## Appendix 8

## Upstream Fishway Construction Permit Applications

a) MDEP Condition Compliance Permit Application for Shawmut Upstream Fishway Construction (December 31, 2019)
b) MWDCA Permit Application for Shawmut Upstream Fishway Construction (May 27, 2019)
c) USACE Joint Permit Application for Shawmut Upstream Fishway Construction (May 20, 2020)

Brookfield

Brookfield Renewable
150 Main Street
Lewiston, ME 04240

Tel 207.755.5600
Fax 207.755.5655
www.brookfieldrenewable.com

December 31, 2019

**VIA FEDERAL EXPRESS**

Ms. Kathy Howatt
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333

Condition Compliance Application for the Shawmut Hydroelectric Project (FERC No. 2322) Upstream Fish Passage Facility

Dear Ms. Howatt:

Brookfield White Pine Hydro, LLC (BWPH), licensee for the Shawmut Hydroelectric Project (FERC No. 2322) (Project), herein provides a Condition Compliance Application 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 Project would be triggered by a) increases in numbers of American shad reaching the Lockwood Project (FERC No. 2574) located approximately one mile downstream of the Shawmut Project or b) development of an alternate trigger for fishway installation based on the biological assessment process for Atlantic salmon, alewife, and blueback herring, whichever comes first.

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. To proactively address protection and enhancement of the Atlantic salmon ahead of any pending action before the Commission (such as Project relicensing), 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 1998 WQC Condition F 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). The agencies provided comments on the 90% design of fish passage facility which have been incorporated into the final design. NMFS provided by letters dated Dec. 26, 2019 comments on review of the final design drawings. FERC's Order Approving Upstream Fishway Design Plans is being sought concurrently with this submittal and will be provided once received.

The fishway's Operations and Maintenance Plan has been developed in coordination with resource agencies to the extent reasonable. Comments on the plan to be incorporated into the final document were provided by NMFS via email dated December 18, 2019. Comments were received from USFWS and MDMR via email dated December 18, 2019. The plan has been submitted to MDIFW and approval will be provided once received. FERC approval is being sought concurrently with this submittal and will be provided once received.

The processing fee of $167.00 is remitted with this Condition Compliance Application. Attached to the Application you will additionally find Exhibits A, B, C, D, E, and F which provide the Project's 1998 WQC, description of the proposed project, final engineering drawings, Operations and Maintenance Plan, Erosion and Sediment Control Plan, and documentation of agency consultation, respectively. Proposed construction activities will comply with the 1998 WQC and Maine Waterway Development and Conservation Act Permit, issued concurrently (#L-19751-33-A-M).

Please contact me should you have any questions.

Sincerely,

Kelly Maloney

Kelly Maloney
Manager, Compliance - Northeast

cc: Kelly Maloney, BWPH
Gerry Mitchell, BWPH

Enclosures: Condition Compliance Application
MDEP Order L-19751-33-A-M
Condition Compliance Application Exhibits
Exhibit A – 1998 WQC
Exhibit B – Project Description
Exhibit C - Final Engineering Drawings
Exhibit D - Operations and Maintenance Plan
Exhibit E - Erosion and Sediment Control Plan
Exhibit F - Agency Consultation Documentation
Condition Compliance Processing Fee (Check, No. 69258)

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Land Resources

FOR DEP USE

#L- ______________________
ATS #____________________
Fees Paid_________________
Date Received _____________

## CONDITION COMPLIANCE APPLICATION

This form shall be used to comply with a condition(s) on an Order that require approval from the Board or Department of Environmental Protection (Department).

Current fee schedule information can be found by contacting the Department or on the Department's website at: http://www.maine.gov/dep/feeschedule.pdf. The fee schedule is updated every November 1. Fees are payable to "Treasurer, State of Maine", and **MUST** accompany the application.

**Please type or print in black ink only**

| | | | |
|---|---|---|---|
| **1. Name of Applicant:** | Kelly Maloney (Brookfield White Pine Hydro LLC) | **5. Name of Agent:** | Greg Allen (Alden) |
| **2. Applicant's Mailing Address:** | 150 Main Street Lewiston, ME 04240 | **6. Agent's Mailing Address:** | 30 Shrewsbury Street Holden, MA 01520 |
| **3. Applicant's Daytime Phone #:** | (207) 755-5600 | **7. Agent's Daytime Phone #:** | (508) 829-6000 |
| **4. Applicant e-mail address (REQUIRED):** | Kelly.Maloney@brookfieldrenewable.com | **8. Agent e-mail address (REQUIRED):** | gallen@aldenlab.com |
| **LOCATION OF ACTIVITY** | | | |
| **9. Name of Project:** | Shawmut Hydroelectric Project | | |
| **10. Name of Town where project is located:** | Fairfield, ME | **11. County:** | Somerset County |
| **REQUIRED INFORMATION** | | | |
| **12. Existing Department Order number:** | #L-19751-33-A-M | **13. Order condition number(s):** | A, D, F |
| **14. Summary of the information being provided:** | Permanent upstream passage facilities will be installed at the Shawmut Hydroelectric Project (FERC No. P-2322) to provide volitional passage of migrating Atlantic salmon and other anadromous fish species past the project. This will include a concrete and steel fish lift with integrated downstream fish passage, a small control building on the dam, a fish ladder connecting the two project tailraces, and two training walls in the tailrace.<br><br>Construction of the new facilities will include the demolition of a small portion of the non-overflow concrete dam to create a channel through this section, the demolition of a training wall in the tailrace, excavation for structure and wall footings, and excavation for a fish ladder exit channel. Any fill will be placed for the purpose of supporting project structures.<br><br>Please see Attachment A for existing department orders, Attachment B for a further detailed project description, and Attachment C for final project drawings. | | |
| **15. Project Manager, if known:** | Kathy Howatt | | |

This completed application form, fee, and all supporting documents summarized above shall be sent to the appropriate Department Office in Augusta, Portland, or Bangor.

| | | |
|---|---|---|
| Department of Environmental Protection<br>17 State House Station<br>Augusta, ME 04333<br>Tel: (207) 287-7688 | Department of Environmental Protection<br>312 Canco Road<br>Portland, ME 04103<br>Tel: (207) 822-6300 | Department of Environmental Protection<br>106 Hogan Road<br>Bangor, ME 04401<br>(207) 941-4570 |

**CERTIFICATIONS / SIGNATURES on PAGE 2**

**<u>IMPORTANT</u>: IF THE SIGNATURE BELOW IS NOT THE APPLICANT'S SIGNATURE, ATTACH LETTER OF AGENT AUTHORIZATION SIGNED BY THE APPLICANT.**

**By signing below, the applicant (or authorized agent), certifies that he or she has read and understood the following:**

## CERTIFICATIONS / SIGNATURES

**"I certify under penalty of law that I have personally examined the information submitted in this document and all attachments thereto and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the information is true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I authorize the Department to enter the property that is the subject of this application, at reasonable hours, including buildings, structures or conveyances on the property, to determine the accuracy of any information provided herein.**

**Further, I hereby authorize the Department to send me an electronically signed decision on the license I am applying for with this application by e-mailing the decision to the electronic address located on the front page of this application (see #4 and #8)"**

**Signed:** Kelly Maloney **Title:** Manager, Compliance **Date:** 12/31/2019

# Exhibit A- 1998 WQC

STATE OF MAINE
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
17 STATE HOUSE STATION
AUGUSTA, MAINE
04333

ANGUS S. KING, JR.
GOVERNOR

DEPARTMENT ORDER

IN THE MATTER OF

| | | |
|---|---|---|
| CENTRAL MAINE POWER COMPANY | ) | WATER QUALITY CERTIFICATION |
| FAIRFIELD, SOMERSET COUNTY, ME. | ) | |
| SHAWMUT HYDRO PROJECT | ) | |
| | ) | FINDINGS OF FACT AND ORDER |
| #L-19751-33-A-M (Approval) | ) | FISH PASSAGE MODIFICATION |

Pursuant to the provisions of 38 MRSA Sections 464 et seq. and Section 401 of the Federal Water Pollution Control Act (a.k.a. Clean Water Act), the Department of Environmental Protection has considered the application of CENTRAL MAINE POWER COMPANY with its supportive data, agency review comments, and other related materials on file and FINDS THE FOLLOWING FACTS:

1. APPLICATION SUMMARY

   The applicant proposes to modify the fish passage conditions of the existing federal license for the Shawmut Hydro Project to be consistent with the terms of the May 26, 1998 *Agreement Between Members of the Kennebec Hydro Developers Group, the Kennebec Coalition, the National Marine Fisheries Service, the State of Maine, and the US Fish and Wildlife Service ("KHDG Settlement Agreement")*. The Shawmut Project is licensed to Central Maine Power Company as FERC Project No. 2322, and is located on the Kennebec River in the Towns of Fairfield, Benton and Clinton, Somerset and Kennebec Counties, Maine.

2. PROCEDURAL HISTORY

   a. 1986 KHDG Agreement. In 1986, the applicant joined with several other hydropower project owners in entering into an agreement with the State's fisheries agencies regarding the restoration of anadromous fish to the Kennebec River system. Under the terms of the *Agreement Between the State of Maine and Kennebec Hydro Developers Group ("1986 KHDG Agreement")*, effective January 23, 1987, the project owners were to provide a total of $1.86 million over a 12-year period to facilitate restoration efforts (specifically, to finance the trapping, trucking and stocking of anadromous fish and studies of fish passage efficiencies and habitat needs) and to provide permanent fish passage at their dams during the 1999-2001 period in accordance with a revised restoration plan. The agreement covered four projects (Lockwood, Hydro-Kennebec, Shawmut, and Weston) on the Kennebec River and three projects (Fort Halifax, Benton Falls, and Burnham) on the Sebasticook River.

The *1986 KHDG Agreement* did not address fish passage at the Edwards Dam in Augusta, which represents the first barrier on the Kennebec River to the upstream spawning migration of anadromous fish.

b. Original Approval. In its original application, the applicant proposed that the FERC license for the Shawmut Project be amended to incorporate fish passage conditions consistent with the terms of the *1986 KHDG Agreement*. In an Order issued January 25, 1989, FERC approved the amendment of the license. The DEP waived water quality certification on this action.

In summary, the *1986 KHDG Agreement* provided that the applicant:

- Provide funding and conduct fisheries studies in accordance with the 1986 KHDG Agreement;
- Install permanent upstream and downstream fish passage facilities at the project no later than May 1, 2000;
- Submit final design and operational plans for all fish passage facilities for agency approval prior to construction;
- Conduct a follow-up study to determine the effectiveness of all fish passage facilities;
- Submit a fish passage study plan for agency approval prior to implementation of the study; and
- Submit the results of the fish passage study and any recommendations for improvements in fish passage design or operation.

Both the condition and the *1986 KHDG Agreement* provided that, if continuation of the interim trap and truck program after 1998 (when the 12-year program funding ran out) will meet the fish restoration objectives of the State's restoration plan, any party to the agreement could apply for a revision of the fish passage conditions for the project.

c. Restoration Activities. For the 11 years between 1987 and 1997, inclusive, the Department of Marine Resources stocked a total of over 530,000 adult alewive spawners into the Kennebec and Sebasticook Rivers above the Edwards Dam. These fish were trapped and trucked from the Brunswick fishway on the Androscoggin River and from the Edwards Dam using an experimental fish pump installed in 1989.

During the same time period, DMR stocked a total of 7,830 adult shad spawners and over 3.5 million juvenile shad (fry and fingerlings) into the Kennebec and Sebasticook River systems. The adult shad were trapped and trucked from the Narraguagus River in Washington County, Maine, and from the Connecticut River in Holyoke, Massachusetts.

Beginning in 1993, juvenile shad were trucked from a new hatchery on the Medomak River in Waldoboro.

Currently, there is no plan for active salmon restoration in the Kennebec drainage. To date, the interim plan has been to move whatever salmon become available at the Edwards Dam upriver. Only a few salmon were released above the Edwards Dam during the 11 year restoration period.

In addition, permanent downstream fish passage facilities were constructed at the Fort Halifax and Benton Falls Projects and studies were conducted of alewive downstream passage on the Sebasticook River and a cooperative study among DEP, DMR and DIF&W to determine whether alewife stocking would be detrimental to resident fish species and water quality in lakes in the Kennebec drainage.

As of 1997, and apart from the experimental fish pump that was installed in 1989 and which proved effective only for alewives, no progress had been made in obtaining permanent state-of-the-art fish passage for all anadromous fish at the Edwards Dam.

d. <u>1997 Proposal</u>. On April 23, 1997, after negotiations between the KHDG members, the State, and the Kennebec Coalition to revise fish passage installation dates and to allow for continued contributions to the trap and truck program reached an impasse, the KHDG members filed to amend the FERC licenses for the projects covered by the *1986 KHDG Agreement* to, among other things, (1) require installation of fish passage facilities only when (a) either permanent fish passage is available at the Edwards Dam or that dam is removed, and (b) a biological assessment process determines that restoration efforts have advanced sufficiently to require fish passage at the dams above the Edwards Dam, and (2) modify the schedule to submit fish passage design plans until after it has been determined through a biological assessment process that fish passage facilities are necessary.

The KHDG members' proposal was subsequently opposed by the State of Maine, the US Departments of Interior and Commerce, and the Kennebec Coalition.

On August 1, 1997, the DEP received a filing from the KHDG members to amend the fish passage conditions of the DEP permits /certifications for several KHDG member-owned projects to be consistent with the April 23, 1997 KHDG members' filing with FERC.

By Order dated September 26, 1997, FERC found the KHDG members' applications for amendment of licenses to change fish passage requirements to be untimely, and denied the proposed amendments without prejudice to the applications being refiled after new licenses were issued for the Fort Halifax and Weston Projects.

By letter dated October 20, 1997, the DEP agreed to retain the KHDG members' applications on file as pending applications, subject to appropriate action after (1) new licenses had been issued by FERC for the Fort Halifax and Weston Projects, (2) the KHDG members' applications for license amendments had been refiled with FERC, and (3) there had been an opportunity for a negotiated agreement between the KHDG members and the State of Maine on all outstanding fish passage issues.

e. 1998 Agreements. On May 26, 1998, various parties, including the State of Maine and the KHDG members, signed the Lower Kennebec River Comprehensive Hydropower Settlement Accord. Once approved by FERC and other regulatory agencies, this accord will accomplish the following:

- A charitable donation of the Edwards Dam from Edwards Manufacturing Company to the state of Maine;
- The removal of the Edwards Dam by the State of Maine in 1999;
- Contribution of $2.5 million for dam removal and related activities by Bath Iron Works and $4.75 million for fish restoration activities and studies and dam removal by the members of the Kennebec Hydro Developers Group; and
- The amendment of certain fish passage obligations at seven dams on the Kennebec and Sebasticook Rivers owned by KHDG members.

Included as part of the accord is the *Agreement Between Members of the Kennebec Hydro Developers Group, the Kennebec Coalition, the National Marine Fisheries Service, the State of Maine, and the US Fish and Wildlife Service ("KHDG Settlement Agreement")*. The Agreement is intended to: achieve a comprehensive settlement governing fisheries restoration, for numerous anadromous and catadromous species, that will rapidly assist in the restoration of these species in the Kennebec River after the termination on December 31, 1998 of the *1986 KHDG Agreement*; avoid extensive litigation over fish passage methodologies, timetables and funding; assist in the removal of the Edwards Dam; and fund the next phase of a fisheries restoration program for the Kennebec River.

By letter dated July 20, 1998, the KHDG members have requested that DEP resume the processing of their pending applications such that the fish passage conditions of the DEP permits/certifications for several KHDG member-owned projects are amended to be consistent with the *KHDG Settlement Agreement*. CMP has also requested that DEP process water quality certification for the Shawmut project to incorporate the terms of the *KHDG Settlement Agreement*.

3. REVIEW COMMENTS

The Maine Department of Marine Resources, Department of Inland Fisheries and Wildlife, and State Planning Office, the Kennebec Coalition (American Rivers, Inc., the Atlantic Salmon Federation, Kennebec Valley Chapter of Trout Unlimited, the Natural Resources Council of Maine, and Trout Unlimited), the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the Edwards Manufacturing Company, and the City of Augusta, Maine, are all on record in support of the Settlement Accord and the *KHDG Settlement Agreement*.

No comments in opposition to the terms of the *KHDG Settlement Agreement* have been received from any public or private entity or person.

BASED on the above Findings of Fact, and the evidence contained in the application and supporting documents, the Department CONCLUDES that there is a reasonable assurance that the modification of the fish passage conditions of the FERC license for the Shawmut Hydro Project to be consistent with the terms of the *KHDG Settlement Agreement* will not violate applicable water quality standards.

THEREFORE, the Department hereby GRANTS water quality certification for the installation of fish passage facilities and other activities relating to the restoration of anadromous fish with respect to the Shawmut Hydro Project, subject to the following conditions:

A. FISHERIES RESTORATION SUPPORT

The applicant shall provide funding, conduct studies, engage in consultation, install fish passage facilities, report on annual restoration activities, and comply with all additional duties and obligations as set forth in the *Agreement Between Members of the Kennebec Hydro Developers Group, the Kennebec Coalition, the National Marine Fisheries Service, the State of Maine, and the US Fish and Wildlife Service ("KHDG Settlement Agreement")*, dated May 26, 1998.

B. EEL PASSAGE

(1) Study. The applicant shall, in consultation with the National Marine Fisheries Service and the US Fish and Wildlife Service, join other KHDG members and the Department of Marine Resources in undertaking a three-year research project to determine (a) the appropriate placement of upstream fish passage for American eel at each of the seven KHDG member-owned dams, and (b) appropriate downstream fish passage measures for American eel at each KHDG member-owned project.

(2) Consultation. Based on the results of the eel passage study and beginning no later than January 1, 2002 and ending no later than June 30, 2002, the applicant shall join other KHDG members in consulting with NMFS, USFWS, and DMR to attempt to reach agreement on the appropriate location of upstream eel passage at each KHDG member-owned dam, and the appropriate downstream eel passage measures to apply to each KHDG member-owned project.

(3) Upstream Passage. If agreement is reached by all consulting parties on the location of upstream eel passage at each project, the applicant shall install such passage facilities at the Shawmut Project during 2002.

(4) Downstream Passage. If agreement is reached by all consulting parties on appropriate downstream eel passage measures, the applicant shall join the other parties in requesting that FERC approve the agreed-to passage measures.

(5) Lack of Consensus. If no consensus is reached on eel passage issues by June 30, 2002, the applicant or any of the consulting parties shall be free to petition DEP or FERC to approve appropriate conditions relating to eel passage at the project.

(6) Lack of Funding. In the event that DMR does not receive the necessary appropriation or legislative spending authorization required to fund the eel passage study discussed above, all provisions of this condition regarding eel passage shall be null and void.

C. INTERIM DOWNSTREAM FISH PASSAGE

The applicant shall continue and where needed improve existing interim operational measures to diminish entrainment, allow downstream passage, and eliminate significant injury or mortality to out-migrating anadromous fish, in accordance with the terms of the *KHDG Settlement Agreement.*

D. PERMANENT UPSTREAM FISH PASSAGE

(1) Installation and operation. Permanent upstream fish passage facilities shall be installed and operational at the project no later than 2 years following (a) the passage of at least 15,000 American shad in a single season through a permanent upstream fish passage facility at the Hydro Kennebec Project or (b) development of an alternate trigger for fishway installation based on the biological assessment process for Atlantic salmon, alewife and blueback herring described below, whichever comes first, provided, however, that in no event shall permanent upstream fish passage facilities be required to be operational at the project before May 1, 2012.

(2) Biological assessment process. State and federal fisheries agencies will continue to assess the status and growth of the populations of shad and other anadromous fish in the Kennebec River drainage. Should the growth of Atlantic salmon, alewife or blueback

herring spawning runs make it necessary to adopt an alternative approach for triggering fishway installation to the shad trigger used above, the agencies will meet with the applicant to attempt to reach consensus on the need for and timing and design of permanent upstream fish passage facilities at the project. Any disputes on the need for an alternate trigger for fishway installation will be handled through the FERC process.

E. PERMANENT DOWNSTREAM FISH PASSAGE

Permanent downstream fish passage facilities shall be installed and operational at the project no later than the date on which permanent upstream fish passage facilities are operational at the project as required by this approval.

F. FISH PASSAGE FACILITIES PLANS

The applicant shall, in accordance with the schedule(s) established by FERC, submit final design and operational plans for all interim and 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.

G. FISH PASSAGE EFFICIENCY STUDIES AND RESULTS

(1) Studies. The applicant shall, in consultation with state and federal fisheries agencies, conduct a study or studies to determine the effectiveness of all interim and permanent upstream and downstream fish passage facilities and/or operational measures required by this approval, in accordance with the terms of the *KHDG Settlement Agreement*.

(2) Study plans. The applicant shall, in accordance with the schedule(s) established by FERC, submit plans for a study or studies to determine the effectiveness of all interim and 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 implementation.

(3) Results of studies. The applicant shall, in accordance with the schedule(s) established by FERC, submit the results of any fish passage effectiveness study or studies, along with any recommendations for changes in the design and/or operation of any interim or permanent upstream or downstream fish passage facilities constructed and/or operated pursuant to this approval. The Department reserves the right, after notice and opportunity for hearing, to require reasonable changes in the design and/or operation of these fish passage facilities as may be deemed necessary to adequately pass anadromous fish through the project site. Any such changes must be approved by FERC prior to implementation.

CENTRAL MAINE POWER COMPANY ) WATER QUALITY CERTIFICATION
FAIRFIELD, SOMERSET COUNTY, ME. )
SHAWMUT HYDRO PROJECT )
) FINDINGS OF FACT AND ORDER
#L-19751-33-A-M (Approval) ) FISH PASSAGE MODIFICATION

DONE AND DATED AT AUGUSTA, MAINE, THIS 31st DAY OF July, 1998.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY: Martha Kirkpatrick
for Edward O. Sullivan, Commissioner

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES

Date of initial receipt of application: 8/1/97

Date application accepted for processing: 8/7/97

FILED
AUG - 4 1998
BOARD OF ENVIRONMENTAL PROT.
STATE OF MAINE

Date filed with Board of Environmental Protection: ______________

This Order prepared by Dana Murch, Bureau of Land & Water Quality.

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# Exhibit B- Project Description

# Shawmut Hydroelectric Project (FERC No. 2322)
## Upstream Fish Passage Facility

### Project Description

The Shawmut Hydroelectric Project (FERC No. 2322) (Project), owned and operated by Brookfield White Pine Hydro, LLC (BWPH), is located on the Kennebec River (river mile 66) in the Towns of Benton and Fairfield, Somerset County, Maine.

The Shawmut Project includes a 1,310-acre reservoir, a 1,135 foot long dam with an average height of about 24 feet, headworks and intake structure, 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 8 foot deep log sluice equipped with a timber and steel gate.

The headworks and intake structure 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; the 1912 powerhouse is located to the east, and the 1982 powerhouse is located to the south. 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. 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 1912 powerhouse contains six generating units (Units 1 – 6), and the 1982 powerhouse contains two generating units (Unit 7 and 8). The project typically operates as run-of-river, with a target reservoir elevation near the full pond elevation of 112.0 feet during normal conditions. The total maximum hydraulic capacity of the turbines is 6,755 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. Figure 1 provides an overview of Shawmut.


**FIGURE 1. SHAWMUT PROJECT OVERVIEW**

Under the FERC approved Interim SPP, BWPH proposes to install a permanent upstream fish passage facility at the Project so to provide volitional passage for the upstream migration of salmon and other anadromous species.  This will include a fish lift with integrated attraction water intake and spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse, a short fish ladder connecting the Units 7 and 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 and 8 powerhouse.

*Fish Lift*

The lower portion of the fish lift structure will consist of about an 81 ft long, 21 ft wide, and 24 ft tall concrete and steel entrance flume.  The entrance flume will include a pivoting entrance gate, a set of v-trap gates, approximately 11 ft by 11 ft traveling hopper, a baffle wall, and a v-shaped baffled weir.  Set upon the entrance flume will be an approximately 31 ft long, 15 ft wide, and 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 16 to 10 ft wide (varying width) spillway will be cut into the non-overflow portion of the dam and extend while turning about 53 degrees to spill 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 out into the reservoir. At the downstream edge of the existing dam the floor of the spillway channel will include an intake consisting of a 16 ft long by 16 ft wide wedge wire screen which diverts water from the spillway to the energy dissipation pool.
The attraction water intake and spillway is designed to divert 340 cfs from the upper pond; of this 115 to 225 cfs will be diverted through the wedge wire screen intake to the energy dissipation pool and then the fish lift entrance flume. The remaining 115 to 225 cfs will continue to spill adjacent to the fish lift entrance. See Attachment E for facility drawings.

*Fish Ladder*

An approximately 77 ft long 10.5 ft wide fish ladder will be placed at the upstream end of the island to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway 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 through 6 tailrace to the fish ladder exit. The excavated rock channel will be at existing grade near the Unit 1 through 6 tailrace and about 5 ft deep at the fish ladder. Access stairs from the roof of the Unit 7 and 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 ladder.

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. This channel is located adjacent to the Unit 7 and 8 powerhouse and fish ladder. See Attachment D for facility drawings.

The proposed fishway will be operational from May 1st to October 1st and the fish lift hopper will have a cycle time of approximately 15 minutes. The fishway will have an operating range designed for river flows between 2,540 cubic feet per second (cfs) and 20,270 cfs and will maintain an attraction flow of 0.5 feet per second (FPS) in the exit flume and 6 FPS in 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).

The following temporary and permanent impacts are anticipated from the proposed project:

| **Resource Area** | **Temporary /Permanent** | **Type** | **Amount** |
|---|---|---|---|
| Riverine | Permanent excavation | Bedrock Removal | 16,000 $ft^2$ and 590 $yd^3$ |
| Riverine | Permanent Fill | Concrete Placement<br>Structural Fill | Concrete 1550 CY<br>Structural Fill 250 CY |
| Shore Land | Temporary | Temporary staging areas and temporary construction facilities | 12,000 $ft^2$ of disturbance with no volume placed or removed |

**Construction Schedule, Means and Methods**

Construction of the proposed facility is scheduled to being in spring 2020. Targeted completion of the facility is scheduled for spring 2021.

The following is an overview of assumed construction sequencing for the proposed fish lift and fish ladder at Shawmut. Actual sequencing may vary depending on the means and methods chosen by the selected contractor.

*Fish Lift*

The assumed staging area for fish lift construction will be about 300 ft upstream of the work location on land adjacent to the railroad tracks and river which is accessible by an existing gravel road.  Personnel and small tools may be transported to the site in light vehicles driven over the head gate and dam structures.  It is assumed that heavy machinery and construction materials will be transported from the staging area to the work site by barge and lifted into place by a barge mounted crane.  A temporary barge tressle will be installed adjacent to the staging area for docking and loading the barge.

It is assumed that a custom cofferdam or steel bulkhead will be fastened to the upstream face of the dam and drained to construct the attraction water intake channel through the non-overflow section of the dam. A dewatering structure would be installed in the tailrace to surround the lower pond construction.  The contractor will design dewatering structures (cofferdams and bulkhead) to meet applicable standards and meet their access and construction sequencing needs. It is assumed that steel sheet pile, sand bag, or equivalent would be used in cofferdam construction.

Erosion control will be required around all disturbed land and staging areas.  Suspended turbidity curtains will surround all dewatering structures.  Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river. Once dewatering and erosion measures are in place demolition and excavation will commence.  For the fish lift, demolition will include the removal of an approximately 16 ft wide 14 ft deep channel in the non-overflow portion of the concrete dam.

*Fish Ladder*

The staging area for fish ladder construction is assumed to be adjacent to the Units 7 and 8 Tailrace in the flat area just downstream of the power house.  This area is accessible by the paved project entrance lot.  It is assumed that personnel will travel over the Units 7 and 8 powerhouse to the training wall island carrying small tools and supplies while a crane would lift large equipment and construction materials from the staging area to the island.

Two dewatering structures (cofferdams) will be required for the fish ladder construction: one is assumed to extend from the downstream most corner of the Units 1 through 6 Power House to about the bend in the existing tailrace training wall, and another is assumed to span from the Northeast corner of the Units 7 and 8 powerhouse to about the center of the training wall island. The contractor will design dewatering structures (bulkhead and cofferdams) to meet applicable standards and meet their access and construction sequencing needs. It is assumed that steel sheet pile, sand bag, or equivalent would be used in cofferdam construction.

Erosion control will be required around all disturbed land and staging areas. Suspended turbidity curtains will surround all cofferdams. Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river.

**Proposed Project Photos**

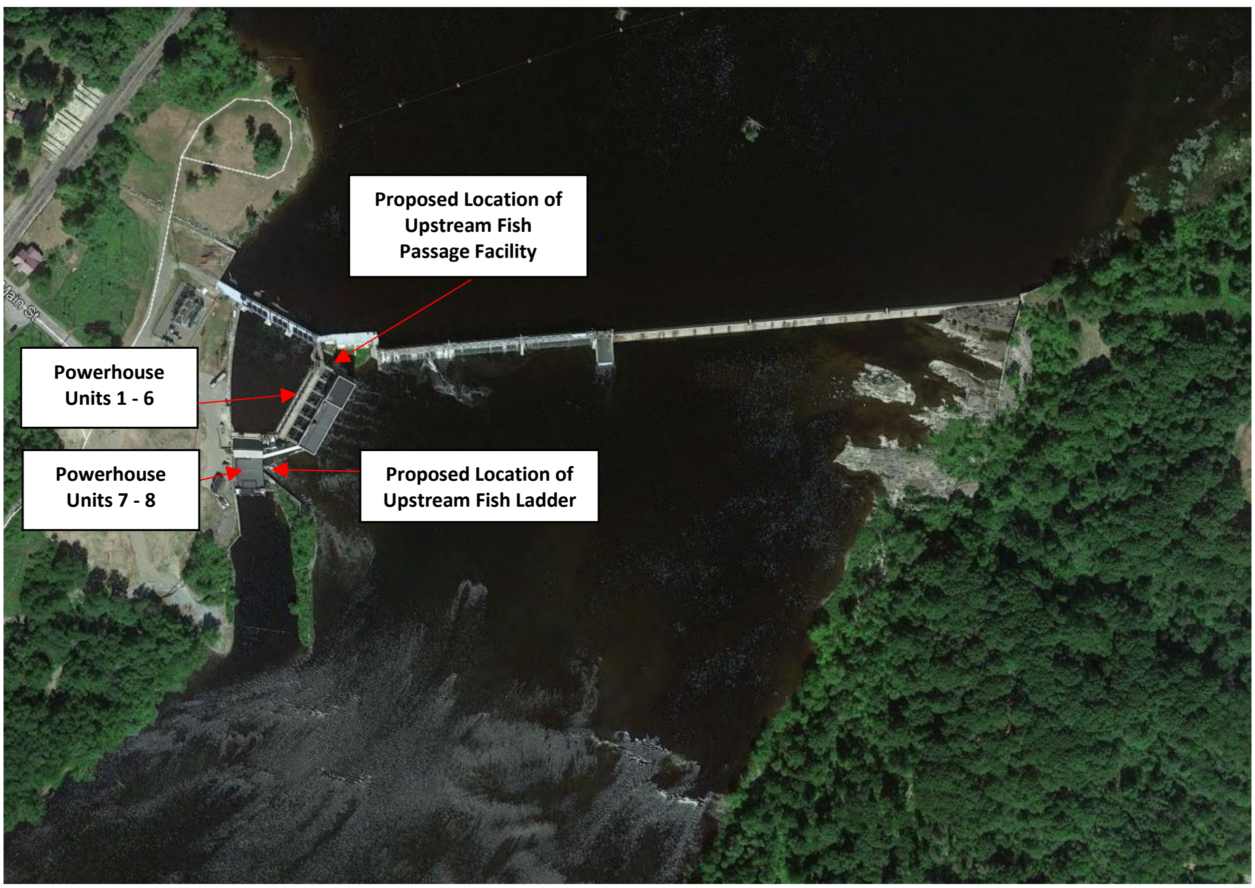



**FIGURE 2. SHAWMUT DAM, POWERHOUSES, TAILRACES, PROPOSED LOCATION OF UPSTREAM FISH PASSAGE FACILITY (PHOTO YEAR: 2018)**

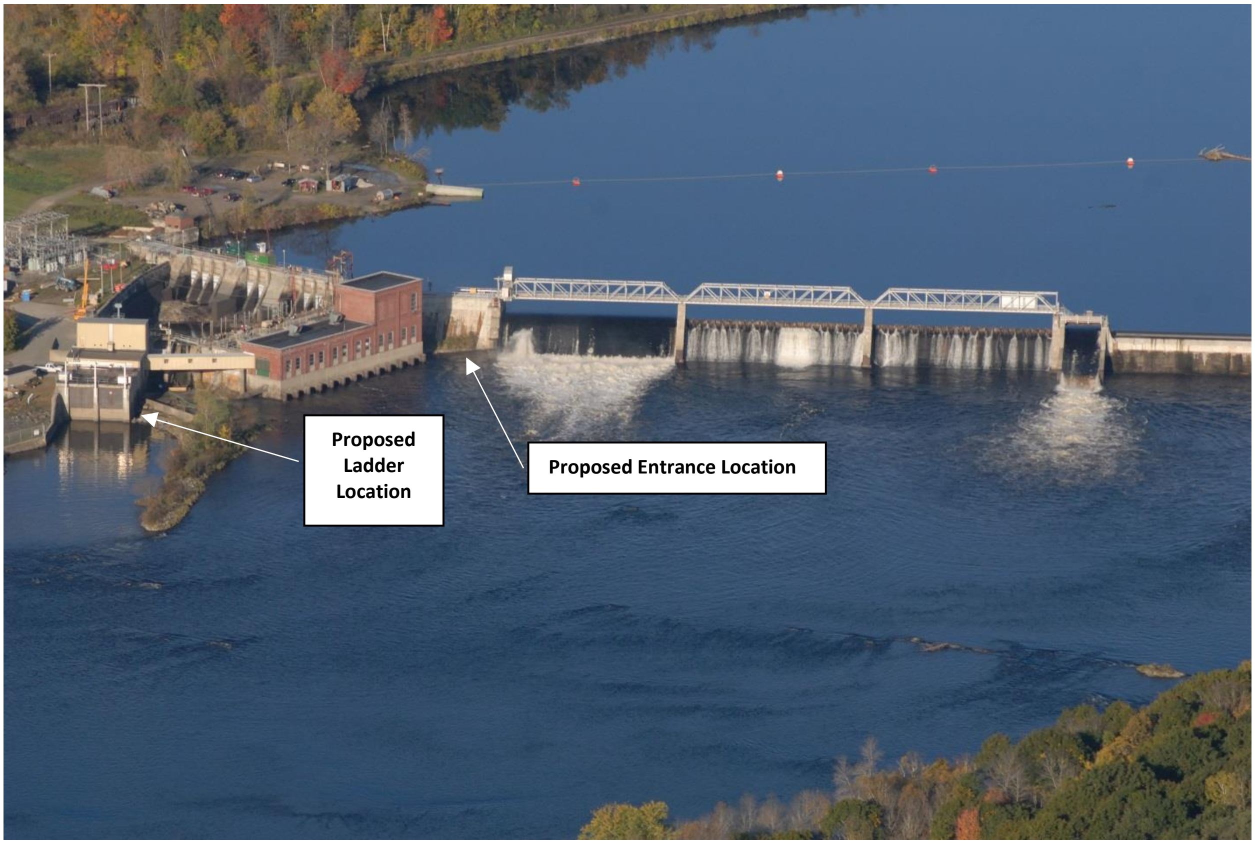



**FIGURE 3. PROPOSED ENTRANCE LOCATION TO UPSTREAM FISH PASSAGE FACILITY AND FISH LADDER (PHOTO DATE: 10/12/09)**


**FIGURE 4. PROPOSED EXIT LOCATION FROM UPSTREAM FISH PASSAGE FACILITY (PHOTO DATE: 10/12/09)**

**FIGURE 5: VIEW FROM THE TOP OF THE HEAD GATES LOOKING AT THE EXISTING CONCRETE DECK ABOVE THE NON-OVERFLOW PORTION OF THE DAM TO BE MODIFIED.**

In the bottom of view is a concrete ramp leading from the head gate structure walkway to the non-overflow section structure; the spillway sections of the dam extend across the river in the top of the view. A fish lift for upstream fish passage and a channel for the attraction water intake will be placed downstream (right in view) of the non-overflow dam structure. A 12 ft wide intake channel will be cut into this portion of the dam near the far end of this platform about where the equipment and worker are located; this intake channel will provide attraction water for the fish lift. A 20 inch diameter fiberglass fish return pipe will be run from right to left across the far end of the platform; this will discharge fish collected by the fish lift system to the impoundment. The upper level of the lift tower will be accessible from the downstream side (right in view) of this platform via a new steel grating platform.

**FIGURE 6: VIEW FROM WHERE THE NON-OVERFLOW DAM SECTION MEETS THE HEAD GATE STRUCTURE LOOKING TOWARD THE DOWNSTREAM SIDE OF THE NON-OVERFLOW PORTION OF THE DAM.**

The platform from Figure 5 is to the left and the Units 1 through 6 power house is to the right. The fish lift tower and downstream bypass channel will be placed in what is now the grass covered area extending out to be in line with the stepped buttress near the center of the image. The power house structure will not be affected by the fish lift or new spill way.

**FIGURE 7: VIEW FROM ABOVE THE HEAD GATE STRUCTURE LOOKING DOWNSTREAM INTO THE FOREBAY.**

The brick building to the left is the Units 1 through 6 powerhouse, the yellow structure in center-view sits atop the Units 7 and 8 powerhouse. Between the two structures is the Tainter gate. No modifications will be made to any of the structures in this view, however it provides an orientation for the Tainter gate.

**FIGURE 8: VIEW FROM AN ACCESS PLATFORM BEHIND THE UNITS 7 AND 8 POWERHOUSE LOOKING AT THE DOWNSTREAM FACE OF THE TAINTER GATE.**

Upstream of the gate is the forebay pictured in Figure 7. No modifications will be made to the gate, but the discharge from the gate will be modified to discharge into the Unit 7 and 8 powerhouse adjacent to the fish ladder.

**FIGURE 9: VIEW FROM AN ACCESS PLATFORM BEHIND THE UNITS 1 THROUGH 6 POWERHOUSE LOOKING AT THE DISCHARGE FROM THE TAINTER GATE SHOWN IN FIGURE 8.**

The concrete structure in the background is the Units 7 and 8 powerhouse and the yellow structure is a covered catwalk connecting the two project powerhouses. The grey steel Tainter gate pivot arms are visible in the upper center view. A concrete channel will be placed in the Tainter gate discharge to route this flow to Units 7 and 8 tailrace adjacent to the new fish ladder.

**FIGURE 10: VIEW FROM ABOVE THE TAINTER GATE LOOKING DOWNSTREAM.**

The Units 7 and 8 powerhouse is to the right and the corrugated steel structure is a catwalk connecting the two project powerhouses.  A concrete spillway channel will be placed in the discharge of the Tainter gate to discharge flow to the unit 7 and 8 powerhouse tailrace adjacent to the fish ladder.

**FIGURE 11: VIEW FROM THE PLATFORM ON THE DOWNSTREAM END OF THE FOREBAY BETWEEN THE TWO POWERHOUSES LOOKING DOWNSTREAM.**

In the bottom of the view is the roof of the covered catwalk that connects the two project powerhouses, the concrete building to the right is the Units 7 and 8 powerhouse, in the center is the training wall and island, and above the wall is the Units 7 and 8 tailrace. About 25 ft of the wall the near the powerhouse (right in view) will be demolished and the adjacent earth excavated to make room for a fish ladder and concrete spillway channel. A10 ft wide concrete channel will be placed where the wall meets the powerhouse following the powerhouse wall to the Tainter gate (not shown). Parallel and abutting the channel will be a 10.5 to 6.8 ft wide by 77 ft long fishway (fish ladder). A concrete training wall will extend from the fish ladder approximately 80 ft along the right side of the island. A stairway will come off the powerhouse roof down to a steel grating walkway over the channel and fishway. Excavations below the waterline will be made in the foreground and in the tailrace.

# Exhibit C- Drawings

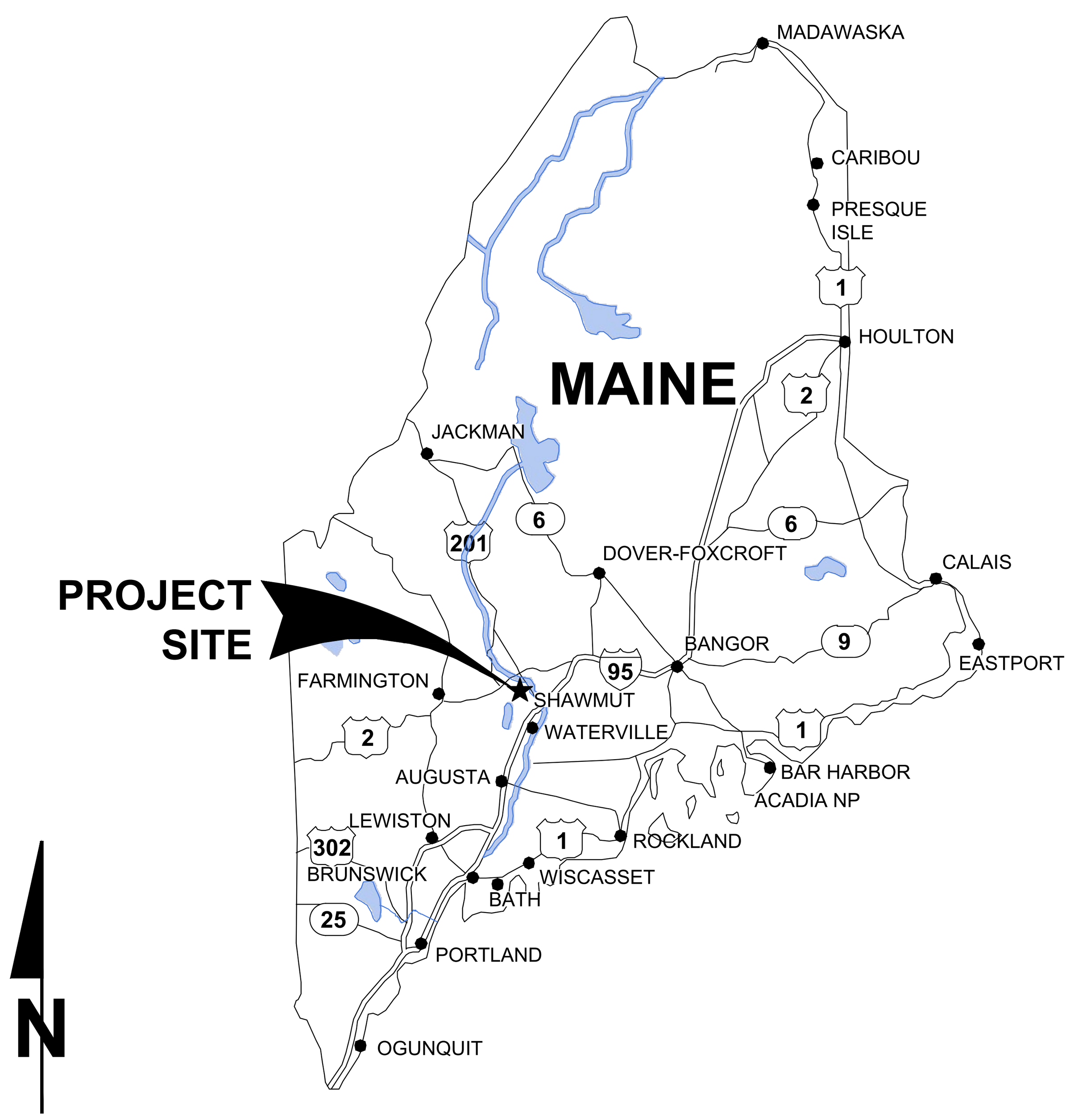
# SHAWMUT HYDROELECTRIC STATION
# UPSTREAM FISH PASSAGE

## PREPARED FOR

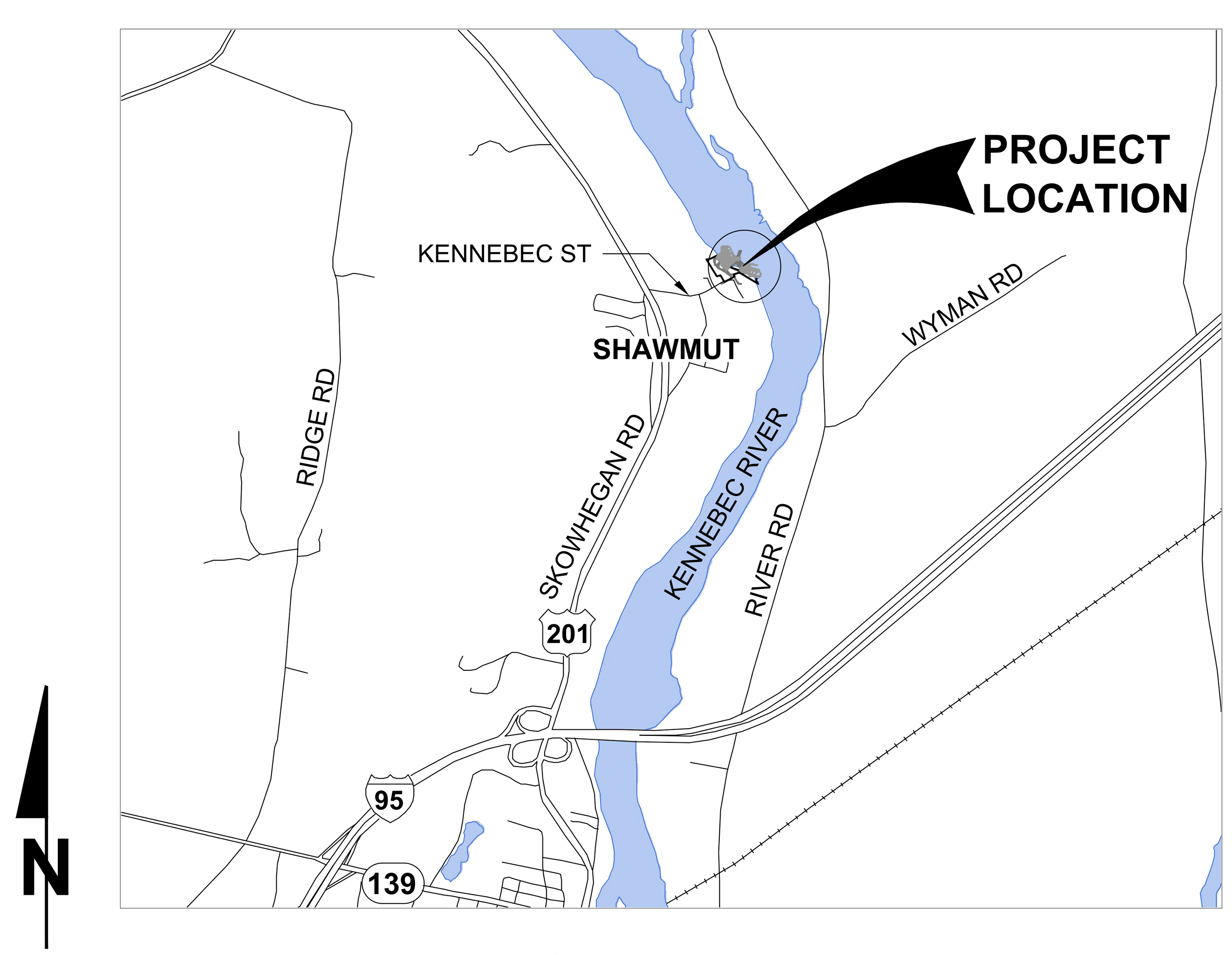
# BROOKFIELD WHITE PINE HYDRO, LLC

## PREPARED BY

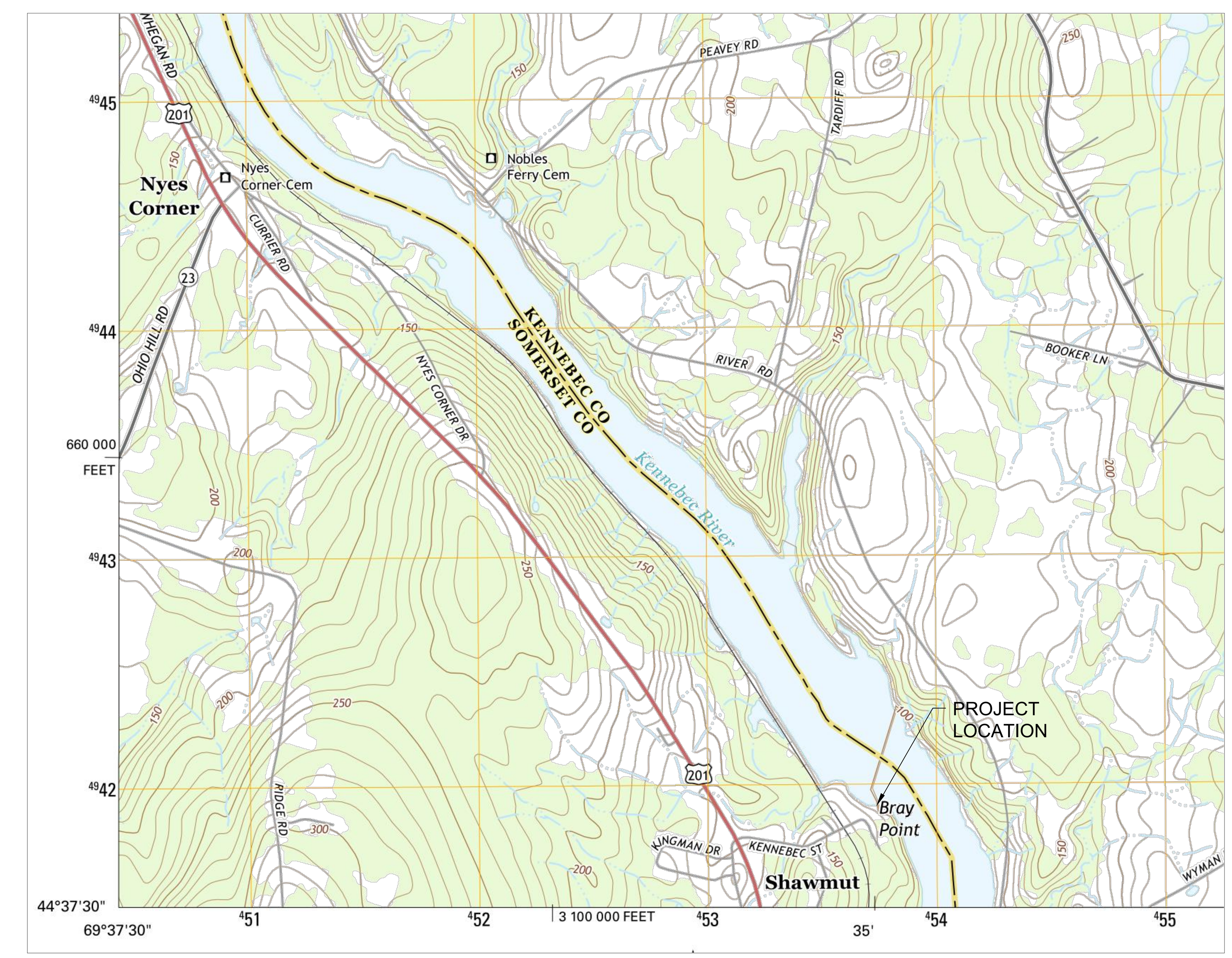
ALDEN RESEARCH LABORATORY, INC




**LOCATION MAP**
SCALE: NTS




**VICINITY MAP**
SCALE: NTS




**LOCATION MAP**
SCALE: NTS

**FINAL FOR BID**
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**DECEMBER 13, 2019**

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


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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\3109-alden misc 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

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**DECEMBER 13, 2019**

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TEL: (508) 829-6000 www.aldenlab.com

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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

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden msa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\G\G-002.dwg USER: Agrogan
DATE: Dec 13, 2019 2:32pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT G-SHWMT-7-8_STAMP MAINE-PE-STAMP-MDG IMAGES:

## 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 |
| CONSTR | 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 |

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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 |

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**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.

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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 |


## 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 |

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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 |


## 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

**SITE PLAN**
SCALE: 1"=30'

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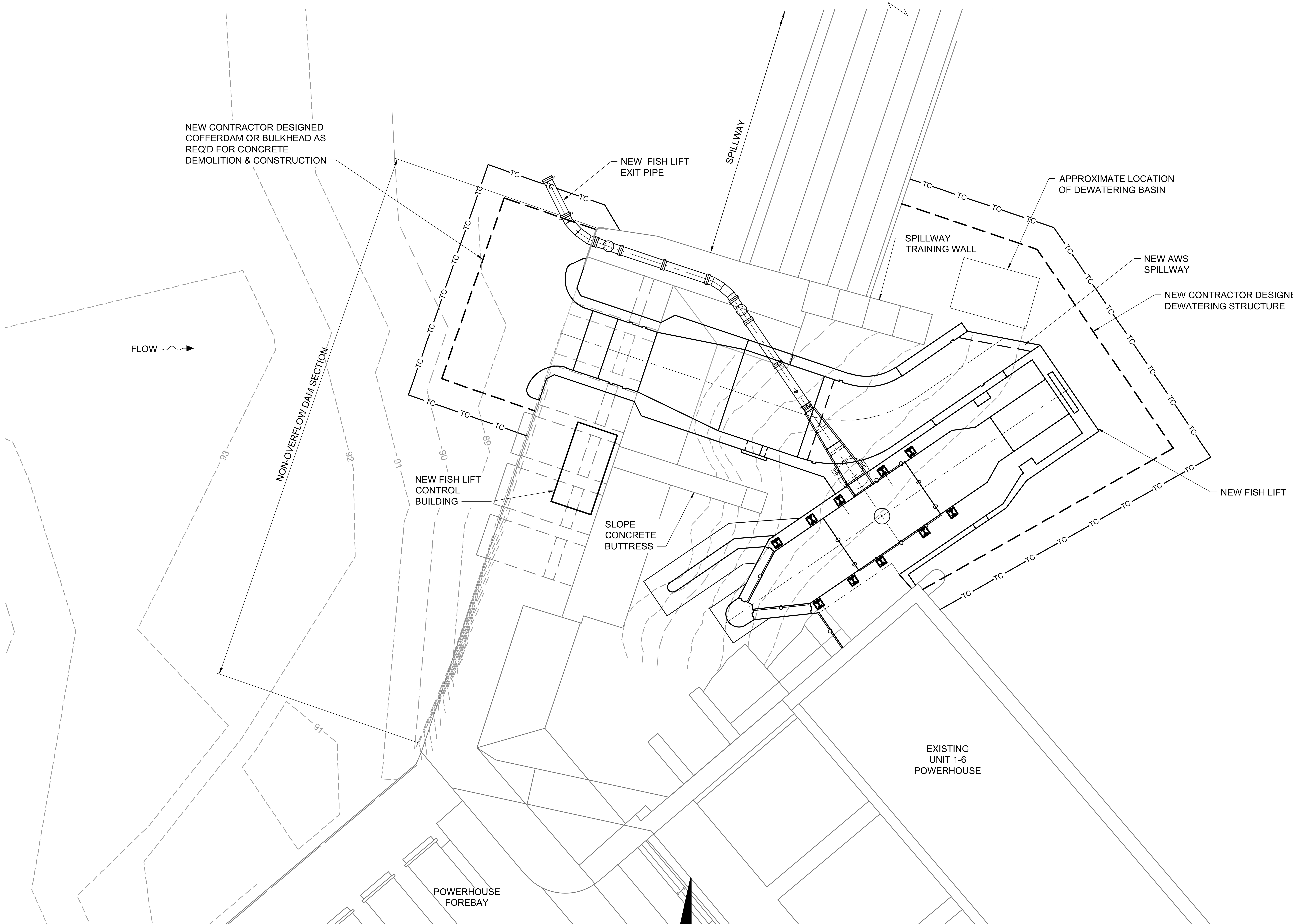
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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

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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\agrogan\documents\autocad sheet sets\131009-alden nss and projects\holden office projects\SHAWMUT\1900 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-PL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP C-SHWMT-PFW S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

**NOTE:**

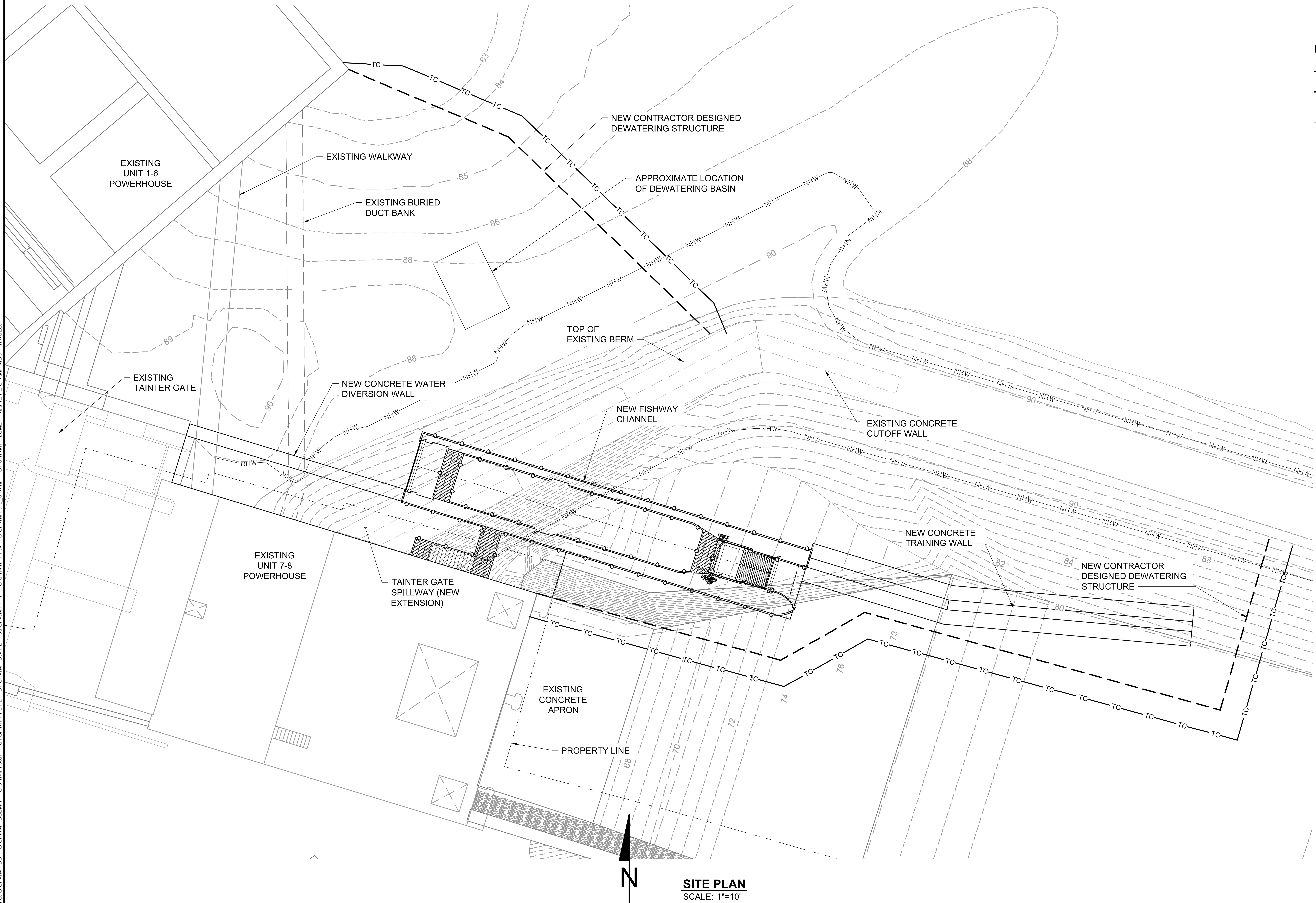
1. SEE DRAWING G-009 FOR TYPICAL DETAILS.

**LEGEND:**

—TC—— TC—— TURBIDITY CURTAIN

— — — — COFFERDAM/BULKHEAD/DEWATERING STRUCTURE

—NHW—— NHW—— NORMAL HIGH WATER LINE




**SITE PLAN**

SCALE: 1"=10'

**FINAL FOR BID**

**NOT FOR CONSTRUCTION**

**DECEMBER 13, 2019**

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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 |

DWG: C:\users\agrogan\documents\autocad sheet sets\31009-alden niss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\G-008.dwg USER: Agrogan
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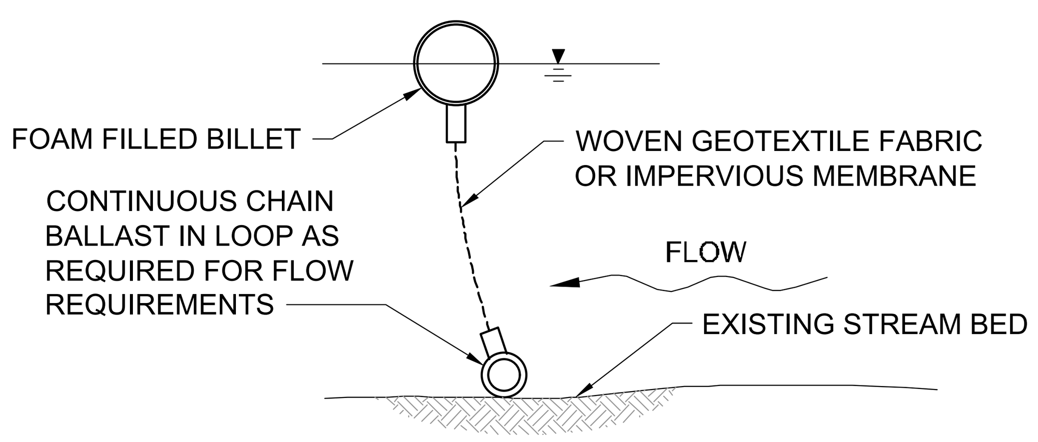
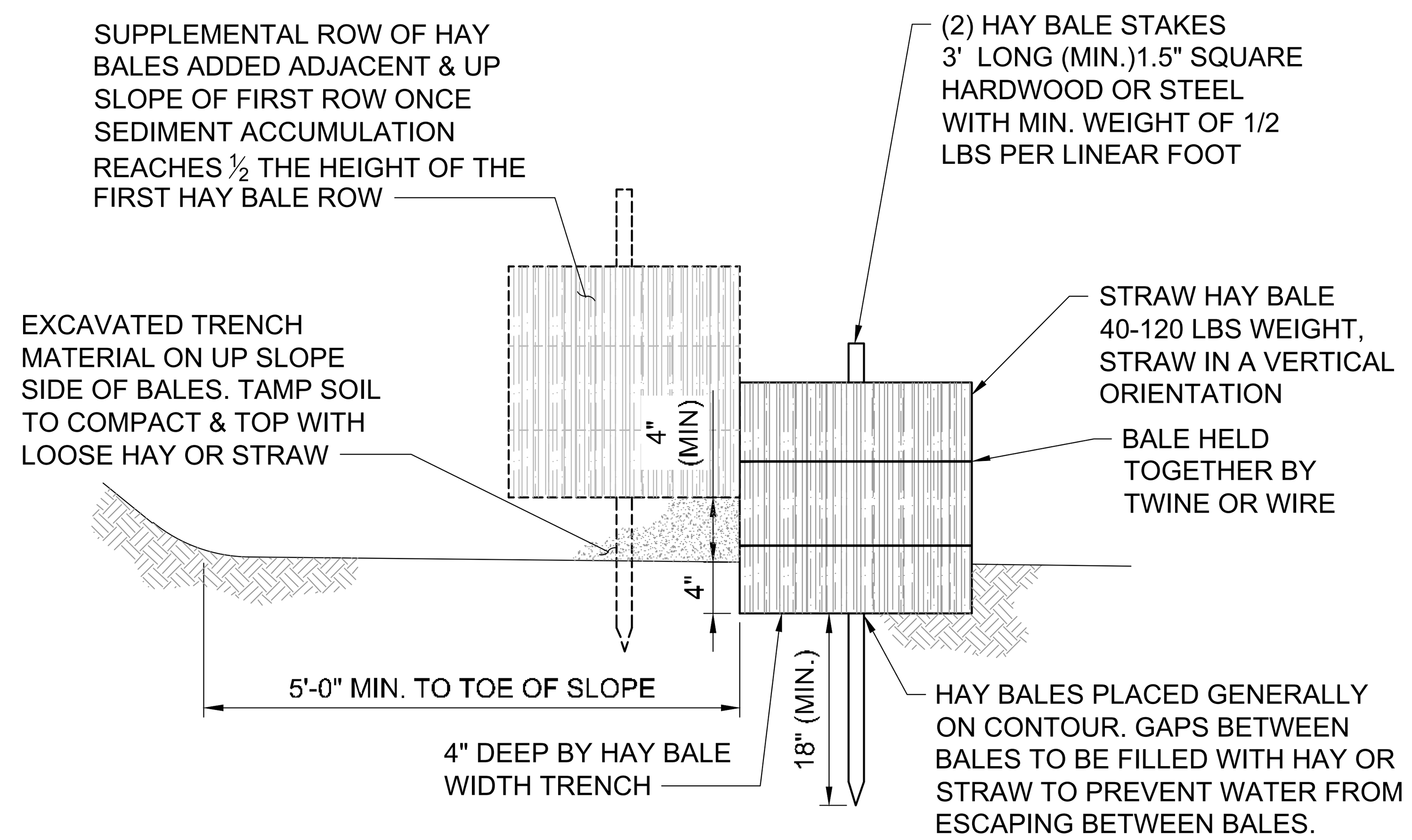
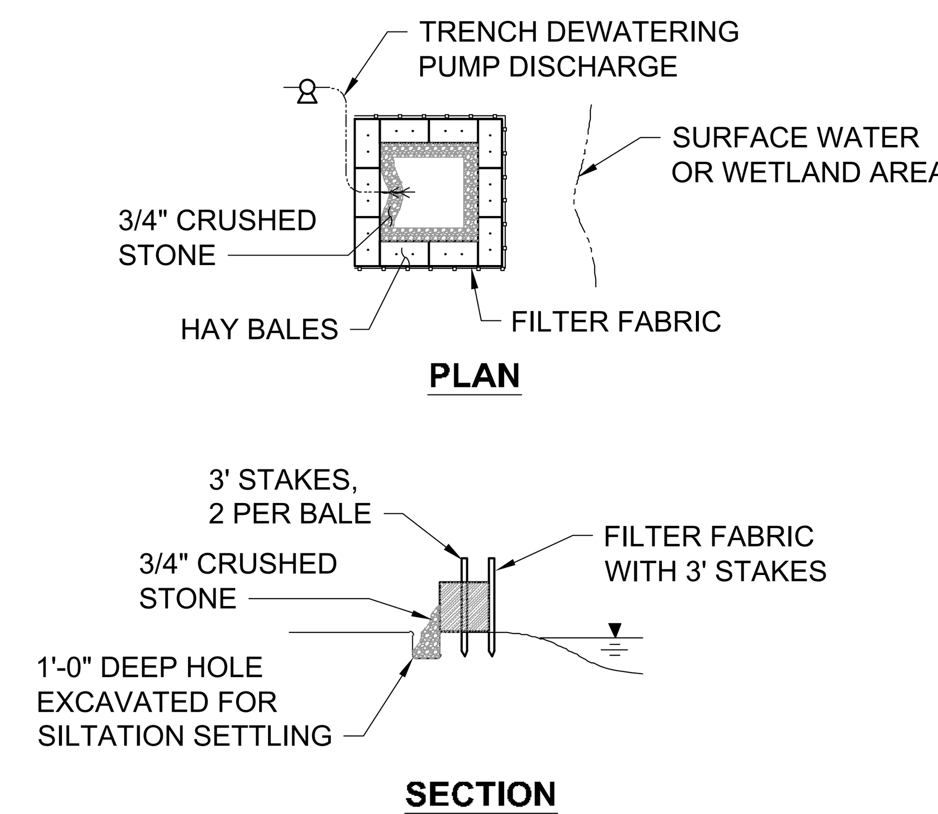



**1 TURBIDITY CURTAIN**
SCALE: NTS



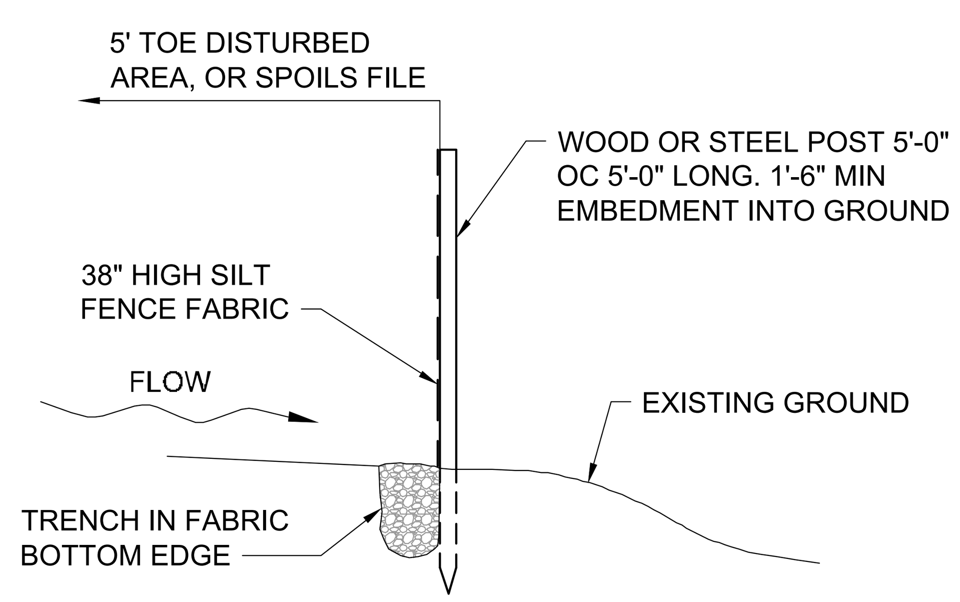

**2 HAY BALE BARRIER**
SCALE: NTS

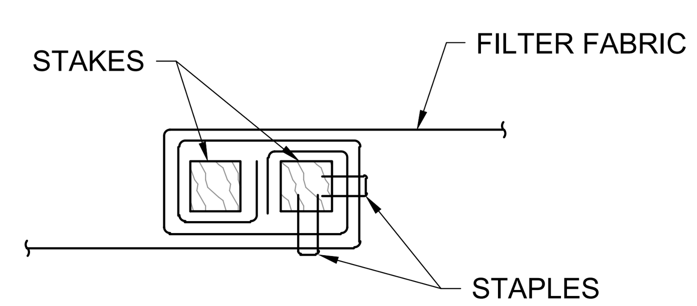



**3 DEWATERING/SETTLING BASIN**
SCALE: NTS

## 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

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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'

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

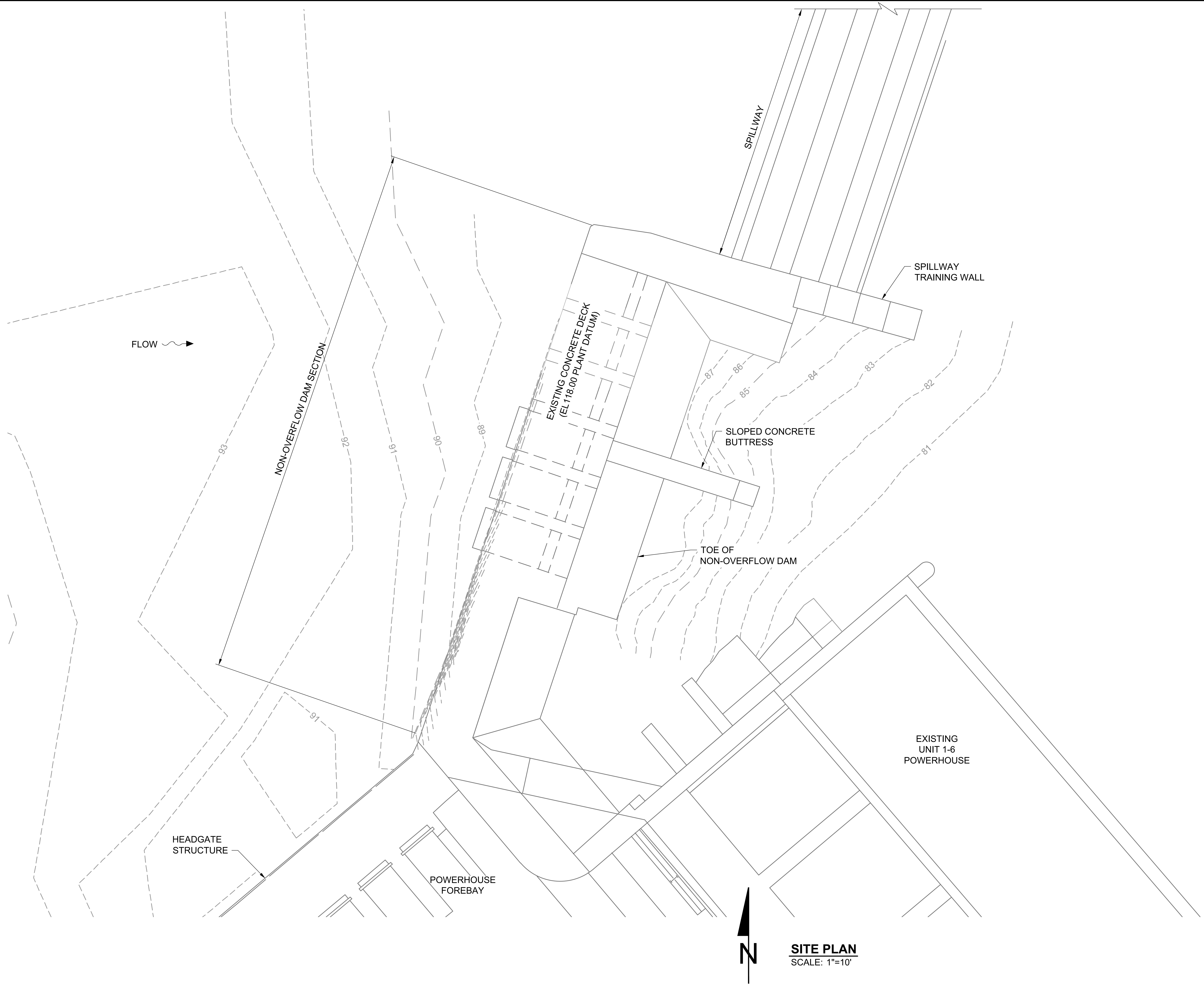
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

OVERALL SITE PLAN

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

**NOTE:**

1. VERTICAL DATUM IS BASED ON PLANT DATUM.




**SITE PLAN**
SCALE: 1"=10'

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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

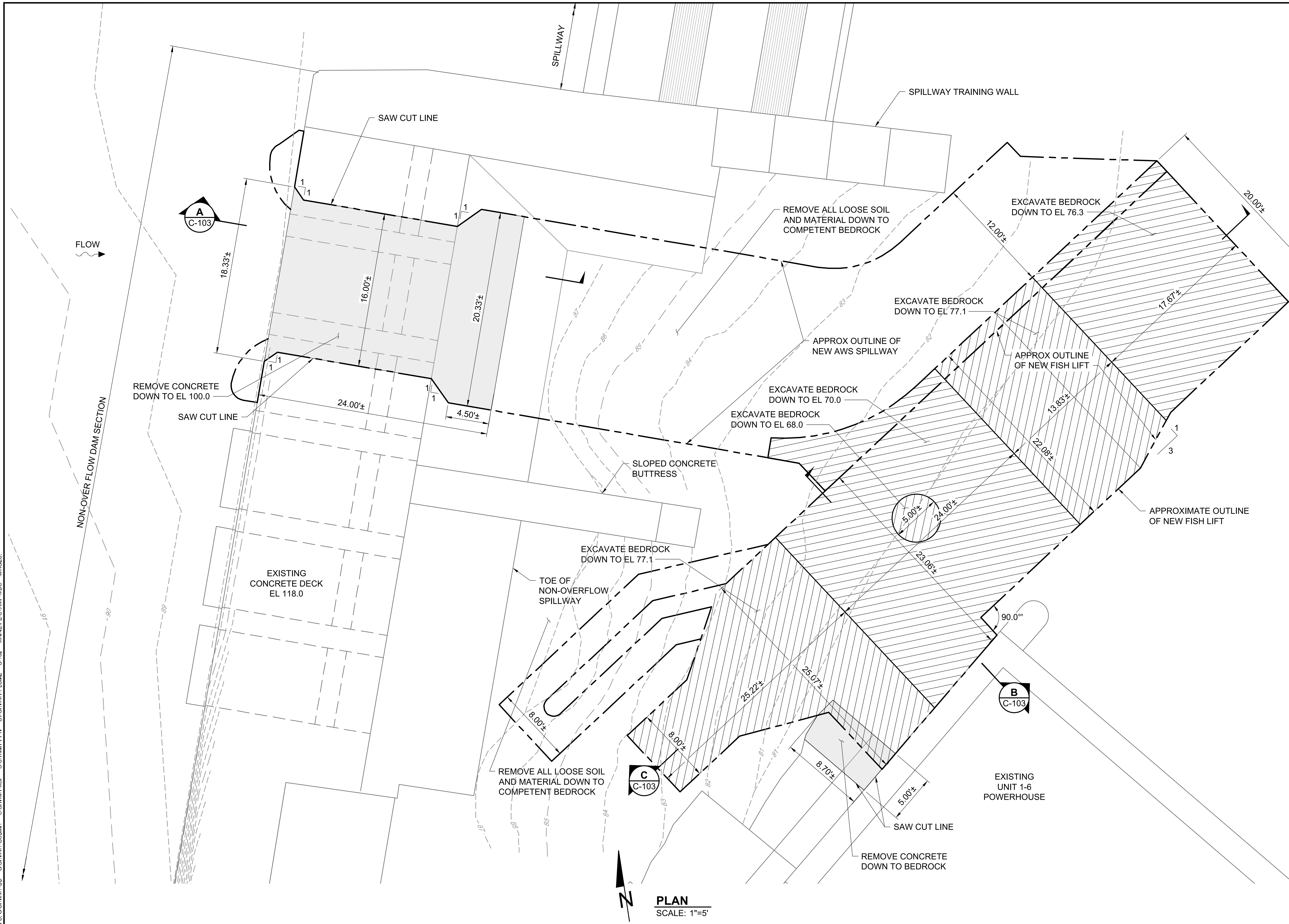
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | B. McMAHON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 11 OF 176 |
| DRAWING: | C-101 |

**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




**PLAN**
SCALE: 1"=5'

FLOW

KENNEBEC RIVER

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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 |

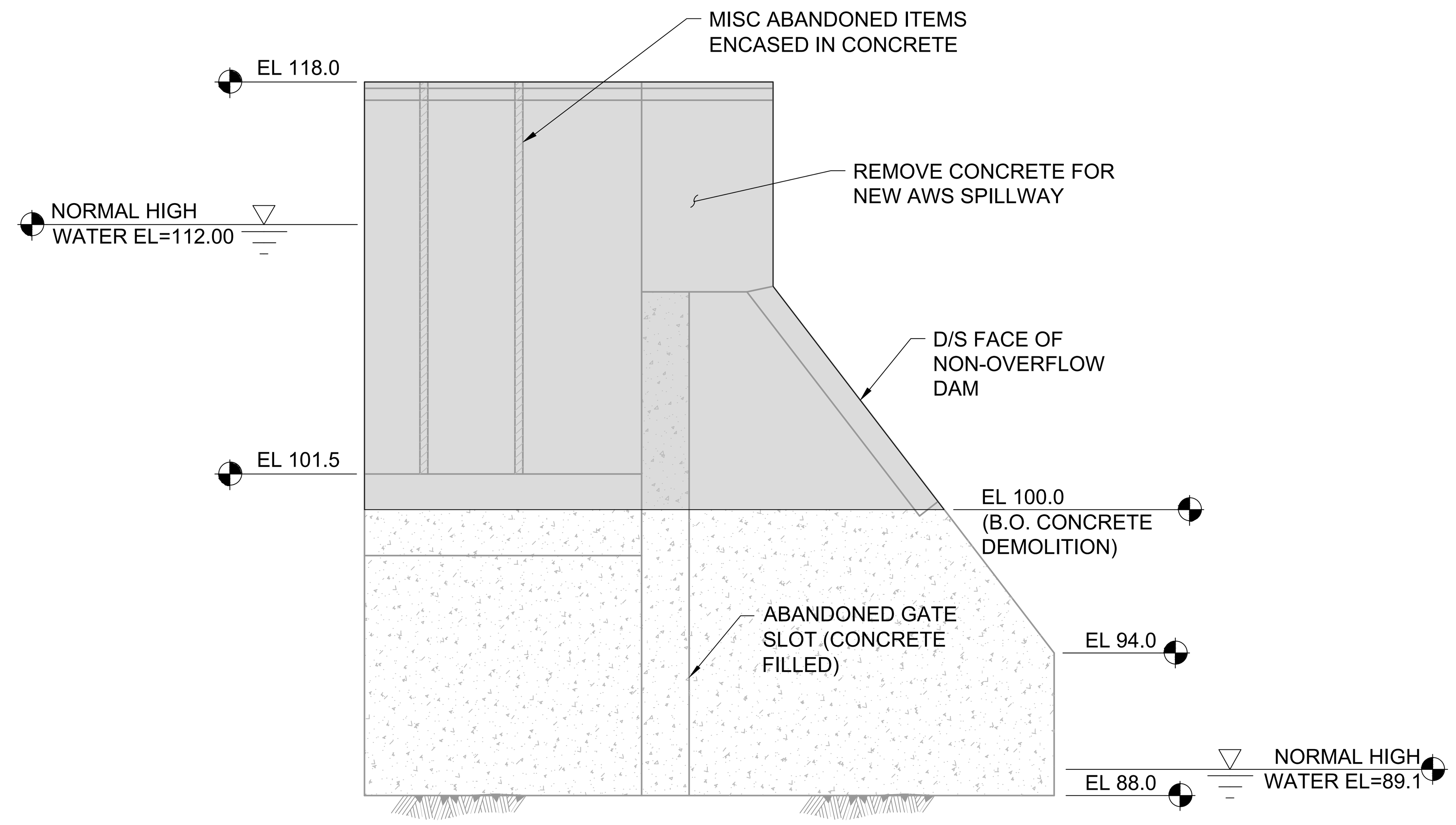

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mass and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\C\C-102.dwg USER: Agrogan IMAGES: DATE: Dec 13, 2019 2:33pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FLUME S-102 MAINE-PE-STAMP-MDG

**EXCAVATION NOTE:**

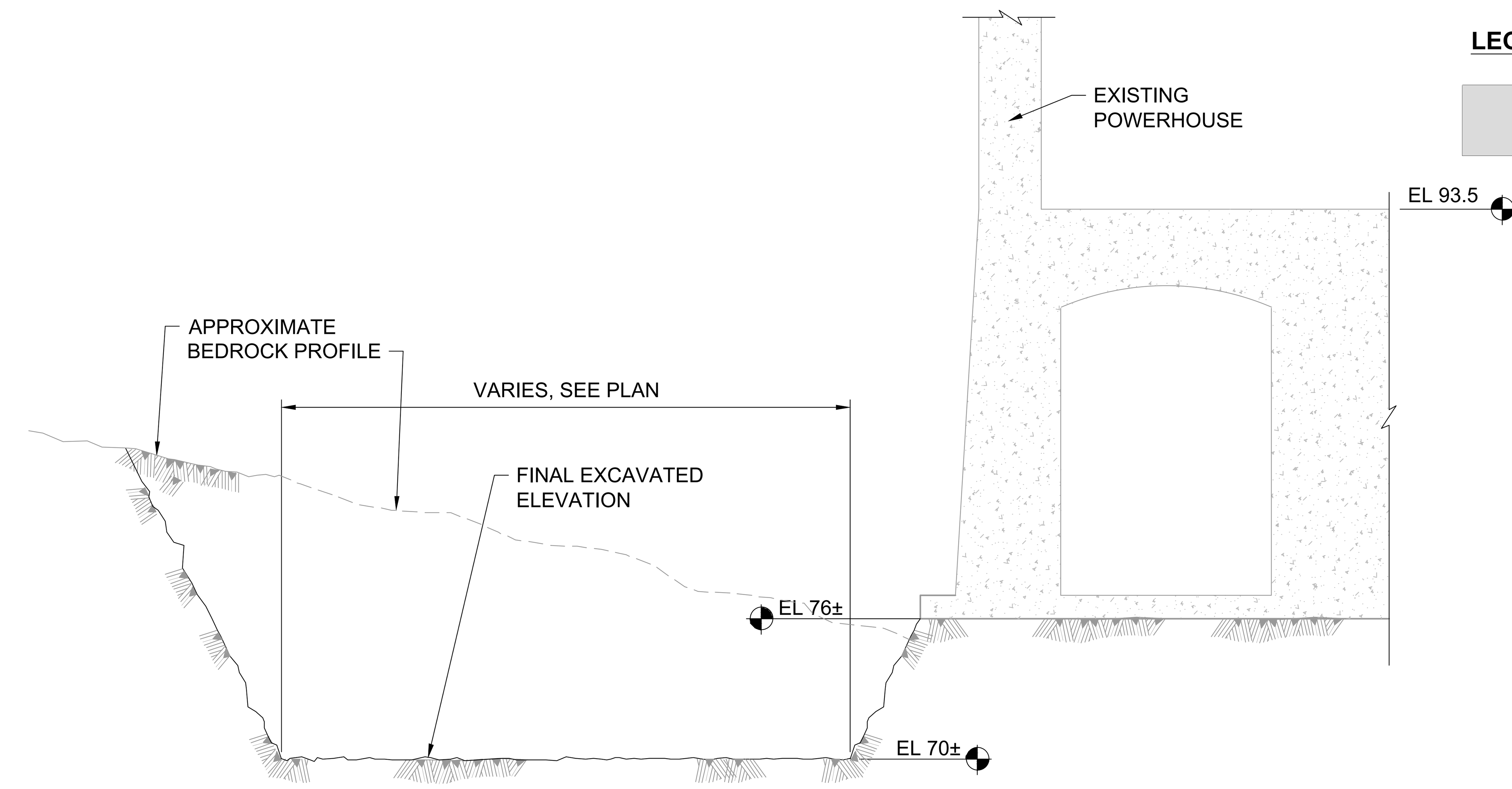
1. SLOPES SHOWN ARE APPROXIMATE. ACTUAL SLOPES WILL VARY BASED ON CONTRACTORS COMPLIANCE WITH APPLICABLE SAFETY REQUIREMENTS.

**LEGEND:**

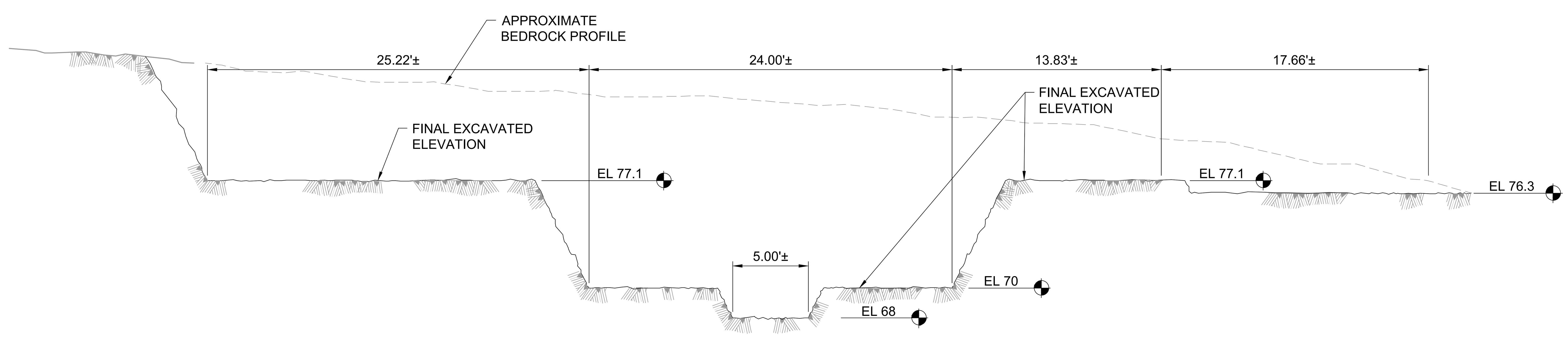
CONCRETE DEMOLITION




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




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




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

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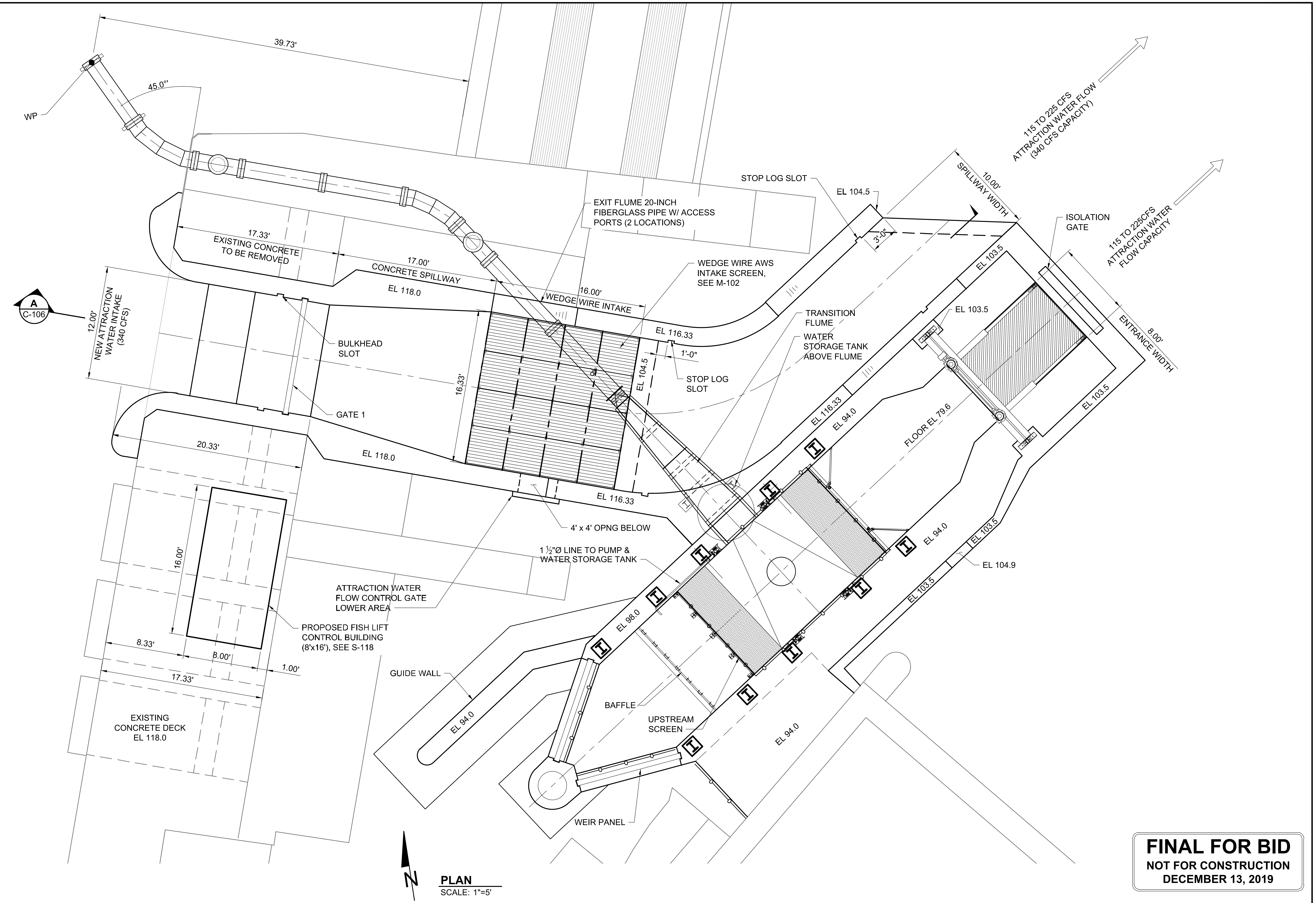
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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




**PLAN**

SCALE: 1"=5'

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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 |

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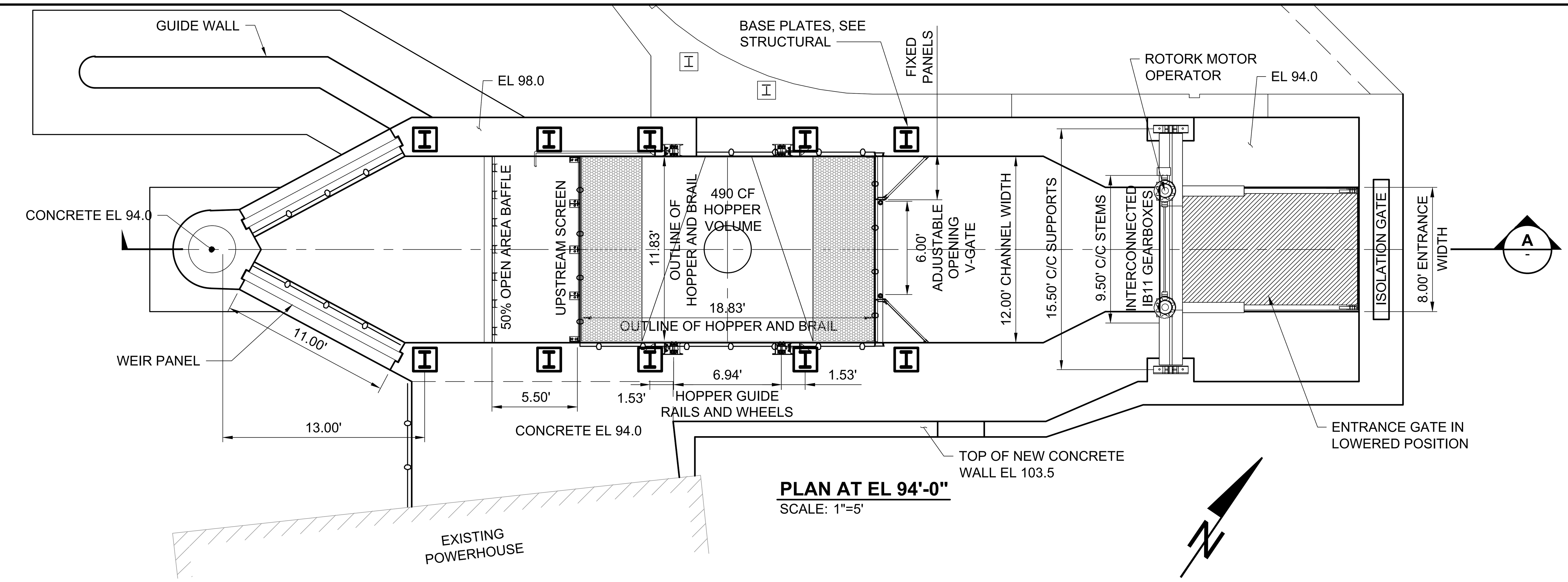
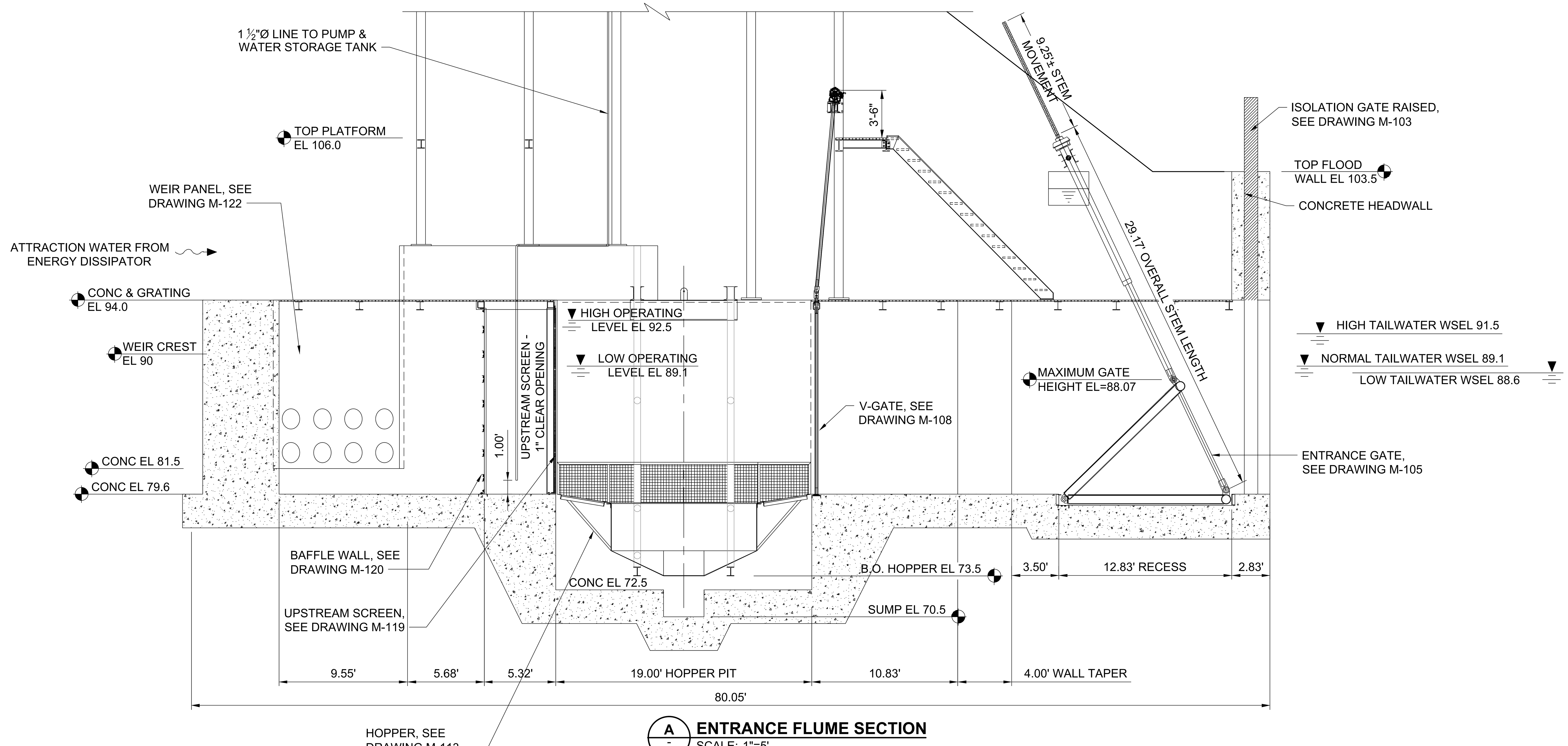



**PLAN AT EL 94'-0"**
SCALE: 1"=5'

## NOTES:

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




**A - ENTRANCE FLUME SECTION**
SCALE: 1"=5'

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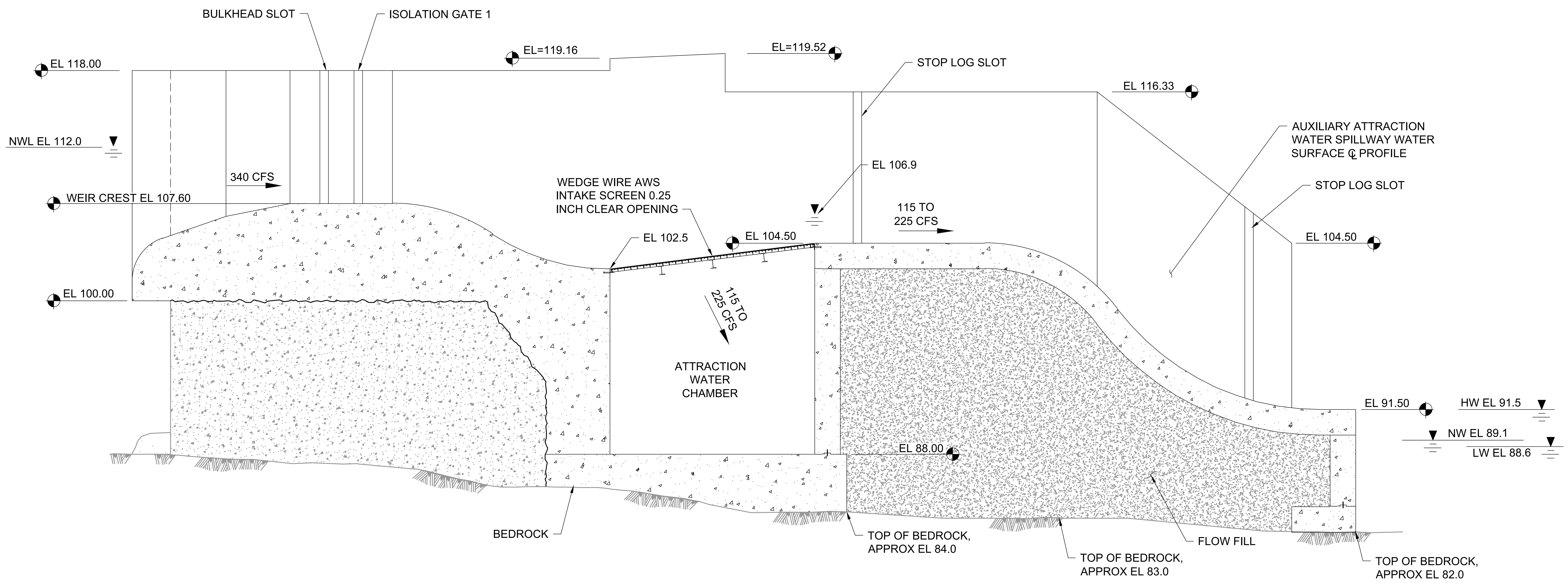
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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




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

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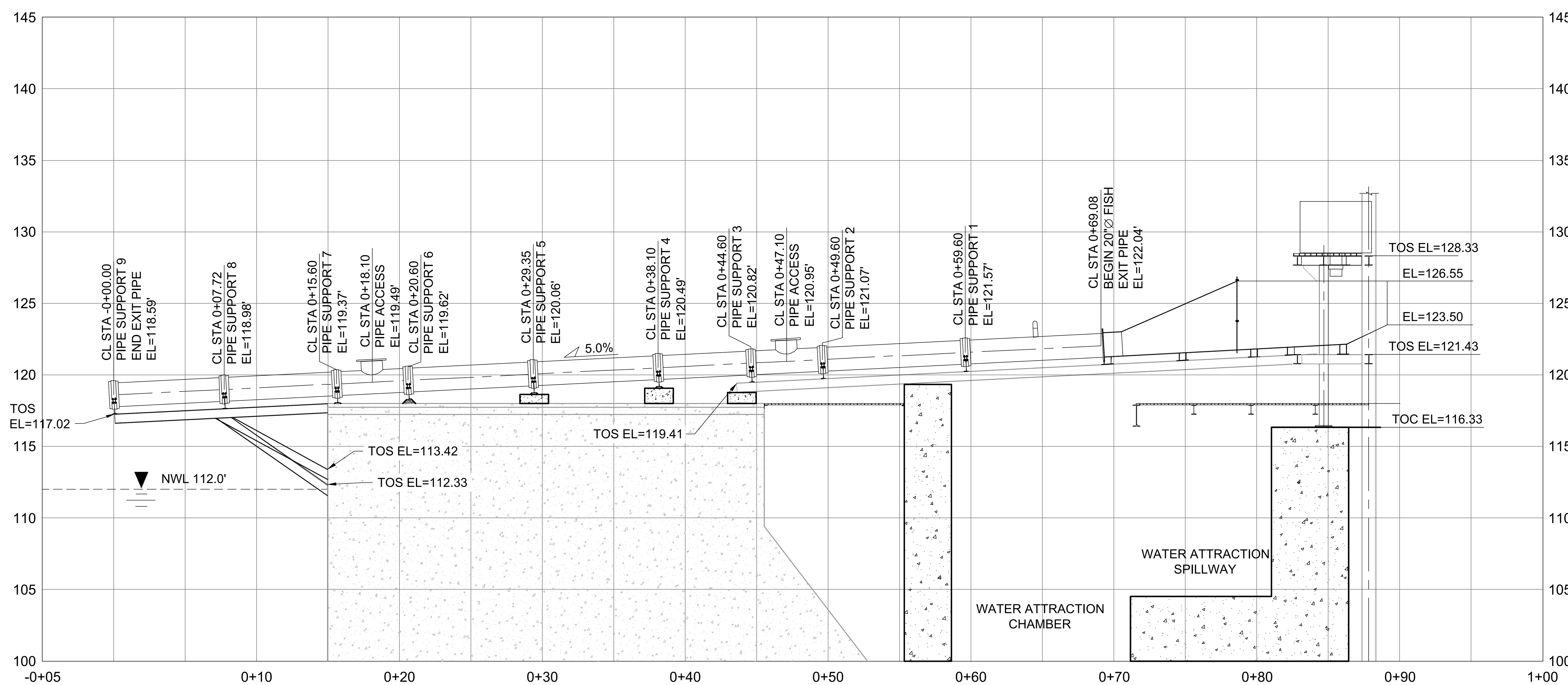
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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'

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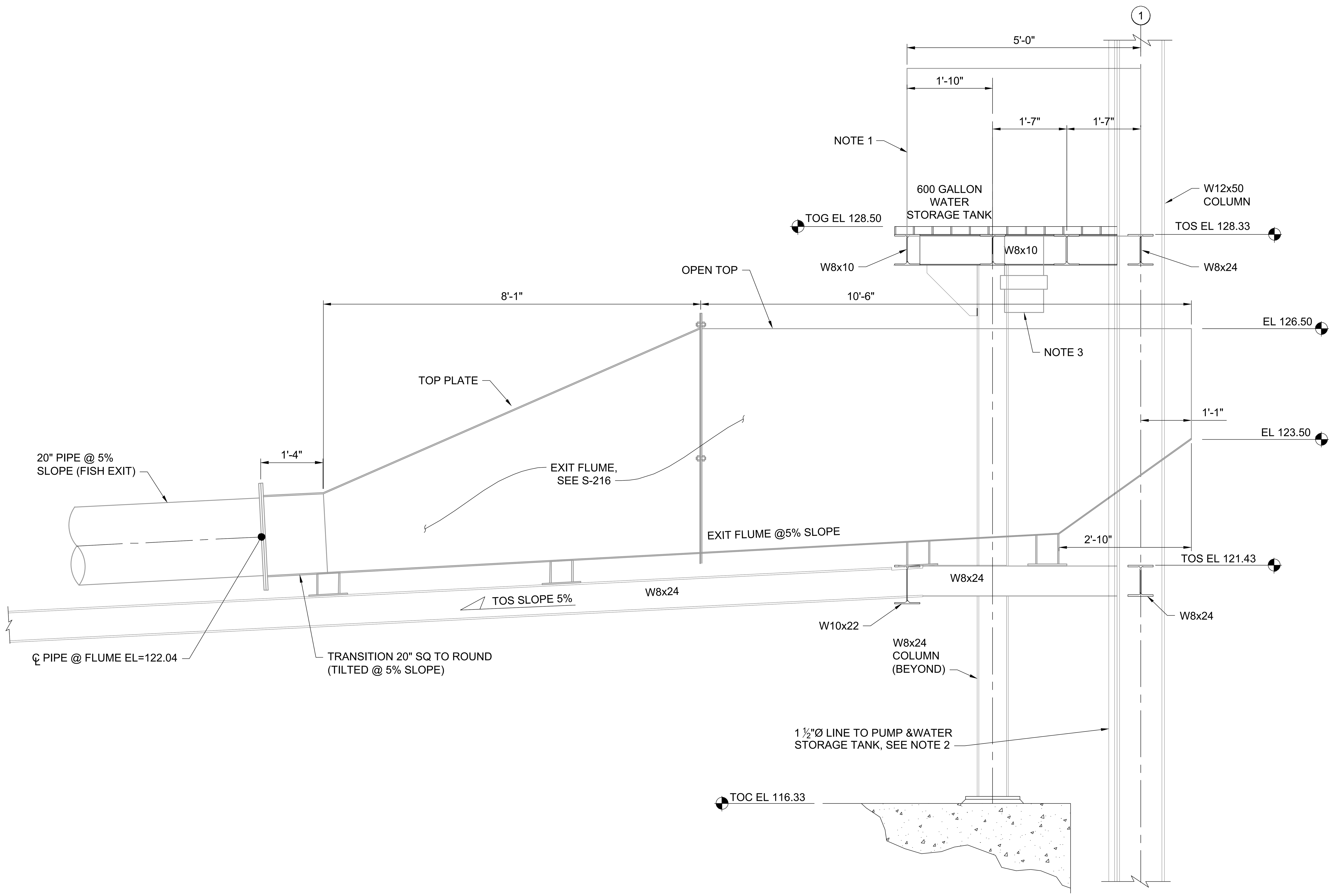
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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 |




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

**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.

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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 |


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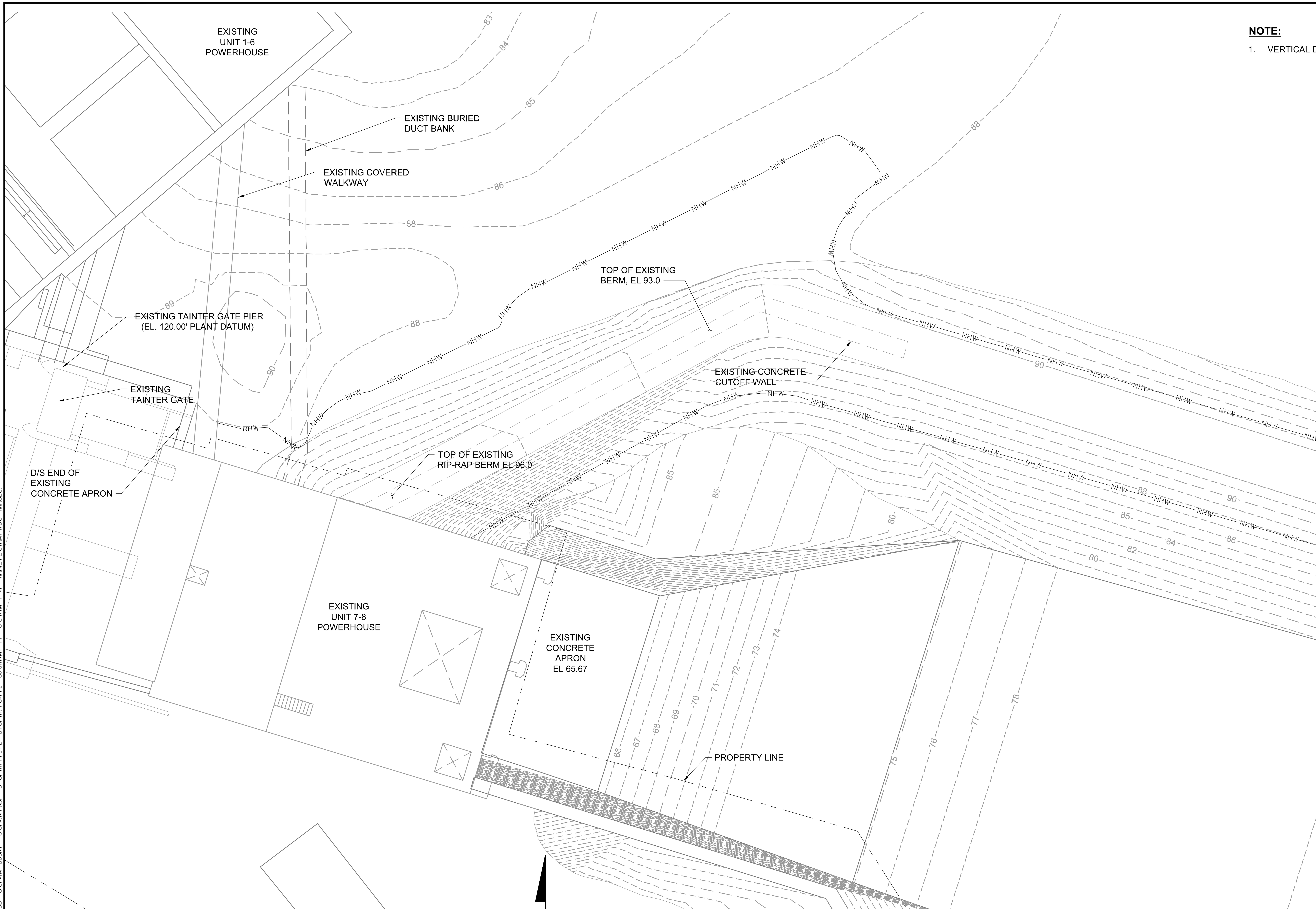
**NOTE:**

1. VERTICAL DATUM IS BASED ON PLANT DATUM.




**SITE PLAN**
SCALE: 1"=10'

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**DECEMBER 13, 2019**


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PROFESSIONAL ENGINEER

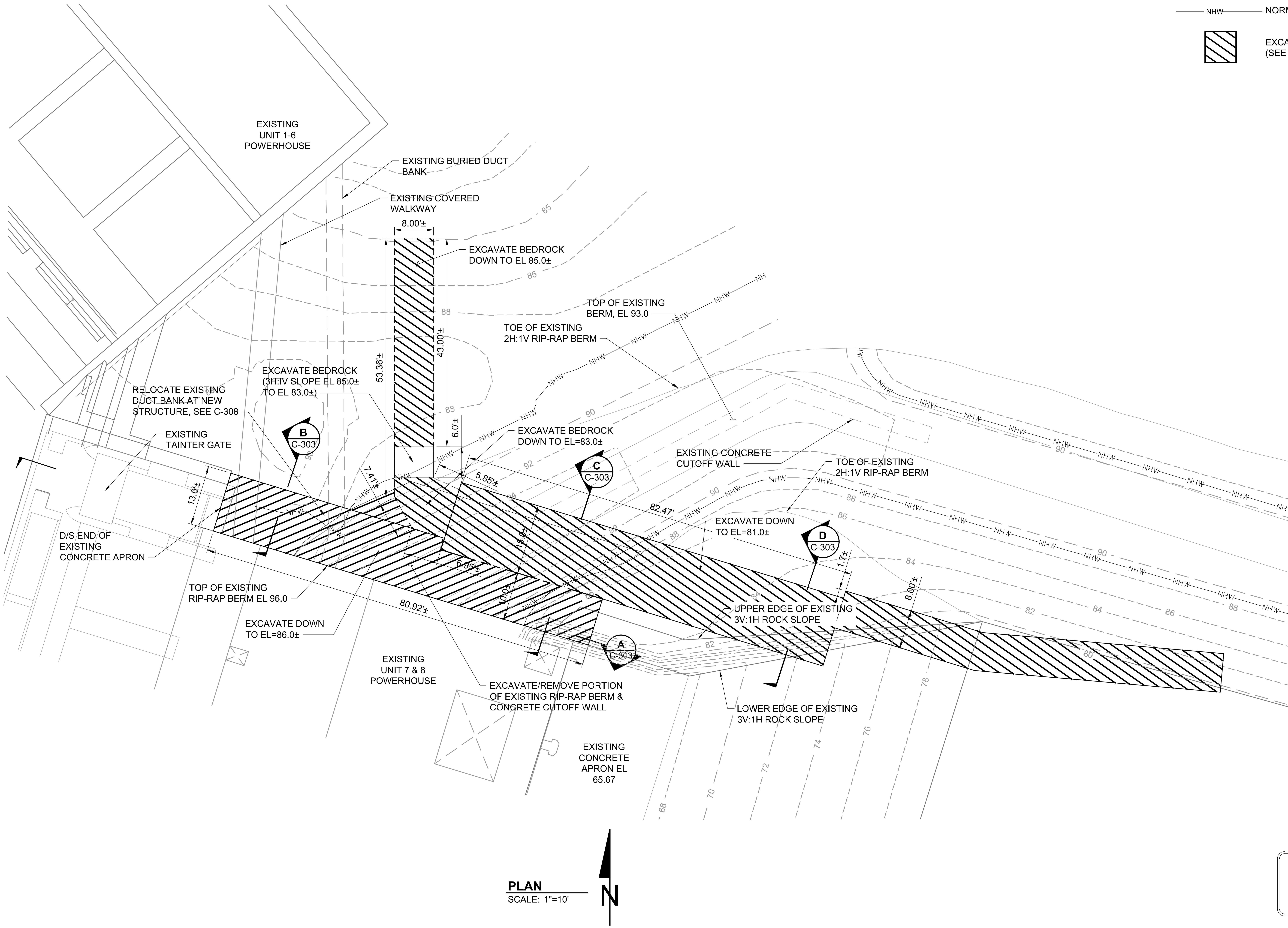
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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) EXCAVATED BEDROCK (SEE PLAN FOR ELEVATION)




**PLAN**
SCALE: 1"=10'

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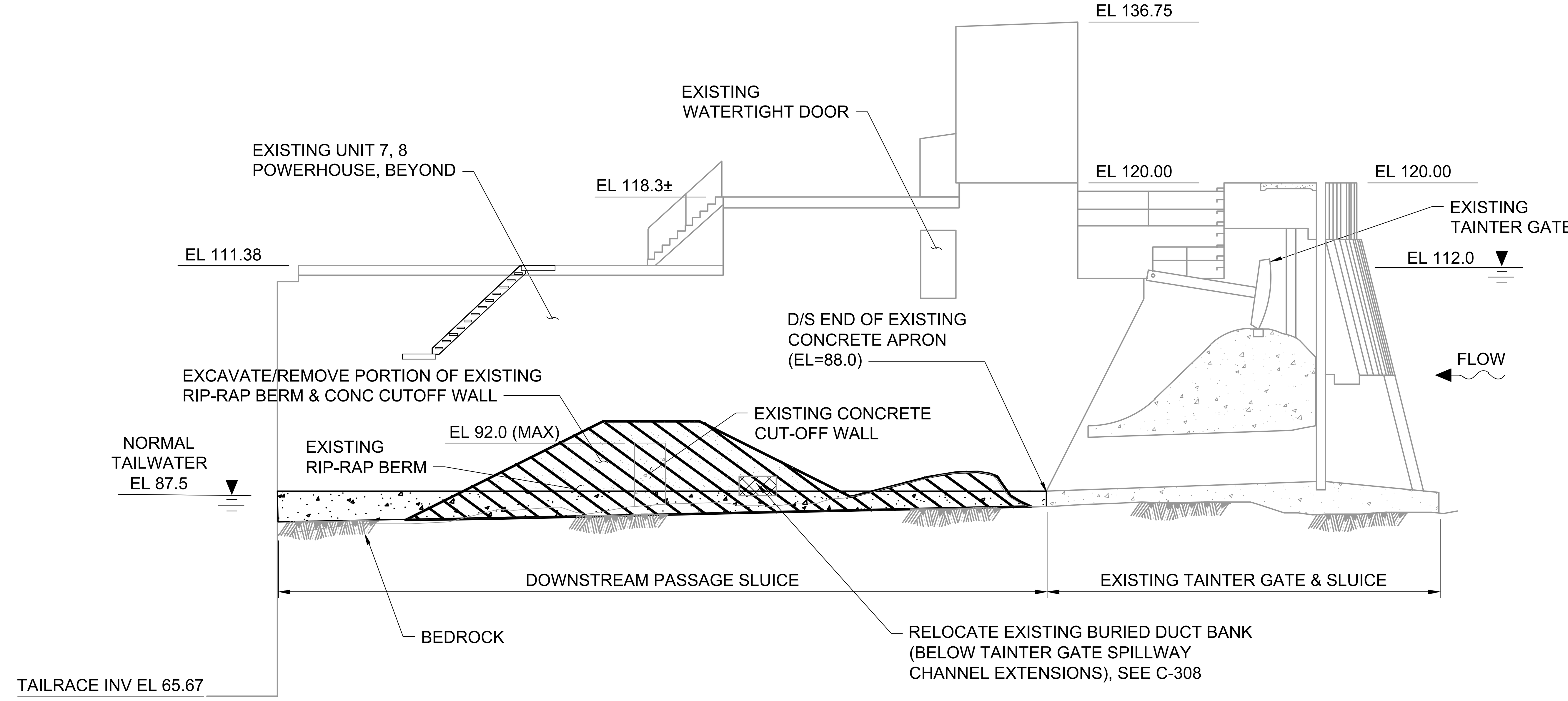
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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


DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nes and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\C\C-302.dwg USER: Agrogan
DATE: Dec 13, 2019 2:34pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP S-SHWMT-FISHWAY-PL S-SHWMT-FISHWAY-SC C3-SHWMT-PFP C-SHWMT-PFW S3-SHWMT-PFP S1-SHWMT-SW-PL S1-SHWMT-FL-PL S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES: 163-42-0561.tif



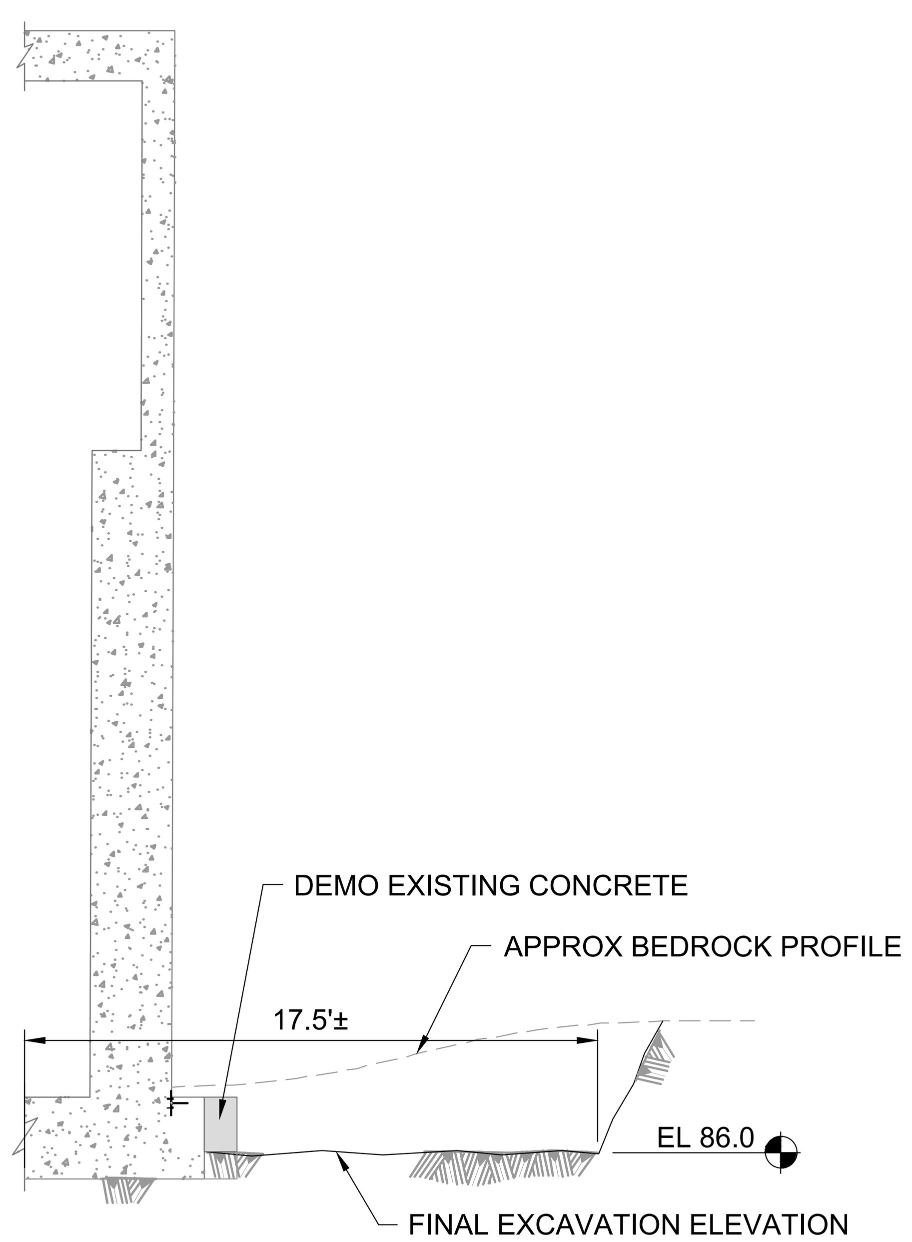

**A** (C-302) **DEMOLITION SECTION**
SCALE: 1"=10'

**NOTE:**

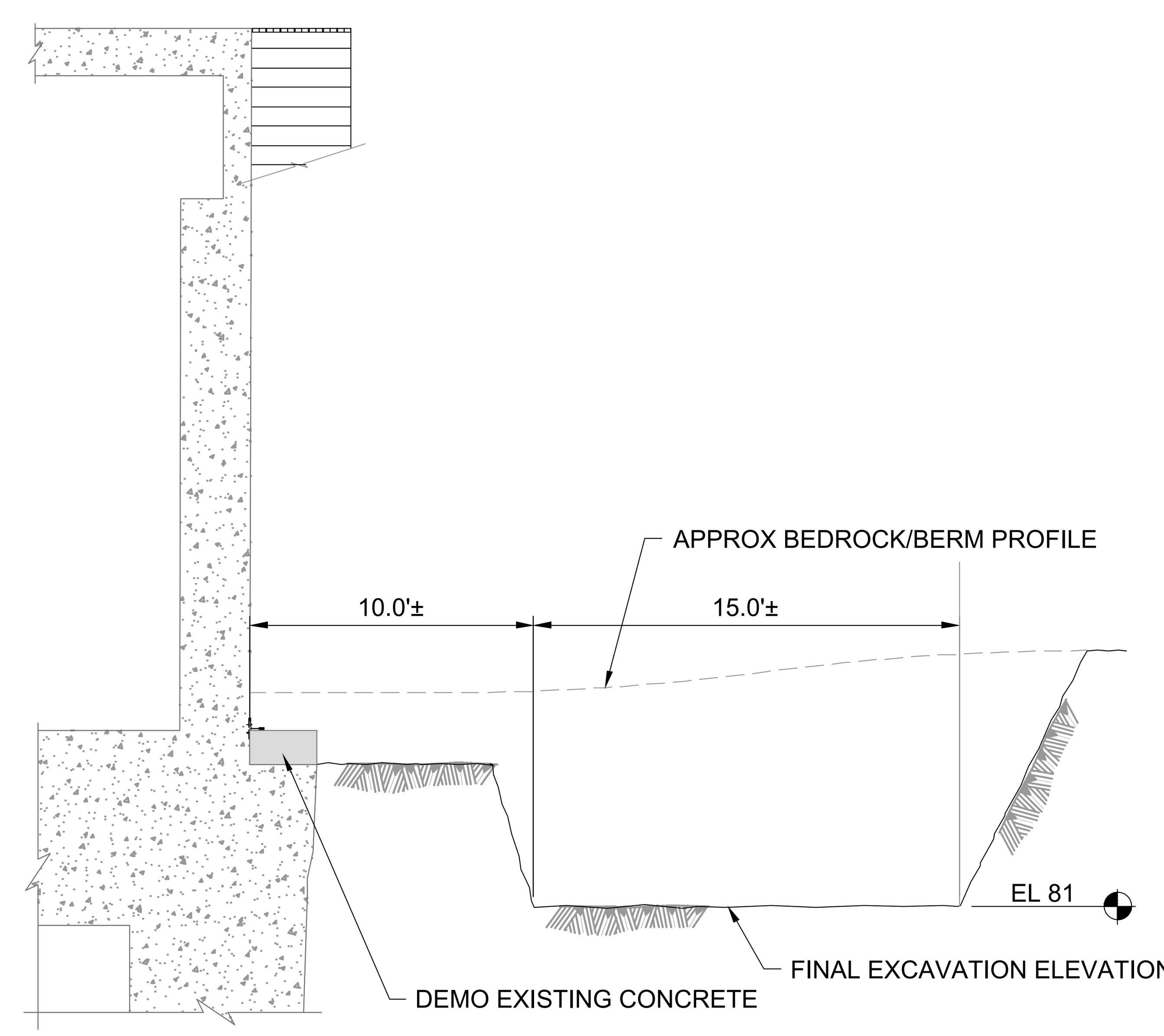
1. SLOPES SHOWN ARE APPROXIMATE. ACTUAL SLOPES WILL VARY BASED ON CONTRACTORS COMPLIANCE WITH APPLICABLE SAFETY REQUIREMENTS.

**LEGEND:**

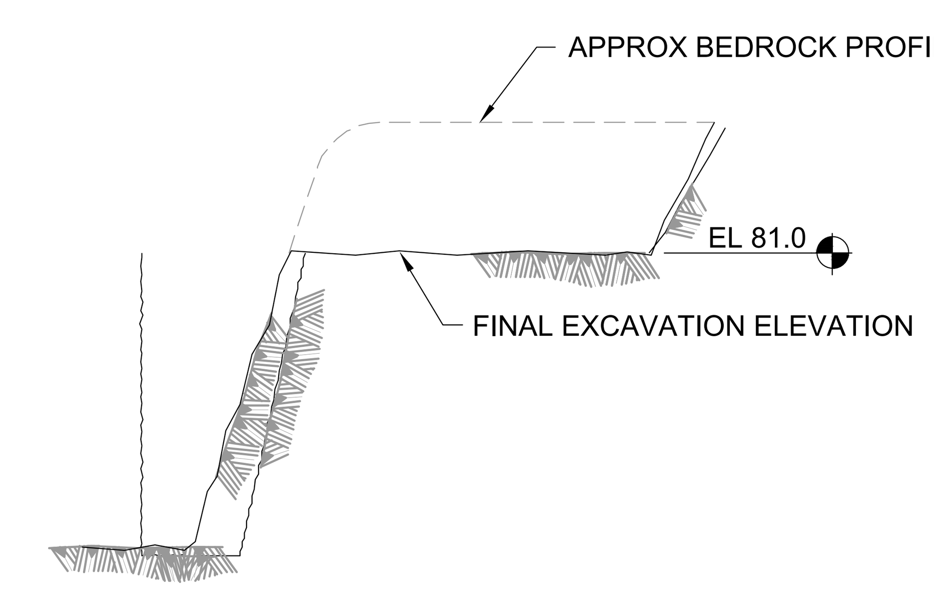
- EXCAVATE/REMOVE PORTION OF EXISTING RIP-RAP BERM & CONC CUT-OFF-WALL
- RELOCATE EXISTING BURIED DUCT BANK (BELOW NEW TAINTER GATE SPILLWAY CHANNEL EXTENSIONS), SEE C-308.
- CONCRETE DEMOLITION




**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

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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

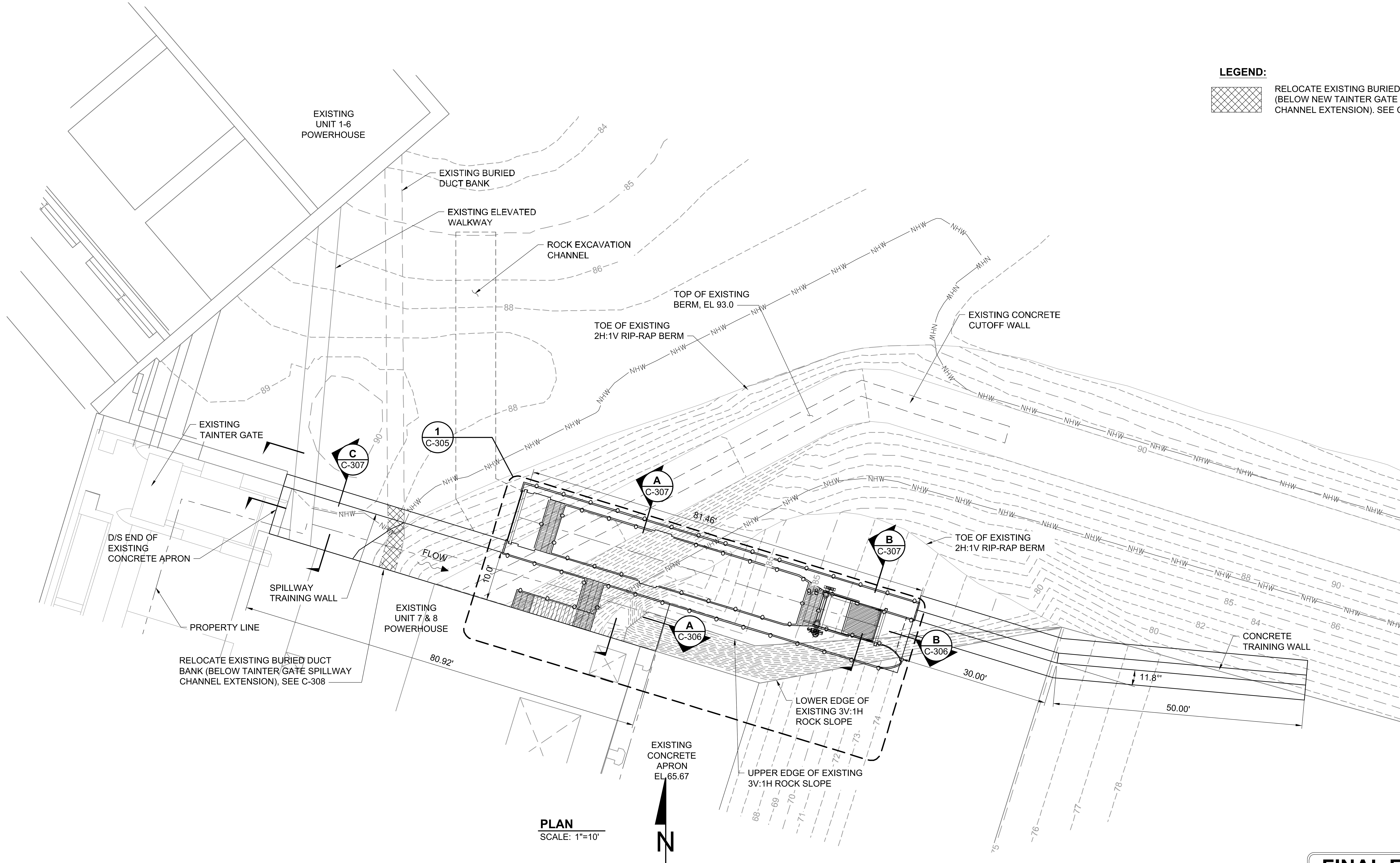
DEMOLITION AND EXCAVATION SECTIONS - UNIT 7 & 8 FISH PASSAGE

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

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden nsis and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\C\C-303.dwg USER: Agrogan
DATE: Dec 13, 2019 2:34pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S-SHWMT-FISHWAY-PL S-SHWMT-FISHWAY-SC C3-SHWMT-PFP MAINE-PE-STAMP-MDG IMAGES:

**LEGEND:**

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




**PLAN**
SCALE: 1"=10'

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**DECEMBER 13, 2019**


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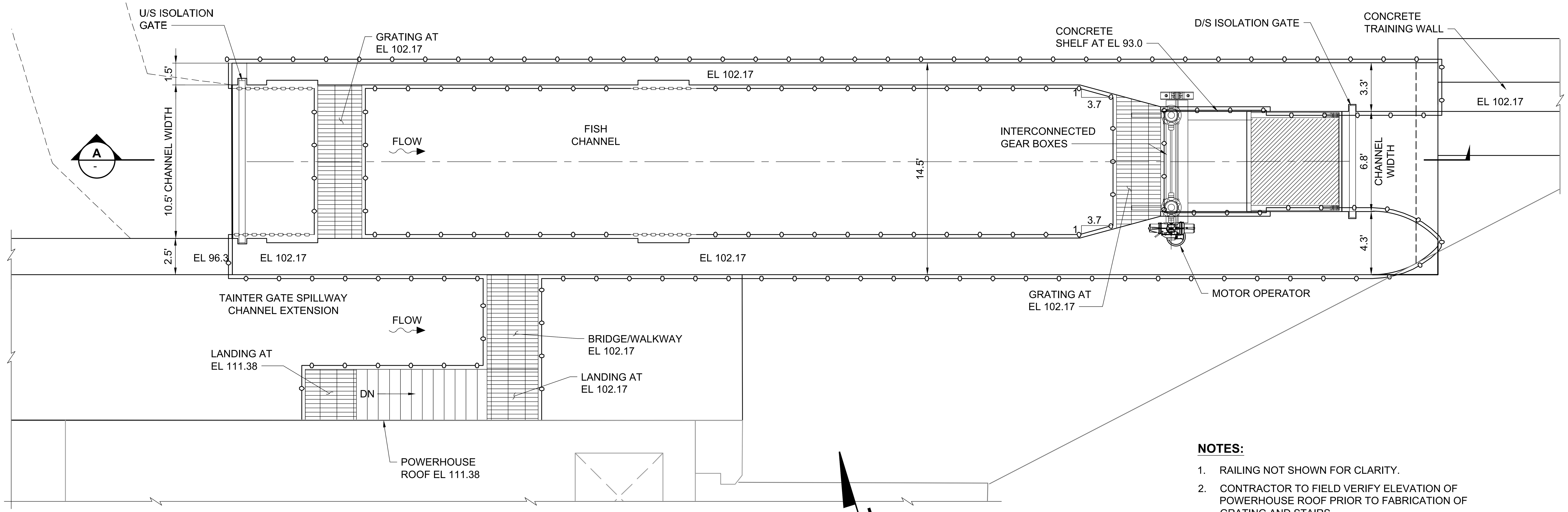
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

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

UNIT 7 & 8 FISH PASSAGE
GENERAL PLAN

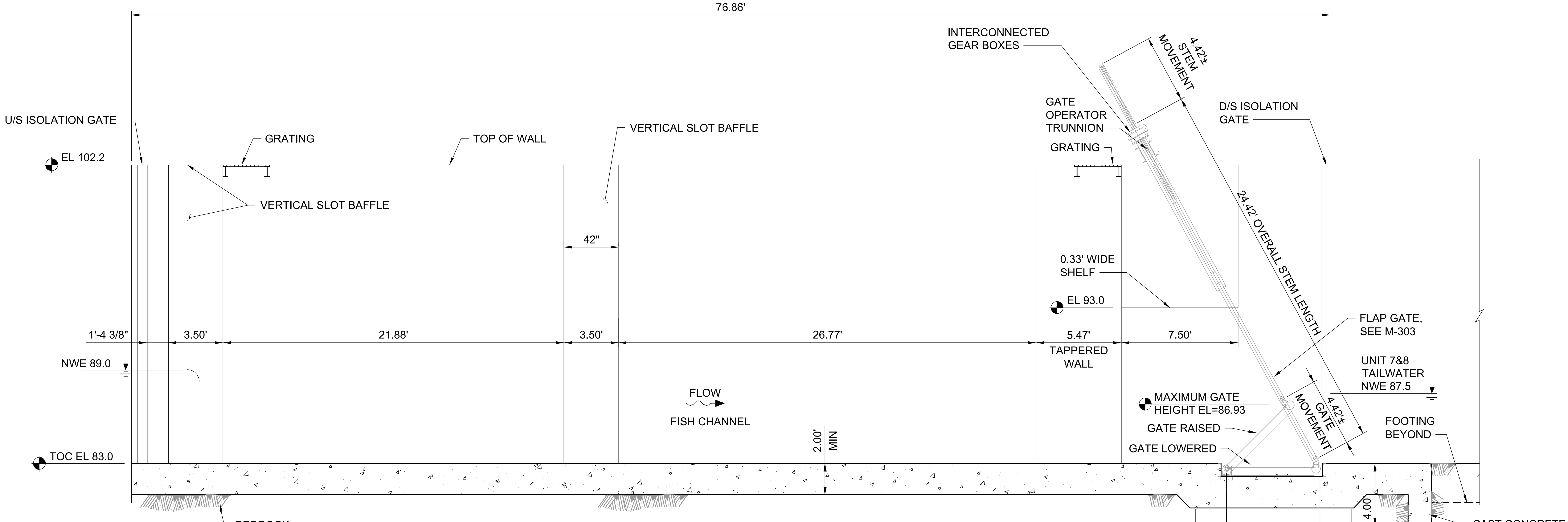
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 22 OF 176
DRAWING: C-304




1 FISHWAY CHANNEL ENLARGED PLAN
C-304 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"

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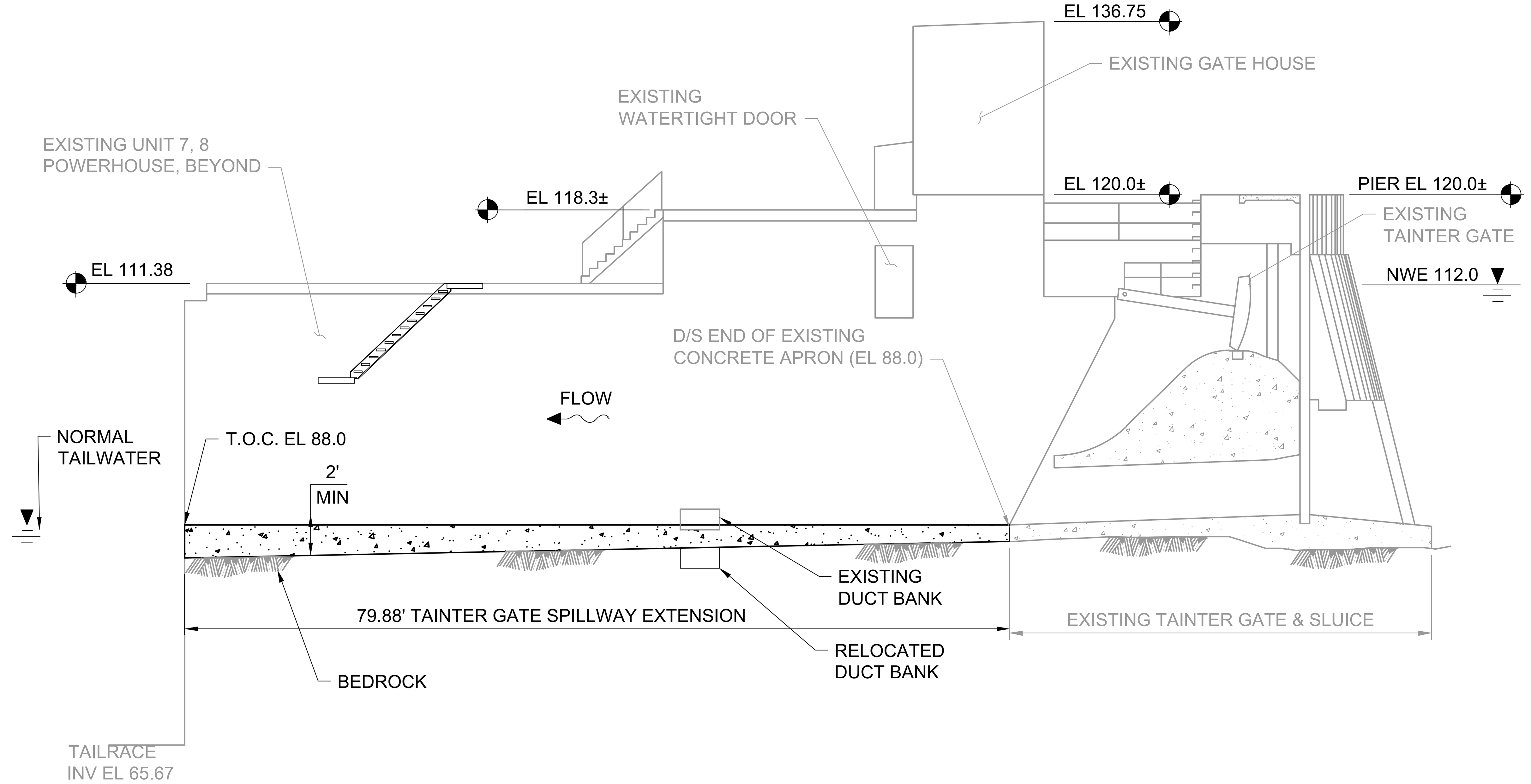
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

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

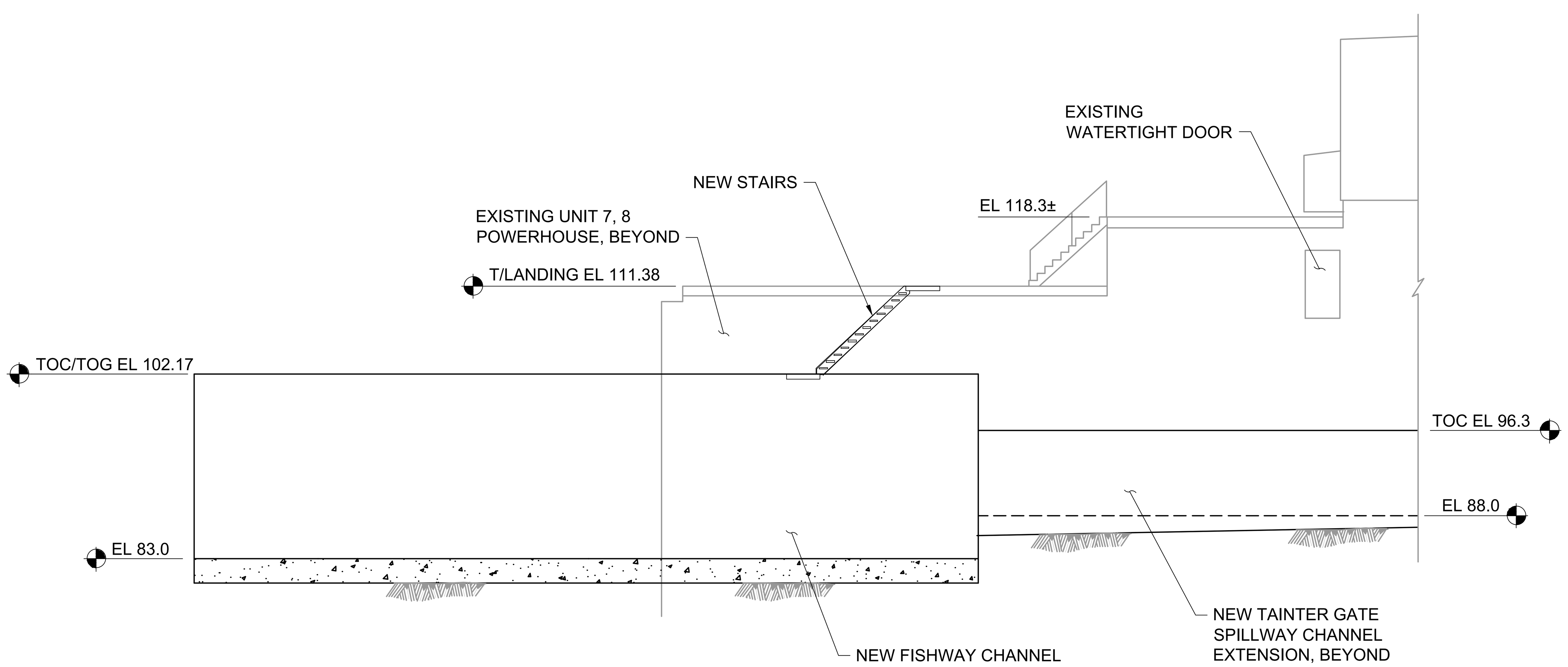
UNIT 7 & 8 FISH PASSAGE
PLAN AND SECTION

| | |
|---|---|
| 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 nss and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\C\C-305.dwg USER: Agrogan
DATE: Dec 13, 2019 2:34pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT S-SHWMT-FISHWAY-SC S3-SHWMT-PFP S3-SHWMT-EFP MAINE-PE-STAMP-MDG IMAGES:




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




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

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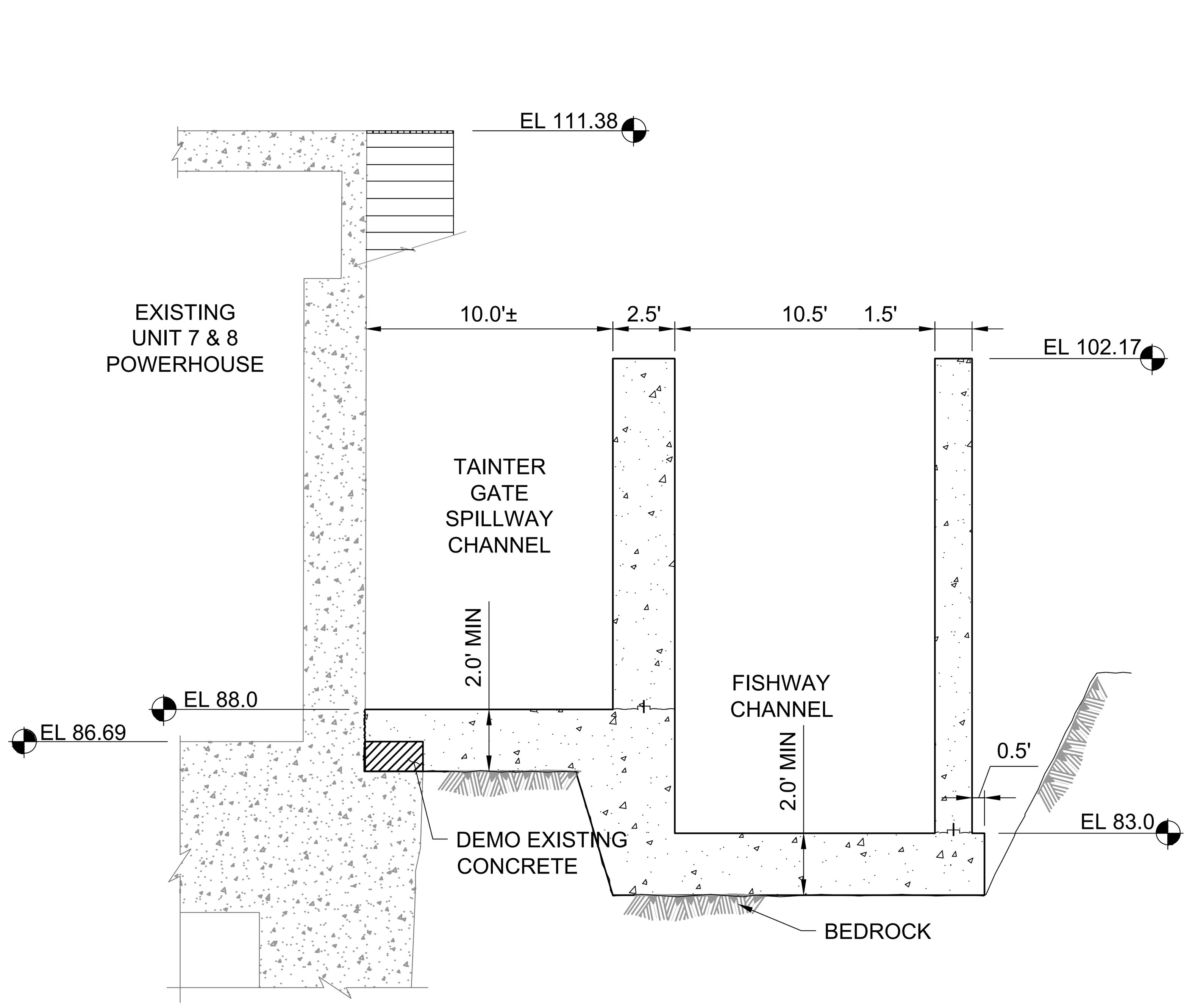
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

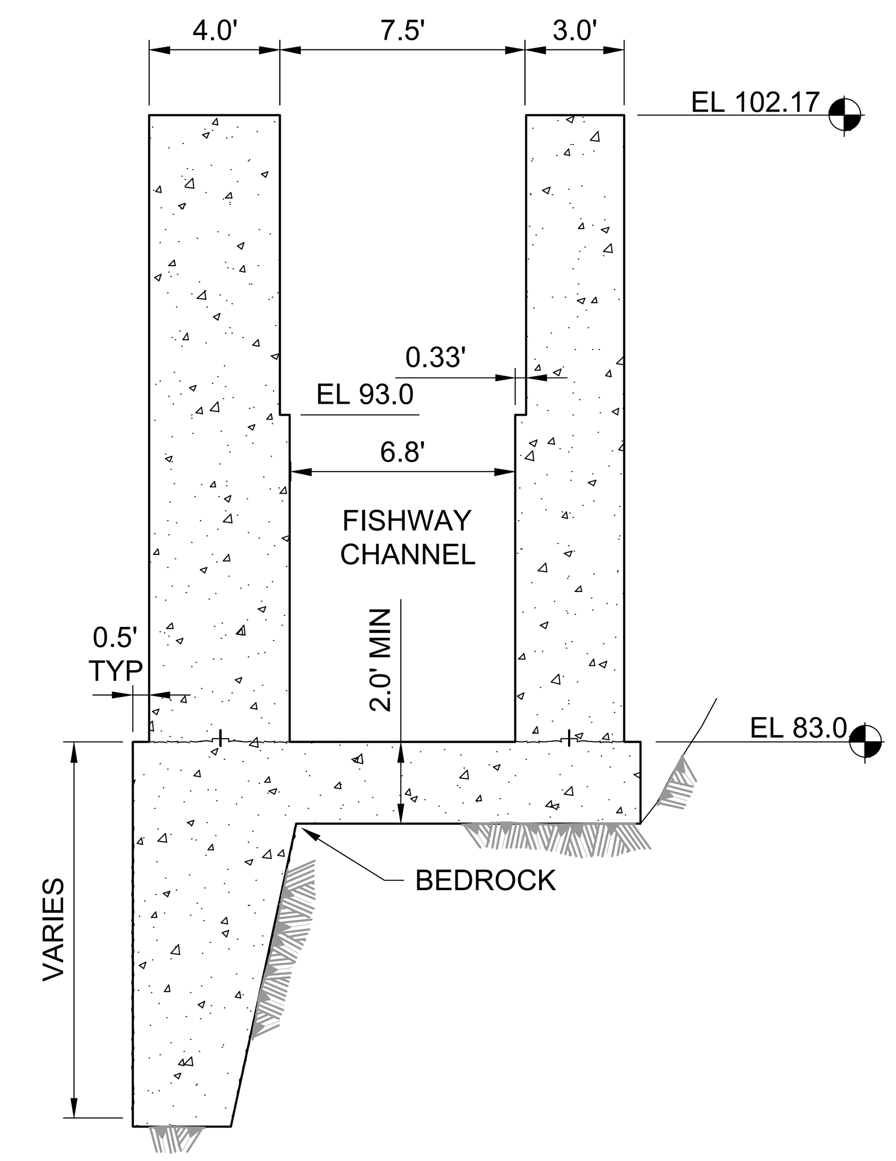
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
SECTIONS

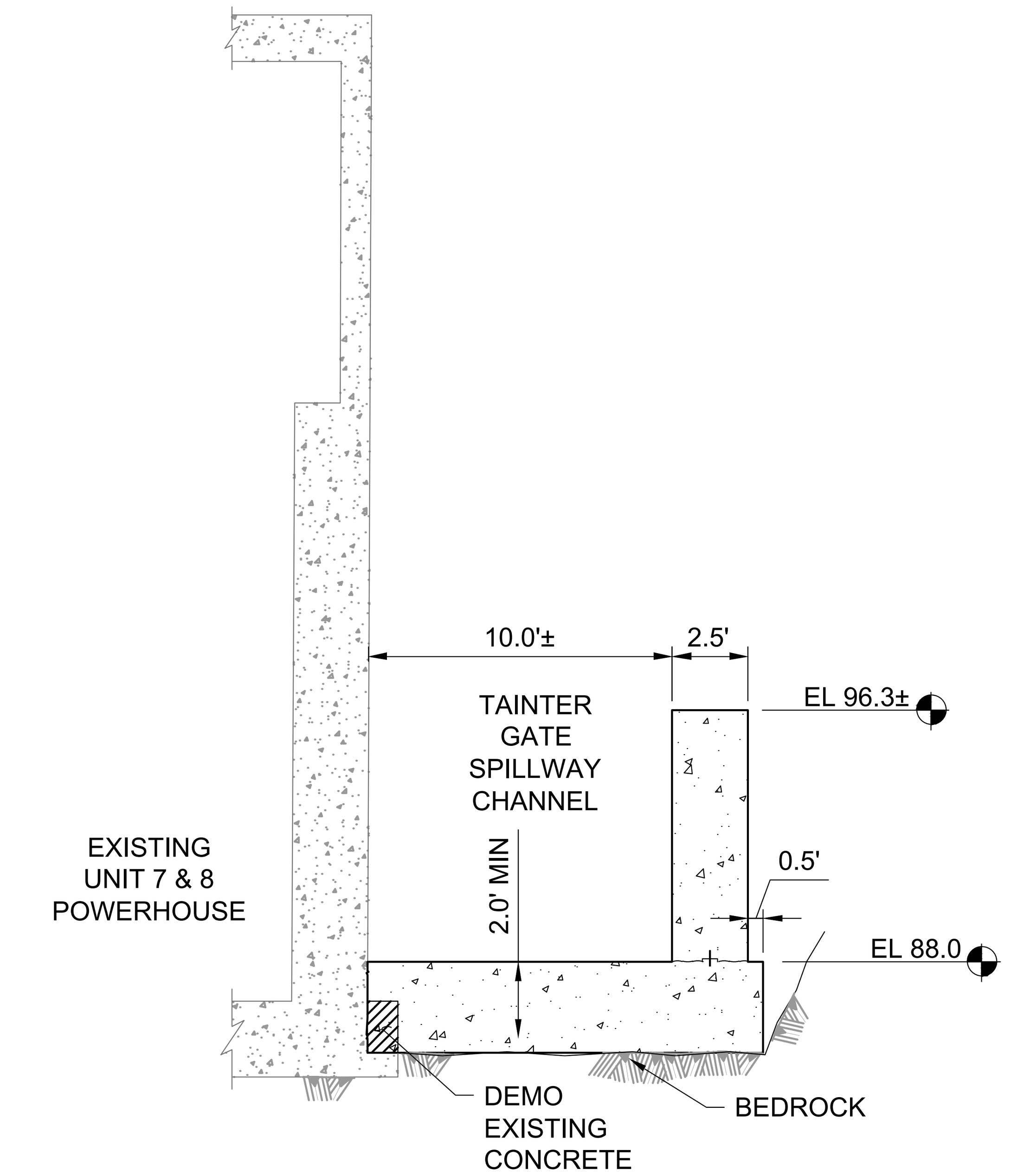
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 24 OF 176 |
| DRAWING: | C-306 |




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




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




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

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**DECEMBER 13, 2019**

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

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

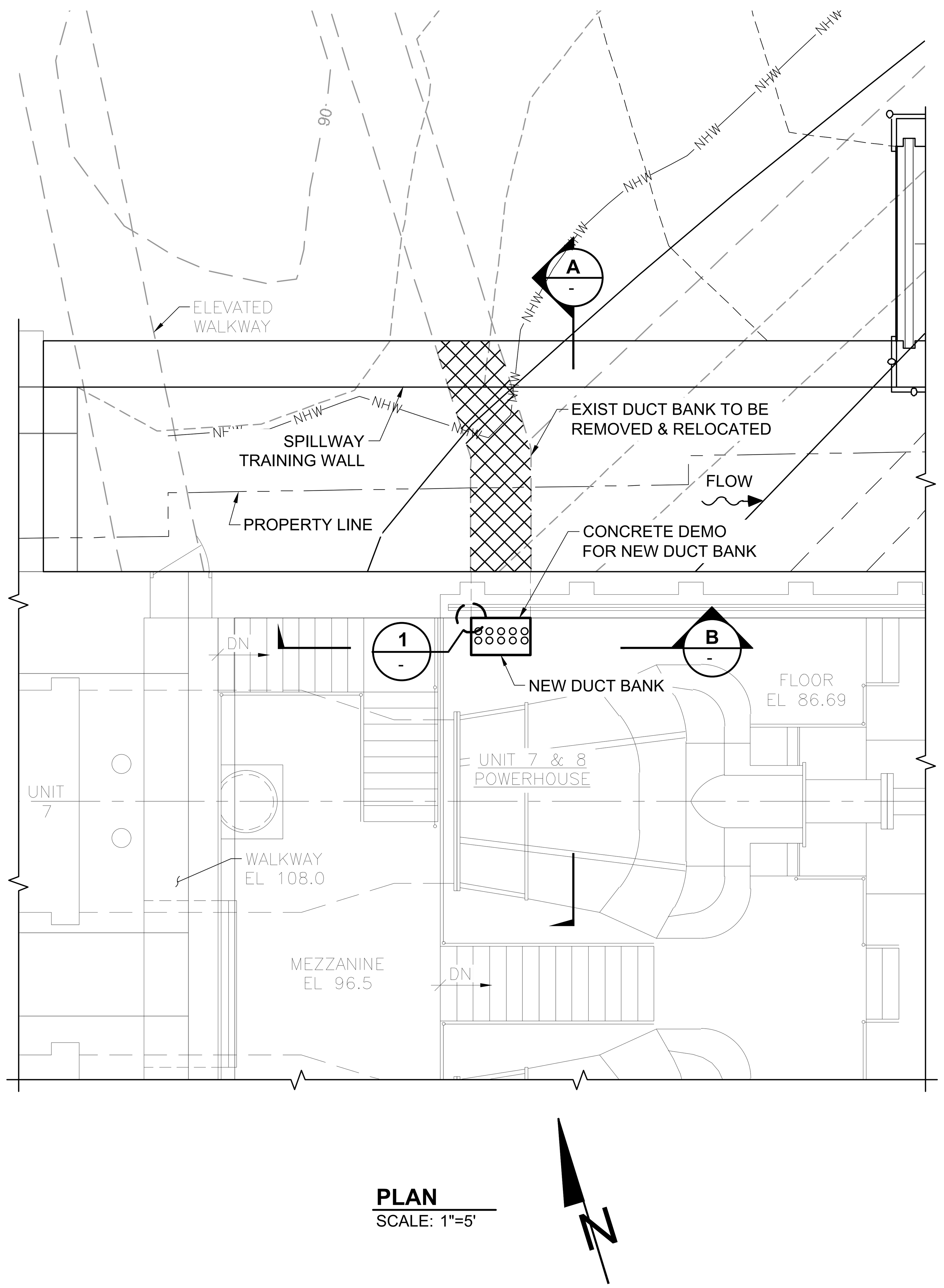
UNIT 7 & 8 FISH PASSAGE
SECTIONS

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

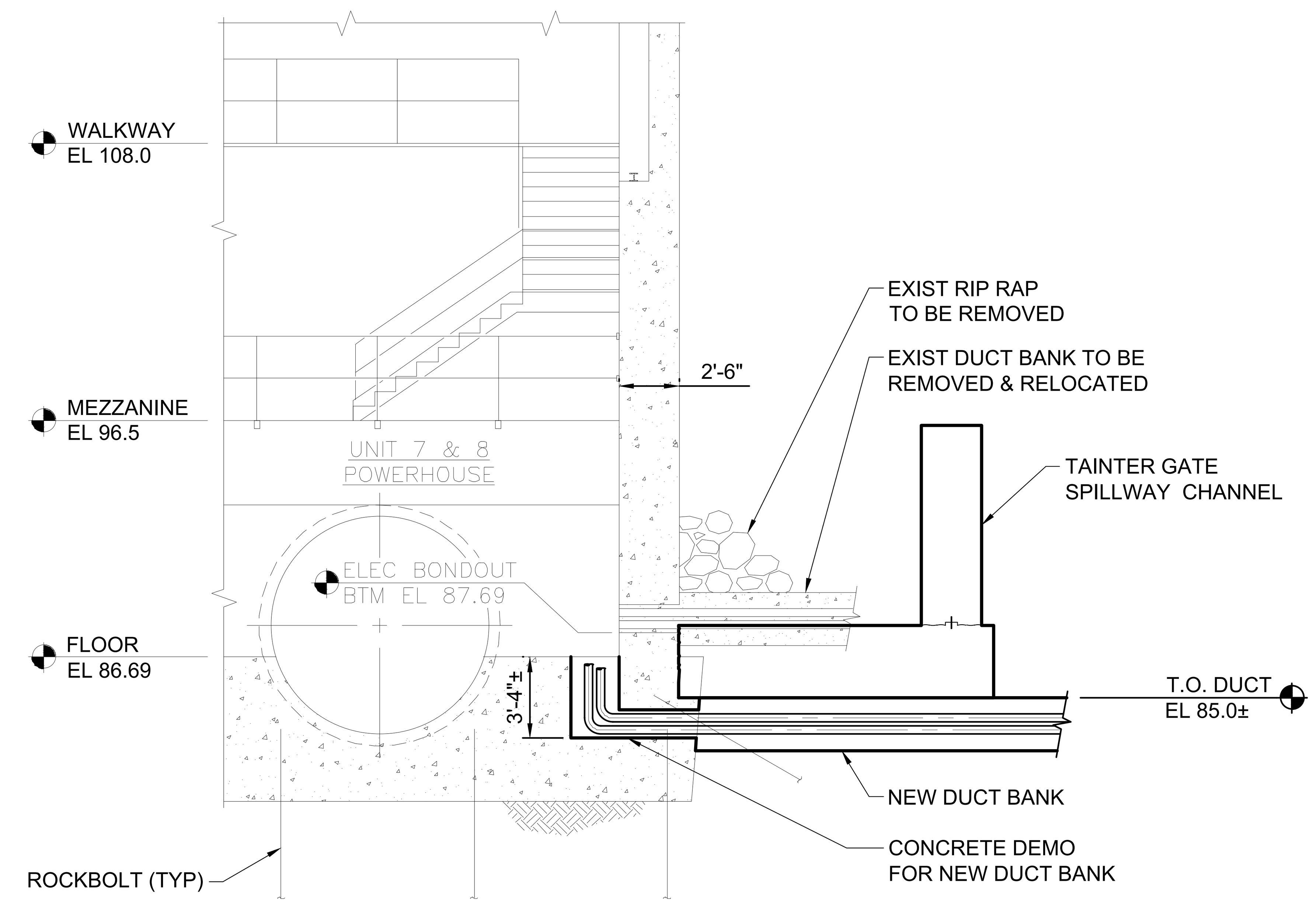
**LEGEND:**

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

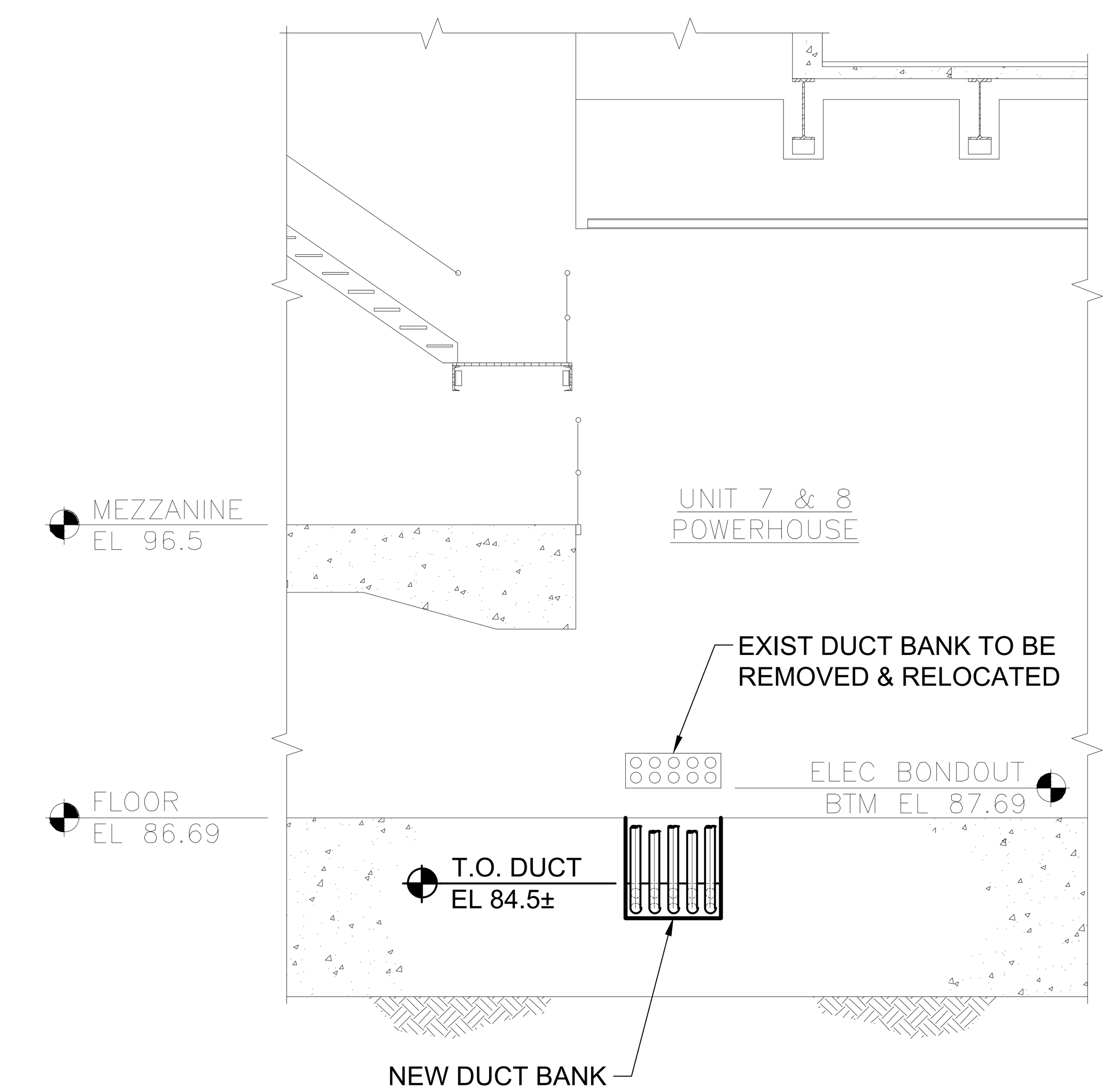
CONCRETE DEMOLITION



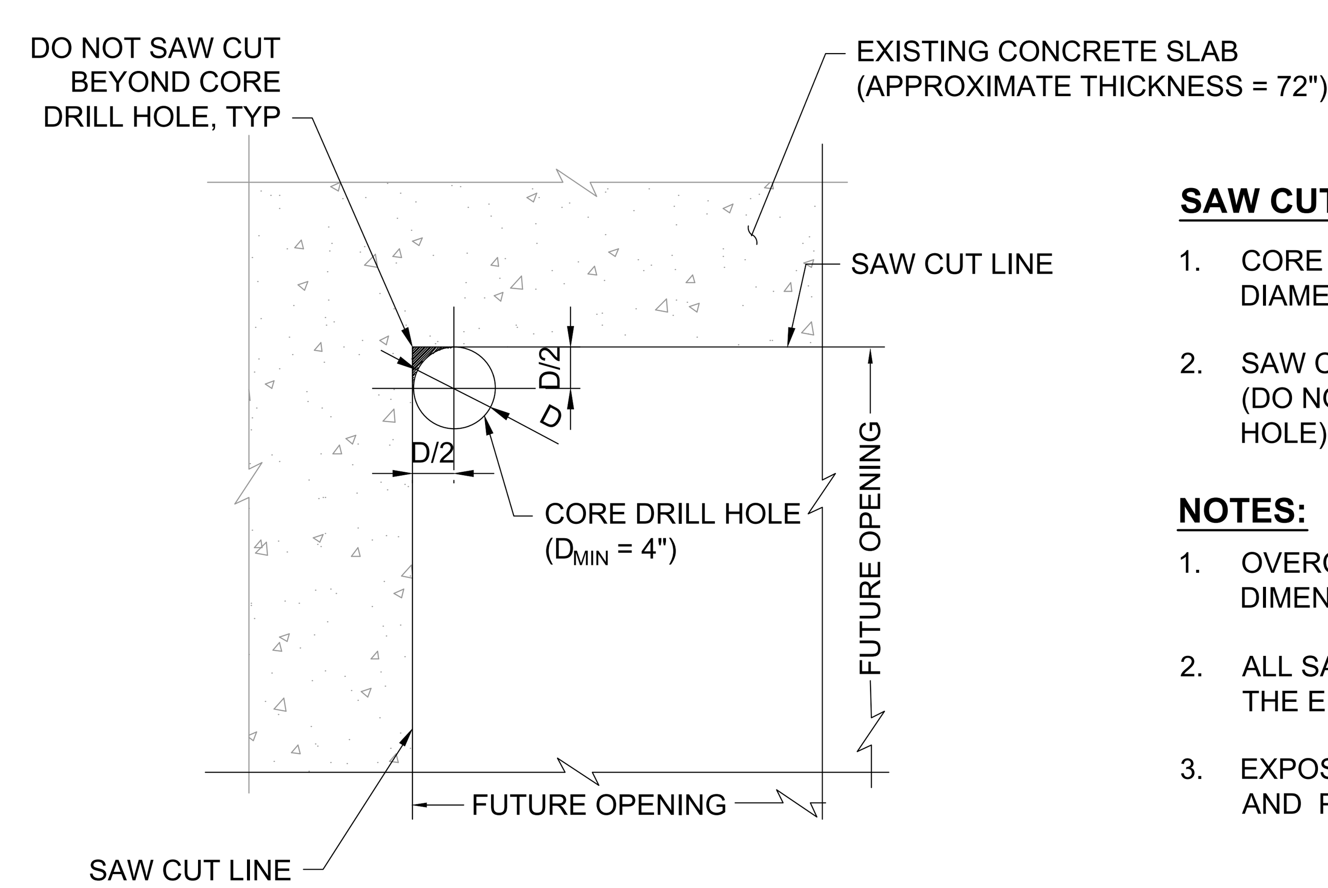

**PLAN**
SCALE: 1"=5'




A - **SECTION**
SCALE: 1"-5'




B - **SECTION**
SCALE: 1"-5'

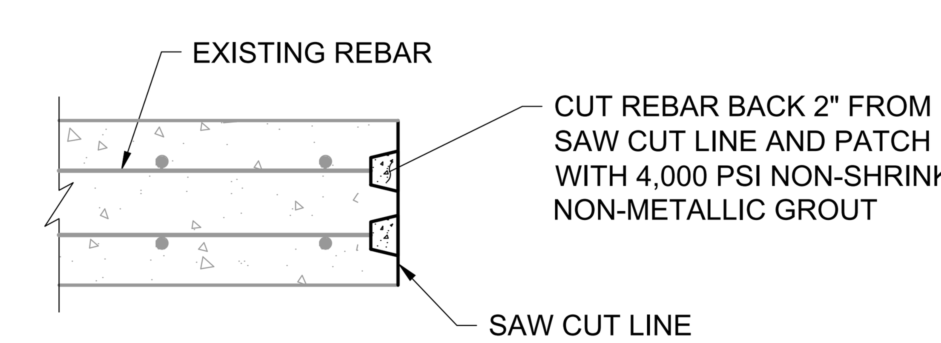



**SAW CUT / DEMO SEQUENCE:**

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"

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

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**NOT FOR CONSTRUCTION**
**DECEMBER 13, 2019**

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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 |


DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden rsa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\C\C-308.dwg USER: Agrogan
DATE: Dec 13, 2019 2:34pm XREFS: G-SHWMT-BD G-SHWMT-SLBMT C-SHWMT-XSP S-SHWMT-FISHWAY-PL S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-FFP C-SHWMT-PFW S1-SHWMT-FLUME C-SHWMT-PHOUSE-DUCT MAINE-PE-STAMP-MDG IMAGES

## 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:

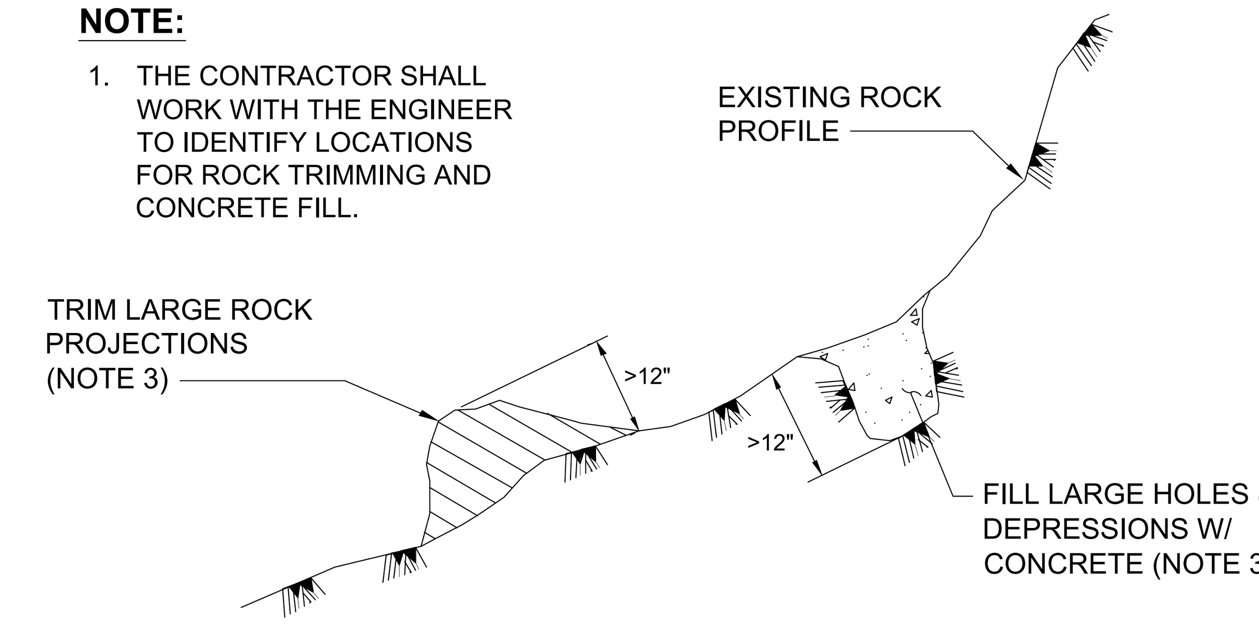
1. PROVIDE ADEQUATE SURVEY CONTROL TO AVOID UNAUTHORIZED OVEREXCAVATION.
2. REMOVE THE ORGANIC AND LOOSE/WEATHERED MATERIAL DOWN TO SOUND ROCK.
3. EXCAVATE TO LINES, GRADES, AND DIMENSIONS SHOWN AND AS NECESSARY TO ACCOMPLISH WORK.
4. TRIM TO NEAT LINES WHERE CONCRETE IS TO BE PLACED AGAINST FOUNDATION 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

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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.

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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


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No.39328
12/13/2019
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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.

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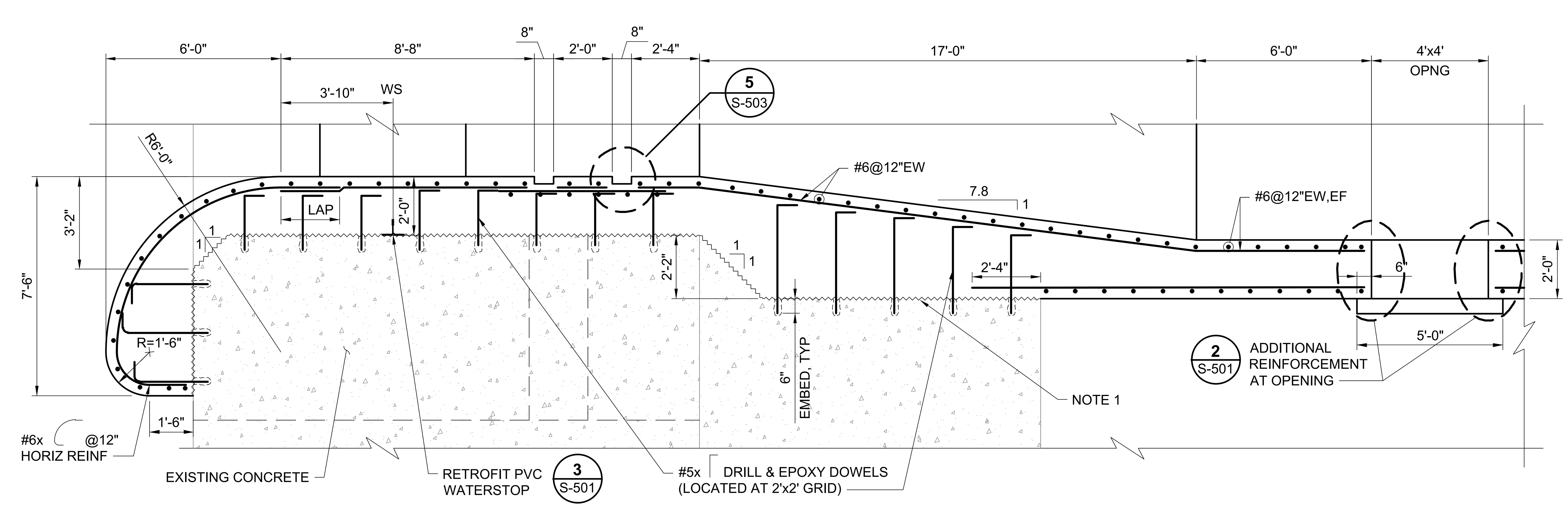
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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

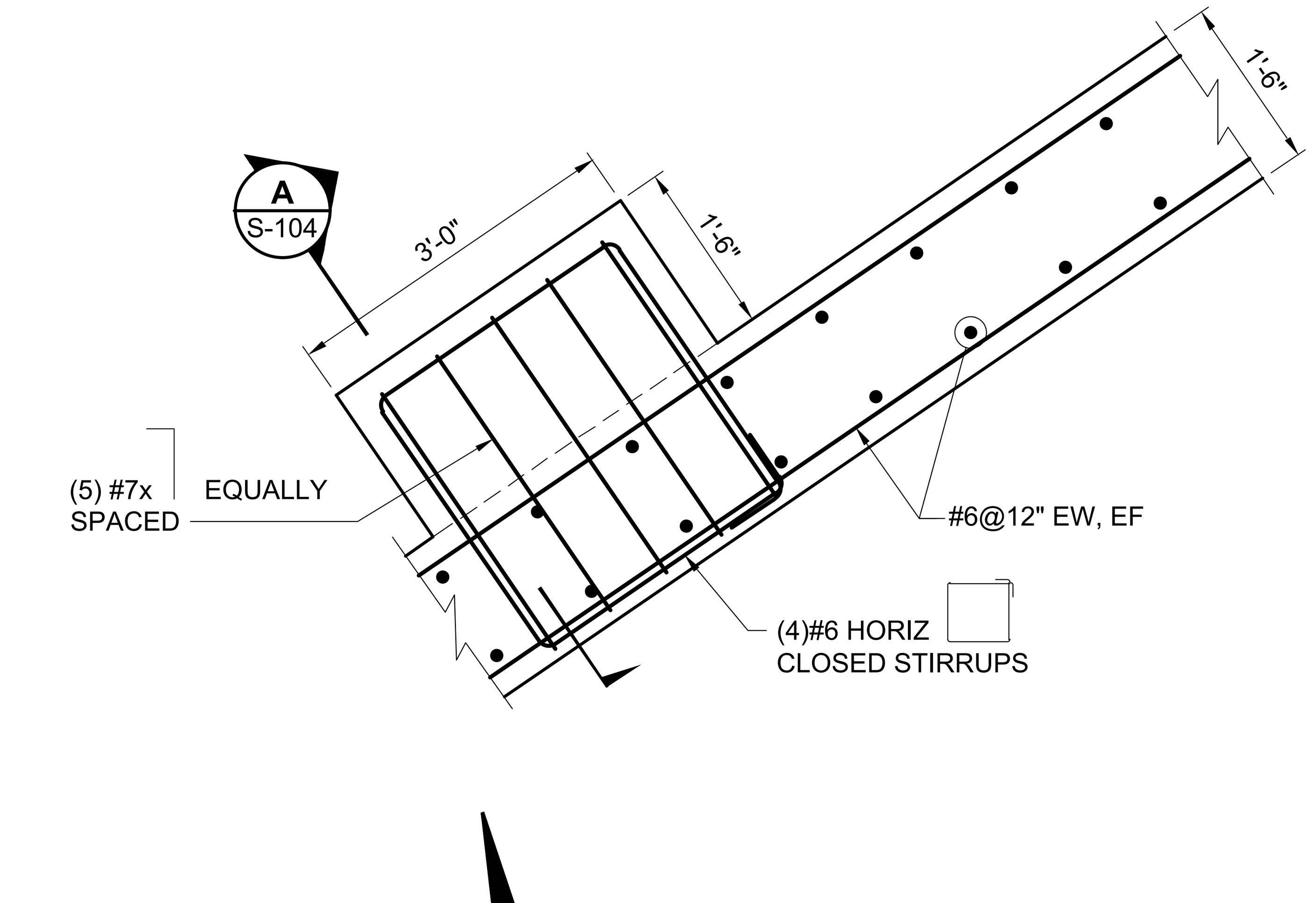
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 30 OF 176 |
| DRAWING: | S-102 |

**NOTE:**

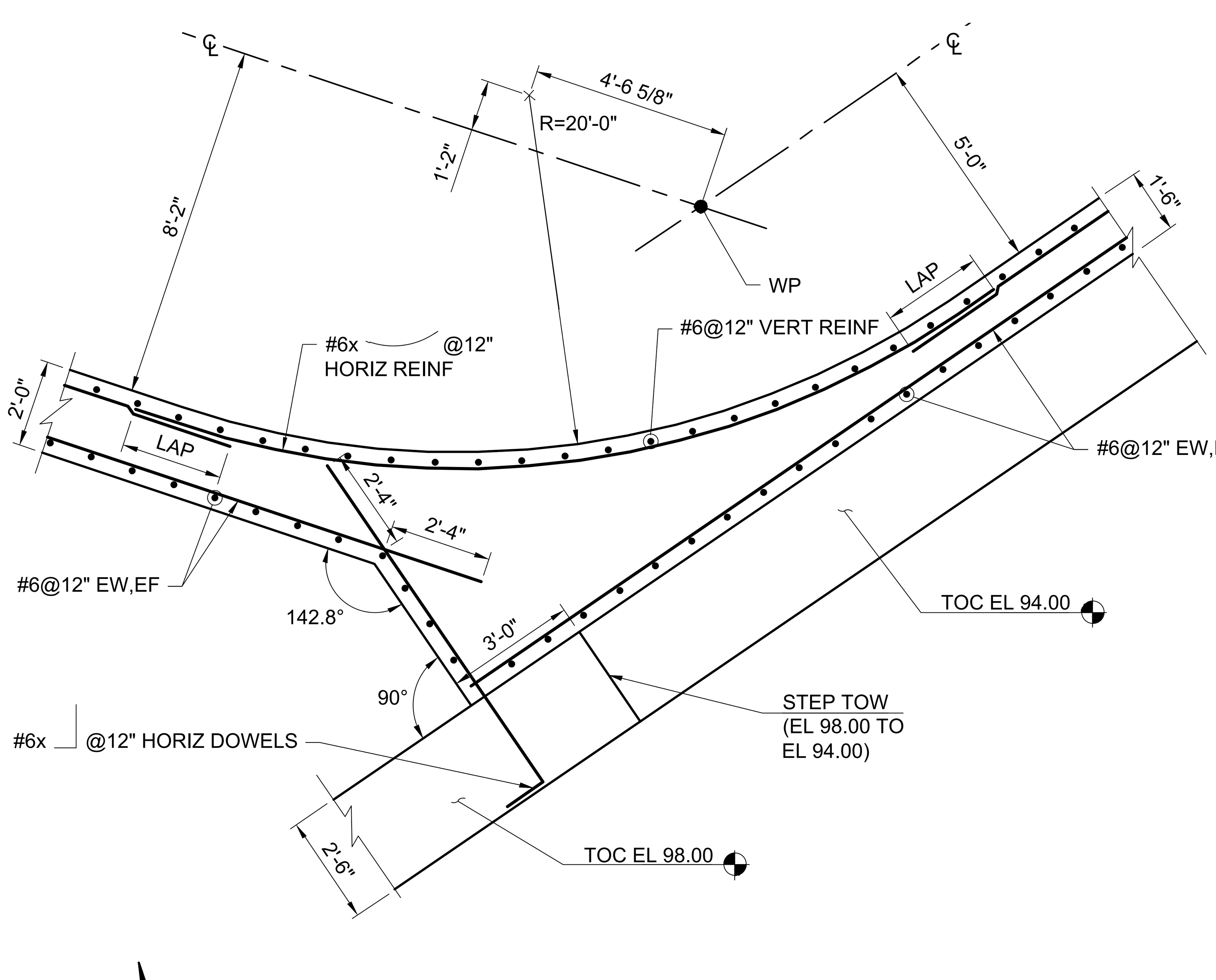
1. MECHANICALLY ROUGHEN EXISTING CONCRETE SURFACE TO ¼" MINIMUM AMPLITUDE.



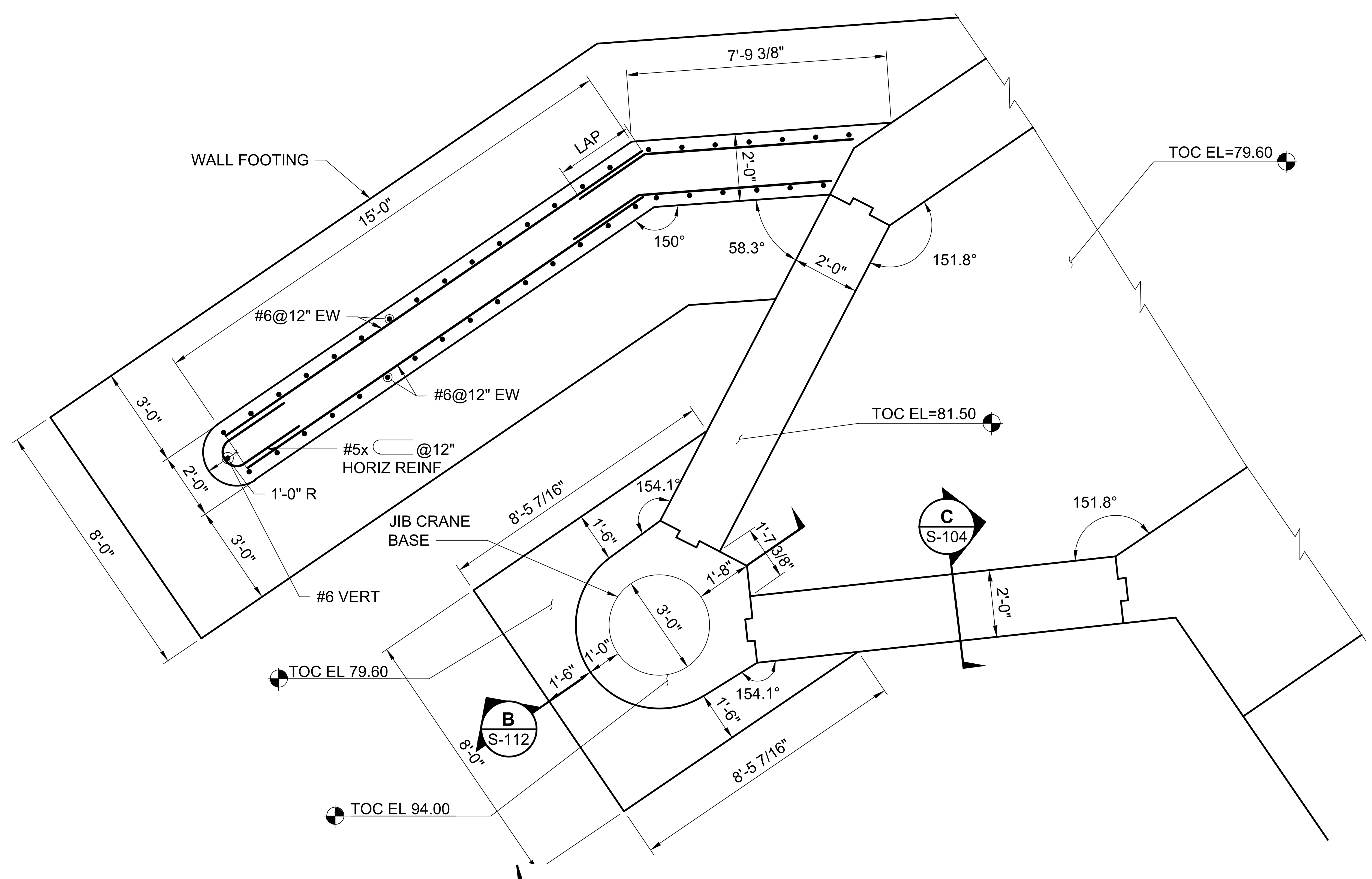

1 S-101 **ENLARGED VIEW**
SCALE: 3/8"=1'-0"
S-102




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




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




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

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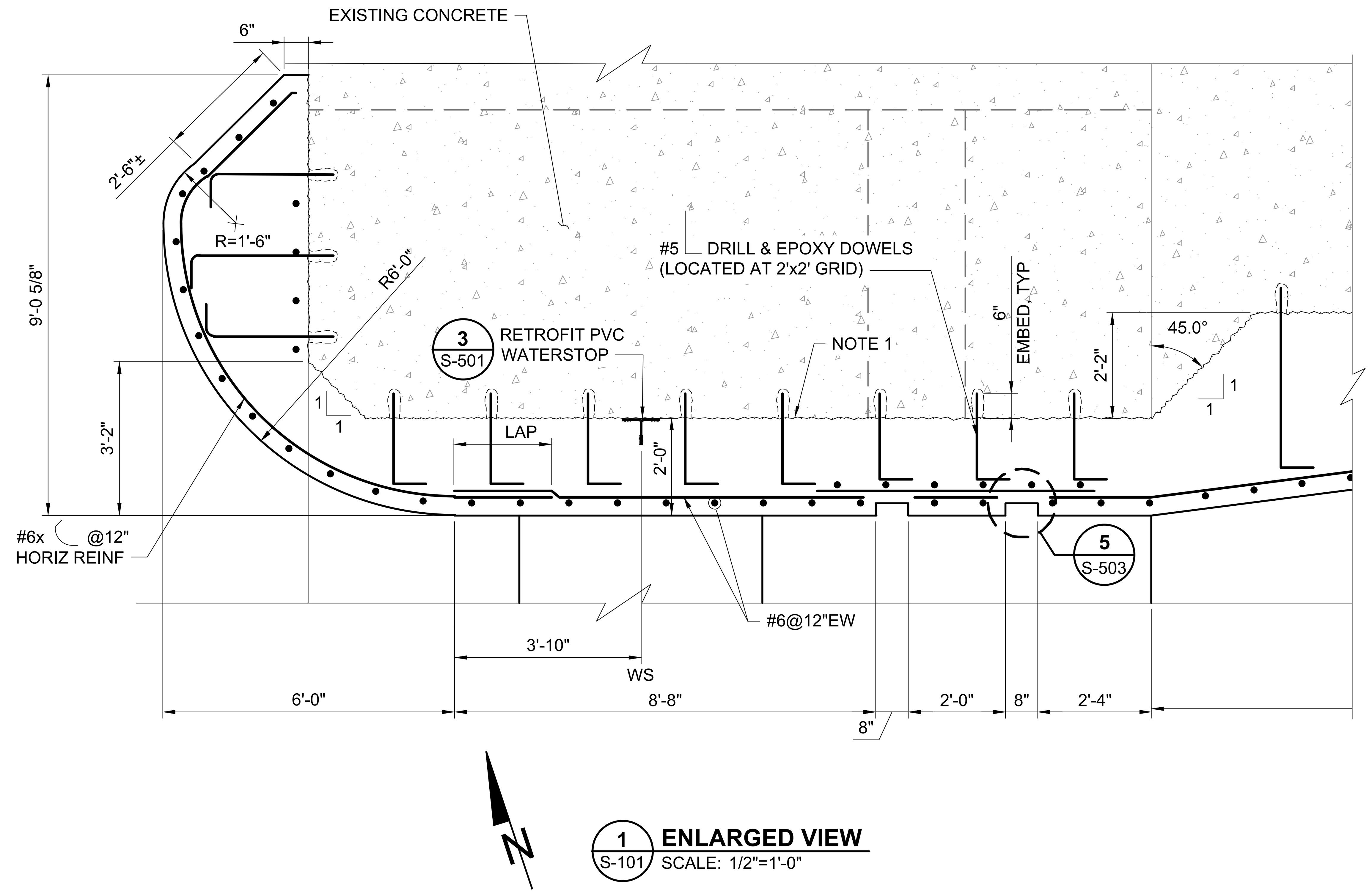
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

AWS SPILLWAY & FISH LIFT - ENLARGED PLANS & DETAILS

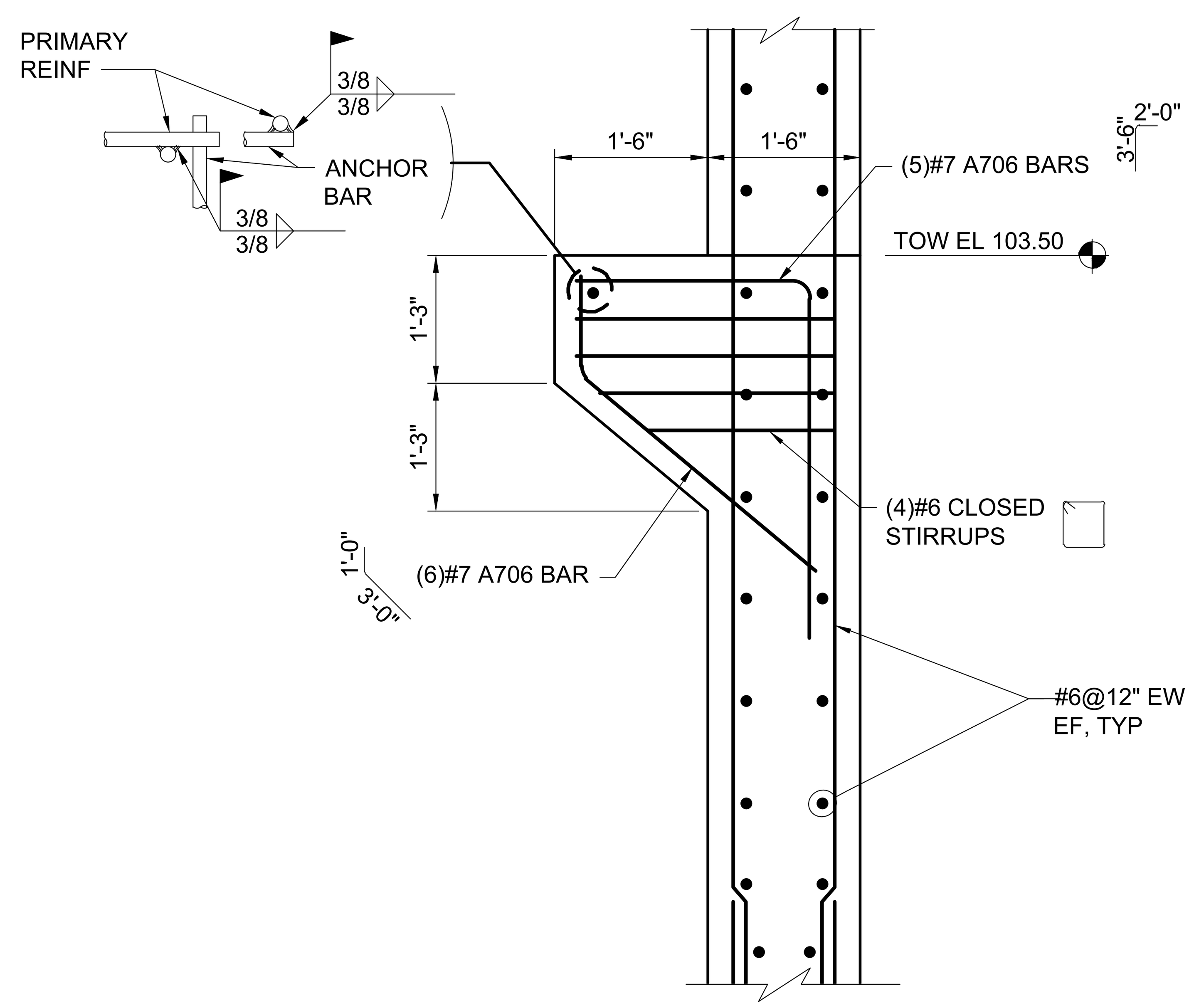
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 31 OF 176 |
| DRAWING: | S-103 |

**NOTE:**

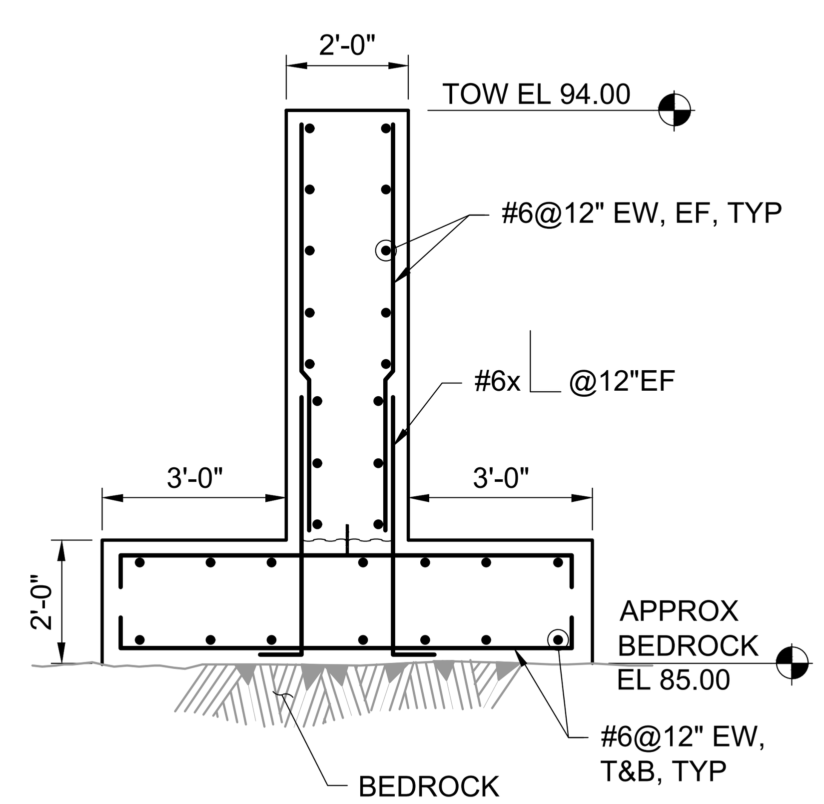
1. MECHANICALLY ROUGHEN EXISTING CONCRETE SURFACE TO ¼" MINIMUM AMPLITUDE.



