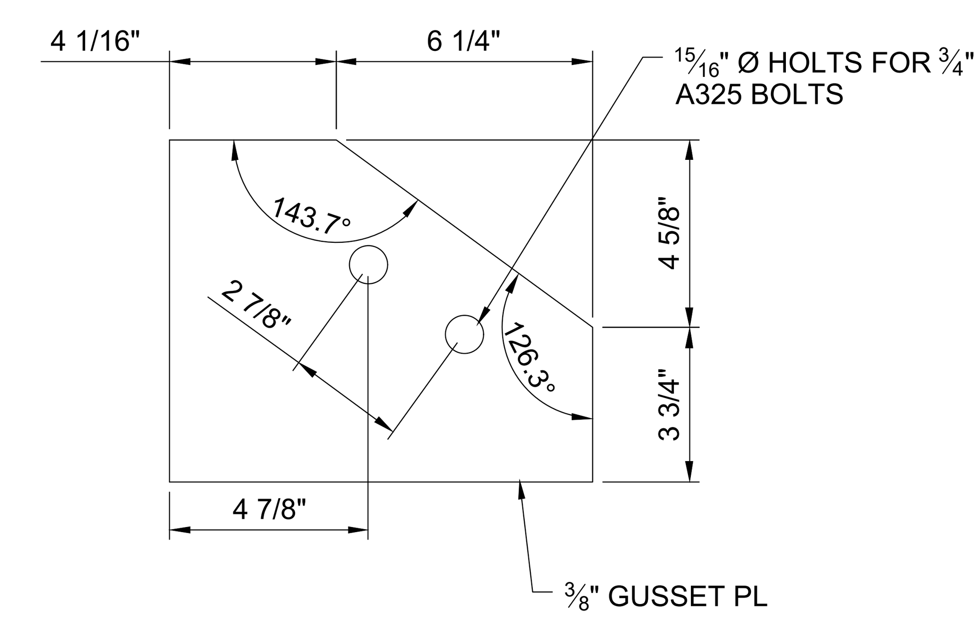
3 PLAN
S-215
SCALE: 2"=1'-0"



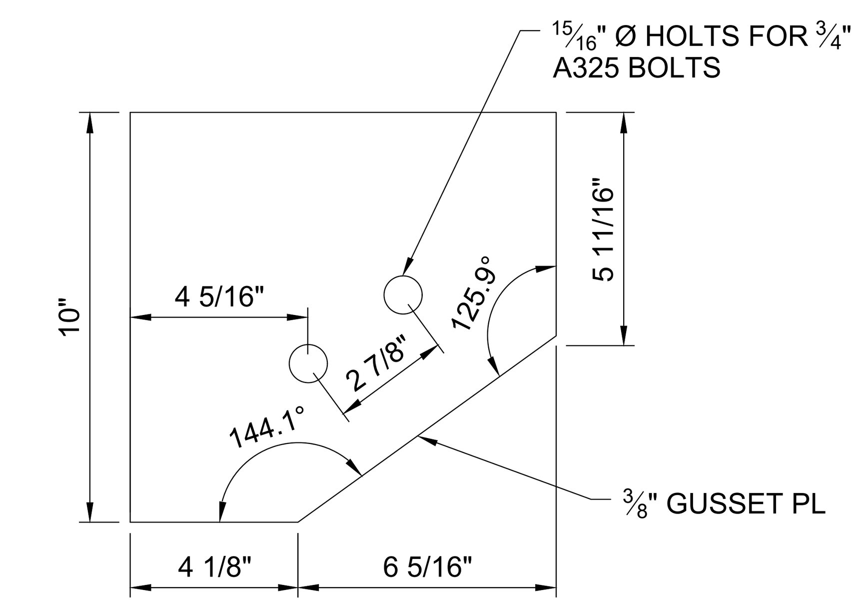
A SECTION
S-215
SCALE: 1"=1'-0"



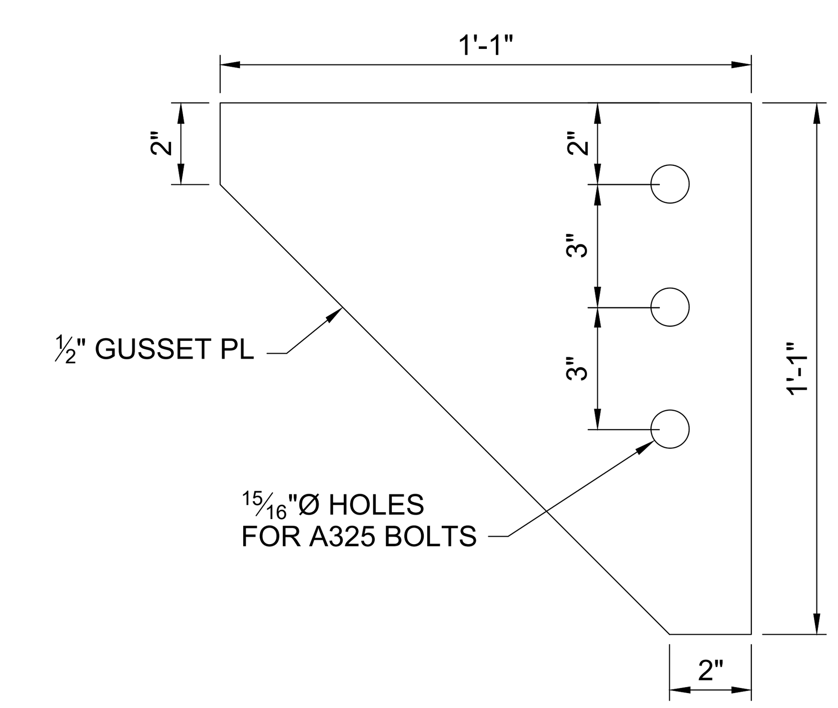
4 GUSSET PLATE 6 DETAIL
-
SCALE: 1 1/2"=1'-0"



5 GUSSET PLATE 7 DETAIL
-
SCALE: 3"=1'-0"



6 GUSSET PLATE 8 DETAIL
-
SCALE: 3"-1'-0"



7 GUSSET PLATE 9 DETAIL
-
SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

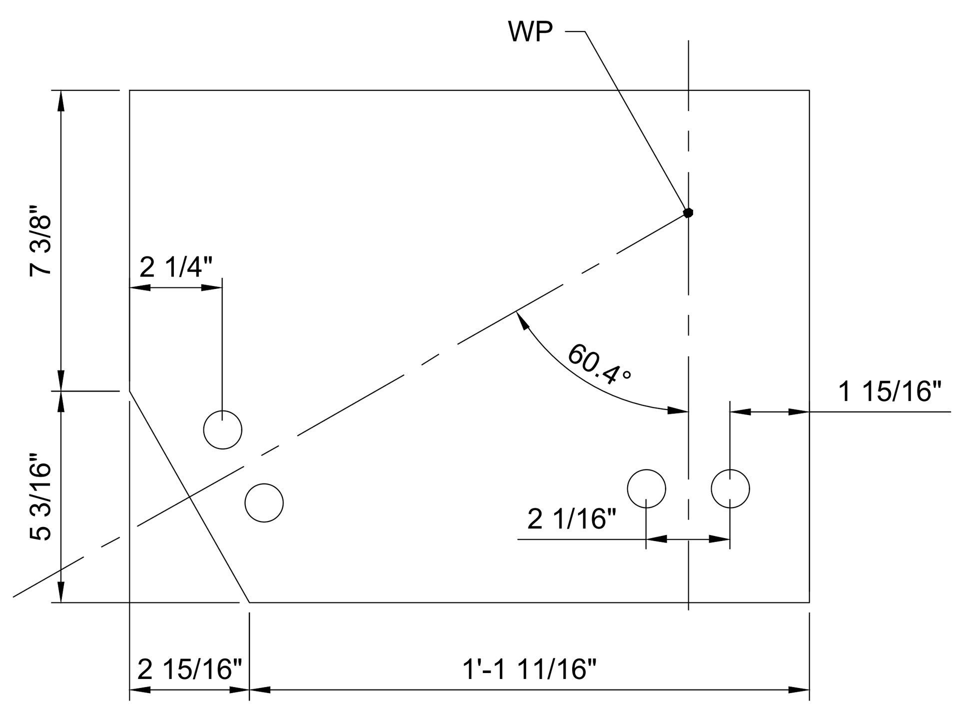
STATE OF MAINE
MARK DANIEL GRAESER
No. 39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

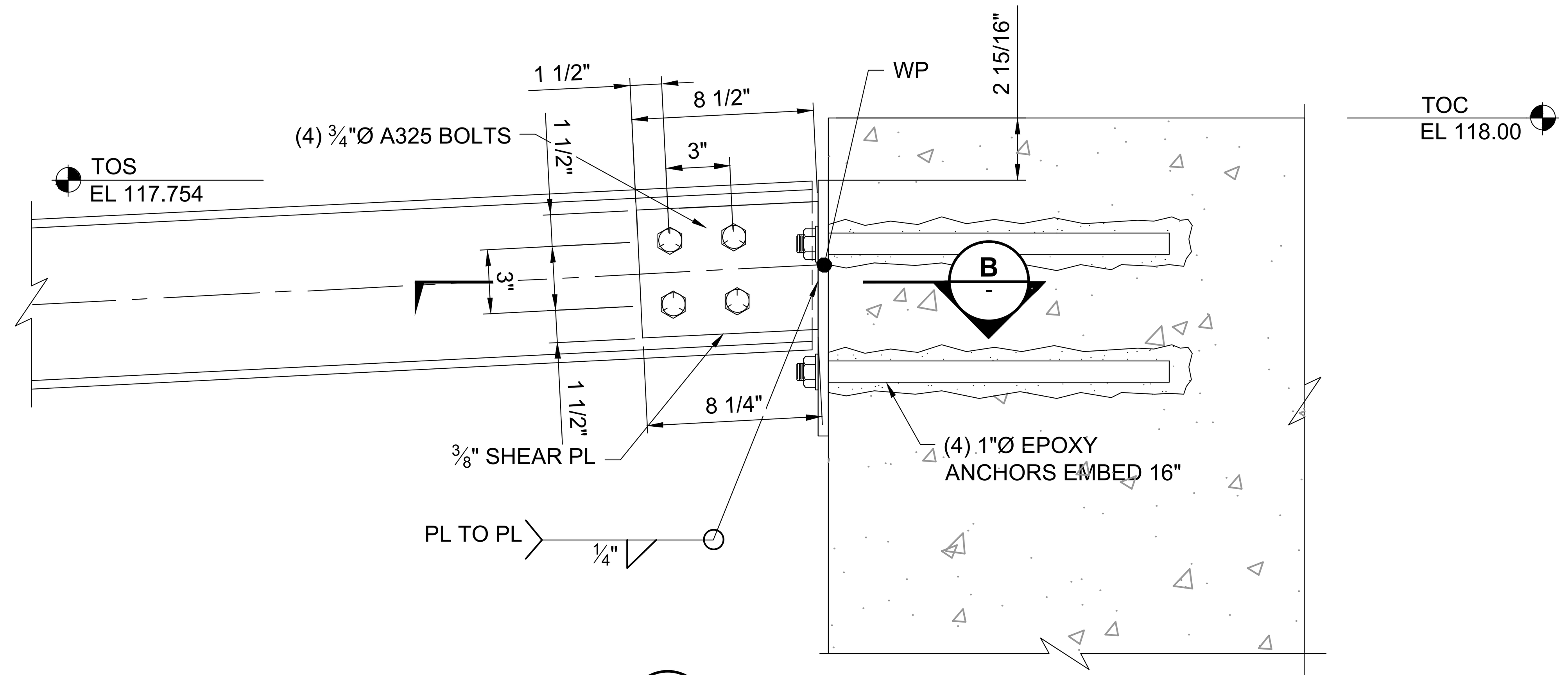
TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	66 OF 176
DRAWING:	S-220

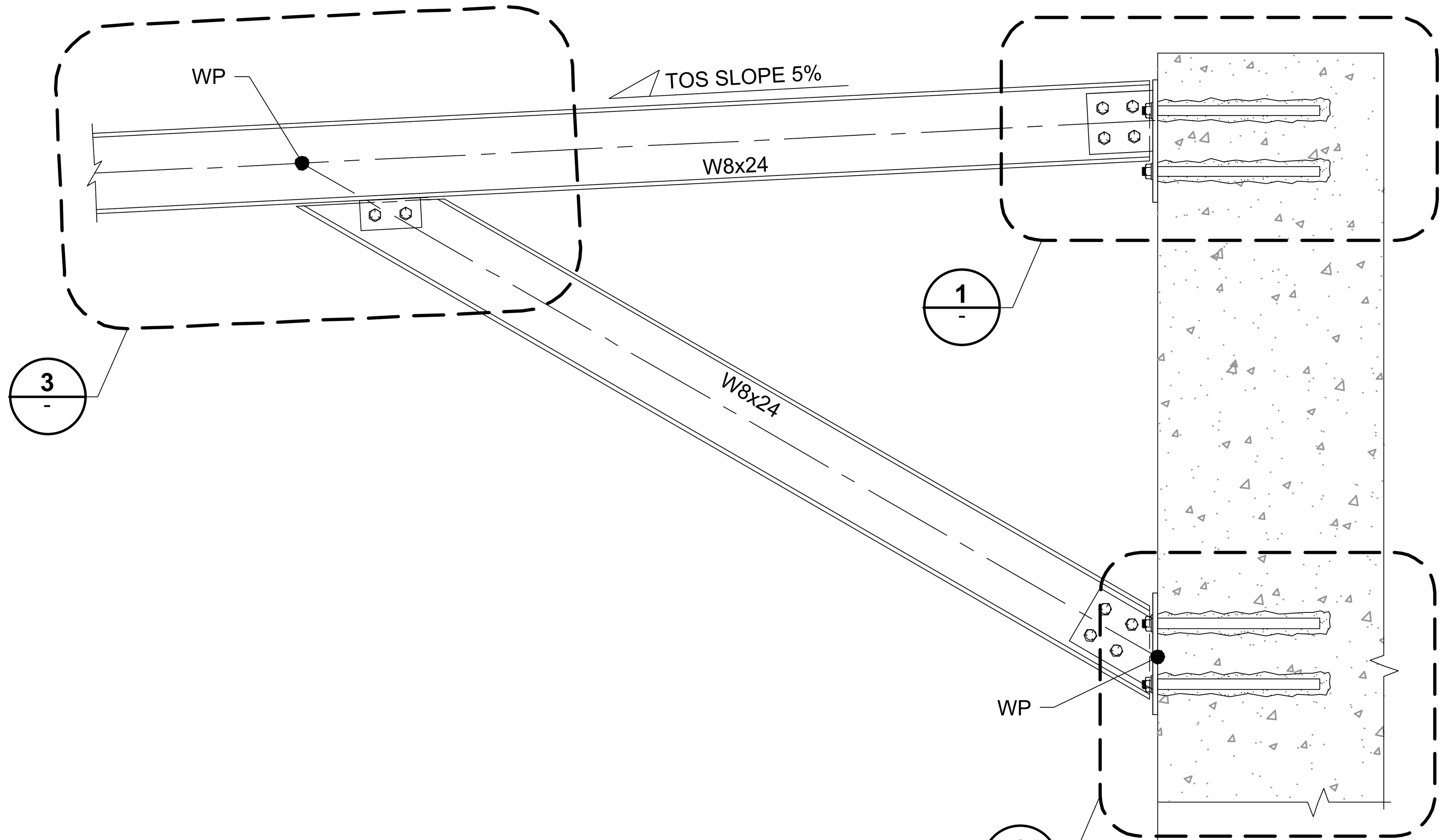
DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nsa and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-220.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:



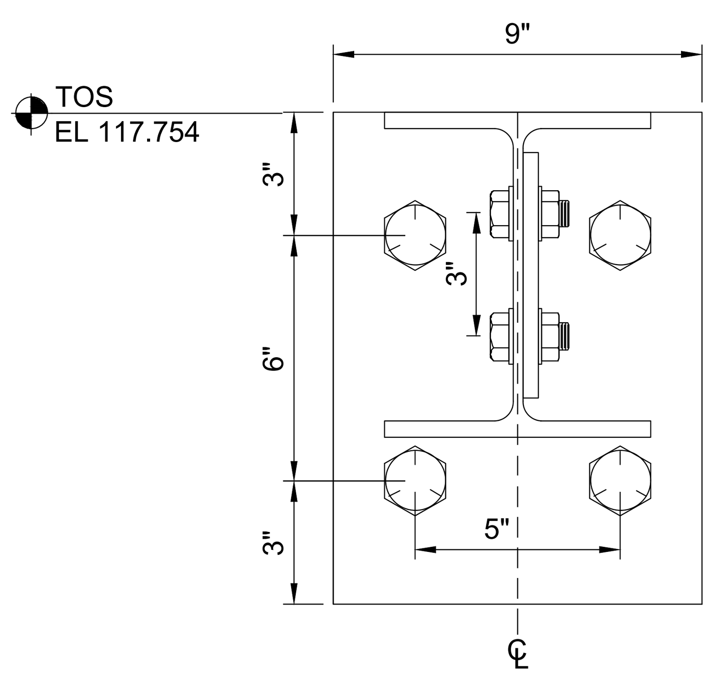
4 **GUSSET PLATE 10 DETAIL**
SCALE: 3"=1'-0"



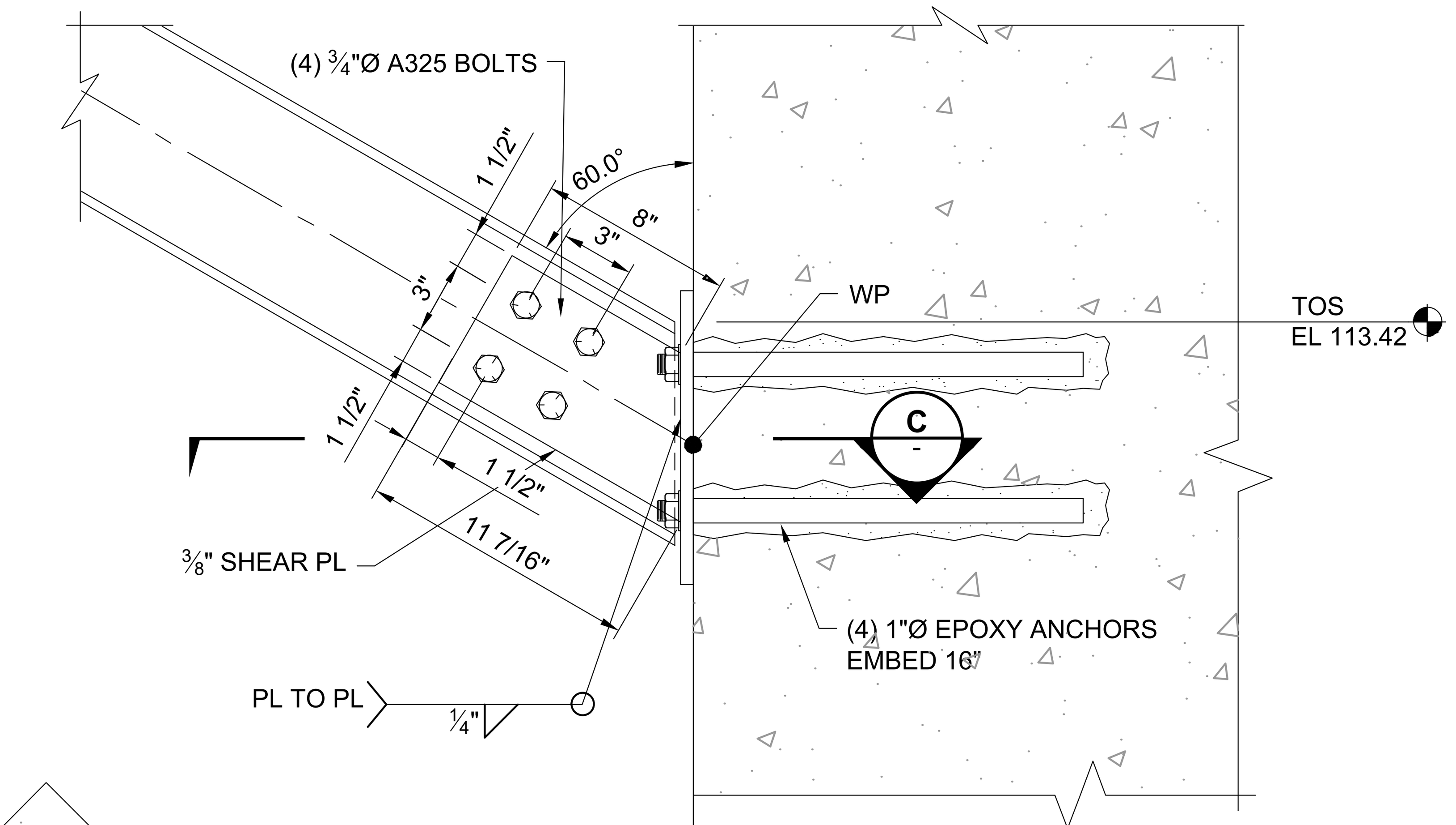
1 **DETAIL**
SCALE: 2"=1'-0"



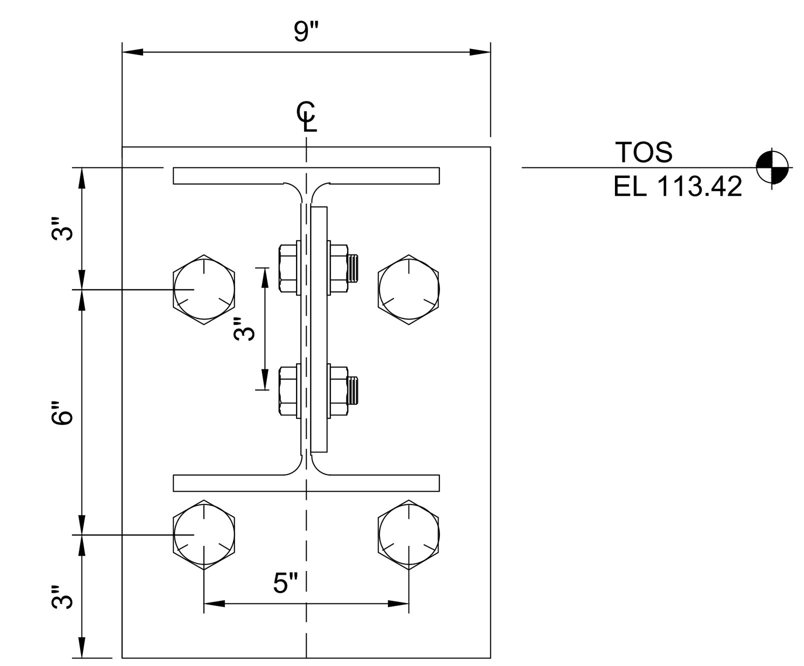
A **SECTION**
S-215
SCALE: 1"=1'-0"



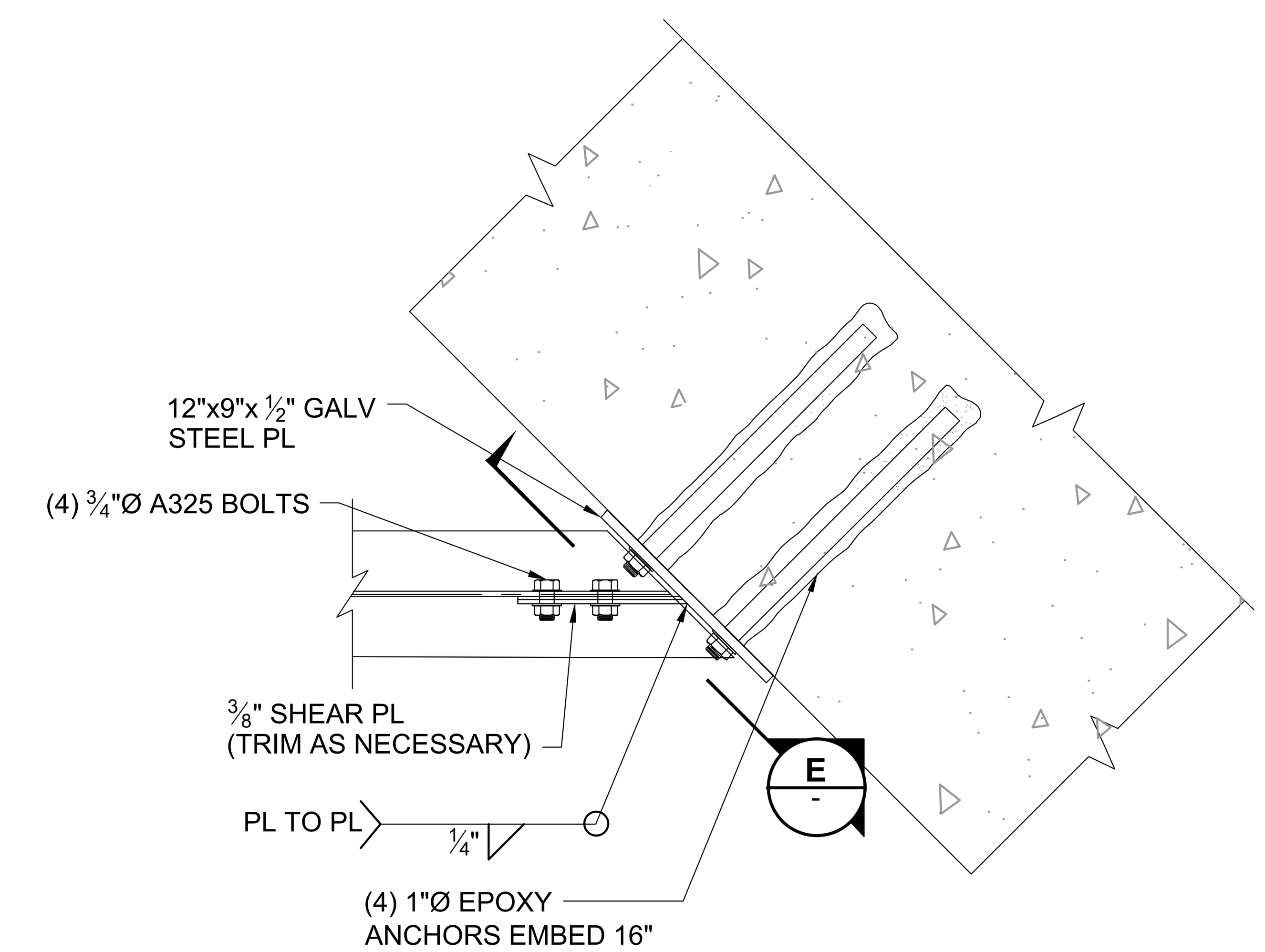
D **SECTION**
SCALE: 3"=1'-0"
S-222



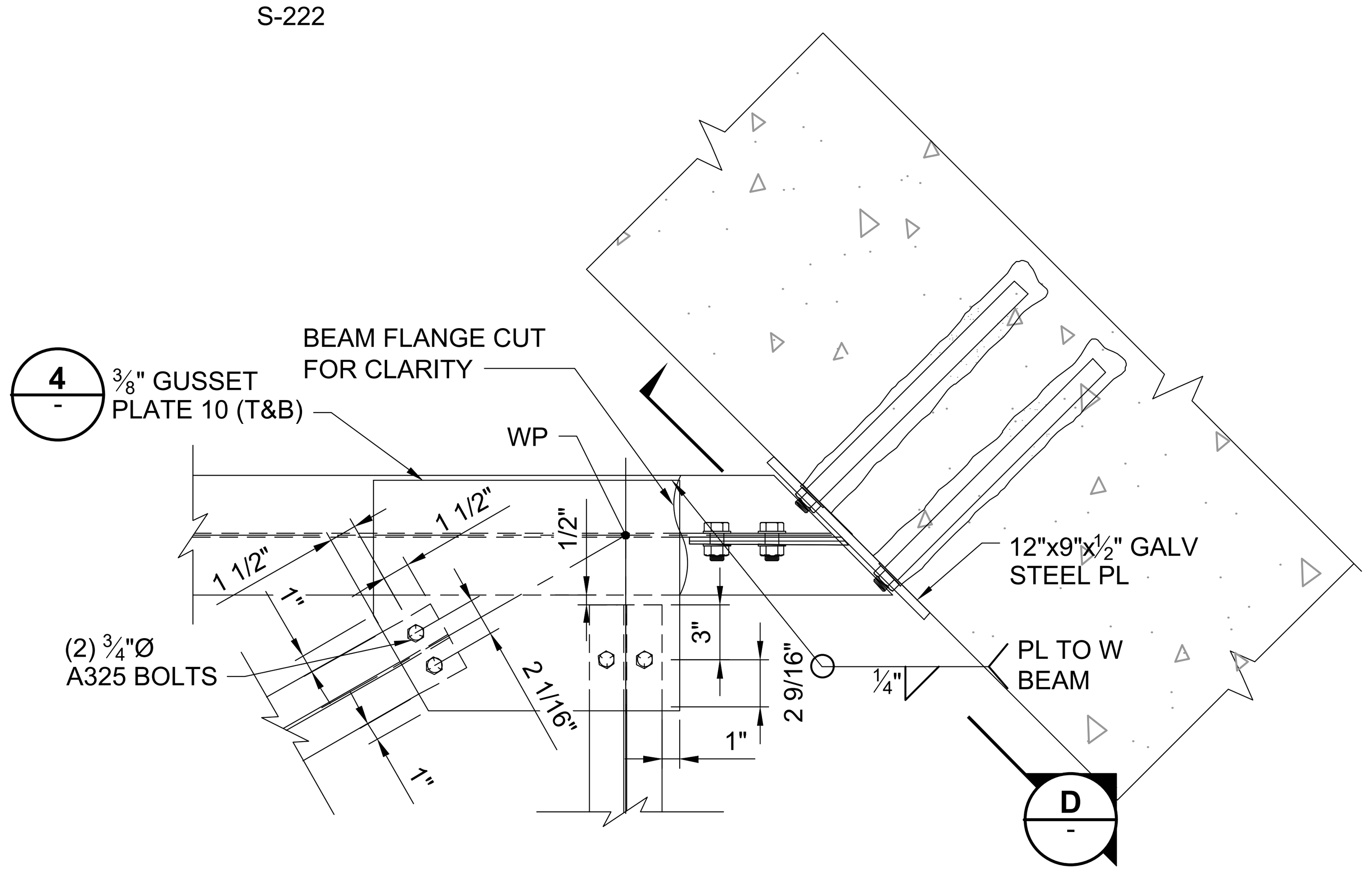
2 **DETAIL**
SCALE: 2"=1'-0"



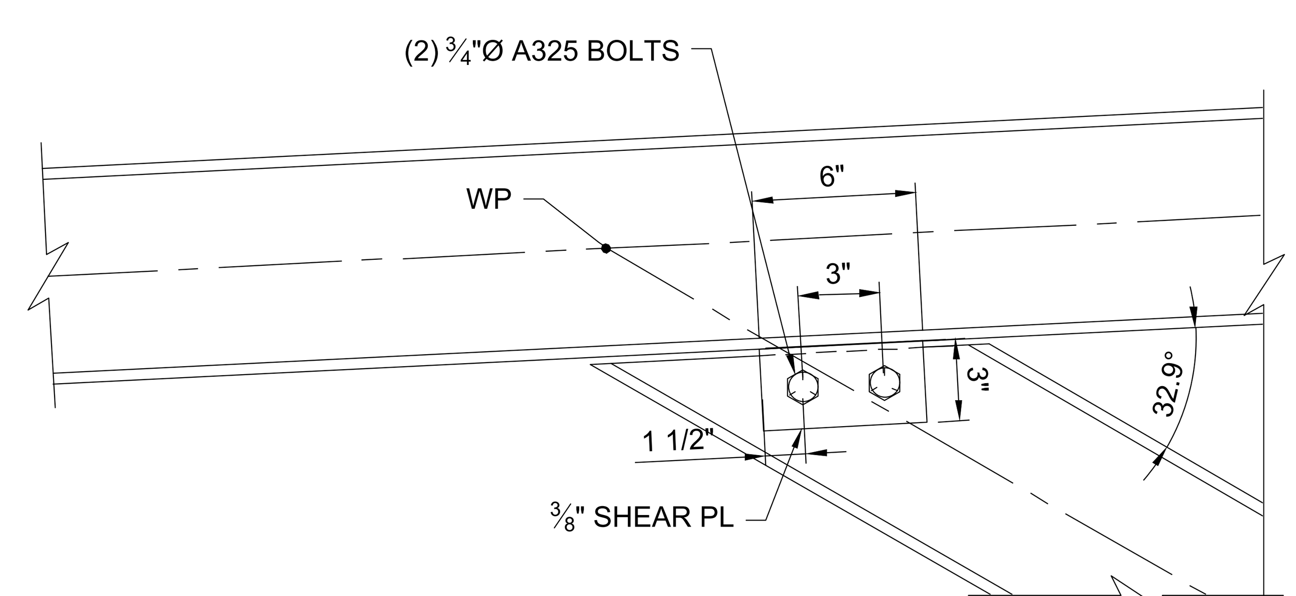
E **SECTION**
SCALE: 3"=1'-0"



C **SECTION**
SCALE: 1 1/2"=1'-0"



B **SECTION**
SCALE: 1 1/2"=1'-0"
S-215



3 **DETAIL**
SCALE: 2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

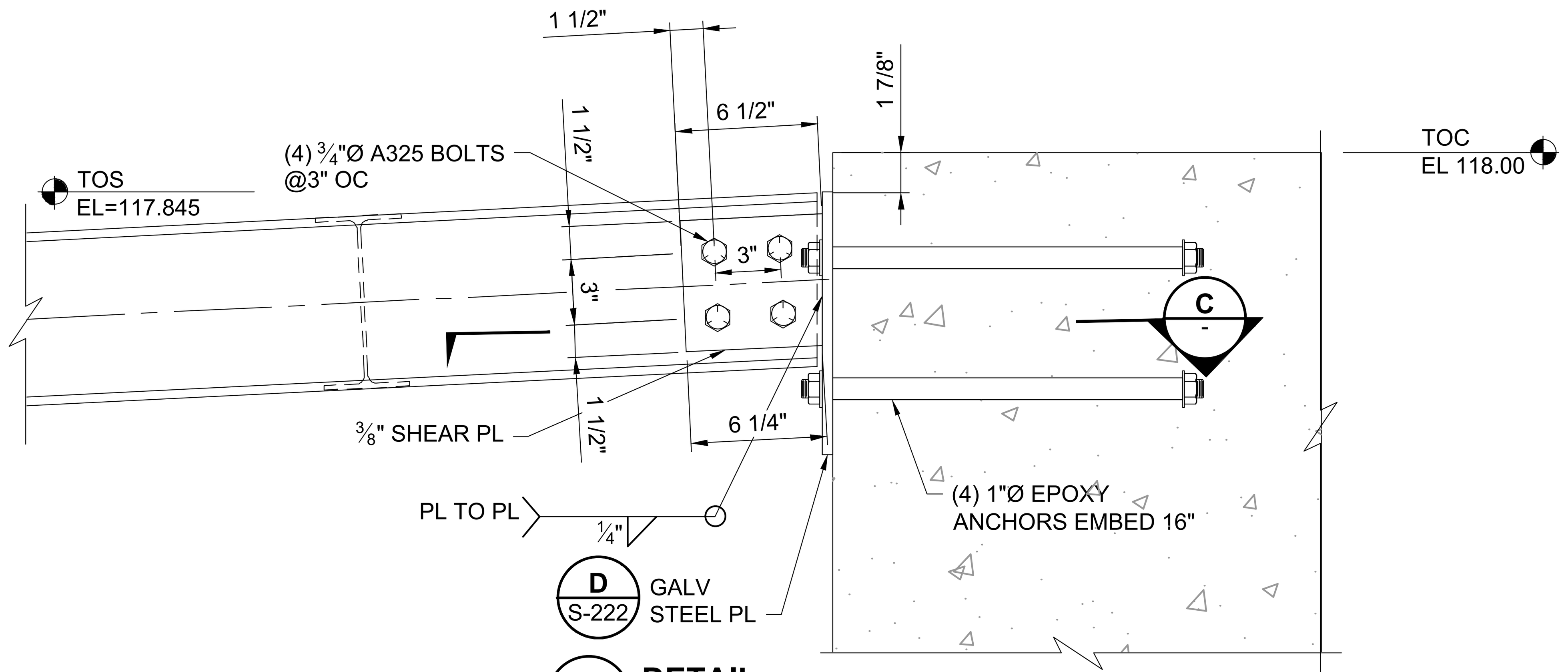
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

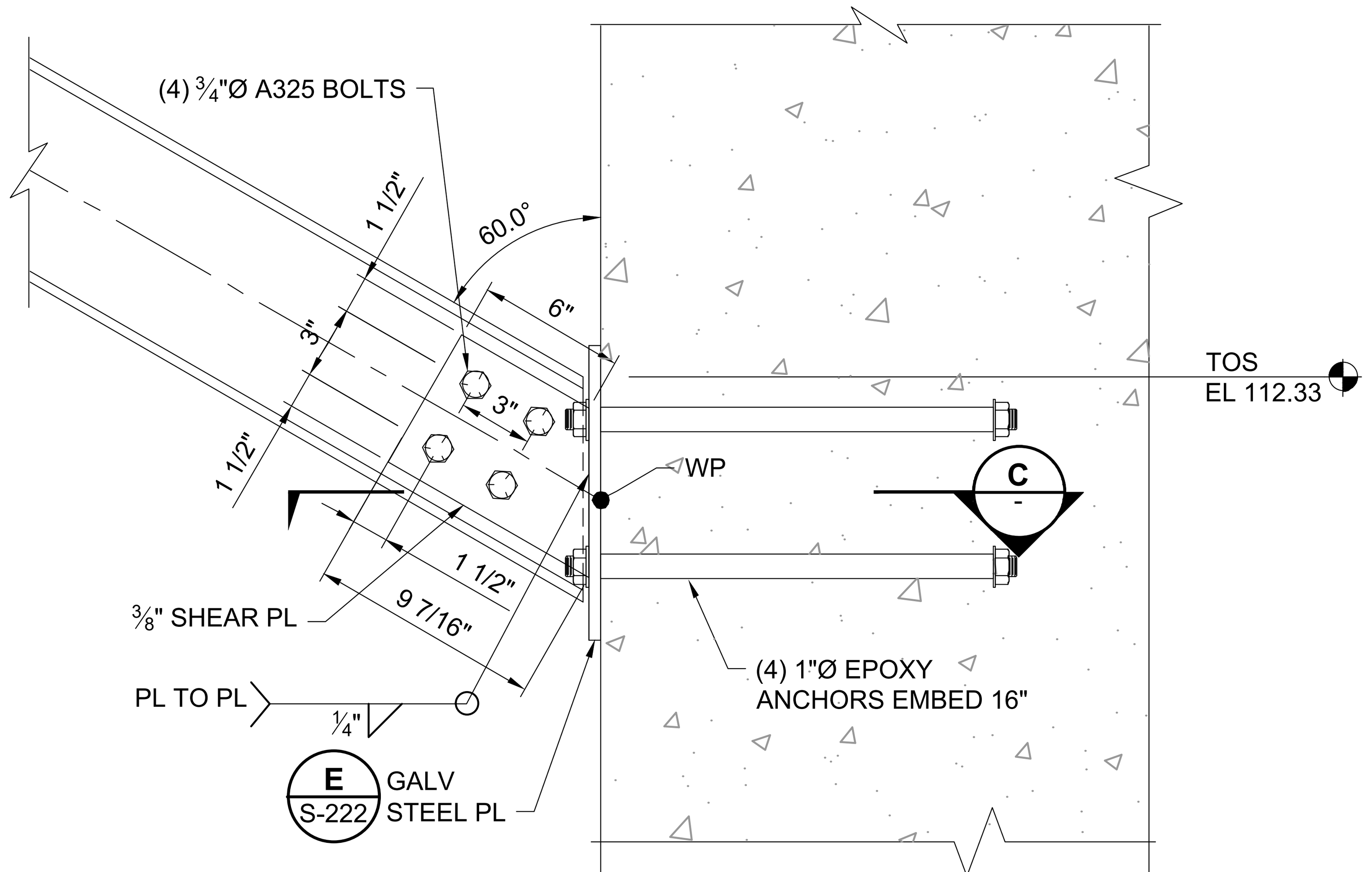
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

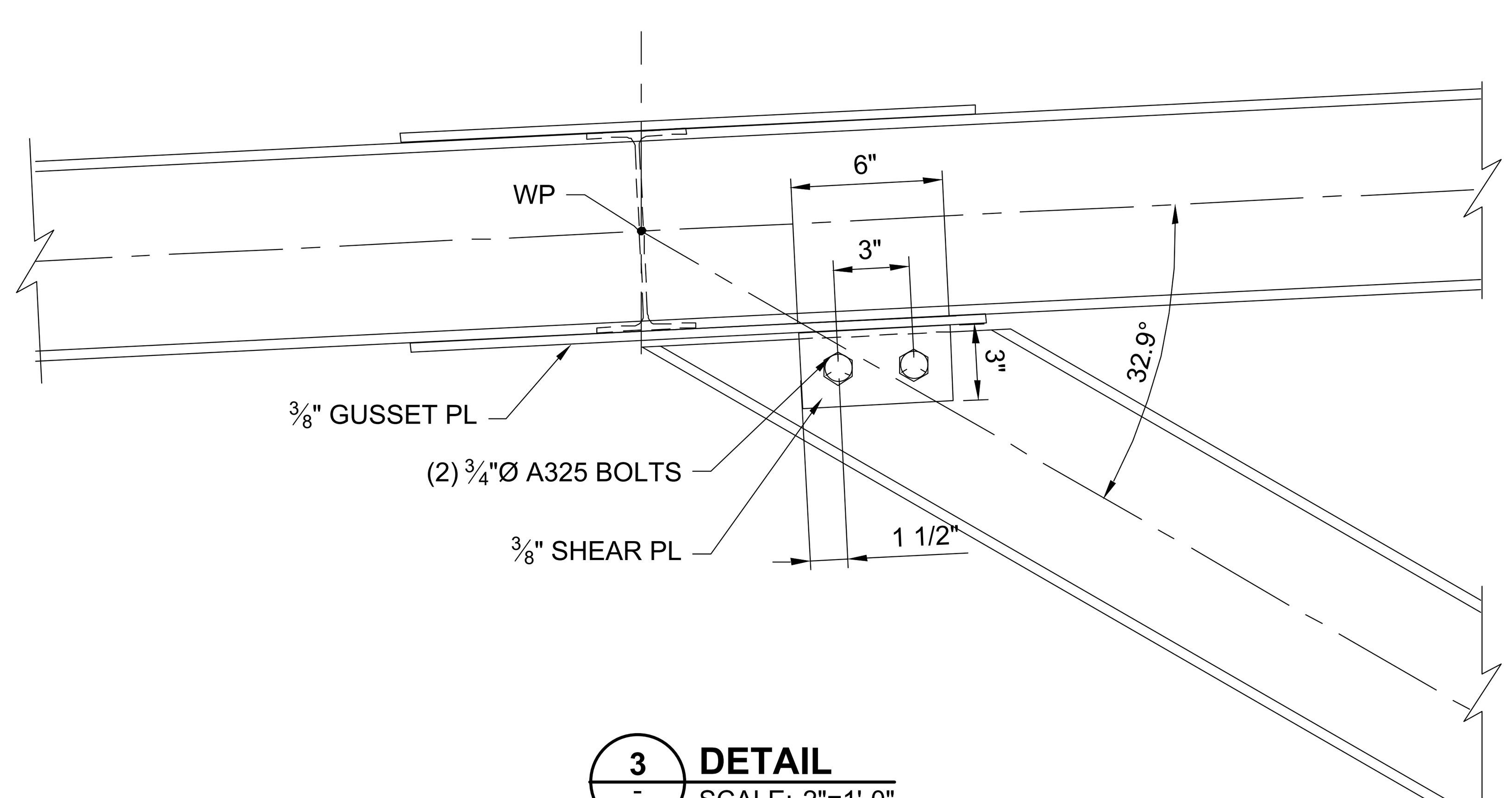
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	67 OF 176
DRAWING:	S-221



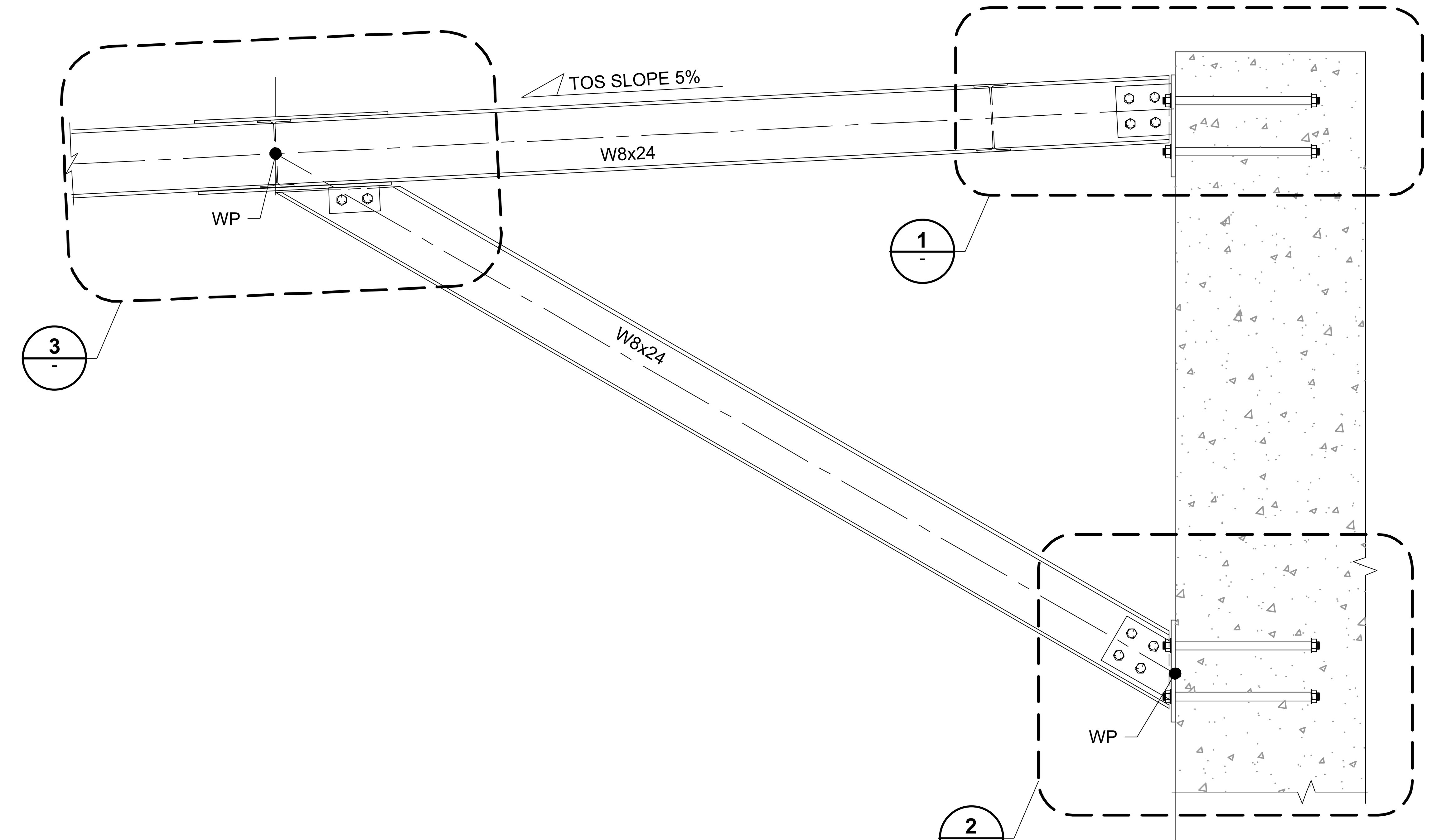
1 - **DETAIL**
SCALE: 2"=1'-0"



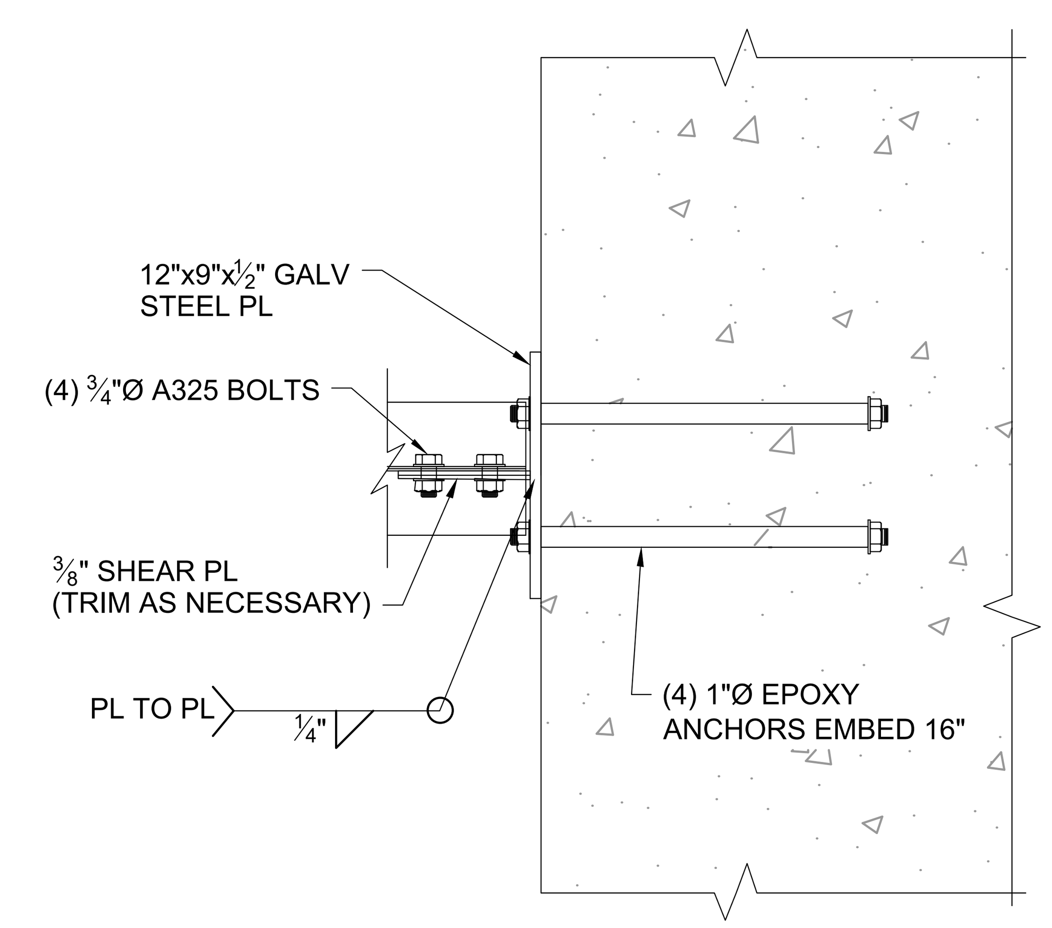
2 - **DETAIL**
SCALE: 2"=1'-0"



3 - **DETAIL**
SCALE: 2"=1'-0"



B S-215 **SECTION**
SCALE: 1"=1'-0"



C - **SECTION**
SCALE: 1-1/2"=1'-0"
S-215

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

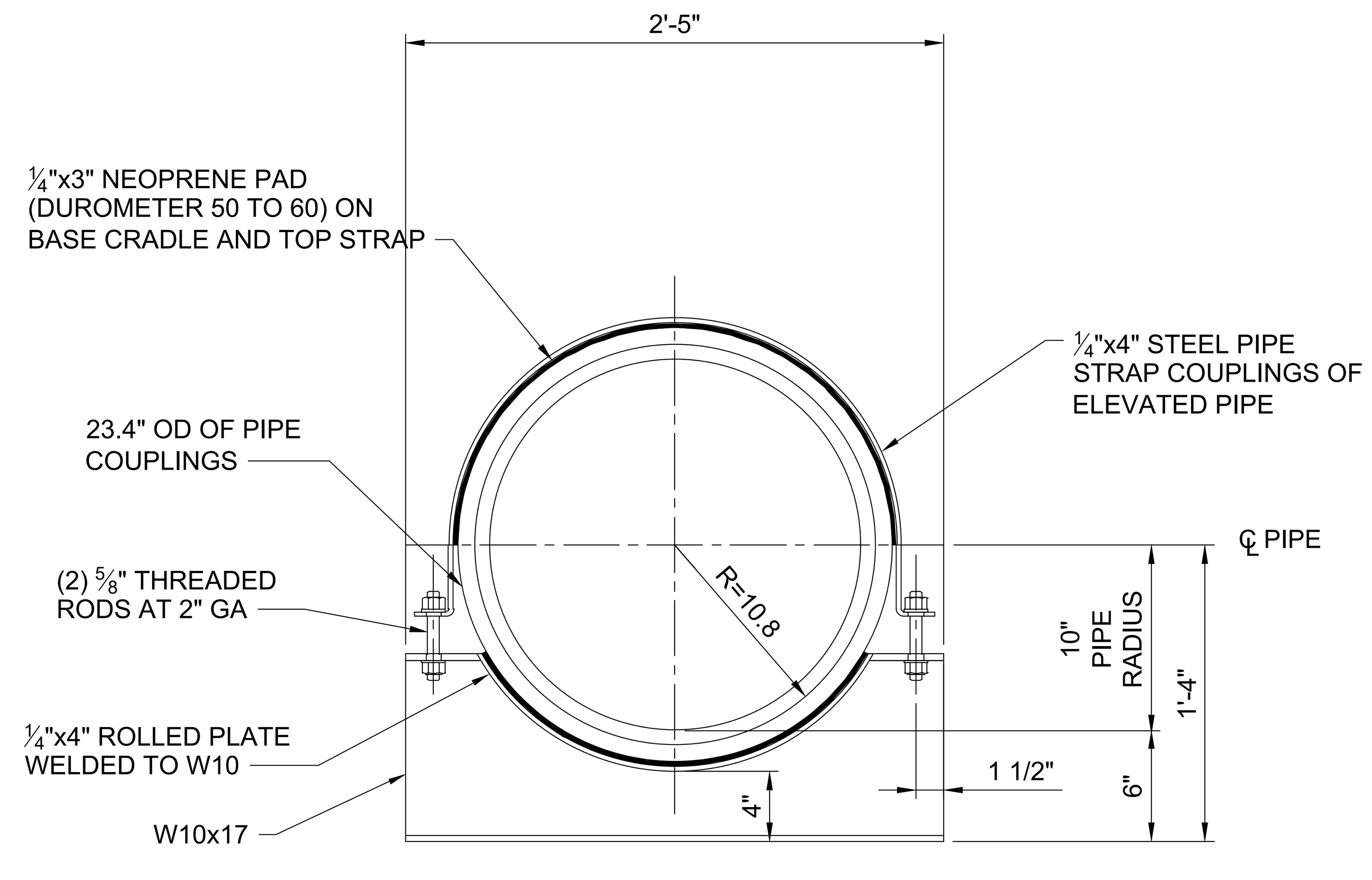
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

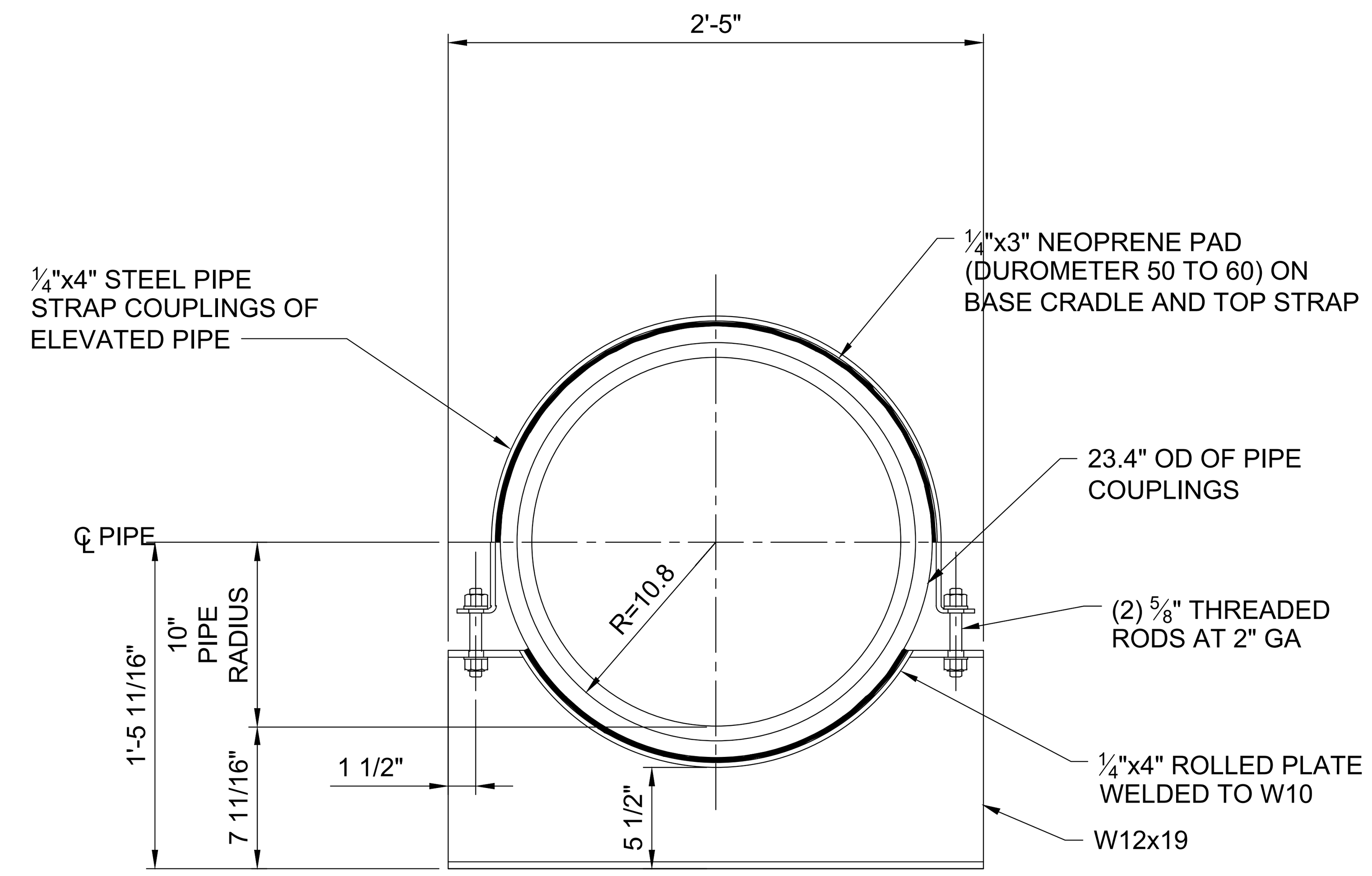
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

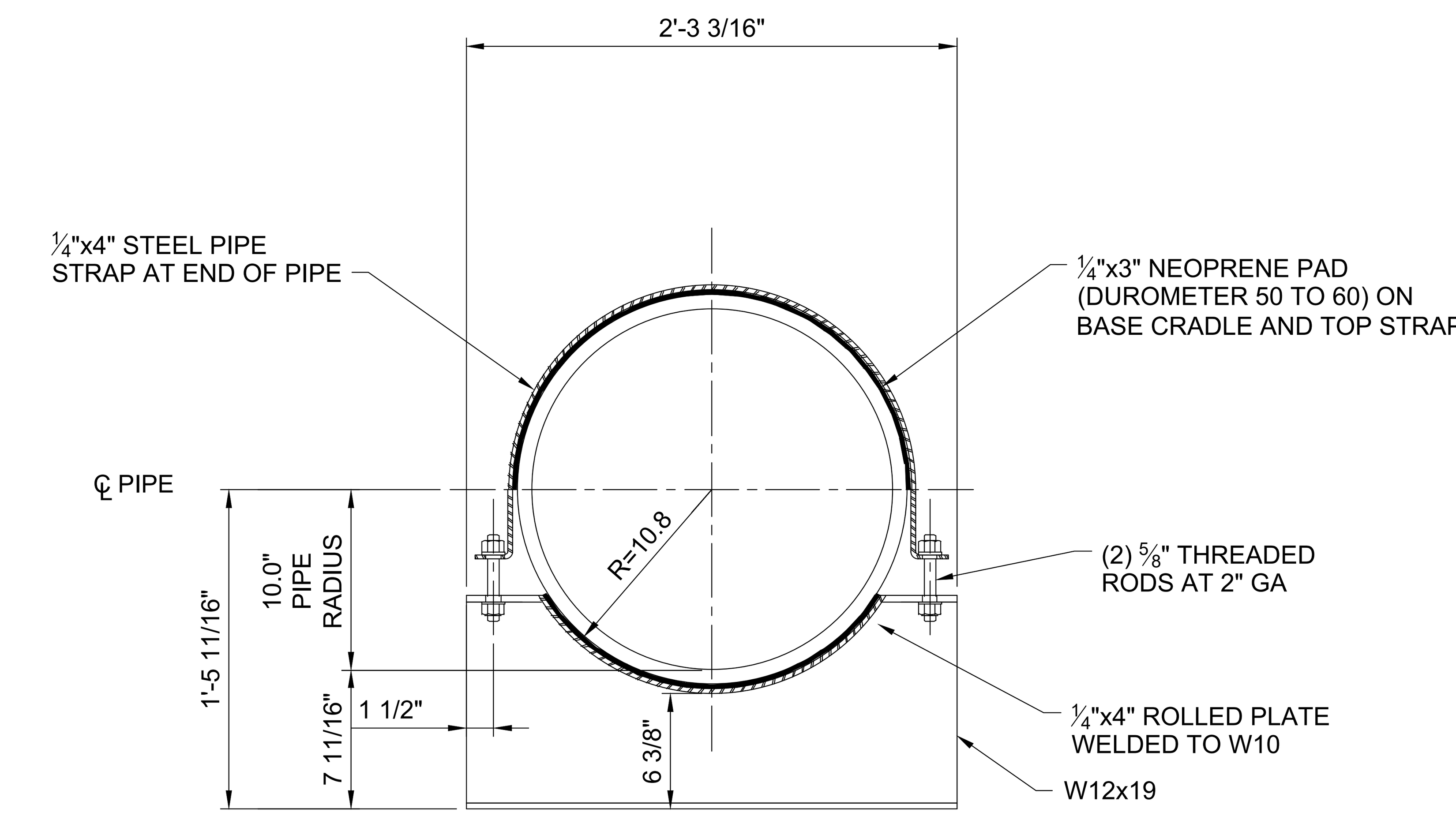
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	68 OF 176
DRAWING:	S-222



1 CRADLE SUPPORT DETAIL (TYPE A)
SCALE: 1 1/2"=1'-0"



3 CRADLE SUPPORT DETAIL (TYPE C)
SCALE: 1 1/2"=1'-0"



2 CRADLE SUPPORT DETAIL (TYPE B)
SCALE: 1 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

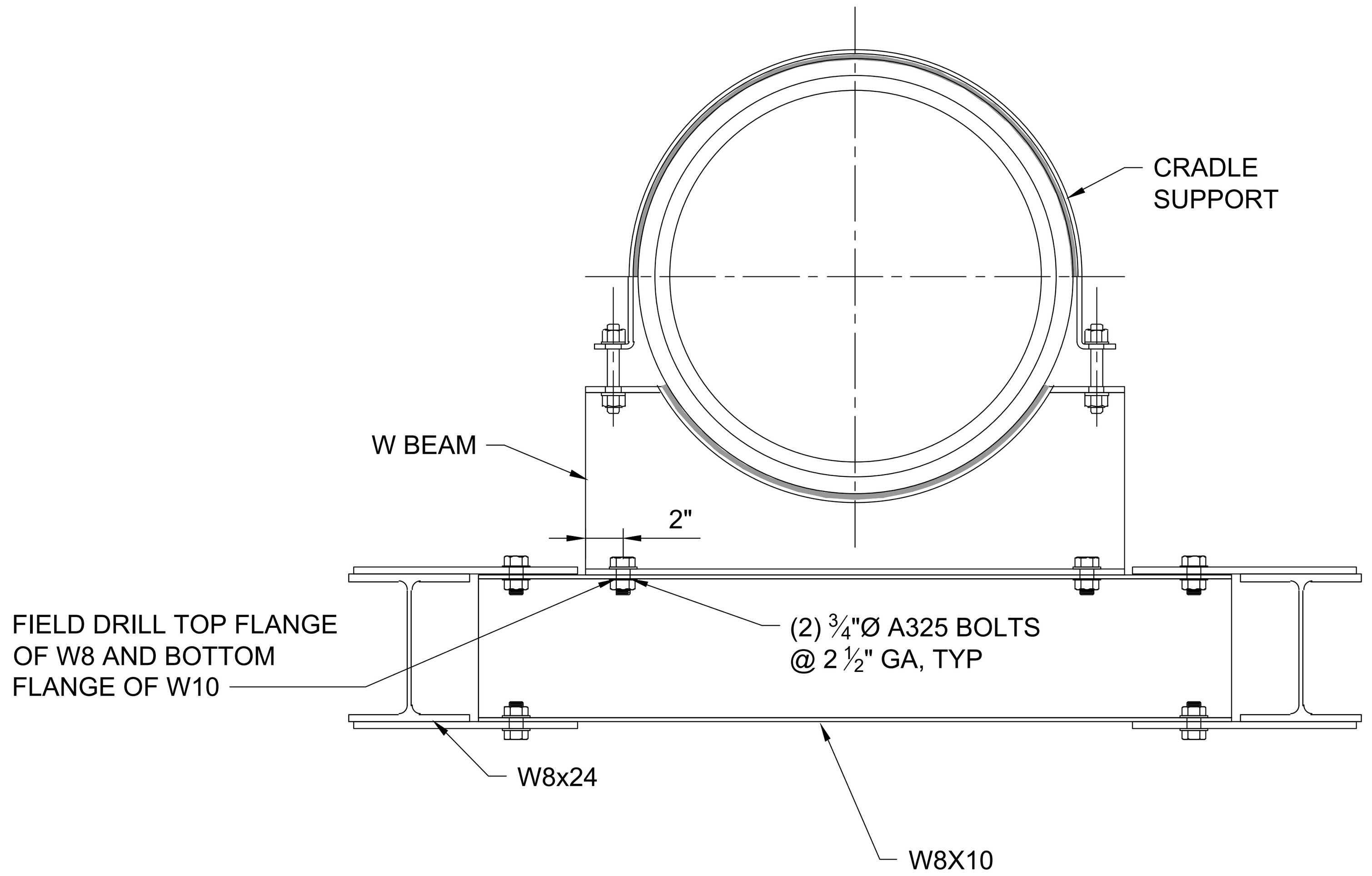
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE MARK DANIEL GRAESER No.39328 12/13/2019 LICENSED PROFESSIONAL ENGINEER

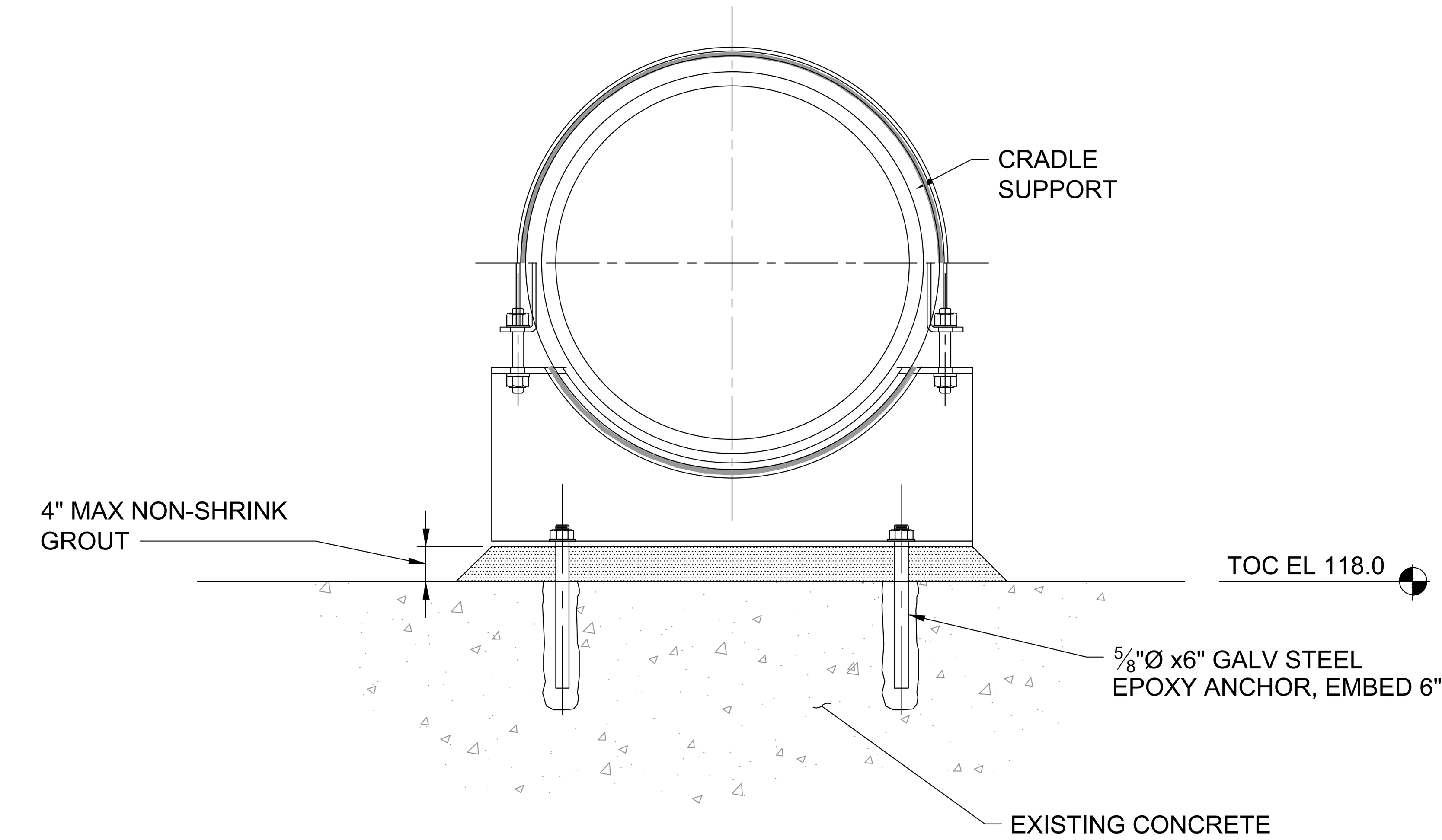
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH EXIT PIPE SUPPORT DETAILS

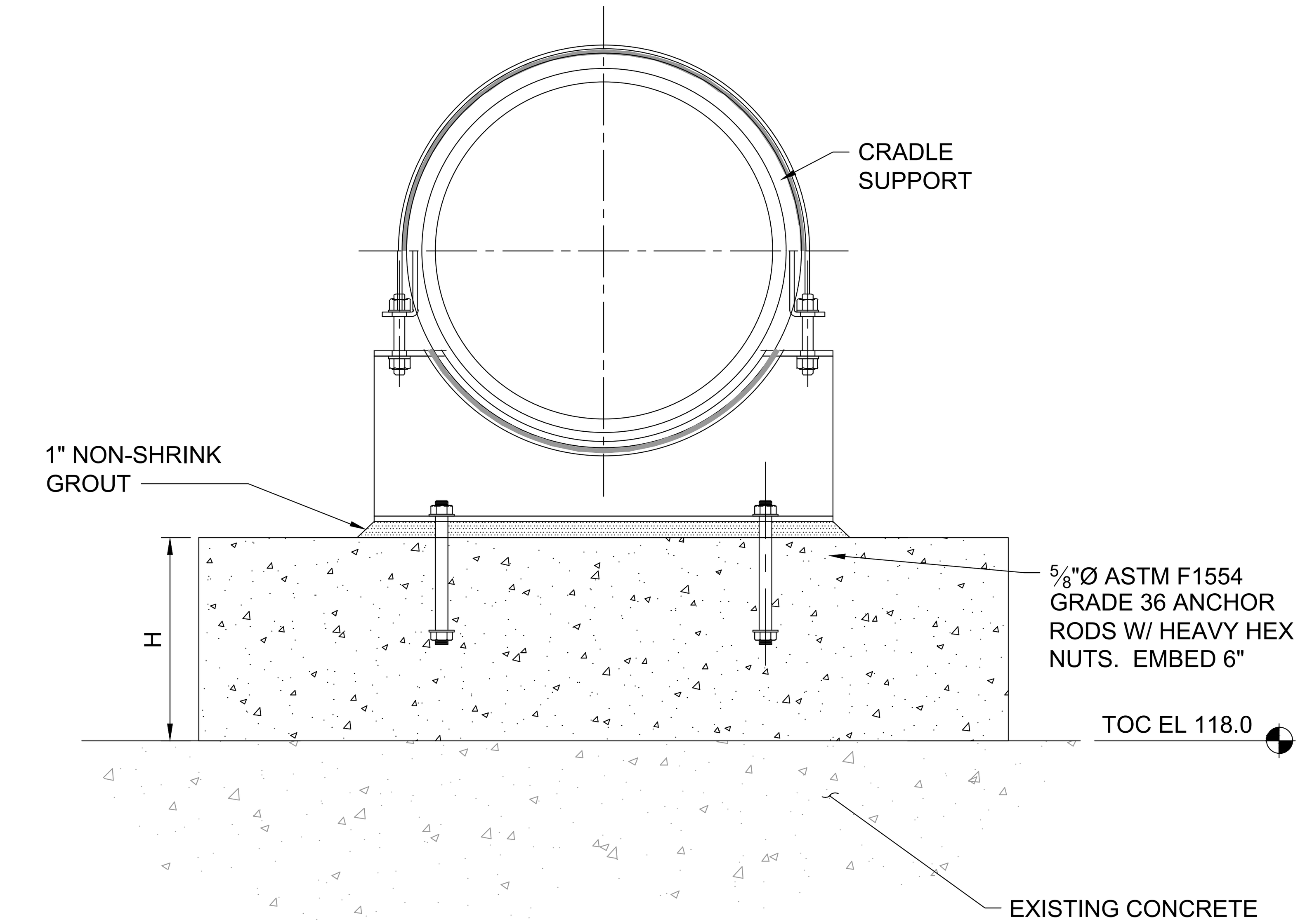
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 69 OF 176
DRAWING: S-223



1 - **PIPE SUPPORT DETAIL (TYPE I)**
SCALE: 1 1/2"=1'-0"



2 - **PIPE SUPPORT DETAIL (TYPE II)**
SCALE: 1 1/2"=1'-0"



3 - **PIPE SUPPORT DETAIL (TYPE III)**
SCALE: 1 1/2"=1'-0"

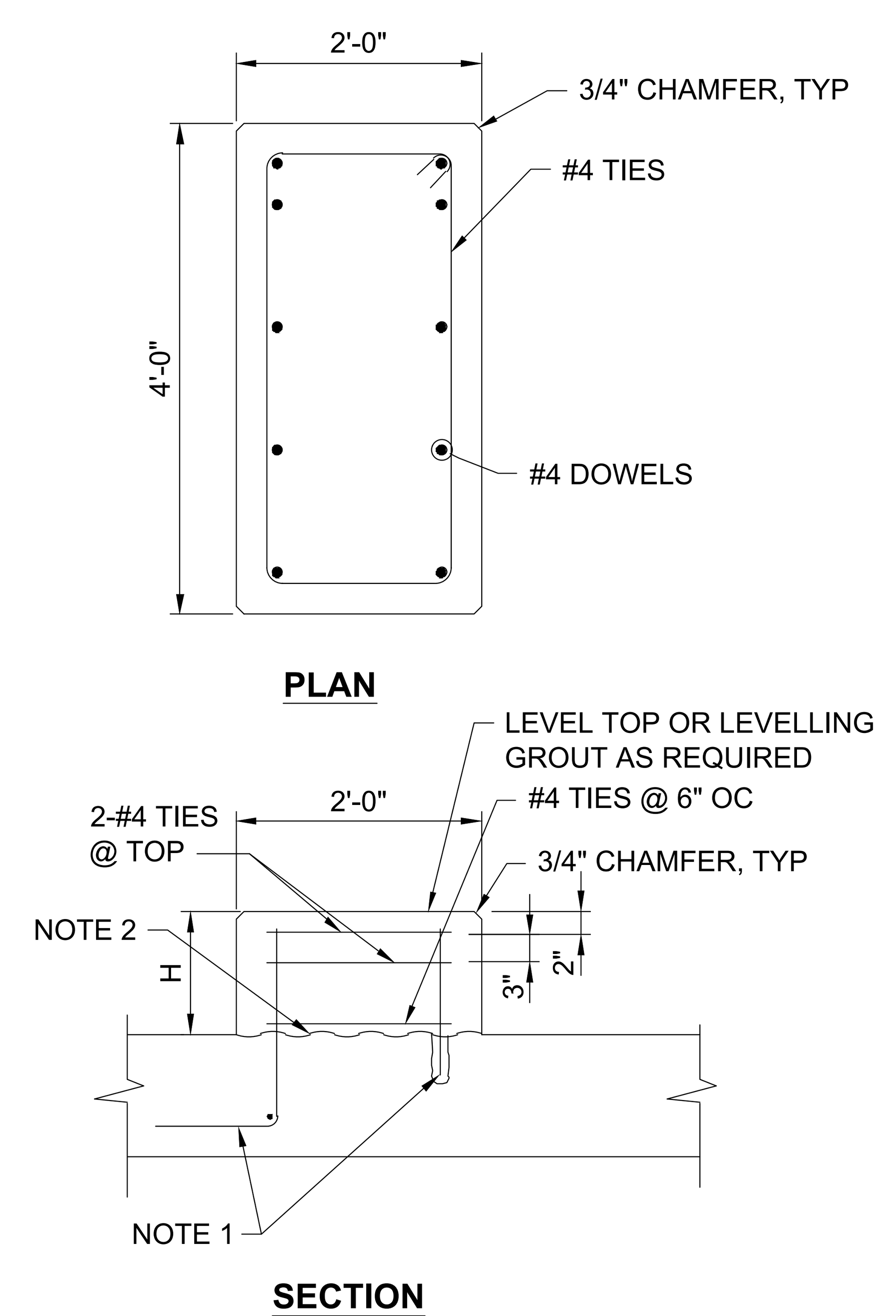
PIPE SUPPORT SCHEDULE

NUMBER	CRADLE SUPPORT TYPE	SUPPORT MATERIAL	DETAIL	HEIGHT, H
1	A	STEEL	TYPE I	-
2	A	STEEL	TYPE I	-
3	A	STEEL	TYPE I	-
4	A	CONCRETE	TYPE III	1'-0 14/16"
5	A	CONCRETE	TYPE III	7 12/16"
6	A	CONCRETE	TYPE II	3 7/16"
7	A	CONCRETE	TYPE II	7/16"
8	B	STEEL	TYPE I	-
9	C	STEEL	TYPE I	-

* CONCRETE SUPPORT HEIGHTS ARE APPROXIMATE, FIELD VERIFY.

NOTES:

1. AT NEW CONCRETE FLOOR: #4 x ⅃ @ 12" OC (MINIMUM 4 DOWELS PER SUPPORT). AT EXISTING CONCRETE FLOOR: #4 DRILL & EPOXY DOWELS @ 12" OC W/ 4" EMBED (MINIMUM 4 DOWELS PER SUPPORT).
2. ROUGHEN CONCRETE TO 1/4" AMPLITUDE & APPLY BONDING AGENT.
3. PLACE EXPANSION JOINT MATERIAL BETWEEN VALVE/PIPE & THE CONCRETE SUPPORT (MINIMUM 1/2" THICK).



TYPE III CONCRETE SUPPORT

4 - **CONCRETE SUPPORT DETAIL**
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH EXIT PIPE SUPPORT DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 70 OF 176
DRAWING: S-224

NOTE:

1. SEE S-306 FOR GRATING AND STAIR PLAN.

PLAN
SCALE: 1/8"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

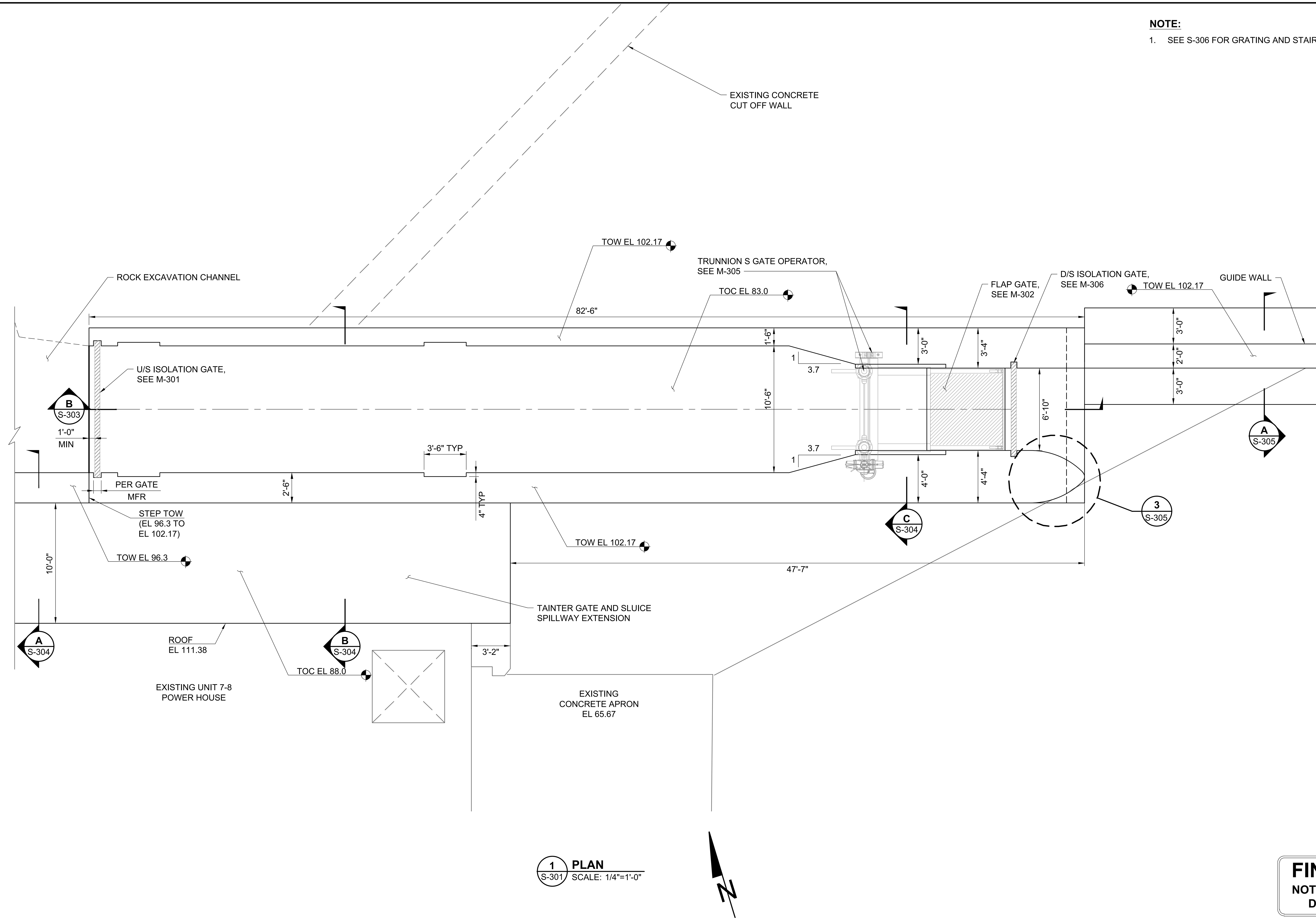
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
STRUCTURAL CONCRETE PLAN

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	71 OF 176
DRAWING:	S-301

NOTE:

1. SEE S-306 FOR GRATING AND STAIR PLAN.



1 PLAN
S-301 SCALE: 1/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

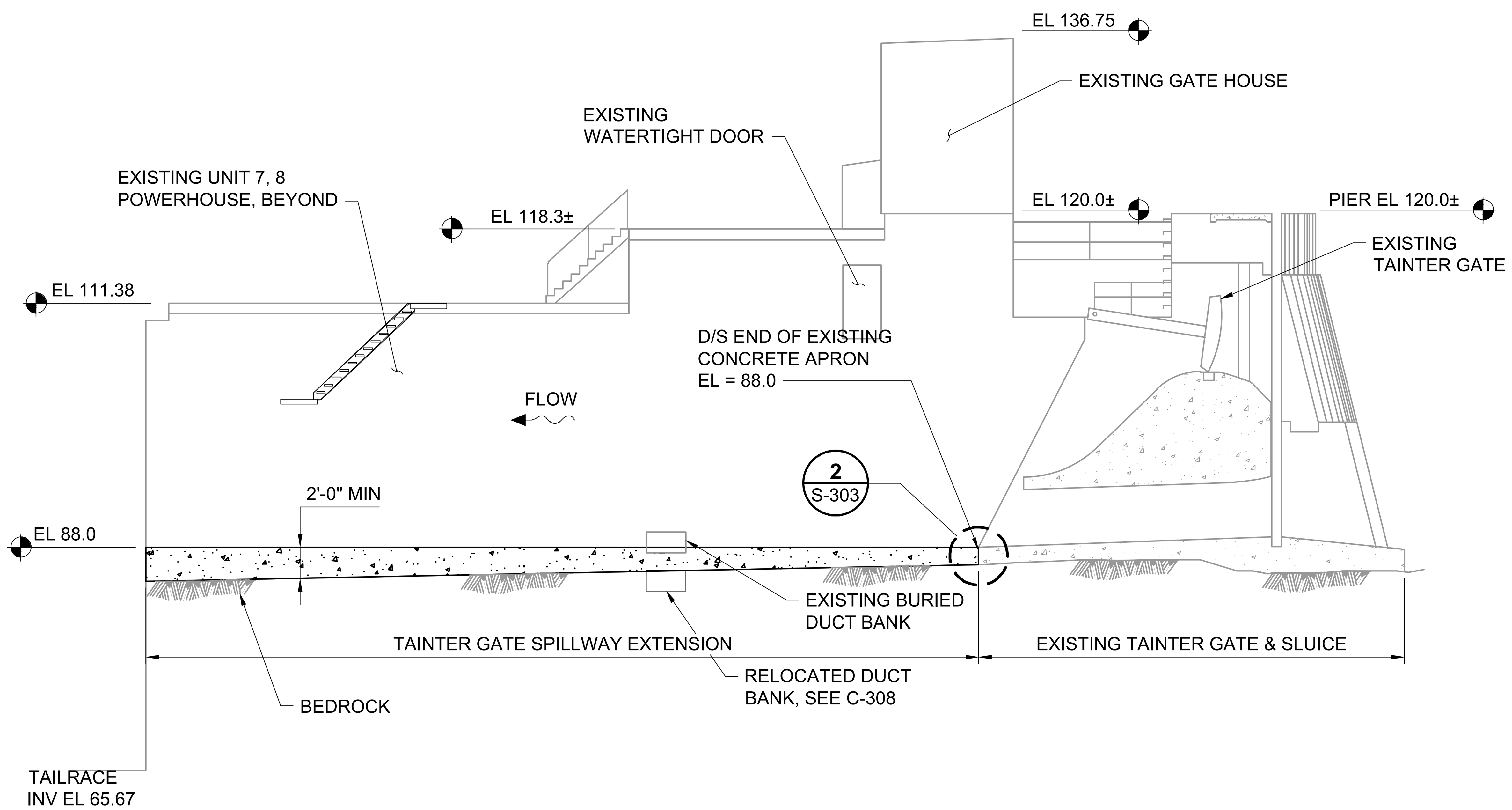
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

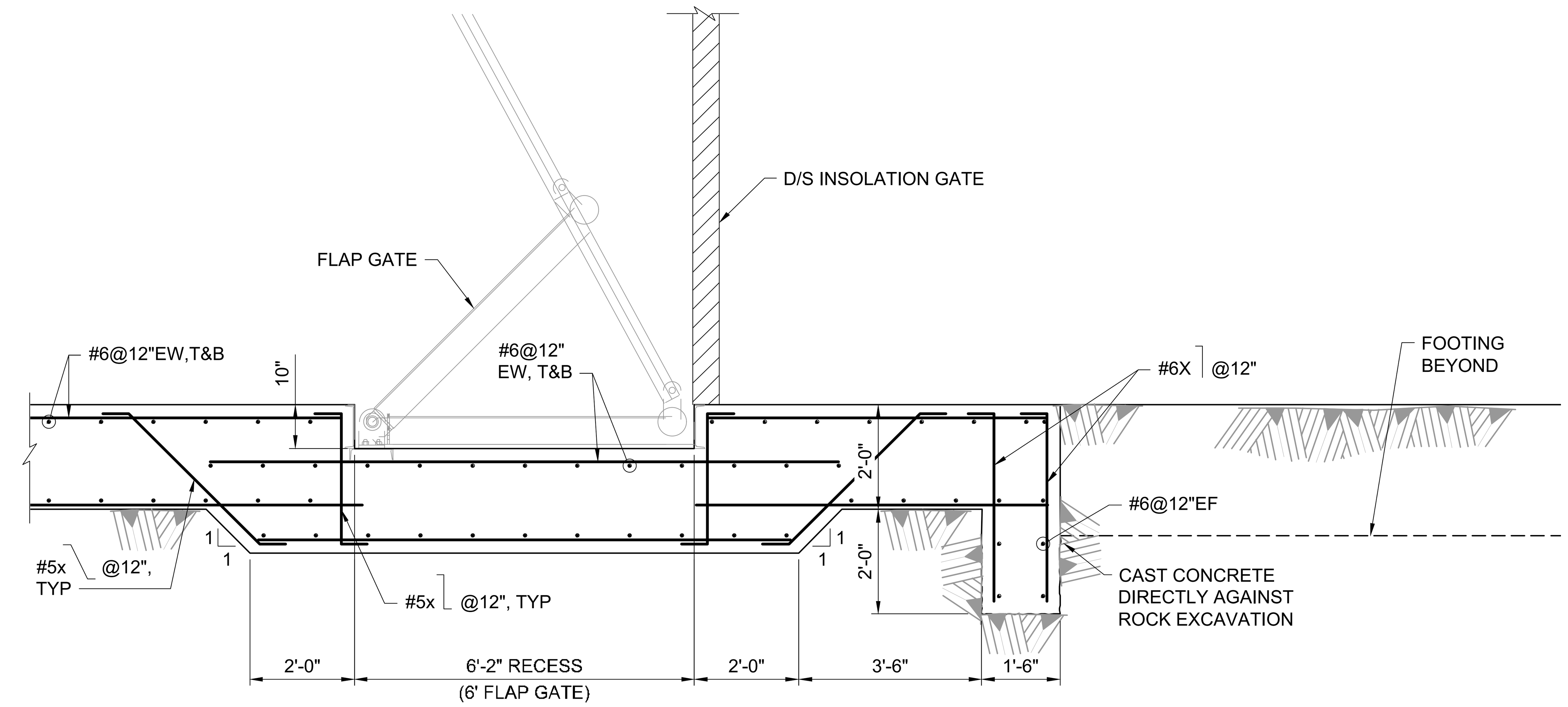
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
STRUCTURAL ENLARGED
CONCRETE PLAN

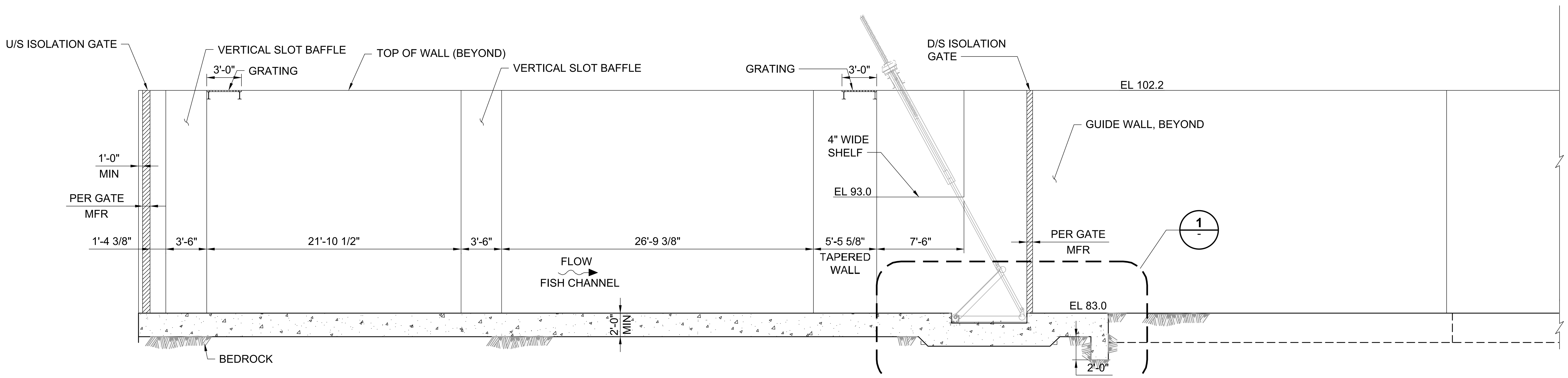
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	72 OF 176
DRAWING:	S-302



A S-301 **DOWNSTREAM PASSAGE SECTION**
SCALE: 1/8"=1'-0"



1 - **DETAIL**
SCALE: 1/2"=1'-0"



B S-301 **FISHWAY CHANNEL SECTION**
SCALE: 3/16"=1'-0"
S-302

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

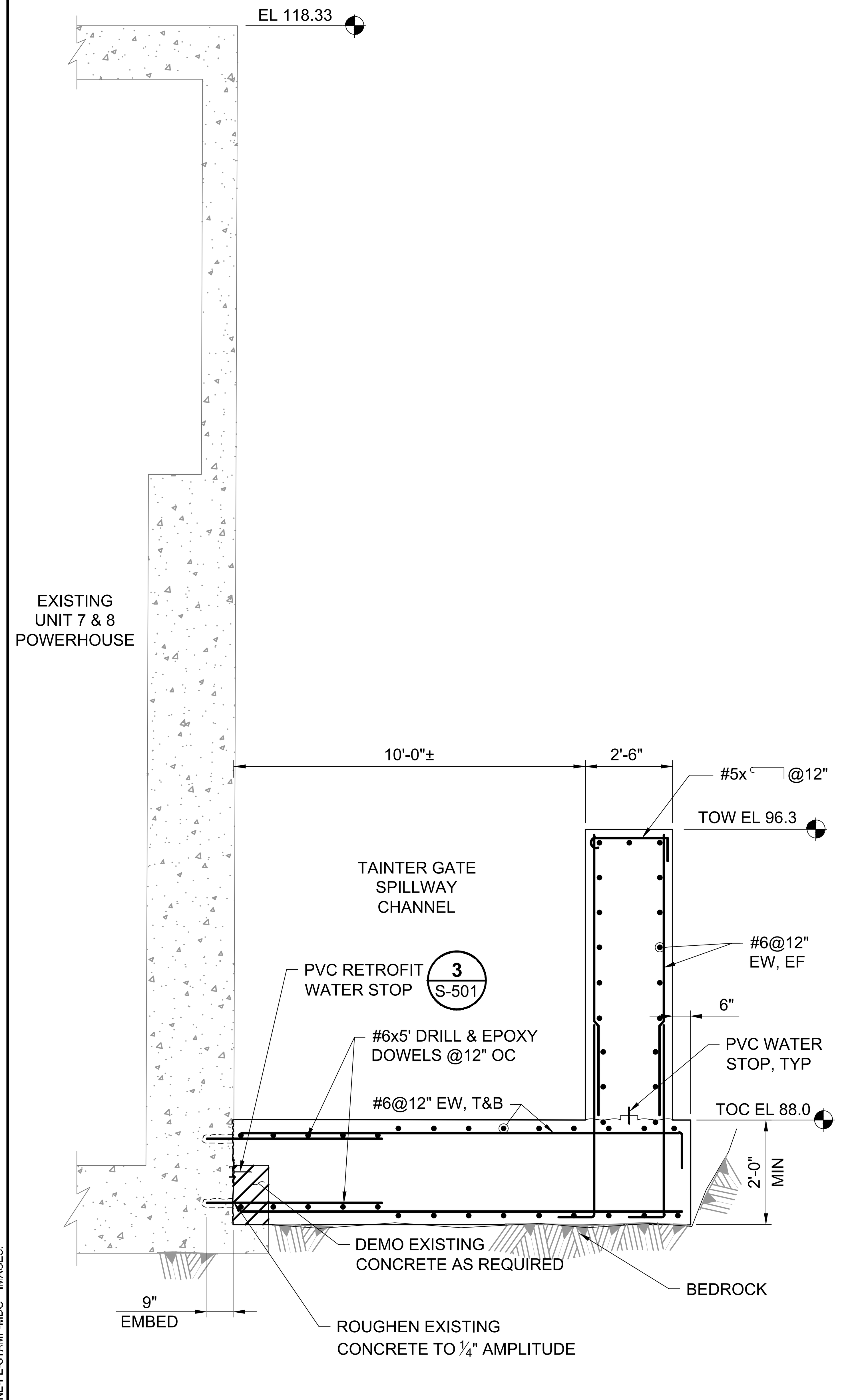
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

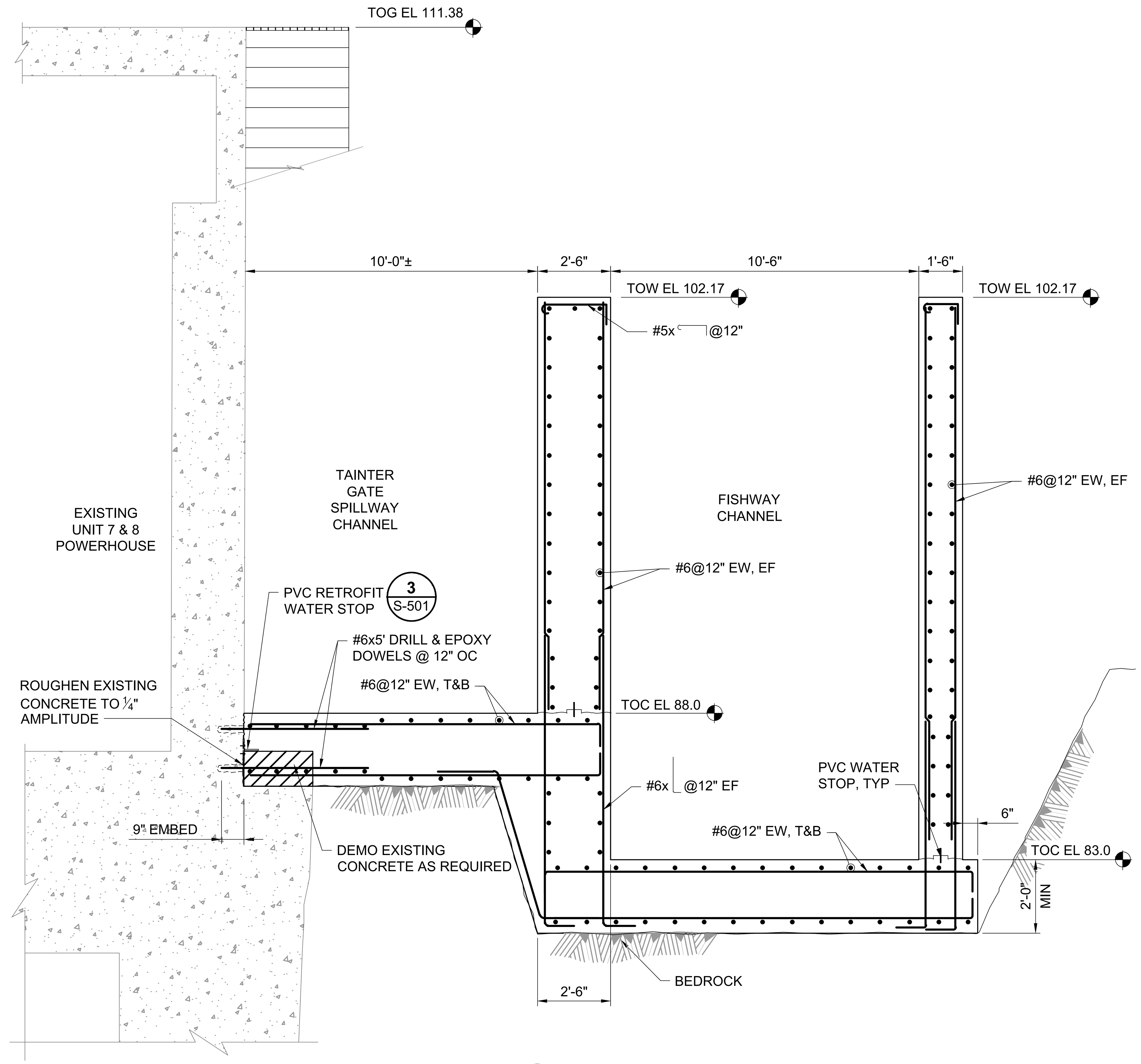
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
CONCRETE SECTIONS & DETAILS

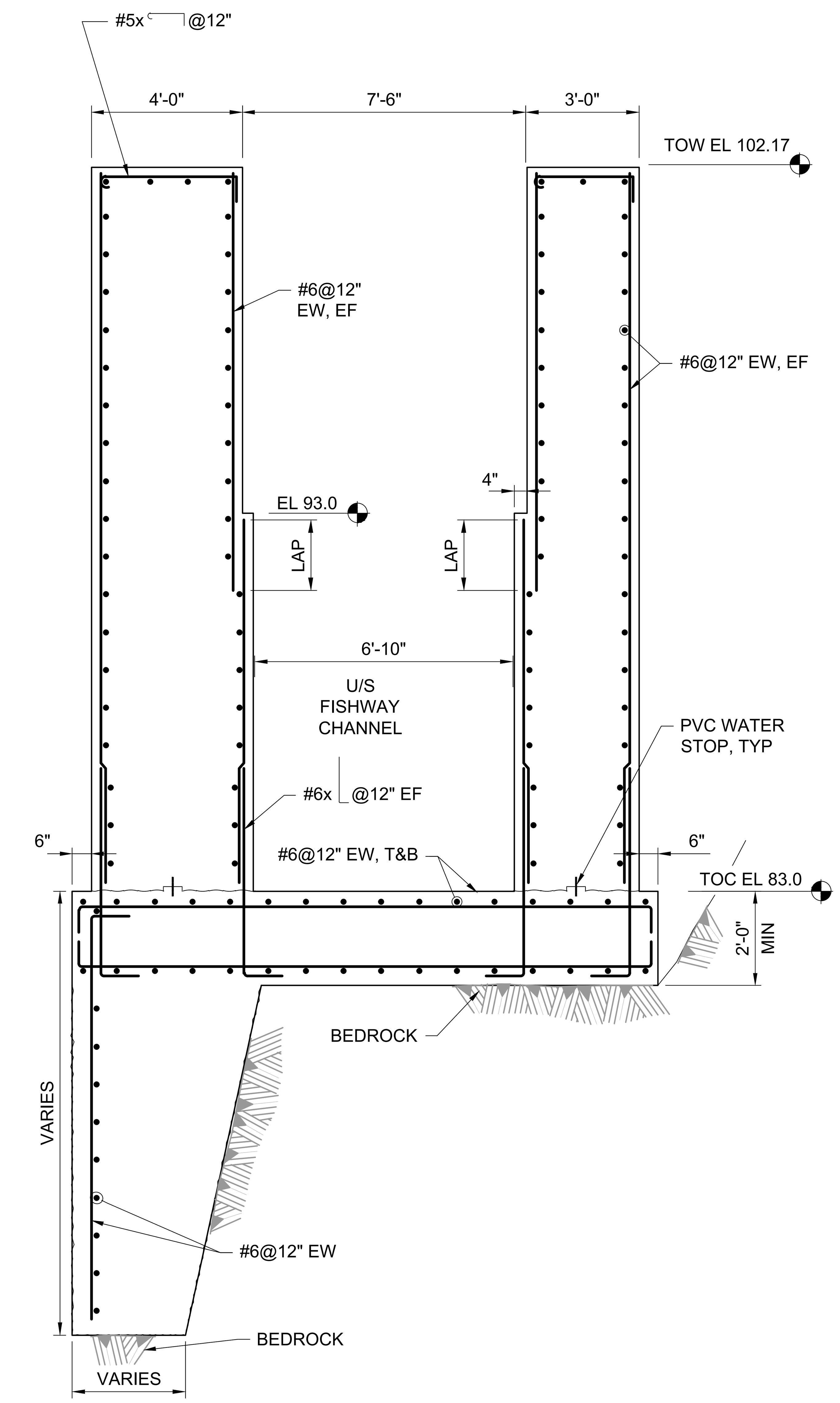
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	73 OF 176
DRAWING:	S-303



A
S-301
S-302
CHANNEL SECTION
SCALE: 3/8" = 1'-0"



B
S-301
S-302
FISHWAY CHANNEL SECTION
SCALE: 3/8" = 1'-0"



C
S-301
S-302
TAINTER GATE SPILLWAY CHANNEL SECTION
SCALE: 3/8" = 1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

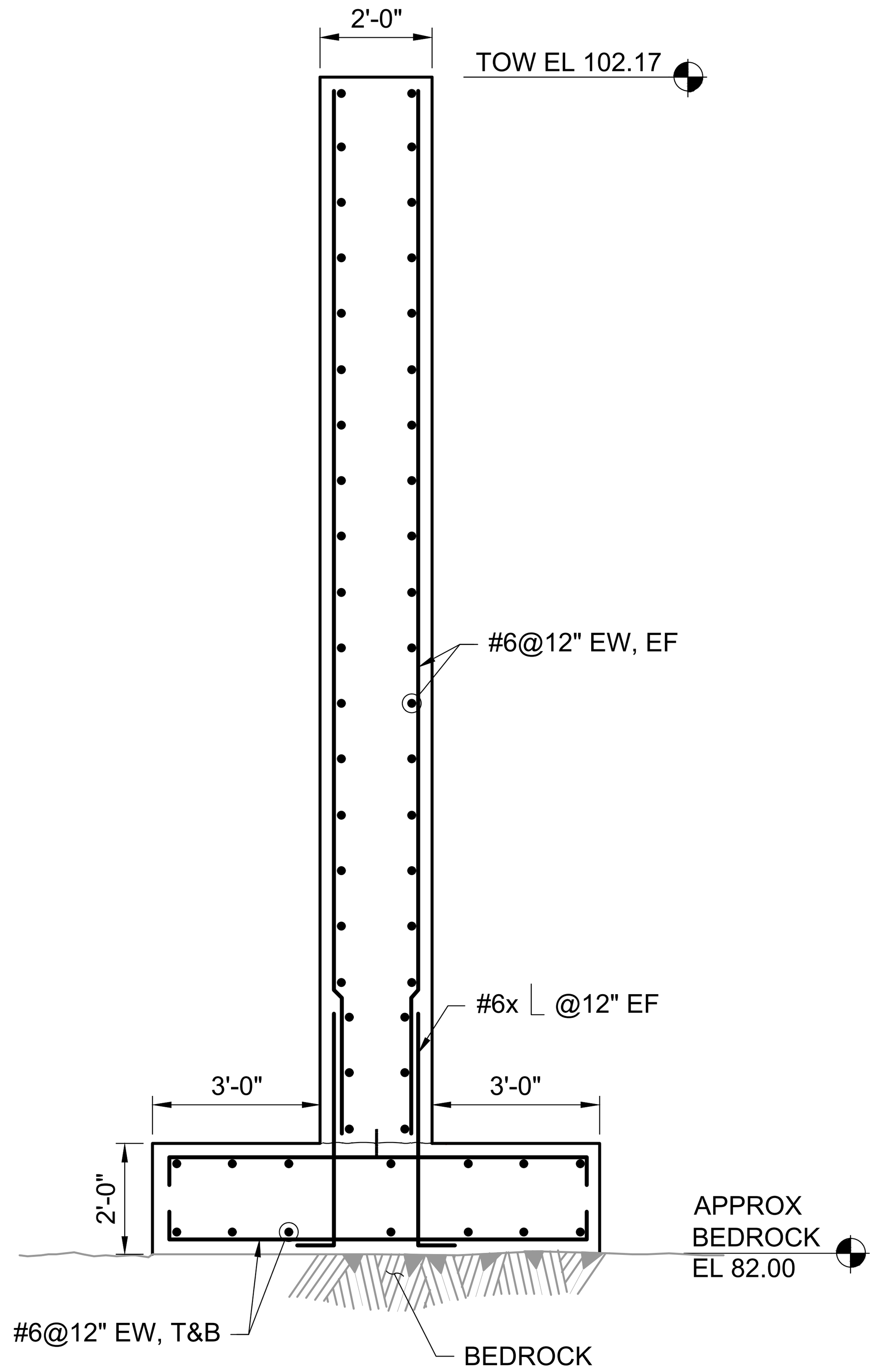
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

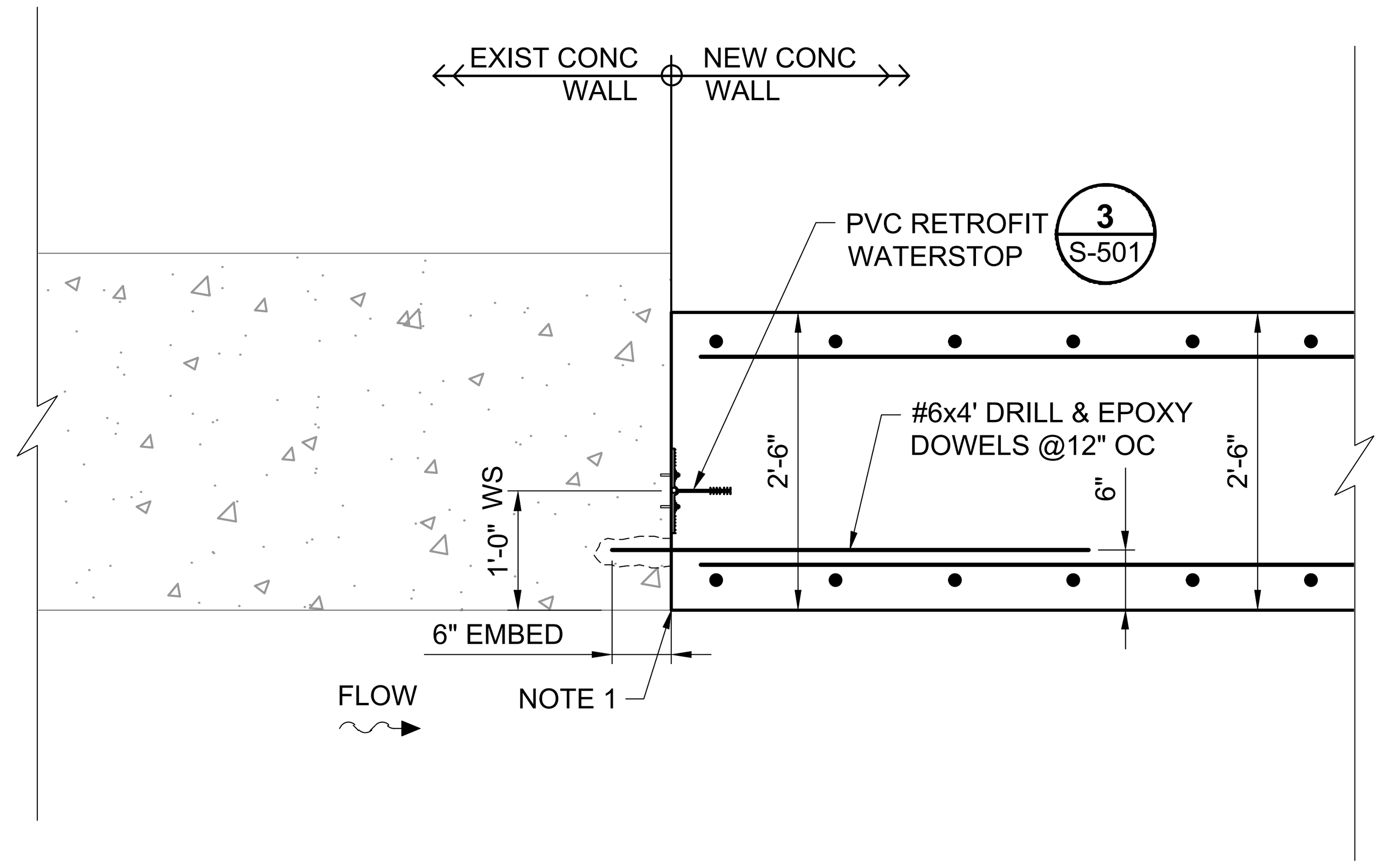
UNIT 7 & 8 FISH PASSAGE
CONCRETE SECTIONS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 74 OF 176
DRAWING: S-304



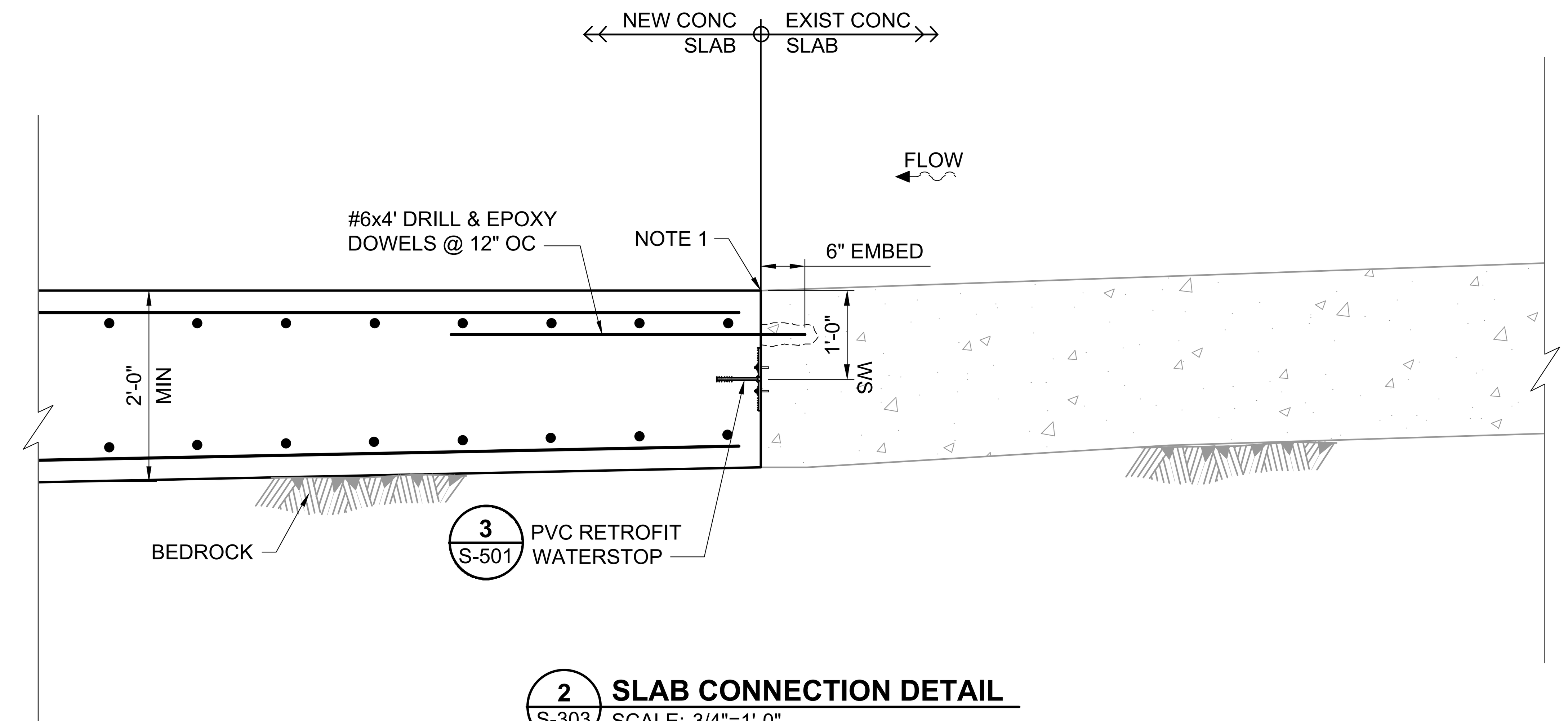
A SECTION
S-301 SCALE: 3/8"=1'-0"
S-302

NOTE:
1. TRANSITION BETWEEN EXISTING CONCRETE AND NEW CONCRETE SHALL BE HYDRAULICALLY SMOOTH.

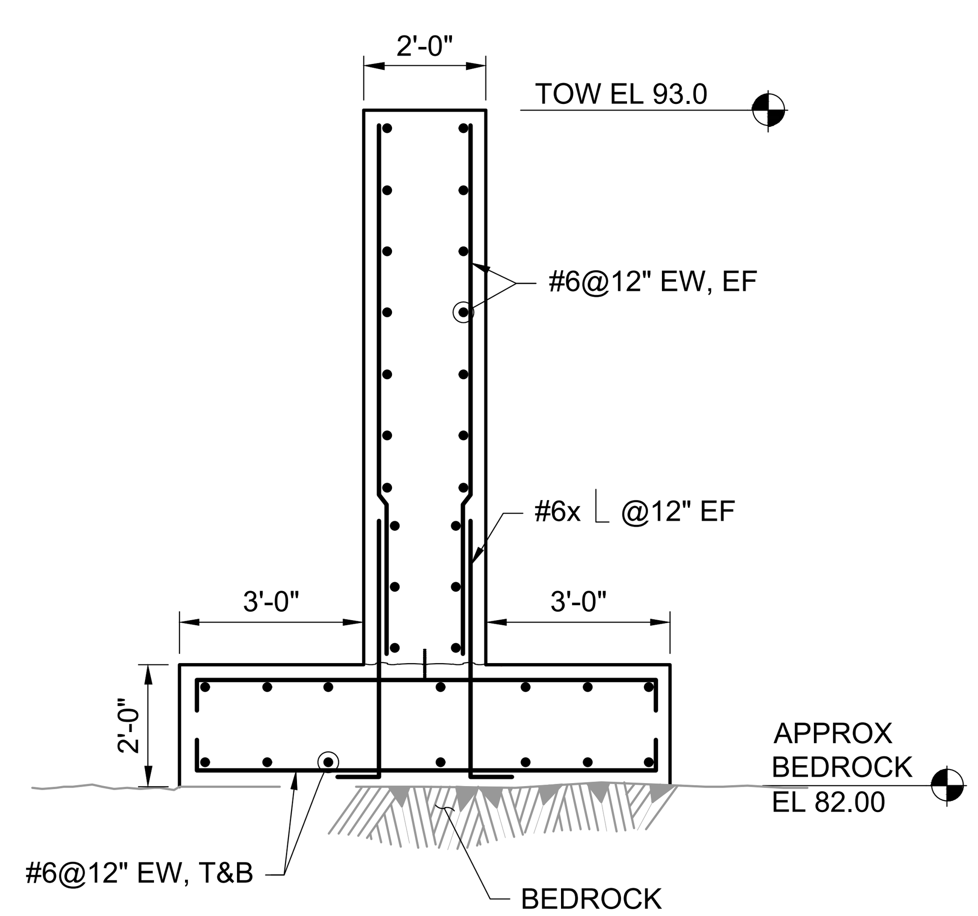


1 WALL CONNECTION DETAIL
S-301 SCALE: 3/4"=1'-0"

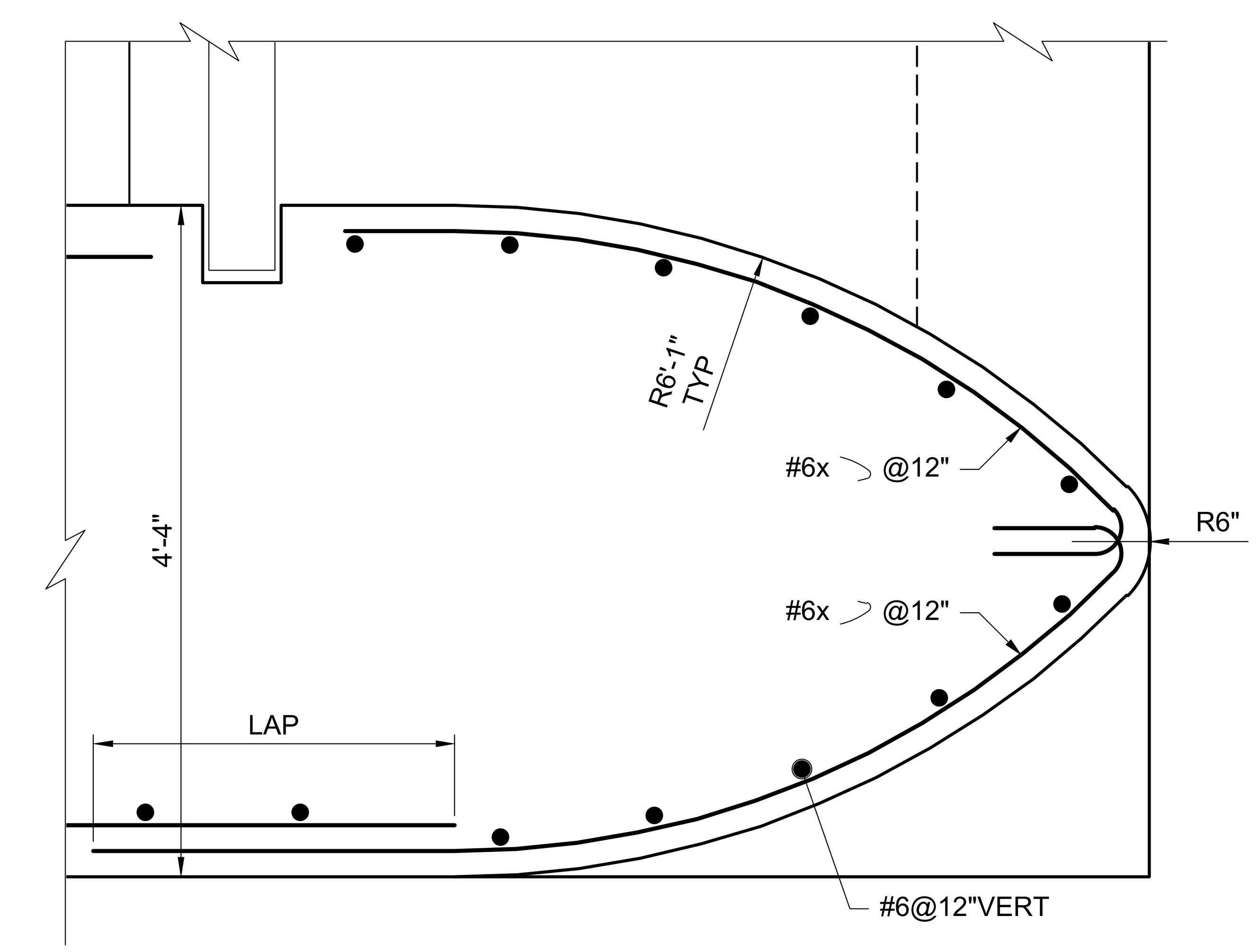
NOTE:
1. TRANSITION BETWEEN EXISTING CONCRETE AND NEW CONCRETE SHALL BE HYDRAULICALLY SMOOTH.



2 SLAB CONNECTION DETAIL
S-303 SCALE: 3/4"=1'-0"



B SECTION
S-301 SCALE: 3/8"=1'-0"



3 ENLARGED PLAN
S-302 SCALE: 1"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No. 39328 — LICENSED — PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE CONCRETE SECTIONS & DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 75 OF 176
DRAWING: S-305

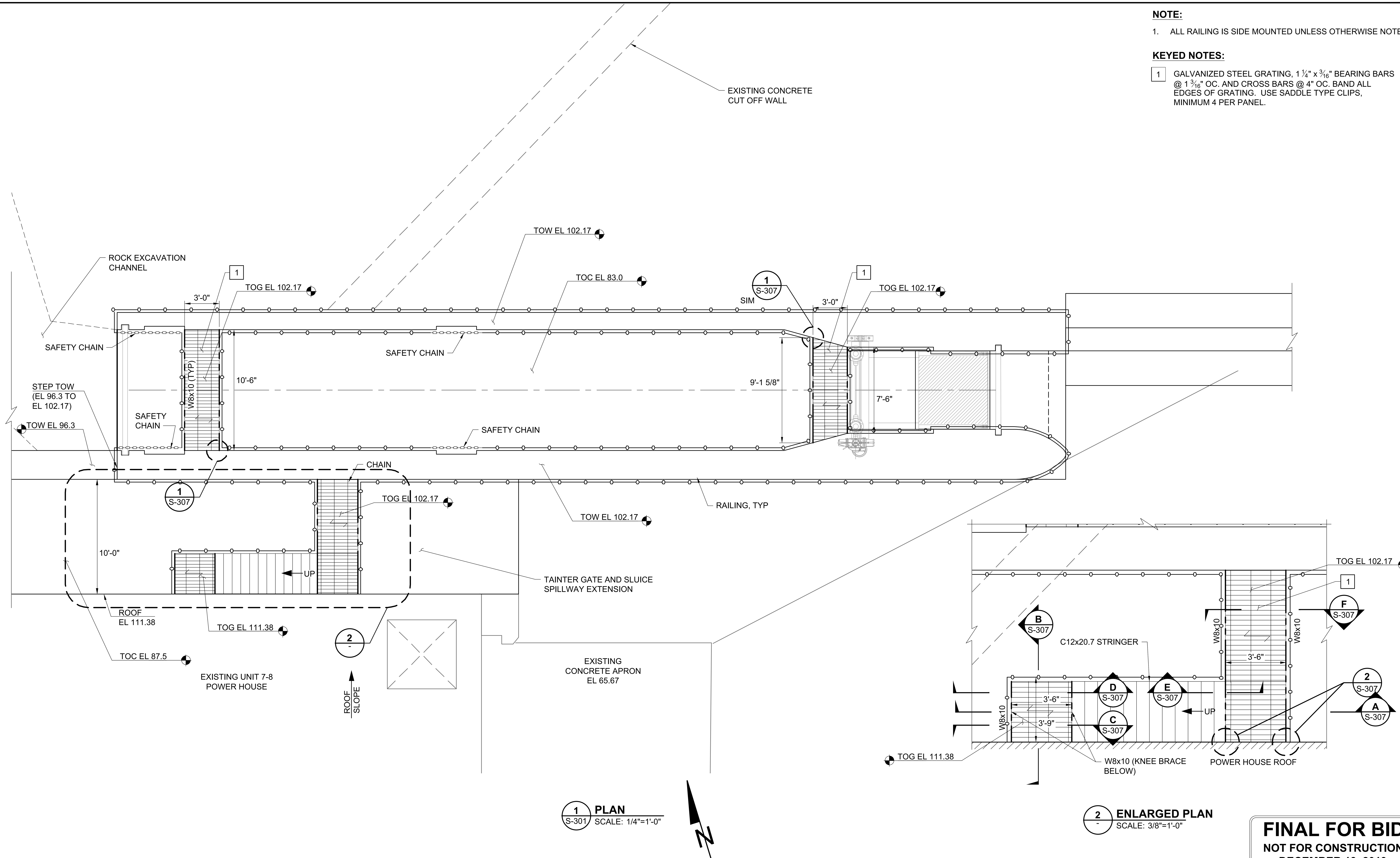
DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mes and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-305.dwg USER: Agrogan IMAGES:
DATE: Dec 13, 2019 2:38pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S-SHWMT-FISHWAY-SC S3-SHWMT-FFP S3-SHWMT-EFP MAINE-PE-STAMP-MDG

NOTE:

1. ALL RAILING IS SIDE MOUNTED UNLESS OTHERWISE NOTED.

KEYED NOTES:

[1] GALVANIZED STEEL GRATING, 1 1/4" x 3/16" BEARING BARS @ 1 3/16" OC. AND CROSS BARS @ 4" OC. BAND ALL EDGES OF GRATING. USE SADDLE TYPE CLIPS, MINIMUM 4 PER PANEL.



FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE STEEL GRATING AND STAIR PLAN

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	76 OF 176
DRAWING:	S-306

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE STEEL, SECTIONS & DETAILS

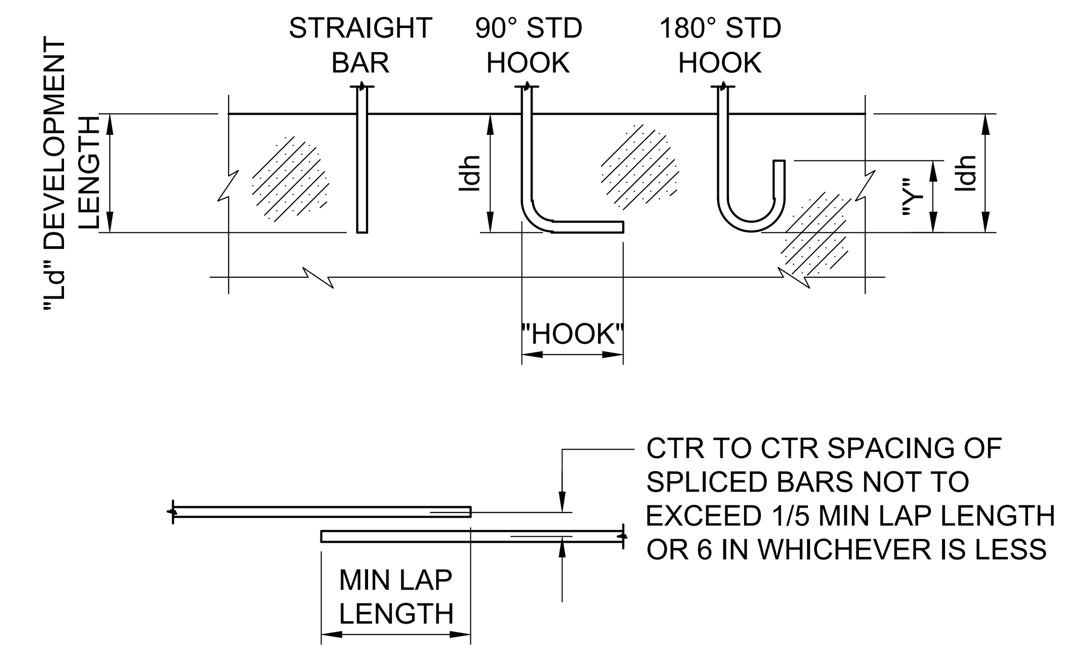
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	77 OF 176
DRAWING:	S-307

f'c = 4500 psi	fy = 60,000 psi	bar spacing = 6" min						
BAR SIZE	DIAMETER (d_b) (INCHES)	DEVELOPMENT LENGTH (L_d) (INCHES)		CLASS B LAP SPLICE (INCHES)		90° STD HOOK (INCHES)		180° STD HOOK "Y"
		"TOP" BARS	OTHER	"TOP" BARS	OTHER	HOOK	l_{dh}	
REINFORCING BARS IN TENSION								
#3	0.375	12	12	16	16	6	6	4
#4	0.5	14	12	19	16	8	7	5
#5	0.625	18	14	24	19	10	8	5
#6	0.75	21	17	28	23	12	10	6
#7	0.875	31	24	41	32	14	11	7
#8	1.0	35	27	46	36	16	13	8
#9	1.128	44	34	58	45	20	15	11
#10	1.270	52	40	68	52	22	16	12
#11	1.375	62	48	81	63	24	18	13
REINFORCING BARS IN COMPRESSION								
#3	0.375	8		12		HOOKED BARS SHALL NOT BE USED IN COMPRESSION		
#4	0.5	9		15				
#5	0.625	12		19				
#6	0.75	14		23				
#7	0.875	16		27				
#8	1.0	18		30				
#9	1.125	21		34				
#10	1.270	23		38				
#11	1.375	25		42				

f'c = 4500 psi	fy = 60,000 psi	bar spacing = $2*d_b$ min						
BAR SIZE	DIAMETER (d_b) (INCHES)	DEVELOPMENT LENGTH (L_d) (INCHES)		CLASS B LAP SPLICE (INCHES)		90° STD HOOK (INCHES)		180° STD HOOK "Y"
		"TOP" BARS	OTHER	"TOP" BARS	OTHER	HOOK	l_{dh}	
REINFORCING BARS IN TENSION								
#3	0.375	27	21	36	28	6	6	4
#4	0.5	35	27	46	36	8	7	5
#5	0.625	44	34	58	45	10	8	6
#6	0.75	53	41	69	54	12	10	6
#7	0.875	77	59	101	77	14	11	7
#8	1.0	88	68	115	89	16	13	8
#9	1.128	98	76	128	99	20	15	11
#10	1.270	108	83	141	108	22	16	12
#11	1.375	147	113	192	147	24	18	13
REINFORCING BARS IN COMPRESSION								
#3	0.375	8		12		HOOKED BARS SHALL NOT BE USED IN COMPRESSION		
#4	0.5	9		15				
#5	0.625	12		19				
#6	0.75	14		23				
#7	0.875	16		27				
#8	1.0	18		30				
#9	1.125	21		34				
#10	1.270	23		38				
#11	1.375	25		42				

NOTES:

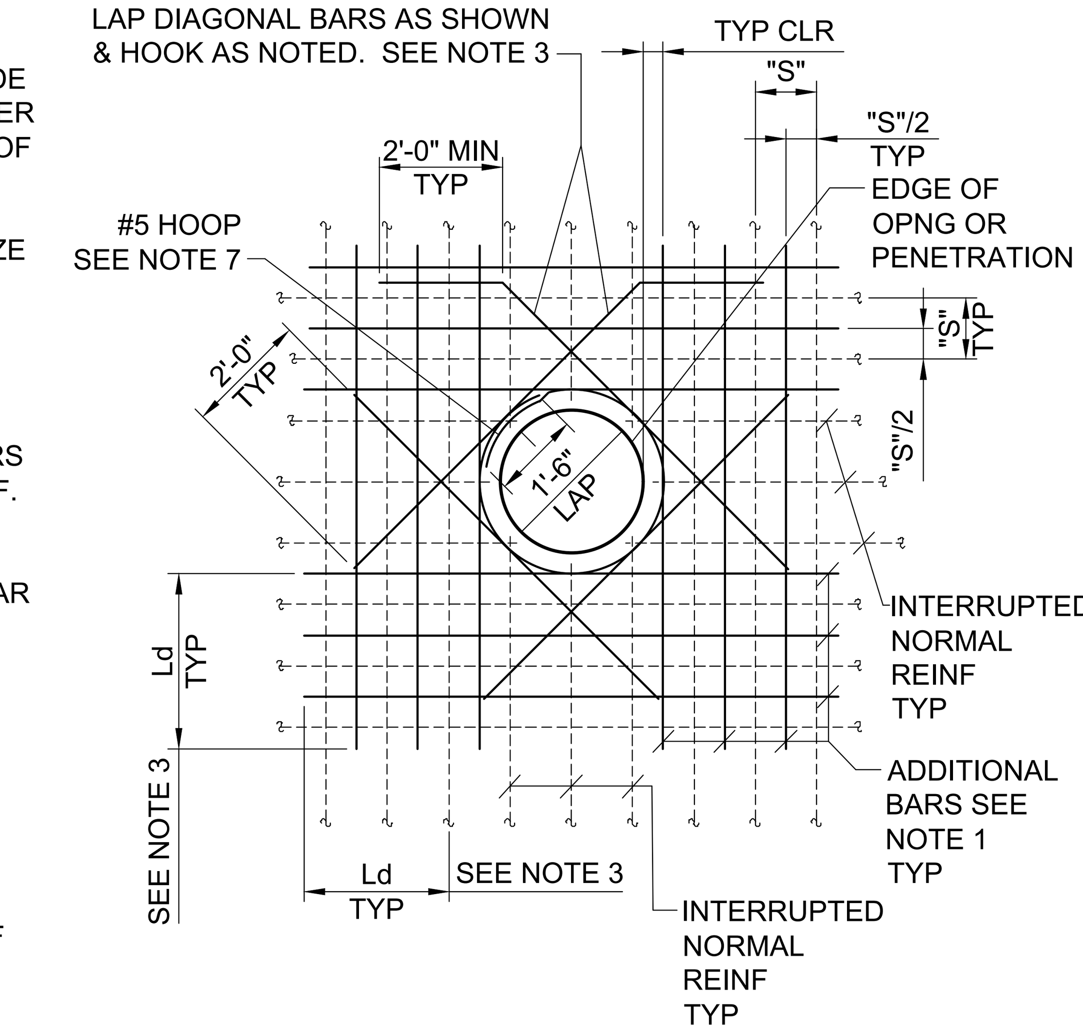
1. "TOP" BARS SHALL BE HORIZONTAL REINFORCEMENT PLACED SO THAT MORE THAN 12" OF FRESH CONCRETE IS CAST IN THE MEMBER BELOW THE DEVELOPMENT LENGTH OR SPLICE.
2. ALL LAP SPLICES SHALL BE CLASS B UNLESS NOTED OTHERWISE.
3. SPLICES ARE TO BE MADE SO THAT THE GIVEN DISTANCES TO FACE OF CONCRETE WILL BE MAINTAINED.

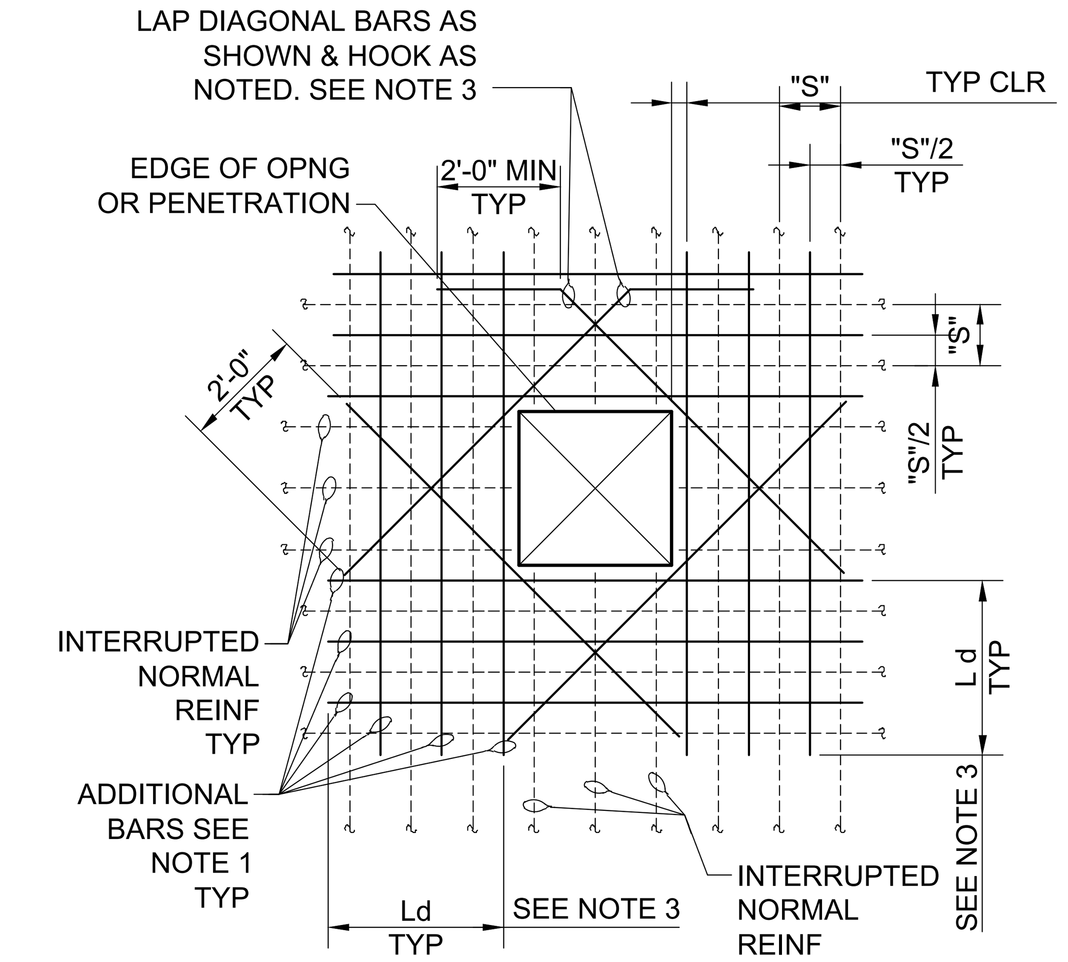


1 STANDARD HOOK AND REINF LAP SPLICE
SCALE: NTS

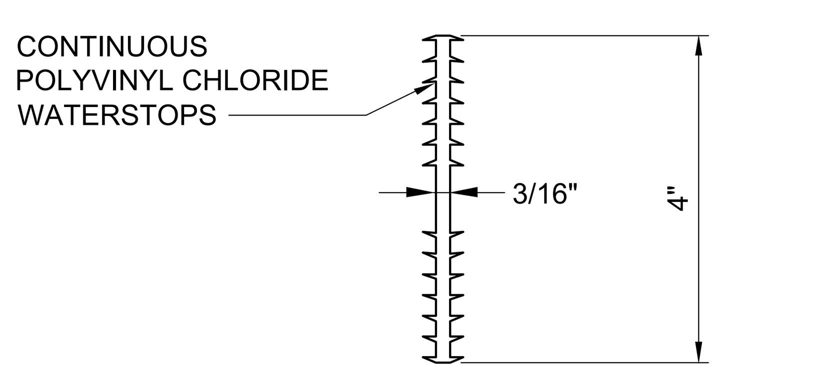
NOTES:

1. NUMBER OF ADD'L REINF BARS AT EA SIDE OF OPNG SHALL EQUAL HALF THE NUMBER OF INTERRUPTED BARS IN EACH LAYER OF REINF, 2 MIN.
2. SIZE OF ADD'L REINF BARS TO EQUAL SIZE OF INTERRUPTED REINF BARS.
3. PROVIDE STD HOOKS FOR BARS IF LAP LENGTH EXTENSION CANNOT BE OBTAINED AT JOINTS OR OTHER OBSTRUCTIONS. PLACE ADDITIONAL BARS IN SAME PLANES AS INTERRUPTED REINF.
4. SIZE OF DIAGONAL BARS SHALL BE THE SIZE OF THE LARGEST NORMAL REINF BAR CUT, UON. LOCATE DIAGONALS IN EACH LAYER OF REINF.
5. PLACE DIAGONAL BARS INSIDE NORMAL REINF.
6. ALL REINF TO CLEAR OPNG OR FLANGE COLLARS BY 2".
7. PROVIDE ADD'L HOOP @ EACH LAYER OF REINF.



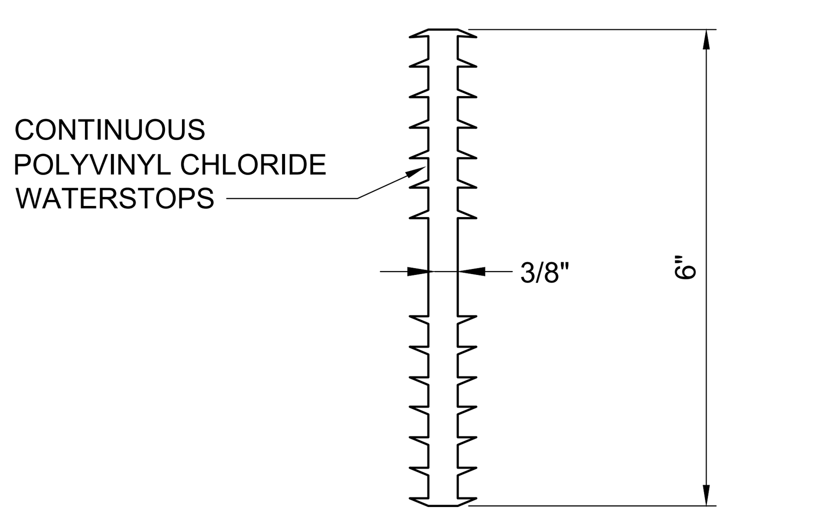


2 ADDITIONAL REINF BAR DETAILS
SCALE: NTS



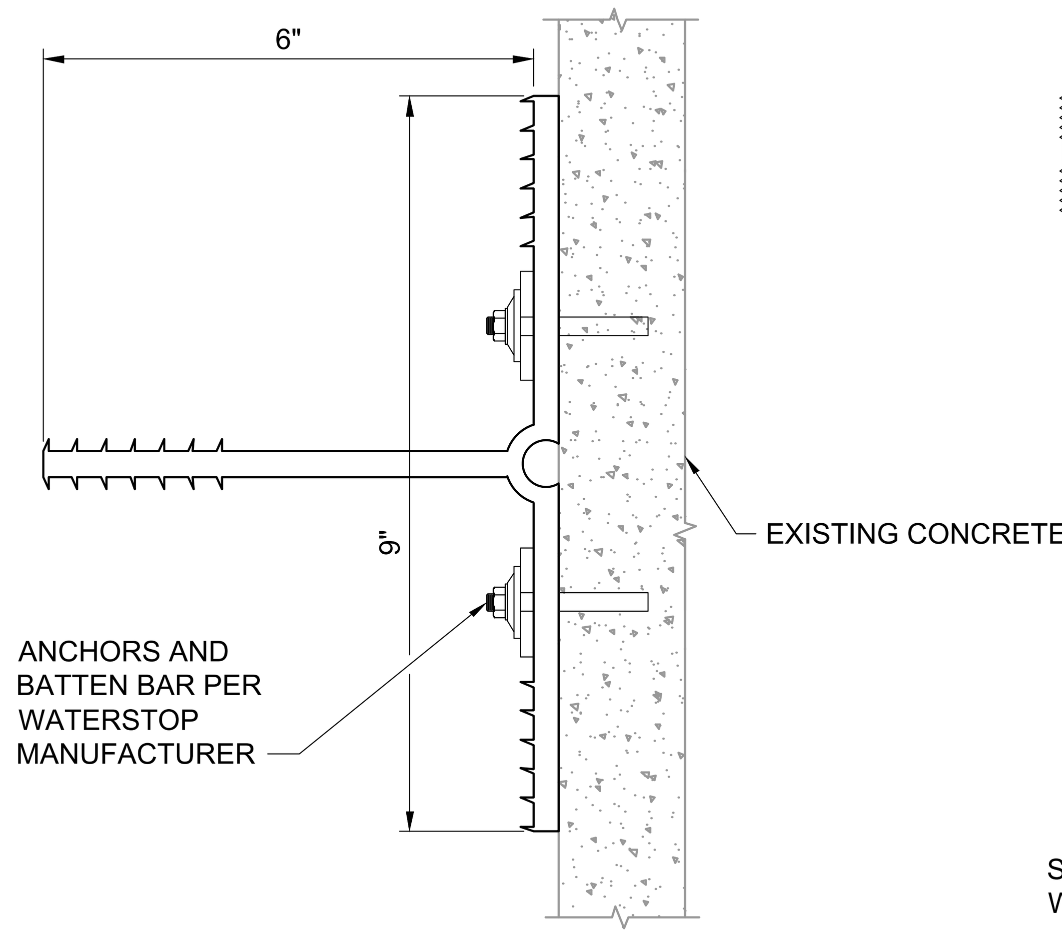
SEE JT NOTES & SPECIFICATIONS FOR REQD LOCATIONS

4" PVC FLAT WATERSTOP



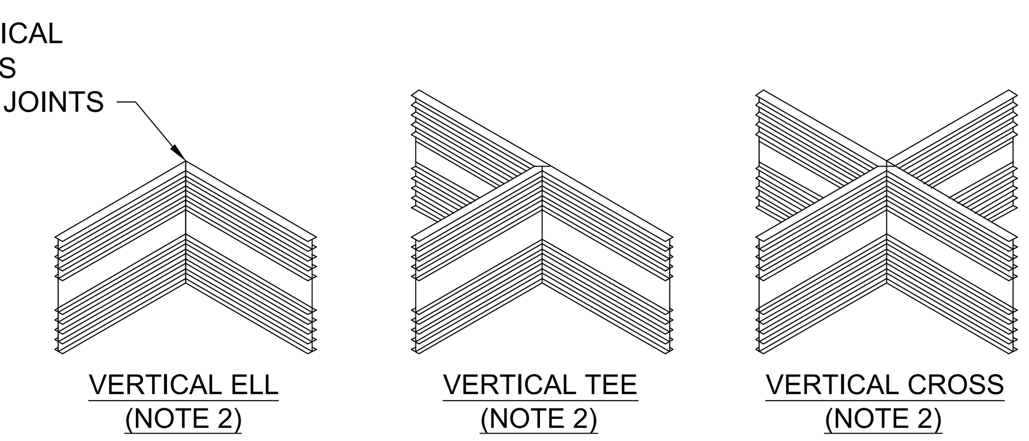
SEE JT NOTES & SPECIFICATIONS FOR REQD LOCATIONS

6" PVC FLAT WATERSTOP

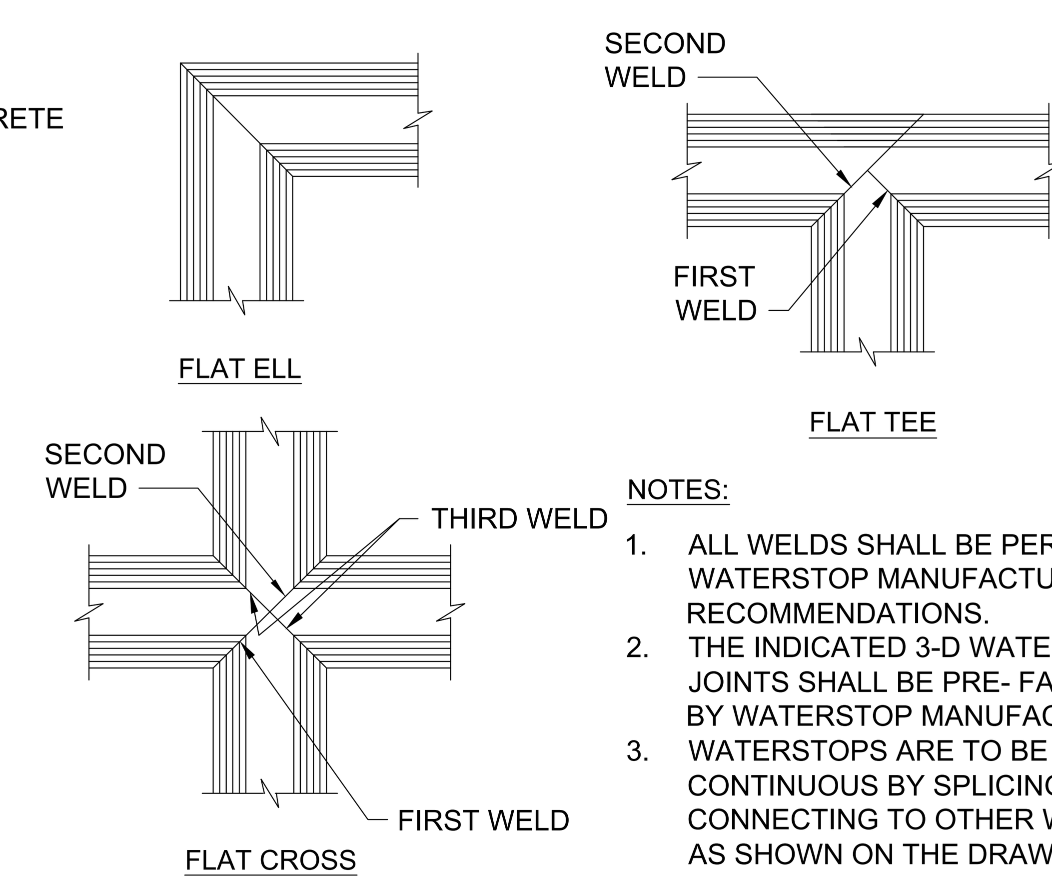


SEE JT NOTES & SPECIFICATIONS FOR REQD LOCATIONS

6" PVC CENTER BULB RETROFIT WATERSTOP



WATERSTOP 3-D JOINTS

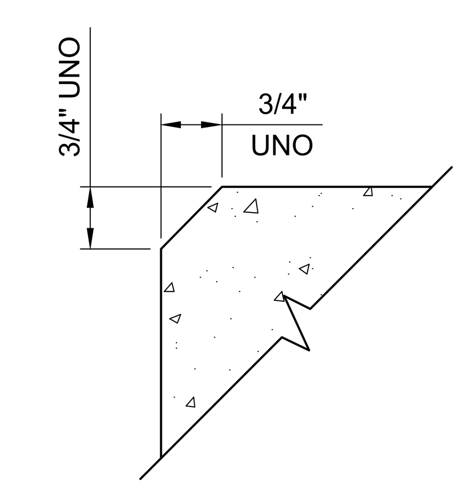


NOTES:

1. ALL WELDS SHALL BE PER WATERSTOP MANUFACTURER'S RECOMMENDATIONS.
2. THE INDICATED 3-D WATERSTOP JOINTS SHALL BE PRE- FABRICATED BY WATERSTOP MANUFACTURER.
3. WATERSTOPS ARE TO BE MADE CONTINUOUS BY SPLICING AND CONNECTING TO OTHER WATERSTOPS AS SHOWN ON THE DRAWINGS.

WATERSTOP SPLICE DETAILS

3 PVC WATERSTOPS
SCALE: NTS



4 CHAMFER DETAIL
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

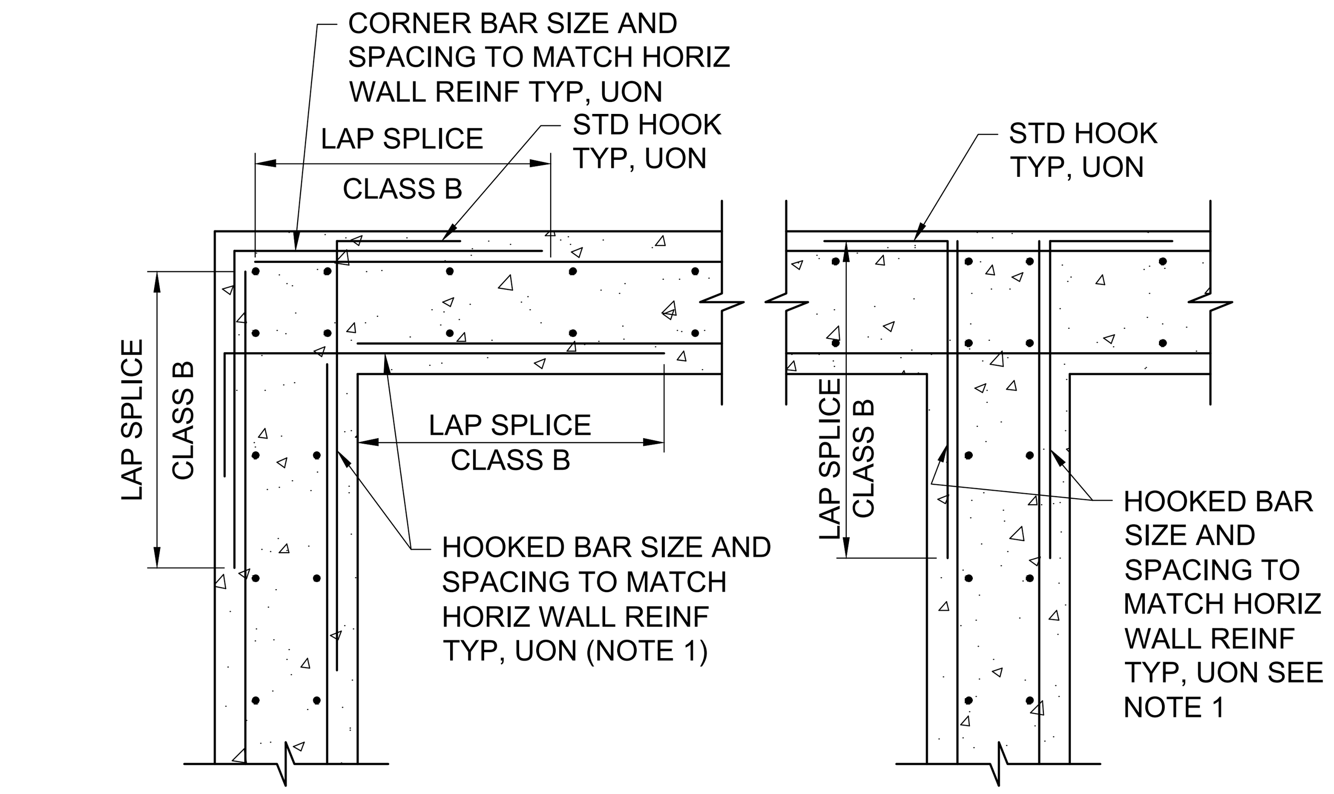
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

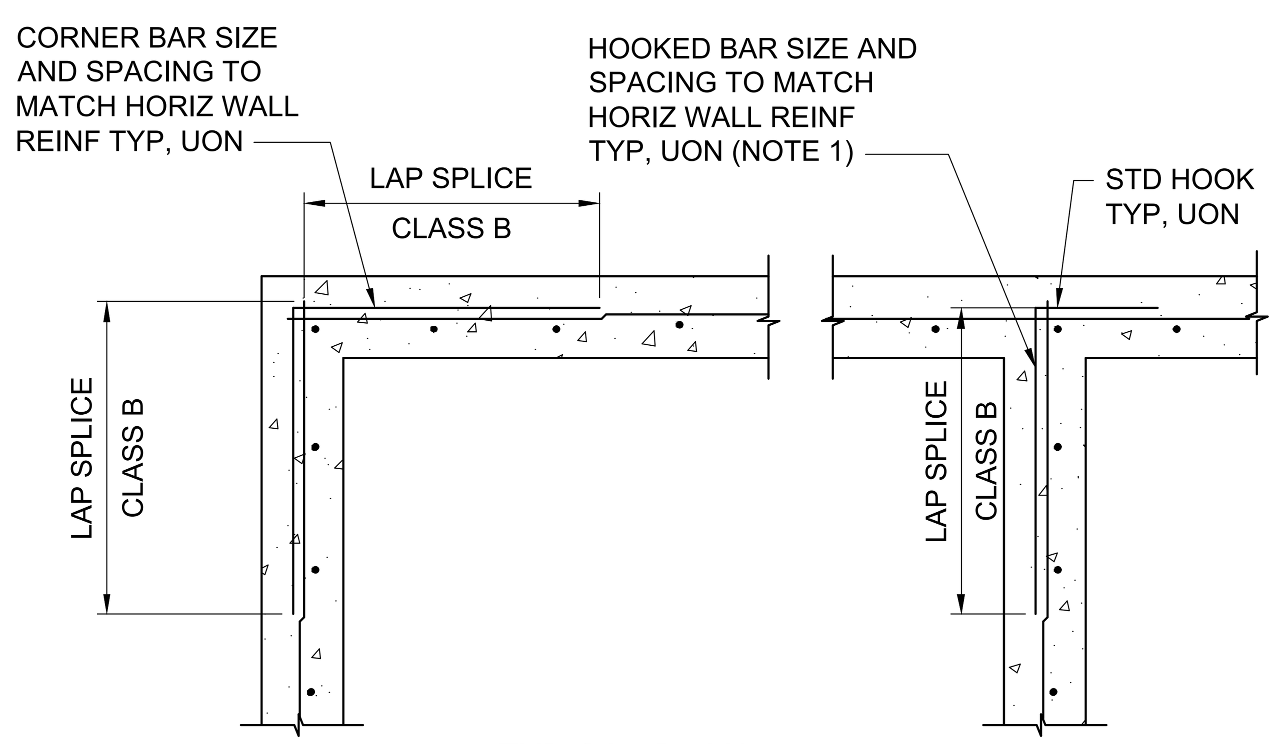
STRUCTURAL STANDARD DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	78 OF 176
DRAWING:	S-501

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mass and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-501.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:



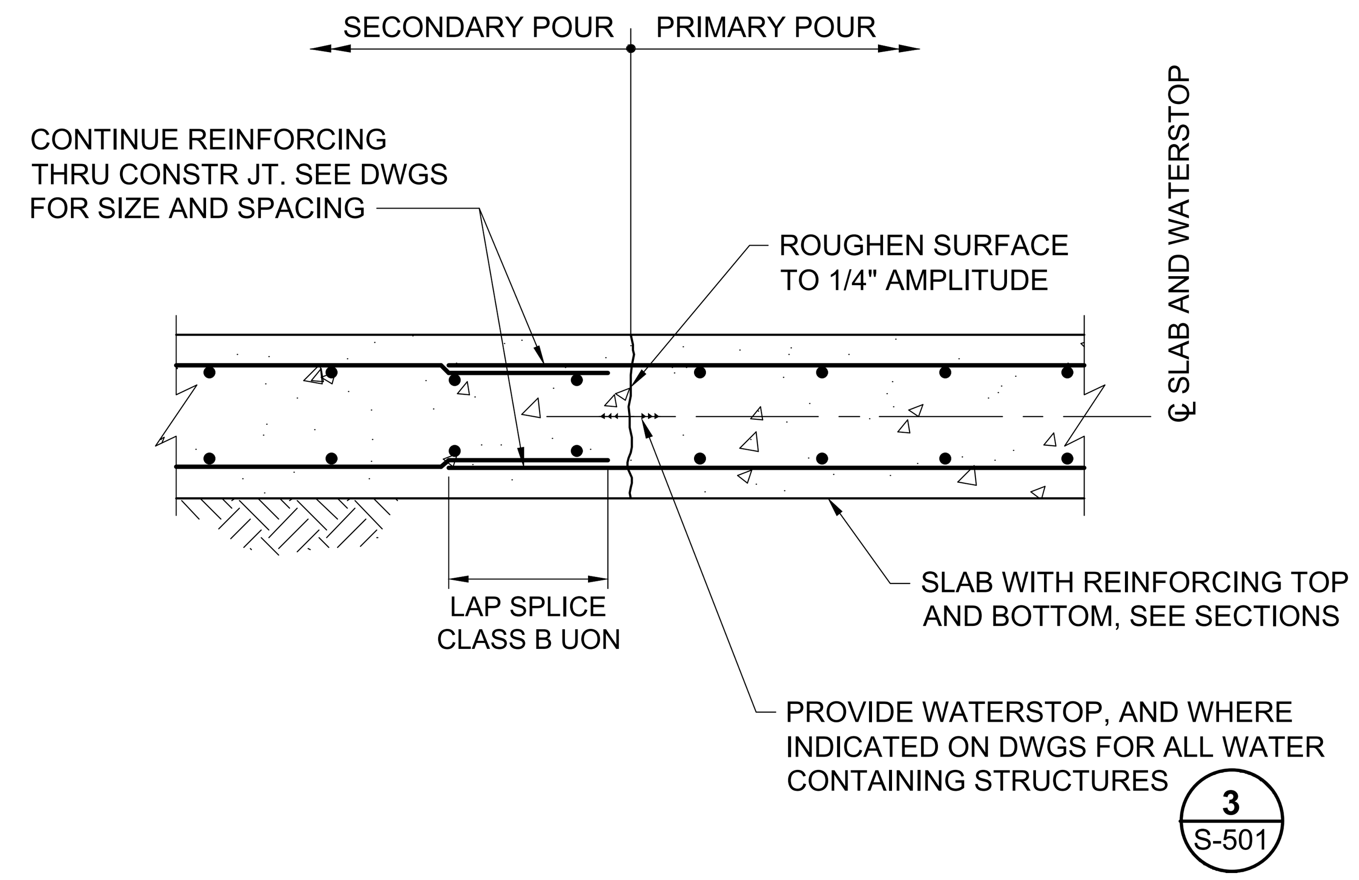
TYPICAL PLAN
REINFORCING EACH FACE



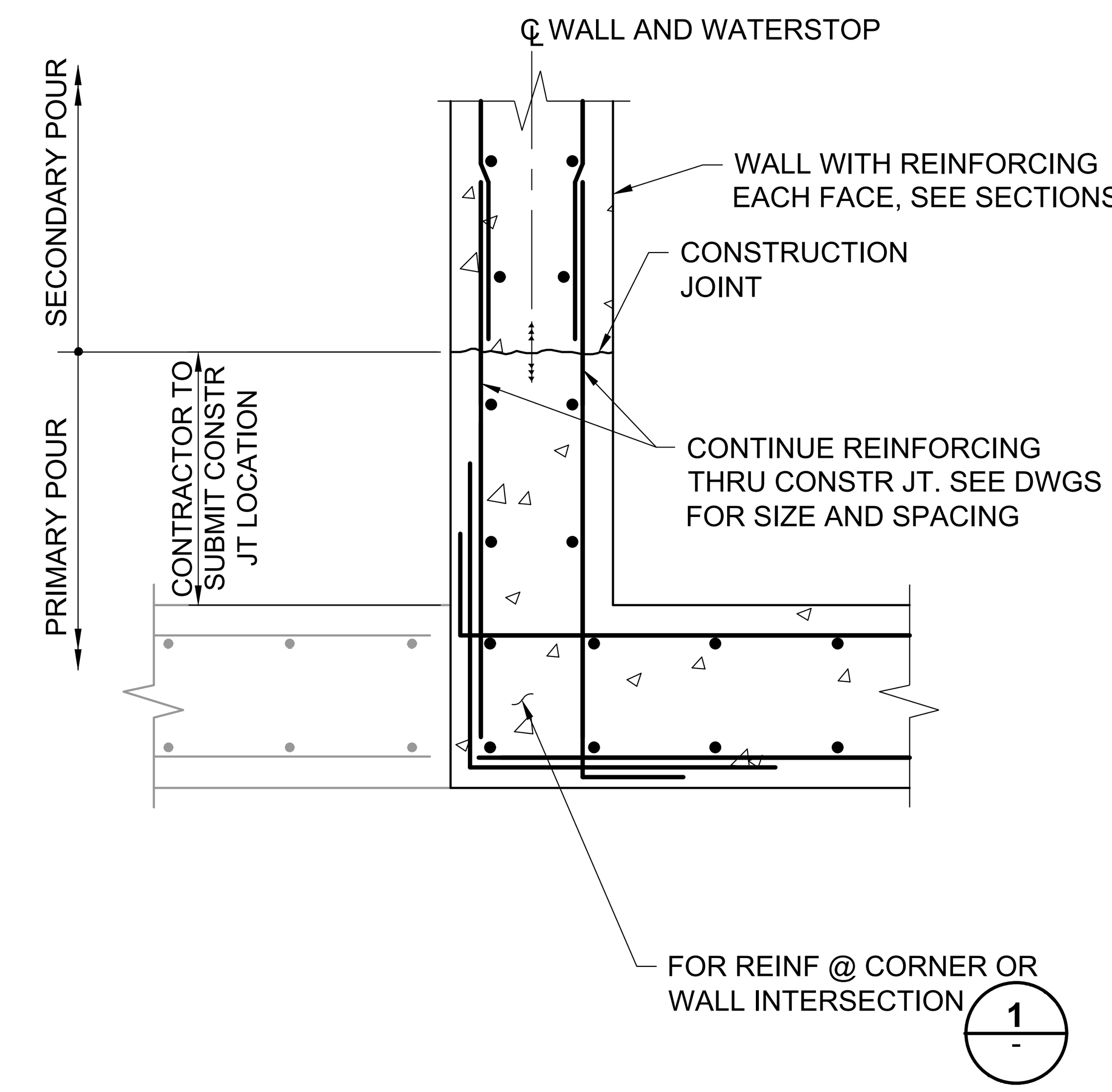
TYPICAL PLAN
SINGLE LAYER REINFORCING

NOTE:
IN LIEU OF SEPARATE HOOKED BAR, CONTRACTOR OPTION TO USE HORIZ REINF WITH STD HOOK EA END.

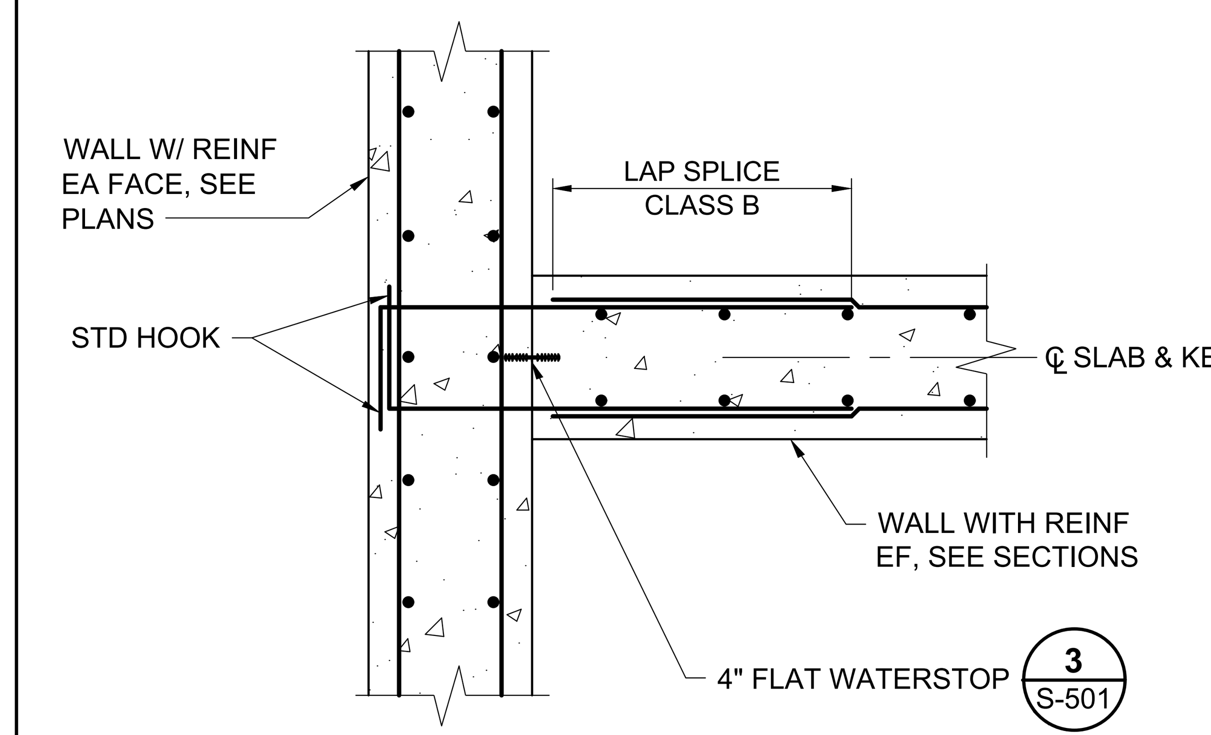
1 WALL INTERSECTION / CORNER REINF
SCALE: NTS



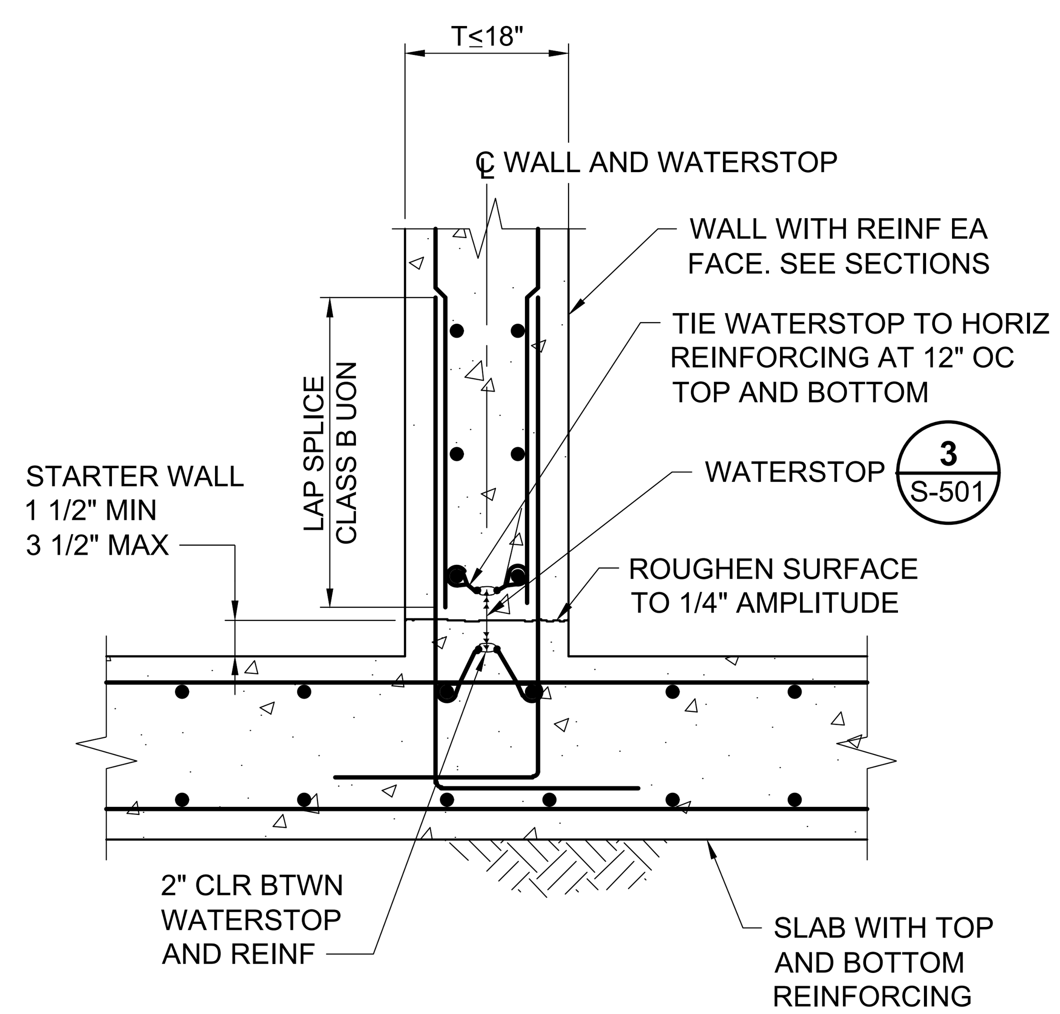
2 CONSTRUCTION JOINT (CJ)
SCALE: NTS



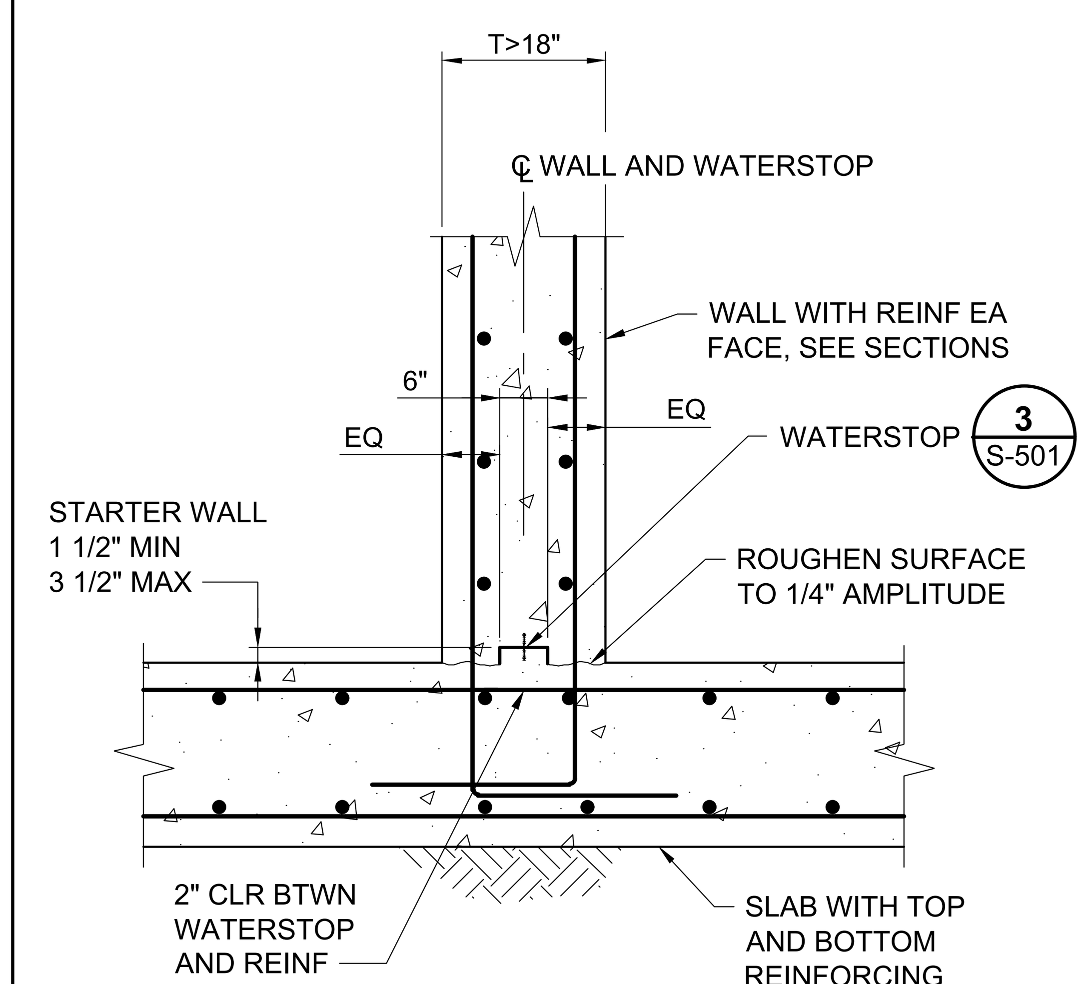
3 CONSTRUCTION JOINT-WALL TO WALL
SCALE: NTS



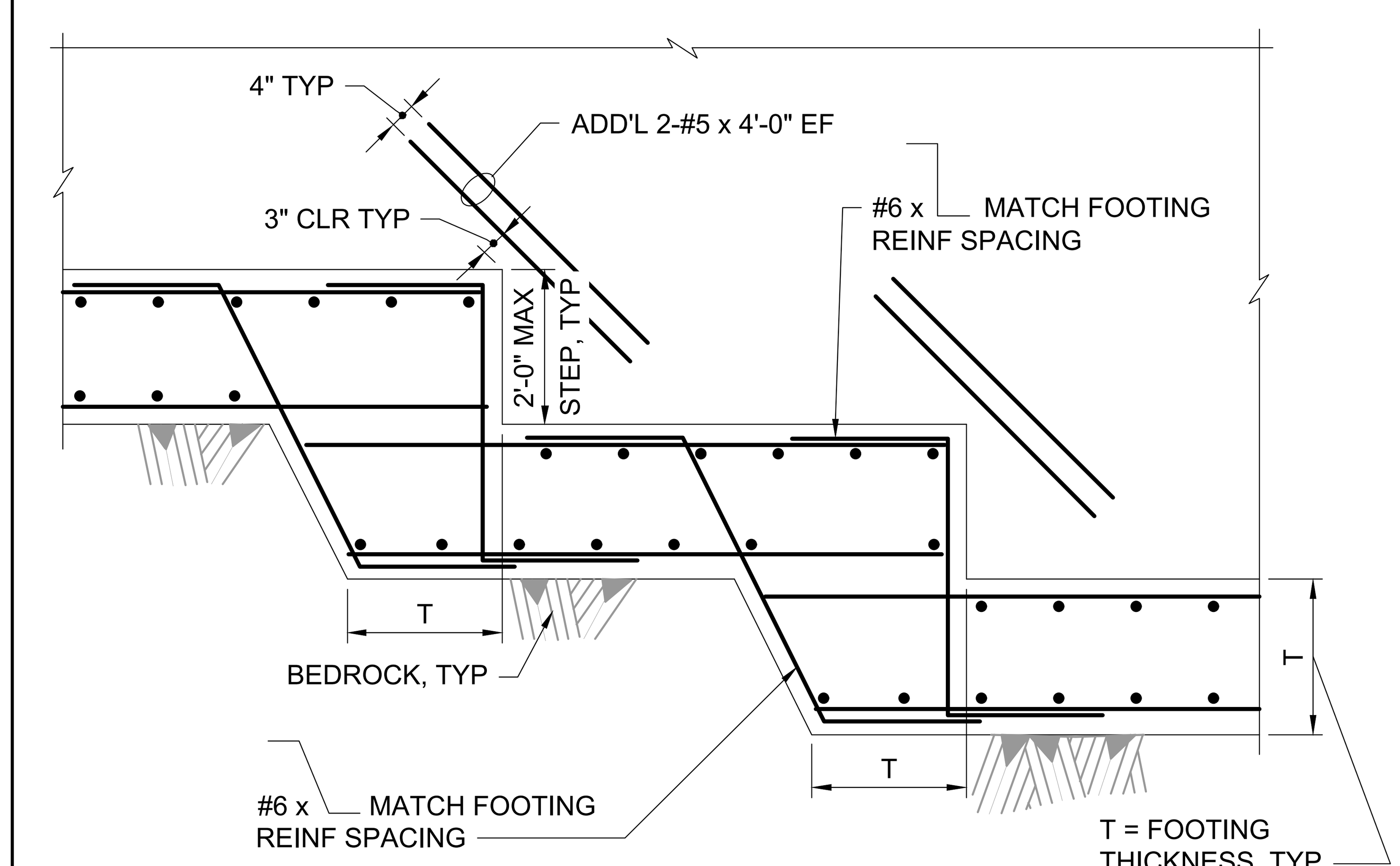
4 CONSTRUCTION JOINT-WALL TO WALL
SCALE: NTS



5 CONSTRUCTION JOINT-WALL TO SLAB (T<18")
SCALE: NTS



6 CONSTRUCTION JOINT WALL TO SLAB (T>18")
SCALE: NTS



7 STEPPED FOOTING
SCALE: 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden ness and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-502.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

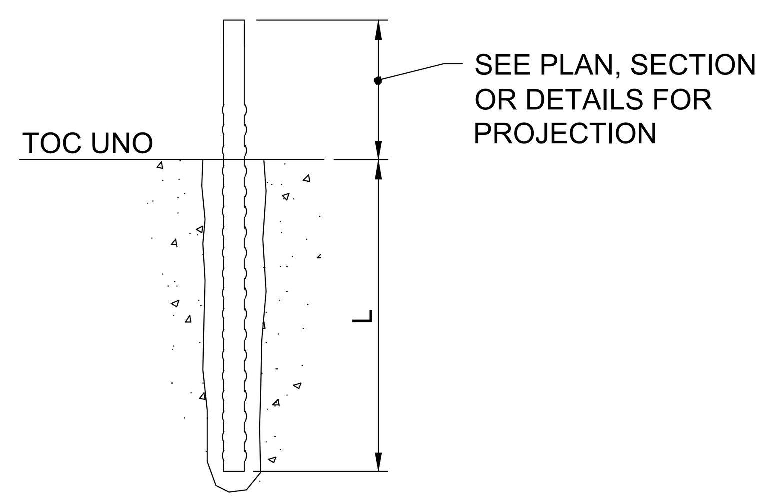
STRUCTURAL STANDARD DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 79 OF 176
DRAWING: S-502

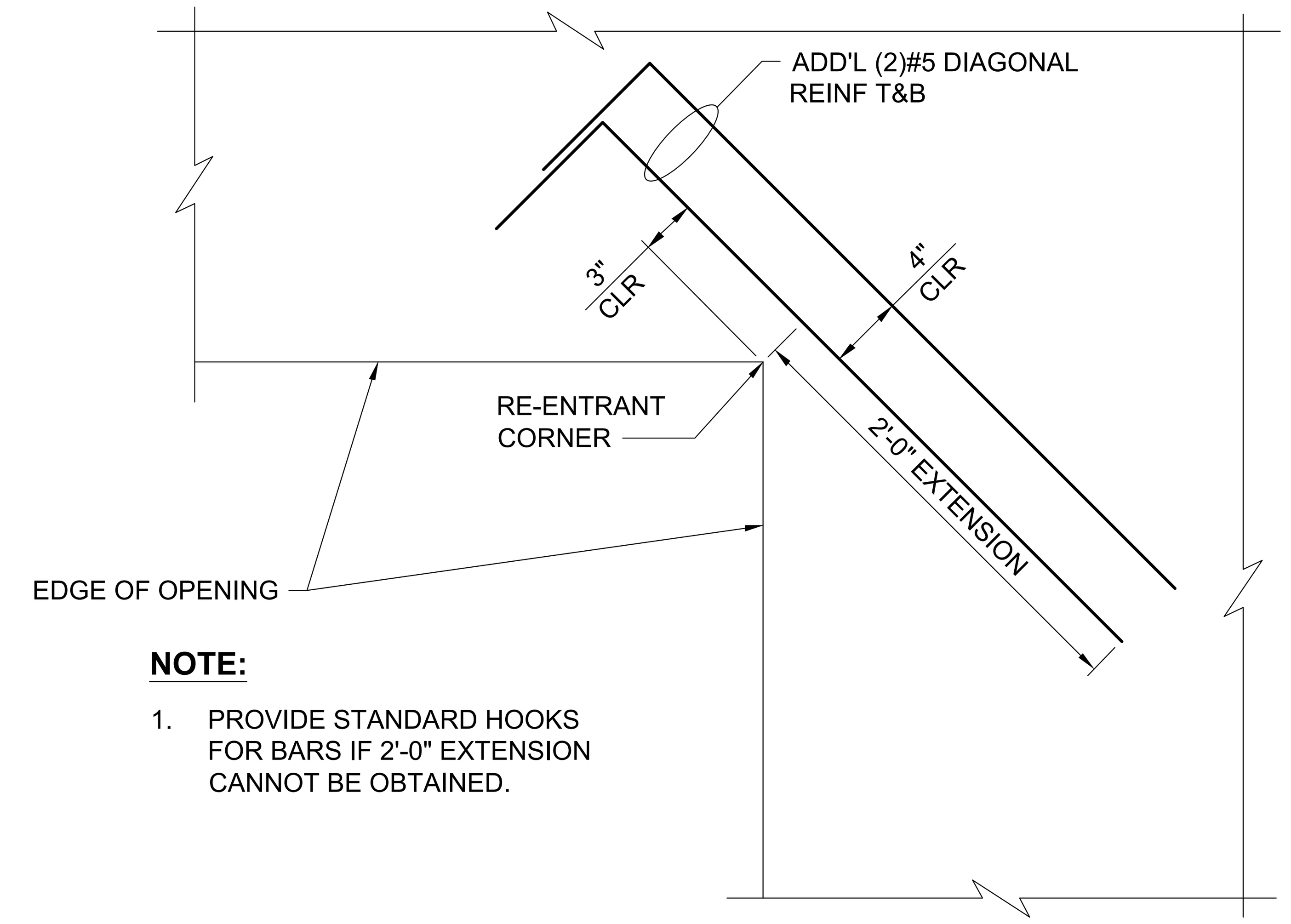
NOTES:

1. DOWEL EDGE DISTANCE SHALL BE A MINIMUM OF 1.5 X L, UNO ON THE DRAWINGS. SMALLER EDGE DISTANCES SHALL BE APPROVED BY THE ENGINEER OF RECORD.
2. MINIMUM CENTER TO CENTER SPACING OF DOWELS SHALL BE 3 X L, UNO ON THE DRAWINGS. SMALLER BOLT SPACINGS SHALL BE APPROVED BY THE ENGINEER OF RECORD.
3. HOLES SHALL BE DRILLED USING A HAMMER DRILL AND CARBIDE BIT, OR EQUAL.
4. REINFORCEMENT SHALL BE ASTM A615 GRADE 60.

BAR SIZE	"L" MIN (IN)
4	6
5	8
6	10
7	13.5
8	16
9	18.5
10	21



1 REBAR ADHESIVE ANCHOR DEAIL
SCALE: NTS

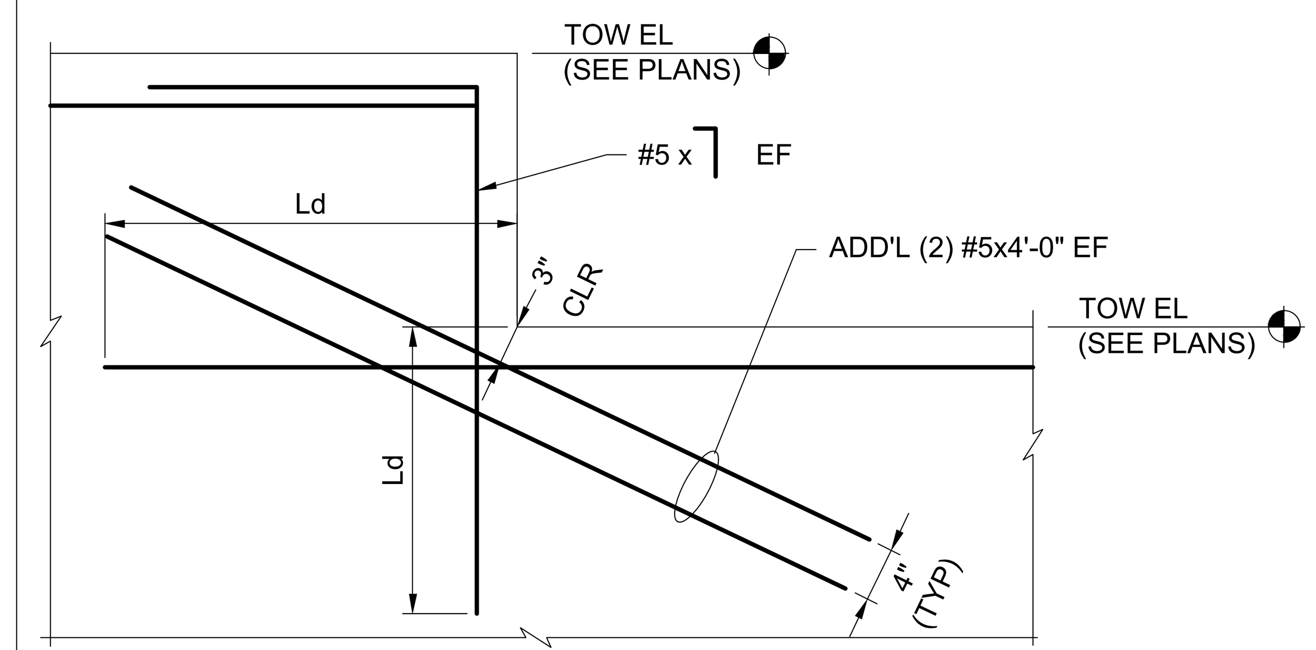


NOTE:
1. PROVIDE STANDARD HOOKS FOR BARS IF 2'-0" EXTENSION CANNOT BE OBTAINED.

PLAN

2 RE-ENTRANT CORNER DETAIL
SCALE: 1-1/2"=1'-0"

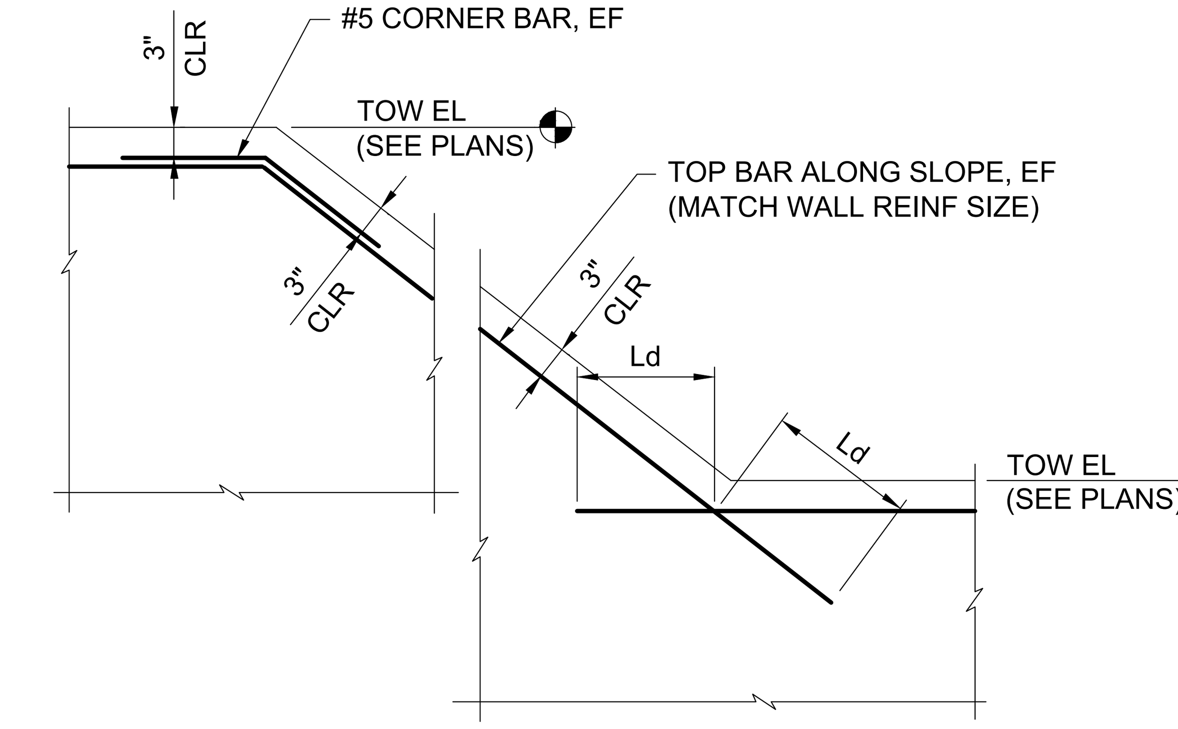
NOTE:
Ld SHALL BE DEVELOPMENT LENGTH PER DETAIL 1/S-501



ELEVATION

3 STEP IN TOP OF WALL DETAIL
SCALE: 1"=1'-0"

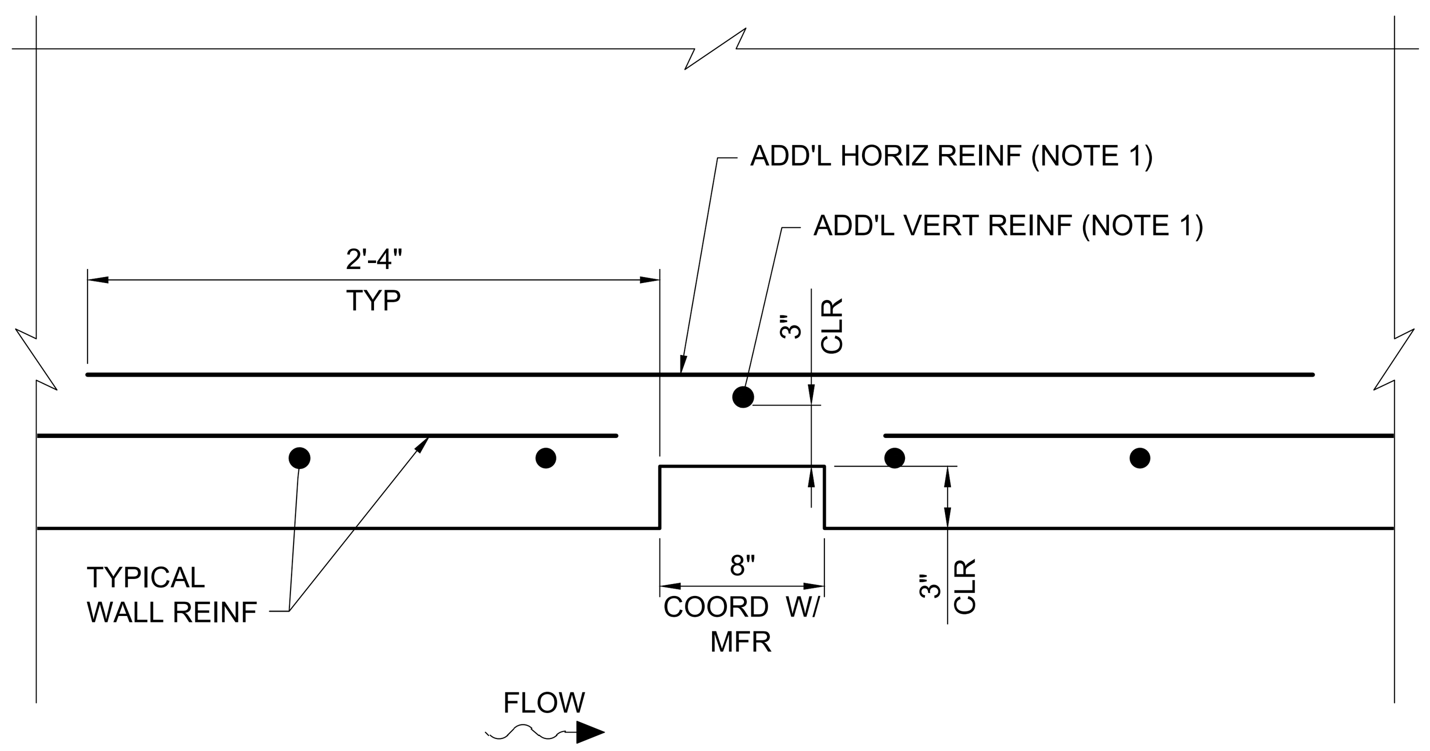
NOTE:
Ld SHALL BE DEVELOPMENT LENGTH PER DETAIL 1/S-501



ELEVATION

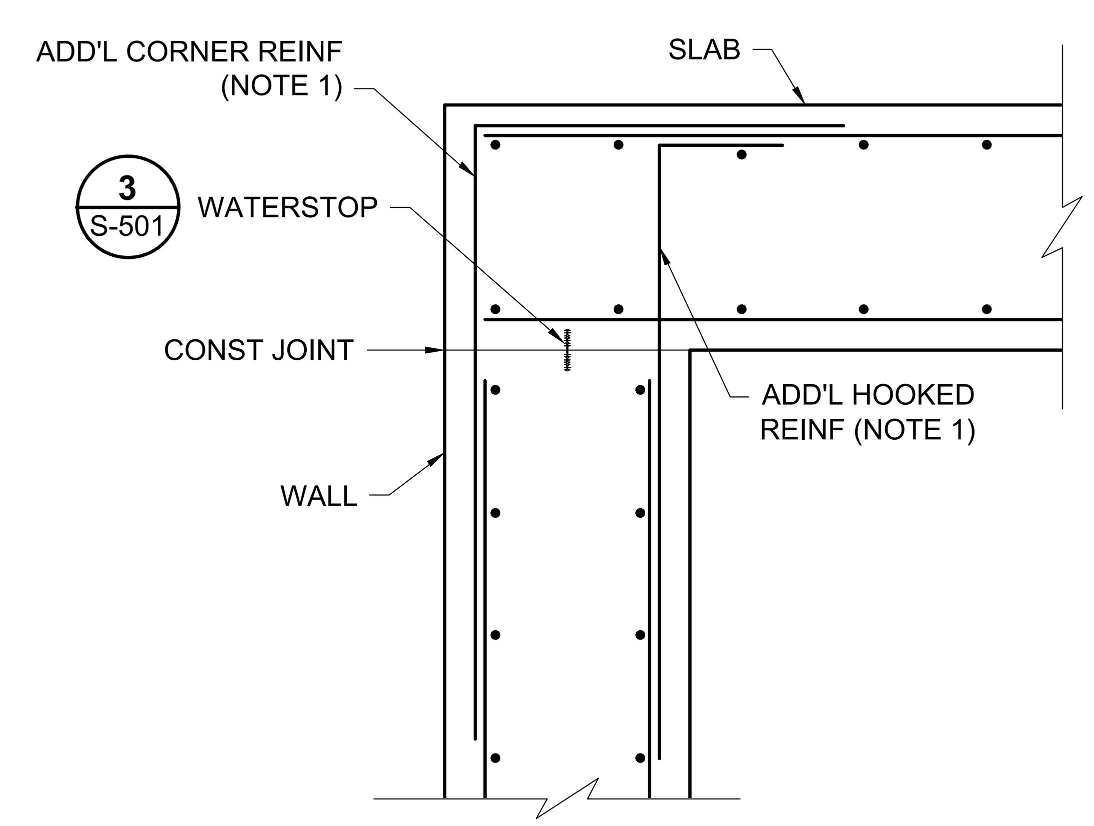
4 SLOPING TOP OF WALL DETAIL
SCALE: 1/4"=1'-0"

NOTE:
1. ADD'L REINF SIZE AND SPACING SHALL MATCH WALL REINF.



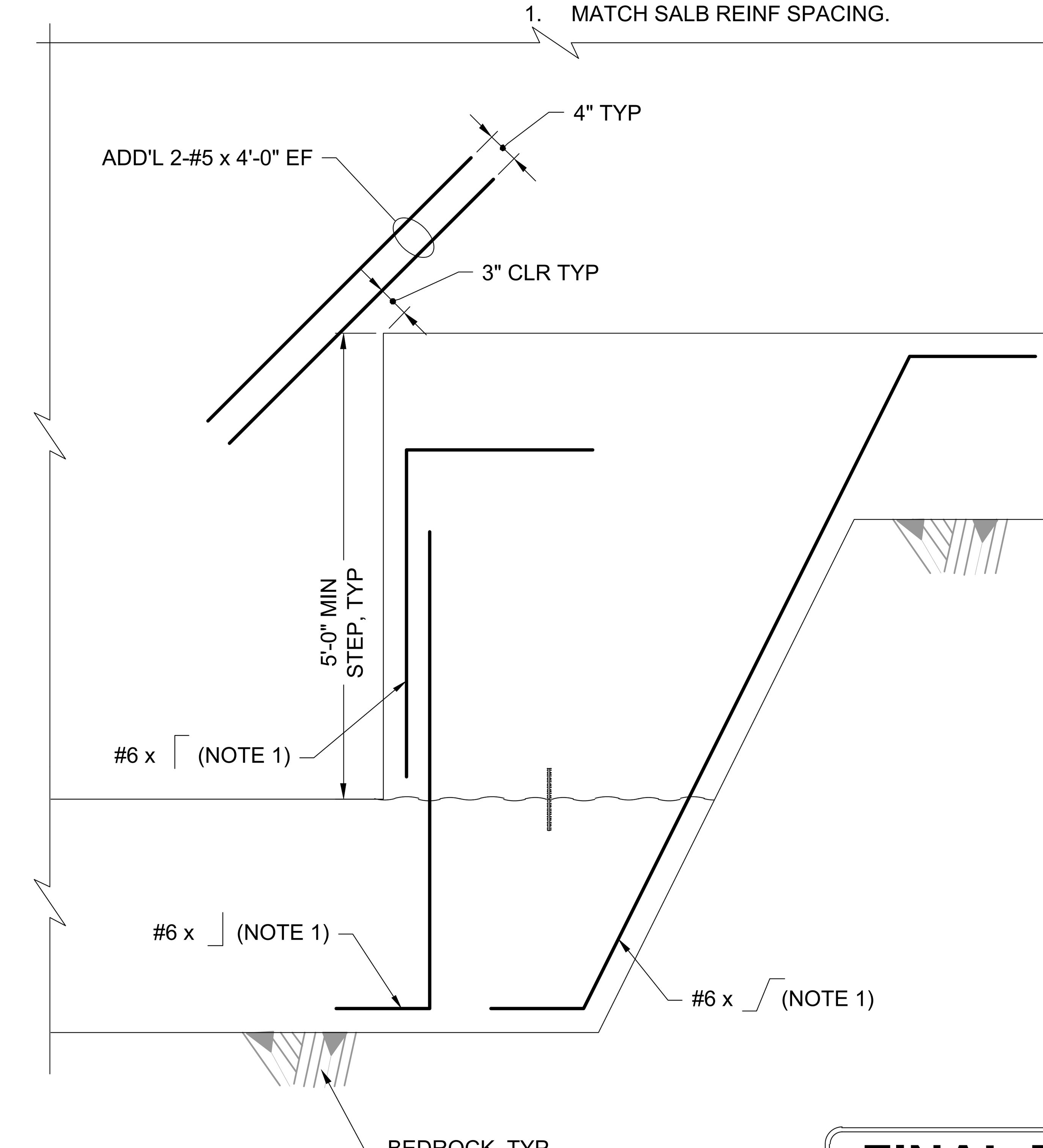
5 BULKHEAD/STOPLOG SLOT DETAIL
SCALE: 1-1/2"=1'-0"

NOTE:
1. ADD'L REINF SIZE & SPACING SHALL MATCH WALL REINF.



6 TOP SLAB TO WALL DETAIL
SCALE: NTS

NOTE:
1. MATCH SALB REINF SPACING.



7 LARGE CONC STEP DETAIL
SCALE: NTS

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

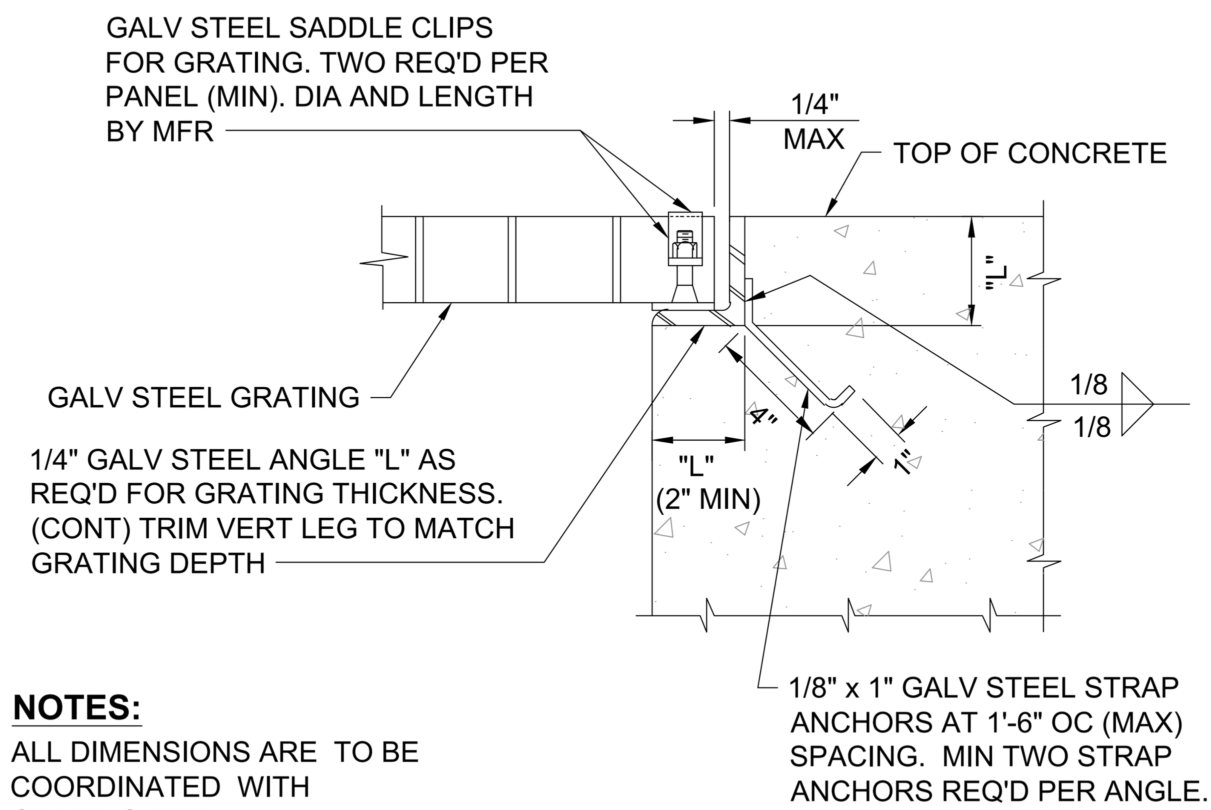
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

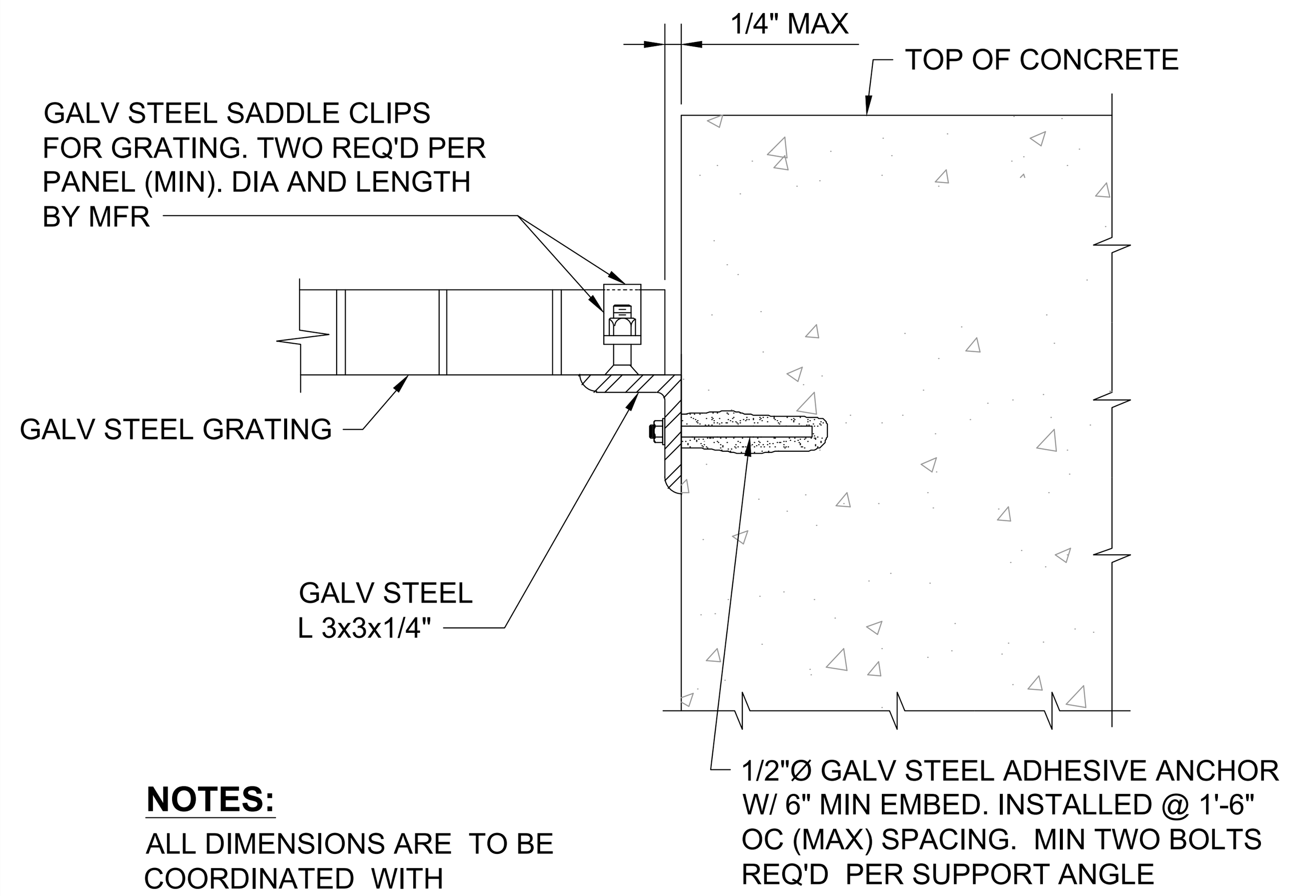
STRUCTURAL STANDARD DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 80 OF 176
DRAWING: S-503



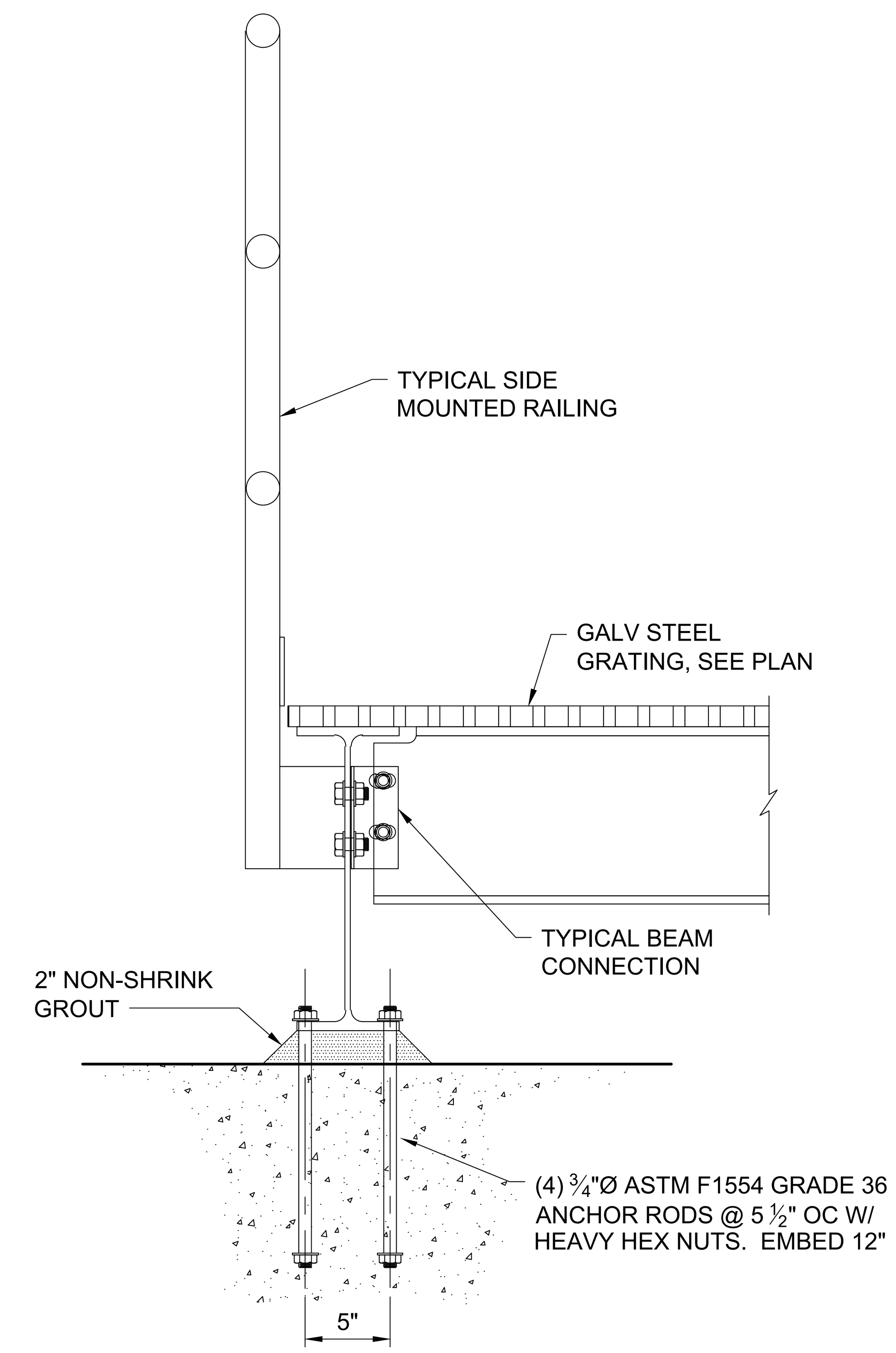
NOTES:
ALL DIMENSIONS ARE TO BE COORDINATED WITH GRATING MFR.

1 GRATING SUPPORT TYPE 1
SCALE: NTS



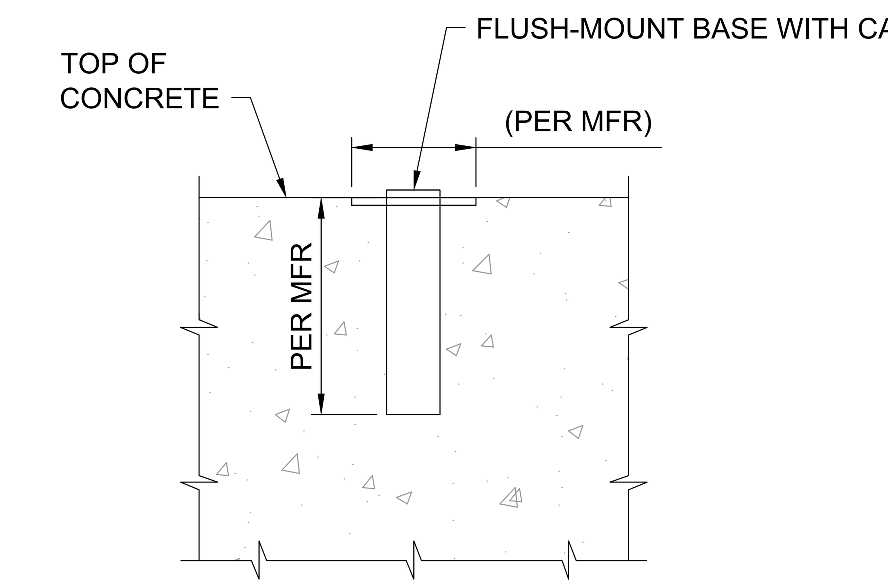
NOTES:
ALL DIMENSIONS ARE TO BE COORDINATED WITH GRATING MFR.

2 GRATING SUPPORT TYPE 2
SCALE: NTS

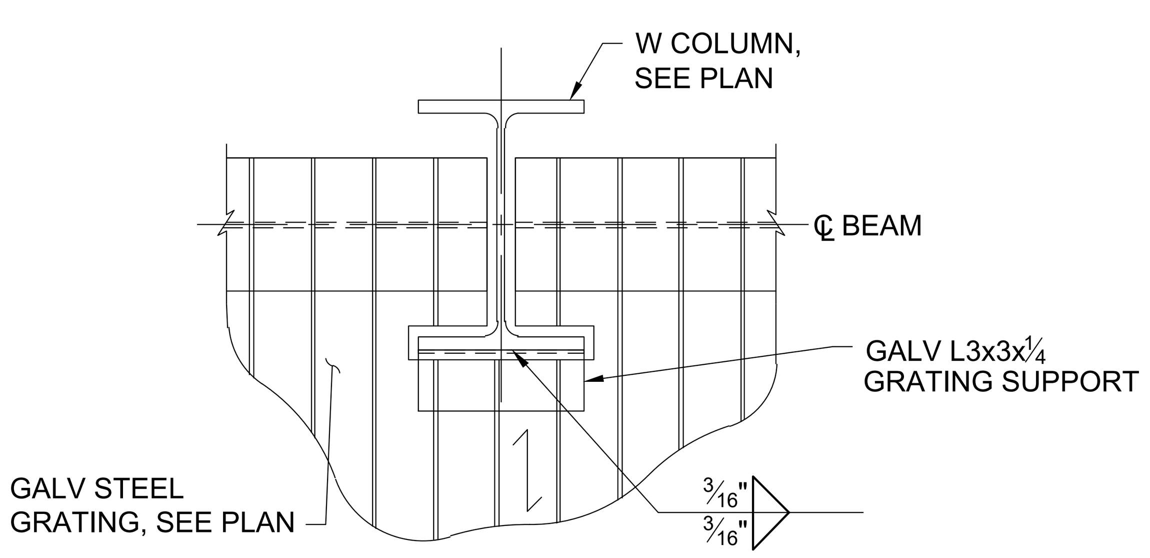


A DETAIL
SCALE: 1 1/2"=1'-0"

NOTES:
1. FLUSH FLOOR MOUNT SLEEVE SHALL BE MADE OF STURCTURAL STEEL.
2. LOCATE SLEEVE AT DIRECTION OF OWNER.
3. EACH MOUNT SHALL HAVE A CAP TO KEEP WATER AND DEBRIS OUT OF BASE.

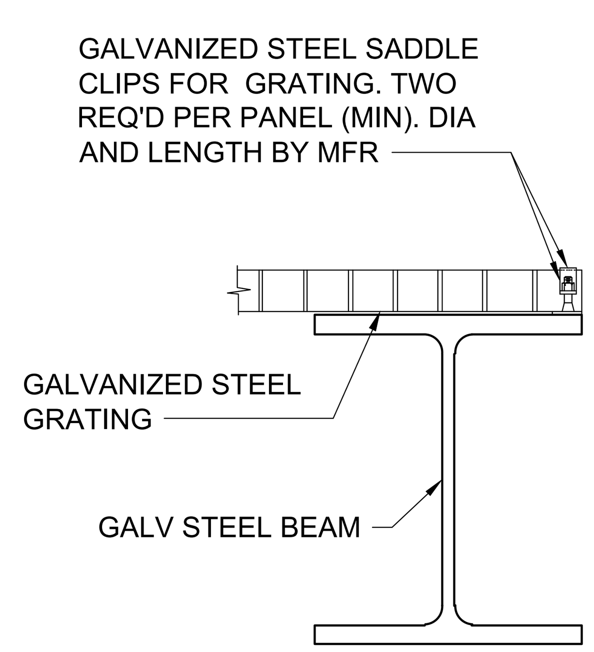


5 SAFETY ANCHORAGE BASE
SCALE: 3/4"=1'-0"



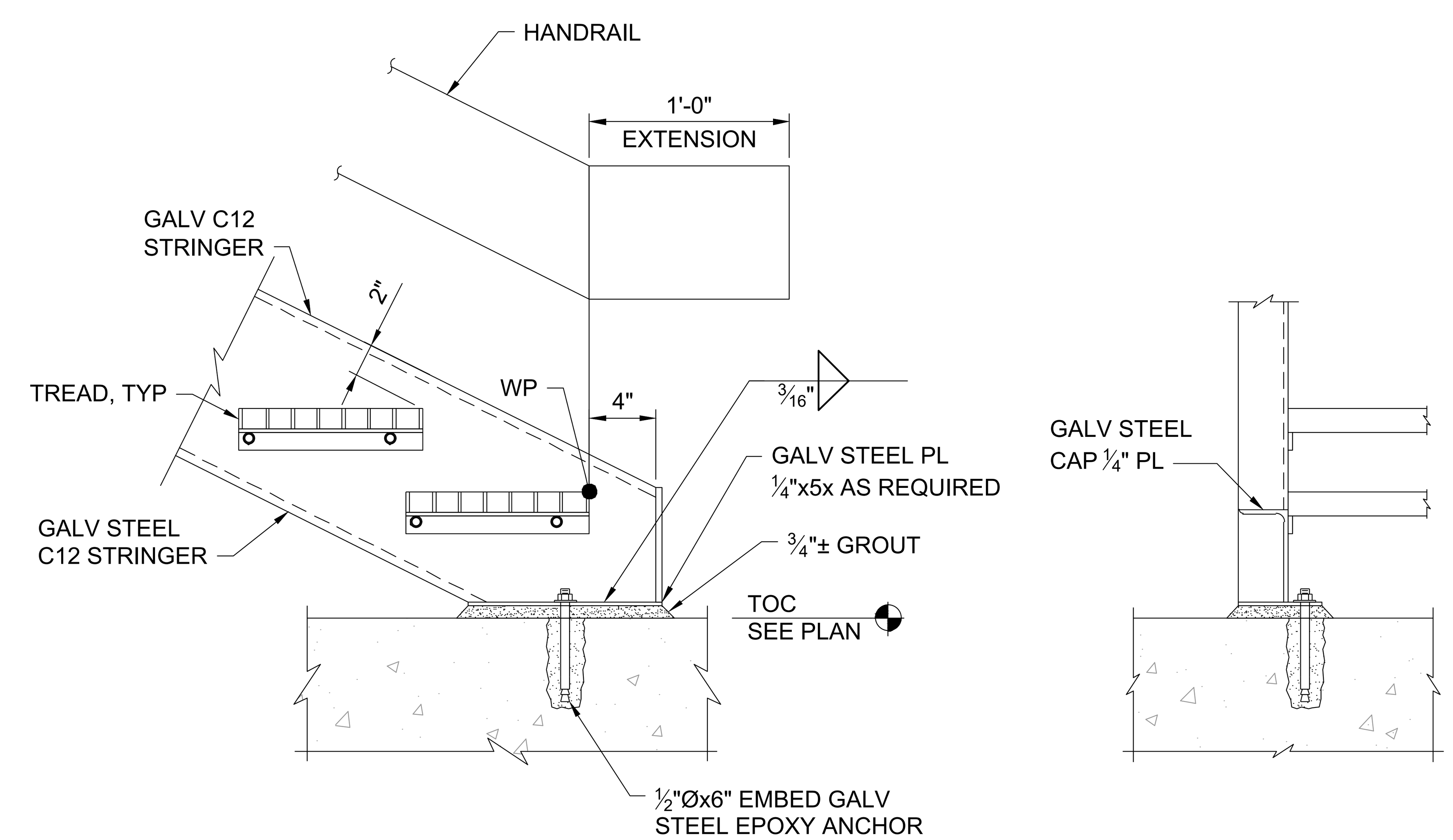
PLAN

3 GRATING SUPPORT @ COLUMNS
SCALE: 1 1/2"=1'-0"



NOTES:
ALL DIMENSIONS ARE TO BE COORDINATED WITH GRATING MFR.

4 GRATING SUPPORT (AT PLATFORM)
SCALE: 3"=1'-0"



B LANDING DETAIL
SCALE: 1 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

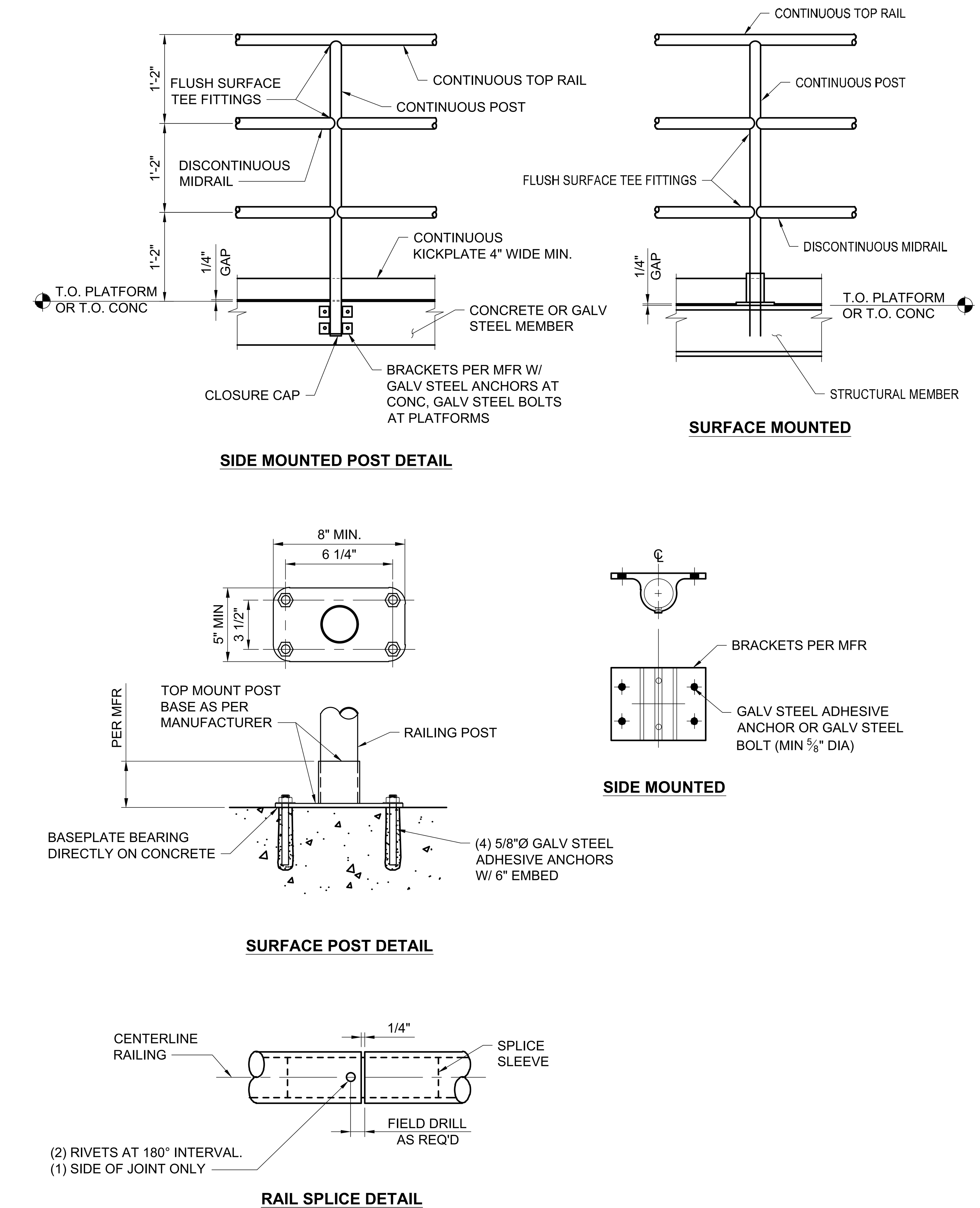
STATE OF MAINE MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STRUCTURAL STANDARD DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	81 OF 176
DRAWING:	S-504

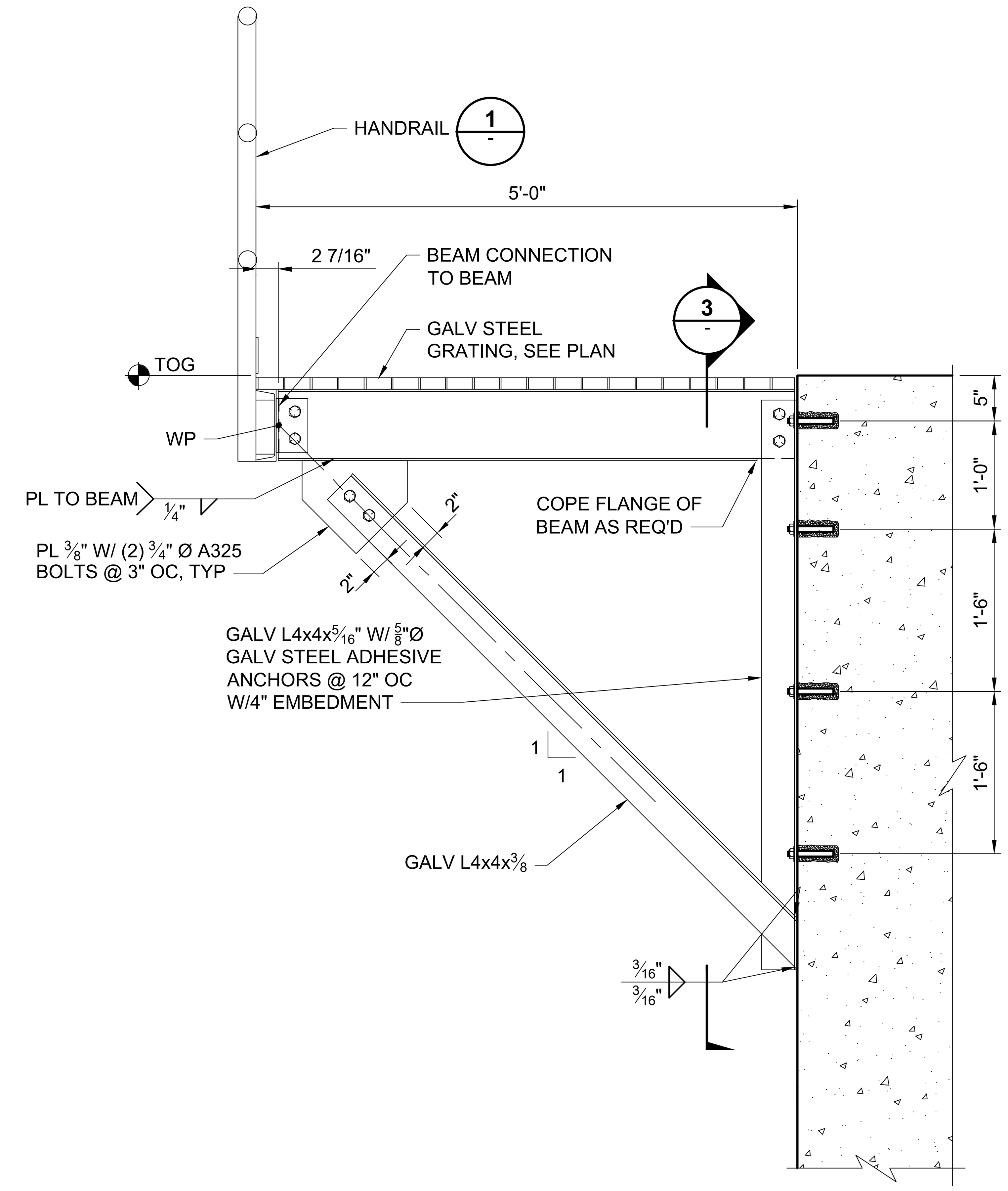
DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden niss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-504.dwg USER: Agrogan
DATE: Dec 13, 2019 2:39pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:



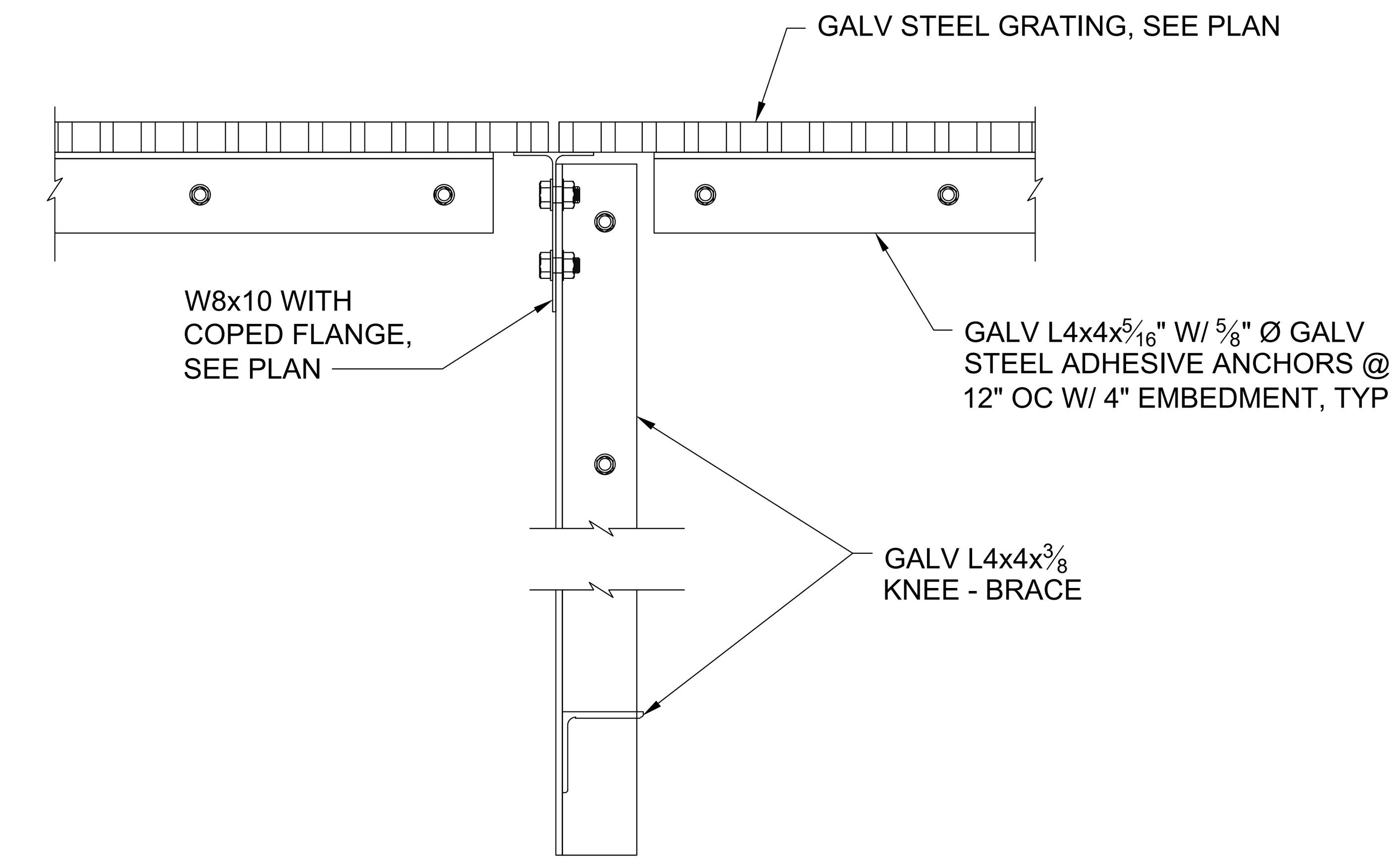
RAILING NOTES

1. ALL RAILING, KICKPLATES, AND ACCESSORIES SHALL BE GALVANIZED STEEL, PER SPECIFICATIONS.
2. ALL RAILS AND POSTS MUST BE SIZED AND SPACED TO SATISFY ALL APPLICABLE CODES AND STANDARDS. MAX POST SPACING = 4'-0".
3. MAXIMUM RAIL SPLICE LENGTH = 24'-0".