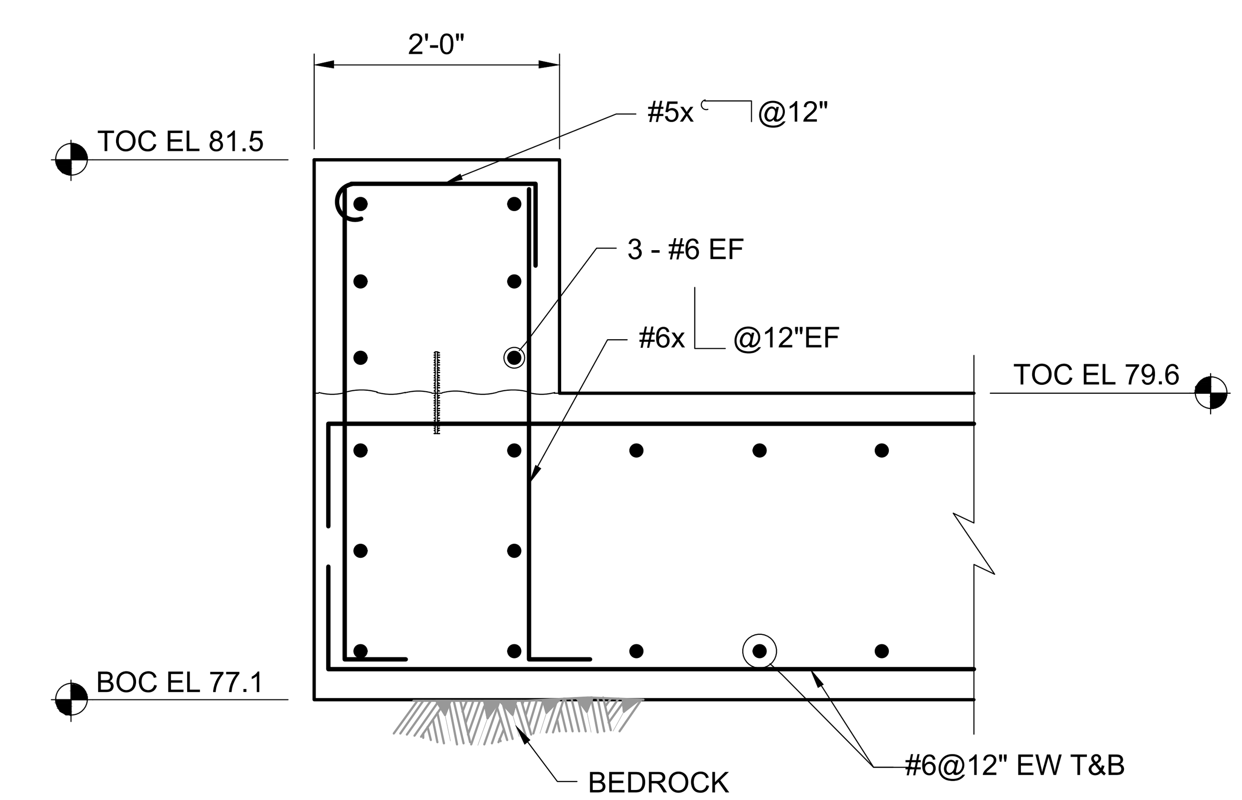

**1 ENLARGED VIEW** (S-101)
SCALE: 1/2"=1'-0"




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




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




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

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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 |

DWG: C:\Users\agrogan\documents\autocad sheet sets\3173009-alden mass and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-104.dwg USER: Agrogan
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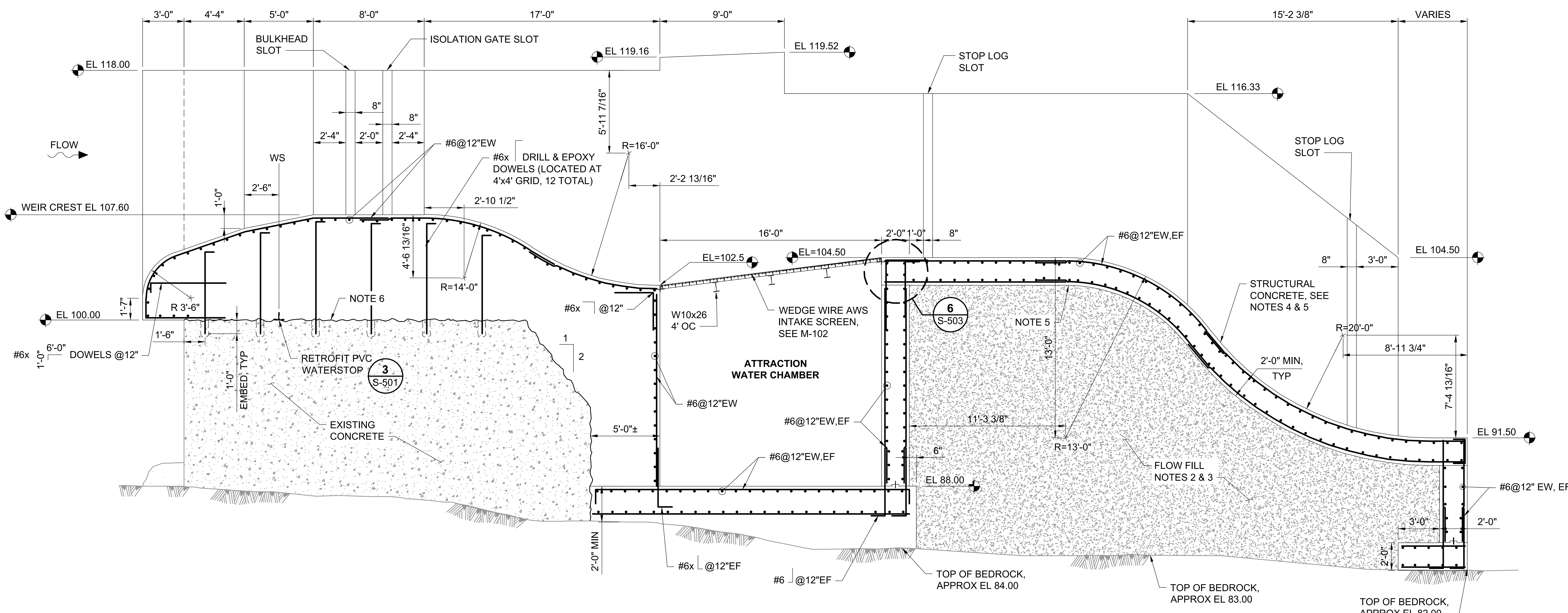
**NOTES:**

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

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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 |


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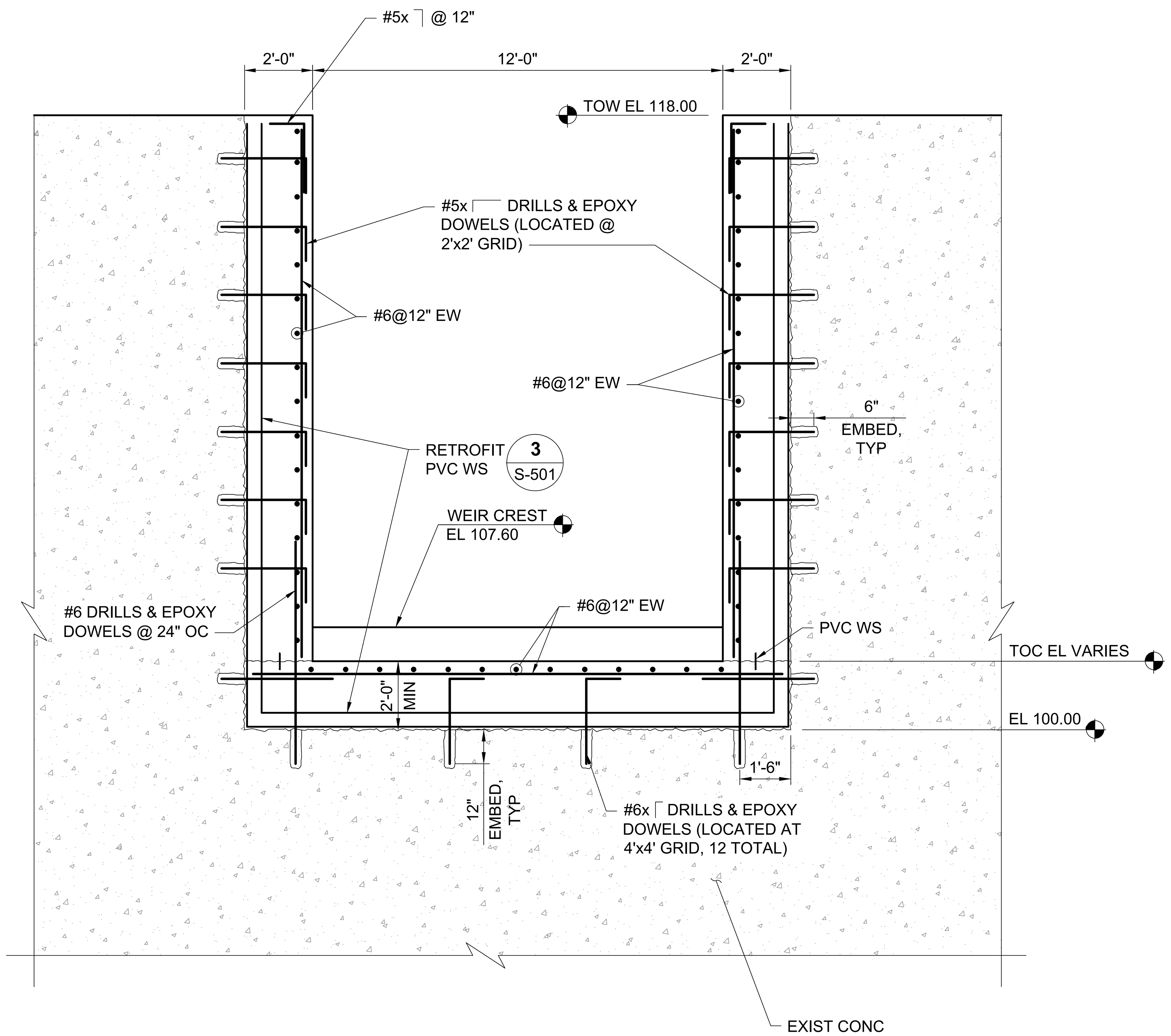
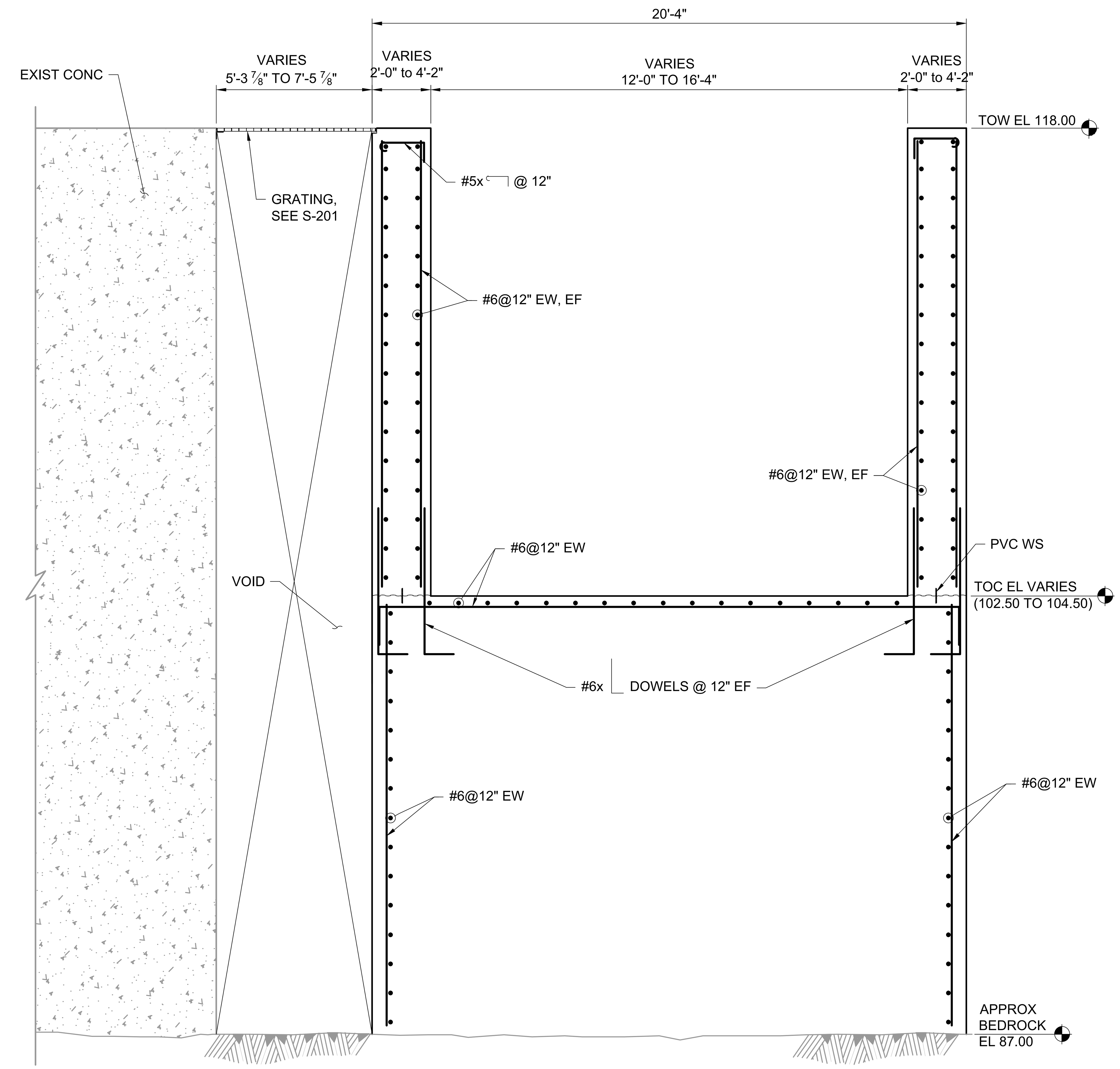
**NOTES:**

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

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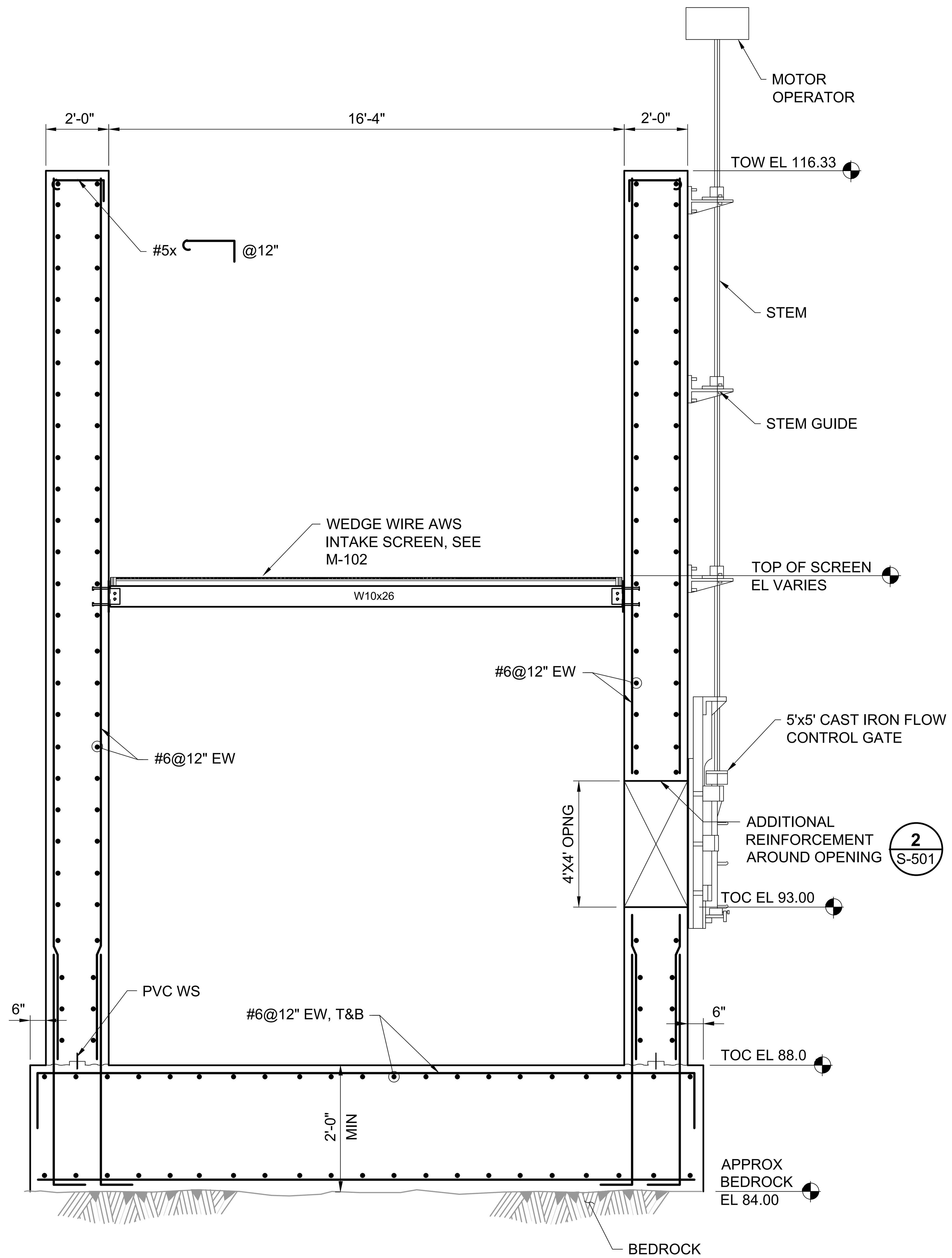
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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

**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

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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

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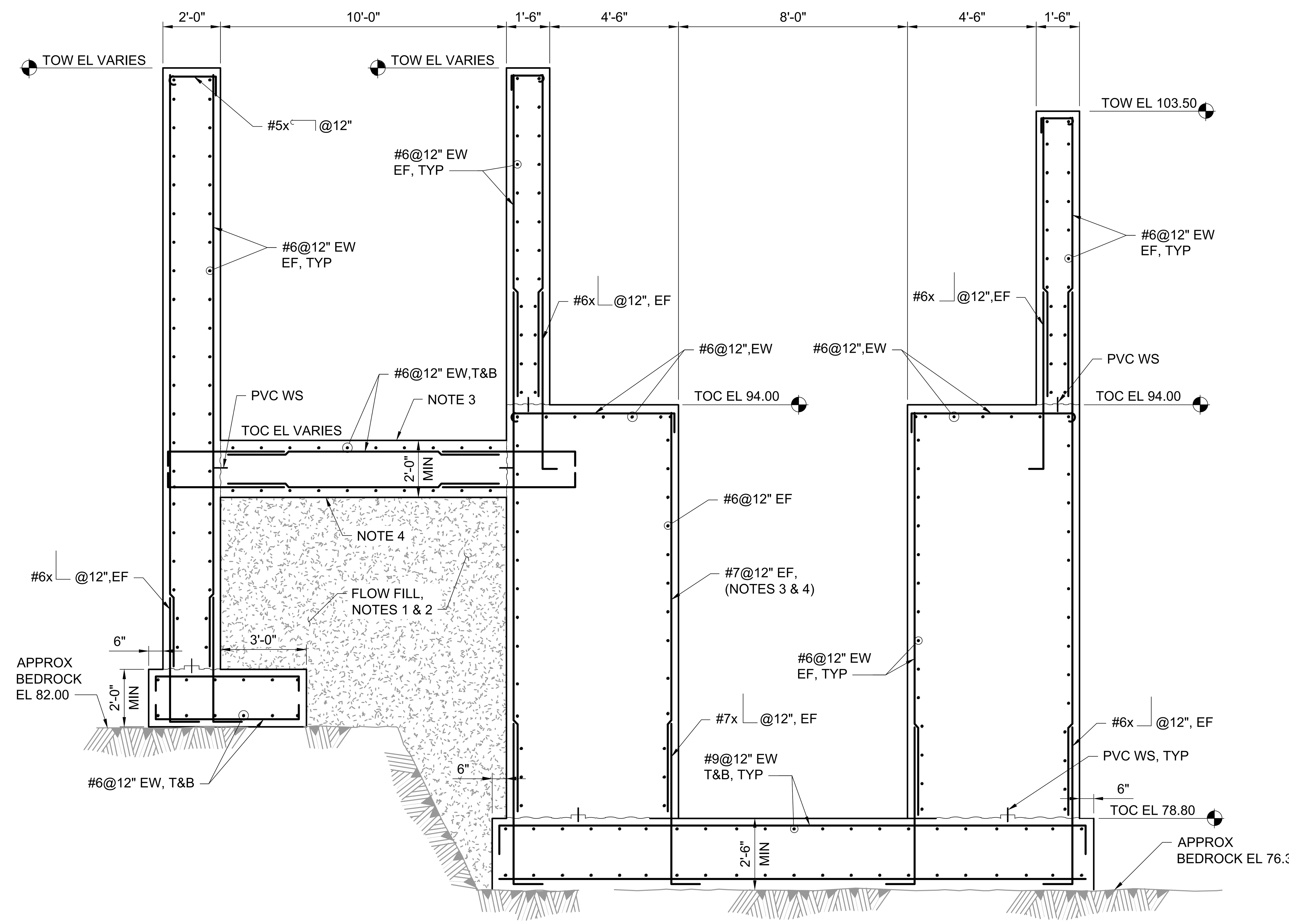
## NOTES:

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

S-102

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**DECEMBER 13, 2019**

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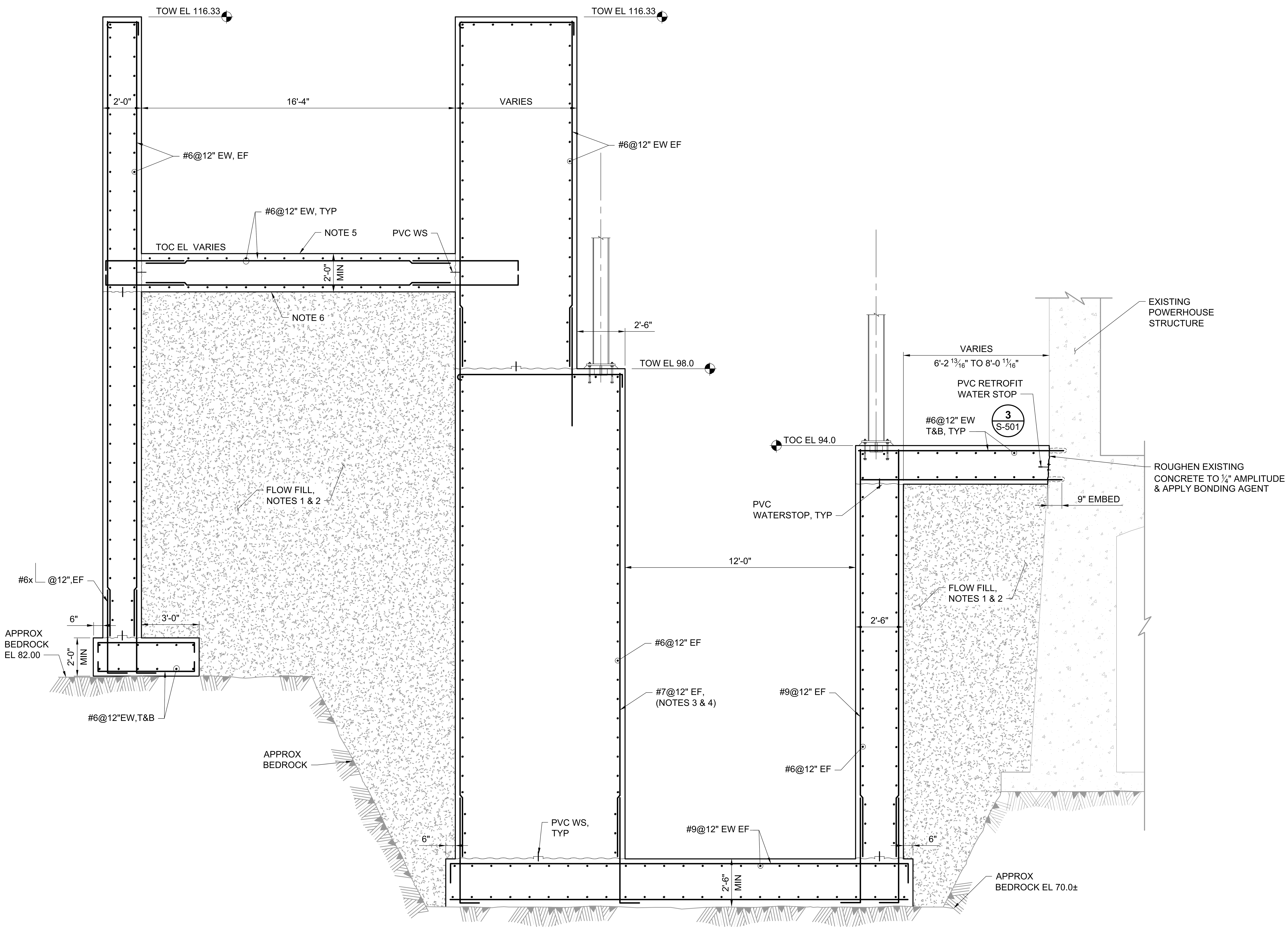
STATE OF MAINE
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED
PROFESSIONAL ENGINEER

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 SECTION
S-101 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.

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**DECEMBER 13, 2019**


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

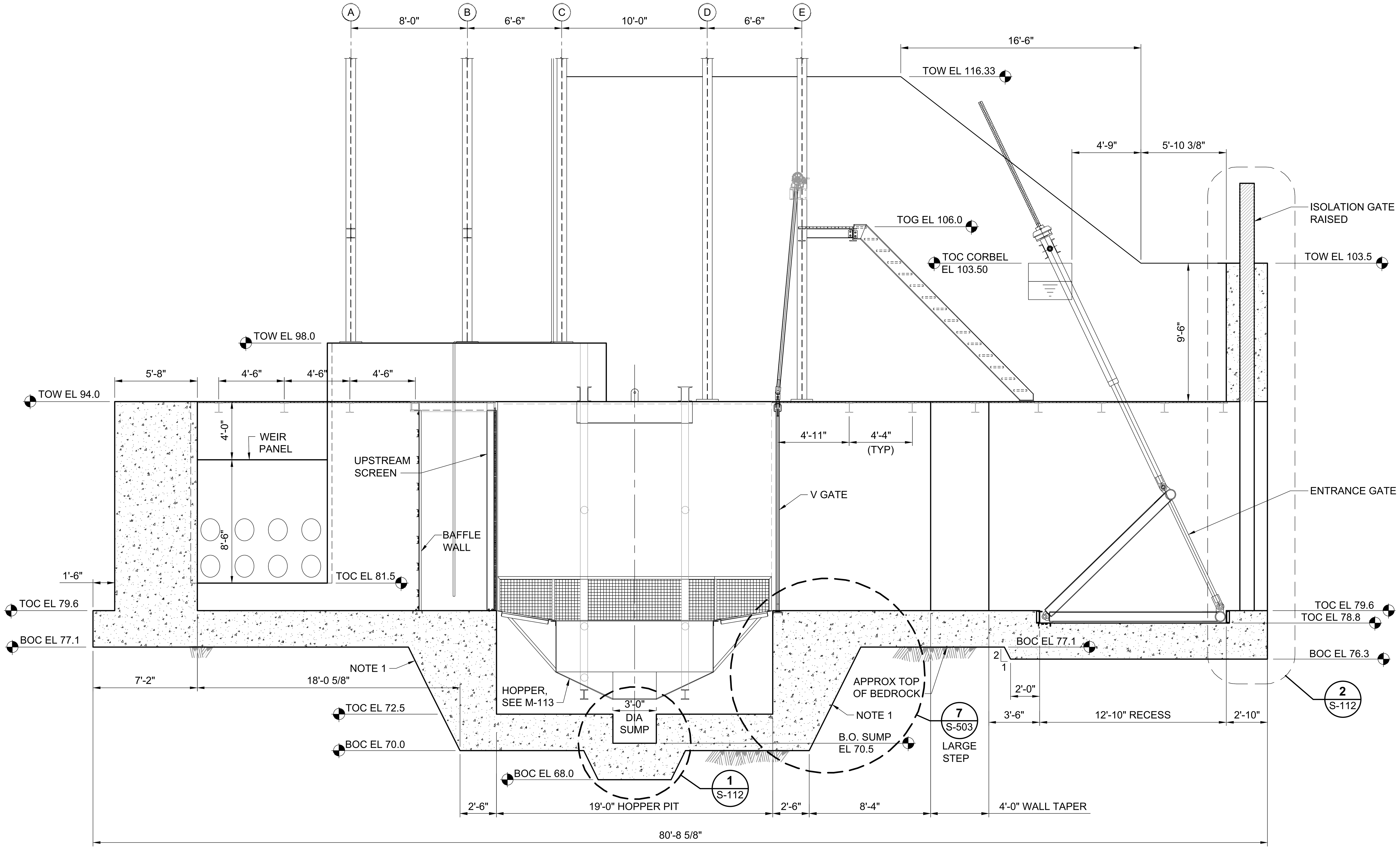
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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"

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**DECEMBER 13, 2019**

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

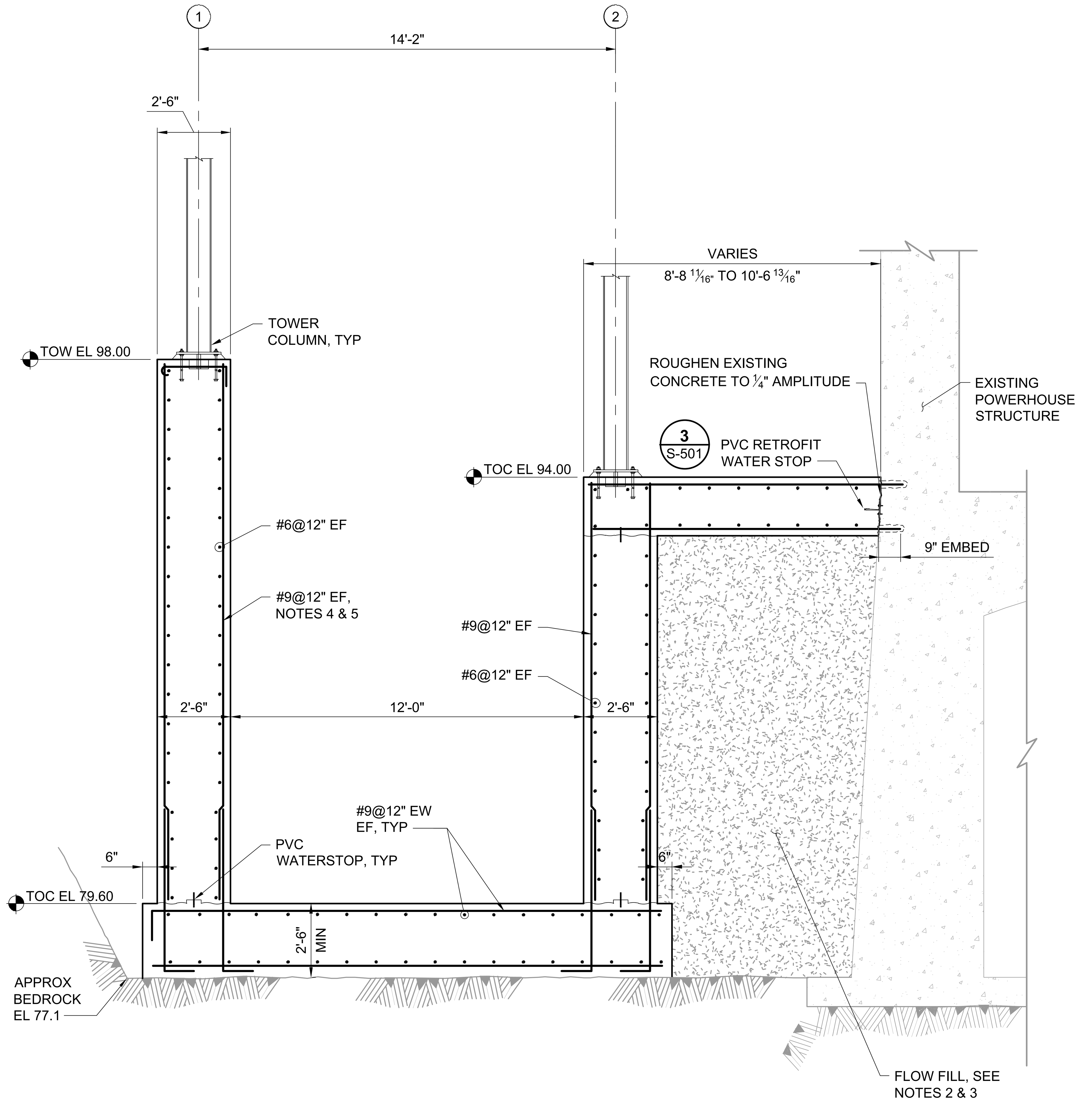
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT STRUCTURAL CONCRETE SECTIONS

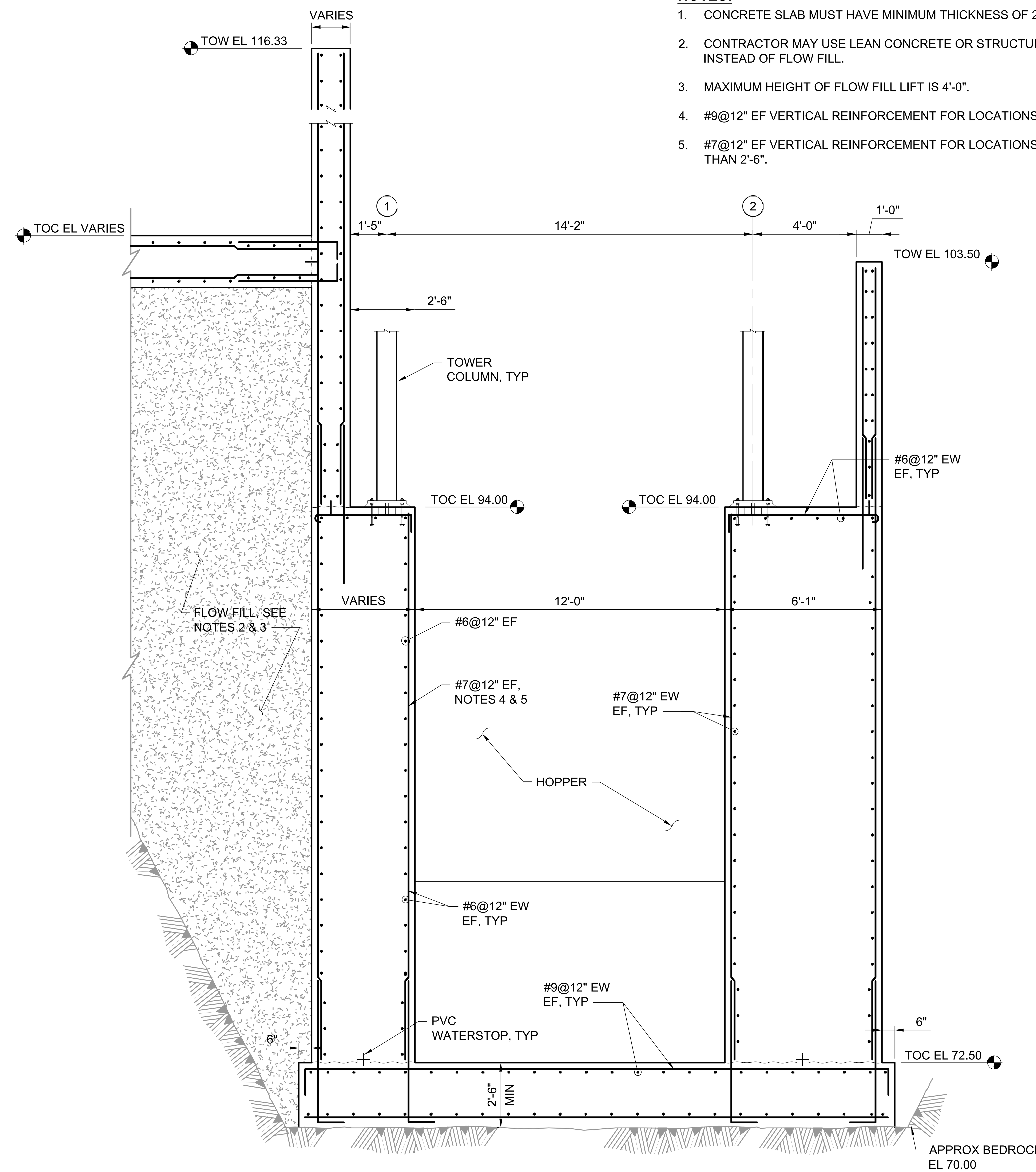
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 38 OF 176
DRAWING: S-110

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




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

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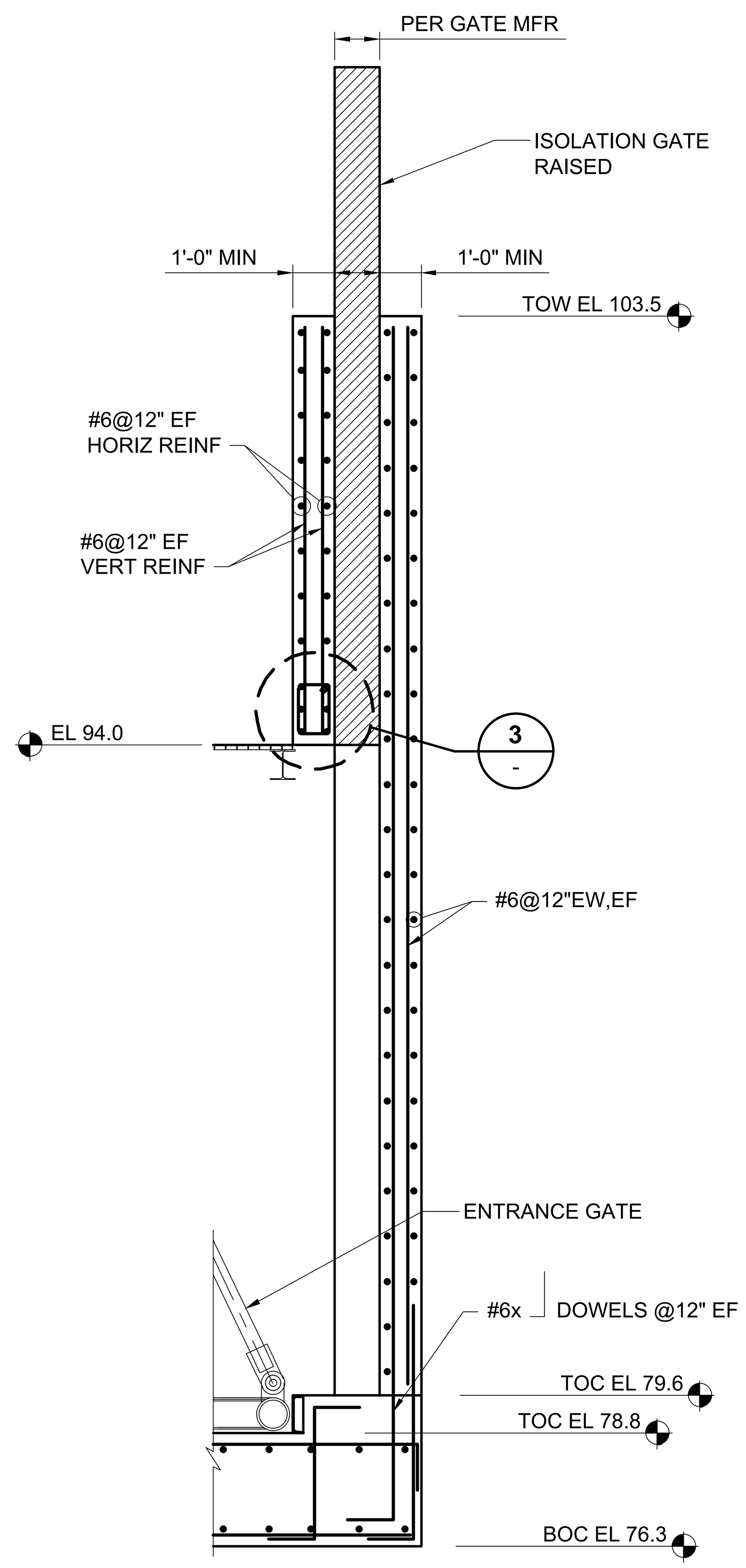
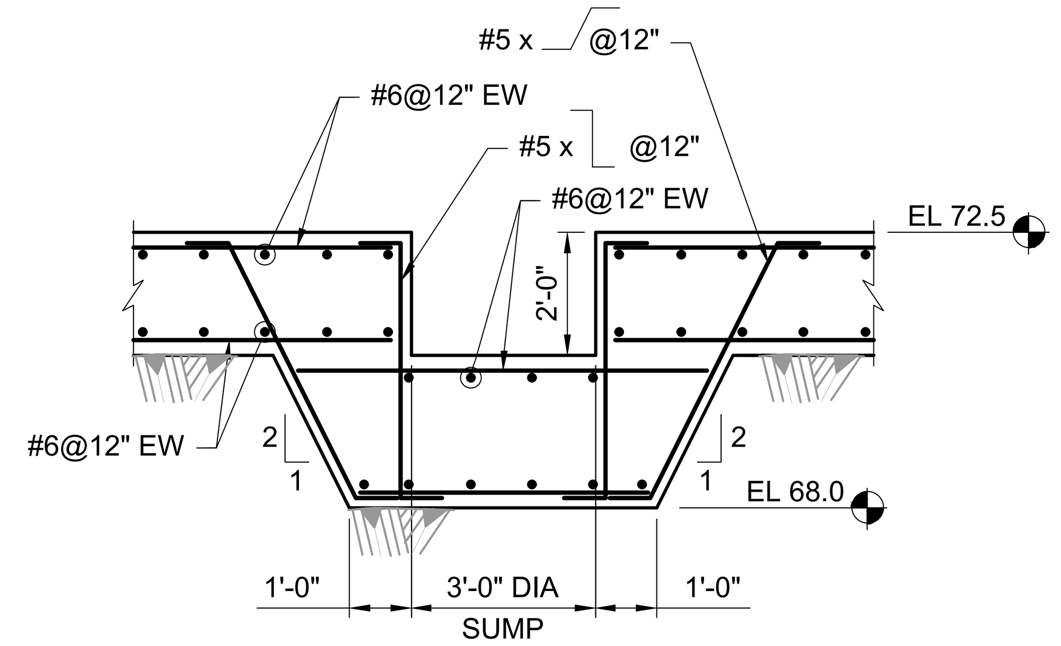
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT STRUCTURAL CONCRETE SECTIONS

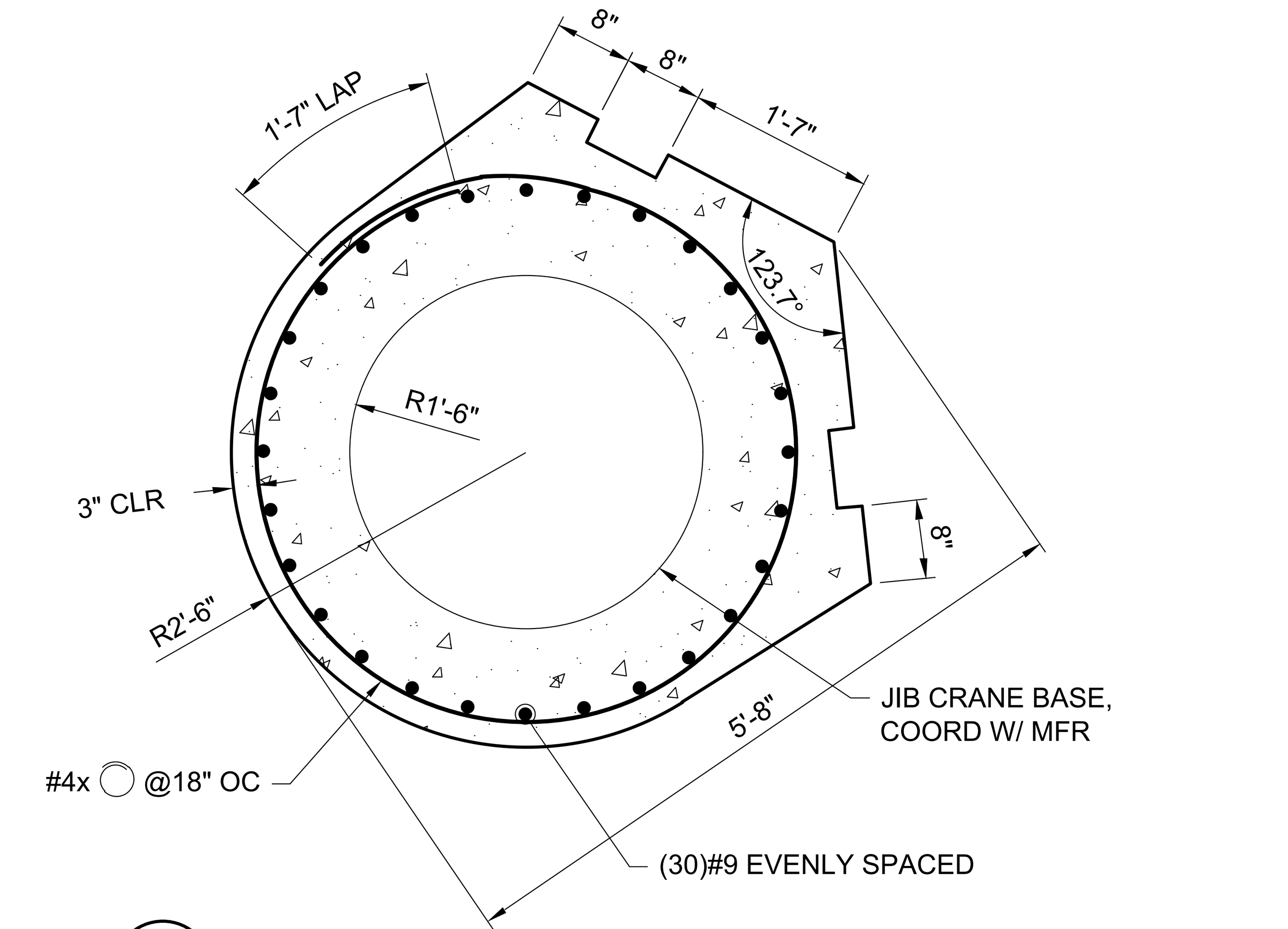
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 39 OF 176 |
| DRAWING: | S-111 |



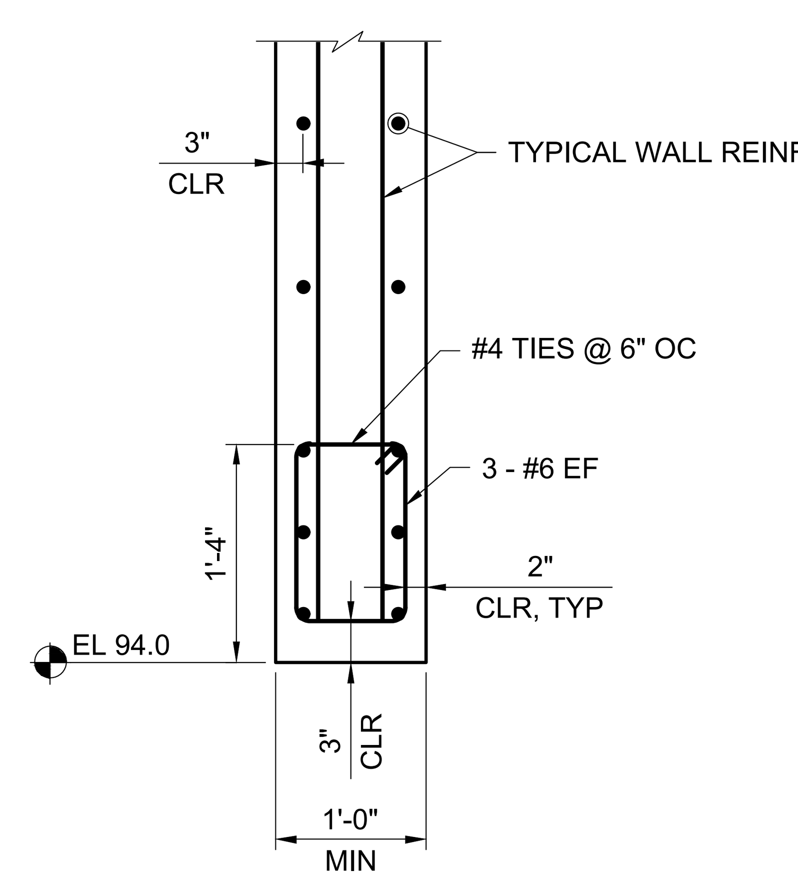

2 S-110 **DETAIL**
SCALE: 3/8"=1'-0"



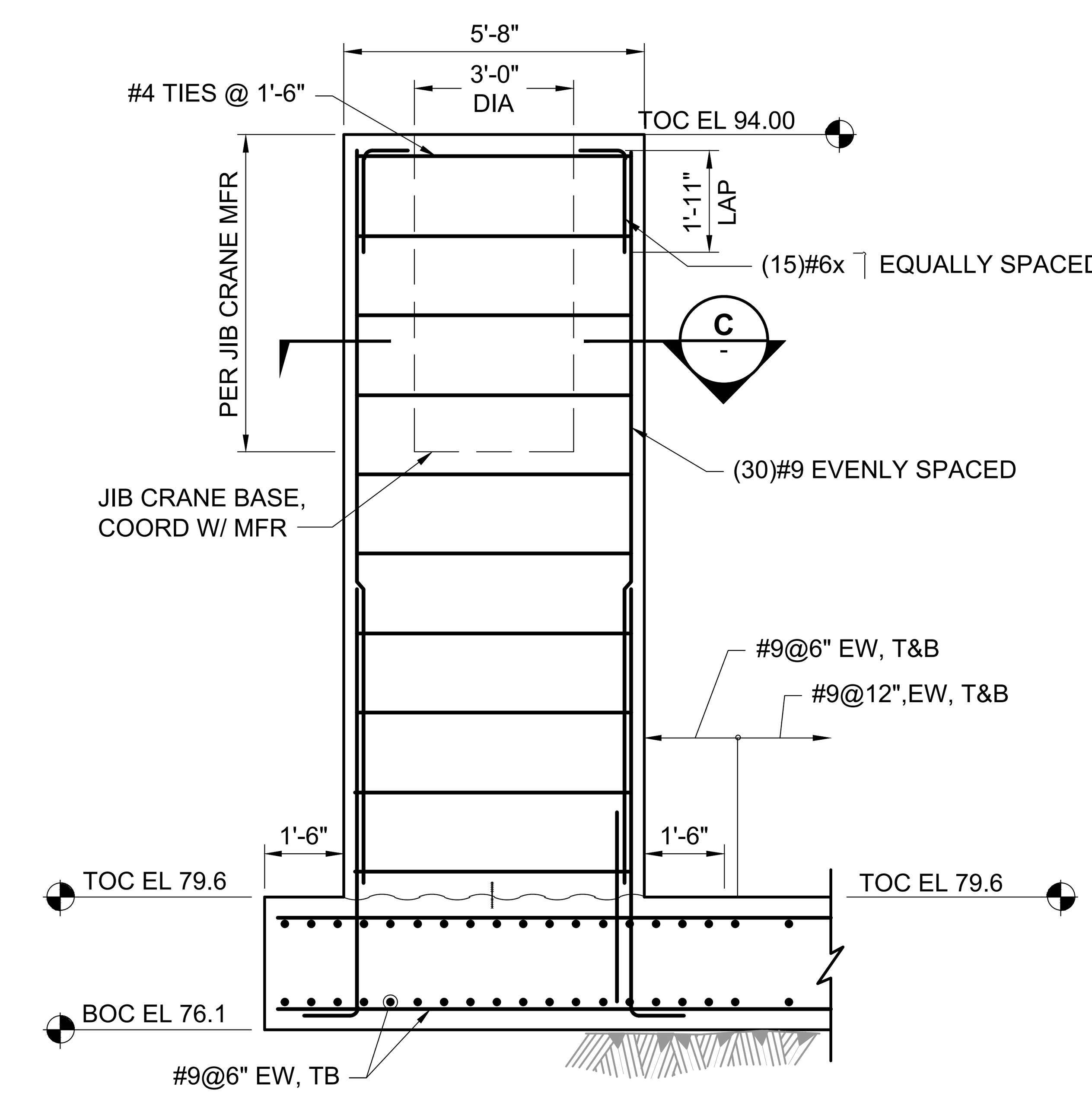

1 S-110 **SUMP PIT DETAIL**
SCALE: 3/8"=1'-0"




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"

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12/13/2019
LICENSED PROFESSIONAL ENGINEER

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

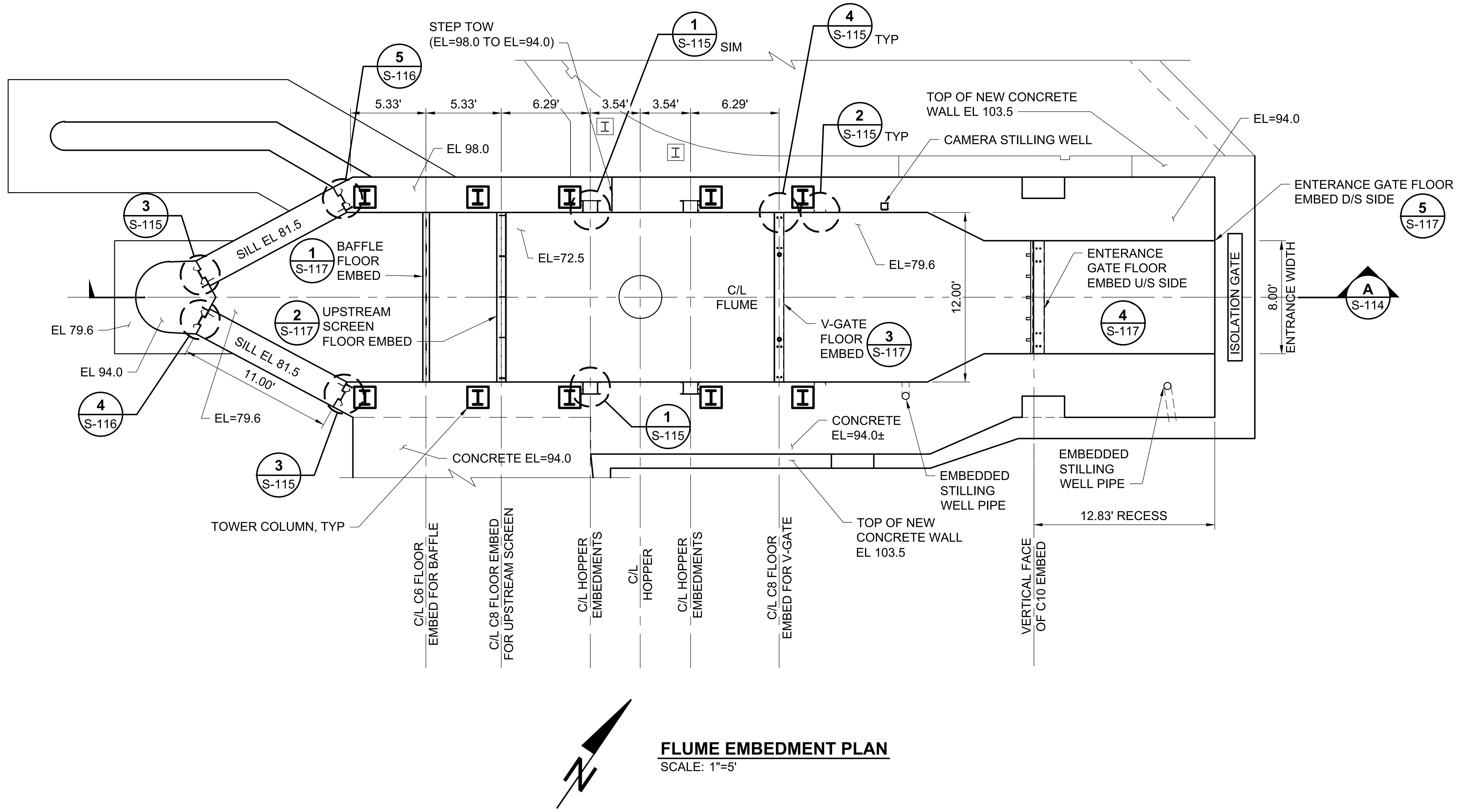
FISH LIFT STRUCTURAL
CONCRETE SECTIONS & DETAILS

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

DWG: C:\Users\agrogan\documents\autocad sheet sets\31009-alden nisa and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-112.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-SURVT C-SHWMT-XSP S3-SHWMT-PFW S1-SHWMT-PFP S1-SHWMT-FL-PL S1-SHWMT-SW-PL S-SHWMT-LIFT-SC S1-SHWMT-FLUME G-SHWMT-BD 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.




**FLUME EMBEDMENT PLAN**

SCALE: 1"=5'

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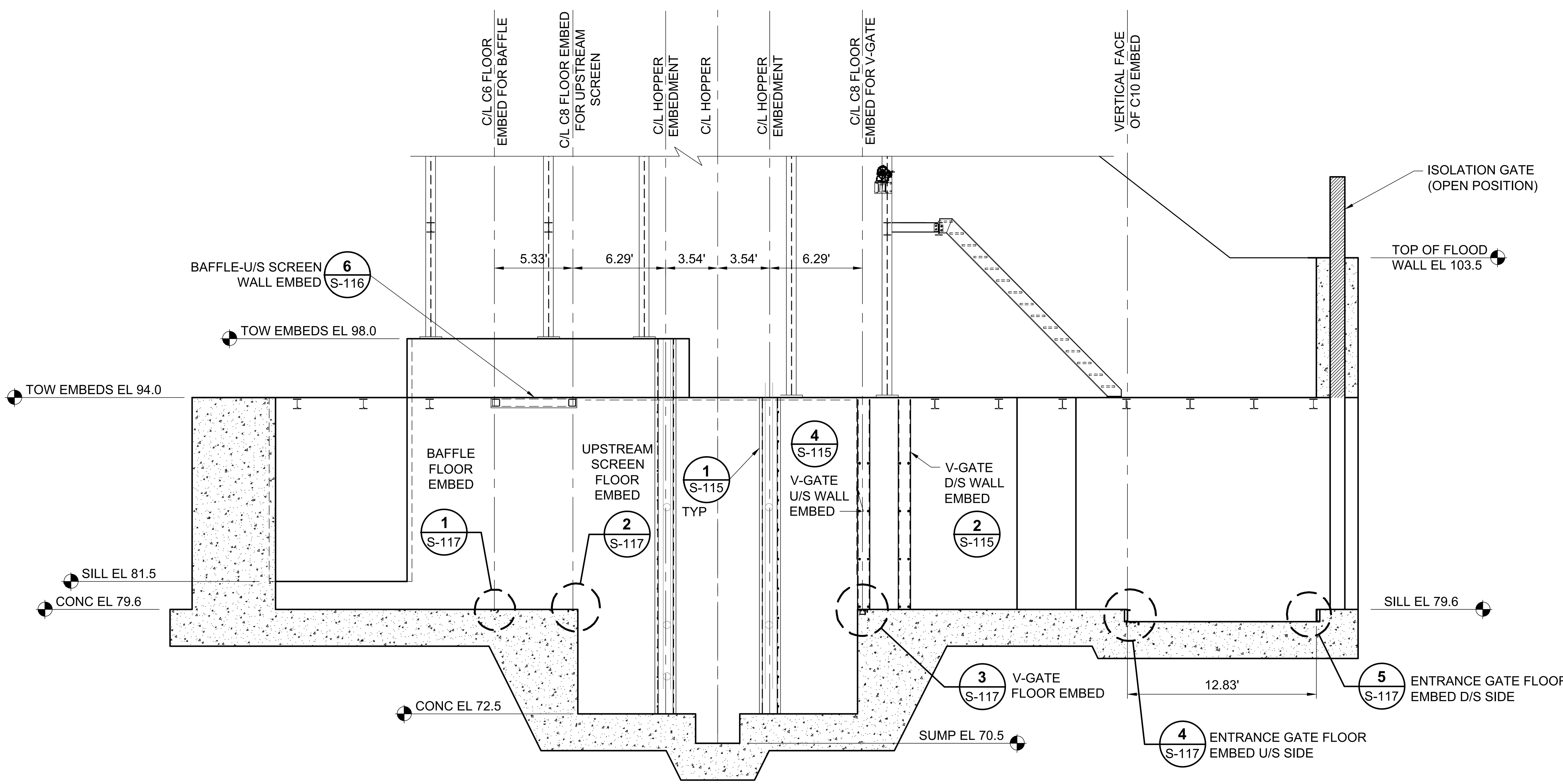
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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'

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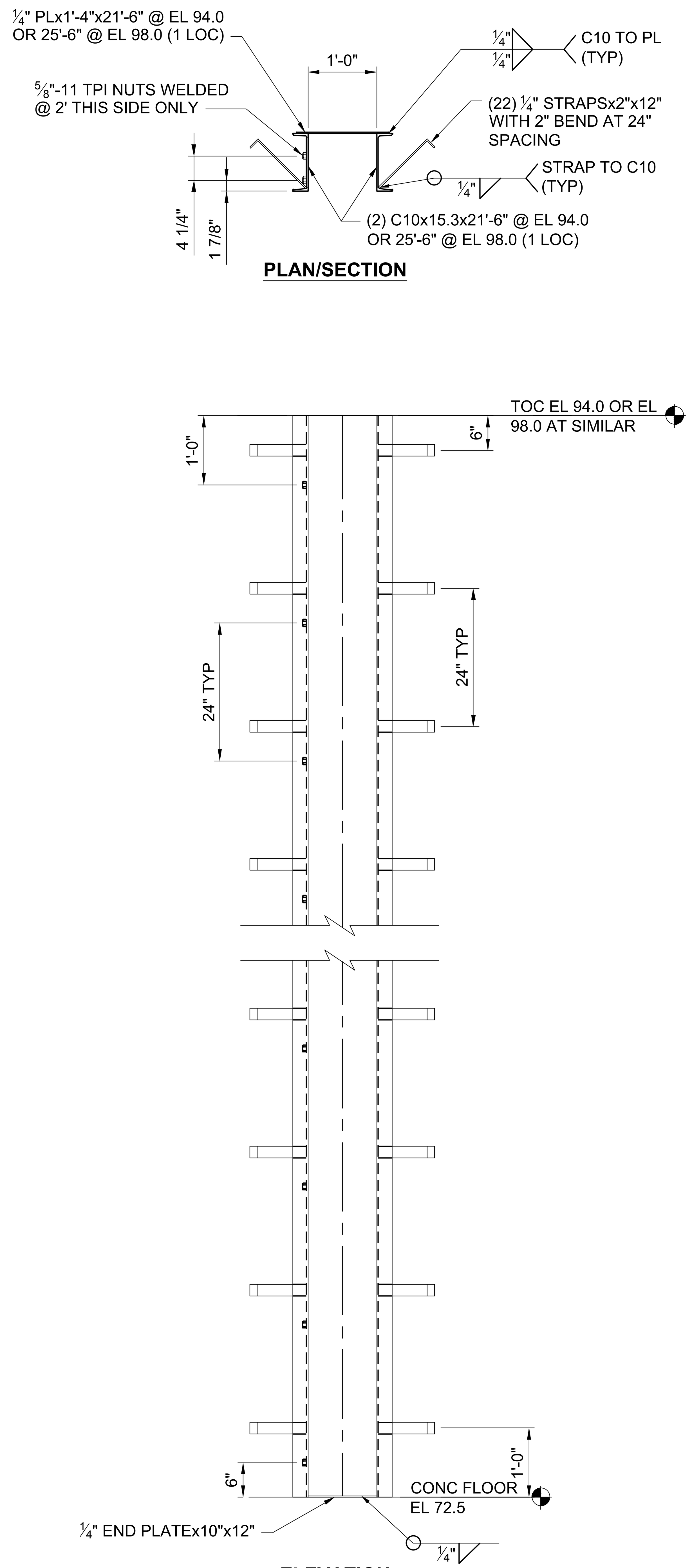
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT CONCRETE ENTRANCE
FLUME EMBEDMENT ELEVATION

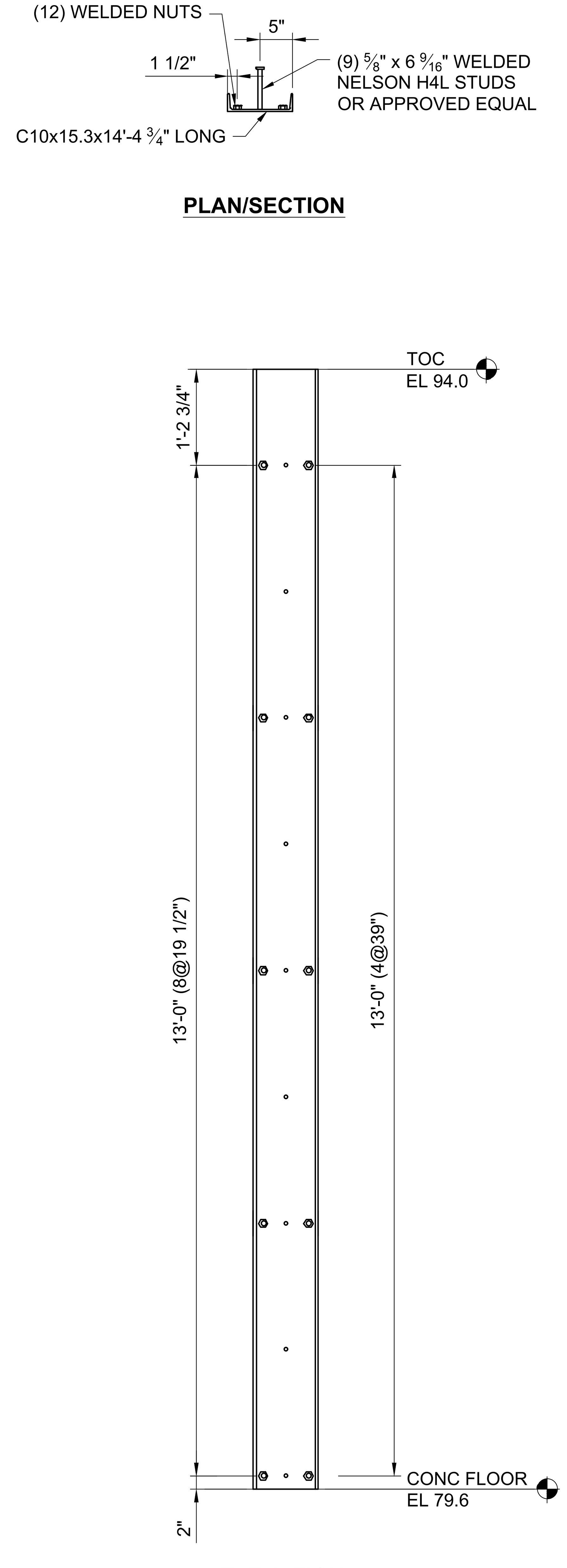
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 42 OF 176 |
| DRAWING: | S-114 |

## EMBEDMENT NOTES:

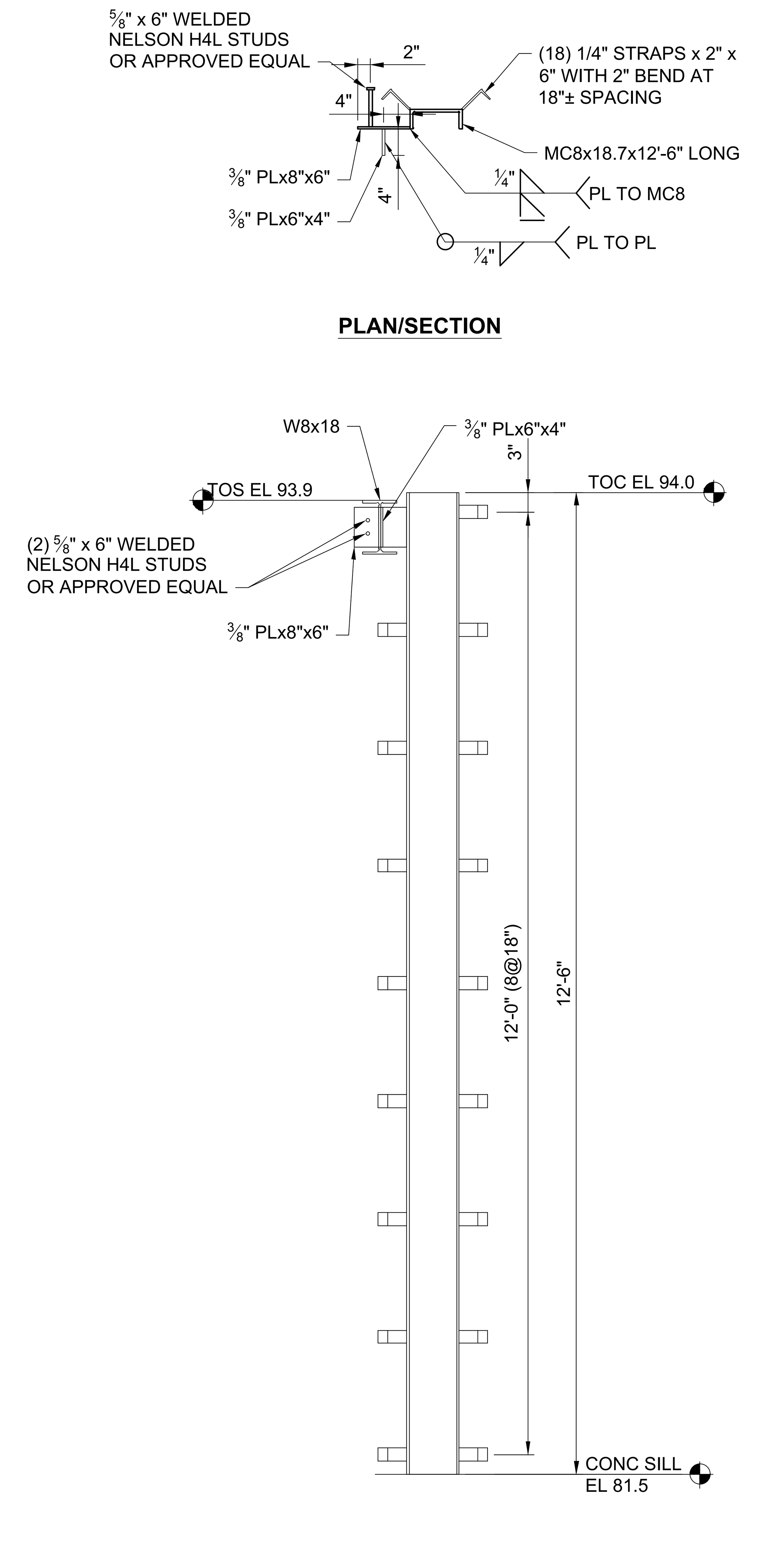
1. WELDS FOR 1/4" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE 3/4" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.



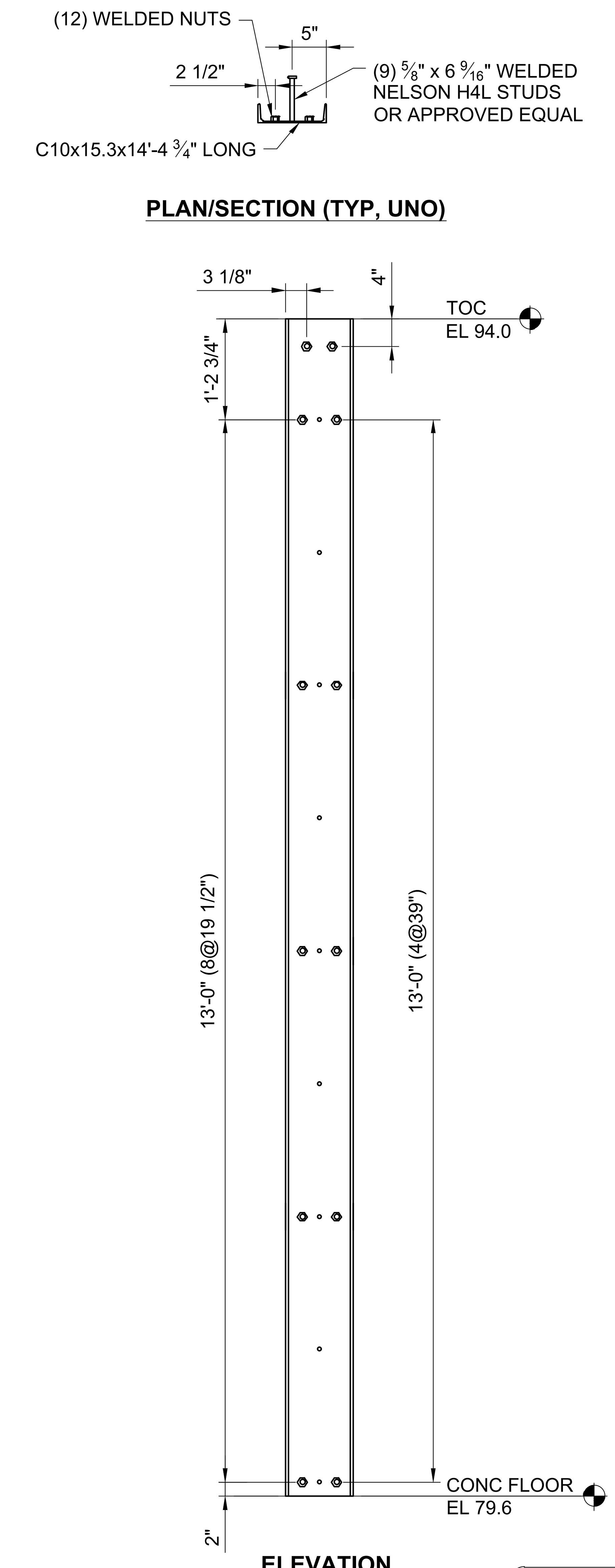

### 1 HOPPER RAIL WALL EMBEDMENTS (4 LOC)
S-113 S-114 SCALE: 3/4"=1'-0"




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




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




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

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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 |

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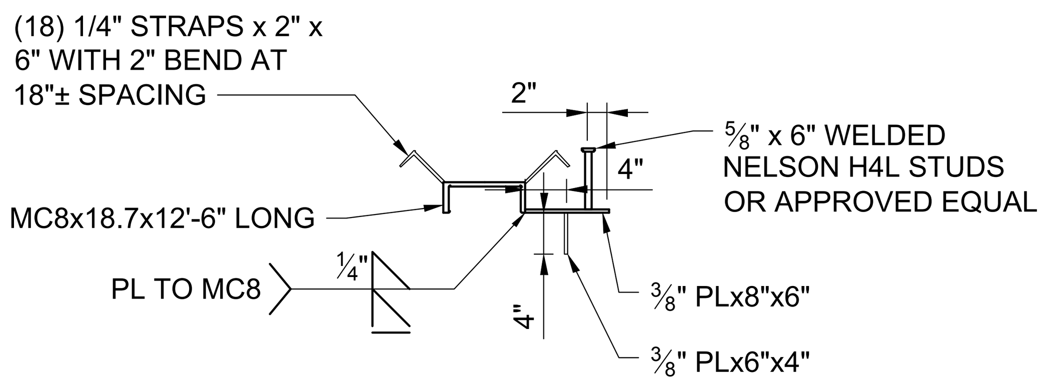
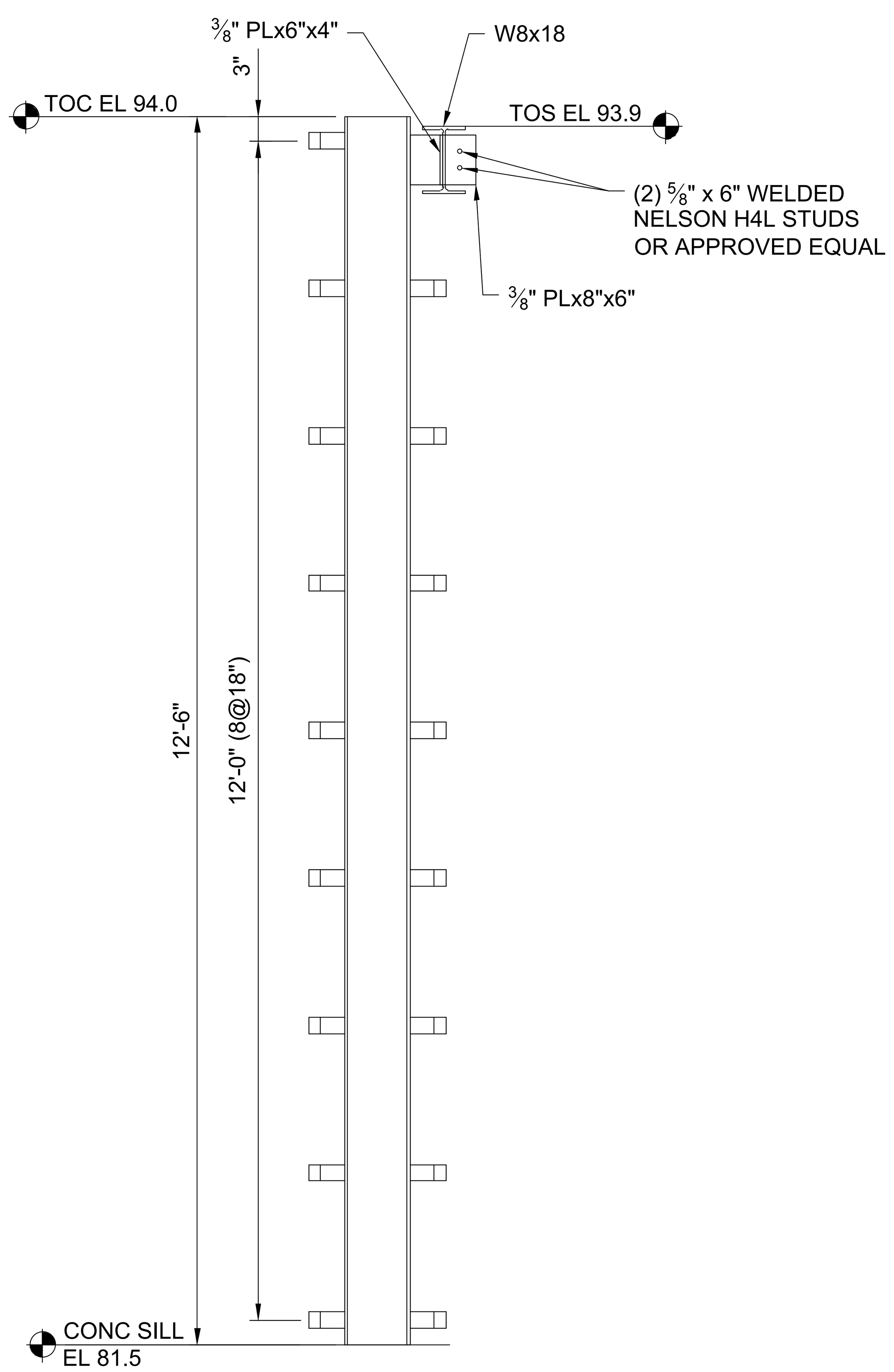
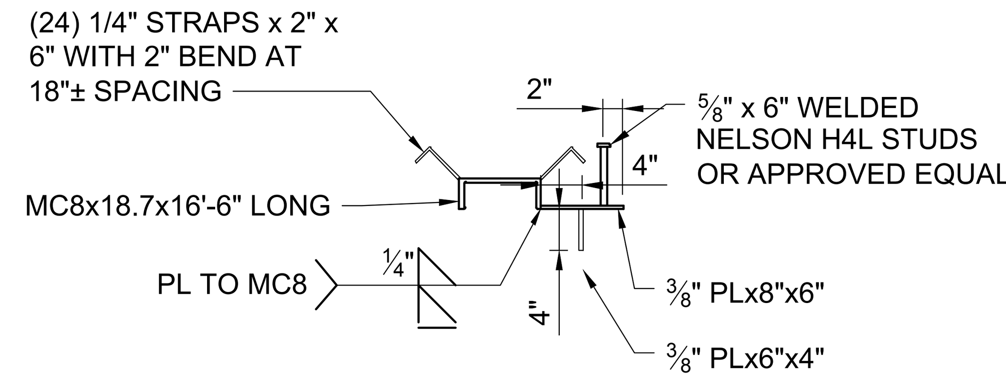



PLAN/SECTION

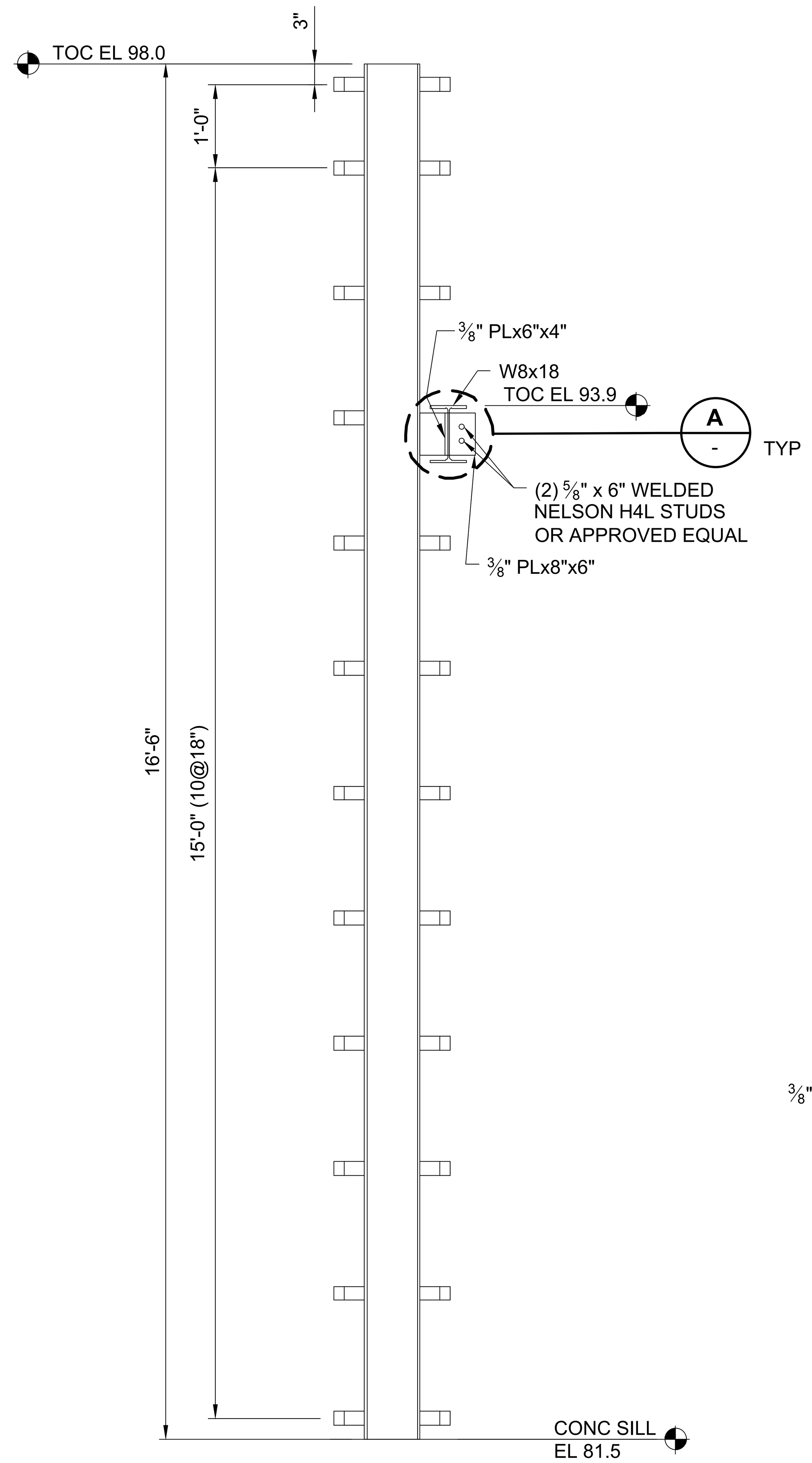



ELEVATION

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




PLAN/SECTION

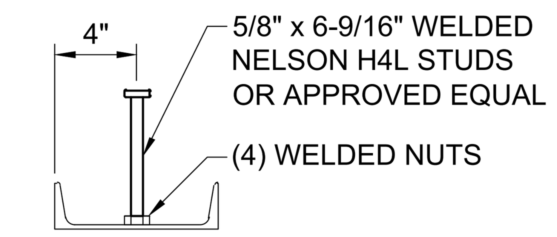



ELEVATION

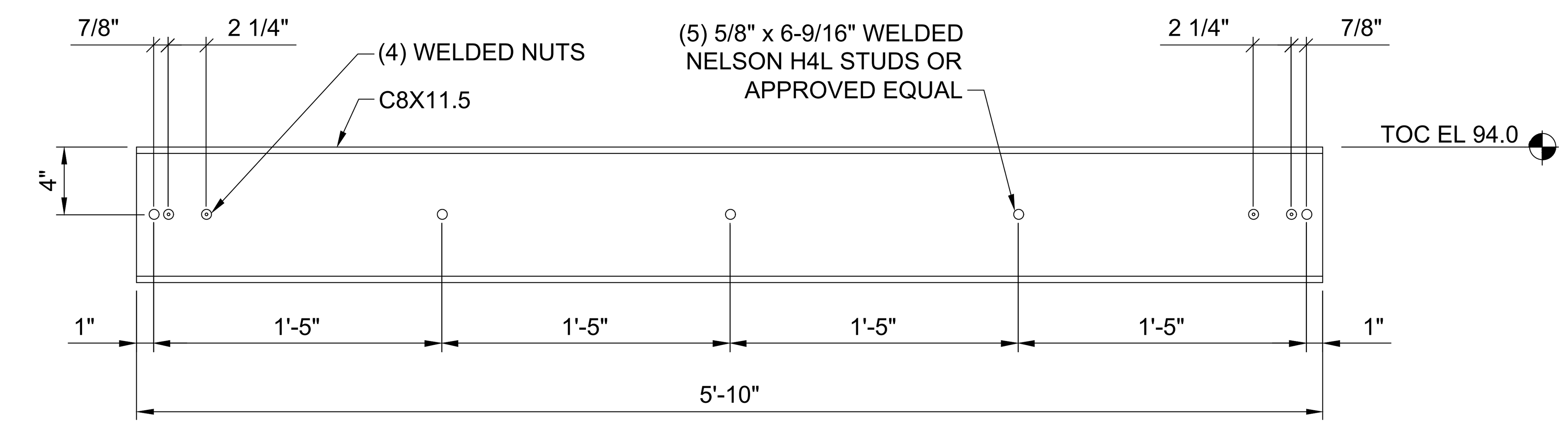
## 5 FISH LIFT WEIR WALL EMBEDMENTS (1 LOC)
S-113 SCALE: 3/4"=1'-0"

**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.

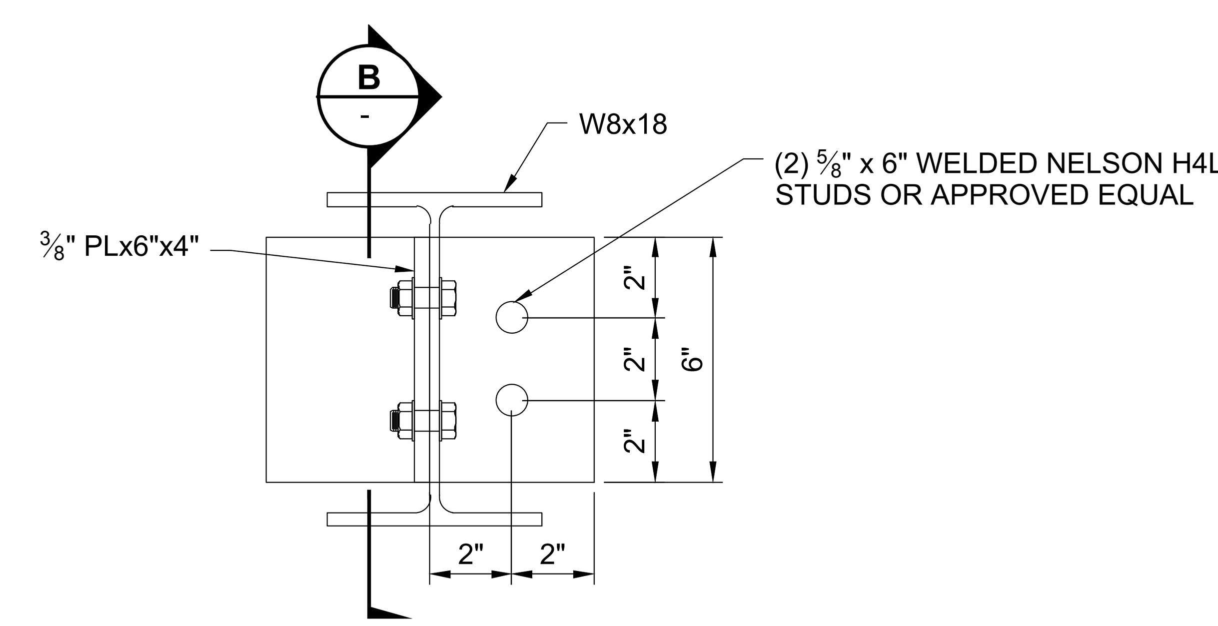



PLAN/SECTION

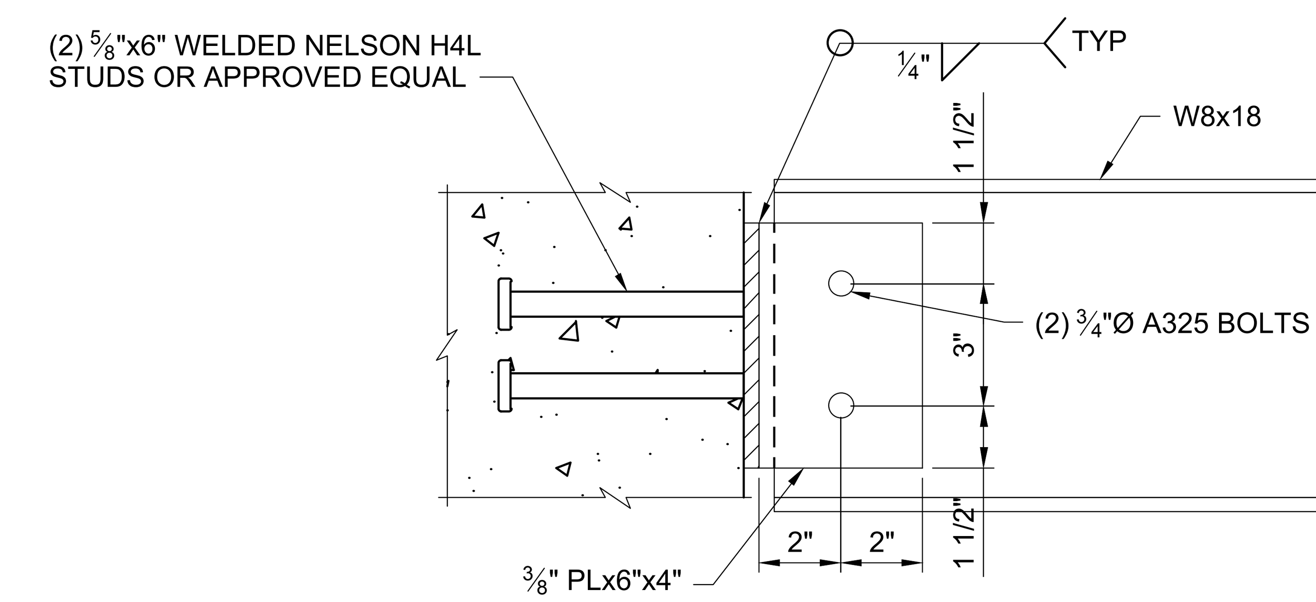



ELEVATION

## 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"

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No.39328
LICENSED PROFESSIONAL ENGINEER

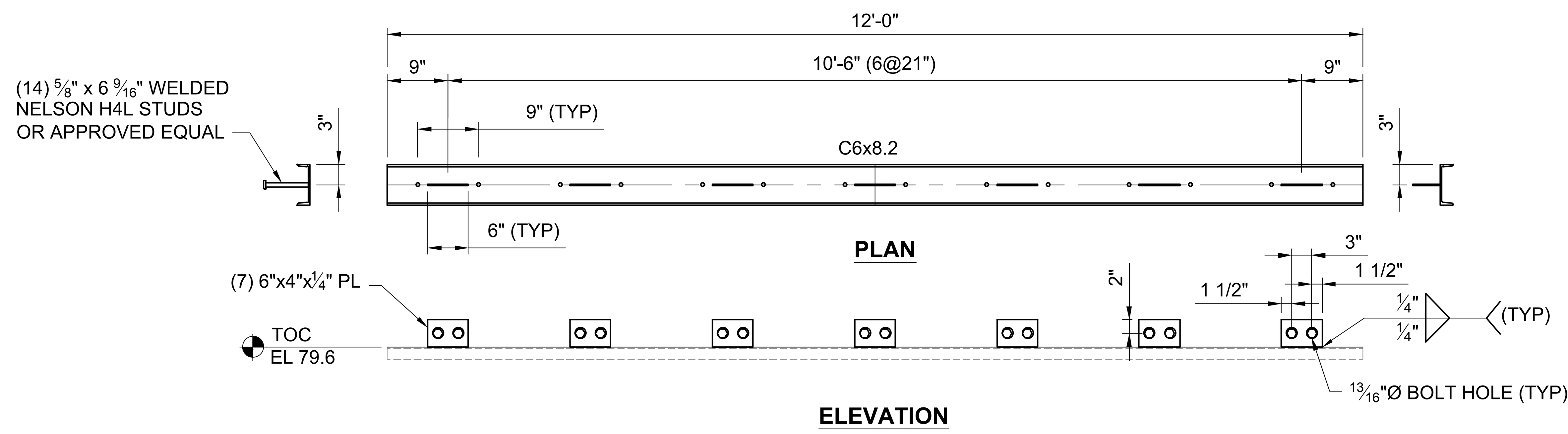
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT CONCRETE ENTRANCE
FLUME EMBEDMENT DETAILS

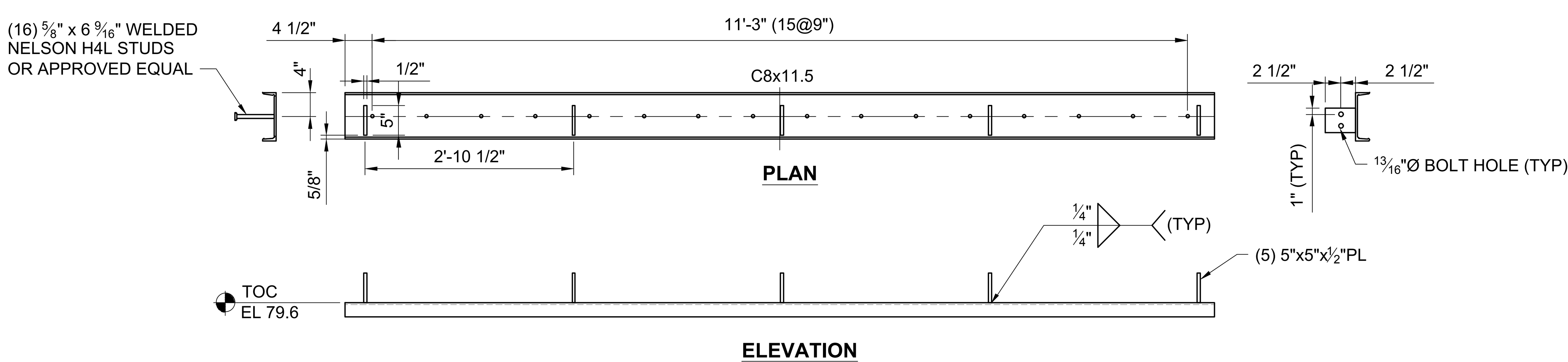
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 44 OF 176 |
| DRAWING: | S-116 |

## EMBEDMENT NOTES:

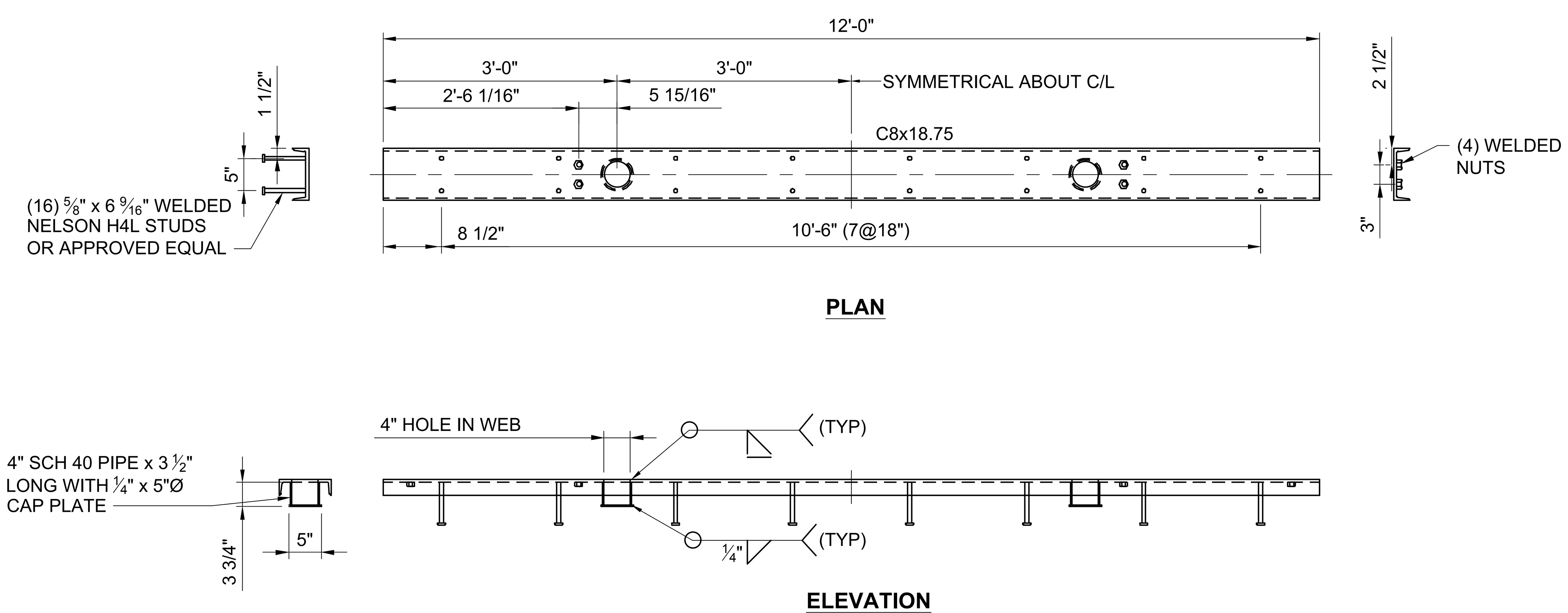
1. WELDS FOR ¼" x 2" STRAPS TO STRUCTURAL MEMBERS SHALL BE ALL AROUND FILLET WELD.
2. NUTS WELDED TO STRUCTURAL MEMBERS SHALL BE ¾" DIAMETER, 10 TPI (UNO) - ALL AROUND FILLET WELD.
3. LENGTH OF STRAPS SHOWN ON DRAWING INCLUDE A 2" BEND AT THE END.
4. THREADS OF WELDED NUTS SHALL BE CHASED AFTER GALVANIZING.



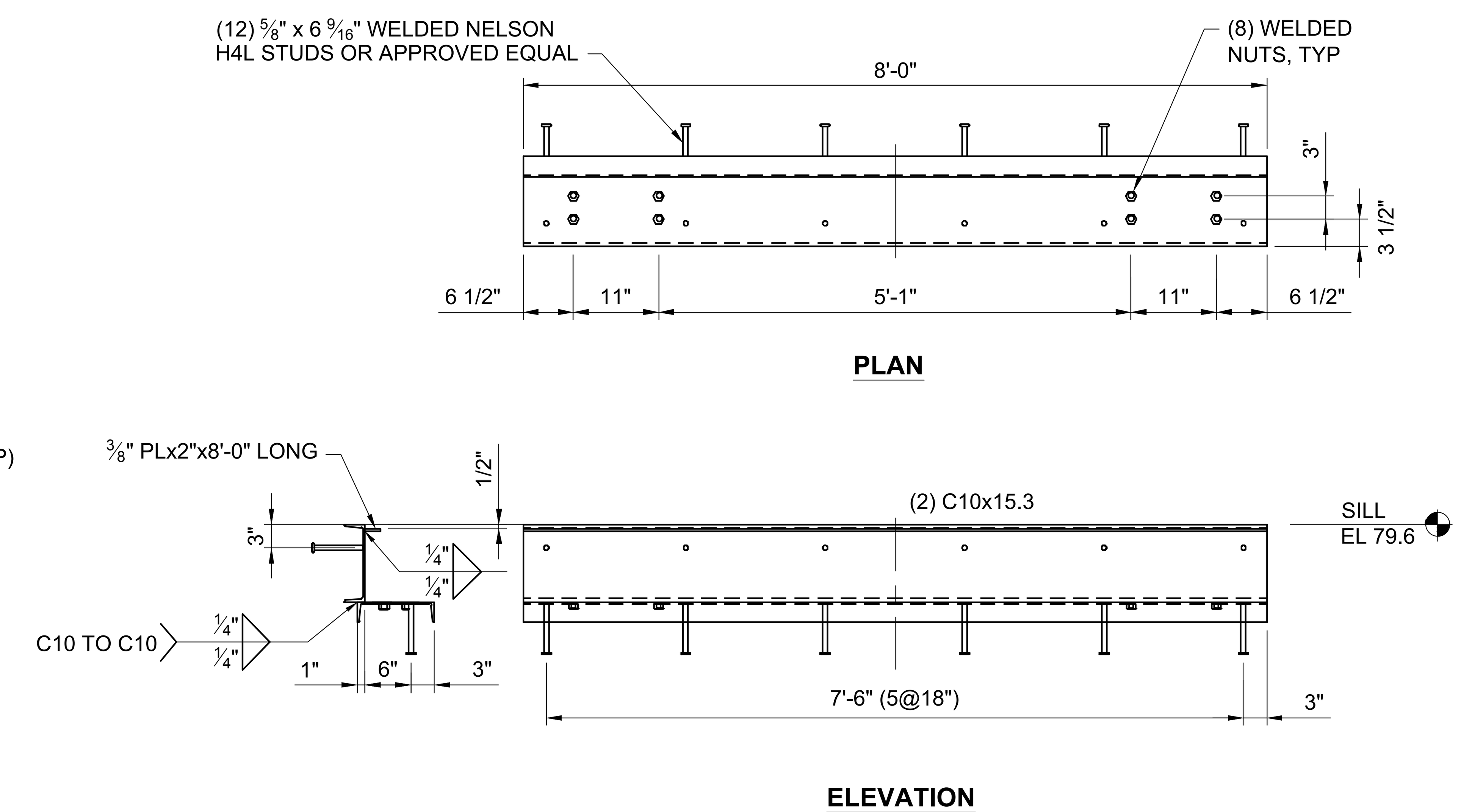

**1** S-113 S-114 **BAFFLE FLOOR EMBEDMENT (1 LOC)**
SCALE: 3/4"=1'-0"



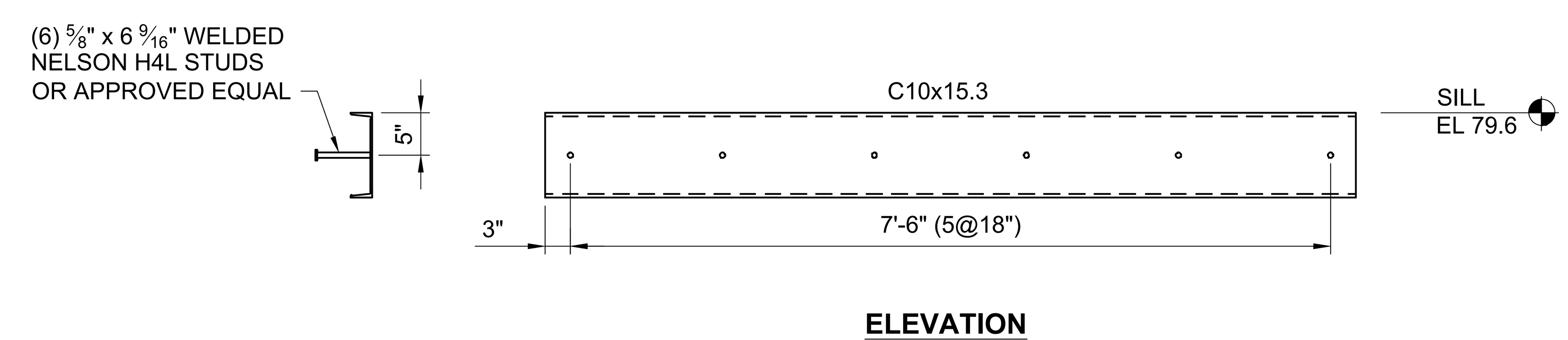

**2** S-113 S-114 **UPSTREAM SCREEN FLOOR EMBEDMENT (1 LOC)**
SCALE: 3/4"=1'-0"




**3** S-113 S-114 **V-GATE FLOOR EMBEDMENT (1 LOC)**
SCALE: 3/4"=1'-0"




**4** S-113 S-114 **ENTRANCE GATE FLOOR EMBEDMENT, UPSTREAM SIDE (1 LOC)**
SCALE: 3/4"=1'-0"




**5** S-113 S-114 **ENTRANCE GATE FLOOR EMBEDMENT, DOWNSTREAM SIDE (1 LOC)**
SCALE: 3/4"=1'-0"

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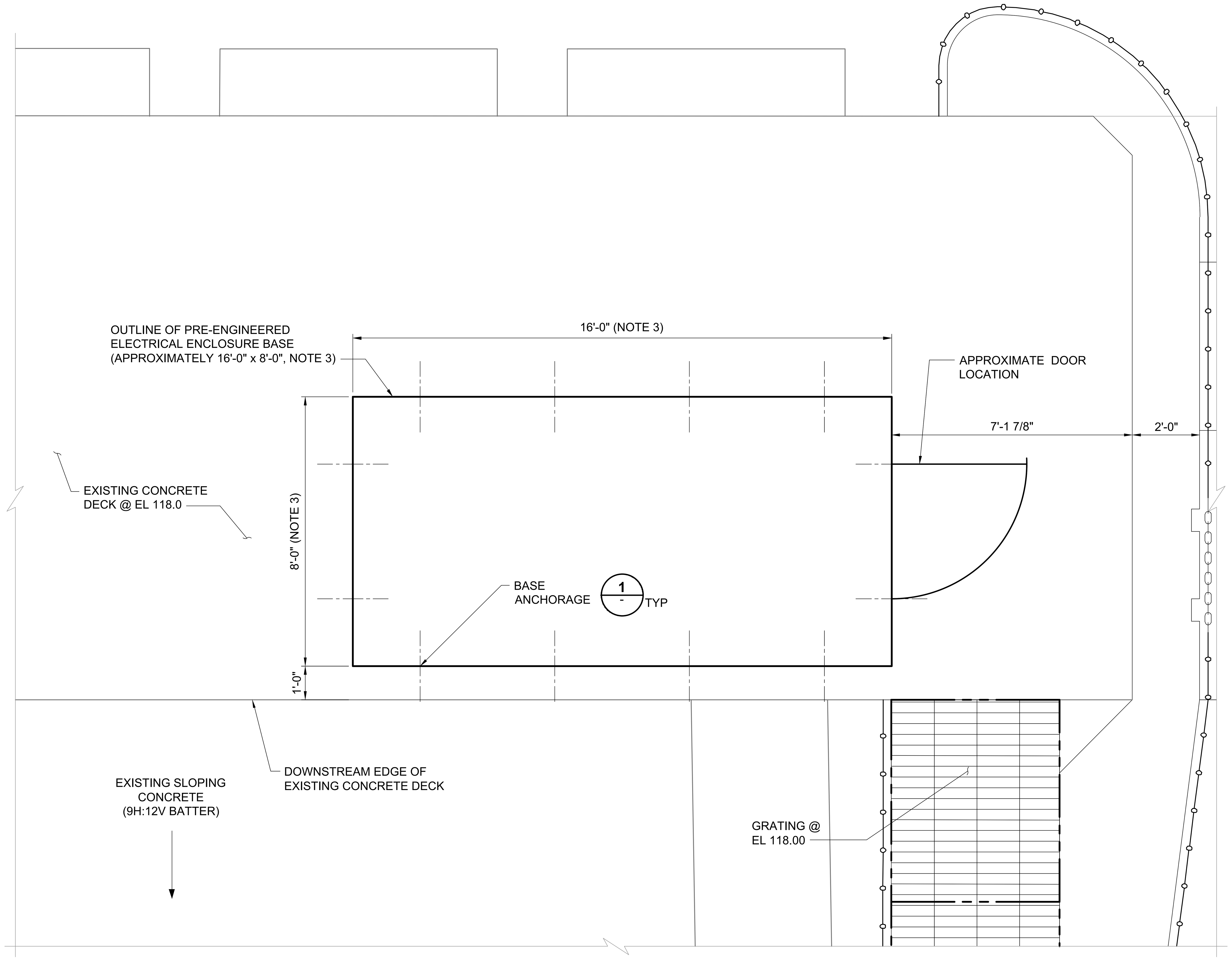
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT CONCRETE ENTRANCE
FLUME EMBEDMENT DETAILS

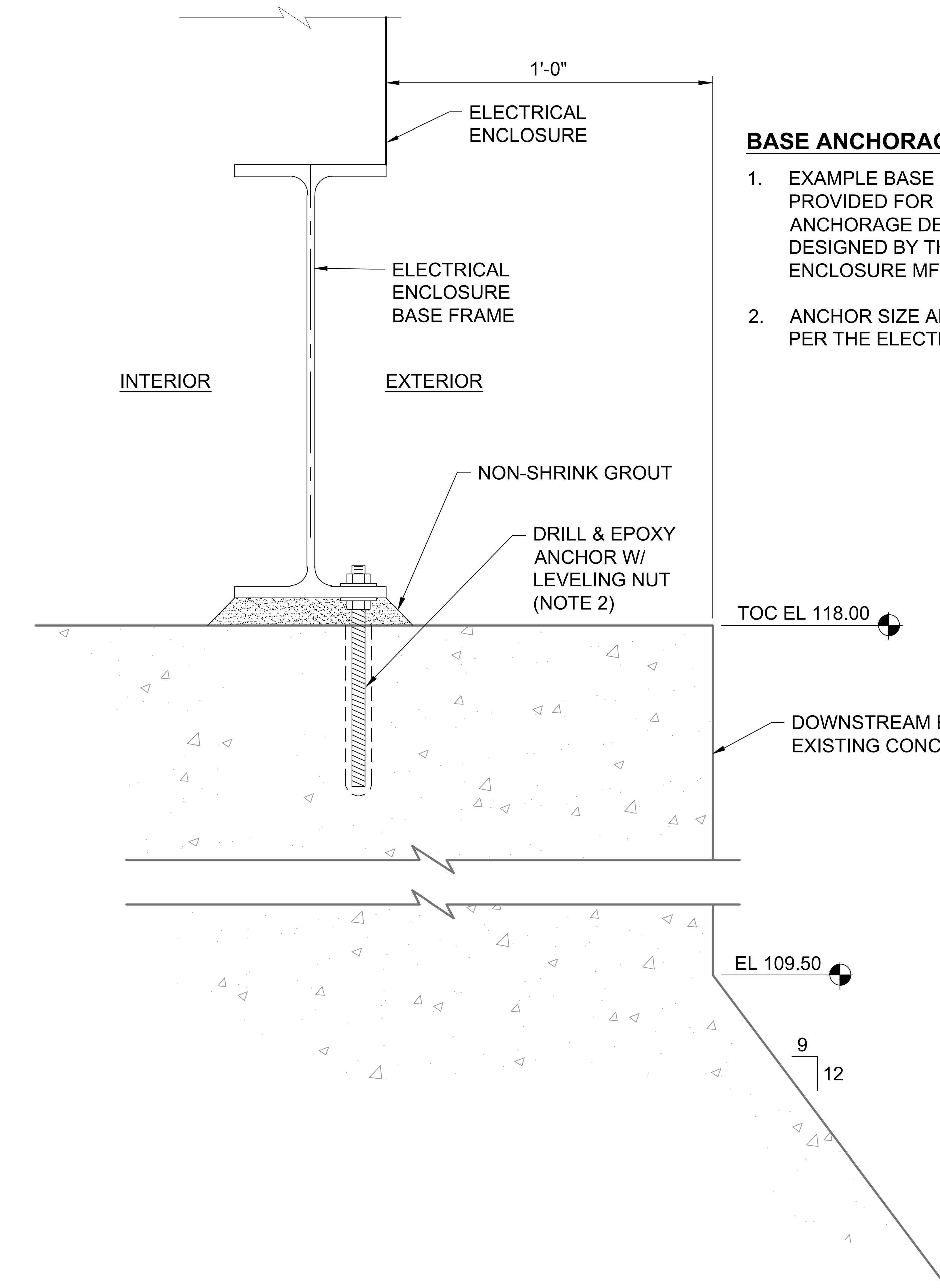
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 45 OF 176 |
| DRAWING: | S-117 |

**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"

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| 12/13/2019 | FINAL FOR BID - NOT FOR CONSTRUCTION | M. GRAESER |
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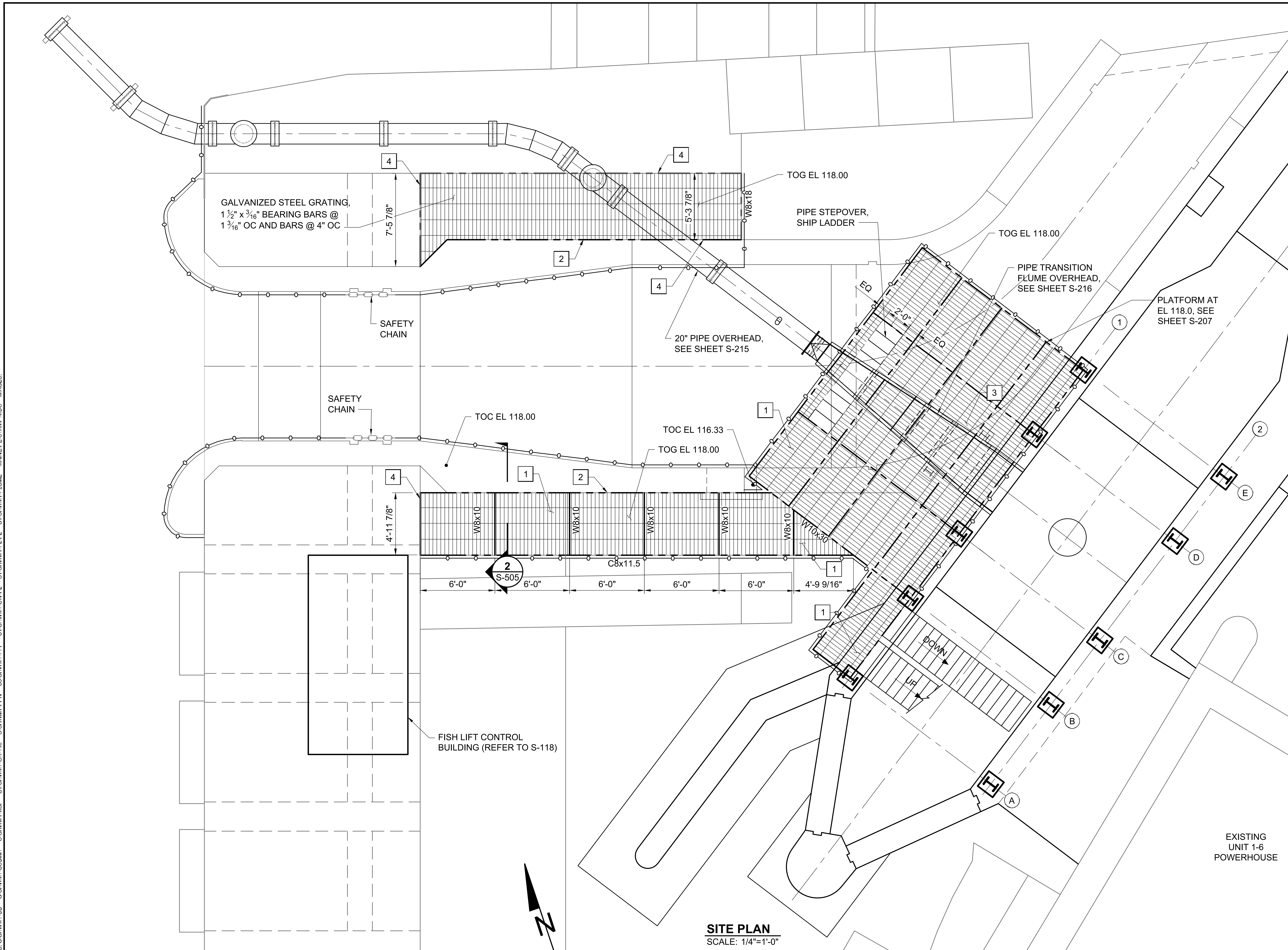
STATE OF MAINE · MARK DANIEL GRAESER · No.39328 · 12/13/2019 · LICENSED · PROFESSIONAL ENGINEER

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

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 nss and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-118.dwg USER: Agrogan
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 MAINE-PE-STAMP-MDG IMAGES:




## NOTES:

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

## KEYED NOTES:

1. GALVANIZED STEEL GRATING, 1 ¼" 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)

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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"

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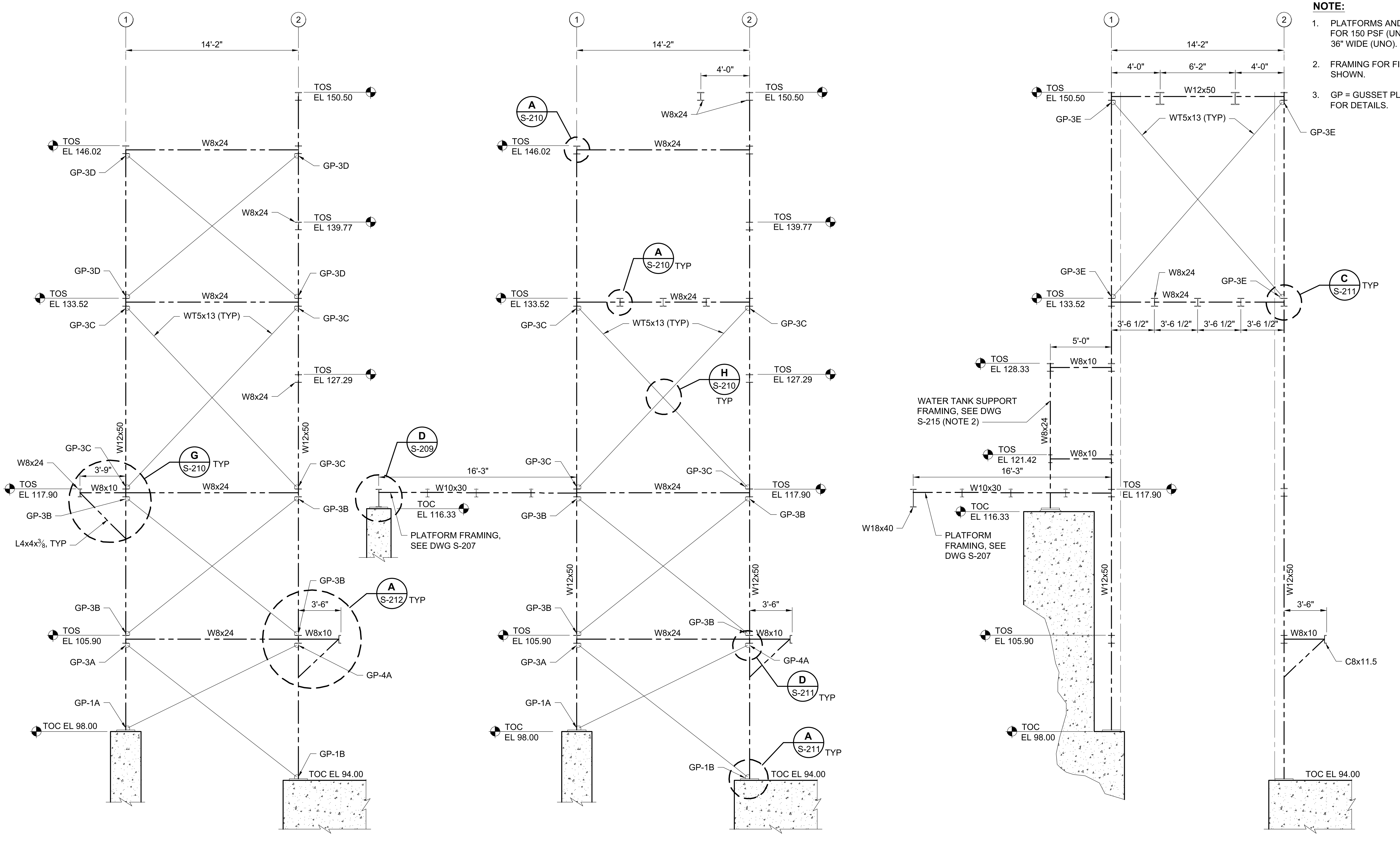
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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"

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

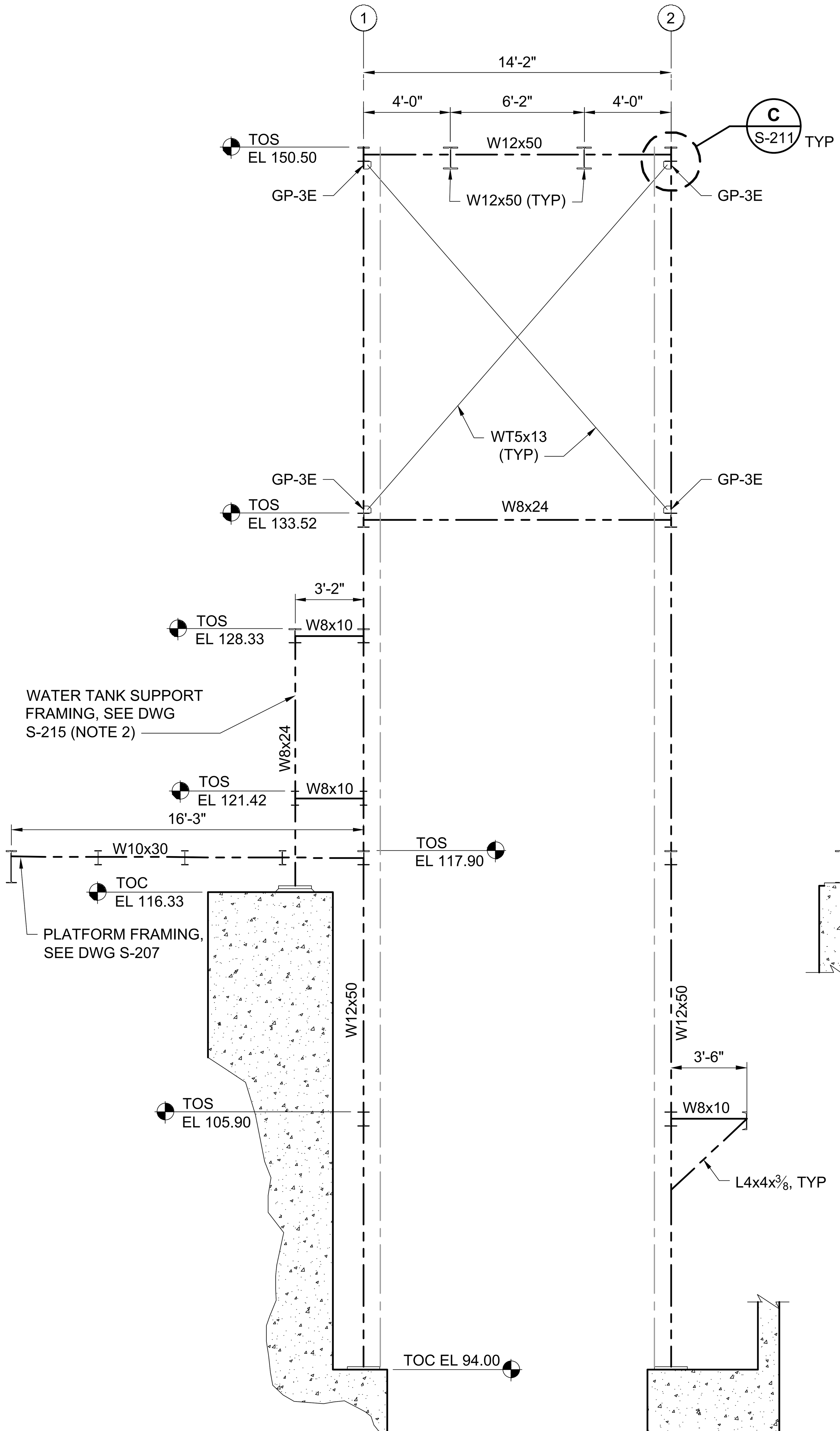
TOWER STEEL FRAMING SECTIONS

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

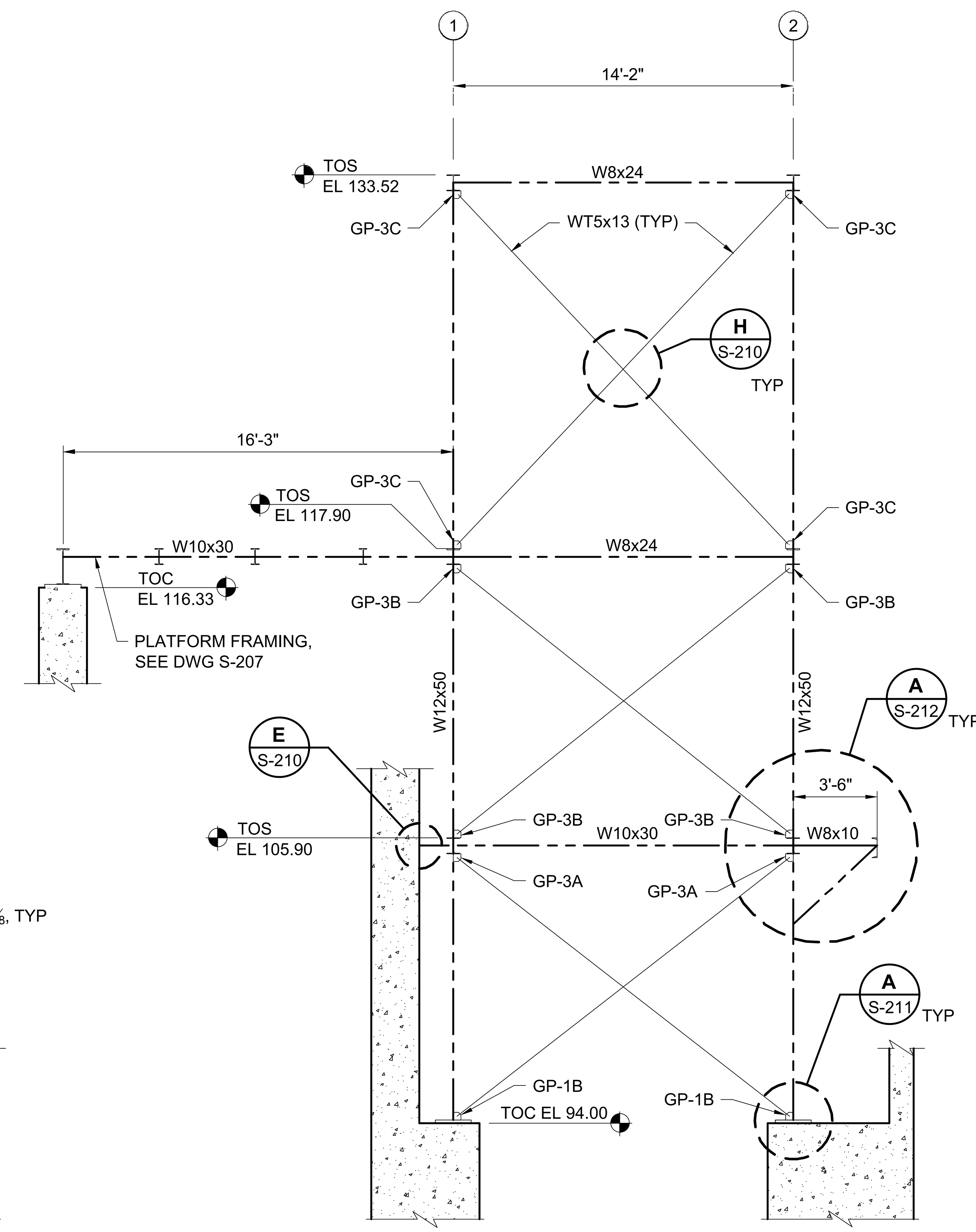

DWG: C:\Users\agroga\documents\autocad sheet sets\131009-alden mes and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-203.dwg USER: Agrogan
DATE: Dec 13, 2019 2:36pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

**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"

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

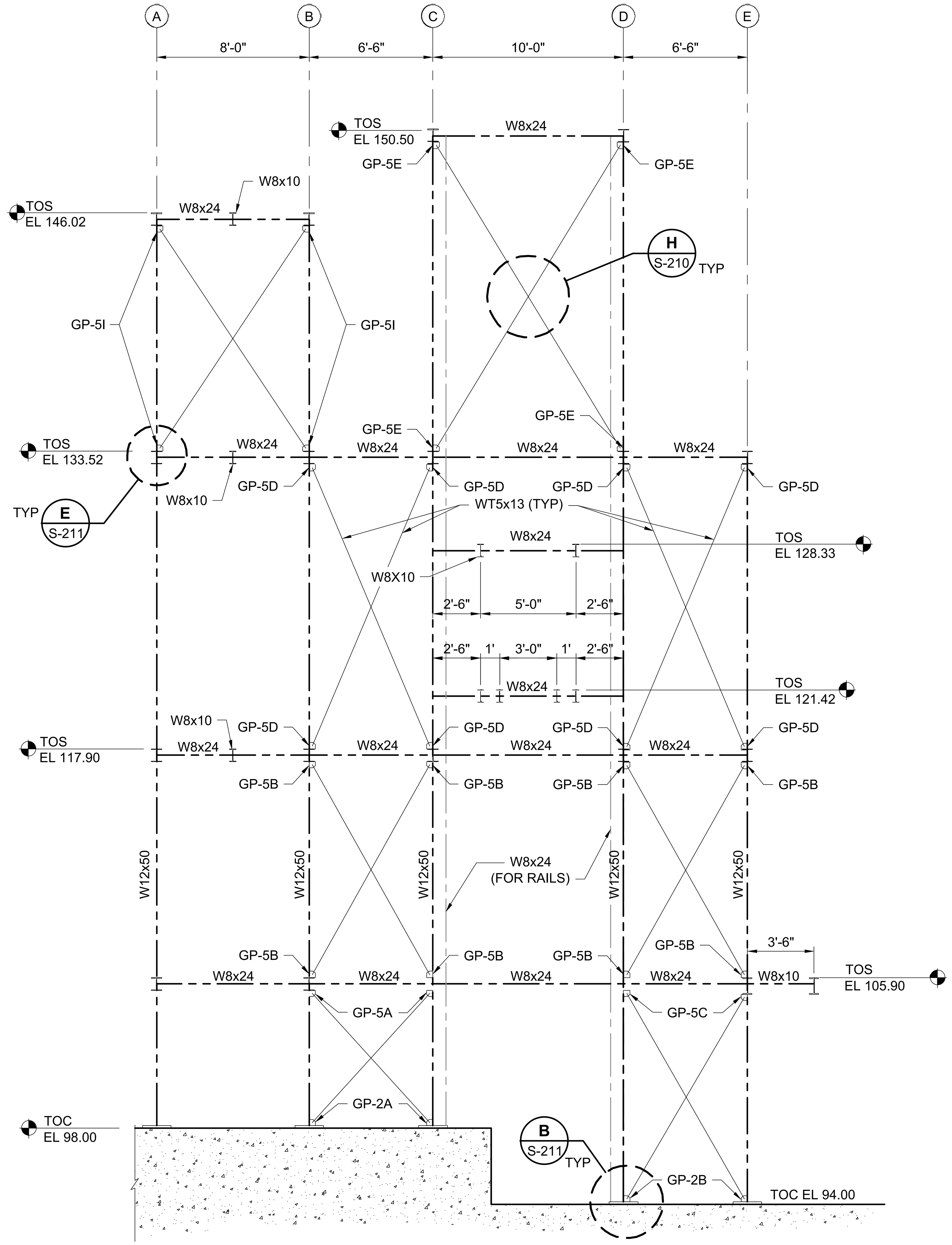
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS

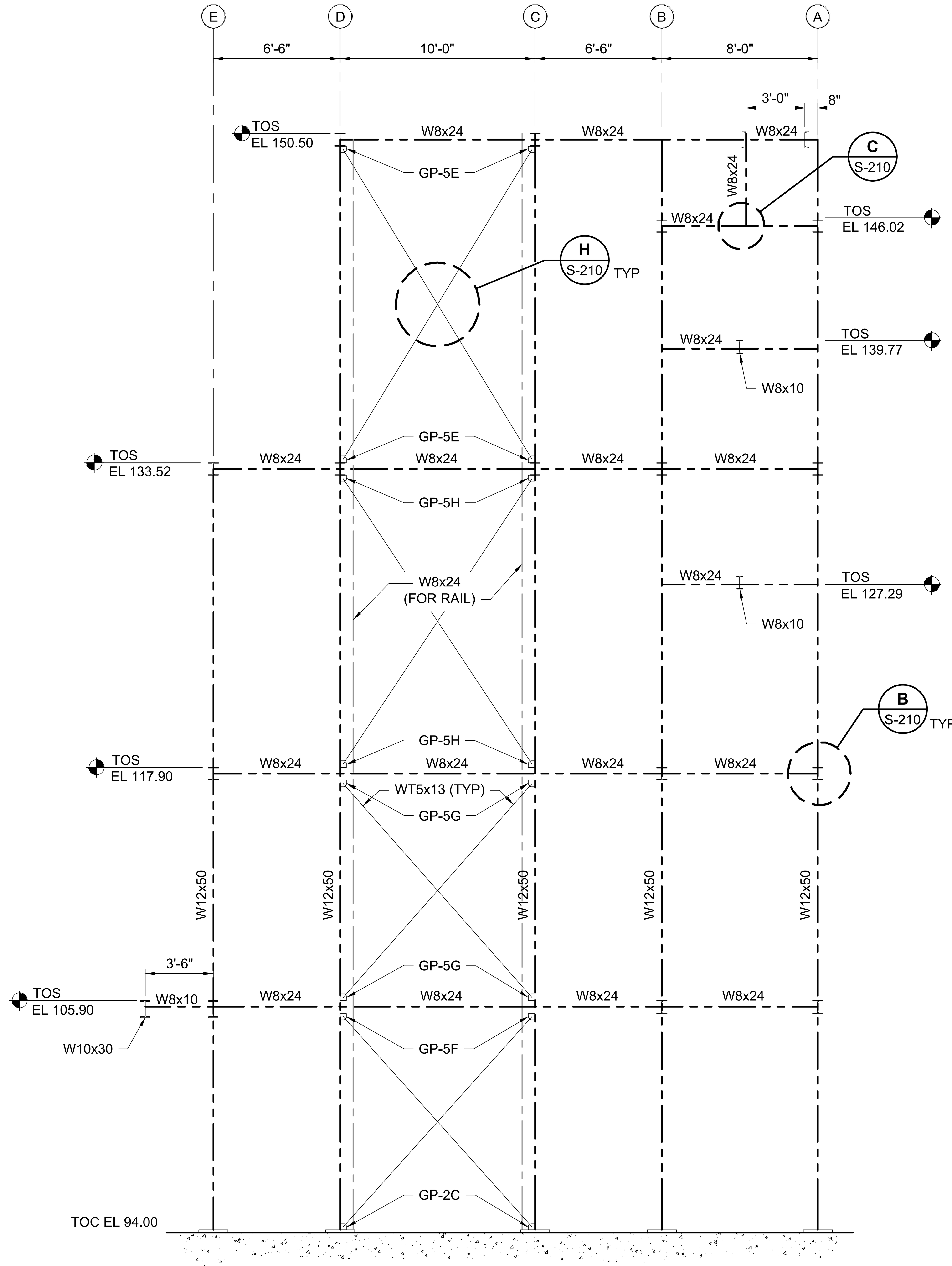
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 50 OF 176 |
| DRAWING: | S-204 |

**NOTE:**

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




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




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

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

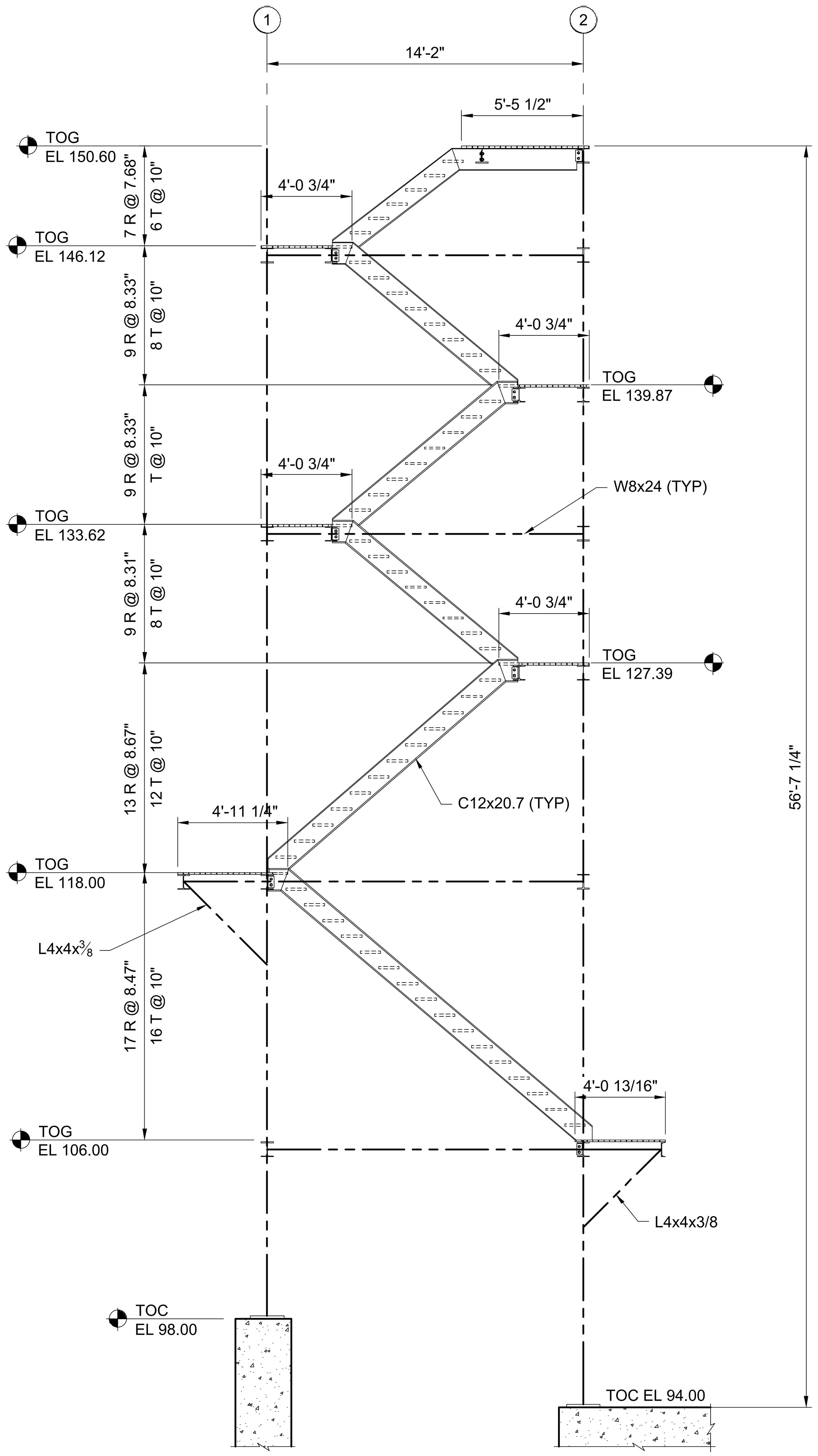
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS

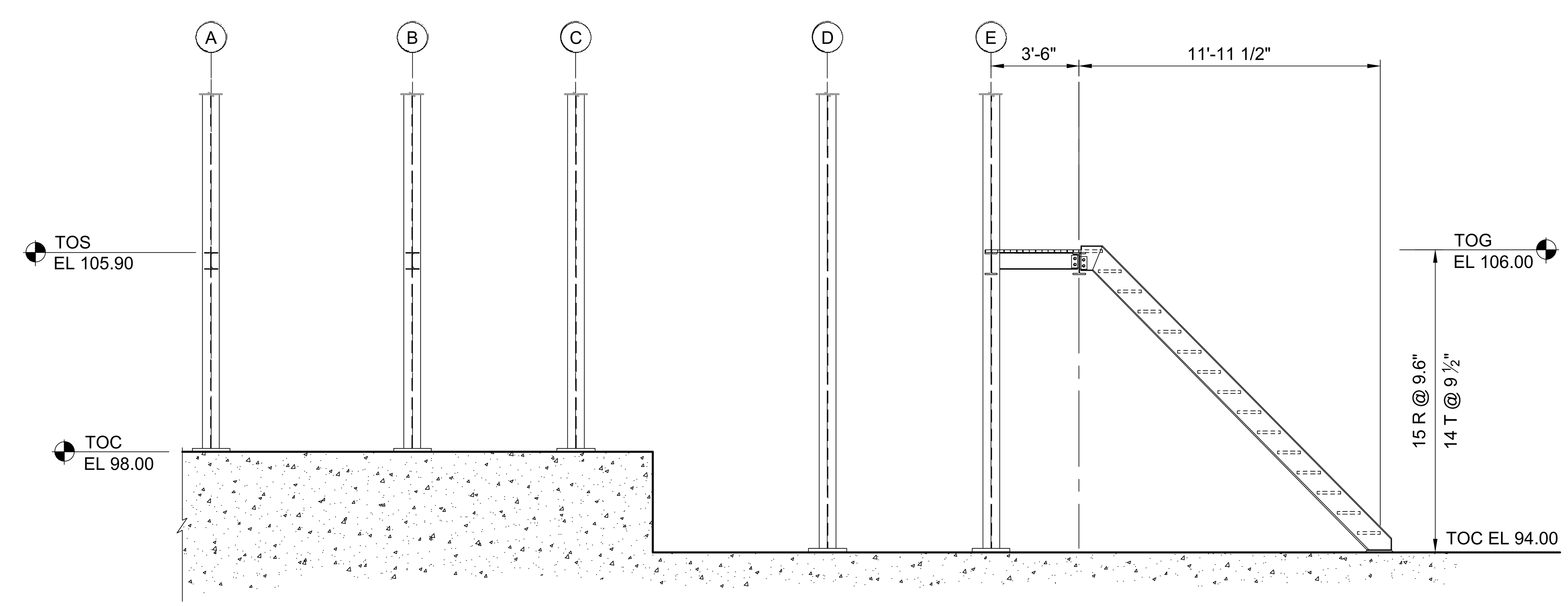
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 51 OF 176 |
| DRAWING: | S-205 |

**NOTES:**

1. PLATFORMS AND WALKWAYS DESIGNED FOR 150 PSF (UNO) STAIR TREADS TO BE 36" WIDE (UNO).
2. TOP OF GRATING (TOG) IS 1 ¼" HIGHER THAN TOP OF STEEL (TOS).
3. RAILING NOT SHOWN FOR CLARITY.




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




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

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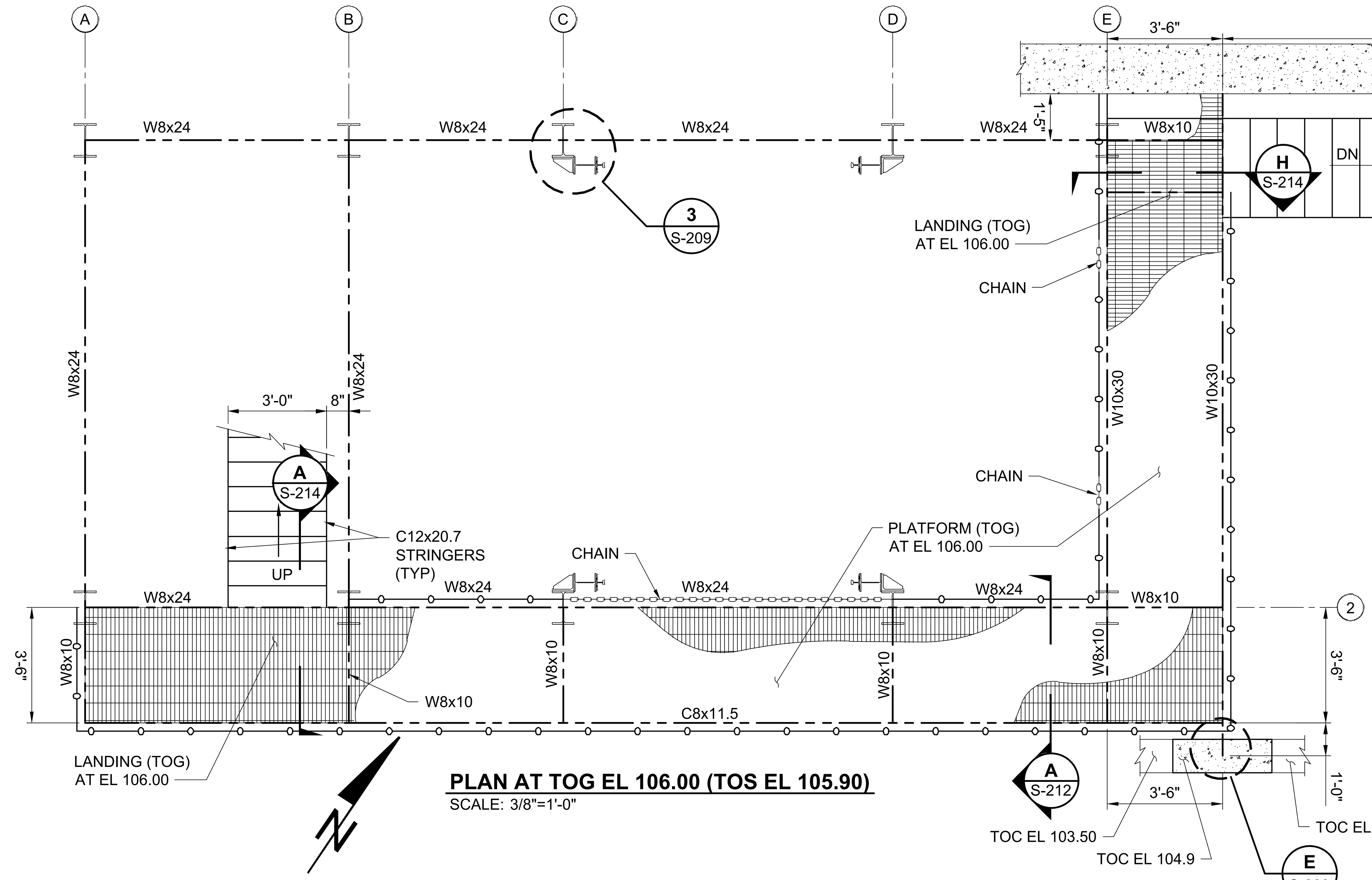
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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 |

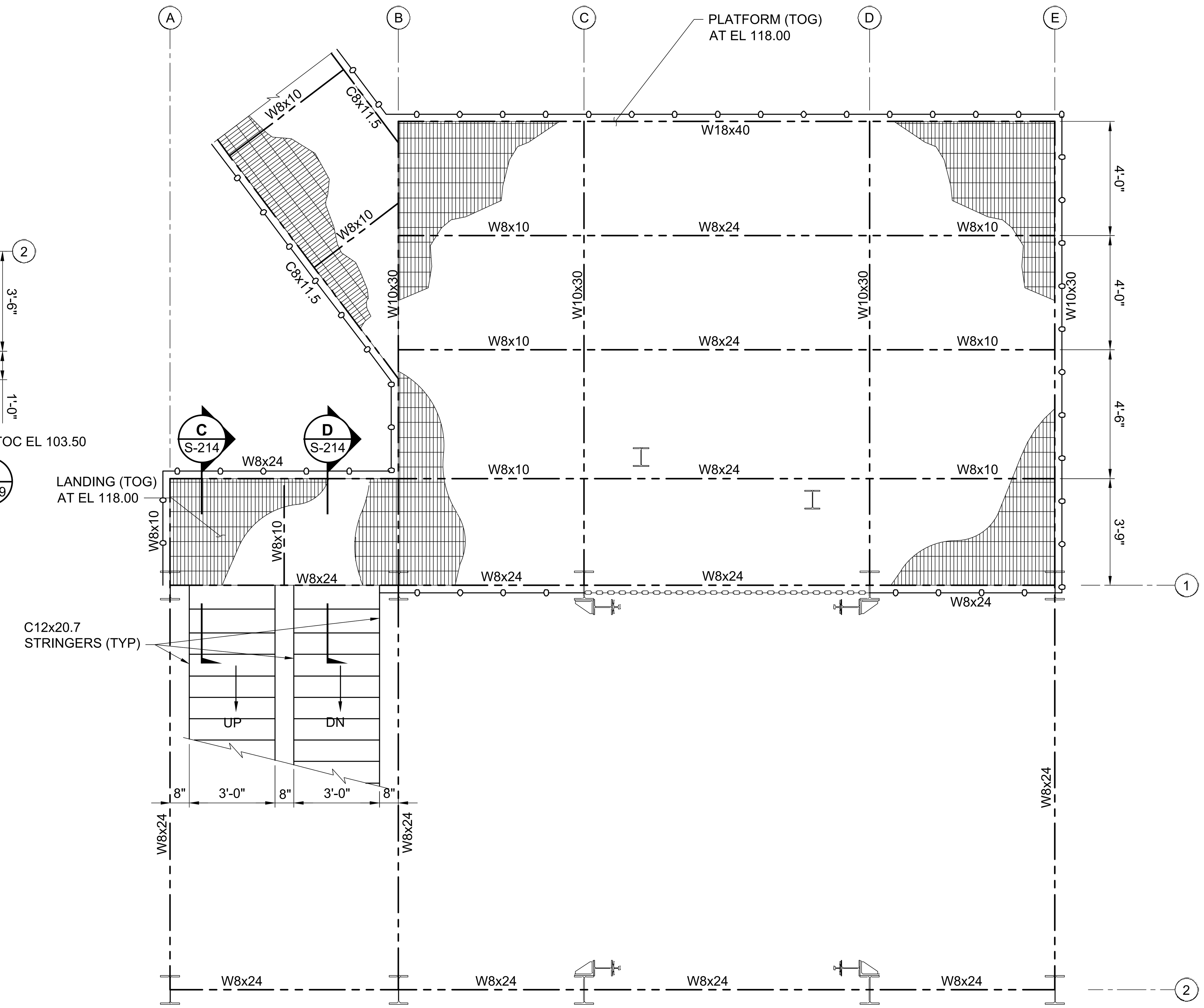



PLAN AT TOG EL 106.00 (TOS EL 105.90)

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

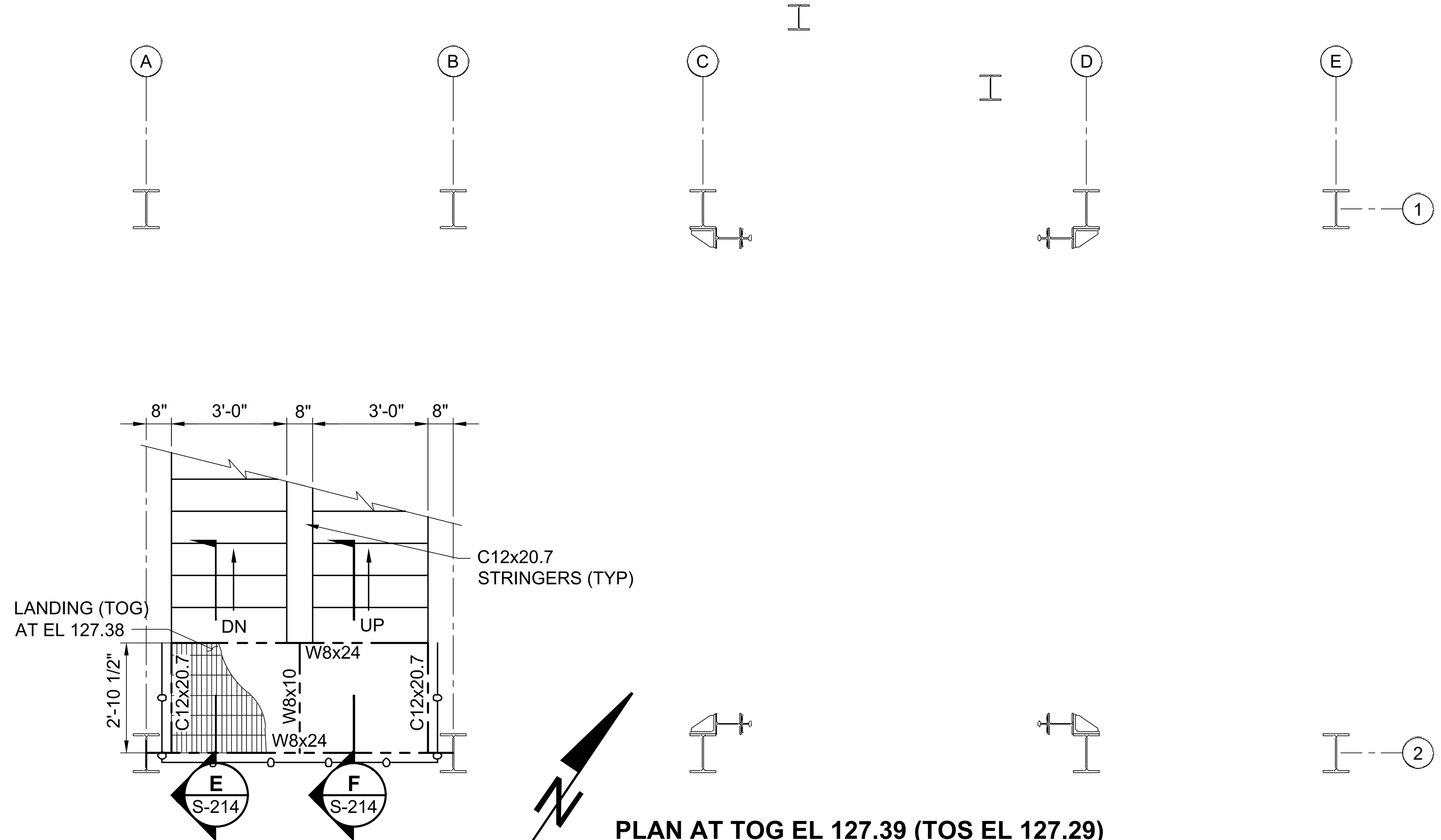
## NOTES:

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




PLAN AT TOG EL 118.00 (TOS EL 117.90)

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




PLAN AT TOG EL 127.39 (TOS EL 127.29)

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

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**DECEMBER 13, 2019**


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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.


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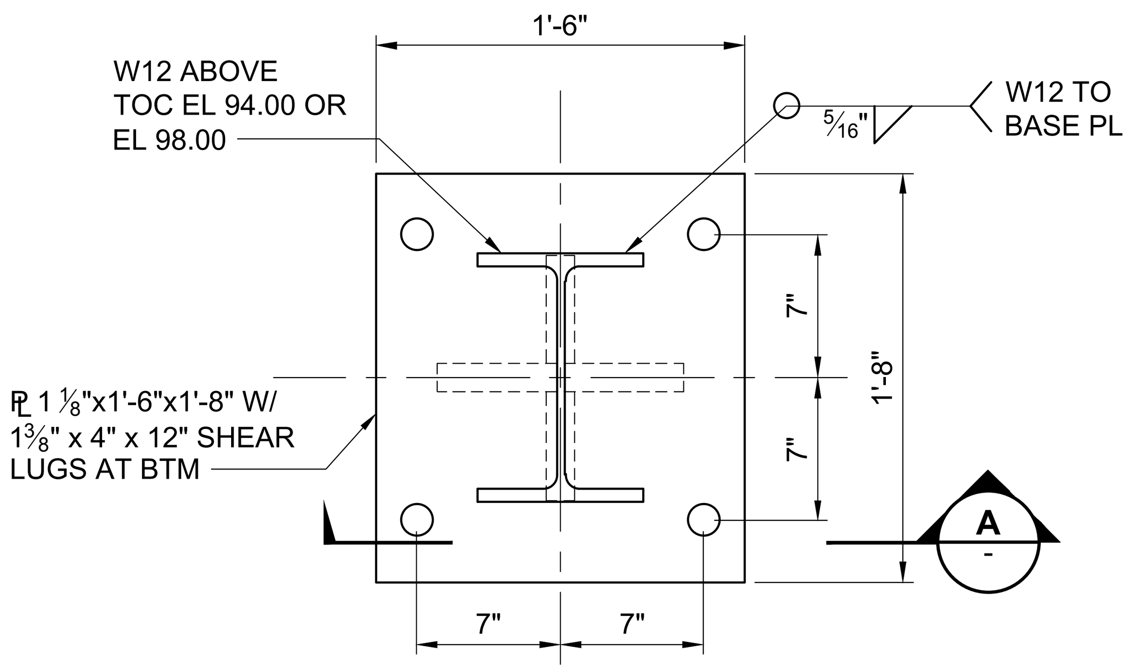
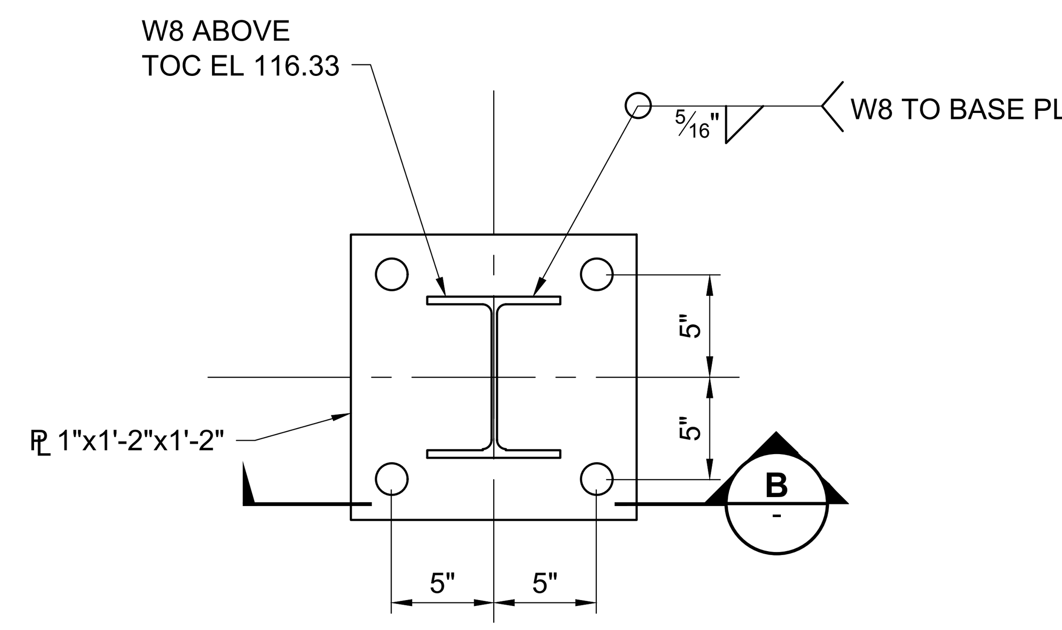
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING
PLATFORM PLANS

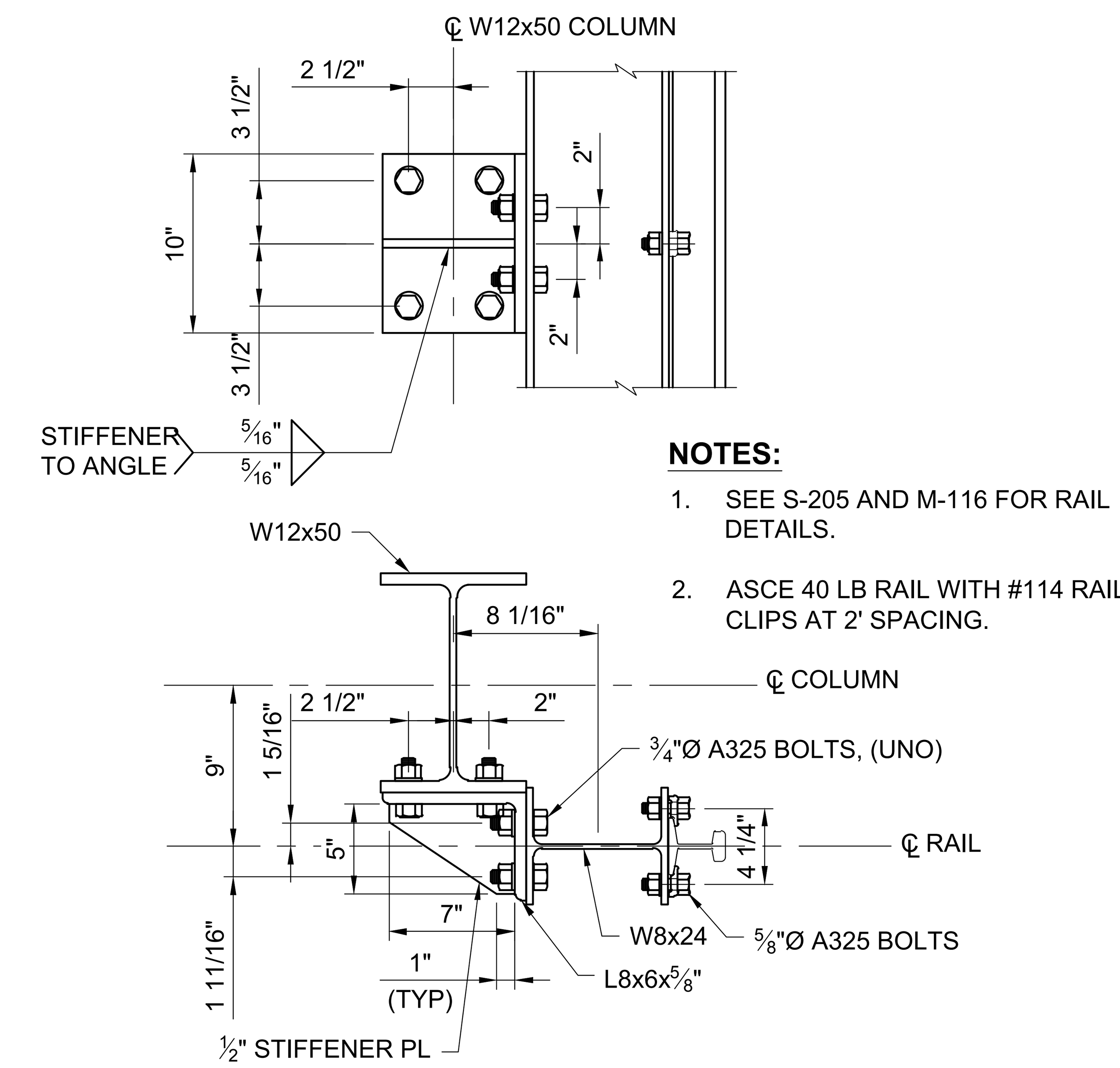
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 54 OF 176
DRAWING: S-208




**1 / S-202 COLUMN BASE PLATE DETAIL**
SCALE: 1 1/2"=1'-0"



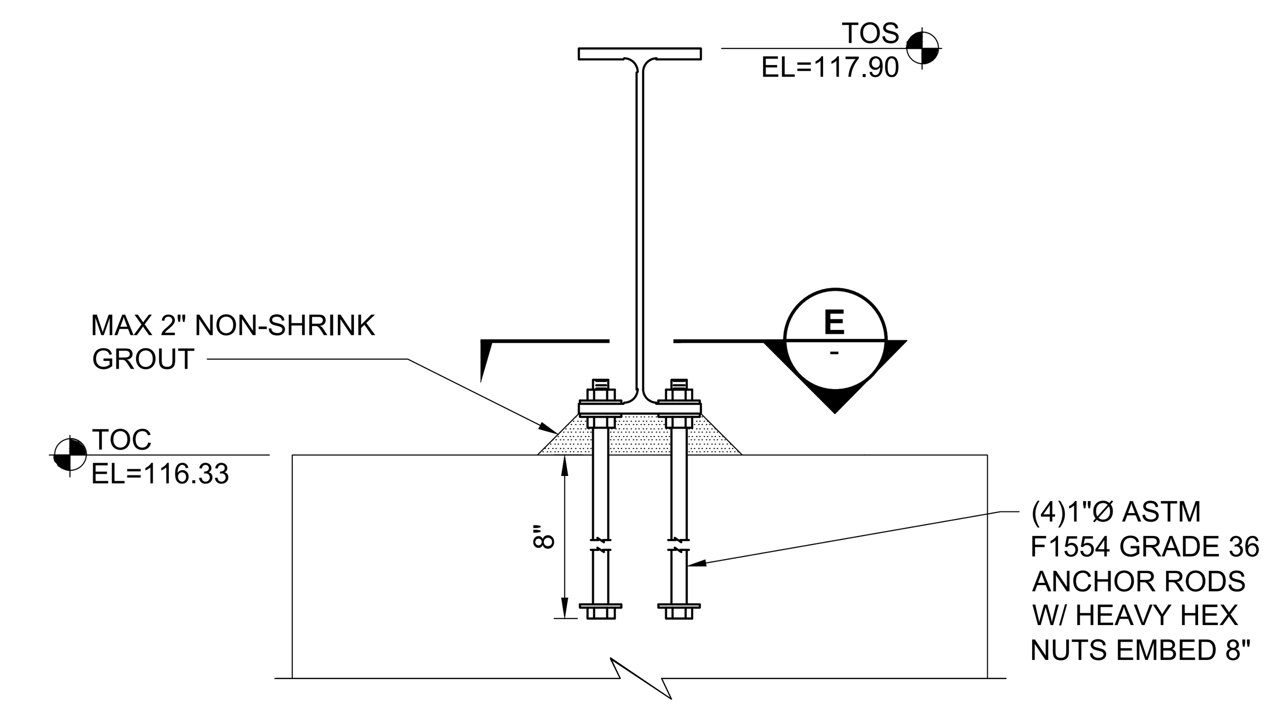

**2 / S-202 COLUMN BASE PLATE DETAIL**
SCALE: 1 1/2"=1'-0"



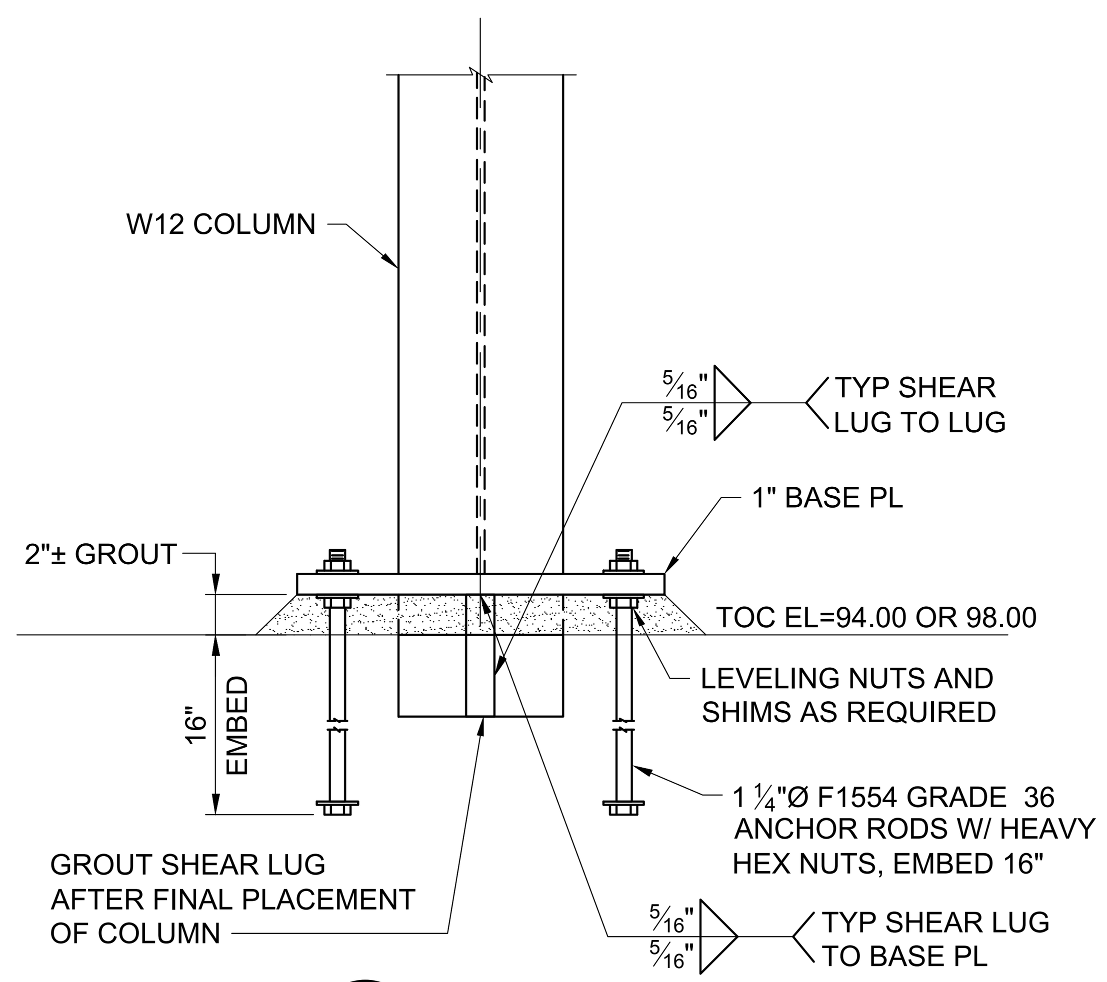

**NOTES:**

1. SEE S-205 AND M-116 FOR RAIL DETAILS.
2. ASCE 40 LB RAIL WITH #114 RAIL CLIPS AT 2' SPACING.

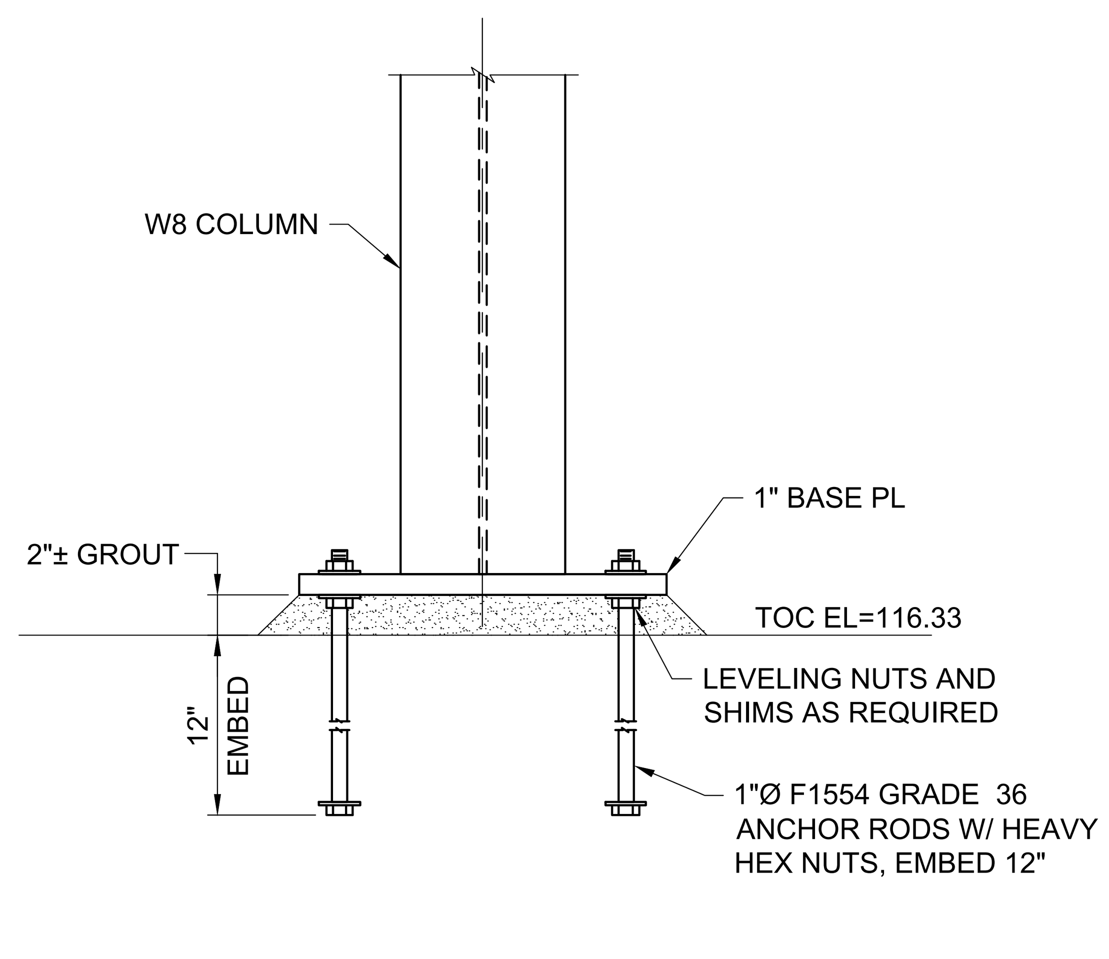
**3 / S-207 FISH HOPPER GUIDE RAIL DETAIL**
SCALE: 1 1/2"=1'-0"



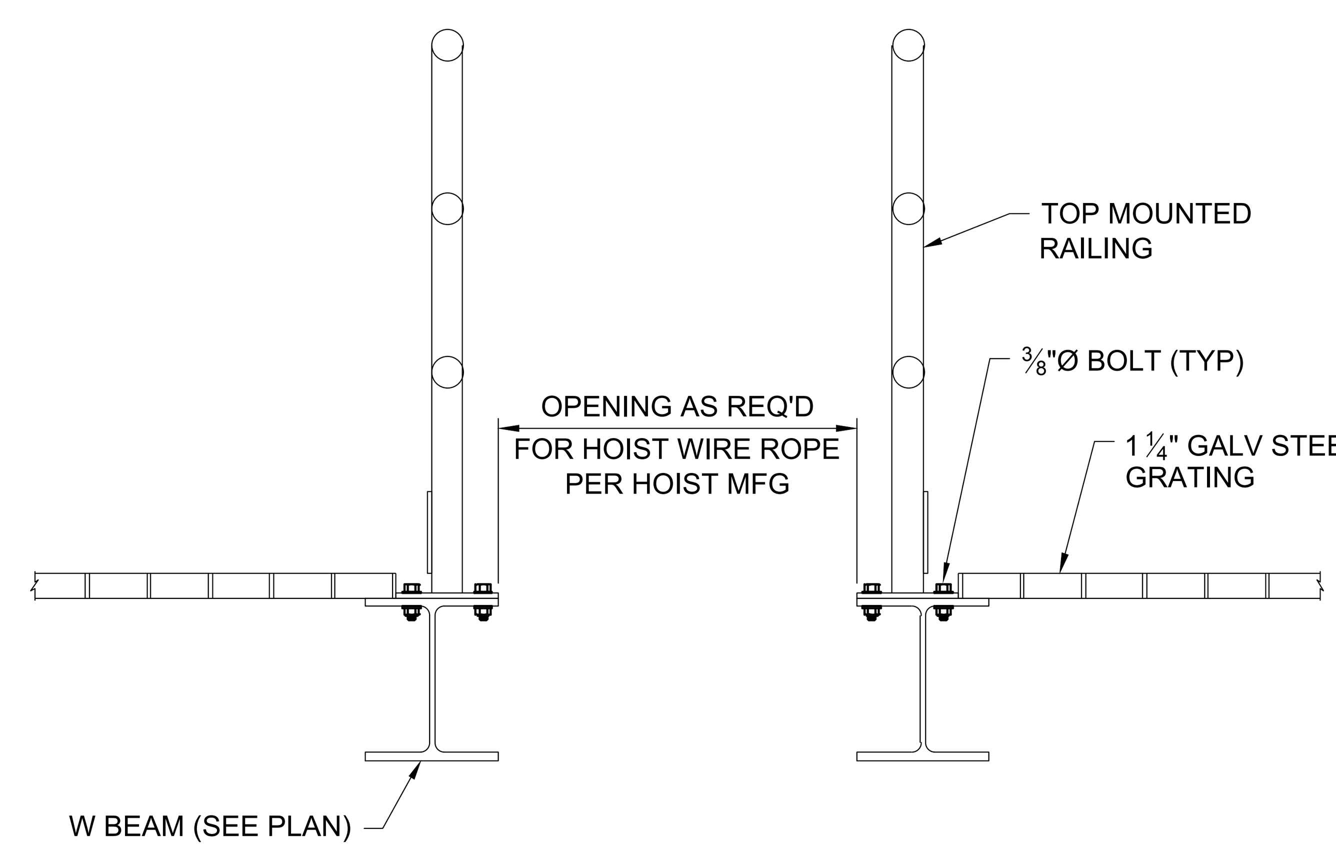

**D / S-203 BEAM BEARING DETAIL**
SCALE: 1 1/2"=1'-0"



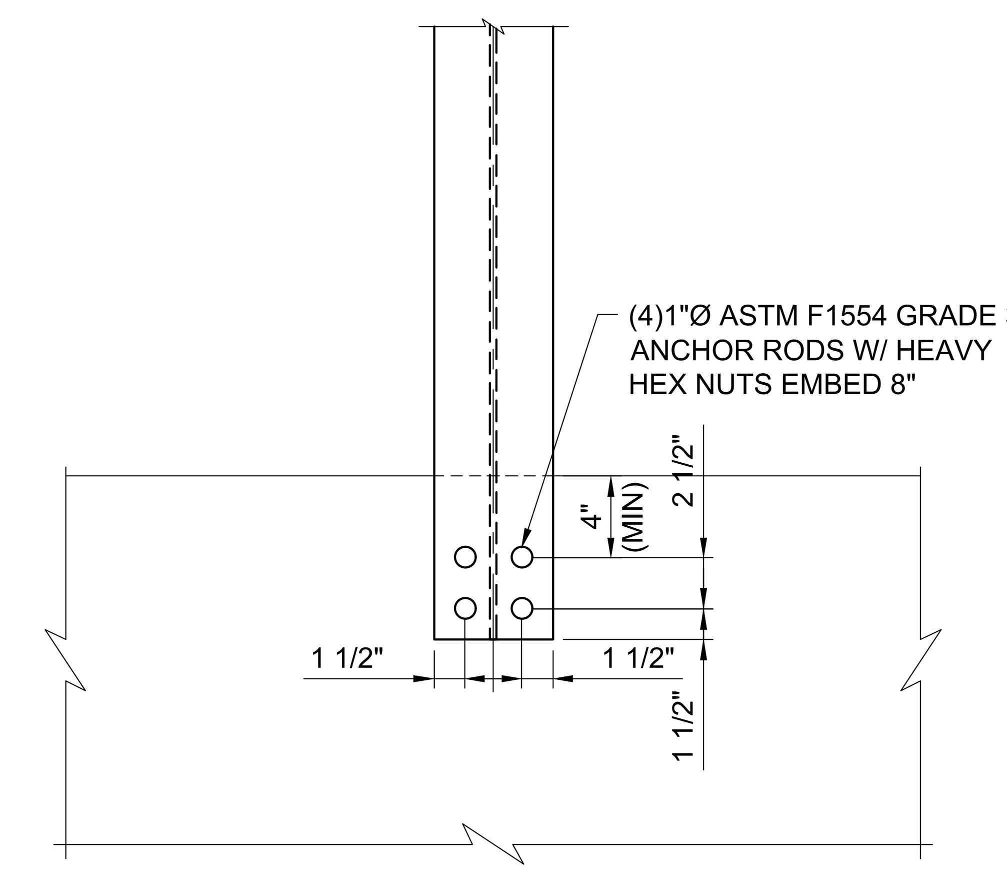

**A / - SECTION**
SCALE: 1 1/2"=1'-0"




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




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




**E / - BEAM BEARING DETAIL**
SCALE: 1 1/2"=1'-0"
S-207

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**DECEMBER 13, 2019**

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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\131009-alden mass 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:


**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.

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

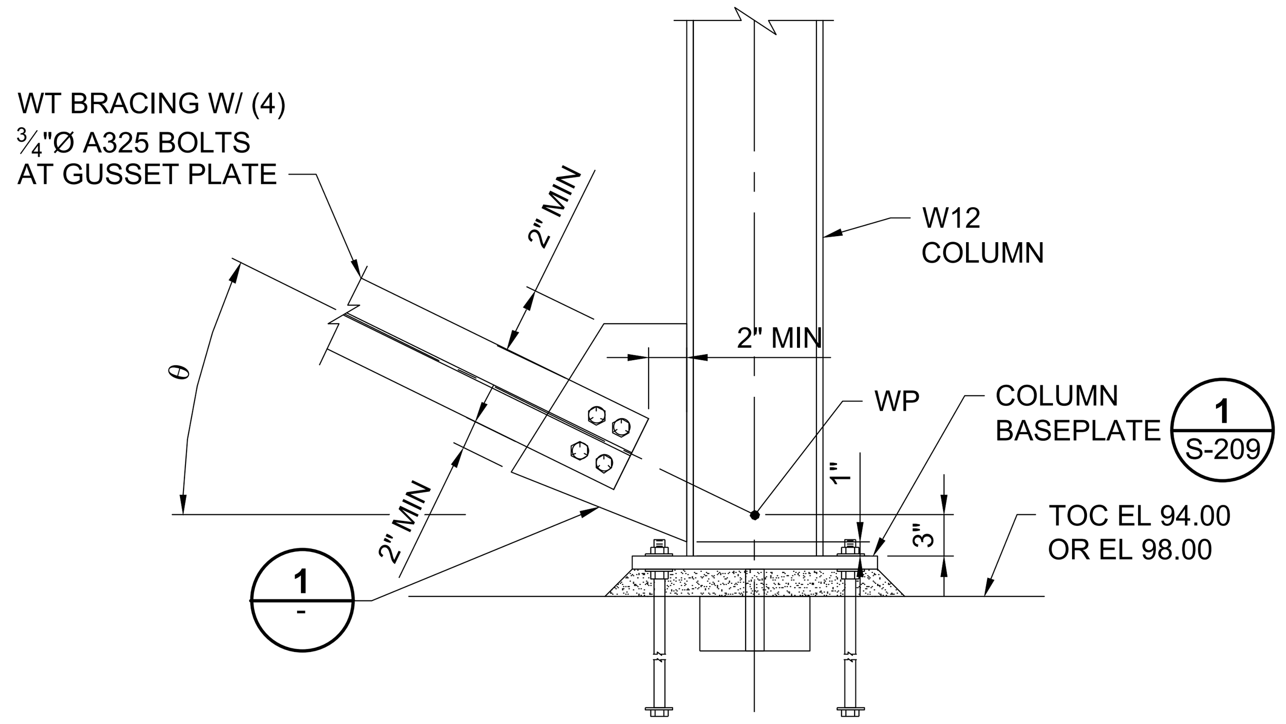
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS AND DETAILS

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

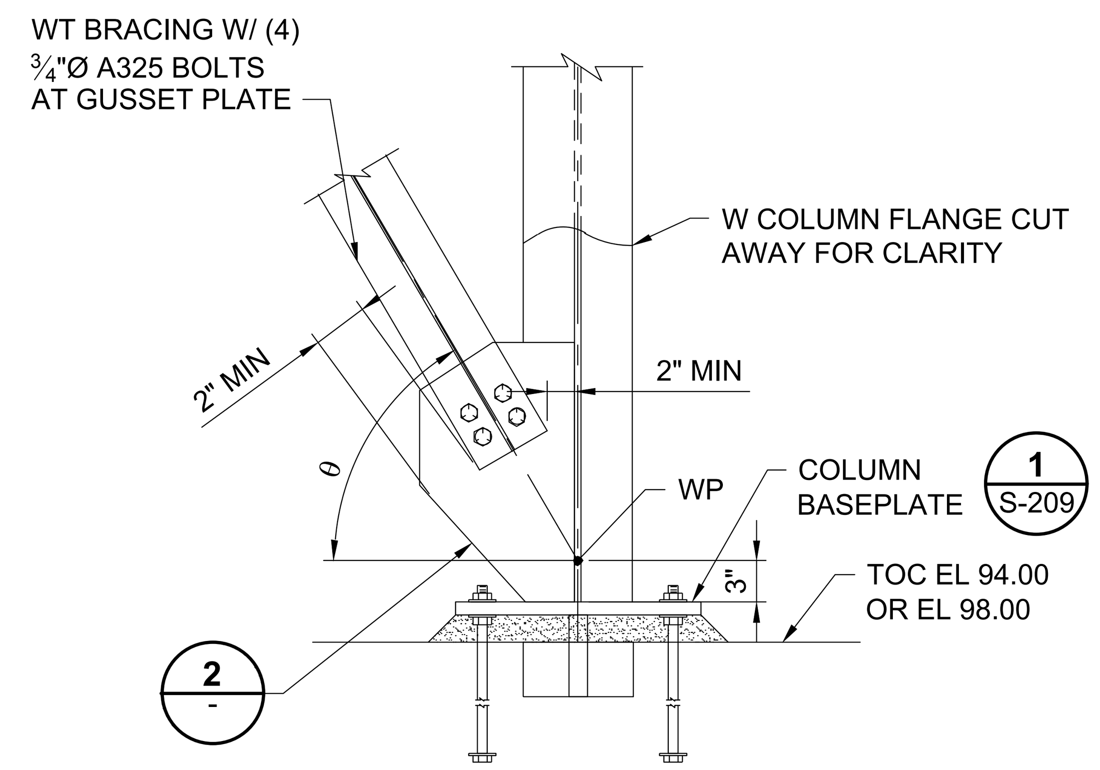
**NOTE:**

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

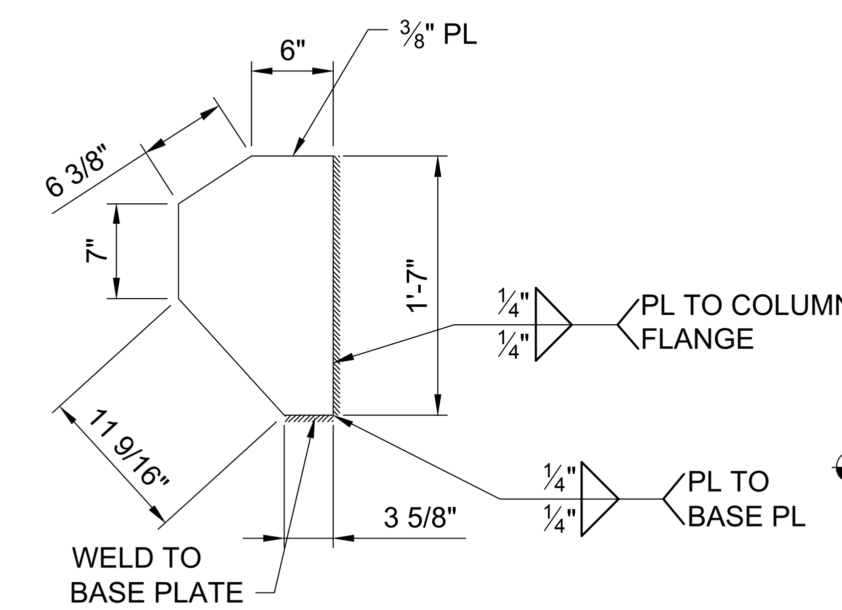



A S-203 **SECTION** SCALE: 1"=1'-0"

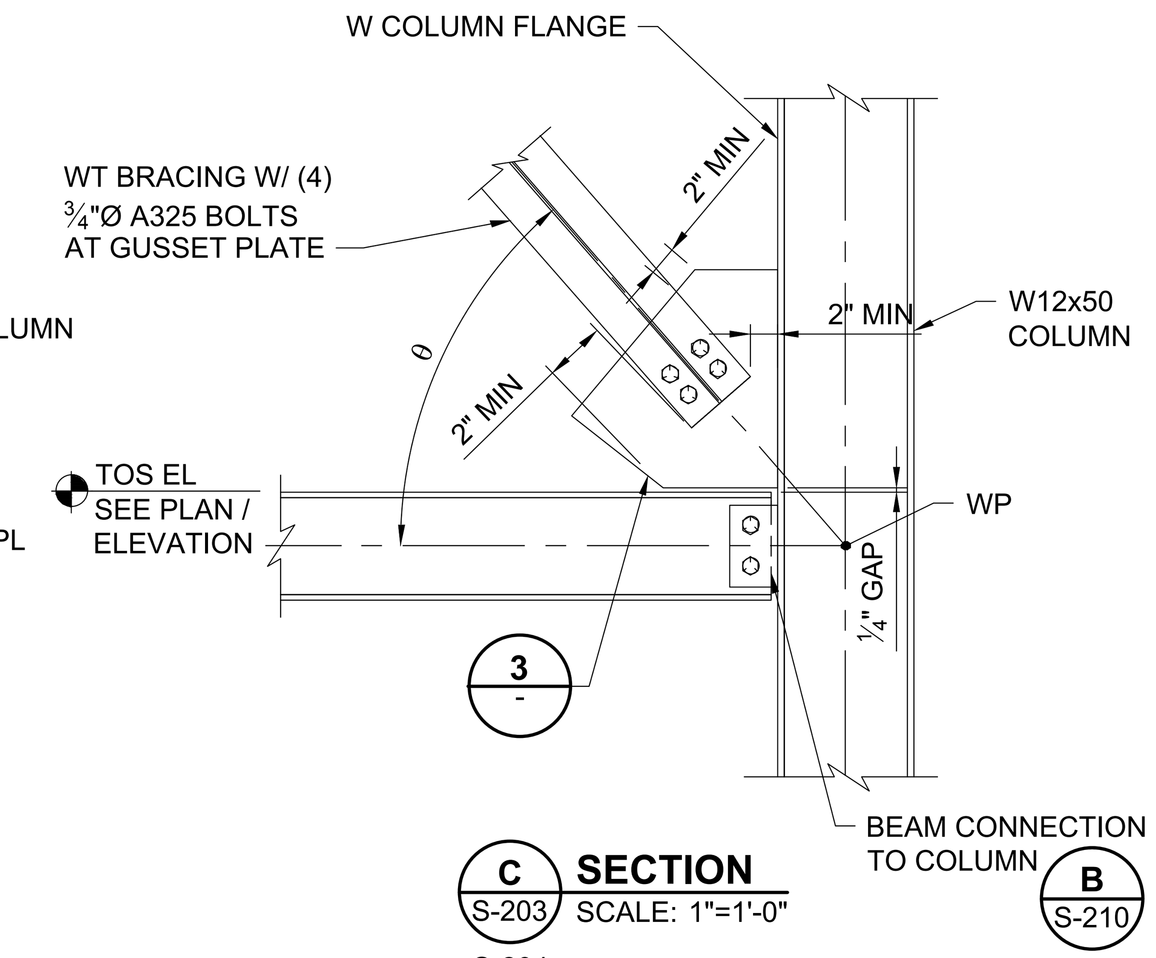
S-204




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

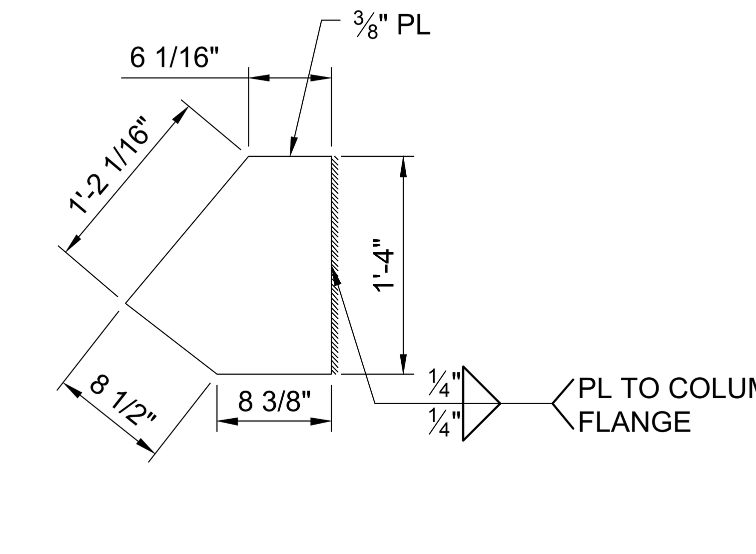



2 - **GUSSET PLATE 2 DETAIL** SCALE: 1"=1'-0"



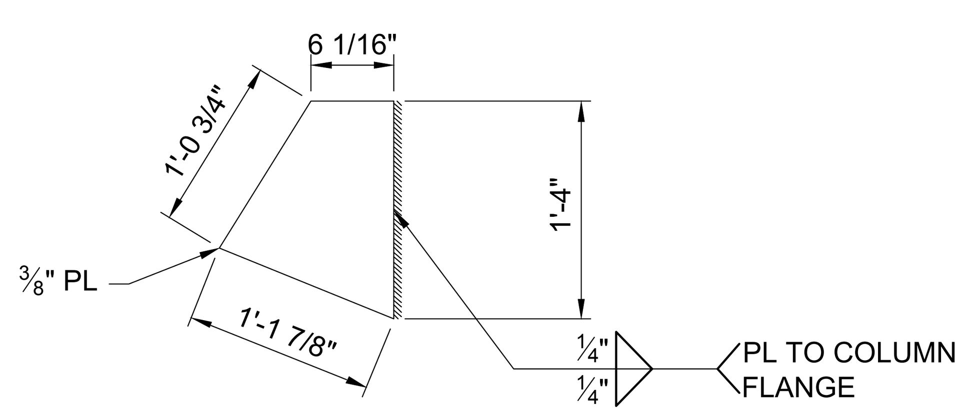

C S-203 **SECTION** SCALE: 1"=1'-0"

S-204

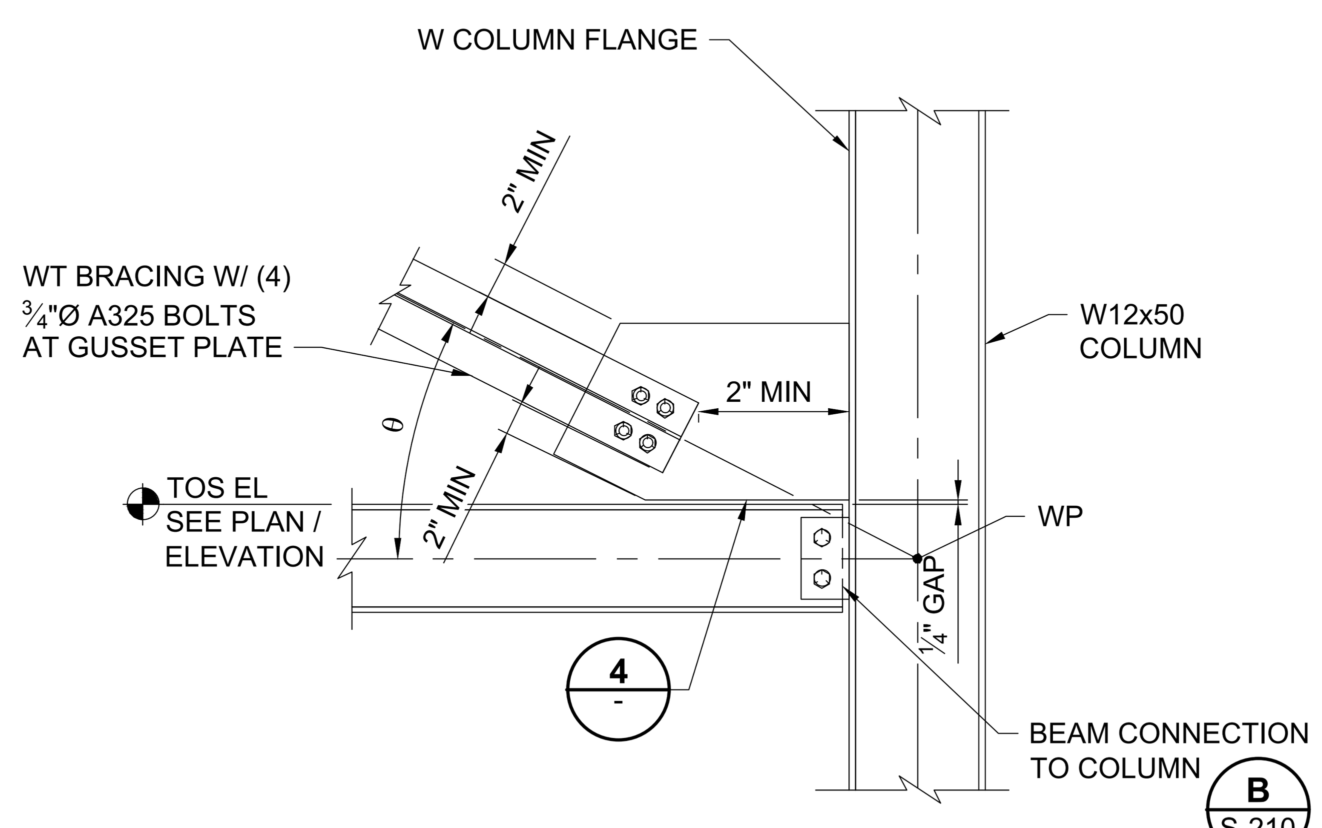



3 - **GUSSET PLATE 3 DETAIL** SCALE: 1"=1'-0"

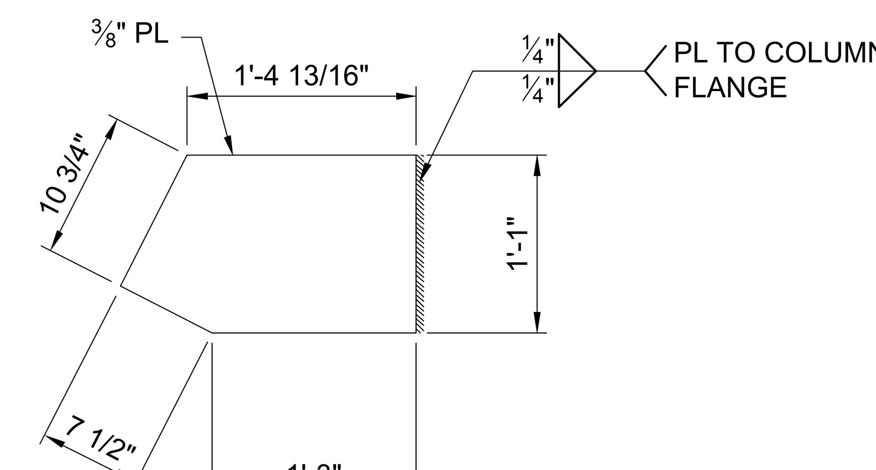
| Connection Name | GUSSET PLATE | θ | NUMBER OF CONNECTIONS |
|---|---|---|---|
| GP-1A | 1 | 26.1° | 2 |
| GP-1B | 1 | 37.9° | 4 |
| GP-2A | 2 | 47.7° | 2 |
| GP-2B | 2 | 59.7° | 2 |
| GP-2C | 2 | 48.1° | 2 |
| GP-3A | 3 | 37.9° | 4 |
| GP-3B | 3 | 38.5° | 12 |
| GP-3C | 3 | 46.6° | 12 |
| GP-3D | 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 |



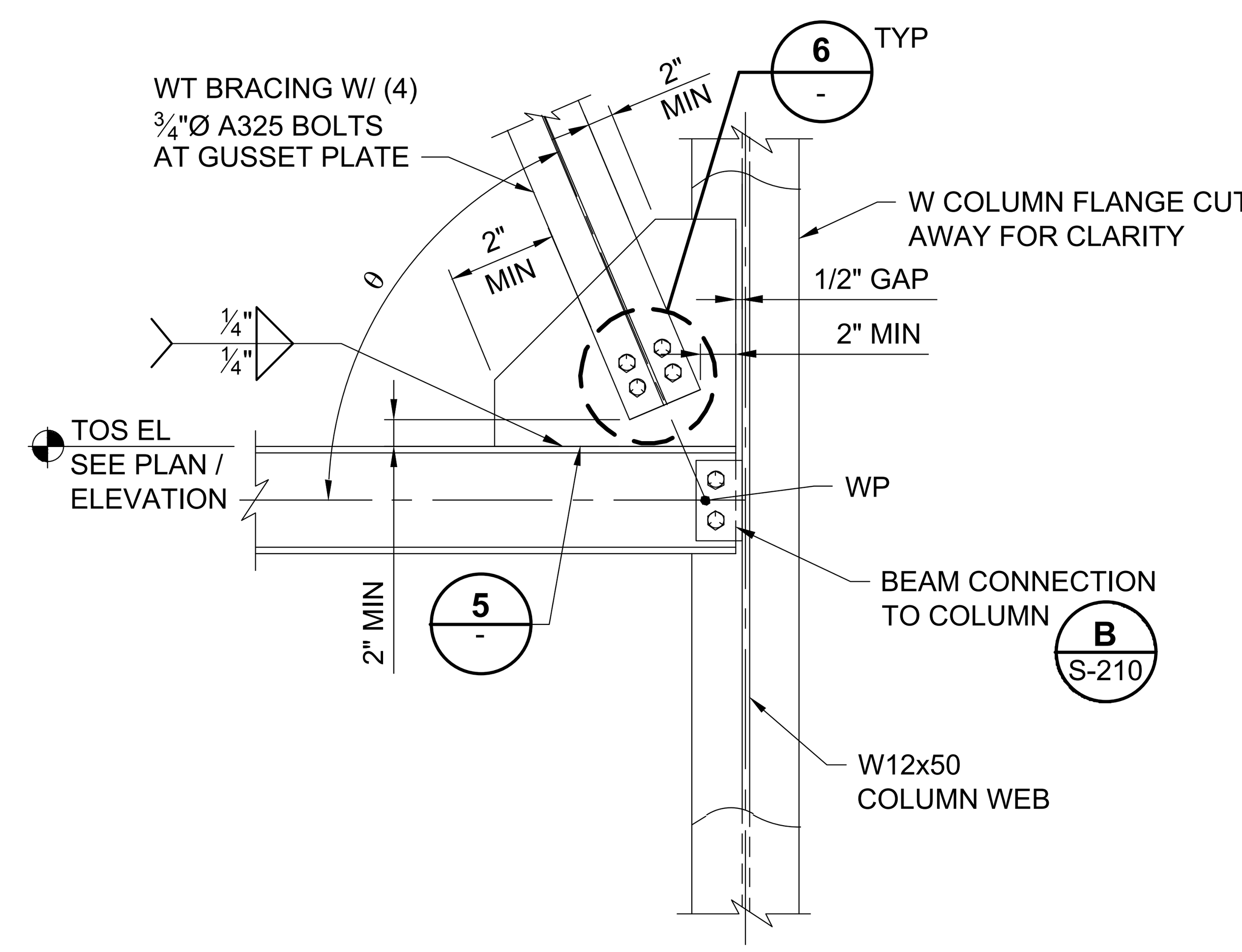

1 - **GUSSET PLATE 1 DETAIL** SCALE: 1"=1'-0"



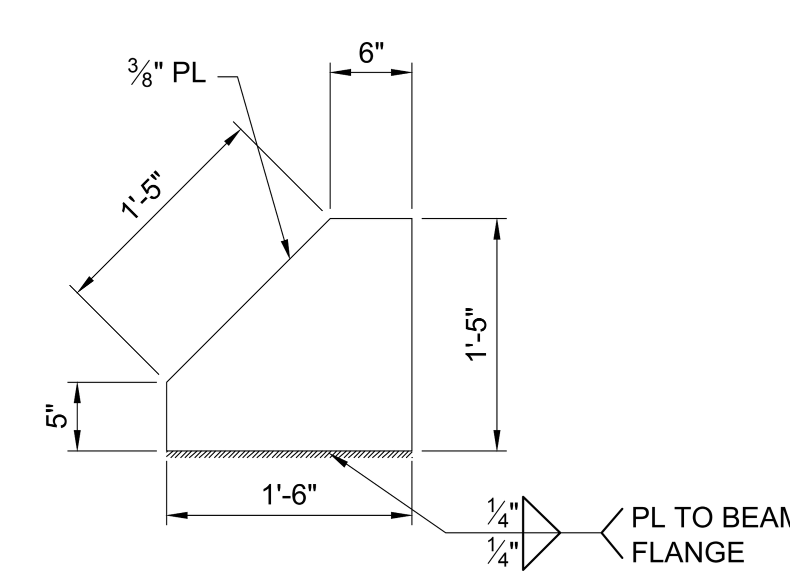

D S-203 **SECTION** SCALE: 1"=1'-0"



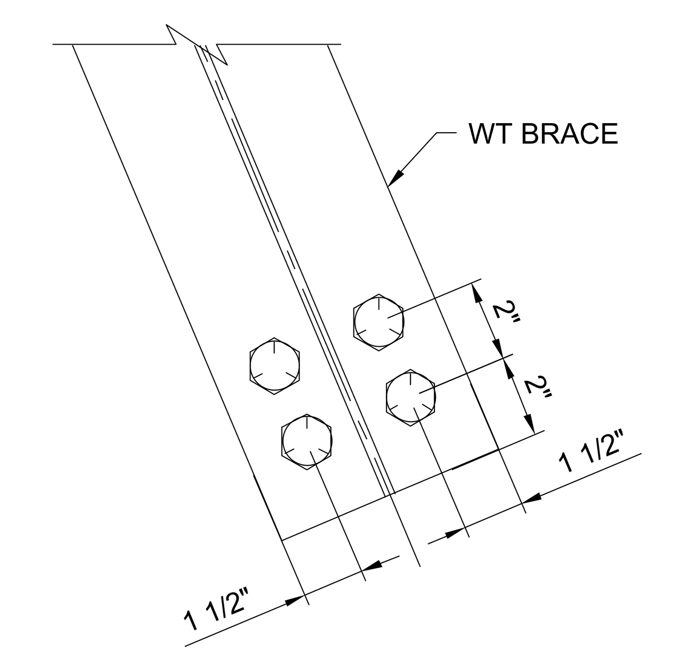

4 - **GUSSET PLATE 4 DETAIL** SCALE: 1"=1'-0"




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




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




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

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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

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mas and projects\holden office projects\SHAWMUT\900 CAD\02-sheets\S\S-211.dwg USER: Agrogan
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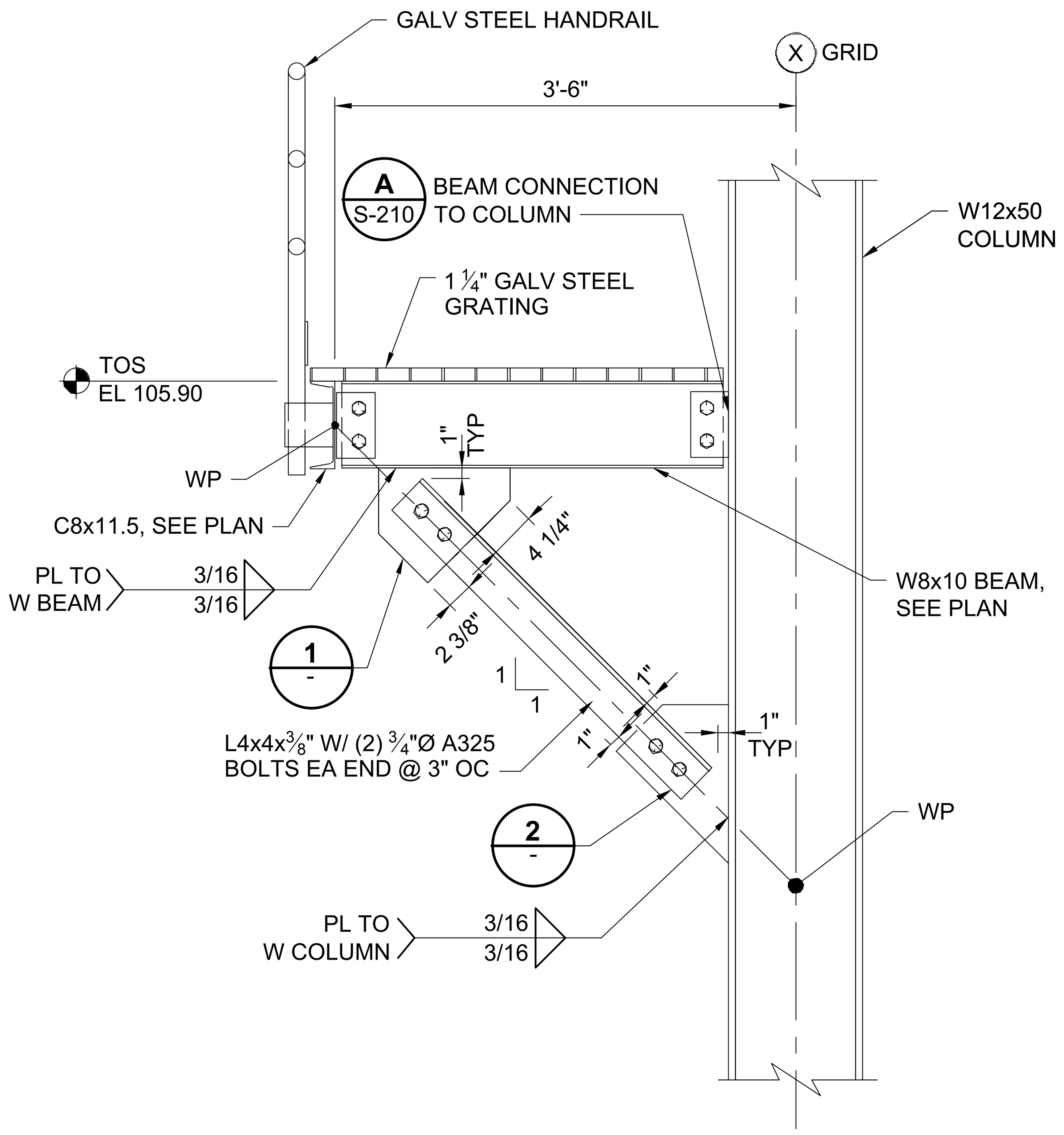
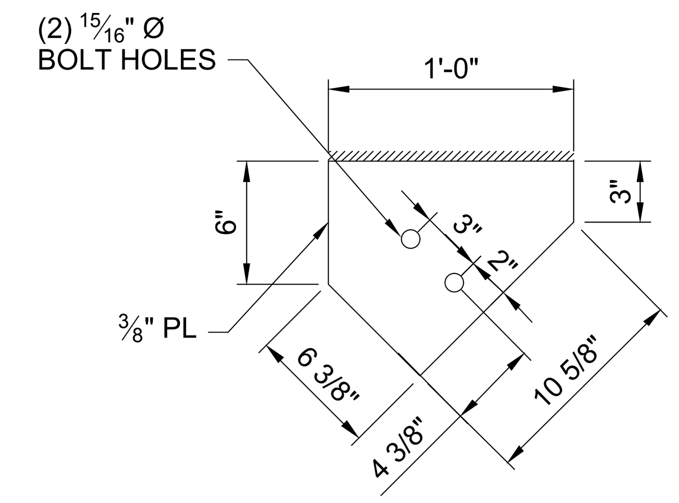
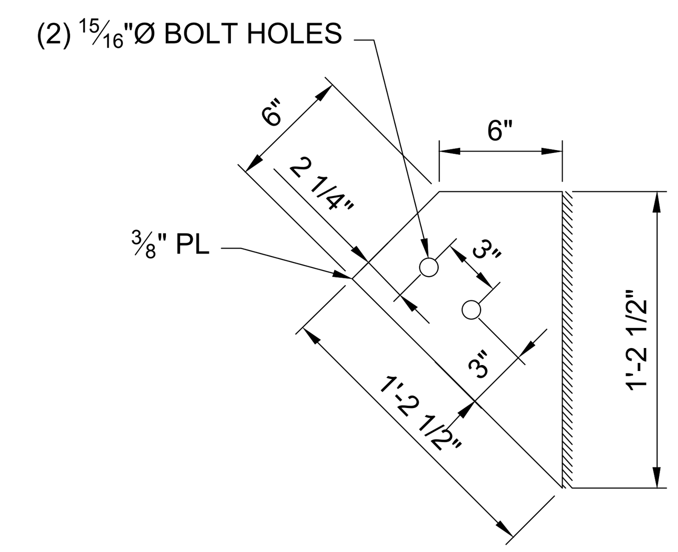


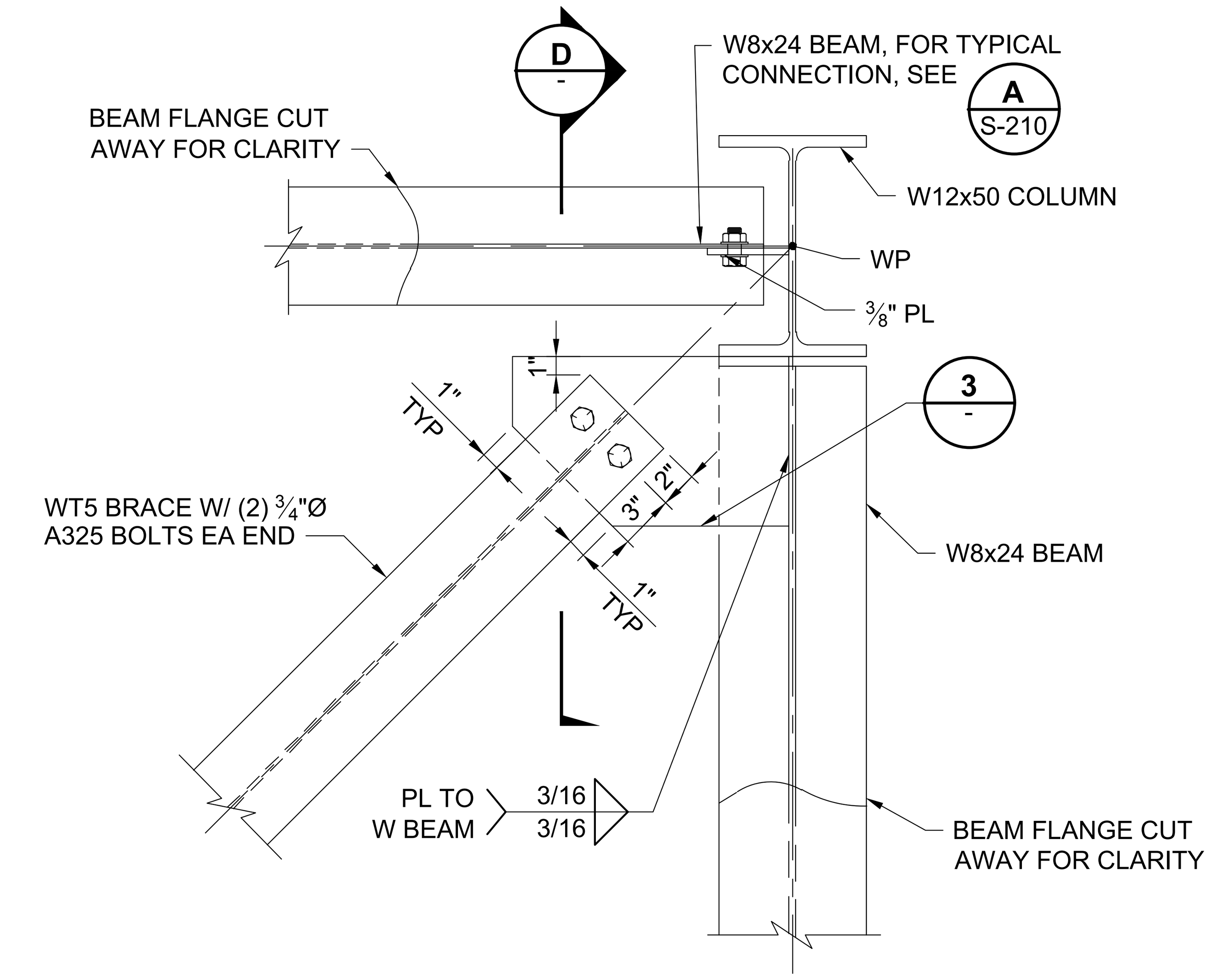

**A SECTION**
S-203 SCALE: 1"=1'-0"
S-204
S-207



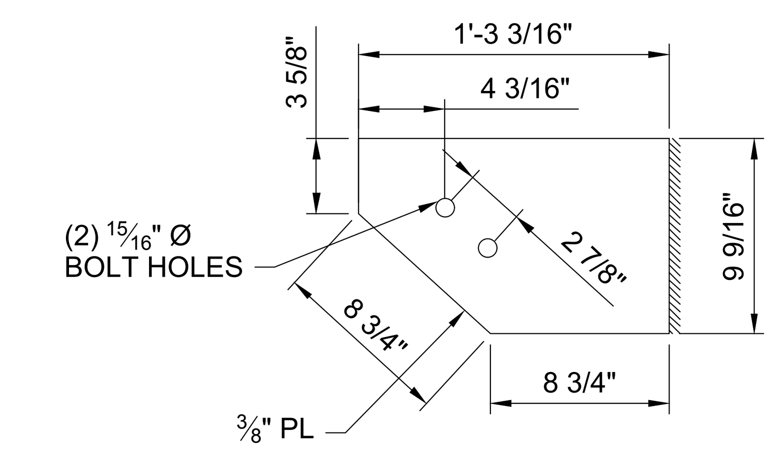

**1 GUSSET PLATE DETAIL**
SCALE: 1-1/2"=1'-0"



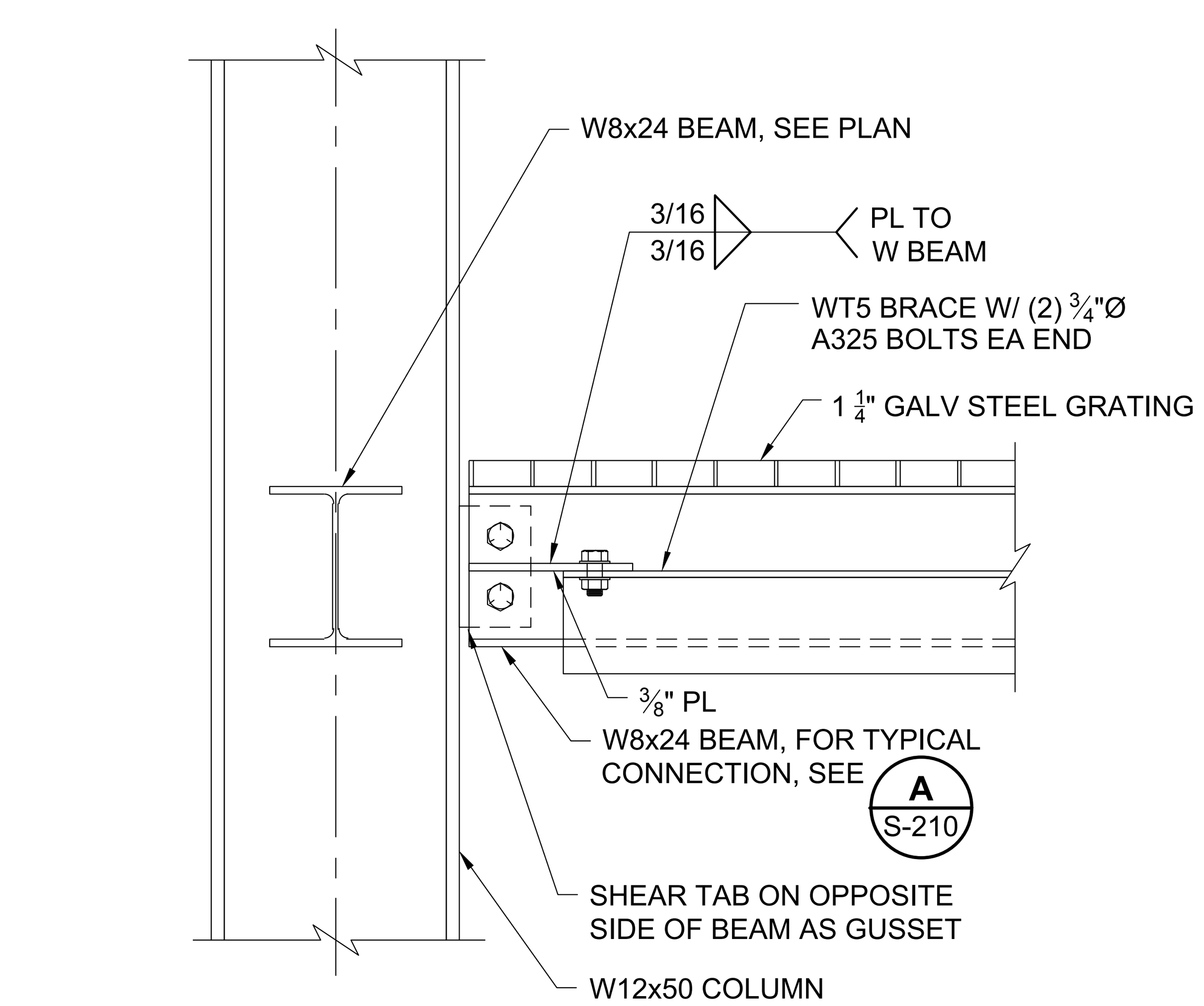

**2 GUSSET PLATE DETAIL**
SCALE: 1-1/2"=1'-0"



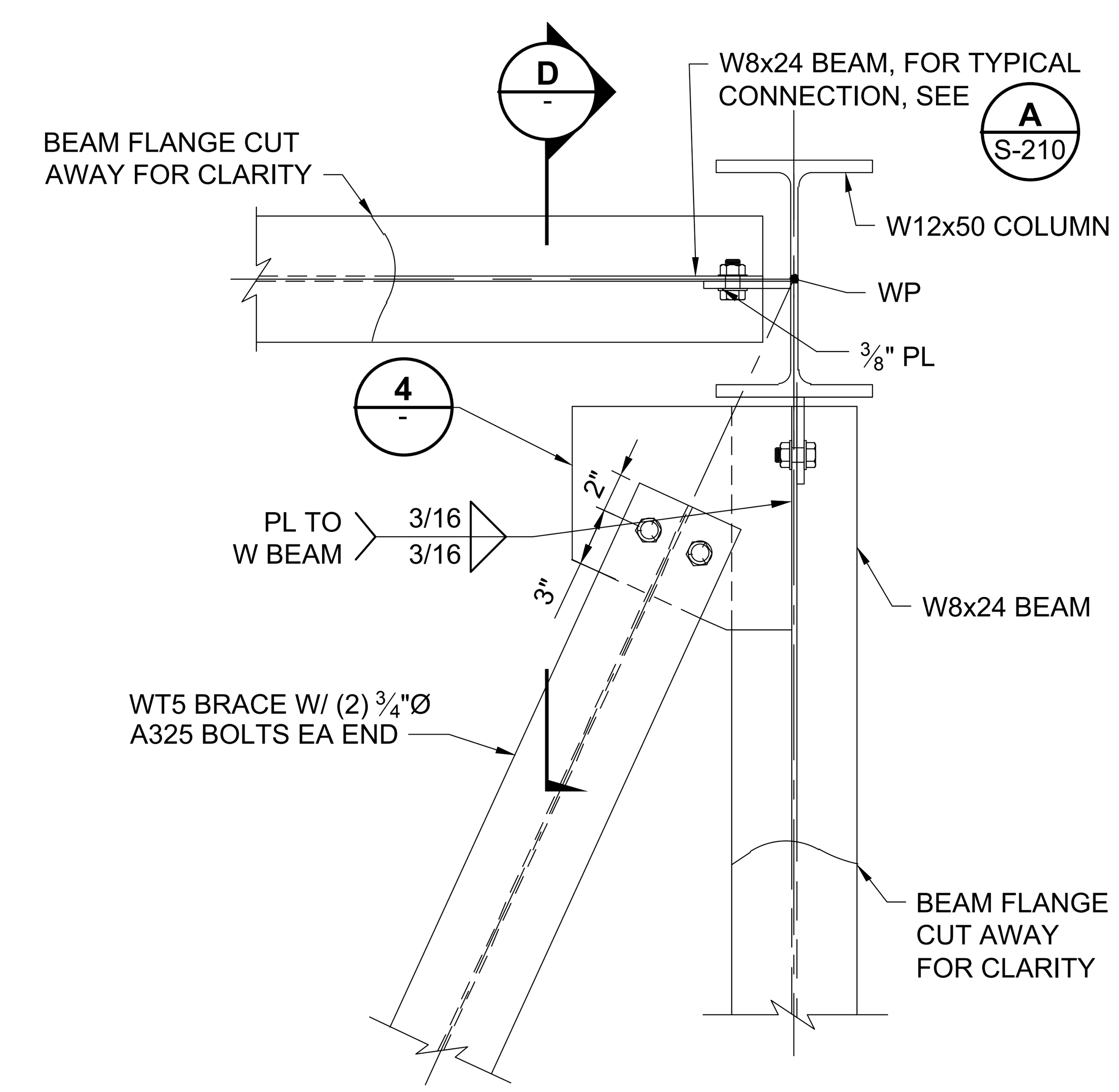

**C SECTION**
S-208 SCALE: 1 1/2"=1'-0"



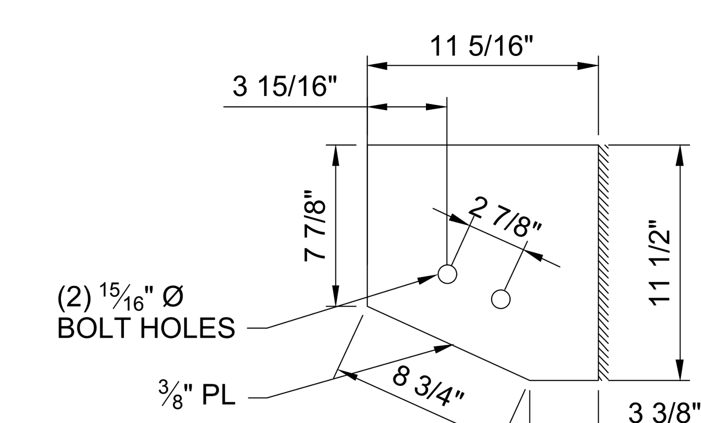

**3 GUSSET PLATE DETAIL**
SCALE: 1 1/2"=1'-0"




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




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




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

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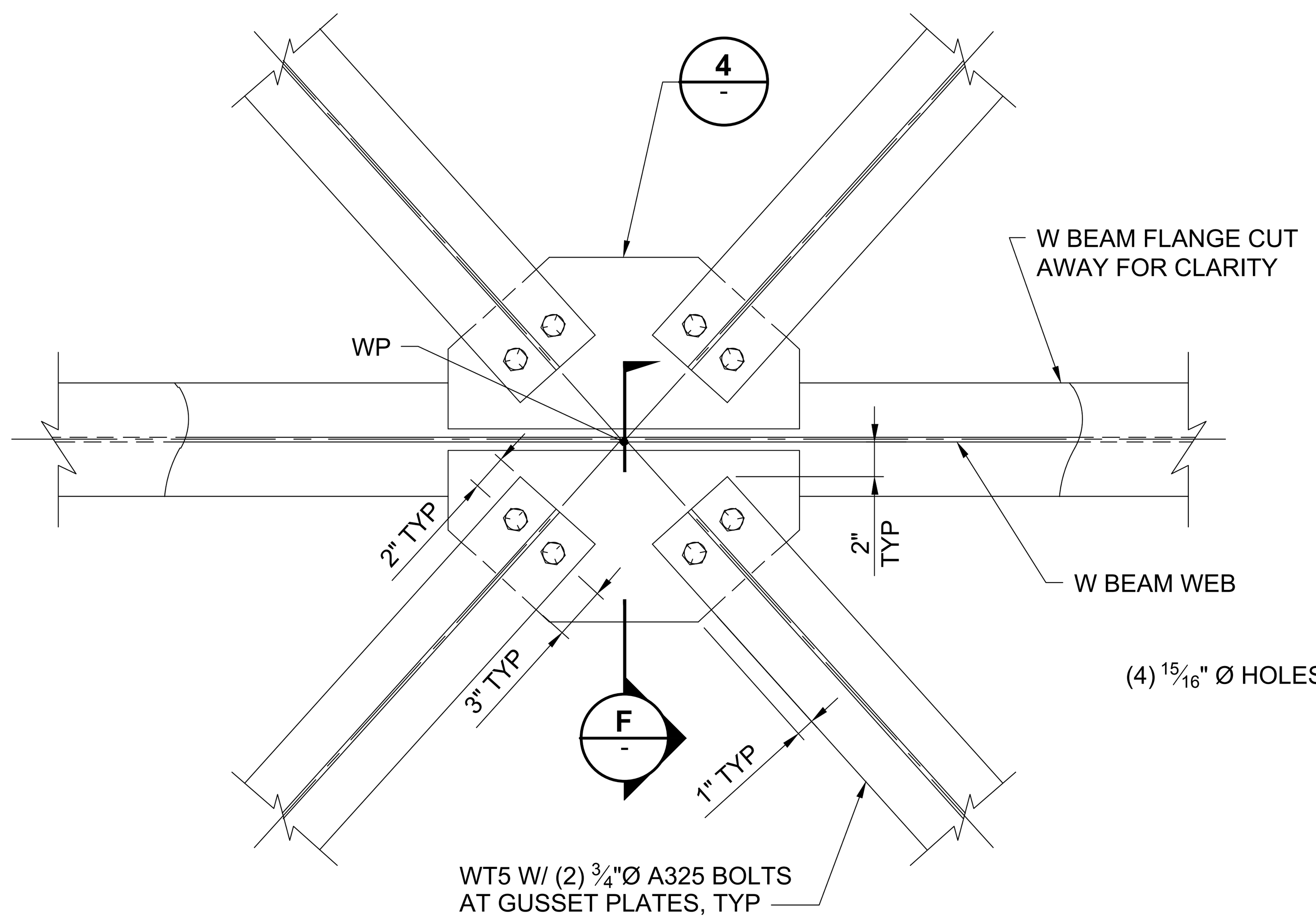
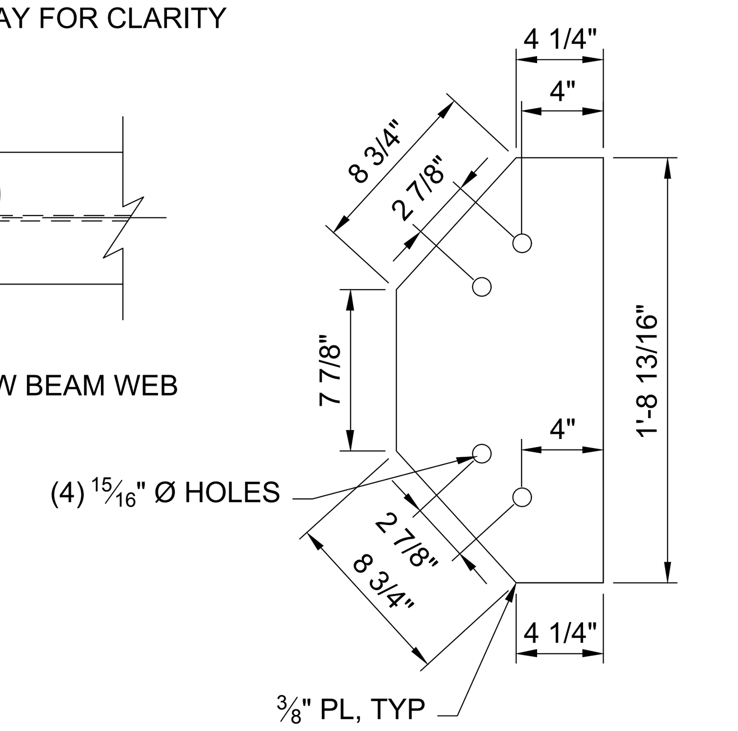
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS AND DETAILS

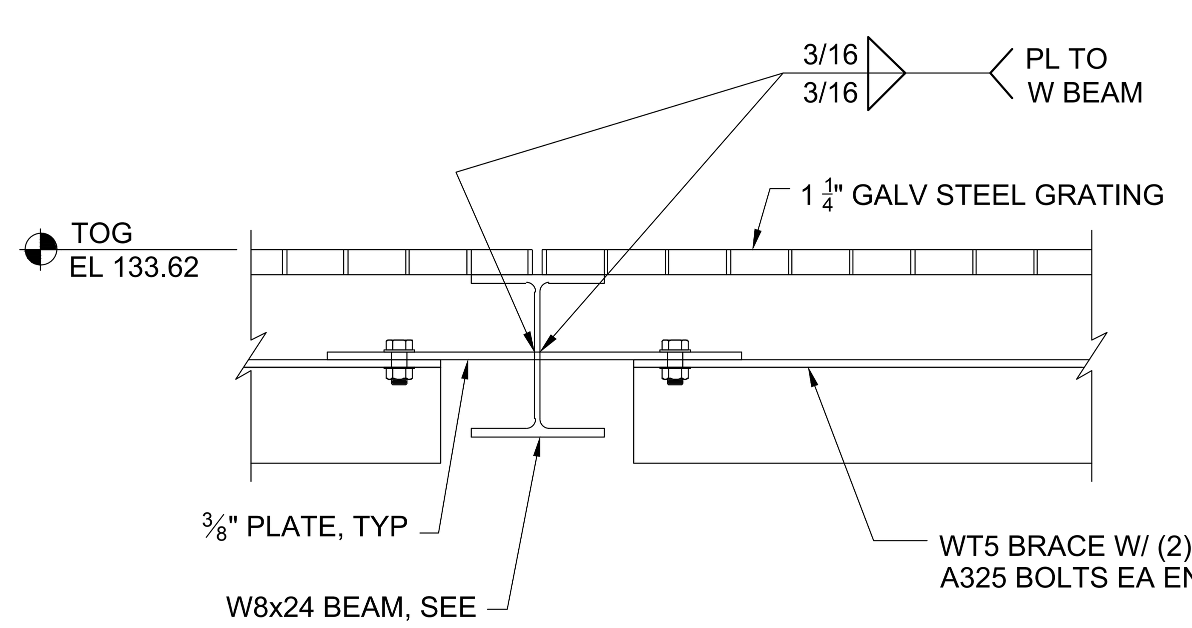
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 58 OF 176 |
| DRAWING: | S-212 |



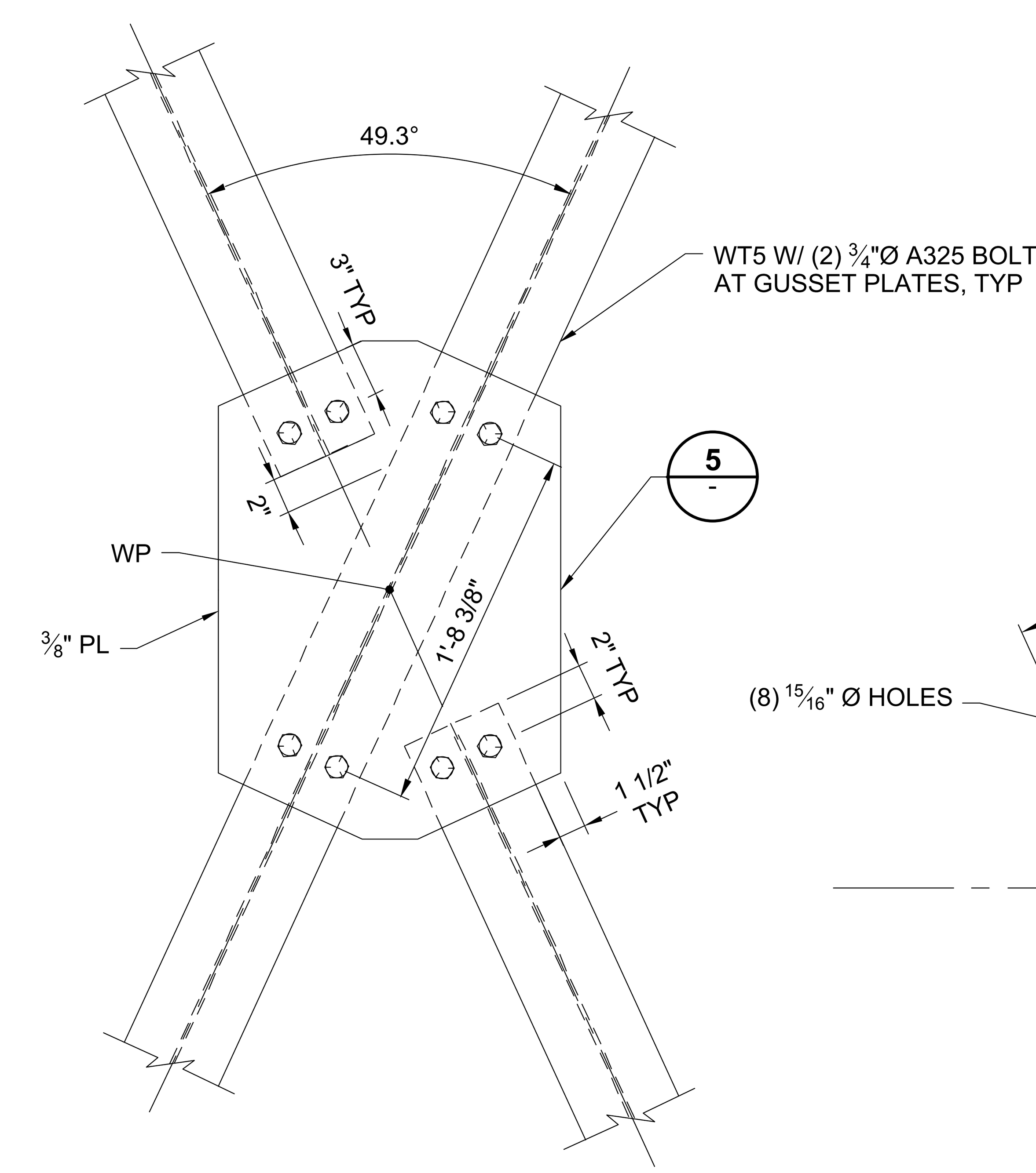

**E** S-208 **PLAN**
SCALE: 1-1/2"=1'-0"



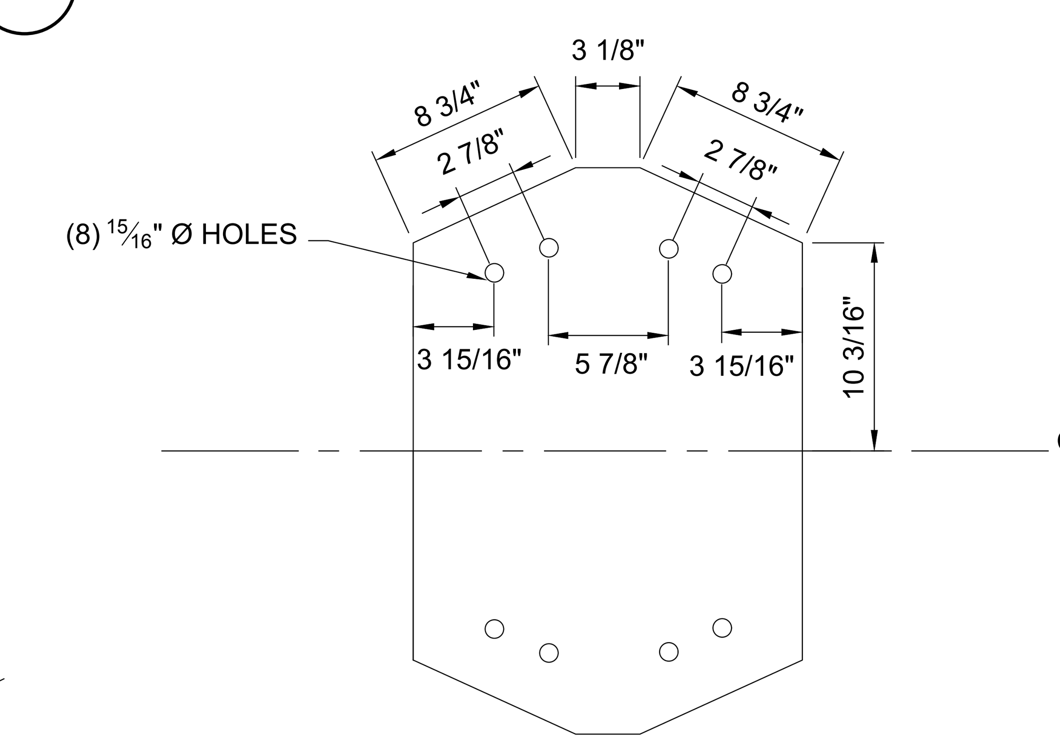

**4** - **GUSSET PLATE DETAIL**
SCALE: 1-1/2"=1'-0"




**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"

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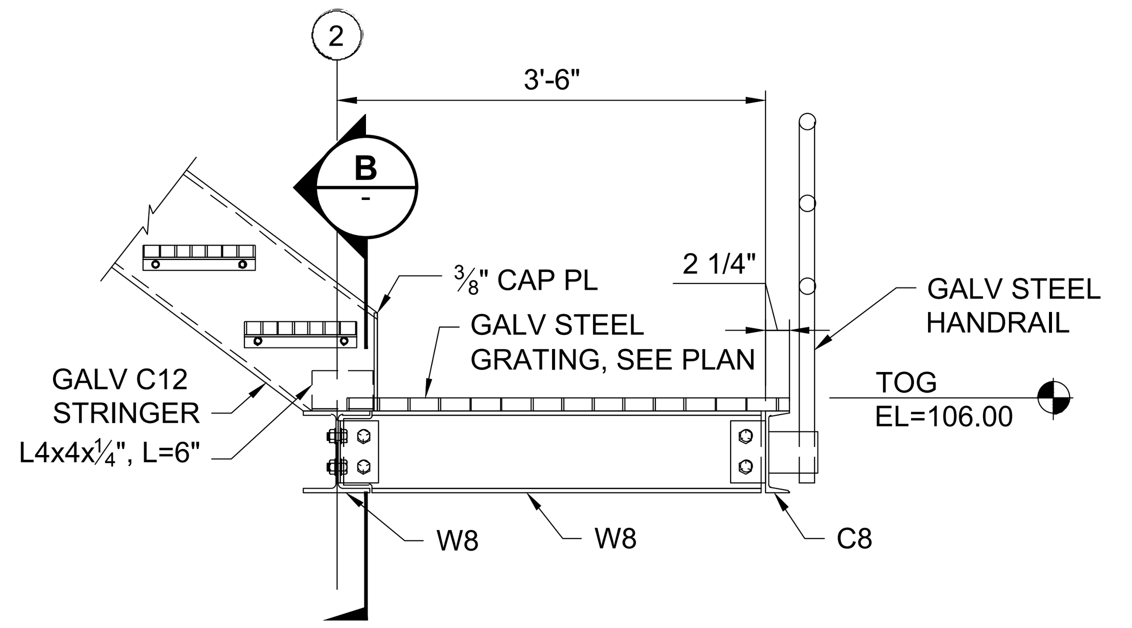
PROFESSIONAL ENGINEER

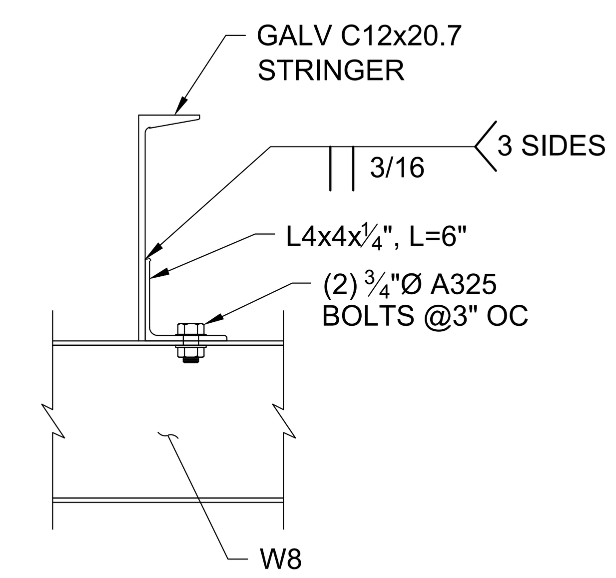
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TOWER STEEL FRAMING SECTIONS
AND DETAILS

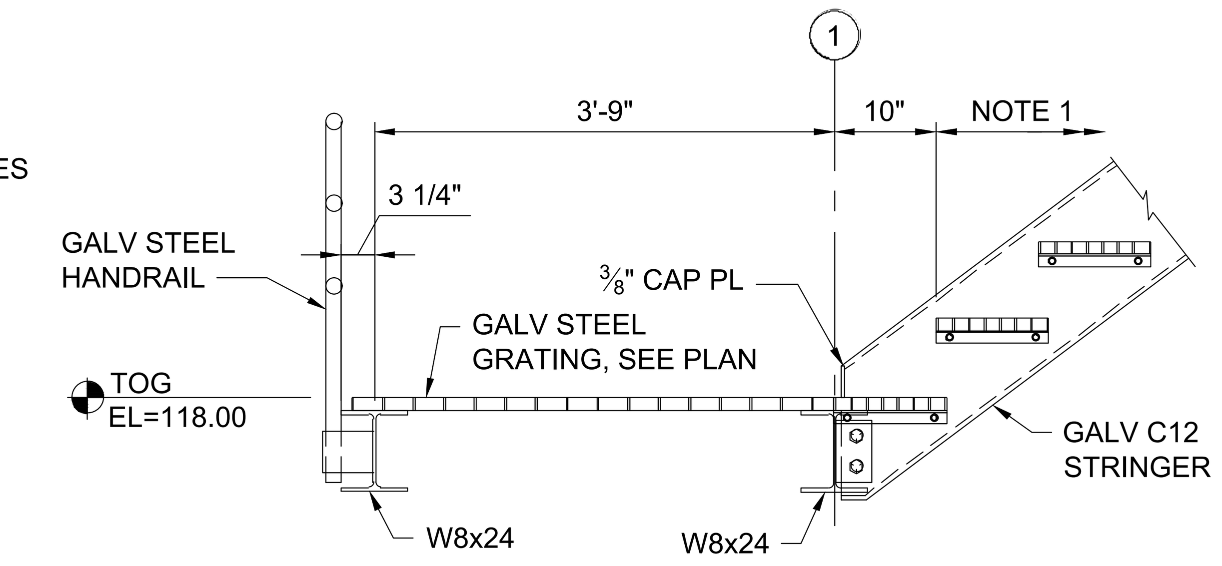
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 59 OF 176 |
| DRAWING: | S-213 |



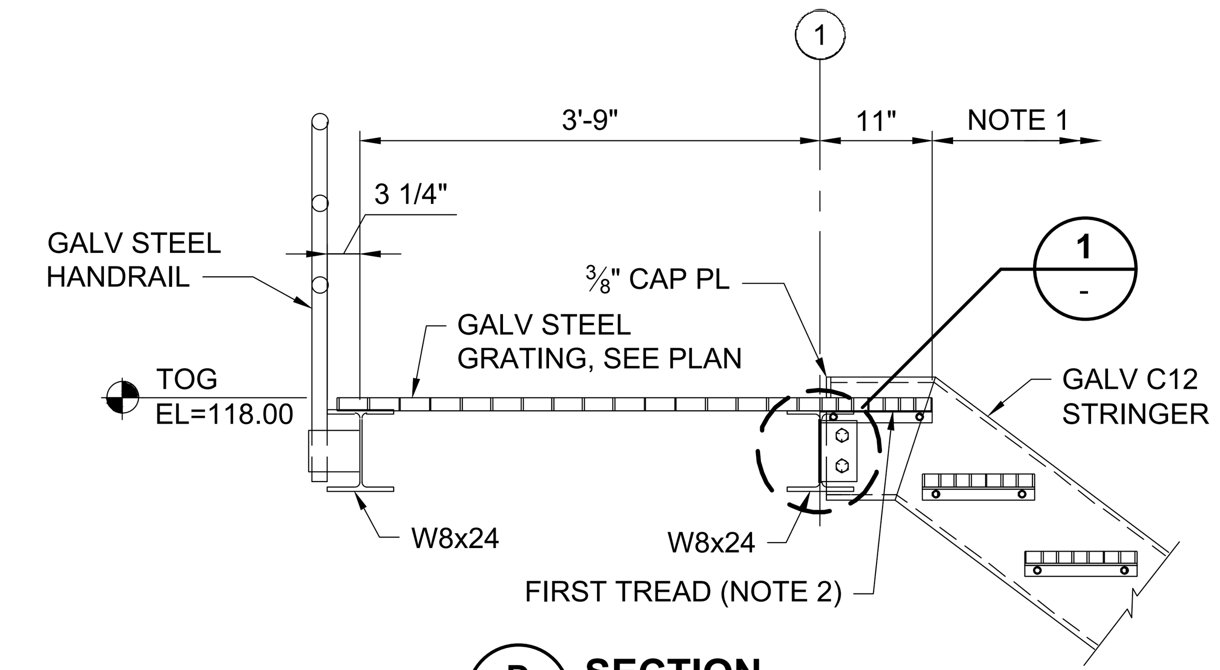

A SECTION
S-207 SCALE: 3/4"=1'-0"




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



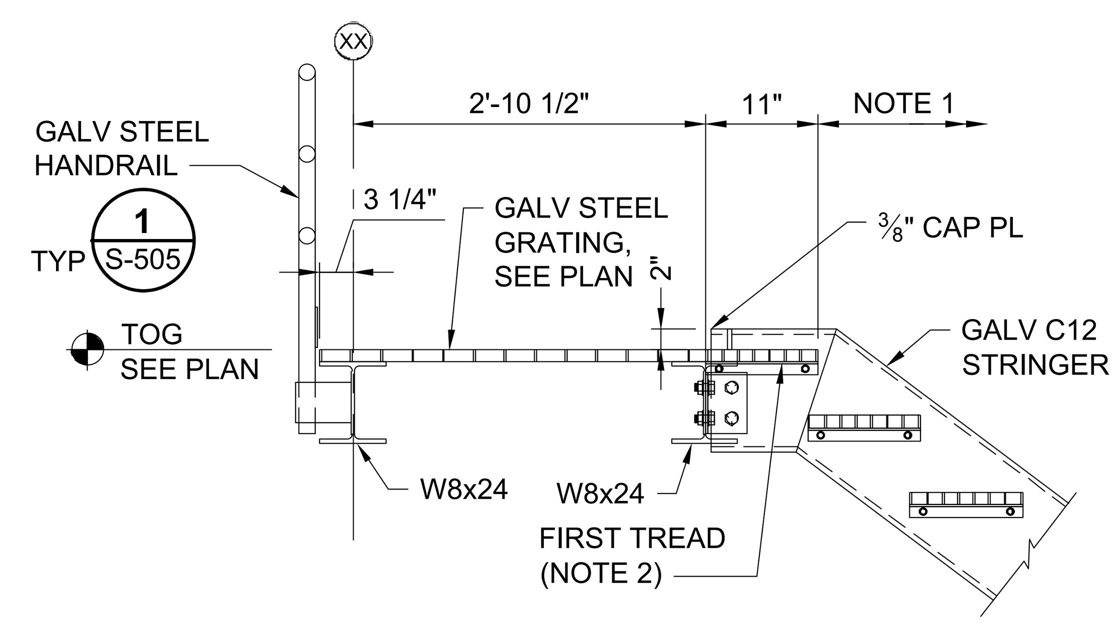

C SECTION
S-207 SCALE: 3/4"=1'-0"



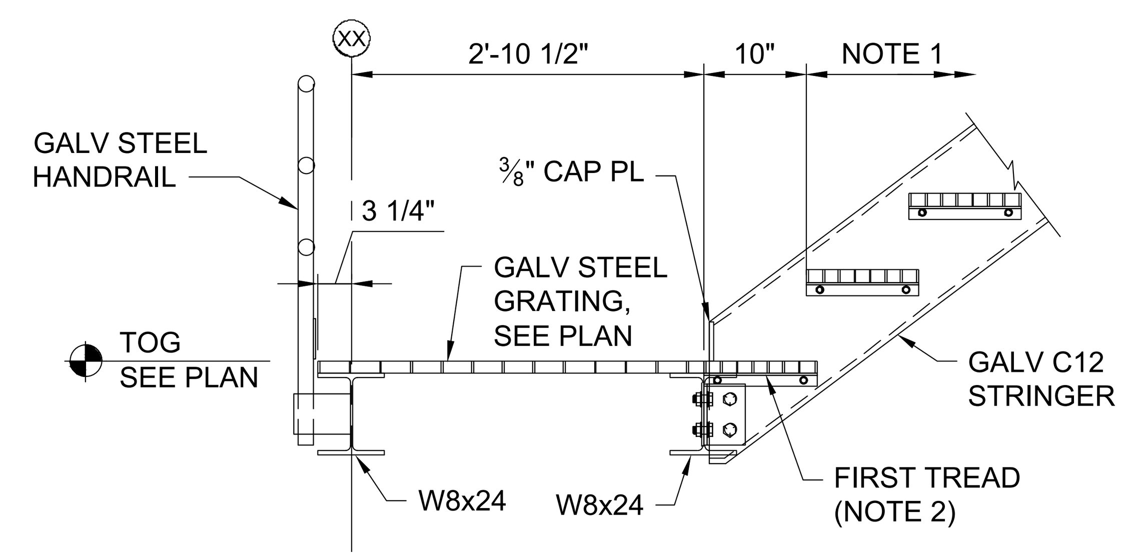

D SECTION
S-207 SCALE: 3/4"=1'-0"

NOTES:

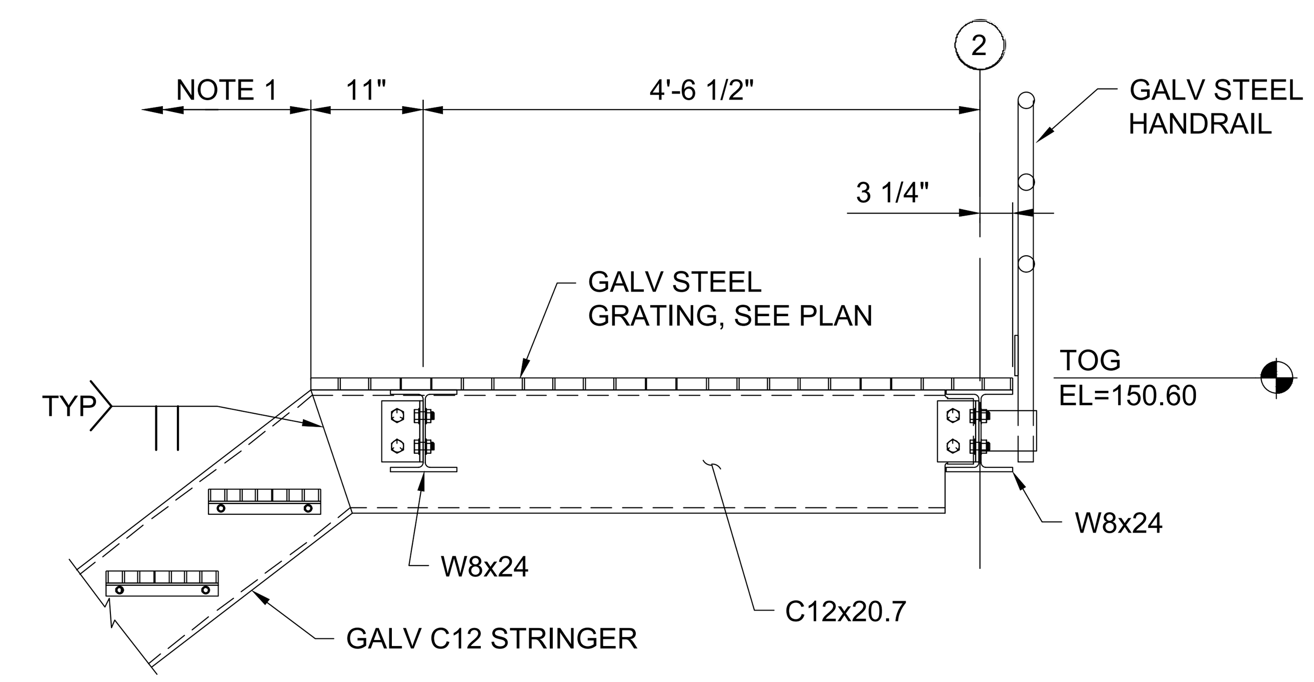
1. FOR TREAD SPACING, SEE STAIR SECTIONS A S-206 B S-206
2. FIRST TREAD SHALL BE AT SAME ELEVATION AS ADJACENT GRATING UNLESS OTHERWISE NOTED.



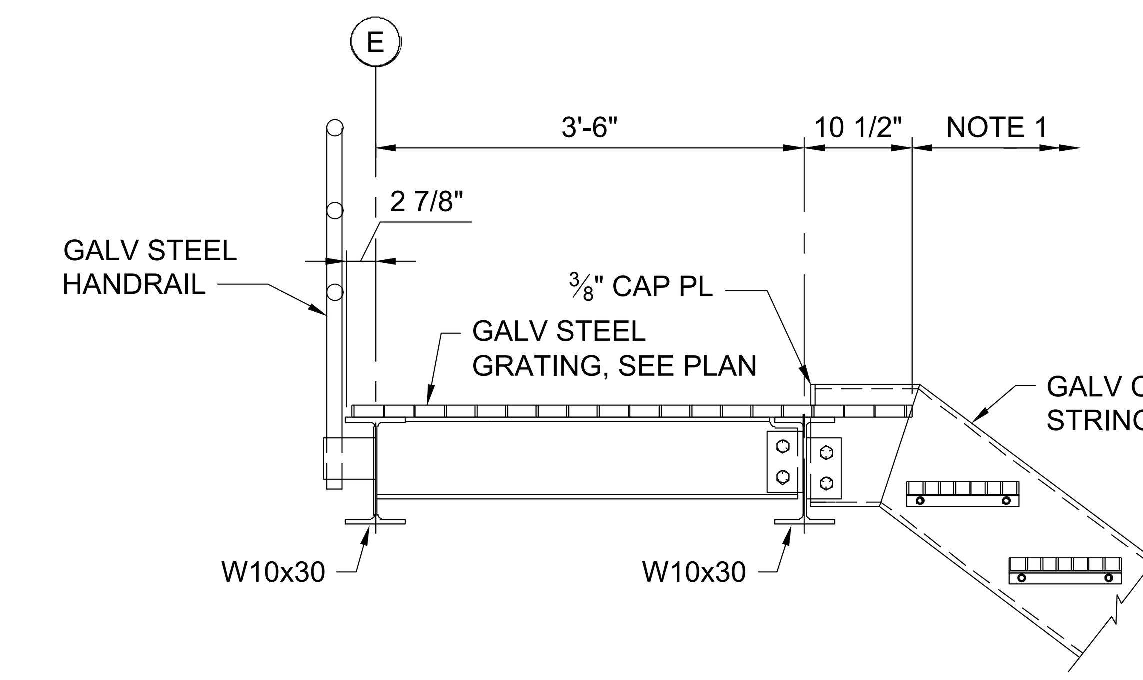

E SECTION
S-207 SCALE: 3/4"=1'-0"
S-208



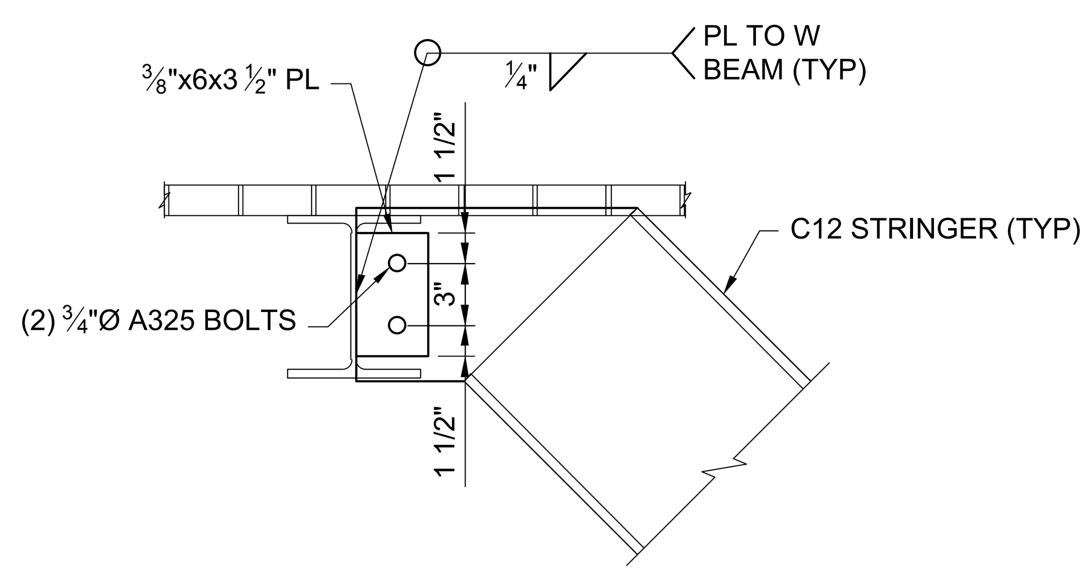

F SECTION
S-207 SCALE: 3/4"=1'-0"
S-208




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




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




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

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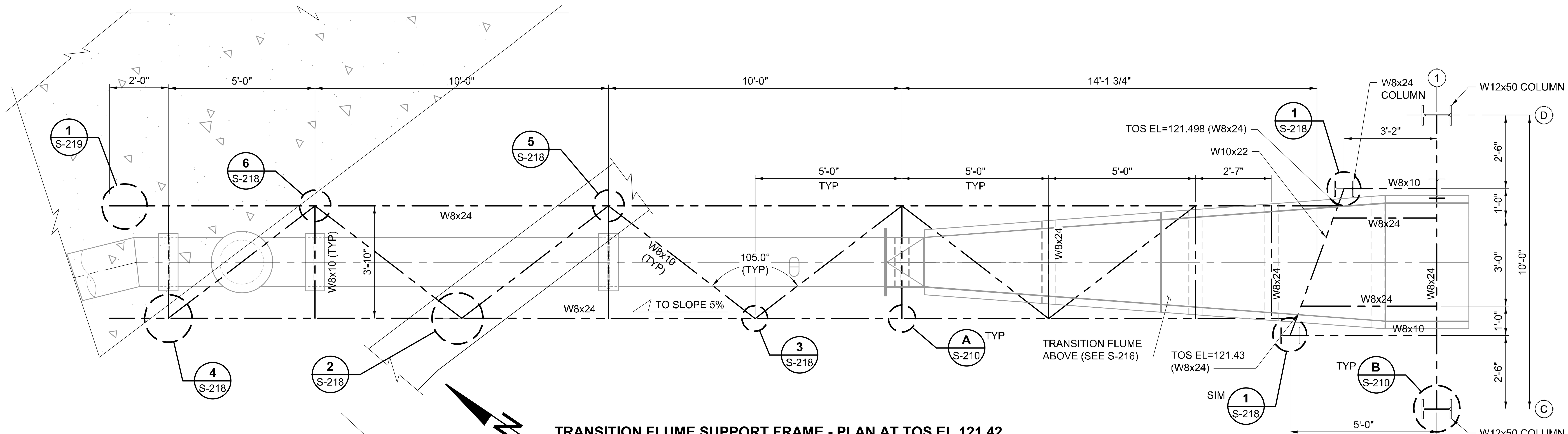
LICENSED PROFESSIONAL ENGINEER

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

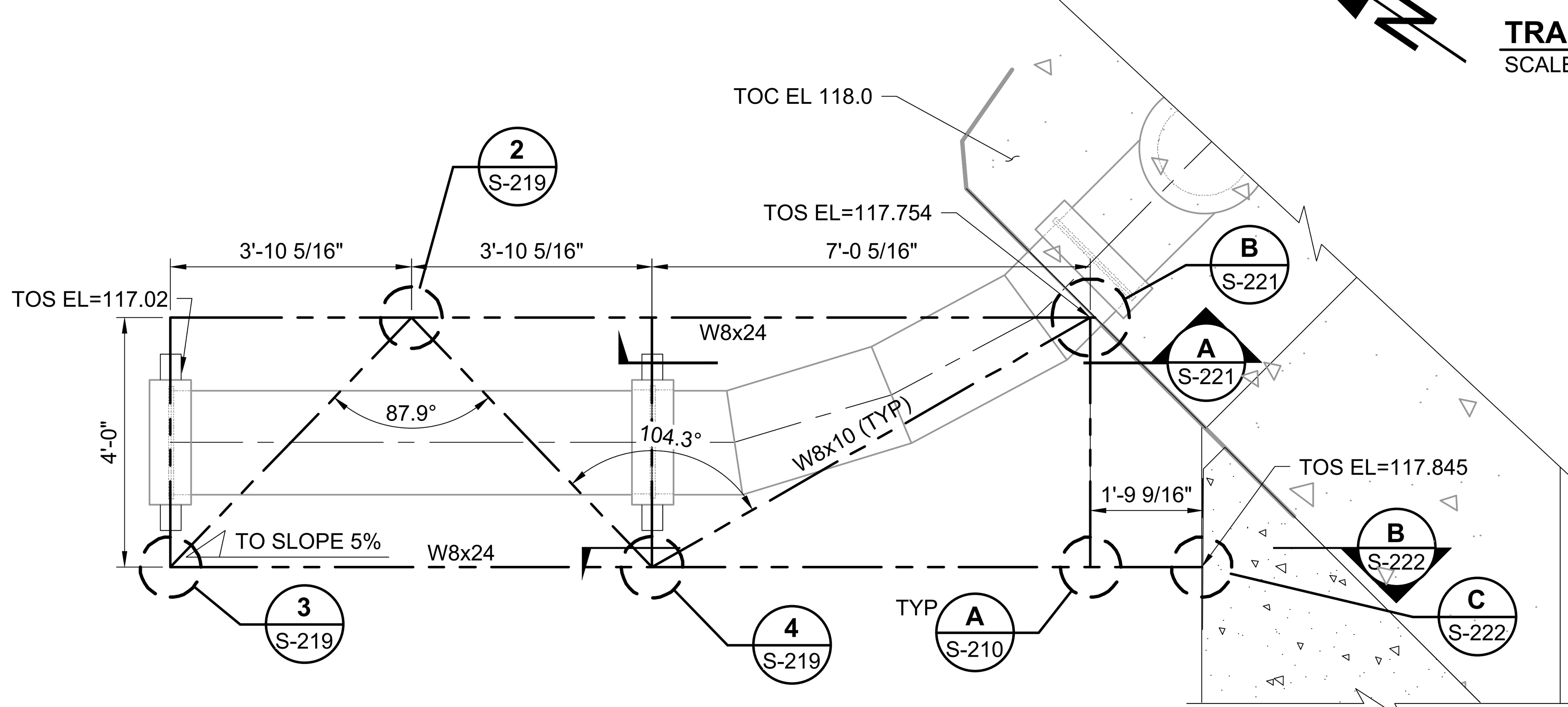
STAIR SECTIONS AND DETAILS

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



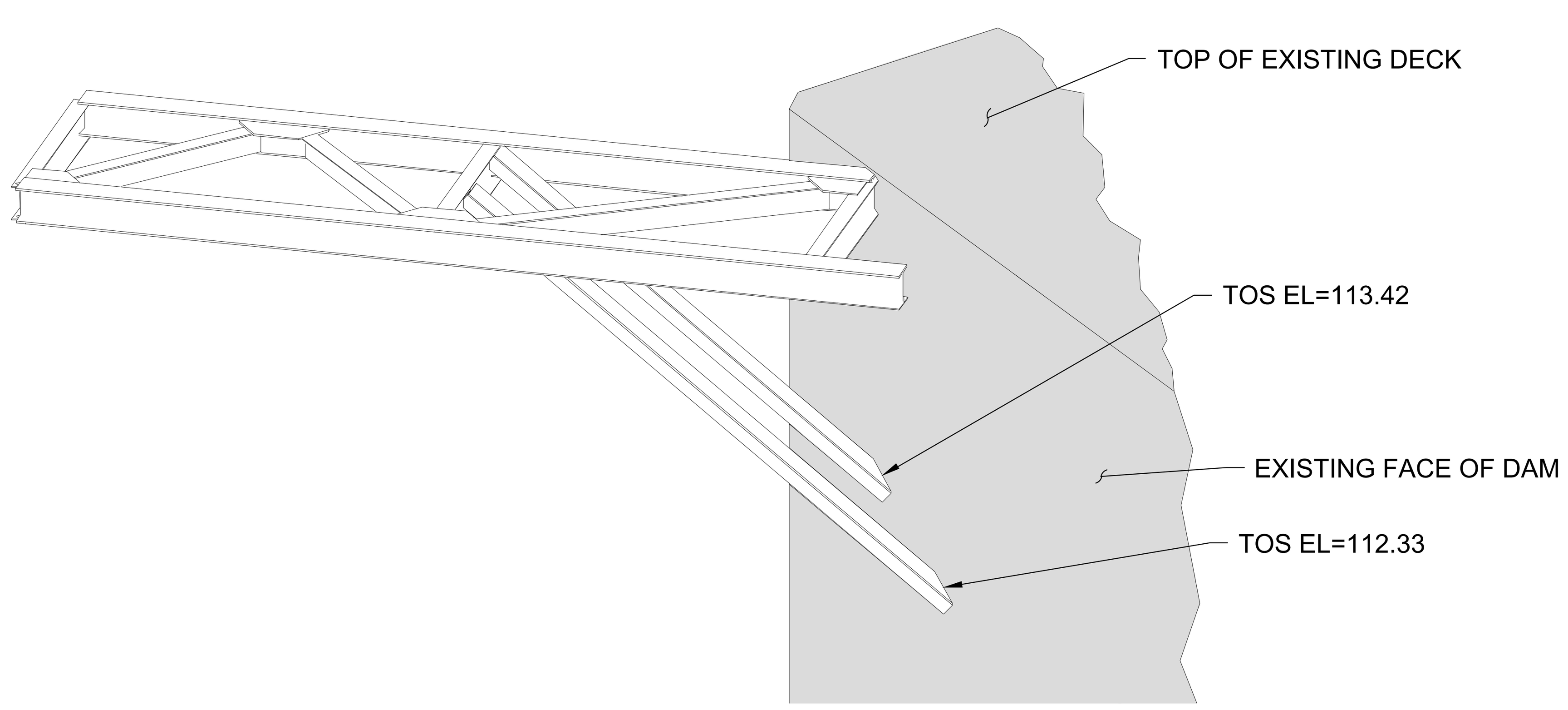

**TRANSITION FLUME SUPPORT FRAME - PLAN AT TOS EL 121.42**

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




**TRANSITION FLUME SUPPORT FRAME - PLAN AT TOS EL 118.00**

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

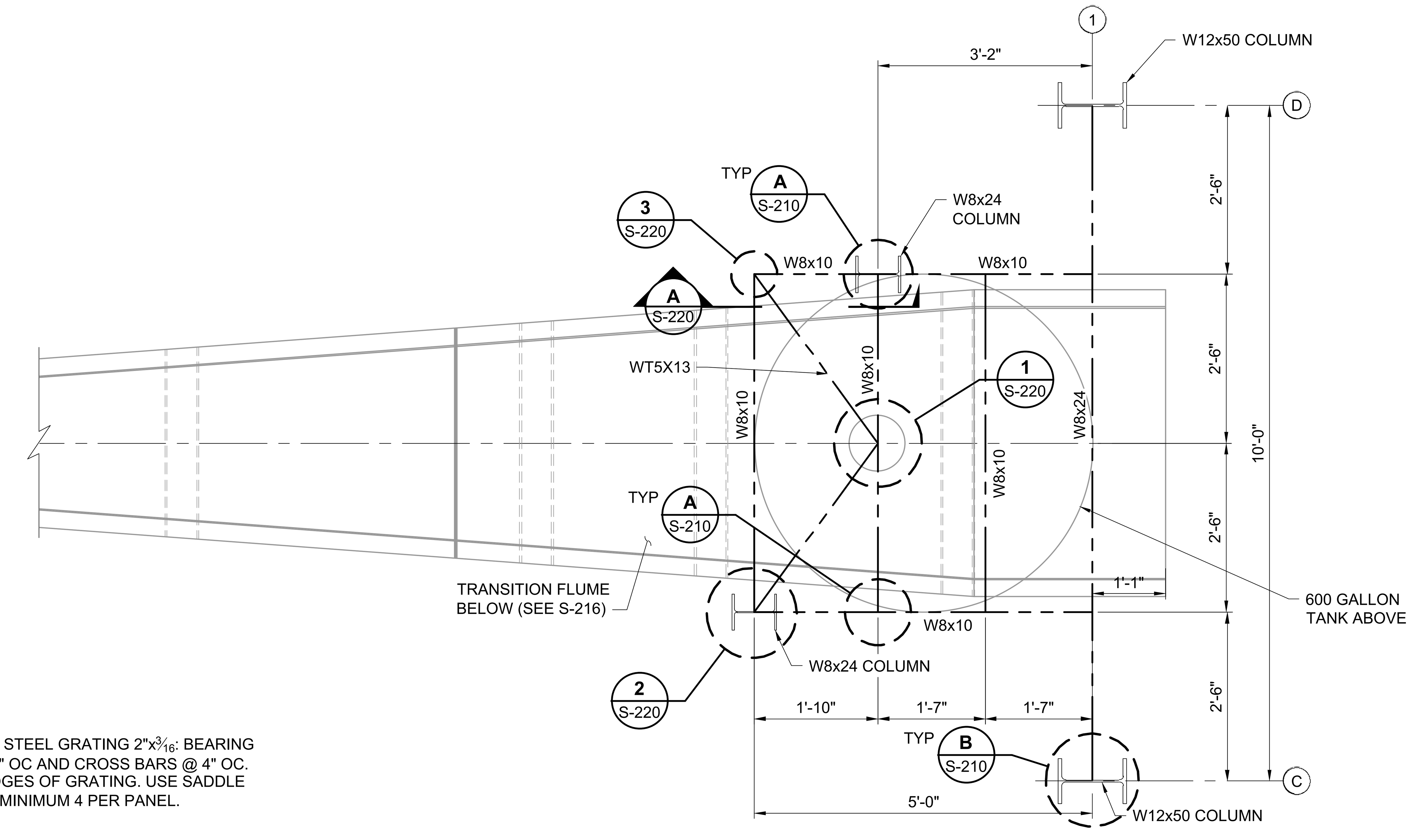



**TRANSITION FLUME SUPPORT FRAME ISOMETRIC**

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

**NOTE:**

1. GALVANIZED STEEL GRATING 2"x$\frac{3}{16}$: BEARING BARS @ 1 $\frac{3}{16}$" 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"

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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 |

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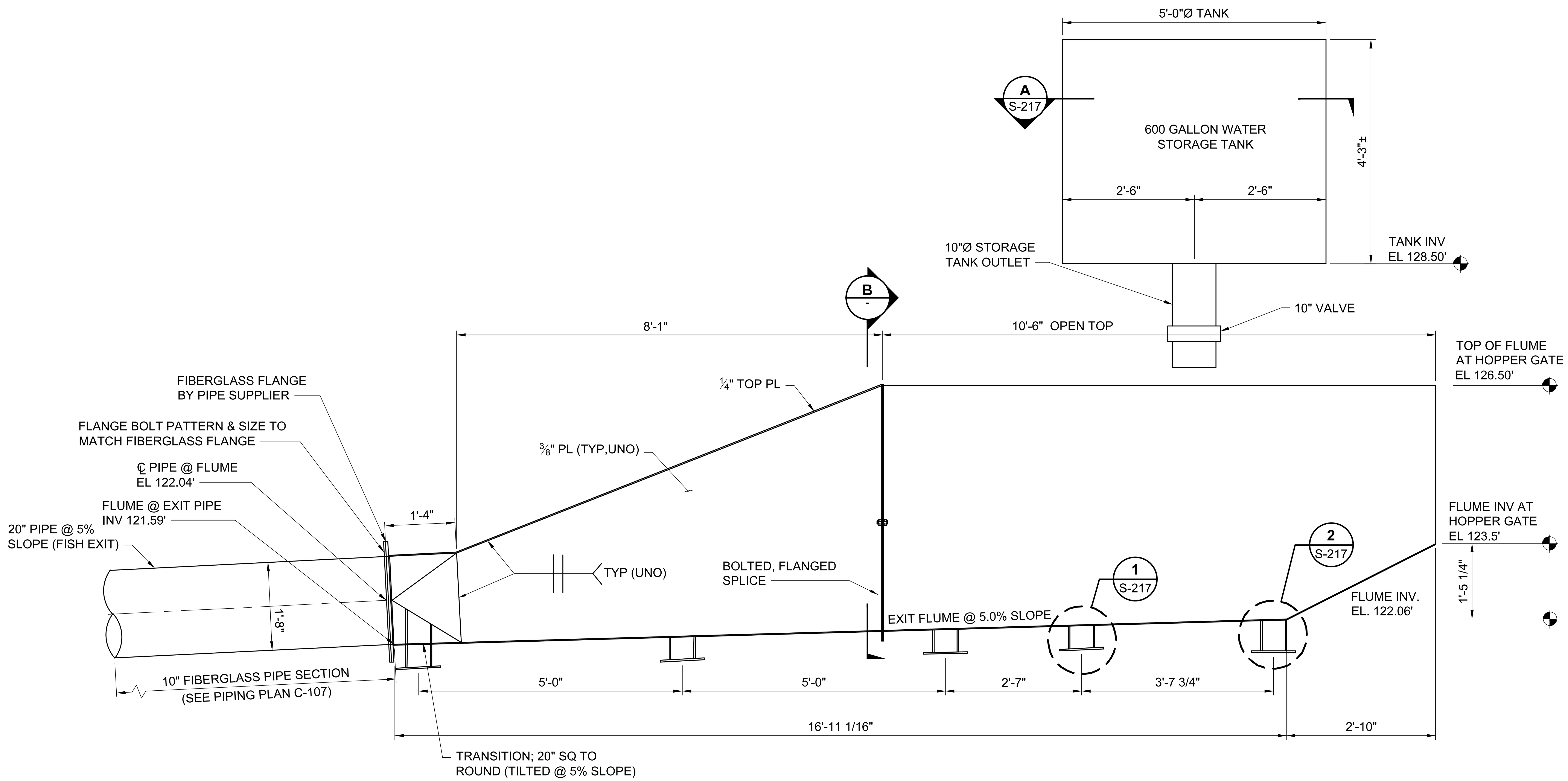
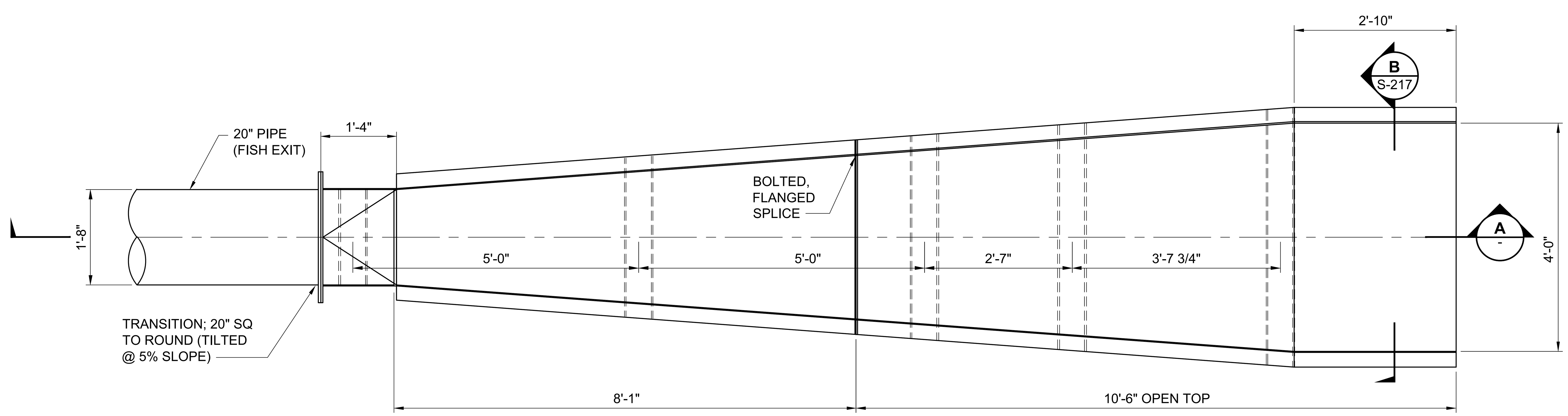
**NOTE:**

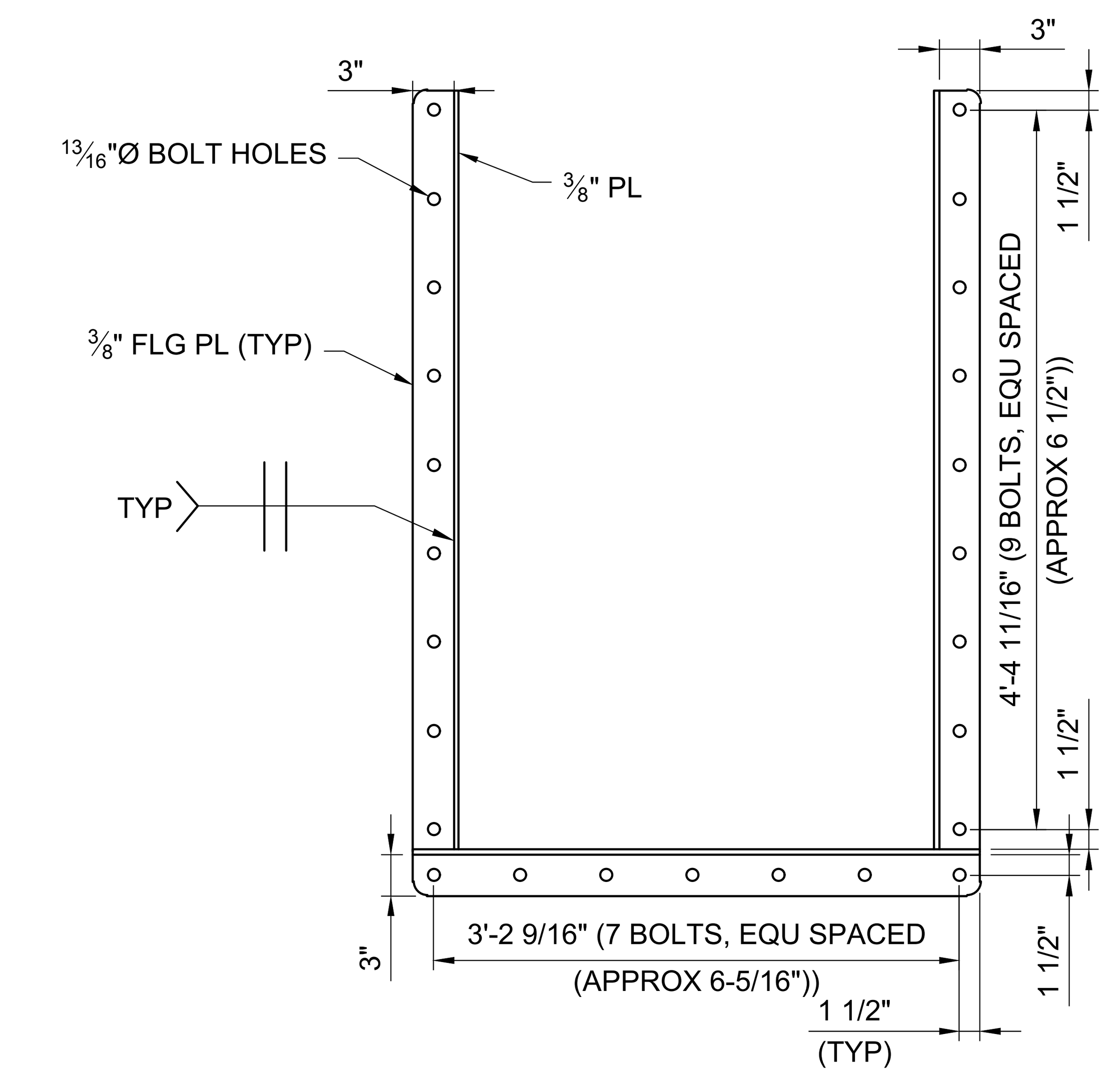
1. STEEL FRAME NOT SHOWN FOR CLARITY.




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




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




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

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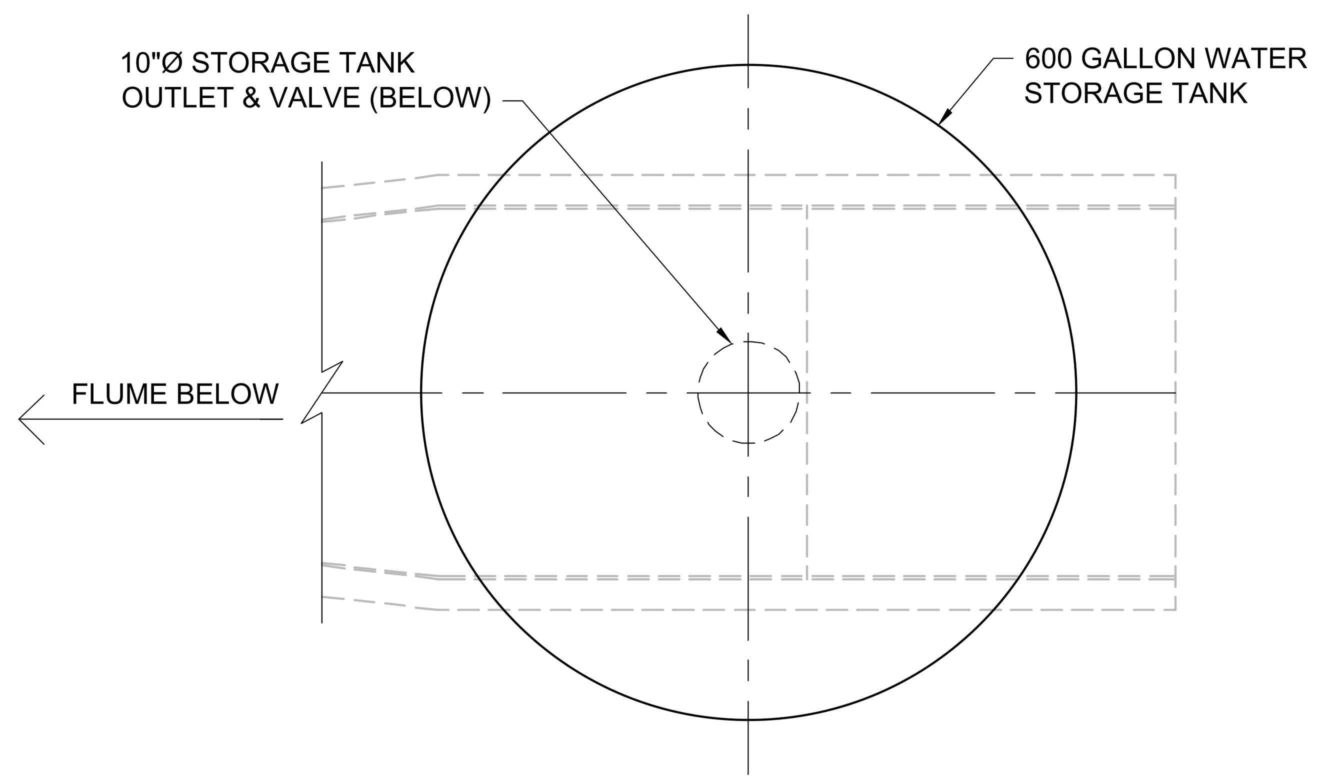
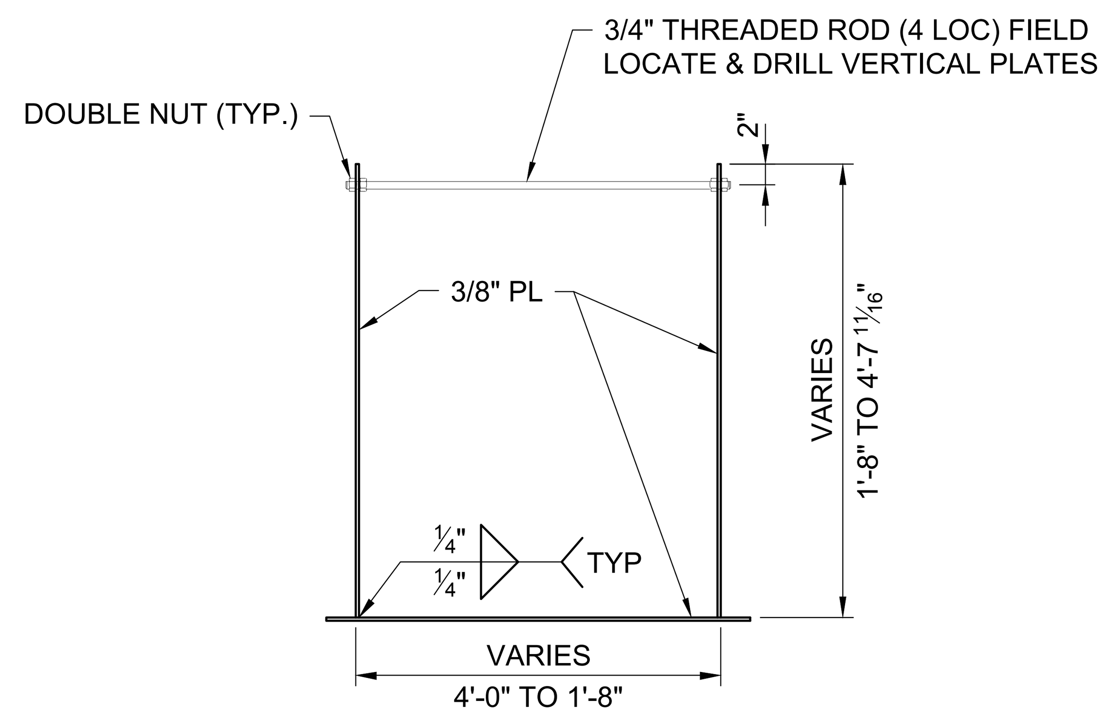
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME PLAN & SECTIONS

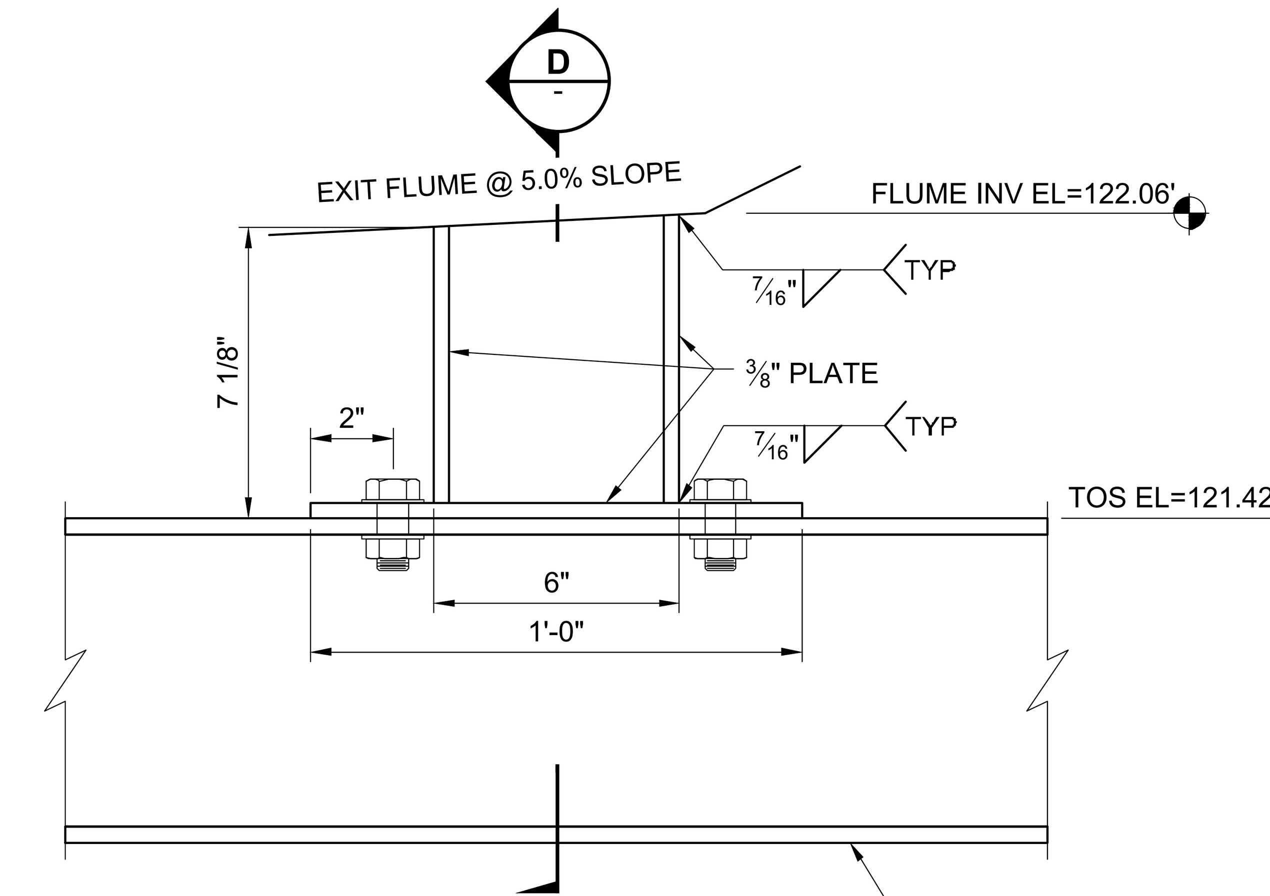
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 62 OF 176 |
| DRAWING: | S-216 |



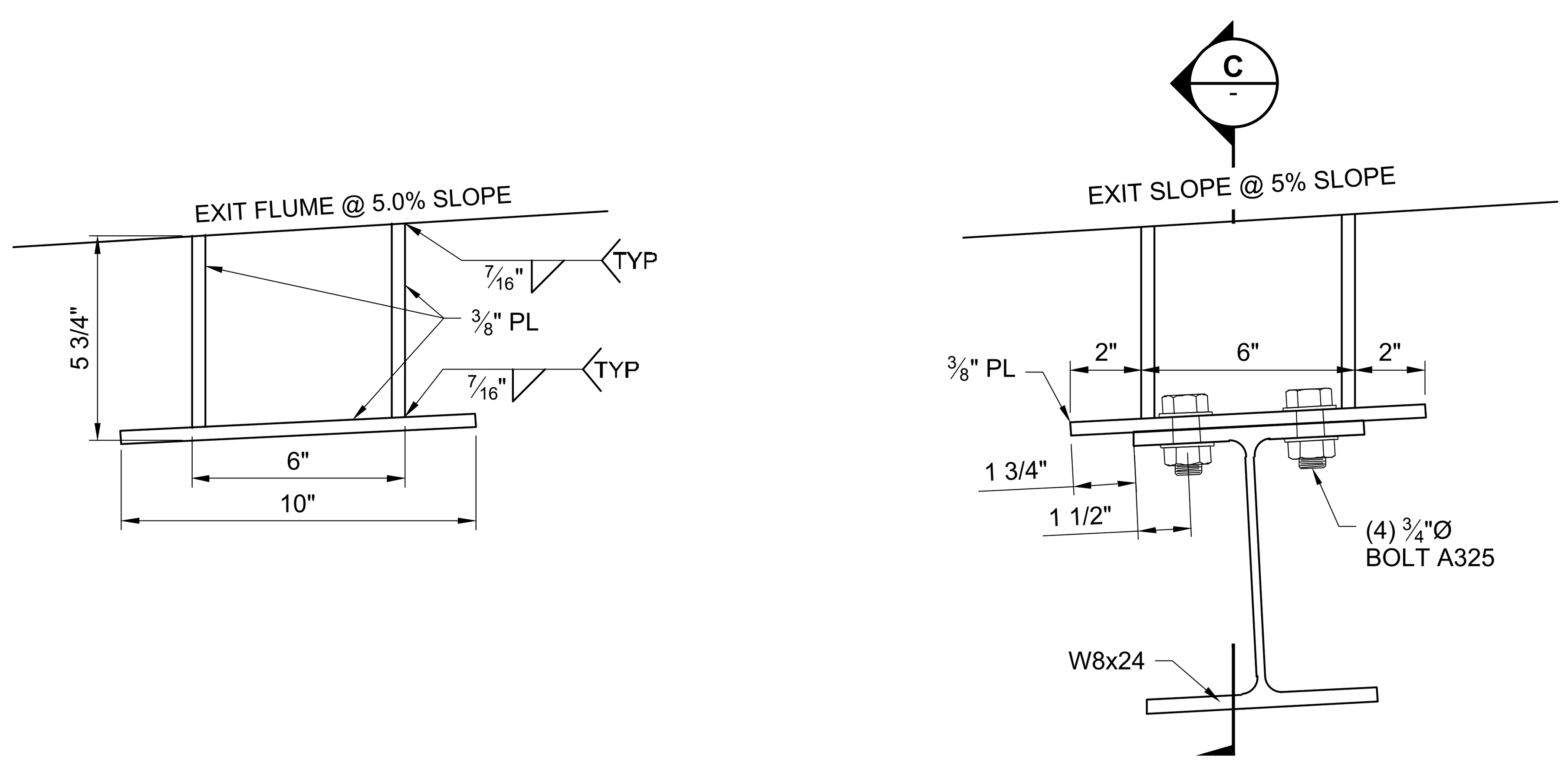

**A** S-216 **STORAGE TANK PLAN**
SCALE: 3/4"=1'-0"



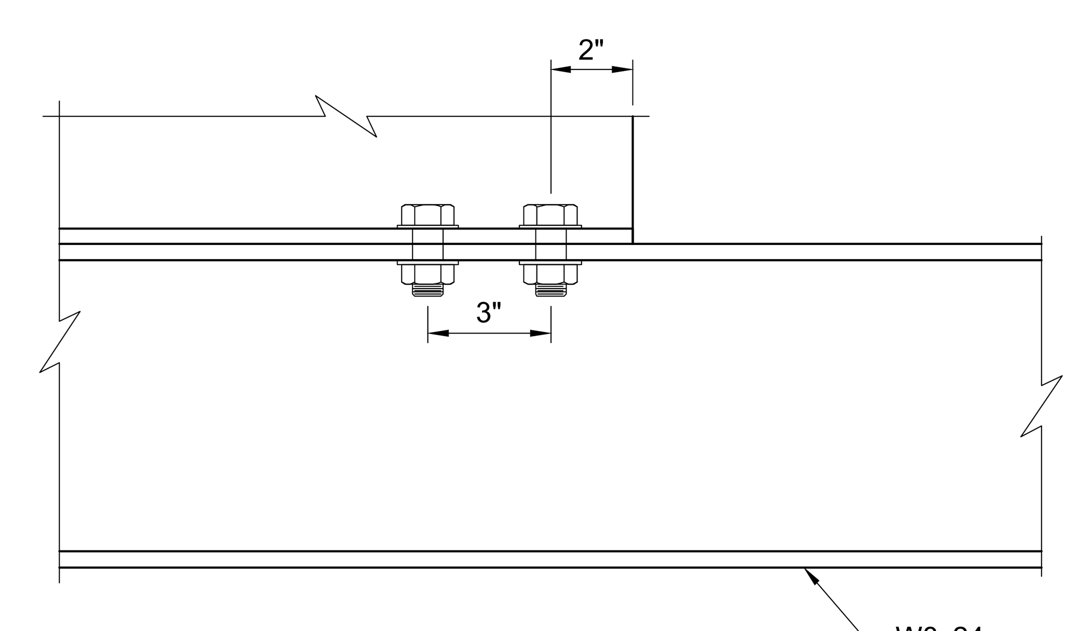

**B** S-216 **FISH EXIT TRANSITION FLUME TYPICAL SECTION**
SCALE: 3/4"=1'-0"



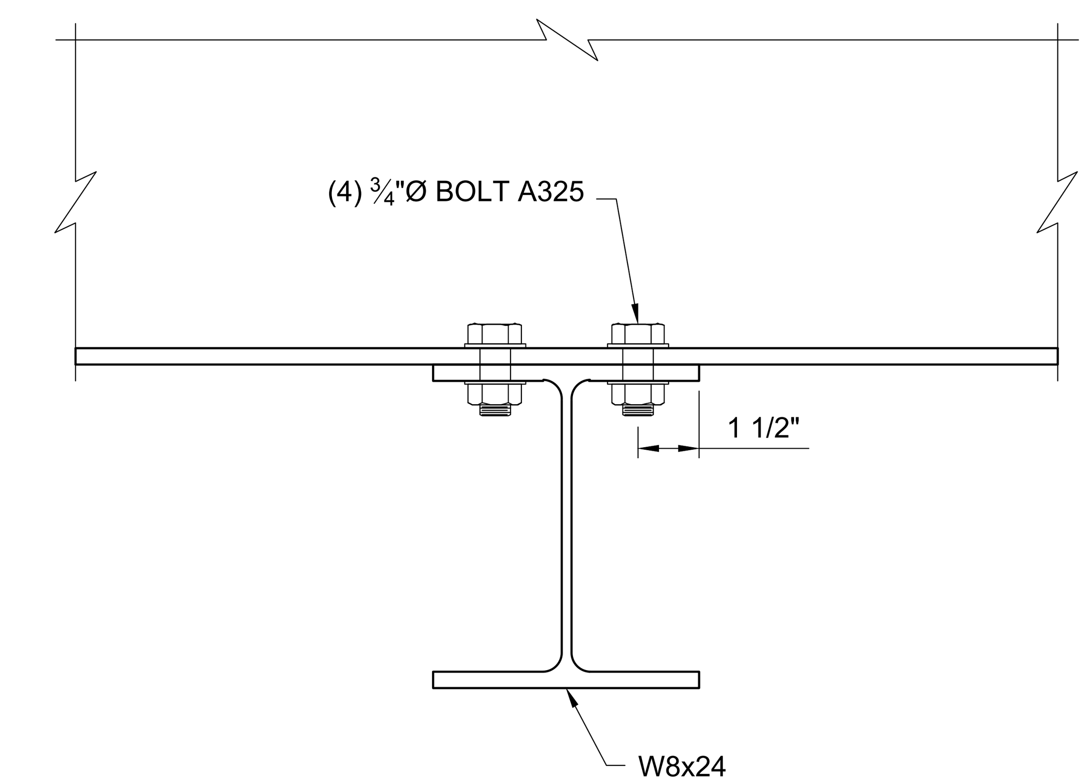

**2** S-216 **TRANSITION FLUME FOOT DETAIL AND CONNECTION**
SCALE: 3"=1'-0"




**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"

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

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


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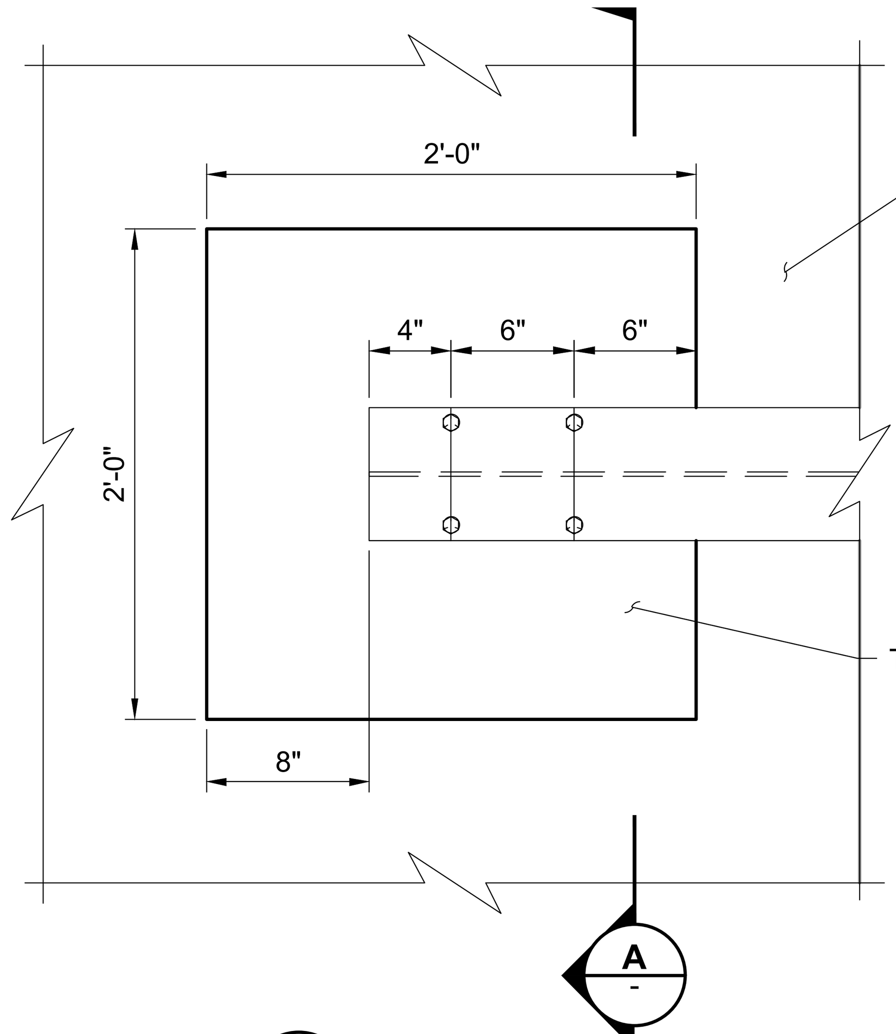
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

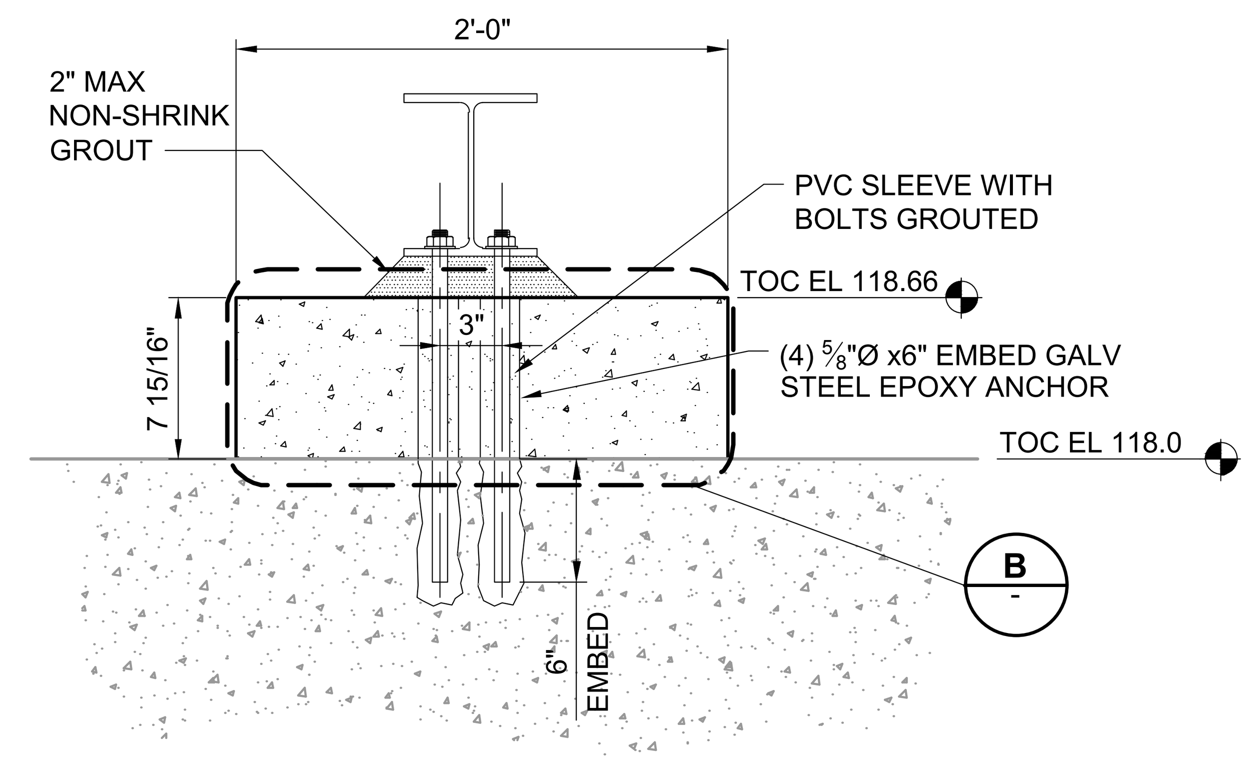
TRANSITION FLUME AND FISH EXIT PIPE FRAMING SECTIONS & DETAILS

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

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden misc and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\S\S-218.dwg USER: Agrogan
DATE: Dec 13, 2019 2:37pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:



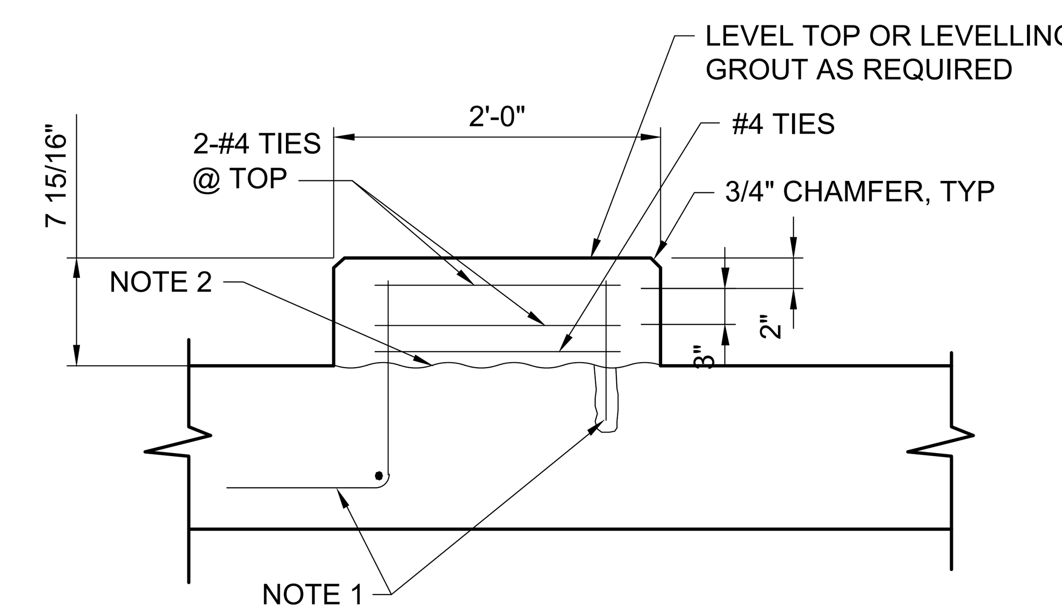

1 DETAIL
S-215 SCALE: 1 1/2"=1'-0"



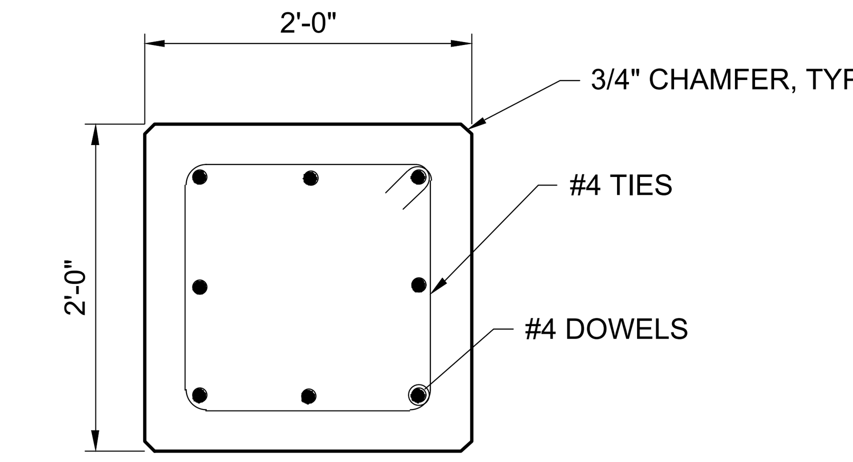

A SECTION
SCALE: 1 1/2"=1'-0"

**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.

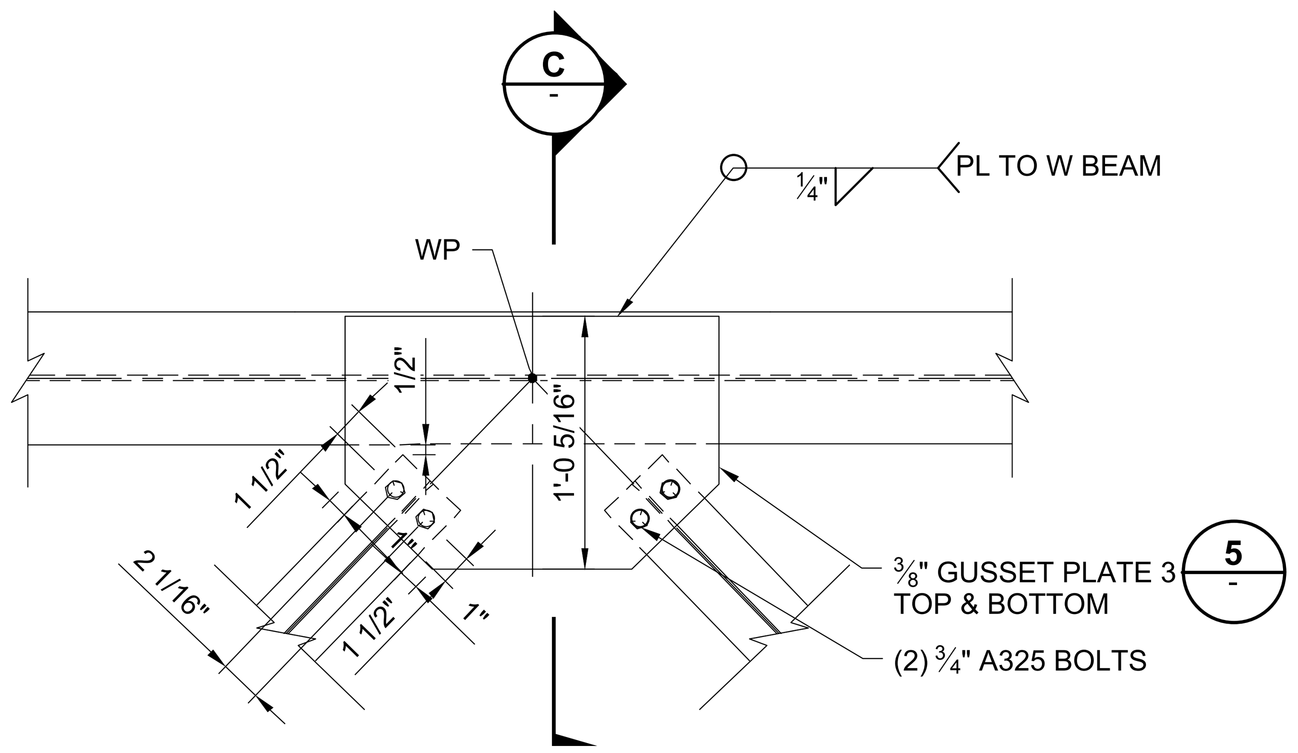



SECTION

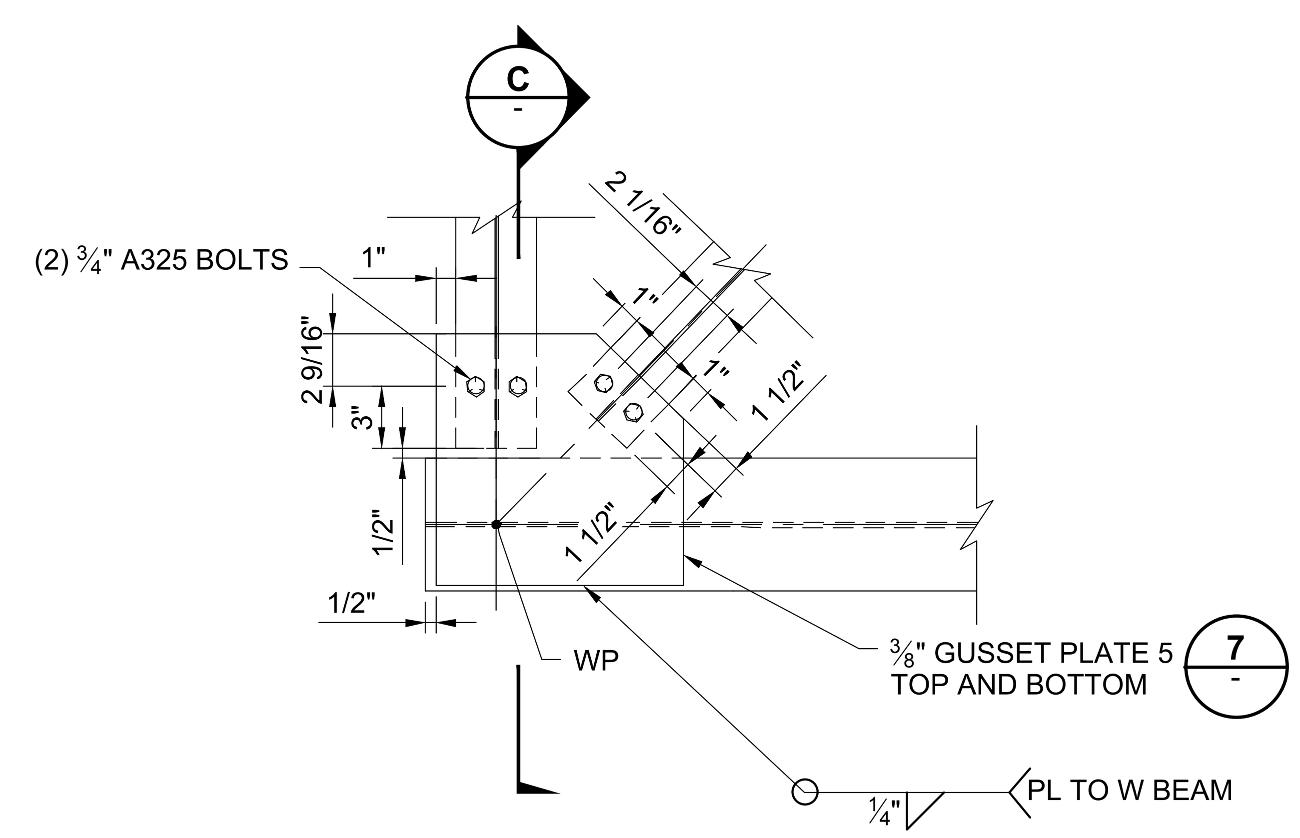



PLAN

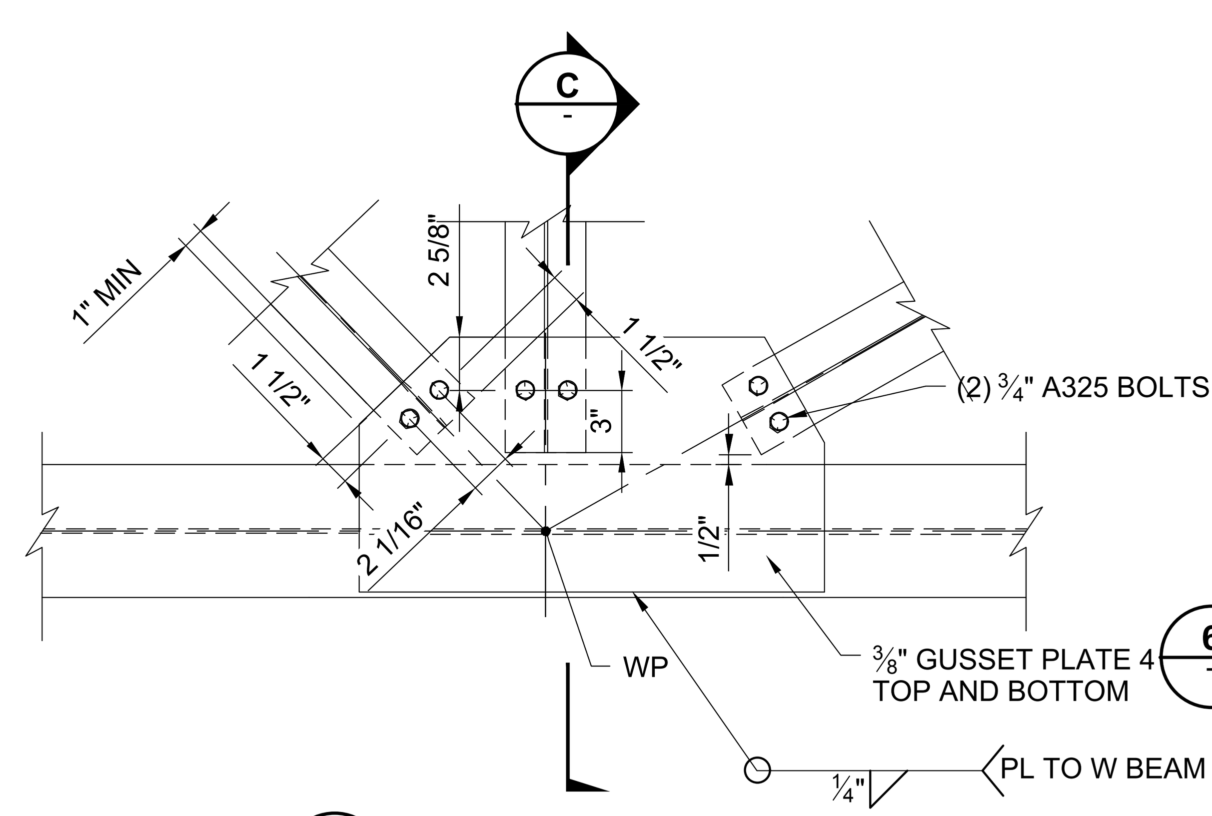
B DETAIL
SCALE: 1"=1'-0"



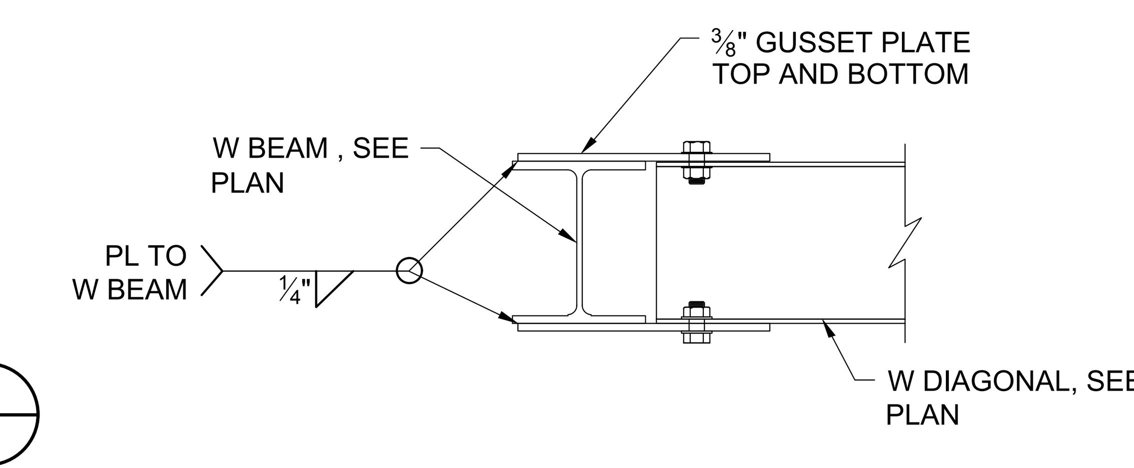

2 DETAIL
S-215 SCALE: 1 1/2"=1'-0"



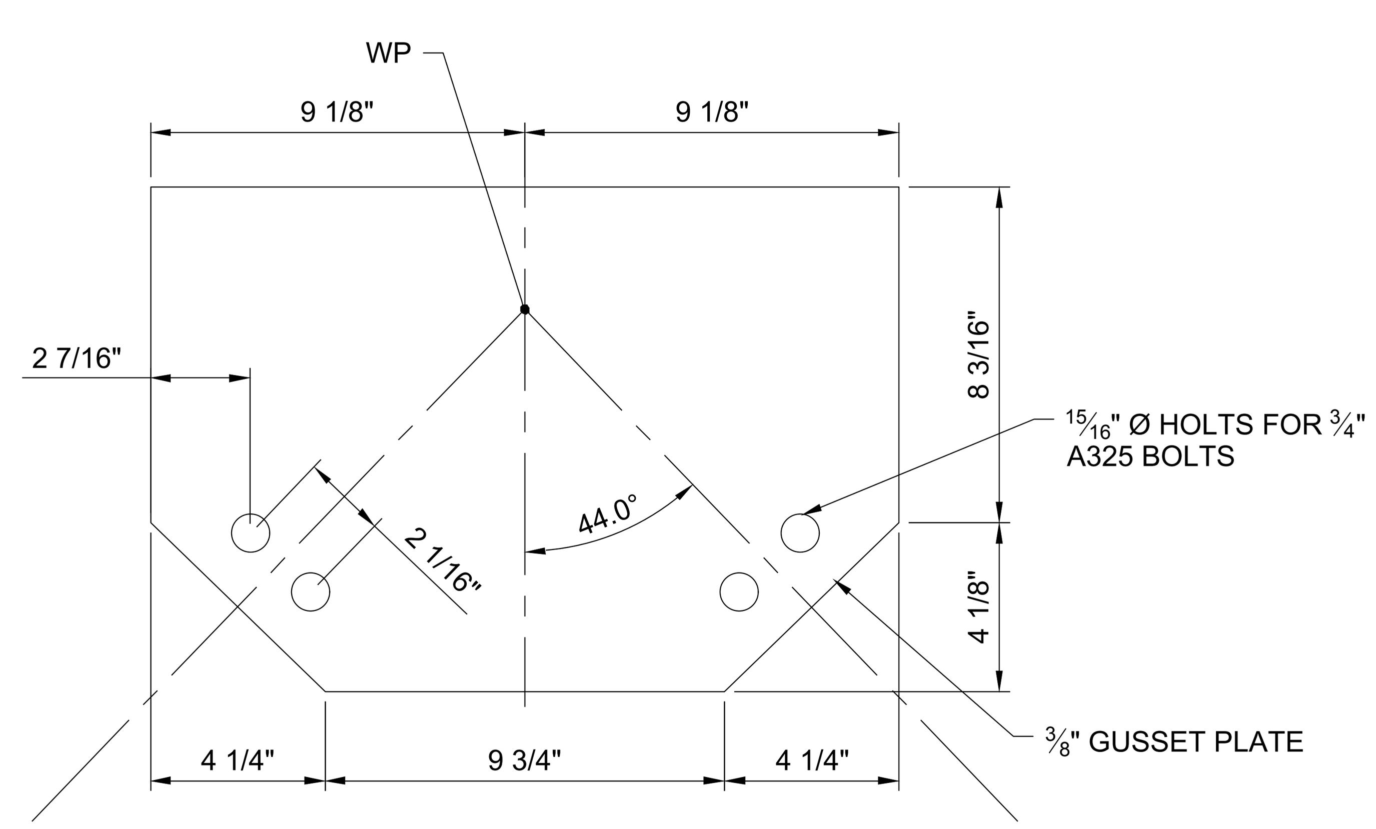

3 DETAIL
S-215 SCALE: 1 1/2"=1'-0"



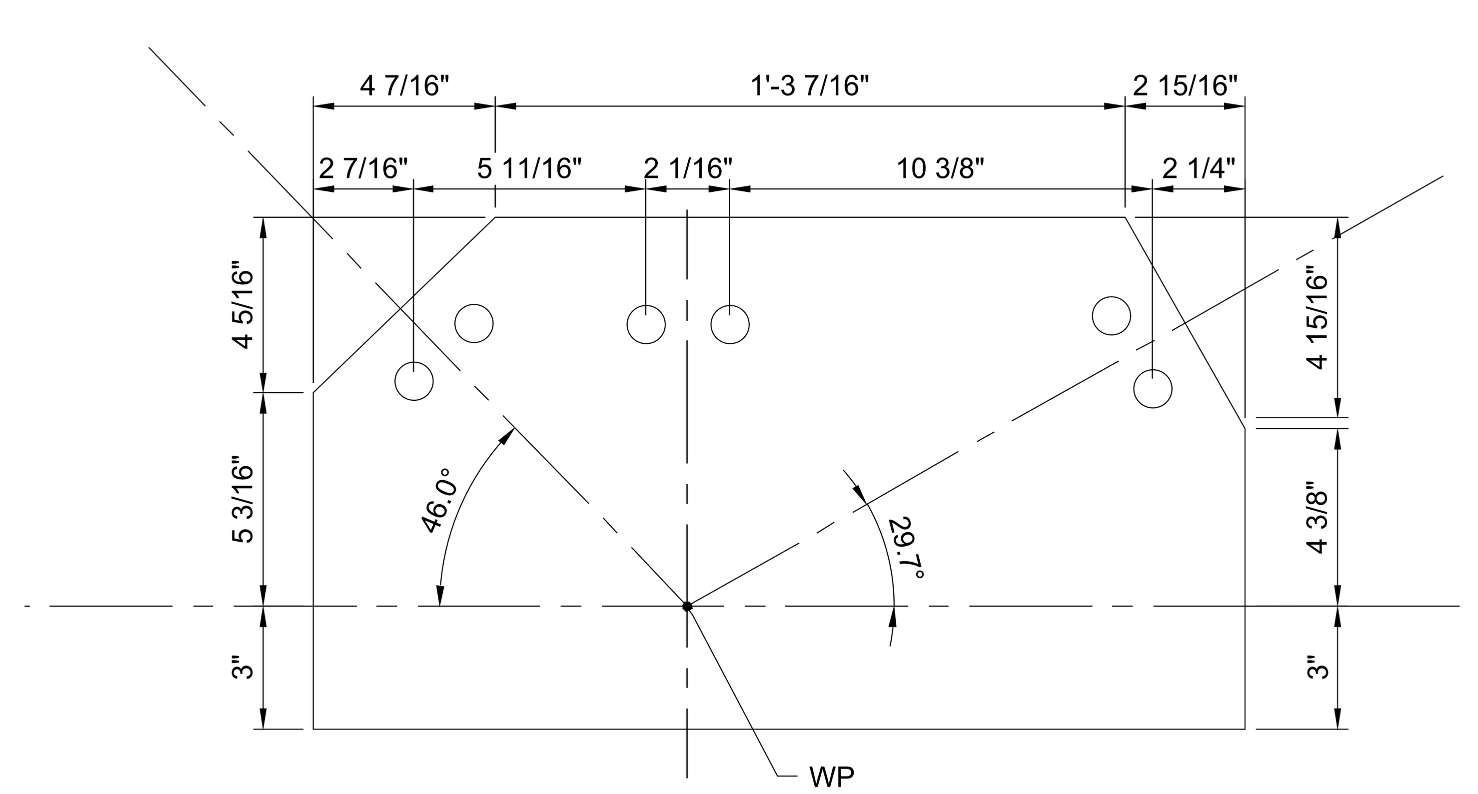

4 DETAIL
SCALE: 1 1/2"=1'-0"



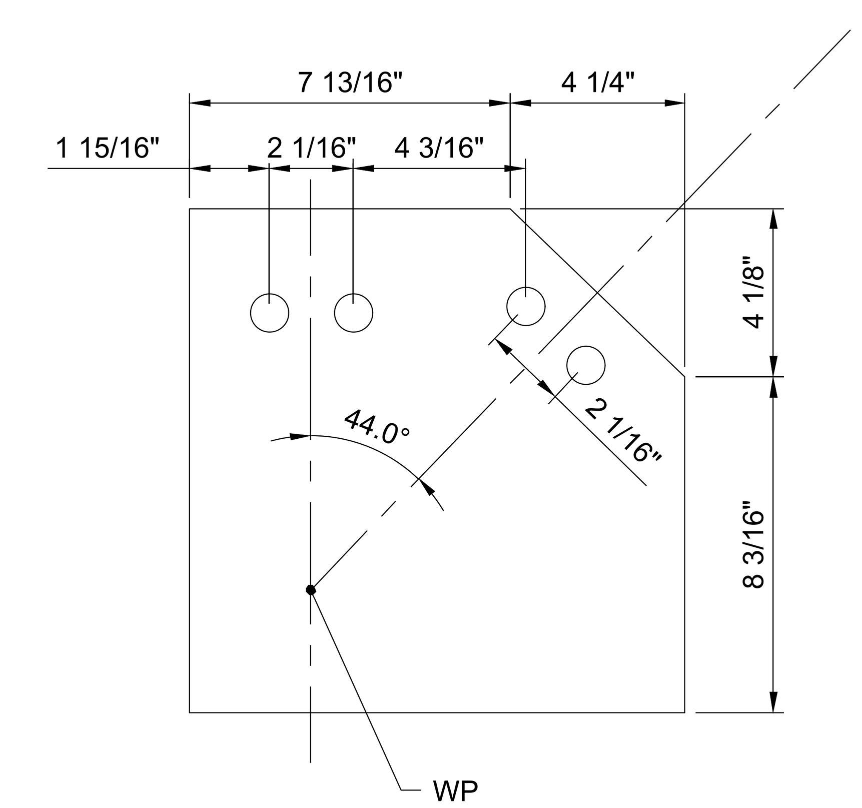

C SECTION
SCALE: 1 1/2"=1'-0"




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"

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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 |


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DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE STAMP-MDG IMAGES:

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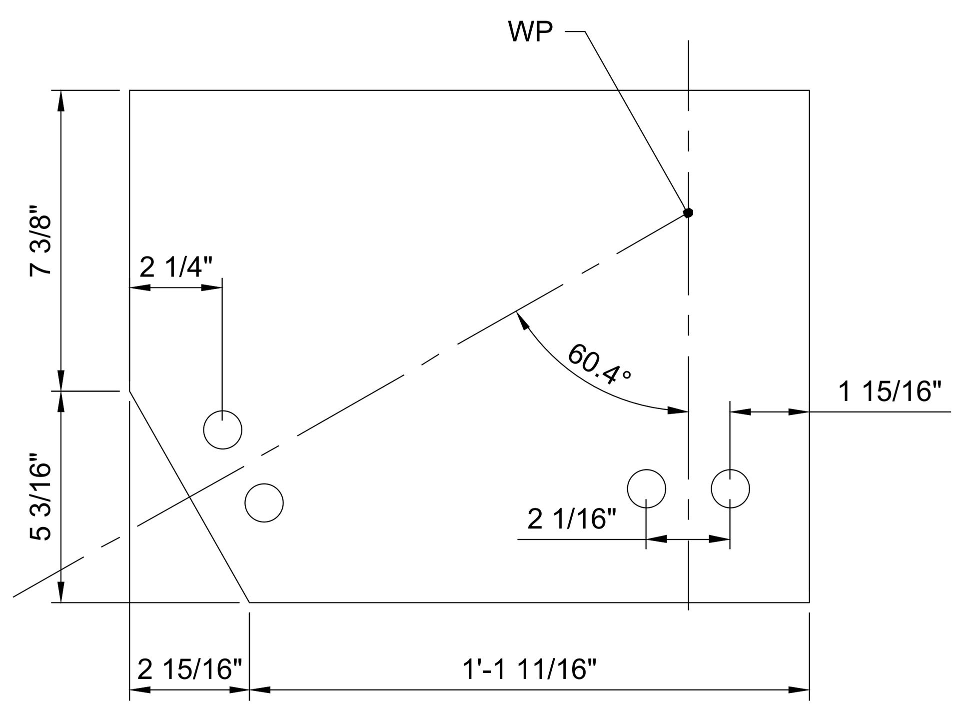
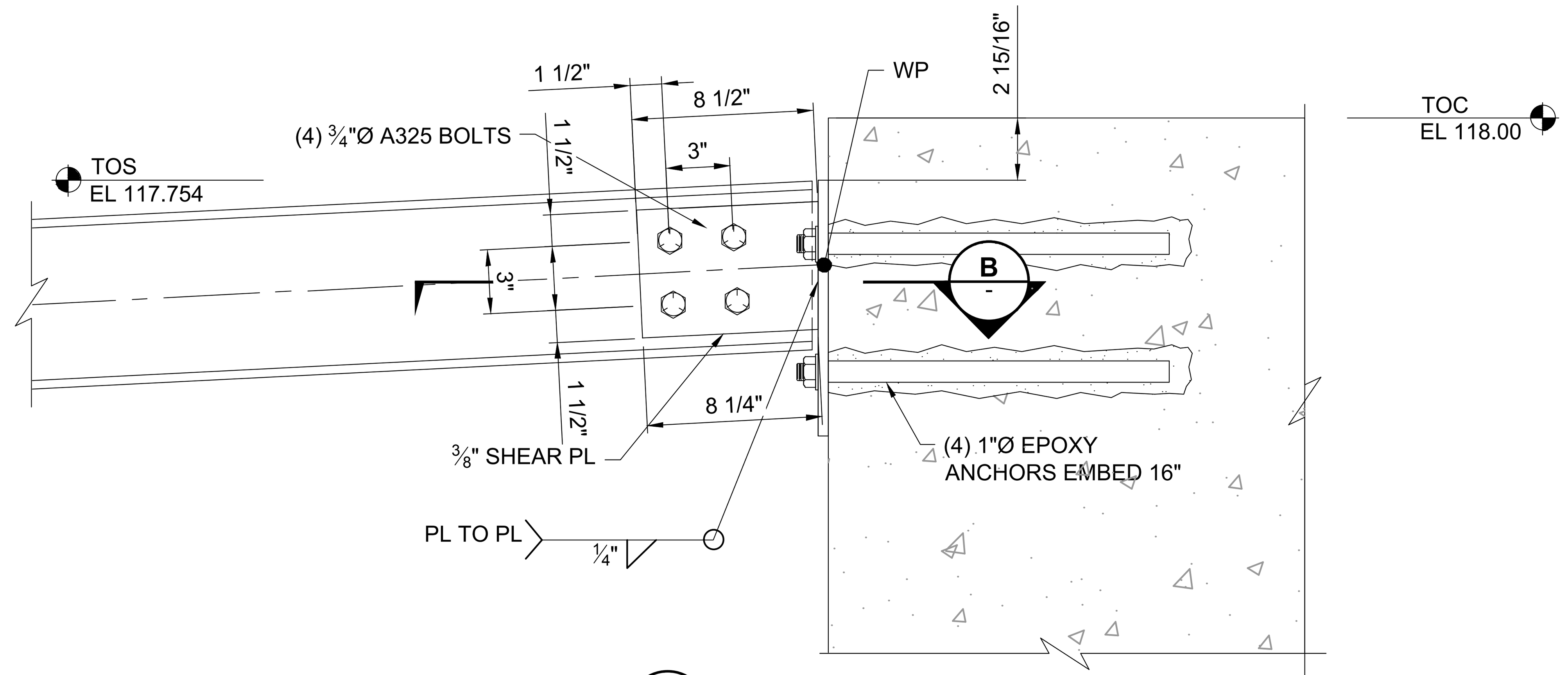
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

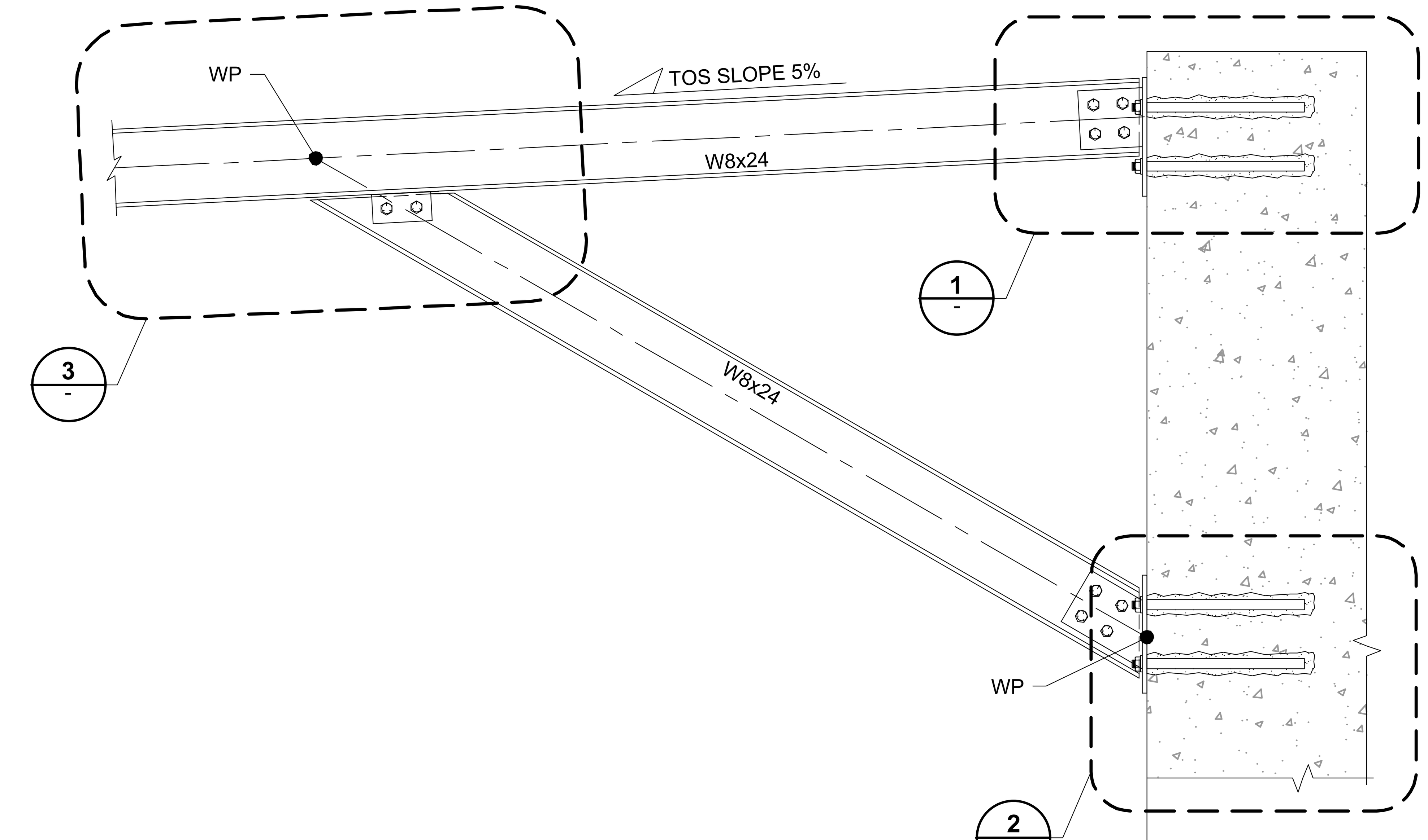
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 66 OF 176
DRAWING: S-220



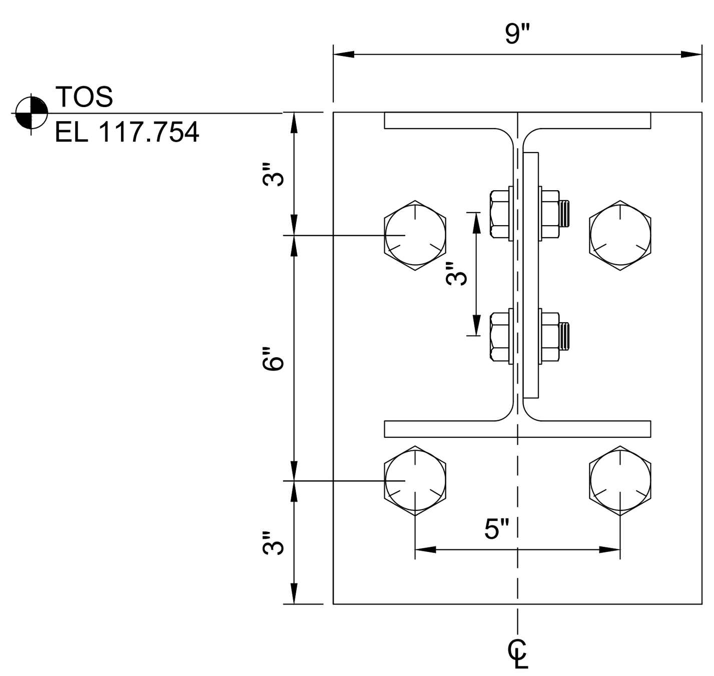

**4 GUSSET PLATE 10 DETAIL**
SCALE: 3"=1'-0"



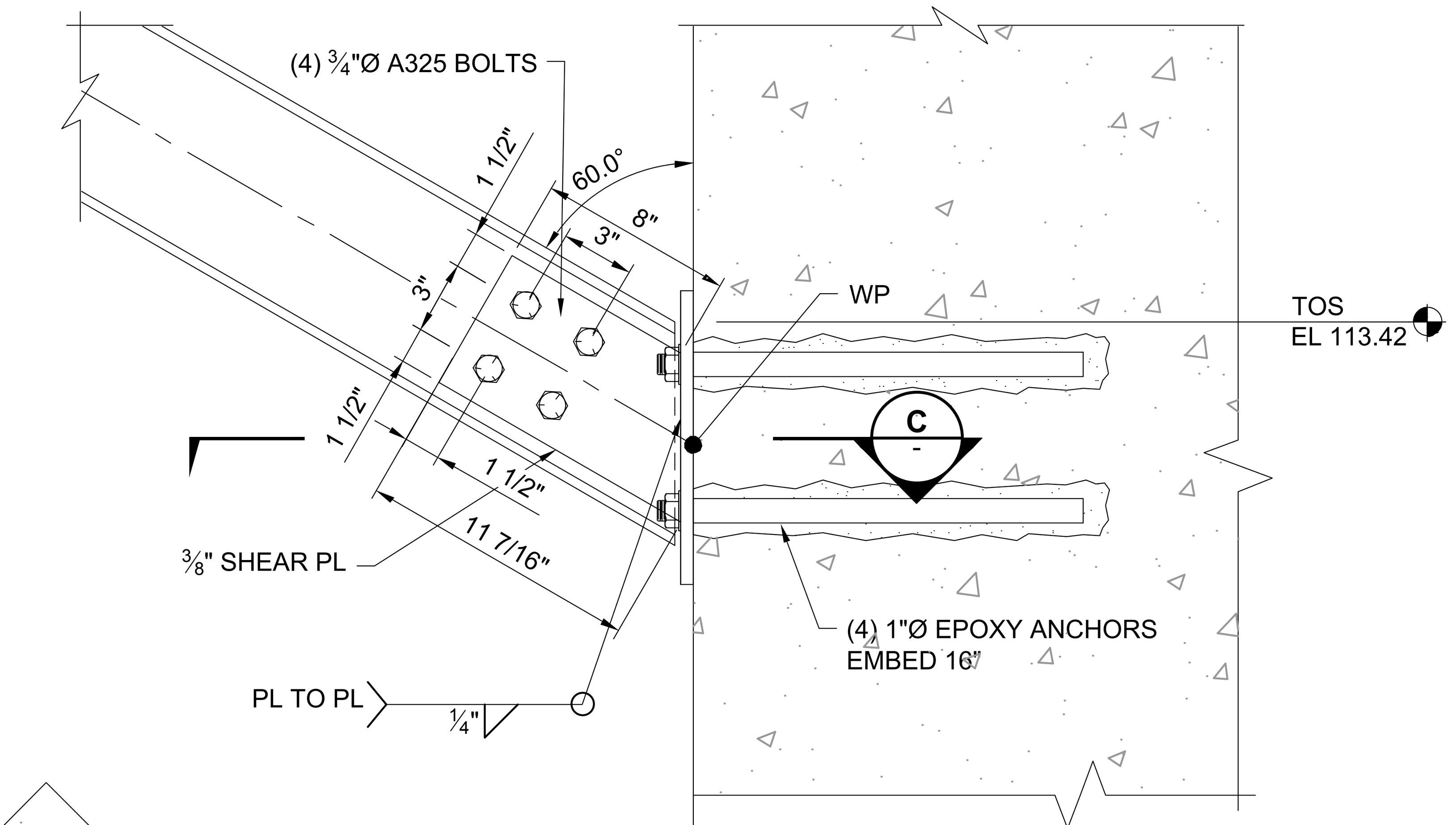

**1 DETAIL**
SCALE: 2"=1'-0"




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




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




**2 DETAIL**
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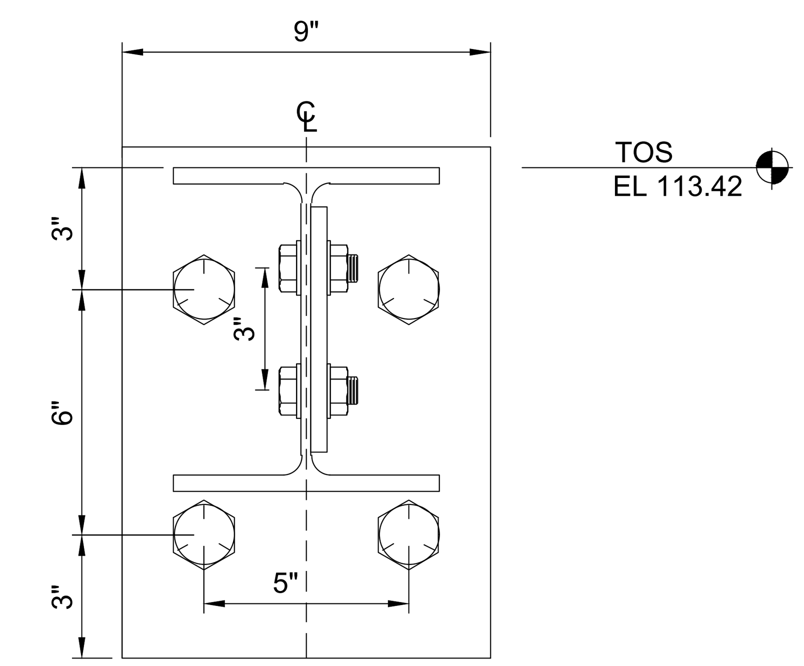
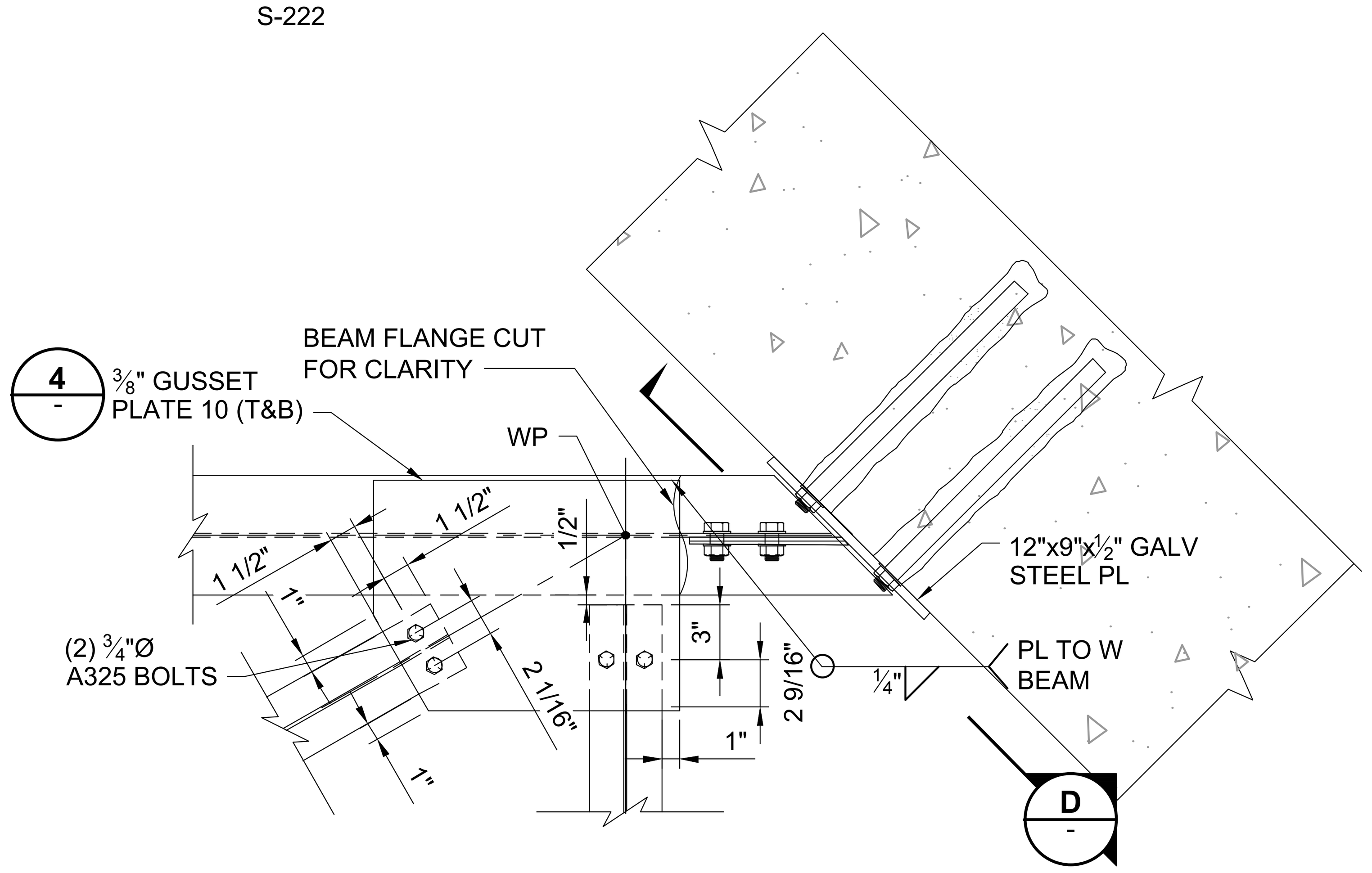
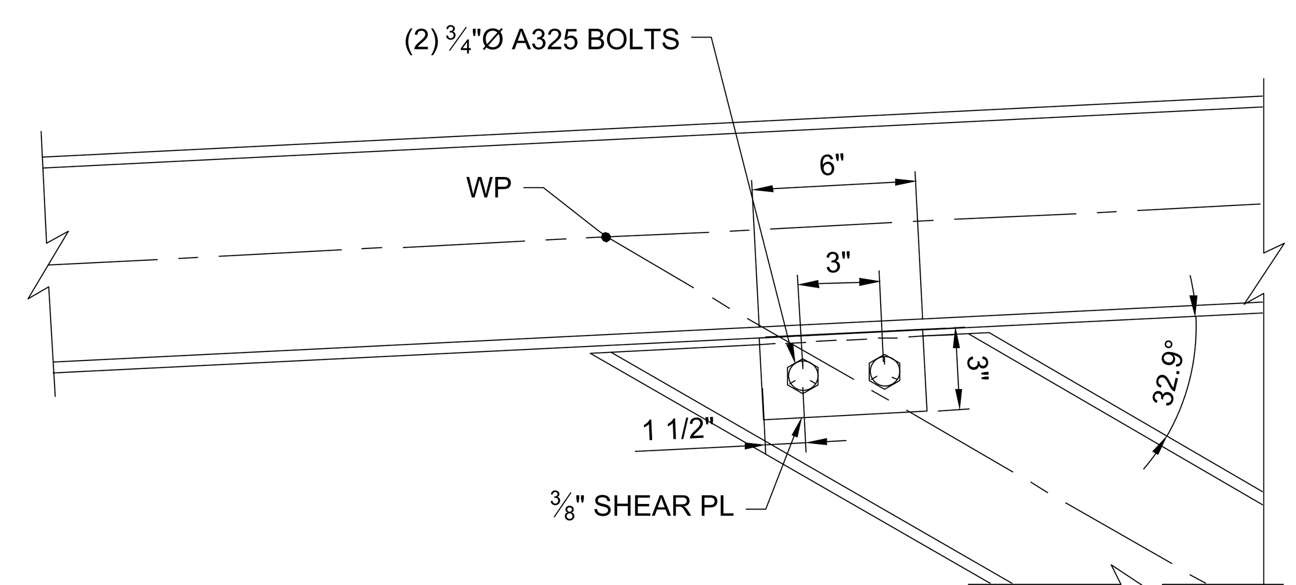


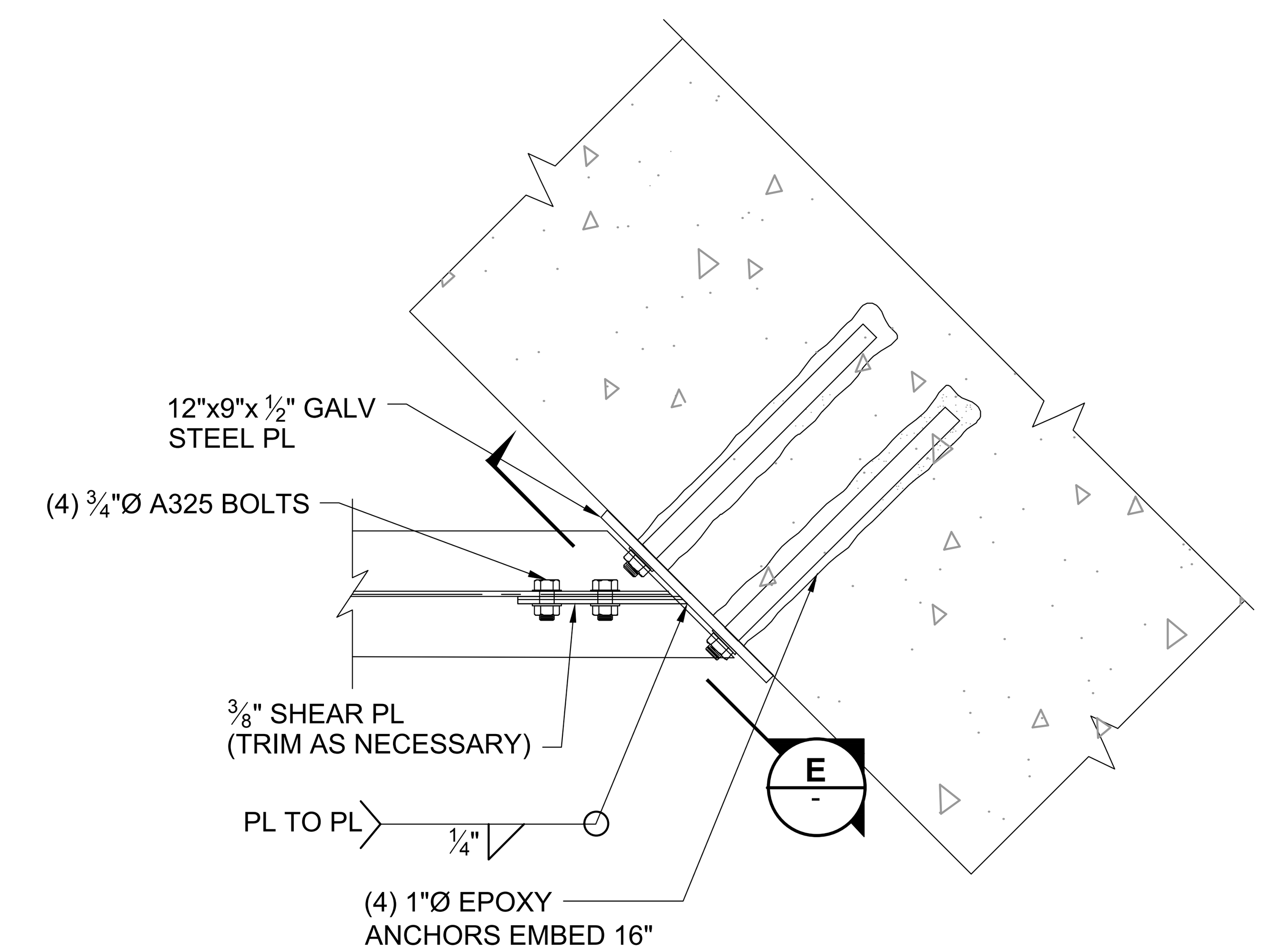

**E SECTION**
SCALE: 3"=1'-0"




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




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




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

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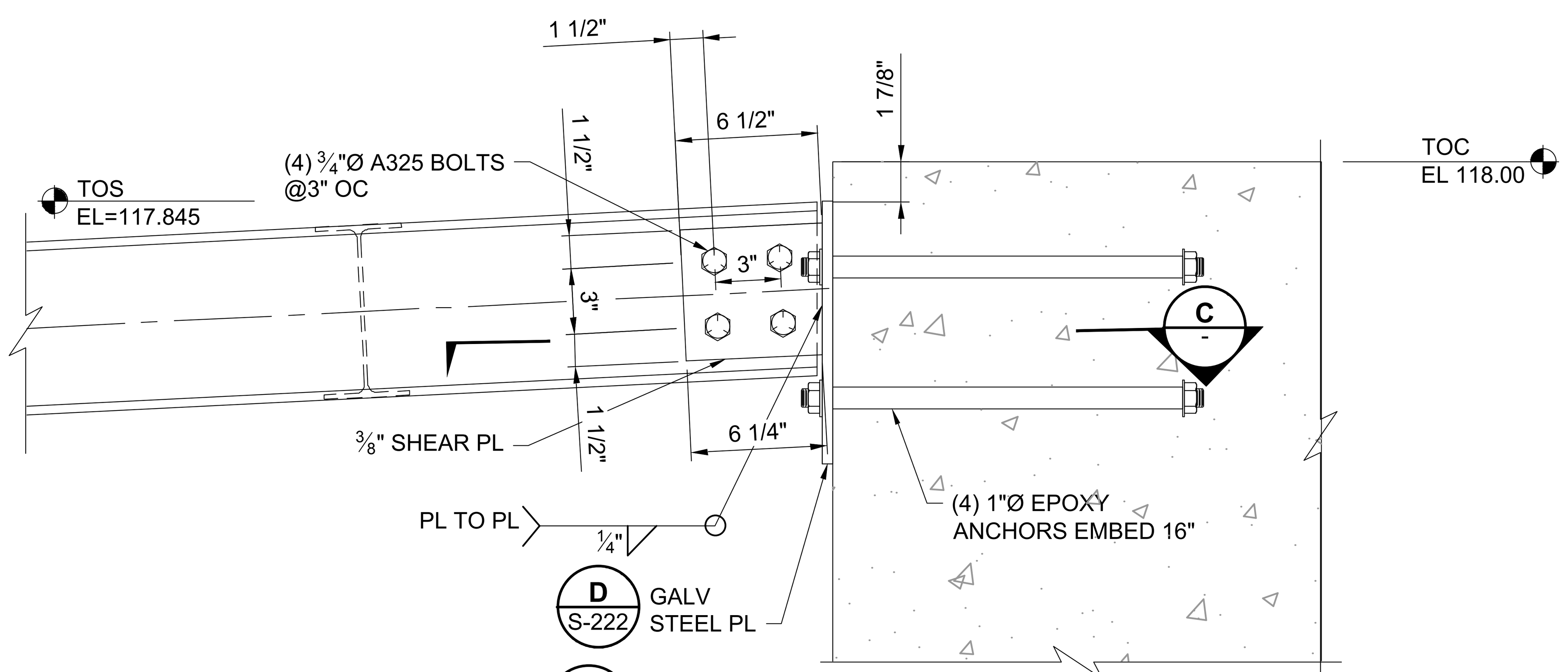
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

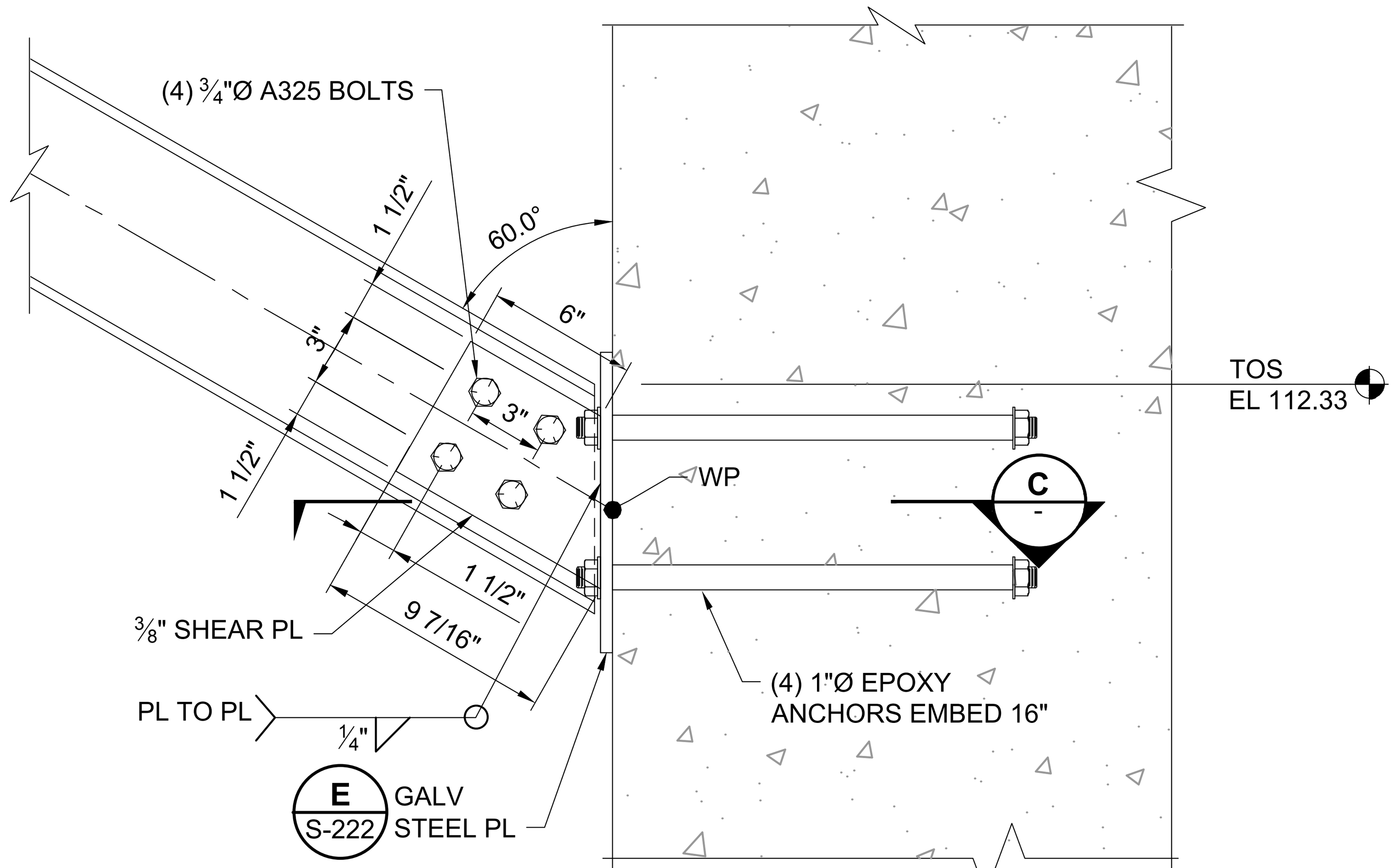
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

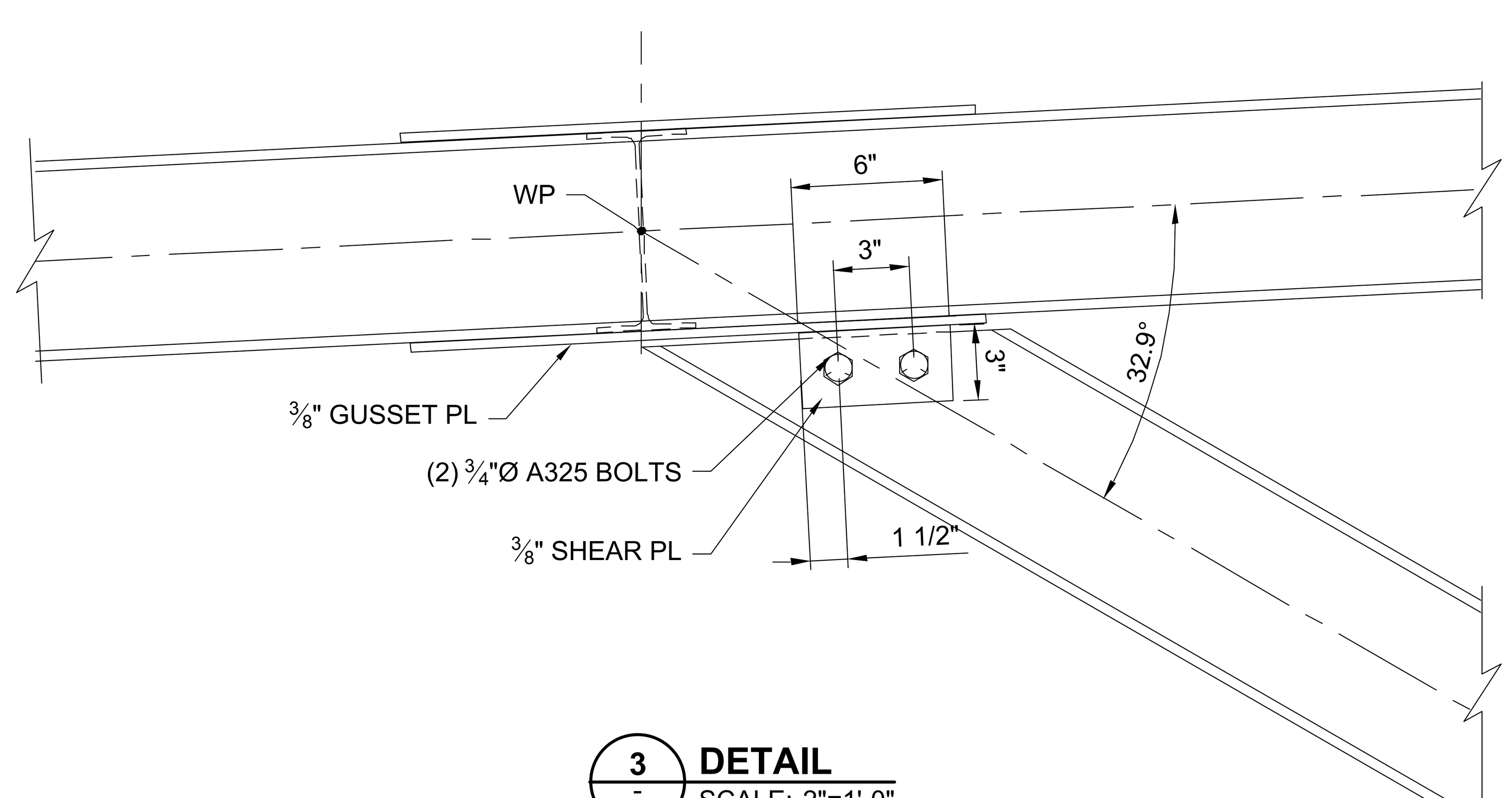
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 67 OF 176 |
| DRAWING: | S-221 |



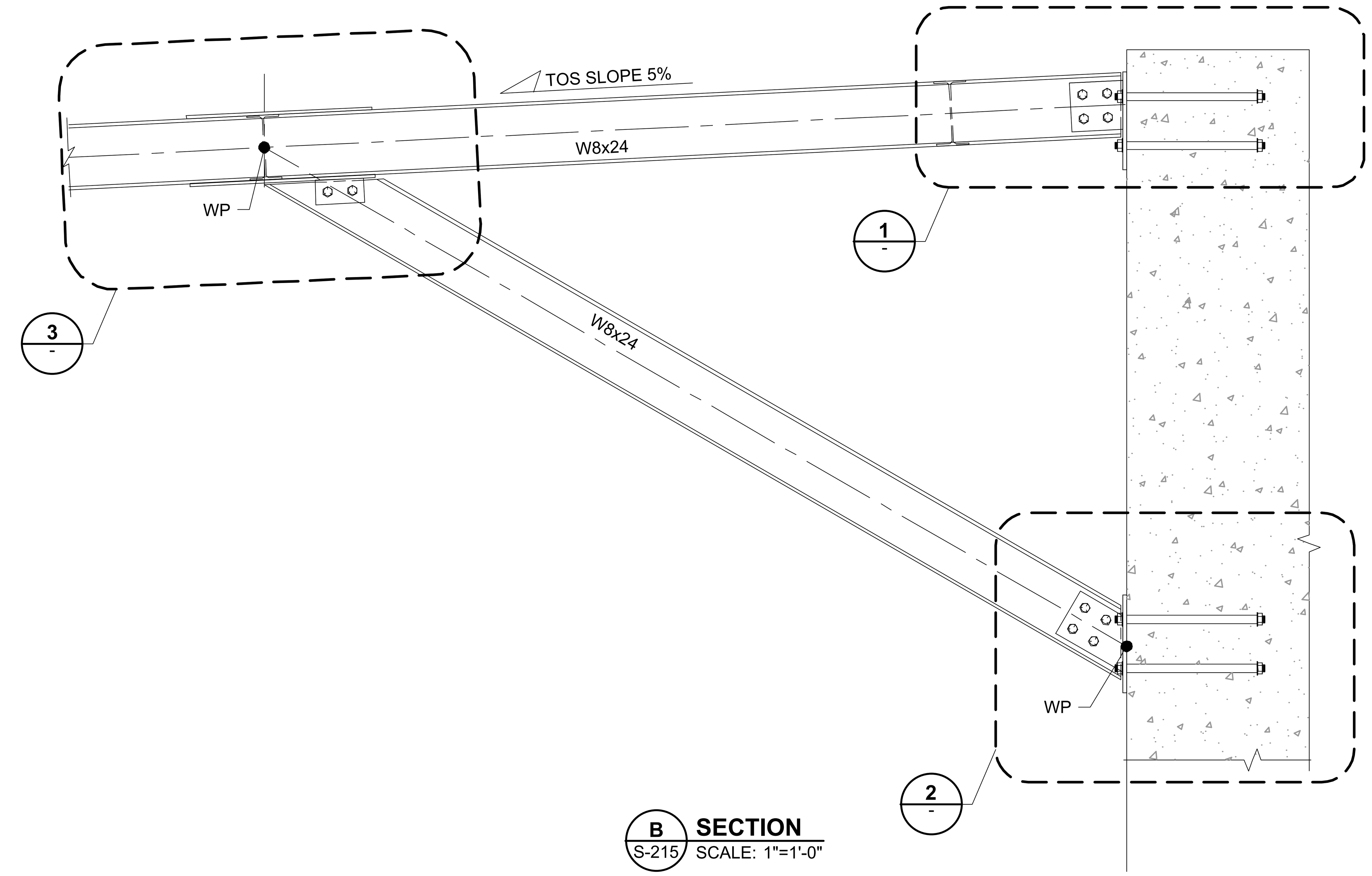

1 - **DETAIL**
SCALE: 2"=1'-0"



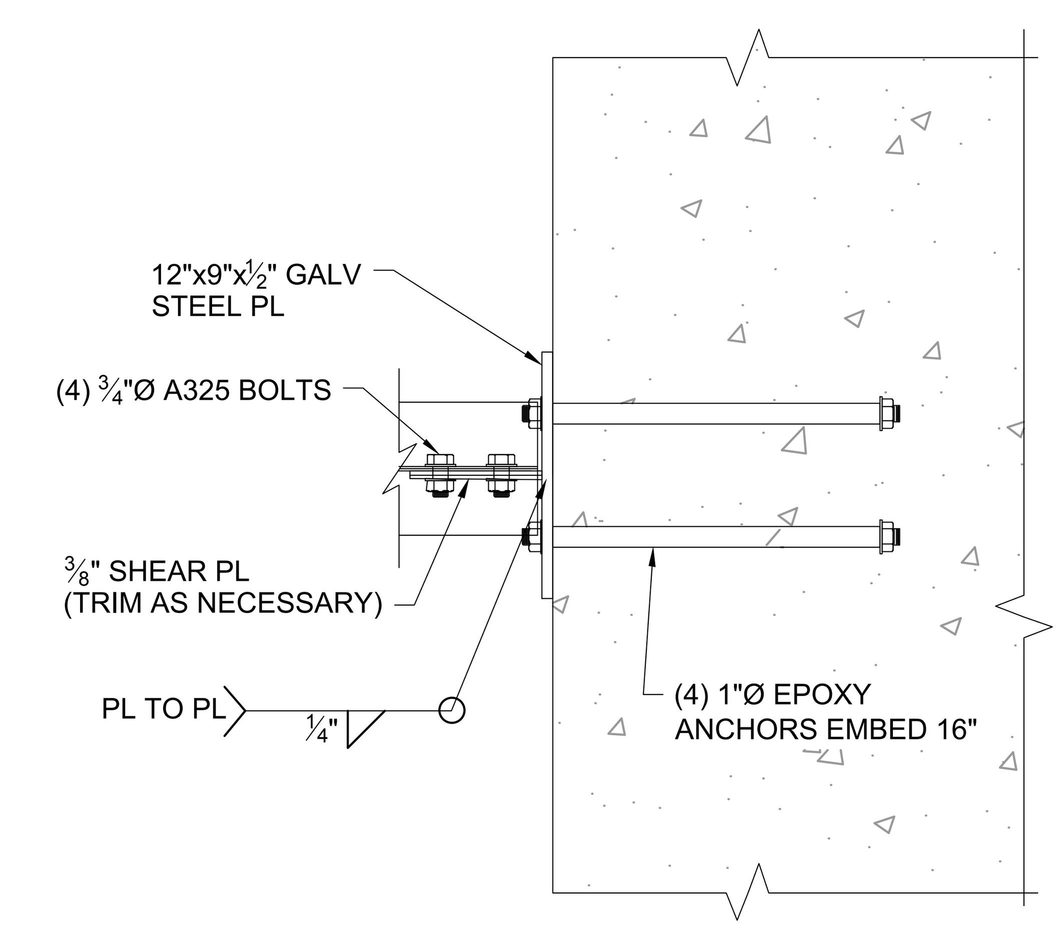

2 - **DETAIL**
SCALE: 2"=1'-0"




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




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




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

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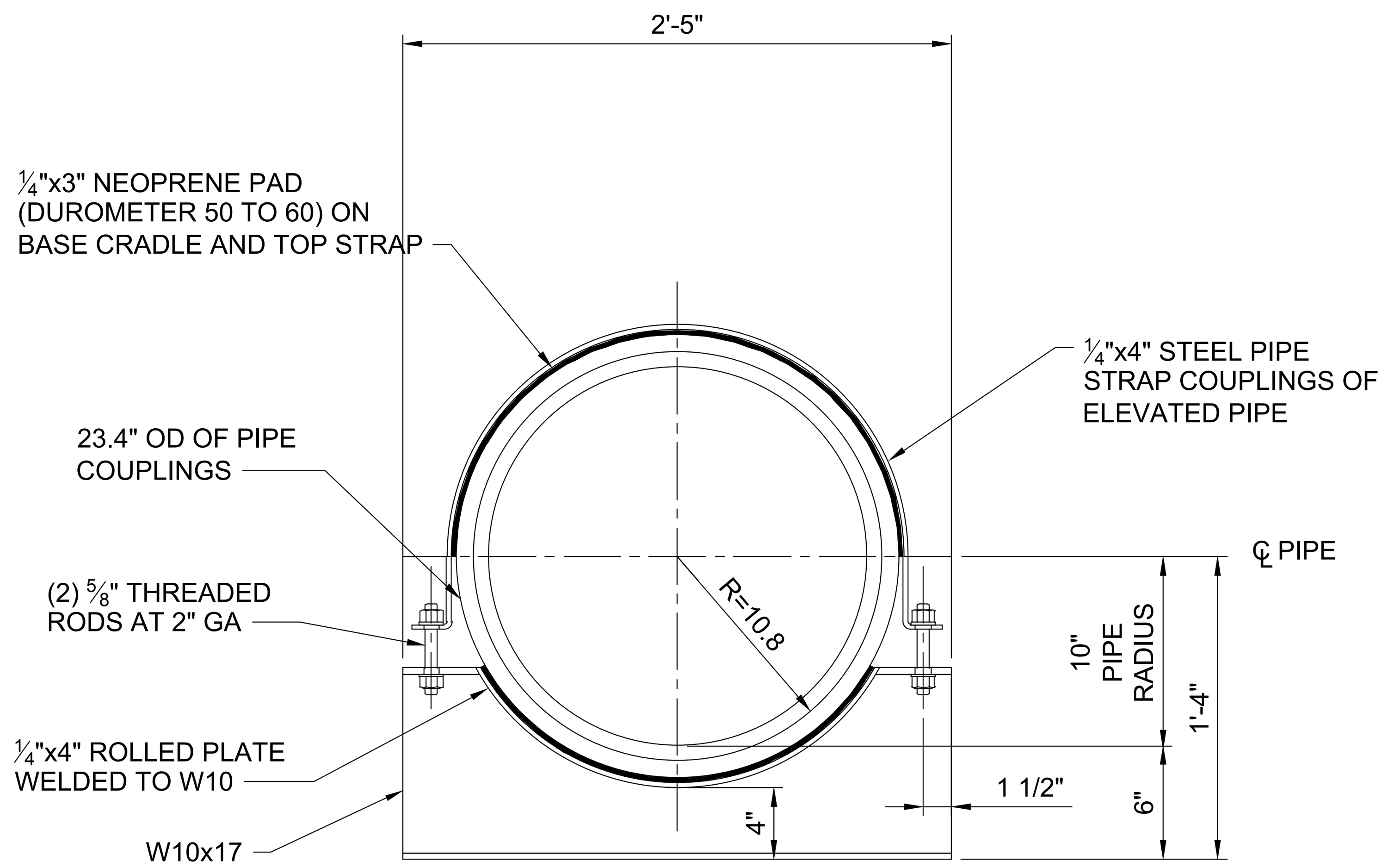
12/13/2019

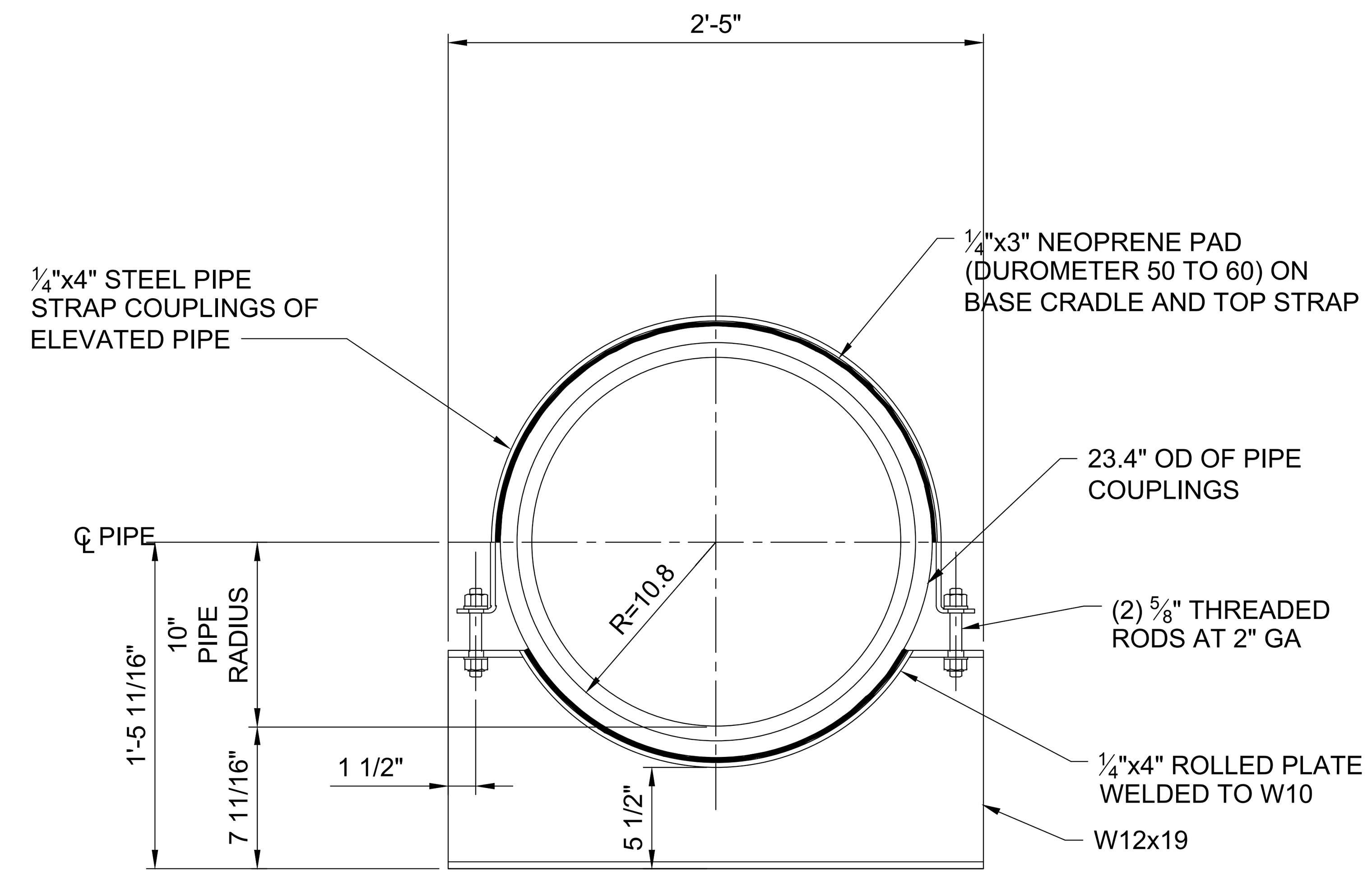
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

TRANSITION FLUME AND FISH EXIT
PIPE FRAMING SECTIONS & DETAILS

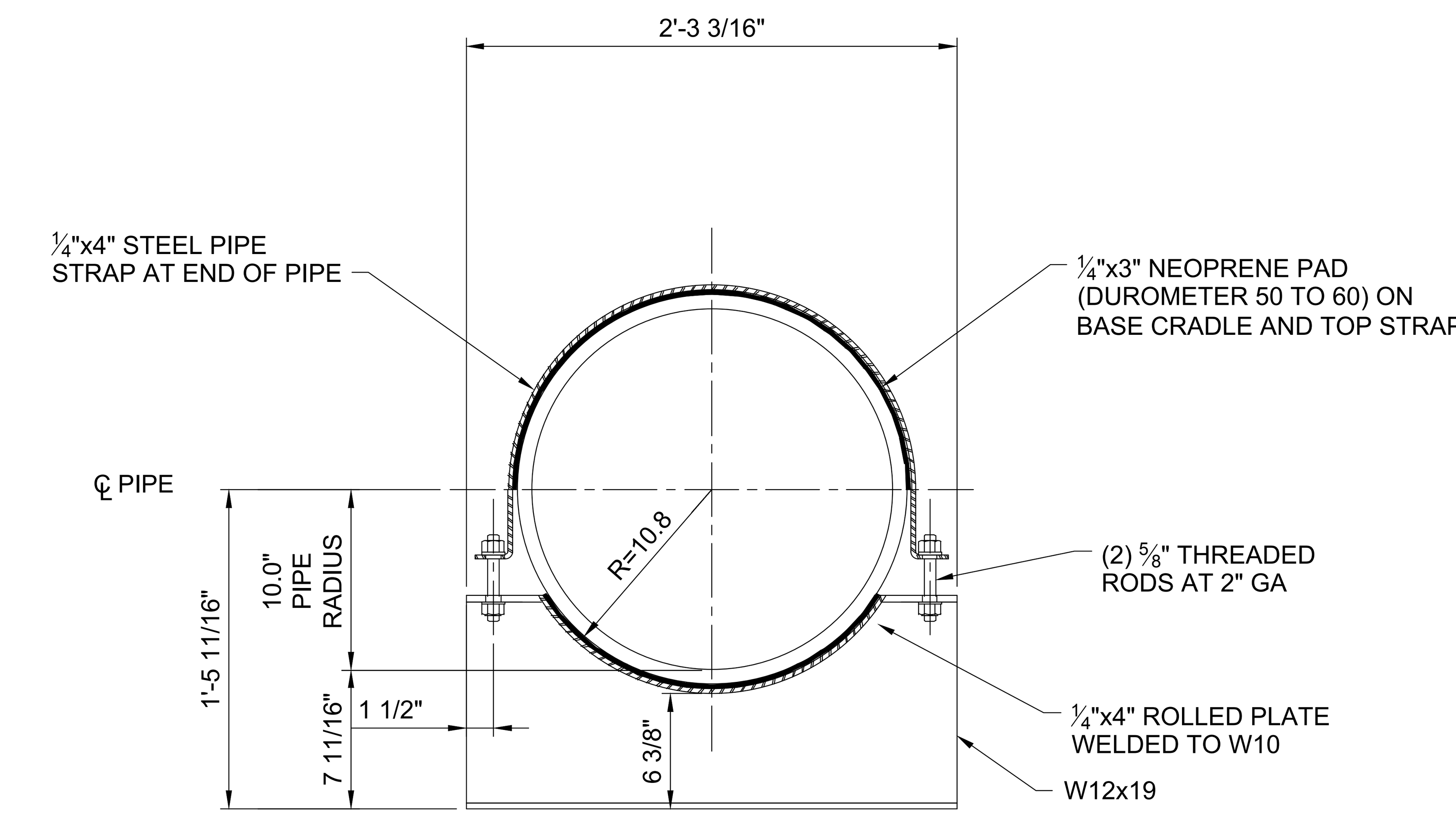
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 68 OF 176
DRAWING: S-222




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"

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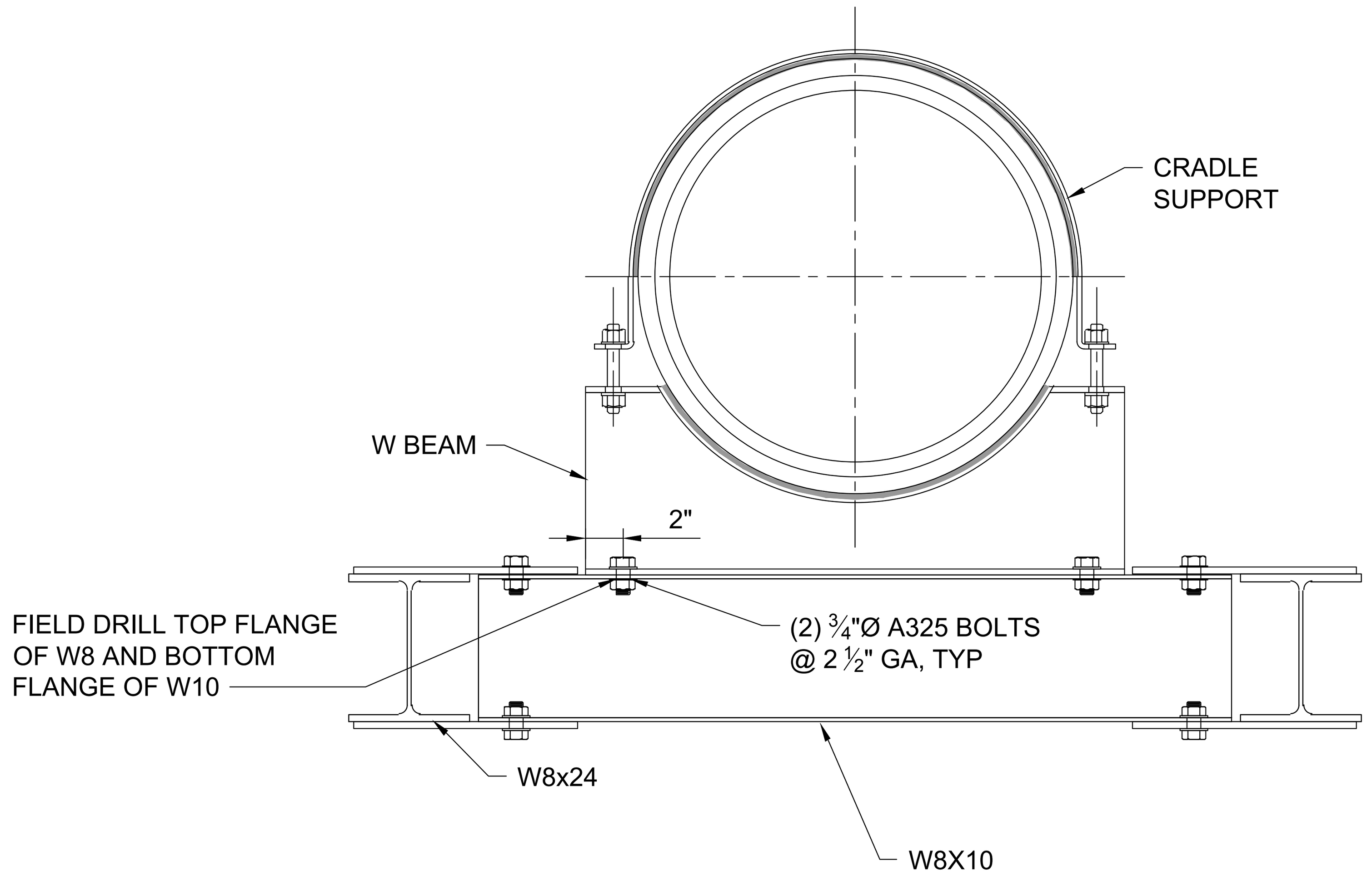
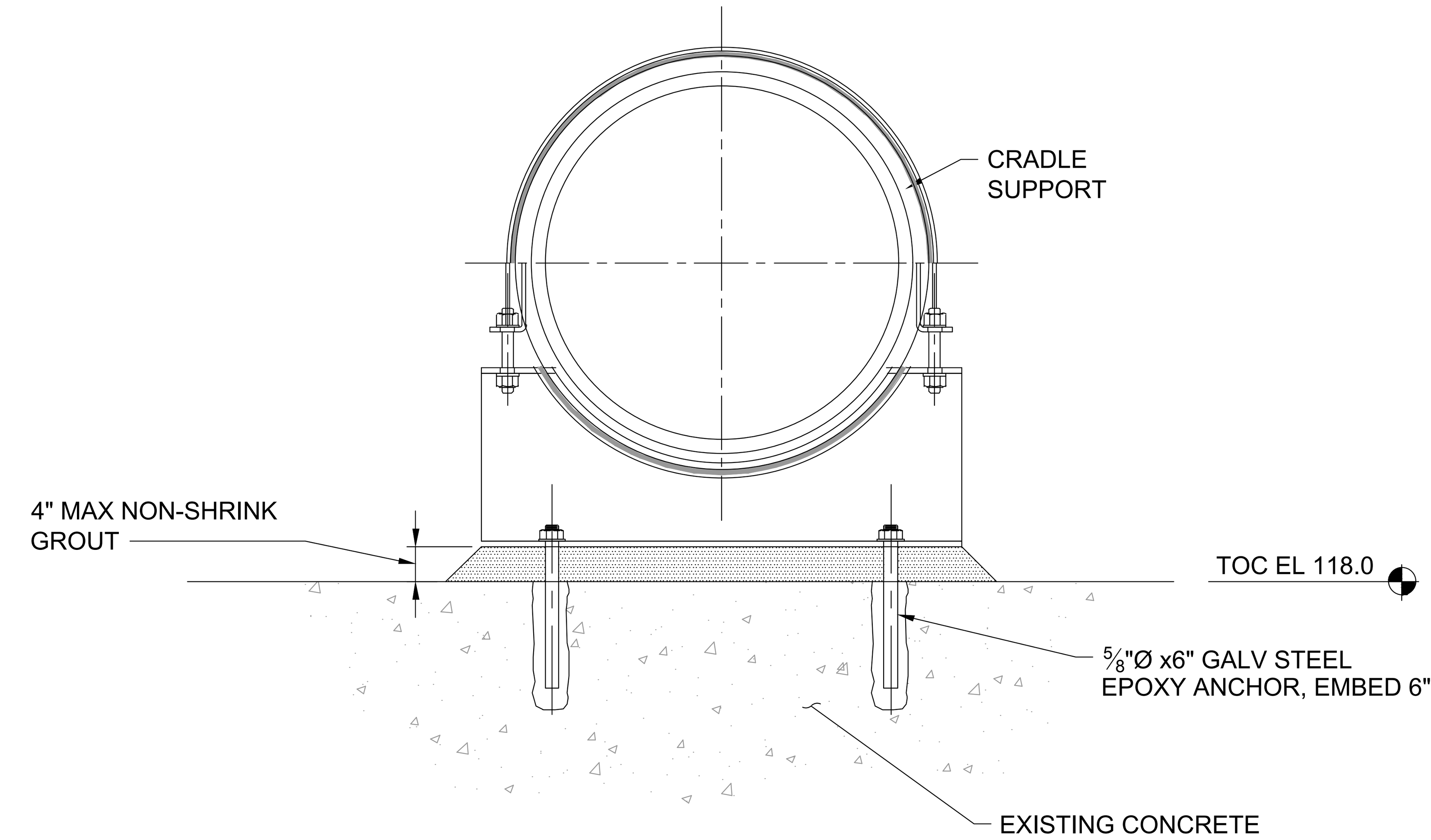
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH EXIT PIPE SUPPORT DETAILS

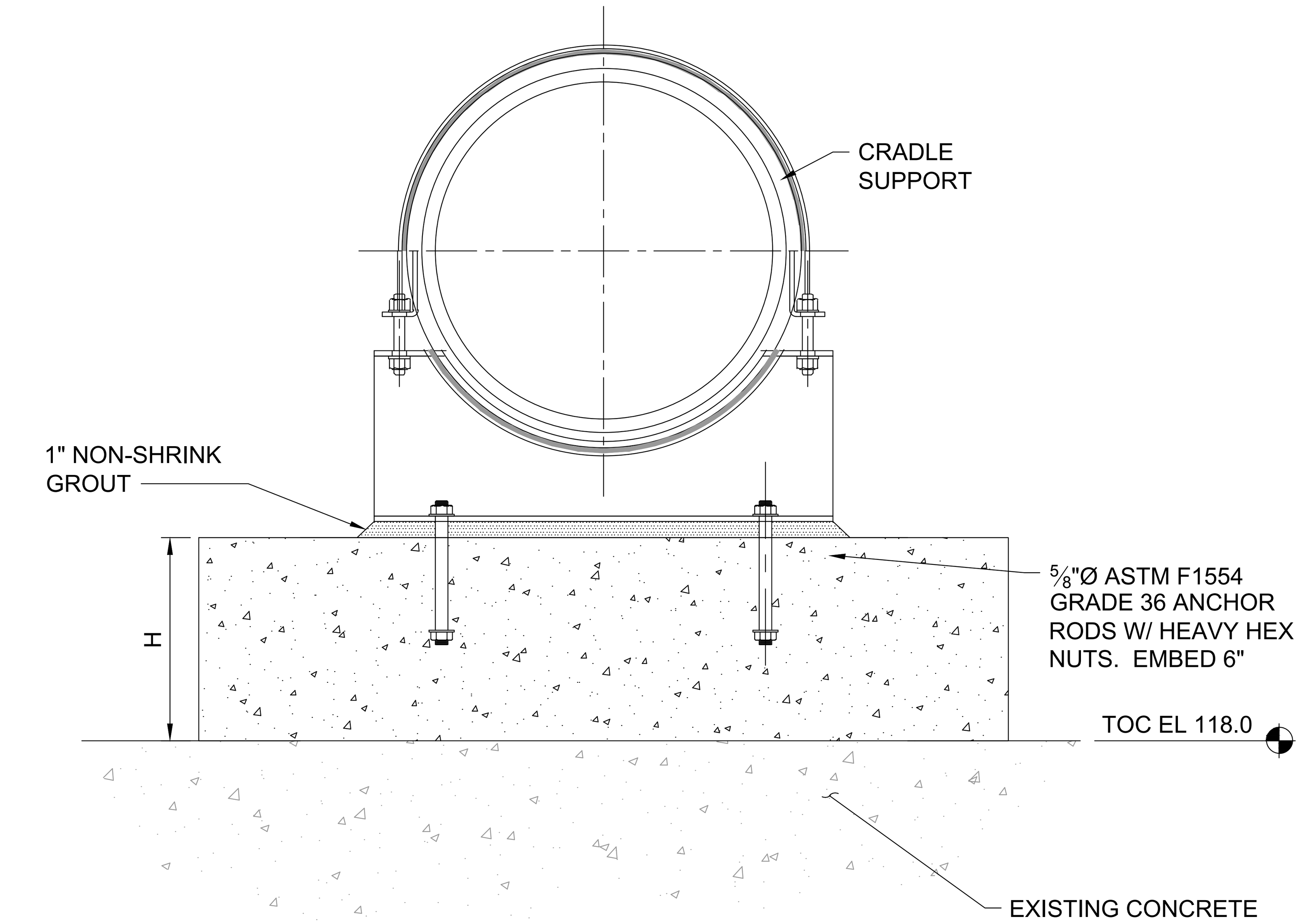
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 69 OF 176
DRAWING: S-223




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"

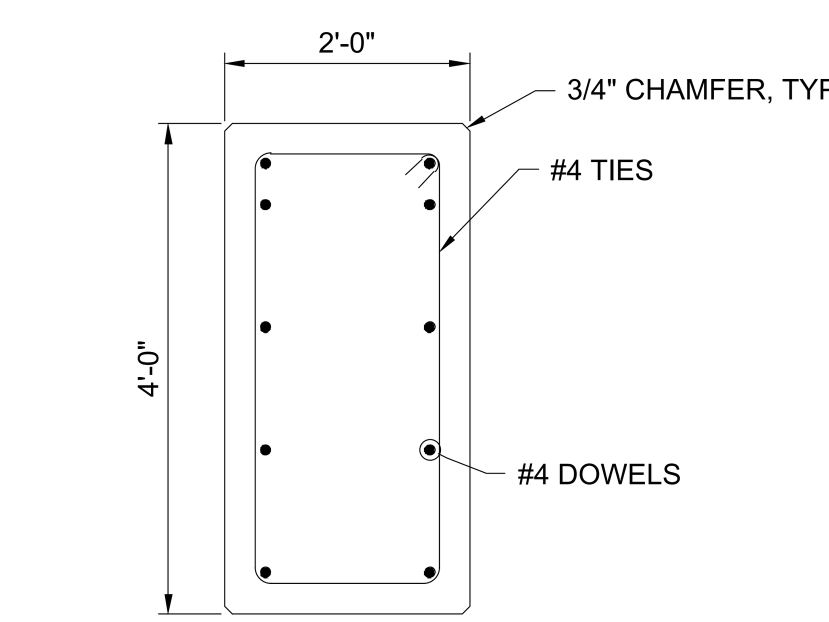
**PIPE SUPPORT SCHEDULE**

| 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 | - |

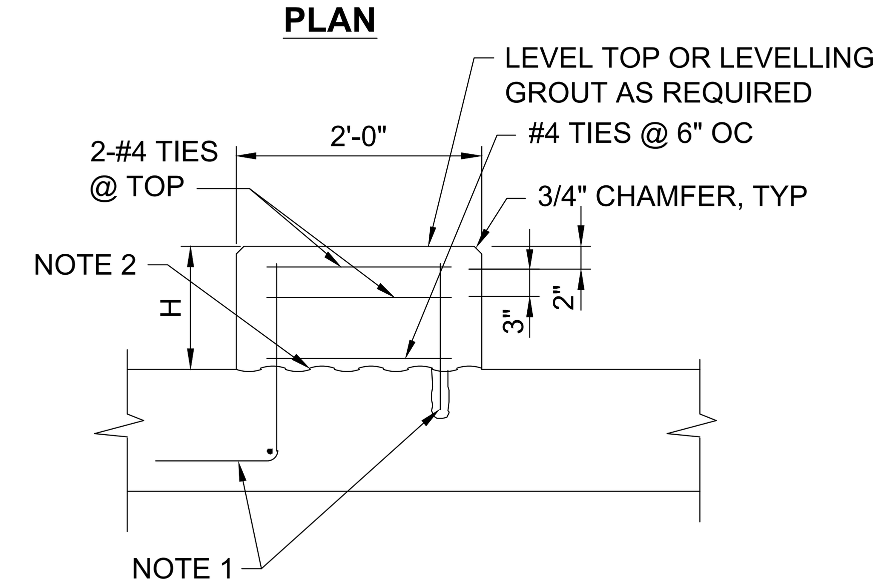
* CONCRETE SUPPORT HEIGHTS ARE APPROXIMATE, FIELD VERIFY.

**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 ¼" AMPLITUDE & APPLY BONDING AGENT.
3. PLACE EXPANSION JOINT MATERIAL BETWEEN VALVE/PIPE & THE CONCRETE SUPPORT (MINIMUM ½" THICK).




PLAN




SECTION

TYPE III CONCRETE SUPPORT

4 CONCRETE SUPPORT DETAIL
SCALE: NTS

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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"

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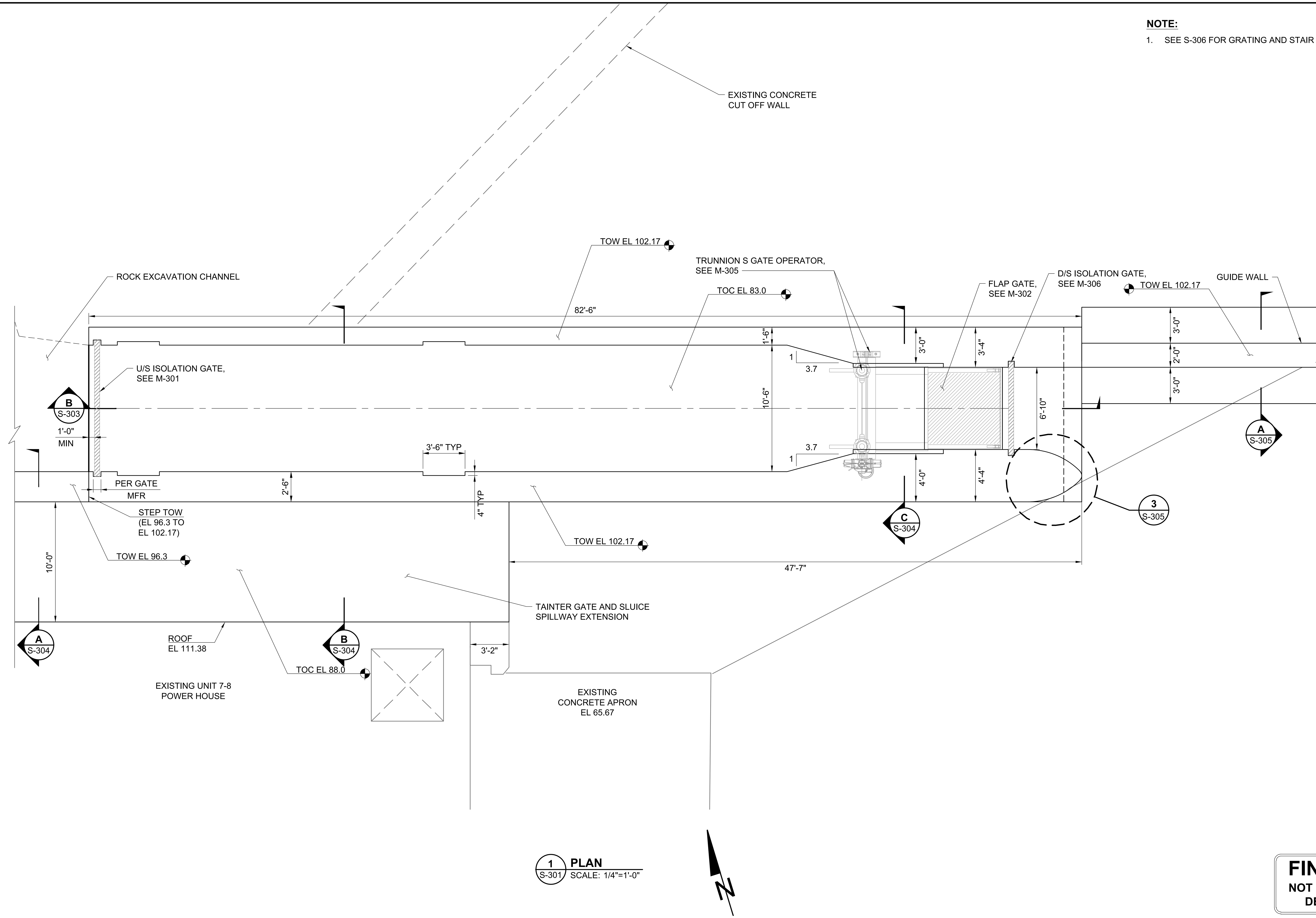
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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.