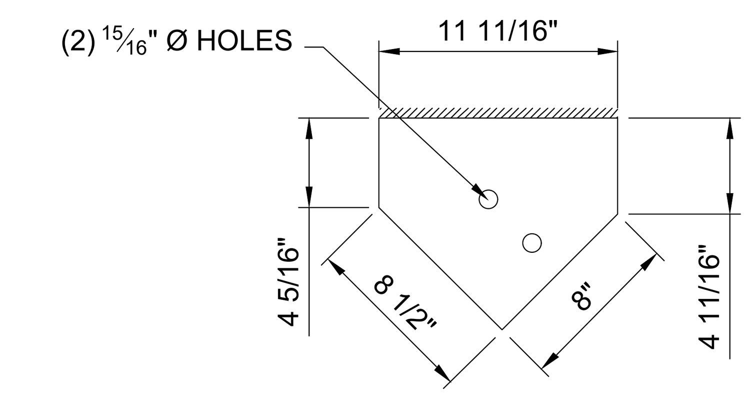
1 HANDRAIL DETAIL
SCALE: NTS



2 TYPICAL KNEE-BRACE PLATFORM
S-202
SCALE: 1"=1'-0"



3 SECTION
SCALE: 1 1/2"=1'-0"



4 GUSSET PLATE DETAIL
SCALE: 1-1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

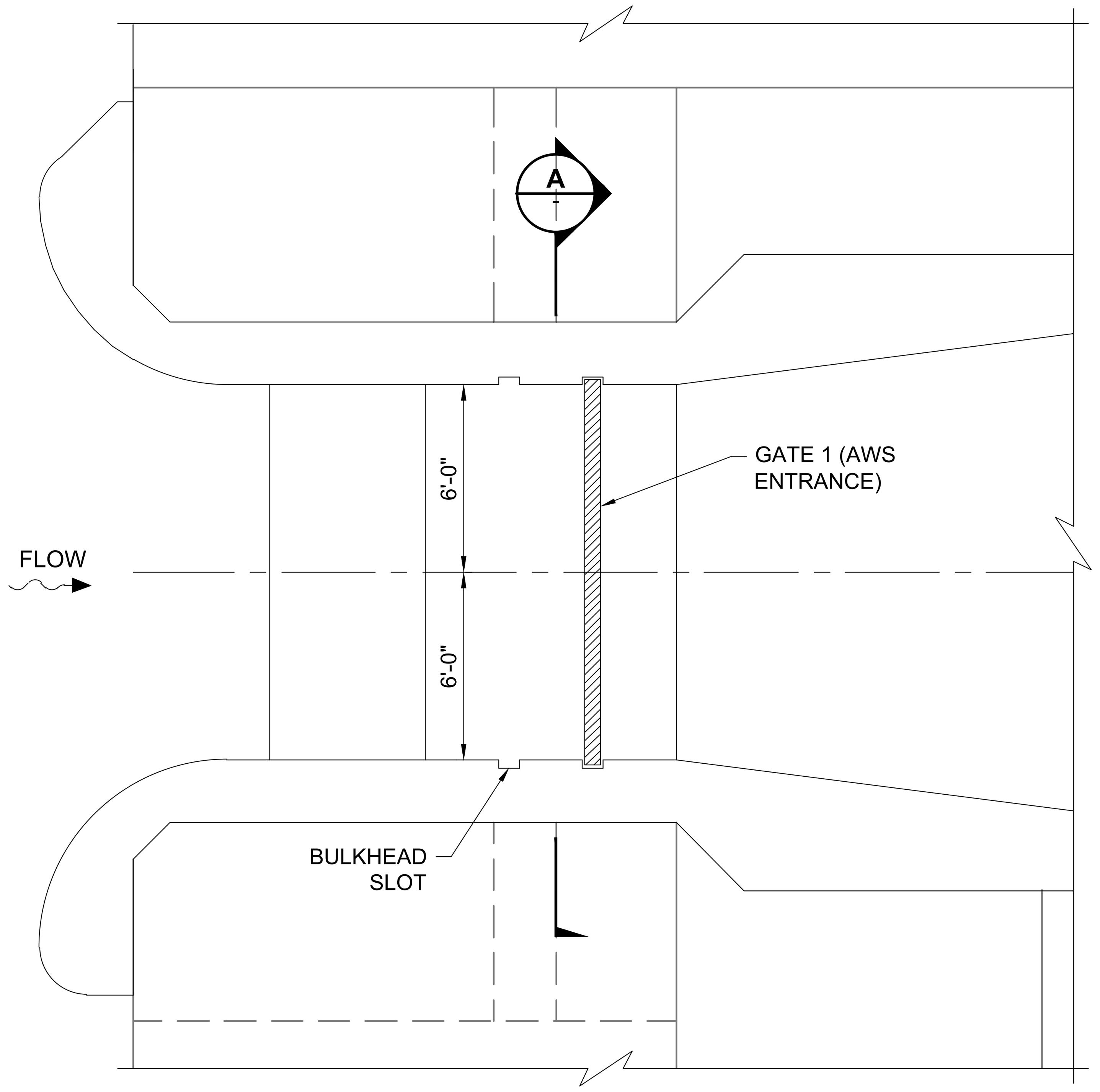
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

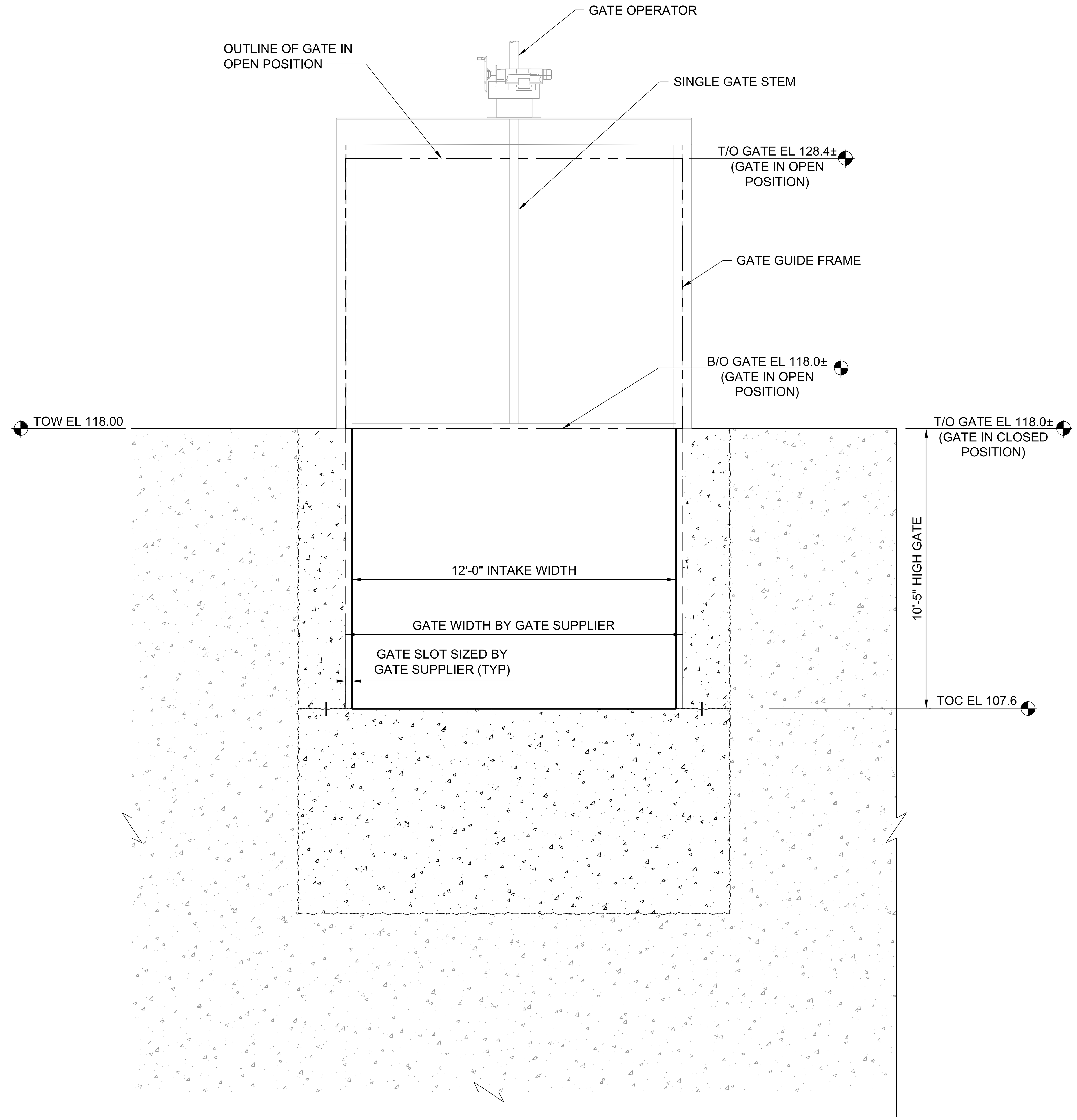
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STRUCTURAL STANDARD DETAILS

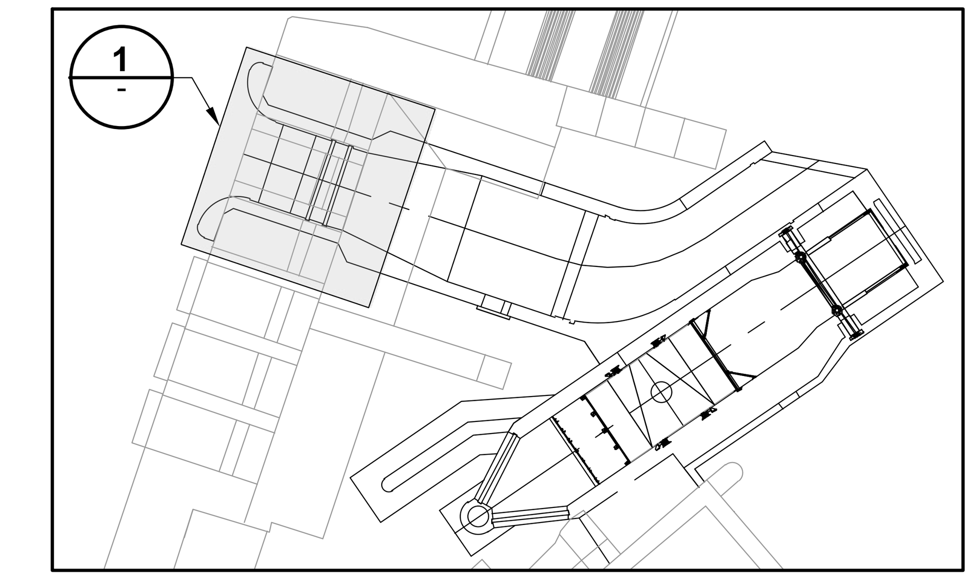
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	R. YOUNG
APPROVED BY:	M. GRAESER
SHEET:	82 OF 176
DRAWING:	S-505



1 - **ENLARGED PLAN**
SCALE: 1/4"=1'-0"



A - **ELEVATION GATE 1 (AWS ENTRANCE)**
SCALE: 3/8"=1'-0"



AWS / FISH LIFT KEY MAP
SCALE: NTS

NOTES:

1. GENERAL OVERVIEW OF GATE 1 (AWS ENTRANCE) IS PROVIDED:
   - SIZE OF OPENING, 12.00'W x 10.42'H
   - MOVEMENT OF GATE. UPWARD OPENING.
   - OPERATION OF GATE: OPEN / CLOSE
2. HEAD POND WATER LEVELS:
   - MINIMUM 108
   - NORMAL 112
   - MAXIMUM 122 (100 YR)

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

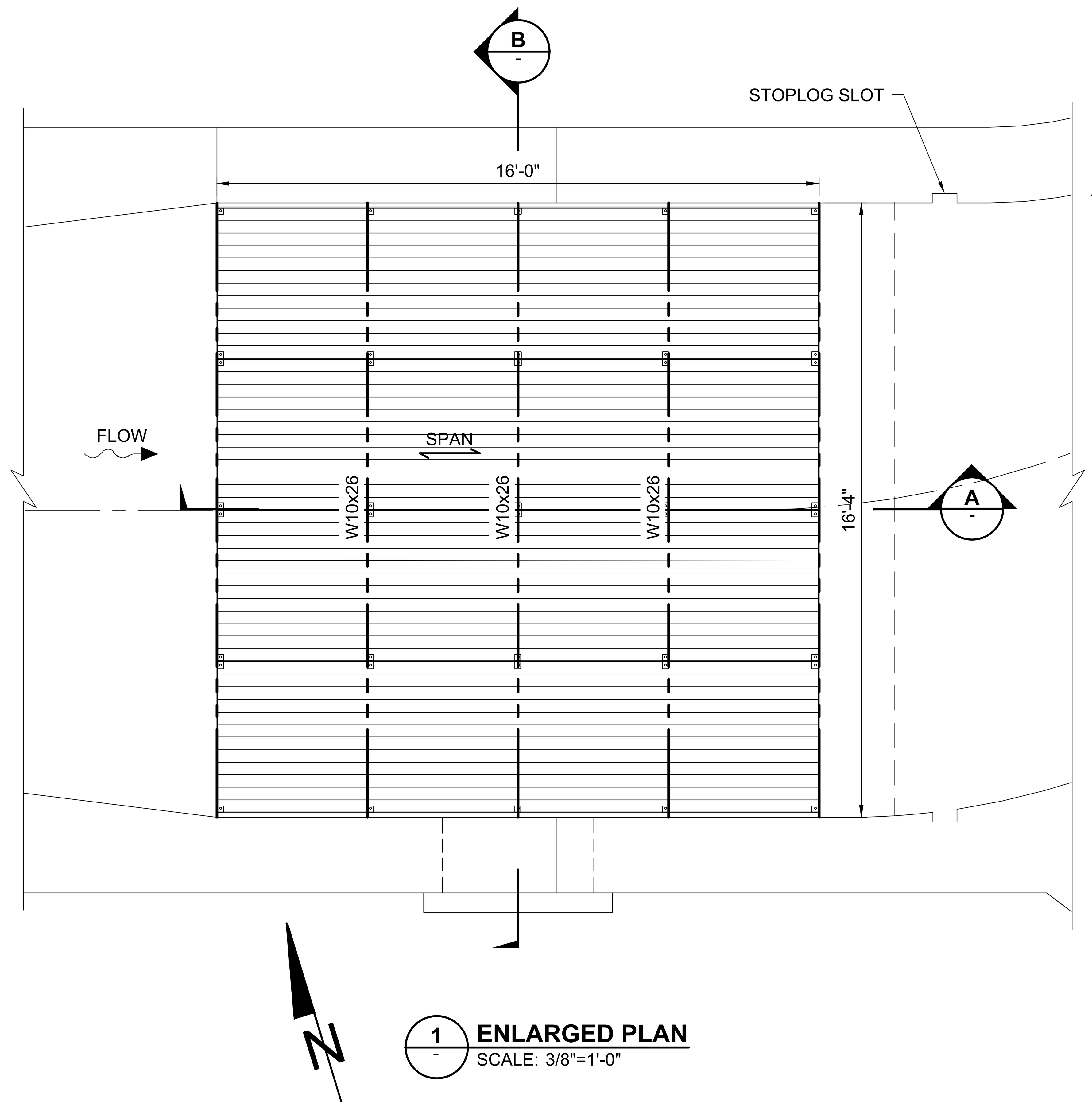
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

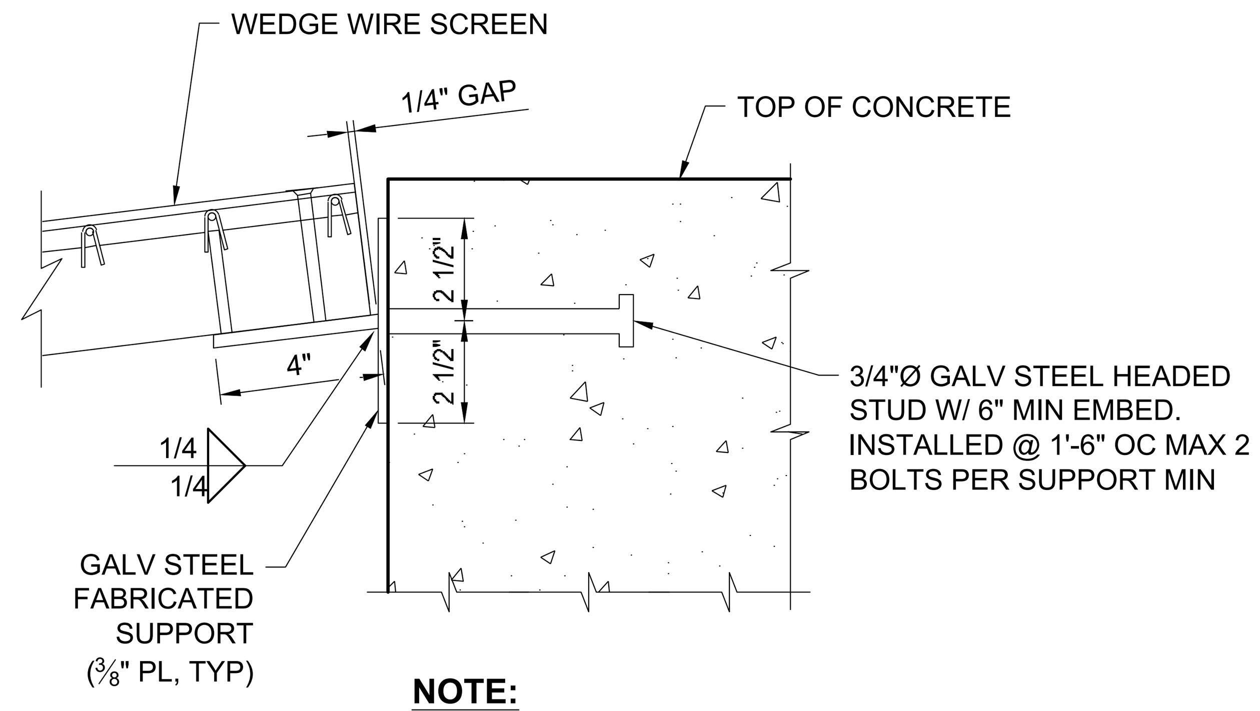
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

ATTRACTION WATER INTAKE
HEADGATE REQUIREMENTS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	83 OF 176
DRAWING:	M-101

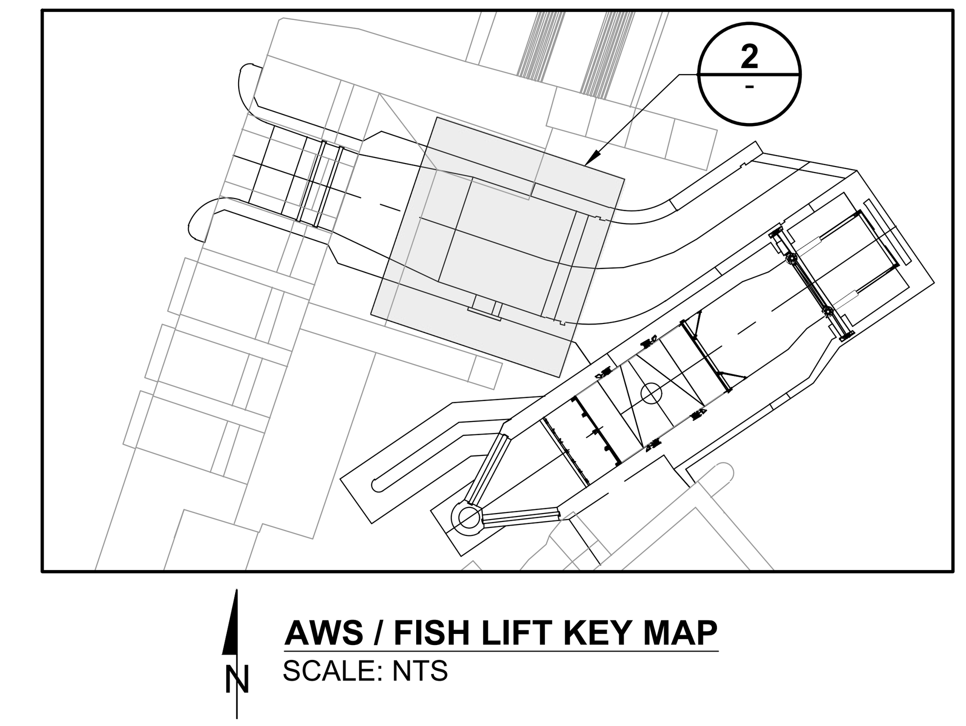


1 ENLARGED PLAN
SCALE: 3/8"=1'-0"



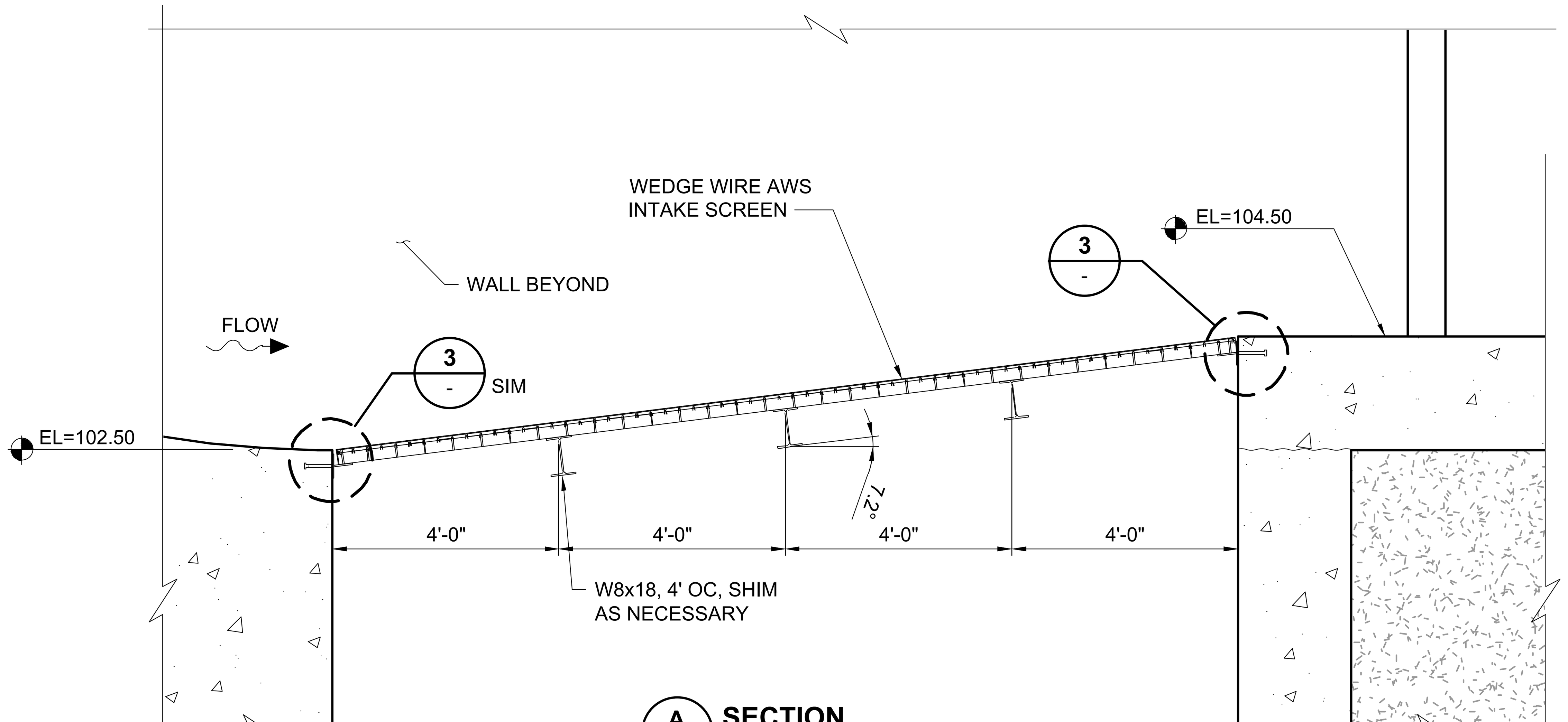
NOTE:
1. ALL DIMENSIONS ARE TO BE COORDINATED WITH WEDGE WIRE SCREEN MFR.

3 WEDGE WIRE SCREEN SUPPORT
SCALE: NTS

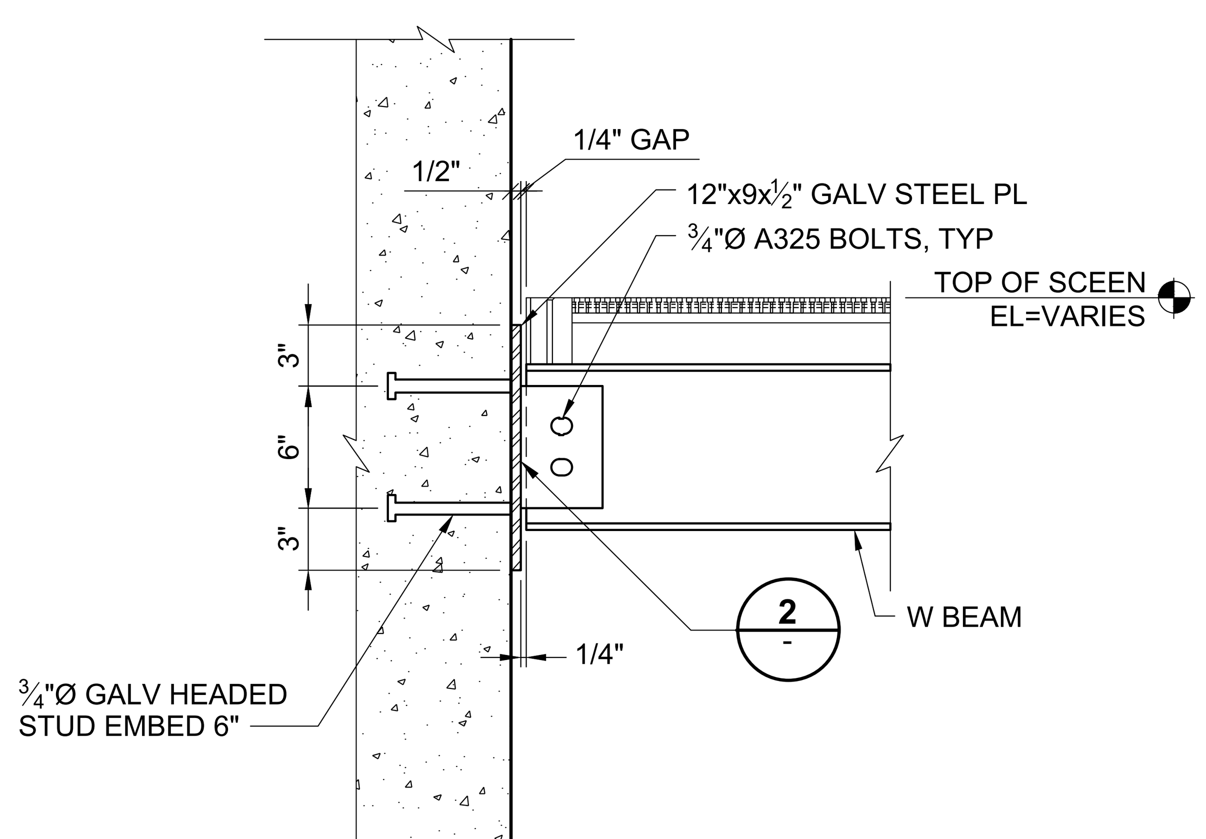


AWS / FISH LIFT KEY MAP
SCALE: NTS

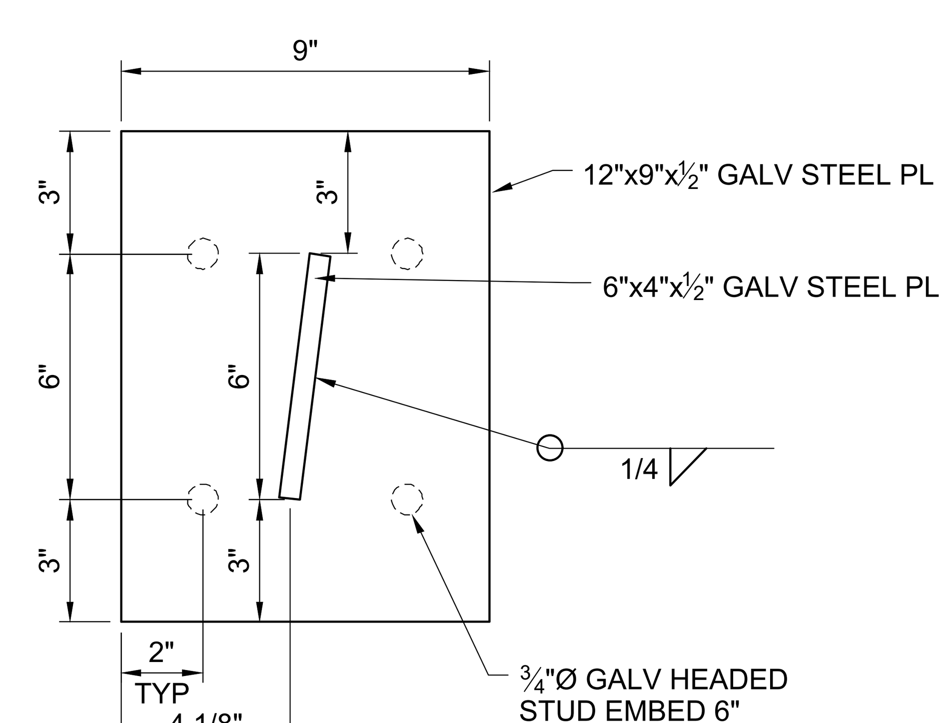
NOTE:
1. PROVIDE AIR BURST SYSTEM. SEE SPECIFICATION 35 20 13 FOR DETAILS.



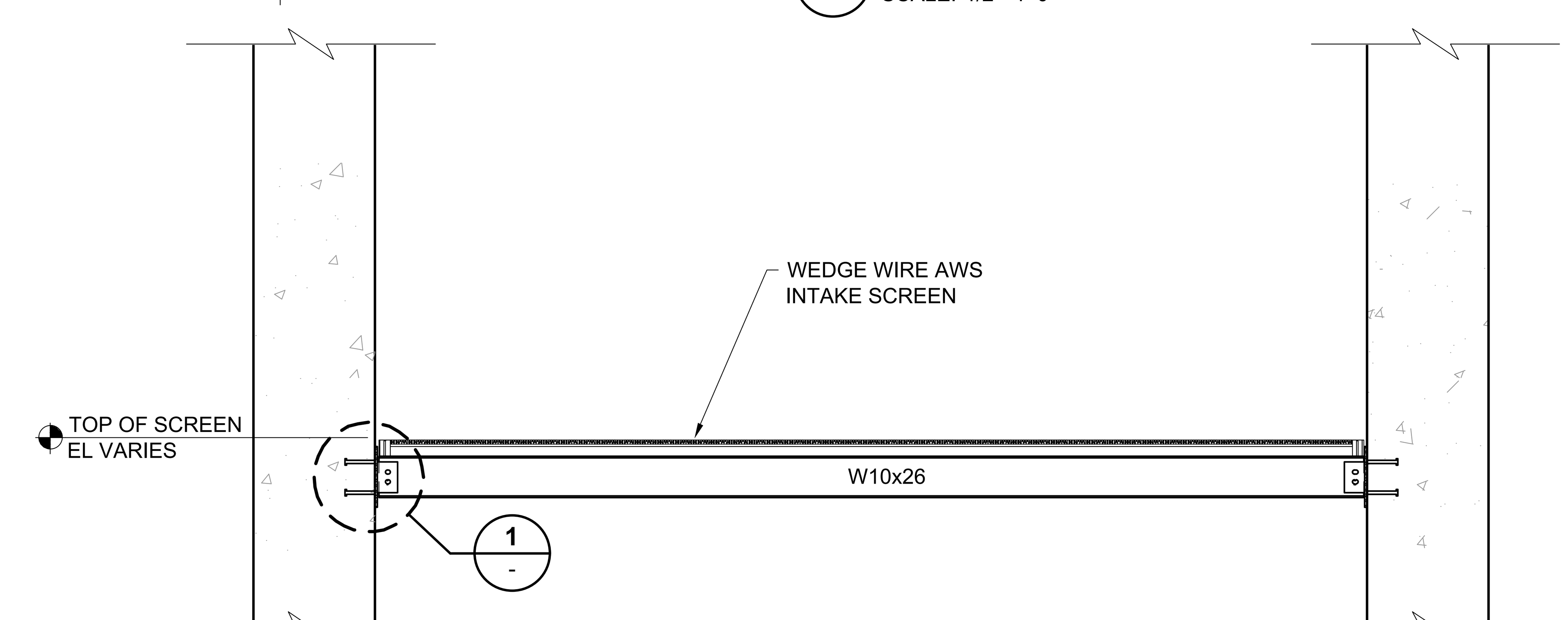
A SECTION
SCALE: 1/2"=1'-0"



1 CONNECTION SECTION
SCALE: 1-1/2"=1'-0"



2 CONNECTION PLATE DETAIL
SCALE: 3"=1'-0"



B SECTION
SCALE: 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

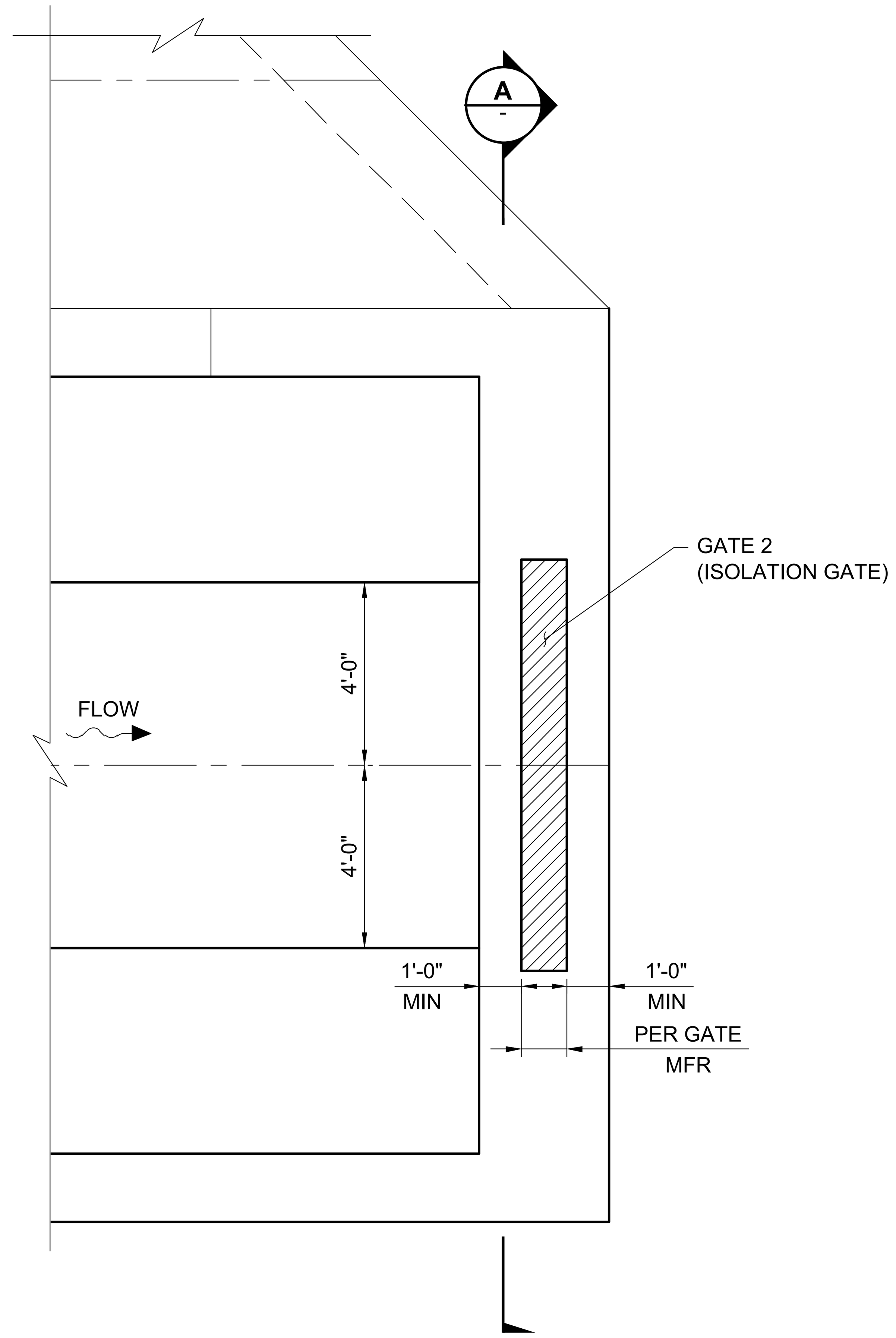
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

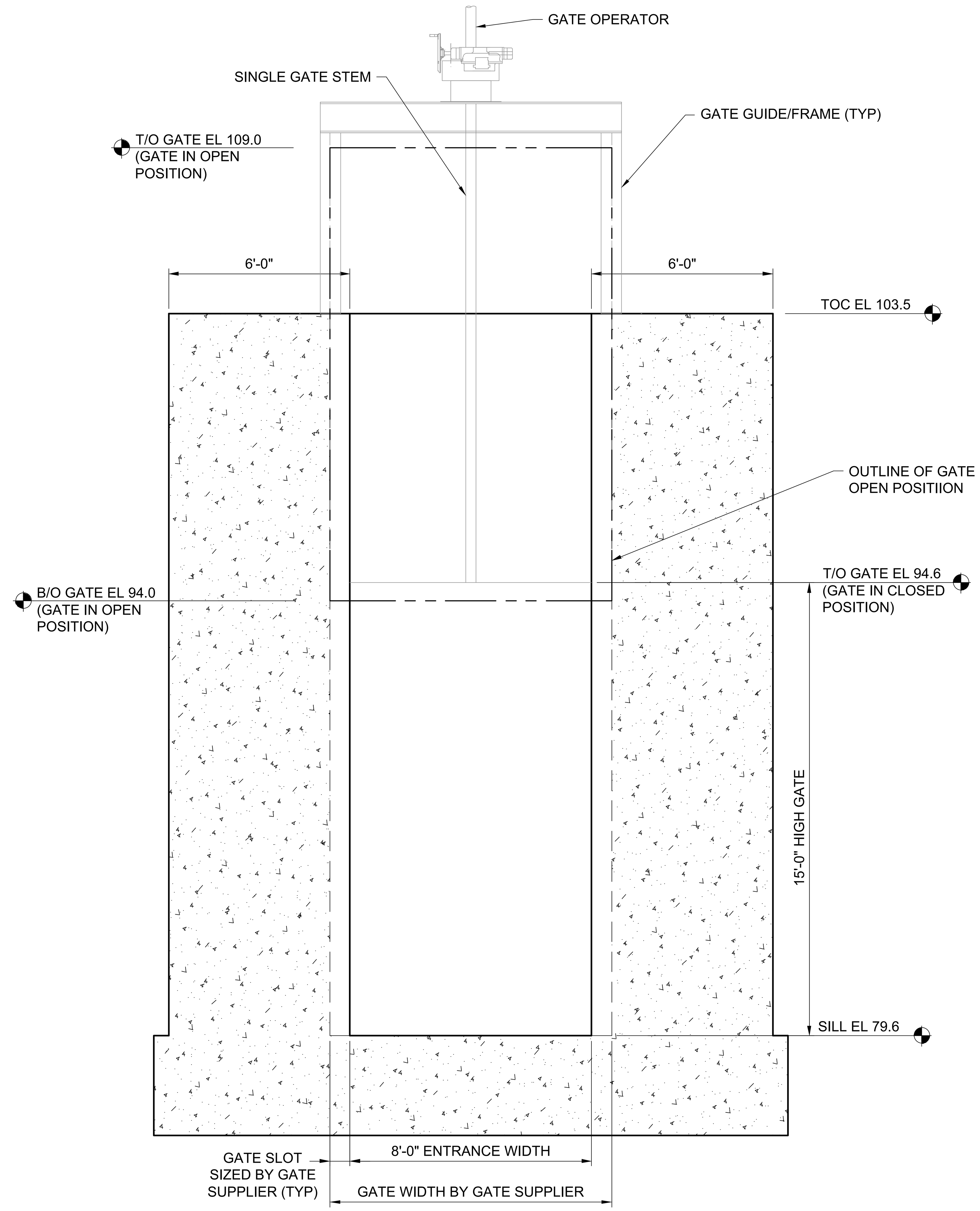
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

WEDGE WIRE AWS INTAKE SCREEN

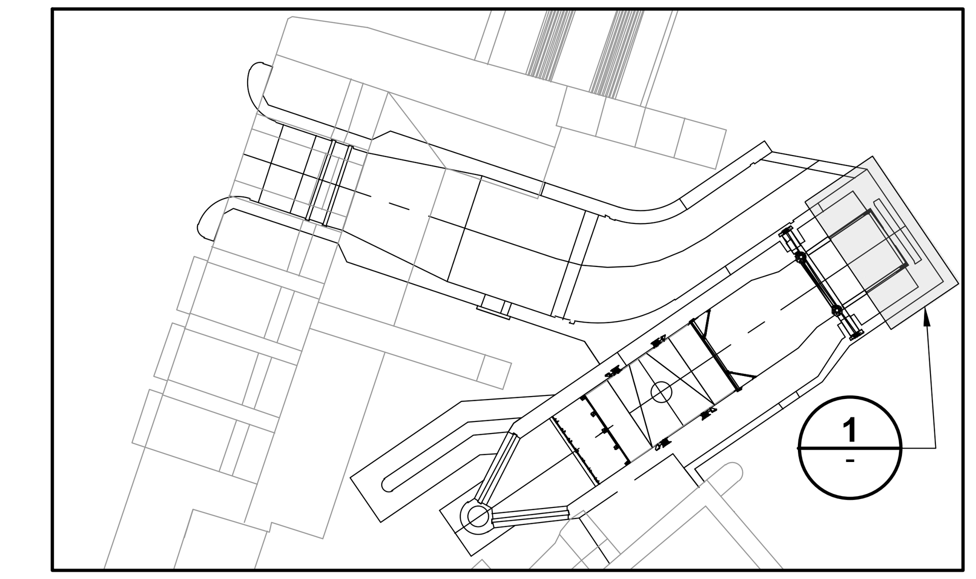
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	84 OF 176
DRAWING:	M-102



1 ENLARGED PLAN
SCALE: 3/8"=1'-0"



A ELEVATE GATE 2 (ISOLATION GATE)
SCALE: 3/8"=1'-0"



N
AWS / FISH LIFT KEY MAP
SCALE: NTS

NOTES:

1. GENERAL OVERVIEW OF GATE 2 (ISOLATION GATE) IS PROVIDED:
   - SIZE OF OPENING, 8.00'W x 14.38'H
   - MOVEMENT OF GATE. UPWARD OPENING.
   - OPERATION OF GATE: OPEN / CLOSE
2. TAILWATER ELEVATIONS:
   - DESIGN LOW 88.6
   - NORMAL 89.1
   - DESIGN HIGH 91.5

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

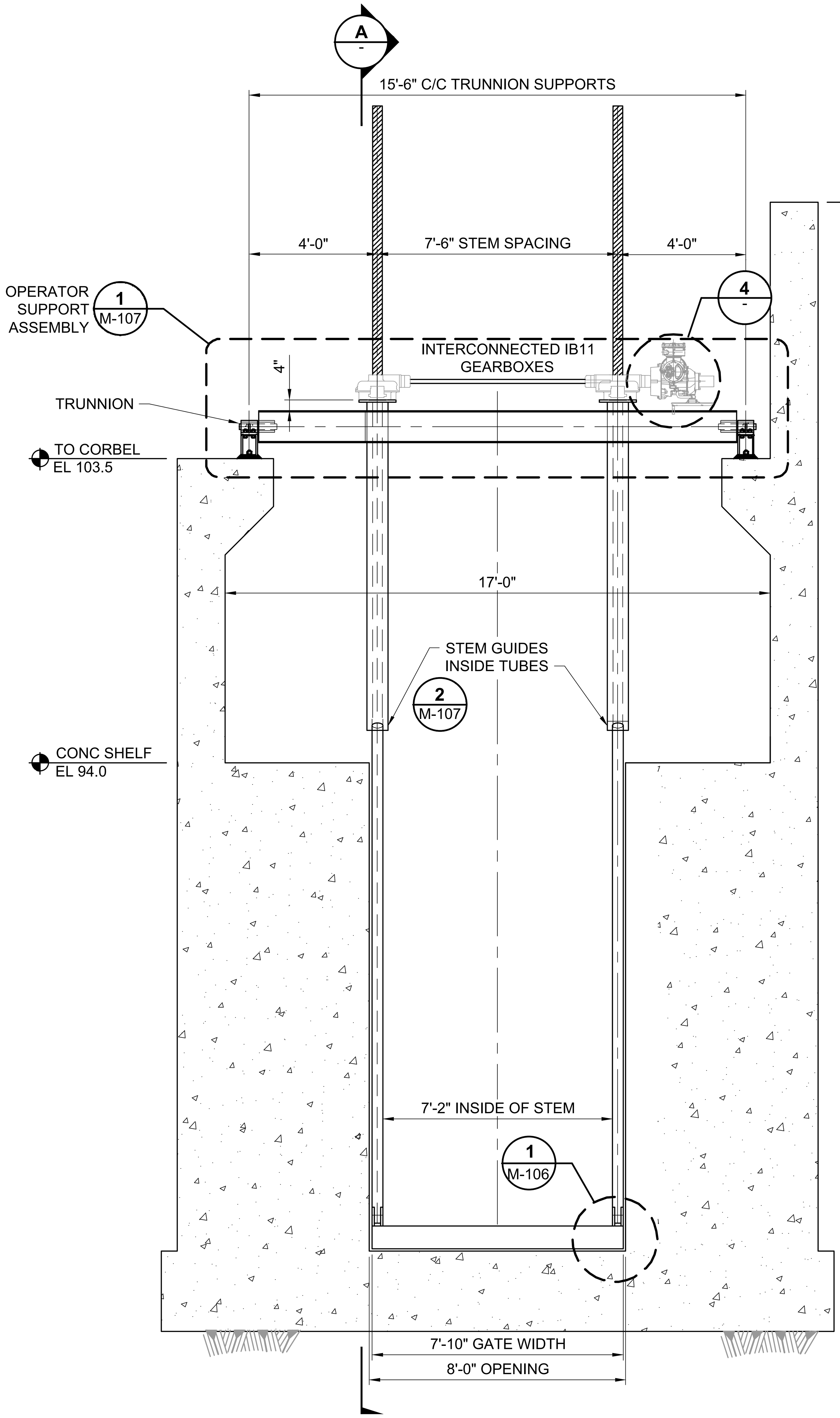
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

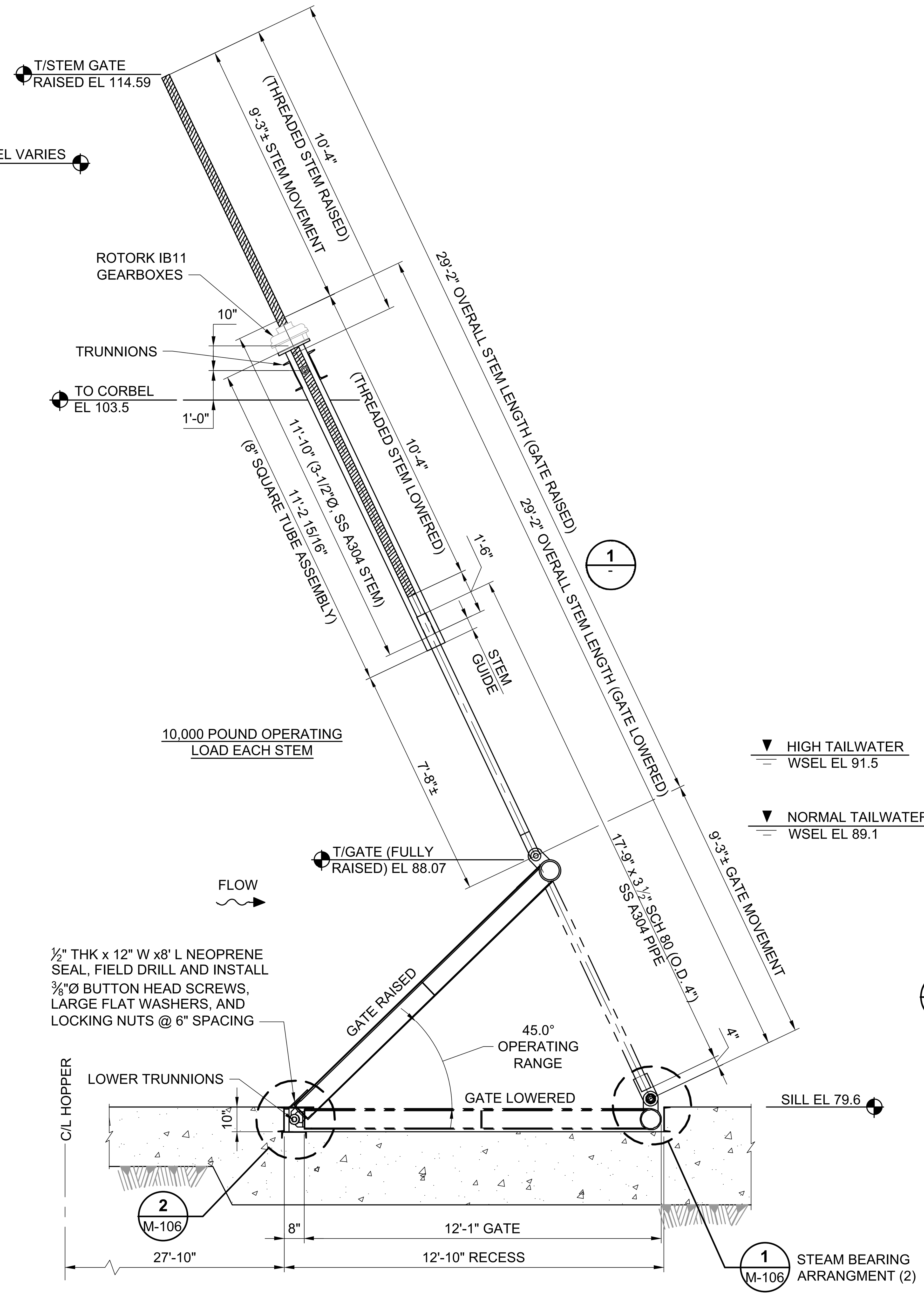
FISH LIFT ENTRANCE ISOLATION GATE REQUIREMENTS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	85 OF 176
DRAWING:	M-103



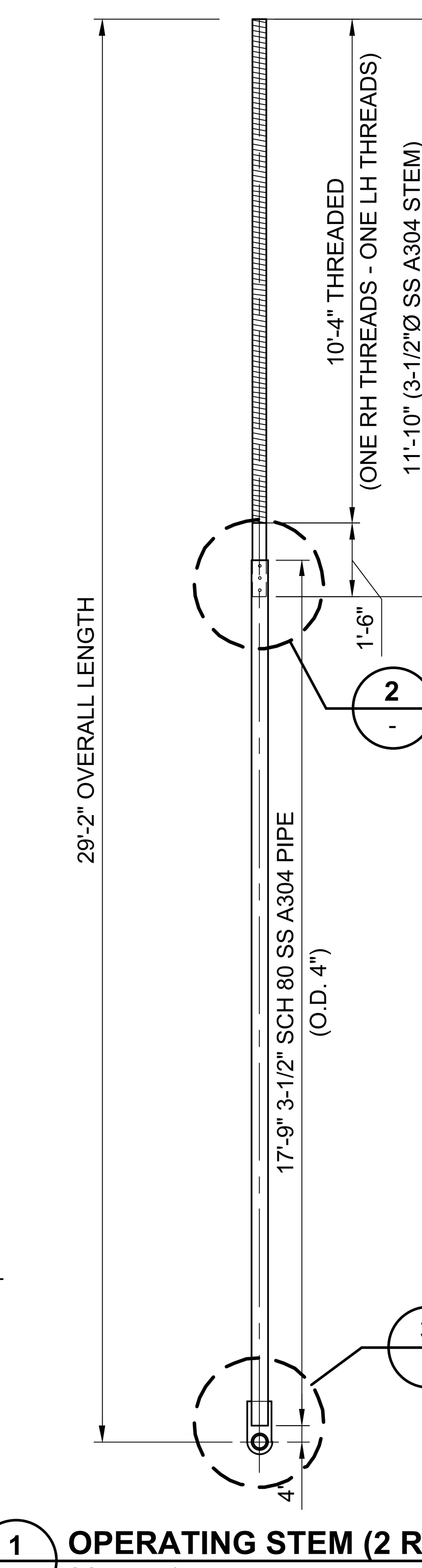
ELEVATION LOOKING UPSTREAM (GATE LOWERED)

SCALE: 3/8"=1'-0"



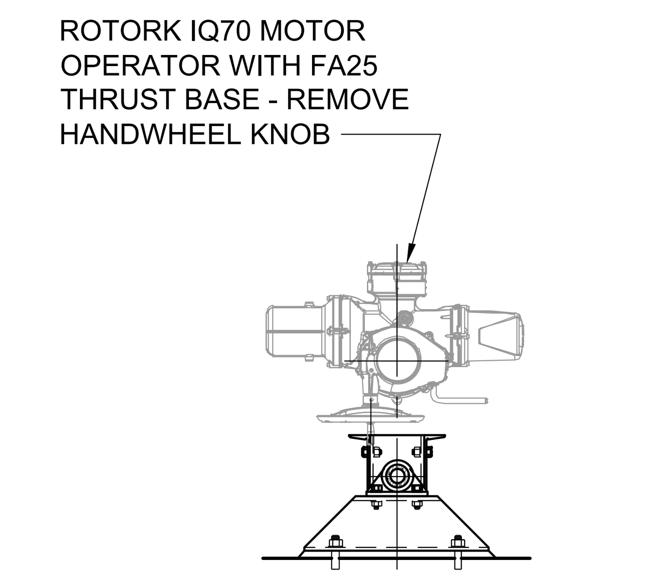
SIDE ELEVATION

SCALE: 3/8"=1'-0"



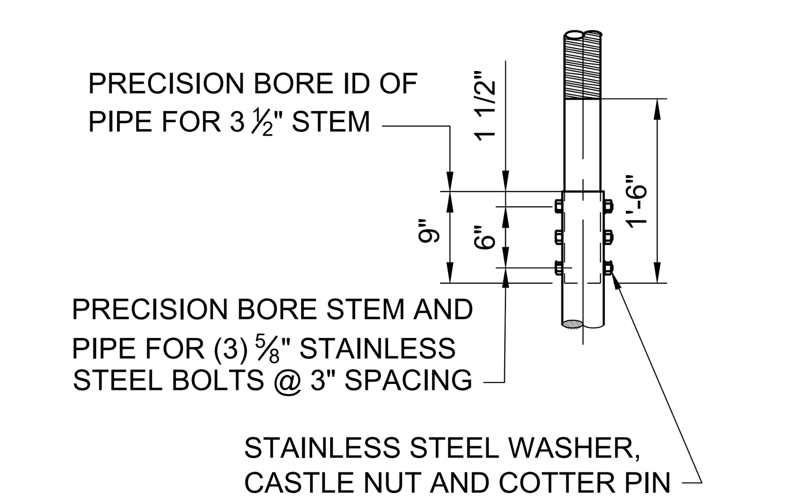
OPERATING STEM (2 REQUIRED)

SCALE: 3/8"=1'-0"



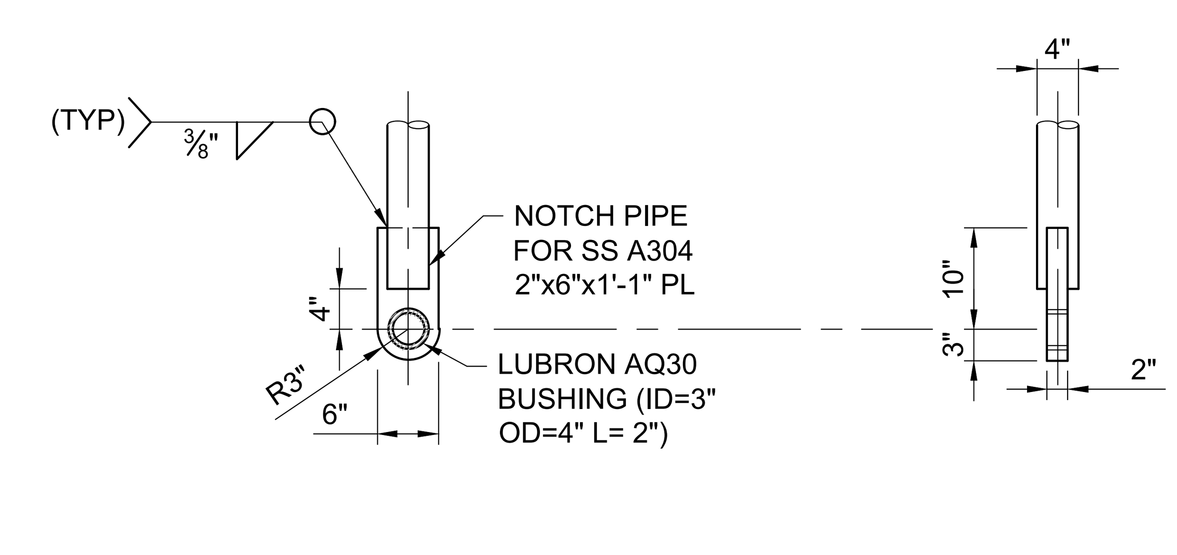
ROTORK MOTOR DETAIL

SCALE: NTS



OPERATING STEM CONNECTION

SCALE: 3/4"=1'-0"



OPERATING STEM ASSEMBLY

SCALE: 3/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

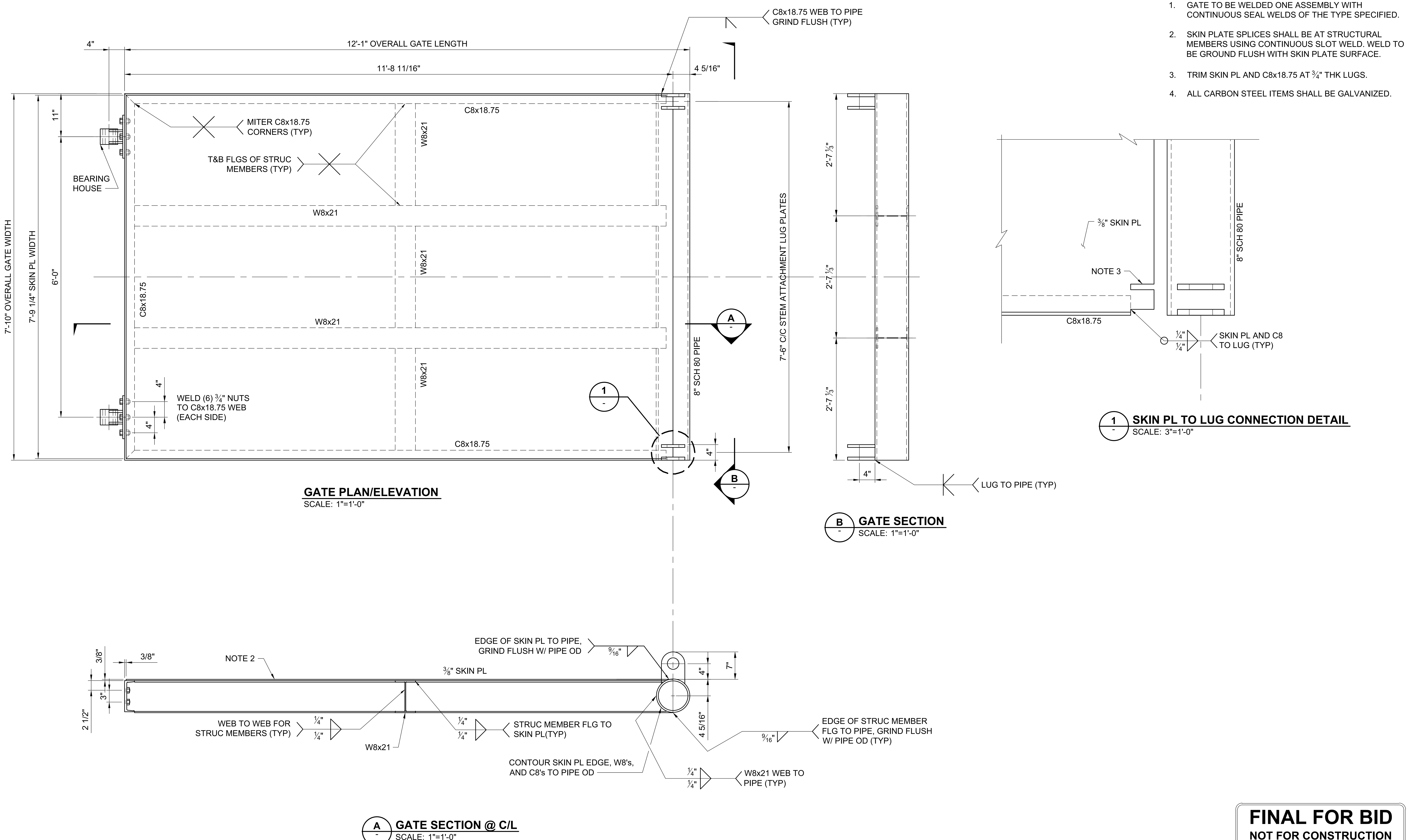
STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT ENTRANCE GATE
ELEVATIONS AND STEM DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	86 OF 176
DRAWING:	M-104

DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden nass and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\M-104.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:



GATE PLAN/ELEVATION
SCALE: 1"=1'-0"

B GATE SECTION
SCALE: 1"=1'-0"

1 SKIN PL TO LUG CONNECTION DETAIL
SCALE: 3"=1'-0"

A GATE SECTION @ C/L
SCALE: 1"=1'-0"

NOTES:

1. GATE TO BE WELDED ONE ASSEMBLY WITH CONTINUOUS SEAL WELDS OF THE TYPE SPECIFIED.
2. SKIN PLATE SPLICES SHALL BE AT STRUCTURAL MEMBERS USING CONTINUOUS SLOT WELD. WELD TO BE GROUND FLUSH WITH SKIN PLATE SURFACE.
3. TRIM SKIN PL AND C8x18.75 AT ¾" THK LUGS.
4. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT ENTRANCE GATE STEEL SECTIONS & DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D ROBINSON
APPROVED BY: M. GRAESER
SHEET: 87 OF 176
DRAWING: M-105

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden rsss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\M\M-105.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

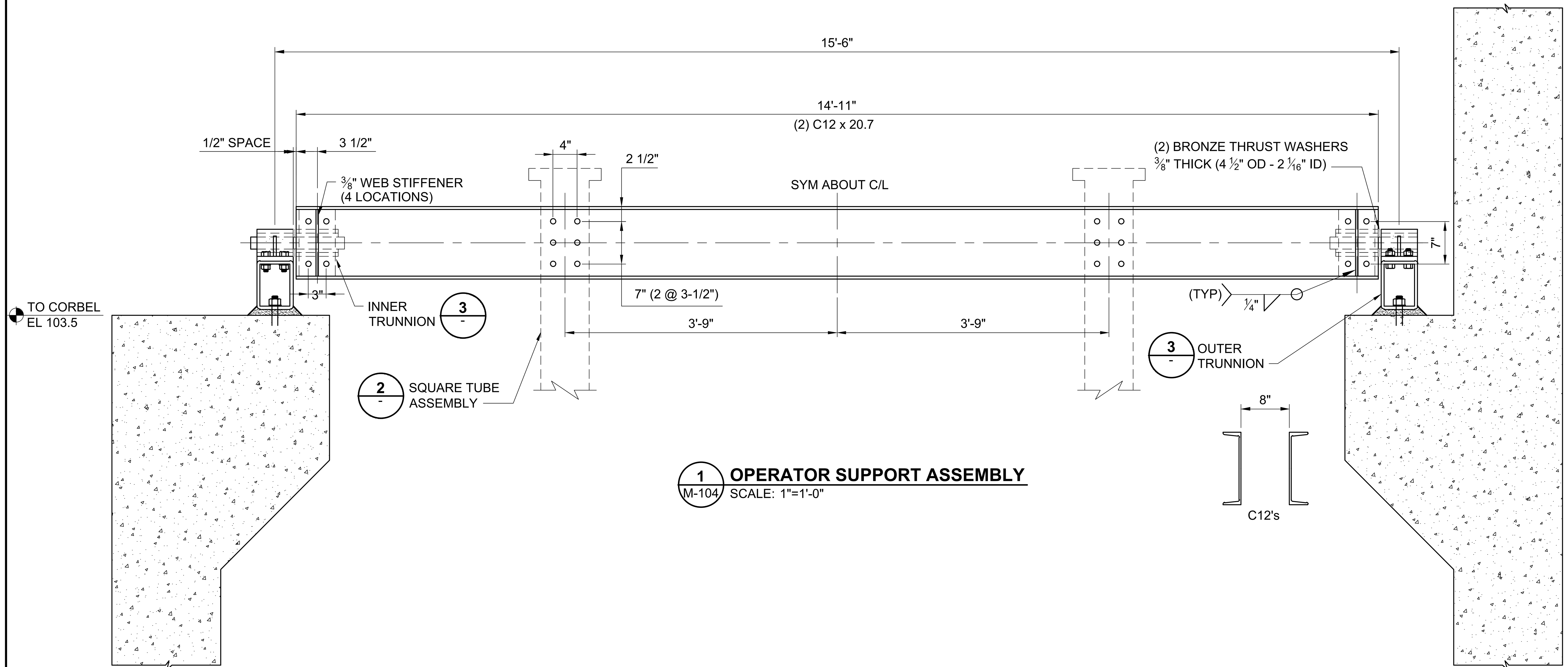
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

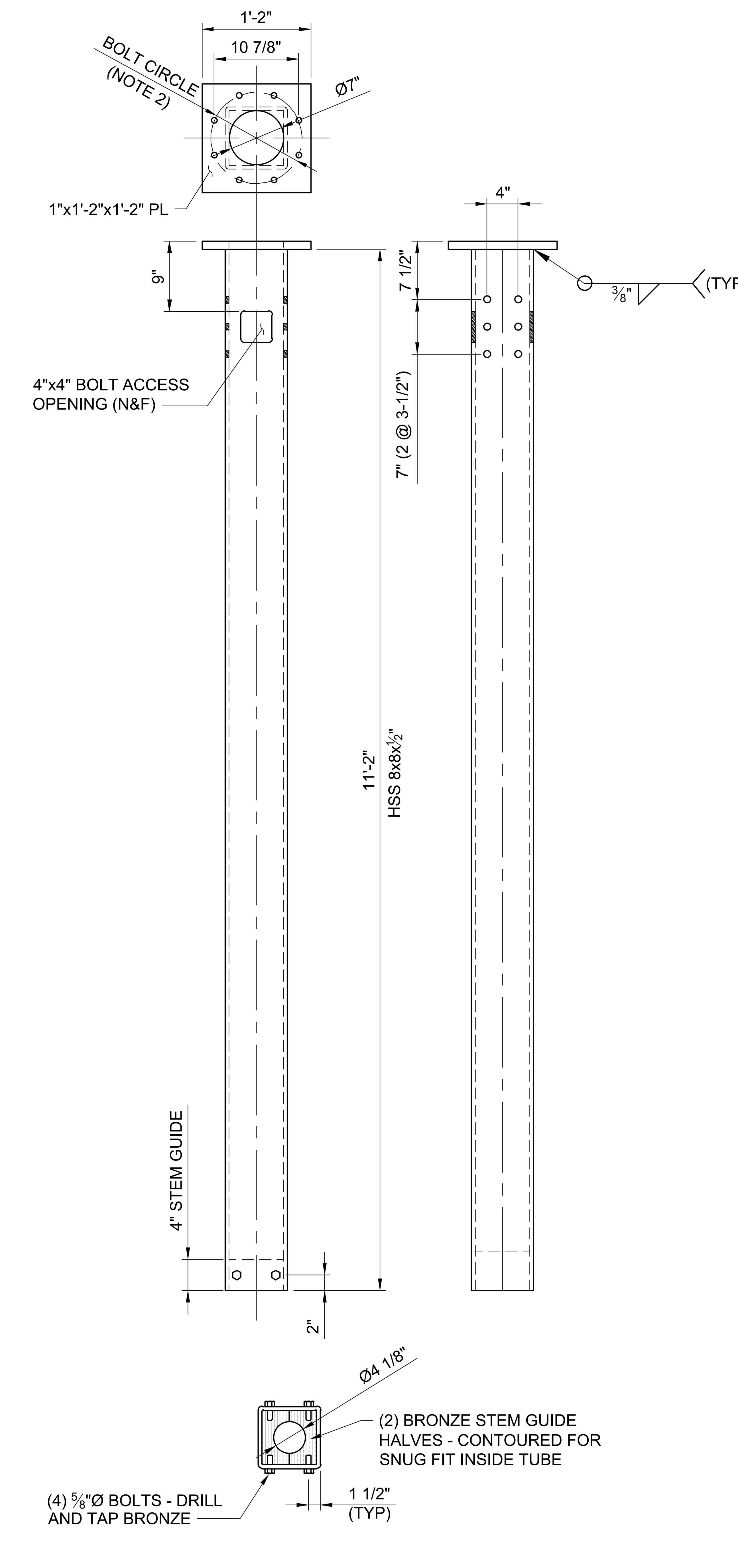
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT ENTRANCE GATE STEEL DETAILS

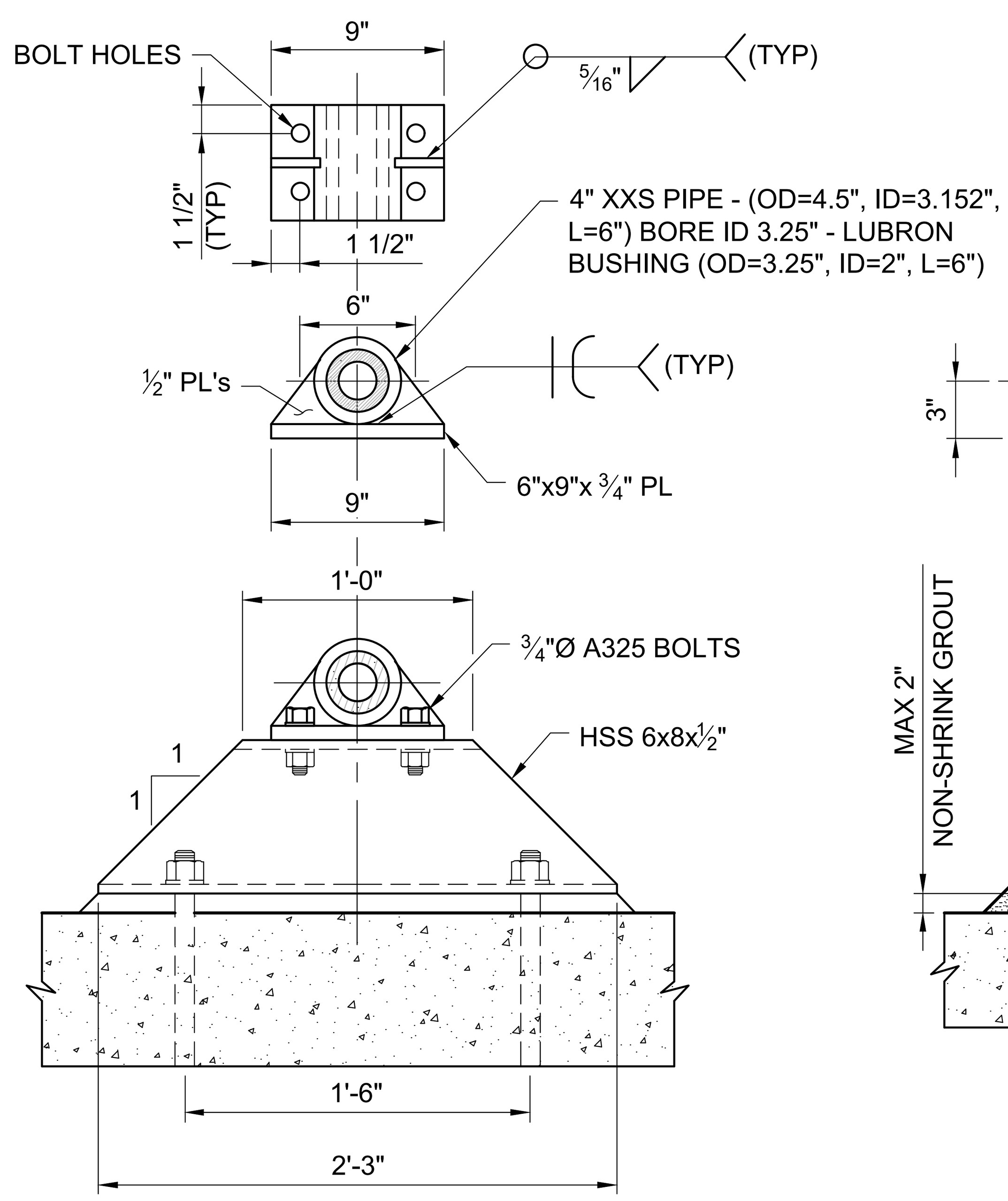
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	88 OF 176
DRAWING:	M-106



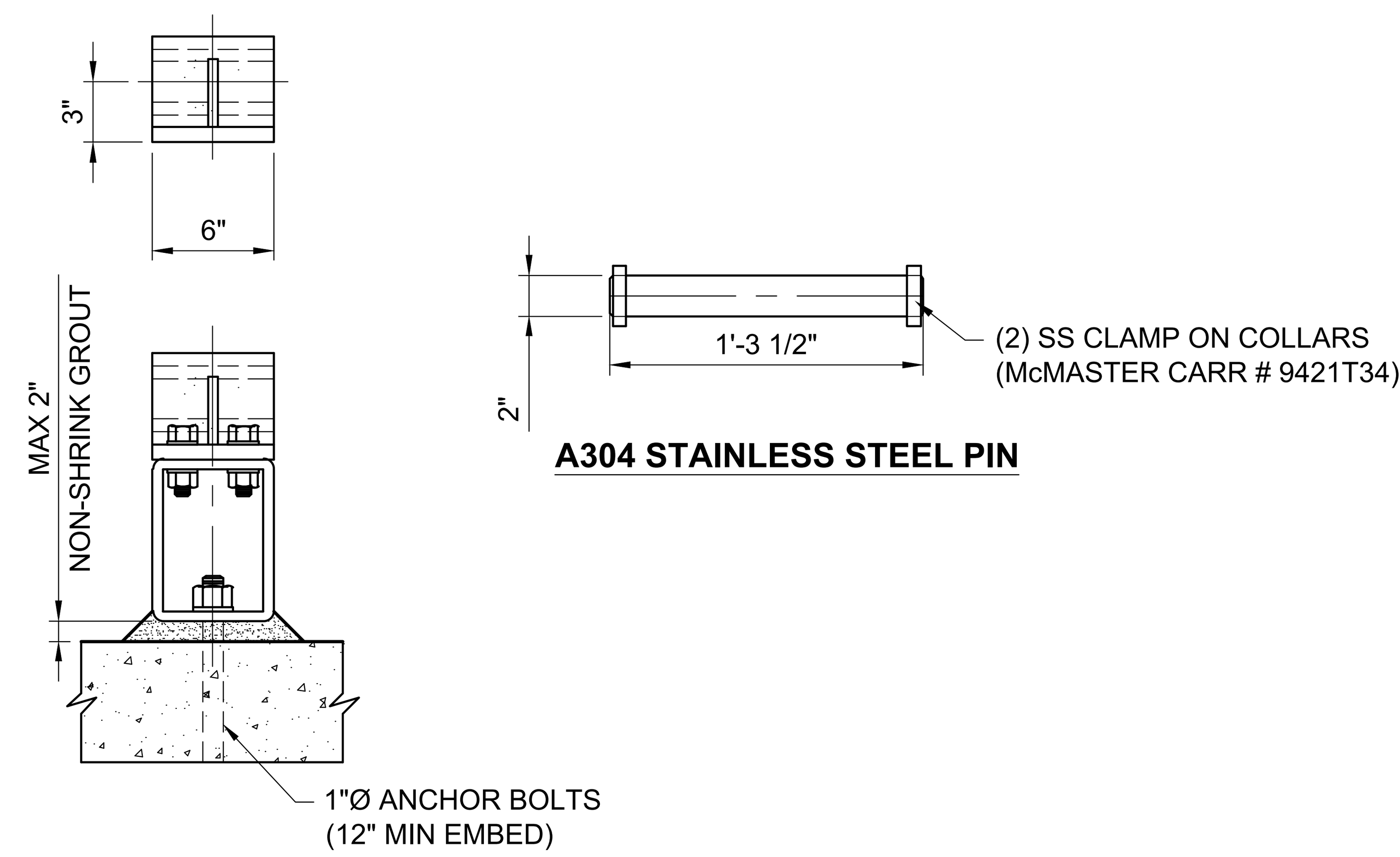
1 / M-104 OPERATOR SUPPORT ASSEMBLY
SCALE: 1"=1'-0"



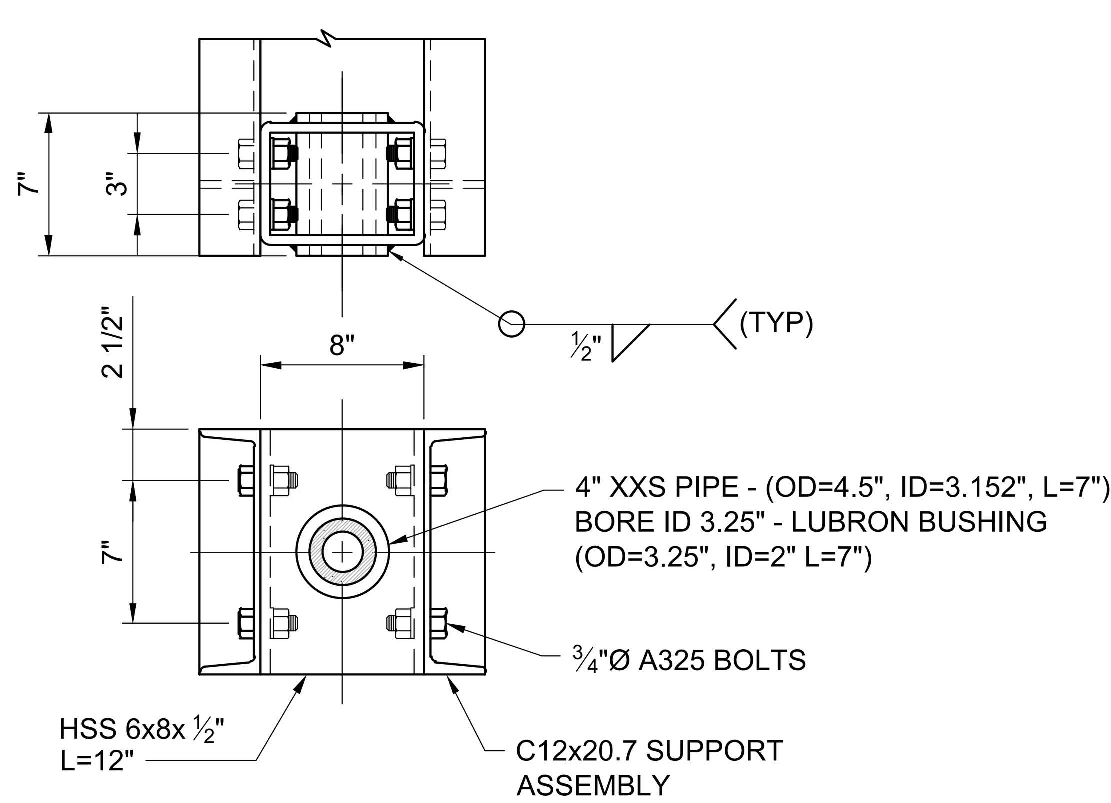
2 / M-104 SQUARE TUBE ASSEMBLY (2 REQUIRED)
SCALE: 1"=1'-0"



OUTER TRUNNION ASSEMBLY



3 / - TRUNNION COMPONENTS
SCALE: 1 1/2"=1'-0"



INNER TRUNNION ASSEMBLY

NOTES:

1. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.
2. COORDINATE WITH EQUIPMENT SUPPLIED.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

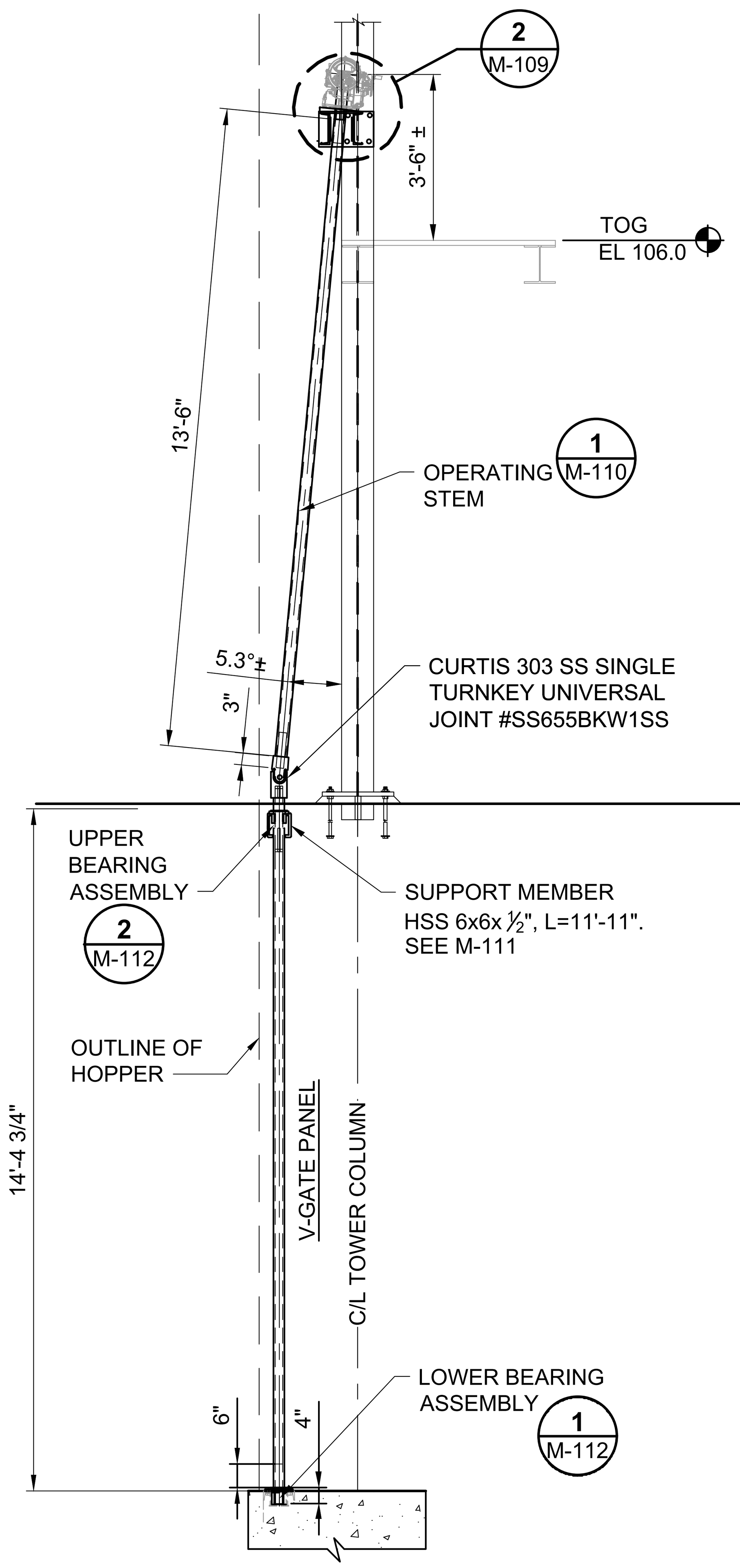
STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

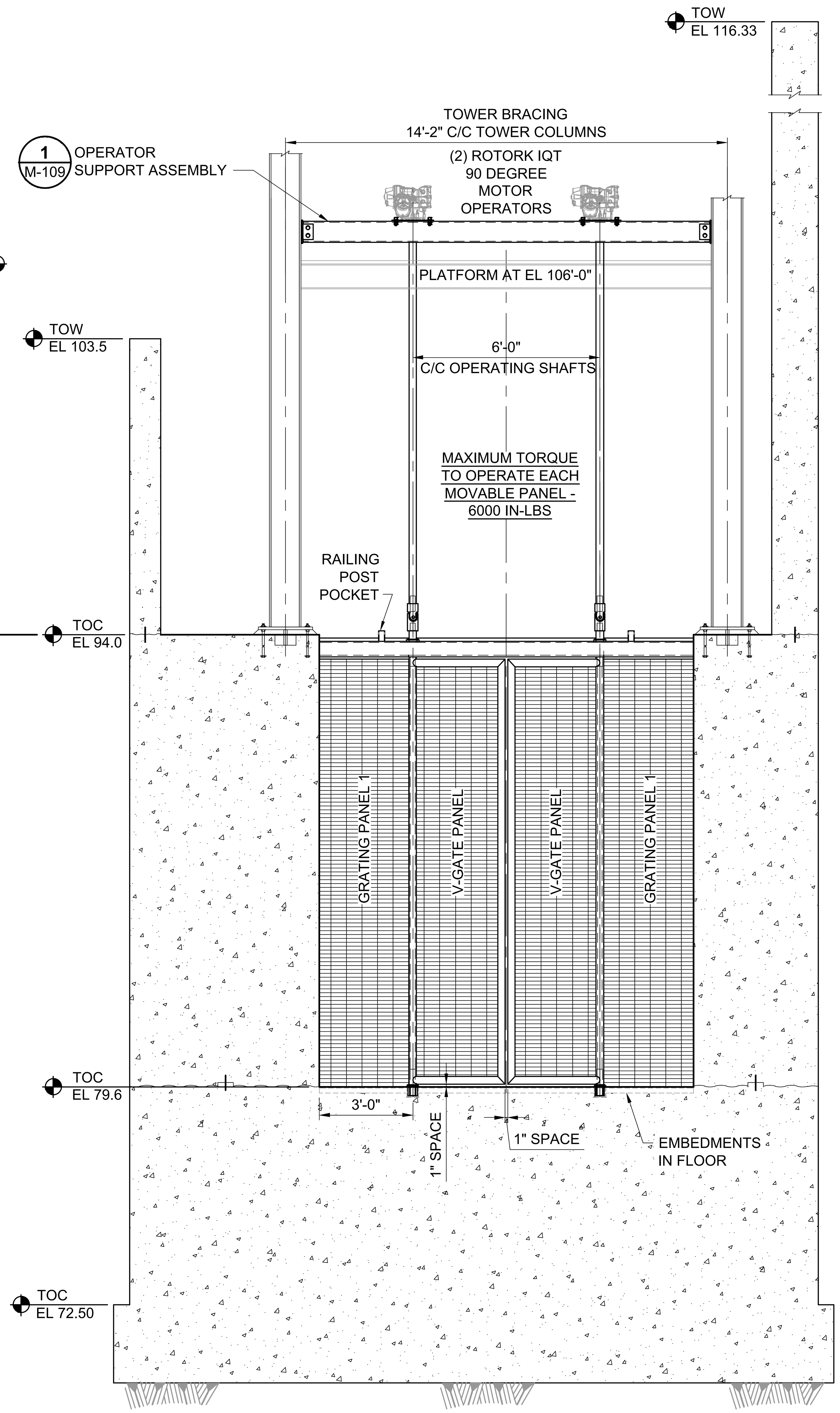
FISH LIFT ENTRANCE GATE
STEEL DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	89 OF 176
DRAWING:	M-107

DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden mss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\M-107.dwg USER: Agrogan
DATE: Dec 13, 2019 2:40pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

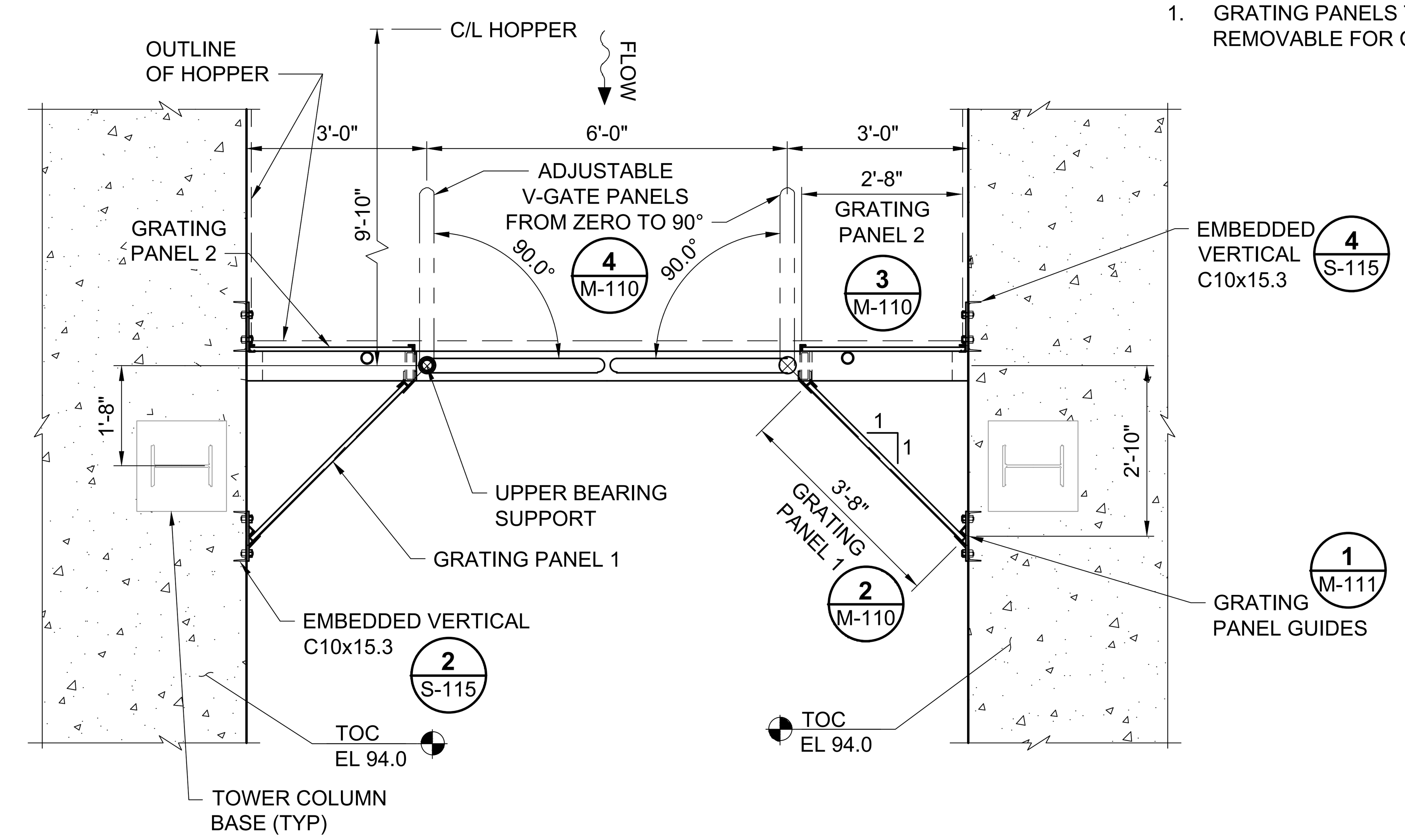


SIDE ELEVATION



ELEVATION LOOKING UPSTREAM
V-GATE CLOSED POSITION

V-GATE ELEVATION VIEWS
SCALE: 3/8"=1'-0"



GENERAL PLAN @ EL 94.0
SCALE: 1/2"=1'-0"

NOTE:

1. GRATING PANELS TYPE 1 & 2 ARE REMOVABLE FOR CLEANING.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 12/13/2019 — PROFESSIONAL ENGINEER LICENSED

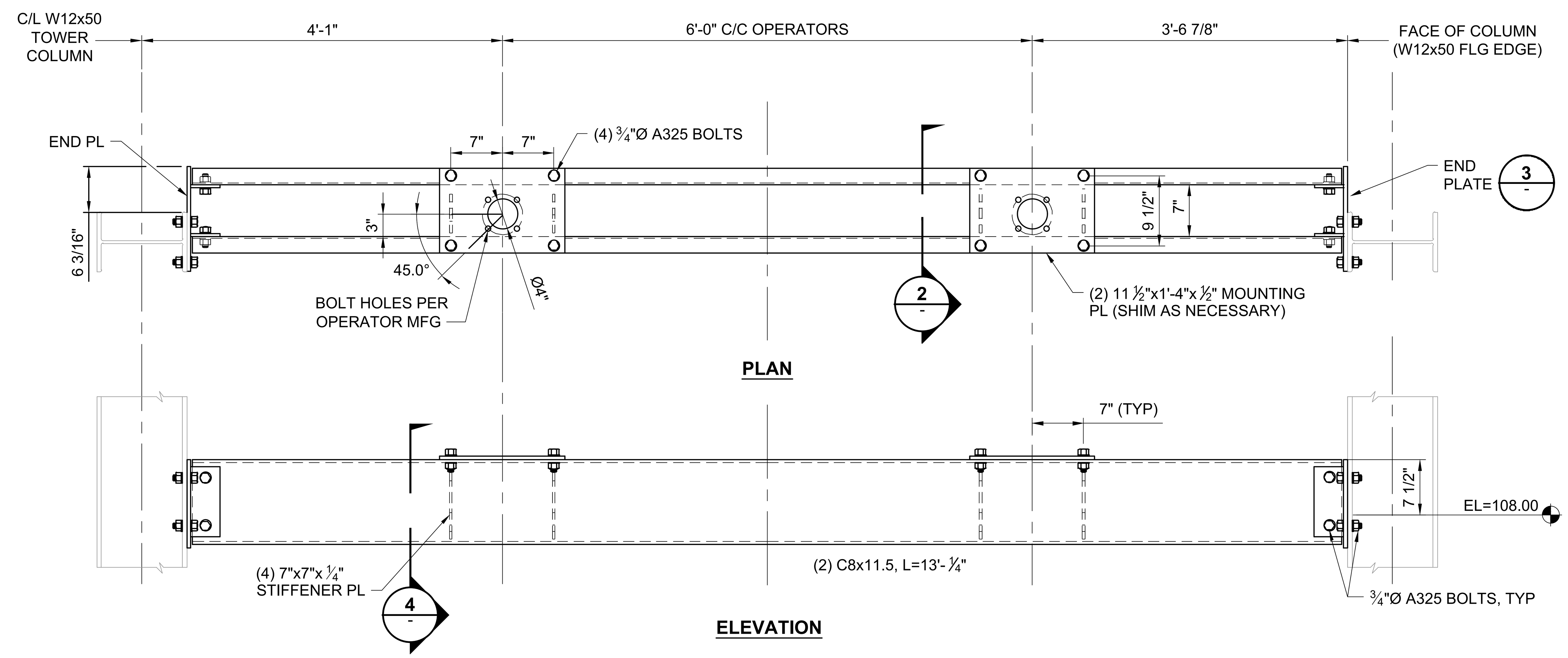
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE GENERAL PLAN, ELEVATIONS, AND DETAILS

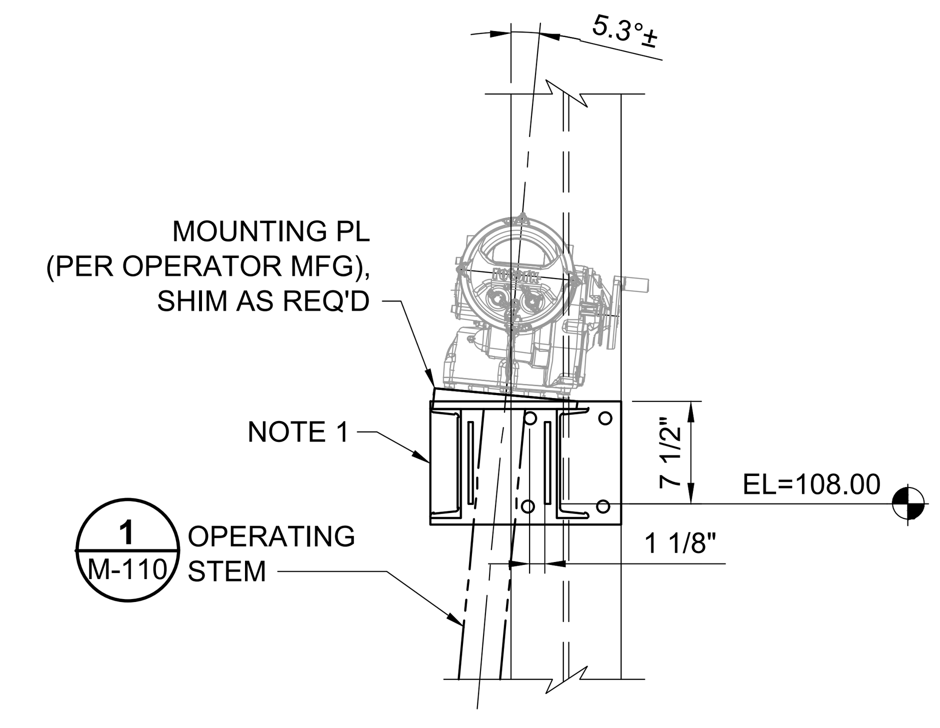
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	90 OF 176
DRAWING:	M-108

NOTES:

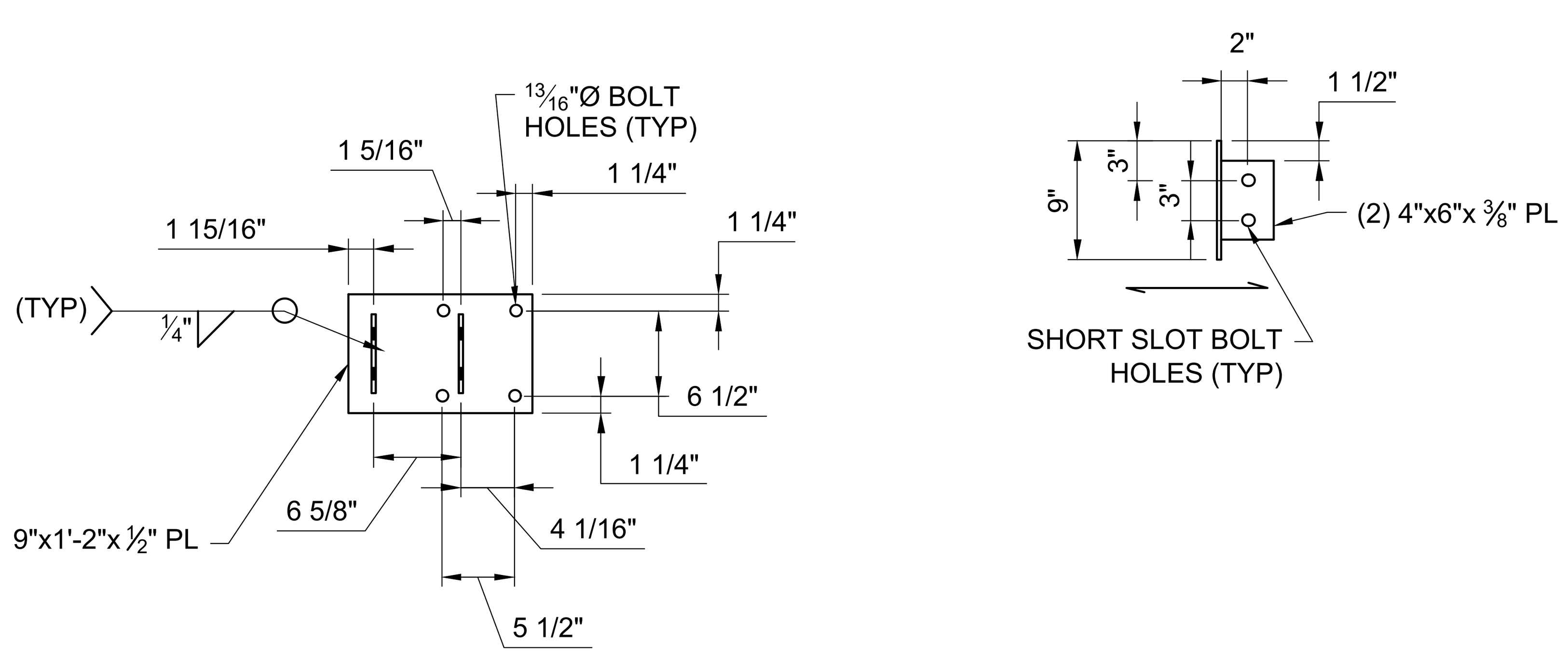
1. BOLTS AND STIFFENER PLATES REMOVED FOR CLARITY.
2. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.



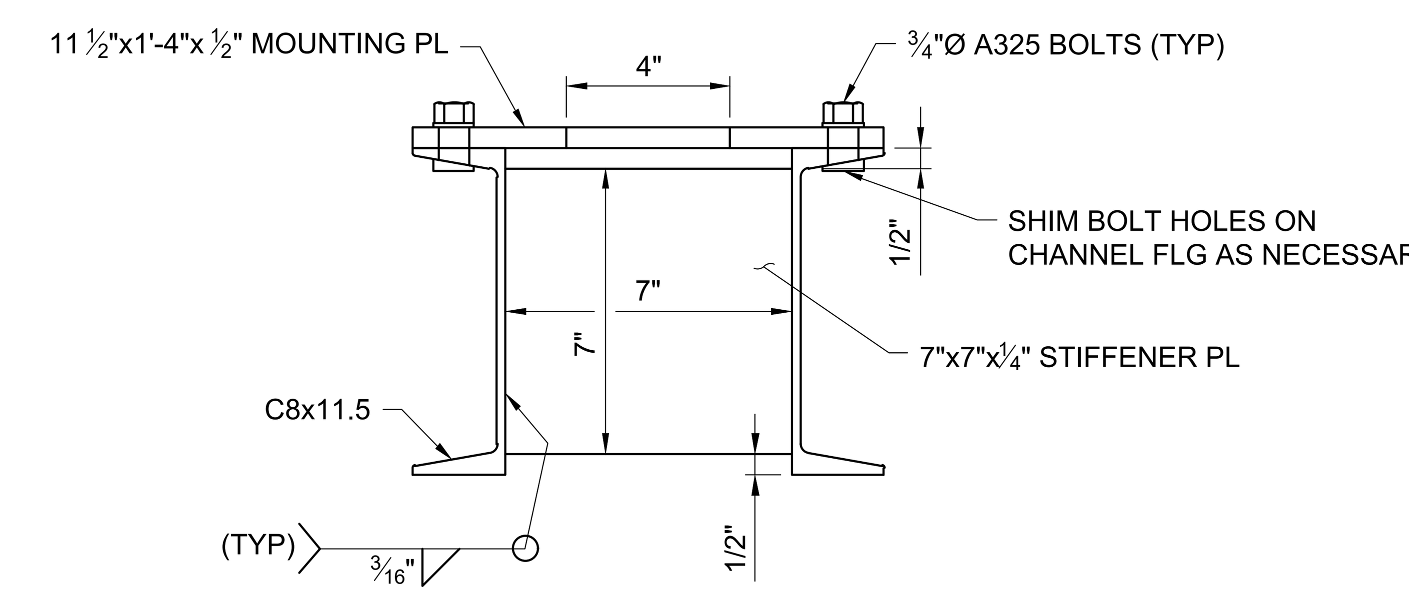
1 OPERATOR SUPPORT ASSEMBLY
M-108
SCALE: 1"=1'-0"



2 END PLATE ASSEMBLY
M-108
SCALE: 1"=1'-0"
M-109



3 END PLATE DETAIL (2 REQUIRED)
SCALE: 1"=1'-0"



4 STIFFENER DETAIL (TYPICAL)
SCALE: 3"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

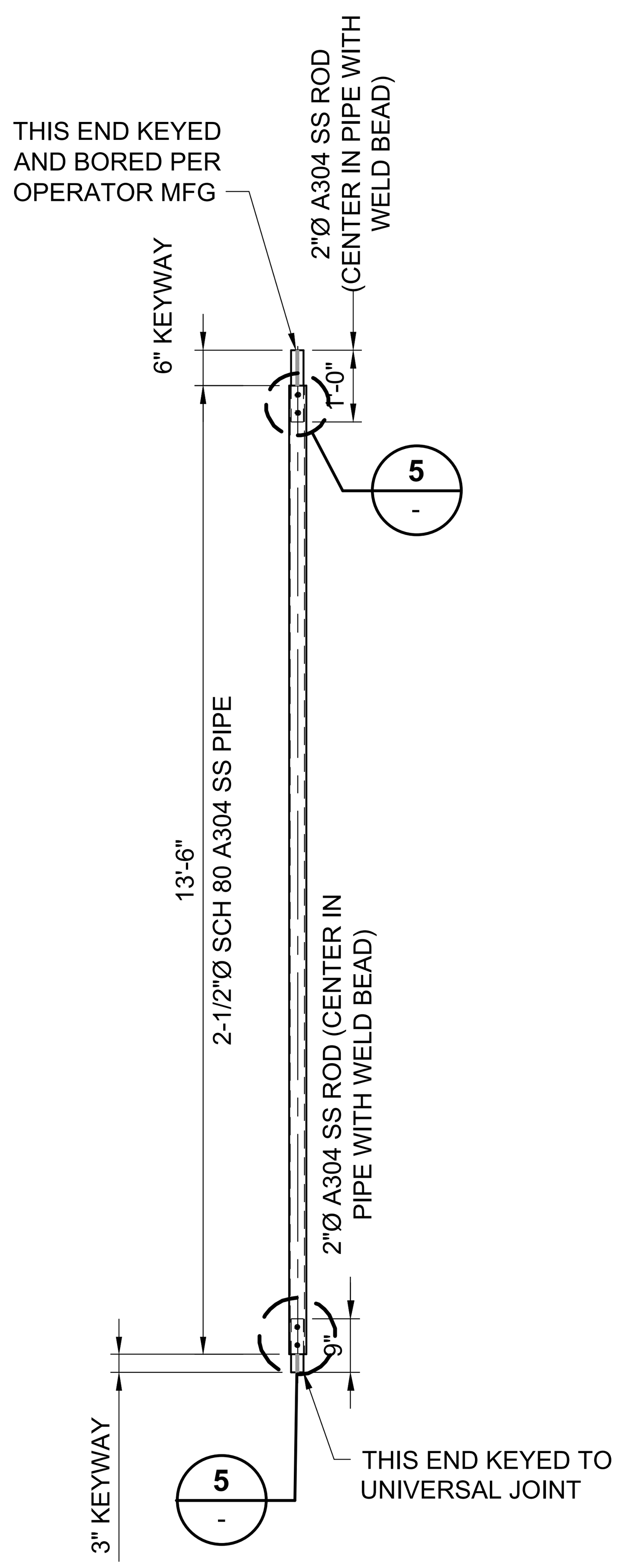
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

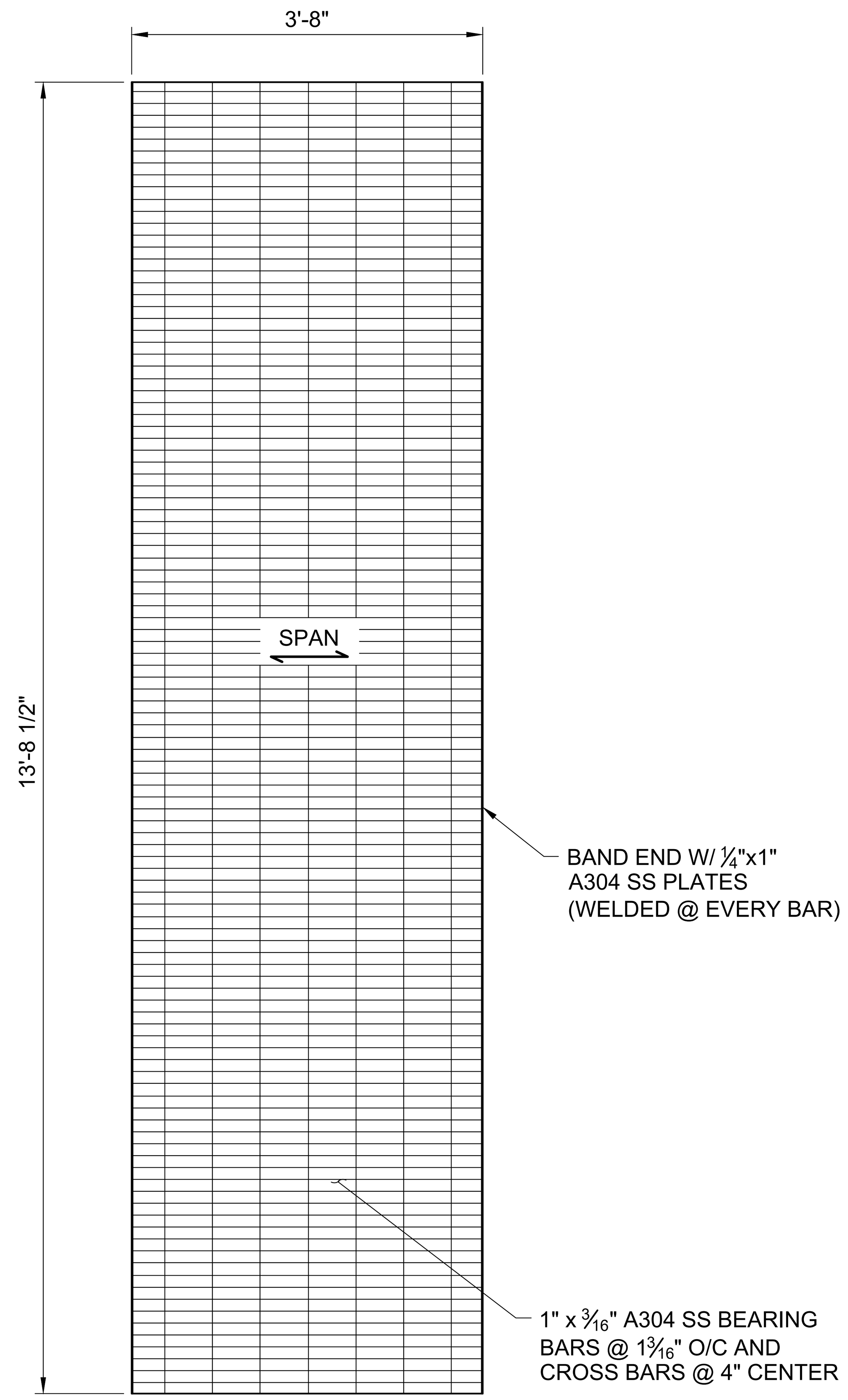
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE OPERATOR SUPPORT DETAILS

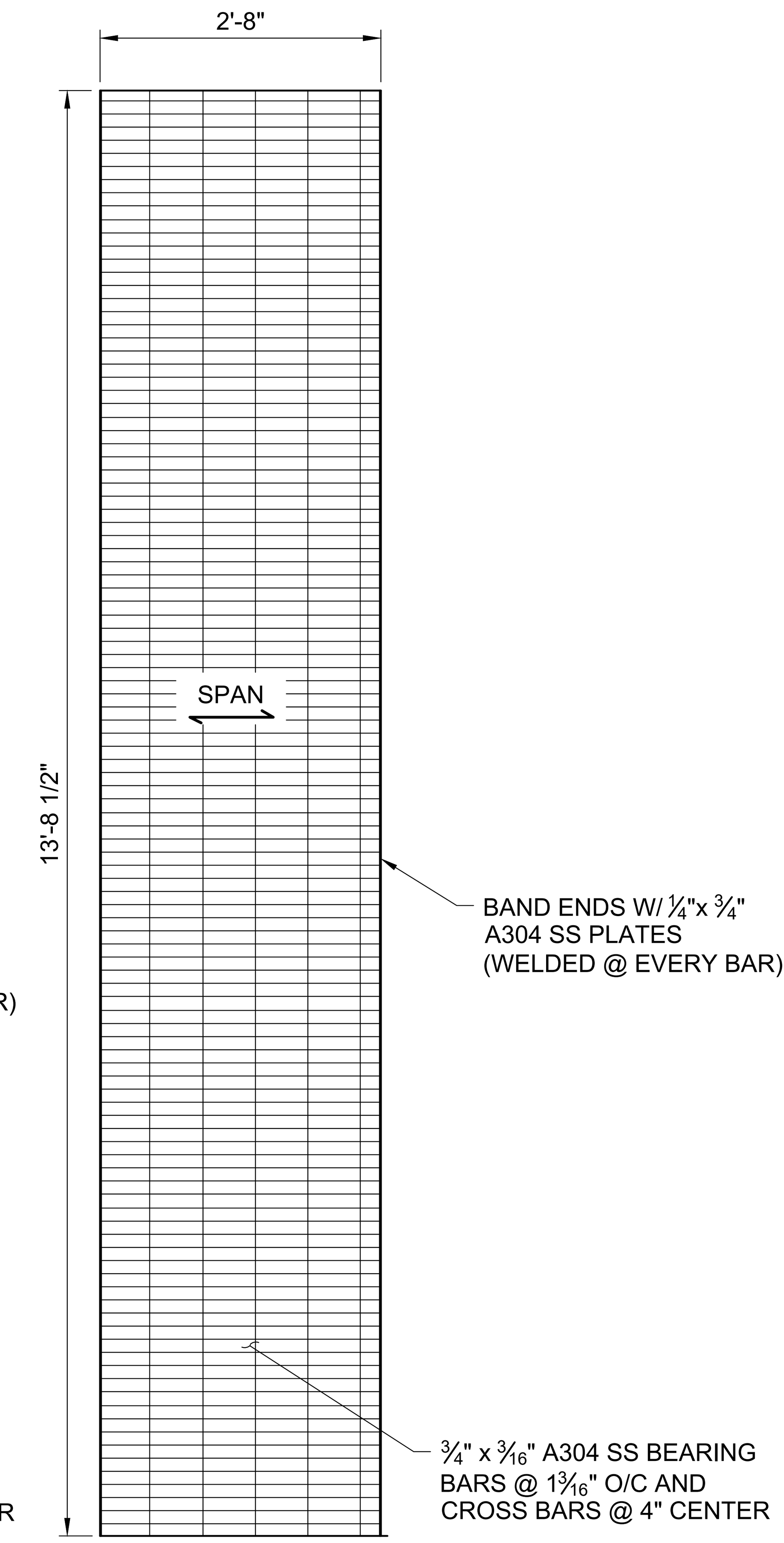
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	91 OF 176
DRAWING:	M-109



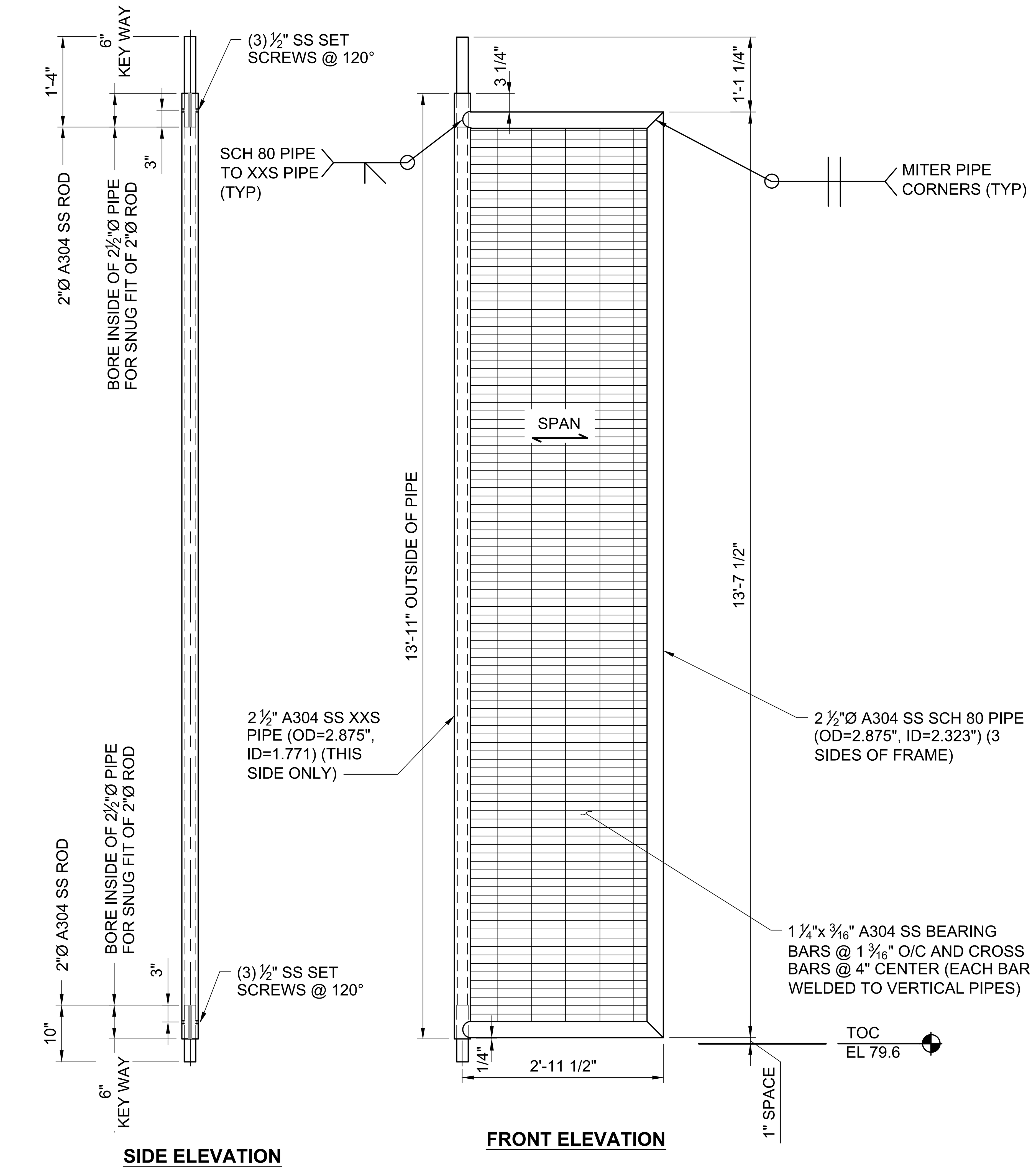
1 M-108 **OPERATING STEM (2 REQUIRED)**
SCALE: 1/2"=1'-0"
M-109



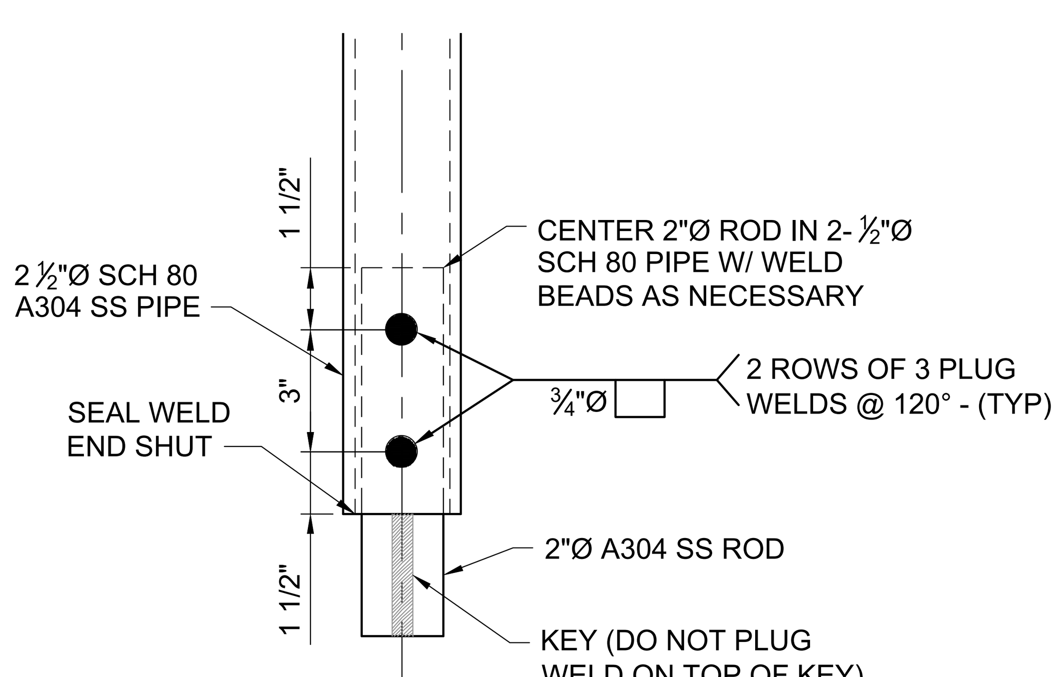
2 M-108 **GRATING PANEL 1 (2 REQUIRED)**
SCALE: 3/4"=1'-0"



3 M-108 **GRATING PANEL 2 (2 REQUIRED)**
SCALE: 3/4"=1'-0"



4 M-108 **V-GATE PANEL (2 REQUIRED)**
SCALE: 3/4"=1'-0"



5 - **PLUG WELD DETAIL (2 LOC)**
SCALE: 3'=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

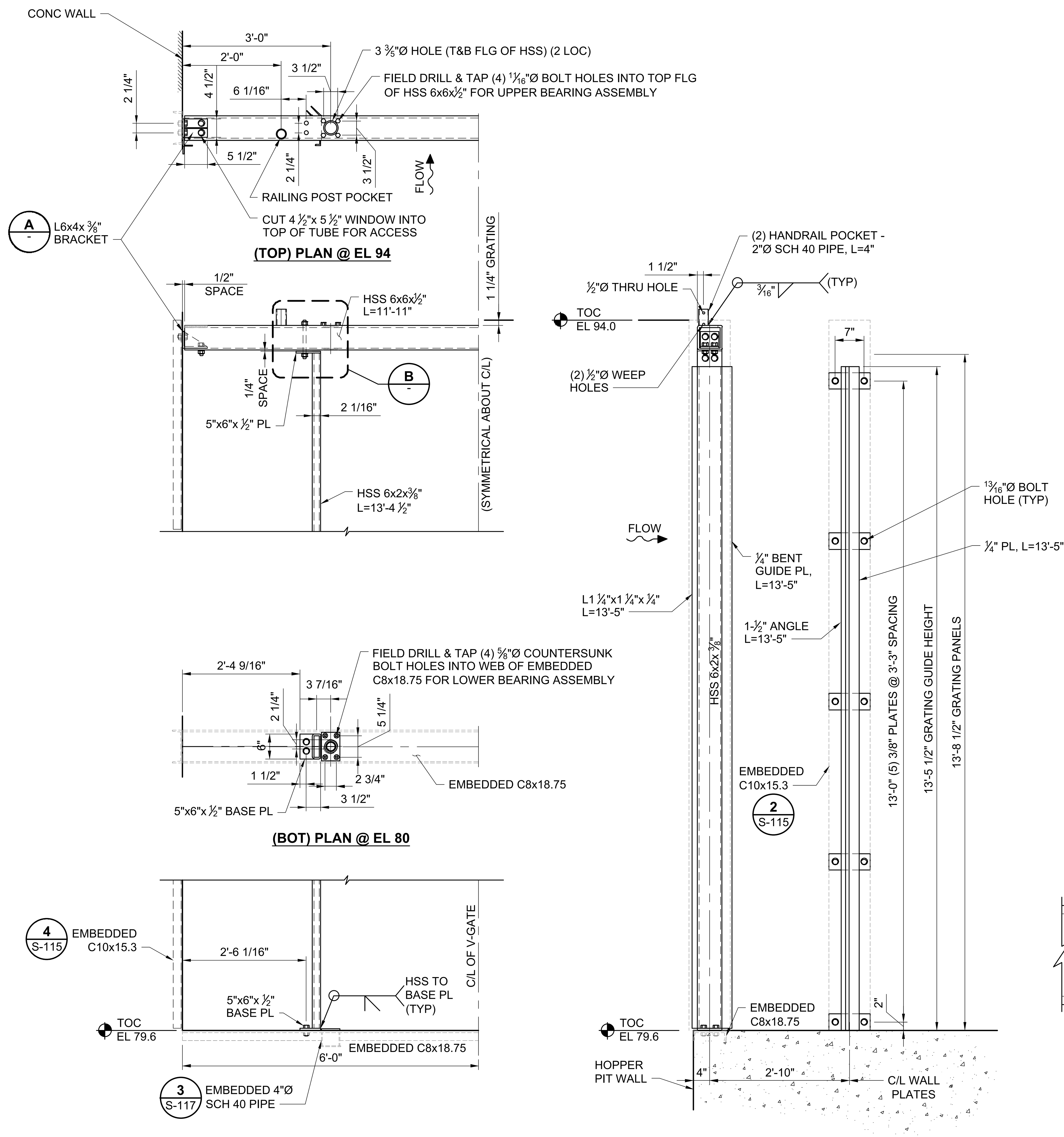
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 92 OF 176
DRAWING: M-110

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden rsss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\M\M-110.dwg USER: Agrogan
DATE: Dec 13, 2019 2:40pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

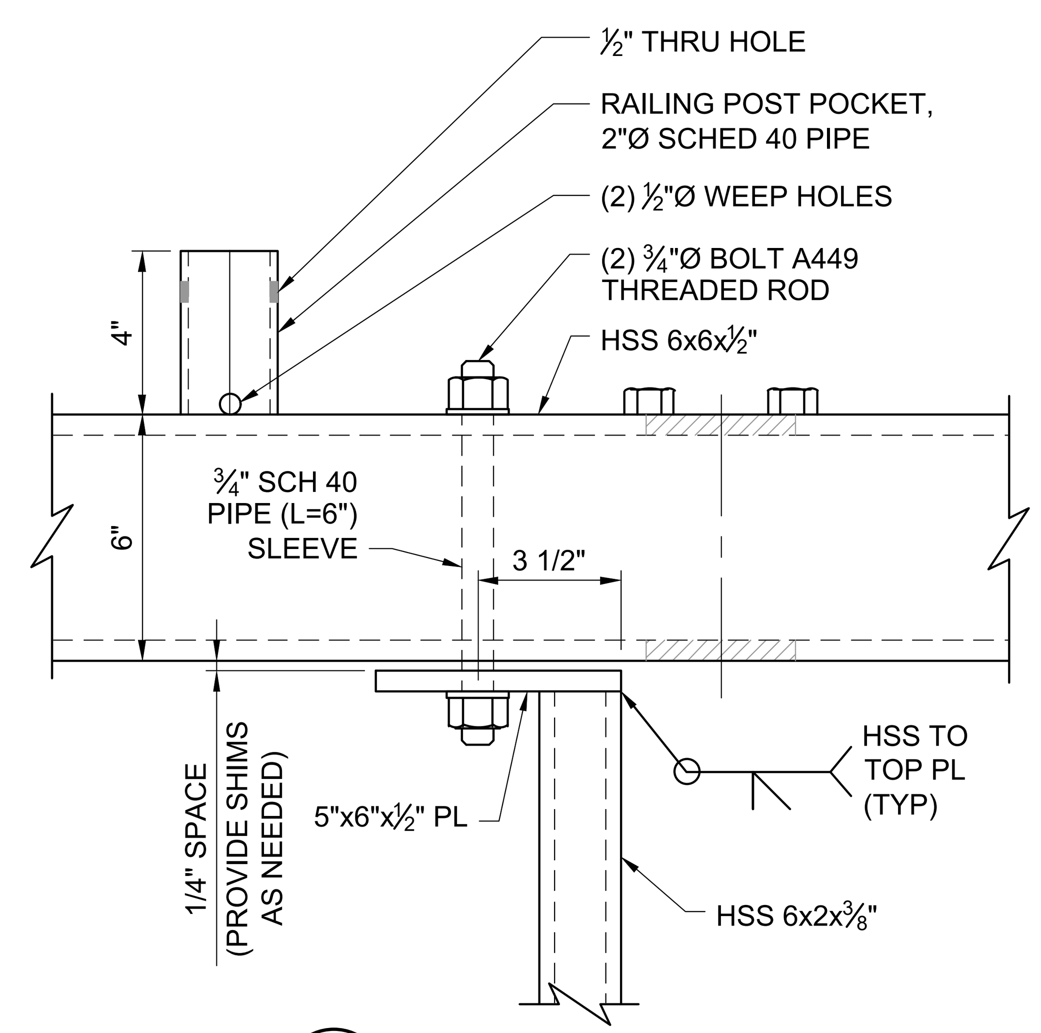


2 STEEL FRAMING FRONT ELEVATION (GUIDES NOT SHOWN)

SCALE: 3/4"=1'-0"

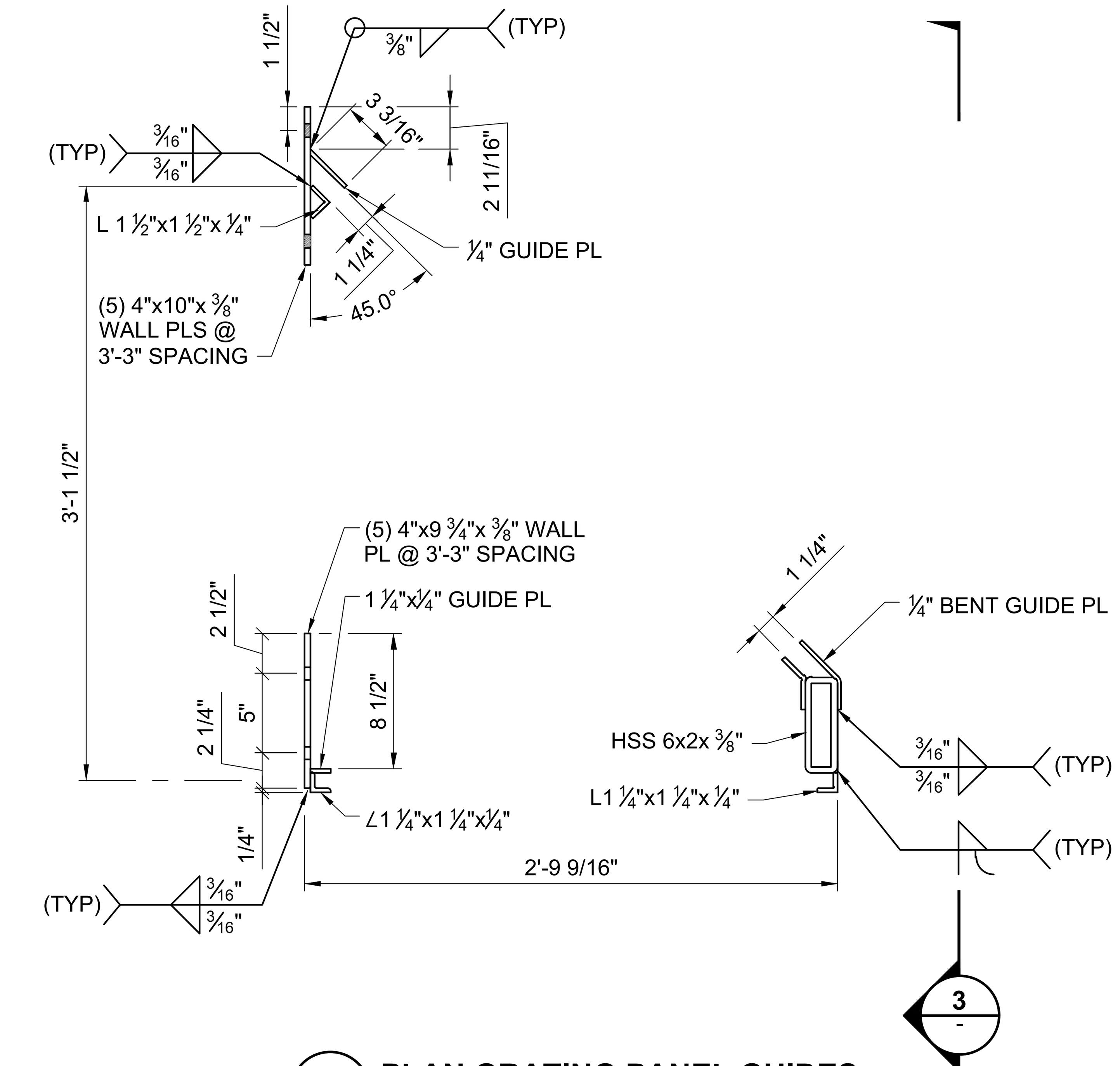
3 STEEL FRAMING SIDE ELEVATION

SCALE: 3/4"=1'-0"



B THROUGH BOLT DETAIL

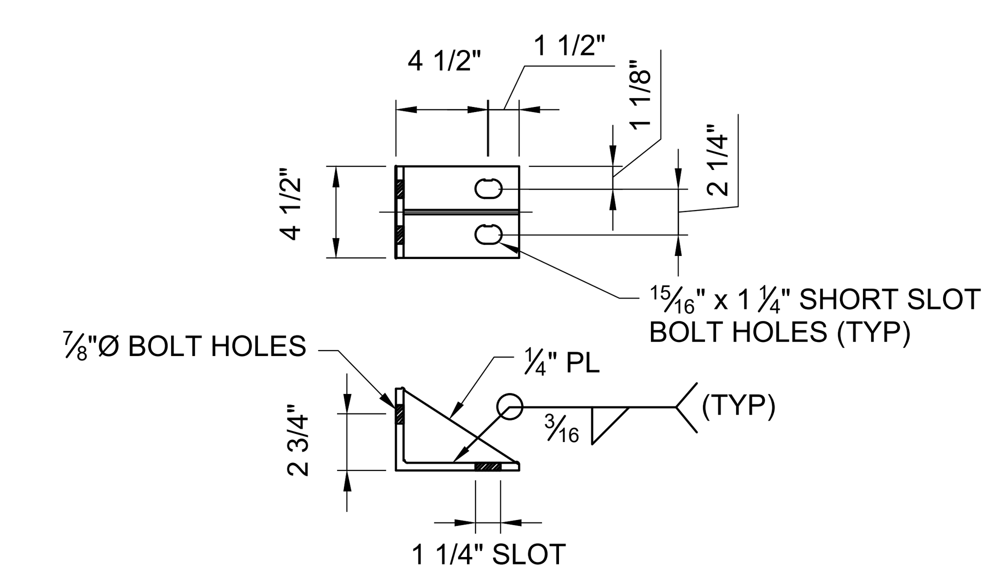
SCALE: 3"=1'-0"



1 PLAN GRATING PANEL GUIDES

M-108

SCALE: 1 1/2"=1'-0"



A L6x4x3/8" BRACKET DETAIL (2 REQUIRED)

SCALE: 1 1/2"=1'-0"

NOTES:

1. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

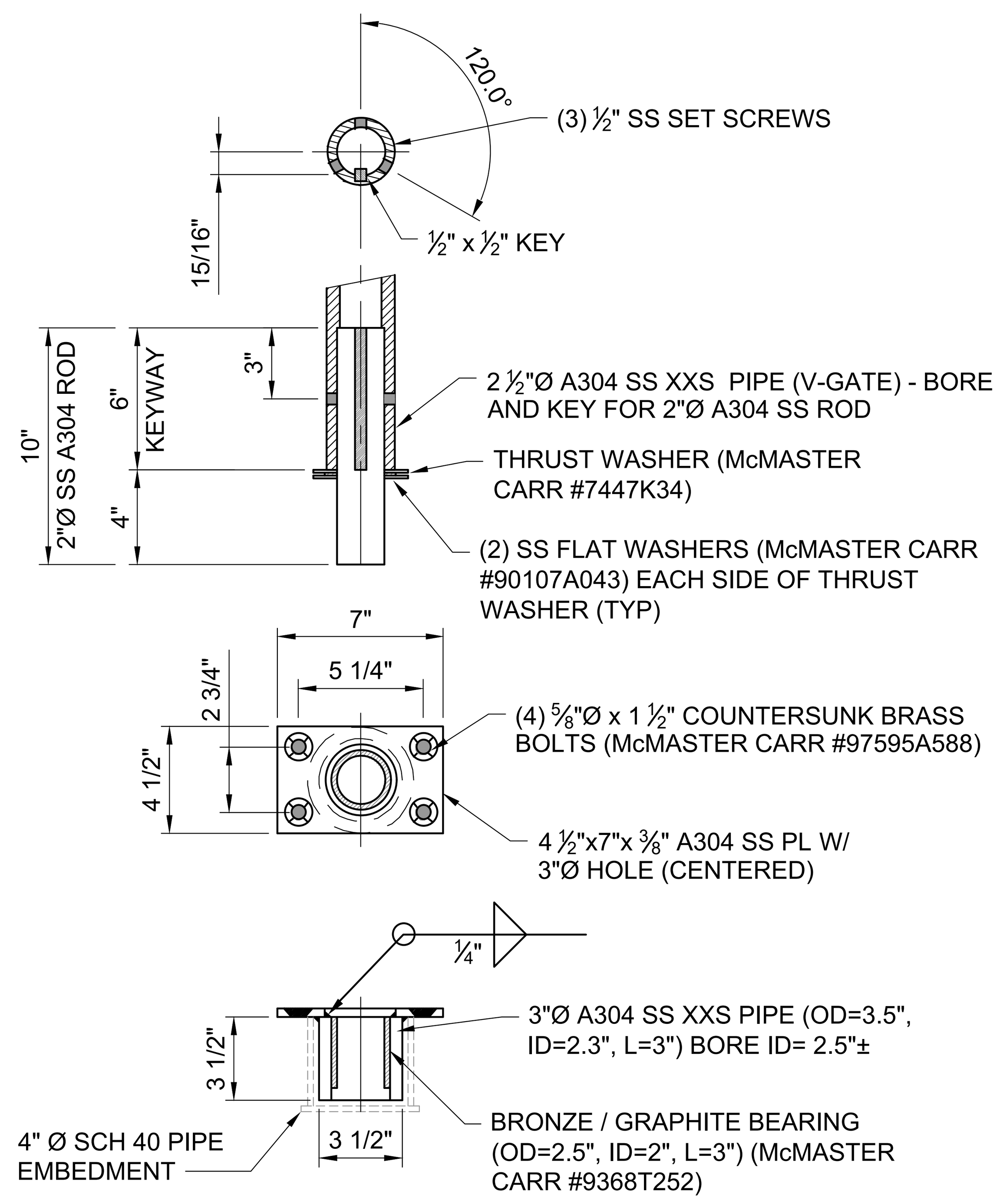
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

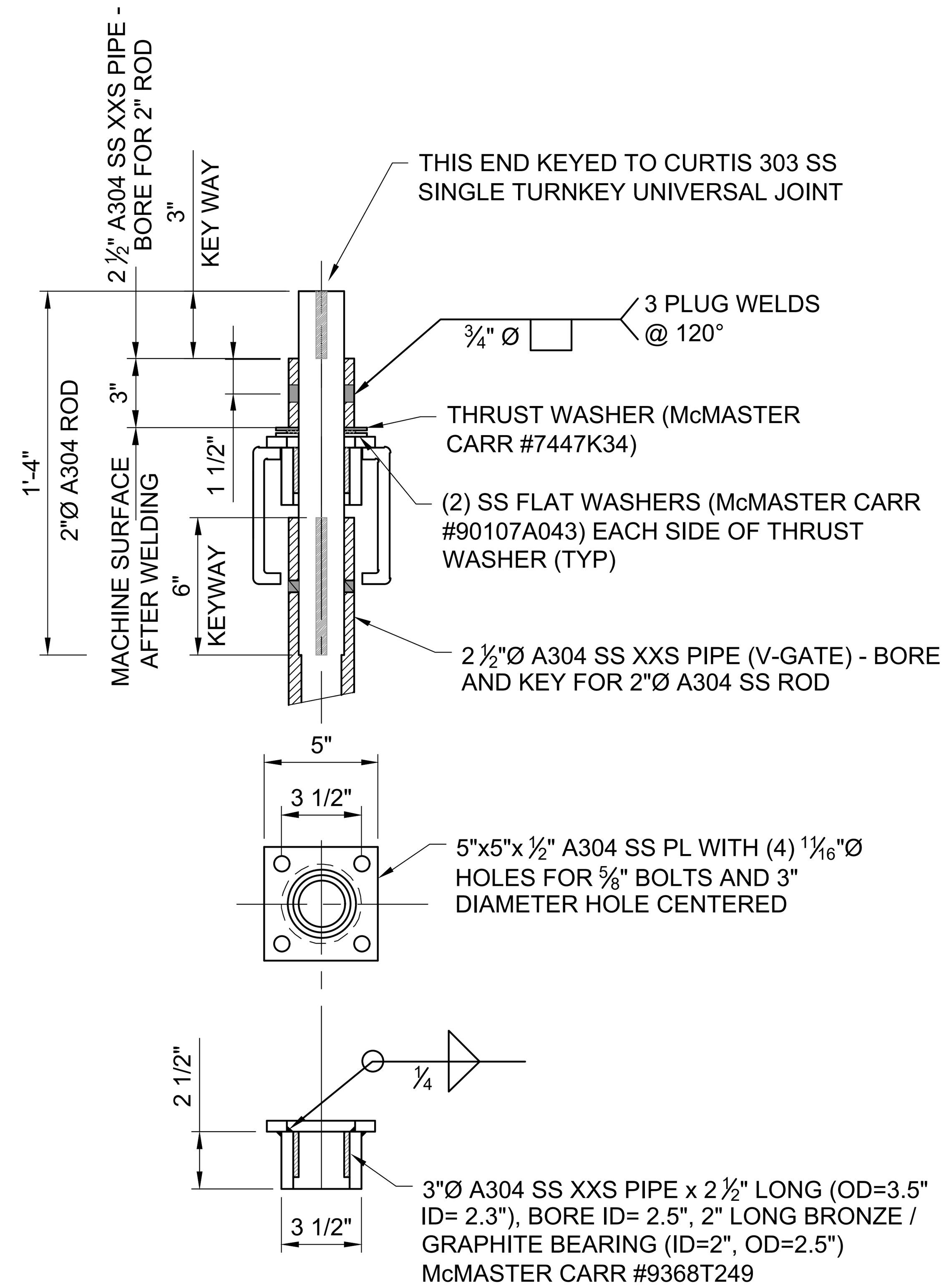
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE STEEL FRAMING PLANS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	93 OF 176
DRAWING:	M-111



1 / M-108 **LOWER BEARING ASSEMBLY (2 REQUIRED)**
SCALE: 2"=1'-0"



NOTE:

CLEARANCE BETWEEN PIN AND BEARING 0.005" INTERFERENCE FIT OF BEARING INTO PIPE HOUSING 0.0015".

2 / M-108 **UPPER BEARING ASSEMBLY (2 REQUIRED)**
SCALE: 2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

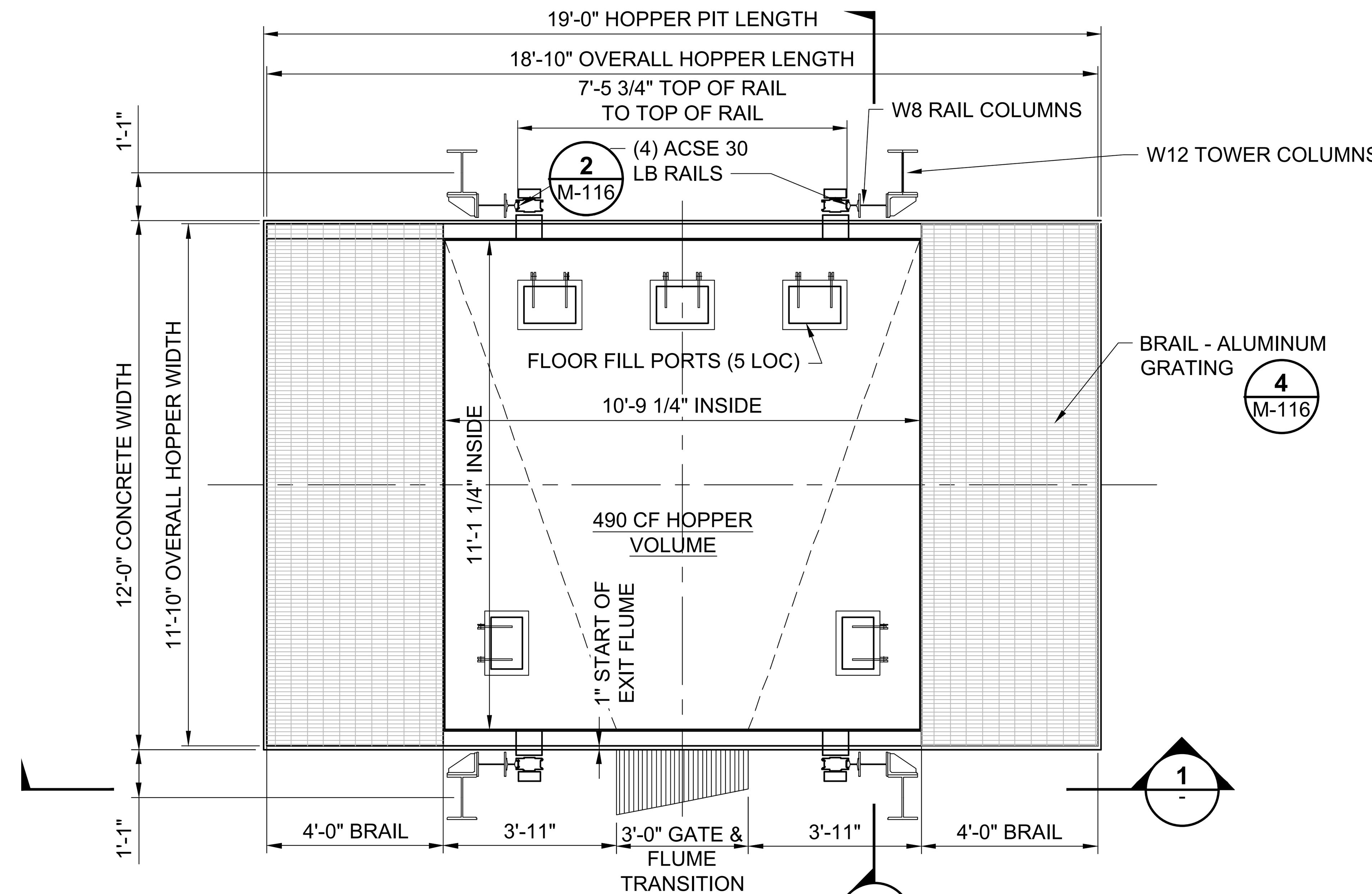
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE BEARING DETAILS

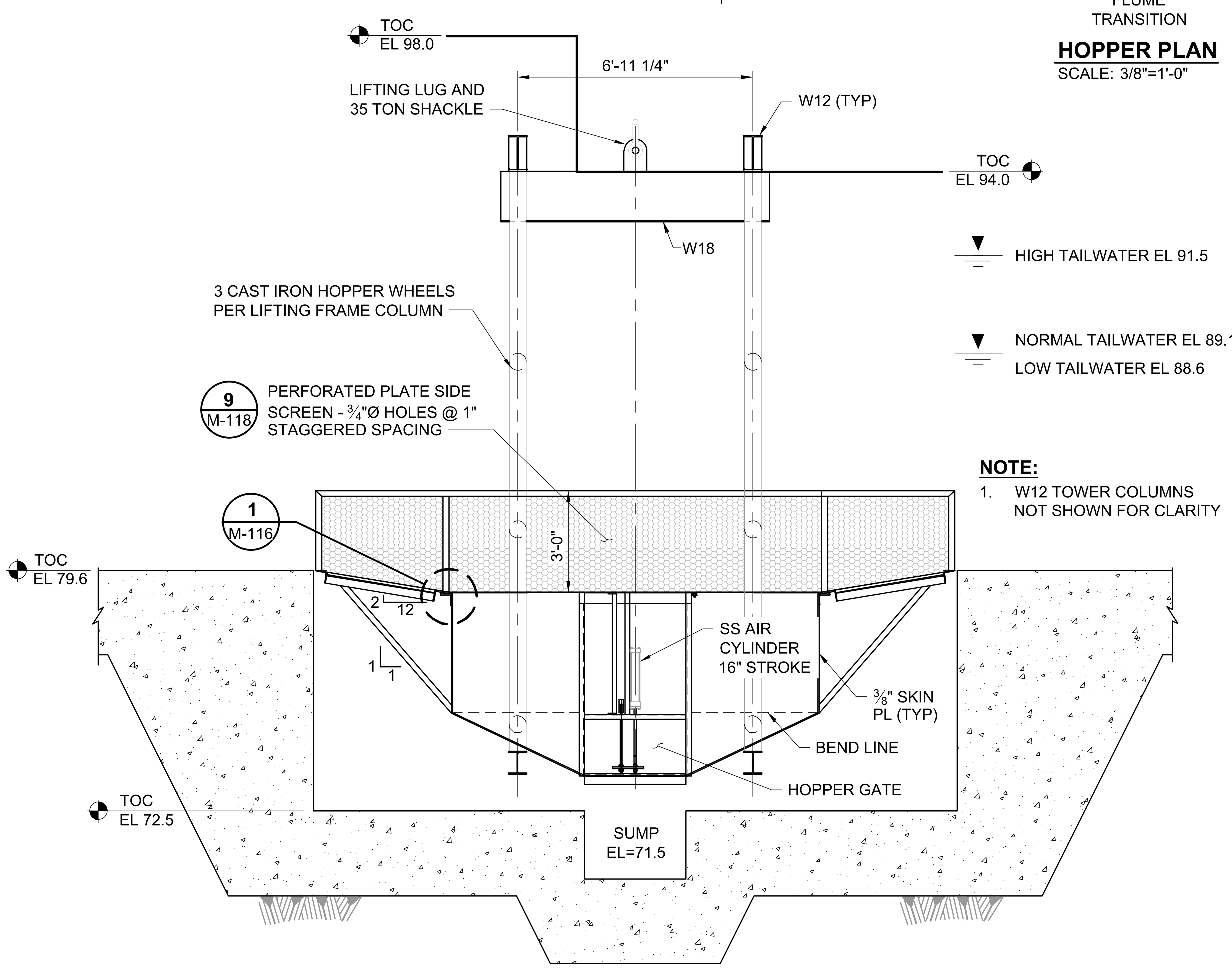
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 94 OF 176
DRAWING: M-112

APPROXIMATE HOPPER COMPONENT WEIGHTS

HOPPER AND HOPPER GATE	7500 LBS
BRAIL PANELS (2)	500 LBS
LIFTING FRAME	6000 LBS
SIDE SCREENS (2)	1500 LBS
BRAIL SUPPORTS (2)	500 LBS
TOTAL	16,000 LBS

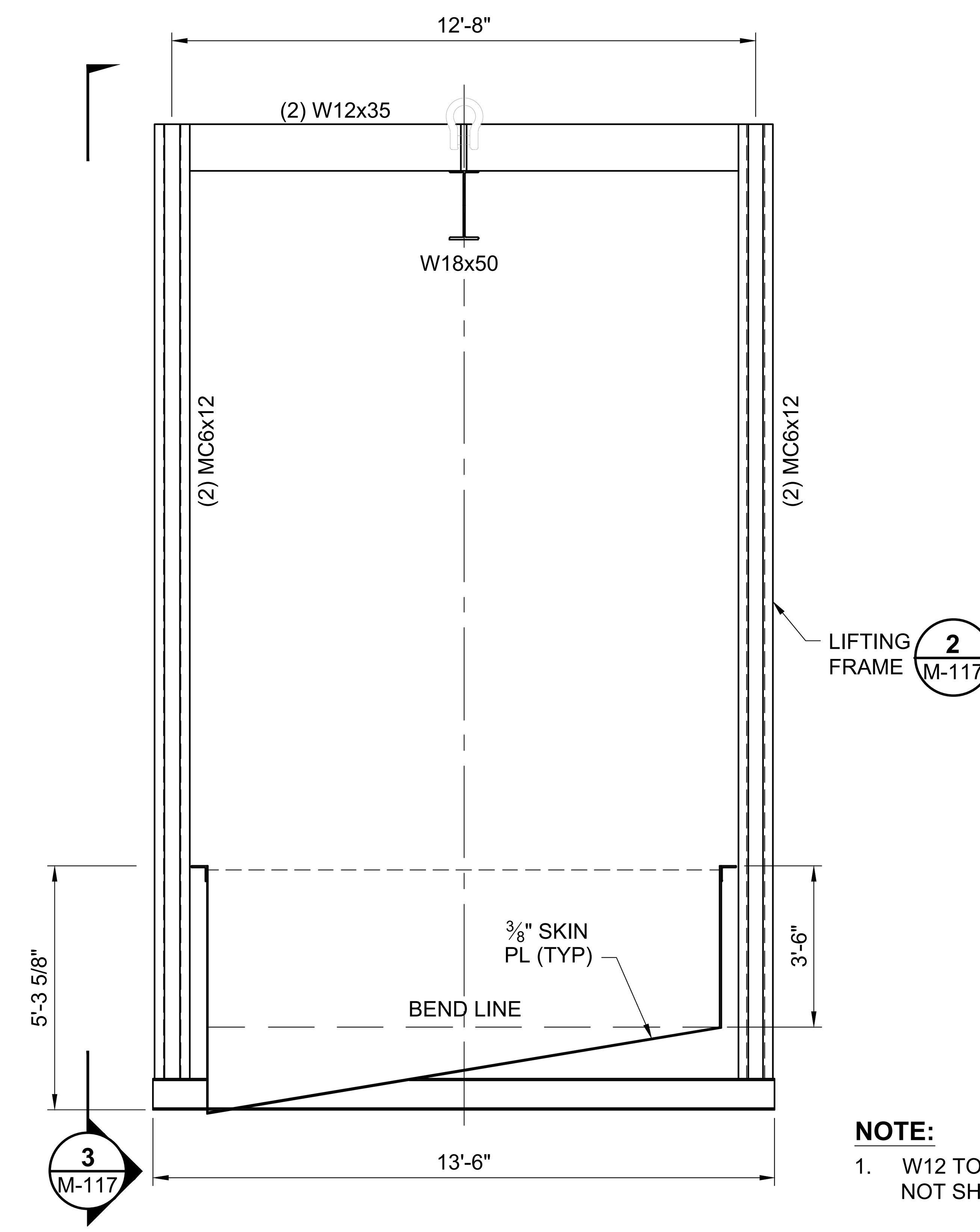


HOPPER PLAN
SCALE: 3/8"=1'-0"



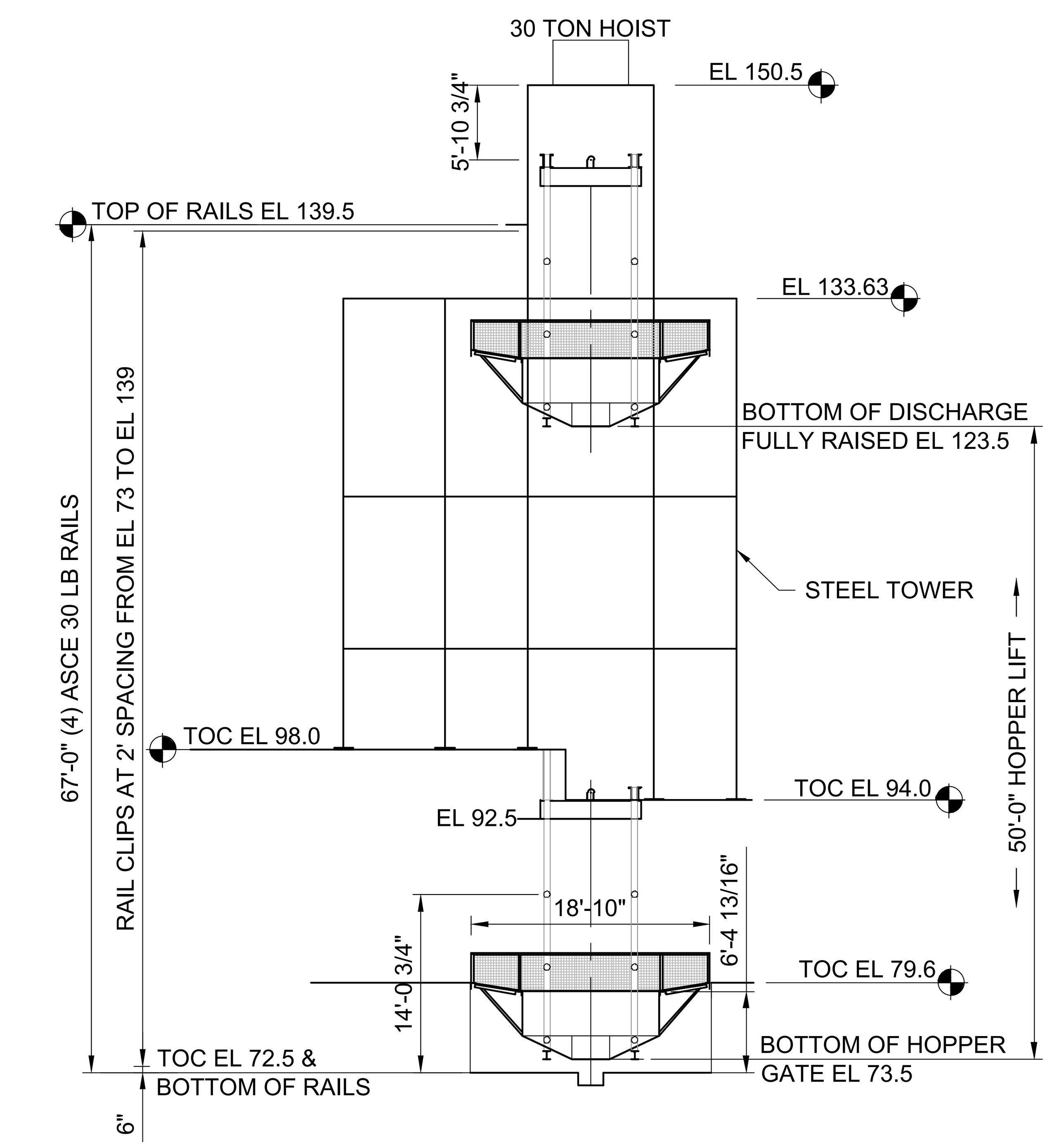
NOTE:
1. W12 TOWER COLUMNS NOT SHOWN FOR CLARITY

1 ELEVATION OF HOPPER LOWERED
SCALE: 3/8"=1'-0"



NOTE:
1. W12 TOWER COLUMNS NOT SHOWN FOR CLARITY

2 SIDE ELEVATION
SCALE: 3/8"=1'-0"



HOPPER TRAVEL
SCALE: 3/32"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

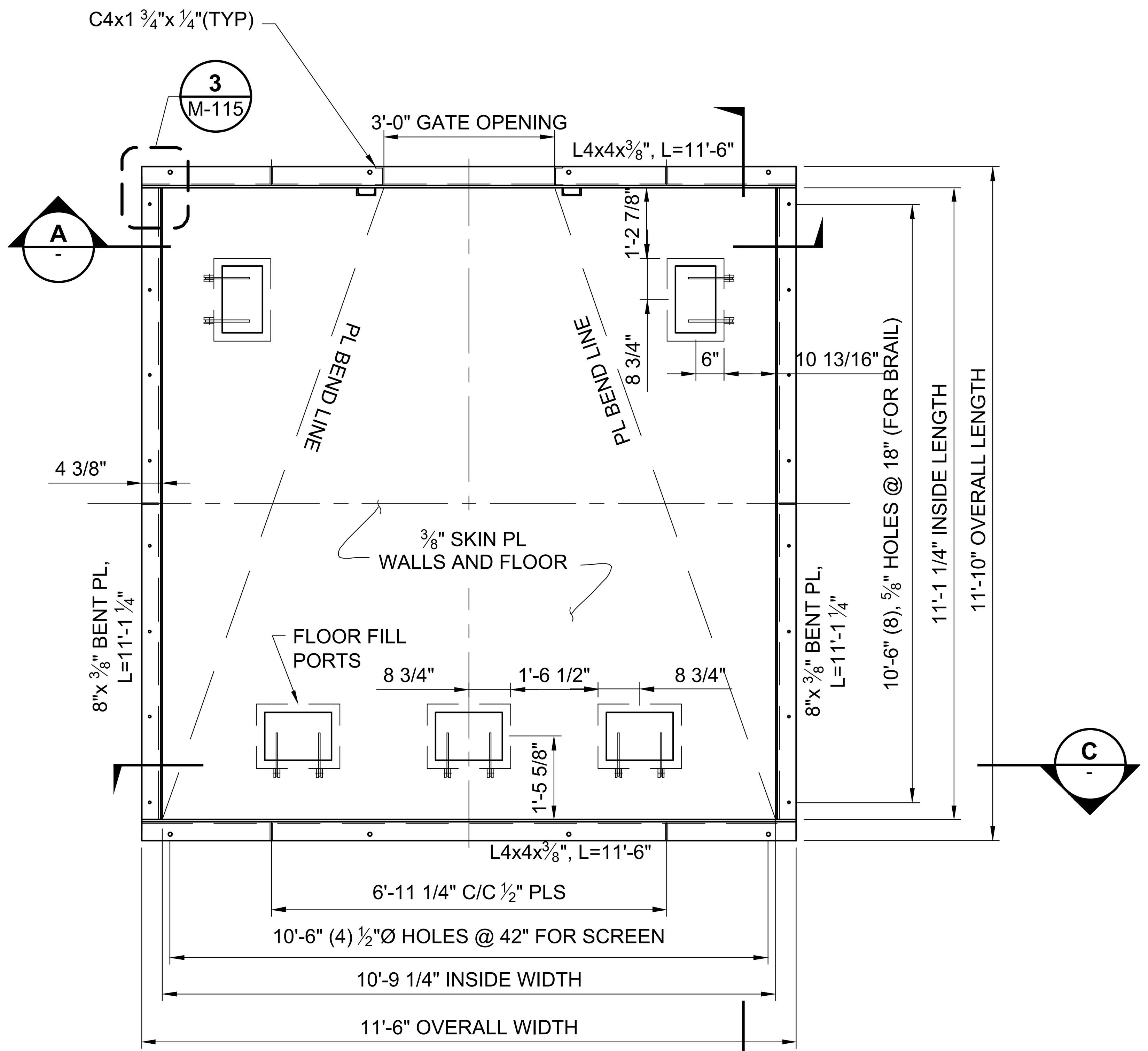
FISH LIFT HOPPER - GENERAL LAYOUT AND INFORMATION

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 95 OF 176
DRAWING: M-113

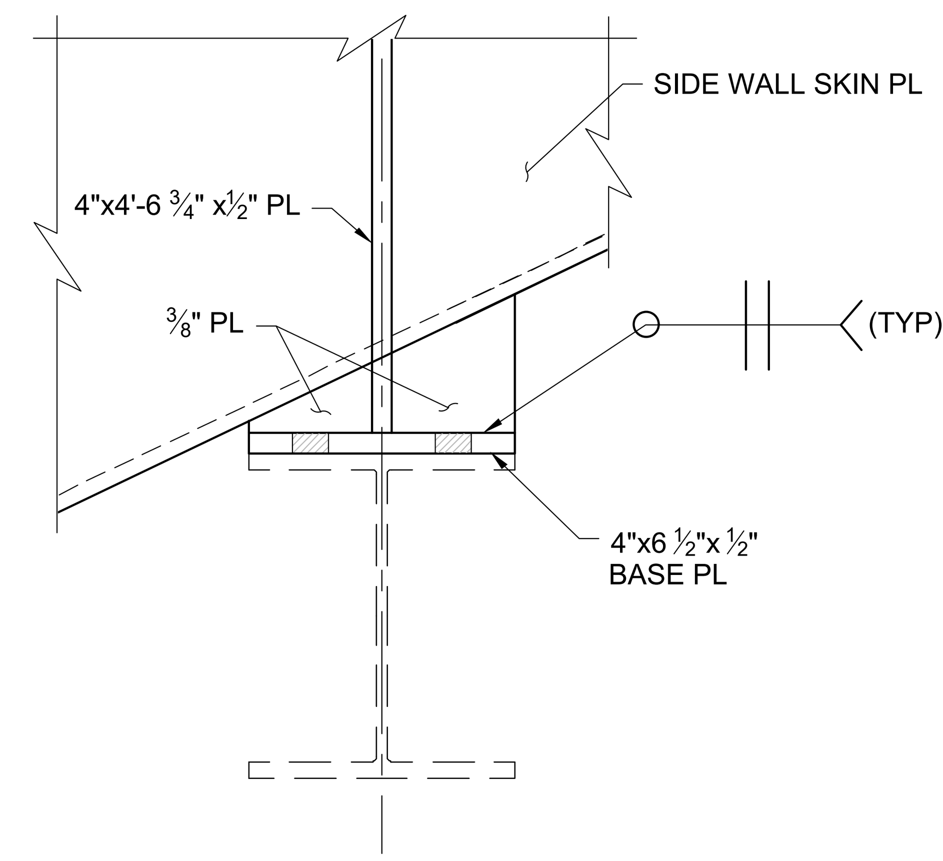
DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden miss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\M-113.dwg USER: Agrogan
DATE: Dec 13, 2019 2:40pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

NOTES:

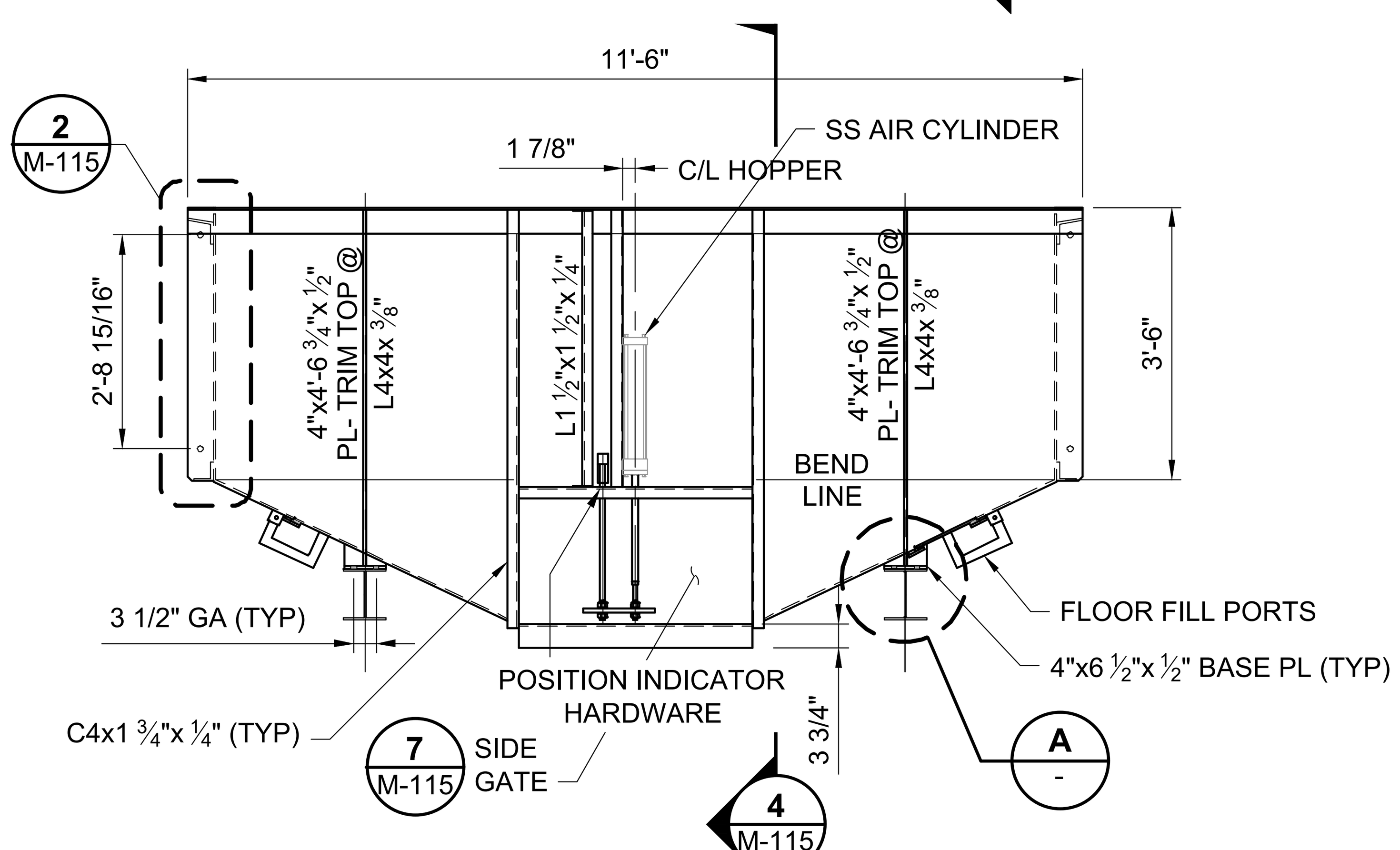
1. NET HOPPER VOLUME=490 CUBIC FEET
2. ALL INTERIOR HOPPER PLATE JOINTS SHALL BE SEAL WELDED.
3. ALL INTERIOR SURFACES & FISH CONTACT AREAS SHALL BE SMOOTH & BURR FREE.
4. GRIND ALL INTERIOR EDGES TO MINIMUM 1/4"R.
5. AIR CYLINDER TO BE STAINLESS STEEL PARKER # 3.25CFSAU19A16.000



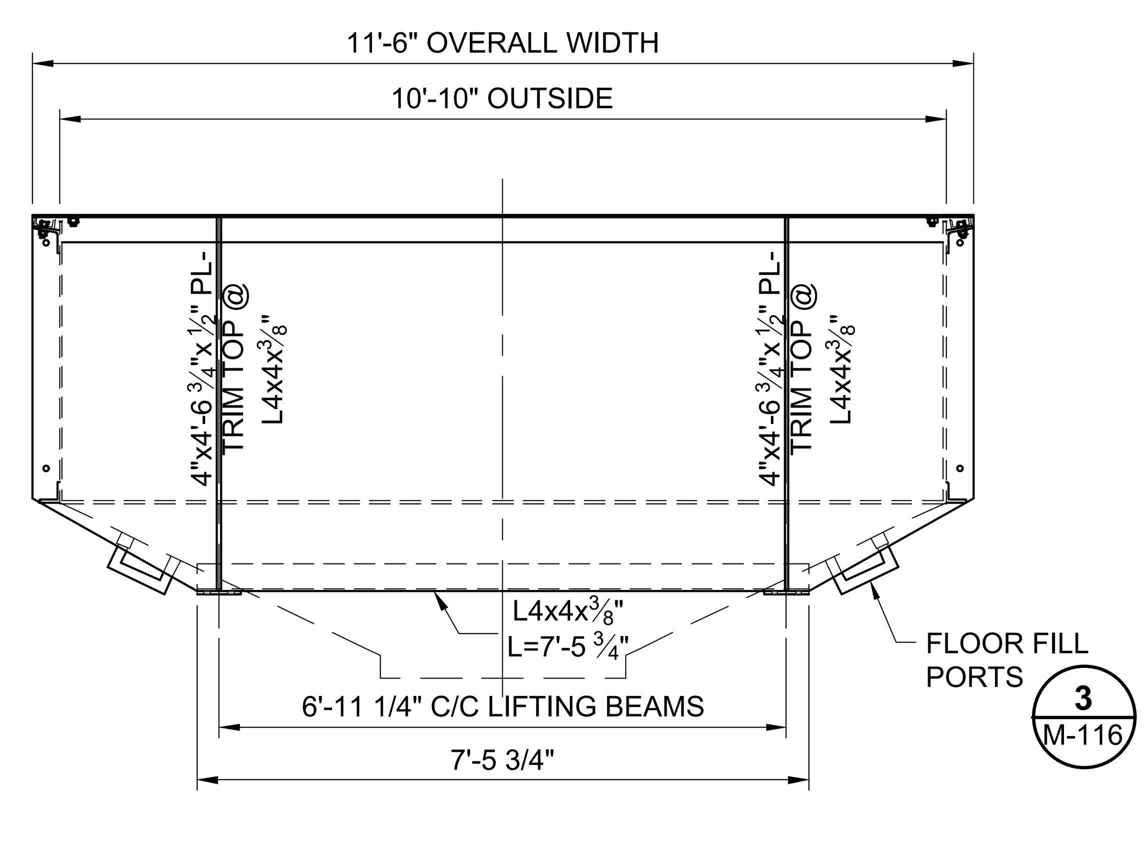
HOPPER PLAN
SCALE: 1/2"=1'-0"



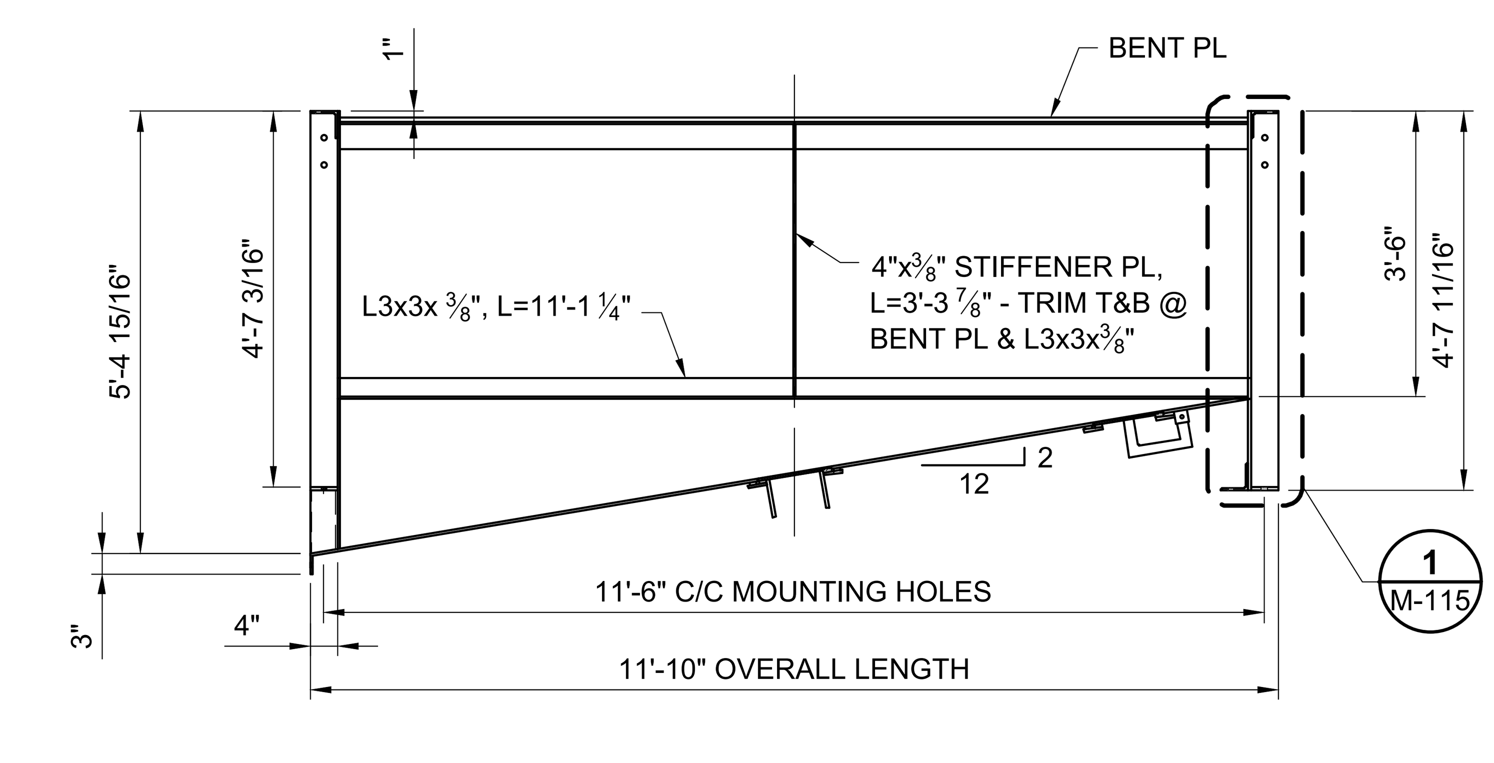
A DETAIL
SCALE: 3"=1'-0"



C FRONT END VIEW
SCALE: 1/2"=1'-0"



A BACK END VIEW
SCALE: 1/2"=1'-0"



B SIDE VIEW
SCALE: 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

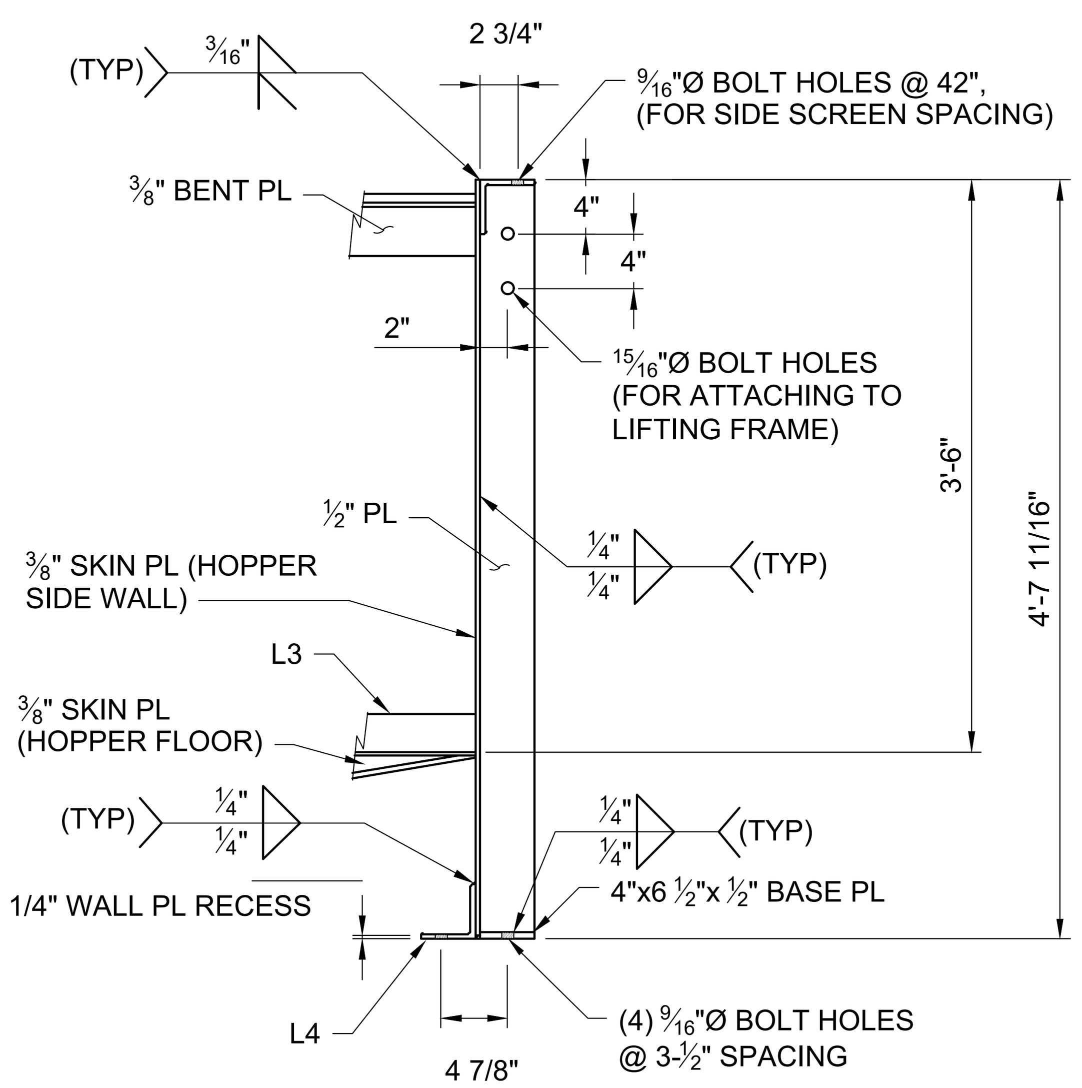
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

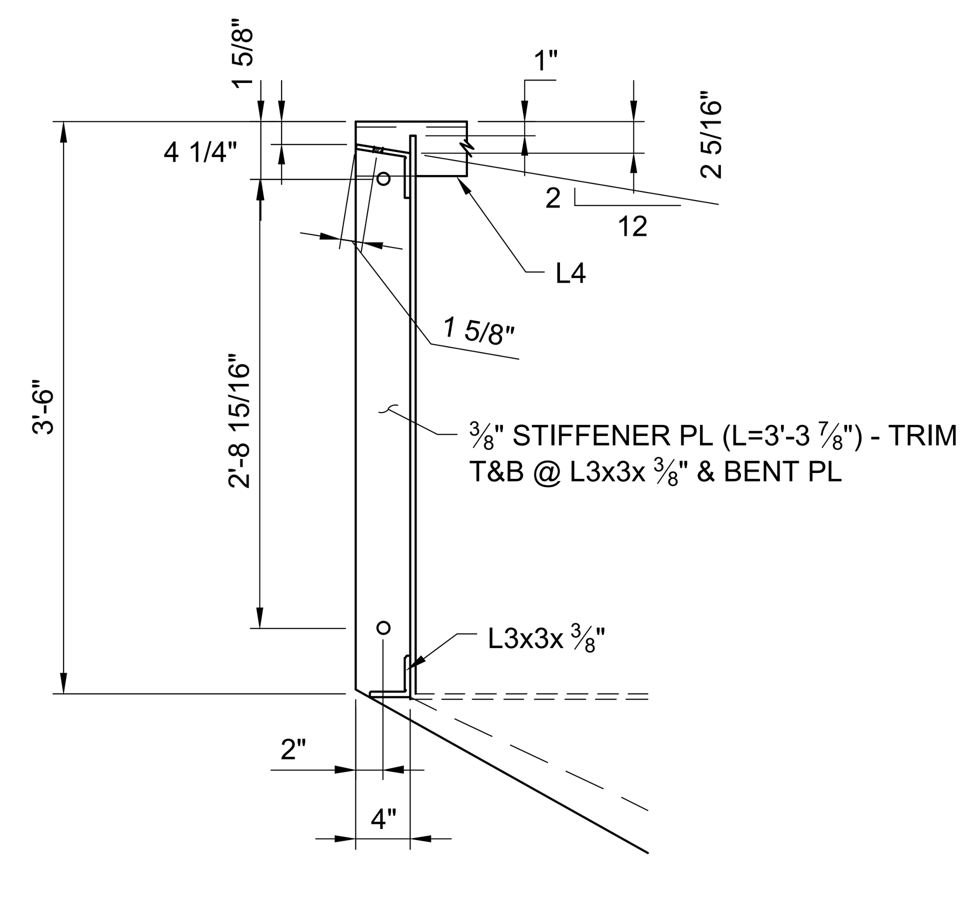
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER DETAILS

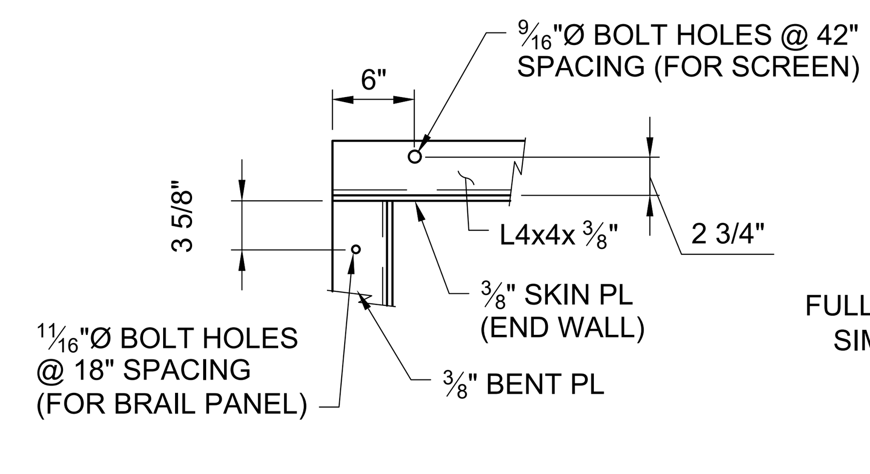
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	96 OF 176
DRAWING:	M-114



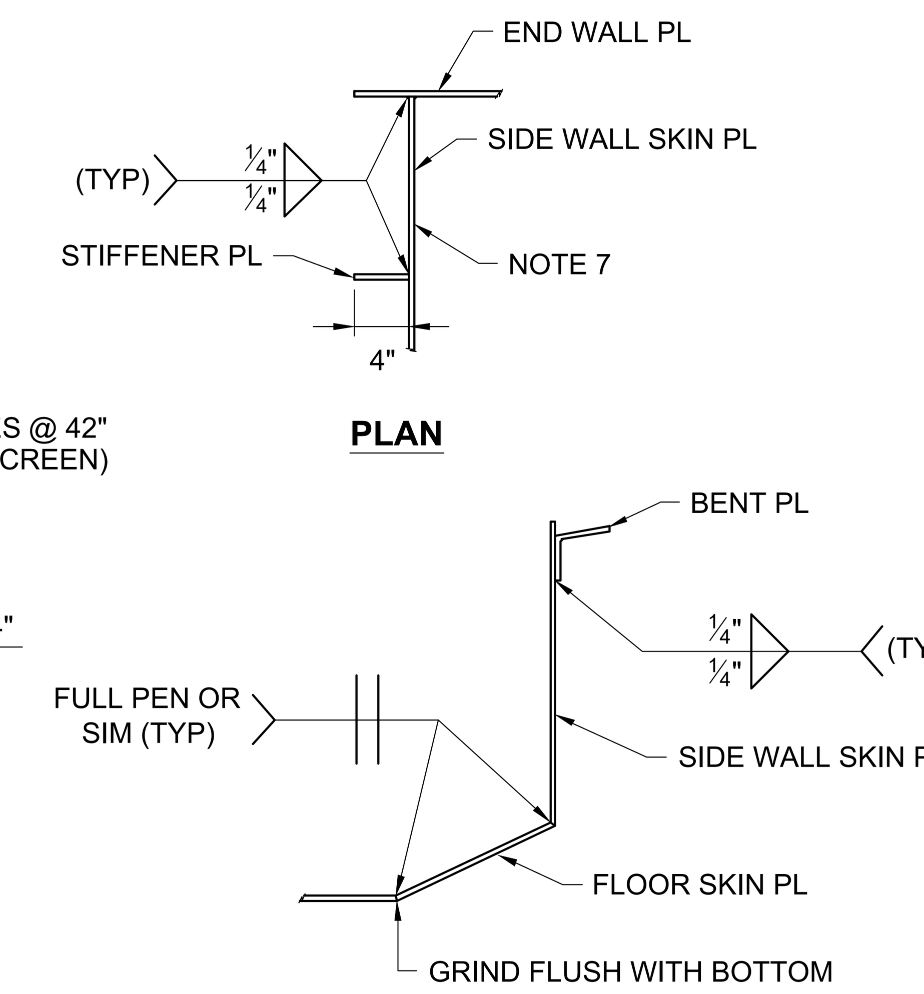
1 DETAIL
M-114 SCALE: 1"=1'-0"



2 DETAIL
M-114 SCALE: 1"=1'-0"



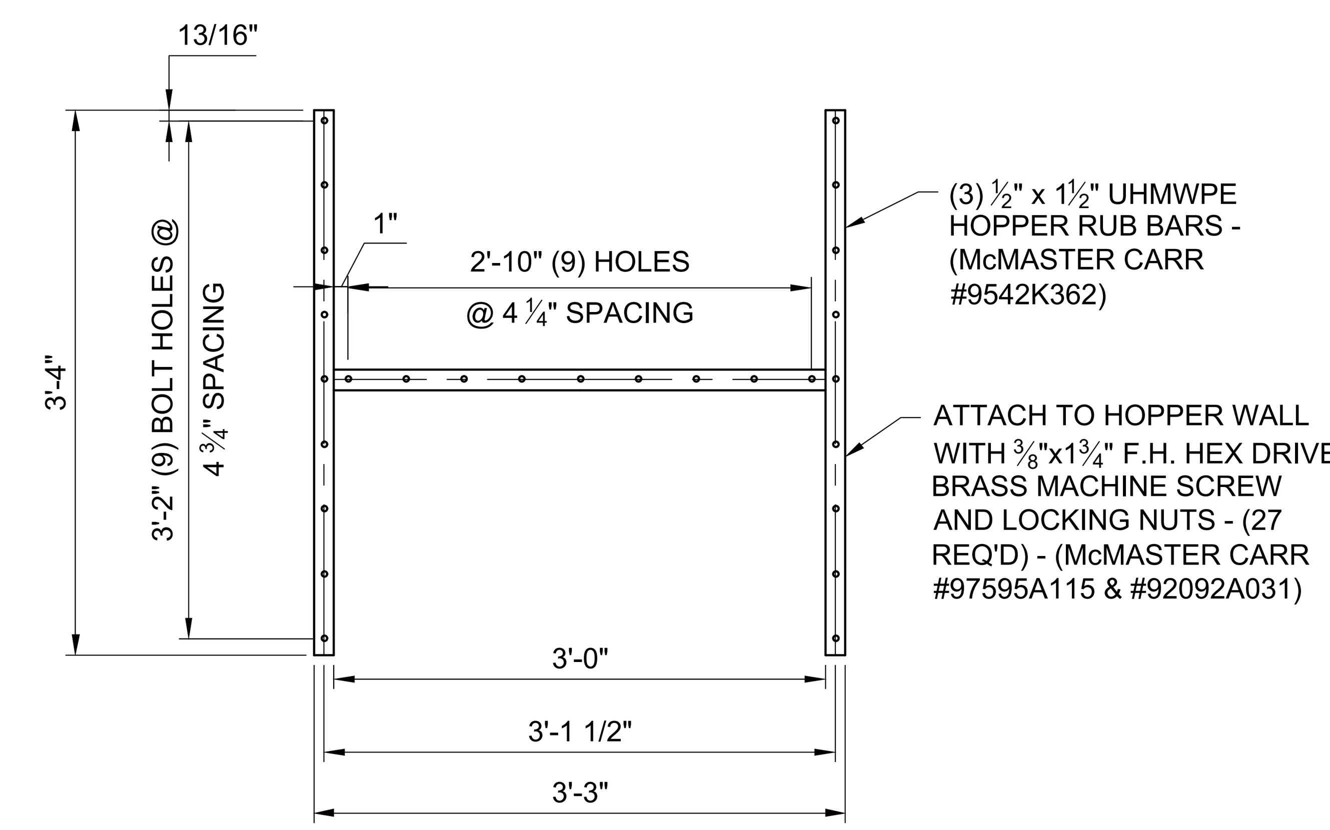
3 DETAIL
M-114 SCALE: 1"=1'-0"



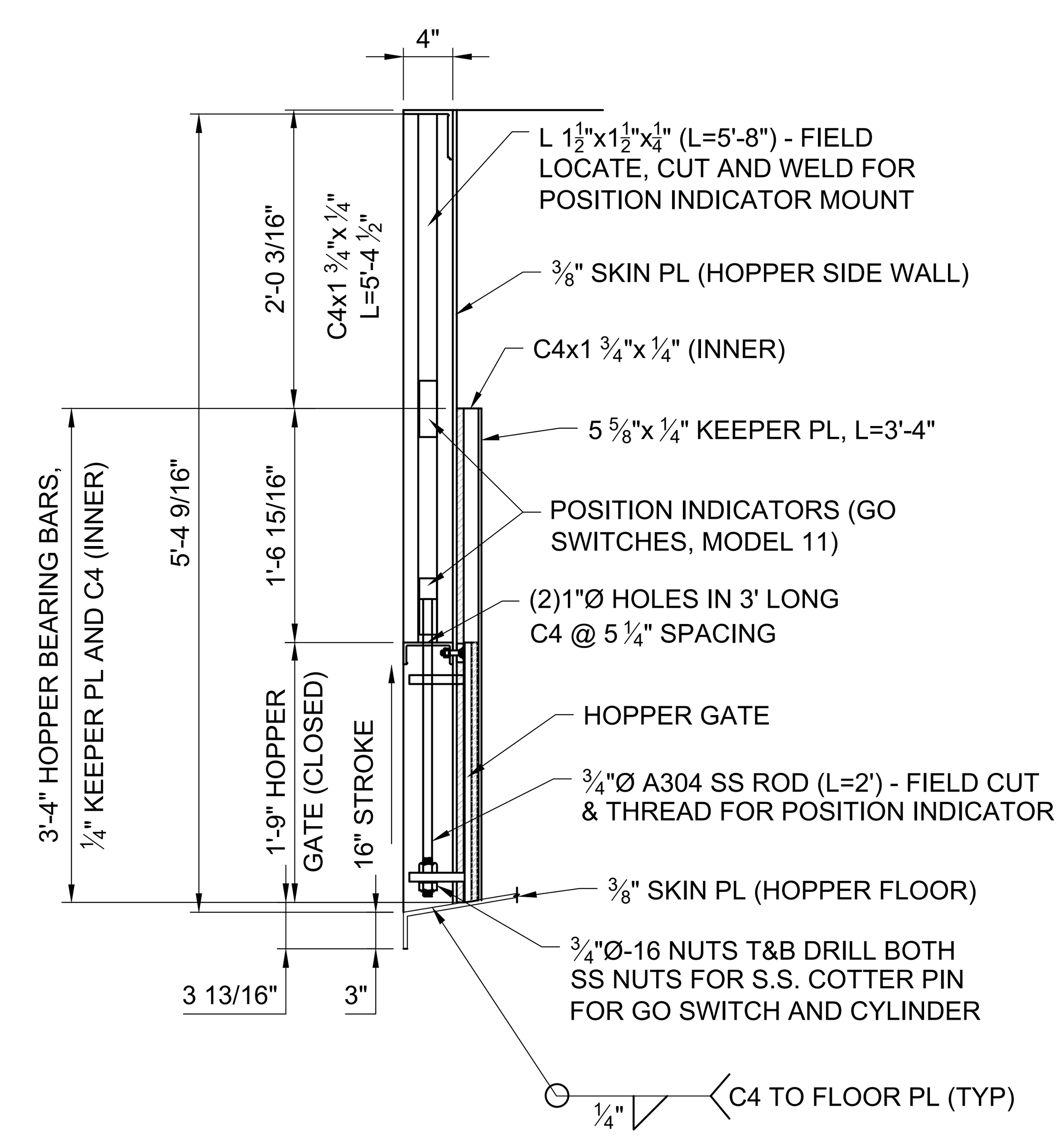
HOPPER - TYPICAL WELD DETAILS

NOTES:

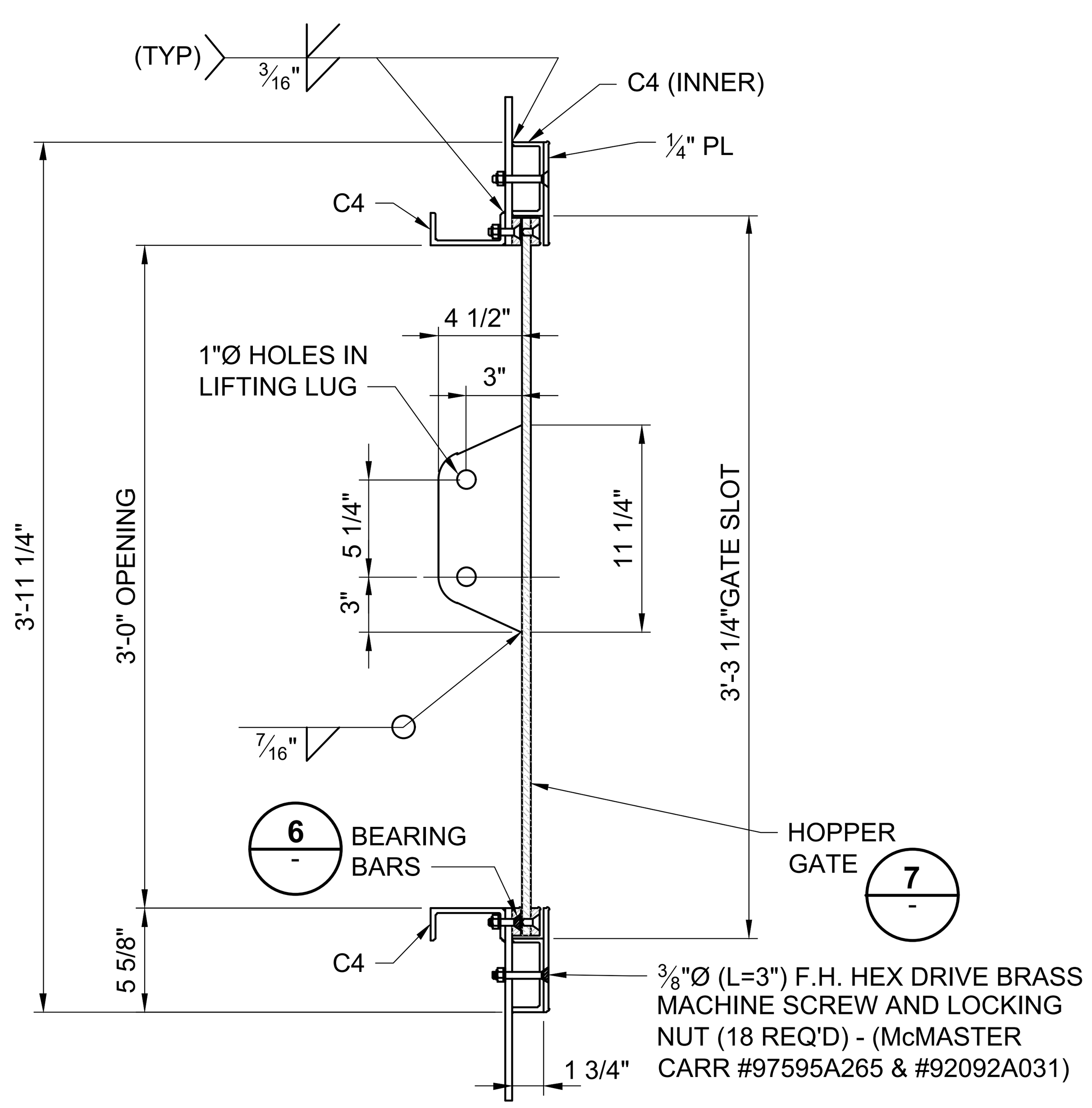
1. ALL MATERIAL ON THIS DRAWING SHALL BE A304 STAINLESS STEEL (UNO)
2. ALL INTERIOR HOPPER PLATE JOINTS SHALL BE SEAL WELDED.
3. ALL INTERIOR SURFACES & FISH CONTACT AREAS SHALL BE SMOOTH & BURR FREE.
4. GRIND ALL INTERIOR EDGES TO MINIMUM 1/4"R.
5. AIR CYLINDER TO BE STAINLESS STEEL PARKER # 3.25CFSAU19A16.000
6. SPLICES AT 3/8" WALL OR FLOOR SKIN PLATES TO BE FULL PENETRATION



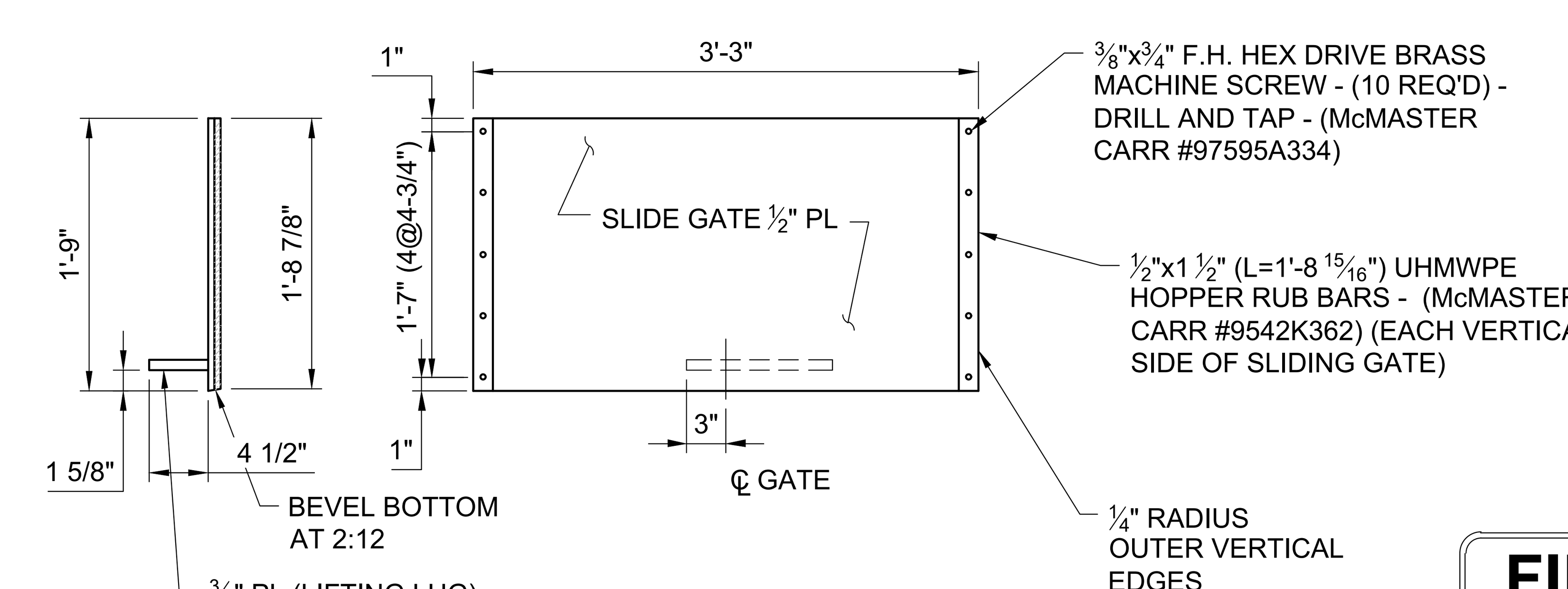
6 HOPPER GATE BEARING BARS DETAILS
SCALE: 1"=1'-0"



4 HOPPER GATE SECTION
M-114 SCALE: 1"=1'-0"



5 HOPPER GATE PLAN
SCALE: 1-1/2"=1'-0"



7 HOPPER GATE DETAIL
M-114 SCALE: 1"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\M\M-115.dwg USER: Agrogan
DATE: Dec 13, 2019 2:40pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE PE STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

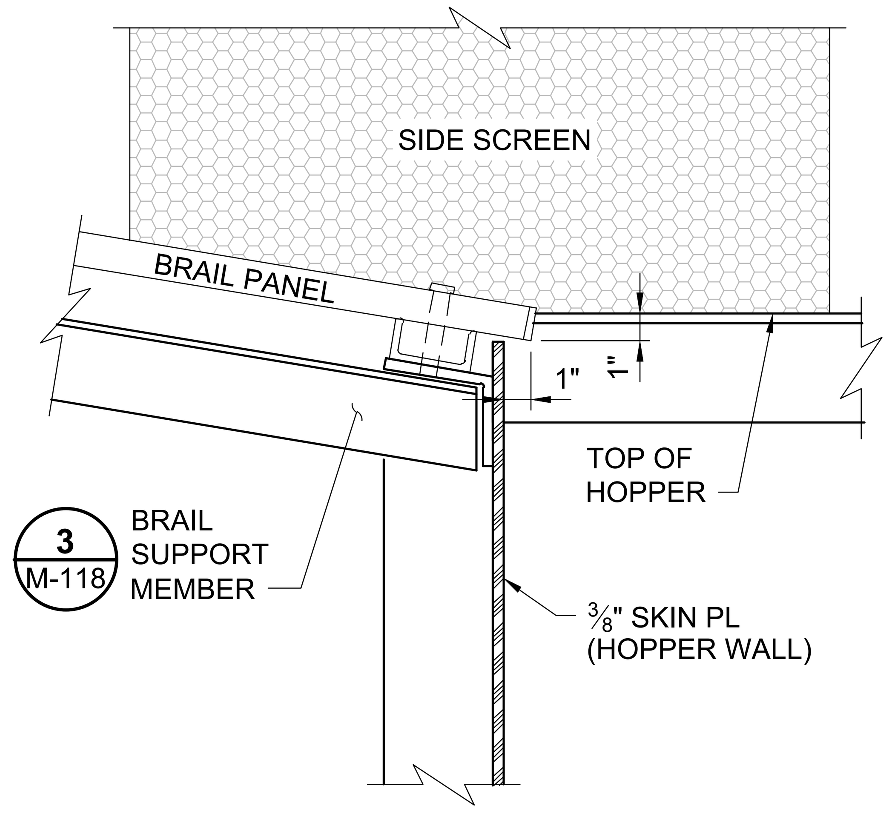
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - HOPPER GATE AND BRAIL DETAILS

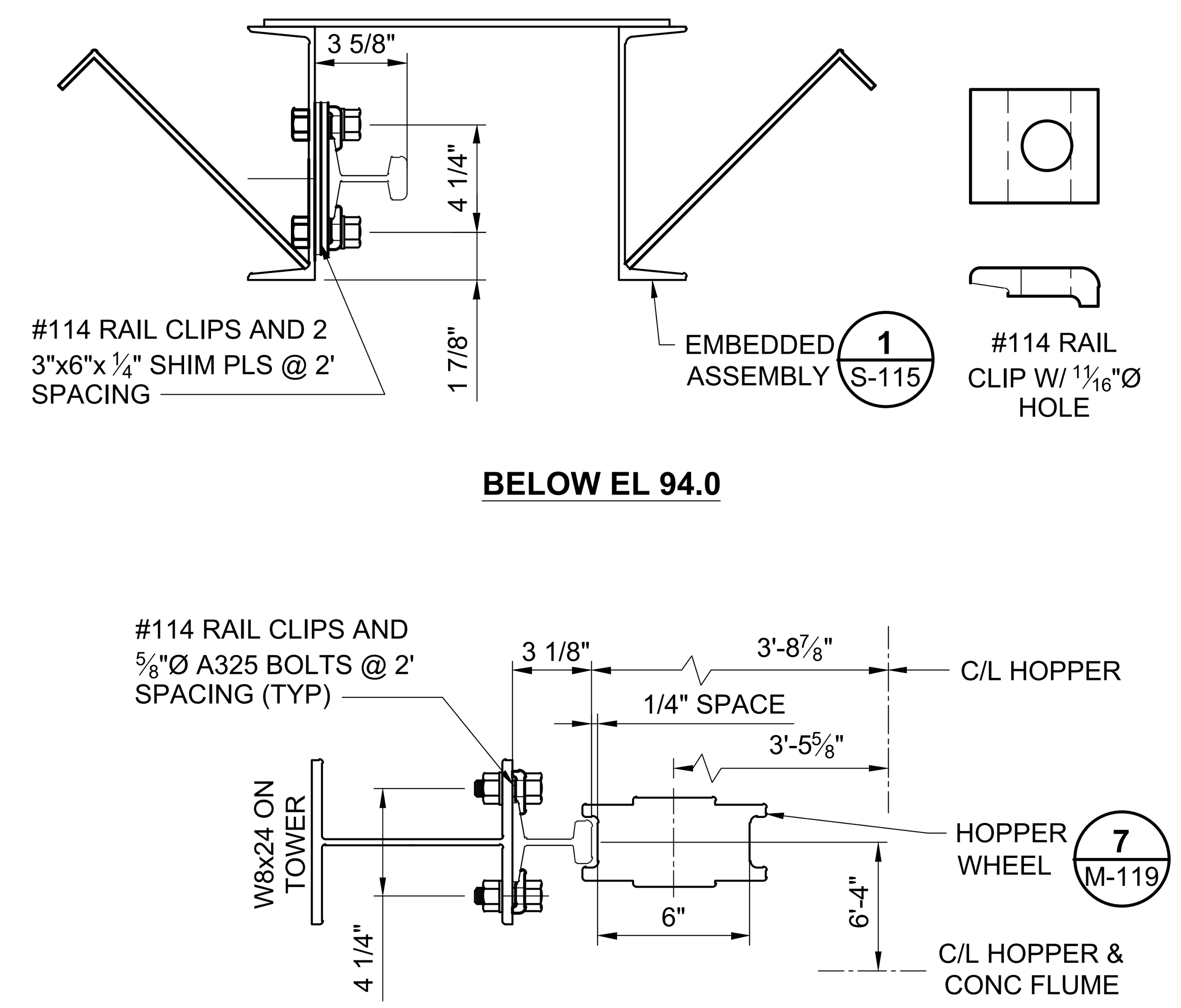
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	97 OF 176
DRAWING:	M-115

NOTES:

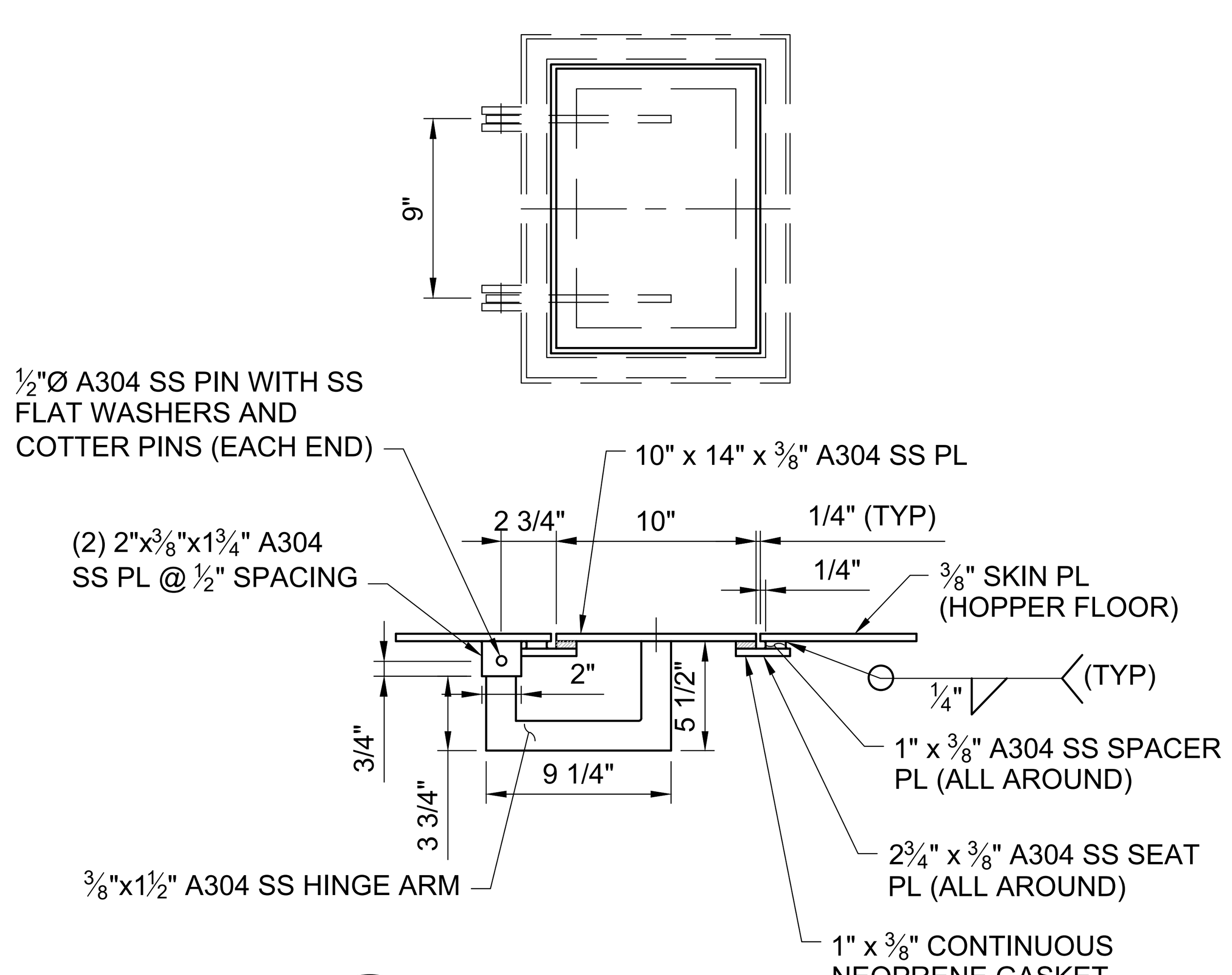
1. ALL MATERIAL ON THIS DRAWING SHALL BE A304 STAINLESS STEEL (UNO)



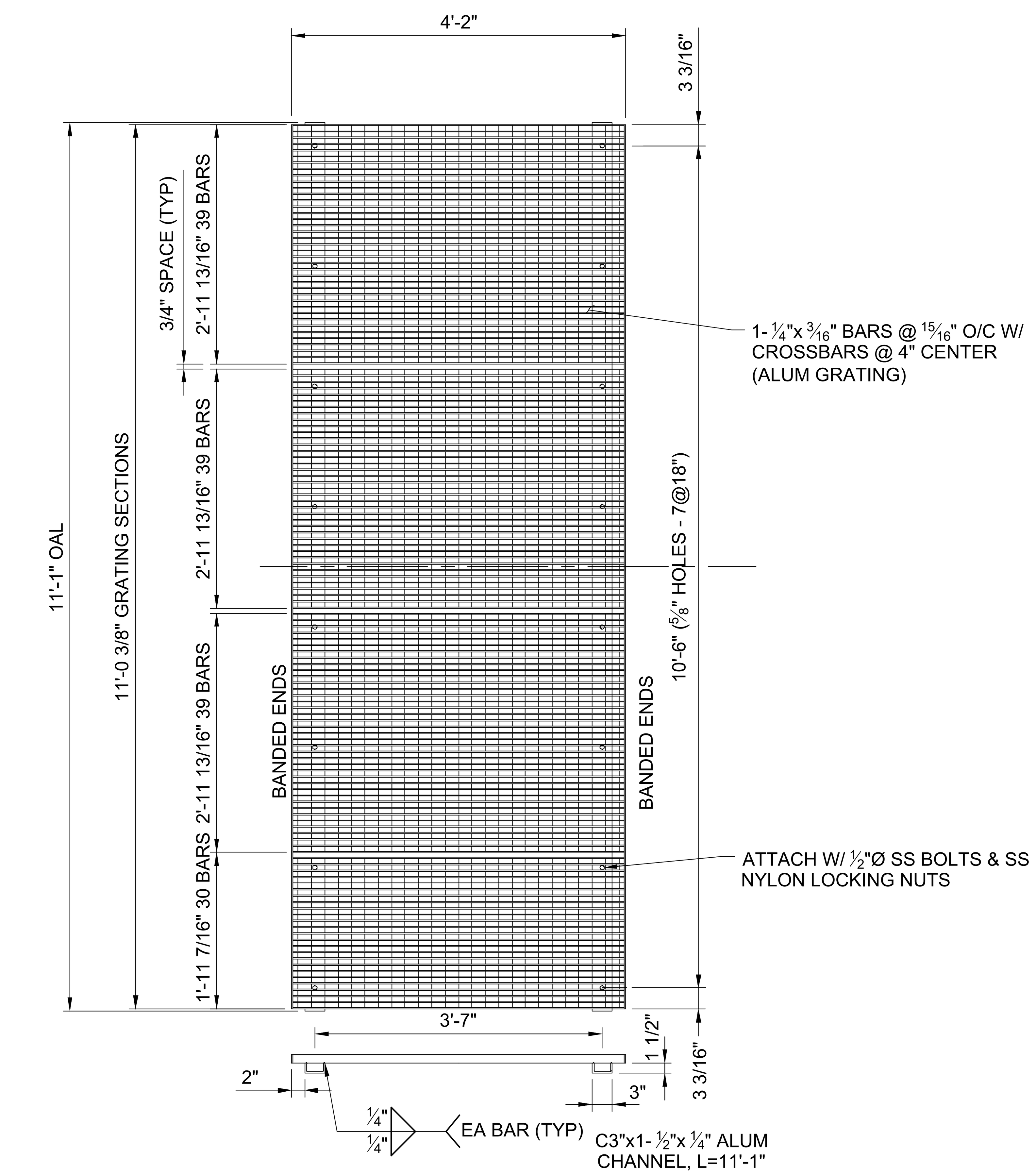
1 M-113 **BRAIL TO HOPPER DETAIL**
SCALE: 2"=1'-0"



2 M-113 **ASCE 30 LB RAIL CONNECTION DETAILS**
SCALE: 2"=1'-0"



3 M-114 **FLOOR FILL PORT**
SCALE: 1-1/2"=1'-0"



4 M-113 **BRAIL DETAIL (2 PANELS REQUIRED)**
SCALE: 3/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT1900 CAD\02-sheets\M\M-116.dwg USER: Agrogan
DATE: Dec 13, 2019 2:40pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
LICENSED
PROFESSIONAL ENGINEER
12/13/2019

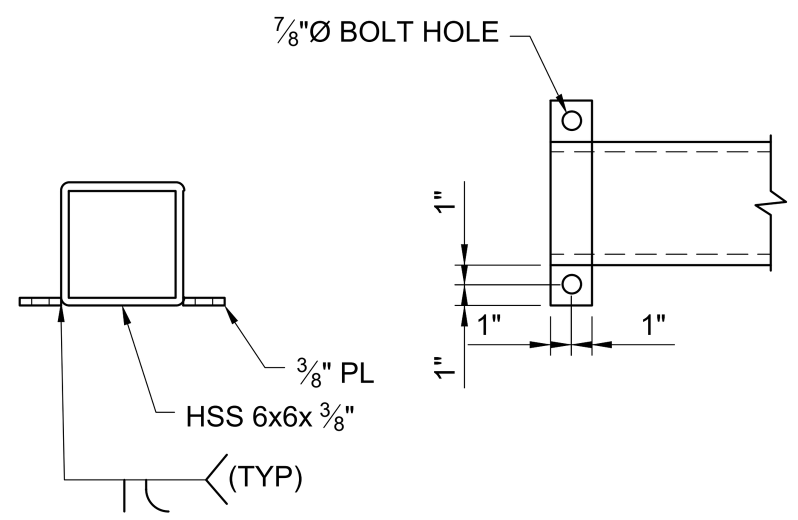
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - GENERAL LAYOUT AND INFORMATION

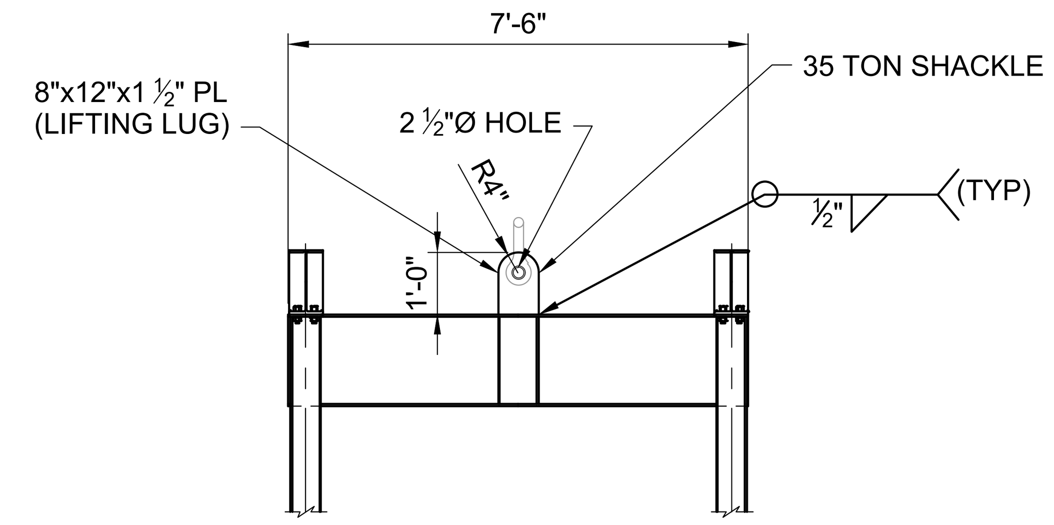
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 98 OF 176
DRAWING: M-116

NOTES:

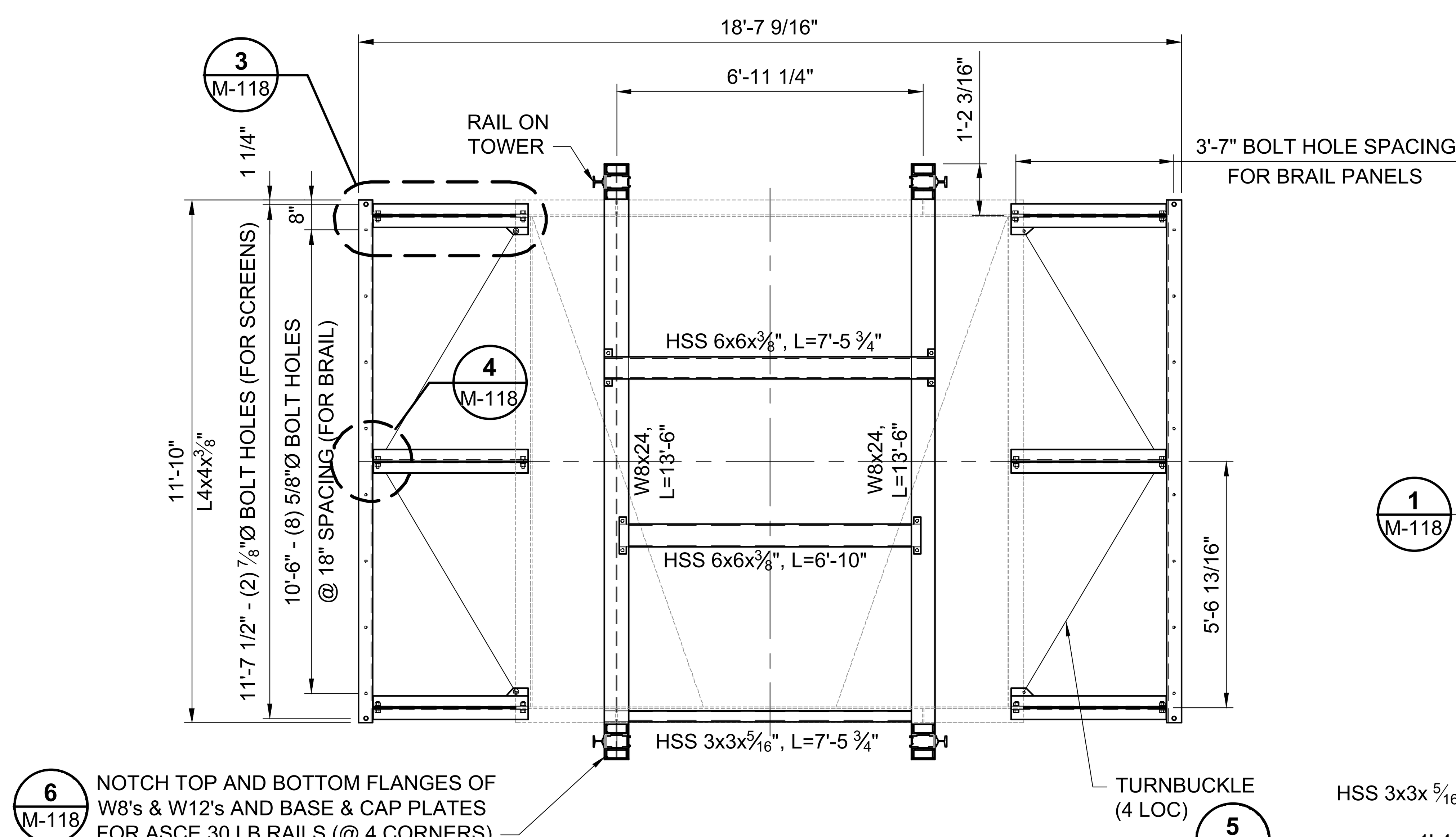
1. ALL MATERIAL ON THIS DRAWING SHALL BE HOT-DIP GALVANIZED CARBON STEEL (UNO).
2. BOLTS TO BE 3/4" A325 BOLTS (UNO). HOLES FOR BOLTS TO BE 7/8". SLOTTED HOLES TO BE 7/8" x 1-1/8".
3. WELDING TO BE PER AWS USING E80XX ELECTRODES.
4. WELDS TO BE CONTINUOUS SEAL FILLET WELDS - MAXIMUM SIZE PER AISC (UNO).



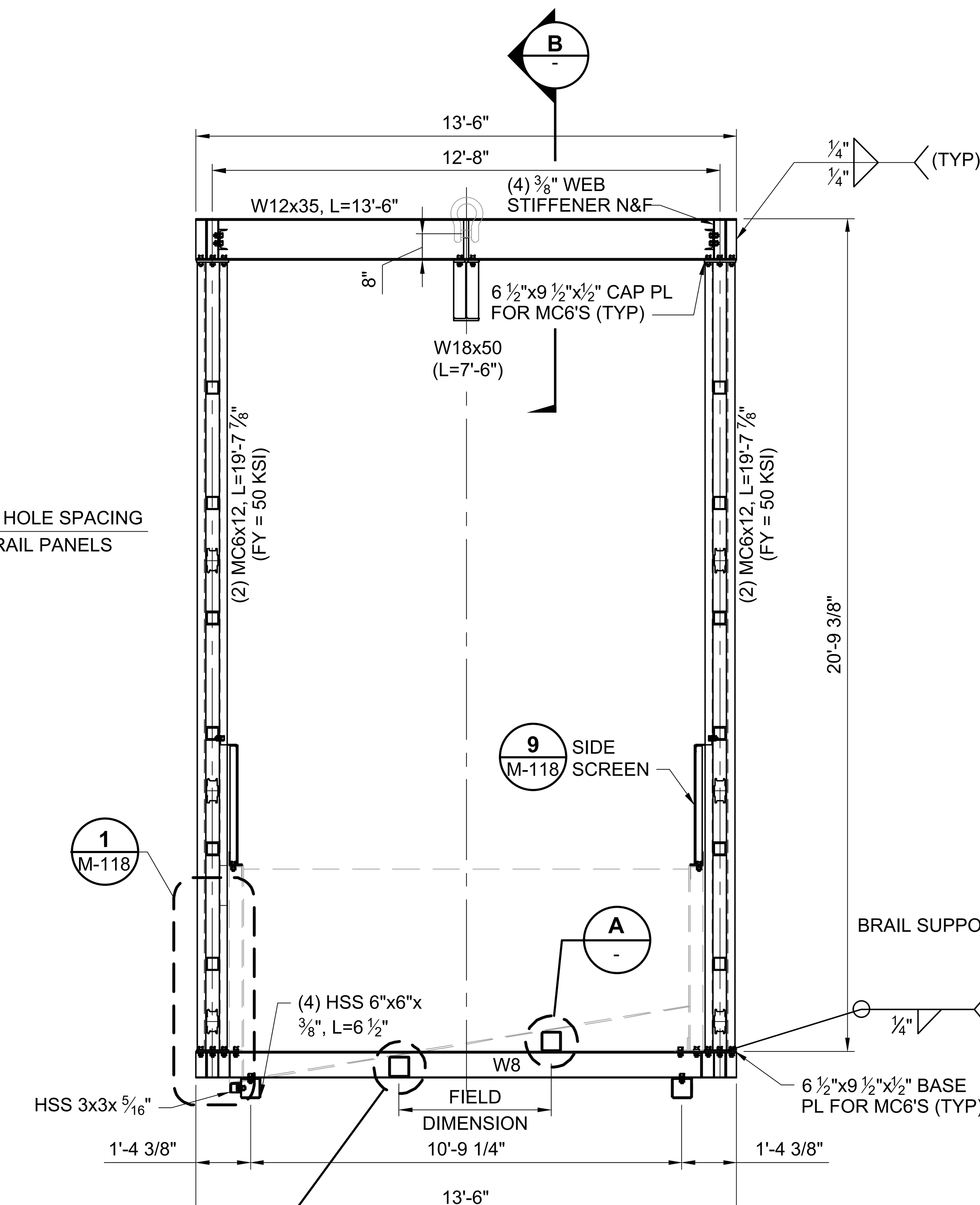
A DETAIL
SCALE: 1-1/2"=1'-0"



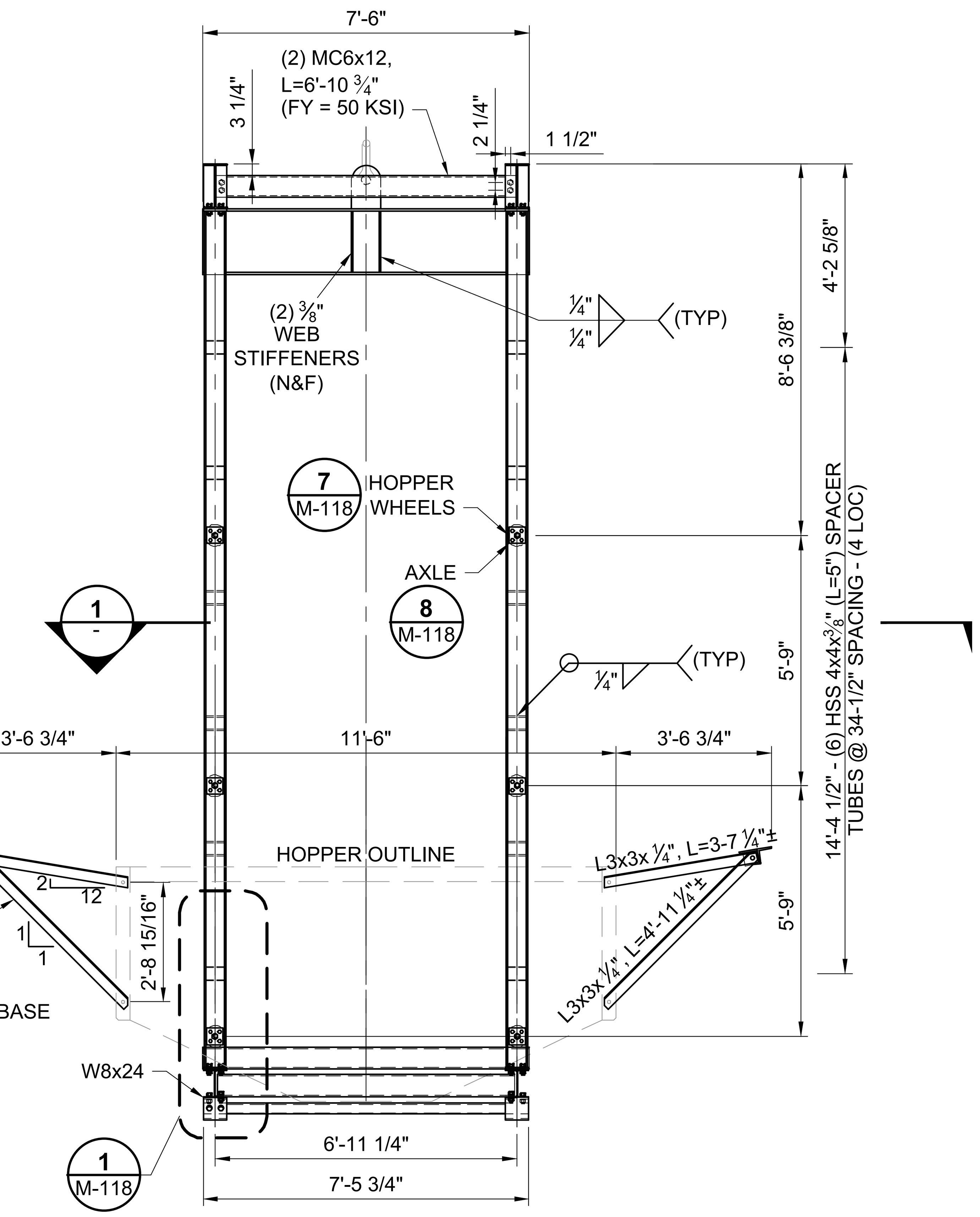
B DETAIL
SCALE: 3/8"=1'-0"



1 LIFTING FRAME LOWERING PLAN
SCALE: 3/8"=1'-0"



2 SIDE ELEVATION
M-113
SCALE: 3/8"=1'-0"



3 END ELEVATION
M-113
SCALE: 3/8"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER
REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

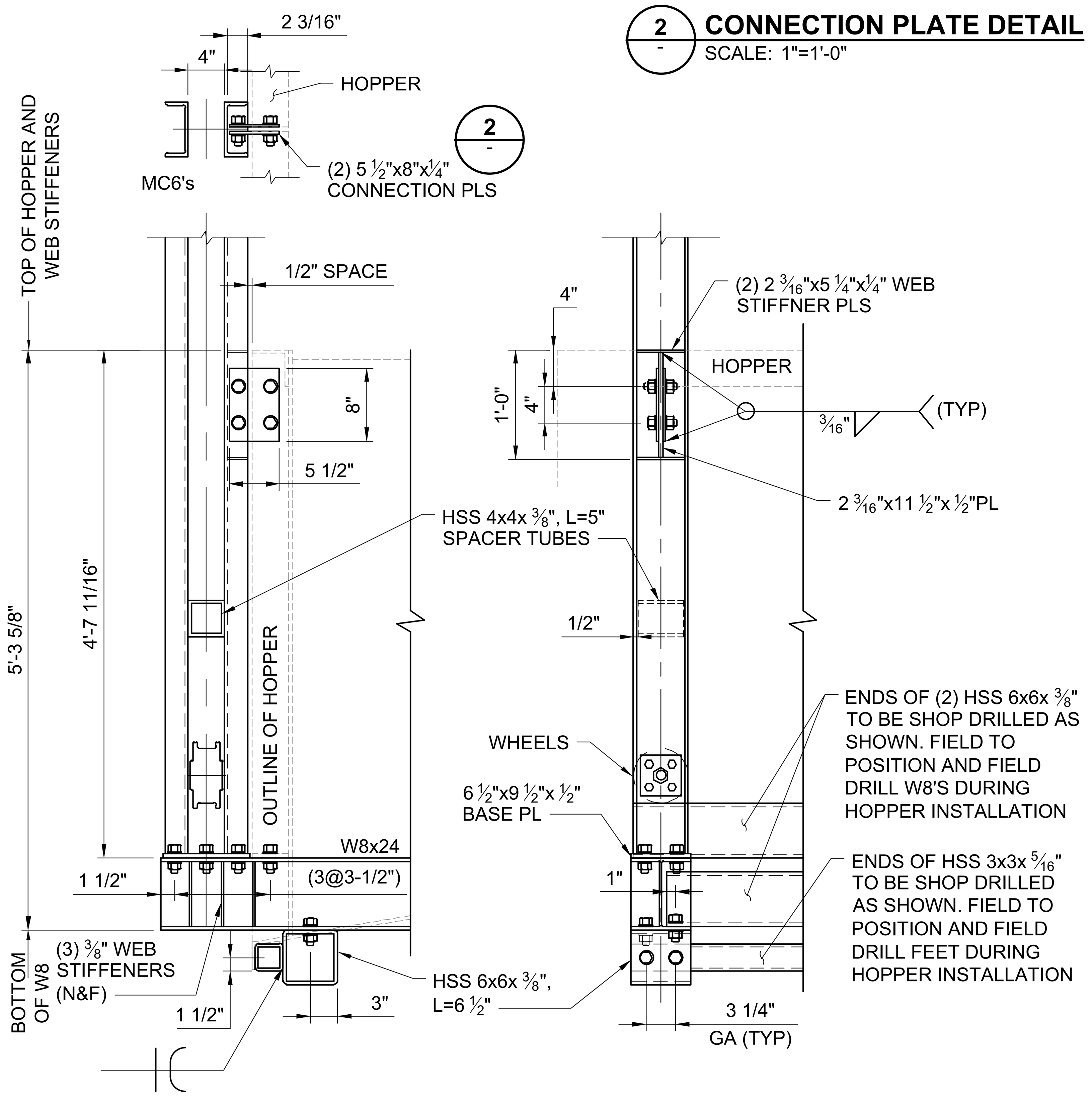
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

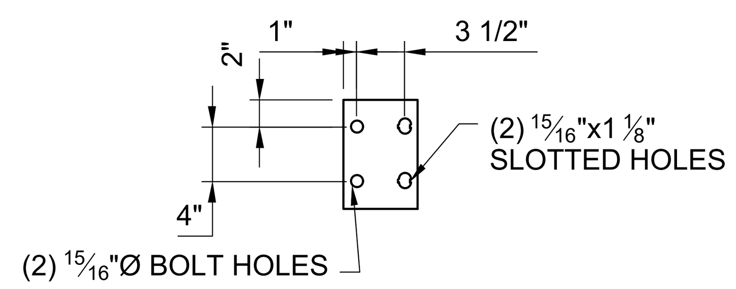
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - STEEL COMPONENTS

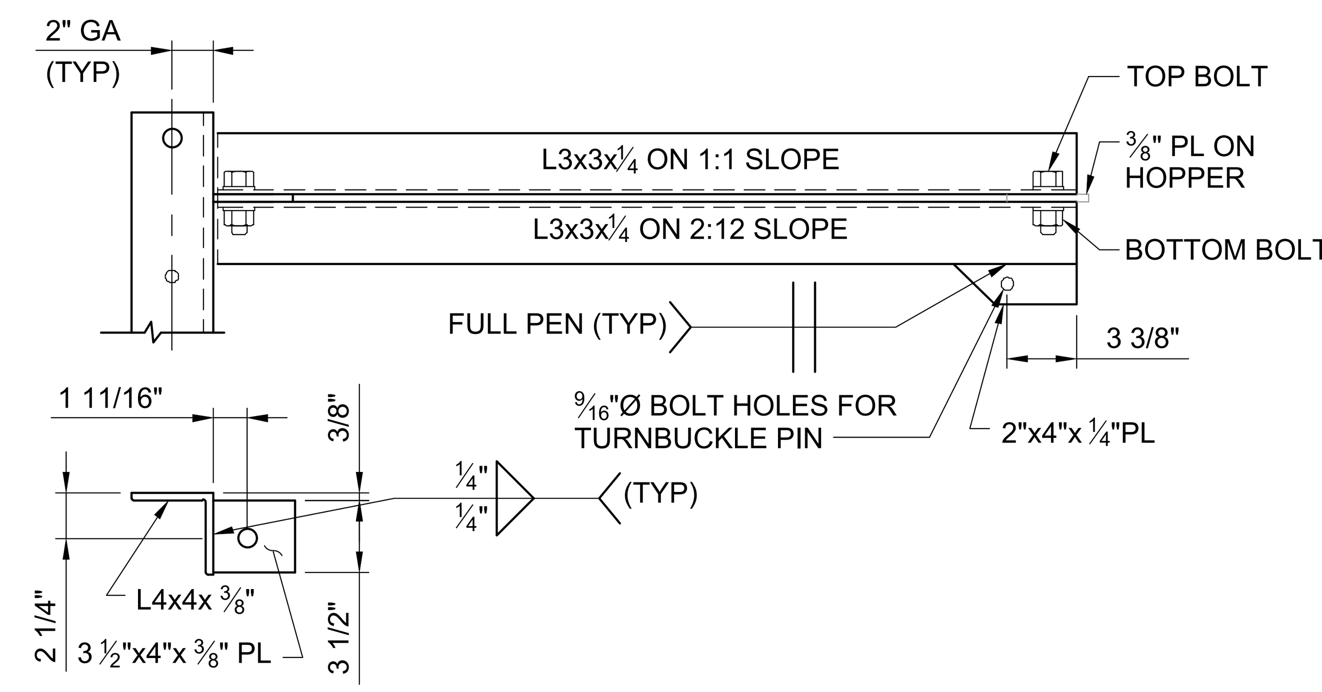
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	99 OF 176
DRAWING:	M-117



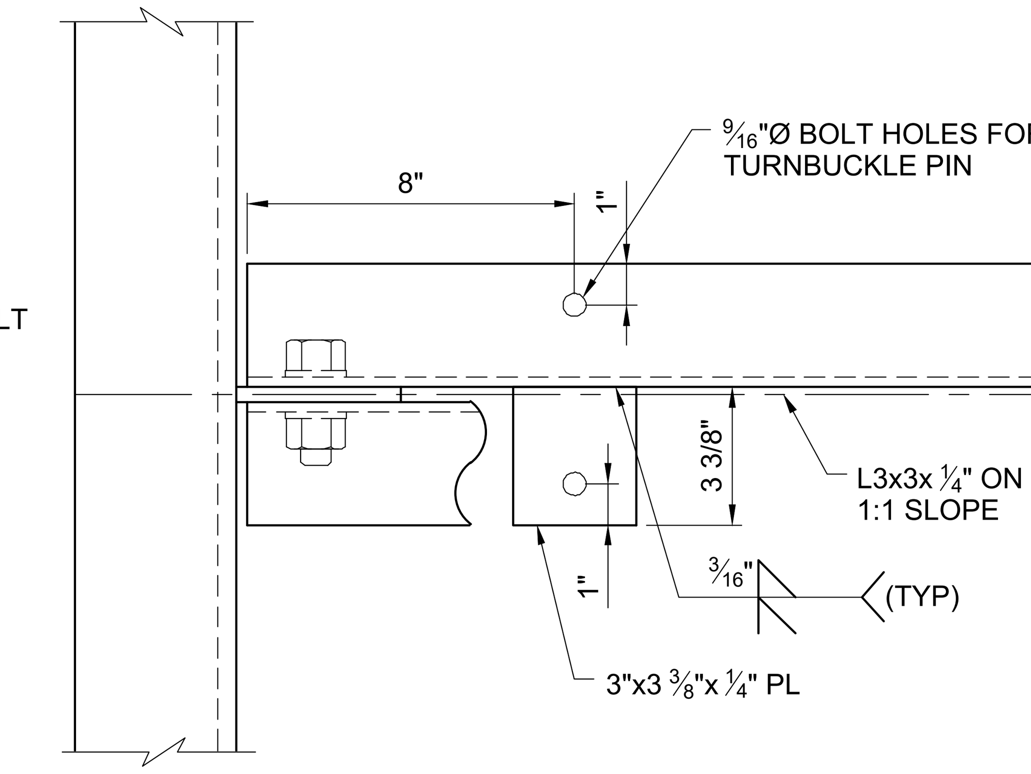
1 M-117 **LIFTING FRAME TO HOPPER CONNECTION**
SCALE: 1"=1'-0"



2 - **CONNECTION PLATE DETAIL**
SCALE: 1"=1'-0"



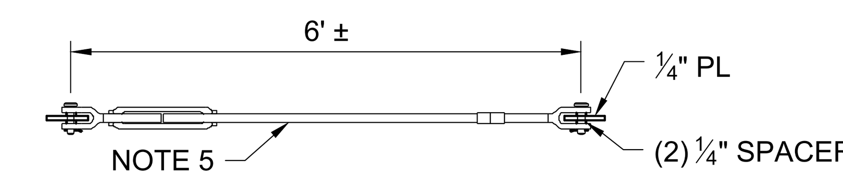
3 M-116 **BRAIL SUPPORT DETAIL**
SCALE: 1 1/2"=1'-0"



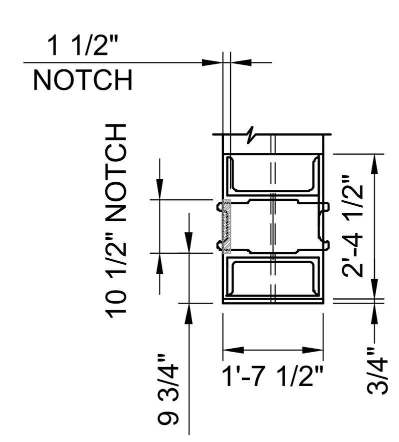
4 M-117 **BRAIL SUPPORT DETAIL**
SCALE: 3"=1'-0"

NOTES:

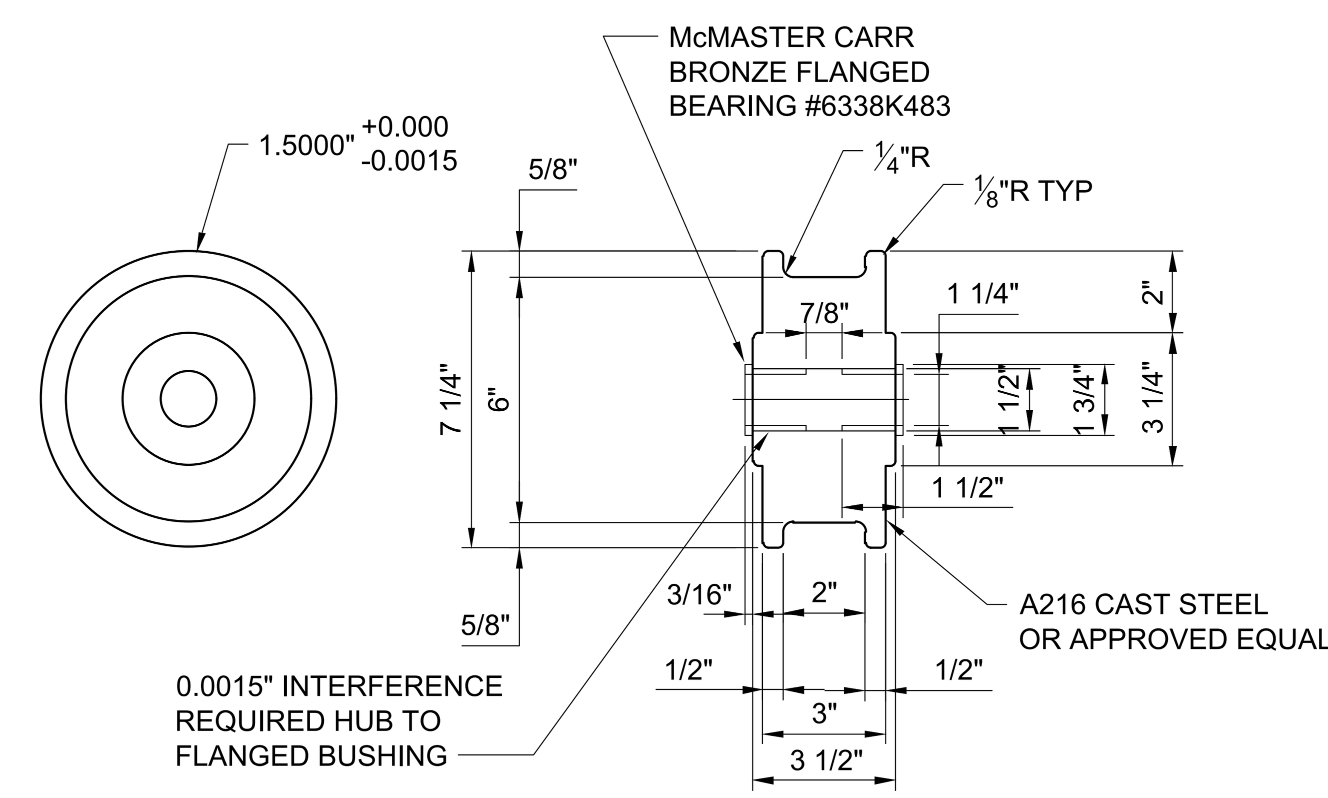
1. ALL MATERIAL ON THIS DRAWING SHALL BE HOT-DIP GALVANIZED CARBON STEEL (UNO).
2. BOLTS TO BE 3/4" A325 BOLTS (UNO). HOLES FOR BOLTS TO BE 7/8". SLOTTED HOLES TO BE 7/8" x 1-1/8".
3. WELDING TO BE PER AWS USING E80XX ELECTRODES.
4. WELDS TO BE CONTINUOUS SEAL FILLET WELDS - MAXIMUM SIZE PER AISC (UNO).
5. ½" GALVANIZED TURNBUCKLE - (McMASTER CARR # 3001T57) AND JAM NUT SET (#3000T56), ⅝"Ø (11 TPI) GALVANIZED THREADED EXTENSION ROD, AND GALVANIZED COUPLING.