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12/13/2019
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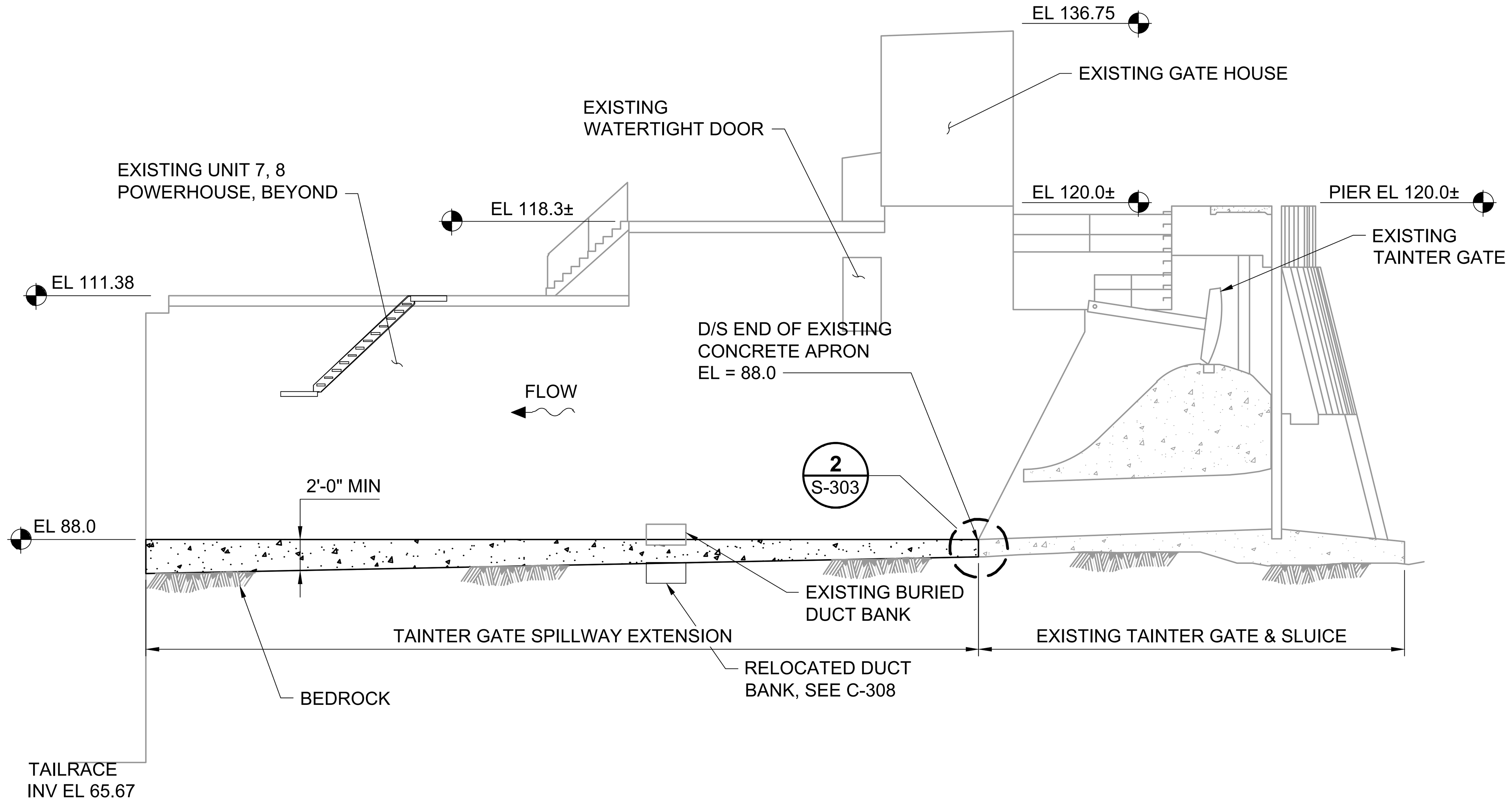
PROFESSIONAL ENGINEER

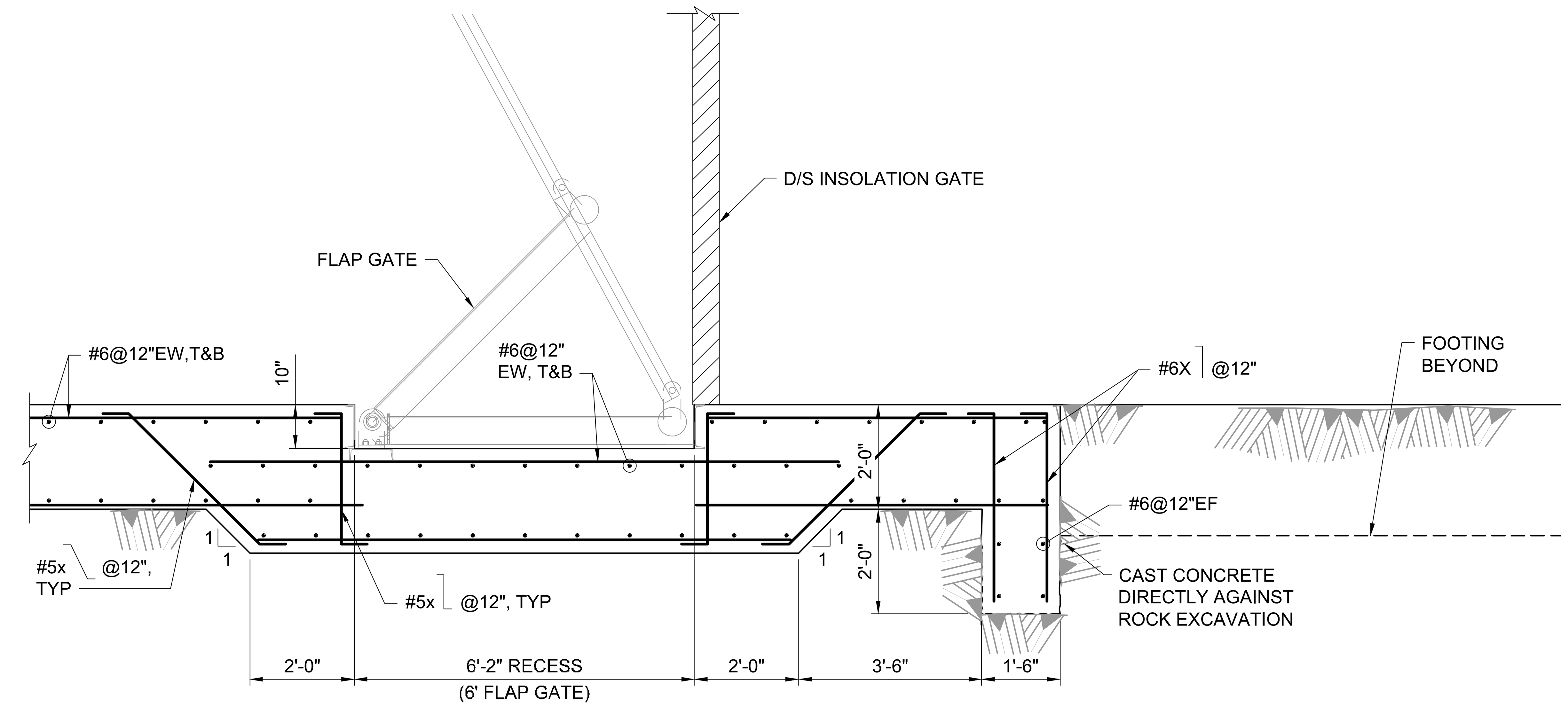
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
STRUCTURAL ENLARGED
CONCRETE PLAN

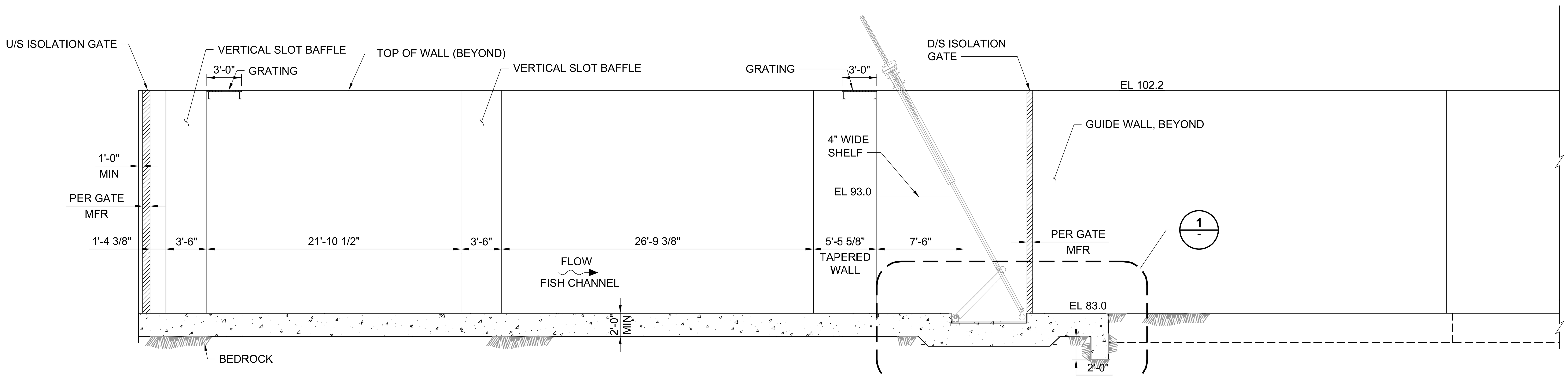
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 72 OF 176 |
| DRAWING: | S-302 |




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

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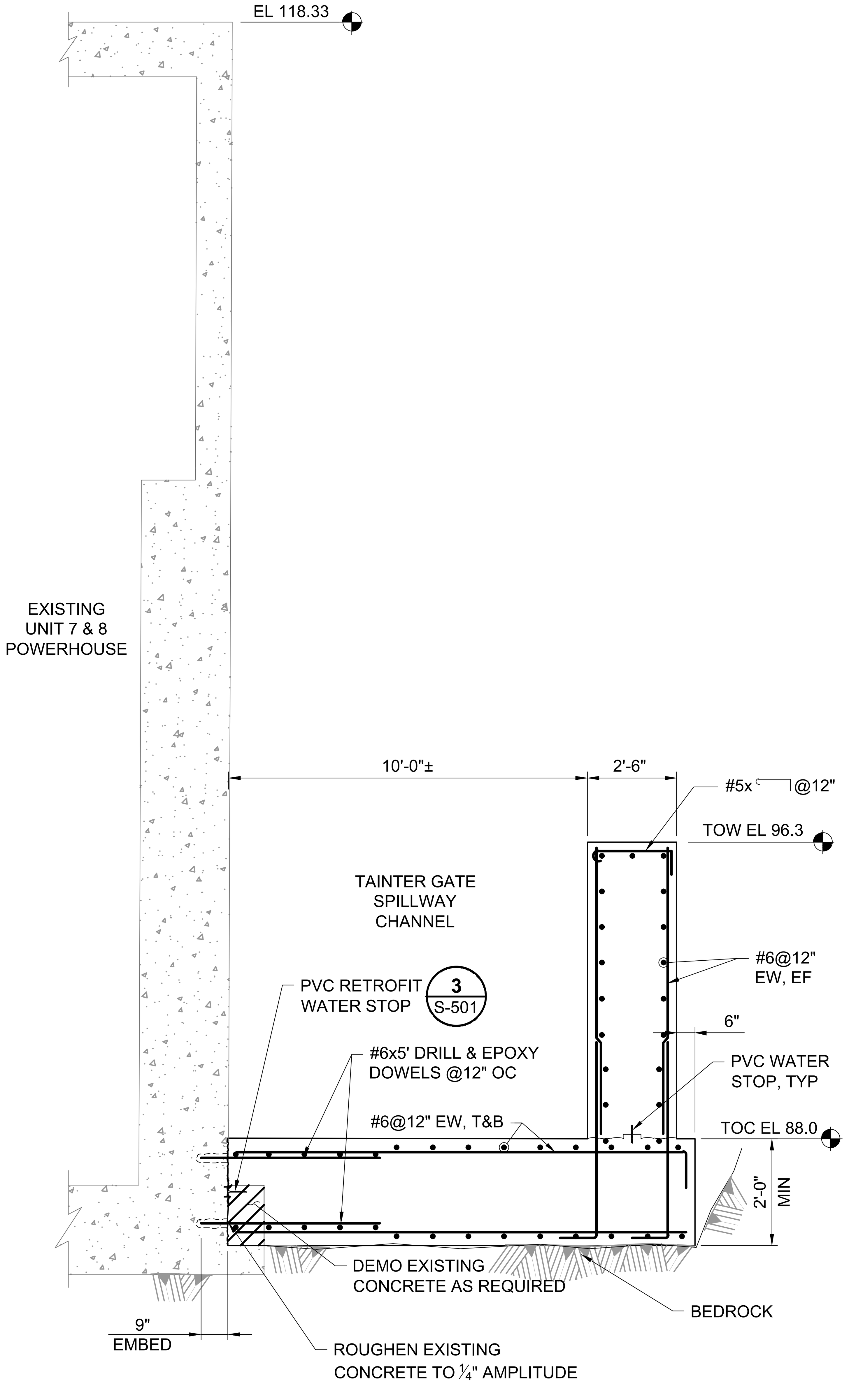
12/13/2019

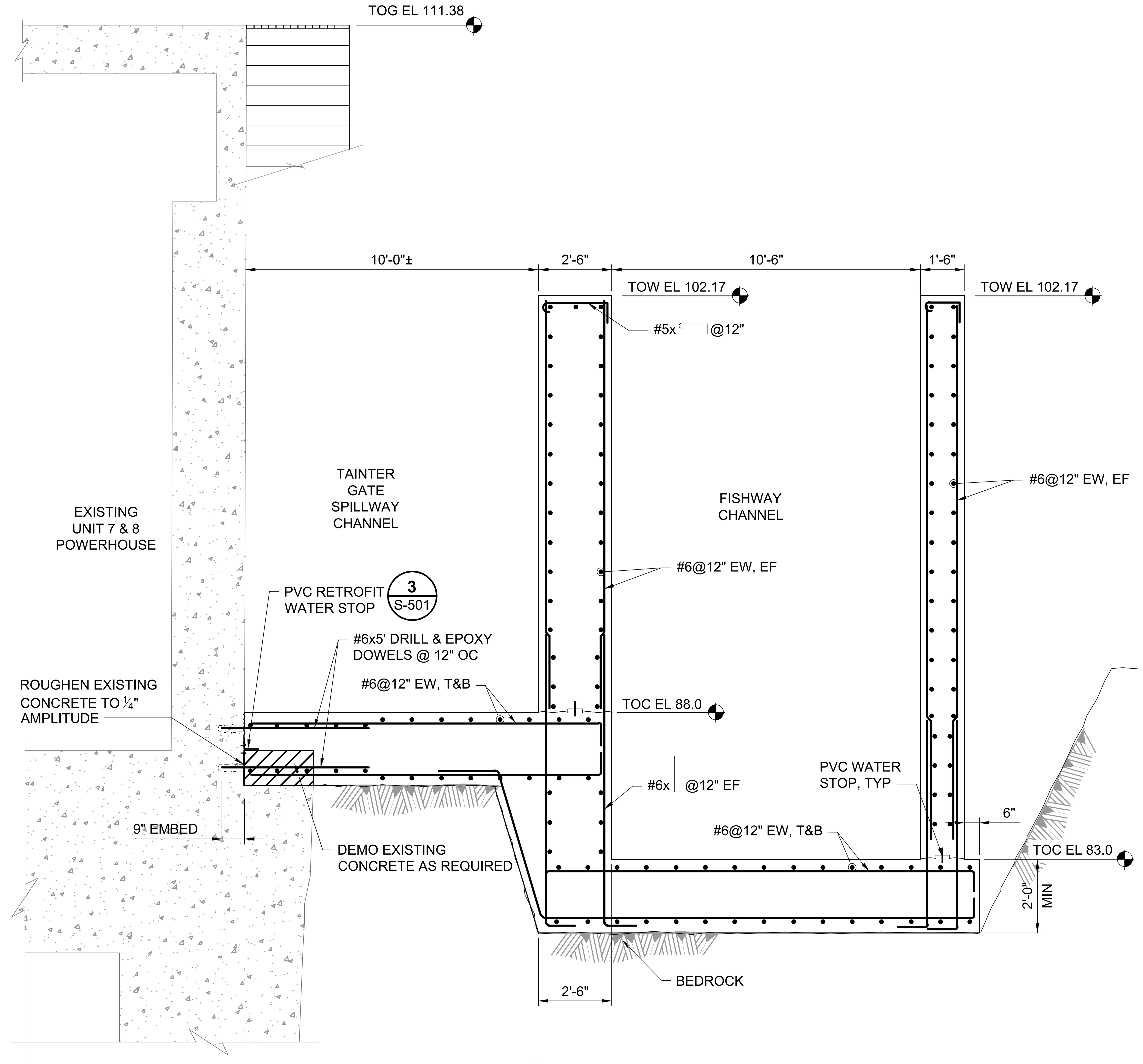
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
CONCRETE SECTIONS & DETAILS

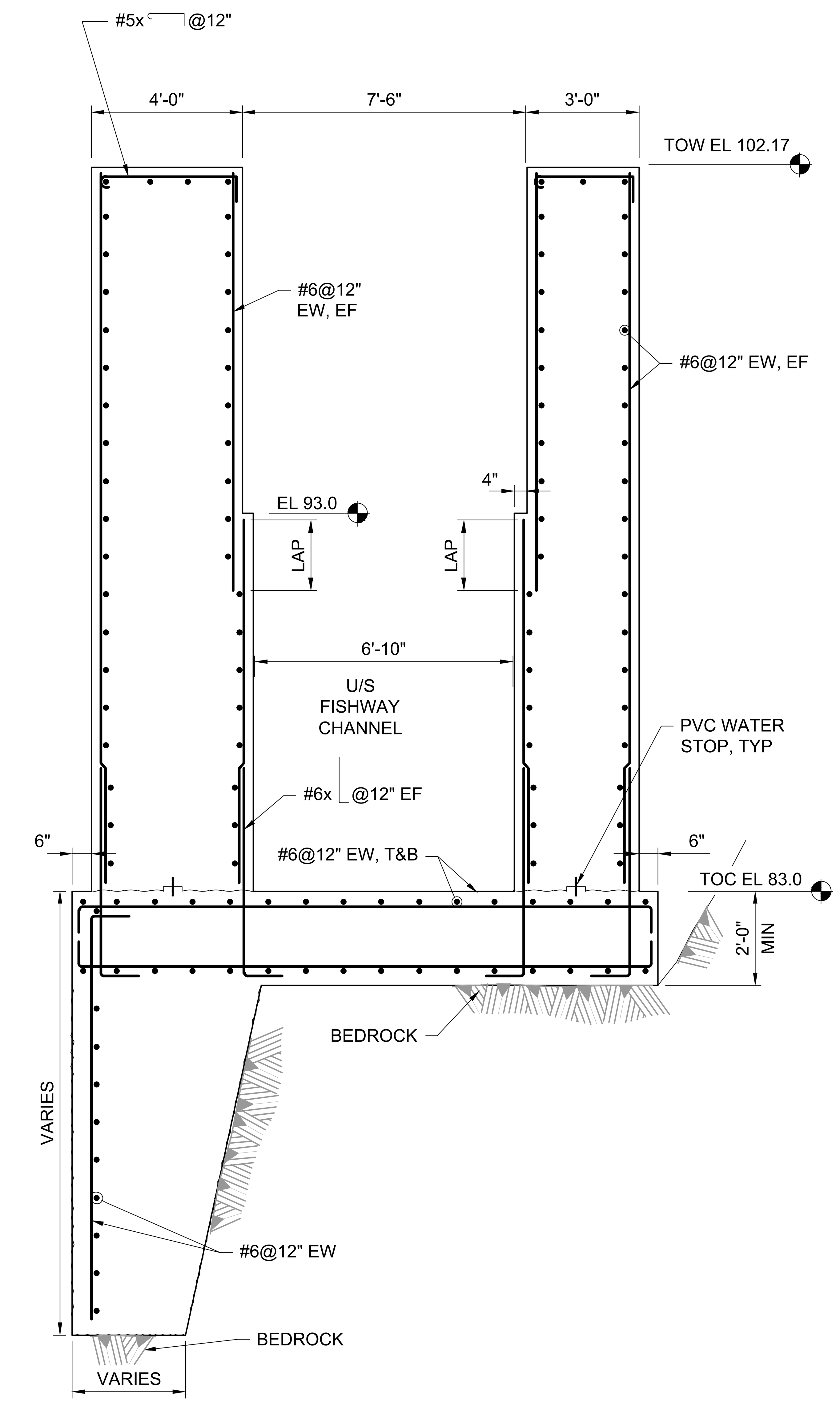
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 73 OF 176 |
| DRAWING: | S-303 |




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"

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**DECEMBER 13, 2019**

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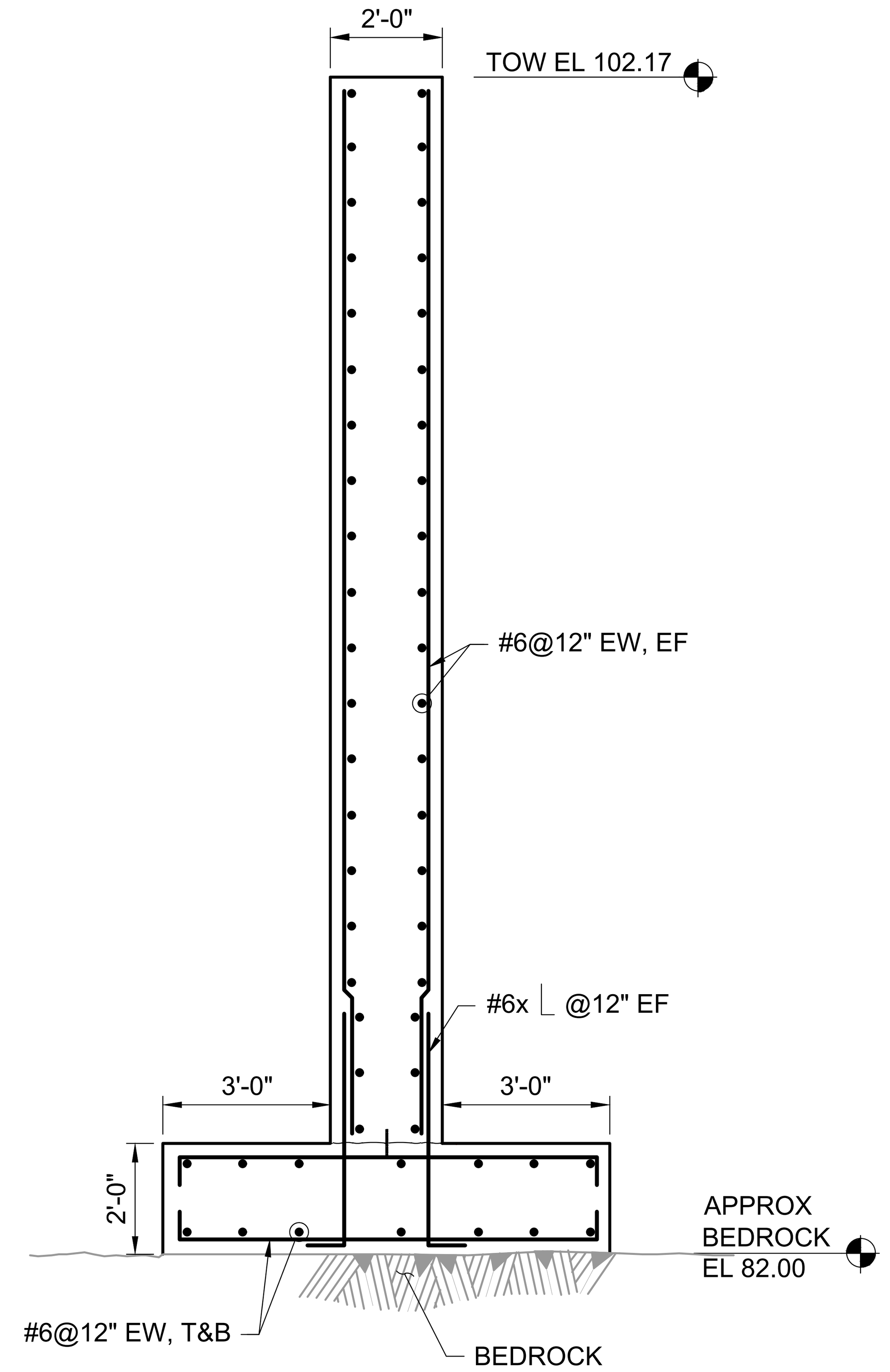
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE
CONCRETE SECTIONS

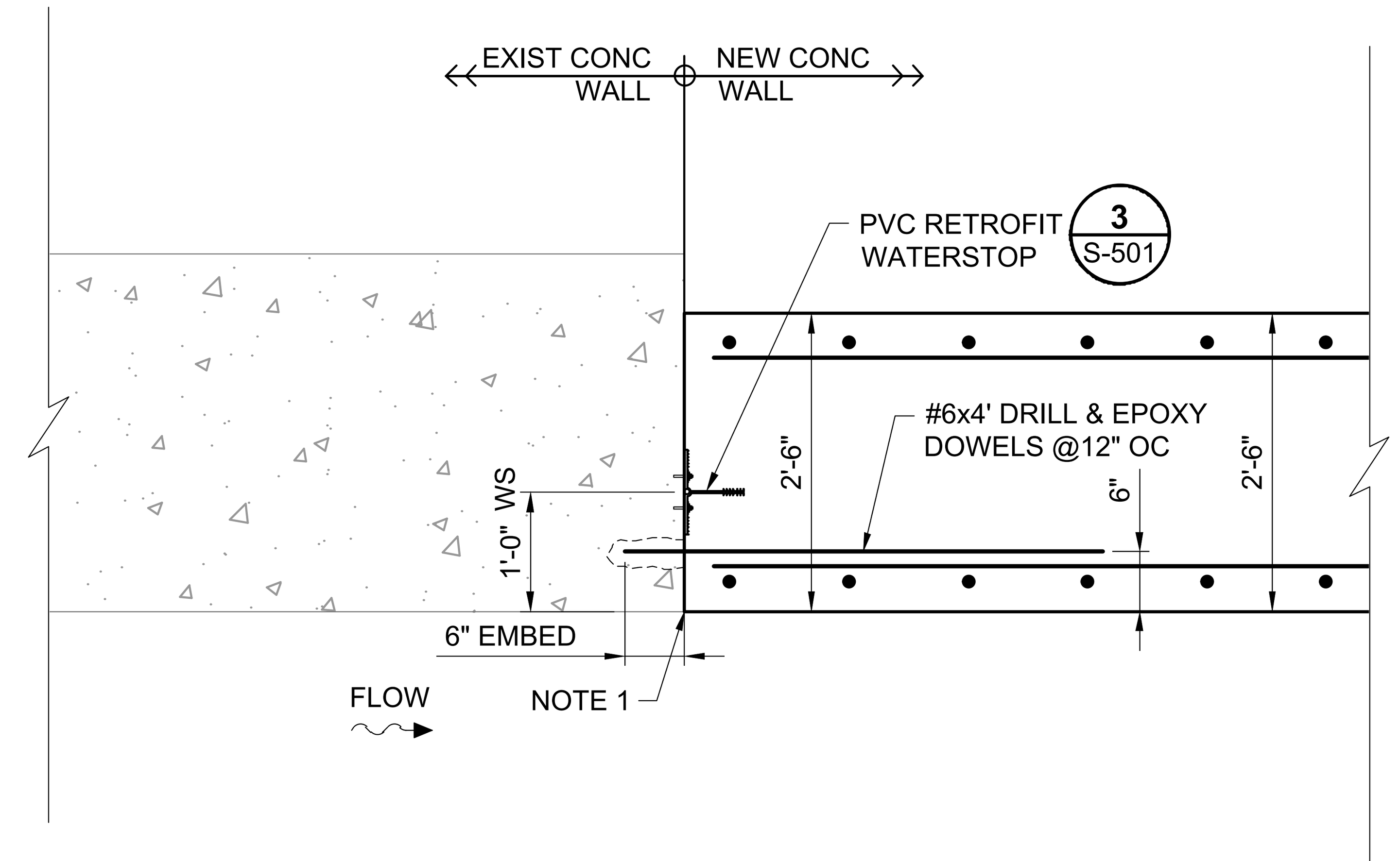
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | A. MENGERT |
| APPROVED BY: | M. GRAESER |
| SHEET: | 74 OF 176 |
| DRAWING: | S-304 |




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

**NOTE:**

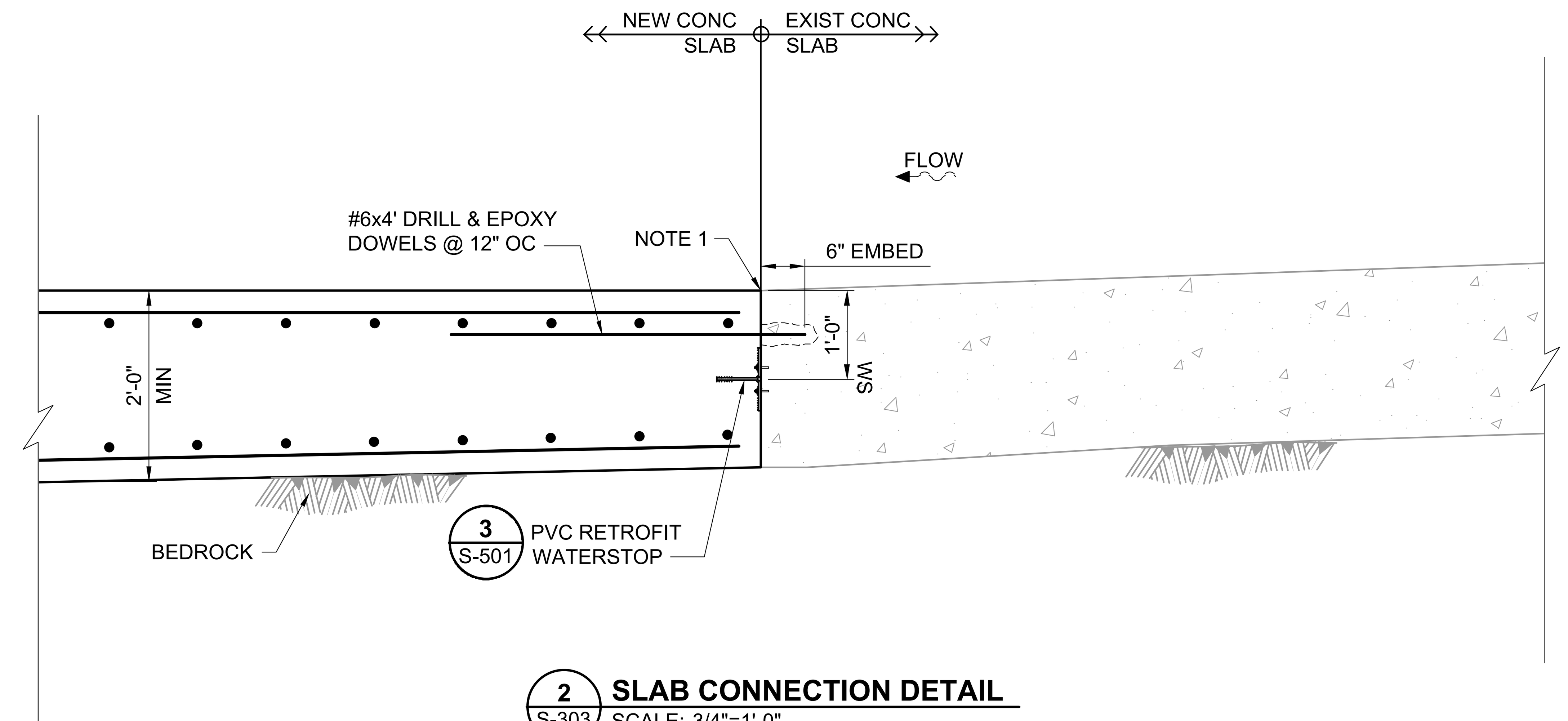
1. TRANSITION BETWEEN EXISTING CONCRETE AND NEW CONCRETE SHALL BE HYDRAULICALLY SMOOTH.



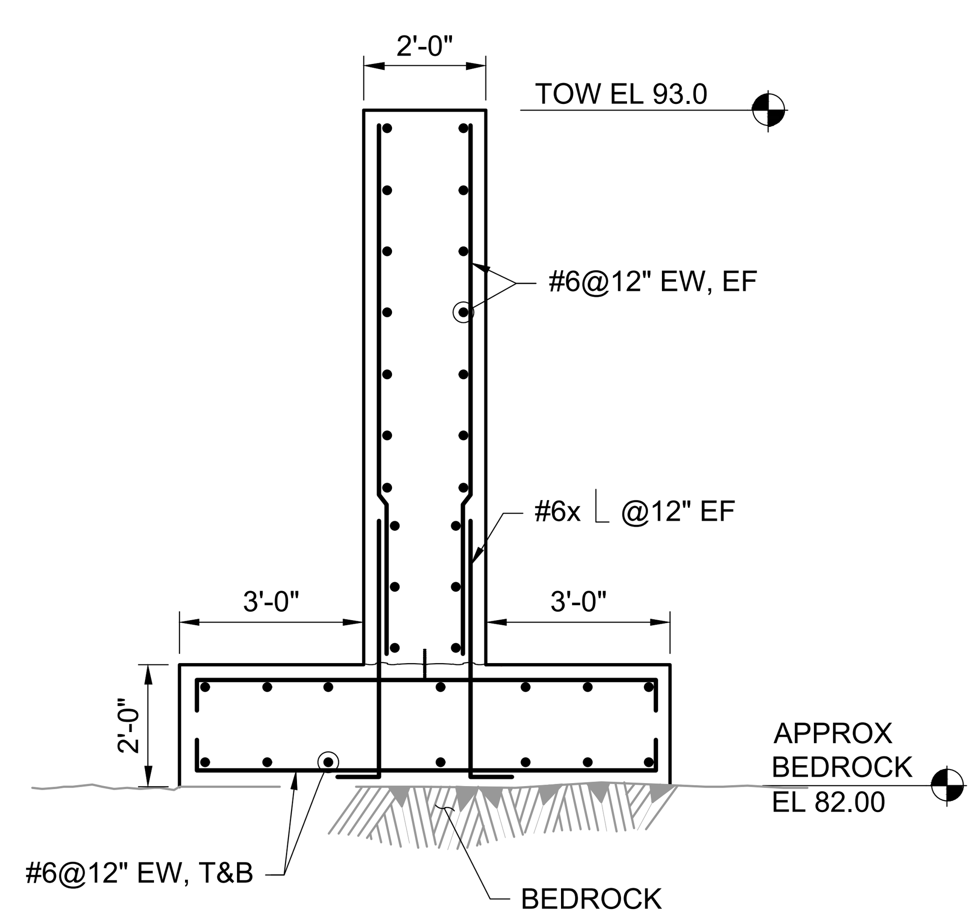

1 S-301 **WALL CONNECTION DETAIL**
SCALE: 3/4"=1'-0"

**NOTE:**

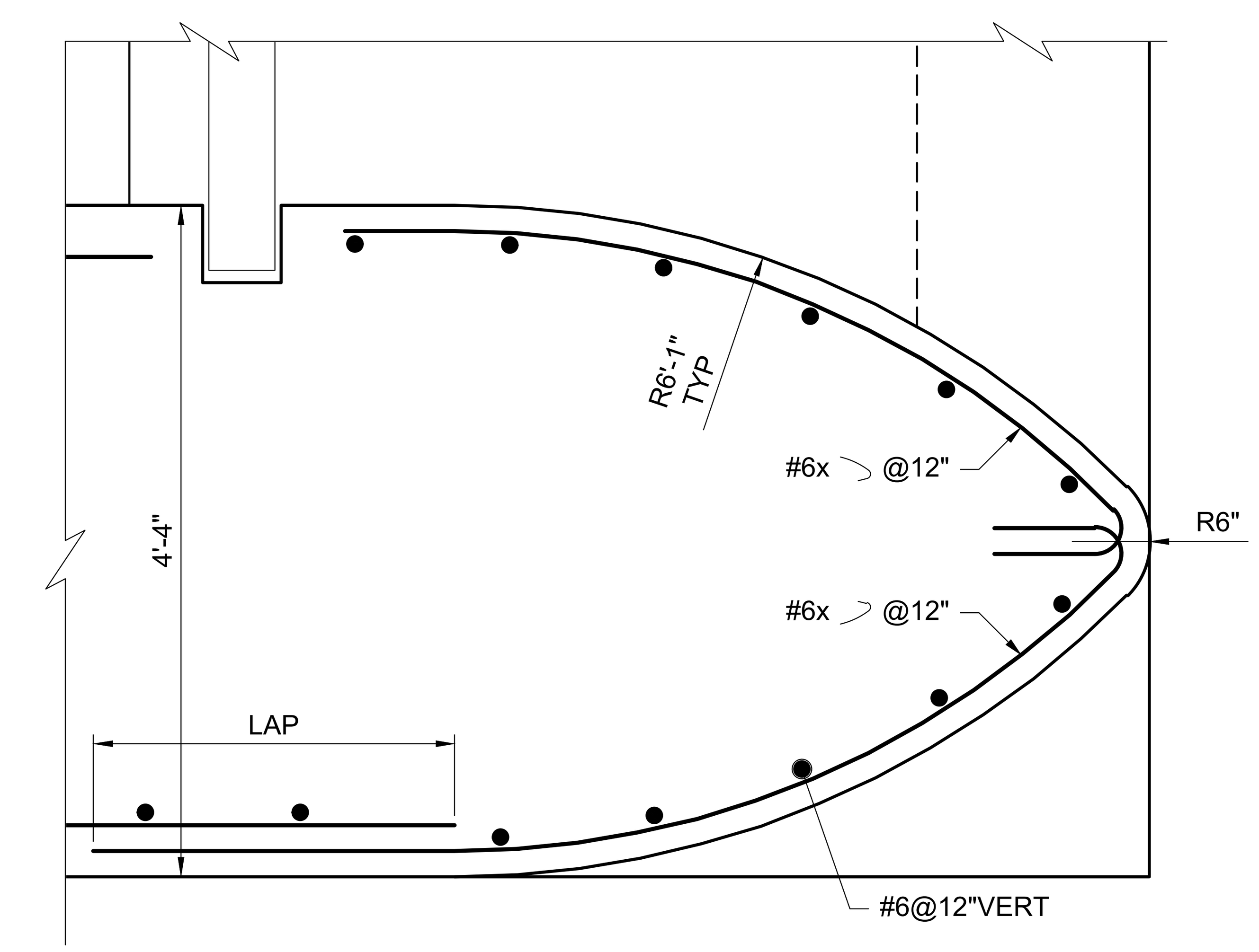
1. TRANSITION BETWEEN EXISTING CONCRETE AND NEW CONCRETE SHALL BE HYDRAULICALLY SMOOTH.




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




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




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

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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

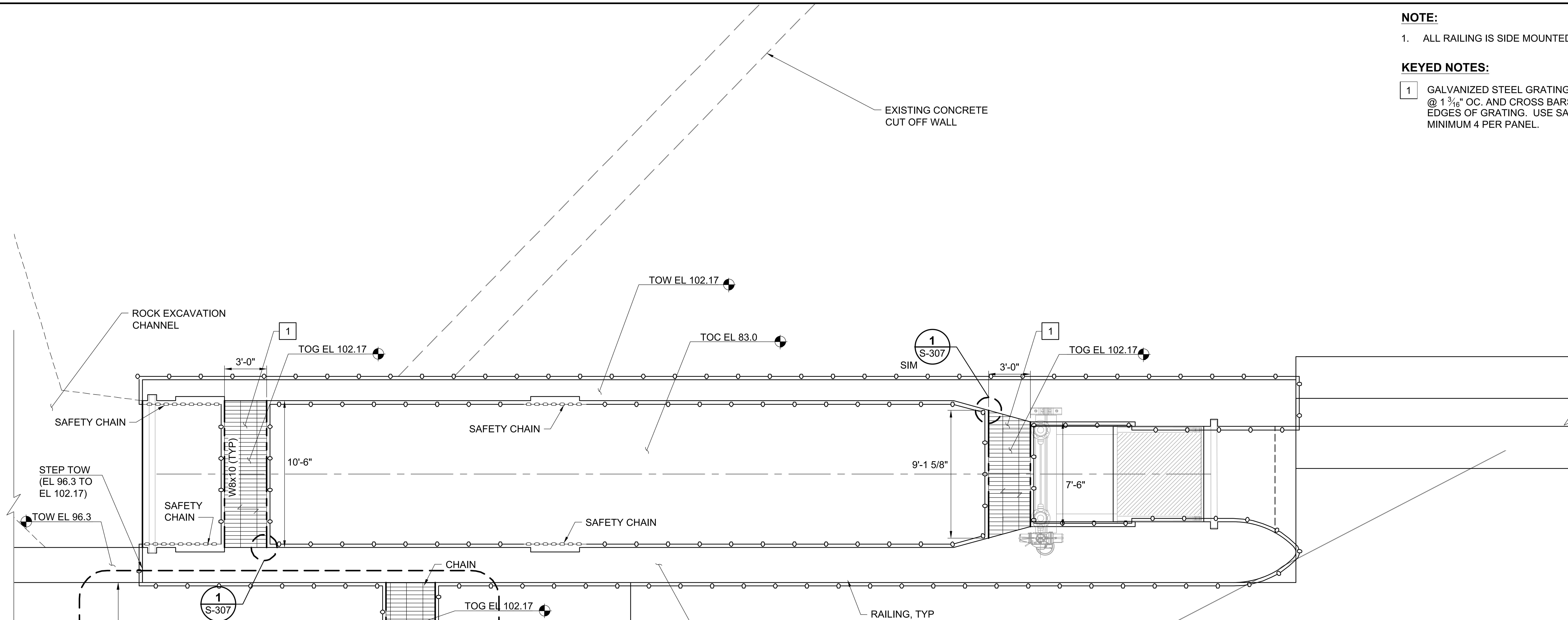
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: A. MENGERT
APPROVED BY: M. GRAESER
SHEET: 75 OF 176
DRAWING: S-305

**NOTE:**

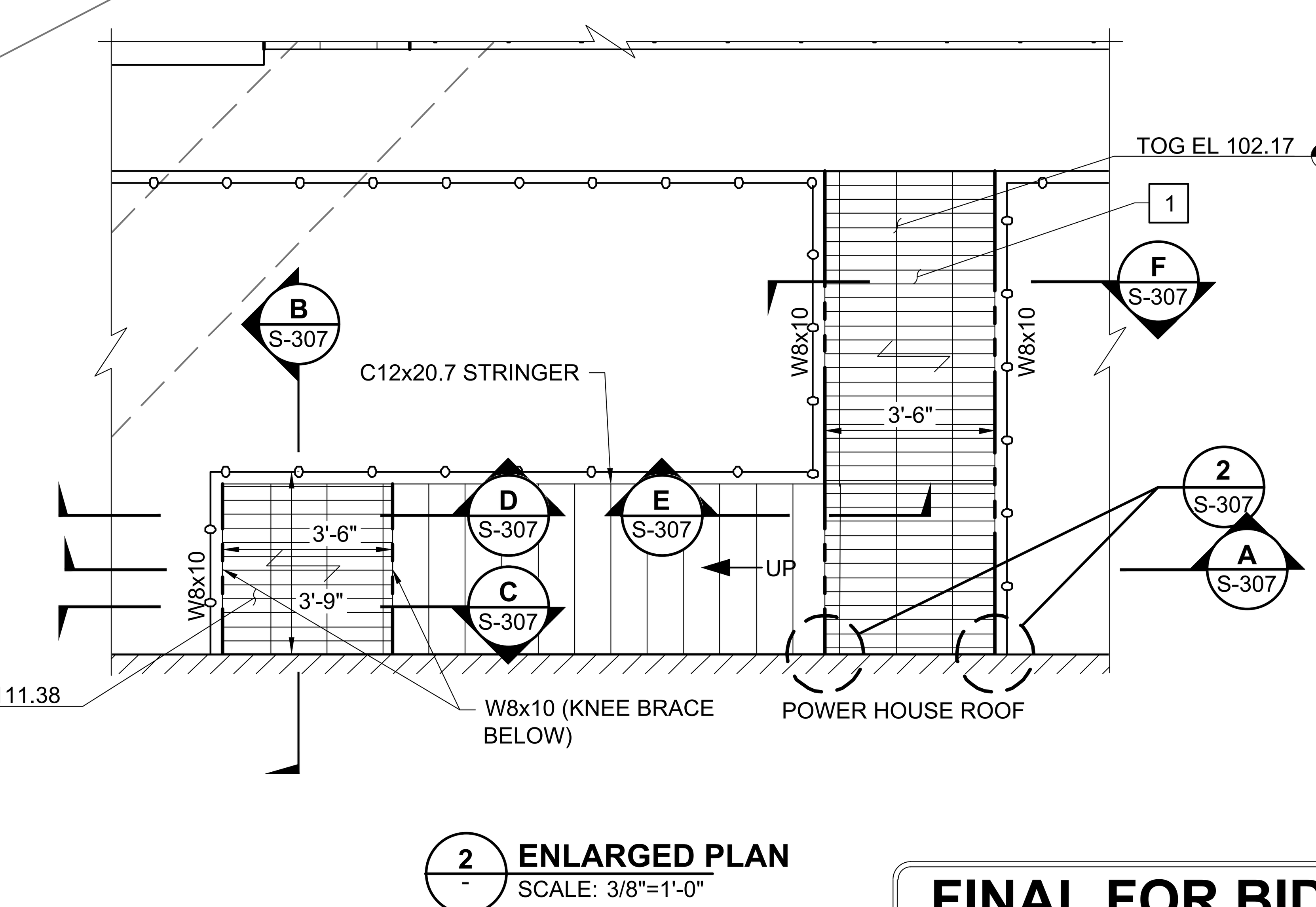
1. ALL RAILING IS SIDE MOUNTED UNLESS OTHERWISE NOTED.

**KEYED NOTES:**

1 — GALVANIZED STEEL GRATING, 1 ¼" 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.




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




2 - **ENLARGED PLAN**
SCALE: 3/8"=1'-0"

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**DECEMBER 13, 2019**


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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 |


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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

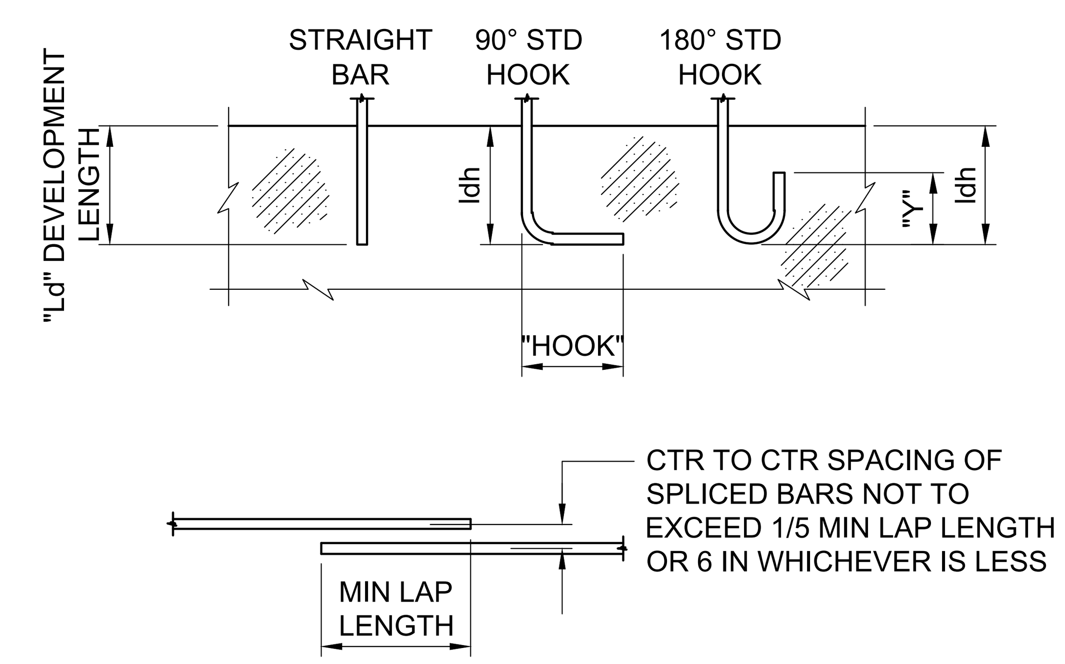
DWG: C:\Users\agrogan\documents\autocad sheet sets\3173-shawmut fish passage\S-307.dwg USER: Agrogan
DATE: Dec 13, 2019 2:35pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

| 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:**

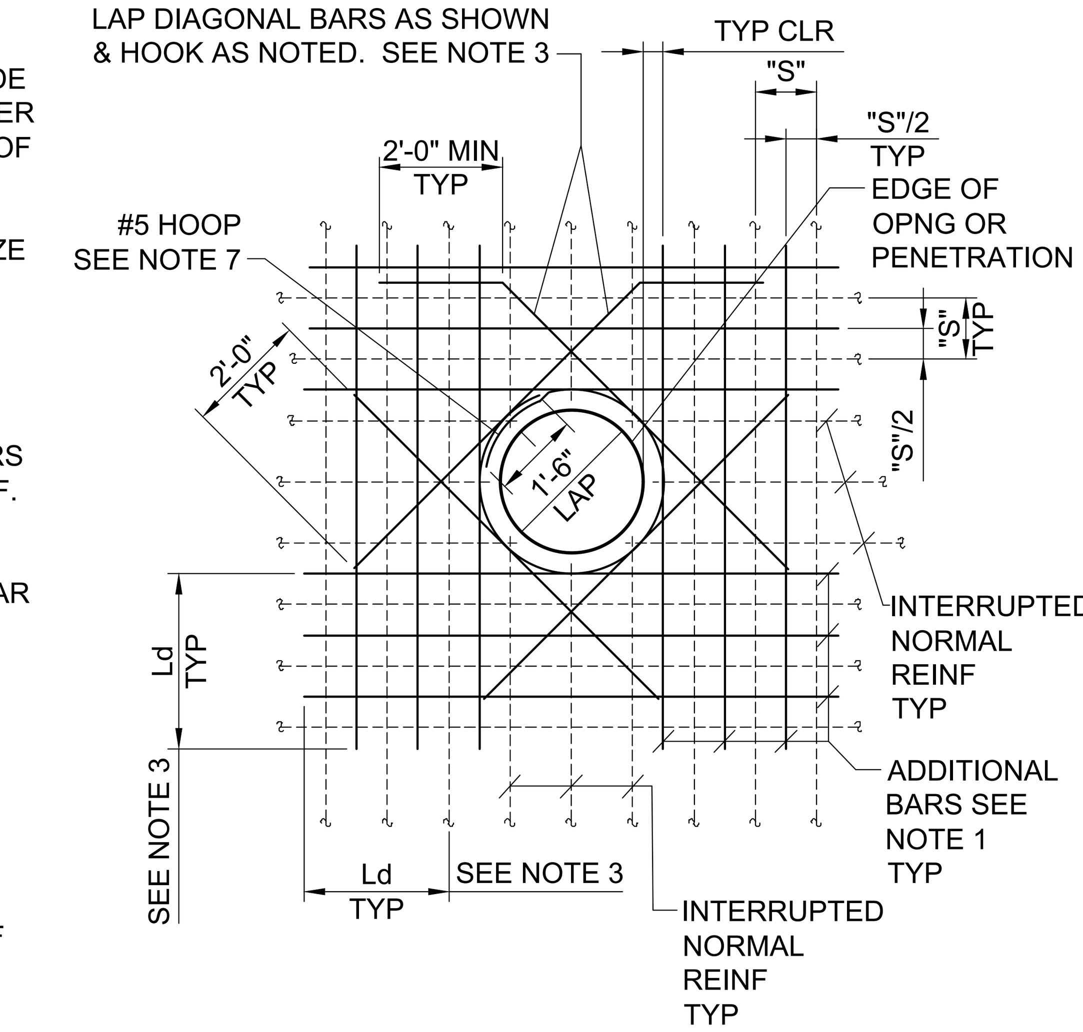
1. "TOP" BARS SHALL BE HORIZONTAL REINFORCEMENT PLACED SO THAT MORE THAN 12" OF FRESH CONCRETE IS CAST IN THE MEMBER BELOW THE DEVELOPMENT LENGTH OR SPLICE.
2. ALL LAP SPLICES SHALL BE CLASS B UNLESS NOTED OTHERWISE.
3. SPLICES ARE TO BE MADE SO THAT THE GIVEN DISTANCES TO FACE OF CONCRETE WILL BE MAINTAINED.

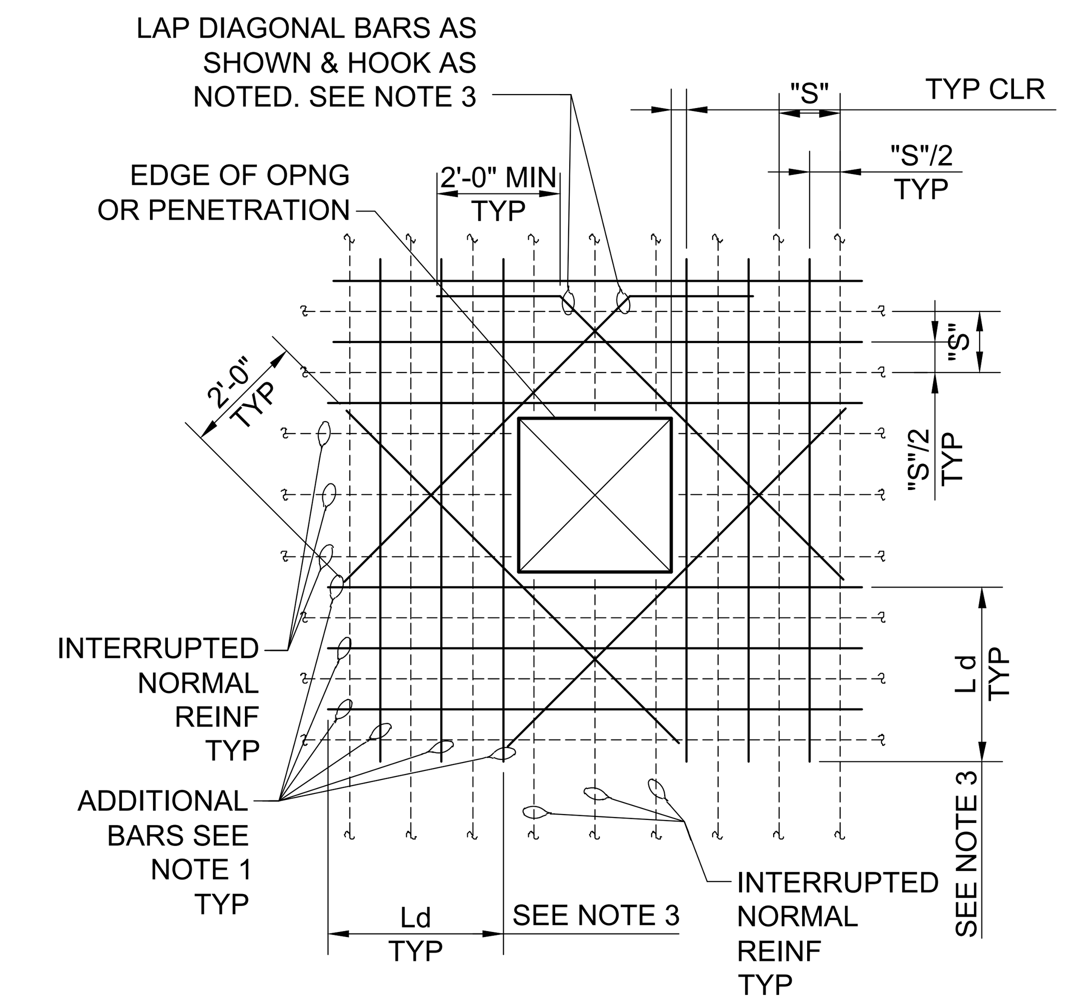



## 1 STANDARD HOOK AND REINF LAP SPLICE
SCALE: NTS

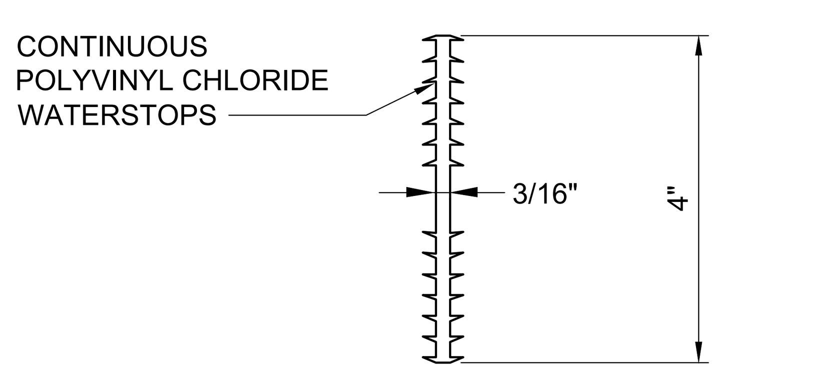
NOTES:

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.



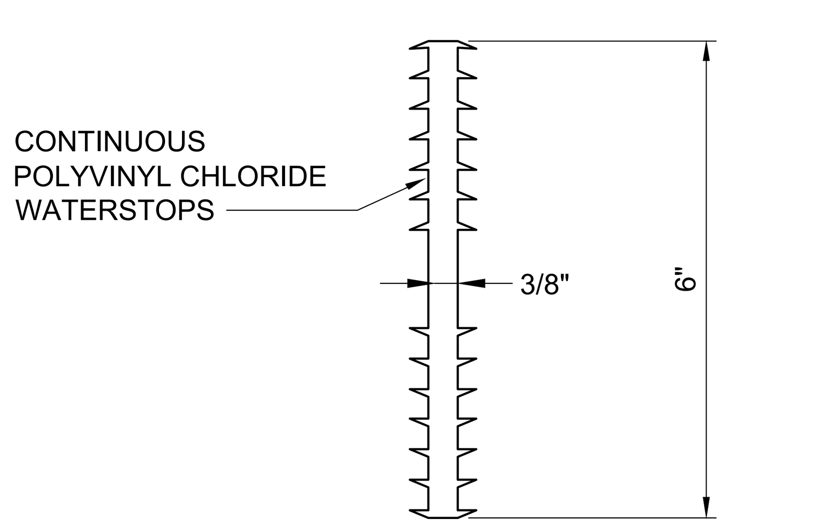




## 2 ADDITIONAL REINF BAR DETAILS
SCALE: NTS



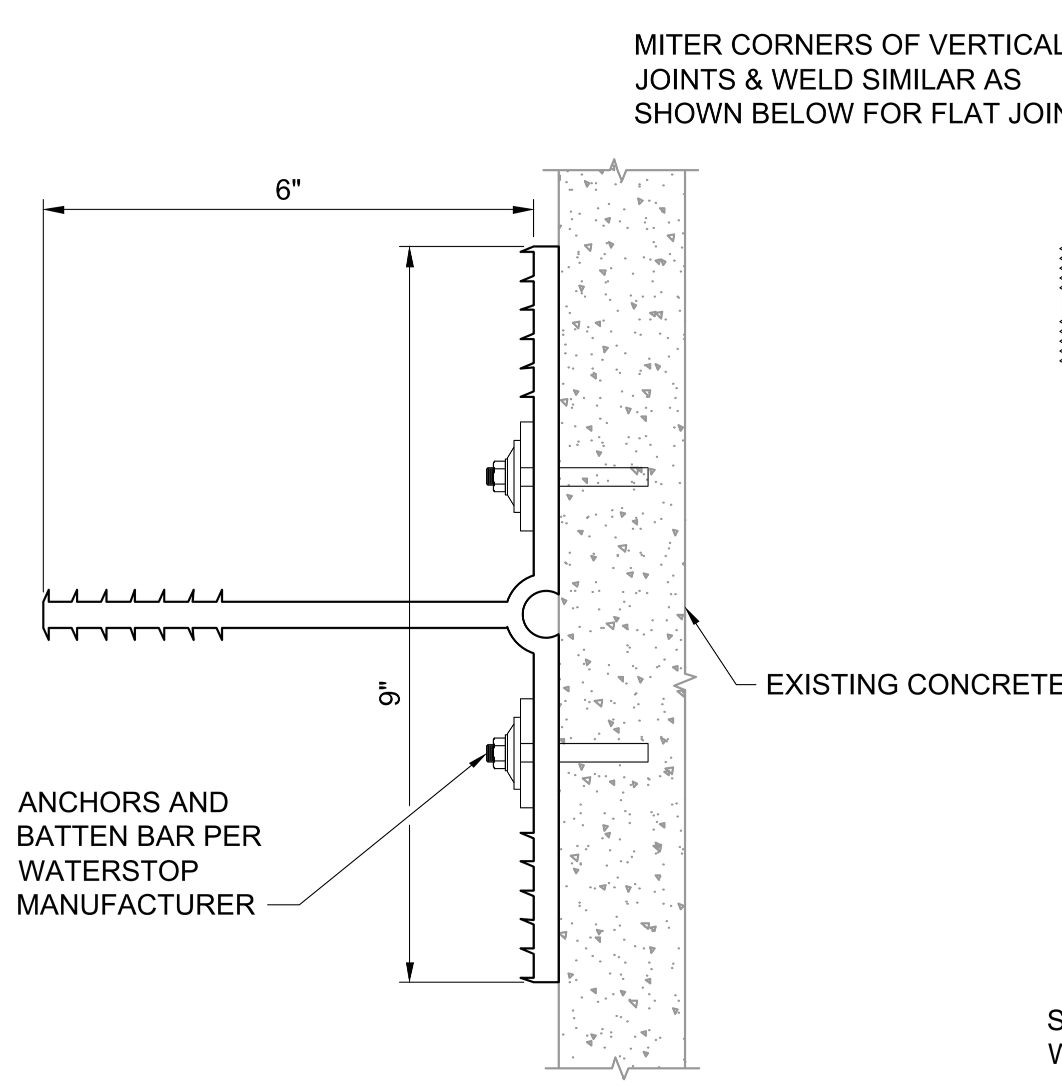

SEE JT NOTES & SPECIFICATIONS FOR REQD LOCATIONS

### 4" PVC FLAT WATERSTOP



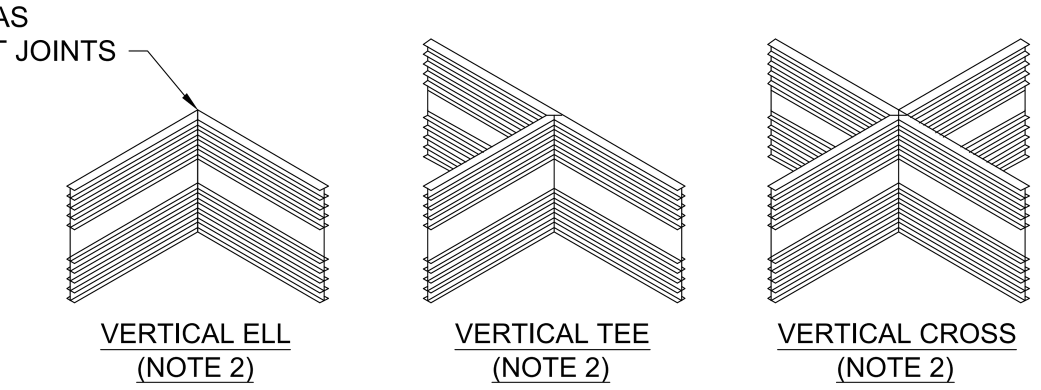

SEE JT NOTES & SPECIFICATIONS FOR REQD LOCATIONS

### 6" PVC FLAT WATERSTOP

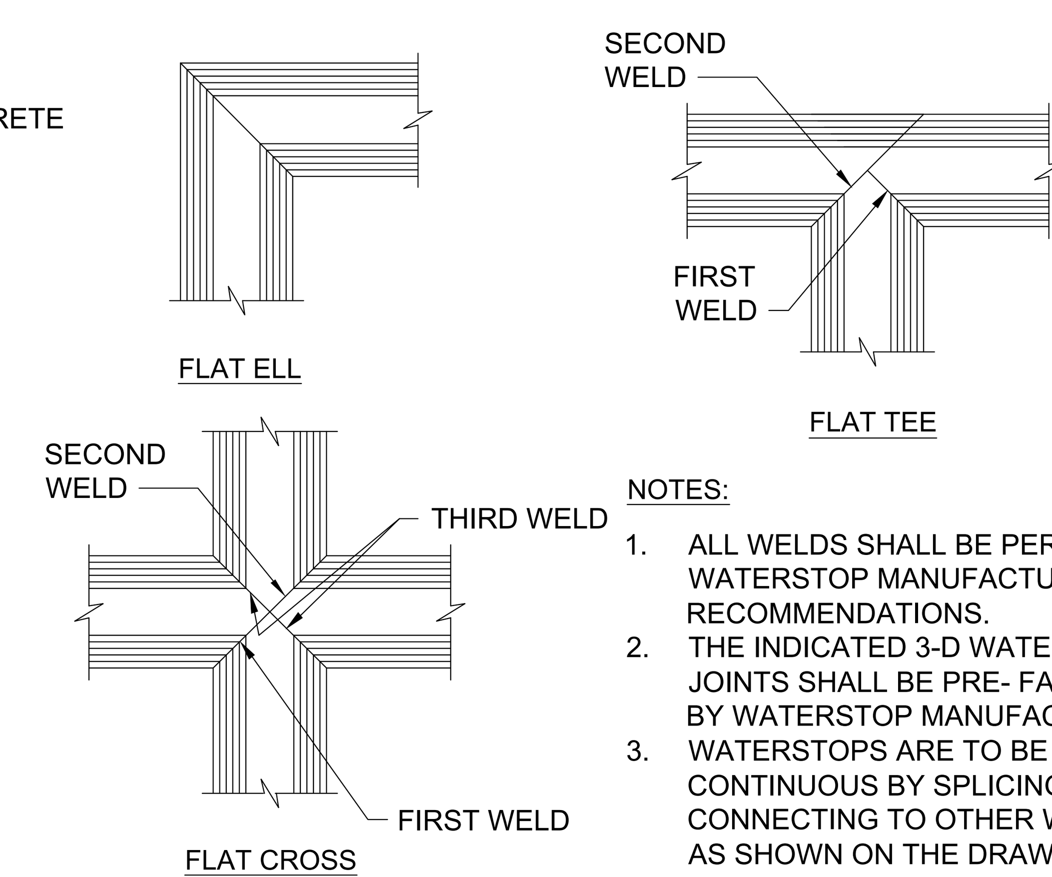



SEE JT NOTES & SPECIFICATIONS FOR REQD LOCATIONS

### 6" PVC CENTER BULB RETROFIT WATERSTOP




### WATERSTOP 3-D JOINTS

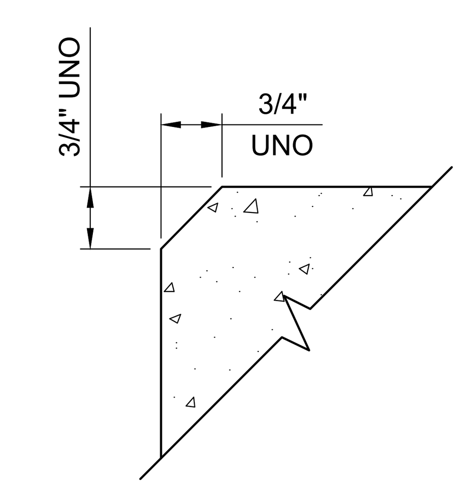



NOTES:

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
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**DECEMBER 13, 2019**

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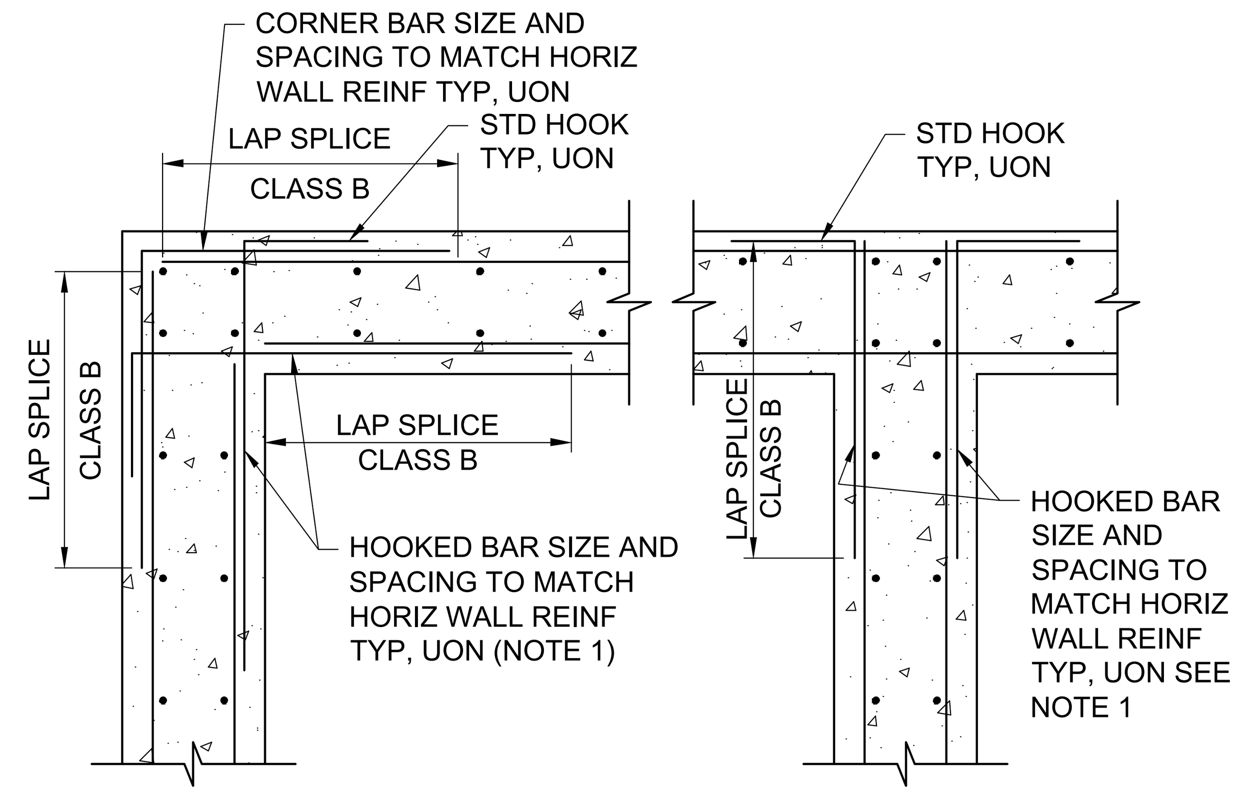
12/13/2019
LICENSED PROFESSIONAL ENGINEER

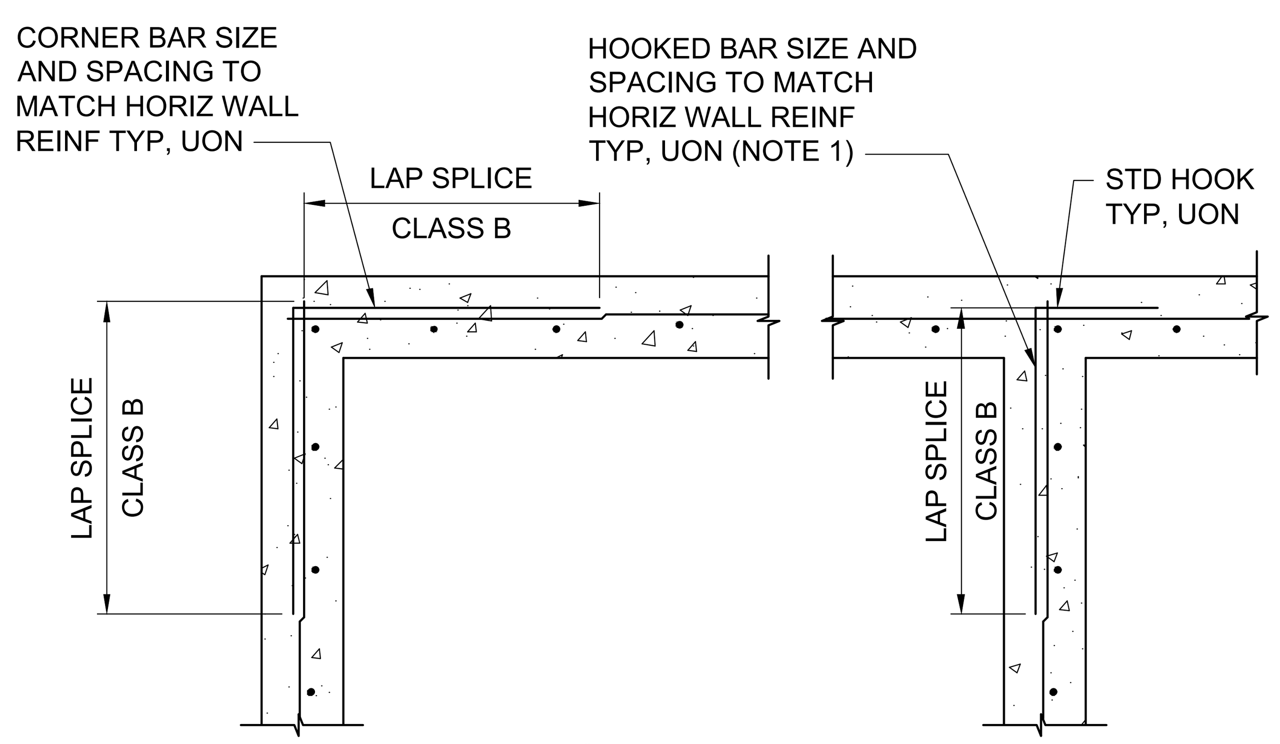
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STRUCTURAL STANDARD DETAILS

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




**TYPICAL PLAN**
**REINFORCING EACH FACE**

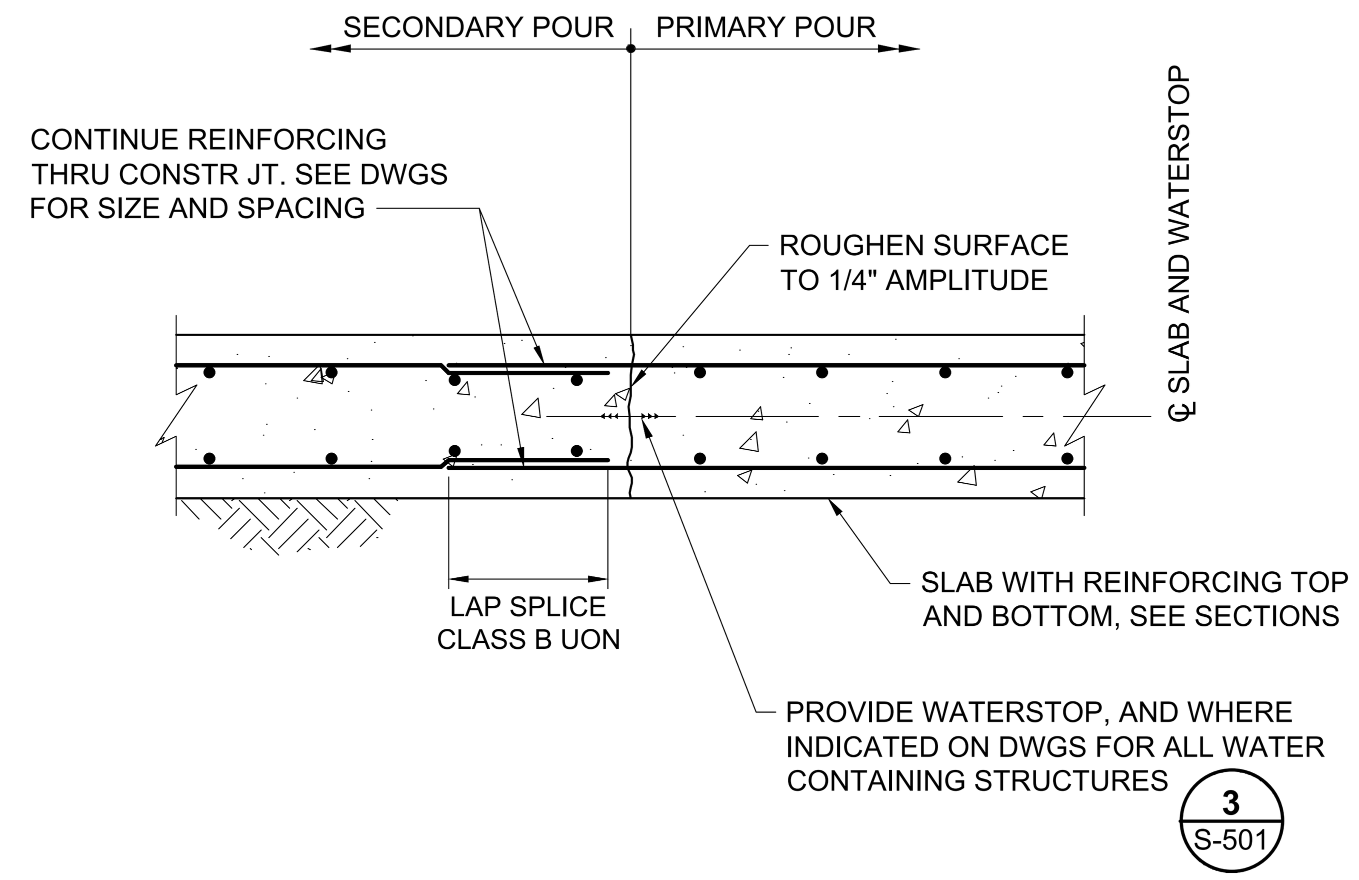



**TYPICAL PLAN**
**SINGLE LAYER REINFORCING**

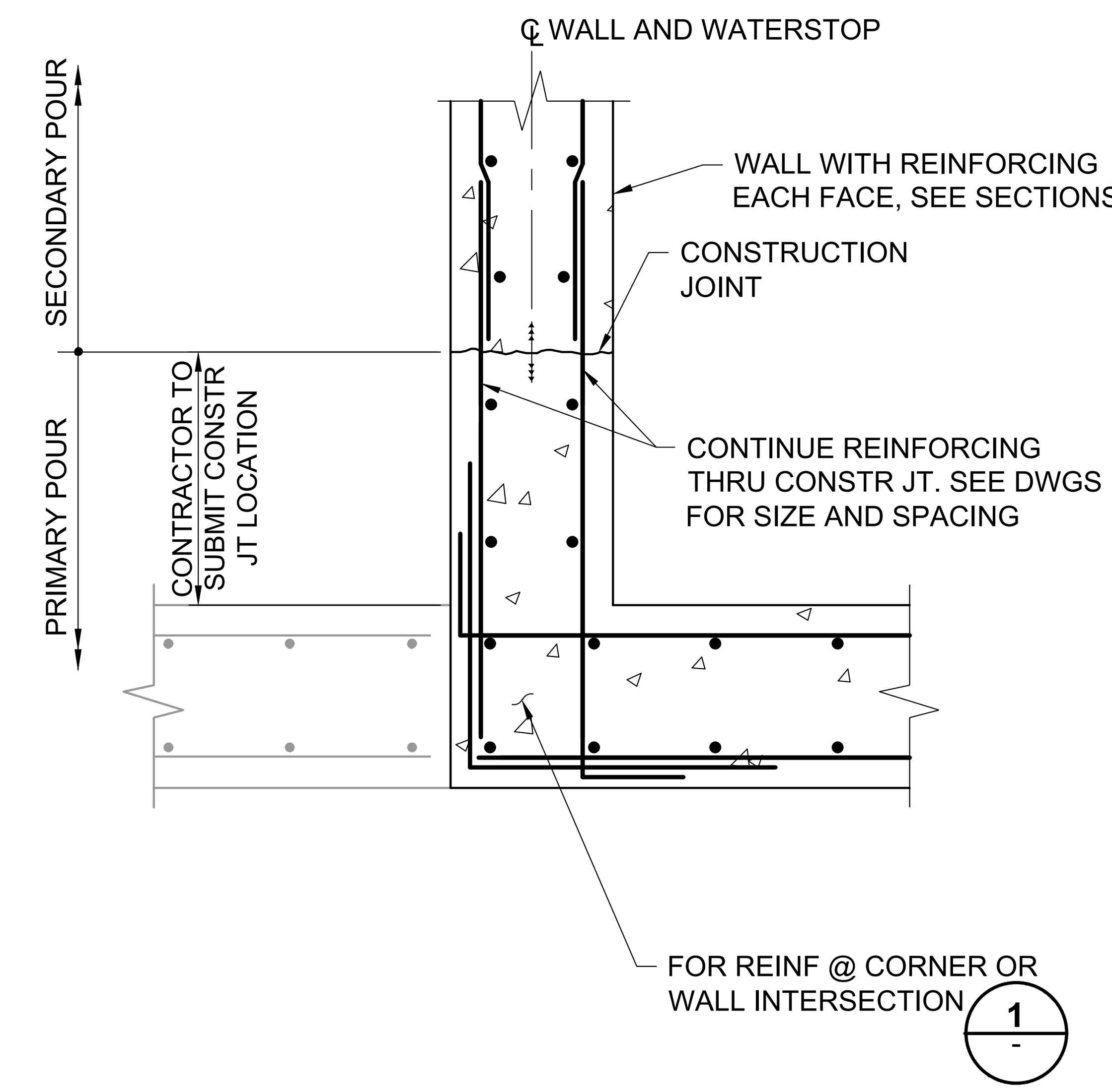
**NOTE:**

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

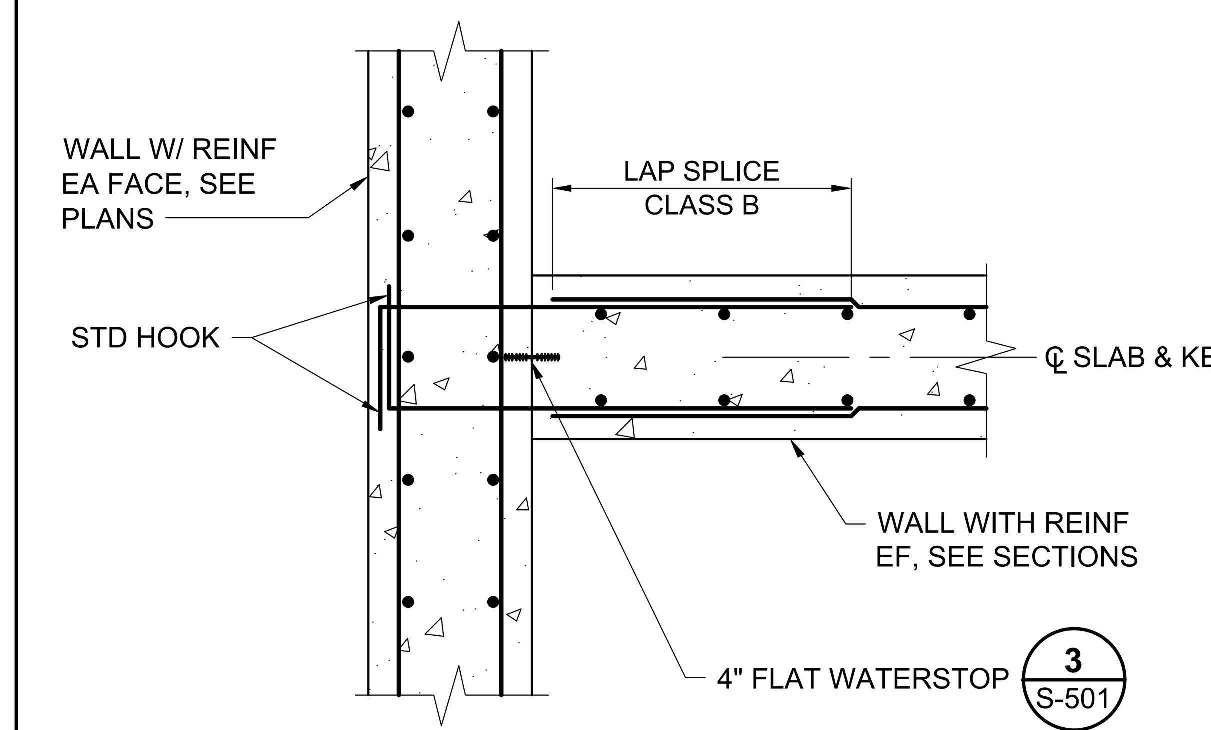
**1 WALL INTERSECTION / CORNER REINF**
SCALE: NTS



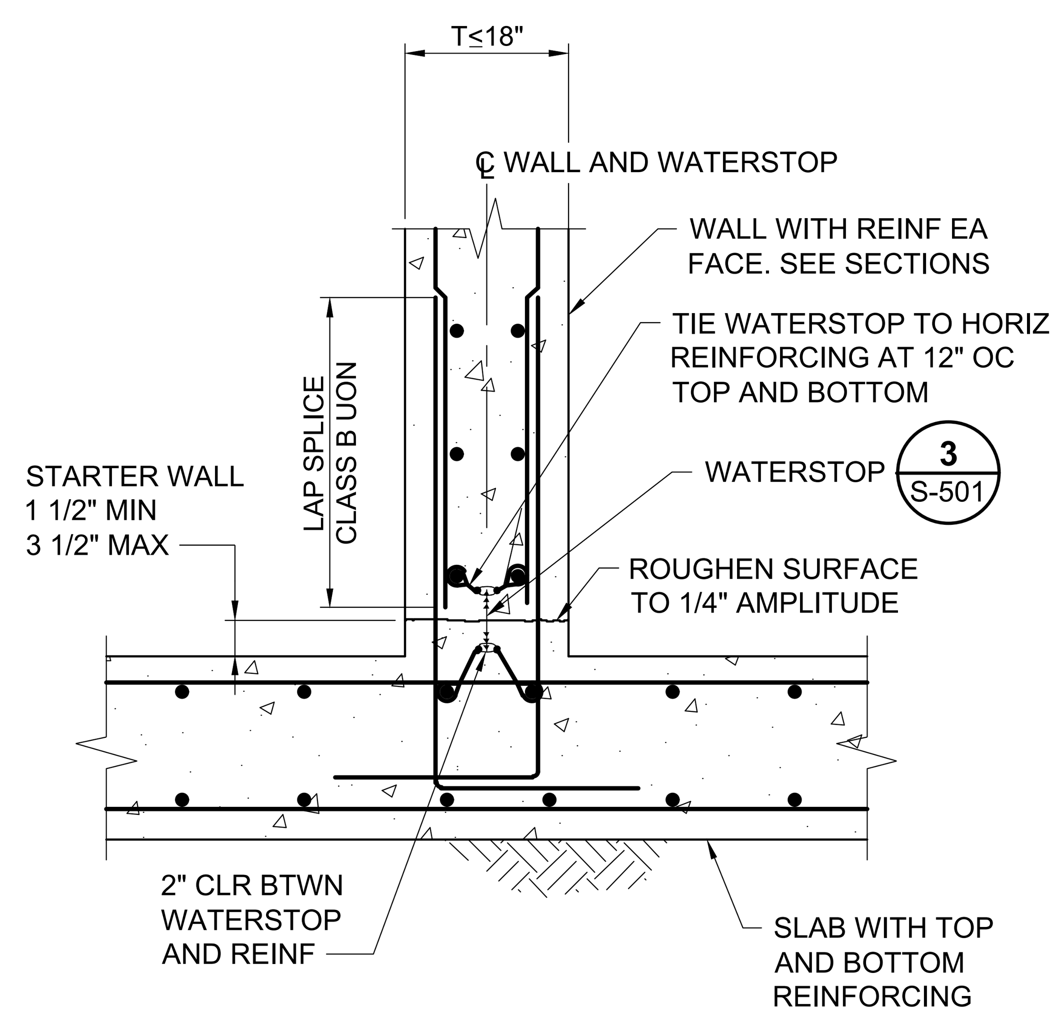

**2 CONSTRUCTION JOINT (CJ)**
SCALE: NTS



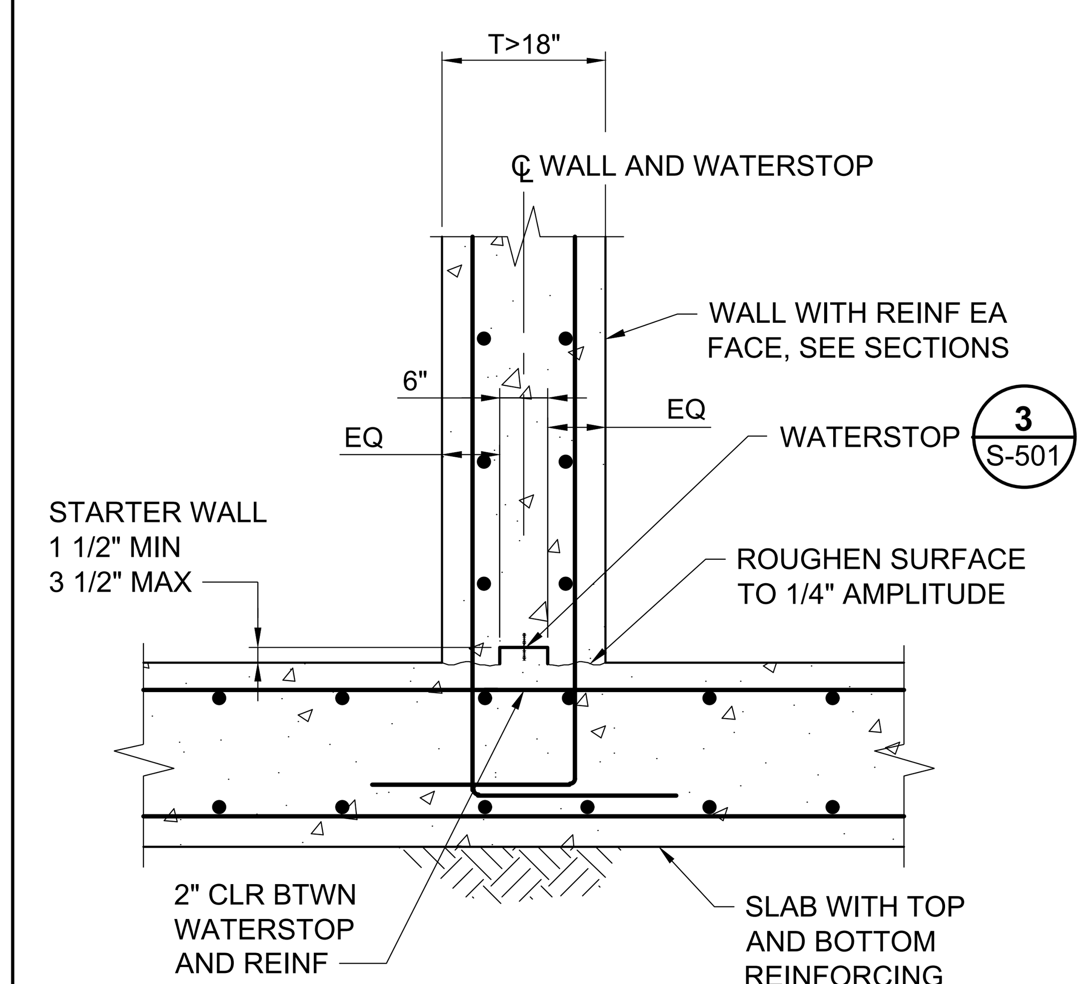

**3 CONSTRUCTION JOINT-WALL TO WALL**
SCALE: NTS



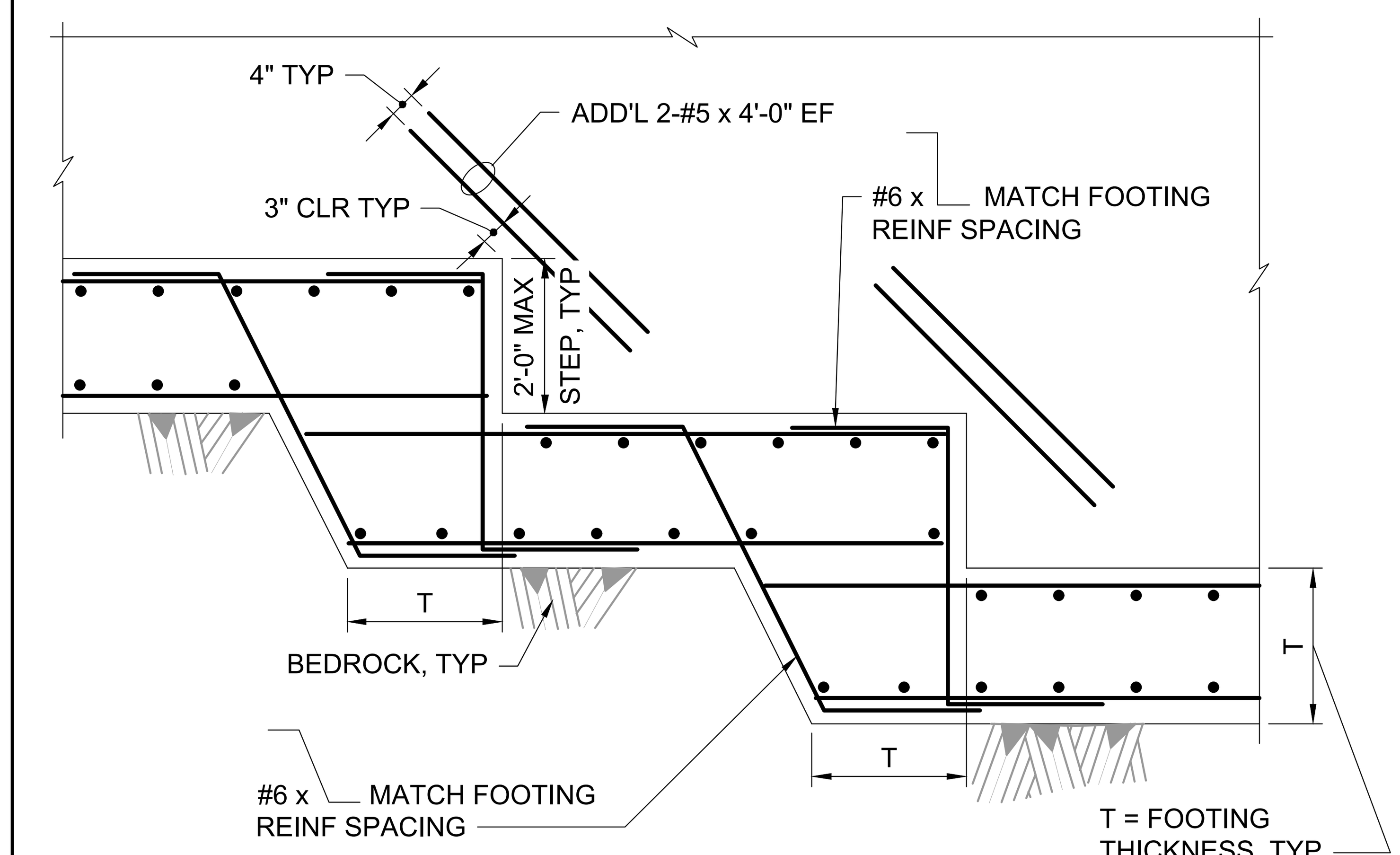

**4 CONSTRUCTION JOINT-WALL TO WALL**
SCALE: NTS




**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"

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**DECEMBER 13, 2019**

DWG: C:\Users\agroga\documents\autocad sheet sets\131009-alden mass 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:

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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

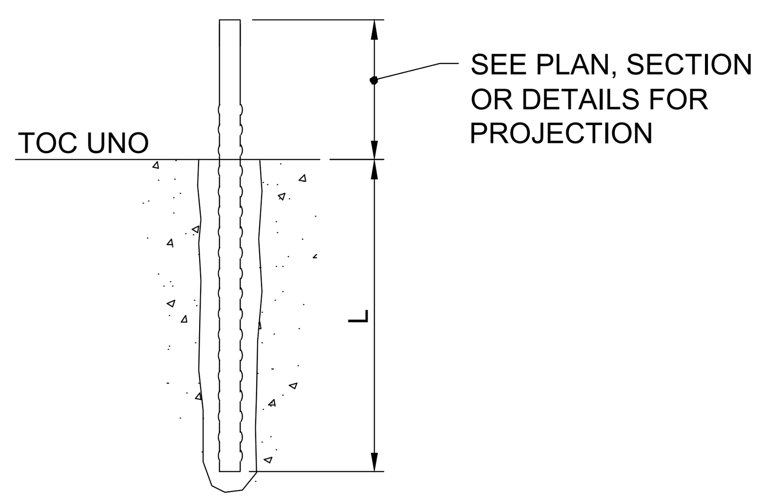
STRUCTURAL STANDARD DETAILS

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

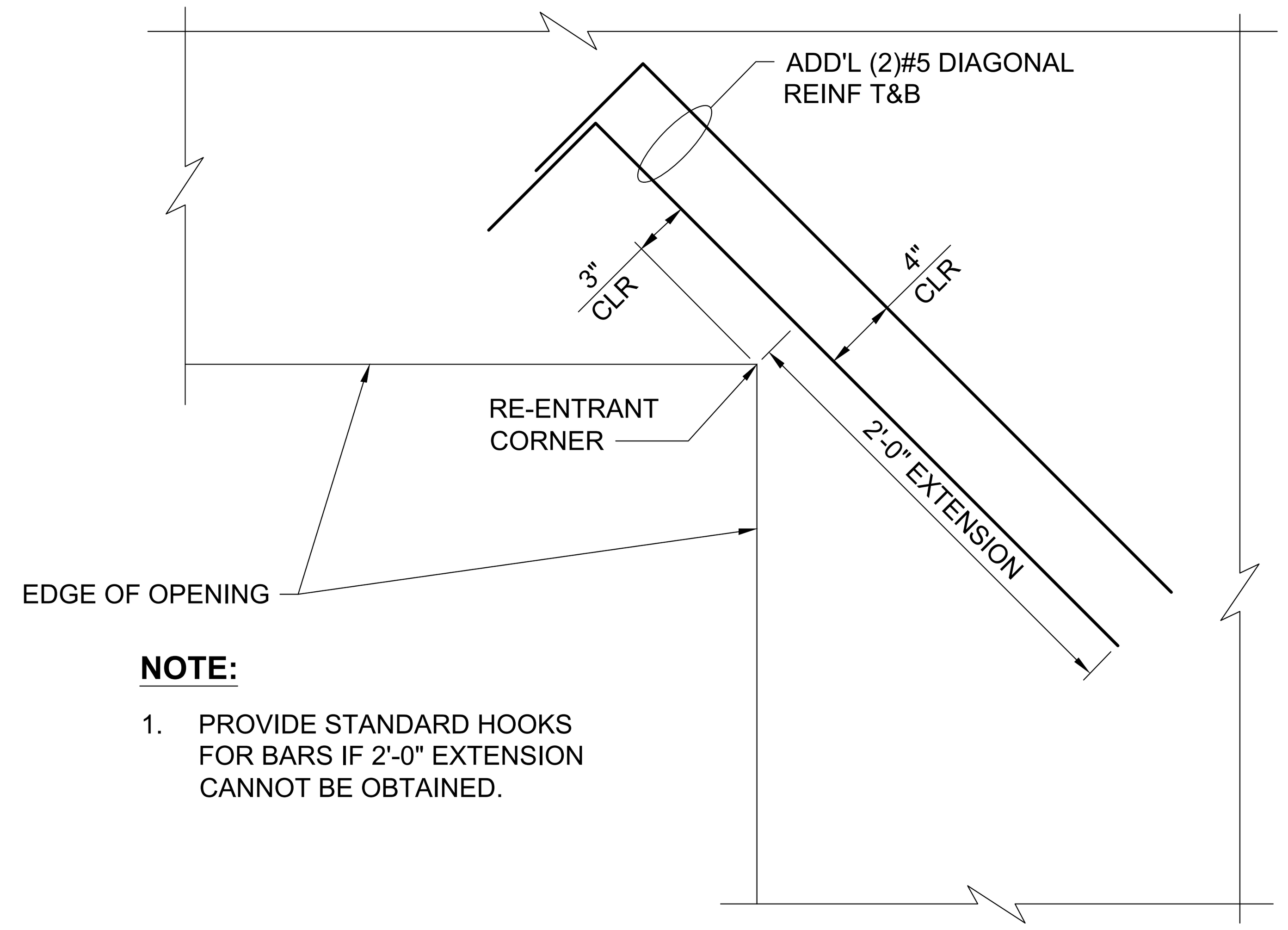
**NOTES:**

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



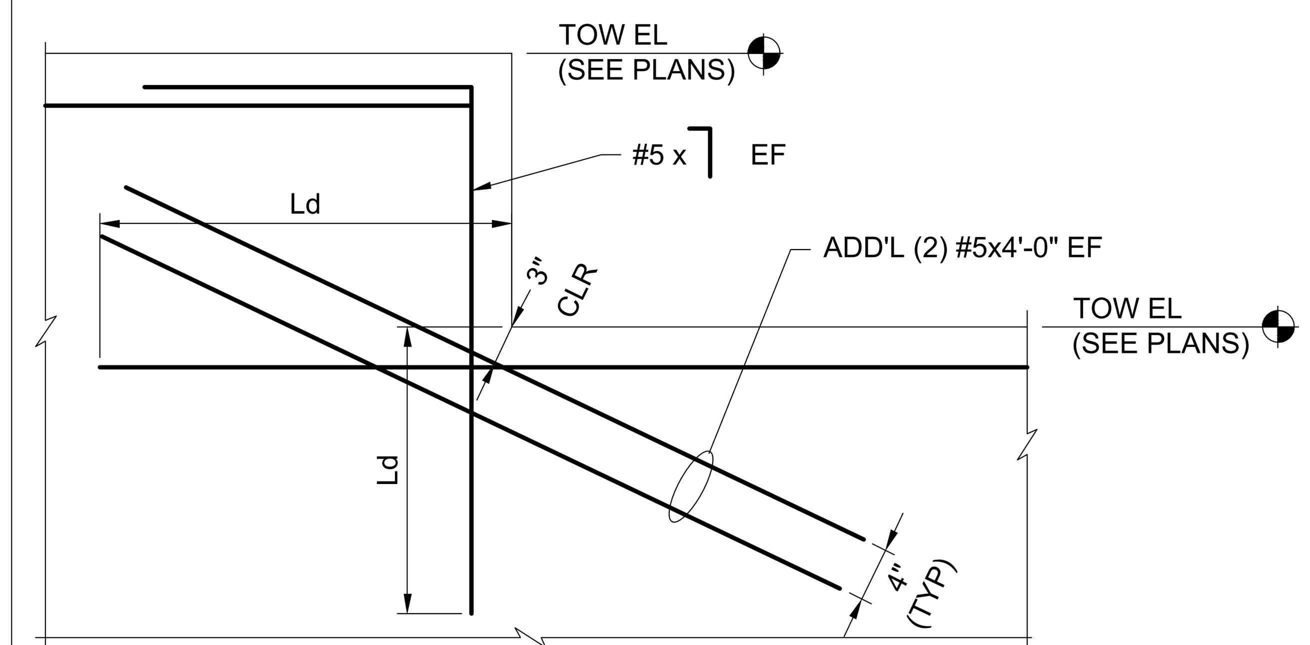

**NOTE:**

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"

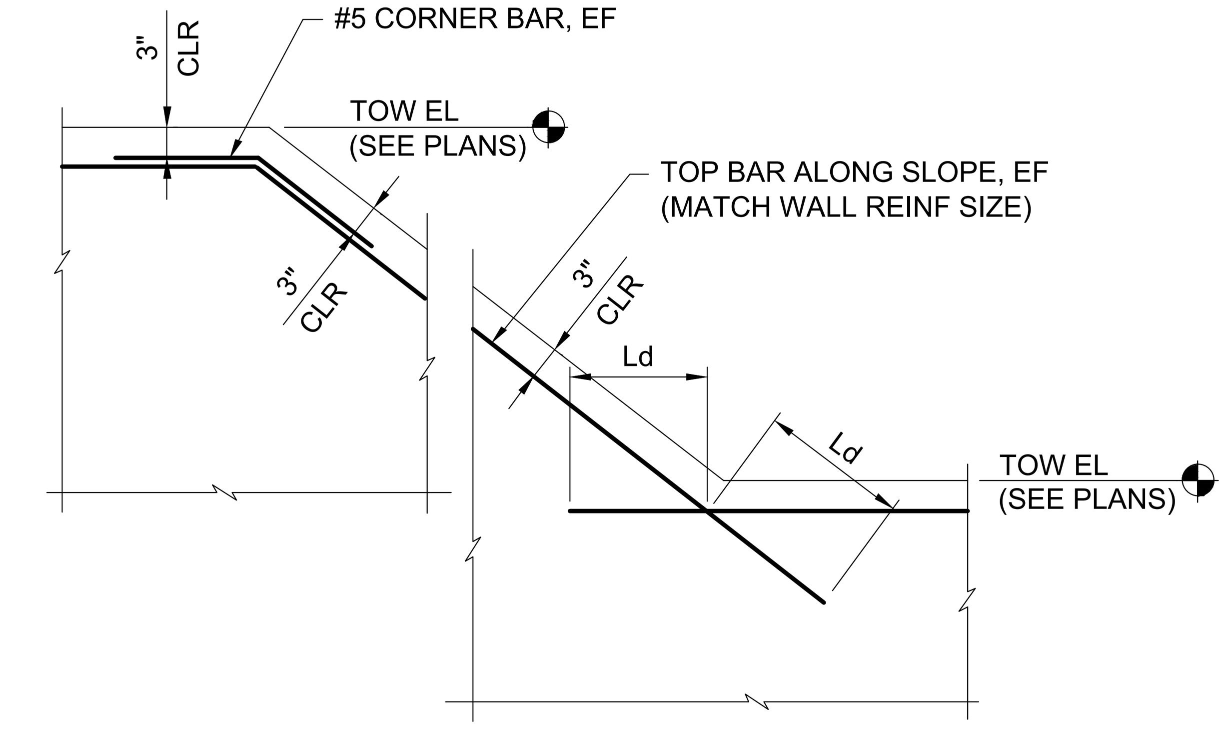
**NOTE:**
Ld SHALL BE DEVELOPMENT LENGTH PER DETAIL 1/S-501




**ELEVATION**

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

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

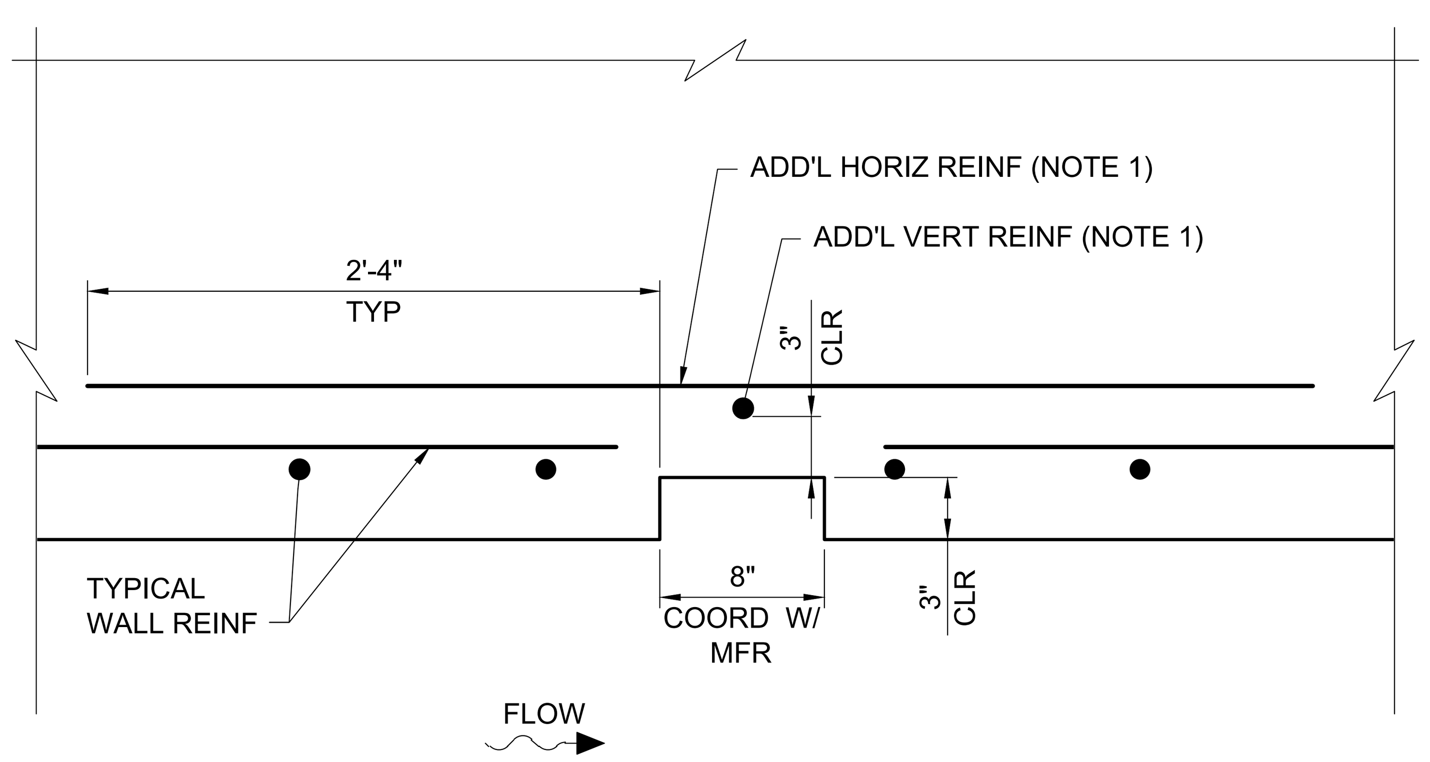



**ELEVATION**

4 - **SLOPING TOP OF WALL DETAIL**
SCALE: 1/4"=1'-0"

**NOTE:**

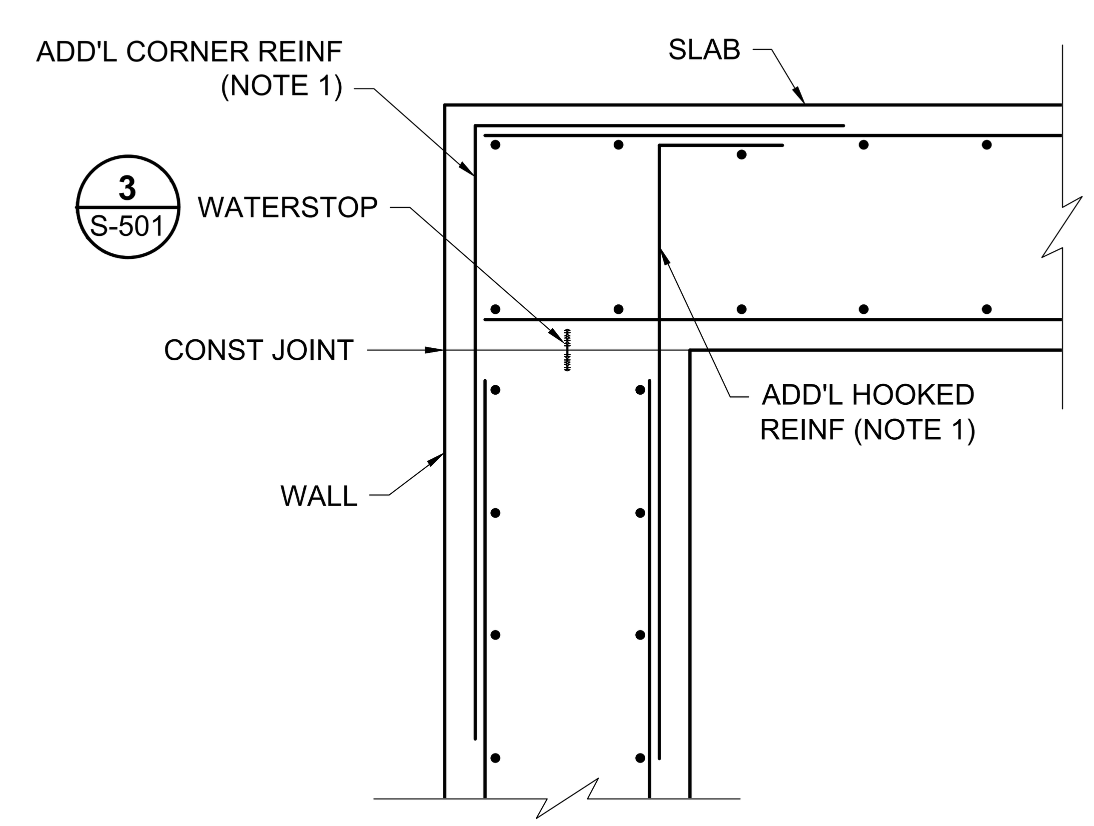
1. ADD'L REINF SIZE AND SPACING SHALL MATCH WALL REINF.




5 - **BULKHEAD/STOPLOG SLOT DETAIL**
SCALE: 1-1/2"=1'-0"

**NOTE:**

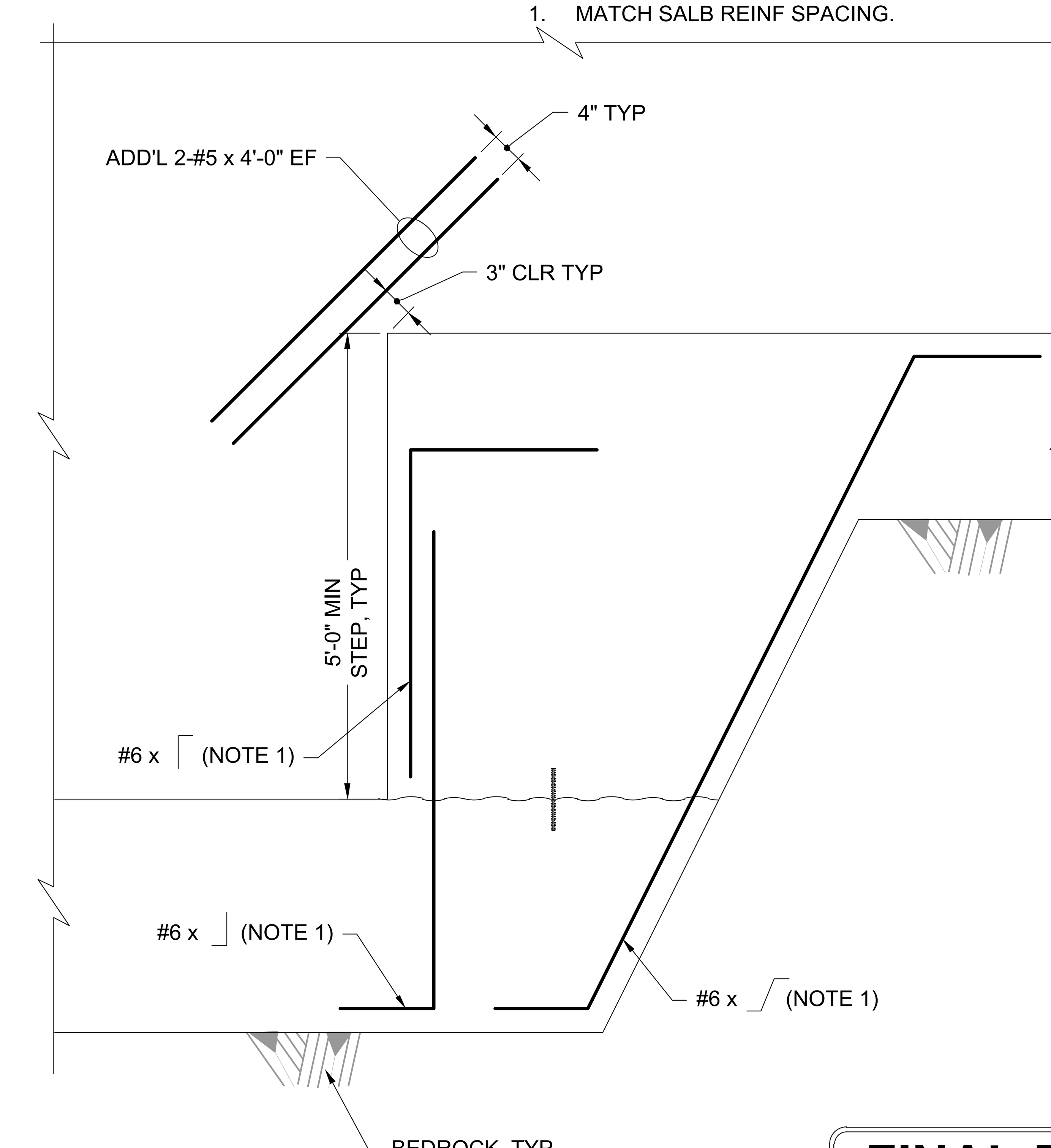
1. ADD'L REINF SIZE & SPACING SHALL MATCH WALL REINF.




6 - **TOP SLAB TO WALL DETAIL**
SCALE: NTS

**NOTE:**

1. MATCH SALB REINF SPACING.




7 - **LARGE CONC STEP DETAIL**
SCALE: NTS

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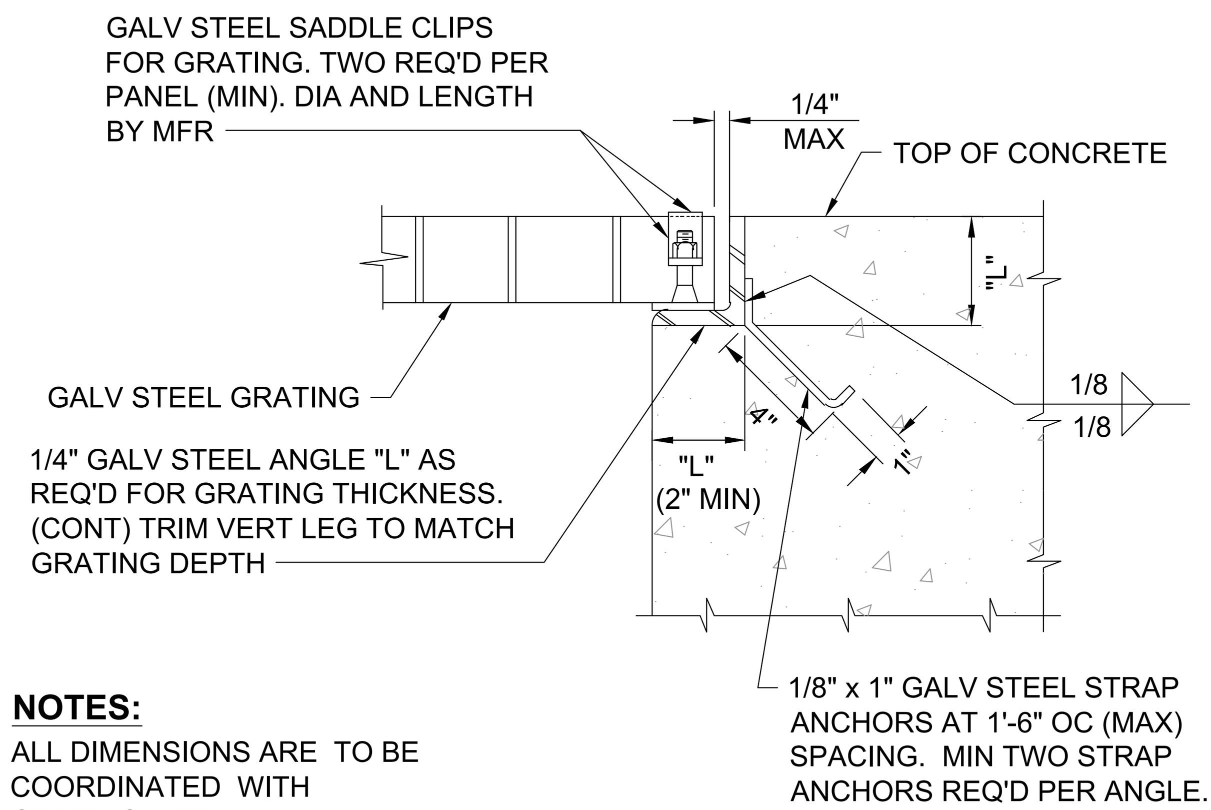
MARK DANIEL GRAESER
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

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

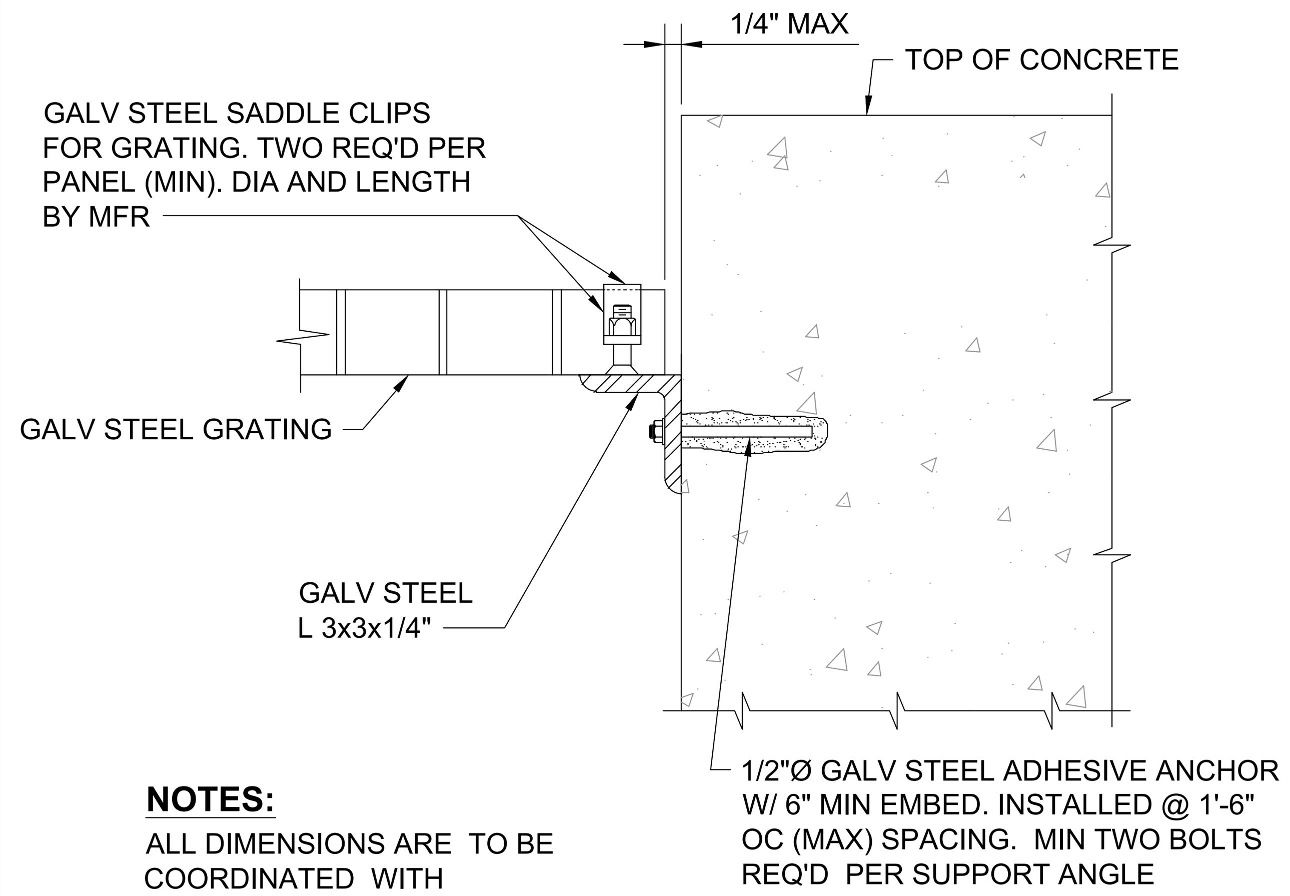
STRUCTURAL STANDARD DETAILS

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:**
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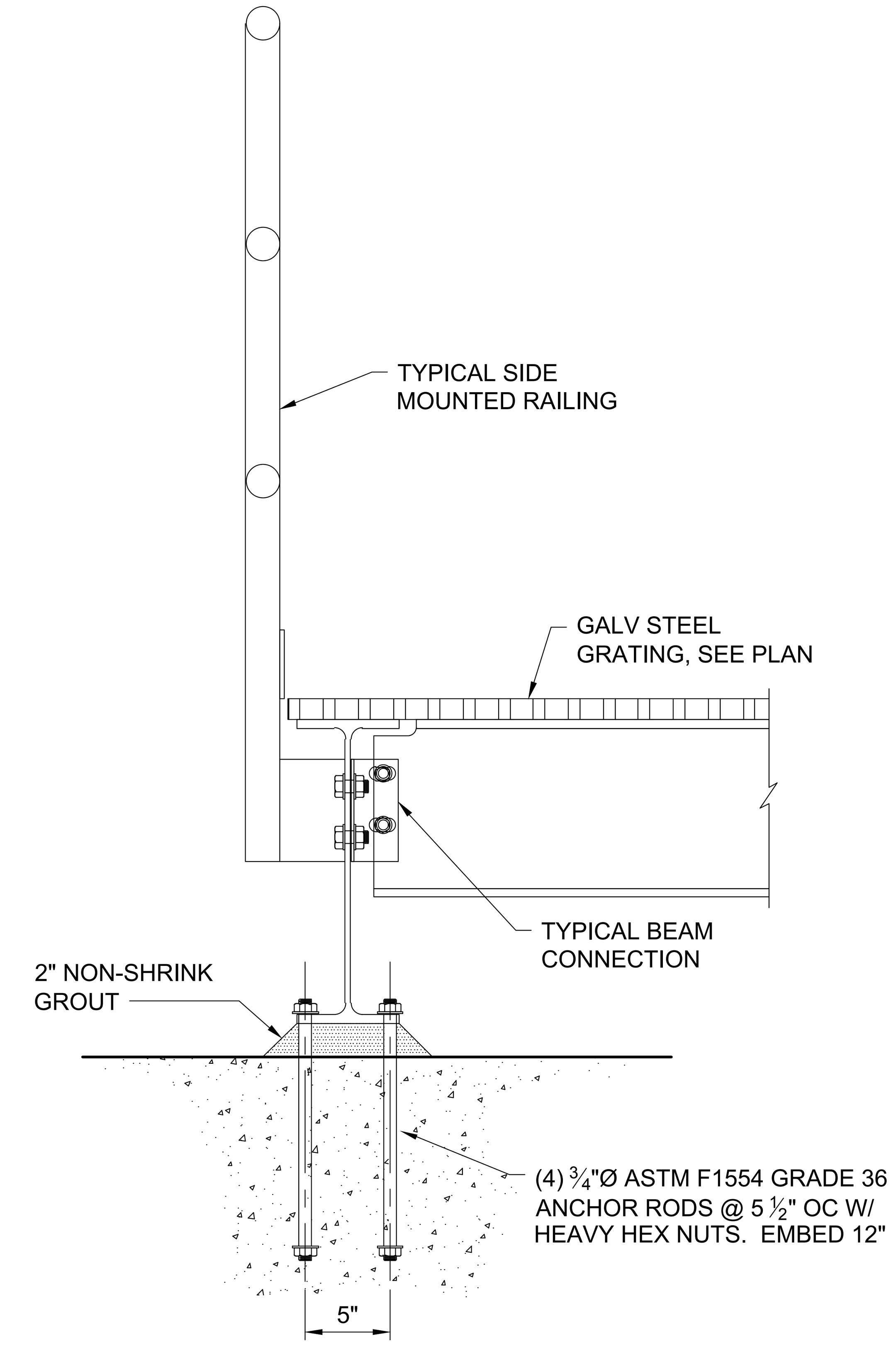
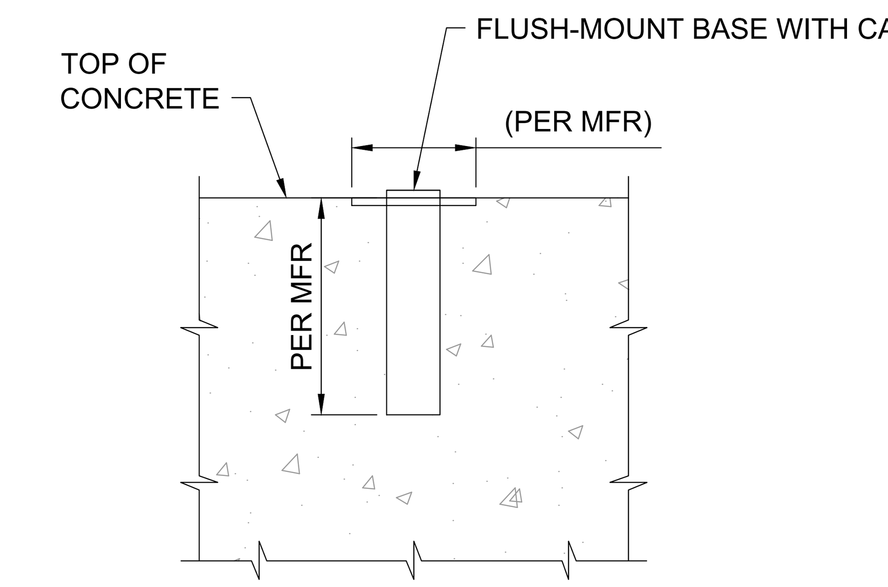
**2 GRATING SUPPORT TYPE 2**
SCALE: NTS

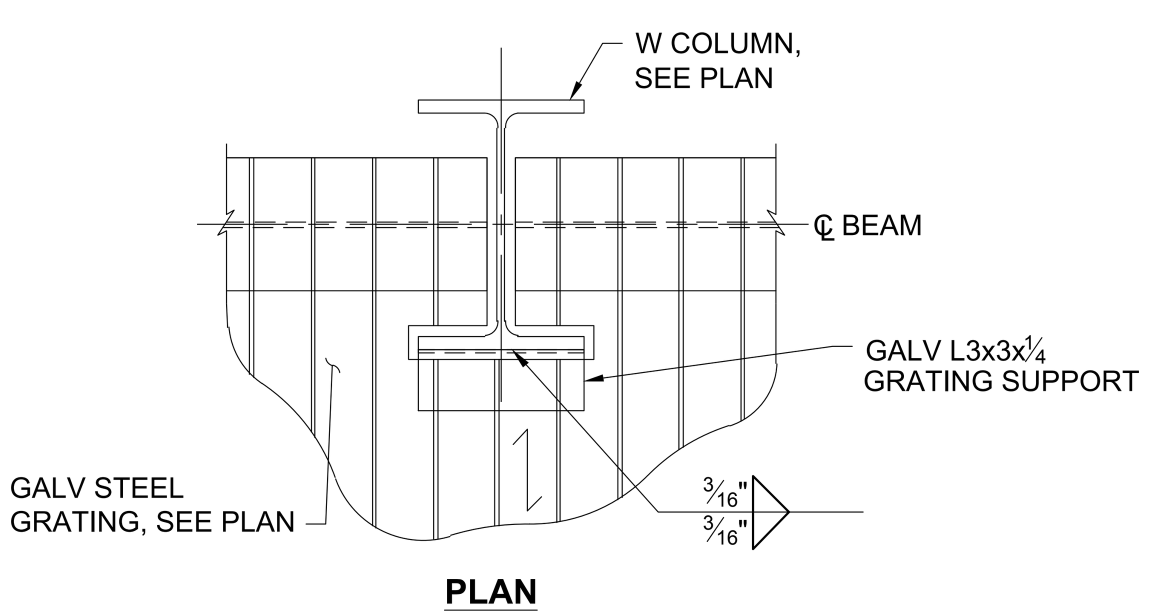



**A DETAIL**
SCALE: 1 1/2"=1'-0"

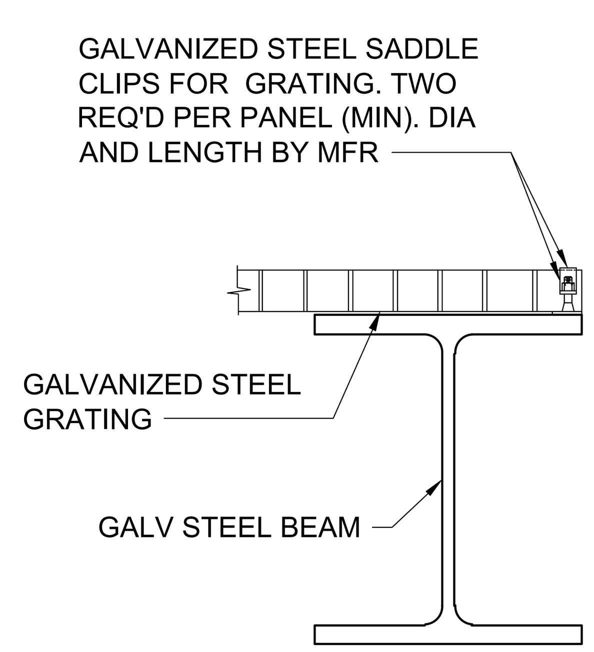
**NOTES:**
1. FLUSH FLOOR MOUNT SLEEVE SHALL BE MADE OF STURCTURAL STEEL.
2. LOCATE SLEEVE AT DIRECTION OF OWNER.
3. EACH MOUNT SHALL HAVE A CAP TO KEEP WATER AND DEBRIS OUT OF BASE.




**5 SAFETY ANCHORAGE BASE**
SCALE: 3/4"=1'-0"

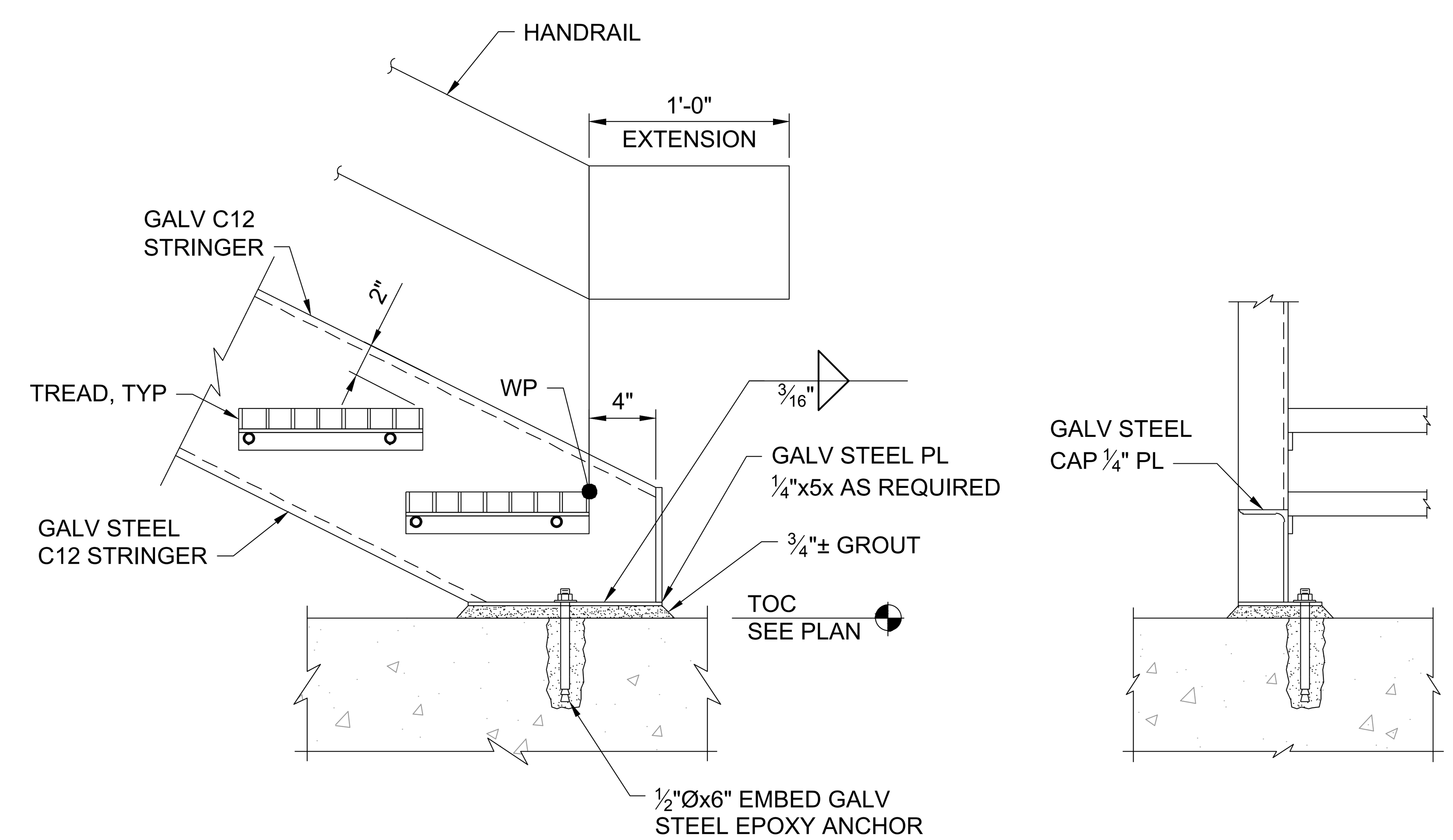



**3 GRATING SUPPORT @ COLUMNS**
SCALE: 1 1/2"=1'-0"




**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"

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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

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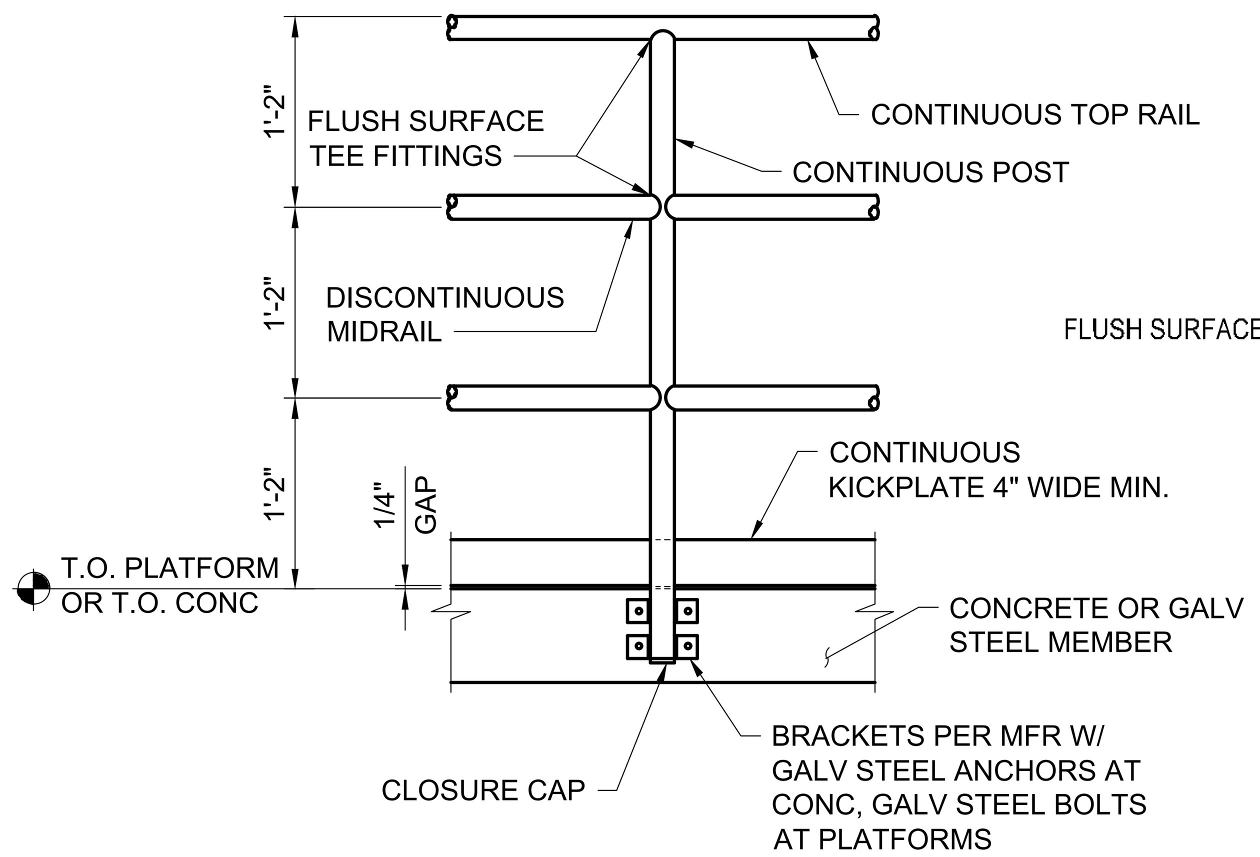
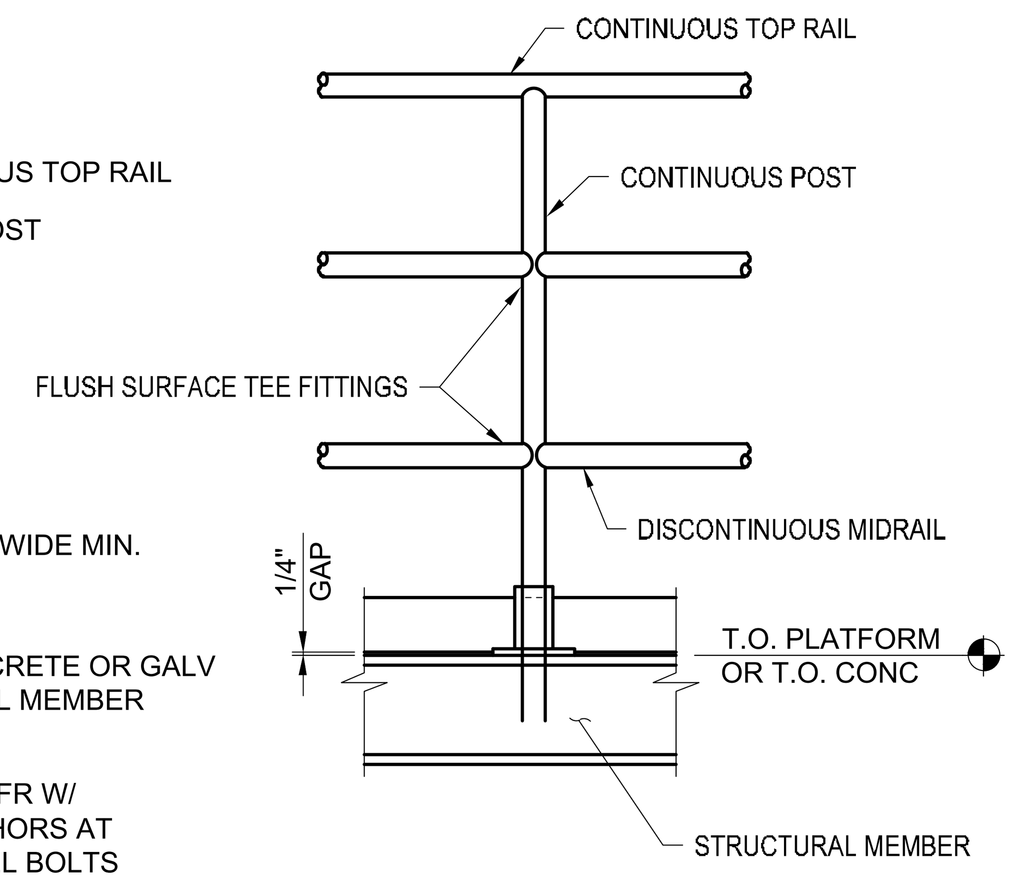
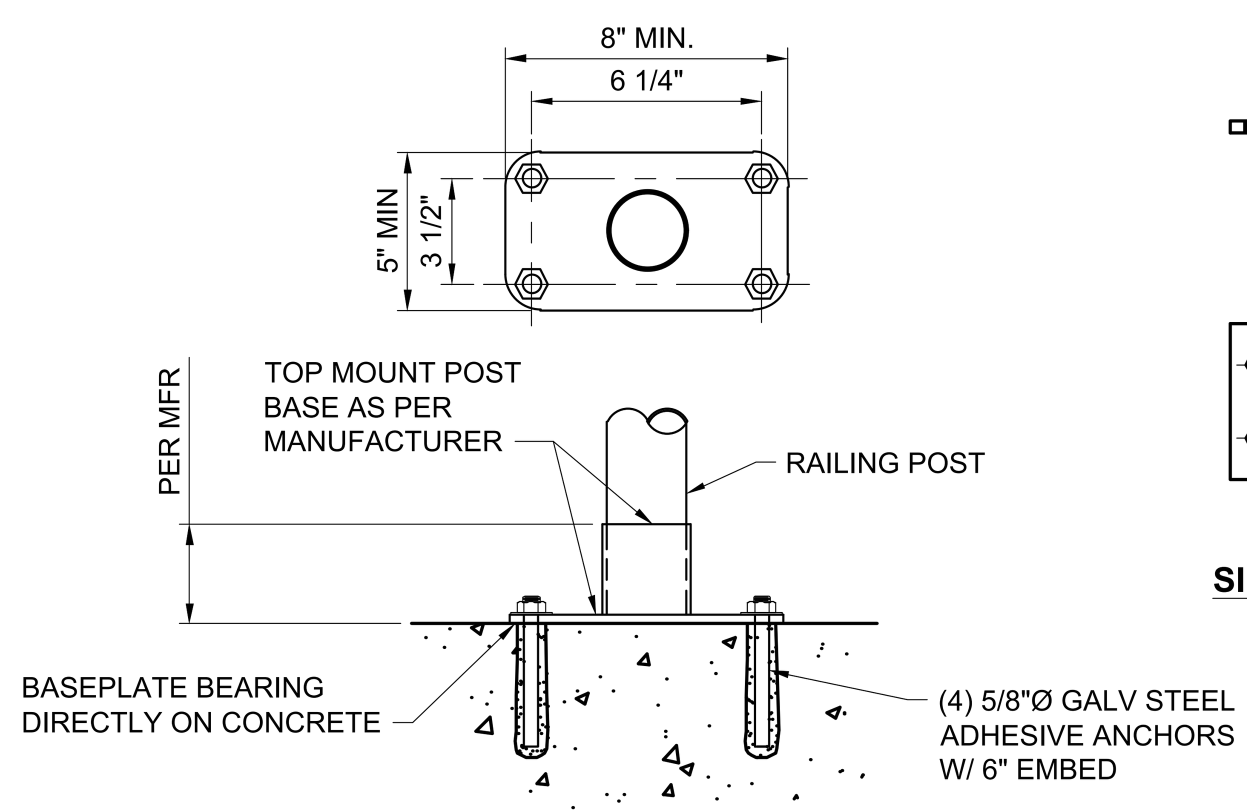


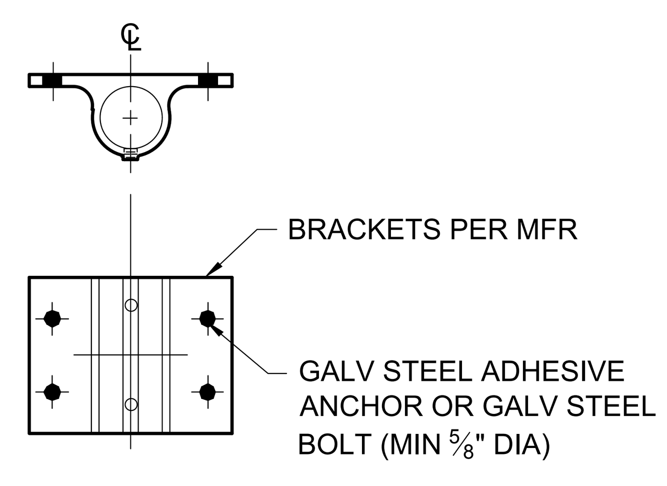

**SIDE MOUNTED POST DETAIL**



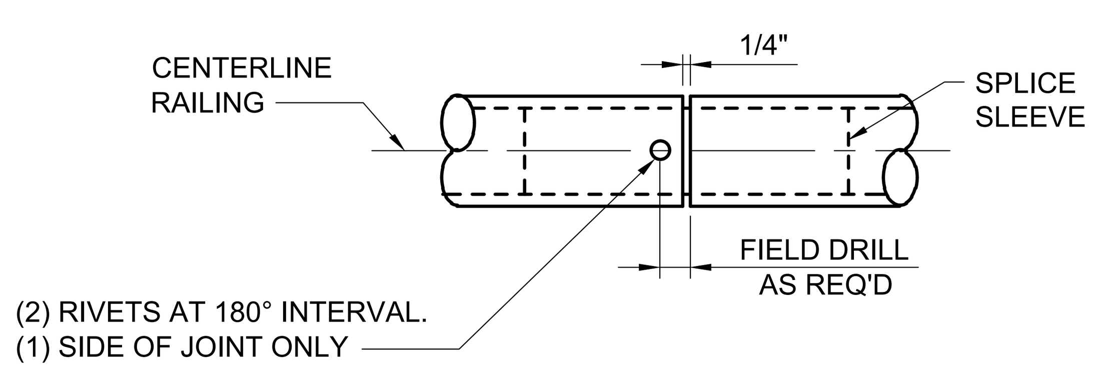

**SURFACE MOUNTED**




**SURFACE POST DETAIL**




**SIDE MOUNTED**

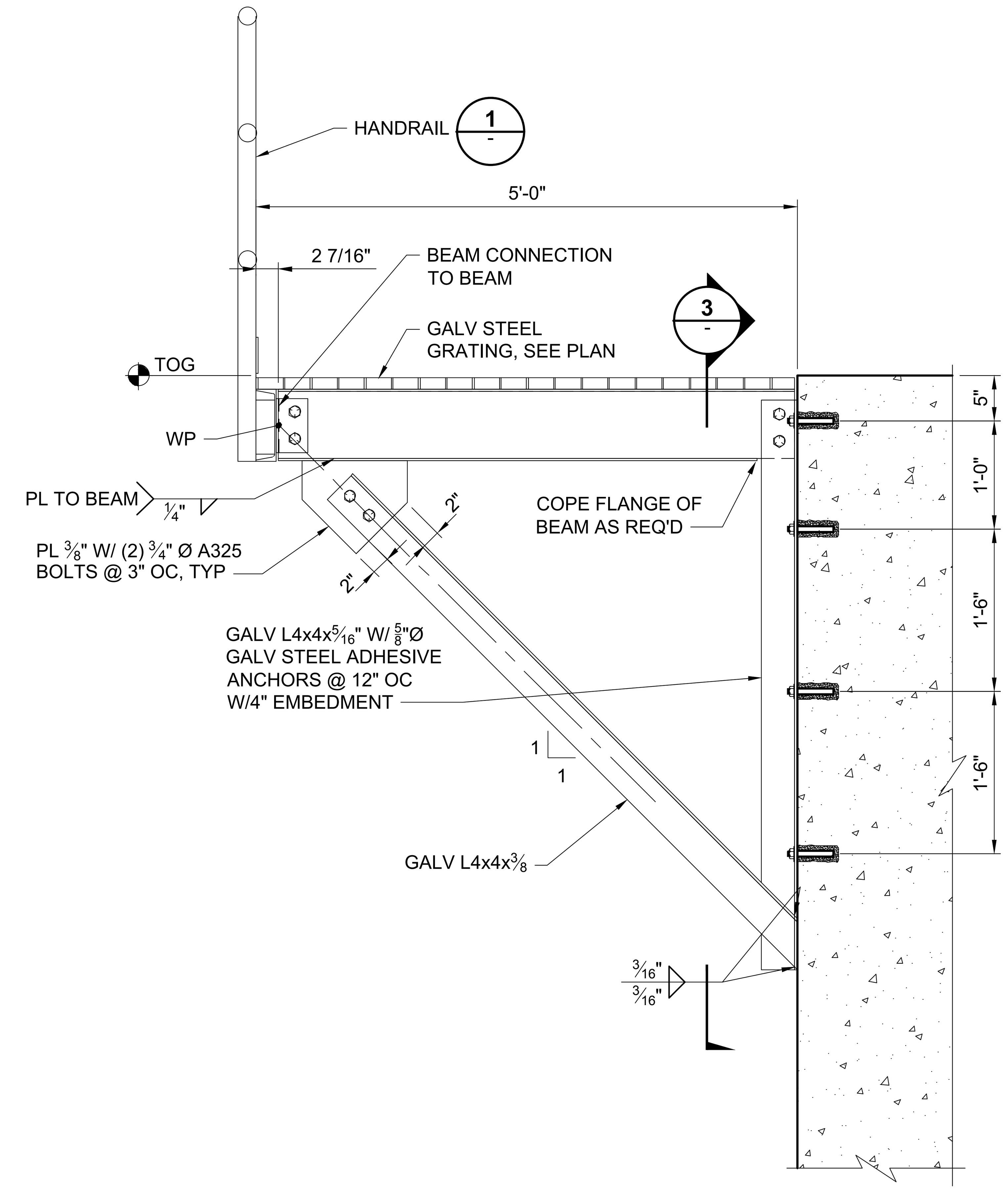



**RAIL SPLICE DETAIL**

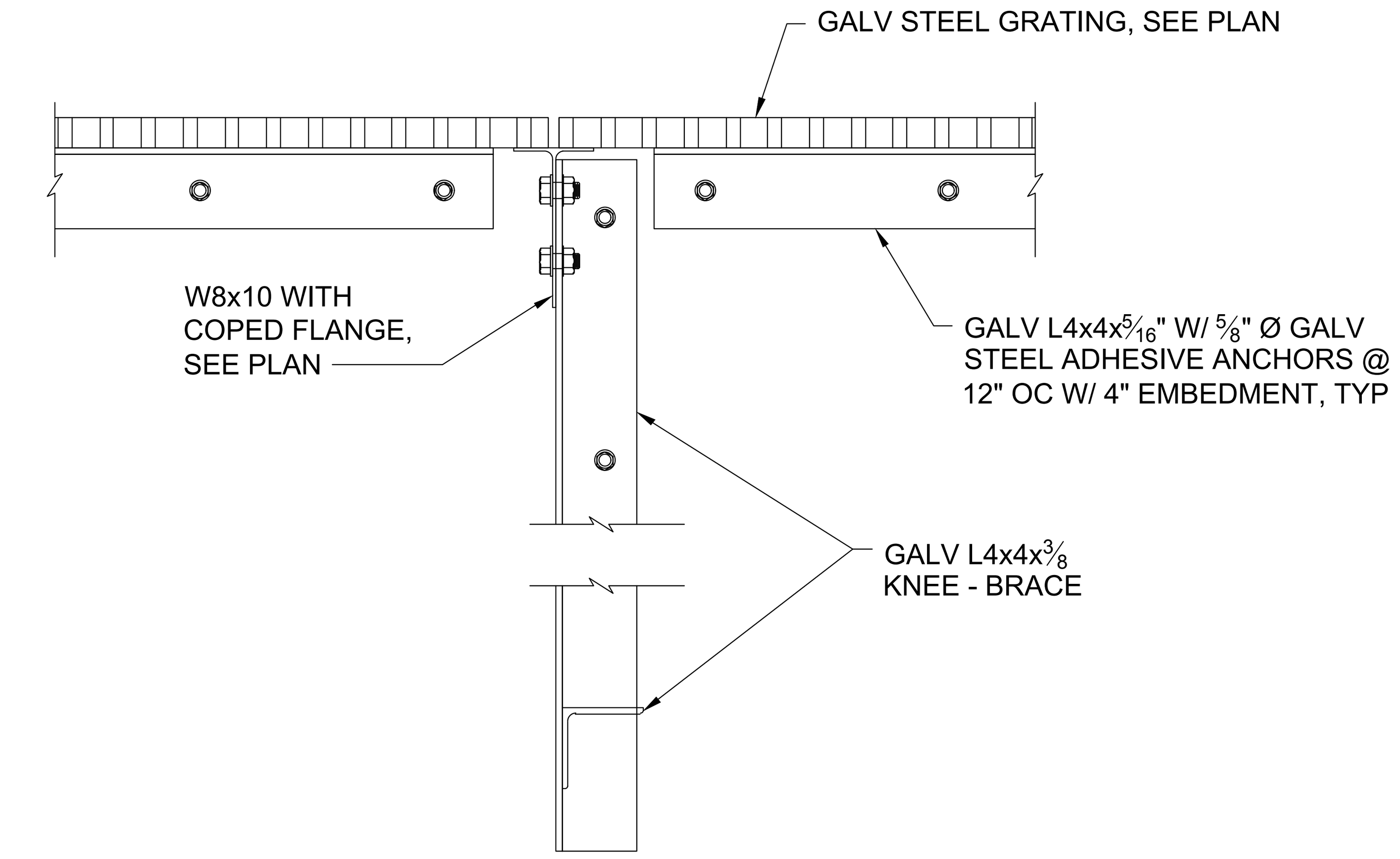
**RAILING NOTES**

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".

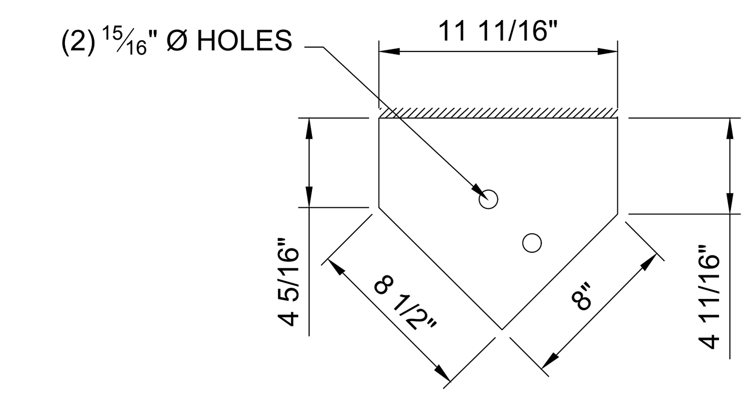
**1 HANDRAIL DETAIL**
SCALE: NTS




**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"

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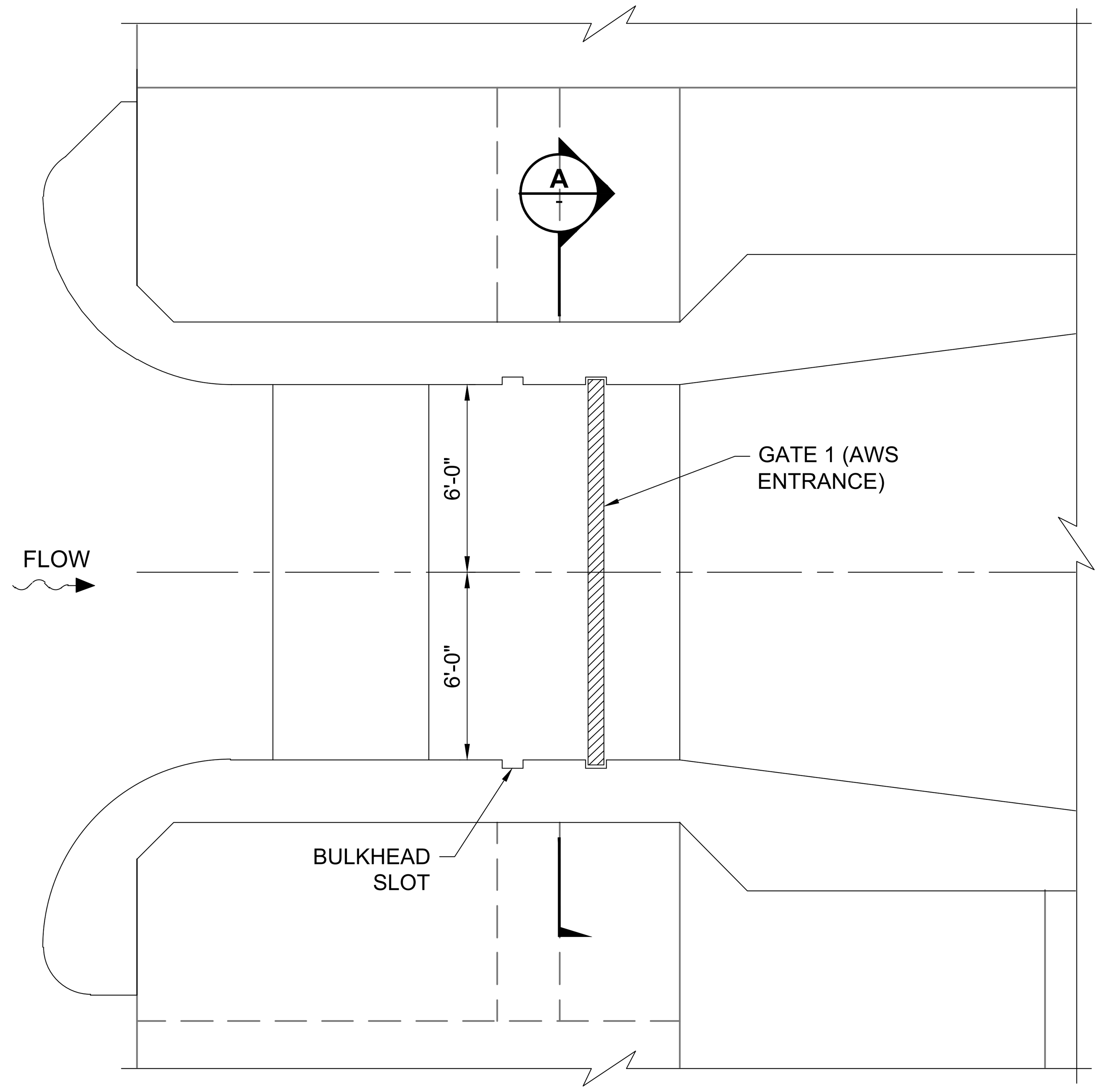
No.39328
LICENSED PROFESSIONAL ENGINEER
12/13/2019

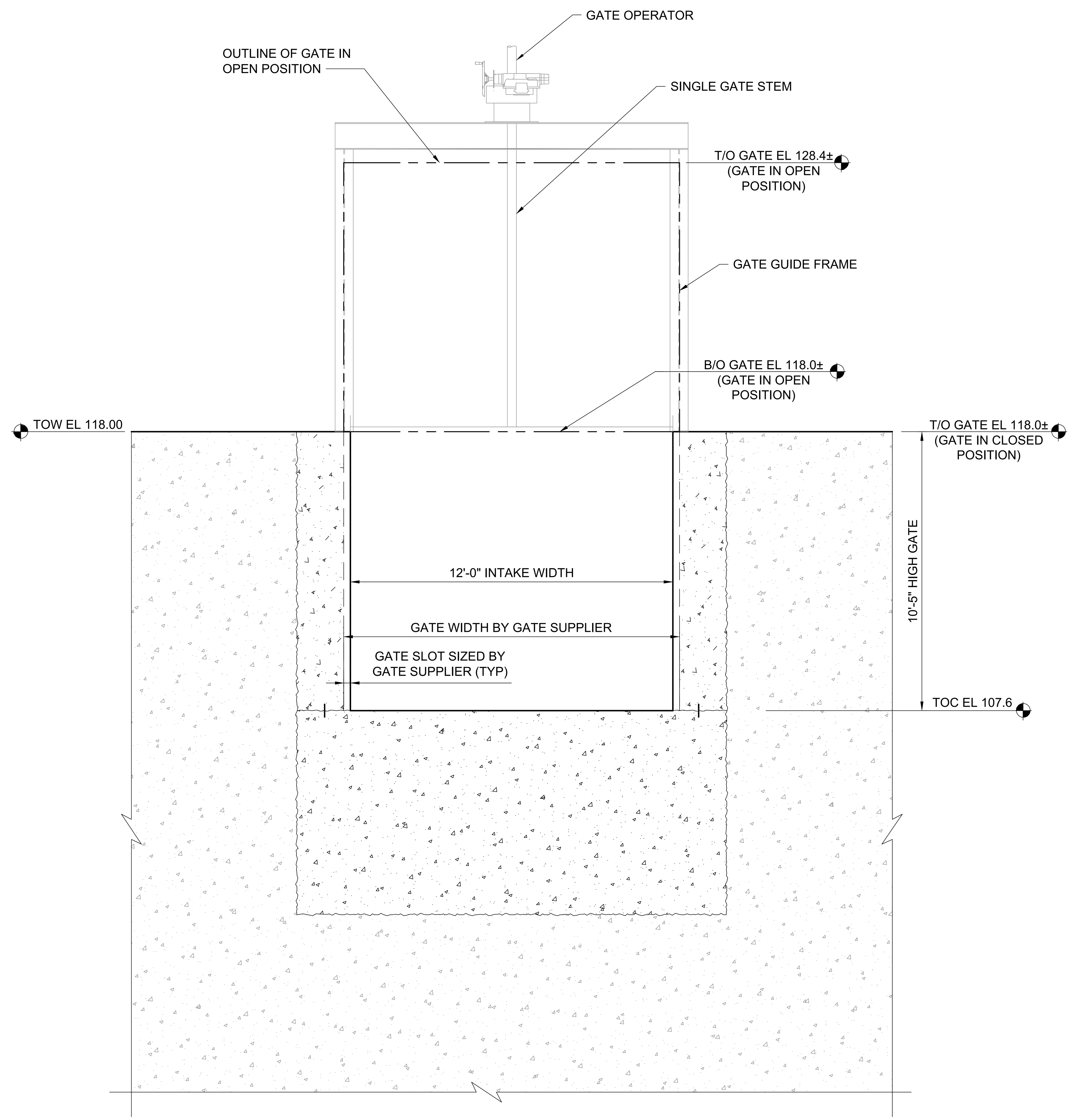
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

STRUCTURAL STANDARD DETAILS

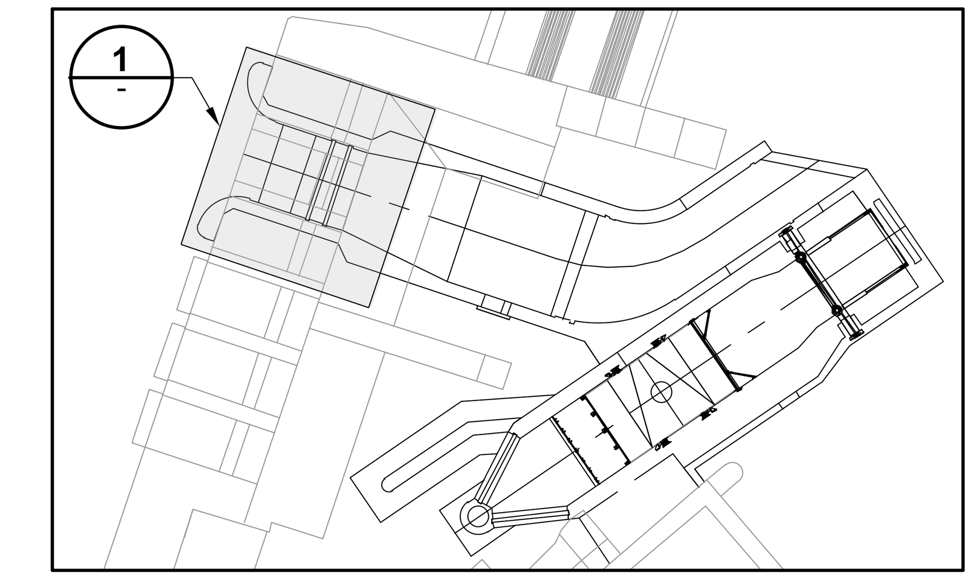
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: R. YOUNG
APPROVED BY: M. GRAESER
SHEET: 82 OF 176
DRAWING: S-505




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)

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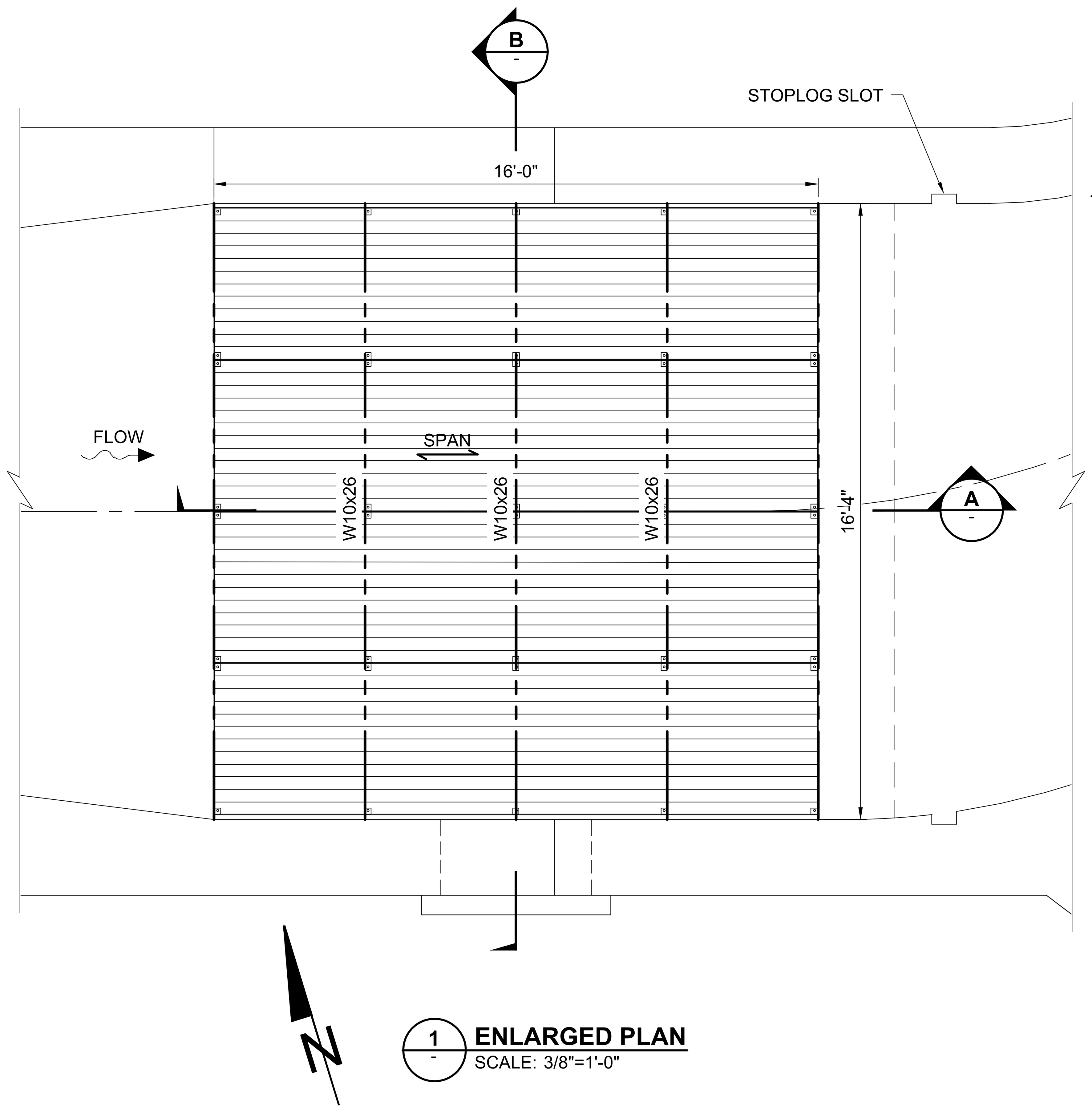
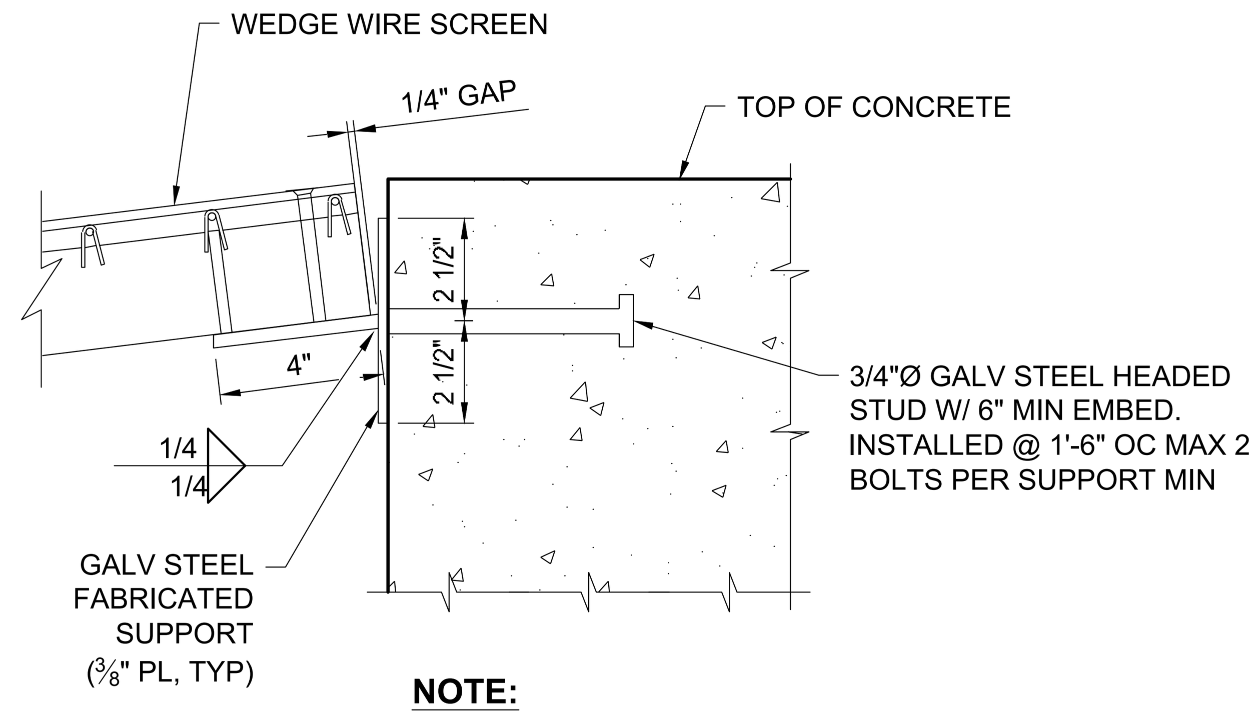
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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

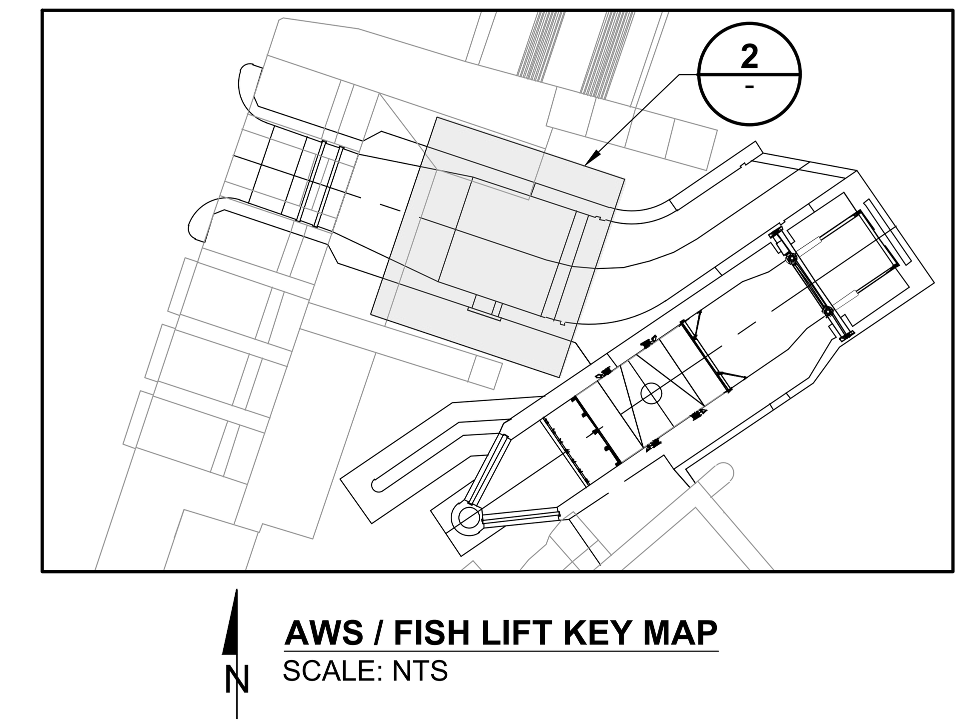



1 ENLARGED PLAN
SCALE: 3/8"=1'-0"



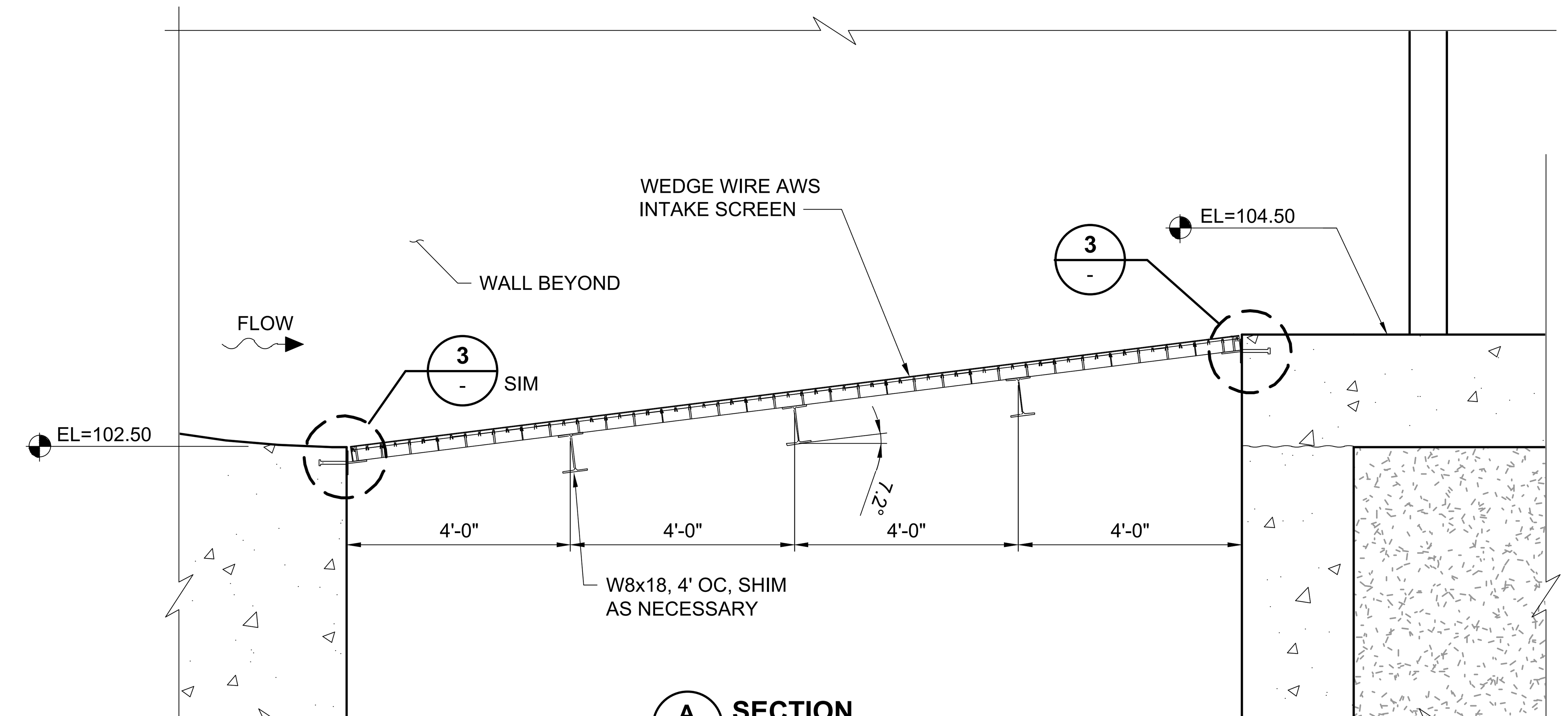

**NOTE:**
1. ALL DIMENSIONS ARE TO BE COORDINATED WITH WEDGE WIRE SCREEN MFR.

3 WEDGE WIRE SCREEN SUPPORT
SCALE: NTS

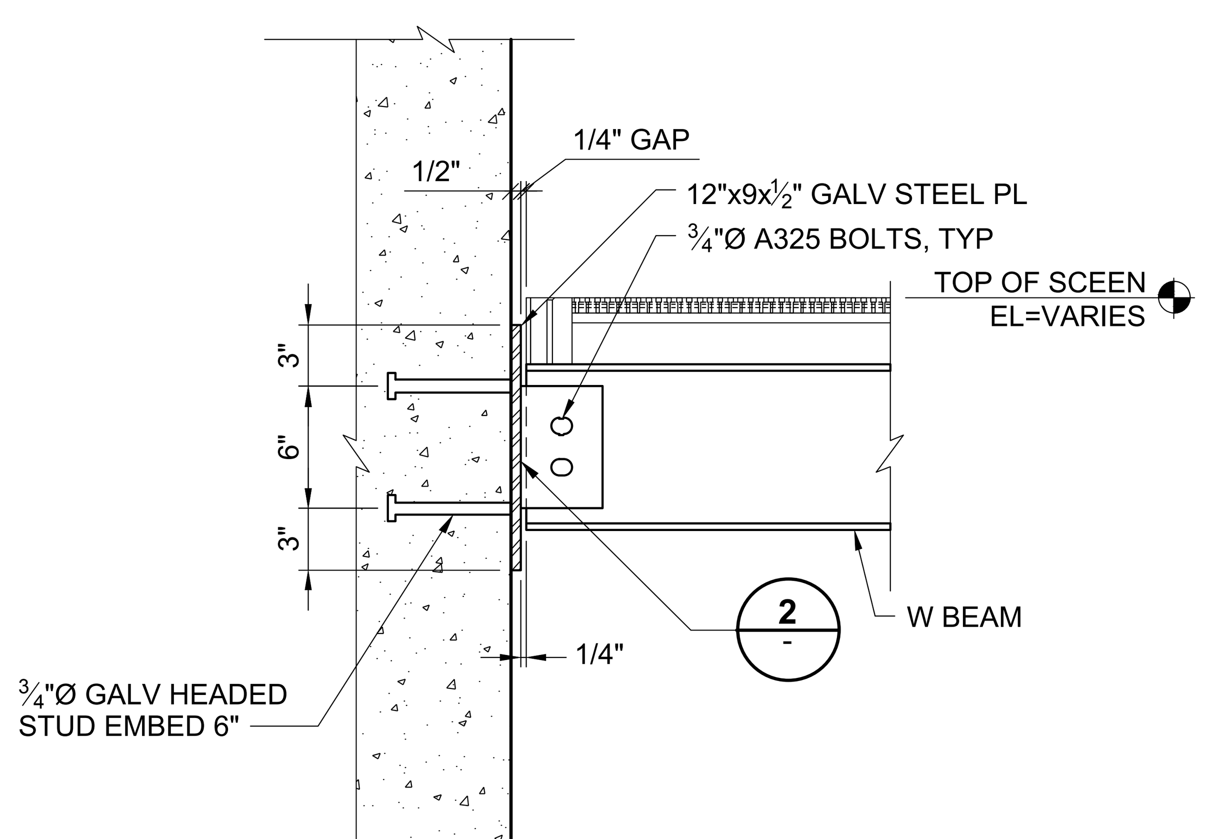



AWS / FISH LIFT KEY MAP
SCALE: NTS

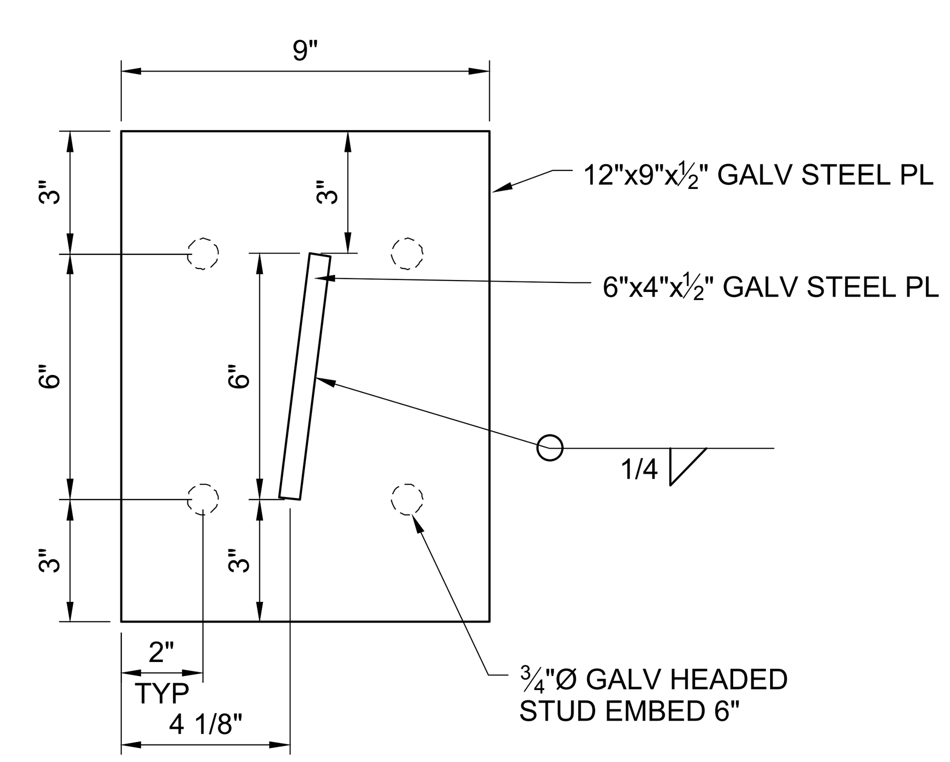
**NOTE:**
1. PROVIDE AIR BURST SYSTEM. SEE SPECIFICATION 35 20 13 FOR DETAILS.



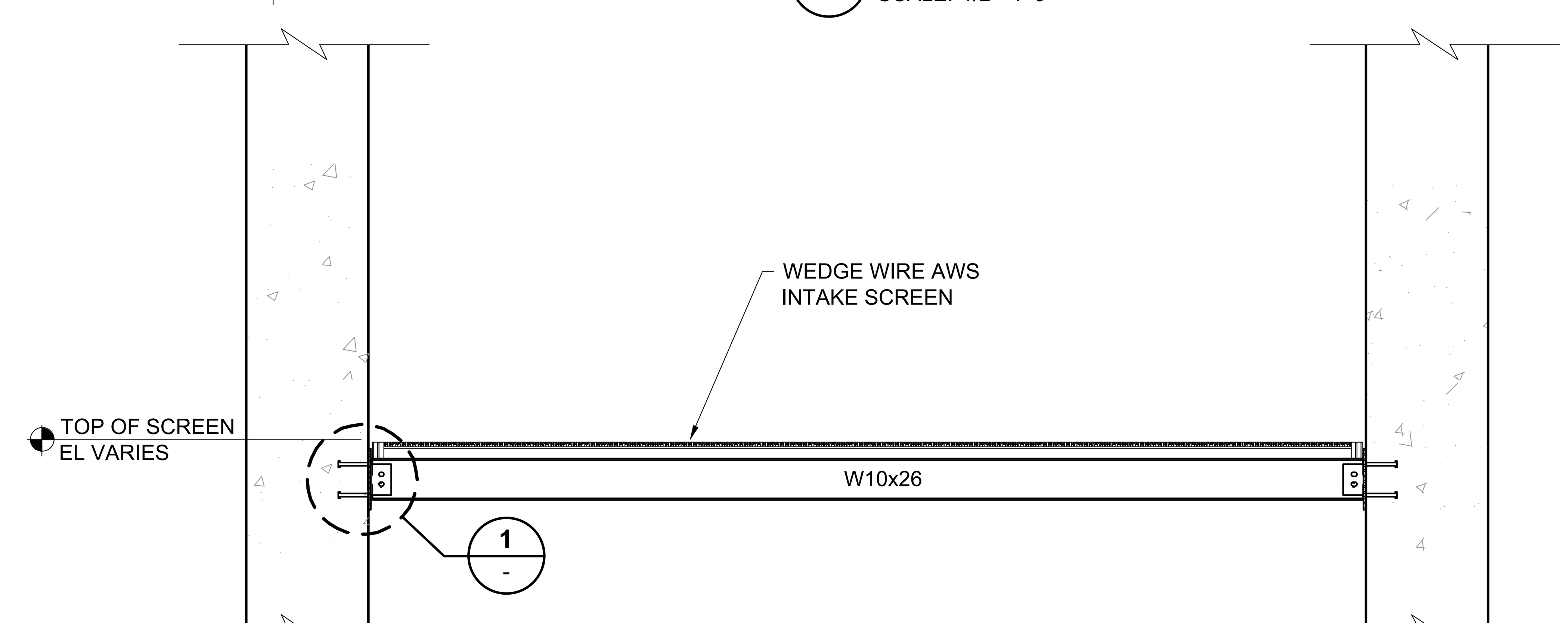

A SECTION
SCALE: 1/2"=1'-0"




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




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




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

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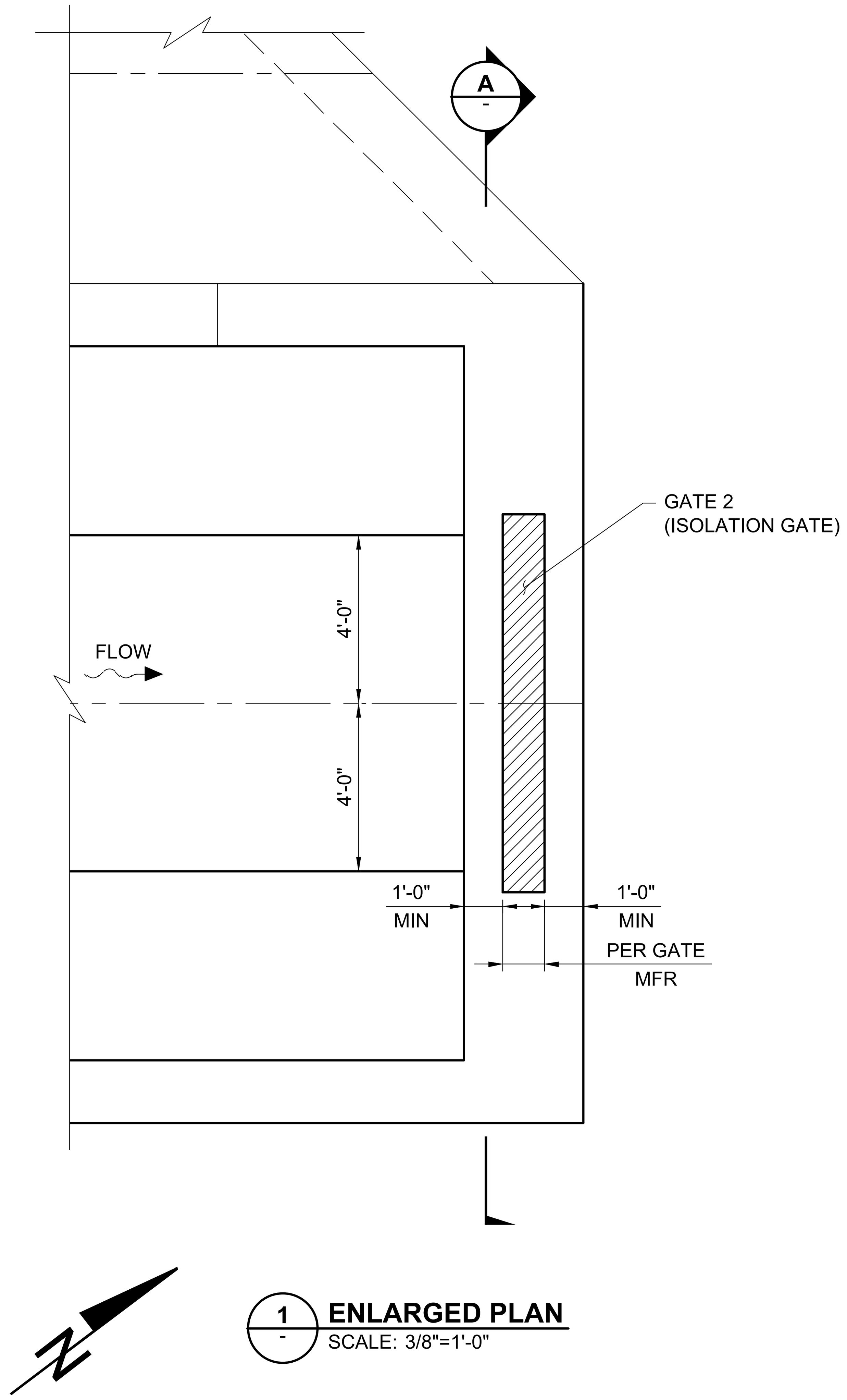
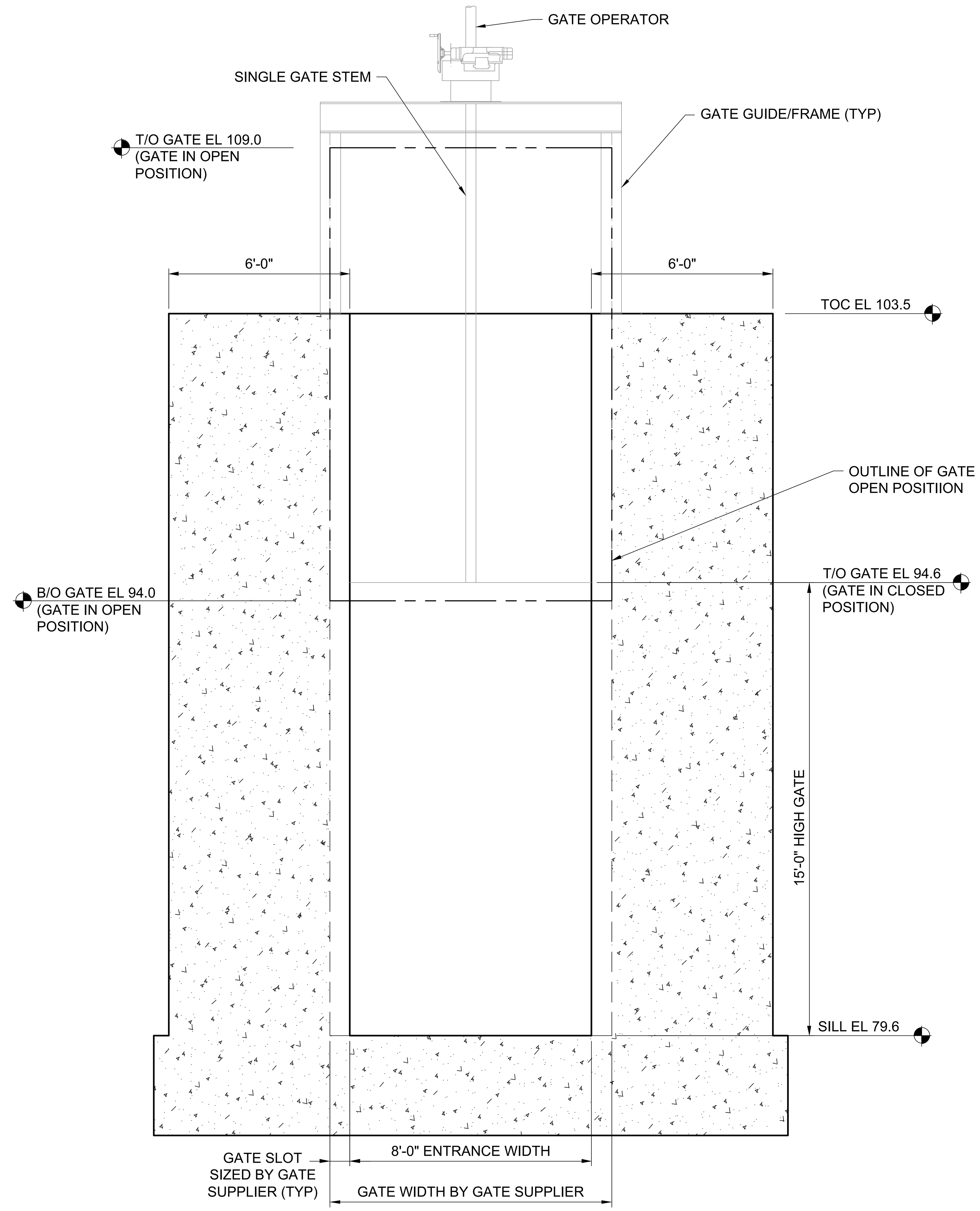
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

WEDGE WIRE AWS INTAKE SCREEN

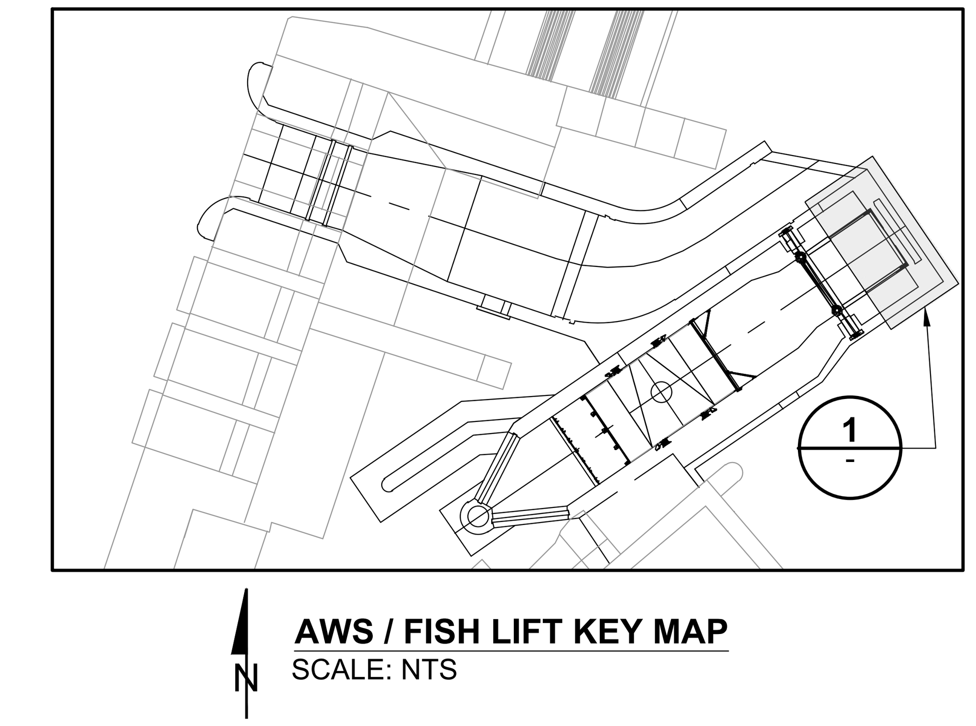
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 84 OF 176 |
| DRAWING: | M-102 |




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




A ELEVATE GATE 2 (ISOLATION GATE)
SCALE: 3/8"=1'-0"




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

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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 |


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

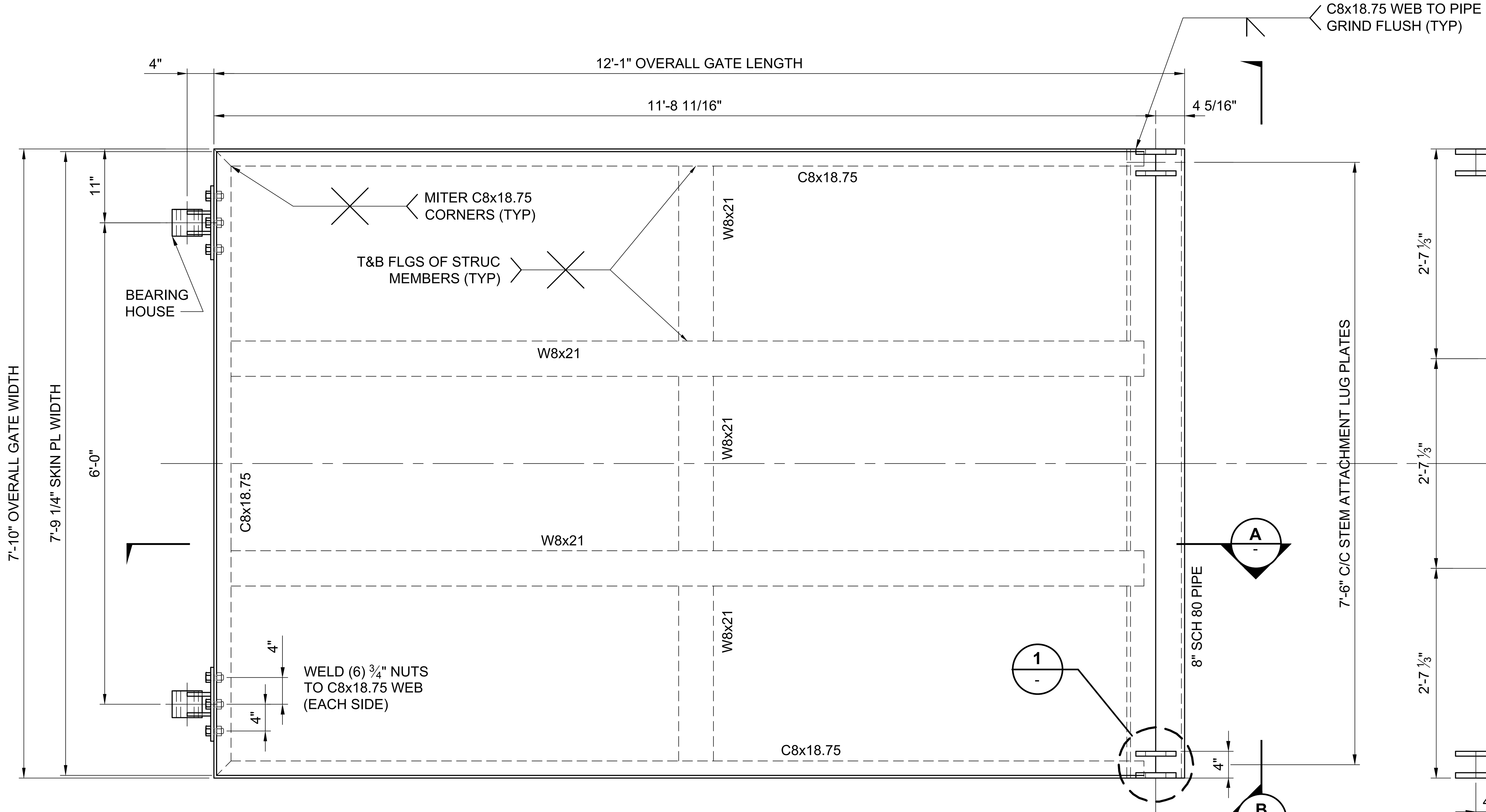
FISH LIFT ENTRANCE GATE
ELEVATIONS AND STEM DETAILS

| | |
|---|---|
| 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\3173009-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:

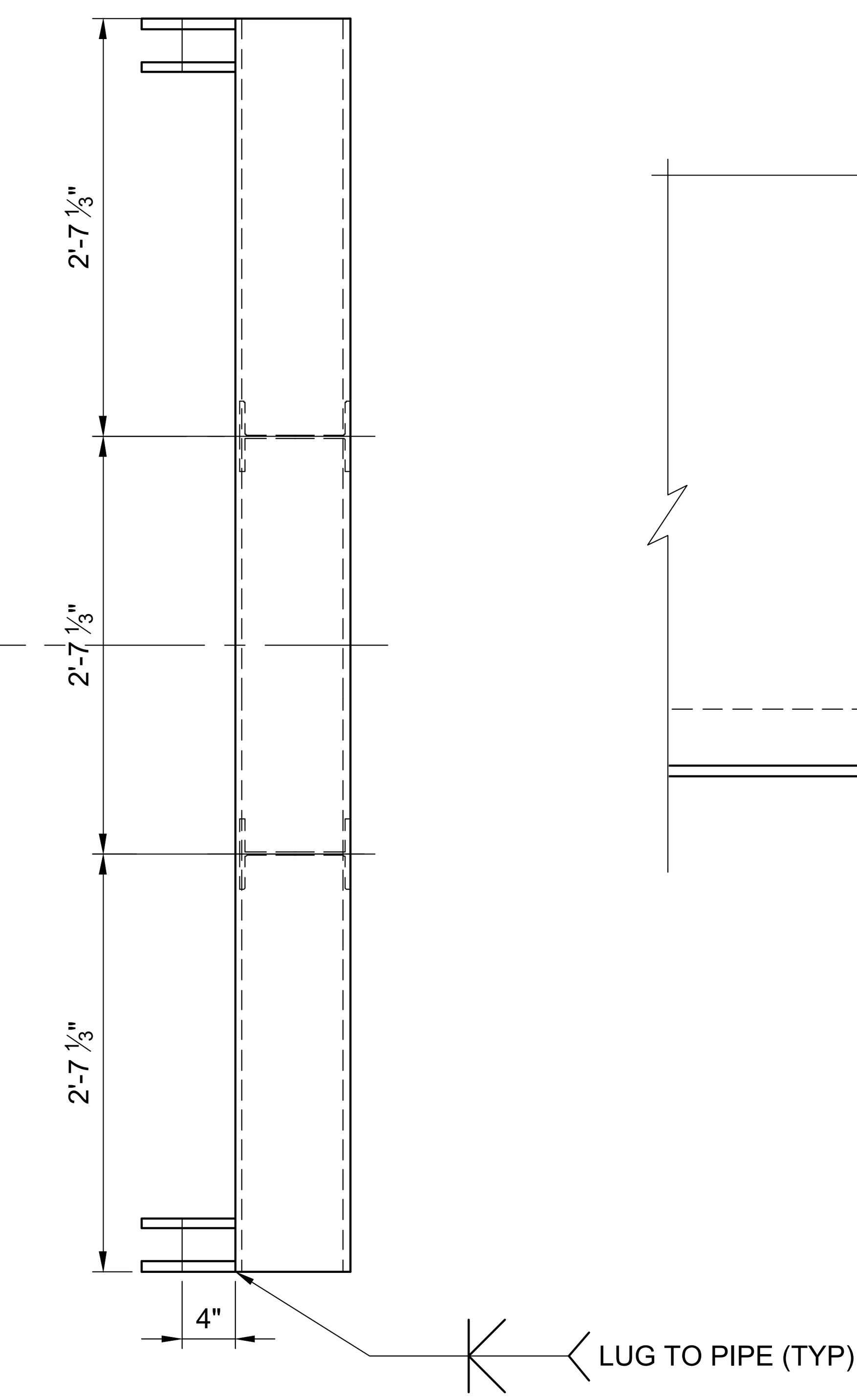
**NOTES:**

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.



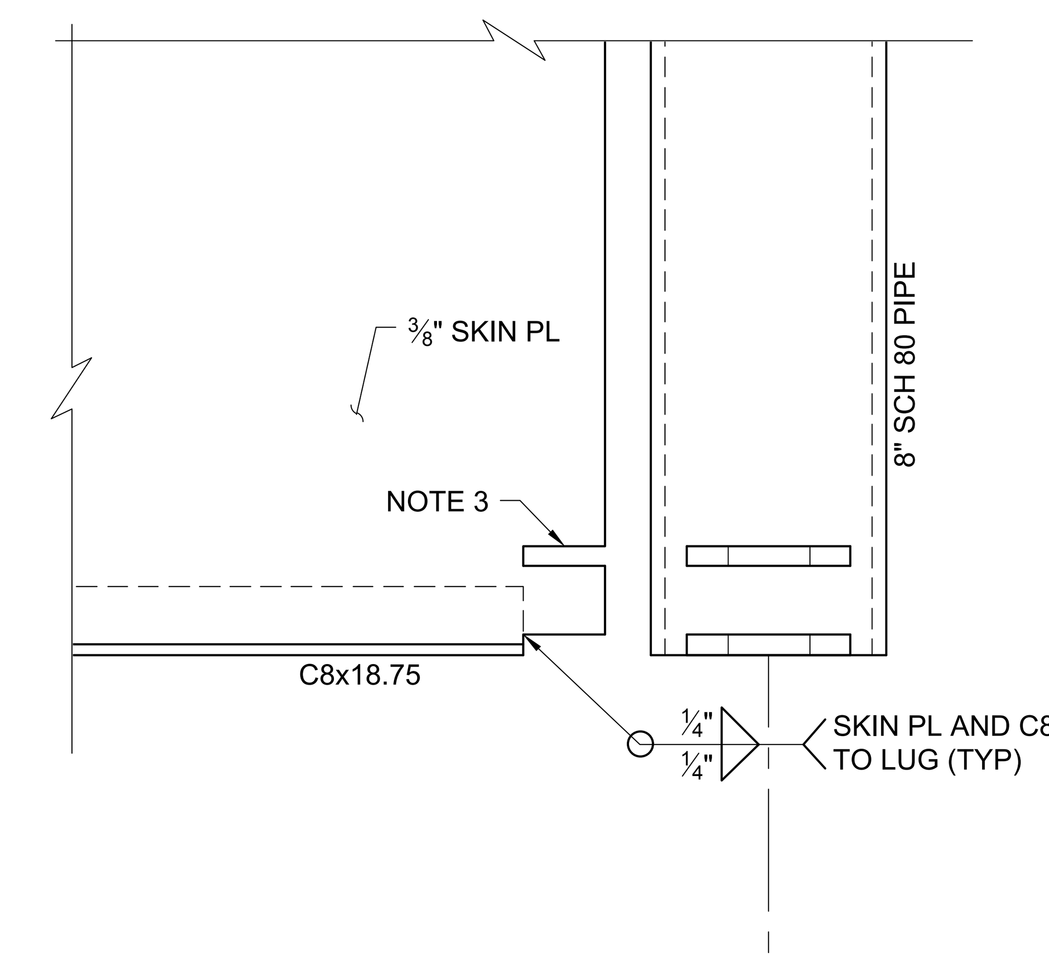

## GATE PLAN/ELEVATION

SCALE: 1"=1'-0"



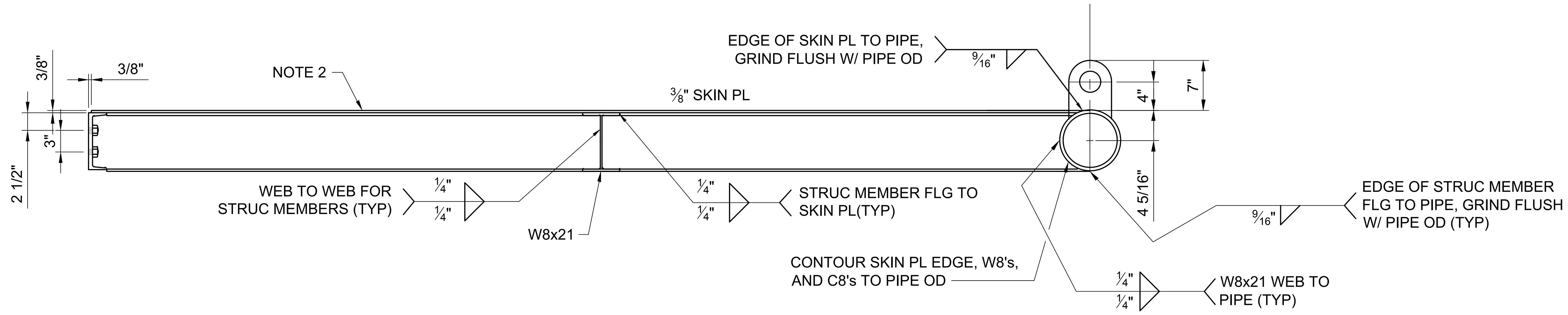

**B** GATE SECTION

SCALE: 1"=1'-0"




**1** SKIN PL TO LUG CONNECTION DETAIL

SCALE: 3"=1'-0"




**A** GATE SECTION @ C/L

SCALE: 1"=1'-0"

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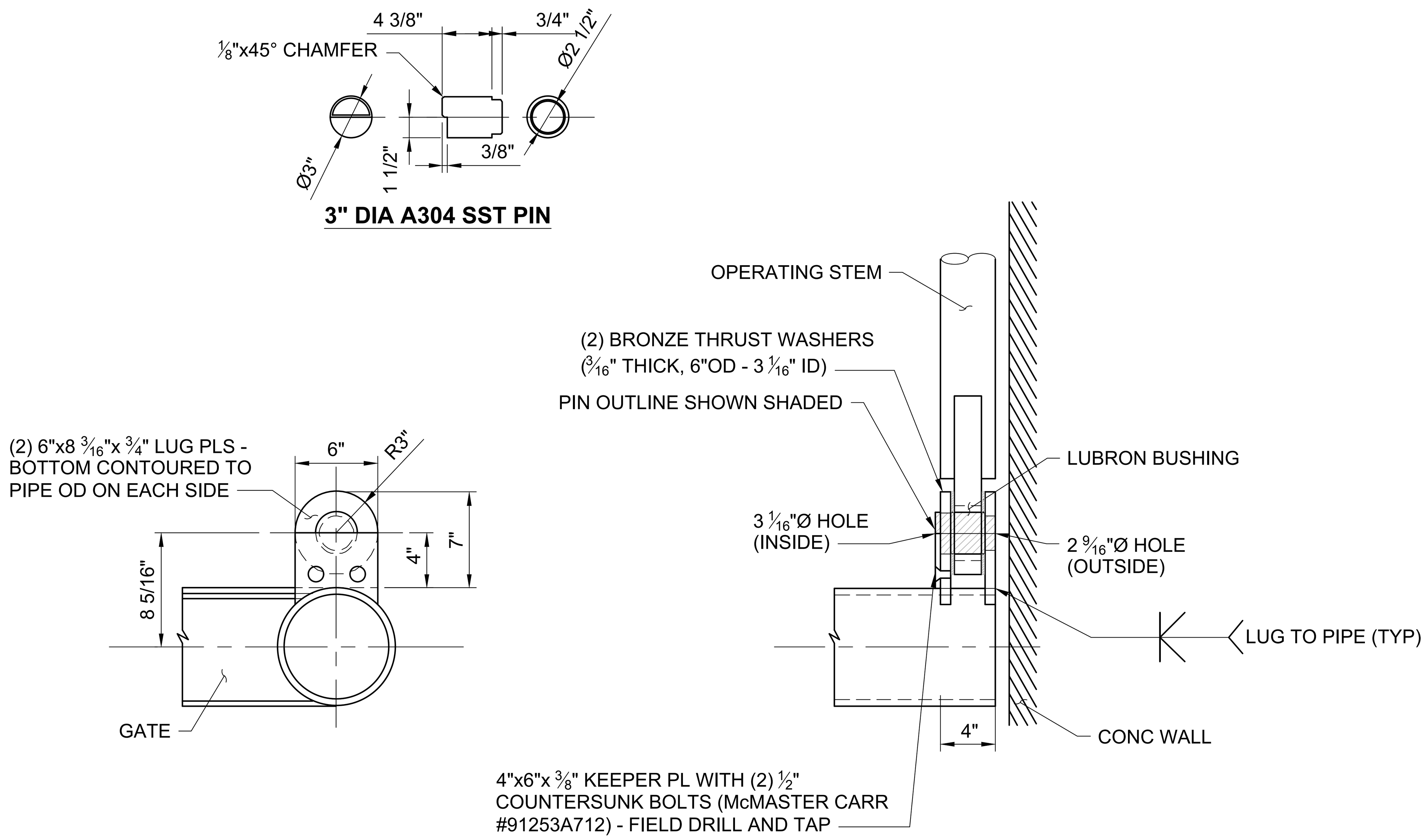
LICENSED PROFESSIONAL ENGINEER

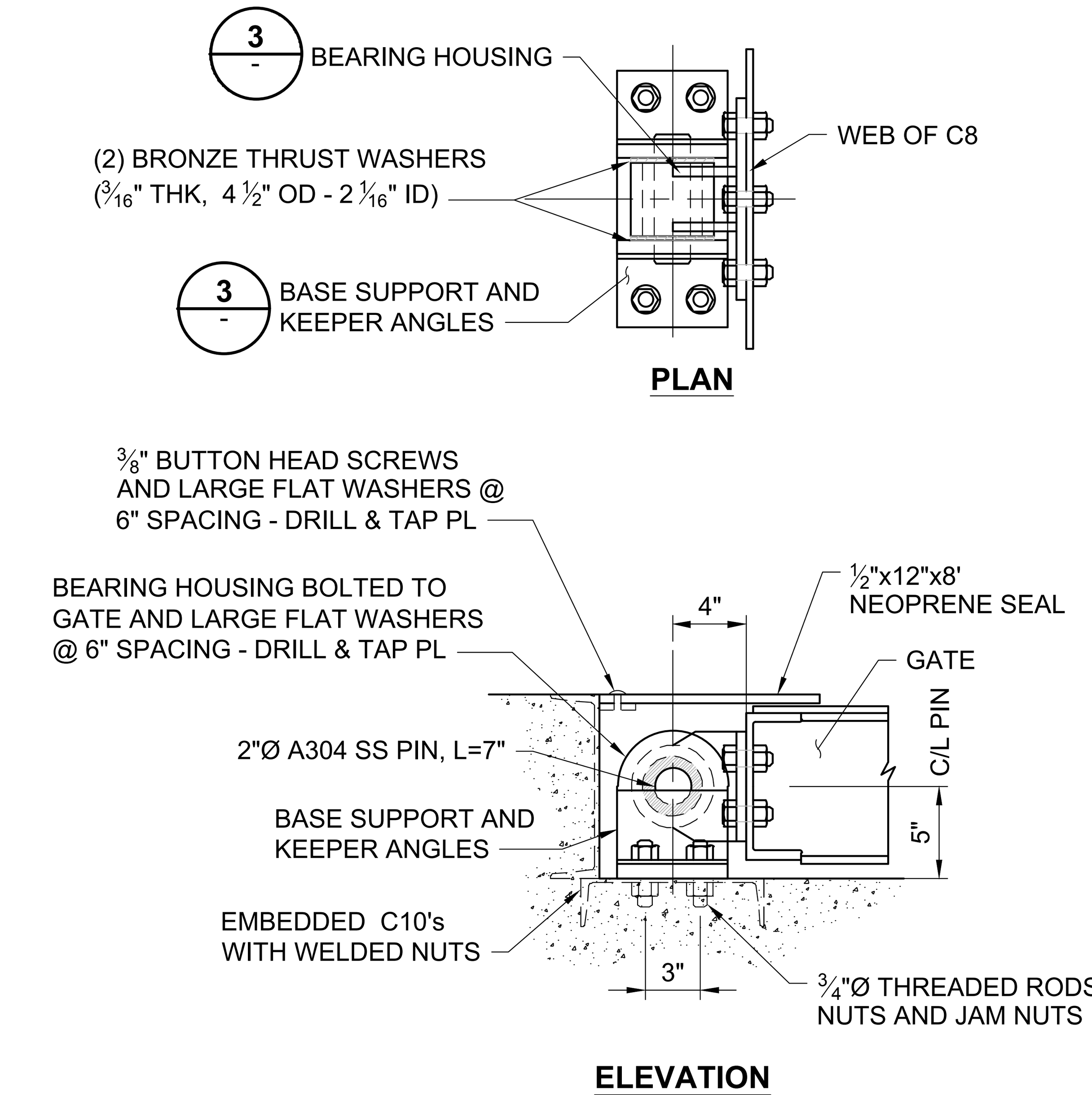
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT ENTRANCE
GATE STEEL SECTIONS & DETAILS

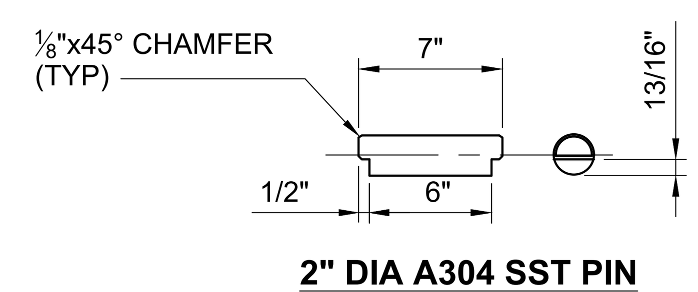
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 87 OF 176 |
| DRAWING: | M-105 |

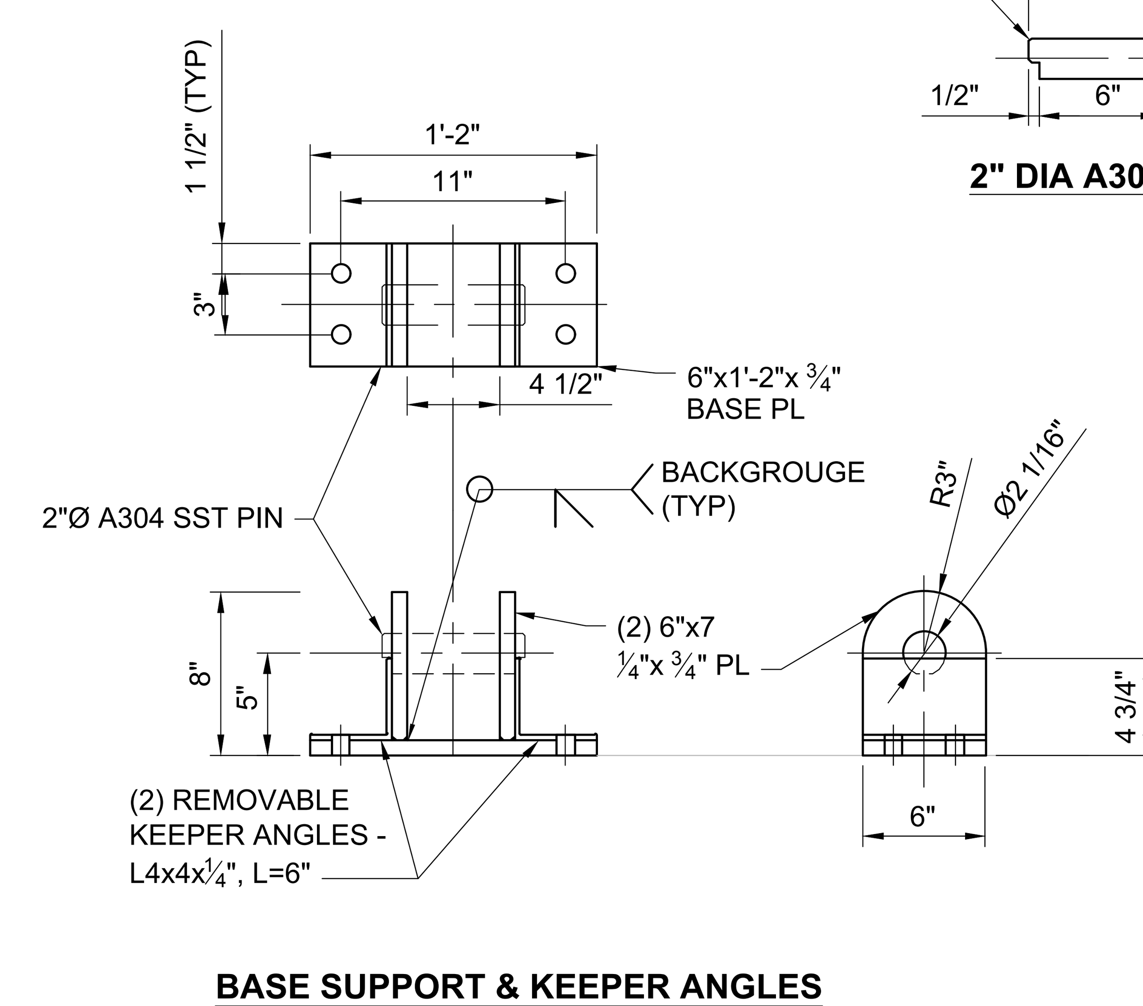


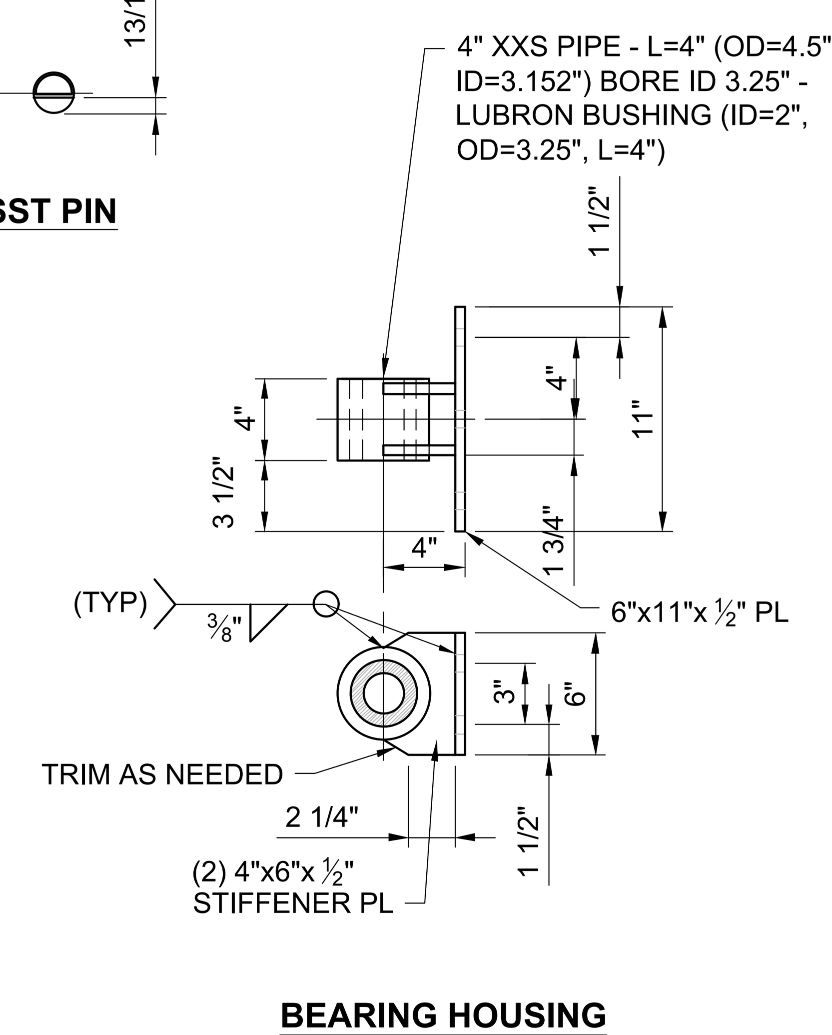

1 / M-104 **STEM BEARING ARRANGEMENT**
SCALE: 1 1/2"=1'-0"




2 / M-104 **LOWER ASSEMBLY ARRANGEMENT**
SCALE: 1 1/2"=1'-0"




3 / - **LOWER BEARING COMPONENTS**
SCALE: 1 1/2"=1'-0"

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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


15'-6"
14'-11"
(2) C12 x 20.7
1/2" SPACE
3 1/2"
4"
2 1/2"
3/8" WEB STIFFENER
(4 LOCATIONS)
SYM ABOUT C/L
(2) BRONZE THRUST WASHERS
3/8" THICK (4 1/2" OD - 2 3/16" ID)
7"
3"
INNER TRUNNION 3
7" (2 @ 3-1/2")
3'-9"
3'-9"
(TYP) 1/4"
OUTER TRUNNION 3
TO CORBEL
EL 103.5
2 SQUARE TUBE ASSEMBLY
8"
C12's
1 OPERATOR SUPPORT ASSEMBLY
M-104 SCALE: 1"=1'-0"
1'-2"
10 7/8"
BOLT CIRCLE
(NOTE 2)
Ø7"
1"x1'-2"x1'-2" PL
4"
9"
7 1/2"
3/8" (TYP)
4"x4" BOLT ACCESS
OPENING (N&F)
7" (2 @ 3-1/2")
11'-2"
HSS 8x8x1/2"
4" STEM GUIDE
2"
Ø4 1/8"
(2) BRONZE STEM GUIDE
HALVES - CONTOURED FOR
SNUG FIT INSIDE TUBE
(4) 5/8"Ø BOLTS - DRILL
AND TAP BRONZE
1 1/2"
(TYP)
2 SQUARE TUBE ASSEMBLY (2 REQUIRED)
M-104 SCALE: 1"=1'-0"
BOLT HOLES
9"
5/16" (TYP)
1 1/2"
(TYP)
1 1/2"
4" XXS PIPE - (OD=4.5", ID=3.152",
L=6") BORE ID 3.25" - LUBRON
BUSHING (OD=3.25", ID=2", L=6")
6"
1/2" PL's
(TYP)
9"
6"x9"x 3/4" PL
1'-0"
3/4"Ø A325 BOLTS
HSS 6x8x1/2"
1
1
1'-6"
2'-3"
OUTER TRUNNION ASSEMBLY
3"
6"
MAX 2"
NON-SHRINK GROUT
1"Ø ANCHOR BOLTS
(12" MIN EMBED)
1'-3 1/2"
2"
(2) SS CLAMP ON COLLARS
(McMASTER CARR # 9421T34)
A304 STAINLESS STEEL PIN
3 TRUNNION COMPONENTS
SCALE: 1 1/2"=1'-0"
7"
3"
1/2" (TYP)
2 1/2"
8"
7"
4" XXS PIPE - (OD=4.5", ID=3.152", L=7")
BORE ID 3.25" - LUBRON BUSHING
(OD=3.25", ID=2" L=7")
3/4"Ø A325 BOLTS
HSS 6x8x 1/2"
L=12"
C12x20.7 SUPPORT
ASSEMBLY
INNER TRUNNION ASSEMBLY
NOTES:
1. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.
2. COORDINATE WITH EQUIPMENT SUPPLIED.
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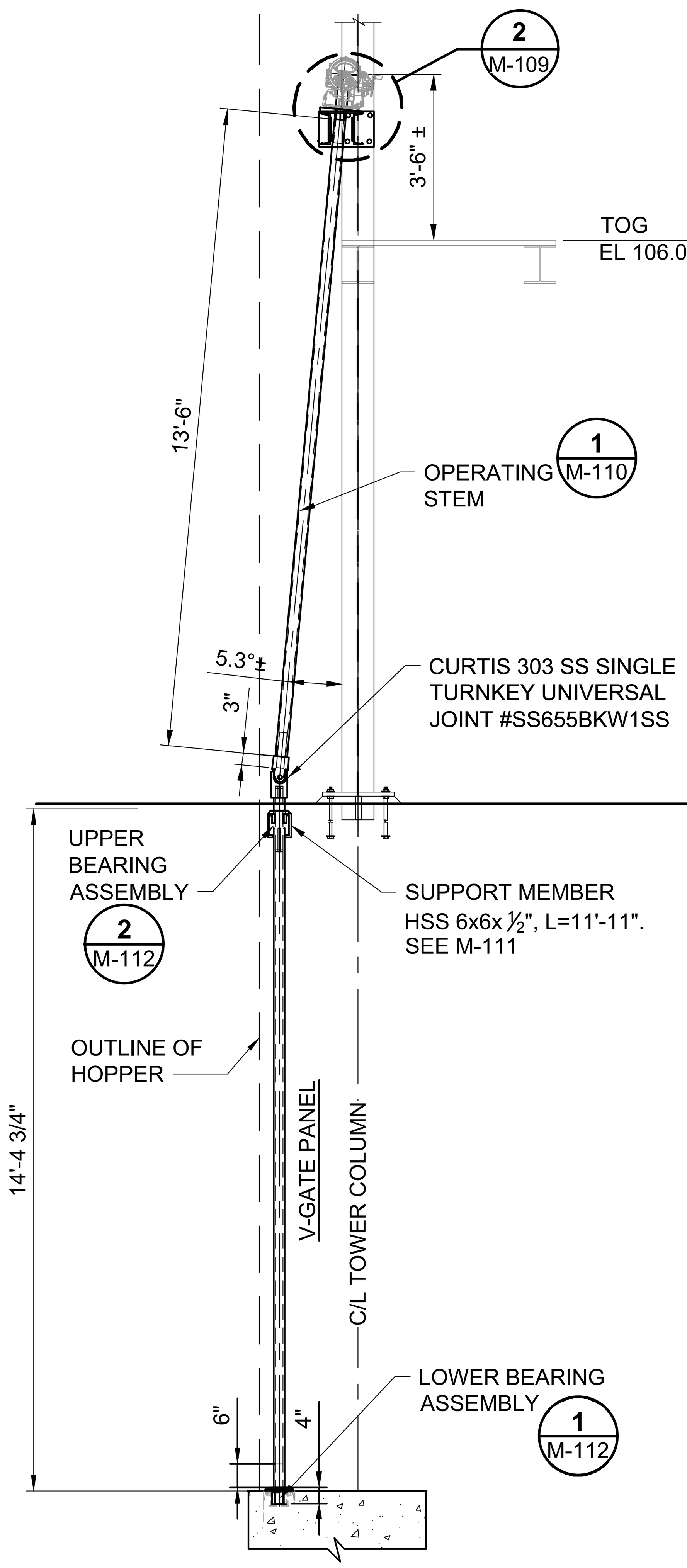
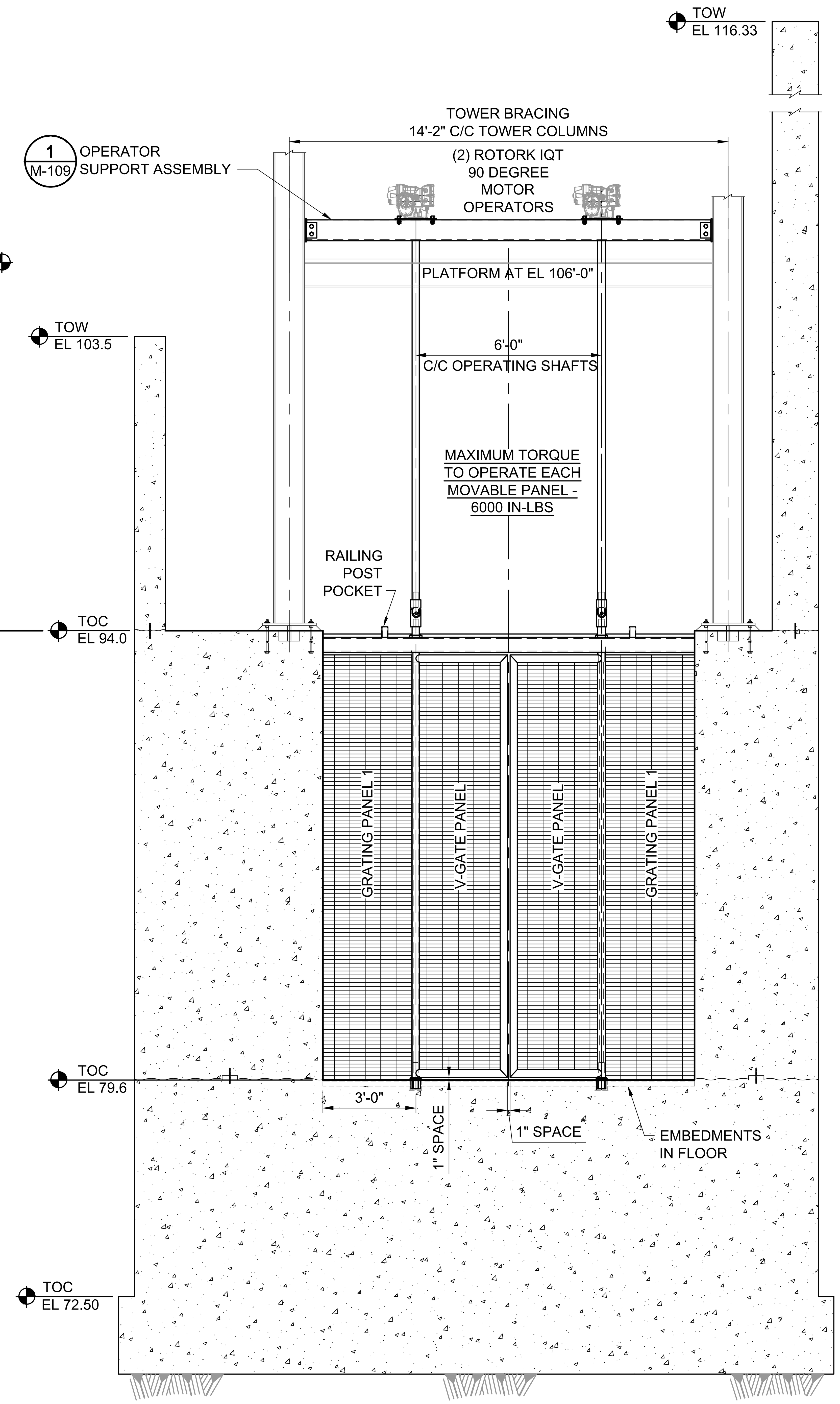
PROFESSIONAL ENGINEER
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC
FISH LIFT ENTRANCE GATE
STEEL DETAILS
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 89 OF 176
DRAWING: M-107

**NOTE:**

1. GRATING PANELS TYPE 1 & 2 ARE REMOVABLE FOR CLEANING.

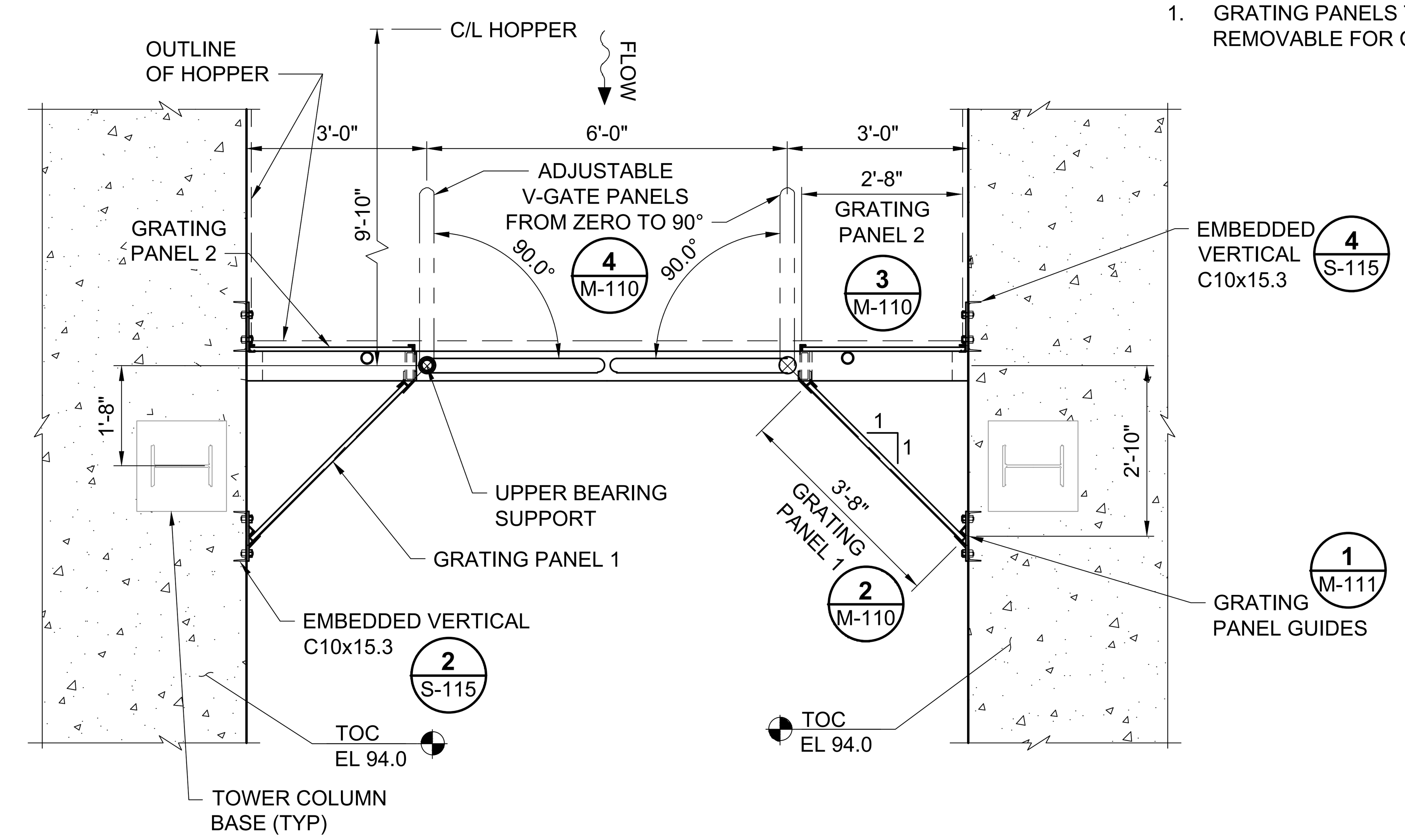



**SIDE ELEVATION**




**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"

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No.39328
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PROFESSIONAL ENGINEER LICENSED

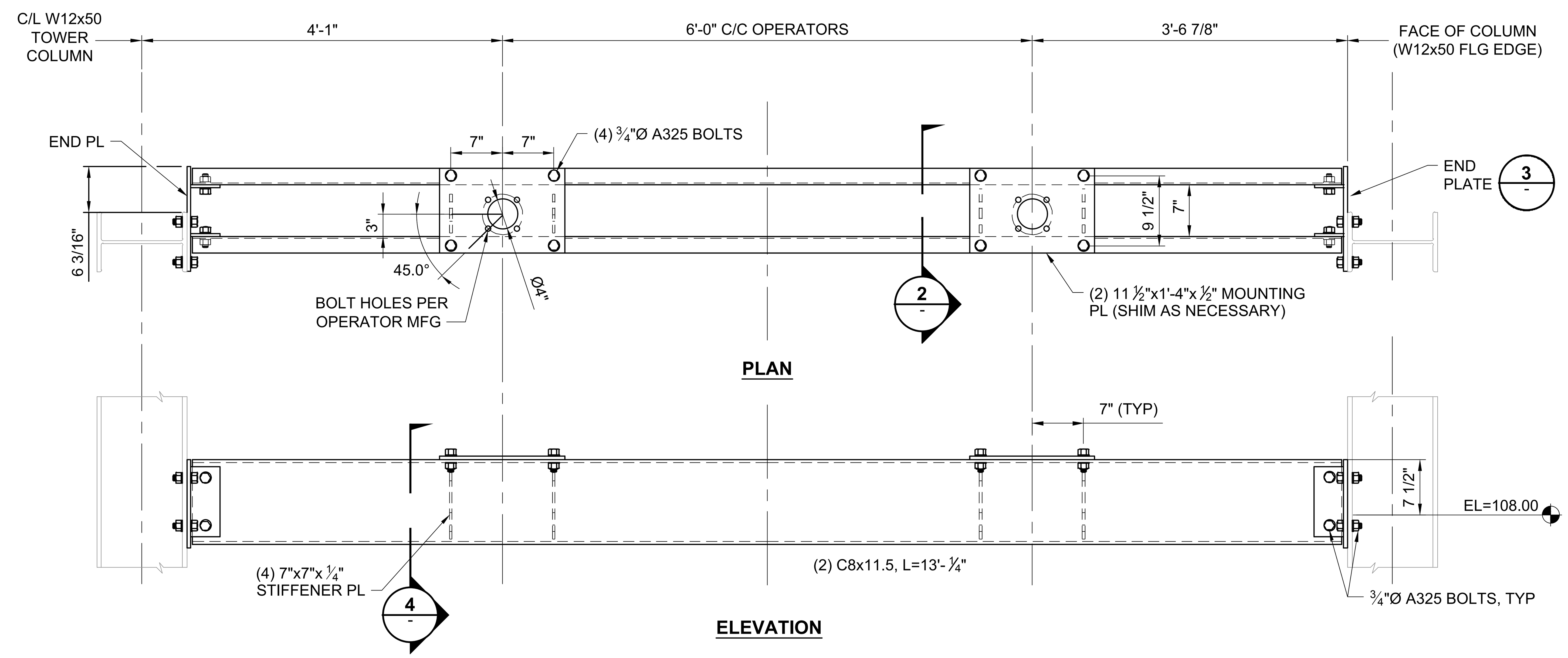
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE GENERAL PLAN, ELEVATIONS, AND DETAILS

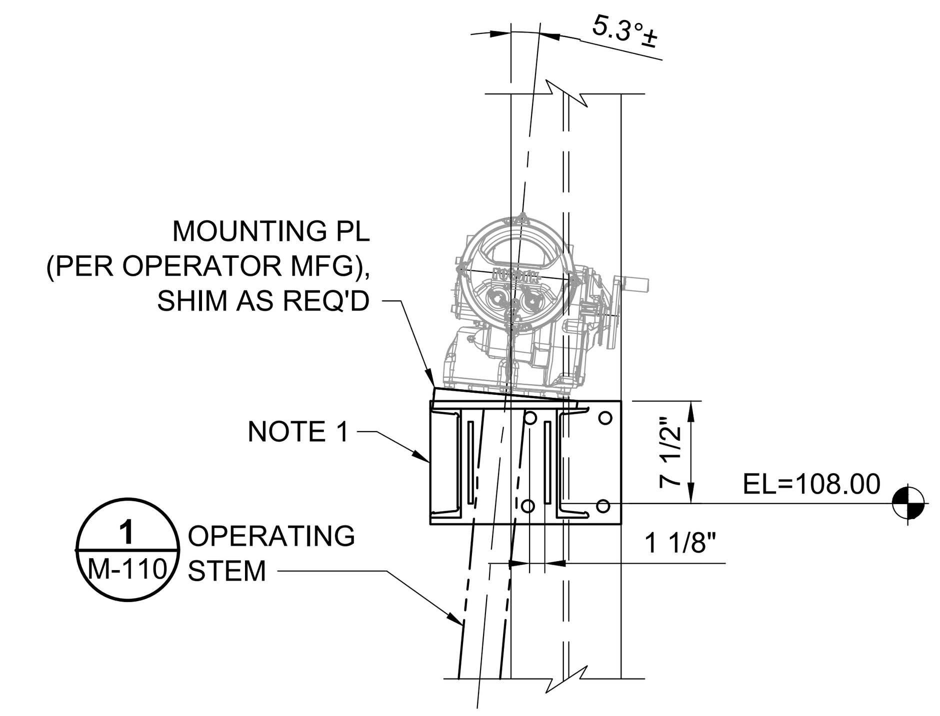
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 90 OF 176 |
| DRAWING: | M-108 |

**NOTES:**

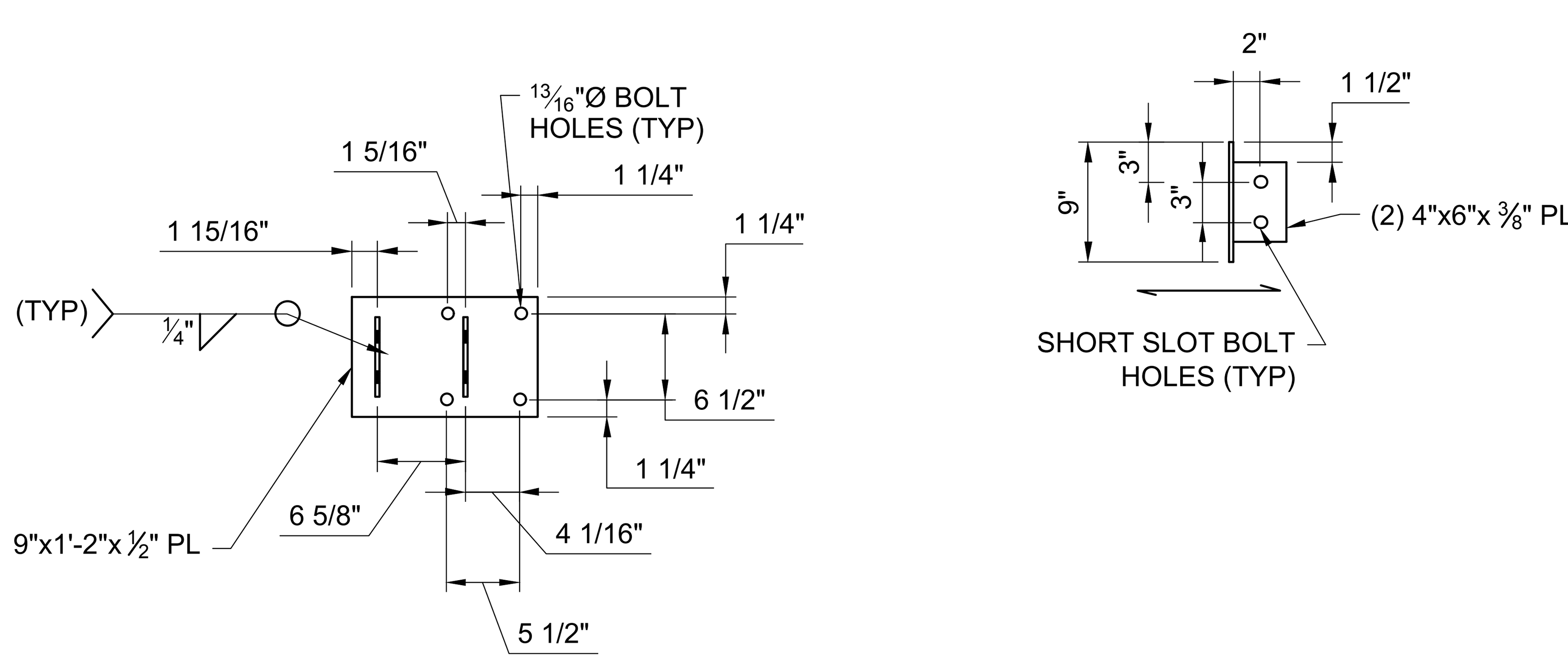
1. BOLTS AND STIFFENER PLATES REMOVED FOR CLARITY.
2. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.



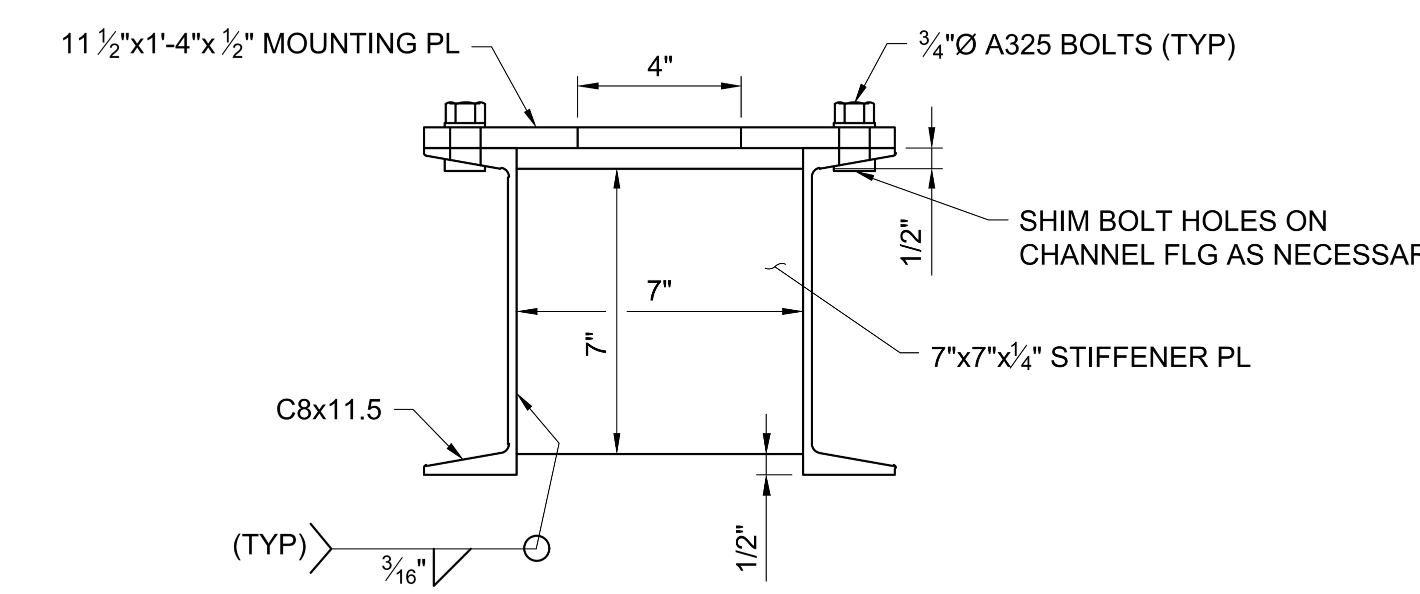

## 1 (M-108) OPERATOR SUPPORT ASSEMBLY
SCALE: 1"=1'-0"




## 2 (M-108, M-109) END PLATE ASSEMBLY
SCALE: 1"=1'-0"




## 3 END PLATE DETAIL (2 REQUIRED)
SCALE: 1"=1'-0"




## 4 STIFFENER DETAIL (TYPICAL)
SCALE: 3"=1'-0"

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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 |

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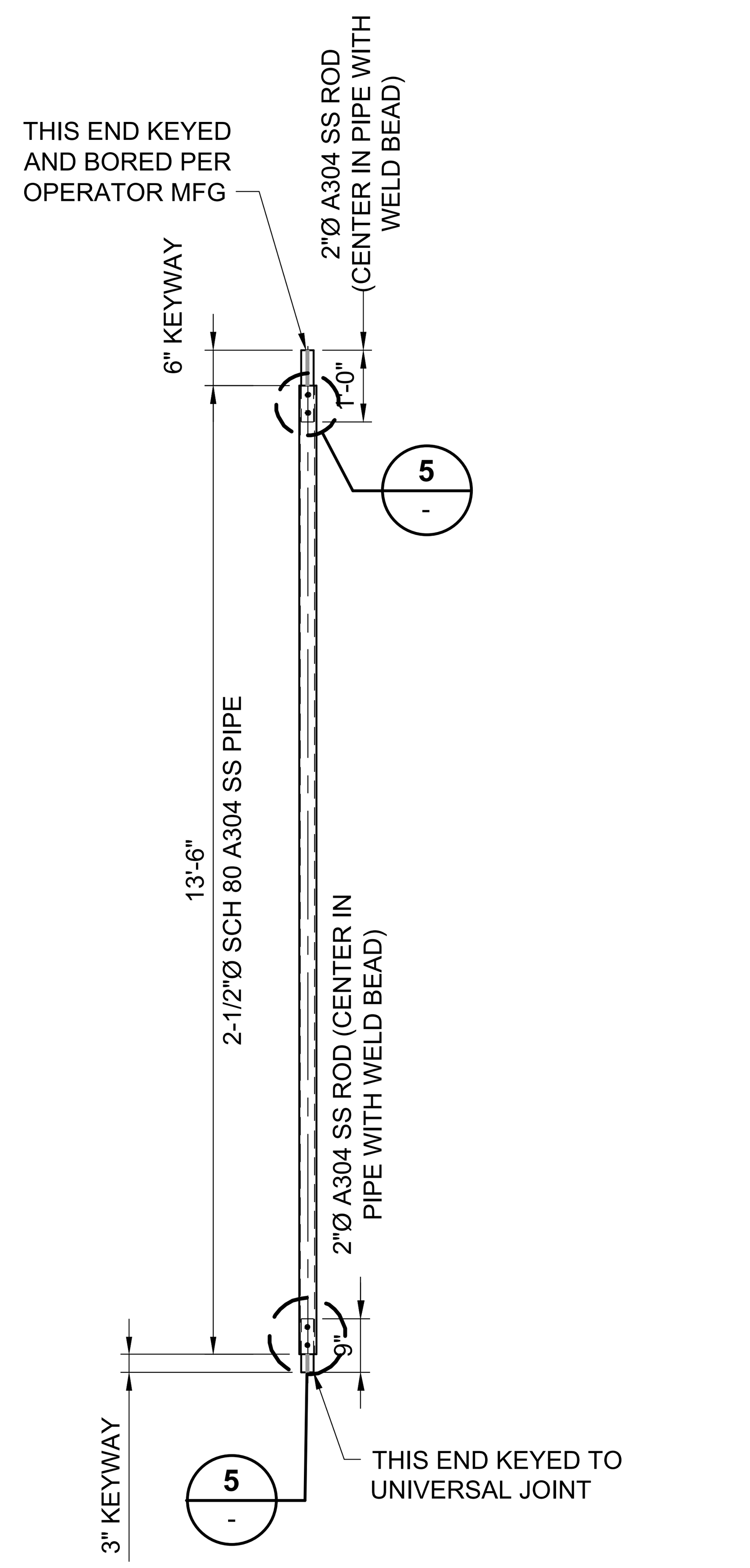
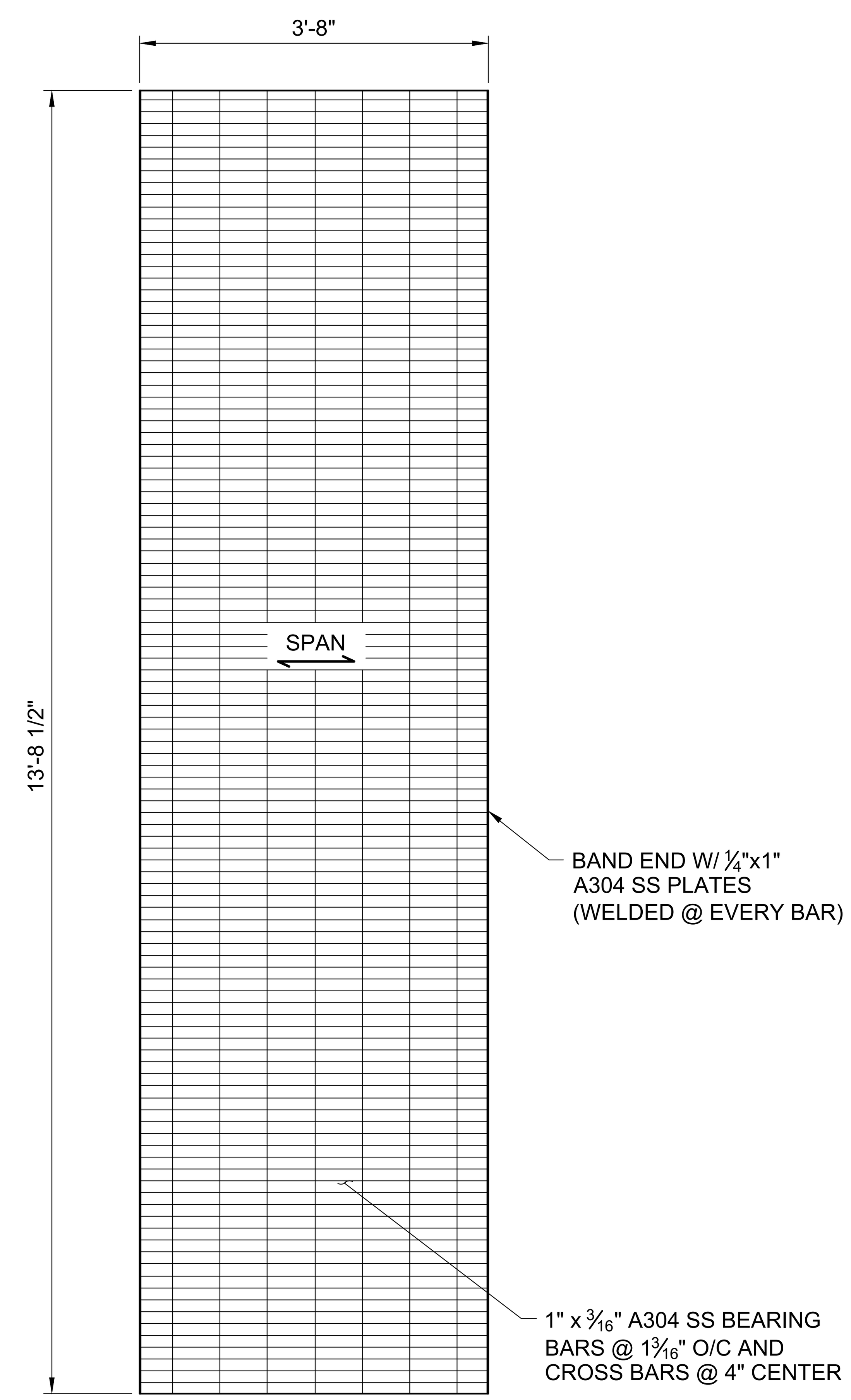
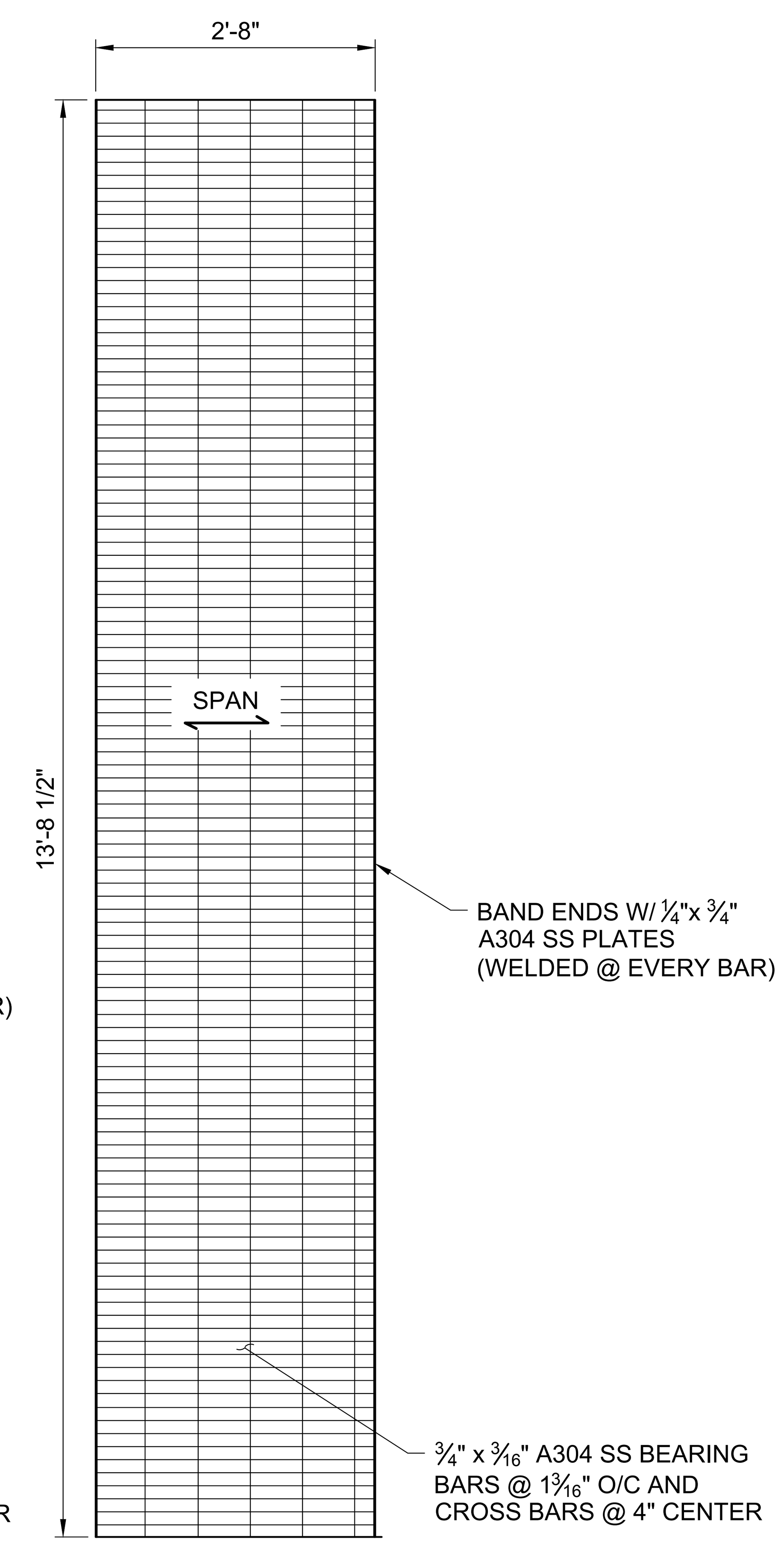


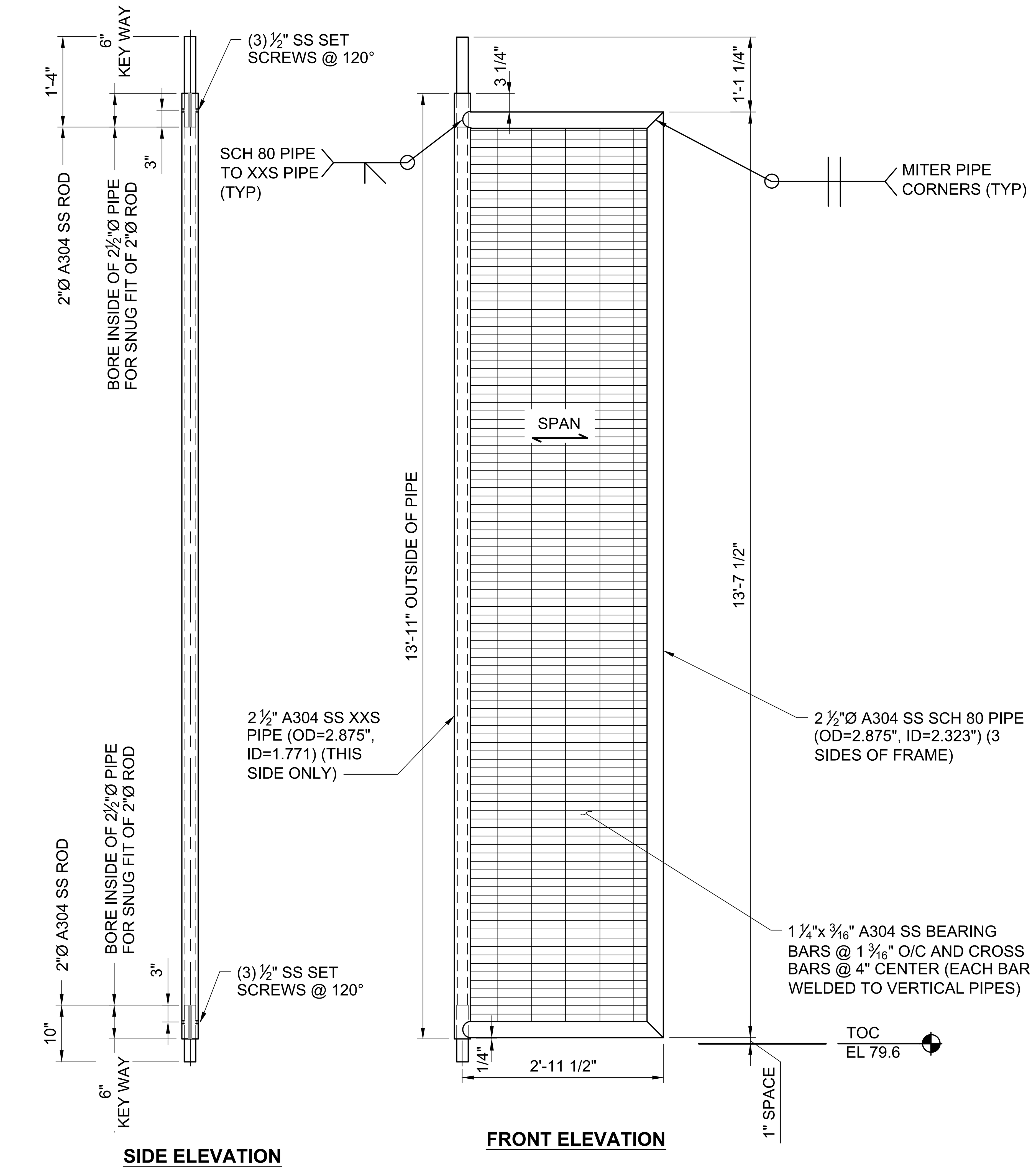

1 M-108 M-109 **OPERATING STEM (2 REQUIRED)**
SCALE: 1/2"=1'-0"



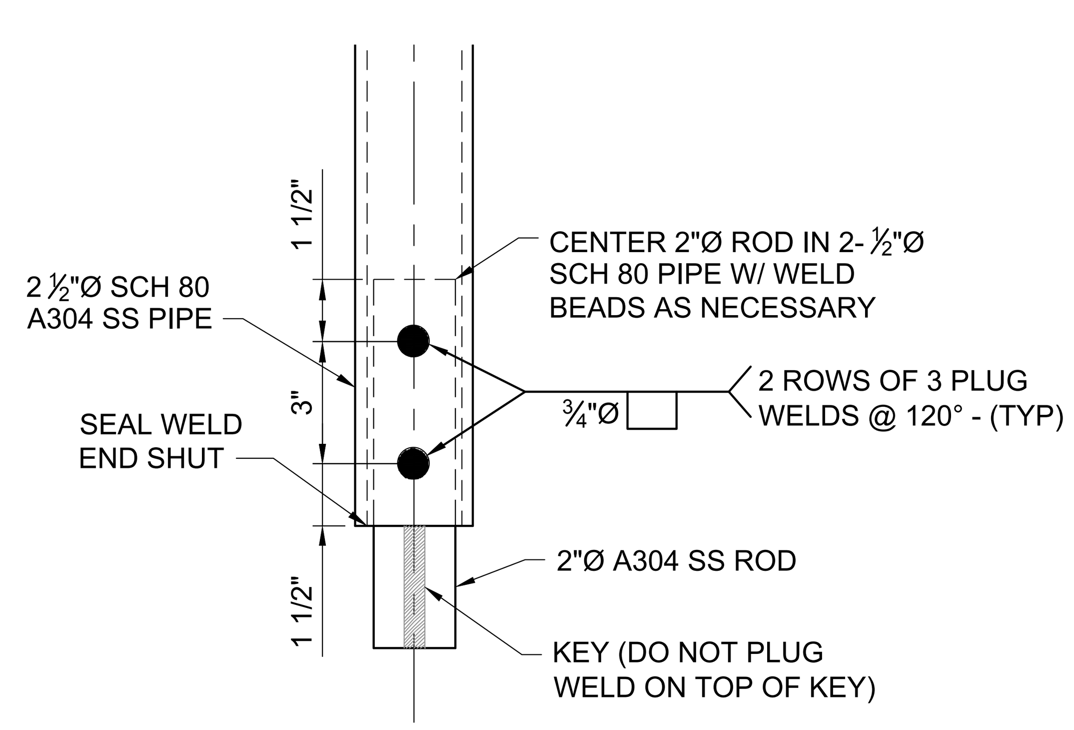

2 M-108 **GRATING PANEL 1 (2 REQUIRED)**
SCALE: 3/4"=1'-0"




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"

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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

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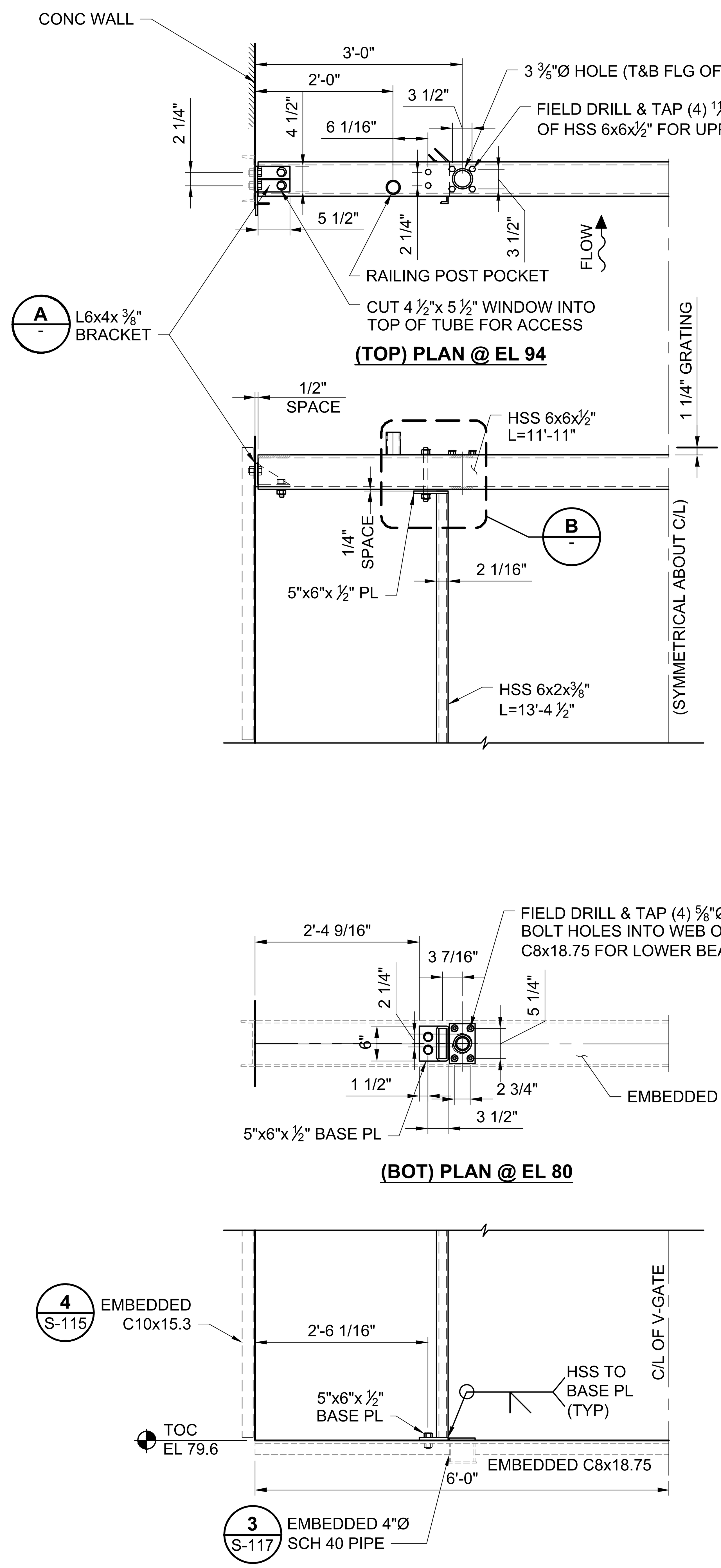
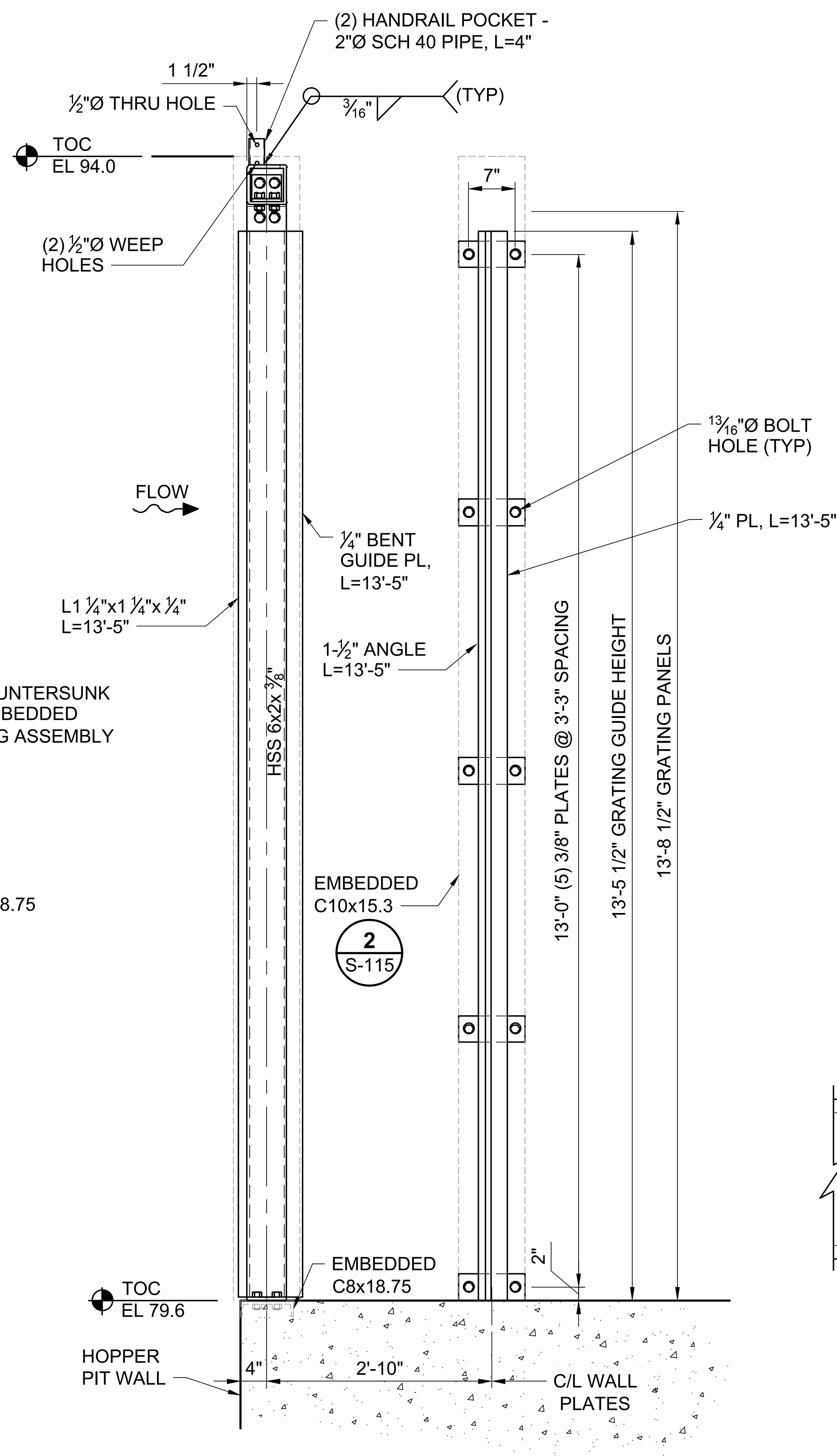


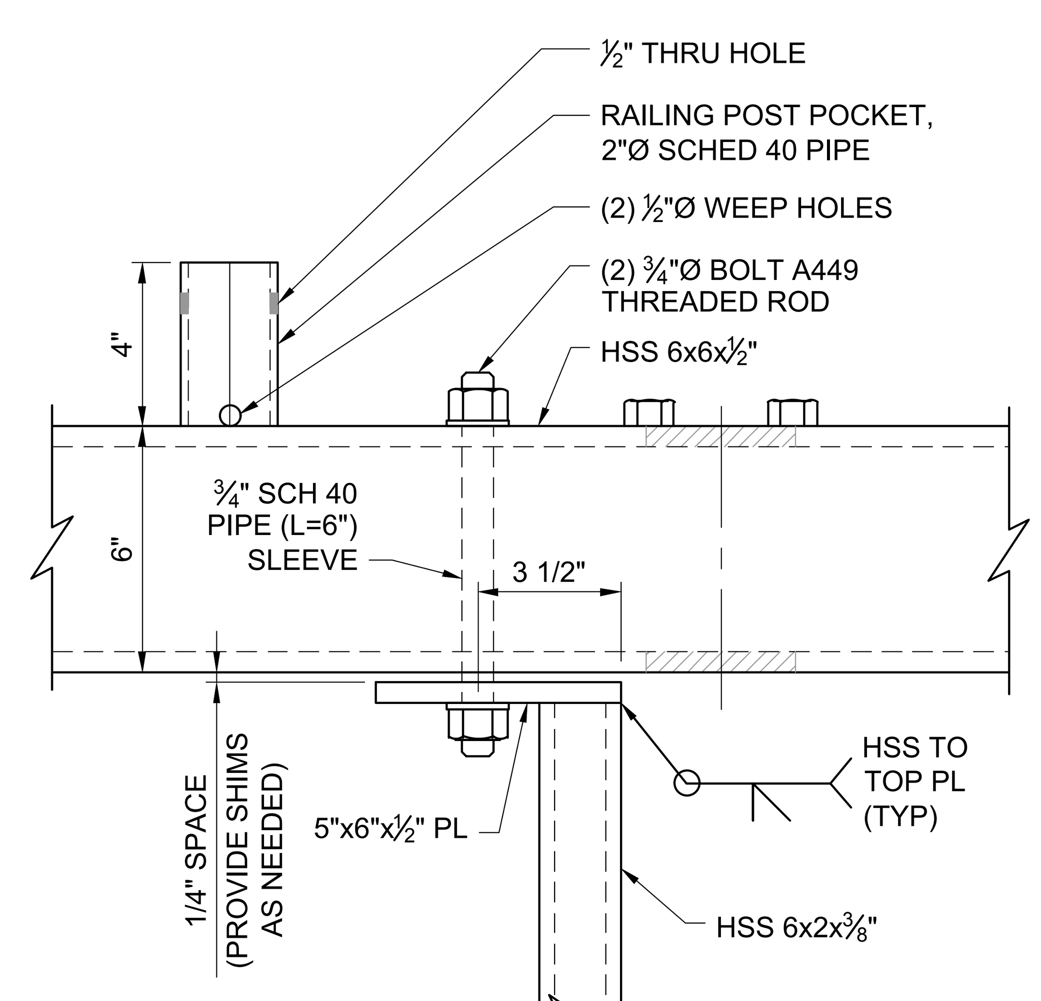

## 2 STEEL FRAMING FRONT ELEVATION (GUIDES NOT SHOWN)

SCALE: 3/4"=1'-0"



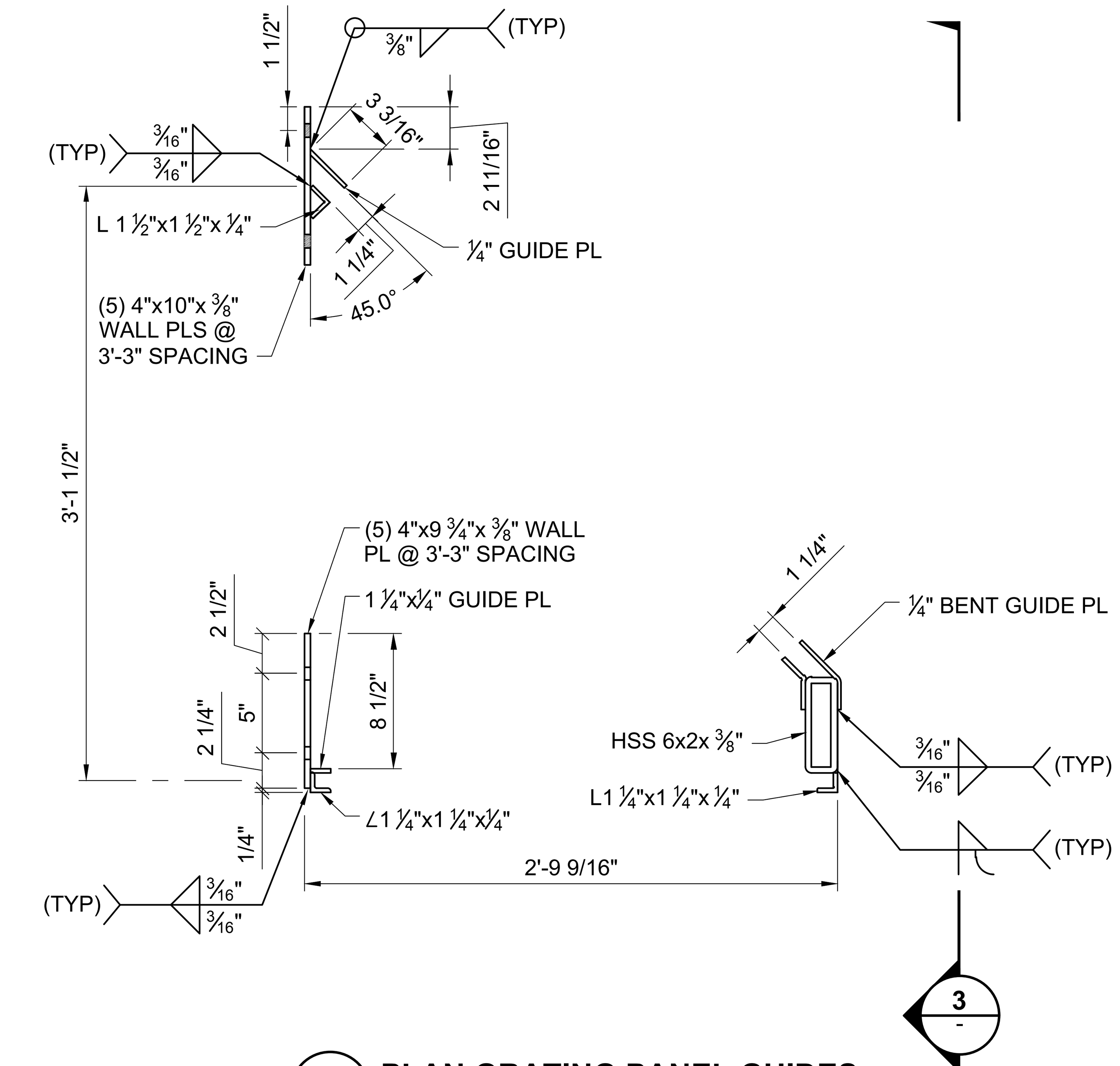

## 3 STEEL FRAMING SIDE ELEVATION

SCALE: 3/4"=1'-0"



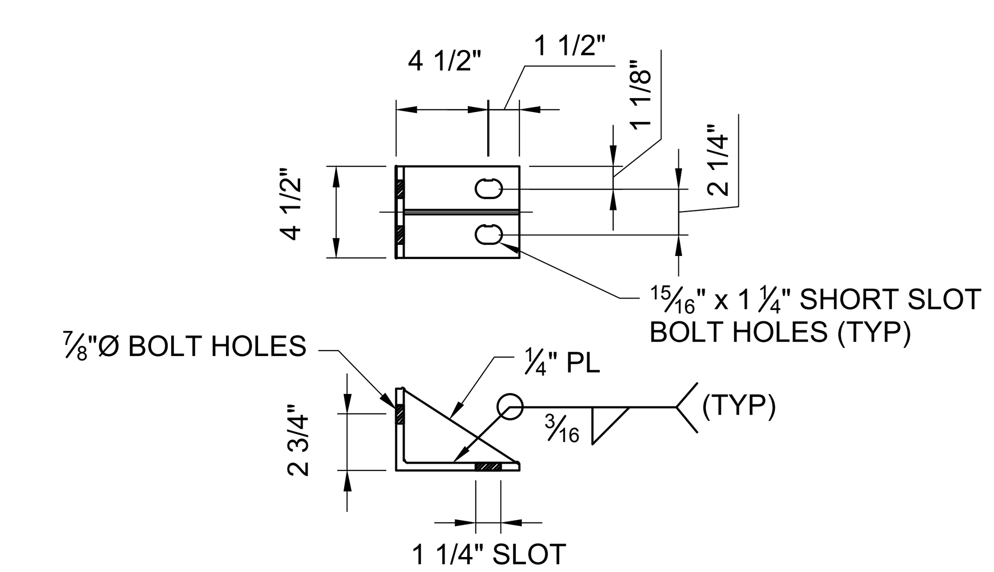

## B THROUGH BOLT DETAIL

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.

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**DECEMBER 13, 2019**

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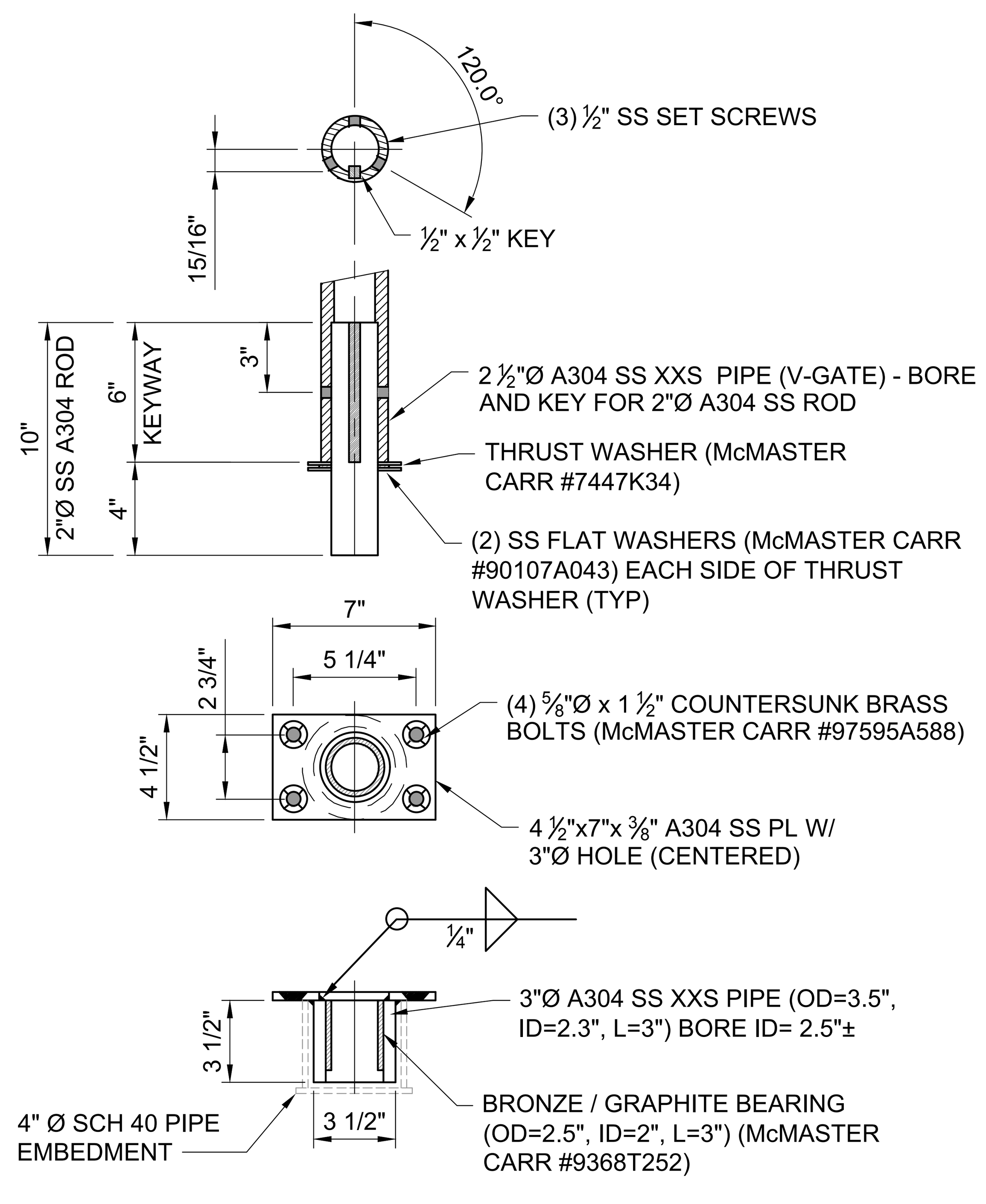
STATE OF MAINE — MARK DANIEL GRAESER No.39328 — 12/13/2019 — LICENSED PROFESSIONAL ENGINEER

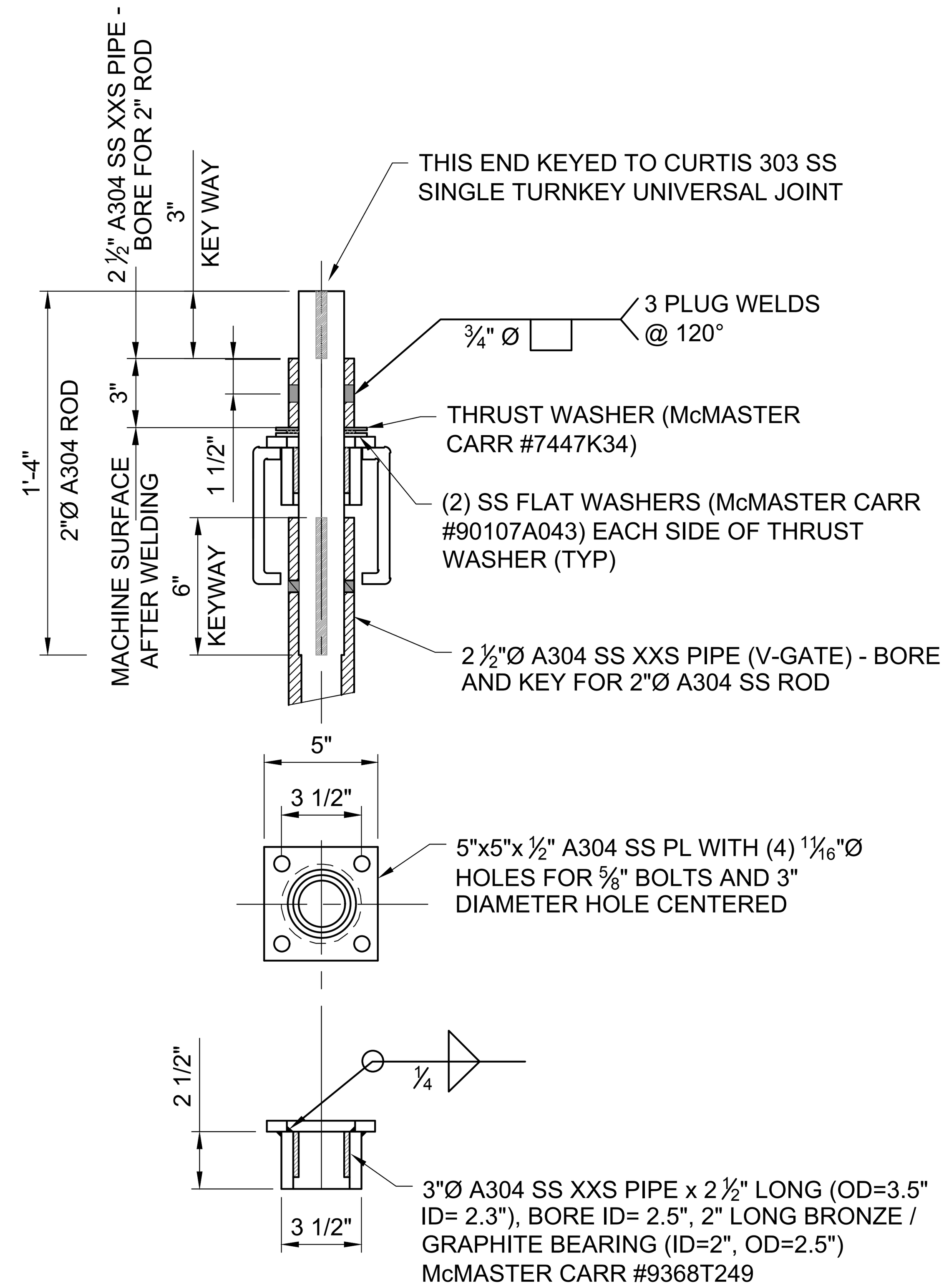
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT V-GATE 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"

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

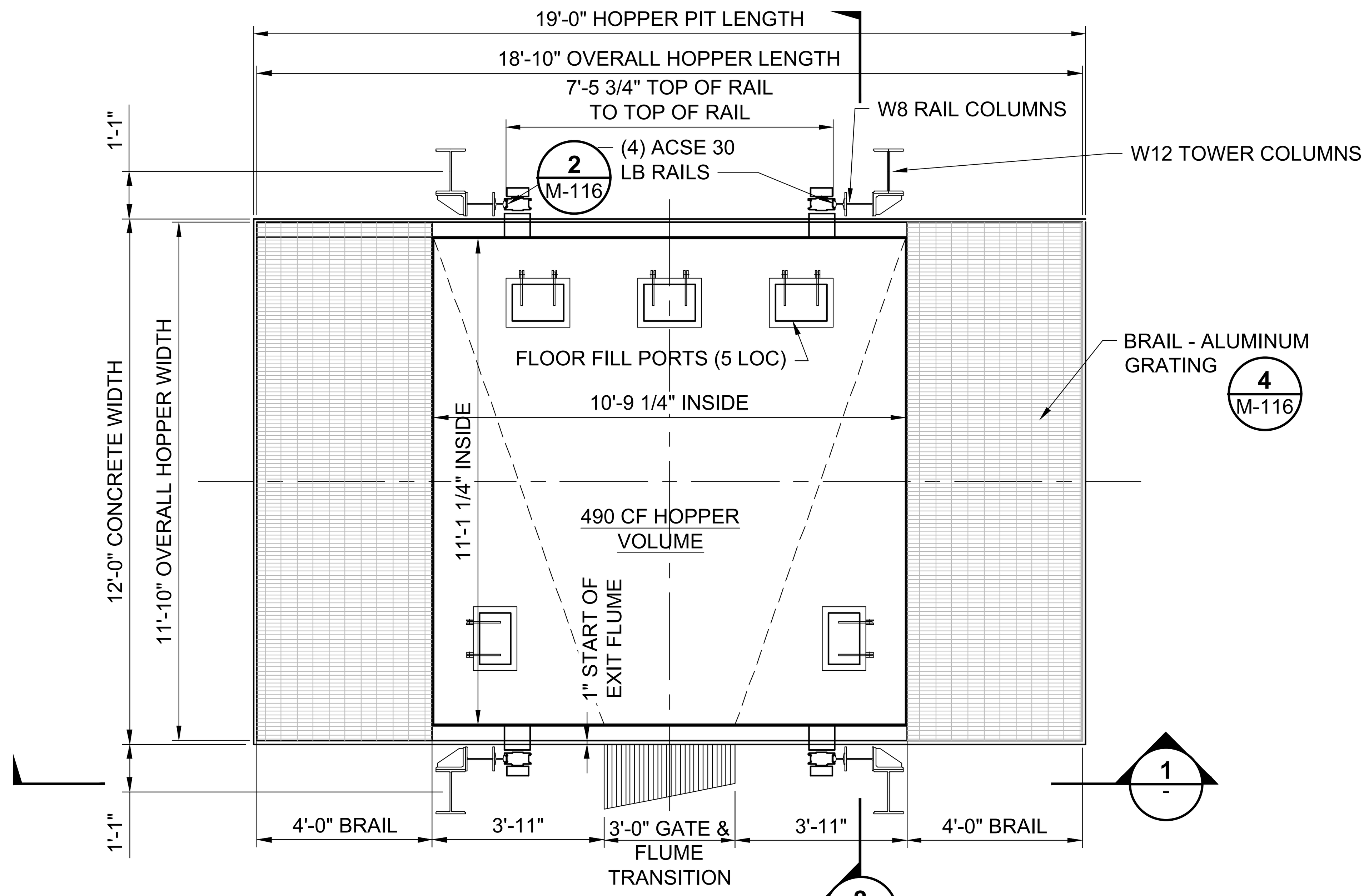
FISH LIFT V-GATE BEARING DETAILS

| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 94 OF 176 |
| DRAWING: | M-112 |

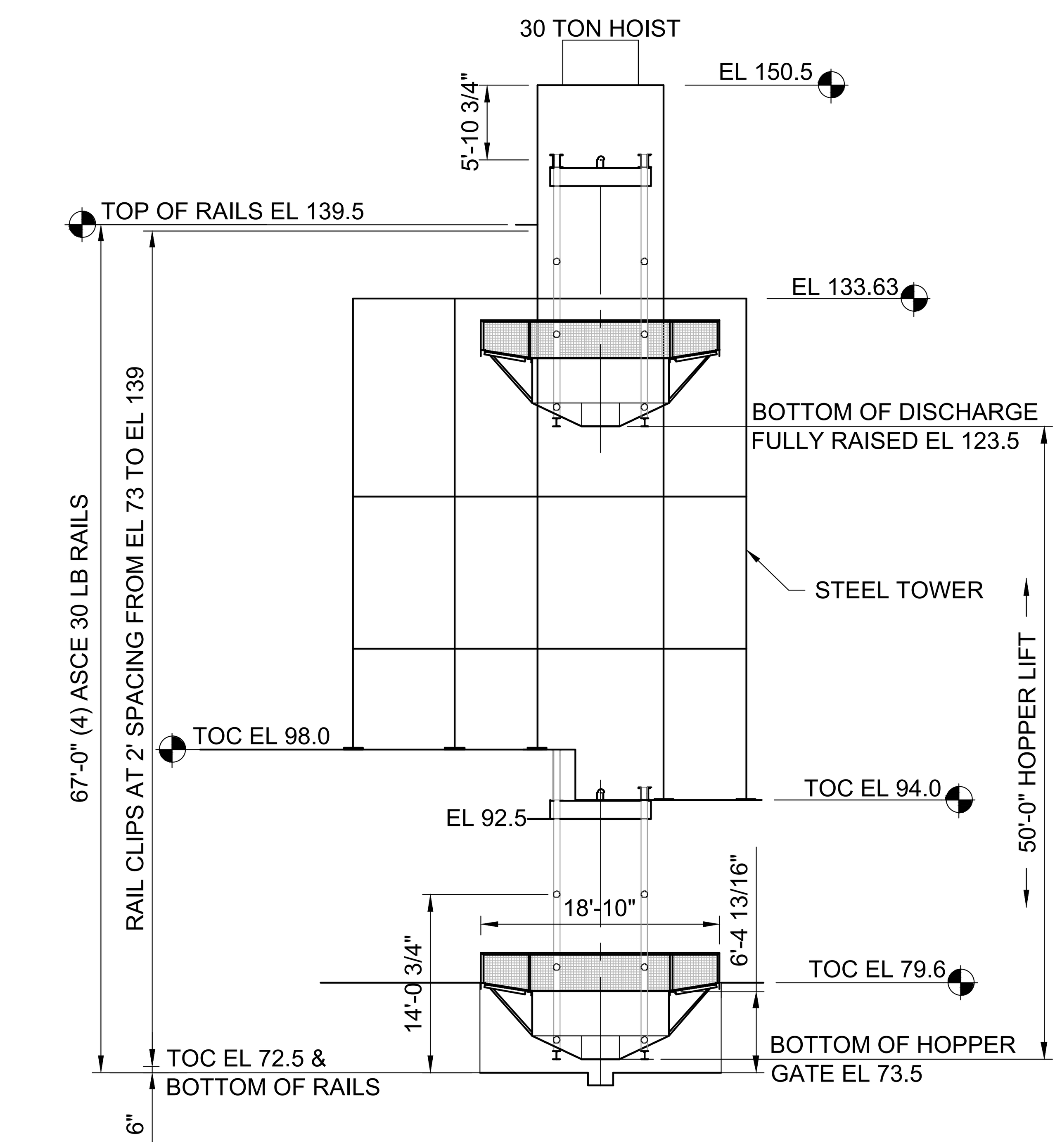
DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mas and projects\holden office projects\SHAWMUT\1900 CAD\02-sheets\M\M-112.dwg USER: Agrogan
DATE: Dec 13, 2019 2:40pm XREFS: G-SHWMT-BD G-SHWMT-SUBMIT MAINE-PE-STAMP-MDG IMAGES:

APPROXIMATE HOPPER COMPONENT WEIGHTS

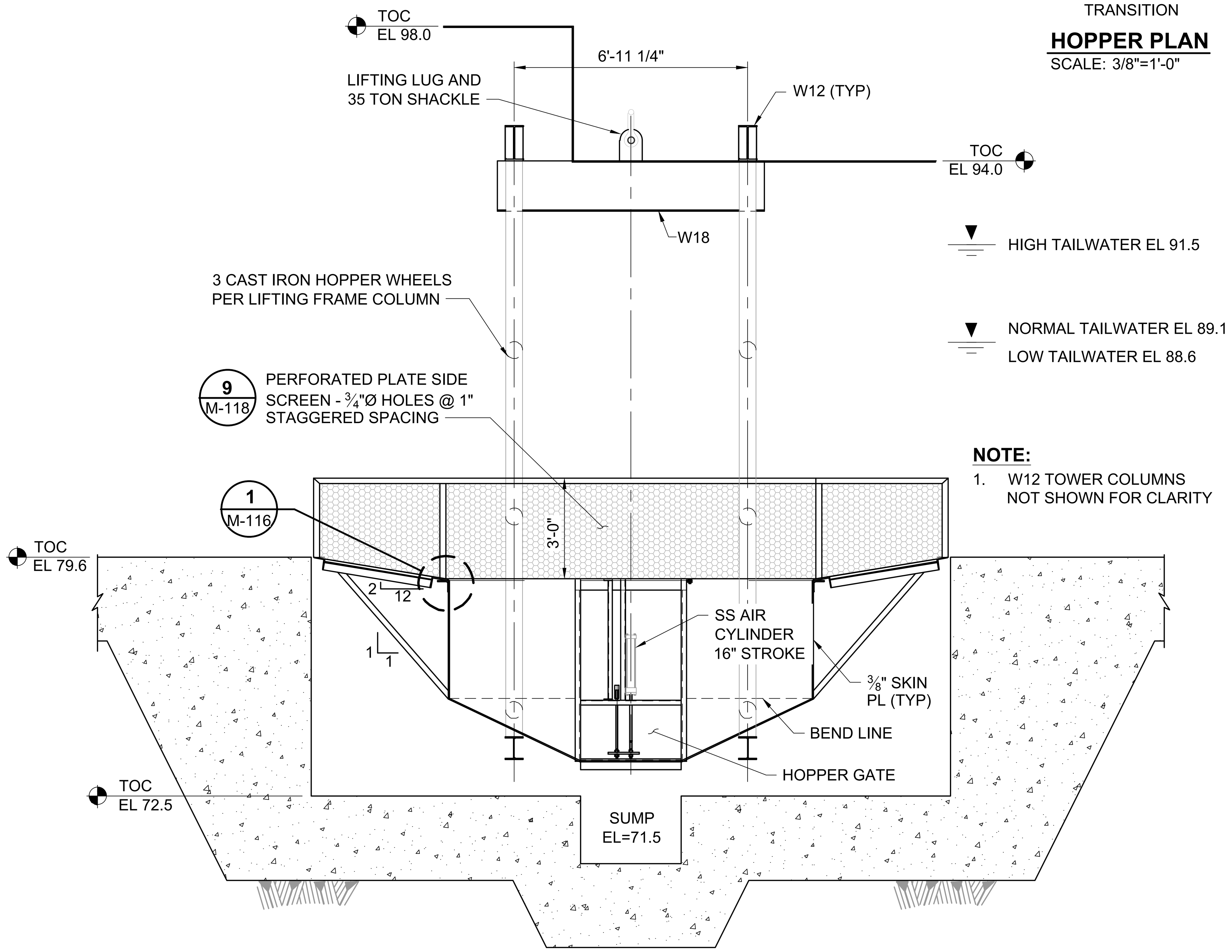
| | |
|---|---|
| HOPPER AND HOPPER GATE | 7500 LBS |
| BRAIL PANELS (2) | 500 LBS |
| LIFTING FRAME | 6000 LBS |
| SIDE SCREENS (2) | 1500 LBS |
| BRAIL SUPPORTS (2) | 500 LBS |
| TOTAL | 16,000 LBS |




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

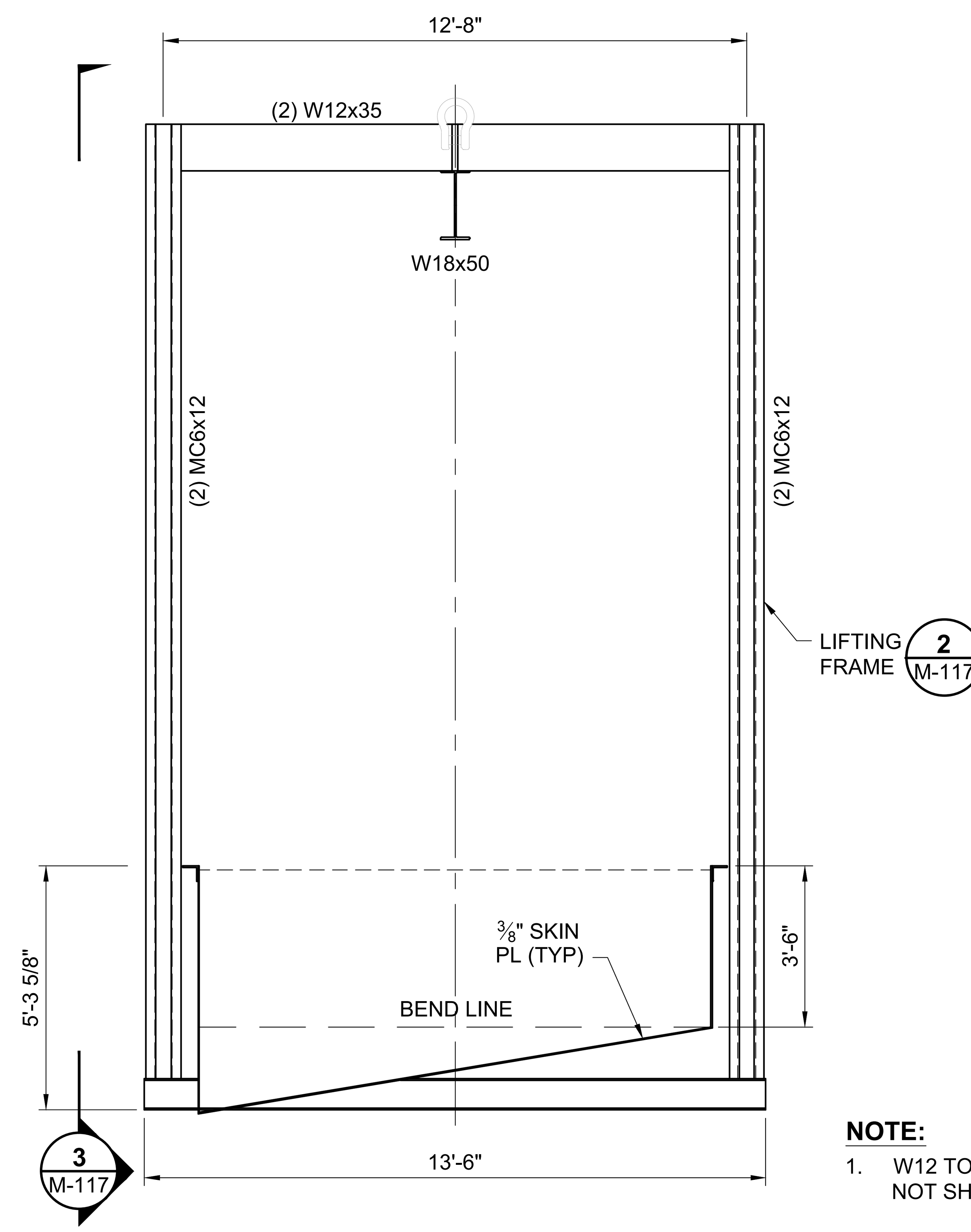



HOPPER TRAVEL
SCALE: 3/32"=1'-0"




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"

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No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

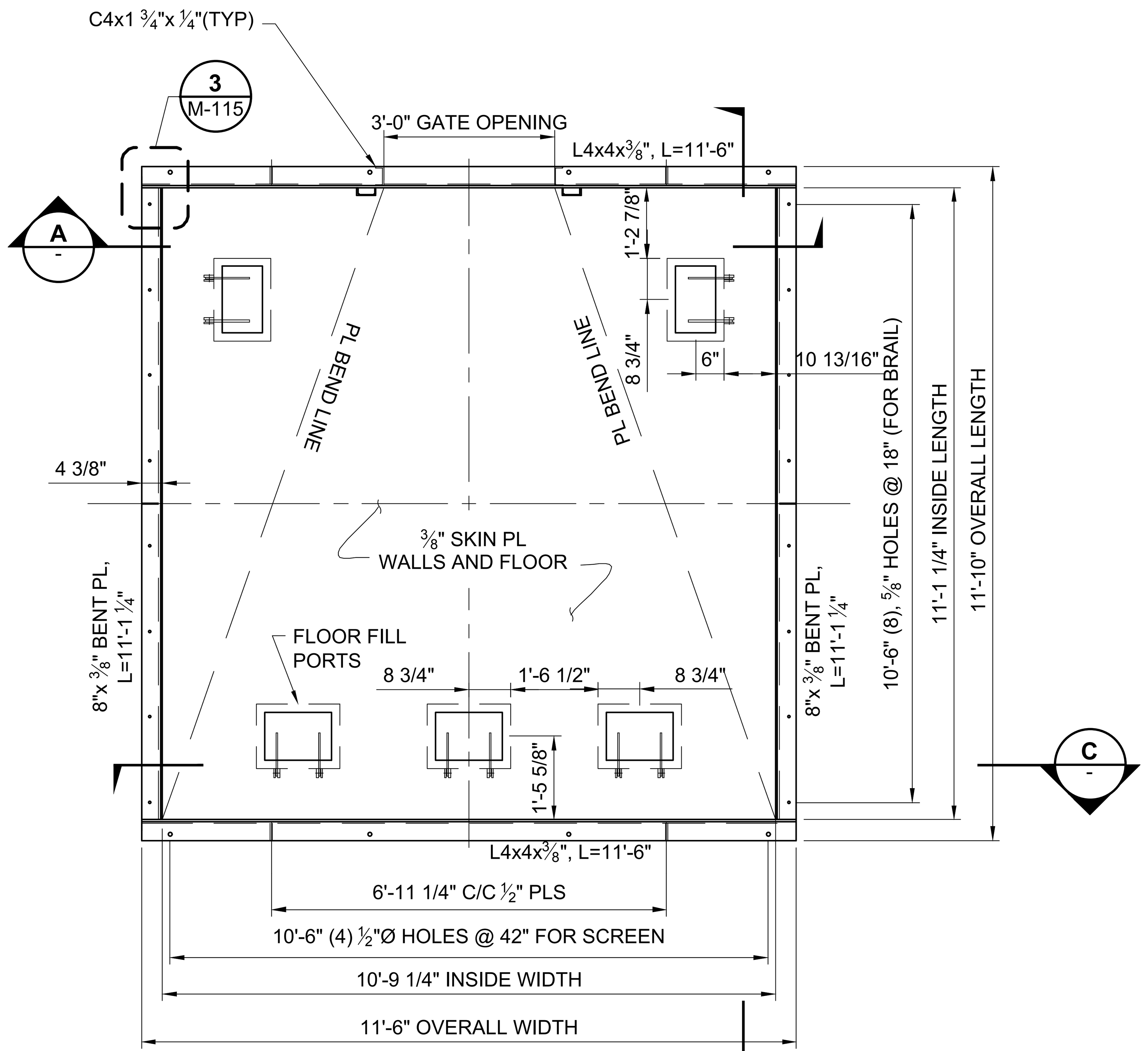
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - GENERAL LAYOUT AND INFORMATION

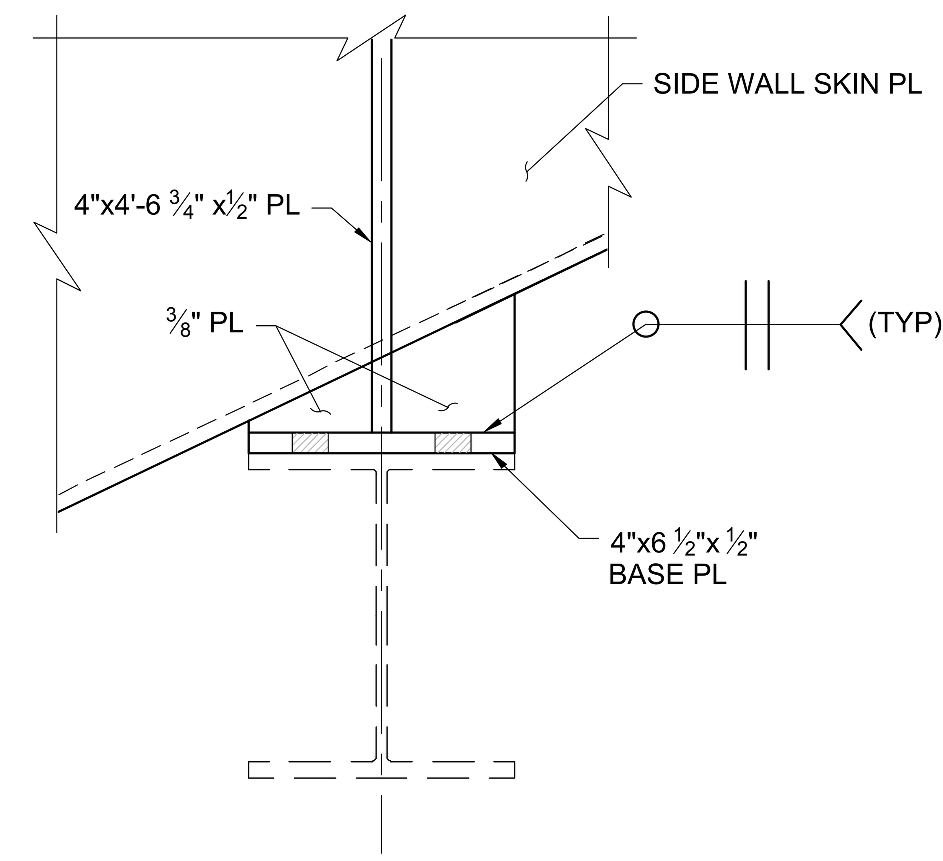
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 95 OF 176 |
| DRAWING: | M-113 |

**NOTES:**

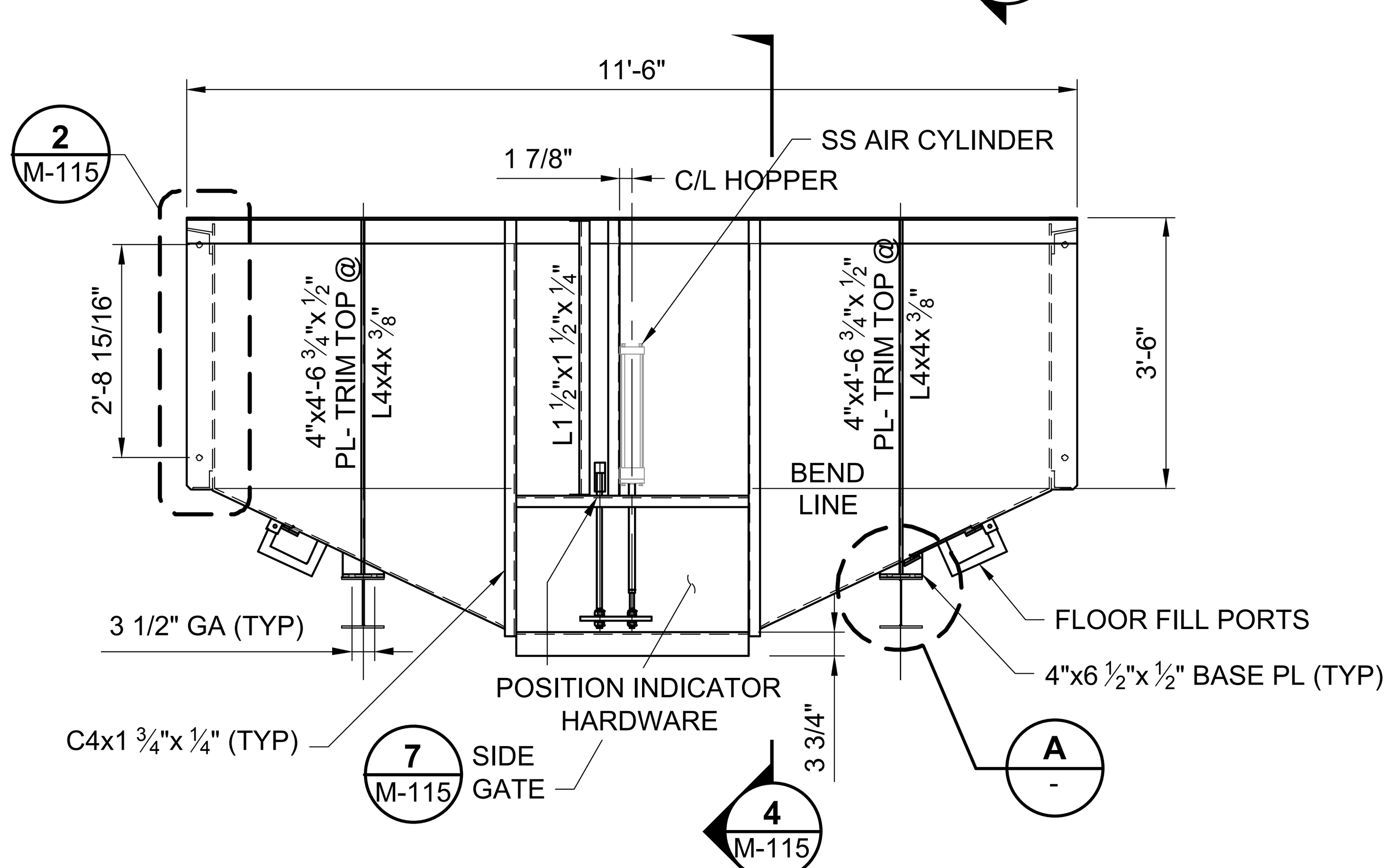
1. NET HOPPER VOLUME=490 CUBIC FEET
2. ALL INTERIOR HOPPER PLATE JOINTS SHALL BE SEAL WELDED.
3. ALL INTERIOR SURFACES & FISH CONTACT AREAS SHALL BE SMOOTH & BURR FREE.
4. GRIND ALL INTERIOR EDGES TO MINIMUM 1/4"R.
5. AIR CYLINDER TO BE STAINLESS STEEL PARKER # 3.25CFSAU19A16.000



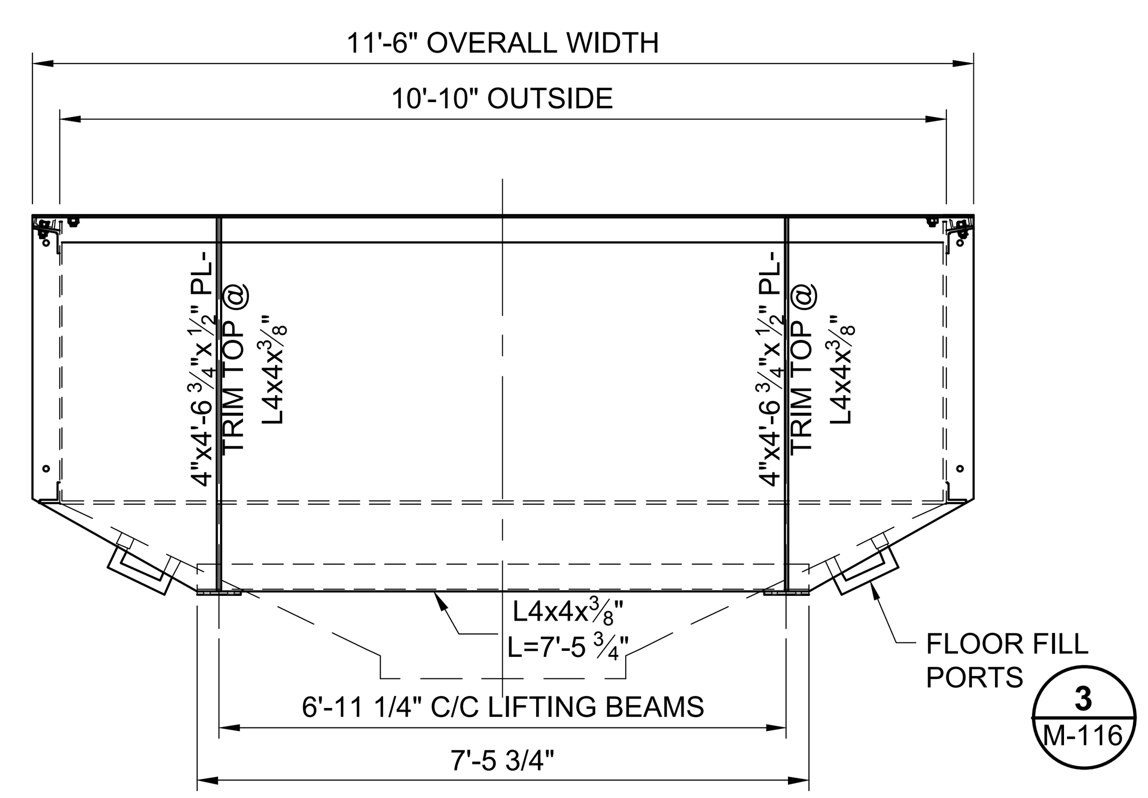

**HOPPER PLAN**
SCALE: 1/2"=1'-0"



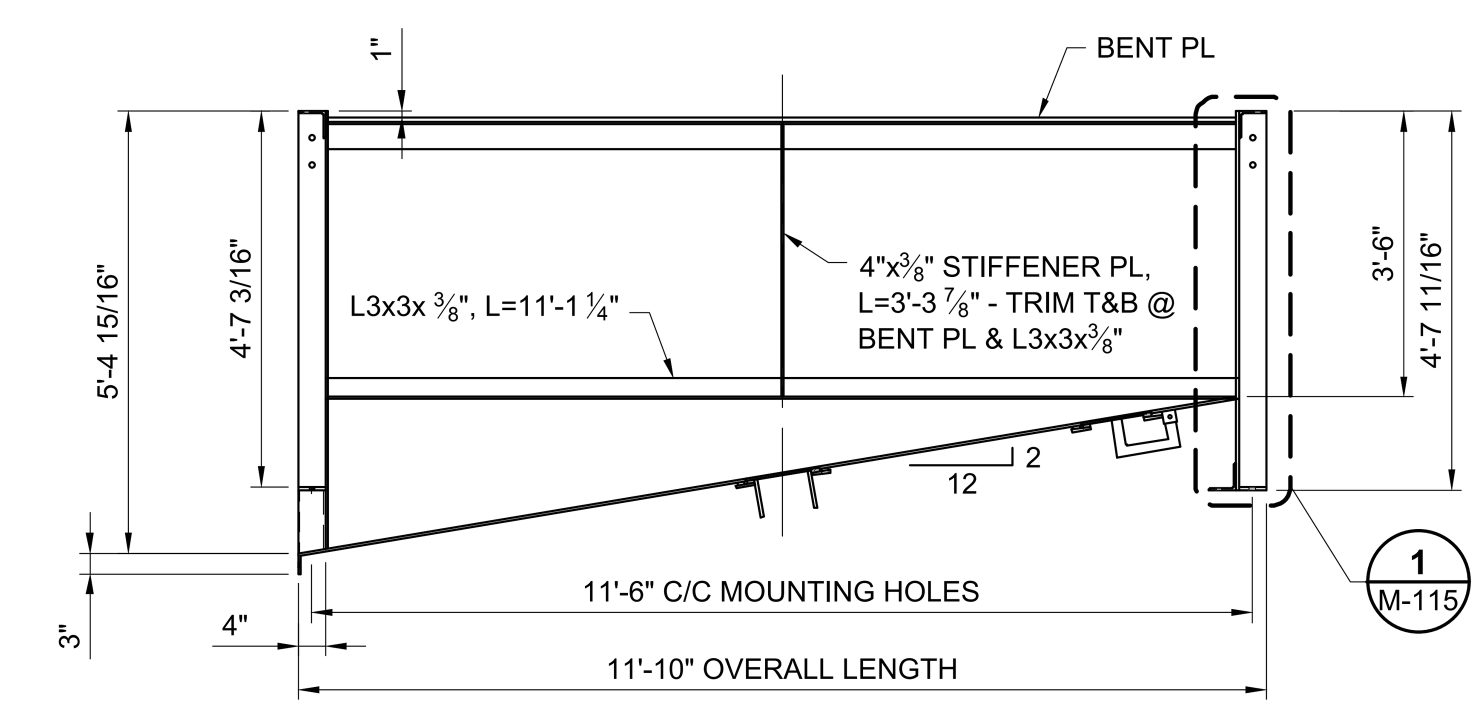

**A DETAIL**
SCALE: 3"=1'-0"




**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"

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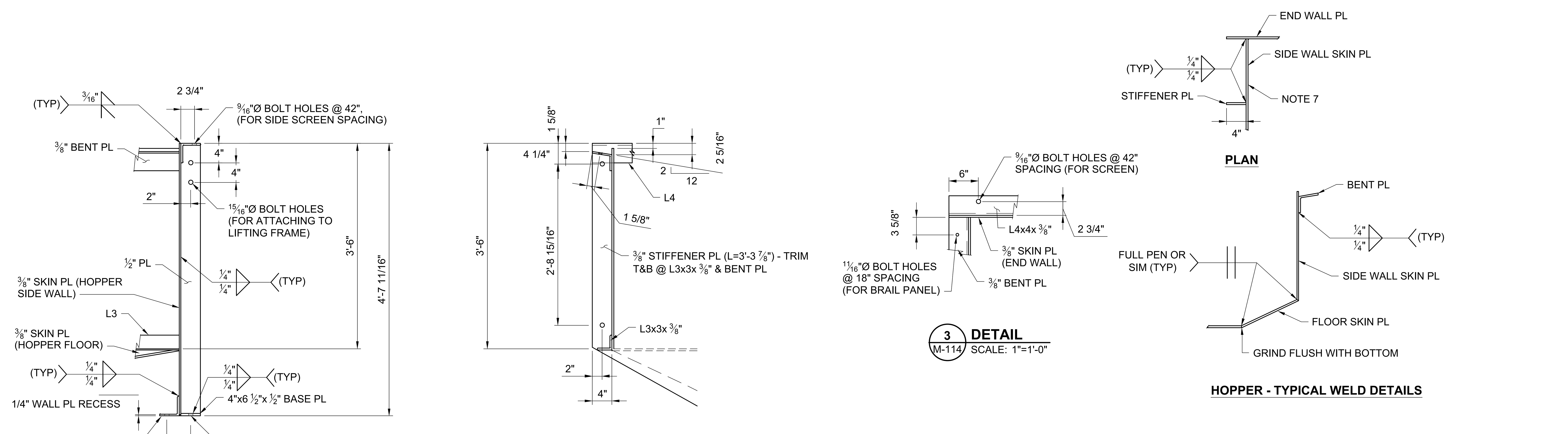
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

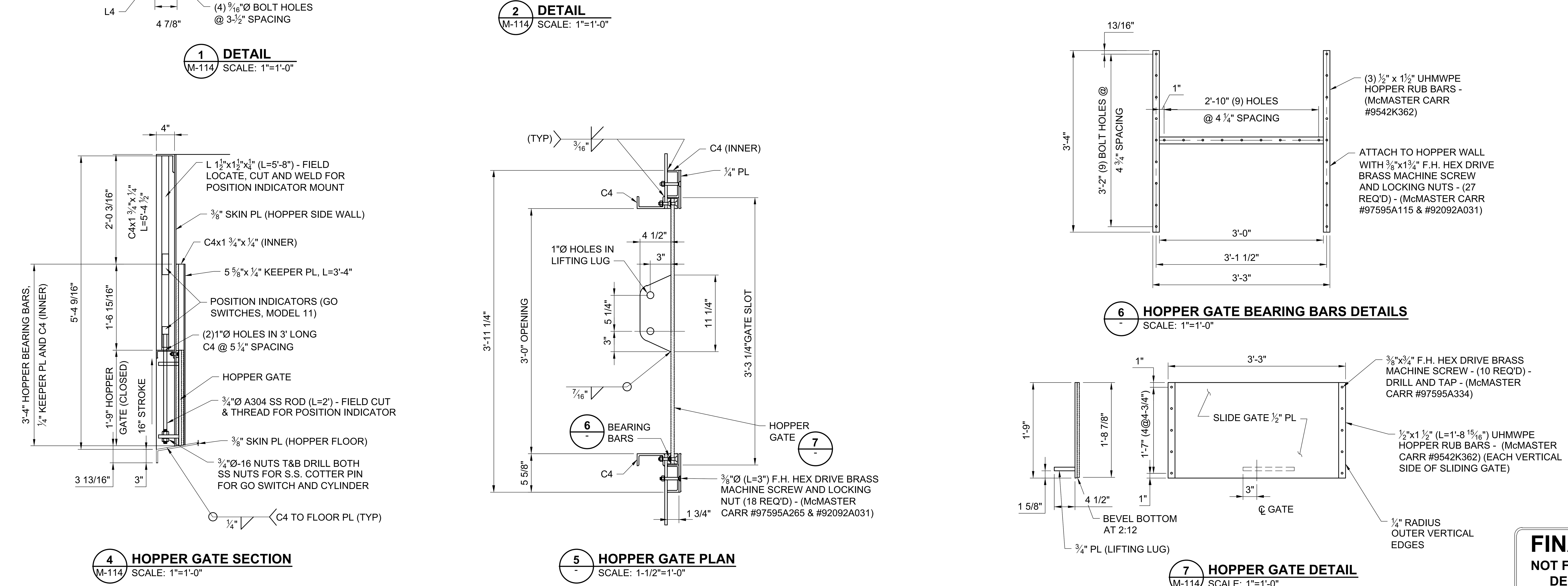
FISH LIFT HOPPER DETAILS

| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 96 OF 176 |
| DRAWING: | M-114 |

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 ¼"R.
5. AIR CYLINDER TO BE STAINLESS STEEL PARKER # 3.25CFSAU19A16.000
6. SPLICES AT ⅜" WALL OR FLOOR SKIN PLATES TO BE FULL PENETRATION

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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 |

DWG: C:\Users\agrogan\documents\autocad sheet sets\3173shawfish\... G-SHWMT-SUBMIT ... USER: Agrogan
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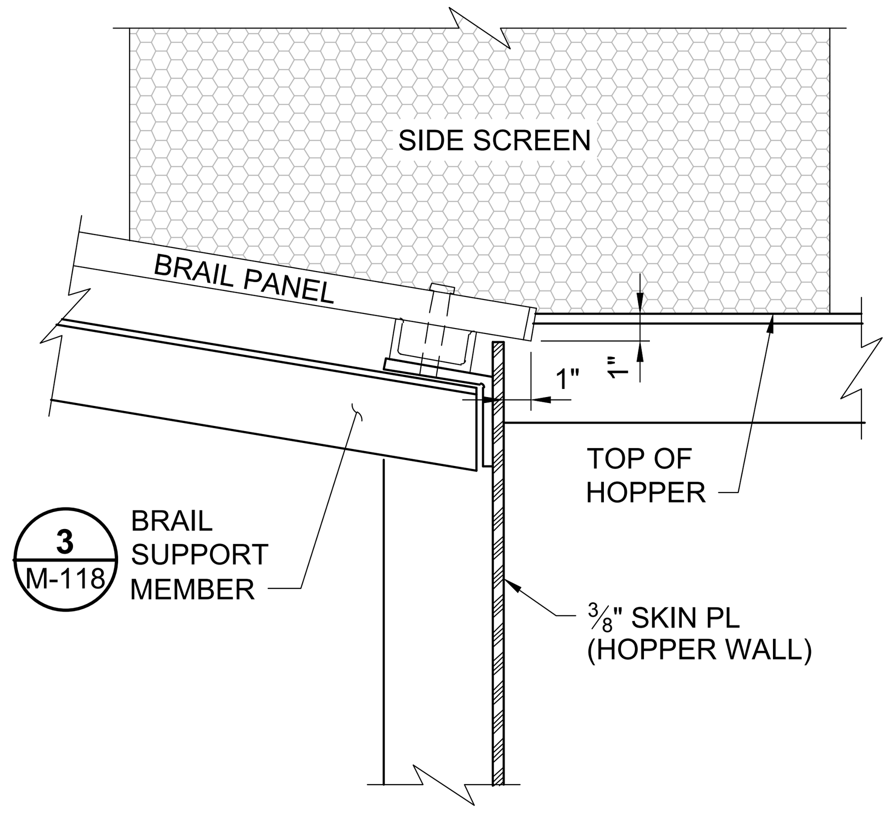
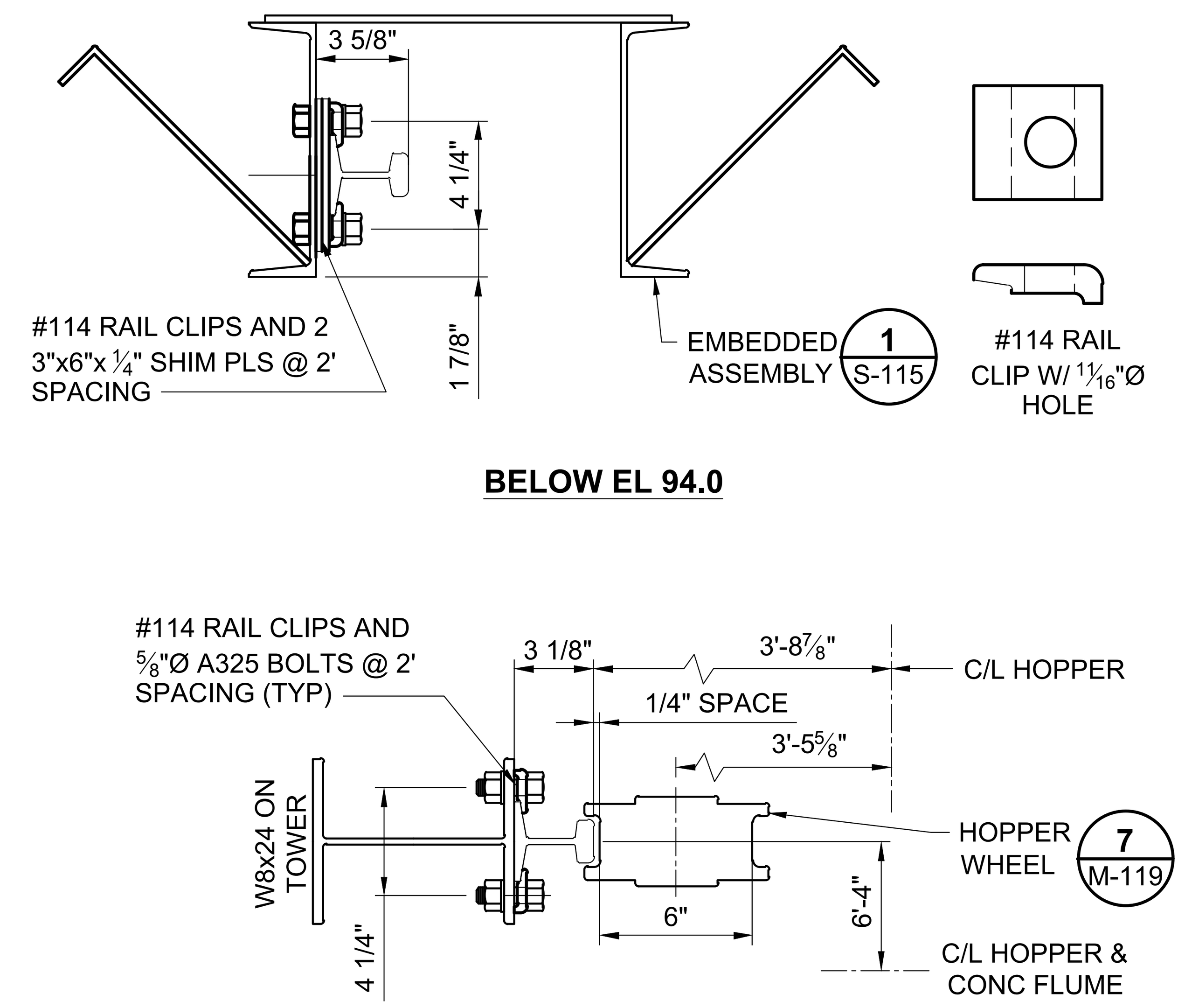
NOTES:

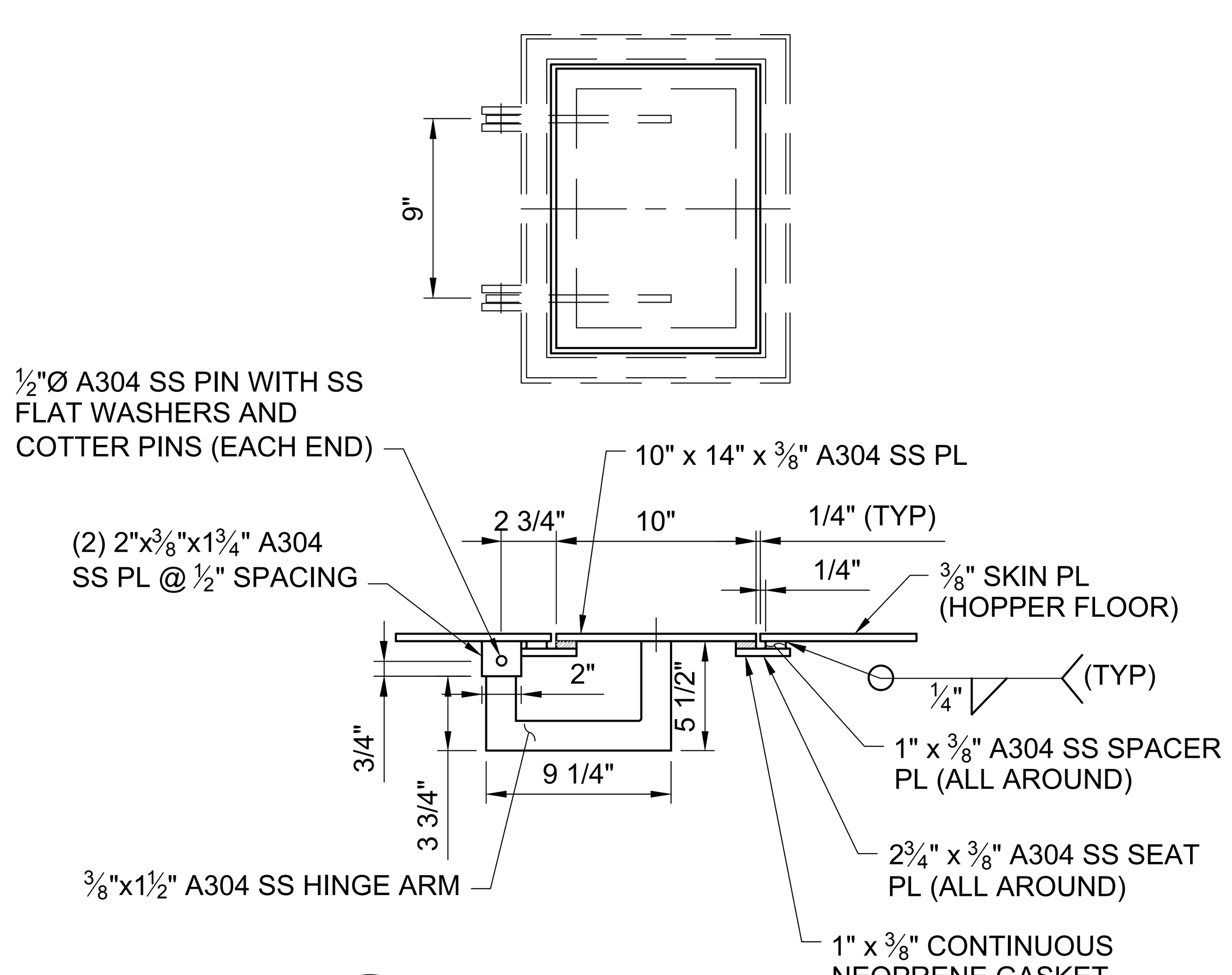
1. ALL MATERIAL ON THIS DRAWING SHALL BE A304 STAINLESS STEEL (UNO)



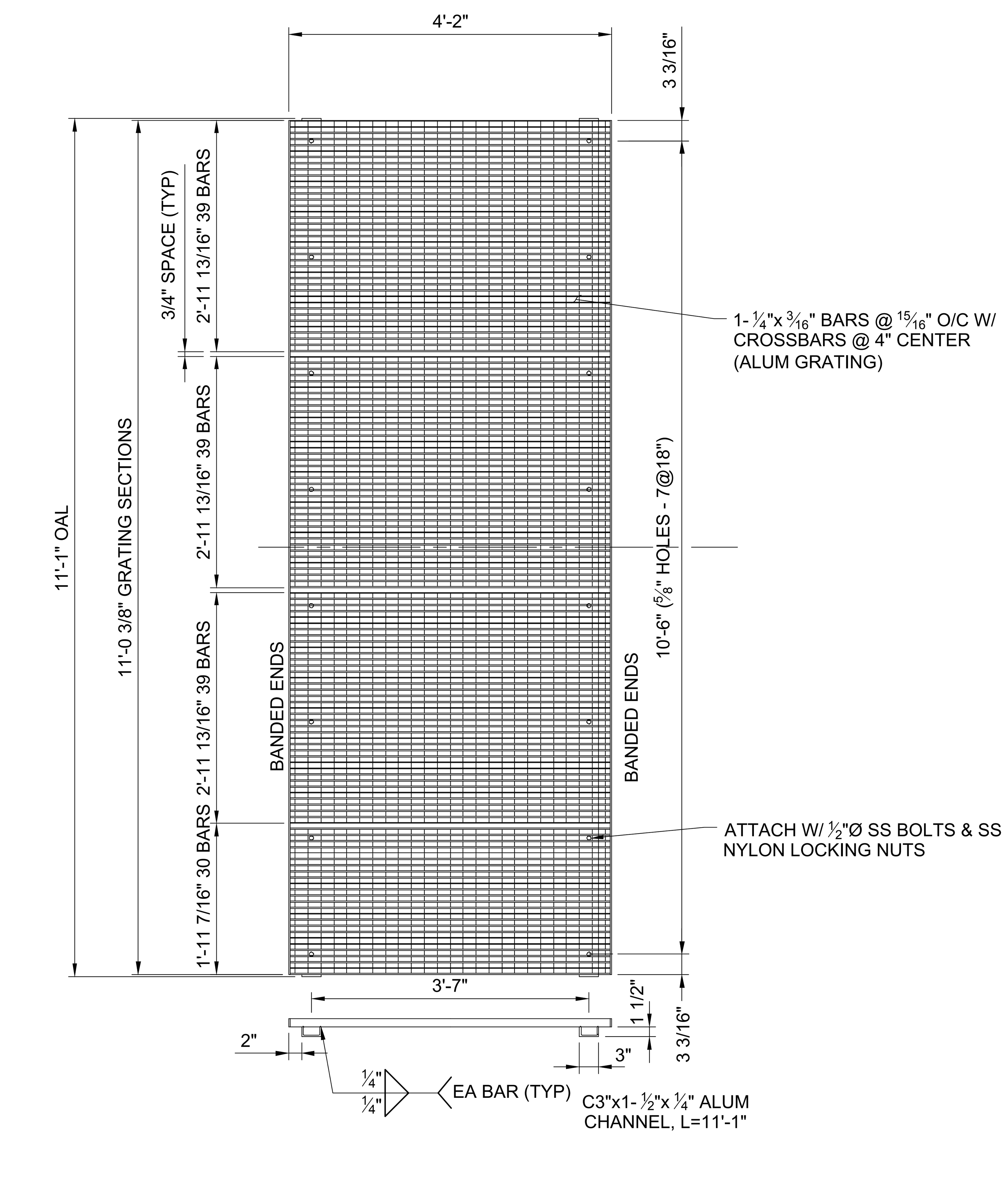

1 M-113 **BRAIL TO HOPPER DETAIL**
SCALE: 2"=1'-0"




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"

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No.39328
LICENSED
PROFESSIONAL ENGINEER
12/13/2019

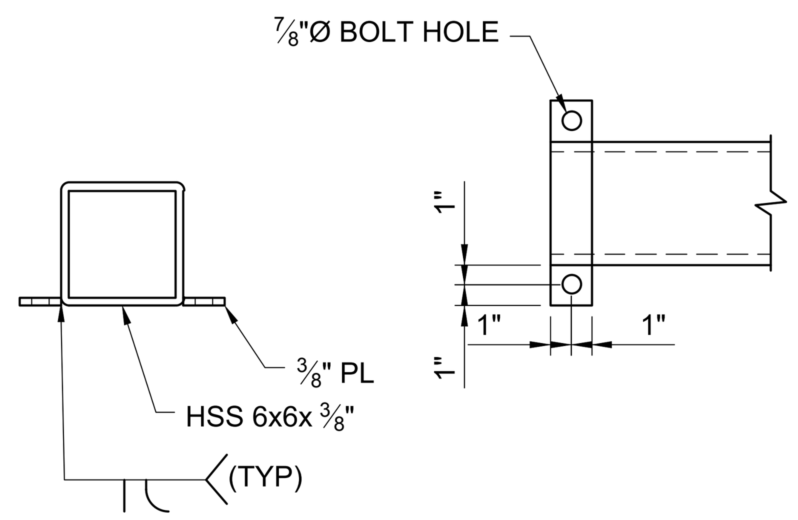
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - GENERAL LAYOUT AND INFORMATION

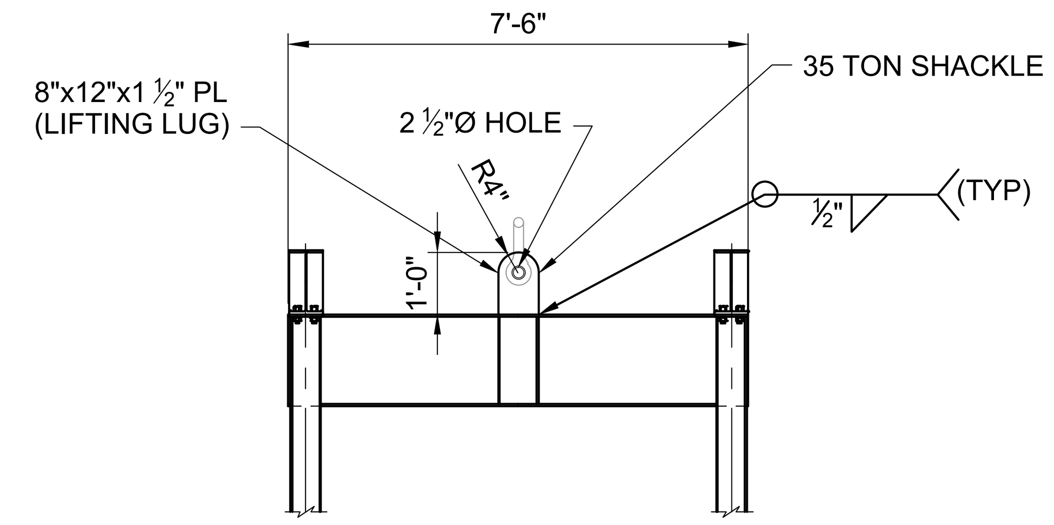
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 98 OF 176 |
| DRAWING: | M-116 |

**NOTES:**

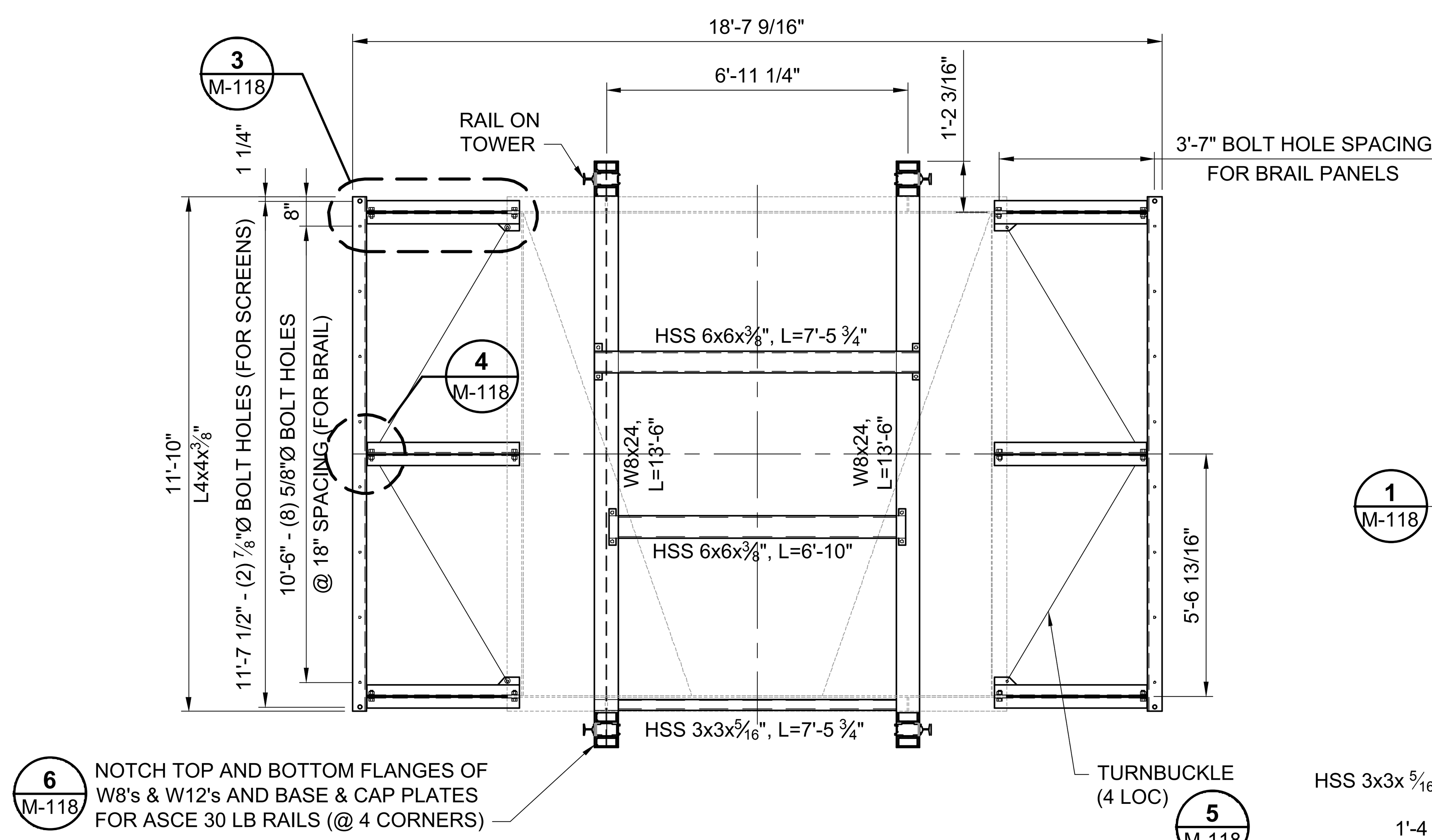
1. ALL MATERIAL ON THIS DRAWING SHALL BE HOT-DIP GALVANIZED CARBON STEEL (UNO).
2. BOLTS TO BE 3/4" A325 BOLTS (UNO). HOLES FOR BOLTS TO BE 7/8". SLOTTED HOLES TO BE 7/8" x 1-1/8".
3. WELDING TO BE PER AWS USING E80XX ELECTRODES.
4. WELDS TO BE CONTINUOUS SEAL FILLET WELDS - MAXIMUM SIZE PER AISC (UNO).



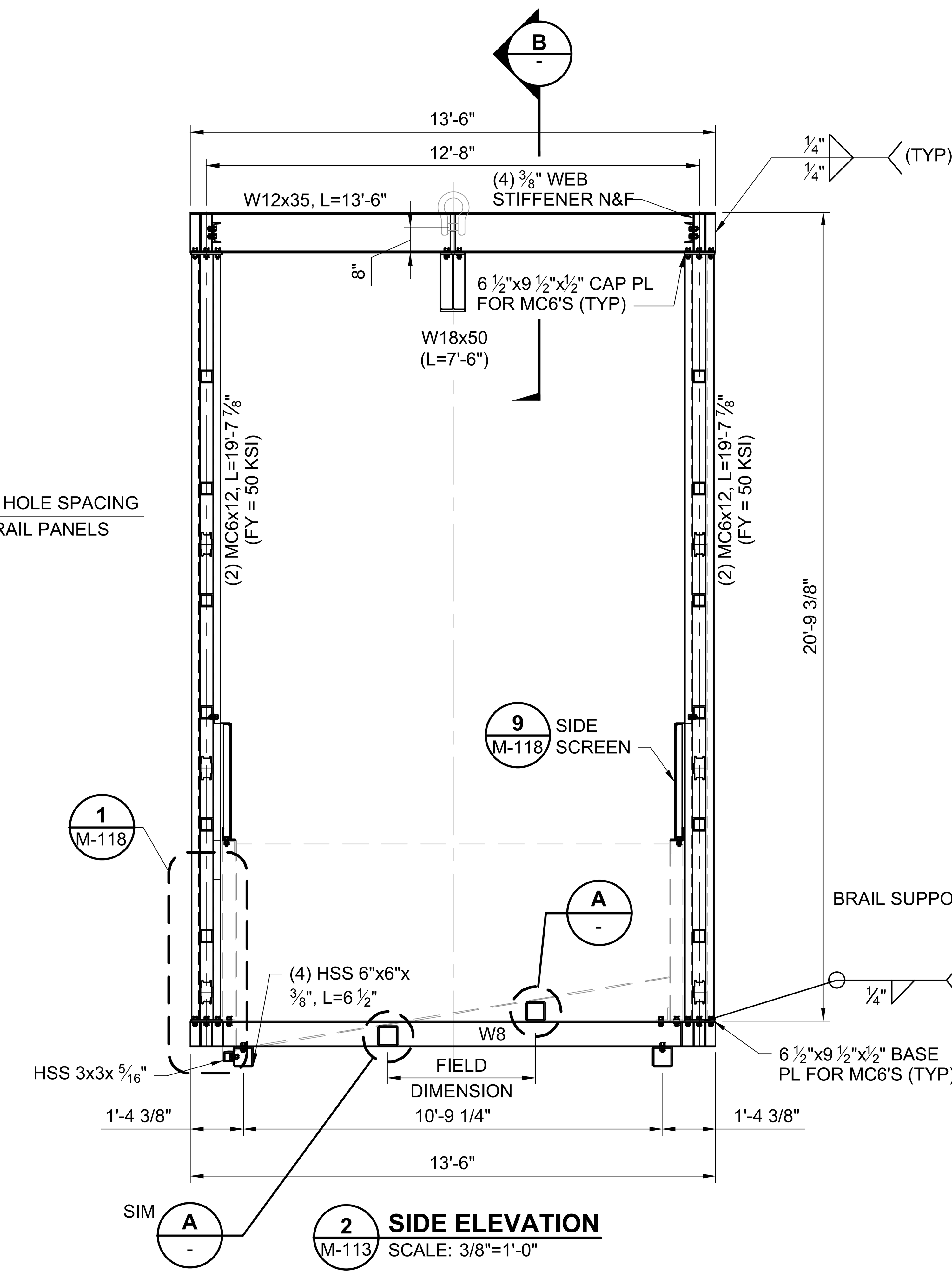

A DETAIL
SCALE: 1-1/2"=1'-0"



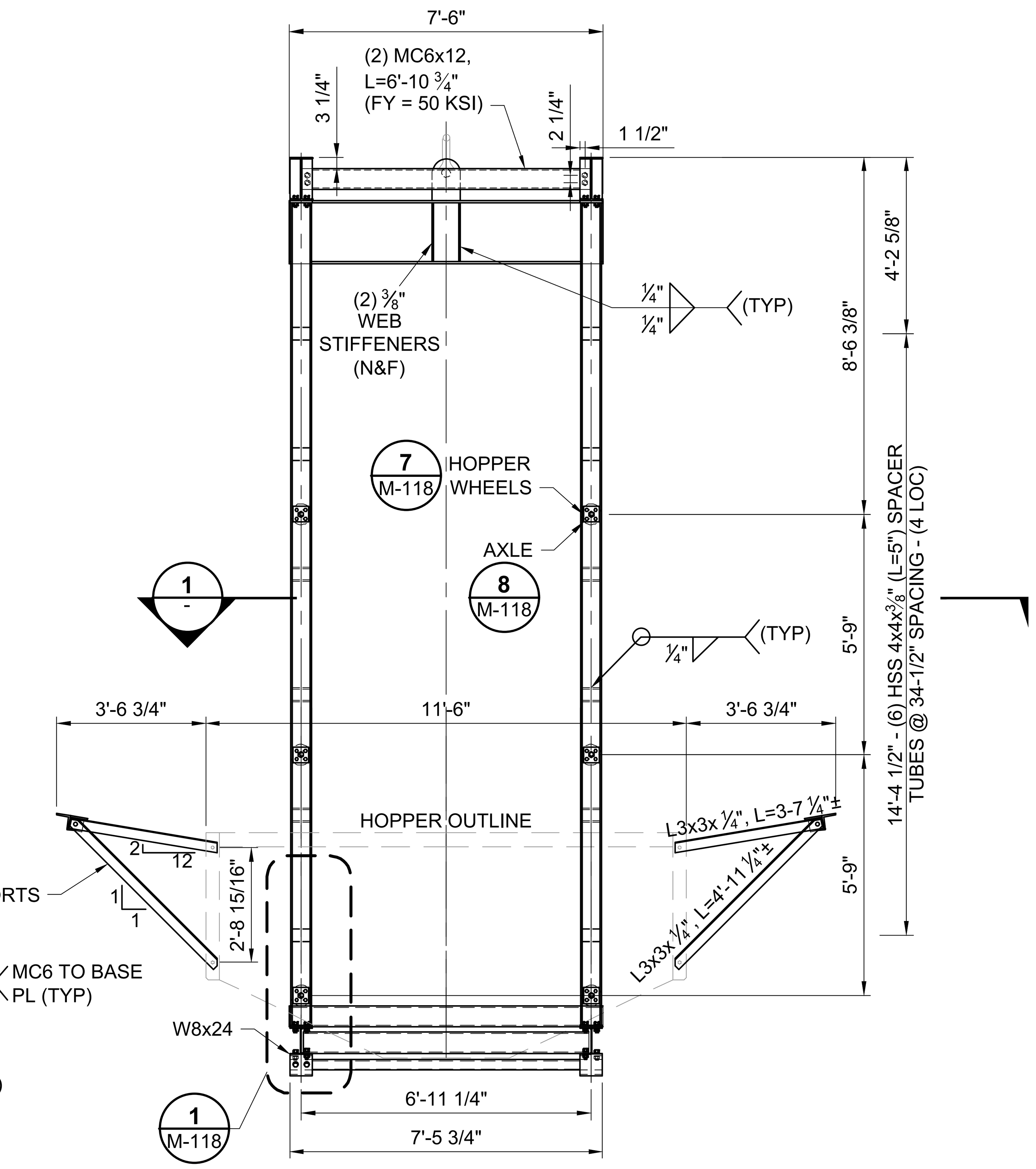

B DETAIL
SCALE: 3/8"=1'-0"




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"

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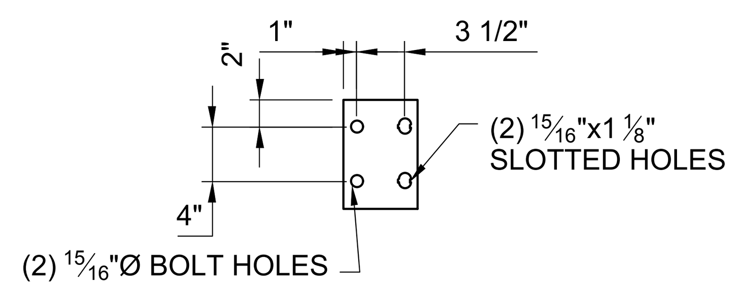
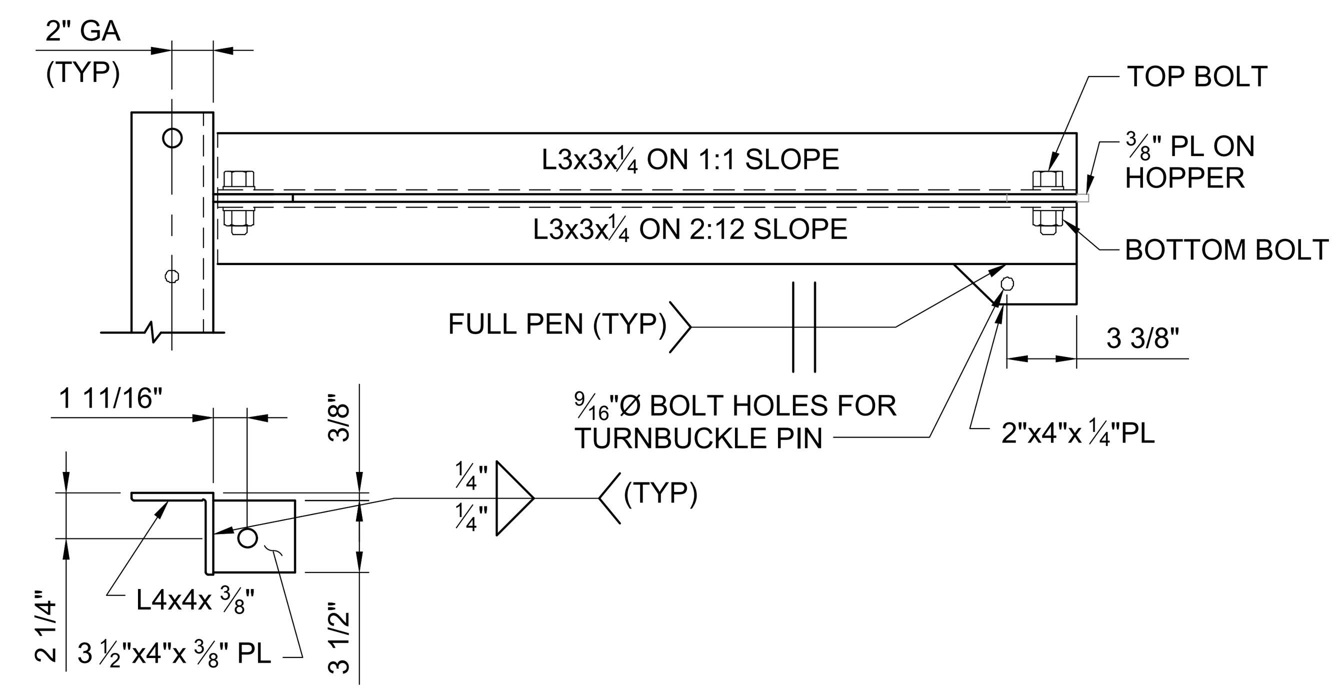
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - STEEL COMPONENTS

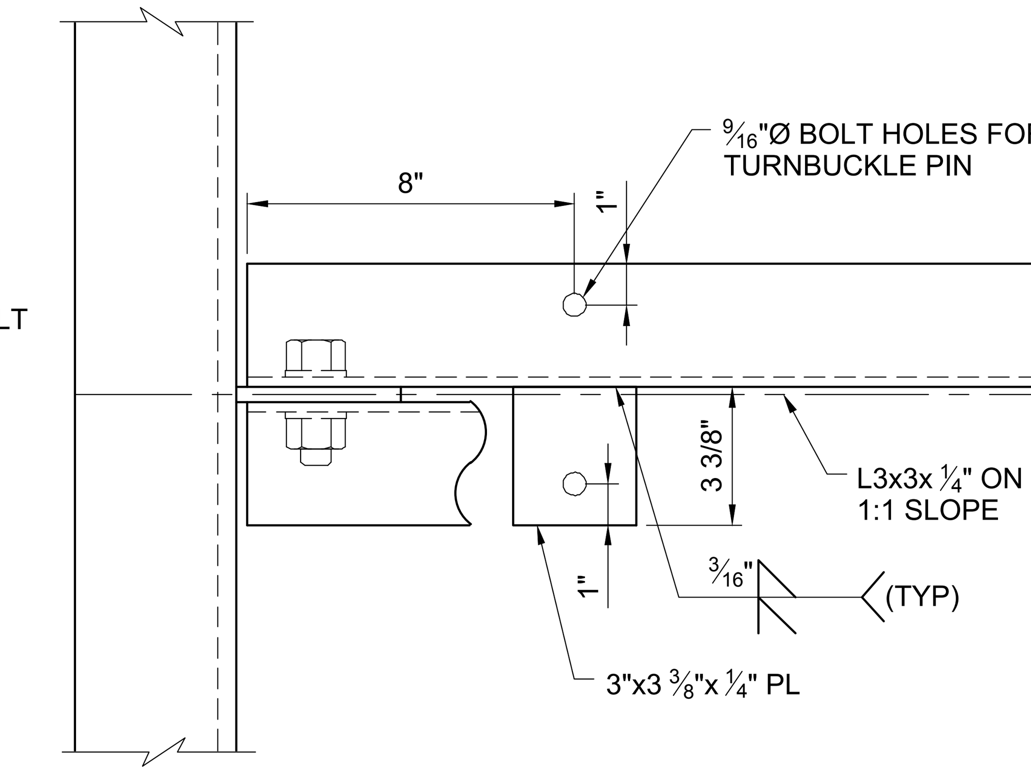
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 99 OF 176 |
| DRAWING: | M-117 |



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



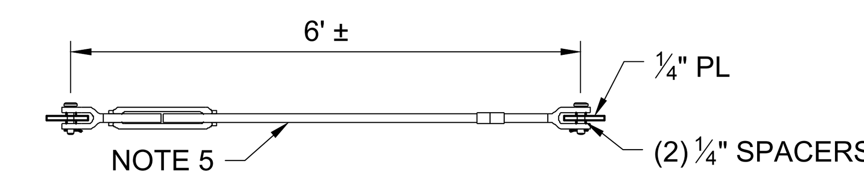
3 BRAIL SUPPORT DETAIL
M-116
SCALE: 1 1/2"=1'-0"



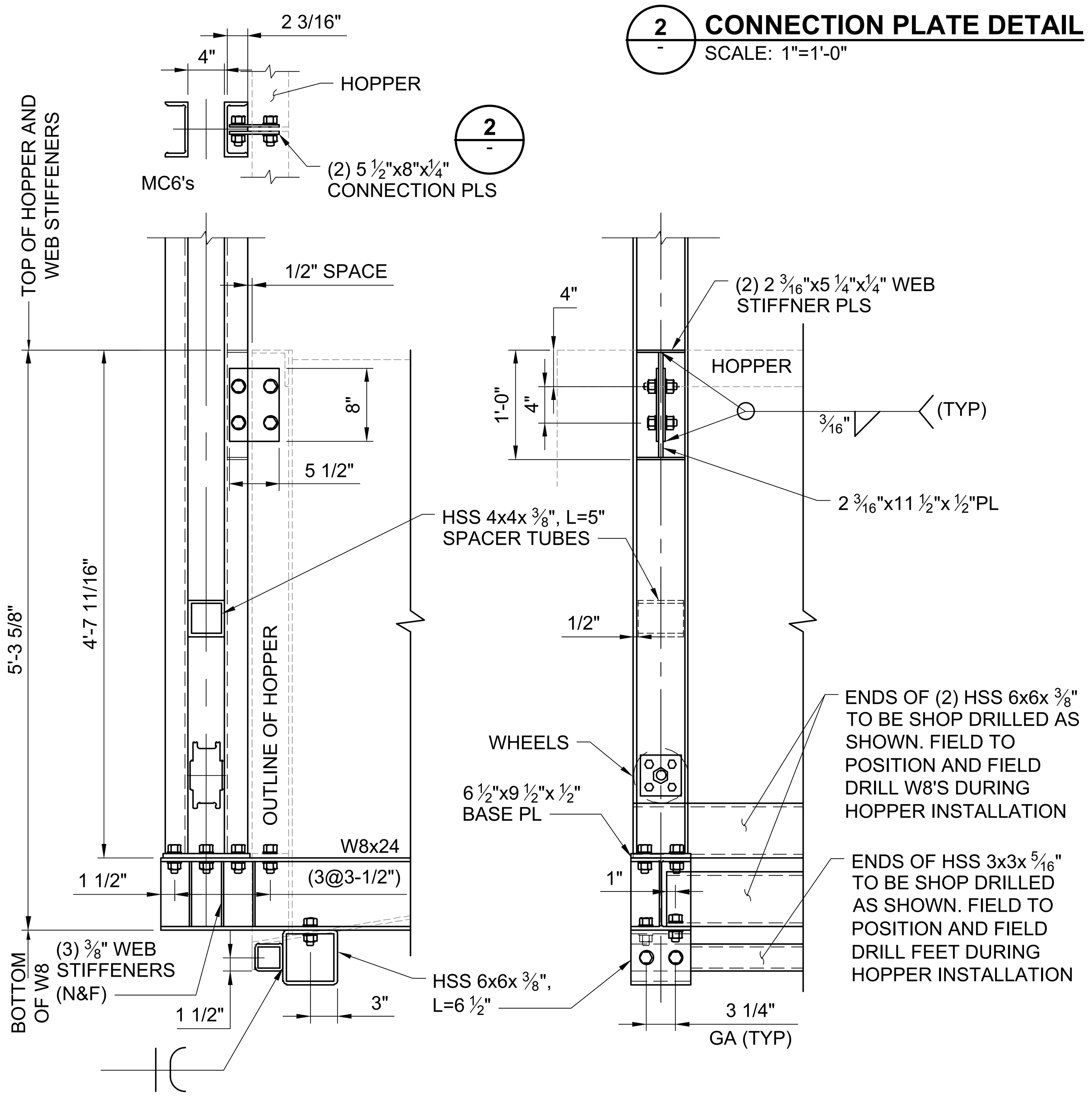
4 BRAIL SUPPORT DETAIL
M-117
SCALE: 3"=1'-0"

NOTES:

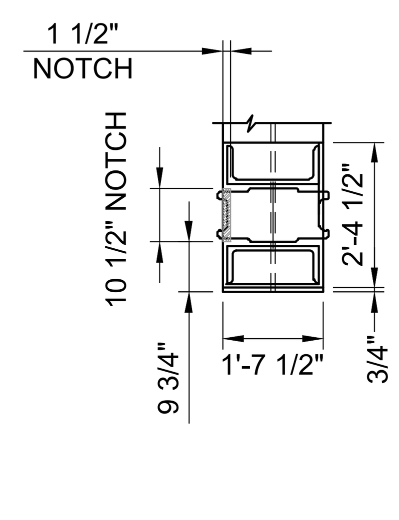
1. ALL MATERIAL ON THIS DRAWING SHALL BE HOT-DIP GALVANIZED CARBON STEEL (UNO).
2. BOLTS TO BE 3/4" A325 BOLTS (UNO). HOLES FOR BOLTS TO BE 7/8". SLOTTED HOLES TO BE 7/8" x 1-1/8".
3. WELDING TO BE PER AWS USING E80XX ELECTRODES.
4. WELDS TO BE CONTINUOUS SEAL FILLET WELDS - MAXIMUM SIZE PER AISC (UNO).
5. 1⁄2" GALVANIZED TURNBUCKLE - (McMASTER CARR # 3001T57) AND JAM NUT SET (#3000T56), 5⁄8"Ø (11 TPI) GALVANIZED THREADED EXTENSION ROD, AND GALVANIZED COUPLING.



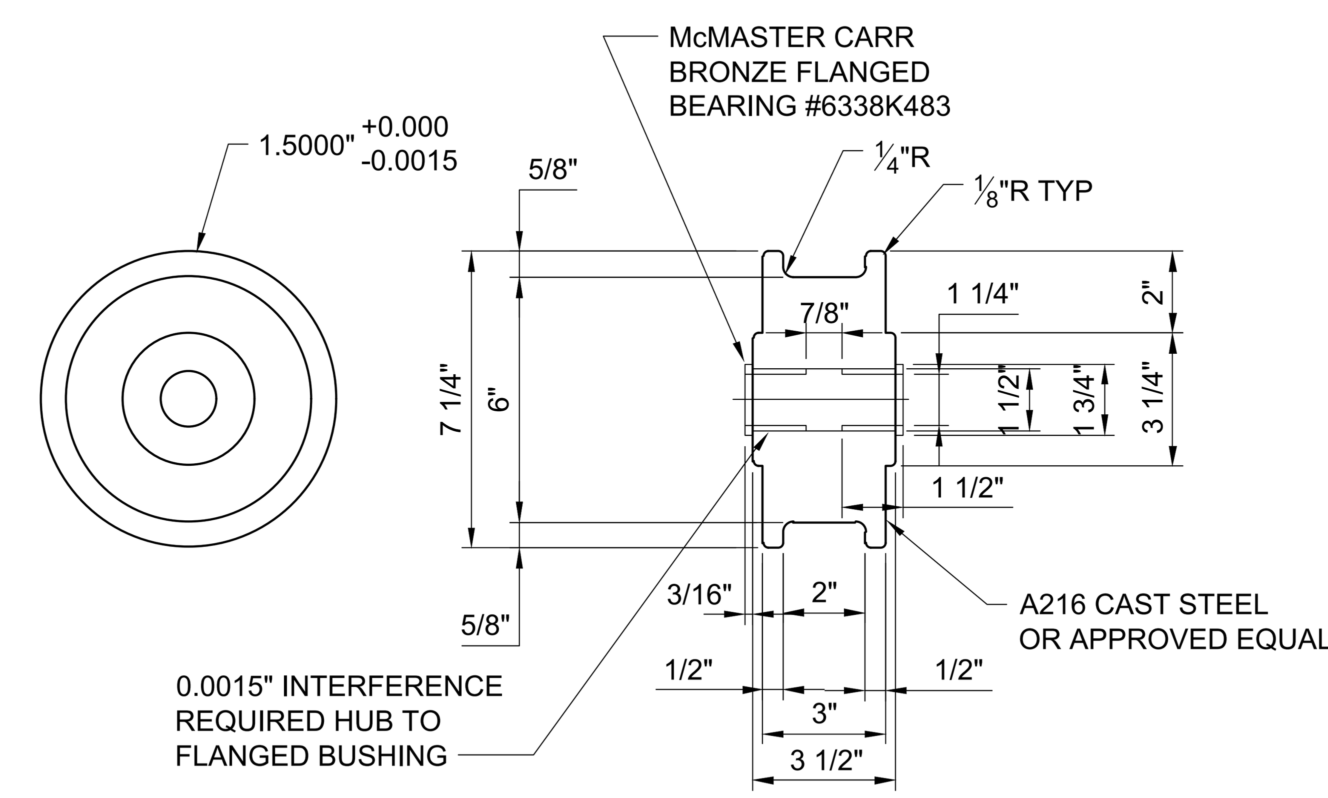
5 TURNBUCKLE DETAIL
M-117
SCALE: 1"=1'-0"



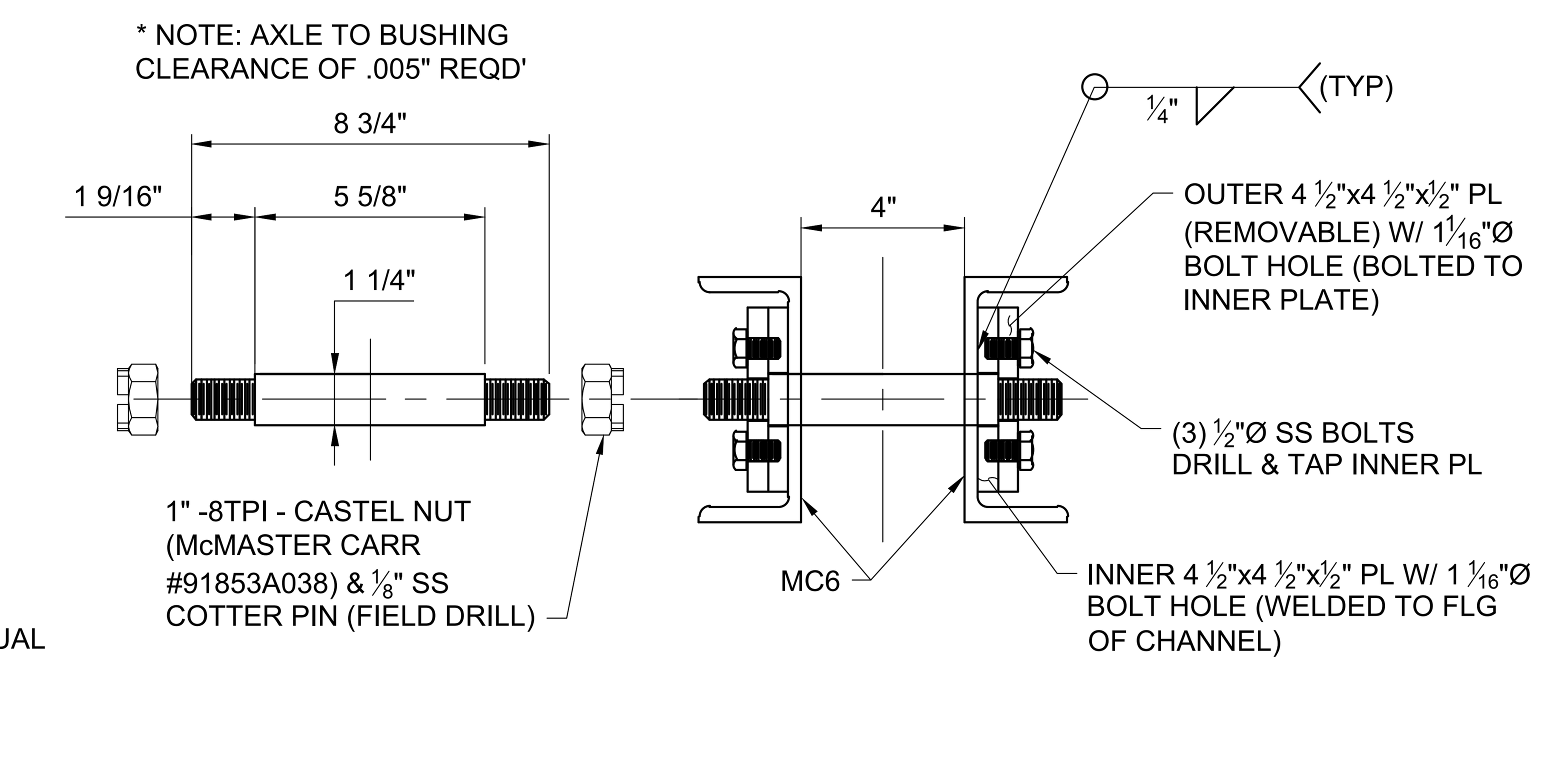
1 LIFTING FRAME TO HOPPER CONNECTION
M-117
SCALE: 1"=1'-0"



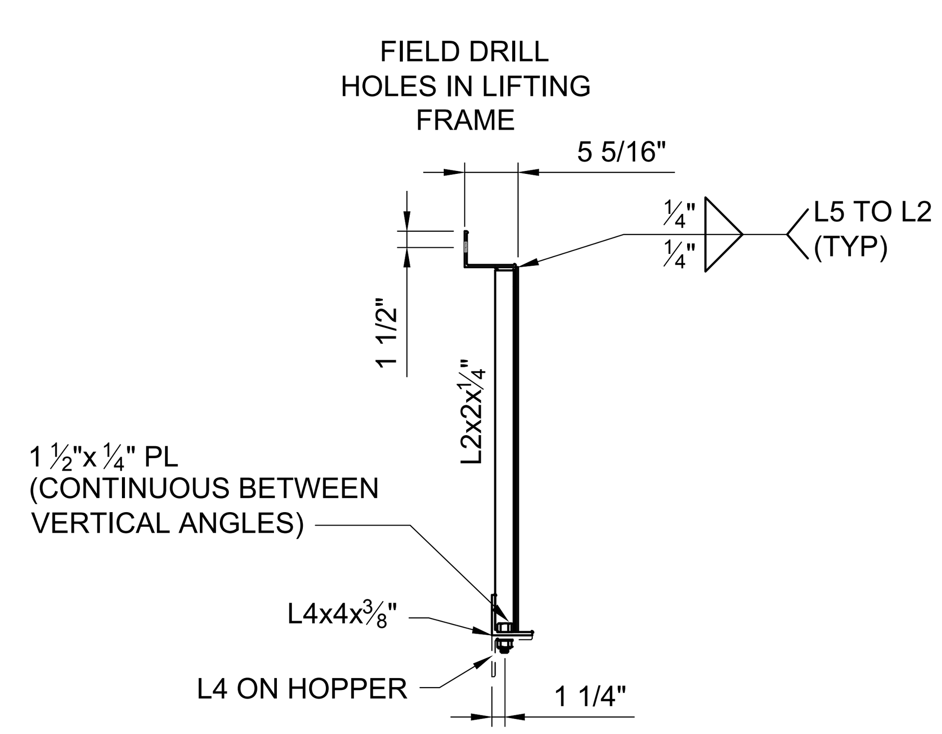
6 NOTCH DETAIL
M-117
SCALE: 3/8"=1'-0"



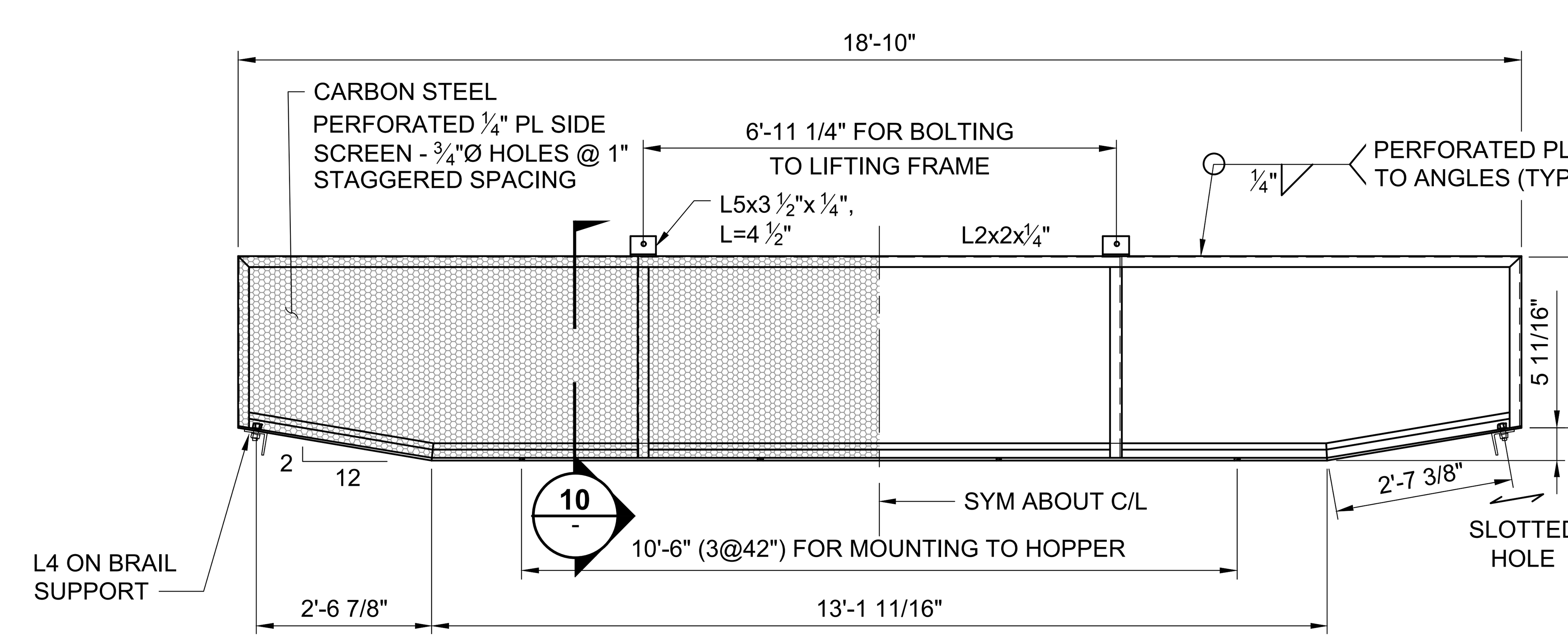
7 SIDE SCREEN DETAIL (2 LOC)
M-116
SCALE: 3"=1'-0"
M-117



8 A304 SS AXLE DETAIL
M-117
SCALE: 3"=1'-0"



10 DETAIL
SCALE: 3/4"=1'-0"



9 SIDE SCREEN DETAIL (2 LOC)
M-113
SCALE: 1/2"=1'-0"
M-117

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**DECEMBER 13, 2019**

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

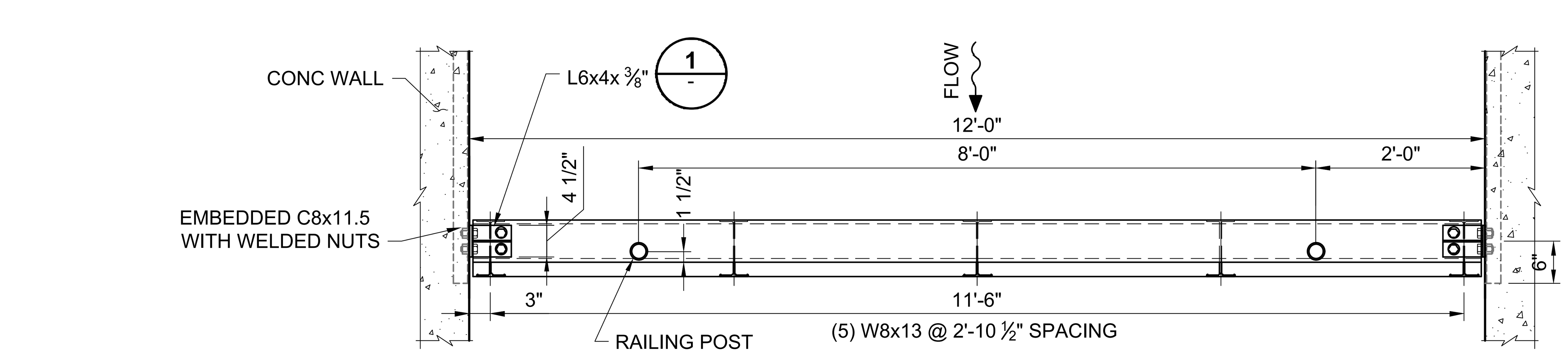
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT HOPPER - STEEL COMPONENTS

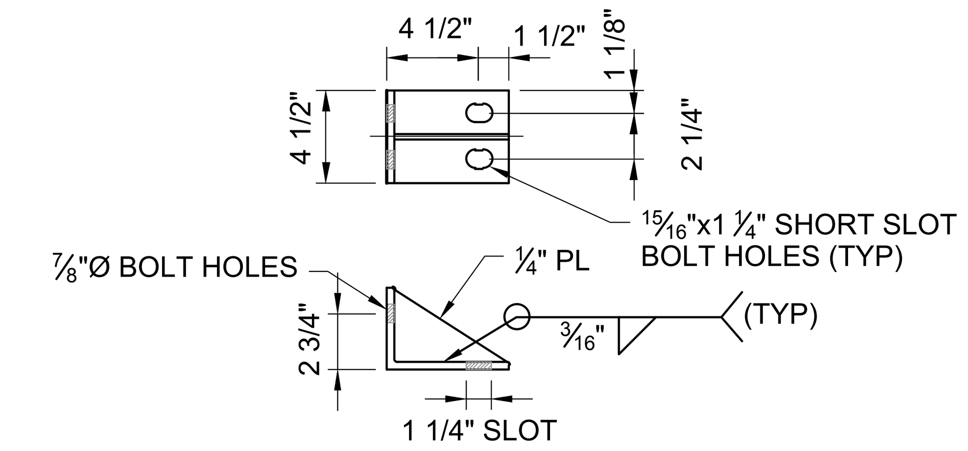
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 100 OF 176 |
| DRAWING: | M-118 |

**NOTES:**

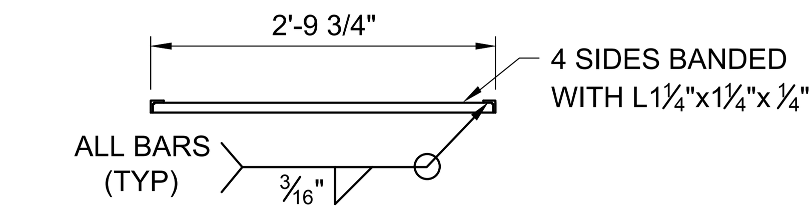
1. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.



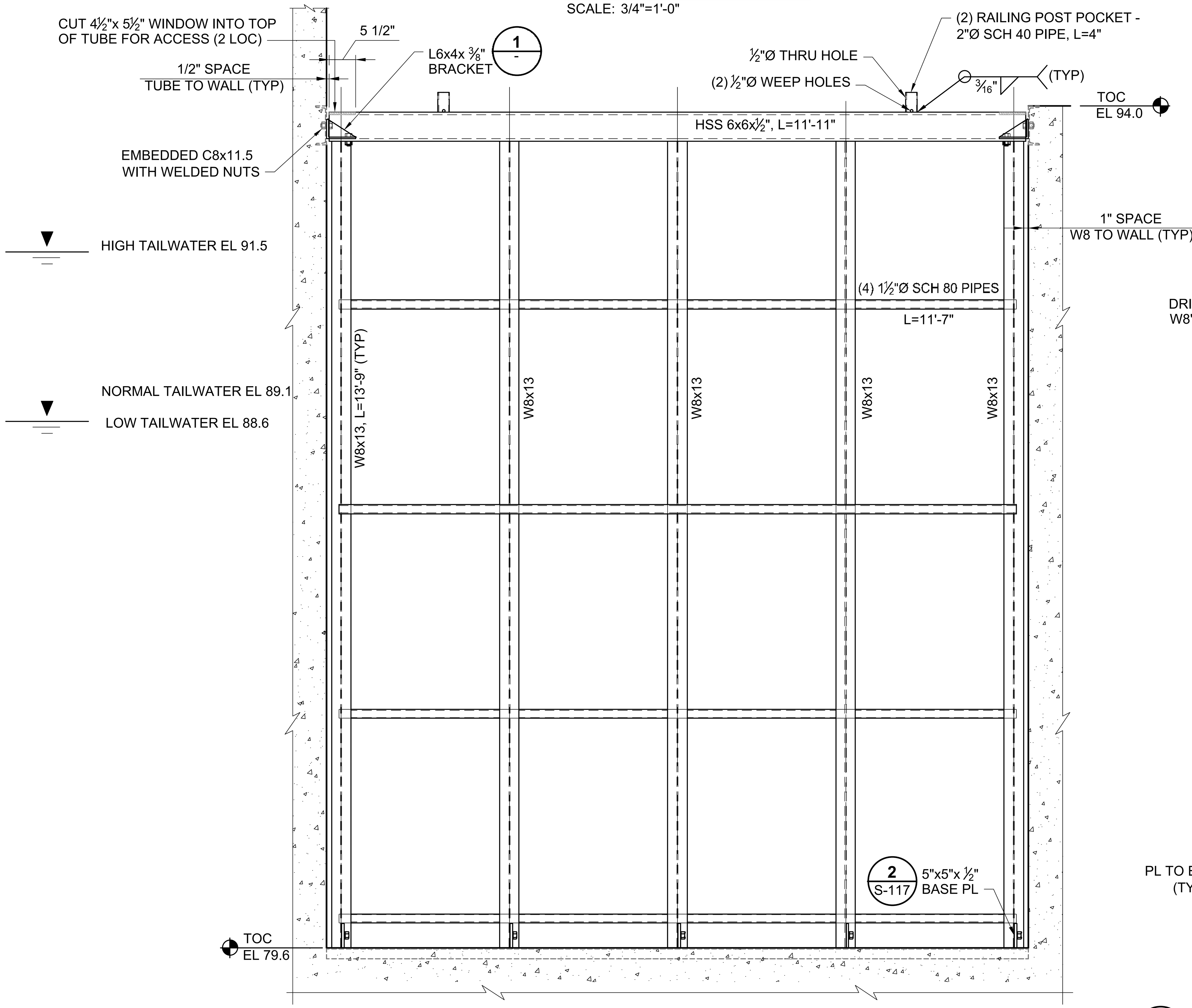

**FRAMING PLAN @ EL 94.0**
SCALE: 3/4"=1'-0"



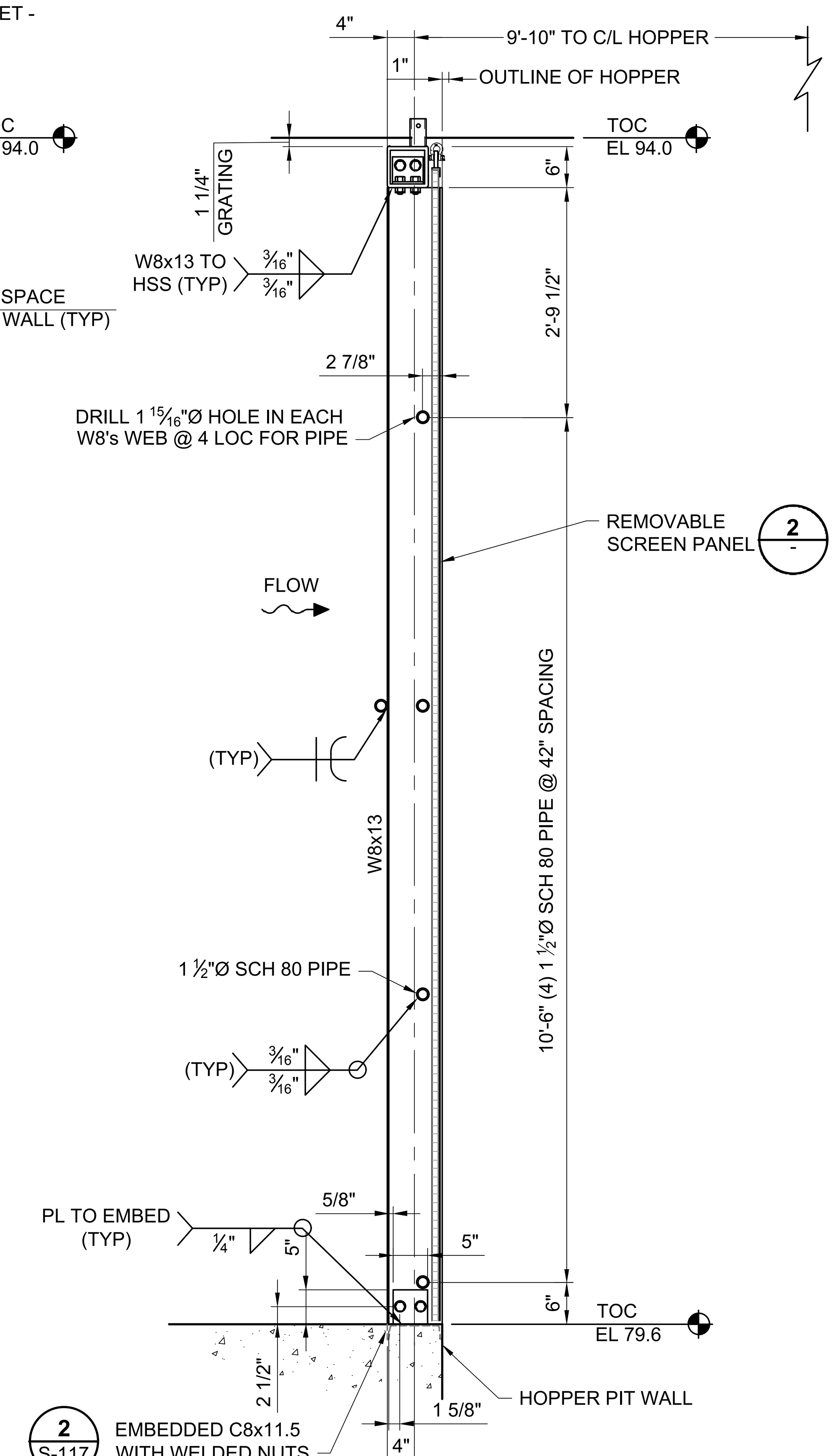

1 L6x4x3/8" BRACKET DETAIL (2 REQUIRED)
SCALE: 1 1/2"=1'-0"



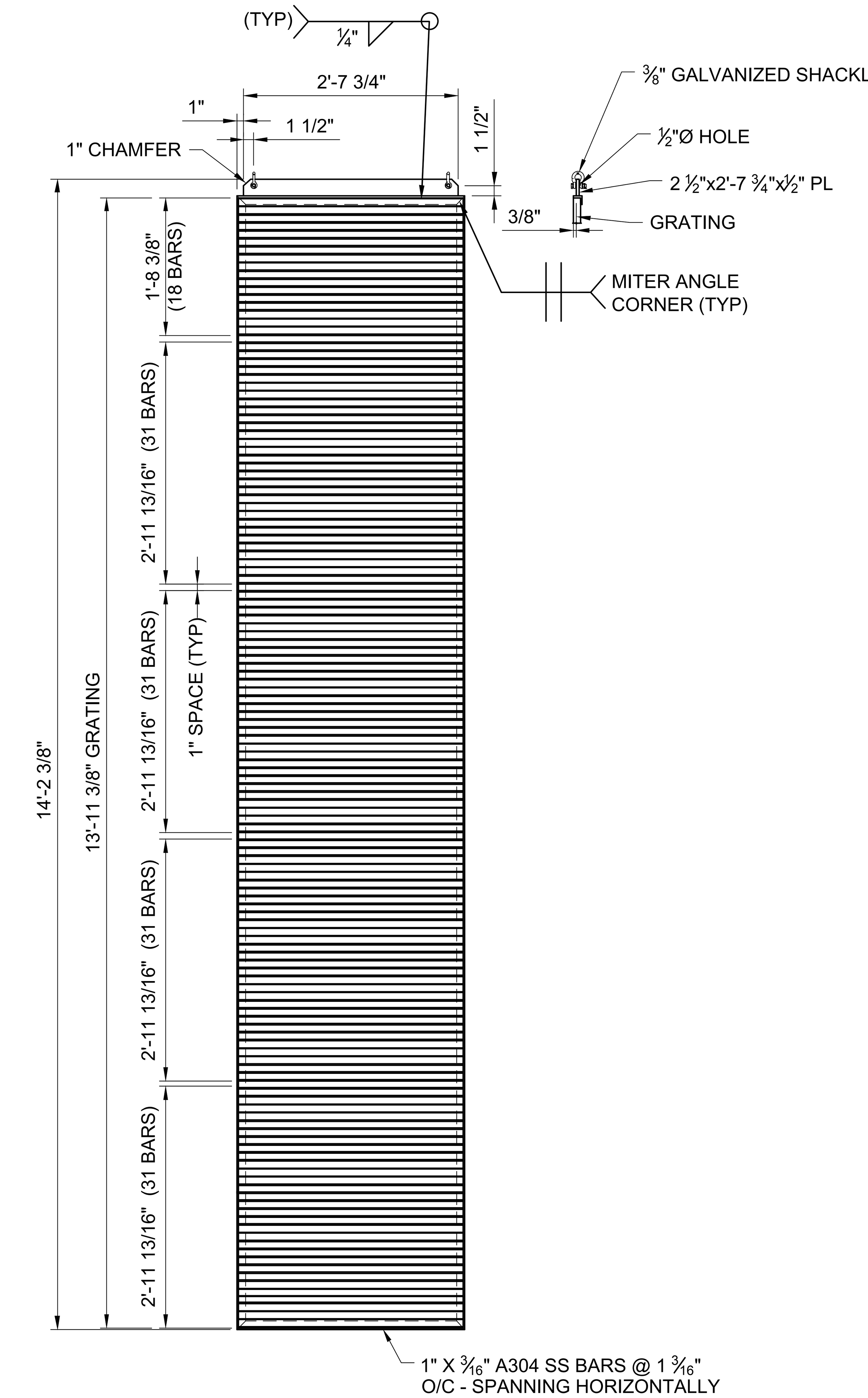

**PLAN**




**FRAMING ELEVATION LOOKING DOWNSTREAM**
SCALE: 3/4"=1'-0"




**SIDE FRAMING ELEVATION (SCREEN PANELS SHOWN)**
SCALE: 3/4"=1'-0"




**ELEVATION**

2 REMOVABLE SCREEN PANELS (4 REQUIRED)
SCALE: 3/4"=1'-0"

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No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

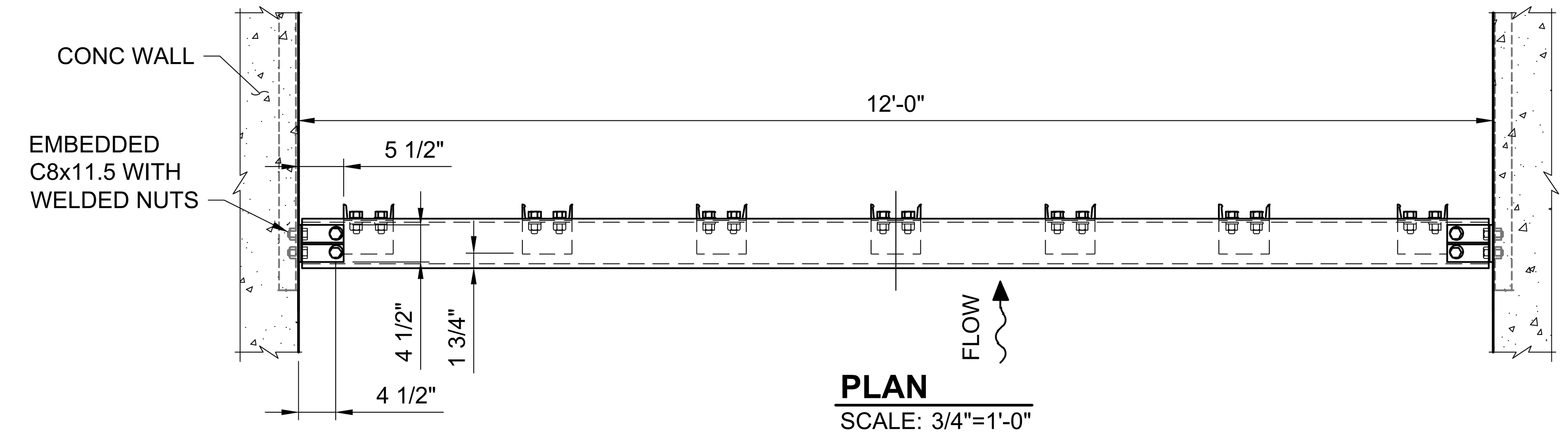
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT UPSTREAM TOWER
SCREEN ELEVATION AND DETAILS

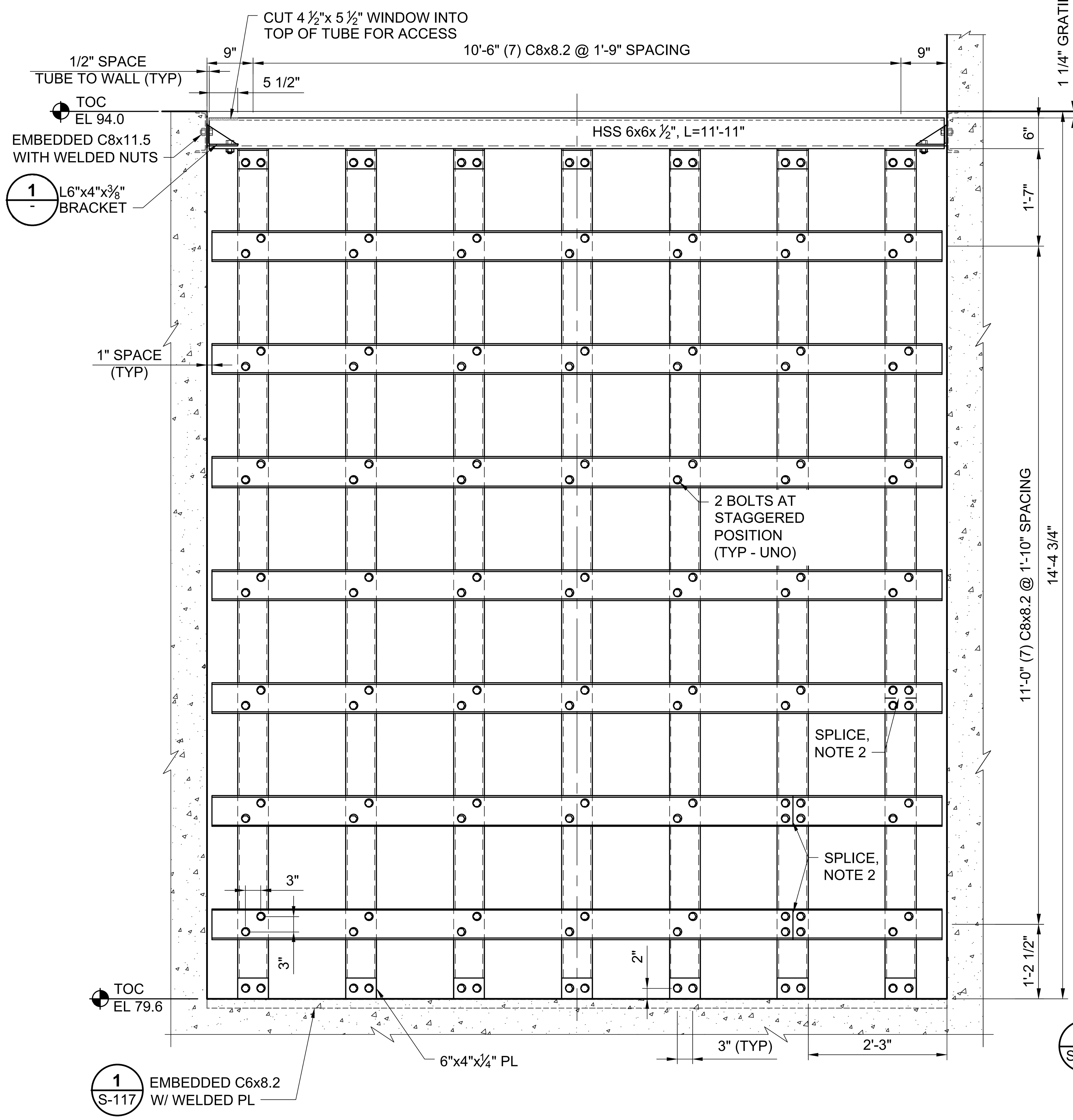
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 101 OF 176
DRAWING: M-119

## NOTES:

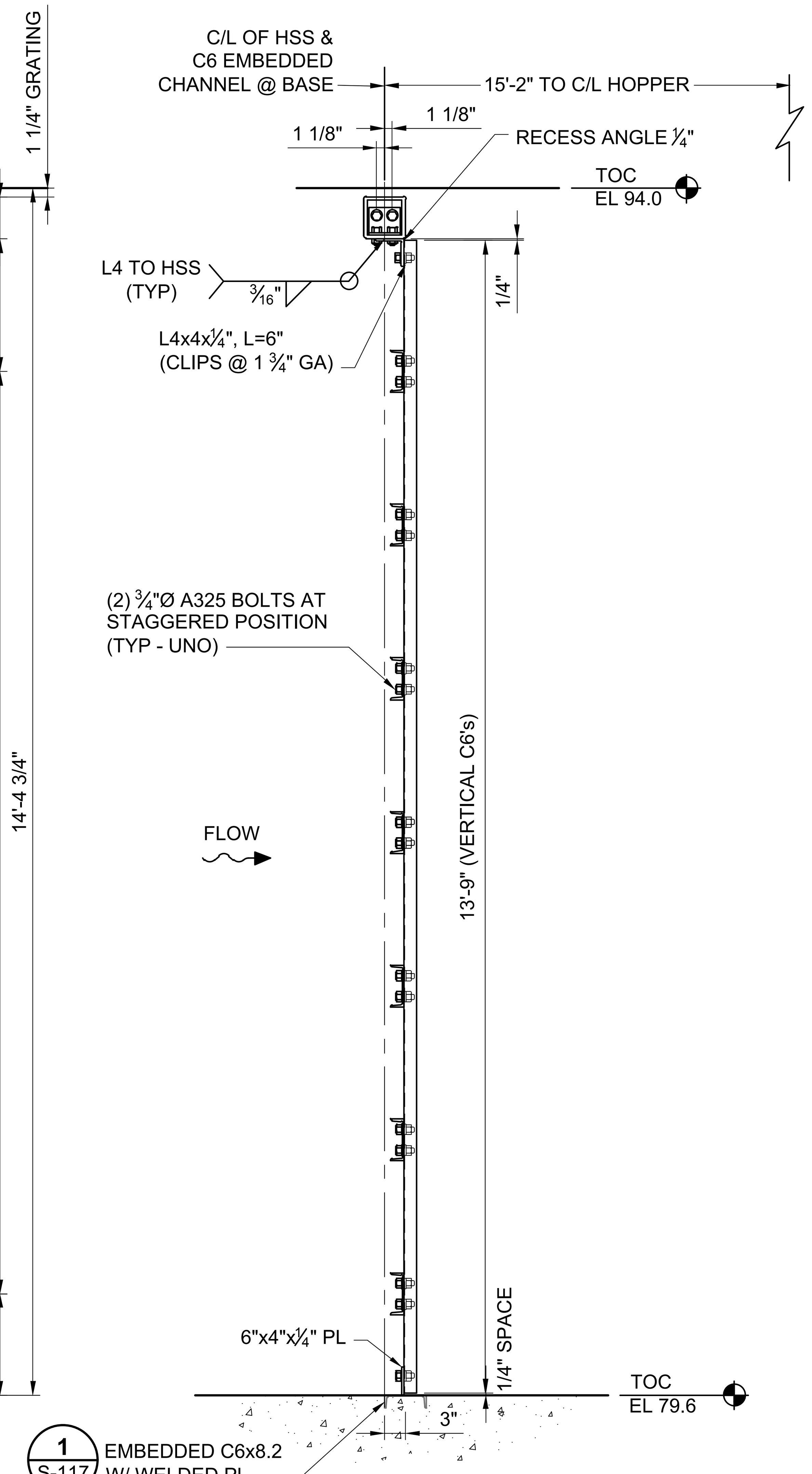
1. ALL MEMBERS C8x8.2 (UNO)
2. SPLICE STEEL MEMBERS AS REQUIRED FOR INSTALLATION. PROVIDE 4 BOLTS AND ⅛" SPACE AS SHOWN.
3. ALL CARBON STEEL ITEMS SHALL BE GALVANIZED.



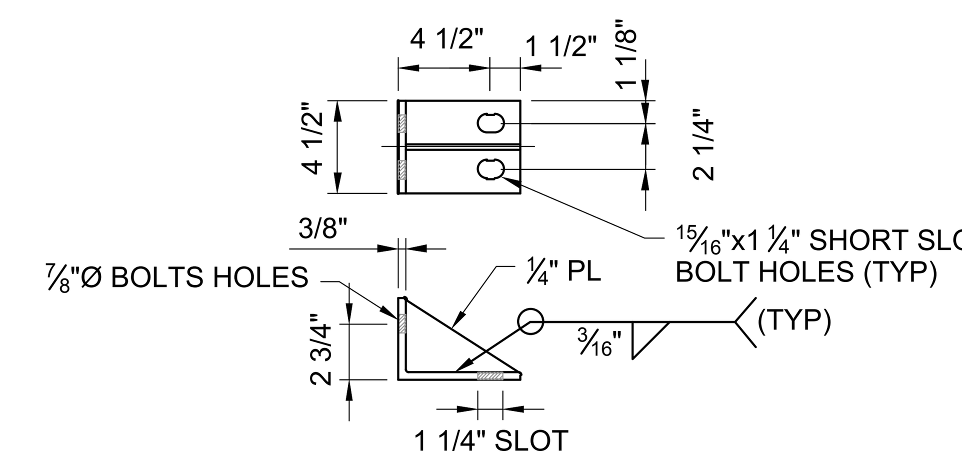

**PLAN**
SCALE: 3/4"=1'-0"




**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"

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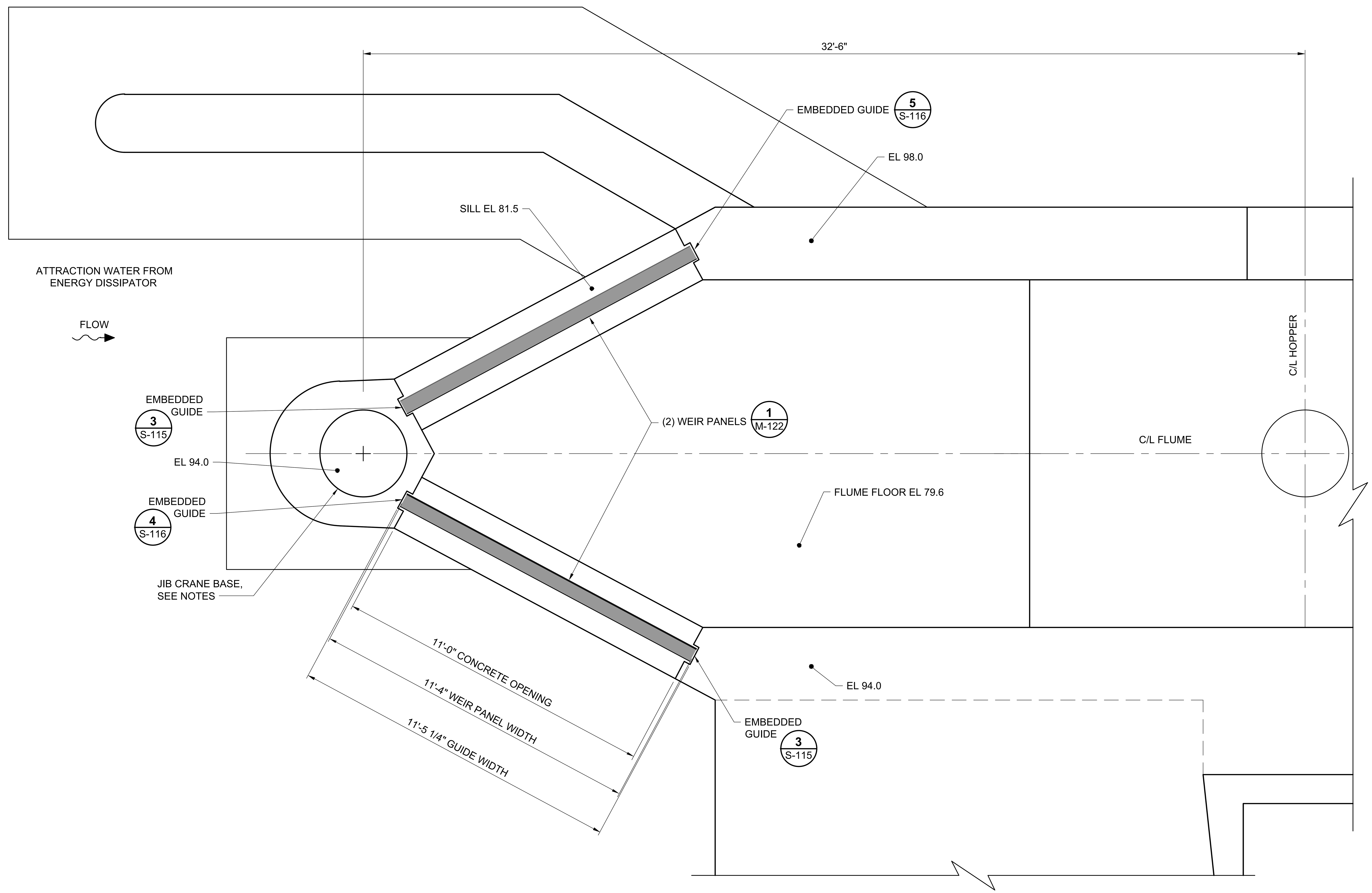
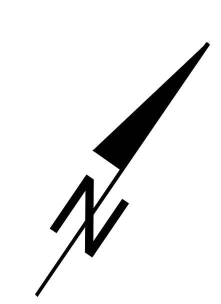
No.39328
12/13/2019
LICENSED PROFESSIONAL ENGINEER

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.