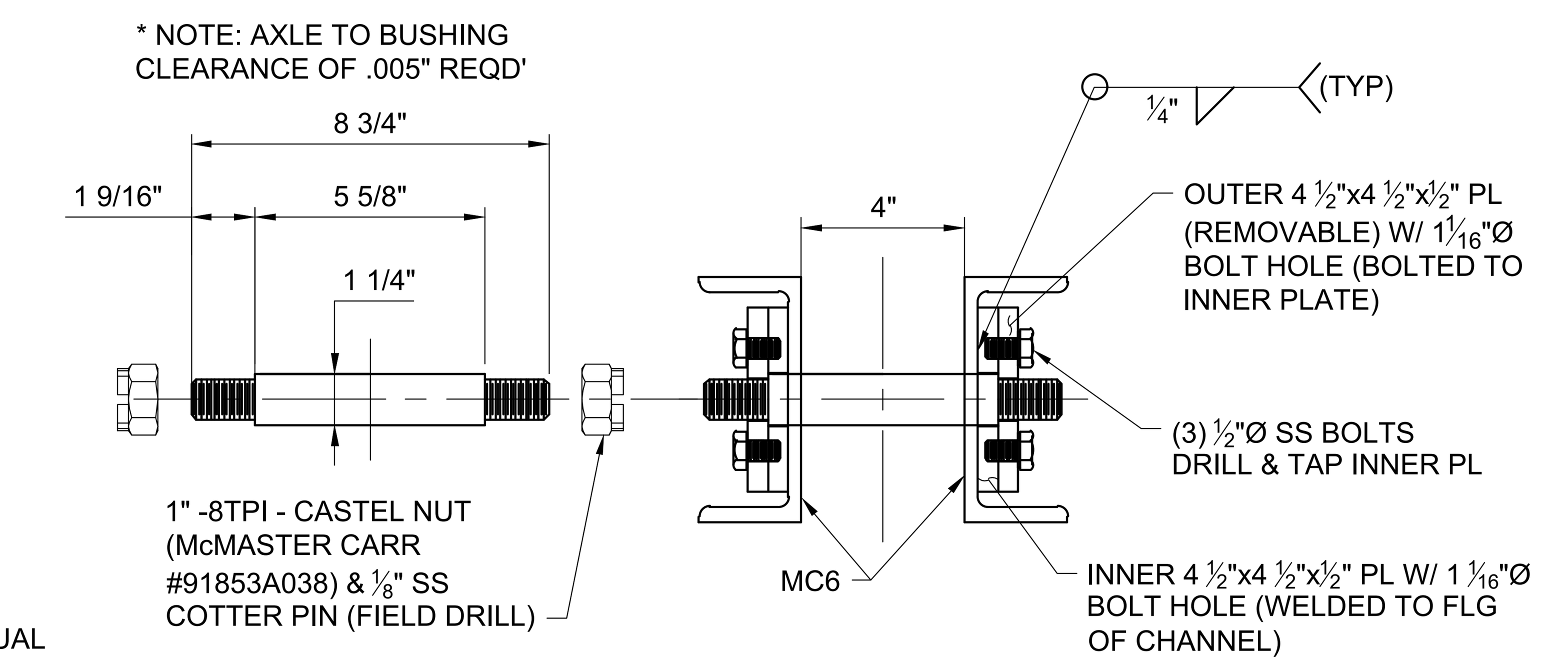
5 M-117 **TURNBUCKLE DETAIL**
SCALE: 1"=1'-0"



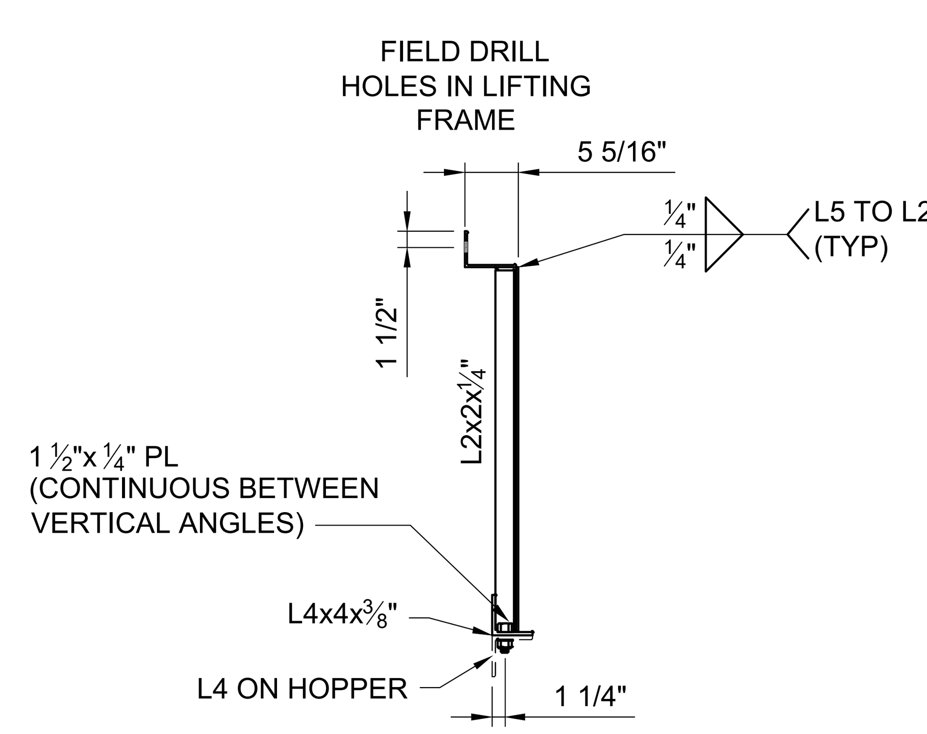
6 M-117 **NOTCH DETAIL**
SCALE: 3/8"=1'-0"



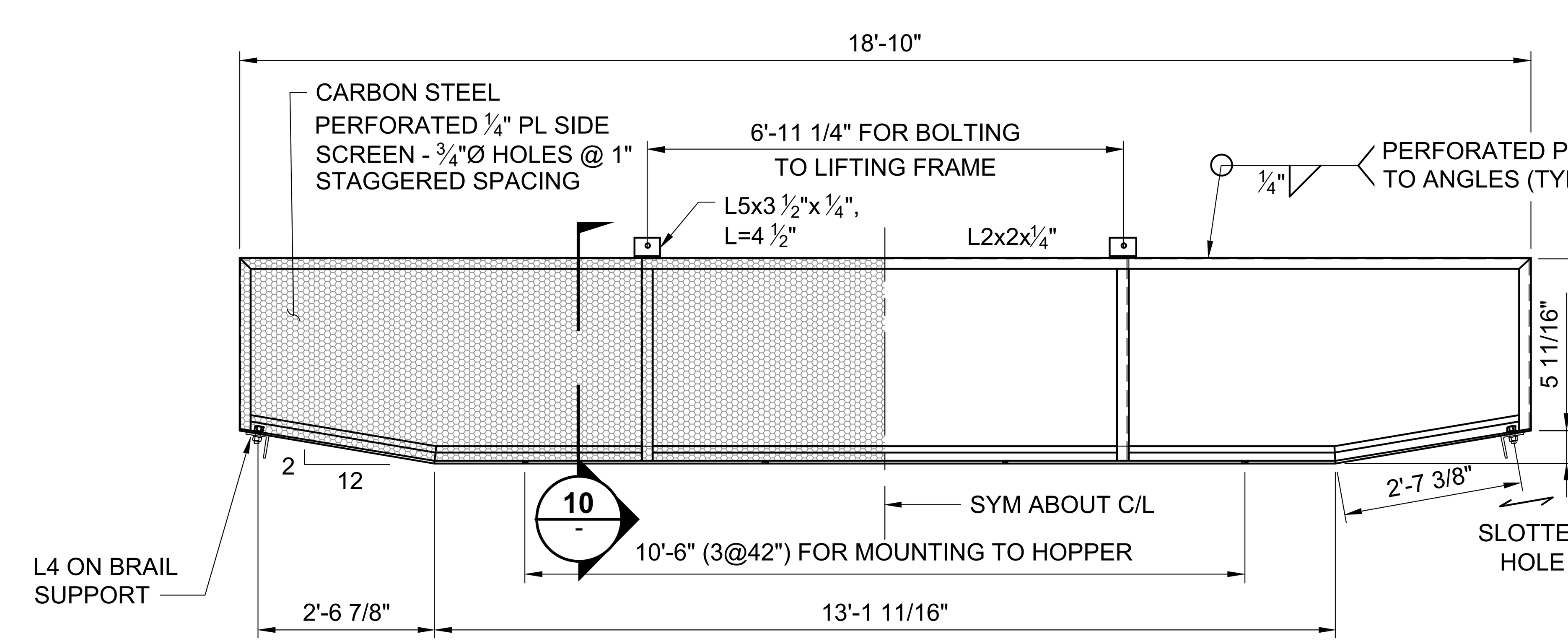
7 M-116 **SIDE SCREEN DETAIL (2 LOC)**
SCALE: 3"=1'-0"
M-117



8 M-117 **A304 SS AXLE DETAIL**
SCALE: 3"=1'-0"



10 - **DETAIL**
SCALE: 3/4"=1'-0"



9 M-113 **SIDE SCREEN DETAIL (2 LOC)**
SCALE: 1/2"=1'-0"
M-117

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE — BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No. 39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - STEEL COMPONENTS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	100 OF 176
DRAWING:	M-118

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden new and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\M-119.dwg USER: Agrogan
DATE: Dec 13, 2019 2:41pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

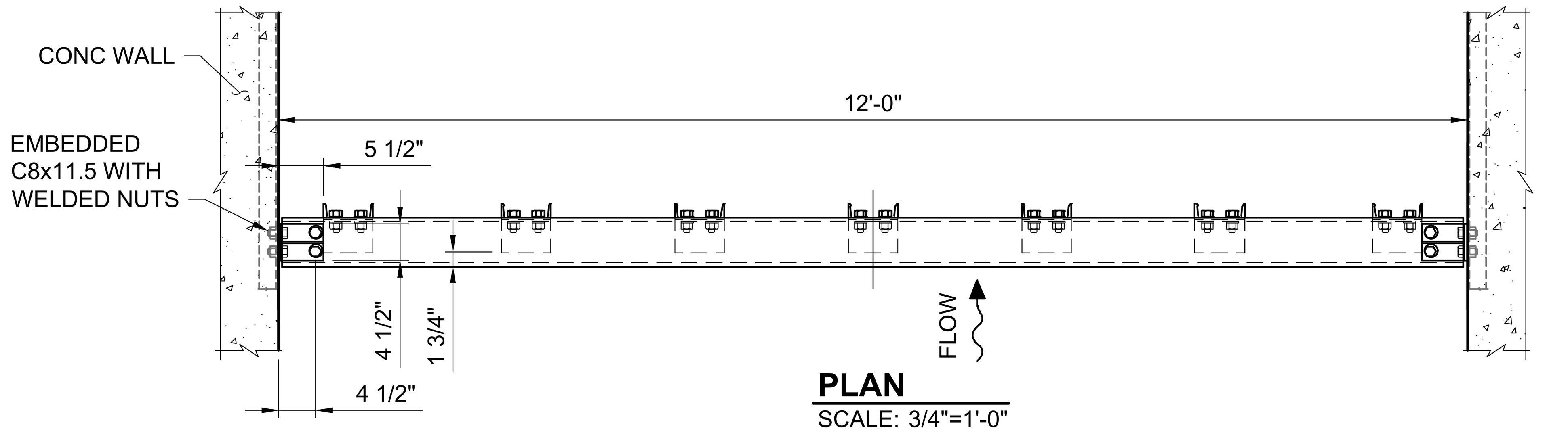
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT UPSTREAM TOWER
SCREEN ELEVATION AND DETAILS

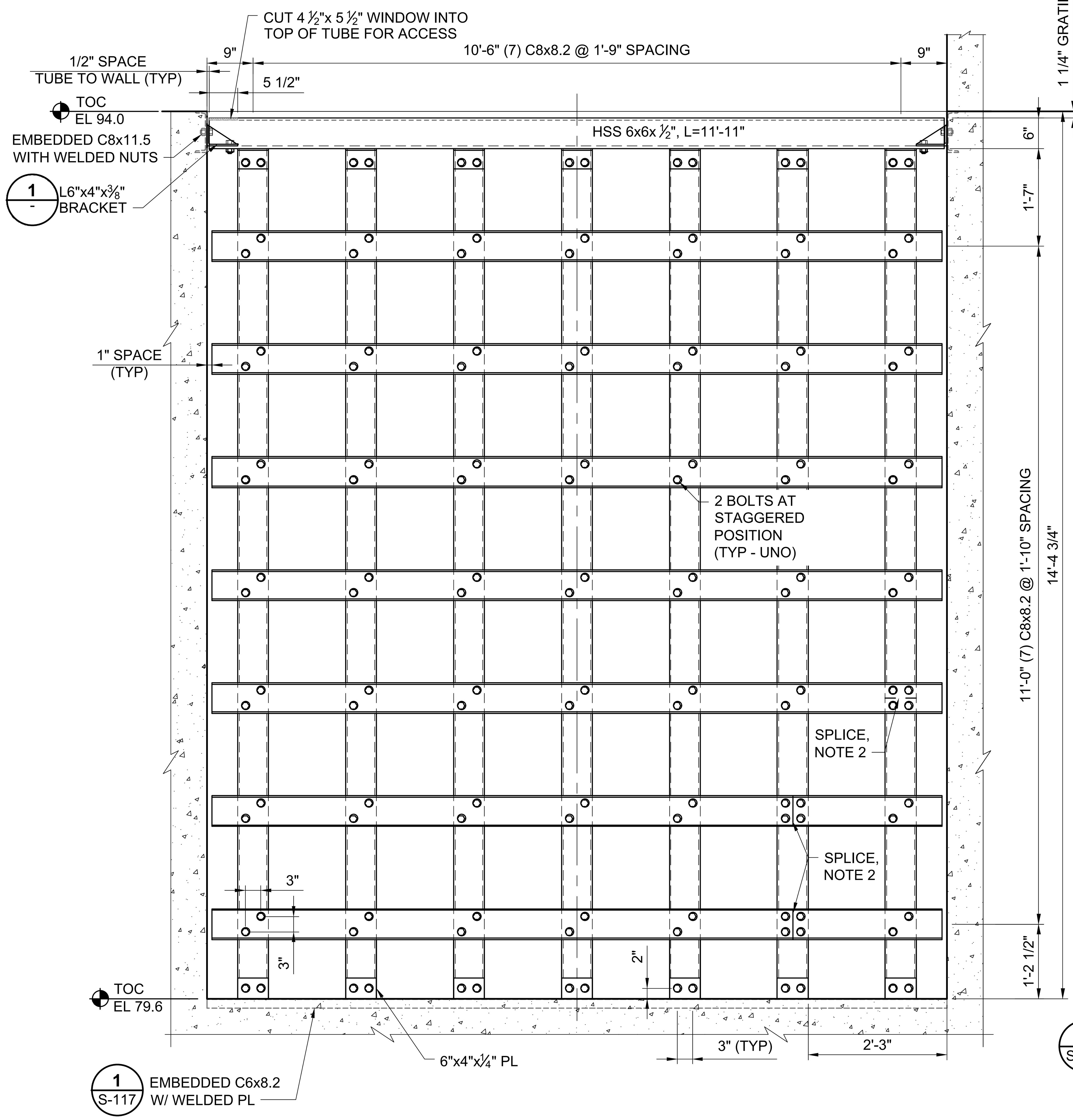
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	101 OF 176
DRAWING:	M-119



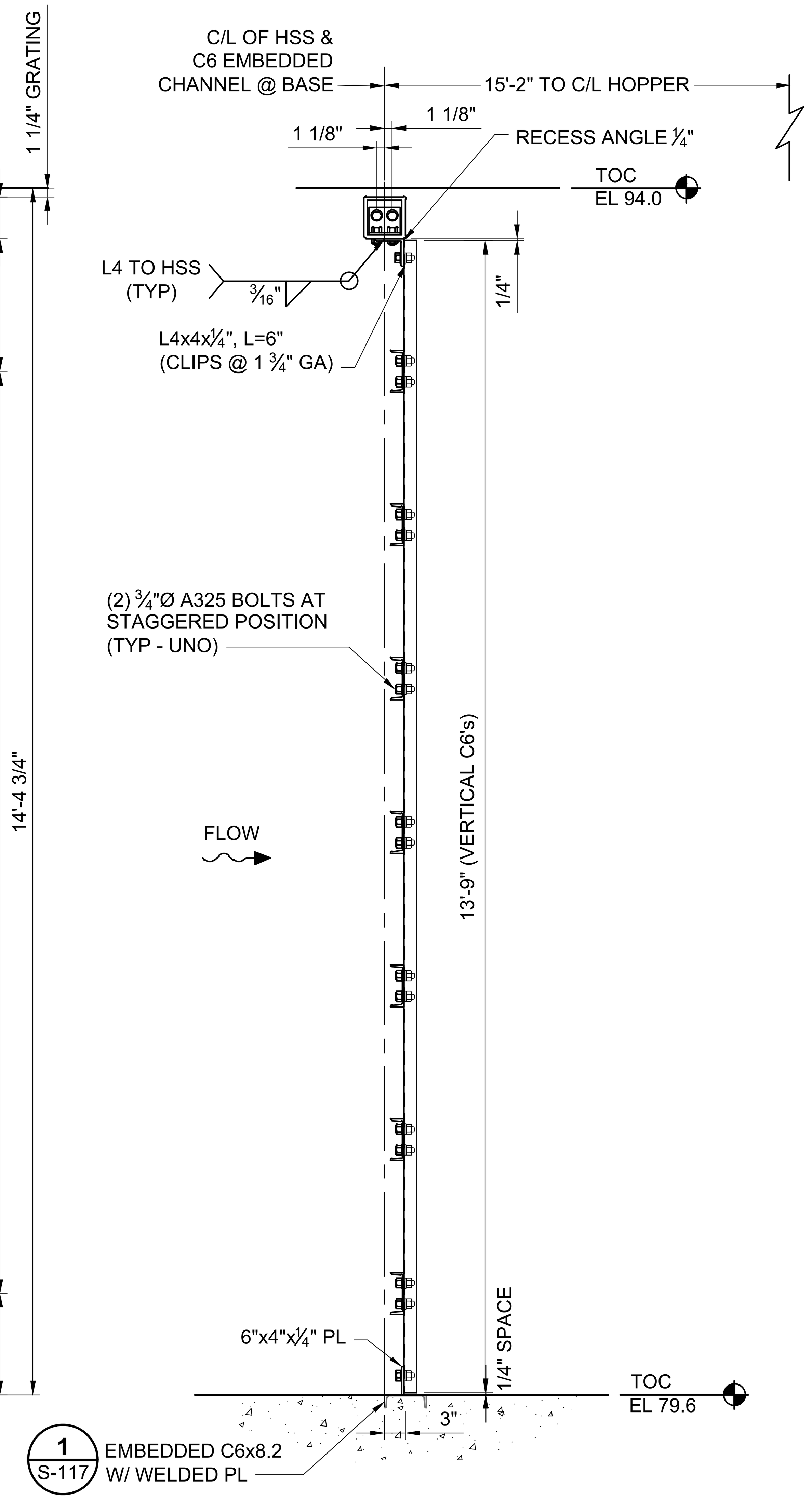
PLAN
SCALE: 3/4"=1'-0"

NOTES:

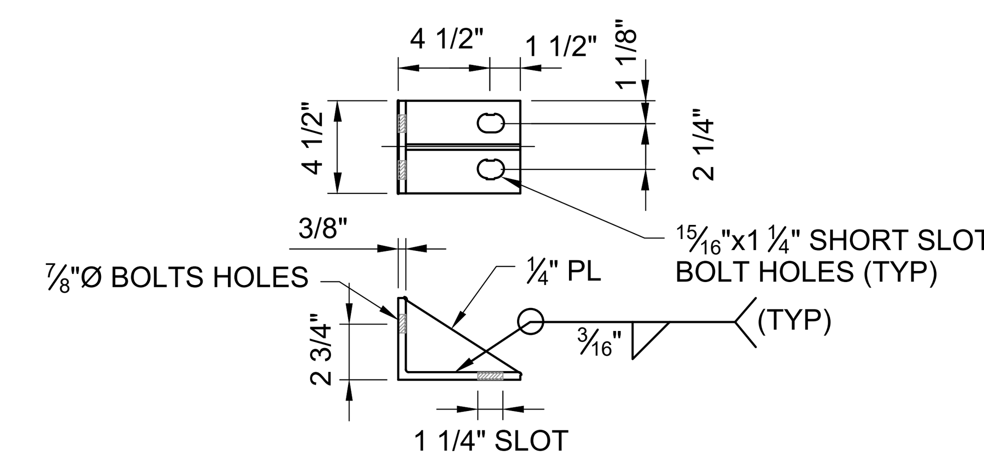
1. ALL MEMBERS C8x8.2 (UNO)
2. SPLICE STEEL MEMBERS AS REQUIRED FOR INSTALLATION. PROVIDE 4 BOLTS AND ⅛" SPACE AS SHOWN.
3. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.



ELEVATION LOOKING DOWNSTREAM
SCALE: 3/4"=1'-0"



SIDE ELEVATION
SCALE: 3/4"=1'-0"



1 L6x4x3/8" BRACKET DETAIL (2 REQUIRED)
SCALE: 1 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

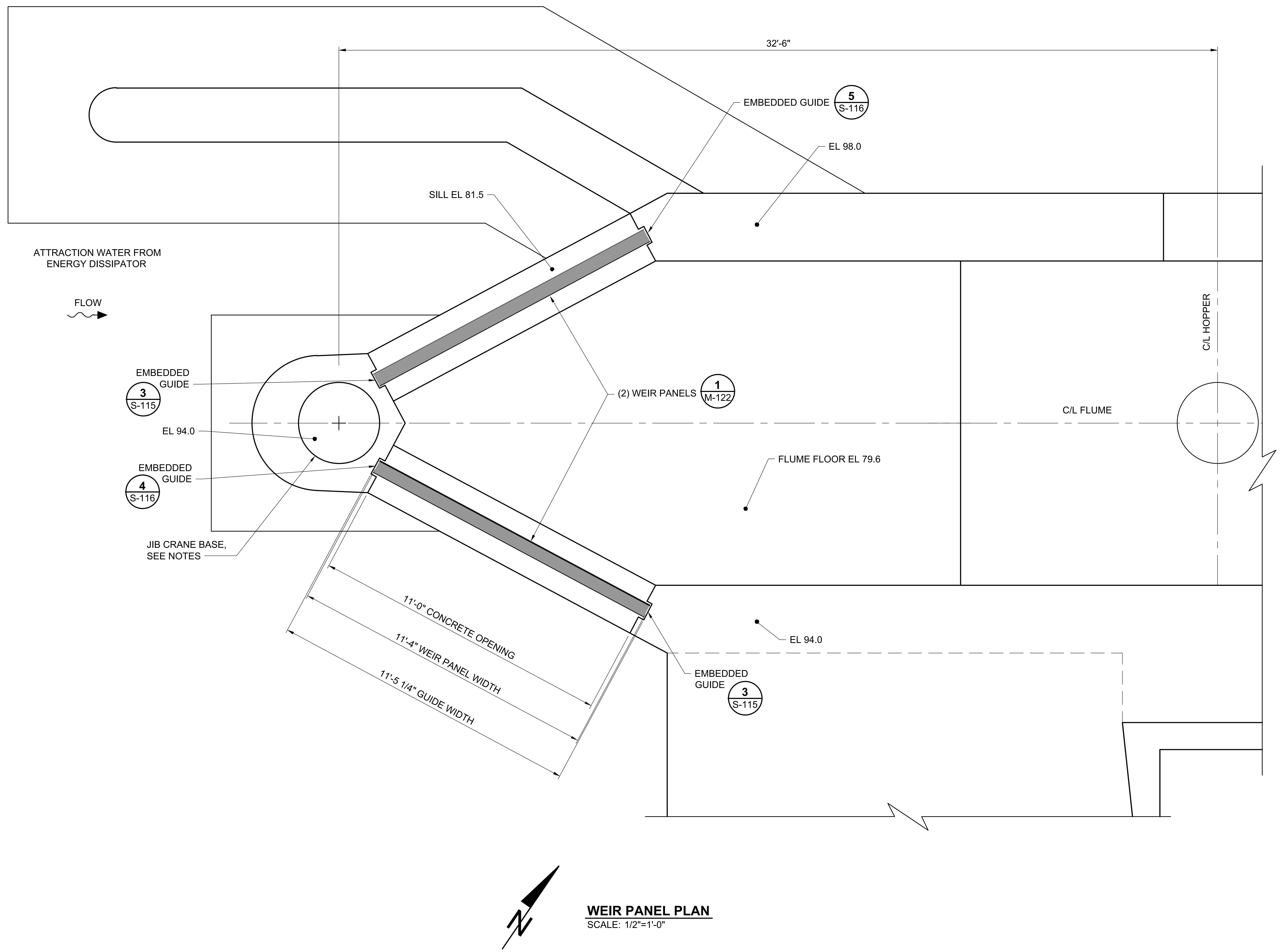
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT BAFFLE ELEVATIONS AND DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 102 OF 176
DRAWING: M-120



WEIR PANEL PLAN
SCALE: 1/2"=1'-0"

NOTES:

1. BASE PLATE MOUNTED JIB CRANE, GORBEL MODEL FS 300-4000-1410 OR APPROVED EQUAL.
   a. 2 TON MINIMUM WORKING LOAD.
   b. 10'-0" MINIMUM SPAN.
   c. 14'-0" MINIMUM HEIGHT UNDER BEAM.
   d. MEET OSHA & ANSI STANDARDS.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

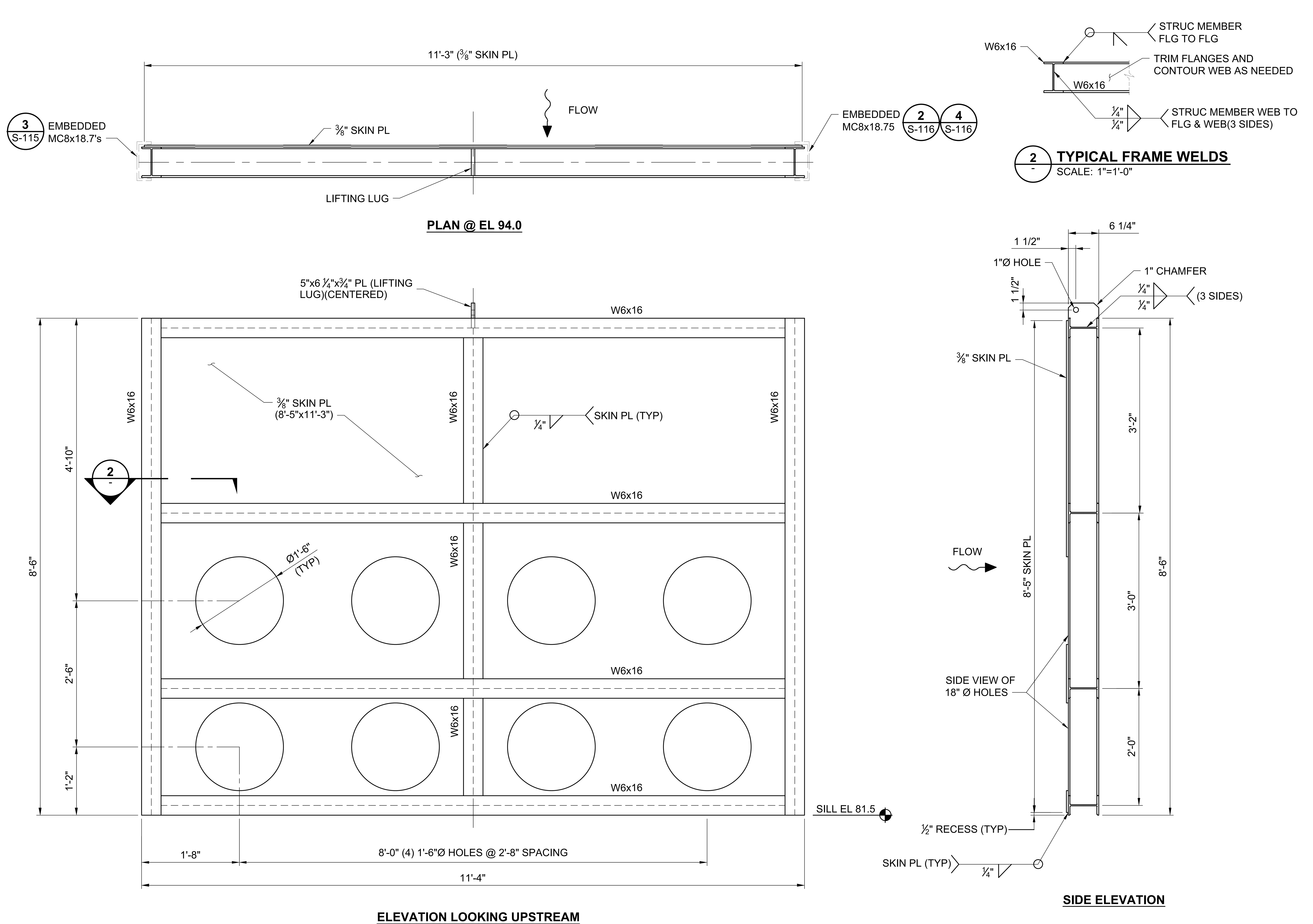
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT WEIR PANEL PLAN

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 103 OF 176
DRAWING: M-121



WELDING NOTES:

1. WELDS SHALL BE CONTINUOUS SEAL WELDS.
2. ANY SKIN PLATE SPLICES SHALL BE FULL PENETRATION.

DESIGN NOTES:

1. WEIGHT OF WEIR PANEL ASSEMBLY - 2500 POUNDS.
2. WEIR PANEL DESIGNED FOR A DIFFERENTIAL HEAD AT WSEL 94.0.

1 WEIR PANEL (2 REQUIRED)
SCALE: 1"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

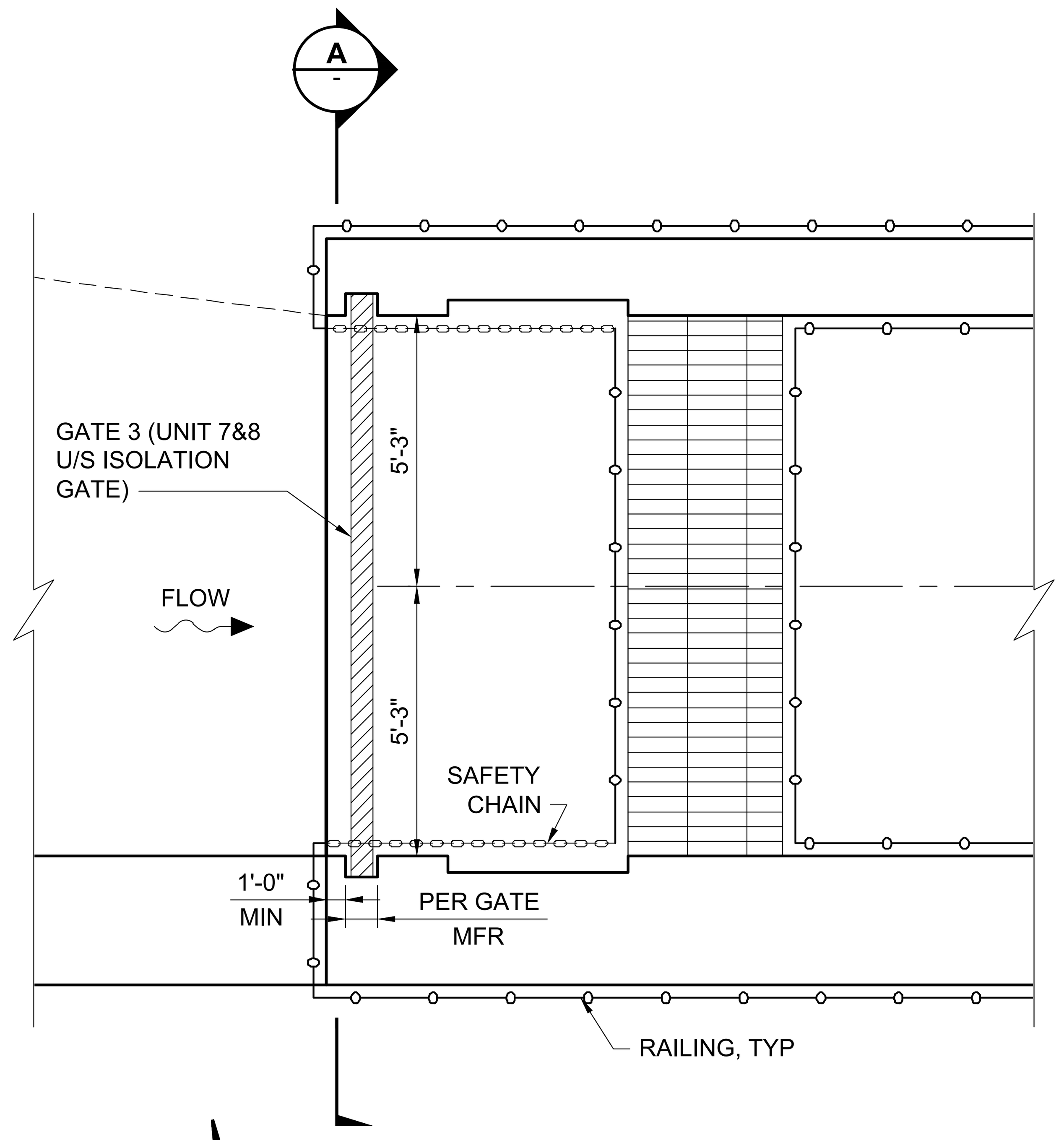
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

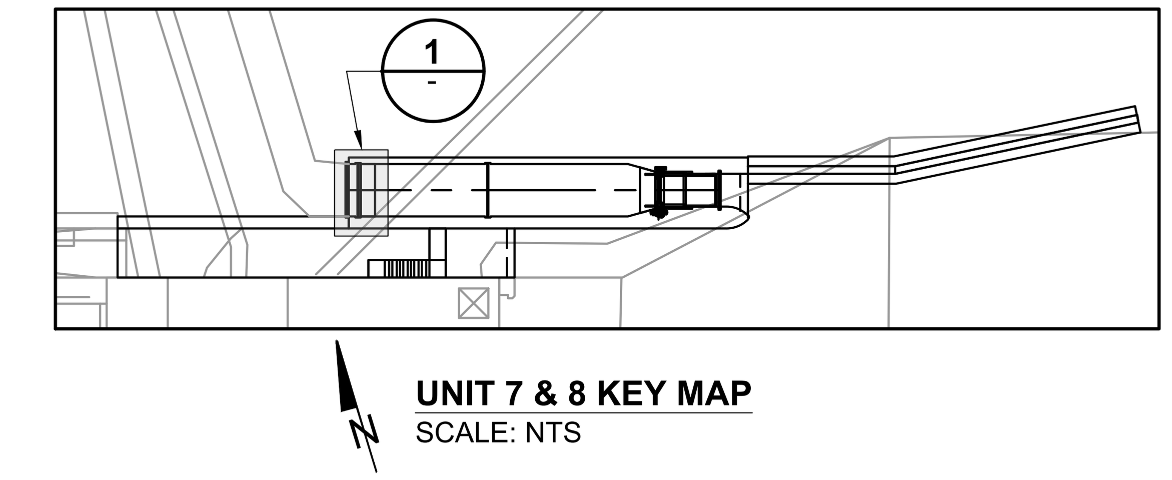
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT WEIR PANEL ELEVATION AND DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	A. MENGERT
APPROVED BY:	M. GRAESER
SHEET:	104 OF 176
DRAWING:	M-122



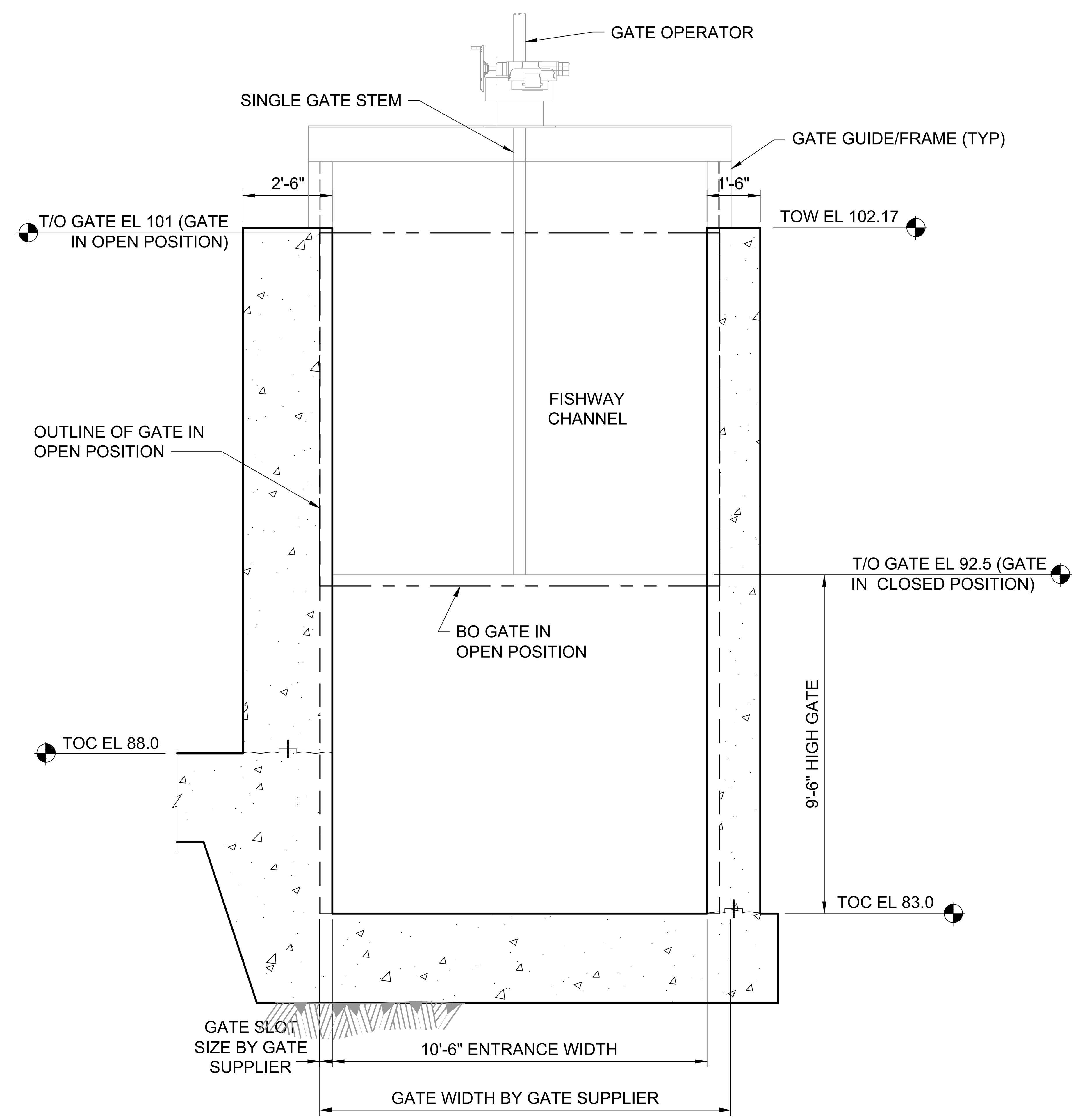
1 ENLARGED PLAN
SCALE: 3/8"=1'-0"



UNIT 7 & 8 KEY MAP
SCALE: NTS

NOTES:

1. GENERAL OVERVIEW OF GATE 3 (UNIT 7 & 8 U/S ISOLATION GATE) IS PROVIDED:
   - SIZE OF OPENING: 10.50'Wx9.5'H
   - MOVEMENT OF GATE: UPWARD OPENING
   - OPERATION OF GATE: OPEN / CLOSE
2. TAILWATER ELEVATIONS:
   - DESIGN LOW 87.1
   - NORMAL 87.6
   - DESIGN HIGH 90.0



A ELEVATION GATE 3 (UNIT 7&8 U/S ISOLATION GATE)
SCALE: 3/8" = 1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

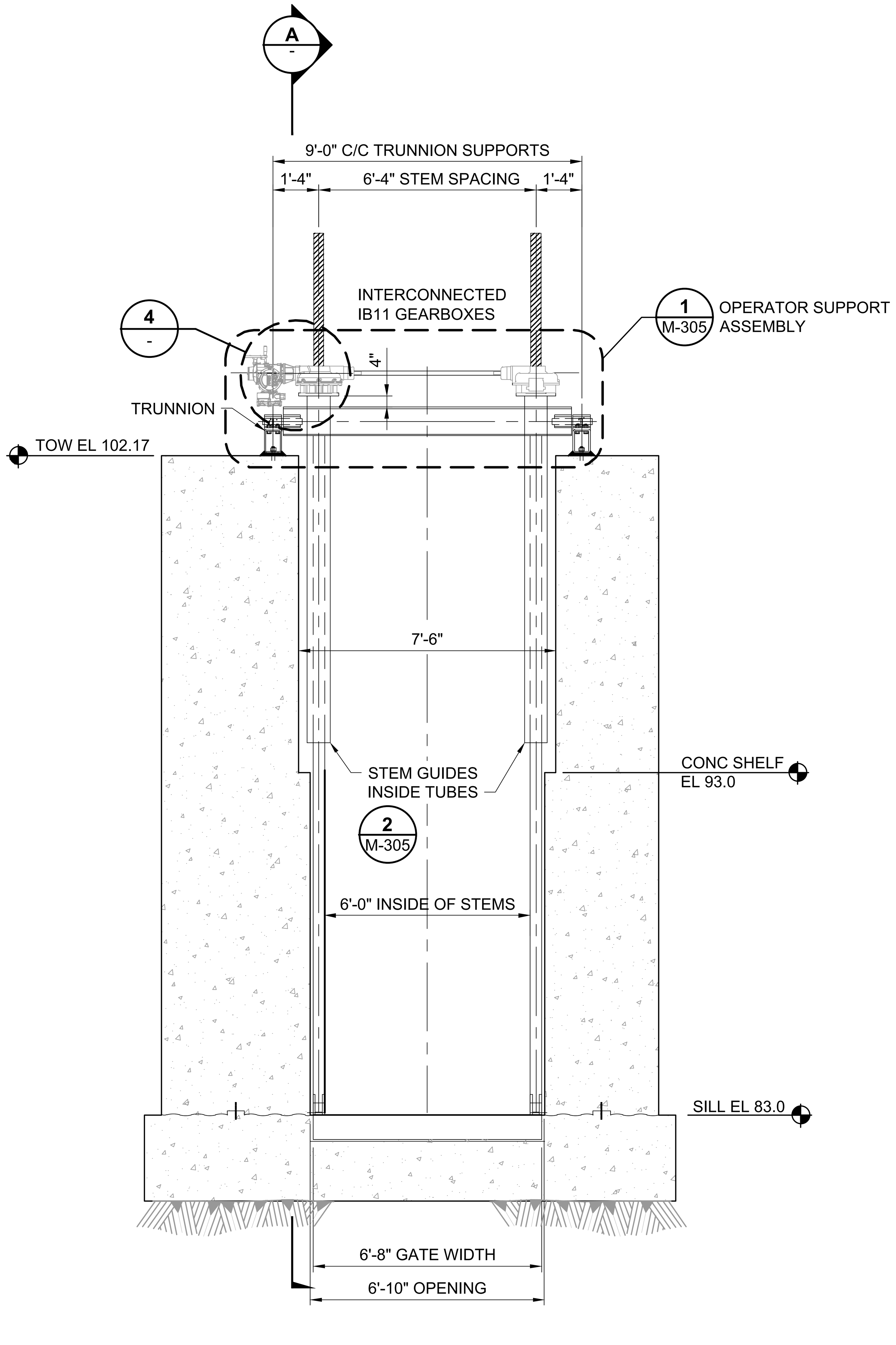
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

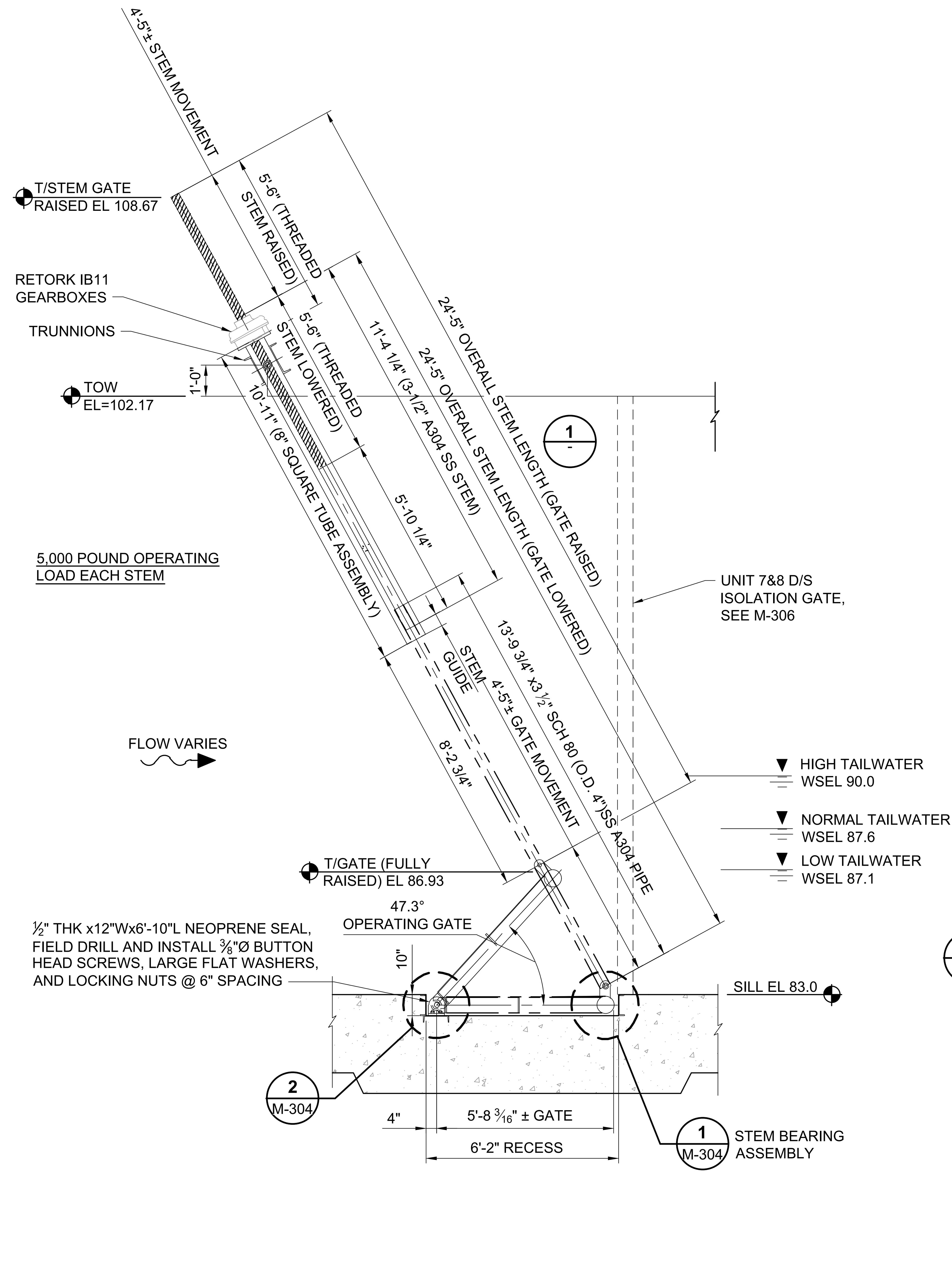
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE U/S ISOLATION GATE REQUIREMENTS

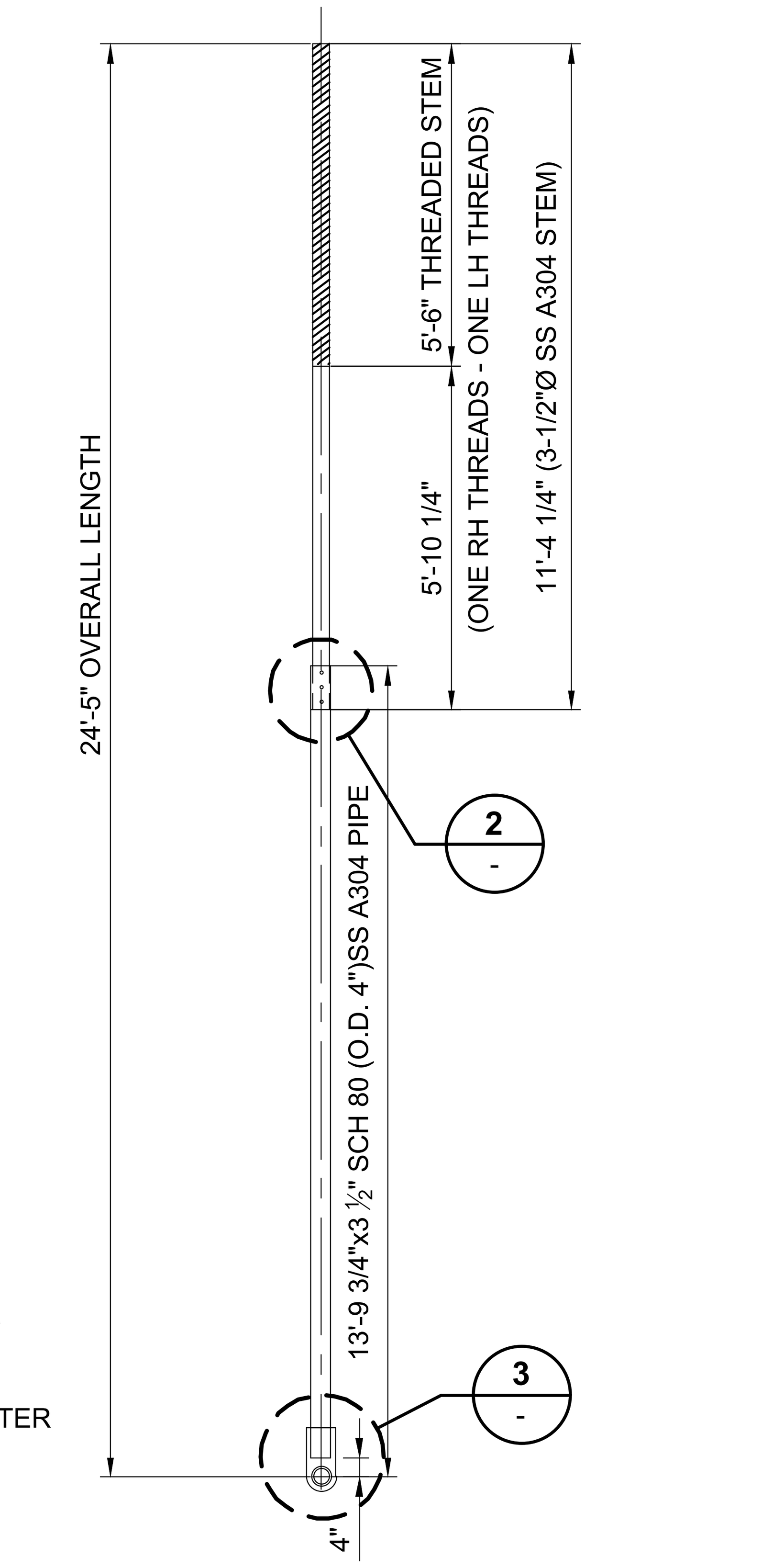
PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	105 OF 176
DRAWING:	M-301



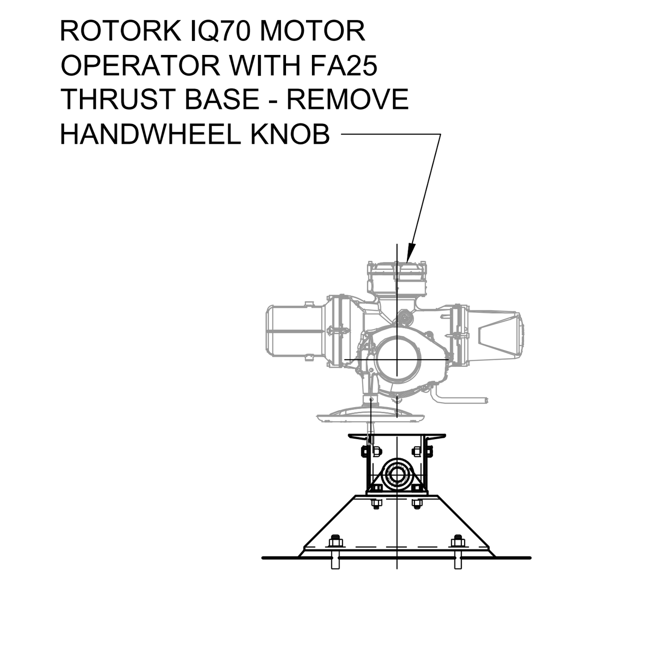
ELEVATION LOOKING UPSTREAM (GATE LOWERED)
SCALE: 3/8"=1'-0"



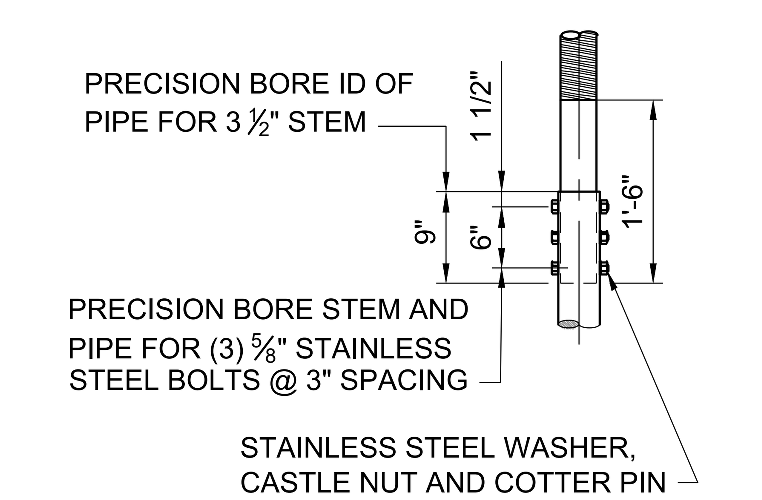
A SIDE ELEVATION
SCALE: 3/8"=1'-0"



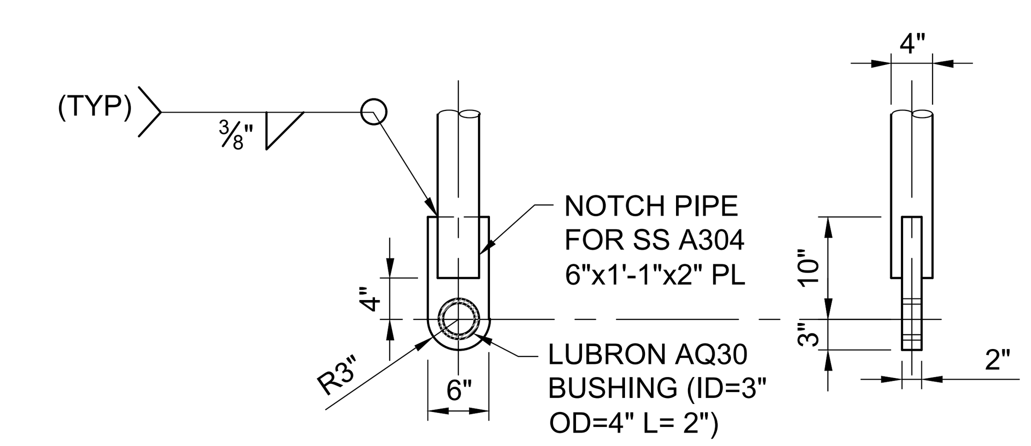
1 OPERATING STEM (2 REQUIRED)
SCALE: 3/8"=1'-0"



4 ROTORK MOTOR DETAIL
SCALE: NTS



2 OPERATING STEM CONNECTION
SCALE: 3/4"=1'-0"



3 OPERATING STEM ASSEMBLY
SCALE: 3/4"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\M\M-302.dwg USER: Agrogan
DATE: Dec 13, 2019 2:41pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

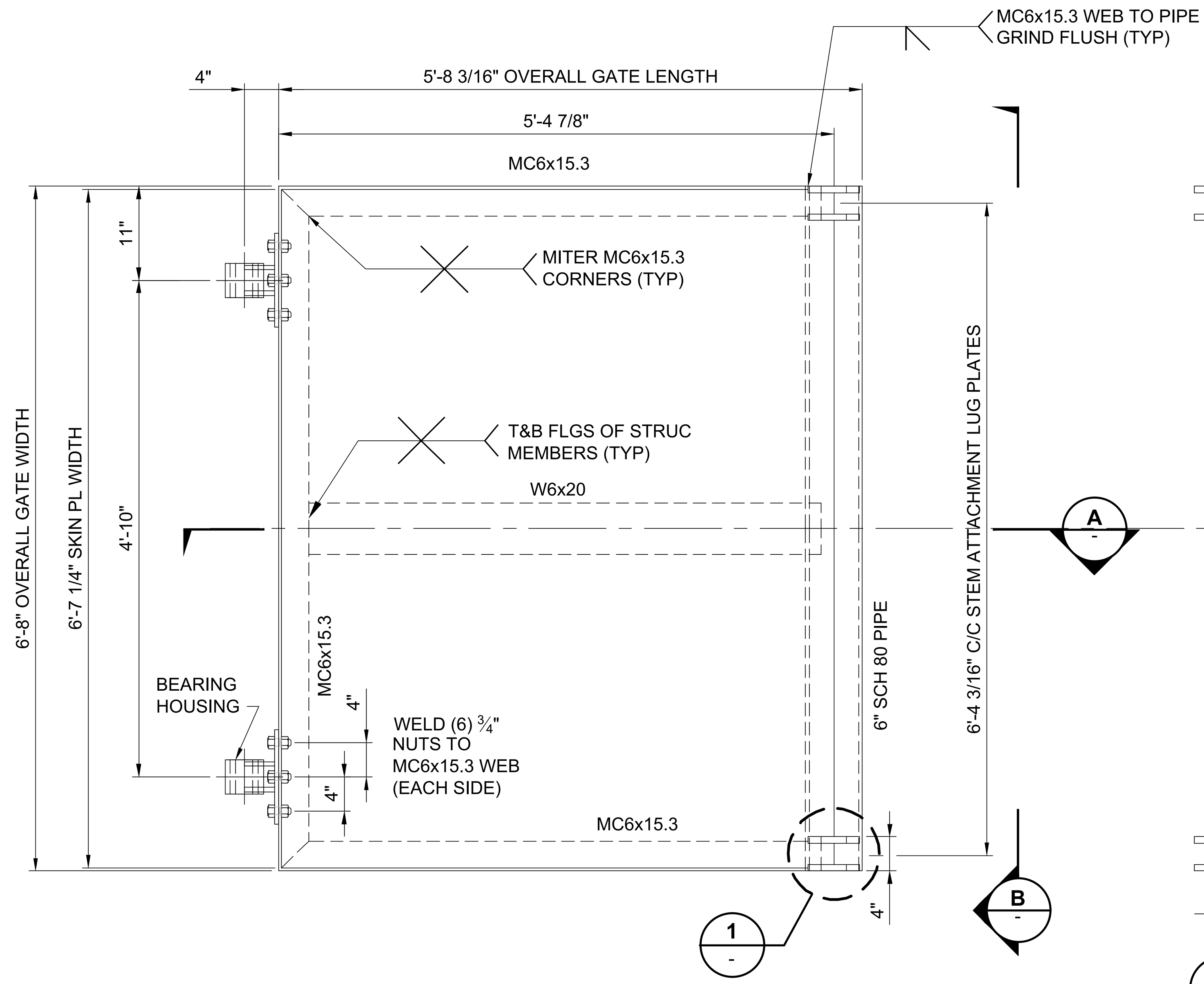
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE FLAP GATE
ELEVATIONS AND STEM DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 106 OF 176
DRAWING: M-302

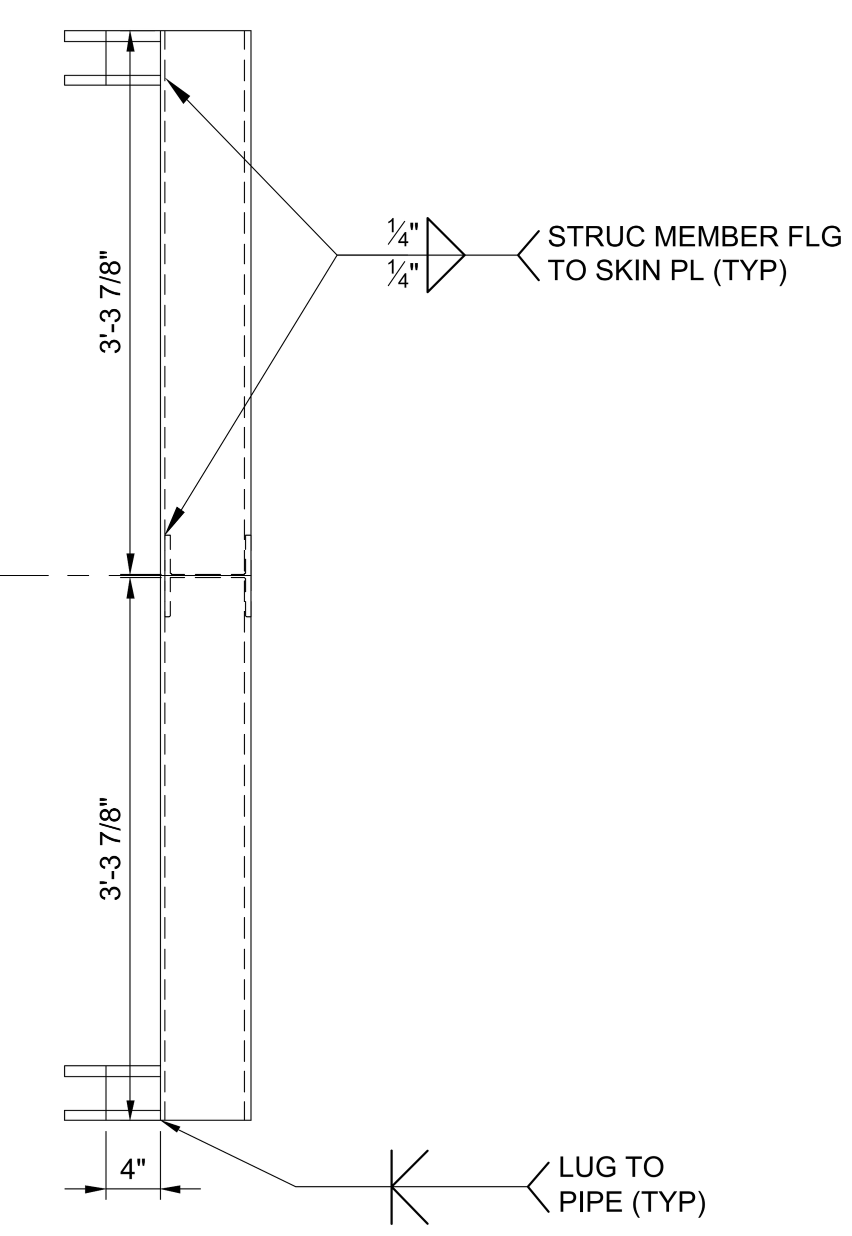
NOTES:

1. GATE TO BE WELDED ONE ASSEMBLY WITH CONTINUOUS SEAL WELDS OF THE TYPE SPECIFIED.
2. SKIN PLATE SPLICES SHALL BE AT STRUCTURAL MEMBERS USING CONTINUOUS SLOT WELD. WELD TO BE GROUND FLUSH WITH SKIN PLATE SURFACE.
3. TRIM SKIN PL AND MC6x15.3 AT ¾" THK LUGS.
4. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.



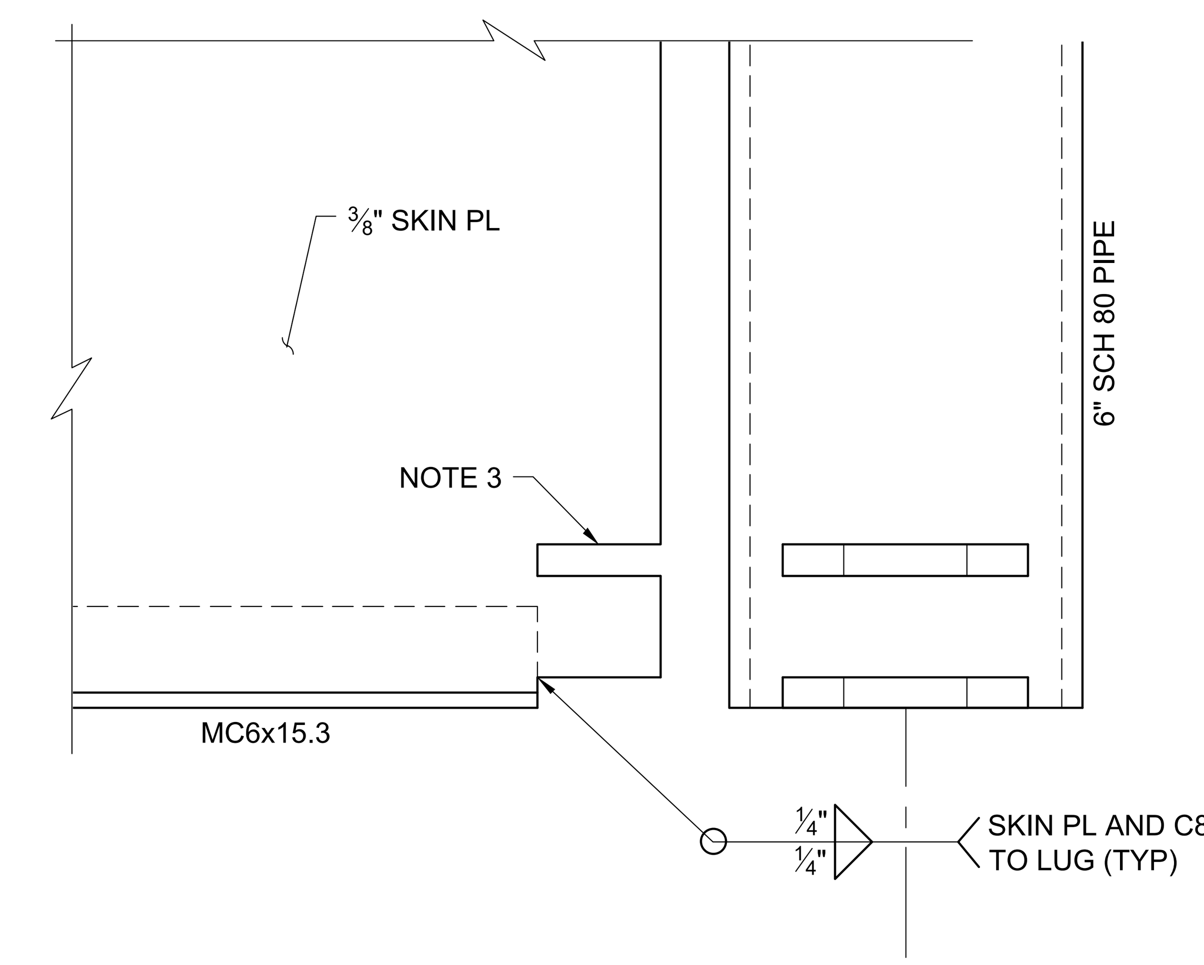
GATE PLAN/ELEVATION

SCALE: 1"=1'-0"



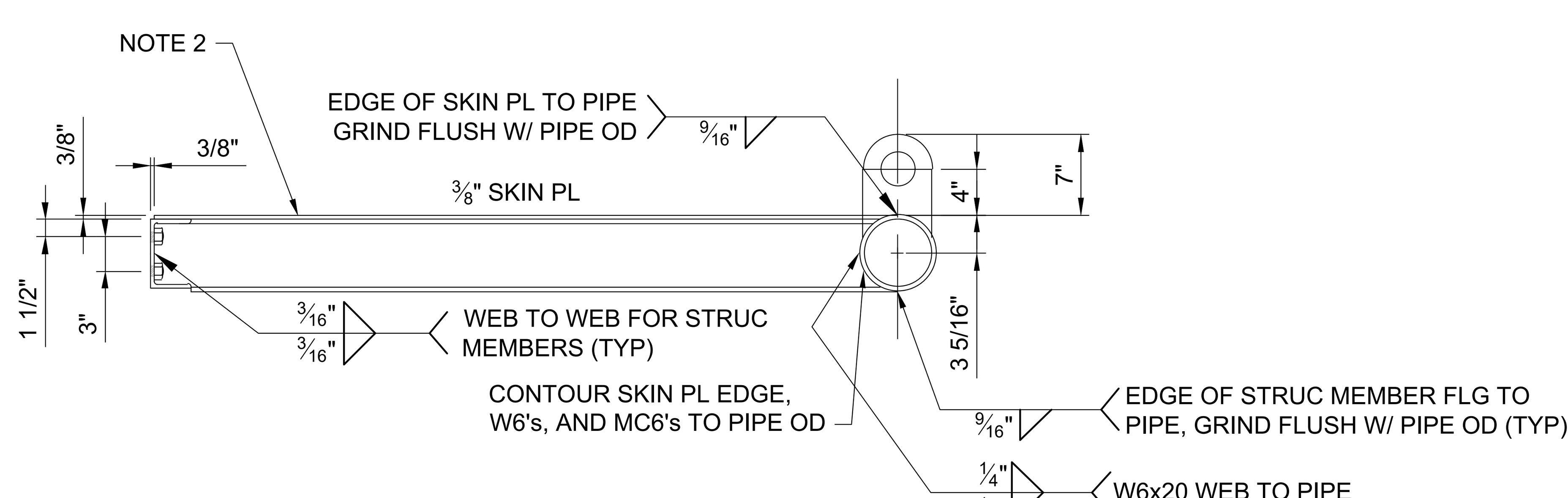
B GATE SECTION

SCALE: 1"=1'-0"



1 SKIN PL TO LUG CONNECTION DETAIL

SCALE: 3"=1'-0"



A GATE SECTION @ C/L

SCALE: 1"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

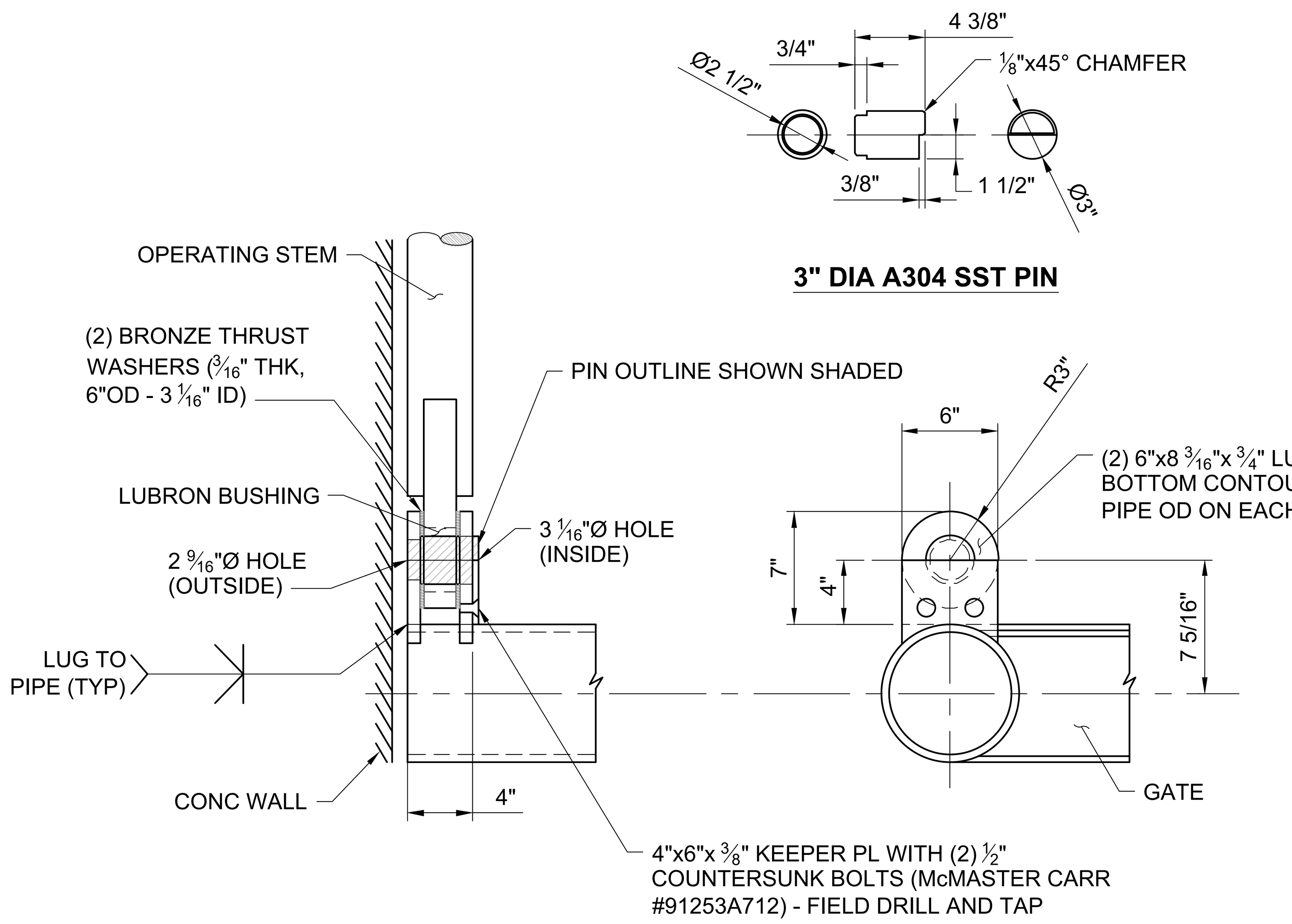
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 12/13/2019

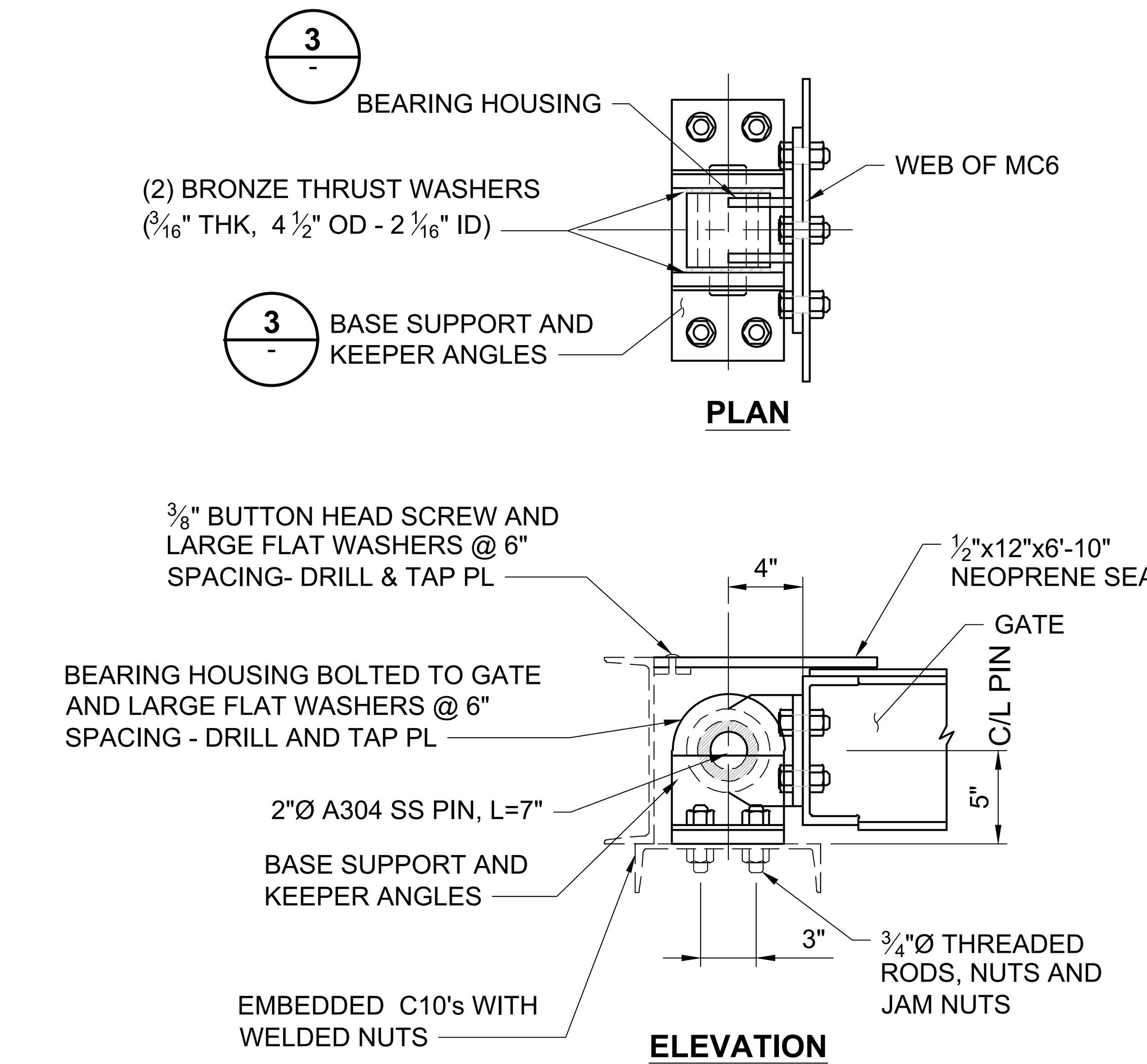
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
FLAP GATE STEEL SECTION
AND DETAILS

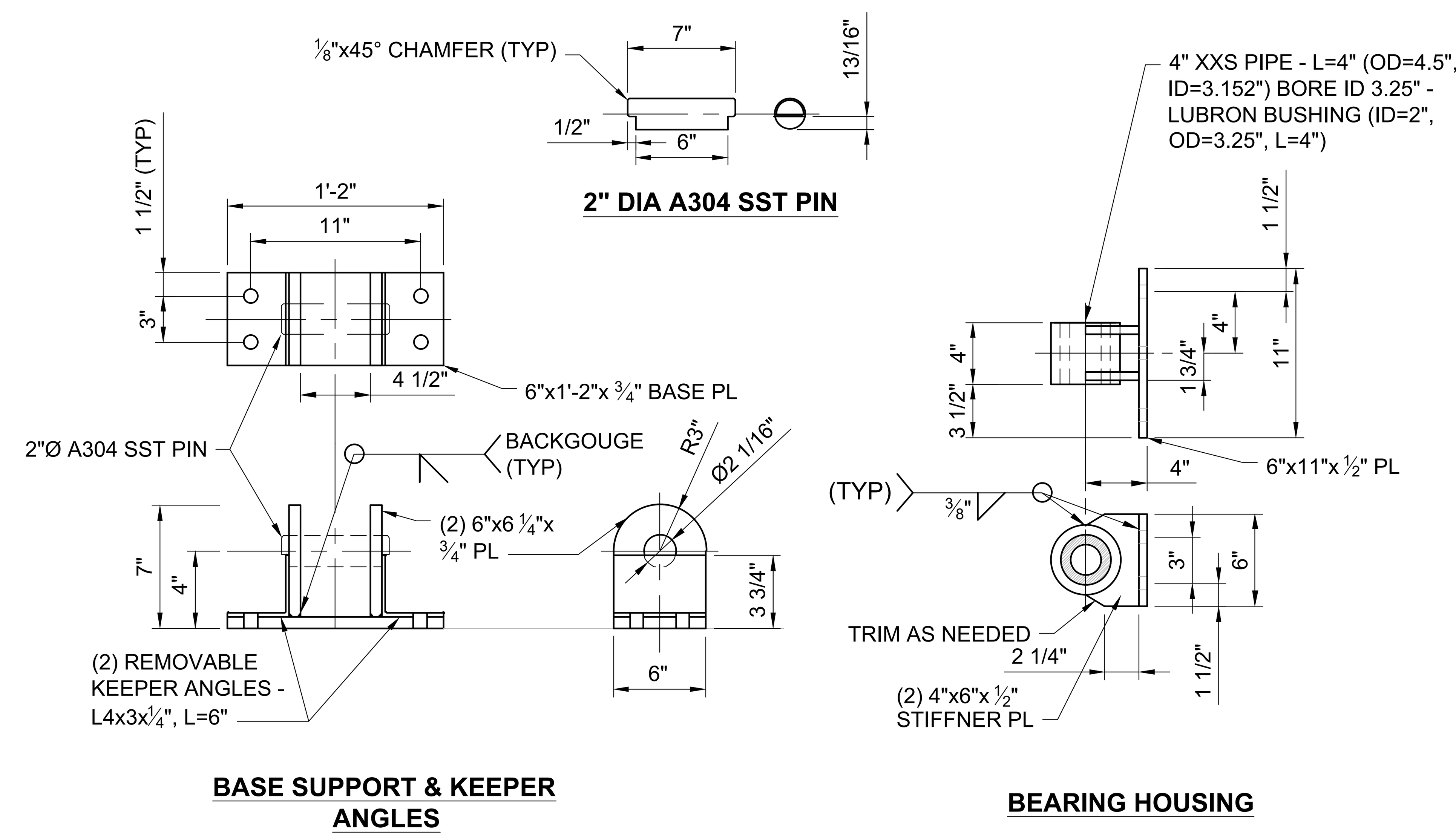
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 107 OF 176
DRAWING: M-303



1 — STEM BEARING ARRANGEMENT (M-302)
SCALE: 1 1/2"=1'-0"



2 — LOWER ASSEMBLY ARRANGEMENT (M-302)
SCALE: 1 1/2"=1'-0"



3 — LOWER BEARING COMPONENTS
SCALE: 1 1/2"=1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

DWG: C:\Users\agroga\documents\autocad sheet sets\131009-alden mea and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\M-304.dwg USER: Agrogan
DATE: Dec 13, 2019 2:41pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

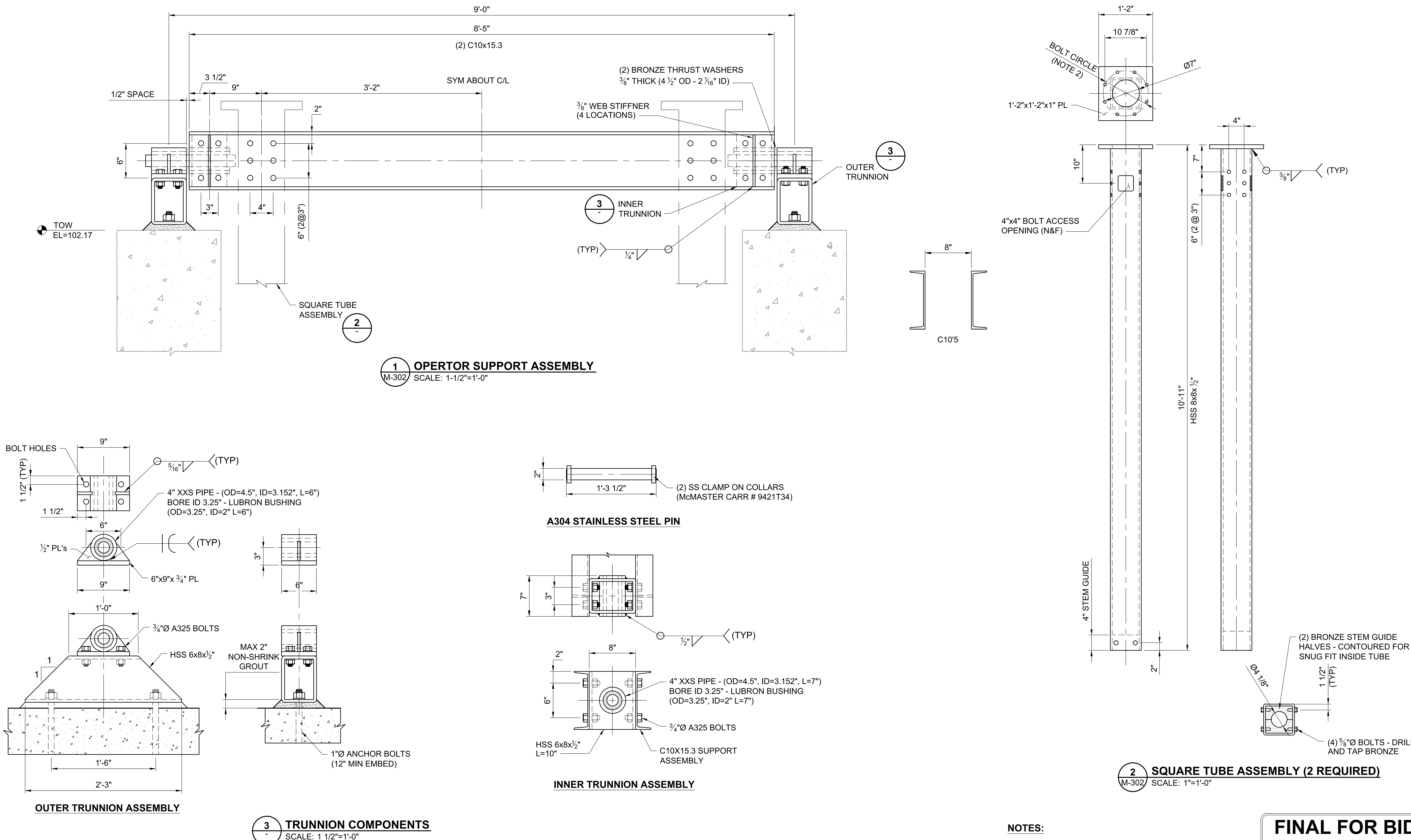
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE FLAP GATE STEEL DETAILS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 108 OF 176
DRAWING: M-304



NOTES:

1. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.
2. COORDINATE WITH EQUIPMENT SUPPLIED.

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

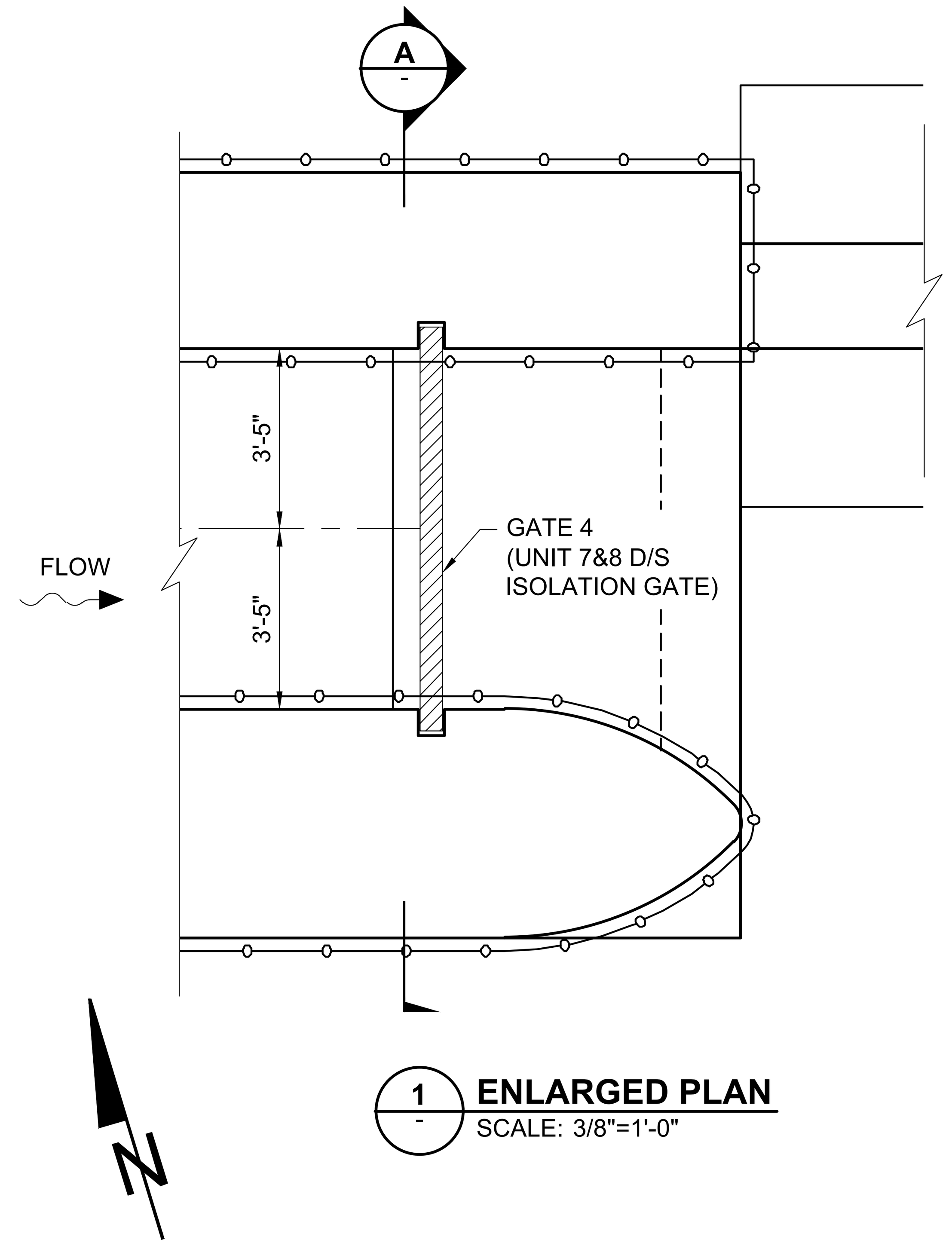
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE
MARK DANIEL GRAESER
No.39328
LICENSED PROFESSIONAL ENGINEER
12/13/2019

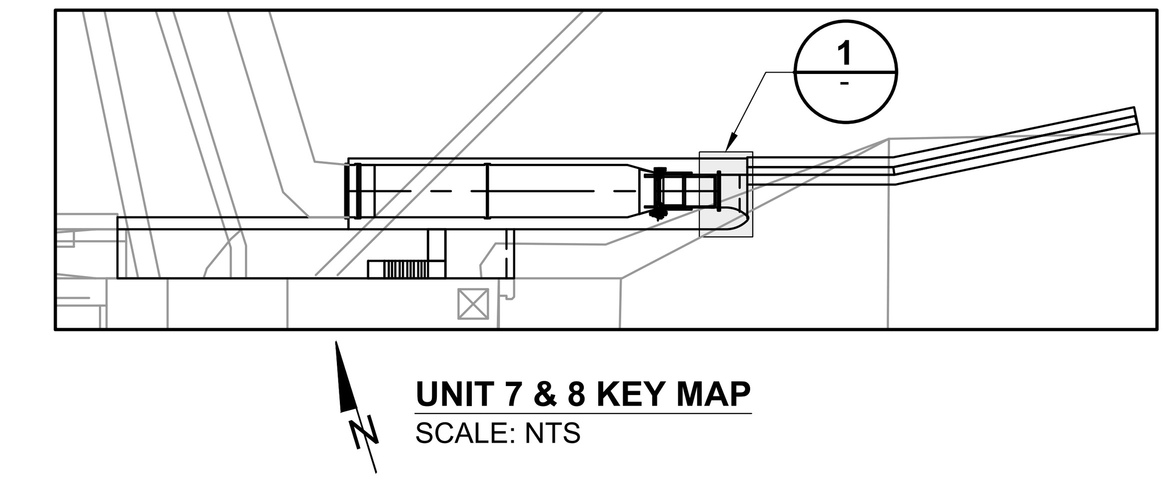
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE FLAP GATE STEEL DETAILS

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	D. ROBINSON
APPROVED BY:	M. GRAESER
SHEET:	109 OF 176
DRAWING:	M-305



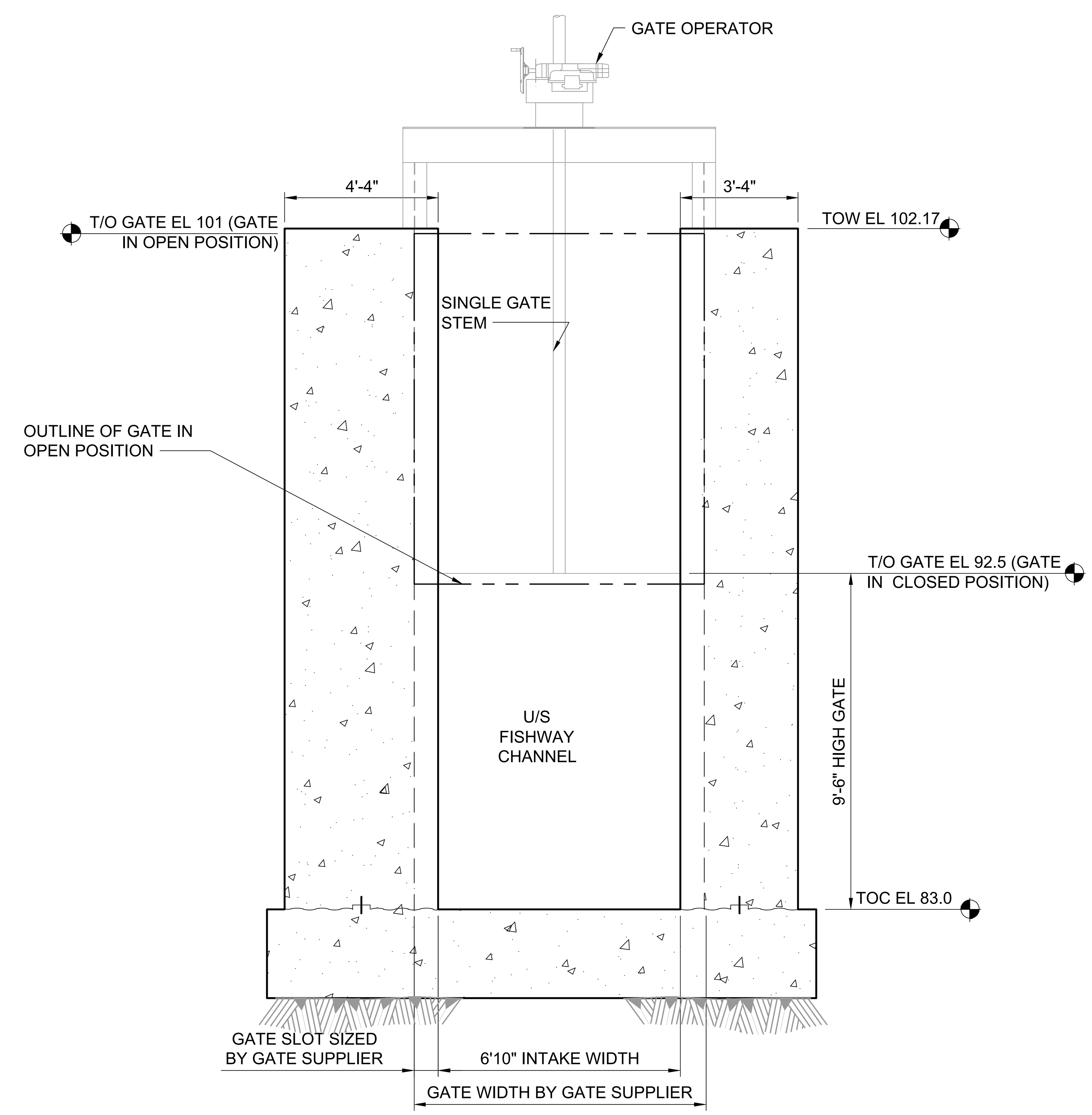
1 ENLARGED PLAN
SCALE: 3/8"=1'-0"



UNIT 7 & 8 KEY MAP
SCALE: NTS

NOTES:

1. GENERAL OVERVIEW OF GATE 4 (7 & 8 D/S ISOLATION GATE) IS PROVIDED:
   - SIZE OF OPENING: 6.83'W x 9.50'H
   - MOVEMENT OF GATE: UPWARD OPENING
   - OPERATION OF GATE: OPEN / CLOSE
2. TAILWATER ELEVATIONS:
   - DESIGN LOW 87.1
   - NORMAL 87.6
   - DESIGN HIGH 90.0



A ELEVATION GATE 4 (UNIT 7&8 D/S ISOLATION)
SCALE: 3/8" = 1'-0"

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE D/S ISOLATION GATE REQUIREMENTS

PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GREASER
SHEET: 110 OF 176
DRAWING: M-306

Exhibit B – Operation & Maintenance Plan

SHAWMUT PROJECT

FERC NO. 2322-ME

FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

Version 1.0

Revision: December 19, 2019

Operated by:

Brookfield White Pine Hydro, LLC

An indirect subsidiary of

Brookfield Renewable Energy Group

Skowhegan, ME

SHAWMUT FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

Table of Contents

SHAWMUT FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

1.0 - INTRODUCTION

This Fish Passage Operations and Maintenance Plan (the “Plan” or “O&M Plan”) is intended to define how Brookfield White Pine Hydro will operate and maintain the fish passage facilities at the Shawmut Project FERC No. 2322 (the “Project”). This Plan is part of Brookfield’s commitment to our environmental principles that are based on the fundamental values of accountability, partnership and open communication. As such, we have accepted the responsibility entrusted to us to manage natural resources in ways to ensure sustainable development.

The Plan will define what fish passage facilities (the “Facilities”) are to be constructed at the Shawmut Project, the period in which the existing and new facilities are to be operated, guidance on the annual start-up and shut-down procedures, routine operating guidelines, debris management, and safety rules and procedures that are in place. Along with these defined procedures and guidelines, the Plan includes the necessary supporting information such as contact information, daily inspection forms, drawings, and spare parts on-site. This Plan should be considered a living document, and as such it will be updated annually, as needed.

2.0 - BACKGROUND

The Shawmut Project is located at river mile 66 on the Kennebec River in the towns of Fairfield and Benton, in Somerset and Kennebec Counties, Maine. Shawmut is the third dam upstream on the Kennebec River. The Shawmut Project has a total installed capacity of 8.8 megawatts at a normal head of 24.0 feet. The principal Project facilities include a concrete gravity dam with hinged flashboards and rubber bladder, forebay, reservoir, transmission line, appurtenant facilities, and two powerhouses. The Units 1-6 powerhouse, built in 1912, consists of horizontal Francis quad runner turbines. The Units 7-8 powerhouse, built in 1982, consists of two horizontal single regulated propeller turbines.

The Shawmut Project includes a 1,310-acre reservoir, a 1,135-foot-long dam with an average height of 24 feet, headworks and intake structures, enclosed forebay, and two powerhouses. The crest of the dam has a 380-foot section of four-foot-high hinged flashboards serviced by a steel bridge with a gantry crane; a 730 foot long section of dam topped with an inflatable bladder composed of three sections, each 4.46 feet high when inflated; and a 25 foot wide by downward opening 8 foot deep sluice equipped with a timber and steel gate.

The headworks and intake structures are integral to the dam and the powerhouse. On the west end of the dam there is a head gate structure which along with the two power houses creates a forebay. Also, on the south end of the forebay between the two powerhouses, is a ten-foot-wide by seven foot deep Tainter gate set above a six foot wide by six foot tall deep sluice gate, and directly adjacent to the Tainter gate is an approximately 6 ft wide surface sluice gate. A non-overflow concrete gravity section of dam connects the west end of the forebay gate openings with a concrete cut-off wall, which serves as a core wall of an earth dike.

The Project typically operates as run-of-river, with a target reservoir elevation near the full pond elevation of 112.0 ft during normal conditions. The total maximum hydraulic capacity of the turbines is approximately 6,700 cubic feet per second (cfs). After maximum flow to the turbines has been achieved, excess water is spilled through the existing log sluice. When flows exceed the capacity of the log sluice, sections of the rubber dam are deflated to pass additional water.

3.0 - DESCRIPTION OF FISH PASSAGE FACILITIES

3.1 - UPSTREAM FISH PASSAGE

The upstream fish passage design, to be constructed and operational by 2022, consists of a fish lift with an integrated attraction water intake and spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1-6 powerhouse, a short fish bypass channel connecting the Units 7-8 tailrace to the Units 1 through 6 tailrace at the upstream end of the training wall/island, and modifications to the discharge of the Tainter gate adjacent to the Units 7-8 powerhouse.

Fish Lift

The lower portion of the fish lift structure will consist of a concrete and steel entrance flume with an 8 foot wide entrance that widens to a 12 ft entrance channel leading to a fish blocking screen and the lifting hopper. The entrance flume will include a hinged flap entrance gate to maintain velocity and head drop, a set of adjustable V-trap gates, an approximately 11 ft by 11 ft traveling hopper, a baffle wall, and a V-shaped wooden baffled weir for dissipating energy and entrained air from the attraction water system. Set upon the entrance flume will be an approximately 31 ft long by 15 ft wide by 56.5 ft tall structural steel tower within which the hopper will travel to the upper level; the open steel tower will also contain an access stairway. At the upper level (the top of the non-overflow portion of the dam) will be an exit flume (20-inch diameter pipe), a 600-gallon supplemental water storage tank, and steel grating access platform.

An approximately 93 ft long by 10 to 16 ft varying width spillway will be cut into the non-overflow portion of the dam which extends and turns approximately 53 degrees to discharge adjacent to the fish lift entrance to the flume. At the upstream edge of the spillway a beveled broad crested weir will extend about five feet into the headpond. Internally, the spillway channel will include a 16 ft long by 16 ft wide wedge wire screen floor which will convey water from the spillway channel to the energy dissipation pool located just upstream of the fish lift hopper and will provide the attraction flow to the entrance flume of the fish lift.

The attraction water intake and spillway are designed to convey 340 cfs of flow from the head pond; of this 115 to 225 cfs will be diverted through the wedge wire screen intake to the energy dissipation pool and then to the fish lift entrance flume. The remaining 115 to 225 cfs will be bypassed and spilled adjacent to the fish lift entrance.

Unit 7-8 Fish Bypass Channel

An approximately 77 ft long by 10.5 ft wide bypass channel will be constructed at the upstream end of the island to provide fish egress from the Unit 7-8 tailrace across to the Unit 1-6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7-8 tailrace. The bypass channel structure will be comprised of a concrete channel with two baffles, a hinged entrance gate, and isolation gates. The southern side of the channel will share a wall with the modified Tainter gate spillway channel and the northern wall will extend 80 ft downstream along the island as a training wall. An approximately 75 ft long by 8 ft wide channel will be excavated into the bedrock turning about 84 degrees from the Units 1-6 tailrace to the bypass channel exit. The excavated rock channel will be at existing grade near the Unit 1-6 powerhouse tailrace and about 5 ft deep. Access stairs from the roof of the Unit 7- 8 powerhouse will lead down to a steel grating walkway near the exit of the Tainter gate spillway channel. This walkway will cross over both channels to allow access to the fish bypass.

A new 79 ft long by 10 ft wide concrete spillway channel will extend from the discharge of the existing Tainter gate to the Unit 7-8 tailrace. See Attachment D for facility drawings.

Upstream fishway operations

The proposed fish lift will be operational from May 1st to October 31st, annually. The fish lift has a designed operating range of 2,540 cfs and 20,270 cfs and will maintain a flow of 0.5 feet per second (fps) at the fish lift attraction water intake Flow in the entrance flume will be maintained at 1.0-1.5 fps through the hopper and 4-6 fps at the fishway entrance. The facility has been designed in consultation with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, Maine Department of Marine Resources, the Maine Department of Inland Fisheries and Wildlife and is designed to pass Atlantic salmon (population size 12,000), American shad (population size 177,000), alewives (population size 134,000), and blueback herring (population size 1,535,000).

3.2 - DOWNSTREAM FISH PASSAGE

Downstream passage at Shawmut is currently provided through a combination of a surface weir (sluice), Tainter gate, Deep gate (for downstream passage of adult eel in the late summer/fall) and opened hinged flashboards. The sluice is located at the right side of the intake structure next to Unit 6. It is 4 ft wide by 22-inches deep and flow can be adjusted by adding or removing stoplogs. With all stoplogs removed, the sluice passes between 30 and 35 cfs which is discharged over the face of the dam into a 3 ft deep plunge pool. The Tainter gate located next to the sluice measures 7 ft high by 10 ft wide and can pass up to 600 cfs.

Currently, the sluice and Tainter gate are operated for Atlantic salmon smolt and kelt passage from April 1 through June 15 and from November 1 through December 31, as river flow and ice conditions allow. Downstream passage is also provided along the Shawmut spillway during periods of excess river flow that results in spill. To provide additional passage during the

Atlantic salmon smolt migration season, the Licensee also drops four sections of hinged flashboards, located immediately adjacent to the power canal headworks which provides up to approximately 560 cfs of spill flow.[1] Based on the results of downstream eel passage studies conducted in 2007 and 2008, and with concurrence resource agencies, the deep drain gate is opened for 6 weeks during the period September 15th to November 15th annually for downstream eel passage, in combination with Unit 7-8 shutdowns for at least 8 hours per night.

To minimize the potential for stranding fish on the ledges below Rubber Dam No. 3, Brookfield deflates rubber dams in numerical order (Section l first, Section 3 last) and inflate in reverse order.

With the new license, Brookfield will continue to operate the existing downstream passage facilities and is also proposing to install a guidance boom in the forebay to improve downstream passage at the Shawmut Project. The combined new and existing downstream measures are listed below.

- Install a guidance boom (e.g., Worthington boom) in the forebay in front of Units 7-8. The proposed boom will have a depth of 10 ft., be made of rigid panels with ½ inch perforations (48% opening) and will be installed year-round.
    - Undertake measures necessary to keep the guidance boom in place and in good operating condition. If the guidance boom becomes dislodged or damaged, the resource agencies will be notified and the repair or replacements to the guidance boom will be made as soon as can be safely and reasonably done.
- Continue to operate the forebay bypass gate/surface sluice for utilization by downstream migrating diadromous fish from April 1 through December 31, as river conditions allow.
- Continue to ensure that the forebay Tainter gate is operated to maintain a flow of 6% of station unit flow through the gate (600 cfs through the smolt passage season).
- For a 6 week period between September 15th through November 15th, continue to open the deep drain gate next to Unit 7 at least two and one half feet (approx. 425cfs) and shut down Units 7 and 8 for at least 8 hours per night starting one hour after sunset for eel passage.

The new upstream fish passage facility will also provide additional downstream passage opportunity via the spillway channel auxiliary attraction water system (AWS). AWS flow of 115-225 cfs in excess of the flow required for the fish lift operation will be discharged (along with any downstream migrating fish passing through the system) to the Unit 1-6 tailrace adjacent to the fish lift entrance.

[1] The hinged flashboard sections pass a flow of approximately 140 cfs per section. With three sections down the flow is approximately 420 cfs; with four sections down the flow is approximately 560 cfs.

4.0 - OPERATION AND MAINTENANCE OF FISH PASSAGE FACILITIES

4.1 - UPSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

The upstream fish lift and Unit 7-8 bypass channel facilities will be operated and maintained by Brookfield. To maximize attraction to the upstream passage facility, the unit closest to the fish lift entrance (Unit 1) is operated first-on and last-off, followed consecutively by Units 2 through 6. In the future, unit prioritization for upstream fish passage may be adjusted based on the results of fish passage studies, and in consultation with the resource agencies.

Brookfield personnel shall visit the fishway several times each day to ensure:

1. there is no debris clogging throughout the fish lift facility,
2. there is adequate velocity (1 to 1.5 ft/s) through the hopper,
3. adequate velocity (4-6 ft/s) at the fishway entrance,
4. and, a 6-9" head drop from inside the entrance to the tailwater. The head drop at entrance gate is automatically adjusted via a programmable logic controller (PLC) which tracks the tailrace elevation and associated operator interface terminal (OIT) touch screen.

Proper operation of all the fishway water systems and maintenance of appropriate water velocities will be calculated via staff gauges and/or transducers, flow curves and AWS flow control gate setting. Cleaning of the AWS will be determined based on visual inspection. Brookfield personnel will confirm that the velocities through the fish lift, the attraction flow distribution upstream and downstream of the hopper, and that the entrance flow conditions are set in accordance with agency instructions applicable at the time. All fish passage operational information will be recorded in daily fishway logs and then entered into an electronic data sheet that can be provided to the resource agencies on timely intervals as agreed upon.

Brookfield personnel shall also visit the Unit 7-8 fish bypass channel several times each day to ensure:

1. there is no debris clogging throughout the fish bypass channel,
2. adequate velocity (4-6 ft/s) at fishway entrance,
3. and, a 6-9" head drop from inside the entrance to the tailwater. The head drop at flap gate is automatically adjusted via a programmable logic controller (PLC) which tracks the tailrace elevation and associated operator interface terminal (OIT) touch screen.

Proper operation of all the fishway water systems and maintenance of appropriate water velocities will be calculated via staff gauges and/or transducers, flow curves and flap gate setting and recorded in the daily fishway logs and the electronic data sheet. Brookfield personnel will confirm that the velocity through the fishway and that the entrance flow conditions are set in accordance with agency instructions applicable at the time.

The fish lift and bypass channel shall be dewatered annually inspection and maintenance. Typically, August is a good time for this effort as river temperatures often exceed the threshold for handling salmon. Flow will be reduced and fish within the fishway will be safely removed before stopping flow completely in order to prevent stranding. Routine annual maintenance shall include dewatering the fishway, removing accumulated debris from within the fishway as necessary (vacuum truck may be needed) and inspection of the integrity of the fishway. Any fishway components that are found to be damaged shall be replaced, in kind. All mechanical and electrical systems shall be inspected, serviced and maintained per manufacturer specifications.

OPERATIONAL PERIOD

- May 1 to October 31, seven days a week as river conditions allow. Daily hours of operation will be established in consultation with resource agencies based on run timing for the target fish species and numbers of fish present.

OPENING METHODS

At least two to three weeks prior to fish lift and fish bypass start-up if river conditions allow:

Fish Lift

1) Remove ice eaters from the lower flume of the fish lift
2) De-water fish lift lower flume, inspect and clear all debris from within the entrance channel as well as the AWS diffusion chamber
3) Inspect for any damaged components and repair as necessary
4) Remove safety chain from the hopper
5) Inspect and repair hopper mechanical components as necessary (cotter pins, turn buckles, cable, limit switches, etc.)
6) Grease entrance gate operators
7) Following the fish lift start up procedure (to be developed and included in this O&M Plan in the future), water up fish lift by opening attraction water valves and adjust entrance gate via the operator interface terminal (OIT) for approximately 6-9 inch differential from inside the fish lift entrance flume to the tailrace

Unit 7-8 Fish Bypass Channel

1) Remove ice eaters from the fish bypass channel
2) De-water fish bypass channel, inspect and clear all debris from within the channel
3) Inspect for any damaged components and repair as necessary (cotter pins, turn buckles, cable, limit switches, etc.)
4) Grease entrance gate operators
5) Water up bypass channel by opening the upstream and downstream isolation gates and adjust the flap gate via the operator interface terminal (OIT) for approximately 6-9 inch differential from inside the bypass channel entrance flume to the tailrace

SPARE PARTS

- 4 hopper wheels
- 4 hopper pulleys
- 2 drive bushings for entrance gate operator
- 2 drive bushing for attraction water valve operators
- 2 drive bushings for V-gate operator
- 1 (Operator interface terminal PLC touch screen OIT)
- 2 Hoist fuses
- 2 Limit switches
- Encoder for hoist if required
- Stop logs
    - Location and dimensions to be listed here
- Hopper hoist cable
    - Specifications and supplier (if a spare is not kept on site) to be listed here

WORKFORCE PLANNING

- <u>Staffing Requirements:</u>
    - Start Up - Crew of 2
    - Routine Operations – Crew of 2
    - Routine Maintenance – Crew of 2 for standard maintenance, crew of 3 for fishway entry for cleaning and fish removal
    - Shut Down – Crew of 2

- <u>Daily basis:</u>
    - The fish lift and fish bypass channel will be inspected for debris accumulation. Staff will remove debris from fish lift. If debris is not manageable by hand, operations crew will de-water fish lift lower flume as described below and remove debris. The resource agencies will be notified if debris management requires shutting down of the facility for more than 4 hours.
    - The attraction water gates will be adjusted to maintain a velocity of 1.0-1.5 fps through the hopper and 4-6 fps velocity at the entrance based on head pond and tailwater elevations and flow curves.
    - The fish lift entrance hinged flap gate will be adjusted for via the PLC/OIT resulting in a 6-9" head drop from inside the entrance to the tailwater as determined by water level gauges.
    - The fishway log sheets are completed consistent with Appendices A and C.

  - The daily fishway log information will be entered into an electronic data sheet that can be provided to the resource agencies on timely intervals as agreed upon.

- Weekly basis:
  - Facility's lead fishway technician to distribute a weekly Fishway Operations Report consistent with Appendix C to the fishery resource agencies

- Cleaning process lower flume:
  - Set up fall arrest/fall retrieval device, inspect fall harness (per procedure)
  - Install access ladder
  - Dewater fish lift lower flume to 6 inch depth and inspect for stranded fish and safely remove fish as necessary
  - Complete dewatering of lower flume can take place only after all fish are safely removed
  - Remove debris as necessary

- Preventative Maintenance process:
  - Monthly :
    - Grease the entrance gate, attraction water gate and V-gate operator mechanisms
    - Inspect and repair hopper mechanical (cotter pins, turn buckles, cable, limit switches, etc.) as necessary
  - Yearly:
    - Inspect the fish lift hopper hoist
    - Inspect attraction water dewatering gate operators
    - Inspect fish lift hopper isolation screen hoist
    - Inspect the entrance gate, attraction water gate and V-gate operators
    - The fish lift and fish bypass channel shall be dewatered annually (dates and duration to be determined in consultation with the resource agencies, but generally in August) for inspection, cleaning, to make essential repairs, and to adjust the various mechanical and structural systems as needed.

WINTERIZING METHODS

- Close the attraction water gates and seal to minimize leakage
- Close isolation gates on fish bypass channel
- Remove all debris from fish lift and fish bypass channel
- Lift hopper and install safety chains

- Install 2 ice eaters in lower flume of fish lift and 2 in the fish bypass channel
- Close V-gates
- Open entrance gate
- De-energize all electrical equipment
- Drain water storage tank and leave all valves in the open position
- Drain water storage tank fill piping and pump
- Close upstream isolation gate and seal to minimize leakage

4.2 - DOWNSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

OPERATIONAL PERIOD

The combined new and existing downstream measures are listed below.

- Forebay Guidance Boom: permanently installed and angled to forebay guidance sluice.
- Open forebay bypass gate/surface sluice: April 1 through December 31, as river conditions allow
- Open forebay Tainter gate to 6% station flow: 600 cfs during smolt migration period (two week period, starting when the river temperature reaches 10°C, typically in month of May).
- For a 6 week period between September 15th through November 15, continue to open the deep drain gate next to Unit 7 at least two and one half feet (approx. 425cfs) and shut down Units 7 and 8 for at least 8 hours per night starting one hour after sunset for eel passage.
- New downstream passage opportunity via spillway channel AWS system – May 1 – October 31

OPENING METHODS: for the new downstream passage associated with the fish lift spillway AWS system

1) Grease AWS isolation gate and attraction water flow control gate operator mechanisms
2) Open the upstream fishway (AWS) head gate 100% to pass 340 cfs of flow.
3) Adjust fish lift attraction flow gate to divert 115 to 225 cfs of the AWS flow.
4) Close attraction water flow control gate when fish lift is not in operation

SPARE PARTS

- 1 drive bushing for each gate operator

WORKFORCE PLANNING

- Staffing Requirements:
  - Start Up – Crew of 1
  - Routine Operations – Crew of 1
  - Routine Maintenance – Crew of 2 for standard maintenance, crew of 3 for fishway entry for cleaning
  - Shut Down – Crew of 1

- Daily basis:
  - Inspect the downstream fish passage entrances for debris and remove it. If debris can't be easily removed, operations crew will assist. Notify the resource agencies (see Section 8.0) if downstream fish passages can't be cleaned the same day.
  - Verify proper outflow of the downstream fish passages.
  - The fishway log sheets are completed consistent with Appendices A and C. Information within the daily inspection form will be entered into a database for ease of data sharing throughout and at the end of the season

- Weekly basis:
  - Facility's lead fishway technician to distribute a weekly Fishway Operations Report consistent with Appendix C to the fishery resource agencies
- Cleaning process:
  - De-water the downstream fish passage (AWS) and inspect fishway for stranded fish
  - Set up fall arrest/fall retrieval device, inspect fall harness (Brookfield procedure)
  - Prepare chainsaw for operation, inspect all chainsaw PPE
  - Inspect all rigging for hoisting debris

- Preventative Maintenance process:
  - Yearly:
    - Inspect the isolation gate and attraction water flow control gate operators
    - Inspect the wedge wire intake screen and spillway

DOWNSTREAM FISH PASSAGE DE-WATERING METHOD

- Close the AWS gate and de-energize
- Open attraction water flow control gate and de-energize

WINTERIZING METHODS

- Close AWS gate to drain water and de-energize
- Open attraction water flow control gate to drain water and de-energize

5.0 – FISH STRANDING PLAN

- If a stranding event occurs, contact the Senior Fisheries Lead or Seasonal Fish Technicians along with the local Compliance Specialist and Stakeholder Relations.
- To minimize the chance of fish stranding on the ledges below the spillway, coordinate with the National System Control Center (NSCC) to potentially lower inflatable rubber bladder No. 3 as applicable.
- If there is a stranding event on the ledges, access the ledges on the east shore via the access road to the spillway. There is a hand carry launch directly below the station and a public boat launch approximately four miles downstream of the dam, in Fairfield, below the three bridges.

5.1 - OBSERVATION POINTS

- The east shoreline access road located off the River Road, to the spillway overlook.

5.2 – AVAILABLE RESOURCES

- Nets and handle extensions located at the Lockwood Dam fishlift
- Salmon “vinyl” socks, five-gallon buckets and a trash can located at the Lockwood fishlift
- Canoe and paddles located inside Lockwood Dam powerhouse
- 14-foot motor boat located at Hydro Kennebec

6.0 - FISH MORTALITY DISPOSAL PLAN

- With prior approval of resources agencies, fish mortalities can be picked up by a local bait dealer (Wild Things Bait Shop) located in Oakland. Contact is Scott Horne at 207-313-9741. All mortalities shall be noted on the fish lift daily log sheets.

7.0 - SAFETY

7.1 - SAFETY RULES & PROCEDURES

- Pursuant to Brookfield’s Safety Procedure SP9, Job Safety and Environmental Plans are completed prior to, and ideally, well in advance of any work at the various fish ways are started. Job Safety and Environmental Plans are to be completed using the standard form which may be updated from time to time. Review of prior Job Safety and Environmental Plans for similar work is encouraged to help capture all safety risks that may be present at the site.

8.0 – NOTIFICATION AND CONTACT INFORMATION

NOTICE:

- Contact NMFS and MDMR within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS[2]
- Notify resource agencies of any changes in Project and fishway operations (including maintenance activities)[3]
- The first Brookfield point of contact for all Fishway related issues is the local Operations Manager

BROOKFIELD CONTACTS

- Dave Watson, Operations Manager, Brookfield
  - (o) 207-474-3921 x 12
  - (c) 207-520-8870
  - David.watson@brookfieldrenewable.com
  -
- Joel Rancourt, Senior Operations Manager, Brookfield
  - (o) 207-474-3921 x 11
  - (c) 207-458-6775
  - joel.rancourt@brookfieldrenewable.com

- Kelly Maloney, Manager of Compliance, Brookfield
  - (o) 207-755-5606
  - (c) 207-233-1995
  - Kelly.maloney@brookfieldrenewable.com

[2] This would typically include date collected, species, measurements, photographs, etc.

[3] *This does not include typical operational changes such as generator load swings, putting generators online and offline, normal impoundment and flow fluctuations, and opening/closing gates to control spillage. The resource agencies should be notified for any fishway dewatering's or maintenance issues, problems meeting fishway operational dates, impoundment drawdowns for flashboard or other maintenance, or any other atypical project operations such as dewatering of tunnels, conduits, or penstocks*

- Jason Seyfried, Compliance Specialist, Brookfield
    - (o) 207-755-5615
    - (c) 207-312-8323
    - Jason.seyfried@brookfieldrenewable.com

- Adam Brown, Senior Fisheries Lead, Brookfield
    - (c) 207-343-1941
    - Adam.brown@brookfieldrenewable.com

AGENCY CONTACTS

- Matt Buyoff, Atlantic Salmon Recovery Coordinator, NMFS
    - (c) 207-866-4238
    - Matt.buhyoff@noaa.gov

- Don Dow, Hydro Engineer, NMFS
    - (o) 207-866-3758
    - (c) 207-416-7510
    - Donald.dow@noaa.gov

- Antonio Bentivoglio, Fishery Biologist, USFWS
    - (o) 207-781-8364 x18
    - (c) 207-974-6965
    - Antonio_bentivoglio@fws.gov

- Bryan Sojkowski, Fish Passage Engineer, USFWS
    - (o) 413-253-8645
    - Bryan_sojkowski@fws.gov

- Sean Ledwin, Director Sea Run Fisheries Division, MDMR
    - (o) 207-624-6348
    - Sean.m.ledwin@maine.gov

- Gail Wippelhauser, Marine Resources Scientist, MDMR
    - (o) 207-624-6349
    - Gail.wippelhauser@maine.gov

- Paul Christman, Marine Resources Scientist, MDMR
    - (c) 207-577-5780
    - (o) 624-6352

- paul.christman@maine.gov

- John Perry, Environmental Coordinator, MDIFW
  - (o) 207-287-5254
  - (c) 207-446-5145
  - John.perry@maine.gov

- Dwayne (Jason) Seiders, Fishery Biologist, MDIFW
  - (o) 207-287-5254
  - Dwayne.j.seiders@maine.gov

- Kathy Howatt, Hydropower Coordinator, MDEP
  - (o) 207-446-2642
  - Kathy.howatt@maine.gov

- Chris Sferra, Hydropower Specialist III, MDEP
  - (o) 207-446-1619
  - Christopher.sferra@maine.gov

9.0 - APPENDICES

Appendix A: DAILY INSPECTION FORM

Shawmut Daily Fishway Inspection Form

Date: ____________________ Time: ____________________ Inspector: ______

River Flow (cfs):		Unit 5 flow (cfs)	
Unit 1 flow (cfs)		Unit 6 flow (cfs)	
Unit 2 flow (cfs)		Unit 7 flow (cfs)	
Unit 3 flow (cfs)		Unit 8 flow (cfs)	
Unit 4 flow (cfs)			
Unit 5 flow (cfs)			

Tainter gate operation and flow (cfs) ____________________

Rubber Dam condition ____________________

Fish Lift

1	Lift operating mode	Automatic	___	Manual	___
		Frequency	___	Min.	___
2	Fish lift debris	___			
3	Attraction water Screen	___			
4	Hopper blocking screen	___			
5	V-Trap screen	___			
6	Entrance gate	___			
	a	Setting	___		
	b	Flume water elev.	___		
	c	Tailwater elev.	___		
	d	Head differential	___		

Auxiliary water system

	Headpond elev. (ft)	___			
	AWS flow control gate	Setting (in)	___	Flow (cfs)	___

7 & 8 Fish Ladder

7	Unit 7 & 8 Fish ladder mode	Automatic	___	Manual	___
8	Unit 7 & 8 Fish debris				
9	Flap gate				
	a	Setting	___		
	b	Flume water elev.	___		
	c	Tailwater elev.	___		
	d	Head differential	___		

Auxiliary water system

10	Forebay elev. (ft)	___			
11	Tainter gate	Setting (in)	___	Flow (cfs)	___

Comments:

___

___

Downstream Fishway

12	Flow Adequate	___
13	Debris	___

Comments:

___

___

Please provide completed inspection forms to the Compliance Group every Monday morning

Appendix B: FISHWAY DRAWINGS

Appendix C: <u>FISHWAY OPERATIONS WEEKLY REPORT</u>

Shawmut Fishway Operation Weekly Report Form

Project Name ______________________________

Fishway Facility ______________________________

Date ______________________________

Species	**#'s Detected (Weekly)**	**Total For Season**
Atlantic Salmon (MSW):		
Atlantic Salmon (1SW):		
River Herring:		
American Shad:		
Striped Bass:		
Sea Lamprey:		

Weekly Operational Status: ______________________________

____

____

____

____

____

Note:

Weekly Fishway Operations report to be provided to the resource agencies.

Appendix D: <u>Fishway PLC Operations</u> (placeholder)

Appendix E: Fishway Attraction Water Valve Curve (placeholder)

Appendix F: <u>Handling Plan for Shortnose and Atlantic Sturgeon</u> (placeholder)

Exhibit C – Agency Consultation Documentation

Shawmut Fish Passage Design Agency Consultation Timeline

	Dates
Preliminary Design Consultations	
Schedule E-mail	9/27/2016
Preliminary Design E-mail	3/6/2017
Preliminary design comments received	3/6/2017
Response to comments	6/1/2017
30% Design Consultations	
30% design submittal	7/31/2017
agency draft comments received	8/17/2017
30% review meeting	8/28/2017
Agency comments received	10/19/2017
Response to comments	11/1/2017
60% Design Consultations	
60 % design submittal	11/1/2017
agency comment received	11/29/2017
60% design review meeting	12/13/2017
60% design submittal DRT requested modifications	1/22/2018
Alden design submittal memo	1/22/2018
Agency comments received (CFD study request)	2/2/2018
CFD results submittal	8/22/2018
Agency CFD review meeting	9/27/2018
CFD results E-mail	10/3/2018
90% Design Consultations	
90% design submittal	11/29/2018
Alden design submittal memo	11/29/2018
Agency comments received	2/6/2019
90% design review meeting	2/7/2019
90% Design E-mail	2/8/2019
90% Design E-mail	2/14/2019
O & M Manual and Final Design Plans Consultations	
O & M plan submitted to agency	11/22/2019
agency comments received	11/26/2019
agency comments received	11/26/2019
agency comments received	12/17/2019
agency comments received	12/18/2019
agency comments received	12/18/2019
agency comments received	12/20/2019
Revised O & M plan submitted to agency	12/20/2019
agency comments received	12/20/2019

Brian McMahon

From:	Bentivoglio, Antonio <antonio_bentivoglio@fws.gov> on behalf of Bentivoglio, Antonio
Sent:	Wednesday, December 18, 2019 4:21 PM
To:	Mitchell, Gerry
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris
Subject:	Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments:	20191218 Shawmut-FWS-Draft Fish Passage OM Plan AAB and BS edits.docx
Categories:	Red Category

Gerry,
here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

Good Morning All,

Did anyone have any comments on the O &M or the final design drawings?

Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From: Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> on behalf of Mitchell, Gerry
Sent: Friday, December 20, 2019 11:00 AM
To: Bentivoglio, Antonio
Cc: Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject: RE: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments: 20191220 Shawmut Fish Passage OM Plan II.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Good morning,

Please find attached the final Shawmut O&M Plan. We have incorporated or otherwise addressed comments received, as appropriate. Please note that this O&M Plan is being filed pursuant to the requirements for the proposed upstream and downstream fishways and the existing authorized upstream and downstream eel passage measures, as this is intended to target the pre-construction filing requirements for the new fishways.

We appreciate everyone's prompt review and will assume concurrence unless anyone has any additional comments or edits by December 27.

Happy Holidays, Everyone!

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Wednesday, December 18, 2019 4:21 PM
To: Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>
Cc: Gregory Allen <gallen@aldenlab.com>; Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>; Anna Harris <anna_harris@fws.gov>
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,
here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,

Did anyone have any comments on the O &M or the final design drawings?

Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409

gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, December 18, 2019 4:24 PM
To: Nicholas Lucia; Brian McMahon
Subject: FW: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments: 20191218 Shawmut-FWS-Draft Fish Passage OM Plan AAB and BS edits.docx

Categories: Red Category

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Bentivoglio, Antonio [mailto:antonio_bentivoglio@fws.gov]
Sent: Wednesday, December 18, 2019 4:21 PM
To: Mitchell, Gerry
Cc: Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,
here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,
>
> Did anyone have any comments on the O &M or the final design drawings?
>
> Thanks
>
> Gerry
>
> ---
>
> **From:** Gregory Allen <gallen@aldenlab.com>
> **Sent:** Friday, November 22, 2019 7:40 PM

To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov> on behalf of Bentivoglio, Antonio
Sent: Friday, December 20, 2019 11:08 AM
To: Mitchell, Gerry
Cc: Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Follow Up Flag: Follow up
Flag Status: Flagged

Thanks Gerry.

On Fri, Dec 20, 2019 at 11:03 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good morning,
>
> Please find attached the final Shawmut O&M Plan. We have incorporated or otherwise addressed comments received, as appropriate. Please note that this O&M Plan is being filed pursuant to the requirements for the proposed upstream and downstream fishways and the existing authorized upstream and downstream eel passage measures, as this is intended to target the pre-construction filing requirements for the new fishways.
>
> We appreciate everyone's prompt review and will assume concurrence unless anyone has any additional comments or edits by December 27.
>
> Happy Holidays, Everyone!
>
> **From:** Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
> **Sent:** Wednesday, December 18, 2019 4:21 PM
> **To:** Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>
> **Cc:** Gregory Allen <gallen@aldenlab.com>; Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>; Anna Harris <anna_harris@fws.gov>
> **Subject:** Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,

here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

Good Morning All,

Did anyone have any comments on the O &M or the final design drawings?

Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

> 4 Fundy Road #R
>
> Falmouth, Maine 04105
>
> Telephone: (207) 781-8364 x18
>
> Fax: (207) 469-6725

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From:	Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent:	Friday, December 20, 2019 12:00 PM
To:	Sojkowski, Bryan; Bentivoglio, Antonio
Cc:	Mitchell, Gerry; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject:	RE: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments:	Shawmut Drawings - Sheet C-104 Final for Bid (12-13-2019).pdf

Thanks Bryan for your thorough review.
We also caught that one on Sheet C-104 and it has been corrected in our latest set issued for bid. See attached for reference.

Thanks and enjoy the holidays!
Greg

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Sojkowski, Bryan [mailto:bryan_sojkowski@fws.gov]
Sent: Friday, December 20, 2019 11:39 AM
To: Bentivoglio, Antonio
Cc: Mitchell, Gerry; Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Good Morning Gerry,

Thanks for the updated O&M. I have reviewed the final design plan set and only have one minor edit:

Sheet C-104: The dimension of the entrance width shows 10.0 ft. This dimension should be 8.0 ft.

Thanks for the opportunity to review both documents, Happy Holidays!

On Fri, Dec 20, 2019 at 11:08 AM Bentivoglio, Antonio <antonio_bentivoglio@fws.gov> wrote:

> Thanks Gerry.
>
> On Fri, Dec 20, 2019 at 11:03 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:
>
> > Good morning,

Please find attached the final Shawmut O&M Plan. We have incorporated or otherwise addressed comments received, as appropriate. Please note that this O&M Plan is being filed pursuant to the requirements for the proposed upstream and downstream fishways and the existing authorized upstream and downstream eel passage measures, as this is intended to target the pre-construction filing requirements for the new fishways.

We appreciate everyone's prompt review and will assume concurrence unless anyone has any additional comments or edits by December 27.

Happy Holidays, Everyone!

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Wednesday, December 18, 2019 4:21 PM
To: Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>
Cc: Gregory Allen <gallen@aldenlab.com>; Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>; Anna Harris <anna_harris@fws.gov>
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,

here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,
>
> Did anyone have any comments on the O &M or the final design drawings?
>
> Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office

Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

--
Bryan Sojkowski, P.E.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
Fish Passage Engineering
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
413-253-8645
bryan_sojkowski@fws.gov

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not." - Dr. Seuss

Brian McMahon

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Tuesday, December 17, 2019 3:38 PM
To: Brian McMahon; Nicholas Lucia
Subject: FW: Shawmut Final Design drawings and O&M Plan for Approval

See below

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Donald Dow - NOAA Federal [mailto:donald.dow@noaa.gov]
Sent: Tuesday, December 17, 2019 3:35 PM
To: Gregory Allen
Cc: Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.
4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, December 18, 2019 3:30 PM
To: Brian McMahon; Nicholas Lucia
Subject: FW: Shawmut Final Design drawings and O&M Plan for Approval

fyi

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Wippelhauser, Gail [mailto:Gail.Wippelhauser@maine.gov]
Sent: Wednesday, December 18, 2019 3:29 PM
To: Donald Dow - NOAA Federal; Gregory Allen
Cc: Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Christman, Paul; Bentivoglio, Antonio; Sojkowski, Bryan; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: RE: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry:

I just reviewed the O&M plan and concur with Don's comments.

Gail Wippelhauser, Ph. D.
Marine Resources Scientist
Maine Department of Marine Resources
#172 State House Station
Augusta, ME 04333

Phone: 207-624-6349
email: gail.wippelhauser@maine.gov

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, December 17, 2019 3:35 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>; Christman, Paul <Paul.Christman@maine.gov>; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

EXTERNAL: This email originated from outside of the State of Maine Mail System. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.
4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> **ALDEN** Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409

gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent:	Tuesday, December 17, 2019 3:35 PM
To:	Gregory Allen
Cc:	Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	Re: Shawmut Final Design drawings and O&M Plan for Approval
Follow Up Flag:	Follow up
Flag Status:	Flagged

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.
4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent: Tuesday, November 26, 2019 1:42 PM
To: Gregory Allen
Cc: Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg, Thank you for sending the final design drawings. We do not typically review the final design drawings but instead keep them for project construction to reference. We only review concept, 30%, 60% and 90% design drawings. Therefore, you should be good to go with these. I will review the O&M manual but there is nothing pressing on that. We also like to have a copy of the Specifications you are going to bid with in case there is an issue with the specs.

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> **ALDEN** Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409
> gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent:	Tuesday, November 26, 2019 3:05 PM
To:	Maloney, Kelly
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	Re: Shawmut Final Design drawings and O&M Plan for Approval

Kelly -

This design matches what we consulted on and our verbal comments that we worked through at the 90% design review meeting. Regardless of what the 401 states, I'm not of the position to "approve" of a fishway until it performs and meets expectations for the endangered species. In regards to the O&M plan, we will have our review to you before the 23rd, however, as with all other O&M plans with Brookfield sites in the DPS, we review the plans every few years for updates. This was agreed upon with your predecessor Scott Hall after we found a number of fishways across the state inactive or in disrepair during our annual inspections after Brookfield first assumed ownership of the sites. Again, thank you for the opportunity to review, we appreciate Brookfields' and Aldens' hard work on this project.

Regards,
Don

On Tue, Nov 26, 2019 at 2:44 PM Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

> Donnie,
>
> You are correct. However, pursuant to our existing 401 water quality certification for the Shawmut Project, we are required to: "submit final design and operational plans for all…permanent upstream and downstream fish passage facilities and/or operational measures required by this approval, prepared in consultation with state and federal fisheries agencies. These plans shall be reviewed by and must receive approval of the fisheries agencies, the DEP, and FERC prior to construction."
>
> To that end, we are requesting your concurrence with the final design plans and O&M Plan by December 23. As I indicated previously, should you have any comments on the attached drawings or O&M Plan, we would be happy to convene a meeting to discuss if necessary. To the extent there are only minor comments, if you could please indicate your approval contingent upon the addressing of those comments, that would be appreciated.
>
> Thanks and Happy Thanksgiving All!
>
> Kelly

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, November 26, 2019 1:42 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg, Thank you for sending the final design drawings. We do not typically review the final design drawings but instead keep them for project construction to reference. We only review concept, 30%, 60% and 90% design drawings. Therefore, you should be good to go with these. I will review the O&M manual but there is nothing pressing on that. We also like to have a copy of the Specifications you are going to bid with in case there is an issue with the specs.

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> **ALDEN** Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409
> gallen@aldenlab.com | www.aldenlab.com

NOTICE OF CONFIDENTIALITY: This email, and any attachments thereto, is intended for use only by the addressee(s) named herein and may contain confidential information. If you are not the intended recipient of this email, you are hereby notified that any dissemination, distribution or copying of this email, and any attachments thereto, is strictly prohibited. If you have received this email in error, please notify the sender by email or telephone and permanently delete the original email and any printed copies. Thank you.

--

Donald A. Dow III, PE

Hydro/Fish Passage Engineer

Protected Resources Division

Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Maine Field Station

17 Godfrey Drive, Suite 1

Orono, ME 04473

Office: 207-866-8563

Cell: 207-416-7510

Donald.Dow@noaa.gov

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent:	Tuesday, November 26, 2019 3:05 PM
To:	Maloney, Kelly
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	Re: Shawmut Final Design drawings and O&M Plan for Approval

Kelly -

This design matches what we consulted on and our verbal comments that we worked through at the 90% design review meeting. Regardless of what the 401 states, I'm not of the position to "approve" of a fishway until it performs and meets expectations for the endangered species. In regards to the O&M plan, we will have our review to you before the 23rd, however, as with all other O&M plans with Brookfield sites in the DPS, we review the plans every few years for updates. This was agreed upon with your predecessor Scott Hall after we found a number of fishways across the state inactive or in disrepair during our annual inspections after Brookfield first assumed ownership of the sites. Again, thank you for the opportunity to review, we appreciate Brookfields' and Aldens' hard work on this project.

Regards,
Don

On Tue, Nov 26, 2019 at 2:44 PM Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

> Donnie,
>
> You are correct. However, pursuant to our existing 401 water quality certification for the Shawmut Project, we are required to: "submit final design and operational plans for all…permanent upstream and downstream fish passage facilities and/or operational measures required by this approval, prepared in consultation with state and federal fisheries agencies. These plans shall be reviewed by and must receive approval of the fisheries agencies, the DEP, and FERC prior to construction."
>
> To that end, we are requesting your concurrence with the final design plans and O&M Plan by December 23. As I indicated previously, should you have any comments on the attached drawings or O&M Plan, we would be happy to convene a meeting to discuss if necessary. To the extent there are only minor comments, if you could please indicate your approval contingent upon the addressing of those comments, that would be appreciated.
>
> Thanks and Happy Thanksgiving All!
>
> Kelly

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, November 26, 2019 1:42 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg, Thank you for sending the final design drawings. We do not typically review the final design drawings but instead keep them for project construction to reference. We only review concept, 30%, 60% and 90% design drawings. Therefore, you should be good to go with these. I will review the O&M manual but there is nothing pressing on that. We also like to have a copy of the Specifications you are going to bid with in case there is an issue with the specs.

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE

Hydro/Fish Passage Engineer

Protected Resources Division

Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Maine Field Station

17 Godfrey Drive, Suite 1

Orono, ME 04473

Office: 207-866-8563

Cell: 207-416-7510

Donald.Dow@noaa.gov

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Wippelhauser, Gail <Gail.Wippelhauser@maine.gov> on behalf of Wippelhauser, Gail
Sent: Wednesday, December 18, 2019 3:29 PM
To: Donald Dow - NOAA Federal; Gregory Allen
Cc: Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Christman, Paul; Bentivoglio, Antonio; Sojkowski, Bryan; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: RE: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry:

I just reviewed the O&M plan and concur with Don's comments.

Gail Wippelhauser, Ph. D.
Marine Resources Scientist
Maine Department of Marine Resources
#172 State House Station
Augusta, ME 04333

Phone: 207-624-6349
email: gail.wippelhauser@maine.gov

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, December 17, 2019 3:35 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>; Christman, Paul <Paul.Christman@maine.gov>; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.

4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> **ALDEN** Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409
> gallen@aldenlab.com | www.aldenlab.com
>
>

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Monday, March 06, 2017 4:16 PM
To: Mitchell, Gerry
Cc: Richter, Robert; Maloney, Kelly; Greg Allen; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Wilson, Carl; Matt Buhyoff - NOAA Federal; Dan Tierney; Julie Crocker; Sean McDermott; Bryan Sojkowski; Bentivoglio, Antonio; Anna Harris
Subject: Shawmut Conceptual Design DRT comments
Attachments: Shawmut Upstream Fish Lift Conceptual Design Review.pdf

Good Afternoon Gerry -

As we discussed on Friday, attached are the Design Review Teams comments on the conceptual design for the new Shawmut Fish Lift. As always, we are open to discuss and work through the design to come up with the best options to successfully pass fish at this site. Thank you for the opportunity to review and comment and thank you and Brookfield for your commitment to this important project.

Regards
Don

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, September 27, 2016 9:22 AM
To: Mitchell, Gerry
Cc: Richter, Robert; Maloney, Kelly; Seiders, Dwayne J; Christman, Paul; Bentivoglio, Antonio; Wippelhauser, Gail; Bryan Sojkowski; Jeff Murphy - NOAA Federal; Julie Crocker - NOAA Federal
Subject: Fwd: Shawmut
Attachments: Shawmut DRT Opening Letter.docx; Kennebec Schedule.xlsx

Good Morning Gerry -

As we discussed last week. Based upon the project schedule we developed a few weeks ago, we are now on the critical path for the Shawmut fishway if we expect it to be constructed by May 1, 2019. This will be one year beyond what was in the BA/SPP and the BO.
Attached is our original note to Guy Senechal from April of 2015 to commence the project in order to meet the May 1, 2018 date.
At this point, I do not see any float in our schedule to make the 2019 date. In the same light, I see about 10 months of float in the Weston schedule.

In order to stay on schedule we should be seeing the 3-D modeling for Shawmut this week and the river herring tagging study within the next 30 days. The conceptual design phase should begin Jan 1 with a design engineer already selected.

I've attached the schedule.

Please let me know if you have any questions.

---------- Forwarded message ----------
From: **Wippelhauser, Gail** <Gail.Wippelhauser@maine.gov>
Date: Thu, Apr 16, 2015 at 9:23 AM
Subject: Shawmut
To: "Senechal,Guy (Guy.Senechal@brookfieldrenewable.com)" <Guy.Senechal@brookfieldrenewable.com>
Cc: Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>, "Seiders, Dwayne J" <Dwayne.J.Seiders@maine.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, "Christman, Paul" <Paul.Christman@maine.gov>, Jeff Murphy - NOAA Federal <jeff.murphy@noaa.gov>, "Bentivoglio, Antonio" <antonio_bentivoglio@fws.gov>, Sean McDermott - NOAA Federal <sean.mcdermott@noaa.gov>

Hi Guy.

I am attaching a letter about the Shawmut design process from the Design Review Team.

Gail Wippelhauser, Ph. D.
Marine Resources Scientist
Maine Department of Marine Resources
#172 State House Station
Augusta, ME 04333

Phone: 207-624-6349 Fax: 207-624-6501
email: gail.wippelhauser@maine.gov

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut Upstream Fish Lift Conceptual Design Review

Intra Agency Design Review Team Comments

March 6, 2017

The following comments were prepared by the United States Fish and Wildlife Service, the Maine Department of Marine Resources, the Maine Department of Inland Fisheries and Wildlife and the National Marine Fisheries Service. These comments may or may not accurately reflect each agencies views. The agencies may still wish to submit comments on their own or to support these comments. This review was not done considering building codes or life safety codes and was not done considering the structural integrity of the facility or with construction safety in mind. We assume that these considerations will be done by the design engineer. We would like for your design engineer to pay careful attention to the design in terms of access in the facility for the purposes of cleaning.

1. The diffusion pit is not large enough and water enters the pit too close to the hopper. We recommend that the entire area behind the lift be used for diffusion with the distance from the outlet of the spurger to the blocking screen to be at least 30 to 40 ft (see attached drawing).

2. Despite the explanation from Alden, and per the drawings, there seems to be enough room to build a fishway that could provide the full 5% of station capacity (see attached drawing). This criteria is not based upon individual powerhouses but rather on the hydraulic capacity of the site in order to provide adequate far field attraction to the lift. The agencies recommend more flow be provided for fish passage since this site is under-designed by about 20 to 30% when compared to other run-of-river projects. This fishway should be designed to pass 5% of total station capacity as there are such large distances and so many outlets for water to attract fish. The emailed table shows 190 cfs total AWS flow which is about 2.8% of station capacity. We need at least 5% (~ 335 cfs), but because this site is under-designed we could shoot for a capacity as high as 500 cfs. Either way, the proposed diffusion chamber is obviously not big enough. If space still becomes a limitation, then additional attraction water could be supplied on the upstream side of the fishway entrance.

3. The width of the entrance needs to be increased. We recommend that the width of the entrance be 10-12 feet (see attached drawing)

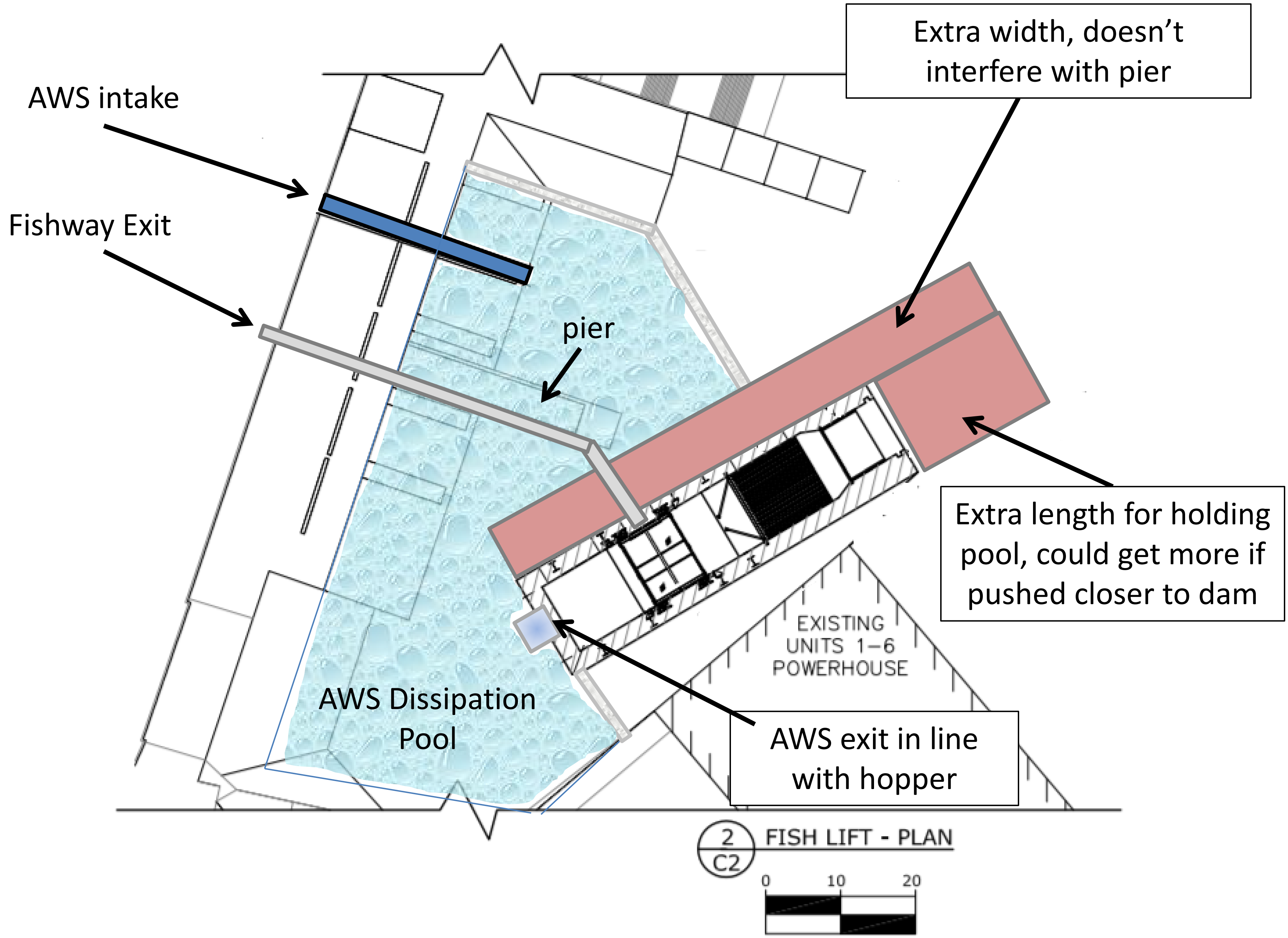
4. There is no holding pool in this design. A holding pool is required and should not be considered the area above a horizontal diffuser. In the proposed design, the holding pool consists of the fixed brail floor which is a very small volume of water to hold fish. A quick look at capacity, using the numbers on drawing 1 show that we will need a holding pool that is roughly 800 cubic ft or approximately 6,000 gal (not sure how this compares to HK). The hopper should be the same volume as the hopper at Hydro Kennebec.

5. This size of the floor diffuser should be limited in the design or totally eliminated. The velocity exiting the floor and wall diffusers should be no greater than 0.5 fps.

6. The discharge channel is too long and its 8% slope may not be sufficient to safely and quickly move fish into the headpond. The steeper the better. The channel should be open flume with man access provide at all points. A different hopper location may shorten the channel.

7. The difference in tailwater elevations from the Unit 1-6 and Unit 7-8 tailraces are 1.6 ft for the low, normal, and high design flows. Does this match reality? We would like to know what data was utilized to arrive at those elevations.

8. At Milford and Cataract there is a concrete retaining wall that runs down long past the fishway entrance. We have witnessed shad line up along these walls prior to entering the fishway. It may be that if shad do not use this after it is constructed that we should look at constructing such a wall.



Extra width, doesn't interfere with pier
AWS intake
Fishway Exit
pier
Extra length for holding pool, could get more if pushed closer to dam
EXISTING UNITS 1–6 POWERHOUSE
AWS Dissipation Pool
AWS exit in line with hopper
2 C2 FISH LIFT - PLAN
0 10 20

Shawmut Upstream Fish Passage Design Populations
Submitted to Brookfield Power on December 23, 2016 by Don Dow, P.E., NMFS
Data assembled by Maine Department of Marine Resources (contact: Gail Wippelhauser, Ph.D.), and National Marine Fisheries Service (contact: Dan Tierney)

Abbreviations
Maine Department of Marine Resources (MDMR)
National Oceanic and Atmospheric Administration (NOAA)
NOAA's National Marine Fisheries Service (NMFS)
United States Fish and Wildlife Service (USFWS)
United States Geological Survey (USGS)

Introduction
Shawmut is currently the third mainstem dam on the Kennebec River located just above the Hydro Kennebec Project in the Village of Shawmut in the towns of Fairfield and Benton Maine. In 2018, it is anticipated that Brookfield Power will construct an upstream fishway as a condition of their ESA Section 7 Interim Species Protection Plan with NMFS. Order of magnitude estimates are needed for diadromous fish such as adult shad, alewife, blueback herring and Atlantic salmon in order to size the upstream passage facilities appropriately. A similar exercise was completed for the Hydro Kennebec Project and submitted on March 23, 2013 to Brookfield Power. This design memorandum is a modification of that design memorandum.

American Shad (as calculated by MDMR)
Total Production: 354,000 shad (111 shad/acre x 3189 acres)
Total to be passed at Shawmut: 177,000 shad

In the 1980s, the MDMR developed a method of estimating the number of adult American shad that would be produced by a specific amount of habitat (total production) and the number of adult spawners that would be needed to sustain that total production (spawning escapement). Unit production for American shad is based on information from the Connecticut River, because runs of shad in Maine have not been restored and detailed information on historical abundance is lacking. In the past, MDMR used 111 shad/acre (=2.3 shad/100 yd^2), based on the number of American shad annually passed at the Holyoke Dam during the early 1980s and the amount of habitat between Holyoke Dam and Turners Falls Dam, the next upriver dam. Annual passage numbers for Holyoke from 1980-2004 indicate a slight decline in unit production to 101 shad/acre (2.0 shad/100 yd^2); however, we will use 111shad/acre to maintain consistency with other Maine fisheries management plans.

The use of 111 shad/acre is further supported by historical information on commercial landings in Maine. A significant fishery for American shad existed in the freshwater tidal section of the Kennebec River and its tributaries after access to inland waters was obstructed by impassable dams at the head-of-tide. From 1896-1906 the average annual landings of American shad in the Kennebec River were 802,514 pounds. This represents 267,500 adult shad, assuming an average weight of three pounds per fish (note: fish way design assumes four pounds per fish), and a commercial yield of 0.6778 shad/100 $yd^{2.}$ If the exploitation rate ranged from 25-50%, then the total run from Merrymeeting Bay to Augusta (including tributaries) may have ranged from 535,000-1,070,000 shad. This represents a production of to 68-131shad/acre (equivalent to 1.4-2.7 adult shad/100 $yd^{2)}$.

There is 15,391,304 yd^2 of shad habitat above the Shawmut Project. The following formula converts shad per acre to shad per 100 yd^2.

111 shad/acre x 1 acre / 4.84 100 yd^2 = 2.3 shad per 100 yd^2

Therefore total production is:

(15,391,304 yd^2 / 100 yd^2) x 2.3 shad per 100 yd^2 = 354,000 shad

Assuming a 50% escapement rate to maintain a shad run above Shawmut, the required amount of passage at Shawmut is:

354,000 shad x 50% escapement = 177,000 shad

Alewives (as calculated by MDMR)
Total Production: 614,995 alewives (235 alewives per acre x 2617 acres)
Total to be passed at Shawmut: 134,000 alewives

In the 1980s, the MDMR developed a method of estimating the number of adult alewife that would be produced by a specific amount of habitat (total production) and the number of adult spawners that would be needed to sustain that total production (spawning escapement). Total production is computed by multiplying the total surface area of known or assumed historical spawning habitat by the number of adults produced per unit of spawning habitat (unit production). Spawning escapement is a percentage of total production. Both total production and spawning escapement are computed for specific bodies of water, for example, a river reach or lake. The number of adult fish that need to be passed upstream at each fishway is estimated by dividing spawning escapement needed for all waters above the facility by an assumed passage efficiency (a goal of 90% is typically used). The surface area of spawning habitat for each species was determined from USGS 7.5 minute topographical maps.

Unit production for alewife (235 fish/acre) was developed from the commercial harvest in six coastal Maine watersheds for the years 1971-1983, which was assumed to be 100 pounds/surface acre of ponded habitat. This value was slightly less than the average of the lowest yield/acre for all six rivers, and within the range of yields experienced in other watersheds. Assuming a weight of 0.5 pounds per adult, the commercial yield equals 200 adults/surface acre. The commercial harvest was assumed to represent an exploitation rate of 85%, because most alewife runs were harvested six days per week. Exploitation rates on the Damariscotta River, for example, ranged from 85-97% for the years 1979-1982. When commercial yield is adjusted for the 15% escapement rate, the total production is 235 adult alewives/acre.

The unit production is derived from coastal alewife populations that spawn in lakes and ponds that are relatively rich in nutrients (mesotrophic or eutrophic). Many of the large lakes in the Penobscot basin (e.g. Sebec Lake, Schoodic Lake, and Seboeis Lake) are relatively nutrient poor (oligotrophic) and may not produce 235 alewife/acre. However, MDMR is not aware of any information on alewife production in oligotrophic lakes, and will use 235 fish/acre for planning purposes.

Because Maine's commercially harvested alewife populations began to decline in the mid-1980s under this high exploitation level, MDMR is now recommending that municipalities have a three-day closure for conservation purposes. Therefore, minimum escapement for this plan is assumed to be 45% of total production (equivalent to a three-day closure).

The total production above Shawmut is adjusted by the 15% escapement rate which yields:

235 alewives/acre x 15% = 35 alewives per acre.

The number of alewives needed to pass Shawmut to sustain a population is then decreased by 10% for each barrier passage inefficiency between Shawmut and the subject spawning habitat area. Through a spreadsheet analysis, this equals 134,000 alewives (10% less than Hydro Kennebec) needed to pass Shawmut to sustain a population.

Blueback Herring (as calculated by MDMR)
Total Production: 1,535,000 Blueback Herring (484blueback herring per acre)
Total to be passed at Shawmut: 1,535,000 Blueback Herring

In the past, MDMR has not had sufficient information about blueback herring runs in Maine to develop an estimate of unit production. However, based on three years of passage data at Benton Falls, production is 237 to 484 per acre for 875,500-1,788,000 fish. MDMR has no information on how much available habitat is used or escapement needs. Therefore, 1,535,000 blueback herring is the conservatively assumed design population for the Shawmut fish lift

Atlantic Salmon (as calculated by NMFS and MDMR)
Total Production: 11,639 Atlantic salmon adults (174,581 habitat units (240 eggs per unit)) /7200 eggs per female)*2= 11,639 adults (male + female)*
Total to be passed at Shawmut: 11,639 Atlantic salmon

The amount of Atlantic salmon habitat units (1 unit = 100 m^2) above the project will be determined based on information from a GIS model developed by the USFWS and NMFS (NMFS et al. 2010). The total number of habitat units can then be used to estimate Atlantic salmon production (i.e., the number of juvenile Atlantic salmon smolts that could be produced in the available habitat upstream of the dam). The spawning and rearing habitat above the Shawmut Dam is estimated to be 178,143 salmon habitat units. Using the current estimate of 240 eggs per habitat unit and approximately 7200 eggs produced per female Atlantic salmon (Baum, E.T. January 1997. Maine Atlantic Salmon Management Plan with Recommendations Pertaining to Staffing and Budget Matters), the estimated number of Atlantic salmon productivity above Shawmut is estimated to be 11,639 adults.

Summary of Design Population Rates for Fish Passage at Hydro Kennebec (Rounded Up)

American Shad	177,000 fish
Alewives	134,000 fish
Blueback Herring	1,535,000 fish
Atlantic Salmon	12,000 fish

Memorandum

To: Robert Richter and Gerry Mitchell, Brookfield

From: Greg Allen and Brian McMahon, Alden

Date: June 21, 2017

Re: **Shawmut Fish Passage Design Project, FERC No. 2332**
Conceptual Design Submittal and Response to Agency Comments

In response to comments received for the Shawmut fish passage conceptual design Alden Research Laboratory, Inc. (Alden) provides the following responses to comments and a revised conceptual design.

The following comments were received on March 6, 2017. Alden's responses are provided in *italics*.

1. The diffusion pit is not large enough and water enters the pit too close to the hopper. We recommend that the entire area behind the lift be used for diffusion with the distance from the outlet of the spurger to the blocking screen to be at least 30 to 40 ft (see attached drawing).

***Response** – The fish lift entrance flume and attraction water system (AWS) has been revised. The area between the non- overflow dam section and the powerhouse is now used as an energy dissipation pool. See attached drawings.*

2. Despite the explanation from Alden, and per the drawings, there seems to be enough room to build a fishway that could provide the full 5% of station capacity (see attached drawing). This criteria is not based upon individual powerhouses but rather on the hydraulic capacity of the site in order to provide adequate far field attraction to the lift. The agencies recommend more flow be provided for fish passage since this site is underdesigned by about 20 to 30% when compared to other run-of-river projects. This fishway should be designed to pass 5% of total station capacity as there are such large distances and so many outlets for water to attract fish. The emailed table shows 190 cfs total AWS flow which is about 2.8% of station capacity. We need at least 5% (~ 335 cfs), but because this site is under-designed we could shoot for a capacity as high as 500 cfs. Either way, the proposed diffusion chamber is obviously not big enough. If space still

becomes a limitation, then additional attraction water could be supplied on the upstream side of the fishway entrance.

Response *– The fish lift entrance flume and AWS has been revised, see attached drawings. The AWS system is designed to provide up to 225 cfs at the entrance to the fish lift and additional flow adjacent to the lift (115 cfs min). The combined flow of the fish lift entrance and adjacent chute would provide 5% of station capacity (340 cfs) and up to 500 cfs, if desired. This design is also compatible with the proposed new rack upstream of the head gate structure that was proposed back in 2011.*

3. The width of the entrance needs to be increased. We recommend that the width of the entrance be 10-12 feet (see attached drawing)

Response *– The fish lift entrance flume is now 12 feet.*

4. There is no holding pool in this design. A holding pool is required and should not be considered the area above a horizontal diffuser. In the proposed design, the holding pool consists of the fixed brail floor which is a very small volume of water to hold fish. A quick look at capacity, using the numbers on drawing 1 show that we will need a holding pool that is roughly 800 cubic ft or approximately 6,000 gal (not sure how this compares *to HK). The hopper should be the same volume as the hopper at Hydro Kennebec.*

Response *– The area upstream of the hinged flap gate and downstream of the V-trap is considered a holding pool. This volume is 1296 cubic feet. The hopper is 490 cubic feet in capacity, which is the same as HK.*

5. This size of the floor diffuser should be limited in the design or totally eliminated. The velocity exiting the floor and wall diffusers should be no greater than 0.5 fps.

Response *– We have revised the design to eliminate the floor diffuser.*

6. The discharge channel is too long and its 8% slope may not be sufficient to safely and quickly move fish into the headpond. The steeper the better. The channel should be open flume with man access provide at all points. A different hopper location may shorten the channel.

Response *– We will provide information to indicate the hydraulic conditions within the discharge channel (exit flume). As the slope increases the water depth will decrease. We need to select a slope that provides both ideal velocity and water depth conditions.*

7. The difference in tailwater elevations from the Unit 1-6 and Unit 7-8 tailraces are 1.6 ft for the low, normal, and high design flows. Does this match reality? We would like to know what data was utilized to arrive at those elevations.

Response *– Tailwater rating curves for both powerhouse tailraces are presented in a document provided by Brookfield titled "Declaration of Incremental Hydropower, Shawmut Hydroelectric Project FERC No. 2322-ME", dated December 17, 2009 and prepared by Kleinschmidt Associates. This document indicates about a 1.5 ft difference in water level between tailraces. In addition, recent modeling indicates a difference of about 1 to 1.5 ft. We will compare this data to field data that may be available.*

8. At Milford and Cataract there is a concrete retaining wall that runs down long past the fishway entrance. We have witnessed shad line up along these walls prior to entering the fishway. It may be that if shad do not use this after it is constructed that we should look at constructing such a wall.

Response *– Comment noted. The proposed fishway channel between the tailraces does include a training wall leading up to the fishway entrance.*

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Thursday, August 17, 2017 2:26 PM
To: Richter, Robert
Cc: Mitchell, Gerry; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Matt Buhyoff - NOAA Federal; Bryan Sojkowski; Bentivoglio, Antonio; Greg Allen
Subject: Shawmut - Draft Notes Questions Comments
Attachments: Shawmut 30.docx

Bob - attached is a file with our draft notes questions and comments - I am sure some of it will make no sense, but this is only to be used as talking points for when we meet on the 30% design. I will formalize our comments after the meeting. I hope this will help Greg get an idea of the questions we'll be asking so he can prepare. If you have any questions ahead of time, please don't hesitate to contact me.

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut 30% Design – Agency Comments/Questions/Talking Points Draft

Drawing G-001

No Comments

Drawing G-002

1. Note 5 "Design Range" not Operating Range
2. Note 6 – 6 inches may be fine, Milford Target is 8 inches, what is HK target?
3. Note 7 - AWS flow should be changed to Total Attraction Flow
4. Note 7 – 3/8 opening – is this similar to HK – may change based upon HK performance
5. Is 15 minutes the minimum?

Drawing C-002

1. How is the Flow Apportioned?
2. Can we gate off the AWS?
3. Screen Intake
4. Put on TW for units 7/8

Drawing C-103

1. Move exit of discharge pipe away from spillway and intake
2. Need to discuss holding pool/brail etc (move upstream to accommodate holding pool and set up pool.
3. 10 ft of set up pool
4. Can we make the brail longer?
5. Can we change the AWS exit 90 degree? Need Dialogue
6. No need for brail on backside
7. What is preventing fish from entering AWS? Need Dialogue
8. Do we really need the Weir? Need Dialogue.
9. Where is the control gate located?

Drawing C-104

1. I do not like the weir…it will add bubbles.
2. Again discuss holding pool/braile
3. What is the velocity at the diffusers, across the hopper, in the holding pool
4. 490 cf – How does that compare to HK?
5. Sump Pump?
6. Hopper Filler pipe?
7. Screen on top of hopper
8. Is the top of concrete elevation at 93.0 ft too low?

Drawing C-105

1. AWS top gate can be upward opening
2. Need stop logs

3. Need aws intake screens
4. Compare ww screen to orono
5. What are the gates half way down AWS
6. Why spill at the bottom of AWS
7. Why is the top section just above chamber not level?
8. Not sure we understand this drawing
9. Need Dialogue on what flow goes where on AWS.

Drawing C-110

1. Not sure we need brail on the backside
2. Need to discussion on T-position on V-Gate.
3. Can we make entrance gate to track tailwater?

Drawing C-301

Drawing C-303

1. Need more definition on separation and flow amounts between d/s flow and upstream fish channel
2. Elevations of lower and upper edges of rock slope in the tailwater below channel?

Drawing C-304

1. Need velocity Flow data
2. Need more definition on downstream data on Section A
3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Thursday, October 19, 2017 2:32 PM
To: Richter, Robert
Cc: Mitchell, Gerry; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Matt Buhyoff - NOAA Federal; Bryan Sojkowski; Bentivoglio, Antonio; Greg Allen
Subject: Re: Shawmut - Draft Notes Questions Comments
Attachments: Shawmut 30 Design DRT Comments.pdf

Good Afternoon Bob -

Attached is the DRT final comments on the 30% Shawmut design. There is not much changes from our discussion on 8/28, however we would like an additional 10 ft of holding area below the V-gate in order to adequately stage fish while the hopper is in the raised position and FWS has a couple options for the exit of the AWS beside the fishway for you to look at . If you have any questions please contact me.

Regards,
Don

On Thu, Aug 17, 2017 at 2:25 PM, Donald Dow - NOAA Federal <donald.dow@noaa.gov> wrote:
Bob - attached is a file with our draft notes questions and comments - I am sure some of it will make no sense, but this is only to be used as talking points for when we meet on the 30% design. I will formalize our comments after the meeting. I hope this will help Greg get an idea of the questions we'll be asking so he can prepare. If you have any questions ahead of time, please don't hesitate to contact me.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration

National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Good Afternoon Bob –

I would like to thank you for the opportunity to review the 30% Shawmut Upstream Fish Passage Design. The Design Review Team (DRT), consisting of representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries & Wildlife (IF&W), United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), met with Brookfield and their consultant Alden Labs on August 28th to collectively review the design and the DRT comments. At the end of that meeting it was agreed that the notes from the meeting were going to be based upon the collaboration and discussion and that the DRT would later send final comments reflecting those discussion and answering a few other questions. It was also agreed that Alden had enough information from that meeting to continue working on the 60% design.

This review has been done collectively with all pertinent agencies and may or may not completely reflect each agency's comments. If the agencies have additional comments or disagreements outside of the DRT comments they would file a separate comment letter to Brookfield.

This review was done considering the biological and engineering hydraulic principles to design an effective upstream fishway considering NMFS and USFWS design standards as well as engineering and biological judgments if necessary. This review was not done considering Life Safety Codes, Building Codes, Allowable Stress Design, or Load Resistance Factor Design, or any other typical engineering design codes for concrete, steel, structures, or building. We have assumed that the consulting engineer has taken those codes and practices into consideration.

Shawmut 30% Design – Agency Comments

Drawing G-001

No Comments

Drawing G-002

1. Note 5 "Design Range" not Operating Range
2. Note 6 – 6 inches may be fine, Milford Target is 8 inches, we believe HK is around a foot.
3. Note 7 - AWS flow should be changed to Total Attraction Flow
4. Note 7 – less than 3/8 opening – similar to Hydro Kennebec
5. Is 15 minutes the minimum? What is the minimum cycle time?

Drawing C-002

1. Please show how the flow is apportioned
2. Please put on TW El on the drawing for units 7 and 8 tailrace

Drawing C-103

1. Please move exit of discharge pipe away from spillway and intake to prevent fish from being washed back into the tailrace.
2. The area below the V-gate is considered the holding pool on a large braille hopper and must be sized accordingly in order for fish to "stage" while the hopper is not in a fishing position. Similar to Hydro Kennebec this distance may be around 20 ft or so below the V-Gate. Please size according to FWS criteria for a holding pool.

3. Alden to provide nappe profiles, possibly move nappe upstream.
4. Braille size opening should be less than 3/8 inch clear

Drawing C-104

1. Add diffuser velocities, velocities across hopper, velocities in holding pool and velocities at entrance
2. Prefer flapper gates to filler pipe.
3. Screen on top of hopper
4. Is the top of concrete elevation at 93.0 ft too low? Please double check

Drawing C-105

1. Please include stop log slots
2. Please include depth of water along Section A.

Drawing C-110

1. The hopper gate should be at the bottom of the hopper. It may be that the drawing is just hard to read.
2. Entrance gate to track Tailwater

Drawing C-301

Drawing C-303

1. We need more definition on separation and flow amounts between d/s flow and upstream fish channel. Flow/elevation curves associated with HW/TW and resulting flow should be provided for the flow through the crossover fishway.
2. We need more definition on the elevations of lower and upper edges of rock slope in the tailwater below channel.

Drawing C-304

1. Need velocity/Flow data
2. Need more definition on downstream data on Section A – WSEL through section A
3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

Additional Comments from USFWS:

USFWS Engineering recommends additional space (10 ft of length) between the proposed v-trap and entrance gate to act as a holding pool. There was discussion during the August 28th meeting pertaining to utilizing the volume above the hopper and braille as the holding pool. We agree that this will be available as a holding pool space when the lift is not being operated. However, this space will not be available when the hopper is being raised and lowered (assumed time of 10 minutes). Therefore, if the hopper is to be raised every half hour, a third of the time the holding pool will not be effective. It is for this reason that an additional 10 ft of length be added in between the proposed v-trap and entrance

gate to provide a holding pool that is available at all times. Ideally a second v-trap would be added to reduce the amount of fallback as much as possible.

There is a need for more discussion related to the attraction water system (AWS) and its use as a downstream bypass. A consensus was not reached during the August 28th meeting. USFWS Engineering has the following comments/concerns:

1. For both cases below it is recommended that the slope of the AWS channel be lowered as displayed in Figure 1 in order to meet the tailwater. This will prevent the nappe of the flow from plunging into the tailwater some distance downstream of the entrance. The intent is to ensure that the AWS flow is as close as possible to the entrance of the fishway and operates within the streaming regime to avoid hydraulics that are not conducive near the entrance (e.g., turbulence, aeration, upwelling). Figure 2 displays a second alternative that could achieve the same results.

If the AWS is to be used as a downstream bypass

1. Effectiveness of the proposed geometry is unknown. As shown, the AWS flow first passes over a sharp crested weir, then a percentage of the flow falls through the floor, and the leftover amount goes down the sloped channel (which would produce another drawdown and increase in velocity which the downstream migrants may reject). A sharp crested weir does not produce hydraulics that are conducive to downstream passage, and there is risk of downstream migrants getting entrained within the AWS chamber below the floor.
2. For this case, USFWS Engineering would recommend implementing an Alden style entrance rather than the sharp crested weir. We agree that the 0.125 inch spacing will prevent entrainment of downstream migrating species. The plans should also display the calculated through velocity which should be less than 0.5 ft/s. The screen should be easily accessible during the season to ensure that the screen is clear of debris and not damaged.

If the AWS is not used as a downstream bypass

1. In this case the intake would need to be screened to prevent downstream migrating species from entering the AWS. If an upstream migrating Atlantic salmon were to traverse the AWS system to the top, the screen would prevent it from entering the headpond. In this case an alternative method to passing the AWS flow, as shown in Figure 2, could be considered. This would assist in preventing Atlantic salmon from entering the system by screening off the AWS flow. The AWS flow would be submerged which would provide the attraction flow and ensure that it did not plunge near the fishway entrance. This would necessitate a larger intake screen so that all the AWS flow is passed through the floor.

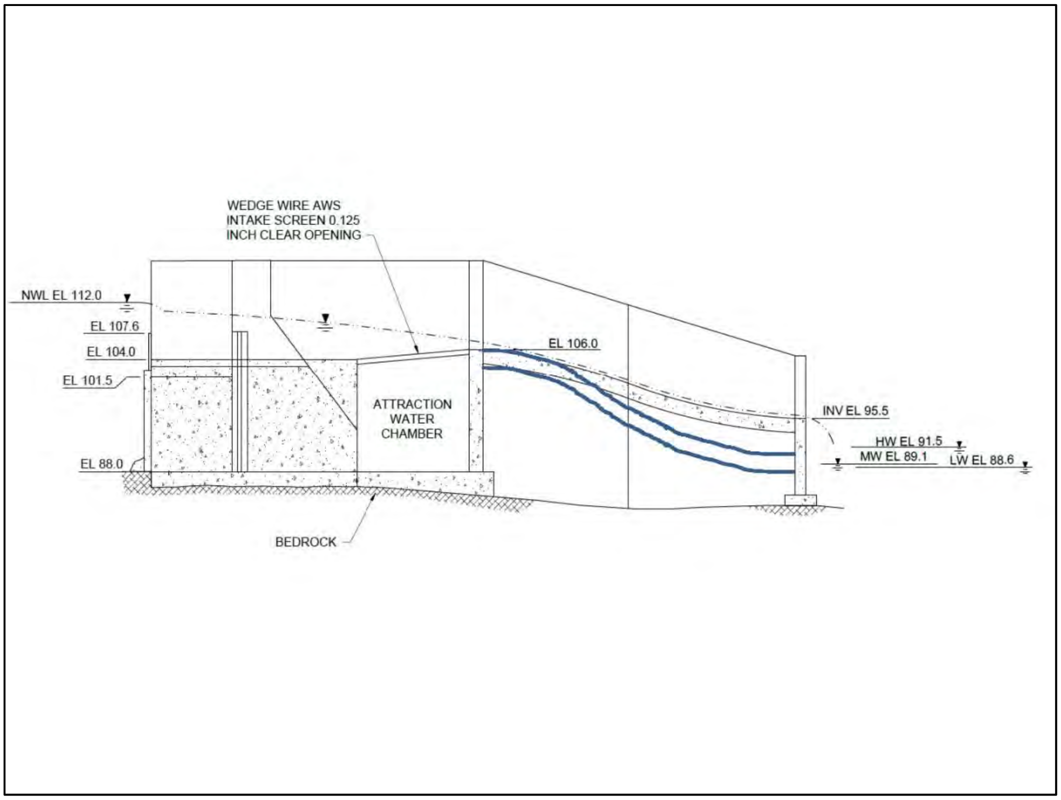


Figure 1 – Lowered AWS channel floor to meet tailwater

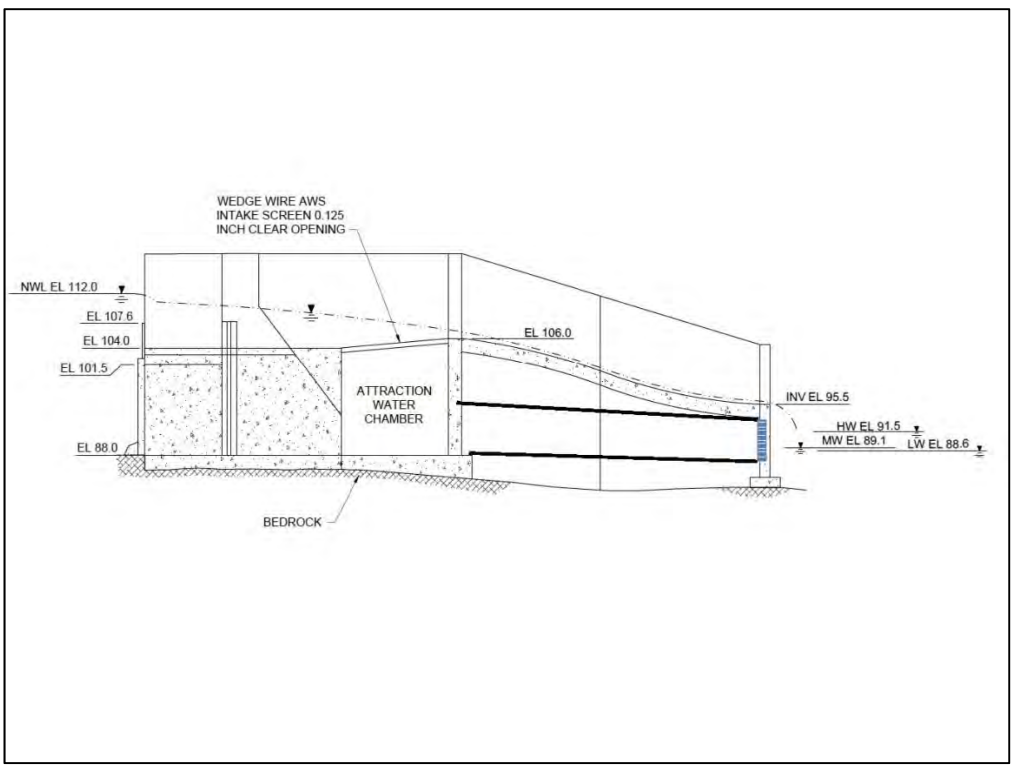


Figure 2 – AWS Alternative

Technical Memorandum

To: Mr. Gerry Mitchel and Robert Richter, Brookfield Renewable

From: Greg Allen and Steve Amaral, Alden

Date: November 1, 2017

Re: **30% design review agency comments responses for the Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities**

Alden Research Laboratory, Inc. (Alden) developed 30% design drawings for fish passage facilities for the Shawmut Hydroelectric Project (Shawmut). Brookfield Renewable (Brookfield) submitted these drawings to resource agencies on July 31, 2017 and a design review meeting was held on August 28, 2017. Representatives from the US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Environmental Protection (MEDEP), Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries and Wildlife (IF&W), Brookfield and Alden were in attendance at the 30% design review meeting. The resource agencies design review team (DTR) consisting of NMFS, FWS, IF&W and MDMR provided written comments on October 19, 2017 (Attachment 1) and this memorandum provides a response to those comments. Comments are shown below in bold and followed by Alden's responses.

Drawing G-002

1. **Note 5 "Design Range" not Operating Range**

   Note will be revised accordingly

2. **Note 6 – 6 inches may be fine, Milford Target is 8 inches, we believe HK is around a foot.**

   Head drop of 6 inches is consistent with HK

3. **Note 7 - AWS flow should be changed to Total Attraction Flow**

   Note will be revised accordingly

4. Note 7 – less than 3/8 opening – similar to Hydro Kennebec

Note changed to “0.125 inch opening or less” in response to FWS comments.

5. Is 15 minutes the minimum? What is the minimum cycle time?

Yes, the fish lift is designed for a 15 minute minimum cycle time.

Drawing C-002

1. Please show how the flow is apportioned

Drawing will be revised accordingly

2. Please put on TW El on the drawing for units 7 and 8 tailrace

Drawing will be revised accordingly

Drawing C-103

1. Please move exit of discharge pipe away from spillway and intake to prevent fish from being washed back into the tailrace.

The exit of the discharge pipe has been moved further from the attraction water intake as shown in Figure 1. The discharge location is now 40 ft from the spillway and 23 ft from the attraction water intake which minimizes risk of potential fall back of upstream migrants.

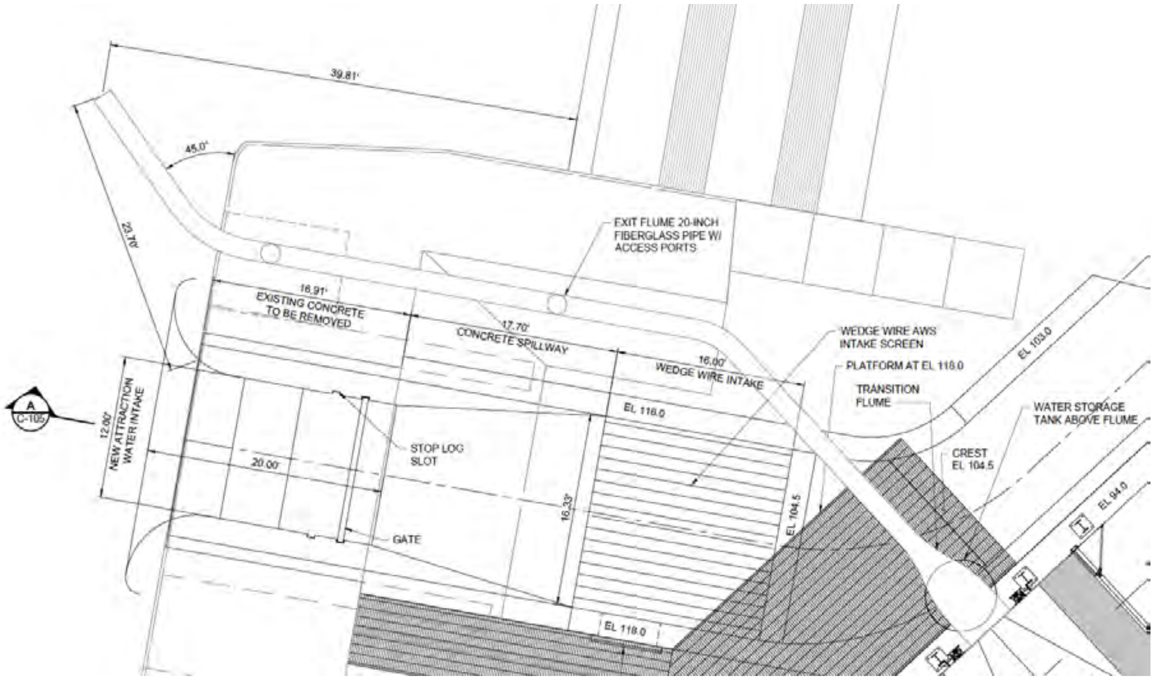


Figure 1. Attraction Water Intake Plan

2. **The area below the V-gate is considered the holding pool on a large braille hopper and must be sized accordingly in order for fish to "stage" while the hopper is not in a fishing position. Similar to Hydro Kennebec this distance may be around 20 ft or so below the V-Gate. Please size according to FWS criteria for a holding pool.**

The area downstream of the V-gate and upstream of the hinged entrance gate is considered a holding pool, which allows fish to stage while the fish lift is in operation and the V-gate is closed (shown in Figure 2). This holding pool volume is 12 ft long, 12 ft wide and 9 ft deep at low water, which equates to 1296 cubic feet. The FWS criteria (USFWS, 2017) lists the crowding limit of 0.10 ft^3/lb for a hopper and 0.25 ft^3/lb for a holding pool. Therefore, the required holding pool volume is 2.5 times the hopper volume. The Shawmut hopper is 490 cubic feet and multiplied by 2.5 provides a 1225 cubic feet holding pool volume. This confirms the design meets the FWS criteria for holding pool volume.

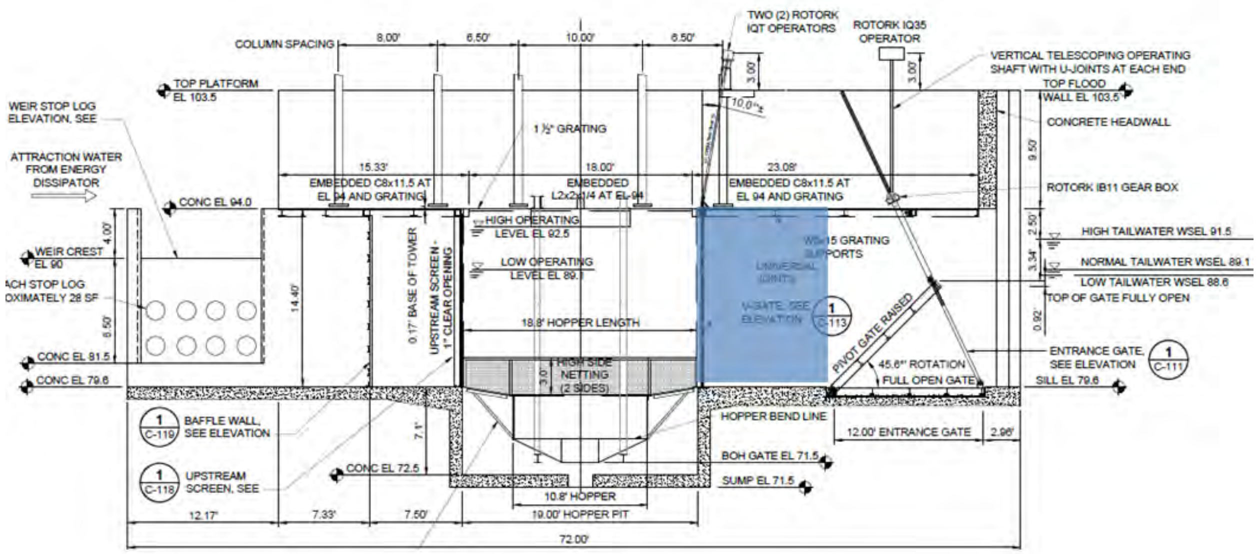


Figure 2. Fish Lift Flume Section, Holding Pool Area shaded blue

In addition, we note that the hopper volume of 490 cubic feet is more than adequate for the design populations provided for Shawmut and therefore the holding pool volume (which is based on the hopper volume) is also more than adequate. If we follow the FWS criteria (USFWS, 2017) with the design populations provided for Shawmut for American shad of 177,000, the required hopper volume is 314 cubic feet, and the required holding pool volume is 785 cubic feet which indicates the current design of the hopper and holding pool is 56% and 65% more than the FWS criteria requirements, respectively. Table 1 lists the design population estimates (provided by MDMR) and presents the calculated required volumes based on FWS criteria.

Table 1. Shawmut Design Populations and Calculated Hopper and Holding Pool Volumes

Species	Design Populations	Required Hopper Volume[1] (ft^3)	Required Holding Pool Volume[1] (ft^3)
American Shad	177,000	314	785
Alewives	134,000	32	80
Blueback Herring	1,535,000	159	396
Atlantic Salmon	12,000	71	177

1. Based on FWS criteria

Another factor that constrains the design is the limited space available for the fish lift structure between the dam and the powerhouse. The fish lift entrance is located so that it does not protrude into flow from the spillway to avoid being impacted by flood flows or cause potentially adverse hydraulic conditions created by high velocity spillway flow deflected by the fish lift entrance structure. Space is not available to lengthen the fish lift without protruding into the spillway flow.

3. Alden to provide nappe profiles, possibly move nappe upstream.

The following figures provide water surface profiles for the AWS intake, auxiliary spillway, fish lift flume and unit 7&8 fishway channel.

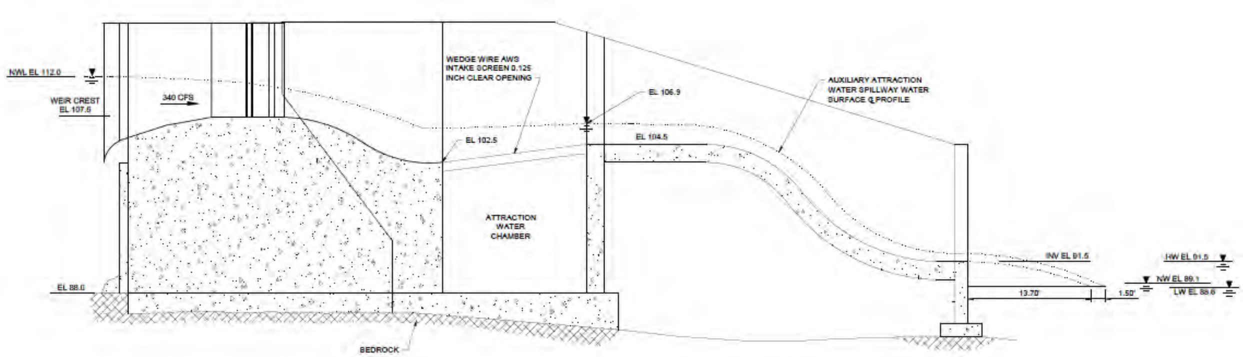


Figure 3. Attraction Water System Water Surface Profile

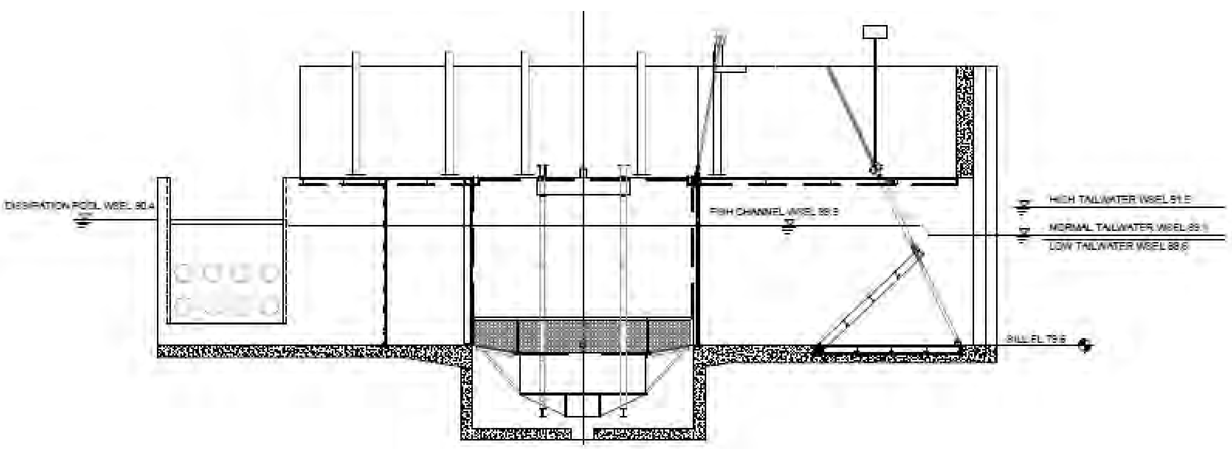


Figure 4. Fish Lift Channel Water Surface Profile

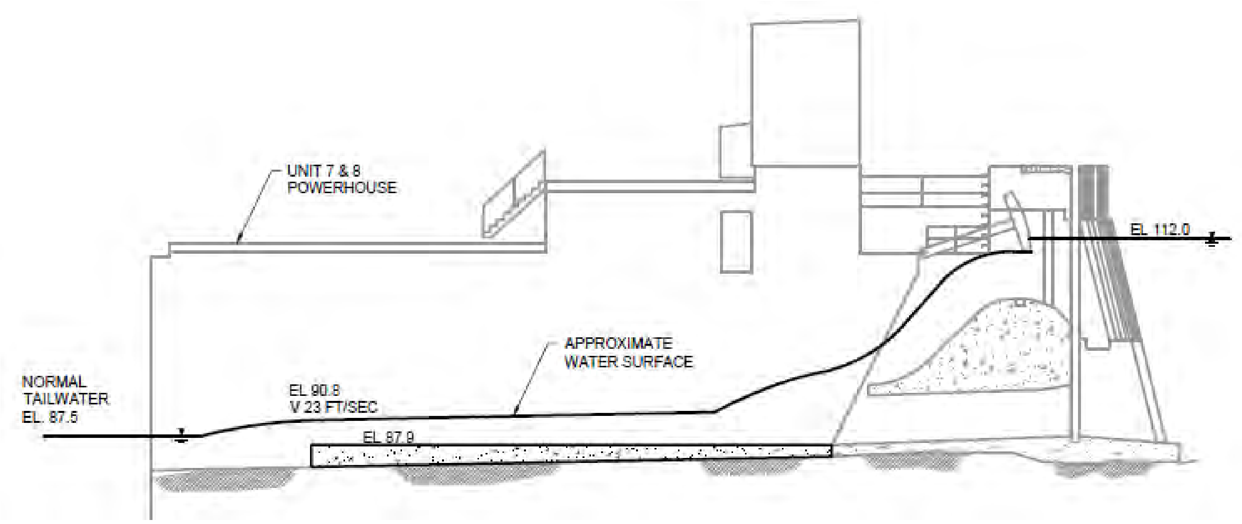


Figure 5. Tainter Gate Spillway Water Surface Profile

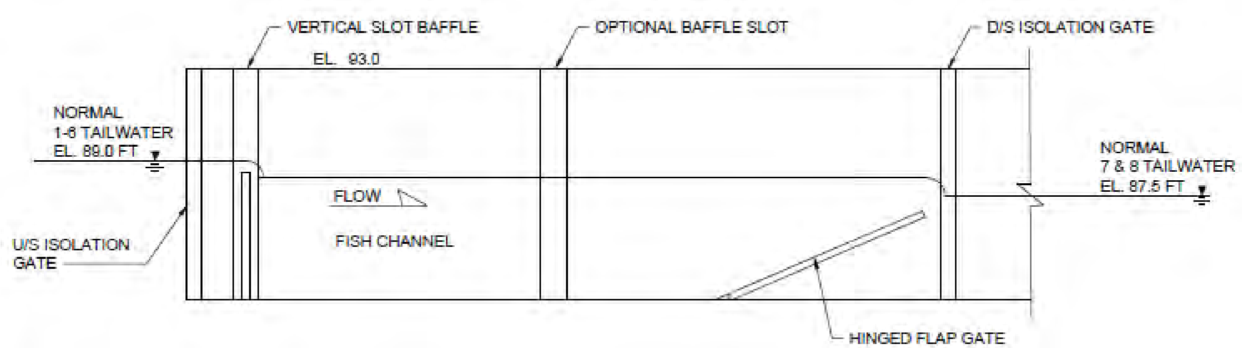


Figure 6. Crossover Fishway Water Surface Profile

4. **Braille size opening should be less than 3/8 inch clear**

   The hopper is designed with a two sided braille system with 3/8 inch hole diameter perforations.

Drawing C-104

1. **Add diffuser velocities, velocities across hopper, velocities in holding pool and velocities at entrance**

The velocity through the fish lift flume at 115 cfs flow rate ranges from 1.0 ft/sec at a low water elevation of 88.6 ft to 0.8 ft/sec at a high water elevation of 91.5 ft. The velocity over the hopper will be slightly less due to the greater depth. The target head drop at the entrance hinged gate is assumed to be 9 inches which will provide an entrance velocity of about 6 ft/sec.

2. Prefer flapper gates to filler pipe.

Noted, design changed accordingly.

3. Screen on top of hopper

Noted, design changed accordingly.

4. Is the top of concrete elevation at 93.0 ft too low? Please double check

The top of concrete has been raised to elevation 94.0 ft to provide additional freeboard.

Drawing C-105

1. Please include stop log slots

We have added stop log slots to the attraction water intake to facilitate intake gate maintenance.

2. Please include depth of water along Section A.

Water profile information, including depths are provided in Figure 3.

Drawing C-110

1. The hopper gate should be at the bottom of the hopper. It may be that the drawing is just hard to read.

Yes, the hopper gate is at the bottom of the hopper

2. Entrance gate to track Tailwater

Noted, the hinged entrance gate will track tailwater to maintain a constant head drop across the entrance.

Drawing C-303

1. **We need more definition on separation and flow amounts between d/s flow and upstream fish channel. Flow/elevation curves associated with HW/TW and resulting flow should be provided for the flow through the crossover fishway.**

The difference in tailwater elevation between the powerhouse tailraces is about 1.5 ft as shown on Figure 7 (Kleinschmidt, 2009). Hydraulic modeling conducted by Blue Hill Hydraulics (BHH) predicts about 1 to 1.5 foot difference. The following discharge curve (Figure 8) for the crossover fishway assumes a 15 inch difference in tailwater levels and a full depth 24 inch wide slot at the upstream end to control flow. We have assumed a constant differential between the two powerhouses as indicated in Figure 7.

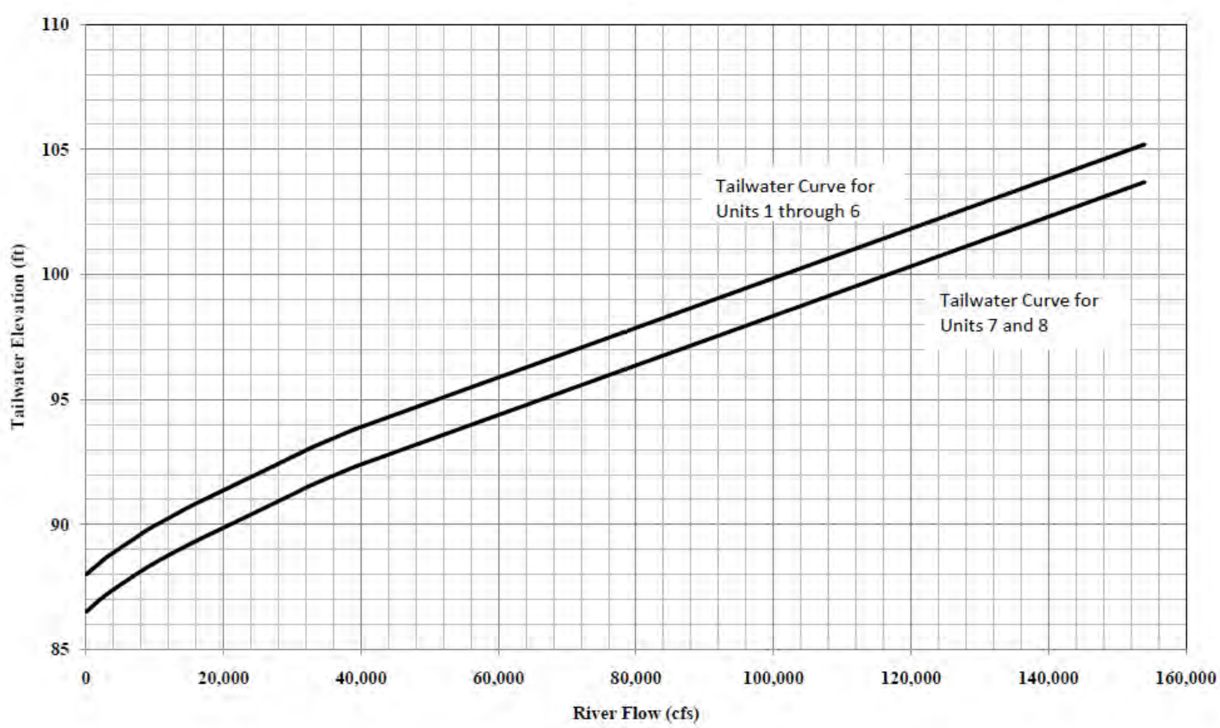


Figure 7. Tailwater Operating Curves (Kleinschmidt, 2009)

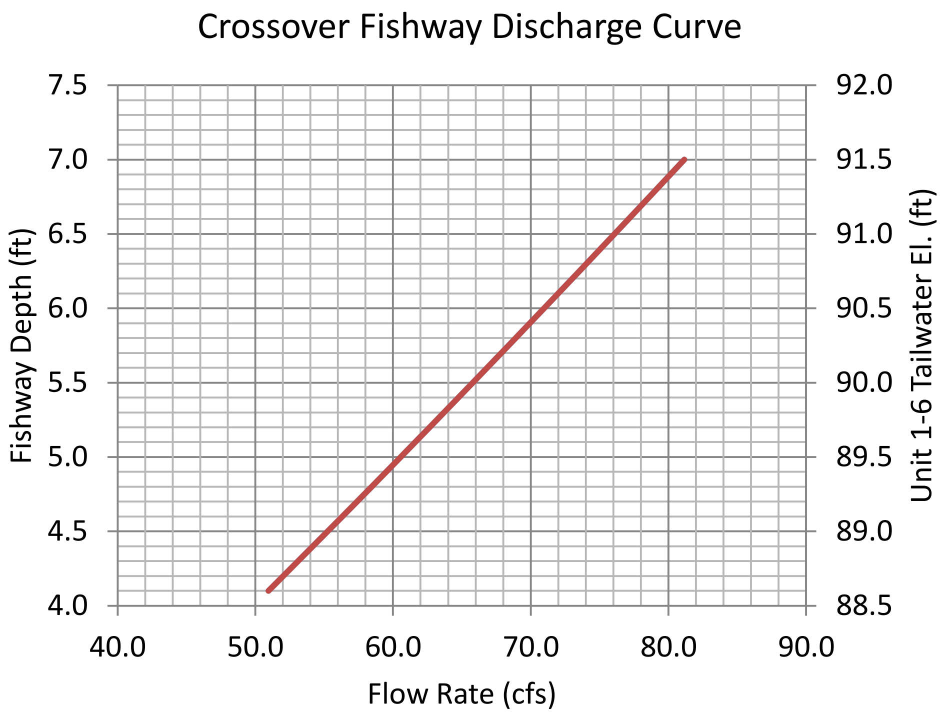


Figure 8. Cross over Fishway Discharge Curve

2. **We need more definition on the elevations of lower and upper edges of rock slope in the tailwater below channel.**

This information is provided in the 60% design submittal.

Drawing C-304

1. **Need velocity/Flow data**

Flow information for the crossover fishway is provided in Figure 8. Average velocity within the fishway channel is about 2 ft/sec.

Flow through the downstream passage channel is 600 cfs with a velocity of about 35 ft/sec.

2. **Need more definition on downstream data on Section A – WSEL through section A**

See Figure 6 for water surface profile for Section A. More detail will be provided in the 60% design submittal.

3. **Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.**

The following table provides the water depth over the hinged gate as the flow/ tailwater level varies for a 6 ft wide entrance width.

Table 2. Crossover Fishway Entrance Conditions

Unit 1-6 TW El. (ft)	Unit 7&8 TW El. (ft)	Crossover fishway flow (cfs)	Target entrance vel (ft/sec)	Depth over Hinged Gate (ft)
91.5	90.0	81.2	7	1.9
91.0	89.5	76.1	7	1.8
90.5	89.0	71.0	7	1.7
90.0	88.5	65.8	7	1.6
89.5	88.0	60.6	7	1.5
89.1	87.6	56.3	7	1.4
88.6	87.1	51.0	7	1.2

Additional comments from FWS

FWS provided additional comments regarding the AWS intake geometry, wedge wire screen and holding pool volume. Each item is discussed below.

Holding pool volume

FWS requested an additional 10 ft in length be added to the fish lift flume to provide additional holding pool volume. Our response to this request is detailed earlier in this memo. The proposed fish lift design as presented in the 30% design drawings meets FWS criteria (USFWS, 2017) regarding holding pool volume. In addition, there is not available space to lengthen the fish lift flume without protruding into the spillway flow.

Attraction Water System

Spillway channel discharge elevation

FWS requested the discharge invert of the auxiliary spillway channel to be lowered from elevation 95.5 ft to elevation 91.5 ft. The auxiliary spillway design has been modified accordingly.

AWS Intake

The intake design may be used as passage for downstream migrants as well as debris. For this scenario, FWS requests an Alden style weir, wedge wire spacing less than 0.125 inches and through screen velocity of less than 0.5 ft/sec. An Alden style weir and wedge wire spacing of less than 0.125 inches has been incorporated. A discussion regarding design velocity for the wedge wire screen is provided below.

<u>Wedge wire screen design</u>

The intake for the attraction water system uses a wedge wire screen that is 16 ft long by 16 ft wide. The wedge wire configuration is similar to that of high velocity screen designs that have shown to effectively guide and transport downstream migrating fish. Examples of high velocity screen designs include Eicher screens, Modular Inclined Screens (MIS), fish samplers within downstream bypasses and for fish collection for laboratory studies. The design proposed for Shawmut most closely resembles the samplers at Hadley Falls and Cabot hydroelectric projects and many fish collection systems Alden has designed for laboratory studies. The concept is different than that of cylindrical wedge wire screens that are designed as passive intakes. Typically, submerged cylindrical wedge wire screens are often installed in situations with very low ambient velocity (lake or reservoir) and the very low intake velocity reduces debris accumulation and impingement of small fish, eggs, and larvae. These passive screen designs do not have a discernable intake influenced velocity beyond less than an inch from the screen surface. In contrast, high velocity screens designed for juvenile and adult fish have a high sweeping velocity (along the screen) to guide fish and debris away from the screen. The high ratio of sweeping velocity to through-screen velocity guides and reduces the risk of fish impingement. Laboratory and field studies have indicated that a ratio greater than 3 to 1 significantly reduces risk of impingement and injury (Alden, 2010). Alden has conducted laboratory and field evaluations of Eicher, MIS and submerged cylindrical wedge wire screens. A review of available literature for Eicher and MIS evaluations was prepared by Alden in 2010 and can be made available upon request. The review shows that Eicher and MIS screens are effective (~98% survival for most studies) at diverting fish downstream.

The wedge wire intake design proposed for Shawmut has the following features:

Wedge wire screen flow – 115 cfs
Bypass/ auxiliary spillway flow – 225 cfs
Wedge wire screen average velocity (perpendicular to screen face) – 0.4 ft/sec
Through-screen velocity – 0.9 ft/sec
Average sweeping velocity – 5 ft/sec (varies ~15 ft/sec near Alden weir)
Screen angle – 5 degrees
Sweeping to intake velocity ratio - 11

The proposed design will effectively guide fish over the screen and down the auxiliary spillway channel. In comparison to the designs reviewed for Eicher and MIS screens, the Shawmut design bypasses significantly more flow (225 cfs, 66% of total flow compared to 5% for other designs), has a larger sweeping to screen velocity ratio (11 versus 3 to 6), a shallow screen angle (5 degrees versus 16 degrees) and a lower through-screen velocity (0.9 ft/sec versus 2 to 4 ft/sec). These differences are expected to provide even better performance than the referenced studies in the Alden 2010 literature review. Given this review of existing data and the limited space available to expand the screen area, it is our opinion that reducing the through-screen velocity to less than 0.5 ft/sec is not warranted and overly conservative.

References

Alden. (2010). *Fall Creek Hydroelectric Project, FERC No. 12778-001, Eicher Screen Literature Review.* Holden, MA: Alden Research Laboratory, Inc.

Kleinschmidt. (2009). *Declaration of Incremental Hydropower, Shawmut Hydroelectric Project FERC No. 2322-ME.* Pittsfield, ME: Kleinschmidt Associates.

USFWS. (2017). *Fish Passage Engineering Design Criteria.* Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region R5.

Attachment 1

Design Review Team Comments

Received October 19, 2017

Good Afternoon Bob –

I would like to thank you for the opportunity to review the 30% Shawmut Upstream Fish Passage Design. The Design Review Team (DRT), consisting of representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries & Wildlife (IF&W), United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), met with Brookfield and their consultant Alden Labs on August 28th to collectively review the design and the DRT comments. At the end of that meeting it was agreed that the notes from the meeting were going to be based upon the collaboration and discussion and that the DRT would later send final comments reflecting those discussion and answering a few other questions. It was also agreed that Alden had enough information from that meeting to continue working on the 60% design.

This review has been done collectively with all pertinent agencies and may or may not completely reflect each agency's comments. If the agencies have additional comments or disagreements outside of the DRT comments they would file a separate comment letter to Brookfield.

This review was done considering the biological and engineering hydraulic principles to design an effective upstream fishway considering NMFS and USFWS design standards as well as engineering and biological judgments if necessary. This review was not done considering Life Safety Codes, Building Codes, Allowable Stress Design, or Load Resistance Factor Design, or any other typical engineering design codes for concrete, steel, structures, or building. We have assumed that the consulting engineer has taken those codes and practices into consideration.

Shawmut 30% Design – Agency Comments

Drawing G-001

No Comments

Drawing G-002

1. Note 5 “Design Range” not Operating Range
2. Note 6 – 6 inches may be fine, Milford Target is 8 inches, we believe HK is around a foot.
3. Note 7 - AWS flow should be changed to Total Attraction Flow
4. Note 7 – less than 3/8 opening – similar to Hydro Kennebec
5. Is 15 minutes the minimum? What is the minimum cycle time?

Drawing C-002

1. Please show how the flow is apportioned
2. Please put on TW El on the drawing for units 7 and 8 tailrace

Drawing C-103

1. Please move exit of discharge pipe away from spillway and intake to prevent fish from being washed back into the tailrace.
2. The area below the V-gate is considered the holding pool on a large braille hopper and must be sized accordingly in order for fish to “stage” while the hopper is not in a fishing position. Similar to Hydro Kennebec this distance may be around 20 ft or so below the V-Gate. Please size according to FWS criteria for a holding pool.

3. Alden to provide nappe profiles, possibly move nappe upstream.
4. Braille size opening should be less than 3/8 inch clear

Drawing C-104

1. Add diffuser velocities, velocities across hopper, velocities in holding pool and velocities at entrance
2. Prefer flapper gates to filler pipe.
3. Screen on top of hopper
4. Is the top of concrete elevation at 93.0 ft too low? Please double check

Drawing C-105

1. Please include stop log slots
2. Please include depth of water along Section A.

Drawing C-110

1. The hopper gate should be at the bottom of the hopper. It may be that the drawing is just hard to read.
2. Entrance gate to track Tailwater

Drawing C-301

Drawing C-303

1. We need more definition on separation and flow amounts between d/s flow and upstream fish channel. Flow/elevation curves associated with HW/TW and resulting flow should be provided for the flow through the crossover fishway.
2. We need more definition on the elevations of lower and upper edges of rock slope in the tailwater below channel.

Drawing C-304

1. Need velocity/Flow data
2. Need more definition on downstream data on Section A – WSEL through section A
3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

Additional Comments from USFWS:

USFWS Engineering recommends additional space (10 ft of length) between the proposed v-trap and entrance gate to act as a holding pool. There was discussion during the August 28th meeting pertaining to utilizing the volume above the hopper and braille as the holding pool. We agree that this will be available as a holding pool space when the lift is not being operated. However, this space will not be available when the hopper is being raised and lowered (assumed time of 10 minutes). Therefore, if the hopper is to be raised every half hour, a third of the time the holding pool will not be effective. It is for this reason that an additional 10 ft of length be added in between the proposed v-trap and entrance

gate to provide a holding pool that is available at all times. Ideally a second v-trap would be added to reduce the amount of fallback as much as possible.

There is a need for more discussion related to the attraction water system (AWS) and its use as a downstream bypass. A consensus was not reached during the August 28th meeting. USFWS Engineering has the following comments/concerns:

1. For both cases below it is recommended that the slope of the AWS channel be lowered as displayed in Figure 1 in order to meet the tailwater. This will prevent the nappe of the flow from plunging into the tailwater some distance downstream of the entrance. The intent is to ensure that the AWS flow is as close as possible to the entrance of the fishway and operates within the streaming regime to avoid hydraulics that are not conducive near the entrance (e.g., turbulence, aeration, upwelling). Figure 2 displays a second alternative that could achieve the same results.

If the AWS is to be used as a downstream bypass

1. Effectiveness of the proposed geometry is unknown. As shown, the AWS flow first passes over a sharp crested weir, then a percentage of the flow falls through the floor, and the leftover amount goes down the sloped channel (which would produce another drawdown and increase in velocity which the downstream migrants may reject). A sharp crested weir does not produce hydraulics that are conducive to downstream passage, and there is risk of downstream migrants getting entrained within the AWS chamber below the floor.
2. For this case, USFWS Engineering would recommend implementing an Alden style entrance rather than the sharp crested weir. We agree that the 0.125 inch spacing will prevent entrainment of downstream migrating species. The plans should also display the calculated through velocity which should be less than 0.5 ft/s. The screen should be easily accessible during the season to ensure that the screen is clear of debris and not damaged.

If the AWS is not used as a downstream bypass

1. In this case the intake would need to be screened to prevent downstream migrating species from entering the AWS. If an upstream migrating Atlantic salmon were to traverse the AWS system to the top, the screen would prevent it from entering the headpond. In this case an alternative method to passing the AWS flow, as shown in Figure 2, could be considered. This would assist in preventing Atlantic salmon from entering the system by screening off the AWS flow. The AWS flow would be submerged which would provide the attraction flow and ensure that it did not plunge near the fishway entrance. This would necessitate a larger intake screen so that all the AWS flow is passed through the floor.

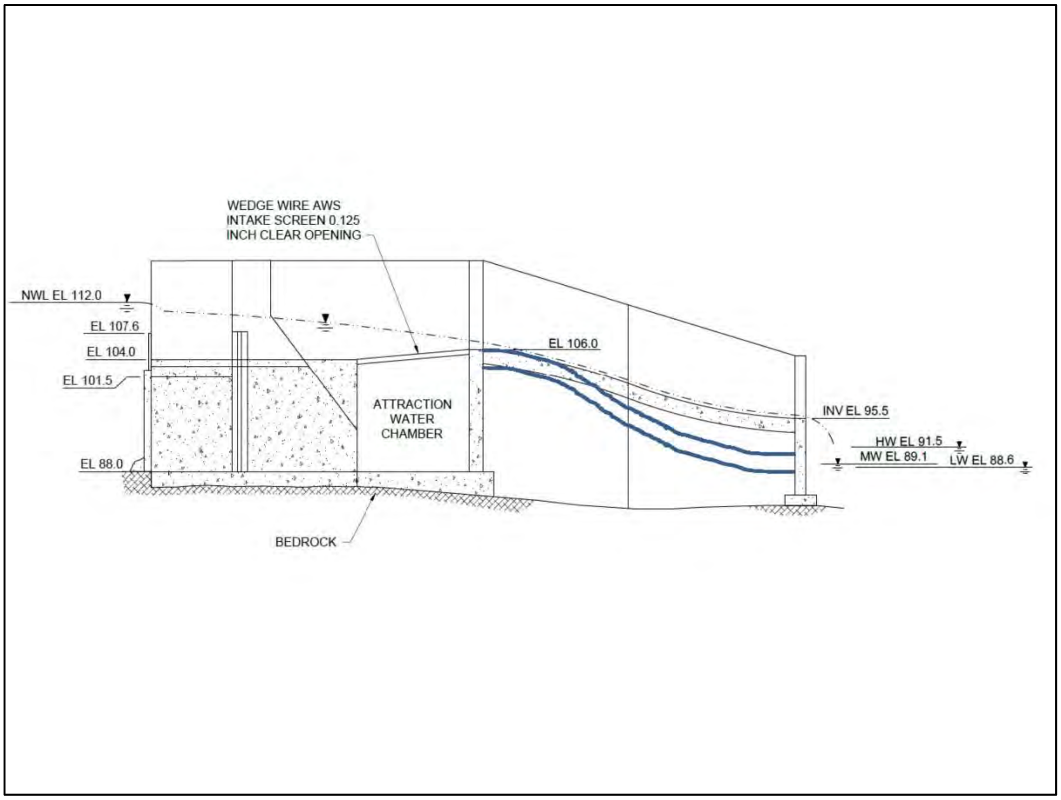


Figure 1 – Lowered AWS channel floor to meet tailwater

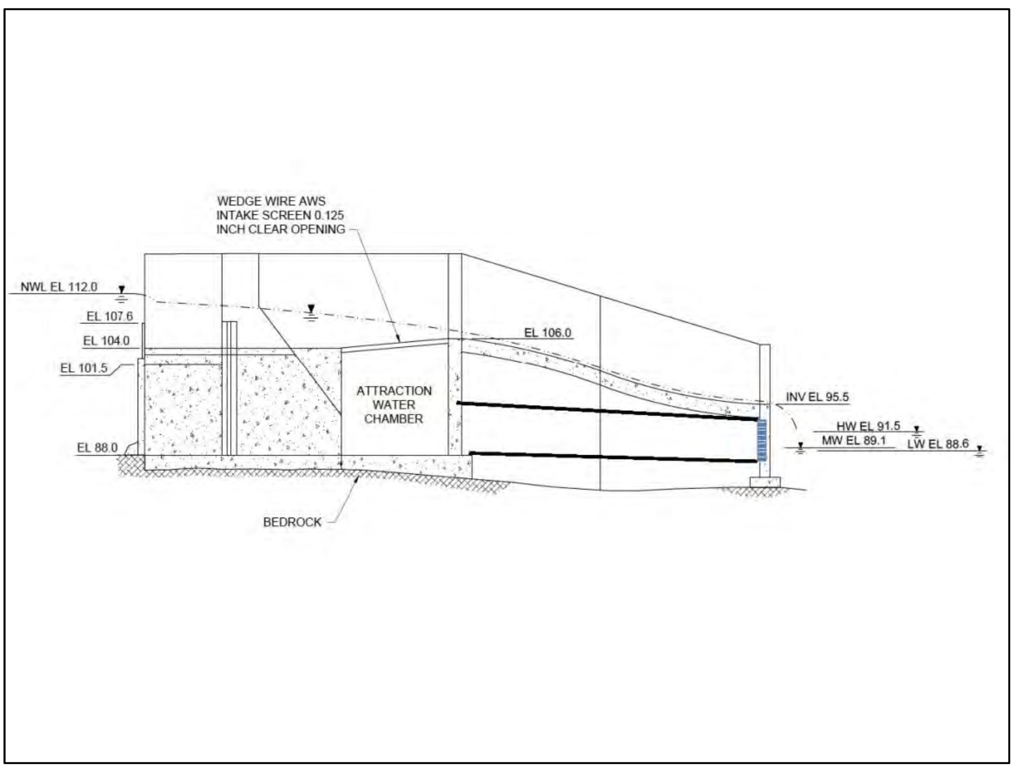


Figure 2 – AWS Alternative

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Wednesday, November 29, 2017 3:39 PM
To: Richter, Robert; Mitchell, Gerry; Matt Buhyoff - NOAA Federal; Bryan Sojkowski; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Bentivoglio, Antonio; Maloney, Kelly; Greg Allen
Subject: Shawmut 60% Design Draft Comments - Discussion Points
Attachments: Shawmut 60% Design Review Team Draft Comments-Discussion points.docx

Good Afternoon Bob -

Thank you for the opportunity to review and comment on the Shawmut 60% Design. I met with the Design Review Team on 11/22 and prepared the following draft comments and discussion points for our next meeting. Please do not misconstrue these comments, we are looking for discussion on the points and then we will finalize the comments after we meet. I have not sent this to the other agencies for review, however, they took part in constructing the comments with exception to IF&W as Jason was on leave. In the interest of time, I'm sending them to you now before getting fully reviewed.

Regards,
Don

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut Design Review Team **Draft** Comments/Discussion Points for next Agency, Consultant, Owner Design Review Meeting on 60% Design

Drawing G-002

1. Note 6 Entrance Velocity 4 to 6 fps, 6 to 8 fps capable
2. Note 6 Entrance Depth 3ft Minimum under all circumstances
3. Note 7 Need to Discuss flow apportionment with Alden and Brookfield
4. Note 10 Please include Grade of Exit Flume

Drawing C-002

1. There are no drawings of the control gates that we could find
2. Can you throttle the 115 cfs?
3. Is attraction water gate downward opening? - Does it need to be?
4. Need to discuss the 600 cfs vs 50 to 80 cfs in Fish Bypass Channel
   a. Could we discharge 600 cfs to old powerhouse tailrace
   b. or use wedged wire screen and some of the 600 cfs to fishway bypass and make it wider?

Drawing C-103

1. Should there be a downward opening gate at the attraction water entrance?
2. We need more manholes or transparency on the top of the 20 inch pipe
3. We are still very worried about false attraction and need to discuss
4. could we have 1 stop log panel from the guide wall to the building perpendicular
5. can we move everything except the entrance closer to the dam
6. What happened to the gate drawings for the AWS system?

Drawing C-105

1. Should the isolation gate be downward opening
2. We need to discuss the AWS to Tailrace Transition

Drawing C-110

1. Minimize the Gaps between stems & wall on entrance gate so Atlantic salmon and other species do not get caught
2. Greased Stems should not be in water
3. Can we increase height of punch plate walls on hopper?
4. The entrance gate does not meet the following:
   a. 3ft of depth minimum over the weir
   b. Only meets the 4 to 6 fps because it does not meet the 3ft of depth
   c. doubtful to achieve 1/2 ft of HL at high tailwater
   d. can't meet higher HL at normal tailwater

Drawing C-111

1. Why is 2fps there inside gate on the elevation view?
2. No sharp edges
3. What happens if pin on gate breaks?

Drawing C-112

1. What is a Gate Disc?

Drawing C-113 - No Comments

Drawing C-114 - No Comments

Drawing C-115

1. Where are the filler flap valves?
2. should have more details on this by now.
3. 3ft high walls should be higher....likely out of water column and high enough so salmon can't jump out.
4. Use punch plate not mesh for walls on top of hopper
5. Need to show position of lifting cables

Drawing C-118 - No Comments

Drawing C-119

1. Need to Provide ManDoor

Drawing C-120 - No Comments

Drawing C-301

1. Please show elevation of upper edge of existing 3V:1H Rock Slope

Drawing C-303 - See comments in regards to 600 cfs

Drawing C-304

1. Need more depth over hinged gate
2. How are gates operated?
3. Shouldn't baffle slots be above isolation?
4. What about eels?

Drawing C-305 - See comments in regards to 600 cfs

Drawing S-001 - No Comments

Drawing S-201 - No Comments

Drawing S-202 - No Comments

Drawing S-203 - No Comments

Drawing S-204 - No Comments

Drawing S-205 - No Comments

Drawing S-206 - No Comments

Drawing S-207 - No Comments

Tech Memo:

1. Page 1 - Can we adjust Headloss looking to go as high as 1.5 ft over 20 to 40 ft
2. Fig 3 - Shouldn't this be of lower velocity than the entrance?
3. Fig 5 - 23 fps - need to have discussion on 23 fps vs velocity at entrance
4. DWG C-104 Note 1 - did not show depth
5. DWG C-104 Note 3 - Need more than 3 ft of screen
6. Page 8 - Has this tailwater curve been confirmed?
7. Upper gate on AWS should not be used to control flow
8. Page 10 - need 3 ft of depth on Table 2

DRAFT
Meeting Notes
Shawmut Design Review Team Meeting
Wednesday, December 13, 2017
9:00 AM – 1:00 PM

Attendees:

Bryan Sojkowski (USFWS)
Antonio Bentivoglio (USFWS)
Donald Dow (NOAA)
Matt Buhyoff, via phone (NOAA)
Gail Wippelhauser, via phone (MEDMR)
Jason Seiders (IF&W)
Kelly Maloney (Brookfield)
Bob Richter (Brookfield)
Gerry Mitchell (Brookfield)
Jason Seyfried (Brookfield)
Dave Robinson (Alden)
Greg Allen (Alden)

A 60% design review meeting was held at Brookfield's Hydro Kennebec Project in Winslow, ME for the Shawmut Fish Passage Project. The resource agencies' design review team (DTR) consisting of NMFS, FWS, IF&W and MDMR provided comments on November 29, 2017.

Notes:

Don Dow mentioned that this project will be required to meet a performance standard for upstream passage of Atlantic salmon, likely higher than 95%. He noted that the Milford project on the Penobscot is approximately 99% effective.

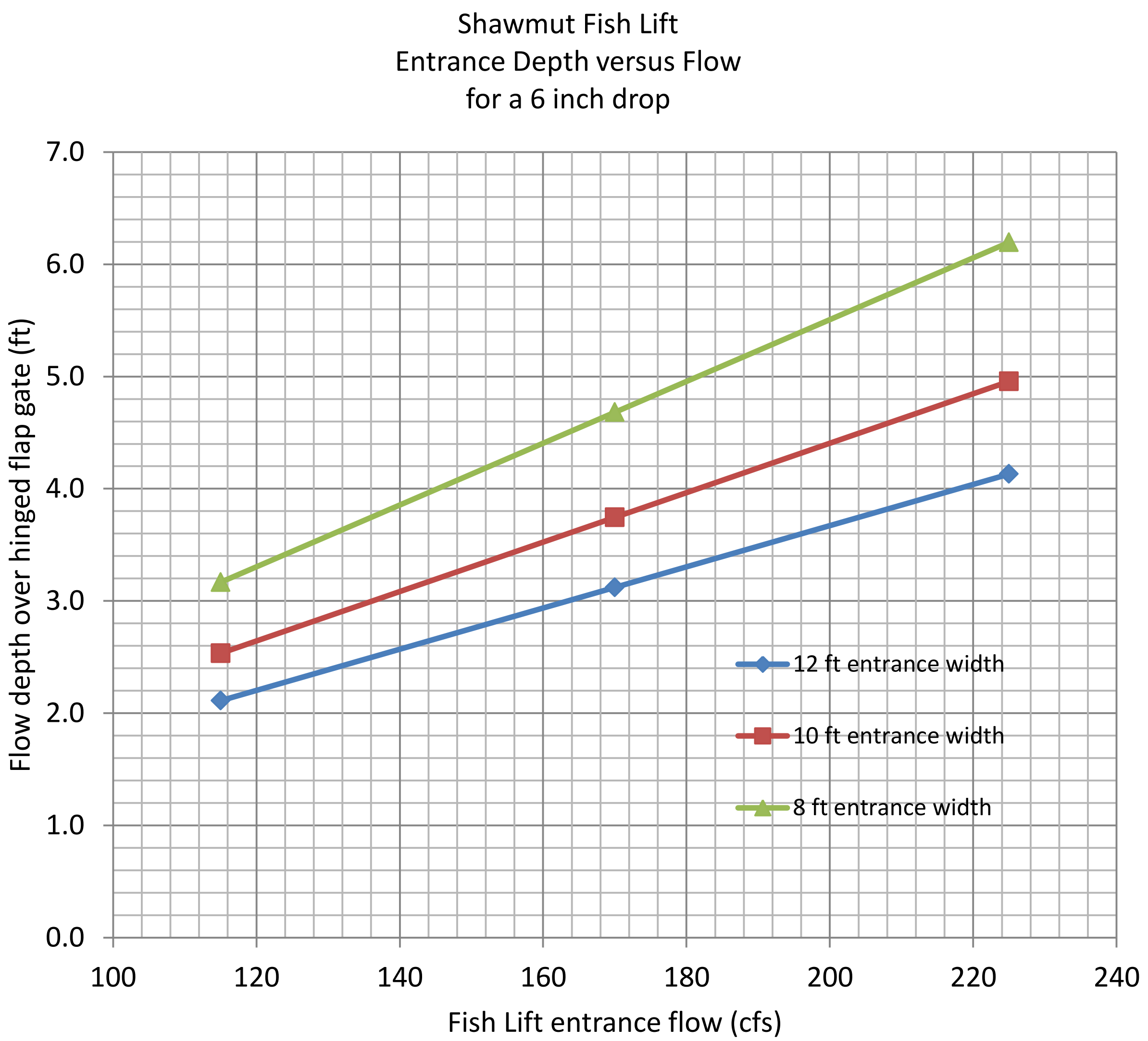
The DRT written comments are provided in bold below and notes of the meeting discussion follow.

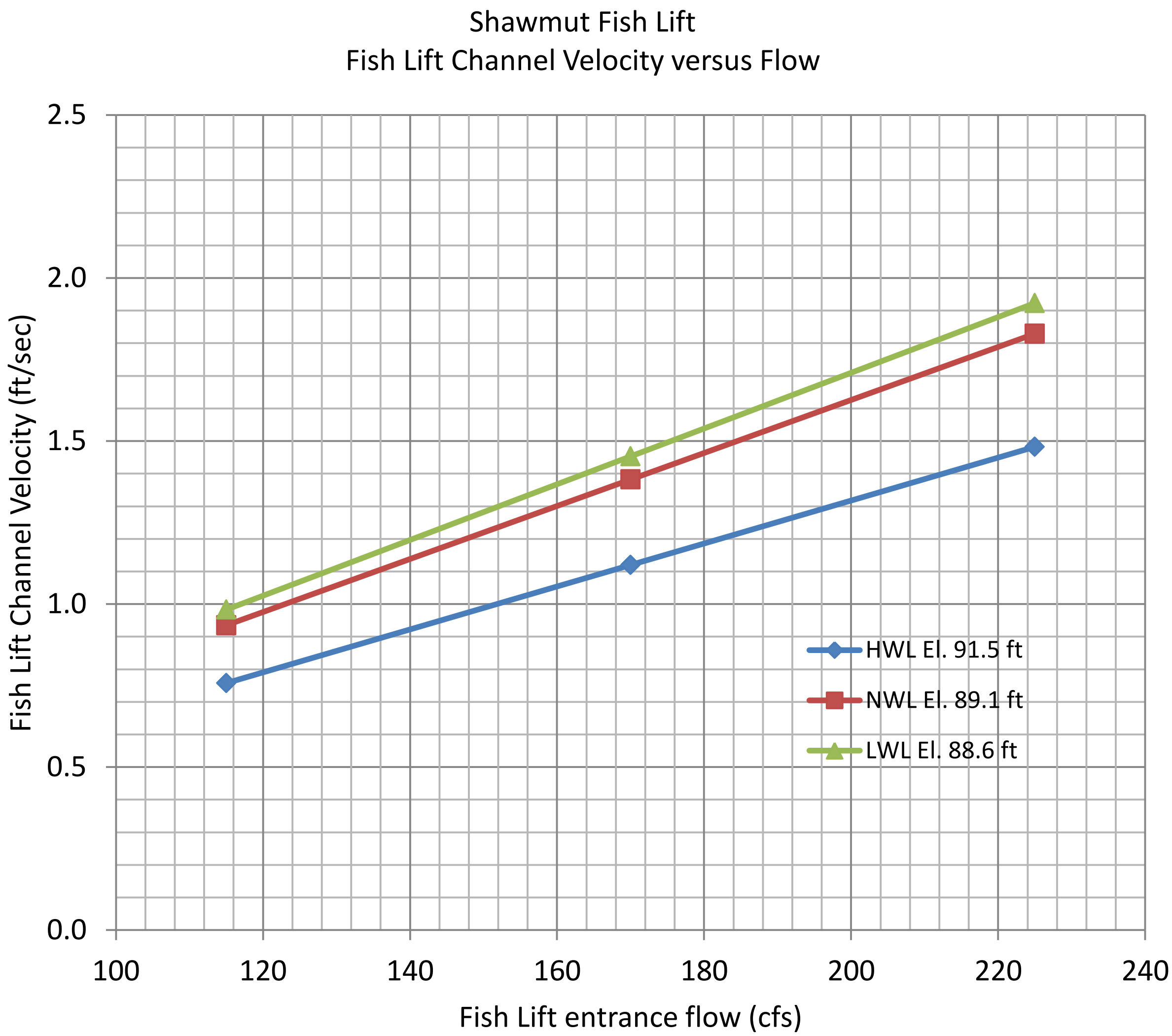
Drawing G-002

1. **Note 6 Entrance Velocity 4 to 6 fps, 6 to 8 fps capable**
2. **Note 6 Entrance Depth 3ft Minimum under all circumstances**
3. **Note 7 Need to Discuss flow apportionment with Alden and Brookfield**
4. **Note 10 Please include Grade of Exit Flume**

Comments 1 through 3 are related to the fish lift entrance configuration and hinged flap gate. Bryan mentioned that the desired depth over the hinged flap gate is 3 ft based on studies that were conducted with American shad at the Conte Lab by Kevin Mulligan.

Greg discussed the entrance hydraulic conditions and circulated two graphs to the group that show how fish lift entrance flow, flap gate width, fish lift channel velocity and tail water levels are related. These graphs are provided below. In order to increase depth over the hinged flap gate, flow would need to be increased and/ or the entrance width would need to be decreased.





Bryan also circulated information for a 10 ft wide entrance. After reviewing the graphs above the group concluded that changing the width to 10 ft wide (versus 12 ft) would provide greater water depth over the flap gate while also providing acceptable flow velocity within the fish lift channel. It was noted that the fish lift channel flow would need to be increased to about 135 cfs to attain 3 ft water depth over the hinged flap gate. It was also noted that flow would need to be increase to about 165 cfs to attain a 6 inch drop at the entrance during high water. The group agreed to:

- Reduce the fish lift entrance to 10 ft and that
- a velocity within the fish lift channel of 1.5 ft/sec is acceptable.

Don Dow mentioned that the entrance should be capable of providing a 1.5 ft drop for salmon. The water depth over the hinged gate and the fish lift channel velocities are not a concern for this scenario for Atlantic salmon. The flow through the fish lift channel can be increased to attain the 1.5 ft drop.

Flow distribution between the fish lift channel and the auxiliary spillway was discussed. It was agreed that the fish lift channel would have the capacity to operate between 115 cfs and 225 cfs to provide operational flexibility. The remainder of the total 340 cfs attraction water flow would be discharged down the auxiliary spillway.

The grade of the exit flume (20 inch diameter fiberglass pipe) is 5% and will be noted on the design drawings.

Drawing C-002

1. **There are no drawings of the control gates that we could find**

A drawing was circulated during the meeting which provided details of the control gate for the fish lift channel attraction flow.

2. **Can you throttle the 115 cfs?**

The control gate is adjustable from 0 cfs to 225 cfs.

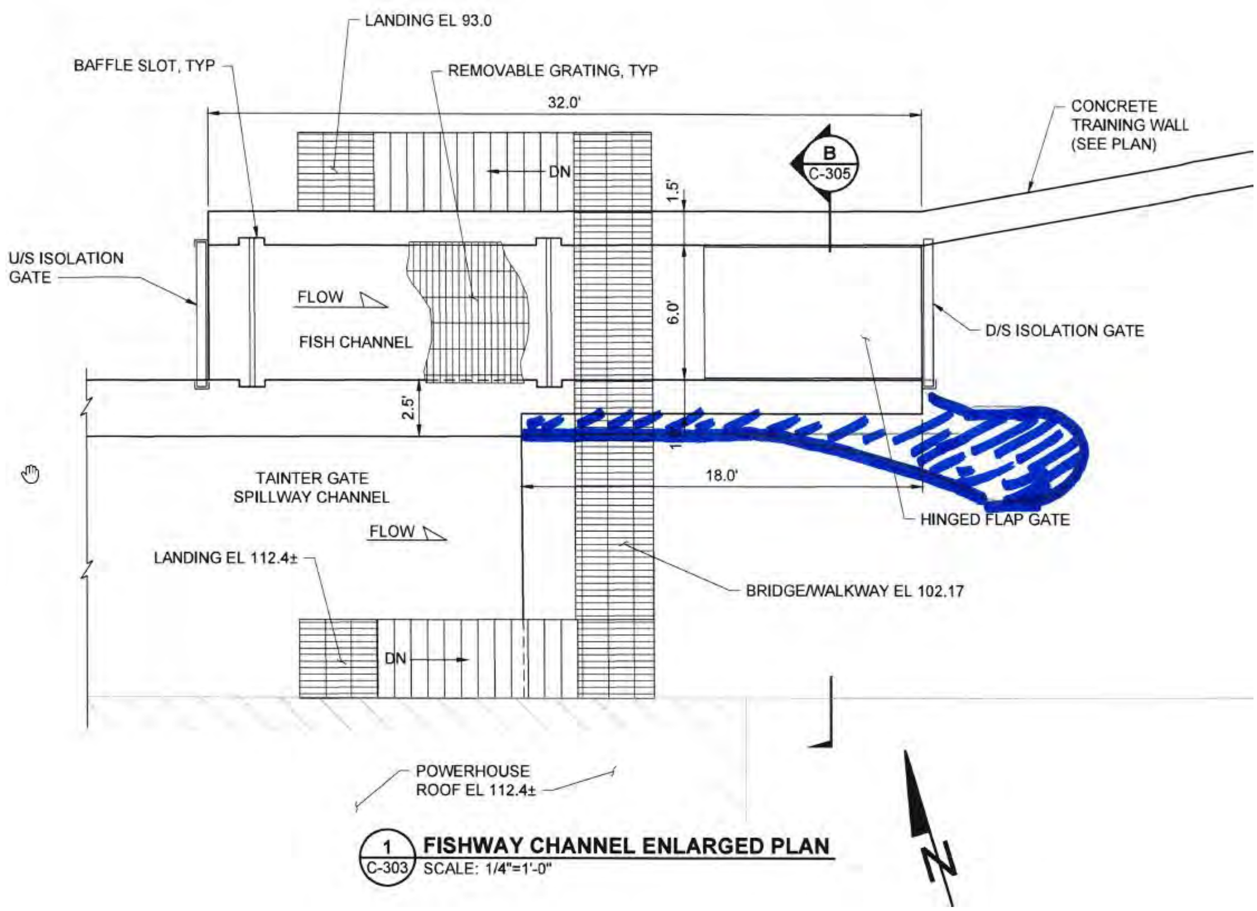
3. **Is attraction water gate downward opening? - Does it need to be?**

Greg explained the attraction water gate from the impoundment is an upward opening gate. We discussed that the gate would be either open or closed. The intake from the impoundment includes a geometry of a NU/ Alden weir and for ideal operation it is important that there are no obstructions in the flow path. If desired the gate could be throttled, but under normal operation the gate would be either fully open or fully closed.

4. **Need to discuss the 600 cfs vs 50 to 80 cfs in Fish Bypass Channel**
    a. **Could we discharge 600 cfs to old powerhouse tailrace**
    b. **or use wedged wire screen and some of the 600 cfs to fishway bypass and make it wider?**

The configuration of the fish bypass channel (fishway) and 600 cfs taintor gate flow was discussed. The taintor gate flow would be discharged into the Unit 7&8 tailrace to avoid false attraction of fish to the old powerhouse tailrace.

The discharge of the 600 cfs and the configuration near the proposed bypass channel was discussed at length. To limit the potential of the high velocity (23 ft/sec) taintor gate discharge from washing out and masking the entrance to the fishway, the group agreed to change the geometry to deflect the flow towards the middle of the tailrace (toward the right looking downstream) as shown in the following sketch (deflector shown in blue).



Drawing C-103

1. **Should there be a downward opening gate at the attraction water entrance?**

This comment was discussed previously.

2. **We need more manholes or transparency on the top of the 20 inch pipe**

Don Dow asked if a fish were to get stuck in the pipe how would the operator know and how would the fish be removed.

Greg explained more flushing flow could be added and that additional ports could be added so that the entire length of pipe could be inspected.

The group agreed that an additional access port is needed in the last straight section of pipe.

3. **We are still very worried about false attraction and need to discuss**

There was much discussion regarding the auxiliary spillway configuration adjacent to the fish lift entrance. Bryan questioned whether the bottom elevation of the aux spillway should be raised to limit false attraction in particular for salmon with strong swimming abilities. After lengthy discussion the group agreed that the current configuration would be best for far field attraction of fish to the fish lift entrance.

4. **could we have 1 stop log panel from the guide wall to the building perpendicular**

Bryan discussed a concern of the existing weir/ orifice panels upstream of the hopper and potential interference with the powerhouse. Greg and Dave explained there was not interference and the lines on the drawing outline a powerhouse buttress which slopes towards the powerhouse. This buttress does not interfere with the weir panel. Bryan discussed moving the weir further upstream extending from the guidewall to the powerhouse and eliminating the baffle. The group decided the current configuration is acceptable.

5. **can we move everything except the entrance closer to the dam**

Bryan requested more length be added to the fish lift channel to provide greater length for the holding pool. Greg discussed concerns of moving the hopper pit, which requires deep excavation, closer to the powerhouse and dam to avoid impacting the integrity of existing structures. Dave and Greg discussed keeping the same channel foot print upstream of the hopper but, moving the tower and hopper further upstream, by about 2 to 4 ft. In addition the entrance could be moved further downstream (~4 ft), but not into the flow path from the spillway. Bryan and the group agreed with these suggested changes to the fish lift channel.

6. **What happened to the gate drawings for the AWS system?**

A drawing was circulated during the meeting.

Drawing C-105

1. **Should the isolation gate be downward opening**
2. **We need to discuss the AWS to Tailrace Transition**

These items were discussed previously.

Drawing C-110

1. **Minimize the Gaps between stems & wall on entrance gate so Atlantic salmon and other species do not get caught**

Don discussed concerns with fish getting caught between the gate stems and channel wall. Dave mentioned that these gaps would be minimized to the extent possible.

2. **Greased Stems should not be in water**

Dave explained that the stems would not be greased (only the housing).

3. **Can we increase height of punch plate walls on hopper?**

The group agreed that the current height of 3 ft is acceptable and similar to Hydro Kennebec.

4. **The entrance gate does not meet the following:**
    a. **3ft of depth minimum over the weir**
    b. **Only meets the 4 to 6 fps because it does not meet the 3ft of depth**
    c. **doubtful to achieve 1/2 ft of HL at high tailwater**
    d. **can't meet higher HL at normal tailwater**

These items were discussed at length earlier in the meeting.

Drawing C-111

1. **Why is 2fps there inside gate on the elevation view?**

Greg explained that this note was a carryover from a previous design iteration and will be removed.

2. **No sharp edges**

Explained by Don Dow and noted by Greg and Dave. The brail was discussed and it was ultimately decided that grating would be acceptable as long as there were no sharp edges.

3. **What happens if pin on gate breaks?**

Drawing C-112

1. **What is a Gate Disc?**

A gate disc is terminology for the bulkhead portion of a gate (skin plate and associated framing).

Drawing C-115

1. **Where are the filler flap valves?**

Dave explained they would be located in the floor of the hopper.

2. **should have more details on this by now.**

3. **3ft high walls should be higher....likely out of water column and high enough so salmon can't jump out.**

The height of the walls were discussed previously

4. **Use punch plate not mesh for walls on top of hopper**

Dave agreed to change the design to use punch plate

5. **Need to show position of lifting cables**

Dave explained how the hopper would be supported. No lifting cables would extend below the water surface to the hopper. The hopper would be supported by a cradle with a single cable lifting the entire hopper structure well above the water surface.

Dave asked if there was a preference for the hopper to be painted, galvanized or made of stainless steel. The hopper at HK is painted, and Brookfield expects it will need to be repainted frequently. The hopper is likely too big for it to be galvanized. Gerry and Bob recommended going with a stainless hopper. Dave agreed to go with stainless.

Drawing C-119

1. **Need to Provide ManDoor**

Dave explained a man door would be included within the baffle in the fish lift channel.

Drawing C-301

1. **Please show elevation of upper edge of existing 3V:1H Rock Slope**

Greg explained that this can be added to the drawings by labeling the existing contours.

Drawing C-303 - See comments in regards to 600 cfs

Previously discussed

Drawing C-304

1. **Need more depth over hinged gate**

Bryan discussed the need for greater depth over the hinged flap gate (3 ft min for shad). Both Bryan and Don agreed that a 6 ft fishway entrance width should be the minimum width. Greg agreed to review the ability to increase flow through the fishway by increasing the slot width (currently 24 inches) at the upstream end of the channel. The goal is to provide at least 3 ft of depth over the flap gate for the range of operating conditions. The width of the fishway channel would be increased to at least 8 ft.

2. **How are gates operated?**

The hinged flap gate would be automated

3. **Shouldn't baffle slots be above isolation?**

Don agreed that the baffle slot should be as shown on the drawings, downstream of the isolation gate.

Greg also explained that there would be one baffle installed at the upstream end of the channel with a full depth 24 inch wide slot. The other baffle slot is included at the midpoint of the channel to provide flexibility

4. **What about eels?**

Bob Richter explained that an area adjacent the auxiliary spillway near the dam spillway may be a good location to collect eels. This location is similar to the current location, but would need to be confirmed in the field.

Drawing C-305 - See comments in regards to 600 cfs

Discussed previously

Tech Memo:

1. **Page 1 - Can we adjust Headloss looking to go as high as 1.5 ft over 20 to 40 ft**

Discussed previously

2. **Fig 3 - Shouldn't this be of lower velocity than the entrance?**

The group agreed that the current arrangement of the auxiliary spillway is acceptable.

3. **Fig 5 - 23 fps - need to have discussion on 23 fps vs velocity at entrance**

This was discussed previously

4. **DWG C-104 Note 1 - did not show depth**

Noted by Greg, and drawings will be updated.

5. **DWG C-104 Note 3 - Need more than 3 ft of screen**

This was discussed previously

6. **Page 8 - Has this tailwater curve been confirmed?**

Don asked if the tailwater curve has been confirmed. Greg mentioned that it was compared to CFD modeling done by John Richardson and appears to be close. A field comparison has not been done.

7. **Upper gate on AWS should not be used to control flow**
8. **Page 10 - need 3 ft of depth on Table 2**

These two items were discussed previously.

General discussion

Greg explained that Alden would update the footprint of the fish lift channel, by making it longer, as discussed. A new configuration of the Unit 7&8 fishway would also be developed based on discussions and these two plans would be submitted to the DRT for comment within the next few weeks. A quick response with comments was requested to limit impact to the schedule. Greg mentioned that Alden would move forward with all aspects of the design unless there were any other issues that need to be addressed. The group agreed that all issues were discussed and Alden can continue with all aspects of the design.

Kelly discussed the status of the Interim Species Protection Plan (ISSP) for Lockwood, Shawmut and Weston and explained an update would be submitted to FERC by March 30.

Greg mentioned the 90% drawings are scheduled to be submitted in February.

Action Items:

Alden to submit revised footprints of the fish lift channel and the unit 7&8 fishway.

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Greg Allen, Alden

Date: January 22, 2018

Re: **Follow up on action items from the 60% design review meeting**
Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities

---

Alden Research Laboratory, Inc. (Alden) met with Brookfield and the Design Review Team[1] (DRT) to discuss Alden's 60% design submittal for fish passage facilities at the Shawmut Hydroelectric project (Shawmut) on December 12, 2017. This memorandum provides additional information that was requested during the meeting and presents revised designs of the fish lift entrance flume and the unit 7 and 8 fishway channel. The following attached sheets have been updated for DRT review:

C-002, Overall Site Plan

C-103, Fish Lift General Arrangement Plan

C-110, Fish Lift Entrance Flume General Plan and Sections

C-303, Unit 7&8 Fish Passage General Plan

C-304, Unit 7&8 Fish Passage Plan and Sections

C-305, Unit 7&8 Fish Passage Sections

Alden requests confirmation from the DRT that the presented design is acceptable to advance to the 90% design review stage.

A summary of significant design changes and hydraulic design information is provided below.

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

Fish Lift

As discussed during the 60% design review meeting the entrance channel was lengthened to the extent practical to increase the holding pool area. The fish lift entrance was moved further into the river, but not so far as to protrude into the spillway flow. The fish lift hopper, hoist and tower were moved upstream by 4 ft. These changes added 8 ft to the holding pool which is now 19 ft in length. The entrance width was reduced to 10 ft as discussed during the meeting to provide 3 ft of water over the hinged entrance gate. A plan is shown in Figure 1 and hydraulic characteristics of the modified design are shown in Figure 2 and Figure 3.

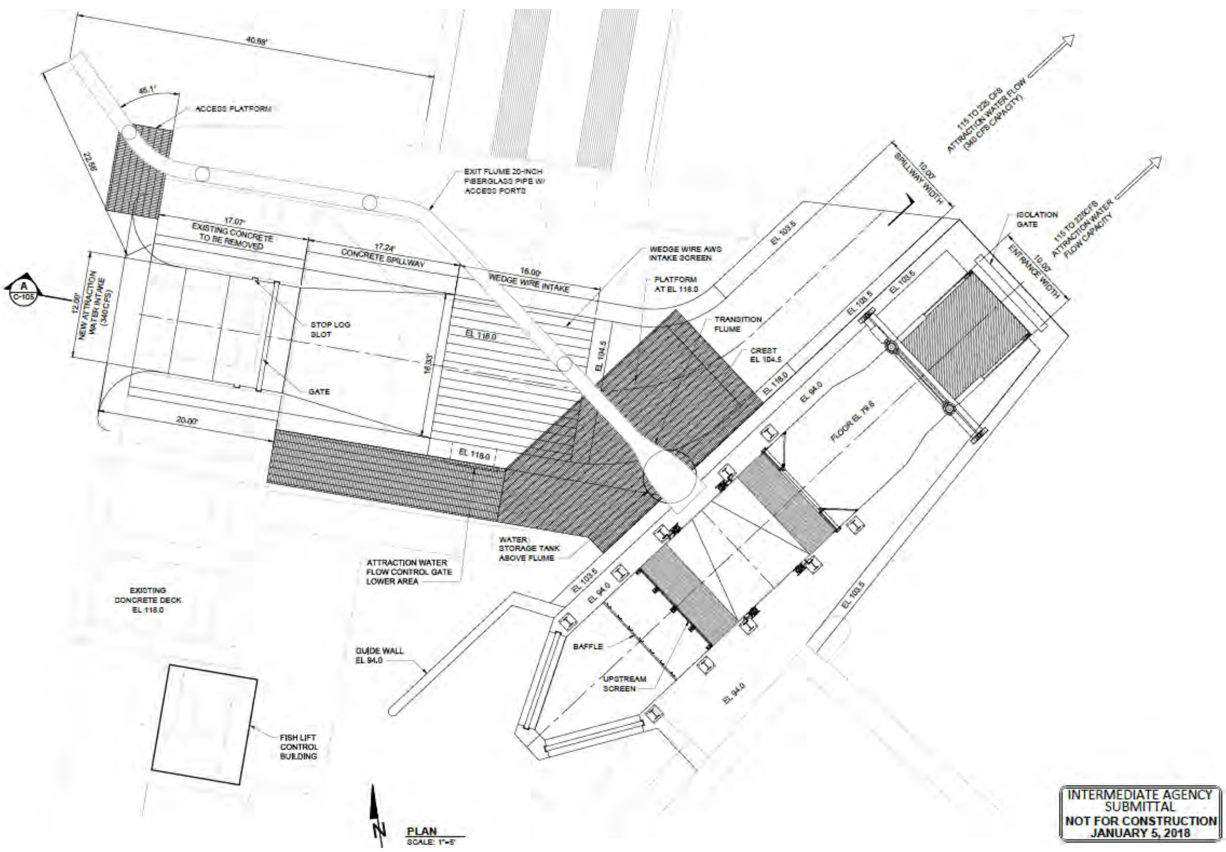


Figure 1. Fish Lift Entrance Channel Plan

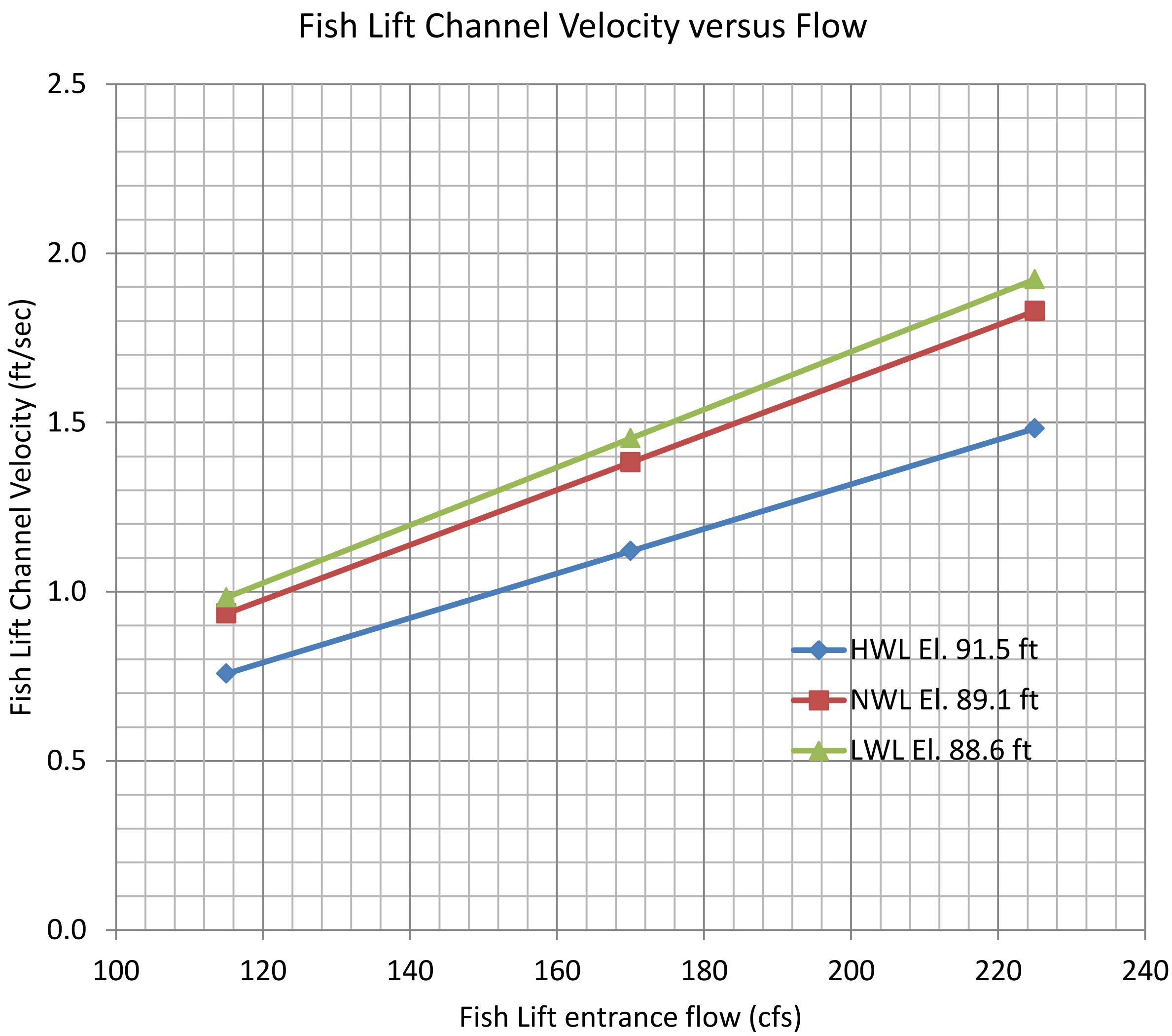


Figure 2. Fish lift entrance channel velocity versus flow rate for high, normal and low tailwater conditions.