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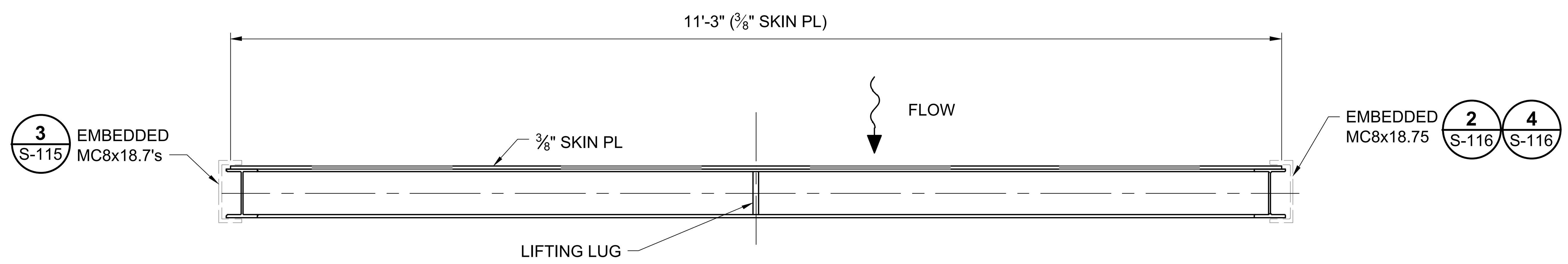
LICENSED PROFESSIONAL ENGINEER

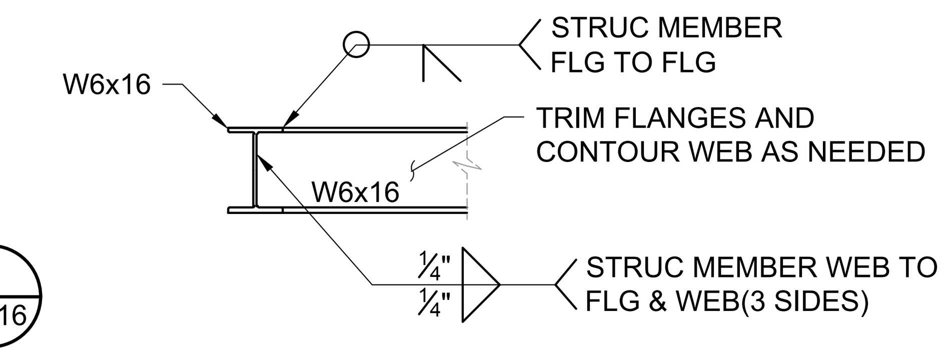
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

FISH LIFT WEIR PANEL PLAN

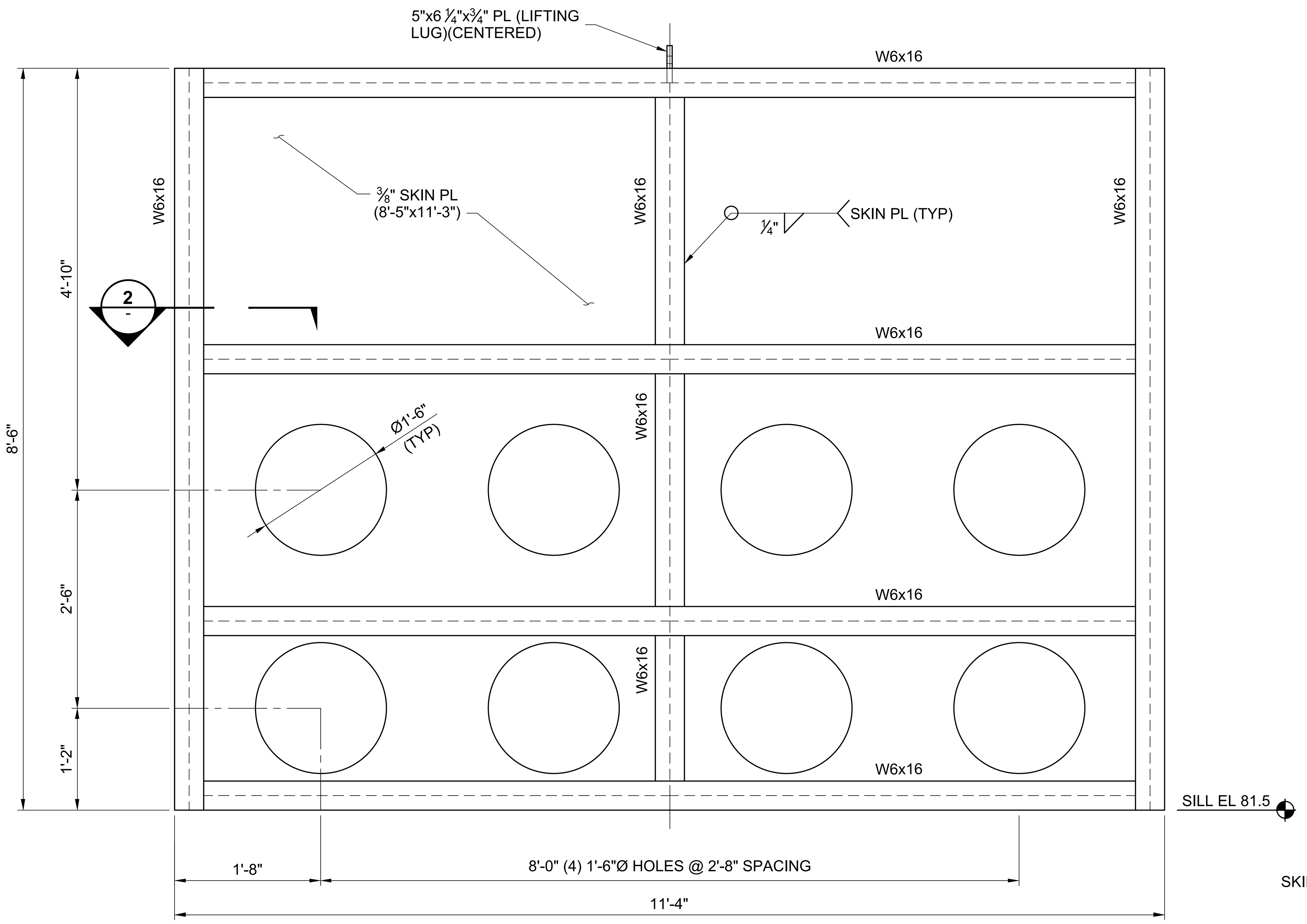
PROJECT: 3173SHAWFISH
DRAWN BY: M. PITTMAN
DESIGNED BY: D. ROBINSON
APPROVED BY: M. GRAESER
SHEET: 103 OF 176
DRAWING: M-121



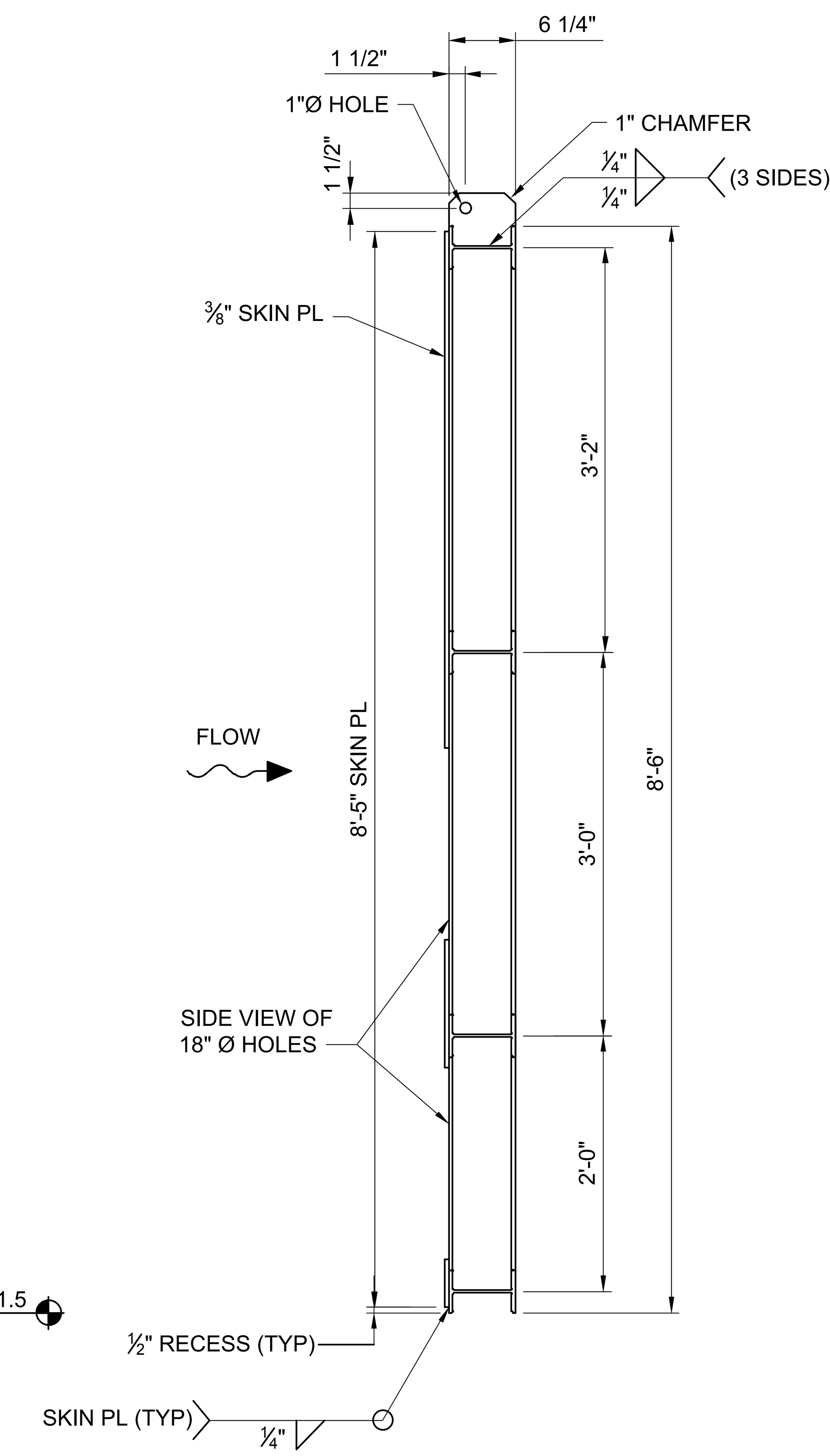

PLAN @ EL 94.0




2 TYPICAL FRAME WELDS
SCALE: 1"=1'-0"




ELEVATION LOOKING UPSTREAM




SIDE ELEVATION

1 WEIR PANEL (2 REQUIRED)
SCALE: 1"=1'-0"

**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.

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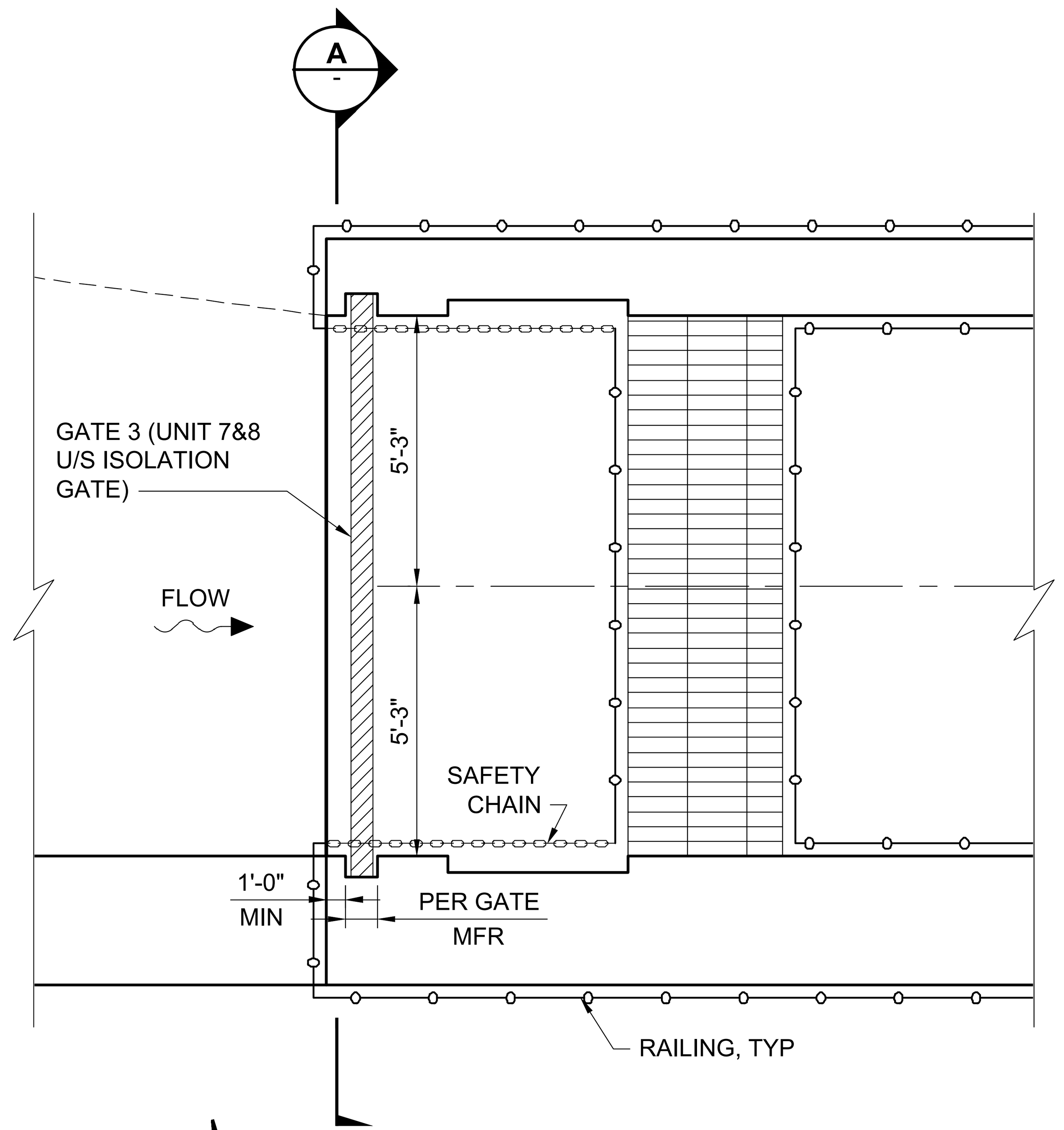
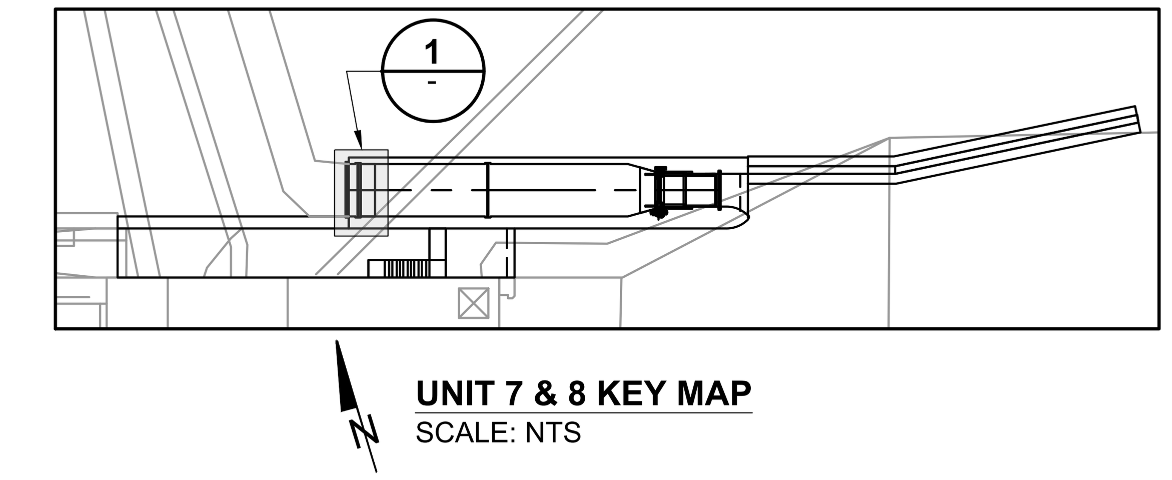
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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



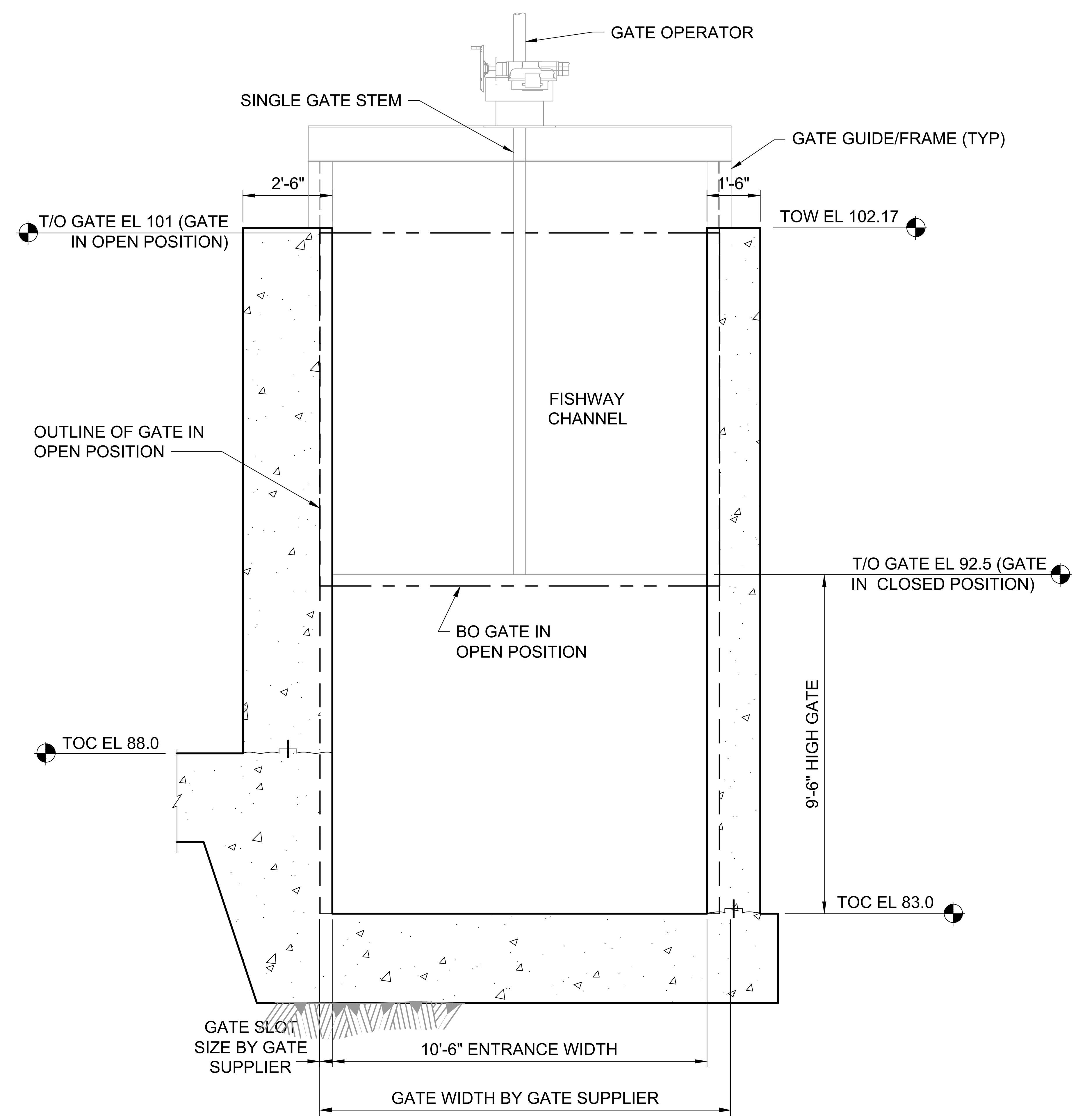

**1 ENLARGED PLAN**
SCALE: 3/8"=1'-0"




**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"

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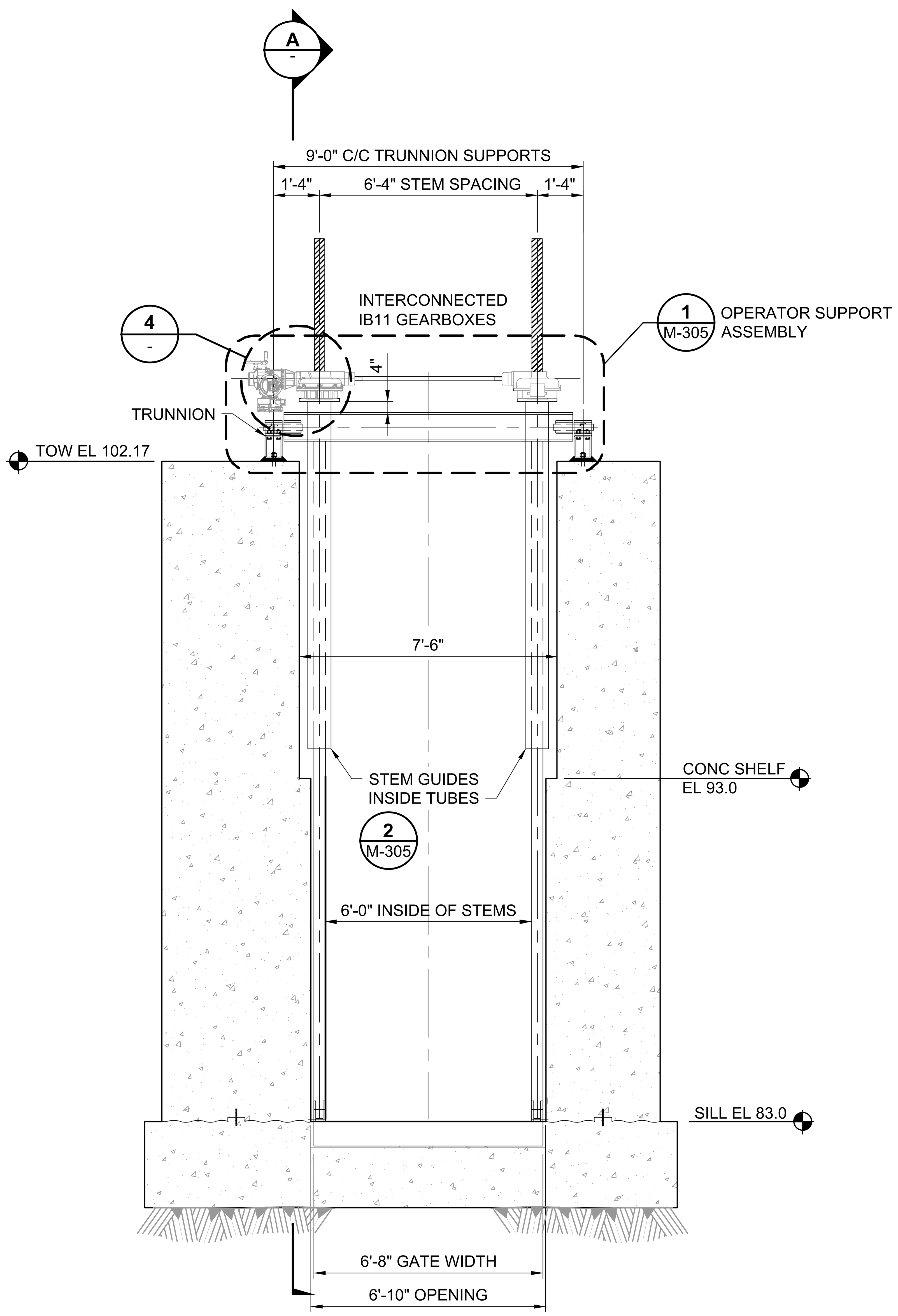
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

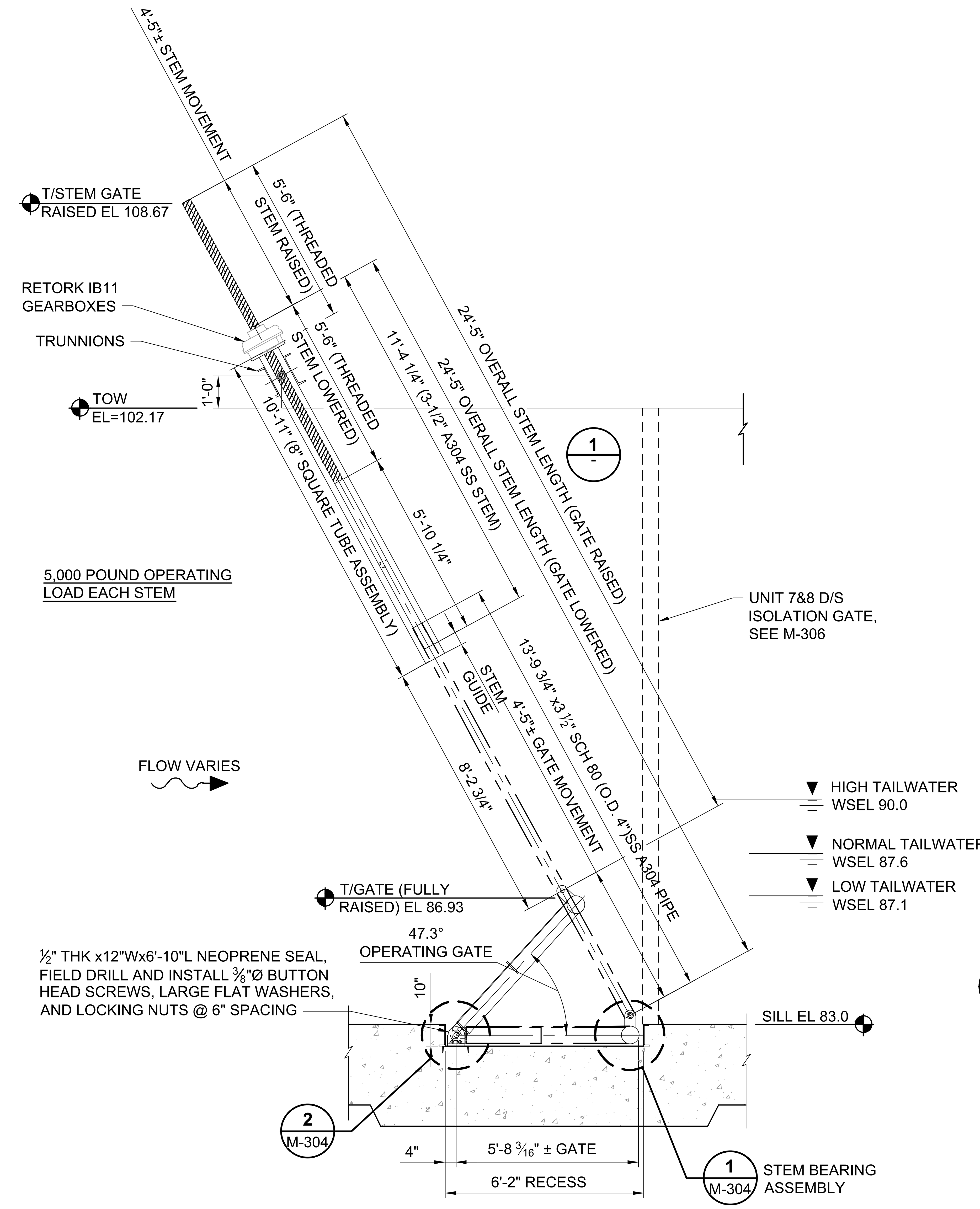
UNIT 7 & 8 FISH PASSAGE U/S ISOLATION GATE REQUIREMENTS

| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 105 OF 176 |
| DRAWING: | M-301 |



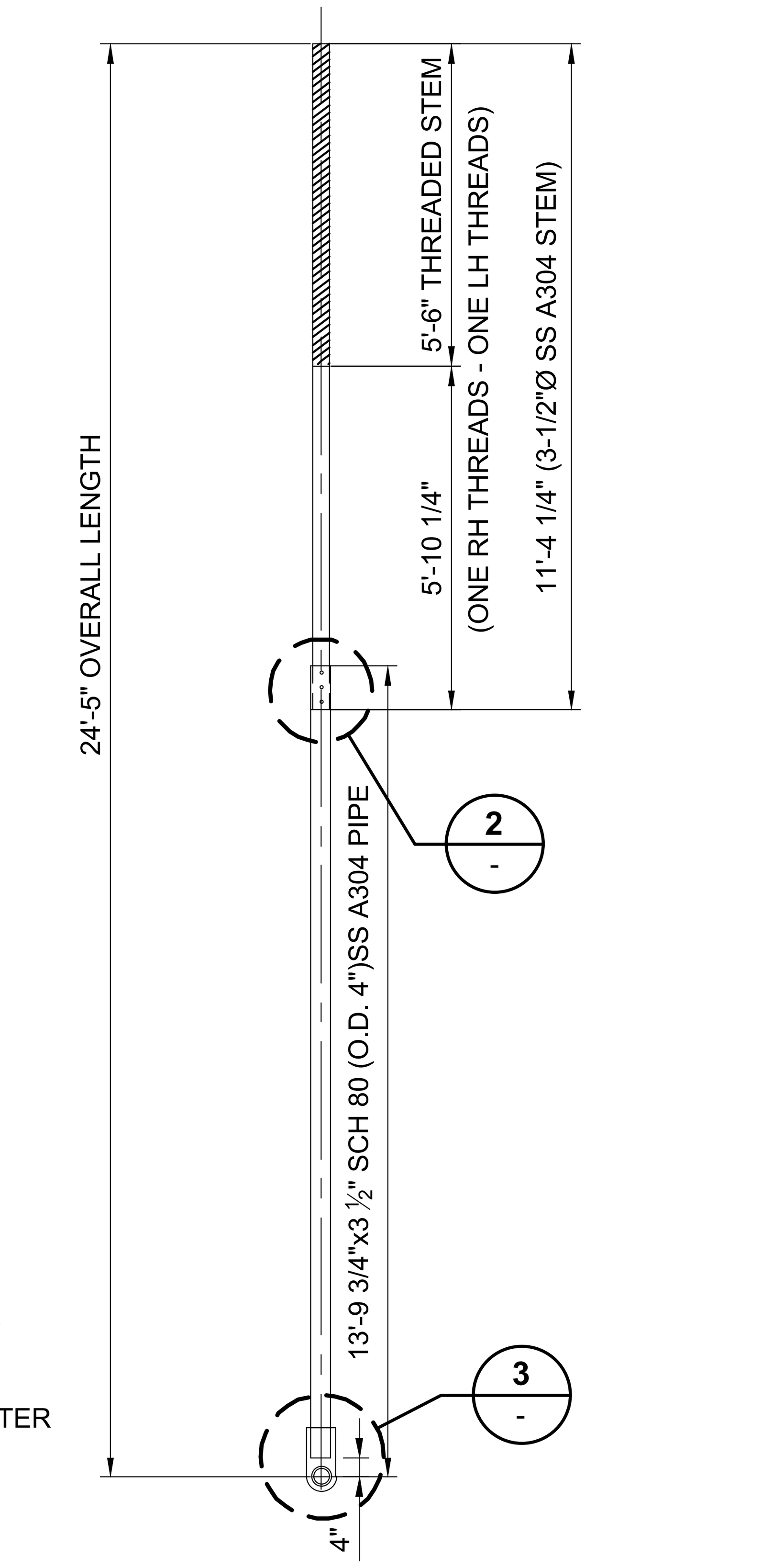

## ELEVATION LOOKING UPSTREAM (GATE LOWERED)

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



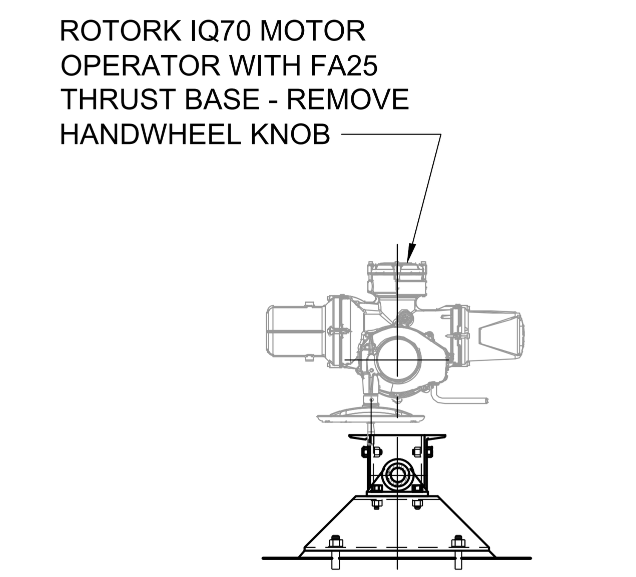

## A SIDE ELEVATION

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



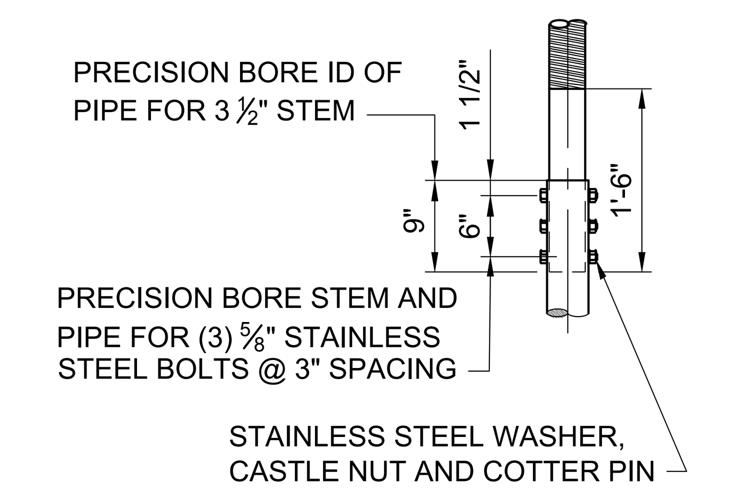

## 1 OPERATING STEM (2 REQUIRED)

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



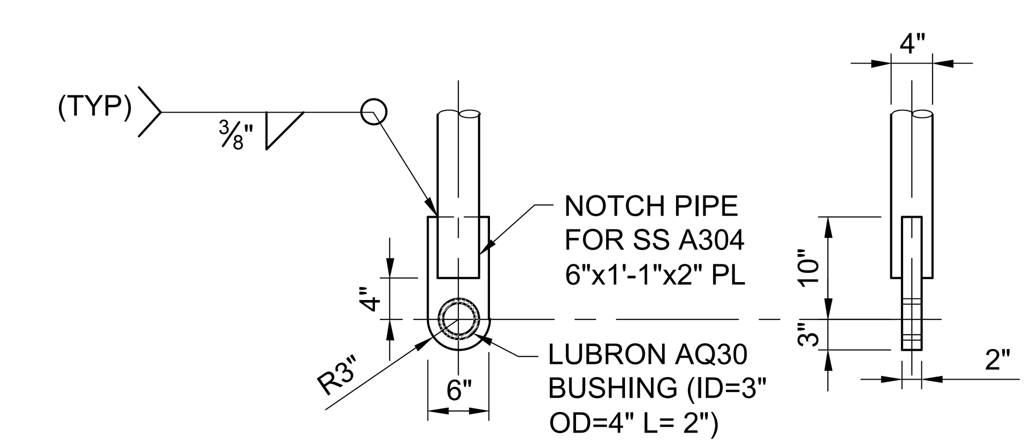

## 4 ROTORK MOTOR DETAIL

SCALE: NTS




## 2 OPERATING STEM CONNECTION

SCALE: 3/4"=1'-0"




## 3 OPERATING STEM ASSEMBLY

SCALE: 3/4"=1'-0"

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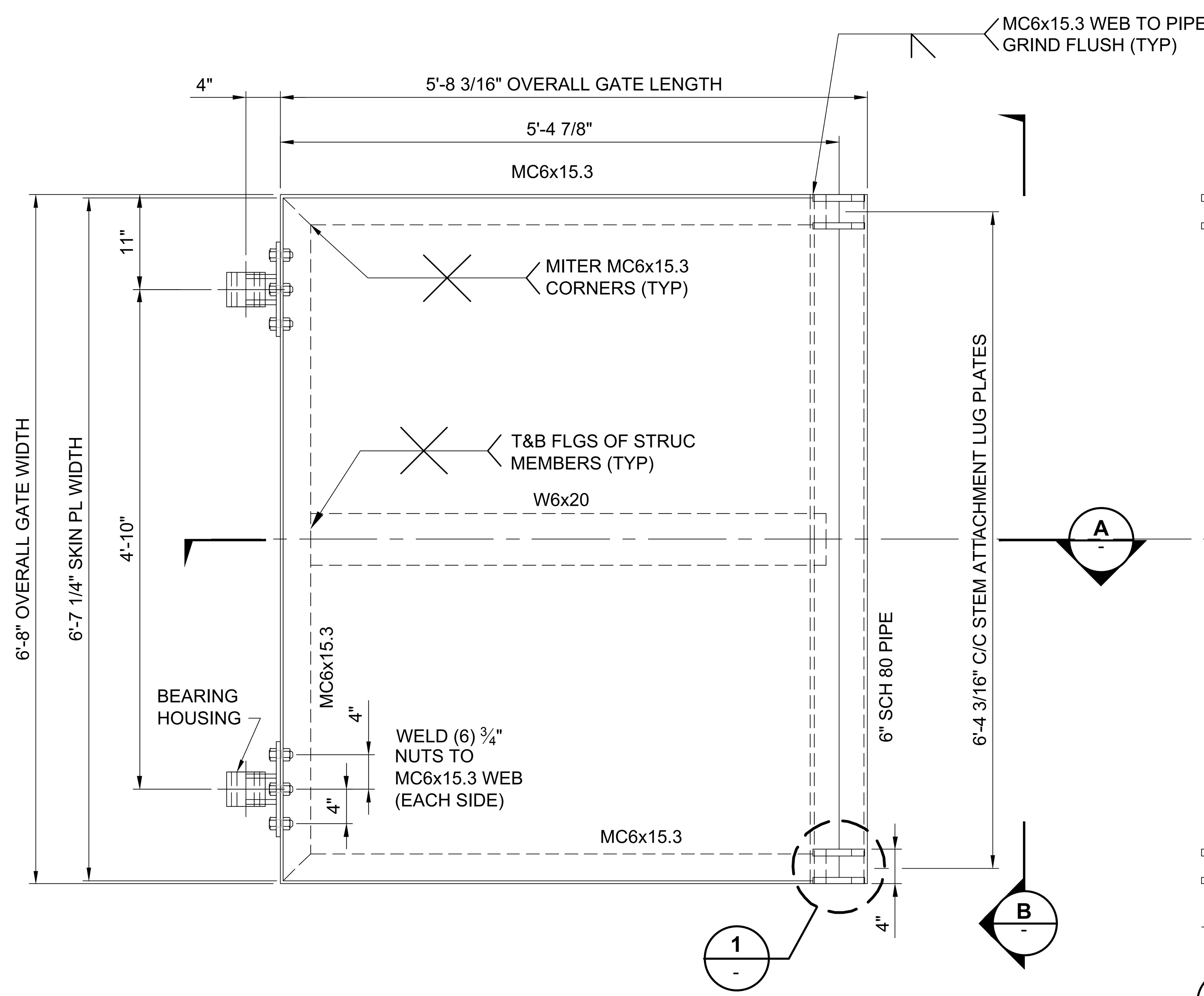
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

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 |

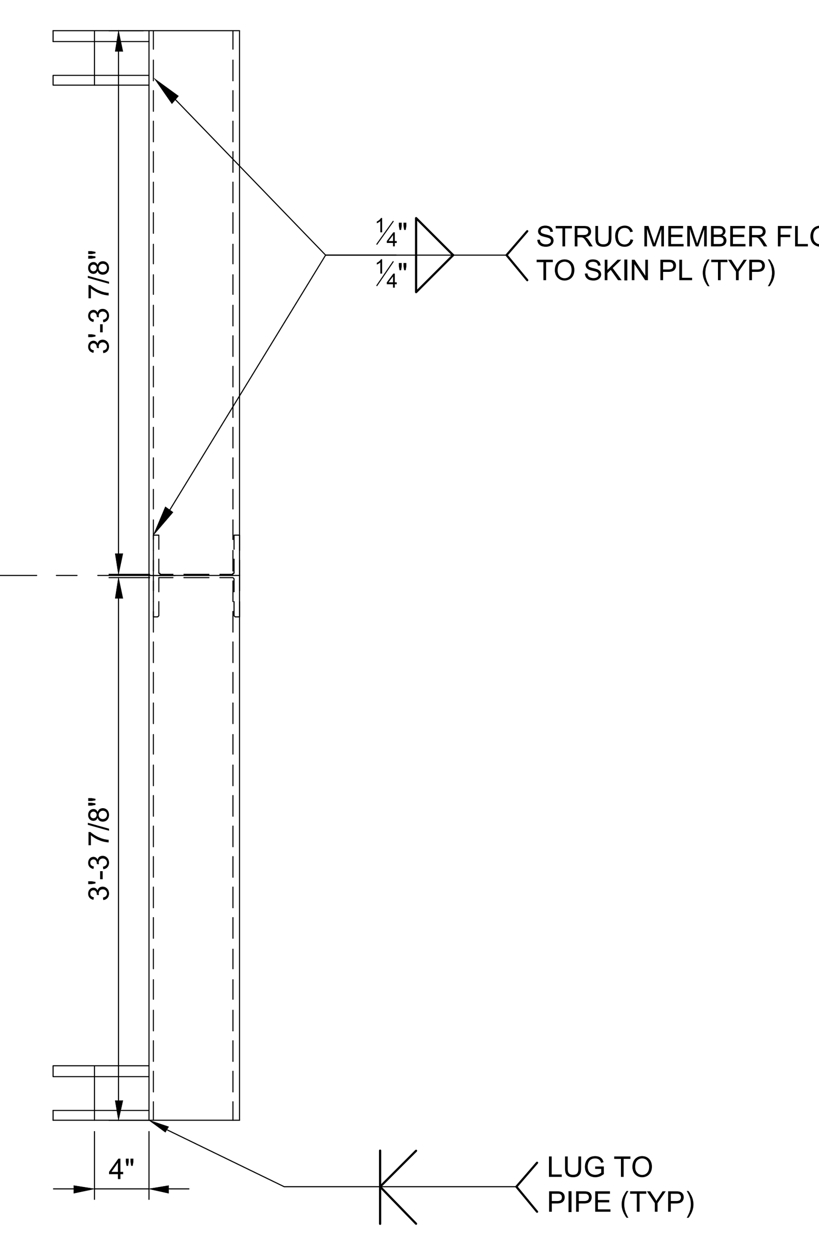
**NOTES:**

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.



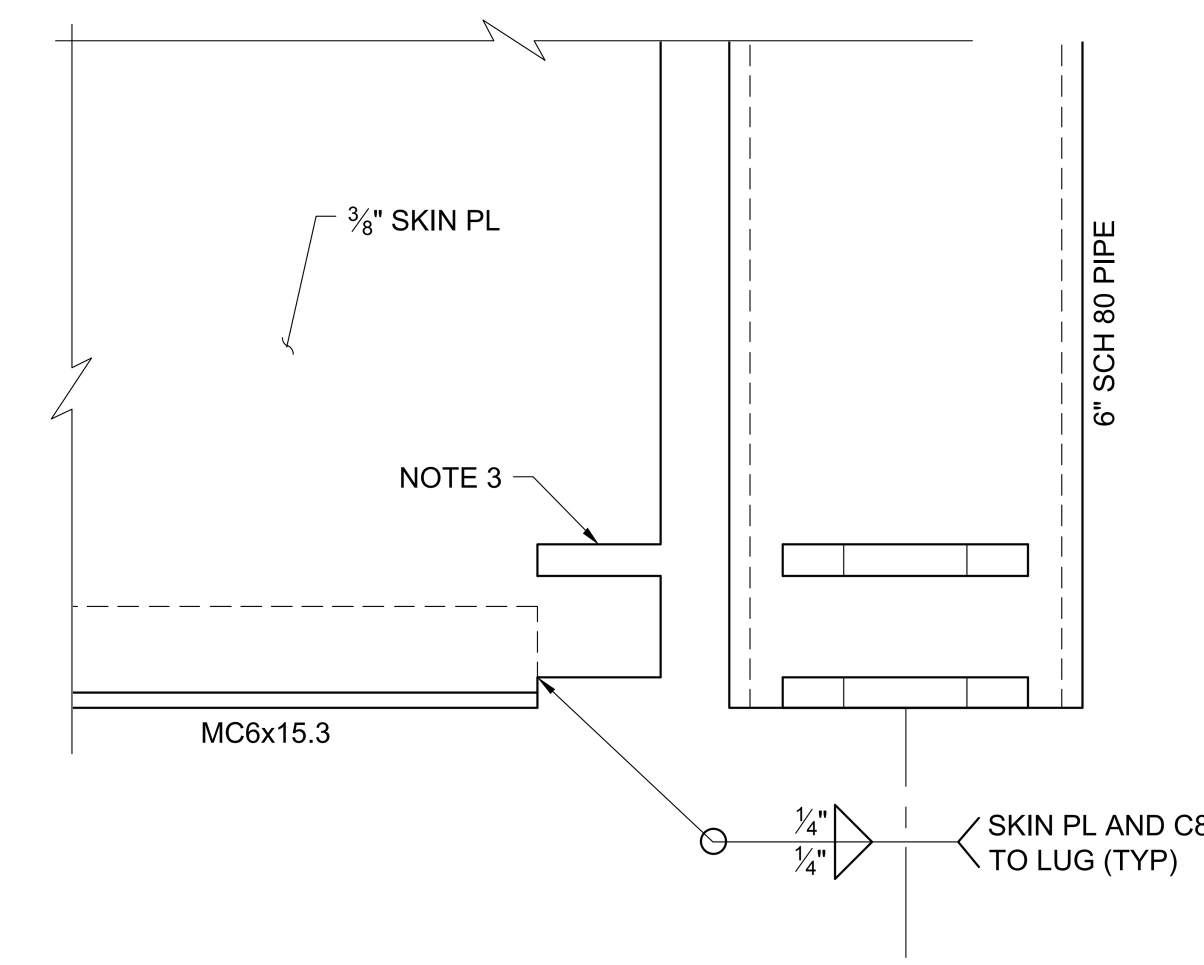

## GATE PLAN/ELEVATION

SCALE: 1"=1'-0"



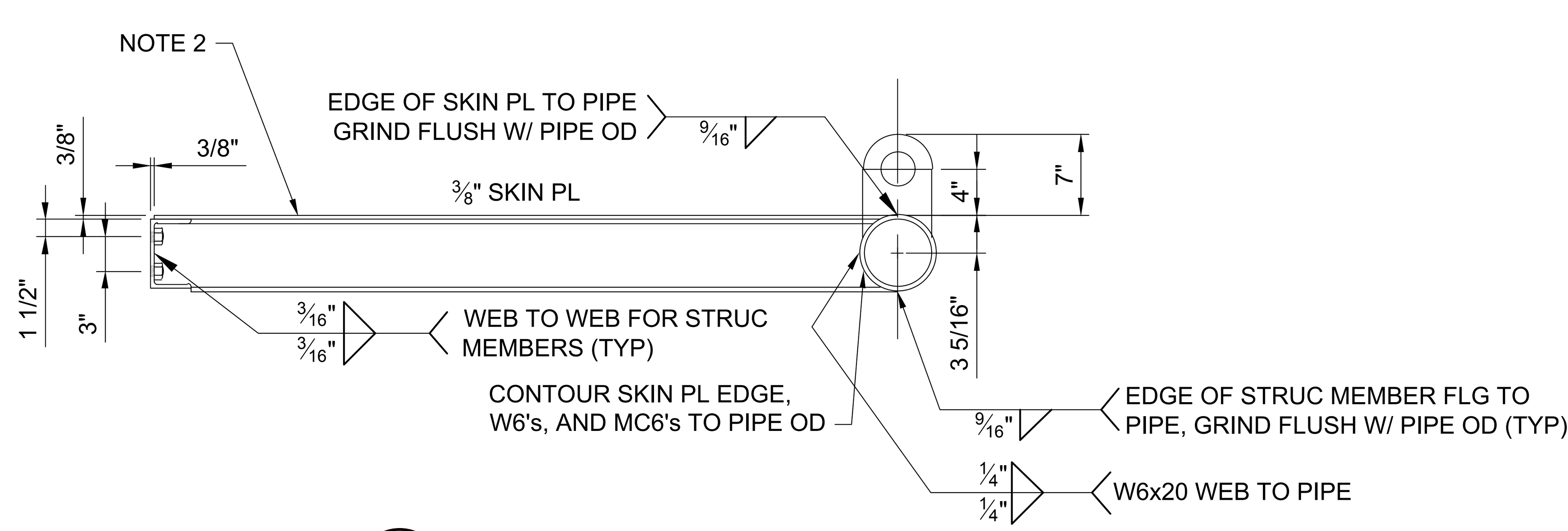

## B GATE SECTION

SCALE: 1"=1'-0"




## 1 SKIN PL TO LUG CONNECTION DETAIL

SCALE: 3"=1'-0"




## A GATE SECTION @ C/L

SCALE: 1"=1'-0"

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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


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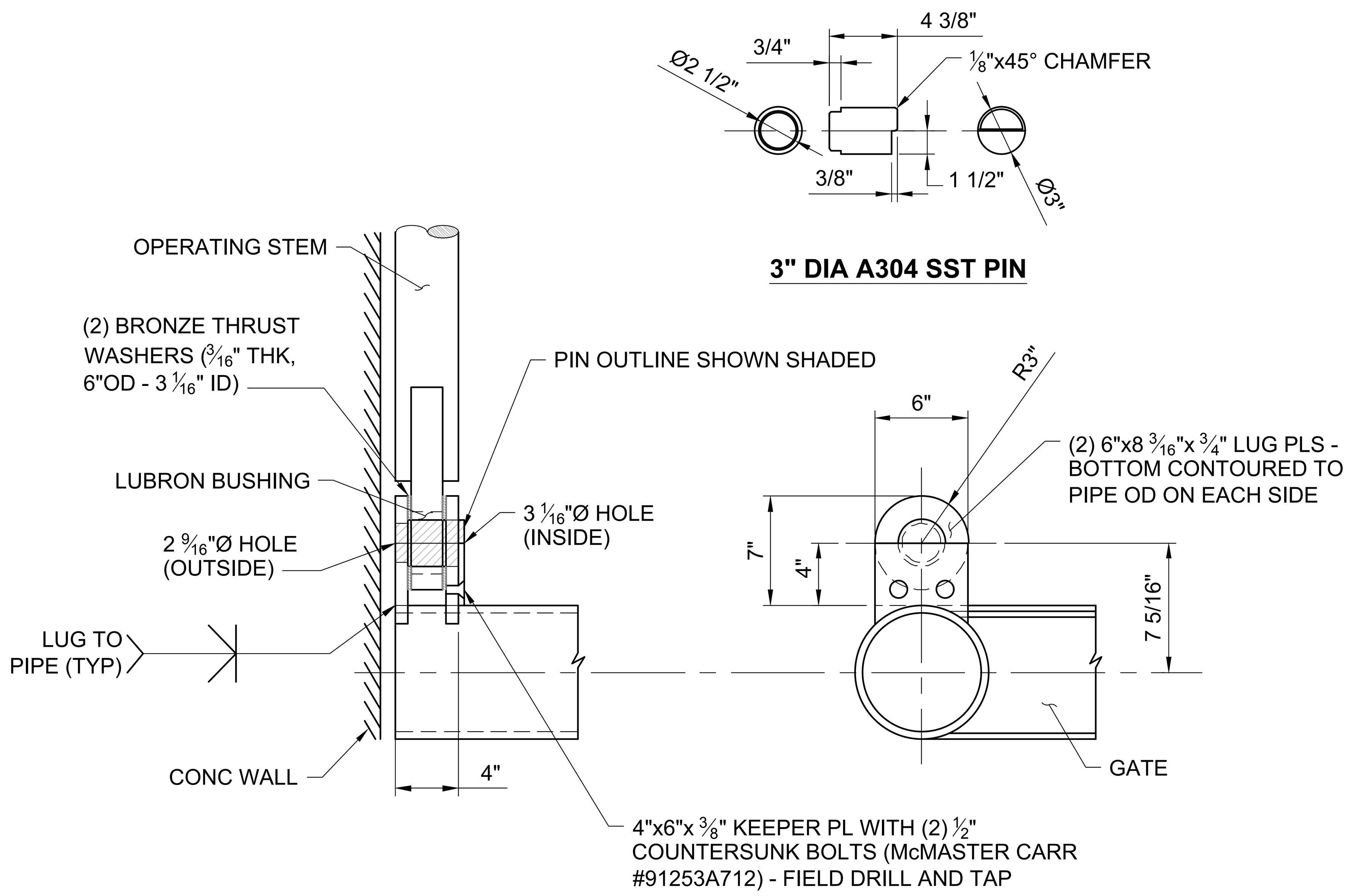
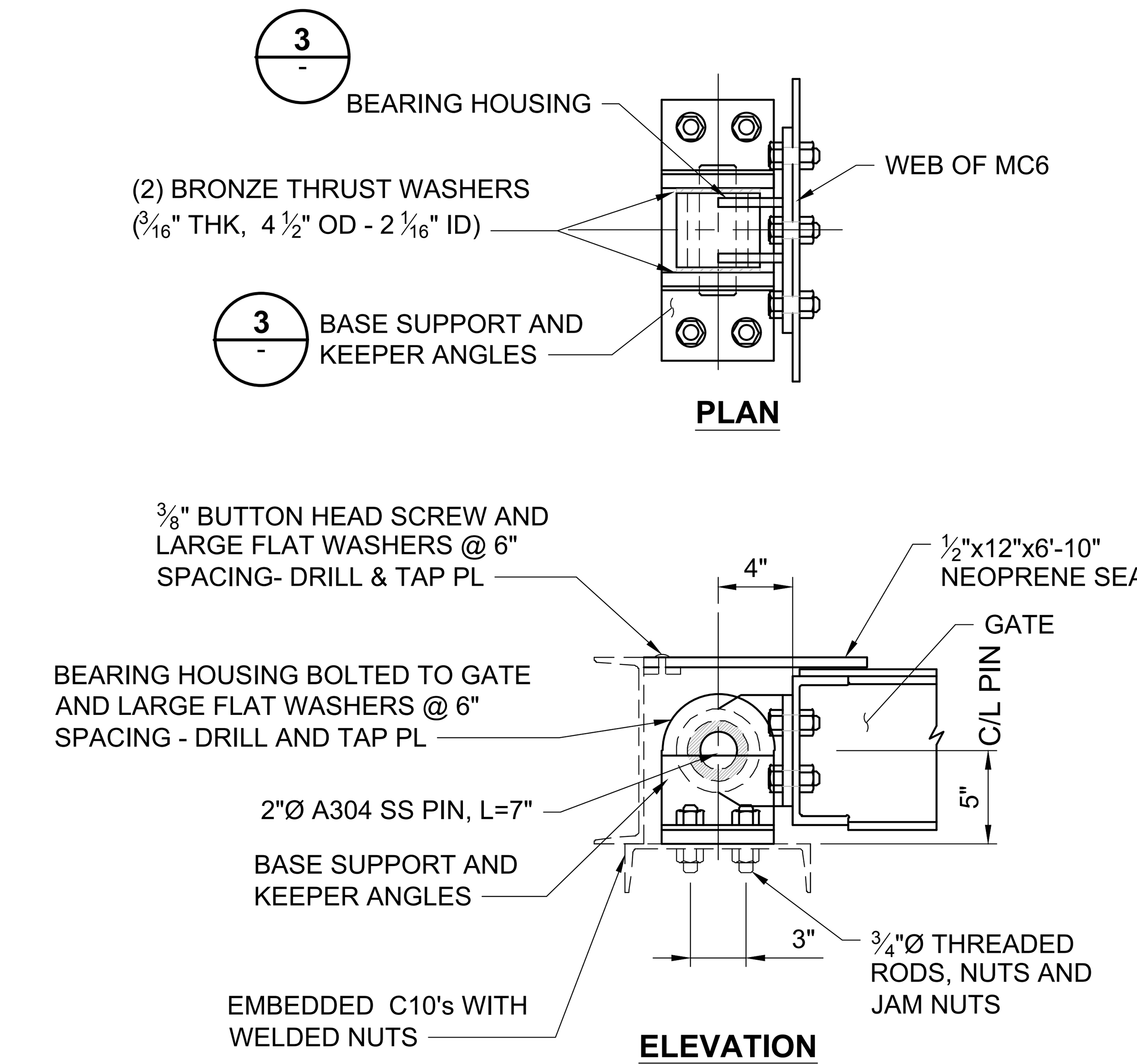
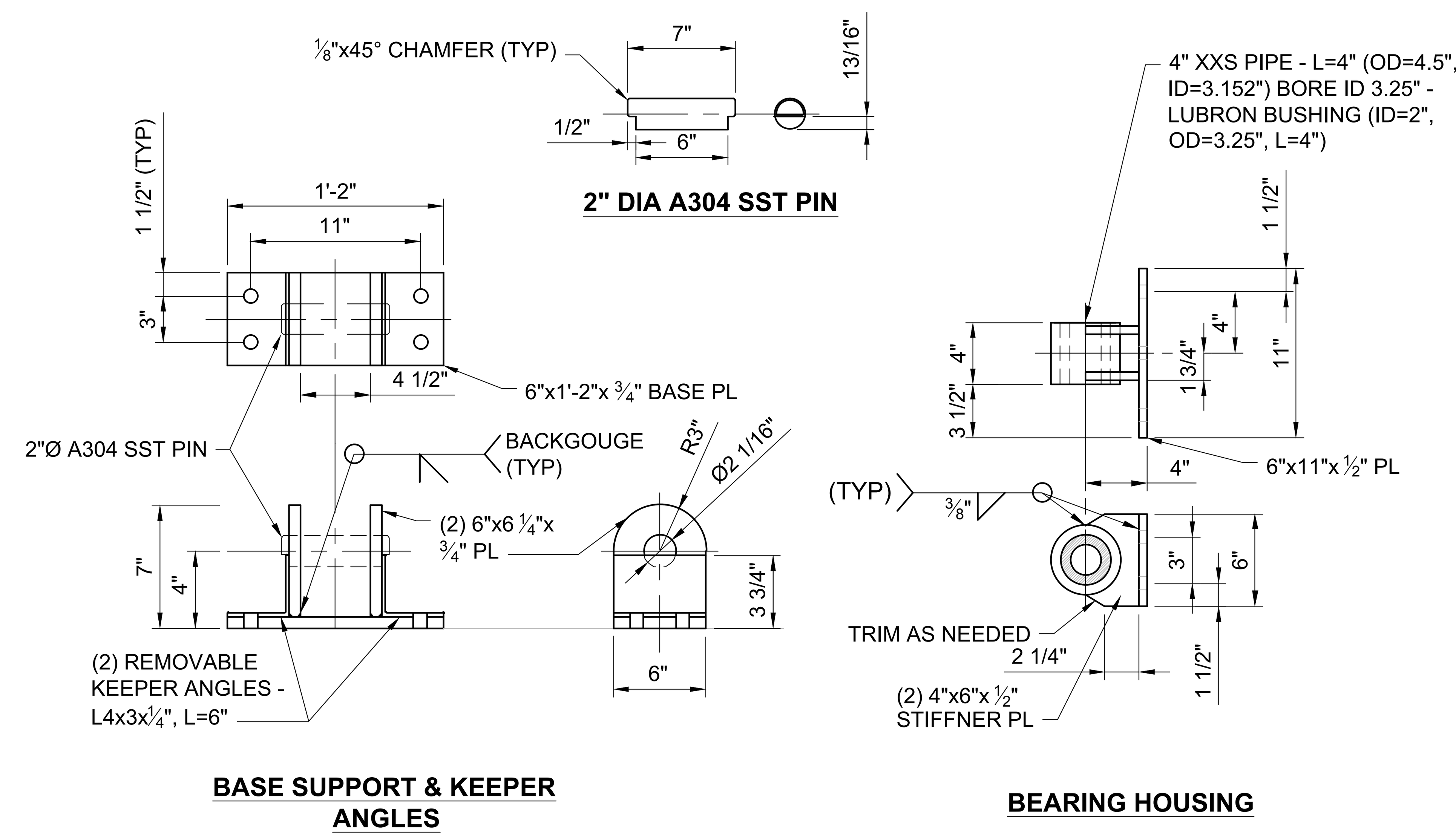



1 M-302 **STEM BEARING ARRANGEMENT**
SCALE: 1 1/2"=1'-0"




2 M-302 **LOWER ASSEMBLY ARRANGEMENT**
SCALE: 1 1/2"=1'-0"




3 - **LOWER BEARING COMPONENTS**
SCALE: 1 1/2"=1'-0"

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**DECEMBER 13, 2019**


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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


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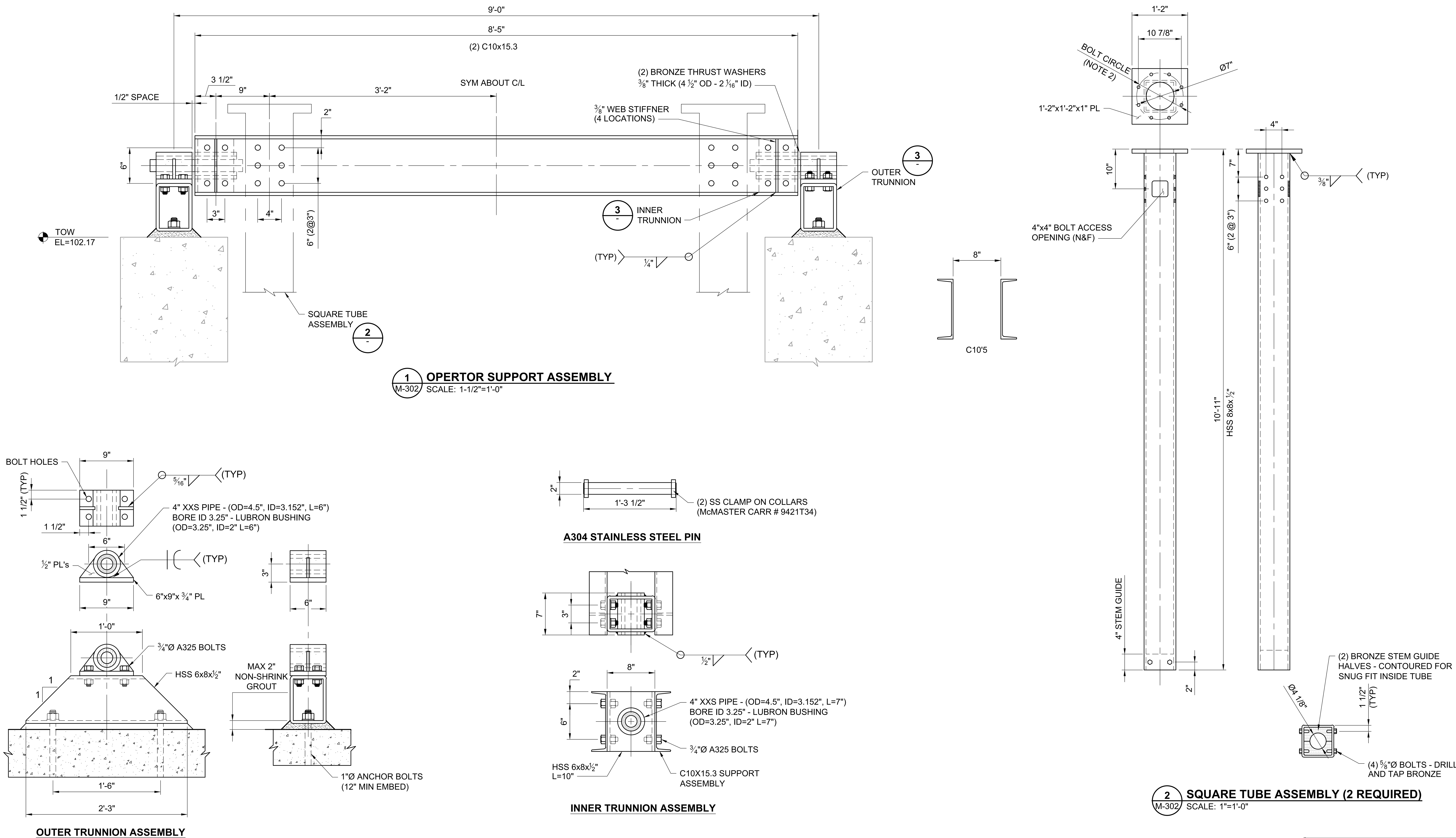



**NOTES:**

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 |

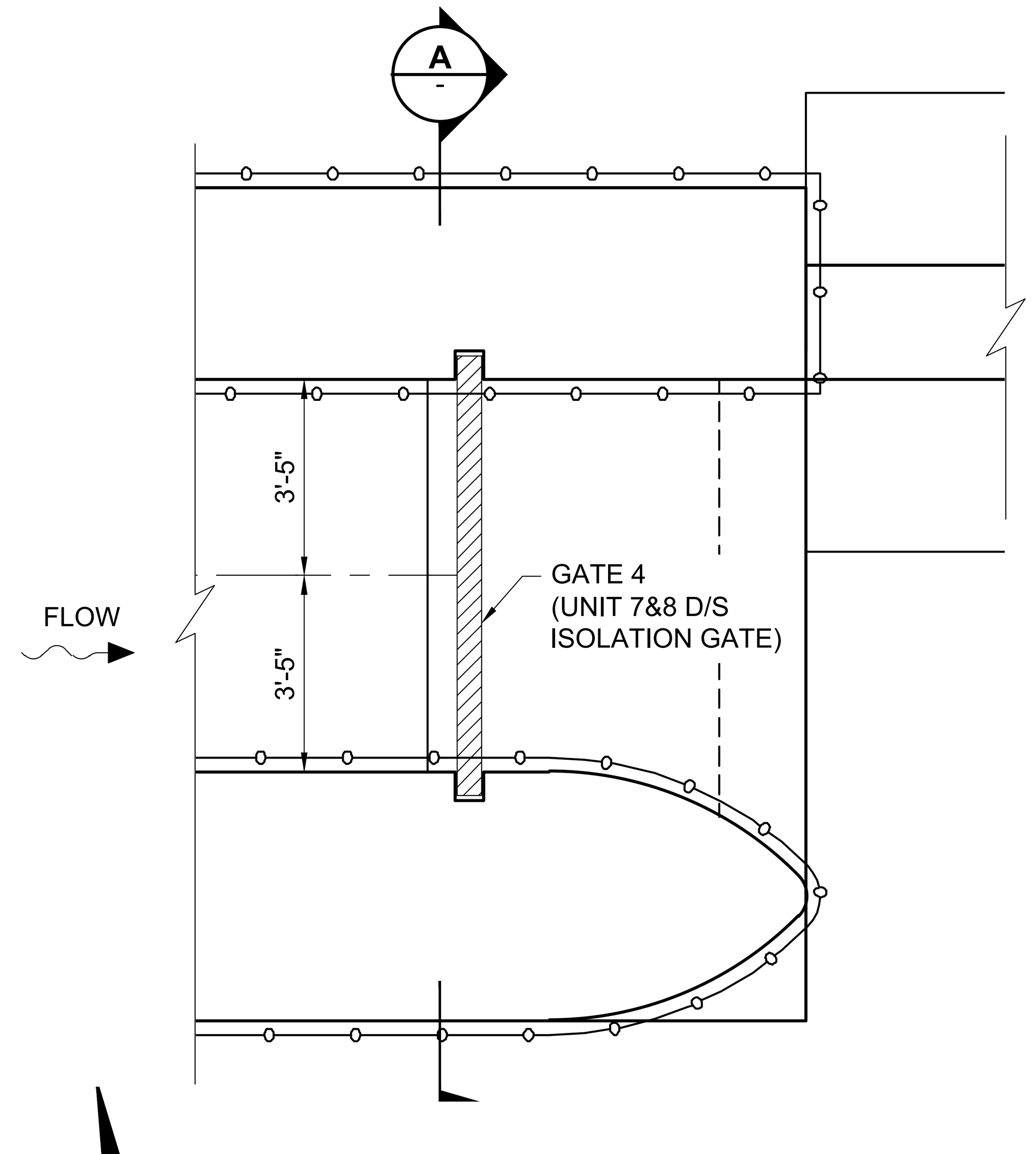
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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

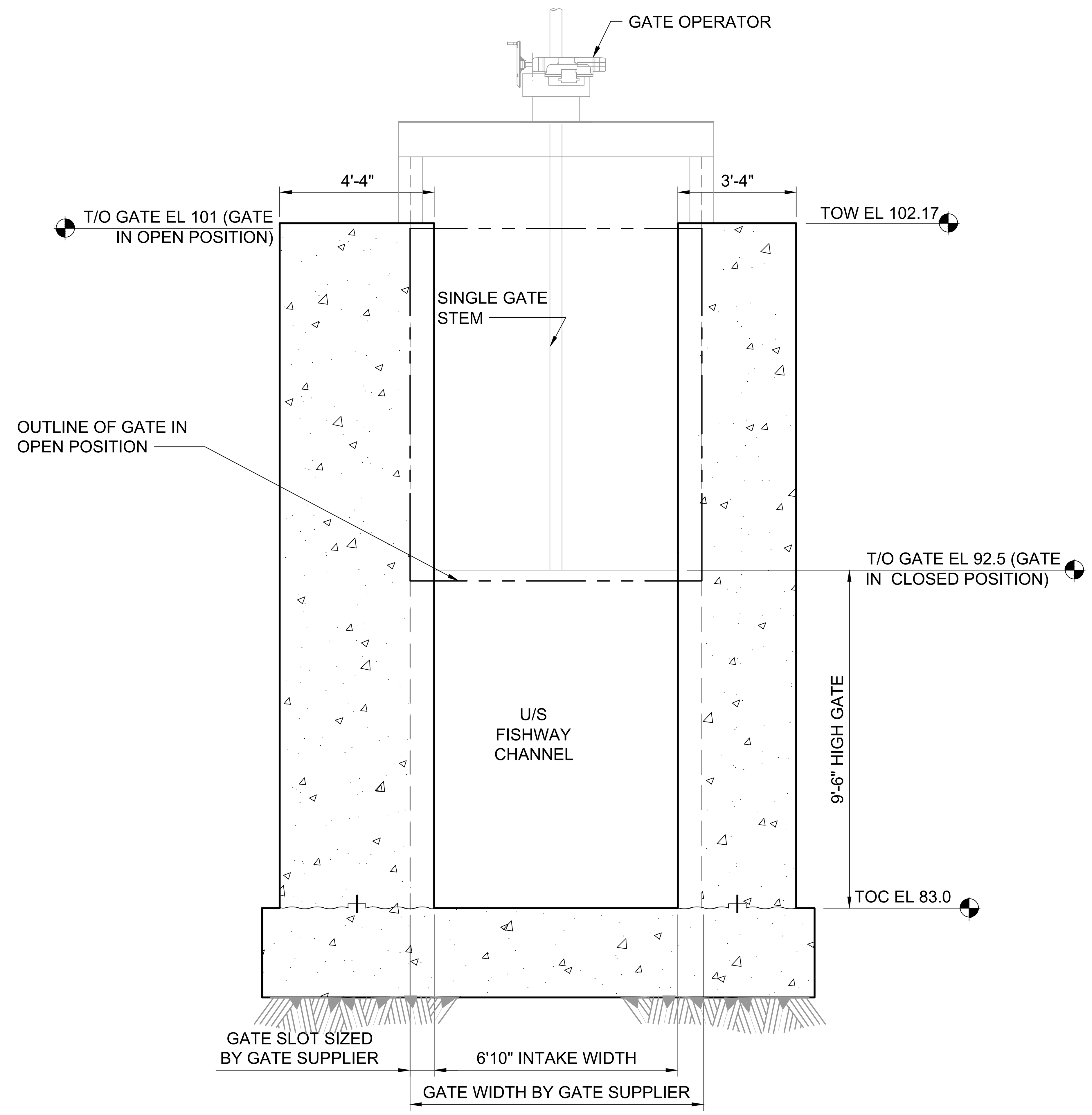
SHAWMUT HYDROELECTRIC STATION
UPSTREAM FISH PASSAGE
BROOKFIELD WHITE PINE HYDRO, LLC

UNIT 7 & 8 FISH PASSAGE FLAP GATE STEEL DETAILS

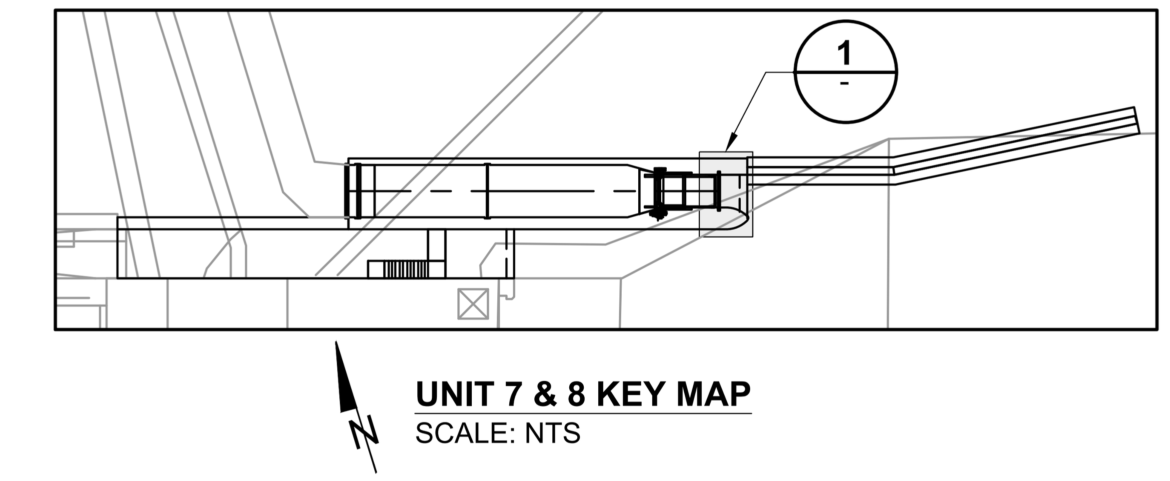
| | |
|---|---|
| PROJECT: | 3173SHAWFISH |
| DRAWN BY: | M. PITTMAN |
| DESIGNED BY: | D. ROBINSON |
| APPROVED BY: | M. GRAESER |
| SHEET: | 109 OF 176 |
| DRAWING: | M-305 |




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




A ELEVATION GATE 4 (UNIT 7&8 D/S ISOLATION)
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

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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 D- Operation and 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

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Appendix A: Daily Inspection Form

Appendix B: Fishway Drawings

Appendix C: Fishway Operations Weekly Report

Appendix D: Fishway PLC Operations (placeholder)

Appendix E: Fishway Attraction Water Valve Curve (placeholder)

Appendix F: Handling Plan for Shortnose and Atlantic Sturgeon (placeholder)

# 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 15$^{th}$ to November 15$^{th}$ 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 15$^{th}$ through November 15$^{th}$, 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 15$^{th}$ 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 E- Erosion and Control Plan

**P-2322 Shawmut Hydroelectric**
**Soil Erosion and Sediment Control Plan**

## Project Description

Shawmut, LLC (BWPH), Licensee of the Shawmut Hydroelectric Project (Project) submits the following Soil Erosion and Sediment Control Plan for the construction of permanent upstream fish passage facility at the Project that will include a fish lift with integrated attraction water intake and 81-foot-long by 21-foot-high entrance flume and 93-foot-long spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse. The attraction water intake and spillway is designed to divert 340 cfs from the impoundment with 115 to 225 cfs diverted to the fish lift entrance flume and 115 to 225 cfs provided as spill adjacent to the fish lift entrance. An approximately 77-foot-long by 10.5-foot-wide fish ladder will be placed at the upstream end of the island between the two project powerhouses to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway channel with two baffles, entrance flap gate, and isolation gates.

## Plan Details

As indicated by the attached plans (Exhibit C), the perimeter of any area of permanent or temporary construction activity will be protected by the measures shown or equivalent protection as chosen by the contractor. In addition, the perimeter of the site that abuts the river will be staked with hay bales to prevent sediment migration.

Coffer dams will be required for the fish lift and fish ladder construction: one on the upstream face of the non-over flow portion for the for the installation of the attraction water system which will include the removal of an approximately 18 ft wide 14 ft deep channel , one downstream of the non-overflow portion of the dam from the unit 1-6 powerhouse to the dam abutment for the installation of the fish lift, one from the island between the unit 1-6 for the installation of the fish ladder and excavation of the exit channel and one in the unit 7-8 tailrace for the installation of the fish ladder.

It will be the contractor’s responsibility to design the coffer dam and soil erosion and sediment control to meet their access and construction sequencing needs, to meet OSHA safety standards, State of Maine and International Building codes, and any other applicable regulations. It is assumed that steel sheet pile, sand bag, or equivalent would be used in cofferdam construction.

Erosion control will be installed around all disturbed land and staging areas. Suspended turbidity curtains will surround all cofferdams. Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river.

# Exhibit F- 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

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Gerry

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**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>
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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

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> **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>
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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:

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**Subject:** Re: [EXTERNAL] Shawmut Final Design drawings and O&M Plan for Approval

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**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



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https://we.tl/t-rJlHsBs0Re

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--

Antonio

Antonio Bentivoglio

US Fish and Wildlife Service

Maine Field Office

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> 4 Fundy Road #R
>
> Falmouth, Maine 04105
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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



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https://we.tl/t-rJlHsBs0Re

Thank you and have a great weekend,

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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

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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 -

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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.
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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,
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Cell:     207-416-7510
Donald.Dow@noaa.gov

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**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

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**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.**

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Orono, ME 04473

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Cell: 207-416-7510
Donald.Dow@noaa.gov

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| **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 |

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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

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| | |
|---|---|
| **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.

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On Tue, Nov 26, 2019 at 2:44 PM Maloney, Kelly <Kelly.Maloney@brookfieldrenewable.com> wrote:

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>
> 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."
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Donald A. Dow III, PE

Hydro/Fish Passage Engineer

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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
>
> 

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Donald A. Dow III, PE
Hydro/Fish Passage Engineer

Protected Resources Division
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(formerly Northeast Regional Office)
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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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

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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

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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)

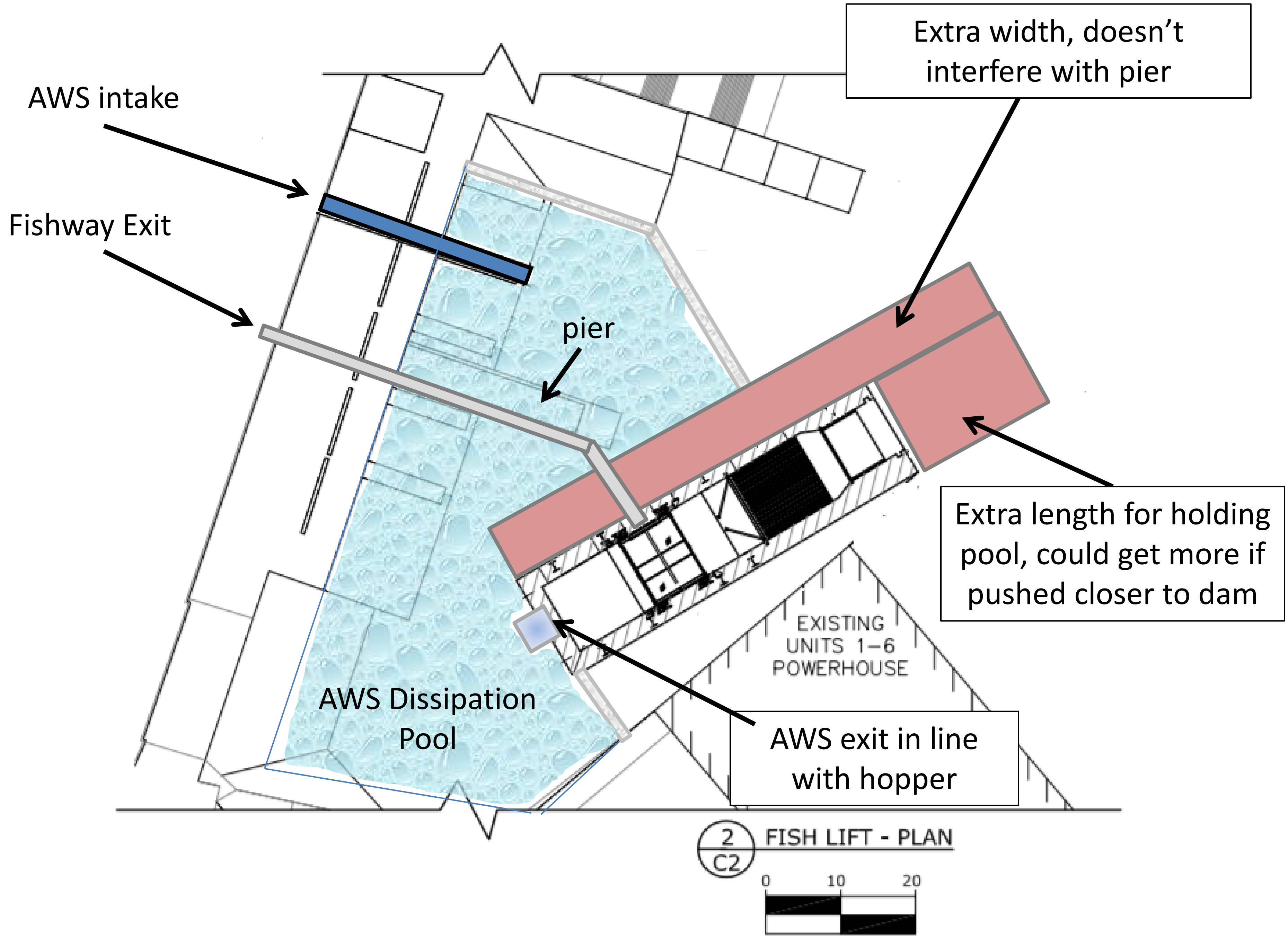
4. There is no holding pool in this design. A holding pool is required and should not be considered the area above a horizontal diffuser. In the proposed design, the holding pool consists of the fixed brail floor which is a very small volume of water to hold fish. A quick look at capacity, using the 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 m²) 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



# 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
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National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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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

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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.

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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
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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

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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.

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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.

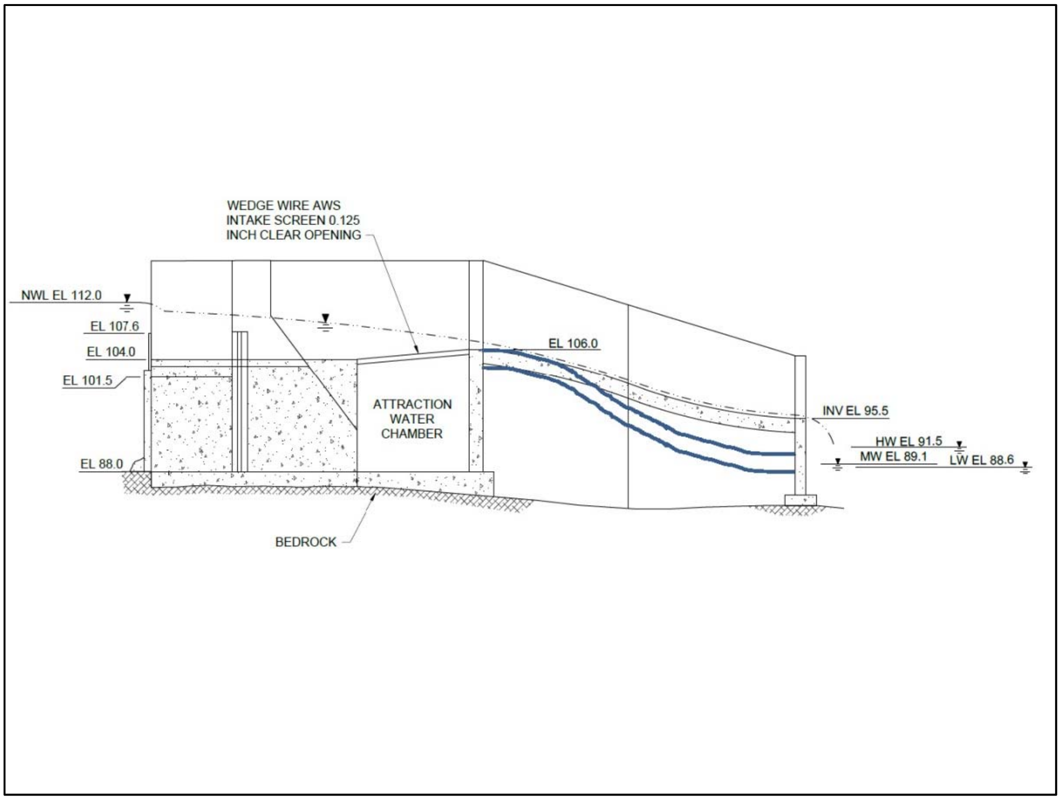


**Figure 1 –** Lowered AWS channel floor to meet tailwater

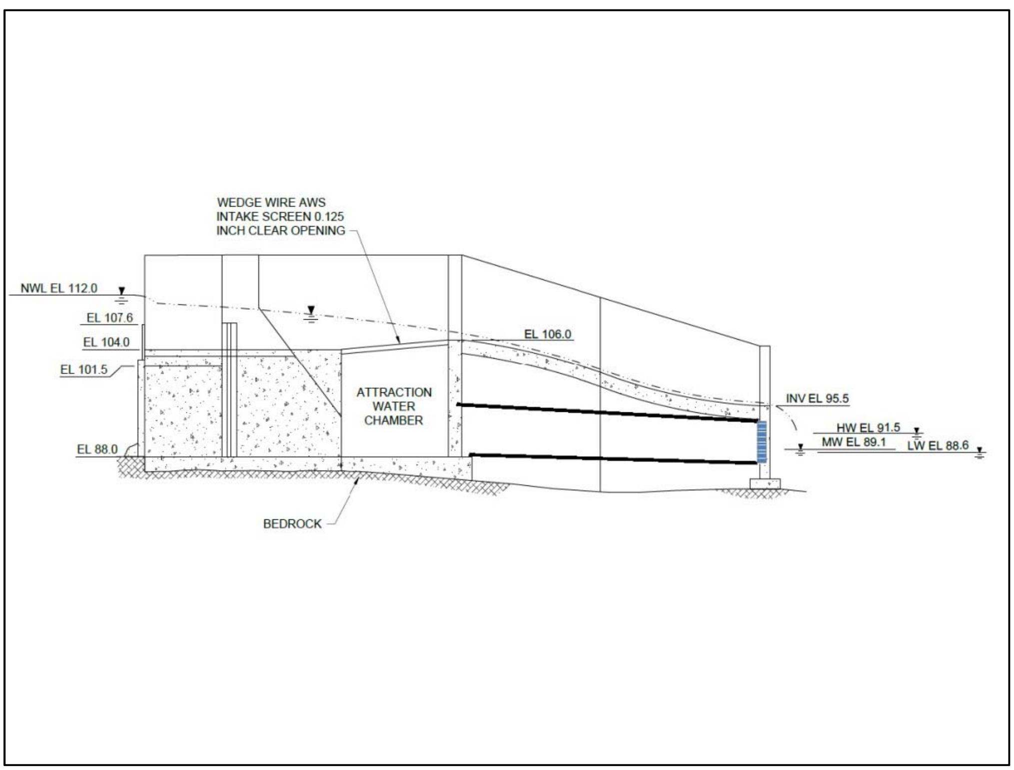


**Figure 2** – AWS Alternative

# 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**

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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.

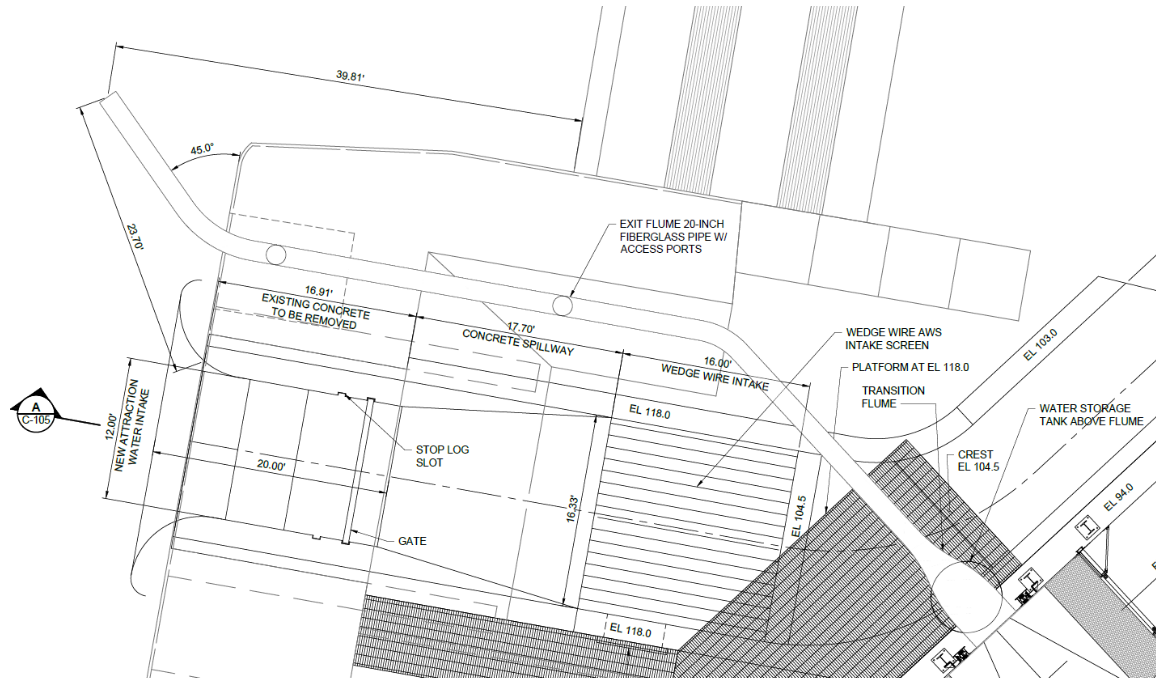


**Figure 1. Attraction Water Intake Plan**

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.

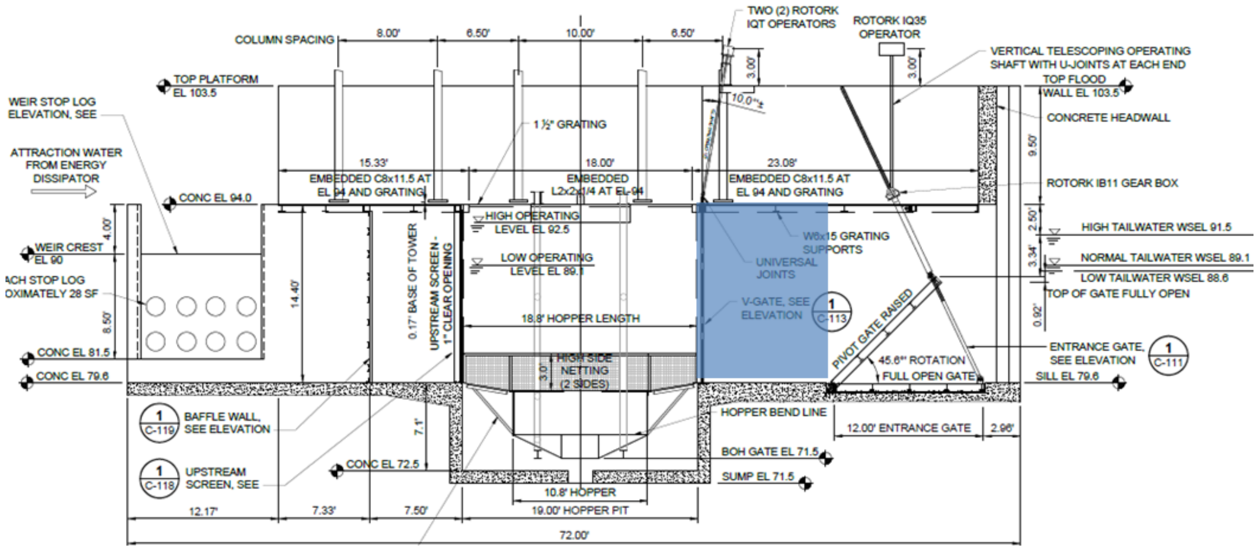


**Figure 2. Fish Lift Flume Section, Holding Pool Area shaded blue**

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.

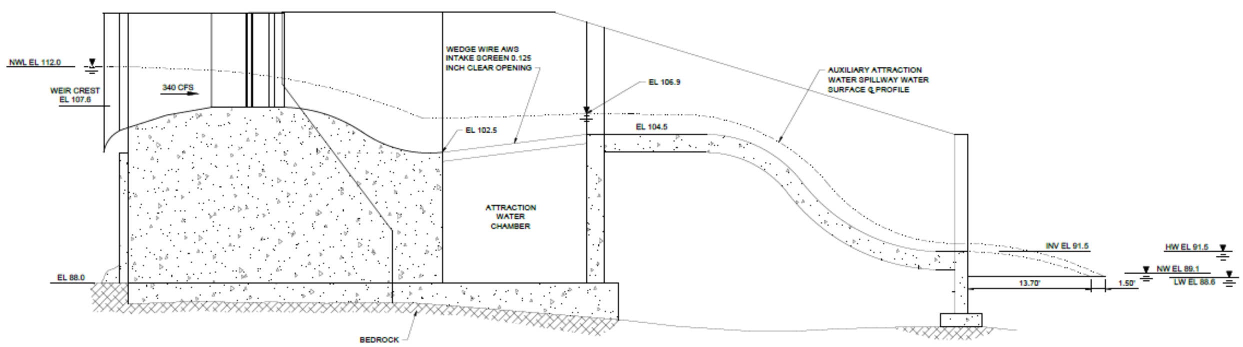


**Figure 3. Attraction Water System Water Surface Profile**

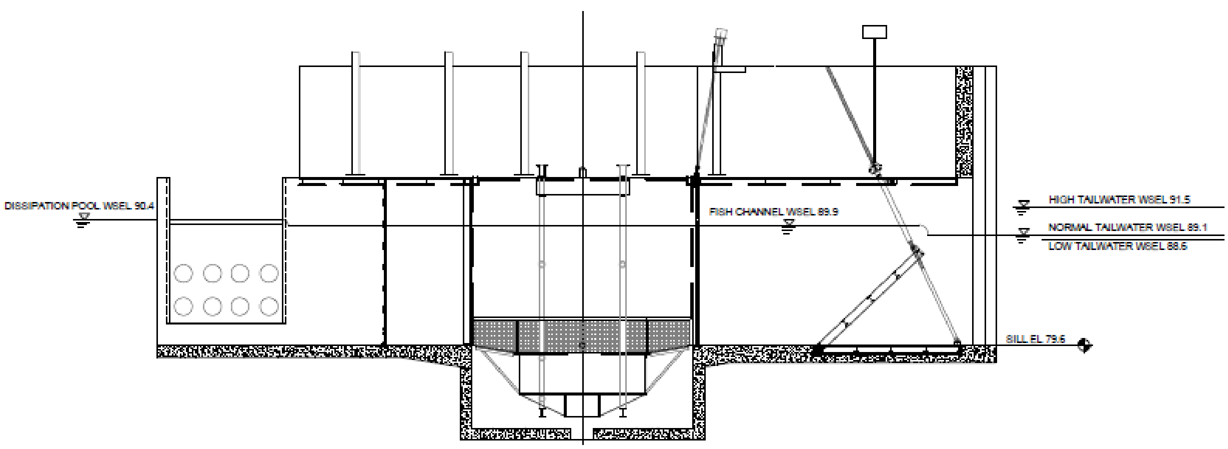


**Figure 4. Fish Lift Channel Water Surface Profile**

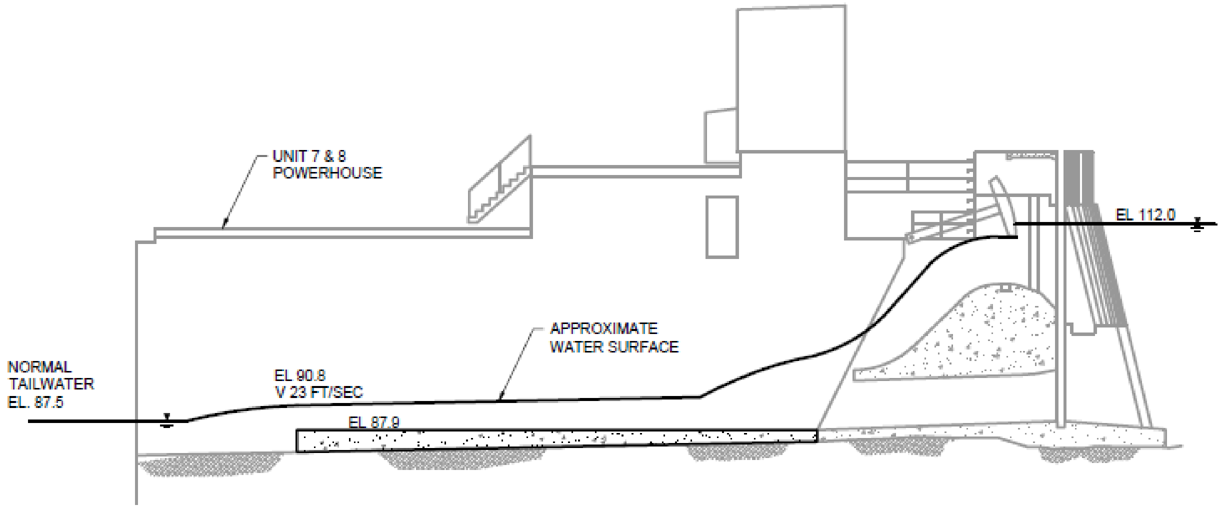


**Figure 5. Tainter Gate Spillway Water Surface Profile**

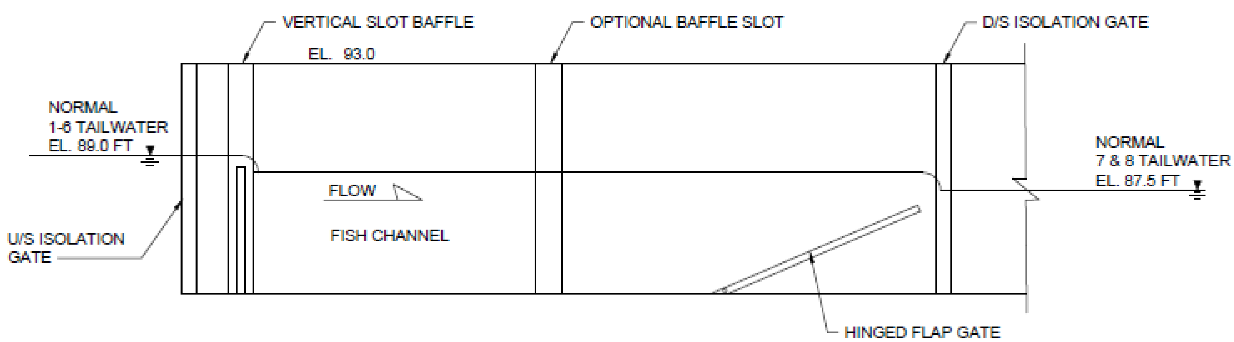


**Figure 6. Crossover Fishway Water Surface Profile**

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.

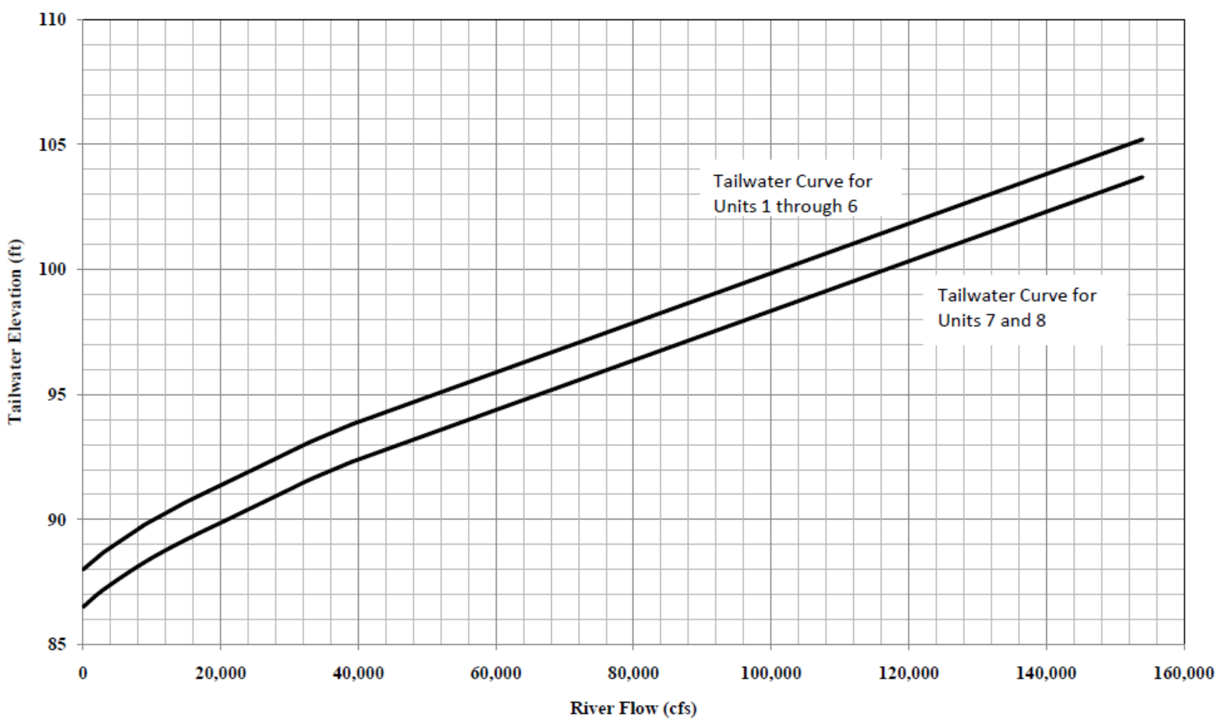


**Figure 7. Tailwater Operating Curves (Kleinschmidt, 2009)**

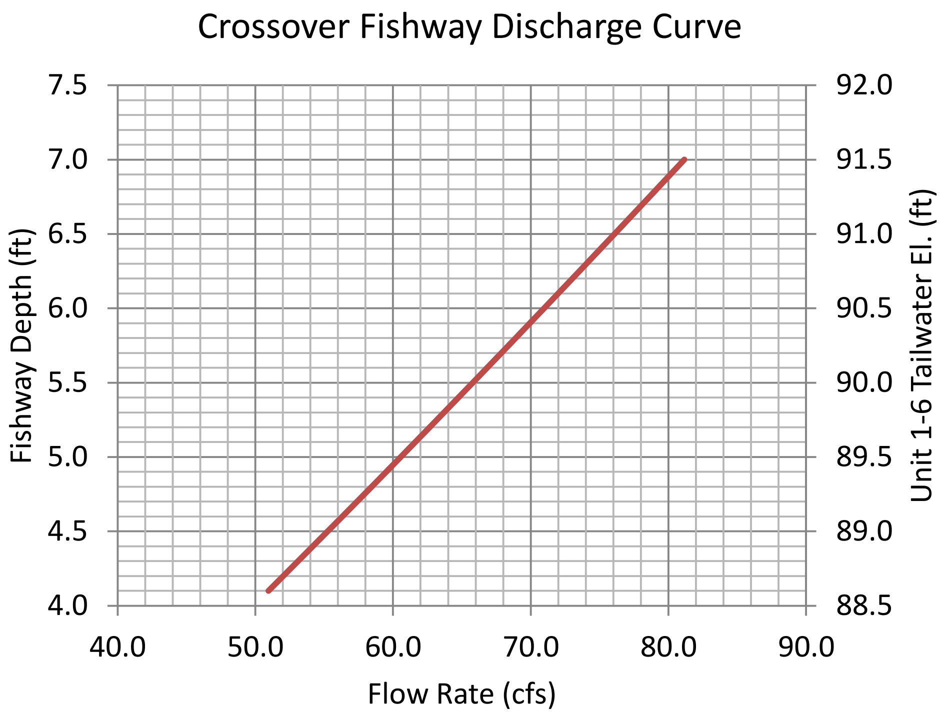


**Figure 8. Cross over Fishway Discharge Curve**

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

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Shawmut 30% Design – Agency Comments

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*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.

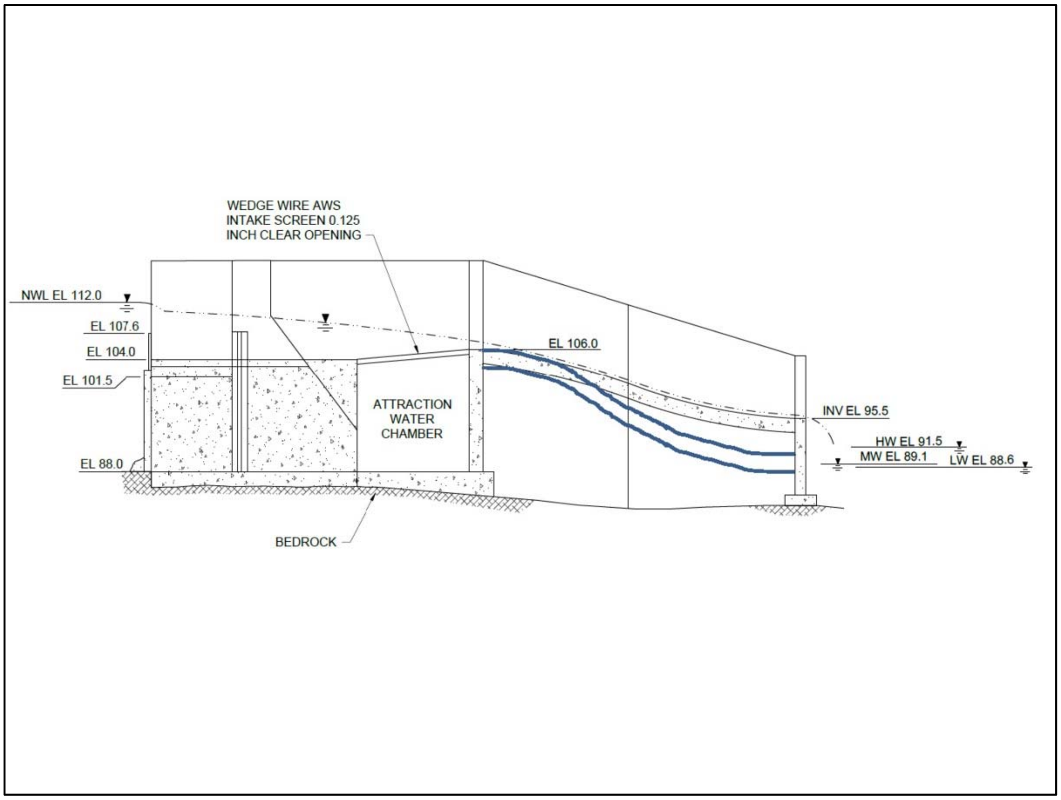


**Figure 1 –** Lowered AWS channel floor to meet tailwater

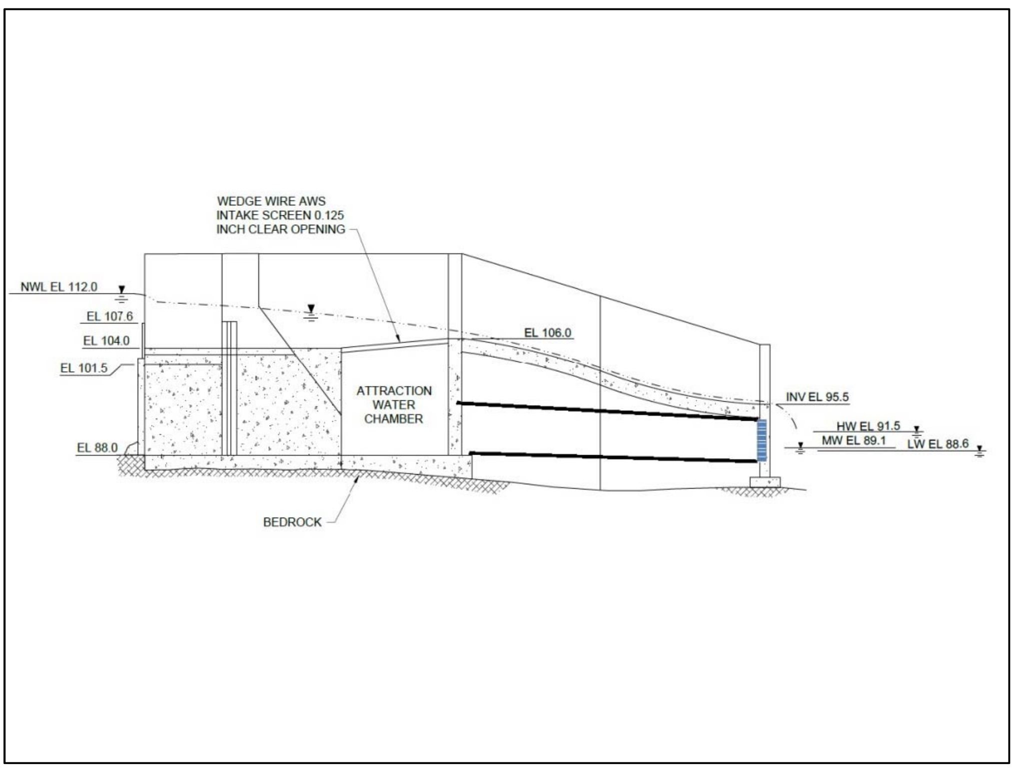


**Figure 2** – AWS Alternative

## 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
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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.

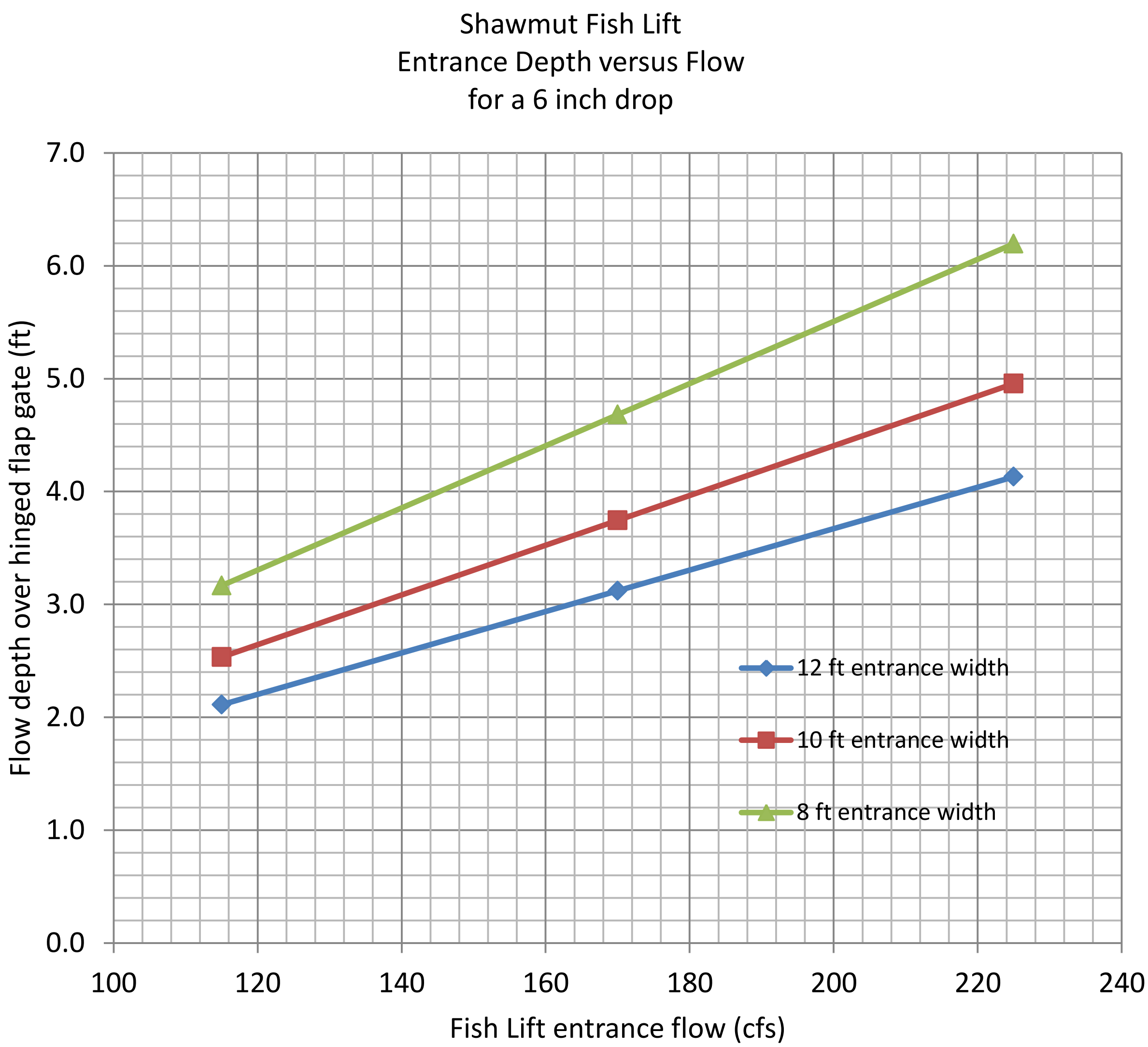
The DRT written comments are provided in bold below and notes of the meeting discussion follow.

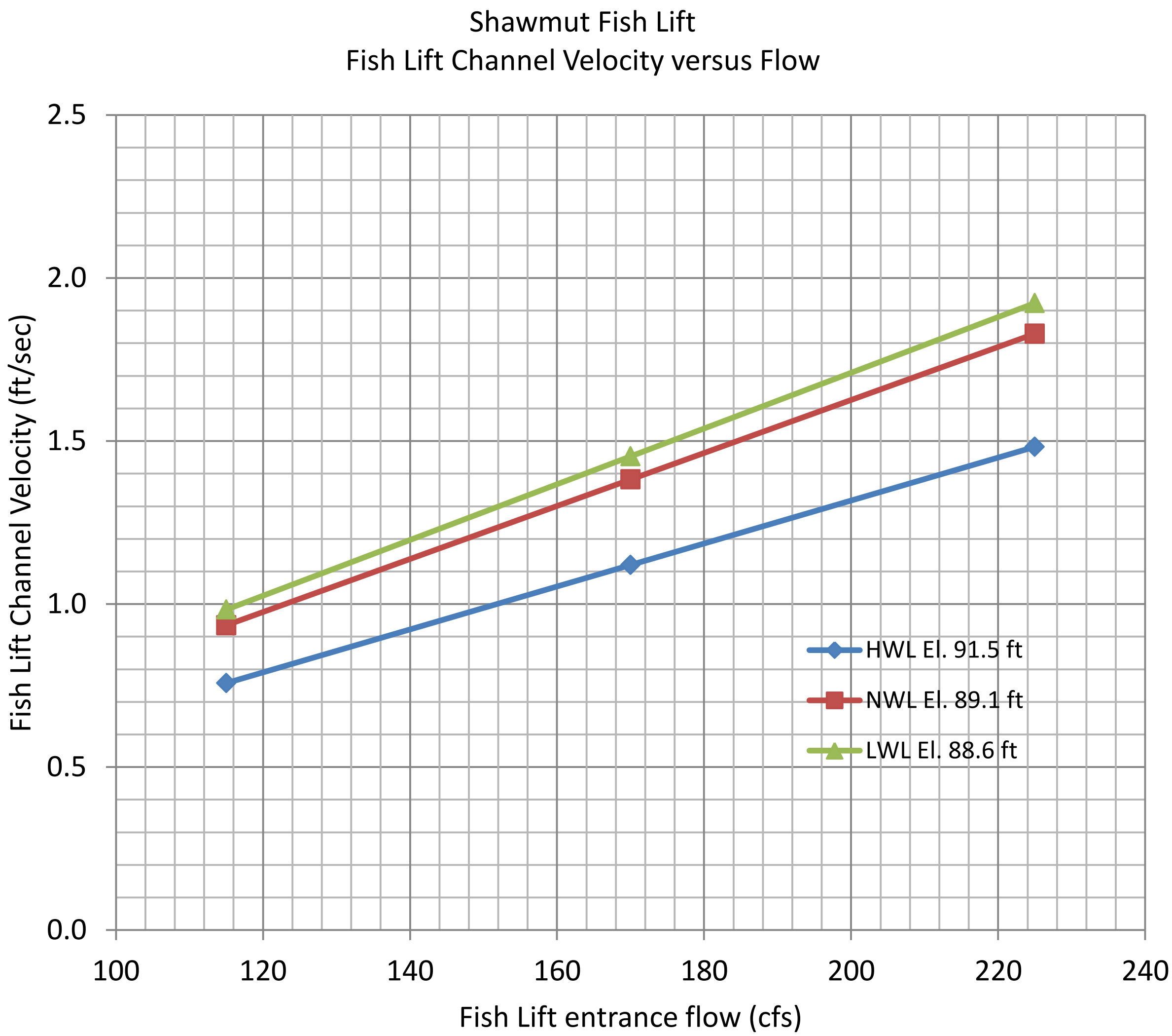
**Drawing G-002**

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.

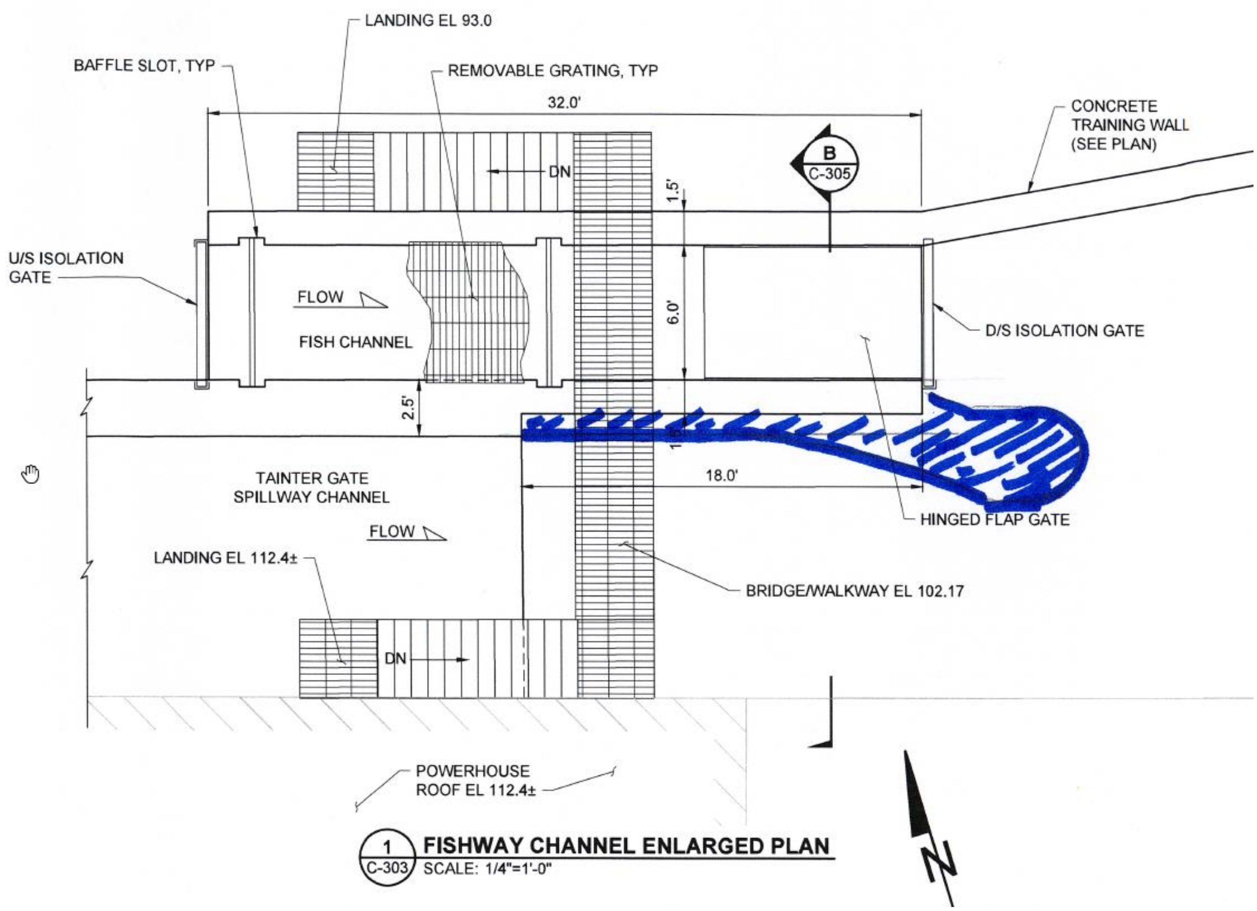
3. **Is attraction water gate downward opening? - Does it need to be?**

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.

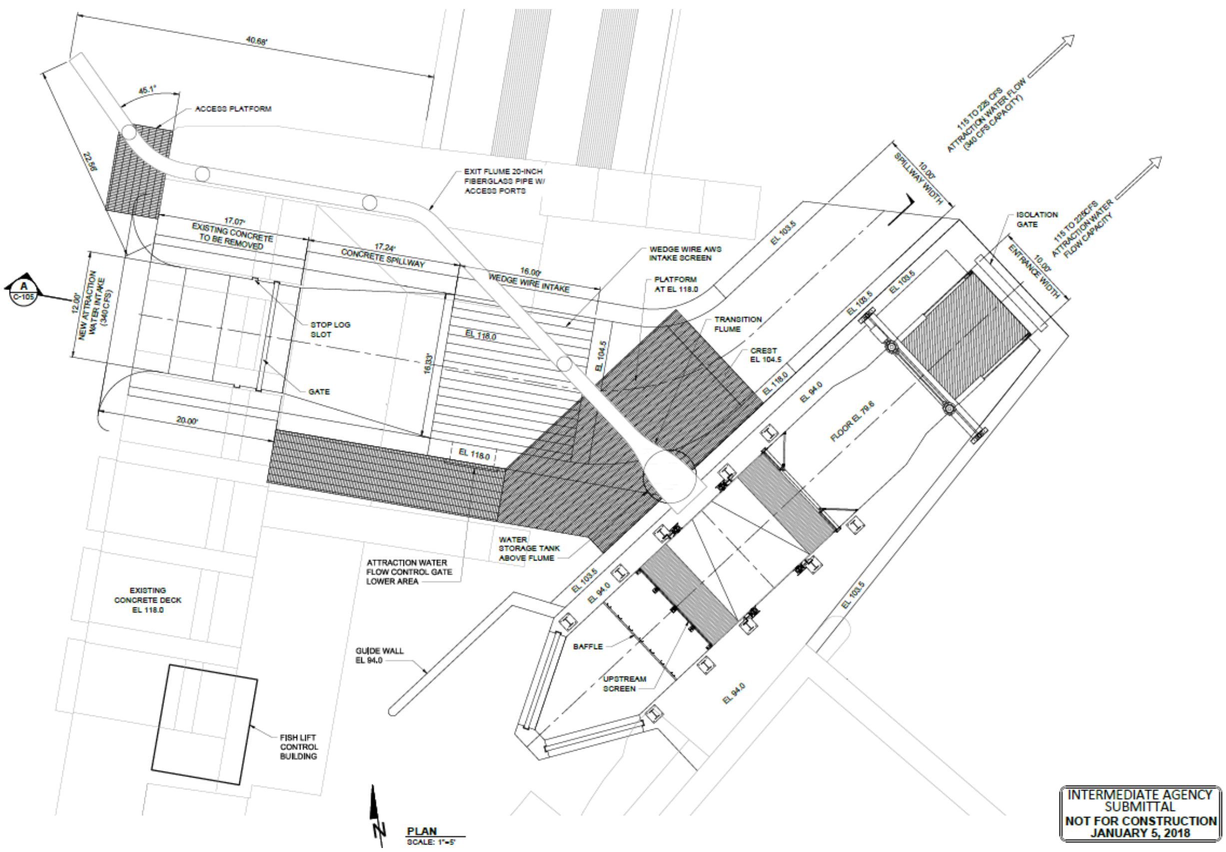



**Figure 1. Fish Lift Entrance Channel Plan**

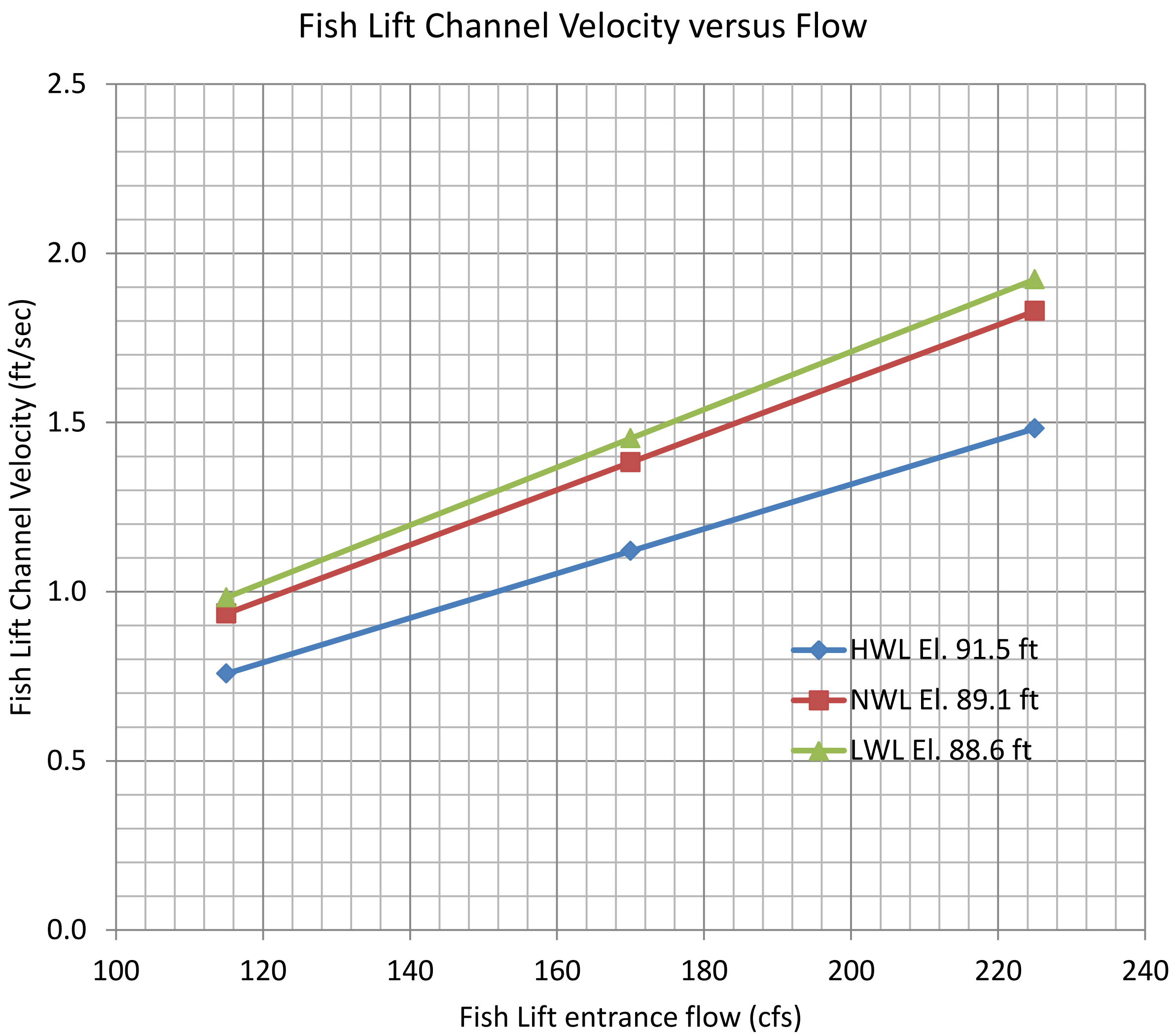



**Figure 2. Fish lift entrance channel velocity versus flow rate for high, normal and low tailwater conditions.**

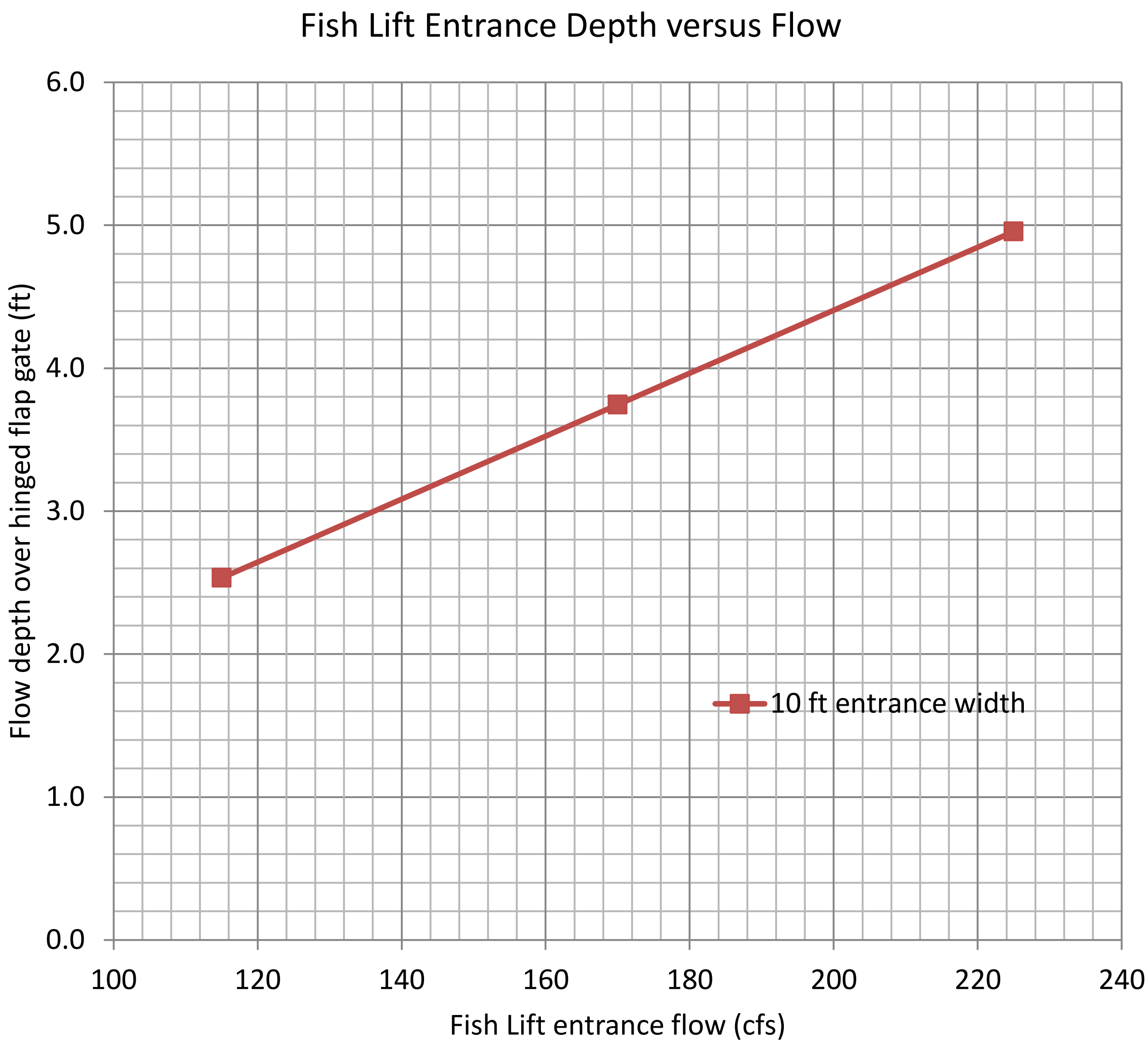



**Figure 3. Fish lift entrance flow depth over the hinged flap gate versus flow for a 6 ft/sec entrance velocity condition.**

**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.

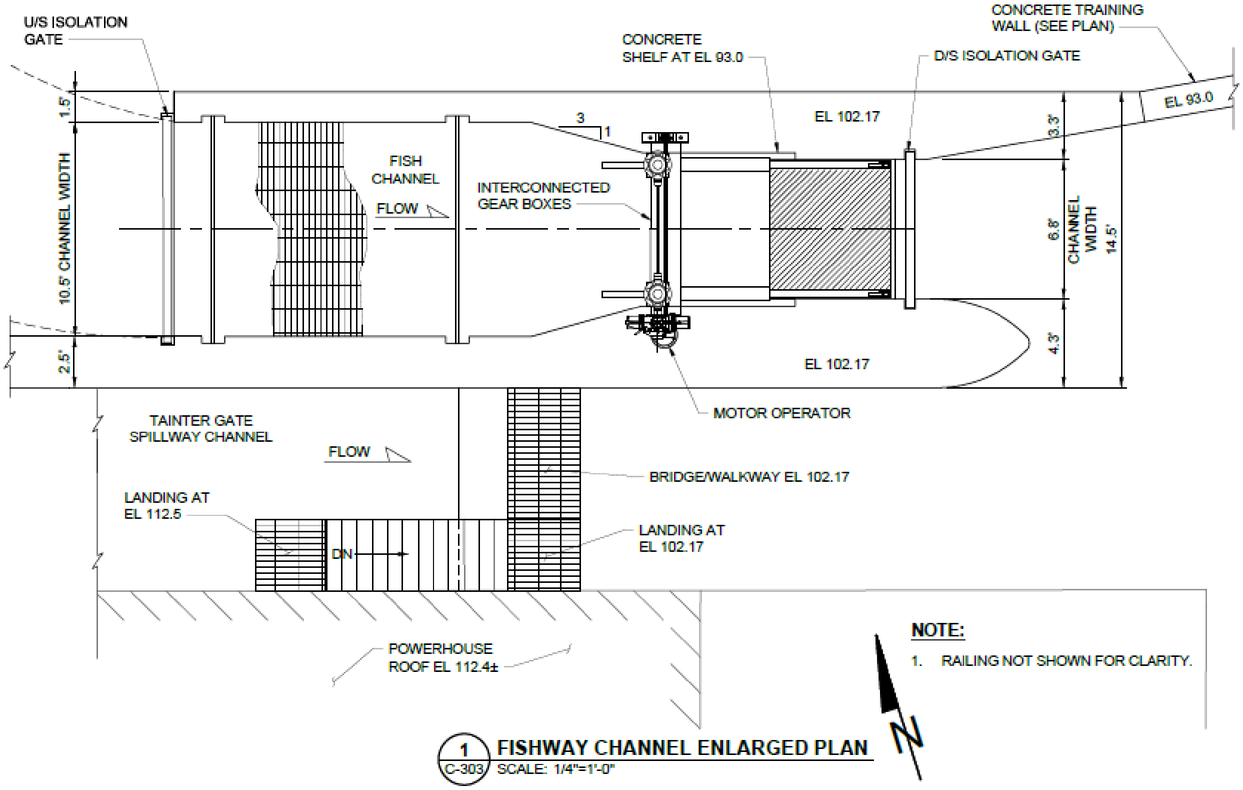



**Figure 5. Unit 7&8 fish passage channel plan**

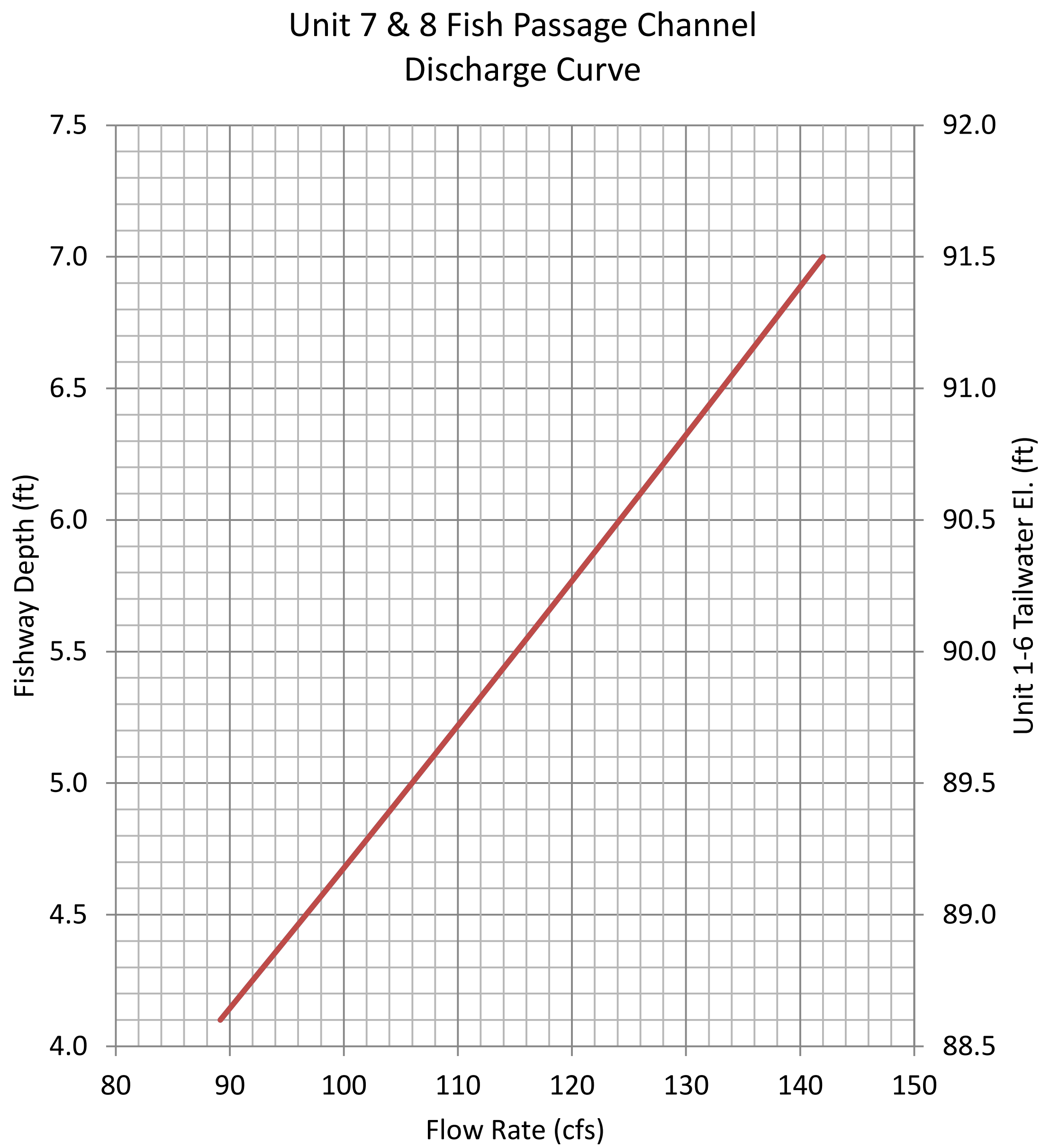



**Figure 6. Unit 7&8 fish passage channel discharge curve for a full depth 42 inch wide baffle slot.**

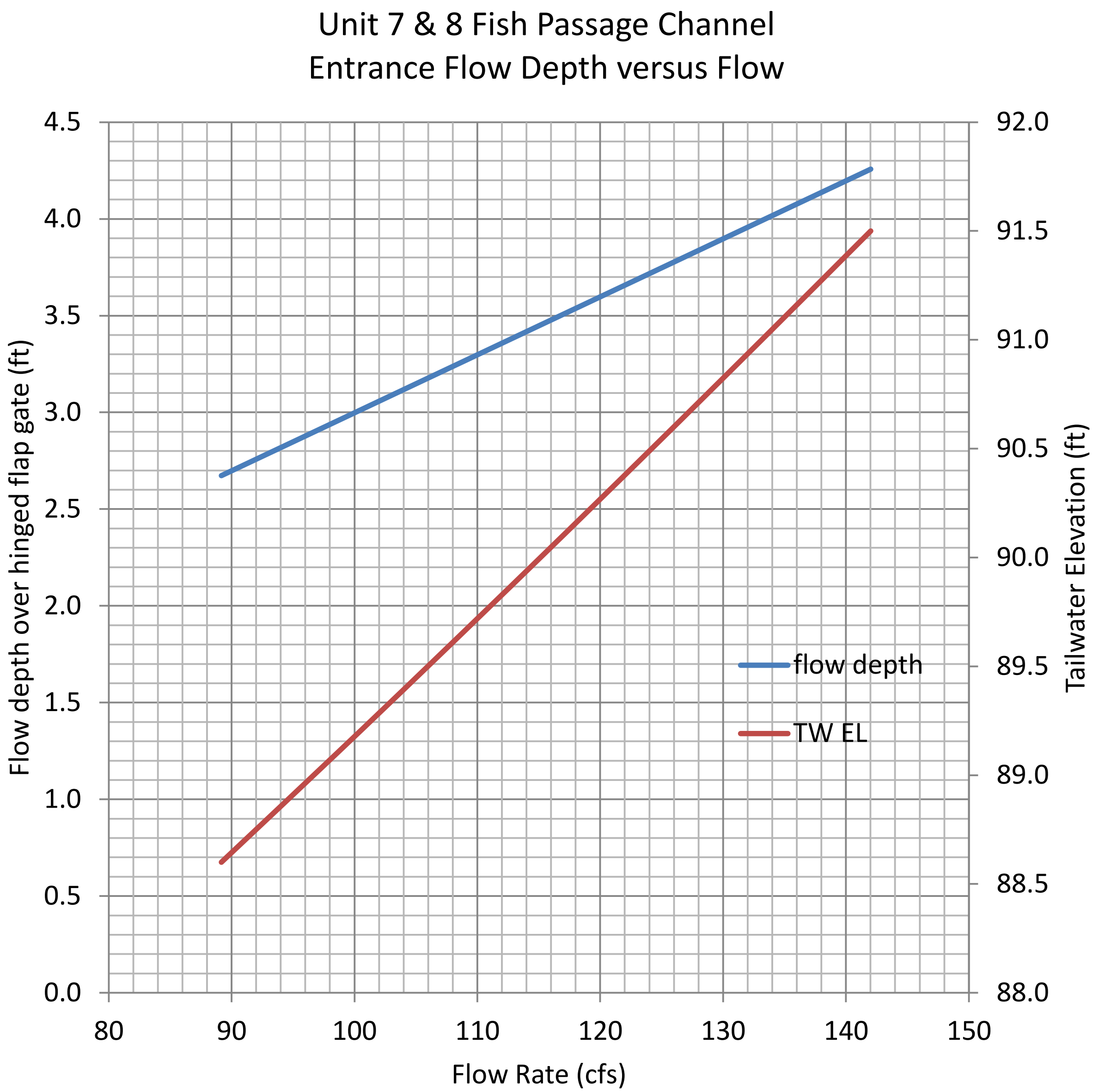



**Figure 7. Unit 7&8 fish passage channel entrance flow depth over the hinged flap gate versus flow.**

## 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
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--

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## 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

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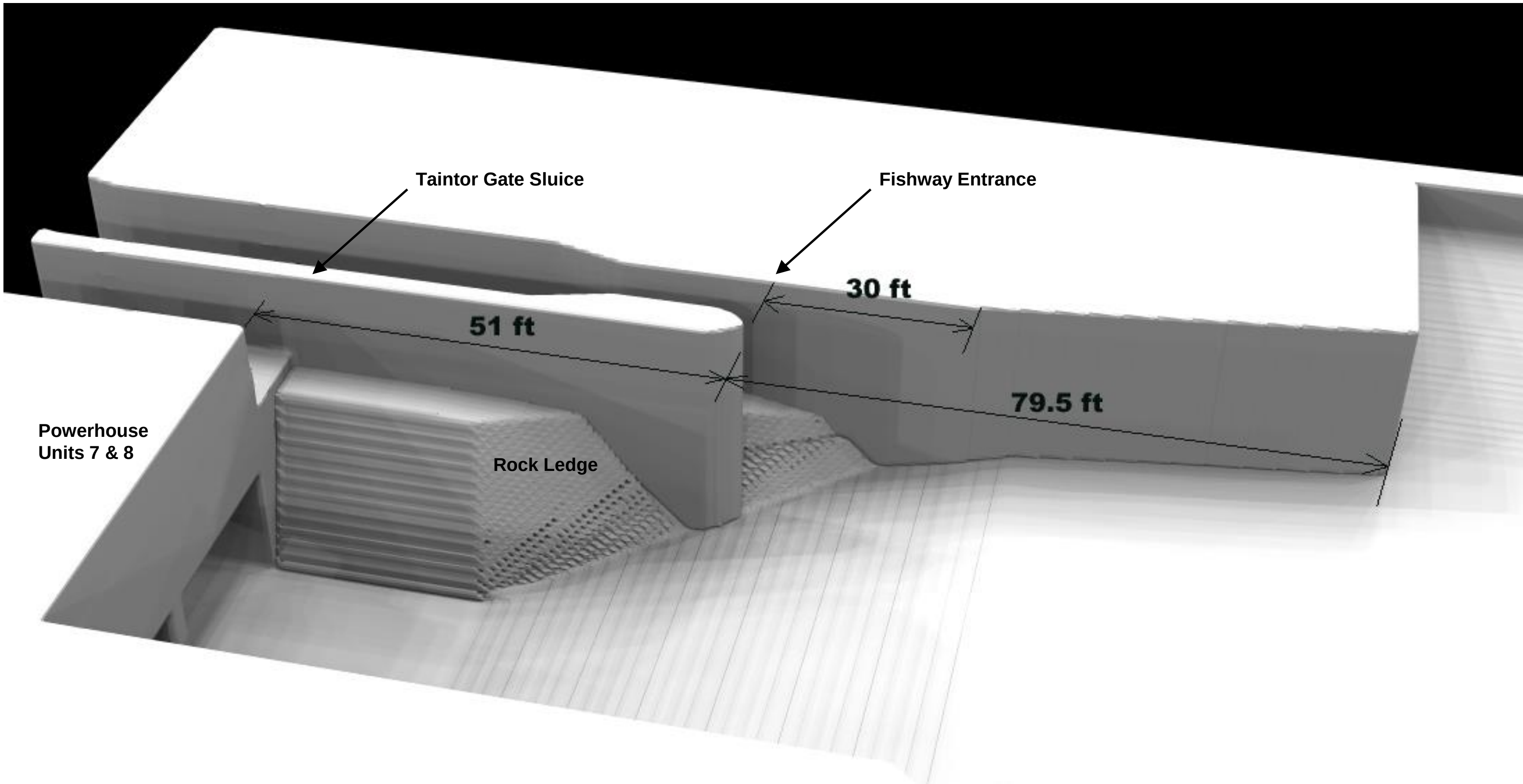
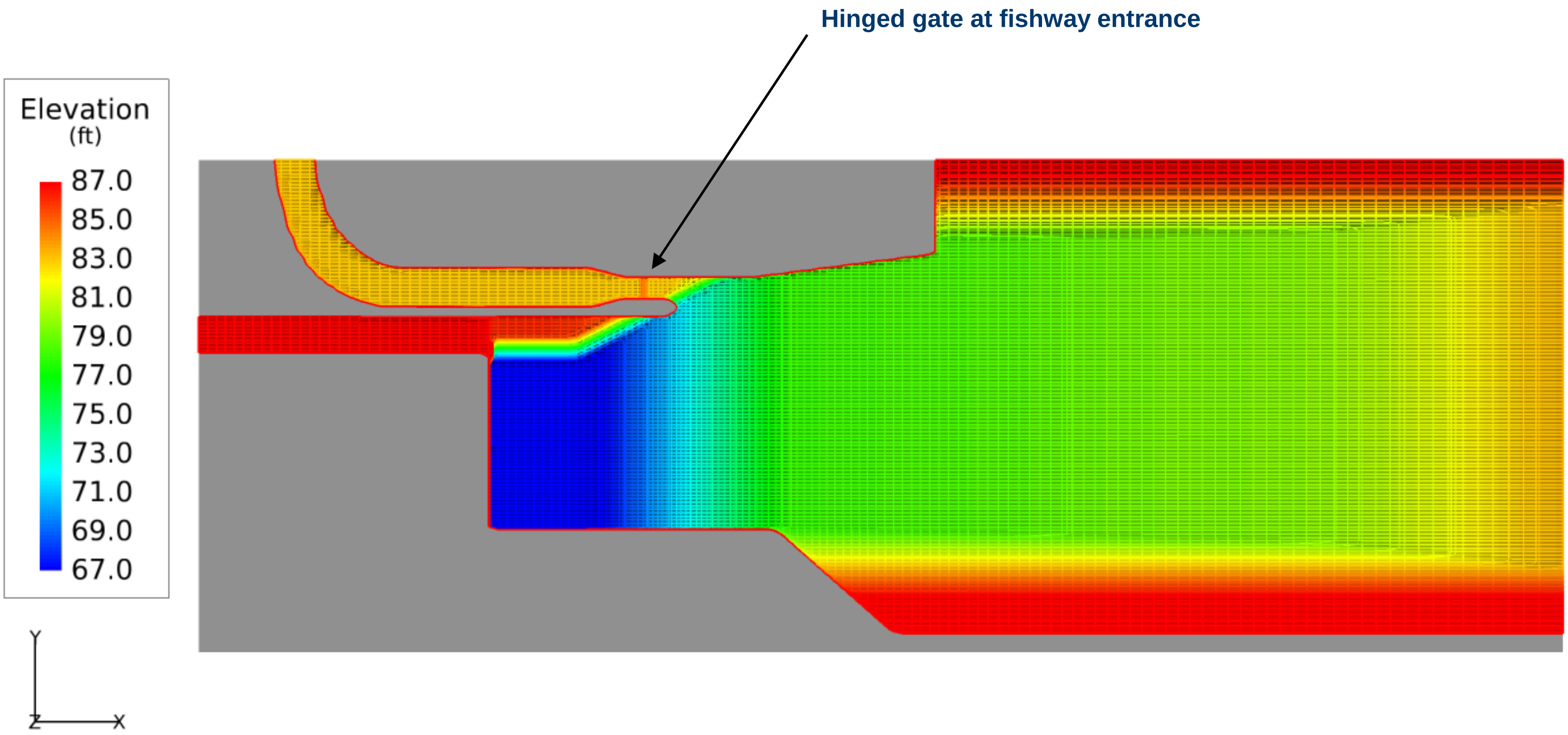
# Proposed Upstream Fishway Configuration




## Fishway – Three Dimensional Perspective

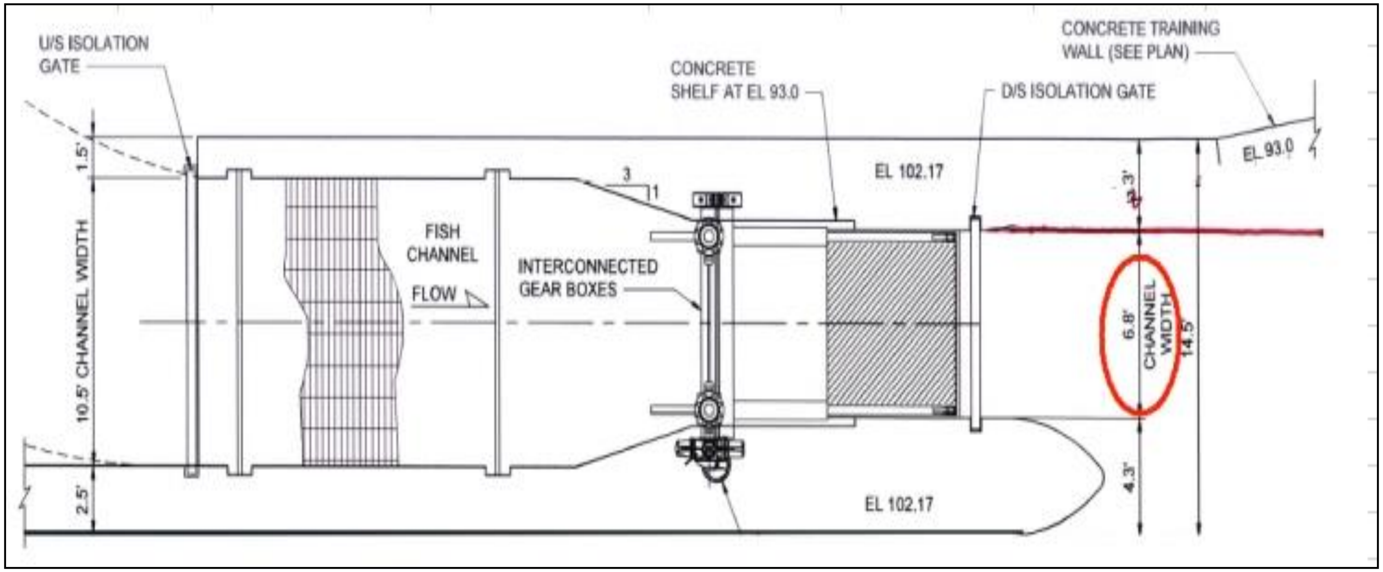
# Proposed Upstream Fishway Configuration – Plan View



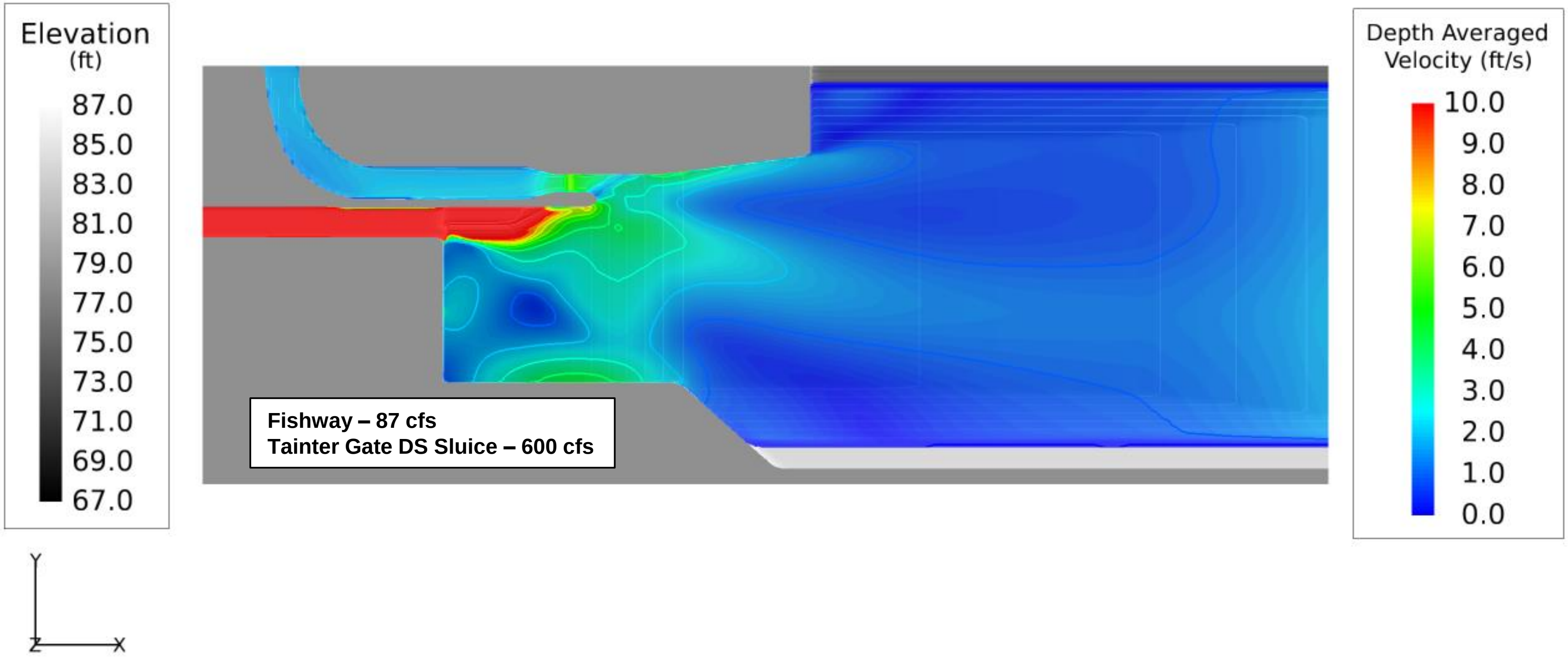

## Model Domain with Grid Overlay

# 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 |

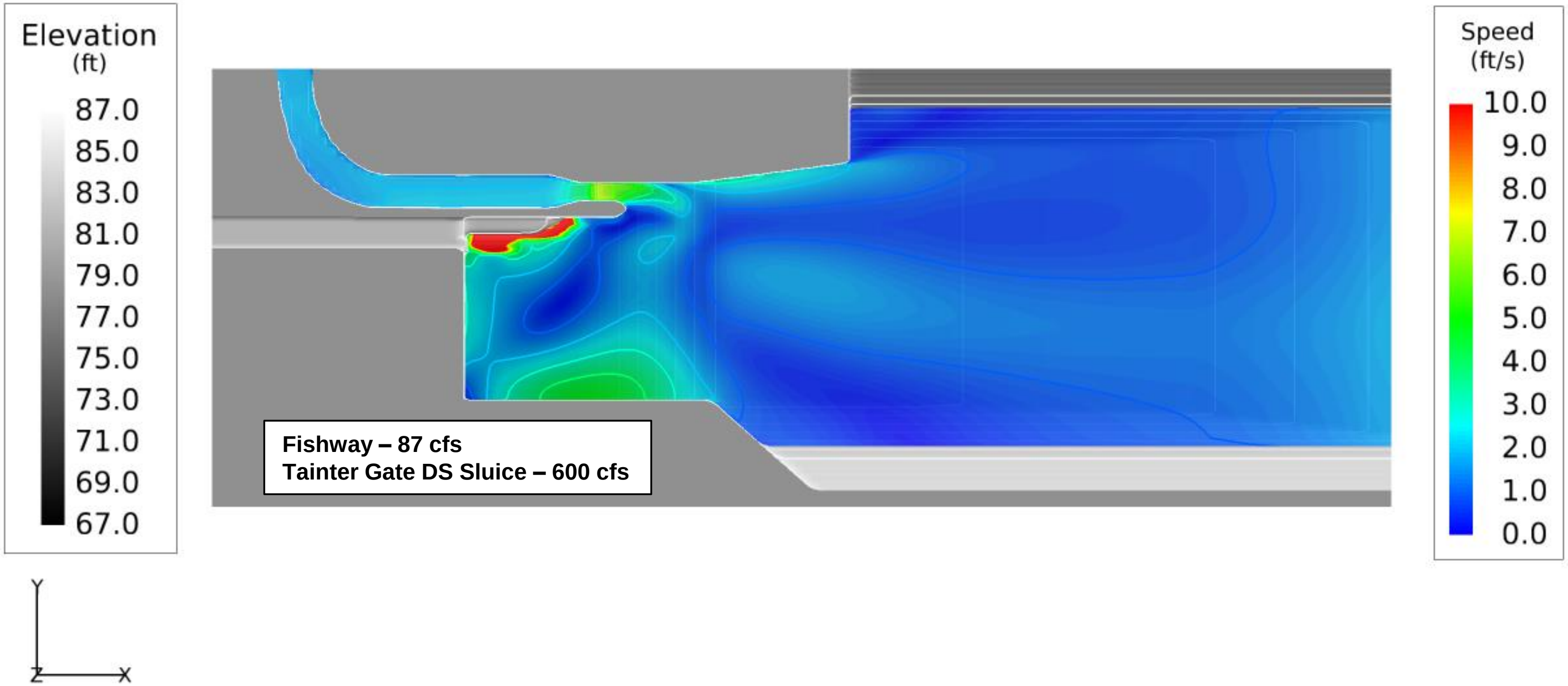


# Simulation Results



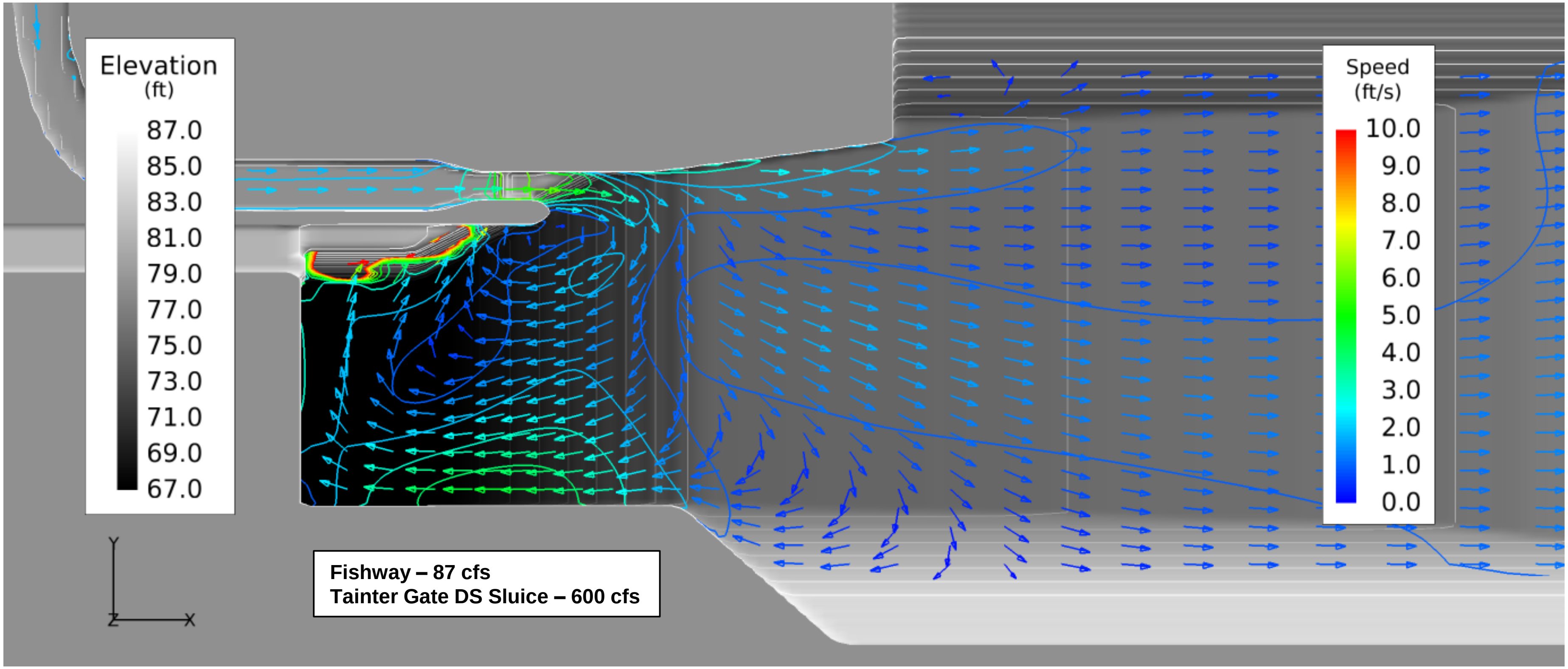

**Depth Averaged Velocity**
**(plotting plane elevation – 88.4 ft)**

# Simulation Results




**Flow Speeds**
**(plotting plane elevation 85.0 ft, 2.1 ft below surface)**

# Simulation Results

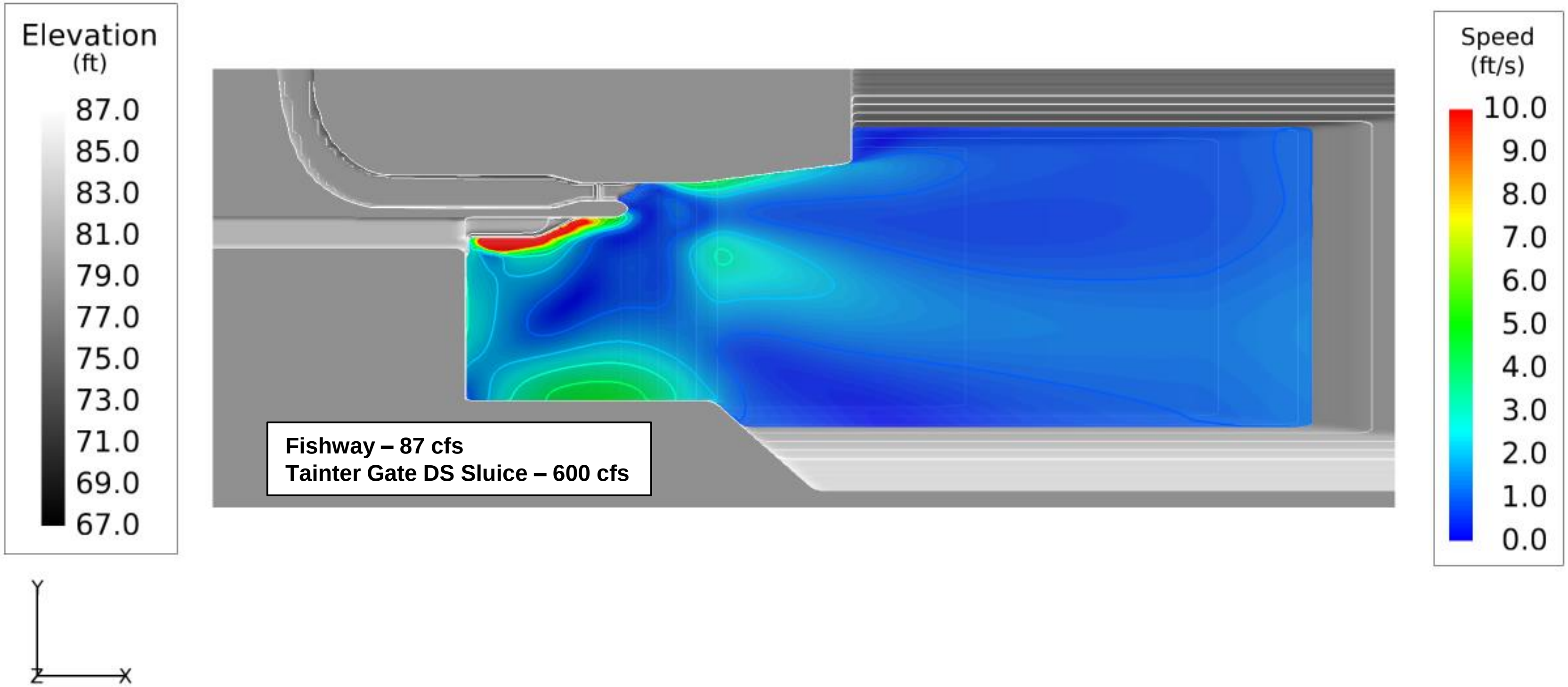



**Total Vectors colored by Speed**
**(plotting plane elevation 85.0 ft, 2.1 ft below surface)**



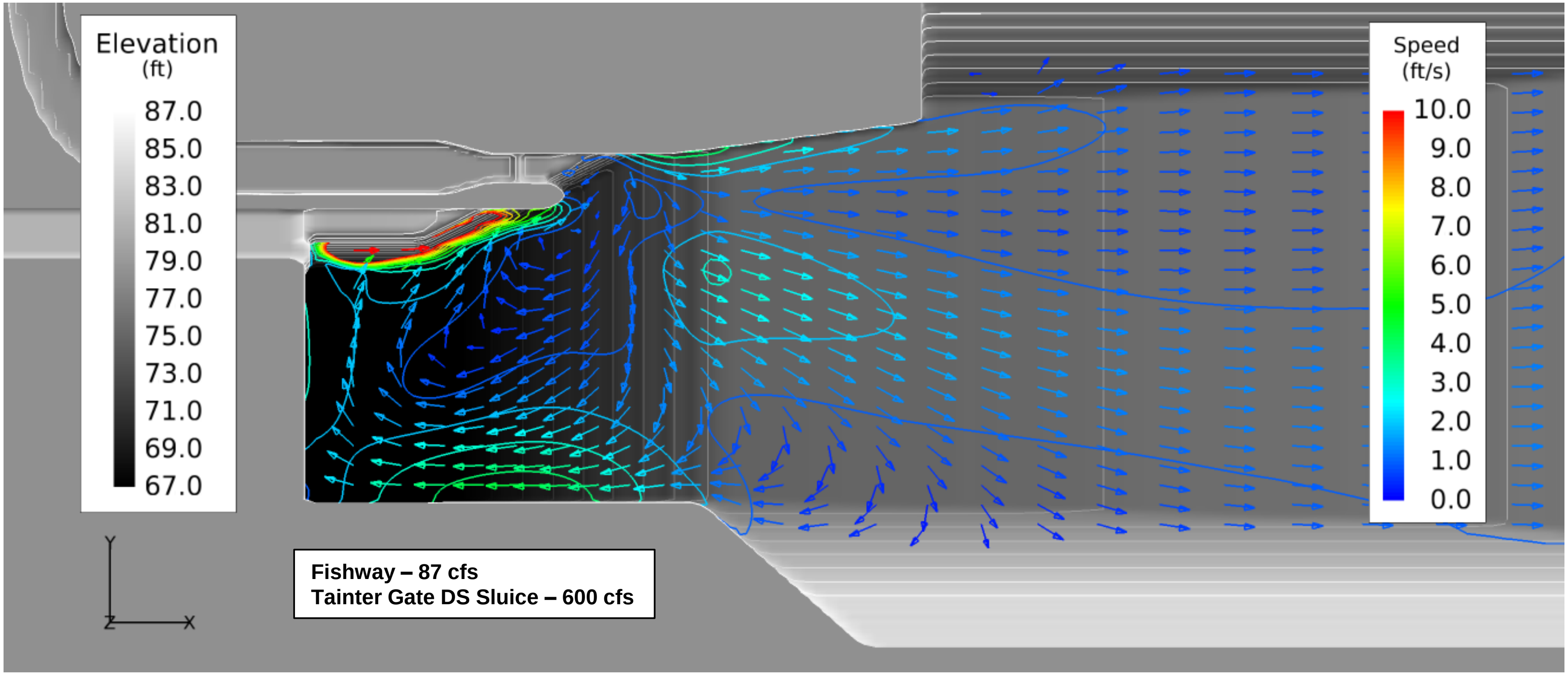
Every 4th Vector Shown

# Simulation Results




**Flow Speeds**
**(plotting plane elevation 82.0 ft, 5.1 ft below surface)**

# Simulation Results

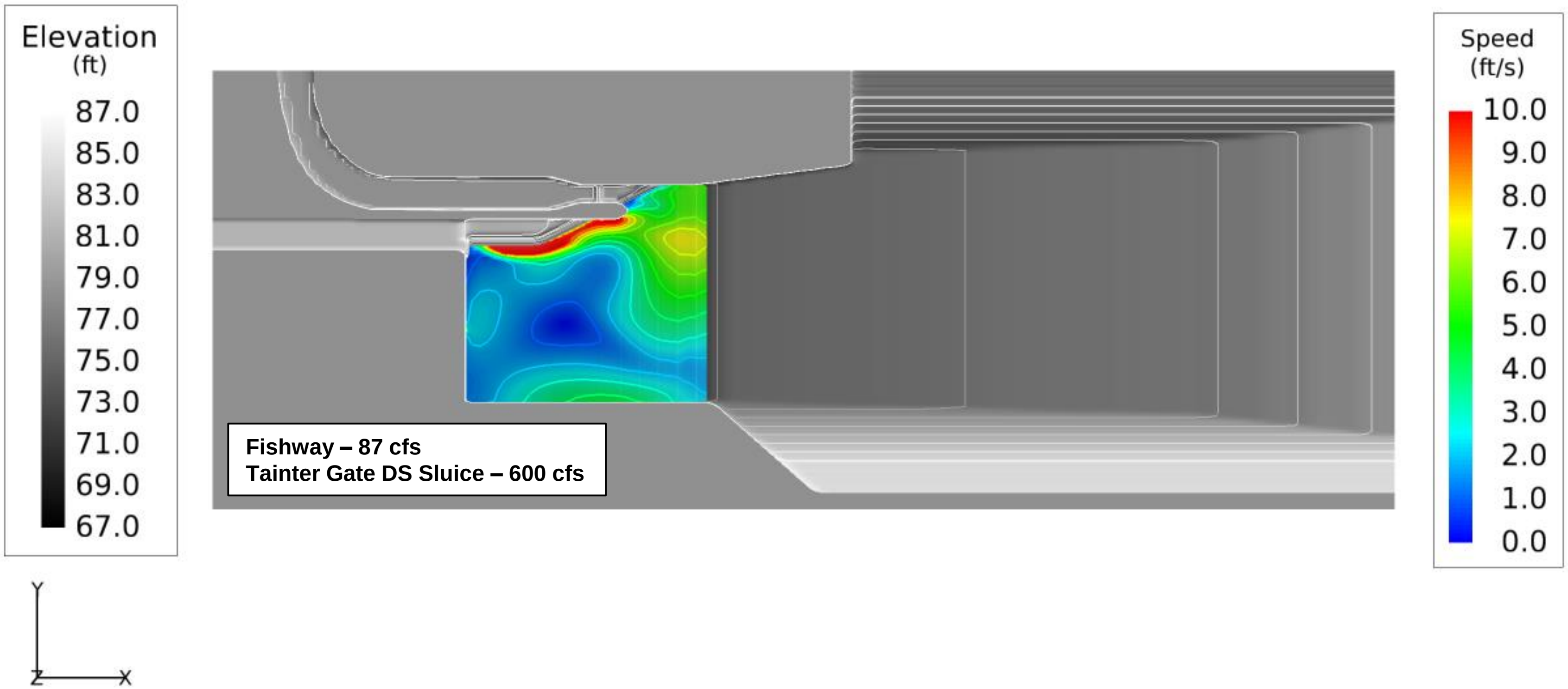



**Total Vectors colored by Speed**
**(plotting plane elevation 82.0 ft, 5.1 ft below surface)**



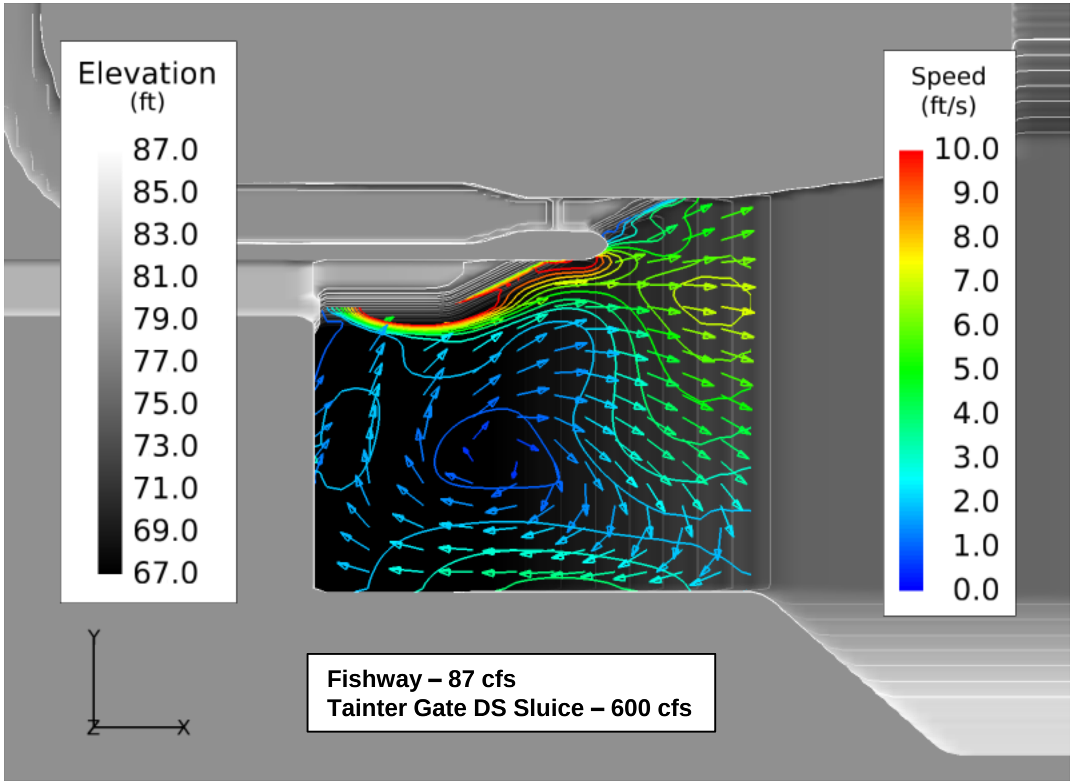
Every 4th Vector Shown

# Simulation Results




**Flow Speeds**
**(plotting plane elevation 77.0 ft, 10.1 ft below surface)**

# Simulation Results

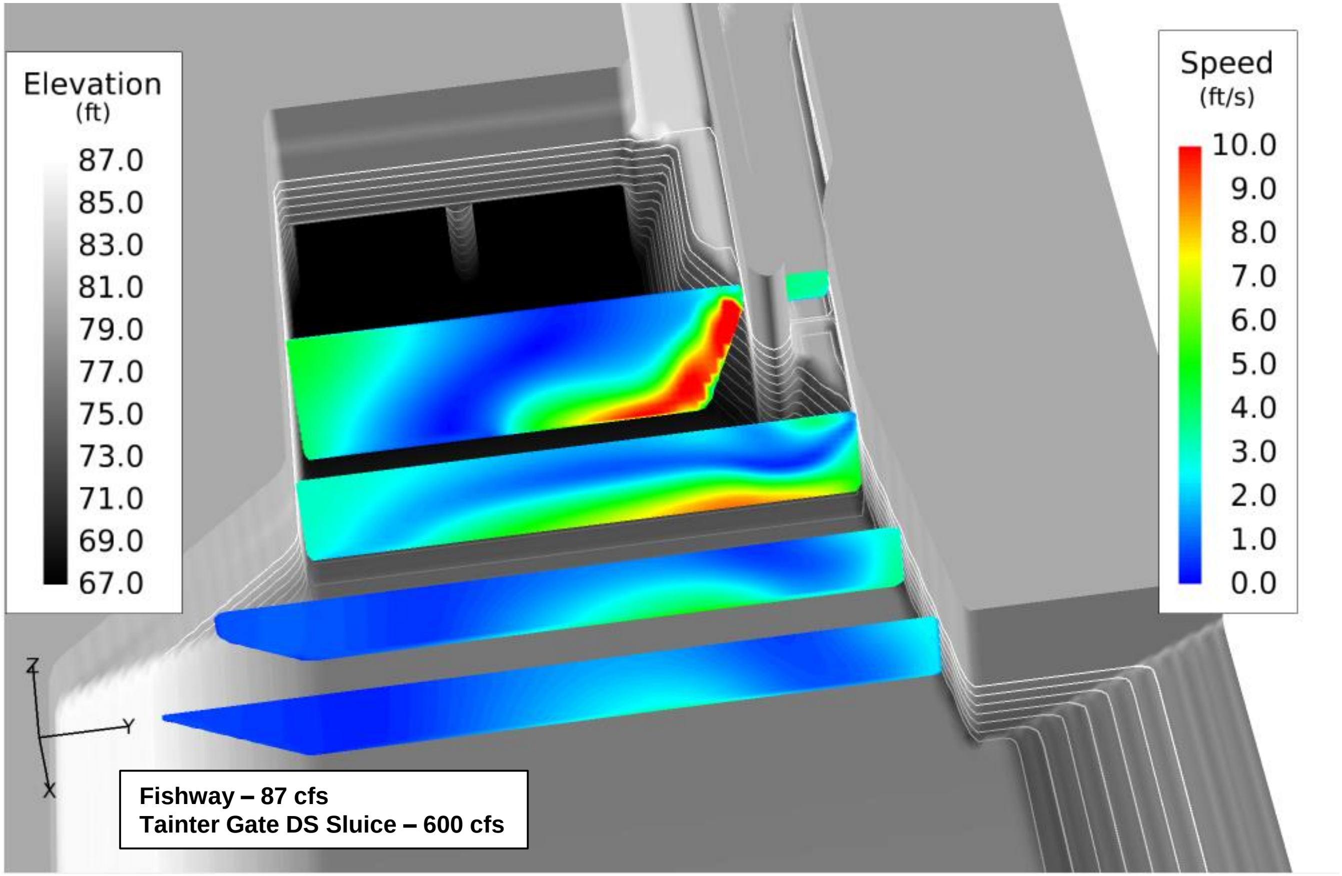



**Total Vectors colored by Speed**
**(plotting plane elevation 77.0 ft, 10.1 ft below surface)**



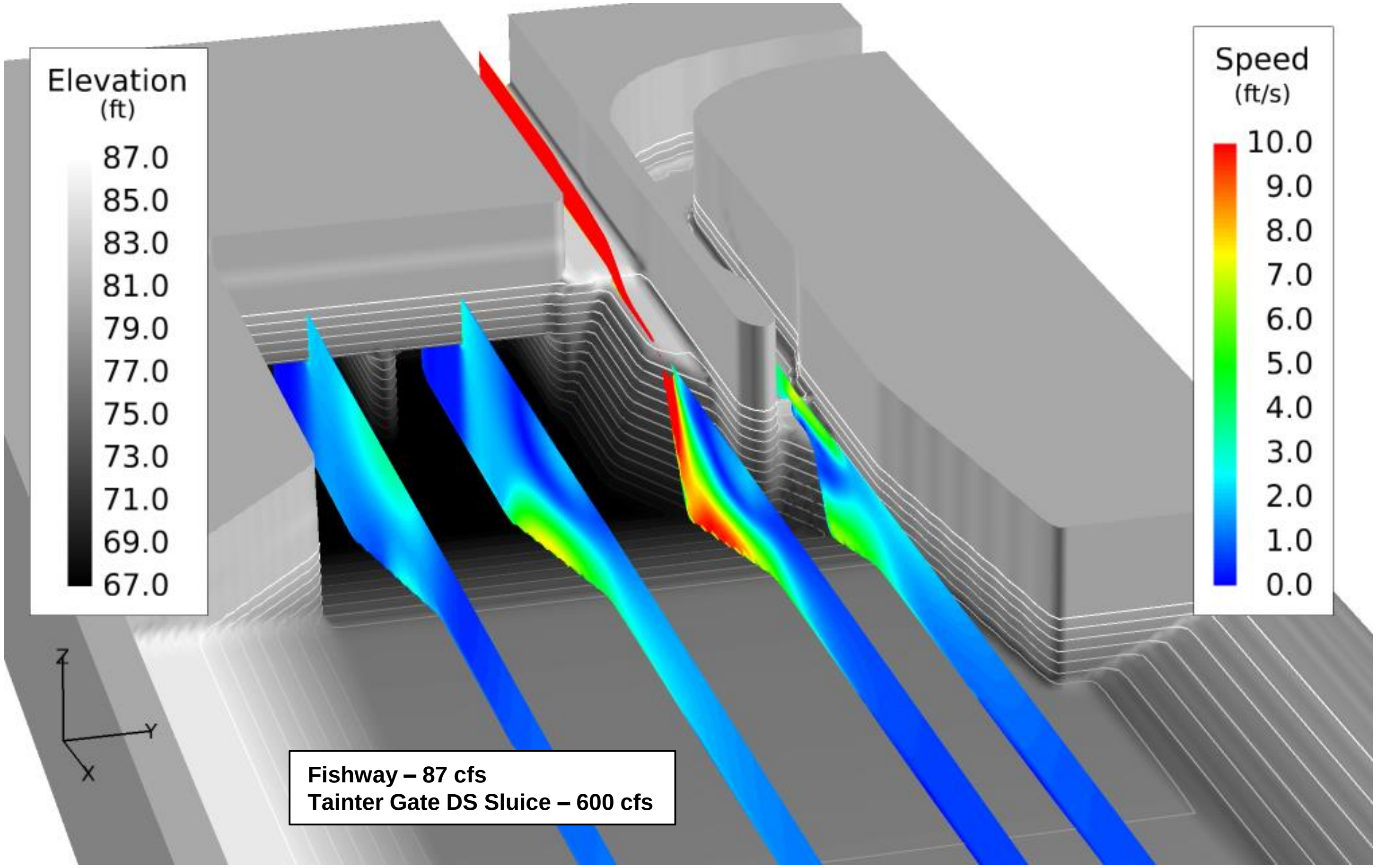
Every 4th Vector Shown

# 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

--
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## 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

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---

# 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.

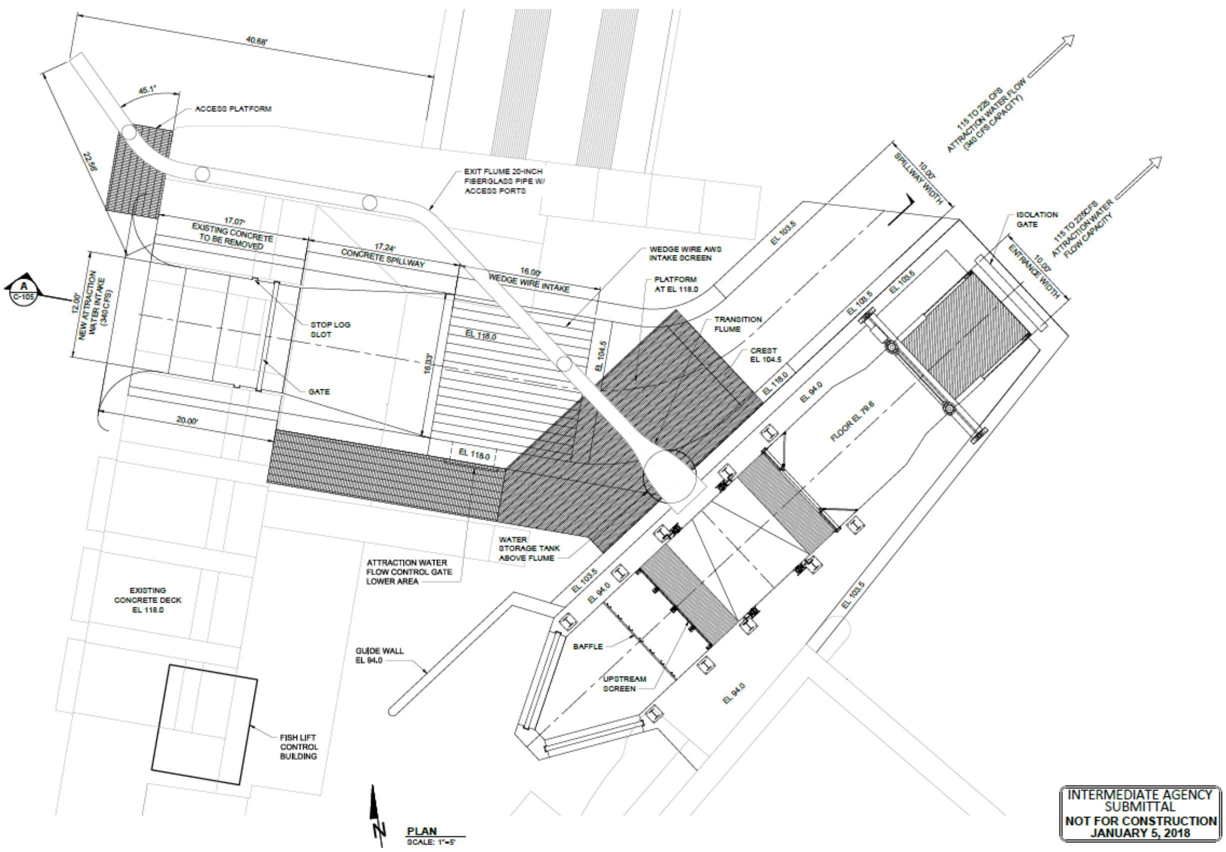



**Figure 1. Fish Lift Entrance Channel Plan**

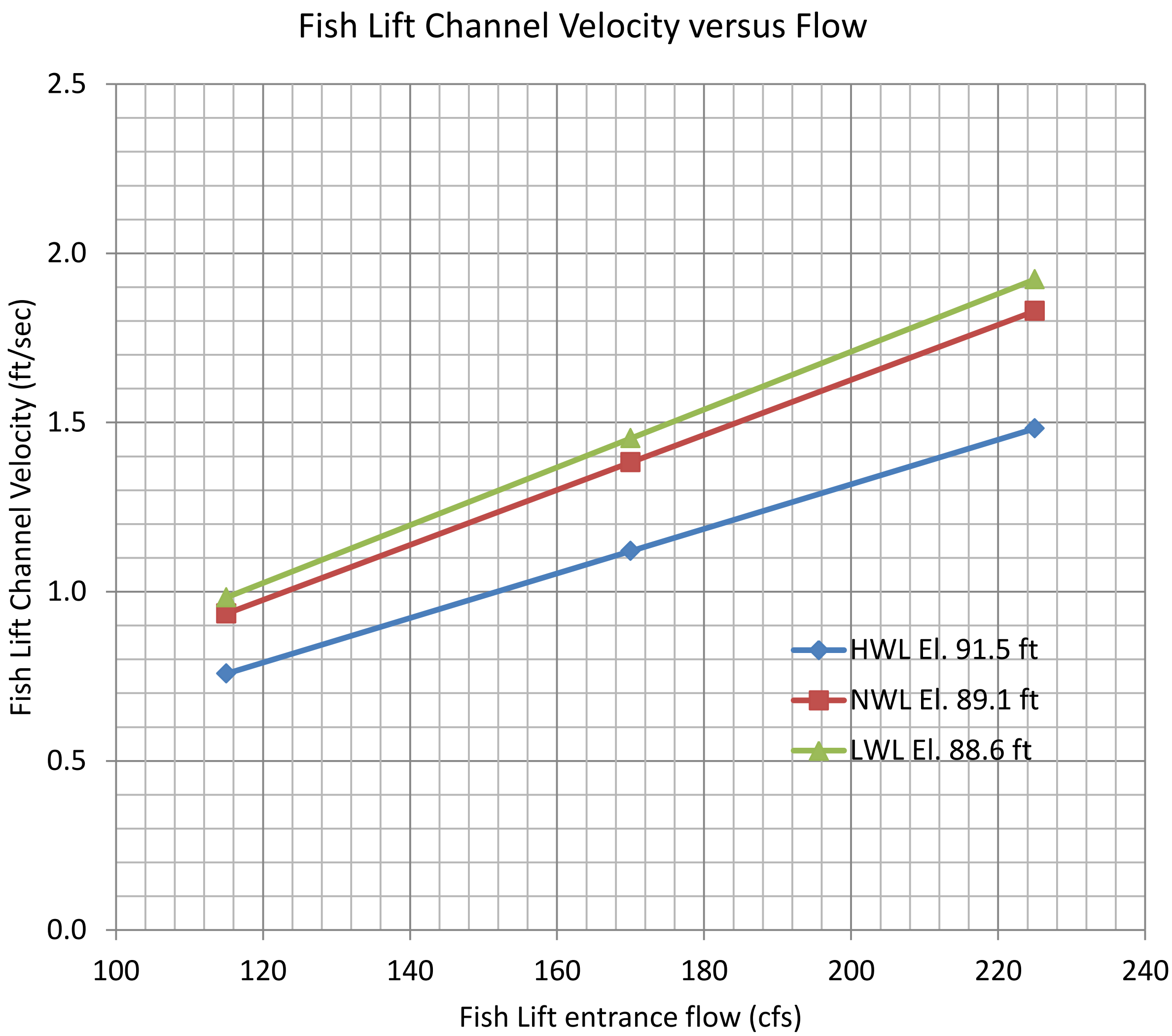



**Figure 2. Fish lift entrance channel velocity versus flow rate for high, normal and low tailwater conditions.**

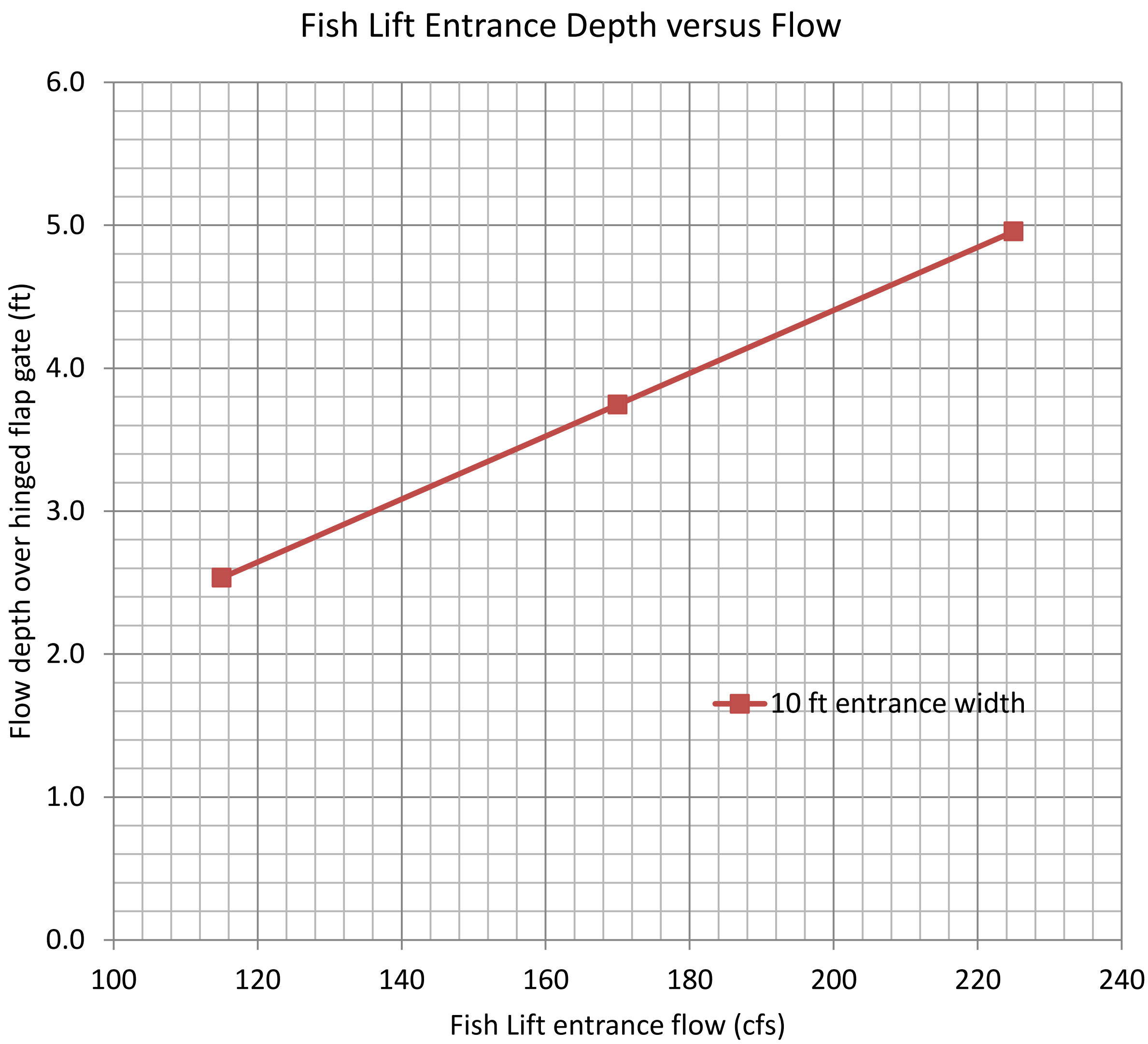
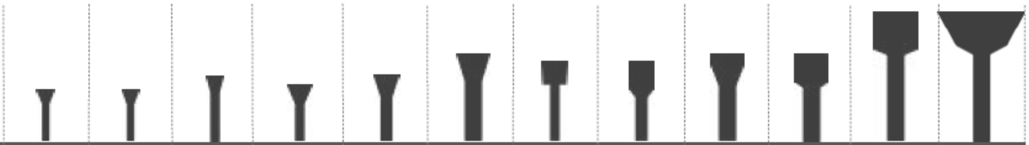



**Figure 3. Fish lift entrance flow depth over the hinged flap gate versus flow for a 6 ft/sec entrance velocity condition.**

**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.

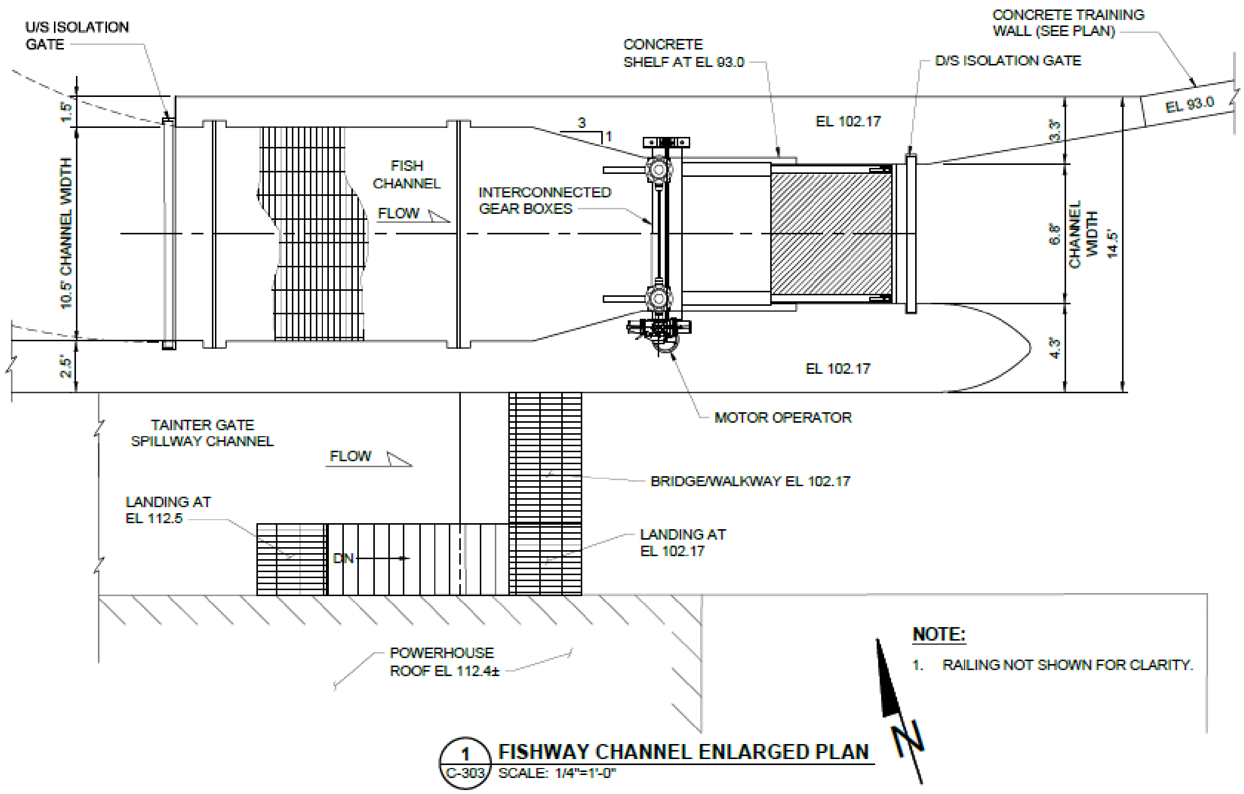



**Figure 5. Unit 7&8 fish passage channel plan**

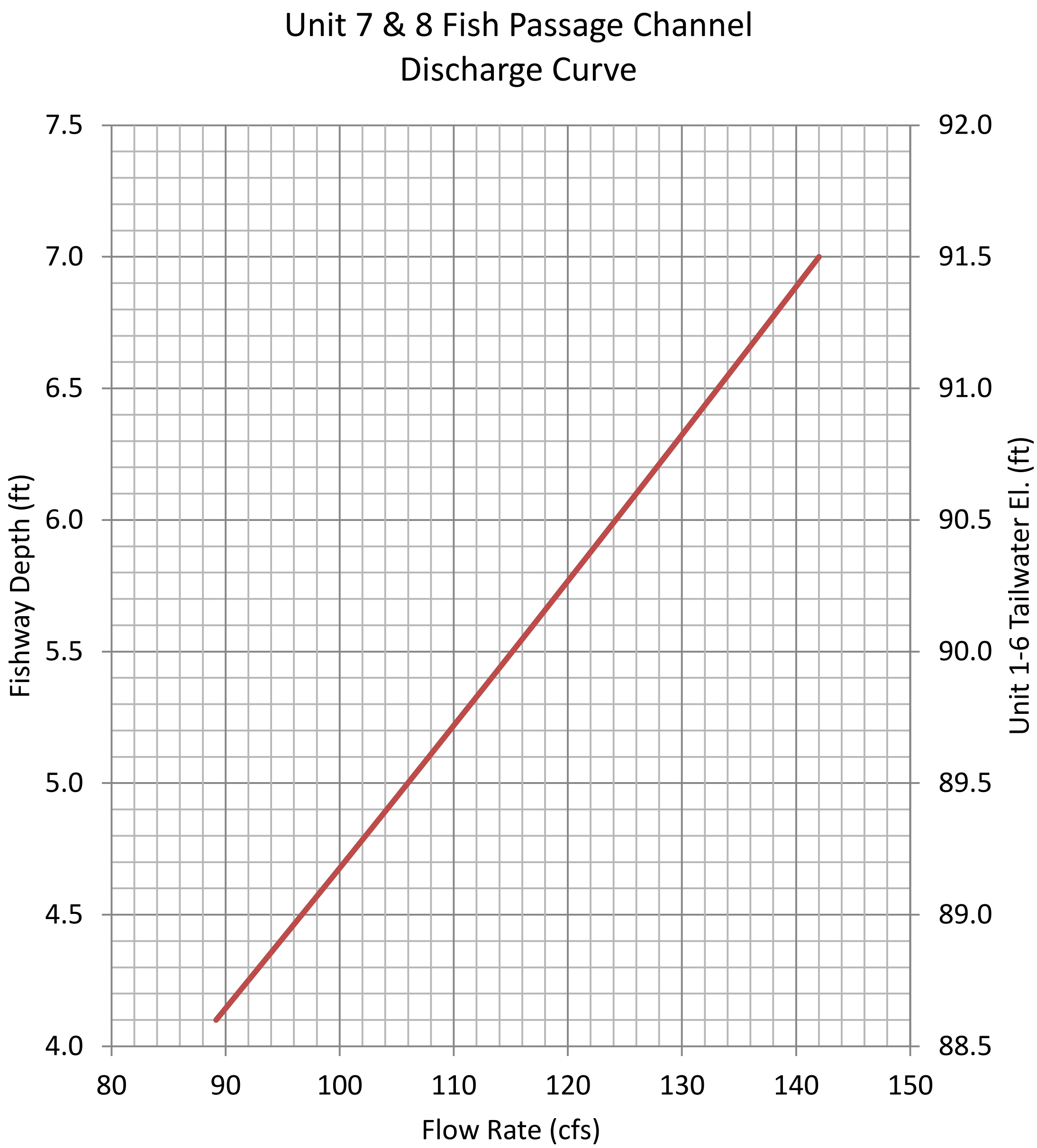



**Figure 6. Unit 7&8 fish passage channel discharge curve for a full depth 42 inch wide baffle slot.**

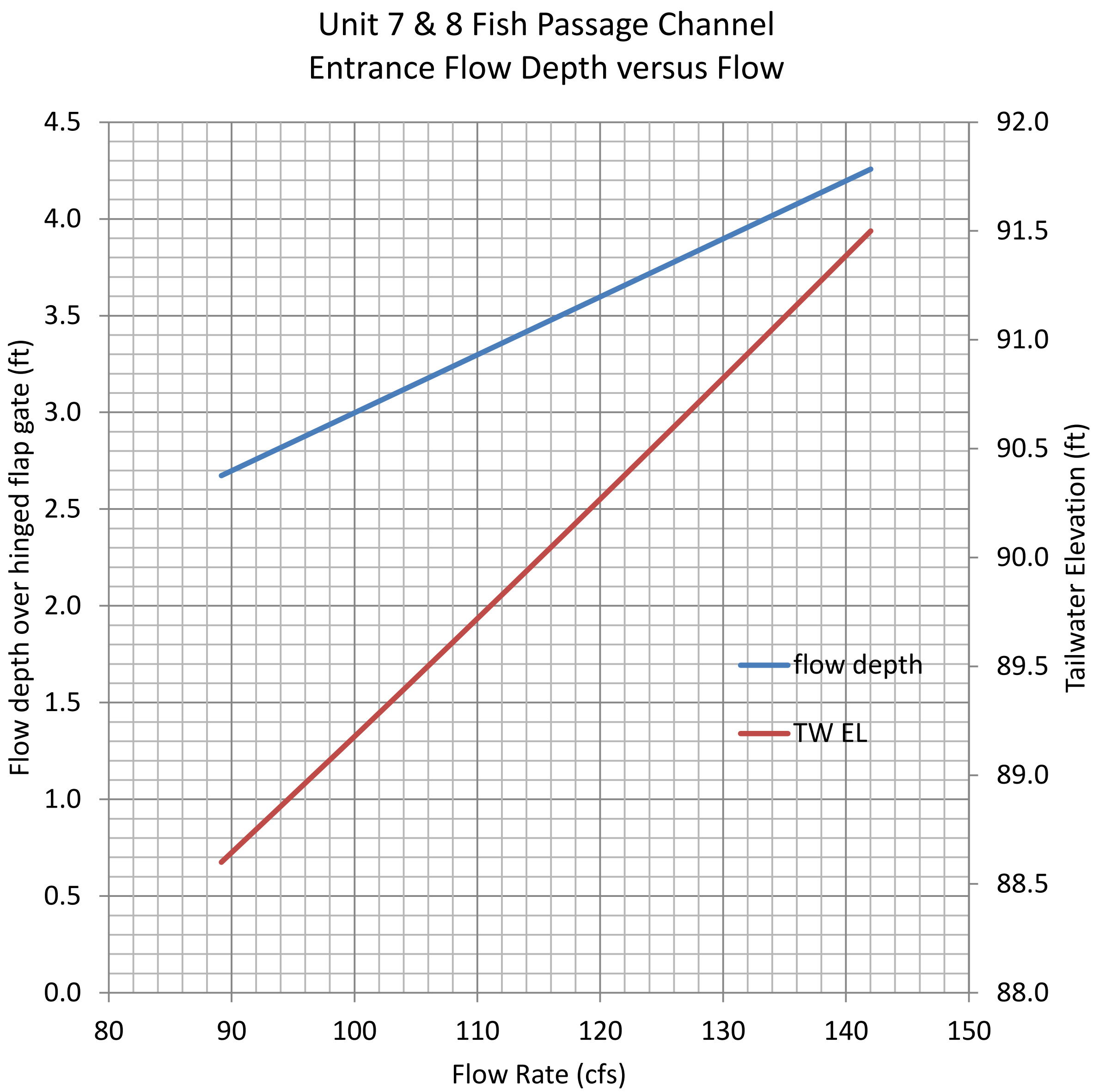



**Figure 7. Unit 7&8 fish passage channel entrance flow depth over the hinged flap gate versus flow.**

## 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
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Donald.Dow@noaa.gov

--
**Gregory Allen, P.E.**
**Director, Environmental and Engineering Services**
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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

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--
Antonio

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# 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
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--
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


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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

May 27, 2020

VIA FEDERAL EXPRESS
Ms. Kathy Howatt
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333

Maine Waterway Development and Conservation Act Application and Condition Compliance Application Supplement for the Shawmut Hydroelectric Project (FERC No. 2322) Upstream Fish Passage Facility

Dear Ms. Howatt:

Brookfield White Pine Hydro, LLC (BWPH), licensee for the Shawmut Hydroelectric Project (FERC No. 2322) (Project), herein provides a Maine Waterway Development and Conservation Act Application and supplemental Condition Compliance Application information 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.

The processing fee of $7,453.65 is remitted with this Maine Waterway Development and Conservation Act Application and Condition Compliance Application Supplement.

Please contact me should you have any questions.