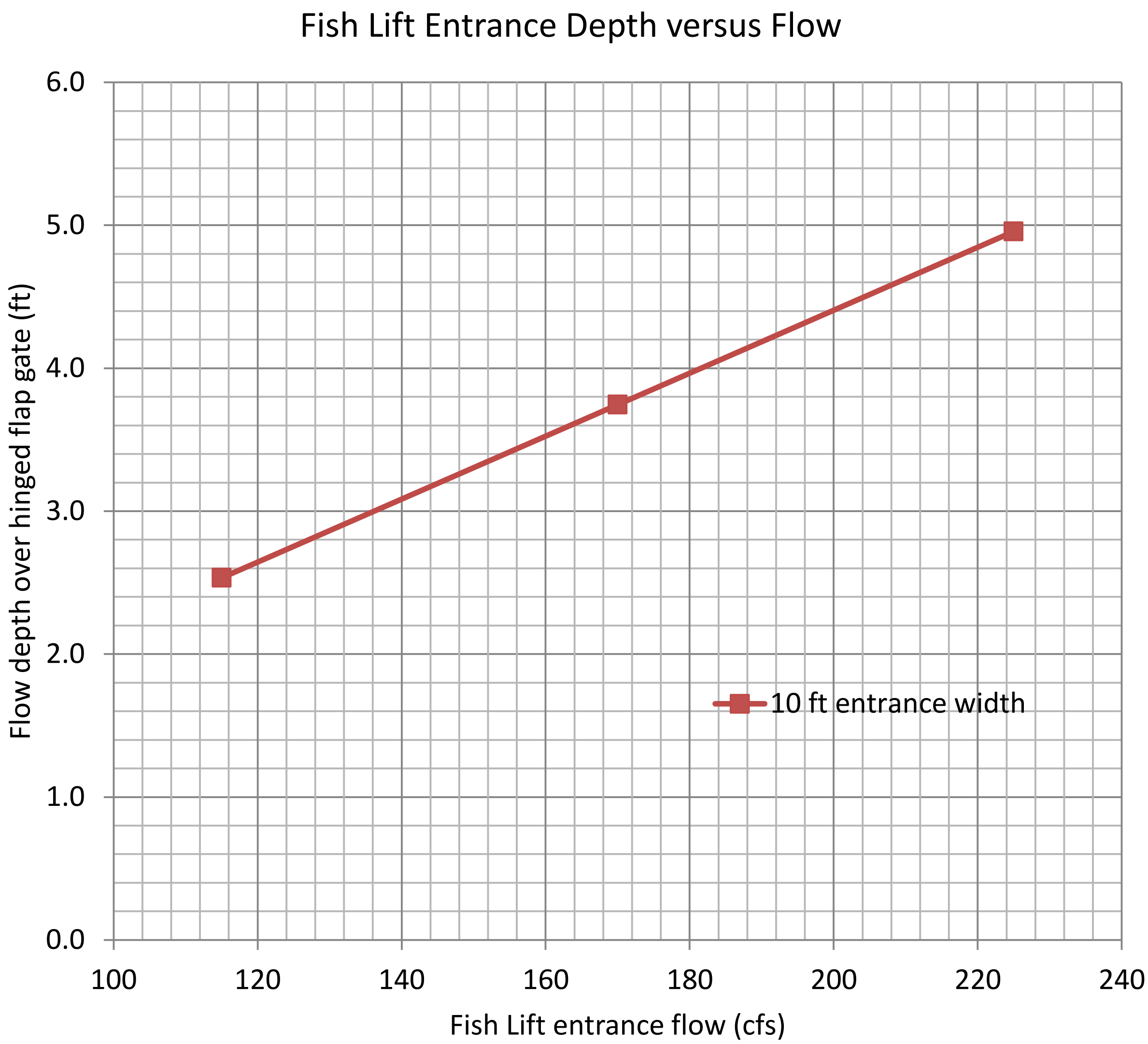


Figure 3. Fish lift entrance flow depth over the hinged flap gate versus flow for a 6 ft/sec entrance velocity condition.

Wedge Wire Screen Clear Spacing

FWS requested a 0.125 inch clear opening screen for the attraction water intake for Shawmut. After review of available wedge wire bar profile options, we recommend a screen clear opening of 0.25 inches, based on selection of a Hendrick T16 bar profile (see Figure 4) while maintaining a 50% screen open area. The T16 bar is a heavy duty bar profile which is recommended to withstand expected debris loading. Maintaining the 0.125 inch clear space with the T16 bar profile would reduce the screen open area, increase through screen velocity and increase

maintenance to remove debris. Therefore, we recommend a 0.25 inch clear spaced screen, which is less than FWS criteria of 0.375 inches for attraction water intakes (USFWS, 2017).

Profile Bar
Images not to scale

Profile Bar	B69	B6S	B6	B9S	B9	B12	T9M	T9	F12	T12	T16	T24
Bar Width	.069	.093	.093	.140	.140	.187	.140	.140	.187	.187	.250	.500
Bar Height	.290	.290	.375	.320	.375	.500	.453	.453	.500	.500	.750	.750
Cap Height	.080	.080	.093	.110	.125	.156	.125	.203	.185	.188	.250	.250

- *304L, 316L, Various Grades of Stainless & Exotic Alloys, Carbon Aluminum (6061) in B9, B12 & T16*
- *Non-welded Interlocked Construction*

Figure 4. Hendrick Screen Wedge Wire Profile Bar Options

Unit 7&8 Fish Passage Channel

The Unit 7 and 8 fish passage channel has been modified based on discussions during the meeting. The flow through the channel has been increased to provide greater flow depth over the entrance hinged flap gate. The channel width has been increased to 10.5 ft and a full depth vertical slot at the upstream end of the channel will have a 42 inch opening width. The channel now has an operating range of 90 cfs to 140 cfs for the range of tailwater conditions. A plan of the modified design is shown in Figure 5 and hydraulic characteristics are provided in Figure 6 and Figure 7.

The 60% DRT meeting included a discussion of the taintor gate spillway discharge adjacent to the fish passage channel and a concern that this flow may interfere with the fishway flow. The DRT recommended that the taintor gate spillway channel deflect the flow to the right (looking downstream) away from the fish passage channel entrance. We have consider and reviewed potential deflectors to steer the flow away from the fishway entrance since the meeting and we are concerned that deflecting the high velocity taintor gate flow could have the unintended consequence of creating an eddy near the fishway entrance. Therefore, we do not recommend deflecting the taintor gate flow as discussed during the 60% DRT meeting. If the DRT would like to pursue this option further, we would recommend the use of CFD modeling to aid and optimize the design to avoid unintended adverse conditions for fish passage.

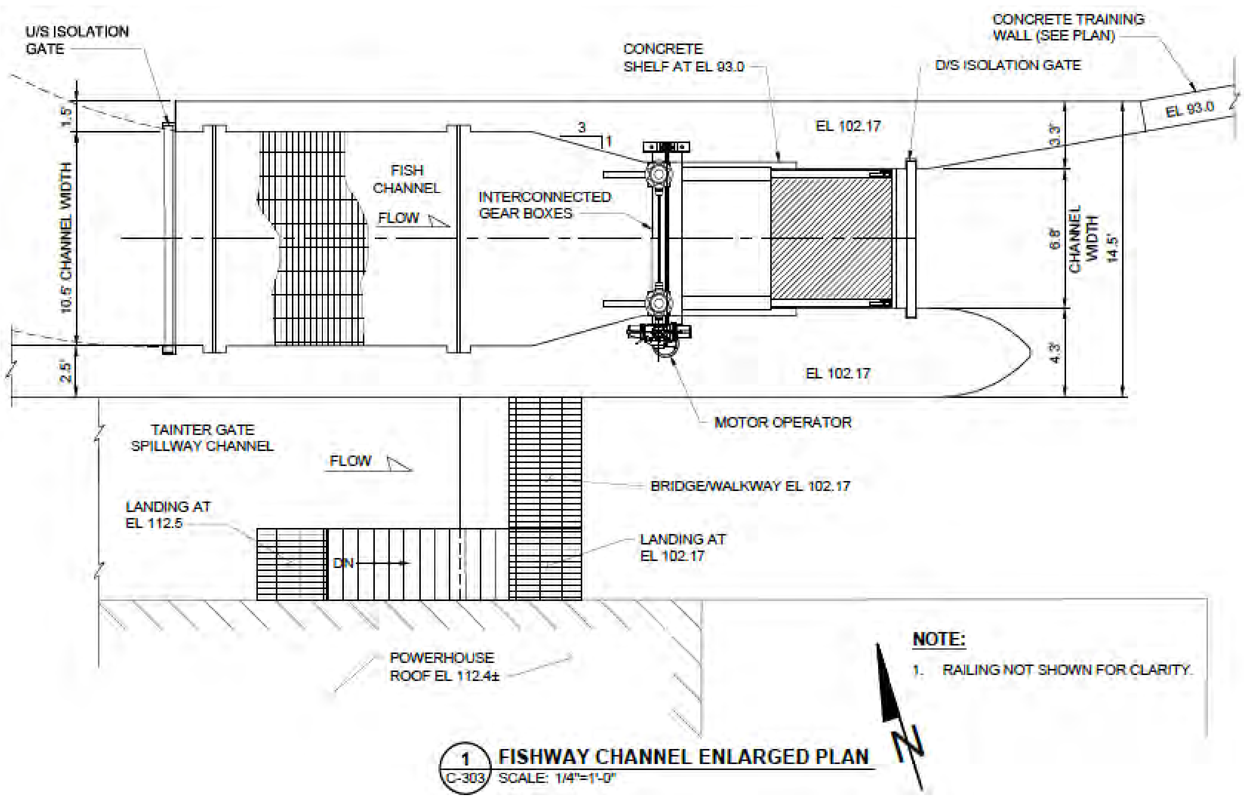


Figure 5. Unit 7&8 fish passage channel plan

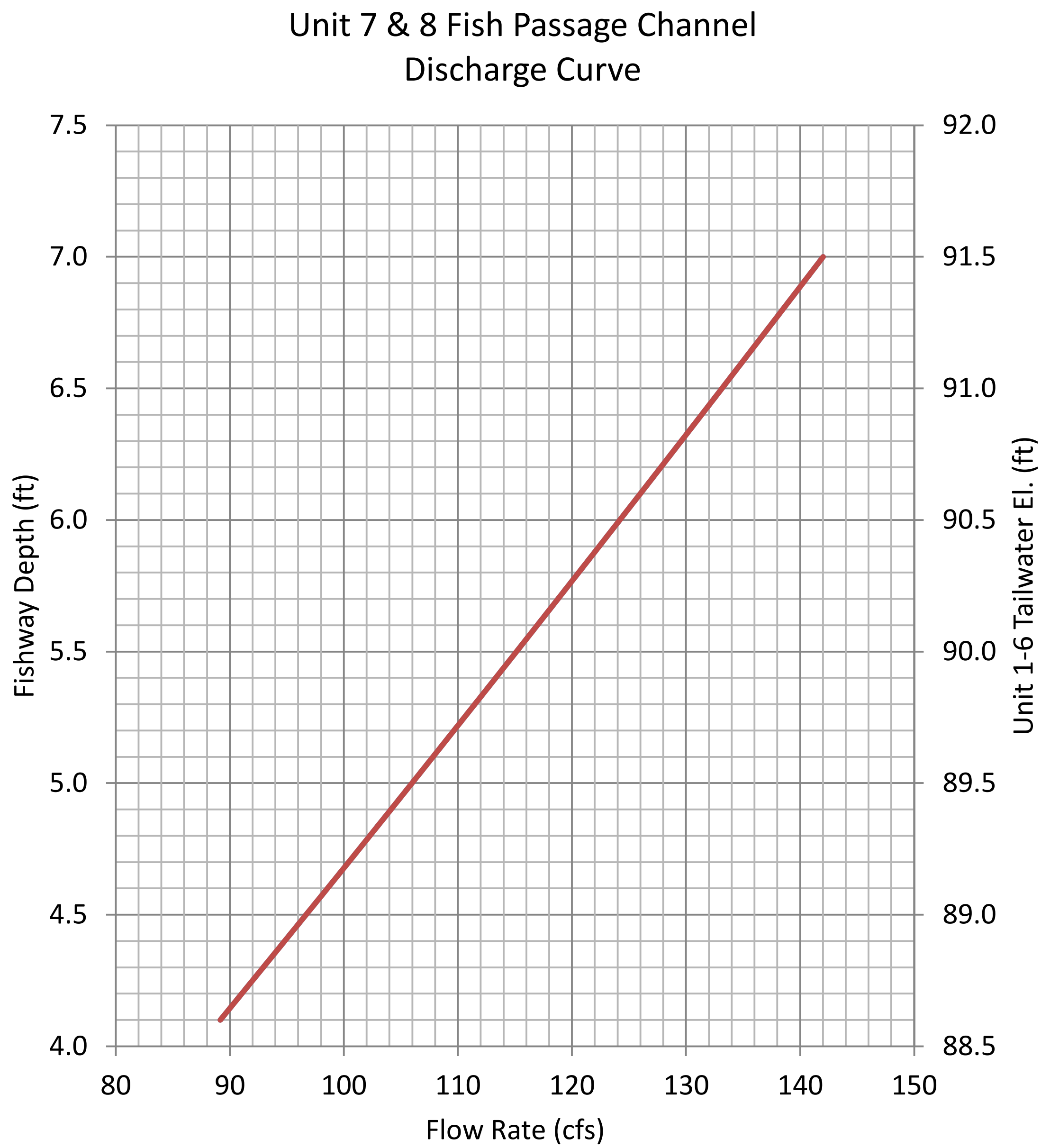


Figure 6. Unit 7&8 fish passage channel discharge curve for a full depth 42 inch wide baffle slot.

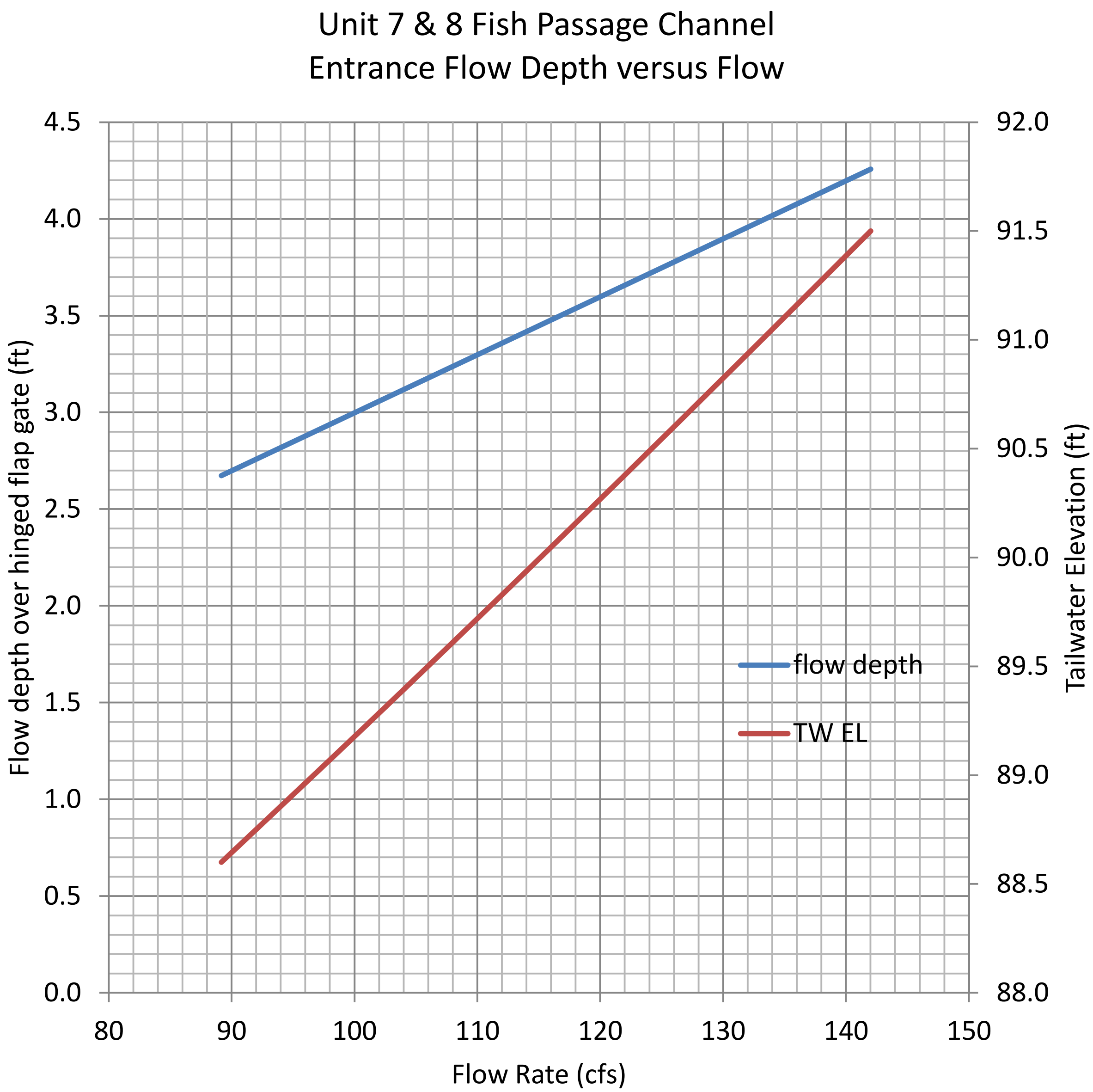


Figure 7. Unit 7&8 fish passage channel entrance flow depth over the hinged flap gate versus flow.

References

USFWS. (2017). *Fish Passage Engineering Design Criteria.* Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region R5.

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 11:11 AM
To: Greg Allen
Subject: Fwd: Shawmut 60% Design Supplemental Drawings DRT Comments
Attachments: Shawmut 60% Design Review Team Draft Comments-Discussion points.docx

---------- Forwarded message ---------
From: **Donald Dow - NOAA Federal** <donald.dow@noaa.gov>
Date: Fri, Feb 2, 2018 at 3:27 PM
Subject: Shawmut 60% Design Supplemental Drawings DRT Comments
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Cc: Greg Allen <gallen@aldenlab.com>, Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>, Wippelhauser, Gail <gail.wippelhauser@maine.gov>, Christman, Paul <Paul.Christman@maine.gov>, Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>

Good Afternoon Richard –

I would like to thank you for the opportunity to review the 60% Shawmut Upstream Fish Passage Design - Supplemental Submittal. The Design Review Team (DRT), consisting of representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries & Wildlife (IF&W), United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), met with Brookfield and their consultant Alden Labs on December 13th to collectively review the design and the DRT comments. DRT comments were submitted prior to the meeting noted as "Draft for Discussion only". At the end of that meeting it was agreed that Alden had enough information from that meeting to continue working on the 90% design. Brookfield submitted a supplemental 60% design to the Agencies on January 22nd.

The only comment that we have on the supplemental submittal is that we would like to request an extension of the existing 3-D hydraulic model for the tailrace area below Unit 7/8 including the proposed training wall and the flow through the fish passage between the two tailraces. We feel that it is important to verify that this area will have streamlined flow free from broken eddys, hydraulic jumps, etc. that will adequately attract fish.

We would also request that for the 90% design that Alden review the "draft for discussion only" comments and answer each comment on how they handled it for the 90% design. We have reattached that document with this email. This document is unedited based upon our meeting so some comments may have been agreed to be not applicable.

This review has been done collectively with all pertinent agencies and may or may not completely reflect each agency's comments. If the agencies have additional comments or disagreements outside of the DRT comments they would file a separate comment letter to Brookfield.

This review was done considering the biological and engineering hydraulic principles to design an effective upstream fishway considering NMFS and USFWS design standards as well as engineering and biological judgments if necessary. This review was not done considering Life Safety Codes, Building Codes, Allowable Stress Design, or Load Resistance Factor Design, or any other typical engineering design codes for concrete, steel, structures, or building. We have assumed that the consulting engineer has taken those codes and practices into consideration

Regards,

Don

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

--

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

Gregory Allen

From: Gregory Allen
Sent: Wednesday, August 22, 2018 12:55 PM
To: 'donald.dow@noaa.gov'; 'gail.wippelhauser@maine.gov'; 'Paul.Christman@maine.gov'; 'antonio_bentivoglio@fws.gov'; 'Bryan Sojkowski'; 'Dwayne.J.Seiders@maine.gov'; 'Matt Buhyoff - NOAA Federal'
Cc: 'Maloney, Kelly'; Dill, Richard; 'Mitchell, Gerry'; John Richardson (jrichardson@bluehillhydraulics.com); Dave Robinson (home); Steve Amaral
Subject: Shawmut CFD results and meeting request
Attachments: Shawmut Preferred Design (8-6-18).pdf

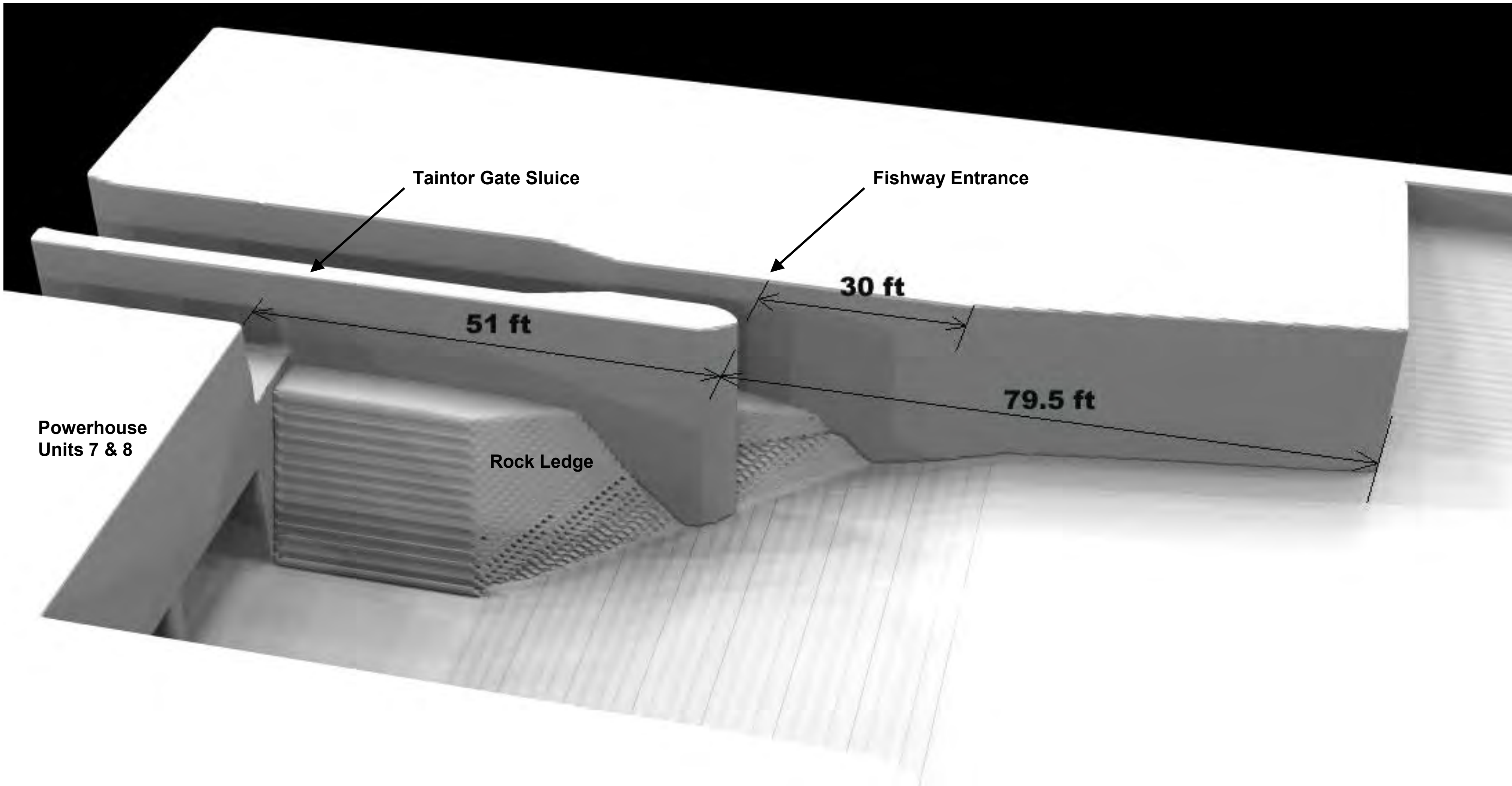
Hello Everyone,
Based on feedback we received from the Design Review Team (DRT) regarding Brookfield's submittal of the 60% design for fish passage facilities at Shawmut, we have completed a 3-D hydraulic model (CFD) of the Unit 7&8 tailrace to evaluate the hydraulic conditions approaching the fish passage between the two tailraces. CFD results of our recommended design are attached. Simulations were run for a worse case condition, assuming Unit 7&8 units are not running at the 95% exceedance river flow and a 600 cfs discharge from the tainter gate sluice. This recommended design is the result of 7 design iterations and we can share details of the various iterations during a meeting, if needed. In addition, we have been continuing with the design effort for the fish lift facilities adjacent to the spillway and we can share and present details during the meeting to review CFD results.

Please let us know if you are available to meet on Monday, September 17 to discuss these CFD results. Alternate dates the following week include Sept 24, 26, 27 & 28.

Thank you,
Greg

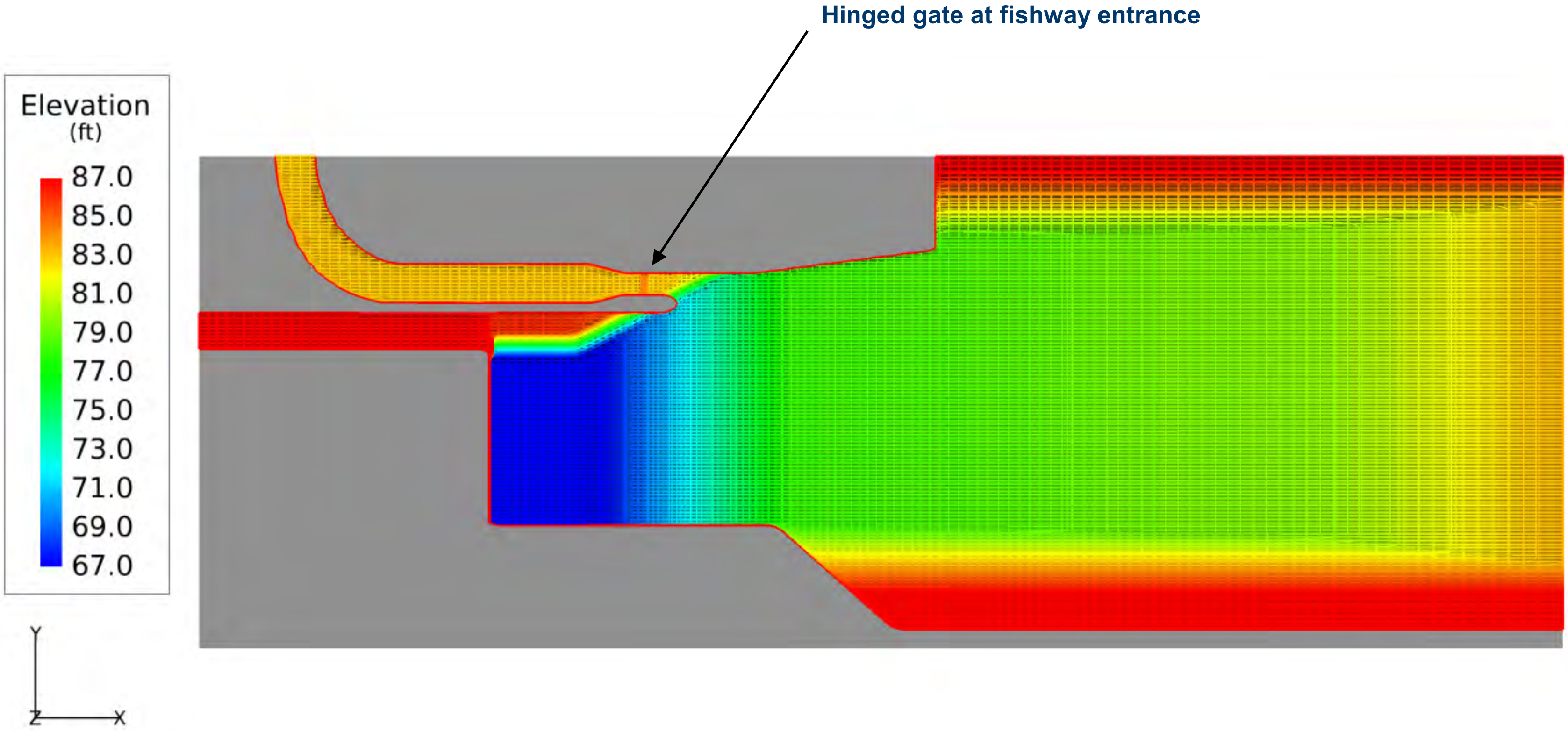
Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

Proposed Upstream Fishway Configuration



Fishway – Three Dimensional Perspective

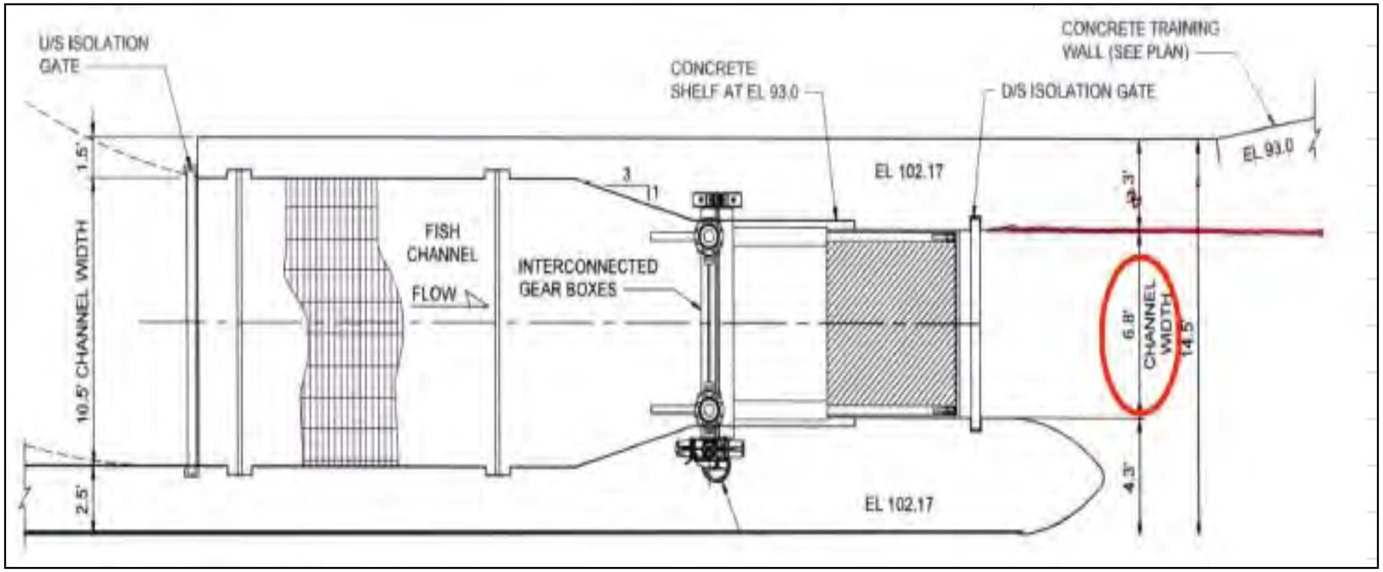
Proposed Upstream Fishway Configuration – Plan View



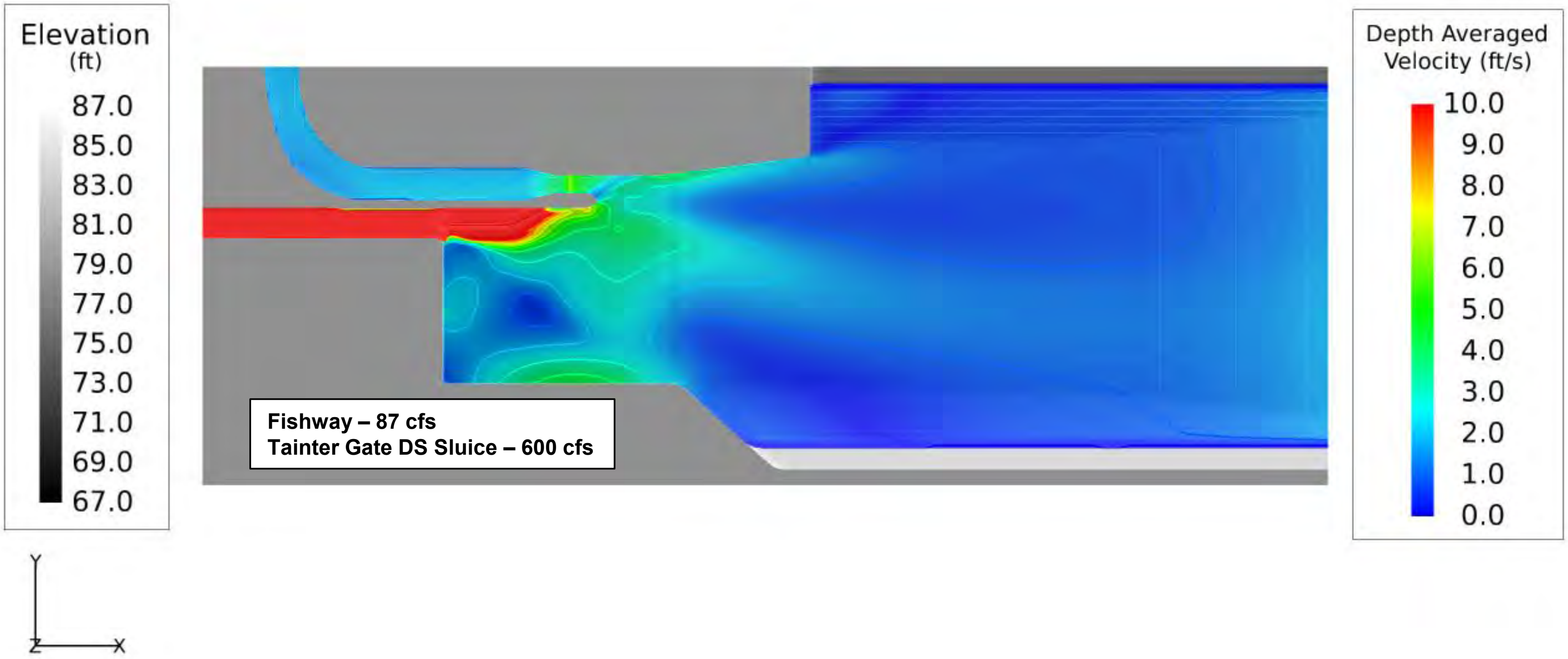
Model Domain with Grid Overlay

Model Boundary Conditions and Fishway Entrance Setup

95% Exceedance River Flow Condition	2540 cfs
Taintor Gate Sluice Discharge	600 cfs
Fishway Channel Discharge	87 cfs
Total Tailrace Flow	687 cfs
Approx. Unit 7 & 8 Tailwater Elevation	87.1 ft
Hinged Gate Setting / Elevation	84.5 ft
Depth Over Gate	2.6 ft
Gate Width	6.8 ft

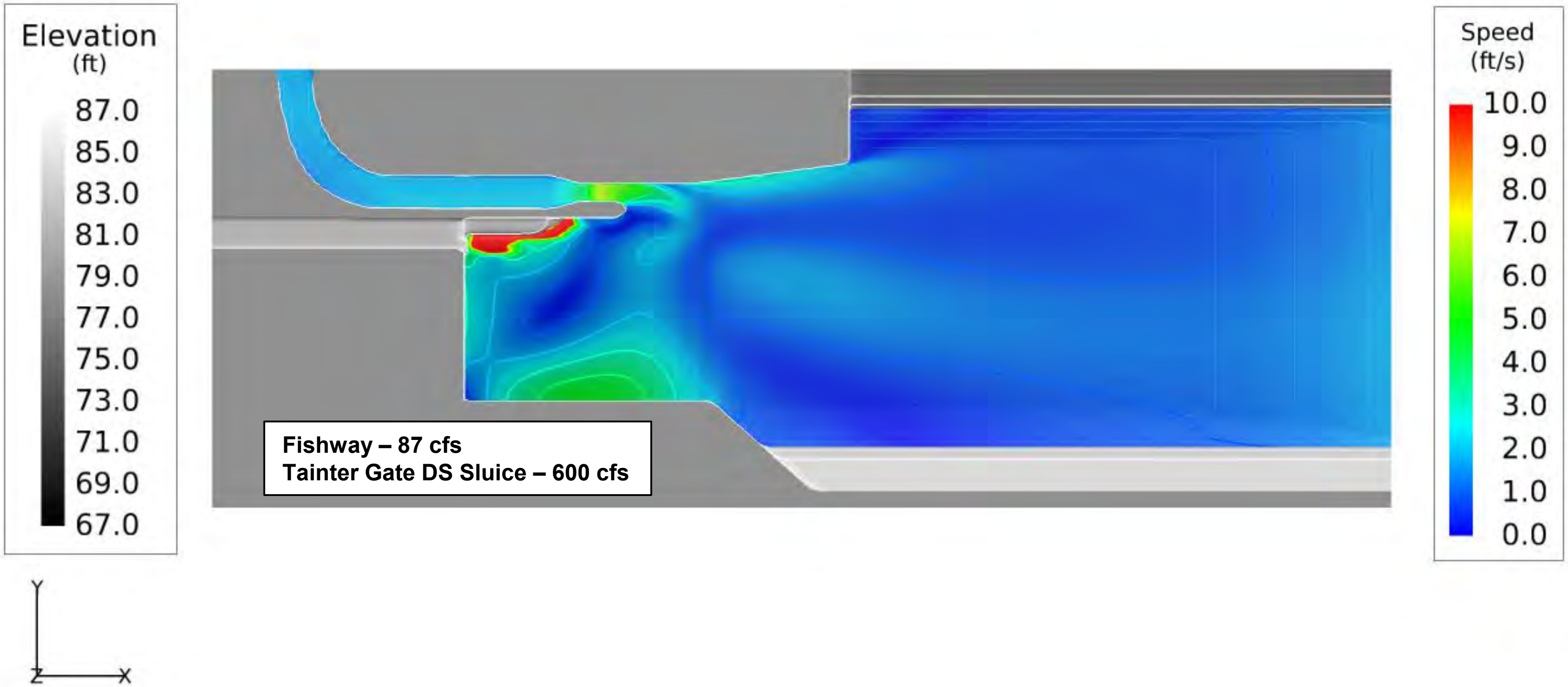


Simulation Results



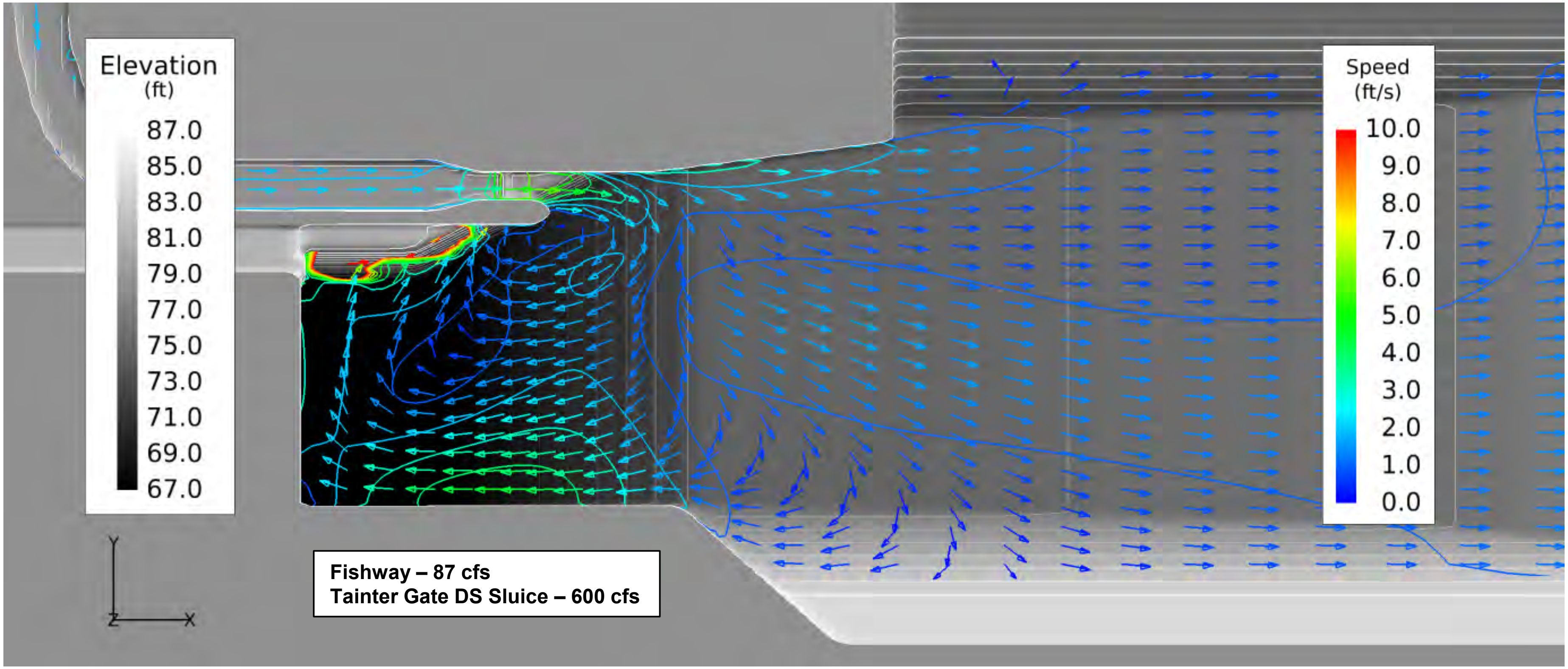
Depth Averaged Velocity
(plotting plane elevation – 88.4 ft)

Simulation Results



Flow Speeds
(plotting plane elevation 85.0 ft, 2.1 ft below surface)

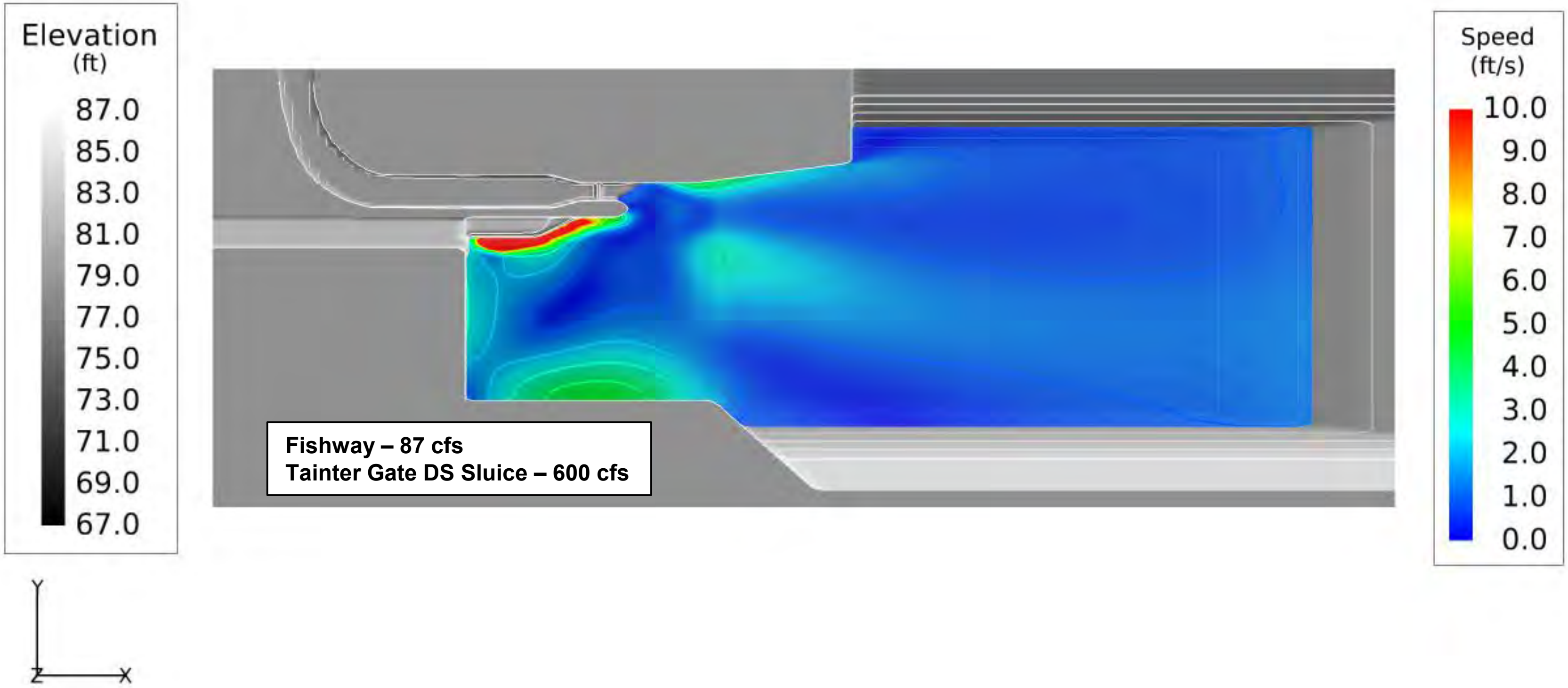
Simulation Results



Total Vectors colored by Speed
(plotting plane elevation 85.0 ft, 2.1 ft below surface)

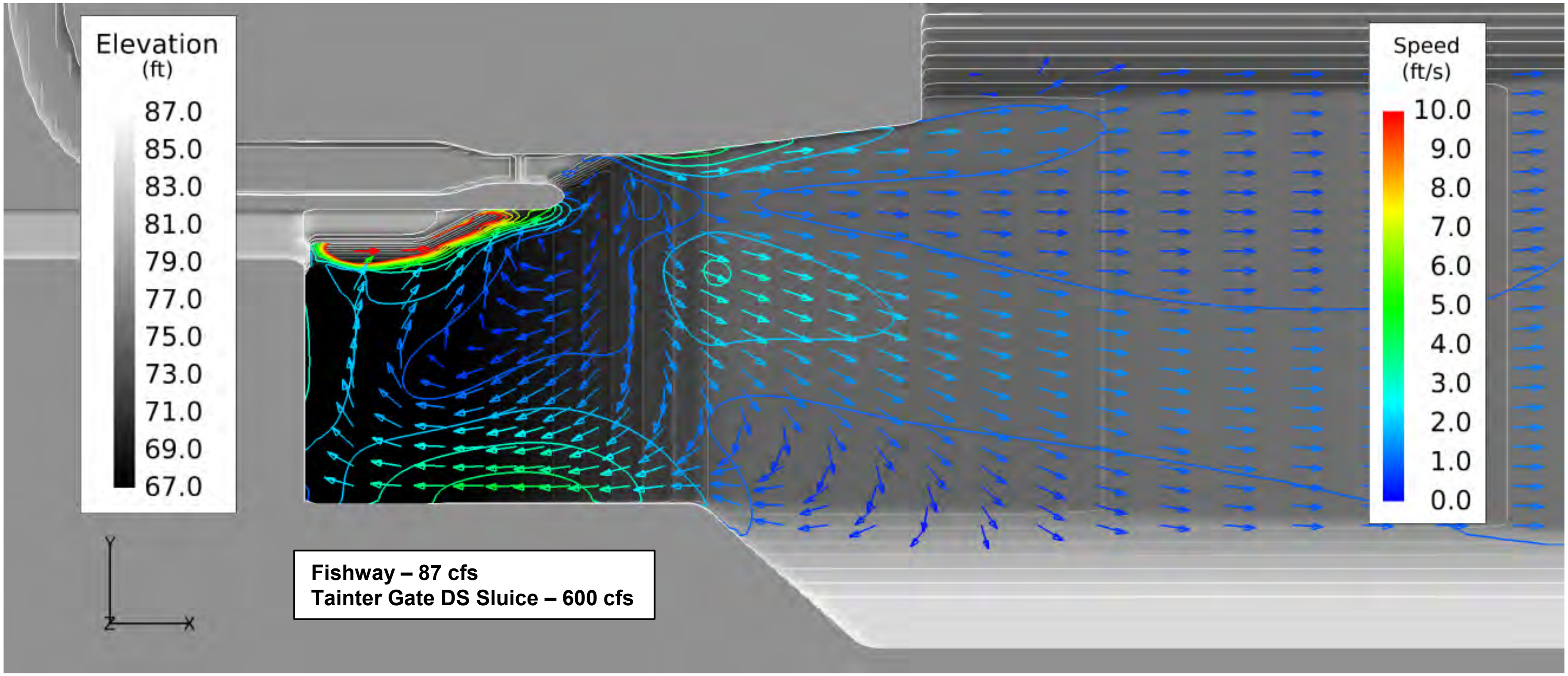
Every 4th Vector Shown

Simulation Results



Flow Speeds
(plotting plane elevation 82.0 ft, 5.1 ft below surface)

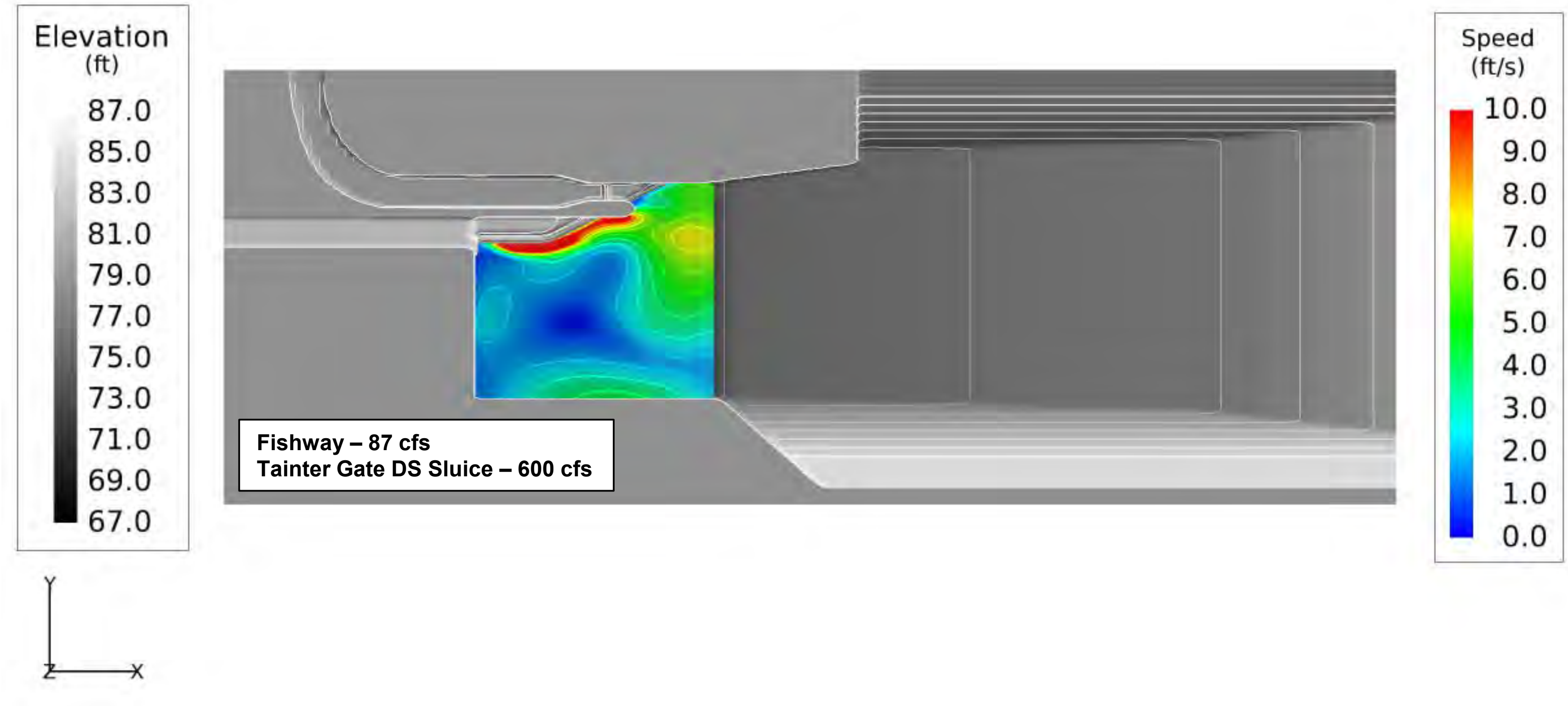
Simulation Results



Total Vectors colored by Speed
(plotting plane elevation 82.0 ft, 5.1 ft below surface)

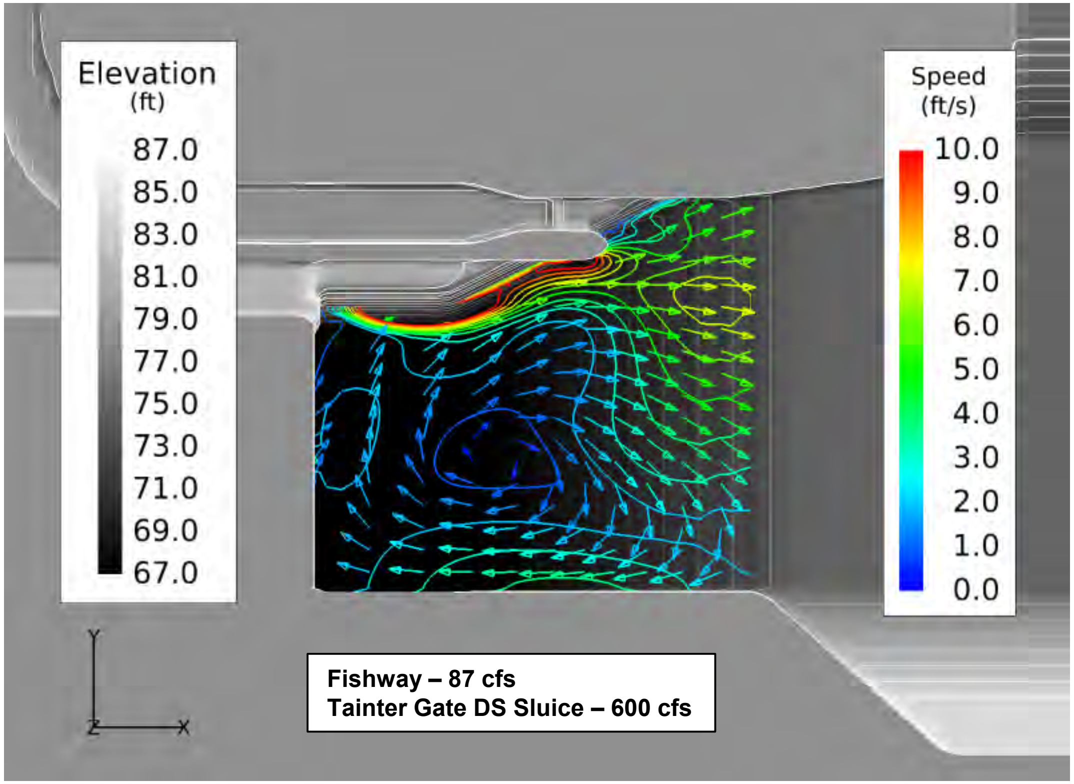
Every 4th Vector Shown

Simulation Results



Flow Speeds
(plotting plane elevation 77.0 ft, 10.1 ft below surface)

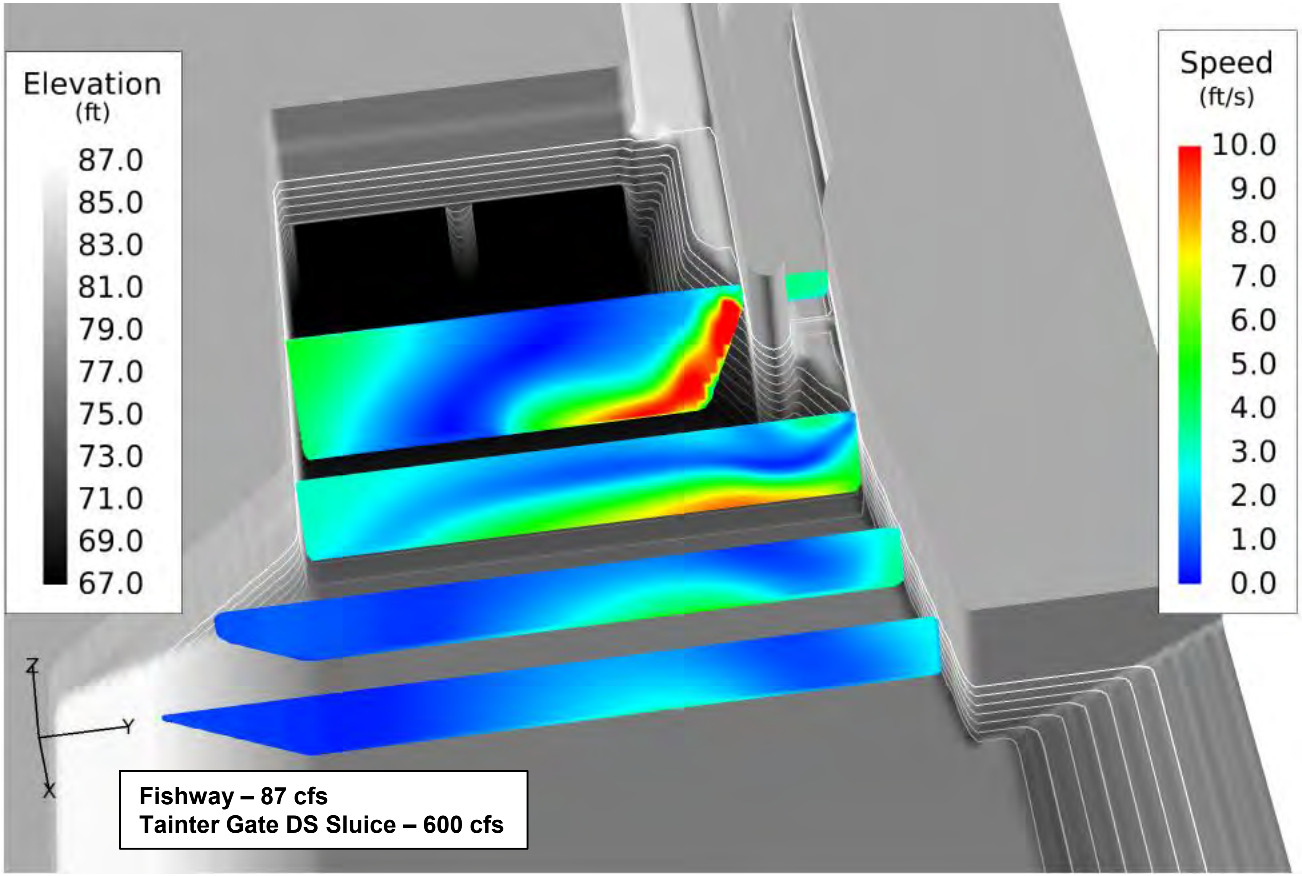
Simulation Results



Total Vectors colored by Speed
(plotting plane elevation 77.0 ft, 10.1 ft below surface)

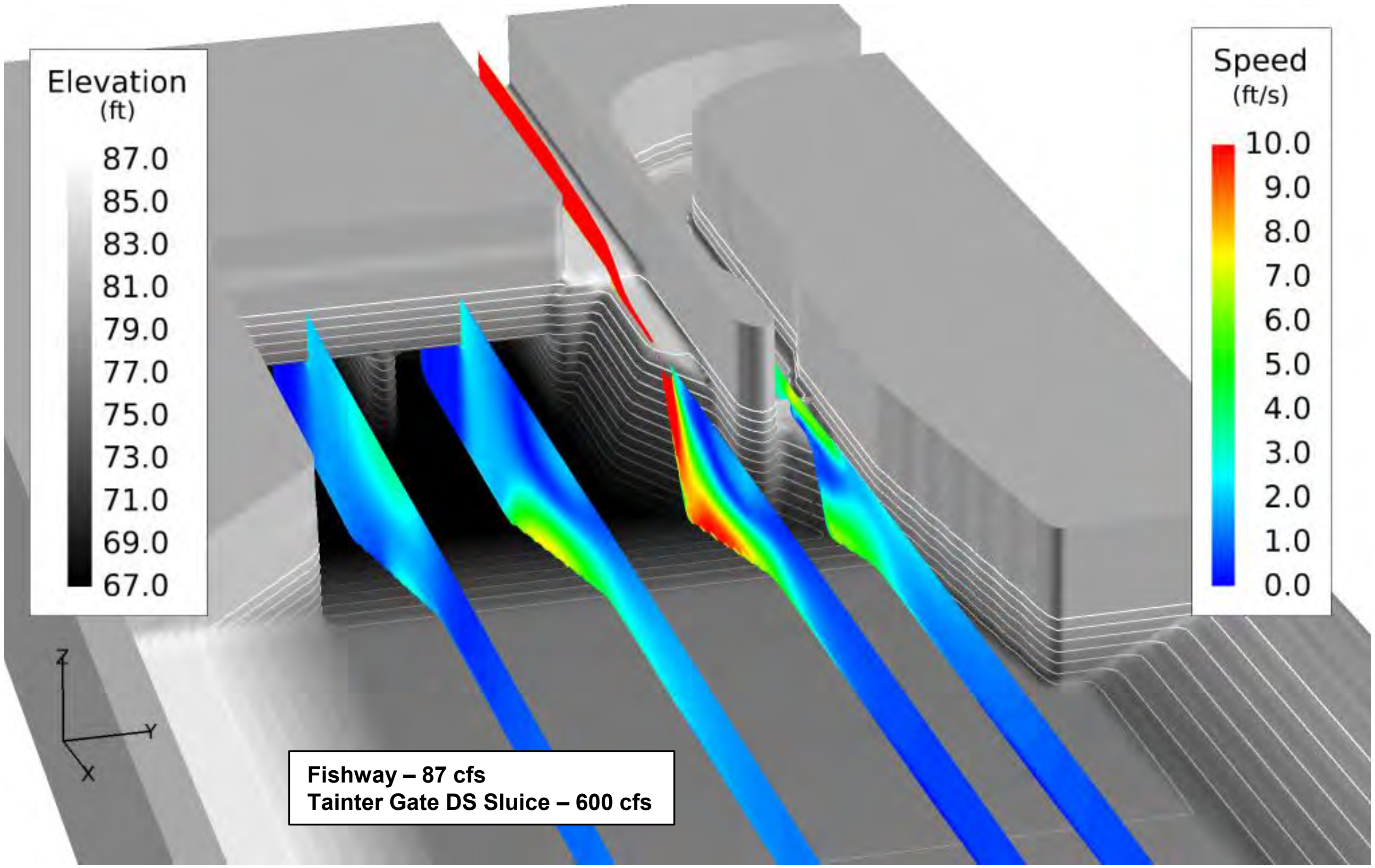
Every 4th Vector Shown

Simulation Results



Flow Speeds

Simulation Results



Flow Speeds

DRAFT

Meeting Notes
Shawmut Design Review Team Meeting
Thursday, September 27, 2018
9:00 AM – 11:00 AM

Attendees:

Bryan Sojkowski (USFWS)
Antonio Bentivoglio (USFWS)
Donald Dow (NOAA)
Matt Buhyoff (NOAA)
Gail Wippelhauser, via phone (MDMR)
Jason Seiders (IF&W)
Kelly Maloney, via phone (Brookfield)
Richard Dill (Brookfield)
Gerry Mitchell (Brookfield)
Stephen Amaral, via phone (Alden)
Dave Robinson (Alden)
Greg Allen (Alden)
John Richardson (Blue Hill Hydraulics)

A design review team (DRT) meeting was held at the US Fish and Wildlife's office in Falmouth, ME for the Shawmut Fish Passage Project to review CFD results of the proposed Unit 7&8 fishway. The design review team includes NMFS, FWS, IF&W and MDMR resource agencies.

The meeting began with a review of activities and schedules of projects on the Kennebec River. The DRT requested an update regarding the design status for both Lockwood and Weston. Kelly explained that the projects have been on hold awaiting acceptance of a new Species Protection Plan and the results of the Kennebec River Feasibility Assessment.

The schedule for fish passage modifications to be completed at Lockwood is 2022. Options under consideration for a spillway fishway include a vertical slot ladder and a nature-like fishway (NLF). Brookfield is awaiting completion of the Kennebec River Feasibility Assessment which reviewed various NLF options.

Kelly also explained that Brookfield intends to move forward with a fish lift design at Weston with an entrance near the log sluice with design provisions to accommodate the addition of a second entrance at some future date.

Gerry and Greg discussed the Shawmut design schedule. Greg mentioned the 90% design package would be submitted within 4 to 6 weeks of this meeting, assuming the DRT accepts the proposed design. Gerry reviewed a schedule he sent to the DRT previously as follows:

90% design submittal to agencies	October 30, 2018
30 day agency comment period	
Final construction bid	August 2019
Permitting	2019
Start construction	January 2020
Operational	April 2021

John Richardson presented the CFD results of the Unit 7&8 fishway. The proposed design presented was the result of 7 design iterations and CFD modeling. The fishway entrance is 51 ft downstream from the powerhouse, approximately 40 ft further downstream than the initial design. John Richardson also briefly reviewed the CFD results of the design iterations.

The group was in agreement that the proposed design for the Unit 7&8 fishway was acceptable.

Greg explained that the fish lift design has progressed and is at about the 90% design level and he provided work-in-progress drawings to the group. Greg explained that the fish lift entrance flume was lengthened by 8 ft and the entrance width reduced to 10 ft following feedback from the 60% DRT review meeting. Dave Robinson explained the design of the entrance flap gate and drive system and that all greased components would be above water. Dave also explained alternatives to greased components.

Action Items:

Alden to submit the 90% design package within 4 to 6 weeks.

Brian McMahon

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Wednesday, October 03, 2018 12:31 PM
To: John Richardson (jrichardson@bluehillhydraulics.com)
Cc: Donald Dow - NOAA Affiliate; gallen@aldenlab.com; Gail Wippelhauser; Paul Christman; Bryan Sojkowski; Seiders, Dwayne J; Matt Buhyoff; Maloney, Kelly; Dill, Richard; Mitchell, Gerry; daverobinson111@yahoo.com; amaral@aldenlab.com
Subject: Re: [EXTERNAL] Shawmut Design Review Meeting

That is what I hoped would be the answer. Thanks John. No other questions.

On Wed, Oct 3, 2018 at 11:55 AM Blue Hill Hydraulics <jrichardson@bluehillhydraulics.com> wrote:

> **No**, 0.0 velocities across the 1.3 ft distance you identified were not included in the averages.
>
> The depth-averaged flow speeds were determined by the CFD program (in this case ***FLOW-3D***). In this case, the program calculated the average flow speed between the fluid free surface and "bottom" in a plan view area.
>
> NOTE: the 88.4 ft elevation was chosen for plotting to appropriately show "water in the sluice."
>
> Let me know if this answers your question. If not, then I can give you a call to discuss.
>
> **From:** Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
> **Sent:** Wednesday, October 3, 2018 10:04 AM
> **To:** gallen@aldenlab.com
> **Cc:** Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>; Gail Wippelhauser <gail.wippelhauser@maine.gov>; Paul Christman <Paul.Christman@maine.gov>; Bryan Sojkowski <Bryan_Sojkowski@fws.gov>; Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>; Matt Buhyoff <matt.buhyoff@noaa.gov>; Kelly Maloney <Kelly.Maloney@brookfieldrenewable.com>; Richard Dill <Richard.Dill@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; John Richardson (jrichardson@bluehillhydraulics.com) <jrichardson@bluehillhydraulics.com>; daverobinson111@yahoo.com; amaral@aldenlab.com
> **Subject:** Re: [EXTERNAL] Shawmut Design Review Meeting
>
> Greg and John,

Thanks for the presentation you gave us last week.

I just had a follow up question about the CFD modeling. When we were talking about the Depth Average Velocity slide. I mentioned that the plotting plane elevation was 88.4ft but the tailrace was 87.1ft. My Q is, is the difference between the two, 1.3ft, included in the averaging? Presumable the velocity in the 1.3ft would be 0 so is this averaged into the results or is the 88.4ft just an upper limit and the averaging only starts once the "water", at 87.1ft, is met?

On Thu, Aug 30, 2018 at 11:52 AM <gallen@aldenlab.com> wrote:

Meeting to discuss design status and CFD results for the Shawmut Fish Passage Project.

Draft Agenda

- Review CFD results for Unit 7&8 fishway
- Discuss recommended Unit 7&8 fishway design
- Review status and design of fish lift

<<...>>

--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 11:04 AM
To: Greg Allen
Subject: Fwd: Shawmut 90% Design submittal
Attachments: Alden 90 Perc Design submittal memo 11-15-2018.pdf

---------- Forwarded message ---------
From: **Gregory Allen** <gallen@aldenlab.com>
Date: Thu, Nov 29, 2018 at 3:08 PM
Subject: Shawmut 90% Design submittal
To: <donald.dow@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, <Dwayne.J.Seiders@maine.gov>, Dill, Richard <Richard.Dill@brookfieldrenewable.com>, Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>, <Paul.Christman@maine.gov>, Steve Amaral <amaral@aldenlab.com>, <antonio_bentivoglio@fws.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Dave Robinson (home) <daverobinson111@yahoo.com>, <gail.wippelhauser@maine.gov>, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>

Hello Everyone,

The 90% design drawings for Shawmut can be downloaded from the link below. There are two files, one for the electrical/ controls design and the other the civil/ structural design. I have also attached a memo that provides explanations on how we addressed the DRT's comments received from the 60% design. We would like to schedule a 90% design review meeting after the holidays. We will propose some dates in a separate email.

https://we.tl/t-6qH7ZFpUMT

Let me know if anyone has trouble downloading the drawings.

Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Greg Allen, Alden

Date: November 15, 2018

Re: **90% design submittal**
Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities

---

Alden Research Laboratory, Inc. (Alden) has developed a 90% design submittal for fish passage facilities at the Shawmut Hydroelectric project (Shawmut). This design submittal addresses comments received from the Design Review Team[1] (DRT) and discussions from the 60% design review meeting on December 13, 2017. Written comments were received from the DRT on November 29, 2017 and February 2, 2018. Alden provided a response to action items developed from the 60% design review meeting in a memorandum (attached) and supplemental drawings on January 22, 2018. As requested by the DRT, this memorandum summarizes how each comment was addressed in this 90% design submittal.

DRT's comments are shown in bold, followed by an explanation of how the comments were addressed.

Drawing G-002

1. **Note 6 Entrance Velocity 4 to 6 fps, 6 to 8 fps capable**

Reference to entrance velocity was removed from note 6. A target head drop of 6 inches is included, which corresponds to an entrance velocity of 6 ft/sec. The hydraulic conditions of the fish lift entrance are discussed in Alden's January 22 memo.

2. **Note 6 Entrance Depth 3ft Minimum under all circumstances**

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

As discussed during the 60% DRT review meeting, the entrance width was reduced to 10 ft to provide greater entrance depth. The entrance depth conditions are provided in Alden's January 22nd memo.

3. **Note 7 Need to Discuss flow apportionment with Alden and Brookfield**

Attraction flow discharged through the fish lift entrance and AWS auxiliary spillway was discussed in depth during the 60% DRT review meeting. The outcome of the discussion was to provide flexibility to adjust the flow split between the AWS auxiliary spillway and the fish lift over a broad range as follows;

- Total attraction flow – 340 cfs (5% of station capacity)
- AWS auxiliary spillway – up to 340 cfs
- Fish lift entrance – up to 225 cfs

It was agreed that the fish lift channel would have the capacity to operate between 115 and 225 cfs to provide operational flexibility, while the remainder of the total 340 cfs attraction water flow would be discharged through the auxiliary spillway.

4. **Note 10 Please include Grade of Exit Flume**

Included, 5% grade

Drawing C-002

1. **There are no drawings of the control gates that we could find**

Now included

2. **Can you throttle the 115 cfs?**

Flow is adjustable through the fish lift entrance up to 225 cfs.

3. **Is attraction water gate downward opening? - Does it need to be?**

The gate for the AWS is an isolation gate that opens upward. The AWS intake includes geometry of a NU/ Alden weir and for ideal operation it is important that there are no obstructions in the flow path. If desired, the gate could be throttled, but under normal operation the gate would be either fully open or fully closed. As discussed during the 60% DRT review meeting the elevation of the weir crest controls the total AWS flow.

4. **Need to discuss the 600 cfs vs 50 to 80 cfs in Fish Bypass Channel**
    a. **Could we discharge 600 cfs to old powerhouse tailrace**
    b. **or use wedged wire screen and some of the 600 cfs to fishway bypass and make it wider?**

Computational Fluid Dynamic (CFD) modeling was conducted to optimize the Unit 7&8 fishway entrance relative to the 600 cfs tainter gate flow. A meeting with the DRT was held on September 27, 2018 to review the CFD results and the recommended Unit 7&8 fishway channel configuration. This 90% design submittal reflects the recommended geometry from CFD modeling.

Drawing C-103

1. **Should there be a downward opening gate at the attraction water entrance?**

Discussed previously

2. **We need more manholes or transparency on the top of the 20 inch pipe**

A total of 3 manholes are included so that the entire exit pipe length is visible for inspection.

3. **We are still very worried about false attraction and need to discuss**
4. **could we have 1 stop log panel from the guide wall to the building perpendicular**
5. **can we move everything except the entrance closer to the dam**
6. **What happened to the gate drawings for the AWS system?**

As a result of a discussion on the above items during the 60% DRT design review meeting, the fish lift channel was lengthened by 8 ft. Additional detail is provided in the January 22 memo.

Drawing C-105

1. **Should the isolation gate be downward opening**

Discussed previously

2. **We need to discuss the AWS to Tailrace Transition**

This was discussed during the 60% DRT review meeting and the current design reflects the outcome of the discussion.

Drawing C-110

1. **Minimize the Gaps between stems & wall on entrance gate so Atlantic salmon and other species do not get caught**

Noted and addressed

2. **Greased Stems should not be in water**

Noted and addressed

3. **Can we increase height of punch plate walls on hopper?**

Wall height is 3 ft.

4. **The entrance gate does not meet the following:**
   a. **3ft of depth minimum over the weir**
   b. **Only meets the 4 to 6 fps because it does not meet the 3ft of depth**
   c. **doubtful to achieve 1/2 ft of HL at high tailwater**
   d. **can't meet higher HL at normal tailwater**

These items were discussed in Alden's January 22nd memo.

Drawing C-111

1. **Why is 2fps there inside gate on the elevation view?**
2. **No sharp edges**
3. **What happens if pin on gate breaks?**

These items were discussed during the 60% DRT review meeting.

Drawing C-112

1. **What is a Gate Disc?**

A gate disc is terminology for the bulkhead portion of a gate (skin plate and associated framing)

Drawing C-115

1. **Where are the filler flap valves?**
2. **should have more details on this by now.**
3. **3ft high walls should be higher....likely out of water column and high enough so salmon can't jump out.**

It was decided during the 60% DRT meeting that 3 ft high walls are adequate and consistent with Milford and Hydro Kennebec designs.

4. **Use punch plate not mesh for walls on top of hopper**

Design changed to included perforated plate.

5. **Need to show position of lifting cables**

As discussed during the 60% DRT meeting no lifting cables would extend below the water surface to the hopper. The hopper would be supported by a cradle with a single cable lifting the entire hopper structure well above the water surface. See sheet M-113.

Drawing C-118 - No Comments

Drawing C-119

1. **Need to Provide ManDoor**

included

Drawing C-301

1. **Please show elevation of upper edge of existing 3V:1H Rock Slope**

Shown on drawing G-008

Drawing C-303 - See comments in regards to 600 cfs

Drawing C-304

1. **Need more depth over hinged gate**
2. **How are gates operated?**
3. **Shouldn't baffle slots be above isolation?**
4. **What about eels?**

See Alden's January 22nd memo.

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Greg Allen, Alden

Date: January 22, 2018

Re: **Follow up on action items from the 60% design review meeting**
Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities

---

Alden Research Laboratory, Inc. (Alden) met with Brookfield and the Design Review Team[1] (DRT) to discuss Alden's 60% design submittal for fish passage facilities at the Shawmut Hydroelectric project (Shawmut) on December 12, 2017. This memorandum provides additional information that was requested during the meeting and presents revised designs of the fish lift entrance flume and the unit 7 and 8 fishway channel. The following attached sheets have been updated for DRT review:

C-002, Overall Site Plan

C-103, Fish Lift General Arrangement Plan

C-110, Fish Lift Entrance Flume General Plan and Sections

C-303, Unit 7&8 Fish Passage General Plan

C-304, Unit 7&8 Fish Passage Plan and Sections

C-305, Unit 7&8 Fish Passage Sections

Alden requests confirmation from the DRT that the presented design is acceptable to advance to the 90% design review stage.

A summary of significant design changes and hydraulic design information is provided below.

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

Fish Lift

As discussed during the 60% design review meeting the entrance channel was lengthened to the extent practical to increase the holding pool area. The fish lift entrance was moved further into the river, but not so far as to protrude into the spillway flow. The fish lift hopper, hoist and tower were moved upstream by 4 ft. These changes added 8 ft to the holding pool which is now 19 ft in length. The entrance width was reduced to 10 ft as discussed during the meeting to provide 3 ft of water over the hinged entrance gate. A plan is shown in Figure 1 and hydraulic characteristics of the modified design are shown in Figure 2 and Figure 3.

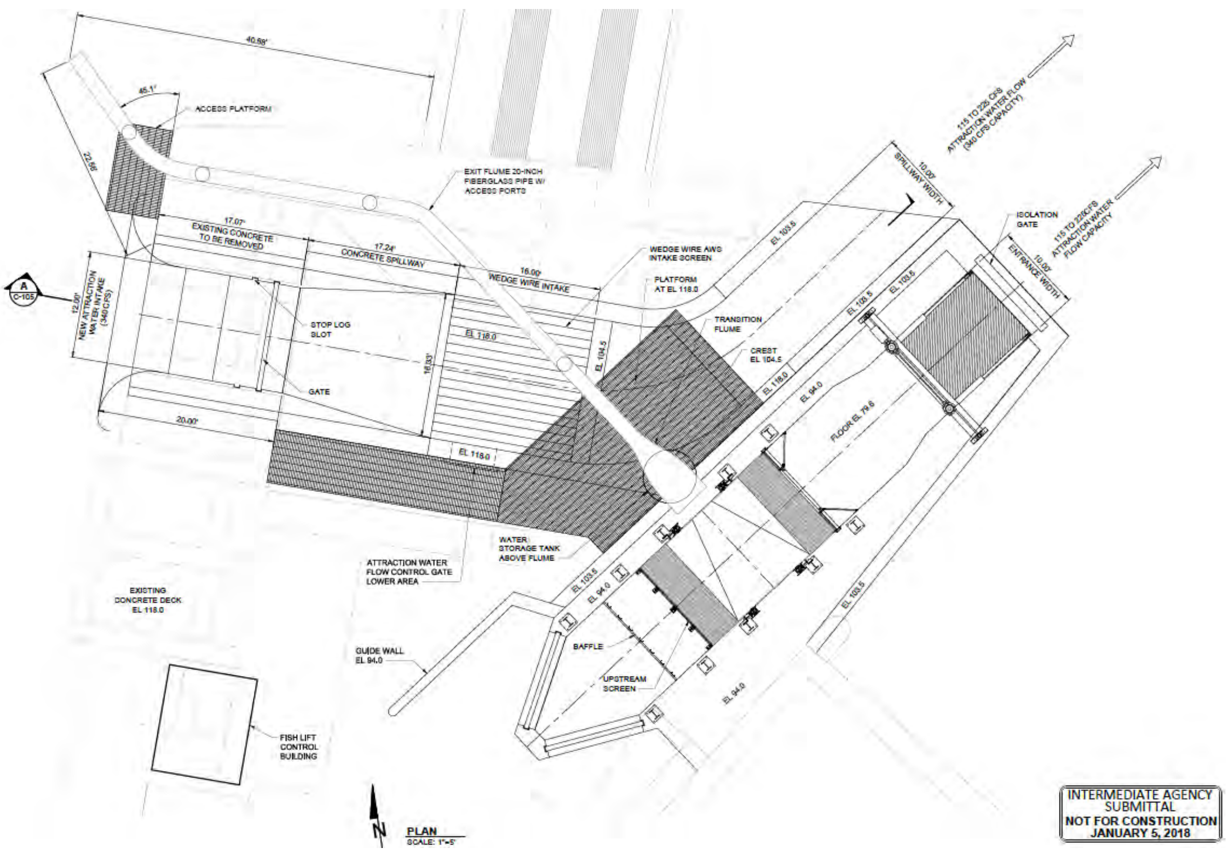


Figure 1. Fish Lift Entrance Channel Plan

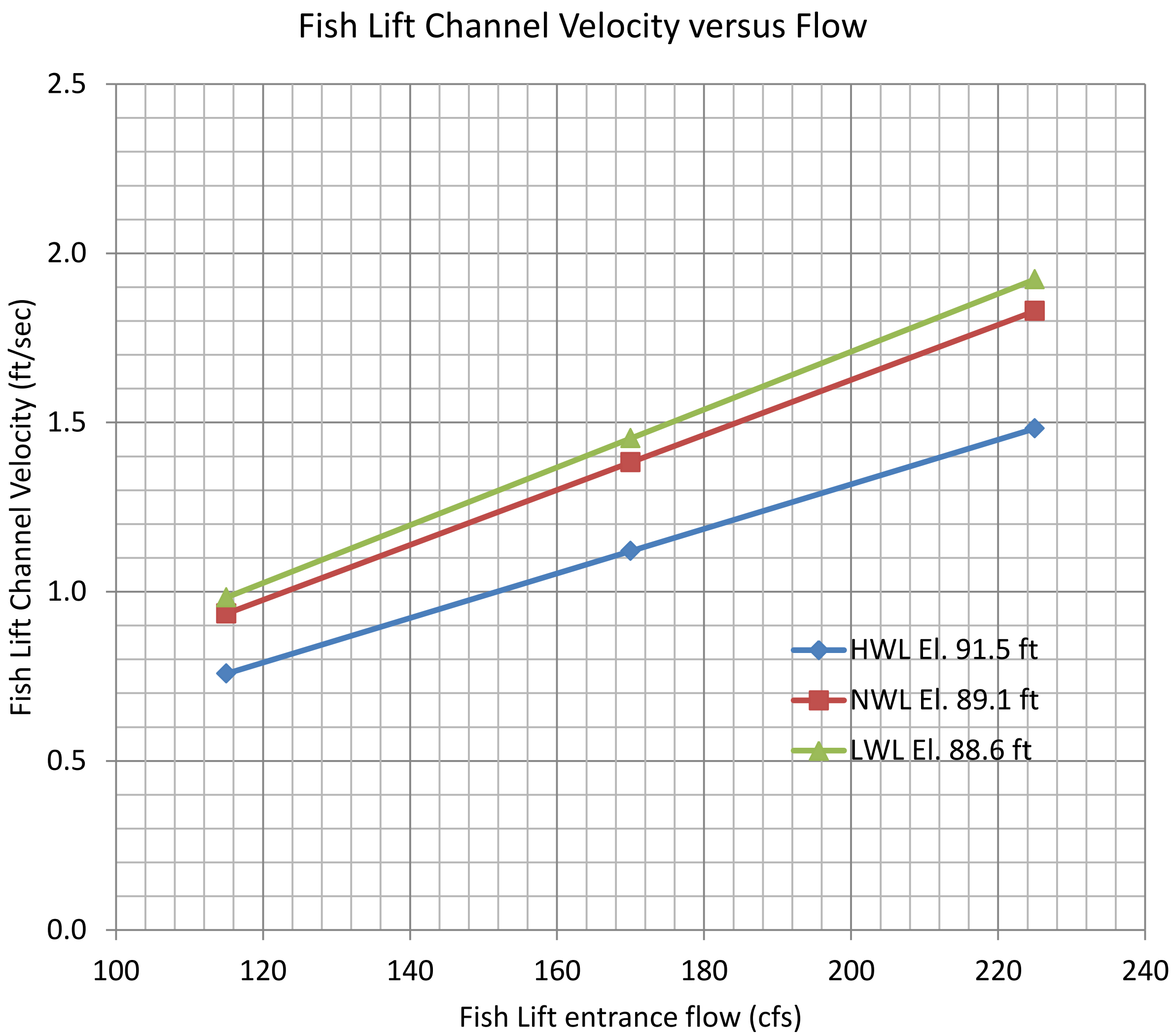


Figure 2. Fish lift entrance channel velocity versus flow rate for high, normal and low tailwater conditions.

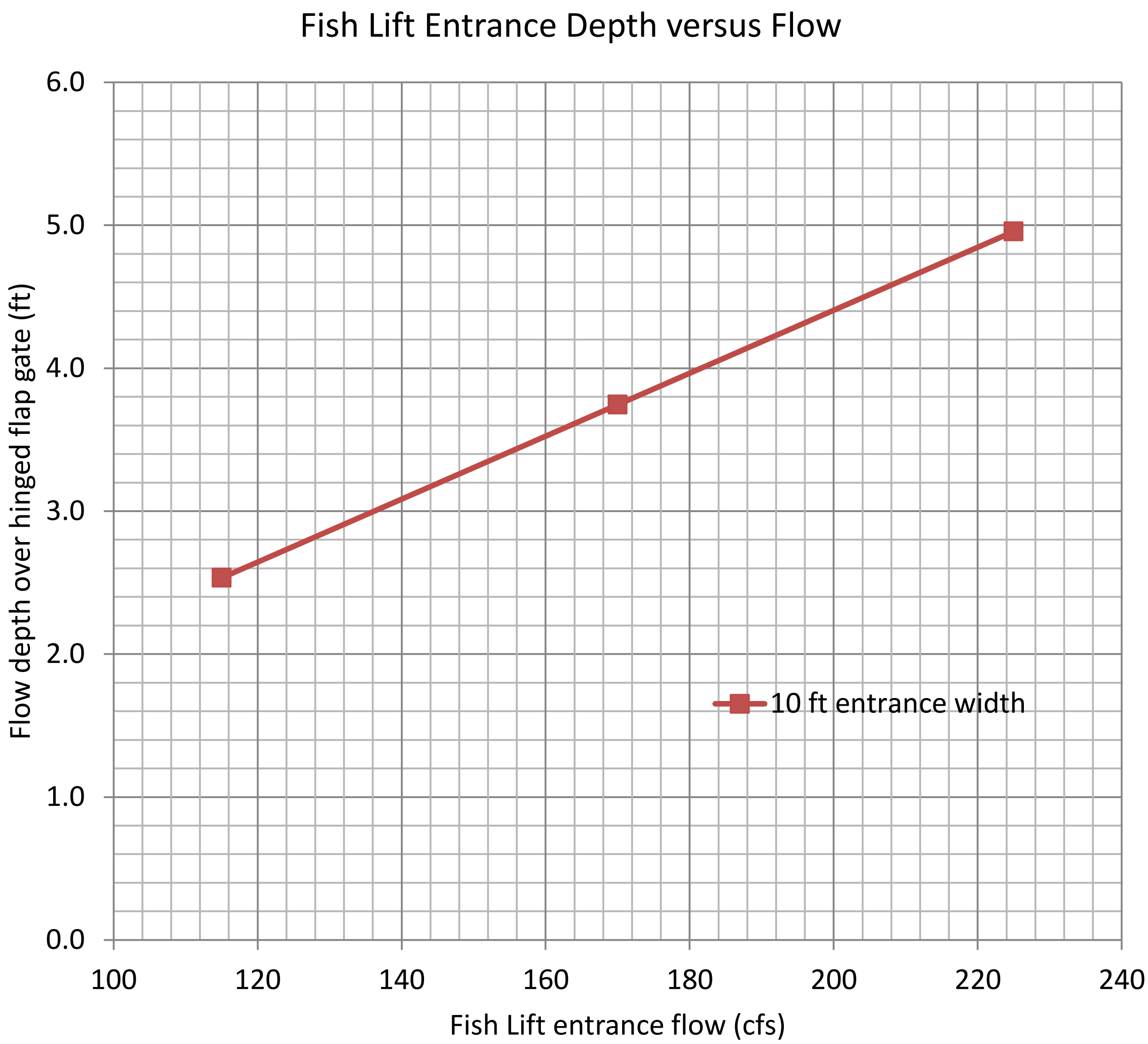


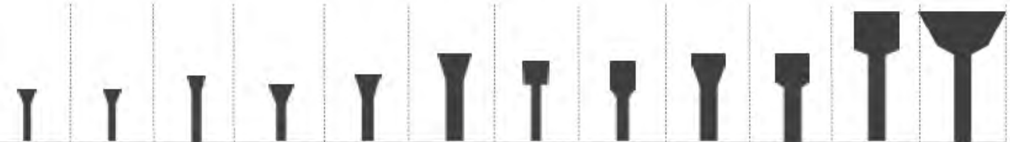
Figure 3. Fish lift entrance flow depth over the hinged flap gate versus flow for a 6 ft/sec entrance velocity condition.

Wedge Wire Screen Clear Spacing

FWS requested a 0.125 inch clear opening screen for the attraction water intake for Shawmut. After review of available wedge wire bar profile options, we recommend a screen clear opening of 0.25 inches, based on selection of a Hendrick T16 bar profile (see Figure 4) while maintaining a 50% screen open area. The T16 bar is a heavy duty bar profile which is recommended to withstand expected debris loading. Maintaining the 0.125 inch clear space with the T16 bar profile would reduce the screen open area, increase through screen velocity and increase

maintenance to remove debris. Therefore, we recommend a 0.25 inch clear spaced screen, which is less than FWS criteria of 0.375 inches for attraction water intakes (USFWS, 2017).

Profile Bar
Images not to scale



	B69	B6S	B6	B9S	B9	B12	T9M	T9	F12	T12	T16	T24
Bar Width	.069	.093	.093	.140	.140	.187	.140	.140	.187	.187	.250	.500
Bar Height	.290	.290	.375	.320	.375	.500	.453	.453	.500	.500	.750	.750
Cap Height	.080	.080	.093	.110	.125	.156	.125	.203	.185	.188	.250	.250

- *304L, 316L, Various Grades of Stainless & Exotic Alloys, Carbon Aluminum (6061) in B9, B12 & T16*
- *Non-welded Interlocked Construction*

Figure 4. Hendrick Screen Wedge Wire Profile Bar Options

Unit 7&8 Fish Passage Channel

The Unit 7 and 8 fish passage channel has been modified based on discussions during the meeting. The flow through the channel has been increased to provide greater flow depth over the entrance hinged flap gate. The channel width has been increased to 10.5 ft and a full depth vertical slot at the upstream end of the channel will have a 42 inch opening width. The channel now has an operating range of 90 cfs to 140 cfs for the range of tailwater conditions. A plan of the modified design is shown in Figure 5 and hydraulic characteristics are provided in Figure 6 and Figure 7.

The 60% DRT meeting included a discussion of the taintor gate spillway discharge adjacent to the fish passage channel and a concern that this flow may interfere with the fishway flow. The DRT recommended that the taintor gate spillway channel deflect the flow to the right (looking downstream) away from the fish passage channel entrance. We have consider and reviewed potential deflectors to steer the flow away from the fishway entrance since the meeting and we are concerned that deflecting the high velocity taintor gate flow could have the unintended consequence of creating an eddy near the fishway entrance. Therefore, we do not recommend deflecting the taintor gate flow as discussed during the 60% DRT meeting. If the DRT would like to pursue this option further, we would recommend the use of CFD modeling to aid and optimize the design to avoid unintended adverse conditions for fish passage.

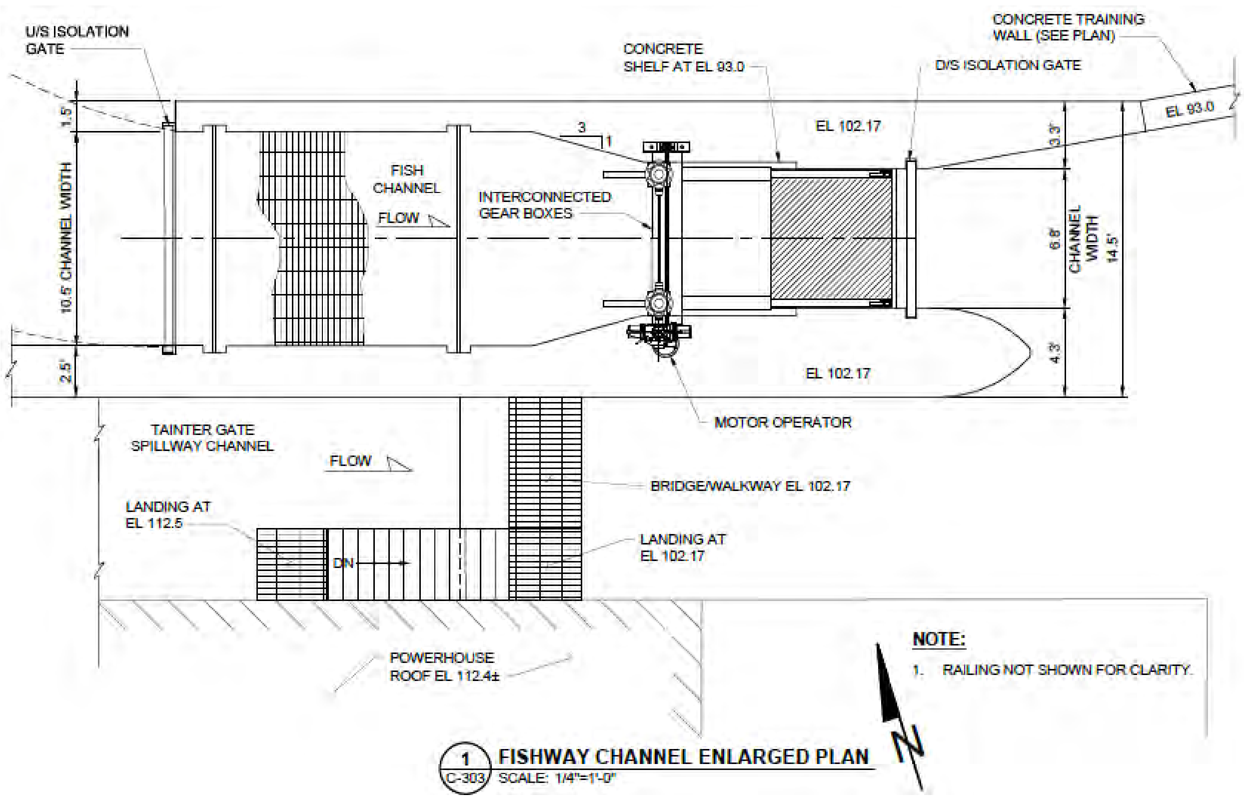


Figure 5. Unit 7&8 fish passage channel plan

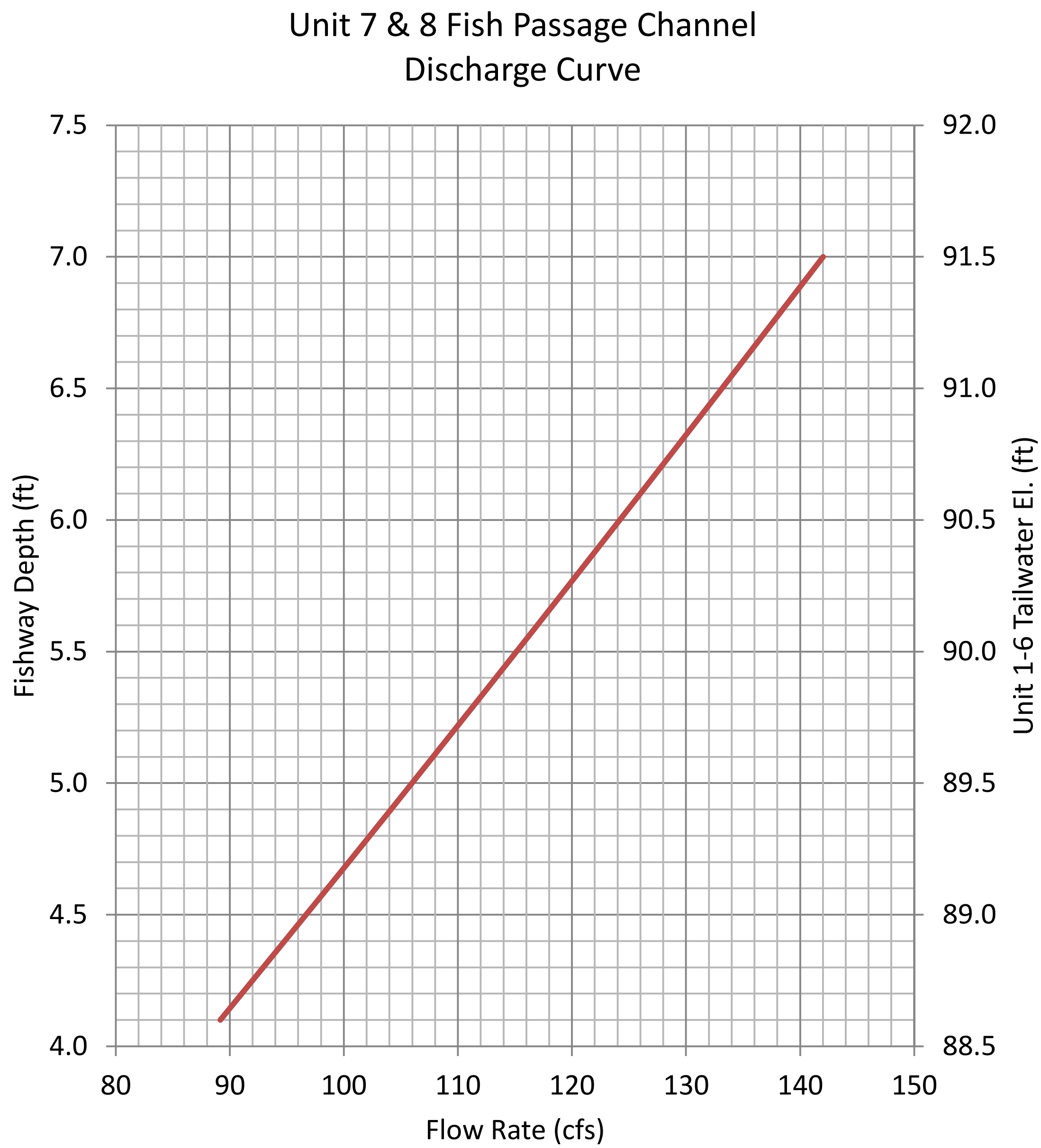


Figure 6. Unit 7&8 fish passage channel discharge curve for a full depth 42 inch wide baffle slot.

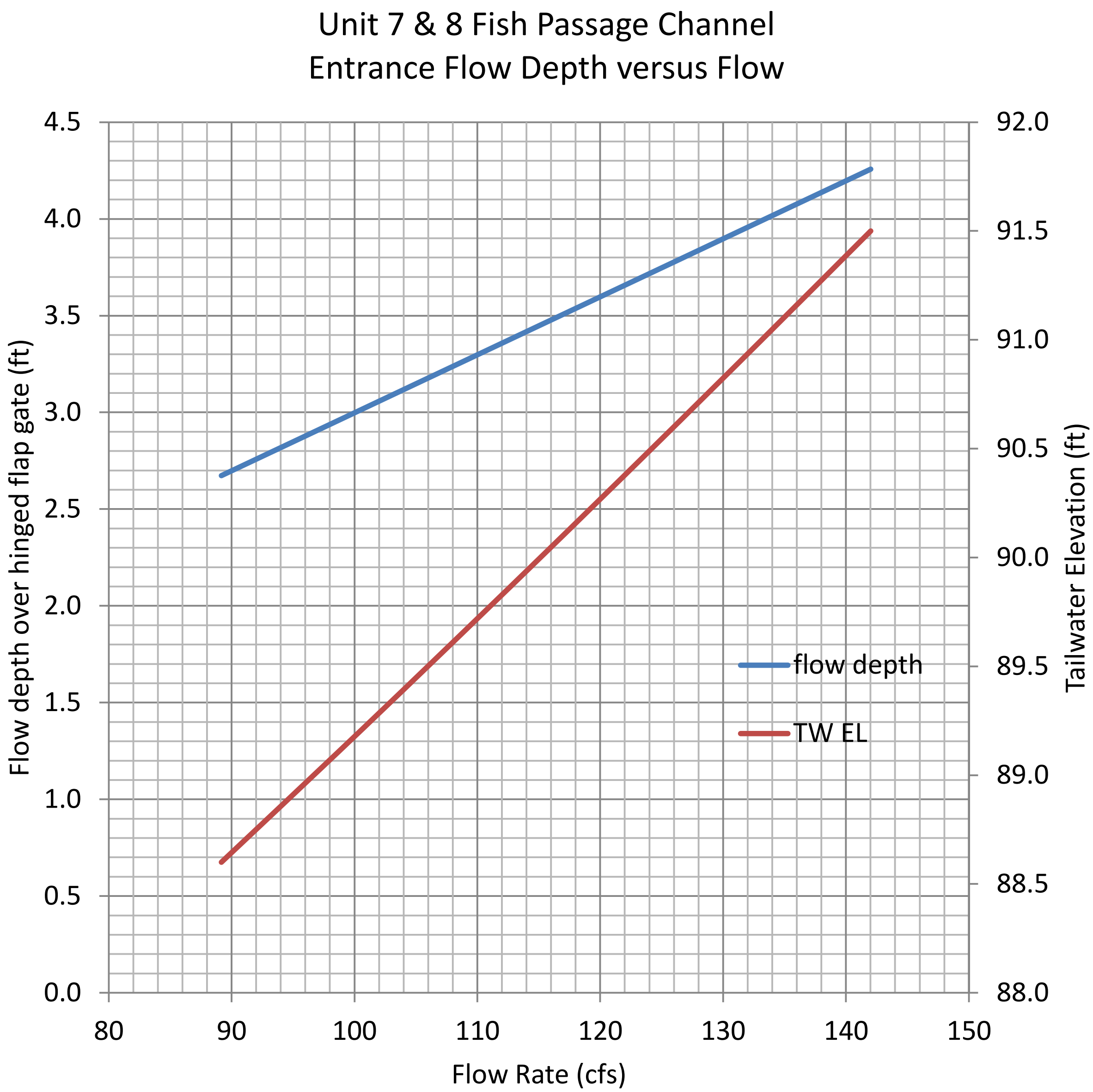


Figure 7. Unit 7&8 fish passage channel entrance flow depth over the hinged flap gate versus flow.

References

USFWS. (2017). *Fish Passage Engineering Design Criteria.* Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region R5.

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Friday, February 01, 2019 2:55 PM
To: Dill, Richard; Bryan Sojkowski; Greg Allen
Subject: Questions on Shawmut

Richard -
A couple items came up today in our review that we'd like to get some answers on by the meeting.

1. We still have some concerns about the entrance - i.e. flow, head loss, tailrace elevation, depth over the entrance gate.......can we get a table at different target headlosses from 0.5 ft to 1.5 ft across the entrance for the range of flows (115 to 225) at the various tailwater elevations 88.6 to 91.5 showing the entrance jet velocity and the entrance pool velocity as well as the depth of water over the weir.
2. We see that there is no way to throttle the flow into the system. We may be able to reduce the flow to the lift but the balance goes down the attraction water system. We see no way that we could run the lift at say 115 cfs and the AWS at 115. We are thinking we need a downward opening gate at the top where there is an isolation gate. We believe we need the flexibility....and possibly shutting the AWS off altogether if need be.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 11:02 AM
To: Greg Allen
Subject: Fwd: Shawmut 90% Talking Points
Attachments: 2019-02-06 Shawmut Draft 90% Talking Points.docx

---------- Forwarded message ---------
From: **Donald Dow - NOAA Federal** <donald.dow@noaa.gov>
Date: Wed, Feb 6, 2019 at 3:14 PM
Subject: Shawmut 90% Talking Points
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>, Greg Allen <gallen@aldenlab.com>
Cc: Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>, Wippelhauser, Gail <gail.wippelhauser@maine.gov>, Christman, Paul <Paul.Christman@maine.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>, Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>

Richard -

Attached are some talking points for tomorrows meeting. Do not consider these comments, they are just to help us have discussions after our review. I think Alden did a great job on this design.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

--

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409

gallen@aldenlab.com

Shawmut 90% talking points –

1. Entrance Conditions - The depth of water over the lip of the entrance gate has been a topic of discussion throughout this design. During the 60% design phase Alden came back to the table with a contracted entrance (from 12ft to 10ft) and according to Figure 3 within their Jan 22, 2018 memo they could achieve a 3ft depth for most of the fishway flow range (115-225cfs). I looked back at that memo and my calculations and discovered that the fishway can achieve the 3ft minimum depth but only for a drop of 6 inches. If we want the fishway to operate at a drop of say 1 ft (an operational setting that is common and has been effective on the Merrimack for Alosines) then we cannot achieve the 3ft minimum depth unless we max out the fishway flow to 225cfs but at that level of flow the entrance channel velocity is near 2 ft/s. That high of a velocity increases the risk of fallback. We have the ability to decrease the flow but then we sacrifice the 3 ft depth (which we may find out soon from the Conte study is a critical design parameter).

2. Attraction Water Control - I think we should all feel comfortable with how this fishway will operate and the variables we can adjust if needed. As of right now when the fishway is turned on we will get 340 cfs of total flow which will be split between the fishway and attraction water channel. The fishway can only take up to 225 so at a minimum there will be 115 going down the adjacent channel. I agree with Don that the effectiveness of the channel is unknown and is an area that fish (especially salmon) could be falsely attracted to and make attempts into. If for some reason we discover it is an issue we will need to shut it off. As of right now we do not have this ability. Don raised the point that we need a downward opening gate at the intake during the 60% design review but I don't think Alden incorporated this due to the fact that we are also using the attraction water channel as a downstream bypass. We will need to have further discussion with Alden in regards to how the attraction water will be operated and if we can incorporate the ability to shut if off.

G-001 – No Comment

G-002 – No Comment

G-003 – 1. Need to check 95% Exceedance Low Flow Elevations to Seasons

2. Note 5. Design Range is not necessarily operating range

G-004 – No Comment

G-005 – 1. Still Don't love the orientation of the AWS Spillway Exit

G-006 – No Comment

G-007 – No Comment

G-008 – No Comment

G-009 – No Comment

C-001 – No Comment

C-101 – No Comment

C-102 – No Comment

C-103 – No Comment

C-104 – No Comment

C-105 – No Comment

C-106 – No Comment

C-107 – 1. Still Very Nervous about this pipe

C-301 – No Comment

C-301 – No Comment

C-302 – No Comment

C-303 – No Comment

C-304 – No Comment

C-305 – No Comment

C-306 – No Comment

C-307 – No Comment

S-001 – No Comment

S-002 – No Comment

S-101 – No Comment

S-102 – No Comment

S-103 – No Comment

S-104 – No Comment

S-105 – No Comment

S-106 – No Comment

S-107 – No Comment

S-108 – No Comment

S-109 – No Comment

S-110 – No Comment

S-111 – No Comment

S-112 – No Comment

S-113 – No Comment

S-114 – 1. All Nuts and Bolt heads exposed to fish must be counter sunk, covered or rounded with no sharp edges exposed.

S-115 – No Comment

S-201 – No Comment

S-202 – No Comment

S-203 – No Comment

S-204 – No Comment

S-205 – No Comment

S-206 – No Comment

S-207 – No Comment

S-208 – No Comment

S-209 – No Comment

S-210 – No Comment

S-211 – No Comment

S-212 – No Comment

S-213 – No Comment

S-214 – No Comment

S-215 – No Comment

S-216 – No Comment

S-217 – No Comment

S-301 – No Comment

S-302 – No Comment

S-303 – No Comment

S-304 – No Comment

S-305 – No Comment

S-306 – No Comment

S-501 – No Comment

S-502 – No Comment

S-503 – No Comment

S-504 – No Comment

S-505 – No Comment

M-105 – No Comment

M-106 – No Comment

M-107 – No Comment

M-108 – No Comment

M-109 – No Comment

M-110 – 1. Need to discuss Grating on V-Gate Panel

M-111 – No Comment

M-112 – No Comment

M-113 – No Comment

M-114 – No Comment

M-115 – 1. Prefer punch plate or the like…..something smooth for brail

M-116 – No Comment

M-117 – No Comment

M-118 – No Comment

M-119 – 1. Discuss spacing on removable screen panels….

M-120 – No Comment

M-121 – No Comment

Note – 1. Missing Dwgs on water tank, and attraction flow exit

EE-AA-001 – No Comment

EE-AB-001 – No Comment

EE-AD-001 – No Comment

EE-AE-001 – No Comment

EE-AG-001 – No Comment

EE-BA-001 – No Comment

EE-BB-001 – No Comment

EE-CA-001 – No Comment

EE-CD-001 – No Comment

EE-CE-001 – No Comment

EE-CE-002 – No Comment

EE-CE-003 – No Comment

EE-CE-004 – No Comment

EE-CE-005 – No Comment

EE-CE-006 – No Comment

EE-CE-007 – No Comment

EE-CE-008 – No Comment

EE-DB-001 – No Comment

EE-DB-002 – No Comment

EE-DB-003 – No Comment

EE-DB-004 – No Comment

EE-DB-005 – No Comment

EE-DB-006 – No Comment

EE-DB-007 – No Comment

EE-DB-008 – No Comment

EE-DB-009 – No Comment

EE-DB-010 – No Comment

EE-DB-011 – No Comment

EE-DB-012 – No Comment

EE-DC-001 – No Comment

EE-DC-002 – No Comment

EE-DD-001 – No Comment

EE-DD-002 – No Comment

EE-DD-003 – No Comment

EE-DD-004 – No Comment

EE-DD-005 – No Comment

EE-DD-006 – No Comment

EE-DD-007 – No Comment

EE-DD-008 – No Comment

EE-DD-009 – No Comment

EE-DD-010 – No Comment

EE-DD-011 – No Comment

EE-DD-021 – No Comment

EE-DD-022 SH1 – No Comment

EE-DD-022 SH2 – No Comment

EE-DD-023 SH1 – No Comment

EE-DD-023 SH2 – No Comment

EE-DD-024 – No Comment

EE-ED-001 – No Comment

EE-ED-002 – No Comment

EE-ED-003 – No Comment

EE-ED-004 – No Comment

EE-EF-001 – No Comment

EE-EF-002 – No Comment

EE-EG-001 – No Comment

EE-EH-001 – No Comment

EE-EJ-001 – No Comment

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 10:55 AM
To: Greg Allen
Subject: Fwd: [EXTERNAL] RE: 90% Design Review Meeting

---------- Forwarded message ---------
From: **Bentivoglio, Antonio** <antonio_bentivoglio@fws.gov>
Date: Fri, Feb 8, 2019 at 1:24 PM
Subject: Re: [EXTERNAL] RE: 90% Design Review Meeting
To: Gregory Allen <gallen@aldenlab.com>
Cc: Steve Amaral <amaral@aldenlab.com>, Bryan Sojkowski <bryan_sojkowski@fws.gov>, Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Mitchell, Gerry <gerry.mitchell@brookfieldrenewable.com>, Gail Wippelhauser <gail.wippelhauser@maine.gov>, Dill, Richard <richard.dill@brookfieldrenewable.com>, Dave Robinson (home) <daverobinson111@yahoo.com>, Maloney, Kelly <kelly.maloney@brookfieldrenewable.com>, Dwayne.J.Seiders@maine.gov <dwayne.j.seiders@maine.gov>, Paul.Christman@maine.gov <paul.christman@maine.gov>

Greg, Gerry, Steve, Kelly, Richard, Dave,
thanks for the very informative meeting yesterday. Seems like there are a few (very few) issues to look at again. The Resource Agencies will try to get you feedback on the brail spec preferences next week.
Greg, thanks for redoing the fish lift hydraulic conditions for an 8ft fishway entrance. We think that will be very beneficial. As we said in the meeting, please make sure your definition of Depth over Entrance Gate is the same as Bryan's that we discussed, tailwater to top of gate.
Thanks Antonio

On Fri, Feb 8, 2019 at 11:35 AM Gregory Allen <gallen@aldenlab.com> wrote:

> Good morning Everyone,
>
> I have attached two handouts that were discussed during yesterday’s meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.
>
> Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

--

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843

Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Gregory Allen, P.E.

Date: February 13, 2019

Re: **Hydraulic Conditions of Shawmut Fish Lift Entrance with an 8 ft Entrance Width. Supplemental information requested from 90% Design Review Meeting for the Shawmut Fish Passage Project**

A design review meeting was held on February 7, 2019 for the Shawmut Fish Passage Project 90% design submittal. The Design Review Team[1] (DRT) requested that Alden provide hydraulic characteristics of the fish lift entrance conditions for a reduced entrance width of 8 ft. The attached table is similar to the hand out provided during the meeting with the entrance width reduced to 8 ft. In addition, the range of the hinged entrance gate operation was increased to a maximum elevation of 87.5 ft (previously El. 87 ft). The attached table is based on the following assumptions;

Fish lift entrance width 8 ft (previously 10 ft)
(reduced by 7 inches in calculations to 7.42 ft to account for gate stems)

Fish lift channel invert El. 79.6 ft

Fish lift channel width 12 ft

Maximum hinged gate El. 87.5 ft (previously 87.0 ft)

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

Hydraulic Conditions of Shawmut Fish Lift Entrance
(8 ft entrance width)

highlighted cells indicate maximum hinged gate height

	TW El.	Fish Lift Flow (cfs)	Entrance drop (ft)	Entrance Pool Velocity (ft/sec)	Entrance Velocity (ft/sec)	Depth over entrance gate (ft)
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.50	0.8	5.7	3.0
	90.0	115	0.50	0.9	5.7	3.0
	89.5	115	0.50	0.9	5.7	3.0
NWL	89.1	115	0.50	1.0	5.7	3.0
LWL	88.6	115	0.50	1.0	5.7	3.0
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.51	0.8	5.7	3.0
	90.0	115	0.75	0.9	6.9	2.5
	89.5	115	0.75	0.9	6.9	2.5
NWL	89.1	115	0.75	0.9	6.9	2.5
LWL	88.6	115	0.75	1.0	6.9	2.5
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.51	0.8	5.7	3.0
	90.0	115	0.74	0.9	6.9	2.5
	89.5	115	1.00	0.9	8.0	2.1
NWL	89.1	115	1.00	0.9	8.0	2.1
LWL	88.6	115	1.00	1.0	8.0	2.1
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.51	0.8	5.7	3.0
	90.0	115	0.74	0.9	6.9	2.5
	89.5	115	1.15	0.9	8.6	2.0
NWL	89.1	115	1.50	0.9	9.8	1.8
LWL	88.6	115	1.50	0.9	9.8	1.8
HWL	91.5	170	0.50	1.1	5.7	4.5
	91.0	170	0.50	1.2	5.7	4.5
	90.5	170	0.50	1.2	5.7	4.5
	90.0	170	0.50	1.3	5.7	4.5
	89.5	170	0.50	1.4	5.7	4.5
NWL	89.1	170	0.50	1.4	5.7	4.5

highlighted cells indicate maximum hinged gate height

	TW El.	Fish Lift Flow (cfs)	Entrance drop (ft)	Entrance Pool Velocity (ft/sec)	Entrance Velocity (ft/sec)	Depth over entrance gate (ft)
LWL	88.6	170	0.50	1.5	5.7	4.5
HWL	91.5	170	0.63	1.1	6.4	4.0
	91.0	170	0.75	1.2	6.9	3.7
	90.5	170	0.75	1.2	6.9	3.7
	90.0	170	0.75	1.3	6.9	3.7
	89.5	170	0.75	1.3	6.9	3.7
NWL	89.1	170	0.75	1.4	6.9	3.7
LWL	88.6	170	0.75	1.5	6.9	3.7
HWL	91.5	170	0.63	1.1	6.4	4.0
	91.0	170	0.82	1.2	7.3	3.5
	90.5	170	1.00	1.2	8.0	3.2
	90.0	170	1.00	1.2	8.0	3.2
	89.5	170	1.00	1.3	8.0	3.2
NWL	89.1	170	1.00	1.3	8.0	3.2
LWL	88.6	170	1.00	1.4	8.0	3.2
HWL	91.5	170	0.63	1.1	6.4	4.0
	91.0	170	0.82	1.2	7.3	3.5
	90.5	170	1.12	1.2	8.5	3.0
	90.0	170	1.50	1.2	9.8	2.6
	89.5	170	1.50	1.2	9.8	2.6
NWL	89.1	170	1.50	1.3	9.8	2.6
LWL	88.6	170	1.50	1.3	9.8	2.6
HWL	91.5	225	0.50	1.5	5.7	5.9
	91.0	225	0.50	1.6	5.7	5.9
	90.5	225	0.50	1.6	5.7	5.9
	90.0	225	0.50	1.7	5.7	5.9
	89.5	225	0.50	1.8	5.7	5.9
NWL	89.1	225	0.50	1.9	5.7	5.9
LWL	88.6	225	0.50	2.0	5.7	5.9
HWL	91.5	225	0.75	1.5	6.9	4.9
	91.0	225	0.75	1.5	6.9	4.9
	90.5	225	0.75	1.6	6.9	4.9
	90.0	225	0.75	1.7	6.9	4.9
	89.5	225	0.75	1.8	6.9	4.9
NWL	89.1	225	0.75	1.8	6.9	4.9
LWL	88.6	225	0.75	1.9	6.9	4.9
HWL	91.5	225	1.00	1.5	8.0	4.2

highlighted cells indicate maximum hinged gate height

	TW El.	Fish Lift Flow (cfs)	Entrance drop (ft)	Entrance Pool Velocity (ft/sec)	Entrance Velocity (ft/sec)	Depth over entrance gate (ft)
	91.0	225	1.00	1.5	8.0	4.2
	90.5	225	1.00	1.6	8.0	4.2
	90.0	225	1.00	1.6	8.0	4.2
	89.5	225	1.00	1.7	8.0	4.2
NWL	89.1	225	1.00	1.8	8.0	4.2
LWL	88.6	225	1.00	1.9	8.0	4.2
HWL	91.5	225	1.10	1.4	8.4	4.0
	91.0	225	1.44	1.5	9.6	3.5
	90.5	225	1.50	1.5	9.8	3.4
	90.0	225	1.50	1.6	9.8	3.4
	89.5	225	1.50	1.6	9.8	3.4
NWL	89.1	225	1.50	1.7	9.8	3.4
LWL	88.6	225	1.50	1.8	9.8	3.4

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 10:53 AM
To: Greg Allen
Subject: Fwd: [EXTERNAL] RE: RE: 90% Design Review Meeting
Attachments: Spot Check on 8ft Hydraulics Table.pdf

---------- Forwarded message ---------
From: **Sojkowski, Bryan** <bryan_sojkowski@fws.gov>
Date: Thu, Feb 14, 2019 at 2:49 PM
Subject: Re: [EXTERNAL] RE: RE: 90% Design Review Meeting
To: Gregory Allen <gallen@aldenlab.com>
Cc: Steve Amaral <amaral@aldenlab.com>, Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Mitchell, Gerry <gerry.mitchell@brookfieldrenewable.com>, Antonio Bentivoglio <antonio_bentivoglio@fws.gov>, Wippelhauser, Gail <gail.wippelhauser@maine.gov>, Dill, Richard <richard.dill@brookfieldrenewable.com>, Dave Robinson (home) <daverobinson111@yahoo.com>, Maloney, Kelly <kelly.maloney@brookfieldrenewable.com>, Dwayne.J.Seiders@maine.gov <dwayne.j.seiders@maine.gov>, Paul.Christman@maine.gov <paul.christman@maine.gov>

Thanks for doing this Greg. I performed a spot check of the numbers (see attached) using an SMath tool that USFWS Engineering developed using a gate width of 7.4 ft. Are the listed entrance velocities an average or maximum (mine are average)? I'm close on some and then far off on others but typically less than what you calculated so that's good. The more important factor is depth and I'm pretty close to your numbers for all cases except for the 170 cfs, 0.5 ft drop (0.7 ft lower), and the 225 cfs, 0.5 ft drop (1.3 ft lower). All that said, the depth values that were off still meet the 3 ft depth threshold. The results coincide with my thinking in that we'll want to run this fishway at flows higher than 115 cfs, probably towards the 150 cfs mark in order to achieve the 3 ft depth. We won't be able to achieve the depth when producing drops of 1.0 ft but that was expected. Overall I agree with the results and recommend moving forward with the 8 ft entrance width (others chime in if you see it differently). Thanks again for your efforts!

On Wed, Feb 13, 2019 at 11:48 AM Gregory Allen <gallen@aldenlab.com> wrote:

> Good morning Everyone,
>
> I have updated the table I sent out last week for an entrance with an 8 ft width. The maximum elevation of the hinged gate was also increased by 6 inches to El. 87.5 ft. This information is presented in the attached memo. I would also like to point out that I discovered an error in the entrance velocity calculation that were part of the table I handed out at the meeting which has been corrected for the new table.
>
> Regards,
>
> Greg

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Gregory Allen [mailto:gallen@aldenlab.com]
Sent: Friday, February 08, 2019 11:34 AM
To: Steve Amaral; 'Bryan Sojkowski'; 'donald.dow@noaa.gov'; 'Matt Buhyoff - NOAA Federal'; 'Mitchell, Gerry'; 'antonio_bentivoglio@fws.gov'; 'gail.wippelhauser@maine.gov'; 'Dill, Richard'; 'Dave Robinson (home)'; 'Maloney, Kelly'; 'Dwayne.J.Seiders@maine.gov'; 'Paul.Christman@maine.gov'
Subject: RE: 90% Design Review Meeting

Good morning Everyone,

I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.

Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Bryan Sojkowski, P.E.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
413-253-8645
bryan_sojkowski@fws.gov

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not." - Dr. Seuss

--

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

Brian McMahon

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Friday, February 08, 2019 1:25 PM
To: Gregory Allen
Cc: Steve Amaral; Bryan Sojkowski; Donald Dow - NOAA Affiliate; Matt Buhyoff - NOAA Federal; Mitchell, Gerry; Gail Wippelhauser; Dill, Richard; Dave Robinson (home); Maloney, Kelly; Dwayne.J.Seiders@maine.gov; Paul.Christman@maine.gov
Subject: Re: [EXTERNAL] RE: 90% Design Review Meeting

Greg, Gerry, Steve, Kelly, Richard, Dave,
thanks for the very informative meeting yesterday. Seems like there are a few (very few) issues to look at again. The Resource Agencies will try to get you feedback on the brail spec preferences next week.
Greg, thanks for redoing the fish lift hydraulic conditions for an 8ft fishway entrance. We think that will be very beneficial. As we said in the meeting, please make sure your definition of Depth over Entrance Gate is the same as Bryan's that we discussed, tailwater to top of gate.
Thanks Antonio

On Fri, Feb 8, 2019 at 11:35 AM Gregory Allen <gallen@aldenlab.com> wrote:

> Good morning Everyone,
>
> I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.
>
> Thank you,
>
> Greg
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> ALDEN Solving flow problems since 1894

30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

From: Gregory Allen [mailto:gallen@aldenlab.com]
Sent: Friday, February 08, 2019 11:34 AM
To: Steve Amaral; 'Bryan Sojkowski'; 'donald.dow@noaa.gov'; 'Matt Buhyoff - NOAA Federal'; 'Mitchell, Gerry'; 'antonio_bentivoglio@fws.gov'; 'gail.wippelhauser@maine.gov'; 'Dill, Richard'; 'Dave Robinson (home)'; 'Maloney, Kelly'; 'Dwayne.J.Seiders@maine.gov'; 'Paul.Christman@maine.gov'
Subject: RE: 90% Design Review Meeting

Good morning Everyone,

I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.

Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Bryan Sojkowski, P.E.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
413-253-8645
bryan_sojkowski@fws.gov

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not." - Dr. Seuss

Brookfield
Renewable

July 30, 2020

VIA E-FILING

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N. E.
Washington, DC 20426

RE: Shawmut Hydroelectric Project FERC No. 2322-069
Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions

Dear Secretary Bose:

On January 31, 2020, Brookfield White Pine Hydro LLC (BWPH or Licensee), filed with the Federal Energy Regulatory Commission ("Commission" or "FERC") a Final License Application for the Shawmut Hydroelectric Project.[1] On March 2, 2020 the Commission issued an Additional Information Request (AIR) to BWPH. On June 1, 2020 BWPH filed the requested information. On July 1, 2020 the Commission issued its Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions (REA Notice).

Prior to filing the Final License Application, on December 31, 2019, BWPH filed its design plans for the construction of an upstream fishway facility at the Shawmut Project, in conformance with the provisions of the Interim Species Protection Plan (ISPP), and existing FERC license, as amended by Order issued May 19, 2016.[2] In accordance with the ISPP and current FERC license, the Shawmut upstream fishway was scheduled to be constructed in 2020 and operational in 2021.[3] Also, on December 31, 2019, BWPH filed a final Species Protection Plan (SPP) for Atlantic salmon.[4] The SPP included provisions for installation, modification,

[1] Application for License of Brookfield White Pine Hydro LLC under P-2322 (January 21, 2020).
[2] Order Amending Licenses to Require Interim Species Protection Plan For Atlantic Salmon, and Handling and Protection Plan for Shortnose and Atlantic Sturgeon May 19, 2016 , 155 FERC ¶ 61,185 (2016).
[3] Id.
[4] Brookfield White Pine Hydro LLC, Species Protection Plan (SPP) and Draft BA for the Lockwood Hydroelectric, et al. under P-2574, December 31, 2019.

150 Main Street
Lewiston, ME 04240
www.brookfieldrenewable.com
Tel: 207.755.5600
Fax: 207.755.5655

operation and monitoring of fishways at the Shawmut Project as well as three other hydroelectric projects on the Lower Kennebec River - Lockwood Project (FERC No. 2374), Hydro-Kennebec Project (FERC No. 2611), and Weston Project (FERC No. 2325).[5]

On July 13, 2020 the Commission issued a letter to BWPH informing the licensee that construction of a new upstream fishway at the Shawmut Project would be considered as part of the ongoing relicensing proceeding.[6] The Commission also stated that it did not intend to act on the Licensee's request to amend the current Shawmut license to incorporate the final SPP, review the final upstream fish passage design drawings[7] that were submitted, or act on any request to commence fishway construction at Shawmut under the ISPP, pursuant to the Commission's Order dated May 19, 2016. Also, on July 13, 2020 the Commission issued an order denying the extension of time to construct upstream fish passage at the Shawmut Project and keeping in place certain provisions of the ISPP, including annual reporting with updates on the status of their preparation of any Final Species Protection Plan.[8]

In response to the letter and order issued by the Commission on July 13, state and federal resource agencies subsequently filed letters asking FERC to extend the deadline for filing preliminary terms and conditions.[9] On July 23, 2020, the Commission issued a letter denying the agencies' requests for extension of time for the REA comment period.[10] In that letter, the Commission stated that their July 13, 2020 letter did not "fundamentally change the fact that the record, including the license application, clearly shows that Brookfield intends to construct, operate, and maintain upstream passage at its Shawmut Project under any new license issued for the project. Because an upstream passage facility does not currently exist at the project, it follows that a proposal to operate and maintain an upstream fishway also indicates an intent to

---

[5] . The final SPP included provisions for the operation of previously authorized and required upstream passage facilities at the Lockwood, Hydro-Kennebec, Shawmut and Weston Projects; the installation and/or modification and operation of downstream fishways at the four Projects; and monitoring of both upstream and downstream fishways at the four Projects..

[6] FERC Letter to Brookfield White Pine Hydro, LLC discussing the proposed Lower Kennebec Species Protection Plan for Atlantic Salmon, etc. and the related draft Biological Assessment for four hydroelectric projects including the Shawmut Project under P-2322, July 13, 2020.

[7] Brookfield White Pine Hydro LLC Brookfield White Pine Hydro, LLC submits the final design drawings operation and maintenance plan and consultation records for the Shawmut Upstream Fish Passage Facility re the Shawmut Hydro Project under P-2322, December 31, 2019. The final upstream fish passage design drawings were completed with full agency consultation at all phases of design.

[8] FERC Order on Request for Extensions of Time to Install Fish Passage (Issued July 13, 2020). FERC order denying the extension of time to construct upstream fish passage at the Shawmut Project, though approving the extensions of time to construct upstream fish passage at the Lockwood and Weston Projects.

[9] National Marine Fisheries Service letter to FERC dated July 15, 2020, Maine Department of Marine Resources letter to FERC dated July 15, 2020, and U.S Fish and Wildlife Service letter to FERC dated July 20, 2020.

[10] FERC Letter to NMFS, MDMR and USFWS Denying Request for Extension of Time to file Comments, Recommendations, and Preliminary Terms and Conditions, July 23, 2020.

Brookfield Renewable

construct it first." The Commission concluded that "[t]here is no ambiguity as to Brookfield's proposal."

BWPH does not contest the Commission's determination to move its review of the proposed Shawmut upstream fishway to the relicensing proceeding. The upstream fishway final design package was filed with the Commission on December 31, 2019 and BWPH's commitment to the proposed upstream fishway remains unchanged. The submitted design reflects extensive study as well as two years of sustained consultation with state and federal fishery agencies that extends all the way from conceptual to final design.

BWPH previously filed additional details into the relicensing docket regarding the upstream fishway[11]. The full agency consultation record for the Shawmut upstream fishway design including results of fish passage studies, is provided herein as Attachment A and demonstrates that the proposed design is the best upstream fish passage option for the Shawmut project. BWPH greatly appreciates the agencies' extensive efforts in developing the submitted design; we fully expect that this collaboration will allow for expedited approval of the fish passage facilities as part of the relicensing of the Shawmut Project. Further, BWPH is amendable to filing any additional information, details, or amendments to the Shawmut License Application that would facilitate the Commission's review.

If you have any questions, please contact me by phone at (207) 755-5605 or by email at Randy.Dorman@BrookfieldRenewable.com.

Sincerely,

Randy Dorman
Licensing Manager
Brookfield Renewable

cc: Mr. Matt Cutlip, FERC
Distribution List

Attachment: Shawmut Project Fishway Design Agency Consultation Record

[11] Response to Additional Information Request of Brookfield White Pine Hydro LLC under P-2322 (June 1, 2020).

Federal Agencies

Matt Cutlip
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

John Spain
Regional Engineer, Division of Dam Safety and Inspections
Federal Energy Regulatory Commission
New York Regional Office
19 W 34th St Ste 400
New York, NY 10001

John T Eddins
Office of Project Review
Advisory Council on Historic Preservation
401 F Street, NW, Suite 308
Washington, DC 20001-2637

Harold Peterson
Bureau of Indian Affairs
Eastern Regional Office
545 Marriott Drive, Suite 700
Nashville, TN 37214

Donald Dow
National Marine Fisheries Service
Maine Field Office
17 Godfrey Drive - Suite 1
Orono, ME 04473

Jeff Murphy
Biologist
National Marine Fisheries Service
Maine Field Office
17 Godfrey Drive - Suite 1
Orono, ME 04473

Matt Buhyoff
Merrymeeting Bay Recovery Coordinator
National Marine Fisheries Service
Maine Field Office
17 Godfrey Drive - Suite 1
Orono, ME 04473

Sean McDermott
Fisheries Biologist
National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930

Jay Clement
U.S. Army Corps of Engineers
442 Civic Center Drive
Suite 35
Augusta, ME 04330

Ralph Abele
U.S. Environmental Protection Agency
5 Post Office Square
Suite 100
Mail Code OEP06-02
Boston, MA 02109-3946

Nick Stasulis
Data Section Chief
United States Geological Survey
196 Whitten Rd
Augusta, ME 04333

Anna Harris
FERC Coordinator
U.S. Fish and Wildlife Service
Ecological Services
Maine Field Office
306 Hatchery Way
East Orland, ME 04431

Andrew L. Raddant
Regional Environmental Officer
U.S. Fish and Wildlife Service
Office of Environmental Policy and Compliance
Northeast Region
15 State Street
Suite 400
Boston, MA 02109

Kevin Mendik
NPS Hydro Program Coordinator
National Park Service
15 State Street, 10th Floor
Boston, MA 02109-3572

Regional Director
U.S. Fish and Wildlife Service
300 Westgate Center Dr.
Northeast Regional Office
Hadley, MA 02109-3572

U.S. Army Corps of Engineers
Divisional Office, Regulatory
696 Virginia Road
Concord, MA 01742-2718

U.S. Army Corps of Engineers
Commander
North Atlantic Division
26 Federal Plaza, #2109
New York, NY 10278-0090

State Agencies

Jim Vogel
Department of Agriculture, Conservation, and Forestry
Division of Parks and Public Lands
18 Elkins Lane, Harlow Building
Augusta, ME 04333-0022

Kathleen Leyden
Maine Coastal Program
Maine Department of Marine Resources
21 State House Station
Augusta, ME 04333-0022

Nick Livesay, Director
Bureau of Land Resources
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333-0022

Kathy Davis Howatt
Hydropower Coordinator
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333-0017

Jason Seiders
Maine Department of Inland Fisheries & Wildlife
270 Lyons Road
Region B
Sidney, ME 04330-9711

Bob Cordes
Regional Wildlife Biologist
Maine Department of Inland Fisheries & Wildlife
689 Farmington Road
Strong, ME 04983

John Perry
Environmental Coordinator
Maine Department of Inland Fisheries & Wildlife
284 State Street
41 State House Station
Augusta, ME 04333-0041

Gail Wippelhauser
Maine Department of Marine Resources
21 State House Station
Augusta, ME 04333

Casey Clark
Resource Coordinator
Maine Department of Marine Resources
32 Blossum Lane
Augusta, ME 04330

Paul Christman
Maine Department of Marine Resources
21 State House Station
Augusta, ME 04333

Megan Hopkin
Review & Compliance / CLG Coordinator
Maine Historic Preservation Commission
55 Capitol Street
65 State House Station
Augusta, ME 04333

Jason Overlock
Maine Department of Marine Resources
21 State House Station
Augusta, ME 04333

Tribes

Edward Peter Paul
Chief
Aroostook Band of Micmacs
7 Northern Road
Presque Isle, ME 04769

Kirk Francis
Chief
Penobscot Indian Nation
12 Wabanaki Way
Indian Island, ME 04468

Chris Sockalexis
THPO
Cultural and Historic Preservation Program
Natural Resources Department
Penobscot Indian Nation
12 Wabanaki Way
Indian Island, ME 04468

Frederick Moore III
Governor
Passamaquoddy Tribe - Pleasant Point
PO Box 343
Perry, ME 04667-0343

Susan Young
Houlton Band of Maliseet
Natural Resources Department
88 Bell Road
Littleton, ME 04730

William Nicolas, Sr.
Chief
Passamaquoddy Tribe - Indian Township
PO Box 301
Princeton, ME 04668

NGO

Brian Graber
Hydropower Notification
American Rivers
1101 14th St. NW, Suite 1400
Washington, DC 20005

Jeffrey Reardon
Maine Brook Trout Program Director
Trout Unlimited
267 Scribner Hill Road
Manchester, ME 04351

Bill Oleszczuk
Chair
Maine Council of Trout Unlimited
11 Osprey Avenue
Saco, ME 04072

Kevin Colburn
National Stewardship Director
American Whitewater
1035 Van Buren St.
Missoula, MT 59802

John R.J. Burrows
Atlantic Salmon Federation
Fort Andross
14 Maine Street
Brunswick, ME 04011

Landis Hudson
Maine Rivers
P.O. Box 782
Yarmouth, ME 04096

Nick Bennett
Natural Resources Council of Maine
3 Wade Street
Augusta, ME 04330

Local / Governments

Kennebec County Government
125 State Street
Augusta, ME 04330

Town of Benton
1279 Clinton Avenue
Benton, ME 04901

Town of Clinton
27 Baker Street
Clinton, ME 04927

Town of Fairfield
19 Lawrence Avenue
PO Box 149
Fairfield, ME 04937

Town of Skowhegan
225 Water Street
Skowhegan, ME 04976

Somerset County Government
41 Court Street
Skowhegan, ME 04976

City of Waterville
One Common Street
Waterville, ME 04901

Town of Winslow
114 Benton Avenue
Winslow, ME 04901

Individuals

Tom Griffin
Environmental Services Manager
SAPPI
1329 Waterville Road
Skowhegan, ME 04976

Douglas Watts
131 Cony Street
Augusta, ME 04330

Sean McCormack
80 East River Road
Whitefield, ME 04353

Stephen W. Brooke
544 Litchfield Rd
Farmingdale, ME 04344-4716

Licensee

Randy Dorman
Licensing Specialist
Brookfield Renewable
Brookfield White Pine Hydro LLC
150 Main Street
Lewiston, ME 04240

Wendy Bley
Project Manager
Kleinschmidt Associates
PO Box 650
Pittsfield, ME 04967

SHAWMUT PROJECT FISHWAY DESIGN AGENCY CONSULTATION RECORD

NOTE:

1. THE CONTRACTOR SHALL VERIFY THE LOCATIONS, ELEVATIONS, AND DIMENSIONS OF ALL EXISTING UTILITIES AND STRUCTURES.

SITE PLAN
SCALE: 1"=30'

FINAL FOR BID
NOT FOR CONSTRUCTION
DECEMBER 13, 2019

ALDEN RESEARCH LABORATORY
30 SHREWSBURY ST, HOLDEN, MA 01520
TEL: (508) 829-6000 www.aldenlab.com

REVISION	DESCRIPTION OF ISSUE / REVISION	REVISED BY
12/13/2019	FINAL FOR BID - NOT FOR CONSTRUCTION	M. GRAESER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STATE OF MAINE — MARK DANIEL GRAESER — No.39328 — LICENSED — PROFESSIONAL ENGINEER — 12/13/2019

SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

OVERALL SITE PLAN

PROJECT:	3173SHAWFISH
DRAWN BY:	M. PITTMAN
DESIGNED BY:	B. McMAHON
APPROVED BY:	M. GRAESER
SHEET:	10 OF 176
DRAWING:	C-001

Exhibit B – Operation & Maintenance Plan

SHAWMUT PROJECT

FERC NO. 2322-ME

FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

Version 1.0

Revision: December 19, 2019

Operated by:

Brookfield White Pine Hydro, LLC

An indirect subsidiary of

Brookfield Renewable Energy Group

Skowhegan, ME

SHAWMUT FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

Table of Contents

SHAWMUT FISH PASSAGE OPERATIONS & MAINTENANCE PLAN

1.0 - INTRODUCTION

This Fish Passage Operations and Maintenance Plan (the "Plan" or "O&M Plan") is intended to define how Brookfield White Pine Hydro will operate and maintain the fish passage facilities at the Shawmut Project FERC No. 2322 (the "Project"). This Plan is part of Brookfield's commitment to our environmental principles that are based on the fundamental values of accountability, partnership and open communication. As such, we have accepted the responsibility entrusted to us to manage natural resources in ways to ensure sustainable development.

The Plan will define what fish passage facilities (the "Facilities") are to be constructed at the Shawmut Project, the period in which the existing and new facilities are to be operated, guidance on the annual start-up and shut-down procedures, routine operating guidelines, debris management, and safety rules and procedures that are in place. Along with these defined procedures and guidelines, the Plan includes the necessary supporting information such as contact information, daily inspection forms, drawings, and spare parts on-site. This Plan should be considered a living document, and as such it will be updated annually, as needed.

2.0 - BACKGROUND

The Shawmut Project is located at river mile 66 on the Kennebec River in the towns of Fairfield and Benton, in Somerset and Kennebec Counties, Maine. Shawmut is the third dam upstream on the Kennebec River. The Shawmut Project has a total installed capacity of 8.8 megawatts at a normal head of 24.0 feet. The principal Project facilities include a concrete gravity dam with hinged flashboards and rubber bladder, forebay, reservoir, transmission line, appurtenant facilities, and two powerhouses. The Units 1-6 powerhouse, built in 1912, consists of horizontal Francis quad runner turbines. The Units 7-8 powerhouse, built in 1982, consists of two horizontal single regulated propeller turbines.

The Shawmut Project includes a 1,310-acre reservoir, a 1,135-foot-long dam with an average height of 24 feet, headworks and intake structures, enclosed forebay, and two powerhouses. The crest of the dam has a 380-foot section of four-foot-high hinged flashboards serviced by a steel bridge with a gantry crane; a 730 foot long section of dam topped with an inflatable bladder composed of three sections, each 4.46 feet high when inflated; and a 25 foot wide by downward opening 8 foot deep sluice equipped with a timber and steel gate.

The headworks and intake structures are integral to the dam and the powerhouse. On the west end of the dam there is a head gate structure which along with the two power houses creates a forebay. Also, on the south end of the forebay between the two powerhouses, is a ten-foot-wide by seven foot deep Tainter gate set above a six foot wide by six foot tall deep sluice gate, and directly adjacent to the Tainter gate is an approximately 6 ft wide surface sluice gate. A non-overflow concrete gravity section of dam connects the west end of the forebay gate openings with a concrete cut-off wall, which serves as a core wall of an earth dike.

The Project typically operates as run-of-river, with a target reservoir elevation near the full pond elevation of 112.0 ft during normal conditions. The total maximum hydraulic capacity of the turbines is approximately 6,700 cubic feet per second (cfs). After maximum flow to the turbines has been achieved, excess water is spilled through the existing log sluice. When flows exceed the capacity of the log sluice, sections of the rubber dam are deflated to pass additional water.

3.0 - DESCRIPTION OF FISH PASSAGE FACILITIES

3.1 - UPSTREAM FISH PASSAGE

The upstream fish passage design, to be constructed and operational by 2022, consists of a fish lift with an integrated attraction water intake and spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1-6 powerhouse, a short fish bypass channel connecting the Units 7-8 tailrace to the Units 1 through 6 tailrace at the upstream end of the training wall/island, and modifications to the discharge of the Tainter gate adjacent to the Units 7-8 powerhouse.

Fish Lift

The lower portion of the fish lift structure will consist of a concrete and steel entrance flume with an 8 foot wide entrance that widens to a 12 ft entrance channel leading to a fish blocking screen and the lifting hopper. The entrance flume will include a hinged flap entrance gate to maintain velocity and head drop, a set of adjustable V-trap gates, an approximately 11 ft by 11 ft traveling hopper, a baffle wall, and a V-shaped wooden baffled weir for dissipating energy and entrained air from the attraction water system. Set upon the entrance flume will be an approximately 31 ft long by 15 ft wide by 56.5 ft tall structural steel tower within which the hopper will travel to the upper level; the open steel tower will also contain an access stairway. At the upper level (the top of the non-overflow portion of the dam) will be an exit flume (20-inch diameter pipe), a 600-gallon supplemental water storage tank, and steel grating access platform.

An approximately 93 ft long by 10 to 16 ft varying width spillway will be cut into the non-overflow portion of the dam which extends and turns approximately 53 degrees to discharge adjacent to the fish lift entrance to the flume. At the upstream edge of the spillway a beveled broad crested weir will extend about five feet into the headpond. Internally, the spillway channel will include a 16 ft long by 16 ft wide wedge wire screen floor which will convey water from the spillway channel to the energy dissipation pool located just upstream of the fish lift hopper and will provide the attraction flow to the entrance flume of the fish lift.

The attraction water intake and spillway are designed to convey 340 cfs of flow from the head pond; of this 115 to 225 cfs will be diverted through the wedge wire screen intake to the energy dissipation pool and then to the fish lift entrance flume. The remaining 115 to 225 cfs will be bypassed and spilled adjacent to the fish lift entrance.

Unit 7-8 Fish Bypass Channel

An approximately 77 ft long by 10.5 ft wide bypass channel will be constructed at the upstream end of the island to provide fish egress from the Unit 7-8 tailrace across to the Unit 1-6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7-8 tailrace. The bypass channel structure will be comprised of a concrete channel with two baffles, a hinged entrance gate, and isolation gates. The southern side of the channel will share a wall with the modified Tainter gate spillway channel and the northern wall will extend 80 ft downstream along the island as a training wall. An approximately 75 ft long by 8 ft wide channel will be excavated into the bedrock turning about 84 degrees from the Units 1-6 tailrace to the bypass channel exit. The excavated rock channel will be at existing grade near the Unit 1-6 powerhouse tailrace and about 5 ft deep. Access stairs from the roof of the Unit 7- 8 powerhouse will lead down to a steel grating walkway near the exit of the Tainter gate spillway channel. This walkway will cross over both channels to allow access to the fish bypass.

A new 79 ft long by 10 ft wide concrete spillway channel will extend from the discharge of the existing Tainter gate to the Unit 7-8 tailrace. See Attachment D for facility drawings.

Upstream fishway operations

The proposed fish lift will be operational from May 1st to October 31st, annually. The fish lift has a designed operating range of 2,540 cfs and 20,270 cfs and will maintain a flow of 0.5 feet per second (fps) at the fish lift attraction water intake Flow in the entrance flume will be maintained at 1.0-1.5 fps through the hopper and 4-6 fps at the fishway entrance. The facility has been designed in consultation with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, Maine Department of Marine Resources, the Maine Department of Inland Fisheries and Wildlife and is designed to pass Atlantic salmon (population size 12,000), American shad (population size 177,000), alewives (population size 134,000), and blueback herring (population size 1,535,000).

3.2 - DOWNSTREAM FISH PASSAGE

Downstream passage at Shawmut is currently provided through a combination of a surface weir (sluice), Tainter gate, Deep gate (for downstream passage of adult eel in the late summer/fall) and opened hinged flashboards. The sluice is located at the right side of the intake structure next to Unit 6. It is 4 ft wide by 22-inches deep and flow can be adjusted by adding or removing stoplogs. With all stoplogs removed, the sluice passes between 30 and 35 cfs which is discharged over the face of the dam into a 3 ft deep plunge pool. The Tainter gate located next to the sluice measures 7 ft high by 10 ft wide and can pass up to 600 cfs.

Currently, the sluice and Tainter gate are operated for Atlantic salmon smolt and kelt passage from April 1 through June 15 and from November 1 through December 31, as river flow and ice conditions allow. Downstream passage is also provided along the Shawmut spillway during periods of excess river flow that results in spill. To provide additional passage during the

Atlantic salmon smolt migration season, the Licensee also drops four sections of hinged flashboards, located immediately adjacent to the power canal headworks which provides up to approximately 560 cfs of spill flow.[1] Based on the results of downstream eel passage studies conducted in 2007 and 2008, and with concurrence resource agencies, the deep drain gate is opened for 6 weeks during the period September 15th to November 15th annually for downstream eel passage, in combination with Unit 7-8 shutdowns for at least 8 hours per night.

To minimize the potential for stranding fish on the ledges below Rubber Dam No. 3, Brookfield deflates rubber dams in numerical order (Section l first, Section 3 last) and inflate in reverse order.

With the new license, Brookfield will continue to operate the existing downstream passage facilities and is also proposing to install a guidance boom in the forebay to improve downstream passage at the Shawmut Project. The combined new and existing downstream measures are listed below.

- Install a guidance boom (e.g., Worthington boom) in the forebay in front of Units 7-8. The proposed boom will have a depth of 10 ft., be made of rigid panels with ½ inch perforations (48% opening) and will be installed year-round.
    - Undertake measures necessary to keep the guidance boom in place and in good operating condition. If the guidance boom becomes dislodged or damaged, the resource agencies will be notified and the repair or replacements to the guidance boom will be made as soon as can be safely and reasonably done.
- Continue to operate the forebay bypass gate/surface sluice for utilization by downstream migrating diadromous fish from April 1 through December 31, as river conditions allow.
- Continue to ensure that the forebay Tainter gate is operated to maintain a flow of 6% of station unit flow through the gate (600 cfs through the smolt passage season).
- For a 6 week period between September 15th through November 15th, continue to open the deep drain gate next to Unit 7 at least two and one half feet (approx. 425cfs) and shut down Units 7 and 8 for at least 8 hours per night starting one hour after sunset for eel passage.

The new upstream fish passage facility will also provide additional downstream passage opportunity via the spillway channel auxiliary attraction water system (AWS). AWS flow of 115-225 cfs in excess of the flow required for the fish lift operation will be discharged (along with any downstream migrating fish passing through the system) to the Unit 1-6 tailrace adjacent to the fish lift entrance.

[1] The hinged flashboard sections pass a flow of approximately 140 cfs per section. With three sections down the flow is approximately 420 cfs; with four sections down the flow is approximately 560 cfs.

4.0 - OPERATION AND MAINTENANCE OF FISH PASSAGE FACILITIES

4.1 - UPSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

The upstream fish lift and Unit 7-8 bypass channel facilities will be operated and maintained by Brookfield. To maximize attraction to the upstream passage facility, the unit closest to the fish lift entrance (Unit 1) is operated first-on and last-off, followed consecutively by Units 2 through 6. In the future, unit prioritization for upstream fish passage may be adjusted based on the results of fish passage studies, and in consultation with the resource agencies.

Brookfield personnel shall visit the fishway several times each day to ensure:

1. there is no debris clogging throughout the fish lift facility,
2. there is adequate velocity (1 to 1.5 ft/s) through the hopper,
3. adequate velocity (4-6 ft/s) at the fishway entrance,
4. and, a 6-9” head drop from inside the entrance to the tailwater. The head drop at entrance gate is automatically adjusted via a programmable logic controller (PLC) which tracks the tailrace elevation and associated operator interface terminal (OIT) touch screen.

Proper operation of all the fishway water systems and maintenance of appropriate water velocities will be calculated via staff gauges and/or transducers, flow curves and AWS flow control gate setting. Cleaning of the AWS will be determined based on visual inspection. Brookfield personnel will confirm that the velocities through the fish lift, the attraction flow distribution upstream and downstream of the hopper, and that the entrance flow conditions are set in accordance with agency instructions applicable at the time. All fish passage operational information will be recorded in daily fishway logs and then entered into an electronic data sheet that can be provided to the resource agencies on timely intervals as agreed upon.

Brookfield personnel shall also visit the Unit 7-8 fish bypass channel several times each day to ensure:

1. there is no debris clogging throughout the fish bypass channel,
2. adequate velocity (4-6 ft/s) at fishway entrance,
3. and, a 6-9” head drop from inside the entrance to the tailwater. The head drop at flap gate is automatically adjusted via a programmable logic controller (PLC) which tracks the tailrace elevation and associated operator interface terminal (OIT) touch screen.

Proper operation of all the fishway water systems and maintenance of appropriate water velocities will be calculated via staff gauges and/or transducers, flow curves and flap gate setting and recorded in the daily fishway logs and the electronic data sheet. Brookfield personnel will confirm that the velocity through the fishway and that the entrance flow conditions are set in accordance with agency instructions applicable at the time.

The fish lift and bypass channel shall be dewatered annually inspection and maintenance. Typically, August is a good time for this effort as river temperatures often exceed the threshold for handling salmon. Flow will be reduced and fish within the fishway will be safely removed before stopping flow completely in order to prevent stranding. Routine annual maintenance shall include dewatering the fishway, removing accumulated debris from within the fishway as necessary (vacuum truck may be needed) and inspection of the integrity of the fishway. Any fishway components that are found to be damaged shall be replaced, in kind. All mechanical and electrical systems shall be inspected, serviced and maintained per manufacturer specifications.

OPERATIONAL PERIOD

- May 1 to October 31, seven days a week as river conditions allow. Daily hours of operation will be established in consultation with resource agencies based on run timing for the target fish species and numbers of fish present.

OPENING METHODS

At least two to three weeks prior to fish lift and fish bypass start-up if river conditions allow:

Fish Lift

1) Remove ice eaters from the lower flume of the fish lift
2) De-water fish lift lower flume, inspect and clear all debris from within the entrance channel as well as the AWS diffusion chamber
3) Inspect for any damaged components and repair as necessary
4) Remove safety chain from the hopper
5) Inspect and repair hopper mechanical components as necessary (cotter pins, turn buckles, cable, limit switches, etc.)
6) Grease entrance gate operators
7) Following the fish lift start up procedure (to be developed and included in this O&M Plan in the future), water up fish lift by opening attraction water valves and adjust entrance gate via the operator interface terminal (OIT) for approximately 6-9 inch differential from inside the fish lift entrance flume to the tailrace

Unit 7-8 Fish Bypass Channel

1) Remove ice eaters from the fish bypass channel
2) De-water fish bypass channel, inspect and clear all debris from within the channel
3) Inspect for any damaged components and repair as necessary (cotter pins, turn buckles, cable, limit switches, etc.)
4) Grease entrance gate operators
5) Water up bypass channel by opening the upstream and downstream isolation gates and adjust the flap gate via the operator interface terminal (OIT) for approximately 6-9 inch differential from inside the bypass channel entrance flume to the tailrace

SPARE PARTS

- 4 hopper wheels
- 4 hopper pulleys
- 2 drive bushings for entrance gate operator
- 2 drive bushing for attraction water valve operators
- 2 drive bushings for V-gate operator
- 1 (Operator interface terminal PLC touch screen OIT)
- 2 Hoist fuses
- 2 Limit switches
- Encoder for hoist if required
- Stop logs
    - Location and dimensions to be listed here
- Hopper hoist cable
    - Specifications and supplier (if a spare is not kept on site) to be listed here

WORKFORCE PLANNING

- Staffing Requirements:
    - Start Up - Crew of 2
    - Routine Operations – Crew of 2
    - Routine Maintenance – Crew of 2 for standard maintenance, crew of 3 for fishway entry for cleaning and fish removal
    - Shut Down – Crew of 2

- Daily basis:
    - The fish lift and fish bypass channel will be inspected for debris accumulation. Staff will remove debris from fish lift. If debris is not manageable by hand, operations crew will de-water fish lift lower flume as described below and remove debris. The resource agencies will be notified if debris management requires shutting down of the facility for more than 4 hours.
    - The attraction water gates will be adjusted to maintain a velocity of 1.0-1.5 fps through the hopper and 4-6 fps velocity at the entrance based on head pond and tailwater elevations and flow curves.
    - The fish lift entrance hinged flap gate will be adjusted for via the PLC/OIT resulting in a 6-9" head drop from inside the entrance to the tailwater as determined by water level gauges.
    - The fishway log sheets are completed consistent with Appendices A and C.

  - The daily fishway log information will be entered into an electronic data sheet that can be provided to the resource agencies on timely intervals as agreed upon.

- Weekly basis:
  - Facility's lead fishway technician to distribute a weekly Fishway Operations Report consistent with Appendix C to the fishery resource agencies

- Cleaning process lower flume:
  - Set up fall arrest/fall retrieval device, inspect fall harness (per procedure)
  - Install access ladder
  - Dewater fish lift lower flume to 6 inch depth and inspect for stranded fish and safely remove fish as necessary
  - Complete dewatering of lower flume can take place only after all fish are safely removed
  - Remove debris as necessary

- Preventative Maintenance process:
  - Monthly :
    - Grease the entrance gate, attraction water gate and V-gate operator mechanisms
    - Inspect and repair hopper mechanical (cotter pins, turn buckles, cable, limit switches, etc.) as necessary
  - Yearly:
    - Inspect the fish lift hopper hoist
    - Inspect attraction water dewatering gate operators
    - Inspect fish lift hopper isolation screen hoist
    - Inspect the entrance gate, attraction water gate and V-gate operators
    - The fish lift and fish bypass channel shall be dewatered annually (dates and duration to be determined in consultation with the resource agencies, but generally in August) for inspection, cleaning, to make essential repairs, and to adjust the various mechanical and structural systems as needed.

WINTERIZING METHODS

- Close the attraction water gates and seal to minimize leakage
- Close isolation gates on fish bypass channel
- Remove all debris from fish lift and fish bypass channel
- Lift hopper and install safety chains

- Install 2 ice eaters in lower flume of fish lift and 2 in the fish bypass channel
- Close V-gates
- Open entrance gate
- De-energize all electrical equipment
- Drain water storage tank and leave all valves in the open position
- Drain water storage tank fill piping and pump
- Close upstream isolation gate and seal to minimize leakage

4.2 - DOWNSTREAM FISH PASSAGE – OPERATIONS & MAINTENANCE

OPERATIONAL PERIOD

The combined new and existing downstream measures are listed below.

- Forebay Guidance Boom: permanently installed and angled to forebay guidance sluice.
- Open forebay bypass gate/surface sluice: April 1 through December 31, as river conditions allow
- Open forebay Tainter gate to 6% station flow: 600 cfs during smolt migration period (two week period, starting when the river temperature reaches 10°C, typically in month of May).
- For a 6 week period between September 15th through November 15, continue to open the deep drain gate next to Unit 7 at least two and one half feet (approx. 425cfs) and shut down Units 7 and 8 for at least 8 hours per night starting one hour after sunset for eel passage.
- New downstream passage opportunity via spillway channel AWS system – May 1 – October 31

OPENING METHODS: for the new downstream passage associated with the fish lift spillway AWS system

1) Grease AWS isolation gate and attraction water flow control gate operator mechanisms
2) Open the upstream fishway (AWS) head gate 100% to pass 340 cfs of flow.
3) Adjust fish lift attraction flow gate to divert 115 to 225 cfs of the AWS flow.
4) Close attraction water flow control gate when fish lift is not in operation

SPARE PARTS

- 1 drive bushing for each gate operator

WORKFORCE PLANNING

- Staffing Requirements:
  - Start Up – Crew of 1
  - Routine Operations – Crew of 1
  - Routine Maintenance – Crew of 2 for standard maintenance, crew of 3 for fishway entry for cleaning
  - Shut Down – Crew of 1

- Daily basis:
  - Inspect the downstream fish passage entrances for debris and remove it. If debris can't be easily removed, operations crew will assist. Notify the resource agencies (see Section 8.0) if downstream fish passages can't be cleaned the same day.
  - Verify proper outflow of the downstream fish passages.
  - The fishway log sheets are completed consistent with Appendices A and C. Information within the daily inspection form will be entered into a database for ease of data sharing throughout and at the end of the season

- Weekly basis:
  - Facility's lead fishway technician to distribute a weekly Fishway Operations Report consistent with Appendix C to the fishery resource agencies
- Cleaning process:
  - De-water the downstream fish passage (AWS) and inspect fishway for stranded fish
  - Set up fall arrest/fall retrieval device, inspect fall harness (Brookfield procedure)
  - Prepare chainsaw for operation, inspect all chainsaw PPE
  - Inspect all rigging for hoisting debris

- Preventative Maintenance process:
  - Yearly:
    - Inspect the isolation gate and attraction water flow control gate operators
    - Inspect the wedge wire intake screen and spillway

DOWNSTREAM FISH PASSAGE DE-WATERING METHOD

- Close the AWS gate and de-energize
- Open attraction water flow control gate and de-energize

WINTERIZING METHODS

- Close AWS gate to drain water and de-energize
- Open attraction water flow control gate to drain water and de-energize

5.0 – FISH STRANDING PLAN

- If a stranding event occurs, contact the Senior Fisheries Lead or Seasonal Fish Technicians along with the local Compliance Specialist and Stakeholder Relations.
- To minimize the chance of fish stranding on the ledges below the spillway, coordinate with the National System Control Center (NSCC) to potentially lower inflatable rubber bladder No. 3 as applicable.
- If there is a stranding event on the ledges, access the ledges on the east shore via the access road to the spillway. There is a hand carry launch directly below the station and a public boat launch approximately four miles downstream of the dam, in Fairfield, below the three bridges.

5.1 - OBSERVATION POINTS

- The east shoreline access road located off the River Road, to the spillway overlook.

5.2 – AVAILABLE RESOURCES

- Nets and handle extensions located at the Lockwood Dam fishlift
- Salmon "vinyl" socks, five-gallon buckets and a trash can located at the Lockwood fishlift
- Canoe and paddles located inside Lockwood Dam powerhouse
- 14-foot motor boat located at Hydro Kennebec

6.0 - FISH MORTALITY DISPOSAL PLAN

- With prior approval of resources agencies, fish mortalities can be picked up by a local bait dealer (Wild Things Bait Shop) located in Oakland. Contact is Scott Horne at 207-313-9741. All mortalities shall be noted on the fish lift daily log sheets.

7.0 - SAFETY

7.1 - SAFETY RULES & PROCEDURES

- Pursuant to Brookfield's Safety Procedure SP9, Job Safety and Environmental Plans are completed prior to, and ideally, well in advance of any work at the various fish ways are started. Job Safety and Environmental Plans are to be completed using the standard form which may be updated from time to time. Review of prior Job Safety and Environmental Plans for similar work is encouraged to help capture all safety risks that may be present at the site.

8.0 – NOTIFICATION AND CONTACT INFORMATION

NOTICE:

- Contact NMFS and MDMR within 24 hours of any interactions with Atlantic salmon, Atlantic sturgeon or shortnose sturgeon, including non-lethal and lethal take
- In the event of any lethal takes, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS[2]
- Notify resource agencies of any changes in Project and fishway operations (including maintenance activities)[3]
- The first Brookfield point of contact for all Fishway related issues is the local Operations Manager

BROOKFIELD CONTACTS

- Dave Watson, Operations Manager, Brookfield
    - (o) 207-474-3921 x 12
    - (c) 207-520-8870
    - David.watson@brookfieldrenewable.com
    -
- Joel Rancourt, Senior Operations Manager, Brookfield
    - (o) 207-474-3921 x 11
    - (c) 207-458-6775
    - joel.rancourt@brookfieldrenewable.com

- Kelly Maloney, Manager of Compliance, Brookfield
    - (o) 207-755-5606
    - (c) 207-233-1995
    - Kelly.maloney@brookfieldrenewable.com

[2] This would typically include date collected, species, measurements, photographs, etc.
[3] *This does not include typical operational changes such as generator load swings, putting generators online and offline, normal impoundment and flow fluctuations, and opening/closing gates to control spillage. The resource agencies should be notified for any fishway dewatering's or maintenance issues, problems meeting fishway operational dates, impoundment drawdowns for flashboard or other maintenance, or any other atypical project operations such as dewatering of tunnels, conduits, or penstocks*

- Jason Seyfried, Compliance Specialist, Brookfield
  - (o) 207-755-5615
  - (c) 207-312-8323
  - Jason.seyfried@brookfieldrenewable.com

- Adam Brown, Senior Fisheries Lead, Brookfield
  - (c) 207-343-1941
  - Adam.brown@brookfieldrenewable.com

AGENCY CONTACTS

- Matt Buyoff, Atlantic Salmon Recovery Coordinator, NMFS
  - (c) 207-866-4238
  - Matt.buhyoff@noaa.gov

- Don Dow, Hydro Engineer, NMFS
  - (o) 207-866-3758
  - (c) 207-416-7510
  - Donald.dow@noaa.gov

- Antonio Bentivoglio, Fishery Biologist, USFWS
  - (o) 207-781-8364 x18
  - (c) 207-974-6965
  - Antonio_bentivoglio@fws.gov

- Bryan Sojkowski, Fish Passage Engineer, USFWS
  - (o) 413-253-8645
  - Bryan_sojkowski@fws.gov

- Sean Ledwin, Director Sea Run Fisheries Division, MDMR
  - (o) 207-624-6348
  - Sean.m.ledwin@maine.gov

- Gail Wippelhauser, Marine Resources Scientist, MDMR
  - (o) 207-624-6349
  - Gail.wippelhauser@maine.gov

- Paul Christman, Marine Resources Scientist, MDMR
  - (c) 207-577-5780
  - (o) 624-6352

  - paul.christman@maine.gov

- John Perry, Environmental Coordinator, MDIFW
  - (o) 207-287-5254
  - (c) 207-446-5145
  - John.perry@maine.gov

- Dwayne (Jason) Seiders, Fishery Biologist, MDIFW
  - (o) 207-287-5254
  - Dwayne.j.seiders@maine.gov

- Kathy Howatt, Hydropower Coordinator, MDEP
  - (o) 207-446-2642
  - Kathy.howatt@maine.gov

- Chris Sferra, Hydropower Specialist III, MDEP
  - (o) 207-446-1619
  - Christopher.sferra@maine.gov

9.0 - APPENDICES

Appendix A: DAILY INSPECTION FORM

Shawmut Daily Fishway Inspection Form

Date: ____________________ Time: ____________________ Inspector: ______

River Flow (cfs):		Unit 5 flow (cfs)	
Unit 1 flow (cfs)		Unit 6 flow (cfs)	
Unit 2 flow (cfs)		Unit 7 flow (cfs)	
Unit 3 flow (cfs)		Unit 8 flow (cfs)	
Unit 4 flow (cfs)			
Unit 5 flow (cfs)			

Tainter gate operation and flow (cfs) ____________________

Rubber Dam condition ____________________

Fish Lift

1	Lift operating mode	Automatic ___	Manual ___	
		Frequency ___	Min. ___	
2	Fish lift debris	___		
3	Attraction water Screen	___		
4	Hopper blocking screen	___		
5	V-Trap screen	___		
6	Entrance gate	___		
	a	Setting	___	
	b	Flume water elev.	___	
	c	Tailwater elev.	___	
	d	Head differential	___	

Auxiliary water system

Headpond elev. (ft) ___

AWS flow control gate Setting (in) ___ Flow (cfs) ___

7 & 8 Fish Ladder

7	Unit 7 & 8 Fish ladder mode	Automatic ___	Manual ___	
8	Unit 7 & 8 Fish debris			
9	Flap gate			
	a	Setting	___	
	b	Flume water elev.	___	
	c	Tailwater elev.	___	
	d	Head differential	___	

Auxiliary water system

10 Forebay elev. (ft) ___

11 Tainter gate Setting (in) ___ Flow (cfs) ___

Comments:

___

___

Downstream Fishway

12 Flow Adequate ___

13 Debris ___

Comments:

___

___

Please provide completed inspection forms to the Compliance Group every Monday morning

Appendix B: FISHWAY DRAWINGS

Appendix C: FISHWAY OPERATIONS WEEKLY REPORT

Shawmut Fishway Operation Weekly Report Form

Project Name ____________________

Fishway Facility ____________________

Date ____________________

Species	#'s Detected (Weekly)	Total For Season
Atlantic Salmon (MSW):		
Atlantic Salmon (1SW):		
River Herring:		
American Shad:		
Striped Bass:		
Sea Lamprey:		

Weekly Operational Status: ____________________

____

____

____

____

____

Note:

Weekly Fishway Operations report to be provided to the resource agencies.

Appendix D: Fishway PLC Operations (placeholder)

Appendix E: Fishway Attraction Water Valve Curve (placeholder)

Appendix F: Handling Plan for Shortnose and Atlantic Sturgeon (placeholder)

Exhibit C – Agency Consultation Documentation

Shawmut Fish Passage Design Agency Consultation Timeline

	Dates
Preliminary Design Consultations	
Schedule E-mail	9/27/2016
Preliminary Design E-mail	3/6/2017
Preliminary design comments received	3/6/2017
Response to comments	6/1/2017
30% Design Consultations	
30% design submittal	7/31/2017
agency draft comments received	8/17/2017
30% review meeting	8/28/2017
Agency comments received	10/19/2017
Response to comments	11/1/2017
60% Design Consultations	
60 % design submittal	11/1/2017
agency comment received	11/29/2017
60% design review meeting	12/13/2017
60% design submittal DRT requested modifications	1/22/2018
Alden design submittal memo	1/22/2018
Agency comments received (CFD study request)	2/2/2018
CFD results submittal	8/22/2018
Agency CFD review meeting	9/27/2018
CFD results E-mail	10/3/2018
90% Design Consultations	
90% design submittal	11/29/2018
Alden design submittal memo	11/29/2018
Agency comments received	2/6/2019
90% design review meeting	2/7/2019
90% Design E-mail	2/8/2019
90% Design E-mail	2/14/2019
O & M Manual and Final Design Plans Consultations	
O & M plan submitted to agency	11/22/2019
agency comments received	11/26/2019
agency comments received	11/26/2019
agency comments received	12/17/2019
agency comments received	12/18/2019
agency comments received	12/18/2019
agency comments received	12/20/2019
Revised O & M plan submitted to agency	12/20/2019
agency comments received	12/20/2019

SHAWMUT FINAL DESIGN AND OPERATIONS AND MAINTENANCE PLAN CONSULTATION

Brian McMahon

From:	Bentivoglio, Antonio <antonio_bentivoglio@fws.gov> on behalf of Bentivoglio, Antonio
Sent:	Wednesday, December 18, 2019 4:21 PM
To:	Mitchell, Gerry
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris
Subject:	Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments:	20191218 Shawmut-FWS-Draft Fish Passage OM Plan AAB and BS edits.docx
Categories:	Red Category

Gerry,
here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,
>
> Did anyone have any comments on the O &M or the final design drawings?
>
> Thanks
>
> Gerry
>
> ---
>
> **From:** Gregory Allen <gallen@aldenlab.com>
> **Sent:** Friday, November 22, 2019 7:40 PM
> **To:** Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
> **Cc:** Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
> **Subject:** Shawmut Final Design drawings and O&M Plan for Approval
>
>

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From:	Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> on behalf of Mitchell, Gerry
Sent:	Friday, December 20, 2019 11:00 AM
To:	Bentivoglio, Antonio
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject:	RE: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments:	20191220 Shawmut Fish Passage OM Plan II.docx
Follow Up Flag:	Follow up
Flag Status:	Flagged

Good morning,

Please find attached the final Shawmut O&M Plan. We have incorporated or otherwise addressed comments received, as appropriate. Please note that this O&M Plan is being filed pursuant to the requirements for the proposed upstream and downstream fishways and the existing authorized upstream and downstream eel passage measures, as this is intended to target the pre-construction filing requirements for the new fishways.

We appreciate everyone's prompt review and will assume concurrence unless anyone has any additional comments or edits by December 27.

Happy Holidays, Everyone!

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Wednesday, December 18, 2019 4:21 PM
To: Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>
Cc: Gregory Allen <gallen@aldenlab.com>; Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>; Anna Harris <anna_harris@fws.gov>
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,
here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,

Did anyone have any comments on the O &M or the final design drawings?

Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409

gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, December 18, 2019 4:24 PM
To: Nicholas Lucia; Brian McMahon
Subject: FW: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments: 20191218 Shawmut-FWS-Draft Fish Passage OM Plan AAB and BS edits.docx

Categories: Red Category

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Bentivoglio, Antonio [mailto:antonio_bentivoglio@fws.gov]
Sent: Wednesday, December 18, 2019 4:21 PM
To: Mitchell, Gerry
Cc: Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,
here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,
>
> Did anyone have any comments on the O &M or the final design drawings?
>
> Thanks
>
> Gerry
>
> ---
>
> **From:** Gregory Allen <gallen@aldenlab.com>
> **Sent:** Friday, November 22, 2019 7:40 PM

To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From:	Bentivoglio, Antonio <antonio_bentivoglio@fws.gov> on behalf of Bentivoglio, Antonio
Sent:	Friday, December 20, 2019 11:08 AM
To:	Mitchell, Gerry
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject:	Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Follow Up Flag:	Follow up
Flag Status:	Flagged

Thanks Gerry.

On Fri, Dec 20, 2019 at 11:03 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good morning,
>
> Please find attached the final Shawmut O&M Plan. We have incorporated or otherwise addressed comments received, as appropriate. Please note that this O&M Plan is being filed pursuant to the requirements for the proposed upstream and downstream fishways and the existing authorized upstream and downstream eel passage measures, as this is intended to target the pre-construction filing requirements for the new fishways.
>
> We appreciate everyone's prompt review and will assume concurrence unless anyone has any additional comments or edits by December 27.
>
> Happy Holidays, Everyone!
>
> **From:** Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
> **Sent:** Wednesday, December 18, 2019 4:21 PM
> **To:** Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>
> **Cc:** Gregory Allen <gallen@aldenlab.com>; Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>; Anna Harris <anna_harris@fws.gov>
> **Subject:** Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,

here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

Good Morning All,

Did anyone have any comments on the O &M or the final design drawings?

Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

Brian McMahon

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Friday, December 20, 2019 12:00 PM
To: Sojkowski, Bryan; Bentivoglio, Antonio
Cc: Mitchell, Gerry; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject: RE: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval
Attachments: Shawmut Drawings - Sheet C-104 Final for Bid (12-13-2019).pdf

Thanks Bryan for your thorough review.
We also caught that one on Sheet C-104 and it has been corrected in our latest set issued for bid. See attached for reference.

Thanks and enjoy the holidays!
Greg

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Sojkowski, Bryan [mailto:bryan_sojkowski@fws.gov]
Sent: Friday, December 20, 2019 11:39 AM
To: Bentivoglio, Antonio
Cc: Mitchell, Gerry; Gregory Allen; Matt Buhyoff - NOAA Federal; Donald Dow - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Wippelhauser, Gail; Maloney, Kelly; Dill, Richard; Brian McMahon; Mark Graeser; Anna Harris; Seyfried, Jason
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Good Morning Gerry,

Thanks for the updated O&M. I have reviewed the final design plan set and only have one minor edit:

Sheet C-104: The dimension of the entrance width shows 10.0 ft. This dimension should be 8.0 ft.

Thanks for the opportunity to review both documents, Happy Holidays!

On Fri, Dec 20, 2019 at 11:08 AM Bentivoglio, Antonio <antonio_bentivoglio@fws.gov> wrote:

> Thanks Gerry.
>
> On Fri, Dec 20, 2019 at 11:03 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:
>
>> Good morning,

Please find attached the final Shawmut O&M Plan. We have incorporated or otherwise addressed comments received, as appropriate. Please note that this O&M Plan is being filed pursuant to the requirements for the proposed upstream and downstream fishways and the existing authorized upstream and downstream eel passage measures, as this is intended to target the pre-construction filing requirements for the new fishways.

We appreciate everyone's prompt review and will assume concurrence unless anyone has any additional comments or edits by December 27.

Happy Holidays, Everyone!

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Wednesday, December 18, 2019 4:21 PM
To: Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>
Cc: Gregory Allen <gallen@aldenlab.com>; Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>; Anna Harris <anna_harris@fws.gov>
Subject: Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

Gerry,

here are the FWS comments for the Shawmut O&M Plan. Bryan is still reviewing the drawings and might have additional comments, if he does he will provide them soon.

On Thu, Dec 12, 2019 at 11:45 AM Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> wrote:

> Good Morning All,
>
> Did anyone have any comments on the O &M or the final design drawings?
>
> Thanks

Gerry

From: Gregory Allen <gallen@aldenlab.com>
Sent: Friday, November 22, 2019 7:40 PM
To: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Donald Dow - NOAA Federal <donald.dow@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>
Cc: Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Shawmut Final Design drawings and O&M Plan for Approval

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office

Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

--
Bryan Sojkowski, P.E.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
Fish Passage Engineering
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
413-253-8645
bryan_sojkowski@fws.gov

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not." - Dr. Seuss

Brian McMahon

From:	Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent:	Tuesday, December 17, 2019 3:38 PM
To:	Brian McMahon; Nicholas Lucia
Subject:	FW: Shawmut Final Design drawings and O&M Plan for Approval

See below

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Donald Dow - NOAA Federal [mailto:donald.dow@noaa.gov]
Sent: Tuesday, December 17, 2019 3:35 PM
To: Gregory Allen
Cc: Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.
4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, December 18, 2019 3:30 PM
To: Brian McMahon; Nicholas Lucia
Subject: FW: Shawmut Final Design drawings and O&M Plan for Approval

fyi

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Wippelhauser, Gail [mailto:Gail.Wippelhauser@maine.gov]
Sent: Wednesday, December 18, 2019 3:29 PM
To: Donald Dow - NOAA Federal; Gregory Allen
Cc: Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Christman, Paul; Bentivoglio, Antonio; Sojkowski, Bryan; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: RE: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry:

I just reviewed the O&M plan and concur with Don's comments.

Gail Wippelhauser, Ph. D.
Marine Resources Scientist
Maine Department of Marine Resources
#172 State House Station
Augusta, ME 04333

Phone: 207-624-6349
email: gail.wippelhauser@maine.gov

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, December 17, 2019 3:35 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>; Christman, Paul <Paul.Christman@maine.gov>; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

EXTERNAL: This email originated from outside of the State of Maine Mail System. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.
4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409

gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent:	Tuesday, December 17, 2019 3:35 PM
To:	Gregory Allen
Cc:	Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	Re: Shawmut Final Design drawings and O&M Plan for Approval
Follow Up Flag:	Follow up
Flag Status:	Flagged

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.
4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent:	Tuesday, November 26, 2019 1:42 PM
To:	Gregory Allen
Cc:	Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg, Thank you for sending the final design drawings. We do not typically review the final design drawings but instead keep them for project construction to reference. We only review concept, 30%, 60% and 90% design drawings. Therefore, you should be good to go with these. I will review the O&M manual but there is nothing pressing on that. We also like to have a copy of the Specifications you are going to bid with in case there is an issue with the specs.

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> ALDEN Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409
> gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent: Tuesday, November 26, 2019 3:05 PM
To: Maloney, Kelly
Cc: Gregory Allen; Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Kelly -

This design matches what we consulted on and our verbal comments that we worked through at the 90% design review meeting. Regardless of what the 401 states, I'm not of the position to "approve" of a fishway until it performs and meets expectations for the endangered species. In regards to the O&M plan, we will have our review to you before the 23rd, however, as with all other O&M plans with Brookfield sites in the DPS, we review the plans every few years for updates. This was agreed upon with your predecessor Scott Hall after we found a number of fishways across the state inactive or in disrepair during our annual inspections after Brookfield first assumed ownership of the sites. Again, thank you for the opportunity to review, we appreciate Brookfields' and Aldens' hard work on this project.

Regards,
Don

On Tue, Nov 26, 2019 at 2:44 PM Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

> Donnie,
>
> You are correct. However, pursuant to our existing 401 water quality certification for the Shawmut Project, we are required to: "submit final design and operational plans for all…permanent upstream and downstream fish passage facilities and/or operational measures required by this approval, prepared in consultation with state and federal fisheries agencies. These plans shall be reviewed by and must receive approval of the fisheries agencies, the DEP, and FERC prior to construction."
>
> To that end, we are requesting your concurrence with the final design plans and O&M Plan by December 23. As I indicated previously, should you have any comments on the attached drawings or O&M Plan, we would be happy to convene a meeting to discuss if necessary. To the extent there are only minor comments, if you could please indicate your approval contingent upon the addressing of those comments, that would be appreciated.
>
> Thanks and Happy Thanksgiving All!
>
> Kelly

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, November 26, 2019 1:42 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg, Thank you for sending the final design drawings. We do not typically review the final design drawings but instead keep them for project construction to reference. We only review concept, 30%, 60% and 90% design drawings. Therefore, you should be good to go with these. I will review the O&M manual but there is nothing pressing on that. We also like to have a copy of the Specifications you are going to bid with in case there is an issue with the specs.

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> **ALDEN** Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409
> gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE

Hydro/Fish Passage Engineer

Protected Resources Division

Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Maine Field Station

17 Godfrey Drive, Suite 1

Orono, ME 04473

Office: 207-866-8563

Cell: 207-416-7510

Donald.Dow@noaa.gov

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov> on behalf of Donald Dow - NOAA Federal
Sent:	Tuesday, November 26, 2019 3:05 PM
To:	Maloney, Kelly
Cc:	Gregory Allen; Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Paul.Christman@maine.gov; Bentivoglio, Antonio; Sojkowski, Bryan; Wippelhauser, Gail; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	Re: Shawmut Final Design drawings and O&M Plan for Approval

Kelly -

This design matches what we consulted on and our verbal comments that we worked through at the 90% design review meeting. Regardless of what the 401 states, I'm not of the position to "approve" of a fishway until it performs and meets expectations for the endangered species. In regards to the O&M plan, we will have our review to you before the 23rd, however, as with all other O&M plans with Brookfield sites in the DPS, we review the plans every few years for updates. This was agreed upon with your predecessor Scott Hall after we found a number of fishways across the state inactive or in disrepair during our annual inspections after Brookfield first assumed ownership of the sites. Again, thank you for the opportunity to review, we appreciate Brookfields' and Aldens' hard work on this project.

Regards,
Don

On Tue, Nov 26, 2019 at 2:44 PM Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

> Donnie,
>
> You are correct. However, pursuant to our existing 401 water quality certification for the Shawmut Project, we are required to: "submit final design and operational plans for all…permanent upstream and downstream fish passage facilities and/or operational measures required by this approval, prepared in consultation with state and federal fisheries agencies. These plans shall be reviewed by and must receive approval of the fisheries agencies, the DEP, and FERC prior to construction."
>
> To that end, we are requesting your concurrence with the final design plans and O&M Plan by December 23. As I indicated previously, should you have any comments on the attached drawings or O&M Plan, we would be happy to convene a meeting to discuss if necessary. To the extent there are only minor comments, if you could please indicate your approval contingent upon the addressing of those comments, that would be appreciated.
>
> Thanks and Happy Thanksgiving All!
>
> Kelly

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, November 26, 2019 1:42 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <dwayne.j.seiders@maine.gov>; Paul.Christman@maine.gov; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg, Thank you for sending the final design drawings. We do not typically review the final design drawings but instead keep them for project construction to reference. We only review concept, 30%, 60% and 90% design drawings. Therefore, you should be good to go with these. I will review the O&M manual but there is nothing pressing on that. We also like to have a copy of the Specifications you are going to bid with in case there is an issue with the specs.

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

Good evening,

Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.

https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Donald A. Dow III, PE

Hydro/Fish Passage Engineer

Protected Resources Division

Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Maine Field Station

17 Godfrey Drive, Suite 1

Orono, ME 04473

Office: 207-866-8563

Cell: 207-416-7510

Donald.Dow@noaa.gov

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Brian McMahon

From:	Wippelhauser, Gail <Gail.Wippelhauser@maine.gov> on behalf of Wippelhauser, Gail
Sent:	Wednesday, December 18, 2019 3:29 PM
To:	Donald Dow - NOAA Federal; Gregory Allen
Cc:	Matt Buhyoff - NOAA Federal; Seiders, Dwayne J; Christman, Paul; Bentivoglio, Antonio; Sojkowski, Bryan; Maloney, Kelly; Mitchell, Gerry; Dill, Richard; Brian McMahon; Mark Graeser
Subject:	RE: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry:

I just reviewed the O&M plan and concur with Don's comments.

Gail Wippelhauser, Ph. D.
Marine Resources Scientist
Maine Department of Marine Resources
#172 State House Station
Augusta, ME 04333

Phone: 207-624-6349
email: gail.wippelhauser@maine.gov

From: Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent: Tuesday, December 17, 2019 3:35 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>; Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>; Christman, Paul <Paul.Christman@maine.gov>; Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Wippelhauser, Gail <Gail.Wippelhauser@maine.gov>; Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>; Brian McMahon <bmcmahon@aldenlab.com>; Mark Graeser <mgraeser@aldenlab.com>
Subject: Re: Shawmut Final Design drawings and O&M Plan for Approval

Greg and Gerry -

I have reviewed the O&M plan. Here are my comments:

1. This plan should be considered a place holder until the plant is constructed. At that time we should gather all relevant parties and edit the plant to a workable form based upon our knowledge at the time. The plan should be updated every few years.
2. There should be some discussion as to the downstream attraction water taking the place of the stanchions that are removed during downstream migration of Atlantic salmon smolts.
3. I am not sure you need a sturgeon handling plan, but let's see how it shakes out with Lockwood and HK before we consider if that is agreeable with Matt.

4. Since the incident at Pejepscot, I thought the hoist cabling was also to be considered a spare part. Please check on it's local availablity. If it is not readily available we should include it as a spare part.

Thank you for the opportunity to review this plan; I approve the plan per NMFS with the above consideration until which time the lift is constructed and we need to edit the plan. My comments do not represent others from the Design Review Team.

My understanding is that I have responded to the Lockwood Study, the Shawmut Design and the O&M plan and you are waiting on a response for the Weston Concept which will be forthcoming.

Regards,
Don

On Fri, Nov 22, 2019 at 7:39 PM Gregory Allen <gallen@aldenlab.com> wrote:

> Good evening,
>
> Please find attached the final design drawings of the proposed fish passage facilities for Shawmut and the Operation and Maintenance Plan for review and final approval. The design drawings can be downloaded from the link provided below. Please let me know if anyone has trouble accessing the files.
>
> https://we.tl/t-rJlHsBs0Re
>
> Thank you and have a great weekend,
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> ALDEN Solving flow problems since 1894
> 30 Shrewsbury St., Holden, MA 01520
> (508) 829-6000 ext. 6409
> gallen@aldenlab.com | www.aldenlab.com
>
>

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

SHAWMUT CONCEPTUAL DESIGN CONSULTATION

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent:	Monday, March 06, 2017 4:16 PM
To:	Mitchell, Gerry
Cc:	Richter, Robert; Maloney, Kelly; Greg Allen; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Wilson, Carl; Matt Buhyoff - NOAA Federal; Dan Tierney; Julie Crocker; Sean McDermott; Bryan Sojkowski; Bentivoglio, Antonio; Anna Harris
Subject:	Shawmut Conceptual Design DRT comments
Attachments:	Shawmut Upstream Fish Lift Conceptual Design Review.pdf

Good Afternoon Gerry -

As we discussed on Friday, attached are the Design Review Teams comments on the conceptual design for the new Shawmut Fish Lift. As always, we are open to discuss and work through the design to come up with the best options to successfully pass fish at this site. Thank you for the opportunity to review and comment and thank you and Brookfield for your commitment to this important project.

Regards
Don

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Good Morning Guy -

As are aware, the various fisheries resource agencies have been working to coordinate the review of the new upstream fishway at the Shawmut Project. Please find below an outline of the agencies' preferred review process of the engineering design of the facilities.

A Kennebec River Design Review Team (DRT) has been formed by the agencies to facilitate the review process of the engineering design. The DRT includes Gail Wippelhauser and Paul Christman of MDMR, Jason Seiders of MDIFW, Don Dow, PE of NOAA, and Bryan Sojkowski of USFWS. The purpose of the DRT is to review your engineering design, prepare comments and recommendations, and work with you and your consultant on developing a satisfactory design. It is our hope that working with this DRT will minimize conflicting design comments and streamline your interaction with the agencies.

The new fishlift at Shawmut must be constructed and operational by May 1, 2018. We expect construction to take 12 to 16 months. Conceptual design and engineering design for construction could take up to 1 year. It is our expectation that you will be submitting the conceptual design drawings on Thursday of this week and shortly thereafter, convening a Conceptual Design Meeting on-site. Please distribute design drawings to members of the DRT and Antonio Bentivoglio, USFWS, Jeff Murphy, NOAA, and Sean McDermott, NOAA. Members of the DRT and others will plan to attend the on-site meeting.

It is our expectation that the design process will follow the typical conceptual stage, 30% complete, 60% complete, and 90% complete design review process. Please submit each set of drawings to the DRT at least four weeks prior to a combined Consultant, Owner, Agency (COA) meeting at each design phase. This will allow two weeks for the DRT to review and submit comments and two weeks for you and your consultant to prepare responses. This will give some float time for each of us. We ask that you respond in writing as well as having the COA meeting to discuss the rationale for including, modifying or excluding design components. We also ask that you respond directly to the DRT as a whole in order to avoid conflicting comments. The DRT will be responsible for compiling design input from other NOAA, USFWS, MDIFW and MDMR staff before passing along comments to you.

All changes to the drawings will need to be red-lined or clouded so that the DRT can see changes that have been adopted and where those changes were made.

Project Specifications, Bidding Documents and Project O&M plan should also be sent to the Team for review. The DRT does not need to review actual bids from contractors.

Changes made after the 90% drawing review should be sent to the DRT for review.

At project close out, final record drawings or as-builts should be submitted to the DRT so that they can be filed with their respective agencies.

By our estimation, the 30% design should be complete in September 1 of 2015, 60% in December 2015, and 90% by February 2016 in order to keep the project on schedule. This will give us 6 months to 1 year in total float for the project schedule.

The DRT will also be responsible for periodic construction inspections. The frequency of the inspections will be dictated by the construction activities occurring and will range from once every couple weeks to once every couple of days.

We will be forwarding to you the design population estimates for the fishway in the next few days.

We believe that it will be likely required to conduct three dimensional hydraulic modeling of the site in order to inform us of locations where a fishway entrance should not be placed. We also believe that it might be possible that we will request tagging studies to help locate an entrance and would like to discuss it further with you.

Thank you for your efforts on this important work and we look forward to working with you over the next couple years on this exciting project.

Brian McMahon

From:	Donald Dow - NOAA Federal <donald.dow@noaa.gov>
Sent:	Tuesday, September 27, 2016 9:22 AM
To:	Mitchell, Gerry
Cc:	Richter, Robert; Maloney, Kelly; Seiders, Dwayne J; Christman, Paul; Bentivoglio, Antonio; Wippelhauser, Gail; Bryan Sojkowski; Jeff Murphy - NOAA Federal; Julie Crocker - NOAA Federal
Subject:	Fwd: Shawmut
Attachments:	Shawmut DRT Opening Letter.docx; Kennebec Schedule.xlsx

Good Morning Gerry -

As we discussed last week. Based upon the project schedule we developed a few weeks ago, we are now on the critical path for the Shawmut fishway if we expect it to be constructed by May 1, 2019. This will be one year beyond what was in the BA/SPP and the BO.
Attached is our original note to Guy Senechal from April of 2015 to commence the project in order to meet the May 1, 2018 date.
At this point, I do not see any float in our schedule to make the 2019 date. In the same light, I see about 10 months of float in the Weston schedule.

In order to stay on schedule we should be seeing the 3-D modeling for Shawmut this week and the river herring tagging study within the next 30 days. The conceptual design phase should begin Jan 1 with a design engineer already selected.

I've attached the schedule.

Please let me know if you have any questions.

---------- Forwarded message ----------
From: **Wippelhauser, Gail** <Gail.Wippelhauser@maine.gov>
Date: Thu, Apr 16, 2015 at 9:23 AM
Subject: Shawmut
To: "Senechal,Guy (Guy.Senechal@brookfieldrenewable.com)" <Guy.Senechal@brookfieldrenewable.com>
Cc: Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>, "Seiders, Dwayne J" <Dwayne.J.Seiders@maine.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, "Christman, Paul" <Paul.Christman@maine.gov>, Jeff Murphy - NOAA Federal <jeff.murphy@noaa.gov>, "Bentivoglio, Antonio" <antonio_bentivoglio@fws.gov>, Sean McDermott - NOAA Federal <sean.mcdermott@noaa.gov>

Hi Guy.

I am attaching a letter about the Shawmut design process from the Design Review Team.

Gail Wippelhauser, Ph. D.
Marine Resources Scientist
Maine Department of Marine Resources
#172 State House Station
Augusta, ME 04333

Phone: 207-624-6349 Fax: 207-624-6501
email: gail.wippelhauser@maine.gov

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut Upstream Fish Lift Conceptual Design Review

Intra Agency Design Review Team Comments

March 6, 2017

The following comments were prepared by the United States Fish and Wildlife Service, the Maine Department of Marine Resources, the Maine Department of Inland Fisheries and Wildlife and the National Marine Fisheries Service. These comments may or may not accurately reflect each agencies views. The agencies may still wish to submit comments on their own or to support these comments. This review was not done considering building codes or life safety codes and was not done considering the structural integrity of the facility or with construction safety in mind. We assume that these considerations will be done by the design engineer. We would like for your design engineer to pay careful attention to the design in terms of access in the facility for the purposes of cleaning.

1. The diffusion pit is not large enough and water enters the pit too close to the hopper. We recommend that the entire area behind the lift be used for diffusion with the distance from the outlet of the spurger to the blocking screen to be at least 30 to 40 ft (see attached drawing).

2. Despite the explanation from Alden, and per the drawings, there seems to be enough room to build a fishway that could provide the full 5% of station capacity (see attached drawing). This criteria is not based upon individual powerhouses but rather on the hydraulic capacity of the site in order to provide adequate far field attraction to the lift. The agencies recommend more flow be provided for fish passage since this site is under-designed by about 20 to 30% when compared to other run-of-river projects. This fishway should be designed to pass 5% of total station capacity as there are such large distances and so many outlets for water to attract fish. The emailed table shows 190 cfs total AWS flow which is about 2.8% of station capacity. We need at least 5% (~ 335 cfs), but because this site is under-designed we could shoot for a capacity as high as 500 cfs. Either way, the proposed diffusion chamber is obviously not big enough. If space still becomes a limitation, then additional attraction water could be supplied on the upstream side of the fishway entrance.

3. The width of the entrance needs to be increased. We recommend that the width of the entrance be 10-12 feet (see attached drawing)

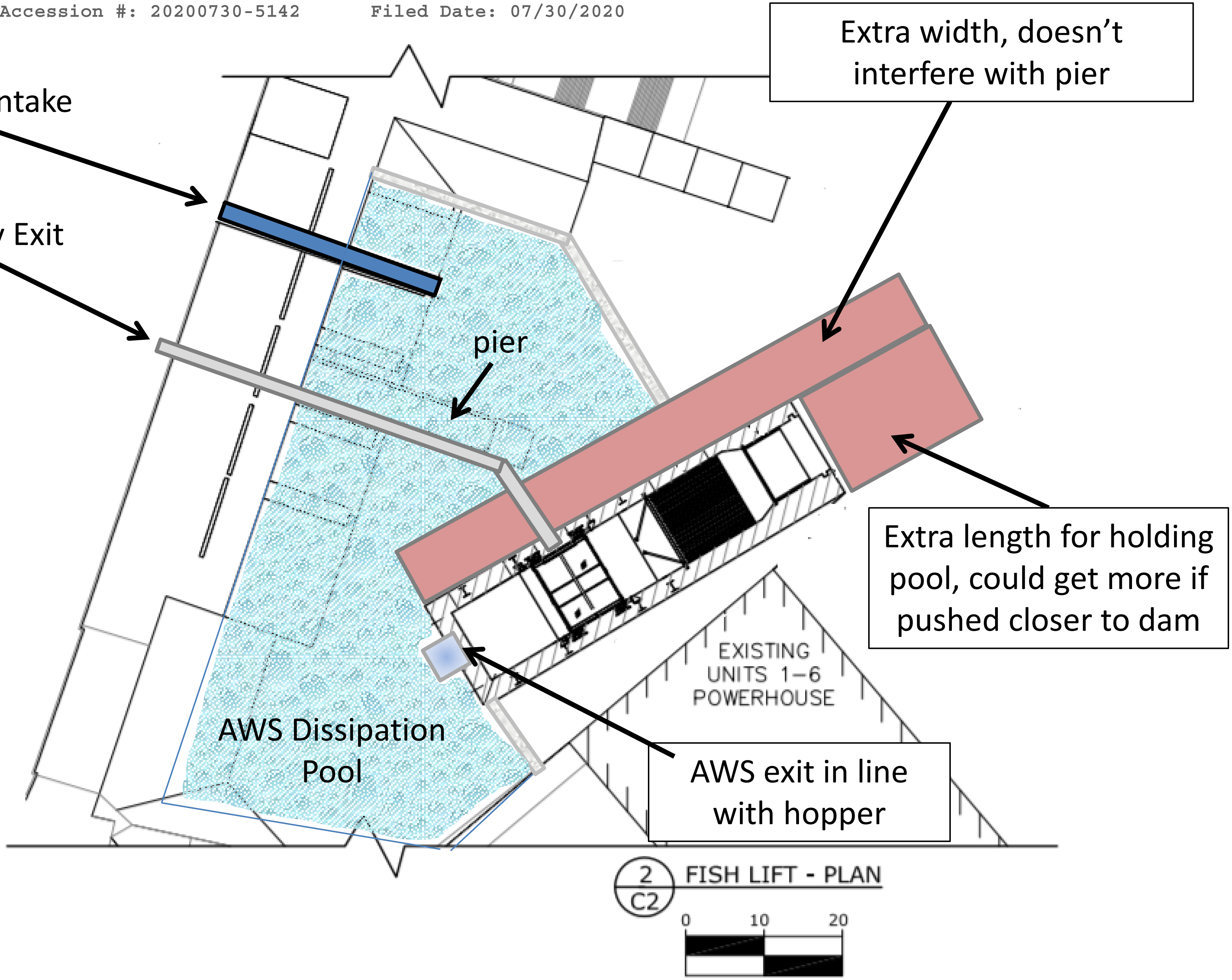
4. There is no holding pool in this design. A holding pool is required and should not be considered the area above a horizontal diffuser. In the proposed design, the holding pool consists of the fixed brail floor which is a very small volume of water to hold fish. A quick look at capacity, using the numbers on drawing 1 show that we will need a holding pool that is roughly 800 cubic ft or approximately 6,000 gal (not sure how this compares to HK). The hopper should be the same volume as the hopper at Hydro Kennebec.

5. This size of the floor diffuser should be limited in the design or totally eliminated. The velocity exiting the floor and wall diffusers should be no greater than 0.5 fps.

6. The discharge channel is too long and its 8% slope may not be sufficient to safely and quickly move fish into the headpond. The steeper the better. The channel should be open flume with man access provide at all points. A different hopper location may shorten the channel.

7. The difference in tailwater elevations from the Unit 1-6 and Unit 7-8 tailraces are 1.6 ft for the low, normal, and high design flows. Does this match reality? We would like to know what data was utilized to arrive at those elevations.

8. At Milford and Cataract there is a concrete retaining wall that runs down long past the fishway entrance. We have witnessed shad line up along these walls prior to entering the fishway. It may be that if shad do not use this after it is constructed that we should look at constructing such a wall.



Extra width, doesn't interfere with pier
AWS intake
Fishway Exit
pier
Extra length for holding pool, could get more if pushed closer to dam
EXISTING UNITS 1–6 POWERHOUSE
AWS exit in line with hopper
AWS Dissipation Pool
2
C2
FISH LIFT - PLAN
0
10
20

Gmail

Gregory Allen <gallen@aldenlab.com>

Shawmut Design Populations Memo

Donald Dow - NOAA Federal <donald.dow@noaa.gov> Fri, Dec 23, 2016 at 8:24 AM
To: "Richter, Robert" <robert.richter@brookfieldrenewable.com>
Cc: "Mitchell, Gerry" <Gerry.Mitchell@brookfieldrenewable.com>, Steve Amaral <amaral@aldenlab.com>, Greg Allen <gallen@aldenlab.com>, "Wippelhauser, Gail" <gail.wippelhauser@maine.gov>, "Bentivoglio, Antonio" <antonio_bentivoglio@fws.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Dan Tierney <dan.tierney@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, "Seiders, Dwayne J" <Dwayne.J.Seiders@maine.gov>, "Christman, Paul" <Paul.Christman@maine.gov>

Good Morning Bob -

As you recall, I sent you the Design Populations for Shawmut on October 24th of this year. This is the design memo to show the backup information for those numbers. We will be working on the Weston numbers right after the Holidays. Merry Christmas to everyone.

Regards,
Don

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut Design Populations1.docx
22K

Shawmut Upstream Fish Passage Design Populations
Submitted to Brookfield Power on December 23, 2016 by Don Dow, P.E., NMFS
Data assembled by Maine Department of Marine Resources (contact: Gail Wippelhauser, Ph.D.), and National Marine Fisheries Service (contact: Dan Tierney)

Abbreviations
Maine Department of Marine Resources (MDMR)
National Oceanic and Atmospheric Administration (NOAA)
NOAA's National Marine Fisheries Service (NMFS)
United States Fish and Wildlife Service (USFWS)
United States Geological Survey (USGS)

Introduction
Shawmut is currently the third mainstem dam on the Kennebec River located just above the Hydro Kennebec Project in the Village of Shawmut in the towns of Fairfield and Benton Maine. In 2018, it is anticipated that Brookfield Power will construct an upstream fishway as a condition of their ESA Section 7 Interim Species Protection Plan with NMFS. Order of magnitude estimates are needed for diadromous fish such as adult shad, alewife, blueback herring and Atlantic salmon in order to size the upstream passage facilities appropriately. A similar exercise was completed for the Hydro Kennebec Project and submitted on March 23, 2013 to Brookfield Power. This design memorandum is a modification of that design memorandum.

American Shad (as calculated by MDMR)
Total Production: 354,000 shad (111 shad/acre x 3189 acres)
Total to be passed at Shawmut: 177,000 shad

In the 1980s, the MDMR developed a method of estimating the number of adult American shad that would be produced by a specific amount of habitat (total production) and the number of adult spawners that would be needed to sustain that total production (spawning escapement). Unit production for American shad is based on information from the Connecticut River, because runs of shad in Maine have not been restored and detailed information on historical abundance is lacking. In the past, MDMR used 111 shad/acre (=2.3 shad/100 yd^2), based on the number of American shad annually passed at the Holyoke Dam during the early 1980s and the amount of habitat between Holyoke Dam and Turners Falls Dam, the next upriver dam. Annual passage numbers for Holyoke from 1980-2004 indicate a slight decline in unit production to 101 shad/acre (2.0 shad/100 yd^2); however, we will use 111shad/acre to maintain consistency with other Maine fisheries management plans.

The use of 111 shad/acre is further supported by historical information on commercial landings in Maine. A significant fishery for American shad existed in the freshwater tidal section of the Kennebec River and its tributaries after access to inland waters was obstructed by impassable dams at the head-of-tide. From 1896-1906 the average annual landings of American shad in the Kennebec River were 802,514 pounds. This represents 267,500 adult shad, assuming an average weight of three pounds per fish (note: fish way design assumes four pounds per fish), and a commercial yield of 0.6778 shad/100 $yd^{2.}$ If the exploitation rate ranged from 25-50%, then the total run from Merrymeeting Bay to Augusta (including tributaries) may have ranged from 535,000-1,070,000 shad. This represents a production of to 68-131shad/acre (equivalent to 1.4-2.7 adult shad/100 $yd^{2)}$.

There is 15,391,304 yd^2 of shad habitat above the Shawmut Project. The following formula converts shad per acre to shad per 100 yd^2.

111 shad/acre x 1 acre / 4.84 100 yd^2= 2.3 shad per 100 yd^2

Therefore total production is:

(15,391,304 yd^2 / 100 yd^2) x 2.3 shad per 100 yd^2= 354,000 shad

Assuming a 50% escapement rate to maintain a shad run above Shawmut, the required amount of passage at Shawmut is:

354,000 shad x 50% escapement = 177,000 shad

Alewives (as calculated by MDMR)
Total Production: 614,995 alewives (235 alewives per acre x 2617 acres)
Total to be passed at Shawmut: 134,000 alewives

In the 1980s, the MDMR developed a method of estimating the number of adult alewife that would be produced by a specific amount of habitat (total production) and the number of adult spawners that would be needed to sustain that total production (spawning escapement). Total production is computed by multiplying the total surface area of known or assumed historical spawning habitat by the number of adults produced per unit of spawning habitat (unit production). Spawning escapement is a percentage of total production. Both total production and spawning escapement are computed for specific bodies of water, for example, a river reach or lake. The number of adult fish that need to be passed upstream at each fishway is estimated by dividing spawning escapement needed for all waters above the facility by an assumed passage efficiency (a goal of 90% is typically used). The surface area of spawning habitat for each species was determined from USGS 7.5 minute topographical maps.

Unit production for alewife (235 fish/acre) was developed from the commercial harvest in six coastal Maine watersheds for the years 1971-1983, which was assumed to be 100 pounds/surface acre of ponded habitat. This value was slightly less than the average of the lowest yield/acre for all six rivers, and within the range of yields experienced in other watersheds. Assuming a weight of 0.5 pounds per adult, the commercial yield equals 200 adults/surface acre. The commercial harvest was assumed to represent an exploitation rate of 85%, because most alewife runs were harvested six days per week. Exploitation rates on the Damariscotta River, for example, ranged from 85-97% for the years 1979-1982. When commercial yield is adjusted for the 15% escapement rate, the total production is 235 adult alewives/acre.

The unit production is derived from coastal alewife populations that spawn in lakes and ponds that are relatively rich in nutrients (mesotrophic or eutrophic). Many of the large lakes in the Penobscot basin (e.g. Sebec Lake, Schoodic Lake, and Seboeis Lake) are relatively nutrient poor (oligotrophic) and may not produce 235 alewife/acre. However, MDMR is not aware of any information on alewife production in oligotrophic lakes, and will use 235 fish/acre for planning purposes.

Because Maine's commercially harvested alewife populations began to decline in the mid-1980s under this high exploitation level, MDMR is now recommending that municipalities have a three-day closure for conservation purposes. Therefore, minimum escapement for this plan is assumed to be 45% of total production (equivalent to a three-day closure).

The total production above Shawmut is adjusted by the 15% escapement rate which yields:

235 alewives/acre x 15% = 35 alewives per acre.

The number of alewives needed to pass Shawmut to sustain a population is then decreased by 10% for each barrier passage inefficiency between Shawmut and the subject spawning habitat area. Through a spreadsheet analysis, this equals 134,000 alewives (10% less than Hydro Kennebec) needed to pass Shawmut to sustain a population.

Blueback Herring (as calculated by MDMR)
Total Production: 1,535,000 Blueback Herring (484blueback herring per acre)
Total to be passed at Shawmut: 1,535,000 Blueback Herring

In the past, MDMR has not had sufficient information about blueback herring runs in Maine to develop an estimate of unit production. However, based on three years of passage data at Benton Falls, production is 237 to 484 per acre for 875,500-1,788,000 fish. MDMR has no information on how much available habitat is used or escapement needs. Therefore, 1,535,000 blueback herring is the conservatively assumed design population for the Shawmut fish lift

Atlantic Salmon (as calculated by NMFS and MDMR)
Total Production: 11,639 Atlantic salmon adults (174,581 habitat units (240 eggs per unit)) /7200 eggs per female)*2= 11,639 adults (male + female)*
Total to be passed at Shawmut: 11,639 Atlantic salmon

The amount of Atlantic salmon habitat units (1 unit = 100 m^2) above the project will be determined based on information from a GIS model developed by the USFWS and NMFS (NMFS et al. 2010). The total number of habitat units can then be used to estimate Atlantic salmon production (i.e., the number of juvenile Atlantic salmon smolts that could be produced in the available habitat upstream of the dam). The spawning and rearing habitat above the Shawmut Dam is estimated to be 178,143 salmon habitat units. Using the current estimate of 240 eggs per habitat unit and approximately 7200 eggs produced per female Atlantic salmon (Baum, E.T. January 1997. Maine Atlantic Salmon Management Plan with Recommendations Pertaining to Staffing and Budget Matters), the estimated number of Atlantic salmon productivity above Shawmut is estimated to be 11,639 adults.

Summary of Design Population Rates for Fish Passage at Hydro Kennebec (Rounded Up)

American Shad	177,000 fish
Alewives	134,000 fish
Blueback Herring	1,535,000 fish
Atlantic Salmon	12,000 fish

ALDEN

Solving flow problems since 1894

Memorandum

To: Robert Richter and Gerry Mitchell, Brookfield

From: Greg Allen and Brian McMahon, Alden

Date: June 21, 2017

Re: **Shawmut Fish Passage Design Project, FERC No. 2332**
Conceptual Design Submittal and Response to Agency Comments

In response to comments received for the Shawmut fish passage conceptual design Alden Research Laboratory, Inc. (Alden) provides the following responses to comments and a revised conceptual design.

The following comments were received on March 6, 2017. Alden's responses are provided in *italics*.

1. The diffusion pit is not large enough and water enters the pit too close to the hopper. We recommend that the entire area behind the lift be used for diffusion with the distance from the outlet of the spurger to the blocking screen to be at least 30 to 40 ft (see attached drawing).

Response *– The fish lift entrance flume and attraction water system (AWS) has been revised. The area between the non- overflow dam section and the powerhouse is now used as an energy dissipation pool. See attached drawings.*

2. Despite the explanation from Alden, and per the drawings, there seems to be enough room to build a fishway that could provide the full 5% of station capacity (see attached drawing). This criteria is not based upon individual powerhouses but rather on the hydraulic capacity of the site in order to provide adequate far field attraction to the lift. The agencies recommend more flow be provided for fish passage since this site is underdesigned by about 20 to 30% when compared to other run-of-river projects. This fishway should be designed to pass 5% of total station capacity as there are such large distances and so many outlets for water to attract fish. The emailed table shows 190 cfs total AWS flow which is about 2.8% of station capacity. We need at least 5% (~ 335 cfs), but because this site is under-designed we could shoot for a capacity as high as 500 cfs. Either way, the proposed diffusion chamber is obviously not big enough. If space still

becomes a limitation, then additional attraction water could be supplied on the upstream side of the fishway entrance.

***Response** – The fish lift entrance flume and AWS has been revised, see attached drawings. The AWS system is designed to provide up to 225 cfs at the entrance to the fish lift and additional flow adjacent to the lift (115 cfs min). The combined flow of the fish lift entrance and adjacent chute would provide 5% of station capacity (340 cfs) and up to 500 cfs, if desired. This design is also compatible with the proposed new rack upstream of the head gate structure that was proposed back in 2011.*

3. The width of the entrance needs to be increased. We recommend that the width of the entrance be 10-12 feet (see attached drawing)

***Response** – The fish lift entrance flume is now 12 feet.*

4. There is no holding pool in this design. A holding pool is required and should not be considered the area above a horizontal diffuser. In the proposed design, the holding pool consists of the fixed brail floor which is a very small volume of water to hold fish. A quick look at capacity, using the numbers on drawing 1 show that we will need a holding pool that is roughly 800 cubic ft or approximately 6,000 gal (not sure how this compares *to HK). The hopper should be the same volume as the hopper at Hydro Kennebec.*

***Response** – The area upstream of the hinged flap gate and downstream of the V-trap is considered a holding pool. This volume is 1296 cubic feet. The hopper is 490 cubic feet in capacity, which is the same as HK.*

5. This size of the floor diffuser should be limited in the design or totally eliminated. The velocity exiting the floor and wall diffusers should be no greater than 0.5 fps.

***Response** – We have revised the design to eliminate the floor diffuser.*

6. The discharge channel is too long and its 8% slope may not be sufficient to safely and quickly move fish into the headpond. The steeper the better. The channel should be open flume with man access provide at all points. A different hopper location may shorten the channel.

***Response** – We will provide information to indicate the hydraulic conditions within the discharge channel (exit flume). As the slope increases the water depth will decrease. We need to select a slope that provides both ideal velocity and water depth conditions.*

7. The difference in tailwater elevations from the Unit 1-6 and Unit 7-8 tailraces are 1.6 ft for the low, normal, and high design flows. Does this match reality? We would like to know what data was utilized to arrive at those elevations.

Response – *Tailwater rating curves for both powerhouse tailraces are presented in a document provided by Brookfield titled "Declaration of Incremental Hydropower, Shawmut Hydroelectric Project FERC No. 2322-ME", dated December 17, 2009 and prepared by Kleinschmidt Associates. This document indicates about a 1.5 ft difference in water level between tailraces. In addition, recent modeling indicates a difference of about 1 to 1.5 ft. We will compare this data to field data that may be available.*

8. At Milford and Cataract there is a concrete retaining wall that runs down long past the fishway entrance. We have witnessed shad line up along these walls prior to entering the fishway. It may be that if shad do not use this after it is constructed that we should look at constructing such a wall.

Response – *Comment noted. The proposed fishway channel between the tailraces does include a training wall leading up to the fishway entrance.*

SHAWMUT CFD MODELLING CONSULTATION

Gregory Allen

From: Senechal,Guy
Sent: Monday, June 29, 2015 2:32 PM
To: Donald A. Dow (Donald.Dow@noaa.gov); Wippelhauser, Gail; Bentivoglio, Antonio; Bryan Sojkowski (bryan_sojkowski@fws.gov); Seiders, Dwayne J; Christman, Paul
Cc: Clere,Jason; Richter, Robert; gallen@aldenlab.com
Subject: Shawmut and Weston CFD modeling plan review

Thank you everyone for your input to today's discussion regarding the Shawmut and Weston CFD modeling study plans. The comments and follow-up action I have are as follows:

Shawmut:
- Everyone seemed ok with the model domain
- What is intended for long term operation of the stanchions for downstream fish passage? Guy to get with Bob Richter.
- Water level downstream of facility fluctuated quite a bit last year., apparently unrelated to weather events. Observed some of the same fluctuations this year (which may be weather related). Is this a change in operation? Guy to review with Operations to get a better understanding as to why this has happened and if it's something we need to consider for the model.
- Model runs will include a benchmark calibration run; 5% flow duration (high flow), 15% flow duration (power house capacity exceeded with some spill), 50% flow (median flow), 95% flow duration (low flow).

Weston:
- One question regarding change in near field and far field model domain in reference to the north channel. Available bathymetry data didn't allow for clear delineation. Alden to attempt to define a delineation based on available data.
- Will log sluice continue to be the primary method for dowstrem fish bypass? Guy to get with Bob Richter.
- Model runs will be the same as shown for Shawmut, with the exception that the 15% flow duration model run may be adjusted some to show river flows exceeding power house capacity with some spill. Alden to evaluate.

Let me know if I've missed anything. We'll proceed with plan revisions and getting data requested as indicated. I'll let you know shortly when study plans will be finalized.

Thanks,
Guy

Guy Senechal, P.E.
Project Manager

Brookfield Renewable Energy Group
26 Katherine Drive, Hallowell, Maine, 04347
T 207-629-1828 **C** 207-423-7691 **F** 207-623-3913
guy.senechal@brookfieldrenewable.com
www.brookfieldrenewable.com

Brookfield

Shawmut Hydroelectric Project

Computational Fluid Dynamics Flow Analysis

Prepared for

Alden Research Laboratory

Prepared by

Blue Hill Hydraulics

Date

28 September 2016

Summary

Shawmut Hydroelectric Project
(FERC No. P-2322)

A Computational Fluid Dynamics (CFD) model of the Shawmut Hydroelectric Project was developed to aid in the design of a future upstream fish passage.

The model includes the tailrace, spillways, training walls, and powerhouse discharges.

Included in this presentation are:

1) **a description of the modeling approach,**
2) **setup information, and**
3) **model results.**

Modeling Approach

Computer Software

- *FLOW-3D* 11.0.3.05

Governing Equations and Model Physics

- Reynolds Averaged Navier-Stokes
- Incompressibility
- Gravity
- RNG turbulence model

Fluid Properties

- Water

Computational Mesh

- Non-uniform structured mesh
- 2,660,000 control volumes
- Nominal control volume size in vicinity of project 2ft x 2ft x 1.9ft

Boundary Conditions

Inflow Conditions

- Mass-momentum sources used to define all discharge elements – Units 1 to 8, log sluice, flashboards, and rubber dam

Downstream Boundary

- Specified water surface elevation and hydrostatic pressure distribution

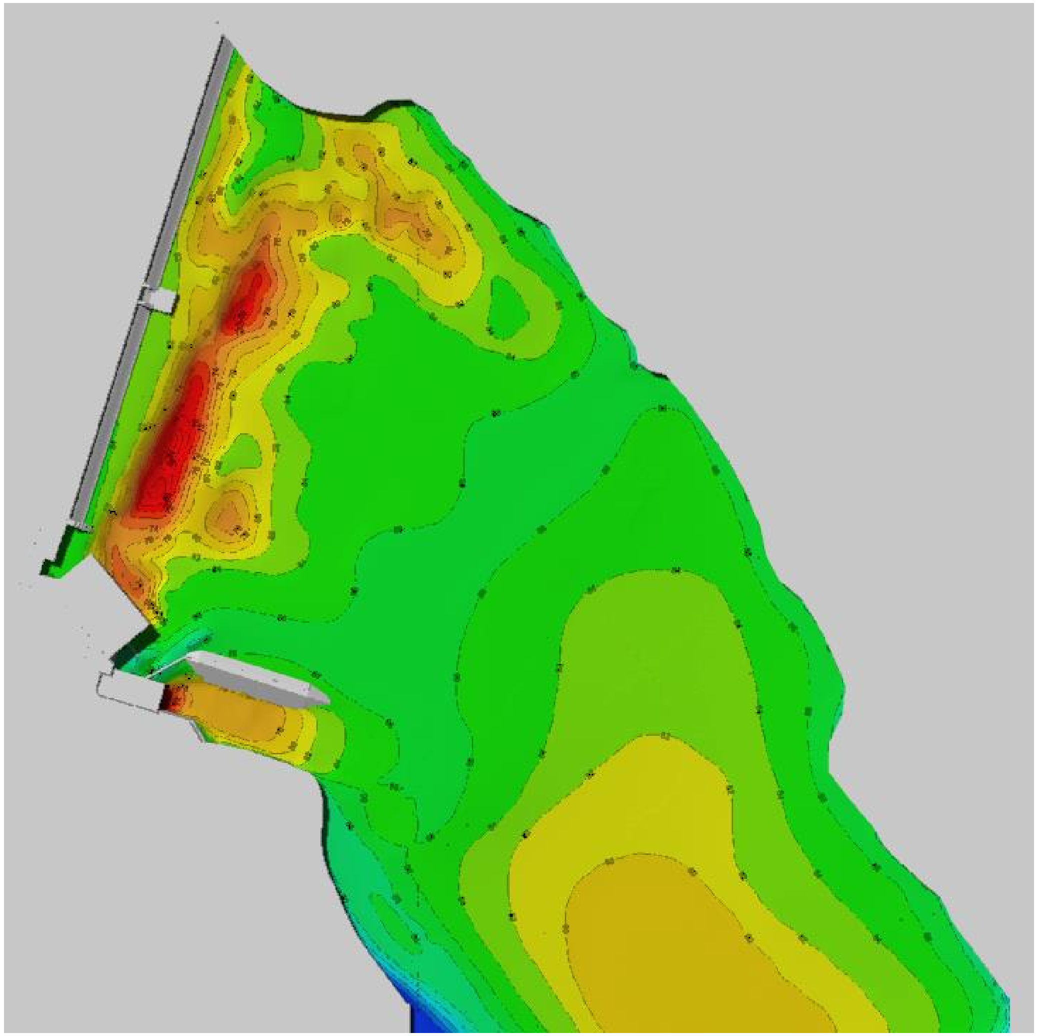
Solid Surfaces

- No-Slip

Free Surface

- Volume of Fluid (VOF) – ref. Hirt and Nichols (1981)

Model Geometry



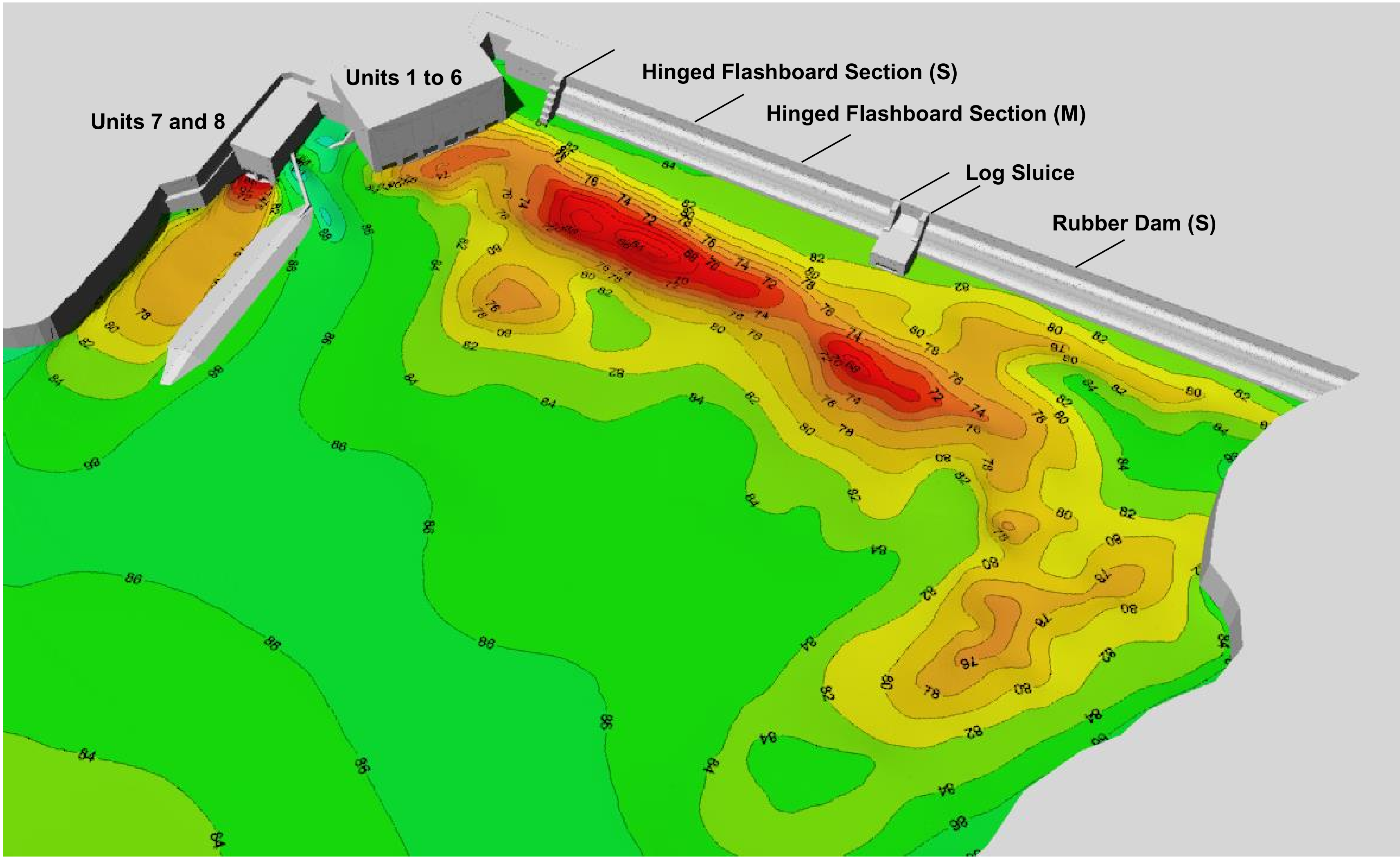
CFD Model Domain

Model geometry was based on information from the following sources:

- **1924 and 1981 surveys**
- **1980s drawings**
- **2015 and 2016 Normandeau surveys**

Relevant structural elements are identified on the following slide

Model Geometry



Source Elements in Model are Identified

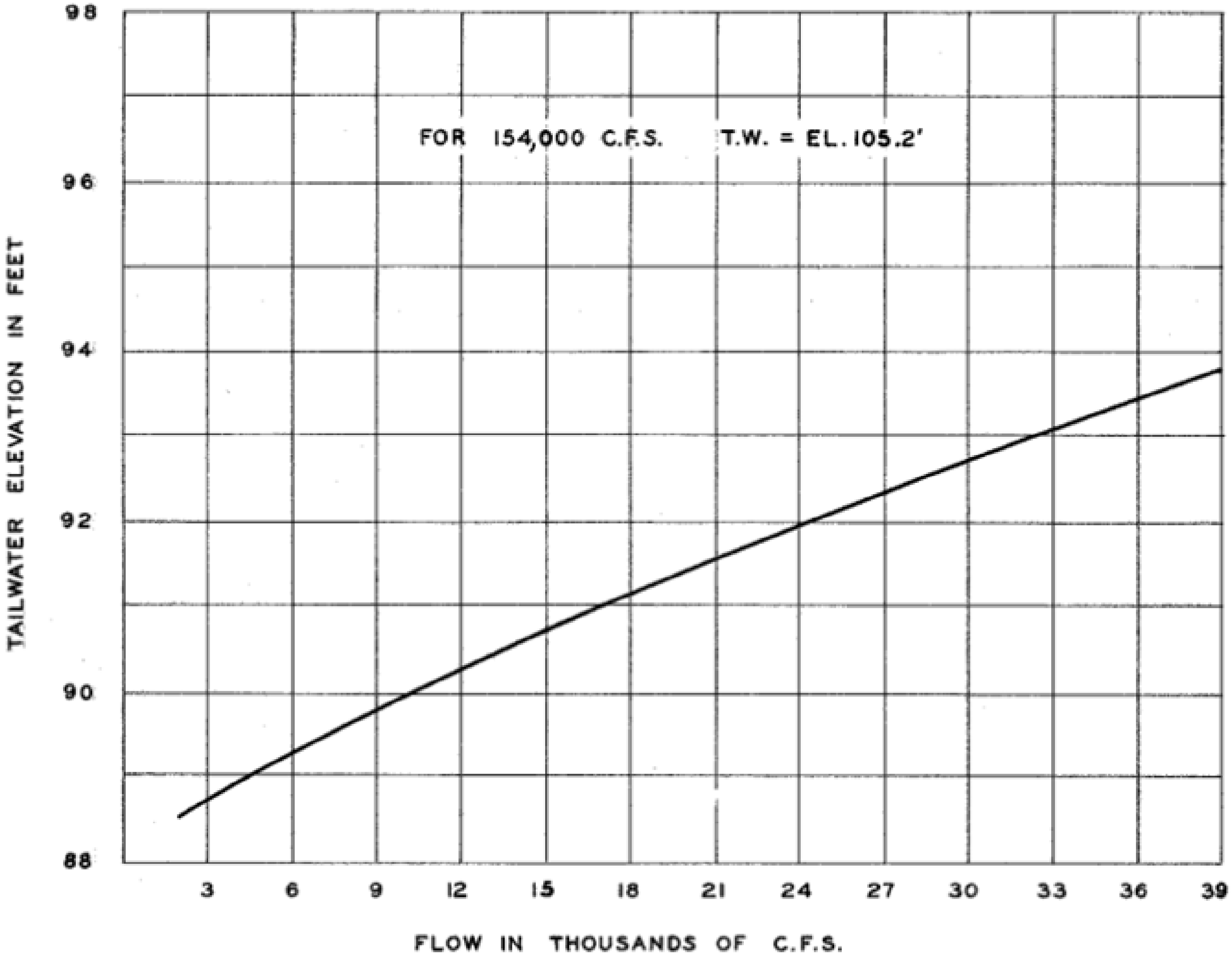
Flow Allocation

Model Simulation	River Flow		Flow Allocation (cfs) May 1 - October 31																	
			Gates and Sluices				Hinged Flashboards			Rubber Dam Sections			1912 PH Turbines						1982 PH Turbines	
	Total Flow (cfs)	Flow Exceedance (%)	10 x 7 ft Tainter Gate (up to 700 cfs)	25 x 8 ft Log Sluice (up to 1,840 cfs)	4 ft x 22 inch Log Sluice (up to 35 cfs)	6 x 6 ft Deep Bypass (up to 35 cfs)	South 123 ft Hinged Flashboard (up to 3,400 cfs)	Middle 123 ft Hinged Flashboard (up to 3,400 cfs)	North 123 ft Hinged Flashboard (up to 3,400 cfs)	South 238 ft Rubber Dam Section (up to 7,000 cfs)	Middle 237 ft Rubber Dam Section (up to 7,000 cfs)	North 231 ft Rubber Dam Section (up to 7,000 cfs)	Unit 1 (up to 635 cfs)	Unit 2 (up to 639 cfs)	Unit 3 (up to 634 cfs)	Unit 4 (up to 611 cfs)	Unit 5 (up to 703 cfs)	Unit 6 (up to 649 cfs)	Unit 7 (up to 1451 cfs)	Unit 8 (up to 1433 cfs)
Benchmark Case	3,463												544	554	596	635	580			
Case 1	2,540	95%											635	622	634			649		
Case 2	4,790	50%											635	125	634	611	703	649		1433
Case 3	10,750	15%		595			3400						635	639	634	611	703	649	1451	1433
Case 4	20,270	5%		1840			3400	1275		7000			635	639	634	611	703	649	1451	1433

Max Flood EL. (ft)	122
100 Year FEMA EL. (ft)	120
Normal Pond EL. (ft)	112
Low Pond EL. (ft)	108
Max Project Turbine Flow (cfs)	6755

- **The flow allocation table provided by BREG is shown above.**
- **Tailwater elevations for Cases 1 to 4 were based on the curve appearing on the following slide.**
- **The tailwater for the benchmark case was report to be 87.27 ft.**

Tailwater Curve

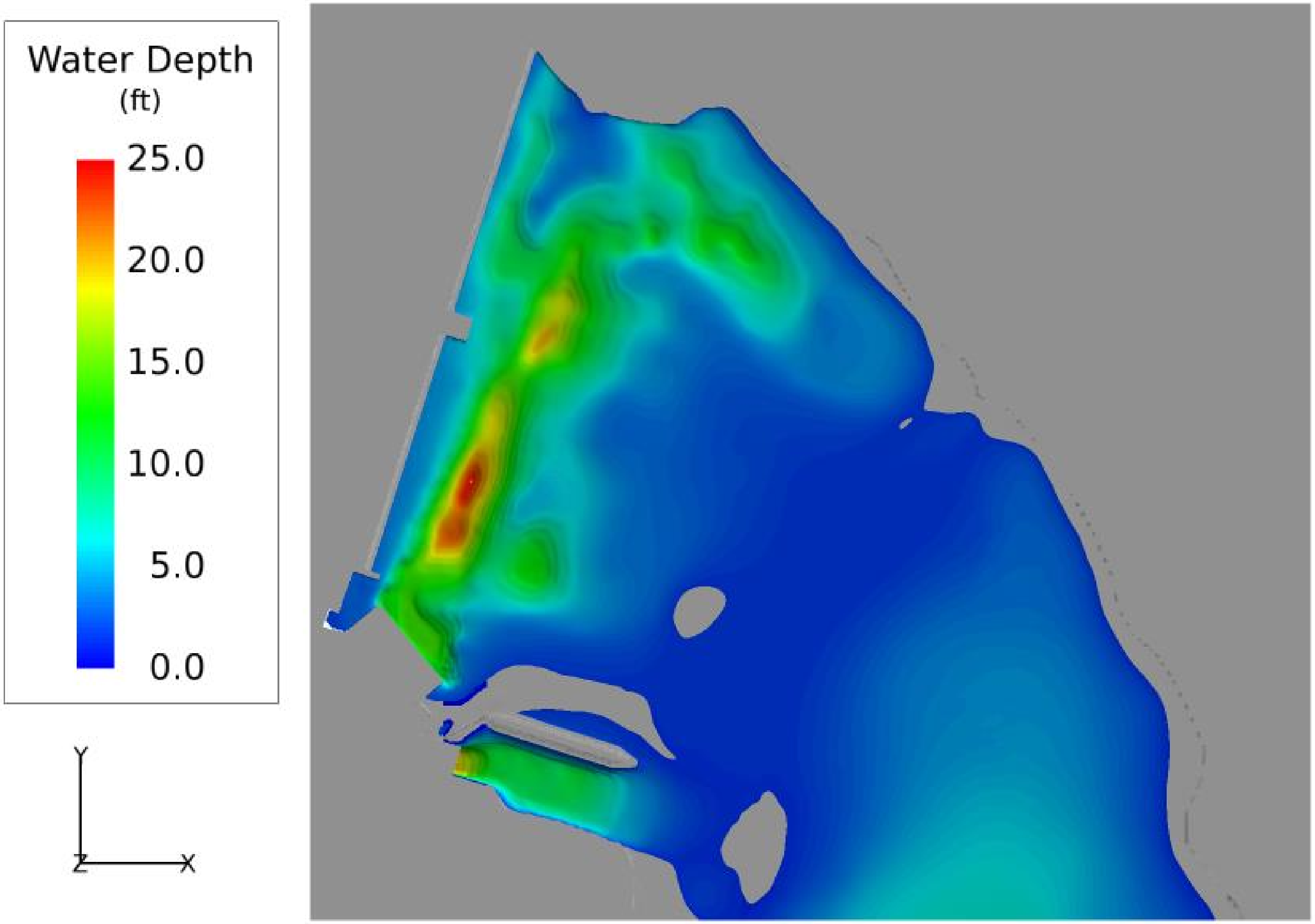


Benchmark Case

Boundary Conditions – 12 July 2016

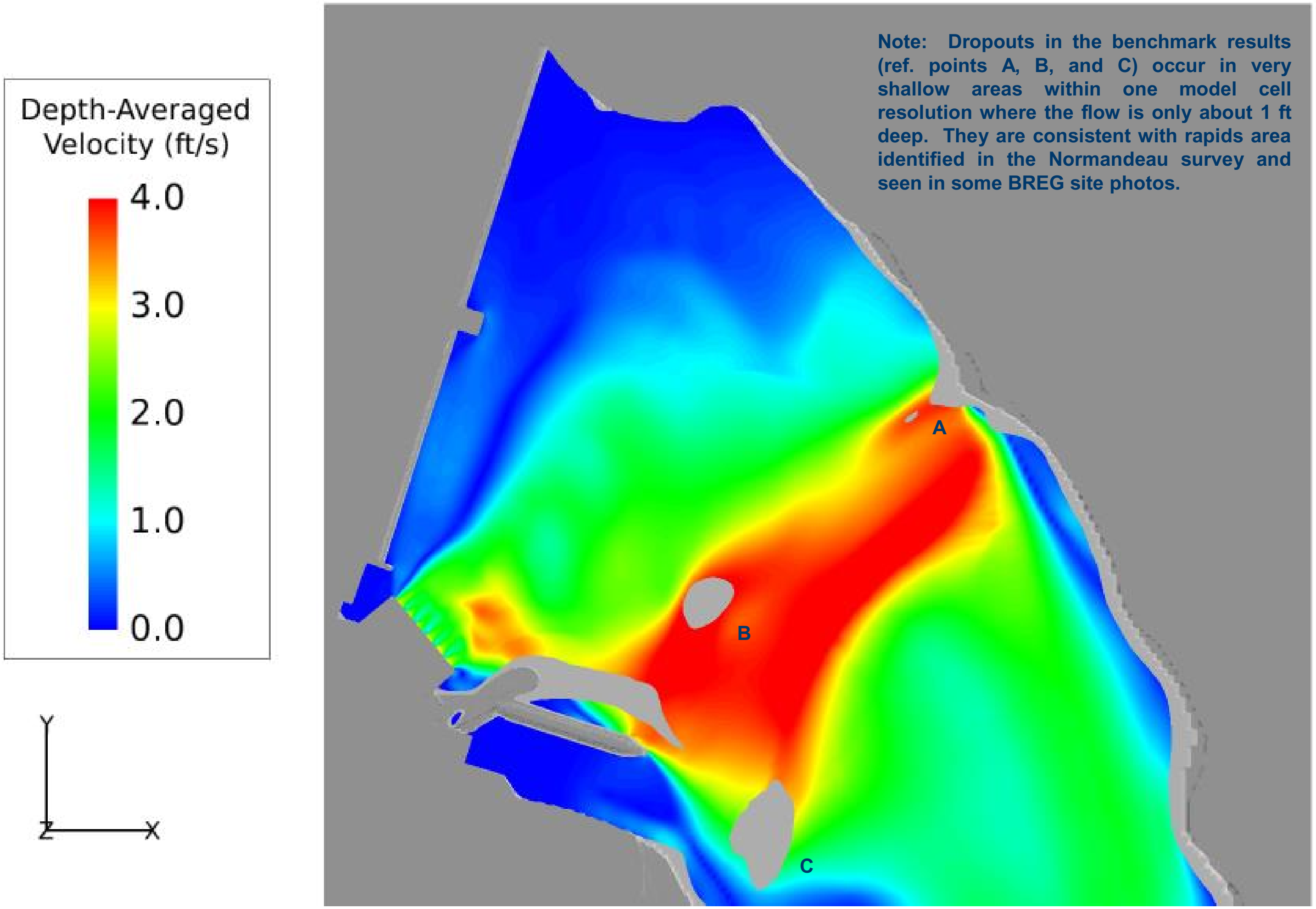
Total Flow	3,463 cfs
Tailwater Elevation	87.27 ft
Unit 01 Discharge	544 cfs
Unit 02 Discharge	554 cfs
Unit 03 Discharge	554 cfs
Unit 04 Discharge	596 cfs
Unit 05 Discharge	635 cfs
Unit 06 Discharge	580 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	0 cfs
Log Sluice	0 cfs
S Flashboards	0 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Benchmark Case



Water Depth, Plan View
(red > 25.0 ft)

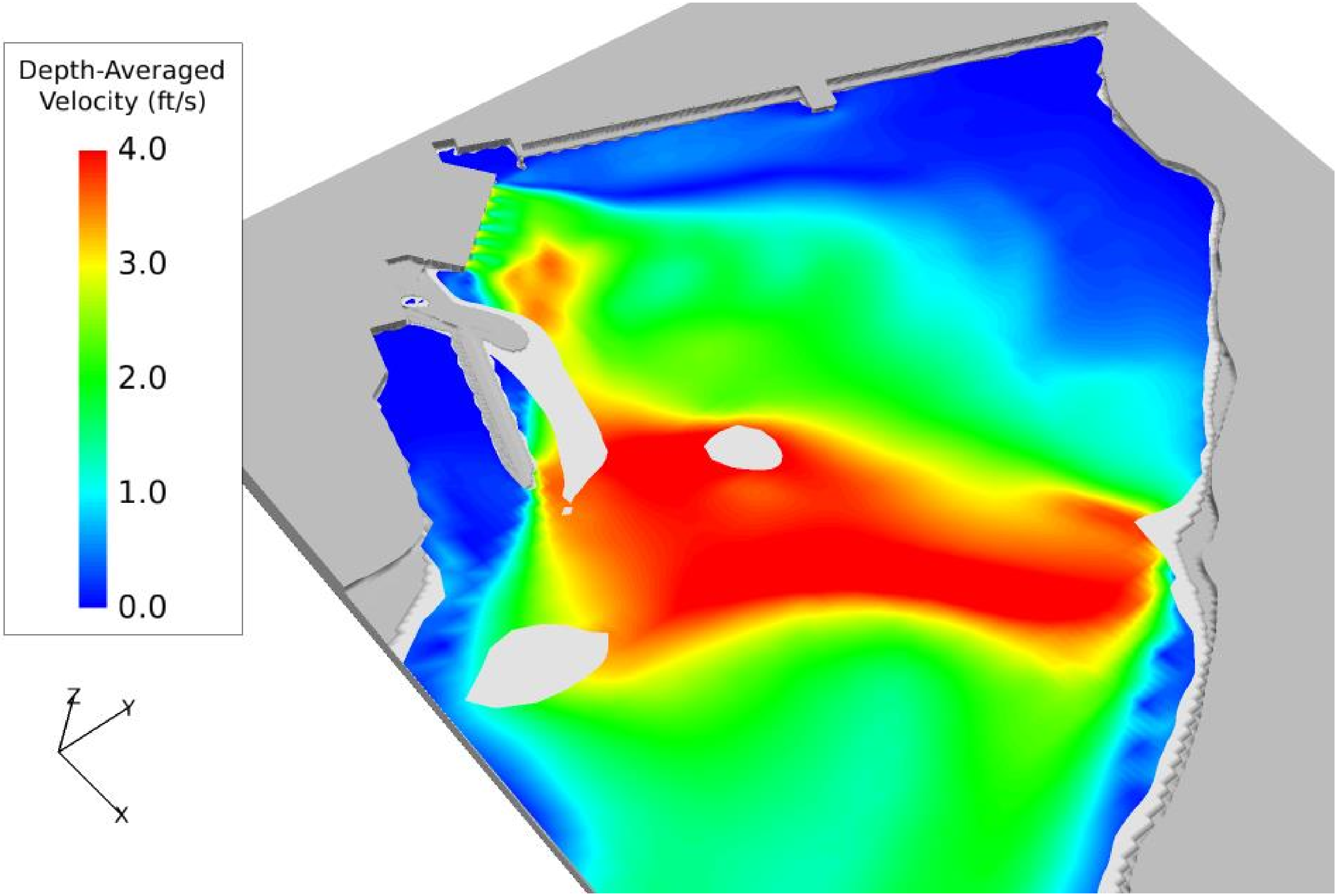
Benchmark Case



Depth-Averaged Velocity, Plan View (red > 4.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

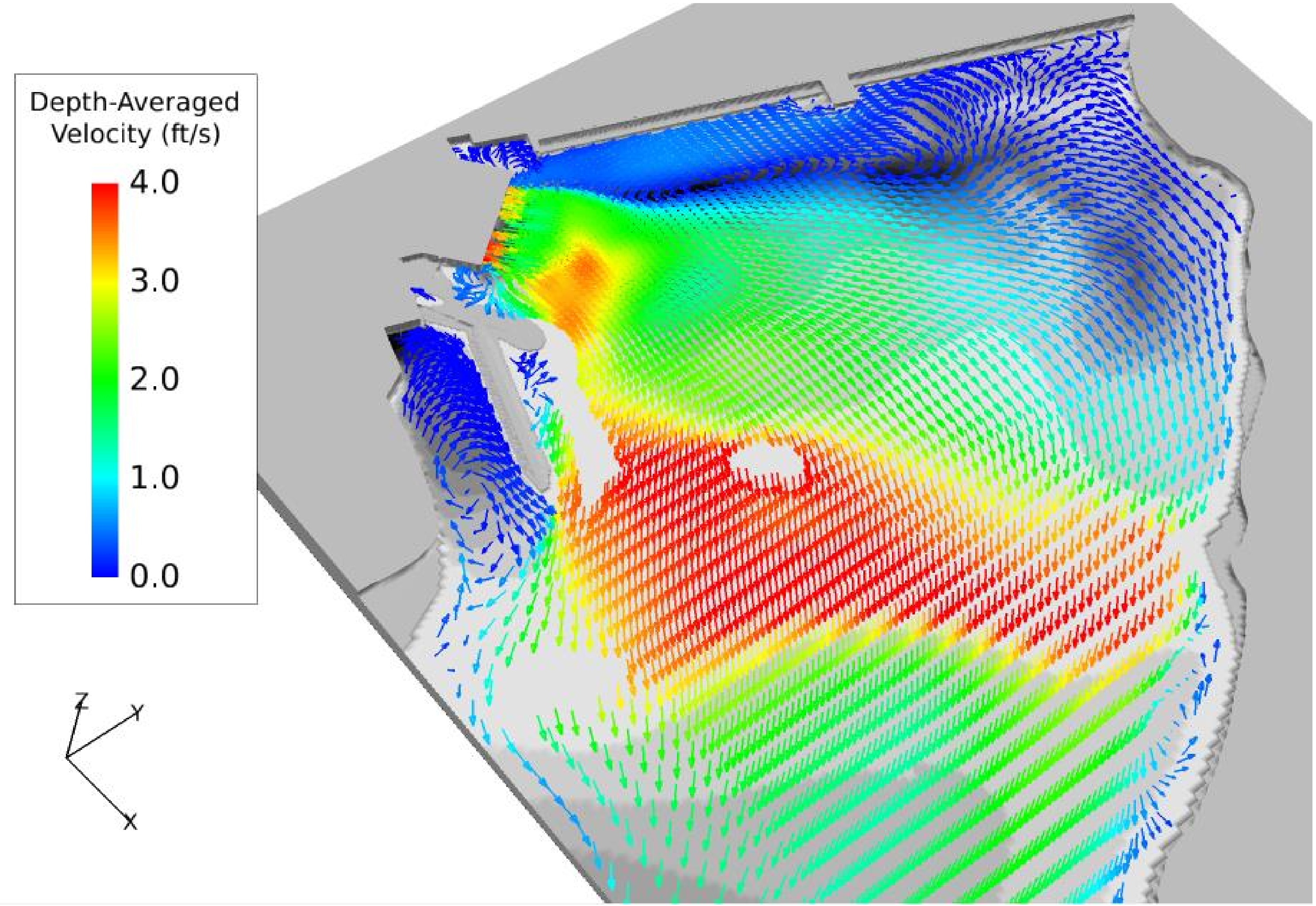
Benchmark Case



Depth-Averaged Velocity, Oblique View
(red > 4.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

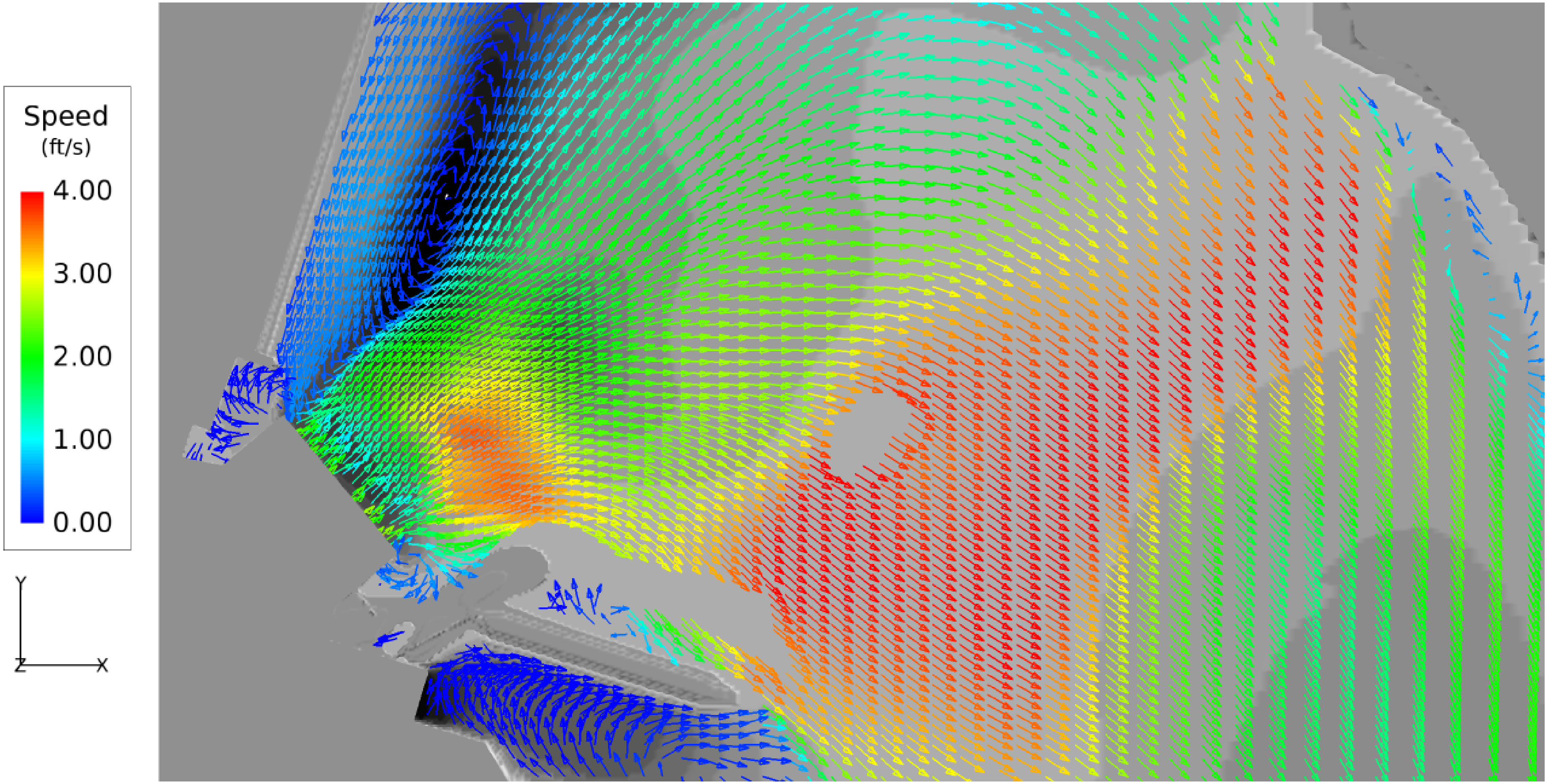
Benchmark Case



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 4.0 ft/s)

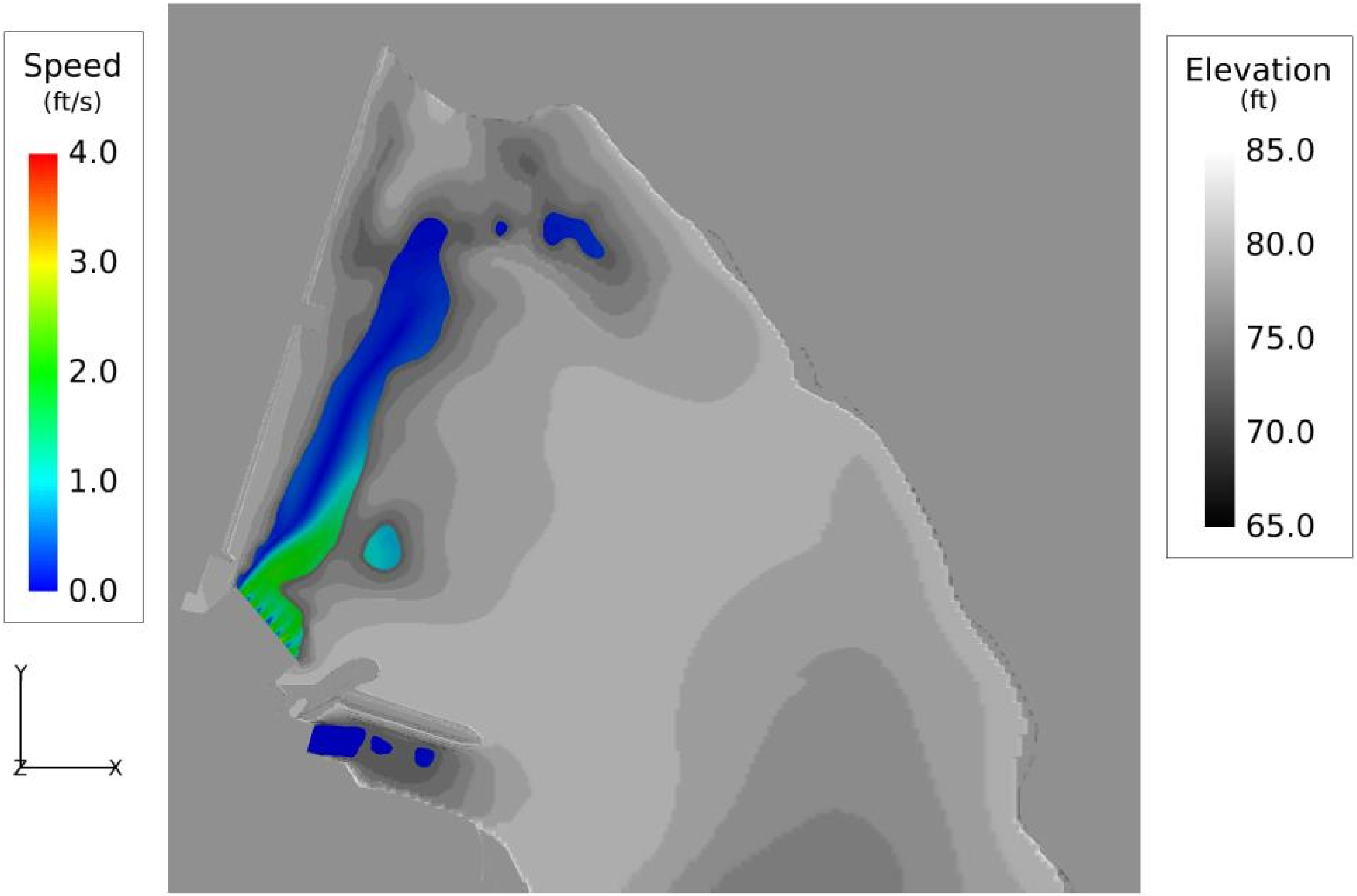
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Benchmark Case



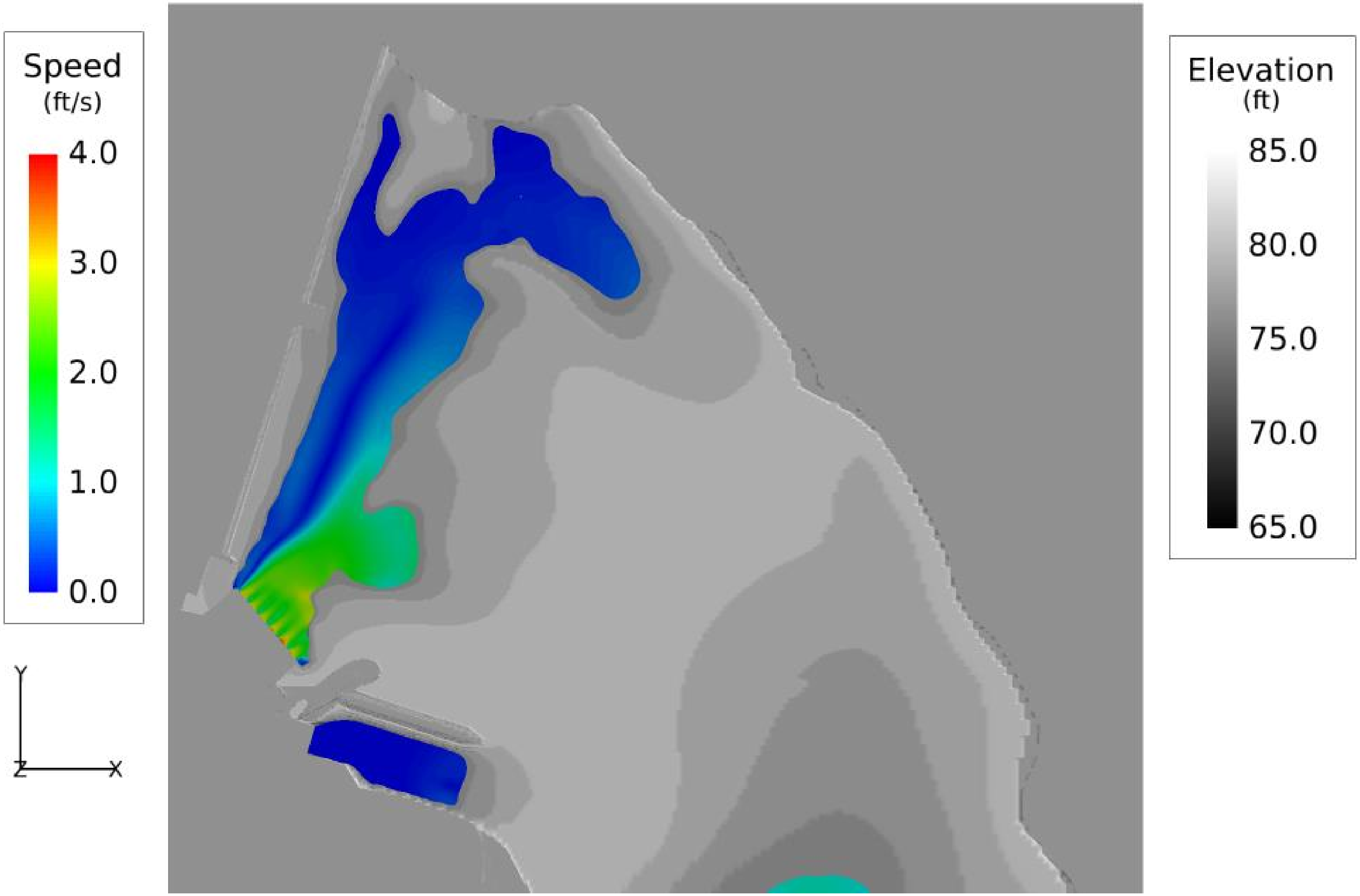
Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 4.0 ft/s)

Benchmark Case



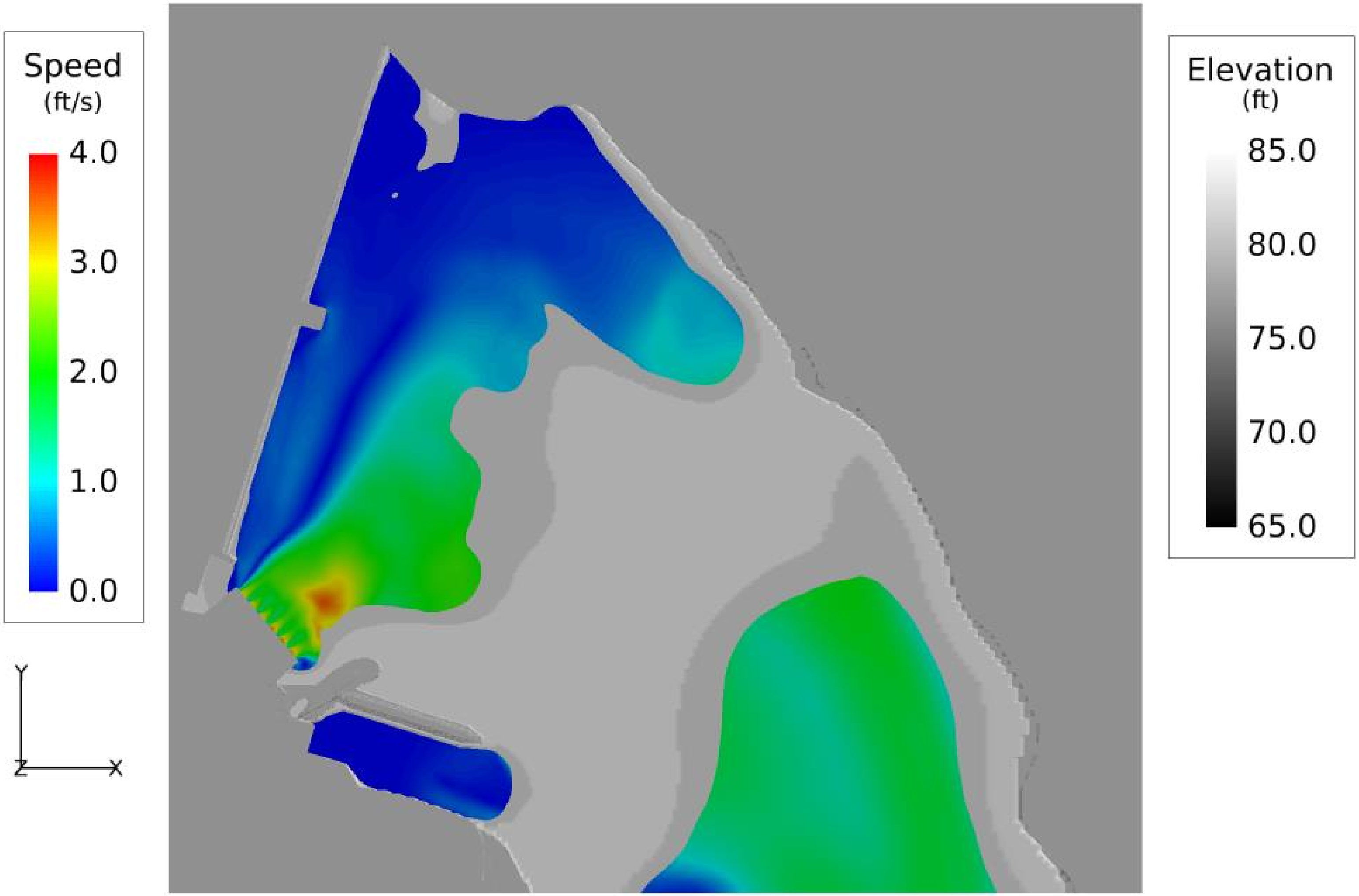
Flow Speed Distribution, Elevation 76.875 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Benchmark Case



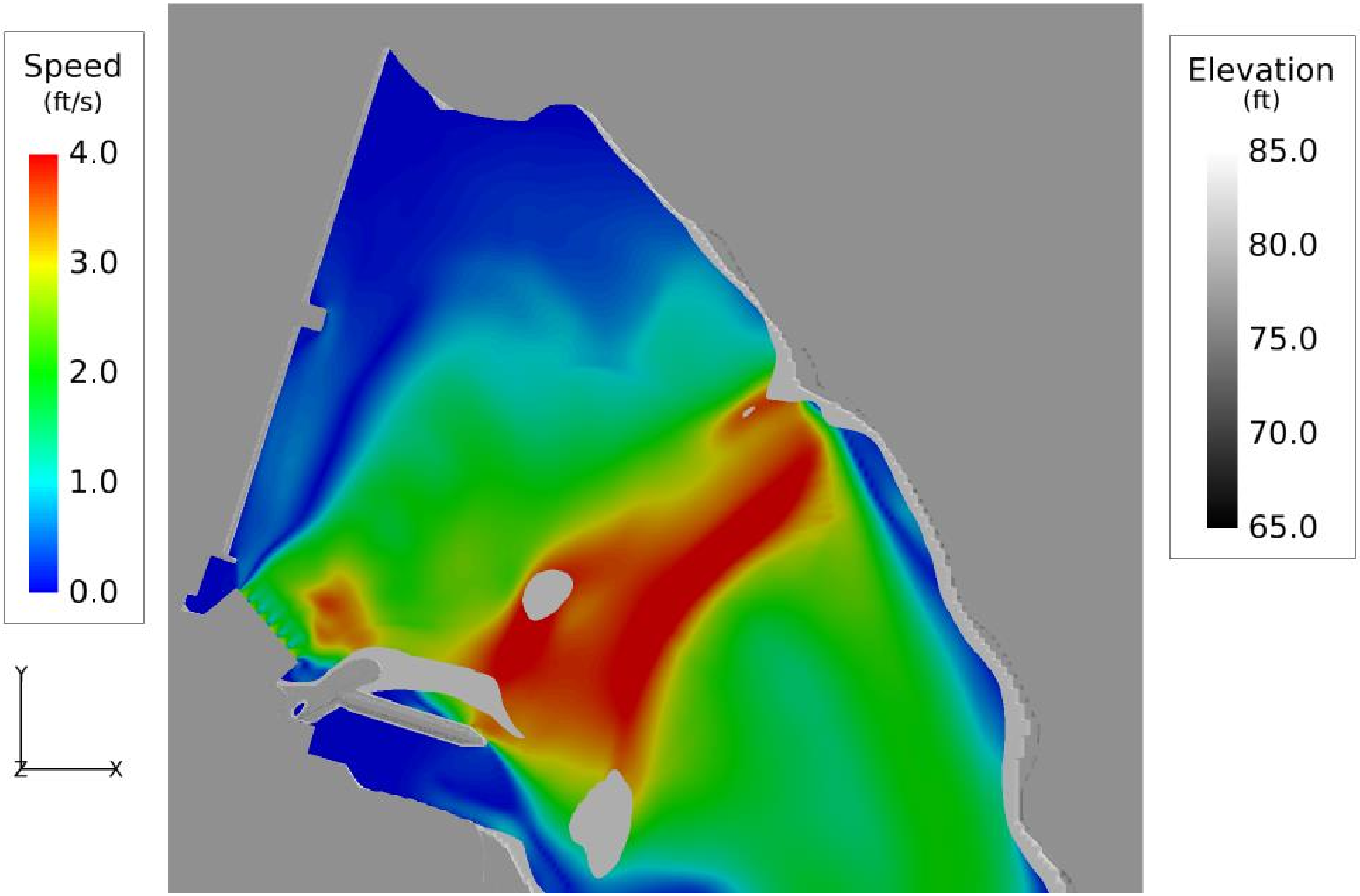
Flow Speed Distribution – Elevation 80.575 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Benchmark Case



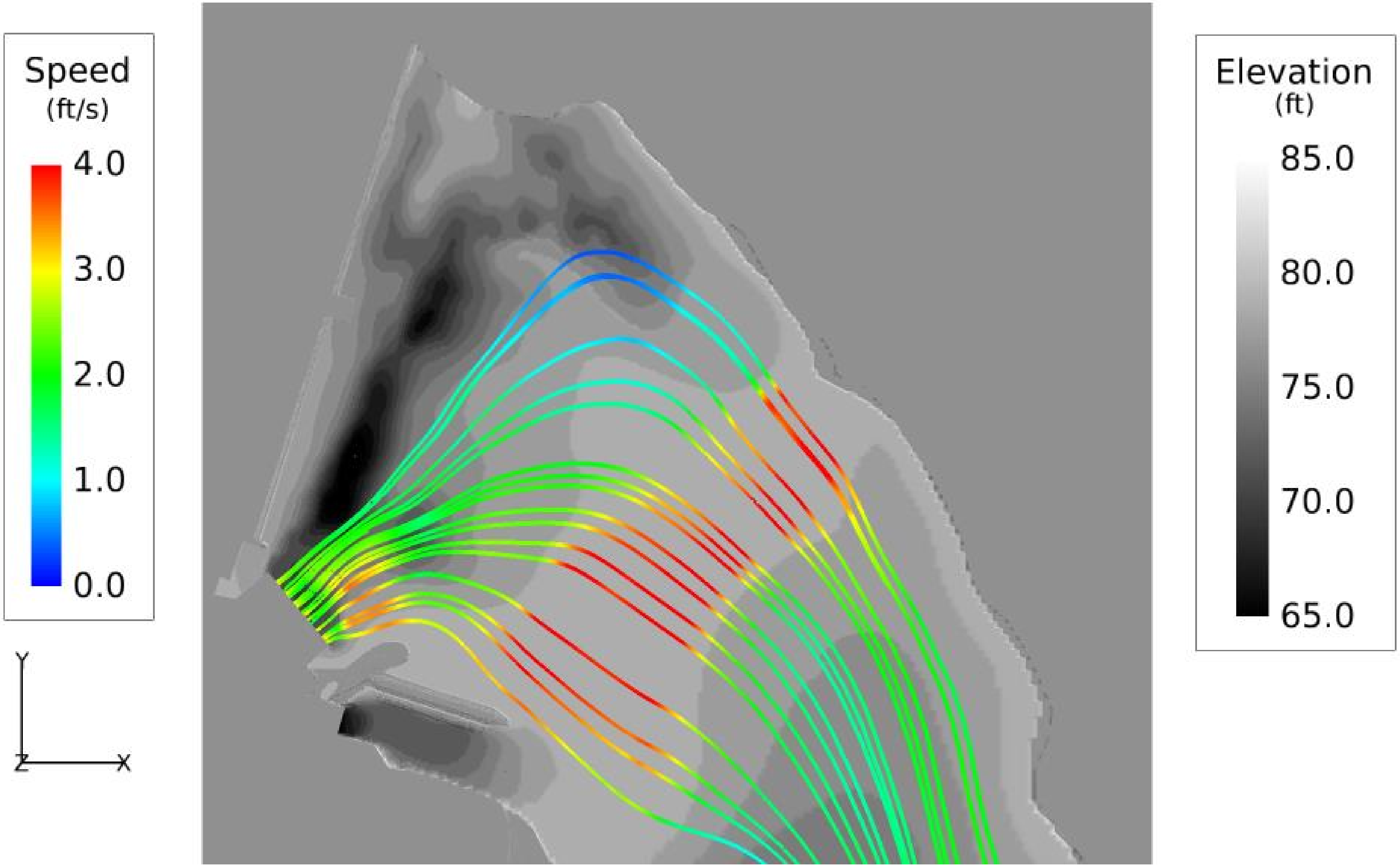
Flow Speed Distribution – Elevation 84.275 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Benchmark Case



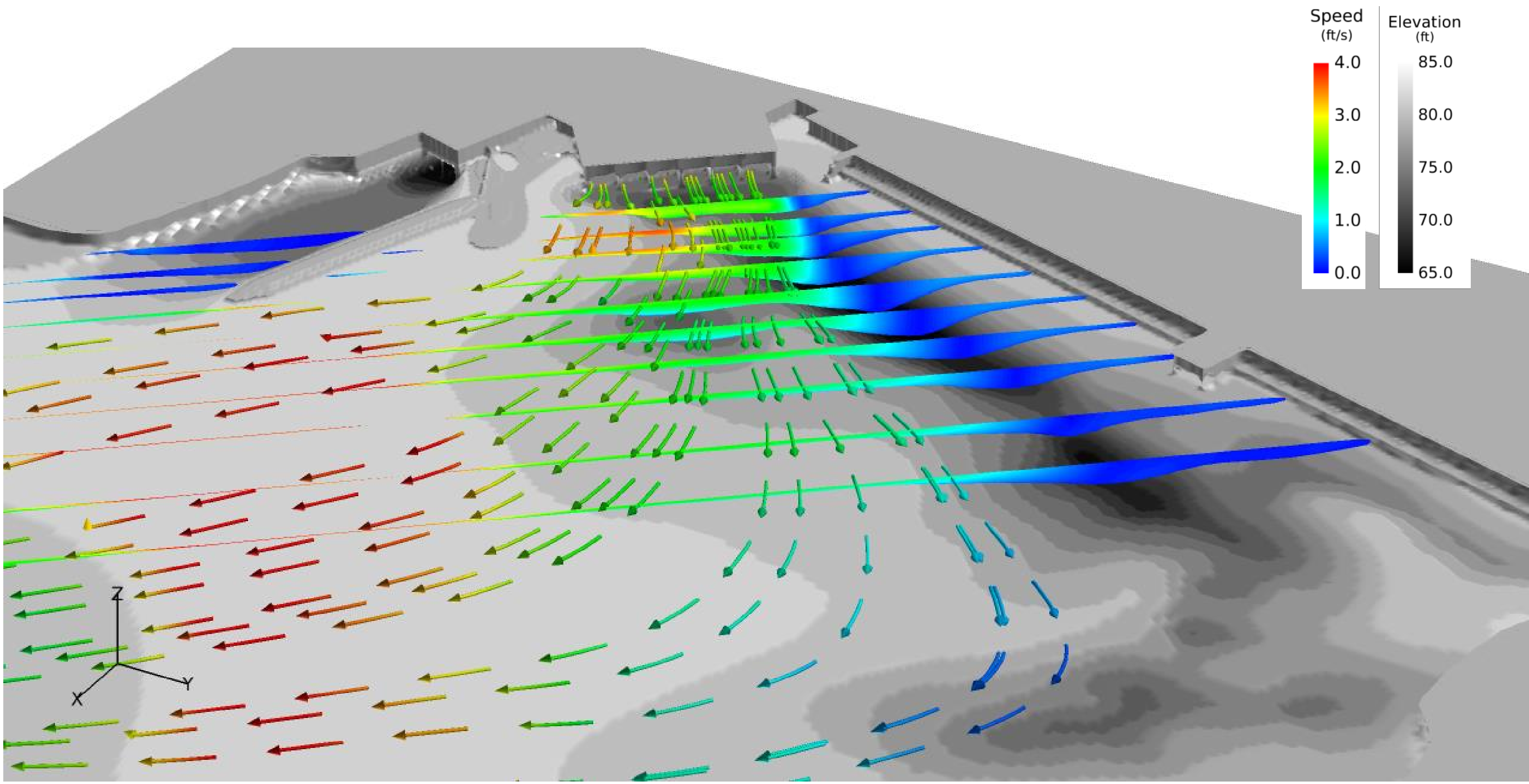
Flow Speed Distribution – Elevation 86.125 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Benchmark Case



Streamlines - Colored by Speed
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Benchmark Case



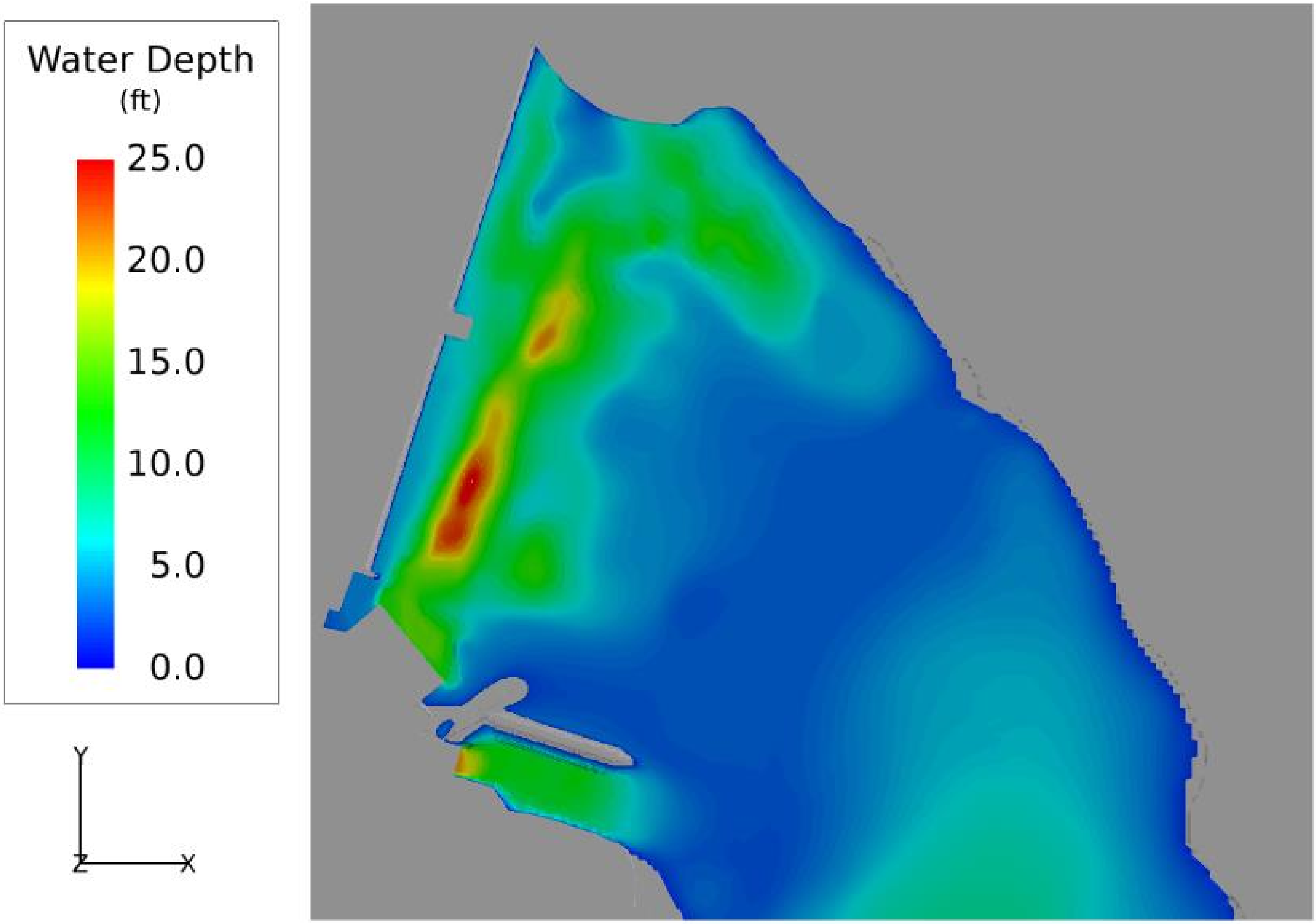
Vertical Variation of Flow Speed and Streamlines
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 01

Boundary Conditions

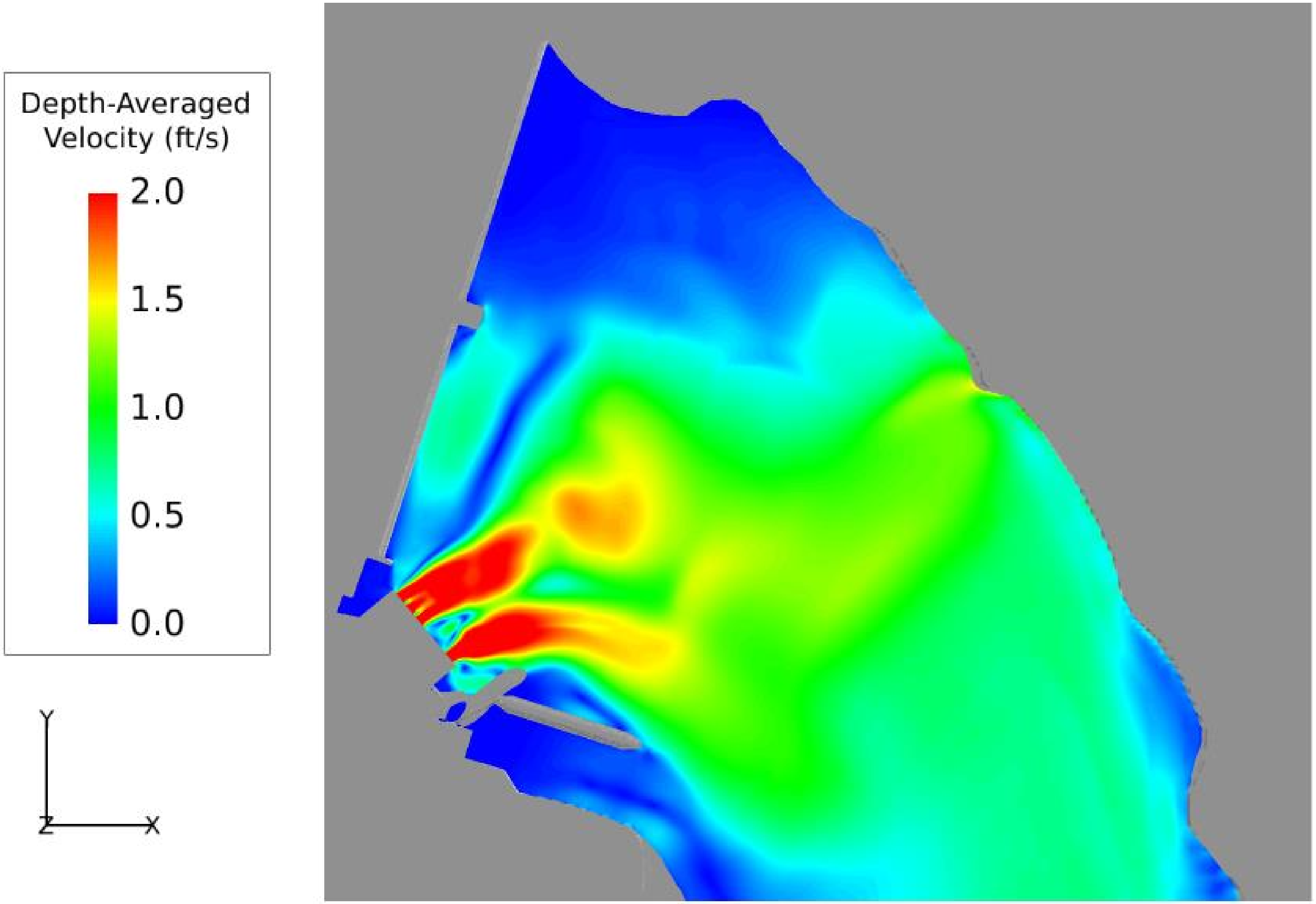
Flow Exceedance	95%
Total Flow	2,540 cfs
Tailwater Elevation	88.6 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	622 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	0 cfs
Unit 05 Discharge	0 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	0 cfs
Log Sluice	0 cfs
S Flashboards	0 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Shawmut – Case 01



Water Depth, Plan View
(red > 25.0 ft)

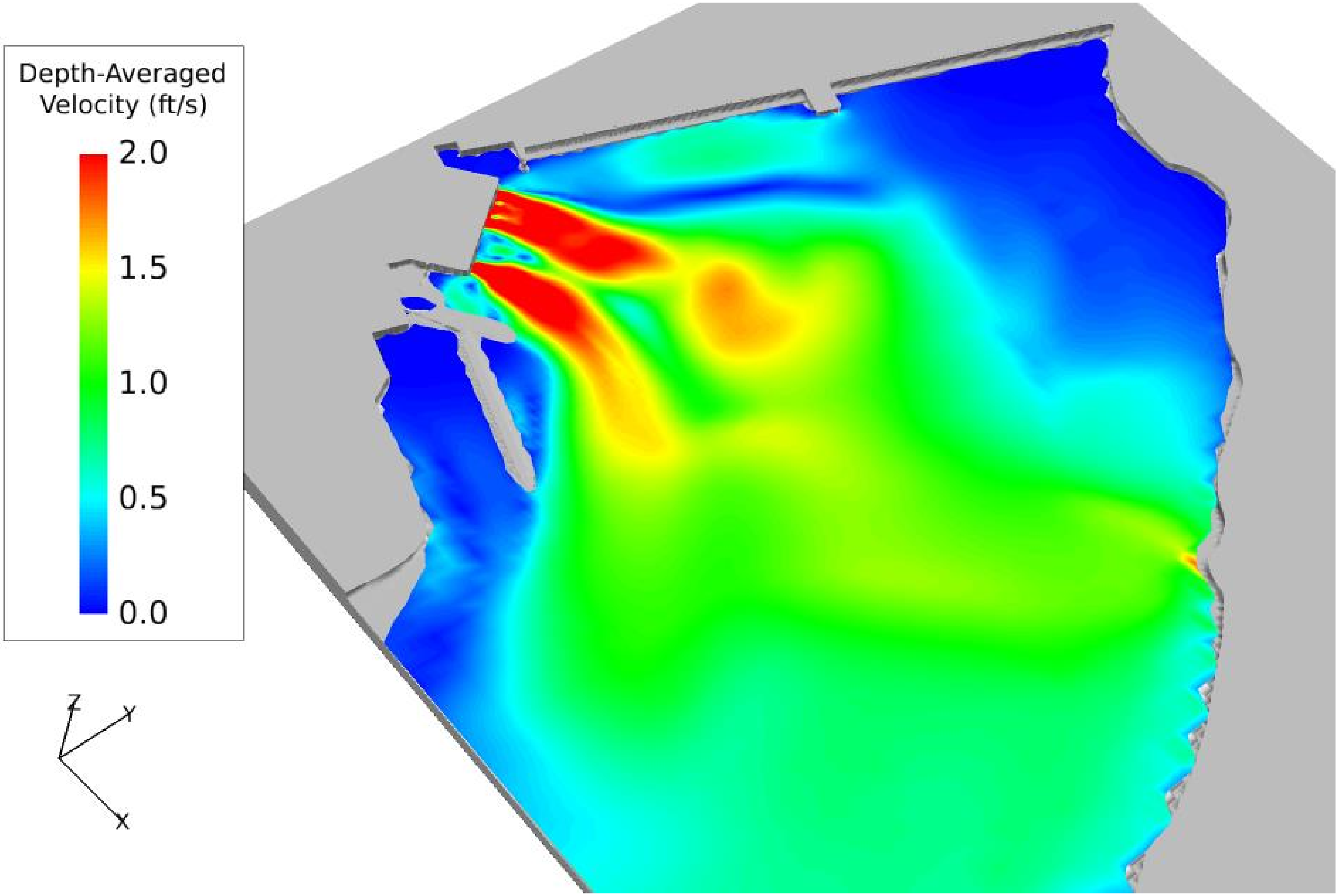
Shawmut – Case 01



Depth-Averaged Velocity, Plan View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

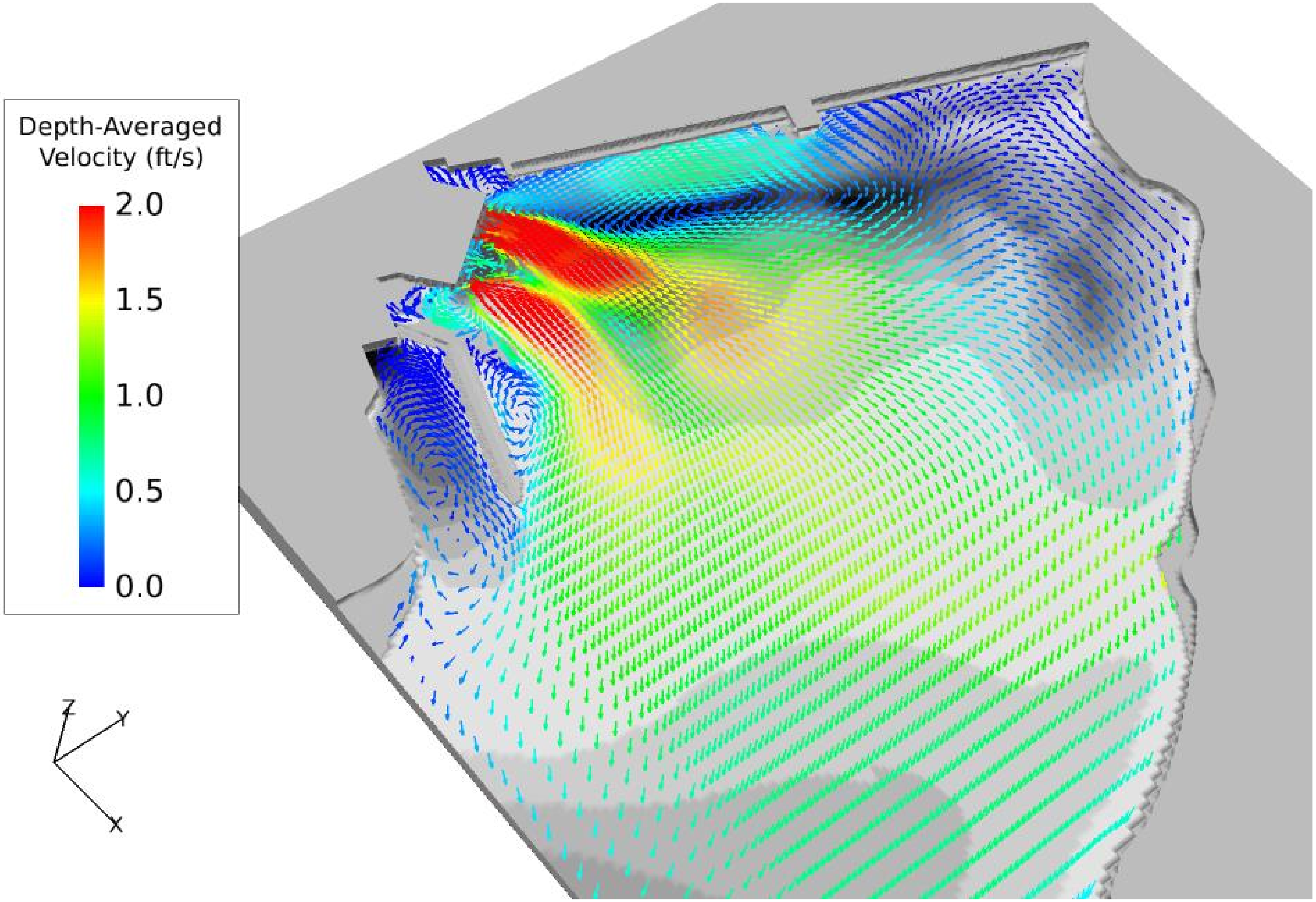
Shawmut – Case 01



Depth-Averaged Velocity, Oblique View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

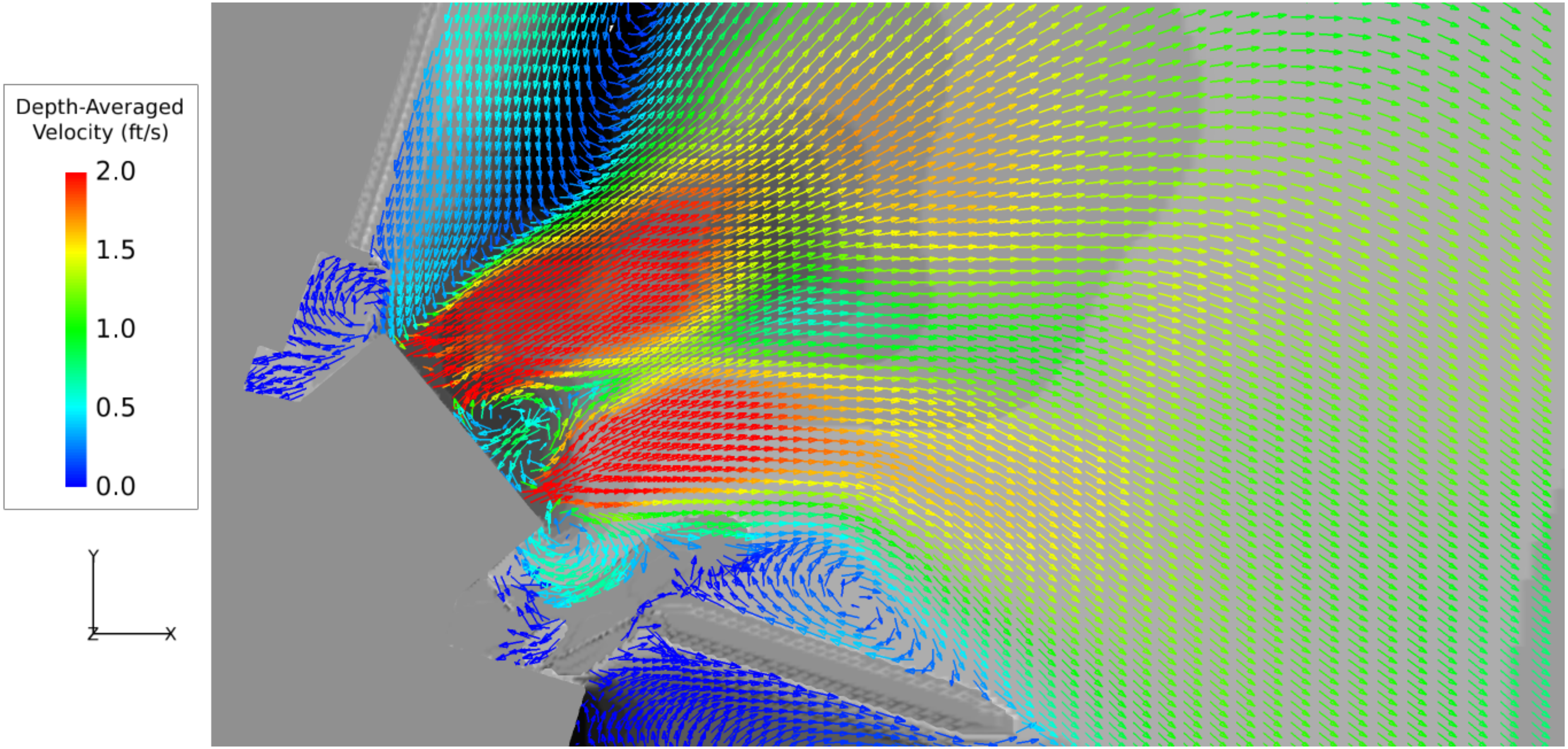
Shawmut – Case 01



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

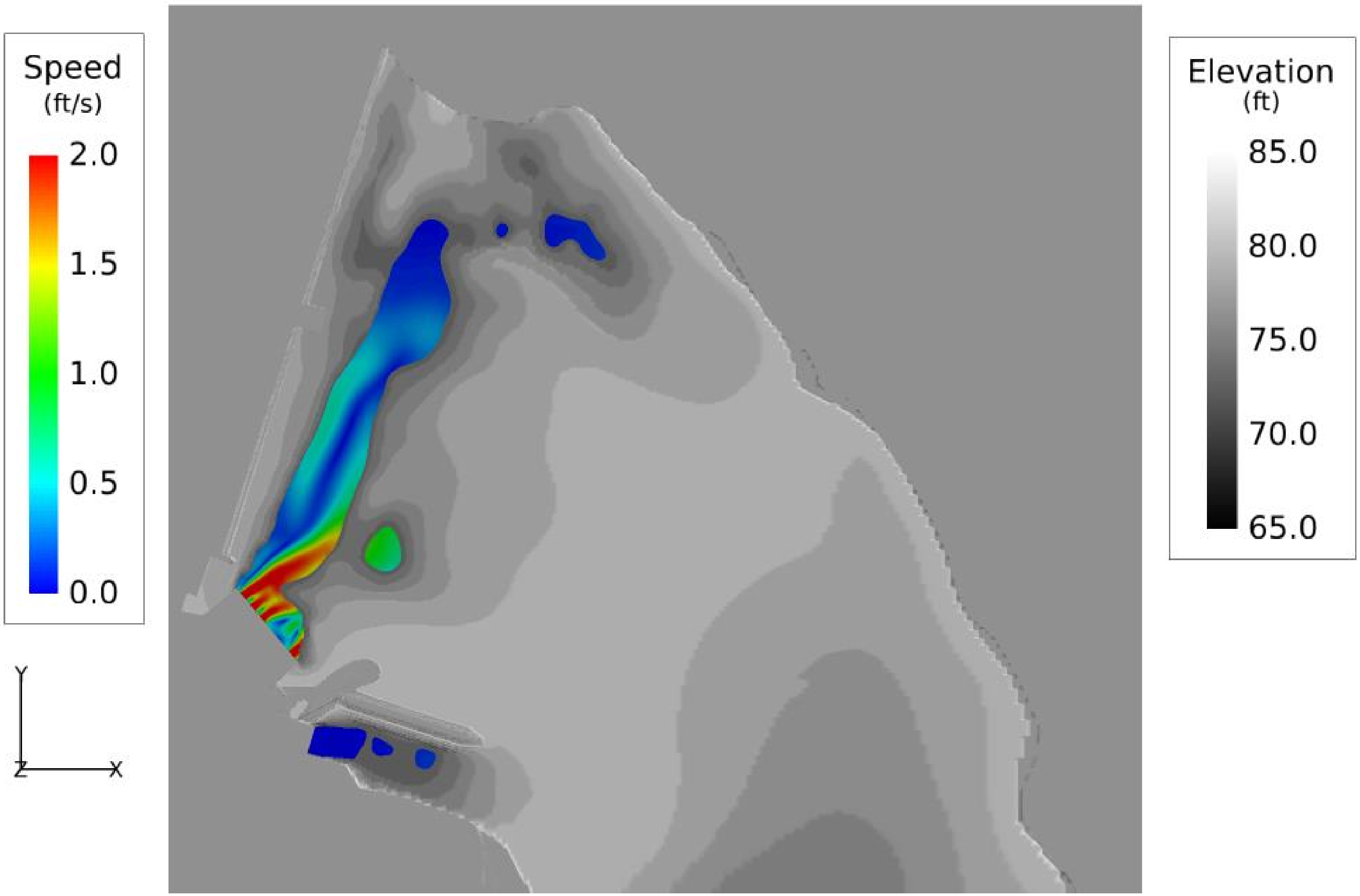
Shawmut – Case 01



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 2.0 ft/s)

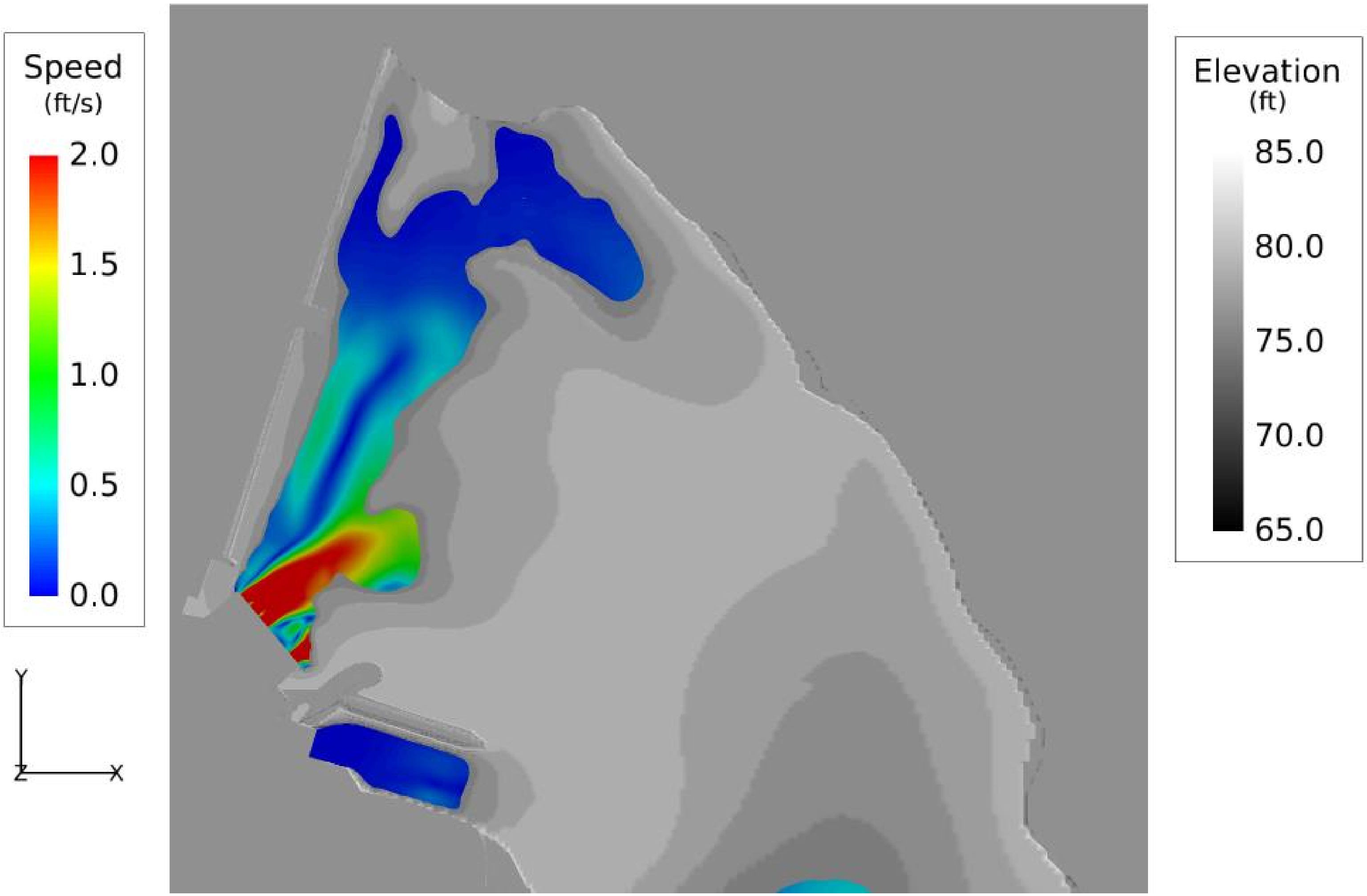
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 01



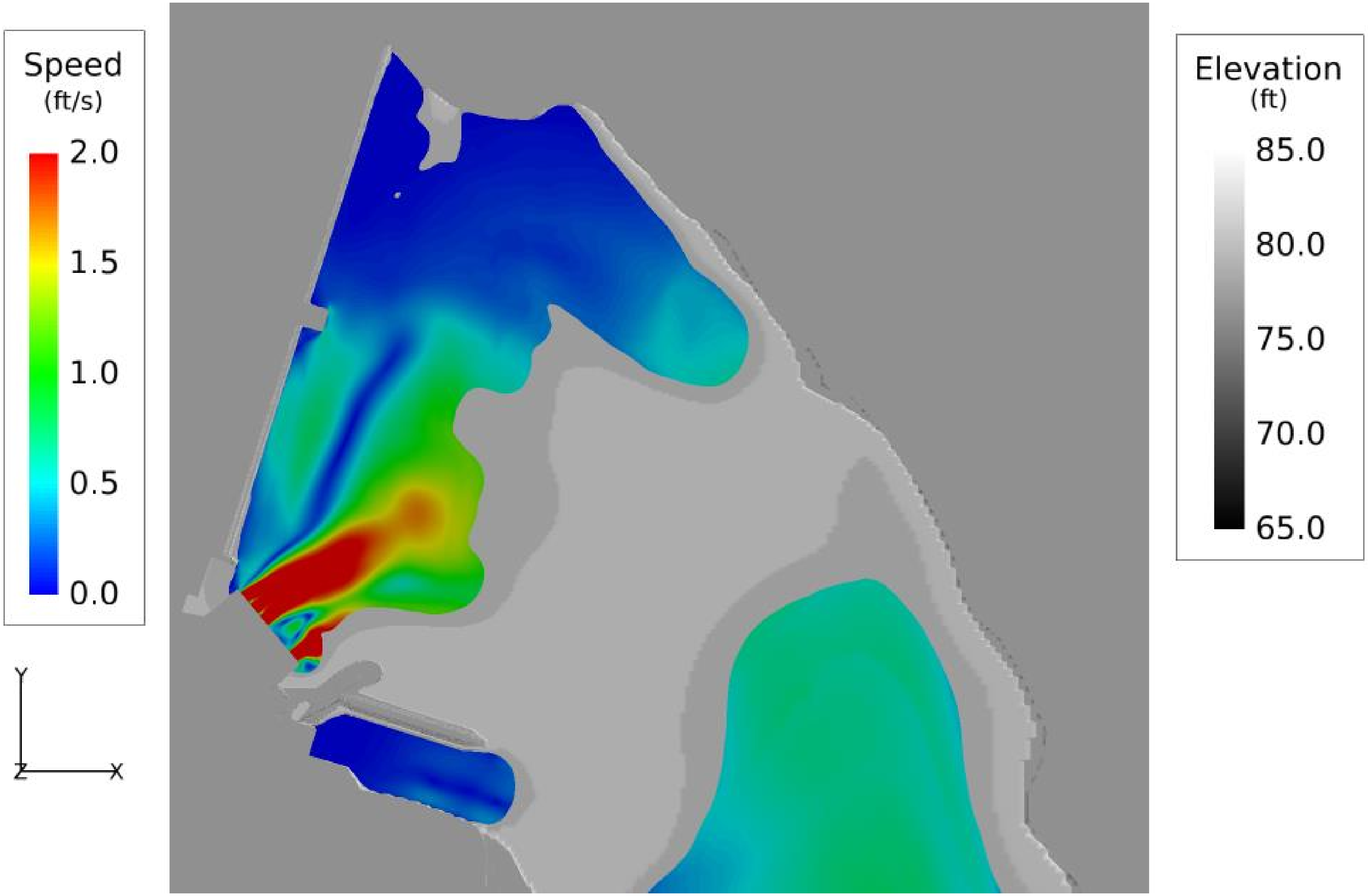
Flow Speed Distribution, Elevation 76.875 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 01



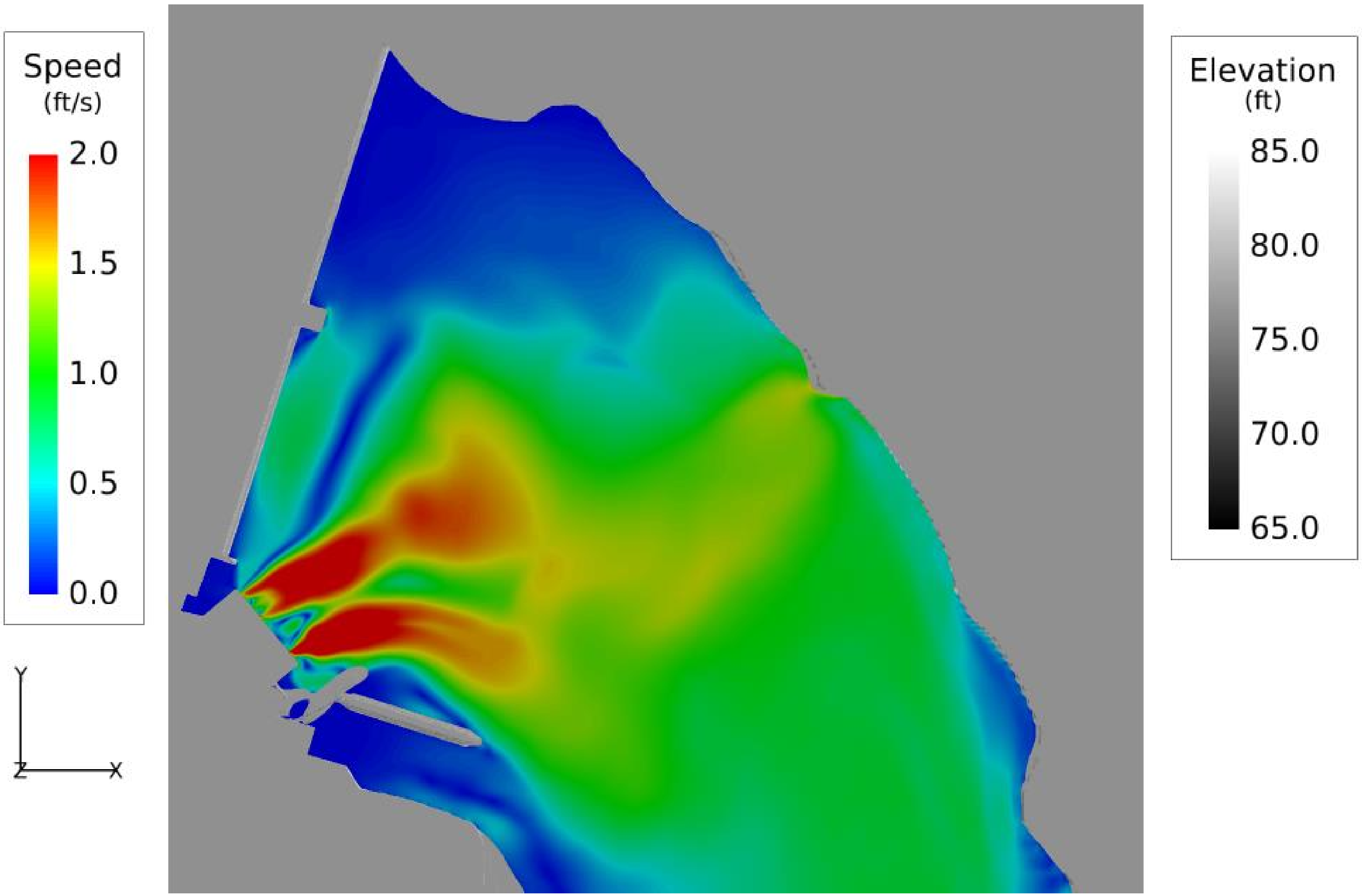
Flow Speed Distribution – Elevation 80.575 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 01



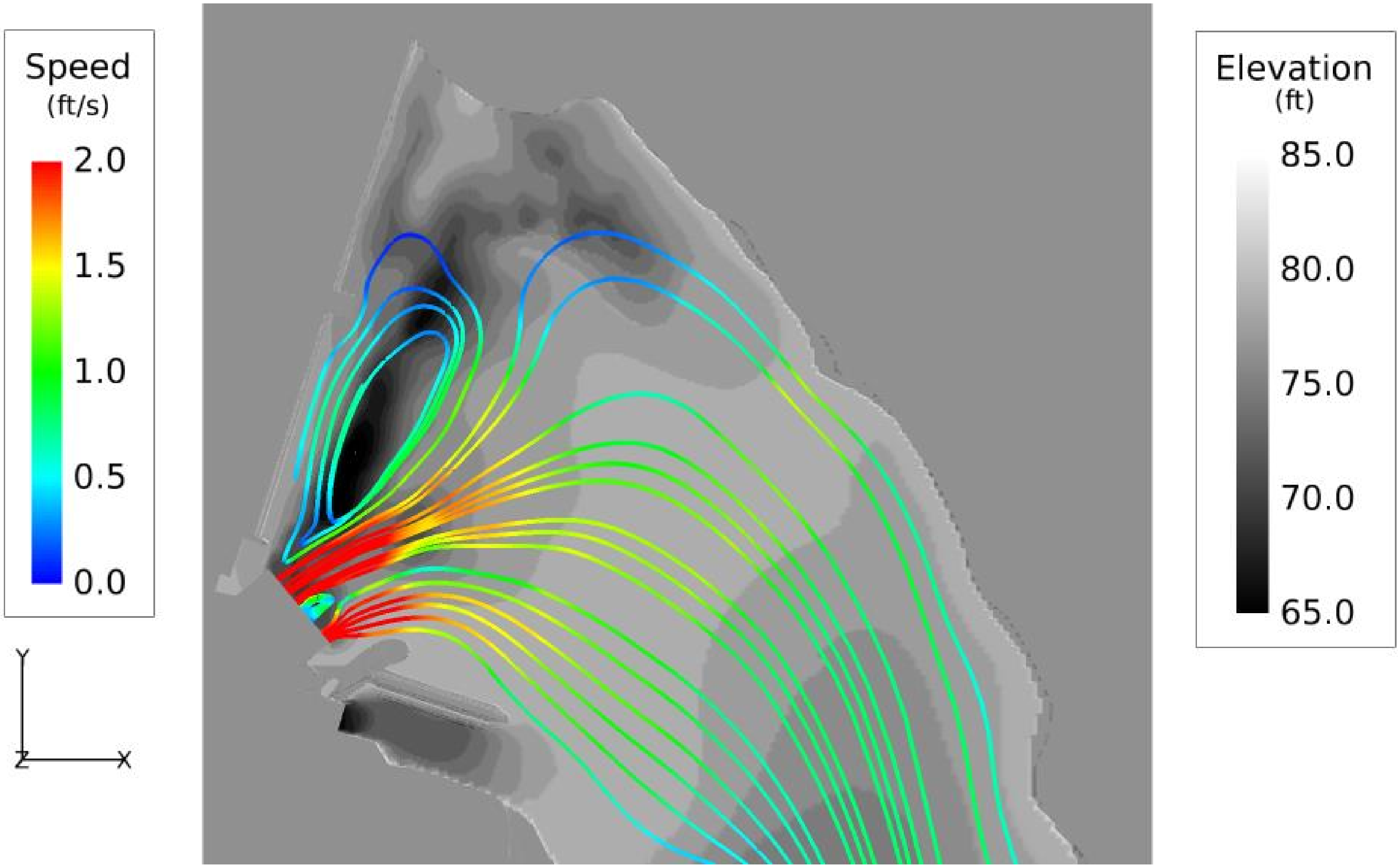
Flow Speed Distribution – Elevation 84.275 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 01



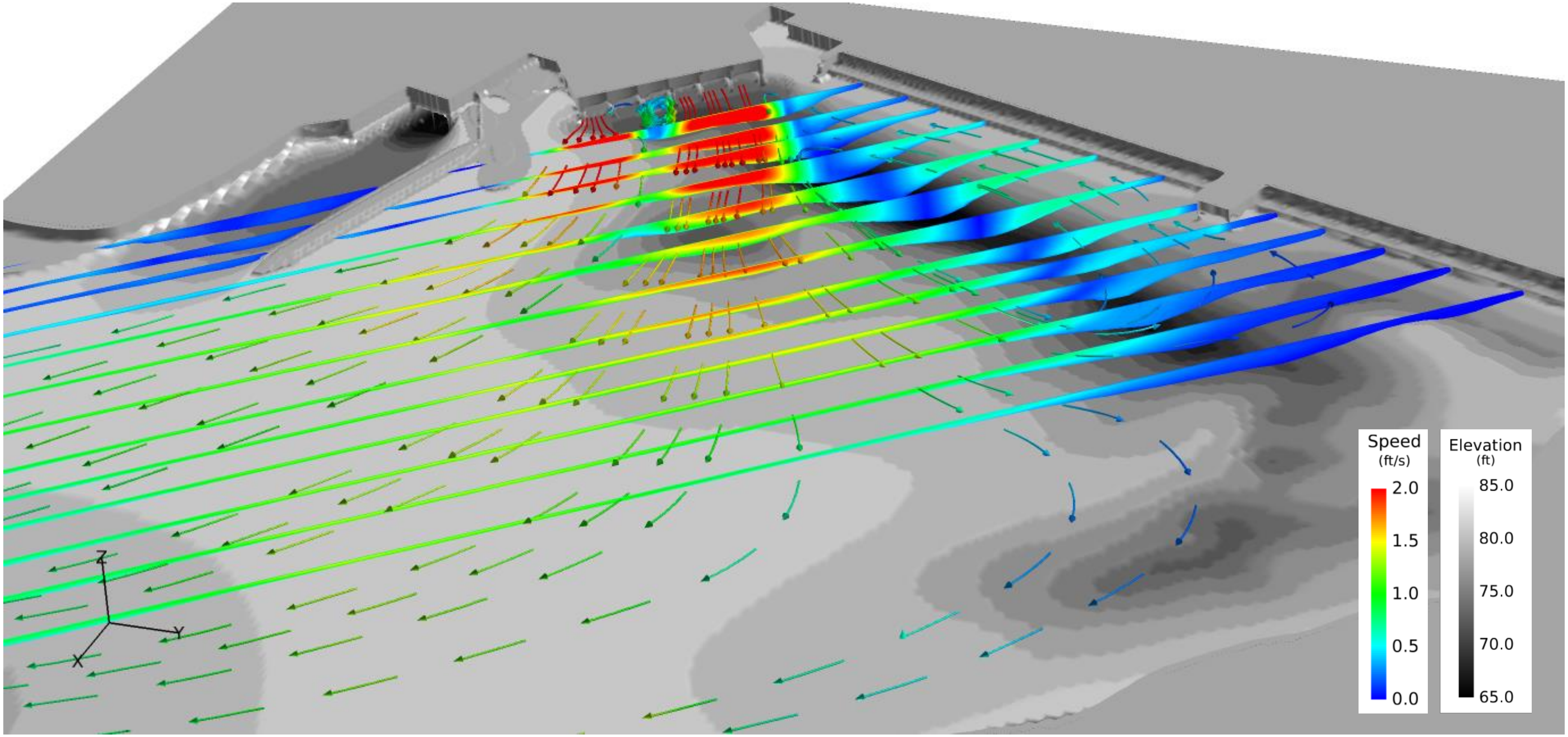
Flow Speed Distribution – Elevation 87.975 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 01



Streamlines - Colored by Speed
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 01



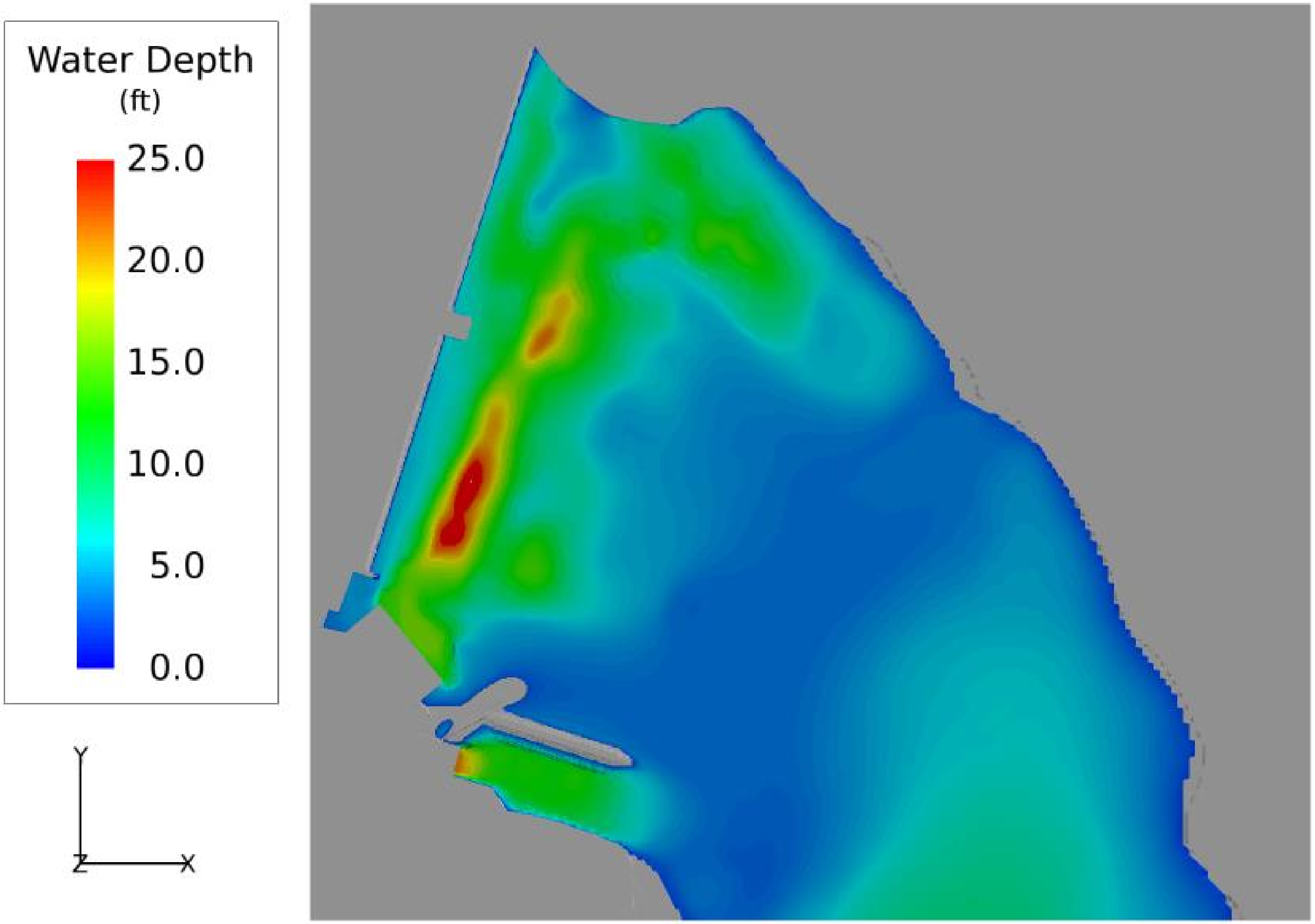
Vertical Variation of Flow Speed and Streamlines
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 02

Boundary Conditions

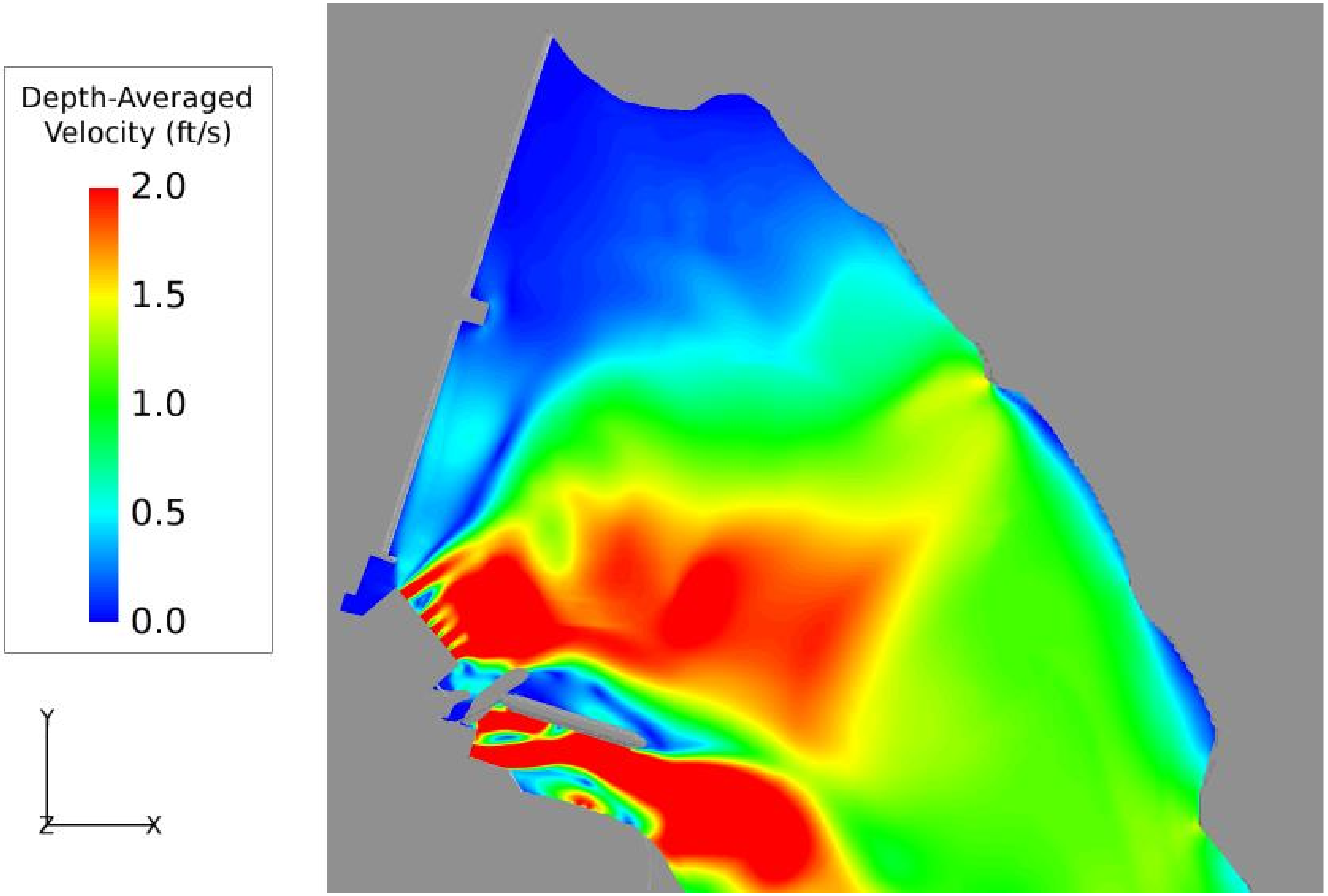
Flow Exceedance	50%
Total Flow	4,790 cfs
Tailwater Elevation	89.1 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	125 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	1433 cfs
Log Sluice	0 cfs
S Flashboards	0 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Shawmut – Case 02



Water Depth, Plan View
(red > 25.0 ft)

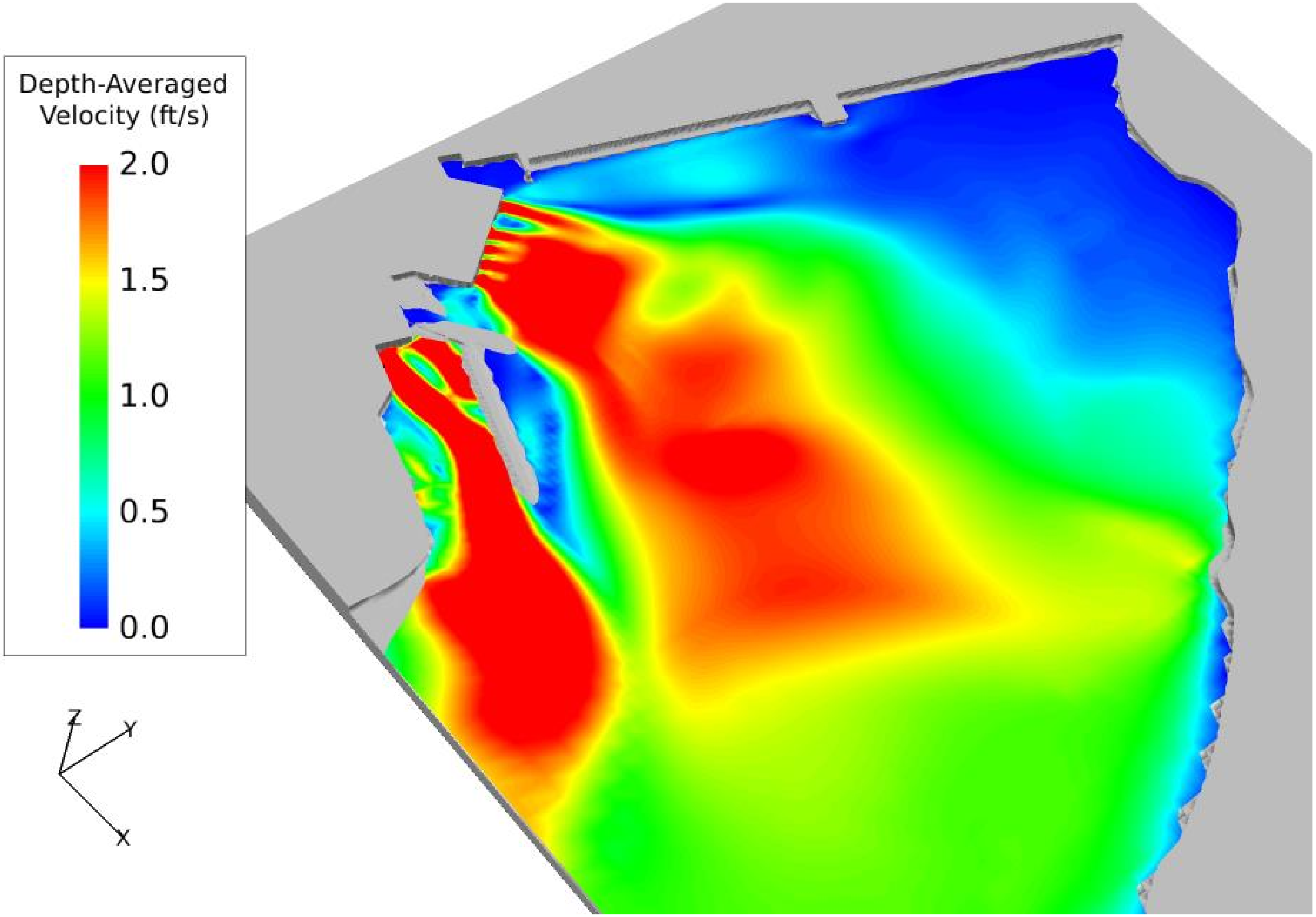
Shawmut – Case 02



Depth-Averaged Velocity, Plan View (red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

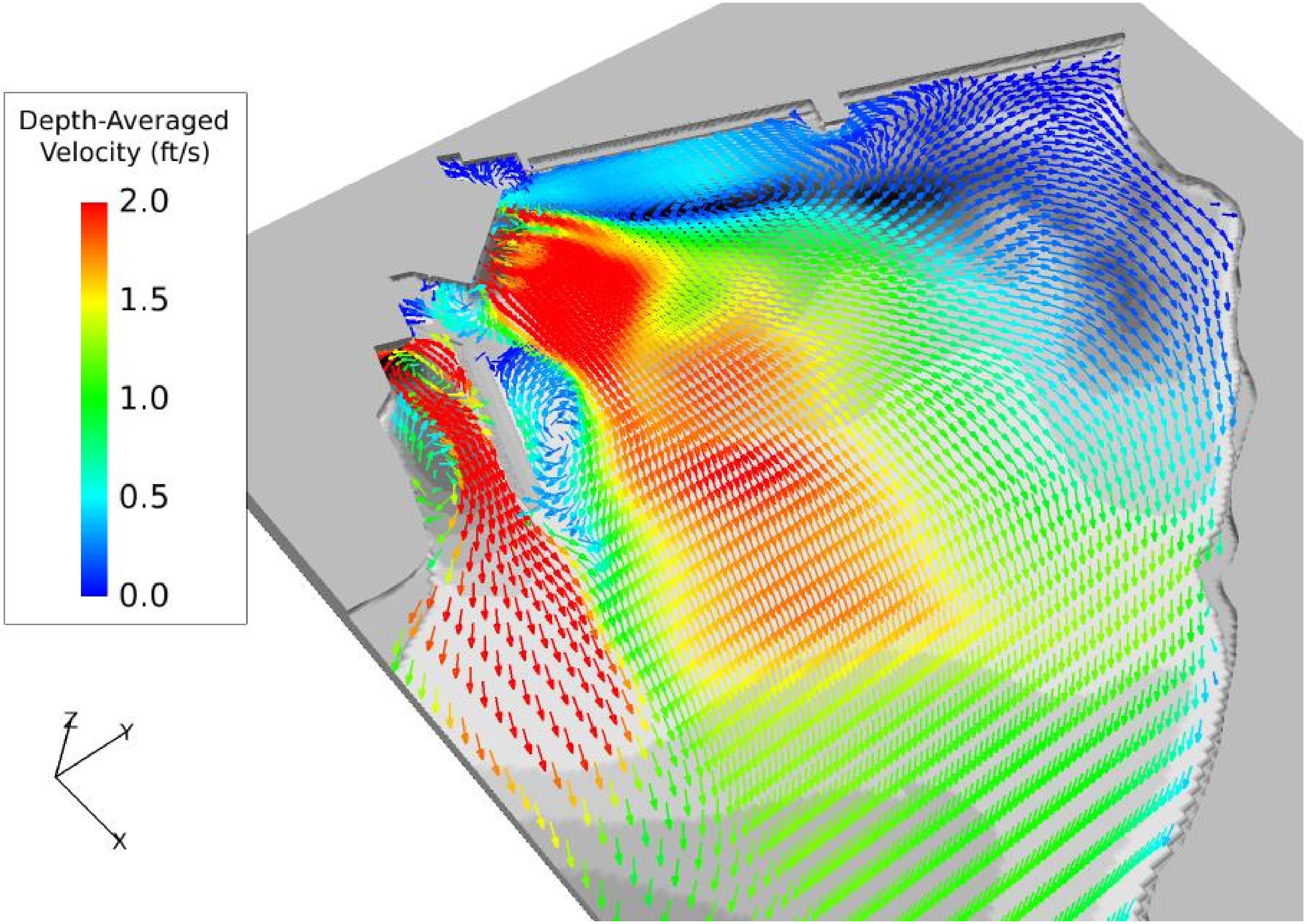
Shawmut – Case 02



Depth-Averaged Velocity, Oblique View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

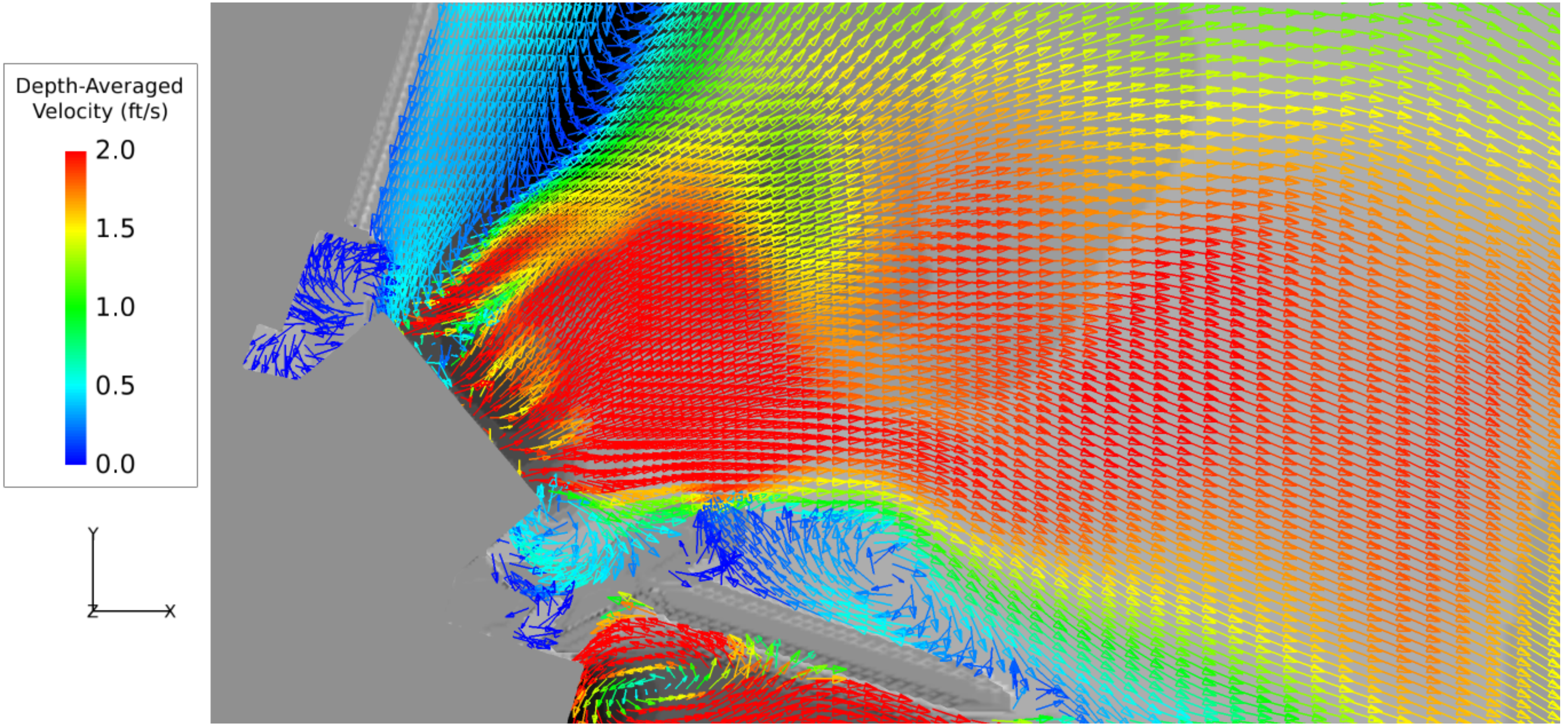
Shawmut – Case 02



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

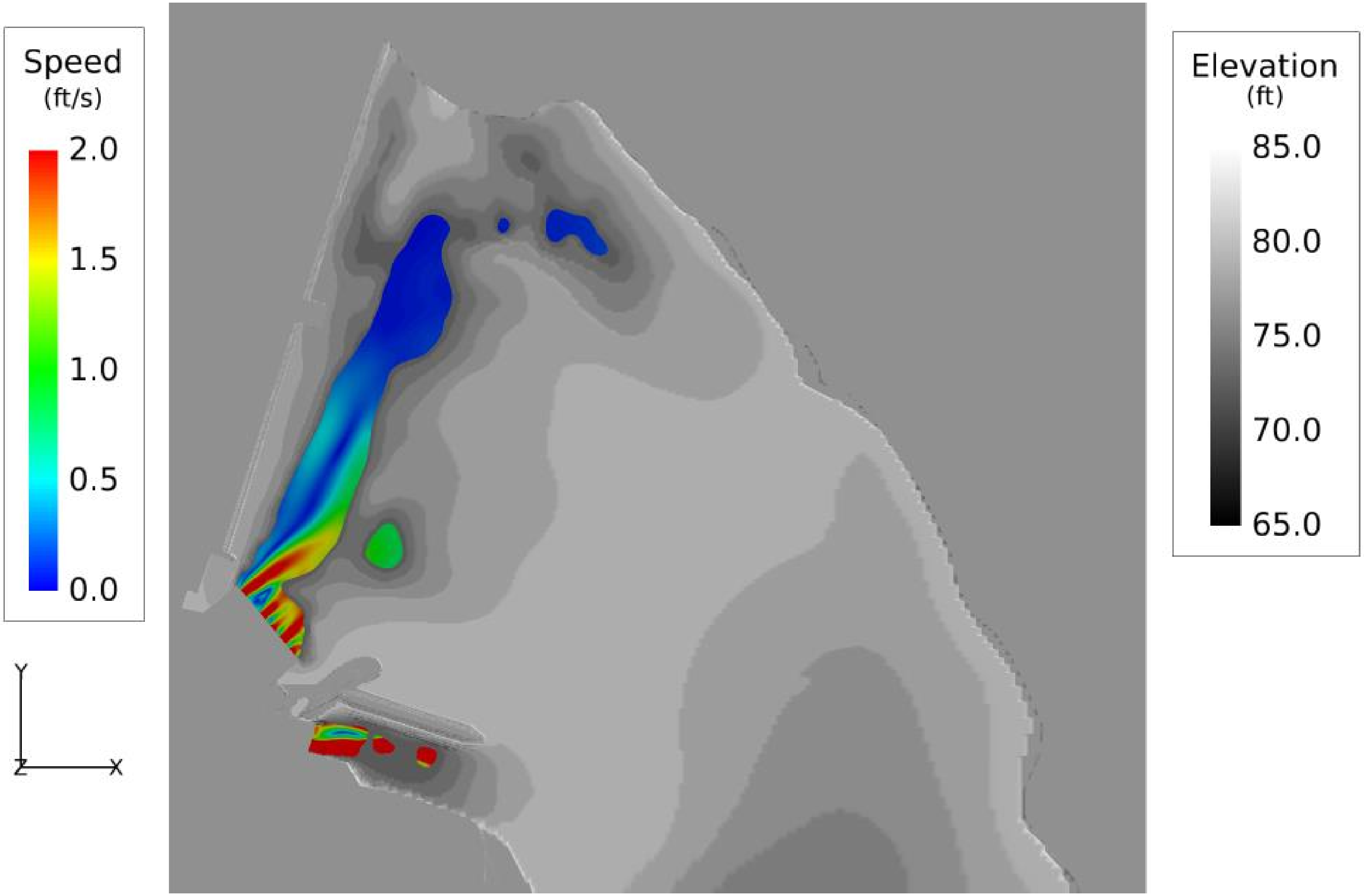
Shawmut – Case 02



Unit Vectors at Free Surface, Plan View, Every 3rd Vector
(red > 2.0 ft/s)

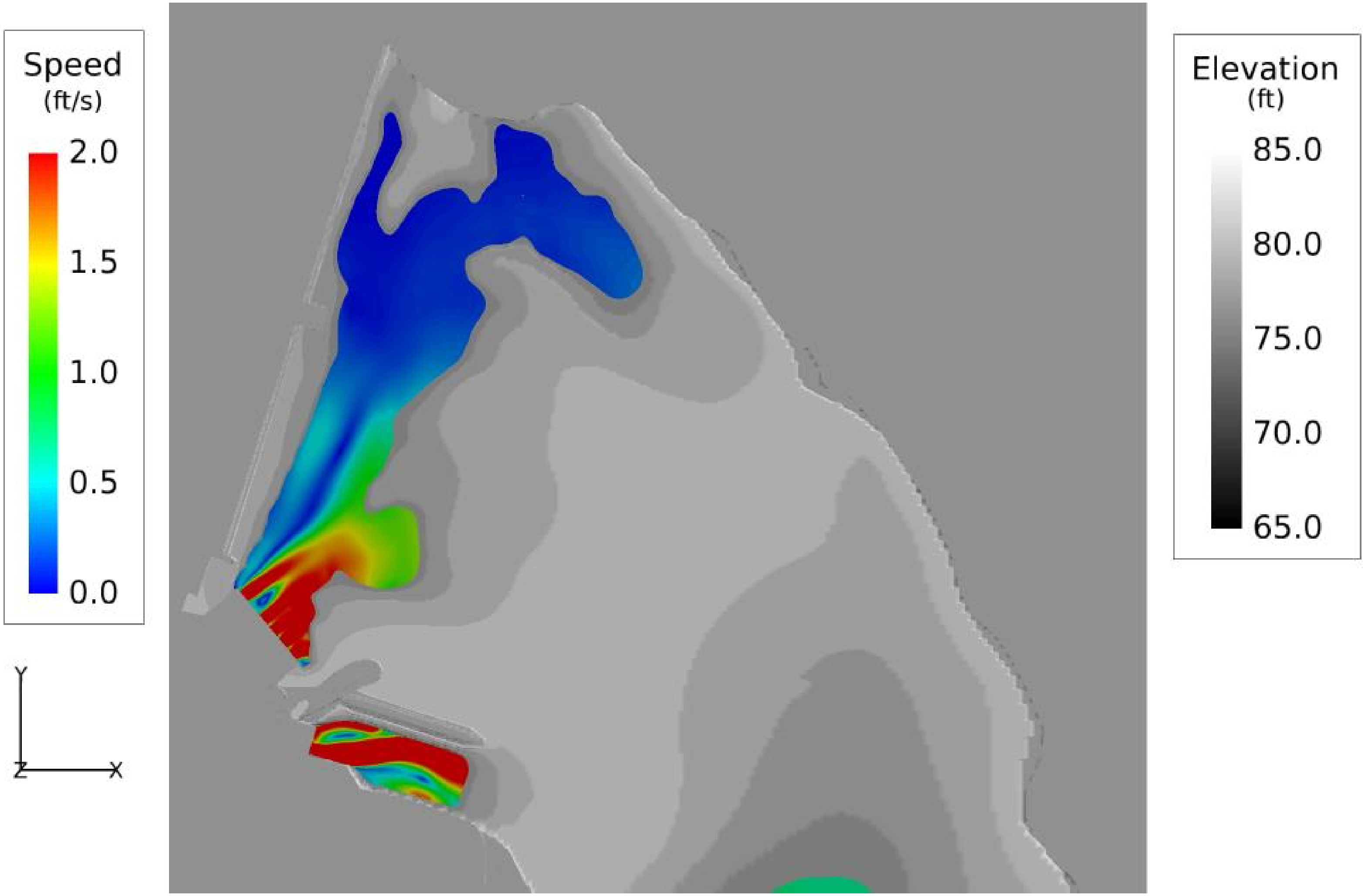
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 02



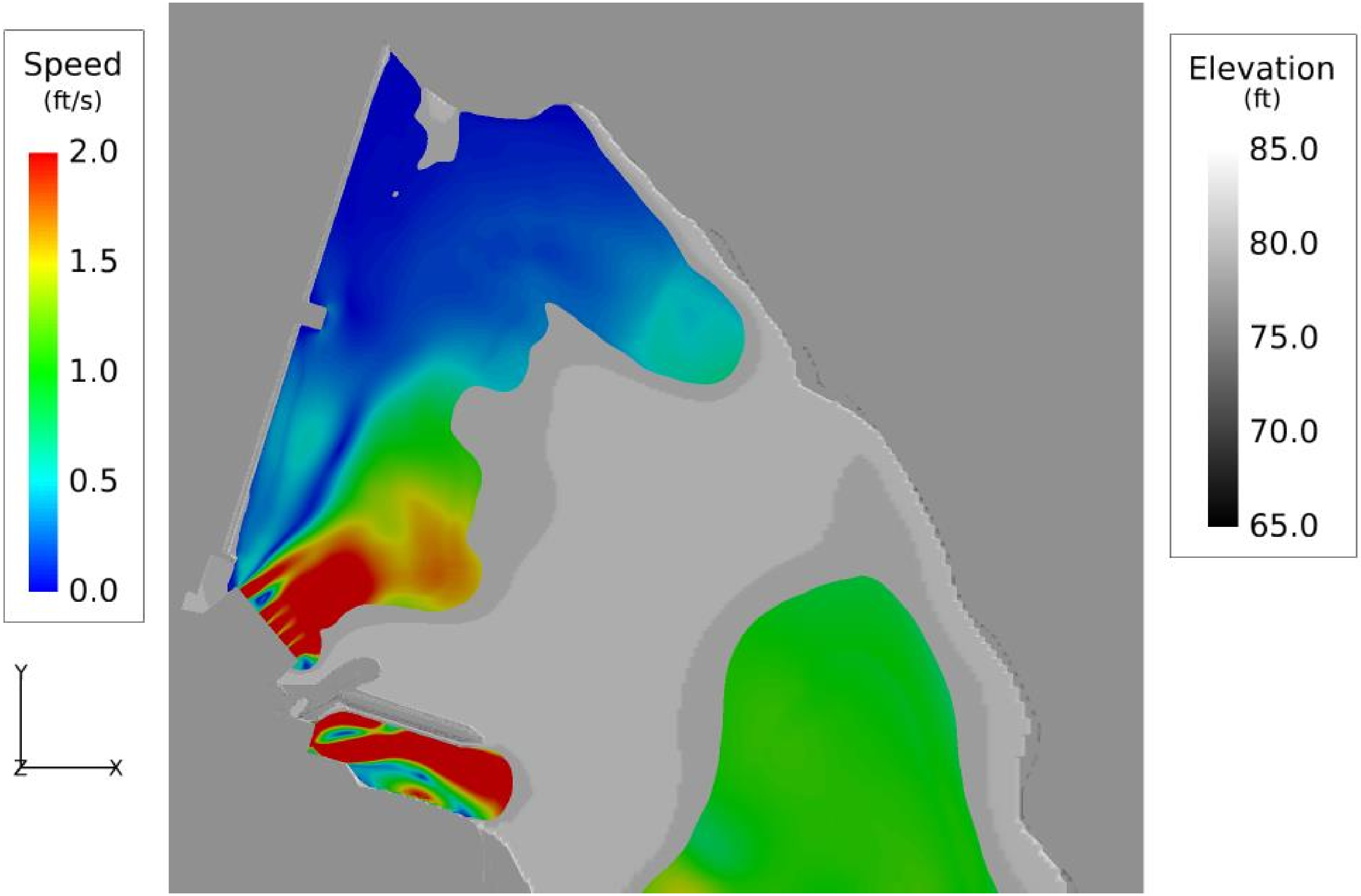
Flow Speed Distribution, Elevation 76.875 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 02



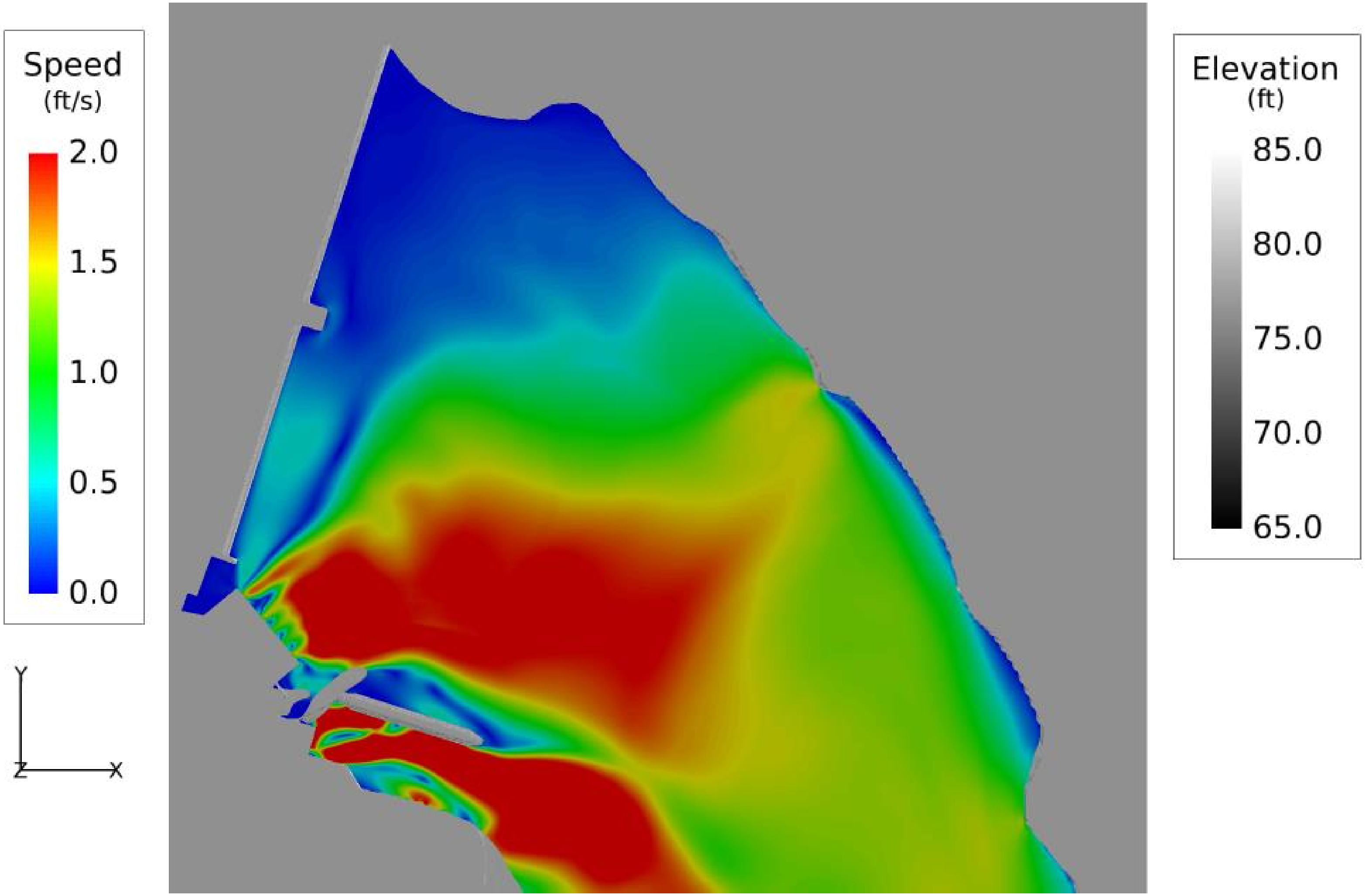
Flow Speed Distribution – Elevation 80.575 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 02



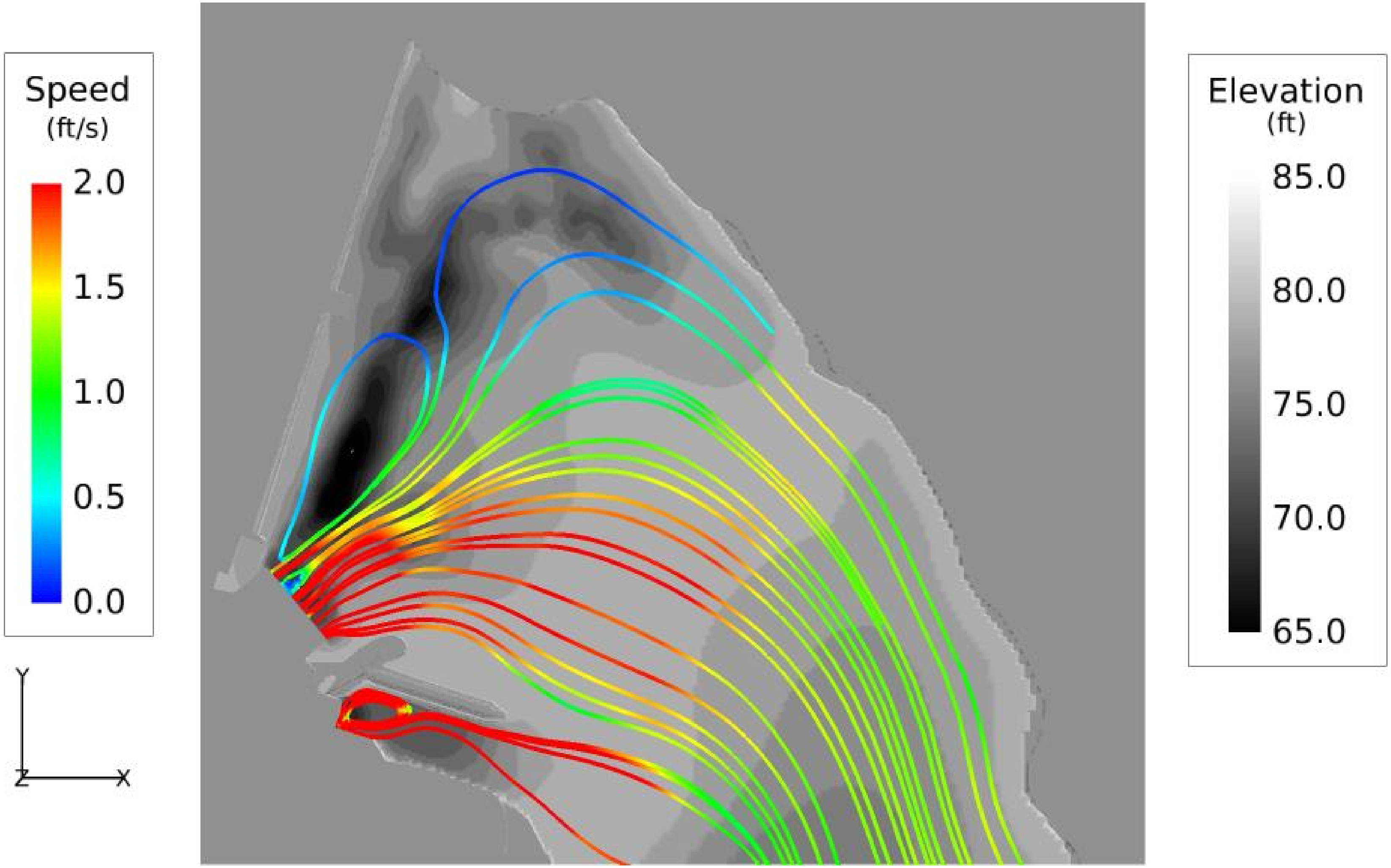
Flow Speed Distribution – Elevation 84.275 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 02



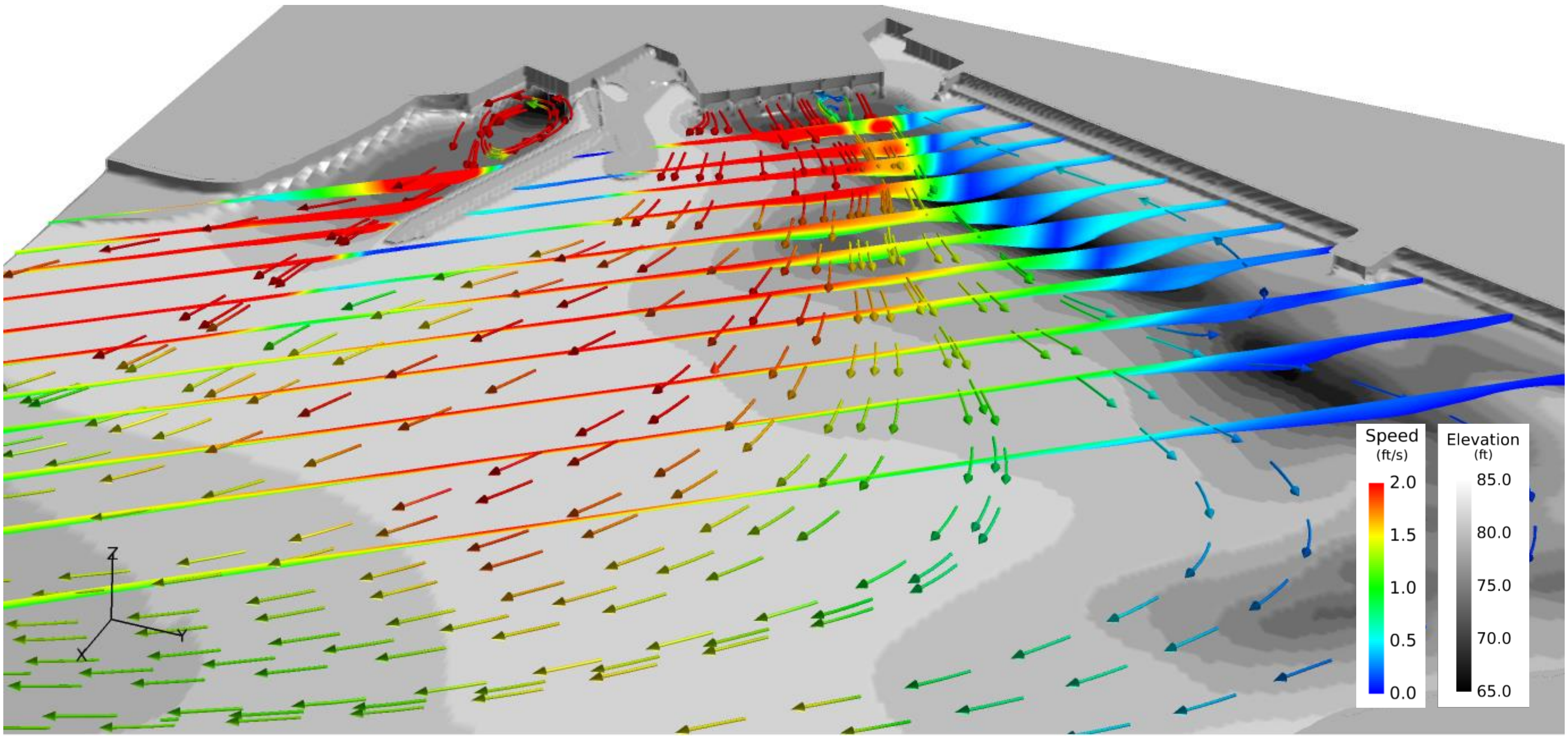
Flow Speed Distribution – Elevation 87.975 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 02



Streamlines - Colored by Speed
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 02



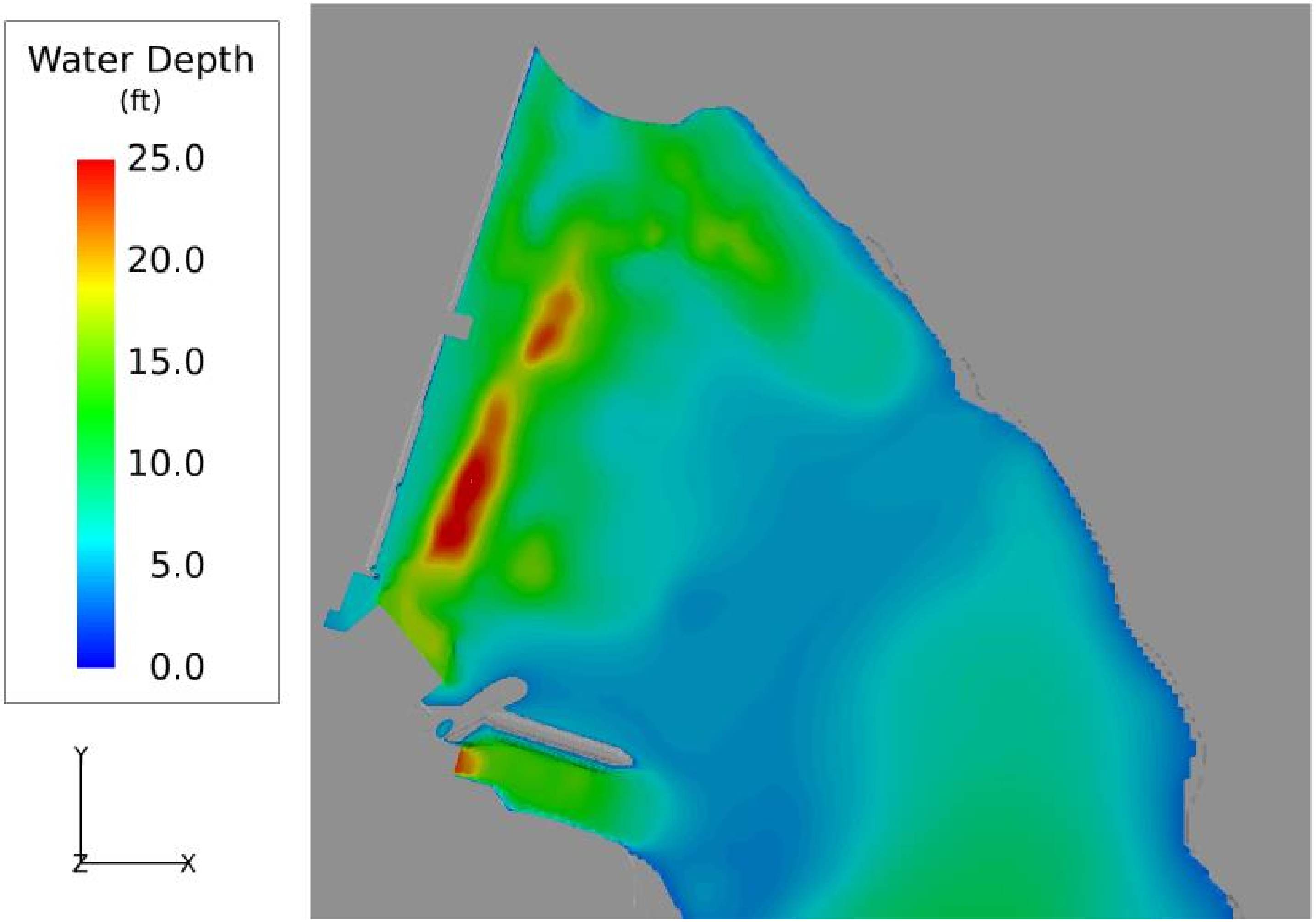
Vertical Variation of Flow Speed and Streamlines
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut - Case 03

Boundary Conditions

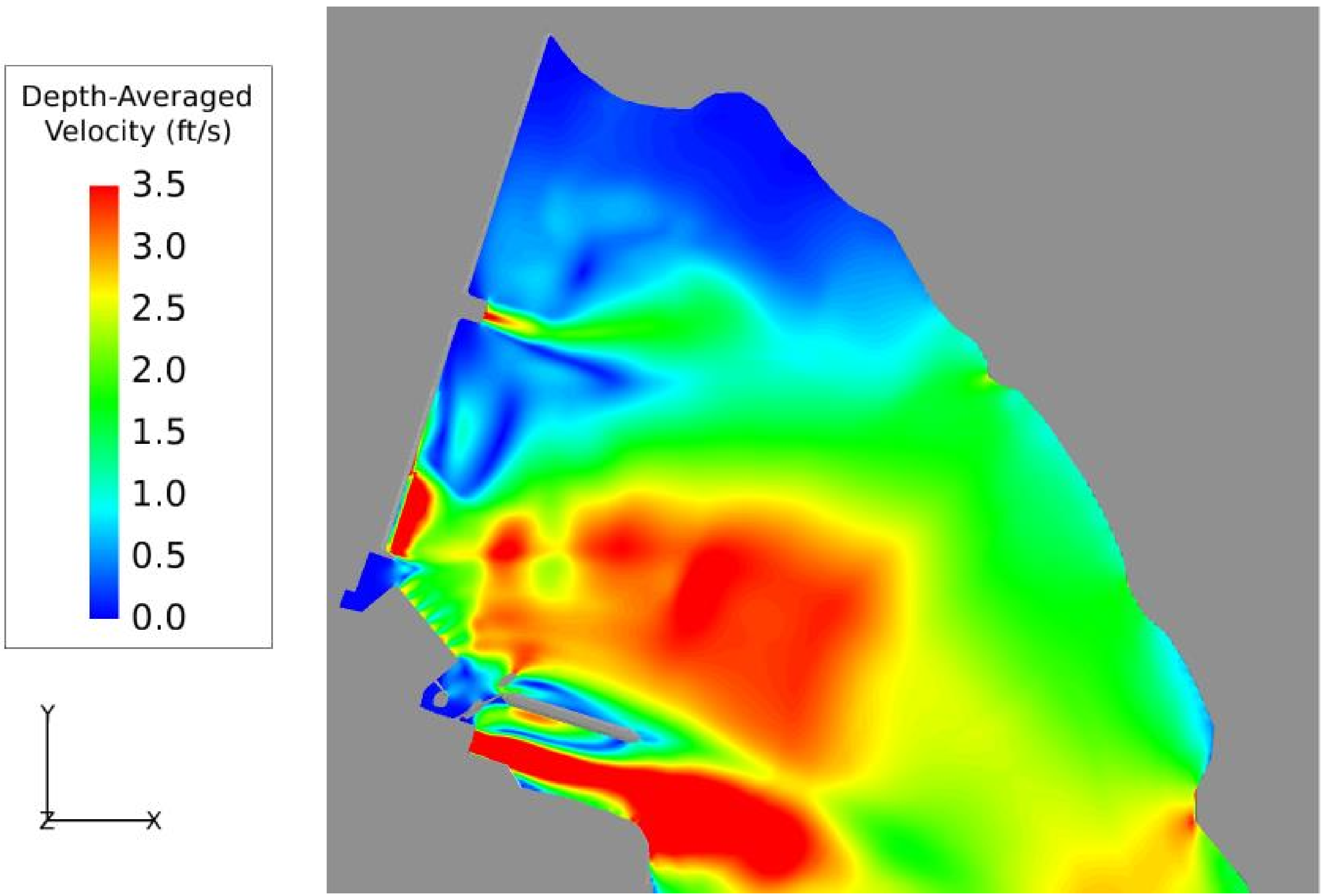
Flow Exceedance	15%
Total Flow	10,750 cfs
Tailwater Elevation	90.2 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	639 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	1433 cfs
Log Sluice	595 cfs
S Flashboards	3400 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Shawmut – Case 03



Water Depth, Plan View
(red > 25.0 ft)

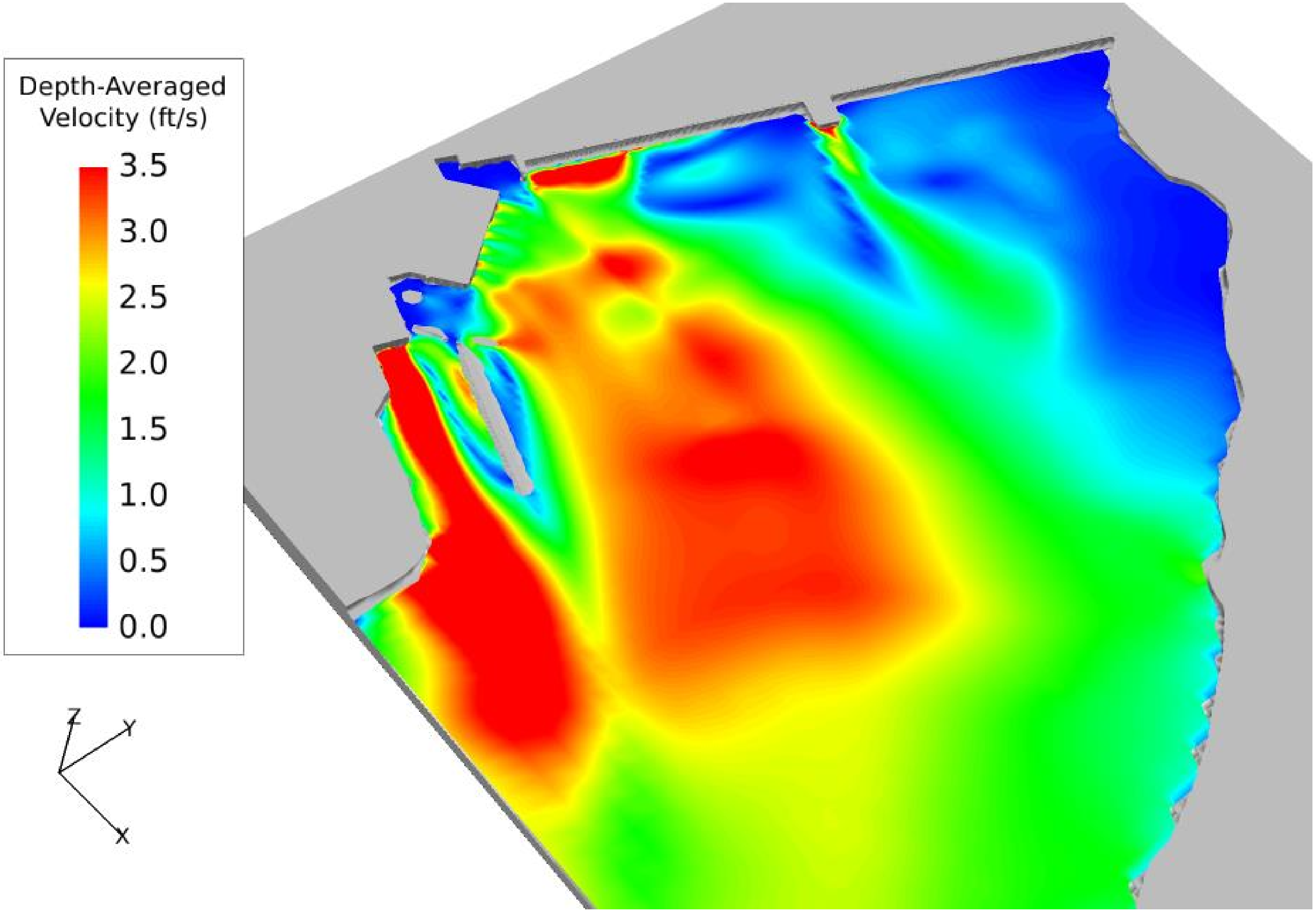
Shawmut – Case 03



Depth-Averaged Velocity, Plan View (red > 3.5 ft/s)

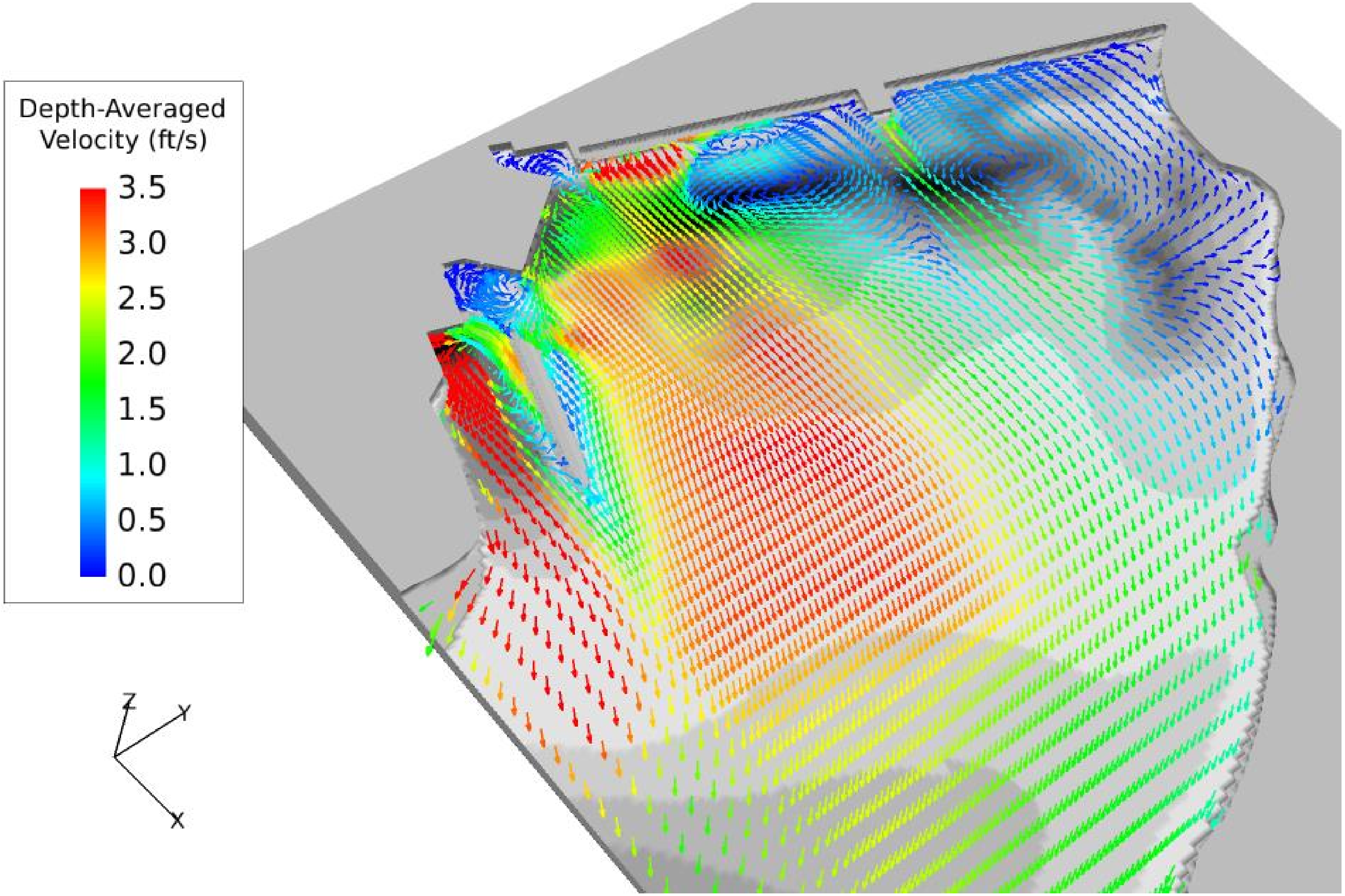
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 03



Depth-Averaged Velocity, Oblique View
(red > 3.5 ft/s)

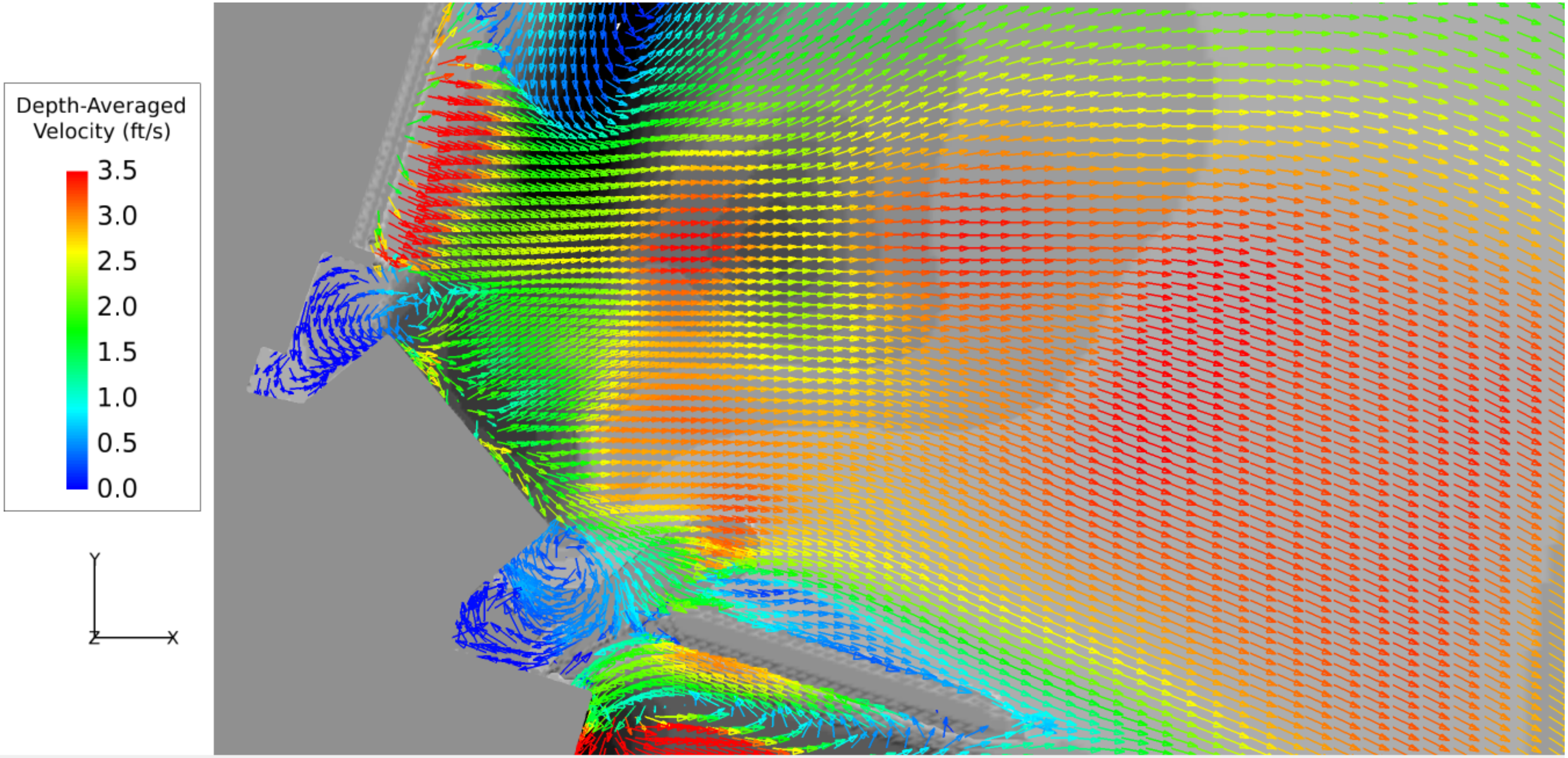
Shawmut – Case 03



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

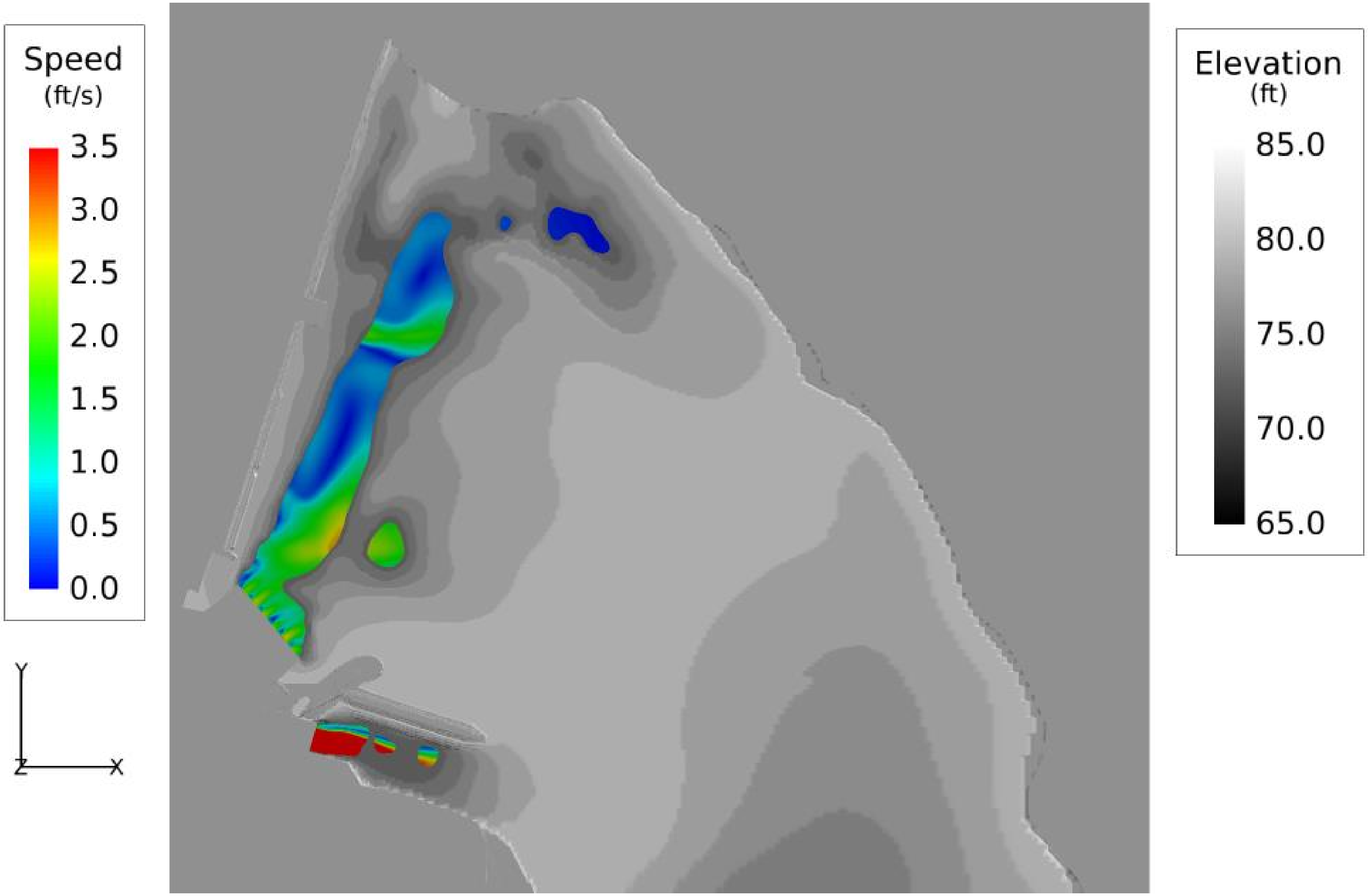
Shawmut – Case 03



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 3.5 ft/s)

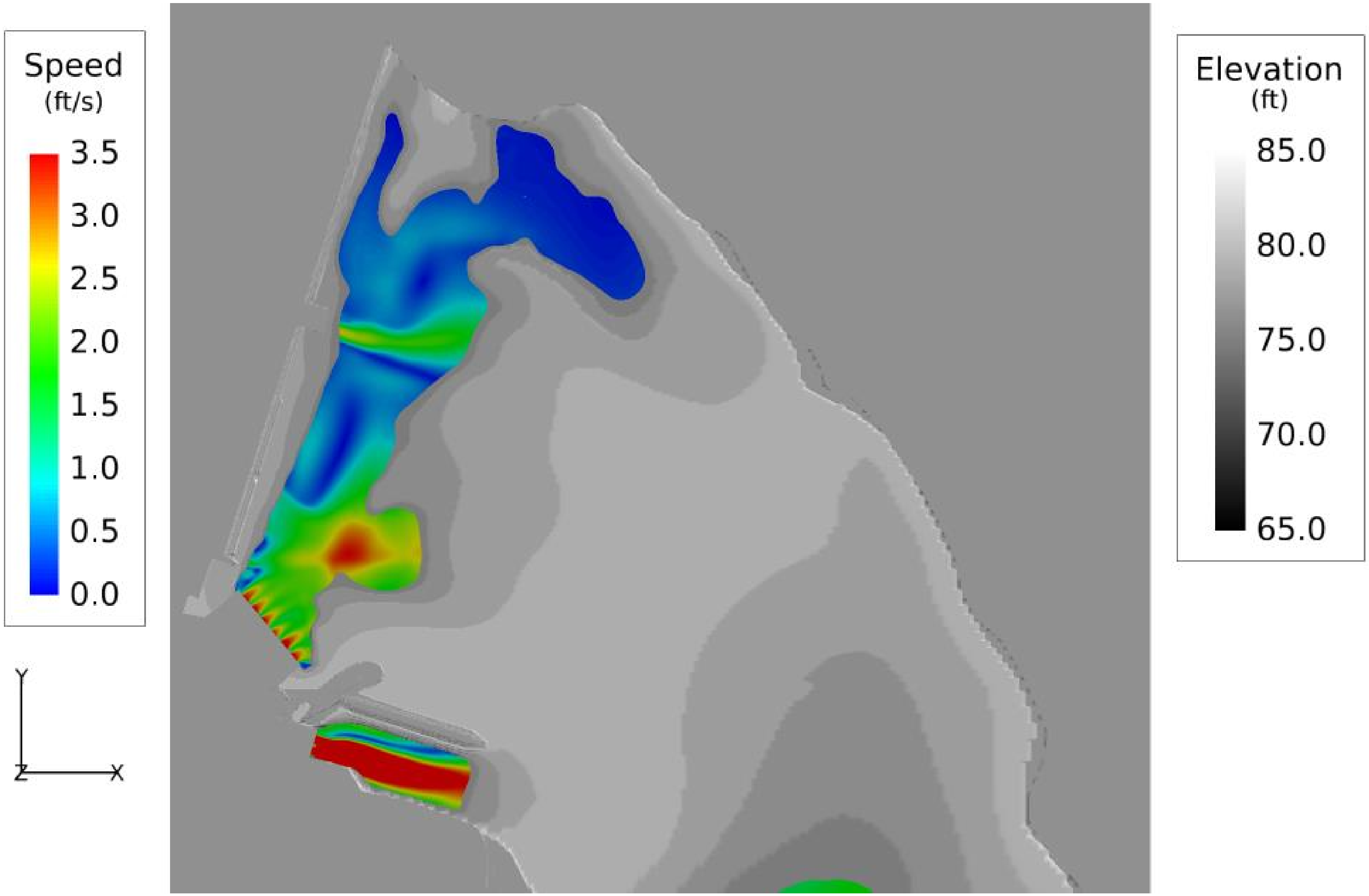
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 03



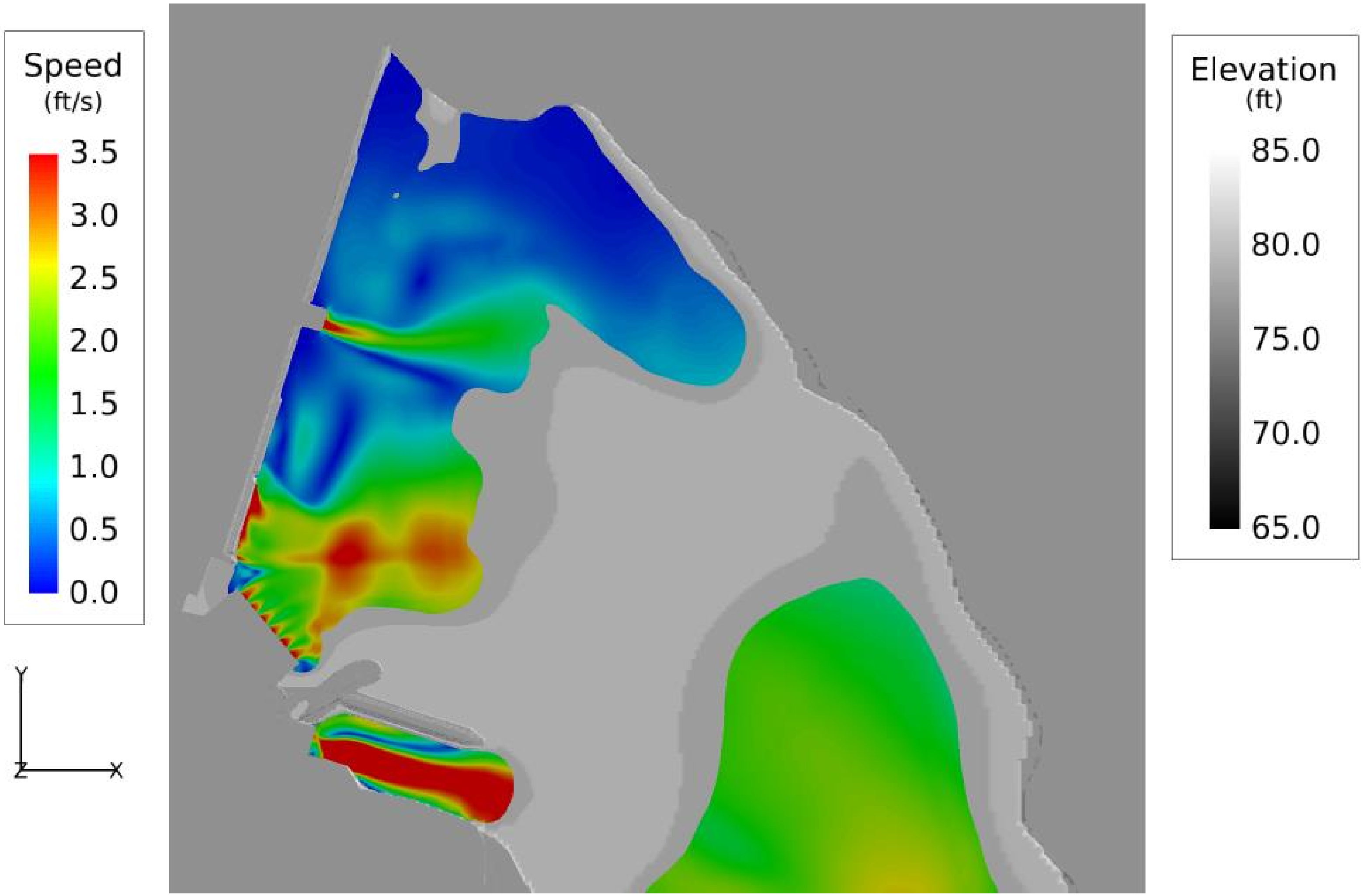
Flow Speed Distribution, Elevation 76.875 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 03



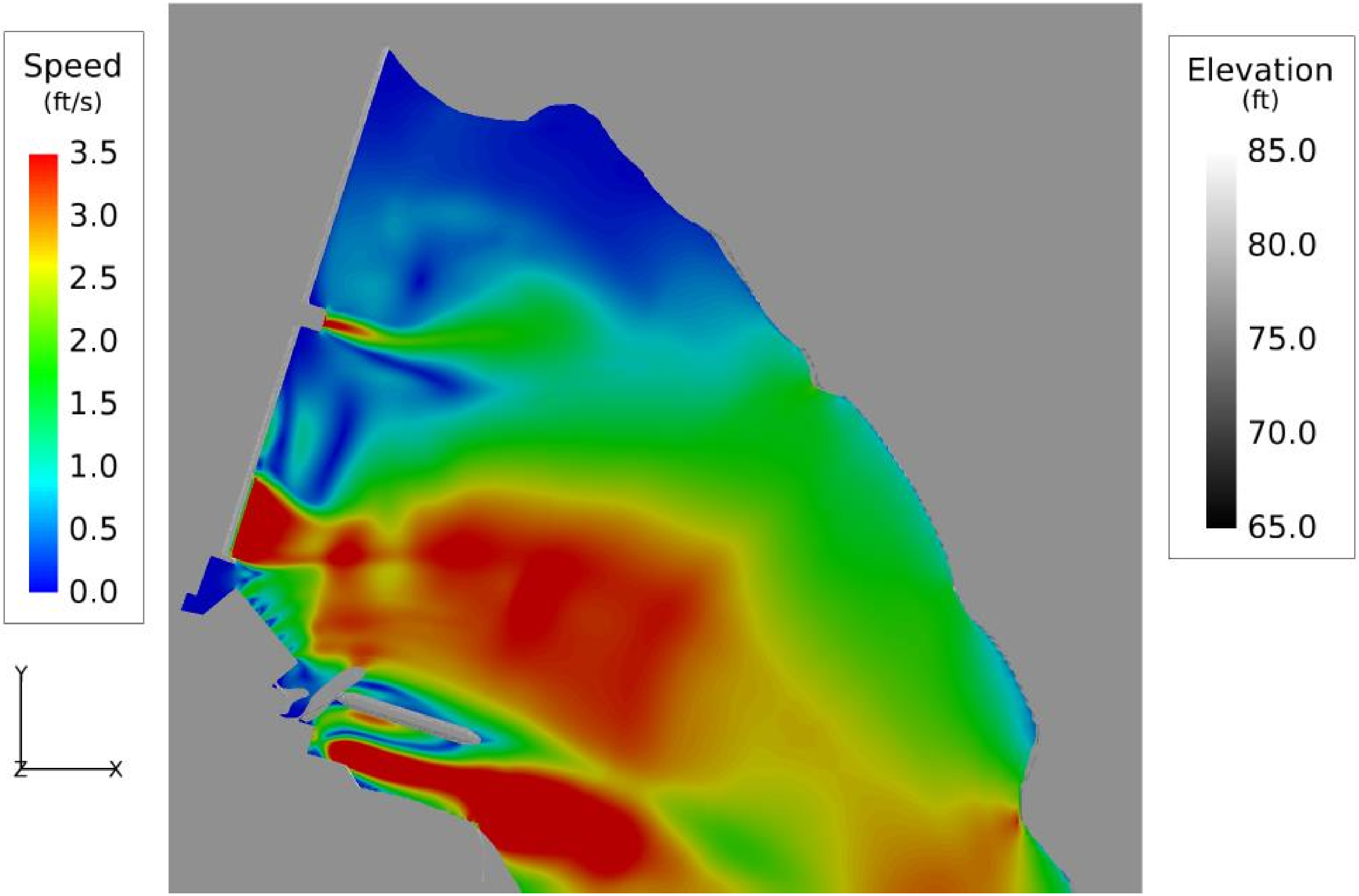
Flow Speed Distribution – Elevation 80.575 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 03



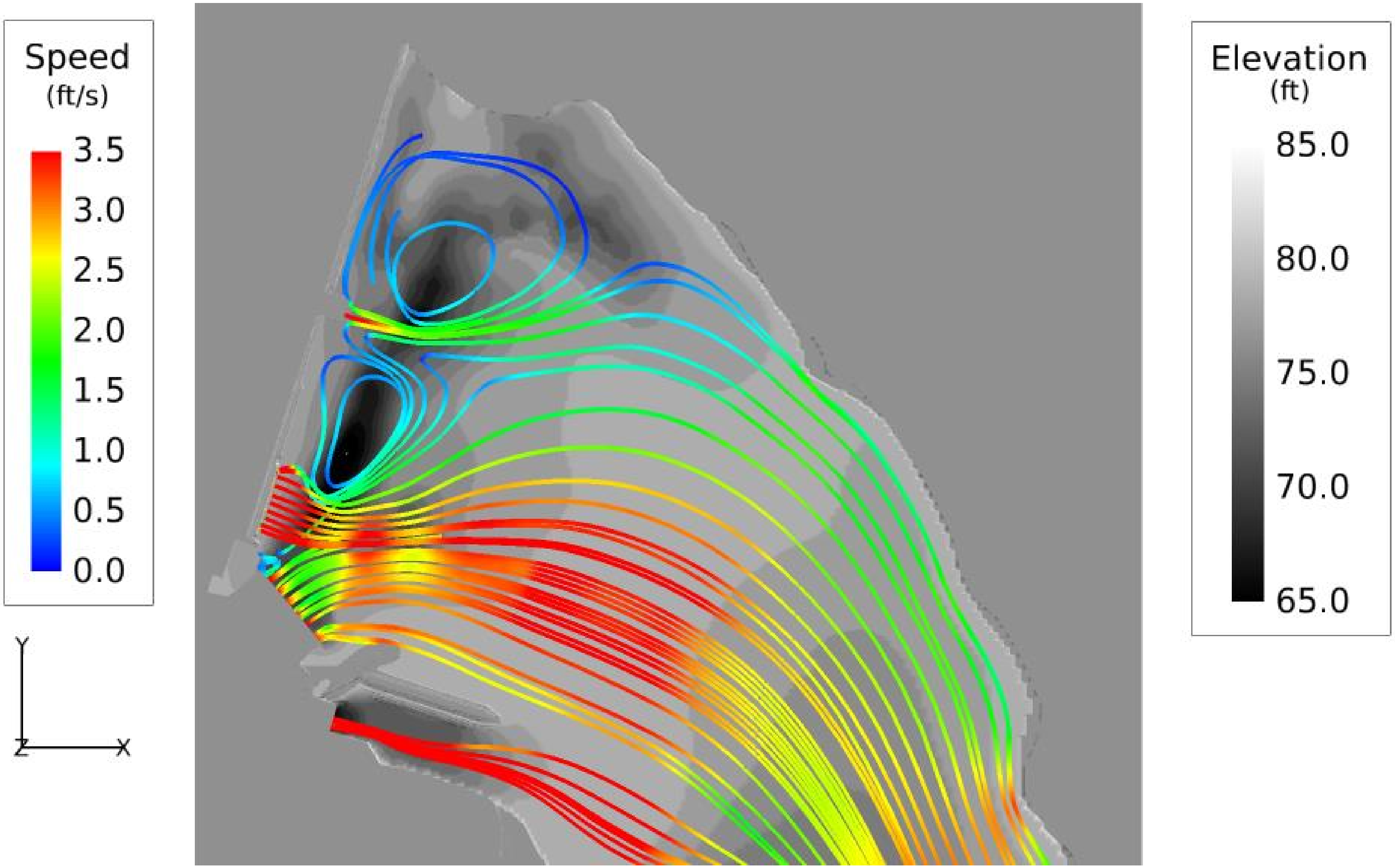
Flow Speed Distribution – Elevation 84.275 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 03



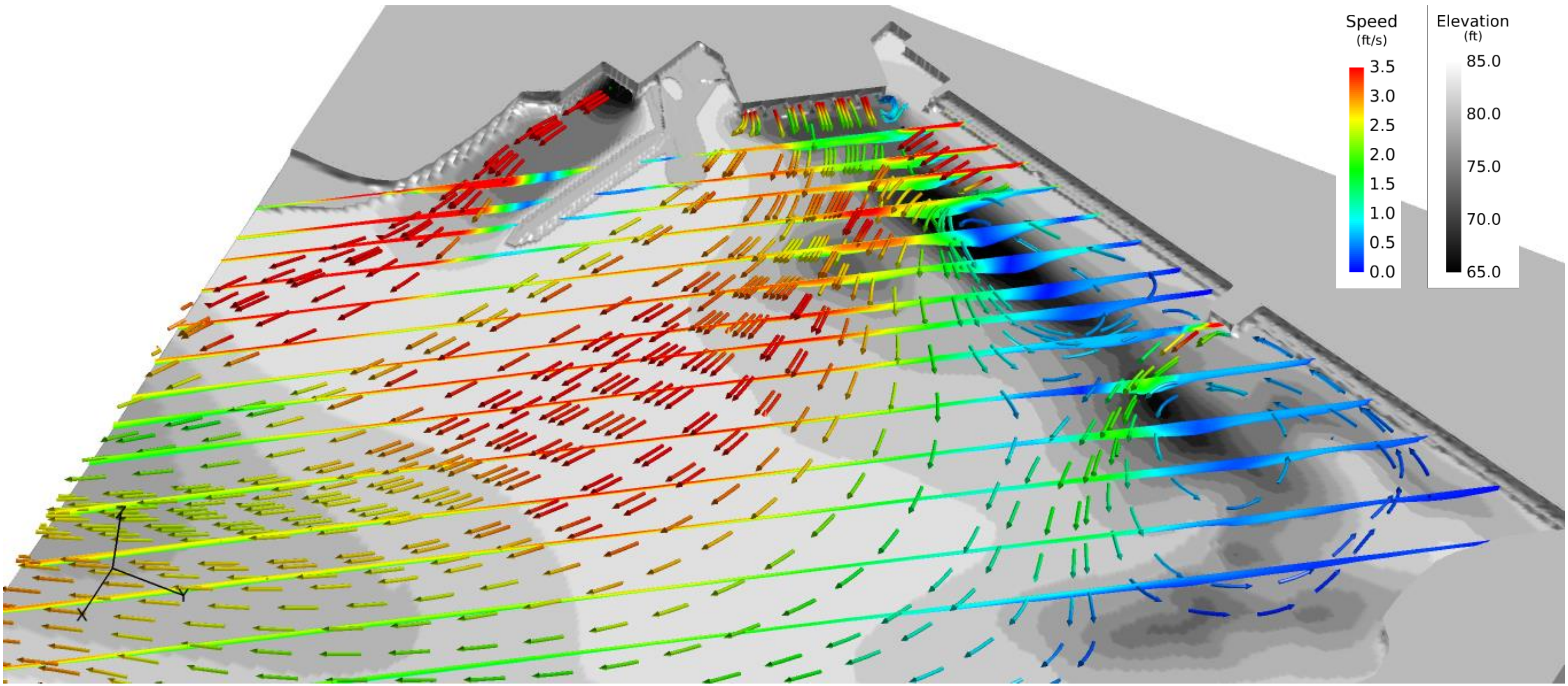
Flow Speed Distribution – Elevation 87.975 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 03



Streamlines - Colored by Speed
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 03



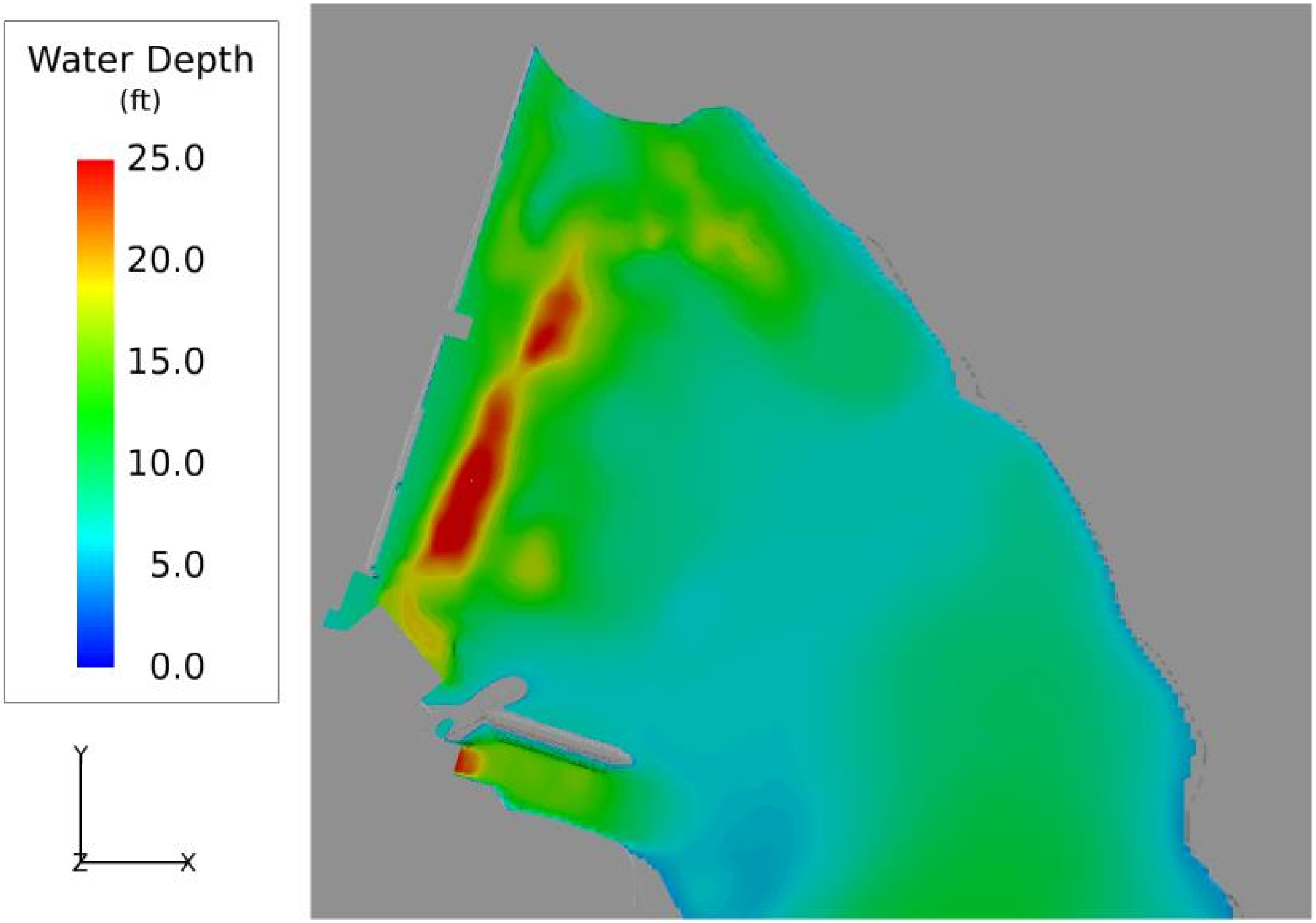
Vertical Variation of Flow Speed and Streamlines
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 04

Boundary Conditions

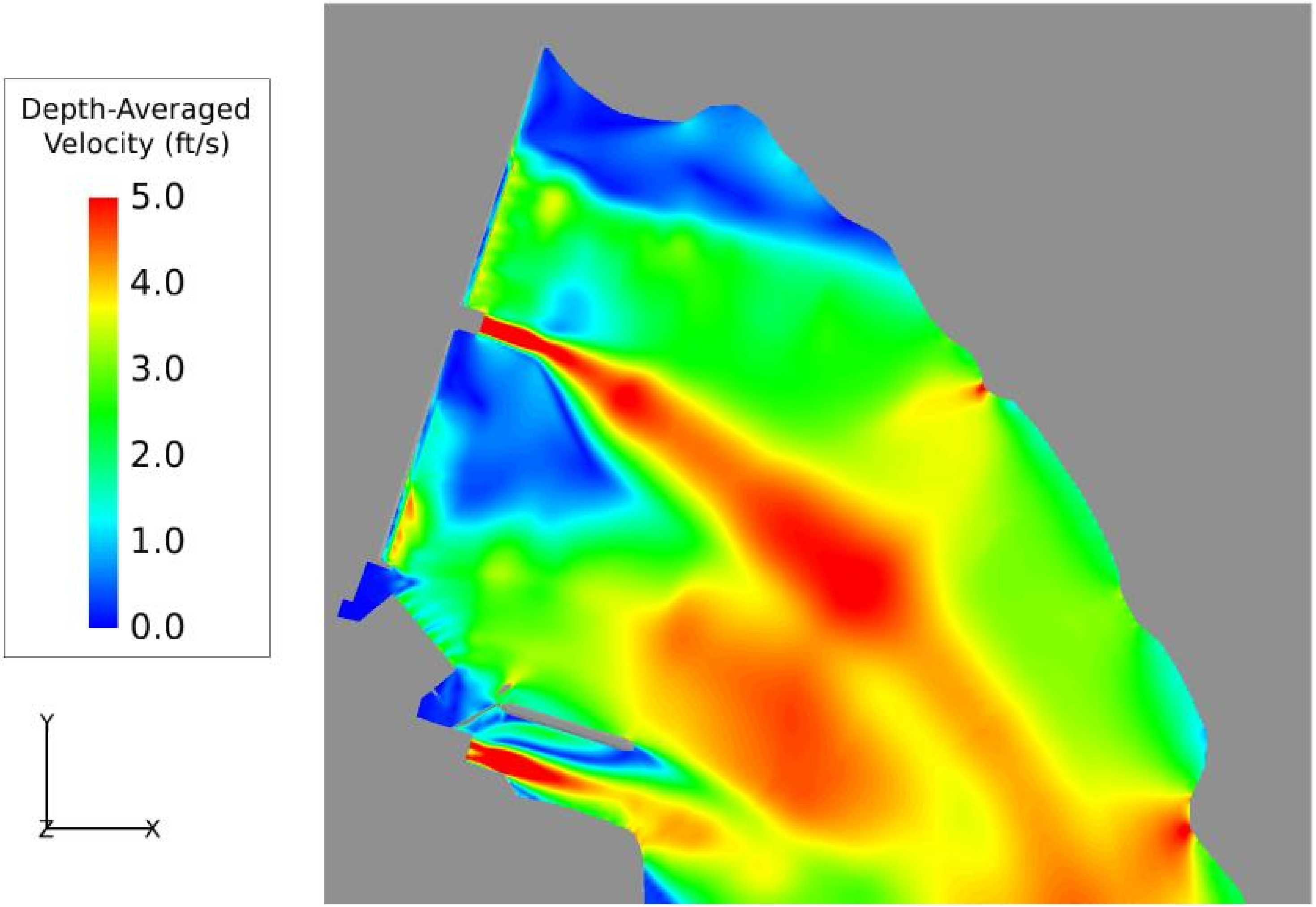
Flow Exceedance	5%
Total Flow	20,270 cfs
Tailwater Elevation	91.5 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	639 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	1433 cfs
Log Sluice	1840 cfs
S Flashboards	3400 cfs
M Flashboards	1275 cfs
S Rubber Dam	7000 cfs

Shawmut – Case 04



Water Depth, Plan View
(red > 25.0 ft)

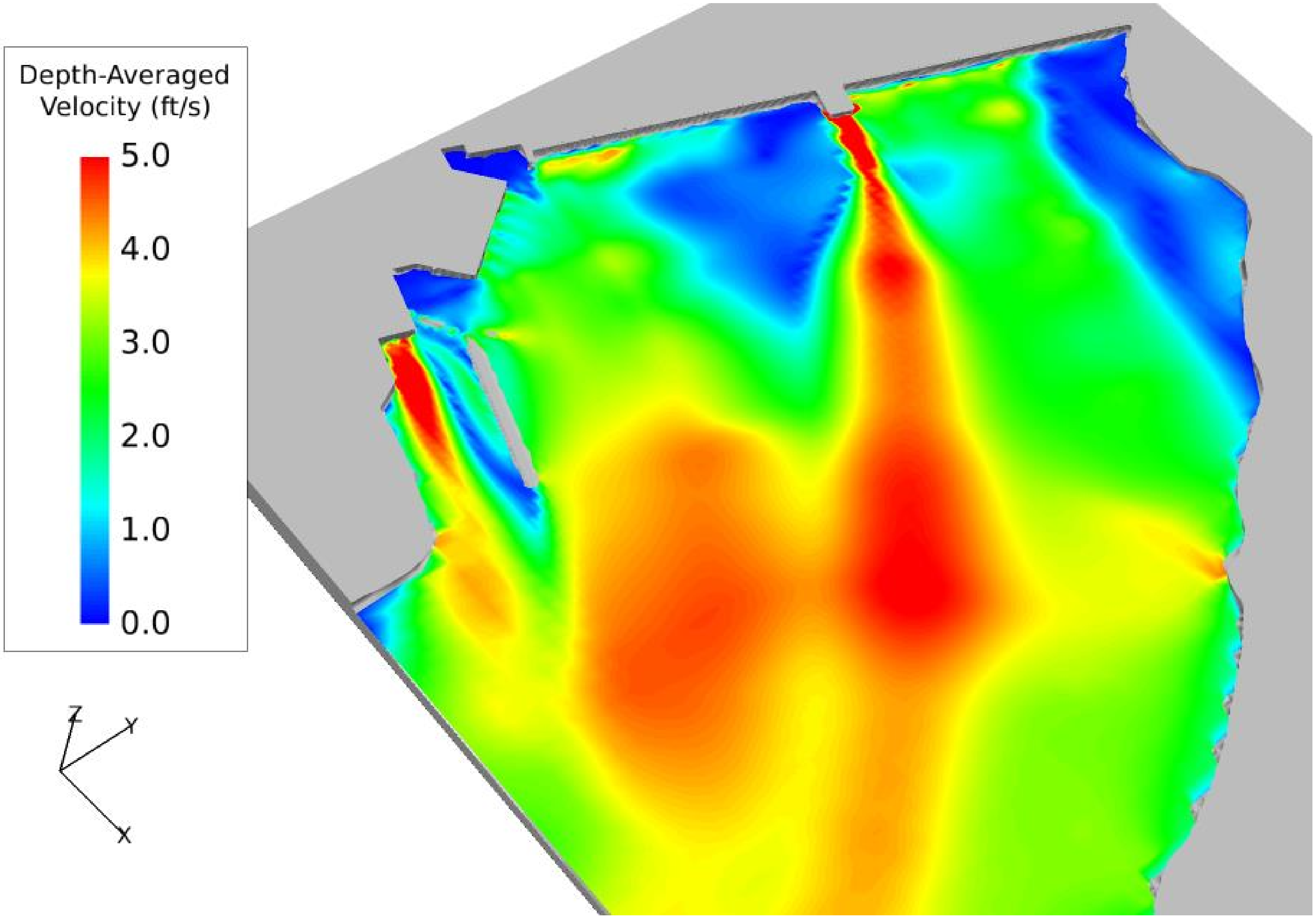
Shawmut – Case 04



Depth-Averaged Velocity, Plan View (red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

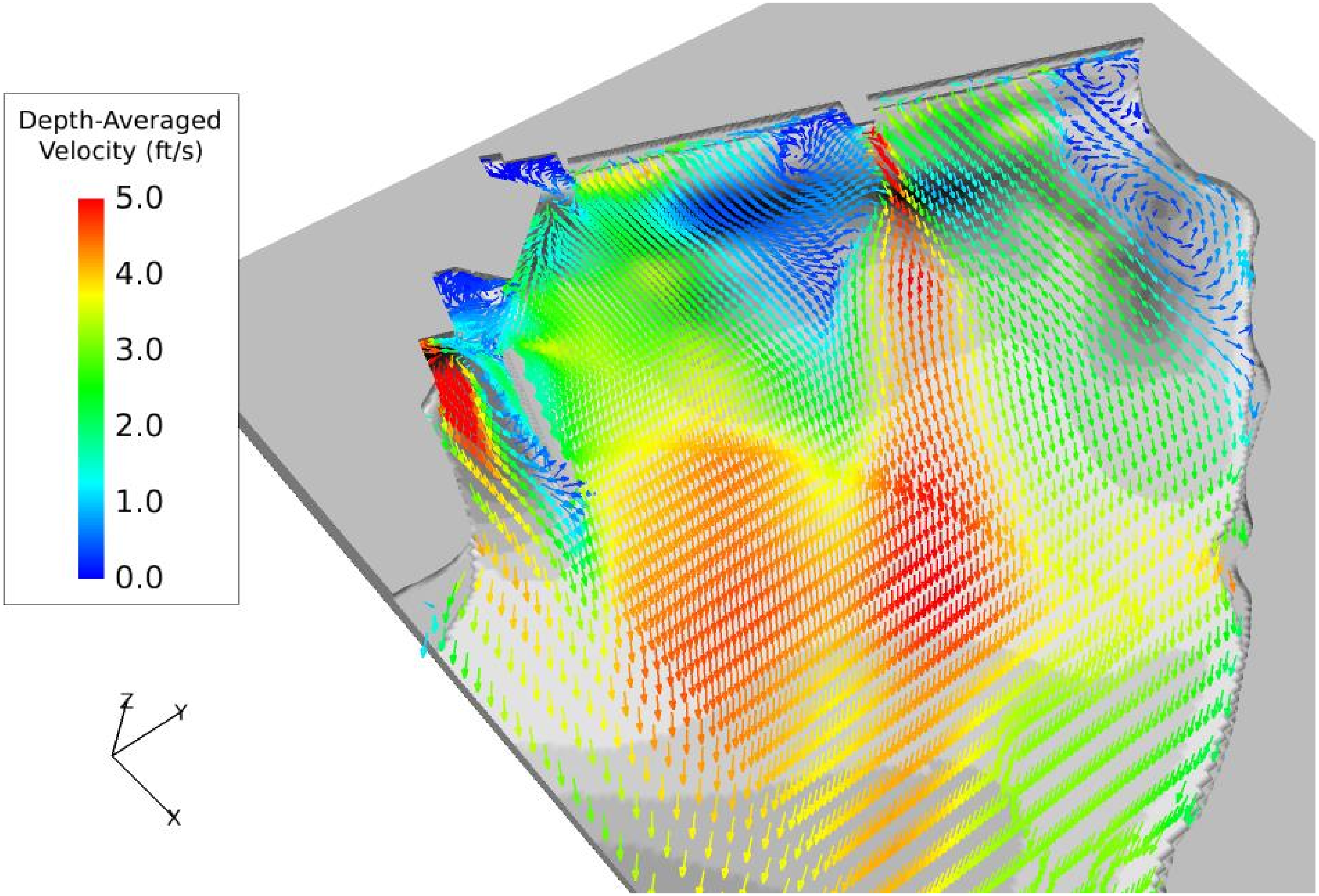
Shawmut – Case 04



Depth-Averaged Velocity, Oblique View
(red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

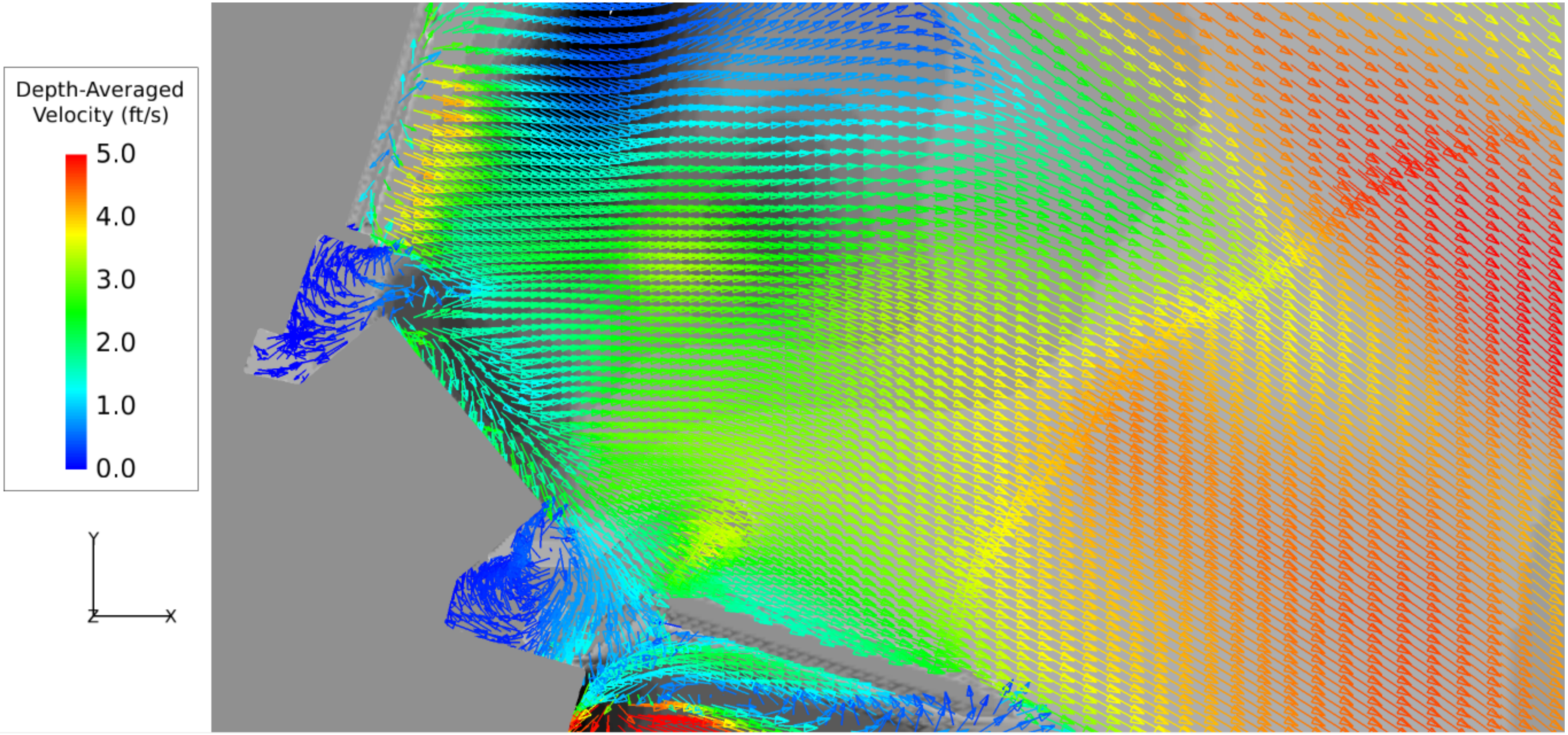
Shawmut – Case 04



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

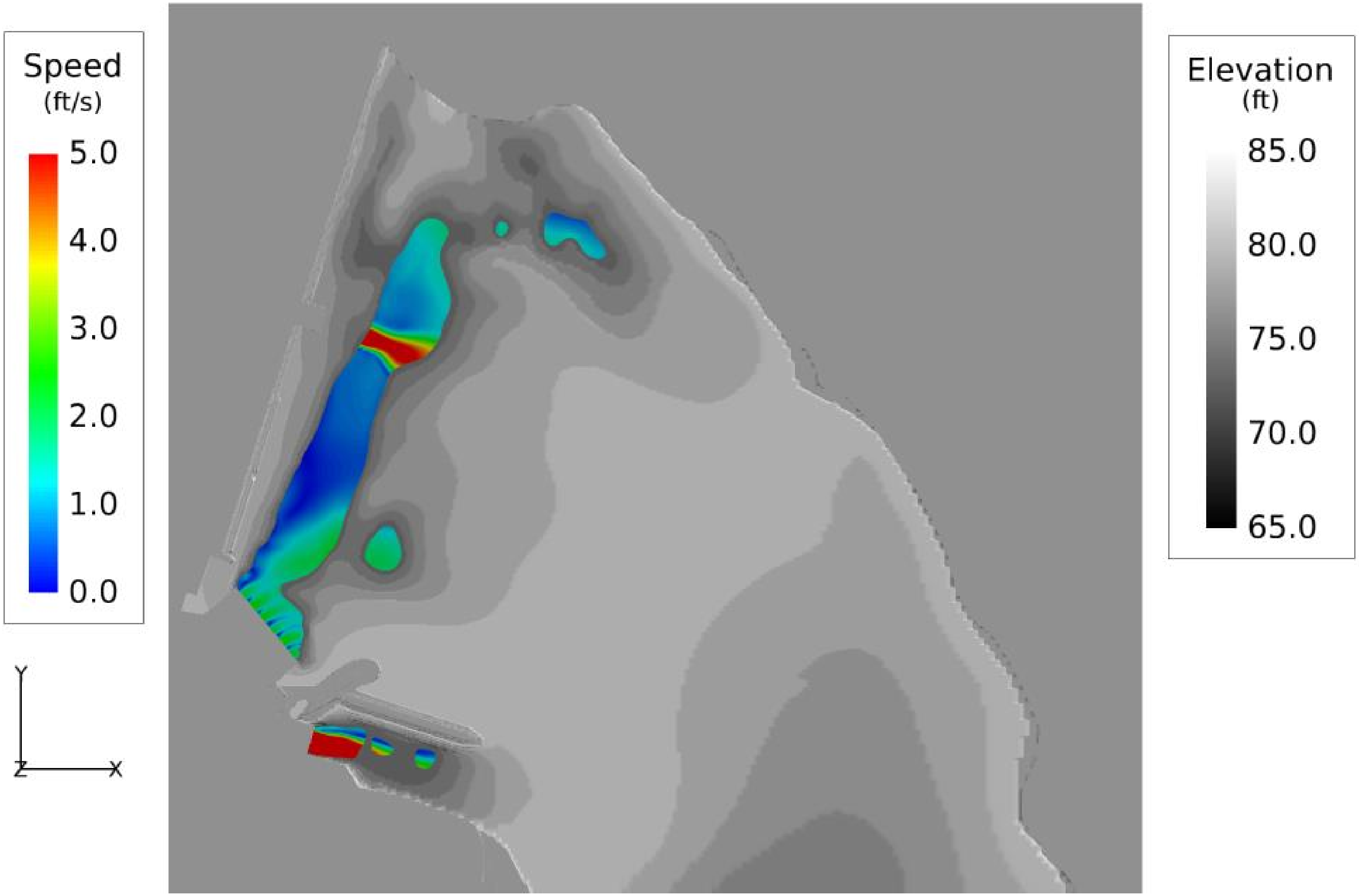
Shawmut – Case 04



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 5.0 ft/s)

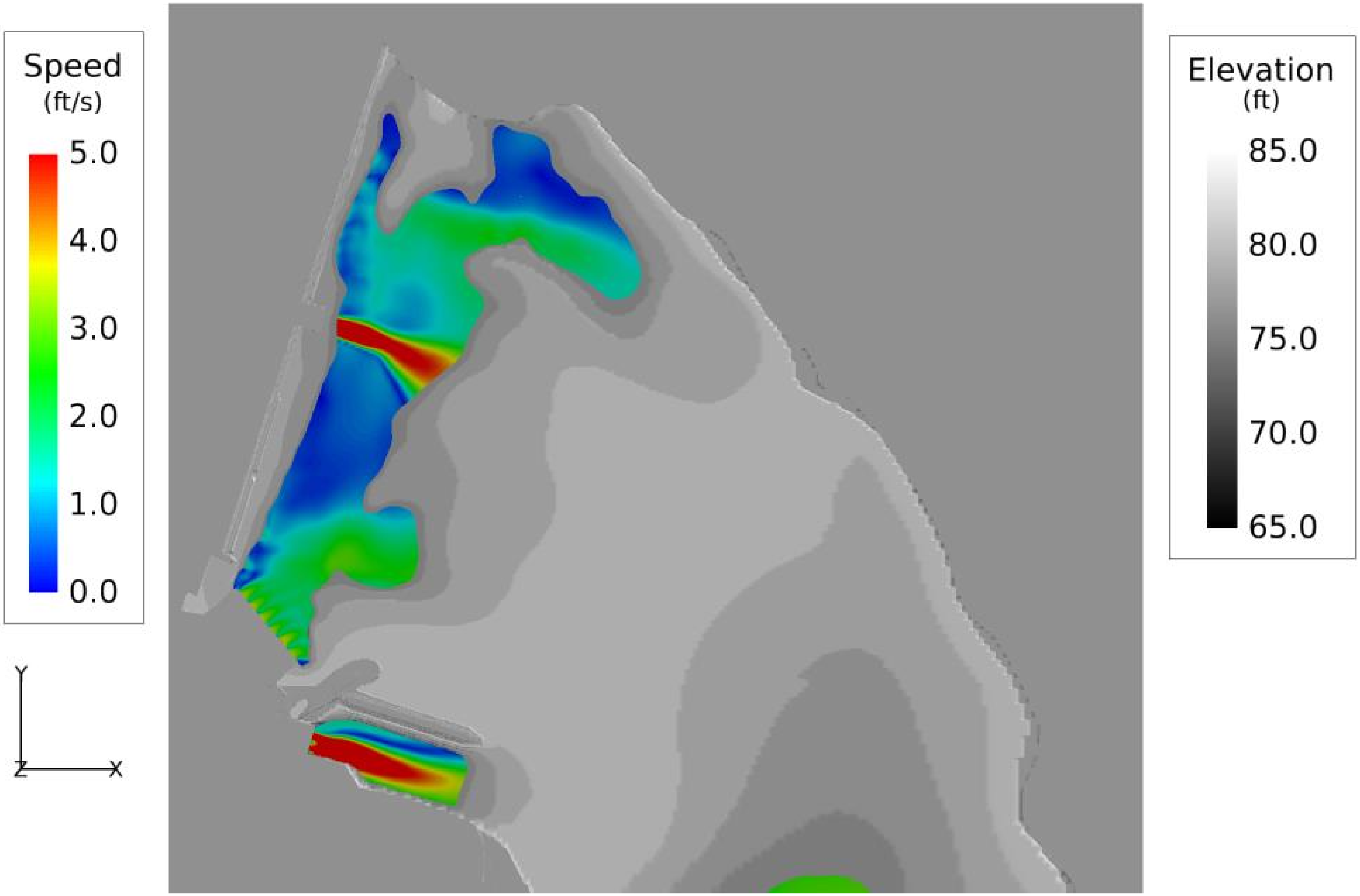
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 04



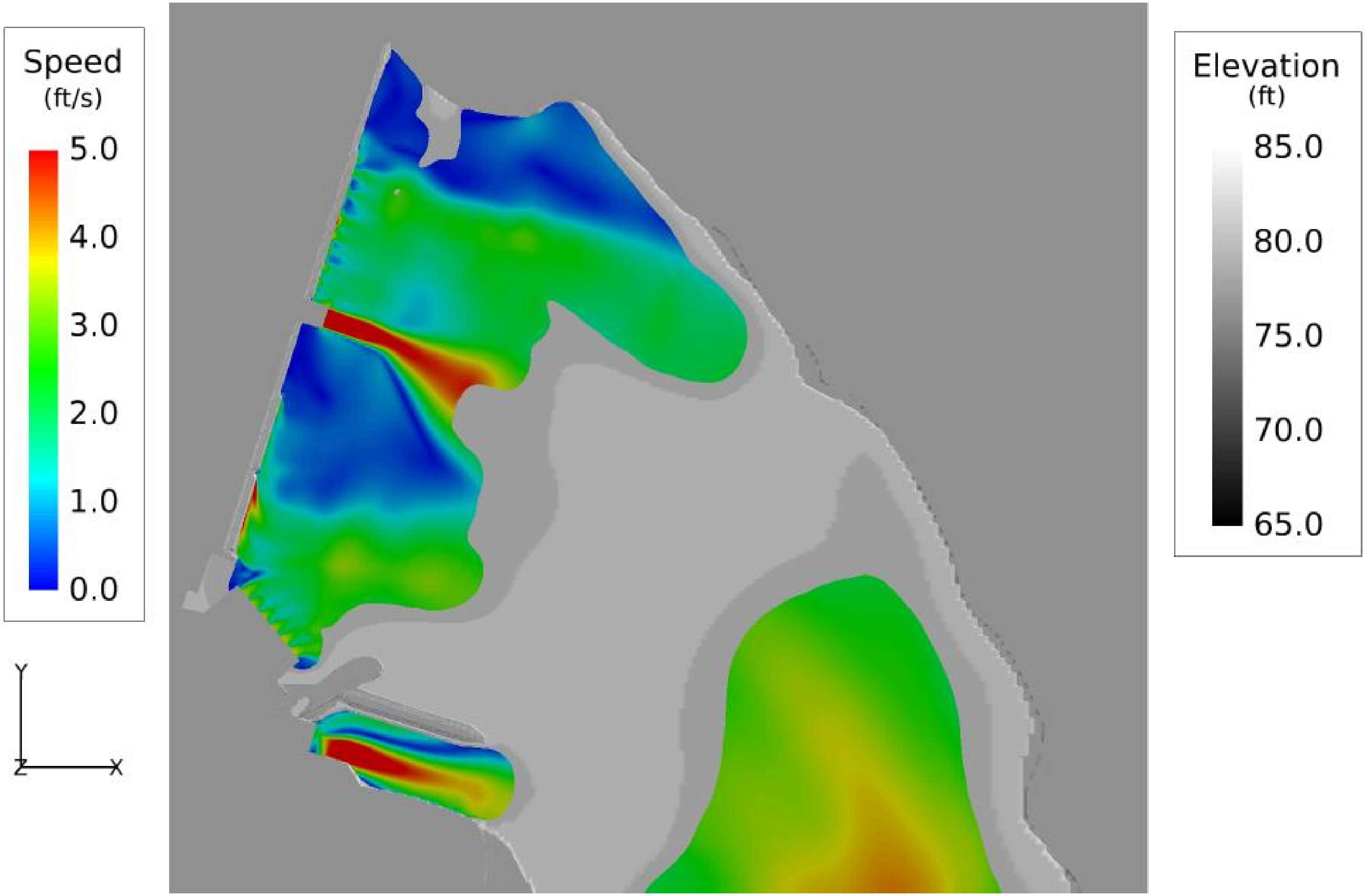
Flow Speed Distribution, Elevation 76.875 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 04



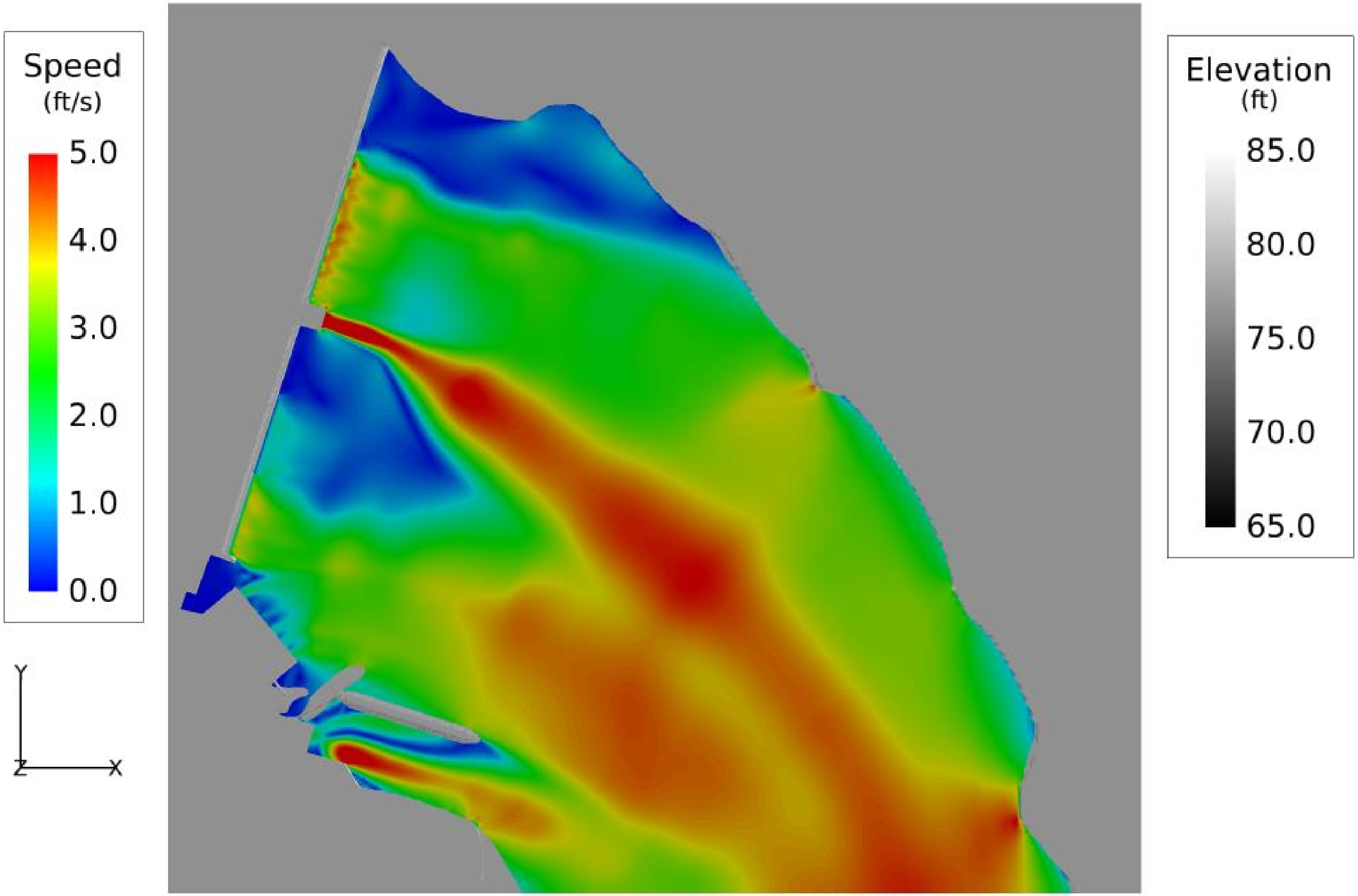
Flow Speed Distribution – Elevation 80.575 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 04



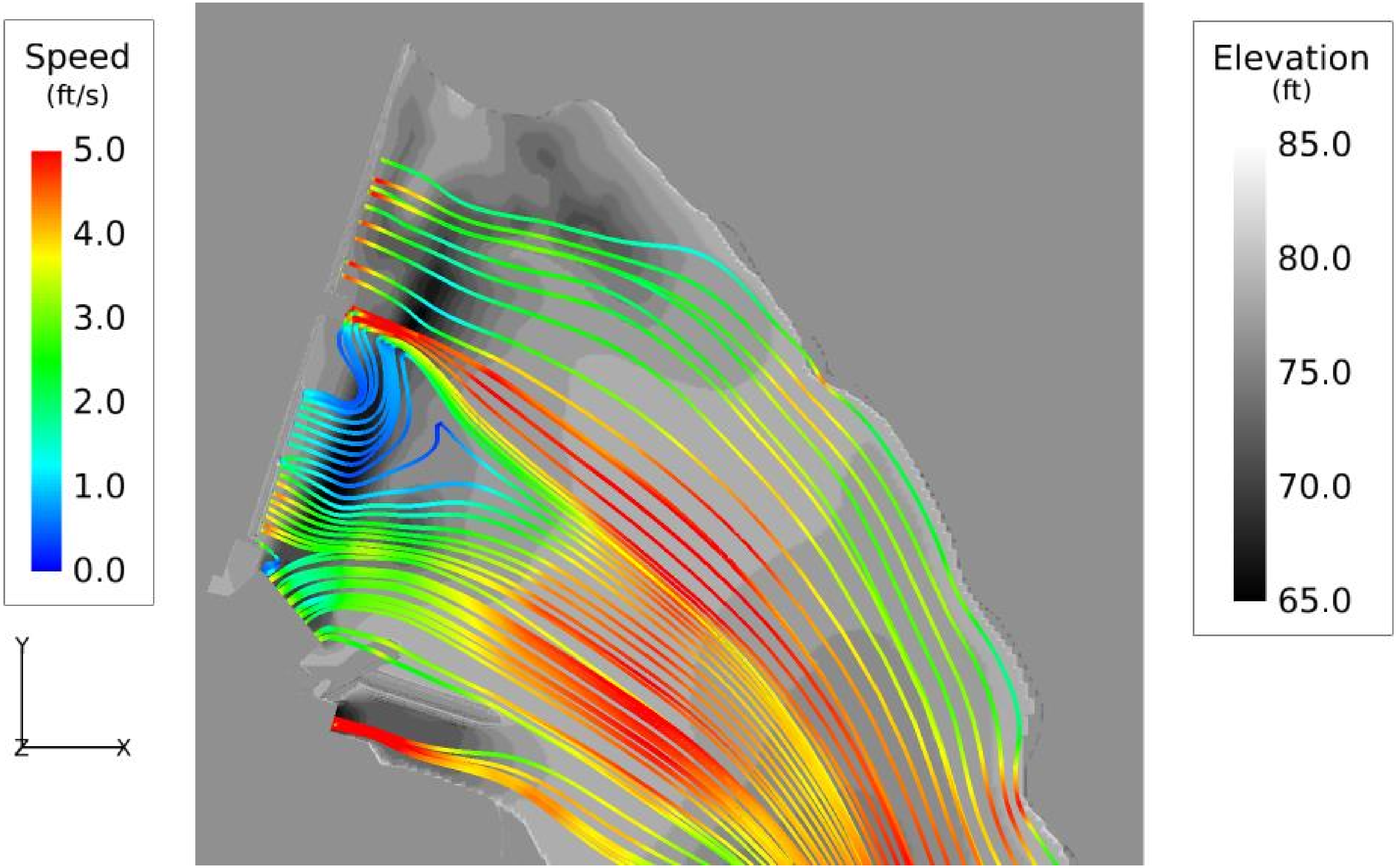
Flow Speed Distribution – Elevation 84.275 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 04



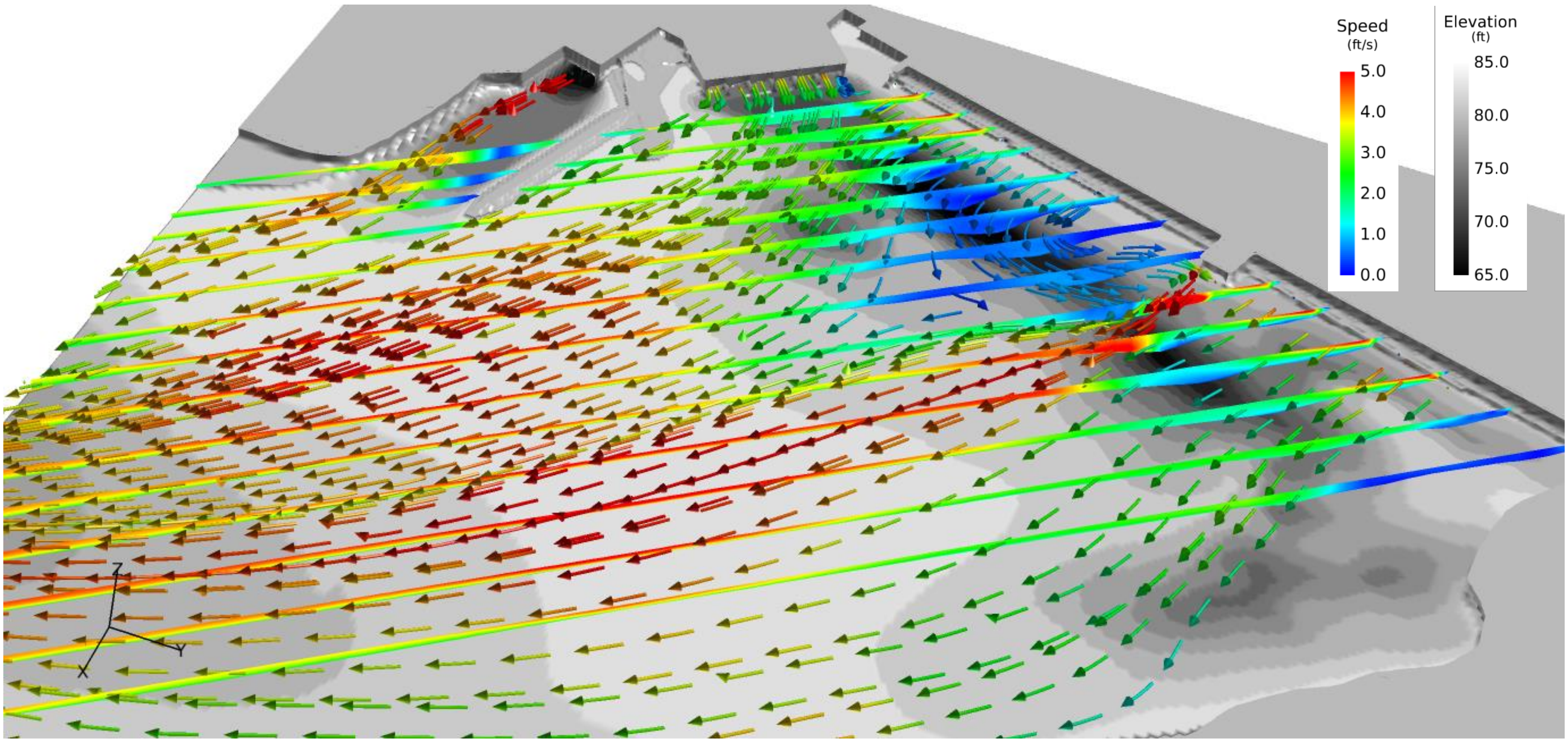
Flow Speed Distribution – Elevation 87.975 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 04



Streamlines - Colored by Speed
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 04



Vertical Variation of Flow Speed and Streamlines
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

From:	Richter, Robert
To:	"Donald Dow"; dan.tierney@noaa.gov; matt.buhyoff@noaa.gov; Bentivoglio, Antonio (antonio_bentivoglio@fws.gov); Bryan Sojkowski (bryan_sojkowski@fws.gov); Dwayne.J.Seiders@maine.gov; "Cox, Oliver"; paul.christman@maine.gov; Wippelhauser, Gail (Gail.Wippelhauser@maine.gov); kathy.howatt@maine.gov
Cc:	Maloney, Kelly; Mitchell, Gerry; gallen@aldenlab.com; Drew Trested; John Richardson (jrichardson@bluehillhydraulics.com)
Subject:	RE: Blue Hill Hydraulics Shawmut CFD Model Draft Report
Date:	Friday, October 07, 2016 2:00:21 PM
Attachments:	Blue Hill Hydraulics Shawmut draft CFD report 10-7-16.pdf

Please see attached an updated version of the CFD report that was previous sent to you back on 9-28-16. This updated version contains all the same information as the previous version plus it contains narratives regarding the model, how it was developed, how the analysis was done and a discussion about each case evaluated.

Feel free to contact me if you have any questions.

Thanks.

Shawmut Hydroelectric Project
Computational Fluid Dynamics
Flow Analysis

Summary Report

Submitted to:

Alden Research Laboratory
Holden, MA

5 October 2016

Table of Contents

1. Introduction

A Computational Fluid Dynamics (CFD) model of the Shawmut Hydroelectric Project was developed to aid in the design of a future upstream fish passage. The model is of the area downstream of the spillway and powerhouses. It includes the tailrace, training walls, spillway sections, and powerhouse discharges as shown in Figure 1.

Figure 1: Shawmut Hydroelectric Project
(FERC No. P-2322)

The goal of the CFD analysis is to provide the necessary hydraulic information needed to properly site and design an upstream passage at the project for adult salmon, shad, and river herring. An effective and efficient upstream passage facility will provide anadromous species with access to important upstream habitat with minimal delay.[1]

[1] For more information concerning the study plan, the reader is referred to Alden/Blue Hill Hydraulics (2015).

2. Modeling Approach

In accordance with agency requests, a ***FLOW-3D*** model was constructed and used to simulate project flows.

FLOW-3D is a commercially available, three-dimensional, CFD software package developed and sold by Flow Science, Inc. (www.flow3d.com). The program was specially designed for the simulation of free surface flow and it has been used world worldwide since the late 1980s.

2.1 Data Collection and Synthesis

Site-specific information from a variety of sources was used to construct the CFD model. This included – site plans and project flow rates made available by Brookfield Renewable Energy Group (BREG), and bathymetric data and velocity measurements provided by Normandeau.

Figure 2 shows the completed bathymetric map used for CFD modeling. The map is based on 1924 and 1981 surveys, drawings from the 1980s, and more recent surveys completed by Normandeau in 2015 and 2016. No bathymetric data was available in the shallow area downstream of the project (within the dashed rectangle) – elevations in this area were estimated using photographs and other historical information.[2] Elevations downstream of the shallow area were also estimated.

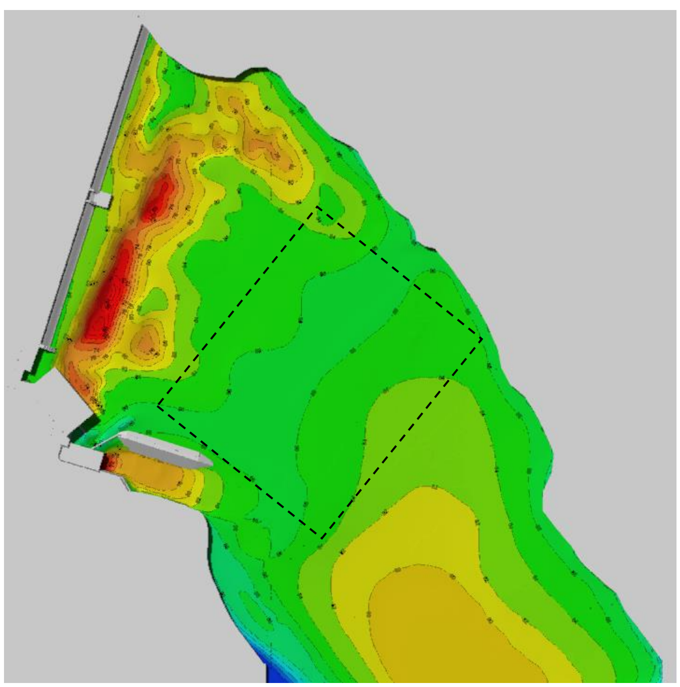


Figure 2: Bathymetric Map used for CFD Modeling

[2] Elevations in this area could not be collected because the flow was too shallow during the period of time that the most recent survey was made.

2.2 Model Domain

The model domain included the full width of the river from the dam to a distance of about 1,700 ft downstream. All flow outlet structures at the project including spillways, gates, and unit discharges were included.

2.3 Model Description

FLOW-3D version 11.0.3.05 was used for the model study. Table 1 provides details of the model setup. Boundary conditions are summarized in Table 2.

Table 1: Model Setup

Computer Software	- ***FLOW-3D*** 11.0.3.05
Governing Equations and Model Physics	- Reynolds Averaged Navier-Stokes - Incompressibility - Gravity - RNG Turbulence Model
Fluid Properties	- Water
Computational Mesh	- Non-uniform structured mesh - 2,660,000 control volumes - Nominal control volume size in vicinity of the project 2ft x 2ft x 1.9ft

Table 2: Boundary Conditions

Inflow Conditions	Mass-momentum sources were used to define all discharge elements (Units 1 to 8, log sluice, flashboards, and rubber dam)
Downstream Boundary	Specified water surface elevation and hydrostatic pressure distribution
Solid Surfaces	No-slip
Free Surface	Volume of Fluid (VOF) – ref. Hirt and Nichols (1981)

2.4 Model Validation

During their 2016 survey, Normandeau made velocity measurements downstream of the dam for model validation. Comparisons of measured and calculated flow speeds agree closely. At the time of this writing, however, comparisons of measured and calculated vectors have not been made. This report will be updated and the results of these comparisons will be added once the validation has been completed entirely.

2.5 Model Simulations

Five simulations were carried out with the ***FLOW-3D*** model – a benchmark simulation for model validation and four additional simulations for flow exceedances equal to 95%, 50%, 15%, and 5%.

Tailwater elevations used in all of the simulations were based on information appearing in Figure 3 except for the benchmark simulation. For the benchmark simulation a reported value of 87.27 ft was used for the Tailwater.

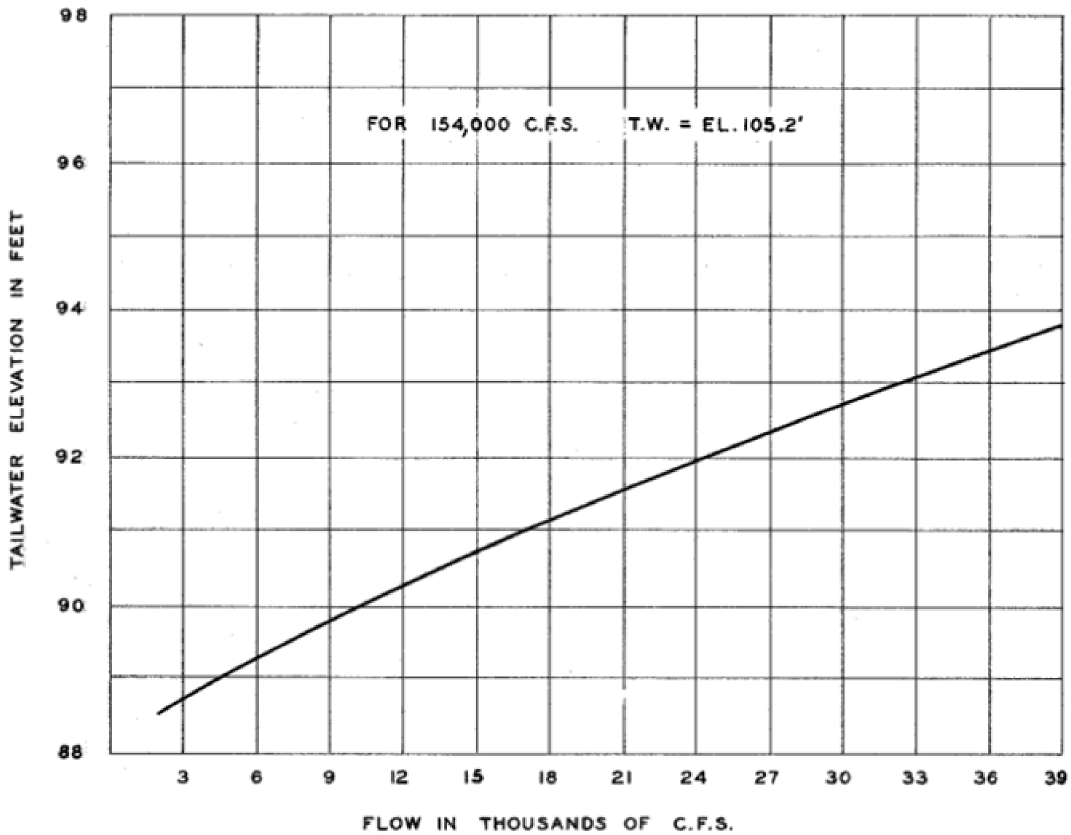


Figure 3: Tailwater Elevations

Table 3 (following page) was provided by BREG and specifies flow allocations used in each simulation.

Table 3: Flow Allocation

Model Simulation	River Flow		Flow Allocation (cfs) May 1 - October 31																	
			Gates and Sluices				Hinged Flashboards			Rubber Dam Sections			1912 PH Turbines						1982 PH Turbines	
	Total Flow (cfs)	Flow Exceedance (%)	10 x 7 ft Tainter Gate (up to 700 cfs)	25 x 8 ft Log Sluice (up to 1,840 cfs)	4 ft x 22 inch Log Sluice (up to 35 cfs)	6 x 6 ft Deep Bypass (up to 35 cfs)	South 123 ft Hinged Flashboard (up to 3,400 cfs)	Middle 123 ft Hinged Flashboard (up to 3,400 cfs)	North 123 ft Hinged Flashboard (up to 3,400 cfs)	South 238 ft Rubber Dam Section (up to 7,000 cfs)	Middle 237 ft Rubber Dam Section (up to 7,000 cfs)	North 231 ft Rubber Dam Section (up to 7,000 cfs)	Unit 1 (up to 635 cfs)	Unit 2 (up to 639 cfs)	Unit 3 (up to 634 cfs)	Unit 4 (up to 611 cfs)	Unit 5 (up to 703 cfs)	Unit 6 (up to 649 cfs)	Unit 7 (up to 1451 cfs)	Unit 8 (up to 1433 cfs)
Benchmark Case	3,463												544	554	596	635	580			
Case 1	2,540	95%											635	622	634			649		
Case 2	4,790	50%											635	125	634	611	703	649		1433
Case 3	10,750	15%		595			3400						635	639	634	611	703	649	1451	1433
Case 4	20,270	5%		1840			3400	1275		7000			635	639	634	611	703	649	1451	1433

Max Flood EL. (ft)		122
100 Year FEMA EL. (ft)		120
Normal Pond EL. (ft)		112
Low Pond EL. (ft)		108
Max Project Turbine Flow (cfs)		6755

3. Results

Graphics produced from the results of the CFD simulations appear in the appendices. There are five appendices, and each one is associated with a different case study. The first figure in each appendix documents flow conditions, and the figures that follow are all of the same design except that limiting values for flow speeds have been adjusted when required. The figures are intended to provide necessary hydraulic information needed to properly site and design an upstream passage at the project for adult salmon, shad, and river herring. Brief notes regarding each study case are provided in the sub-sections that follow.

3.1 Benchmark Analysis (Total Flow 3,463 cfs)

Flow conditions observed by Normandeau (12 July 2016) were used for model validation. Tailwater elevations were comparatively low when the observations were made and calculated water depths at some locations were less than about 2.0 ft. As noted on Figure A-3, these shallow areas appear as dropouts in the graphics produced.

As shown on Figure A-11, flow out of Units 1 to 5 distributes itself uniformly across the width of the river as it moves across the shallow regions below the dam. Field data could not be collected in these shallow areas. However, comparisons of flow speeds (measured vs. modeled) below the dam show good agreement. NOTE: Additional information about these comparisons will be added to an updated version of this report once it is available.

3.2 Case 1 (Total Flow 2,540 cfs)

The flow exceedance for Case 1 is 95%, and the total flow in the river is less than it is in the Benchmark Analysis. However, tailwater elevations are higher than they are in the Benchmark Analysis (88.6 ft versus 87.27 ft). As a result, there are no dropouts in the graphics produced for this case study.

Comparing the results shown in Figures B-11 and A-11, the trajectory of calculated streamlines for both cases are similar. In both instances flow comes from the powerhouse containing Units 1-6, tailwater elevations are low, and flow over the shallows is distributed across the entire width of the river.

3.3 Case 2 (Total Flow 4,790 cfs)

The flow exceedance for Case 2 is 50% and both powerhouses are operational (Units 1-6 in the 1912 Powerhouse and Unit 8 in the 1982 Powerhouse). About 30% of the total flow comes from Unit 8 and its signature is clearly discernable in the model results. Referring to Figure C-10, for example, flow from Unit 8 propagates well downstream of the project and out of the model domain. In comparison, high-speed flows from Units 1-6 are diminished as they cross over the shallow areas (*i.e.*, even with a tailwater elevation of 89.1 ft the shallows still affect the propagation of discharge flows from the 1912 Powerhouse).

3.4 Case 3 (Total Flow 10,750 cfs)

In Case 3 (15% flow exceedance) flow comes from both powerhouses, the hinged flashboard section on the south side, and through the log sluice. Even though the total flow for Case 3 is about twice what it is for Case 2 – the percentage of flow coming from the 1982 Powerhouse is about the same as it is for Case 2 (*i.e.,* 30% in Case 2 and 27% in Case 3) and the resulting flow pattern is similar to the one calculated for Case 2 as well.

3.5 Case 4 (Total Flow 20,270 cfs)

The flow exceedance for Case 4 is 5% - both powerhouses are operational, two of the hinged flashboard sections are down (south and middle), and flow is coming through the log sluice and one of the rubber dam sections (south). In this case, flow is more evenly distributed across the river and the signatures of the two powerhouse flows are not as pronounced (*e.g.,* in Case 2 flow from the 1982 Powerhouse is clearly identifiable downstream of the project).

4. Summary

The computer model simulations cover a wide range of operating conditions and provide information needed to properly site and design an upstream passage at the project. In all of the model results, flow from the 1912 Powerhouse is distributed laterally across the river when it crosses the shallow area downstream of the tailrace. In contrast, flow from the 1982 Powerhouse is less affected by the shallows and its signature (*i.e.,* areas of comparatively high speed flow) is more plainly seen in the Case 2 and Case 3 model results.

5. References

Alden Research Laboratory and Blue Hill Hydraulics (2015), "Study Plan for Hydraulic Modeling at Shawmut Hydroelectric Project (P-2322)," submitted to Brookfield Renewable Energy Group, July.

Hirt, C.W. and B.D. Nichols (1981), "Volume of Fluid (VOF) Method for the Dynamics of Free Boundaries," *Journal of Computational Physics*, **39** (1), pp 201-225.

Appendix A: Benchmark Analysis

Total Flow	3,463 cfs
Tailwater Elevation	87.27 ft
Unit 01 Discharge	544 cfs
Unit 02 Discharge	554 cfs
Unit 03 Discharge	554 cfs
Unit 04 Discharge	596 cfs
Unit 05 Discharge	635 cfs
Unit 06 Discharge	580 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	0 cfs
Log Sluice	0 cfs
S Flashboards	0 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Figure A-1: Boundary Conditions

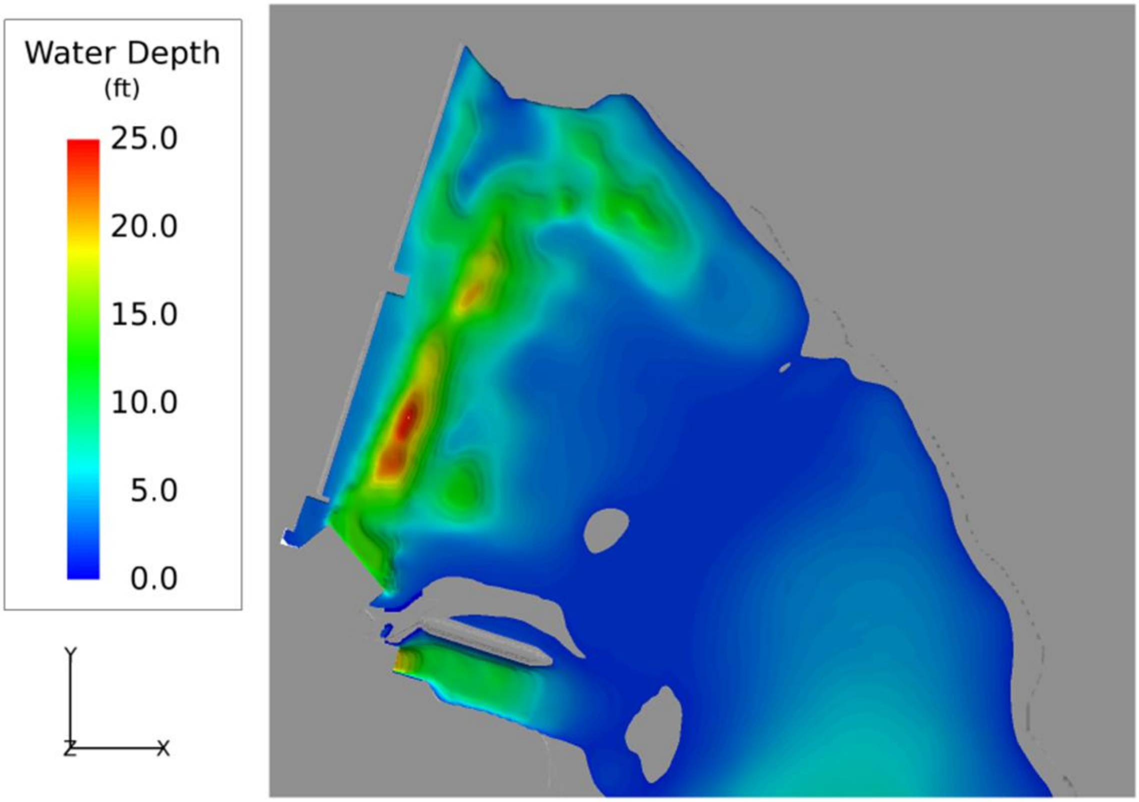


Figure A-2: Water Depth, Plan View
(red > 25.0 ft)

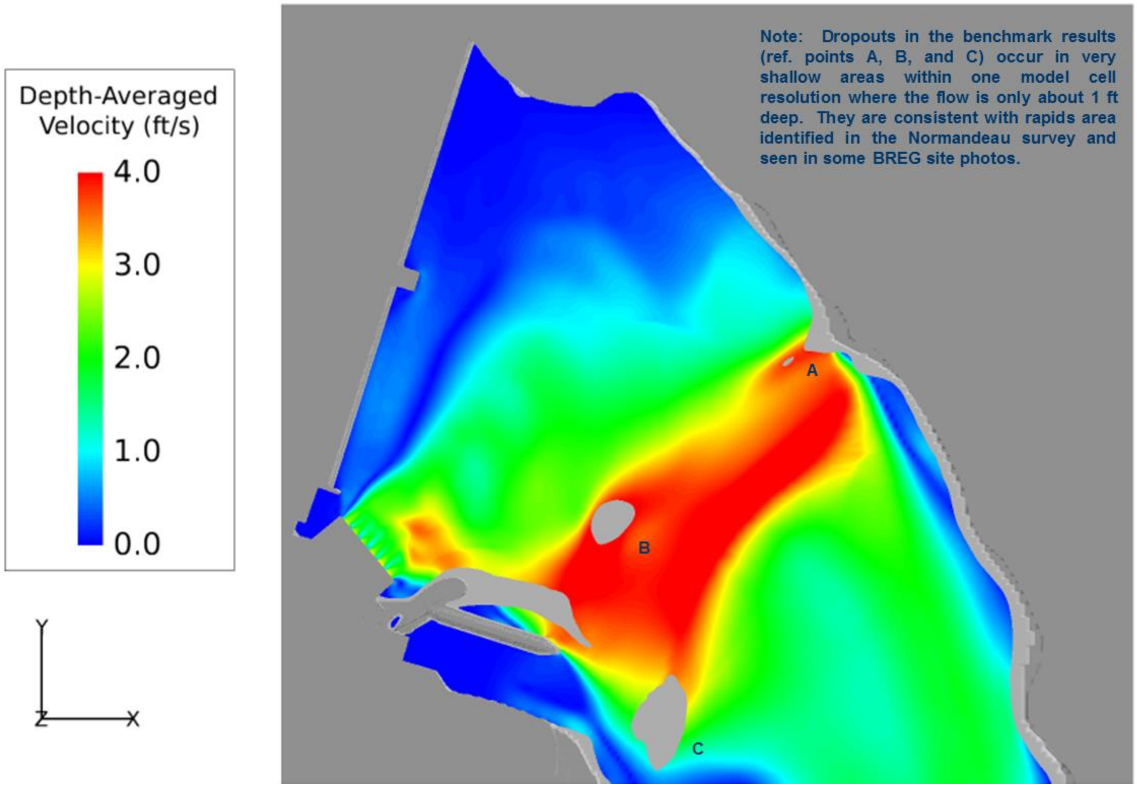


Figure A-3: Depth-Averaged Velocity, Plan View
(red > 4.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

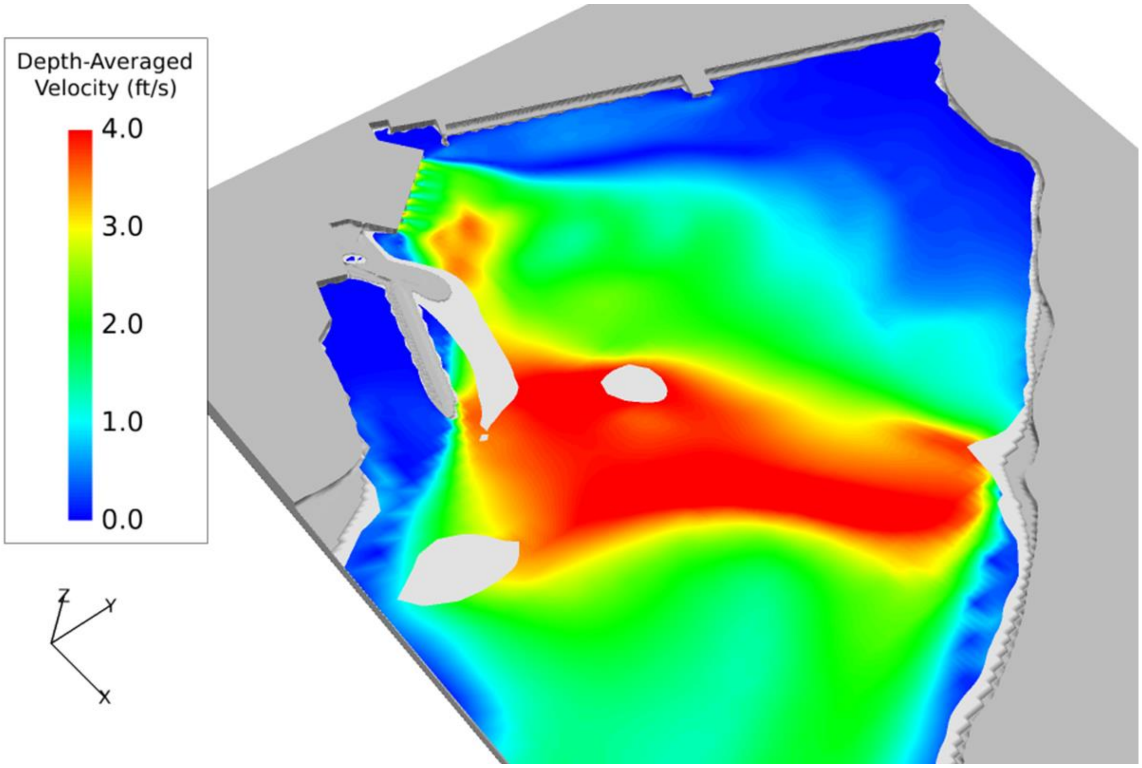


Figure A-4: Depth-Averaged Velocity, Oblique View
(red > 4.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

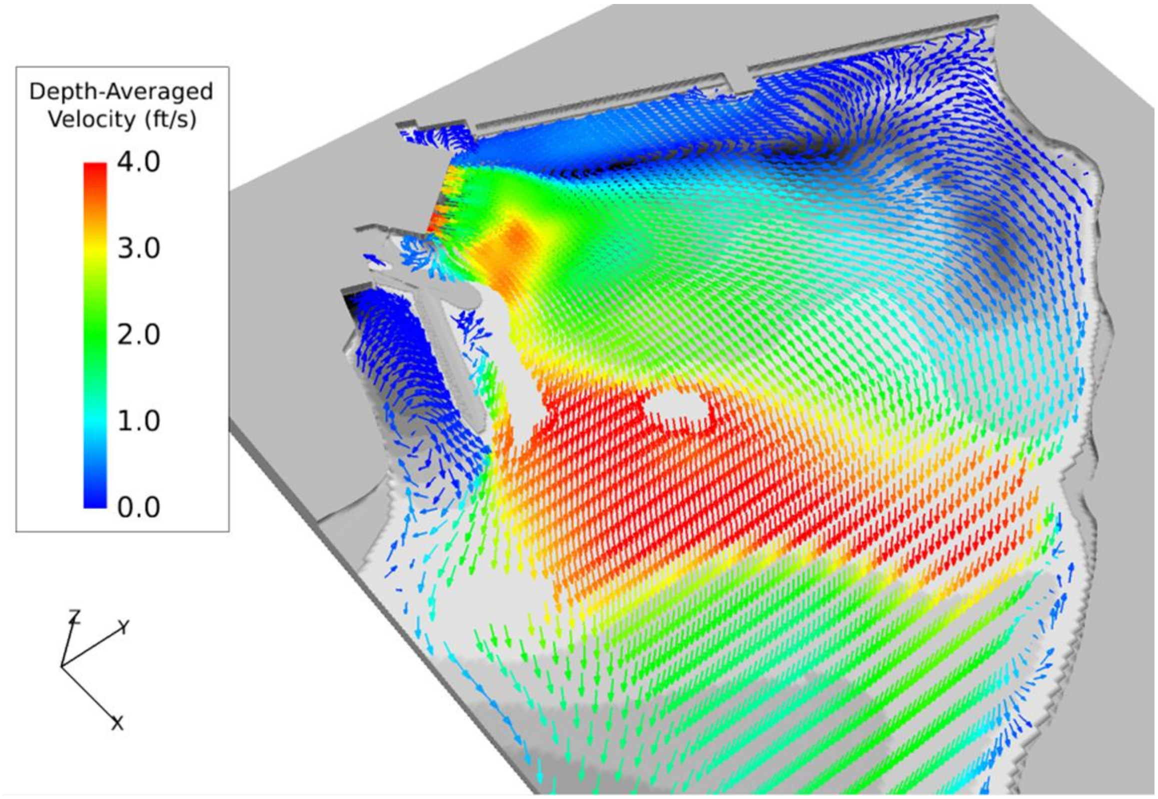


Figure A-5: Unit Vectors at Free Surface, Oblique View, Every 4th Vector
(red > 4.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

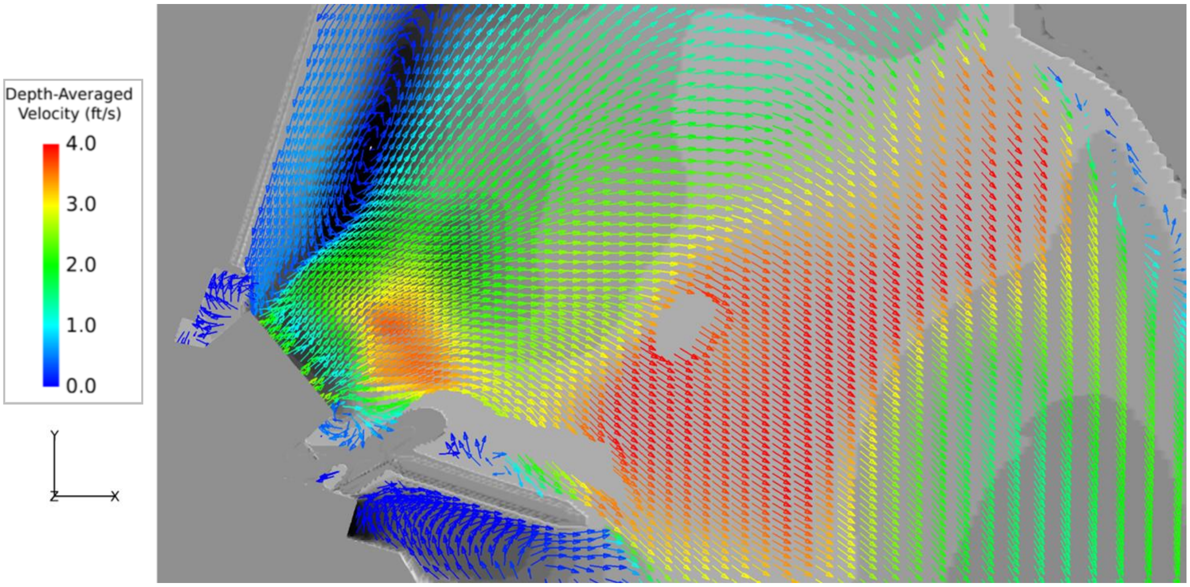


Figure A-6: Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 4.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

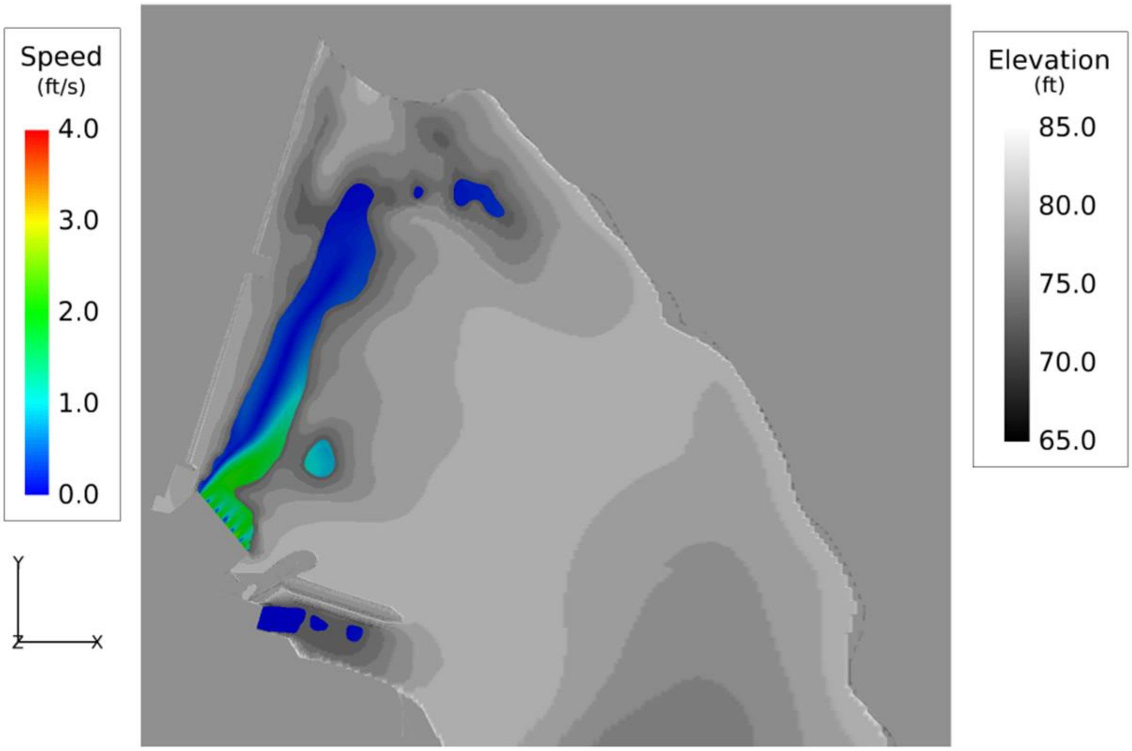


Figure A-7: Flow Speed Distribution, Elevation 76.875 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

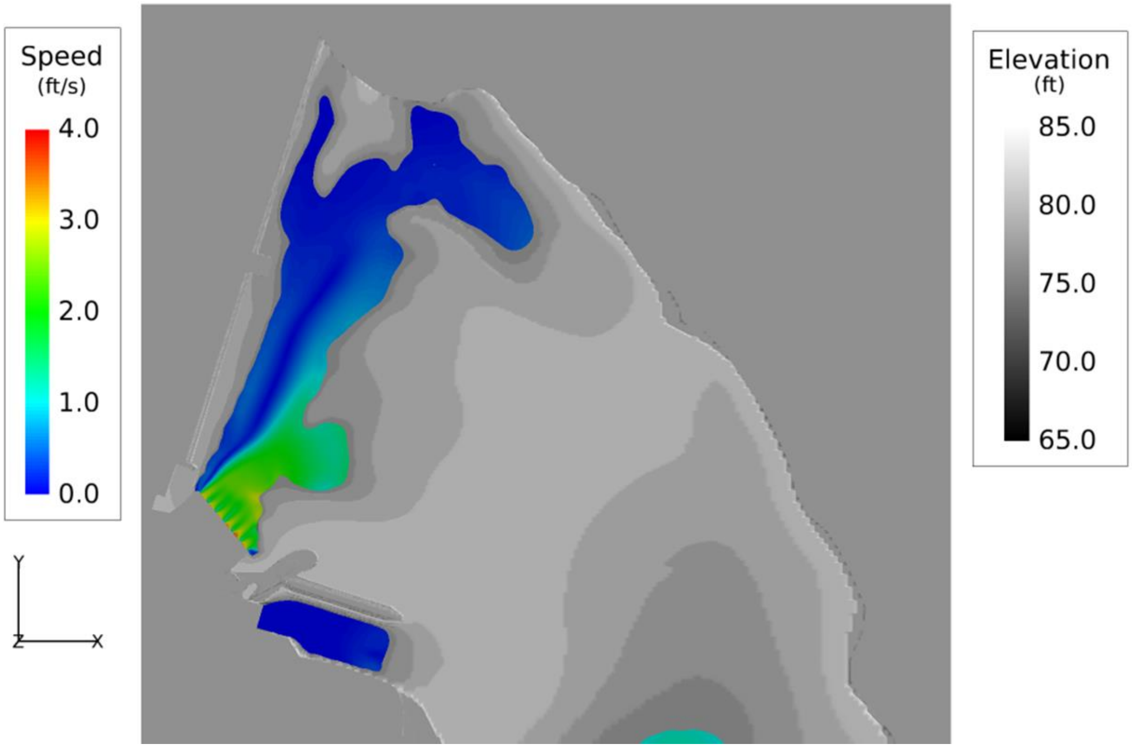


Figure A-8: Flow Speed Distribution, Elevation 80.575 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

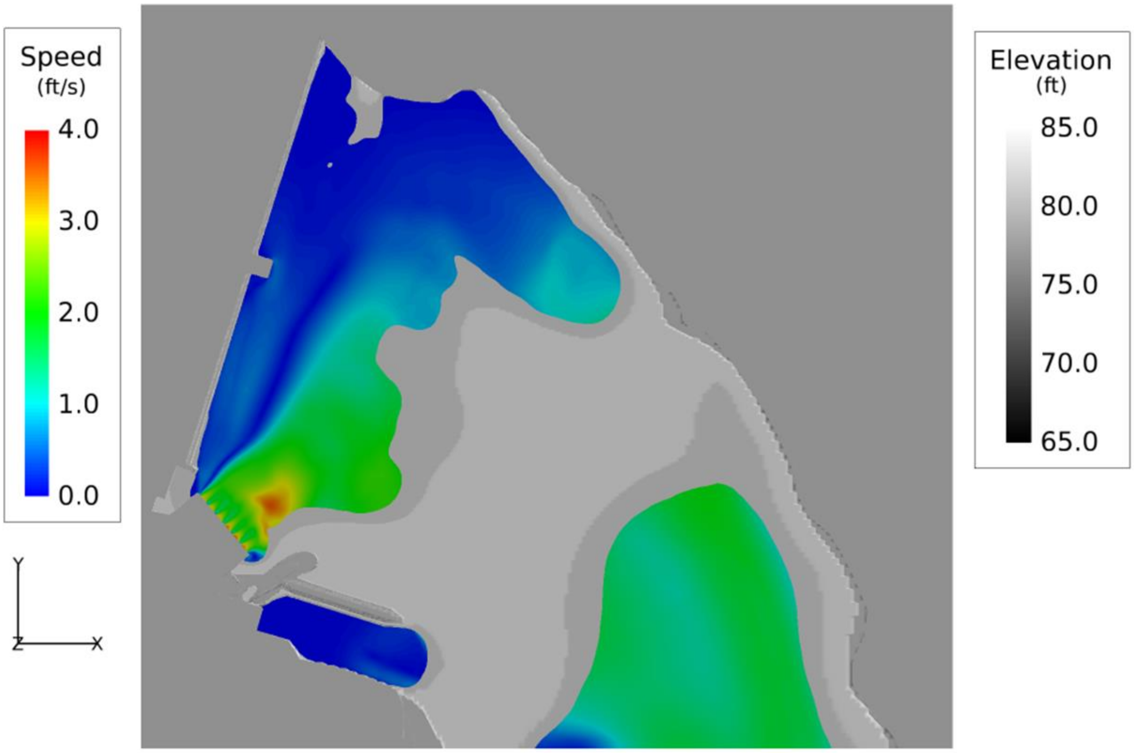


Figure A-9: Flow Speed Distribution, Elevation 84.275 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

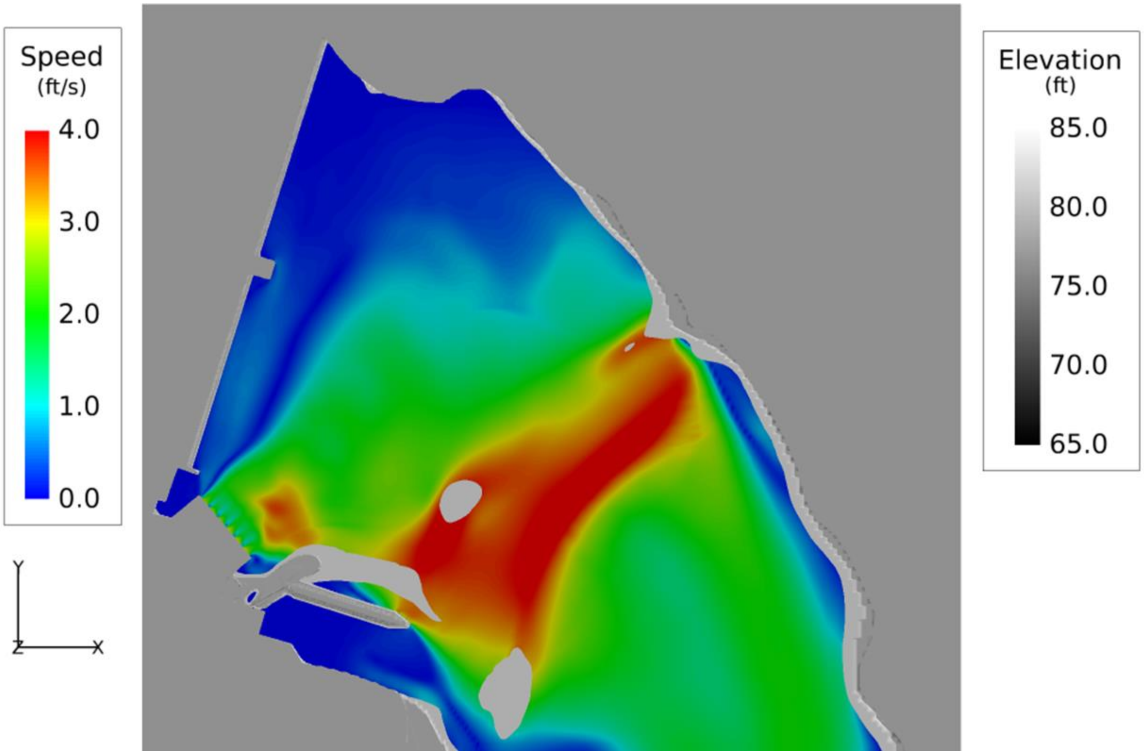


Figure A-10: Flow Speed Distribution, Elevation 86.125 ft
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

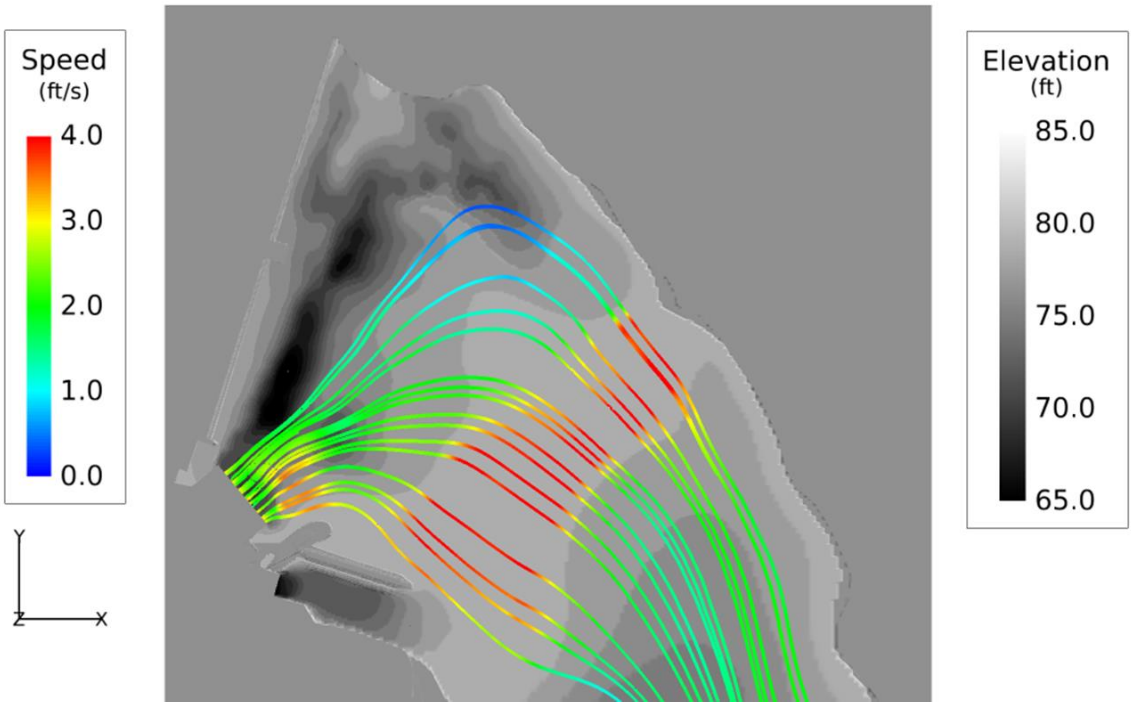


Figure A-11: Streamlines – Colored by Speed
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

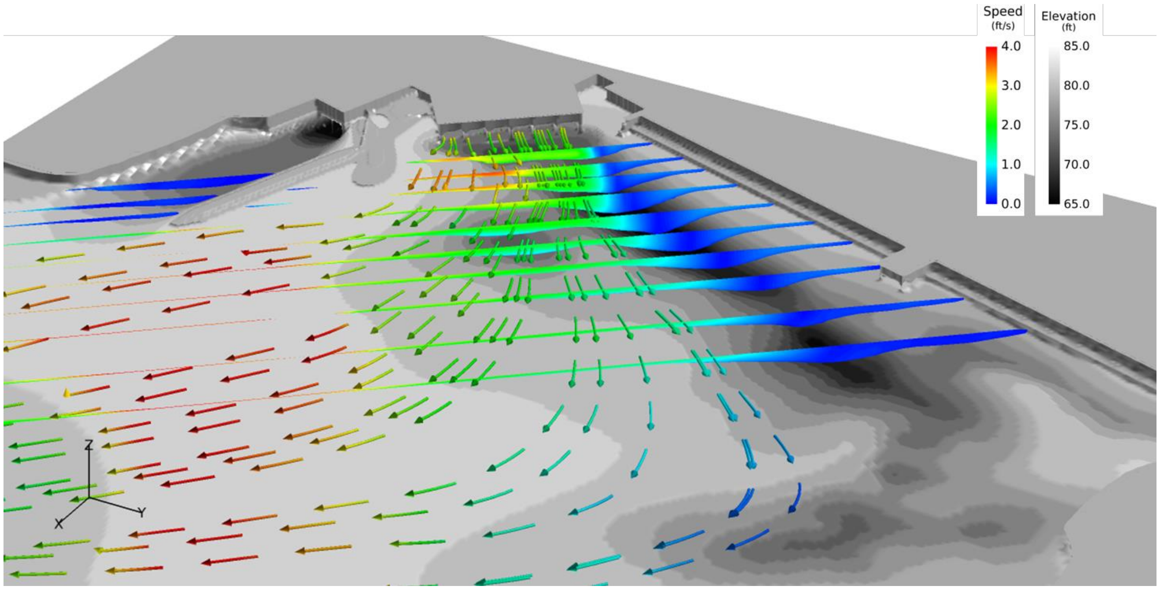


Figure A-12: Vertical Variation of Flow Speed and Streamlines
(red > 4.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Appendix B: Case 01 – 95% Flow Exceedance

Flow Exceedance	95%
Total Flow	2,540 cfs
Tailwater Elevation	88.6 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	622 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	0 cfs
Unit 05 Discharge	0 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	0 cfs
Log Sluice	0 cfs
S Flashboards	0 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Figure B-1: Boundary Conditions

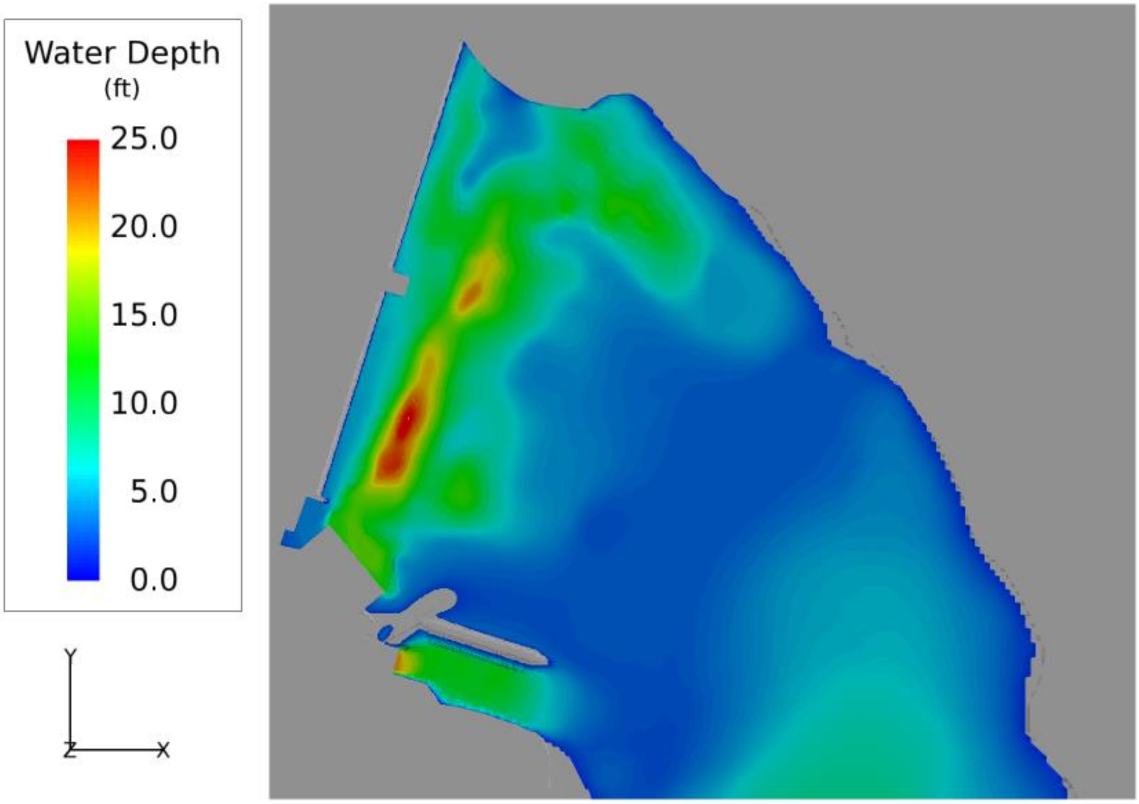


Figure B-2: Water Depth, Plan View
(red > 25.0 ft)

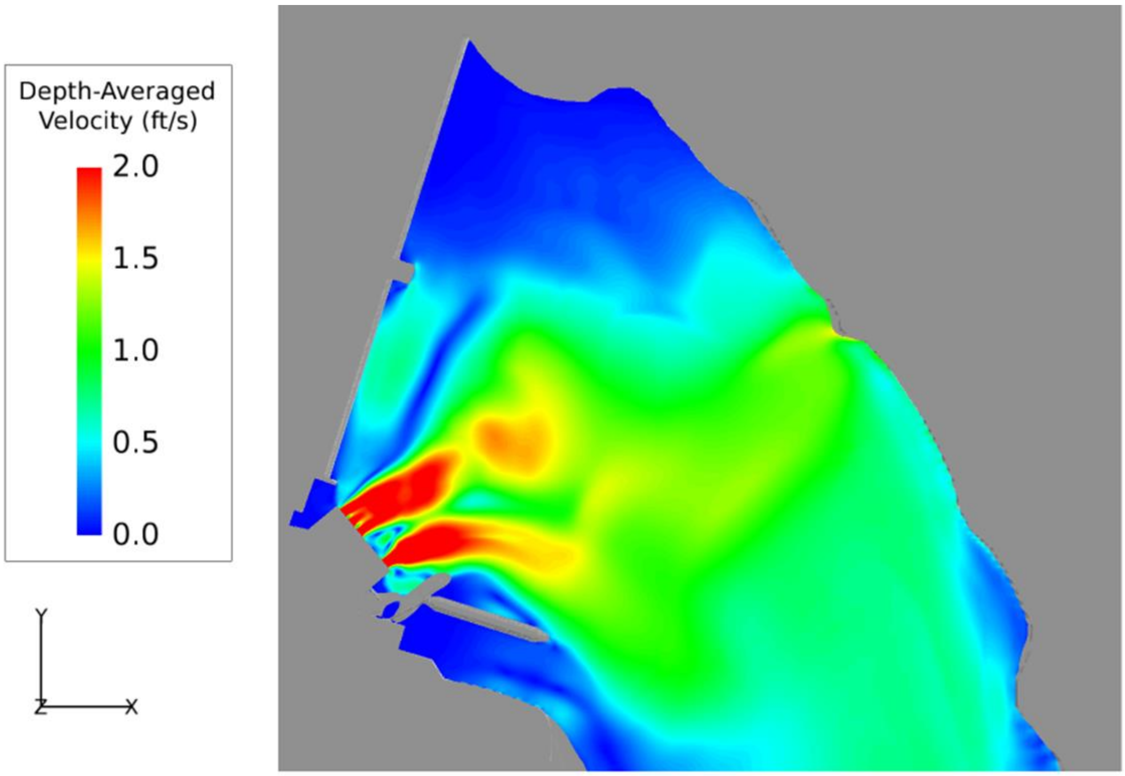


Figure B-3: Depth-Averaged Velocity, Plan View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

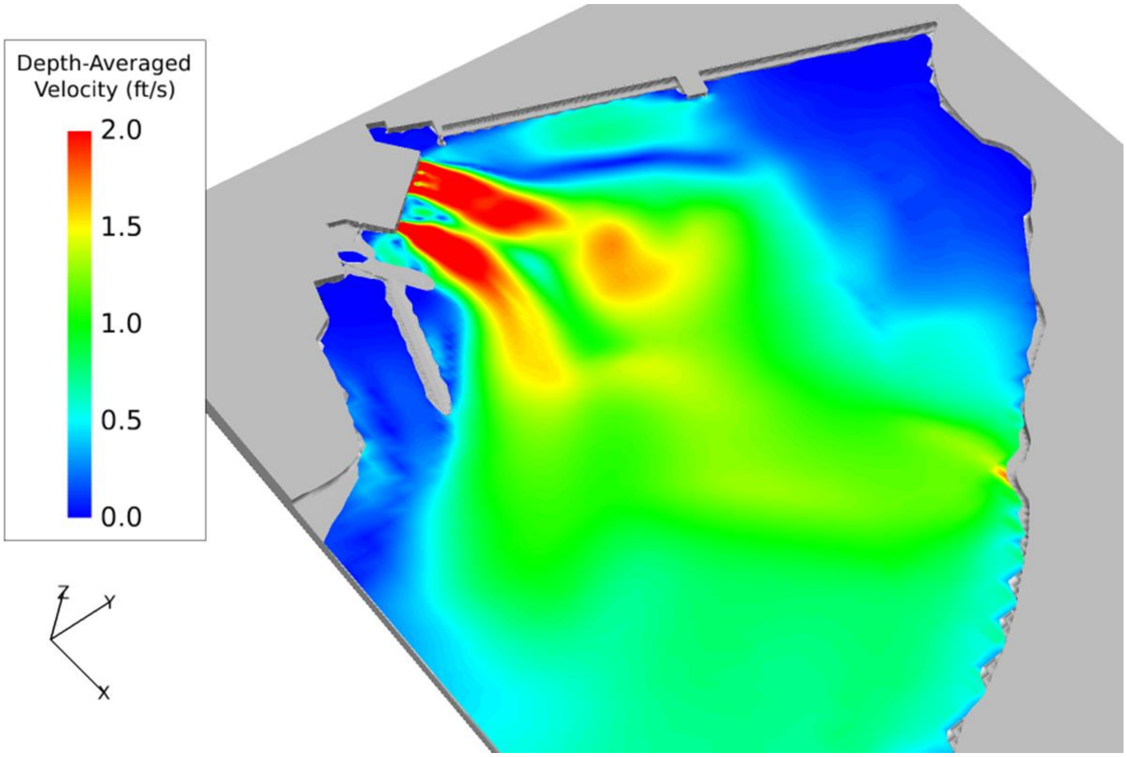


Figure B-4: Depth-Averaged Velocity, Oblique View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