Sincerely,

Kelly Maloney

Kelly Maloney
Manager, Compliance - Northeast

cc: Kelly Maloney, BWPH
Gerry Mitchell, BWPH

Enclosures: Maine Waterway Development and Conservation Act Application
Supplement to the Upstream Fish Passage Facility December 31, 2019 Condition Compliance Application
Maine Waterway Development and Conservation Act Application Processing Fee (Check will be provided separate from this submittal)

# MAINE WATERWAY DEVELOPMENT AND CONSERVATION ACT PERMIT APPLICATION

# SHAWMUT HYDROELECTRIC PROJECT
# FERC NO. 2322

## SUPPLEMENT TO THE UPSTREAM FISH PASSAGE FACILITY DECEMBER 31, 2019 CONDITION COMPLIANCE APPLICATION

*Prepared by:*

**Brookfield White Pine Hydro, LLC**
**150 Main Street**
**Lewiston, Maine**

**SHAWMUT HYDROELECTRIC PROJECT**
**FERC NO. 2322**

**SUPPLEMENT TO THE UPSTREAM FISH PASSAGE FACILITY**
**DECEMBER 31, 2019 CONDITION COMPLIANCE APPLICATION**

**BROOKFIELD WHITE PINE HYDRO, LLC**
**LEWISTON, MAINE**

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APPENDIX E – COFFERDAMS PLANS AND SPECIFICATIONS
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**SHAWMUT HYDROELECTRIC PROJECT**
**FERC NO. 2322**

**SUPPLEMENT TO THE UPSTREAM FISH PASSAGE FACILITY**
**JANUARY 3, 2020 CONDITION COMPLIANCE APPLICATION**

**BROOKFIELD WHITE PINE HYDRO, LLC**
**LEWISTON, MAINE**

# 1 BACKGROUND INFORMATION

Brookfield White Pine Hydro, LLC (BWPH), licensee for the Shawmut Hydroelectric Project (FERC No. 2322) (Project), on December 31, 2019 submitted a Condition Compliance Application for the Shawmut Upstream Fish Passage Facility to the Maine Department of Environmental Protection (MDEP). At the request of MDEP, BWPH provides supplemental information to assist MDEP in its review of the MRS Title 38, Section 636 Maine Waterway Development and Conservation Act (MWDCA) approval criteria.

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 A, D and F). BWPH remitted the Condition Compliance application together with the following exhibits, pursuant to the 1998 WQC and Maine Waterway Development and Conservation Act Permit (MWDCA), issued concurrently (#L-19751-33-A-M):

Exhibit A – 1998 WQC

Exhibit B – Project Description (MWDCA Exhibit 1)

Exhibit C - Final Engineering Drawings (MWDCA Exhibit 2)

Exhibit D - Operations and Maintenance Plan

Exhibit E - Erosion and Sediment Control Plan (MWDCA Exhibit 6)

Exhibit F - Agency Consultation Documentation

Subsequent to the December 31, 2019 submittal, BWPH has engaged a contractor for the completion of the upstream fish passage facility, resulting in a change to the previously submitted scope of work. This supplement provides the information pursuant to the Addendum to Hydropower Project Applications Under the Maine Waterway Development and Conservation Act; Review Standards for Earthfill Cofferdams and provides a revised Erosion and Sediment Control Plan[1].

## 2 COFFERDAM ADDENDUM

### 2.1 COFFERDAM DESCRIPTIONS

Four cofferdams will be utilized in the construction of the upstream fish passage at Shawmut.

A cofferdam for the attraction water intake (Cofferdam 1) will be a sheet pile bulkhead 31 ft wide extending 5 ft upstream into the impoundment with a top elevation of 115 ft located on the upstream face of the non-overflow dam section. . This cofferdam will cover 82 square feet and 125 cubic yards of temporary fill will be placed.

The cofferdam utilized to dewater the fish lift area between the Unit 1-6 powerhouse and spillway (Cofferdam 2) is a braced cofferdam consisting of steel supports and stop logs. The cofferdam will run 45 ft from the spillway turning parallel to the powerhouse for 45 ft and turning perpendicular to the powerhouse 65 ft with a top elevation of 94 ft. This cofferdam will cover 254 square feet and 385 cubic yards of temporary fill will be placed.

The cofferdam from the Unit 1-6 powerhouse to the isolation wall dike (Cofferdam 3) at the Unit 7&8 tailrace is a braced cofferdam consisting of steel supports and stop logs for depths greater than 4 ft and sand bags for depth under 4 ft. The braced coffer dam and sand bags will run from

[1] The Earthfill Cofferdam addendum applies whenever an applicant proposes the use of an earthfill cofferdam as part of a hydropower project construction/reconstruction application (hydro2) or a hydropower project maintenance and repair application (hydro3) under the Maine Waterway Development and Conservation Act. The upstream fish passage facility does not involve a structural alteration of the hydropower project that changes water levels or flows at the dam (hydro2) nor constitutes a project maintenance and repair (hydro3). Nevertheless, it is submitted herein to assist in MDEP's review of the Project pursuant to the regulations of the MWDCA.

the southwest end of the Unit 1-6 powerhouse to the dike with a top elevation of 92 ft. This cofferdam will cover 160 square feet and 400 cubic yards of temporary fill will be placed.

The Unit 7 & 8 powerhouse tailrace Aquadam (Cofferdam 4) will be located about halfway down the dike from the Unit 7 & 8 powerhouse across the tailrace with a top elevation of 96 ft. The Aquadam will remain in place for the duration of the temporary access road. Upstream of the Aquadam a temporary access road or 2600 cubic yards will be placed from the southwest shoreline to the dike with a top elevation of 92 ft. The Aquadam cofferdam will cover 3500 square feet and the temporary access road will cover 11,915 square feet and 2,600 cubic yards of temporary fill will be placed but will be constructed and removed entirely in the dry behind the Aquadam cofferdam.

Included with the revisions to the cofferdams is a change from the temporary tressle to an earthen filled sheet pile cell for barge loading and offloading. The sheet pile cell will be 30 ft. wide by 40 ft. long and earthen filled. Due to the substrate (bed rock) in this area a pile tressle is not feasible. Also due to the potential need for barge access the cell will be a permanent structure to facilitate access. The Revised cofferdam plan and design specifications are provided in Appendix F.

## 2.2 COFFERDAM ALTERNATIVES

Cofferdam 1 will be a sheet pile bulkhead, Cofferdam 2 and Cofferdam 3 are braced cofferdams consistent with the originally proposed cofferdam arrangements with the exceptions of minor dimensional changes to their overall sizes. These cofferdams represent the minimal impact necessary for dewatering of these areas and use materials that pose the least risk of sedimentation and erosion.

Cofferdam 4 is a significant change in approach from the approach presented in the original application. The original proposed cofferdam extended from the unit 7 & 8 powerhouse downstream and then turned back to dike. The selected contractor indicated that this arrangement was challenging, potentially unsafe, provided insufficient work area and insufficient access to get the equipment needed into the construction area. Due to the need for an access road across the Unit 7 & 8 tailrace a sheet pile wall, braced cofferdam and Aquadam were evaluated. The bedrock bottom, dike armoring and the shoreline all presented unique problems for each alternative evaluated. The Aquadam (Cofferdam 4) was selected as the best application to address these challenges. with the least environmental risk and allows for the construction of the temporary access road, which will be comprised of gravel, to be completed and removed in the dry, further minimizing environmental impacts.

### 2.3 FEASIBLE AND PRACTICAL ALTERNATIVE

The Aquadam selected for Cofferdam 4 provides the flexibility to overcome the challenges associated with the other alternatives evaluated and is the most cost effective. The location was selected for safety, to minimize the fill required for the temporary access road, to take advantage of the shoreline slope, shallow water depths at the end of the tailrace and to provide sufficient work area for the construction activities.

## 3 SUPPLEMENTAL MWDCA INFORMATION

### 3.1 FINANCIAL INFORMATION (MWDCA EXHIBIT #4)

The total cost of the Shawmut upstream fish passage facility, including the cost of measures proposed to minimize or prevent adverse environmental effects is $14M. BWPH, owner and licensee for the Shawmut Project No. 2322, has the financial ability to perform the Upstream Fishway Project at the Shawmut Hydroelectric Facility. Work is planned as part of required license and Section 401 WQC conditions at the facility; BWPH annually allocates in excess of $24M for capital expenditures. The funds for this Project, including design and permitting, have been budgeted and approved as part of the 2018, 2019, 2020, and 2021 capital budgets. A Certificate of Good Standing is provided in Appendix A.

### 3.2 PUBLIC SAFETY (MWDCA EXHIBIT #5)

The proposed work will have no adverse impact to public safety as public access to the work area will remain restricted for safety concerns and the majority of work will take place within the project proper. Should any storage areas necessitate occupation of areas outside of the project proper, a temporary 8-foot-high chain link fence with a temporary swing gate will additionally be installed.

## 3.3 TRAFFIC MOVEMENT (MWDCA EXHIBIT #5)

All traffic movement within the Project area will occur over private roads and no adverse impact on existing traffic movement is expected from the proposed activity. BWPH has discussed proposed construction plans with the Town of Fairfield. BWPH is required to apply for Town of Fairfield permits and will coordinate with the Town of Fairfield, as needed, on traffic and public safety measures.

## 3.4 ENVIRONMENTAL IMPACT AND ENERGY CONSIDERATIONS (MWDCA EXHIBIT #5)

### *3.4.1 WATER QUALITY, SOIL STABILITY AND THE NATURAL ENVIRONMENT*

The Kennebec River from the upper reach of the Shawmut impoundment to the Fairfield-Skowhegan town boundary (approximately midway along the Shawmut impoundment) is designated as a Class B water. The Kennebec River from the Fairfield-Skowhegan town boundary to the Shawmut dam is designated as a Class C water. The Kennebec River downstream of the Shawmut dam is designated as a Class B water. Class B and C waters must be of such quality that they are suitable for the designate uses of drinking water after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation; navigation; and as habitat for fish and other aquatic life. The Project operates in accordance with a current water quality certification which was issued on October 14, 1980 and amended on July 31, 1998.

Proposed construction activities are not anticipated to affect water quality. Best Management Practices (BMP's) and the construction Erosion and Sediment Control Plan (submitted to the MDEP on December 31, 2019 and supplemented as provided in Appendix D) will be implemented during project construction to limit any temporary adverse impacts to water quality (sedimentation inputs) and minimum flows will continue to be released downstream via the spillway. The selection of the Aquadam as the appropriate cofferdam for the Unit 7 and 8 tailrace further minimizes environmental impact.

The proposed action does not include a significant change to the licensed quantity or direction of water passed downstream of the dam other than that to be utilized by the fish passage facility for attraction and passage flows. The proposed action is not anticipated to negatively impact water quality, soil stability or the natural environment.

### *3.4.2 FISH AND WILDLIFE*

The Kennebec River supports approximately 50 species of freshwater and diadromous fish species, including cold and warm water angling opportunities for wild and stocked brook trout, landlocked salmon, brown trout, rainbow trout, and smallmouth bass. The lower Kennebec River, including the Shawmut Project waters, supports runs of diadromous fish species, including American shad, blueback herring, alewives, Atlantic salmon, and American eel, as discussed below. Atlantic and shortnose sturgeon also occur in the lower Kennebec River, but no further upstream than the Lockwood Project; so no sturgeon are found in the Shawmut Project area.

Upstream fish passage for Atlantic salmon, American shad, blueback herring, and sea-run alewife in the lower Kennebec River is currently provided through trap-and-truck operations at the Lockwood Project fish lift facility in Waterville, Maine until such time as volitional upstream passage is completed at the Lockwood, Shawmut and Weston Projects as required under the current licenses for these Projects. As such, none of these species are anticipated to be affected by construction activities for the upstream fish lift.

The Atlantic Salmon Gulf of Maine distinct population segment (DPS) is listed as endangered under the Federal Endangered Species Act (ESA). The Kennebec River is identified as Critical Habitat for the Atlantic Salmon Gulf of Maine DPS and Atlantic salmon present in the Kennebec River are listed under the ESA. The Atlantic sturgeon Gulf of Maine DPS is additionally listed as threatened under the ESA (the Atlantic sturgeon New York Bight DPS, Chesapeake Bay DPS, South Atlantic DPS, and Carolina DPS are listed as endangered under the ESA) and the shortnose sturgeon is listed as endangered under the ESA (NOAA Fisheries 2018). There is no critical habitat identified for Atlantic or shortnose sturgeon in the project area. A determination of no or de minimis effects to ESA species was issued by the National Marine Fisheries Service (NMFS) for construction activities for the upstream fish passage facility as part of the US Army Corps of Engineers' Section 404/10 permit.

Throughout construction, prescribed minimum flows will be maintained downstream of the dam and downstream fish passage will be provided via the log sluice. Downstream fish passage facilities will be closed during the construction phase of the work that involves a cofferdam/aquadam in the tailrace of the Unit 7 and 8 powerhouse. Construction activities and operation of the new upstream fishway will not change the normal pond elevation or downstream minimum flows and thus will have no effect on existing aquatic habitat.

The area surrounding the Project on both sides of the river is relatively rural and interspersed with agricultural lands. Common wildlife species inhabit the area including squirrel, deer, skunk, raccoon, muskrat, mice, etc.) and various bird species. The Project boundary encompasses only a small area of habitat outside of the wetted portions of the Project impoundment and tailwater areas; none of which will be affected by construction activities (which are predominantly comprised of in-water work behind cofferdams). Aquatic species are not anticipated to occupy the highly scoured areas of the immediate powerhouse tailraces which are the locations of concentrated construction activity.

According to the USFWS IPAC Report, Atlantic salmon and northern long-eared bat are the only federally protected species that occur, or may occur, in the vicinity of the Project (USFWS 2019). Northern long eared bats are not documented in the Project area. Atlantic salmon occur in the Project area as smolts and kelts during the downstream migration season and Atlantic salmon critical habitat has been designated in the lower Kennebec River, including Project waters and extending upstream to the Sandy River to the vicinity of Madison, Maine. As discussed previously, Section 7 consultation for construction activity effects to listed Atlantic salmon was completed pursuant to the Section 404/10 USACE permit.

#### *3.4.3 HISTORIC AND ARCHAEOLOGICAL RESOURCES*

BWPH consulted with the Maine Historic Preservation Commission (MHPC) State Historic Preservation Officer (SHPO) regarding the construction of the upstream fishway at Shawmut for the Section 404/10 USACE permit. On October 30, 2019, the Project Notification and Information for Project Review for the construction of the upstream fish passage facility for the Shawmut Project was delivered to the Maine Historic Preservation Commission (Appendix B). No comments were received

### *3.4.4 PUBLIC ACCESS AND USE*

The proposed upstream fish passage construction activity may restrict public access and use of the canoe portage facility for times of the project when heavy machinery is being staged from the egress (located just upstream of the intake gate structure). The canoe portage trail may be temporarily closed during these times and signage will be updated to reflect these conditions.

### *3.4.5 FLOOD CONTROL*

The proposed upstream fish passage facility and construction activities will have no effect on the Project's flood flow handling capability. There will be no change in the upstream impoundment elevation of 112 feet USGS. The Project will continue to be able to pass the 100-year flood at the existing level and temporary cofferdams will not impede the Project's ability to pass these flows.

### *3.4.6 HYDROELECTRIC ENERGY BENEFITS*

The Shawmut Upstream Fishway Project will not result in any increase in generating capacity or annual energy output.

# 4 ENVIRONMENTAL MITIGATION (MWDCA EXHIBIT #6)

## 4.1 IN-STREAM EROSION AND SEDIMENTATION CONTROL AND STABILIZATION OF DISTURBED SOILS/SPOILS DISPOSAL AREAS

No significant erosion or sedimentation problems are expected as a result of the proposed improvements; however, to avoid adverse environmental impacts, installation and removal of cofferdams will be scheduled during summer or winter low flows during the designated in water work windows. The Erosion and Sediment Control Plan for the project was submitted previously and has been updated to reflect the installation of cofferdams in the Unit 7 and 8 tailrace (Appendix D).

## 4.2 TEMPORARY OPERATIONAL CHANGES AND MAINTAINING WATER LEVELS AND MINIMUM FLOW RELEASES

During construction, minimum flows will be conveyed via the dam spillway. For safety of workers on the headpond operating boats and on barges, the headpond will be operated approximately 0.5 ft below normal full pond elevation throughout the duration of the project work.

Impoundment drawdowns required for construction activities will not exceed a rate of 1-inch per hour. During periods when downstream flow regulation is necessary to raise the impoundment level, BWPH will follow a 90/10 refill protocol rate: passing 90% of inflow and allowing 10% of inflow to refill the impoundment.

### 4.3 MINIMIZING THE MAGNITUDE AND DURATION OF IN-STREAM ACTIVITY

"Instream activity" will occur in the dry and the work will be purposely scheduled in order to avoid environmentally sensitive time periods, including fish passage season. Construction is proposed within a specific timeframe such that proposed work minimizes the magnitude and duration of in-stream activity.

### 4.4 AVOIDING ENVIRONMENTALLY SENSITIVE AREAS OR TIME PERIODS

The in-water work is proposed to occur during summer low flow conditions in order to avoid peak diadromous fish migration season between July 15 to October 31. In river work cannot be conducted during the downstream smolt migration period – May 1 to June 15. The majority of construction activities will take place in the dry behind the cofferdams.

## 5 PUBLIC NOTICE (EXHIBIT #7)

A copy of the completed public Notice of Intent to File form is attached (Appendix C). This Notice of Intent to File was sent on May 22, 2020 via certified mail to abutting landowners the Town of Fairfield (see Appendix C for Distribution List and certified mail receipts). The Notice of Intent to File was also published in the Morning Sentinel Newspaper, a newspaper circulated in the project area, on May 28, 2020 (see Appendix C for tear proof). The signed Certification of Publication is included in Appendix C.

## 6 TECHNICAL ABILITY (EXHIBIT #8)

BWPH staff has extensive experience overseeing the construction of a number of fish passage facilities, 14 across Maine. Most recently in 2016-2017 Hydro Kennebec was constructed, HK required 20,000 cubic yards of excavation and over 5,000 yards of concrete were placed. The project took over 70,000-man hours to complete.

BWPH operations group trains each year to operate and maintain these facilities trains yearly to operate and maintain these facilities.

# APPENDIX A – CERTIFICATE OF GOOD STANDING

# State of Maine

# Department of the Secretary of State

***I, the Secretary of State of Maine, certify*** *that according to the provisions of the Constitution and Laws of the State of Maine, the Department of the Secretary of State is the legal custodian of the Great Seal of the State of Maine which is hereunto affixed and of the reports of qualification of foreign limited liability companies in this State and annual reports filed by the same.*

***I further certify*** *that BROOKFIELD WHITE PINE HYDRO LLC, formerly FPL ENERGY MAINE HYDRO LLC, a DELAWARE limited liability company, is a duly qualified foreign limited liability company under the laws of the State of Maine and that the application for authority to transact business in this State was filed on April 27, 1998.*

***I further certify*** *that said foreign limited liability company has filed annual reports due to this Department, and that no action is now pending by or on behalf of the State of Maine to forfeit the authority to transact business in this State and that according to the records in the Department of the Secretary of State, said foreign limited liability company is a legally existing limited liability company in good standing under the laws of the State of Maine at the present time.*

***In testimony whereof,*** I have caused the Great Seal of the State of Maine to be hereunto affixed. Given under my hand at Augusta, Maine, this twenty-seventh day of May 2015.

Matthew Dunlap
Secretary of State

# APPENDIX B – MHPC CONSULTATION

**Brookfield**

Brookfield Renewable
150 Main Street
Lewiston, ME 04240

Tel 207.755.5600
Fax 207.755.5655
www.brookfieldrenewable.com

October 28, 2019

**VIA FEDERAL EXPRESS**

Mr. Earle G. Shettleworth
Maine Historic Preservation Commission
65 State House Station
Augusta, ME 04333

Shawmut Hydroelectric Project (FERC No. 2322)
<u>MHPC Project Review</u>

Dear Mr. Shettleworth,

On behalf of Shawmut, LLC (BWPH), Licensee of the Shawmut Hydroelectric Project (Project), BWPH herein files with the Maine Historic Preservation Commission (MHPC) Project Notification and Information for Project Review for the construction of an upstream fish passage facility at the Shawmut Project.

*Project Background:*

The Project is located on the Kennebec River in Kennebec County, Maine (see Attachment A). The Shawmut Project is operated in a run-of-river mode and consists of a 1,135-foot-long 1,135 foot long dam with an average height of about 24 feet, headworks and intake structure, enclosed forebay, and two powerhouses containing eight generating units with a total installed capacity of 8.65 MW; and an impoundment with approximately 4,960 acre-feet gross storage capacity (see Attachment B for Project photos).

On September 16, 1998 the Federal Energy Regulatory Commission (FERC) 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 fish passage requirements. Both the Settlement and WQC stipulate that installation of permanent upstream fish passage at the Project will be triggered by a) increases in numbers of American shad reaching the Lockwood Project (FERC No. 2574) located approximately one mile downstream of the Shawmut Project or b) development of an alternate trigger for fishway installation based on the biological assessment process for Atlantic salmon, alewife, and blueback herring, whichever comes first.

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. To proactively address protection and enhancement of the Atlantic salmon ahead of any pending action before the Commission (such as Project relicensing), BWPH consulted with fisheries agencies and subsequently filed with the FERC an Interim Species Protection Plan for Atlantic Salmon (Interim SPP). Under the FERC approved Interim SPP, BWPH proposes to install a

Brookfield Renewable
150 Main Street
Lewiston, ME 04240

Tel 207.755.5600
Fax 207.755.5655
www.brookfieldrenewable.com

permanent upstream fish passage facility at the Shawmut Project so to provide an unobstructed zone of passage for upstream migration of salmon and other anadromous species.

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. As such, BWPH proposes to install a hopper elevator and flume system to connect the tailrace with the headpond so to provide a zone of passage for upstream migrants and to include a fish ladder connecting the tailraces of the two Project powerhouses. Attachment C depicts the area of project effect. The required construction activities will not physically interact with any known historic properties.

*Project Description*

The permanent upstream fish passage facility at the Project will include a fish lift with integrated attraction water intake and 81-foot-long by 21-foot-high entrance flume and 93-foot-long spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse. The attraction water intake and spillway is designed to divert 340 cfs from the impoundment with 115 to 225 cfs diverted to the fish lift entrance flume and 115 to 225 cfs provided as spill adjacent to the fish lift entrance. An approximately 77-foot-long by 10.5-foot-wide fish ladder will be placed at the upstream end of the island between the two project powerhouses to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway channel with two baffles, a hinged entrance gate, and isolation gates.

*Project Review Request:*

In accordance with Section 106 of the National Historic Preservation Act, appropriate information must be filed with the MHPC for project review. As such, we are providing a USGS topographic quad map for the proposed project (Attachment A), photos of the proposed area of project effect (Attachment B), and engineering drawings depicting the proposed project (Attachment C) for MHPC review. As required by the U.S. Army Corps of Engineers (USACE), a request for review is simultaneously being provided to the appropriate federally recognized Indian tribes.

Should you have any questions regarding this submittal, please contact Gerry Mitchell at 207-755-5614.

Sincerely,

Kelly Maloney

Kelly Maloney
Manager, Compliance - Northeast

Brookfield

Brookfield Renewable
150 Main Street
Lewiston, ME 04240

Tel 207.755.5600
Fax 207.755.5655
www.brookfieldrenewable.com

Cc: Gerry Mitchell, BWPH
Greg Allen, Alden

Attachments: Attachment A - USGS Quad Map
Attachment B - Photographs
Attachment C - Drawings

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**Mr. Earle G. Shettleworth**
Maine Historic Preservation Comm
65 State House Station
AUGUSTA, ME 04333
US

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# APPENDIX C – PUBLIC NOTICE

**NOTICE OF INTENT TO FILE**
**MAINE WATERWAY DEVELOPMENT AND CONSERVATION ACT APPLICATION**

Please take notice that Brookfield White Pine Hydro, LLC (BWPH) (applicant) of 150 Main Street, Lewiston, Maine 04240 (207-522-4147) has filed an application with the Maine Department of Environmental Protection for a permit and Water Quality Certification pursuant to the provisions of the Maine Waterway Development and Conservation Act and the Federal Clean Water Act, Section 401. The application is for the construction of an upstream fish lift (adjacent to the Unit 1-6 powerhouse) with an exit flume to the headpond and a fish ladder (connecting the Unit 7 & 8 and Unit 1-6 powerhouses) at the Shawmut Hydroelectric Project (FERC No. 2322) in the Town of Fairfield, Maine. The application was filed on December 31, 2019 and supplemented on or about May 20, 2020 for public inspection at the DEP's offices in Augusta during normal working hours. A copy of the application may also be seen at the municipal offices in Fairfield, Maine.

A request for a public hearing or a request that the Board of Environmental Protection assume jurisdiction over this application must be received by the Department, in writing, no later than 20 days after the application is found by the Department to be complete and is accepted for processing. Public comment on the application will be accepted throughout the processing of the application.

For Federally licensed, permitted, or funded activities in the Coastal Zone, review of this application shall also constitute the State's consistency review in accordance with the Maine Coastal Program pursuant to Section 307 of the federal Coastal Zone Management Act. Written public comments may be sent to the Department of Environmental Protection, Bureau of Land Resources,17 State House Station, Augusta, Maine 04333

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Clinton, ME 04927

Flood, Sarah
Flood, Dana, Flood, Tim and Flood, Laura
839 River Rd
Clinton, ME 04927

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CHATTANOOGA, TN 37421

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Town of Fairfield, ME

# LOTTERIES

Wednesday, May 27, 2020

**DAY DRAWING**
Pick 3: 7-1-1 Pick 4: 8-8-6-7

**EVENING DRAWING**
Pick 3: 9-5-2 Pick 4: 6-5-6-8

**POWERBALL**
(Saturday drawing)
2-8-18-21-23 PB 16
Power Play x 4

**MEGABUCKS PLUS**
(Wednesday drawing)
3-17-23-35-41 MB 2

**MAINE MEGA MILLIONS**
(Tuesday drawing)
34-52-58-59-62 MB 4
Megaplier x 3

**LOTTO AMERICA**
(Saturday drawing)
29-38-39-49-50 SB 5
All Star Bonus x 4

**LUCKY FOR LIFE**
(Monday drawing)
4-28-31-32-41 LB 2

**GIMME 5**
(Wednesday drawing)
6-8-11-14-18

**WORLD POKER TOUR**
(Tuesday drawing)
5D-KS-JS-9S-3S
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Morning Sentinel
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**CORRECTIONS**
We want our reports to be fair and accurate. To request a correction or clarification, call KJ City Editor Rob Montana at 621-5725, or MS City Editor Greg McManus at 861-9249. Corrections are published on this page.





CORONAVIRUS OUTBREAK

# US surpasses 100,000 deaths

## Nation reaches 'grim milestone' in less than four months

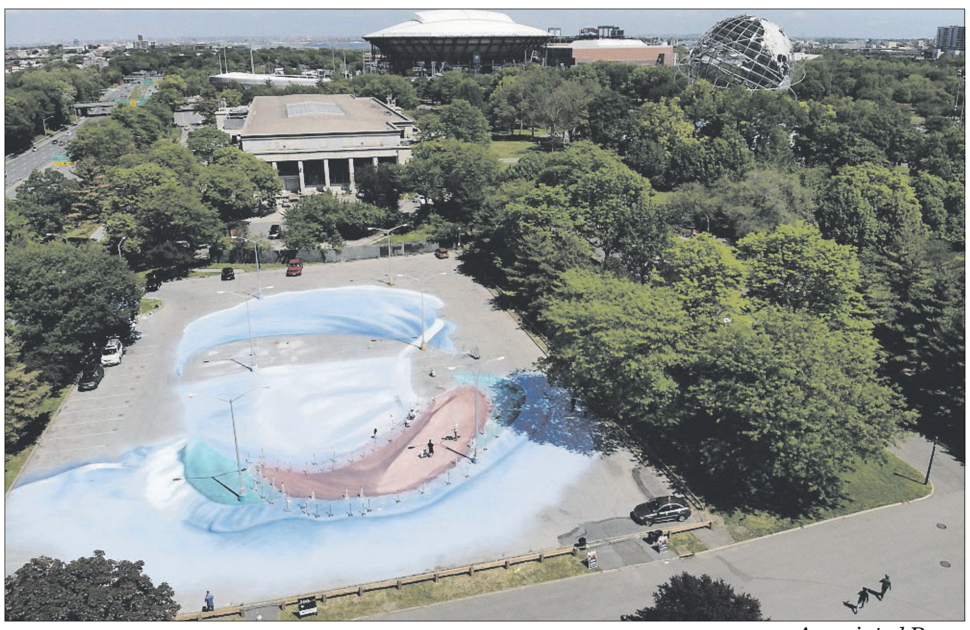
**BY THE ASSOCIATED PRESS**

HARTFORD, Conn. — The U.S. surpassed a jarring milestone Wednesday in the coronavirus pandemic: 100,000 deaths.

That number is the best estimate and most assuredly an undercount. But it represents the stark reality that more Americans have died from the virus than from the Vietnam and Korea wars combined.

"It is a grim milestone," said Josh Michaud, associate director of global health policy with the Kaiser Family Foundation in Washington. "It's a striking reminder of how dangerous this virus can be."

Worldwide, the virus has infected more than 5.6 million people and killed over 350,000, with the U.S. having the most confirmed cases and deaths by far, according to a tally by Johns Hopkins University. Europe has recorded about 170,000 deaths, while the U.S. reached more than 100,000 in less than four months.



*Associated Press*
Artist Jorge Rodriguez-Gerada works on a 20,000-square-foot mural Wednesday of a health-care worker near the Queens Museum, back left, and the USTA Billie Jean King National Tennis Center, back center, in the Queens borough of New York.

The true death toll from the virus, which emerged in China late last year and was first reported in the U.S. in January, is widely believed to be significantly higher, with experts saying many victims died of COVID-19 without ever being tested for it.

At the end of March, the United States eclipsed China with 3,500 deaths. Now, the U.S. has not only the highest death total, but the highest number of confirmed cases of COVID-19 in the world, making up more than 30% of the global total.

Early on, President Donald Trump downplayed the severity of the coronavirus and called it no worse than the common flu. He previously predicted the country wouldn't reach this death toll. As early as March, Dr. Anthony Fauci, the government's top infectious disease expert, was warning that COVID-19 could claim more than 100,000 lives in the U.S.

"I think we'll be substantially under that number," Trump said on April 10. Ten days later, he said, "We're going toward 50- or 60,000 people." Ten days after that: "We're probably heading to 60,000, 70,000."

Critics have said deaths spiked because Trump was slow to respond, but he has contended on Twitter that it could have been 20 times higher without his actions. He has urged states to reopen their economies after months of stay-at-home restrictions.

The virus exacted an especially vicious toll on Trump's hometown of New York City and its surrounding suburbs, killing more than 21,000. At the peak, hundreds of people were dying per day in New York City, and hospitals, ambulances and first responders were inundated with patients.

The densely packed New York metropolitan area, consisting of about 20 million people across a region that encompasses the city's northern suburbs, Long Island and northern New Jersey, has been the hardest-hit corner of the country, accounting for at least one-third of the nation's deaths.

*Associated Press*
A man rides a bicycle while holding an umbrella Wednesday as rain from Tropical Storm Bertha floods a few streets in Charleston, S.C.

TROPICAL STORM BERTHA

# Quick-moving storm surprises South Carolina

**BY JEFFREY COLLINS**
*Associated Press*

COLUMBIA, S.C. — Tropical Storm Bertha surprised the South Carolina coast Wednesday, forming and making landfall within two hours, bringing a poor beach day of rain and gusty winds, but no major problems.

Forecasters expected the bad weather, but didn't predict it to organize so quickly and become the second named storm before the official start of this year's Atlantic hurricane season.

Bertha was named around 8 a.m. Wednesday and was onshore east of Charleston by 9:30 a.m. The state Department of Natural Resources called it "a sunrise surprise." Six hours after the tropical storm formed, the National Hurricane Center downgraded it to a depression well inland.

Like almost all storms with heavy rain, several streets flooded in Charleston, leaving ankle to calf high brown water mixed with trash from knocked over cans Wednesday. Sea rise and an antiquated drainage system mean the city floods an average of more than once a week. Heavy rains from an unnamed storm last week caused more problems.

Less than 1,000 power outages and scattered downed trees were reported as Bertha and its 50 mph (80 kph) maximum sustained winds moved onshore and into eastern South Carolina.

Bertha moved rapidly inland, spreading up to 4 inches of rain into parts of North Carolina and Virginia. Flash flood watches were issued as the region has already seen plenty of rain in May.

The storm was centered about 65 miles north-northwest of Charleston, South Carolina, and was moving north-northwest near 15 mph.

# Trump threatens social media after fact-check

## Tech giants 'silence conservative voices,' he claims

**BY ZEKE MILLER**
*Associated Press*

WASHINGTON — President Donald Trump, the historically prolific tweeter of political barbs and blasts, threatened social media companies with new regulation or even shuttering on Wednesday after Twitter added fact checks to two of his tweets. He turned to his Twitter account — where else? — to tweet his threats.

The president can't unilaterally regulate or close the companies, and any effort would likely require action by Congress. His administration has shelved a proposed executive order empowering the Federal Communications Commission to regulate technology companies, citing concerns it wouldn't pass legal muster. But that didn't stop Trump from angrily issuing strong warnings.

Tech giants "silence conservative voices," he claimed on Twitter early Wednesday. "We will strongly regulate, or close them down, before we can ever allow this to happen." Later, also on Twitter, he threatened, "Big Action to follow."

He repeated his unsubstantiated claim — which sparked his latest showdown with Silicon Valley — that expanding mail-in voting "would be a free for all on cheating, forgery and the theft of Ballots."

There was no immediate reaction from Twitter or other social media companies to

*Associated Press*
President Donald Trump and first lady Melania Trump walk Wednesday on the South Lawn of the White House.

the president's threats.

Twitter's decision to mark the president's tweets regarding mail-in balloting came as the president was sparking another social media firestorm, continuing to stoke a debunked conspiracy theory accusing MSNBC host Joe Scarborough of killing a former staffer. Prominent Republicans, including Rep. Liz Cheney and Sen. Mitt Romney, urged Trump to drop the attack.

Trump and his campaign had lashed out at the company Tuesday after Twitter added a warning phrase to two Trump tweets that called mail-in ballots "fraudulent" and predicted that "mail boxes will be robbed," among other things. Under the tweets, there is now a link reading "Get the facts about mail-in ballots" that guides users to a Twitter "moments" page with fact checks and news stories about Trump's unsubstantiated claims.

**CERTIFICATION OF PUBLICATION**

By signing below, the applicant (or authorized agent) certifies that he or she has:

1. Published a Notice of Intent to File once in a newspaper circulated in the area where the project site is located, within 30 days prior to filing the application;

2. Sent a completed copy of the Notice of Intent to File by certified mail or Certificate of Mailing to abutters, as determined by local tax records or other means, within 30 days prior to filing the application; and

3. Sent a copy of the Notice of Intent to File by certified mail or Certificate of Mailing and filed a duplicate of this application with the town clerk of the municipality(ies) where the project is located, within 30 days prior to filing the application.

Kelly Maloney

Signature

May 19,2020

Date

Kelly Maloney

Name

Manager, Compliance -Northeast

Title

# APPENDIX D – REVISED EROSION AND SEDIMENT CONTROL PLAN

**P-2322 Shawmut Hydroelectric**
**Soil Erosion and Sediment Control Plan**

## Project Description

Shawmut, LLC (BWPH), Licensee of the Shawmut Hydroelectric Project (Project) submits the following Soil Erosion and Sediment Control Plan for the construction of permanent upstream fish passage facility at the Project that will include a fish lift with integrated attraction water intake and 81-foot-long by 21-foot-high entrance flume and 93-foot-long spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse. The attraction water intake and spillway is designed to divert 340 cfs from the impoundment with 115 to 225 cfs diverted to the fish lift entrance flume and 115 to 225 cfs provided as spill adjacent to the fish lift entrance. An approximately 77-foot-long by 10.5-foot-wide fish ladder will be placed at the upstream end of the island between the two project powerhouses to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway channel with two baffles, entrance flap gate, and isolation gates.

## Plan Details

As indicated on the attached plan, the perimeter of any area of permanent or temporary construction activity will be protected by the measures shown or equivalent protection as chosen by the contractor. In addition, the perimeter of the site that abuts the river will be staked with hay bales to prevent sediment migration.

Four cofferdams will be utilized in the construction of the upstream fish passage at Shawmut. A cofferdam for the attraction water intake (Cofferdam 1) will be a sheet pile bulkhead 31 ft wide extending 5 ft upstream into the impoundment with a top elevation of 115 ft located on the upstream face of the non-overflow dam section. . This cofferdam will cover 82 square feet and 125 cubic yards of temporary fill will be placed.

The cofferdam utilized to dewater the fish lift area between the Unit 1-6 powerhouse and spillway (Cofferdam 2) is a braced cofferdam consisting of steel supports and stop logs. The cofferdam will run 45 ft from the spillway turning parallel to the powerhouse for 45 ft and turning perpendicular to the powerhouse 65 ft with a top elevation of 94 ft. This cofferdam will cover 254 square feet and 385 cubic yards of temporary fill will be placed.

The cofferdam from the Unit 1-6 powerhouse to the isolation wall dike (Cofferdam 3) at the Unit 7&8 tailrace is a braced cofferdam consisting of steel supports and stop logs for depths greater than 4 ft and sand bags for depth under 4 ft. The braced coffer dam and sand bags will run from the southwest end of the Unit 1-6 powerhouse to the dike with a top elevation of 92 ft. This cofferdam will cover 160 square feet and 400 cubic yards of temporary fill will be placed.

The Unit 7 & 8 powerhouse tailrace Aquadam (Cofferdam 4) will be located about halfway down the dike from the Unit 7 & 8 powerhouse across the tailrace with a top elevation of 96 ft. The Aquadam will remain in place for the duration of the temporary access road. Upstream of the Aquadam a temporary access road or 2600 cubic yards will be placed from the southwest shoreline to the dike with a top elevation of 92 ft. The Aquadam cofferdam will cover 3500 square feet and the temporary access road will cover 11,915 square feet and 2,600 cubic yards of temporary fill will be placed but will be constructed and removed entirely in the dry behind the Aquadam cofferdam.

An earthen filled sheet pile cell for barge loading and offloading will be located upstream of the project on the western shore. The sheet pile cell will be 30 ft. wide by 40 ft. long and earthen filled. The cell will contain 2,200 CY and impact 1,200 sqft of area.

It will be the contractor's responsibility to design the coffer dam and soil erosion and sediment control to meet their access and construction sequencing needs, to meet OSHA safety standards, State of Maine and International Building codes, and any other applicable regulations.

Erosion control will be installed around all disturbed land and staging areas. Suspended turbidity curtains will surround all cofferdams. Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river.


DWG: S:\200 Projects\131009\Holden\SHAWMUT\(Current)\900 CAD\02-SHEETS\G\G-006.dwg USER: jjenkins
DATE: Apr 15, 2020 8:57am XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

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TEL: (508) 829-6000 www.aldenlab.com

| REVISION | DESCRIPTION OF ISSUE / REVISION | REVISED BY |
|---|---|---|
| 1 | FINAL FOR CONSTRUCTION | M. GRAESER |
| 12/13/2019 | FINAL FOR BID - NOT FOR CONSTRUCTION | M. GRAESER |

STATE OF MAINE — MARK DANIEL GRAESER No. 39328 LICENSED PROFESSIONAL ENGINEER 4/10/2020

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 179
DRAWING: G-006

# APPENDIX E – COFFERDAMS PLANS AND SPECIFICATIONS

BANCROFT Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 004

Contract/Project No. TBD

Attn: Gerry Mitchell

BCC Job No. 2002036

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Upstream Attraction Water Intake Bulkhead |

______________________
Supplier

Bancroft Contracting Corp.
Subcontractor

Stamp

Remarks: Clarification letter has been included to address Alden's comments. This submission is for informational purposes only.

Submitted by: Peter Poor (Name) — Peter Poor (Signature) — 4/23/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks: ______________________

Reviewed by: ______ Name ______ Signature ______ Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

April 23, 2020

Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Attention: Gerry Mitchell

Reference: Shawmut Attraction Water Intake Bulkhead Clarifications

Mr. Mitchell,

Our responses to comments posed by Alden Labs regarding the above referenced cofferdam design are as follows:

1.) Sheet 1 (Headpond 10 Yr Flood vs. Design Elev.)
    a. If the head pond level reaches El. 115.50', the downstream braced cofferdam would already be overtopped as it is not designed to the 10 year flood level (Tailwater 10 year = El. 100.0'/DS Cofferdam Design = El. 94.0').

2.) Sheet 2 (I.A. & I.B. - Sheet pile Shape & Properties Corrections)
    a. The original sheet pile shape options provided the correct section modulus per foot, but labeled the shape incorrectly (AZ13-770, Sx = 23.2 in3/ft). This has been revised to show the correct section modulus and corresponding shape to align with our installation sketch (AZ12-770, Sx = 23.2 in3/ft). This has been corrected for the Hydrostatic Pressure and Tremie Pressure.

3.) Sheet 5 (III.B. - Connections)
    a. We understand the required depth of embedment per Hilti Design Report B to be a minimum requirement (13.5") and felt there was no harm in specifying a greater embedment for installation (16").

4.) Sheet 6 (IV – Tremie Uplift)
    a. We did not consider additional forces opposing uplift (weight of structural steel, shear capacity of anchors) and are comfortable if the unit weight of concrete is reduced to 0.140 k/ft3 to reflect an unreinforced unit weight.

5.) Sheet 13 (VI – Sketches)
    a. Details for stiffener-to-beam and beam-to-beam welded connections have been included as Rev. 1

If you have any questions or require additional information, please feel free to contact me at any time.

Regards,

Bancroft Contracting Corp.

Peter Poor
Project Manager
o. (207) 743-8946
c. (207) 890-7317
ppoor@bancroftcontracting.com

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636


## Shawmut Upstream Bulkhead
## April 10, 2020

Reviewed By: Roger Gagnon – Gagnon Engineering

STATE OF MAINE
ROGER R. GAGNON
No. 3409
LICENSED
PROFESSIONAL ENGINEER

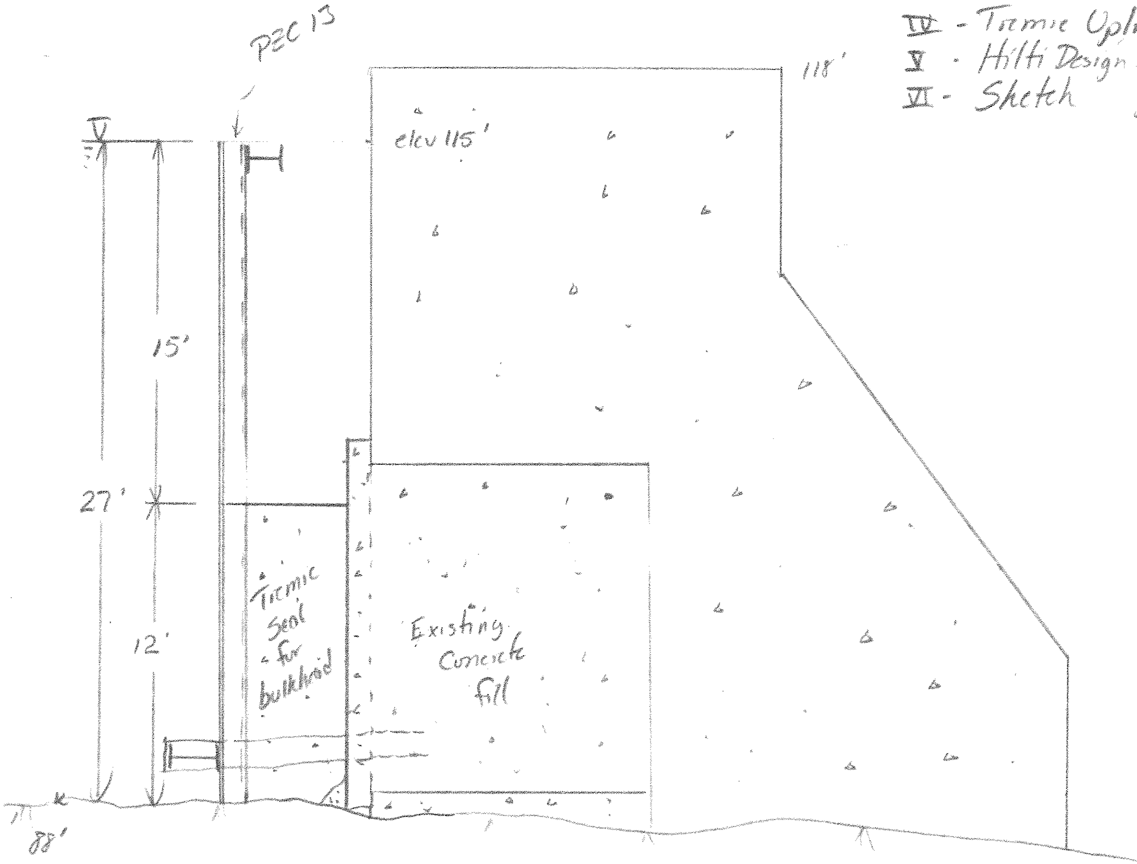
April 13, 2020
(13 Pages Total)

Garrick A. Frost
Bancroft Contracting Corp
April 7, 2020

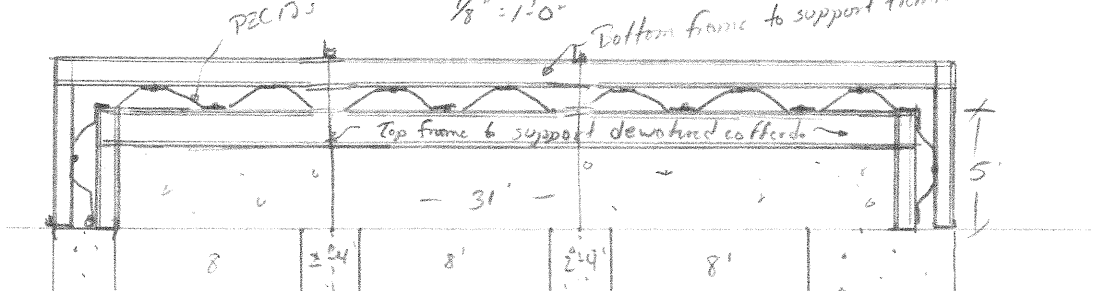
# Upstream Bulkhead

Given: The following Sketch
Fy = 50 ksi (sheets and beams)
Hilti Hit RE500 V3 Epoxy

Find: Design Cofferdam
1 - Design Sheets pg 2
II - Design Waler pgs 3 and 4
III - Connections pg 5 and 6
IV - Tremie Uplift pg 6
V - Hilti Design Reports pg 7-12
VI - Sketch pg 13



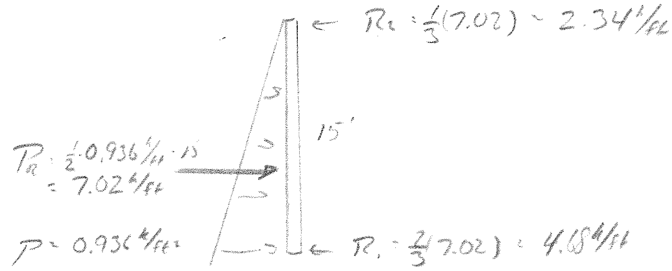

section view
1/8" = 1'-0"




Plan View
1/8" = 1'-0"

## I. Design Sheets

### A) For Hydrostatic Pressure




$M_{max} = 0.1283\,wl = 0.1283(7.02)15 = 13.5$ ft·kip/wft

$M_{allow} = F_b \cdot S_x = 0.6(50^{ksi}) \cdot S_x = 13.5$ ft·k/wft

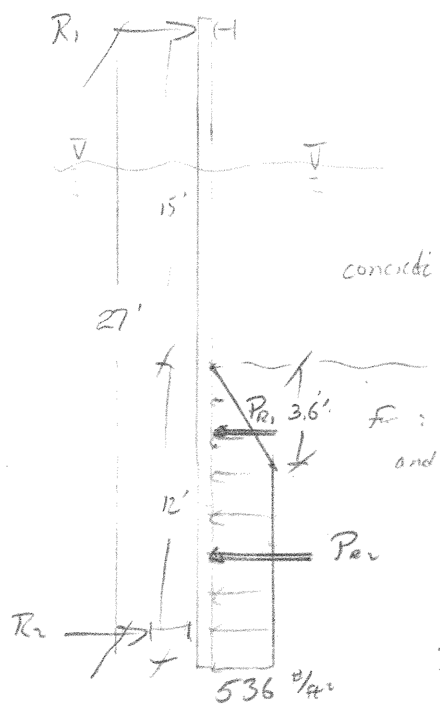
$S_x = 5.4$ in³/wft

4/23/2020 PJP

~~∴ use AZ13-770 $S_x = 23.2$ in³/wft~~
~~PZC13 $S_x$ $S_x = 25.8$ in³/wft~~

USE AZ12-770 $S_x = 23.2$ IN³/FT
4/23/2020
PJP

### B) For Tremie Pressure




concrete underwater = 150#/ft³ − 62.4#/ft³ = 87.6 #/ft³

For: T ≥ 70°F
and: Placement Rate = 3/hr

$P_{max} = 536$ #/sf per ACI SP4 pg 5-12

$P_{max}$ submerged $= 536$ #/sf $\left(\frac{87.6}{150}\right) = 313$ #/sf

$P_{R2} = 313$ #/ft × 8.4 = 2.6 k/ft

$P_{R1} = \frac{1}{2} \cdot 313$ #/ft × 3.6' = 0.6 k/ft

$27R_2 = 0.6^k\left(15 + \frac{2}{3}(3.6)\right) + 2.6^k\left(15 + 3.6 + \frac{1}{2}(8.4)\right)$

$R_2 = 2.6$ k/ft

$R_1 = 0.6$ k/ft

$M_{max}$ @ V = 0

V = 0 @ $P_{R1}$   $R_1 - P_{R1} = 0$

$M_{max} = 0.6\left(15 + \frac{2}{3}(3.6)\right) - \frac{1}{2}\left(0.313^{k/ft}\,\frac{2}{3}(3.6)\right)\frac{2}{3}(3.6)$

$= 9.5$ ft·kip $= 0.6(50)\,S_x$   $S_x = 3.8$

4/23/2020 PJP

~~AZ12-770 $S_x = 23.2$ in³/ft~~
~~PZC13 $S_x = 24.2$ in³/ft~~
~~∴ use~~

4/23/2020
PJP

USE AZ12-770 $S_x = 23.2$ IN³/FT

## II - Design Walers

→ A) Top Waler

$W_{max} = 2.34^{k}/ft$ (during dewatered state)

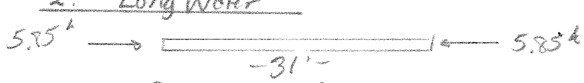
$M_{max} = \frac{wl^2}{8} = \frac{2.34(31)^2}{8} = 281.1$ ft·kips - long waler -

$R_1 = R_2 = \frac{wl}{2} = \frac{2.34(31)}{2} = 36.3^{kips}$ - long waler -

$M_{max} = \frac{wl^2}{8} = \frac{2.34(5)^2}{8} = 7.31^{ft\cdot kip}$ - short return waler -

$R_1 = R_2 = \frac{wl}{2} = \frac{2.34(5)}{2} = 5.85^{kips}$ - short return waler -

1. ~ Long Waler




$M = 281.1^{kip}$

Bolt Sheets to top waler

$M_{Allow} = 0.66 F_b S_x = 0.66(50^{ksi}) S_x = 281.1$ ft·k

$S_x = 102.2 \; in^3$

$\Delta_{Allow} = \frac{span}{240} = \frac{31 \cdot 12}{240} = 1.55^{in} = \frac{5wl^4}{384EI} = \frac{5(2.34)(31)^4 12^3}{384(29000)I}$

$I = 1081.72$

use interaction eqn and try W16×77

$f_a = \frac{P}{A} = \frac{5.85}{22.6 \; in^2} = 0.26$ ksi

$F_a$ is a function of $\frac{Kl}{r_y} = \frac{(1.0)(31 \cdot 12)}{2.47} = 150.6$

given $\frac{Kl}{r_y} = 150.6$ $F_a = 6.50^{ksi}$ per table C-50 AISC 9th ed

$\frac{f_a}{F_a} = \frac{0.26}{6.50} = 0.04 < 0.15$ ∴ use eqn H1-3

$f_{bx} = \frac{M_x}{S_x} = \frac{281.1 \; ft\cdot kip}{134 \; in^3} = 25.2^{ksi}$

$F_{bx} = 0.66(50^{ksi}) = 33^{ksi}$

eqn H1-3 $\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \leq 1.0$

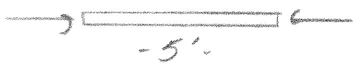
$0.04 + \frac{25.2}{33} + 0 \leq 1.0$

$0.80 \leq 1.0$

ok

∴ use W16×77

2 - Short Return Waler




$P = 36.3^k$ $\quad M = 7.31$ ft·kip

Use Interaction eqn and try W10×49

$f_a = \frac{P}{A} = \frac{36.3}{14.4 in^2} = 2.52\ k/in^2$

$F_a$ is a function of $\frac{Kl}{r_y} = \frac{(1.0)60''}{2.54} = 23.62$

from table C-50 by interpolation $F_a = 20.37$ ksi

$\frac{f_a}{F_a} = \frac{2.52\ k/in^2}{20.37\ k/in^2} = 0.12 < 0.15$ ∴ use eqn H1-3

eqn H1-3 $\quad \frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \leq 1.0$

$f_{bx} = \frac{M_x}{S_x} = \frac{7.31\ ft\cdot kip}{54.6} = 1.61$ ksi

$F_{bx} = 0.66(50) = 33$ ksi

$\frac{1.61\ ksi}{33\ ksi} = 0.05$

eqn H1-3 may be rewritten as $0.12 + 0.05 + 0 \leq 1.0$

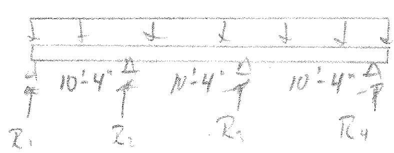
$0.17 \leq 1.0$

ok

**∴ use W10×49**

⟹ B) Bottom Waler

$W_{max} = 2.6$ k/ft (during tremie placement)




$M_{max} = 0.1\,wl^2 = 0.1(2.6)(10'\text{-}4")^2$
$= 27.8$ ft·kip

$R_1 = R_4 = \frac{4}{10}(2.6\ k/ft)\,10'\text{-}4" = 10.7$ kips

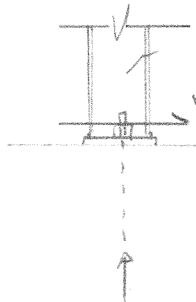
$R_2 = R_3 = \frac{6}{10}(2.6\ k/ft)\,10'\text{-}3" + \frac{5}{10}(2.6)\,10'\text{-}3" =$
$= 29.3$ kips

given the loading condition $M_{max} = 27.8$ ft·kip
$l_b = 10'\text{-}4"$

**use W8×28** $\quad M_{allow} = 60.75 > 27.8$ ft·kip
for $l_b = 10'\text{-}4"$ (per AISC 9th ed pg 2-209)

## III - Connections

### ⟹ A) Top Frame




$V = 5.85^k \times 1.7 = 9.9$ kip (Factored Shear Load)

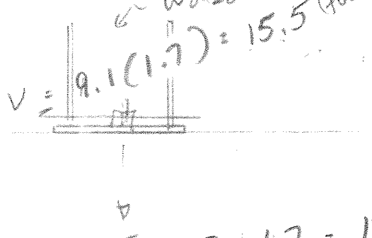
$P = 36.3$ kip

| use 2ea. Kwik Bolt TZ - CS 3/4"Ø w/ min 4 3/4" embedment |

* see hilti design report "A"

### ⟹ B) Bottom Frame

1. End Reactions




$V = 9.1(1.7) = 15.5$ (factored load)

$V = \frac{w\ell}{2} \cdot \frac{2.6 (7' \text{ strut length})}{2} = 9.1$

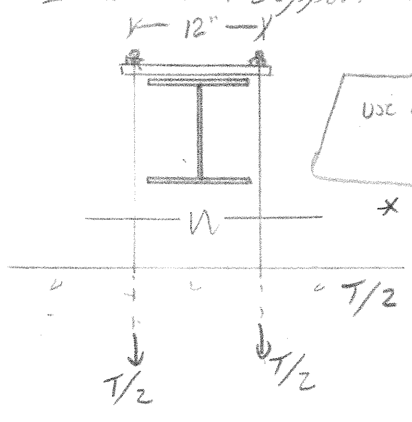
$T = 10.7$

$T = 10.7 \times 1.7 = 18.2$ kip (factored load)

| use 2ea. Hilti Hit RE500V3 + HAS-EB7 7/8"Ø rod w/ 16" embed |

* See Hilti Design Report "B"

2. Intermediate Support Reactions




| use 2ea. Hilti Hit RE500V3 + HAS-EB7 1"Ø rod w/ 18" embedment |

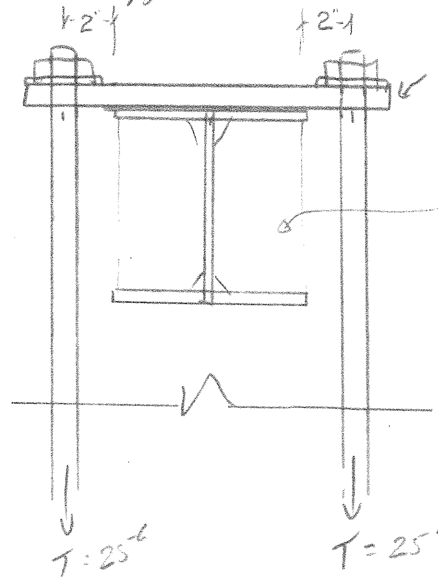
* see Hilti Design Report "C"

$T/2 = \frac{29.3}{2} = 14.7$ k/bolt $\times 1.7 = 25.0$ k/bolt

$T_{combined} = 50$ kips

2. Intermediate Support Reaction

=> a. Rod Supports over beam




$M_{max} = 25^k \times 2" = 4.167$ in-kip

$M_{allow} = 0.66 F_b \cdot S_x = 0.66(36^{ksi}) S_x = 4.167$ in-kip

$S_x = 0.175 \text{ in}^3$

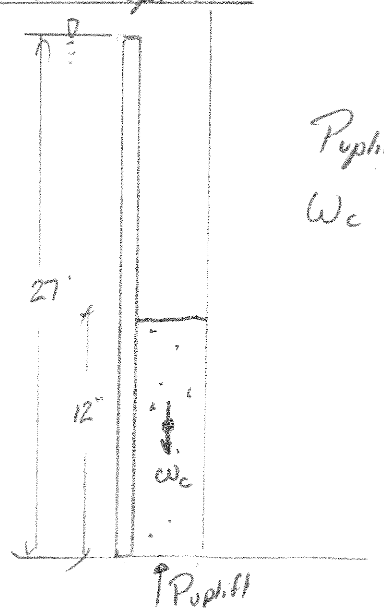
for 4" wide plate, determine req'd thickness t

$0.175 \text{ in}^3 = \frac{bd^2}{6} = \frac{3" \cdot d^2}{6}$

$d = 0.59$ in

**use 3/4" thick plate**

## IV - Tremie Uplift




$P_{uplift} = 0.0624^k/ft^3 \times 27' = 1.68^k/ft^2$

$\omega_c = 0.150^k/ft^3 \times 12' = 1.80^k/ft^2$

$\omega_c > P_{uplift}$

**ok**

V - Hilti Design Reports

Report "A"

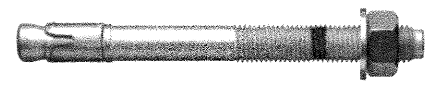
(7/13)



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Top Waler Connection |
| Phone I Fax: | \| | Date: | 4/9/2020 |
| E-Mail: | | | |

**Specifier's comments:** End Reactions

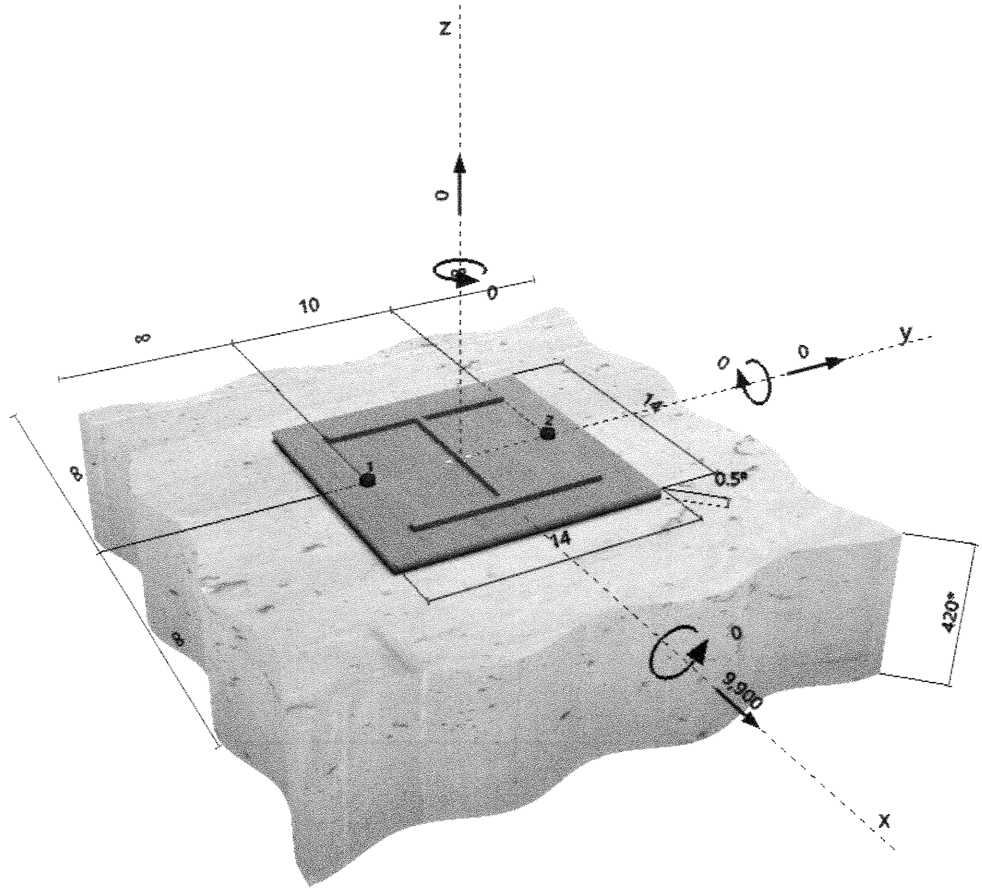
## 1 Input data



| | |
|---|---|
| **Anchor type and diameter:** | **Kwik Bolt TZ - CS 3/4 (4 3/4)** |
| Return period (service life in years): | 50 |
| Effective embedment depth: | $h_{ef}$ = 4.750 in., $h_{nom}$ = 5.563 in. |
| Material: | Carbon Steel |
| Evaluation Service Report: | ESR-1917 |
| Issued I Valid: | 5/1/2019 \| 5/1/2021 |
| Proof: | Design method ACI 318 / AC193 |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 14.000 in. x 14.000 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W10X49; (L x W x T x FT) = 9.980 in. x 10.000 in. x 0.340 in. x 0.560 in. |
| Base material: | uncracked concrete, 3000, $f_c'$ = 3,000 psi; h = 420.000 in. |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: >= No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 2 |
| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Top Waler Connection |
| Phone I Fax: | \| | Date: | 4/9/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| **Loading** | **Proof** | **Load** | **Capacity** | **$\beta_N$ / $\beta_V$ [%]** | **Status** |
| Tension | - | - | - | - / - | - |
| Shear | Steel Strength | 4,950 | 8,888 | - / 56 | OK |

| **Loading** | **$\beta_N$** | **$\beta_V$** | **$\zeta$** | **Utilization $\beta_{N,V}$ [%]** | **Status** |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

| | | | |
|---|---|---|---|
| Company: | | Page: | 1 |
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| Address: | | Sub-Project I Pos. No.: | Bot. Waler Connection |
| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

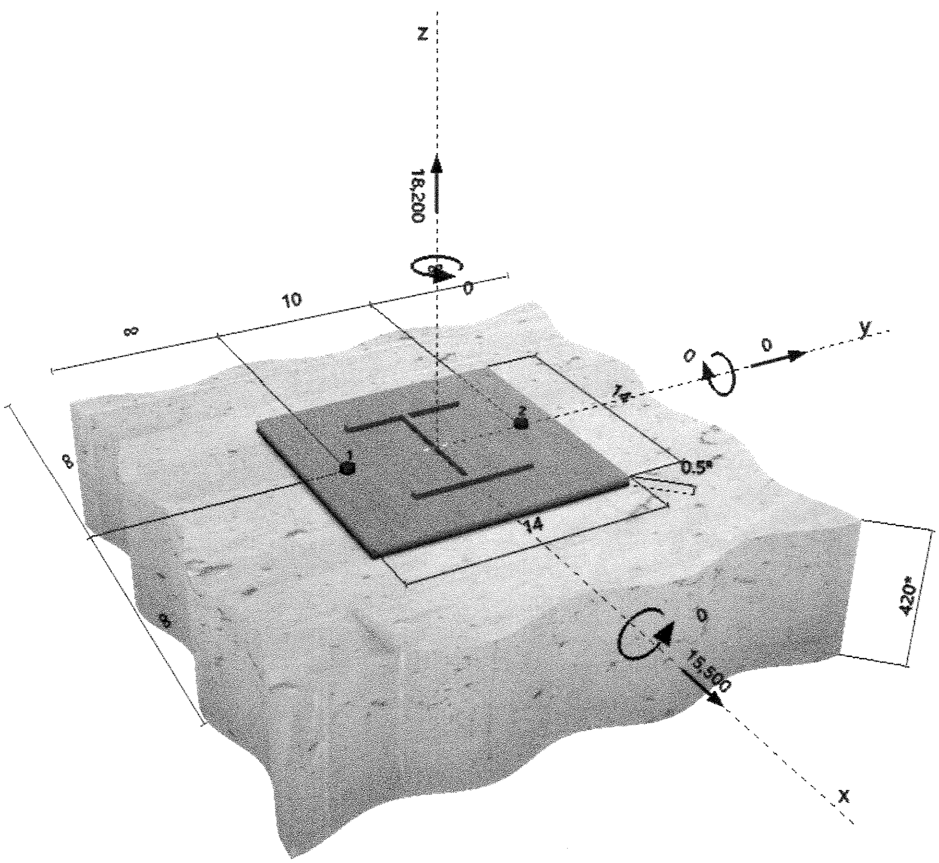
**Specifier's comments:** End Reactions from tremie placement

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 HDG 3/4** |
| Return period (service life in years): | 50 |
| Effective embedment depth: | $h_{ef,act}$ = 13.500 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 14.000 in. x 14.000 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W8X28; (L x W x T x FT) = 8.060 in. x 6.540 in. x 0.285 in. x 0.465 in. |
| Base material: | uncracked concrete, 3000, $f_c'$ = 3,000 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | Bond Strength | 18,200 | 33,723 | 54 / - | OK |
| Shear | Steel Strength | 7,750 | 16,305 | - / 48 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | 0.540 | 0.475 | 5/3 | 65 | OK |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

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- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
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| Address: | | Sub-Project I Pos. No.: | Bot. Waler Connection |
| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

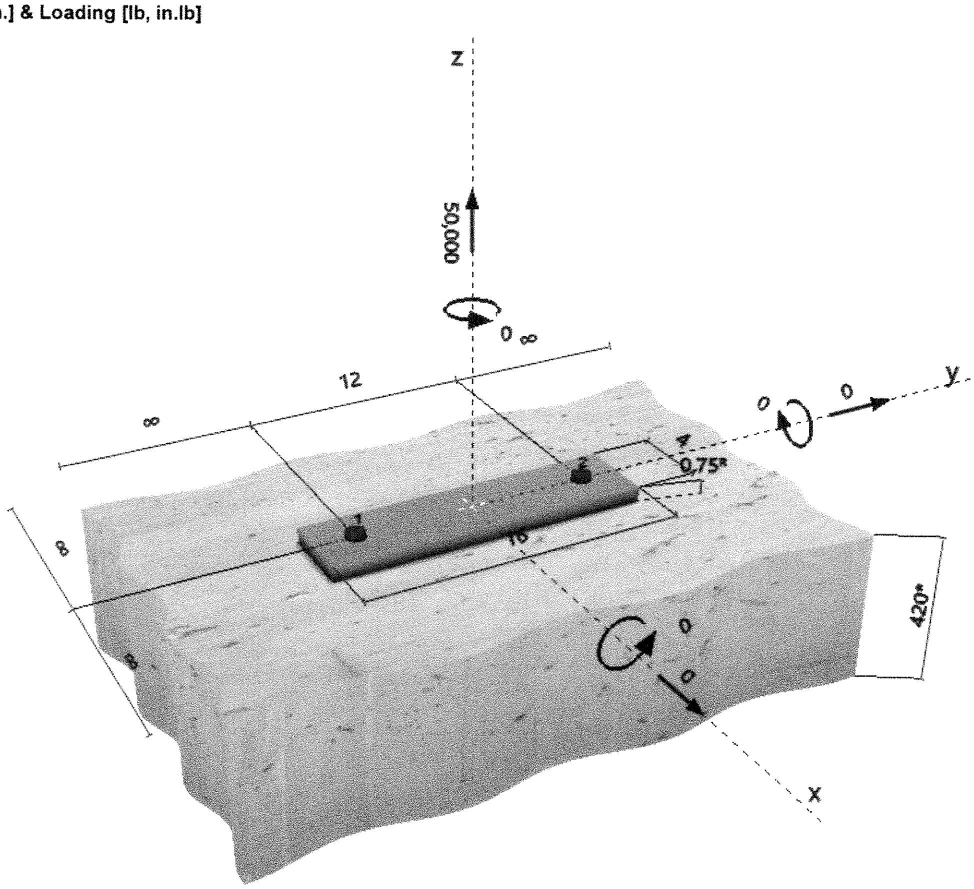
**Specifier's comments:** End Reactions

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1** |
| Return period (service life in years): | 50 |
| Effective embedment depth: | $h_{ef,act}$ = 18.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.750 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 4.000 in. x 16.000 in. x 0.750 in.; (Recommended plate thickness: not calculated |
| Profile: | no profile |
| Base material: | uncracked concrete, 3000, $f_c'$ = 3,000 psi; h = 420.000 in., Temp. short/long: 60/40 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: >= No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 2 |
| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Bot. Waler Connection |
| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | Bond Strength | 50,000 | 55,750 | 90 / - | OK |
| Shear | - | - | - | - / - | - |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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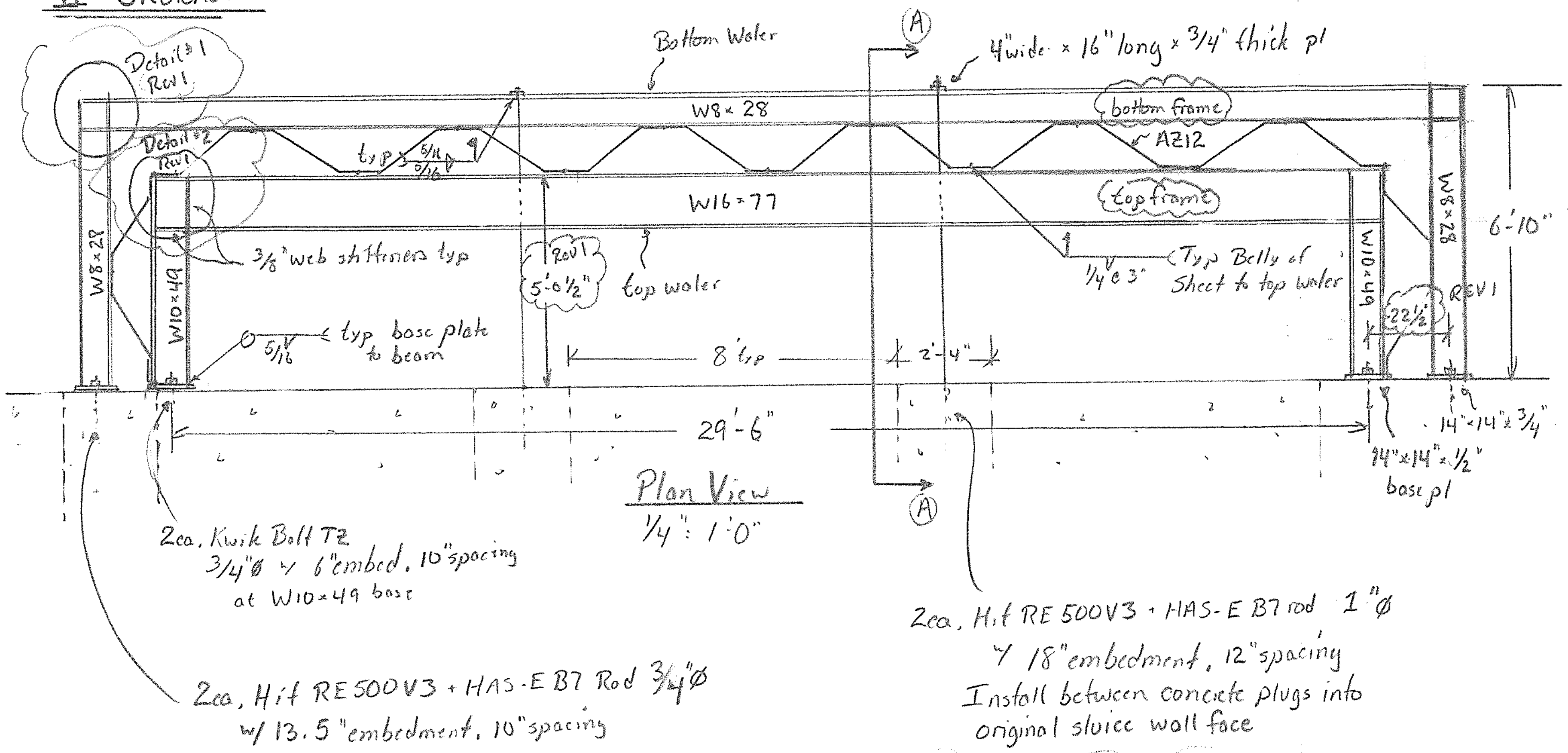
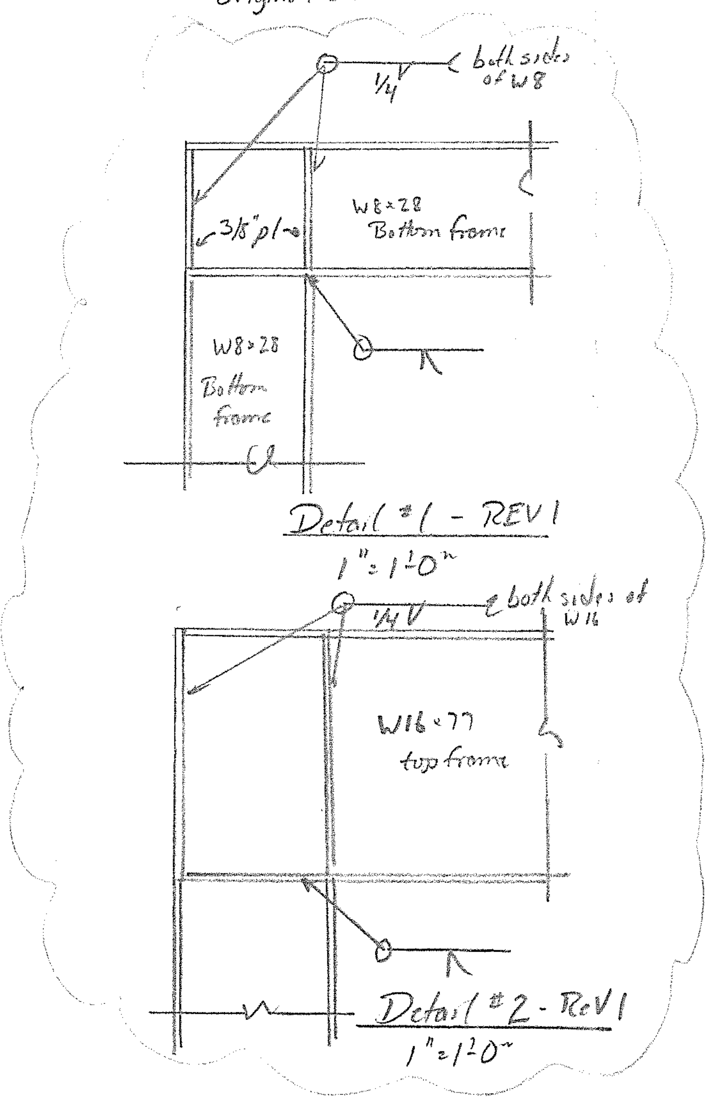
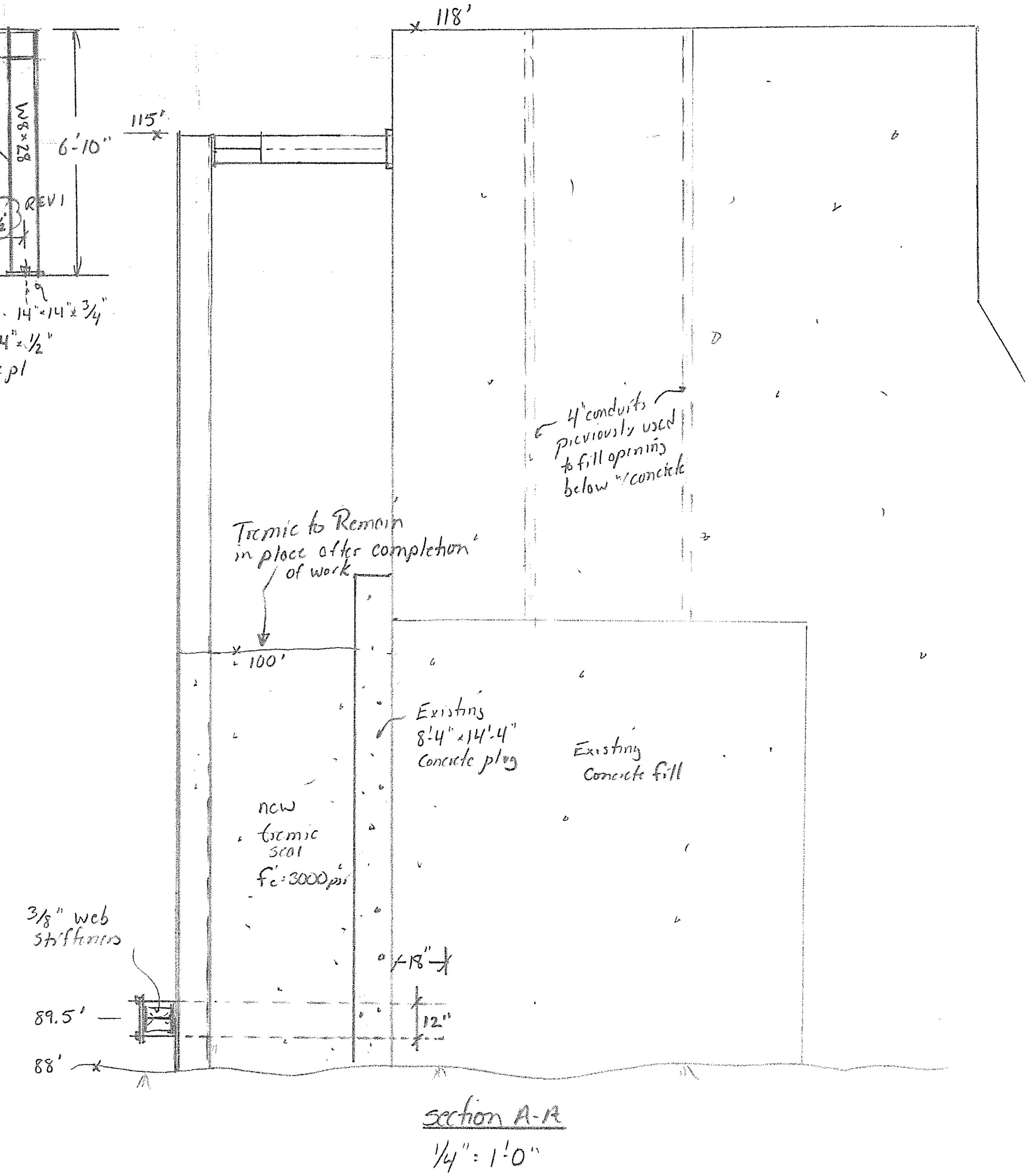
## VI- Sketches




Shawmut Upstream Bulkhead

Bancroft Contracting Corporation

April 10, 2020

Rev#1 - April 22nd

BANCROFT
Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 005

Contract/Project No. TBD

Attn: Gerry Mitchell

BCC Job No. 2002036

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Unit 1-6 Powerhouse to Dike Downstream Cofferdam |

Stamp

______________________
Supplier

Bancroft Contracting Corp.
Subcontractor

Remarks: Clarification letter has been included to address Alden's comments. This submission is for informational purposes only.

Submitted by: Peter Poor (Name) — *Peter Poor* (Signature) — 4/23/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks: ______________________

Reviewed by: ______ Name ______ Signature ______ Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

April 23, 2020

Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Attention: Gerry Mitchell

Reference: Shawmut Unit 1-6 to Dike Braced Cofferdam Clarifications

Mr. Mitchell,

Our responses to comments posed by Alden Labs regarding the above referenced cofferdam design are as follows:

1.) Sheet 1 (Tailwater 10 Yr Flood vs. Design Elev.)
    a. Our decision to propose a design elevation of El. 92.0' was based on a June-December work schedule where, based on historical data, flows required to raise tailwater elevation to El. 92.0' or above occurs 0%-4% of the time. We intend to have most work at ledge elevation complete prior to months that historically have increased flows (October and November).

2.) Sheet 14 (Sketches)
    a. Depth of sandbags revised to 4 ft.

If you have any questions or require additional information, please feel free to contact me at any time.

Regards,

Bancroft Contracting Corp.

Peter Poor
Project Manager
o. (207) 743-8946
c. (207) 890-7317
ppoor@bancroftcontracting.com

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636


## Shawmut Braced Cofferdam
## Location: Between Unit #1-#6 Powerhouse and Dike
## April 15, 2020

Reviewed By: Gagnon Engineering

STATE OF MAINE
ROGER R. GAGNON
No. 3409
LICENSED
PROFESSIONAL ENGINEER

April 16, 2020

58 Pages Total

PETER POOR
BANCROFT CONTRACTING CORP.
APRIL 10, 2020

# DOWNSTREAM BRACED COFFERDAM
## UNIT 1-6 POWERHOUSE TO DIKE

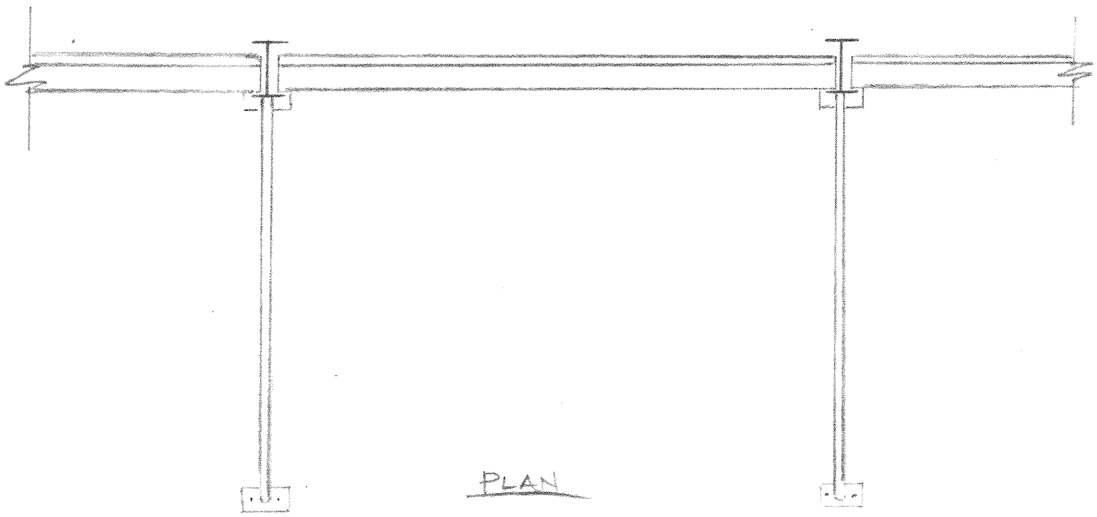
GIVEN:
- FOLLOWING SKETCH
- $F_y = 50$ ksi (BEAMS)
- $F_y = 36$ ksi (PLATE)
- $F_y = 35$ ksi (PIPE)
- WOOD: NO. 2 MIXED SOUTHERN PINE

FIND: DESIGN COFFERDAM

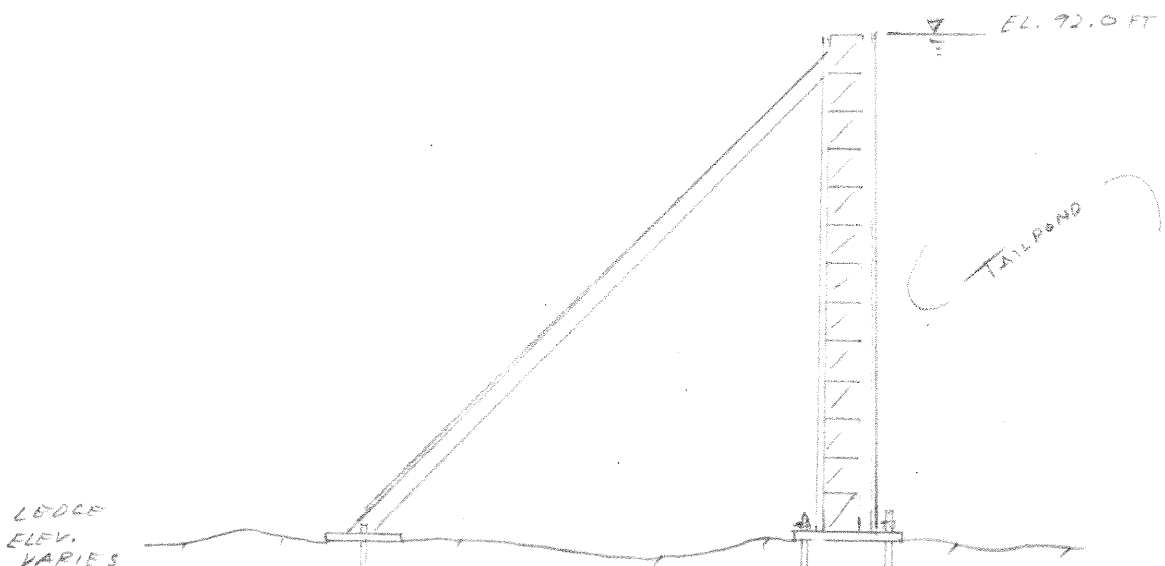
I - DESIGN STOPLOGS - PG. 2
II - DESIGN FRAME - PG. 3-5
III - CONNECTIONS - PG. 6-8
IV - SKETCHES - PG. 9-15
V - MATERIAL LIST - PG. 16
VI - GENERAL LAYOUT - PG. 17
VII - ATTACHMENT "A" - PG. 18-21
VIII - ATTACHMENT "B" - PG. 22-24
HILTI DESIGN REPORT "A"
HILTI DESIGN REPORT "B"

DESIGN REFERENCES:

1.) AISC STEEL CONST. MANUAL ($13^{TH}$-ASD)
2.) AITC TIMBER CONST. MANUAL ($4^{TH}$-ASD)
3.) HILTI PROFIS
4.) SHAWMUT U.S. FISH PASSAGE DRAWING G-008



PLAN




SECTION

I.) DESIGN STOPLOGS

GIVEN: SPAN BETWEEN FRAMES = 7.5 FT

FIND: 1.) FIND MAXIMUM DEPTH WHERE 4×4 CAN BE USED
2.) FIND MAXIMUM DEPTH WHERE 6×6 CAN BE USED

4×4 STOPLOGS

(AITC TABLE 8.4) $F_b = F_b' \cdot C_F \cdot C_r \cdot C_{fu} \cdot C_M$

ADJ. FACTORS
$C_F = 1.0$
$C_r = 1.15$ (PLYWOOD SHEATHING)
$C_{fu} = 1.0$
$C_M = 0.85$

$F_b = 1300\ psi\,(1.0)(1.15)(1.0)(0.85) = 1271\ psi$

$M_{ALLOW} = F_b S_x = \dfrac{1271\ psi\,(7.15\ IN^3)}{12\ ^{IN}/_{FT}} = 757.3\ LB \cdot FT$

$W_{ALLOW} = \dfrac{8 M_{ALLOW}}{\ell^2} = \dfrac{8\,(757.3\ LB \cdot FT)}{(7.5\ FT)^2} = 107.7\ ^{LB}/_{FT}$

$P_{ALLOW} = \dfrac{w}{BEAM\ DEPTH} = \dfrac{107.7\ ^{LB}/_{FT}\,(12\ ^{IN}/_{FT})}{3.5\ IN} = 369.2\ ^{LB}/_{FT^2}$

$MAX\ DEPTH = \dfrac{P_{ALLOW}}{62.4\ ^{LB}/_{FT^3}} = \dfrac{369.2\ ^{LB}/_{FT^2}}{62.4\ ^{LB}/_{FT^3}} = 5.92\ FT$

| |
|---|
| 4×4 STOPLOGS ARE USEABLE TO A DEPTH OF 5.92 FT |

6×6 STOPLOGS

(AITC TABLE 8.6) $F_b = F_b' \cdot C_F \cdot C_M \cdot C_H$

ADJ. FACTORS
$C_F = 1.0$
$C_M = 1.0$
$C_H = 1.0$

$F_b = 850\ psi\,(1.0)(1.0)(1.0) = 850\ psi$

$M_{ALLOW} = F_b S_x = \dfrac{850\ psi\,(27.73\ IN^3)}{12\ ^{IN}/_{FT}} = 1964.2\ LB \cdot FT$

$W_{ALLOW} = \dfrac{8 M_{ALLOW}}{\ell^2} = \dfrac{8\,(1964.2\ LB \cdot FT)}{(7.5\ FT)^2} = 279.4\ ^{LB}/_{FT}$

$P_{ALLOW} = \dfrac{w}{BEAM\ DEPTH} = \dfrac{279.4\ ^{LB}/_{FT}\,(12\ ^{IN}/_{FT})}{5.5\ IN} = 609.6\ ^{LB}/_{FT^2}$

$MAX\ DEPTH = \dfrac{P_{ALLOW}}{62.4\ ^{LB}/_{FT^3}} = \dfrac{609.6\ ^{LB}/_{FT^2}}{62.4\ ^{LB}/_{FT^3}} = 9.77\ FT$

| |
|---|
| 6×6 STOPLOGS ARE USEABLE TO A DEPTH OF 9.77 FT |

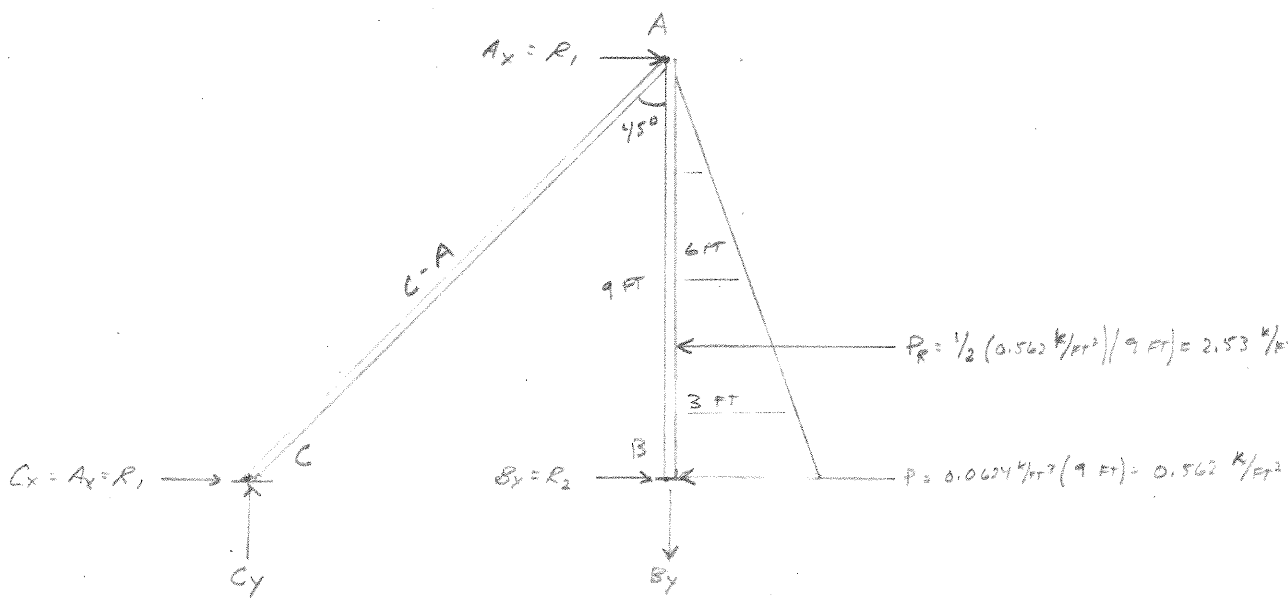
* TABLES PROVIDING MATERIAL PROPERTIES & ADJ. FACTORS ARE INCLUDED IN ATTACHMENT "A"

## II.) DESIGN FRAME

GIVEN: 1.) SPAN BETWEEN FRAMES = 7.5 FT
2.) MAXIMUM DEPTH REQUIRED = 9.0 FT

FIND: 1.) DETERMINE REACTIONS @ 9.0 FT DEPTH
2.) DESIGN VERTICAL MEMBER
3.) DESIGN STRUT

### REACTIONS




### REACTIONS / FORCES

$P_R = 2.53\ ^k/_{FT}\ (7.5\ FT) = 19.0^k$

$R_1 = C_x = A_x = \frac{P_R}{3} = \frac{19.0^k}{3} = 6.33^k$

$R_2 = B_x = \frac{2P_R}{3} = \frac{2(19.0^k)}{3} = 12.67^k$

$C\text{-}A = \frac{R_1}{\sin 45} = \frac{6.33^k}{\sin 45} = 8.95^k$ (COMPRESSION)

$C_y = B_y = \cos 45 (C\text{-}A) = \cos 45 (8.95^k) = 6.33^k$

II.) DESIGN FRAME (CONT.)

VERTICAL MEMBER

(AISC TABLE 3-23) $M_{MAX} = 0.128\,w\ell = 0.128\left(2.53^{k}/FT\,(7.5\ FT)(9\ FT)\right) = 21.86\ k\cdot FT$

TRY W8×18
$Z_x = 17.0\ IN^3$
$S_x = 15.2\ IN^3$
$L_p = 4.34\ FT$
$L_r = 13.50\ FT$

– CHECK LTB WHERE $L_b = 9.0\ FT$

(AISC F2-1) $M_p = F_y Z_x = 50\ ksi\,(17.0\ IN^3) = 850\ k\cdot IN$

(AISC F2-2) $M_n = 1.0\left[M_p - \left(M_p - 0.7F_yS_x\right)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \le M_p$

$M_n = 1.0\left[850\ k\cdot IN - \left(850\ k\cdot IN - 0.7(50\ ksi)(15.2\ IN^3)\right)\left(\frac{9\ FT - 4.34\ FT}{13.5\ FT - 4.34\ FT}\right)\right] = 688.22\ k\cdot IN$

(AISC F2-1) $M_{ALLOW} = \frac{M_n}{\Omega_b} = \frac{688.22\ k\cdot IN}{12\ ^{IN}/FT\,(1.67)} = 34.34\ k\cdot FT$

21.86 k·FT < 34.34 k·FT ∴ OK
USE W8×18 FOR VERT. MEMBERS

– CHECK COMBINED FLEXURE & TENSION OF W8×18

$T_{MAX} = 6.33^{k}$ (FROM REACTIONS, PG. 3)

(AISC D2-1) $T_{ALLOW} = \frac{P_n}{\Omega_t} = \frac{F_y A_g}{\Omega_t} = \frac{50\ ksi\,(5.26\ IN^2)}{1.67} = 157.5^{k}$ O.K.

– INTERACTION

$\frac{P_r}{P_c} = \frac{T_{MAX}}{T_{ALLOW}} = \frac{6.33^{k}}{157.5^{k}} = 0.04 < 0.2 \therefore$ USE $\frac{P_r}{2P_c} + \left(\frac{M_r}{M_c}\right) \le 1.0$ (AISC H1-1b)

$\frac{6.33^{k}}{2(157.5^{k})} + \left(\frac{21.86\ k\cdot FT}{34.34\ k\cdot FT}\right) = 0.66$

0.66 < 1.0 ∴ W8×18 IS OK
IN COMBINED FLEXURE & TENSION

**W8×18 TO BE USED FOR DEPTHS 9 FT OR LESS**

II.) DESIGN FRAME (CONT.)

STRUT

* FROM REACTION SECTION, $P_{MAX} = 8.95^k$

| TRY 3" STD. PIPE |
|---|
| WT/FT = 7.58 LB |
| $A_g = 2.08\ IN^2$ |
| $r = 1.17\ IN$ |

$$\frac{KL}{r} = \frac{1.0\,(12.73\ FT)(12\ ^{IN}/_{FT})}{1.17} = 130.6$$

$$4.71\sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29000\ ksi}{35\ ksi}} = 135.6$$

$$130.6 < 135.6 \quad \therefore \quad F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right]F_y$$

AISC (E3-4) $F_e = \dfrac{\pi^2(29000\ ksi)}{(130.6)^2} = 16.8\ ksi$ (E3-3) $F_{cr} = \left[0.658^{\frac{35}{16.8}}\right]35\ ksi = 14.63\ ksi$

AISC (E3-1) $P_{ALLOW} = \dfrac{F_{cr}A_g}{\Omega_c} = \dfrac{14.63\ ksi\,(2.08\ IN^2)}{1.67} = 18.22^k$

| $8.95^k < 18.22^k \quad \therefore$ OK |
|---|

- CHECK COMBINED FLEXURE & COMPRESSION IN 3" STD. PIPE

$$M_{MAX} = \frac{\text{UNIT WT OF PIPE} \cdot \ell^2}{8} = \frac{0.0076\ ^k/_{FT}\,(12.73\ FT)^2}{8} = 0.154\ K \cdot FT$$

$$M_{ALLOW} = \frac{F_y Z}{1.67} = \frac{35\ ksi\,(2.19\ IN^3)}{1.67\,(12\ ^{IN}/_{FT})} = 3.82\ K \cdot FT$$

- INTERACTION

$$\frac{P_r}{P_c} = \frac{P_{MAX}}{P_{ALLOW}} = \frac{8.95^k}{18.22^k} = 0.49 > 0.2 \quad \therefore \quad \frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_r}{M_c}\right) \leq 1.0 \quad \text{AISC (H1-1a)}$$

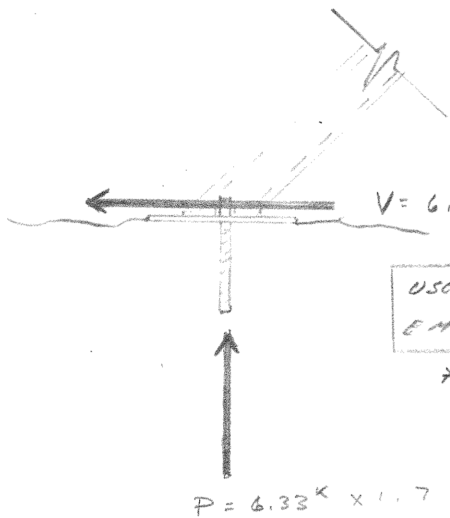
$$\frac{8.95^k}{18.22^k} + \frac{8}{9}\left(\frac{0.154\ K\cdot FT}{3.82\ K\cdot FT}\right) = 0.53$$

| 0.53 < 1.0 $\therefore$ 3" STD PIPE IS OK IN COMBINED FLEXURE & COMPRESSION |
|---|

| **3 IN. STD PIPE TO BE USED FOR DEPTHS 9 FT OR LESS** |
|---|

III.) CONNECTIONS *CALCULATIONS FOR REACTIONS ON PG. 3

STRUT ANCHORING



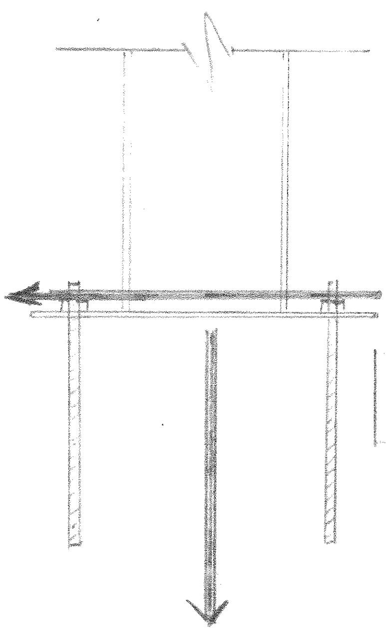
V = 6.33K × 1.7 = 10.761K (FACTORED SHEAR LOAD)

USE 5/8" ϕ HAS-E B7 ROD WITH HILTI HIT-RE 500 V3
EMBED MIN. 6 IN.

* SEE HILTI DESIGN REPORT "A"

P = 6.33K × 1.7 = 10.761K (FACTORED COMPRESSIVE LOAD)

VERTICAL BEAM ANCHORING



V = 12.67K × 1.7 = 21.539K (FACTORED SHEAR LOAD)

USE 7/8" ϕ HAS-E B7 ROD WITH HILTI HIT-RE 500 V3
EMBED MIN. 12 IN.

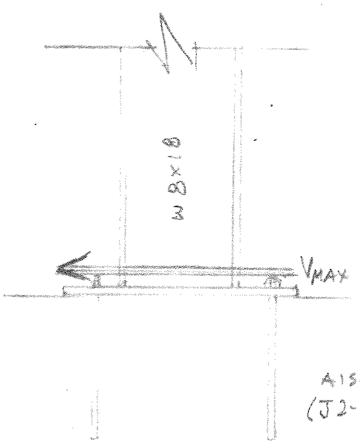
* SEE HILTI DESIGN REPORT "B"

T = 6.33K × 1.7 = 10.761K (FACTORED TENSILE LOAD)

ANCHORING DETAILS SHOWN ABOVE ARE TO BE USED FOR DEPTHS 9 FT OR LESS.

III.) CONNECTIONS - WELDED JOINTS *CALCULATIONS FOR REACTIONS ON PG. 3

VERTICAL BEAM - BASEPLATE




- CHECK WELD STRENGTH VS. SHEAR

KNOWN

$V_{MAX} = 12.67^k$
$l_w = 35.3$ IN (PERIMETER OF W8x18)
$F_{EXX} = 70$ ksi
$t_{min} = 1/4"$ (WEB OF W8x18)

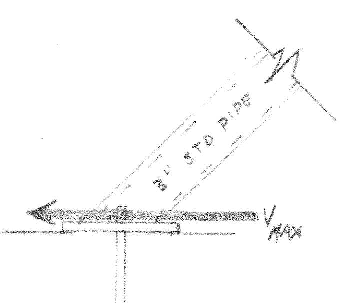
- TRY 1/4" FILLET WELD (ALL-AROUND)

AISC (J2-3) $\frac{R_n}{\Omega} = \frac{F_w A_w}{\Omega} = \frac{0.6 F_{EXX}(0.707)(D)(l_w)}{2.00\ (16)}$

$= \frac{0.6(70\text{ ksi})(0.707)(4)(35.3\text{ IN})}{2.00\ (16)} = 131^k$

**$12.67^k < 131^k$ ∴ OK**
- USE 1/4" FILLET WELD FOR VERT. BEAM - BASEPLATE

STRUT - BASEPLATE




- CHECK WELD STRENGTH VS. SHEAR

KNOWN

$V_{MAX} = 6.33^k$
$l_w = 11.0$ IN (EXCLUDES CONSIDERATION OF ANGLE)
$F_{EXX} = 70$ ksi
$t_{min} = 0.201$ IN (WALL OF PIPE)

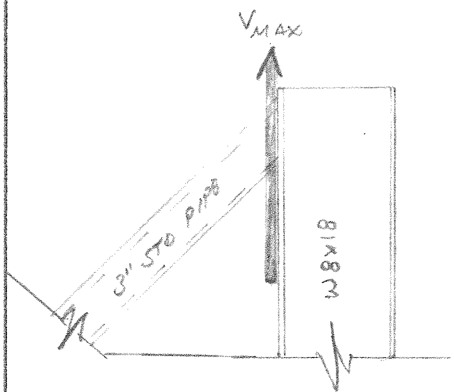
- TRY 3/16" FILLET WELD (ALL-AROUND)

AISC (J2-3) $\frac{R_n}{\Omega} = \frac{0.6(70\text{ ksi})(0.707)(3)(11.0\text{ IN})}{2.00\ (16)} = 30.6^k$

**$6.33^k < 30.6^k$ ∴ OK**
- USE 3/16" FILLET WELD FOR STRUT - BASEPLATE

III.) CONNECTIONS - WELDED JOINTS (CONT.)

STRUT - VERTICAL BEAM




- CHECK WELD STRENGTH VS. SHEAR

KNOWN

$V_{MAX} = 6.83^k$

$l_w = 11.0$ IN (EXCLUDES CONSIDERATION OF ANGLE)

$F_{EXX} = 70$ ksi

$t_{min} = 0.201$ IN (WALL OF PIPE)

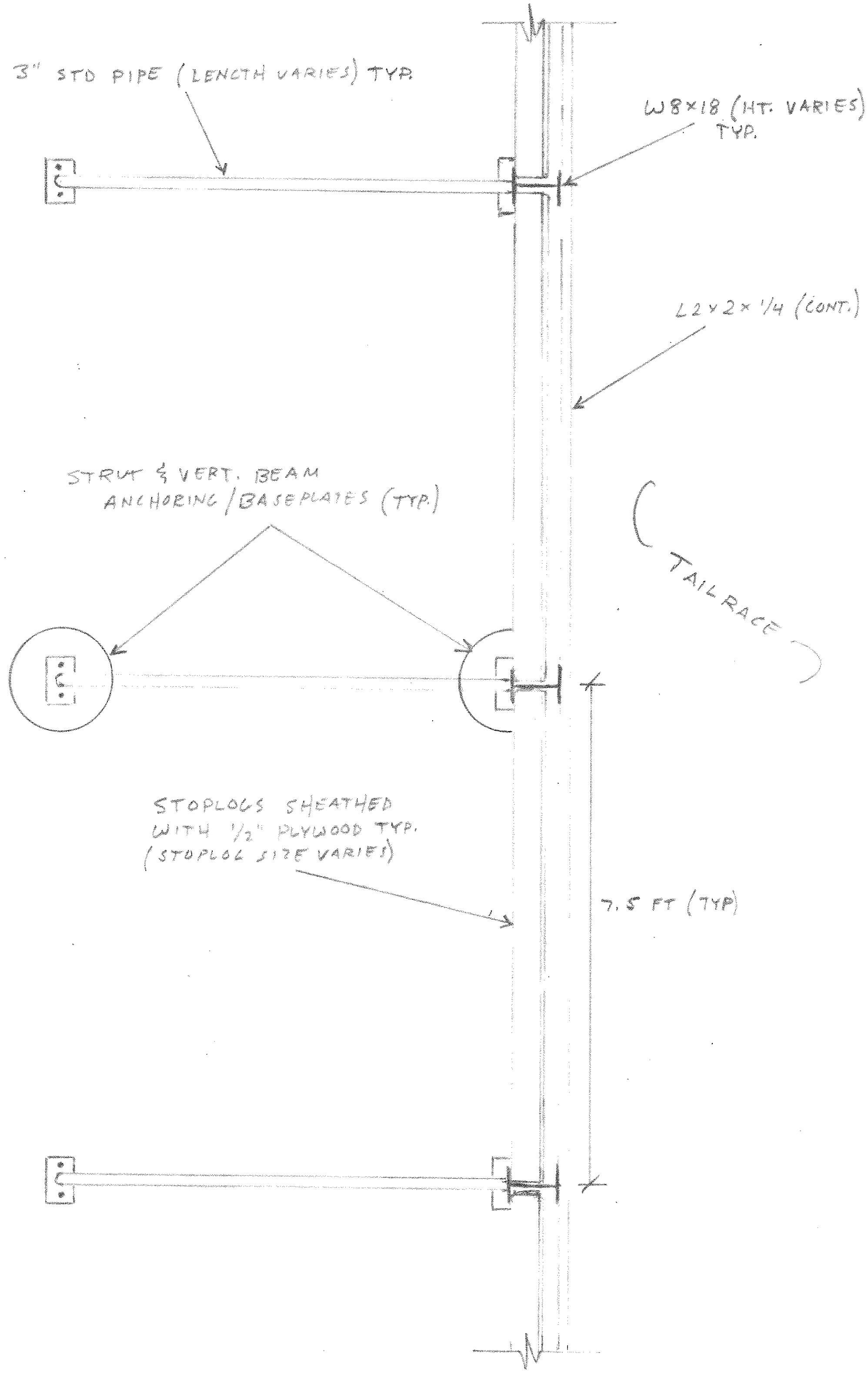
- TRY 3/16" FILLET WELD (ALL-AROUND)

AISC (J2-3) $\frac{R_n}{\Omega} = \frac{0.6(70\ ksi)(0.707)(3)(11.0\ IN)}{2.00(16)} = 30.6^k$

$6.83^k < 30.6^k \therefore$ OK
- USE 3/16" FILLET WELD FOR STRUT - VERT. BEAM

## IV.) SKETCHES

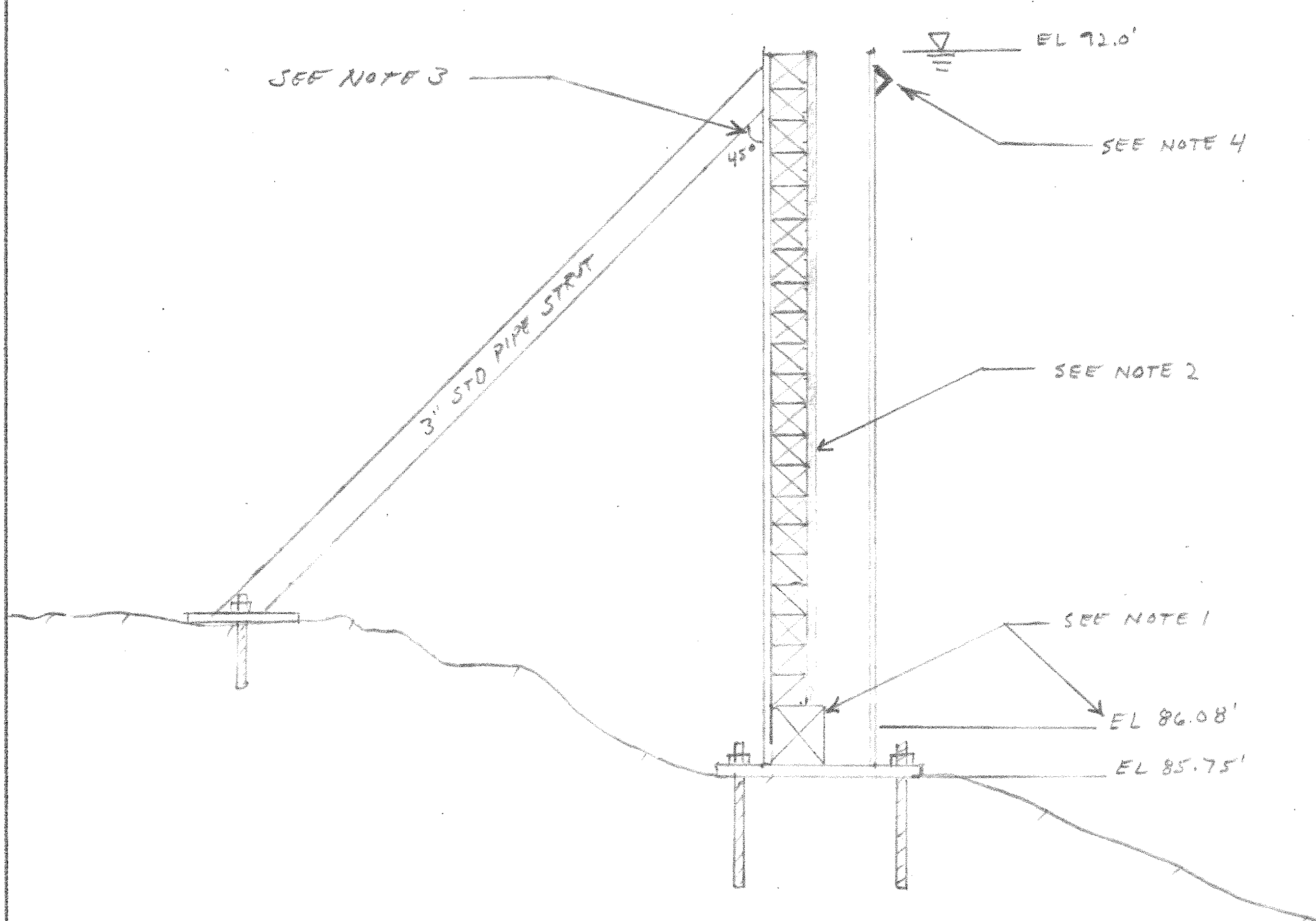
### TYPICAL PLAN



SKETCHES

- EXAMPLE OF INSTALLATION OF BRACED COFFERDAM

SECTION




NOTES

1.) EL. 86.08' PROVIDES THE MAXIMUM DEPTH (ASSUMING A DESIGN ELEV. OF 92.0') WHERE 4X4 LOGS ARE SUITABLE. AT A MINIMUM, 6X6 WOULD BE REQUIRED UP TO THIS ELEVATION PRIOR TO SWITCHING OVER TO 4X4 LOGS

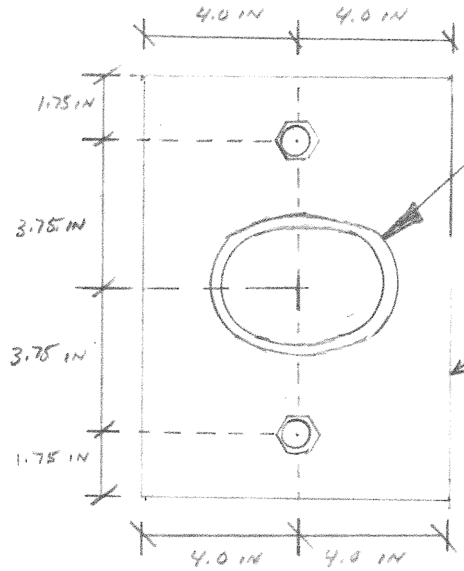
2.) 4X4 STOPLOGS ARE TO BE SHEATHED WITH 1/2" PLYWOOD. 6X6 ARE NOT REQUIRED TO BE SHEATHED.

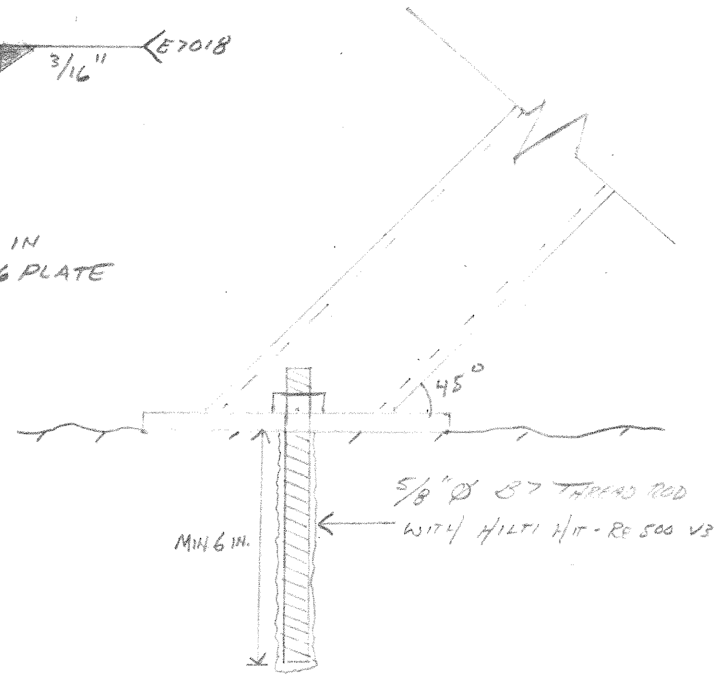
3.) 45° ANGLE TO BE CONSISTENT FOR ALL STRUT INSTALLATIONS

4.) L2X2X1/4 TO BE CONTINUOUS ALONG SECTIONS OF BRACED COFFERDAM

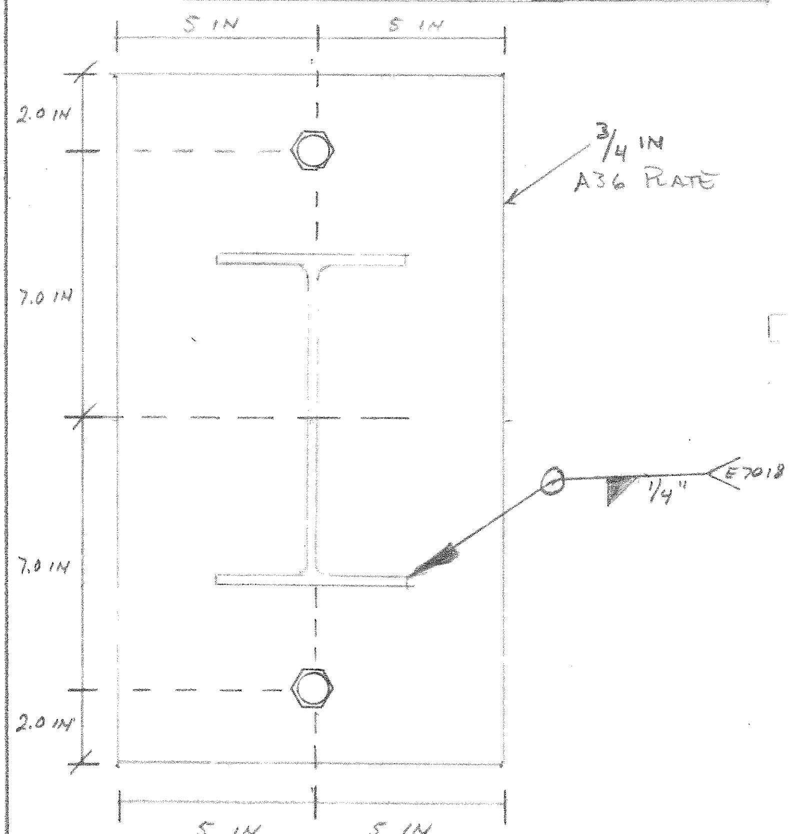
## SKETCHES

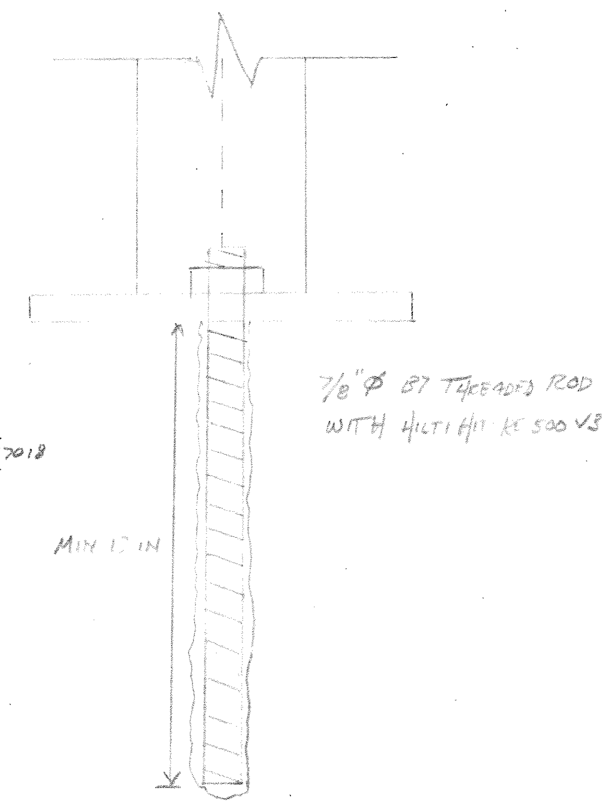
### STRUT ANCHORING & BASEPLATE



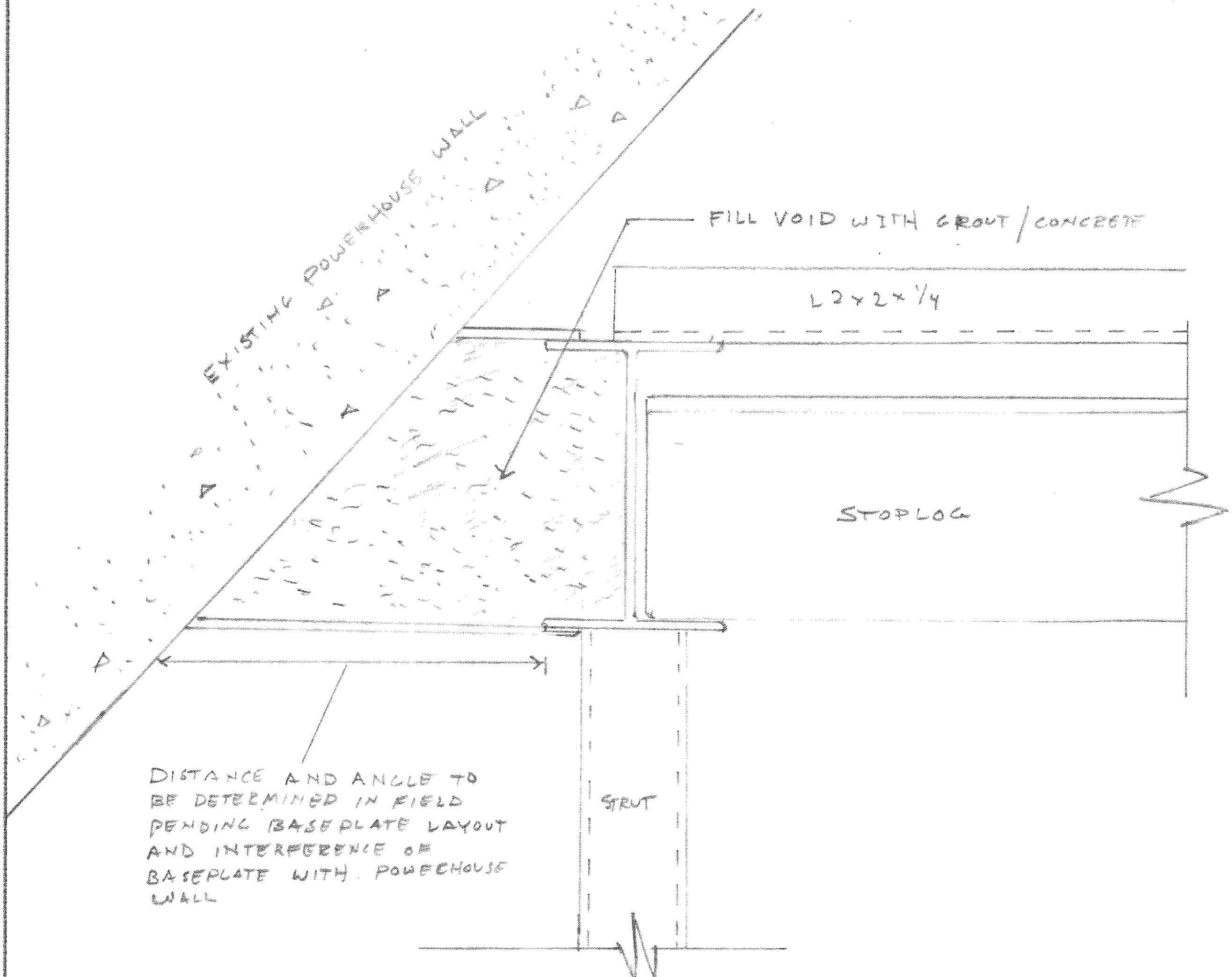

### VERTICAL BEAM ANCHORING & BASEPLATE



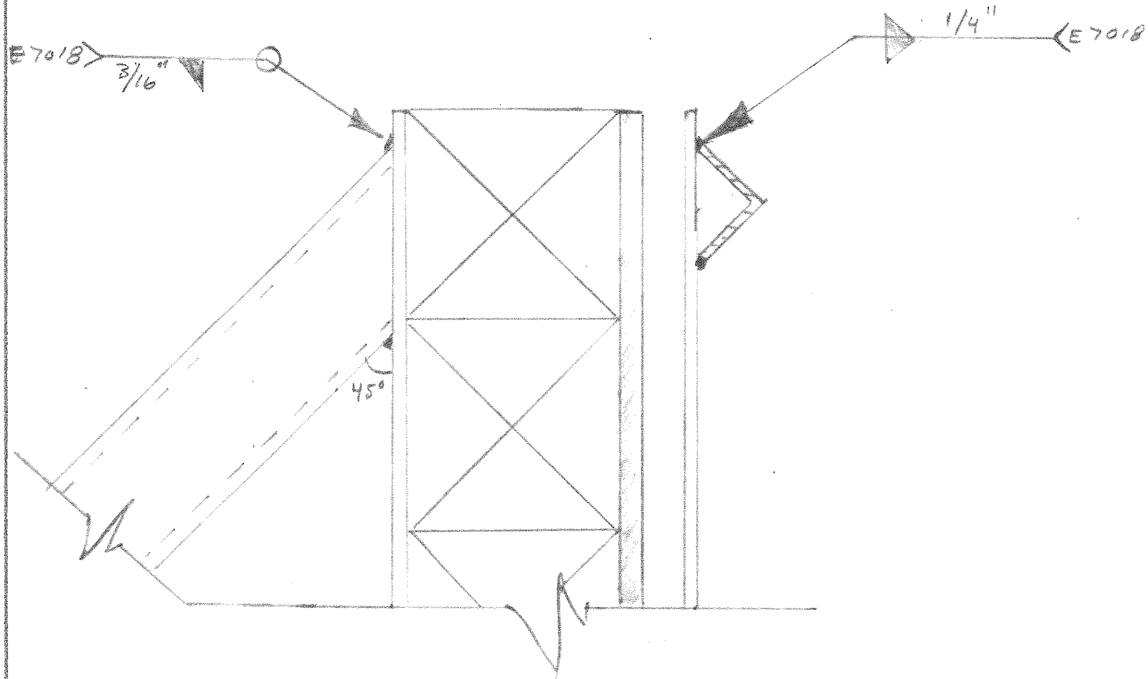
SKETCHES

CONNECTION AT UNIT #1-#6 POWERHOUSE WALL



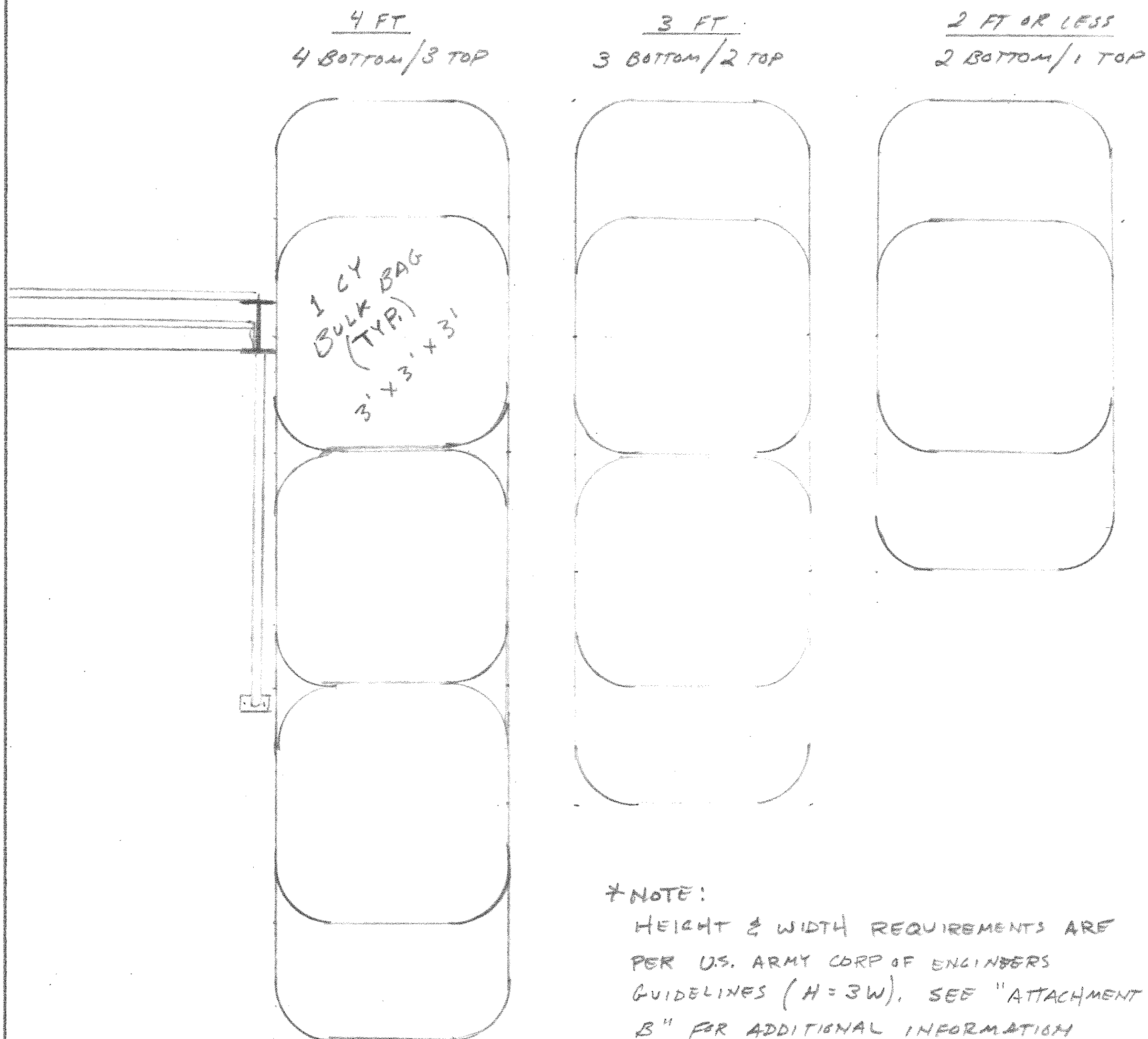
SKETCHES

CONNECTIONS AT TOP OF VERTICAL BEAM



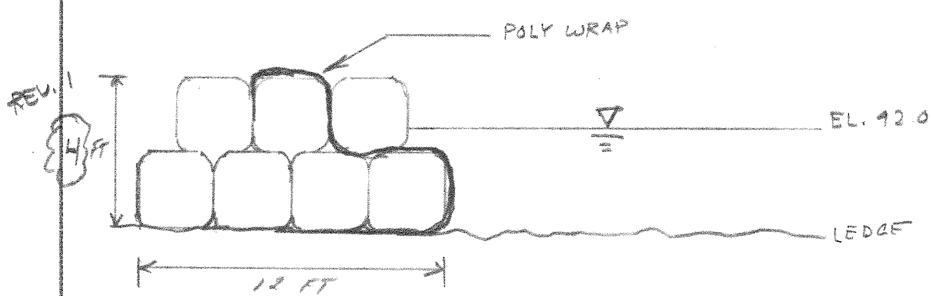
SKETCHES

SANDBAG COFFERDAM FOR DEPTHS UP TO 4 FT




*NOTE:
HEIGHT & WIDTH REQUIREMENTS ARE PER U.S. ARMY CORP OF ENGINEERS GUIDELINES (H = 3W). SEE "ATTACHMENT B" FOR ADDITIONAL INFORMATION

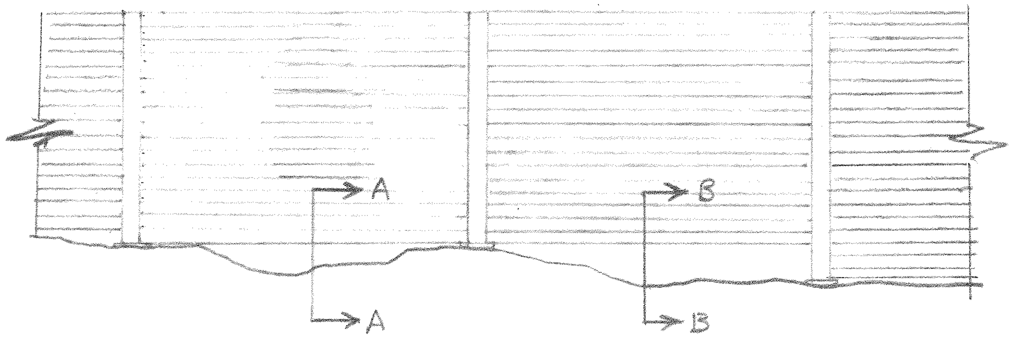
TYPICAL SECTION FOR 4 FT DEPTH



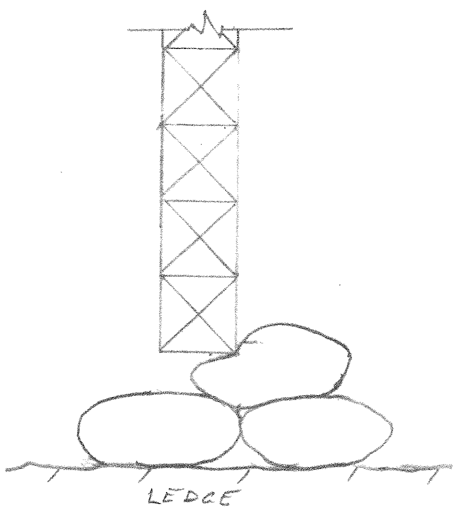
SKETCHES

METHOD FOR SEALING STOPLOGS ON UNEVEN LEDGE

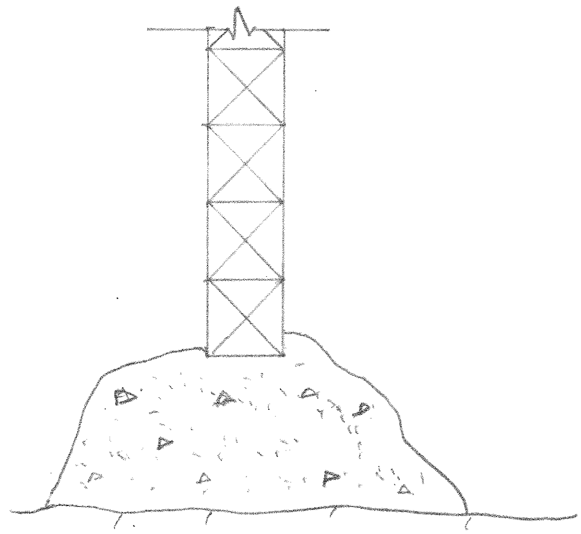
- EXAMPLE SECTIONS




SECTION A-A




SECTION B-B



* DEPEND ON DEPTH OR SIZE OF GAP BETWEEN STOPLOGS AND LEDGE, SANDBAGS AND/OR A TREMIE CONCRETE PLACEMENT ARE TO BE USED FOR SEALING

# I.) MATERIAL LIST

BRACES/FRAMES

| ITEM | SIZE | $F_y$/GRADE |
|---|---|---|
| VERTICAL BEAM | W8×18 | 50 ksi |
| STRUT | 3" STD PIPE | 35 ksi |

BASEPLATES/ANCHORING

| | | |
|---|---|---|
| VERT BEAM BASEPLATE | 3/4"×10"×18" | 36 ksi |
| STRUT BASEPLATE | 1/2"×8"×11" | 36 ksi |
| THREADED ROD - B7 | SEE SKETCH | 105 ksi |
| EPOXY | N/A | HILTI HIT-RE500 V3 |

STOPLOGS

| | | |
|---|---|---|
| STOPLOGS - BELOW 5.92 FT | NOM. 4×4 | NO. 2 MIXED S. PINE |
| STOPLOGS - ABOVE 5.92 FT | NOM. 6×6 | NO. 2 MIXED S. PINE |
| SHEATHING - PLYWOOD | 1/2 IN. | N/A |

MISC.

| | | |
|---|---|---|
| WELDING ELECTRODES | N/A | 70 ksi |

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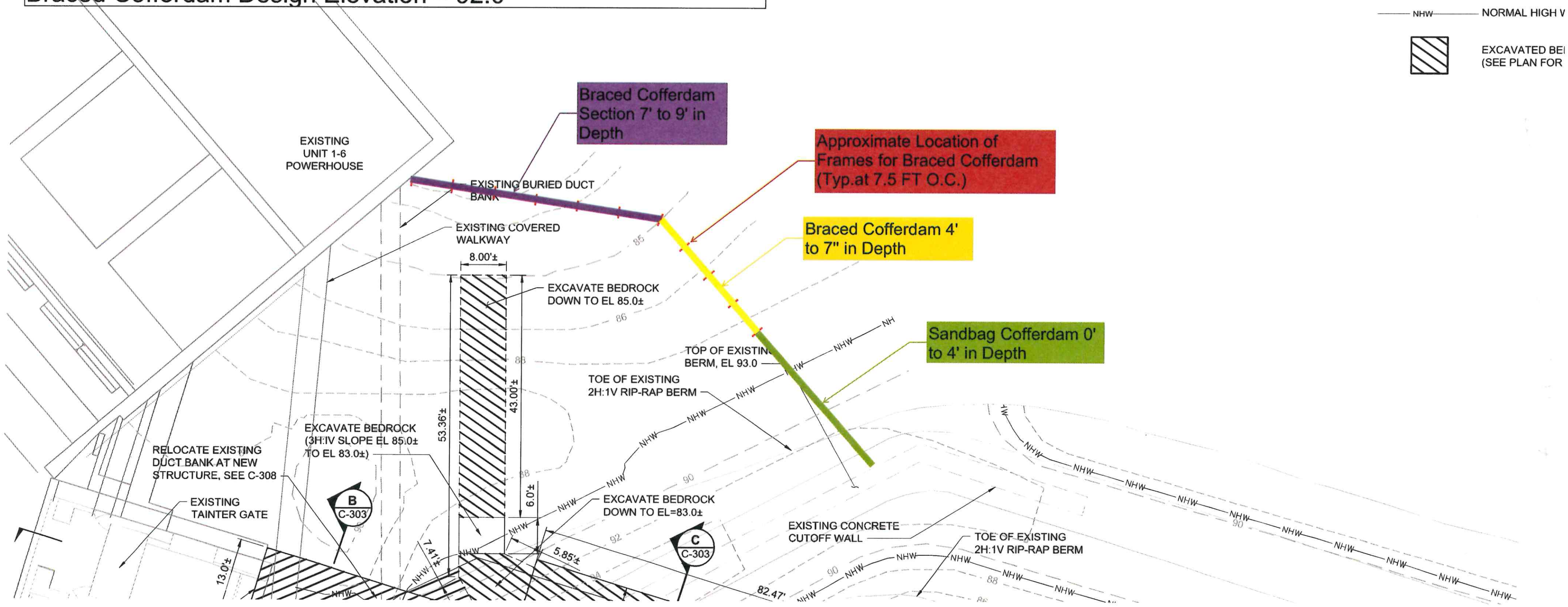
# Layout for Cofferdam Between Unit #1-#6 Powerhouse and Dike
# Braced Cofferdam Design Elevation = 92.0'




VI.) GENERAL LAYOUT

VII.) ATTACHMENT "A"

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# TABLE 8.4

## Design Values for Visually Graded Southern Pine Dimension Lumber

**(Tabulated design values are for normal load duration and dry service conditions, unless specified otherwise. See NDS 2.3 for a comprehensive description of design value adjustment factors.)**

**Use with Adjustment Factors**

| Species and commercial grade | Size classification | Design values in pounds per square inch (psi) | | | | | | Grading Rules Agency |
|---|---|---|---|---|---|---|---|---|
| | | Bending $F_b$ | Tension parallel to grain $F_t$ | Shear parallel to grain $F_v$ | Compression perpendicular to grain $F_{c\perp}$ | Compression parallel to grain $F_c$ | Modulus of Elasticity E | |
| **MIXED SOUTHERN PINE** | | | | | | | | |
| Select Structural | 2"-4"thick | 2050 | 1200 | 100 | 565 | 1800 | 1,600,000 | SPIB |
| No.1 | | 1450 | 875 | 100 | 565 | 1650 | 1,500,000 | |
| No.2 (4x4) | 2"-4" wide | 1300 | 775 | 90 | 565 | 1650 | 1,400,000 | |
| No.3 | | 750 | 450 | 90 | 565 | 950 | 1,200,000 | |
| Stud | | 775 | 450 | 90 | 565 | 950 | 1,200,000 | |
| Construction | 2"-4"thick | 1000 | 600 | 100 | 565 | 1700 | 1,300,000 | |
| Standard | | 550 | 325 | 90 | 565 | 1450 | 1,200,000 | |
| Utility | 4" wide | 275 | 150 | 90 | 565 | 950 | 1,100,000 | |
| Select Structural | 2"-4"thick | 1850 | 1100 | 90 | 565 | 1700 | 1,600,000 | |
| No.1 | | 1300 | 750 | 90 | 565 | 1550 | 1,500,000 | |
| No.2 | 5"-6" wide | 1150 | 675 | 90 | 565 | 1550 | 1,400,000 | |
| No.3 | | 675 | 400 | 90 | 565 | 875 | 1,200,000 | |
| Stud | | 675 | 400 | 90 | 565 | 875 | 1,200,000 | |
| Select Structural | 2"-4"thick | 1750 | 1000 | 90 | 565 | 1600 | 1,600,000 | |
| No.1 | | 1200 | 700 | 90 | 565 | 1450 | 1,500,000 | |
| No.2 | 8" wide | 1050 | 625 | 90 | 565 | 1450 | 1,400,000 | |
| No.3 | | 625 | 375 | 90 | 565 | 850 | 1,200,000 | |
| Select Structural | 2"-4"thick | 1500 | 875 | 90 | 565 | 1600 | 1,600,000 | |
| No.1 | | 1050 | 600 | 90 | 565 | 1450 | 1,500,000 | |
| No.2 | 10" wide | 925 | 550 | 90 | 565 | 1450 | 1,400,000 | |
| No.3 | | 525 | 325 | 90 | 565 | 825 | 1,200,000 | |
| Select Structural | 2"-4"thick | 1400 | 825 | 90 | 565 | 1550 | 1,600,000 | |
| No.1 | | 975 | 575 | 90 | 565 | 1400 | 1,500,000 | |
| No.2 | 12" wide | 875 | 525 | 90 | 565 | 1400 | 1,400,000 | |
| No.3 | | 500 | 300 | 90 | 565 | 800 | 1,200,000 | |
| **SOUTHERN PINE** | | | | | | | | |
| Dense Select Structural | 2"-4"thick | 3050 | 1650 | 100 | 660 | 2250 | 1,900,000 | |
| Select Structural | | 2850 | 1600 | 100 | 565 | 2100 | 1,800,000 | |
| Non-Dense Select Structural | | 2650 | 1350 | 100 | 480 | 1950 | 1,700,000 | |
| No.1 Dense | | 2000 | 1100 | 100 | 660 | 2000 | 1,800,000 | |
| No.1 | | 1850 | 1050 | 100 | 565 | 1850 | 1,700,000 | |
| No.1 Non-Dense | 2"-4" wide | 1700 | 900 | 100 | 480 | 1700 | 1,600,000 | |
| No.2 Dense | | 1700 | 875 | 90 | 660 | 1850 | 1,700,000 | |
| No.2 | | 1500 | 825 | 90 | 565 | 1650 | 1,600,000 | |
| No.2 Non-Dense | | 1350 | 775 | 90 | 480 | 1600 | 1,400,000 | |
| No.3 | | 850 | 475 | 90 | 565 | 975 | 1,400,000 | |
| Stud | | 875 | 500 | 90 | 565 | 975 | 1,400,000 | |
| Construction | 2"-4"thick | 1100 | 625 | 100 | 565 | 1800 | 1,500,000 | |
| | | [illegible] | 350 | 90 | 565 | 1500 | 1,300,000 | |

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## SIZE FACTOR, $C_F$

Appropriate size adjustment factors have already been incorporated in the tabulated design values for most thicknesses of Southern Pine and Mixed Southern Pine dimension lumber. For dimension lumber 4" thick, 8" and wider (all grades except Dense Structural 86, Dense Structural 72 and Dense Structural 65), tabulated bending design values, $F_b$, shall be permitted to be multiplied by the size factor, $C_F = 1.1$. For dimension lumber wider than 12" (all grades except Dense Structural 86, Dense Structural 72 and Dense Structural 65), tabulated bending, tension and compression parallel to grain design values for 12" wide lumber shall be multiplied by the size factor, $C_F = 0.9$. When the depth, d, of Dense Structural 86, Dense Structural 72 or Dense Structural 65 dimension lumber exceeds 12", the tabulated bending design value, $F_b$, shall be multiplied by the following size factor:

$$C_F = (12/d)^{1/9}$$

## REPETITIVE MEMBER FACTOR, $C_r$

Bending design values, $F_b$, for dimension lumber 2" to 4" thick shall be multiplied by the repetitive member factor, $C_r = 1.15$, when such members are used as joists, truss chords, rafters, studs, planks, decking or similar members which are in contact or spaced not more than 24" on centers, are not less than 3 in number and are joined by floor, roof or other load distributing elements adequate to support the design load.

## FLAT USE FACTOR, $C_{fu}$

Bending design values adjusted by size factors are based on edgewise use (load applied to narrow face). When dimension lumber is used flatwise (load applied to wide face), the bending design value, $F_b$, shall also be multiplied by the following flat use factors:

### FLAT USE FACTORS, $C_{fu}$

| Width | Thickness | |
|---|---|---|
| | 2" & 3" | 4" |
| 2" & 3" | 1.0 | --- |
| 4" | 1.1 | 1.0 |
| 5" | 1.1 | 1.05 |
| 6" | 1.15 | 1.05 |
| 8" | 1.15 | 1.05 |
| 10" & wider | 1.2 | 1.1 |

## WET SERVICE FACTOR, $C_M$

When dimension lumber is used where moisture content will exceed 19% for an extended time period, design values shall be multiplied by the appropriate wet service factors from the following table (for Dense Structural 86, Dense Structural 72 and Dense Structural 65 use tabulated design values for wet service conditions without further adjustment):

### WET SERVICE FACTORS, $C_M$

| $F_b$ | $F_t$ | $F_v$ | $F_{c\perp}$ | $F_c$ | E |
|---|---|---|---|---|---|
| 0.85* | 1.0 | 0.97 | 0.67 | 0.8** | 0.9 |

* when $(F_b)(C_F) \leq 1150$ psi, $C_M = 1.0$
** when $F_c \leq 750$ psi, $C_M = 1.0$

## TABLE 8.6 (*Continued*)

| Species and commercial grade | Size classification | Bending $F_b$ | Tension parallel to grain $F_t$ | Shear parallel to grain $F_v$ | Compression perpendicular to grain $F_{c\perp}$ | Compression parallel to grain $F_c$ | Modulus of Elasticity E | Grading Rules Agency |
|---|---|---|---|---|---|---|---|---|
| | | Design values in pounds per square inch (psi) | | | | | | |
| **MIXED OAK** | | | | | | | | |
| Select Structural | Beams and Stringers | 1350 | 800 | 80 | 800 | 825 | 1,000,000 | NELMA |
| No.1 | | 1150 | 550 | 80 | 800 | 700 | 1,000,000 | |
| No.2 | | 725 | 375 | 80 | 800 | 450 | 800,000 | |
| Select Structural | Posts and Timbers | 1250 | 850 | 80 | 800 | 875 | 1,000,000 | |
| No.1 | | 1000 | 675 | 80 | 800 | 775 | 1,000,000 | |
| No.2 | | 575 | 400 | 80 | 800 | 350 | 800,000 | |
| **MIXED SOUTHERN PINE** | | (Wet Service Conditions) | | | | | | |
| Select Structural | 5"x 5" & larger | 1500 | 1000 | 110 | 375 | 900 | 1,300,000 | SPIB |
| No.1 | | 1350 | 900 | 110 | 375 | 800 | 1,300,000 | |
| No.2 | | 850 | 550 | 95 | 375 | 525 | 1,000,000 | |
| **MOUNTAIN HEMLOCK** | | | | | | | | |
| Select Structural | Beams and Stringers | 1350 | 775 | 85 | 570 | 875 | 1,100,000 | WCLIB |
| No.1 | | 1100 | 550 | 85 | 570 | 725 | 1,100,000 | |
| No.2 | | 725 | 375 | 85 | 570 | 475 | 900,000 | |
| Select Structural | Posts and Timbers | 1250 | 825 | 85 | 570 | 925 | 1,100,000 | |
| No.1 | | 1000 | 675 | 85 | 570 | 800 | 1,100,000 | |
| No.2 | | 625 | 400 | 85 | 570 | 550 | 900,000 | |
| **NORTHERN PINE** | | | | | | | | |
| Select Structural | Beams and Stringers | 1250 | 850 | 65 | 435 | 850 | 1,300,000 | NELMA NSLB |
| No.1 | | 1050 | 700 | 65 | 435 | 725 | 1,300,000 | |
| No.2 | | 675 | 350 | 65 | 435 | 450 | 1,000,000 | |
| Select Structural | Posts and Timbers | 1150 | 800 | 65 | 435 | 900 | 1,300,000 | |
| No.1 | | 950 | 650 | 65 | 435 | 800 | 1,300,000 | |
| No.2 | | 550 | 375 | 65 | 435 | 375 | 1,000,000 | |
| **NORTHERN RED OAK** | | | | | | | | |
| Select Structural | Beams and Stringers | 1600 | 950 | 105 | 885 | 950 | 1,300,000 | NELMA |
| No.1 | | 1350 | 675 | 105 | 885 | 800 | 1,300,000 | |
| No.2 | | 875 | 425 | 105 | 885 | 500 | 1,000,000 | |
| Select Structural | Posts and Timbers | 1500 | 1000 | 105 | 885 | 1000 | 1,300,000 | |
| No.1 | | 1200 | 800 | 105 | 885 | 875 | 1,300,000 | |
| No.2 | | 700 | 475 | 105 | 885 | 400 | 1,000,000 | |
| **NORTHERN WHITE CEDAR** | | | | | | | | |
| Select Structural | Beams and Stringers | 900 | 600 | 60 | 370 | 600 | 700,000 | NELMA |
| No.1 | | 750 | 500 | 60 | 370 | 500 | 700,000 | |
| No.2 | | 500 | 250 | 60 | 370 | 325 | 600,000 | |
| Select Structural | Posts and | 850 | 575 | 60 | 370 | 650 | 700,000 | |

2"/24

# TABLE 8.6—Adjustment Factors

## SIZE FACTOR, $C_F$

When the depth, d, of a beam, stringer, post or timber exceeds 12", the tabulated bending design value, $F_b$, shall be multiplied by the following size factor:

$$C_F = (12/d)^{1/9}$$

## WET SERVICE FACTOR, $C_M$

When timbers are used where moisture content will exceed 19% for an extended time period, design values shall be multiplied by the appropriate wet service factors from the following table (for Southern Pine and Mixed Southern Pine use tabulated design values without further adjustment):

**WET SERVICE FACTORS, $C_M$**

| $F_b$ | $F_t$ | $F_v$ | $F_{c\perp}$ | $F_c$ | E |
|---|---|---|---|---|---|
| 1.00 | 1.00 | 1.00 | 0.67 | 0.91 | 1.00 |

## SHEAR STRESS FACTOR, $C_H$

Tabulated shear design values parallel to grain have been reduced to allow for the occurrence of splits, checks and shakes. Tabulated shear design values parallel to grain, $F_v$, shall be permitted to be multiplied by the shear stress factors specified in the following table when length of split, or size of check or shake is known and no increase in them is anticipated. When shear stress factors are used for Redwood, Southern Pine and Mixed Southern Pine, a tabulated design value of $F_v$ = 80 psi shall be assigned for all grades of Redwood and a tabulated design value of $F_v$ = 90 psi shall be assigned for all grades of Southern Pine and Mixed Southern Pine. Shear stress factors shall be permitted to be linearly interpolated.

**SHEAR STRESS FACTORS, $C_H$**

| Length of split on wide face of 5" (nominal) and thicker lumber | $C_H$ | Size of shake* in 5" (nominal) and thicker lumber | $C_H$ |
|---|---|---|---|
| no split | 2.00 | no shake | 2.00 |
| 1/2 x narrow face. | 1.67 | 1/6 x narrow face | 1.67 |
| 3/4 x narrow face | 1.50 | 1/4 narrow face | 1.50 |
| 1 x narrow face | 1.33 | 1/3 x narrow face | 1.33 |
| 1-1/2 x narrow face or more | 1.00 | 1/2 x narrow face or more. | 1.00 |

*Shake is measured at the end between lines enclosing the shake and perpendicular to the loaded face.

# Flood Fighting: How To Use Sandbags

U.S. ARMY CORPS OF ENGINEERS

BUILDING STRONG®

**Sandbag Construction –** The use of sandbags is a simple, but effective way to prevent or reduce flood water damage. Properly filled and placed sandbags can act as a barrier to divert moving water around, instead of through, buildings. Sandbag construction does not guarantee a water-tight seal, but is satisfactory for use in most situations. Sandbags are also used successfully to prevent overtopping of streams with levees, and for training current flows to specific areas.

Untied sandbags are recommended for most situations. Tied sandbags should be used only for special situations when pre-filling and stockpiling may be required, or for specific purposes such as filling holes, holding objects in position, or to form barriers backed by supportive planks. Tied sandbags are generally easier to handle and stockpile. However, sandbag filling operations can generally be best accomplished at or near the placement site, and tying of the bags might be a waste of valuable time and effort. If the bags are to be pre-filled at a distant location, due consideration must be given to transportation vehicles and placement site access.

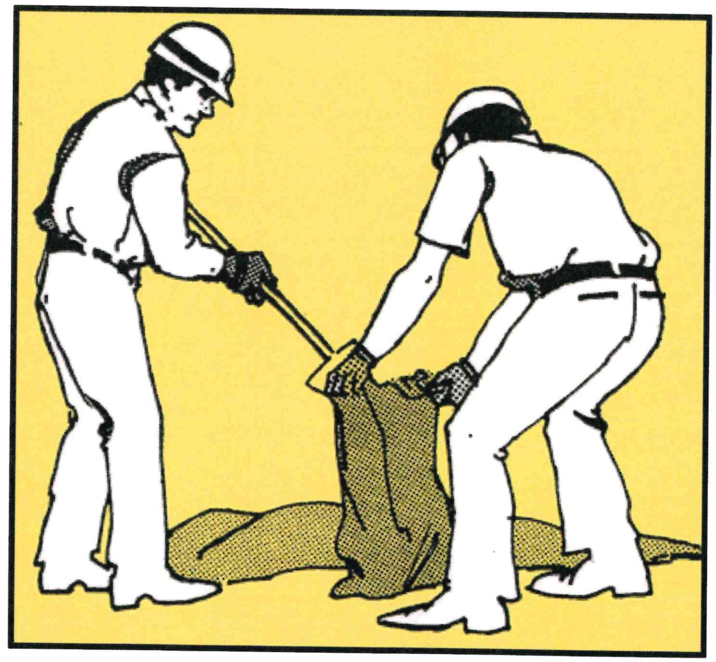
Commercial plastic sandbags, made from polypropylene, are available from most bag suppliers and hardware stores. These will store for a long time with minimum care, and are not biodegradable. Thus, they have to be disposed of after use, or will remain around for a long time. Another option is untreated burlap sacks, often available at feed or hardware stores. Empty bags are biodegradable, and can be stockpiled for several years, if properly stored. Filled burlap bags of earth material will deteriorate quickly. In either case, rodent control is strongly recommended during storage.

Do not use garbage bags, as they are too slick to stack. Avoid the use of feed or seed sacks, as they are too large to handle when filled even half full. If they must be used, keep the weight of filled bags down to what can be handled by one or two people (no more than 60 pounds). Where possible, use bags about 14-18" wide, and 30-36" deep.

A heavy bodied or sandy soil is most desirable for filling sandbags, but any usable material at or near the site has definite advantages. Coarse sand could leak out through the weave in the bag. To prevent this, double bag the material. Gravelly or rocky soils are generally poor choices because of their permeability.

Sandbag barriers are best built by a group of people working as a team. Insure that the individuals have the physical capability to carry or drag a sandbag weighing approximately 30-50 pounds (depending on dampness and type of sand). They should wear work clothing and gloves.

**How to Fill a Sandbag –** Filling sandbags is usually a two-person operation. The use of safety goggles and gloves is recommended. One member of the team places the empty bag between or slightly in front of widespread feet with arms extended. The throat of the bag is folded to form a collar, and held with the hands in a position that will enable the other team member to empty a rounded shovel full of material into the open end. The person holding the sack stands with knees slightly flexed, and head and face as far away from the shovel as possible.



The shoveler carefully releases the rounded shovel full of soil into the throat of the bag. Haste in this operation can result in undue spillage and added work. Bags should be filled between one-third (1/3) to one-half (1/2) of their capacity. This keeps the bag from getting too heavy, and permits the bags to be stacked with a good seal.

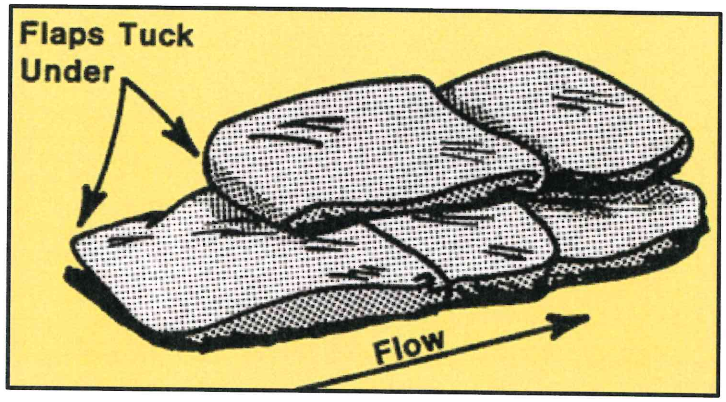
For large scale operations, filling sandbags can be expedited by using bag-holding racks, funnels, or power loading equipment. The special equipment required is not always available during an emergency, but can be fabricated using available materials, and should be identified in local flood response plans.

**Sandbag Placement –** Remove any debris from the area where the bags are to be placed.

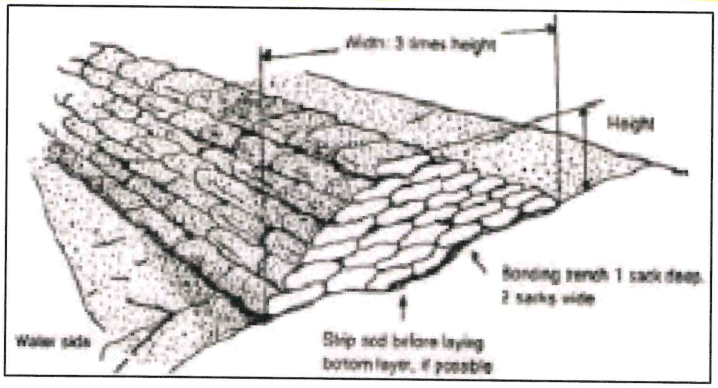
Fold the open end of the unfilled portion of the bag to form a triangle. If tied bags are used, flatten or flare the tied end.

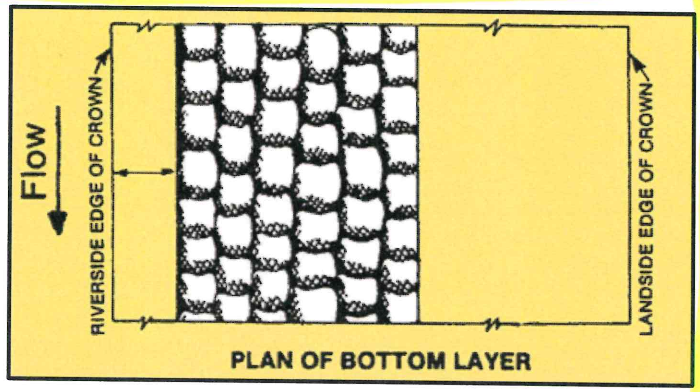
Place the partially filled bags lengthwise and parallel to the direction of flow, with the open end facing against the water flow. Tuck the flaps under, keeping the unfilled portion under the weight of the sack.

Place succeeding bags on top, offsetting by one-half (1/2) filled length of the previous bag, and stamp into place to eliminate voids, and form a tight seal.




Stagger the joint connections when multiple layers are necessary. For unsupported layers over three (3) courses high, use the pyramid placement method (below).




**Pyramid Placement Method –** The pyramid placement is used to increase the height of sandbag protection. Place the sandbags to form a pyramid by alternating header courses (bags placed crosswise) and stretcher courses (bags placed lengthwise). Stamp each bag in place, overlap sacks, maintain staggered joint placement, and tuck in any loose ends.

**Estimating materials –** Use the table below, and assume 40 pounds of sand per bag. A 3 foot levee, 500 feet long, requires 22,500 bags, so you need (40 * 22,500) ÷ 2000 = 450 tons of sand. The weight of sand varies locally.

| DIKE HEIGHT | 50 FT | 100 FT | 200 FT | 250 FT | 300 FT | 350 FT | 400 FT | 450 FT | 500 FT |
|---|---|---|---|---|---|---|---|---|---|
| 1 Foot | 300 | 600 | 1,200 | 1,500 | 1,800 | 2,100 | 2,400 | 2,700 | 3,000 |
| 2 Feet | 1,050 | 2,100 | 4,200 | 5,250 | 6,300 | 7,350 | 8,400 | 9,450 | 10,500 |
| 3 Feet | 2,250 | 4,500 | 9,000 | 11,250 | 13,500 | 15,750 | 18,000 | 20,250 | 22,500 |
| 4 Feet | 3,900 | 7,800 | 15,600 | 19,500 | 23,400 | 27,300 | 31,200 | 35,100 | 39,000 |

**Ringing boils –** A boil is a condition where water is flowing through or under an earth structure (such as a levee) that is retaining water. Free flowing water wants to move to lower elevations. If a levee is stopping floodwaters, the water may be able to find weak points to enter. This action is called "piping". If the water finds a large enough path, the flow will become visible, and is a serious threat to the integrity of the levee. Most boils occur in sand, silt, or some combination.

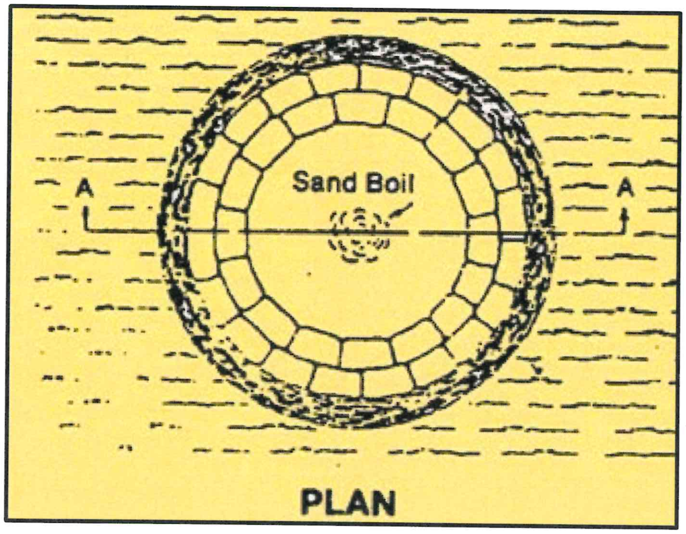
A boil is found on the landward side of the levee, or in the ground past the levee toe (the exact distance varies with local conditions). Possible boil sites can be identified by free standing or flowing water (other than culverts, pumps, etc). A boil can be found only by close inspection. A prime indicator is water bubbling (or "boiling"), much like a natural spring. Another is obvious water movement in what appears to be standing water.

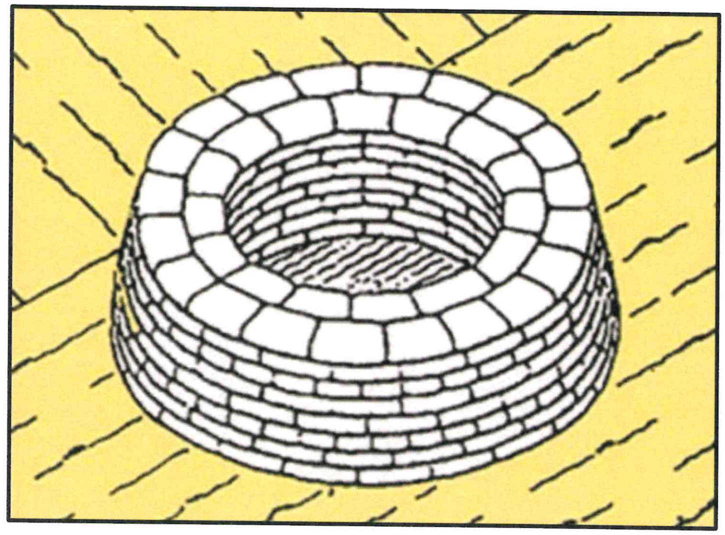
Carefully examine the water for movement. Boils will have an obvious exit (such as a rodent hole), but the water may be cloudy from siltation, or the hole very small. If there is any movement in the water, carefully approach the site, disturbing the water as little as possible. Let the water settle, and look at the suspected site. If you see the hole, examine it carefully. If the water flow is clear, there are no problems as yet. If there is no distinct hole, the water flow is not a threat. Monitor the site regularly for changes, and take no other actions.

A dirty water flow indicates that the soil is being eroded by the water, and that could mean failure of the levee. A boil ring is the best solution. The idea is to reduce the water flow until the water is flowing clear, but not to stop the water flow. This acts as a relief valve for the water pressure; the water continues to flow, but is not eroding the material. If the water flow is stopped, the pressure will remain, and another boil will form. Ring the boil with sandbags, with the first bags back 1-2 feet from the boil. More, if the soil is unstable.

Build the first layer in a circle, 2-4 bags across, and then build up, bringing each layer in. If possible, keep the interior face straight. Build the ring wall with the means for water to flow out, leaving a gap in the wall, or using pipes. Adjust the flows until the water slows, and becomes clear.

Monitor the ring wall constantly. Raise or lower the height of the wall as necessary, maintaining a slow, clear flow. The height should be only enough to slow flow such that no more material is displaced, and the water runs clear.



**Notes:**

Do not sack a boil which does not put out material.
The entire base should be cleared of debris and scarified.
Tie into the levee if the boil is near a toe.
Use loose earth between all of the sacks.
All joints must be staggered.
Be sure to clear the sand discharge.
Never attempt to completely stop the flow through a boil.

**Corps of Engineers Sandbag Policy –** Non-federal governments are responsible for maintaining a supply of sandbags adequate to cover anticipated immediate needs. At the discretion of the District Commander, a portion of the District's stockpile may be loaned to meet a specific local flood emergency. The Walla Walla District maintains a limited sandbag stockpile to augment local jurisdictions during actual flood emergencies, but can access a national contract for additional supplies. We will issue only to agencies or governments, through the designated emergency manager. Individual citizens requesting sandbags will be directed to their local government.

Unused stocks must be returned to Walla Walla District as soon as the emergency is over, unless otherwise released to the supported jurisdiction. Consumed stocks must be replaced in kind, or paid for by the local interests, unless the District Commander directs otherwise This applies only to those jurisdictions within the Walla Walla District's area of operation, the Snake River basin.

**For Further Information –** Refer to the Walla Walla District Flood Fight Handbook: Preparing For a Flood, available for download at the link below. Contact the District Readiness Office, as noted below, for a copy.

---

**U.S. ARMY CORPS OF ENGINEERS – WALLA WALLA DISTRICT**
**READINESS OFFICE**
201 North Third Avenue; Walla Walla, WA 99362-1876
509-527-7146 business hours
1-509-380-4538 emergencies (include 1-509- when calling)
cenww-eoc@usace.army.mil ¤ www.nww.usace.army.mil/Missions/Flood-Assistance/

December 2018

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corp. | Page: | 1 |
| Address: | 23 Phillips Rd. | Specifier: | Peter Poor |
| Phone I Fax: | (207) 743-8946 \| (207) 890-0636 | E-Mail: | ppoor@bancroftcontracting.com |
| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

**Specifier's comments:** HILTI DESIGN REPORT "A" - STRUT ANCHORING & BASEPLATE

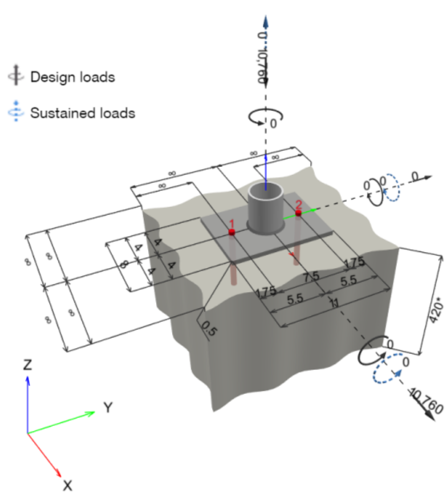
# 1 Anchor Design

## 1.1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 5/8** |
| Item number: | 333783 HAS-E B 5/8"x7 5/8" (element) / 2123401 HIT-RE 500 V3 (adhesive) |
| Effective embedment depth: | $h_{ef,act}$ = 6.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design Method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate$^{CBFEM}$ : | $l_x$ x $l_y$ x t = 8.000 in. x 11.000 in. x 0.500 in.; |
| Profile: | Steel pipe, PIPE3STD; (L x W x T) = 3.500 in. x 3.500 in. x 0.216 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Water filled** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

$^{CBFEM}$ - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

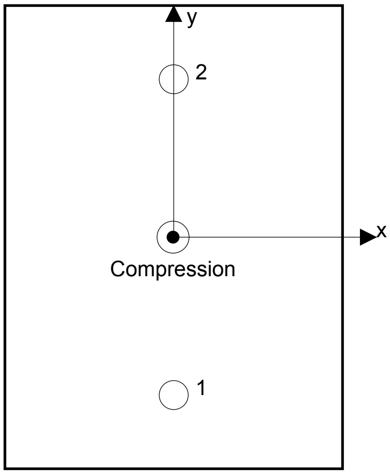
**Geometry [in.] & Loading [lb, in.lb]**



### 1.1.1 Design results

| Case | Description | Forces [lb] / Moments [in.lb] | Seismic | Max. Util. Anchor [%] |
|---|---|---|---|---|
| 1 | Combination 1 | N = -10,760; $V_x$ = 10,760; $V_y$ = 0;<br>$M_x$ = 0; $M_y$ = 0; $M_z$ = 0;<br>$N_{sus}$ = 0; $M_{x,sus}$ = 0; $M_{y,sus}$ = 0; | no | 49 |

### 1.2 Load case/Resulting anchor forces




**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 0 | 5,380 | 5,380 | -16 |
| 2 | 0 | 5,380 | 5,380 | 16 |

resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-0.016/0.000): 10,888 [lb]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

### 1.3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | N/A | N/A | N/A | N/A |
| Bond Strength** | N/A | N/A | N/A | N/A |
| Sustained Tension Load Bond Strength* | N/A | N/A | N/A | N/A |
| Concrete Breakout Failure** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (anchors in tension)

| | | | |
|---|---|---|---|
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| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

**1.4 Shear load**

| | Load $V_{ua}$ [lb] | Capacity $\phi$ $V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 5,380 | 11,017 | 49 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength (Bond Strength controls)** | 10,760 | 23,110 | 47 | OK |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (relevant anchors)

**1.4.1 Steel Strength**

$V_{sa}$ = ESR value refer to ICC-ES ESR-3814

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] | $\alpha_{V,seis}$ |
|---|---|---|
| 0.23 | 125,000 | 1.000 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 16,950 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 16,950 | 0.650 | 11,017 | 5,380 |

| | | | |
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| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |


### 1.4.2 Pryout Strength (Bond Strength controls)

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ ACI 318-11 Eq. (D-41)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-11 Table (D.4.1.1)

$A_{Na}$ see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ ACI 318-11 Eq. (D-20)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ ACI 318-11 Eq. (D-21)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-23)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-25)

$\psi_{cp,Na} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-27)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ ACI 318-11 Eq. (D-22)

**Variables**

| $k_{cp}$ | $\alpha_{overhead}$ | $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|---|
| 2 | 1.000 | 1,660 | 0.625 | 6.000 | ∞ |

| $\tau_{k,c}$ [psi] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|---|
| 940 | 0.000 | 0.000 | 9.302 | 1.000 |

**Calculations**

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 7.643 | 348.32 | 233.67 | 1.000 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 1.000 | 1.000 | 1.000 | 11,074 |

**Results**

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 33,015 | 0.700 | 23,110 | 10,760 |

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corp. | Page: | 5 |
| Address: | 23 Phillips Rd. | Specifier: | Peter Poor |
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| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

### 1.5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- The present version of the software does not account for special design provisions for overhead applications. Refer to related approval (e.g. section 4.1.1 of the ICC-ESR 2322) for details.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- The anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."

**1.6 Installation data**

Profile: Steel pipe, PIPE3STD; (L x W x T) = 3.500 in. x 3.500 in. x 0.216 in.

Hole diameter in the fixture: $d_f$ = 0.688 in.

Plate thickness (input): 0.500 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-RE 500 V3 + HAS-E B7 5/8

Item number: 333783 HAS-E B 5/8"x7 5/8" (element) / 2123401 HIT-RE 500 V3 (adhesive)

Installation torque: 720 in.lb

Hole diameter in the base material: 0.750 in.

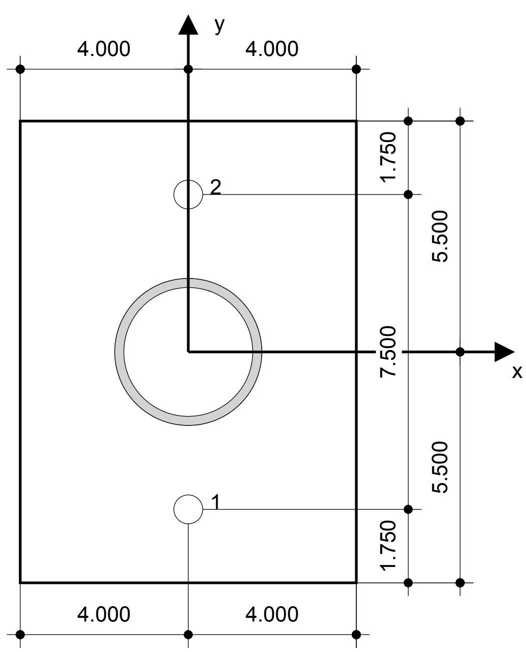
Hole depth in the base material: 6.000 in.

Minimum thickness of the base material: 7.500 in.

5/8 Hilti HAS Carbon steel threaded rod with Hilti HIT-RE 500 V3

**1.6.1 Recommended accessories**

| Drilling | Cleaning | Setting |
|---|---|---|
| • Suitable Rotary Hammer<br>• Properly sized drill bit | • Compressed air with required accessories to blow from the bottom of the hole<br>• Proper diameter wire brush | • Dispenser including cassette and mixer<br>• Torque wrench |




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | 0.000 | -3.750 | - | - | - | - |
| 2 | 0.000 | 3.750 | - | - | - | - |

## 2 Anchor plate design

### 2.1 Input data

| | |
|---|---|
| Anchor plate: | Shape: Rectangular<br>$l_x$ x $l_y$ x t = 8.000 in x 11.000 in x 0.500 in<br>Calculation: CBFEM<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00% |
| Anchor type and size: | HIT-RE 500 V3 + HAS-E B7 5/8, $h_{ef}$ = 6.000 in |
| Anchor stiffness: | The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results. |
| Design method: | AISC and LRFD-based design using component-based FEM |
| Stand-off installation: | $e_b$ = 0.000 in (No stand-off); t = 0.500 in |
| Profile: | PIPE3STD; (L x W x T x FT) = 3.500 in x 3.500 in x 0.216 in x -<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00%<br>Eccentricity x: 0.000 in<br>Eccentricity y: 0.000 in |
| Base material: | Cracked concrete; 2500; $f_{c,cyl}$ = 2,500 psi; h = 420.000 in |
| Welds (profile to anchor plate): | Type of redistribution: Plastic<br>Material: E70xx |
| Mesh size: | Number of elements on edge: 8<br>Min. size of element: 0.394 in<br>Max. size of element: 1.969 in |

| | | | |
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| Fastening point: | | | |


**2.2 Summary**

| | Description | Profile | | Anchor plate | | | Welds [%] | Concrete [%] |
|---|---|---|---|---|---|---|---|---|
| | | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Hole bearing [%] | | |
| 1 | Combination 1 | 36,013 | 0.05 | 15,134 | 0.00 | 17 | 51 | 8 |

**2.3 Anchor plate classification**

Results below are displayed for the decisive load combinations: Combination 1

| Anchor tension forces | Equivalent rigid anchor plate (CBFEM) | Component-based Finite Element Method (CBFEM) anchor plate design |
|---|---|---|
| Anchor 1 | 0 lb | 0 lb |
| Anchor 2 | 0 lb | 0 lb |

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

| | | | |
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### 2.4 Profile/Stiffeners/Plate

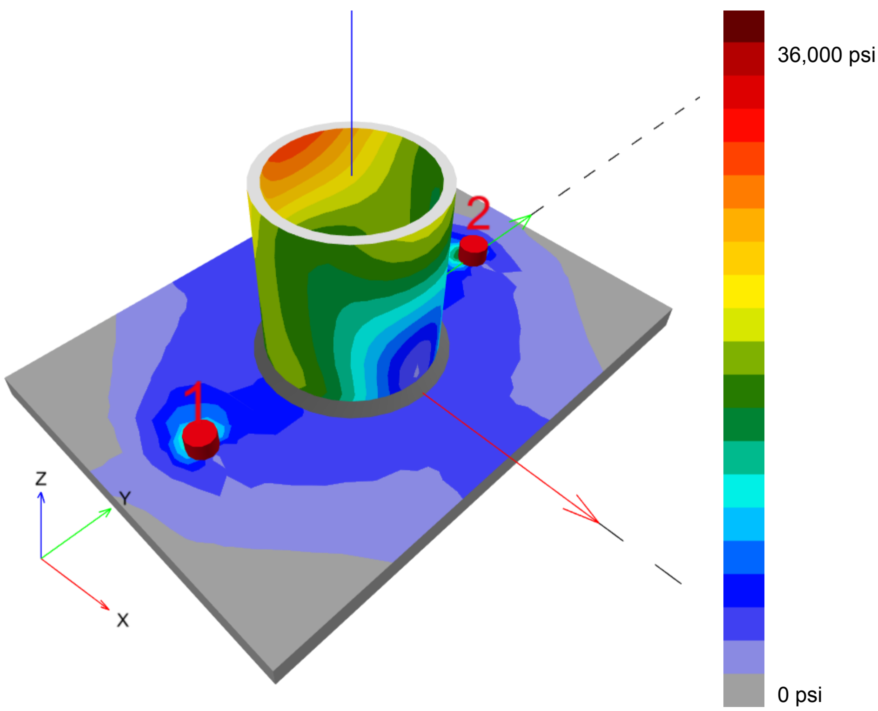
Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

#### 2.4.1 Equivalent stress and plastic strain

| Part | Load combination | Material | $f_y$ [psi] | $\varepsilon_{lim}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Status |
|---|---|---|---|---|---|---|---|
| Plate | Combination 1 | ASTM A36 | 36,000 | 5.00 | 15,134 | 0.00 | OK |
| Profile | Combination 1 | ASTM A36 | 36,000 | 5.00 | 36,013 | 0.05 | OK |

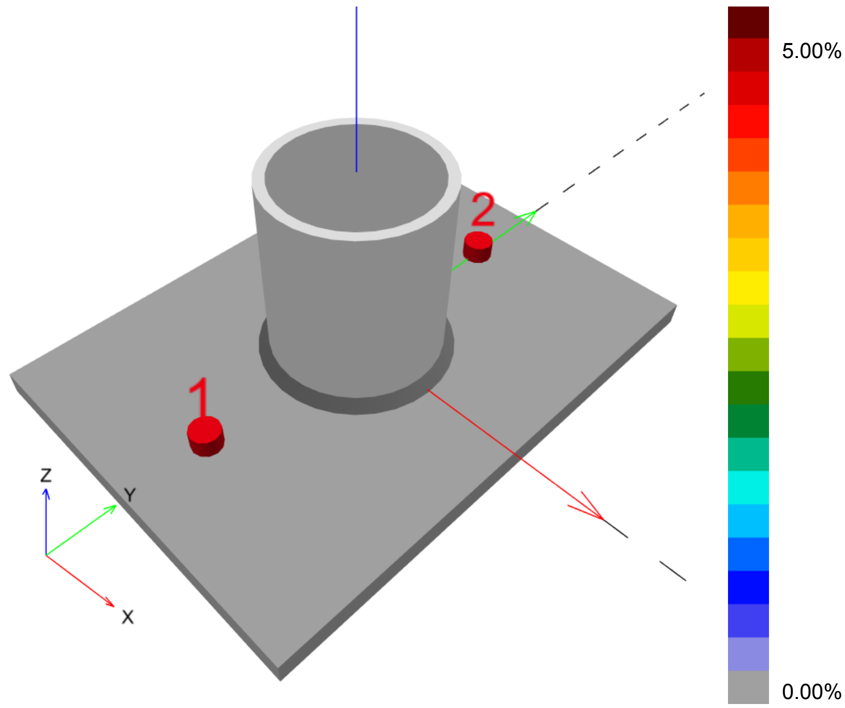
#### 2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Combination 1



#### 2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Combination 1




#### 2.4.2 Plate hole bearing resistance, AISC 360-16 Section J3

Decisive load combination: 1 - Combination 1

**Equations**

$R_n$ = $\min(1.2\ l_c\ t\ F_u\ ,\ 2.4\ d\ t\ F_u)$ (AISC 360-16 J3-6a, c)

$\Phi R_n$ = $0.75\ R_n$

$V \leq \Phi R_n$

**Variables**

| | $l_c$ [in] | t [in] | $F_u$ [psi] | d [in] | $R_n$ [lb] |
|---|---|---|---|---|---|
| Anchor 1 | 3.656 | 0.500 | 58,000 | 0.625 | 43,500 |
| Anchor 2 | 3.656 | 0.500 | 58,000 | 0.625 | 43,500 |

**Results**

| | V [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Anchor 1 | 5,380 | 32,625 | 17 | OK |
| Anchor 2 | 5,380 | 32,625 | 17 | OK |

| | | | |
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| Fastening point: | | | |

## 2.5 Welds

Profiles are modeled without taking the corner radius into account. Special rules for welding (e.g. for cold-formed profiles ...) are not taken into account by the software.

### 2.5.1 Anchor plate to profile

Decisive load combination: 1 - Combination 1

**Equations**

$$F_{nw} = 0.6\, F_{EXX}\, (1.0 + 0.5 \sin^{1.5} \Theta)$$

$$\Phi R_n = \Phi\, F_{nw}\, A_w$$

$$\text{Utilization} = \frac{F_n}{\Phi\, R_n}$$

**Variables**

| Edge | $X_u$ | $T_h$ [in] | $L_s$ [in] | L [in] | $L_c$ [in] | $F_{EXX}$ [psi] | Θ [°] | $A_w$ [in²] |
|---|---|---|---|---|---|---|---|---|
| Member 1 | E70xx | 0.157◣ | 0.223 | 10.300 | 0.322 | 70,000 | 21.3 | 0.05 |

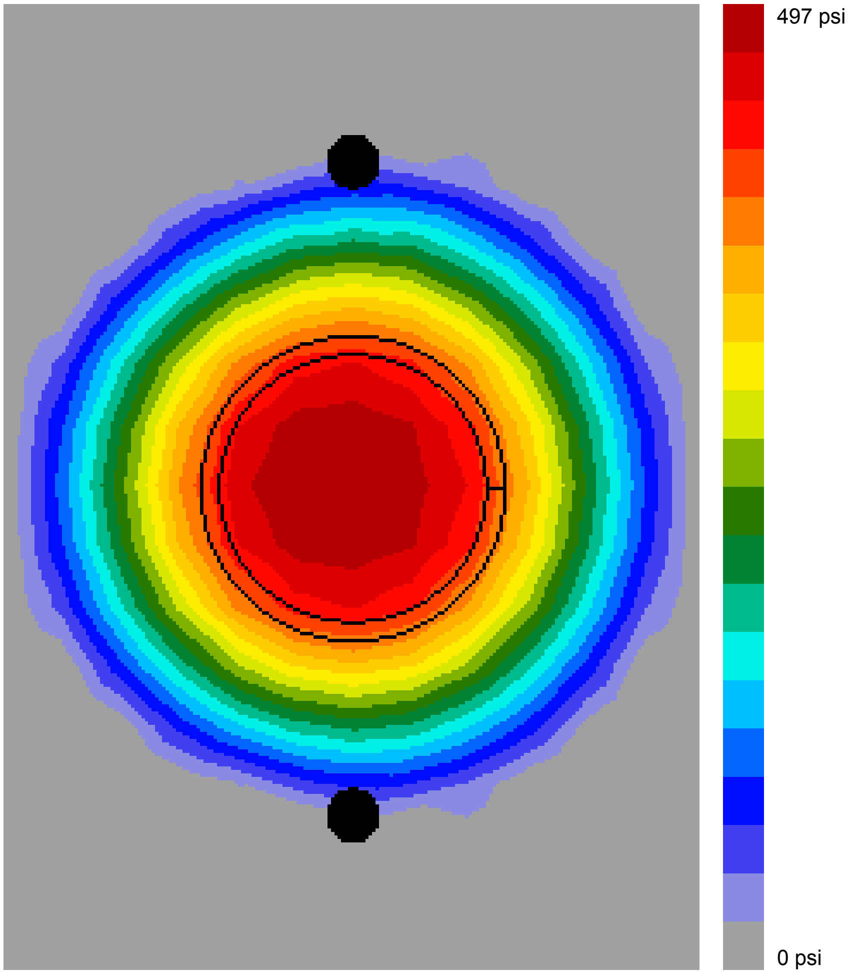
**Results**

| Edge | $F_n$ [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Member 1 | 898 | 1,771 | 51 | OK |

## 2.6 Concrete

Decisive load combination: 1 - Combination 1

### 2.6.1 Compression in concrete under the anchor plate




### 2.6.2 Concrete block compressive strength resistance check, AISC 360-16 Section J8

**Equations**

$F_p = \Phi \, f_{p,max}$

$f_{p,max} = 0.85 \, f_c' \sqrt{\left(\frac{A_2}{A_1}\right)} \leq 1.7 \, f_c; \quad \sqrt{\left(\frac{A_2}{A_1}\right)} \leq 2$

$\sigma = \frac{N}{A_1}$

Utilization $= \frac{\sigma}{F_p}$

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| Fastening point: | | | |

**Variables**

| N [lb] | $f_c'$ [psi] | Φ | $A_1$ [in²] | $A_2$ [in²] |
|---|---|---|---|---|
| 10,888 | 2,500 | 0.65 | 55.79 | 541,848.55 |

**Results**

| Load combination | $F_p$ [psi] | σ [psi] | Utilization [%] | Status |
|---|---|---|---|---|
| Combination 1 | 2,762 | 195 | 8 | OK |

| | | | |
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### 2.7 Symbol explanation

| | |
|---|---|
| $A_1$ | Loaded area of concrete |
| $A_2$ | Supporting area |
| $A_w$ | Effective area of weld critical element |
| d | Nominal diameter of the fastener |
| $\varepsilon_{lim}$ | Limit plastic strain |
| $\varepsilon_{Pl}$ | Plastic strain from CBFEM results |
| $f_c$ | Concrete compressive strength |
| $f_c'$ | Concrete compressive strength |
| $F_{EXX}$ | Electrode classification number, i.e. minimum specified tensile strength |
| $F_u$ | Specified minimum tensile strength of the connected material |
| $F_n$ | Force in weld critical element |
| $F_{nw}$ | Nominal stress of the weld material |
| $F_p$ | Concrete block design bearing strength |
| $f_{p,max}$ | Concrete block design bearing strength maximum |
| $f_y$ | Yield strength |
| $l_c$ | Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material |
| L | Length of weld |
| $L_c$ | Length of weld critical element |
| $L_s$ | Leg size of weld |
| N | Resulting compression force |
| $\sigma$ | Average stress in concrete |
| $\sigma_{Ed}$ | Equivalent stress |
| $\Phi$ | Resistance factor |
| $\Phi R_n$ | Resistance |
| t | Thickness of the anchor plate |
| $\Theta$ | Angle of loading measured from the weld longitudinal axis |
| $T_h$ | Throat thickness of weld |
| V | Resultant of shear forces Vy, Vz in bolt. |
| $X_u$ | Filler metal tensile strength |

### 2.8 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

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| Fastening point: | | | |

## 3 Summary of results

Design of the anchor plate, anchors, welds and other elements are based on CBFEM (component based finite element method) and AISC.

| | Load combination | Max. utilization | Status |
|---|---|---|---|
| Anchors | Combination 1 | 49% | OK |
| Anchor plate | Combination 1 | 43% | OK |
| Welds | Combination 1 | 51% | OK |
| Concrete | Combination 1 | 8% | OK |
| Profile | Combination 1 | 100% | OK |

**Fastening meets the design criteria!**

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**Specifier's comments:** HILTI DESIGN REPORT "B" - VERTICAL BEAM ANCHORING & BASEPLATE

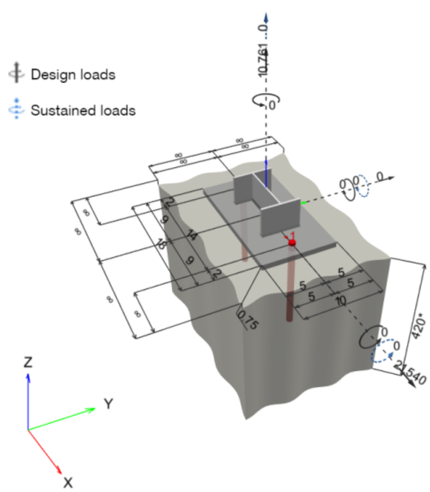
# 1 Anchor Design

## 1.1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 7/8** |
| Item number: | not available (element) / 2123401 HIT-RE 500 V3 (adhesive) |
| Effective embedment depth: | $h_{ef,act}$ = 12.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design Method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.750 in. |
| Anchor plate[CBFEM] : | $l_x$ x $l_y$ x t = 18.000 in. x 10.000 in. x 0.750 in.; |
| Profile: | W shape (AISC), W8X18; (L x W x T x FT) = 8.140 in. x 5.250 in. x 0.230 in. x 0.330 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

[CBFEM] - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

**Geometry [in.] & Loading [lb, in.lb]**



### 1.1.1 Design results

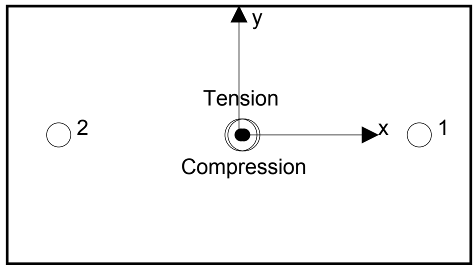
| Case | Description | Forces [lb] / Moments [in.lb] | Seismic | Max. Util. Anchor [%] |
|---|---|---|---|---|
| 1 | Combination 1 | $N = 10,761; V_x = 21,540; V_y = 0;$ $M_x = 0; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$ | no | 78 |

### 1.2 Load case/Resulting anchor forces

**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 6,966 | 10,740 | 10,740 | 0 |
| 2 | 6,817 | 10,800 | 10,800 | 0 |




resulting tension force in (x/y)=(0.076/0.000): 13,783 [lb]
resulting compression force in (x/y)=(0.189/-0.001): 3,823 [lb]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

### 1.3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 6,966 | 43,282 | 17 | OK |
| Bond Strength** | 13,783 | 21,439 | 65 | OK |
| Sustained Tension Load Bond Strength* | N/A | N/A | N/A | N/A |
| Concrete Breakout Failure** | 13,783 | 31,764 | 44 | OK |

* highest loaded anchor **anchor group (anchors in tension)

**1.3.1 Steel Strength**

$N_{sa}$ = ESR value    refer to ICC-ES ESR-3814

$\phi\ N_{sa} \geq N_{ua}$    ACI 318-08 Eq. (D-1)

**Variables**

| $A_{se,N}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.46 | 125,000 |

**Calculations**

| $N_{sa}$ [lb] |
|---|
| 57,710 |

**Results**

| $N_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ N_{sa}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 57,710 | 0.750 | 43,282 | 6,966 |

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### 1.3.2 Bond Strength

$N_{ag} = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ ACI 318-11 Eq. (D-19)

$\phi\ N_{ag} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

$A_{Na}$ = see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ ACI 318-11 Eq. (D-20)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ ACI 318-11 Eq. (D-21)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-23)

$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ ACI 318-11 Eq. (D-25)

$\psi_{cp,Na} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-27)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ ACI 318-11 Eq. (D-22)

**Variables**

| $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] | $\alpha_{overhead}$ | $\tau_{k,c}$ [psi] |
|---|---|---|---|---|---|
| 1,400 | 0.875 | 12.000 | ∞ | 1.000 | 850 |

| $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|
| 0.076 | 0.000 | 18.112 | 1.000 |

**Calculations**

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 9.827 | 661.41 | 386.26 | 1.000 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 0.992 | 1.000 | 1.000 | 28,039 |

**Results**

| $N_{ag}$ [lb] | $\phi_{bond}$ | $\phi\ N_{ag}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 47,643 | 0.450 | 21,439 | 13,783 |

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### 1.3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

$A_{Nc}$ see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

**Variables**

| $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] | $\psi_{c,N}$ |
|---|---|---|---|---|
| 12.000 | 0.076 | 0.000 | ∞ | 1.000 |

| $c_{ac}$ [in.] | $k_c$ | $\lambda$ | $f'_c$ [psi] |
|---|---|---|---|
| 18.112 | 17 | 1 | 2,500 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 1,800.00 | 1,296.00 | 0.996 | 1.000 | 1.000 | 1.000 | 35,334 |

**Results**

| $N_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi\ N_{cbg}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 48,868 | 0.650 | 31,764 | 13,783 |

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**1.4 Shear load**

| | Load $V_{ua}$ [lb] | Capacity $\phi$ $V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi\ V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 10,800 | 22,506 | 48 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength (Bond Strength controls)** | 21,540 | 67,217 | 33 | OK |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (relevant anchors)

**1.4.1 Steel Strength**

$V_{sa}$ = ESR value refer to ICC-ES ESR-3814

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] | $\alpha_{V,seis}$ |
|---|---|---|
| 0.46 | 125,000 | 1.000 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 34,625 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 34,625 | 0.650 | 22,506 | 10,800 |

### 1.4.2 Pryout Strength (Bond Strength controls)

| | |
|---|---|
| $V_{cpg} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ | ACI 318-11 Eq. (D-41) |
| $\phi\ V_{cpg} \geq V_{ua}$ | ACI 318-11 Table (D.4.1.1) |
| $A_{Na}$ see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b) | |
| $A_{Na0} = (2\ c_{Na})^2$ | ACI 318-11 Eq. (D-20) |
| $c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ | ACI 318-11 Eq. (D-21) |
| $\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ | ACI 318-11 Eq. (D-23) |
| $\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{ac}}\right) \leq 1.0$ | ACI 318-11 Eq. (D-25) |
| $\psi_{cp,Na} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ | ACI 318-11 Eq. (D-27) |
| $N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ | ACI 318-11 Eq. (D-22) |

**Variables**

| $k_{cp}$ | $\alpha_{overhead}$ | $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|---|
| 2 | 1.000 | 1,400 | 0.875 | 12.000 | ∞ |

| $\tau_{k,c}$ [psi] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|---|
| 850 | 0.000 | 0.000 | 18.112 | 1.000 |

**Calculations**

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 9.827 | 661.41 | 386.26 | 1.000 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 1.000 | 1.000 | 1.000 | 28,039 |

**Results**

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 96,024 | 0.700 | 67,217 | 21,540 |

### 1.5 Combined tension and shear loads

| $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|
| 0.643 | 0.480 | 5/3 | 78 | OK |

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

| | | | |
|---|---|---|---|
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| Fastening point: | | | |

### 1.6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- The present version of the software does not account for special design provisions for overhead applications. Refer to related approval (e.g. section 4.1.1 of the ICC-ESR 2322) for details.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- The anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."

### 1.7 Installation data

Profile: W shape (AISC), W8X18; (L x W x T x FT) = 8.140 in. x 5.250 in. x 0.230 in. x 0.330 in.

Hole diameter in the fixture: $d_f$ = 0.938 in.

Plate thickness (input): 0.750 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

7/8 Hilti HAS Carbon steel threaded rod with Hilti HIT-RE 500 V3

Anchor type and diameter: HIT-RE 500 V3 + HAS-E B7 7/8

Item number: not available (element) / 2123401 HIT-RE 500 V3 (adhesive)

Installation torque: 1,500 in.lb

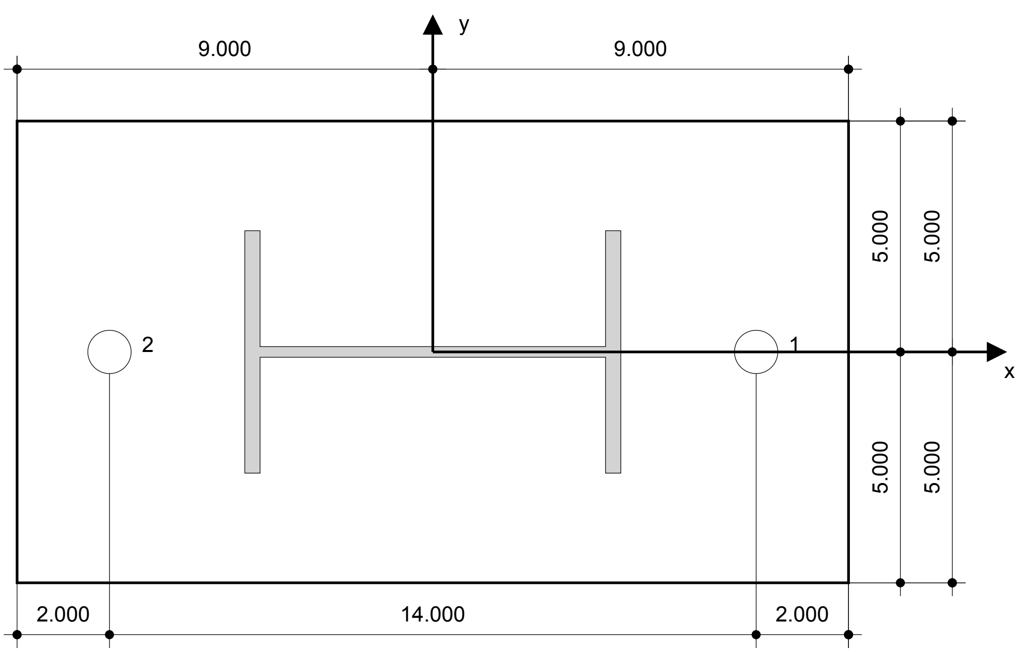
Hole diameter in the base material: 1.000 in.

Hole depth in the base material: 12.000 in.

Minimum thickness of the base material: 14.000 in.

#### 1.7.1 Recommended accessories

| Drilling | Cleaning | Setting |
|---|---|---|
| • Suitable Rotary Hammer<br>• Properly sized drill bit | • Compressed air with required accessories to blow from the bottom of the hole<br>• Proper diameter wire brush | • Dispenser including cassette and mixer<br>• Torque wrench |




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | 7.000 | 0.000 | - | - | - | - |
| 2 | -7.000 | 0.000 | - | - | - | - |

| | | | |
|---|---|---|---|
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| Fastening point: | | | |

## 2 Anchor plate design

### 2.1 Input data

| | |
|---|---|
| Anchor plate: | Shape: Rectangular<br>$l_x$ x $l_y$ x t = 18.000 in x 10.000 in x 0.750 in<br>Calculation: CBFEM<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00% |
| Anchor type and size: | HIT-RE 500 V3 + HAS-E B7 7/8, $h_{ef}$ = 12.000 in |
| Anchor stiffness: | The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results. |
| Design method: | AISC and LRFD-based design using component-based FEM |
| Stand-off installation: | $e_b$ = 0.000 in (No stand-off); t = 0.750 in |
| Profile: | W8X18; (L x W x T x FT) = 8.140 in x 5.250 in x 0.230 in x 0.330 in<br>Material: ASTM A992; $F_y$ = 50,000 psi; $\varepsilon_{lim}$ = 5.00%<br>Eccentricity x: 0.000 in<br>Eccentricity y: 0.000 in |
| Base material: | Cracked concrete; 2500; $f_{c,cyl}$ = 2,500 psi; h = 420.000 in |
| Welds (profile to anchor plate): | Type of redistribution: Plastic<br>Material: E70xx |
| Mesh size: | Number of elements on edge: 8<br>Min. size of element: 0.394 in<br>Max. size of element: 1.969 in |

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| | | | |
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| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |


**2.2 Summary**

| | Description | Profile | | Anchor plate | | | Welds [%] | Concrete [%] |
|---|---|---|---|---|---|---|---|---|
| | | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Hole bearing [%] | | |
| 1 | Combination 1 | 33,051 | 0.00 | 20,937 | 0.00 | 19 | 62 | 6 |

**2.3 Anchor plate classification**

Results below are displayed for the decisive load combinations: Combination 1

| Anchor tension forces | Equivalent rigid anchor plate (CBFEM) | Component-based Finite Element Method (CBFEM) anchor plate design |
|---|---|---|
| Anchor 1 | 5,411 lb | 6,966 lb |
| Anchor 2 | 5,350 lb | 6,817 lb |

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

| | | | |
|---|---|---|---|
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| Fastening point: | | | |

### 2.4 Profile/Stiffeners/Plate

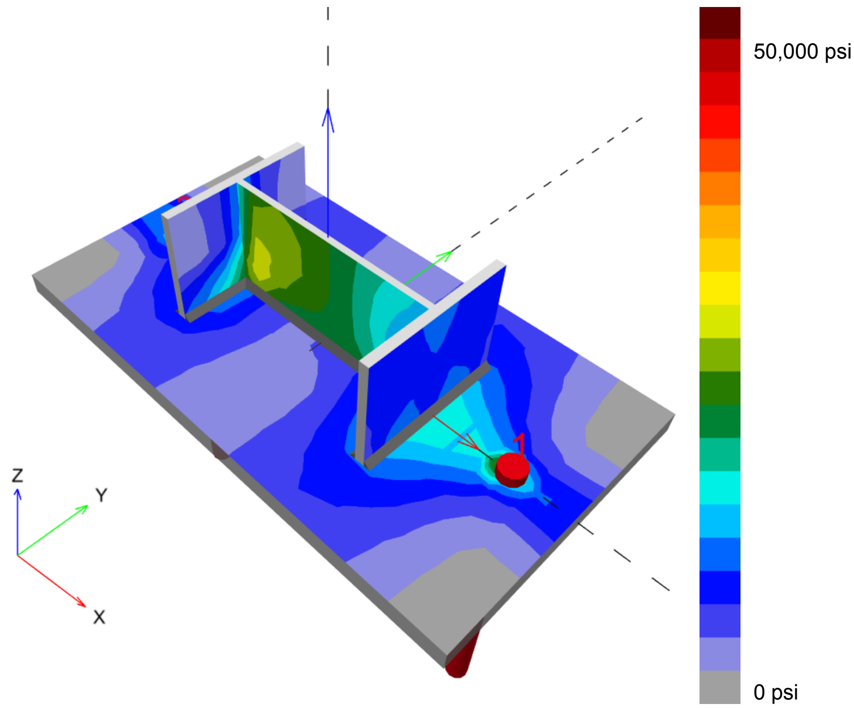
Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

### 2.4.1 Equivalent stress and plastic strain

| Part | Load combination | Material | $f_y$ [psi] | $\varepsilon_{lim}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Status |
|---|---|---|---|---|---|---|---|
| Plate | Combination 1 | ASTM A36 | 36,000 | 5.00 | 20,937 | 0.00 | OK |
| Profile | Combination 1 | ASTM A992 | 50,000 | 5.00 | 21,132 | 0.00 | OK |
| Profile | Combination 1 | ASTM A992 | 50,000 | 5.00 | 25,059 | 0.00 | OK |
| Profile | Combination 1 | ASTM A992 | 50,000 | 5.00 | 33,051 | 0.00 | OK |

#### 2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Combination 1



| | | | |
|---|---|---|---|
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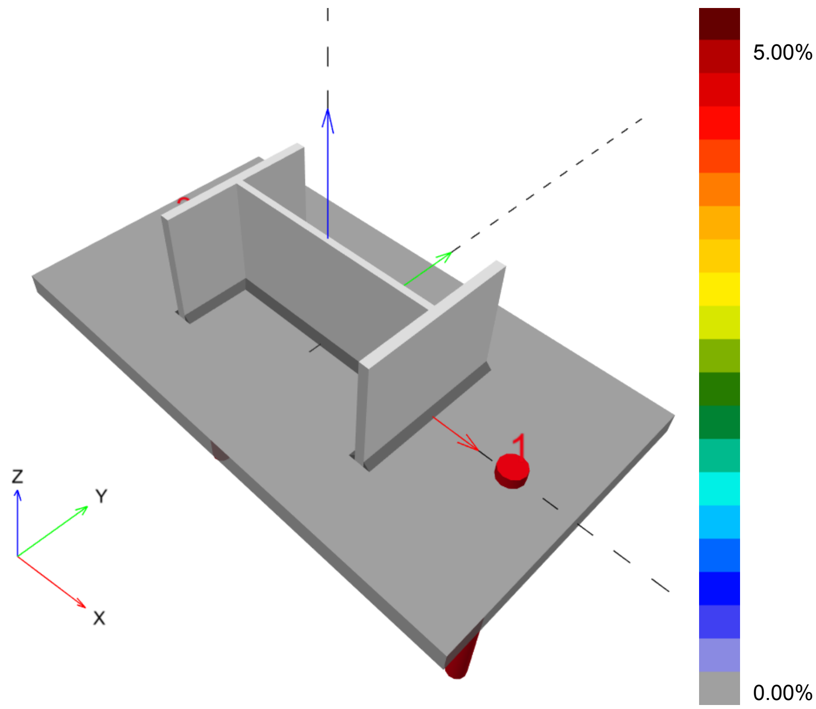
| Fastening point: | | | |

### 2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Combination 1




### 2.4.2 Plate hole bearing resistance, AISC 360-16 Section J3

Decisive load combination: 1 - Combination 1

**Equations**

$R_n = \min(1.2\ l_c\ t\ F_u\ ,\ 2.4\ d\ t\ F_u)$ (AISC 360-16 J3-6a, c)

$\Phi R_n = 0.75\ R_n$

$V \leq \Phi R_n$

**Variables**

| | $l_c$ [in] | t [in] | $F_u$ [psi] | d [in] | $R_n$ [lb] |
|---|---|---|---|---|---|
| Anchor 1 | 13.063 | 0.750 | 58,000 | 0.875 | 91,350 |
| Anchor 2 | 1.531 | 0.750 | 58,000 | 0.875 | 79,931 |

**Results**

| | V [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Anchor 1 | 10,740 | 68,513 | 16 | OK |
| Anchor 2 | 10,800 | 59,948 | 19 | OK |

| | | | |
|---|---|---|---|
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| Fastening point: | | | |

### 2.5 Welds

Profiles are modeled without taking the corner radius into account. Special rules for welding (e.g. for cold-formed profiles ...) are not taken into account by the software.