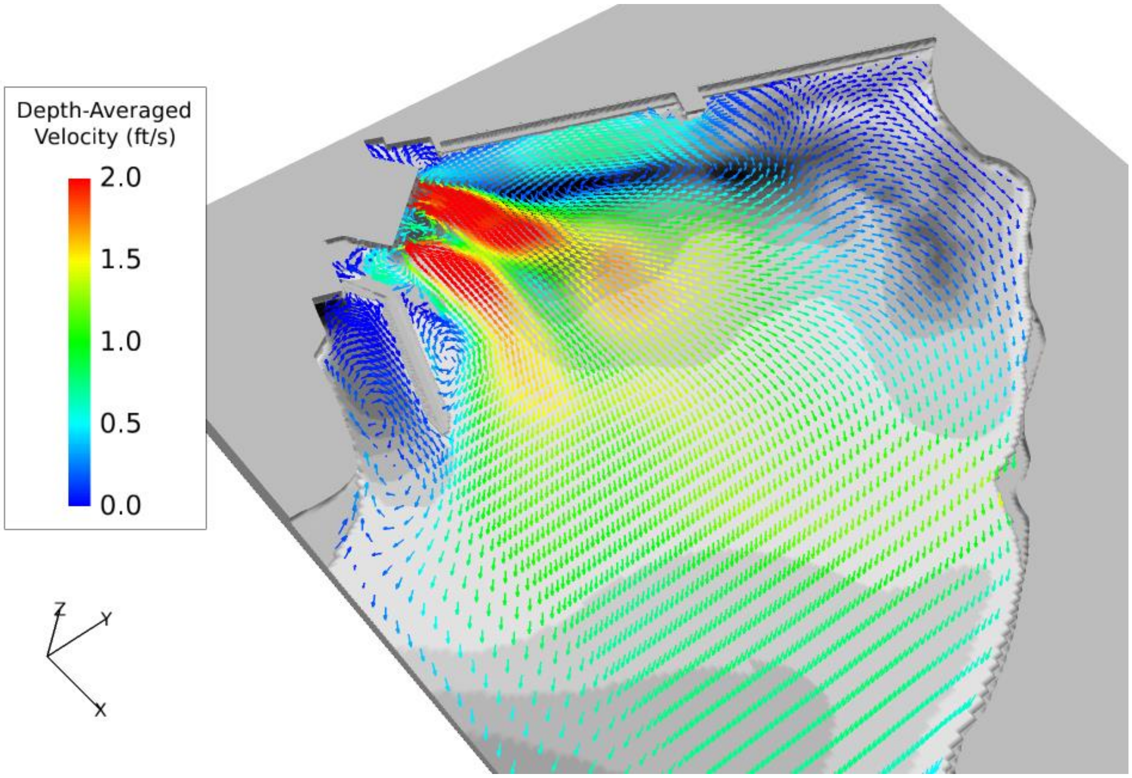


Figure B-5: Unit Vectors at Free Surface, Oblique View, Every 4th Vector
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

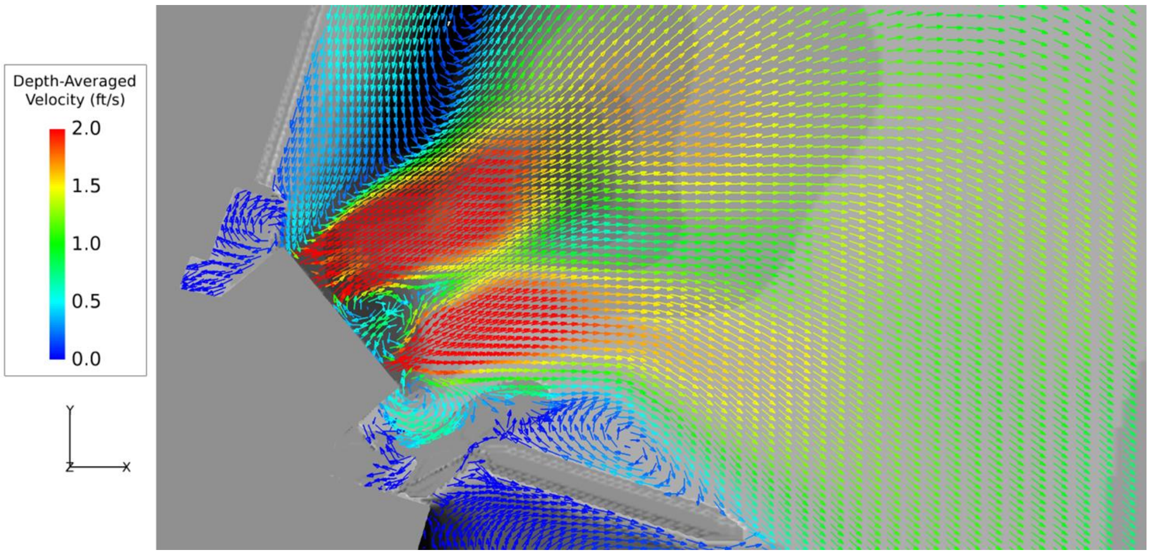


Figure B-6: Unit Vectors at Free Surface, Plan View, Every 3rd Vector
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

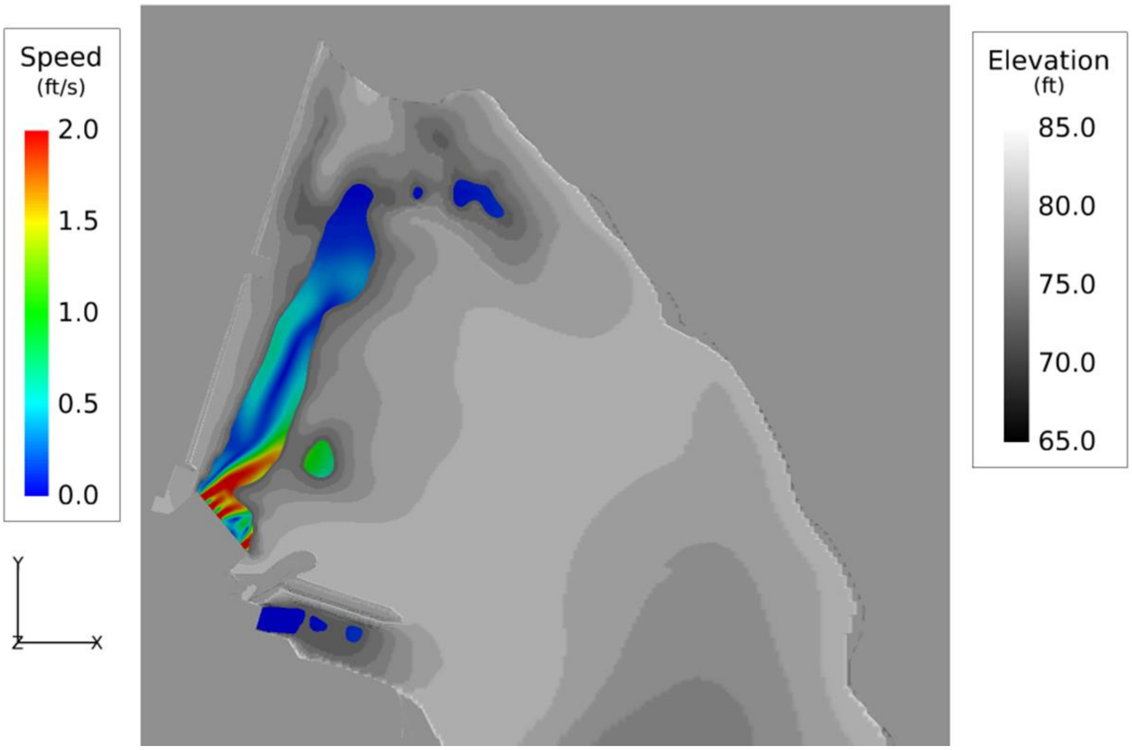


Figure B-7: Flow Speed Distribution, Elevation 76.875 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

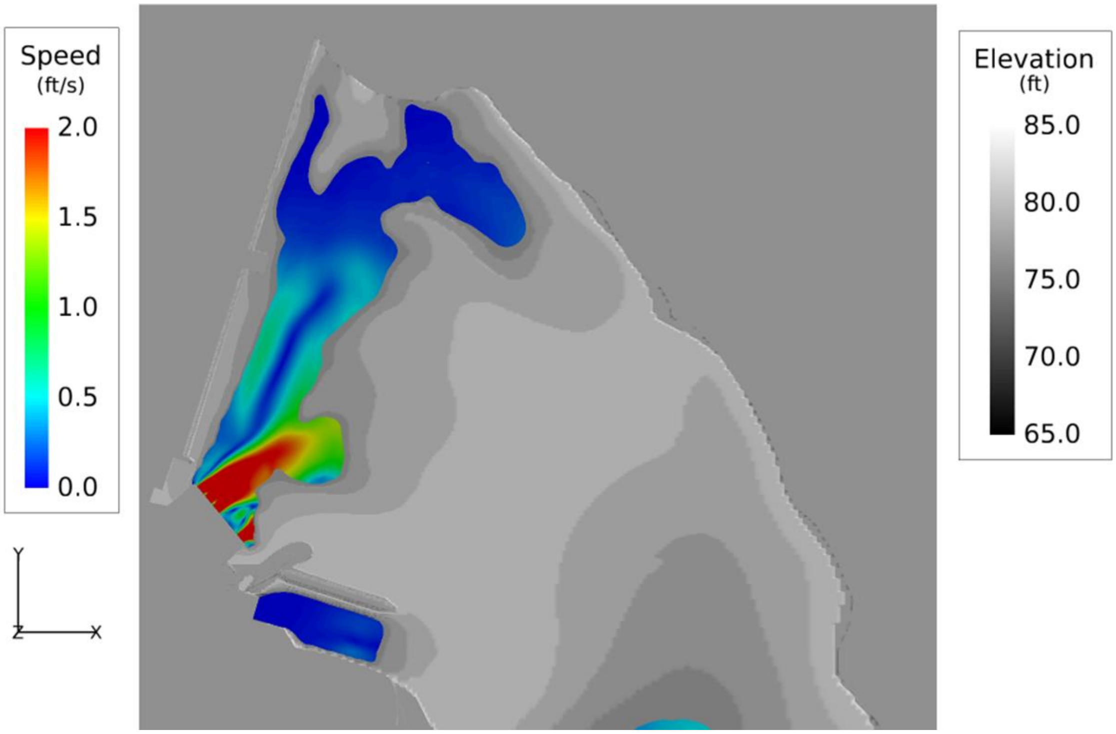


Figure B-8: Flow Speed Distribution, Elevation 80.575 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

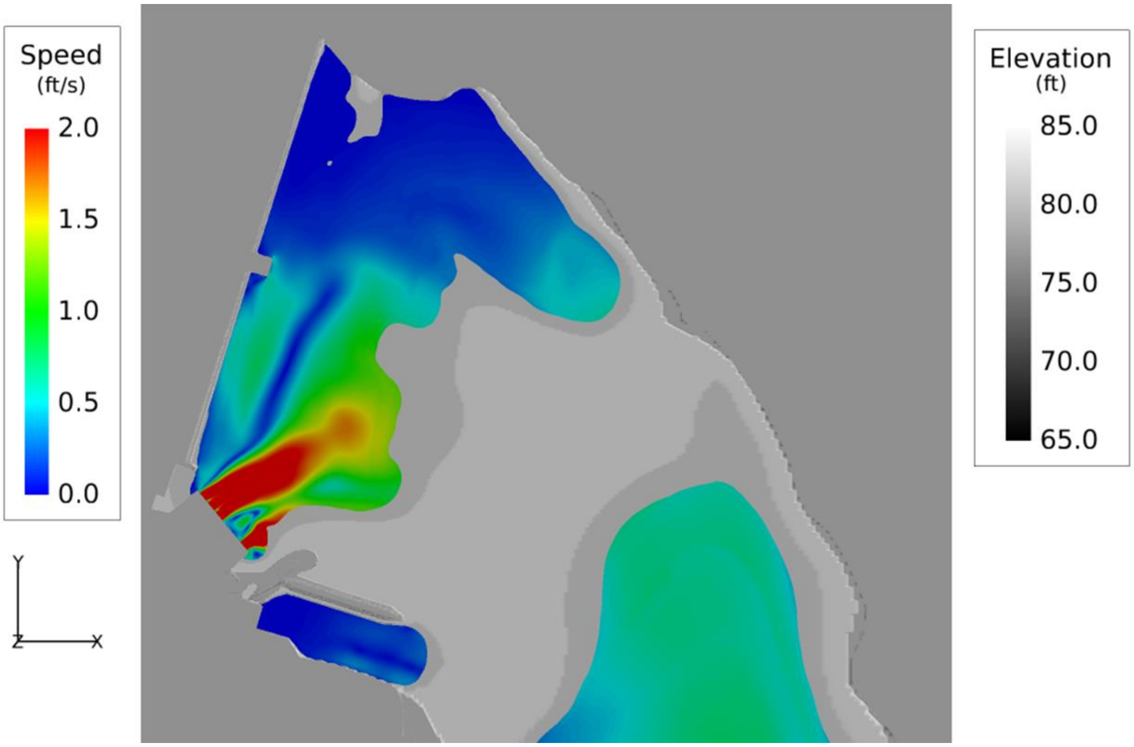


Figure B-9: Flow Speed Distribution, Elevation 84.275 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

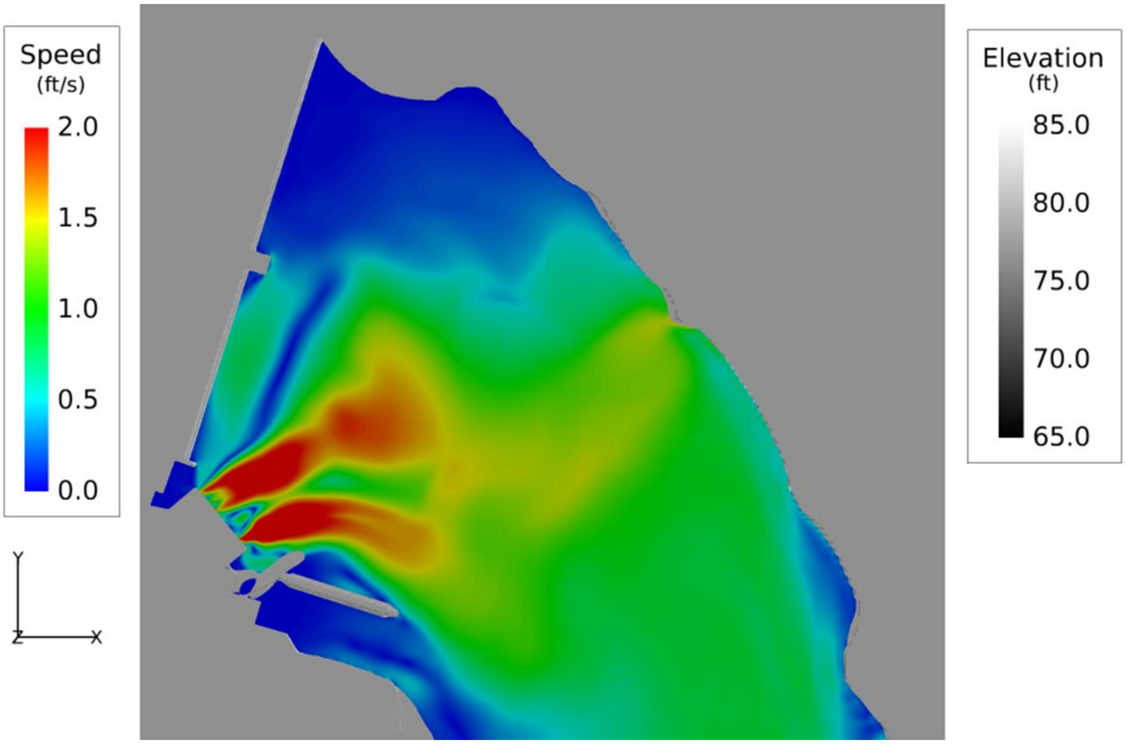


Figure B-10: Flow Speed Distribution, Elevation 86.125 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

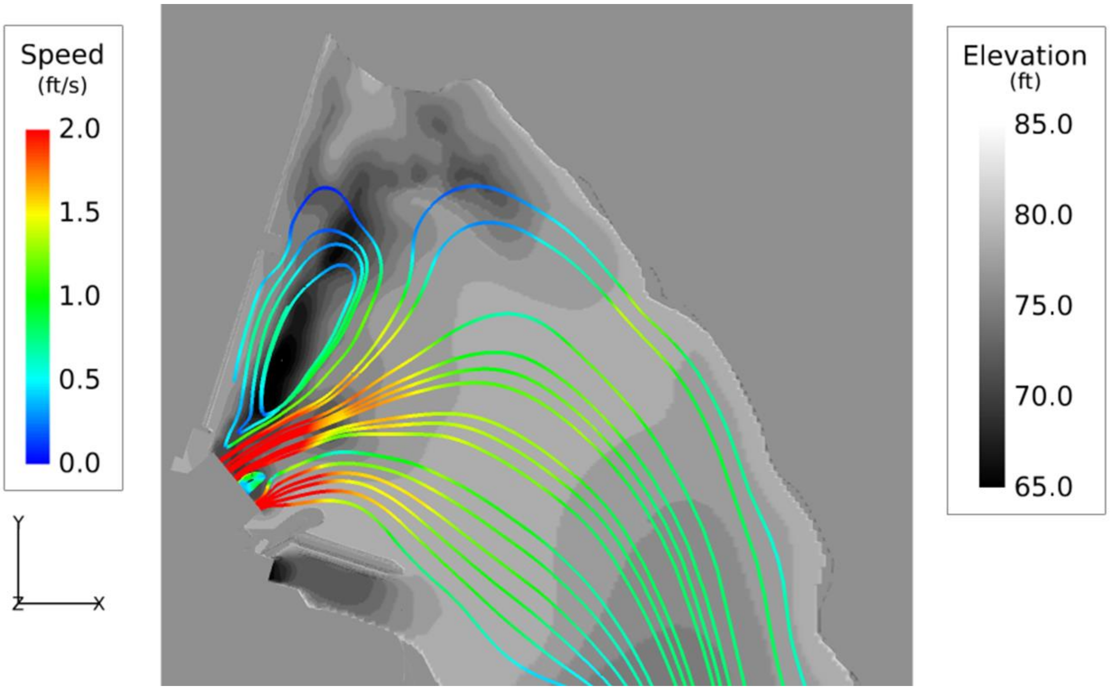


Figure B-11: Streamlines – Colored by Speed
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

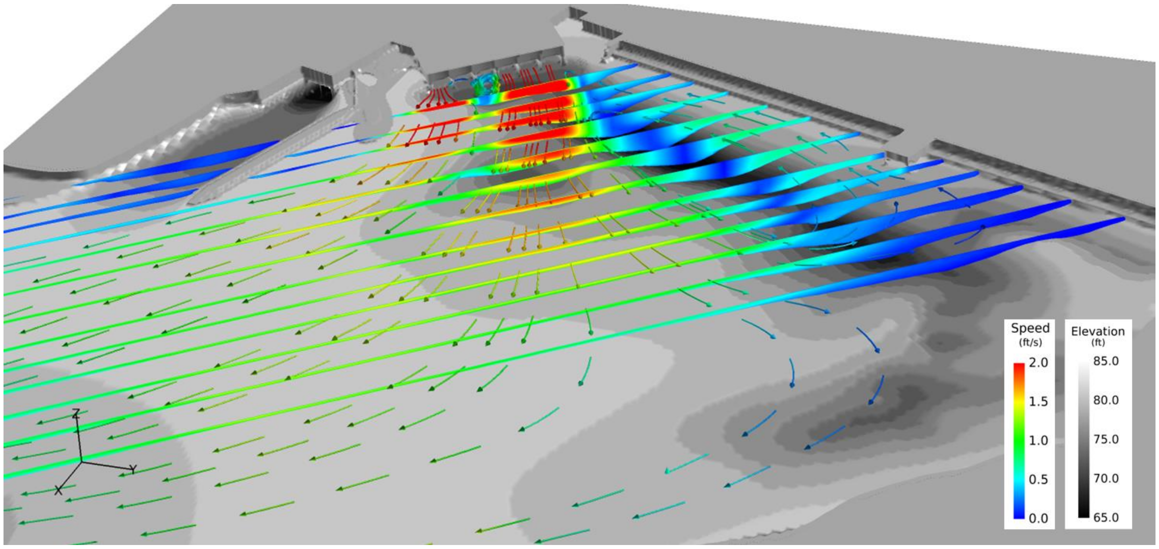


Figure B-12: Vertical Variation of Flow Speed and Streamlines
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Appendix C: Case 02 – 50% Flow Exceedance

Flow Exceedance	50%
Total Flow	4,790 cfs
Tailwater Elevation	89.1 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	125 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	1433 cfs
Log Sluice	0 cfs
S Flashboards	0 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Figure C-1: Boundary Conditions

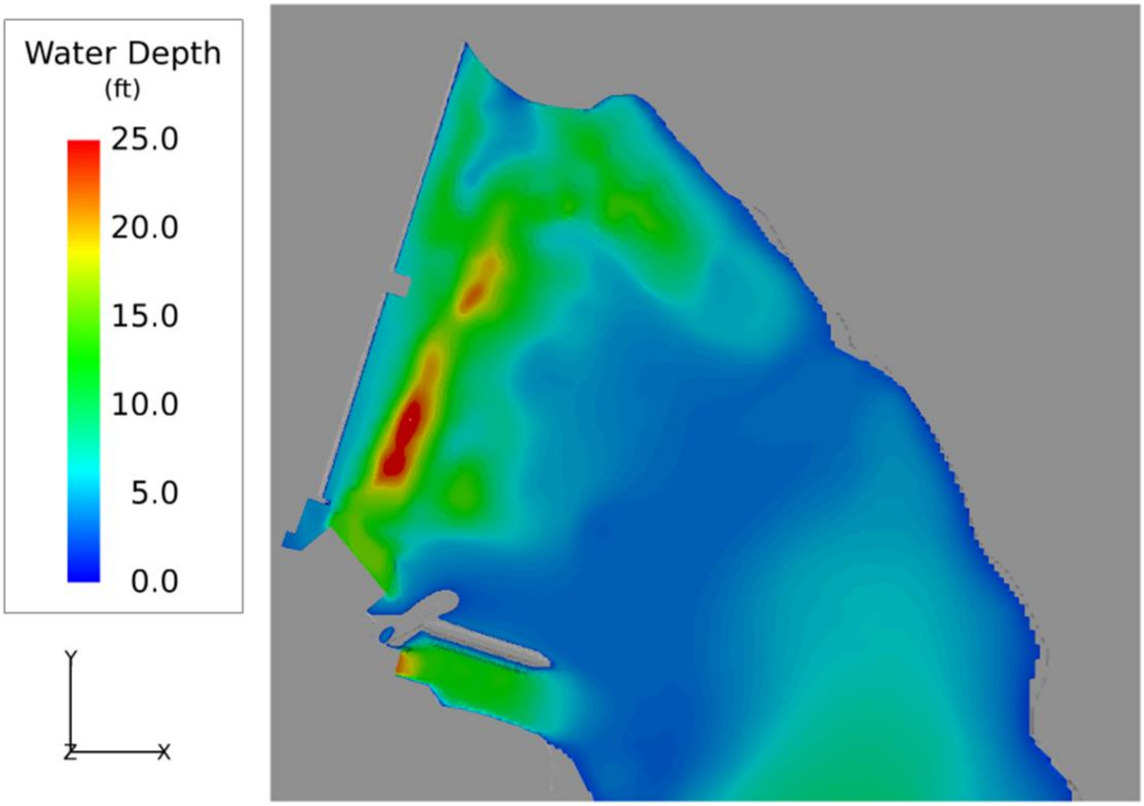


Figure C-2: Water Depth, Plan View
(red > 25.0 ft)

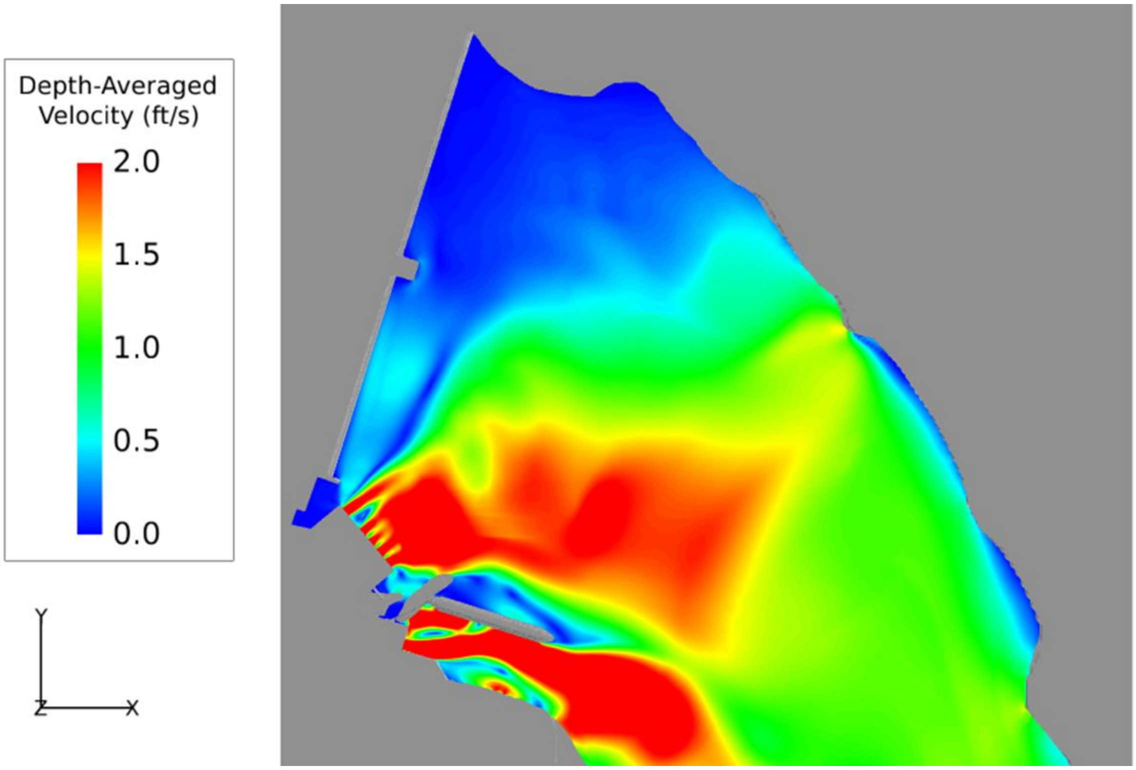


Figure C-3: Depth-Averaged Velocity, Plan View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

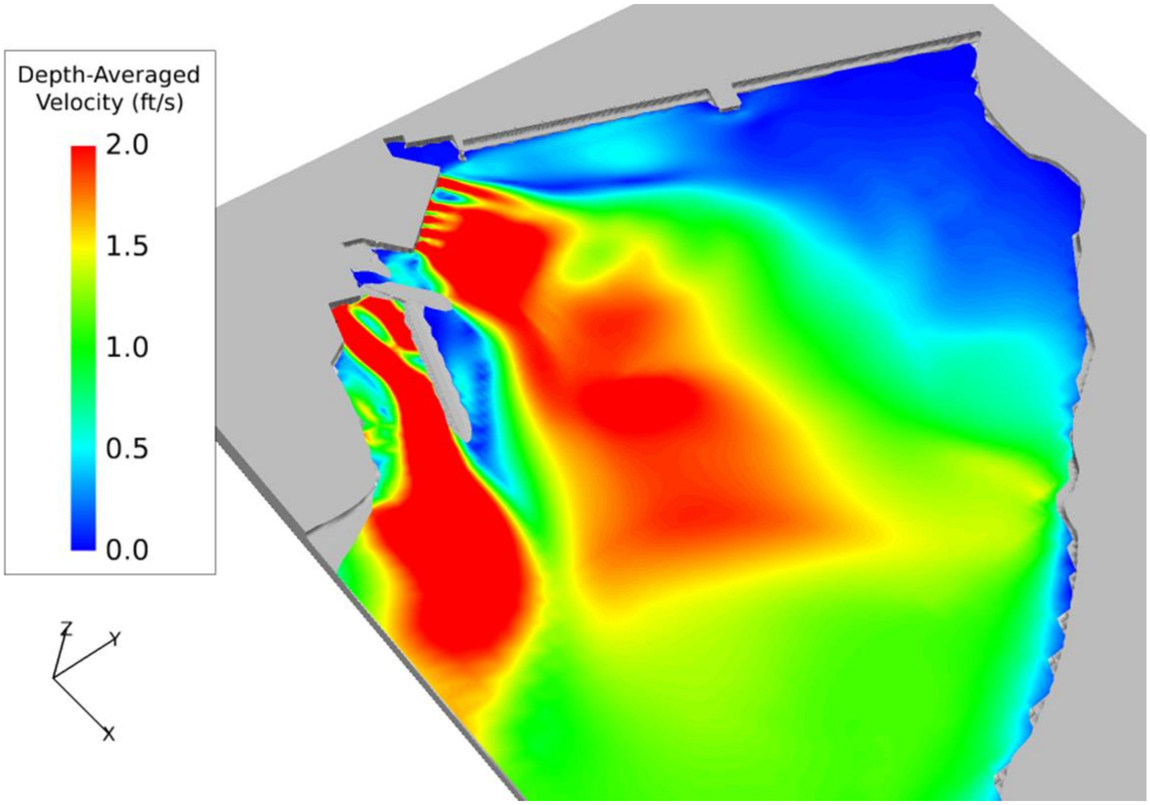


Figure C-4: Depth-Averaged Velocity, Oblique View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

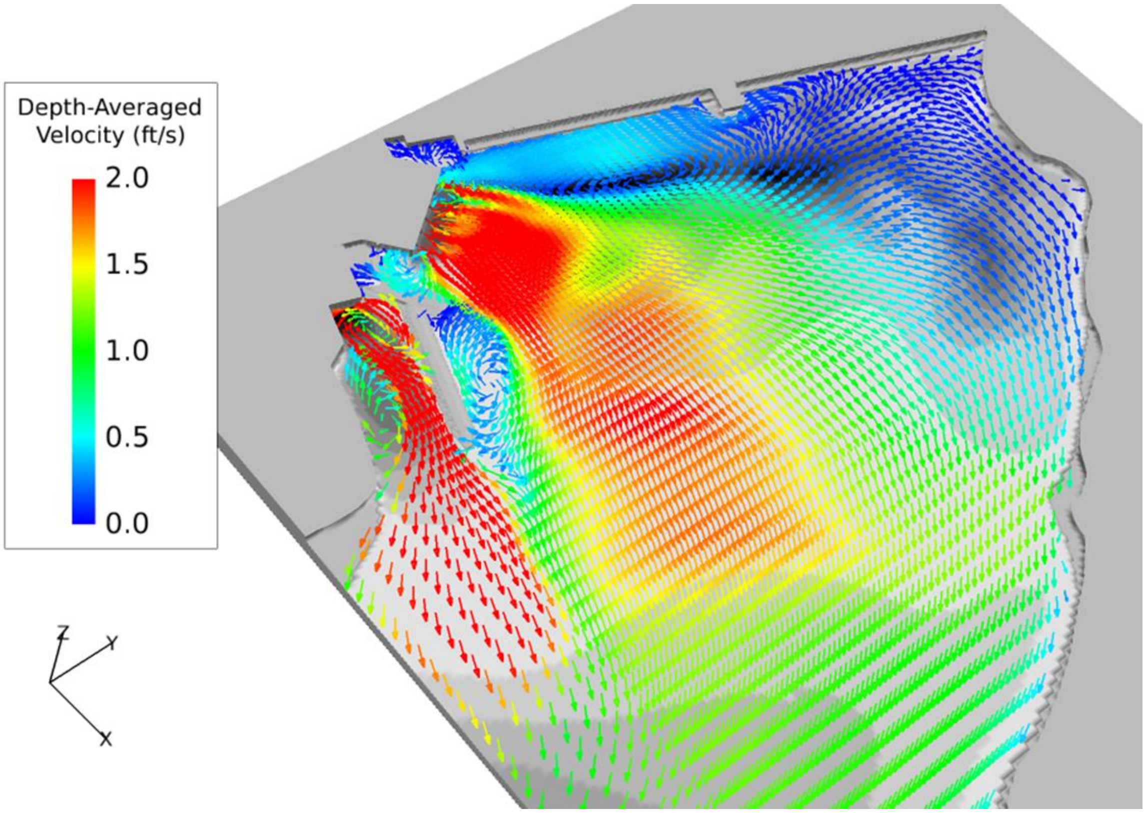


Figure C-5: Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

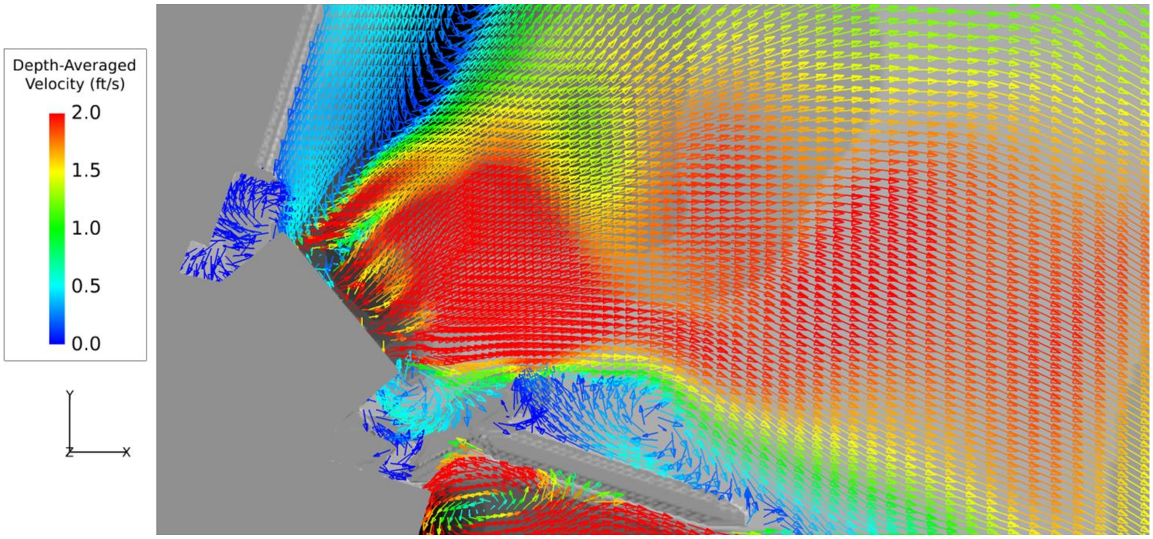


Figure C-6: Unit Vectors at Free Surface, Plan View, Every 3rd Vector
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

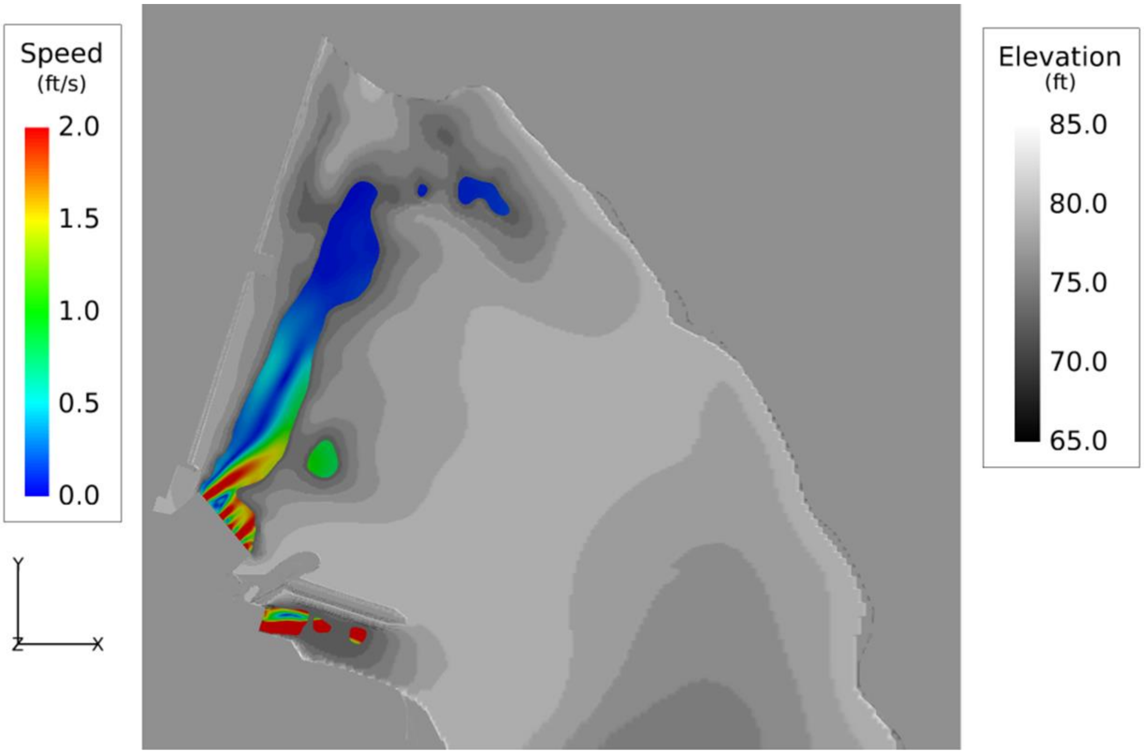


Figure C-7: Flow Speed Distribution, Elevation 76.875 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

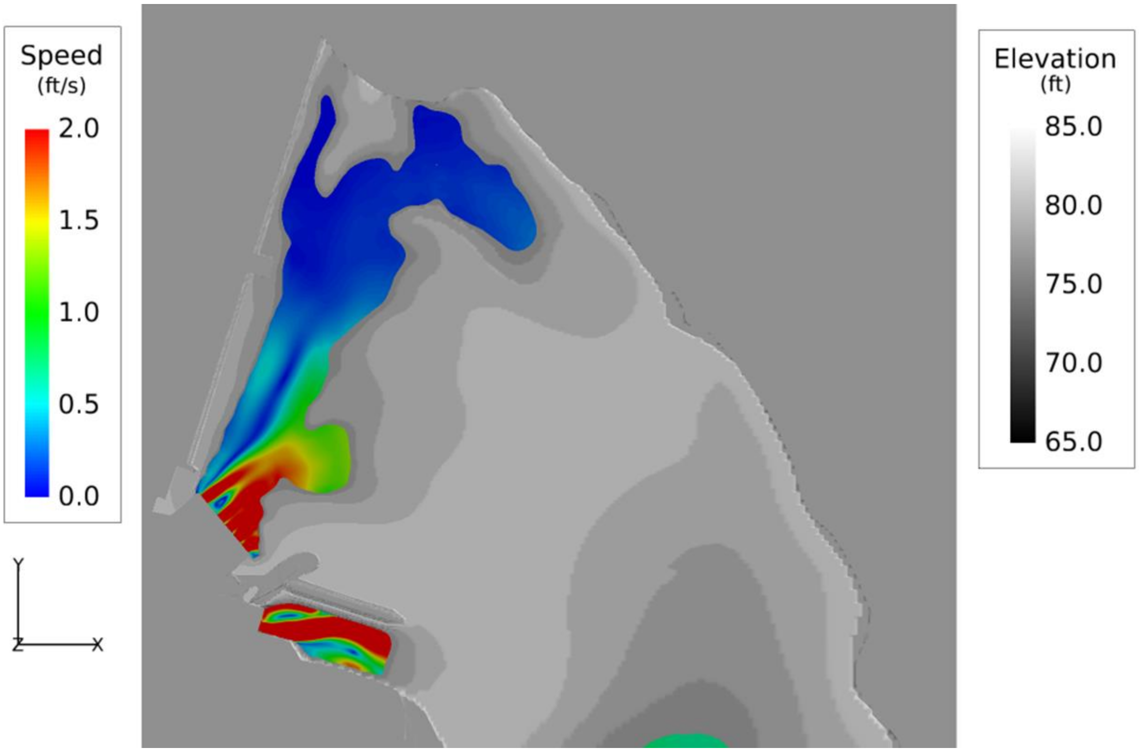


Figure C-8: Flow Speed Distribution, Elevation 80.575 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

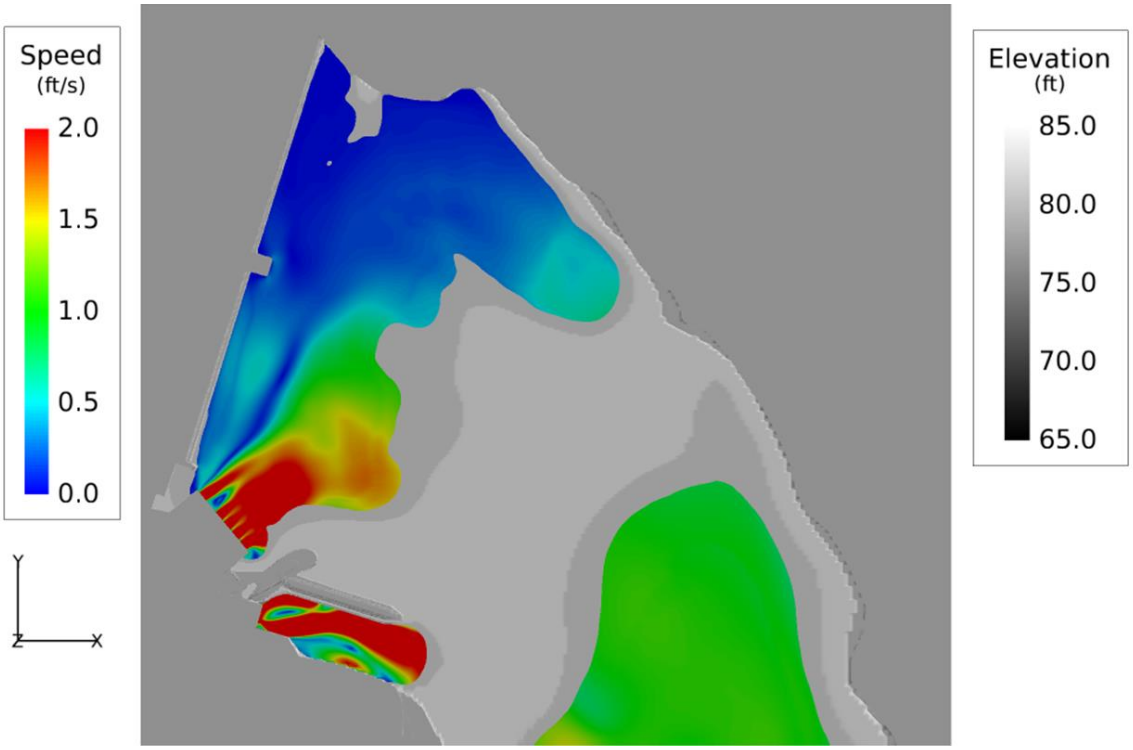


Figure C-9: Flow Speed Distribution, Elevation 84.275 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

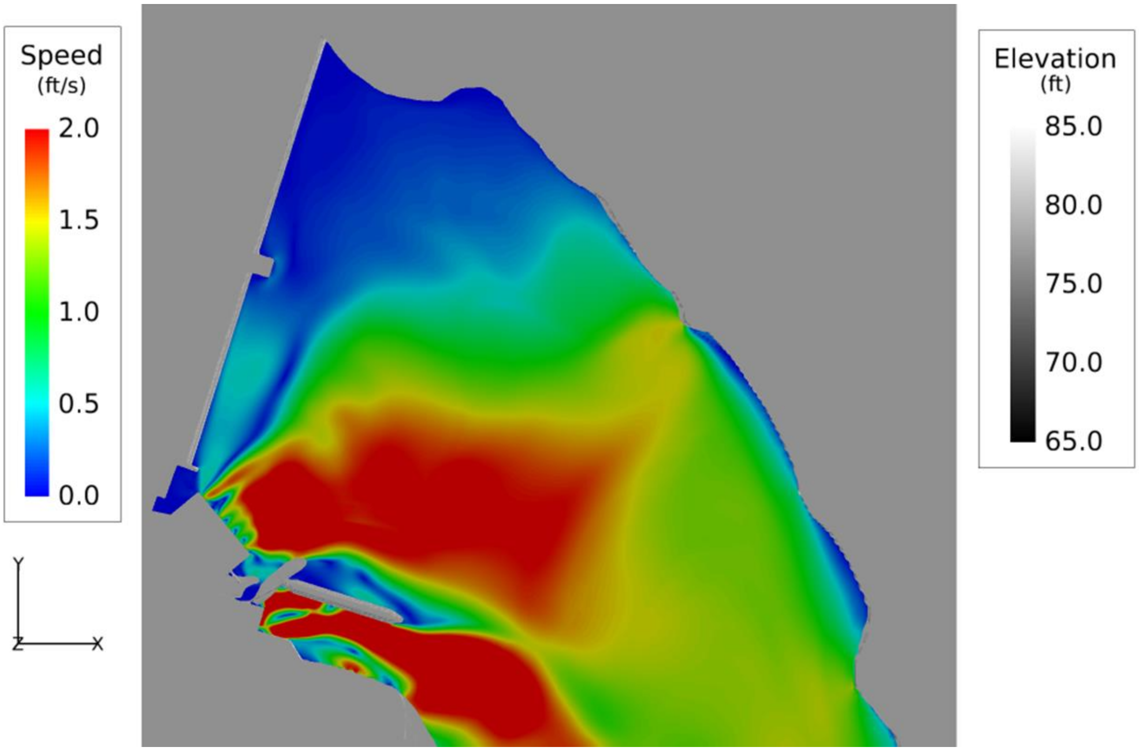


Figure C-10: Flow Speed Distribution, Elevation 86.125 ft
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

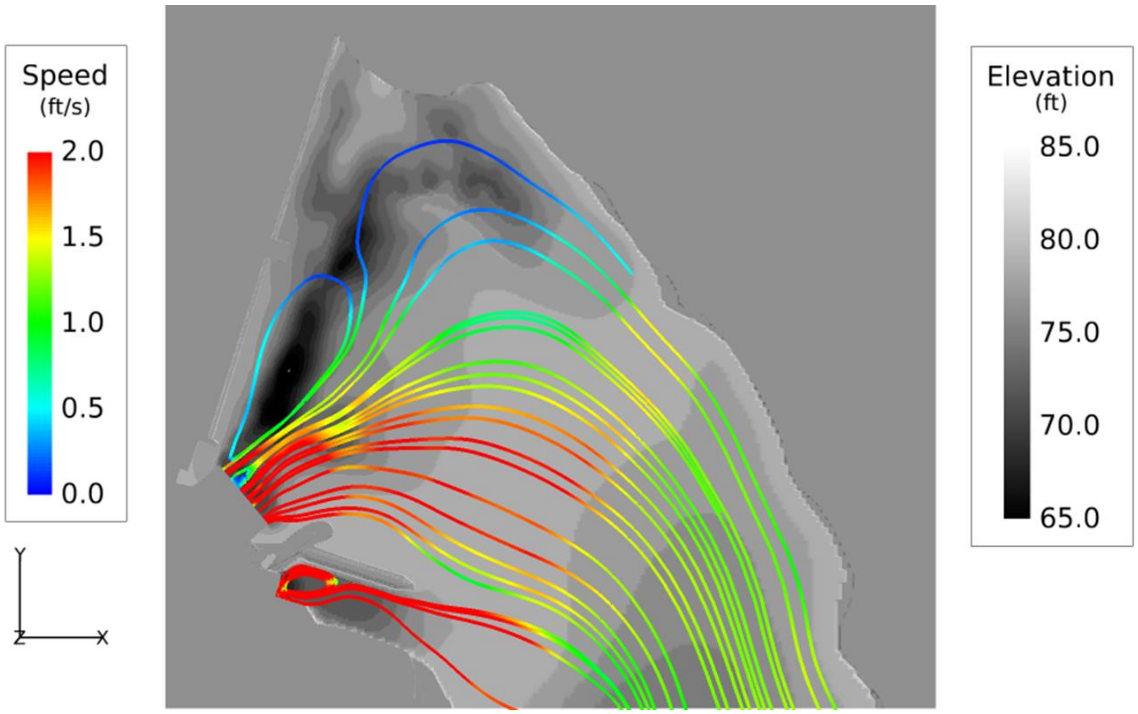


Figure C-11: Streamlines – Colored by Speed
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

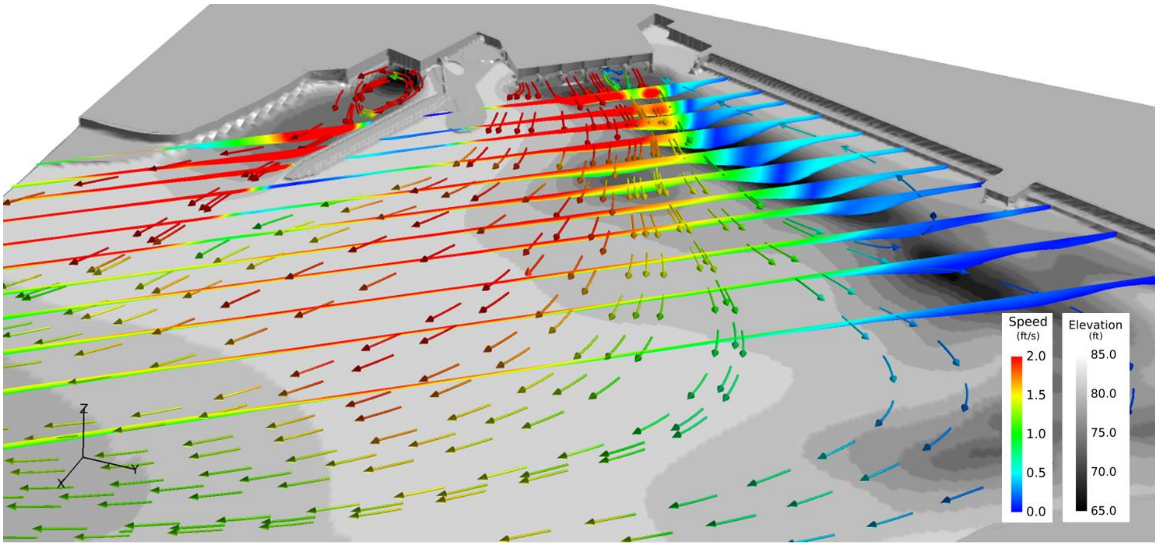


Figure C-12: Vertical Variation of Flow Speed and Streamlines
(red > 2.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Appendix D: Case 03 – 15% Flow Exceedance

Flow Exceedance	15%
Total Flow	10,750 cfs
Tailwater Elevation	90.2 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	639 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	1433 cfs
Log Sluice	595 cfs
S Flashboards	3400 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Figure D-1: Boundary Conditions

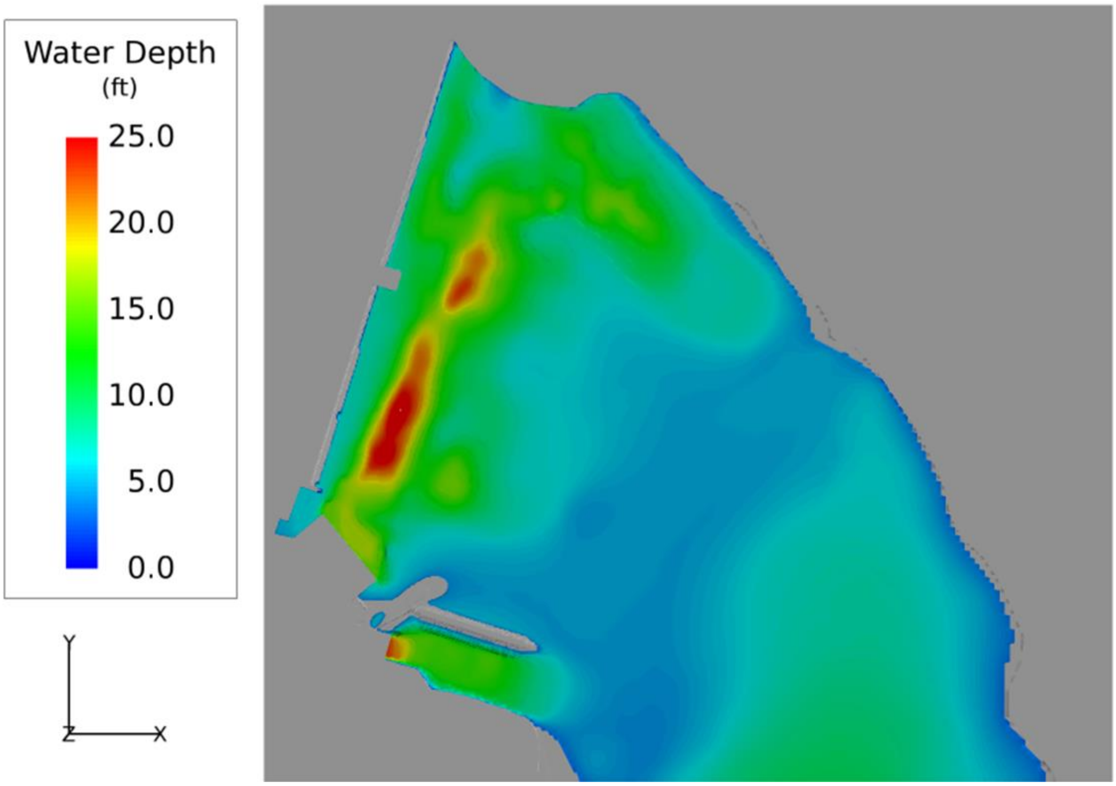


Figure D-2: Water Depth, Plan View
(red > 25.0 ft)

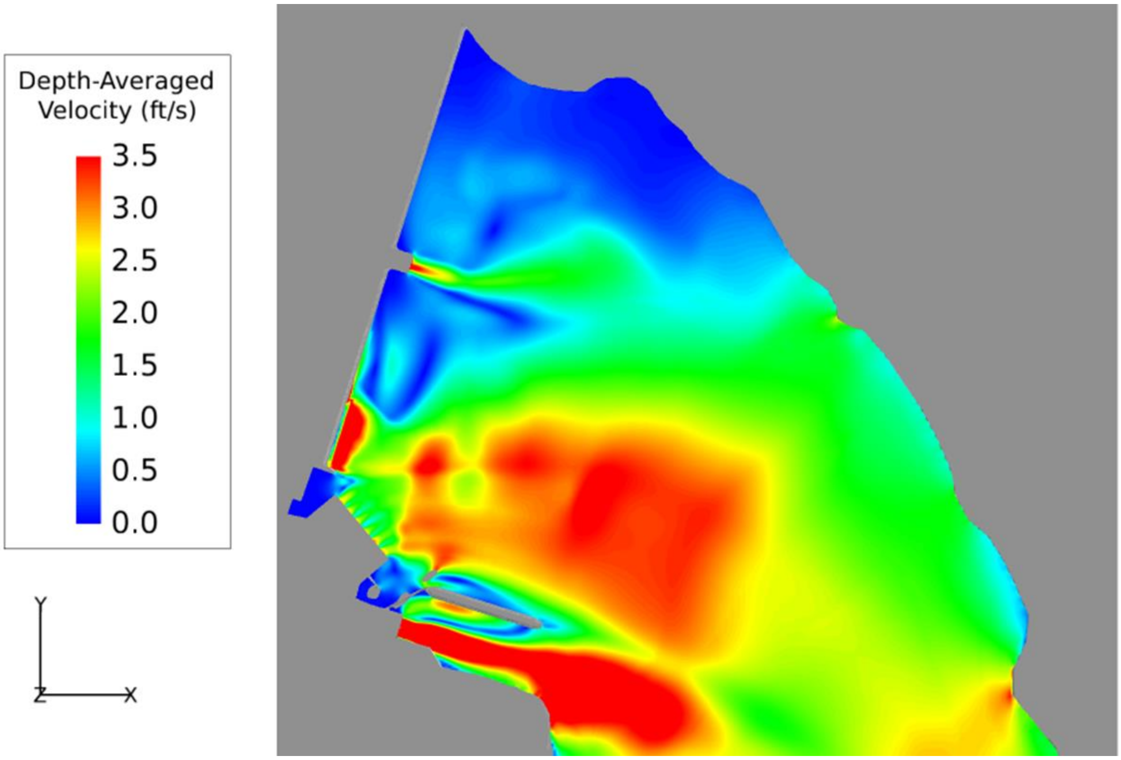


Figure D-3: Depth-Averaged Velocity, Plan View
(red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

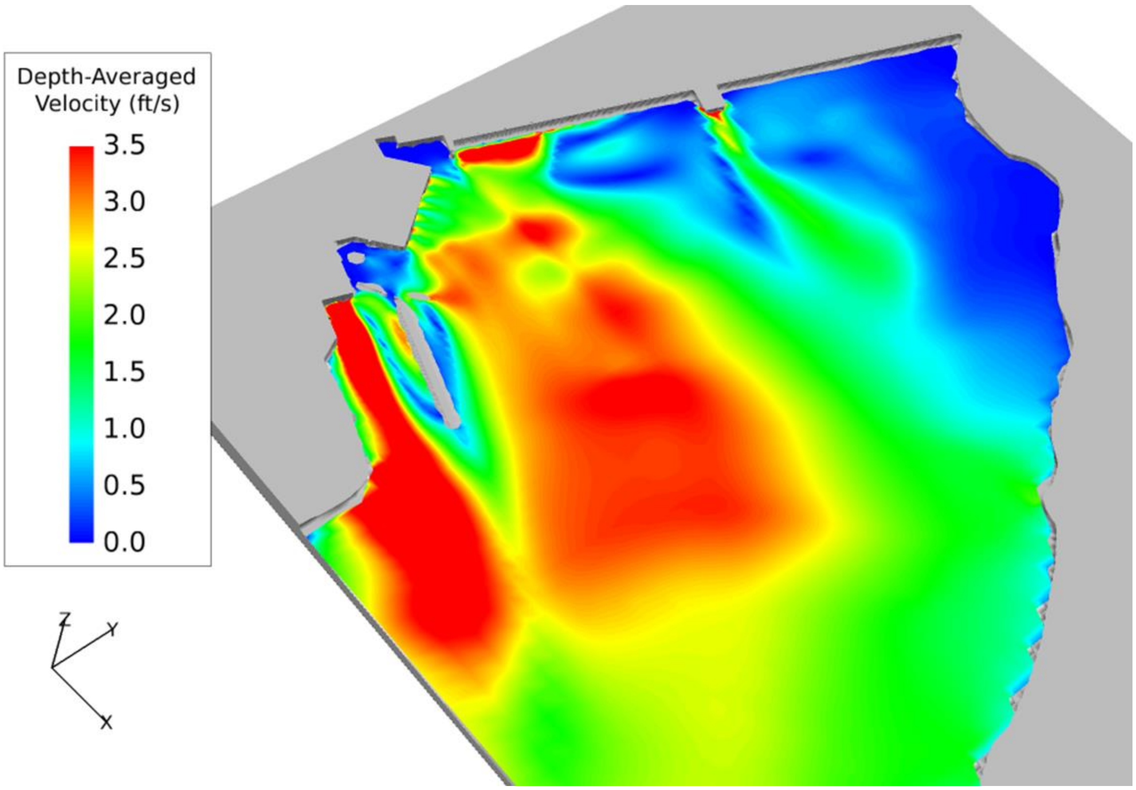


Figure D-4: Depth-Averaged Velocity, Oblique View
(red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

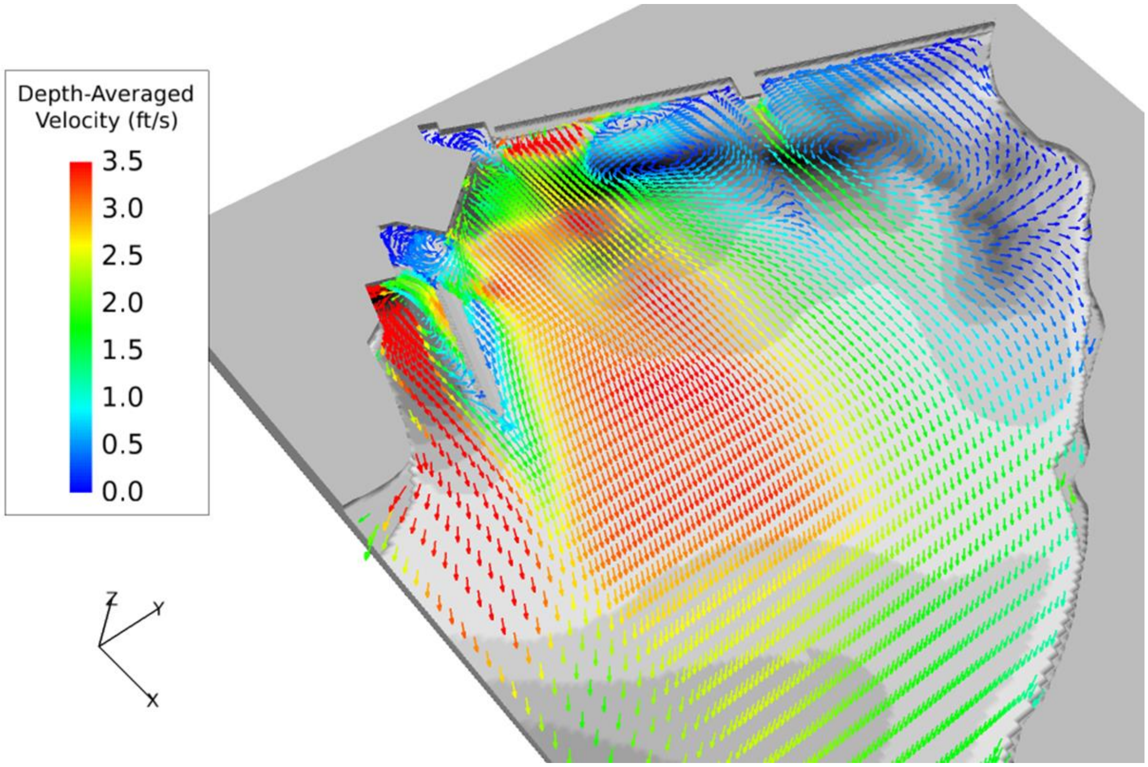


Figure D-5: Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

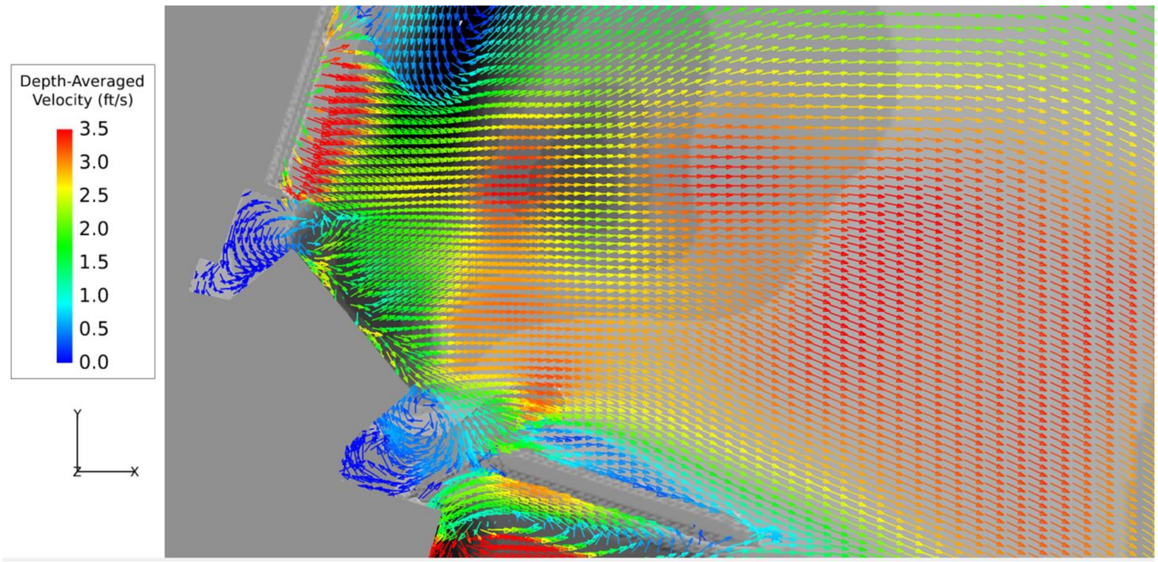


Figure D-6: Unit Vectors at Free Surface, Plan View, Every 3rd Vector
(red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

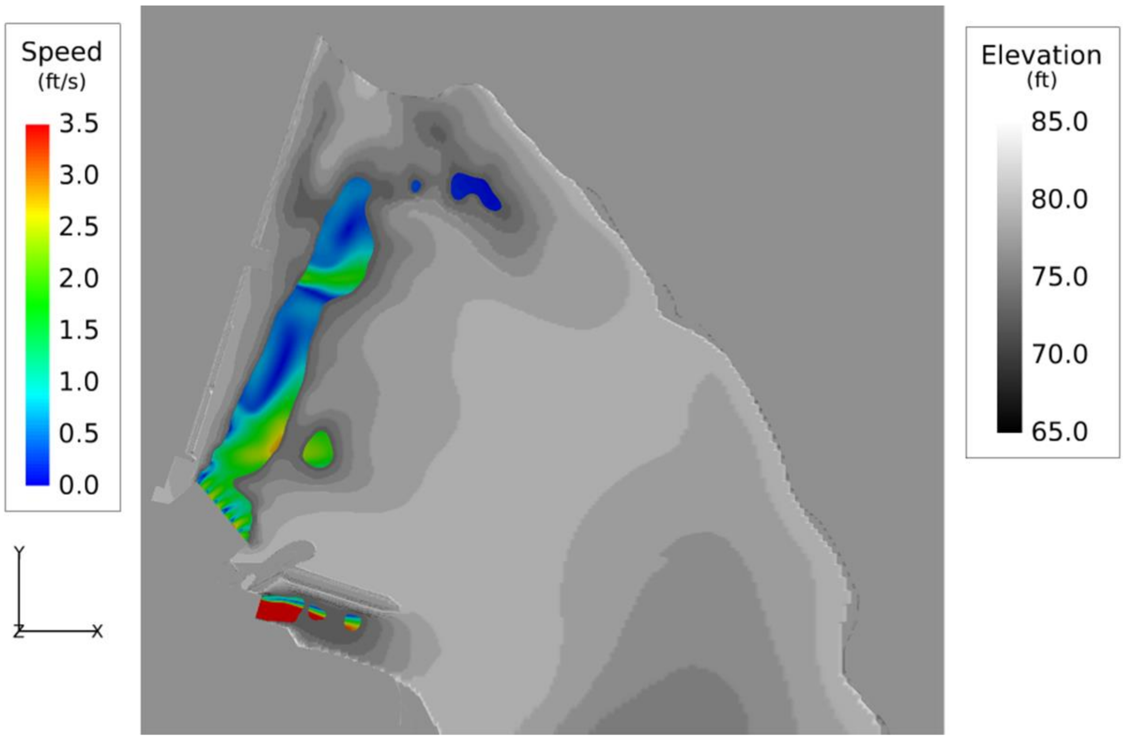


Figure D-7: Flow Speed Distribution, Elevation 76.875 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

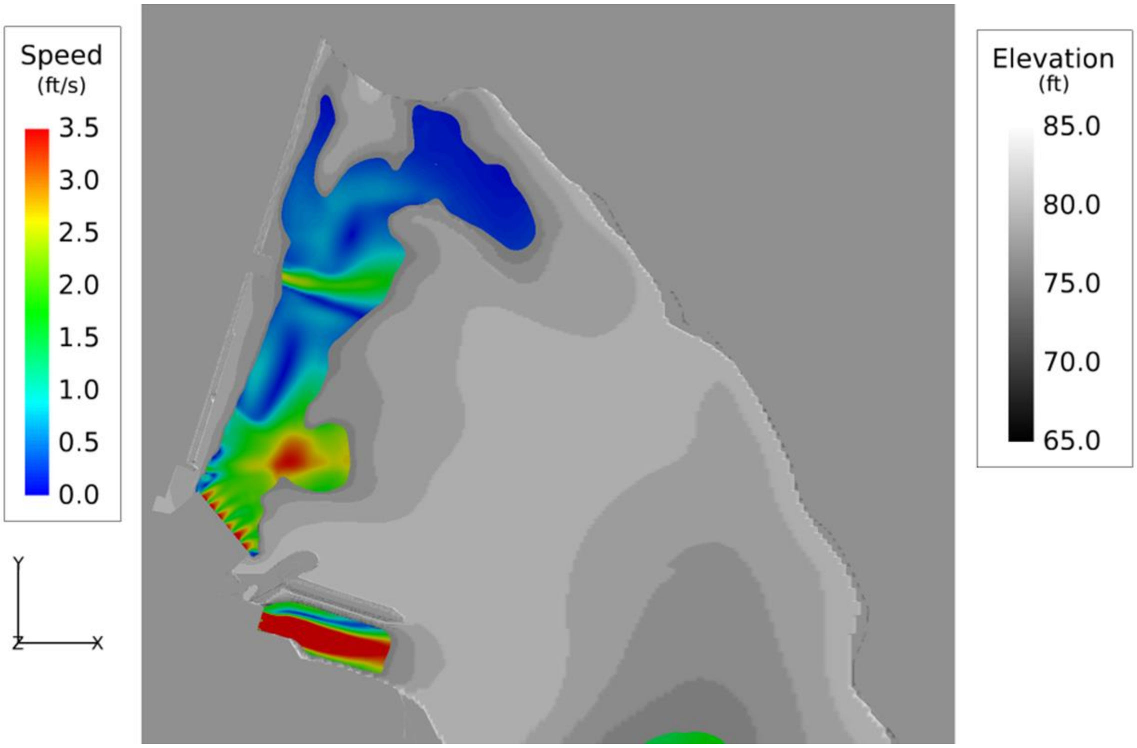


Figure D-8: Flow Speed Distribution, Elevation 80.575 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

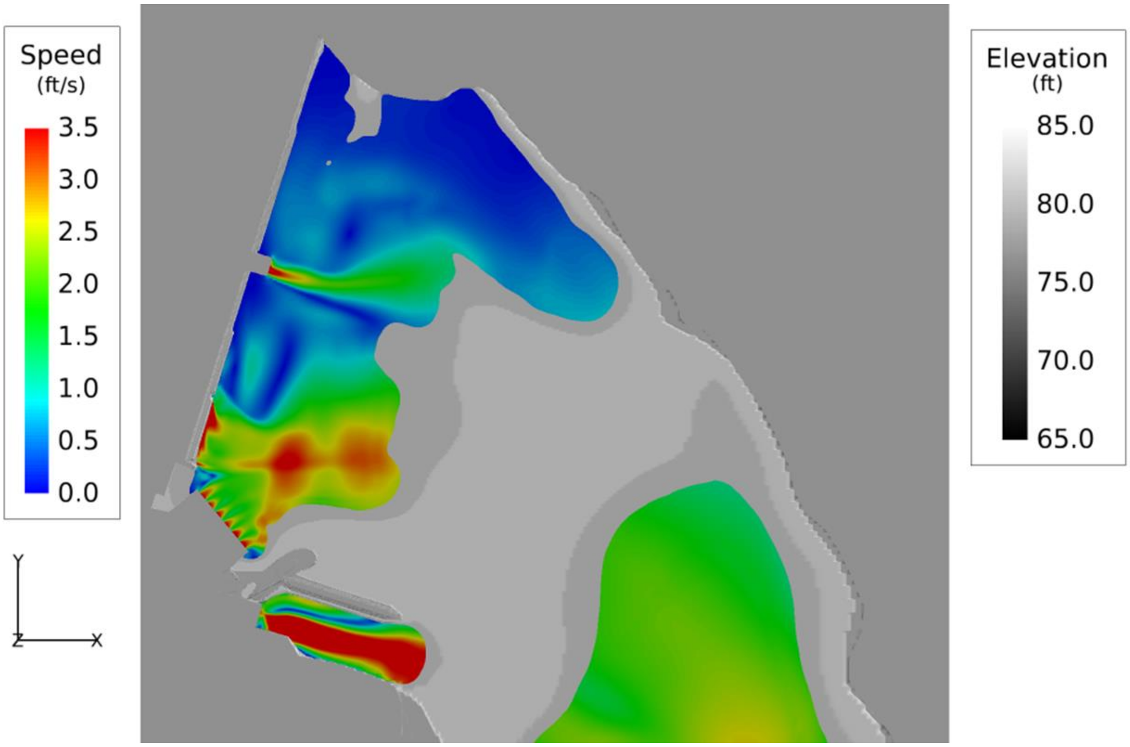


Figure D-9: Flow Speed Distribution, Elevation 84.275 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

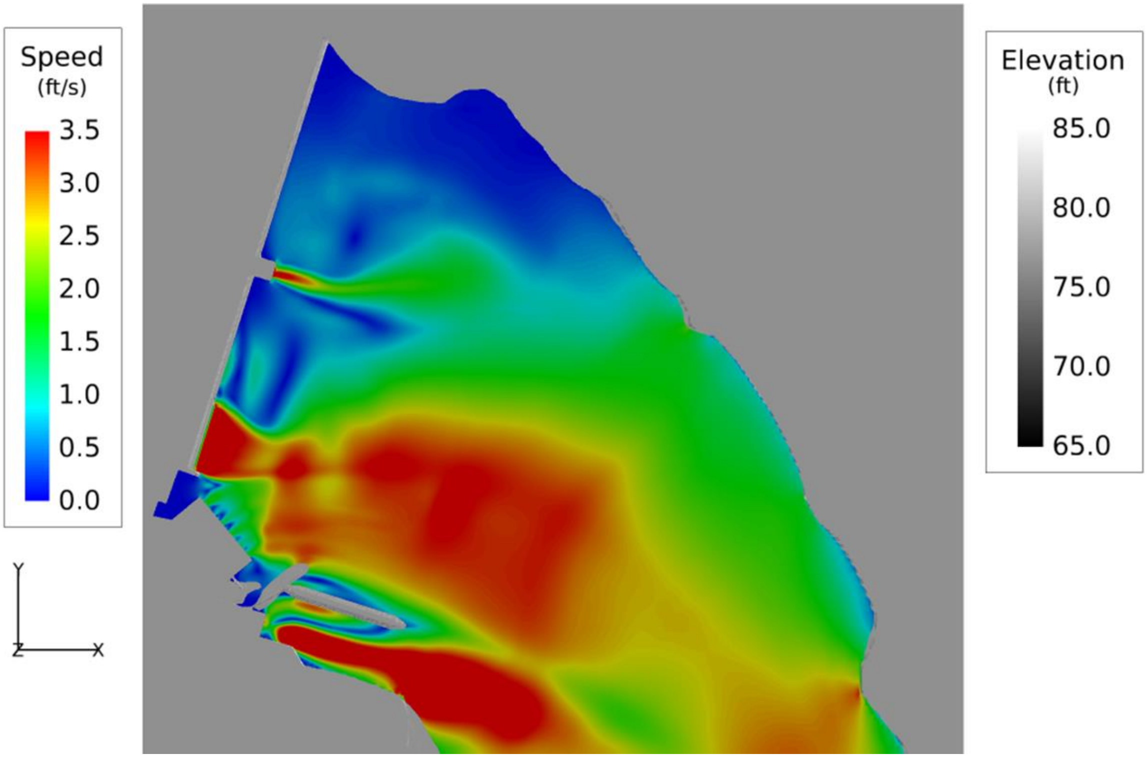


Figure D-10: Flow Speed Distribution, Elevation 86.125 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

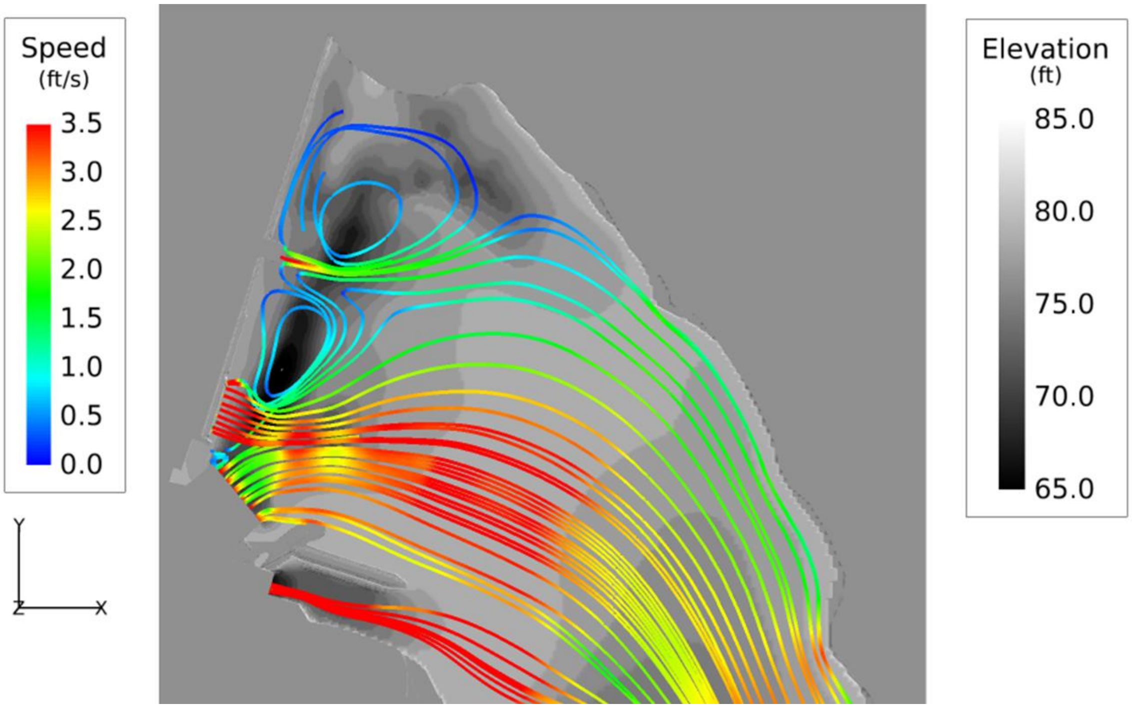


Figure D-11: Streamlines – Colored by Speed
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

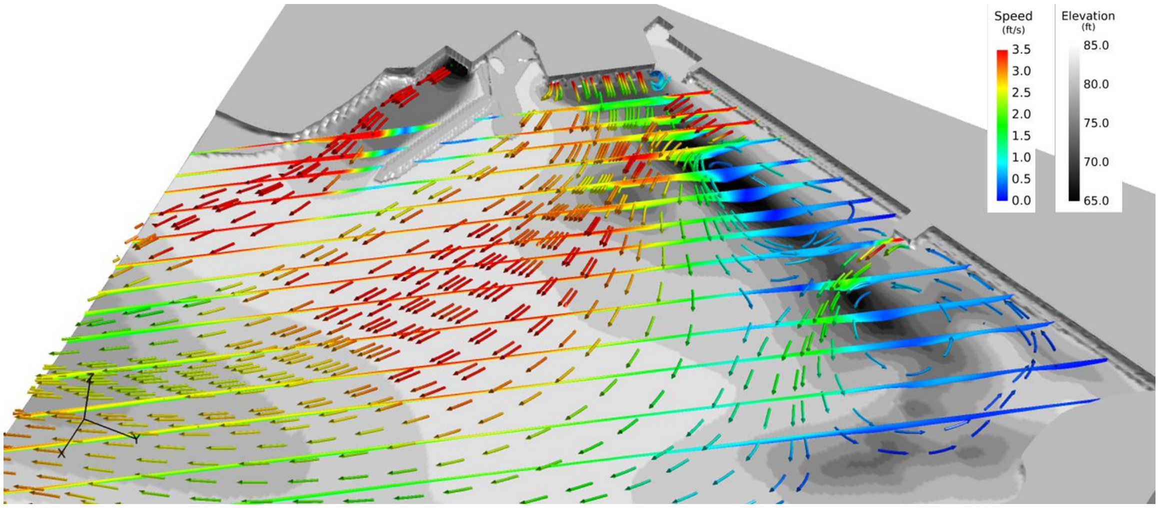


Figure D-12: Vertical Variation of Flow Speed and Streamlines
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Appendix E: Case 04 – 5% Flow Exceedance

Flow Exceedance	5%
Total Flow	20,270 cfs
Tailwater Elevation	91.5 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	639 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	1433 cfs
Log Sluice	1840 cfs
S Flashboards	3400 cfs
M Flashboards	1275 cfs
S Rubber Dam	7000 cfs

Figure E-1: Boundary Conditions

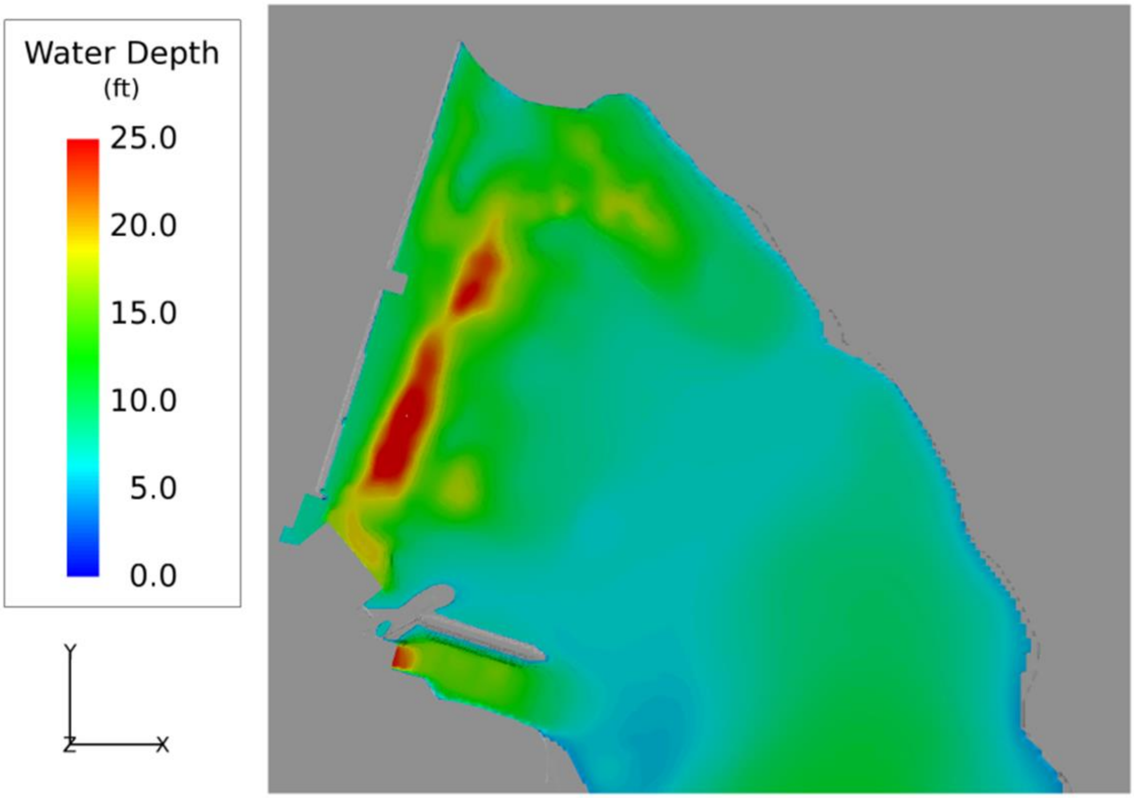


Figure E-2: Water Depth, Plan View
(red > 25.0 ft)

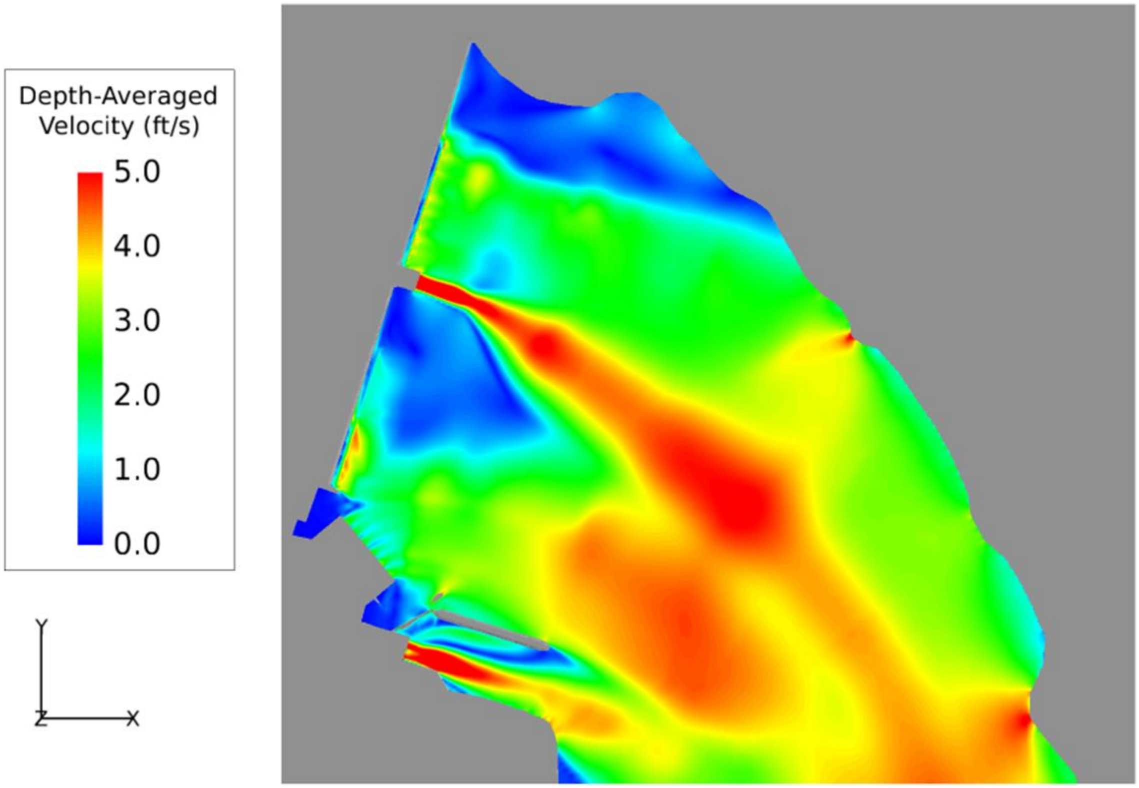


Figure E-3: Depth-Averaged Velocity, Plan View
(red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

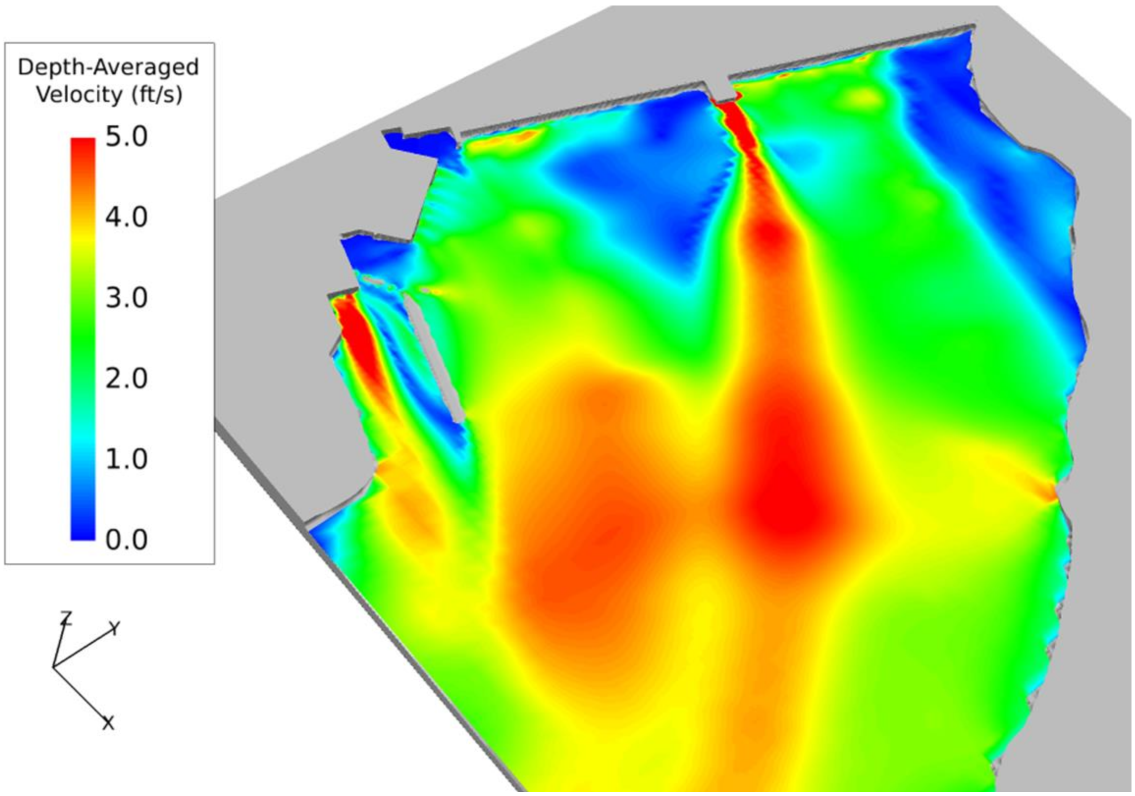


Figure E-4: Depth-Averaged Velocity, Oblique View
(red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

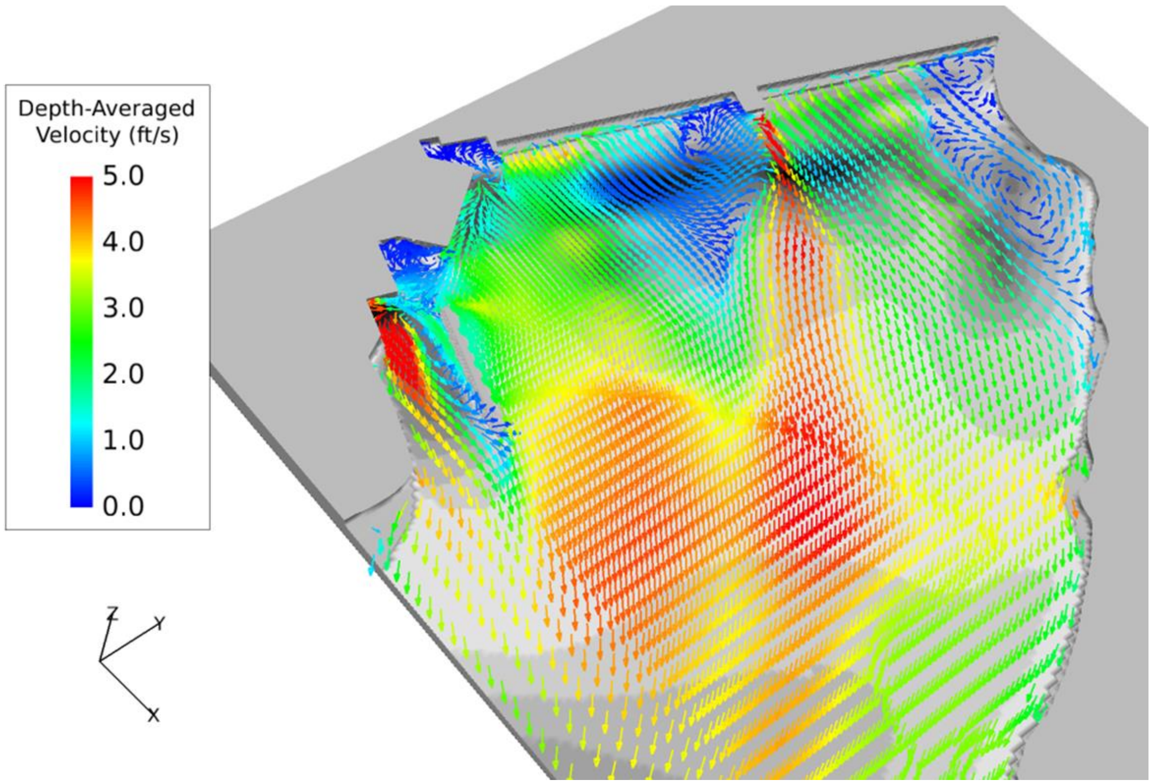


Figure E-5: Unit Vectors at Free Surface, Oblique View, Every 4th Vector
(red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

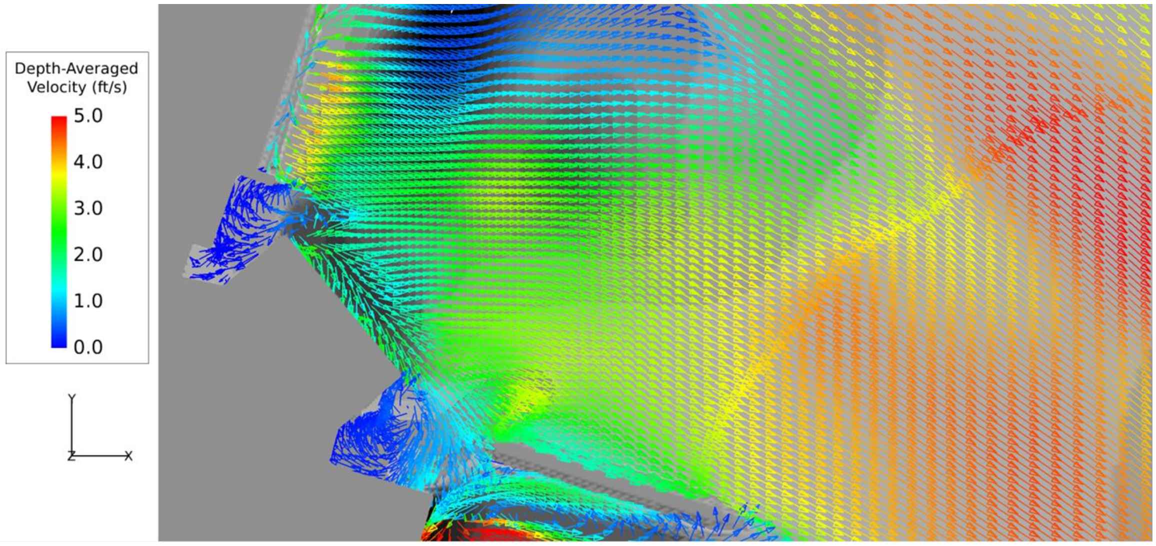


Figure E-6: Unit Vectors at Free Surface, Plan View, Every 3rd Vector
(red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

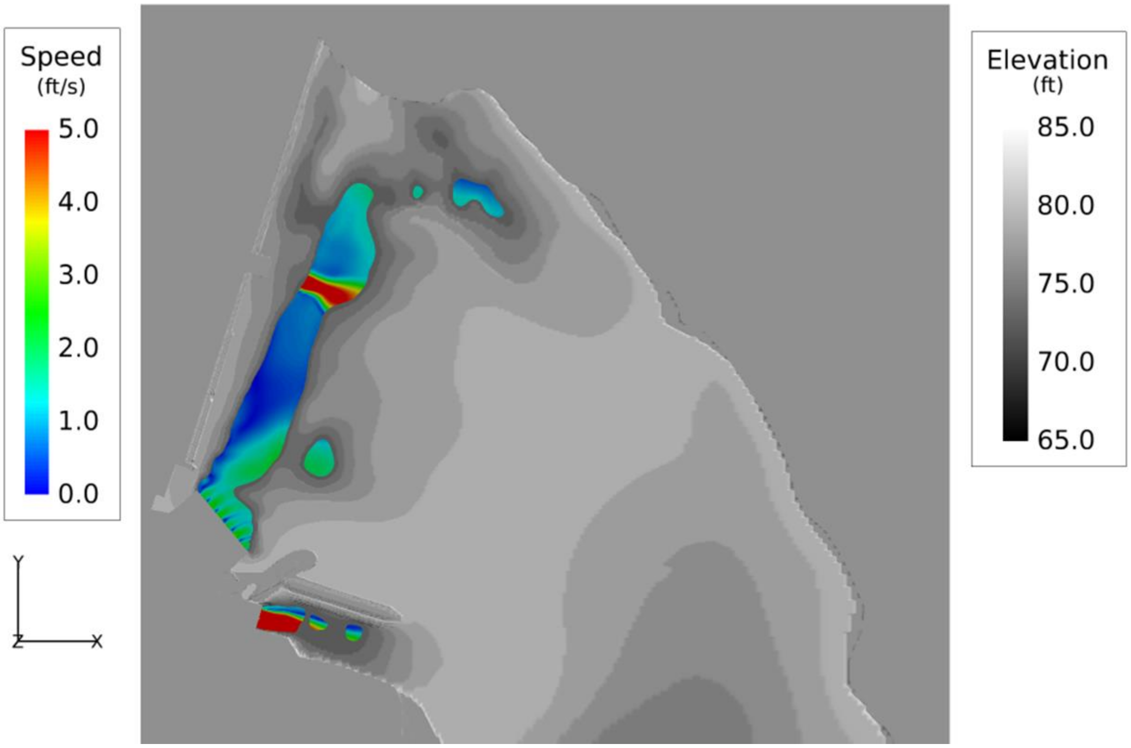


Figure E-7: Flow Speed Distribution, Elevation 76.875 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

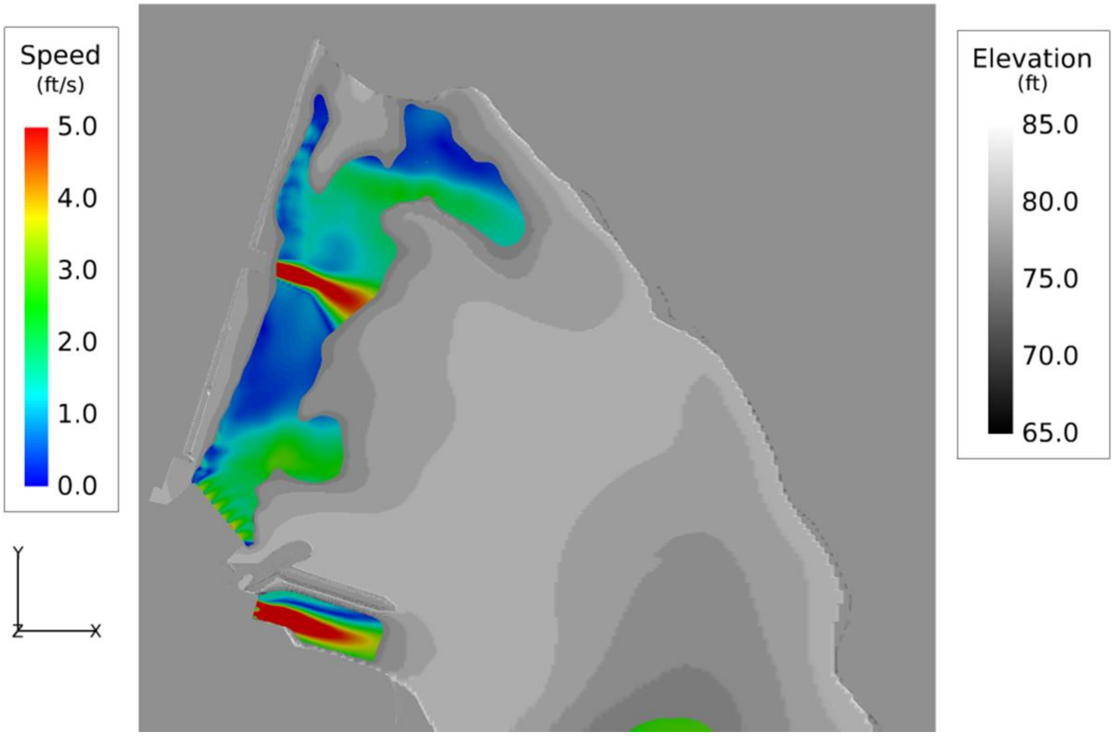


Figure E-8: Flow Speed Distribution, Elevation 80.575 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

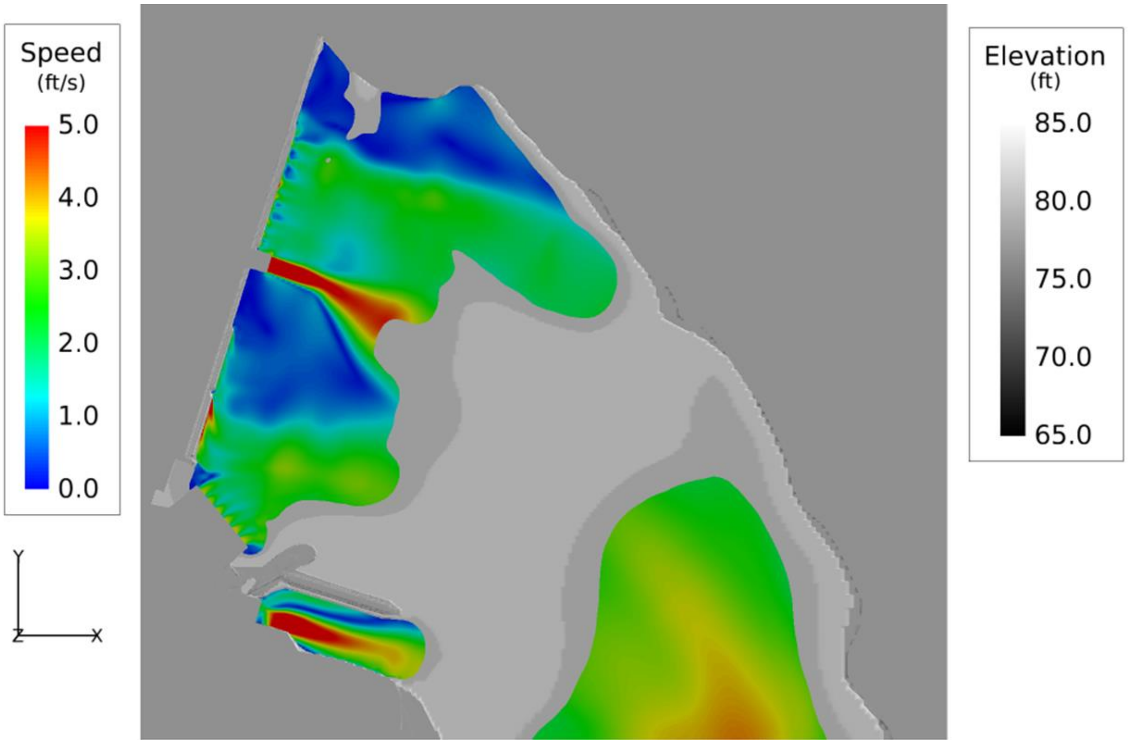


Figure E-9: Flow Speed Distribution, Elevation 84.275 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

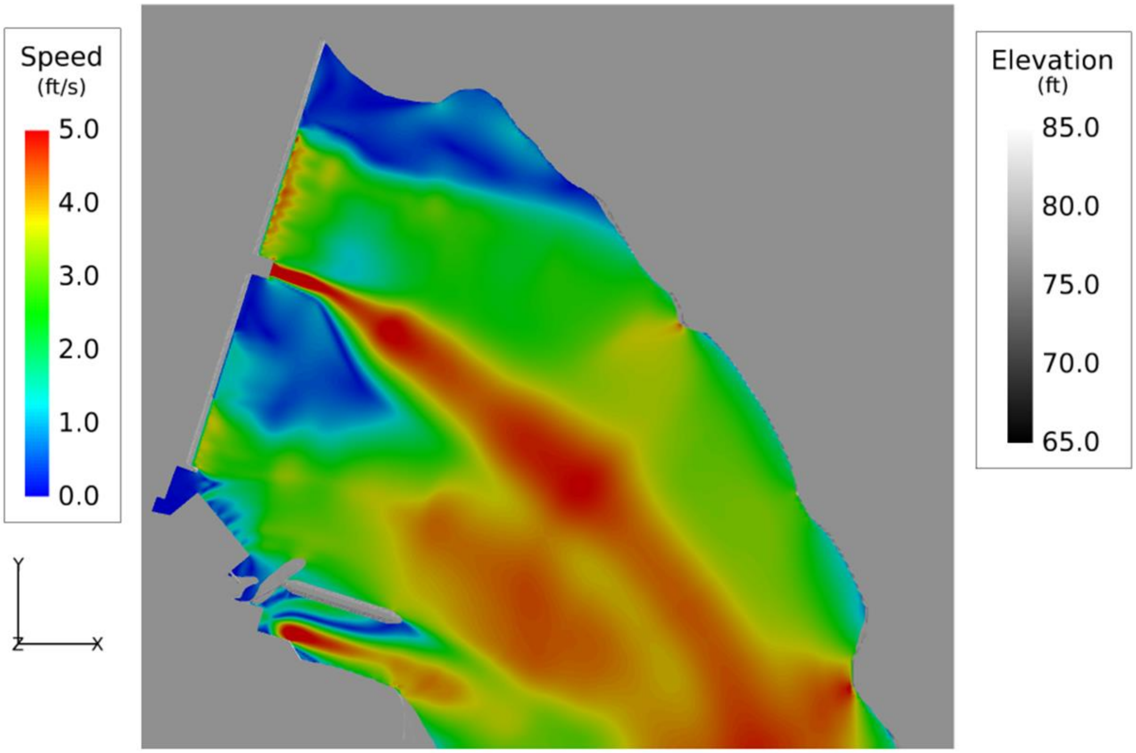


Figure E-10: Flow Speed Distribution, Elevation 86.125 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

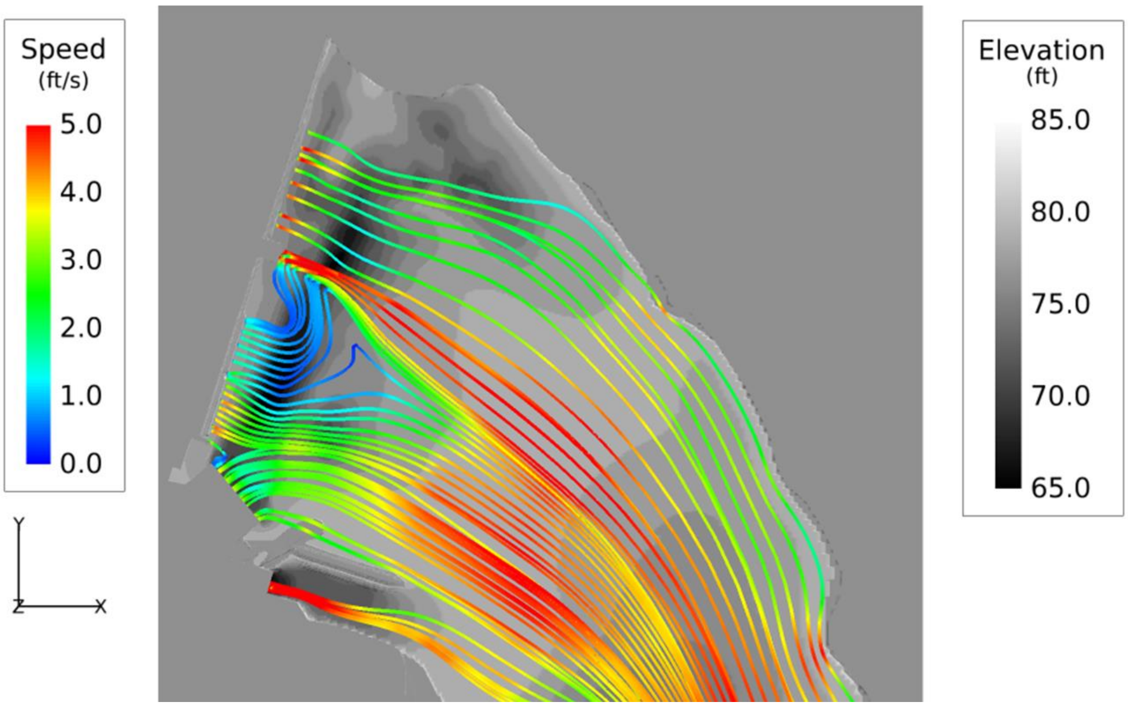


Figure E-11: Streamlines – Colored by Speed
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

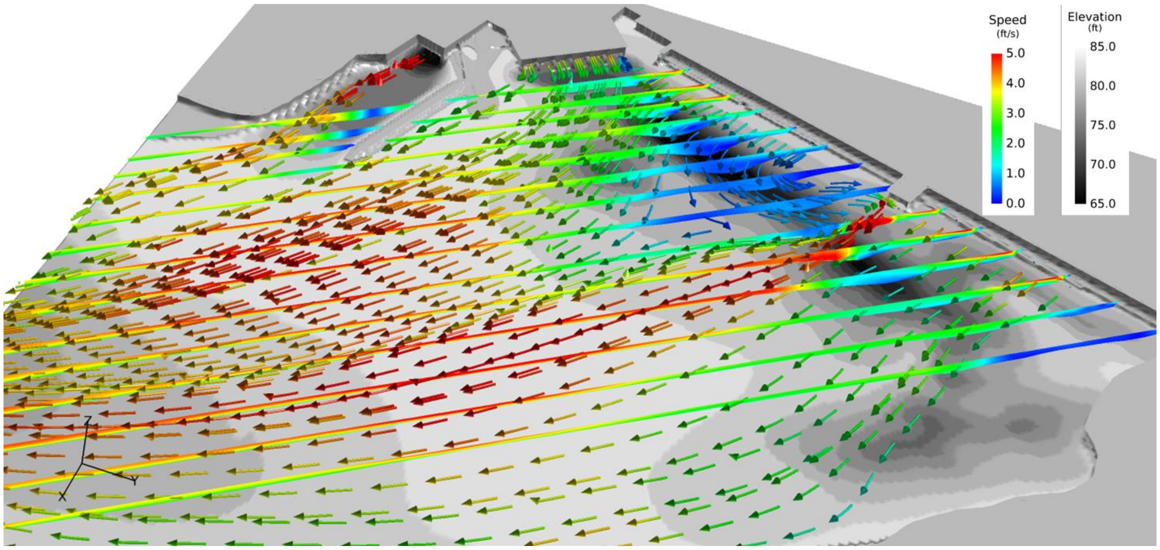


Figure E-12: Vertical Variation of Flow Speed and Streamlines
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut Upstream Fish Passage 3-D Hydraulic Modeling
Intra Agency Design Review Team Comments
October 21, 2016
Final based upon October 13, 2016 Brookfield Meeting.

The following comments were prepared by the United States Fish and Wildlife Service, the National Marine Fisheries Service, the Maine Department of Inland Fisheries & Wildlife, and the Maine Department of Marine Resources. These comments may or may not accurately reflect each agencies views. The agencies may still wish to submit comments on their own or to support these comments.

1. The D/S fish bypass flows need to be included.
2. The consultant should review Brookfield's High Water Guidelines to ensure that the modeling accurately represents how the project is run.
3. The tailwater elevations must be confirmed including the differential between Units 1 through 6 and Units 7&8.
4. The tailwater curve must be confirmed
5. Preliminarily, the maximum design attraction flow of a new fish lift would be up to 5% of the total station capacity per entrance. This includes the auxiliary water system and the fishway conveyance flow. This design flow would be approximately 330 cfs, however, there may be physical constraints to providing this much flow. Typical operation may occur at flows less than the maximum.
6. MDMR is working on new design population estimates based upon the design population estimates for Hydro Kennebec and should have those complete the week of 10/24.
7. New conditions should be run that include the fishway attraction flow for two different locations. The first location would be between the dam and unit 1 in the old powerhouse. The flow should be orientated to provide the best near field attraction as possible. This should be run for all previous flow conditions. The second location would be between Unit 6 and Unit 7. Some of downstream passage flow can be used as auxiliary water for the upstream passage. There should be a means of passage constructed between the tailrace for the new powerhouse to the tailrace of the old powerhouse. This should be run for all previous flow conditions.
8. Scales for the different scenarios are different. Sometimes 2ft/sec, sometimes 5ft/sec. These need to be the same or explained better.
9. As discussed in the meeting, the report says comparisons between measured and calculated have not been made. This needs to be addressed.

Gmail

Gregory Allen <gallen@aldenlab.com>

FW: Shawmut 3-D Modeling Agency Comments

Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com> Tue, Oct 25, 2016 at 4:00 PM
To: Gregory Allen <gallen@aldenlab.com>
Cc: "Richter, Robert" <robert.richter@brookfieldrenewable.com>

Greg,

Attached comments from meeting

Thanks

From: Donald Dow - NOAA Federal [mailto:donald.dow@noaa.gov]
Sent: Monday, October 24, 2016 12:07 PM
To: Richter, Robert; Mitchell, Gerry
Cc: Seiders, Dwayne J; Bentivoglio, Antonio; Wippelhauser, Gail; Matt Buhyoff - NOAA Federal; Dan Tierney; Christman, Paul
Subject: Shawmut 3-D Modeling Agency Comments

Good Afternoon Bob -

Thank you for the opportunity to comment on the 3-D modeling for Shawmut. Attached are our comments based upon last weeks meeting.

Regards,

Don

--

Donald A. Dow III, PE

Hydro/Fish Passage Engineer

Protected Resources Division

Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Maine Field Station

17 Godfrey Drive, Suite 1

Orono, ME 04473

Office: 207-866-8563

Cell: 207-416-7510

Donald.Dow@noaa.gov

Shawmut - 3D Hyd Modeling Comments.docx
17K

Shawmut Hydroelectric Project

Computational Fluid Dynamics Flow Analysis

Prepared for

Alden Research Laboratory

Prepared by

Blue Hill Hydraulics

Date

16 December 2016

Summary

Shawmut Hydroelectric Project
(FERC No. P-2322)

A Computational Fluid Dynamics (CFD) model of the Shawmut Hydroelectric Project was developed to aid in the design of a future upstream fish passage.

The model includes the tailrace, spillways, training walls, and powerhouse discharges.

Included in this presentation are the results of additional simulations (case study numbers 5–8).

Flow Allocation

Model Simulation	River Flow		Flow Allocation (cfs) May 1 - October 31																		Fishway flows (cfs)	
			Gates and Sluices				Hinged Flashboards			Rubber Dam Sections			1912 PH Turbines						1982 PH Turbine			
	Total Flow (cfs)	Flow Exceedance (%)	10 x 7 ft Tainter Gate (up to 700 cfs)	25 x 8 ft Log Sluice (up to 1,840 cfs)	4 ft x 22 inch Log Sluice (up to 35 cfs)	6 x 6 ft Deep Bypass (up to 35 cfs)	South 123 ft Hinged Flashboard (up to 3,400 cfs)	Middle 123 ft Hinged Flashboard (up to 3,400 cfs)	North 123 ft Hinged Flashboard (up to 3,400 cfs)	South 238 ft Rubber Dam Section (up to 7,000 cfs)	Middle 237 ft Rubber Dam Section (up to 7,000 cfs)	North 231 ft Rubber Dam Section (up to 7,000 cfs)	Unit 1 (up to 635 cfs)	Unit 2 (up to 639 cfs)	Unit 3 (up to 634 cfs)	Unit 4 (up to 611 cfs)	Unit 5 (up to 703 cfs)	Unit 6 (up to 649 cfs)	Unit 7 (up to 1451 cfs)	Unit 8 (up to 1433 cfs)	Fish Lift Entrance (cfs)	Attraction Flow (cfs)
New simulations																						
To accomodated the 600 cfs tainter gate flow adjustments to flow allocations were made.																						
Case 5	4,790	50%	600										635	136	634		703	649		1433		
Case 6	10,750	15%	600				3400						635	634	634	611	703	649	1451	1433		
New Fish Lift simulations,																						
Case 7 - Alt 1	4,790	50%	600	0			420						635	462	457	434			1451		100	230
Case 8 - Alt 2	4,790	50%	600	0			420								431	408	500	649	1451		100	230

Fish Lift Alt 1 - would locate a fish lift between the dam and unit 1

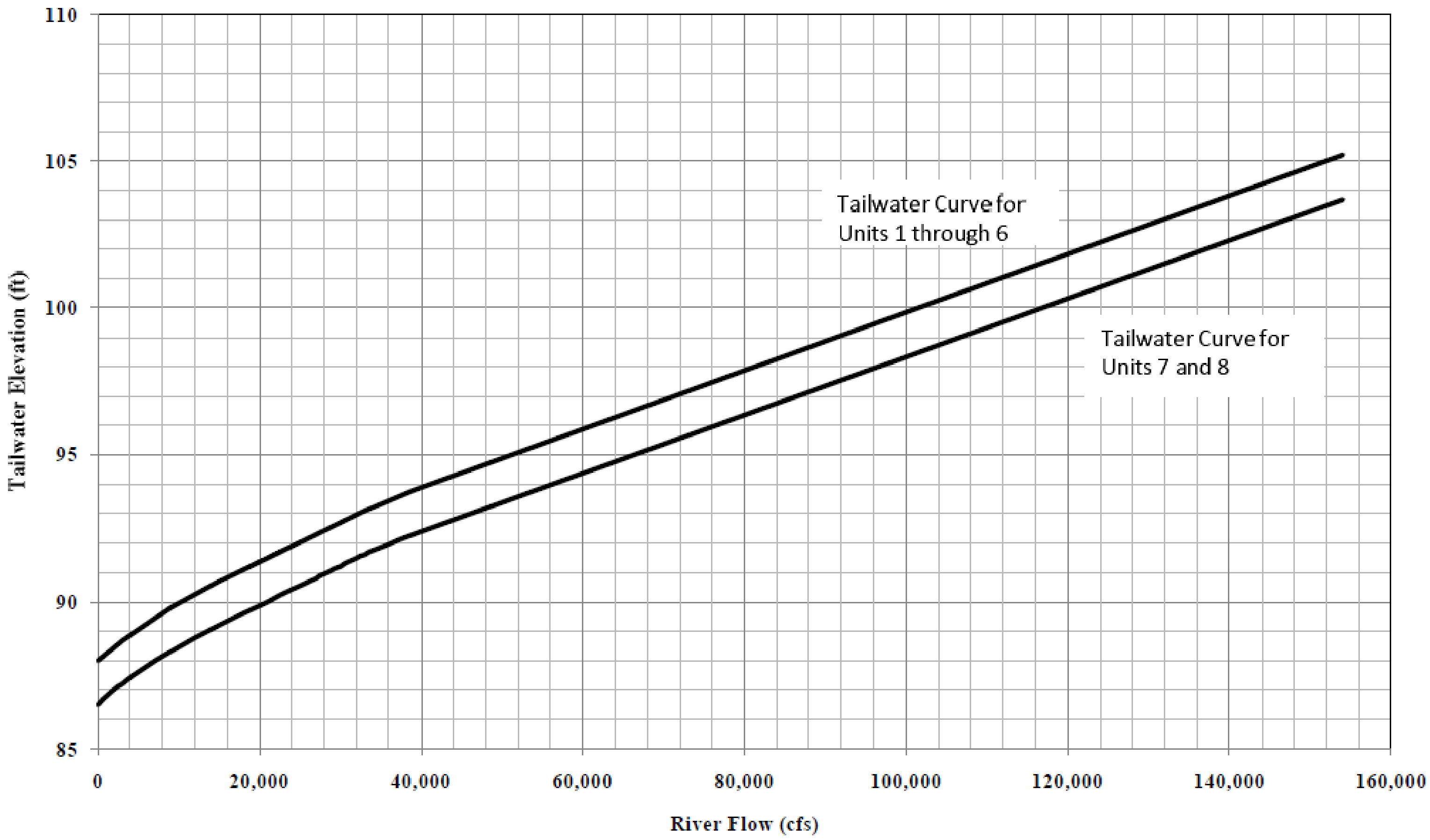
Fihs Lift Alt 2 - would locate a fish lift between the old powerhouse and the Unit 7&8 powerhouse

Flume connecting Unit 1 through 6 tailrace to Unit 7&8 tailrace would discharge 85 cfs to the Unit 7&8 tailrace

Max Flood EL. (ft)	122
100 Year FEMA EL. (ft)	120
Normal Pond EL. (ft)	112
Low Pond EL. (ft)	108
Max Project Turbine Flow (cfs)	6755

- **Tailwater elevations were based on the curve appearing on the following slide.**

Tailwater Curve

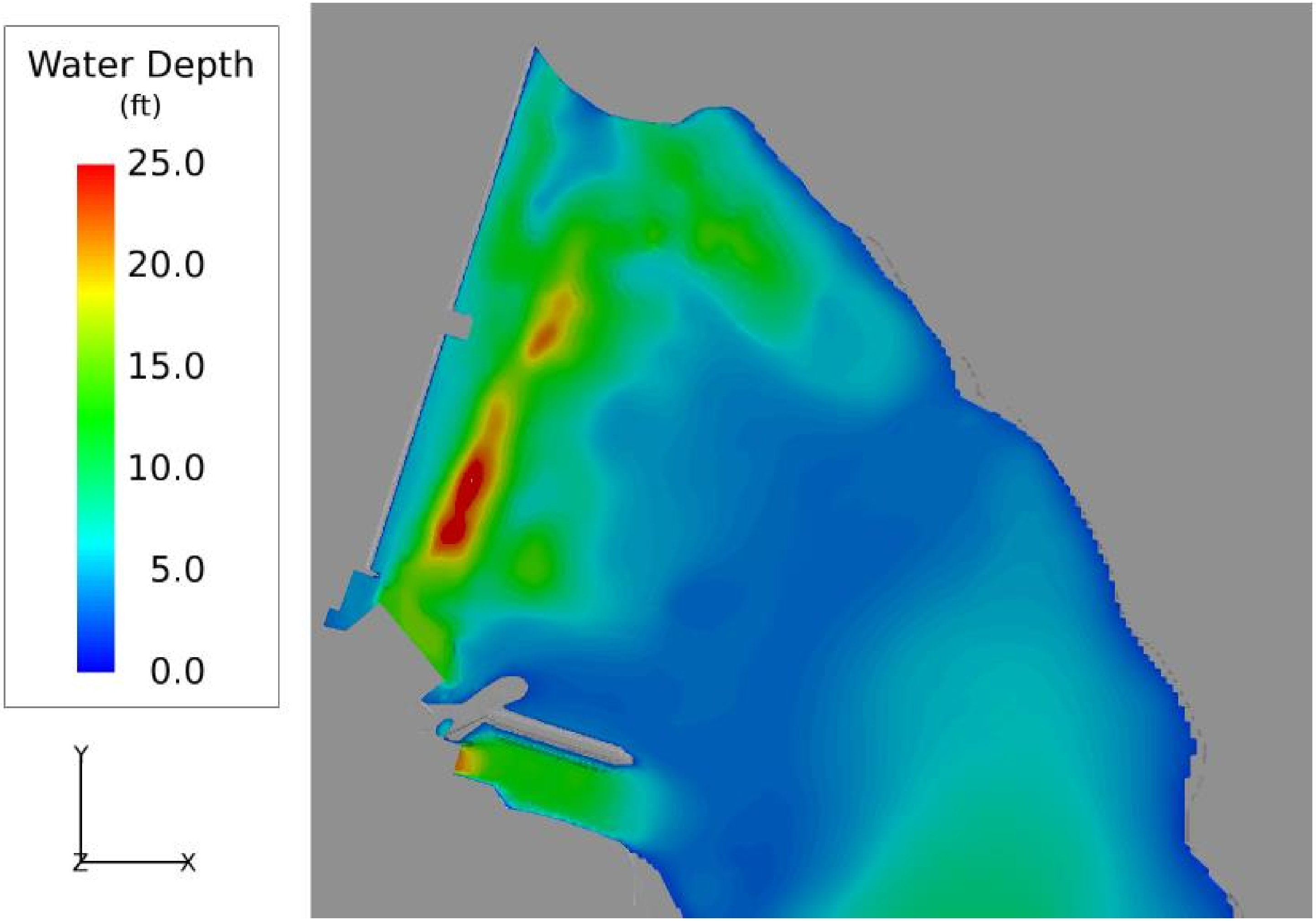


Shawmut – Case 05

Boundary Conditions

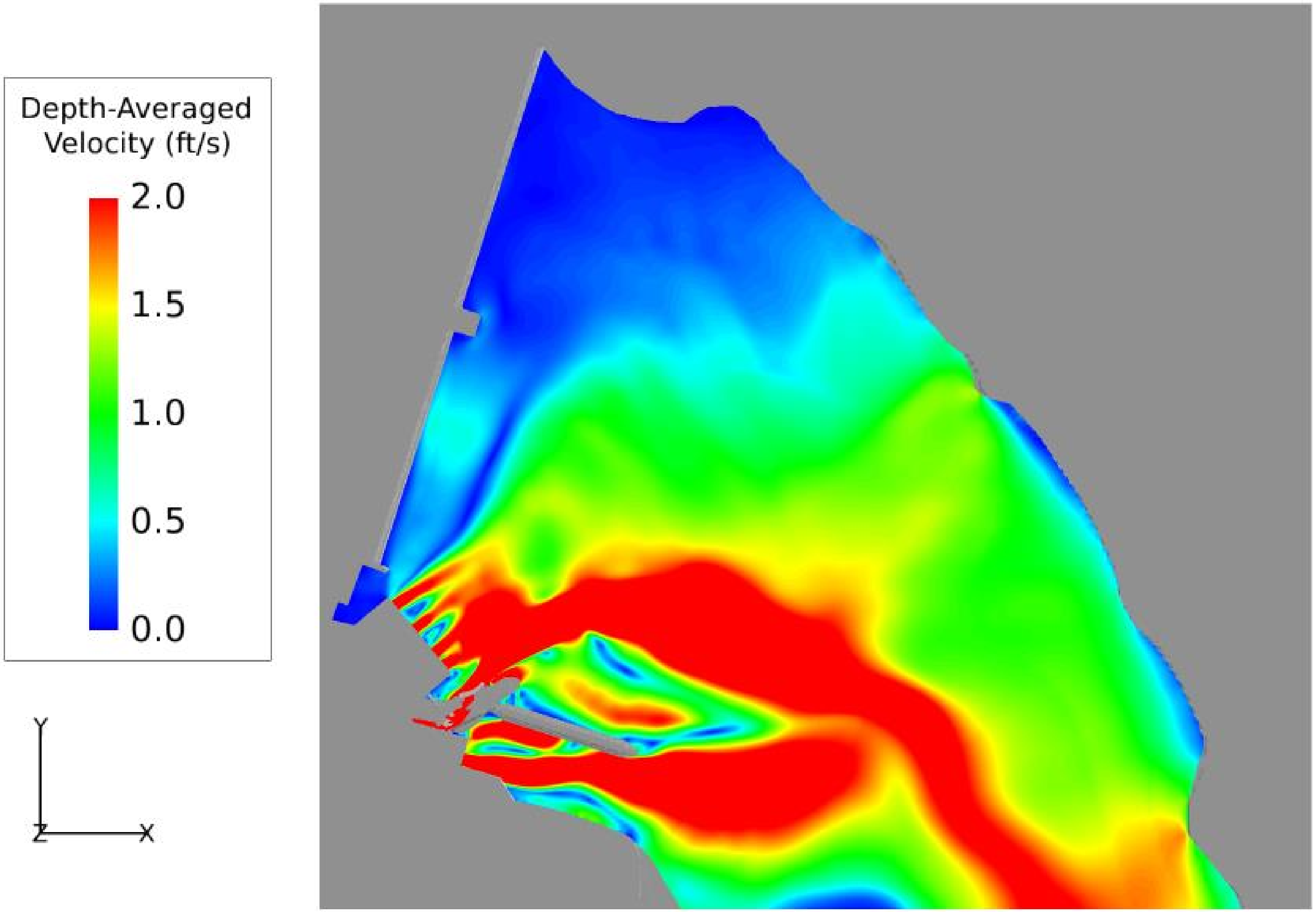
Flow Exceedance	50%
Total Flow	4,790 cfs
Tailwater Elevation	87.5/89.0 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	136 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	0 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	0 cfs
Unit 08 Discharge	1,433 cfs
10 ft x 7 ft Tainter Gate	600 cfs

Shawmut – Case 05



Water Depth, Plan View
(red > 25.0 ft)

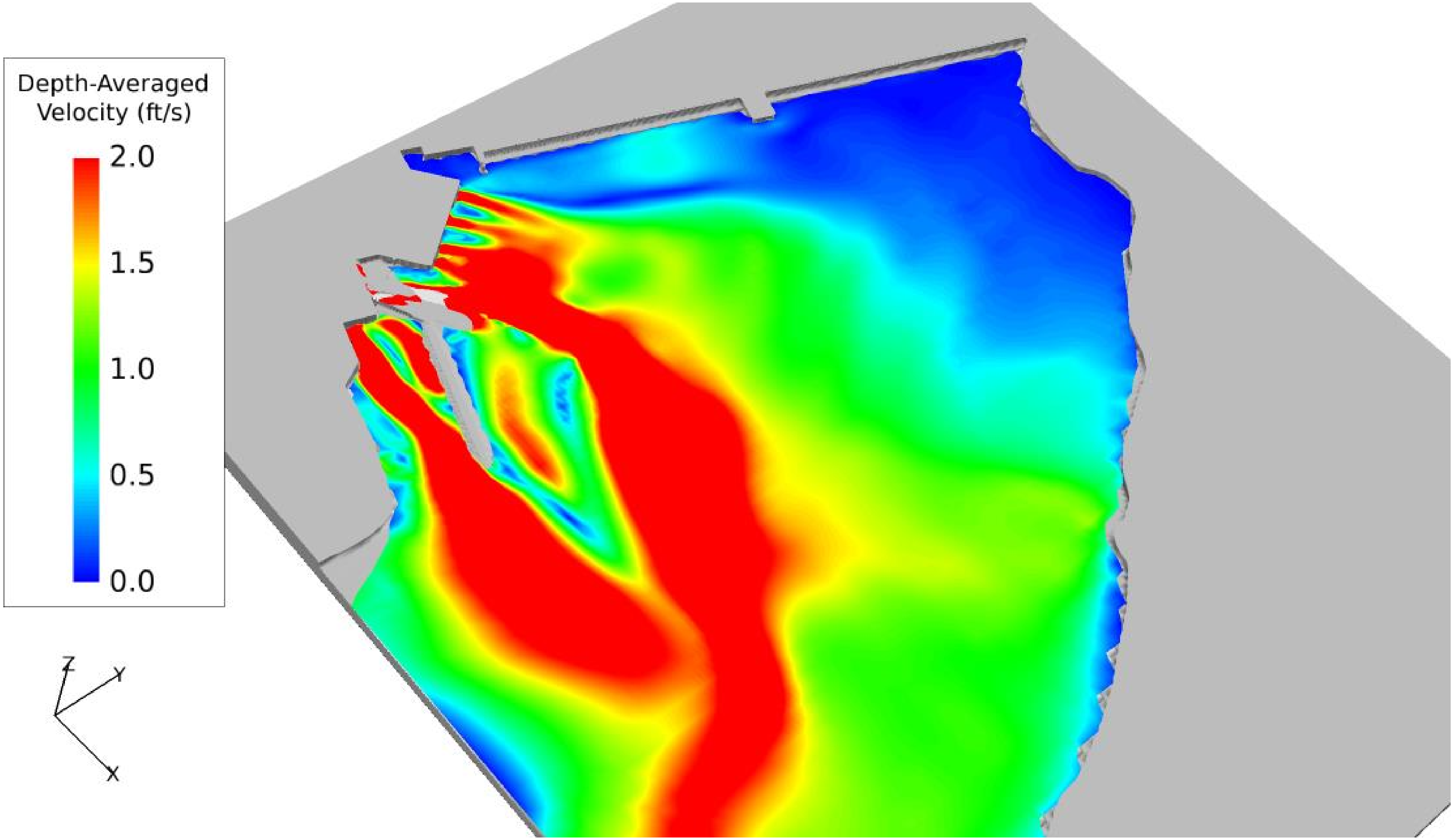
Shawmut – Case 05



Depth-Averaged Velocity, Plan View
(red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

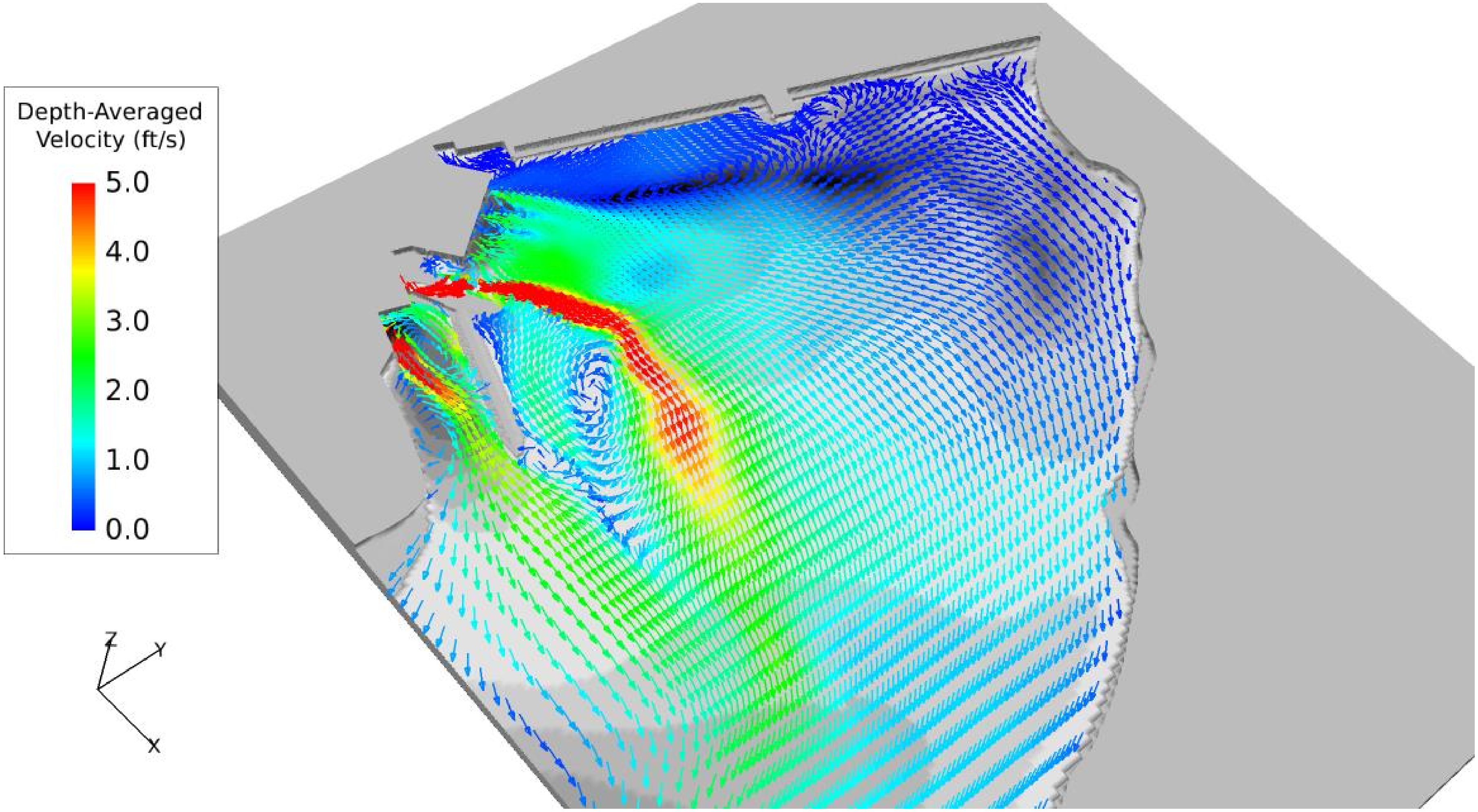
Shawmut – Case 05



Depth-Averaged Velocity, Oblique View (red > 2.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

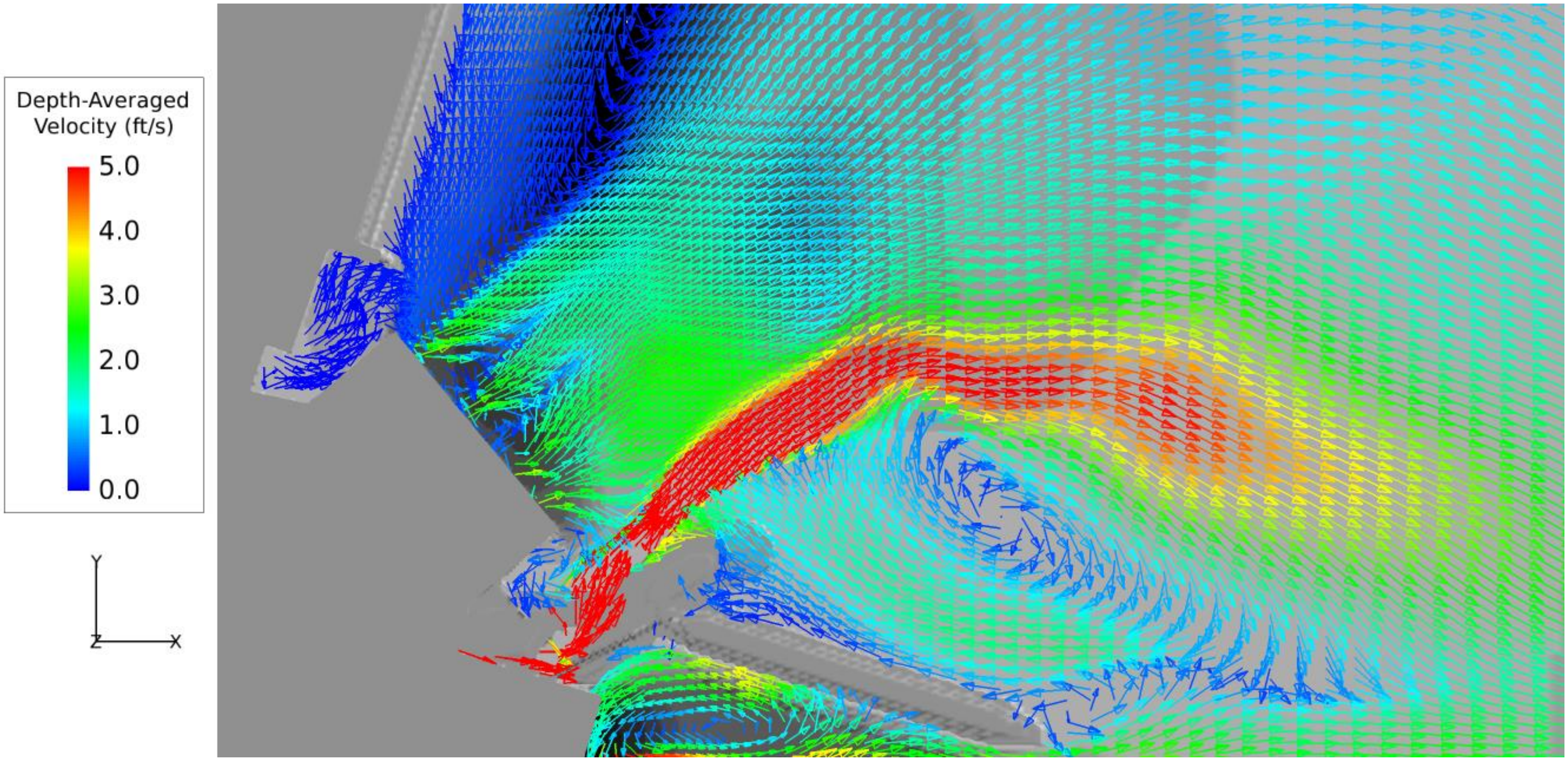
Shawmut – Case 05



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

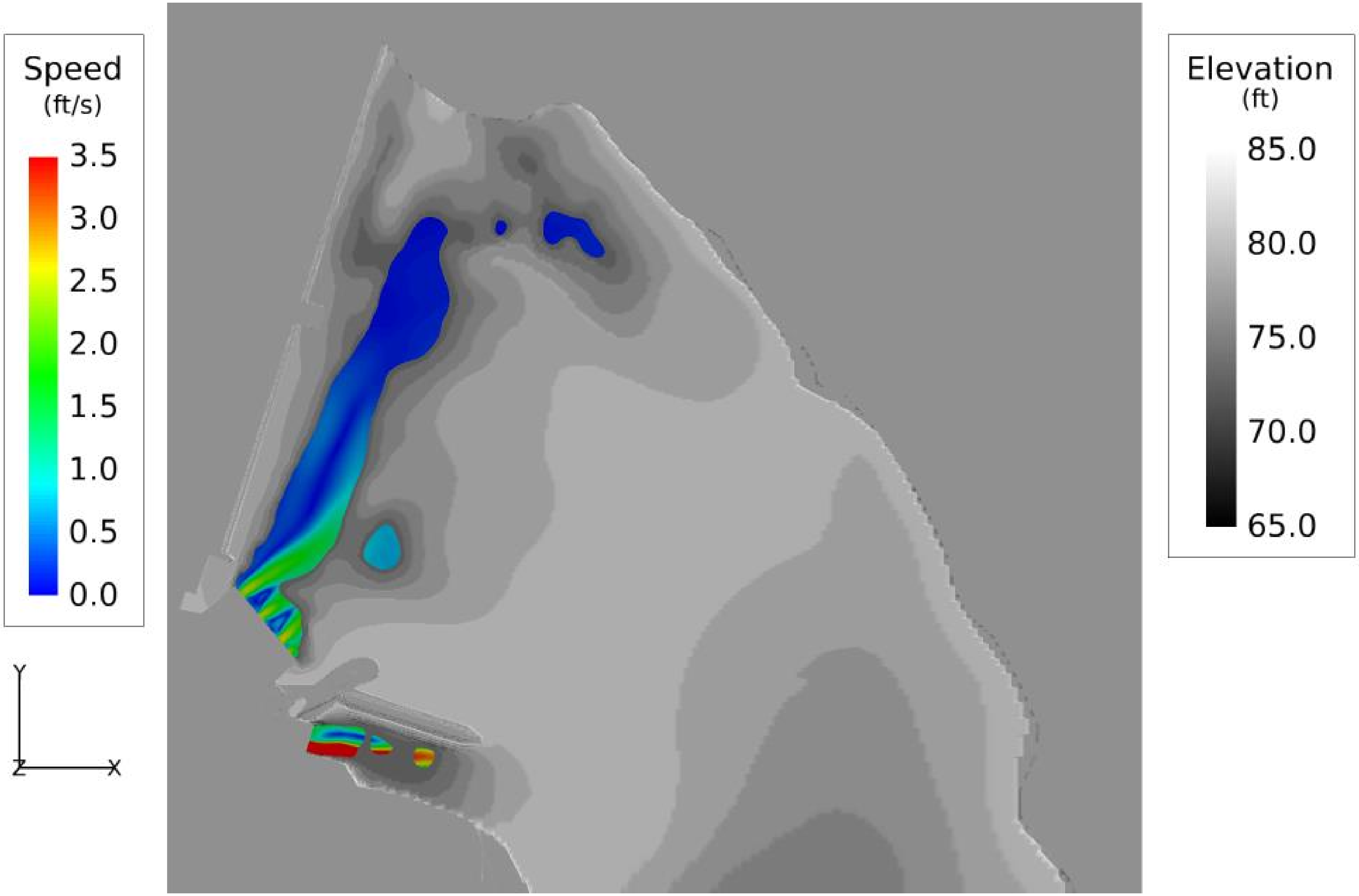
Shawmut – Case 05



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 5.0 ft/s)

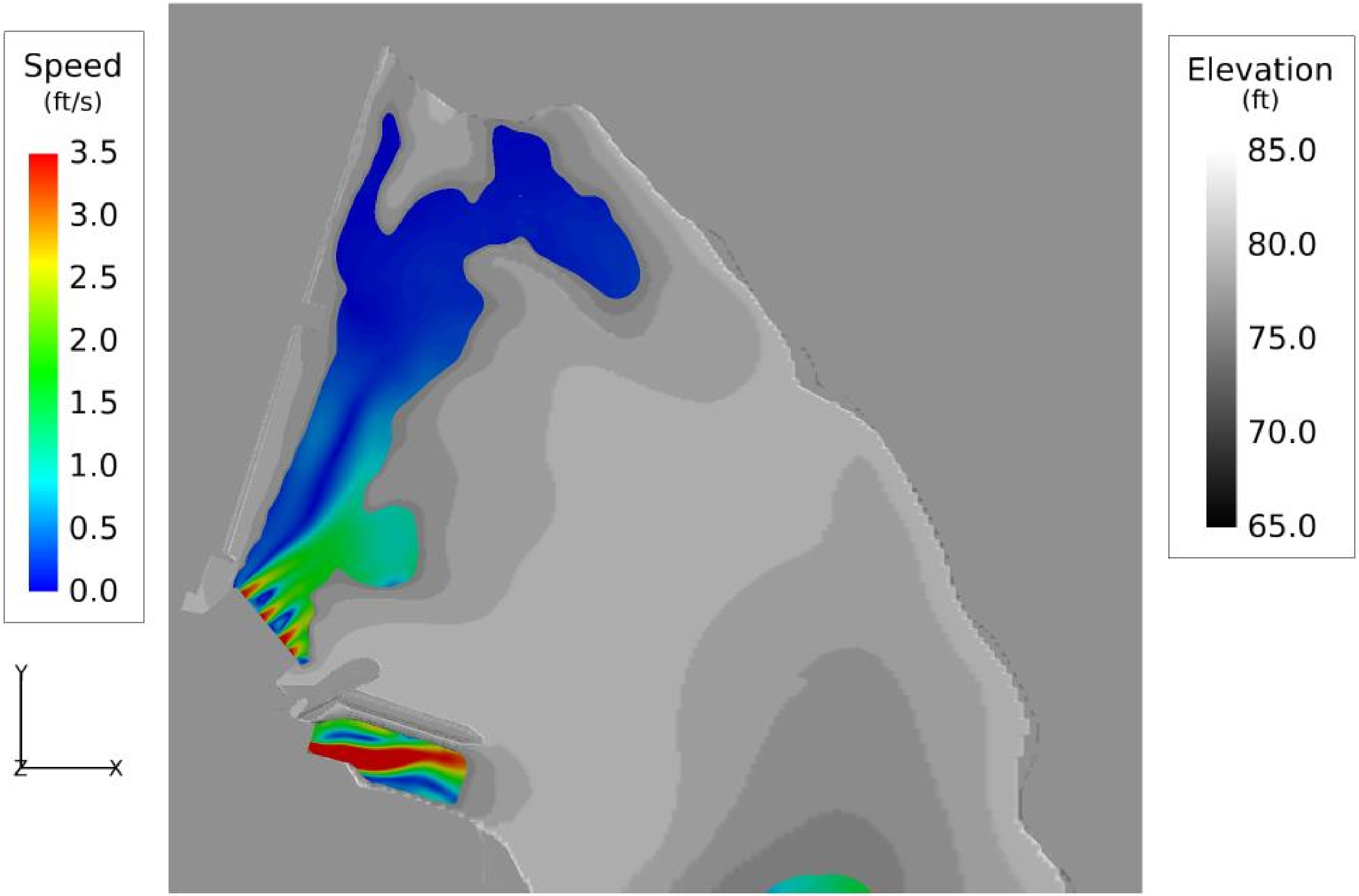
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 05



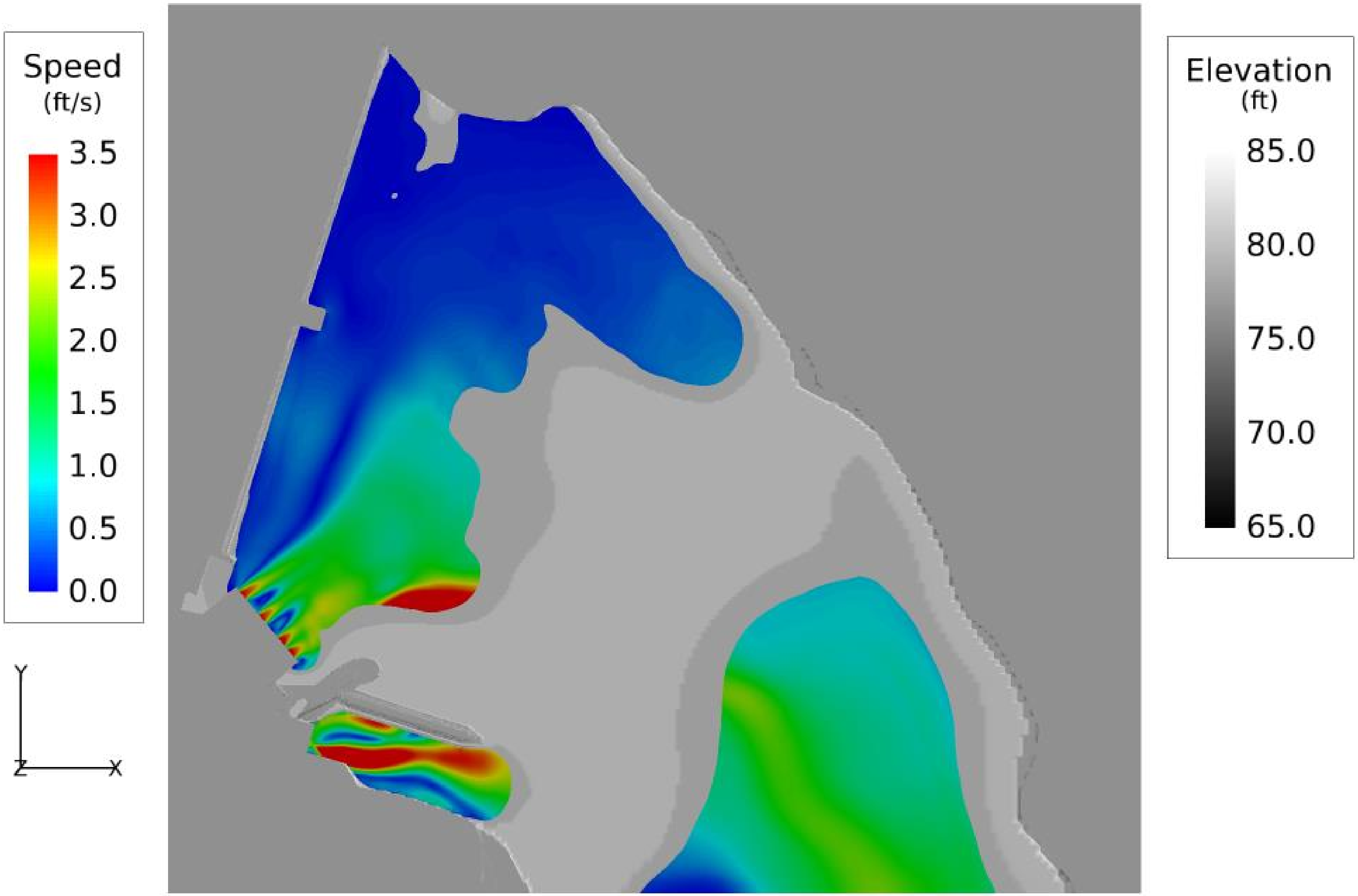
Flow Speed Distribution, Elevation 76.875 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 05



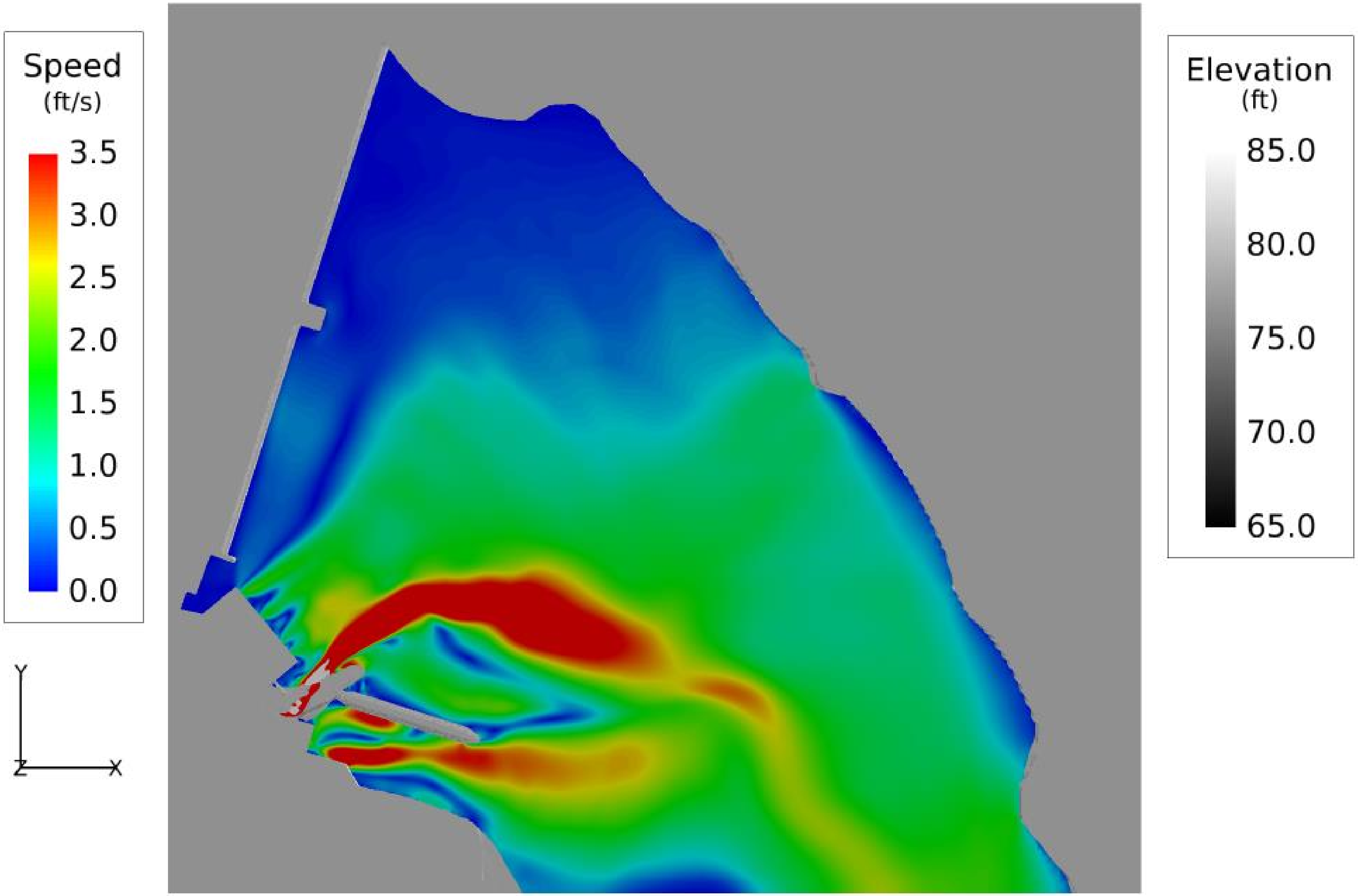
Flow Speed Distribution – Elevation 80.575 ft (red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 05



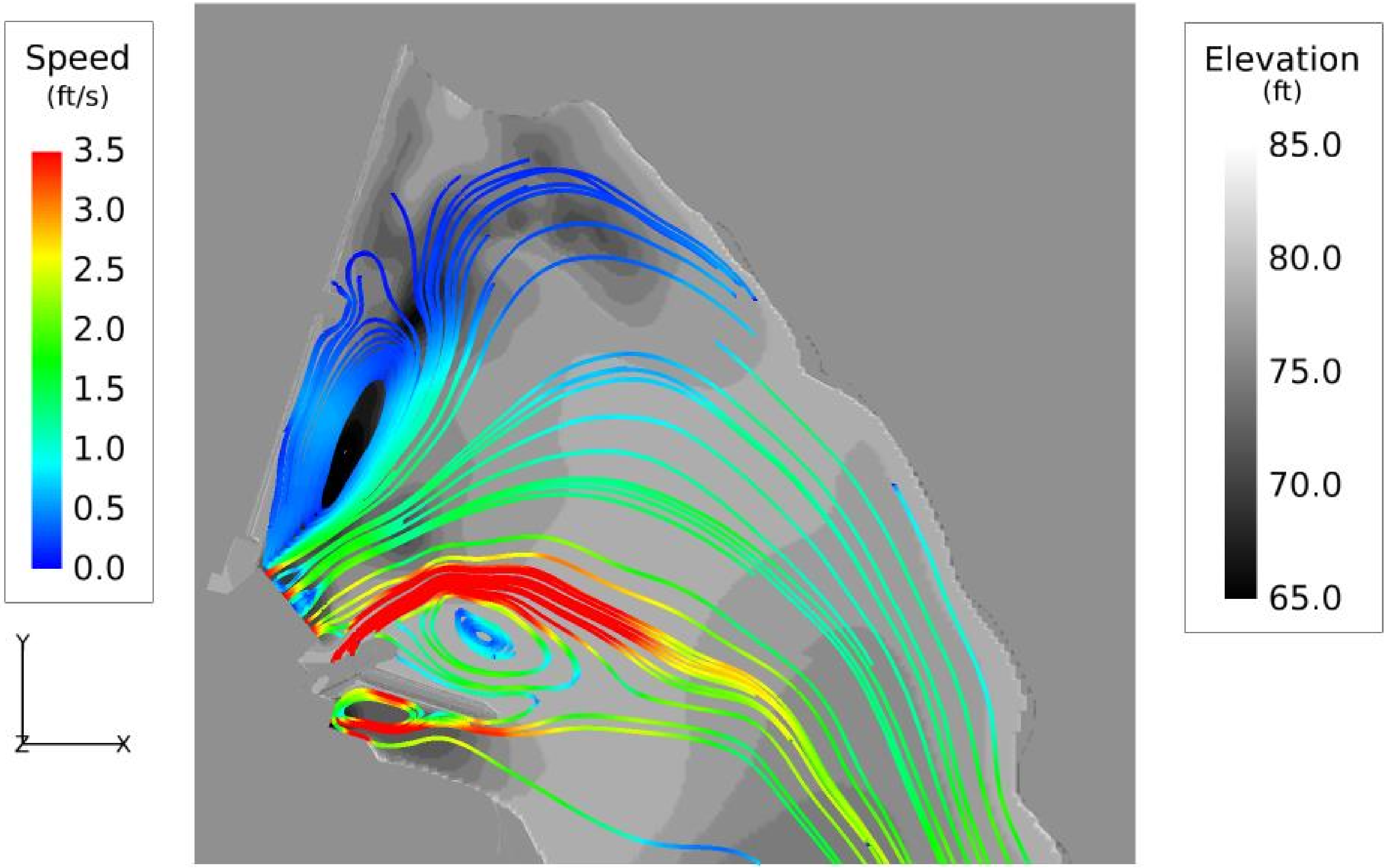
Flow Speed Distribution – Elevation 84.275 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 05



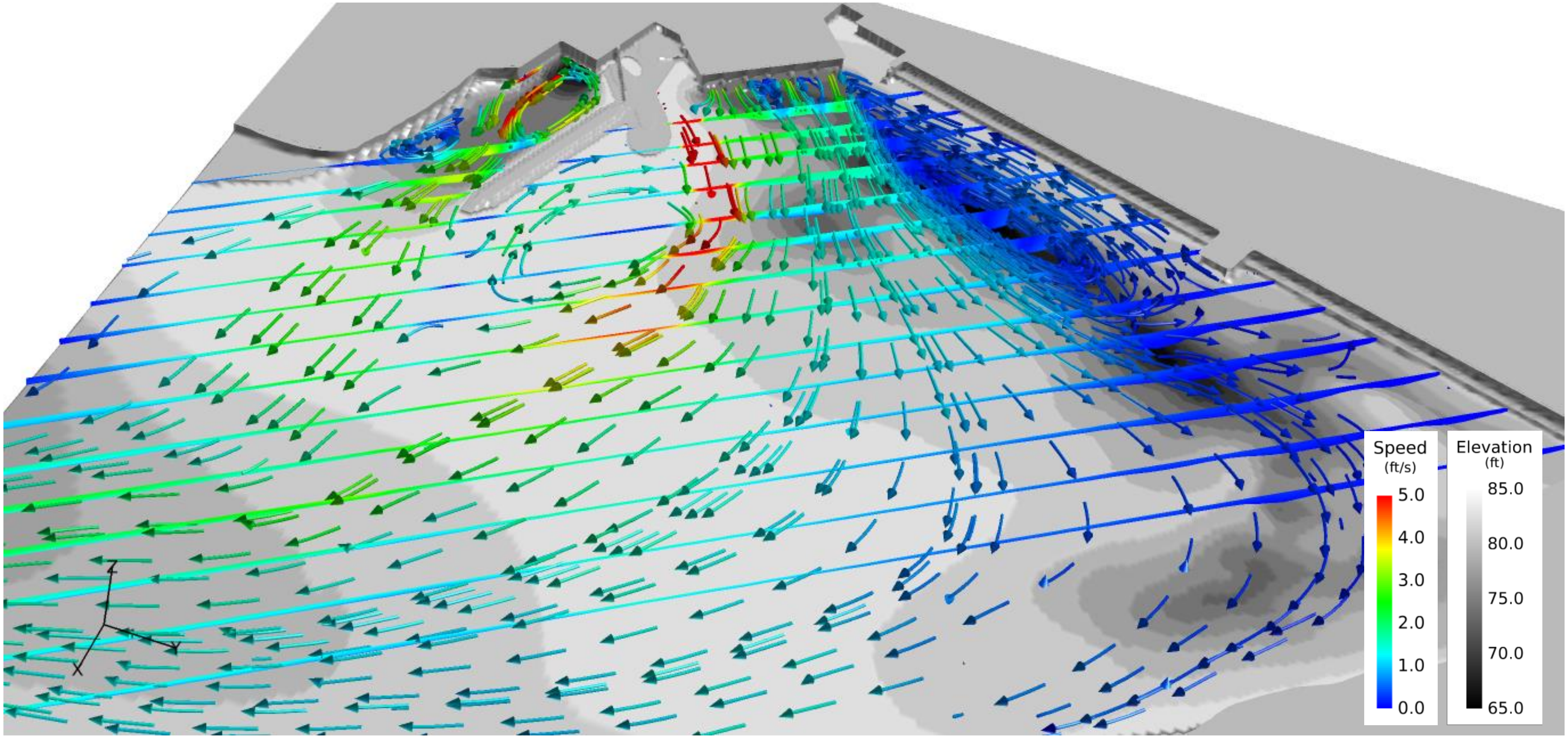
Flow Speed Distribution – Elevation 87.975 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 05



Streamlines - Colored by Speed
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 05



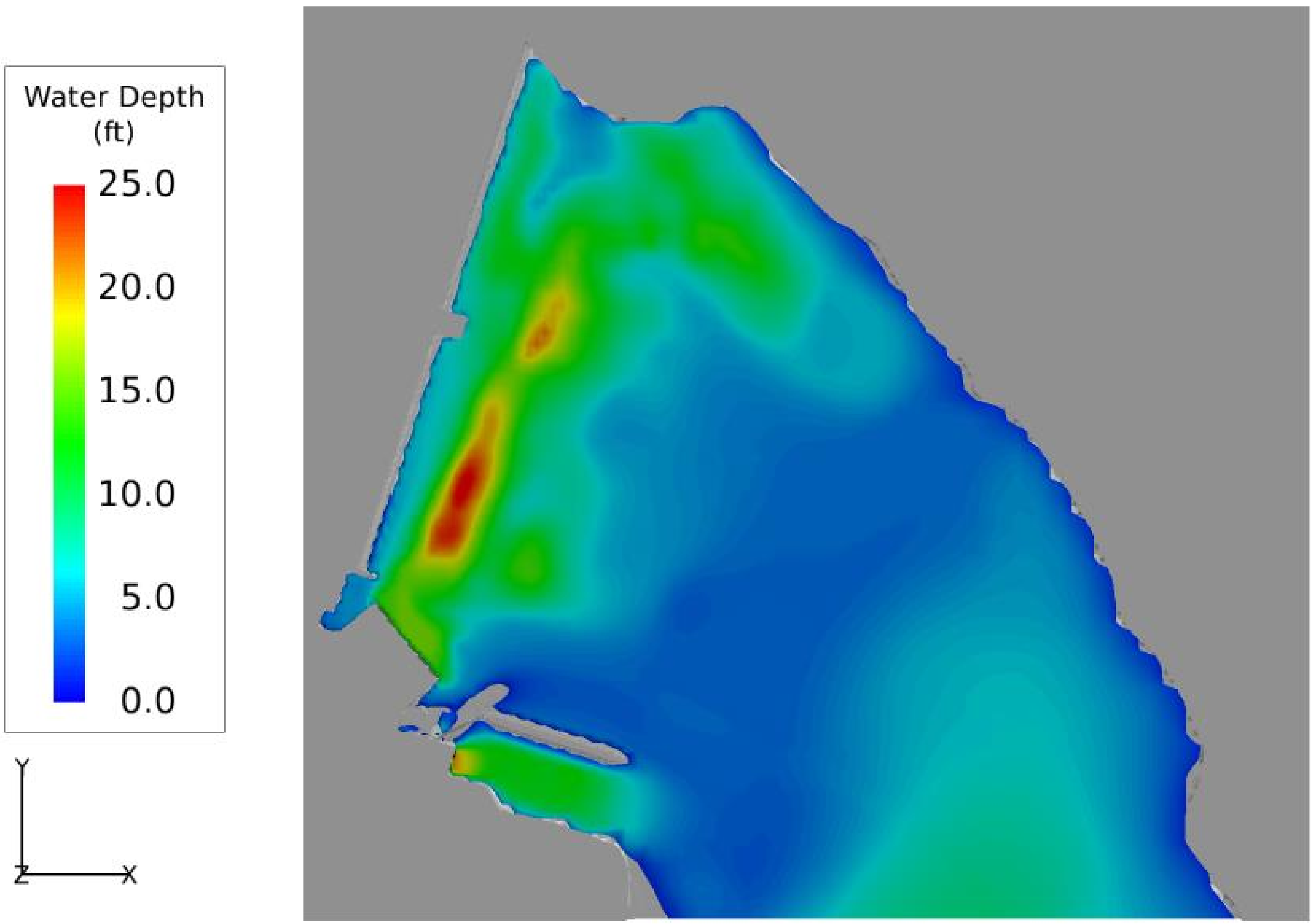
Vertical Variation of Flow Speed and Streamlines
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 06

Boundary Conditions

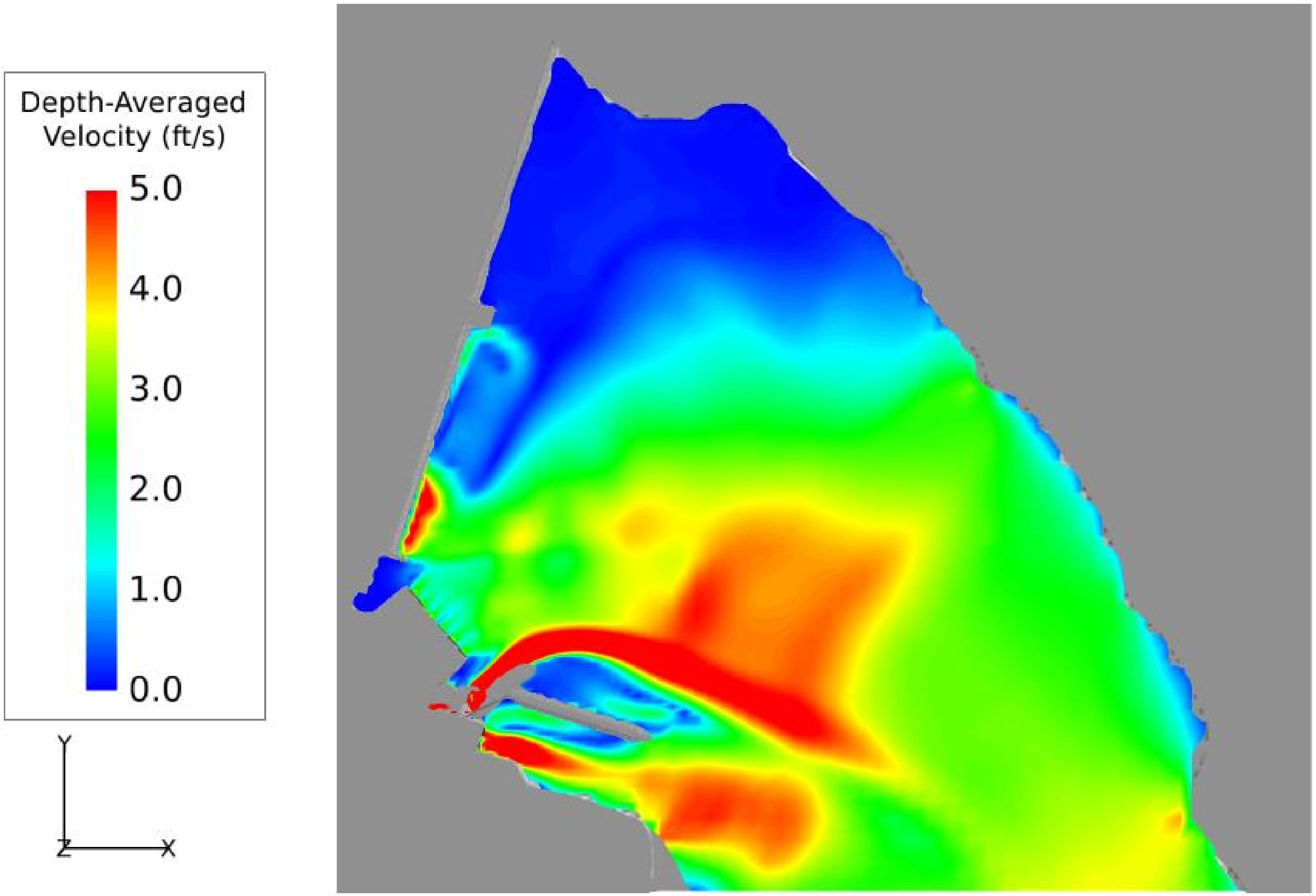
Flow Exceedance	15%
Total Flow	10,750 cfs
Tailwater Elevation	88.6/90.1 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	634 cfs
Unit 03 Discharge	634 cfs
Unit 04 Discharge	611 cfs
Unit 05 Discharge	703 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	1433 cfs
10 ft x 7 ft Tainter Gate	600 cfs
S Flashboards	3,400 cfs
M Flashboards	0 cfs
S Rubber Dam	0 cfs

Shawmut – Case 06



Water Depth, Plan View
(red > 25.0 ft)

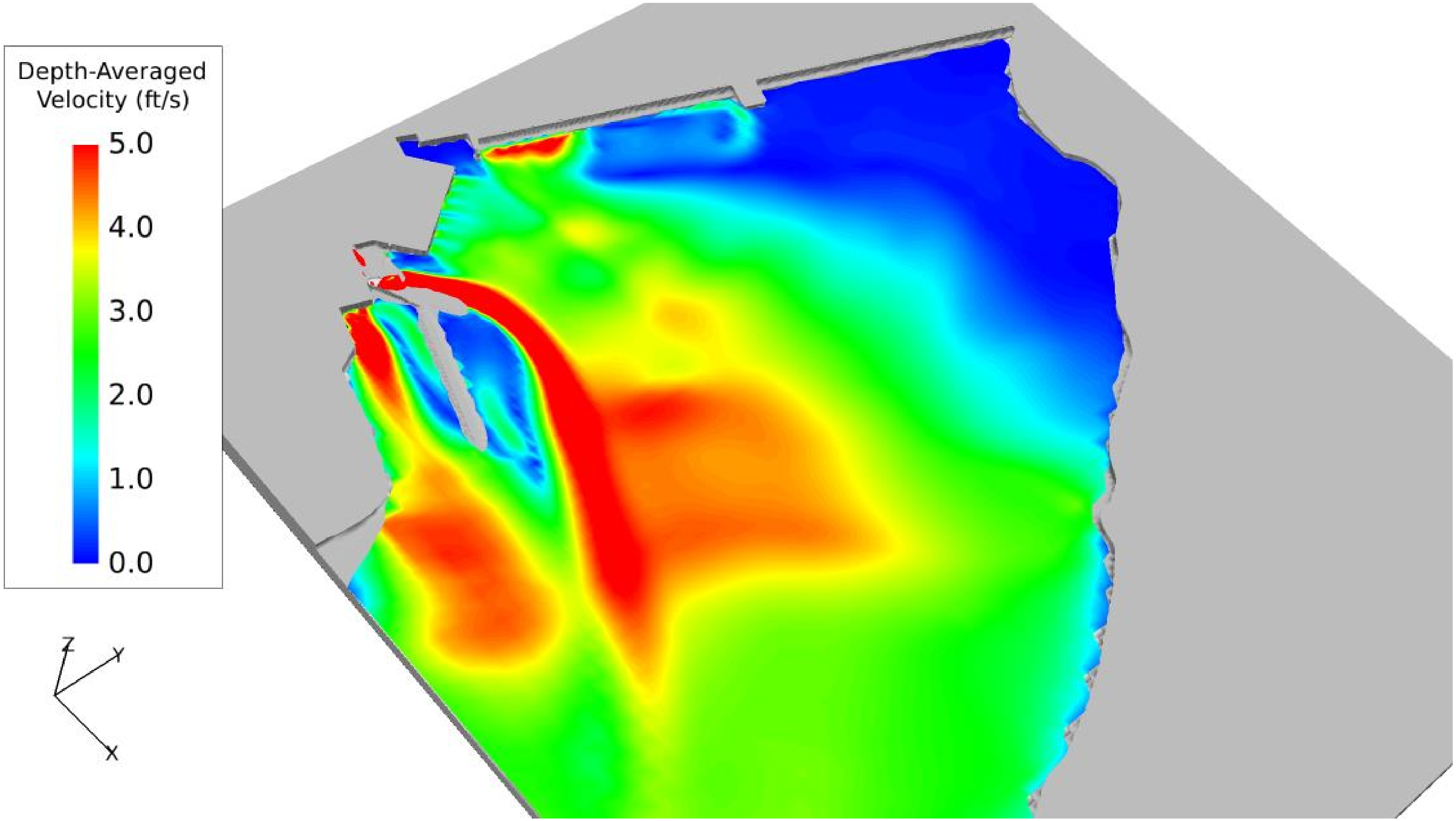
Shawmut – Case 06



Depth-Averaged Velocity, Plan View (red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

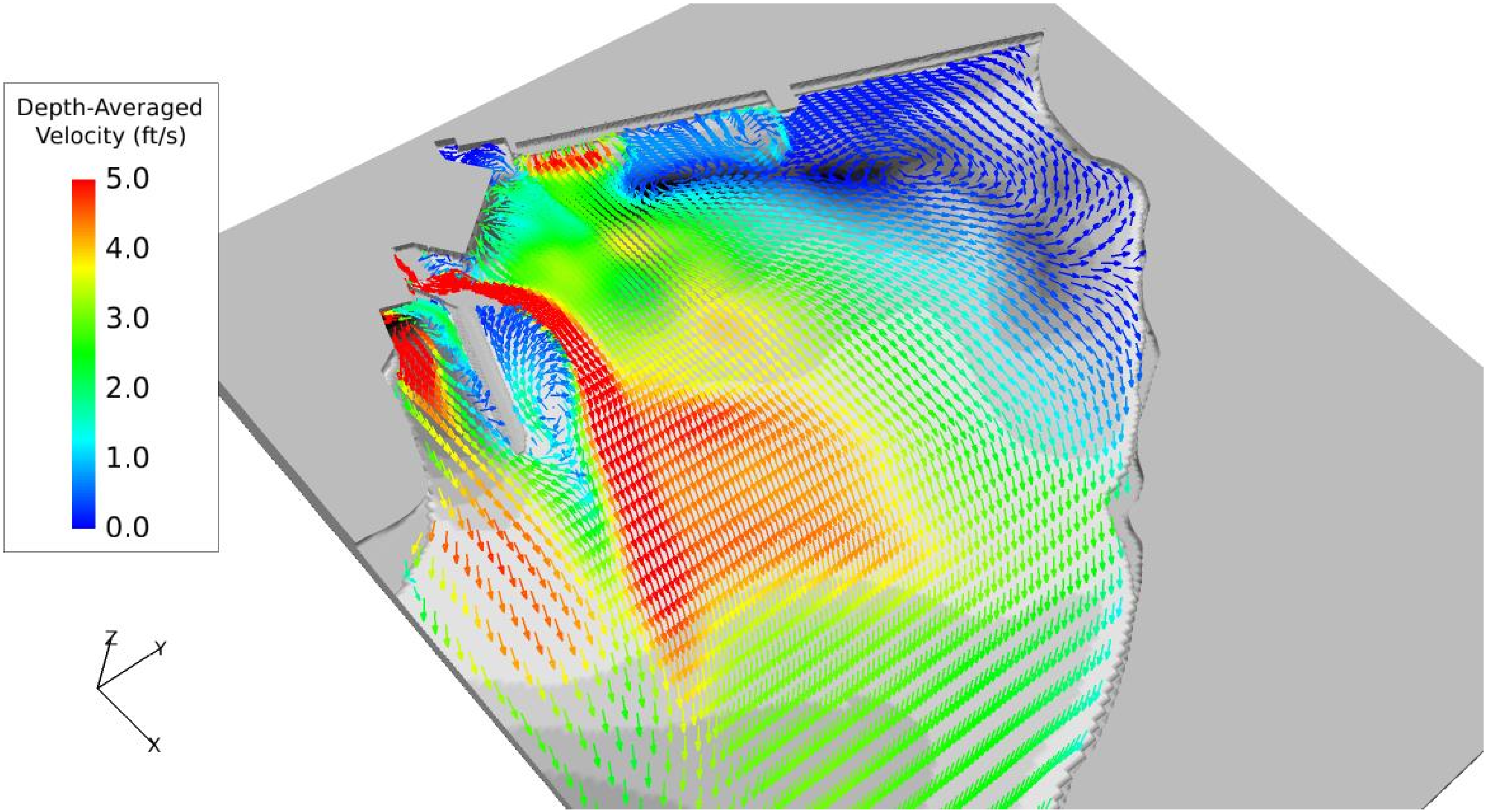
Shawmut – Case 06



Depth-Averaged Velocity, Oblique View (red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

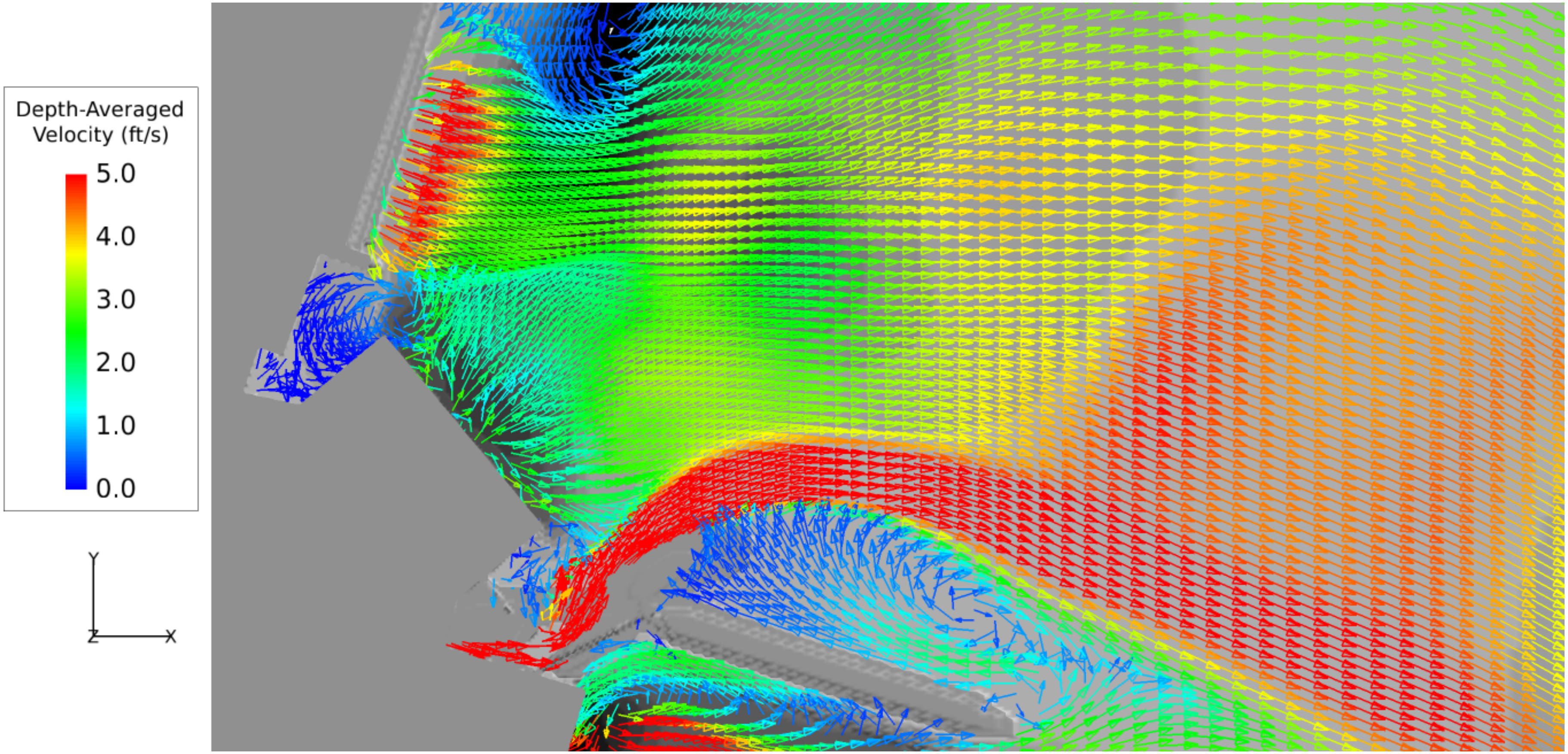
Shawmut – Case 06



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 5.0 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

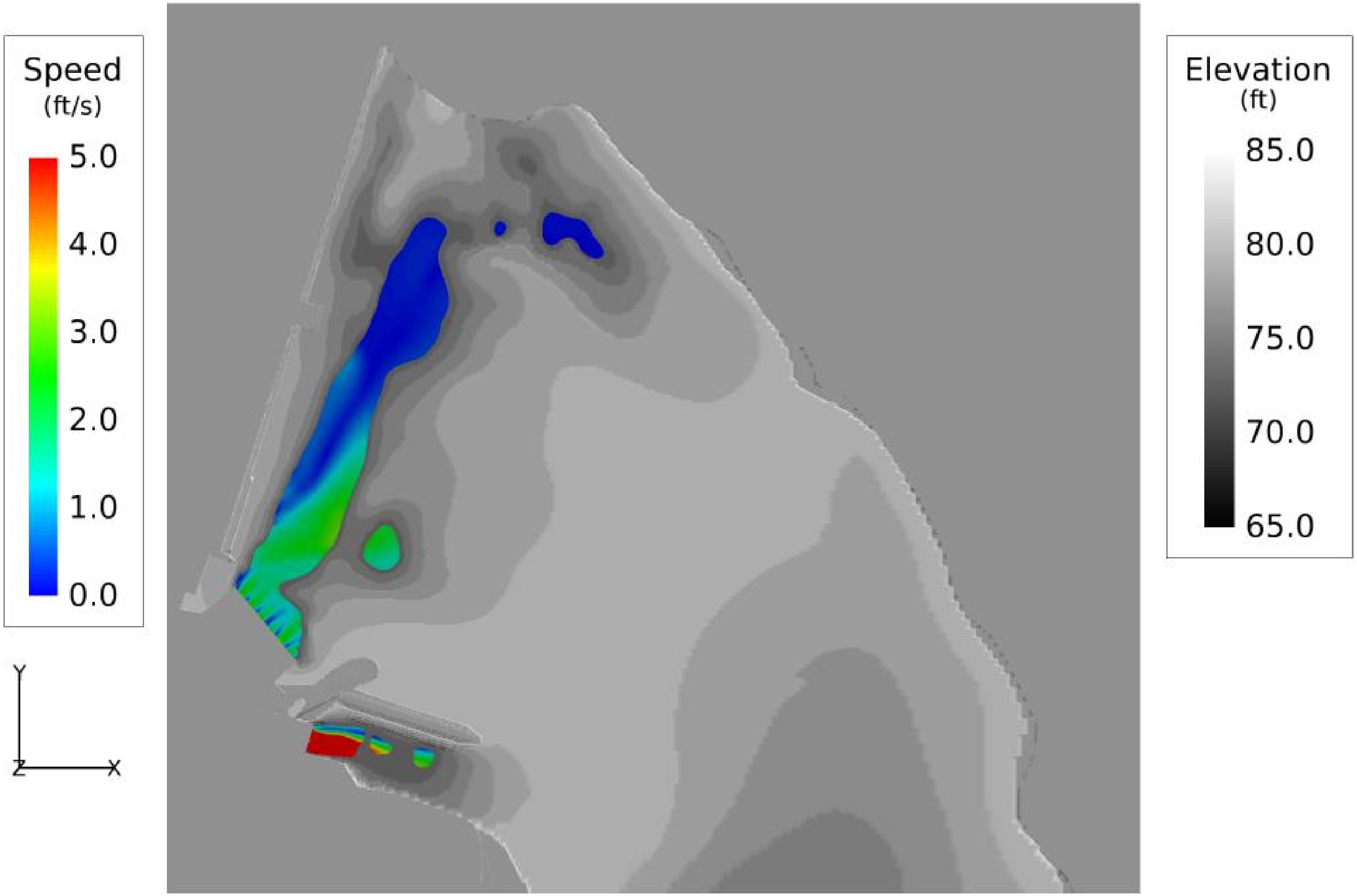
Shawmut – Case 06



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 5.0 ft/s)

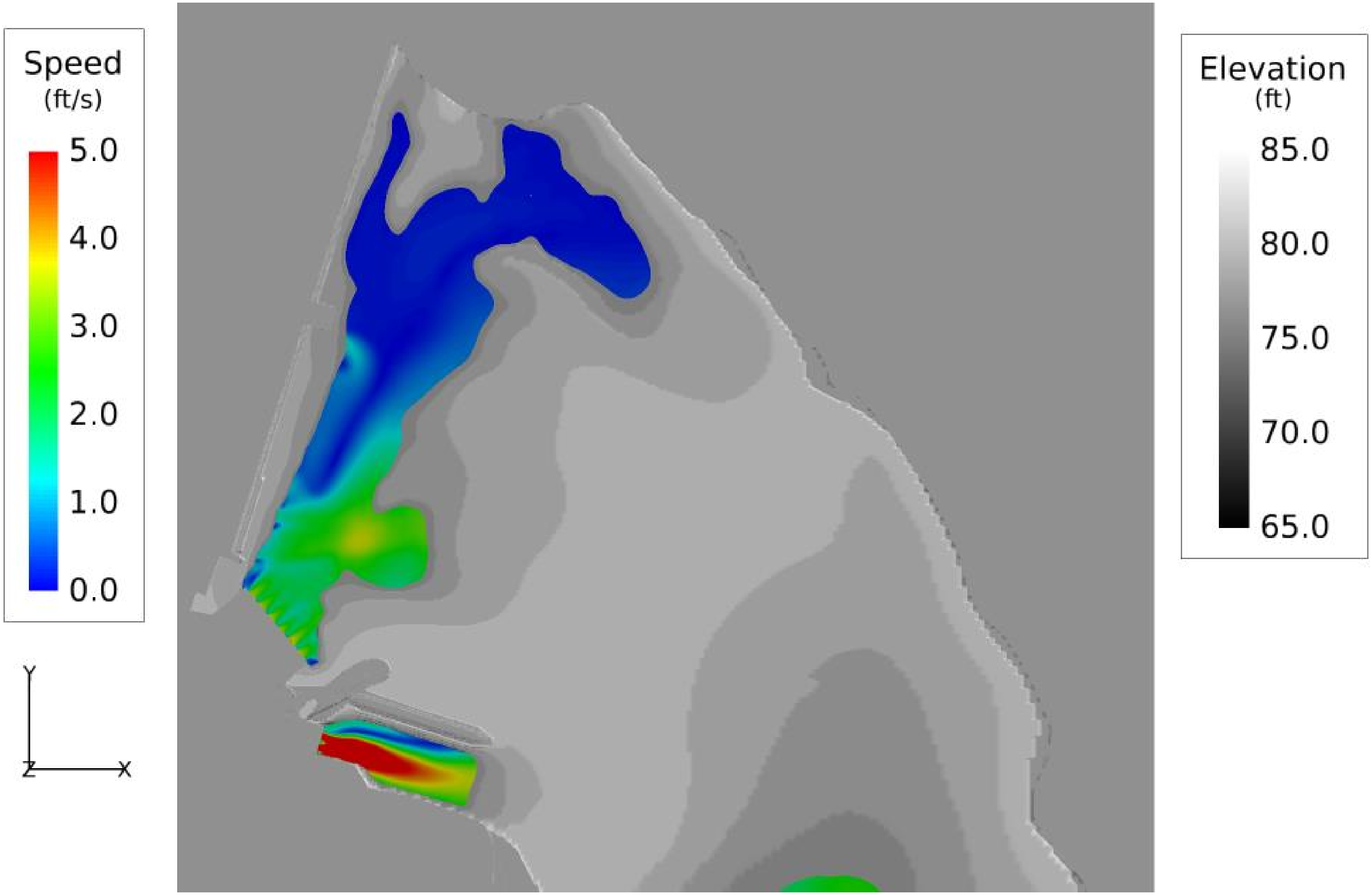
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 06



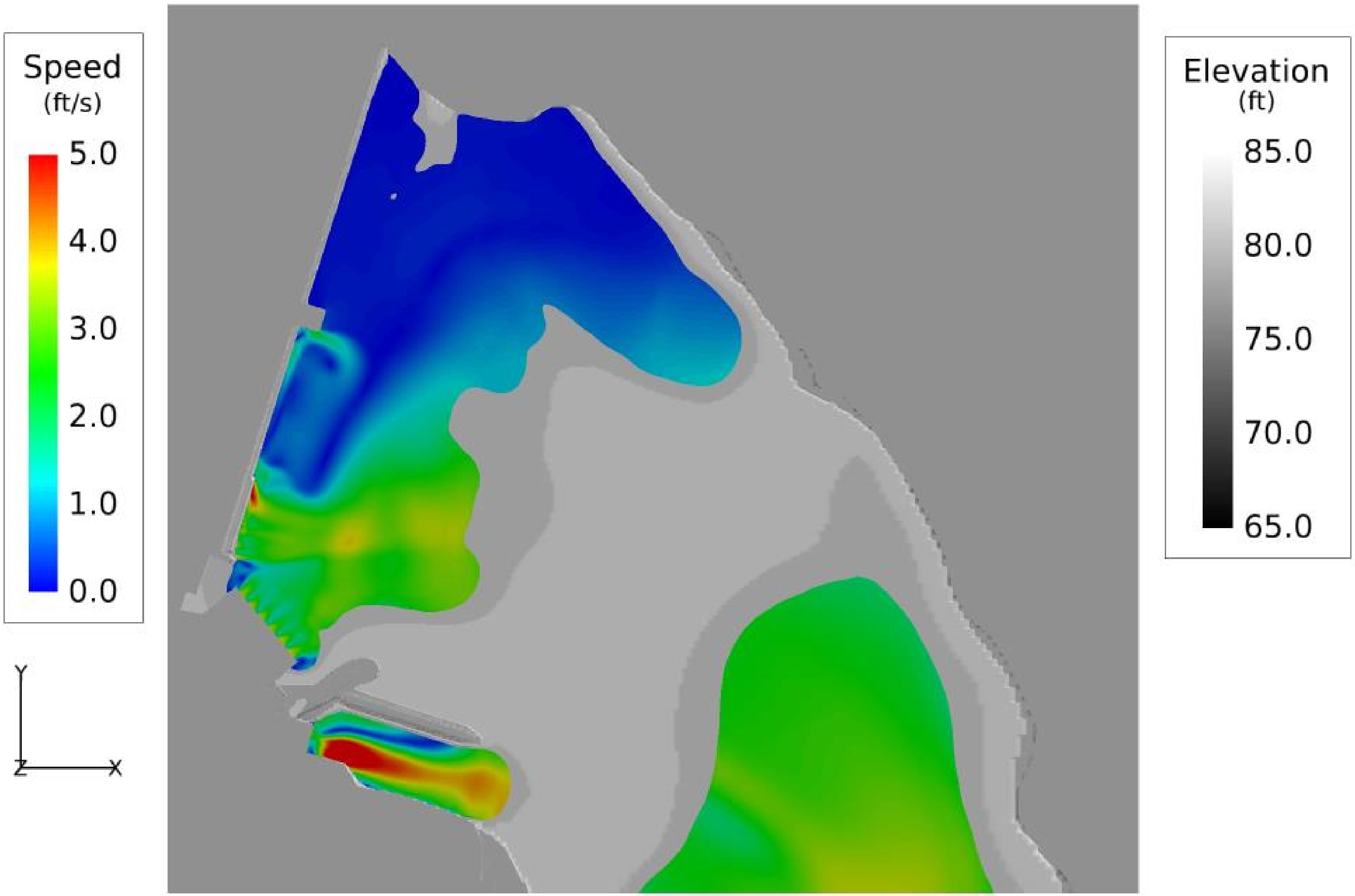
Flow Speed Distribution, Elevation 76.875 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 06



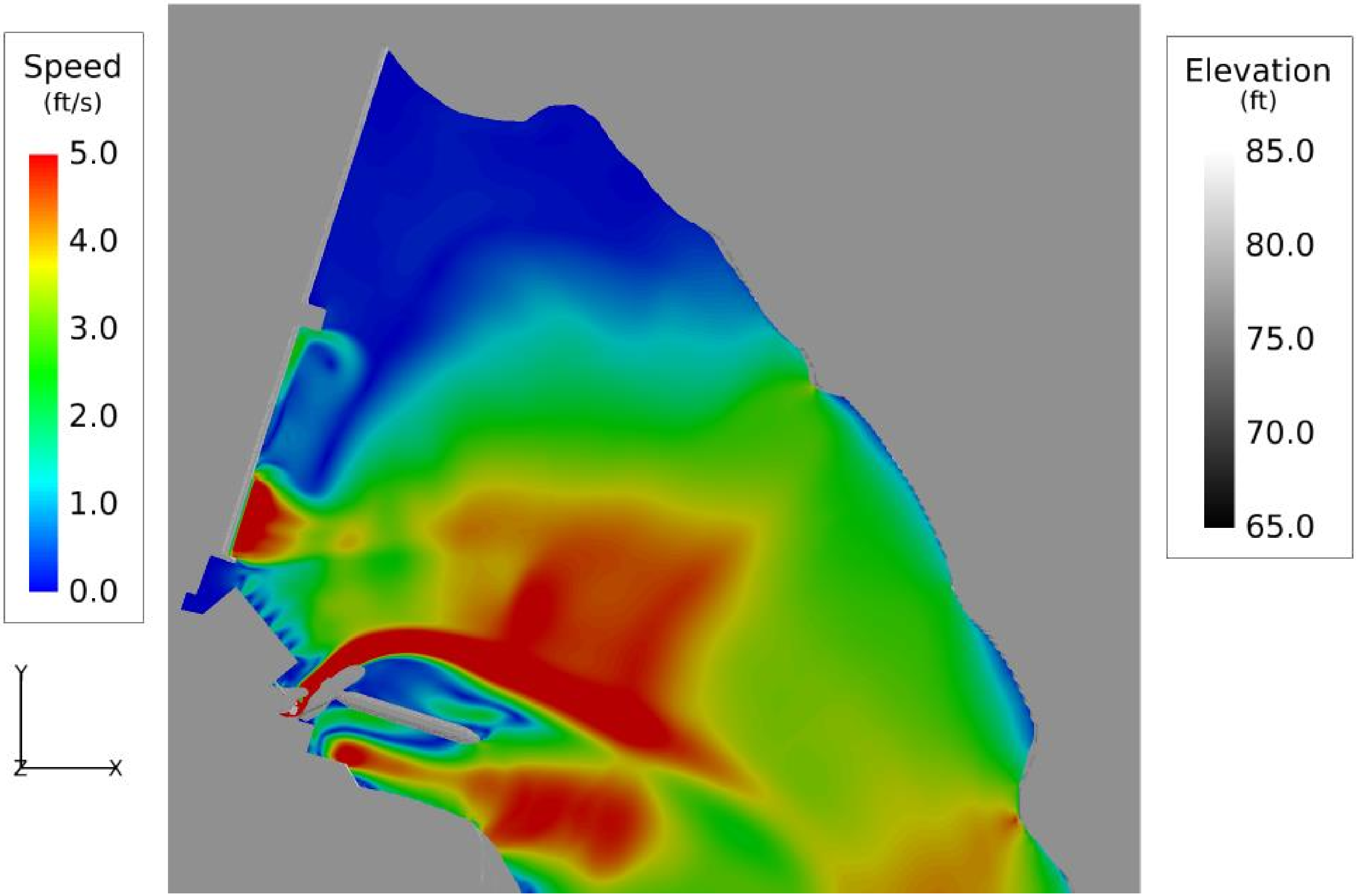
Flow Speed Distribution – Elevation 80.575 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 06



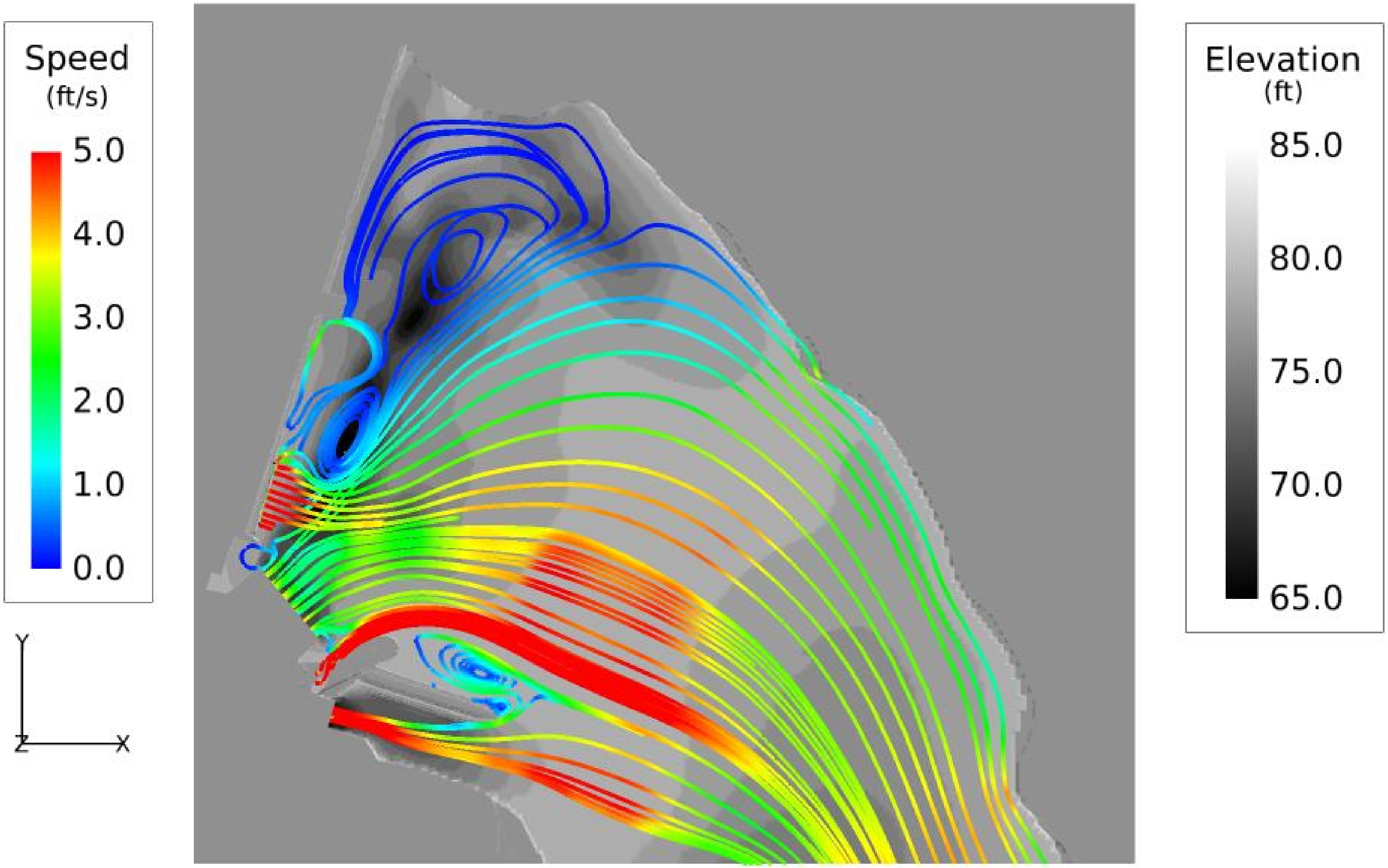
Flow Speed Distribution – Elevation 84.275 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 06



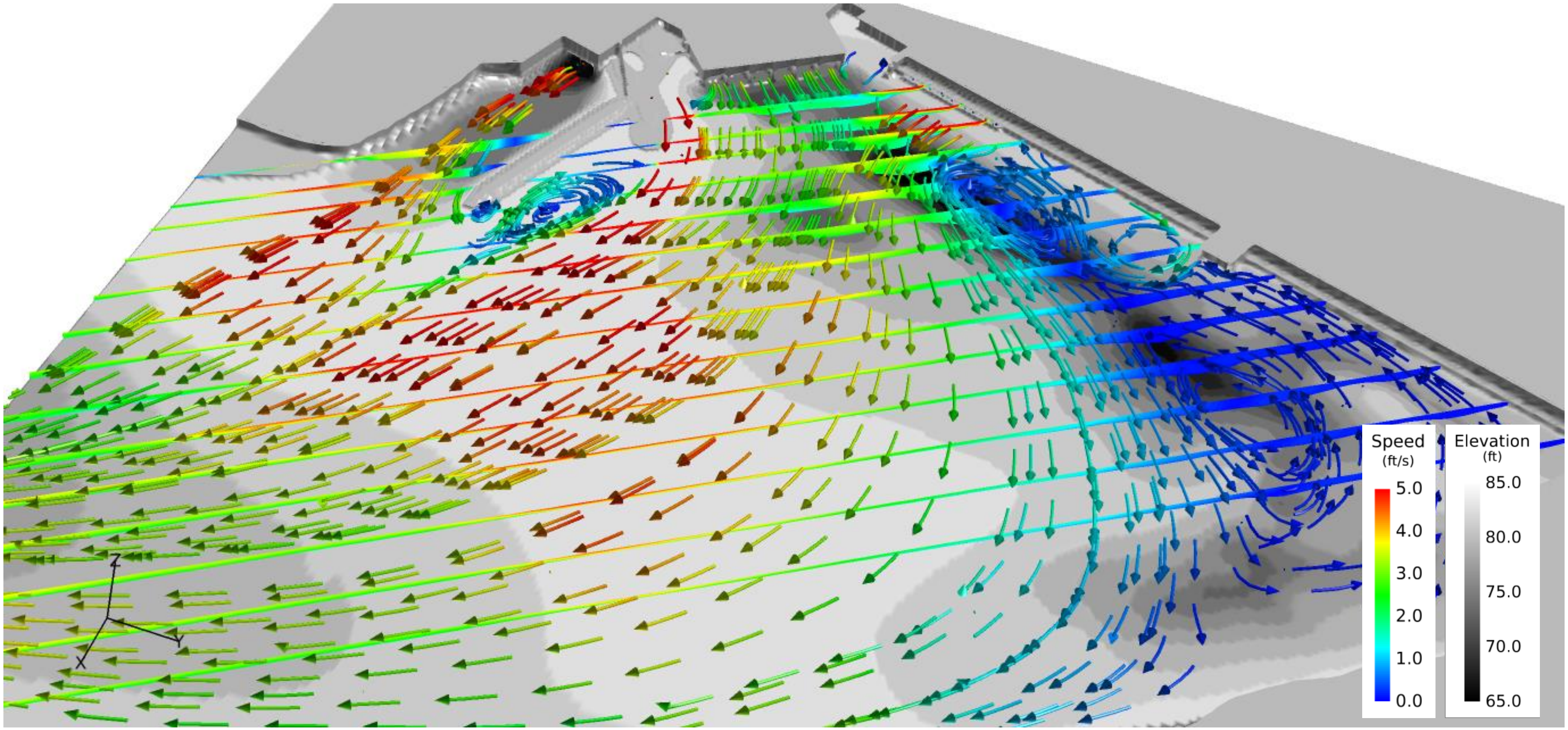
Flow Speed Distribution – Elevation 87.975 ft
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 06



Streamlines - Colored by Speed
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 06



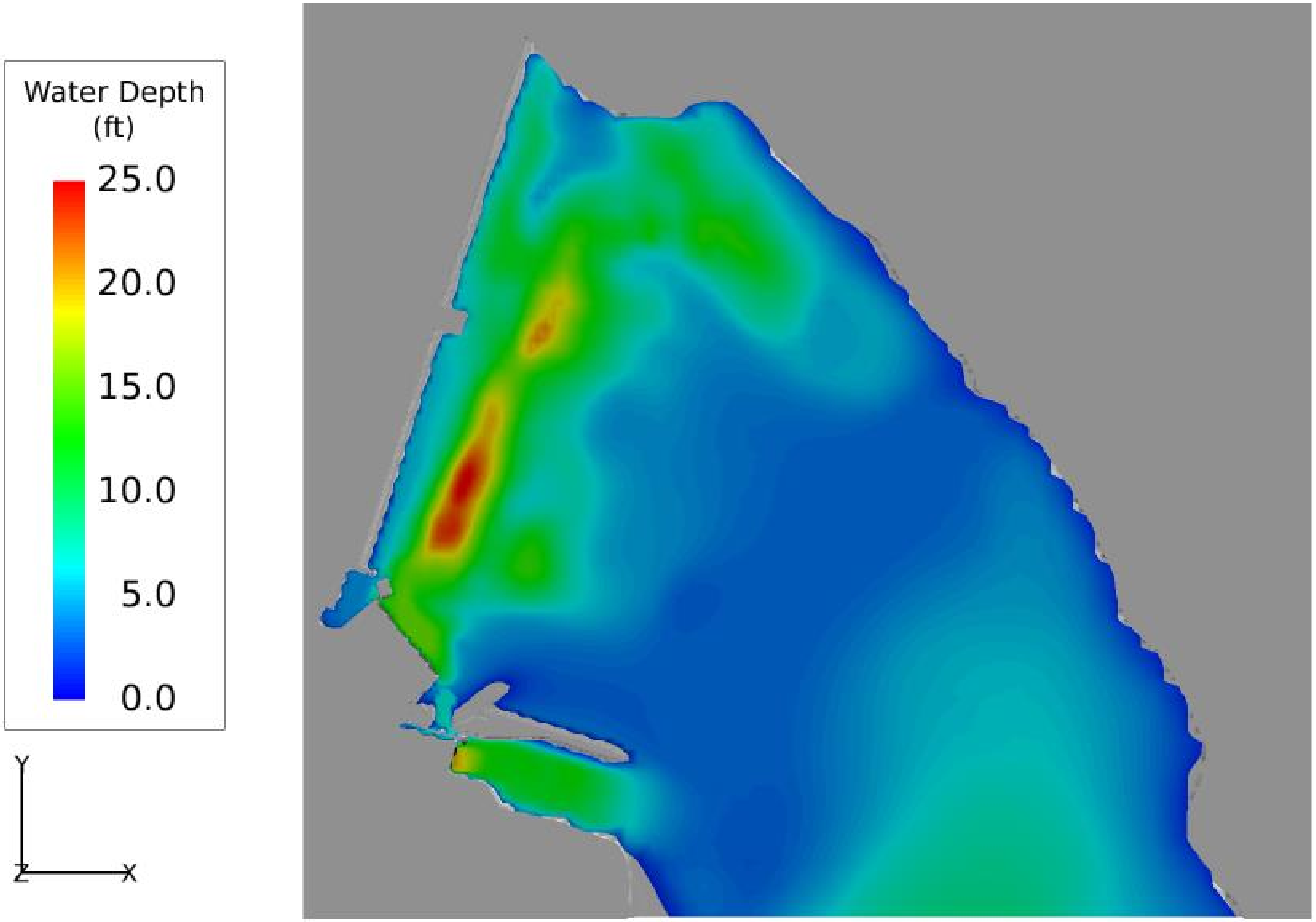
Vertical Variation of Flow Speed and Streamlines
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut - Case 07

Boundary Conditions

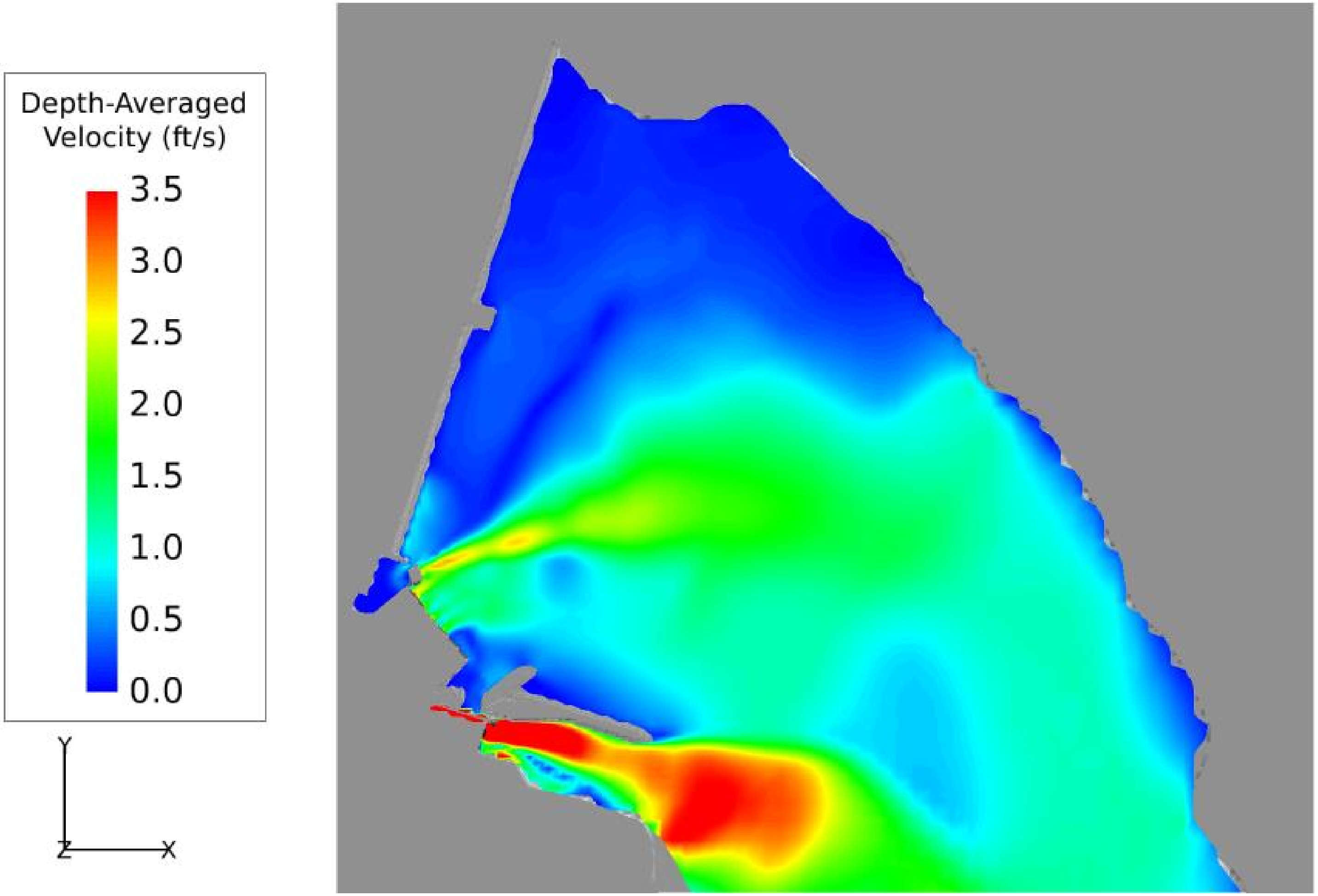
Flow Exceedance	50%
Total Flow	4,790 cfs
Tailwater Elevation	87.5/89.0 ft
Unit 01 Discharge	635 cfs
Unit 02 Discharge	462 cfs
Unit 03 Discharge	457 cfs
Unit 04 Discharge	434 cfs
Unit 05 Discharge	0 cfs
Unit 06 Discharge	0 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	0 cfs
10 ft x 7 ft Tainter Gate	600 cfs
S Flashboards	420 cfs
Fish Lift Entrance	100 cfs
Fish Lift Attraction Flow	230 cfs

Shawmut – Case 07



Water Depth, Plan View
(red > 25.0 ft)

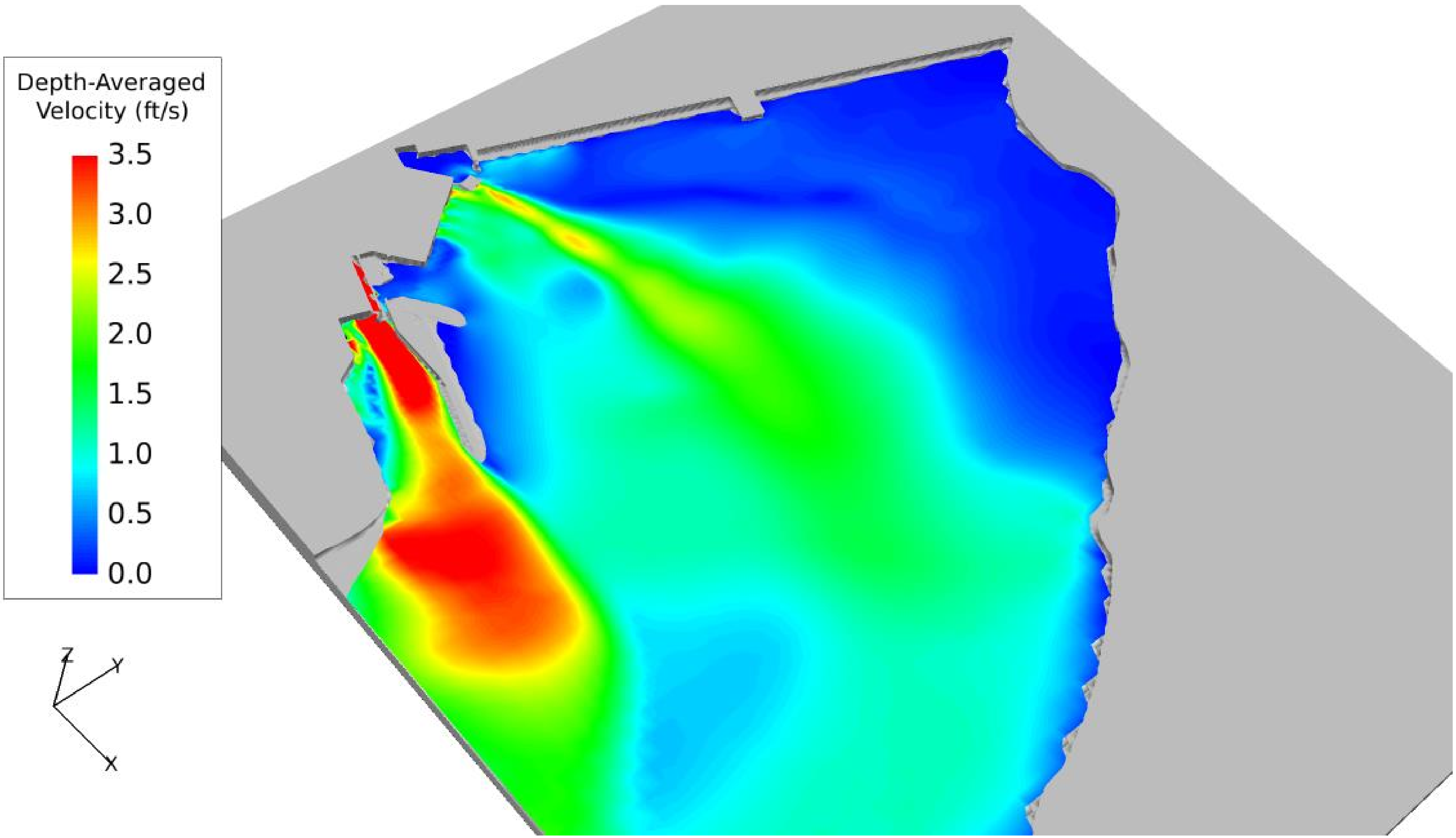
Shawmut – Case 07



Depth-Averaged Velocity, Plan View (red > 3.5 ft/s)

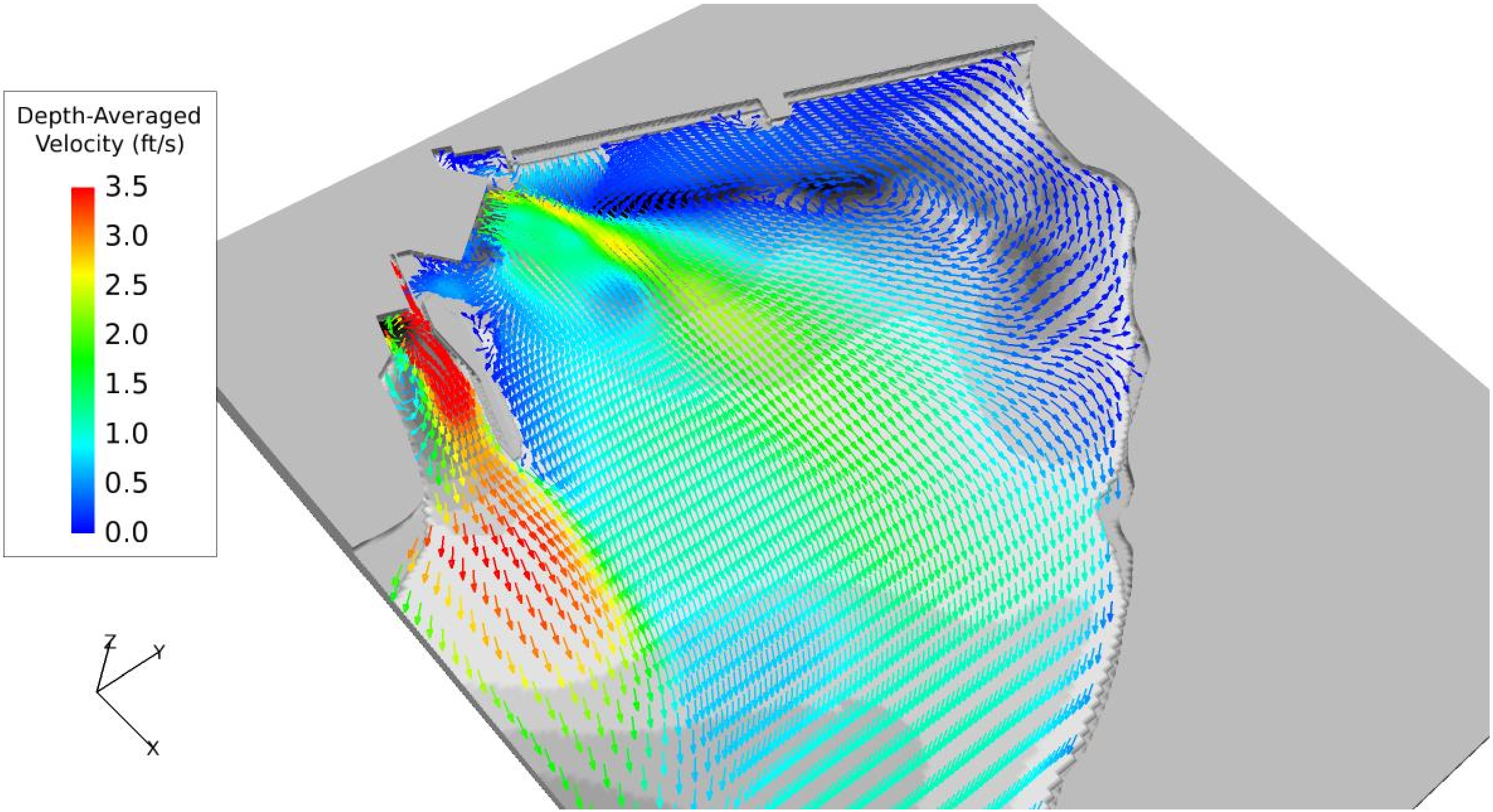
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 07



Depth-Averaged Velocity, Oblique View (red > 3.5 ft/s)

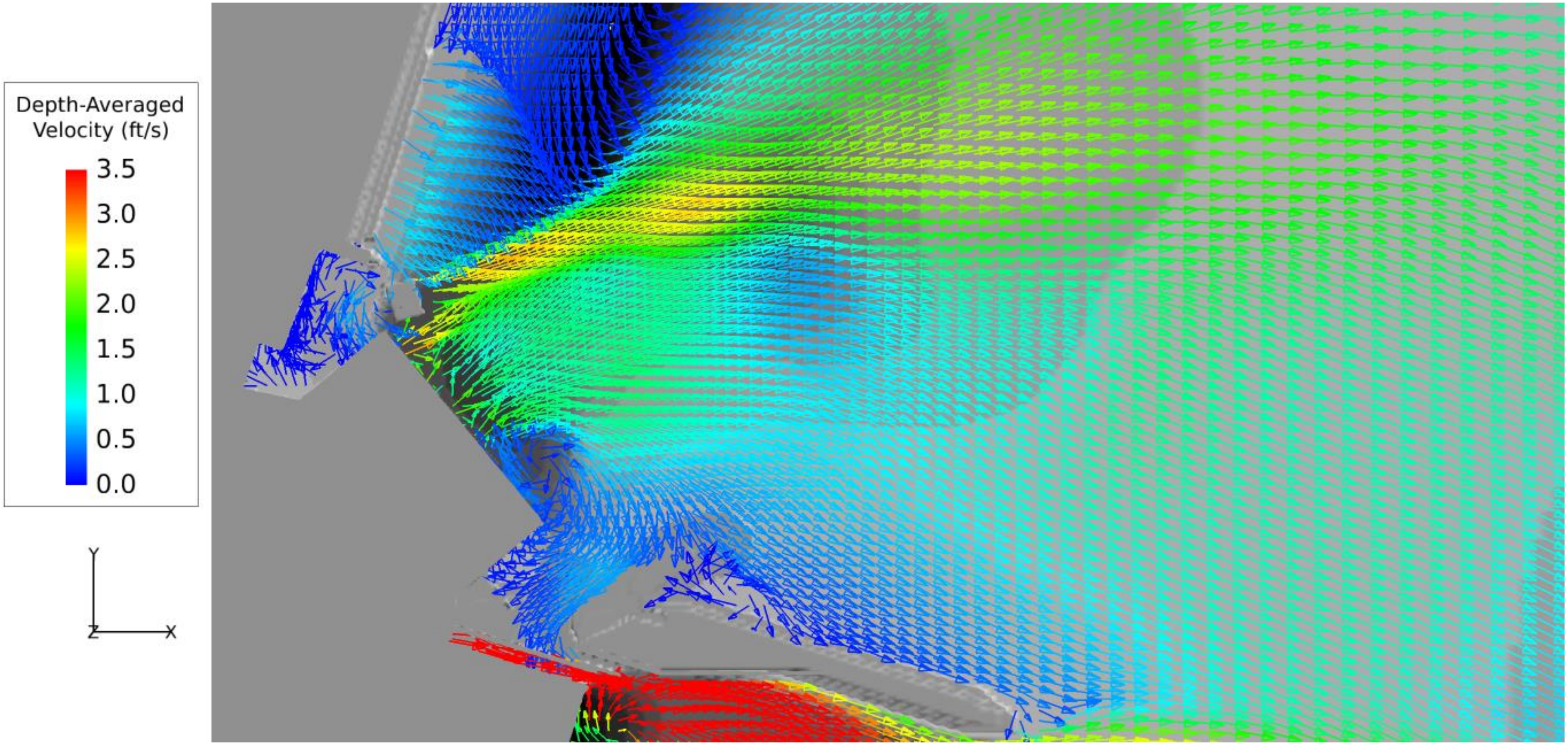
Shawmut – Case 07



Unit Vectors at Free Surface, Oblique View, Every 4th Vector
(red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

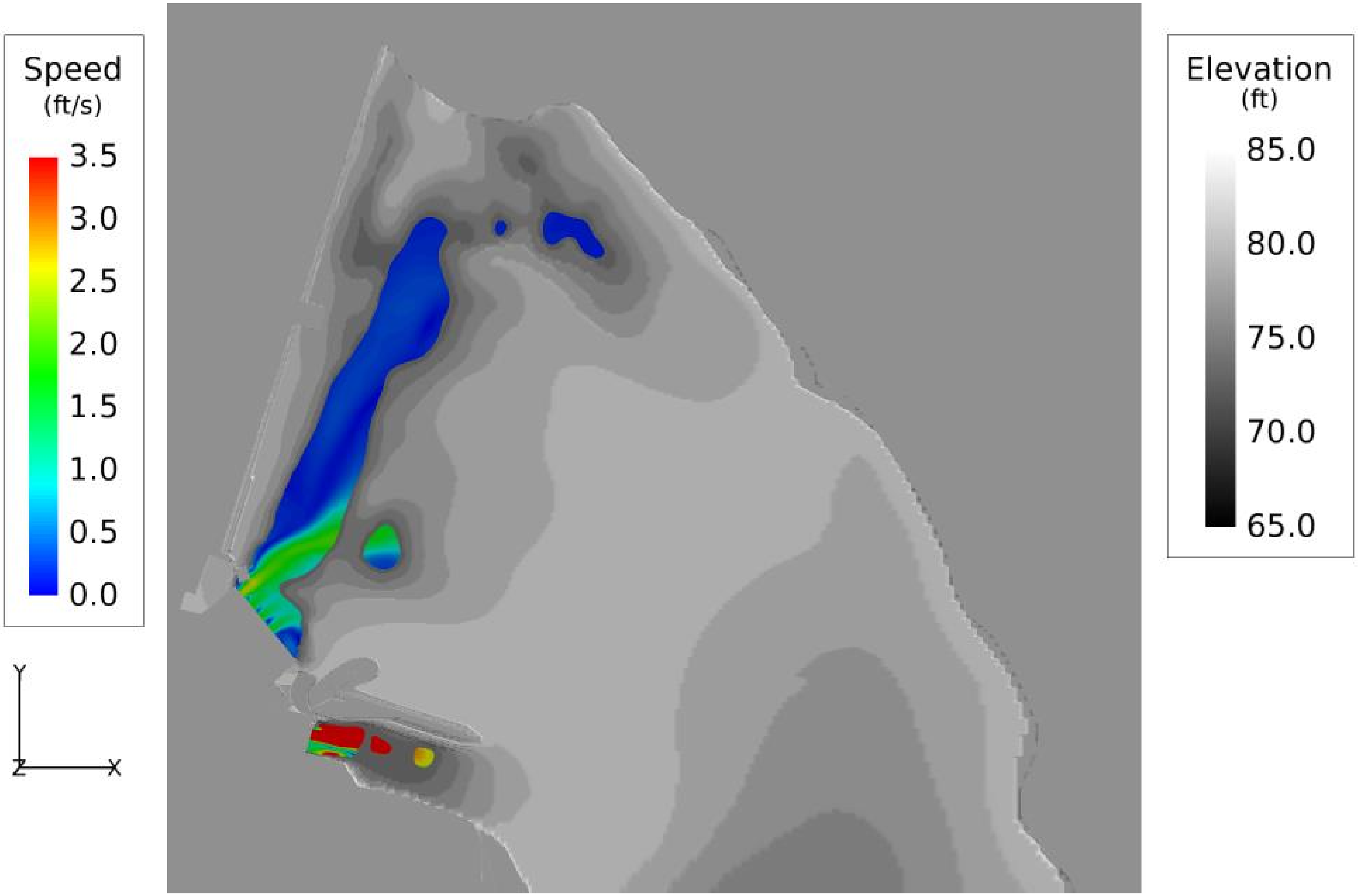
Shawmut – Case 07



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 3.5 ft/s)

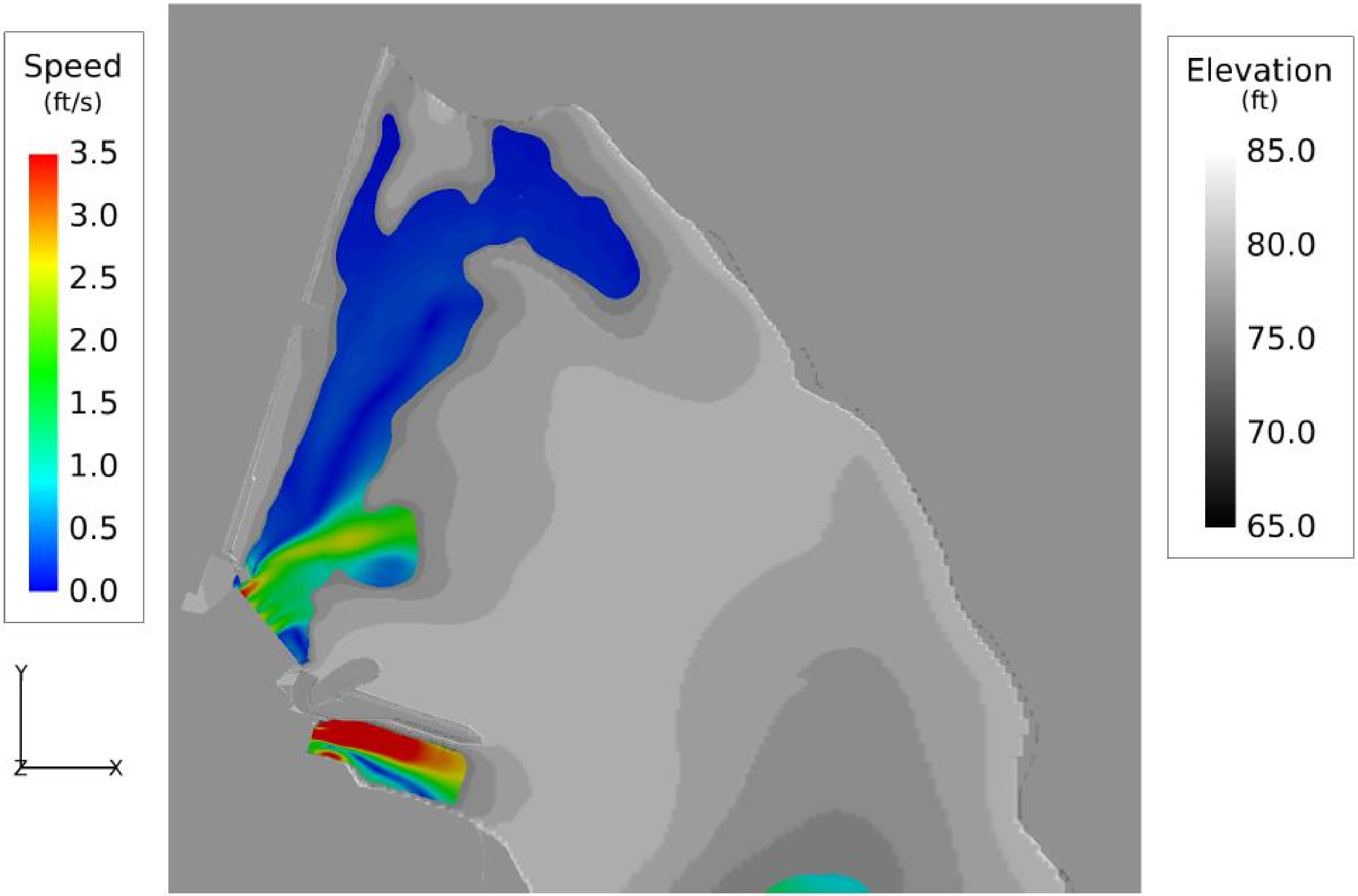
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 07



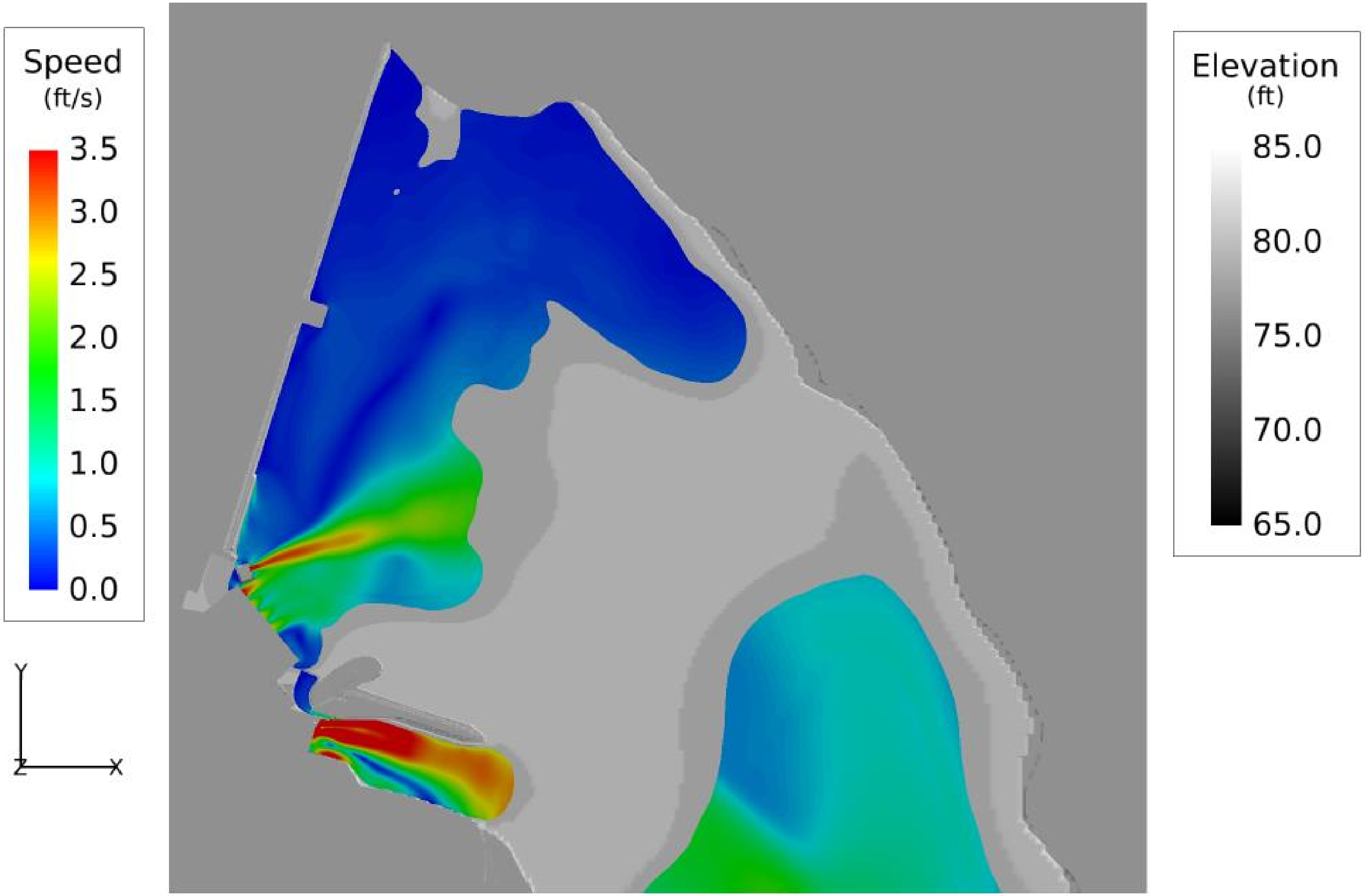
Flow Speed Distribution, Elevation 76.875 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 07



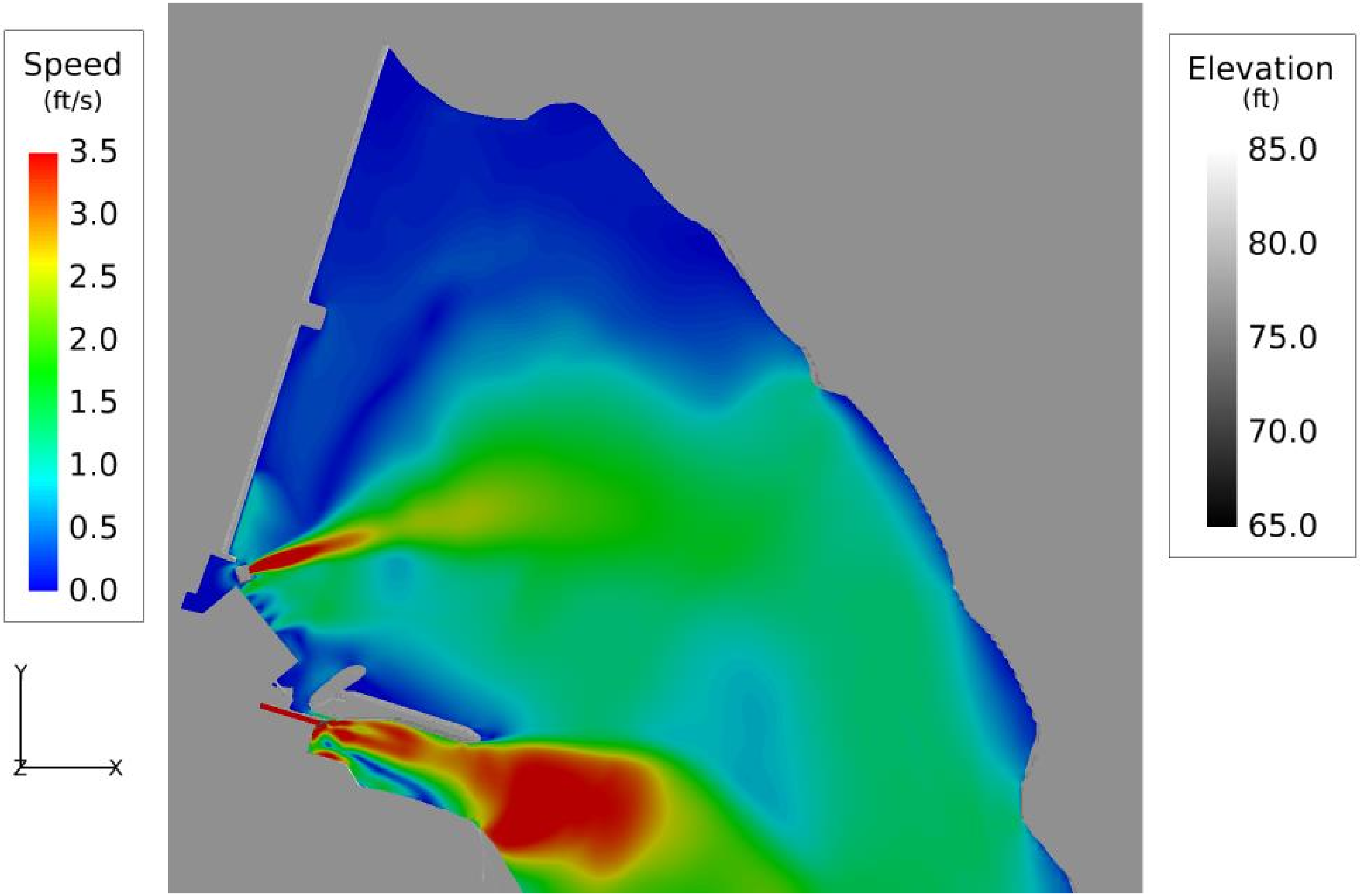
Flow Speed Distribution – Elevation 80.575 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 07



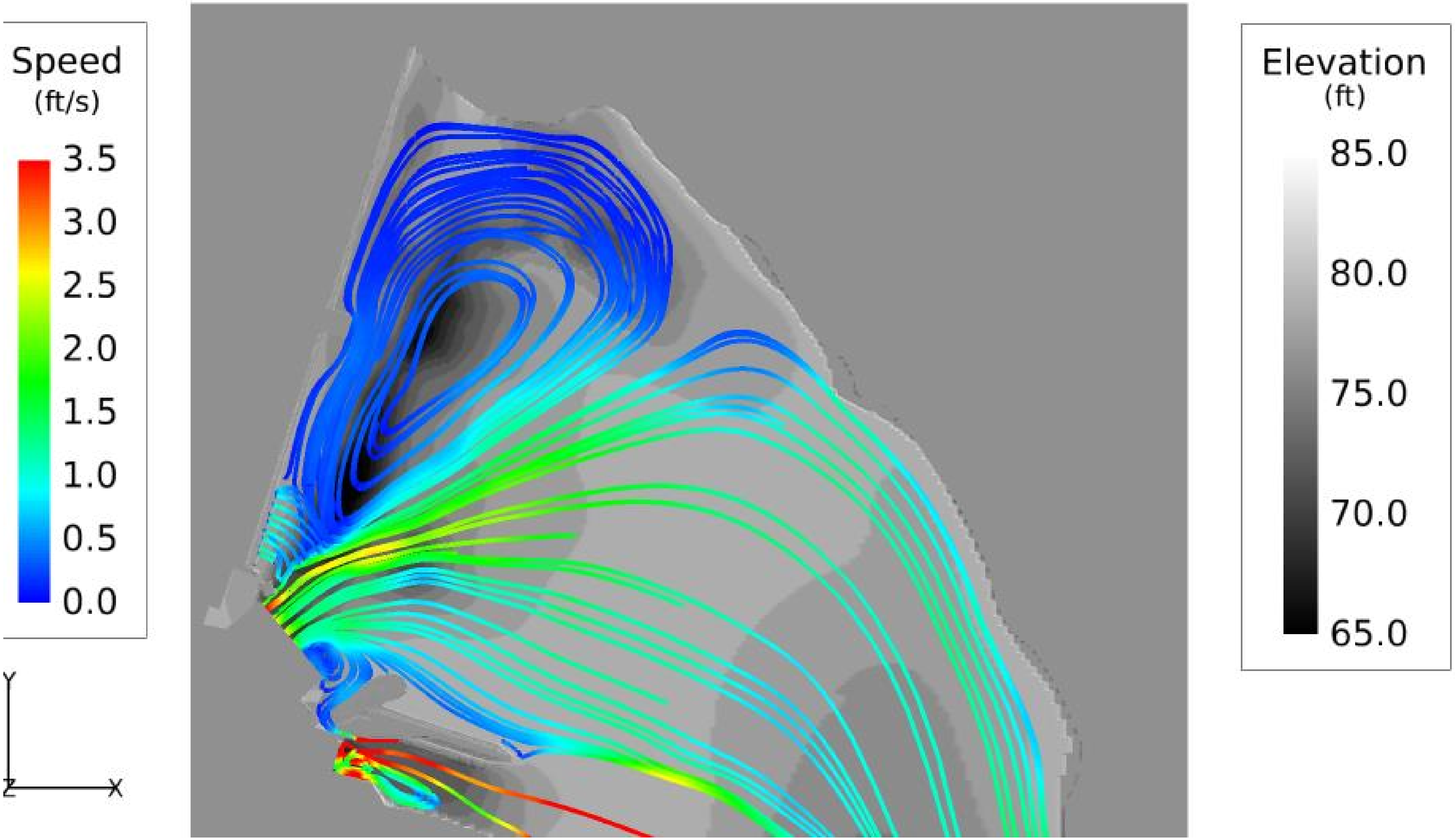
Flow Speed Distribution – Elevation 84.275 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 07



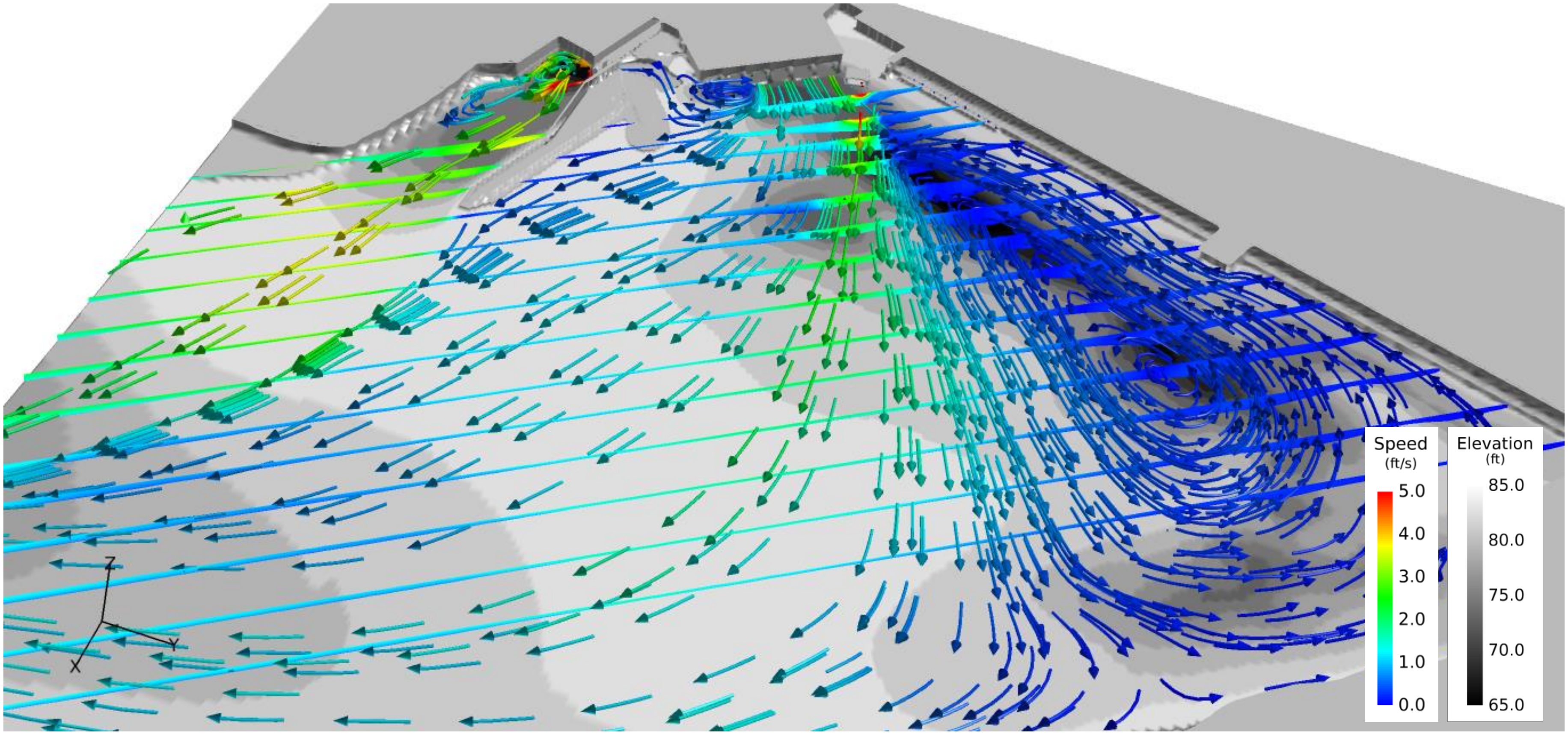
Flow Speed Distribution – Elevation 87.975 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 07



Streamlines - Colored by Speed
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 07



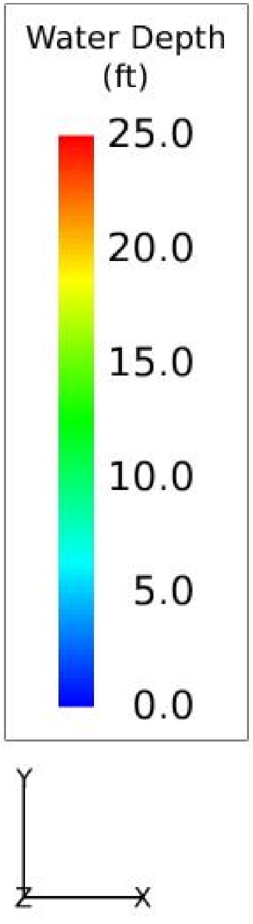
Vertical Variation of Flow Speed and Streamlines (red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

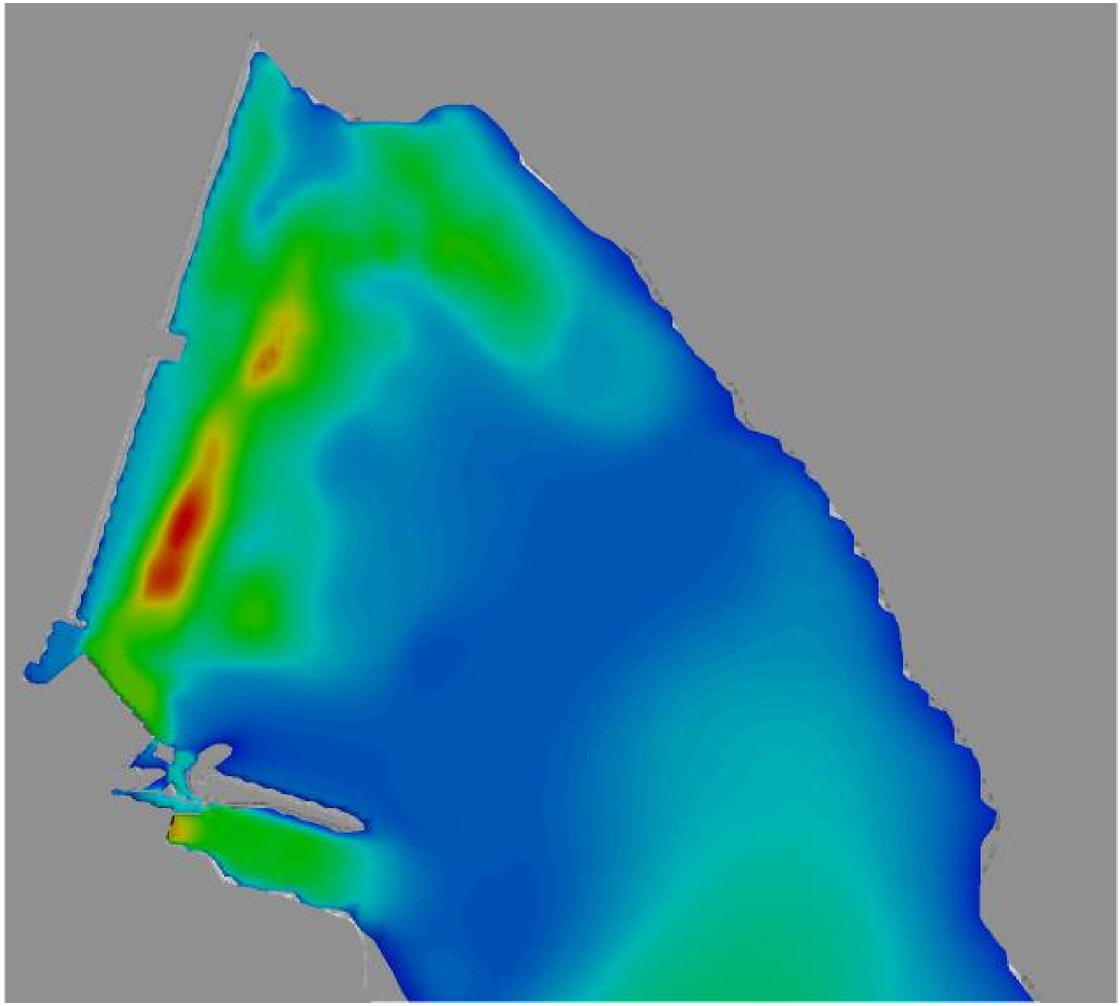
Shawmut – Case 08

Boundary Conditions

Flow Exceedance	50%
Total Flow	4,790 cfs
Tailwater Elevation	87.5/89.0 ft
Unit 01 Discharge	0 cfs
Unit 02 Discharge	0 cfs
Unit 03 Discharge	431 cfs
Unit 04 Discharge	408 cfs
Unit 05 Discharge	500 cfs
Unit 06 Discharge	649 cfs
Unit 07 Discharge	1451 cfs
Unit 08 Discharge	0 cfs
10 ft x 7 ft Tainter Gate	600 cfs
S Flashboards	420 cfs
Fish Lift Entrance	100 cfs
Fish Lift Attraction Flow	230 cfs

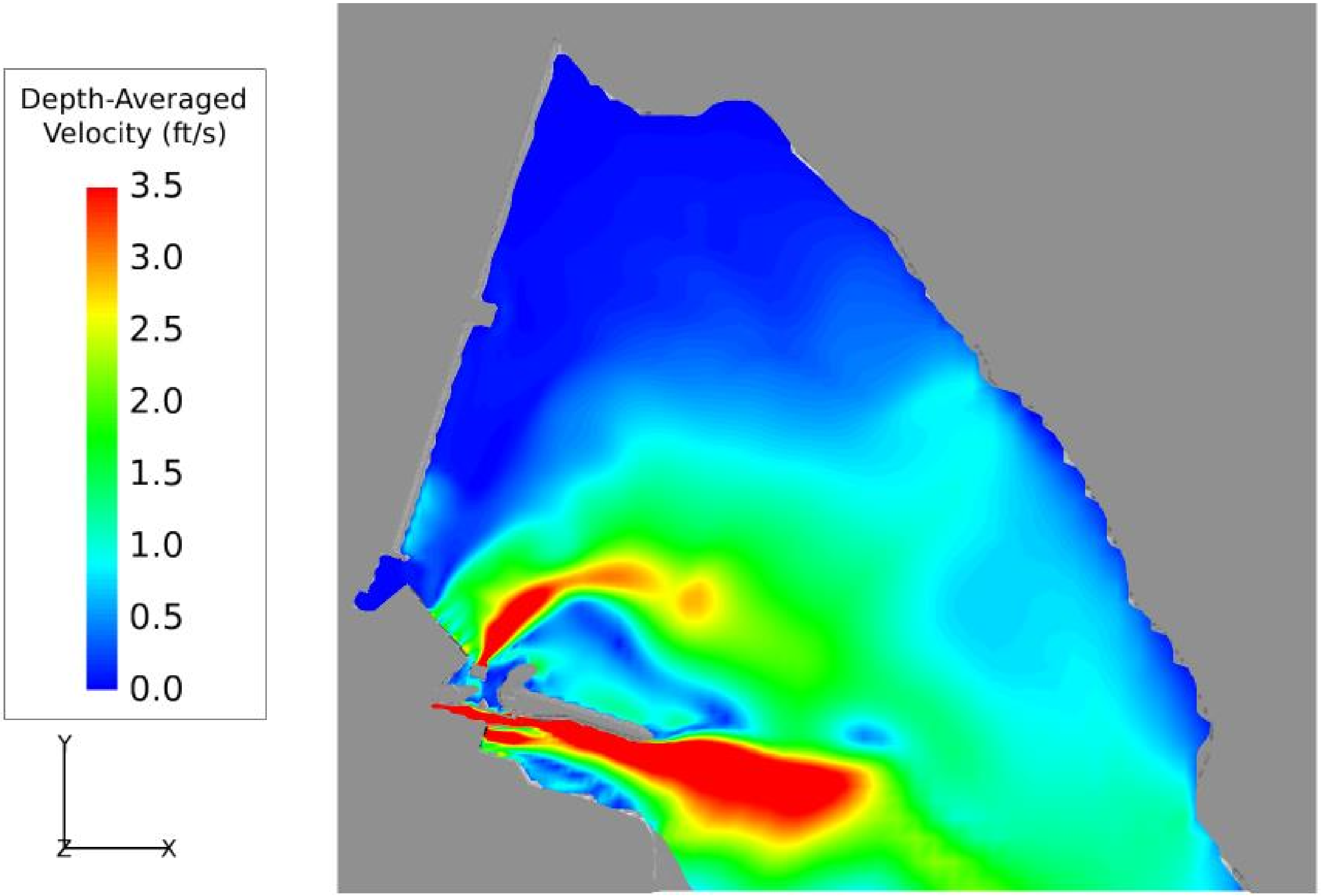
Shawmut – Case 08





Water Depth, Plan View
(red > 25.0 ft)

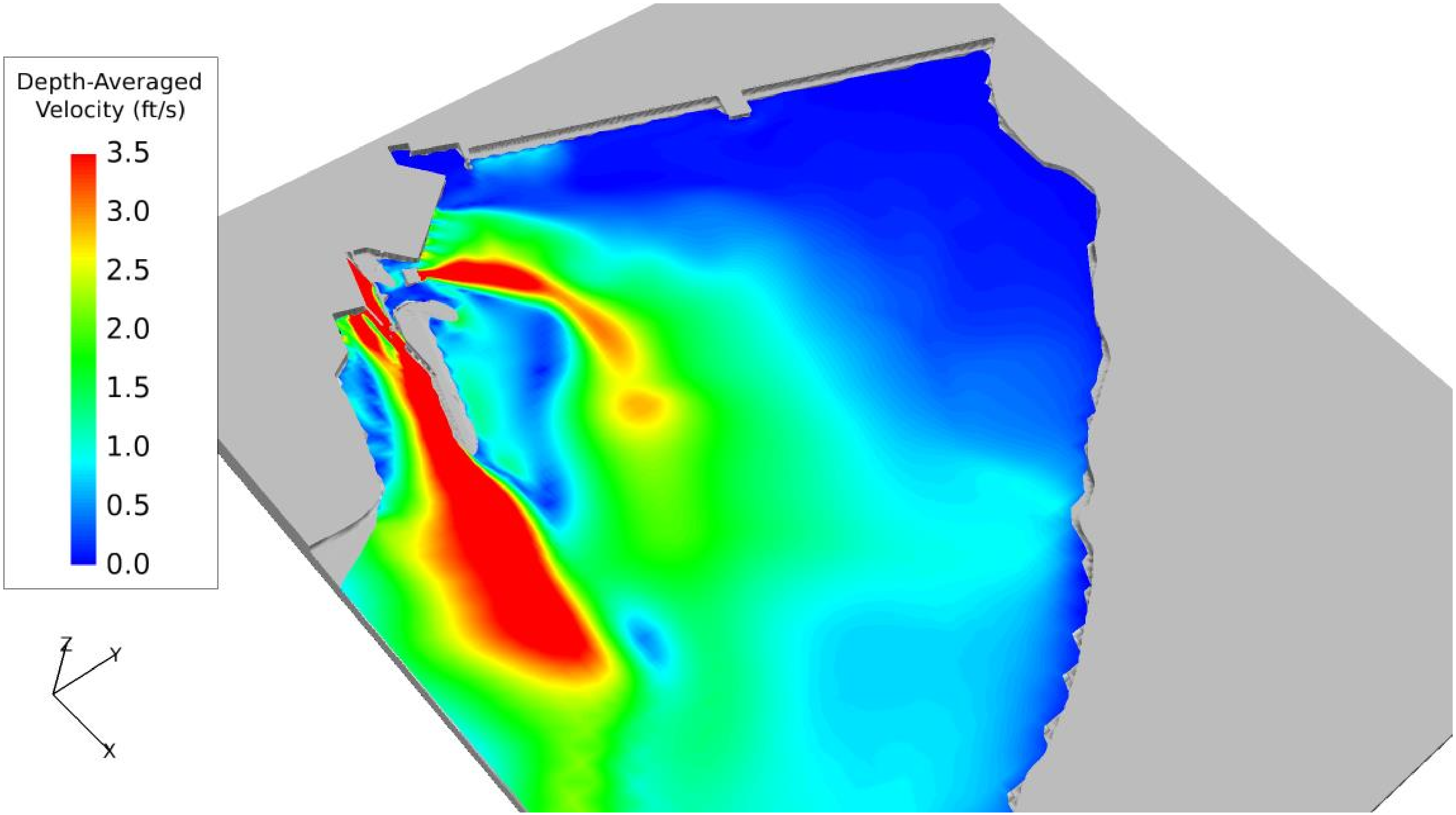
Shawmut – Case 08



Depth-Averaged Velocity, Plan View
(red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

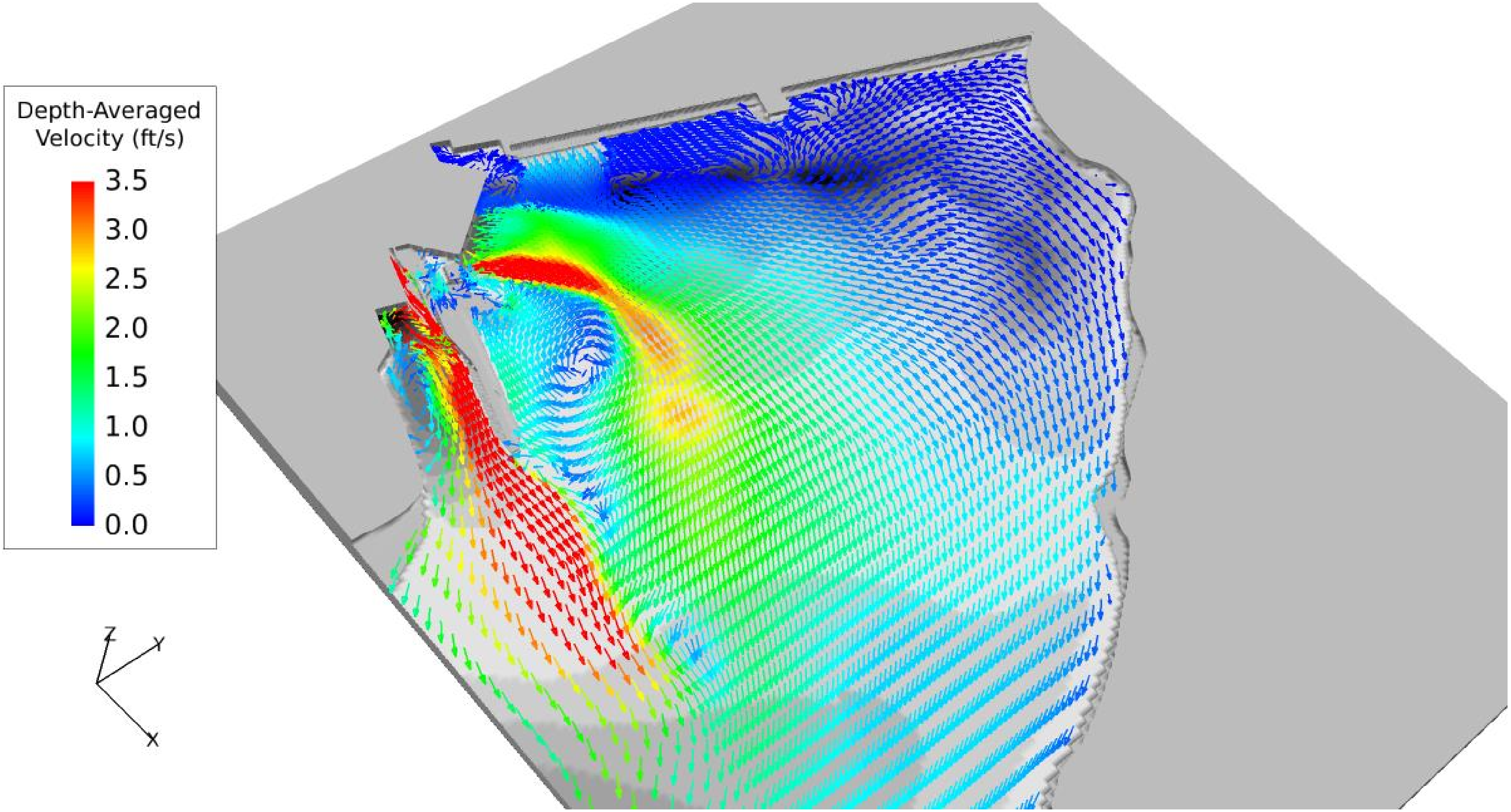
Shawmut – Case 08



Depth-Averaged Velocity, Oblique View (red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

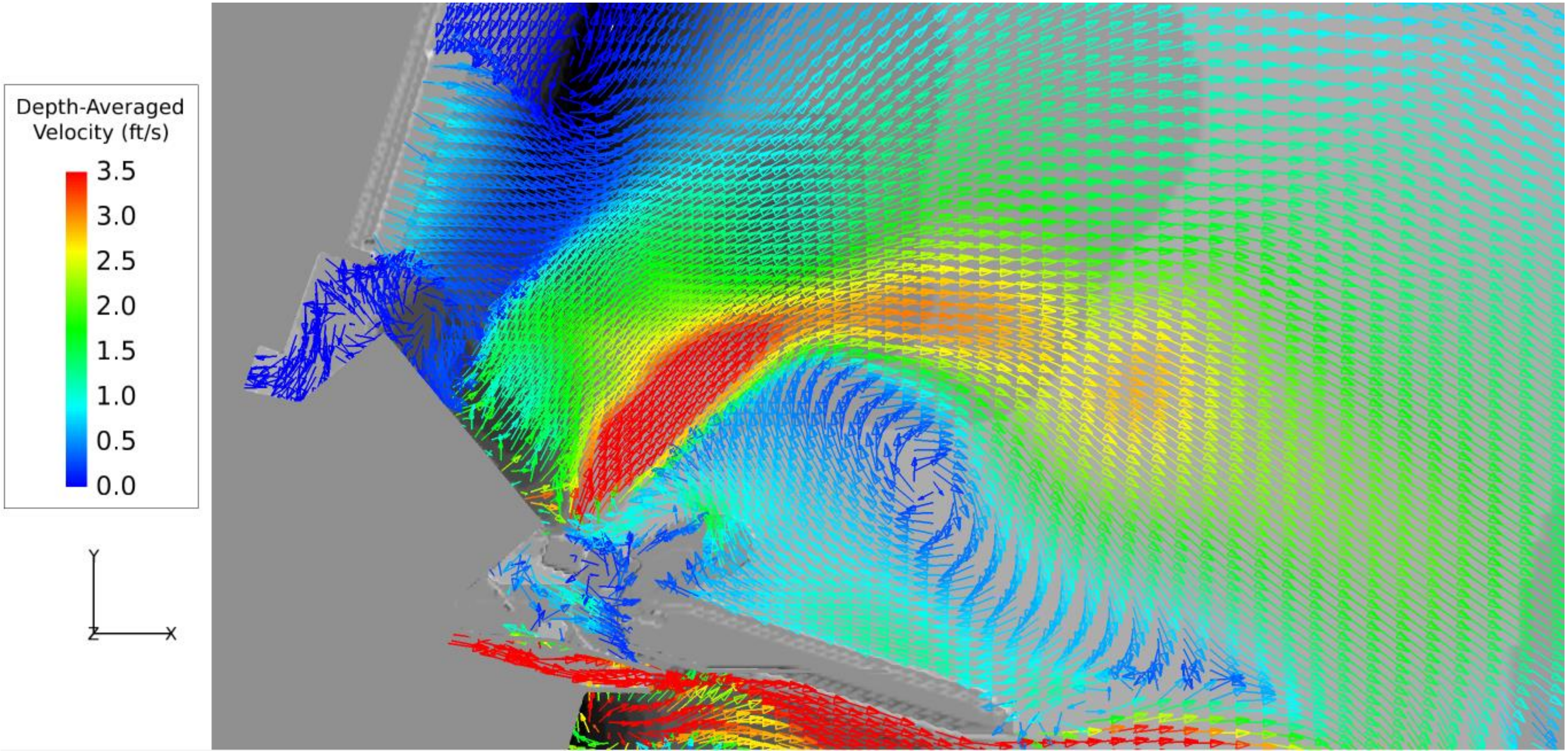
Shawmut – Case 08



Unit Vectors at Free Surface, Oblique View, Every 4th Vector (red > 3.5 ft/s)

Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

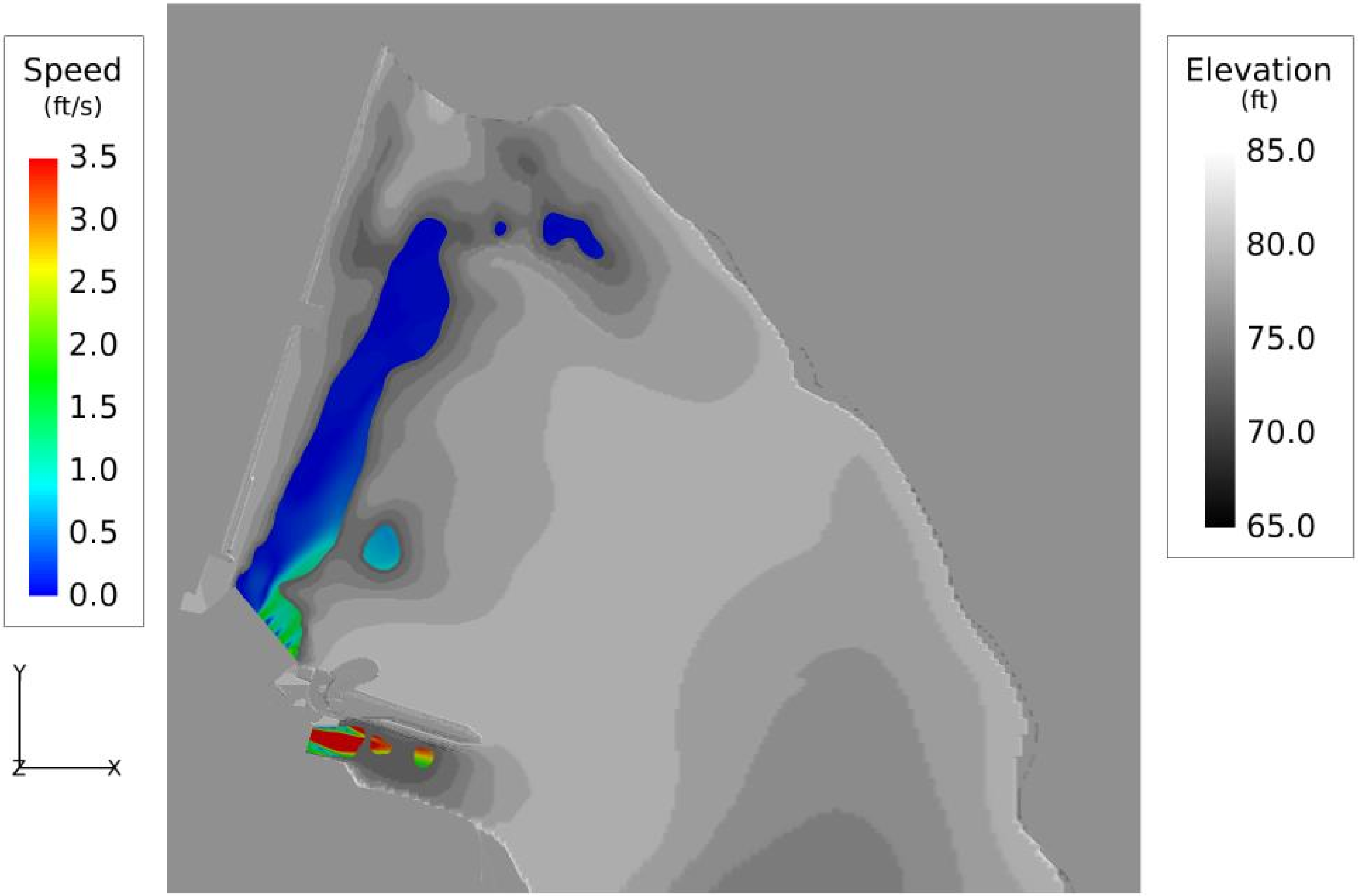
Shawmut – Case 08



Unit Vectors at Free Surface, Plan View, Every 3rd Vector (red > 3.5 ft/s)

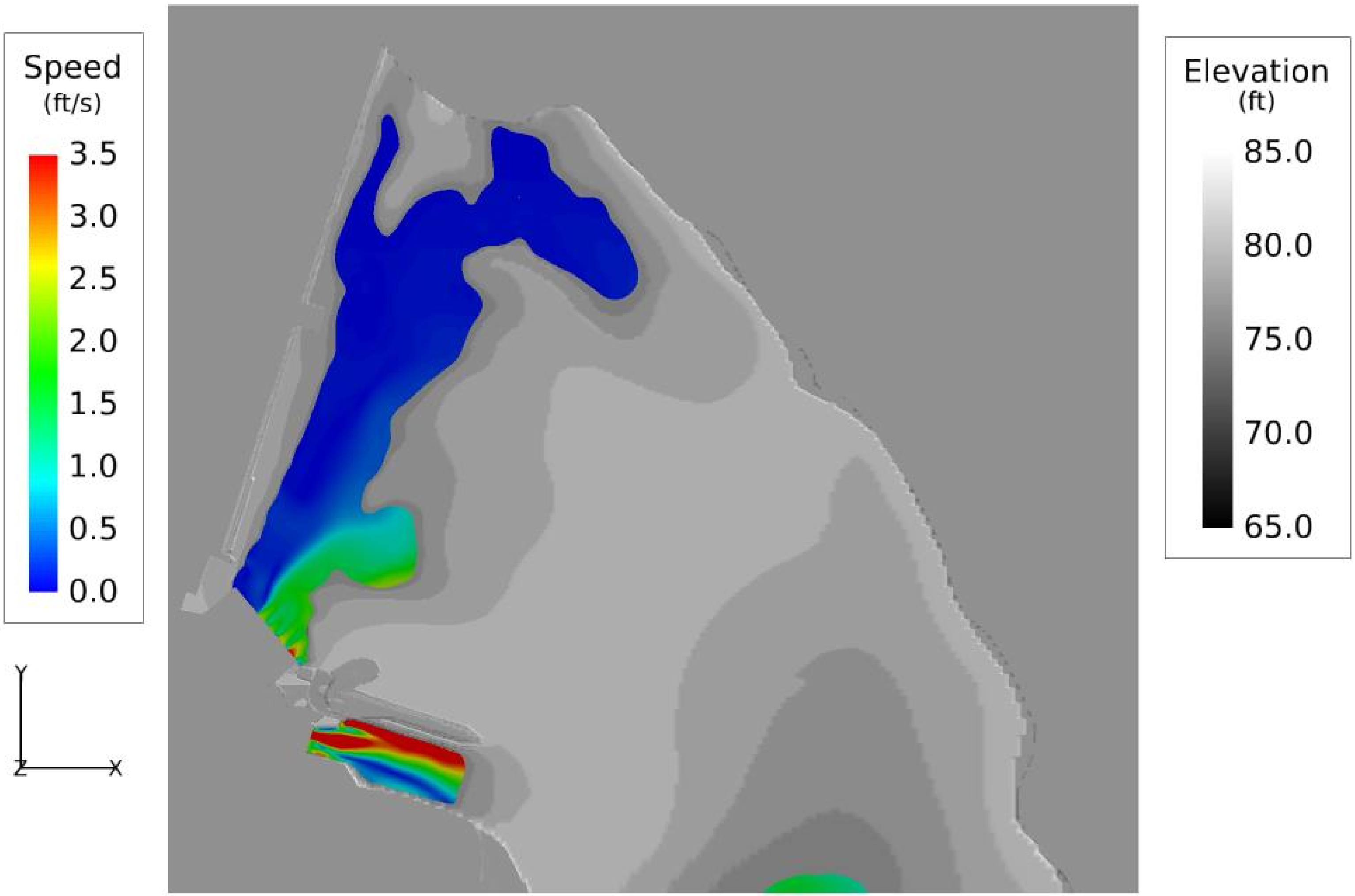
Depth-Averaged Velocity is the average velocity in the water column from the water surface to the river bottom.

Shawmut – Case 08



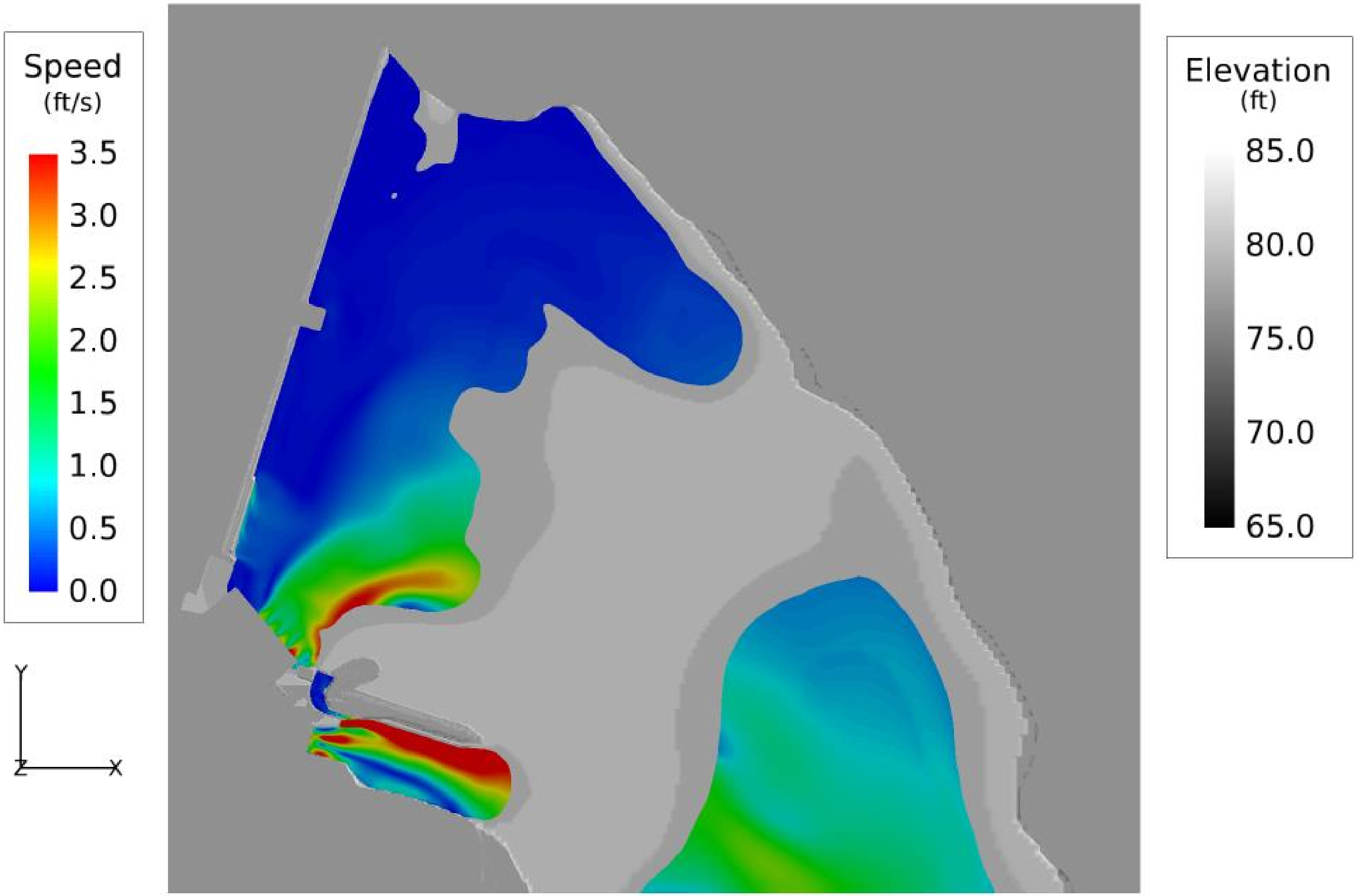
Flow Speed Distribution, Elevation 76.875 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 08



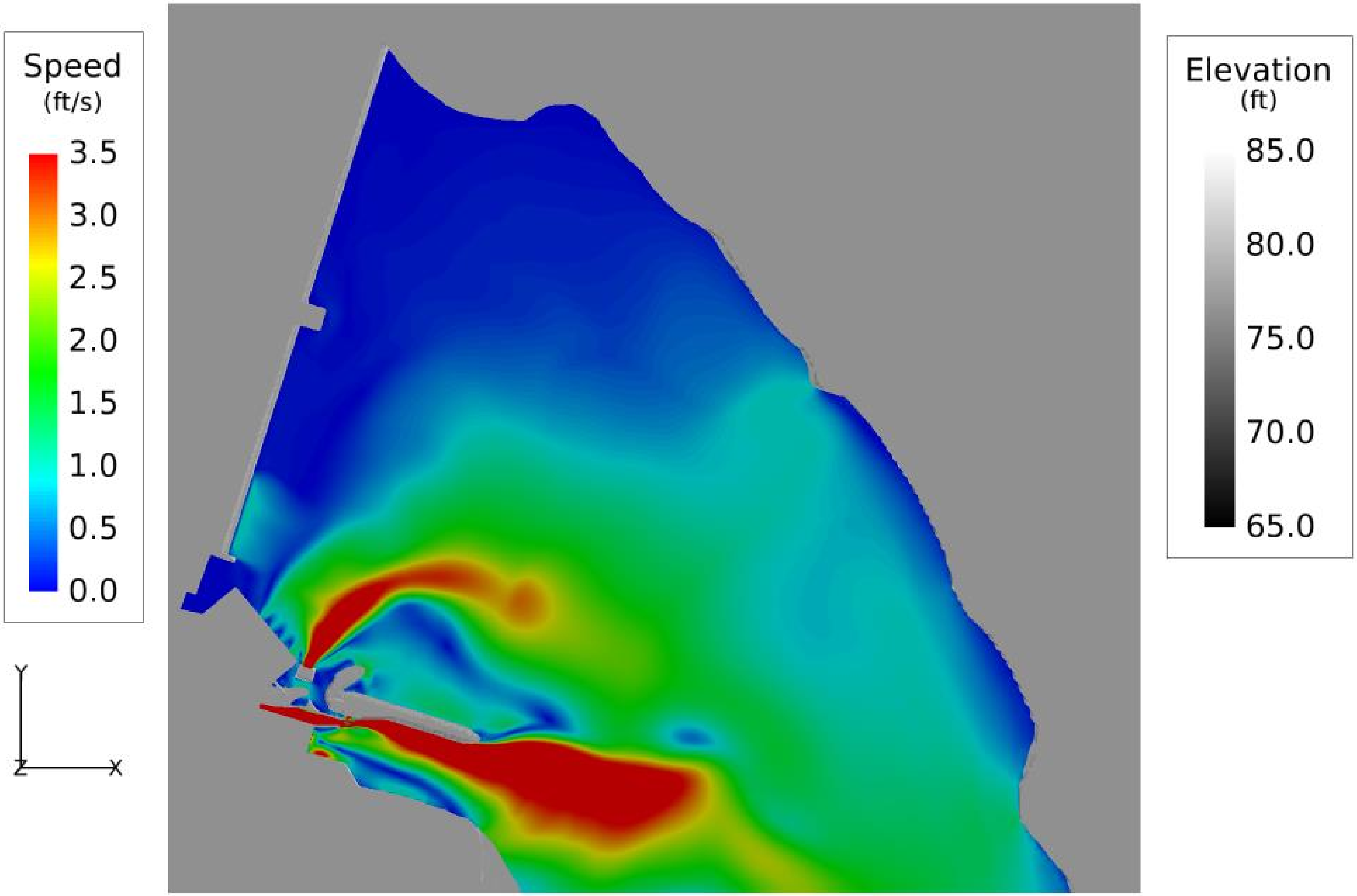
Flow Speed Distribution – Elevation 80.575 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 08



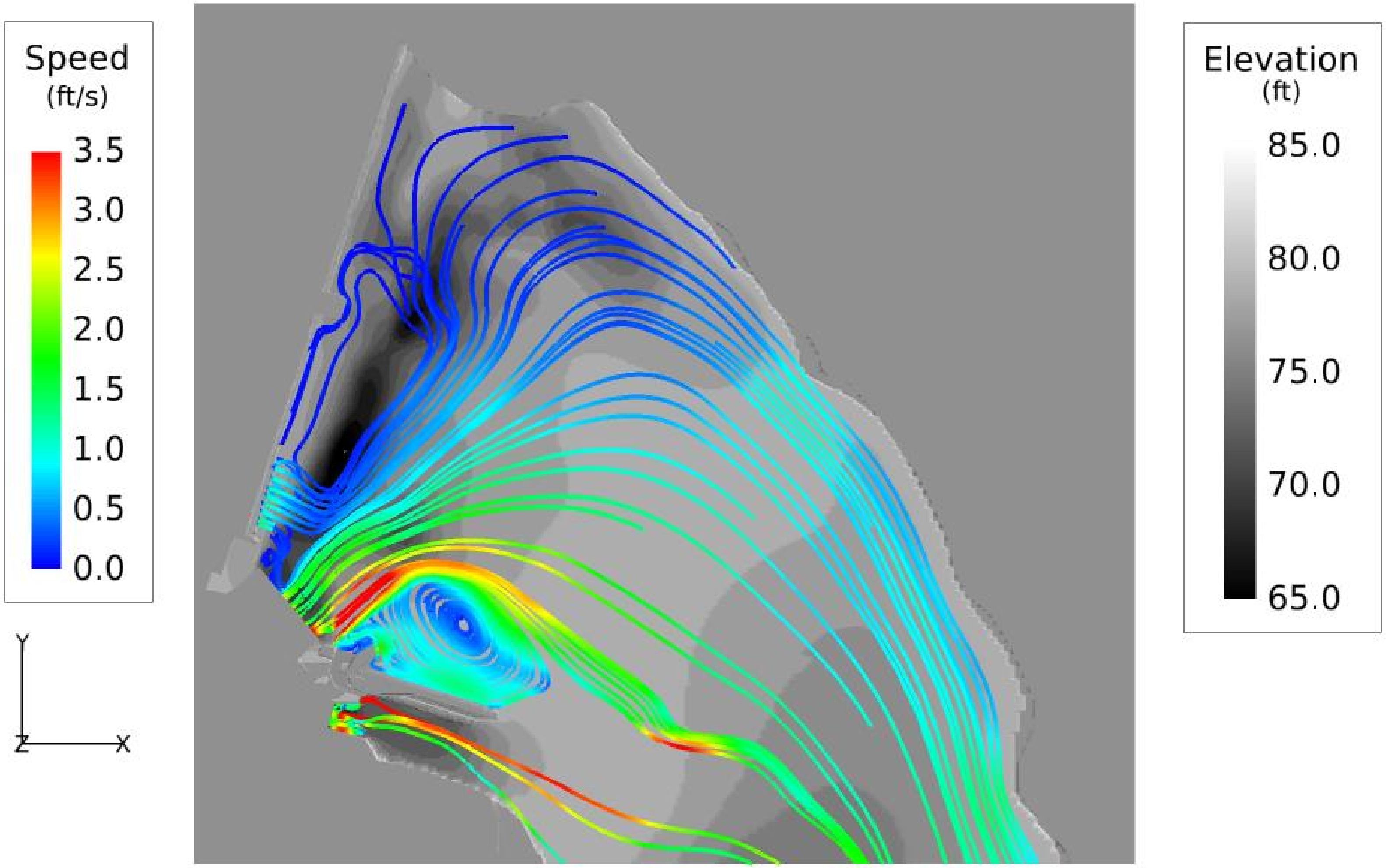
Flow Speed Distribution – Elevation 84.275 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 08



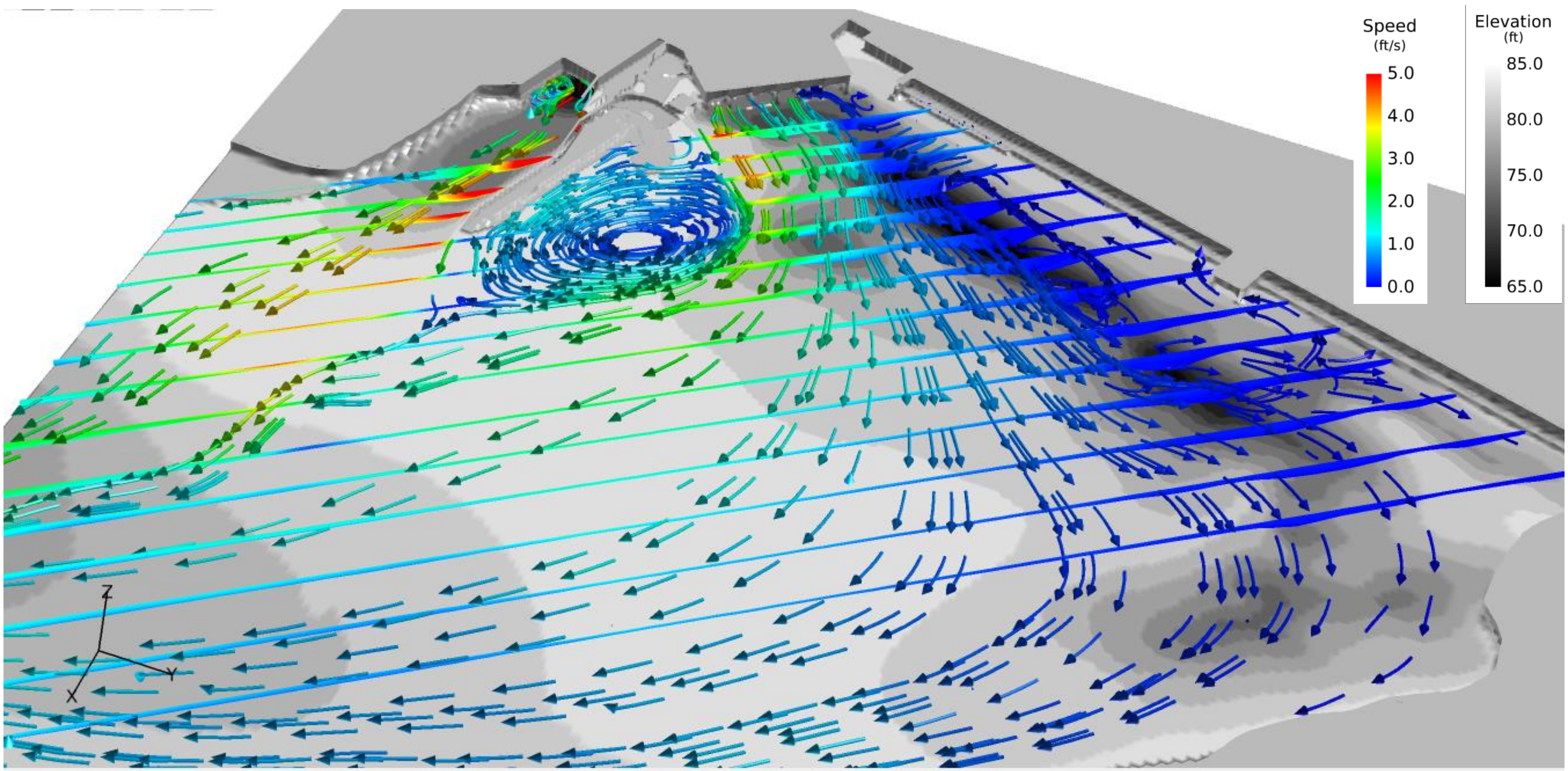
Flow Speed Distribution – Elevation 87.975 ft
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 08



Streamlines - Colored by Speed
(red > 3.5 ft/s, black < 65.0 ft, white > 85.0 ft)

Shawmut – Case 08



Vertical Variation of Flow Speed and Streamlines
(red > 5.0 ft/s, black < 65.0 ft, white > 85.0 ft)

From: Gregory Allen
To: Sojkowski, Bryan; Howatt, Kathy; OConnor, Michael; Seiders, Dwayne J; Donald Dow - NOAA Federal; Matt Buhyoff - NOAA Federal; Wippelhauser, Gail; Christman, Paul; Cox, Oliver N
Cc: John Richardson; amaral@aldenlab.com; Mitchell, Gerry; Maloney, Kelly; Richter, Robert
Subject: Shawmut additional CFD simulations
Date: Monday, December 19, 2016 10:05:04 PM
Attachments: Shawmut (CFD Model Summary, Case 5 to Case 8).pdf

---

Hello Folks,
Attached are results of CFD model simulations for Shawmut that were completed in response to comments and requests received during the October 13 meeting. Four total simulations were completed, two of existing conditions and two fish lift options. Each new simulation is described below and described in the attached presentation.

Please let us know if you have any questions or comments,
Enjoy the Holidays!
Greg

Case 5 – Existing condition simulation at the 50% exceedance river flow. This simulation includes 600 cfs discharged for downstream passage at the tainter gate between the two powerhouses.

Case 6 – Existing condition simulation at the 15% exceedance river flow. This simulation includes the 600 cfs discharged for downstream passage at the tainter gate between the two powerhouses.

Case 7 – Proposed fish lift simulation at the 50% river flow exceedance with the fishway located adjacent to the Unit 1-6 powerhouse and spillway. A total of 330 cfs would be allocated for the fish lift attraction flow. The downstream passage tainter gate flow of 600 cfs between the Unit 1-6 powerhouse and the Unit 7&8 powerhouse would be sluiced into the Unit 7&8 tailrace via a new sluice downstream of the gate. This would mitigate the current attraction of fish between the two powerhouses. In addition, a short fishway flume would be added to connect the Unit 7&8 tailrace to the Unit 1-6 tailrace. This would provide passage to the old powerhouse tailrace for fish that are attracted to the Unit 7&8 tailrace.

Case 8 – Proposed fish lift simulation at the 50% river flow exceedance with the fishway located between the two powerhouses. Similar to Case 8 a total of 330 cfs would be allocated for the fish lift attraction flow. The downstream passage tainter gate flow of between the Unit 1-6 powerhouse and the Unit 7&8 powerhouse would be sluiced into the Unit 7&8 tailrace via a new sluice downstream of the gate. Similar to Case 7 a short fishway flume would be added to connect the Unit 7&8 tailrace to the Unit 1-6 tailrace. This would provide passage to the old powerhouse tailrace for fish that are attracted to the Unit 7&8 tailrace.

____

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843

Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

____

Gregory Allen

From:	Gregory Allen
Sent:	Wednesday, August 22, 2018 12:55 PM
To:	'donald.dow@noaa.gov'; 'gail.wippelhauser@maine.gov'; 'Paul.Christman@maine.gov'; 'antonio_bentivoglio@fws.gov'; 'Bryan Sojkowski'; 'Dwayne.J.Seiders@maine.gov'; 'Matt Buhyoff - NOAA Federal'
Cc:	'Maloney, Kelly'; Dill, Richard; 'Mitchell, Gerry'; John Richardson (jrichardson@bluehillhydraulics.com); Dave Robinson (home); Steve Amaral
Subject:	Shawmut CFD results and meeting request
Attachments:	Shawmut Preferred Design (8-6-18).pdf

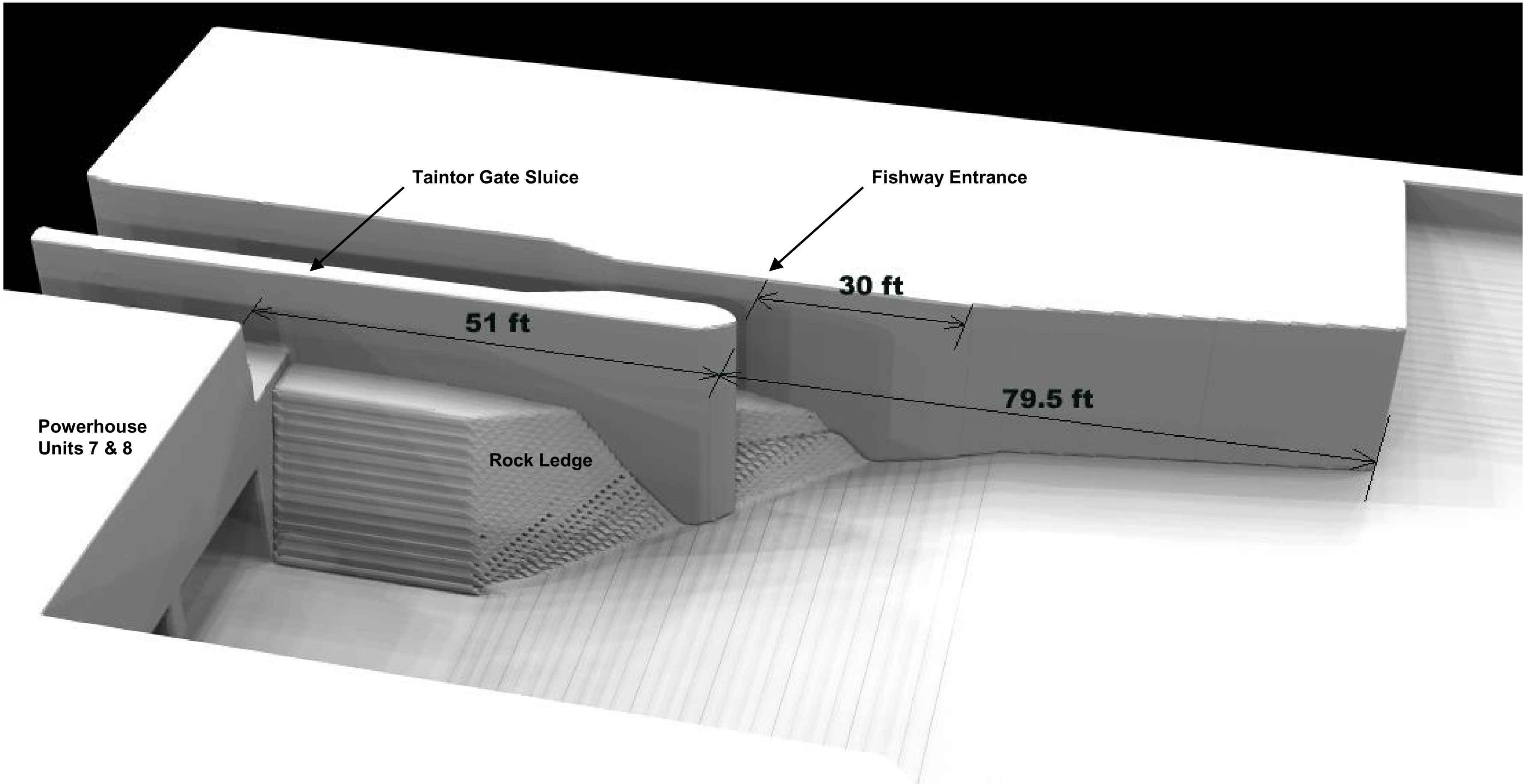
Hello Everyone,
Based on feedback we received from the Design Review Team (DRT) regarding Brookfield's submittal of the 60% design for fish passage facilities at Shawmut, we have completed a 3-D hydraulic model (CFD) of the Unit 7&8 tailrace to evaluate the hydraulic conditions approaching the fish passage between the two tailraces. CFD results of our recommended design are attached. Simulations were run for a worse case condition, assuming Unit 7&8 units are not running at the 95% exceedance river flow and a 600 cfs discharge from the tainter gate sluice. This recommended design is the result of 7 design iterations and we can share details of the various iterations during a meeting, if needed. In addition, we have been continuing with the design effort for the fish lift facilities adjacent to the spillway and we can share and present details during the meeting to review CFD results.

Please let us know if you are available to meet on Monday, September 17 to discuss these CFD results. Alternate dates the following week include Sept 24, 26, 27 & 28.

Thank you,
Greg

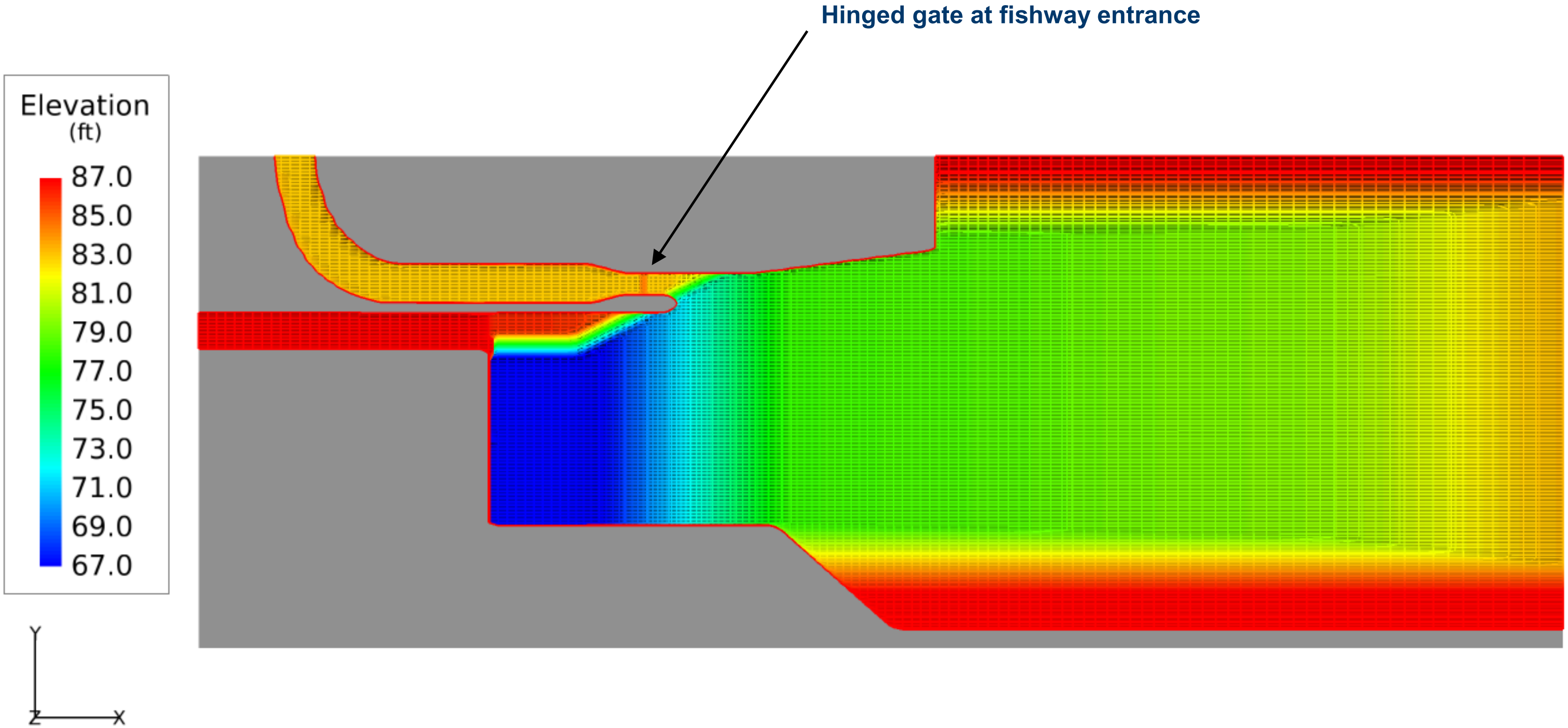
Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

Proposed Upstream Fishway Configuration



Fishway – Three Dimensional Perspective

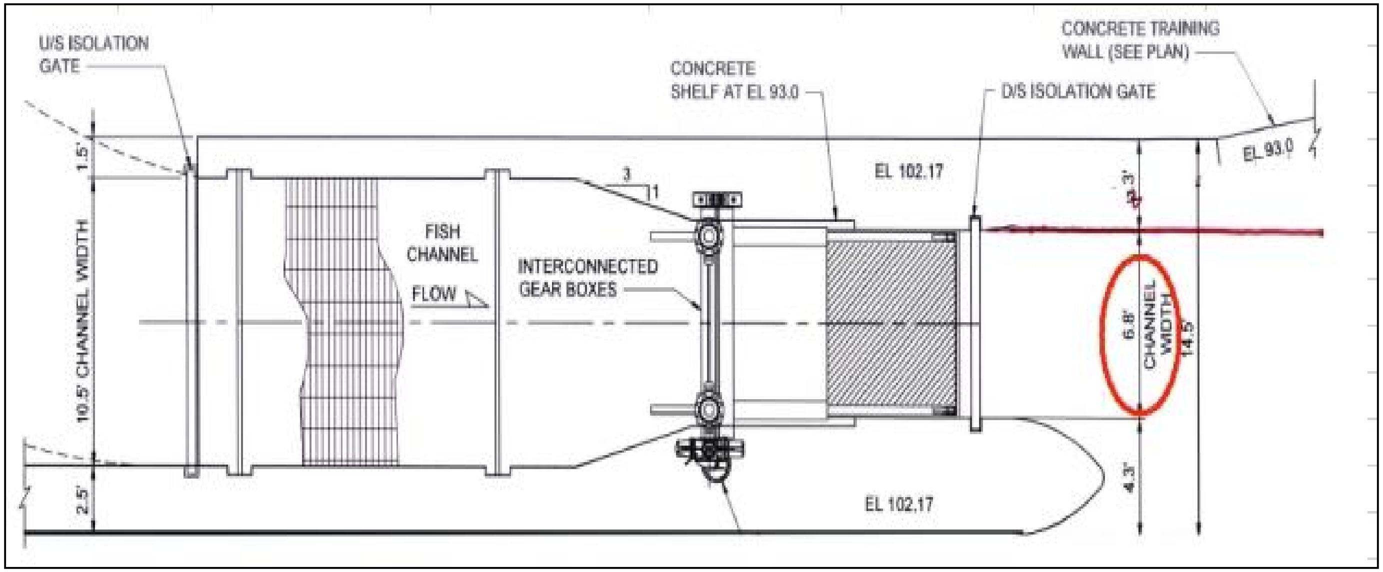
Proposed Upstream Fishway Configuration – Plan View



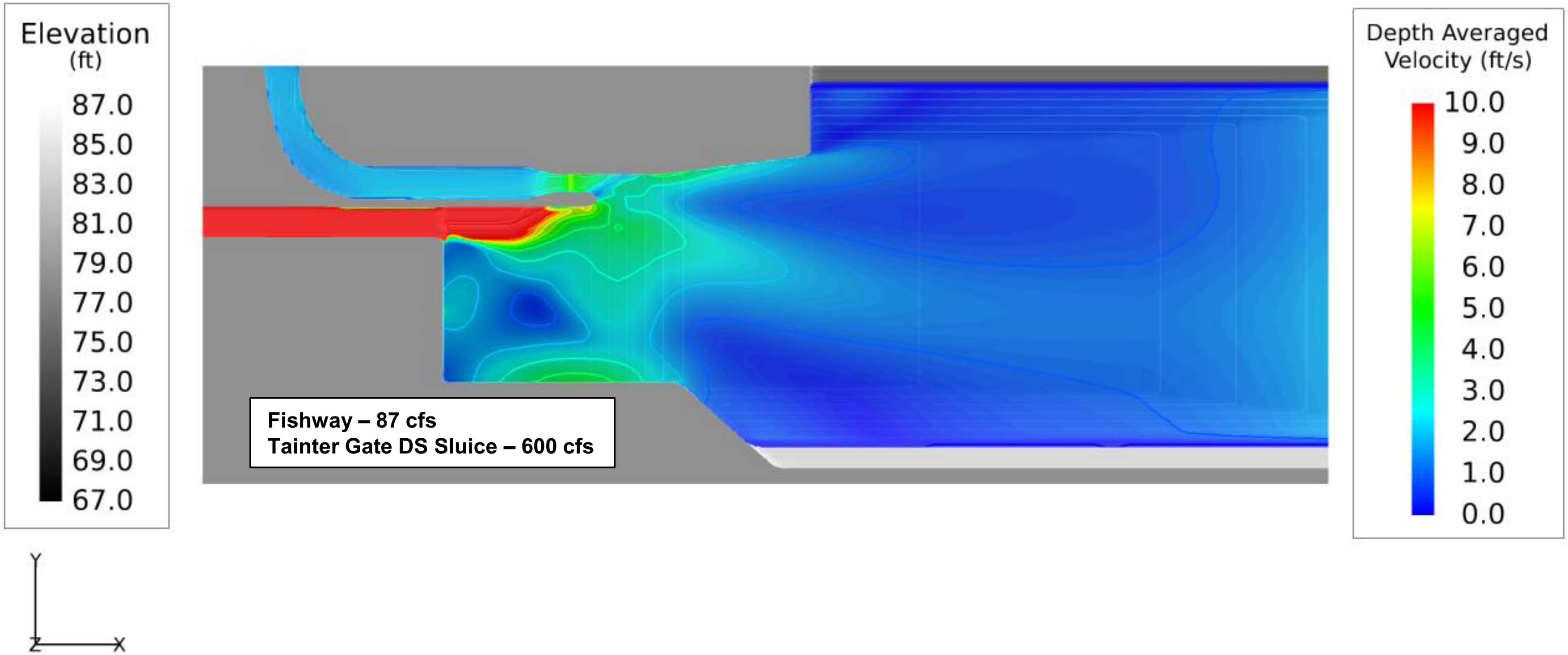
Model Domain with Grid Overlay

Model Boundary Conditions and Fishway Entrance Setup

95% Exceedance River Flow Condition	2540 cfs
Taintor Gate Sluice Discharge	600 cfs
Fishway Channel Discharge	87 cfs
Total Tailrace Flow	687 cfs
Approx. Unit 7 & 8 Tailwater Elevation	87.1 ft
Hinged Gate Setting / Elevation	84.5 ft
Depth Over Gate	2.6 ft
Gate Width	6.8 ft

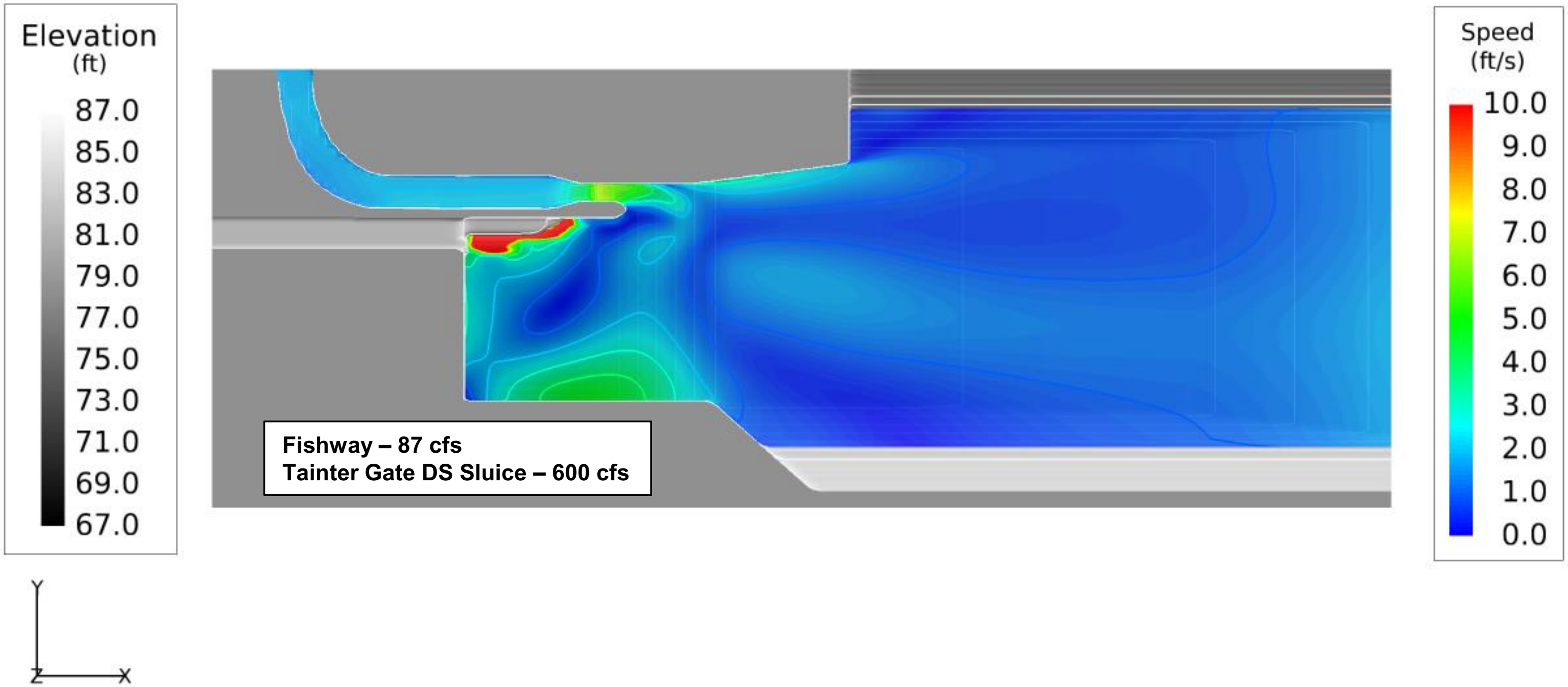


Simulation Results



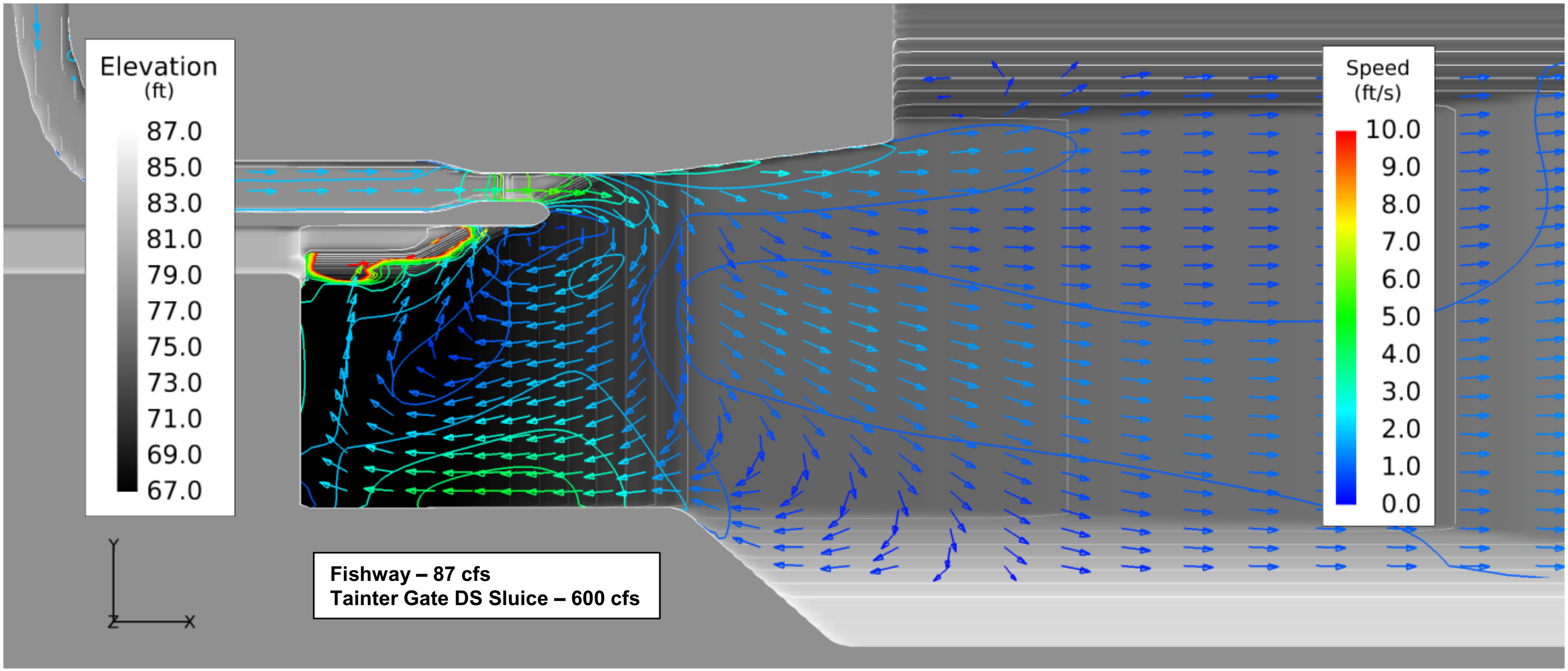
Depth Averaged Velocity
(plotting plane elevation – 88.4 ft)

Simulation Results



Flow Speeds
(plotting plane elevation 85.0 ft, 2.1 ft below surface)

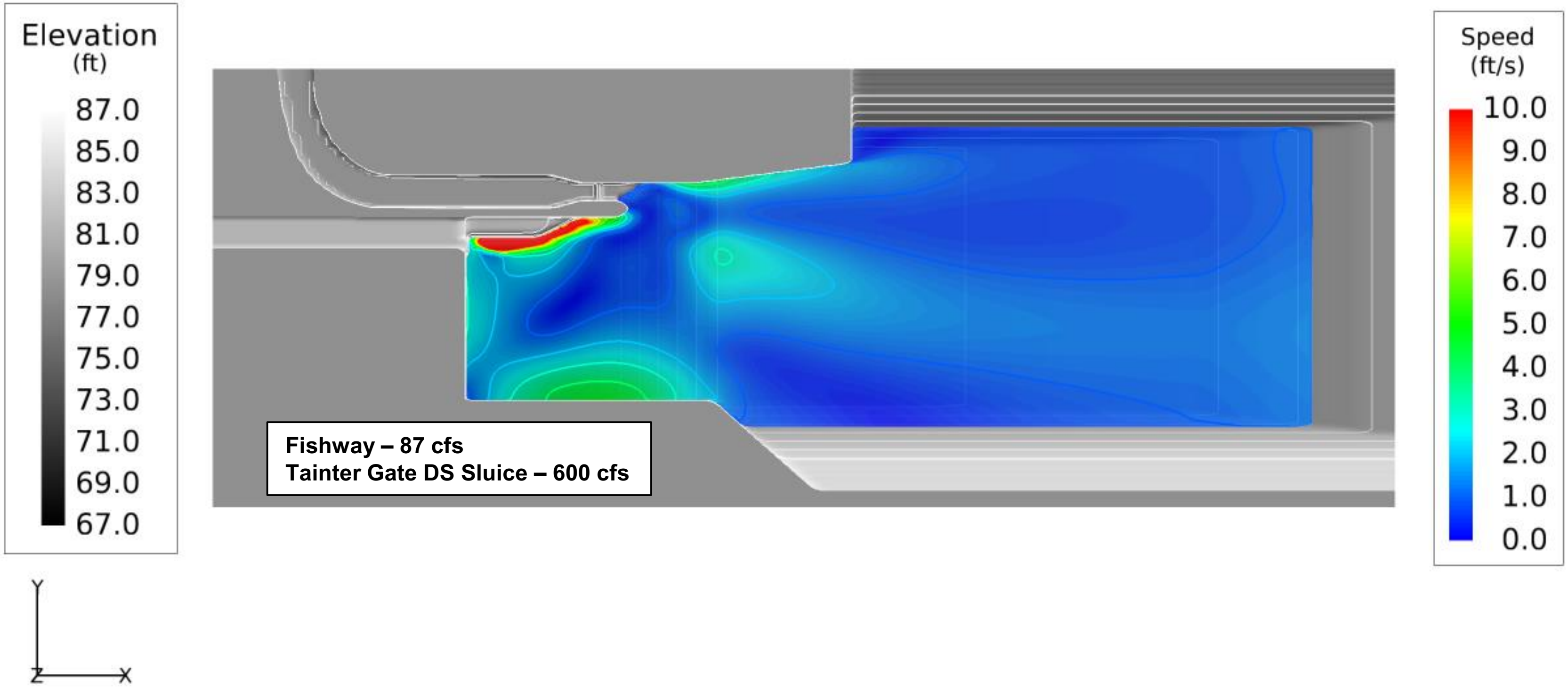
Simulation Results



Total Vectors colored by Speed
(plotting plane elevation 85.0 ft, 2.1 ft below surface)

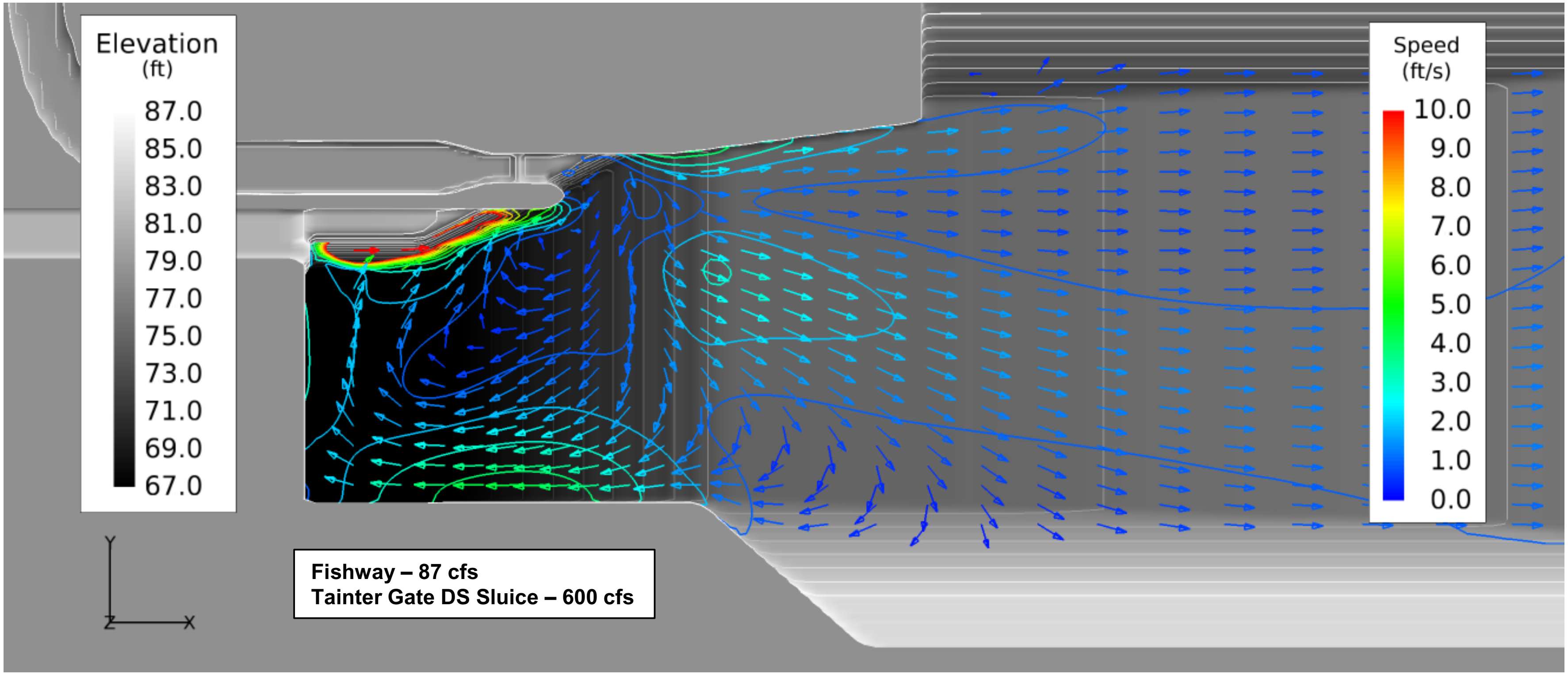
Every 4th Vector Shown

Simulation Results



Flow Speeds
(plotting plane elevation 82.0 ft, 5.1 ft below surface)

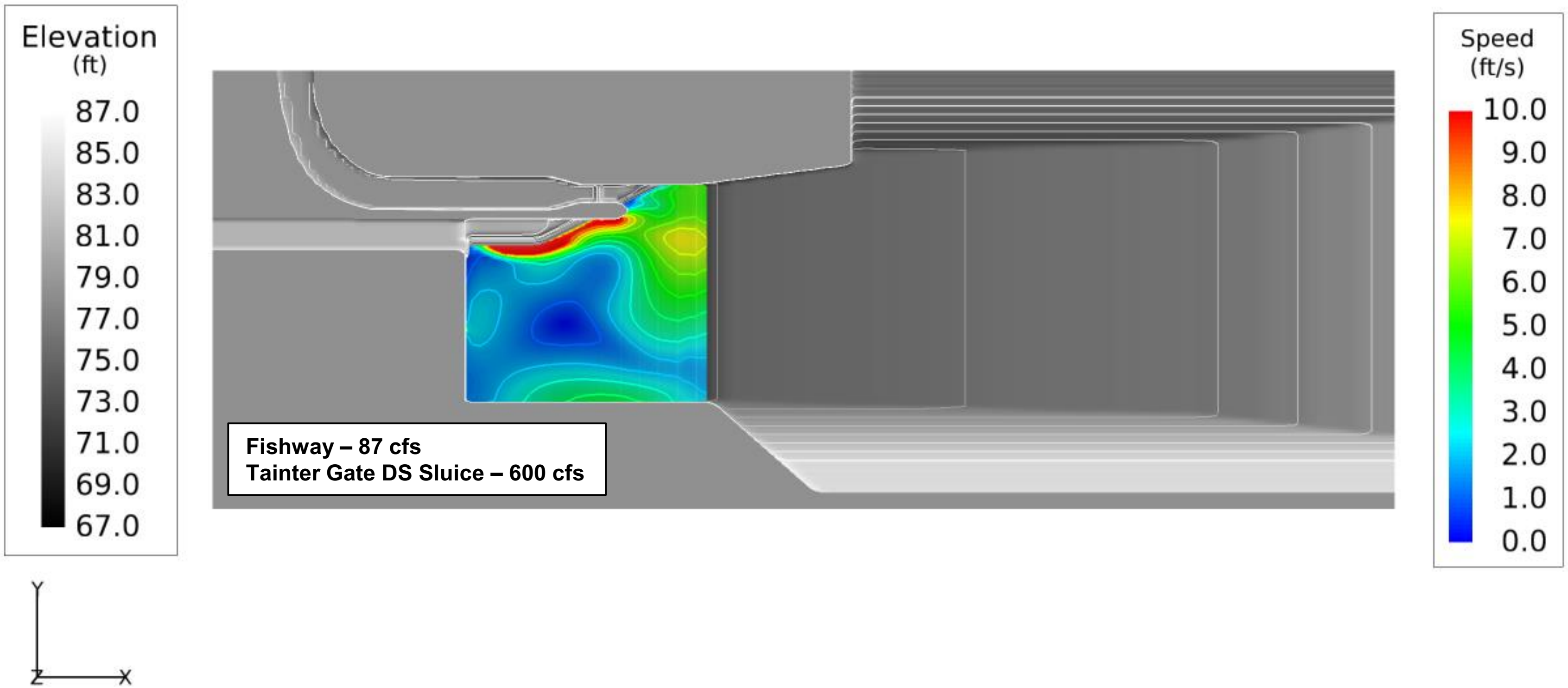
Simulation Results



Total Vectors colored by Speed
(plotting plane elevation 82.0 ft, 5.1 ft below surface)

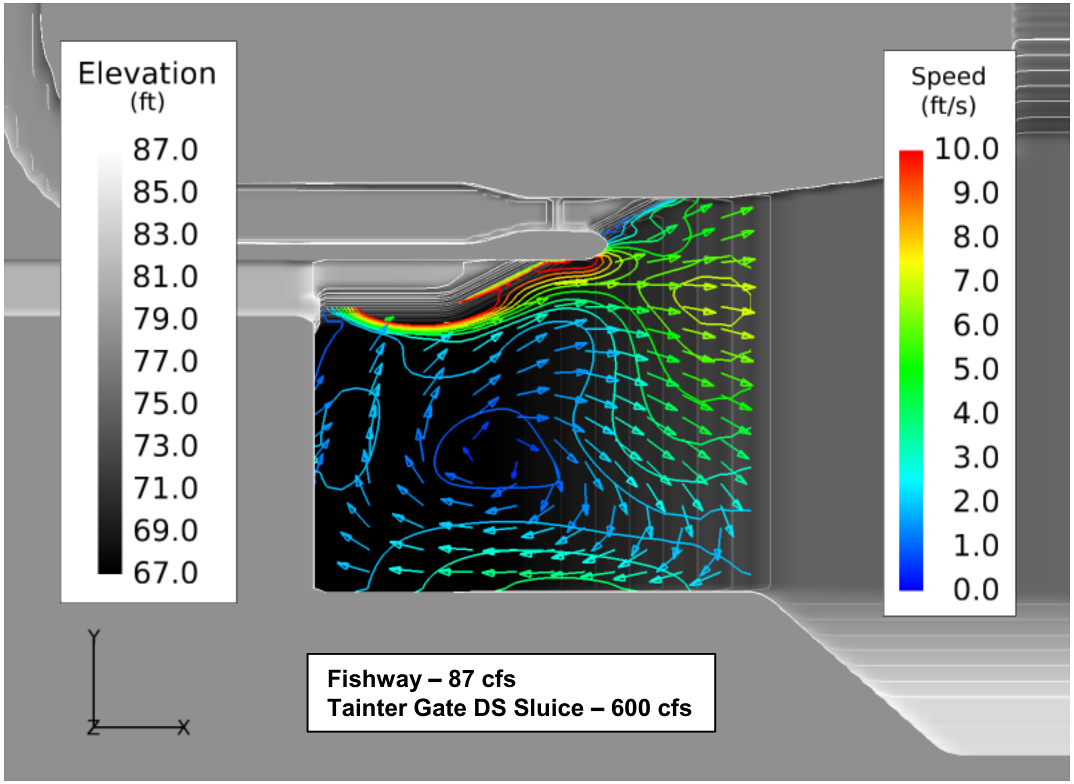
Every 4th Vector Shown

Simulation Results



Flow Speeds
(plotting plane elevation 77.0 ft, 10.1 ft below surface)

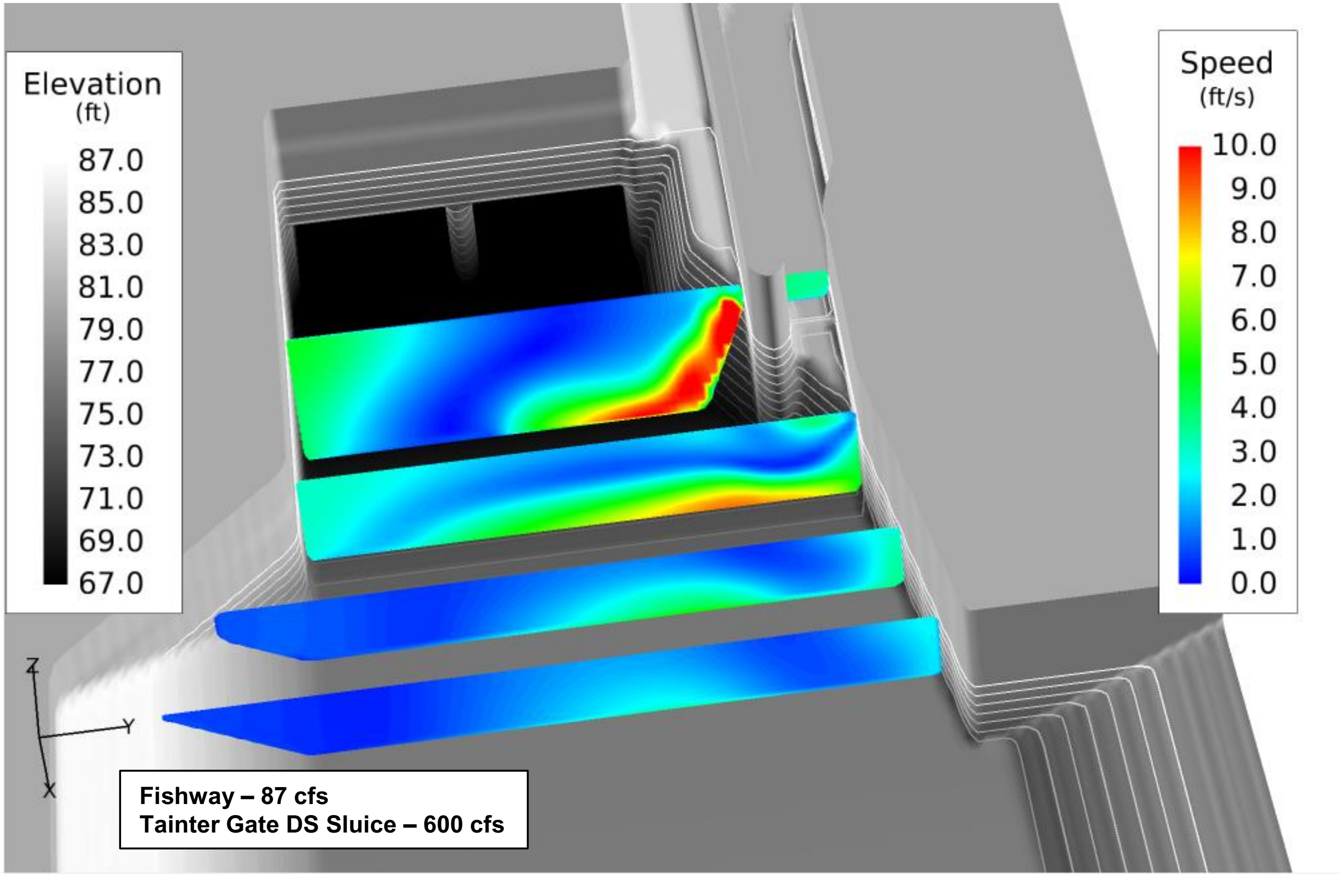
Simulation Results



Total Vectors colored by Speed
(plotting plane elevation 77.0 ft, 10.1 ft below surface)

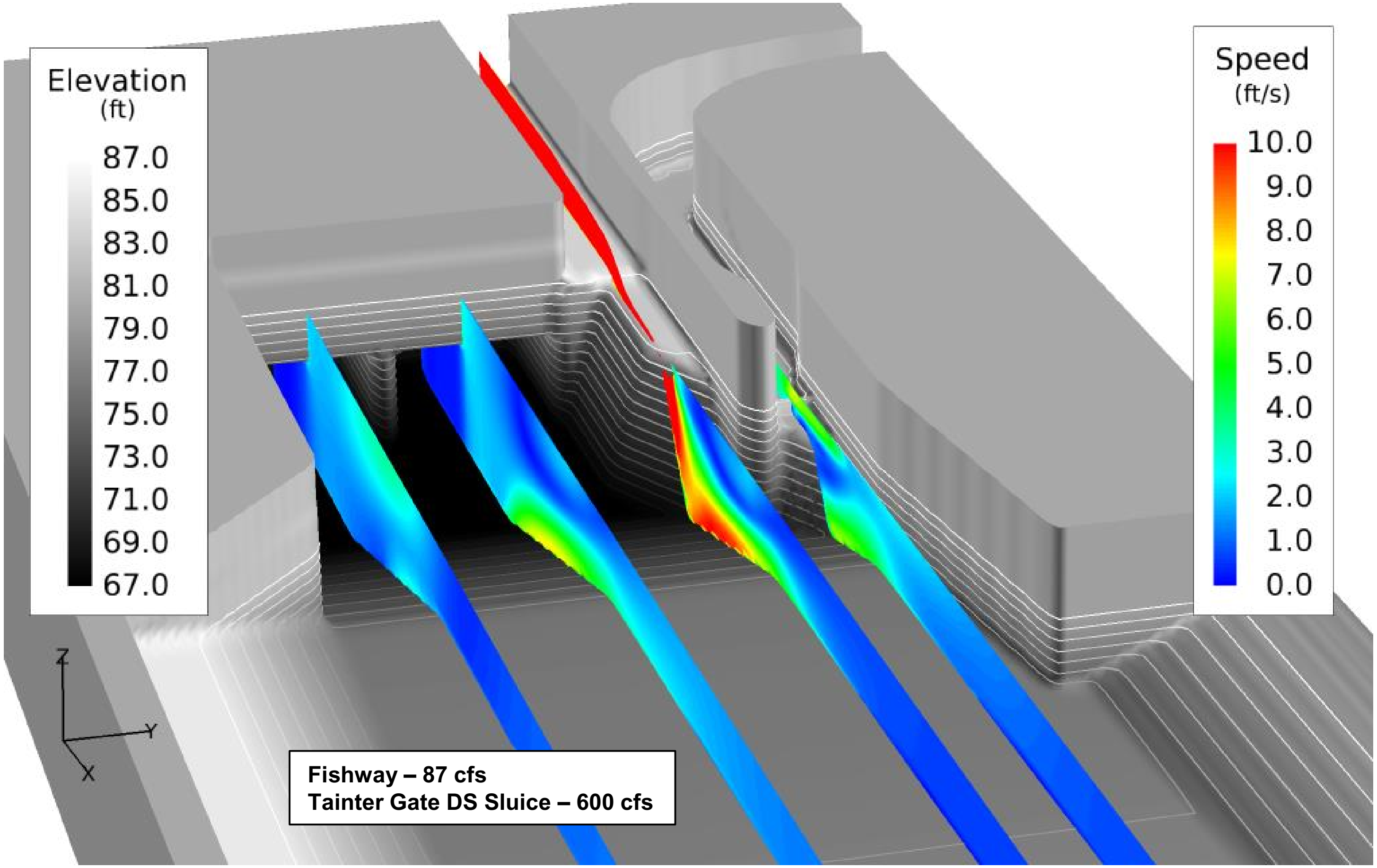
Every 4th Vector Shown

Simulation Results



Flow Speeds

Simulation Results



Flow Speeds

DRAFT

Meeting Notes
Shawmut Design Review Team Meeting
Thursday, September 27, 2018
9:00 AM – 11:00 AM

Attendees:

Bryan Sojkowski (USFWS)
Antonio Bentivoglio (USFWS)
Donald Dow (NOAA)
Matt Buhyoff (NOAA)
Gail Wippelhauser, via phone (MDMR)
Jason Seiders (IF&W)
Kelly Maloney, via phone (Brookfield)
Richard Dill (Brookfield)
Gerry Mitchell (Brookfield)
Stephen Amaral, via phone (Alden)
Dave Robinson (Alden)
Greg Allen (Alden)
John Richardson (Blue Hill Hydraulics)

A design review team (DRT) meeting was held at the US Fish and Wildlife's office in Falmouth, ME for the Shawmut Fish Passage Project to review CFD results of the proposed Unit 7&8 fishway. The design review team includes NMFS, FWS, IF&W and MDMR resource agencies.

The meeting began with a review of activities and schedules of projects on the Kennebec River. The DRT requested an update regarding the design status for both Lockwood and Weston. Kelly explained that the projects have been on hold awaiting acceptance of a new Species Protection Plan and the results of the Kennebec River Feasibility Assessment.

The schedule for fish passage modifications to be completed at Lockwood is 2022. Options under consideration for a spillway fishway include a vertical slot ladder and a nature-like fishway (NLF). Brookfield is awaiting completion of the Kennebec River Feasibility Assessment which reviewed various NLF options.

Kelly also explained that Brookfield intends to move forward with a fish lift design at Weston with an entrance near the log sluice with design provisions to accommodate the addition of a second entrance at some future date.

Gerry and Greg discussed the Shawmut design schedule. Greg mentioned the 90% design package would be submitted within 4 to 6 weeks of this meeting, assuming the DRT accepts the proposed design. Gerry reviewed a schedule he sent to the DRT previously as follows:

90% design submittal to agencies	October 30, 2018
30 day agency comment period	
Final construction bid	August 2019
Permitting	2019
Start construction	January 2020
Operational	April 2021

John Richardson presented the CFD results of the Unit 7&8 fishway. The proposed design presented was the result of 7 design iterations and CFD modeling. The fishway entrance is 51 ft downstream from the powerhouse, approximately 40 ft further downstream than the initial design. John Richardson also briefly reviewed the CFD results of the design iterations.

The group was in agreement that the proposed design for the Unit 7&8 fishway was acceptable.

Greg explained that the fish lift design has progressed and is at about the 90% design level and he provided work-in-progress drawings to the group. Greg explained that the fish lift entrance flume was lengthened by 8 ft and the entrance width reduced to 10 ft following feedback from the 60% DRT review meeting. Dave Robinson explained the design of the entrance flap gate and drive system and that all greased components would be above water. Dave also explained alternatives to greased components.

Action Items:

Alden to submit the 90% design package within 4 to 6 weeks.

Brian McMahon

From: Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent: Wednesday, October 03, 2018 12:31 PM
To: John Richardson (jrichardson@bluehillhydraulics.com)
Cc: Donald Dow - NOAA Affiliate; gallen@aldenlab.com; Gail Wippelhauser; Paul Christman; Bryan Sojkowski; Seiders, Dwayne J; Matt Buhyoff; Maloney, Kelly; Dill, Richard; Mitchell, Gerry; daverobinson111@yahoo.com; amaral@aldenlab.com
Subject: Re: [EXTERNAL] Shawmut Design Review Meeting

That is what I hoped would be the answer. Thanks John. No other questions.

On Wed, Oct 3, 2018 at 11:55 AM Blue Hill Hydraulics <jrichardson@bluehillhydraulics.com> wrote:

> **No**, 0.0 velocities across the 1.3 ft distance you identified were not included in the averages.
>
> The depth-averaged flow speeds were determined by the CFD program (in this case ***FLOW-3D***). In this case, the program calculated the average flow speed between the fluid free surface and "bottom" in a plan view area.
>
> NOTE: the 88.4 ft elevation was chosen for plotting to appropriately show "water in the sluice."
>
> Let me know if this answers your question. If not, then I can give you a call to discuss.
>
> **From:** Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
> **Sent:** Wednesday, October 3, 2018 10:04 AM
> **To:** gallen@aldenlab.com
> **Cc:** Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>; Gail Wippelhauser <gail.wippelhauser@maine.gov>; Paul Christman <Paul.Christman@maine.gov>; Bryan Sojkowski <Bryan_Sojkowski@fws.gov>; Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>; Matt Buhyoff <matt.buhyoff@noaa.gov>; Kelly Maloney <Kelly.Maloney@brookfieldrenewable.com>; Richard Dill <Richard.Dill@brookfieldrenewable.com>; Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>; John Richardson (jrichardson@bluehillhydraulics.com) <jrichardson@bluehillhydraulics.com>; daverobinson111@yahoo.com; amaral@aldenlab.com
> **Subject:** Re: [EXTERNAL] Shawmut Design Review Meeting
>
> Greg and John,

Thanks for the presentation you gave us last week.

I just had a follow up question about the CFD modeling. When we were talking about the Depth Average Velocity slide. I mentioned that the plotting plane elevation was 88.4ft but the tailrace was 87.1ft. My Q is, is the difference between the two, 1.3ft, included in the averaging? Presumable the velocity in the 1.3ft would be 0 so is this averaged into the results or is the 88.4ft just an upper limit and the averaging only starts once the "water", at 87.1ft, is met?

On Thu, Aug 30, 2018 at 11:52 AM <gallen@aldenlab.com> wrote:

> Meeting to discuss design status and CFD results for the Shawmut Fish Passage Project.
>
> Draft Agenda
>
> - Review CFD results for Unit 7&8 fishway
> - Discuss recommended Unit 7&8 fishway design
> - Review status and design of fish lift
>
> <<...>>
>
>

--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

SITING STUDY CONSULTATION

From:	Senechal, Guy
To:	Donald A. Dow (Donald.Dow@noaa.gov); Bentivoglio, Antonio; Jeff Murphy - NOAA Federal; Bryan Sojkowski (bryan_sojkowski@fws.gov); "William McDavitt - NOAA Affiliate"; "Wippelhauser, Gail"; Christman, Paul; Seiders, Dwayne J; Sean McDermott - NOAA Federal
Cc:	Mitchell, Gerry; Richter, Robert; Maloney, Kelly
Subject:	Shawmut Telemetry Study Plan
Date:	Wednesday, March 16, 2016 4:37:35 PM
Attachments:	Draft Study Plan - Shawmut Passage Siting - 021816.docx

All,

Attached is the telemetry study plan for Shawmut that we will be moving forward with. Please let me know if you have any comments regarding this plan.

Thanks,
Guy

Guy Senechal, P.E.
Project Manager

Brookfield Renewable Energy Group
150 Main St, Lewiston, Maine, 04240
T 207-755-5620 **C** 207-423-7691 **F** 207-755-5655
guy.senechal@brookfieldrenewable.com
www.brookfieldrenewable.com

Brookfield

Shawmut, Kennebec River, Maine

DRAFT Study Plan for the Assessment of Entrance Siting and Fish Passage Location

Prepared For:
Brookfield White Pine Hydro
150 Main Street
Lewiston, ME 04240

Submitted:
February 2016

Prepared By:
Normandeau Associates, Inc.
30 International Drive
Portsmouth, NH 03801

www.normandeau.com

NORMANDEAU ASSOCIATES
Environmental Consultants

Table of Contents

List of Figures

1.0 Introduction and Background

Brookfield White Pine Hydro (BWPH) is the licensee for the Shawmut Project (FERC No. 2322). The current license for the Project was issued by FERC on January 5, 1981 to Central Maine Power (CMP) for a term of 40 years. The license was transferred from CMP to FPL Energy Maine Hydro LLC (FPL Energy) on December 28, 1998. On July 29, 2013 the license was amended to change the Licensee's name to Brookfield White Pine Hydro. The current Project license expires January 31, 2021. The Licensee is currently using the FERC Integrated Licensing Process to seek a new License for the Project.

With regards to fish passage at Shawmut, on February 21, 2013, FPL Energy submitted a request to FERC that the Project license be amended to incorporate provisions from a proposed seven year Interim Species Protection Plan (ISPP) developed for Atlantic salmon (for the period 2013-2019). The National Marine Fisheries Service (NMFS) issued its Biological Opinion (BO) and Incidental Take Statement (ITS) on July 19, 2013. The proposed schedule for implementation of the ISPP was included as part of that BO and states that the Licensee will design a new upstream fish passage facility for Shawmut during 2016. This study plan was prepared to provide a description of the study objectives, methodology, schedule and deliverables of an upstream anadromous fish passage location and entrance siting evaluation to be conducted at Shawmut during spring 2016.

2.0 Project Description

The Shawmut Project is located at river mile 70 (24.5 miles above head-of-tide in Augusta) and is the third dam on the mainstem of the Kennebec River . The Shawmut Project includes a 1,310-acre impoundment, a 1,135 foot long dam with an average height of about 24 ft, headworks structure, enclosed forebay, and two powerhouses with intake structures. The crest of the dam has 380 ft of hinged flashboards 4 ft high serviced by a steel bridge with a gantry crane, a 730-foot long inflatable bladder composed of three sections, each 4.5 ft high when inflated and a 25 foot wide by 8 foot deep log sluice equipped with a timber and steel gate.

The headworks and intake structures are integral to the dam and the powerhouses, respectively. The forebay intake section contains eleven headgates and two filler gates. Five of the headgates are installed in openings 10 ft wide by 15.5 ft high and six are installed in openings 10 ft by 12.5 ft. The two filler gate openings are 4 ft by 6 ft. A non-overflow concrete gravity section of dam connects the west end of the concrete filled forebay gate openings with a concrete cut-off wall which serves as a core wall for an earth dike.

The forebay is located immediately downstream of the headgate structure and is enclosed by two powerhouse structures, the original 1924 powerhouse located to the east and the newer 1982 powerhouse located to the south. An approximately 240 foot long concrete retaining wall is located on the west side of the forebay. Located at the south end of the forebay between the powerhouses is a 10 foot by 7 foot taintor gate, which serves as interim downstream anadromous fish passage. In addition, a 6 foot by 6 foot deep gate and a surface sluice (4 foot wide by 22 inch deep, passing 35 cfs) which discharges into a 3 foot deep man-made plunge pool are located at the south end of the forebay. In the old powerhouse, the intake section has six open flumes each fitted with two 10.5 foot by 14 foot double leaf slide gates and a continuous trash rack. In the newer powerhouse, the intake section contains two openings fitted with vertical headgates about 12 ft high by 12 ft wide and operated by hydraulic cylinders. The trash racks are serviced by a track mounted, hydraulically operated trash rake with trash removal capabilities. The trash racks screening the intakes are 1.5 inch clear spacing in front of Units 1-6 and 3.5 inch clear spacing in front of Units 7 and 8. The original powerhouse contains six horizontal Francis-design units and the newer powerhouse contains two horizontal propeller units, having a total combined installed capacity of 8.74 MW and combined flow of approximately 6,700 cfs. The project's tailrace channels are excavated riverbed located downstream of the powerhouses. The project boundary extends upstream about 12 miles.

The Project is typically operated in a run-of-river mode, normally passing a minimum flow of 2,110 cfs, with a target reservoir elevation of about 112.0 ft msl during normal conditions.

3.0 Study Objectives

The objective of this study is to evaluate adult river herring behavior in the Kennebec River immediately downstream of the Shawmut Project. Specifically, this study aims to quantify preferential use of discrete tailwater regions to aid in the future placement of the Project fishway and proper siting of the entrance.

4.0 Proposed Methodology

4.1 Study Overview

Radio-telemetry will be used for the collection of movement data intended to inform decisions related to the location and siting of the upstream fishway and its entrance at the Shawmut Project. Adult river herring will be collected at a downstream location and their period of residence among a number of discrete sections of the Kennebec River immediately downstream of the Project will be quantified.

4.2 Study Timing and Source of Study Fish

Collection of movement data for radio-tagged adult herring downstream of Shawmut will be conducted during May-June, 2016. As presented in the draft 2015 Diadromous Fish Passage Report (BWPH 2016), the majority of the Kennebec River herring run occurs during the second half of May and early June. As reported for the 2015 passage year, the first third of the herring run occurred between May 2 and May 25, the mid-third occurred between May 25 to May 29 and the last third between May 29 and July 9 (Figure 4-1). The adult river herring selected for radio-tagging as a part of this evaluation will be obtained from the fish lift at Lockwood.

4.3 Tagging and Release Procedures

A total of 150 pre-spawned adult river herring will be radio-tagged for the evaluation of upstream fishway passage placement downstream of Shawmut. Individuals will be tagged downstream at the Lockwood fish lift and immediately placed into a large, aerated transport tank. Fish will be maintained in the transport tank for a minimum of two hours for observation of post-tagging mortality and transmitter retention. Following the observation period, tagged herring will be transported to the release site.

Transmitters used for this study will be Sigma-Eight model I-80-D (20.4 mm x 9.1 mm x 9.1 mm; 2.7 g). Alewives collected at the lift at Lockwood during 2015 demonstrated excellent retention and survival over a 7-day observation period following gastric insertion of the I-80-D transmitter (Normandeau 2016). In conjunction with in-river releases of test fish, a total of 10 adult alewives will be tagged using "dummy" I-80-D transmitters. These fish will be held for up to seven days in circular tanks installed at Shawmut and supplied with a flow through water source. Individuals will be evaluated on a daily basis and any mortality or tag loss will be noted. Water quality will be checked daily to ensure that tank conditions are not biasing test results. Information on tag retention and post-tagging survival for the I-80-D model transmitter in adult alewives will be determined during the 2016 tank evaluation.

Adult herring will be examined prior to tagging and any individuals showing elevated scale loss or other signs of stress or trauma will be discarded. A total length will be recorded and an effort to determine gender will be made by gently attempting to express eggs or milt. Transmitters will be inserted using a flexible tube. The insertion end will be tapered to reduce abrasion to the esophagus and a notch will be cut at the opposite end. The antenna of the transmitter will be threaded through the tube and the transmitter held tight by locking the antenna into the cut notch. The tagger will pull down the lower lip and adjust the fish for a clear view down the esophagus. The tube and transmitter will be gently inserted into the gut until resistance is felt at the pyloric sphincter. The antenna will then be freed from the notch and the insertion tube will be removed from the fish leaving the transmitter inserted. No anesthesia will be used for this process.

Radio-tagged herring will be released during three separate release events. Each release event will consist of approximately 50 test fish. Releases will be timed to occur over the duration of the annual migration period (see Figure 4-1) so as to not introduce any potential seasonal bias in tailrace behavior at Shawmut. Radio-tagged adult herring will be released at the Fairfield public boat launch, located approximately 2.75 miles downstream of the dam.

4.4 Radio Telemetry Equipment

Radio telemetry antennas and data logging receivers will be set up at selected locations along the downstream face of the Shawmut facilities to monitor the approach and tailrace residence of radio-tagged herring. Proposed locations of these receiver stations are detailed below but may need to be slightly modified during field installation to account for unforeseen detection issues including but not limited to sources of interference and landowner permission.

Each receiver location will consist of a data-logging receiver, one or more antennas, and a power source. The receivers will be configured to receive signals from a designated area continuously throughout the study period. During installation of each receiver, detection range testing will be conducted to configure the antenna/receiver combinations to maximize detection efficiency. The operation of the system as a whole will be confirmed throughout the study period by the use of beacon tags. Beacon tags will be stationed at strategic locations within the detection range of either multiple or single antenna stations and will emit a signal at scheduled time intervals. These signals will be detected and logged by the receivers and used to record the functionality of the system throughout the study period. Although each receiver will be installed in a manner which limits the ability to detect transmitters from unwanted areas, the possibility of such detections does still exist. As a result, movement data collected in this study (i.e., duration at a specific location) will be inferred based on the signal strength, duration and pattern of contacts documented across the entire detection array.

4.4.1 Monitoring Stations

Radio-tagged herring will be monitored via seven receiver locations (Figure 4-2).

Station A: This receiver will provide coverage of tailrace channel downstream of Units 7 and 8. This area is separated from the remainder of the Shawmut tailrace by an island. Coverage in this area will likely be provided by a single receiver connected to one aerial antenna. The aerial antenna will be oriented downward and the receiver programmed appropriately to minimize detections of radio transmitters outside of the intended detection zone immediately downstream of this powerhouse.

Station B: This receiver will provide coverage of outflow area between the two Project powerhouses and downstream of the forebay taintor gate which is currently serving as an interim downstream bypass for outmigrating fish. An aerial antenna and single receiver will be used to provide coverage of this area.

Station C: This receiver will provide coverage of the tailrace area immediately downstream of the Units 1-6 powerhouse. Coverage in this area will likely be provided by a single receiver connected to one or more aerial antennas. The aerial antenna(s) will be oriented downward and the receiver programmed appropriately to minimize detections of radio transmitters outside of the intended detection zone immediately downstream of this powerhouse.

Station D: This receiver will provide coverage of the approximately 380 foot long section of hinged flashboards forming the western portion of the overflow spillway area. Coverage in this area will be provided by a single receiver connected to one or more aerial antennas. The aerial antennas will be oriented downward and the receiver programmed appropriately to minimize detections of radio transmitters outside of the intended detection zone.

Receiver E: This receiver will provide coverage of the approximately 730 foot long section of inflatable bladder forming the eastern portion of the overflow spillway area. Coverage in this area will be provided by a single receiver connected to one or more aerial antennas. The aerial antennas will be oriented downward and the receiver programmed appropriately to minimize detections of radio transmitters outside of the intended detection zone.

Receiver F: This station will be located at a point approximately 1.1 river miles downstream of the Shawmut Project. It will consist of a single receiver coupled to an aerial antenna and, pending permission, will be located on the property of a private residence on the eastern bank of the river. It will be used to provide information on radio-tagged herring as they approach and subsequently move downstream and away from Shawmut.

Receiver G: This station will be located at a point approximately 3.7 river miles downstream of the Shawmut Project and 2.6 river miles downstream of Station F. It will consist of a single receiver coupled to an aerial antenna and, pending permission, will be located on the Kennebec Sanitary District Fairfield pump station property along the western bank of the river. Station G will be used to provide information on the movement of radio-tagged herring downstream and away from the study area.

4.5 Data Collection and Processing

4.5.1 Data Collection

Data will be off-loaded from receivers every one or two days using a laptop computer and will be stored on removable memory sticks. Backup copies of all telemetry data will be made prior to receiver initialization. Field tests to ensure data integrity and receiver performance include confirmation of file integrity, confirmation that the last record is consistent with the download data (reliance on constant signals provided by beacon transmitters aids this step) and lastly to confirm that the receiver is operational upon restart and actively collecting data post download. Data will be stored in the receivers as a single event. Data stored for each event will include detection date, detection time, channel, code, and signal strength. Manual tracking may be conducted as needed in the river reach between Shawmut and Hydro Kennebec. In addition to radio telemetry data, river temperature, river flow (cfs), project operations (turbine discharge (cfs) and percent gate), and extent of spill will be collected throughout the study.

4.5.2 Data Processing

Tag detections in each downloaded data file will be validated through a series of site-specific and logical criteria. These general criteria will include:

1. Power threshold level of the signal,
2. Frequency of the radio-tag signals per unit of time, and
3. Spatial and temporal distribution of the radio signals detected among stations.

To determine the power threshold for a valid tag signal, power levels associated with background noise will be recorded at each receiver location prior to the release of any radio-tagged individuals. These “false” signals (generally at relatively low power levels) below a specific power threshold will be removed from the database. Similarly, observations made during the extensive range testing prior to the initiation of fish releases will include signal strength information from test tags placed at various points in and out of each intended detection field. Data files will be subjected to additional filtering based on that signal strength information.

Following processing based on signal strength information, tag detections will be sorted by identification code and date-time to screen and flag false detections for exclusion from the analysis. A tag detection will be considered an isolated false detection if the previous and next detection in the time series was from a different antenna location. A minimum of three consecutive tag detections within a specific location will be required to be considered valid.

Following removal of isolated detections, it will then be necessary to identify when fish entered and left one of the five detection areas immediately downstream of the Project (see descriptions for receivers A-E in Section 4.4.1). Since transmissions during a period of residence within one of the detection zones can go unrecorded for a variety of reasons (e.g., signal collision, background interference, etc.), it is not appropriate to set a threshold interval between detections equal to the transmission rate of the tags (Castro-Santos and Perry 2012). To determine an appropriate threshold interval, the intervals between all successive detections within a particular detection zone and for each individual will be calculated. Sequential detections within a particular zone should be some multiple of the burst rate for the transmitters being used with longer intervals decreasing in occurrence. For each detection zone, a threshold interval for determining continued presence will be identified as the 95th percentile of the observed set of interval durations. These intervals will likely vary by location. The zone-specific threshold values will be used to delineate when each period of residence was started and completed for a tagged individual. The final departure of a tagged fish from a given zone will be determined when the time interval between successive detections exceeded the threshold interval for that zone.

Finally, the spatial and temporal distribution of detections across multiple receiver locations will be examined graphically to verify that the pattern of detections did not occur in a manner that is unreasonable for a fish to have relocated within the time between the detections and matches the overall post-release movement pattern. Time series plots for individual radio-tagged herring will be provided.

4.6 Data Reporting

For each individual, a cumulative tailrace residence time will be calculated as the sum of the fish residence durations within the detection zones for Stations A, B, C, D and E. The recorded periods of residence within each of the five detections zones will be determined based on the use of the zone-specific threshold interval values (see Section 4.5.1). In an effort to examine preferred selection among the five detection zones, the observed distribution for the count of individuals residing for some period of time at Stations A, B, C, D and will be compared to the distribution that would be expected if no selection preference was shown by test fish (i.e., 20% of observations occurring within each of the five detection zones). The observed and expected distributions will be compared using a $\chi 2$-analysis. In the event that differences in use are observed among the detection zones, differences in the cumulative residence times for individuals at two or more locations will be compared using an appropriate statistical test for means (e.g., t-test for two locations, ANOVA for three or more locations). Environmental test conditions (river temperature and total flow) and project operating conditions (spill and generation) during the entire study period will be provided in the report and the potential influences of these conditions on fish behavior will be considered.

5.0 Study Schedule

BWPH anticipates the following schedule to complete the Shawmut tailrace study:

- Early-May 2016 – Deployment and testing of telemetry equipment
- Mid-May-Early June 2016 – Tagging and release of three test groups (early, middle, late)
- Late-June 2016 – Removal of telemetry equipment
- July-August 2016 - Data analysis and draft report preparation
- August 2016 – submittal of draft report for agency review

6.0 References

BWPH (Brookfield White Pine Hydro). 2016. Draft Diadromous Fish Passage Report for the Lower Kennebec River Watershed during the 2015 Migration Season.

Castro-Santos, T., and R. Perry. 2012. Time to event analysis as a framework for quantifying fish passage performance. Pages 427-452 *in* N.S. Adams, J.W. Beeman, and J.H. Eiler, editors. Telemetry Techniques: A Users Guide for Fisheries Research. American Fisheries Society, Bethesda, Maryland.

Normandeau (Normandeau Associates, Inc.). 2016. Draft Evaluation of Downstream Passage for Adult and Juvenile River Herring – Lockwood Project, Kennebec River, Maine. Report Prepared for Merimil Limited Partnership.

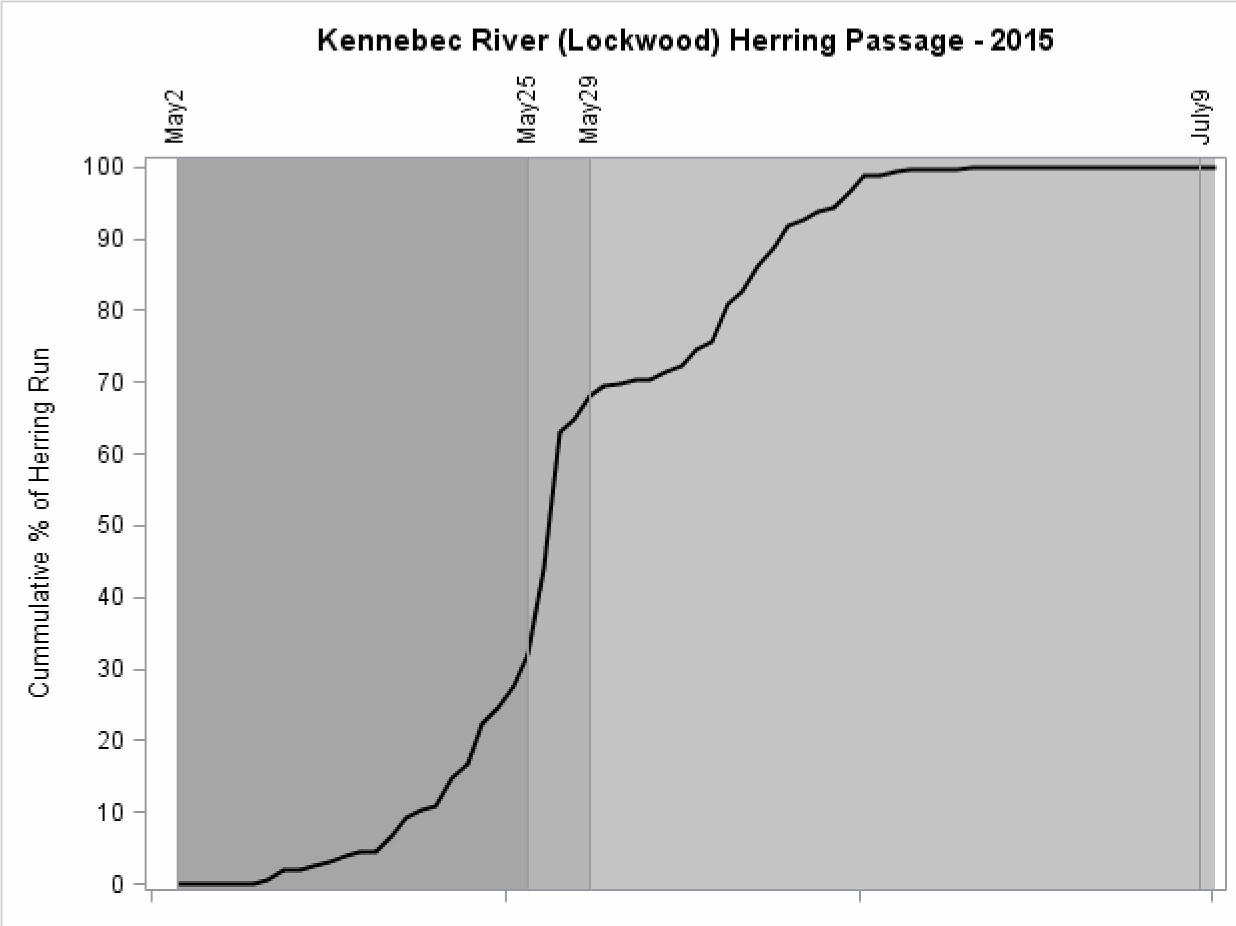


Figure 4–1. Approximate timing for the "early" (i.e., first third), "mid" (i.e., middle third) and "late" (i.e., last third) of upstream passage for adult river herring as recorded at Lockwood during 2015.

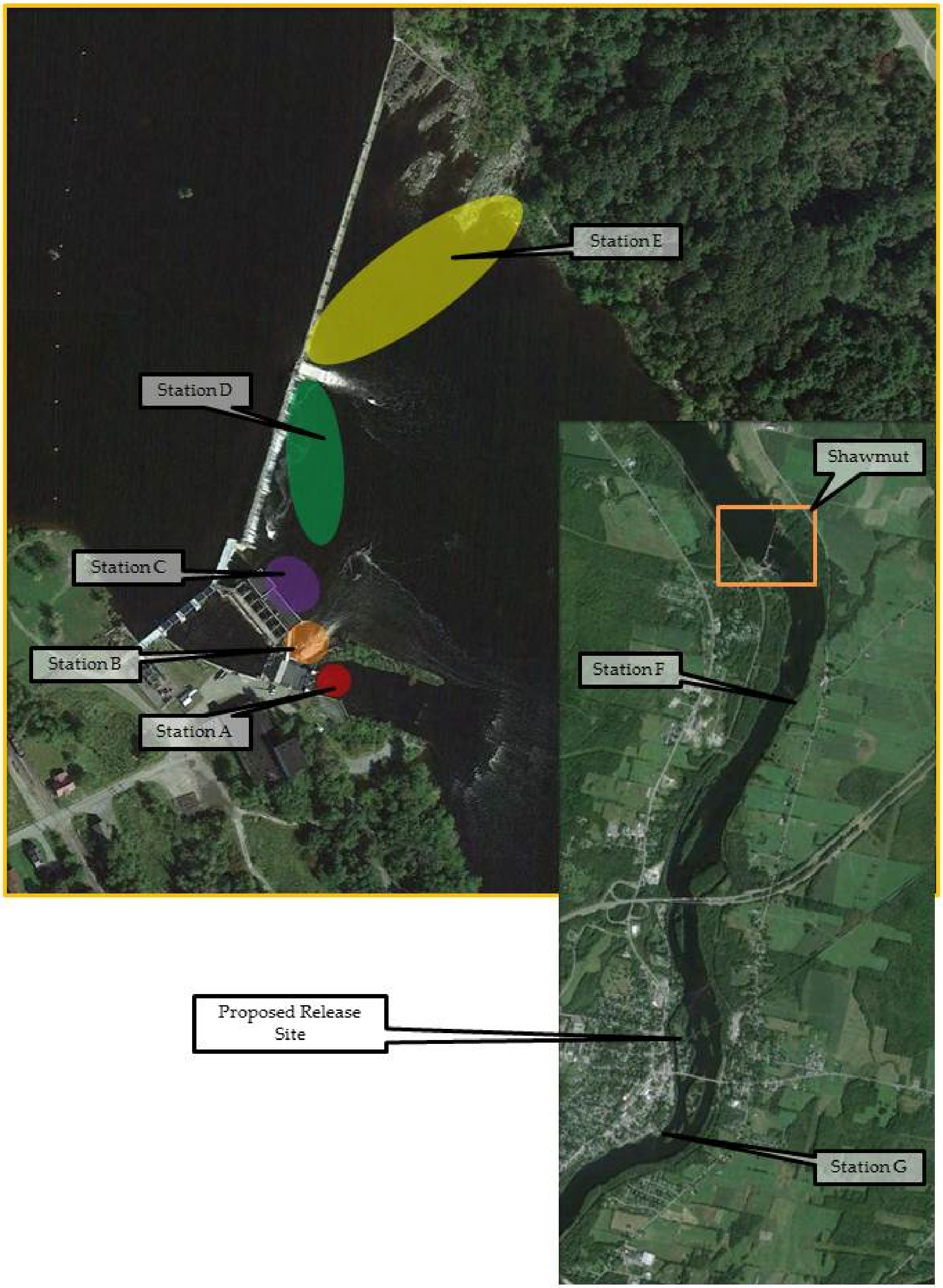


Figure 4–2. Proposed release site and radio-telemetry monitoring locations for evaluating presence of radio-tagged adult herring downstream of Shawmut during 2016.

From:	Bentivoglio, Antonio
To:	Maloney, Kelly; Richter, Robert
Cc:	Bryan Sojkowski; Brett Towler; Shawn McDermott; Donald Dow - NOAA Affiliate; Jeff Murphy; Kathy Howatt; OConnor, Michael; Gail Wippelhauser; Paul Christman; Seiders, Dwayne J; Brown, Michael; Senechal, Guy; Dill, Richard; Steven Shepard
Subject:	FWS comments on Shawmut Draft Study Plan for Assessment of Entrance Siting and Fish Passage
Date:	Wednesday, March 30, 2016 9:48:57 AM
Attachments:	20160330 FWS comments on Shawmut Siting Study using RH.pdf

Kelly and Bob,
attached are the Service's comments on the Shawmut Draft Study Plan.

Please contact me if you have any questions.

Antonio

--
Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office, Orono
Ph: 207 866 3344 x 1151
Fax: 207 866 3351

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
Maine Field Office
17 Godfrey Drive, Suite 2
Orono, Maine 04473
207/866-3344 Fax: 207/866-3351

March 30, 2016

SUBMITTED ELECTRONICALLY

Kelly Maloney
Manager of Licensing and Compliance
Brookfield Renewable Energy Group
150 Main Street
Lewiston, Maine 04240

RE: Comments on the Shawmut (FERC #2322) Draft Study Plan for the Assessment of Entrance Siting and Fish Passage Location

Dear Ms. Maloney:

The U.S. Fish and Wildlife Service (Service) received the *Draft Study Plan for the Assessment of Entrance Siting and Fish Passage Location for the Shawmut Project* (Draft Study Plan) on March 16, 2016. This report was prepared by Normandeau Associates for Brookfield White Pine Hydro (BWPH) the current licensee for the Shawmut Project (FERC #2322). Comments were requested by April 1, 2016. This letter constitutes the Service's official comments on the Draft Study Plan.

The Study Plan's Objective is to evaluate the adult river herring *(Alosa* spp.) behavior in the Kennebec River immediately downstream of the Shawmut Project to quantify preferential use of discrete tailwater regions to aid in the placement of the entrance for the new fishway. Adult river herring will be captured, radio tagged, released downstream of the project and monitored as they approach the project. Localized antennas will detect the tagged fish and create a generalized picture of which attraction flows are used by river herring as they attempt to migrate upstream.

The Draft Study Plan describes using "dummy" tags on 10 adult river herring and holding them for seven days to determine if fish handling affects survival. For this study, the survival of tagged river herring is less important and we recommend tagging additional river herring for the in-river study.

The Draft Study Plan anticipates using three batches of 50 test fish (totaling 150 fishes). The Service has discussed this with the Maine Department of Marine Resources, the Department of Inland Fisheries and Wildlife, and the National Marine Fisheries Service and request that additional river herring are used. The agencies recommend that each time a batch of 50 test fish are released, that an additional 500-600 untagged river herring are released at the same time.

This would result in a total of 1500-1800 untagged and 150 tagged river herring in the river at the same time. The Service considers this action will provide better entrance siting results, because more fish will be in the river and a substantial number will be untagged. The Service considers that more untagged fish will provide better information about where river herring congregate, such as more at station C than expected by chance. Radio antennas determine the location of the tagged fish within a broad area of coverage. In order to more specifically determine the location of tagged fish (*e.g.,* left or right side of powerhouse) we recommend that BWPH conduct mobile tracking with a dropper antenna or have a few dropper antennas that could be deployed from the powerhouse. This additional data would help inform the siting of the fishway entrance. In addition, in order to detect the untagged river herring, we also recommend that floating underwater cameras (similar to those used at Lockwood) be placed at Station A (Unit 7 and 8 Tailrace), Station B (Outflow), Station C (Unit 1-6 Tailrace), Station D (Spillway) and monitored regularly to determine if tagged river herring are congregating with the more abundant untagged river herring. Please coordinate capture and release of river herring with Jason Seiders, with the Maine Department of Inland Fisheries and Wildlife.

The Draft Study Plan also includes radio antennas at two sites downstream: Station F, 1.1 miles downstream, and Station G, 2.6 miles downstream. While we see the need for some downstream monitoring we recommend that one antenna (Station F) should suffice. In addition, in order to decrease the distance the tagged and untagged river herring need to swim before encountering the antennas at the project, we recommend all the river herring be released as close to Station F as possible, but downstream.

Thank you for the opportunity to comment during the early planning stages of this Project. If you have any questions regarding this response, please contact Antonio Bentivoglio at 207/866-3344 extension 1151, by email at *Antonio_Bentivoglio@fws.gov*, or at the above address.

Sincerely,

Kevin Foster
Acting Field Supervisor

cc: B. Sojkowski, B. Towler, RO/EN
S. McDermott, D. Dow, J. Murphy, NOAA
K. Howatt, MDEP
G. Wippelhauser, P. Christman, MDMR
J. Seiders, M. Brown, MDIFW
B. Richter, G. Senechel, R. Dill, BWPH
Reading File

ES: ABentivoglio:16/01/19:(207) 866-3344

From:	Richter, Robert
To:	"Donald Dow"; dan.tierney@noaa.gov; matt.buhyoff@noaa.gov; Bentivoglio, Antonio (antonio_bentivoglio@fws.gov); Bryan Sojkowski (bryan_sojkowski@fws.gov); Dwayne.J.Seiders@maine.gov; "Cox, Oliver"; paul.christman@maine.gov; Wippelhauser, Gail (Gail.Wippelhauser@maine.gov); kathy.howatt@maine.gov
Cc:	Maloney, Kelly; Mitchell, Gerry; gallen@aldenlab.com; Drew Trested; John Richardson (jrichardson@bluehillhydraulics.com)
Subject:	Blue Hill Hydraulics Shawmut CFD Model Draft Report
Date:	Wednesday, September 28, 2016 1:54:58 PM
Attachments:	Blue Hill Hydraulics Shawmut CFD Model Draft Report 9-28-2016.pdf

Please see draft report for your review and comment. We will set up a meeting around the third week in October to discuss this report, the river herring siting report (sent in a previous email) and conceptual designs for fish passage at Shawmut.

In the meantime, feel free to contact me if you have any questions.

Thanks.

DRAFT: Shawmut, Kennebec River, Maine

Radio-telemetry Evaluation for Upstream Fish Passage Entrance Placement

Prepared For:
Brookfield White Pine Hydro
150 Main Street
Lewiston, ME 04240

Submitted:
September 2016

Prepared By:
Normandeau Associates, Inc.
30 International Drive
Portsmouth, NH 03801

www.normandeau.com

Table of Contents

Page

List of Figures

List of Tables

1.0 Introduction and Background

Brookfield White Pine Hydro (BWPH) is the licensee for the Shawmut Project (FERC No. 2322). The current license for the Project was issued by FERC on January 5, 1981 to Central Maine Power (CMP) for a term of 40 years. The license was transferred from CMP to FPL Energy Maine Hydro LLC (FPL Energy) on December 28, 1998. On July 29, 2013 the license was amended to change the Licensee's name to Brookfield White Pine Hydro. The current Project license expires January 31, 2021. The Licensee is currently using the FERC Integrated Licensing Process to seek a new License for the Project.

With regards to fish passage at Shawmut, on February 21, 2013, FPL Energy submitted a request to FERC that the Project license be amended to incorporate provisions from a proposed seven year Interim Species Protection Plan (ISPP) developed for Atlantic salmon (for the period 2013-2019). The National Marine Fisheries Service (NMFS) issued its Biological Opinion (BO) and Incidental Take Statement (ITS) on July 19, 2013. The proposed schedule for implementation of the ISPP was included as part of that BO and states that the Licensee will design a new upstream fish passage facility for Shawmut during 2016.

The objective of this study was to evaluate adult river herring behavior in the Kennebec River immediately downstream of the Shawmut Project. Specifically, this study aimed to quantify preferential use of discrete tailwater regions to aid in the future placement of the Project fishway and proper siting of the entrance. A draft study plan detailing the study objectives, methodology, schedule and deliverables was submitted to USFWS, NMFS, MDIFW, and MDMR on March 16, 2016. To the extent possible, all comments received from the resource agencies were addressed and incorporated in the final study plan version (Appendix A). That study plan served as the guiding document for the evaluation of alewife behavior in the tailwater area downstream of Shawmut during May-June 2016.

2.0 Project Description and Study Area

2.1 Facilities

The Shawmut Project is located at river mile 70 (24.5 miles above head-of-tide in Augusta) and is the third dam on the mainstem of the Kennebec River. The Shawmut Project includes a 1,310-acre impoundment, a 1,135 foot long dam with an average height of about 24 ft, headworks structure, enclosed forebay, and two powerhouses with intake structures. The crest of the dam has 380 ft of hinged flashboards 4 ft high serviced by a steel bridge with a gantry crane, a 730-foot long inflatable bladder composed of three sections, each 4.5 ft high when inflated and a 25 foot wide by 8 foot deep log sluice equipped with a timber and steel gate.

The headworks and intake structures are integral to the dam and the powerhouses, respectively. The forebay intake section contains eleven headgates and two filler gates. Five of the headgates are installed in openings 10 ft wide by 15.5 ft high and six are installed in openings 10 ft by 12.5 ft. The two filler gate openings are 4 ft by 6 ft. A non-overflow concrete gravity section of dam connects the west end of the concrete filled forebay gate openings with a concrete cut-off wall which serves as a core wall for an earth dike.

The forebay is located immediately downstream of the headgate structure and is enclosed by two powerhouse structures, the original 1924 powerhouse located to the east and the newer 1982 powerhouse located to the south. An approximately 240 foot long concrete retaining wall is located on the west side of the forebay. Located at the south end of the forebay between the powerhouses is a 10 foot by 7 foot taintor gate, which serves as interim downstream anadromous fish passage. In addition, a 6 foot by 6 foot deep gate and a surface sluice (4 foot wide by 22 inch deep, passing 35 cfs) which discharges into a 3 foot deep man-made plunge pool are located at the south end of the forebay. In the old powerhouse, the intake section has six open flumes each fitted with two 10.5 foot by 14 foot double leaf slide gates and a continuous trash rack. In the newer powerhouse, the intake section contains two openings fitted with vertical headgates about 12 ft high by 12 ft wide and operated by hydraulic cylinders. The trash racks are serviced by a track mounted, hydraulically operated trash rake with trash removal capabilities. The trash racks screening the intakes are 1.5 inch clear spacing in front of Units 1-6 and 3.5 inch clear spacing in front of Units 7 and 8. The original powerhouse contains six horizontal Francis-design units and the newer powerhouse contains two horizontal propeller units, having a total combined installed capacity of 8.74 MW and combined flow of approximately 6,700 cfs. The project's tailrace channels are excavated riverbed located downstream of the powerhouses. The project boundary extends upstream about 12 miles.

2.2 Streamflow

The Project is typically operated in a run-of-river mode, normally passing a minimum flow of 2,110 cfs, with a target reservoir elevation of about 112.0 ft msl during normal conditions. Monthly flow duration curves were developed for the Project based upon 32 years of daily stream flow (1979-2010; Appendix B). The median flow condition (i.e. the value with 50% flow exceedance) at Shawmut is 9,000 cfs during May and 5,750 cfs during June. Station capacity through the eight turbine units is approximately 6,800 cfs with roughly 1/3 of that flow passing via Units 7 and 8 (propeller units).

2.3 Project Study Area

Radio-tagged alewives were released into the Kennebec River at the Fairfield boat ramp, located approximately 3.4 river miles downstream of the Project (Figure 2-1). A monitoring station was installed at a shoreline location approximately 2.3 miles upstream of the release site and detections at that location were used to indicate entry into the "nearfield" zone. A second monitoring station was installed at a point approximately 0.25 miles downstream of the release site and detections at that location were used to indicate passage out of the "study" zone. Concurrent with evaluation of movements below the Shawmut Project, fish tagged during this study were monitored for downstream passage at Hydro Kennebec. Relative timing of arrival at that Project is included in the time series plots created for study fish and is presented in Appendix C of this report.

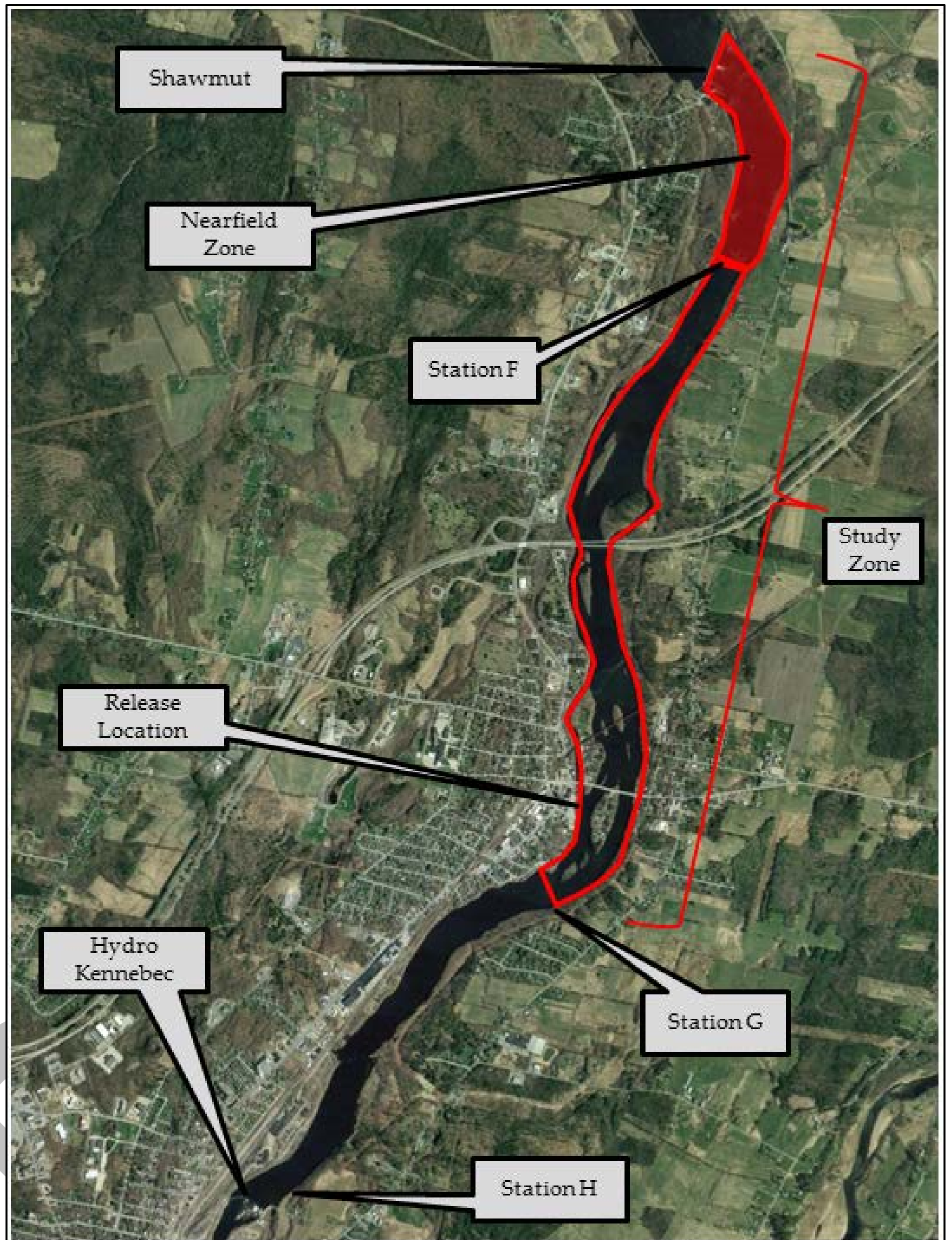


Figure 2–1. Kennebec River showing relative locations of Shawmut and Hydro Kennebec, release location, nearfield zone, study zone as well as receiver stations used to determine zone residence.

3.0 Study Methods

3.1 Capture, Tagging, and Release

Adult alewives were captured for tagging at the Lockwood fish lift located downstream of Shawmut at river mile 63. Following collection in the upstream fish lift, individuals were gently netted from the holding tanks and visually evaluated prior to tagging. Individuals appearing to be stressed or injured were not selected for tagging. Prior to insertion into test fish, transmitters were programmed using Sigma-Eight software and an infrared tag activator. Active status, burst rate and identification code were verified prior to insertion of the transmitter into a fish. Once a transmitter was verified, it was gently inserted into the stomach. To facilitate the gastric implantation, transmitters were affixed to a flexible tube that was pushed through the mouth and down to the stomach. Once in place, the tube was removed, leaving the transmitter antenna trailing from the mouth. Prior to transmitter insertion, individuals were measured (total length, mm) and sex was determined (when possible) by gently expressing eggs or milt from running-ripe fish. Immediately following tagging, alewives were placed in an aerated tank truck. Upon completion of tagging, all individuals in the release group were transported by truck to the Fairfield boat ramp, located approximately 3.4 miles downstream of Shawmut. Each release event was coordinated with MDMR such that an additional 1,200 to 1,500 untagged river herring were released simultaneously at Fairfield. Untagged herring were transported in a MDMR stocking truck following their standard protocols.

Adult alewives tagged during this study were fitted with Pisces radio-transmitters (model: TX-PSC-I-80) manufactured by Sigma-Eight. The selected transmitters were uniquely coded and divided between two frequencies (150.760, and 150.780 MHz). Transmitters were programmed for a burst rate of either 2.5, 2.7, or 3.0 seconds to provide greater separation among signals for fish within a particular location. The burst rates of 2-3 seconds provided a battery life on the order of 90 days. The dry mass for the Pisces TX-PSC-I-80 transmitters selected for this study was approximately four grams.

3.2 Radio-telemetry Monitoring

Within the nearfield reach, radio telemetry antennas and data logging receivers were installed at seven locations along the downstream face of the Shawmut facilities to monitor the approach and tailrace residence of radio-tagged herring (Figure 3-1). These locations included:

Station A: This receiver provided coverage of tailrace channel downstream of Units 7 and 8 which is separated from the remainder of the Shawmut tailrace by an island. Coverage in this area was provided by a single receiver connected to one aerial antenna. The aerial antenna was oriented downward and the receiver programmed to minimize detections of radio transmitters outside of the intended detection zone immediately downstream of this powerhouse.

Station B: This receiver provided coverage of outflow area between the two Project powerhouses and downstream of the forebay taintor gate, currently serving as an interim downstream bypass for outmigrating fish. An aerial antenna and single receiver was used to provide coverage of this area.

Station C: This station provided coverage of the tailrace area immediately downstream of the Units 1-6 powerhouse. Coverage in this area was provided by three separate receivers paired with underwater drop antennas. This approach provided finer resolution to fish movements downstream of the Units 1-6 powerhouse. Station C-1 was located at the northern end of the powerhouse (i.e., the Unit 1 outflow), Station C-2 was located near the mid-point of the powerhouse (i.e., the Unit 3 outflow) and Station C-3 was located near the southern end of the powerhouse (i.e., the Unit 6 outflow).

Station D: This receiver provided coverage of the approximately 380 foot long section of hinged flashboards forming the western portion of the overflow spillway area. Coverage in this area was provided by a single receiver connected to an aerial antenna. The aerial antenna was oriented downward and the receiver programmed to minimize detections of radio transmitters outside of the intended detection zone.

Station E: This receiver provided coverage of the approximately 730 foot long section of inflatable bladder forming the eastern portion of the overflow spillway area. Coverage in this area was provided by a single receiver connected an aerial antenna. The aerial antenna was oriented downward and the receiver programmed to minimize detections of radio transmitters outside of the intended detection zone.

In addition to the receivers installed at Shawmut, a receiver station (Station F or the 'Horse Farm') was installed at a point approximately 1.1 river miles downstream of the dam and was used to provide information on radio-tagged herring as they entered and exited the nearfield zone (Figure 2-1). Additional downstream stations were installed below the release site at the Fairfield Pump Station (Station G) and immediately upstream of Hydro Kennebec (Station H).

The receivers were configured to receive signals from a designated area continuously throughout the study period. During installation of each receiver, detection range testing was conducted to configure the antenna/receiver combinations to maximize detection efficiency. The operation of the system as a whole was confirmed throughout the study period by the use of beacon tags. Beacon tags were stationed at strategic locations within the detection range of one or more monitoring stations and emitted a signal at scheduled time interval. These signals were detected and logged by the receivers and used to record the functionality of the system throughout the study period. Although each receiver was installed in a manner which limited the ability to detect transmitters from unwanted areas, the possibility of such detections did still exist. As a result, movement data collected in this study (i.e., duration at a specific location) was inferred based on the signal strength, duration and pattern of contacts documented across the entire detection array.

3.3 Data Collection

Data was regularly off-loaded from receivers throughout the study. Backup copies of all offloaded data files were made prior to receiver initialization. Field tests to ensure data integrity and receiver performance included confirmation of file status (i.e., not corrupt), confirmation that the last record was consistent with the download data (reliance on constant signals provided by beacon transmitters aided this step) and to confirm that the receiver was operational upon restart and actively collecting data post download. Data was stored in the receivers as a single event and each event consisted of detection date, detection time, channel, code, and signal strength.

In addition to the radio telemetry data, river temperature, river flow (cfs), project operations (total cfs and unit cfs), and extent of spill were collected throughout the study.

3.4 Data Analysis

Tag detections in each downloaded data file were validated through a series of site-specific and logical criteria. These general criteria included:

1. Power threshold level of the signal,
2. Frequency of the radio-tag signals per unit of time, and
3. Spatial and temporal distribution of the radio signals detected among stations.

To determine the power threshold for a valid tag signal, power levels associated with background noise were recorded at each receiver location prior to the release of any radio-tagged individuals. These "false" signals at relatively low power levels below a power threshold were removed from the database. Similarly, observations made during the extensive range testing prior to the initiation of fish releases included signal strength information from test tags placed at various points in and out of each intended detection field. Data files from all detection stations were subjected to additional filtering based on that signal strength information.

Following processing based on signal strength information, tag detections were sorted by identification code and date-time to screen and flag false detections for exclusion from the analysis. A tag detection was considered an isolated false detection if the previous and next detection in the time series was from a different antenna location. A minimum of three consecutive tag detections within a specific location was required to be considered valid.

Following removal of isolated detections, it was then necessary to identify when fish entered and left one of the discrete detection zones downstream of the Project (Stations A, B, C-1, C-2, C-3, D, and E). Since transmissions during a period of residence within one of the detection zones can go unrecorded for a variety of reasons (e.g., receiver scan time, signal collision, background interference, etc.), it is not appropriate to set a threshold interval between detections equal to the transmission rate of the tags (Castro-Santos and Perry 2012). To determine an appropriate threshold interval, the intervals between all successive detections within a particular detection zone and for each individual were calculated. Sequential detections within a particular zone should be some multiple of the burst rate for the transmitters being used with longer intervals decreasing in occurrence. For each detection zone, a threshold interval for determining continued presence was identified as the 95th percentile of the observed set of interval durations. These intervals varied by location and were determined to be 52 seconds for Station A, 32 seconds for Station B, 128 seconds for Station C-1, 224 seconds for Station C-2, 64 seconds for Station C-3, 373 seconds for Station D, and 951 seconds for Station E (Figure 3-2). The zone-specific threshold values were used to delineate when each period of residence was started and completed for a tagged individual. The final departure of a tagged fish from a given zone was determined when the time interval between successive detections exceeded the threshold interval for that zone.

Finally, the spatial and temporal distribution of detections across multiple receiver locations were examined graphically to verify that the pattern of detections was not occurring in a manner that was unreasonable for a fish to have relocated within the time between the detections and matches the overall post-release movement pattern. Time series plots for individual radio-tagged alewives are provided in Appendix C.

Where data were available, a 'time at large' for both the nearfield and study zones was calculated. Time at large in the nearfield zone was calculated as the duration from initial upstream passage past Station F to the final downstream passage past Station F. In some cases (e.g., see time series plot for Alewife ID 150.760-53 in Appendix C), a radio-tagged individual may have departed the nearfield zone (as determined by detections further downstream) then subsequently returned. In those instances, the nearfield time at large represents the cumulative duration for the two or more periods of residence. Additionally, a time at large for the study zone was calculated. This value was calculated as the duration from release into the river until final downstream passage past the Fairfield Pump Station (i.e., Station G).

For each individual, a cumulative tailrace residence time was calculated. That value was obtained by summing the durations for each of the recorded periods of residence determined through use of the zone-specific threshold interval values within the detection zones for Stations A, B, C-1, C-2, C-3, D and E. The cumulative tailrace time could be proportioned by looking at the contribution of cumulative time from each of the distinct detection zones to the total on an individual fish basis. In an effort to examine preferred selection among the detection zones, the observed distribution for the mean proportion of time spent among the seven discrete detection zones was compared to the distribution that would be expected if no selection preference was shown by test fish (e.g., 14.3% of observations occurring within each of the seven detection zones). The observed and expected distributions were compared using a χ^2-analysis. In the event that the observed and expected distributions between the detection zones differed, differences in the cumulative residence times for individuals were compared using an appropriate statistical test for means (e.g., t-test for two locations, ANOVA for three or more locations).

Figure 3-1. Locations of nearfield telemetry monitoring stations A through E at Shawmut, Kennebec River, Maine, May-June 2016.

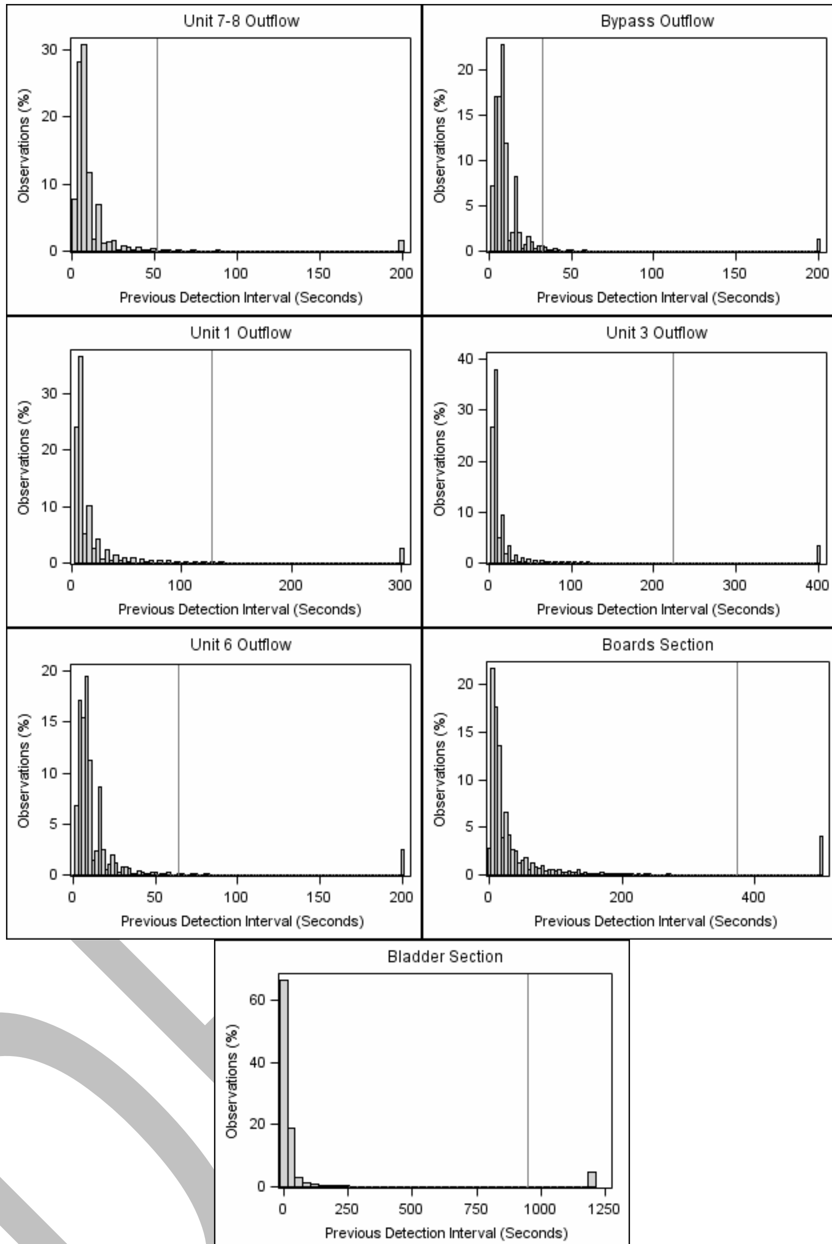


Figure 3-2. Frequency distribution (%) of intervals since last detection of radio-tagged adult alewife transmitting in the Unit7/8 (Station A), bypass (Station B), Unit 1 (Station C-1), Unit 3 (Station C-2), Unit 6 (Station C-3), hinged flashboard section (Station D) and inflatable spill section (Station E) detection zones. Vertical lines indicate the unique threshold interval used to delineate new period of residence within each zone.

4.0 Results

4.1 Shawmut Operations and Kennebec River Conditions

Hourly Kennebec River discharge values for Shawmut are presented graphically in Figure 4-1. The mean Kennebec River discharge for the entire study period (May 19 – June 14, 2016) was 4,039 cfs. When examined by month, mean Kennebec River discharge was 3,805 cfs (range = 3,039-5,301 cfs; SD = 576 cfs) for all study period dates during May and 4,255 cfs (range = 2,944-6,944 cfs; SD = 1,238 cfs) for all study period dates during June. Based on monthly flow duration curves (Appendix B), the observed monthly mean values are exceeded 94% of the time during May and 74% of the time during June. Relative to the May and June flow duration curves for the Kennebec River at Shawmut, river flows observed during the 2016 study period were low.

As would be expected based on river flows during the study period, non-unit discharge was low throughout the study period (Figure 4-2). Non-unit discharge at Shawmut was limited to the forebay taintor gate which maintained a near constant flow for the duration of the study. The forebay taintor gate is currently operated as interim downstream passage during the spring outmigration with an additional 700 cfs passing via that route when fully opened. Discharge for Project units 1-8 is presented in Figure 4-3. Although discharge was not present at all locations for the duration of the study, unit pairings roughly corresponding with the installed monitoring stations had flow present for all or most of the monitoring period (i.e., Units 1 & 2 / Station C-1; Units 3 & 4 / Station C-2; Units 5 & 6 / Station C-3; Units 7 & 8 / Station A). Based on project operations data, Unit 1 operated for 100%, Unit 2 for 59%, Unit 3 for 91%, Unit 4 for 31%, Unit 5 for 54%, Unit 6 for 11%, Unit 7 for 24% and Unit 8 for 100% of the study period.

Kennebec River temperature ranged between 12.1-19.1 ^{o}C during the study period (Figure 4-1).

4.2 Stationary Monitoring Coverage

Figure 4-4 presents the coverage provided by each of the stationary radio-telemetry receivers installed at and downstream of Shawmut during the 2016 herring evaluation. Station coverage was determined by beacon transmitter detections as well as observations reported by the field personnel conducting frequent receiver checks and downloads. Based on the combination of beacon tag detections and manual equipment checks, it was determined that all receivers operated with no issues for the duration of the study.

4.3 Capture, Tagging, and Release

A total of 150 adult alewives were collected at the Lockwood fish lift, tagged, and released downstream of Shawmut during May, 2016 (Table 4-1). Releases took place on May 19, 23, and 26th. The mean daily river flow ranged between 3,600 and 5,100 cfs and river temperatures between 12.7 and 16.7 ^{o}C for the three release dates. To minimize transport stress on tagged fish being released and to facilitate easy access for the concurrent release of untagged herring from a State stocking vehicle, each of the three releases were conducted at the Fairfield public boat launch. Each release group consisted of 50 tagged individuals accompanied by 1,200-1,500 untagged fish. When all release groups are considered, the sex ratio of tagged fish was 2:1 (F:M) and total length ranged from 270 to 327 mm (mean 294 mm).

The timing of releases relative to the annual river herring run at Lockwood dam is presented in Figure 4-5. When release dates are compared to the Kennebec River herring run, the May 19th release group coincided with approximately 5% of the 2016 annual run having been lifted at Lockwood, the May 23rd release group coincided with approximately 20% of the annual run having been lifted at Lockwood and the May 26th release group coincided with approximately 40% of the annual run having been lifted at Lockwood.

4.4 Radio-tagged Alewife Movements

Of the 150 individuals tagged and released downstream of Shawmut, 79% (n=119) moved upstream and were detected within one or more of the tailrace monitoring zones [1](Table 4-2). A percentage of fish from each release group moved downstream near-immediately following introduction into the river with their only detections occurring at the Fairfield pump station and Hydro Kennebec. The percentage of fish not exhibiting continued upstream movement following tagging was lowest during the first two releases (~10%) and highest during the third release (~34%). There were three individuals released which were not detected by any of the monitoring stations.

The mean time at large for radio-tagged alewives in the nearfield zone immediately downstream of Shawmut (defined as duration from initial upstream passage past Station F to the final downstream passage past Station F) was 194 hours (range = 4-535 hours; Table 4-3). Mean time at large for radio-tagged alewives within the full study reach between Shawmut and the Fairfield pump station (defined as duration from time at release until final detection at Station G) was examined for fish exhibiting upstream movement to the Shawmut tailrace (i.e., up-migrants) as well as those dropping downstream and out of the study area shortly following release (i.e., down-migrants). The mean time at large for up-migrants within the study reach was 218 hours (range = 8-557 hours) and for down-migrants was 8 hours (range = 0.6-31; Table 4-3).

A cumulative tailrace residence time for each alewife, representing the sum of all time periods where that individual was determined to be within one of the tailrace detection zones was calculated and average values are presented in Table 4-4. The mean cumulative tailrace residence time for all release groups combined was 49 hours (range = 0.2-265 hours) and ranged from a high of 69 hours for individuals from the May 19th release to a low of 31 hours for individuals from the May 26th release. When cumulative tailrace residence time is examined relative to the total time spent within the nearfield zone, the mean proportion

[1] A full listing of alewives radio-tagged and released during May, 2016 is provided in Appendix D

representing time spent in the nearfield zone was 0.214 (Table 4-5). That is, for an alewife entering the nearfield zone (i.e., the 1.1 mile reach between Station F and the Project), an average of 21.4% of the total time in the nearfield zone was spent within one of the seven discrete detection locations in close proximity to the dam (i.e., Stations A, B, C-1, C-2, C-3, D, and E). Similarly, when cumulative tailrace residence time is examined relative to the total time spent within the study zone, the mean proportion representing time spent in the study zone was 0.193 (Table 4-5). That is, for an alewife which was released at the Fairfield public boat launch, ascended upstream into the nearfield zone prior to departing the study reach, an average of 19.3% of the total time in the study zone was spent within one of the seven discrete detection locations in close proximity to the dam (i.e., Stations A, B, C-1, C-2, C-3, D, and E).

When examined by detection zone, a slightly lower number of individuals were present in the Unit 7-8 and inflatable bladder detection zones than were observed in detections zones downstream of the old powerhouse, forebay outflow or the hinged flashboard spillway area (Table 4-4). When all three releases are considered, the average number of hours of residence time for a radio-tagged alewife was 5.4 hours downstream of Unit 1, 8.4 hours downstream of Unit 3, 8.7 hours downstream of Unit 6, 1.7 hours downstream of Units 7/8, 8.0 hours downstream of the forebay taintor gate, 25.3 hours downstream of the hinged flashboard spillway area and 1.1 hours downstream of the inflatable bladder section (Table 4.4). When duration at each of the seven locations is expressed as a proportion of the entire tailrace residence time, the average values for fish from all three releases was 0.125 for Unit 1, 0.178 for Unit 3, 0.174 for Unit 6, 0.049 for Units 7/8, 0.254 for the downstream taintor gate, 0.439 for the hinged flashboard spillway area, and 0.035 for the inflatable bladder section.

In an effort to assess preferred use among the seven detection zones, the observed mean proportions of residence time for individuals present at Stations A, B, C-1, C-2, C-3, D, and E during the study period was compared to the distribution that would be expected if no selection preference was shown by a test fish (i.e., 14.3% of the total tailrace residence time occurring within each of the seven detection zones). The observed tailrace residency distribution differed significantly from the uniform distribution expected should radio-tagged individuals not show preferential movement towards specific locations ($\chi^2 = 63.45$; $p = <0.0001$). As radio-tagged alewives appeared to exhibit directed movement within the tailrace, the mean proportion of the total tailrace residence time was compared among stations. Prior to evaluation of the monitoring stations, the effect of release group was examined and was determined to be not significant ($F = 0.48$; $P = 0.6215$). However, significant differences in the mean proportion of time spent among the seven discrete detection zones were detected ($F = 85.36$; $P = <0.0001$). Based upon the mean proportion of time, radio-tagged alewives were most frequently detected in the area downstream of the hinged flashboard spillway section. Although the mean proportions of time spent in the area downstream of the inflatable bladder section and in the Unit 7/8 tailrace did not significantly differ from one another, the mean proportions of time observed for those two locations was significantly lower than observed for all other locations. There were no significant differences detected in the mean proportion of time spent among the Unit 1, Unit

3 and Unit 6 detection areas. The mean proportion of time spent in the area downstream of the forebay taintor gate outflow was significantly greater than any of the three regions downstream of the old powerhouse.

To increase the understanding of movements of radio-tagged alewives in the Shawmut tailrace, the total residence time for each individual at each of the seven monitoring stations was partitioned based on diel period. Periods of residence during the hours from 0700 through 1900 were classified as 'day' and during the hours of 2000 through 0600 were classified as 'night'. The average proportion of residence time was skewed towards the daylight hours for tagged fish within the Unit 1 (0.81 day; 0.19 night), Unit 3 (0.77 day; 0.23 night), Unit 6 (0.67 day; 0.33 night), Unit 7/8 (0.75 day; 0.25 night), and forebay taintor gate discharge (0.82 day; 0.18 night) detection zones. In contrast, the average proportion of residence time within the detection zones downstream of the hinged board section (0.59 day; 0.41 night) and downstream of the inflatable bladder section (0.42 day; 0.58 night) did not differ greatly between day and night.

The relationship of unit operation and residence periods downstream of the Francis Units (1-6) was examined. Discharge was present at Monitoring Stations C-1 (Units 1 and 2) and C-2 (Units 3 and 4) for the duration of the study period and as a result, 100% of residence periods for tagged herring in the vicinity of those two locations occurred when discharge was present. When the entire study period is considered, discharge was reduced at Monitoring Station C-3 due to periods of no generation (Figure 4-3). The percentage of residency periods for radio-tagged alewives at Monitoring Station C-3 (Units 5 and 6) was higher when those units were in operation (58%) than offline (42%).

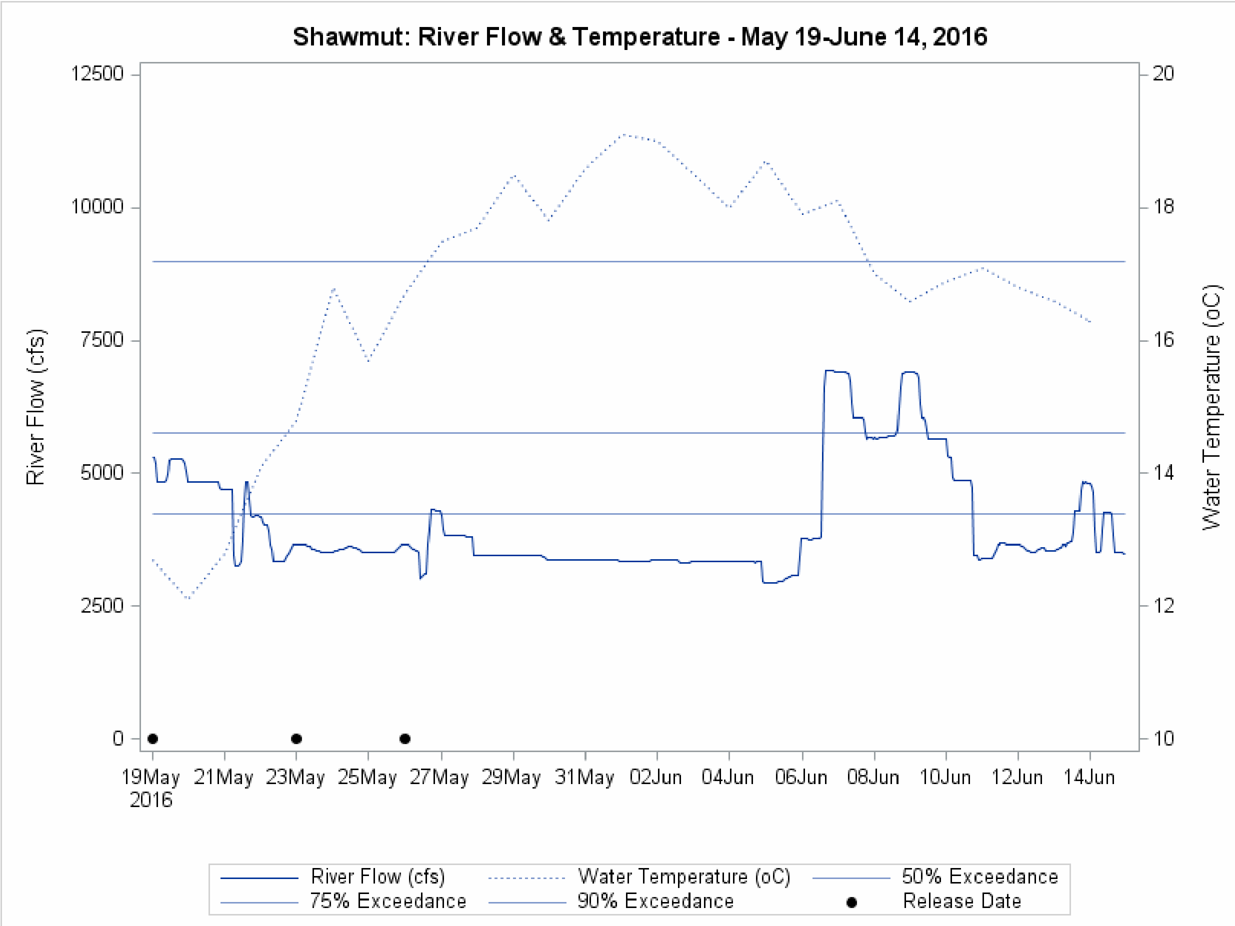


Figure 4-1. Hourly Kennebec River flow (cfs) and daily water temperature (°C) as measured at Shawmut for the time period May 19-June 14, 2016. The 50, 75, and 90% flow exceedance conditions based on historic Kennebec River flow data (for May) as well as tagged fish release dates are included for reference.

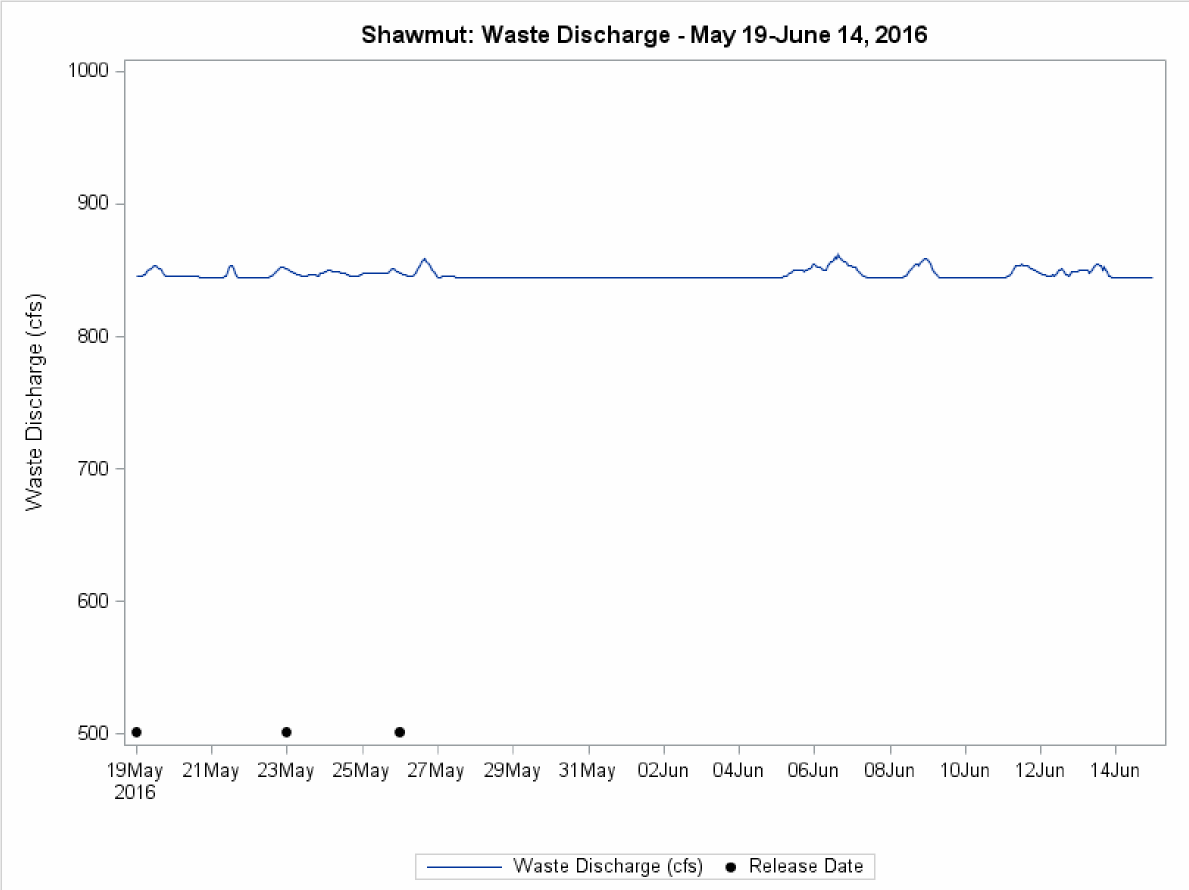


Figure 4-2. Shawmut waste discharge (cfs) for the time period May 19-June 14, 2016. Tagged fish release dates included for reference.

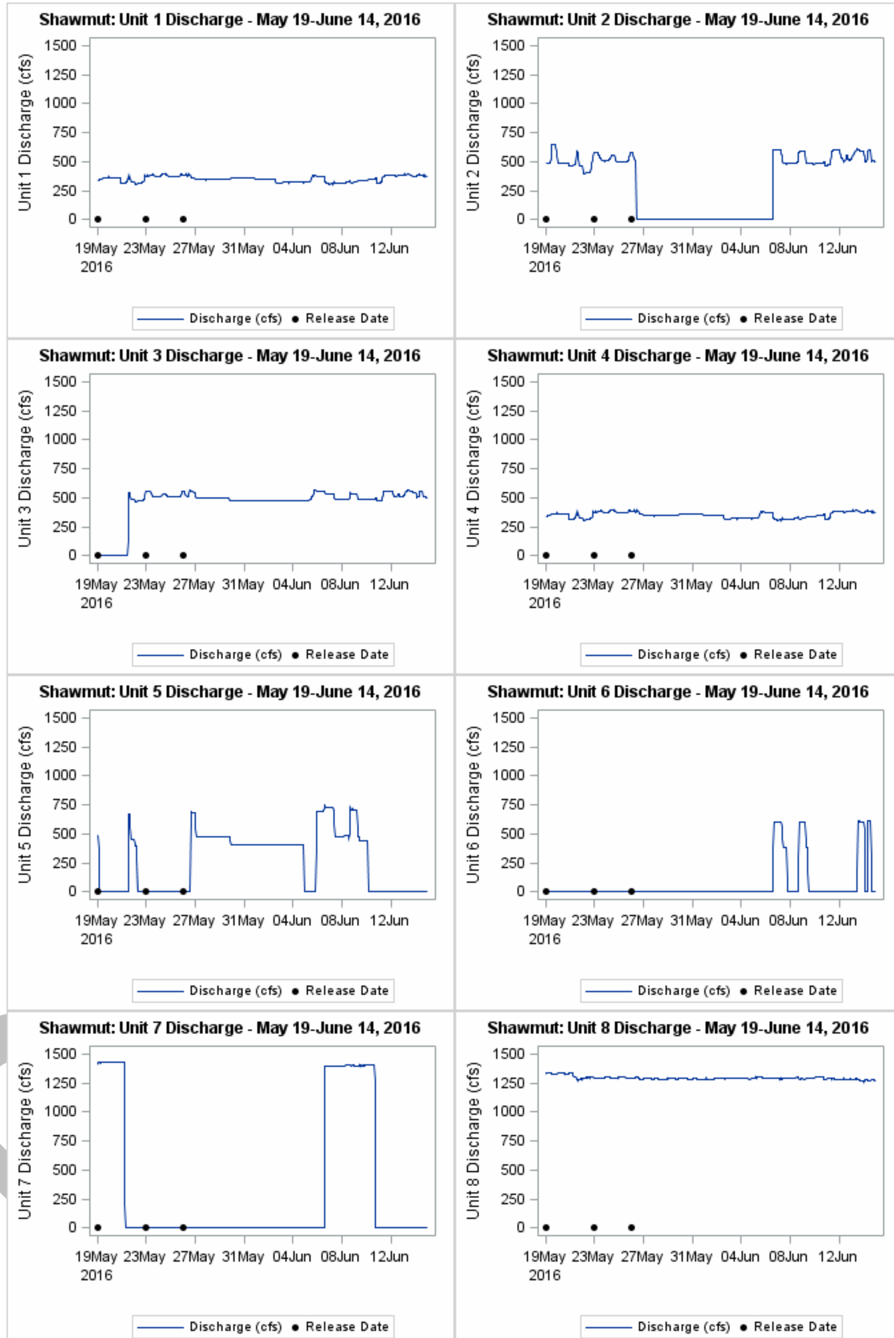


Figure 4-3. Shawmut unit discharge (cfs) for the time period May 19-June 14, 2016. Tagged fish release dates included for reference.

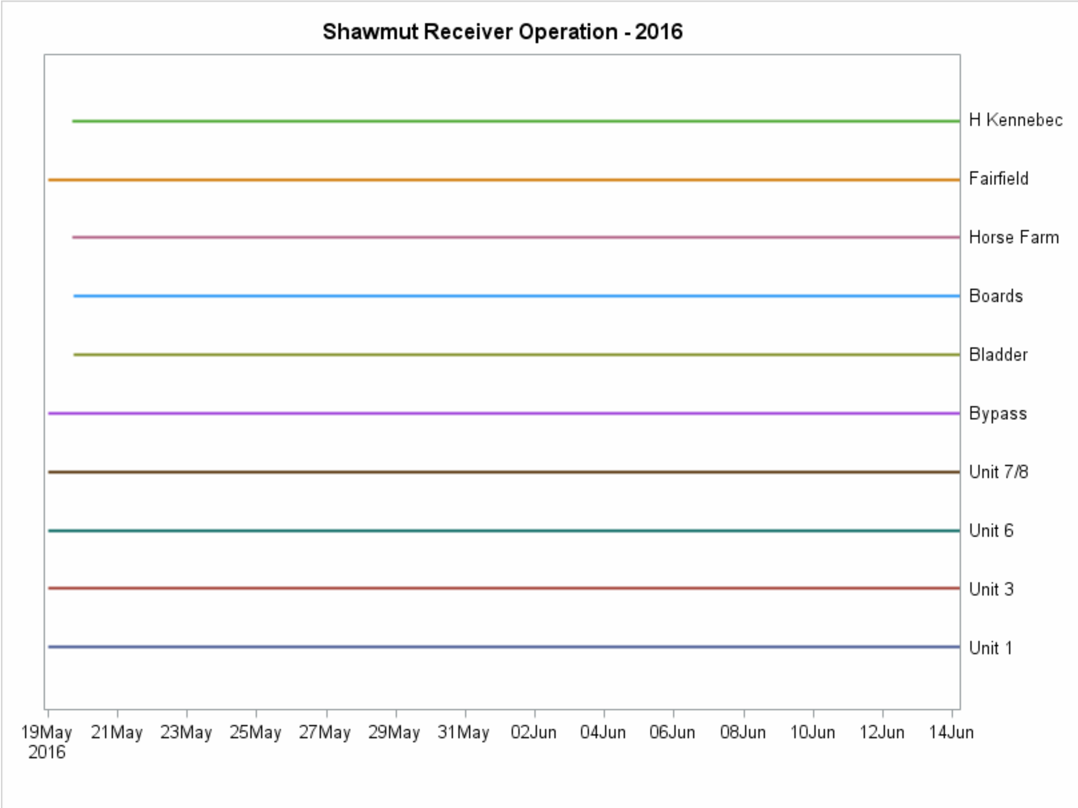


Figure 4-4. Stationary receiver coverage for radio-telemetry stations A through H located at and downstream of Shawmut, May 19-June 14, 2016.

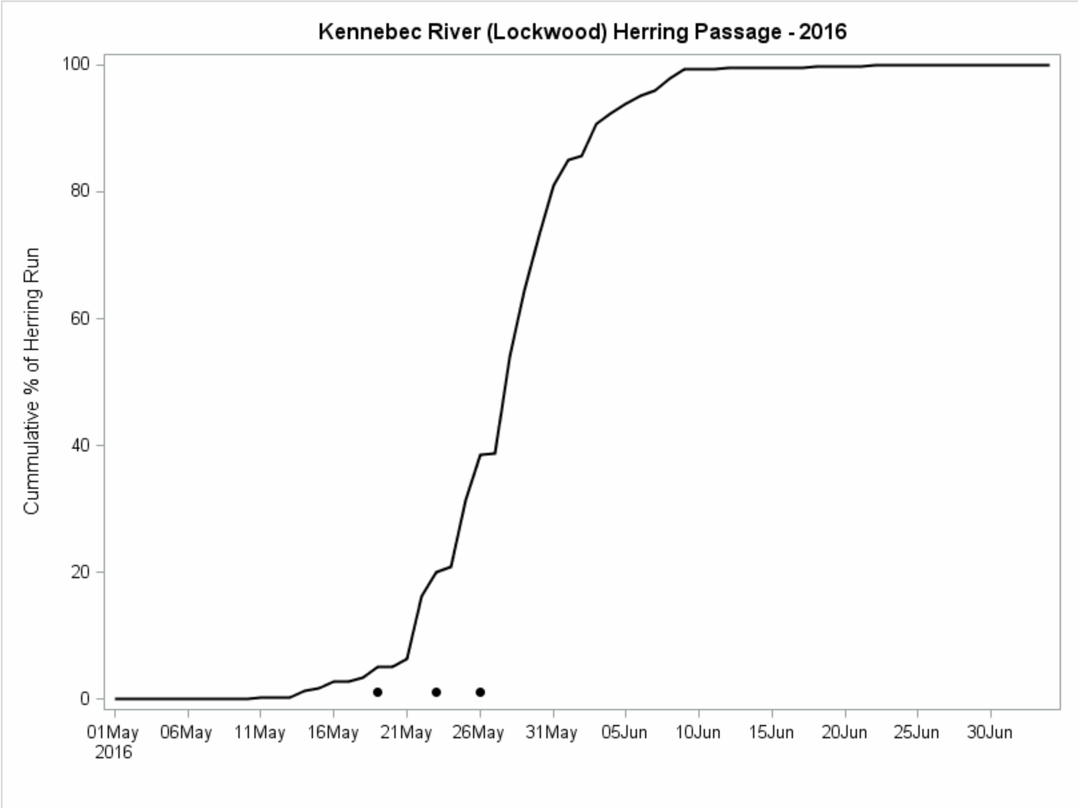


Figure 4-5. Temporal spacing of release dates for radio-tagged herring downstream of Shawmut relative to the Kennebec River herring run as recorded at Lockwood. Tagged fish release dates included for reference.

Table 4-1. Summary of Release, Capture, Gender, and Length Information for Adult Alewife Release Groups 1, 2, and 3 Downstream of Shawmut, May 2016

	Release Group			All Groups
	1	2	3	
Release Date	19-May	23-May	26-May	-
Number of Tagged Fish Released	50	50	50	150
Number of Untagged Fish Released	1,200	1,500	1,200	3,900
River Discharge (cfs)	5,103	3,586	3,711	-
River Temperature (°C)	12.7	14.8	16.7	-
Fish Lift Source	Lockwood	Lockwood	Lockwood	-
Percentage Male (%)	30	44	30	35
Percentage Female (%)	64	56	60	60
Percentage Gender Undetermined (%)	6	-	10	5
Minimum Total Length (mm)	272	276	270	270
Mean Total Length (mm)	296	295	292	294
Maximum Total Length (mm)	327	322	322	327

Table 4-2. Summary of In-River Movements and Detections for Adult Alewife Release Groups 1, 2, and 3 Downstream of Shawmut, May 2016

	Release Group			All Groups
	1	2	3	
Release Date	19-May	23-May	26-May	-
Number Released	50	50	50	150
Number Detected in Tailrace [a]	44	43	32	119
No Detection Information	-	2	1	3
Downstream Detections Only [b]	6	5	17	28

a - Defined by detections at Stations A, B, C-1, C-2, C-3, D, and E

b - Defined by detections at Stations G and H only

Table 4-3. Summary of Time at Large (Hours) in the Nearfield Zone (i.e., Shawmut to Station F) and Within the Study Reach (i.e., Shawmut to Fairfield Pump Station) for Adult Alewife Release Groups 1, 2, and 3 Downstream of Shawmut, May 2016. Study Reach Values Presented for All Fish, Those Moving Upstream to Shawmut (i.e., Up-migrants) and Those Moving Directly Downstream Following Release (i.e., Down-migrants)

	Release Group			All Groups
	1	2	3	
Release Date	19-May	23-May	26-May	-
Number Released	50	50	50	150
Nearfield Time at Large (hours) [a]				
Mean	233	183	155	194
Minimum	4	46	4	4
Maximum	535	433	434	535
Standard error	16.9	14.8	17.5	9.8
Study Area Time at Large (hours) [b] - All fish				
Mean	230	178	122	180
Minimum	1	0.6	0.8	0.6
Maximum	557	441	438	557
Standard error	18.9	15.9	16.9	10.6
Study Area Time at Large (hours) [b] – Up-migrants Only				
n	44	43	32	119
Mean	261	199	183	218
Minimum	30	53	8	8
Maximum	557	441	438	557
Standard error	16.7	14.8	18.4	10.0
Study Area Time at Large (hours) [b] – Down-migrants Only				
n	6	5	17	28
Mean	5	7	9	8
Minimum	1	0.6	0.8	0.6
Maximum	13	15	31	31
Standard error	2.2	2.6	1.9	1.3

a - defined as duration between upstream and downstream passage at Station F

b - defined as duration from time at release until outward detection at Station G (Fairfield)

Table 4-4. Summary of Cumulative Residence Time by Release Group (1, 2, and 3) and Detection Zone for All Stations and Each Discrete Station for Adult Alewife Released Downstream of Shawmut, May 2016

	Release Group			
	1	**2**	**3**	**All Groups**
Release Date	19-May	23-May	26-May	-
Number Released	50	50	50	150
Number Detected in Tailrace	44	43	32	119
Tailrace Cumulative Residence Time (hours) [a]				
Mean	69	43	31	49
Minimum	0.2	0.7	0.25	0.2
Maximum	265	203	143	265
Standard error	9.1	7.8	6.5	4.9
Unit 1 Cumulative Residence Time (hours) [b]				
n	42	43	31	116
Mean	6.7	5.2	4.1	5.4
Minimum	0.3	0.1	0.1	0.1
Maximum	60.3	66.9	29.5	66.9
Standard error	1.7	1.7	1.1	0.9
Unit 3 Cumulative Residence Time (hours) [b]				
n	44	43	32	119
Mean	12.9	7.1	3.9	8.4
Minimum	0.1	0.1	<0.1	<0.1
Maximum	58.9	32.9	26.0	58.9
Standard error	2.3	1.2	1.1	1.0
Unit 6 Cumulative Residence Time (hours) [b]				
n	44	43	32	119
Mean	11.1	8.7	5.4	8.7
Minimum	<0.1	<0.1	0.2	<0.1
Maximum	77.3	5935	30.1	77.3
Standard error	2.4	2.1	1.3	1.2
Unit 7/8 Cumulative Residence Time (hours) [b]				
n	38	37	26	101
Mean	1.8	1.5	1.7	1.7
Minimum	0.1	<0.1	0.1	<0.1
Maximum	12.6	12.7	9.3	12.7
Standard error	0.4	0.4	0.5	0.2

(continued)

Table 4-4. (Continued)

	Release Group			
	1	**2**	**3**	**All Groups**
Bypass Cumulative Residence Time (hours) [b]				
n	44	43	32	119
Mean	12.2	5.6	5.5	8.0
Minimum	<0.1	0.1	0.1	<0.1
Maximum	73.9	19.4	17.4	73.9
Standard error	2.5	0.7	0.8	1.0
Boards Cumulative Residence Time (hours) [b]				
n	44	42	29	115
Mean	35.8	20.1	17.2	25.3
Minimum	<0.1	0.3	0.2	<0.1
Maximum	159.0	139.1	100.3	159.0
Standard error	4.9	4.9	4.8	2.9
Bladder Cumulative Residence Time (hours) [b]				
n	40	37	26	103
Mean	1.3	1.0	1.0	1.1
Minimum	<0.1	<0.1	<0.1	<0.1
Maximum	7.7	12.7	4.6	12.7
Standard error	0.3	0.4	0.2	0.2

a - defined as the sum of all detection intervals recorded at Stations A, B, C-1, C-2, C-3, D, E

b - defined as the sum of all detection intervals recorded the corresponding station (Unit 1 = Stn C-1, Unit 3 - Stn C-2, Unit 6 = Stn C-3, Unit 7/8 = Stn A, Bypass = Stn B, Boards = Stn D, Bladder = Stn E)

Table 4-5. Percentage of Time at Large in the Nearfield Zone and Total Study Area Downstream of Shawmut for Radio-tagged Alewives Present in the Monitored Detection Zones Located Immediately Downstream of the Project

	Release Group			
	1	**2**	**3**	**All Groups**
Release Date	19-May	23-May	26-May	-
% of Nearfield Time at Large [a]				
Mean	27.1	19.1	16.8	21.4
Minimum	4.8	0.5	1.1	0.5
Maximum	57.6	54.9	42.5	57.6
% of Total Time at Large [b]				
Mean	23.8	18.1	14.6	19.3
Minimum	0.6	0.4	1.0	0.4
Maximum	55.8	52.7	40.0	55.8

a - defined as duration between upstream and downstream passage at Station F
b - defined as duration from time at release until outward detection at Station G (Fairfield)

5.0 Discussion

Movement data for 119 adult alewives radio-tagged and released downstream of Shawmut during the latter half of May, 2016 was available to infer usage among seven distinct regions monitored within the Shawmut tailrace. Alewives will respond to directional flow to navigate during their upstream migration period. As a result, river and operational conditions will likely influence the spatial distribution of radio-tagged alewives in a tailrace. During 2016, river flows in the Kennebec River were unseasonably low (the observed mean monthly value for study dates during May is exceeded 94% of the time). As a result, there was no significant spill present at either the hinged flashboard or inflatable bladder sections of the spillway. Discharge during the 2016 study was provided via the Unit 1-6 powerhouse, Unit 7-8 powerhouse and the forebay taintor gate.

As would be expected, radio-tagged alewives did not demonstrate equal proportional use of each of the seven discrete monitoring locations but demonstrated directed movement to and selected use of specific locations. Despite the lack of flow releases, results of the analysis of tailrace residence time for all 119 test fish indicated that the mean proportion of time spent in the detection area downstream of the hinged flashboard section was greater than the other six locations. However, residence times in the detection zones downstream of the two powerhouses and the forebay taintor gate discharge were dominated by occurrence during the daylight and crepuscular hours which represent the primary diel period of upstream movement for alewives. The proportion of detections during the day and night periods were much closer to a 50:50 ratio for the two monitored zones downstream of the spillway. It is likely that during night hours, radio-tagged alewives backed away from discharge downstream of the project powerhouses and were more likely to be found milling around in the lower flow areas downstream of the spillway.

When potential locations for entrance placement downstream of the two powerhouses and below the forebay taintor gate are considered, the mean proportion of time spent by radio-tagged alewives was greatest in the area of the forebay taintor gate discharge, located centrally between the Unit 1-6 powerhouse and the Unit 7-8 powerhouse. The mean proportion of time spent by radio-tagged alewives did not show any significant differences among the three monitoring stations established downstream of the Unit 1-6 powerhouse and movement patterns for fish there showed individuals regularly milling up and down the back of that structure rather than continuously focusing at one location. In general, radio-tagged alewives were drawn to locations along the back of the Unit 1-6 powerhouse where discharge was present. Discharge was present at Monitoring Stations C-1 (Units 1-2) and C-2 (Units 3-4) for the duration of the study and as a result all residence at those locations took place during periods of operation. The higher percentage of residence periods downstream of Monitoring Station C-3 (Units 5-6) during generation versus offline suggests that preferential operation of units could be used to attract migrating alewives to locations along the back of that structure.

6.0 References

Castro-Santos, T., and R. Perry. 2012. Time to event analysis as a framework for quantifying fish passage performance. Pages 427-452 *in* N.S. Adams, J.W. Beeman, and J.H. Eiler, editors. Telemetry Techniques: A Users Guide for Fisheries Research. American Fisheries Society, Bethesda, Maryland.

Appendix A—Study Plan

Appendix B—Flow Duration Curves

Shawmut Hydroelectric Project FERC No. 2322-ME - Flow Duration Curves

Prepared by Don Dow, PE, National Marine Fisheries Service, Orono Maine

The flow duration curve is based upon 32 years (1979-2010) of daily stream flow. In order to understand how the flow from various USGS gages was prorated to the site, it is important to understand the locations of the gages and their drainage areas.

The Sebasticook River flows into the Kennebec River downstream of the Shawmut Project. The entire Sebasticook River has a drainage area of 946 mi^2. There is a gage on the Sebasticook River which is USGS Gage No. 01049000 Sebasticook River near Pittsfield, Maine that has a drainage area of 572 mi^2. For the periods of January 1, 1979 to September 30, 1993 and October 1, 2000 to present, USGS Gage No. 01049265 Kennebec River at North Sidney, Maine was operating. This gage is located some distance downstream of the confluence of the Sebasticook and Kennebec Rivers and has a drainage area of 5,403 mi^2. For the period of October 1, 1993 to September 30, 2000, USGS Gage No. 01049205 Kennebec River near Waterville, ME was in operation. This gage is located just downstream of the confluence of the Sebasticook and Kennebec Rivers and has a drainage area of 5,179 mi^2. The drainage area of the Kennebec just above the confluence with the Sebasticook River is 5,179 mi^2 less 946 mi^2 which is 4,233 mi^2. The drainage area at the project which is upstream of the confluence with the Sebasticook is 4,200 mi^2.

Therefore, for the period where the North Sydney gage was in operation, the flow at the site was prorated from the following formula:

$$Q_{Shawmut} = (Q_{ns} \times (5{,}179\ mi^2 / 5{,}403\ mi^2)^{0.85} - Q_{seb} \times (946\ mi^2/572\ mi^2)^{0.85}) \times (4200\ mi^2/4{,}233\ mi^2)^{0.85}$$

Where:

QShawmut = Average Daily Flow at the Project

Qns= Average Daily Flow at the North Sydney Gage

Qseb= Average Daily Flow at the Sebasticook Gage

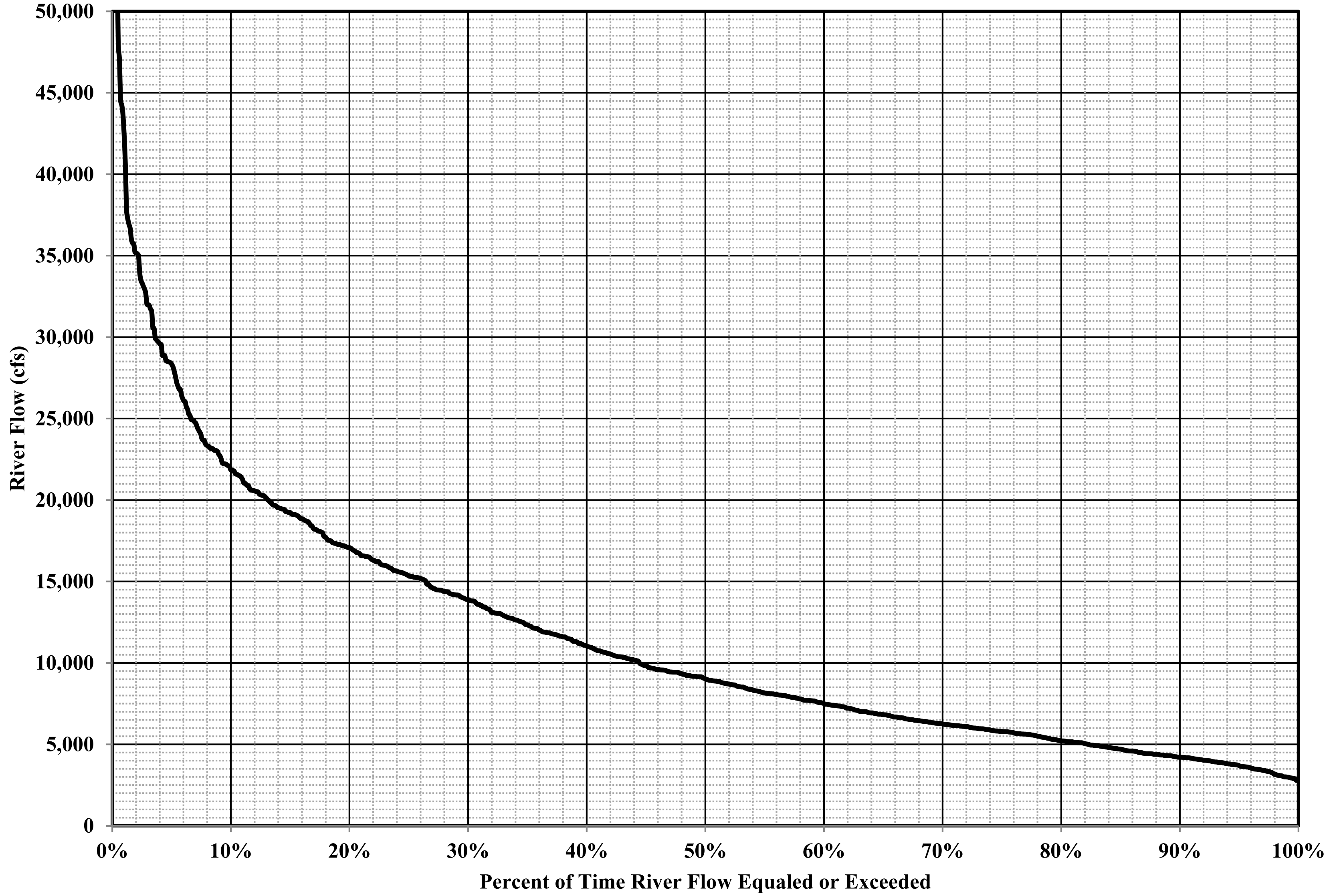
For the period where the Waterville gage was in operation, the flow at the site was prorated from the following formula:

$$Q_{Shawmut} = (Q_{wat} - Q_{seb} \times (946\ mi^2/572\ mi^2)^{0.85}) \times (4200\ mi^2/4{,}233\ mi^2)^{0.85}$$

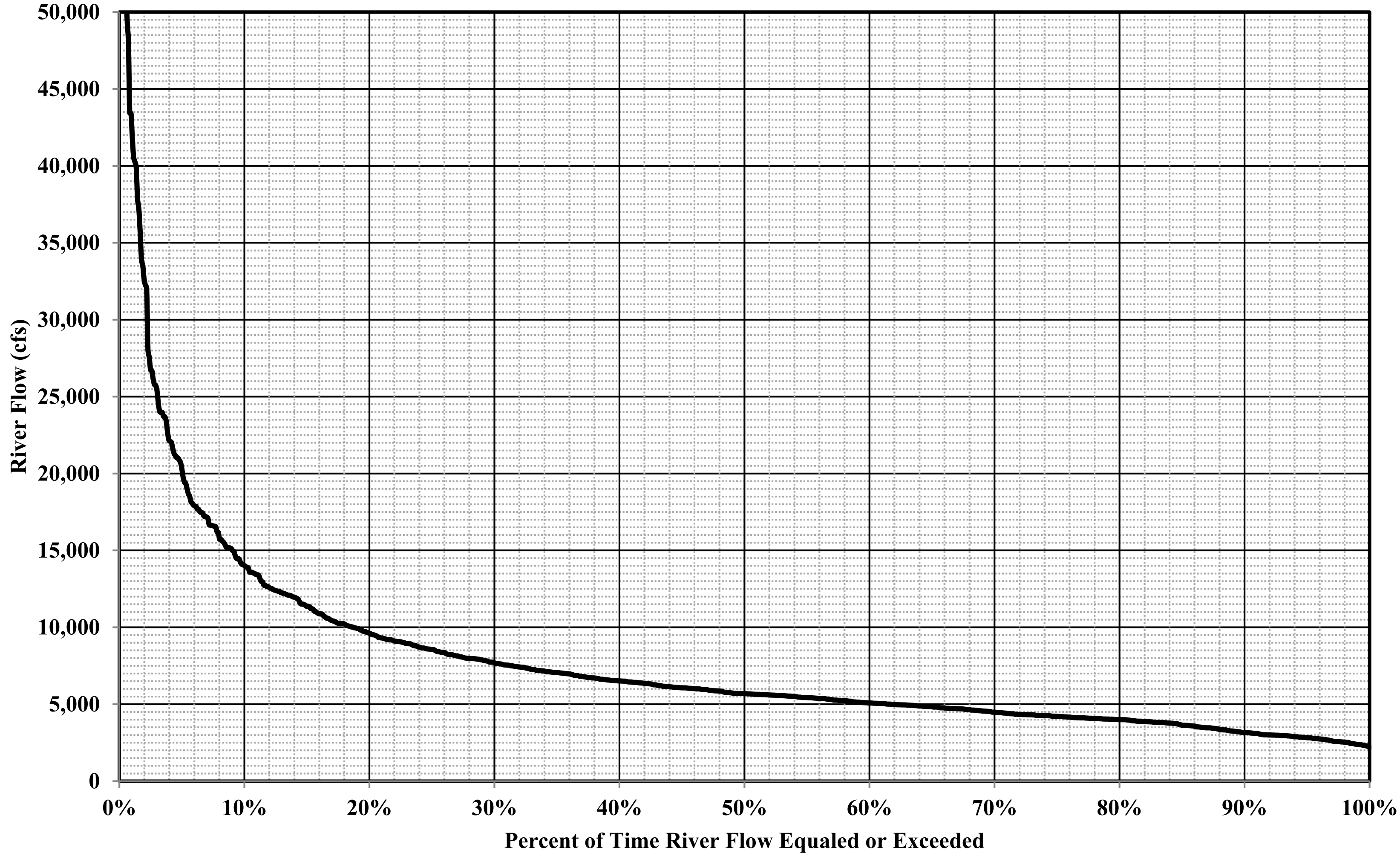
Where:

Qwat = Average Daily Flow at the Waterville Gage

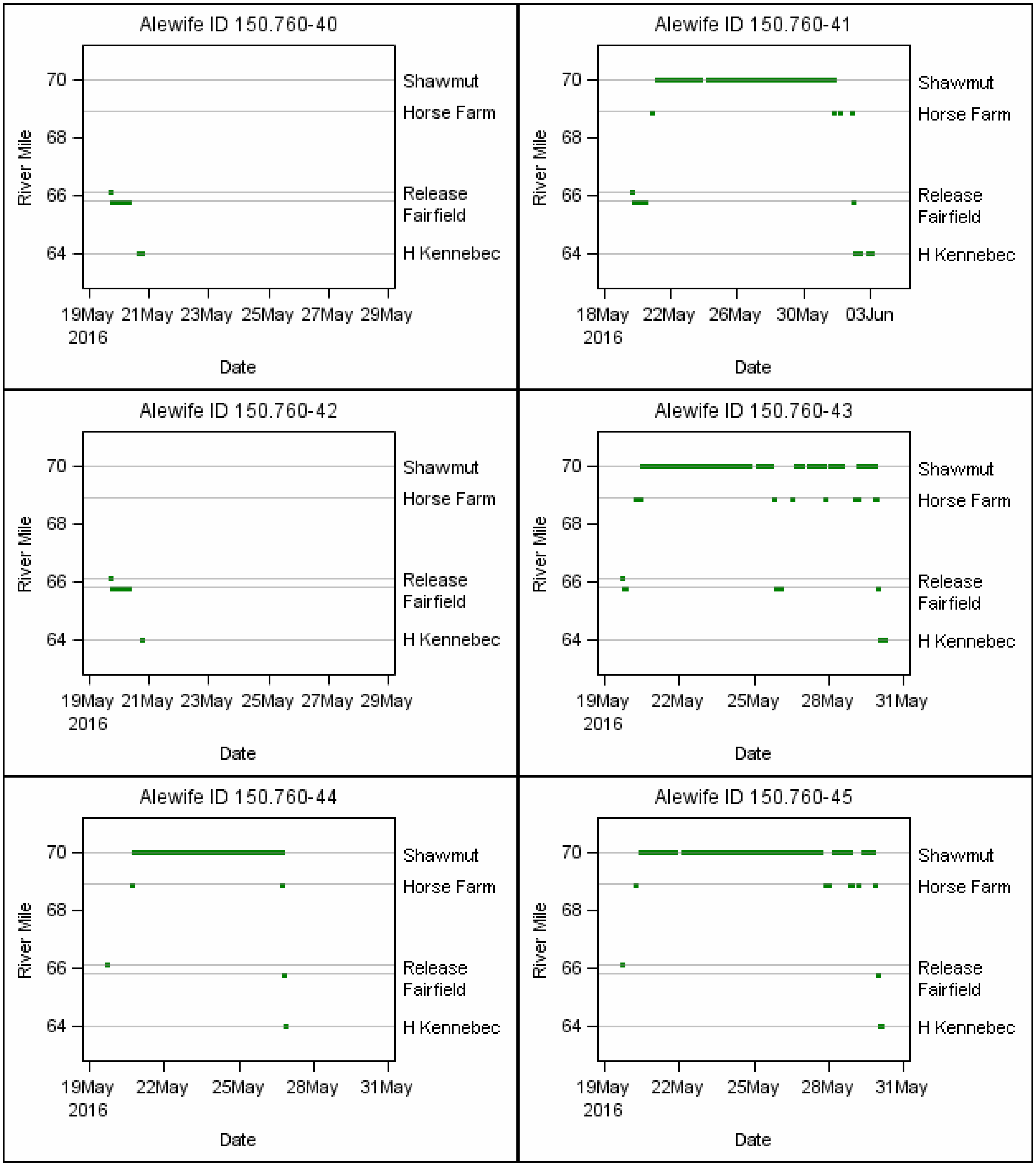
May Flow Duration Curve, Shawmut Hydroelectric Project (FERC No. 2322-ME)

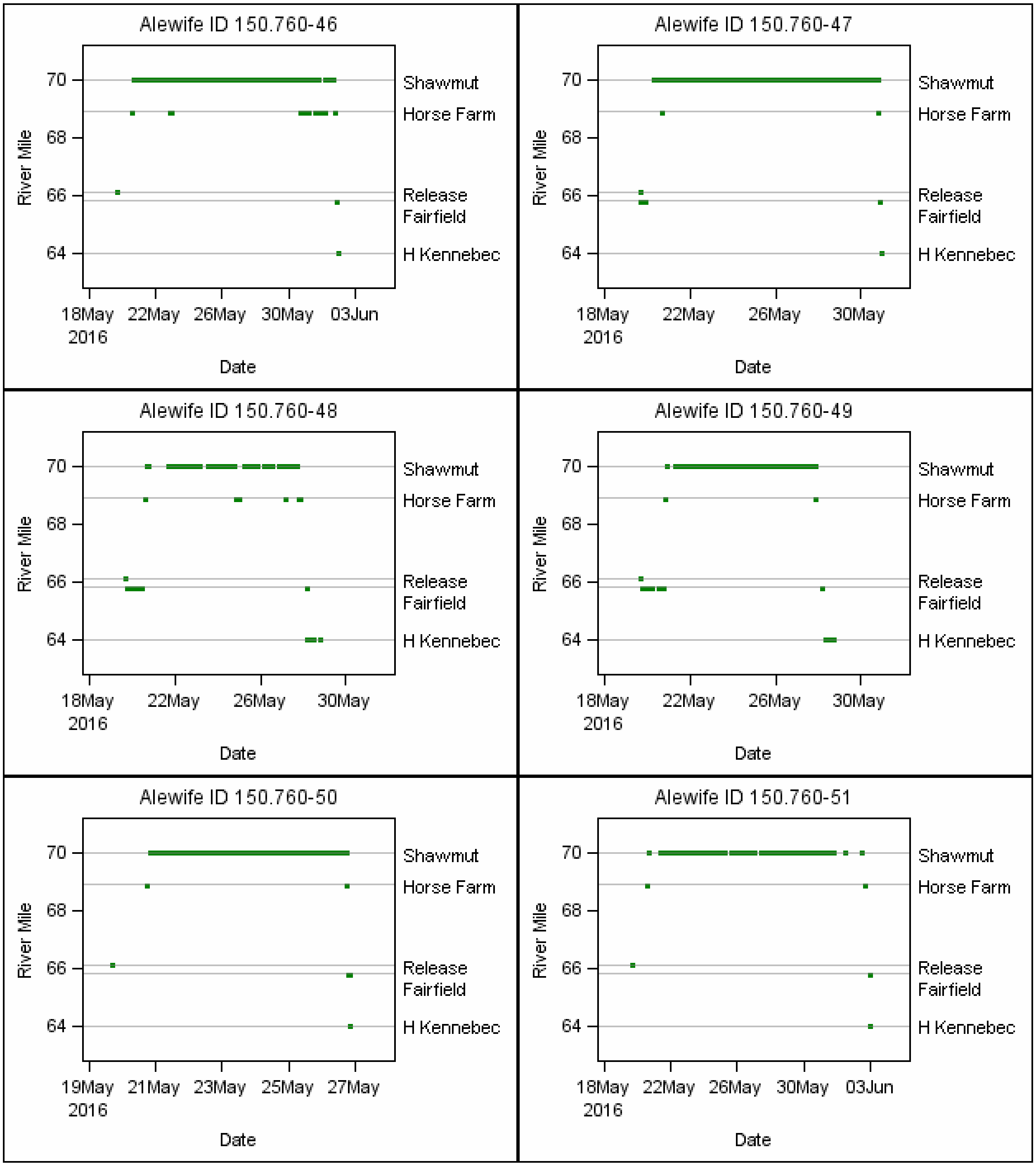


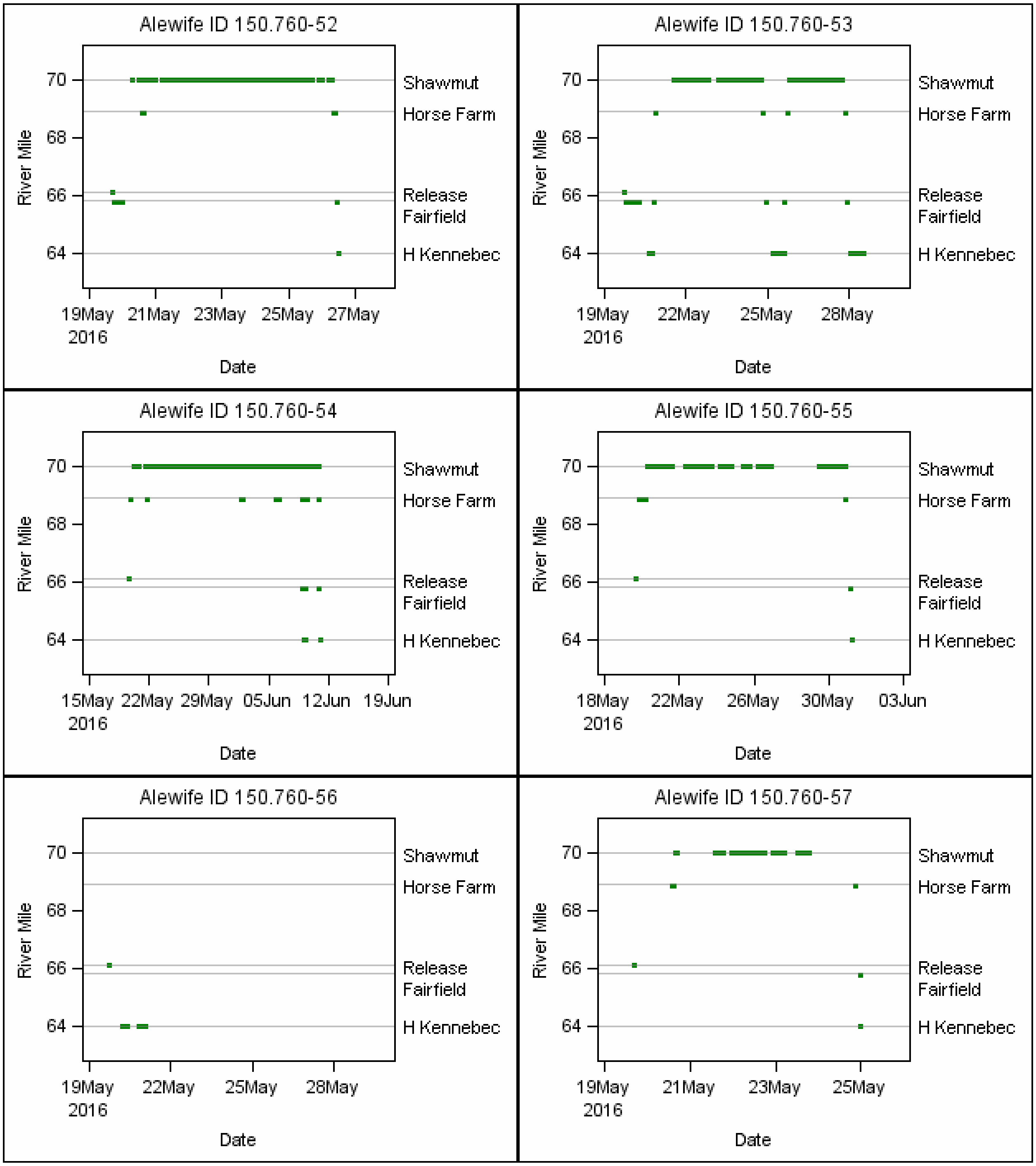
June Flow Duration Curve, Shawmut Hydroelectric Project (FERC No. 2322-ME)

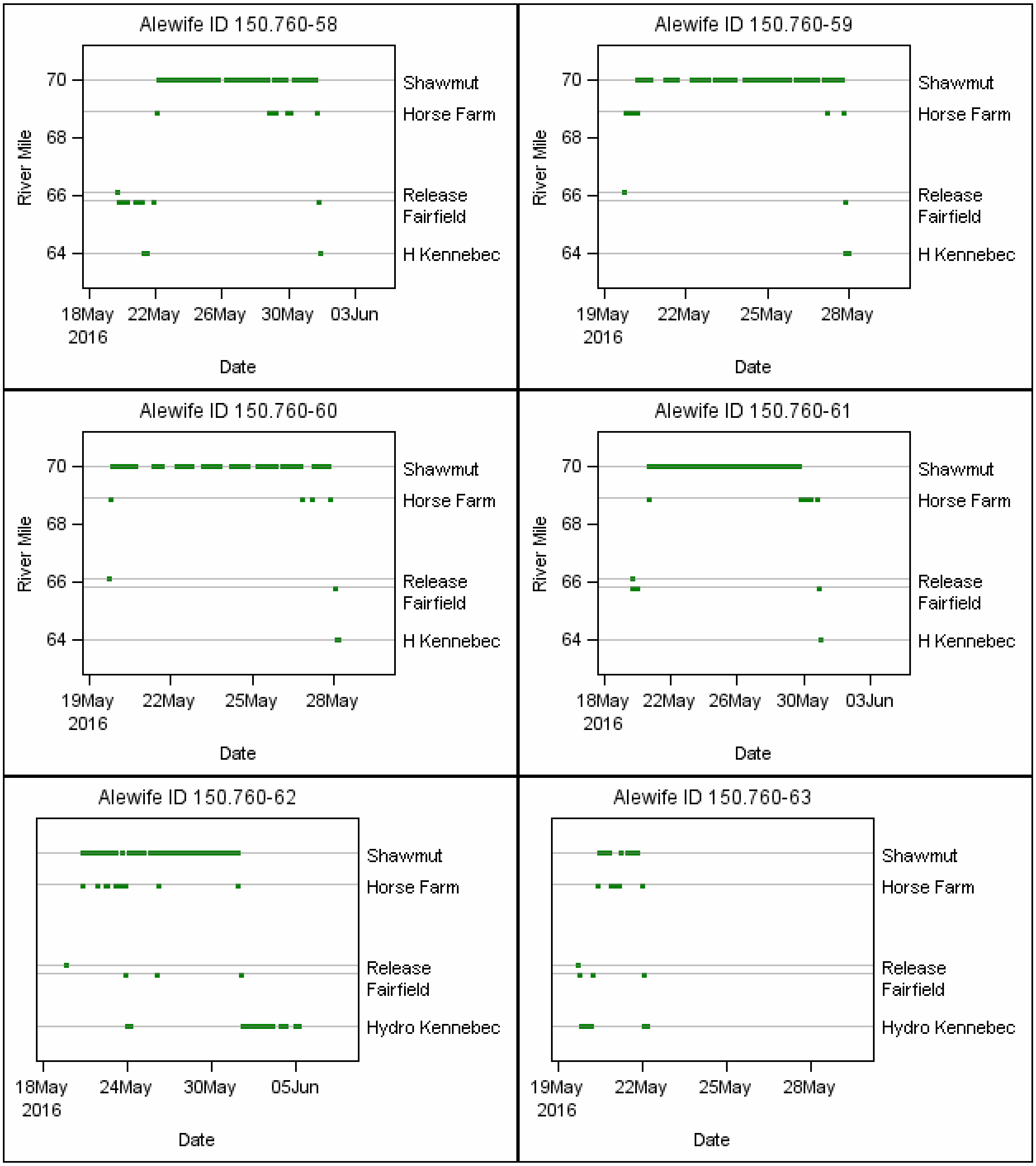


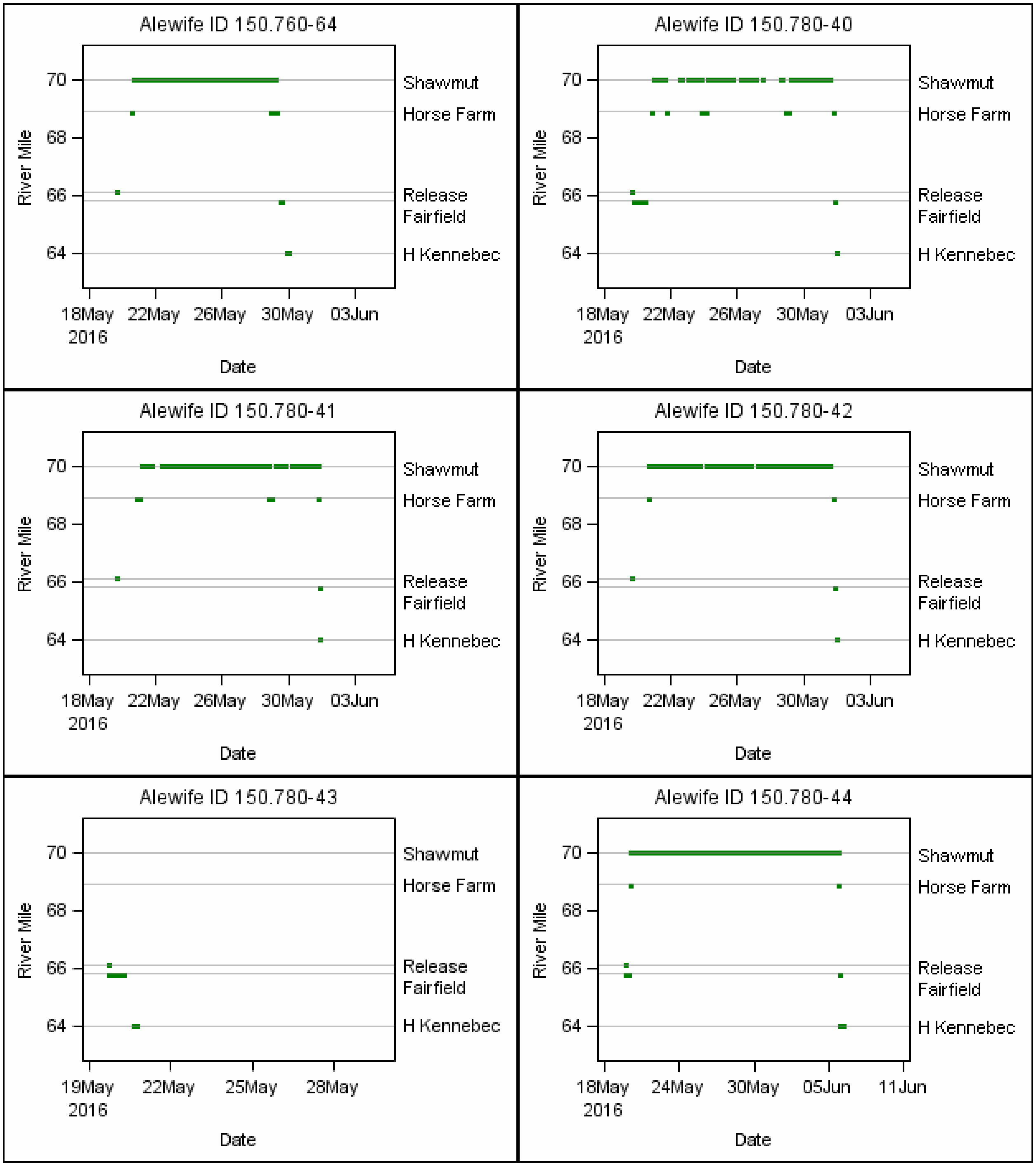
Appendix C—Time Series Plots

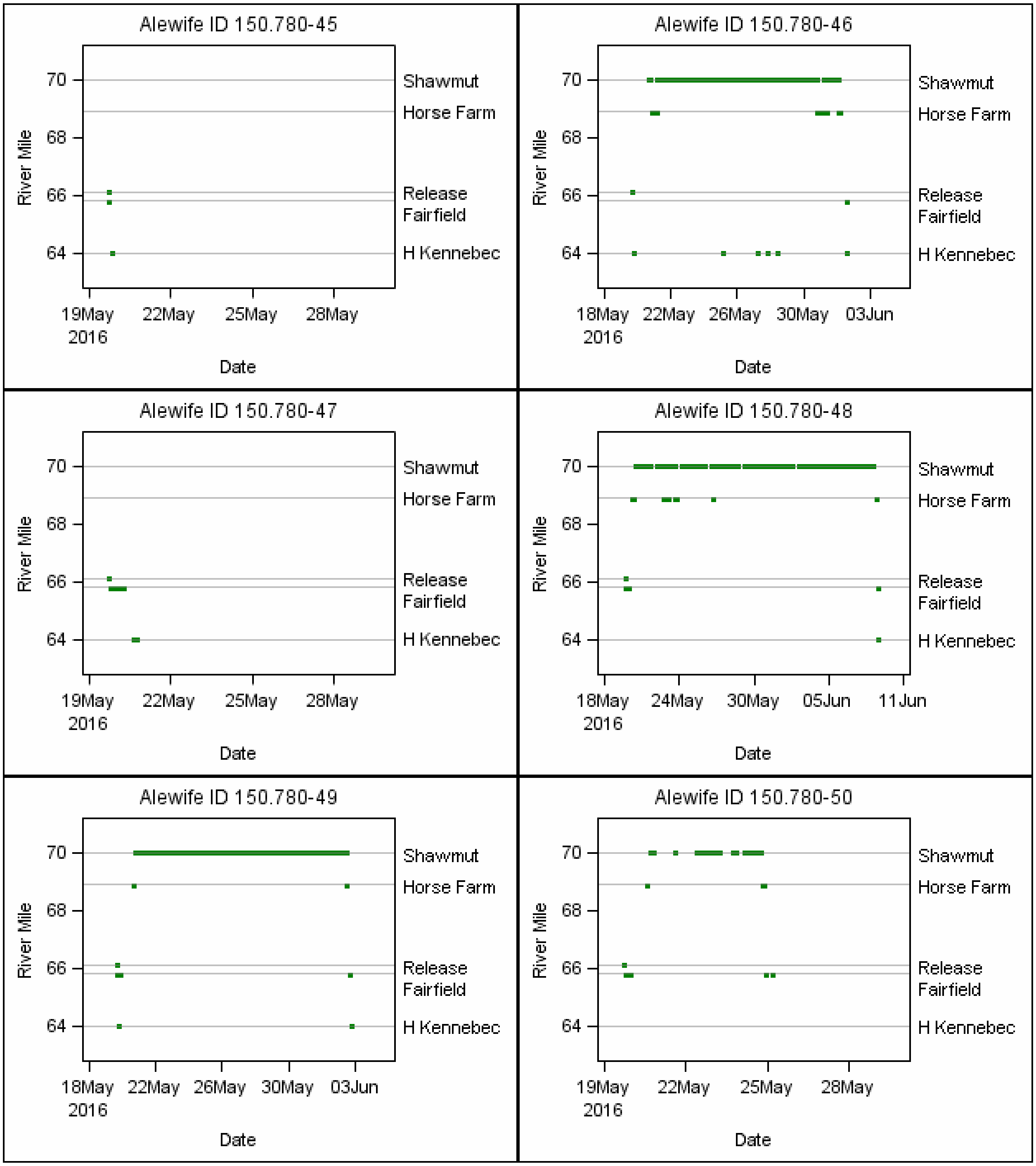


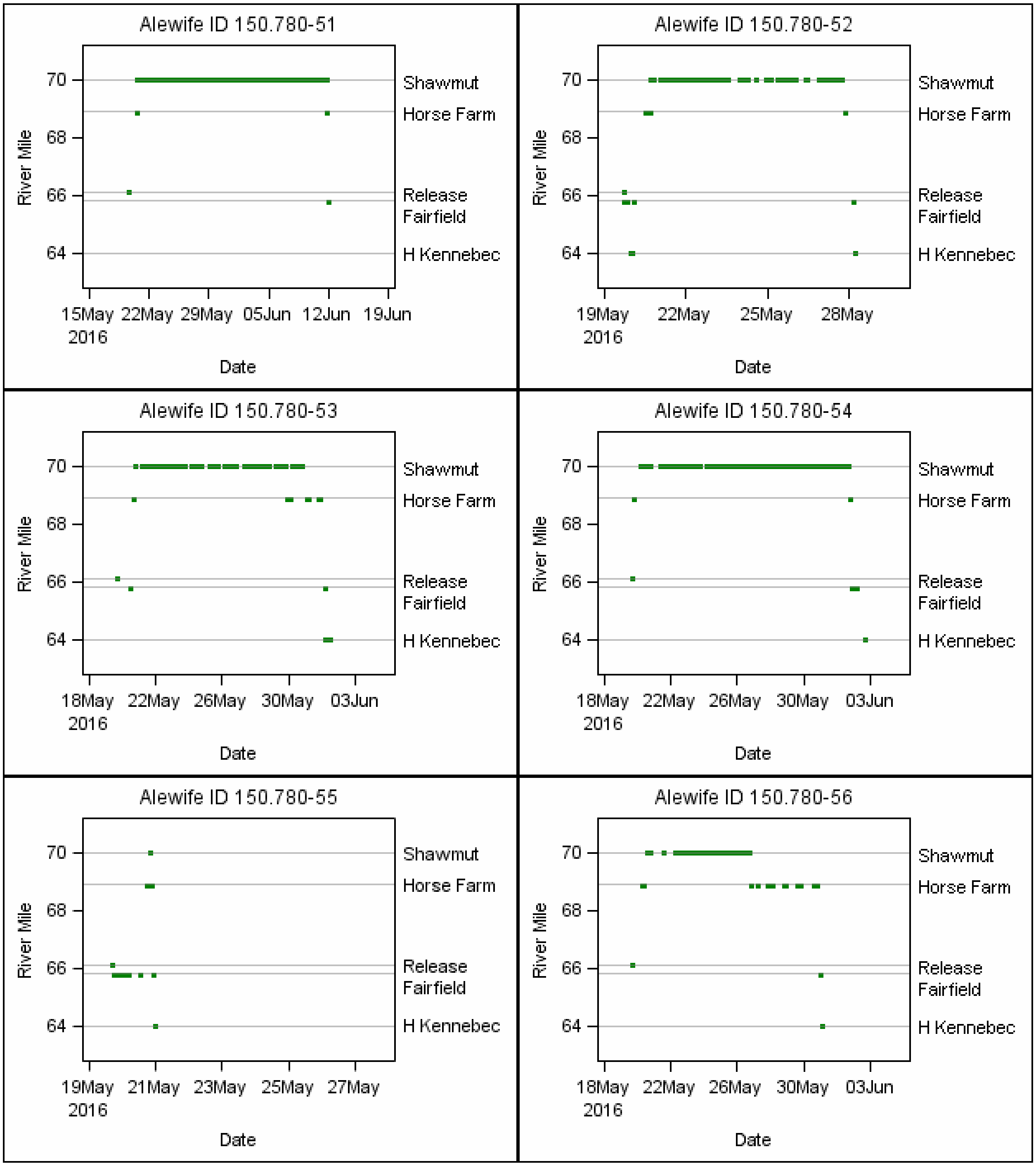

Alewife ID 150.760-46
Alewife ID 150.760-47
Alewife ID 150.760-48
Alewife ID 150.760-49
Alewife ID 150.760-50
Alewife ID 150.760-51
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
18May 2016
19May 2016
21May
22May
23May
25May
26May
27May
30May
03Jun
Date

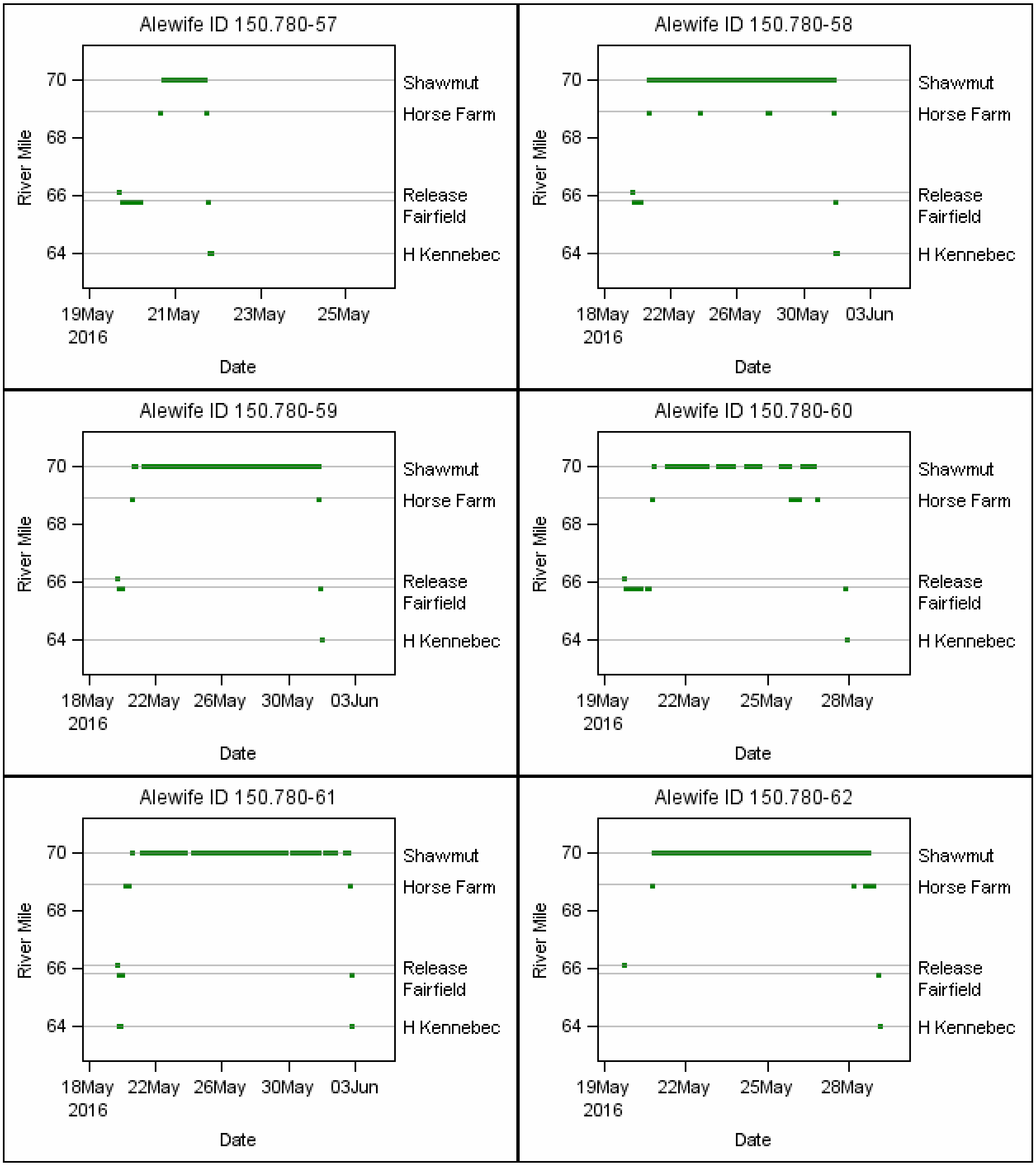

Alewife ID 150.760-52
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
21May
23May
25May
27May
Date
Alewife ID 150.760-53
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
22May
25May
28May
Date
Alewife ID 150.760-54
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
15May 2016
22May
29May
05Jun
12Jun
19Jun
Date
Alewife ID 150.760-55
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
18May 2016
22May
26May
30May
03Jun
Date
Alewife ID 150.760-56
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
22May
25May
28May
Date
Alewife ID 150.760-57
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
21May
23May
25May
Date

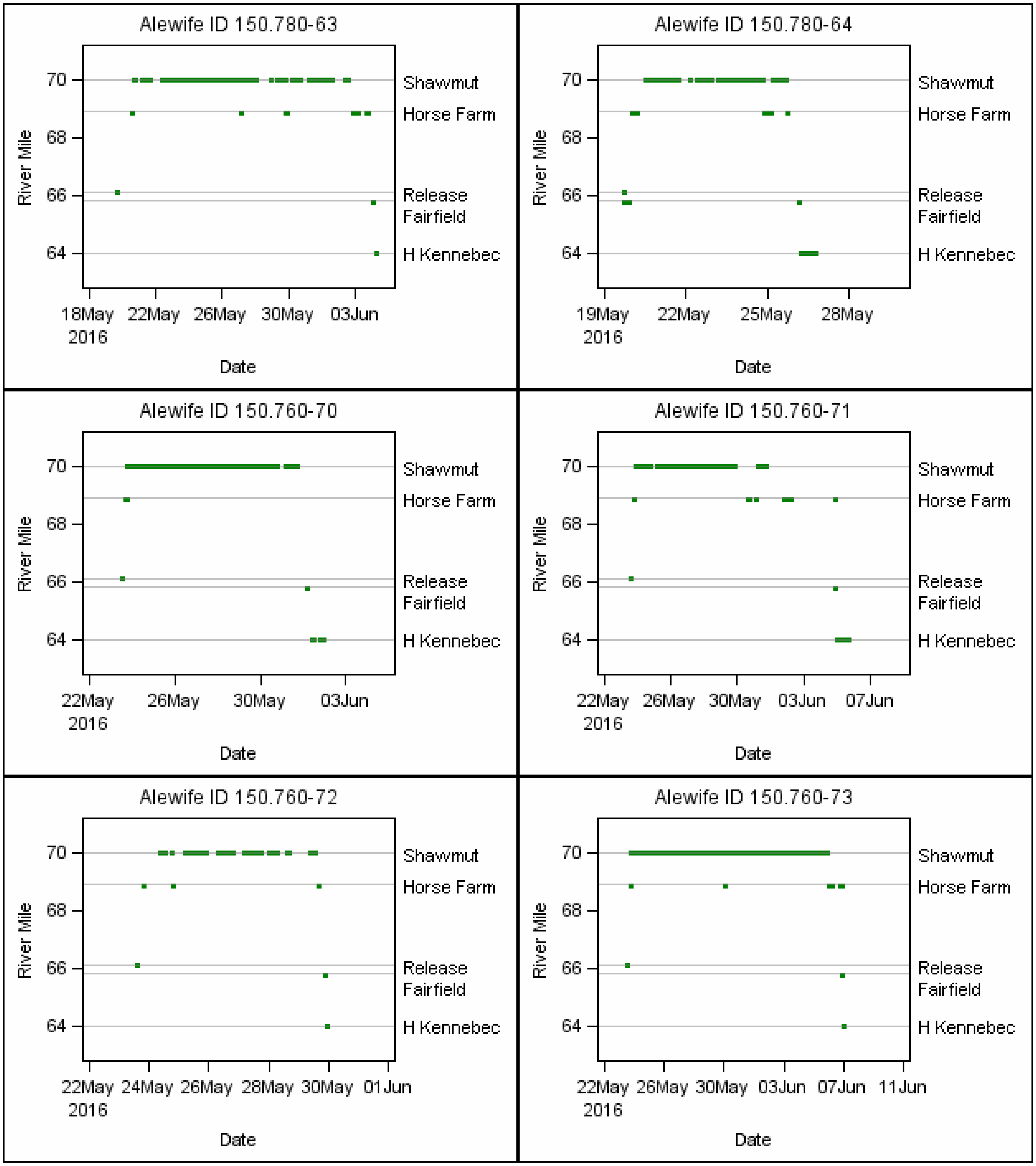

Alewife ID 150.760-58
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
18May 2016
22May
26May
30May
03Jun
Date
Alewife ID 150.760-59
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
22May
25May
28May
Date
Alewife ID 150.760-60
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
22May
25May
28May
Date
Alewife ID 150.760-61
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
18May 2016
22May
26May
30May
03Jun
Date
Alewife ID 150.760-62
Shawmut
Horse Farm
Release
Fairfield
Hydro Kennebec
18May 2016
24May
30May
05Jun
Date
Alewife ID 150.760-63
Shawmut
Horse Farm
Release
Fairfield
Hydro Kennebec
19May 2016
22May
25May
28May
Date

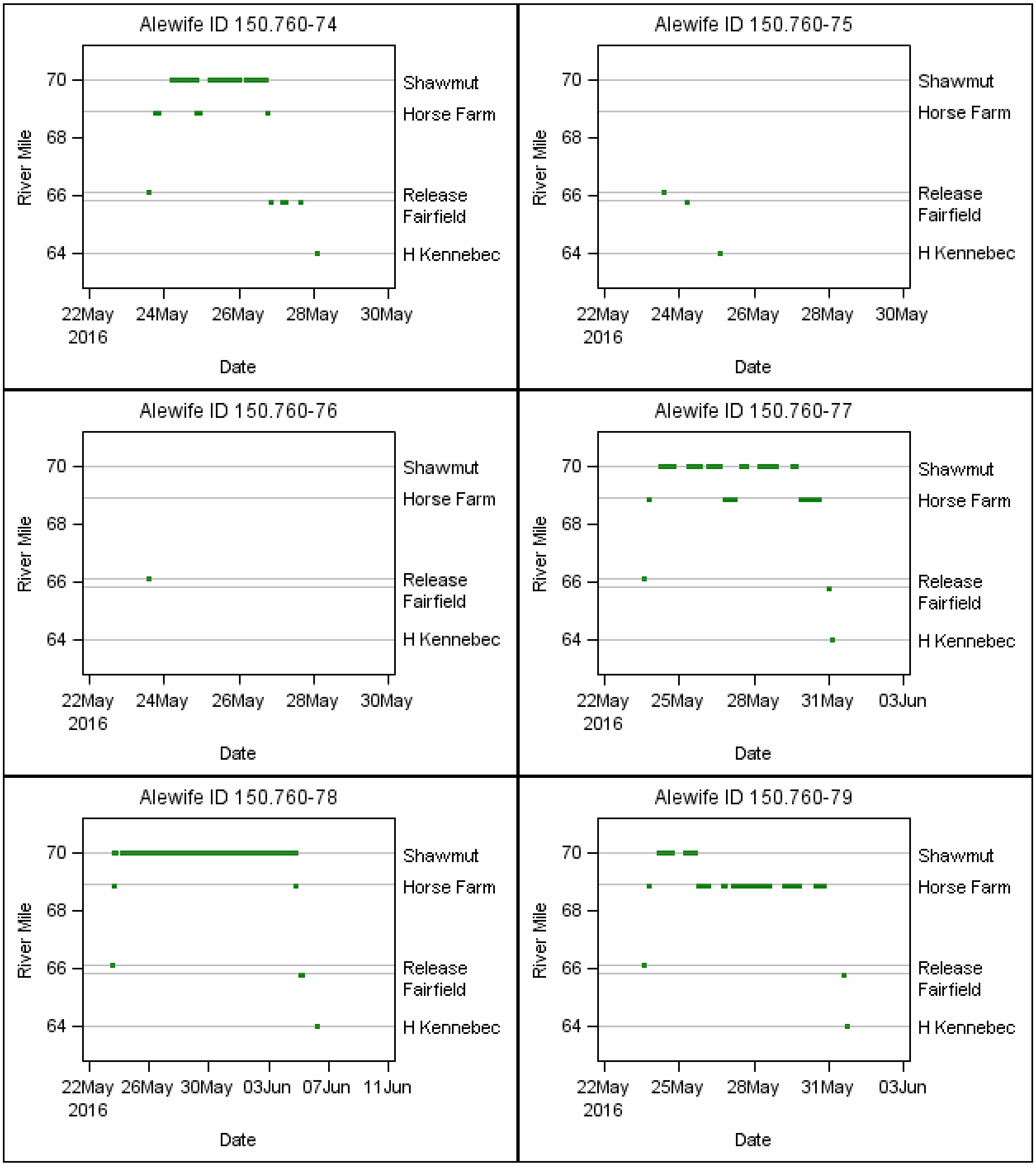

Alewife ID 150.760-64
Alewife ID 150.780-40
Alewife ID 150.780-41
Alewife ID 150.780-42
Alewife ID 150.780-43
Alewife ID 150.780-44
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
18May 2016
22May
26May
30May
03Jun
19May 2016
25May
28May
24May
05Jun
11Jun
Date

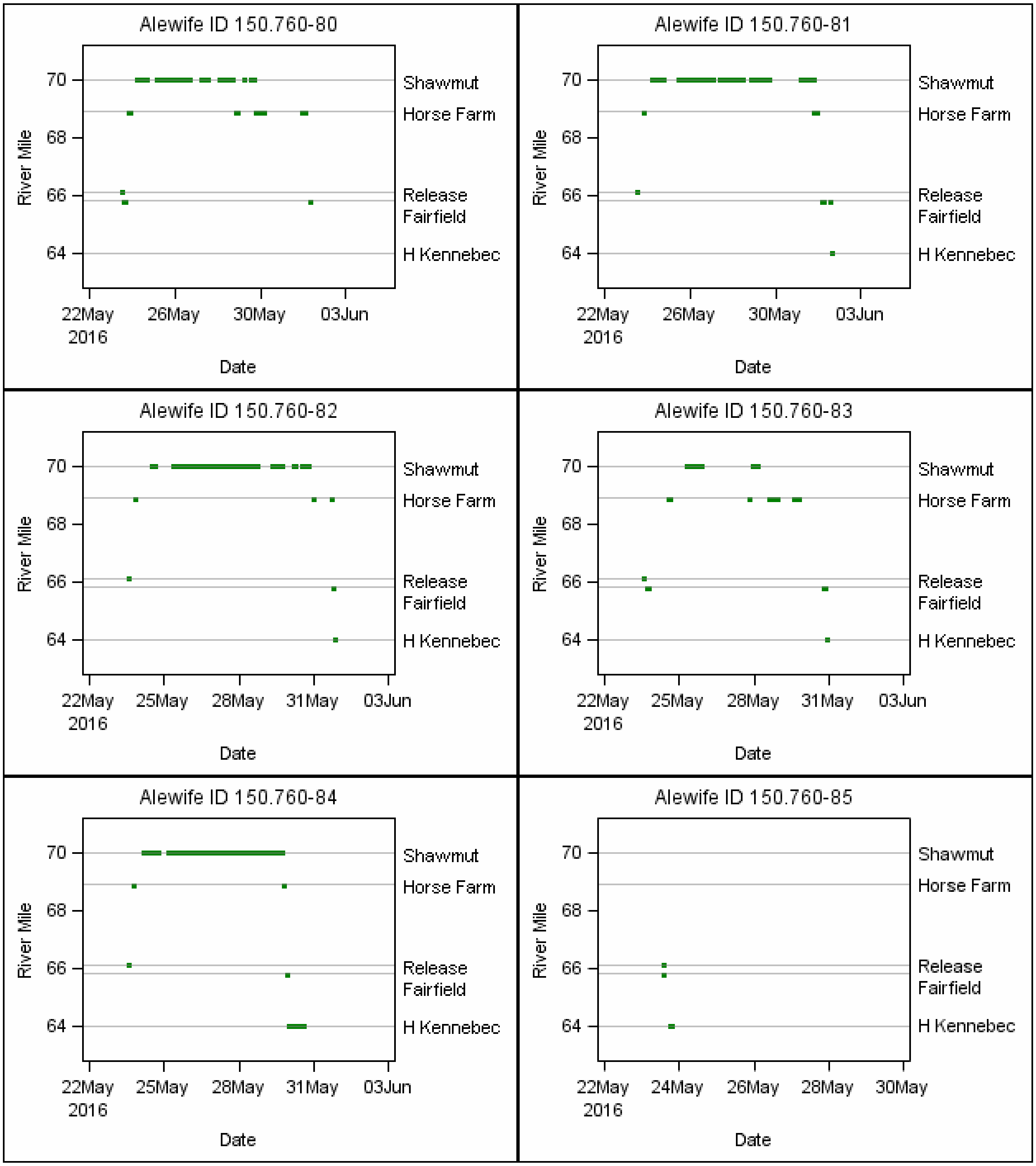

Alewife ID 150.780-45
Alewife ID 150.780-46
Alewife ID 150.780-47
Alewife ID 150.780-48
Alewife ID 150.780-49
Alewife ID 150.780-50
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
22May
25May
28May
18May 2016
22May
26May
30May
03Jun
24May
05Jun
11Jun
Date

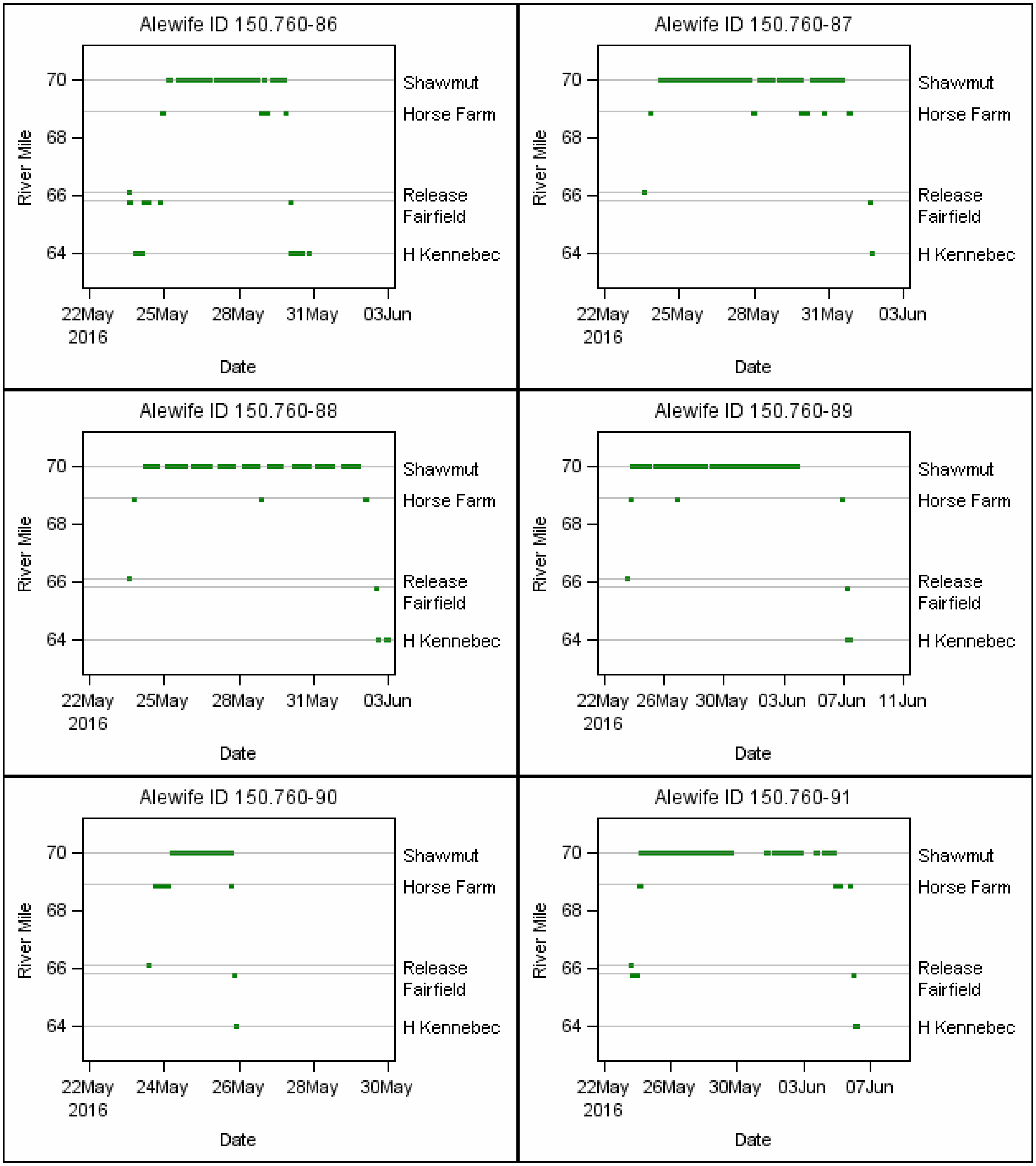

Alewife ID 150.780-51
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
15May 2016
22May
29May
05Jun
12Jun
19Jun
Date
Alewife ID 150.780-52
19May 2016
22May
25May
28May
Alewife ID 150.780-53
18May 2016
22May
26May
30May
03Jun
Alewife ID 150.780-54
Alewife ID 150.780-55
19May 2016
21May
23May
25May
27May
Alewife ID 150.780-56

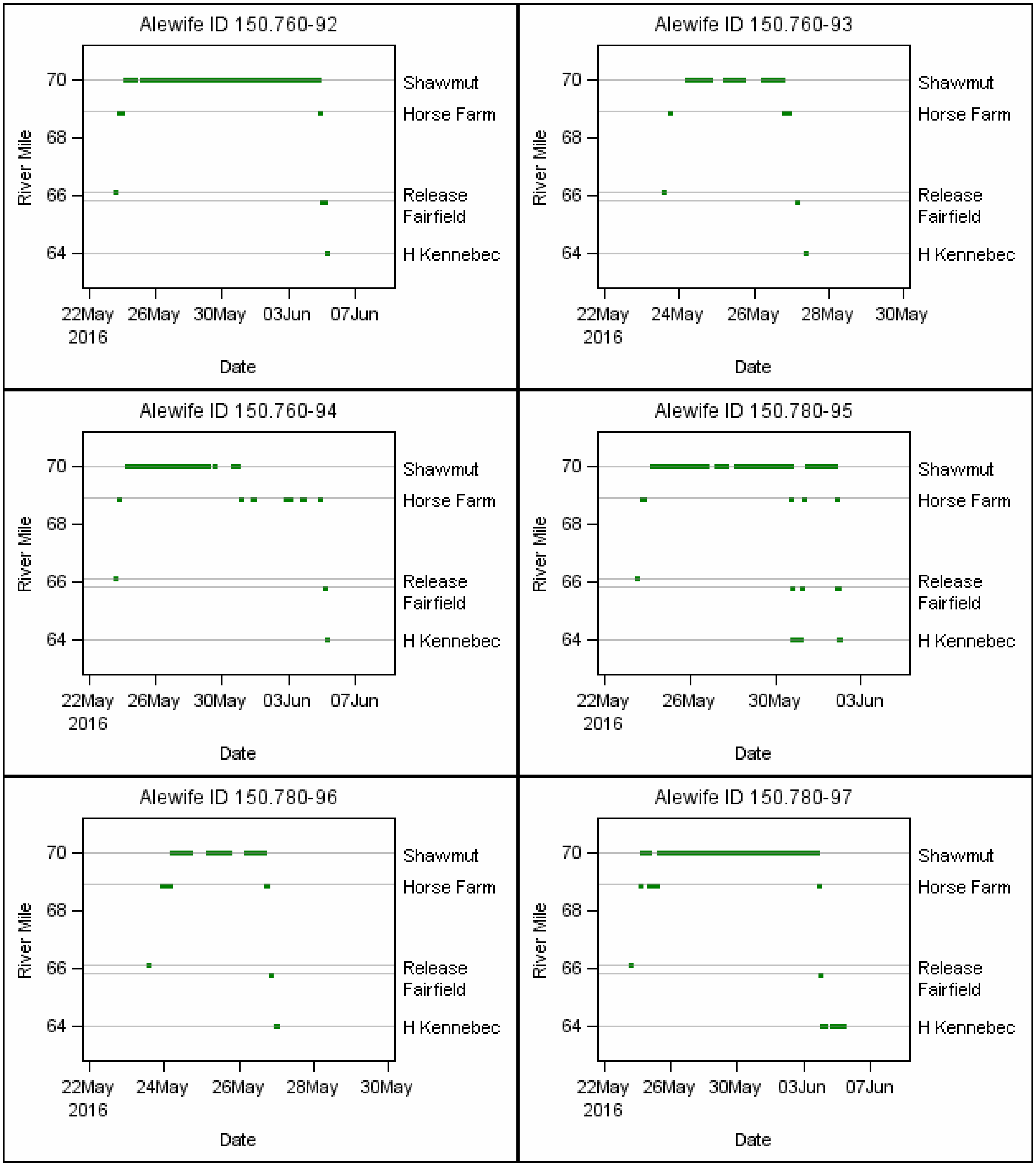

Alewife ID 150.780-57
Alewife ID 150.780-58
Alewife ID 150.780-59
Alewife ID 150.780-60
Alewife ID 150.780-61
Alewife ID 150.780-62
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
19May 2016
21May
23May
25May
18May 2016
22May
26May
30May
03Jun
28May
Date

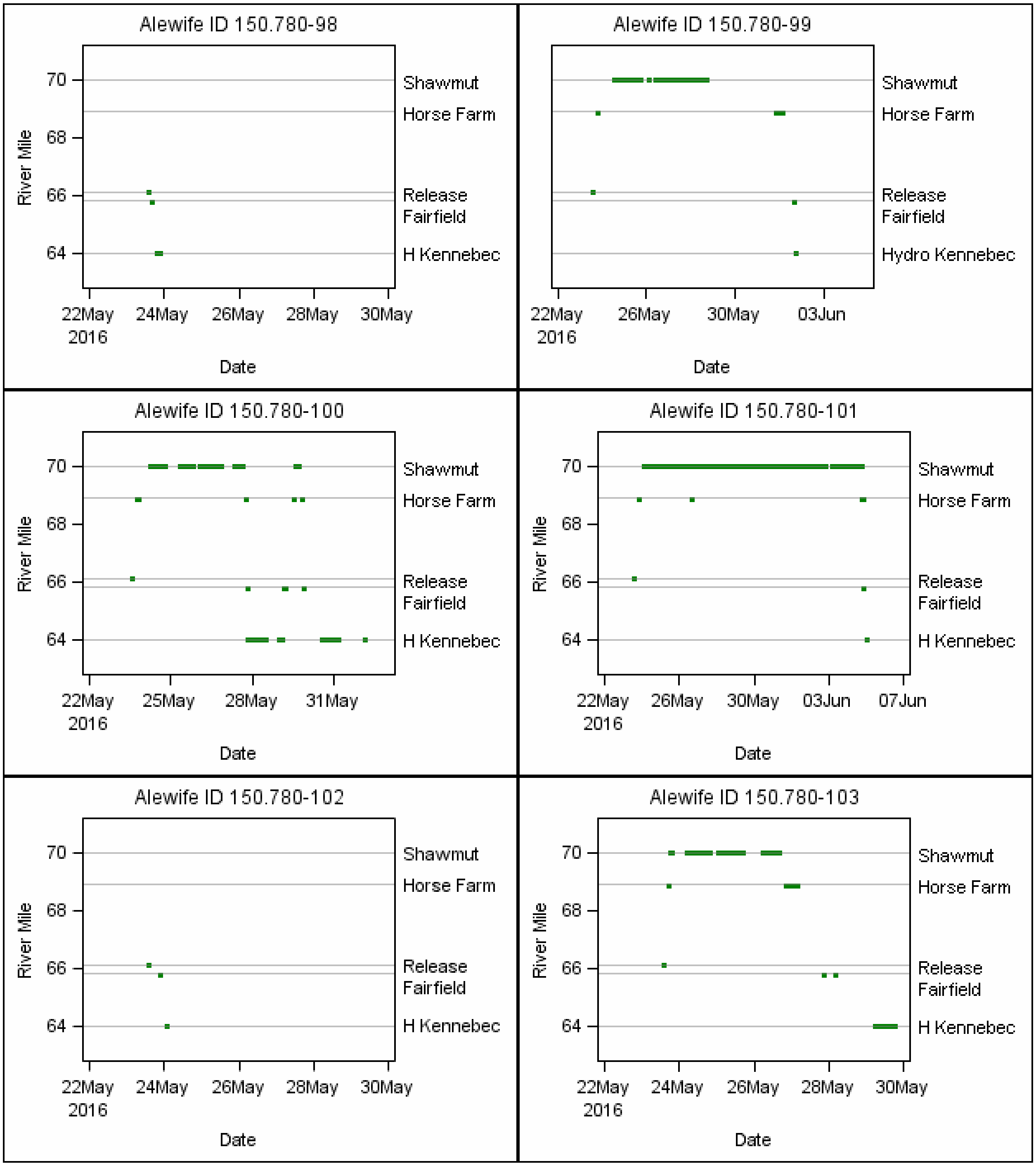

Alewife ID 150.780-63
Alewife ID 150.780-64
Alewife ID 150.760-70
Alewife ID 150.760-71
Alewife ID 150.760-72
Alewife ID 150.760-73
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
Date
18May 2016
22May
26May
30May
03Jun
19May 2016
25May
28May
22May 2016
07Jun
24May
28May
01Jun
11Jun

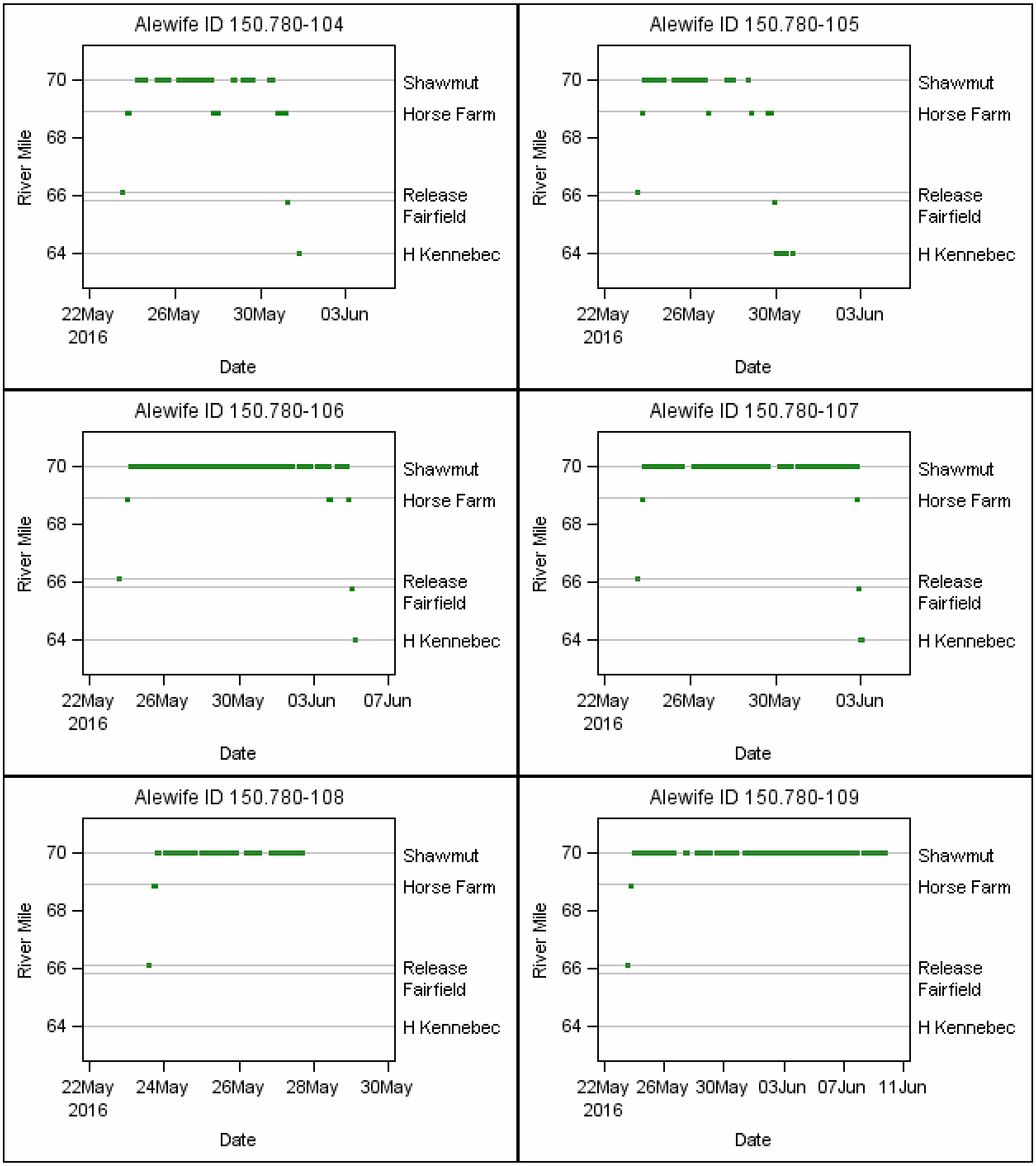

Alewife ID 150.760-74
Alewife ID 150.760-75
Alewife ID 150.760-76
Alewife ID 150.760-77
Alewife ID 150.760-78
Alewife ID 150.760-79
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
25May
26May
28May
30May
31May
03Jun
07Jun
11Jun
Date

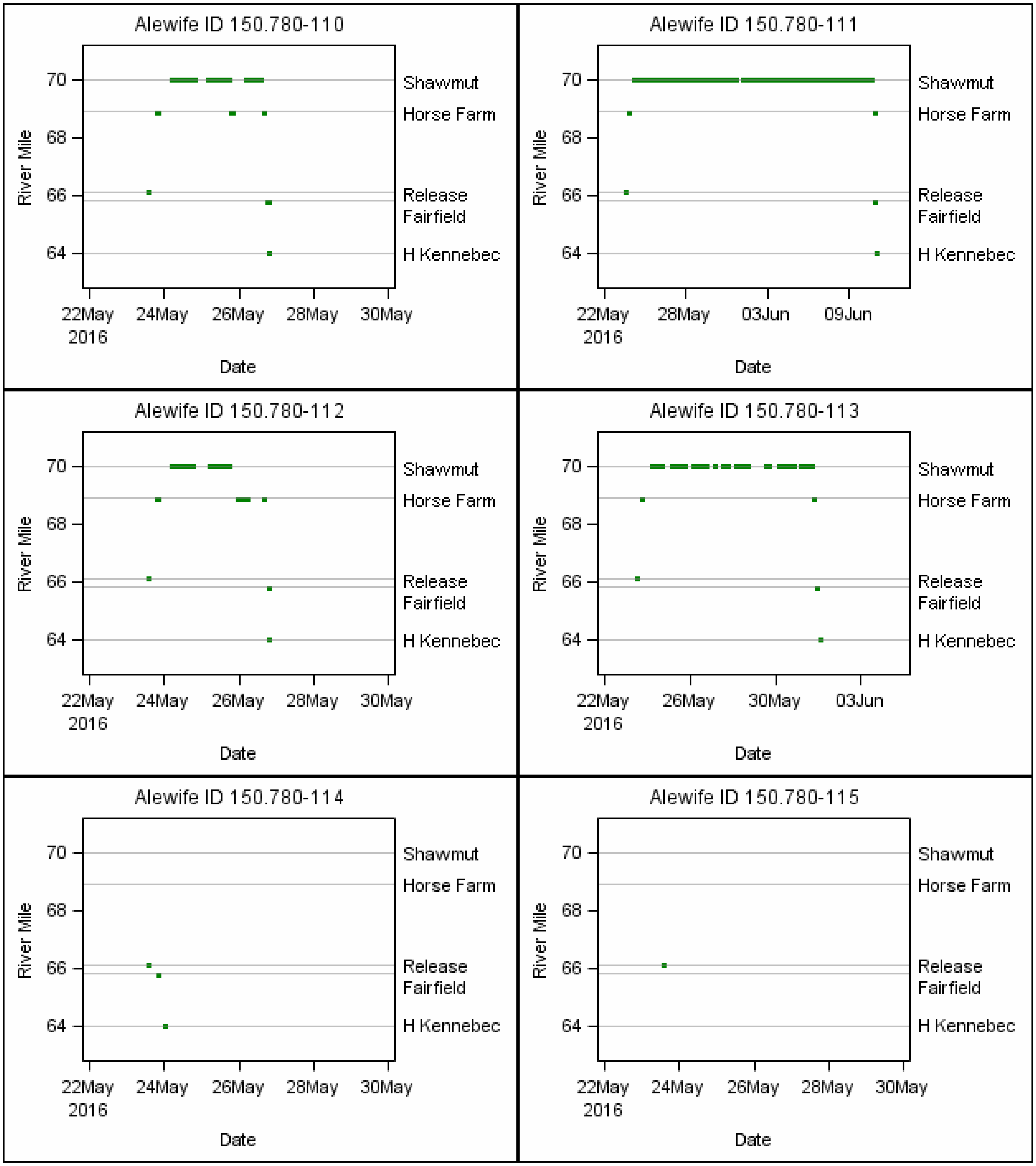

Alewife ID 150.760-80
Alewife ID 150.760-81
Alewife ID 150.760-82
Alewife ID 150.760-83
Alewife ID 150.760-84
Alewife ID 150.760-85
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
25May
26May
28May
30May
31May
03Jun
Date

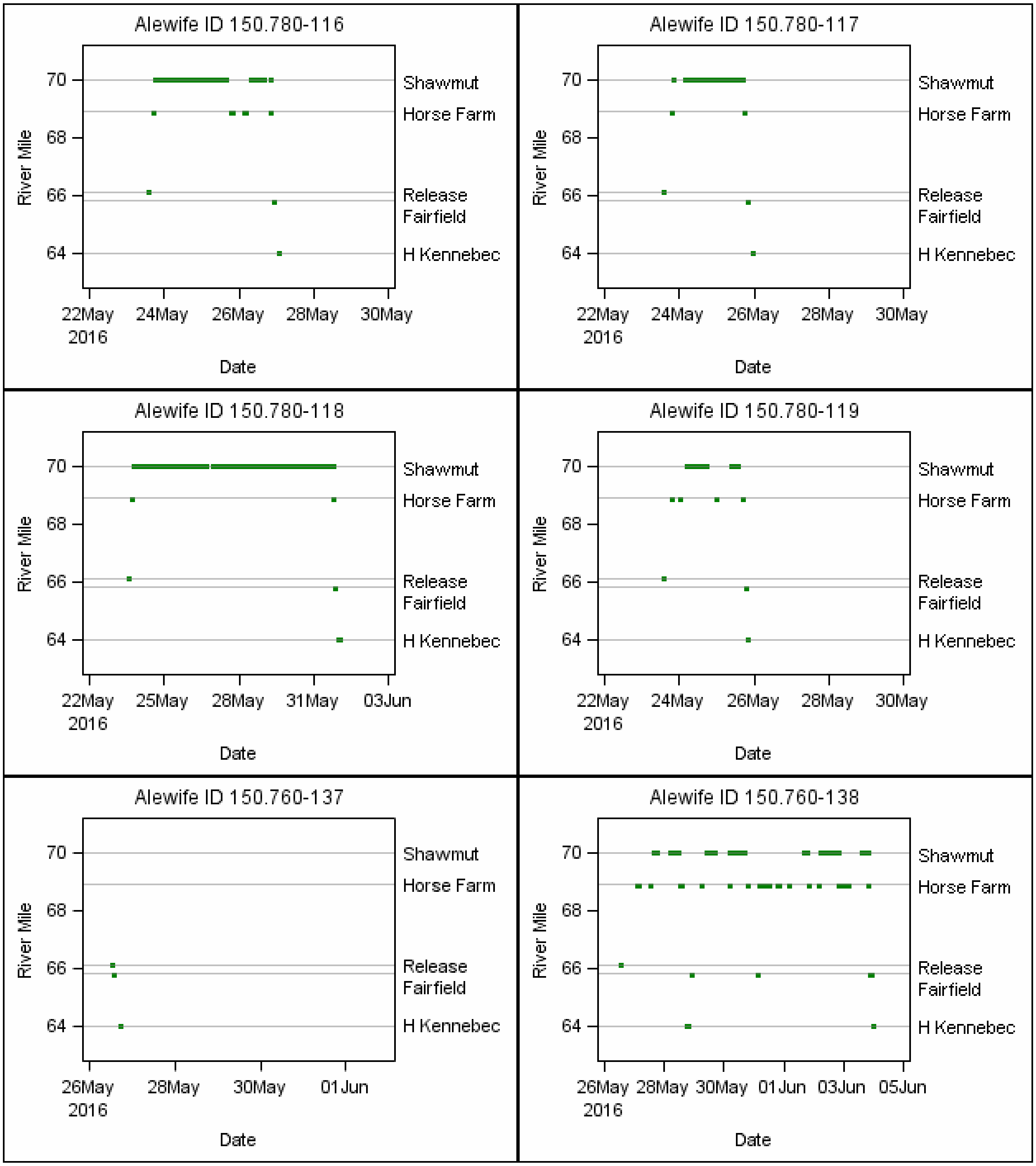

Alewife ID 150.760-86
Alewife ID 150.760-87
Alewife ID 150.760-88
Alewife ID 150.760-89
Alewife ID 150.760-90
Alewife ID 150.760-91
River Mile
64
66
68
70
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
25May
26May
28May
30May
31May
03Jun
07Jun
11Jun
Date

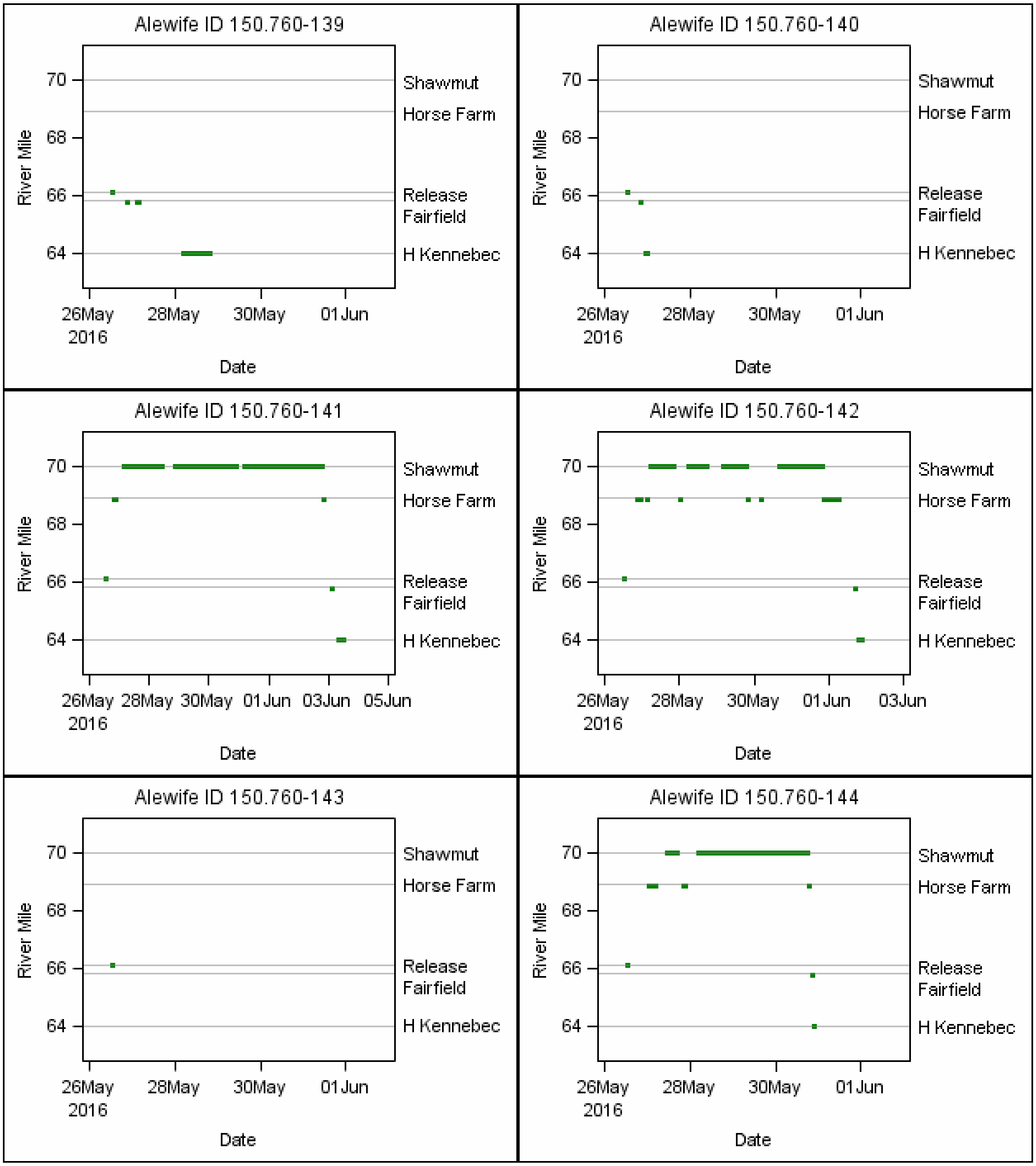

Alewife ID 150.760-92
Alewife ID 150.760-93
Alewife ID 150.760-94
Alewife ID 150.780-95
Alewife ID 150.780-96
Alewife ID 150.780-97
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
26May
28May
30May
03Jun
07Jun
Date

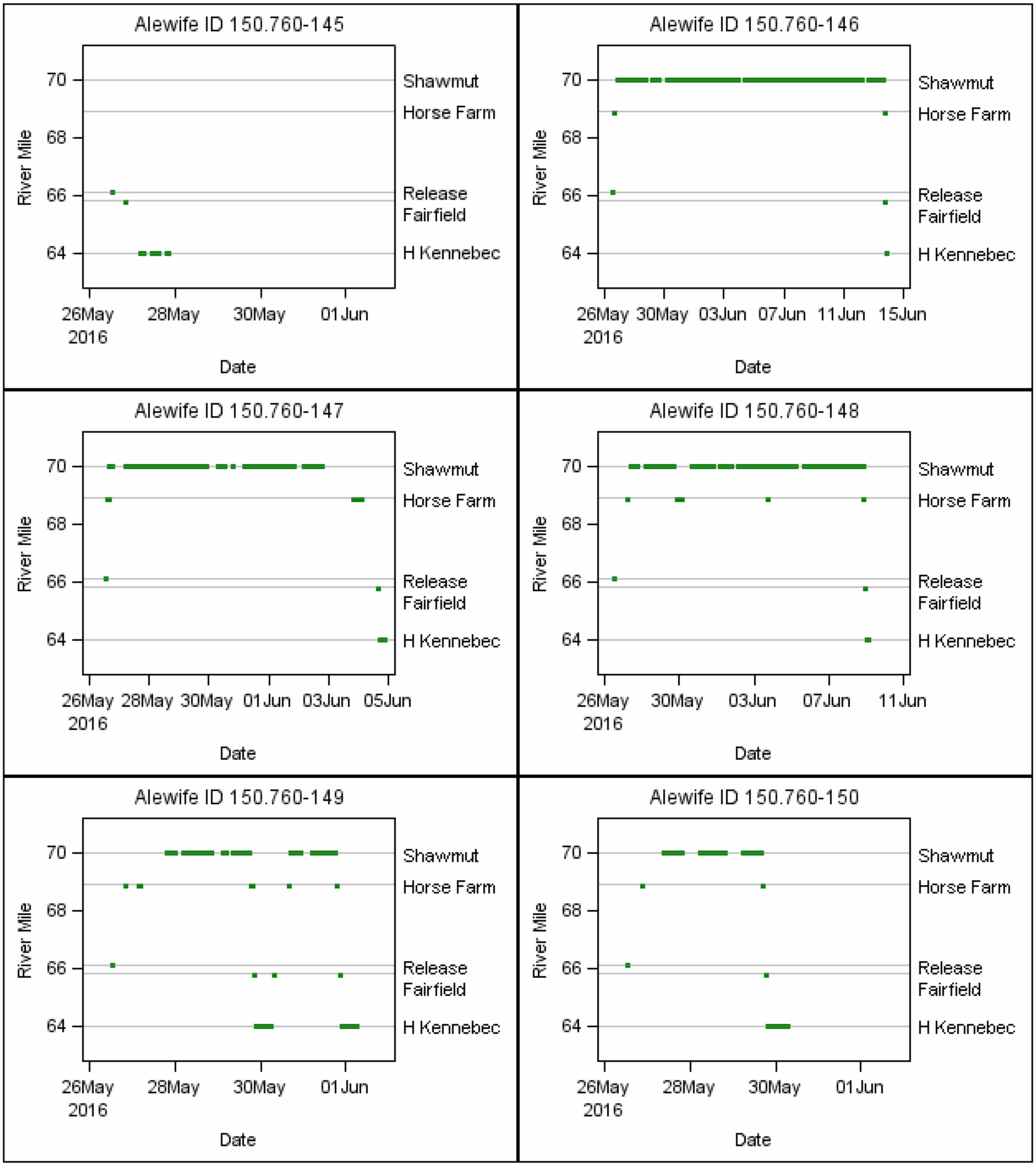

Alewife ID 150.780-98
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
26May
28May
30May
Date
Alewife ID 150.780-99
Shawmut
Horse Farm
Release
Fairfield
Hydro Kennebec
22May 2016
26May
30May
03Jun
Date
Alewife ID 150.780-100
River Mile
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
25May
28May
31May
Date
Alewife ID 150.780-101
River Mile
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
26May
30May
03Jun
07Jun
Date
Alewife ID 150.780-102
River Mile
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
26May
28May
30May
Date
Alewife ID 150.780-103
River Mile
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
26May
28May
30May
Date

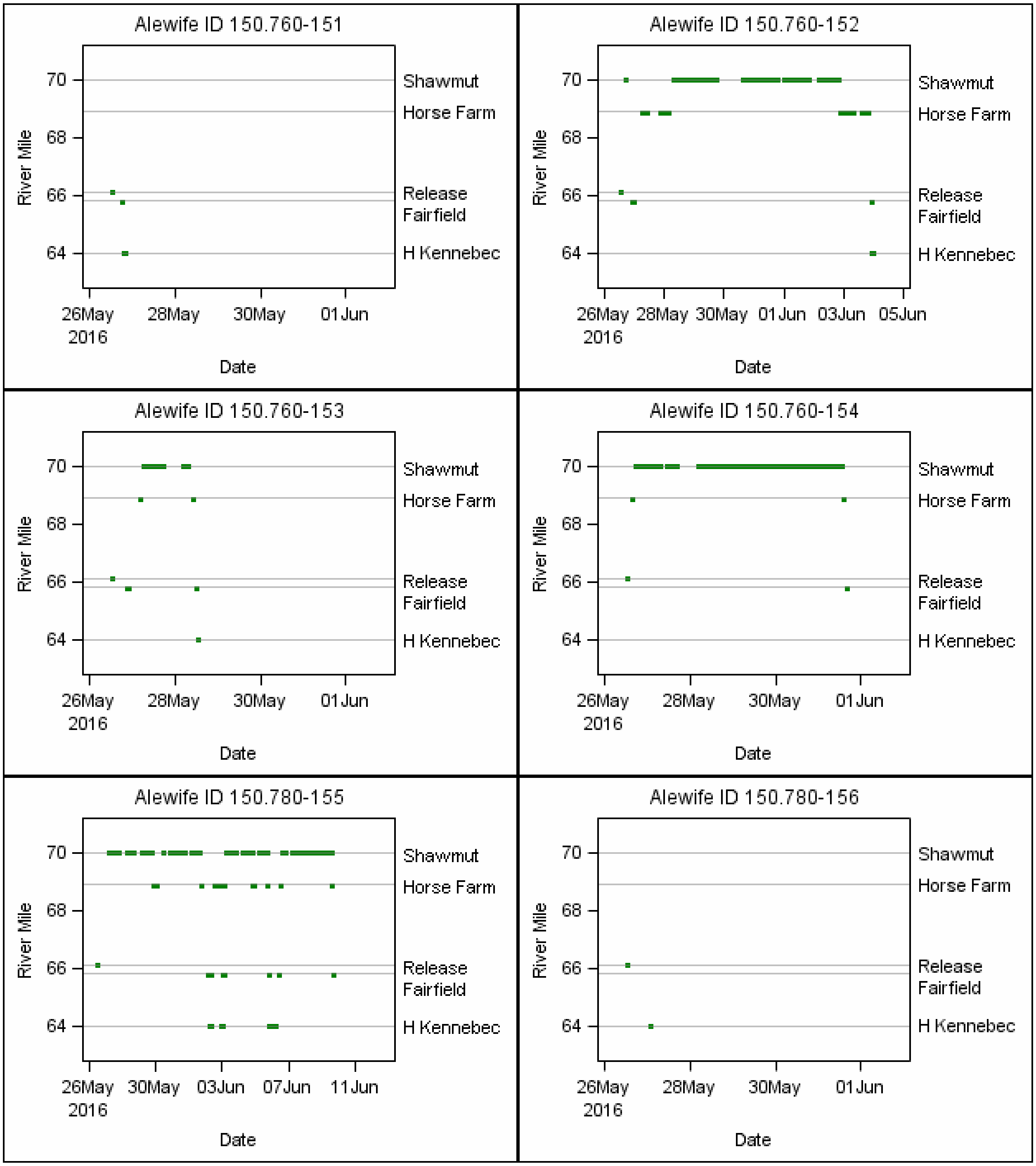

Alewife ID 150.780-104
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
26May
30May
03Jun
Date
Alewife ID 150.780-105
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
26May
30May
03Jun
Date
Alewife ID 150.780-106
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
26May
30May
03Jun
07Jun
Date
Alewife ID 150.780-107
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
26May
30May
03Jun
Date
Alewife ID 150.780-108
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
26May
28May
30May
Date
Alewife ID 150.780-109
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
26May
30May
03Jun
07Jun
11Jun
Date

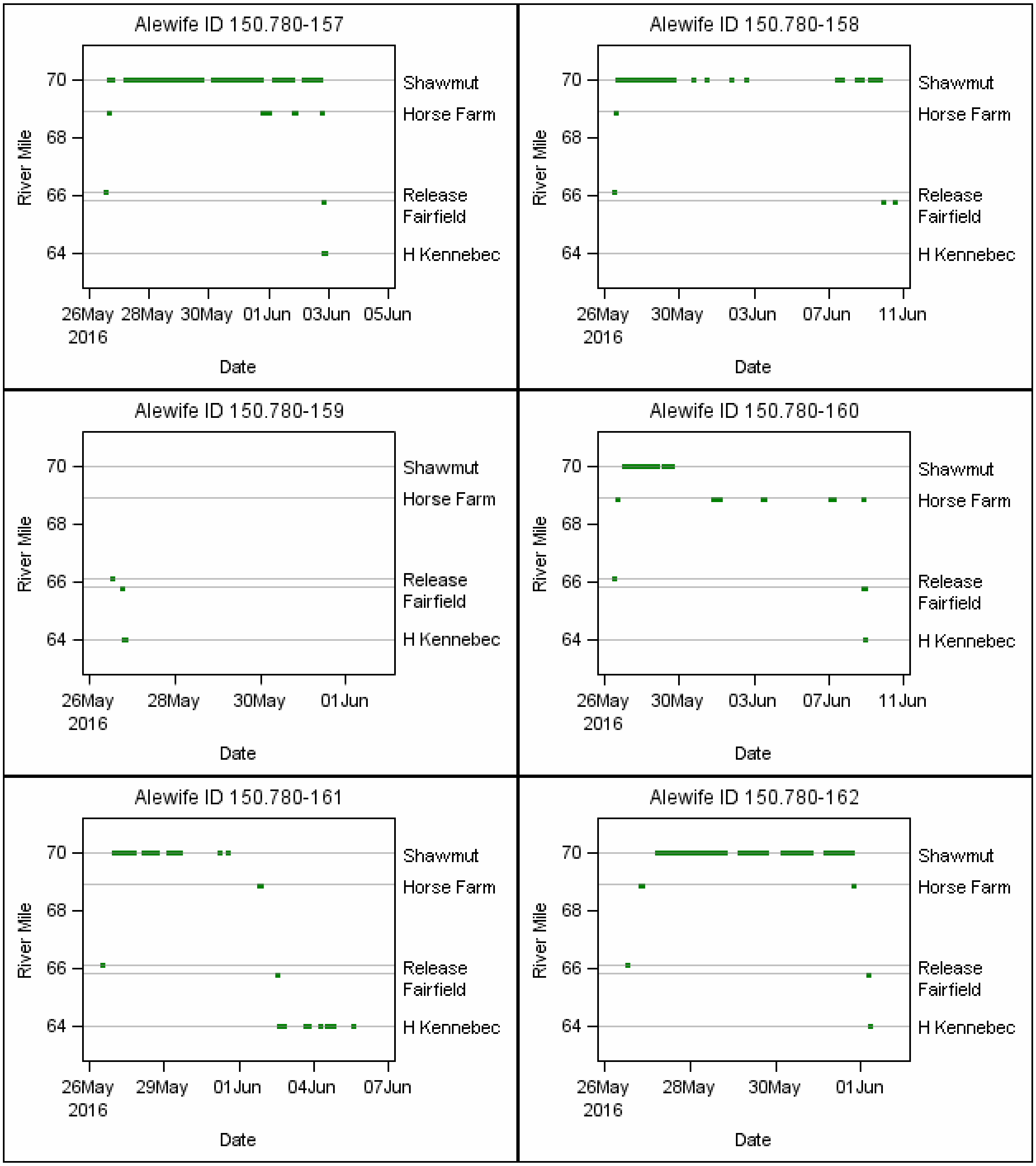

Alewife ID 150.780-110
Alewife ID 150.780-111
Alewife ID 150.780-112
Alewife ID 150.780-113
Alewife ID 150.780-114
Alewife ID 150.780-115
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
22May 2016
24May
26May
28May
30May
03Jun
09Jun
Date

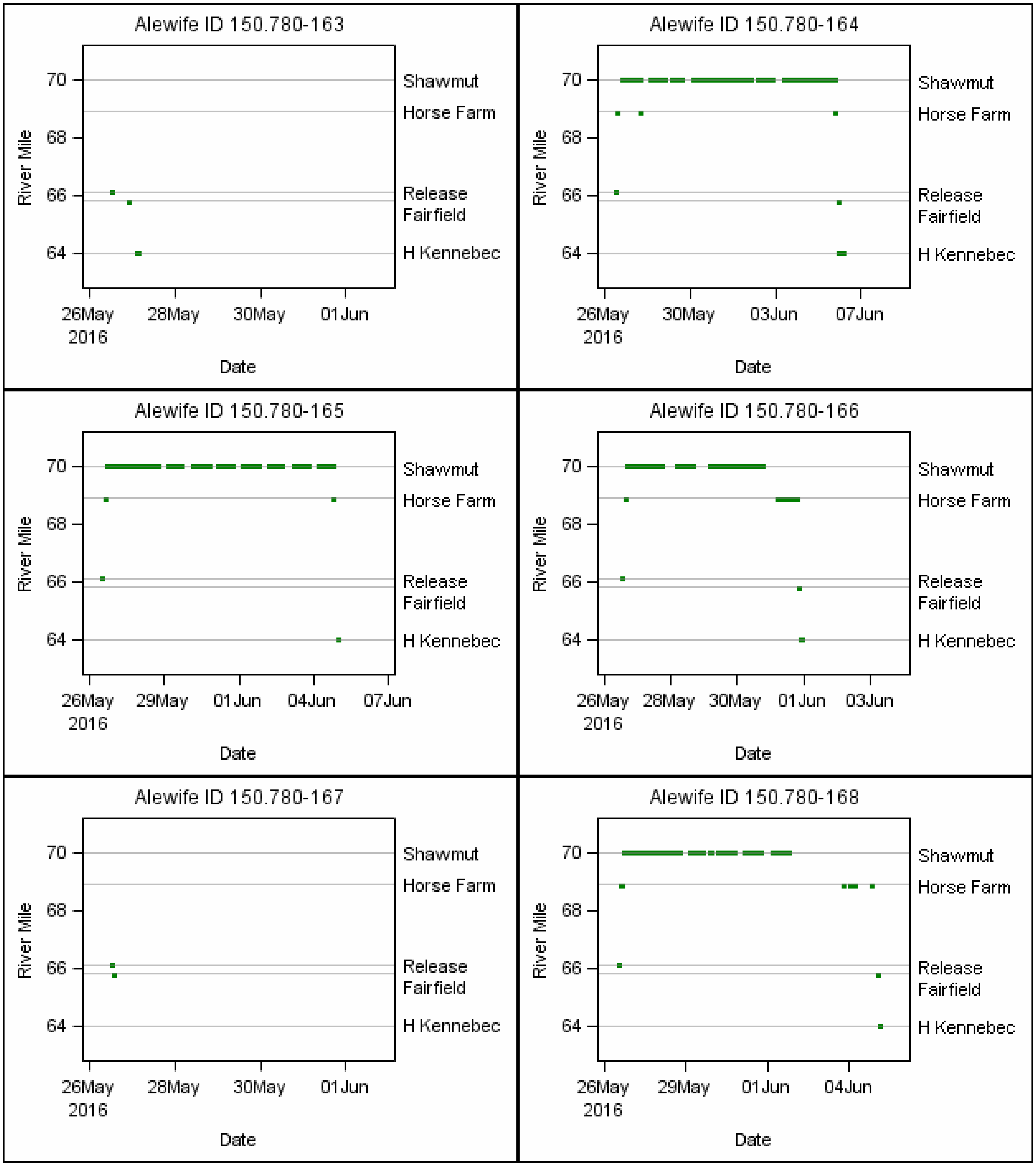

Alewife ID 150.780-116
Alewife ID 150.780-117
Alewife ID 150.780-118
Alewife ID 150.780-119
Alewife ID 150.760-137
Alewife ID 150.760-138
River Mile
Date
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
64
66
68
70
22May 2016
24May
26May
28May
30May
25May
31May
03Jun
26May 2016
01Jun
05Jun

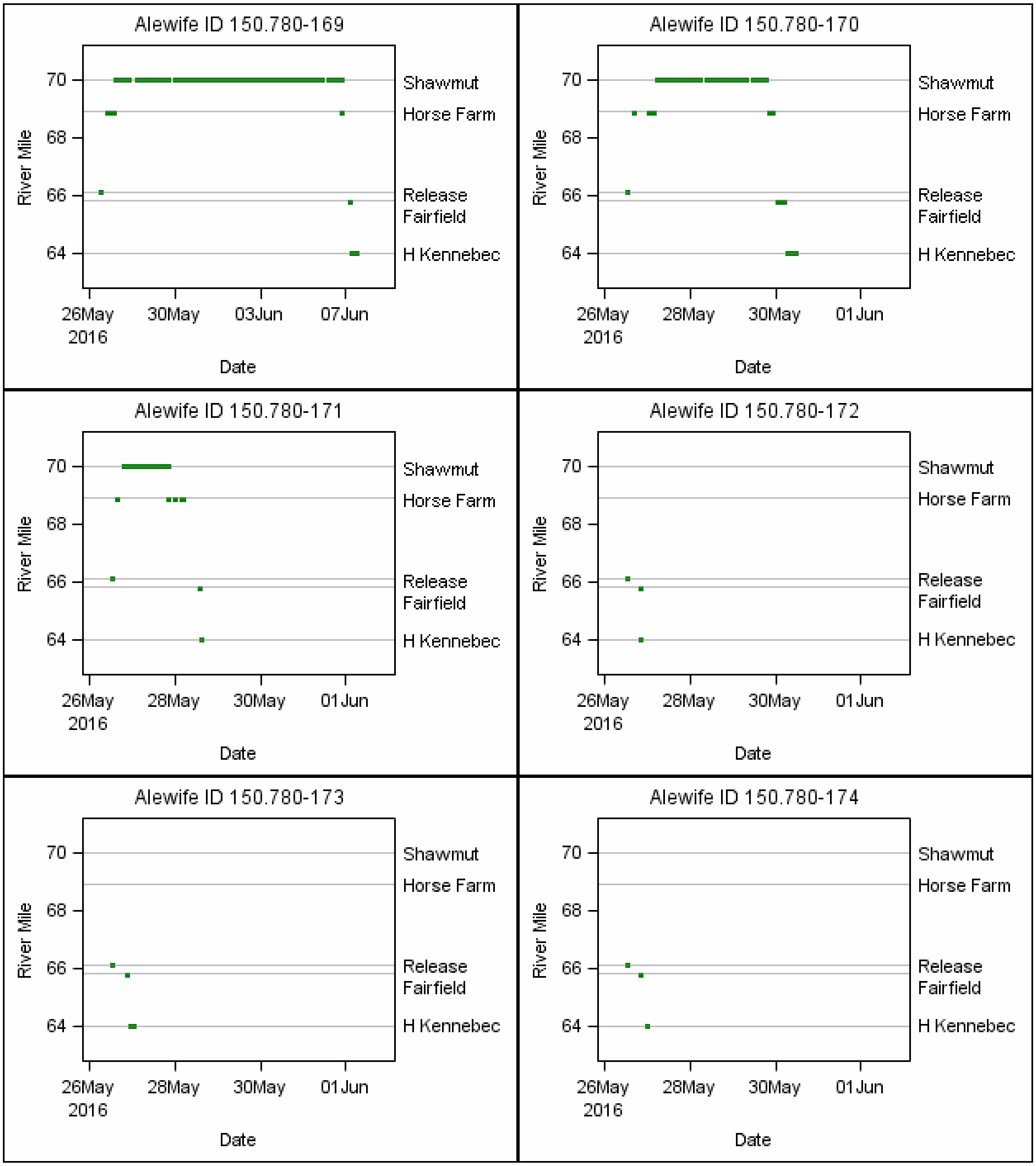

Alewife ID 150.760-139
Alewife ID 150.760-140
Alewife ID 150.760-141
Alewife ID 150.760-142
Alewife ID 150.760-143
Alewife ID 150.760-144
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
05Jun
Date

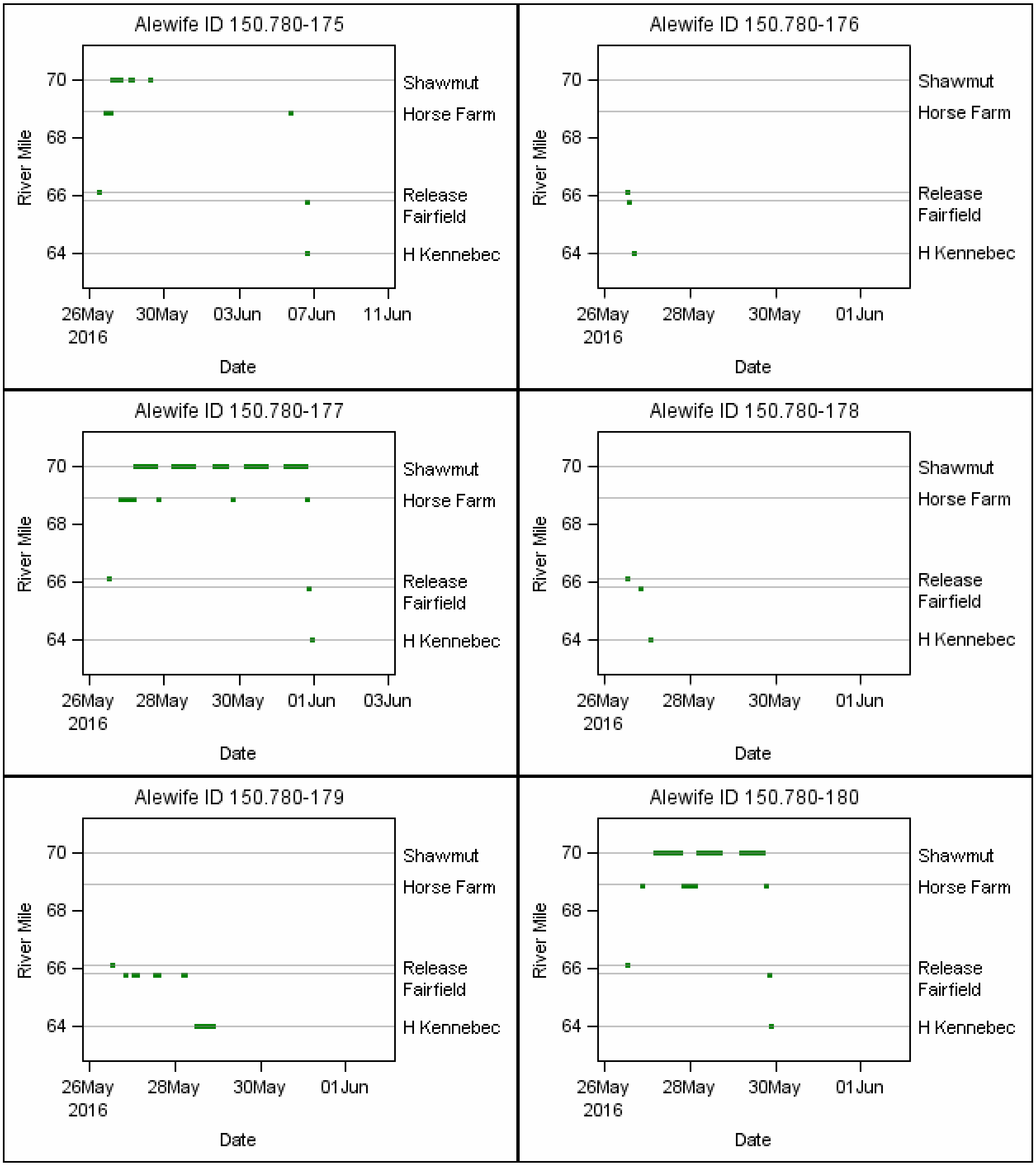

Alewife ID 150.760-145
Alewife ID 150.760-146
Alewife ID 150.760-147
Alewife ID 150.760-148
Alewife ID 150.760-149
Alewife ID 150.760-150
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
05Jun
07Jun
11Jun
15Jun
Date

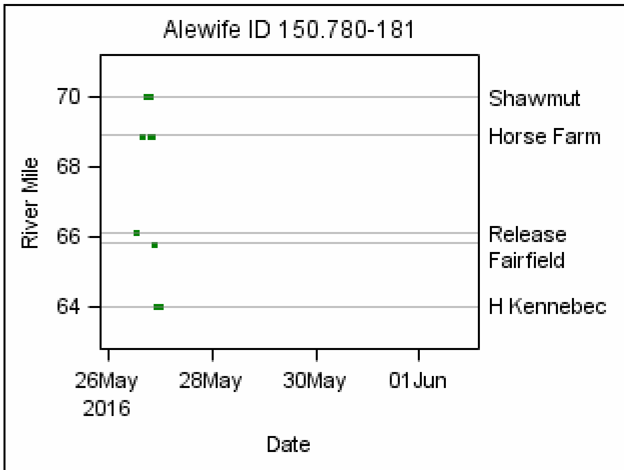

Alewife ID 150.760-151
Alewife ID 150.760-152
Alewife ID 150.760-153
Alewife ID 150.760-154
Alewife ID 150.780-155
Alewife ID 150.780-156
River Mile
Date
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
70
68
66
64
26May 2016
28May
30May
01Jun
03Jun
05Jun
07Jun
11Jun

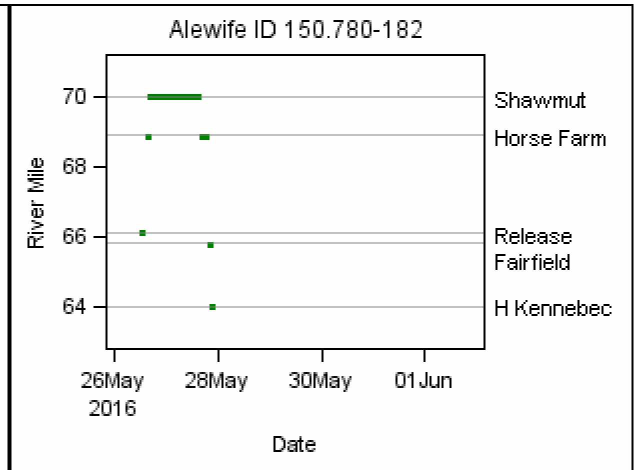

Alewife ID 150.780-157
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
05Jun
Date
Alewife ID 150.780-158
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
30May
03Jun
07Jun
11Jun
Date
Alewife ID 150.780-159
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date
Alewife ID 150.780-160
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
30May
03Jun
07Jun
11Jun
Date
Alewife ID 150.780-161
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
29May
01Jun
04Jun
07Jun
Date
Alewife ID 150.780-162
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date

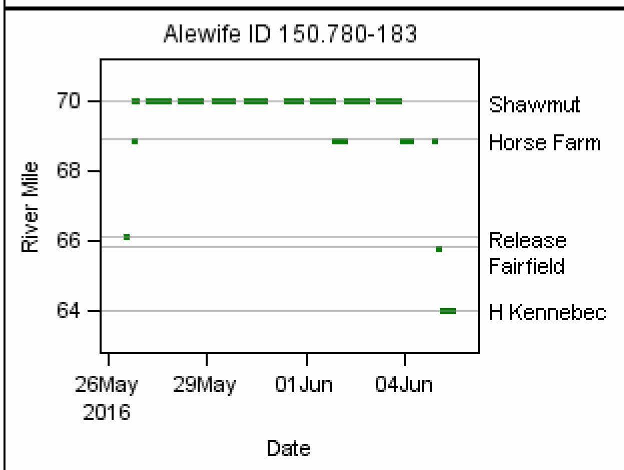

Alewife ID 150.780-163
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date
Alewife ID 150.780-164
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
30May
03Jun
07Jun
Date
Alewife ID 150.780-165
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
29May
01Jun
04Jun
07Jun
Date
Alewife ID 150.780-166
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
Date
Alewife ID 150.780-167
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date
Alewife ID 150.780-168
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
29May
01Jun
04Jun
Date

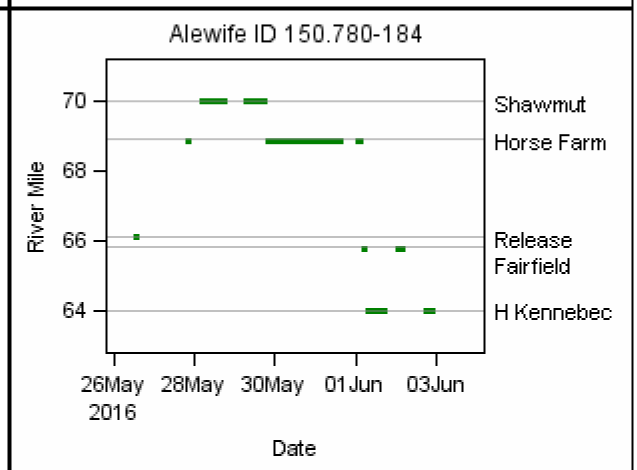

Alewife ID 150.780-169
Alewife ID 150.780-170
Alewife ID 150.780-171
Alewife ID 150.780-172
Alewife ID 150.780-173
Alewife ID 150.780-174
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
07Jun
Date

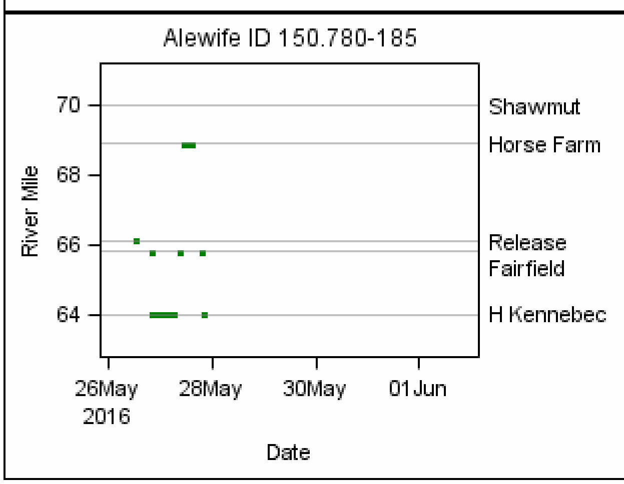

Alewife ID 150.780-175
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
30May
03Jun
07Jun
11Jun
Date
Alewife ID 150.780-176
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date
Alewife ID 150.780-177
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
Date
Alewife ID 150.780-178
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date
Alewife ID 150.780-179
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date
Alewife ID 150.780-180
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date

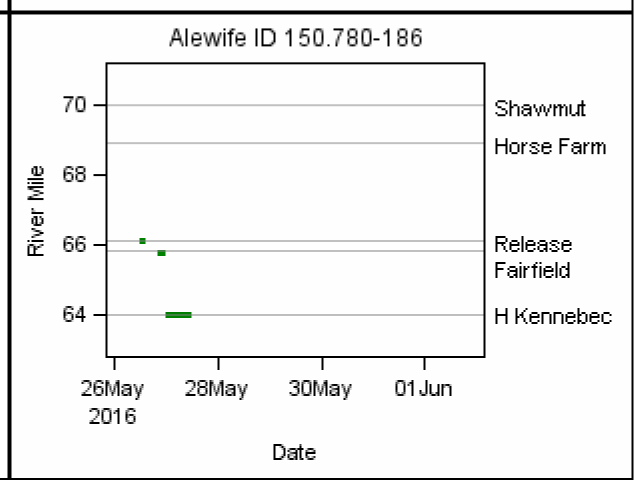

Alewife ID 150.780-181
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date


Alewife ID 150.780-182
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date


Alewife ID 150.780-183
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
29May
01Jun
04Jun
Date


Alewife ID 150.780-184
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
03Jun
Date


Alewife ID 150.780-185
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date


Alewife ID 150.780-186
River Mile
70
68
66
64
Shawmut
Horse Farm
Release
Fairfield
H Kennebec
26May 2016
28May
30May
01Jun
Date

Appendix D—Listing Table

ID	Total Length (mm)	Gender	Release Date	Time at Large (hrs)		Residence Time (hrs)							
				Nearfield	Study Reach	Tailrace	Stn A	Stn B	Stn C-1	Stn C-2	Stn C-3	Stn D	Stn E
76040	300	F	19-May	-	12.56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76041	297	F	19-May	271.427	318.72	132.3	12.6	14.9	3.7	37.3	15.0	48.2	0.6
76042	286	M	19-May	-	1.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76043	326	M	19-May	208.865	246.08	41.9	0.4	3.2	4.5	2.9	8.8	21.7	0.6
76044	296	F	19-May	144.296	171.27	82.5	0.8	5.4	1.8	20.8	7.0	46.7	0.1
76045	281	M	19-May	230.207	246.17	78.8	2.1	19.1	3.0	2.8	4.9	44.4	2.5
76046	287	F	19-May	293.435	316.74	119.1	4.8	4.4	3.2	7.2	62.2	37.3	0.0
76047	276	M	19-May	242.823	269.21	151.5	3.7	73.9	10.5	4.2	6.6	52.1	0.6
76048	281	F	19-May	173.081	203.24	26.9	0.3	2.5	0.6	3.7	2.2	16.9	0.6
76049	284	F	19-May	167.964	203.47	72.9	3.0	21.9	1.2	0.9	10.1	35.8	0.0
76050	296	M	19-May	144.139	170.72	74.7	1.4	14.7	1.0	5.6	2.8	48.3	1.0
76051	291	U	19-May	314.399	341.97	130.0	0.4	29.7	27.7	11.2	20.1	40.9	0.0
76052	312	F	19-May	138.353	161.87	55.1	0.4	3.4	1.1	11.7	8.6	29.2	0.8
76053	272	M	19-May	167.092	197.45	46.7	1.0	1.2	1.4	6.8	11.9	22.9	1.6
76054	283	M	19-May	528.34	533.16	262.2	0.5	2.0	12.2	53.3	34.7	159.0	0.5
76055	305	F	19-May	261.21	275.6	58.0	1.2	4.6	1.8	5.0	13.3	31.7	0.4
76056	286	F	19-May	-	11.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76057	321	F	19-May	102.638	126.26	14.4	0.3	3.6	1.2	1.7	1.5	6.2	0.0
76058	284	U	19-May	232.245	290.93	43.1	0.5	2.1	1.9	13.5	7.1	16.9	1.1
76059	296	F	19-May	191.568	195.47	33.4	0.7	1.4	0.8	4.6	1.0	24.9	0.0
76060	296	F	19-May	193.681	199.73	38.0	1.9	4.0	4.9	6.1	0.9	17.5	2.7
76061	276	M	19-May	220.655	268.72	80.2	0.1	34.7	11.3	4.2	1.9	26.9	1.3
76062	309	F	19-May	199.915	296.94	30.3	3.1	3.2	0.3	0.8	0.4	20.7	1.9
76063	321	U	19-May	38.467	56.29	9.3	1.7	0.3	0.4	0.5	0.2	6.2	0.0
76064	298	F	19-May	207.34	236.92	68.6	2.0	22.4	1.9	10.0	5.3	24.5	2.6
78040	293	F	19-May	263.507	292.75	43.5	2.2	8.0	2.3	2.5	1.0	26.7	0.8
78041	289	F	19-May	262.959	292.12	107.2	0.2	5.6	5.5	42.1	36.2	17.5	0.1
78042	280	M	19-May	267.517	292.13	78.9	1.0	15.3	2.5	7.7	11.0	33.8	7.7

ID	Total Length (mm)	Gender	Release Date	Time at Large (hrs)		Residence Time (hrs)							
				Nearfield	Study Reach	Tailrace	Stn A	Stn B	Stn C-1	Stn C-2	Stn C-3	Stn D	Stn E
78043	284	F	19-May	-	1.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78044	303	F	19-May	401.024	413.41	239.8	0.0	9.0	7.6	58.9	20.3	143.4	0.7
78045	281	F	19-May	-	1.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78046	292	F	19-May	270.624	309.17	68.2	0.7	15.9	1.2	9.4	2.8	37.2	1.0
78047	301	F	19-May	-	2.41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78048	314	F	19-May	464.532	485.43	166.2	3.5	7.3	60.3	19.6	6.2	68.9	0.4
78049	327	F	19-May	307.186	336.01	132.8	2.7	51.3	16.7	14.2	15.9	27.6	4.3
78050	299	M	19-May	102.034	126.29	19.4	0.0	6.4	5.0	6.2	1.2	0.4	0.1
78051	301	F	19-May	534.807	557.31	335.0	0.1	69.7	16.3	56.1	77.3	115.0	0.6
78052	304	M	19-May	174.755	203.4	27.3	0.0	4.6	2.2	3.2	2.9	14.2	0.1
78053	290	M	19-May	267.797	299.01	45.3	0.7	3.3	0.6	3.0	2.7	30.5	4.6
78054	290	F	19-May	310.849	316.65	99.4	0.0	9.0	9.5	17.7	24.3	38.2	0.8
78055	316	F	19-May	3.787	29.54	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0
78056	290	F	19-May	250.171	270.55	48.9	0.7	4.7	1.6	25.0	9.1	7.7	0.1
78057	306	F	19-May	26.001	50.08	9.0	0.0	0.3	0.0	1.0	0.3	5.9	1.5
78058	294	F	19-May	267.744	291.81	118.1	0.4	6.3	18.2	20.3	19.6	49.1	4.2
78059	289	M	19-May	269.414	292.67	86.8	2.3	8.9	23.5	12.3	6.3	30.3	3.1
78060	297	F	19-May	145.996	195.95	33.3	5.5	3.5	0.5	3.2	0.4	17.1	3.2
78061	291	M	19-May	321.929	337.39	85.3	0.6	13.6	3.5	11.0	7.7	48.2	0.8
78062	310	F	19-May	194.359	224.56	76.9	5.6	8.7	6.7	27.5	7.1	21.2	0.2
78063	287	M	19-May	325.153	369.07	55.5	0.1	8.0	1.7	5.5	6.0	33.7	0.4
78064	294	F	19-May	136.991	155.16	46.6	0.4	4.4	1.3	7.3	4.1	28.9	0.2
76070	295	F	23-May	191.66	205.9	55.5	1.2	7.3	1.7	7.2	32.8	3.6	1.8
76071	291	F	23-May	226.678	296.76	32.7	0.0	5.1	6.3	2.6	8.3	9.5	0.9
76072	299	F	23-May	140.144	151.62	12.9	0.3	0.6	0.6	3.1	0.9	6.4	1.0
76073	322	F	23-May	320.694	344.57	180.5	0.7	14.9	25.4	33.0	11.3	95.0	0.3
76074	289	M	23-May	71.889	78.31	9.5	2.3	2.1	0.7	0.4	0.1	2.7	1.3
76075	290	F	23-May	-	15.38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76076	279	M	23-May	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76077	286	M	23-May	153.733	178.49	11.9	1.3	3.0	0.6	1.9	0.4	4.6	0.1
76078	309	M	23-May	290.551	302.42	172.1	2.0	12.7	6.8	29.9	14.7	105.9	0.0
76079	287	F	23-May	166.573	193.21	3.5	1.4	0.5	0.1	0.6	0.3	0.6	0.0

ID	Total Length (mm)	Gender	Release Date	Time at Large (hrs)		Residence Time (hrs)							
				Nearfield	Study Reach	Tailrace	Stn A	Stn B	Stn C-1	Stn C-2	Stn C-3	Stn D	Stn E
76080	291	M	23-May	193.818	210.83	17.8	0.3	3.3	0.4	5.5	1.8	5.9	0.7
76081	299	M	23-May	192.432	207.75	43.2	3.0	9.3	9.3	11.4	3.3	6.9	0.0
76082	279	M	23-May	189.669	197.92	22.7	0.3	2.0	1.8	3.3	5.2	9.3	0.9
76083	287	M	23-May	123.547	174.25	1.3	0.0	0.7	0.3	0.1	0.1	0.0	0.2
76084	301	M	23-May	144.55	152.4	44.7	1.9	6.8	14.7	4.8	14.3	2.0	0.3
76085	277	F	23-May	-	0.61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76086	294	F	23-May	117.859	155.26	17.0	0.8	1.2	2.3	2.2	3.0	7.3	0.3
76087	291	F	23-May	191.151	217.75	40.1	0.7	11.1	10.2	7.3	3.1	7.6	0.0
76088	276	M	23-May	223.024	239.03	47.2	2.9	5.3	5.4	7.9	5.3	19.0	1.3
76089	307	F	23-May	337.363	350.25	122.9	0.4	8.2	3.3	14.4	59.5	36.9	0.2
76090	278	M	23-May	48.66	54.91	20.2	1.2	7.3	0.3	4.8	4.9	1.7	0.0
76091	307	M	23-May	285.296	321.97	88.1	12.7	5.2	5.3	12.7	12.5	39.7	0.0
76092	321	F	23-May	290.052	299.35	158.8	1.9	13.3	66.9	7.8	20.1	48.7	0.1
76093	302	F	23-May	73.725	86.49	11.7	1.0	2.8	0.2	2.4	2.0	2.8	0.6
76094	287	F	23-May	194.736	303.15	35.9	0.0	5.7	2.2	5.7	3.1	18.9	0.4
78095	289	F	23-May	203.462	224.35	78.7	3.2	19.4	1.5	5.0	34.8	14.8	0.0
78096	279	M	23-May	65.388	78.31	6.9	0.0	0.1	0.4	2.1	0.2	3.5	0.5
78097	304	F	23-May	255.734	274.53	104.8	4.3	14.0	7.0	16.3	36.0	27.1	0.1
78098	281	F	23-May	-	2.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78099	281	M	23-May	196.214	218.72	18.4	1.3	4.5	4.6	1.0	0.2	6.5	0.3
780100	287	F	23-May	143.914	150.84	14.2	0.3	3.0	1.0	3.7	0.7	4.3	1.2
780101	295	M	23-May	287.544	295.06	116.5	0.7	15.9	2.1	11.6	7.9	77.1	1.2
780102	289	F	23-May	-	7.83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780103	301	F	23-May	79.932	110.44	9.3	0.1	2.2	0.4	1.2	0.0	5.1	0.4
780104	281	F	23-May	168.335	183.78	15.7	0.5	1.3	4.3	3.4	0.7	3.3	2.2
780105	286	F	23-May	142.644	152.46	18.6	0.3	2.1	0.2	11.5	0.4	4.0	0.1
780106	299	M	23-May	284.021	297.99	98.1	1.0	9.2	3.6	11.3	12.3	60.5	0.2
780107	311	M	23-May	241.173	247.98	64.1	0.2	5.5	5.6	14.1	13.2	22.1	3.4
780108	292	M	23-May	94.325	-	14.9	0.8	2.9	2.6	4.7	0.3	2.9	0.7
780109	309	F	23-May	408.227	-	7.9	0.0	3.2	0.1	0.4	0.1	4.1	0.0
780110	300	F	23-May	68.015	77.01	11.5	0.2	4.4	1.0	2.6	0.5	1.3	1.5
780111	284	F	23-May	433.111	440.56	211.4	0.4	8.5	8.5	29.0	13.1	139.1	12.7

ID	Total Length (mm)	Gender	Release Date	Time at Large (hrs)		Residence Time (hrs)							
				Nearfield	Study Reach	Tailrace	Stn A	Stn B	Stn C-1	Stn C-2	Stn C-3	Stn D	Stn E
780112	297	M	23-May	55.783	77.05	4.8	0.0	1.9	0.2	1.3	0.2	1.1	0.1
780113	299	M	23-May	192.647	201.06	12.1	1.7	6.3	0.3	1.9	0.4	1.5	0.0
780114	295	F	23-May	-	6.33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780115	302	F	23-May	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780116	290	M	23-May	75.579	80.63	17.8	1.2	2.3	0.2	4.6	0.3	9.1	0.0
780117	300	M	23-May	46.984	54.38	10.1	0.0	1.3	2.4	0.8	0.0	4.6	0.9
780118	316	F	23-May	194.61	199.03	83.9	1.6	3.1	11.4	9.0	45.0	13.1	0.9
780119	320	F	23-May	45.517	52.93	3.1	0.3	1.5	0.1	0.5	0.4	0.3	0.1
760137	297	F	26-May	-	0.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760138	301	M	26-May	168.748	200.7	15.7	0.1	5.4	0.5	0.3	0.4	8.5	0.6
760139	281	F	26-May	-	8.16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760140	281	M	26-May	-	7.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760141	286	F	26-May	167.272	181.94	65.2	1.4	5.3	2.6	2.6	19.8	31.9	1.7
760142	284	M	26-May	126.427	147.56	27.6	0.9	9.1	1.7	6.1	7.1	2.6	0.1
760143	291	M	26-May	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760144	289	F	26-May	89.744	103.43	38.2	0.0	6.5	2.0	0.9	23.5	5.4	0.0
760145	311	U	26-May	-	7.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760146	286	M	26-May	433.791	438.03	154.4	1.2	11.5	29.5	19.5	7.5	80.7	4.4
760147	305	U	26-May	200.049	218.09	50.0	7.5	7.7	4.4	3.8	5.1	21.5	0.1
760148	279	M	26-May	303.045	322.42	130.3	0.9	1.4	0.9	26.0	0.6	100.3	0.3
760149	286	F	26-May	90.405	127.63	13.8	0.2	6.1	0.7	0.9	0.6	4.8	0.6
760150	281	M	26-May	67.857	77.86	8.3	0.2	2.9	0.3	0.5	2.8	1.7	0.0
760151	291	F	26-May	-	5.22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
760152	279	M	26-May	143.711	200.82	55.5	0.1	17.4	3.2	1.7	14.6	18.2	0.4
760153	296	U	26-May	29.599	47.05	4.1	0.4	1.3	1.2	0.1	0.7	0.3	0.0
760154	281	M	26-May	119.055	123.3	41.4	4.8	9.8	3.9	2.0	4.1	16.4	0.4
780155	291	M	26-May	276.196	340.84	61.8	4.9	5.5	17.0	7.2	18.9	8.2	0.0
780156	301	F	26-May	-	7.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780157	322	F	26-May	171.013	174.75	37.5	2.6	7.7	5.2	3.4	4.2	14.4	0.1
780158	311	F	26-May	341.874	359.33	45.6	0.0	7.9	2.3	3.6	30.1	1.7	0.0
780159	281	F	26-May	-	5.22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780160	281	F	26-May	132.323	320.57	10.6	0.3	0.5	3.7	1.3	2.7	1.5	0.7

ID	Total Length (mm)	Gender	Release Date	Time at Large (hrs)		Residence Time (hrs)							
				Nearfield	Study Reach	Tailrace	Stn A	Stn B	Stn C-1	Stn C-2	Stn C-3	Stn D	Stn E
780161	299	M	26-May	143.455	168.03	6.0	0.5	1.8	1.4	0.2	0.5	1.6	0.0
780162	301	F	26-May	119.091	135.07	28.9	1.8	15.6	5.5	0.9	2.7	0.9	1.4
780163	303	F	26-May	-	9.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780164	304	F	26-May	245.171	249.83	77.9	9.3	10.1	3.3	11.5	3.9	35.3	4.6
780165	311	F	26-May	220.17	226.57	48.2	0.9	9.2	8.3	10.8	2.2	15.6	1.2
780166	291	F	26-May	115.129	127.59	12.9	0.1	1.8	1.8	1.3	0.9	6.6	0.4
780167	284	F	26-May	-	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780168	291	M	26-May	195.979	228.93	18.7	0.2	4.6	3.1	1.7	1.4	5.4	2.3
780169	301	F	26-May	262.998	280.14	117.0	1.0	8.1	12.6	10.2	5.6	79.3	0.2
780170	301	M	26-May	65.461	84.19	12.9	0.6	1.6	0.1	0.2	4.2	6.2	0.0
780171	284	F	26-May	28.536	48.76	4.2	0.2	0.5	1.2	0.5	0.8	0.5	0.6
780172	300	F	26-May	-	7.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780173	282	U	26-May	-	8.23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780174	270	F	26-May	-	7.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780175	300	F	26-May	231.639	266.77	3.0	0.0	0.4	1.8	0.3	0.2	0.0	0.4
780176	290	F	26-May	-	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780177	289	M	26-May	119.781	128.13	13.1	1.4	2.2	1.1	1.3	3.1	3.8	0.3
780178	279	F	26-May	-	7.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780179	300	F	26-May	-	25.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780180	290	F	26-May	69.698	79.19	8.0	1.7	2.5	1.1	0.3	2.3	0.0	0.1
780181	302	F	26-May	4.341	8.01	0.3	0.0	0.1	0.0	0.0	0.2	0.0	0.0
780182	306	F	26-May	27.002	31.21	6.2	0.0	0.5	0.4	1.2	0.7	3.3	0.0
780183	281	M	26-May	197.228	239.89	38.7	0.4	6.7	3.5	4.1	1.9	22.1	0.1
780184	306	F	26-May	56.58	156.34	5.9	0.0	3.0	1.5	0.4	0.8	0.2	0.0
780185	281	U	26-May	-	30.47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
780186	271	F	26-May	-	7.95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

From: Bentivoglio, Antonio
To: Drew Trested
Cc: Sojkowski, Bryan; Howatt, Kathy; OConnor, Michael; Seiders, Dwayne J; Donald Dow - NOAA Federal; Matt Buhyoff - NOAA Federal; Wippelhauser, Gail; Christman, Paul; Cox, Oliver N; Mitchell, Gerry; Maloney, Kelly; Richter, Robert
Subject: Re: Shawmut and Lockwood Discussion
Date: Wednesday, October 19, 2016 1:01:55 PM

Drew,
thanks for the call earlier today. The discussion helped me understand better the methodology and realize that the "constant" was capturing 95% of the variability which then made comparisons between the sites meaningful. Good discussion.

Antonio

On Wed, Oct 19, 2016 at 12:47 PM, Drew Trested <dtrested@normandeau.com> wrote:

> Hi Antonio –
>
> It was good to talk with you earlier today. To summarize our discussion for the group, the approach in the current Shawmut herring report for determining the receiver specific threshold value used in calculating periods of residence was scaled so that it captured 95% of the variability. This approach was maintained for each of the 7 receivers and provided a consistent methodology for estimating that threshold value. My reservations related to the use of an “arbitrary” (for lack of a better word) threshold value across all 7 receiver locations is the creation of an unbalanced design wherein the use of a pre-selected threshold at locations where that value is greater than the calculated would likely overestimate the amount of residence time and the use of a pre-selected threshold at locations where that value is less than the calculated would likely underestimate the amount of residence time. If we were to select one of the three values mentioned in your note below (52, 128, or 373 seconds) then we would have a mix of over and underestimation among the 7 study receivers. As we discussed, there will be a degree of variability introduced through the use of various receiver types, antenna types and intended coverage areas. Knowing that, we attempt to control for that with the uniformly scaled approach for threshold calculation.
>
> Drew
>
> DREW TRESTED, PhD, Fisheries Biologist

Normandeau Associates, Inc.

30 International Drive, Suite 6, Portsmouth, NH 03801

603.319.5310 (office) 603.973.3179 (cell)

dtrested@normandeau.com www.normandeau.com

From: Bentivoglio, Antonio [mailto:antonio_bentivoglio@fws.gov]
Sent: Monday, October 17, 2016 1:16 PM
To: Drew Trested
Cc: Sojkowski, Bryan; Howatt, Kathy; OConnor, Michael; Seiders, Dwayne J; Donald Dow - NOAA Federal; Matt Buhyoff - NOAA Federal; Wippelhauser, Gail; Christman, Paul; Cox, Oliver N; Mitchell, Gerry; Kelly Maloney

Subject: Re: Shawmut and Lockwood Discussion

Drew,

on Friday we discussed the Shawmut Telemetry study. During the meeting I asked if equalizing the interval periods (currently all different) for the different Stations would change the means for each site. I believe it would change the means and therefore possibly the results. Currently the intervals you used are:
Station A   52 sec

Station B   32sec

Station C-1 128sec

Station C-2 224sec

Station C-3 64sec

Station D 373sec

Station E 951sec

Can you run 3 different scenarios using the same interval for all stations. Can you run it using:

52sec

128sec

373sec

Can you let us know the results in the same format that you gave us in your draft report?

Thanks

Antonio

On Wed, Oct 12, 2016 at 9:43 AM, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

866-592-1962 Conf ID 568-172-8500

From: Bentivoglio, Antonio [mailto:antonio_bentivoglio@fws.gov]
Sent: Wednesday, October 12, 2016 9:42 AM
To: Maloney, Kelly
Cc: Sojkowski, Bryan; Howatt, Kathy; OConnor, Michael; Seiders, Dwayne J; Donald Dow - NOAA Federal; Matt Buhyoff - NOAA Federal; Wippelhauser, Gail; Christman, Paul; Cox, Oliver N; Mitchell, Gerry; Drew Trested; gallen@aldenlab.com; jrichardson@bluehillhydraulics.com; 'Keith.Martin@KleinschmidtGroup.com' (Keith.Martin@KleinschmidtGroup.com); Lucas Stiles
Subject: Re: Shawmut and Lockwood Discussion

Can you get a conf line for those that can not make it?

On Wed, Oct 12, 2016 at 9:39 AM, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

DUE TO LOGISTICAL CONSIDERATIONS, WE ARE MOVING TOMORROW'S MEETING TO KLEINSCHMIDT ASSOCIATES AT 140 MAIN STREET, PITTSFIELD, MAINE.

Hello,

We would like to have a meeting to discuss preliminary comments on the 30% design drawings for the Lockwood flume as well as the study results for the CFD and alewife siting studies at the Shawmut Project. Please let me know of your availability and inclination to attend. We will hold the meeting at our Lockwood Facility in Winslow, Maine. Please bring steel toed boots, hard hats, safety glasses.

Thank you,

Kelly Maloney

Manager, Licensing and Compliance – Northeast

North America

Brookfield Renewable

150 Main Street, Lewiston, Maine, 04240

T 207-755-5606 **C** 207-233-1995 **F** 207-755-5655

Kelly.Maloney@BrookfieldRenewable.com

www.brookfieldrenewable.com

Brookfield

--

Note change of address

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

--

Note change of address

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

Collocated with the Gulf of Maine Coastal Program

4 Fundy Road #R

Falmouth, Maine 04105

Telephone: (207) 781-8364 x18

Fax: (207) 469-6725

Please consider the environment before printing this e-mail.

--

Note change of address

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

SHAWMUT 30% DESIGN CONSULTATION

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Thursday, August 17, 2017 2:26 PM
To: Richter, Robert
Cc: Mitchell, Gerry; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Matt Buhyoff - NOAA Federal; Bryan Sojkowski; Bentivoglio, Antonio; Greg Allen
Subject: Shawmut - Draft Notes Questions Comments
Attachments: Shawmut 30.docx

Bob - attached is a file with our draft notes questions and comments - I am sure some of it will make no sense, but this is only to be used as talking points for when we meet on the 30% design. I will formalize our comments after the meeting. I hope this will help Greg get an idea of the questions we'll be asking so he can prepare. If you have any questions ahead of time, please don't hesitate to contact me.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut 30% Design – Agency Comments/Questions/Talking Points Draft

Drawing G-001

No Comments

Drawing G-002

1. Note 5 "Design Range" not Operating Range
2. Note 6 – 6 inches may be fine, Milford Target is 8 inches, what is HK target?
3. Note 7 - AWS flow should be changed to Total Attraction Flow
4. Note 7 – 3/8 opening – is this similar to HK – may change based upon HK performance
5. Is 15 minutes the minimum?

Drawing C-002

1. How is the Flow Apportioned?
2. Can we gate off the AWS?
3. Screen Intake
4. Put on TW for units 7/8

Drawing C-103

1. Move exit of discharge pipe away from spillway and intake
2. Need to discuss holding pool/brail etc (move upstream to accommodate holding pool and set up pool.
3. 10 ft of set up pool
4. Can we make the brail longer?
5. Can we change the AWS exit 90 degree? Need Dialogue
6. No need for brail on backside
7. What is preventing fish from entering AWS? Need Dialogue
8. Do we really need the Weir? Need Dialogue.
9. Where is the control gate located?

Drawing C-104

1. I do not like the weir…it will add bubbles.
2. Again discuss holding pool/braile
3. What is the velocity at the diffusers, across the hopper, in the holding pool
4. 490 cf – How does that compare to HK?
5. Sump Pump?
6. Hopper Filler pipe?
7. Screen on top of hopper
8. Is the top of concrete elevation at 93.0 ft too low?

Drawing C-105

1. AWS top gate can be upward opening
2. Need stop logs

3. Need aws intake screens
4. Compare ww screen to orono
5. What are the gates half way down AWS
6. Why spill at the bottom of AWS
7. Why is the top section just above chamber not level?
8. Not sure we understand this drawing
9. Need Dialogue on what flow goes where on AWS.

Drawing C-110

1. Not sure we need brail on the backside
2. Need to discussion on T-position on V-Gate.
3. Can we make entrance gate to track tailwater?

Drawing C-301

Drawing C-303

1. Need more definition on separation and flow amounts between d/s flow and upstream fish channel
2. Elevations of lower and upper edges of rock slope in the tailwater below channel?

Drawing C-304

1. Need velocity Flow data
2. Need more definition on downstream data on Section A
3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Thursday, October 19, 2017 2:32 PM
To: Richter, Robert
Cc: Mitchell, Gerry; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Matt Buhyoff - NOAA Federal; Bryan Sojkowski; Bentivoglio, Antonio; Greg Allen
Subject: Re: Shawmut - Draft Notes Questions Comments
Attachments: Shawmut 30 Design DRT Comments.pdf

Good Afternoon Bob -

Attached is the DRT final comments on the 30% Shawmut design. There is not much changes from our discussion on 8/28, however we would like an additional 10 ft of holding area below the V-gate in order to adequately stage fish while the hopper is in the raised position and FWS has a couple options for the exit of the AWS beside the fishway for you to look at . If you have any questions please contact me.

Regards,
Don

On Thu, Aug 17, 2017 at 2:25 PM, Donald Dow - NOAA Federal <donald.dow@noaa.gov> wrote:
Bob - attached is a file with our draft notes questions and comments - I am sure some of it will make no sense, but this is only to be used as talking points for when we meet on the 30% design. I will formalize our comments after the meeting. I hope this will help Greg get an idea of the questions we'll be asking so he can prepare. If you have any questions ahead of time, please don't hesitate to contact me.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration

National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Good Afternoon Bob –

I would like to thank you for the opportunity to review the 30% Shawmut Upstream Fish Passage Design. The Design Review Team (DRT), consisting of representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries & Wildlife (IF&W), United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), met with Brookfield and their consultant Alden Labs on August 28th to collectively review the design and the DRT comments. At the end of that meeting it was agreed that the notes from the meeting were going to be based upon the collaboration and discussion and that the DRT would later send final comments reflecting those discussion and answering a few other questions. It was also agreed that Alden had enough information from that meeting to continue working on the 60% design.

This review has been done collectively with all pertinent agencies and may or may not completely reflect each agency's comments. If the agencies have additional comments or disagreements outside of the DRT comments they would file a separate comment letter to Brookfield.

This review was done considering the biological and engineering hydraulic principles to design an effective upstream fishway considering NMFS and USFWS design standards as well as engineering and biological judgments if necessary. This review was not done considering Life Safety Codes, Building Codes, Allowable Stress Design, or Load Resistance Factor Design, or any other typical engineering design codes for concrete, steel, structures, or building. We have assumed that the consulting engineer has taken those codes and practices into consideration.

Shawmut 30% Design – Agency Comments

Drawing G-001

No Comments

Drawing G-002

1. Note 5 "Design Range" not Operating Range
2. Note 6 – 6 inches may be fine, Milford Target is 8 inches, we believe HK is around a foot.
3. Note 7 - AWS flow should be changed to Total Attraction Flow
4. Note 7 – less than 3/8 opening – similar to Hydro Kennebec
5. Is 15 minutes the minimum? What is the minimum cycle time?

Drawing C-002

1. Please show how the flow is apportioned
2. Please put on TW El on the drawing for units 7 and 8 tailrace

Drawing C-103

1. Please move exit of discharge pipe away from spillway and intake to prevent fish from being washed back into the tailrace.
2. The area below the V-gate is considered the holding pool on a large braille hopper and must be sized accordingly in order for fish to "stage" while the hopper is not in a fishing position. Similar to Hydro Kennebec this distance may be around 20 ft or so below the V-Gate. Please size according to FWS criteria for a holding pool.

3. Alden to provide nappe profiles, possibly move nappe upstream.
4. Braille size opening should be less than 3/8 inch clear

Drawing C-104

1. Add diffuser velocities, velocities across hopper, velocities in holding pool and velocities at entrance
2. Prefer flapper gates to filler pipe.
3. Screen on top of hopper
4. Is the top of concrete elevation at 93.0 ft too low? Please double check

Drawing C-105

1. Please include stop log slots
2. Please include depth of water along Section A.

Drawing C-110

1. The hopper gate should be at the bottom of the hopper. It may be that the drawing is just hard to read.
2. Entrance gate to track Tailwater

Drawing C-301

Drawing C-303

1. We need more definition on separation and flow amounts between d/s flow and upstream fish channel. Flow/elevation curves associated with HW/TW and resulting flow should be provided for the flow through the crossover fishway.
2. We need more definition on the elevations of lower and upper edges of rock slope in the tailwater below channel.

Drawing C-304

1. Need velocity/Flow data
2. Need more definition on downstream data on Section A – WSEL through section A
3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

Additional Comments from USFWS:

USFWS Engineering recommends additional space (10 ft of length) between the proposed v-trap and entrance gate to act as a holding pool. There was discussion during the August 28th meeting pertaining to utilizing the volume above the hopper and braille as the holding pool. We agree that this will be available as a holding pool space when the lift is not being operated. However, this space will not be available when the hopper is being raised and lowered (assumed time of 10 minutes). Therefore, if the hopper is to be raised every half hour, a third of the time the holding pool will not be effective. It is for this reason that an additional 10 ft of length be added in between the proposed v-trap and entrance

gate to provide a holding pool that is available at all times. Ideally a second v-trap would be added to reduce the amount of fallback as much as possible.

There is a need for more discussion related to the attraction water system (AWS) and its use as a downstream bypass. A consensus was not reached during the August 28th meeting. USFWS Engineering has the following comments/concerns:

1. For both cases below it is recommended that the slope of the AWS channel be lowered as displayed in Figure 1 in order to meet the tailwater. This will prevent the nappe of the flow from plunging into the tailwater some distance downstream of the entrance. The intent is to ensure that the AWS flow is as close as possible to the entrance of the fishway and operates within the streaming regime to avoid hydraulics that are not conducive near the entrance (e.g., turbulence, aeration, upwelling). Figure 2 displays a second alternative that could achieve the same results.

If the AWS is to be used as a downstream bypass

1. Effectiveness of the proposed geometry is unknown. As shown, the AWS flow first passes over a sharp crested weir, then a percentage of the flow falls through the floor, and the leftover amount goes down the sloped channel (which would produce another drawdown and increase in velocity which the downstream migrants may reject). A sharp crested weir does not produce hydraulics that are conducive to downstream passage, and there is risk of downstream migrants getting entrained within the AWS chamber below the floor.
2. For this case, USFWS Engineering would recommend implementing an Alden style entrance rather than the sharp crested weir. We agree that the 0.125 inch spacing will prevent entrainment of downstream migrating species. The plans should also display the calculated through velocity which should be less than 0.5 ft/s. The screen should be easily accessible during the season to ensure that the screen is clear of debris and not damaged.

If the AWS is not used as a downstream bypass

1. In this case the intake would need to be screened to prevent downstream migrating species from entering the AWS. If an upstream migrating Atlantic salmon were to traverse the AWS system to the top, the screen would prevent it from entering the headpond. In this case an alternative method to passing the AWS flow, as shown in Figure 2, could be considered. This would assist in preventing Atlantic salmon from entering the system by screening off the AWS flow. The AWS flow would be submerged which would provide the attraction flow and ensure that it did not plunge near the fishway entrance. This would necessitate a larger intake screen so that all the AWS flow is passed through the floor.

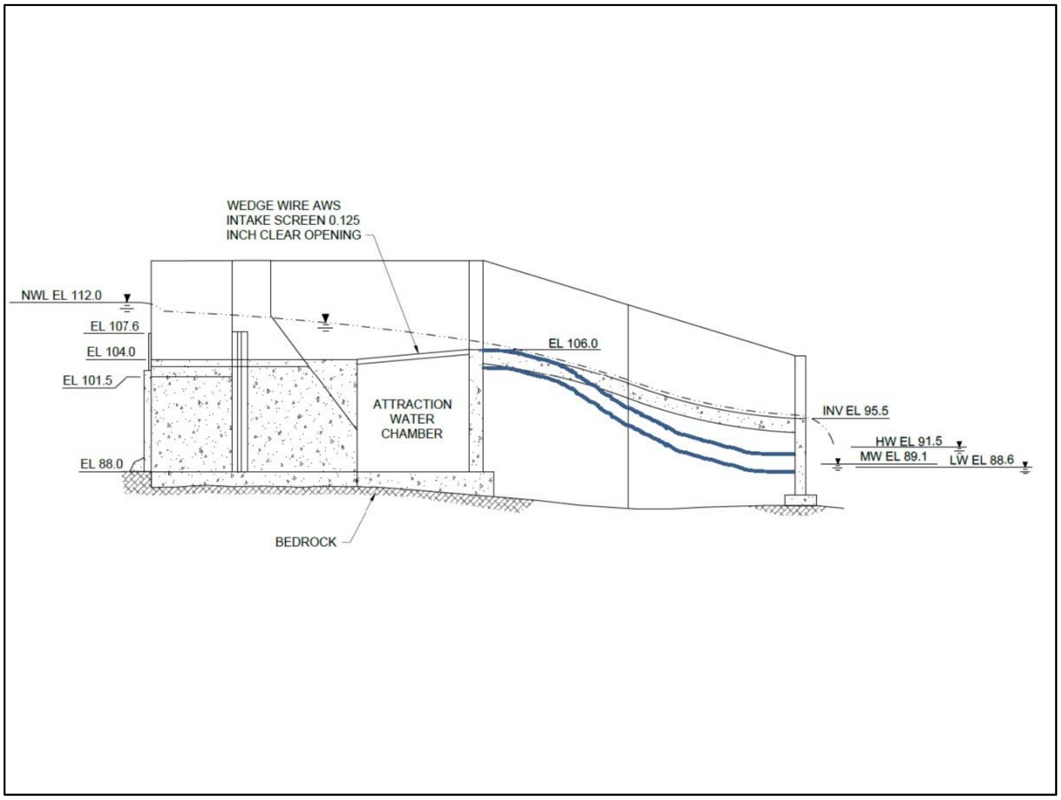


Figure 1 – Lowered AWS channel floor to meet tailwater

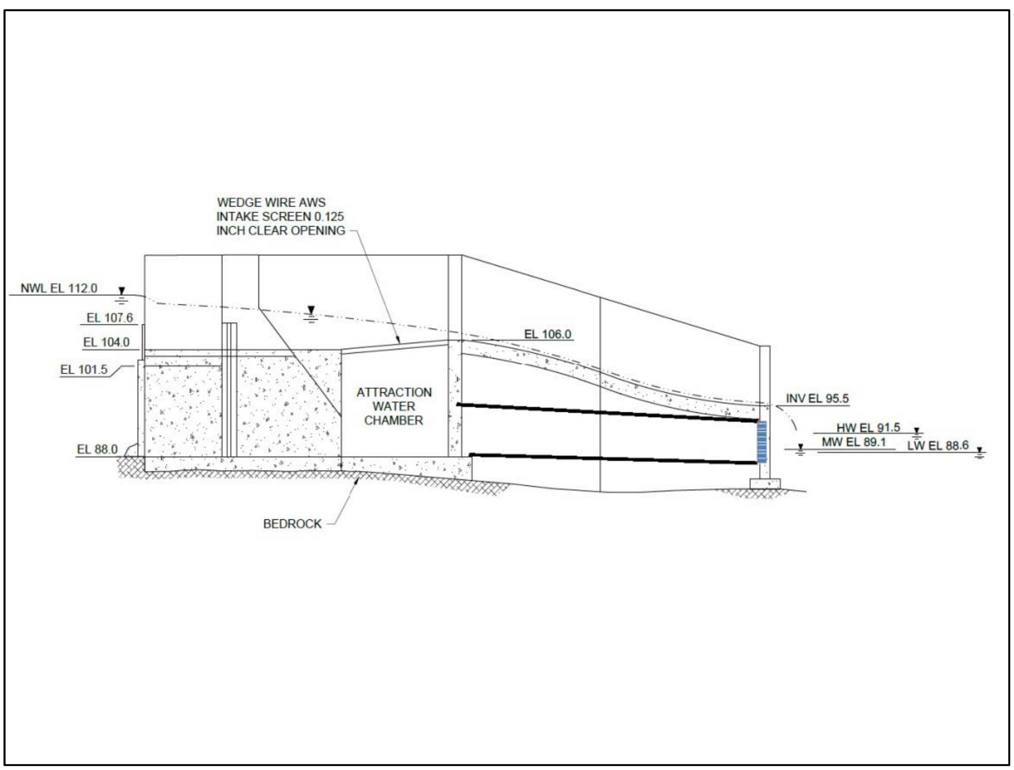


Figure 2 – AWS Alternative

Technical Memorandum

To: Mr. Gerry Mitchel and Robert Richter, Brookfield Renewable

From: Greg Allen and Steve Amaral, Alden

Date: November 1, 2017

Re: **30% design review agency comments responses for the Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities**

Alden Research Laboratory, Inc. (Alden) developed 30% design drawings for fish passage facilities for the Shawmut Hydroelectric Project (Shawmut). Brookfield Renewable (Brookfield) submitted these drawings to resource agencies on July 31, 2017 and a design review meeting was held on August 28, 2017. Representatives from the US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Environmental Protection (MEDEP), Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries and Wildlife (IF&W), Brookfield and Alden were in attendance at the 30% design review meeting. The resource agencies design review team (DTR) consisting of NMFS, FWS, IF&W and MDMR provided written comments on October 19, 2017 (Attachment 1) and this memorandum provides a response to those comments. Comments are shown below in bold and followed by Alden's responses.

Drawing G-002

1. **Note 5 "Design Range" not Operating Range**

   Note will be revised accordingly

2. **Note 6 – 6 inches may be fine, Milford Target is 8 inches, we believe HK is around a foot.**

   Head drop of 6 inches is consistent with HK

3. **Note 7 - AWS flow should be changed to Total Attraction Flow**

   Note will be revised accordingly

4. Note 7 – less than 3/8 opening – similar to Hydro Kennebec

Note changed to "0.125 inch opening or less" in response to FWS comments.

5. Is 15 minutes the minimum? What is the minimum cycle time?

Yes, the fish lift is designed for a 15 minute minimum cycle time.

Drawing C-002

1. Please show how the flow is apportioned

Drawing will be revised accordingly

2. Please put on TW El on the drawing for units 7 and 8 tailrace

Drawing will be revised accordingly

Drawing C-103

1. Please move exit of discharge pipe away from spillway and intake to prevent fish from being washed back into the tailrace.

The exit of the discharge pipe has been moved further from the attraction water intake as shown in Figure 1. The discharge location is now 40 ft from the spillway and 23 ft from the attraction water intake which minimizes risk of potential fall back of upstream migrants.

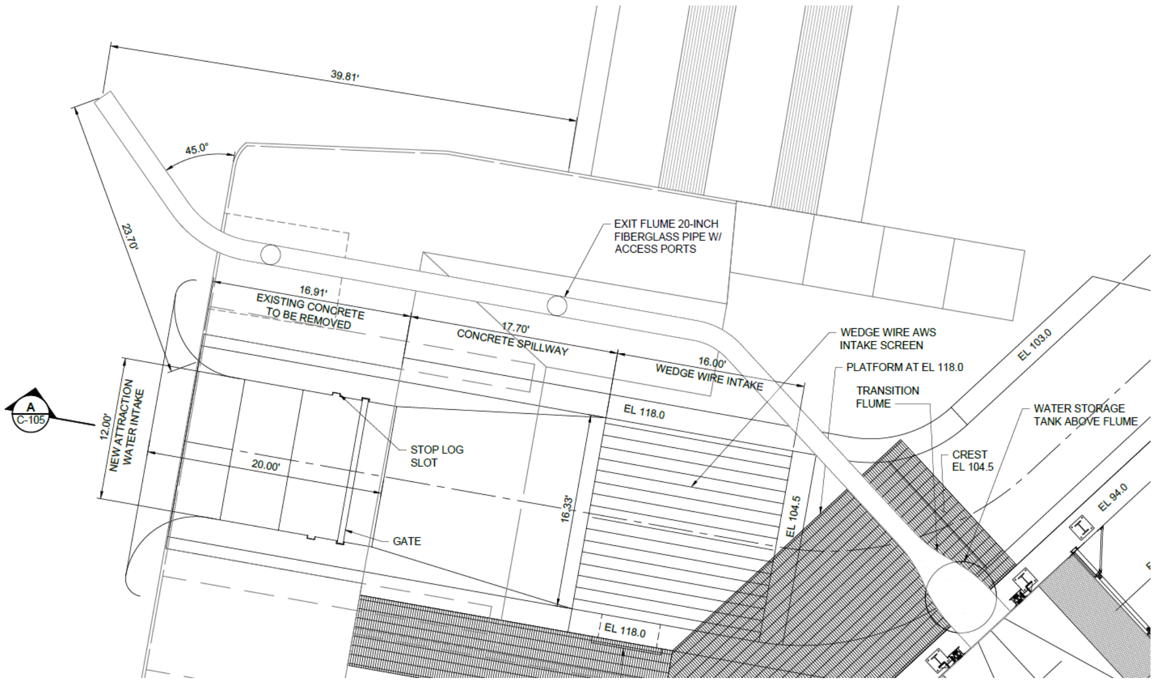


Figure 1. Attraction Water Intake Plan

2. **The area below the V-gate is considered the holding pool on a large braille hopper and must be sized accordingly in order for fish to "stage" while the hopper is not in a fishing position. Similar to Hydro Kennebec this distance may be around 20 ft or so below the V-Gate. Please size according to FWS criteria for a holding pool.**

The area downstream of the V-gate and upstream of the hinged entrance gate is considered a holding pool, which allows fish to stage while the fish lift is in operation and the V-gate is closed (shown in Figure 2). This holding pool volume is 12 ft long, 12 ft wide and 9 ft deep at low water, which equates to 1296 cubic feet. The FWS criteria (USFWS, 2017) lists the crowding limit of 0.10 ft^3/lb for a hopper and 0.25 ft^3/lb for a holding pool. Therefore, the required holding pool volume is 2.5 times the hopper volume. The Shawmut hopper is 490 cubic feet and multiplied by 2.5 provides a 1225 cubic feet holding pool volume. This confirms the design meets the FWS criteria for holding pool volume.

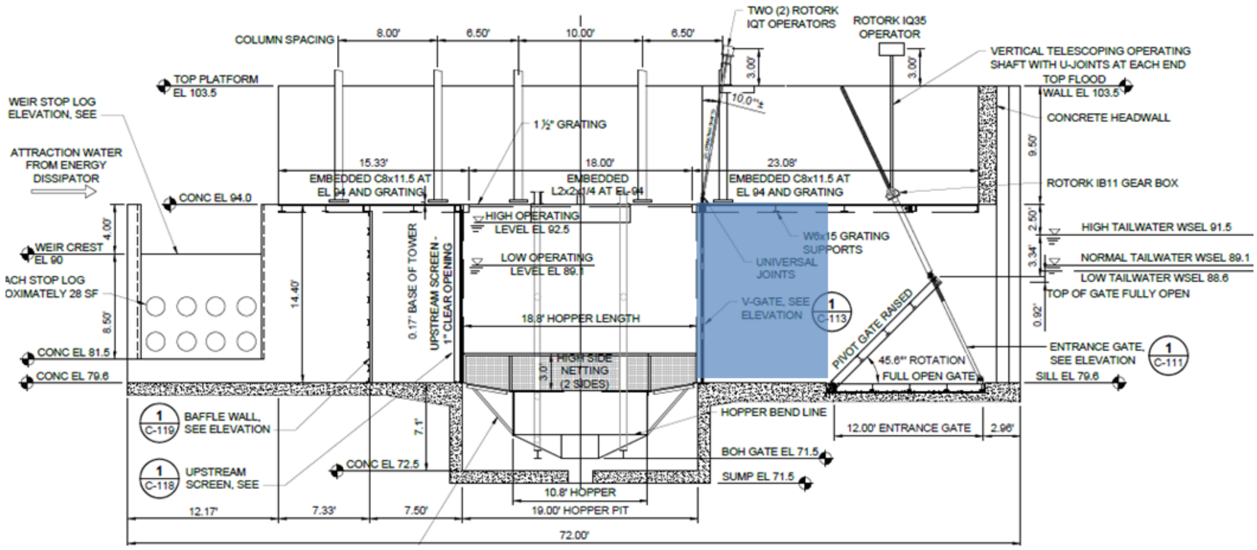


Figure 2. Fish Lift Flume Section, Holding Pool Area shaded blue

In addition, we note that the hopper volume of 490 cubic feet is more than adequate for the design populations provided for Shawmut and therefore the holding pool volume (which is based on the hopper volume) is also more than adequate. If we follow the FWS criteria (USFWS, 2017) with the design populations provided for Shawmut for American shad of 177,000, the required hopper volume is 314 cubic feet, and the required holding pool volume is 785 cubic feet which indicates the current design of the hopper and holding pool is 56% and 65% more than the FWS criteria requirements, respectively. Table 1 lists the design population estimates (provided by MDMR) and presents the calculated required volumes based on FWS criteria.

Table 1. Shawmut Design Populations and Calculated Hopper and Holding Pool Volumes

Species	Design Populations	Required Hopper Volume[1] (ft^3)	Required Holding Pool Volume[1] (ft^3)
American Shad	177,000	314	785
Alewives	134,000	32	80
Blueback Herring	1,535,000	159	396
Atlantic Salmon	12,000	71	177

1. Based on FWS criteria

Another factor that constrains the design is the limited space available for the fish lift structure between the dam and the powerhouse. The fish lift entrance is located so that it does not protrude into flow from the spillway to avoid being impacted by flood flows or cause potentially adverse hydraulic conditions created by high velocity spillway flow deflected by the fish lift entrance structure. Space is not available to lengthen the fish lift without protruding into the spillway flow.

3. Alden to provide nappe profiles, possibly move nappe upstream.

The following figures provide water surface profiles for the AWS intake, auxiliary spillway, fish lift flume and unit 7&8 fishway channel.

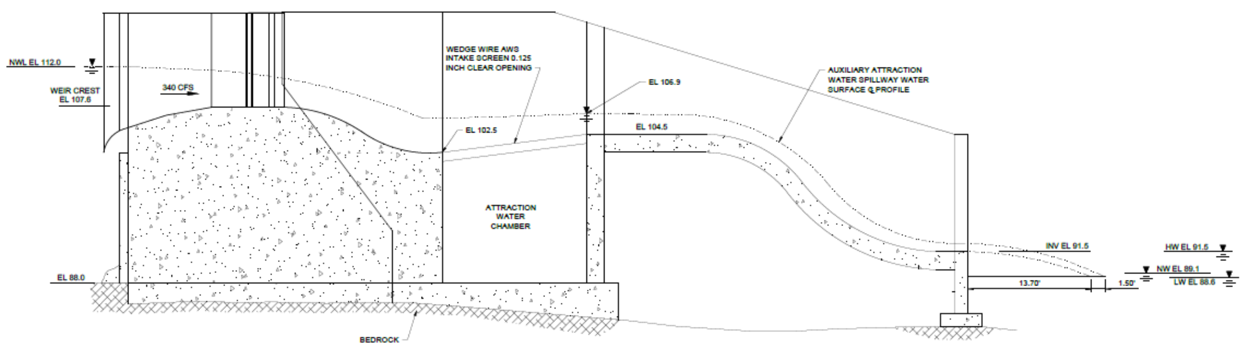


Figure 3. Attraction Water System Water Surface Profile

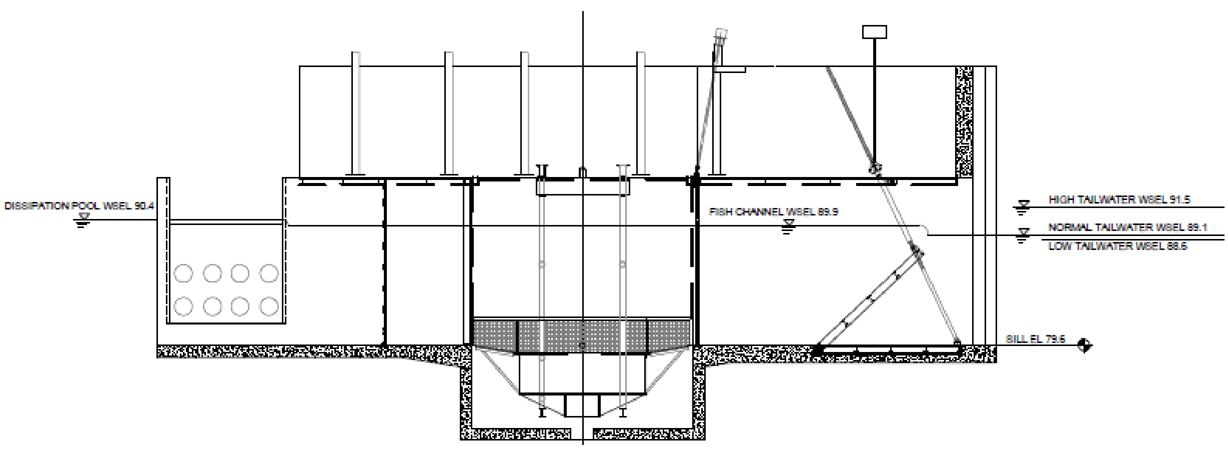


Figure 4. Fish Lift Channel Water Surface Profile

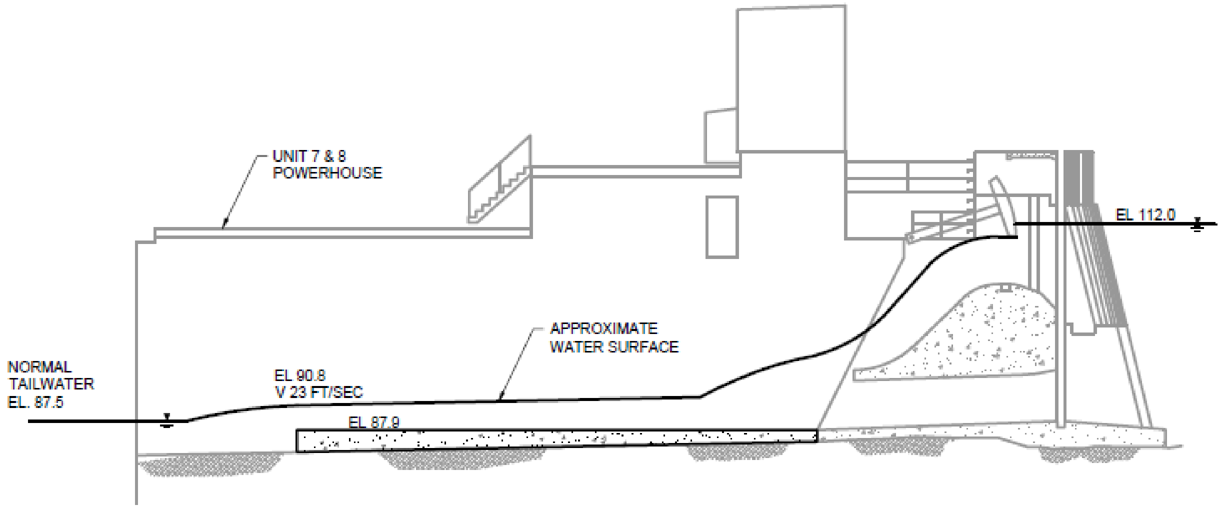


Figure 5. Tainter Gate Spillway Water Surface Profile

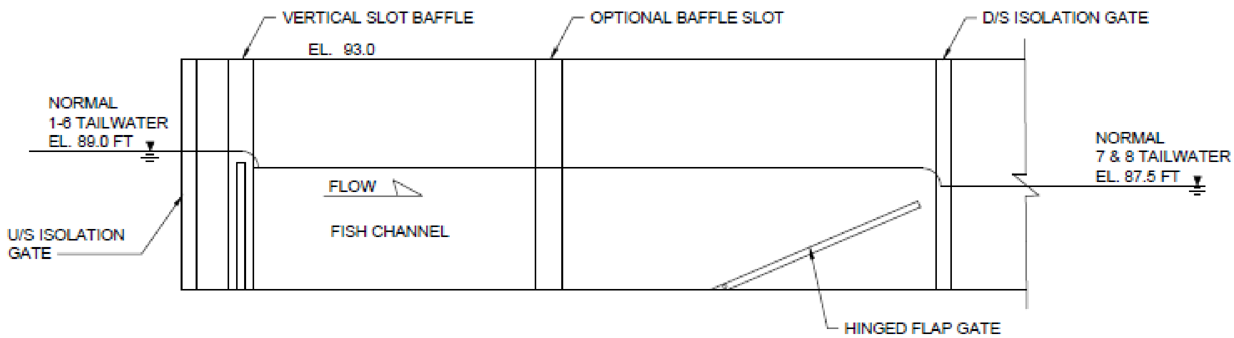


Figure 6. Crossover Fishway Water Surface Profile

4. Braille size opening should be less than 3/8 inch clear

The hopper is designed with a two sided braille system with 3/8 inch hole diameter perforations.

Drawing C-104

1. Add diffuser velocities, velocities across hopper, velocities in holding pool and velocities at entrance

The velocity through the fish lift flume at 115 cfs flow rate ranges from 1.0 ft/sec at a low water elevation of 88.6 ft to 0.8 ft/sec at a high water elevation of 91.5 ft. The velocity over the hopper will be slightly less due to the greater depth. The target head drop at the entrance hinged gate is assumed to be 9 inches which will provide an entrance velocity of about 6 ft/sec.

2. Prefer flapper gates to filler pipe.

Noted, design changed accordingly.

3. Screen on top of hopper

Noted, design changed accordingly.

4. Is the top of concrete elevation at 93.0 ft too low? Please double check

The top of concrete has been raised to elevation 94.0 ft to provide additional freeboard.

Drawing C-105

1. Please include stop log slots

We have added stop log slots to the attraction water intake to facilitate intake gate maintenance.

2. Please include depth of water along Section A.

Water profile information, including depths are provided in Figure 3.

Drawing C-110

1. The hopper gate should be at the bottom of the hopper. It may be that the drawing is just hard to read.

Yes, the hopper gate is at the bottom of the hopper

2. Entrance gate to track Tailwater

Noted, the hinged entrance gate will track tailwater to maintain a constant head drop across the entrance.

Drawing C-303

1. We need more definition on separation and flow amounts between d/s flow and upstream fish channel. Flow/elevation curves associated with HW/TW and resulting flow should be provided for the flow through the crossover fishway.

The difference in tailwater elevation between the powerhouse tailraces is about 1.5 ft as shown on Figure 7 (Kleinschmidt, 2009). Hydraulic modeling conducted by Blue Hill Hydraulics (BHH) predicts about 1 to 1.5 foot difference. The following discharge curve (Figure 8) for the crossover fishway assumes a 15 inch difference in tailwater levels and a full depth 24 inch wide slot at the upstream end to control flow. We have assumed a constant differential between the two powerhouses as indicated in Figure 7.

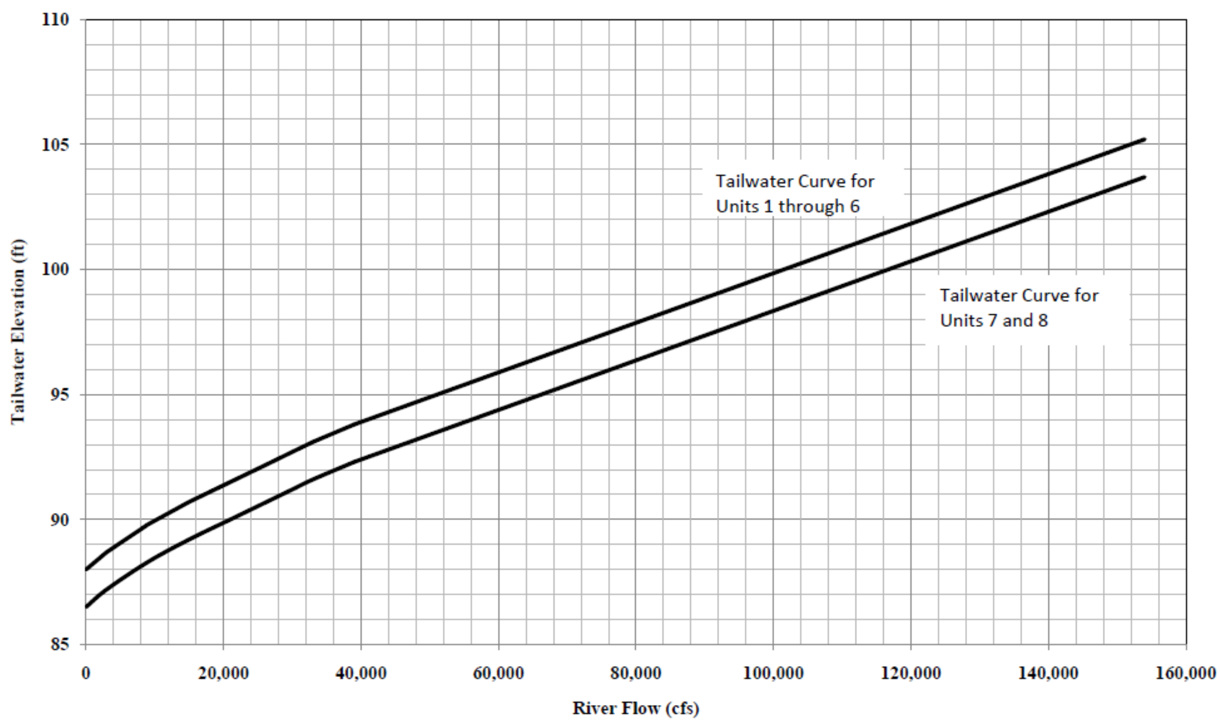


Figure 7. Tailwater Operating Curves (Kleinschmidt, 2009)

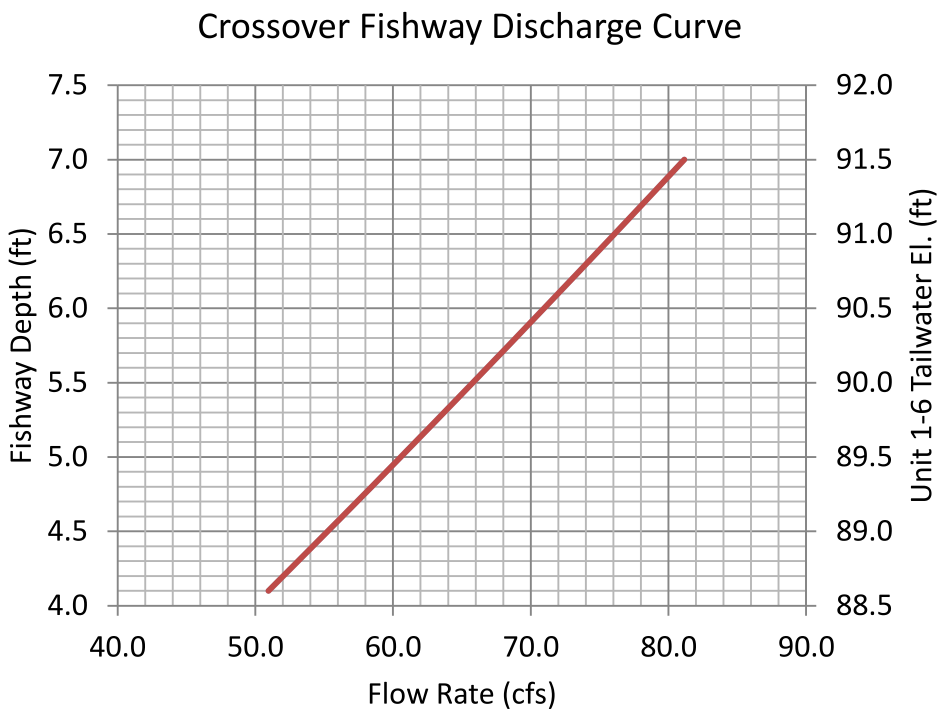


Figure 8. Cross over Fishway Discharge Curve

2. **We need more definition on the elevations of lower and upper edges of rock slope in the tailwater below channel.**

This information is provided in the 60% design submittal.

Drawing C-304

1. **Need velocity/Flow data**

Flow information for the crossover fishway is provided in Figure 8. Average velocity within the fishway channel is about 2 ft/sec.

Flow through the downstream passage channel is 600 cfs with a velocity of about 35 ft/sec.

2. **Need more definition on downstream data on Section A – WSEL through section A**

See Figure 6 for water surface profile for Section A. More detail will be provided in the 60% design submittal.

3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

The following table provides the water depth over the hinged gate as the flow/ tailwater level varies for a 6 ft wide entrance width.

Table 2. Crossover Fishway Entrance Conditions

Unit 1-6 TW El. (ft)	Unit 7&8 TW El. (ft)	Crossover fishway flow (cfs)	Target entrance vel (ft/sec)	Depth over Hinged Gate (ft)
91.5	90.0	81.2	7	1.9
91.0	89.5	76.1	7	1.8
90.5	89.0	71.0	7	1.7
90.0	88.5	65.8	7	1.6
89.5	88.0	60.6	7	1.5
89.1	87.6	56.3	7	1.4
88.6	87.1	51.0	7	1.2

Additional comments from FWS

FWS provided additional comments regarding the AWS intake geometry, wedge wire screen and holding pool volume. Each item is discussed below.

Holding pool volume

FWS requested an additional 10 ft in length be added to the fish lift flume to provide additional holding pool volume. Our response to this request is detailed earlier in this memo. The proposed fish lift design as presented in the 30% design drawings meets FWS criteria (USFWS, 2017) regarding holding pool volume. In addition, there is not available space to lengthen the fish lift flume without protruding into the spillway flow.

Attraction Water System

Spillway channel discharge elevation

FWS requested the discharge invert of the auxiliary spillway channel to be lowered from elevation 95.5 ft to elevation 91.5 ft. The auxiliary spillway design has been modified accordingly.

AWS Intake

The intake design may be used as passage for downstream migrants as well as debris. For this scenario, FWS requests an Alden style weir, wedge wire spacing less than 0.125 inches and through screen velocity of less than 0.5 ft/sec. An Alden style weir and wedge wire spacing of less than 0.125 inches has been incorporated. A discussion regarding design velocity for the wedge wire screen is provided below.

<u>Wedge wire screen design</u>

The intake for the attraction water system uses a wedge wire screen that is 16 ft long by 16 ft wide. The wedge wire configuration is similar to that of high velocity screen designs that have shown to effectively guide and transport downstream migrating fish. Examples of high velocity screen designs include Eicher screens, Modular Inclined Screens (MIS), fish samplers within downstream bypasses and for fish collection for laboratory studies. The design proposed for Shawmut most closely resembles the samplers at Hadley Falls and Cabot hydroelectric projects and many fish collection systems Alden has designed for laboratory studies. The concept is different than that of cylindrical wedge wire screens that are designed as passive intakes. Typically, submerged cylindrical wedge wire screens are often installed in situations with very low ambient velocity (lake or reservoir) and the very low intake velocity reduces debris accumulation and impingement of small fish, eggs, and larvae. These passive screen designs do not have a discernable intake influenced velocity beyond less than an inch from the screen surface. In contrast, high velocity screens designed for juvenile and adult fish have a high sweeping velocity (along the screen) to guide fish and debris away from the screen. The high ratio of sweeping velocity to through-screen velocity guides and reduces the risk of fish impingement. Laboratory and field studies have indicated that a ratio greater than 3 to 1 significantly reduces risk of impingement and injury (Alden, 2010). Alden has conducted laboratory and field evaluations of Eicher, MIS and submerged cylindrical wedge wire screens. A review of available literature for Eicher and MIS evaluations was prepared by Alden in 2010 and can be made available upon request. The review shows that Eicher and MIS screens are effective (~98% survival for most studies) at diverting fish downstream.

The wedge wire intake design proposed for Shawmut has the following features:

Wedge wire screen flow – 115 cfs
Bypass/ auxiliary spillway flow – 225 cfs
Wedge wire screen average velocity (perpendicular to screen face) – 0.4 ft/sec
Through-screen velocity – 0.9 ft/sec
Average sweeping velocity – 5 ft/sec (varies ~15 ft/sec near Alden weir)
Screen angle – 5 degrees
Sweeping to intake velocity ratio - 11

The proposed design will effectively guide fish over the screen and down the auxiliary spillway channel. In comparison to the designs reviewed for Eicher and MIS screens, the Shawmut design bypasses significantly more flow (225 cfs, 66% of total flow compared to 5% for other designs), has a larger sweeping to screen velocity ratio (11 versus 3 to 6), a shallow screen angle (5 degrees versus 16 degrees) and a lower through-screen velocity (0.9 ft/sec versus 2 to 4 ft/sec). These differences are expected to provide even better performance than the referenced studies in the Alden 2010 literature review. Given this review of existing data and the limited space available to expand the screen area, it is our opinion that reducing the through-screen velocity to less than 0.5 ft/sec is not warranted and overly conservative.

References

Alden. (2010). *Fall Creek Hydroelectric Project, FERC No. 12778-001, Eicher Screen Literature Review.* Holden, MA: Alden Research Laboratory, Inc.

Kleinschmidt. (2009). *Declaration of Incremental Hydropower, Shawmut Hydroelectric Project FERC No. 2322-ME.* Pittsfield, ME: Kleinschmidt Associates.

USFWS. (2017). *Fish Passage Engineering Design Criteria.* Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region R5.

Attachment 1

Design Review Team Comments

Received October 19, 2017

Good Afternoon Bob –

I would like to thank you for the opportunity to review the 30% Shawmut Upstream Fish Passage Design. The Design Review Team (DRT), consisting of representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries & Wildlife (IF&W), United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), met with Brookfield and their consultant Alden Labs on August 28th to collectively review the design and the DRT comments. At the end of that meeting it was agreed that the notes from the meeting were going to be based upon the collaboration and discussion and that the DRT would later send final comments reflecting those discussion and answering a few other questions. It was also agreed that Alden had enough information from that meeting to continue working on the 60% design.

This review has been done collectively with all pertinent agencies and may or may not completely reflect each agency's comments. If the agencies have additional comments or disagreements outside of the DRT comments they would file a separate comment letter to Brookfield.

This review was done considering the biological and engineering hydraulic principles to design an effective upstream fishway considering NMFS and USFWS design standards as well as engineering and biological judgments if necessary. This review was not done considering Life Safety Codes, Building Codes, Allowable Stress Design, or Load Resistance Factor Design, or any other typical engineering design codes for concrete, steel, structures, or building. We have assumed that the consulting engineer has taken those codes and practices into consideration.

Shawmut 30% Design – Agency Comments

Drawing G-001

No Comments

Drawing G-002

1. Note 5 "Design Range" not Operating Range
2. Note 6 – 6 inches may be fine, Milford Target is 8 inches, we believe HK is around a foot.
3. Note 7 - AWS flow should be changed to Total Attraction Flow
4. Note 7 – less than 3/8 opening – similar to Hydro Kennebec
5. Is 15 minutes the minimum? What is the minimum cycle time?

Drawing C-002

1. Please show how the flow is apportioned
2. Please put on TW El on the drawing for units 7 and 8 tailrace

Drawing C-103

1. Please move exit of discharge pipe away from spillway and intake to prevent fish from being washed back into the tailrace.
2. The area below the V-gate is considered the holding pool on a large braille hopper and must be sized accordingly in order for fish to "stage" while the hopper is not in a fishing position. Similar to Hydro Kennebec this distance may be around 20 ft or so below the V-Gate. Please size according to FWS criteria for a holding pool.

3. Alden to provide nappe profiles, possibly move nappe upstream.
4. Braille size opening should be less than 3/8 inch clear

Drawing C-104

1. Add diffuser velocities, velocities across hopper, velocities in holding pool and velocities at entrance
2. Prefer flapper gates to filler pipe.
3. Screen on top of hopper
4. Is the top of concrete elevation at 93.0 ft too low? Please double check

Drawing C-105

1. Please include stop log slots
2. Please include depth of water along Section A.

Drawing C-110

1. The hopper gate should be at the bottom of the hopper. It may be that the drawing is just hard to read.
2. Entrance gate to track Tailwater

Drawing C-301

Drawing C-303

1. We need more definition on separation and flow amounts between d/s flow and upstream fish channel. Flow/elevation curves associated with HW/TW and resulting flow should be provided for the flow through the crossover fishway.
2. We need more definition on the elevations of lower and upper edges of rock slope in the tailwater below channel.

Drawing C-304

1. Need velocity/Flow data
2. Need more definition on downstream data on Section A – WSEL through section A
3. Need definition on hinged gate/velocities at entrance and depth over the gate at varying tw elevations and flows.

Additional Comments from USFWS:

USFWS Engineering recommends additional space (10 ft of length) between the proposed v-trap and entrance gate to act as a holding pool. There was discussion during the August 28th meeting pertaining to utilizing the volume above the hopper and braille as the holding pool. We agree that this will be available as a holding pool space when the lift is not being operated. However, this space will not be available when the hopper is being raised and lowered (assumed time of 10 minutes). Therefore, if the hopper is to be raised every half hour, a third of the time the holding pool will not be effective. It is for this reason that an additional 10 ft of length be added in between the proposed v-trap and entrance

gate to provide a holding pool that is available at all times. Ideally a second v-trap would be added to reduce the amount of fallback as much as possible.

There is a need for more discussion related to the attraction water system (AWS) and its use as a downstream bypass. A consensus was not reached during the August 28th meeting. USFWS Engineering has the following comments/concerns:

1. For both cases below it is recommended that the slope of the AWS channel be lowered as displayed in Figure 1 in order to meet the tailwater. This will prevent the nappe of the flow from plunging into the tailwater some distance downstream of the entrance. The intent is to ensure that the AWS flow is as close as possible to the entrance of the fishway and operates within the streaming regime to avoid hydraulics that are not conducive near the entrance (e.g., turbulence, aeration, upwelling). Figure 2 displays a second alternative that could achieve the same results.

If the AWS is to be used as a downstream bypass

1. Effectiveness of the proposed geometry is unknown. As shown, the AWS flow first passes over a sharp crested weir, then a percentage of the flow falls through the floor, and the leftover amount goes down the sloped channel (which would produce another drawdown and increase in velocity which the downstream migrants may reject). A sharp crested weir does not produce hydraulics that are conducive to downstream passage, and there is risk of downstream migrants getting entrained within the AWS chamber below the floor.
2. For this case, USFWS Engineering would recommend implementing an Alden style entrance rather than the sharp crested weir. We agree that the 0.125 inch spacing will prevent entrainment of downstream migrating species. The plans should also display the calculated through velocity which should be less than 0.5 ft/s. The screen should be easily accessible during the season to ensure that the screen is clear of debris and not damaged.

If the AWS is not used as a downstream bypass

1. In this case the intake would need to be screened to prevent downstream migrating species from entering the AWS. If an upstream migrating Atlantic salmon were to traverse the AWS system to the top, the screen would prevent it from entering the headpond. In this case an alternative method to passing the AWS flow, as shown in Figure 2, could be considered. This would assist in preventing Atlantic salmon from entering the system by screening off the AWS flow. The AWS flow would be submerged which would provide the attraction flow and ensure that it did not plunge near the fishway entrance. This would necessitate a larger intake screen so that all the AWS flow is passed through the floor.

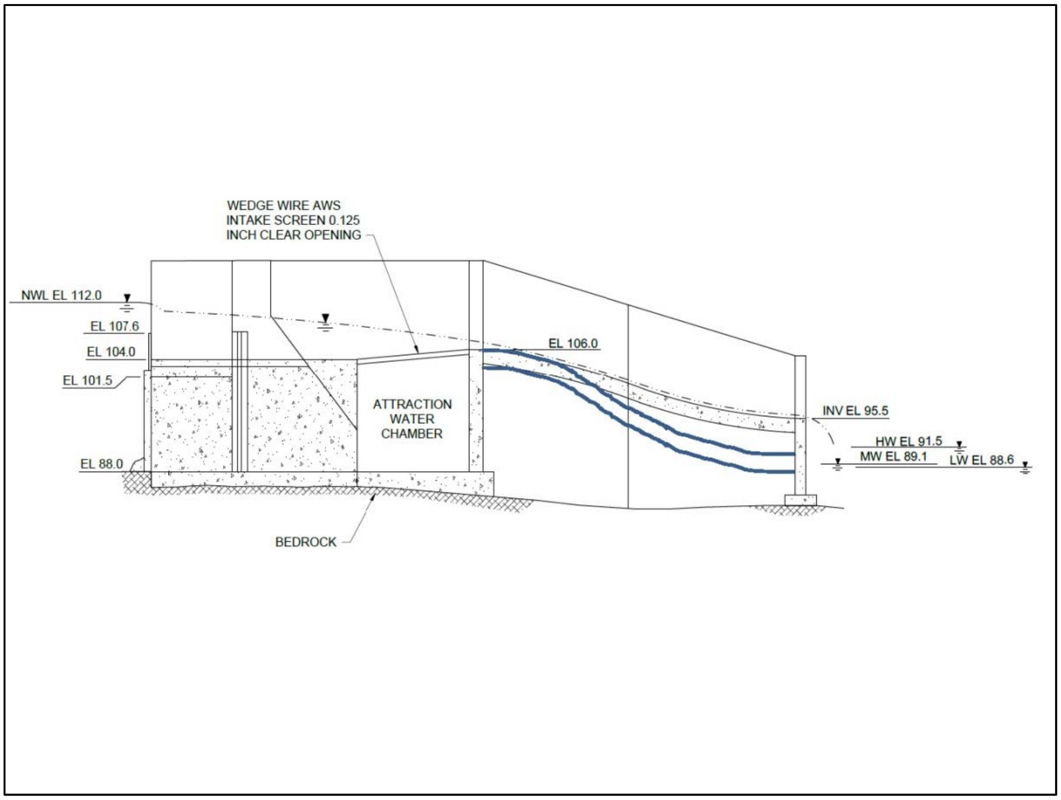


Figure 1 – Lowered AWS channel floor to meet tailwater

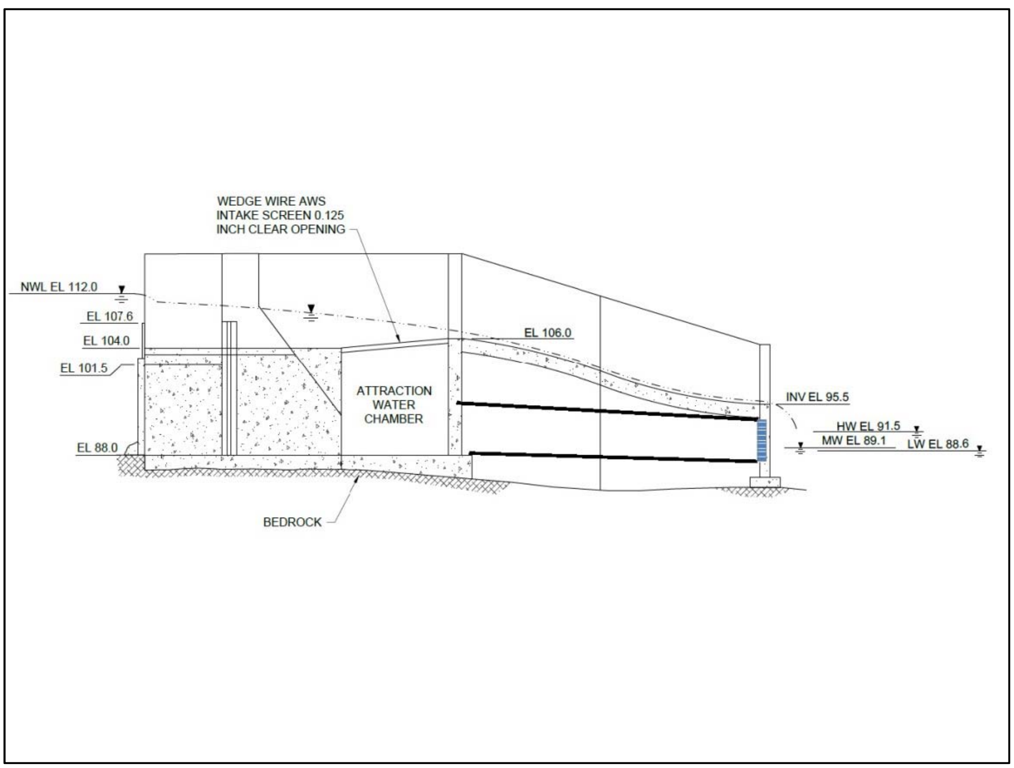


Figure 2 – AWS Alternative

SHAWMUT 60% DESIGN CONSULTATION

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Wednesday, November 29, 2017 3:39 PM
To: Richter, Robert; Mitchell, Gerry; Matt Buhyoff - NOAA Federal; Bryan Sojkowski; Seiders, Dwayne J; Wippelhauser, Gail; Christman, Paul; Bentivoglio, Antonio; Maloney, Kelly; Greg Allen
Subject: Shawmut 60% Design Draft Comments - Discussion Points
Attachments: Shawmut 60% Design Review Team Draft Comments-Discussion points.docx

Good Afternoon Bob -

Thank you for the opportunity to review and comment on the Shawmut 60% Design. I met with the Design Review Team on 11/22 and prepared the following draft comments and discussion points for our next meeting. Please do not misconstrue these comments, we are looking for discussion on the points and then we will finalize the comments after we meet. I have not sent this to the other agencies for review, however, they took part in constructing the comments with exception to IF&W as Jason was on leave. In the interest of time, I'm sending them to you now before getting fully reviewed.

Regards,
Don

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

Shawmut Design Review Team **Draft** Comments/Discussion Points for next Agency, Consultant, Owner Design Review Meeting on 60% Design

Drawing G-002

1. Note 6 Entrance Velocity 4 to 6 fps, 6 to 8 fps capable
2. Note 6 Entrance Depth 3ft Minimum under all circumstances
3. Note 7 Need to Discuss flow apportionment with Alden and Brookfield
4. Note 10 Please include Grade of Exit Flume

Drawing C-002

1. There are no drawings of the control gates that we could find
2. Can you throttle the 115 cfs?
3. Is attraction water gate downward opening? - Does it need to be?
4. Need to discuss the 600 cfs vs 50 to 80 cfs in Fish Bypass Channel
   a. Could we discharge 600 cfs to old powerhouse tailrace
   b. or use wedged wire screen and some of the 600 cfs to fishway bypass and make it wider?

Drawing C-103

1. Should there be a downward opening gate at the attraction water entrance?
2. We need more manholes or transparency on the top of the 20 inch pipe
3. We are still very worried about false attraction and need to discuss
4. could we have 1 stop log panel from the guide wall to the building perpendicular
5. can we move everything except the entrance closer to the dam
6. What happened to the gate drawings for the AWS system?

Drawing C-105

1. Should the isolation gate be downward opening
2. We need to discuss the AWS to Tailrace Transition

Drawing C-110

1. Minimize the Gaps between stems & wall on entrance gate so Atlantic salmon and other species do not get caught
2. Greased Stems should not be in water
3. Can we increase height of punch plate walls on hopper?
4. The entrance gate does not meet the following:
   a. 3ft of depth minimum over the weir
   b. Only meets the 4 to 6 fps because it does not meet the 3ft of depth
   c. doubtful to achieve 1/2 ft of HL at high tailwater
   d. can't meet higher HL at normal tailwater

Drawing C-111

1. Why is 2fps there inside gate on the elevation view?
2. No sharp edges
3. What happens if pin on gate breaks?

Drawing C-112

1. What is a Gate Disc?

Drawing C-113 - No Comments

Drawing C-114 - No Comments

Drawing C-115

1. Where are the filler flap valves?
2. should have more details on this by now.
3. 3ft high walls should be higher....likely out of water column and high enough so salmon can't jump out.
4. Use punch plate not mesh for walls on top of hopper
5. Need to show position of lifting cables

Drawing C-118 - No Comments

Drawing C-119

1. Need to Provide ManDoor

Drawing C-120 - No Comments

Drawing C-301

1. Please show elevation of upper edge of existing 3V:1H Rock Slope

Drawing C-303 - See comments in regards to 600 cfs

Drawing C-304

1. Need more depth over hinged gate
2. How are gates operated?
3. Shouldn't baffle slots be above isolation?
4. What about eels?

Drawing C-305 - See comments in regards to 600 cfs

Drawing S-001 - No Comments

Drawing S-201 - No Comments

Drawing S-202 - No Comments

Drawing S-203 - No Comments

Drawing S-204 - No Comments

Drawing S-205 - No Comments

Drawing S-206 - No Comments

Drawing S-207 - No Comments

Tech Memo:

1. Page 1 - Can we adjust Headloss looking to go as high as 1.5 ft over 20 to 40 ft
2. Fig 3 - Shouldn't this be of lower velocity than the entrance?
3. Fig 5 - 23 fps - need to have discussion on 23 fps vs velocity at entrance
4. DWG C-104 Note 1 - did not show depth
5. DWG C-104 Note 3 - Need more than 3 ft of screen
6. Page 8 - Has this tailwater curve been confirmed?
7. Upper gate on AWS should not be used to control flow
8. Page 10 - need 3 ft of depth on Table 2

DRAFT
Meeting Notes
Shawmut Design Review Team Meeting
Wednesday, December 13, 2017
9:00 AM – 1:00 PM

Attendees:

Bryan Sojkowski (USFWS)
Antonio Bentivoglio (USFWS)
Donald Dow (NOAA)
Matt Buhyoff, via phone (NOAA)
Gail Wippelhauser, via phone (MEDMR)
Jason Seiders (IF&W)
Kelly Maloney (Brookfield)
Bob Richter (Brookfield)
Gerry Mitchell (Brookfield)
Jason Seyfried (Brookfield)
Dave Robinson (Alden)
Greg Allen (Alden)

A 60% design review meeting was held at Brookfield's Hydro Kennebec Project in Winslow, ME for the Shawmut Fish Passage Project. The resource agencies' design review team (DTR) consisting of NMFS, FWS, IF&W and MDMR provided comments on November 29, 2017.

Notes:

Don Dow mentioned that this project will be required to meet a performance standard for upstream passage of Atlantic salmon, likely higher than 95%. He noted that the Milford project on the Penobscot is approximately 99% effective.

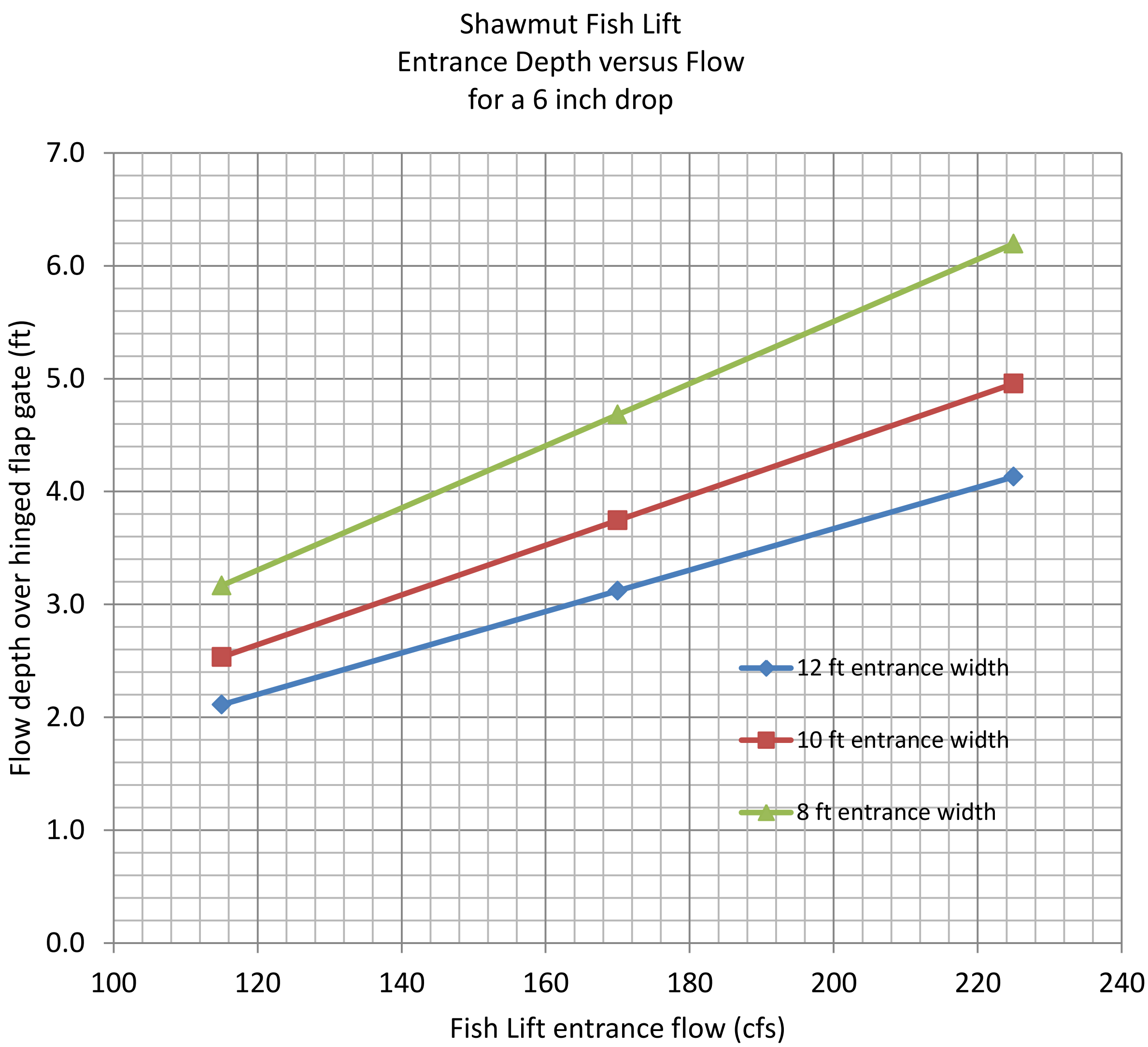
The DRT written comments are provided in bold below and notes of the meeting discussion follow.

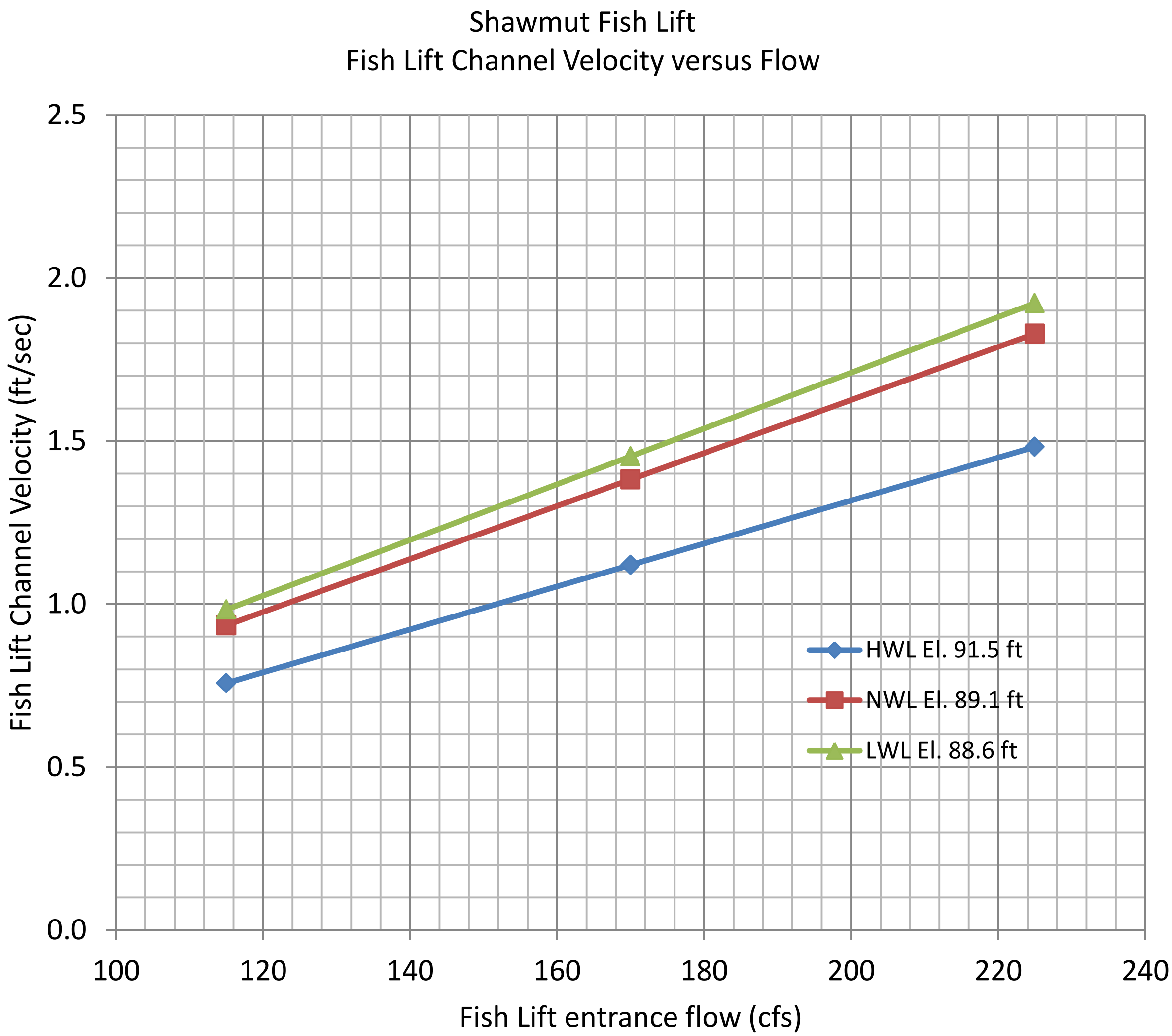
Drawing G-002

1. **Note 6 Entrance Velocity 4 to 6 fps, 6 to 8 fps capable**
2. **Note 6 Entrance Depth 3ft Minimum under all circumstances**
3. **Note 7 Need to Discuss flow apportionment with Alden and Brookfield**
4. **Note 10 Please include Grade of Exit Flume**

Comments 1 through 3 are related to the fish lift entrance configuration and hinged flap gate. Bryan mentioned that the desired depth over the hinged flap gate is 3 ft based on studies that were conducted with American shad at the Conte Lab by Kevin Mulligan.

Greg discussed the entrance hydraulic conditions and circulated two graphs to the group that show how fish lift entrance flow, flap gate width, fish lift channel velocity and tail water levels are related. These graphs are provided below. In order to increase depth over the hinged flap gate, flow would need to be increased and/ or the entrance width would need to be decreased.





Bryan also circulated information for a 10 ft wide entrance. After reviewing the graphs above the group concluded that changing the width to 10 ft wide (versus 12 ft) would provide greater water depth over the flap gate while also providing acceptable flow velocity within the fish lift channel. It was noted that the fish lift channel flow would need to be increased to about 135 cfs to attain 3 ft water depth over the hinged flap gate. It was also noted that flow would need to be increase to about 165 cfs to attain a 6 inch drop at the entrance during high water. The group agreed to:

- Reduce the fish lift entrance to 10 ft and that
- a velocity within the fish lift channel of 1.5 ft/sec is acceptable.

Don Dow mentioned that the entrance should be capable of providing a 1.5 ft drop for salmon. The water depth over the hinged gate and the fish lift channel velocities are not a concern for this scenario for Atlantic salmon. The flow through the fish lift channel can be increased to attain the 1.5 ft drop.

Flow distribution between the fish lift channel and the auxiliary spillway was discussed. It was agreed that the fish lift channel would have the capacity to operate between 115 cfs and 225 cfs to provide operational flexibility. The remainder of the total 340 cfs attraction water flow would be discharged down the auxiliary spillway.

The grade of the exit flume (20 inch diameter fiberglass pipe) is 5% and will be noted on the design drawings.

Drawing C-002

1. **There are no drawings of the control gates that we could find**

A drawing was circulated during the meeting which provided details of the control gate for the fish lift channel attraction flow.

2. **Can you throttle the 115 cfs?**

The control gate is adjustable from 0 cfs to 225 cfs.

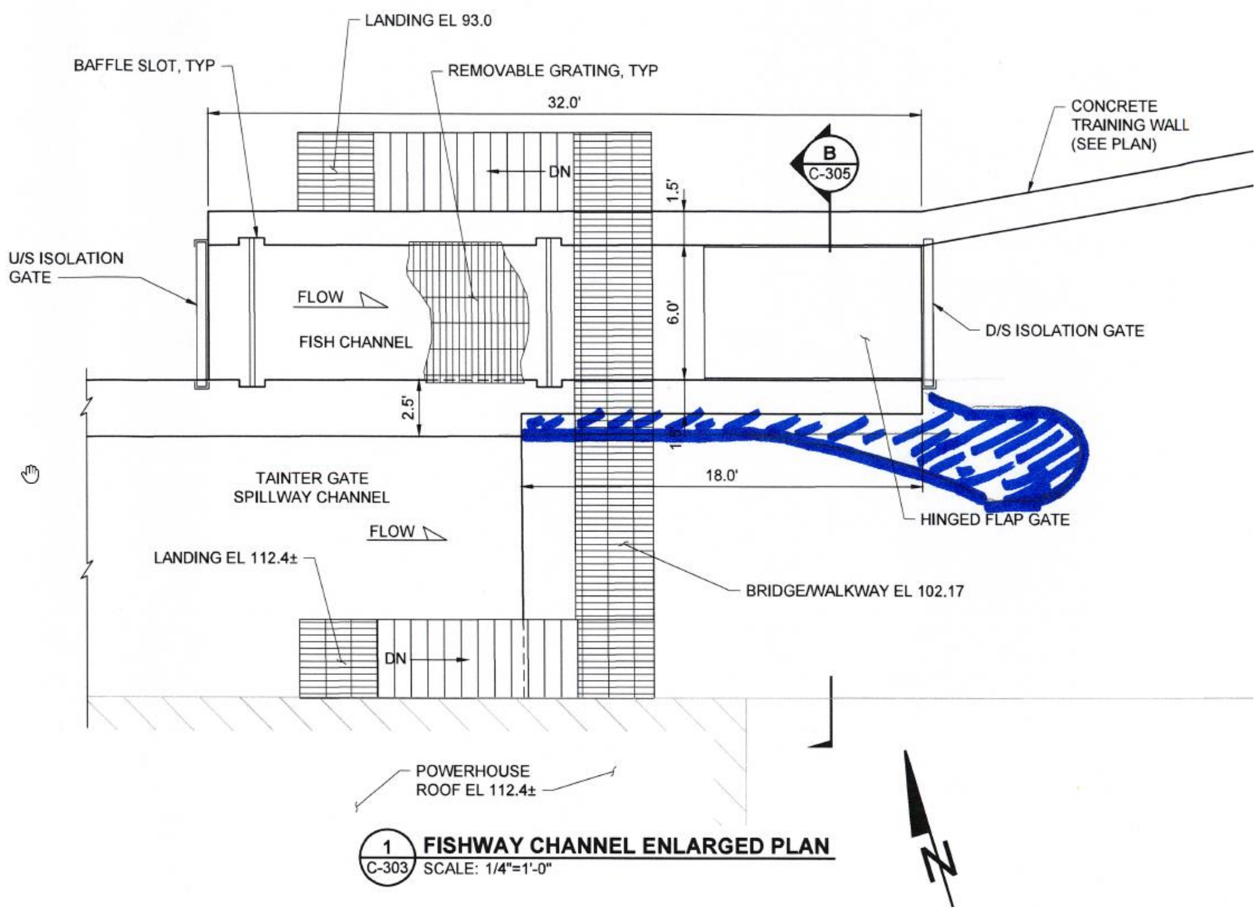
3. **Is attraction water gate downward opening? - Does it need to be?**

Greg explained the attraction water gate from the impoundment is an upward opening gate. We discussed that the gate would be either open or closed. The intake from the impoundment includes a geometry of a NU/ Alden weir and for ideal operation it is important that there are no obstructions in the flow path. If desired the gate could be throttled, but under normal operation the gate would be either fully open or fully closed.

4. **Need to discuss the 600 cfs vs 50 to 80 cfs in Fish Bypass Channel**
    a. **Could we discharge 600 cfs to old powerhouse tailrace**
    b. **or use wedged wire screen and some of the 600 cfs to fishway bypass and make it wider?**

The configuration of the fish bypass channel (fishway) and 600 cfs taintor gate flow was discussed. The taintor gate flow would be discharged into the Unit 7&8 tailrace to avoid false attraction of fish to the old powerhouse tailrace.

The discharge of the 600 cfs and the configuration near the proposed bypass channel was discussed at length. To limit the potential of the high velocity (23 ft/sec) taintor gate discharge from washing out and masking the entrance to the fishway, the group agreed to change the geometry to deflect the flow towards the middle of the tailrace (toward the right looking downstream) as shown in the following sketch (deflector shown in blue).



Drawing C-103

1. **Should there be a downward opening gate at the attraction water entrance?**

This comment was discussed previously.

2. **We need more manholes or transparency on the top of the 20 inch pipe**

Don Dow asked if a fish were to get stuck in the pipe how would the operator know and how would the fish be removed.

Greg explained more flushing flow could be added and that additional ports could be added so that the entire length of pipe could be inspected.

The group agreed that an additional access port is needed in the last straight section of pipe.

3. **We are still very worried about false attraction and need to discuss**

There was much discussion regarding the auxiliary spillway configuration adjacent to the fish lift entrance. Bryan questioned whether the bottom elevation of the aux spillway should be raised to limit false attraction in particular for salmon with strong swimming abilities. After lengthy discussion the group agreed that the current configuration would be best for far field attraction of fish to the fish lift entrance.

4. **could we have 1 stop log panel from the guide wall to the building perpendicular**

Bryan discussed a concern of the existing weir/ orifice panels upstream of the hopper and potential interference with the powerhouse. Greg and Dave explained there was not interference and the lines on the drawing outline a powerhouse buttress which slopes towards the powerhouse. This buttress does not interfere with the weir panel. Bryan discussed moving the weir further upstream extending from the guidewall to the powerhouse and eliminating the baffle. The group decided the current configuration is acceptable.

5. **can we move everything except the entrance closer to the dam**

Bryan requested more length be added to the fish lift channel to provide greater length for the holding pool. Greg discussed concerns of moving the hopper pit, which requires deep excavation, closer to the powerhouse and dam to avoid impacting the integrity of existing structures. Dave and Greg discussed keeping the same channel foot print upstream of the hopper but, moving the tower and hopper further upstream, by about 2 to 4 ft. In addition the entrance could be moved further downstream (~4 ft), but not into the flow path from the spillway. Bryan and the group agreed with these suggested changes to the fish lift channel.

6. **What happened to the gate drawings for the AWS system?**

A drawing was circulated during the meeting.

Drawing C-105

1. **Should the isolation gate be downward opening**
2. **We need to discuss the AWS to Tailrace Transition**

These items were discussed previously.

Drawing C-110

1. **Minimize the Gaps between stems & wall on entrance gate so Atlantic salmon and other species do not get caught**

Don discussed concerns with fish getting caught between the gate stems and channel wall. Dave mentioned that these gaps would be minimized to the extent possible.

2. **Greased Stems should not be in water**

Dave explained that the stems would not be greased (only the housing).

3. **Can we increase height of punch plate walls on hopper?**

The group agreed that the current height of 3 ft is acceptable and similar to Hydro Kennebec.

4. **The entrance gate does not meet the following:**
   a. **3ft of depth minimum over the weir**
   b. **Only meets the 4 to 6 fps because it does not meet the 3ft of depth**
   c. **doubtful to achieve 1/2 ft of HL at high tailwater**
   d. **can't meet higher HL at normal tailwater**

These items were discussed at length earlier in the meeting.

Drawing C-111

1. **Why is 2fps there inside gate on the elevation view?**

Greg explained that this note was a carryover from a previous design iteration and will be removed.

2. **No sharp edges**

Explained by Don Dow and noted by Greg and Dave. The brail was discussed and it was ultimately decided that grating would be acceptable as long as there were no sharp edges.

3. **What happens if pin on gate breaks?**

Drawing C-112

1. **What is a Gate Disc?**

A gate disc is terminology for the bulkhead portion of a gate (skin plate and associated framing).

Drawing C-115

1. **Where are the filler flap valves?**

Dave explained they would be located in the floor of the hopper.

2. **should have more details on this by now.**

3. **3ft high walls should be higher....likely out of water column and high enough so salmon can't jump out.**

The height of the walls were discussed previously

4. **Use punch plate not mesh for walls on top of hopper**

Dave agreed to change the design to use punch plate

5. **Need to show position of lifting cables**

Dave explained how the hopper would be supported. No lifting cables would extend below the water surface to the hopper. The hopper would be supported by a cradle with a single cable lifting the entire hopper structure well above the water surface.

Dave asked if there was a preference for the hopper to be painted, galvanized or made of stainless steel. The hopper at HK is painted, and Brookfield expects it will need to be repainted frequently. The hopper is likely too big for it to be galvanized. Gerry and Bob recommended going with a stainless hopper. Dave agreed to go with stainless.

Drawing C-119

1. **Need to Provide ManDoor**

Dave explained a man door would be included within the baffle in the fish lift channel.

Drawing C-301

1. **Please show elevation of upper edge of existing 3V:1H Rock Slope**

Greg explained that this can be added to the drawings by labeling the existing contours.

Drawing C-303 - See comments in regards to 600 cfs

Previously discussed

Drawing C-304

1. **Need more depth over hinged gate**

Bryan discussed the need for greater depth over the hinged flap gate (3 ft min for shad). Both Bryan and Don agreed that a 6 ft fishway entrance width should be the minimum width. Greg agreed to review the ability to increase flow through the fishway by increasing the slot width (currently 24 inches) at the upstream end of the channel. The goal is to provide at least 3 ft of depth over the flap gate for the range of operating conditions. The width of the fishway channel would be increased to at least 8 ft.

2. How are gates operated?

The hinged flap gate would be automated

3. Shouldn't baffle slots be above isolation?

Don agreed that the baffle slot should be as shown on the drawings, downstream of the isolation gate.

Greg also explained that there would be one baffle installed at the upstream end of the channel with a full depth 24 inch wide slot. The other baffle slot is included at the midpoint of the channel to provide flexibility

4. What about eels?

Bob Richter explained that an area adjacent the auxiliary spillway near the dam spillway may be a good location to collect eels. This location is similar to the current location, but would need to be confirmed in the field.

Drawing C-305 - See comments in regards to 600 cfs

Discussed previously

Tech Memo:

1. Page 1 - Can we adjust Headloss looking to go as high as 1.5 ft over 20 to 40 ft

Discussed previously

2. Fig 3 - Shouldn't this be of lower velocity than the entrance?

The group agreed that the current arrangement of the auxiliary spillway is acceptable.

3. Fig 5 - 23 fps - need to have discussion on 23 fps vs velocity at entrance

This was discussed previously

4. DWG C-104 Note 1 - did not show depth

Noted by Greg, and drawings will be updated.

5. DWG C-104 Note 3 - Need more than 3 ft of screen

This was discussed previously

6. **Page 8 - Has this tailwater curve been confirmed?**

Don asked if the tailwater curve has been confirmed. Greg mentioned that it was compared to CFD modeling done by John Richardson and appears to be close. A field comparison has not been done.

7. **Upper gate on AWS should not be used to control flow**
8. **Page 10 - need 3 ft of depth on Table 2**

These two items were discussed previously.

General discussion

Greg explained that Alden would update the footprint of the fish lift channel, by making it longer, as discussed. A new configuration of the Unit 7&8 fishway would also be developed based on discussions and these two plans would be submitted to the DRT for comment within the next few weeks. A quick response with comments was requested to limit impact to the schedule. Greg mentioned that Alden would move forward with all aspects of the design unless there were any other issues that need to be addressed. The group agreed that all issues were discussed and Alden can continue with all aspects of the design.

Kelly discussed the status of the Interim Species Protection Plan (ISSP) for Lockwood, Shawmut and Weston and explained an update would be submitted to FERC by March 30.

Greg mentioned the 90% drawings are scheduled to be submitted in February.

Action Items:

Alden to submit revised footprints of the fish lift channel and the unit 7&8 fishway.

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Greg Allen, Alden

Date: January 22, 2018

Re: **Follow up on action items from the 60% design review meeting Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities**

Alden Research Laboratory, Inc. (Alden) met with Brookfield and the Design Review Team[1] (DRT) to discuss Alden's 60% design submittal for fish passage facilities at the Shawmut Hydroelectric project (Shawmut) on December 12, 2017. This memorandum provides additional information that was requested during the meeting and presents revised designs of the fish lift entrance flume and the unit 7 and 8 fishway channel. The following attached sheets have been updated for DRT review:

C-002, Overall Site Plan

C-103, Fish Lift General Arrangement Plan

C-110, Fish Lift Entrance Flume General Plan and Sections

C-303, Unit 7&8 Fish Passage General Plan

C-304, Unit 7&8 Fish Passage Plan and Sections

C-305, Unit 7&8 Fish Passage Sections

Alden requests confirmation from the DRT that the presented design is acceptable to advance to the 90% design review stage.

A summary of significant design changes and hydraulic design information is provided below.

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

Fish Lift

As discussed during the 60% design review meeting the entrance channel was lengthened to the extent practical to increase the holding pool area. The fish lift entrance was moved further into the river, but not so far as to protrude into the spillway flow. The fish lift hopper, hoist and tower were moved upstream by 4 ft. These changes added 8 ft to the holding pool which is now 19 ft in length. The entrance width was reduced to 10 ft as discussed during the meeting to provide 3 ft of water over the hinged entrance gate. A plan is shown in Figure 1 and hydraulic characteristics of the modified design are shown in Figure 2 and Figure 3.

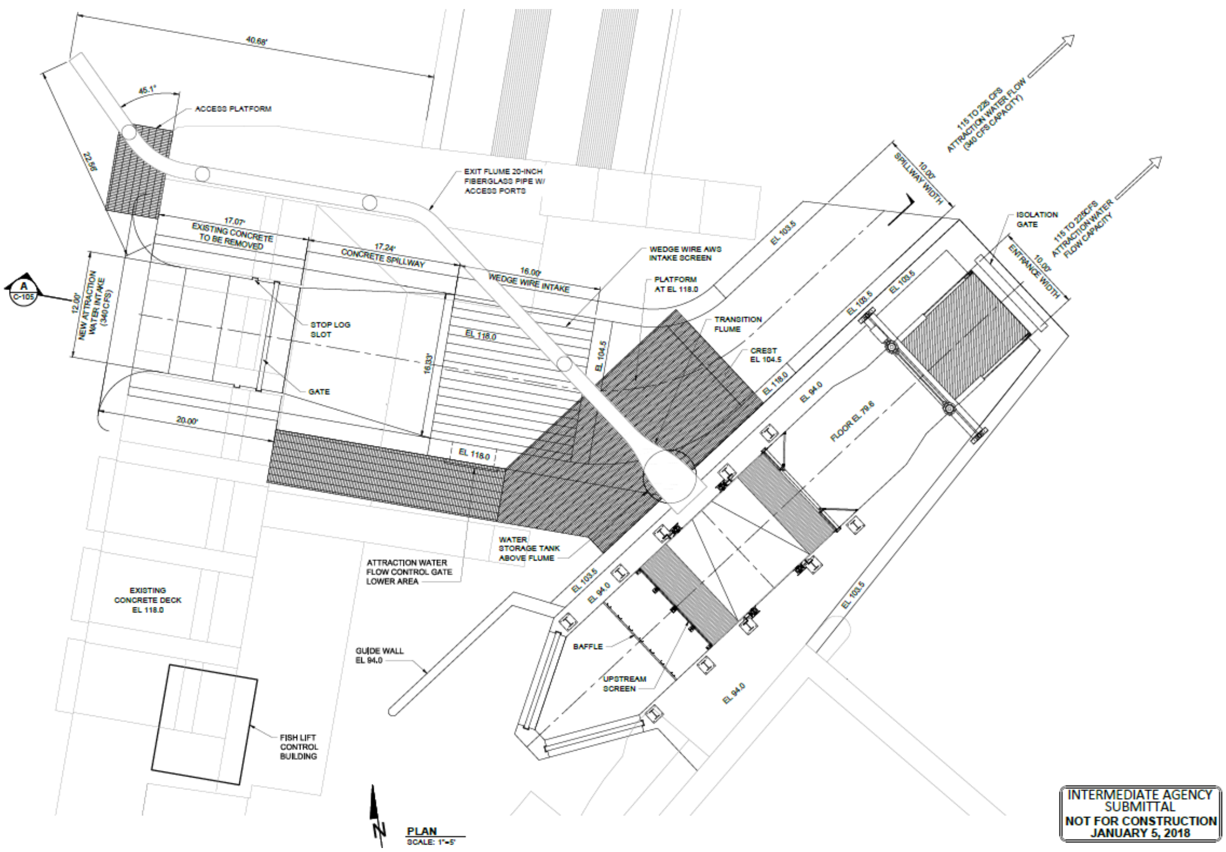


Figure 1. Fish Lift Entrance Channel Plan

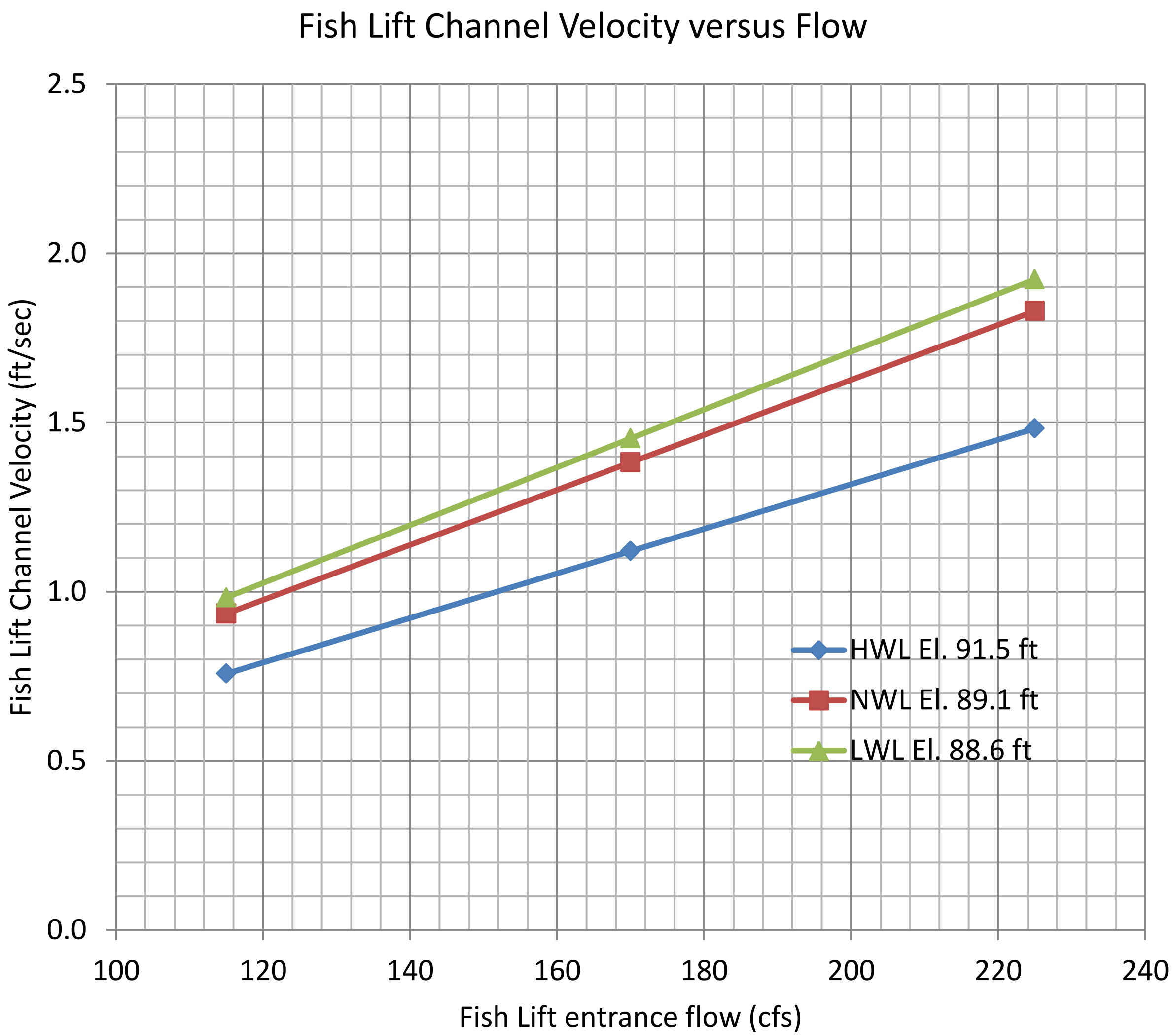


Figure 2. Fish lift entrance channel velocity versus flow rate for high, normal and low tailwater conditions.

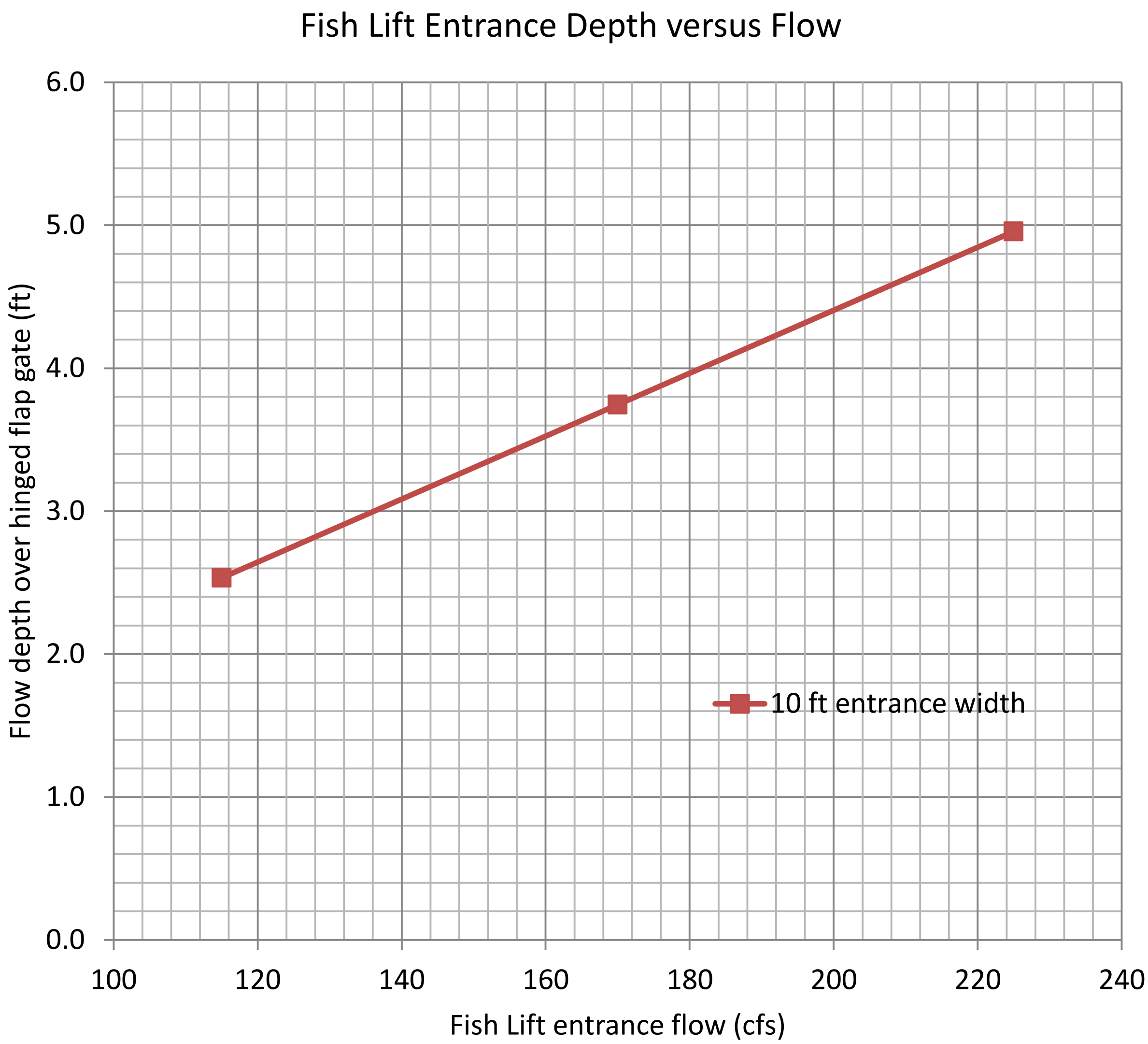


Figure 3. Fish lift entrance flow depth over the hinged flap gate versus flow for a 6 ft/sec entrance velocity condition.

Wedge Wire Screen Clear Spacing

FWS requested a 0.125 inch clear opening screen for the attraction water intake for Shawmut. After review of available wedge wire bar profile options, we recommend a screen clear opening of 0.25 inches, based on selection of a Hendrick T16 bar profile (see Figure 4) while maintaining a 50% screen open area. The T16 bar is a heavy duty bar profile which is recommended to withstand expected debris loading. Maintaining the 0.125 inch clear space with the T16 bar profile would reduce the screen open area, increase through screen velocity and increase

maintenance to remove debris. Therefore, we recommend a 0.25 inch clear spaced screen, which is less than FWS criteria of 0.375 inches for attraction water intakes (USFWS, 2017).

Profile Bar
Images not to scale

	B69	B6S	B6	B9S	B9	B12	T9M	T9	F12	T12	T16	T24
Bar Width	.069	.093	.093	.140	.140	.187	.140	.140	.187	.187	.250	.500
Bar Height	.290	.290	.375	.320	.375	.500	.453	.453	.500	.500	.750	.750
Cap Height	.080	.080	.093	.110	.125	.156	.125	.203	.185	.188	.250	.250

- *304L, 316L, Various Grades of Stainless & Exotic Alloys, Carbon Aluminum (6061) in B9, B12 & T16*
- *Non-welded Interlocked Construction*

Figure 4. Hendrick Screen Wedge Wire Profile Bar Options

Unit 7&8 Fish Passage Channel

The Unit 7 and 8 fish passage channel has been modified based on discussions during the meeting. The flow through the channel has been increased to provide greater flow depth over the entrance hinged flap gate. The channel width has been increased to 10.5 ft and a full depth vertical slot at the upstream end of the channel will have a 42 inch opening width. The channel now has an operating range of 90 cfs to 140 cfs for the range of tailwater conditions. A plan of the modified design is shown in Figure 5 and hydraulic characteristics are provided in Figure 6 and Figure 7.

The 60% DRT meeting included a discussion of the taintor gate spillway discharge adjacent to the fish passage channel and a concern that this flow may interfere with the fishway flow. The DRT recommended that the taintor gate spillway channel deflect the flow to the right (looking downstream) away from the fish passage channel entrance. We have consider and reviewed potential deflectors to steer the flow away from the fishway entrance since the meeting and we are concerned that deflecting the high velocity taintor gate flow could have the unintended consequence of creating an eddy near the fishway entrance. Therefore, we do not recommend deflecting the taintor gate flow as discussed during the 60% DRT meeting. If the DRT would like to pursue this option further, we would recommend the use of CFD modeling to aid and optimize the design to avoid unintended adverse conditions for fish passage.

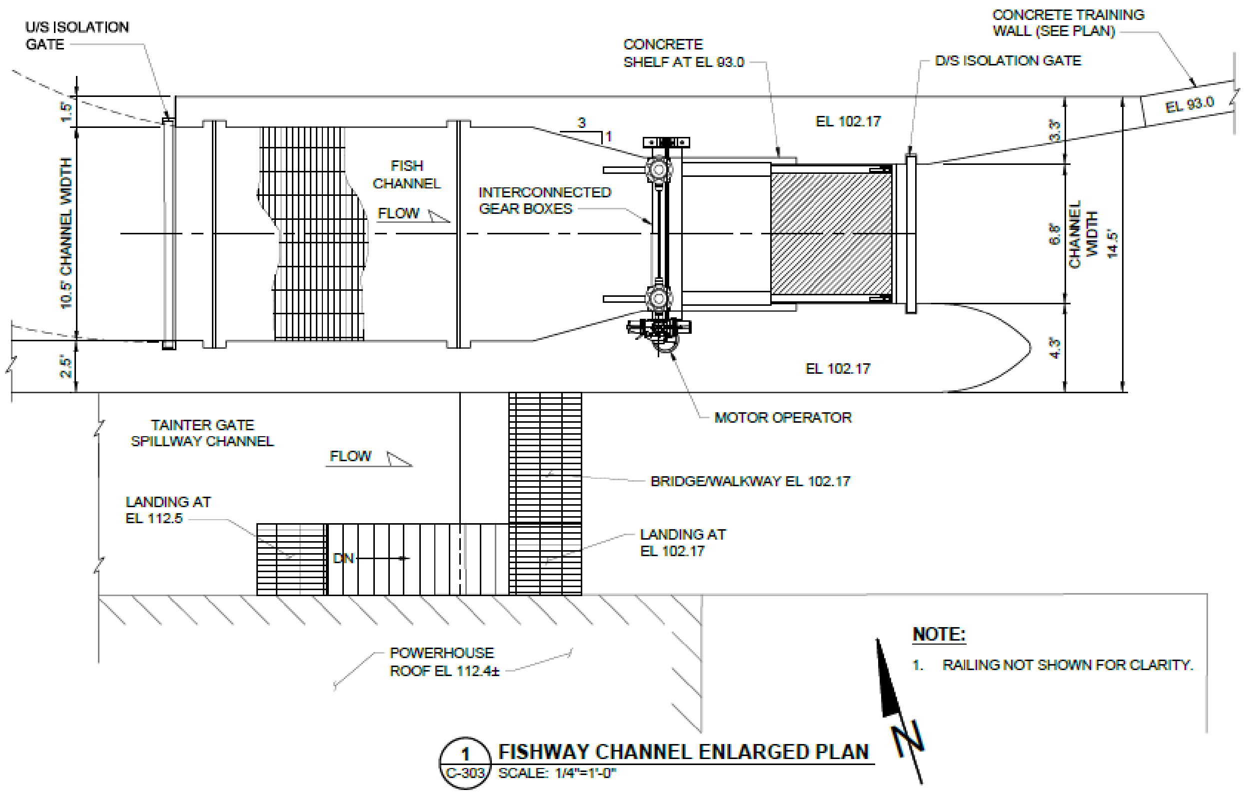


Figure 5. Unit 7&8 fish passage channel plan

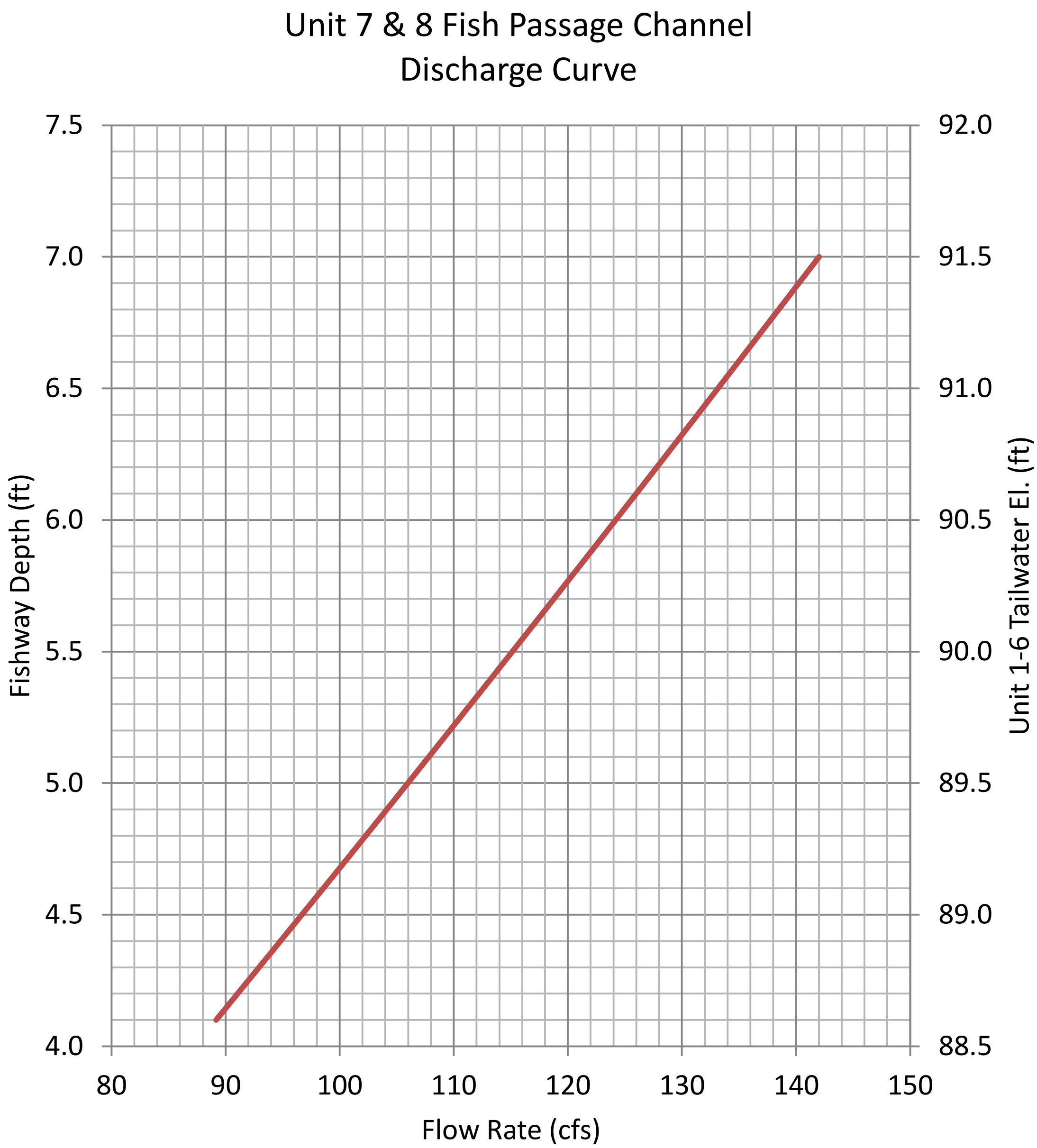


Figure 6. Unit 7&8 fish passage channel discharge curve for a full depth 42 inch wide baffle slot.

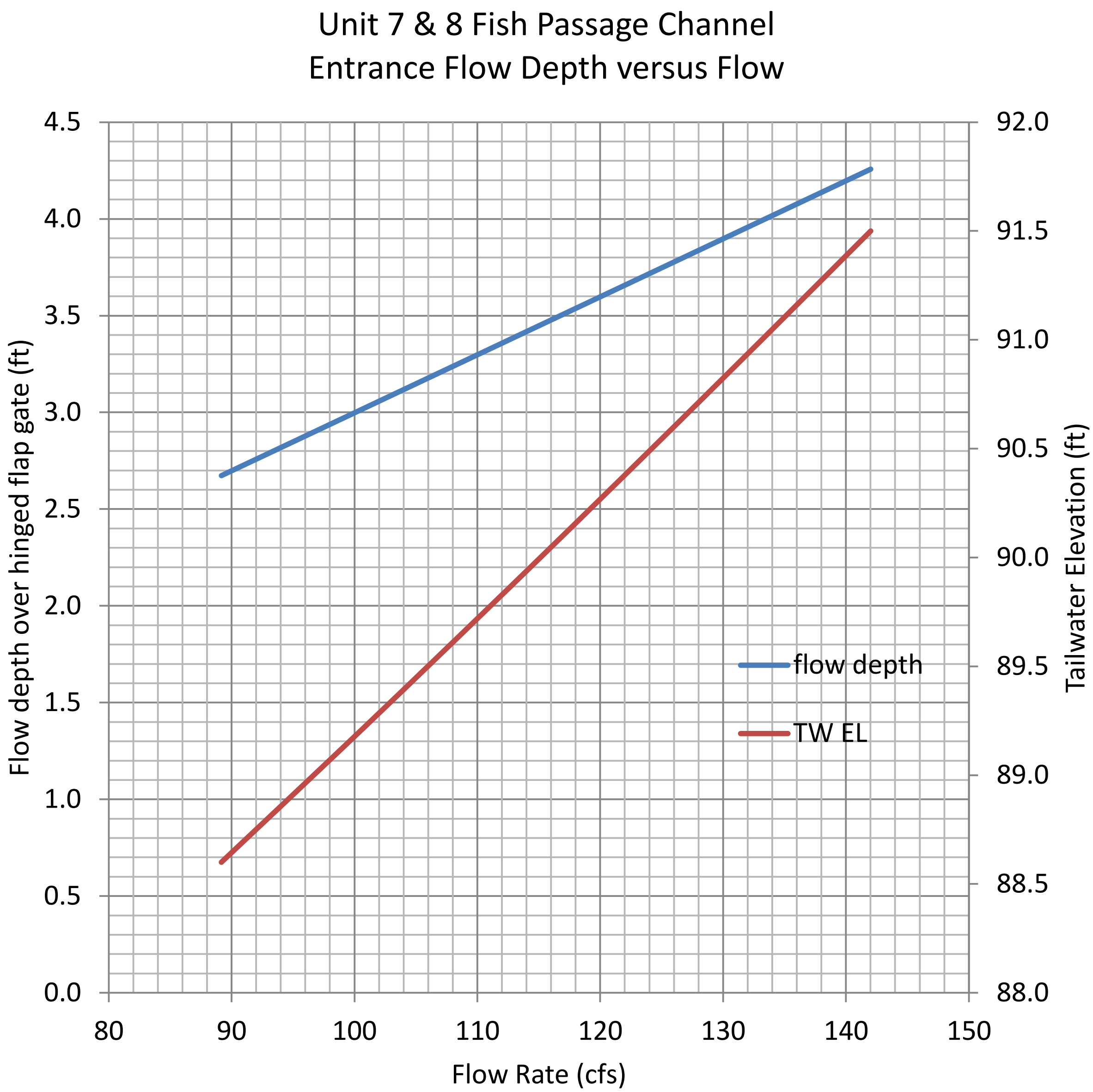


Figure 7. Unit 7&8 fish passage channel entrance flow depth over the hinged flap gate versus flow.

References

USFWS. (2017). *Fish Passage Engineering Design Criteria.* Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region R5.

Gregory Allen

From:	Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent:	Wednesday, November 20, 2019 11:11 AM
To:	Greg Allen
Subject:	Fwd: Shawmut 60% Design Supplemental Drawings DRT Comments
Attachments:	Shawmut 60% Design Review Team Draft Comments-Discussion points.docx

---------- Forwarded message ---------
From: **Donald Dow - NOAA Federal** <donald.dow@noaa.gov>
Date: Fri, Feb 2, 2018 at 3:27 PM
Subject: Shawmut 60% Design Supplemental Drawings DRT Comments
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Cc: Greg Allen <gallen@aldenlab.com>, Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>, Wippelhauser, Gail <gail.wippelhauser@maine.gov>, Christman, Paul <Paul.Christman@maine.gov>, Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>

Good Afternoon Richard –

I would like to thank you for the opportunity to review the 60% Shawmut Upstream Fish Passage Design - Supplemental Submittal. The Design Review Team (DRT), consisting of representatives of the Maine Department of Marine Resources (MDMR), Maine Department of Inland Fisheries & Wildlife (IF&W), United States Fish & Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), met with Brookfield and their consultant Alden Labs on December 13th to collectively review the design and the DRT comments. DRT comments were submitted prior to the meeting noted as "Draft for Discussion only". At the end of that meeting it was agreed that Alden had enough information from that meeting to continue working on the 90% design. Brookfield submitted a supplemental 60% design to the Agencies on January 22nd.

The only comment that we have on the supplemental submittal is that we would like to request an extension of the existing 3-D hydraulic model for the tailrace area below Unit 7/8 including the proposed training wall and the flow through the fish passage between the two tailraces. We feel that it is important to verify that this area will have streamlined flow free from broken eddys, hydraulic jumps, etc. that will adequately attract fish.

We would also request that for the 90% design that Alden review the "draft for discussion only" comments and answer each comment on how they handled it for the 90% design. We have reattached that document with this email. This document is unedited based upon our meeting so some comments may have been agreed to be not applicable.

This review has been done collectively with all pertinent agencies and may or may not completely reflect each agency's comments. If the agencies have additional comments or disagreements outside of the DRT comments they would file a separate comment letter to Brookfield.

This review was done considering the biological and engineering hydraulic principles to design an effective upstream fishway considering NMFS and USFWS design standards as well as engineering and biological judgments if necessary. This review was not done considering Life Safety Codes, Building Codes, Allowable Stress Design, or Load Resistance Factor Design, or any other typical engineering design codes for concrete, steel, structures, or building. We have assumed that the consulting engineer has taken those codes and practices into consideration

Regards,

Don

--

Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

--

____

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

____

Gregory Allen

From:	Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent:	Wednesday, November 20, 2019 11:04 AM
To:	Greg Allen
Subject:	Fwd: Shawmut 90% Design submittal
Attachments:	Alden 90 Perc Design submittal memo 11-15-2018.pdf

---------- Forwarded message ---------
From: **Gregory Allen** <gallen@aldenlab.com>
Date: Thu, Nov 29, 2018 at 3:08 PM
Subject: Shawmut 90% Design submittal
To: <donald.dow@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, <Dwayne.J.Seiders@maine.gov>, Dill, Richard <Richard.Dill@brookfieldrenewable.com>, Mitchell, Gerry <Gerry.Mitchell@brookfieldrenewable.com>, <Paul.Christman@maine.gov>, Steve Amaral <amaral@aldenlab.com>, <antonio_bentivoglio@fws.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Dave Robinson (home) <daverobinson111@yahoo.com>, <gail.wippelhauser@maine.gov>, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>

Hello Everyone,

The 90% design drawings for Shawmut can be downloaded from the link below. There are two files, one for the electrical/ controls design and the other the civil/ structural design. I have also attached a memo that provides explanations on how we addressed the DRT's comments received from the 60% design. We would like to schedule a 90% design review meeting after the holidays. We will propose some dates in a separate email.

https://we.tl/t-6qH7ZFpUMT

Let me know if anyone has trouble downloading the drawings.

Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
____

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com
____

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Greg Allen, Alden

Date: November 15, 2018

Re: **90% design submittal**
Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities

---

Alden Research Laboratory, Inc. (Alden) has developed a 90% design submittal for fish passage facilities at the Shawmut Hydroelectric project (Shawmut). This design submittal addresses comments received from the Design Review Team[1] (DRT) and discussions from the 60% design review meeting on December 13, 2017. Written comments were received from the DRT on November 29, 2017 and February 2, 2018. Alden provided a response to action items developed from the 60% design review meeting in a memorandum (attached) and supplemental drawings on January 22, 2018. As requested by the DRT, this memorandum summarizes how each comment was addressed in this 90% design submittal.

DRT's comments are shown in bold, followed by an explanation of how the comments were addressed.

Drawing G-002

1. **Note 6 Entrance Velocity 4 to 6 fps, 6 to 8 fps capable**

Reference to entrance velocity was removed from note 6. A target head drop of 6 inches is included, which corresponds to an entrance velocity of 6 ft/sec. The hydraulic conditions of the fish lift entrance are discussed in Alden's January 22 memo.

2. **Note 6 Entrance Depth 3ft Minimum under all circumstances**

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

As discussed during the 60% DRT review meeting, the entrance width was reduced to 10 ft to provide greater entrance depth. The entrance depth conditions are provided in Alden's January 22nd memo.

3. **Note 7 Need to Discuss flow apportionment with Alden and Brookfield**

Attraction flow discharged through the fish lift entrance and AWS auxiliary spillway was discussed in depth during the 60% DRT review meeting. The outcome of the discussion was to provide flexibility to adjust the flow split between the AWS auxiliary spillway and the fish lift over a broad range as follows;

- Total attraction flow – 340 cfs (5% of station capacity)
- AWS auxiliary spillway – up to 340 cfs
- Fish lift entrance – up to 225 cfs

It was agreed that the fish lift channel would have the capacity to operate between 115 and 225 cfs to provide operational flexibility, while the remainder of the total 340 cfs attraction water flow would be discharged through the auxiliary spillway.

4. **Note 10 Please include Grade of Exit Flume**

Included, 5% grade

Drawing C-002

1. **There are no drawings of the control gates that we could find**

Now included

2. **Can you throttle the 115 cfs?**

Flow is adjustable through the fish lift entrance up to 225 cfs.

3. **Is attraction water gate downward opening? - Does it need to be?**

The gate for the AWS is an isolation gate that opens upward. The AWS intake includes geometry of a NU/ Alden weir and for ideal operation it is important that there are no obstructions in the flow path. If desired, the gate could be throttled, but under normal operation the gate would be either fully open or fully closed. As discussed during the 60% DRT review meeting the elevation of the weir crest controls the total AWS flow.

4. **Need to discuss the 600 cfs vs 50 to 80 cfs in Fish Bypass Channel**
   a. **Could we discharge 600 cfs to old powerhouse tailrace**
   b. **or use wedged wire screen and some of the 600 cfs to fishway bypass and make it wider?**

Computational Fluid Dynamic (CFD) modeling was conducted to optimize the Unit 7&8 fishway entrance relative to the 600 cfs tainter gate flow. A meeting with the DRT was held on September 27, 2018 to review the CFD results and the recommended Unit 7&8 fishway channel configuration. This 90% design submittal reflects the recommended geometry from CFD modeling.

Drawing C-103

1. **Should there be a downward opening gate at the attraction water entrance?**

Discussed previously

2. **We need more manholes or transparency on the top of the 20 inch pipe**

A total of 3 manholes are included so that the entire exit pipe length is visible for inspection.

3. **We are still very worried about false attraction and need to discuss**
4. **could we have 1 stop log panel from the guide wall to the building perpendicular**
5. **can we move everything except the entrance closer to the dam**
6. **What happened to the gate drawings for the AWS system?**

As a result of a discussion on the above items during the 60% DRT design review meeting, the fish lift channel was lengthened by 8 ft. Additional detail is provided in the January 22 memo.

Drawing C-105

1. **Should the isolation gate be downward opening**

Discussed previously

2. **We need to discuss the AWS to Tailrace Transition**

This was discussed during the 60% DRT review meeting and the current design reflects the outcome of the discussion.

Drawing C-110

1. **Minimize the Gaps between stems & wall on entrance gate so Atlantic salmon and other species do not get caught**

Noted and addressed

2. **Greased Stems should not be in water**

Noted and addressed

3. **Can we increase height of punch plate walls on hopper?**

Wall height is 3 ft.

4. **The entrance gate does not meet the following:**
   a. **3ft of depth minimum over the weir**
   b. **Only meets the 4 to 6 fps because it does not meet the 3ft of depth**
   c. **doubtful to achieve 1/2 ft of HL at high tailwater**
   d. **can't meet higher HL at normal tailwater**

These items were discussed in Alden's January 22nd memo.

Drawing C-111

1. **Why is 2fps there inside gate on the elevation view?**
2. **No sharp edges**
3. **What happens if pin on gate breaks?**

These items were discussed during the 60% DRT review meeting.

Drawing C-112

1. **What is a Gate Disc?**

A gate disc is terminology for the bulkhead portion of a gate (skin plate and associated framing)

Drawing C-115

1. **Where are the filler flap valves?**
2. **should have more details on this by now.**
3. **3ft high walls should be higher....likely out of water column and high enough so salmon can't jump out.**

It was decided during the 60% DRT meeting that 3 ft high walls are adequate and consistent with Milford and Hydro Kennebec designs.

4. **Use punch plate not mesh for walls on top of hopper**

Design changed to included perforated plate.

5. **Need to show position of lifting cables**

As discussed during the 60% DRT meeting no lifting cables would extend below the water surface to the hopper. The hopper would be supported by a cradle with a single cable lifting the entire hopper structure well above the water surface. See sheet M-113.

Drawing C-118 - No Comments

Drawing C-119

1. **Need to Provide ManDoor**

included

Drawing C-301

1. **Please show elevation of upper edge of existing 3V:1H Rock Slope**

Shown on drawing G-008

Drawing C-303 - See comments in regards to 600 cfs

Drawing C-304

1. **Need more depth over hinged gate**
2. **How are gates operated?**
3. **Shouldn't baffle slots be above isolation?**
4. **What about eels?**

See Alden's January 22nd memo.

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Greg Allen, Alden

Date: January 22, 2018

Re: **Follow up on action items from the 60% design review meeting Shawmut Hydroelectric Project (FERC Project No. 2332) proposed fish passage facilities**

Alden Research Laboratory, Inc. (Alden) met with Brookfield and the Design Review Team[1] (DRT) to discuss Alden's 60% design submittal for fish passage facilities at the Shawmut Hydroelectric project (Shawmut) on December 12, 2017. This memorandum provides additional information that was requested during the meeting and presents revised designs of the fish lift entrance flume and the unit 7 and 8 fishway channel. The following attached sheets have been updated for DRT review:

C-002, Overall Site Plan

C-103, Fish Lift General Arrangement Plan

C-110, Fish Lift Entrance Flume General Plan and Sections

C-303, Unit 7&8 Fish Passage General Plan

C-304, Unit 7&8 Fish Passage Plan and Sections

C-305, Unit 7&8 Fish Passage Sections

Alden requests confirmation from the DRT that the presented design is acceptable to advance to the 90% design review stage.

A summary of significant design changes and hydraulic design information is provided below.

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

Fish Lift

As discussed during the 60% design review meeting the entrance channel was lengthened to the extent practical to increase the holding pool area. The fish lift entrance was moved further into the river, but not so far as to protrude into the spillway flow. The fish lift hopper, hoist and tower were moved upstream by 4 ft. These changes added 8 ft to the holding pool which is now 19 ft in length. The entrance width was reduced to 10 ft as discussed during the meeting to provide 3 ft of water over the hinged entrance gate. A plan is shown in Figure 1 and hydraulic characteristics of the modified design are shown in Figure 2 and Figure 3.

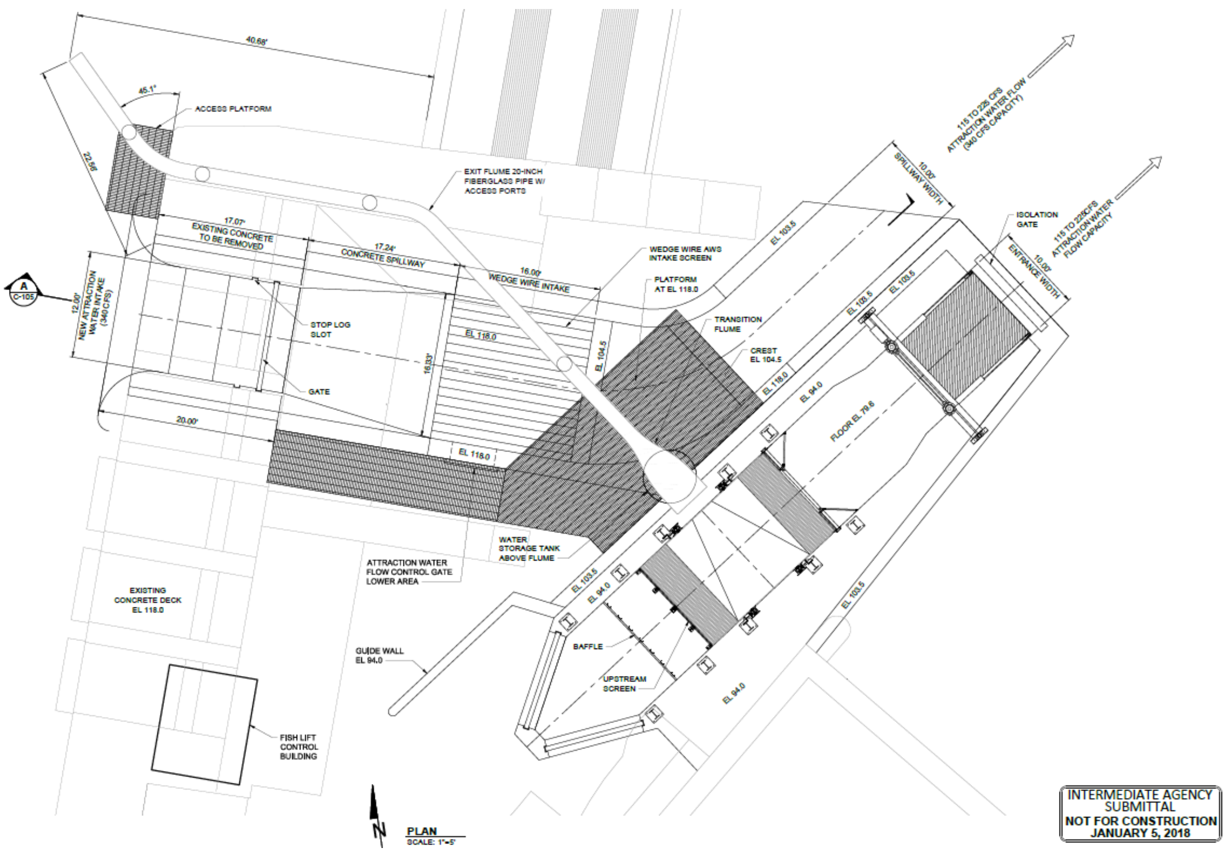


Figure 1. Fish Lift Entrance Channel Plan

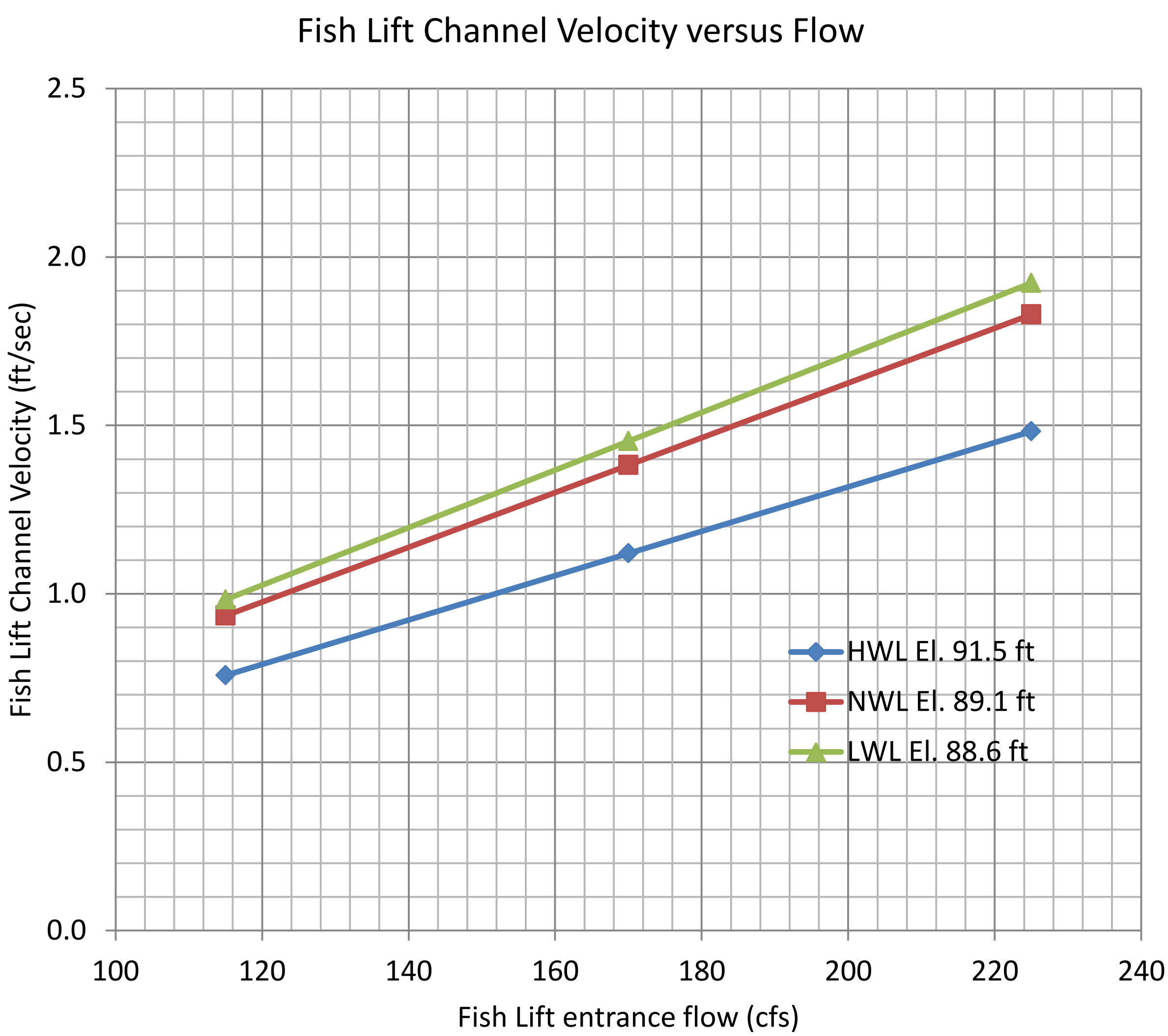


Figure 2. Fish lift entrance channel velocity versus flow rate for high, normal and low tailwater conditions.

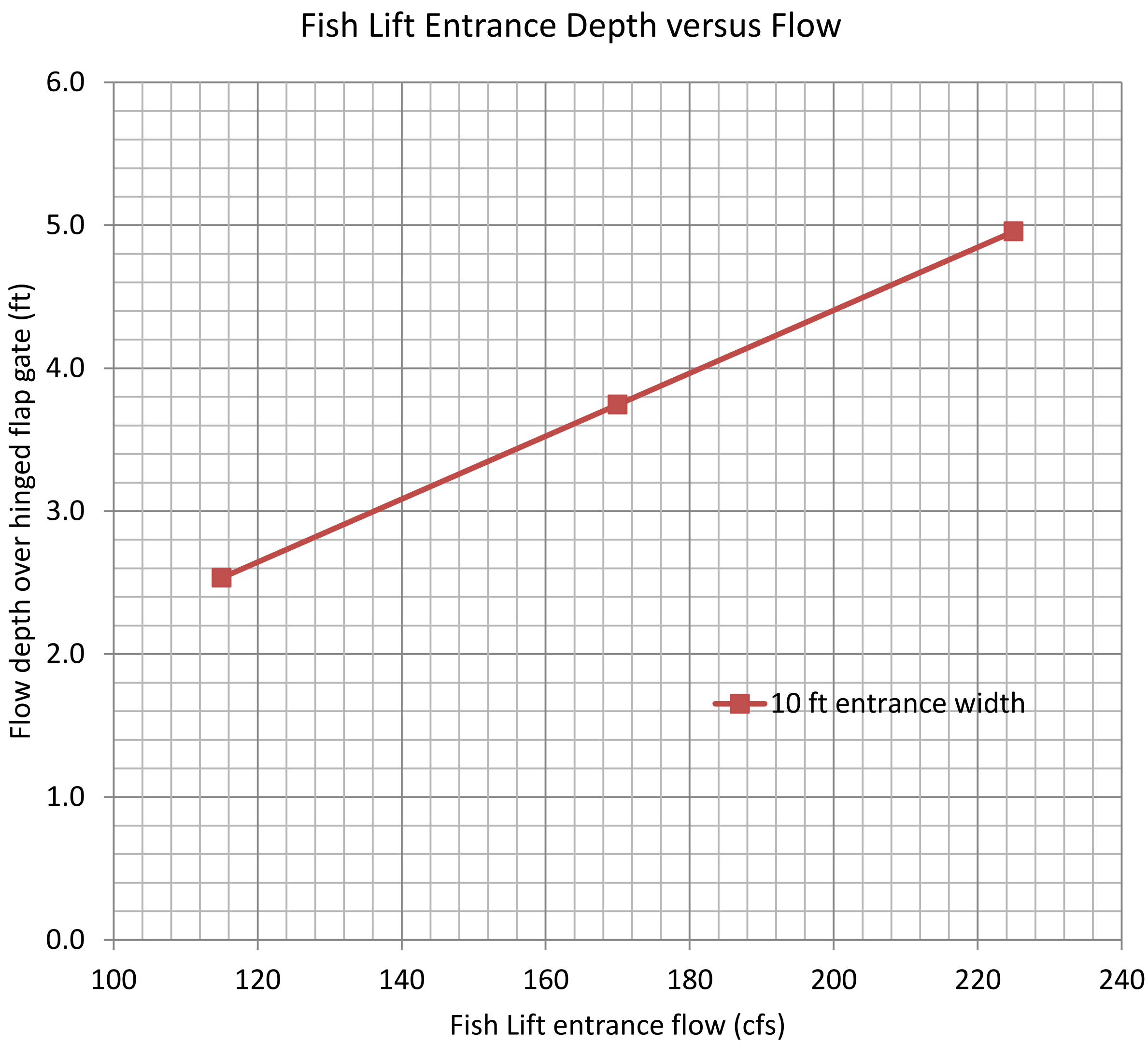


Figure 3. Fish lift entrance flow depth over the hinged flap gate versus flow for a 6 ft/sec entrance velocity condition.

Wedge Wire Screen Clear Spacing

FWS requested a 0.125 inch clear opening screen for the attraction water intake for Shawmut. After review of available wedge wire bar profile options, we recommend a screen clear opening of 0.25 inches, based on selection of a Hendrick T16 bar profile (see Figure 4) while maintaining a 50% screen open area. The T16 bar is a heavy duty bar profile which is recommended to withstand expected debris loading. Maintaining the 0.125 inch clear space with the T16 bar profile would reduce the screen open area, increase through screen velocity and increase

maintenance to remove debris. Therefore, we recommend a 0.25 inch clear spaced screen, which is less than FWS criteria of 0.375 inches for attraction water intakes (USFWS, 2017).

Profile Bar (Images not to scale)	B69	B6S	B6	B9S	B9	B12	T9M	T9	F12	T12	T16	T24
Bar Width	.069	.093	.093	.140	.140	.187	.140	.140	.187	.187	.250	.500
Bar Height	.290	.290	.375	.320	.375	.500	.453	.453	.500	.500	.750	.750
Cap Height	.080	.080	.093	.110	.125	.156	.125	.203	.185	.188	.250	.250

- *304L, 316L, Various Grades of Stainless & Exotic Alloys, Carbon Aluminum (6061) in B9, B12 & T16*
- *Non-welded Interlocked Construction*

Figure 4. Hendrick Screen Wedge Wire Profile Bar Options

Unit 7&8 Fish Passage Channel

The Unit 7 and 8 fish passage channel has been modified based on discussions during the meeting. The flow through the channel has been increased to provide greater flow depth over the entrance hinged flap gate. The channel width has been increased to 10.5 ft and a full depth vertical slot at the upstream end of the channel will have a 42 inch opening width. The channel now has an operating range of 90 cfs to 140 cfs for the range of tailwater conditions. A plan of the modified design is shown in Figure 5 and hydraulic characteristics are provided in Figure 6 and Figure 7.

The 60% DRT meeting included a discussion of the taintor gate spillway discharge adjacent to the fish passage channel and a concern that this flow may interfere with the fishway flow. The DRT recommended that the taintor gate spillway channel deflect the flow to the right (looking downstream) away from the fish passage channel entrance. We have consider and reviewed potential deflectors to steer the flow away from the fishway entrance since the meeting and we are concerned that deflecting the high velocity taintor gate flow could have the unintended consequence of creating an eddy near the fishway entrance. Therefore, we do not recommend deflecting the taintor gate flow as discussed during the 60% DRT meeting. If the DRT would like to pursue this option further, we would recommend the use of CFD modeling to aid and optimize the design to avoid unintended adverse conditions for fish passage.

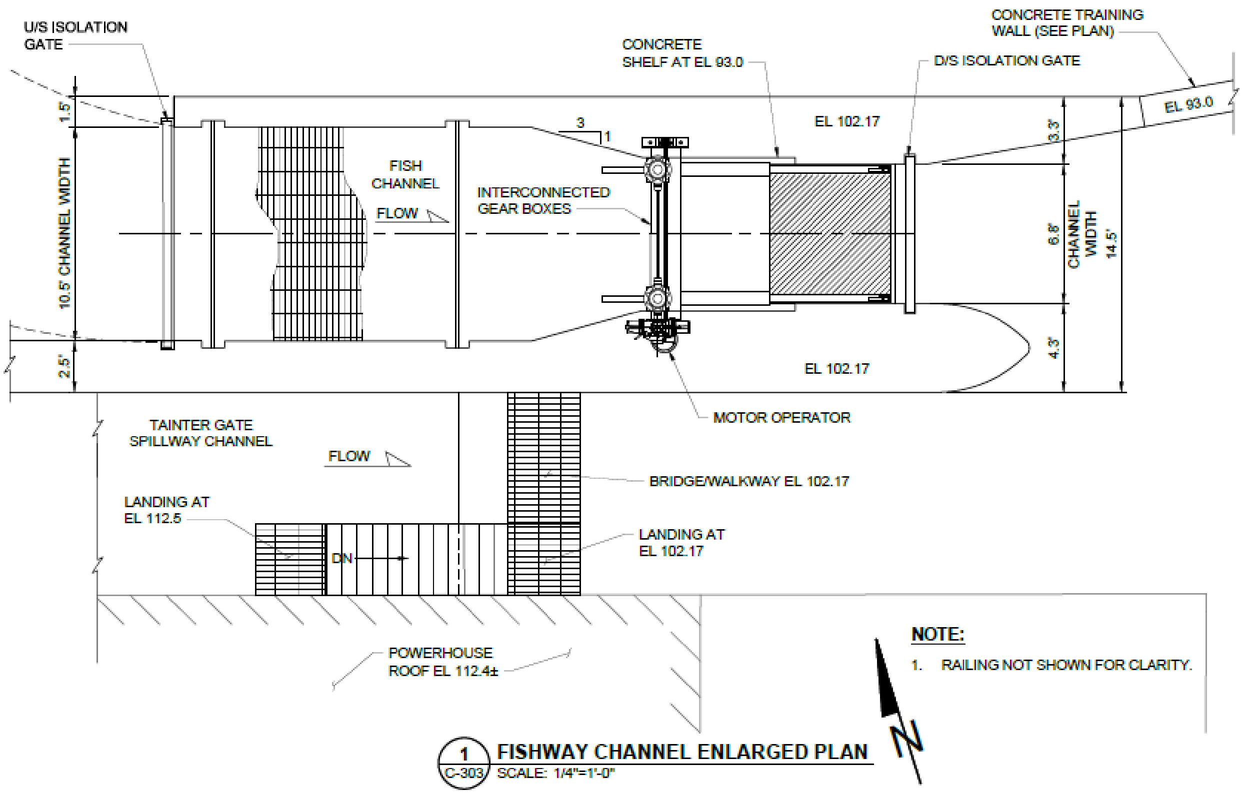


Figure 5. Unit 7&8 fish passage channel plan

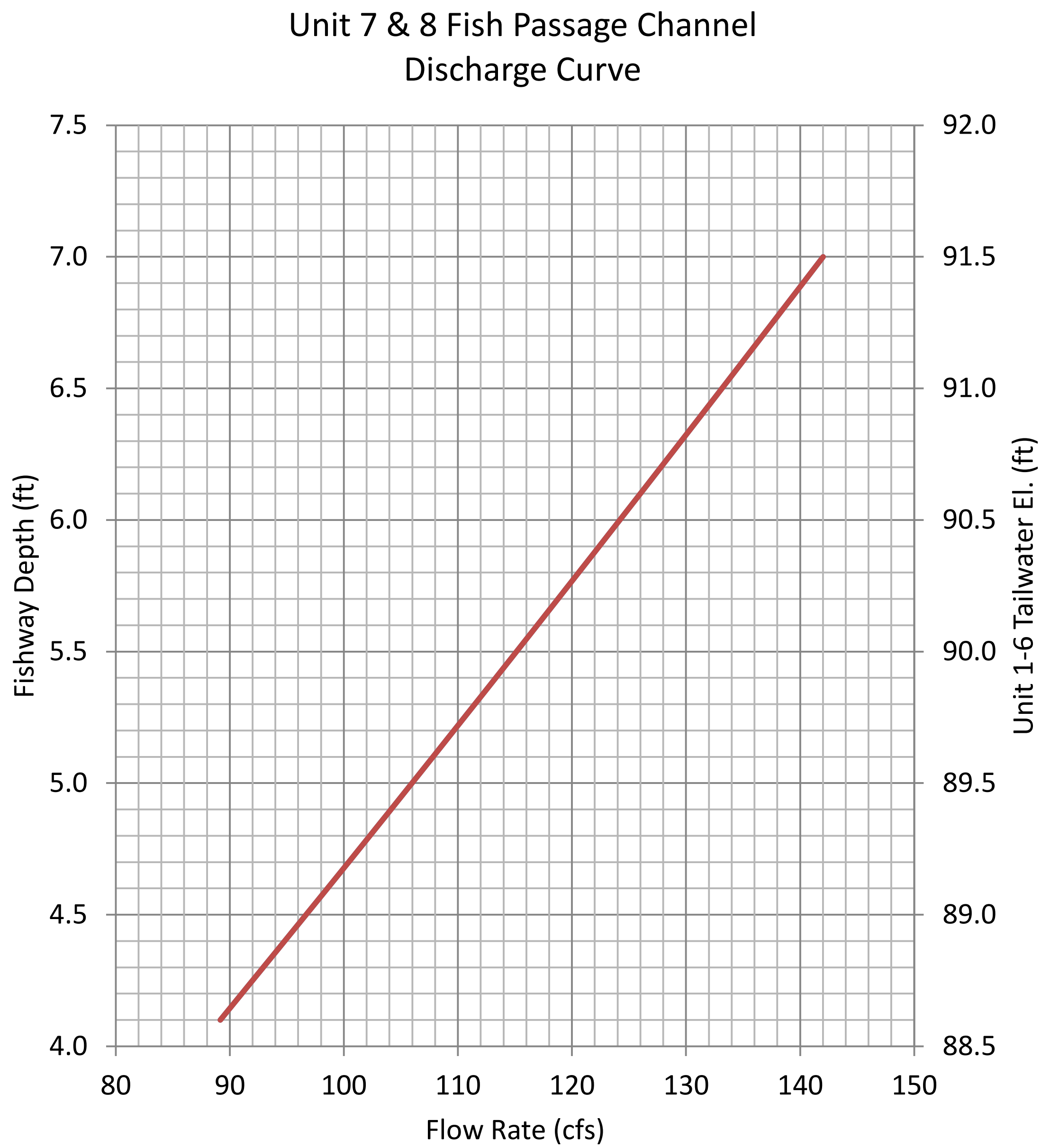


Figure 6. Unit 7&8 fish passage channel discharge curve for a full depth 42 inch wide baffle slot.

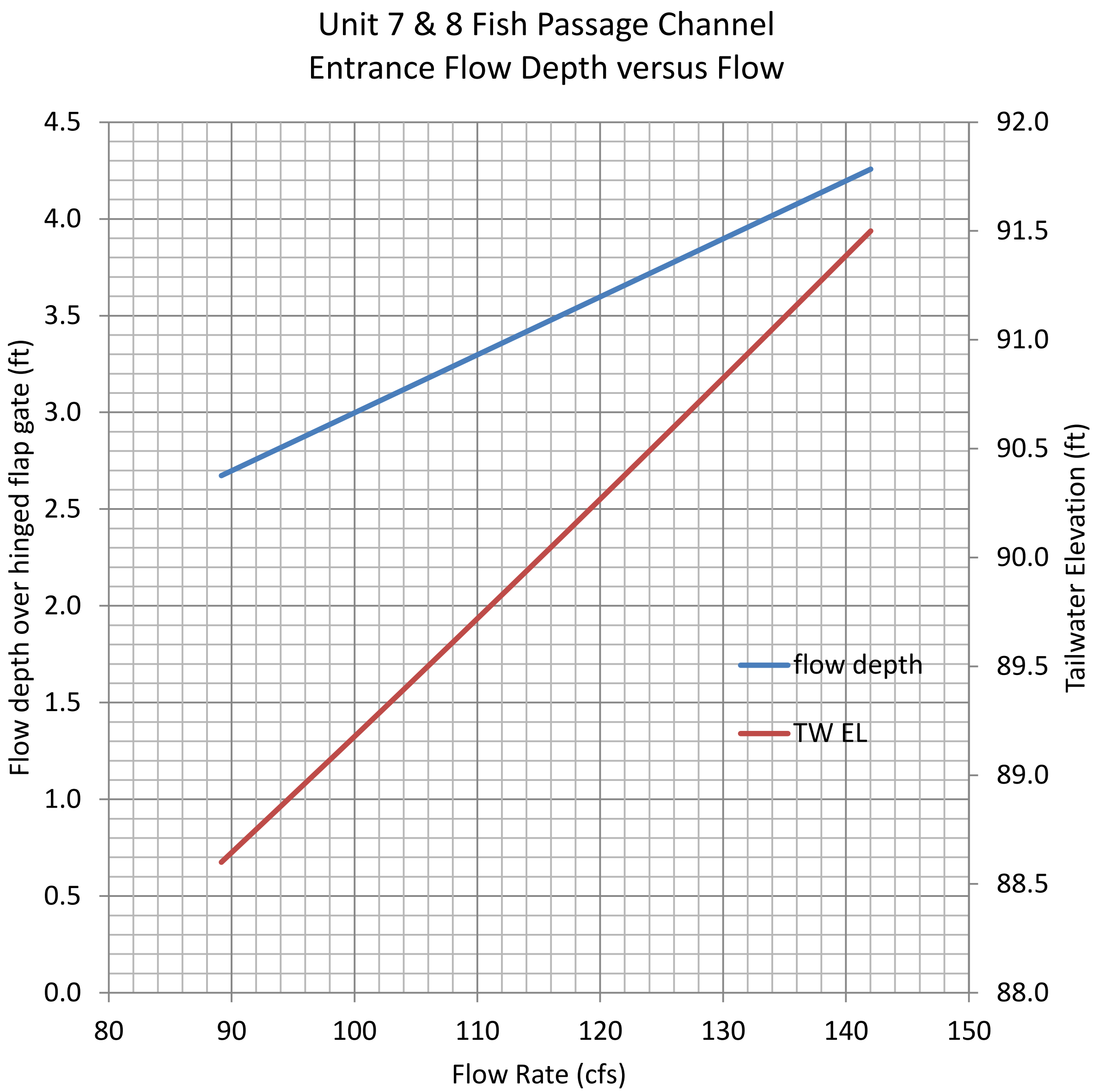


Figure 7. Unit 7&8 fish passage channel entrance flow depth over the hinged flap gate versus flow.

References

USFWS. (2017). *Fish Passage Engineering Design Criteria.* Hadley, MA: U.S. Fish and Wildlife Service, Northeast Region R5.

Gregory Allen

From: Donald Dow - NOAA Federal
Sent: Friday, February 01, 2019 2:55 PM
To: Dill, Richard; Bryan Sojkowski; Greg Allen
Subject: Questions on Shawmut

Richard -
A couple items came up today in our review that we'd like to get some answers on by the meeting.

1. We still have some concerns about the entrance - i.e. flow, head loss, tailrace elevation, depth over the entrance gate.......can we get a table at different target headlosses from 0.5 ft to 1.5 ft across the entrance for the range of flows (115 to 225) at the various tailwater elevations 88.6 to 91.5 showing the entrance jet velocity and the entrance pool velocity as well as the depth of water over the weir.
2. We see that there is no way to throttle the flow into the system. We may be able to reduce the flow to the lift but the balance goes down the attraction water system. We see no way that we could run the lift at say 115 cfs and the AWS at 115. We are thinking we need a downward opening gate at the top where there is an isolation gate. We believe we need the flexibility....and possibly shutting the AWS off altogether if need be.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

SHAWMUT 90% DESIGN CONSULTATION

Gregory Allen

From:	Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent:	Wednesday, November 20, 2019 11:02 AM
To:	Greg Allen
Subject:	Fwd: Shawmut 90% Talking Points
Attachments:	2019-02-06 Shawmut Draft 90% Talking Points.docx

---------- Forwarded message ---------
From: **Donald Dow - NOAA Federal** <donald.dow@noaa.gov>
Date: Wed, Feb 6, 2019 at 3:14 PM
Subject: Shawmut 90% Talking Points
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>, Greg Allen <gallen@aldenlab.com>
Cc: Seiders, Dwayne J <Dwayne.J.Seiders@maine.gov>, Wippelhauser, Gail <gail.wippelhauser@maine.gov>, Christman, Paul <Paul.Christman@maine.gov>, Bryan Sojkowski <Bryan_Sojkowski@fws.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com>, Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>

Richard -

Attached are some talking points for tomorrows meeting. Do not consider these comments, they are just to help us have discussions after our review. I think Alden did a great job on this design.

--
Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
Greater Atlantic Regional Fisheries Office
(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive, Suite 1
Orono, ME 04473

Office: 207-866-8563
Cell: 207-416-7510
Donald.Dow@noaa.gov

--
____
Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409

gallen@aldenlab.com

____

Shawmut 90% talking points –

1. Entrance Conditions - The depth of water over the lip of the entrance gate has been a topic of discussion throughout this design. During the 60% design phase Alden came back to the table with a contracted entrance (from 12ft to 10ft) and according to Figure 3 within their Jan 22, 2018 memo they could achieve a 3ft depth for most of the fishway flow range (115-225cfs). I looked back at that memo and my calculations and discovered that the fishway can achieve the 3ft minimum depth but only for a drop of 6 inches. If we want the fishway to operate at a drop of say 1 ft (an operational setting that is common and has been effective on the Merrimack for Alosines) then we cannot achieve the 3ft minimum depth unless we max out the fishway flow to 225cfs but at that level of flow the entrance channel velocity is near 2 ft/s. That high of a velocity increases the risk of fallback. We have the ability to decrease the flow but then we sacrifice the 3 ft depth (which we may find out soon from the Conte study is a critical design parameter).

2. Attraction Water Control - I think we should all feel comfortable with how this fishway will operate and the variables we can adjust if needed. As of right now when the fishway is turned on we will get 340 cfs of total flow which will be split between the fishway and attraction water channel. The fishway can only take up to 225 so at a minimum there will be 115 going down the adjacent channel. I agree with Don that the effectiveness of the channel is unknown and is an area that fish (especially salmon) could be falsely attracted to and make attempts into. If for some reason we discover it is an issue we will need to shut it off. As of right now we do not have this ability. Don raised the point that we need a downward opening gate at the intake during the 60% design review but I don't think Alden incorporated this due to the fact that we are also using the attraction water channel as a downstream bypass. We will need to have further discussion with Alden in regards to how the attraction water will be operated and if we can incorporate the ability to shut if off.

G-001 – No Comment

G-002 – No Comment

G-003 – 1. Need to check 95% Exceedance Low Flow Elevations to Seasons

2. Note 5. Design Range is not necessarily operating range

G-004 – No Comment

G-005 – 1. Still Don’t love the orientation of the AWS Spillway Exit

G-006 – No Comment

G-007 – No Comment

G-008 – No Comment

G-009 – No Comment

C-001 – No Comment

C-101 – No Comment

C-102 – No Comment

C-103 – No Comment

C-104 – No Comment

C-105 – No Comment

C-106 – No Comment

C-107 – 1. Still Very Nervous about this pipe

C-301 – No Comment

C-301 – No Comment

C-302 – No Comment

C-303 – No Comment

C-304 – No Comment

C-305 – No Comment

C-306 – No Comment

C-307 – No Comment

S-001 – No Comment

S-002 – No Comment

S-101 – No Comment

S-102 – No Comment

S-103 – No Comment

S-104 – No Comment

S-105 – No Comment

S-106 – No Comment

S-107 – No Comment

S-108 – No Comment

S-109 – No Comment

S-110 – No Comment

S-111 – No Comment

S-112 – No Comment

S-113 – No Comment

S-114 – 1. All Nuts and Bolt heads exposed to fish must be counter sunk, covered or rounded with no sharp edges exposed.

S-115 – No Comment

S-201 – No Comment

S-202 – No Comment

S-203 – No Comment

S-204 – No Comment

S-205 – No Comment

S-206 – No Comment

S-207 – No Comment

S-208 – No Comment

S-209 – No Comment

S-210 – No Comment

S-211 – No Comment

S-212 – No Comment

S-213 – No Comment

S-214 – No Comment

S-215 – No Comment

S-216 – No Comment

S-217 – No Comment

S-301 – No Comment

S-302 – No Comment

S-303 – No Comment

S-304 – No Comment

S-305 – No Comment

S-306 – No Comment

S-501 – No Comment

S-502 – No Comment

S-503 – No Comment

S-504 – No Comment

S-505 – No Comment

M-105 – No Comment

M-106 – No Comment

M-107 – No Comment

M-108 – No Comment

M-109 – No Comment

M-110 – 1. Need to discuss Grating on V-Gate Panel

M-111 – No Comment

M-112 – No Comment

M-113 – No Comment

M-114 – No Comment

M-115 – 1. Prefer punch plate or the like…..something smooth for brail

M-116 – No Comment

M-117 – No Comment

M-118 – No Comment

M-119 – 1. Discuss spacing on removable screen panels….

M-120 – No Comment

M-121 – No Comment

Note – 1. Missing Dwgs on water tank, and attraction flow exit

EE-AA-001 – No Comment

EE-AB-001 – No Comment

EE-AD-001 – No Comment

EE-AE-001 – No Comment

EE-AG-001 – No Comment

EE-BA-001 – No Comment

EE-BB-001 – No Comment

EE-CA-001 – No Comment

EE-CD-001 – No Comment

EE-CE-001 – No Comment

EE-CE-002 – No Comment

EE-CE-003 – No Comment

EE-CE-004 – No Comment

EE-CE-005 – No Comment

EE-CE-006 – No Comment

EE-CE-007 – No Comment

EE-CE-008 – No Comment

EE-DB-001 – No Comment

EE-DB-002 – No Comment

EE-DB-003 – No Comment

EE-DB-004 – No Comment

EE-DB-005 – No Comment

EE-DB-006 – No Comment

EE-DB-007 – No Comment

EE-DB-008 – No Comment

EE-DB-009 – No Comment

EE-DB-010 – No Comment

EE-DB-011 – No Comment

EE-DB-012 – No Comment

EE-DC-001 – No Comment

EE-DC-002 – No Comment

EE-DD-001 – No Comment

EE-DD-002 – No Comment

EE-DD-003 – No Comment

EE-DD-004 – No Comment

EE-DD-005 – No Comment

EE-DD-006 – No Comment

EE-DD-007 – No Comment

EE-DD-008 – No Comment

EE-DD-009 – No Comment

EE-DD-010 – No Comment

EE-DD-011 – No Comment

EE-DD-021 – No Comment

EE-DD-022 SH1 – No Comment

EE-DD-022 SH2 – No Comment

EE-DD-023 SH1 – No Comment

EE-DD-023 SH2 – No Comment

EE-DD-024 – No Comment

EE-ED-001 – No Comment

EE-ED-002 – No Comment

EE-ED-003 – No Comment

EE-ED-004 – No Comment

EE-EF-001 – No Comment

EE-EF-002 – No Comment

EE-EG-001 – No Comment

EE-EH-001 – No Comment

EE-EJ-001 – No Comment

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 10:55 AM
To: Greg Allen
Subject: Fwd: [EXTERNAL] RE: 90% Design Review Meeting

---------- Forwarded message ---------
From: **Bentivoglio, Antonio** <antonio_bentivoglio@fws.gov>
Date: Fri, Feb 8, 2019 at 1:24 PM
Subject: Re: [EXTERNAL] RE: 90% Design Review Meeting
To: Gregory Allen <gallen@aldenlab.com>
Cc: Steve Amaral <amaral@aldenlab.com>, Bryan Sojkowski <bryan_sojkowski@fws.gov>, Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Mitchell, Gerry <gerry.mitchell@brookfieldrenewable.com>, Gail Wippelhauser <gail.wippelhauser@maine.gov>, Dill, Richard <richard.dill@brookfieldrenewable.com>, Dave Robinson (home) <daverobinson111@yahoo.com>, Maloney, Kelly <kelly.maloney@brookfieldrenewable.com>, Dwayne.J.Seiders@maine.gov <dwayne.j.seiders@maine.gov>, Paul.Christman@maine.gov <paul.christman@maine.gov>

Greg, Gerry, Steve, Kelly, Richard, Dave,
thanks for the very informative meeting yesterday. Seems like there are a few (very few) issues to look at again. The Resource Agencies will try to get you feedback on the brail spec preferences next week.
Greg, thanks for redoing the fish lift hydraulic conditions for an 8ft fishway entrance. We think that will be very beneficial. As we said in the meeting, please make sure your definition of Depth over Entrance Gate is the same as Bryan's that we discussed, tailwater to top of gate.
Thanks Antonio

On Fri, Feb 8, 2019 at 11:35 AM Gregory Allen <gallen@aldenlab.com> wrote:

> Good morning Everyone,
>
> I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.
>
> Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

--
____

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843

Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

Technical Memorandum

To: Mr. Gerry Mitchell and Richard Dill, Brookfield Renewable

From: Gregory Allen, P.E.

Date: February 13, 2019

Re: **Hydraulic Conditions of Shawmut Fish Lift Entrance with an 8 ft Entrance Width. Supplemental information requested from 90% Design Review Meeting for the Shawmut Fish Passage Project**

A design review meeting was held on February 7, 2019 for the Shawmut Fish Passage Project 90% design submittal. The Design Review Team[1] (DRT) requested that Alden provide hydraulic characteristics of the fish lift entrance conditions for a reduced entrance width of 8 ft. The attached table is similar to the hand out provided during the meeting with the entrance width reduced to 8 ft. In addition, the range of the hinged entrance gate operation was increased to a maximum elevation of 87.5 ft (previously El. 87 ft). The attached table is based on the following assumptions;

Fish lift entrance width 8 ft (previously 10 ft)
(reduced by 7 inches in calculations to 7.42 ft to account for gate stems)

Fish lift channel invert El. 79.6 ft

Fish lift channel width 12 ft

Maximum hinged gate El. 87.5 ft (previously 87.0 ft)

[1] The Design Review Team includes members from the following resource agencies; US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (MDMR) and Maine Department of Inland Fisheries and Wildlife (IF&W)

Hydraulic Conditions of Shawmut Fish Lift Entrance
(8 ft entrance width)

highlighted cells indicate maximum hinged gate height

	TW El.	Fish Lift Flow (cfs)	Entrance drop (ft)	Entrance Pool Velocity (ft/sec)	Entrance Velocity (ft/sec)	Depth over entrance gate (ft)
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.50	0.8	5.7	3.0
	90.0	115	0.50	0.9	5.7	3.0
	89.5	115	0.50	0.9	5.7	3.0
NWL	89.1	115	0.50	1.0	5.7	3.0
LWL	88.6	115	0.50	1.0	5.7	3.0
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.51	0.8	5.7	3.0
	90.0	115	0.75	0.9	6.9	2.5
	89.5	115	0.75	0.9	6.9	2.5
NWL	89.1	115	0.75	0.9	6.9	2.5
LWL	88.6	115	0.75	1.0	6.9	2.5
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.51	0.8	5.7	3.0
	90.0	115	0.74	0.9	6.9	2.5
	89.5	115	1.00	0.9	8.0	2.1
NWL	89.1	115	1.00	0.9	8.0	2.1
LWL	88.6	115	1.00	1.0	8.0	2.1
HWL	91.5	115	0.29	0.8	4.3	4.0
	91.0	115	0.38	0.8	4.9	3.5
	90.5	115	0.51	0.8	5.7	3.0
	90.0	115	0.74	0.9	6.9	2.5
	89.5	115	1.15	0.9	8.6	2.0
NWL	89.1	115	1.50	0.9	9.8	1.8
LWL	88.6	115	1.50	0.9	9.8	1.8
HWL	91.5	170	0.50	1.1	5.7	4.5
	91.0	170	0.50	1.2	5.7	4.5
	90.5	170	0.50	1.2	5.7	4.5
	90.0	170	0.50	1.3	5.7	4.5
	89.5	170	0.50	1.4	5.7	4.5
NWL	89.1	170	0.50	1.4	5.7	4.5

highlighted cells indicate maximum hinged gate height

	TW El.	Fish Lift Flow (cfs)	Entrance drop (ft)	Entrance Pool Velocity (ft/sec)	Entrance Velocity (ft/sec)	Depth over entrance gate (ft)
LWL	88.6	170	0.50	1.5	5.7	4.5
HWL	91.5	170	0.63	1.1	6.4	4.0
	91.0	170	0.75	1.2	6.9	3.7
	90.5	170	0.75	1.2	6.9	3.7
	90.0	170	0.75	1.3	6.9	3.7
	89.5	170	0.75	1.3	6.9	3.7
NWL	89.1	170	0.75	1.4	6.9	3.7
LWL	88.6	170	0.75	1.5	6.9	3.7
HWL	91.5	170	0.63	1.1	6.4	4.0
	91.0	170	0.82	1.2	7.3	3.5
	90.5	170	1.00	1.2	8.0	3.2
	90.0	170	1.00	1.2	8.0	3.2
	89.5	170	1.00	1.3	8.0	3.2
NWL	89.1	170	1.00	1.3	8.0	3.2
LWL	88.6	170	1.00	1.4	8.0	3.2
HWL	91.5	170	0.63	1.1	6.4	4.0
	91.0	170	0.82	1.2	7.3	3.5
	90.5	170	1.12	1.2	8.5	3.0
	90.0	170	1.50	1.2	9.8	2.6
	89.5	170	1.50	1.2	9.8	2.6
NWL	89.1	170	1.50	1.3	9.8	2.6
LWL	88.6	170	1.50	1.3	9.8	2.6
HWL	91.5	225	0.50	1.5	5.7	5.9
	91.0	225	0.50	1.6	5.7	5.9
	90.5	225	0.50	1.6	5.7	5.9
	90.0	225	0.50	1.7	5.7	5.9
	89.5	225	0.50	1.8	5.7	5.9
NWL	89.1	225	0.50	1.9	5.7	5.9
LWL	88.6	225	0.50	2.0	5.7	5.9
HWL	91.5	225	0.75	1.5	6.9	4.9
	91.0	225	0.75	1.5	6.9	4.9
	90.5	225	0.75	1.6	6.9	4.9
	90.0	225	0.75	1.7	6.9	4.9
	89.5	225	0.75	1.8	6.9	4.9
NWL	89.1	225	0.75	1.8	6.9	4.9
LWL	88.6	225	0.75	1.9	6.9	4.9
HWL	91.5	225	1.00	1.5	8.0	4.2

highlighted cells indicate maximum hinged gate height

	TW El.	Fish Lift Flow (cfs)	Entrance drop (ft)	Entrance Pool Velocity (ft/sec)	Entrance Velocity (ft/sec)	Depth over entrance gate (ft)
	91.0	225	1.00	1.5	8.0	4.2
	90.5	225	1.00	1.6	8.0	4.2
	90.0	225	1.00	1.6	8.0	4.2
	89.5	225	1.00	1.7	8.0	4.2
NWL	89.1	225	1.00	1.8	8.0	4.2
LWL	88.6	225	1.00	1.9	8.0	4.2
HWL	91.5	225	1.10	1.4	8.4	4.0
	91.0	225	1.44	1.5	9.6	3.5
	90.5	225	1.50	1.5	9.8	3.4
	90.0	225	1.50	1.6	9.8	3.4
	89.5	225	1.50	1.6	9.8	3.4
NWL	89.1	225	1.50	1.7	9.8	3.4
LWL	88.6	225	1.50	1.8	9.8	3.4

Gregory Allen

From: Gregory Allen <gallen@aldenlab.com> on behalf of Gregory Allen
Sent: Wednesday, November 20, 2019 10:53 AM
To: Greg Allen
Subject: Fwd: [EXTERNAL] RE: RE: 90% Design Review Meeting
Attachments: Spot Check on 8ft Hydraulics Table.pdf

---------- Forwarded message ---------
From: **Sojkowski, Bryan** <bryan_sojkowski@fws.gov>
Date: Thu, Feb 14, 2019 at 2:49 PM
Subject: Re: [EXTERNAL] RE: RE: 90% Design Review Meeting
To: Gregory Allen <gallen@aldenlab.com>
Cc: Steve Amaral <amaral@aldenlab.com>, Donald Dow - NOAA Affiliate <donald.dow@noaa.gov>, Matt Buhyoff - NOAA Federal <matt.buhyoff@noaa.gov>, Mitchell, Gerry <gerry.mitchell@brookfieldrenewable.com>, Antonio Bentivoglio <antonio_bentivoglio@fws.gov>, Wippelhauser, Gail <gail.wippelhauser@maine.gov>, Dill, Richard <richard.dill@brookfieldrenewable.com>, Dave Robinson (home) <daverobinson111@yahoo.com>, Maloney, Kelly <kelly.maloney@brookfieldrenewable.com>, Dwayne.J.Seiders@maine.gov <dwayne.j.seiders@maine.gov>, Paul.Christman@maine.gov <paul.christman@maine.gov>

Thanks for doing this Greg. I performed a spot check of the numbers (see attached) using an SMath tool that USFWS Engineering developed using a gate width of 7.4 ft. Are the listed entrance velocities an average or maximum (mine are average)? I'm close on some and then far off on others but typically less than what you calculated so that's good. The more important factor is depth and I'm pretty close to your numbers for all cases except for the 170 cfs, 0.5 ft drop (0.7 ft lower), and the 225 cfs, 0.5 ft drop (1.3 ft lower). All that said, the depth values that were off still meet the 3 ft depth threshold. The results coincide with my thinking in that we'll want to run this fishway at flows higher than 115 cfs, probably towards the 150 cfs mark in order to achieve the 3 ft depth. We won't be able to achieve the depth when producing drops of 1.0 ft but that was expected. Overall I agree with the results and recommend moving forward with the 8 ft entrance width (others chime in if you see it differently). Thanks again for your efforts!

On Wed, Feb 13, 2019 at 11:48 AM Gregory Allen <gallen@aldenlab.com> wrote:

> Good morning Everyone,
>
> I have updated the table I sent out last week for an entrance with an 8 ft width. The maximum elevation of the hinged gate was also increased by 6 inches to El. 87.5 ft. This information is presented in the attached memo. I would also like to point out that I discovered an error in the entrance velocity calculation that were part of the table I handed out at the meeting which has been corrected for the new table.
>
> Regards,
>
> Greg

Gregory Allen, P.E.
(508) 829-6000 ext. 6409

From: Gregory Allen [mailto:gallen@aldenlab.com]
Sent: Friday, February 08, 2019 11:34 AM
To: Steve Amaral; 'Bryan Sojkowski'; 'donald.dow@noaa.gov'; 'Matt Buhyoff - NOAA Federal'; 'Mitchell, Gerry'; 'antonio_bentivoglio@fws.gov'; 'gail.wippelhauser@maine.gov'; 'Dill, Richard'; 'Dave Robinson (home)'; 'Maloney, Kelly'; 'Dwayne.J.Seiders@maine.gov'; 'Paul.Christman@maine.gov'
Subject: RE: 90% Design Review Meeting

Good morning Everyone,

I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.

Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--

Bryan Sojkowski, P.E.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
413-253-8645
bryan_sojkowski@fws.gov

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not." - Dr. Seuss

--

____

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520-1843
Office Phone (508) 829-6000 ext. 6409
gallen@aldenlab.com

____

Brian McMahon

From:	Bentivoglio, Antonio <antonio_bentivoglio@fws.gov>
Sent:	Friday, February 08, 2019 1:25 PM
To:	Gregory Allen
Cc:	Steve Amaral; Bryan Sojkowski; Donald Dow - NOAA Affiliate; Matt Buhyoff - NOAA Federal; Mitchell, Gerry; Gail Wippelhauser; Dill, Richard; Dave Robinson (home); Maloney, Kelly; Dwayne.J.Seiders@maine.gov; Paul.Christman@maine.gov
Subject:	Re: [EXTERNAL] RE: 90% Design Review Meeting

Greg, Gerry, Steve, Kelly, Richard, Dave,
thanks for the very informative meeting yesterday. Seems like there are a few (very few) issues to look at again. The Resource Agencies will try to get you feedback on the brail spec preferences next week.
Greg, thanks for redoing the fish lift hydraulic conditions for an 8ft fishway entrance. We think that will be very beneficial. As we said in the meeting, please make sure your definition of Depth over Entrance Gate is the same as Bryan's that we discussed, tailwater to top of gate.
Thanks Antonio

On Fri, Feb 8, 2019 at 11:35 AM Gregory Allen <gallen@aldenlab.com> wrote:

> Good morning Everyone,
>
> I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.
>
> Thank you,
>
> Greg
>
> **Gregory Allen, P.E.**
> Director, Environmental and Engineering Services
> **ALDEN** Solving flow problems since 1894

30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Antonio

Antonio Bentivoglio
US Fish and Wildlife Service
Maine Field Office
Collocated with the Gulf of Maine Coastal Program
4 Fundy Road #R
Falmouth, Maine 04105
Telephone: (207) 781-8364 x18
Fax: (207) 469-6725

From: Gregory Allen [mailto:gallen@aldenlab.com]
Sent: Friday, February 08, 2019 11:34 AM
To: Steve Amaral; 'Bryan Sojkowski'; 'donald.dow@noaa.gov'; 'Matt Buhyoff - NOAA Federal'; 'Mitchell, Gerry'; 'antonio_bentivoglio@fws.gov'; 'gail.wippelhauser@maine.gov'; 'Dill, Richard'; 'Dave Robinson (home)'; 'Maloney, Kelly'; 'Dwayne.J.Seiders@maine.gov'; 'Paul.Christman@maine.gov'
Subject: RE: 90% Design Review Meeting

Good morning Everyone,

I have attached two handouts that were discussed during yesterday's meeting. As we discussed yesterday, I will follow up with a new hydraulic table for an 8 ft entrance width.

Thank you,

Greg

Gregory Allen, P.E.
Director, Environmental and Engineering Services
ALDEN Solving flow problems since 1894
30 Shrewsbury St., Holden, MA 01520
(508) 829-6000 ext. 6409
gallen@aldenlab.com | www.aldenlab.com

--
Bryan Sojkowski, P.E.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035
413-253-8645
bryan_sojkowski@fws.gov

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not." - Dr. Seuss

Document Content(s)