#### 2.5.1 Anchor plate to profile

Decisive load combination: 1 - Combination 1

**Equations**

$$F_{nw} = 0.6\, F_{EXX}\, (1.0 + 0.5 \sin^{1.5} \Theta)$$

$$\Phi R_n = \Phi\, F_{nw}\, A_w$$

$$\text{Utilization} = \frac{F_n}{\Phi\, R_n}$$

**Variables**

| Edge | $X_u$ | $T_h$ [in] | $L_s$ [in] | L [in] | $L_c$ [in] | $F_{EXX}$ [psi] | Θ [°] | $A_w$ [in²] |
|---|---|---|---|---|---|---|---|---|
| Member 1-bfl 1 | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 90.0 | 0.16 |
| Member 1-bfl | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 89.6 | 0.16 |
| Member 1-tfl 1 | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 89.7 | 0.16 |
| Member 1-tfl | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 90.0 | 0.16 |
| Member 1-w 1 | E70xx | ◢0.157◣ | 0.222 | 7.794 | 0.974 | 70,000 | 19.5 | 0.15 |
| Member 1-w | E70xx | ◢0.157◣ | 0.222 | 7.794 | 0.974 | 70,000 | 19.5 | 0.15 |

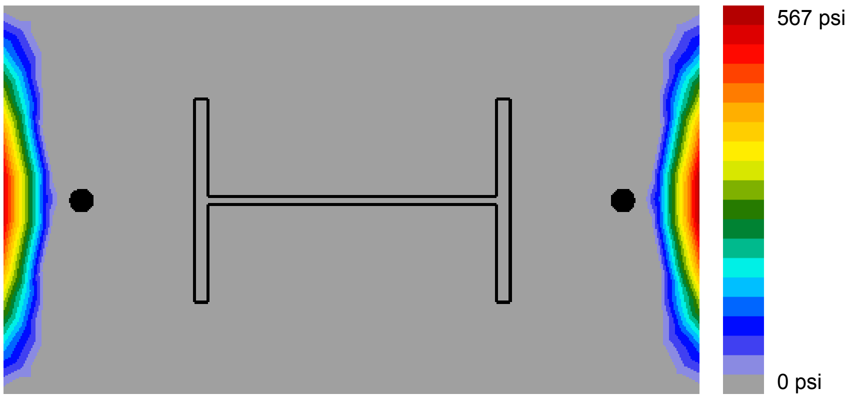
**Results**

| Edge | $F_n$ [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Member 1-bfl 1 | 4,766 | 7,760 | 62 | OK |
| Member 1-bfl | 1,811 | 7,760 | 24 | OK |
| Member 1-tfl 1 | 1,389 | 7,760 | 18 | OK |
| Member 1-tfl | 3,429 | 7,760 | 45 | OK |
| Member 1-w 1 | 1,890 | 5,282 | 36 | OK |
| Member 1-w | 1,889 | 5,282 | 36 | OK |

**2.6 Concrete**

Decisive load combination: 1 - Combination 1

**2.6.1 Compression in concrete under the anchor plate**




**2.6.2 Concrete block compressive strength resistance check, AISC 360-16 Section J8**

**Equations**

$$F_p = \Phi f_{p,max}$$

$$f_{p,max} = 0.85 f_c' \sqrt{\left(\frac{A_2}{A_1}\right)} \leq 1.7 f_c; \quad \sqrt{\left(\frac{A_2}{A_1}\right)} \leq 2$$

$$\sigma = \frac{N}{A_1}$$

$$\text{Utilization} = \frac{\sigma}{F_p}$$

**Variables**

| N [lb] | $f_c'$ [psi] | $\Phi$ | $A_1$ [in²] | $A_2$ [in²] |
|---|---|---|---|---|
| 3,823 | 2,500 | 0.65 | 23.95 | 541,696.74 |

**Results**

| Load combination | $F_p$ [psi] | $\sigma$ [psi] | Utilization [%] | Status |
|---|---|---|---|---|
| Combination 1 | 2,762 | 160 | 6 | OK |

| | | | |
|---|---|---|---|
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## 2.7 Symbol explanation

| | |
|---|---|
| $A_1$ | Loaded area of concrete |
| $A_2$ | Supporting area |
| $A_w$ | Effective area of weld critical element |
| d | Nominal diameter of the fastener |
| $\varepsilon_{lim}$ | Limit plastic strain |
| $\varepsilon_{Pl}$ | Plastic strain from CBFEM results |
| $f_c$ | Concrete compressive strength |
| $f_c'$ | Concrete compressive strength |
| $F_{EXX}$ | Electrode classification number, i.e. minimum specified tensile strength |
| $F_u$ | Specified minimum tensile strength of the connected material |
| $F_n$ | Force in weld critical element |
| $F_{nw}$ | Nominal stress of the weld material |
| $F_p$ | Concrete block design bearing strength |
| $f_{p,max}$ | Concrete block design bearing strength maximum |
| $f_y$ | Yield strength |
| $l_c$ | Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material |
| L | Length of weld |
| $L_c$ | Length of weld critical element |
| $L_s$ | Leg size of weld |
| N | Resulting compression force |
| $\sigma$ | Average stress in concrete |
| $\sigma_{Ed}$ | Equivalent stress |
| $\Phi$ | Resistance factor |
| $\Phi R_n$ | Resistance |
| t | Thickness of the anchor plate |
| $\Theta$ | Angle of loading measured from the weld longitudinal axis |
| $T_h$ | Throat thickness of weld |
| V | Resultant of shear forces Vy, Vz in bolt. |
| $X_u$ | Filler metal tensile strength |

## 2.8 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

| | | | |
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| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

## 3 Summary of results

Design of the anchor plate, anchors, welds and other elements are based on CBFEM (component based finite element method) and AISC.

| | Load combination | Max. utilization | Status |
|---|---|---|---|
| Anchors | Combination 1 | 78% | OK |
| Anchor plate | Combination 1 | 59% | OK |
| Welds | Combination 1 | 62% | OK |
| Concrete | Combination 1 | 6% | OK |
| Profile | Combination 1 | 67% | OK |

**Fastening meets the design criteria!**

| | | | |
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## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 006

Contract/Project No. TBD

Attn: Gerry Mitchell

BCC Job No. 2002036

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Unit 7-8 Powerhouse Tailrace Aquadam |

Stamp

______________________
Supplier

Bancroft Contracting Corp.
Subcontractor

Remarks: ______________________

Submitted by: Peter Poor (Name) — Peter Poor (Signature) — 4/24/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks: ______________________

Reviewed by: ______________ Name ______________ Signature ______________ Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

## Shawmut Unit 7 & 8 Cofferdam (Aquadam)
## Location: Tailrace of Unit 7 & 8 Powerhouse
## April 15, 2020

Reviewed By: Gagnon Engineering

APRIL 24, 2019

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

April 15, 2020

Gagnon Engineering
10 Solomon Dr.
Gorham, ME 04038

Mid-December 2020

Attention: Roger Gagnon, PE

Reference: Shawmut Upstream Fish Passage Project – Unit 7 & 8 Aquadam

Mr. Gagnon,

Please find attached documents providing information on the aquadam product we intend to use for dewatering the tailrace of the Unit 7 & 8 Powerhouse for installation of a new Fish Bypass Structure.

The current schedule for this area of work and duration required is from Mid-July 2020 to Mid-December 2021.

<u>Relevant Information</u>

1.) 16' Aquadam Effective Depth – El. 91.0' (Based on 132" or 11' as provided in Attachment C)
    a. We feel this elevation is conservative based on existing record drawings (Attachment A) showing the potential for a higher effective depth due to increases in ledge elevation as you move downstream.
2.) Design Elevation – El. 90.5' (See Attachment B)
    a. Our current schedule shows this area being complete by the end of 2020 (prior to runoff).

<u>Attachment Summary</u>

1.) Attachment A - Proposed location for the Aquadam and temporary access road, and elevations for installed and effective height of Aquadam.
2.) Attachment B – Site plan drawing indicating tailrace low, normal and design tailpond elevations
3.) Attachment C – Aquadam User's Guide (effective depths, installation instructions, etc.)
4.) Attachment D – Aquadam Tube Fabric Mill Certification
5.) Attachment E – Aquadam Specifications

If you have any questions or require additional information, please feel free to contact me.

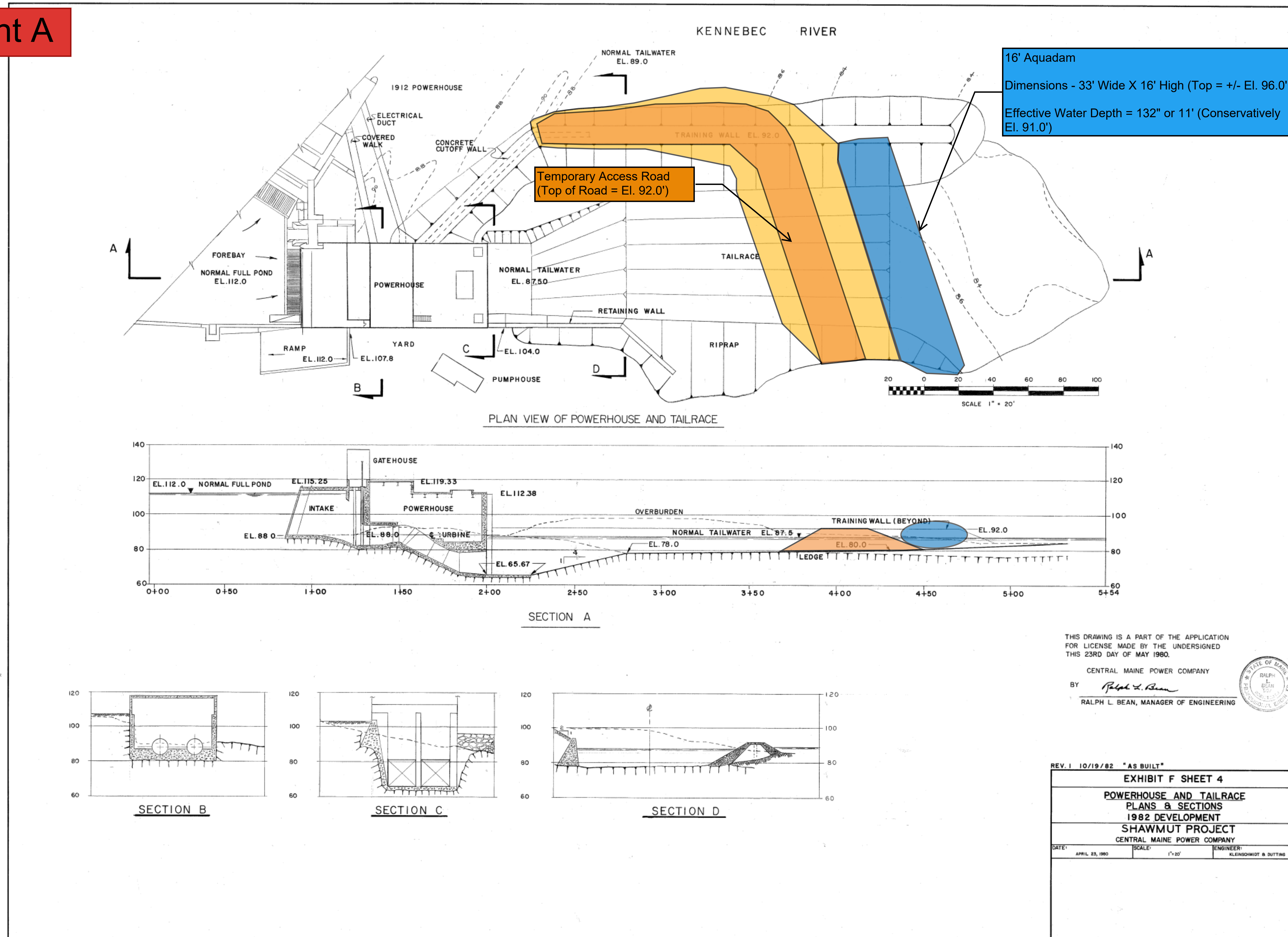
Regards,

Bancroft Contracting Corp.

Peter Poor
Project Manager
o. (207) 743-8946
c. (207) 890-7317
ppoor@bancroftcontracting.com

183-234 Sheet 4

# Attachment A




## 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
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12/13/2019
LICENSED PROFESSIONAL ENGINEER

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

OVERALL SITE PLAN

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SHEET: 10 OF 176
DRAWING: C-001

Attachment C

# AquaDam®
# User's Guide ~ 2004

***(Includes Material Specifications)***


## *"Water Controlling Water"*™

LOW-IMPACT, ENVIRONMENTALLY FRIENDLY WATER FILLED COFFERDAMS FOR STREAM DIVERSIONS, FLOOD CONTROL, HAZ-MAT CONTAINMENT, AND DEWATERING STRUCTURES.

AquaDams® are water filled barriers that can be used as dams or cofferdams for stream diversions and dewatering boat ramps, boat docks, and pond liners for repairs.Also excellent for flood protection, they are more effective than sandbags and other water control devices.

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## INTRODUCTION

AquaDam Inc® manufactures AquaDams®, a low-impact alternative to temporary earthen fill cofferdams (barriers). The Clean Water Act demands the use of alternatives to fill discharges to achieve Best Management Practices. On site mitigation is mandatory. Alternative protective devices, such as water filled cofferdams, are the ideal tools for water management programs that protect the aquatic environment. The US Army Corps of Engineers has and is presently approving the use of AquaDams® as a viable, environmentally acceptable method of diverting or containing water.

The following is an overview of Aqua Dam Inc; the various applications of AquaDams®; site and size requirements; equipment and manpower requirements; installation techniques; safety, maintenance, and removal.

## ABOUT THE COMPANY

AquaDam Inc was incorporated in 2003, after 20 years of using the idea created in the late 1980's to offer a new concept for managing water diversions, dewatering, flood control barriers, levee toppings, and water storage by using AquaDam Inc® offers installation services and free consulting services regarding the installation and implementation of a water filled cofferdam. The most important features of AquaDams® are the ease and speed at which they can be installed (especially in emergency situations). They consist almost entirely of onsite water, and are reusable.

## PATENTS

Aqua Dam Inc uses patents on the design and utilization of multiple chambered AquaDams® that use water and air as the inflation media, and the technique used in connecting multiple AquaDams® together to achieve any necessary length.

US Patent No. 5059065
US Patent No. 5125767
US Patent No. 6481928

Several other patents are currently pending.

## CONCEPT

AquaDams® are portable dams filled with onsite water that can be installed wherever needed to cofferdam, contain, or divert the flow of water. AquaDams® consist of two basic parts: an outer or "master tube" (**C**) made of a heavy duty geotextile woven polypropylene which holds the two inner tubes (**A & B**) in contact when filled with water. The outer and inner tubes combine to form an AquaDam® as shown in Figure 1, a cut away section illustrating the relationship between the inner and outer tubes of a typical filled AquaDam®.

**Figure 1: A TYPICAL FILLED AQUADAM®**

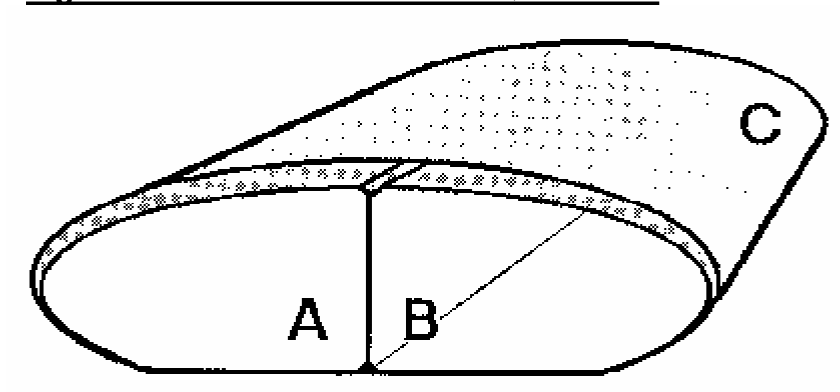



**Figure 1.** A cross section of a typical AquaDam®, illustrating the relationship between the two inner tubes which contain the water and the "master" tube that keeps the inner tubes parallel and in contact with each other.

**A** and **B** illustrates the two inner tubes inflated with water.
**C** is the outer or "master" tube made of very tough polypropylene woven geotextile fabric which confines the water filled inner tubes, making the AquaDam® a solid wall of water. These two confined columns of water provide the mass, weight, and pressure that gives the AquaDam® its stability.

To install an AquaDam®, onsite water is pumped into the two inner tubes during the installation process. The durable woven outer tube confines the water-inflated inner tubes. The counter friction / hydraulic pressure between the inner tube and the outer tube, along with the mass and weight of the water, creates pressure and stabilizes the AquaDam® when lateral water pressure is exerted against it. Due to the inherent flexibility of the materials used to confine the water, AquaDams® will conform to most surfaces, providing an excellent seal and keeping water seepage to a minimum.

AquaDams® come in a variety of sizes, ranging from 1 to 16 feet in height when inflated. AquaDams® come in standard lengths of 50 or 100 feet, and are available for immediate shipment. Any length can be fabricated. Shorter, longer, or irregular lengths are available with notice. Using attachment collars, two or more AquaDams® can be joined together to form a continuous cofferdam of any necessary length. AquaDams® are joined together by a patented coupling collar connection (standard with each AquaDam®). Large and small AquaDams® can be used in conjunction with each other. The possible configurations are almost endless. They can be used in a straight line, to form an arc, or to encircle a building. AquaDams® can also be connected at angles to each other, as may be required by the job requirements.

AquaDams® are usually assembled at the factory and shipped rolled and ready for use at the job site. However, it is not unusual to assemble larger AquaDams® on site. A typical AquaDam® consists of the "master tube" and a pair of inner tubes rolled up on a wooden or metal core as shown in Figure 2. In many instances, the core also plays an important part in the installation, rerolling for future use, and transportation of AquaDams®.

**Figure 2:**

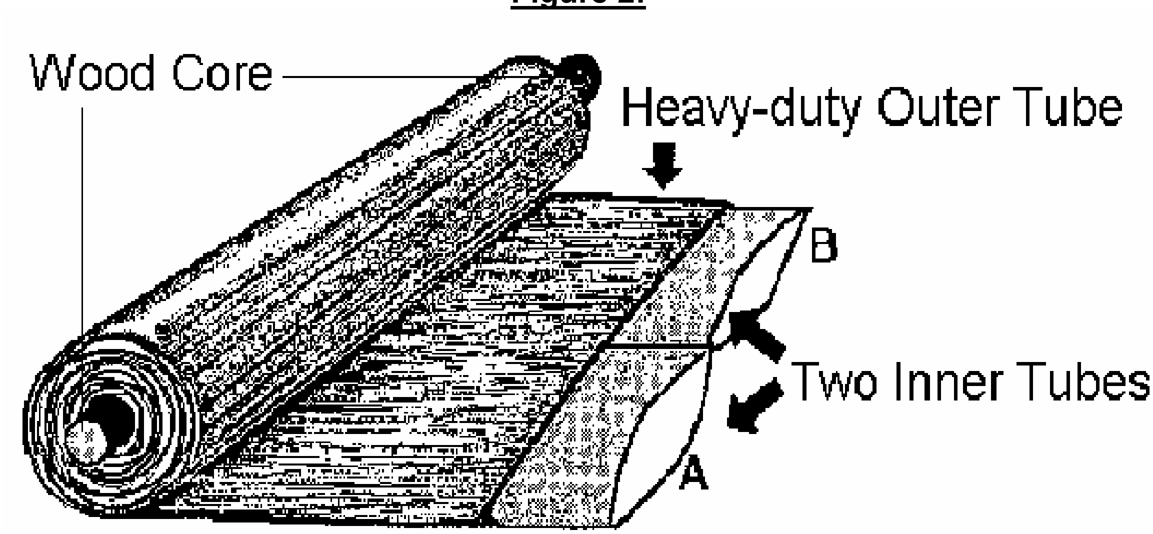



*Figure 2. A typical factory assembled AquaDam® prior to inflation, showing the inner and outer tubes rolled up around the core. The AquaDams'® tubes (A & B) are left open for filling purposes. This end will be elevated up the stream bank (the starting point) which has to be higher than the height of the AquaDam® when fully inflated. The other end is sealed and has an attached coupling collar used for joining a second AquaDam®.*

## APPLICATIONS

AquaDams® can be used in a wide range of applications. Listed below are some of the more common applications of AquaDams®:

- Cofferdams for dewatering construction sites
- Water diversion in rivers and wetlands
- Water containment
- Flood control
- Erosion control through diversion or containment of flowing water
- Water storage
- Boat ramp dewatering
- Pond liner repair dewatering
- Bridge pier repair
- Pipeline crossings

- Water intake structures for municipalities
- Water discharge structures
- Fish habitat improvement
- Silt containment, sediment collection, or settling ponds
- Levees, levee toppings
- Hazardous material or chemical spills (containment)
- Temporary foot causeway through environmentally sensitive areas
- Wetlands management

The old ways of earthen fill discharges and expensive sheet piling have been the historic ways of working in waterways. These methods are environmentally detrimental, time consuming, and expensive because of their reliance on heavy equipment.

Water filled cofferdams make the ideal water control structure for construction sites. Onsite water is pumped into an AquaDam®, which unrolls due to the water pressure inside it and can be installed in hours in most applications, without causing damage to the aquatic environment. Complete dewatering of the work site can be achieved to form and pour concrete, remove sediments, and install geotextiles.

When used for flood control and augmenting levees, for example, AquaDams® are much more effective than sandbags. They can be installed far quicker, at a fraction of the cost, without all the foot traffic associated with labor-intensive sandbagging, and best of all AquaDams® are reusable.

The amount of water that can be stored in a standard 4 foot AquaDam®, with a width of 10 feet and a length of 100 feet (filled to capacity), is about 25,000 gallons. AquaDams® are durable, long lasting, and with proper installation and removal can be stored and used again and again. Should an inner tube develop a leak, patching tape is available. If necessary, replacement tubes are available from Aqua Dam Inc.
AquaDams® are relatively easy to install, requiring only a couple of portable pumps, an onsite water supply, and two or more laborers depending on the size of the AquaDam®.

# AQUADAM® HEIGHT SELECTION AND SIZE CRITERIA

AquaDam® height selection is determined by work site conditions, the water depth to be contained or diverted, and to a lesser degree, stream bed slope and water velocity. Maximum projected changes in water depth are very important during the life of the diversion project. Table 1 lists sizes of AquaDams® and their recommended water depth usage. Customized dams of any length can be ordered.

**TABLE 1: STANDARD AQUADAM® SIZES AND RECOMMENDED USE**

| INFLATED HEIGHT (FEET) | INFLATED WIDTH (FEET) | CONTROLLED WATER DEPTH (INCHES) |
|---|---|---|
| 1 | 2 | 9 |
| 1.5 | 3 | 14 |
| 2 | 4 | 18 |
| 3 | 7 | 30 |
| 4 | 9 | 38 |
| 5 | 11 | 44 |
| 6 | 13 | 56 |
| 8 | 17 | 74 |
| 10 | 23 | 90 |
| 12 | 27 | 104 |
| 16 | 33 | 132 |

*This chart represents maximum water depths to be controlled on flat surfaces. The slope and topography of the streambed needs to be accounted for as well as water depths.*

## Water Depth:

The height of water to be contained by the AquaDam® is the most important factor when selecting the proper size. A good rule of thumb for determining the water height after diversion is as follows:

Add:

1.) the maximum water depth along the installation site,

2.) the average depth of water at the installation site,

3.) and the difference in elevation (water levels) between the installation and diverted water sites.

These three numbers equal the height of water that will be found at the installation site after the AquaDams® have been installed and water is flowing through the diversion channel.

The importance of determining the correct projected maximum water depths after installation and diversion of the stream cannot be taken too lightly. Too small of an AquaDam® will fail. **The depth of water to be retained by an AquaDam® is often underestimated, resulting in an AquaDam® that is too small for the project. This results in delays, increased costs and potentially unsafe work conditions!**

## Water Velocity:

When an AquaDam® is used to dam or divert flowing water, water velocity is a concern. During installation, the AquaDam® is being filled with water, causing it to unroll across the stream channel. This causes water flow to back up and increase in water depth. The water velocity around the end of the AquaDam® is increased. Depending on the firmness of the river bed, some undercutting might occur around the end of the AquaDam® as it is being installed. This results in an increase in the depth of water to be retained and should be factored into the analysis. Velocity of current is also a factor. The water head will build up on the upstream side and water on the downstream side flows away before the completion of the installation.

## Installation Site:

AquaDams® can be installed on top of most types of soils or fluvial materials, including: flat lying bed rock, mud, sand, gravel, small rocks, and vegetation. Select a site that is flat, and void of: wire, rebar, sharp objects, garbage, glass or dead vegetation containing tree branches, or other rip-rap. The slope of the riverbed should also be relatively flat or inclined in the direction of the upstream or contained water. Make sure to check the installation course for holes, obstructions or washed out areas that may cause problems during installation.

## Weather / Spring Run-off:

Local wet seasons and thunderstorms affect water levels in rivers, lakes, and wetlands and are important to understand during your construction Project. Projects that have flexible construction dates should be coordinated with favorable weather conditions that avoid high water levels. Water depth being retained by the AquaDam® should never exceed the recommended maximum water depth during the life of the project, not just the day you install it.

## Other Site Criteria:

All of the previous factors are important considerations once the site has been selected. The following are additional factors that may influence the site selection:

### Width of the River:

A location on a wide, shallow river is easier to cofferdam than a narrow river channel. Wide rivers will allow a diversion with only minor increases in water depth. A narrow river will quickly increase in water depth. The larger and wider the diversion channel, the less water depth will increase.

### Rough River Bed:

An extremely rugged alpine river bed (such as the Eagle River) with large angular boulders within the stream bed is a difficult area, since a good tight seal can only be accomplished through the removal of said boulders by hand or heavy equipment. In the case of the Eagle River, the boulders were scraped into a line, and the AquaDam® was installed directly upstream so that the boulders would help support it. Using four ropes was also important in the installation.

# INSTALLATION

## SMALL AQUADAMS® (1'- 4' high)

### ≋ Equipment List:

- We recommend that you use at least two portable gasoline water 2"-3" discharge pumps or one gasoline discharge pump switched from fill tube to fill tube during inflation; any available water supply will work. Anything from fire hydrants to garden hoses is acceptable; it all depends on the speed at which you want to install the AquaDam®. *
- Two discharge and suction hoses, one each per pump; no fitting is required on the end of the discharge hoses.
- A roll of duct tape to secure and constrict the size of the fill tubes when coupling AquaDams® together.
- For safety reasons, each laborer should carry a utility knife.

**The Aqua Dam Inc® crew uses 5.5HP Honda-powered 3" Volume Pumps which provide a maximum flow rate of 16,200 GPH. They are available from your local distributor for sale or rental. They can also be ordered from Great Plains Manufacturers and Distributors 1-800-525-9716;** using two of these, you can inflate: A 1' high by 100' long AquaDam® in less than 15 minutes; a 2' high by 100' long AquaDam® in 30 minutes; a 3' high by 100' long AquaDam® in under an hour; and a 4' high by 100' long AquaDam® in under an hour and a half.

### Manpower:

Two to four laborers are required to install the smaller AquaDams®. Plan out the installation beforehand and discuss it with your work party. The number of AquaDams® to be installed, time constraints, and access to the installation sites may dictate the need for additional help.

### Rock removal:

Someone will have to remove rocks by hand from the path of the AquaDam® to assure that a good seal is achieved (see the Lemhi River installation on our website). The laborers installing the AquaDam® are already committed, and cannot be the rock picking crew. Please see the Installation Section of our web site. Rocks should be picked out from directly in front of the AquaDam® as it is being installed. The rocks can be stacked on the downstream side of the AquaDam® to provide additional support (see the Williams Transco Gas Pipeline installation project in Williamsport, PA. on our website).

# LARGE AQUADAMS® (6' – 16' high)

## ≋ Equipment List:

- ≋ At least two discharge pumps are required; using larger or more numerous pumps will inflate the AquaDam® faster; the fill tubes can be opened to accommodate any size discharge hose.
- ≋ One discharge and suction hose per pump; discharge hoses do not require fittings.
- ≋ A roll of duct tape for securing the fill tubes.
- ≋ For safety reasons, each laborer should have a utility knife.
- ≋ In moving water, restraining ropes need to be used to assist the installation; at the very least, each 100 foot AquaDam® that is installed requires 250 feet of ½ inch rope. A four rope setup is strongly recommended on the installation of AquaDams® 6' high or larger in fast-moving rivers and streams (please see the Eagle River Crossing under the Installation section of our web site).

### Manpower (for installation in non-moving water):

Three to five laborers are needed to install the larger AquaDams® in non-moving water. Ropes are usually not needed to restrain the AquaDam® from unrolling during the installation process, but can be used to pull the AquaDam® around if water depths are too great for a laborer to stand. Non-moving water conditions require the fewest number of laborers.

### Manpower (for installation in moving water):

Five to seven laborers are needed to install the larger AquaDams®; the exact number of laborers is related to the size and number of AquaDams® to be installed, terrain, water velocity, water depths, and time constraints. Table 2 better describes the manpower needs during a typical installation of AquaDams® 6' or more in height in moving water.

Table 2: RECOMMENDED MANPOWER REQUIREMENTS DURING INSTALLATION IN MOVING WATER

| AQUADAM® SIZE | ROPE ASSISTED INSTALLATION | NUMBER OF LABORERS IN WATER | NUMBER OF LABORERS ON PUMPS |
|---|---|---|---|
| 1-3 FEET | NO | 2-4 | 0-1 |
| 4 FEET | NO | 3-5 | 1 |
| 4 FEET | YES-2 | 2-4 | 1 |
| 6 FEET | YES-3 | 2-3 | 1 |
| 8 FEET | YES-4 | 2-3 | 1 |

**Table 2 (cont.):**
Manpower requirements are based on a particular size of AquaDam® in moving water. The chart also provides the number of ropes commonly used with a specific size AquaDam®. Note that 4, 6, and 8 foot structures are commonly installed with the aid of ropes to prevent them from unrolling prematurely. Only in standing water would rope assisted installations not be used on larger size AquaDams®.

Strong water velocities or currents require more manpower to insure proper installation, and to secure the safety of those installing the AquaDam®. The above list does not address personnel that might be operating heavy equipment, such as an excavator. An AquaDam Inc® supervisor who oversees the installation procedure is also recommended.

In most installations, very little site preparation work is required, but to obtain a good seal, rock picking is a must. The area should also be policed for objects that might puncture the AquaDam® during installation.

<u>This Guide assumes that all Federal, State, County, and City Permits have been obtained from the appropriate government authority.</u> Aqua Dam Inc also recommends that the buyer (Prime Contractor, Company Supervisor, etc.) have an understanding of the necessary permits and what can or cannot be done within the river bed (lake) should the use of heavy equipment be necessary.

## AquaDam® Installation Procedures

Installation can be broken down into two categories: Moving water (rivers and streams) and nonmoving water (lake shores).

### Step 1-Transport:

Transport the AquaDam® to the installation starting point. Smaller AquaDams® can be easily moved into position by hand.

Carrying straps are provided on larger AquaDams®. Just hook or tie the straps to a piece of heavy equipment for transportation. Unpack the AquaDam® by carefully removing the protective wrap from the outside after cutting the packing ropes and carrying straps with a knife.

## Step 2-Starting Point:

The end of the AquaDam® will have long fill tubes to start with (usually 2-6 foot long). These are for connecting one AquaDam® to another using a collar. They are not the start of the AquaDam®. The AquaDam® starts at the outside (usually black or white) master tube that confines the two inside fill tubes (see Figure 1). Position the end of the outer tube up the bank at least as high as the AquaDam® will be when fully inflated (i.e., a 3 foot high AquaDam® would have at least 4 feet in elevation up the bank. The bank slope will have to be calculated in, and the end will have to be higher than the water level inside the AquaDam® after inflation. The AquaDam® will only achieve a height of 3+ feet at the lowest point along its path.).

If the bank is not steep enough to achieve the necessary starting height, a small amount of fill material can be placed at the waters edge to create a false bank or berm. This is the least expensive way to make a good starting point.

## Step 3-Preparing the AquaDam® for Inflation:

Insert a discharge hose into each inside fill tube. Excess fill tubes can be cut off if not desired for future use. Wrap duct tape or tie packing rope tightly around the fill tubes to keep the discharge hose from slipping out. The corners at the end of the AquaDam® can be tied to a tree or rock to prevent it from slipping down the bank slope. For smaller dams (3 feet and under), laborers are needed to stand in back of the AquaDam® roll at the foot of the slope along the waters edge. The pumping begins by pumping into both inside tubes at the same rate. The rolled portion of the AquaDam® will try to unroll, and will push up against the laborers' legs. The laborers' will wait for the water level to rise and build pressure inside the AquaDam®. When the height of the AquaDam® is great enough, the laborers should take a step back. Then they must wait until the height builds up again before taking another step backwards. All laborers must step backwards in unison and cooperate so that a foot does not get caught while unrolling it®. Water levels inside the AquaDam® must be kept at a level higher than the upstream water side of the AquaDam® (see the Pacific Gas and Electric and other installations on our website). This water depth will increase as the unrolling AquaDam® begins to constrict (cut off) the stream flow.

## Step 4-Moving Rocks and Debris:

When installing an AquaDam®, you must not only remove rocks from its path to ensure a good seal, you must remove all debris. Sharp, angular objects are often located under the water level, and usually the only way to find them is to walk around in the water until you step on them. Not only will these obstructions cause a greater amount of leakage, there is always the possibility that they may cause damage to the AquaDam®. **Never take it for granted that your work area is free from debris! ALWAYS CHECK FIRST!**

*THIS IS YOUR ENEMY…*

*This shopping cart was completely invisible during high tide.*

## Step 5-Restraining Ropes:

### Large AquaDams®

AquaDams® that are four or more feet in height commonly require restraining ropes to restrain the unrolled portion of the AquaDam® during the installation process in live streams. Without these lines or ropes the pressure of the water in the inner tubes would cause the AquaDam® to unroll before the proper inside head pressure is achieved. Preventing this pressure from prematurely unrolling the AquaDam® is very important. The pressure of the water mass inside the AquaDam® has to overpower the pressure of the water on the upstream side (compared to the downstream side). In lake water, the pressure will be the same on both sides of the AquaDam® (until dewatering begins by pumping).

The number of ropes (lines) required by a particular sized AquaDam® is discussed in Table 2 and Figure 3. If ropes are to be used in the installation process, they should be placed under the AquaDam® before water is added. The ropes are attached to the base of the metal posts or trees, then run under the AquaDam®, over the top, and back to the starting point. They should be held in a manner that will allow the rope to be let out as the AquaDam® unrolls across the stream. The rope should be twice as long as the AquaDam® when inflated, plus an extra 50 feet.

## Standing Water Applications:

Standing water or lake installations are much simpler than those using AquaDams® or in live streams. The AquaDam® will unroll itself with a minimum number of laborers to assist in the installation. Ropes can be used to turn the AquaDam® in places where it is too deep for laborers to stand. Water pressure from one side of the AquaDam® to the other should stay equal, making it unnecessary to maintain head pressure inside the unit. Laborers just need to guide it in the right direction.

## Step 6-Determine Height & Elevation:

The rolled AquaDam® should start at the top of the riverbank or berm. The end of the AquaDam® must be raised higher up the starting bank than the estimated height of the fully inflated AquaDam®. Gravity keeps the water used to fill the AquaDam® from flowing back out the elevated end. (Actually, we recently began offering double closed-ended AquaDams® which no not need to have the end elevated to hold water. However, the start of the AquaDam® must still tie into something like a bank or berm or water would just go around the end.)

**Figure 3: LARGE AQUADAM® INSTALLATION ACROSS A FLOWING STREAM**

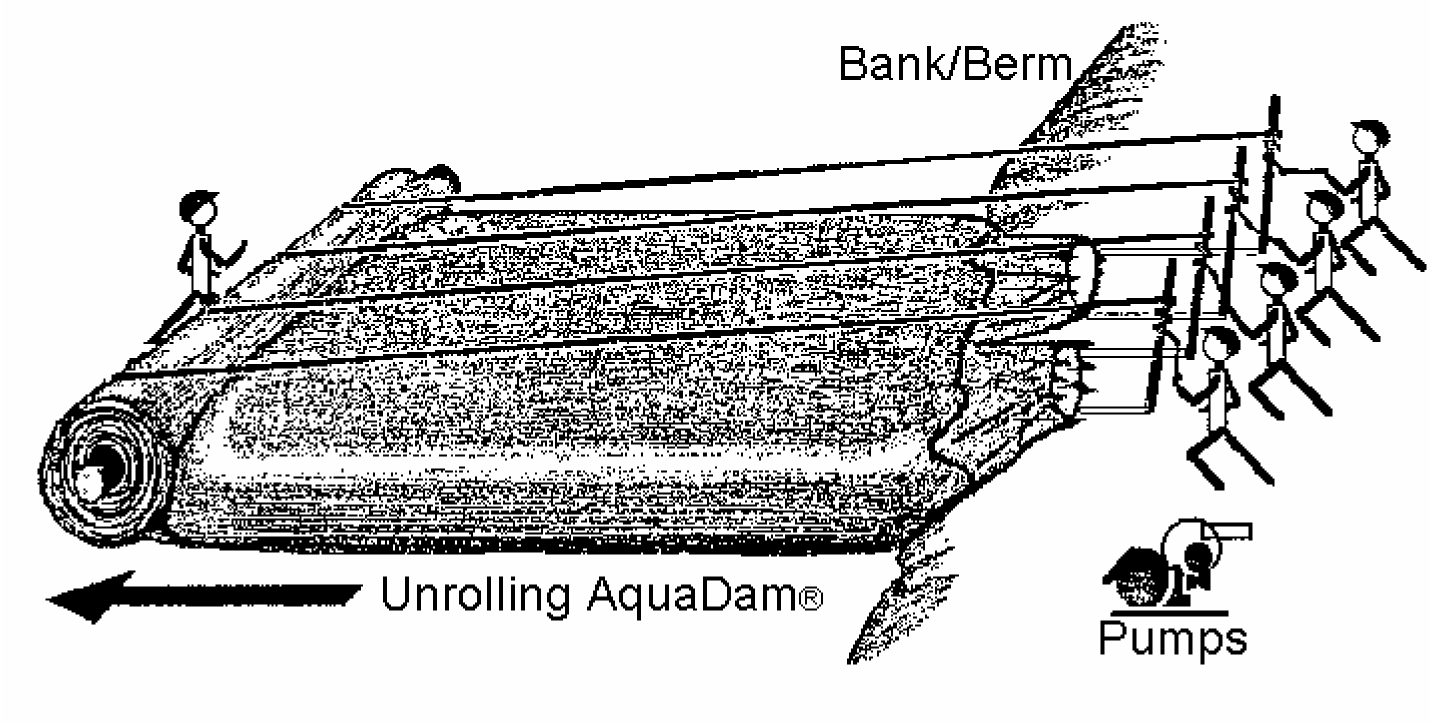



*Figure 3. shows the location of the ropes, posts, laborers and the inflating AquaDam®.*

## Step 7-Inflating the AquaDam®:

Figure 3 represents the most difficult installation scenario, such as a flowing stream where ropes must be used. The onsite conditions can change quickly in live streams because water depths will change from one side of the AquaDam® to the other. This difference in pressure will make the AquaDam® move downstream unless head pressure is maintained inside the AquaDam® during all phases of the installation. An AquaDam® that is unrolled too quickly and is not allowed to inflate above the level of the surrounding water will move downstream with the water flow. The workers on the bank slowly let the ropes out to allow the AquaDam® to unroll when inside water pressure and mass are achieved. Unroll 2-3 feet at a time, then wait for head pressure to build again, repeating this process until the AquaDam® is fully unrolled (see the Eagle River installation in Vail, CO on our website). Timing is everything. **Do not get in a hurry! Let your pumps work!** A requirement of using ropes is that the AquaDam® must be installed in a straight line. Head pressure must be maintained inside the AquaDam® to prevent it from moving. Ropes tend to move to the outside of the unrolling AquaDam®. The worker at the end of the unrolling AquaDam® adjusts the ropes and keeps them in the center by slackening and moving one rope at a time while the other ropes maintain the necessary inside pressure to keep the AquaDam® from moving downstream. On site rock that needs to be moved to assure a good seal should always be moved to the downstream side and used for support.

**Figure 4:**

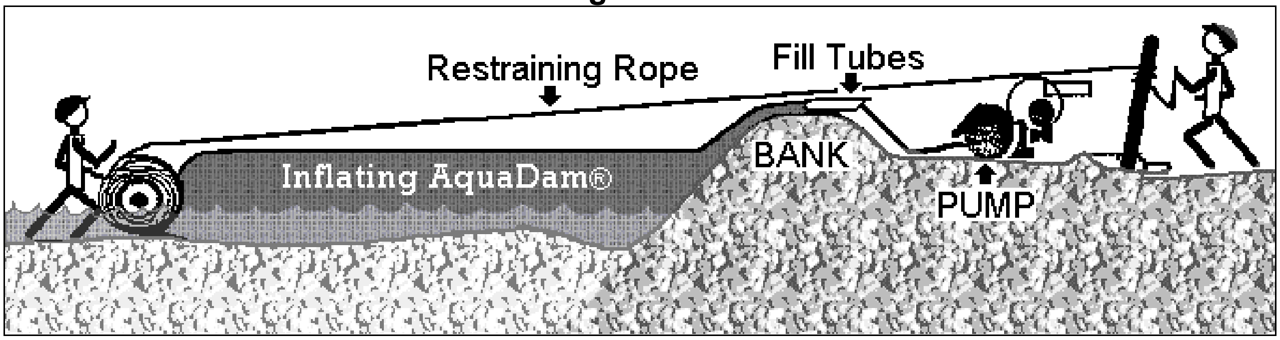



*Figure 4. A cross section of a large AquaDam® being installed in flowing water, illustrating the location of the berm, pumps, ropes, laborers and the inside water head pressure, compared to the outside water levels.*

## Manning the Ropes:

Once the ropes are manned, the pumps are primed, and the AquaDam® is aimed in the proper direction (at a right angle to the starting point on the bank), the pumps can be turned on and the inflation process can begin. Figure 5 shows a picture of restraining ropes used during installation of a large AquaDam® in a fast moving river. The small diversion channel in this project demands that a large AquaDam® be used despite the low water level, because of the anticipated increase in water depth (above 6 feet). The AquaDam® should be unrolled at a rate of about 1 to 3 feet every time the ropes are slipped and maintain a 12-24 inch (or greater) head of water pressure inside the AquaDam® ,compared to the upstream water depth, which will be increasing. Each foot of installed AquaDam® requires 2 feet of additional rope. The AquaDam® has to overcome imbalances of water head displacements happening in the river during the installation process. **Only experienced installation personnel should attempt to install large AquaDams® in moving water.** Smaller AquaDams® can be installed more easily and require less expertise.

**Figure 5: USING ROPES TO INSTALL AN AQUADAM® IN FLOWING WATER**

*Figure 5.: A large AquaDam® being installed on the Saddle River in northeastern New Jersey. Only one laborer is needed in the water to keep the ropes in position. Using ropes require that the AquaDam® only be installed in a straight line. Connections can be made at a later date if turns are required. Coupling collars are placed underneath the first AquaDam® as it is being unrolled( if connections are necessary).*

## Lateral Movement:

An AquaDam® being installed in flowing water can be vulnerable to moving downstream during the installation process. Maintaining internal head pressure is very important. To give support along the side of the AquaDam® a small mound of fill material can be placed directly downstream so that the AquaDam® rests against it. A small mound every 20-30 feet provides a tremendous amount of support. Of course, turbidity is kept to a minimum because the flow has already been diverted by the AquaDam® as it is being installed.

Another technique used to install large AquaDams® in flowing water is to install a shorter, sometimes smaller dam in a straight line using ropes (this is sometimes referred to as a “buffer”), and then place the bigger AquaDam® directly upstream, allowing it to rest against the smaller AquaDam®. In this fashion, the pressure in the larger upstream AquaDam® can be lowered to allow it to turn around the end of the smaller AquaDam®, without it having to be kept in a straight line with ropes. You can see an example of this on the Williams Transco Gas Pipeline project in McComb, MS on our website.

## How Lateral Movement Occurs:

Lateral movement of an AquaDam® during installation occurs when there is insufficient water mass inside the AquaDam® to overcome the difference in water pressure on the upstream side of the AquaDam® (compared to the downstream side, which will always be less). The difference in water depth must be compensated for by the amount of pressure inside the AquaDam® during and after installation. Water levels will rise rapidly during installation and should be monitored continuously by the crew in the water.

Sometimes lateral movement is hard to detect, but usually the following are indications:

- Visual lateral movement of the AquaDam®.
- The seams on the AquaDam® are straight for some distance but appear bent in the middle.
- The AquaDam® is no longer pointed in the direction originally taken.

If lateral movement begins to take place or evidence of rolling can be detected, then steps should be taken to correct it. A 6-12 inch change in water level could wipe out all of the installed AquaDams® if the proper amount of head pressure is not kept inside. One step that can be taken to prevent lateral movement is to increase the internal water volume that creates the internal pressure. Fill material can be placed directly on the downstream side in small amounts, allowing the AquaDam® to rest on it. All rocks moved for seepage control should be used to shore it up during installation. Often, fill material has to be excavated from the channel. This is placed behind the AquaDam® for storage, and allows the AquaDam® to rest on it so that more water depth can be controlled than what our User's Guide suggests.

AquaDams® should always be filled with the maximum amount of water possible. Always fill your AquaDams® to their recommended height.

Other solutions to moving or sliding are to install a smaller AquaDam® directly behind the main AquaDam® on the dewatered side. In standing water, stop dewatering and allow the bodies of water on either side of the AquaDam® to equalize.

**Figure 6: SHORING-UP CROSS SECTION**

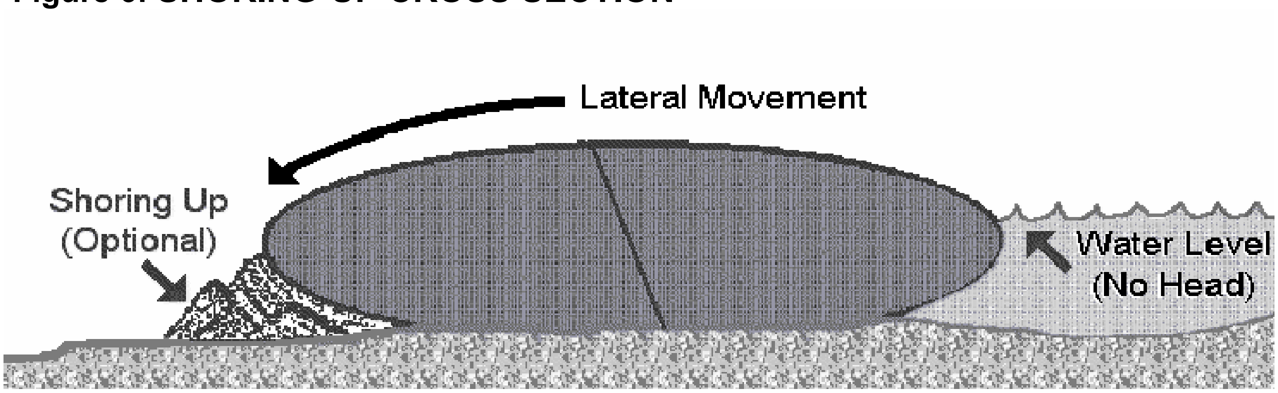



*Figure 6. A cross section showing the placement of earthen fill material to shore up an AquaDam® that shows signs of lateral movement.*

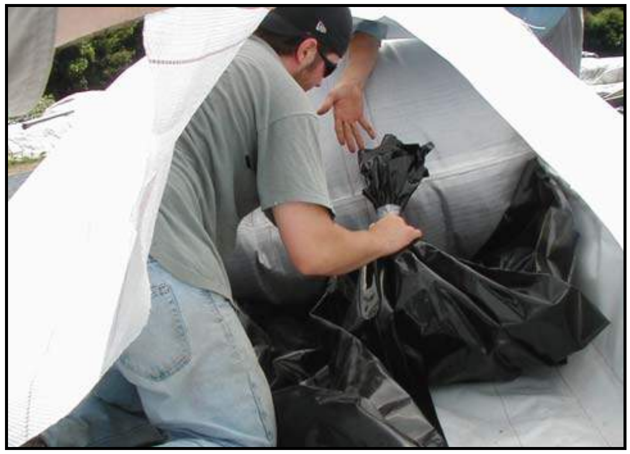
## CONNECTING AQUADAM® SECTIONS USING COUPLING COLLARS:

**Step 1:** Certain applications require two or more sections to be coupled together to form a longer, continuous water-filled cofferdam. The following illustrates how this is accomplished (the procedure assumes that the AquaDams® are being joined in a straight line end to end). All standard closed-ended AquaDams® come with a coupling collar on the closed end. The other end has the fill tubes, and has been designed to fit snugly into the coupling collar. Before a second AquaDam® can be attached, step one is to install an AquaDam® fitted with a coupling collar.

**Step 2:** Position the second AquaDam® directly behind and in-line with the filled AquaDam® and unroll about 10 feet of the new section, plus the length of the fill tubes *(see Figure 7a).*

**Step 3:** Gather up the end of one fill tube, gently twist or bunch it up, and wrap with duct tape. Do the same thing to the other tube. This will allow the inner tubes to be easily inserted and pulled through the round holes cut into the top of the coupling collar at the end of the installed AquaDam® *(see Figure 7b)*

**Step 4:** Carefully cut two round holes 6 inches in diameter in the top of the collar attached to the filled AquaDam® master tube. Each hole should be large enough to accommodate the bunched inner fill tube of the AquaDam® that is being attached. The two holes should be positioned midway between each side of the AquaDam®.
They should be about 1-2 feet apart on a four foot AquaDam® and 4 feet apart on a six foot high AquaDam®.



**Step 5:** Insert the wrapped right inner tube through the hole on the right side of the coupling collar, and the wrapped left inner tube through the hole on the left side of the coupling collar. This is done by working your way inside the coupling collar, pushing the inner tube toward the hole and having a second person reach through the hole from the outside, grab the tube, and pull it through the hole (about four feet of fill tube should be pulled on top for a four foot high AquaDam®). Pull the outer tube of the AquaDam® being connected inside the coupling collar and around the inner tubes as well as possible. The new section should be totally enclosed by the coupling collar, and the master tube of the AquaDam® being installed should be pulled up so as to be in contact with the end of the water-filled AquaDam®. Pull all excess fill tube material up on top through the holes.
*(see Figure 7c).*

**Step 6:** The 4'X8'X ½" sheet of plywood described in the equipment list is for the pumps to sit on, should they need to be placed on an inflated AquaDam®. When two AquaDams® are coupled or attached together, pumps are generally set on the previously filled AquaDam®, about 15-20 feet away from the end of the AquaDam®. The plywood will prevent damage to the AquaDam®, but it is not necessary by any means.

**Step 7:** Remove the tape or string from around the bunched inner fill tubes and insert the discharge hoses deep inside them, making sure that they extend past the coupling collar. Removal of fittings on the discharge hoses is recommended. If they cannot be removed, cover metal ones with duct tape. To keep the fill hoses from sliding back out, bunch the fill tubes up around them and secure with duct tape

(see Figure 7d).

**Step 8:** At this point the new section is ready to be filled in the same manner as the first section. Follow all of the instructions previously presented to install the first AquaDam®. Figure 8 is a drawing of two AquaDams®, one filled and the other ready to be filled.

**Figure 7: CONNECTING AQUADAMS® USING COUPLING COLLARS**

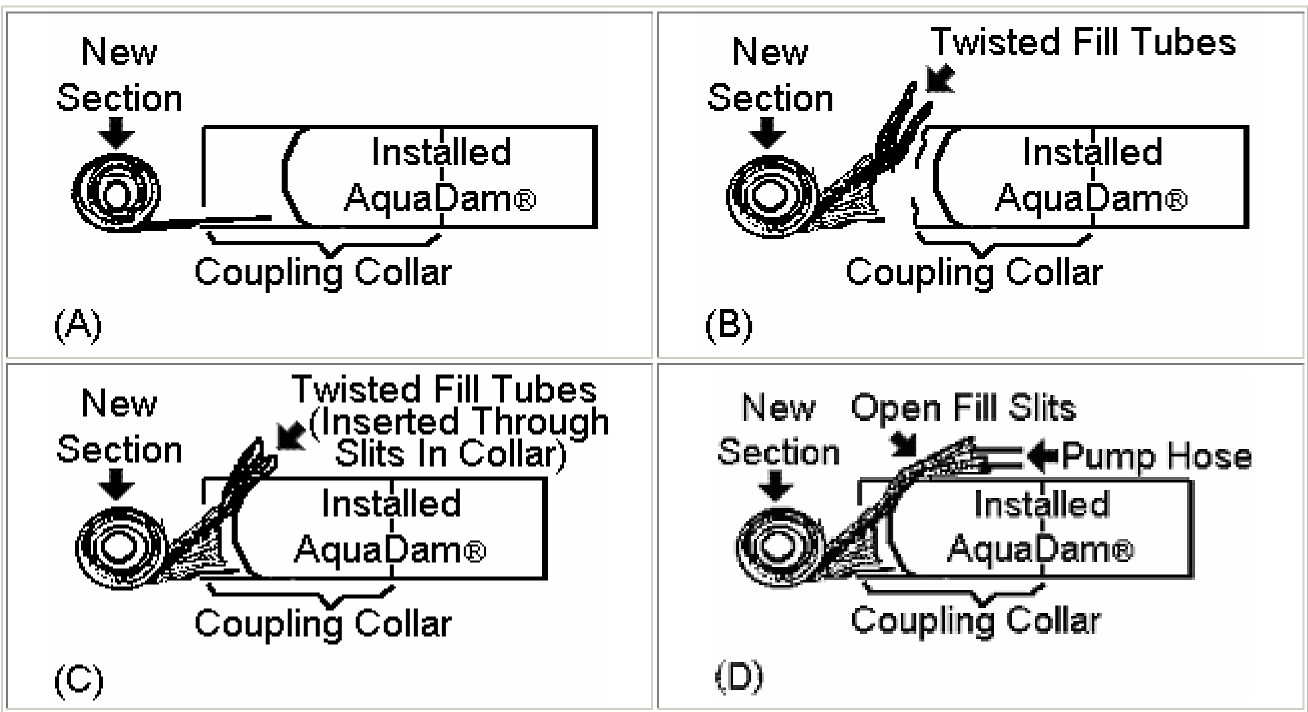



*Figure 7, illustrations a, b, c, and d show the different steps taken in the process of joining two AquaDams® together using a collar.*

**Figure 8: TWO AQUADAMS® COUPLED TOGETHER:**

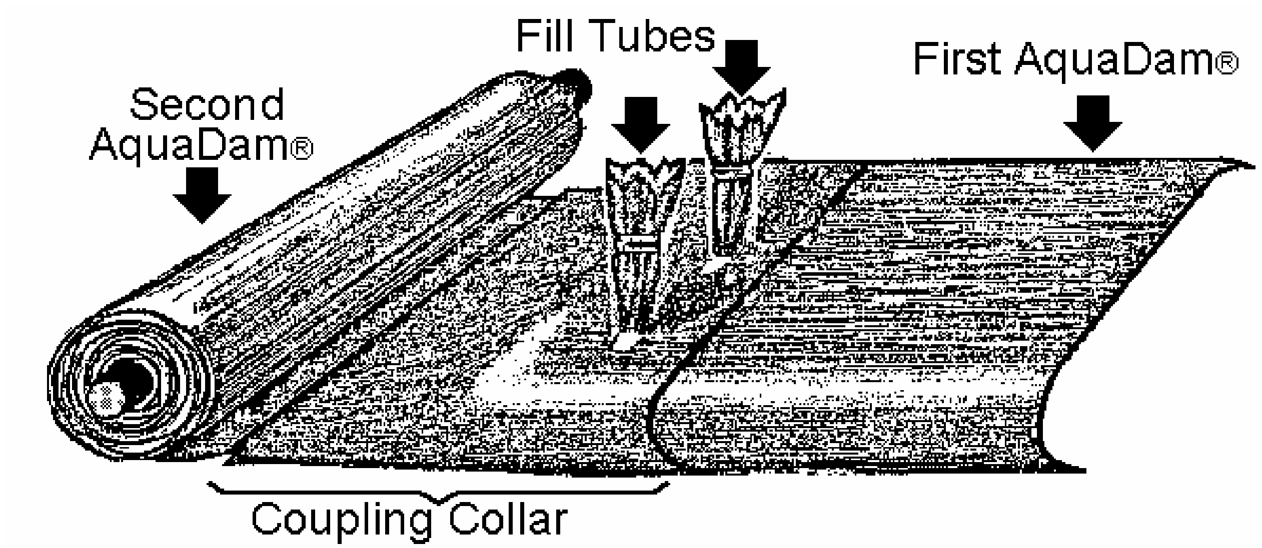



*Figure 8: Two AquaDams® are joined together by a coupling collar and ready to be inflated. The two inner tubes stick out and up from the middle portion of the coupling collar. These are the extra fill tubes located at the open end of each AquaDam®.*

**Step 9:** When the second section is filled, the water hoses can be removed from the inner tubes. The fill tubes are rewrapped with duct tape tightly and in such a manner that the tubes will stand up by themselves (see the Woodlawn Lake Sediment Removal project in San Antonio, TX on our website). If possible, use duct tape to attach the two upright inner tubes together, making them even more stable and preventing water from leaking out. Gravity will keep the water from rising above the height of the fill tubes.

## MAINTENANCE PROCEDURES

Installed AquaDams® are durable and will last a long time. Each installed section should be monitored regularly for leaks. The easiest way to deal with a leak without removing the AquaDam® is to pump more water into it. Small leaks can be patched with special repair tape

There are four important observations that should be made on a regular basis.

- Leaks in the AquaDams®
- Seepage under the AquaDams®
- Inner fill tubes that have fallen over and are draining water
- Lateral movement of the AquaDam®



Most leaks are of such a nature that they can be resolved simply by pumping additional water into the AquaDams® on a periodic basis. Identify which of the tubes is leaking, untie and unwrap the inner tube and insert the discharge hose from the water pump and fill it. Sometimes, a leak is large enough to require a patch. To repair such a leak, first identify and isolate the area around it. Then, using a sharp knife, cut a 'cross' or X through the master tube and pull the material apart to expose the leak, being careful not to further damage the inner tube. Then, using tape provided by AquaDam Inc
, apply
the patch to the inner tube. Once the leak is repaired, cover the 'cross' cut in the master tube with the same repair tape. In most cases it is best to just add water on a regular basis, until the AquaDam® can be taken out of service and patched properly from the inside or the inner tubes can be replaced.

## AQUADAM® REMOVAL USING REROLLING BRACKETS

Rerolling a small AquaDam® after use in a small stream. When two or more AquaDams® are connected together the downstream AquaDam® is removed first by pumping out the inside water, or allowing the fill tubes to drain the AquaDam® down to a level where the connection can be disassembled, allowing the water to pass out freely once rewinding begins at the other end. This forces the water to the open end and out.

Note: in some cases, it may be a better idea to hook the closed end to an excavator or other piece of equipment, lift it up, and simply let gravity drain the water out *(see below)*.

# LARGE AQUADAM® REMOVAL

For larger AquaDams® that are too big to reroll in place, equipment such as an excavator or backhoe can be used to pull the AquaDam® from the lake (in standing water). Pump out or drain as much of the water as you can, and put a strap around the closed end of the AquaDam®. Place the strap as close to the end as possible or water will remain trapped inside. **Do not pull on the collar.** Very slowly lift up on the strap. The water should drain out the open end. Make sure that the fill tubes are draining, they might need to be pulled further off the bank. Go slowly so that you do not lift the water any higher than is necessary for it to drain. Pull the deflated AquaDam® out of the water. It can now be blown up with air for inspection and rerolling. After the AquaDam® has been inspected and any holes have been patched, make sure that the coupling collar is still in place. It is now time to reroll the AquaDam® for storage and reuse. AquaDams® can be reused over and over again, depending on the application. They can also be used on a one-time basis and be destroyed when they are removed, or if they become contaminated with a hazardous material. It is difficult to remove large AquaDams® used to block off flowing streams and rivers. Sometimes, there is no way to remove the AquaDam® and maintain the internal water pressure necessary to hold it in place at the same time.

As the AquaDam® is being emptied, it will be forced out of the way by the difference in water depth from the upstream side of the AquaDam® to the downstream side.

There are many applications where an AquaDam® can be saved and rerolled for use at a later date. All smaller AquaDams® can be rerolled. Rerolling requires brackets to fit over the ends of the wooden beams that the AquaDams® come assembled on. A 3/4" drive ratchet can then be attached to the bracket. A 5' long section of pipe is slid over the handle of the ratchet (a cheater bar) to achieve maximum torque. Water can be pushed to the open end and out.

# SAFETY

## Emergency Removal:

Laborers should stay out of harm's way and be aware that standing at the end of the unrolling AquaDam® is dangerous, and they should stand clear whenever possible. The number of personnel in this position should be kept to a minimum. Should the laborers holding the ropes let go of them, the AquaDam® will rapidly unroll, and a laborer could be pinned underneath. That is why **all laborers should carry safety knives**, so that the AquaDam® can be slit open on the upstream side to relieve inside water pressure so that the AquaDam® will immediately drain, allowing it to move off of the trapped worker. The best way to do this is with a single long, lateral slice down the side of the AquaDam®. You must be standing on the upstream side. The downstream side is the direction that the AquaDam® and all of the water behind it will move in. It is very important that everyone works together!

## Obstacles & Debris:

The beds of rivers and streams are rough and can have holes and other obstacles that should be avoided in them. The easiest way to avoid them is to just go around. Removing something large that is silted into the riverbed will leave a large hole. This leaves you worse off than you were before. Going over this type of area will have more seepage, and it will also affect the height of the AquaDam®.

## Cold Weather:

In cold water, neoprene chest waders are highly recommended. All OSHA rules and guidelines should be followed closely. Personal Flotation Devices (PFDs) should be also used.

## Walking on the AquaDam®

The woven geo-textile fabric that the master tube is made of is puncture and UVI resistant. Heavy foot traffic on top of the AquaDam® is okay. The only time you might curtail foot traffic is during cold weather, when ice occurs within the inner tubes, but they can still be walked on. The ice may cut the polyethylene when it cracks or breaks from foot traffic.

# AquaDam Specifications

| Dimensions (completely full) | Controllable Mud/Water Depth | Specifications of Inner and Outer Tubes | Capacity in Gallons (gal per ft.) | Empty Weight (lbs per ft.) |
|---|---|---|---|---|
| **1' H x 2' W*** (0.3m high) | **9”** (23 cm) | Same material thickness and strength as 4' high AquaDam | 12 | 0.75 lbs |
| **1.5' H x 3' W*** (0.5m high) | **14”** (36 cm) | Same material thickness and strength as 4' high AquaDam | 25 | 0.95 lbs |
| **2.5' H x 5' W*** (0.76m high) | **24”** (61 cm) | Same material thickness and strength as 4' high AquaDam | 88 | 1.85 lbs |
| **3' H x 7' W** (1m high) | **30”** (77 cm) | Same material thickness and strength as 4' high AquaDam | 120 | 2.5 lbs |
| **4' H x 9' W** (1.2m high) | **38”** (97 cm) | 12 mil polyethylene inside tube.<br><br>300 lb/in² burst strength woven polyethylene geotextile outside tube. | 240 | 4.25 lbs |
| **5' H x 11' W** (1.5m high) | **44”** (112 cm) | Same material thickness and strength as a 8' high AquaDam | 320 | 6.4 lbs |
| **6' H x 13' W** (1.8m high) | **54”** (137 cm) | Same material thickness and strength as a 8' high AquaDam | 400 | 8.5 lbs |
| **8' H x 17' W** (2.4m high) | **74”** (188 cm) | 12 mil polyethylene inside tube.<br><br>2 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 500 | 12 lbs |
| **10' H x 21' W** (3m high) | **90”** (229 cm) | 8 mil polyethylene inside tube.<br><br>3 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 800 | 25 lbs |
| **12' H x 25' W** (3.7m high) | **104”** (264 cm) | 2 plys of 8 mil polyethylene inside tube<br>1 ply shroud surrounding inside tubes<br>4 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 900 | 31 lbs |
| **16' H x 33' W** (4.8m high) | **132”** (335 cm) | 2 plys of 5 mil polyethylene inside tube<br>1 ply shroud surrounding inside tubes<br>5 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 1250 | 45 lbs |

All AquaDams 3' and taller are manufactured with an internal baffle for added stability. Smaller AquaDams can be special ordered with a baffle. Call for pricing.


Aqua Dam Inc
*“Water Controlling Water”*
www.aquadam.net
1.800.682.9283
+1.707.764.1999
matthew@aquadam.net

Attachment D

# TUBE FABRIC MILL CERT

**PRODUCT:** AQ-105LF

**CONSTRUCTION:** Woven geotextile of consisting of strong, rot resistant, chemically stable long chain synthetic polymer materials, dimensionally stable with each other. The plastic yarn or fibers used in this geotextile consist of at least 95% percent by mass of polyolefins, polyesters, or polymides; and contain stabilizers and inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure.

## CERTIFIED MARV VALUES:

GRAB TENSILE MD (ASTM D 4632): 315 POUNDS
GRAB TENSILE CD (ASTM D 4632): 315 POUNDS
ELONGATION MD (ASTM D 4632): 15 %
ELONGATION CD (ASTM D 4632): 15 %
PUNCTURE (ASTM D 4833): 140 POUNDS
TRAP TEAR MD (ASTM D 4533): 135 POUNDS
TRAP TEAR MD (ASTM D 4533): 135 POUNDS
AOS* (ASTM D 4751): 40 US SIEVE
PERMITTIVITY (ASTM D 4491): 0.05 PER SEC
FLOW RATE (ASTM D 4491): 4.2 GPM/SF
UV STRENGTH AT 2500 HOURS (ASTM D 4355): 80%

* ASTM D 4751, AOS is a Maximum Opening Diameter Value

**Manufacturers Name:** VANTAGE PARTNERS, LLC **Date:** ___________
**Manufacturer's Official:** Randy DeMao **Title:** President

Attachment E

# AquaDam Specifications

| Inflated Dimensions | Controllable Mud/Water Depth* | Specifications of Inner and Outer Tubes | Capacity** per linear ft | Dry Weight per linear ft |
|---|---|---|---|---|
| **1' H x 2' W** (0.3m tall) | **9"** (23 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 12 gal/LF 45 liters/LF | 0.75 lbs/LF 0.34 kg/LF |
| **1.5' H x 3' W** (0.45m tall) | **14"** (36 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 25 gal/LF 95 liters/LF | 0.95 lbs/LF 0.43 kg/LF |
| **2' H x 4' W** (0.61m high) | **18"** (45cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 50 gal/LF 189 liters/LF | 1.5lbs/LF 0.68kg/LF |
| **2.5' H x 5' W** (0.76m tall) | **24"** (61 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 88 gal/LF 333 liters/LF | 1.85 lbs/LF 0.84 kg/LF |
| **3' H x 7' W** (0.9m tall) | **30"** (77 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 120 gal/LF 454 liters/LF | 2.5 lbs/LF 1.1 kg/LF |
| **4' H x 9' W** (1.2m tall) | **38"** (97 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 210 gal/LF 795 liters/LF | 4.3 lbs/LF 1.9 kg/LF |
| **5' H x 11' W** (1.5m tall) | **44"** (112 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 2 plys of 300 lb/in² burst strength PP | 320 gal/LF 1,211 liters/LF | 6.4 lbs/LF 2.9 kg/LF |
| **6' H x 13' W** (1.8m tall) | **54"** (137 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 2 plys of 300 lb/in² burst strength PP | 450 gal/LF 1,703 liters/LF | 8.5 lbs/LF 3.9 kg/LF |
| **8' H x 17' W** (2.4m tall) | **74"** (188 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 2 plys of 300 lb/in² burst strength PP | 700 gal/LF 2,650 liters/LF | 12 lbs/LF 5.4 kg/LF |
| **10' H x 21' W** (3m tall) | **88"** (223 cm) | **Inner Tubing:** 2 plys, 8 mil, Polyethylene **Shroud:** 1 PP woven shroud around both inner tubes **Outer Sleeve:** 4 plys of 300 lb/in² burst strength PP | 1,000 gal/LF 3,785 liters/LF | 25 lbs/LF 11.3 kg/LF |
| **12' H x 25' W** (3.7m tall) | **100"** (254 cm) | **Inner Tubing:** 2 plys, 8 mil, Polyethylene **Shroud:** 1 PP woven shroud around each inner tube. **Outer Sleeve:** 5 plys of 300 lb/in² burst strength PP | 1,700 gal/LF 6,435 liters/LF | 35 lbs/LF 15.9 kg/LF |
| **16' H x 33' W** (4.8m tall) | **126"** (320 cm) | **Inner Tubing:** 3 plys, 5 mil, Polyethylene **Shroud:** 2 PP woven shrouds between inside tubes **Outer Sleeve:** 7-plys of 300 lb/in² burst strength PP | 3,000 gal/LF 11,356 liters/LF | 51 lbs/LF 23 kg/LF |

*This number is based on the friction of a rocky bottom. Slick mud, poly pond liners, and other slick surfaces may require the use of a taller primary AquaDam and/or a support dam installed behind the primary AquaDam.

** Capacity is based on installation on flat ground. Slopes will reduce internal volume of AquaDam.

BANCROFT
Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 007

Contract/Project No. TBD

Attn: Gerry Mitchell

BCC Job No. 2002036

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Downstream Fish Lift Braced Cofferdam |

______________________
Supplier

Bancroft Contracting Corp.
Subcontractor

Stamp

Remarks: This submission is for informational purposes only.

Submitted by: Peter Poor (Name) | Peter Poor (Signature) | 5/3/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks: ______________________

Reviewed by: ______ Name ______ Signature ______ Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

# Shawmut Fish Lift Cofferdam Downstream
## April 22, 2020

Reviewed By: Roger Gagnon – Gagnon Engineering

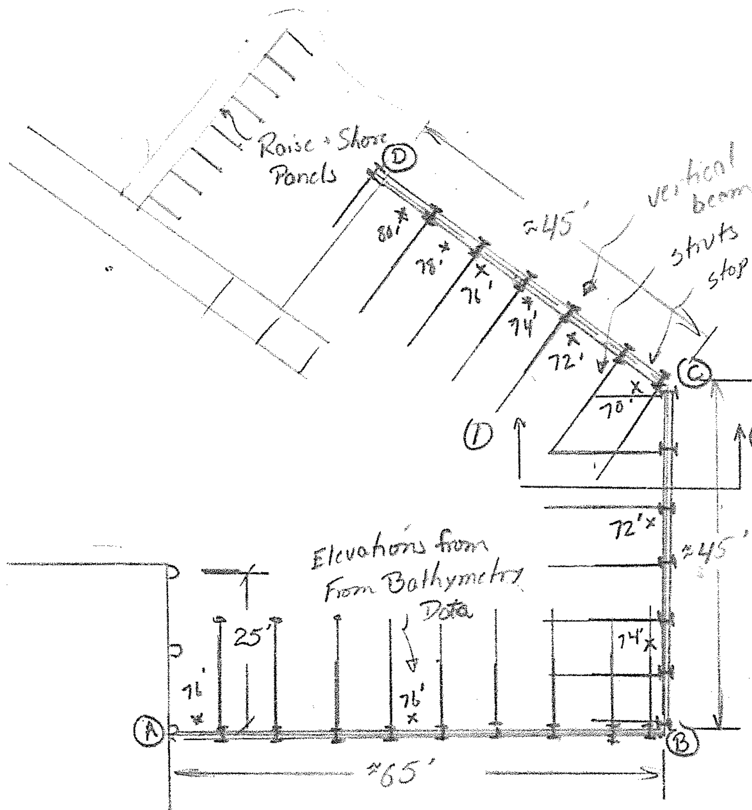
STATE OF MAINE
ROGER R.
GAGNON
No. 3409
LICENSED
PROFESSIONAL ENGINEER

Garrick Frost
Bancroft Contracting Corp
April 8, 2019

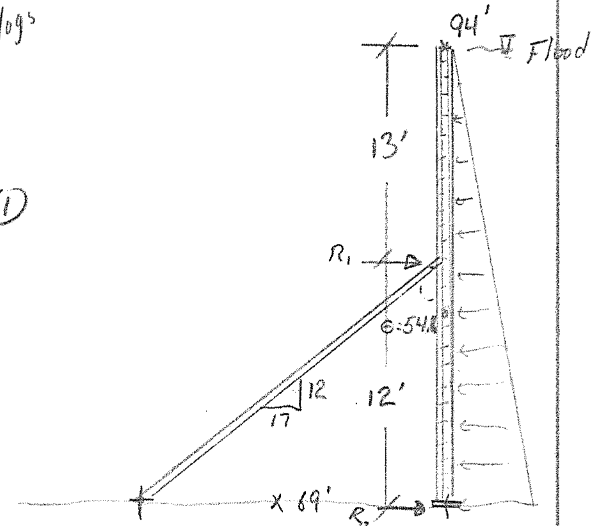
# Shawmut Fish Lift Downstream Cofferdam

given: The Following Sketch
$F_y = 50$ ksi (sheets : Braces)
Hilti Hit RE500V3 Epoxy
Top of Cofferdam = 94'
Deepest Location = 69' (comparing 2 sets of data)

find
A - Intermediate Frames
I - Design Vertical Beams
II - Design Strut
III - Design Stop Logs
IV - Design Connections
B - End Frames
I - Check Beam / Strut Loads for strut angle = 58°
II - Design connections to resist strut angle = 54.8° and 58.3°
C - Spreadsheet Showing Loads / depth
D - Sketches




Plan View

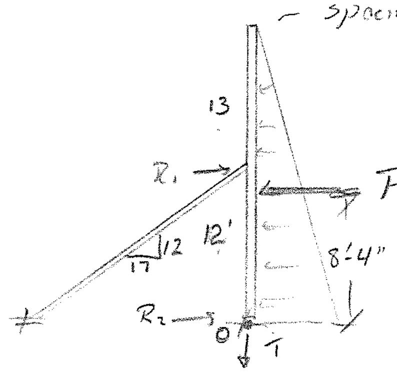



Elevation View
3/32" = 1'-0"

## A - Intermediate Frames

### I - Design Vertical Beams

- spacing = 6.5'




$P_R = \left(\frac{1}{2}(0.0624\ \text{k/ft}^3 \cdot 25')\, 25'\right) 6.5'$ o.c.
$= 126.8$ kips

$\Sigma M_o = 0$
$126.8^k (8'4") = 12 R_1$
$R_1 = 88.1$ kips

$\Sigma F_x = 0$
$88.1^k + R_2 = 126.8^k$
$R_2 = 38.7$ kips

$\frac{88.1}{17} = \frac{T}{12}$
$T = 62.2^k$

$M_{max}$ @ $V=0$ : Det. depth "d", where $V=0$

$$\left(\tfrac{1}{2}(0.0624\ ^{k}/_{ft^2} \times d)\, d\right) 6.50' - 88.1^{kips} = 0$$

$$0.2028 d^2 = 88.1$$

$$d = 20.8'$$

$M_{max}$ at depth = 20.8'

$$M_{max} = (88.1^k \times 7.8') - \left(\tfrac{1}{2}(0.0624 \cdot 20.8)\, 20.8')\, 6.5'\right) \times \tfrac{1}{3} \cdot 20.8'$$

$M_{max}$ = 78.9 ft·kips

for $M_{max}$ = 78.9 ft·kips and $l_b$ = 25'

use W12×50 per AISC 9th ed. pg 2-208

$M_{allow}$ = 91.5 ft·kips > 78.9 ft·kips

ok

Checking Combined Tension and Bending by interaction equation

$$\frac{M_{app}}{M_{allow}} + \frac{T_{applied}}{T_{allow}} \le 1.0$$

$$\frac{78.9}{91.5} + \frac{62.2^k}{0.6(14.7_{in^2})\,50^{ksi}} \le 1.0$$

$$0.88 + 0.14 \le 1.0$$

$$1.02 \le 1.0 \quad \text{for W12×50}$$

ok

$M_{max}$ at depth = 13'

$$M_{max} = \left[\tfrac{1}{2}(0.0624\ ^{k}/_{ft^3} \times 13' \times 6.5' \text{o.c.})\ 13'\right] \frac{13'}{3}$$

= 148.5 ft·kips  $l_b$ = 25'  use W10×60  $M_{allow}$ = 149.5 (pg 2-206 AISC 9th ed)

or W12×65 = 175 ft·kips

or W14×68 = 177 ft·kips

**use W14×68**

## II - Design Strut

$$C = \sqrt{R_1^2 + T^2} = \sqrt{(88.1^k)^2 + (62.2)^2} = 107.8 \text{ kips}$$

$$L = \sqrt{12^2 + 17^2} = 20.8'$$

use interaction and check W12×50   $P_{allow}$ = 133.5 kip for $l_b$ = 21' (per AISC 9th ed pg 3-28)

$$f_a = \frac{P}{A} = \frac{107.8}{14.7\ in^2} = 7.33 \text{ ksi}$$

$F_a$ is a function of $\frac{KL}{R_y} = \frac{(1.0)(21 \cdot 12)}{1.96} = 128.6$, from table C-50 $F_a = 9.03^{ksi}$

$$\therefore \frac{f_a}{F_a} = \frac{7.33\ ksi}{9.03\ ksi} = 0.81 > 0.15$$

∴ use eqns H1-1 and H1-2 both must be satisfied

AISCS Eqn H1-1 $\quad \frac{f_a}{F_a} + \frac{C_{mx} f_{bx}}{(1 - f_a/F'_{ex}) F_{bx}} + 0 \le 1.0$

AISCS Eqn H1-2 $\quad \frac{f_a}{0.6F_y} + \frac{f_{bx}}{F_{bx}} + 0 \le 1.0$

## II - Design Strut (Cont'd)

$f_{bx} = \frac{M_x}{S_x}$ $\quad M_x = \frac{wl^2}{8} = \frac{0.050(21)^2}{8} = 2.76 \text{ ft}\cdot\text{kip}$

$S_x = 64.7 \text{ in}^3$

$f_{bx} = \frac{2.76 \text{ ft}\cdot\text{kip}(12)}{64.7 \text{ in}^3} = 0.51 \text{ ksi}$

$F_{bx} = \frac{M_{allow}}{S_x}$ $\quad M_{allow}$ from pg 2-207 AISC 9th ed $= 109.5' \text{ ft}\cdot\text{kip}$

$= \frac{109.5 \text{ ft}\cdot\text{kip}}{64.7 \text{ in}^3} = 20.31 \text{ ksi}$

$\frac{f_{bx}}{F_{bx}} = \frac{0.51}{20.31} = 0.03$

$F'_{ex} = \frac{12\pi^2 E}{23(Kl/r_b)^2}$ from Table 8 of numerical values given $\frac{Kl}{r_x} = \frac{1.1(20.5)(12)}{5.18}$

$= 47.5$

given $\frac{Kl}{r_x} = 47.5$ $\quad F_{bx} = 66.21 \text{ ksi}$

eqn H1-1 may be rewritten as: $0.81 + \frac{(1.0)(0.51)}{(1 - 7.33/66.21)20.31} + 0 \le 1.0$

$0.84 \le 1.0$

ok

eqn H1-2 may be rewritten as: $\frac{7.33}{0.6(50)} + 0.03 \le 1.0$

$0.27 \le 1.0$

ok

**∴ use W12×50**

## III - Design Stop Logs

At depth = 25' w/ beam spacing @ 6.5'

$P = 62.4 \text{ \#/ft}^3 \times 25' = 1{,}560 \text{ \#/ft}^2$

if using 10" (9½" dressed) timbers $w = 1560 \text{ \#/ft}^2 \times \frac{9\frac{1}{2}''}{12''/\text{ft}} = 1{,}235 \text{ \#/ft}$

$M_{allow} = F^*b \cdot S_x$

$M_{allow} = \frac{wl^2}{8} = \frac{1235 \text{ \#/ft}(6.5)^2}{8} = 6522.3 \text{ ft}\cdot\text{\#'s}$

$F^*b = F_b \cdot$ Adjustment Factors

$F_b = 850\,psi$ for No 2 SYP 5×5 and larger

$C_D$ = Load Duration Factor for 1yr = 1.1 (conservative)
$C_r = 1.15$ (sheathed w/ plywood)

$F^*b = 850\,psi(1.1)(1.15) = 1075.25\,psi$

$M_{allow} = F^*b \cdot S_y = \left(\frac{12''}{1ft}\right)(6522.3\ ft\cdot\#'s) = 1075.25\ \frac{\#}{in^2} \cdot S_y$

$S_y = 72.8\,in^3$

∴ use 8×10 S4S No 2 SYP to 25' depth — $S_y = 89.1 > 72.8\,in^3$ ok

At depth: 15' w/ beam spacing @ 6.5'

$P = 62.4\,\#/ft^3 \times 15' = 936.0\,\#/ft^2$

$w = 936\left(\frac{9\frac{1}{2}}{12}\right) = 741\,\#/ft$

$\frac{wl^2}{8} = \frac{741\#/ft(6.5)^2}{8} = 3913.4\ ft\cdot\#\left(\frac{12''}{ft}\right) = 1075.25\ \frac{\#}{in^2}\cdot S_y$

$S_y = 43.7\,in^3$

∴ use 6×10 S4S No 2 SYP to 15' depth — $S_y = 47.9\,in^3 > 43.7\,in^3$ ok

At depth = 8' w/ beam spacing at 6.5'

$P = 62.4\,\#/ft^3 \cdot 8' = 499.2\,\#/ft^2$

$w = 499.2\,\#/ft^2 \cdot \frac{7\frac{1}{2}}{12} = 312\,\#/ft$

$\frac{wl^2}{8} = \frac{312(6.5)^2}{8} = 1647.75\ ft\cdot\#'s = F^*b \cdot S_y$

for 4×8 timbers, see table 8.4 AITC 9th ed $F_b = 1200\,psi$

$F^*b = 1200\,psi \times 1.15 \times 1.1 = 1518\,\#/in^2$

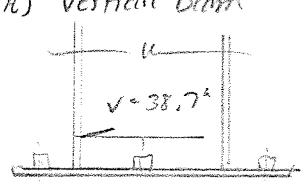
$\left(\frac{12''}{1ft}\right)1647.75\ ft\#'s = 1518\,\#/in^2 \cdot S_y$

$S_y = 13.0\,in^3$

∴ use 4×8 S4S No 2 SYP to 8' depth — $S_y = 14.8\,in^3 > 13.0\,in^3$ ok

## IV - Connections

A) Vertical Beam




load factor
$V = 38.7 \times 1.7 = 65.8\ kips$
$T = 62.2^k \times 1.7 = 105.7\ kips$

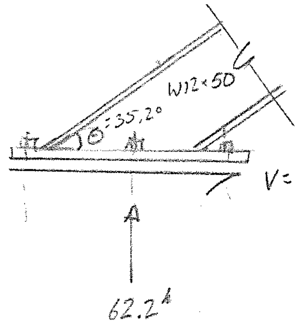
$T = 62.2\ kips$

Calculating w/ Hilti Profis Anchor 2.8.8

use 6ea, 1¼"Ø HAS E B7 rods, embed 25" and secure with Hilti Hit RE500V3

see Hilti Design Report "A"

B) Struts




V= 88.1 kips

load factor

$V = 88.1^k \times 1.7 = 149.8$ kips

Calculating w/ Hilti Profis Anchor 2.8.8

use 4ea, 1¼"Ø HAS E B7 rods, embed 25" and secure with Hilti Hit RE500 V3

See Hilti Design Report "B"

Report "A"

6/19



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporations | Page: | 1 |
| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

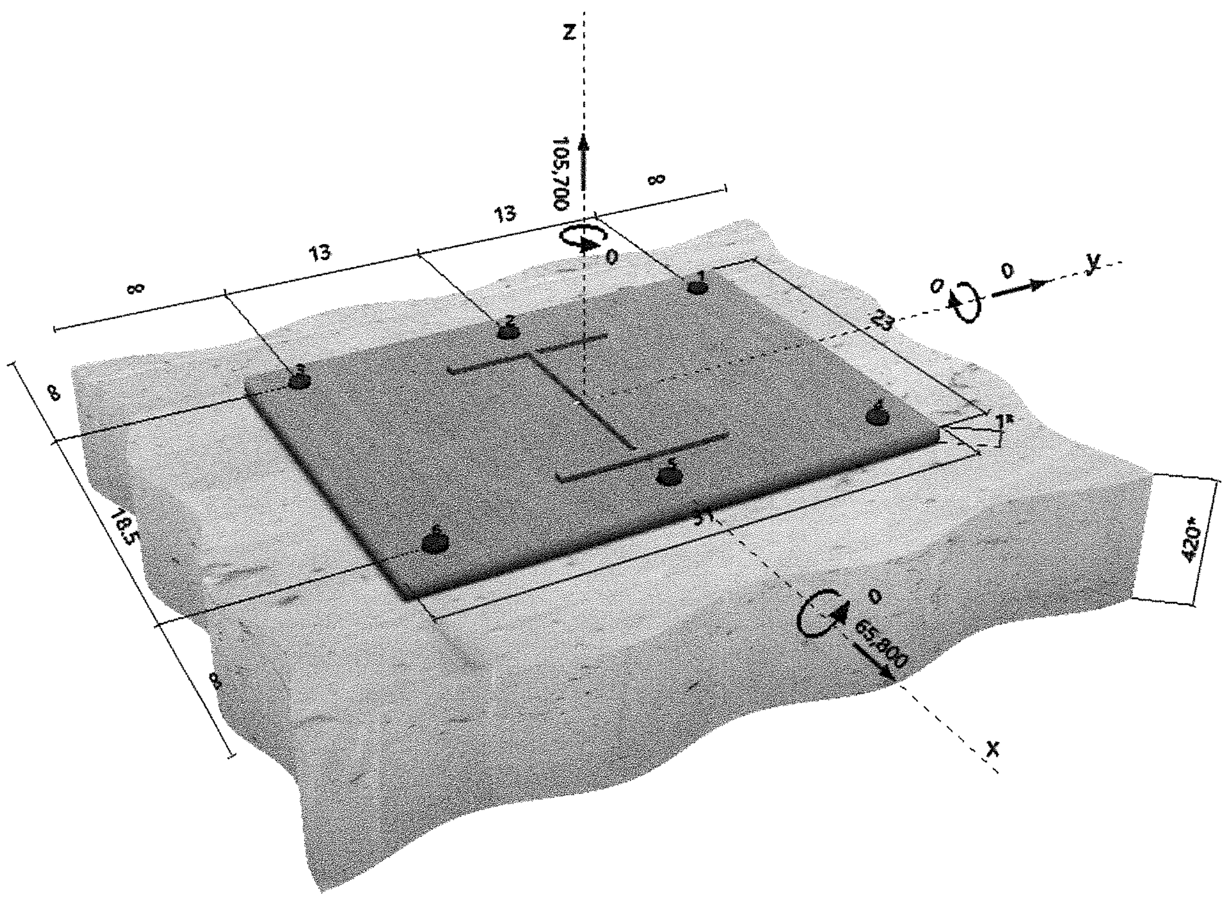
**Specifier's comments:**

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1 1/4** |
| Effective embedment depth: | $h_{ef,act}$ = 25.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 23.000 in. x 31.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W14X68; (L x W x T x FT) = 14.000 in. x 10.000 in. x 0.415 in. x 0.720 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 65/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporations | Page: | 2 |
| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | Concrete Breakout Strength | 105,700 | 115,945 | 92 / - | OK |
| Shear | Pryout Strength (Concrete Breakout Strength controls) | 65,800 | 249,728 | - / 27 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | 0.912 | 0.263 | 5/3 | 97 | OK |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Report B

8/19



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/13/2020 |
| E-Mail: | | | |

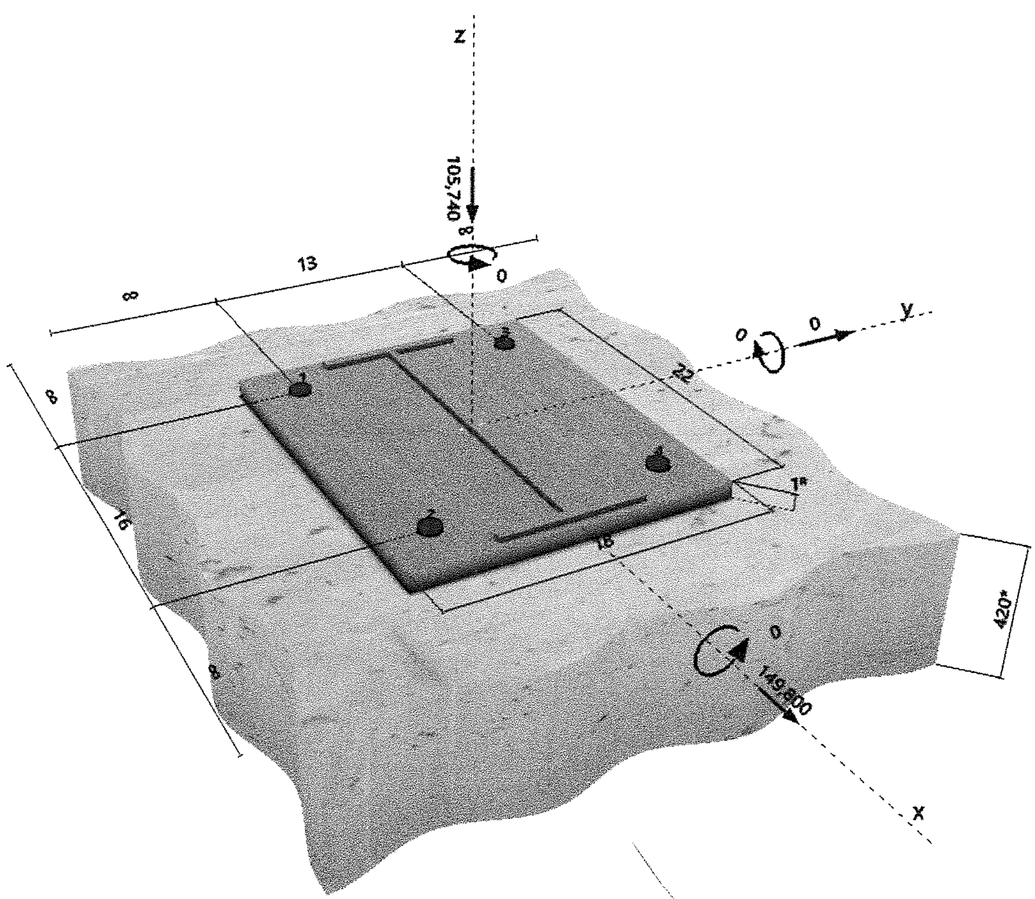
**Specifier's comments:**

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1 1/4** |
| Effective embedment depth: | $h_{ef,act}$ = 25.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 22.000 in. x 18.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W21X62; (L x W x T x FT) = 21.000 in. x 8.240 in. x 0.400 in. x 0.615 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | - | - | - | - / - | - |
| Shear | Steel Strength | 37,450 | 47,242 | - / 80 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

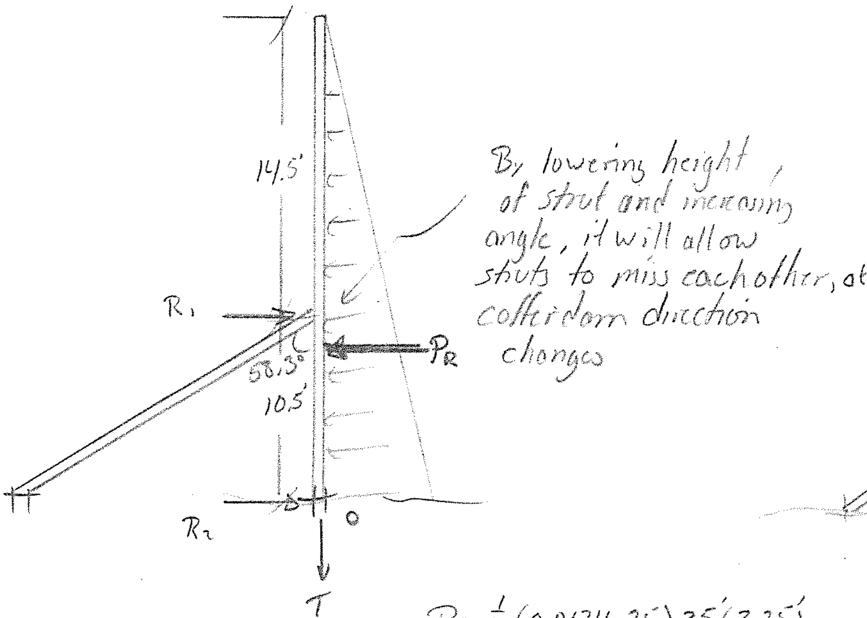
## 4 Remarks; Your Cooperation Duties

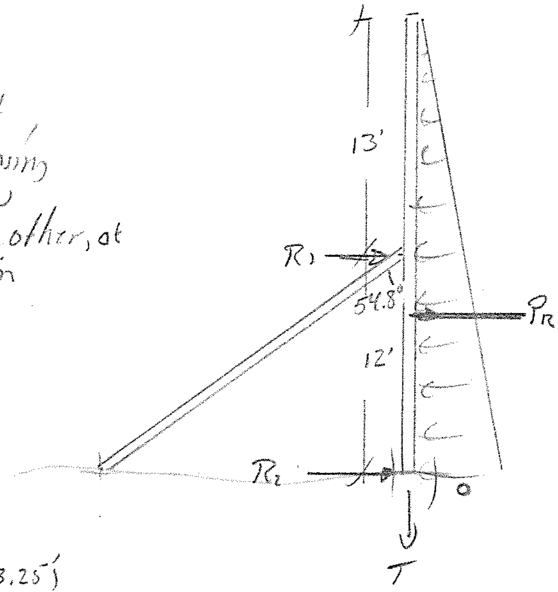
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

## B - End Frames

### I - Check Beam / Strut Loads for Strut Angle = 58.3°

Trib Area for end frames = $\frac{6.5' \text{ o.c.}}{2}$ = 3.25'




$P = \frac{1}{2}(0.0624 \cdot 25')\,25'(3.25')$
$= 63.4^k$

**For 58.3 strut angle**

$\Sigma M_o = 0$

$63.4^k\left(\frac{1}{3}(25)\right) = R_1\,10.5'$

$R_1 = 50.3^k$

$R_2 = 63.4^k - 50.3^k = 13.1^{kips}$

$M_{max}$ @ $V = 0$

$V = 0$ at $\frac{1}{2}(0.0624 \cdot d)\,d \cdot 3.25' - 50.3^k = 0$

$d = 22.27$

$M_{max} = 50.3^k(10.5 - (25' - 22.27) - 50.3\left(\frac{1}{3}(22.27)\right)$

$= 17.4$ ft·kip , $M_{max}$ @ $R_1$ $\left(\left(\frac{1}{2}(0.0624 \cdot 14.5)14.5\right)3.25\right)\frac{14.5}{3}$

$= 103$ ft·kip

* using same member sizes as those for intermediate frames, Allowable Loads are greater than applied Loads for change of angle to 58.3°

**For 54.8° strut angle**

For Half tributary area, Reactions will be half as those calculated for intermediate struts

$\therefore R_1 = \frac{88.1}{2} = 44.1^{kips}$

$R_2 = \frac{38.7}{2} = 19.4^{kips}$

$T = \frac{62.2^k}{2} = 31.1^{kips}$

$M_{max} = \frac{78.9}{2} = 39.5$ ft·kip

Design End Frame Anchors per these loads:

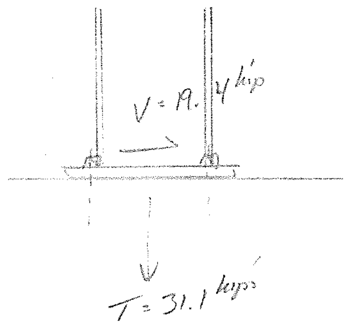
Max $T = 31.1^{kips}$ , (at both strut angles)

Max $R_2 = 19.4^{kips}$ (at 54.8° strut angle)

Max $R_1 = 50.3^{kips}$ (at 58.3° strut angle)

II - Design Connections that will support end frame reactions & strut angle equal to: 54.8° and 58.3°

⇒ 1. Vertical beam




Factored Loads = V: 19.4 × 1.7 = 33.0 kips
T: 31.1 × 1.7 = 52.9 kips

use: 4 ea. 1"Ø HAS-E B7 rods, embed 20" and secure with Hilti Hit RE 500 V3

see: Hilti Design Report "C"

⇒ 2. Strut


Factored Load = V = 50.3k × 1.7 = 85.5 kips

use: 2 ea. 1¼"Ø HAS-E B7 rod, embed ~~20"~~ 25" 5/1/20 GAF and secure with Hilti Hit RE500 V3

see: Hilti Design Report "D"

| | | | |
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| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

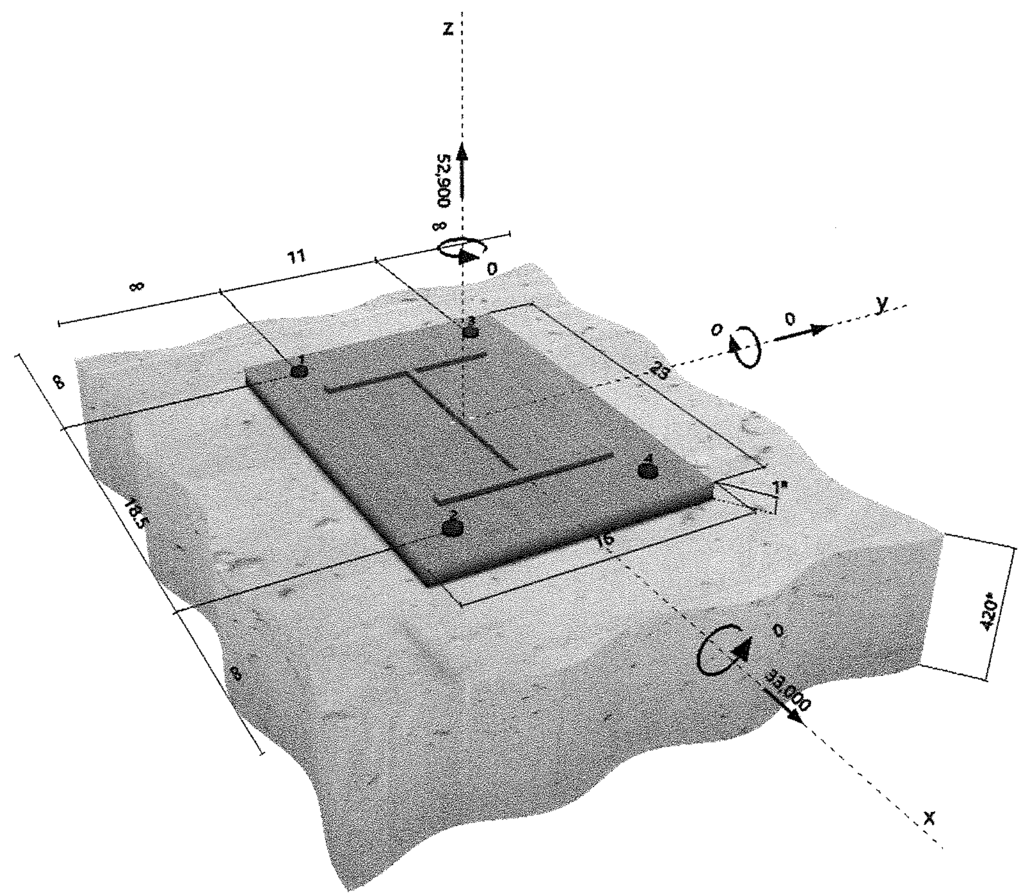
**Specifier's comments:** End Frame Anchors

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1** |
| Effective embedment depth: | $h_{ef,act}$ = 20.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 23.000 in. x 16.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W14X68; (L x W x T x FT) = 14.000 in. x 10.000 in. x 0.415 in. x 0.720 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 65/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



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| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| Loading | Proof | Load | Capacity | $\beta_N$ / $\beta_V$ [%] | Status |
| Tension | Bond Strength | 52,900 | 66,623 | 80 / - | OK |
| Shear | Steel Strength | 8,250 | 29,526 | - / 28 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | 0.794 | 0.279 | 5/3 | 81 | OK |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Report 'D'

14/19



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/14/2020 |
| E-Mail: | | | |

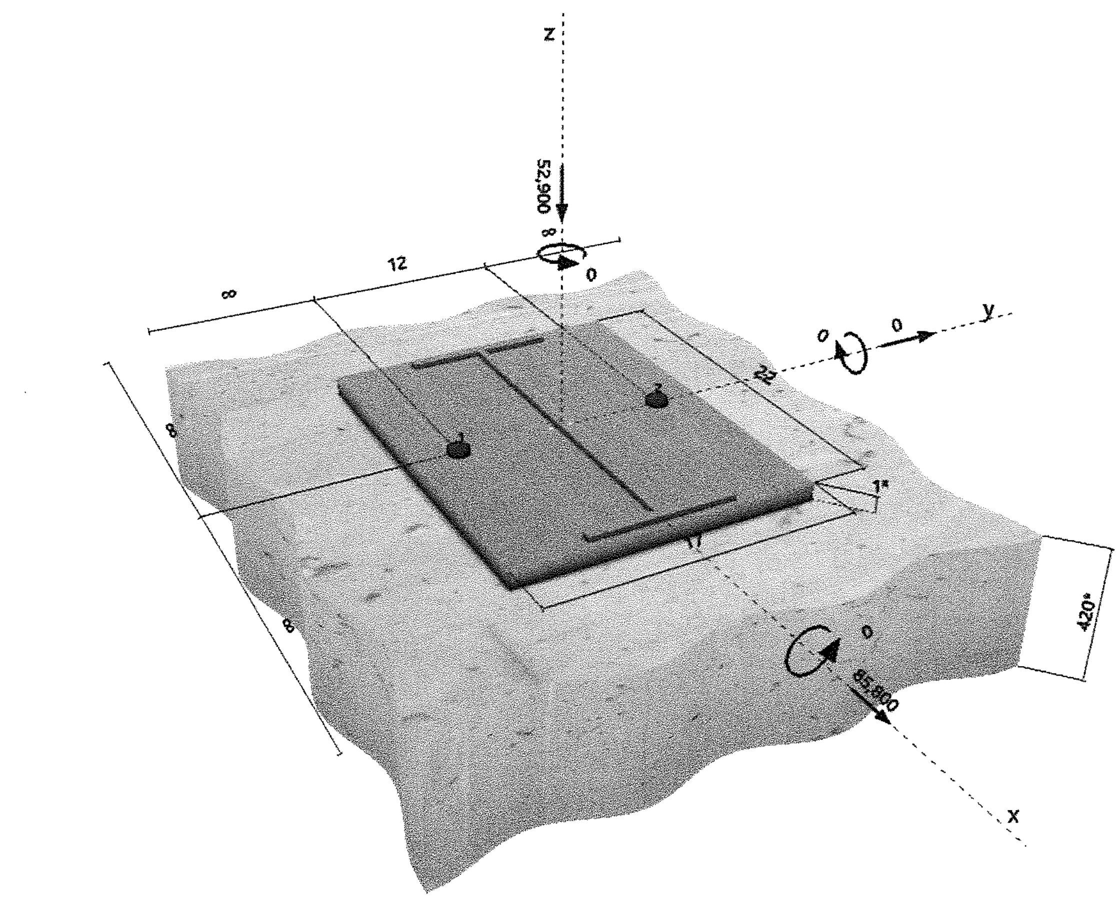
**Specifier's comments:** End Frames

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1 1/4** |
| Effective embedment depth: | $h_{ef,act}$ = 25.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 22.000 in. x 17.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W21X62; (L x W x T x FT) = 21.000 in. x 8.240 in. x 0.400 in. x 0.615 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 2 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/14/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| **Loading** | **Proof** | **Load** | **Capacity** | $\beta_N$ / $\beta_V$ [%] | **Status** |
| Tension | - | - | - | - / - | - |
| Shear | Steel Strength | 42,900 | 47,242 | - / 91 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

## 4 Remarks; Your Cooperation Duties

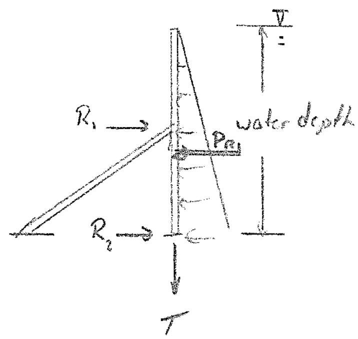
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

16/19

**Intermediate Frames - Strut Angle is 12/17 , frame spacing is 6.5' o.c.**

| water depth (ft) | Pr (kips) | R1 (kips) | R2 (kips) | T (kips) | depth where V=0 (ft) | Mmax (Between R1 and R2) (ft*kips) | Mmax (at R1) (ft*kips) |
|---|---|---|---|---|---|---|---|
| 25 | 126.75 | 88.02 | 38.73 | 62.13 | 20.83 | 78.24 | 148.52 |
| 24 | 116.81 | 77.88 | 38.94 | 54.97 | 19.60 | 82.85 | |
| 23 | 107.28 | 68.54 | 38.74 | 48.38 | 18.38 | 86.09 | |
| 22 | 98.16 | 59.98 | 38.17 | 42.34 | 17.20 | 87.90 | |
| 21 | 89.43 | 52.17 | 37.26 | 36.83 | 16.04 | 88.31 | |
| 20 | 81.12 | 45.07 | 36.05 | 31.81 | 14.91 | 87.34 | |
| 19 | 73.21 | 38.64 | 34.57 | 27.27 | 13.80 | 85.09 | |
| 18 | 65.71 | 32.85 | 32.85 | 23.19 | 12.73 | 81.65 | |
| 17 | 58.61 | 27.68 | 30.93 | 19.54 | 11.68 | 77.16 | |
| 16 | 51.92 | 23.07 | 28.84 | 16.29 | 10.67 | 71.79 | |
| 15 | 45.63 | 19.01 | 26.62 | 13.42 | 9.68 | 65.69 | |
| 14 | 39.75 | 15.46 | 24.29 | 10.91 | 8.73 | 59.05 | |
| 13 | 34.27 | 12.38 | 21.90 | 8.74 | 7.81 | 52.08 | |
| 12 | 29.20 | 9.73 | 19.47 | 6.87 | 6.93 | 44.96 | |

Note: Distance between R1 and R2 is always 12' and strut angle is always 12/17




Mmax = 148.52 ft*kips at Reaction R1
Max Strut compression occurs at water depth = 25'
Max Strut Anchor Load occur at water depth = 25'
Max Vertical Beam Anchor loads occur at water depth = 25' w/ T=62.13kips

**End Frames - Strut Angle is 12/17 , tributary width is 6.5'/2**

| water depth (ft) | Pr (kips) | R1 (kips) | R2 (kips) | T (kips) | depth where V=0 (ft) | Mmax (Between R1 and R2) (ft*kips) | Mmax (at R1) (ft*kips) |
|---|---|---|---|---|---|---|---|
| 25 | 63.38 | 44.01 | 19.36 | 31.07 | 20.83 | 39.12 | 74.26 |
| 24 | 58.41 | 38.94 | 19.47 | 27.49 | 19.60 | 41.43 | |
| 23 | 53.64 | 34.27 | 19.37 | 24.19 | 18.38 | 43.04 | |
| 22 | 49.08 | 29.99 | 19.09 | 21.17 | 17.20 | 43.95 | |
| 21 | 44.72 | 26.09 | 18.63 | 18.41 | 16.04 | 44.15 | |
| 20 | 40.56 | 22.53 | 18.03 | 15.91 | 14.91 | 43.67 | |
| 19 | 36.61 | 19.32 | 17.29 | 13.64 | 13.80 | 42.54 | |
| 18 | 32.85 | 16.43 | 16.43 | 11.60 | 12.73 | 40.83 | |
| 17 | 29.30 | 13.84 | 15.47 | 9.77 | 11.68 | 38.58 | |
| 16 | 25.96 | 11.54 | 14.42 | 8.14 | 10.67 | 35.89 | |
| 15 | 22.82 | 9.51 | 13.31 | 6.71 | 9.68 | 32.84 | |
| 14 | 19.87 | 7.73 | 12.15 | 5.46 | 8.73 | 29.53 | |
| 13 | 17.14 | 6.19 | 10.95 | 4.37 | 7.81 | 26.04 | |
| 12 | 14.60 | 4.87 | 9.73 | 3.44 | 6.93 | 22.48 | |

Note: Distance between R1 and R2 is always 12' and strut angle is always 12/17

For End frames, we will be using the same vertical beam and strut sizes as those for intermediate frames. Given lesser loads, members are OK
Connections will be redesigned w/ the following loads:
Vertical beam, V=19.4kips and T=31.1kips
Strut, V = 44.0kips

(tributary width) GAF 5/1/20

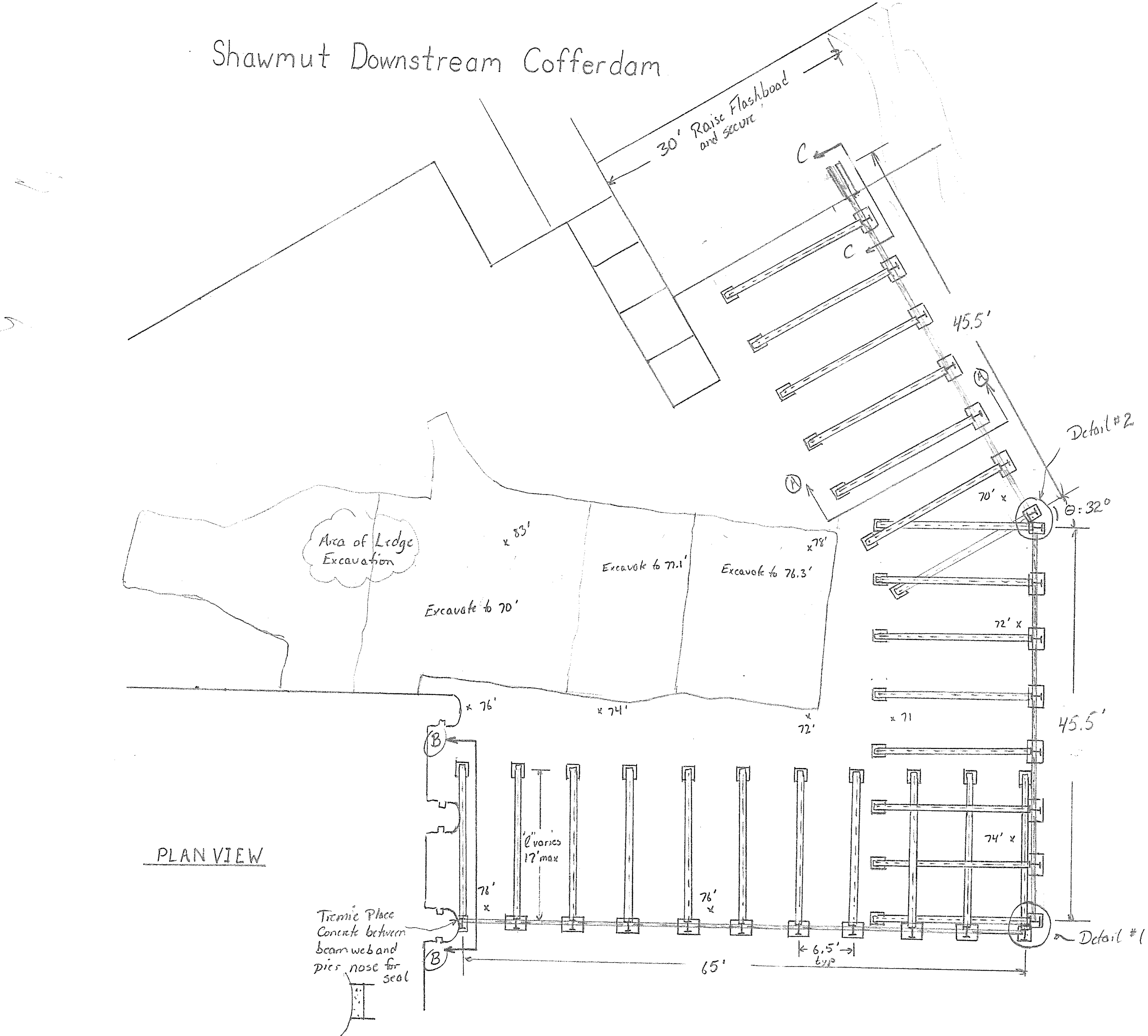
**End Frames - Strut Angle is 10.5/17 , ~~frame spacing~~ is 6.5'/2**

| water depth (ft) | Pr (kips) | R1 (kips) | R2 (kips) | T (kips) | depth where V=0 (ft) | Mmax (Between R1 and R2) (ft*kips) | Mmax (at R1) (ft*kips) |
|---|---|---|---|---|---|---|---|
| 25 | 63.38 | 50.30 | 13.08 | 31.07 | 22.27 | 17.50 | 103.04 |
| 24 | 58.41 | 44.50 | 13.91 | 27.49 | 20.95 | 20.73 | |
| 23 | 53.64 | 39.17 | 14.47 | 24.19 | 19.65 | 23.59 | |
| 22 | 49.08 | 34.28 | 14.80 | 21.17 | 18.39 | 25.95 | |
| 21 | 44.72 | 29.81 | 14.91 | 18.41 | 17.15 | 27.75 | |
| 20 | 40.56 | 25.75 | 14.81 | 15.91 | 15.94 | 28.95 | |
| 19 | 36.61 | 22.08 | 14.53 | 13.64 | 14.76 | 29.53 | |
| 18 | 32.85 | 18.77 | 14.08 | 11.60 | 13.61 | 29.50 | |
| 17 | 29.30 | 15.82 | 13.49 | 9.77 | 12.49 | 28.88 | |
| 16 | 25.96 | 13.19 | 12.77 | 8.14 | 11.40 | 27.72 | |
| 15 | 22.82 | 10.86 | 11.95 | 6.71 | 10.35 | 26.08 | |
| 14 | 19.87 | 8.83 | 11.04 | 5.46 | 9.33 | 24.05 | |
| 13 | 17.14 | 7.07 | 10.06 | 4.37 | 8.35 | 21.69 | |
| 12 | 14.60 | 5.56 | 9.04 | 3.44 | 7.41 | 19.12 | |

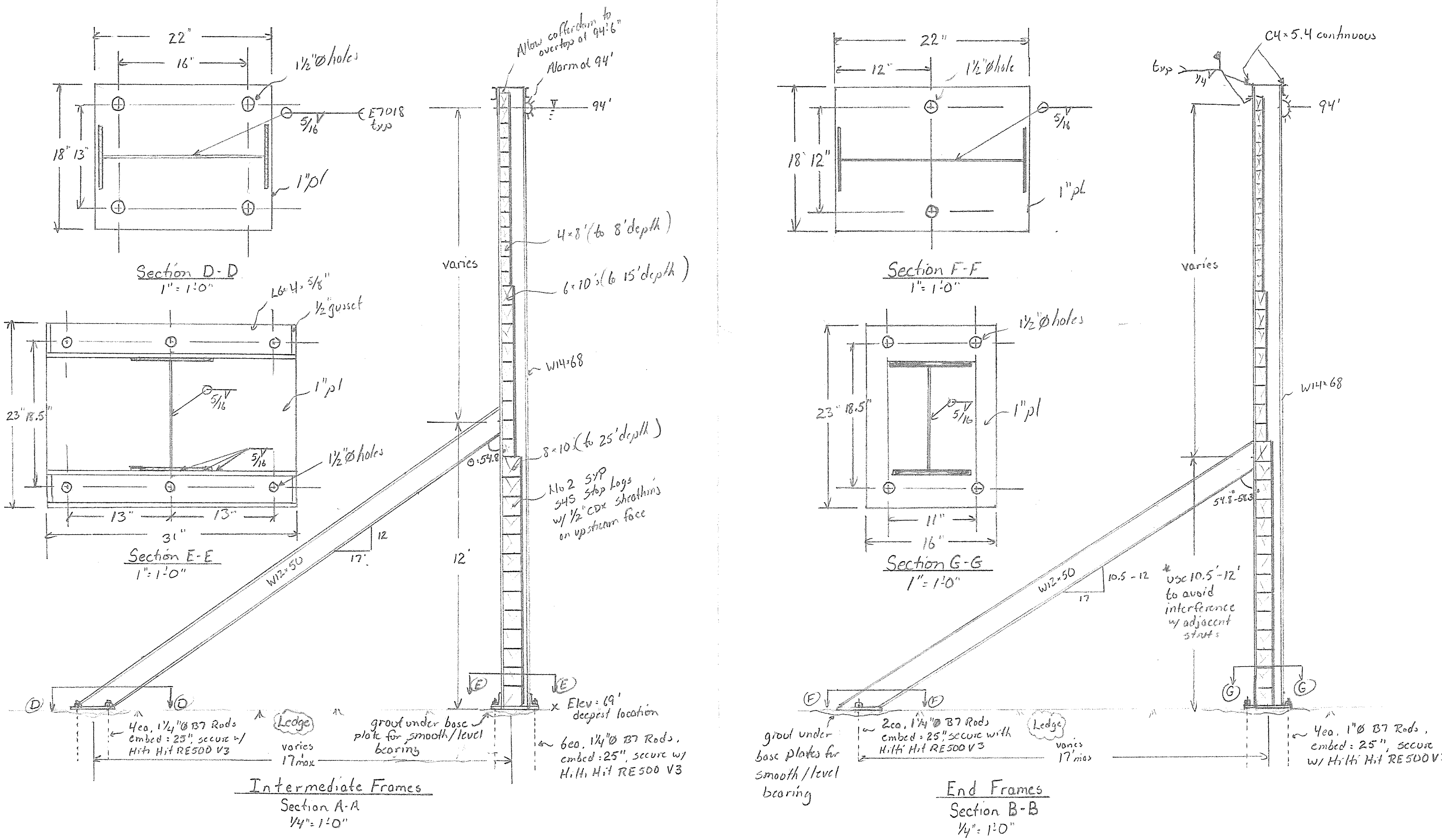
Note: Distance between R1 and R2 is always ~~12' and strut angle is always 12/17~~ (10' and strut angle is always 10.5/17) GAF 5/1/20

For End frames, we will be using the same vertical beam and strut sizes as those for intermediate frames. Given lesser loads, members are OK
Connections will be redesigned w/ the following loads:
Vertical beam, V=19.4kips and T=31.1kips
Strut, V = 44.0kips

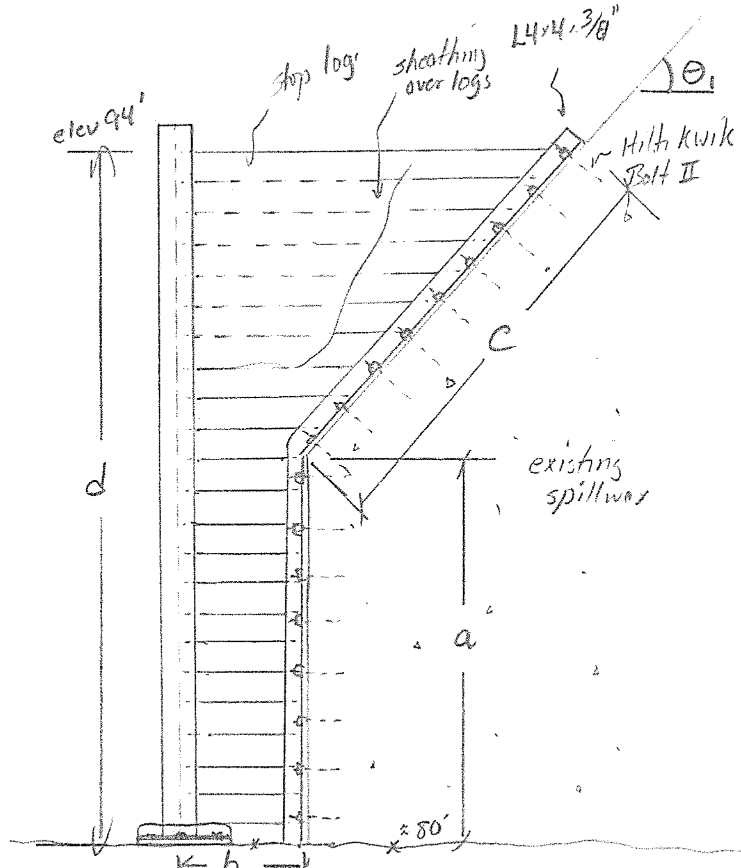
# Shawmut Downstream Cofferdam



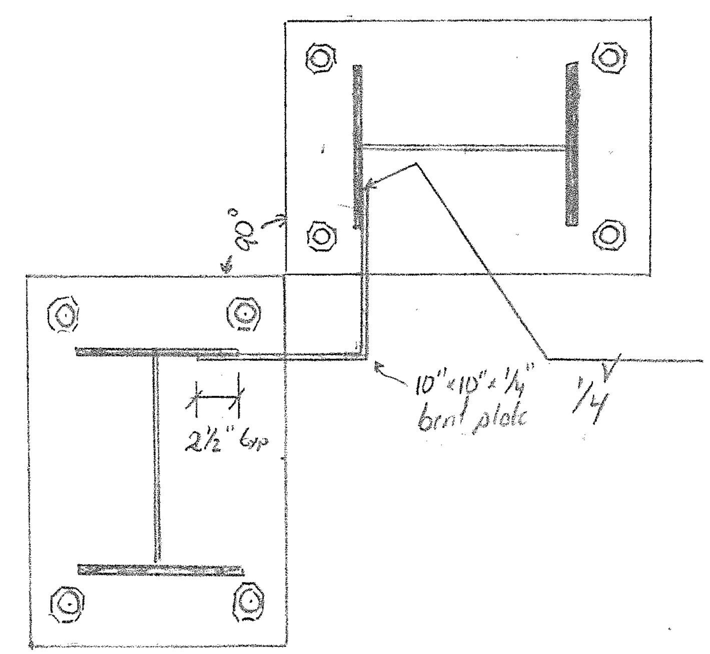

PLAN VIEW


Section D-D
1" = 1'-0"
22"
16"
1½"Ø holes
E7018 typ
5/16
18"
13"
1" pl
Section E-E
1" = 1'-0"
L6×4×5/8"
½" gusset
1" pl
23"
18.5"
5/16
1½"Ø holes
13"
13"
31"
Allow cofferdam to overtop at 94'6"
Alarm at 94'
94'
varies
4×8's (to 8' depth)
6×10's (to 15' depth)
W14×68
8×10's (to 25' depth)
No 2 SYP S4S Stop Logs w/ ½" CDX sheathing on upstream face
θ=54.8
W12×50
12
17
12'
Elev = 69' deepest location
grout under base plate for smooth/level bearing
4ea, 1¼"Ø B7 Rods embed = 25", secure w/ Hilti Hit RE500 V3
Ledge
varies 17' max
6ea, 1¼"Ø B7 Rods, embed = 25", secure w/ Hilti Hit RE500 V3
Intermediate Frames
Section A-A
¼" = 1'-0"
Section F-F
1" = 1'-0"
22"
12"
1½"Ø hole
5/16
18"
12"
1" pl
Section G-G
1" = 1'-0"
1½"Ø holes
23"
18.5"
5/16
1" pl
11"
16"
C4×5.4 continuous
typ
¼
94'
varies
W14×68
54.8-58.3
W12×50
10.5 - 12
17
* use 10.5'-12' to avoid interference w/ adjacent struts
grout under base plates for smooth/level bearing
2ea, 1¼"Ø B7 Rods embed = 25", secure with Hilti Hit RE500 V3
Ledge
varies 17' max
4ea, 1"Ø B7 Rods, embed = 25", secure w/ Hilti Hit RE500 V3
End Frames
Section B-B
¼" = 1'-0"

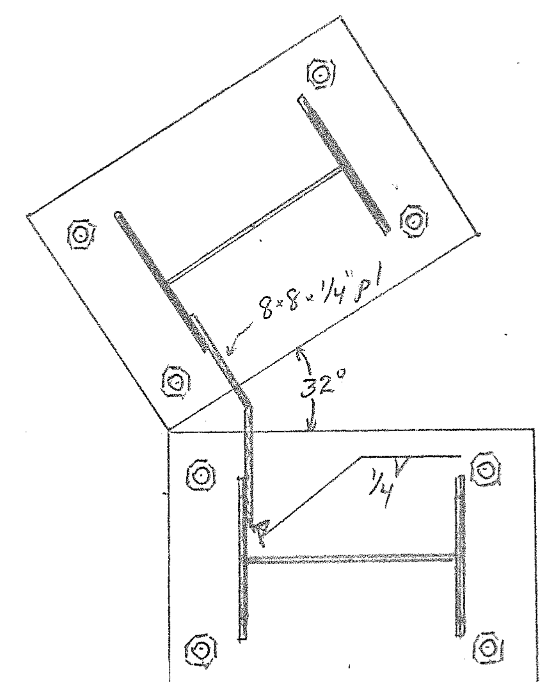
* Closure Design to be finalized upon reciept of as-found conditions including dimensions, a, b, c, d, and $\Theta_1$




Section C-C
1/4" = 1'-0"




Detail #1
1" = 1'-0"




Detail #2
1" = 1'-0"


**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 CONSTRUCTION**
**APRIL 10, 2020**

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

| REVISION | DESCRIPTION OF ISSUE / REVISION | REVISED BY |
|---|---|---|
| 1 | FINAL FOR CONSTRUCTION | M. GRAESER |
| 12/13/2019 | FINAL FOR BID - NOT FOR CONSTRUCTION | M. GRAESER |

STATE OF MAINE — MARK DANIEL GRAESER — No. 39328 — LICENSED PROFESSIONAL ENGINEER — 4/10/2020

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 179 |
| DRAWING: | G-006 |

DWG: S:\200 Projects\131009\Holden\SHAWMUT(Current)\900 CAD\02-SHEETS\G\G-006.dwg USER: jjenkins
DATE: Apr 15, 2020 8:57am XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

# APPENDIX F – PROJECT DESCRIPTION

**SHAWMUT HYDROELECTRIC PROJECT (FERC NO. 2322)**

**UPSTREAM FISH PASSAGE FACILITY**

## Project Description

The Shawmut Hydroelectric Project (FERC No. 2322) (Project), owned and operated by Brookfield White Pine Hydro, LLC (BWPH), is located on the Kennebec River (river mile 66) in the Towns of Benton and Fairfield, Somerset County, Maine.

The Shawmut Project includes a 1,310-acre reservoir, a 1,135 foot long dam with an average height of about 24 feet, headworks and intake structure, 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 8 foot deep log sluice equipped with a timber and steel gate.

The headworks and intake structure 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; the 1912 powerhouse is located to the east, and the 1982 powerhouse is located to the south. 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. 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 1912 powerhouse contains six generating units (Units 1 – 6), and the 1982 powerhouse contains two generating units (Unit 7 and 8). The project typically operates as run-of-river, with a target reservoir elevation near the full pond elevation of 112.0 feet during normal conditions. The total maximum hydraulic capacity of the turbines is 6,755 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. Figure 1 provides an overview of Shawmut.


**FIGURE 1. SHAWMUT PROJECT OVERVIEW**

Under the FERC approved Interim SPP, BWPH proposes to install a permanent upstream fish passage facility at the Project so to provide volitional passage for the upstream migration of salmon and other anadromous species. This will include a fish lift with integrated attraction water intake and spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse, a short fish ladder connecting the Units 7 and 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 and 8 powerhouse.

*Fish Lift*

The lower portion of the fish lift structure will consist of about an 81 ft long, 21 ft wide, and 24 ft tall concrete and steel entrance flume. The entrance flume will include a pivoting entrance gate, a set of v-trap gates, approximately 11 ft by 11 ft traveling hopper, a baffle wall, and a v-shaped baffled weir. Set upon the entrance flume will be an approximately 31 ft long, 15 ft wide, and 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 16 to 10 ft wide (varying width) spillway will be cut into the non-overflow portion of the dam and extend while turning about 53 degrees to spill 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 out into the reservoir. At the downstream edge of the existing dam the floor of the spillway channel will include an intake consisting of a 16 ft long by 16 ft wide wedge wire screen which diverts water from the spillway to the energy dissipation pool.
The attraction water intake and spillway is designed to divert 340 cfs from the upper pond; of this 115 to 225 cfs will be diverted through the wedge wire screen intake to the energy dissipation pool and then the fish lift entrance flume. The remaining 115 to 225 cfs will continue to spill adjacent to the fish lift entrance. See Attachment E of the permit application previously submitted for facility drawings.

*Fish Ladder*

An approximately 77 ft long 10.5 ft wide fish ladder will be placed at the upstream end of the island to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway 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 through 6 tailrace to the fish ladder exit. The excavated rock channel will be at existing grade near the Unit 1 through 6 tailrace and about 5 ft deep at the fish ladder. Access stairs from the roof of the Unit 7 and 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 ladder.

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. This channel is located adjacent to the Unit 7 and

8 powerhouse and fish ladder.  See Attachment E of the permit application previously submitted for facility drawings.

The proposed fishway will be operational from May 1st to October 1st and the fish lift hopper will have a cycle time of approximately 15 minutes. The fishway will have an operating range designed for river flows between 2,540 cubic feet per second (cfs) and 20,270 cfs and will maintain an attraction flow of 0.5 feet per second (FPS) in the exit flume and 6 FPS in 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).

The following temporary and permanent impacts are anticipated from the proposed project:

| **Resource Area** | **Temporary /Permanent** | **Type** | **Amount** |
|---|---|---|---|
| Riverine | Permanent excavation | Bedrock Removal | 16,000 $ft^2$ and 590 $yd^3$ |
| Riverine | Permanent Fill | Concrete Placement | Concrete 1,884 CY |
| Riverine | Permanent Fill | Structural | Structural Fill 5,224 CY |
| Shore Land | Temporary | Temporary staging areas and temporary construction facilities | 12,000 $ft^2$ of disturbance with no volume placed or removed |
| Riverine | Temporary | Temporary access road / Temporary cofferdam fill | Gravel Fill 3,510 CY |
| Riverine | Temporary | Cofferdam/ Aquadam and temporary road footprint | 19,409 $ft^2$ of disturbance |
| Riverine | Permanent | Sheetpile barge loading cell | Gravel Fill 2200 CY |

**Construction Schedule, Means and Methods**

Construction of the proposed facility is scheduled to being in spring 2020. Targeted completion of the facility is scheduled for spring 2021.

The following is an overview of assumed construction sequencing for the proposed fish lift and fish ladder at Shawmut. Actual sequencing may vary depending on the means and methods chosen by the selected contractor.

*Fish Lift & Attraction Water Intake*

The assumed staging area for fish lift and attraction water intake construction will be about 300 ft upstream of the work location on land adjacent to the railroad tracks and river which is accessible by an existing gravel road. Personnel and small tools may be transported to the site in light vehicles driven over the head gate and dam structures. It is assumed that heavy machinery and construction materials will be transported from the staging area to the work site by barge and lifted into place by a barge mounted crane.

*Fish Ladder*

The staging area for fish ladder construction is assumed to be adjacent to the Units 7 and 8 Tailrace in the flat area just downstream of the power house. This area is accessible by the paved project entrance lot. Personnel will travel over the Units 7 and 8 powerhouse to the training wall island dike via a temporary access road.

*Cofferdam Descriptions*

Four cofferdams will be utilized in the construction of the upstream fish passage at Shawmut.

A cofferdam for the attraction water intake (Cofferdam 1) will be a sheet pile bulkhead 31 ft wide extending 5 ft upstream into the impoundment with a top elevation of 115 ft located on the upstream face of the non-overflow dam section. This cofferdam will cover 82 square feet and 125 cubic yards of temporary fill will be placed.

The cofferdam utilized to dewater the fish lift area between the Unit 1-6 powerhouse and spillway (Cofferdam 2) is a braced cofferdam consisting of steel supports and stop logs.  The cofferdam will run 45 ft from the spillway turning parallel to the powerhouse for 45 ft and turning perpendicular to the powerhouse 65 ft with a top elevation of 94 ft. This cofferdam will cover 254 square feet and 385 cubic yards of temporary fill will be placed.

The cofferdam from the Unit 1-6 powerhouse to the isolation wall dike (Cofferdam 3) at the Unit 7&8 tailrace is a braced cofferdam consisting of steel supports and stop logs for depths greater than 4 ft and sand bags for depth under 4 ft.  The braced coffer dam and sand bags will run from the southwest end of the Unit 1-6 powerhouse to the dike with a top elevation of 92 ft. This cofferdam will cover 160 square feet and 400 cubic yards of temporary fill will be placed.

The Unit 7 & 8 powerhouse tailrace Aquadam (Cofferdam 4) will be located about halfway down the dike from the Unit 7 & 8 powerhouse across the tailrace with a top elevation of 96 ft. The Aquadam will remain in place for the duration of the temporary access road. Upstream of the Aquadam a temporary access road or 2600 cubic yards will be placed from the southwest shoreline to the dike with a top elevation of 92 ft. The Aquadam cofferdam will cover 3500 square feet and the temporary access road will cover 11,915 square feet and 2,600 cubic yards of temporary fill will be placed but will be constructed and removed entirely in the dry behind the Aquadam cofferdam.

Included with the revisions to the cofferdams is a change from the temporary tressle to an earthen filled sheet pile cell for barge loading and offloading. The sheet pile cell will be 30 ft. wide by 40 ft. long and earthen filled. Due to the substrate (bed rock) in this area a pile tressle is not feasible. Also due to the potential need for barge access the cell will be a permanent structure to facilitate access.  The Revised cofferdam plan and design specifications are provided in Appendix A below.

Erosion control will be required around all disturbed land and staging areas.  Suspended turbidity curtains will surround all cofferdams.  Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river.

**Proposed Project Photos**


**FIGURE 2. SHAWMUT DAM, POWERHOUSES, TAILRACES, PROPOSED LOCATION OF UPSTREAM FISH PASSAGE FACILITY (PHOTO YEAR: 2018)**


**FIGURE 3.** **PROPOSED ENTRANCE LOCATION TO UPSTREAM FISH PASSAGE FACILITY AND FISH LADDER (PHOTO DATE: 10/12/09)**


**FIGURE 4. PROPOSED EXIT LOCATION FROM UPSTREAM FISH PASSAGE FACILITY (PHOTO DATE: 10/12/09)**

**FIGURE 5: VIEW FROM THE TOP OF THE HEAD GATES LOOKING AT THE EXISTING CONCRETE DECK ABOVE THE NON-OVERFLOW PORTION OF THE DAM TO BE MODIFIED.**

In the bottom of view is a concrete ramp leading from the head gate structure walkway to the non-overflow section structure; the spillway sections of the dam extend across the river in the top of the view. A fish lift for upstream fish passage and a channel for the attraction water intake will be placed downstream (right in view) of the non-overflow dam structure. A 12 ft wide intake channel will be cut into this portion of the dam near the far end of this platform about where the equipment and worker are located; this intake channel will provide attraction water for the fish lift. A 20 inch diameter fiberglass fish return pipe will be run from right to left across the far end of the platform; this will discharge fish collected by the fish lift system to the impoundment. The upper level of the lift tower will be accessible from the downstream side (right in view) of this platform via a new steel grating platform.

**FIGURE 6: VIEW FROM WHERE THE NON-OVERFLOW DAM SECTION MEETS THE HEAD GATE STRUCTURE LOOKING TOWARD THE DOWNSTREAM SIDE OF THE NON-OVERFLOW PORTION OF THE DAM.**

The platform from Figure 5 is to the left and the Units 1 through 6 power house is to the right. The fish lift tower and downstream bypass channel will be placed in what is now the grass covered area extending out to be in line with the stepped buttress near the center of the image. The power house structure will not be affected by the fish lift or new spill way.

**FIGURE 7: VIEW FROM ABOVE THE HEAD GATE STRUCTURE LOOKING DOWNSTREAM INTO THE FOREBAY.**

The brick building to the left is the Units 1 through 6 powerhouse, the yellow structure in center-view sits atop the Units 7 and 8 powerhouse. Between the two structures is the Tainter gate. No modifications will be made to any of the structures in this view, however it provides an orientation for the Tainter gate.

**FIGURE 8: VIEW FROM AN ACCESS PLATFORM BEHIND THE UNITS 7 AND 8 POWERHOUSE LOOKING AT THE DOWNSTREAM FACE OF THE TAINTER GATE.**

Upstream of the gate is the forebay pictured in Figure 7. No modifications will be made to the gate, but the discharge from the gate will be modified to discharge into the Unit 7 and 8 powerhouse adjacent to the fish ladder.

**FIGURE 9: VIEW FROM AN ACCESS PLATFORM BEHIND THE UNITS 1 THROUGH 6 POWERHOUSE LOOKING AT THE DISCHARGE FROM THE TAINTER GATE SHOWN IN FIGURE 8.**

The concrete structure in the background is the Units 7 and 8 powerhouse and the yellow structure is a covered catwalk connecting the two project powerhouses. The grey steel Tainter gate pivot arms are visible in the upper center view. A concrete channel will be placed in the Tainter gate discharge to route this flow to Units 7 and 8 tailrace adjacent to the new fish ladder.

**FIGURE 10: VIEW FROM ABOVE THE TAINTER GATE LOOKING DOWNSTREAM.**

The Units 7 and 8 powerhouse is to the right and the corrugated steel structure is a catwalk connecting the two project powerhouses.  A concrete spillway channel will be placed in the discharge of the Tainter gate to discharge flow to the unit 7 and 8 powerhouse tailrace adjacent to the fish ladder.

**FIGURE 11: VIEW FROM THE PLATFORM ON THE DOWNSTREAM END OF THE FOREBAY BETWEEN THE TWO POWERHOUSES LOOKING DOWNSTREAM.**

In the bottom of the view is the roof of the covered catwalk that connects the two project powerhouses, the concrete building to the right is the Units 7 and 8 powerhouse, in the center is the training wall and island, and above the wall is the Units 7 and 8 tailrace.  About 25 ft of the wall the near the powerhouse (right in view) will be demolished and the adjacent earth excavated to make room for a fish ladder and concrete spillway channel.  A10 ft wide concrete channel will be placed where the wall meets the powerhouse following the powerhouse wall to the Tainter gate (not shown).  Parallel and abutting the channel will be a 10.5 to 6.8 ft wide by 77 ft long fishway (fish ladder).  A concrete training wall will extend from the fish ladder approximately 80 ft along the right side of the island.  A stairway will come off the powerhouse roof down to a steel grating walkway over the channel and fishway.  Excavations below the waterline will be made in the foreground and in the tailrace.

# Appendix A


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

| REVISION | DESCRIPTION OF ISSUE / REVISION | REVISED BY |
|---|---|---|
| 1 | FINAL FOR CONSTRUCTION | M. GRAESER |
| 12/13/2019 | FINAL FOR BID - NOT FOR CONSTRUCTION | M. GRAESER |

STATE OF MAINE — MARK DANIEL GRAESER No.39328 LICENSED PROFESSIONAL ENGINEER 4/10/2020

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 179
DRAWING: G-006

DWG: S:\200 Projects\131009\Holden\SHAWMUT(Current)\900 CAD\02-SHEETS\G\G-006.dwg USER: jjenkins
DATE: Apr 15, 2020 8:57am XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP S1-SHWMT-FLUME 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.
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

**RESOURCE IMPACT TABLE**

| | | |
|---|---|---|
| TEMPORARY IMPACT BELOW NORMAL HIGH WATER | (yellow) | 11,160 SF |
| TEMPORARY IMPACT BANKS | (purple) | 12,184 SF |
| PERMANENT ALTERATION BELOW NORMAL HIGH WATER | (blue) | 913 SF |
| PROPOSED CONCRETE BELOW NORMAL HIGH WATER | (pink) | 5,562 SF |
| UPLAND DISTURBED AREAS (STAGING AREAS) | (green) | 50,455 SF |

**SITE PLAN**
SCALE: 1"=30'

**FINAL**
**FOR CONSTRUCTION**
**APRIL 10, 2020**

DWG: S:\1131009\Holden\SHAWMUT\(Current)\900 CAD\02-SHEETS\G\Shawmut Impact Map.dwg USER: MKA00889 IMAGES:
DATE: Jun 03, 2020 7:15am XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP S1-SHWMT-FLUME MAINE-PE-STAMP-MDG


ALDEN RESEARCH LABORATORY
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| 1 | FINAL FOR CONSTRUCTION | M. GRAESER |
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STATE OF MAINE — MARK DANIEL GRAESER No. 39328 — LICENSED PROFESSIONAL ENGINEER — 4/10/2020

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 178 |
| DRAWING: | G-006 |

Brookfield
Renewable

May 20, 2020

**VIA FEDERAL EXPRESS**

Mrs. Jana Jacobson
Permit Project Manager
U. S. Army Corps of Engineers
New England District, Maine Project Office
442 Civic Center Drive, Suite 350
Augusta, Maine 04330
Jana.L.Jacobson@usace.army.mil

**RE: Request Amendment for Department of the Army Permit (NEA-2019-03035) Shawmut Hydroelectric Project (FERC No. 2322)**

Dear Mrs. Jacobson,

Brookfield White Pine Hydro LLC (BWPH), licensee for the Shawmut Hydroelectric Project (FERC No. 2322) (Project), submits to the U.S. Army Corps of Engineers (USACE) the enclosed request for Amendment to the Department of the Army Permit NEA-2019-023035 for the proposed upstream fish passage facility at the Project.

BWPH has hired a contractor to complete the construction of the upstream fish passage at the project. The contractor has made revisions to the previously presented cofferdams for the attraction water intake, fish lift area and Unit 1-6 power house to isolation dike wall cofferdams.

A more significant change has been proposed for the Unit 7 & 8 powerhouse tailrace cofferdam. An Aquadam is proposed which will be located about halfway down the dike from the Unit 7 & 8 powerhouse across the tailrace with a top elevation of 96 ft. Upstream of the Aquadam a proposed temporary access road will be placed from the southwest shoreline to the dike with a top elevation of 92 ft. and will require about 2600 cubic yards of material.

Included with the revisions to the cofferdams is a change from the temporary tressle to a proposed earthen filled sheet pile cell for barge loading and offloading. The sheet pile cell will be 30 ft. wide by 40 ft. long and earthen filled. Due to the substrate (bed rock) in this area a pile tressle is not feasible. Also due to the potential need for barge access the cell will be a permanent structure to facilitate access.

Brookfield
Renewable

The designs, revised drawing and detail description reflecting these changes are provide in the Project Description (Exhibit A) attached. The revised Soil Erosion and Sediment Control Plan reflecting the proposed changes are provided in Exhibit B.

Please contact me should you have any questions.

Sincerely,

Kelly Maloney

Manager, Licensing and Compliance

KOM:TMJ

Cc Gerry Mitchell, BWPH
Greg Allen, Alden

Enclosures: Revised Application for Department of the Army Permit Eng. Form 4345
Exhibit A – Project Description
Exhibit B – Soil Erosion and Sediment Control Plan

# Appendix A

## Shawmut Hydroelectric Project (FERC No. 2322)

## Upstream Fish Passage Facility

### Project Description

The Shawmut Hydroelectric Project (FERC No. 2322) (Project), owned and operated by Brookfield White Pine Hydro, LLC (BWPH), is located on the Kennebec River (river mile 66) in the Towns of Benton and Fairfield, Somerset County, Maine.

The Shawmut Project includes a 1,310-acre reservoir, a 1,135 foot long dam with an average height of about 24 feet, headworks and intake structure, 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 8 foot deep log sluice equipped with a timber and steel gate.

The headworks and intake structure 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; the 1912 powerhouse is located to the east, and the 1982 powerhouse is located to the south. 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. 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 1912 powerhouse contains six generating units (Units 1 – 6), and the 1982 powerhouse contains two generating units (Unit 7 and 8). The project typically operates as run-of-river, with a target reservoir elevation near the full pond elevation of 112.0 feet during normal conditions. The total maximum hydraulic capacity of the turbines is 6,755 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. Figure 1 provides an overview of Shawmut.


**FIGURE 1. SHAWMUT PROJECT OVERVIEW**

Under the FERC approved Interim SPP, BWPH proposes to install a permanent upstream fish passage facility at the Project so to provide volitional passage for the upstream migration of salmon and other anadromous species. This will include a fish lift with integrated attraction water intake and spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse, a short fish ladder connecting the Units 7 and 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 and 8 powerhouse.

*Fish Lift*

The lower portion of the fish lift structure will consist of about an 81 ft long, 21 ft wide, and 24 ft tall concrete and steel entrance flume. The entrance flume will include a pivoting entrance gate, a set of v-trap gates, approximately 11 ft by 11 ft traveling hopper, a baffle wall, and a v-shaped baffled weir. Set upon the entrance flume will be an approximately 31 ft long, 15 ft wide, and 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 16 to 10 ft wide (varying width) spillway will be cut into the non-overflow portion of the dam and extend while turning about 53 degrees to spill 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 out into the reservoir. At the downstream edge of the existing dam the floor of the spillway channel will include an intake consisting of a 16 ft long by 16 ft wide wedge wire screen which diverts water from the spillway to the energy dissipation pool.
The attraction water intake and spillway is designed to divert 340 cfs from the upper pond; of this 115 to 225 cfs will be diverted through the wedge wire screen intake to the energy dissipation pool and then the fish lift entrance flume. The remaining 115 to 225 cfs will continue to spill adjacent to the fish lift entrance. See Attachment E of the permit application previously submitted for facility drawings.

*Fish Ladder*

An approximately 77 ft long 10.5 ft wide fish ladder will be placed at the upstream end of the island to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway 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 through 6 tailrace to the fish ladder exit. The excavated rock channel will be at existing grade near the Unit 1 through 6 tailrace and about 5 ft deep at the fish ladder. Access stairs from the roof of the Unit 7 and 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 ladder.

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. This channel is located adjacent to the Unit 7 and

8 powerhouse and fish ladder. See Attachment E of the permit application previously submitted for facility drawings.

The proposed fishway will be operational from May 1st to October 1st and the fish lift hopper will have a cycle time of approximately 15 minutes. The fishway will have an operating range designed for river flows between 2,540 cubic feet per second (cfs) and 20,270 cfs and will maintain an attraction flow of 0.5 feet per second (FPS) in the exit flume and 6 FPS in 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).

The following temporary and permanent impacts are anticipated from the proposed project:

| **Resource Area** | **Temporary /Permanent** | **Type** | **Amount** |
|---|---|---|---|
| Riverine | Permanent excavation | Bedrock Removal | 16,000 $ft^2$ and 590 $yd^3$ |
| Riverine | Permanent Fill | Concrete Placement | Concrete 1,550 CY |
| Shore Land | Temporary | Temporary staging areas and temporary construction facilities | 12,000 $ft^2$ of disturbance with no volume placed or removed |
| Riverine | Temporary | Temporary access road / Temporary cofferdam fill | Gravel Fill 3,510 CY |
| Riverine | Temporary | Cofferdam/ Aquadam and temporary road footprint | 19,409 $ft^2$ of disturbance |
| Riverine | Permanent | Sheet pile barge loading cell | Gravel Fill 2200 CY |

**Construction Schedule, Means and Methods**

Construction of the proposed facility is scheduled to being in spring 2020. Targeted completion of the facility is scheduled for spring 2021.

The following is an overview of assumed construction sequencing for the proposed fish lift and fish ladder at Shawmut. Actual sequencing may vary depending on the means and methods chosen by the selected contractor.

*Fish Lift & Attraction Water Intake*

The assumed staging area for fish lift and attraction water intake construction will be about 300 ft upstream of the work location on land adjacent to the railroad tracks and river which is accessible by an existing gravel road. Personnel and small tools may be transported to the site in light vehicles driven over the head gate and dam structures. It is assumed that heavy machinery and construction materials will be transported from the staging area to the work site by barge and lifted into place by a barge mounted crane.

*Fish Ladder*

The staging area for fish ladder construction is assumed to be adjacent to the Units 7 and 8 Tailrace in the flat area just downstream of the power house. This area is accessible by the paved project entrance lot. Personnel will travel over the Units 7 and 8 powerhouse to the training wall island dike via a temporary access road.

*Cofferdam Descriptions*

Four cofferdams will be utilized in the construction of the upstream fish passage at Shawmut.

A cofferdam for the attraction water intake (Cofferdam 1) will be a sheet pile bulkhead 31 ft wide extending 5 ft upstream into the impoundment with a top elevation of 115 ft located on the upstream face of the non-overflow dam section. This cofferdam will cover 82 square feet and 125 cubic yards of temporary fill will be placed.

The cofferdam utilized to dewater the fish lift area between the Unit 1-6 powerhouse and spillway (Cofferdam 2) is a braced cofferdam consisting of steel supports and stop logs. The cofferdam will run 45 ft from the spillway turning parallel to the powerhouse for 45 ft and turning perpendicular to the powerhouse 65 ft with a top elevation of 94 ft. This cofferdam will cover 254 square feet and 385 cubic yards of temporary fill will be placed.

The cofferdam from the Unit 1-6 powerhouse to the isolation wall dike (Cofferdam 3) at the Unit 7&8 tailrace is a braced cofferdam consisting of steel supports and stop logs for depths greater than 4 ft and sand bags for depth under 4 ft. The braced coffer dam and sand bags will run from the southwest end of the Unit 1-6 powerhouse to the dike with a top elevation of 92 ft. This cofferdam will cover 160 square feet and 400 cubic yards of temporary fill will be placed.

The Unit 7 & 8 powerhouse tailrace Aquadam (Cofferdam 4) will be located about halfway down the dike from the Unit 7 & 8 powerhouse across the tailrace with a top elevation of 96 ft. The Aquadam will remain in place for the duration of the temporary access road. Upstream of the Aquadam a temporary access road or 2600 cubic yards will be placed from the southwest shoreline to the dike with a top elevation of 92 ft. The Aquadam cofferdam will cover 3500 square feet and the temporary access road will cover 11,915 square feet and 2,600 cubic yards of temporary fill will be placed but will be constructed and removed entirely in the dry behind the Aquadam cofferdam.

Included with the revisions to the cofferdams is a change from the temporary tressle to an earthen filled sheet pile cell for barge loading and offloading. The sheet pile cell will be 30 ft. wide by 40 ft. long and earthen filled. Due to the substrate (bed rock) in this area a pile tressle is not feasible. Also due to the potential need for barge access the cell will be a permanent structure to facilitate access. The Revised cofferdam plan and design specifications are provided in Appendix A below.

Erosion control will be required around all disturbed land and staging areas. Suspended turbidity curtains will surround all cofferdams. Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river.

**Proposed Project Photos**


**FIGURE 2. SHAWMUT DAM, POWERHOUSES, TAILRACES, PROPOSED LOCATION OF UPSTREAM FISH PASSAGE FACILITY (PHOTO YEAR: 2018)**


**FIGURE 3. PROPOSED ENTRANCE LOCATION TO UPSTREAM FISH PASSAGE FACILITY AND FISH LADDER (PHOTO DATE: 10/12/09)**


**FIGURE 4. PROPOSED EXIT LOCATION FROM UPSTREAM FISH PASSAGE FACILITY (PHOTO DATE: 10/12/09)**

**FIGURE 5: VIEW FROM THE TOP OF THE HEAD GATES LOOKING AT THE EXISTING CONCRETE DECK ABOVE THE NON-OVERFLOW PORTION OF THE DAM TO BE MODIFIED.**

In the bottom of view is a concrete ramp leading from the head gate structure walkway to the non-overflow section structure; the spillway sections of the dam extend across the river in the top of the view. A fish lift for upstream fish passage and a channel for the attraction water intake will be placed downstream (right in view) of the non-overflow dam structure. A 12 ft wide intake channel will be cut into this portion of the dam near the far end of this platform about where the equipment and worker are located; this intake channel will provide attraction water for the fish lift. A 20 inch diameter fiberglass fish return pipe will be run from right to left across the far end of the platform; this will discharge fish collected by the fish lift system to the impoundment. The upper level of the lift tower will be accessible from the downstream side (right in view) of this platform via a new steel grating platform.

**FIGURE 6: VIEW FROM WHERE THE NON-OVERFLOW DAM SECTION MEETS THE HEAD GATE STRUCTURE LOOKING TOWARD THE DOWNSTREAM SIDE OF THE NON-OVERFLOW PORTION OF THE DAM.**

The platform from Figure 5 is to the left and the Units 1 through 6 power house is to the right. The fish lift tower and downstream bypass channel will be placed in what is now the grass covered area extending out to be in line with the stepped buttress near the center of the image. The power house structure will not be affected by the fish lift or new spill way.

**FIGURE 7: VIEW FROM ABOVE THE HEAD GATE STRUCTURE LOOKING DOWNSTREAM INTO THE FOREBAY.**

The brick building to the left is the Units 1 through 6 powerhouse, the yellow structure in center-view sits atop the Units 7 and 8 powerhouse.  Between the two structures is the Tainter gate.  No modifications will be made to any of the structures in this view, however it provides an orientation for the Tainter gate.

**FIGURE 8: VIEW FROM AN ACCESS PLATFORM BEHIND THE UNITS 7 AND 8 POWERHOUSE LOOKING AT THE DOWNSTREAM FACE OF THE TAINTER GATE.**

Upstream of the gate is the forebay pictured in Figure 7. No modifications will be made to the gate, but the discharge from the gate will be modified to discharge into the Unit 7 and 8 powerhouse adjacent to the fish ladder.

**FIGURE 9: VIEW FROM AN ACCESS PLATFORM BEHIND THE UNITS 1 THROUGH 6 POWERHOUSE LOOKING AT THE DISCHARGE FROM THE TAINTER GATE SHOWN IN FIGURE 8.**

The concrete structure in the background is the Units 7 and 8 powerhouse and the yellow structure is a covered catwalk connecting the two project powerhouses. The grey steel Tainter gate pivot arms are visible in the upper center view. A concrete channel will be placed in the Tainter gate discharge to route this flow to Units 7 and 8 tailrace adjacent to the new fish ladder.

**Figure 10: View from above the Tainter gate looking downstream.**

The Units 7 and 8 powerhouse is to the right and the corrugated steel structure is a catwalk connecting the two project powerhouses.  A concrete spillway channel will be placed in the discharge of the Tainter gate to discharge flow to the unit 7 and 8 powerhouse tailrace adjacent to the fish ladder.

**FIGURE 11: VIEW FROM THE PLATFORM ON THE DOWNSTREAM END OF THE FOREBAY BETWEEN THE TWO POWERHOUSES LOOKING DOWNSTREAM.**

In the bottom of the view is the roof of the covered catwalk that connects the two project powerhouses, the concrete building to the right is the Units 7 and 8 powerhouse, in the center is the training wall and island, and above the wall is the Units 7 and 8 tailrace. About 25 ft of the wall the near the powerhouse (right in view) will be demolished and the adjacent earth excavated to make room for a fish ladder and concrete spillway channel. A10 ft wide concrete channel will be placed where the wall meets the powerhouse following the powerhouse wall to the Tainter gate (not shown). Parallel and abutting the channel will be a 10.5 to 6.8 ft wide by 77 ft long fishway (fish ladder). A concrete training wall will extend from the fish ladder approximately 80 ft along the right side of the island. A stairway will come off the powerhouse roof down to a steel grating walkway over the channel and fishway. Excavations below the waterline will be made in the foreground and in the tailrace.

# Appendix A

BANCROFT Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 004
Contract/Project No. TBD
BCC Job No. 2002036

Attn: Gerry Mitchell

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:
☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Upstream Attraction Water Intake Bulkhead |

Stamp

______________________
Supplier

Bancroft Contracting Corp.
Subcontractor

Remarks: Clarification letter has been included to address Alden's comments. This submission is for informational purposes only.

Submitted by: Peter Poor (Name) — Peter Poor (Signature) — 4/23/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.
☐ Approved As Noted. Work May Proceed.
☐ Approved As Noted. Resubmission Required. Work May Proceed.
☐ Not Approved. Resubmission Required. Work May Not Proceed.
☐ Review Not Required.

Stamp

Remarks: ______________________

Reviewed by: ______ Name ______ Signature ______ Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

April 23, 2020

Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Attention: Gerry Mitchell

Reference: Shawmut Attraction Water Intake Bulkhead Clarifications

Mr. Mitchell,

Our responses to comments posed by Alden Labs regarding the above referenced cofferdam design are as follows:

1.) Sheet 1 (Headpond 10 Yr Flood vs. Design Elev.)
    a. If the head pond level reaches El. 115.50’, the downstream braced cofferdam would already be overtopped as it is not designed to the 10 year flood level (Tailwater 10 year = El. 100.0’/DS Cofferdam Design = El. 94.0’).

2.) Sheet 2 (I.A. & I.B. - Sheet pile Shape & Properties Corrections)
    a. The original sheet pile shape options provided the correct section modulus per foot, but labeled the shape incorrectly (AZ13-770, Sx = 23.2 in3/ft). This has been revised to show the correct section modulus and corresponding shape to align with our installation sketch (AZ12-770, Sx = 23.2 in3/ft). This has been corrected for the Hydrostatic Pressure and Tremie Pressure.

3.) Sheet 5 (III.B. - Connections)
    a. We understand the required depth of embedment per Hilti Design Report B to be a minimum requirement (13.5”) and felt there was no harm in specifying a greater embedment for installation (16”).

4.) Sheet 6 (IV – Tremie Uplift)
    a. We did not consider additional forces opposing uplift (weight of structural steel, shear capacity of anchors) and are comfortable if the unit weight of concrete is reduced to 0.140 k/ft3 to reflect an unreinforced unit weight.

5.) Sheet 13 (VI – Sketches)
    a. Details for stiffener-to-beam and beam-to-beam welded connections have been included as Rev. 1

If you have any questions or require additional information, please feel free to contact me at any time.

Regards,

Bancroft Contracting Corp.

Peter Poor
Project Manager
o. (207) 743-8946
c. (207) 890-7317
ppoor@bancroftcontracting.com

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

## Shawmut Upstream Bulkhead
## April 10, 2020

Reviewed By: Roger Gagnon – Gagnon Engineering

STATE OF MAINE
ROGER R.
GAGNON
No. 3409
LICENSED
PROFESSIONAL ENGINEER

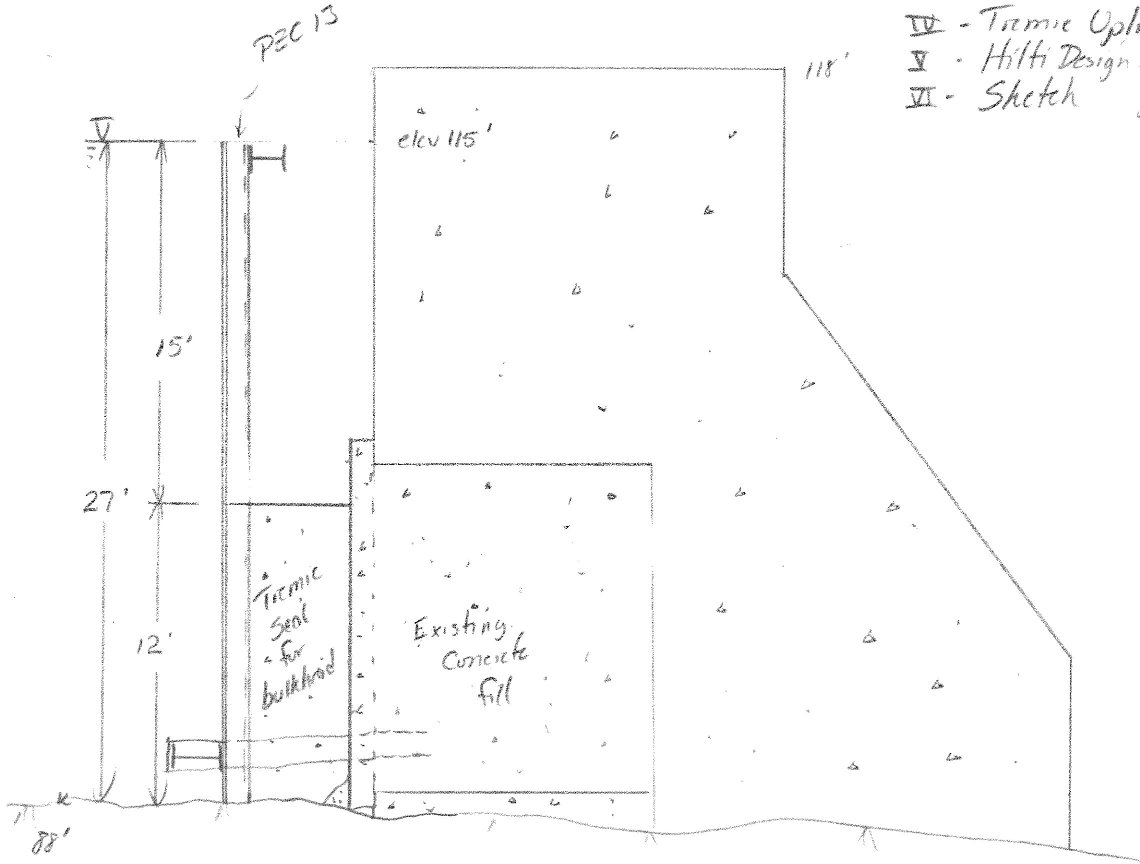
April 13, 2020
(13 Pages Total)

Garrick A. Frost
Bancroft Contracting Corp
April 7, 2020

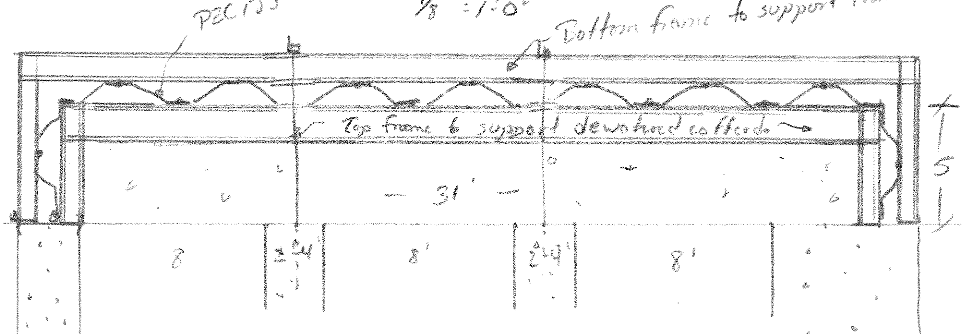
# Upstream Bulkhead

given: The following Sketch
Fy = 50 ksi (sheets and beams)
Hilti Hit RE500V3 Epoxy

Find: Design Cofferdam
I - Design Sheets pg 2
II - Design Waler pgs 3 and 4
III - Connections pgs 5 and 6
IV - Tremie Uplift pg 6
V - Hilti Design Reports pg 7-12
VI - Sketch pg 13



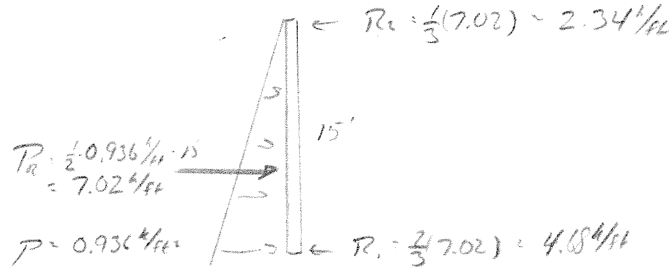

section view
1/8" = 1'-0"




Plan View
1/8" = 1'-0"

## I - Design Sheets

### A) For Hydrostatic Pressure




$M_{max} = 0.1283\, wl = 0.1283(7.02)15 = 13.5$ ft·kip/wft

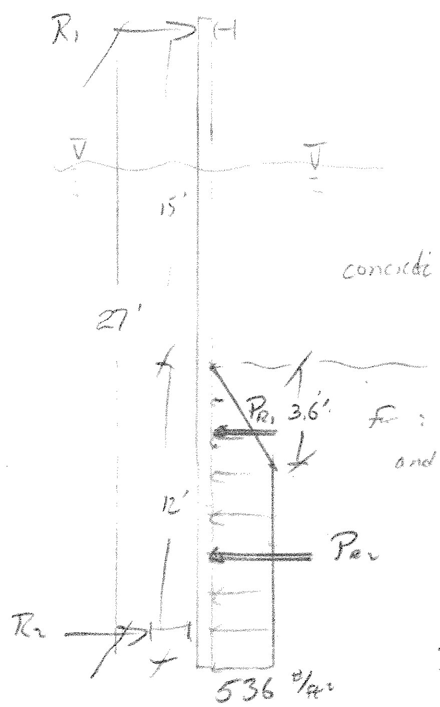
$M_{allow} = F_b \cdot S_x = 0.6(50^{ksi}) \cdot S_x = 13.5$ ft·k/wft

$S_x = 5.4\, in^3/wft$

4/23/2020 PJP ~~∴ use AZ13-770 $S_x = 23.2\, in^3/wft$~~
~~PZC13 $S_x$ $S_x = 25.8\, in^3/wft$~~

USE AZ12-770 $S_x = 23.2\, in^3/ft$
4/23/2020 PJP

### B) For Tremie Pressure




concrete underwater = $150^{\#}/ft^3 - 62.4^{\#}/ft^3 = 87.6^{\#}/ft^3$

for: $T \geq 70°F$

and: Placement Rate = 3/hr

$P_{max} = 536^{\#}/sf$ per ACI SP4 pg 5-12

$P_{max}$ submerged: $536^{\#}/sf\left(\frac{87.6}{150}\right) = 313^{\#}/sf$

$P_{R_2}$ $313^{\#}/sf \times 8.4 = 2.6^k/ft$

$P_{R_1} = \frac{1}{2} \cdot 313^{\#}/ft \times 3.6' = 0.6^k/ft$

$27R_2 = 0.6^k\left(15 + \frac{2}{3}(3.6)\right) + 2.6^k\left(15 + 3.6 + \frac{1}{2}(8.4)\right)$

$R_2 = 2.6^k/ft$

$R_1 = 0.6^k/ft$

$M_{max}$ @ $V = 0$

$V = 0$ @ $P_{R_1}$ $R_1 - P_{R_1} = 0$

$M_{max} = 0.6\left(15 + \frac{2}{3}(3.6)\right) - \frac{1}{2}\left(0.313^{k/sf}\, \frac{2}{3}(3.6)\right)\frac{2}{3}(3.6)$

$= 9.5$ ft·kip $= 0.6(50) S_x$ $S_x = 3.8$

4/23/2020 PJP ~~AZ12-770 $S_x = 23.2\, in^3/ft$~~
~~PZC13 $S_x = 24.2\, in^3/ft$~~
~~∴ use~~

4/23/2020 PJP USE AZ12-770 $S_x = 23.2\, in^3/ft$

## II - Design Walers

→ A) Top Waler

$W_{max} = 2.34^{k}/ft$ (during dewatered state)

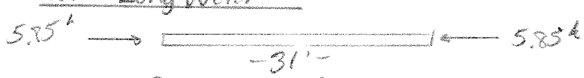
$M_{max} = \frac{wl^2}{8} = \frac{2.34(31)^2}{8} = 281.1$ ft·kips - long waler -

$R_1 = R_2 = \frac{wl}{2} = \frac{2.34(31)}{2} = 36.3$ kips - long waler -

$M_{max} = \frac{wl^2}{8} = \frac{2.34(5)^2}{8} = 7.31$ ft·kip - short return waler -

$R_1 = R_2 = \frac{wl}{2} = \frac{2.34(5)}{2} = 5.85$ kips - short return waler -

1 ~ Long Waler




$M = 281.1$ kip

Bolt Sheets to top waler

$M_{allow} = 0.66 F_b S_x = 0.66(50^{ksi}) S_x = 281.1$ ft·k

$S_x = 102.2\ in^3$

$\Delta_{allow} = \frac{span}{240} = \frac{31 \cdot 12}{240} = 1.55^{in} = \frac{5wl^4}{384EI} = \frac{5(2.34)(31)^4 12^3}{384(29000)I}$

$I = 1081.72$

use interaction eqn and try W16×77

$f_a = \frac{P}{A} = \frac{5.85}{22.6\ in^2} = 0.26$ ksi

$F_a$ is a function of $\frac{Kl}{r_y} = \frac{(1.0)(31 \cdot 12)}{2.47} = 150.6$

given $\frac{Kl}{r_y} = 150.6$ $F_a = 6.50^{ksi}$ per table C-50 AISC 9th ed

$\frac{f_a}{F_a} = \frac{0.26}{6.50} = 0.04 < 0.15$ ∴ use eqn H1-3

$f_{bx} = \frac{M_x}{S_x} = \frac{281.1\ ft\text{-}kip}{134\ in^3} = 25.2$ ksi

$F_{bx} = 0.66(50^{ksi}) = 33$ ksi

eqn H1-3 $\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \le 1.0$

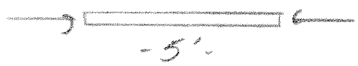
$0.04 + \frac{25.2}{33} + 0 \le 1.0$

$0.80 \le 1.0$

ok

∴ use W16×77

2 - Short Return Waler




$P = 36.3^{k}$ $M = 7.31$ ft·kip

Use Interaction eqn and try W10×49

$f_a = \frac{P}{A} = \frac{36.3}{14.4\,in^2} = 2.52\,^{k}/in^2$

$F_a$ is a function of $\frac{Kl}{r_y} = \frac{(1.0)60''}{2.54} = 23.62$

from table C-50 by interpolation $F_a = 20.37$ ksi

$\frac{f_a}{F_a} = \frac{2.52\,^{k}/in^2}{20.37\,^{k}/in^2} = 0.12 < 0.15$ ∴ use eqn H1-3

eqn H1-3 $\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \le 1.0$

$f_{bx} = \frac{M_x}{S_x} = \frac{7.31\text{ ft·kip}}{54.6} = 1.61$ ksi

$F_{bx} = 0.66(50) = 33$ ksi

$\frac{1.61\text{ ksi}}{33\text{ ksi}} = 0.05$

eqn H1-3 may be rewritten as $0.12 + 0.05 + 0 \le 1.0$

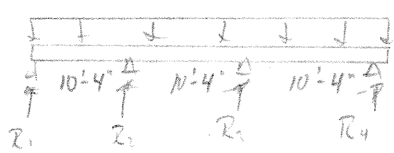
$0.17 \le 1.0$

ok

**∴ use W10×49**

⇒ B) Bottom Waler

$W_{max} = 2.6\,^{k}/ft$ (during tremie placement)




$M_{max} = 0.1\,wl^2 = 0.1(2.6)(10'-4")^2$
$= 27.8$ ft·kip

$R_1 = R_4 = \frac{4}{10}(2.6\,^{k}/ft)\,10'-4" = 10.7$ kips

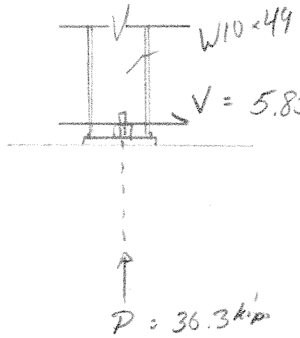
$R_2 = R_3 = \frac{6}{10}(2.6\,^{k}/ft)\,10'-3" + \frac{5}{10}(2.6)\,10'-3" =$
$= 29.3$ kips

given the loading condition $M_{max} = 27.8$ ft·kip
$l_b = 10'-4"$

**use W8×28** $M_{allow} = 60.75 > 27.8$ ft·kip
for $l_b = 10'-4"$ (per AISC 9th ed pg 2-209)

## III - Connections

⟹ A) Top Frame



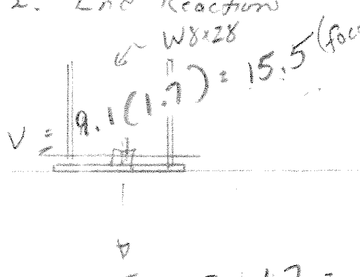

$V = 5.85^k \times 1.7 = 9.9$ kip (Factored Shear Load)

| use 2ea. Kwik Bolt TZ - CS 3/4"Ø w/ min 4 3/4" embedment |

* see hilti design report "A"

⟹ B) Bottom Frame

1. End Reactions




$V = 9.1(1.7) = 15.5$ (factored load)

$V = \frac{wl}{2} \cdot \frac{2.6(7' \text{ strut length})}{2} = 9.1$

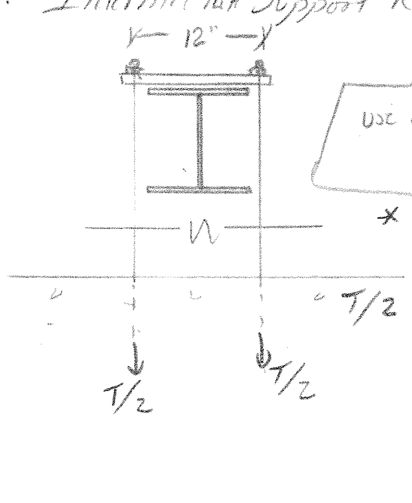
$T = 10.7$

$T = 10.7 \times 1.7 = 18.2$ kip (Factored load)

| use 2ea. Hilti Hit RE500V3 + HAS-E B7 7/8"Ø rod w/ 16" embed |

* See Hilti Design Report "B"

2. Intermediate Support Reactions




| use 2ea. Hilti Hit RE500V3 + HAS-E B7 1"Ø rod w/ 18" embedment |

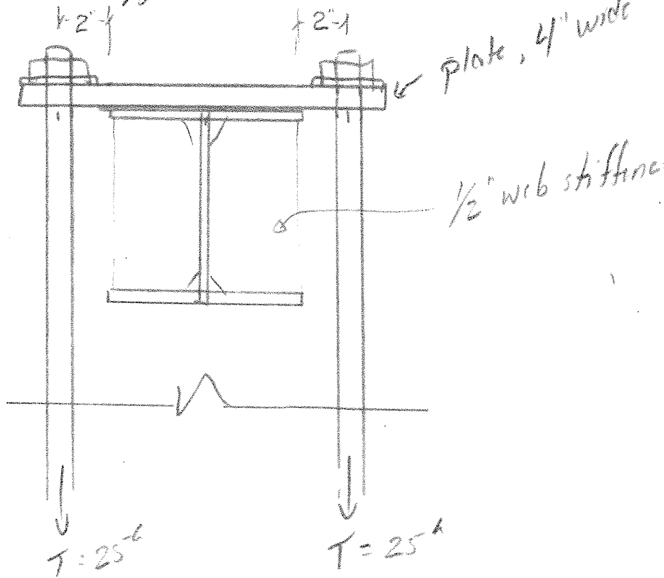
* see Hilti Design Report "C"

$T/2 = \frac{29.3}{2} = 14.7$ k/bolt $\times 1.7 = 25.0$ k/bolt

$T_{combined} = 50$ kips

2. Intermediate Support Reaction

=> a. Rod Supports over beam




$M_{max} = 25^k \times 2" = 4.167$ in-kip

$M_{allow} = 0.66 F_b \cdot S_y = 0.66(36^{ksi}) S_y = 4.167$ in-kip

$S_y = 0.175 \text{ in}^3$

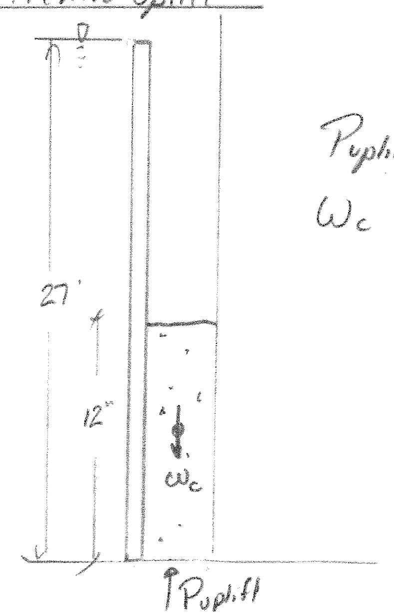
for 4" wide plate, determine req'd thickness t

$0.175 \text{ in}^3 = \frac{bd^2}{6} = \frac{3" \cdot d^2}{6}$

$d = 0.59$ in

**use 3/4" thick plate**

IV - Tremie Uplift




$P_{uplift} = 0.0624^k/ft^3 \times 27' = 1.68^k/ft^2$

$\omega_c = 0.150^k/ft^3 \times 12' = 1.80^k/ft^2$

$\omega_c > P_{uplift}$

ok

V - Hilti Design Reports

Report "A"

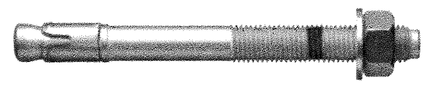
(7/13)



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Top Waler Connection |
| Phone I Fax: | \| | Date: | 4/9/2020 |
| E-Mail: | | | |

**Specifier's comments:** End Reactions

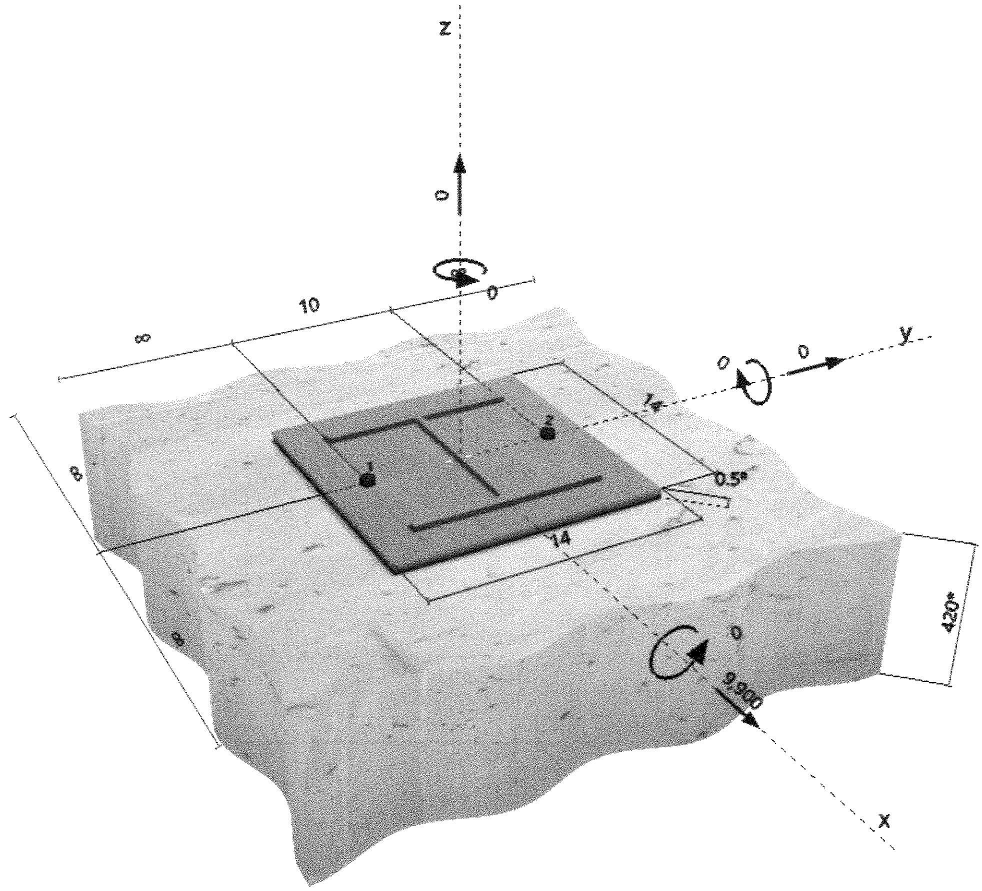
## 1 Input data



| | |
|---|---|
| **Anchor type and diameter:** | **Kwik Bolt TZ - CS 3/4 (4 3/4)** |
| Return period (service life in years): | 50 |
| Effective embedment depth: | $h_{ef}$ = 4.750 in., $h_{nom}$ = 5.563 in. |
| Material: | Carbon Steel |
| Evaluation Service Report: | ESR-1917 |
| Issued I Valid: | 5/1/2019 \| 5/1/2021 |
| Proof: | Design method ACI 318 / AC193 |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 14.000 in. x 14.000 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W10X49; (L x W x T x FT) = 9.980 in. x 10.000 in. x 0.340 in. x 0.560 in. |
| Base material: | uncracked concrete, 3000, $f_c'$ = 3,000 psi; h = 420.000 in. |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: >= No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

[R] - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



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| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Top Waler Connection |
| Phone I Fax: | \| | Date: | 4/9/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | - | - | - | - / - | - |
| Shear | Steel Strength | 4,950 | 8,888 | - / 56 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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|---|---|---|---|
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| Address: | | Sub-Project I Pos. No.: | Bot. Waler Connection |
| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

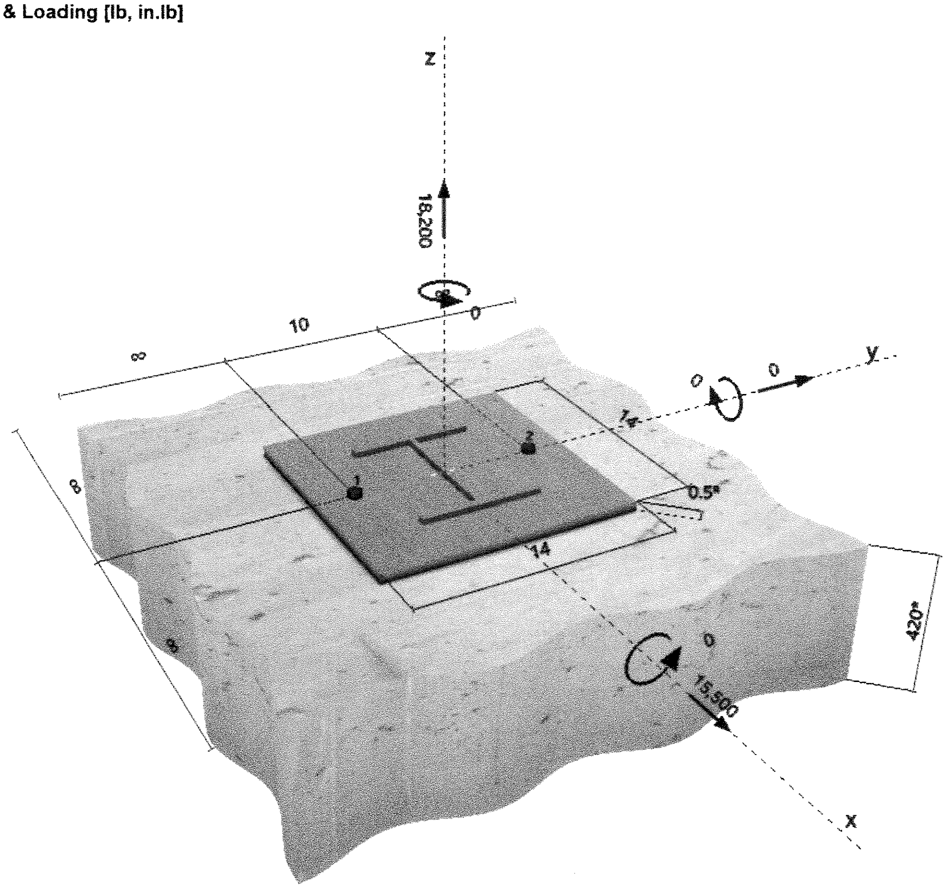
**Specifier's comments:** End Reactions from tremie placement

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 HDG 3/4** |
| Return period (service life in years): | 50 |
| Effective embedment depth: | $h_{ef,act}$ = 13.500 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 14.000 in. x 14.000 in. x 0.500 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W8X28; (L x W x T x FT) = 8.060 in. x 6.540 in. x 0.285 in. x 0.465 in. |
| Base material: | uncracked concrete, 3000, $f_c'$ = 3,000 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



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|---|---|---|---|
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| Specifier: | | Project: | Upstream Bulkhead |
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| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| Loading | Proof | Load | Capacity | $\beta_N$ / $\beta_V$ [%] | Status |
| Tension | Bond Strength | 18,200 | 33,723 | 54 / - | OK |
| Shear | Steel Strength | 7,750 | 16,305 | - / 48 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | 0.540 | 0.475 | 5/3 | 65 | OK |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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| | | | |
|---|---|---|---|
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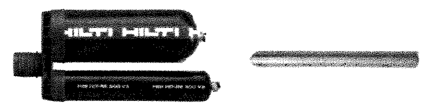
| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Bot. Waler Connection |
| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

**Specifier's comments:** End Reactions

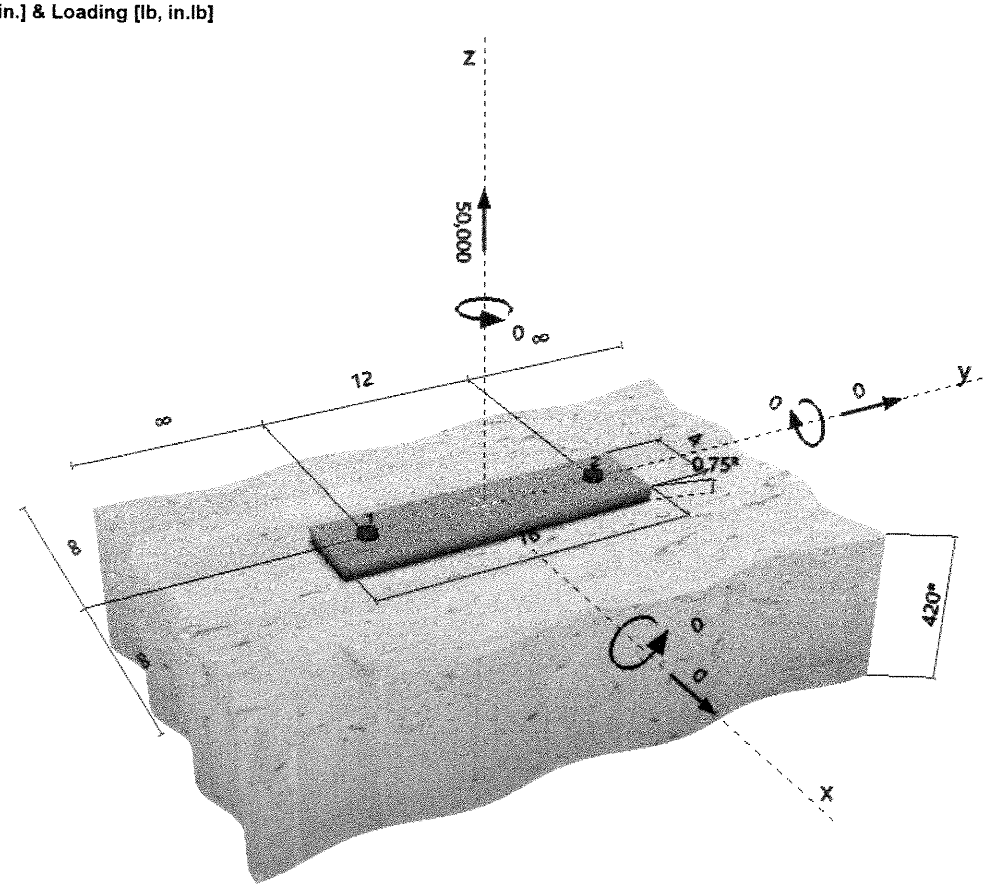
## 1 Input data



| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1** |
| Return period (service life in years): | 50 |
| Effective embedment depth: | $h_{ef,act}$ = 18.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.750 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 4.000 in. x 16.000 in. x 0.750 in.; (Recommended plate thickness: not calculated |
| Profile: | no profile |
| Base material: | uncracked concrete, 3000, $f_c'$ = 3,000 psi; h = 420.000 in., Temp. short/long: 60/40 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: >= No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
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| Specifier: | | Project: | Upstream Bulkhead |
| Address: | | Sub-Project I Pos. No.: | Bot. Waler Connection |
| Phone I Fax: | \| | Date: | 4/10/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | Bond Strength | 50,000 | 55,750 | 90 / - | OK |
| Shear | - | - | - | - / - | - |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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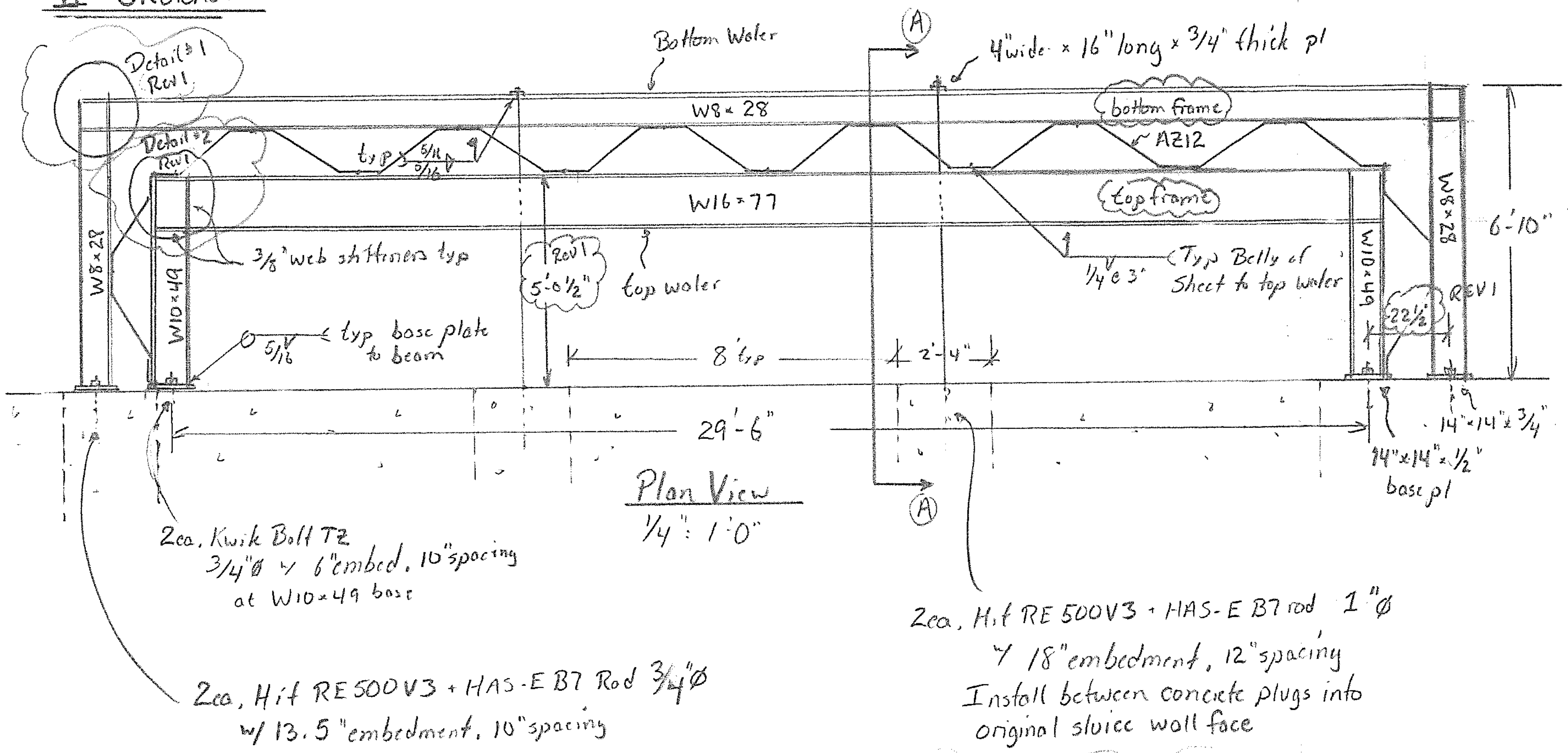
## VI- Sketches



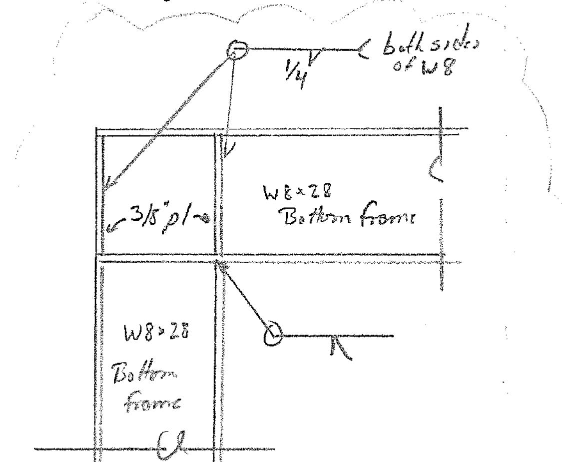

Plan View
1/4" : 1'0"

Shawmut Upstream Bulkhead

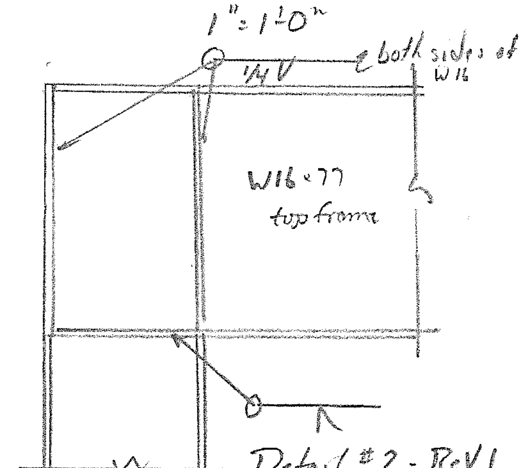
Bancroft Contracting Corporation

April 10, 2020

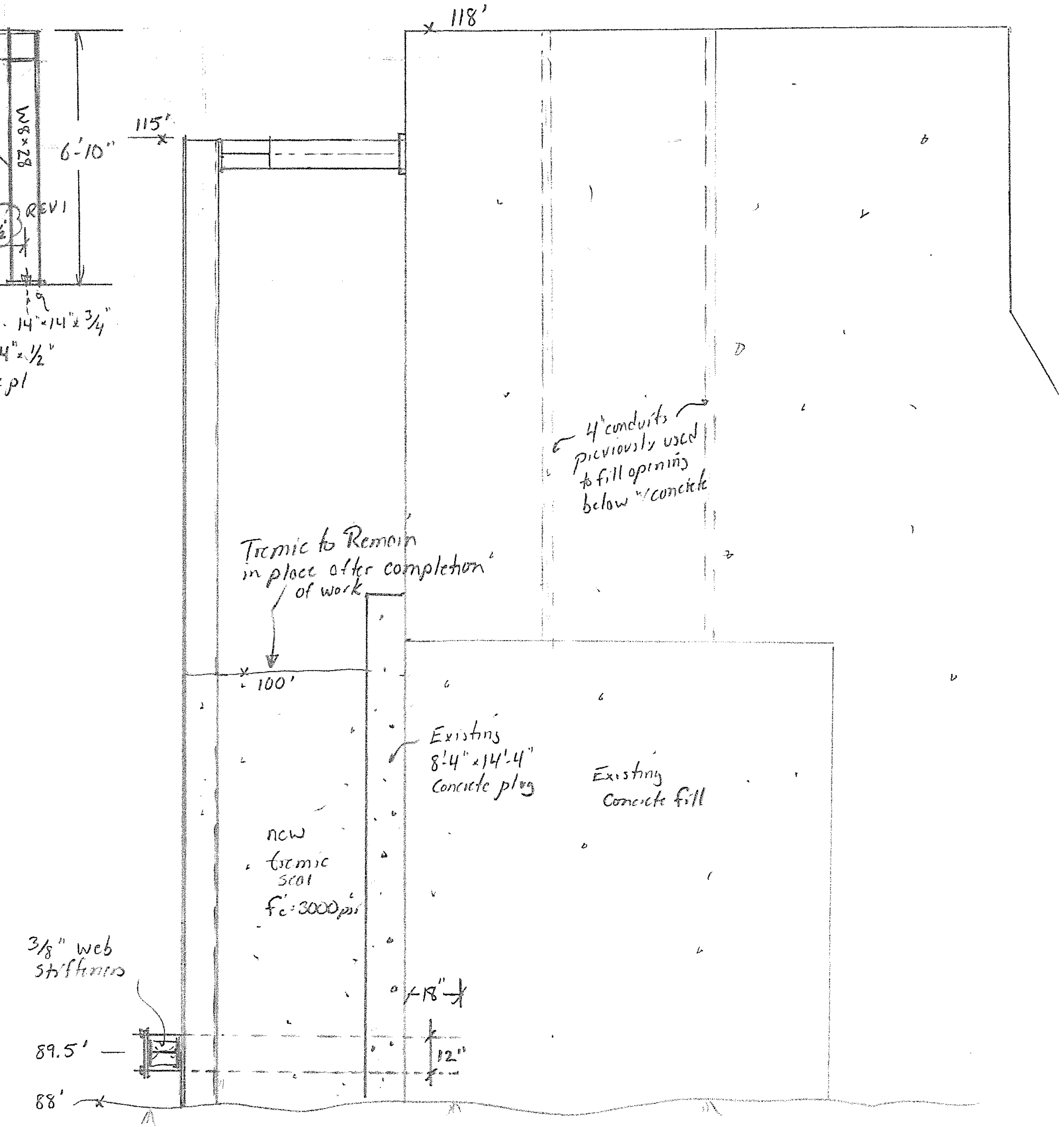
Rev#1 - April 22nd




Detail #1 - REV 1
1" = 1'0"




Detail #2 - Rev 1
1" = 1'0"




Section A-A
1/4" : 1'0"

BANCROFT Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 005

Contract/Project No. TBD

Attn: Gerry Mitchell

BCC Job No. 2002036

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Unit 1-6 Powerhouse to Dike Downstream Cofferdam |

Supplier

Bancroft Contracting Corp.
Subcontractor

Stamp

Remarks: Clarification letter has been included to address Alden's comments. This submission is for informational purposes only.

Submitted by: Peter Poor (Name) Peter Poor (Signature) 4/23/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks:

Reviewed by: Name Signature Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

April 23, 2020

Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Attention: Gerry Mitchell

Reference: Shawmut Unit 1-6 to Dike Braced Cofferdam Clarifications

Mr. Mitchell,

Our responses to comments posed by Alden Labs regarding the above referenced cofferdam design are as follows:

1.) Sheet 1 (Tailwater 10 Yr Flood vs. Design Elev.)
    a. Our decision to propose a design elevation of El. 92.0’ was based on a June-December work schedule where, based on historical data, flows required to raise tailwater elevation to El. 92.0’ or above occurs 0%-4% of the time. We intend to have most work at ledge elevation complete prior to months that historically have increased flows (October and November).

2.) Sheet 14 (Sketches)
    a. Depth of sandbags revised to 4 ft.

If you have any questions or require additional information, please feel free to contact me at any time.

Regards,

Bancroft Contracting Corp.

Peter Poor
Project Manager
o. (207) 743-8946
c. (207) 890-7317
ppoor@bancroftcontracting.com

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

## Shawmut Braced Cofferdam
## Location: Between Unit #1-#6 Powerhouse and Dike
## April 15, 2020

Reviewed By: Gagnon Engineering

STATE OF MAINE
ROGER R. GAGNON
No. 3409
LICENSED
PROFESSIONAL ENGINEER

April 16, 2020

58 Pages Total

PETER POOR
BANCROFT CONTRACTING CORP.
APRIL 10, 2020

# DOWNSTREAM BRACED COFFERDAM
## UNIT 1-6 POWERHOUSE TO DIKE

GIVEN:
- FOLLOWING SKETCH
- $F_y = 50$ ksi (BEAMS)
- $F_y = 36$ ksi (PLATE)
- $F_y = 35$ ksi (PIPE)
- WOOD: NO. 2 MIXED SOUTHERN PINE

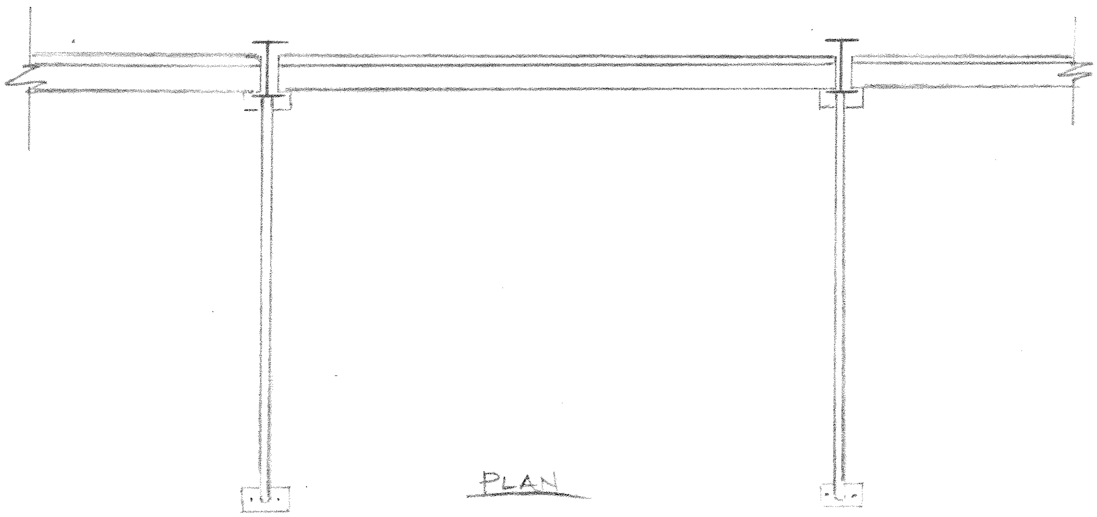
FIND: DESIGN COFFERDAM

I - DESIGN STOPLOGS - PG. 2
II - DESIGN FRAME - PG. 3-5
III - CONNECTIONS - PG. 6-8
IV - SKETCHES - PG. 9-15
V - MATERIAL LIST - PG. 16
VI - GENERAL LAYOUT - PG. 17
VII - ATTACHMENT "A" - PG. 18-21
VIII - ATTACHMENT "B" - PG. 22-24

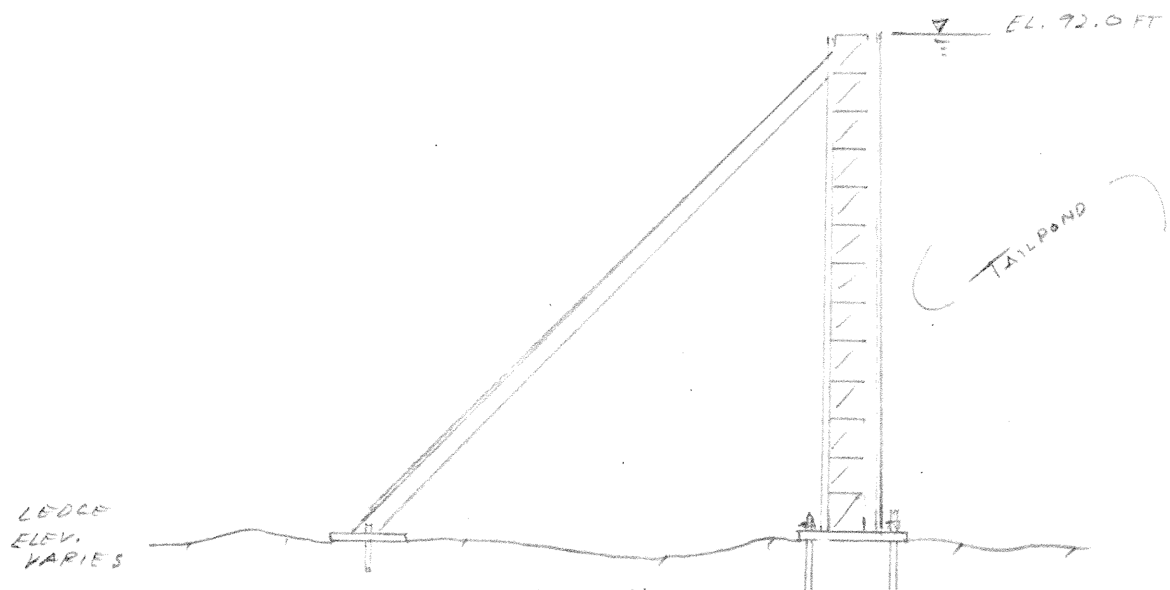
HILTI DESIGN REPORT "A"
HILTI DESIGN REPORT "B"

DESIGN REFERENCES:

1.) AISC STEEL CONST. MANUAL (13TH - ASD)
2.) AITC TIMBER CONST. MANUAL (4TH - ASD)
3.) HILTI PROFIS
4.) SHAWMUT U.S. FISH PASSAGE DRAWING G-008



PLAN




SECTION

I.) DESIGN STOPLOGS

GIVEN: SPAN BETWEEN FRAMES = 7.5 FT

FIND: 1.) FIND MAXIMUM DEPTH WHERE 4×4 CAN BE USED
2.) FIND MAXIMUM DEPTH WHERE 6×6 CAN BE USED

4×4 STOPLOGS

(AITC TABLE 8.4) $F_b = F_b' \cdot C_F \cdot C_r \cdot C_{fu} \cdot C_M$

ADJ. FACTORS
$C_F = 1.0$
$C_r = 1.15$ (PLYWOOD SHEATHING)
$C_{fu} = 1.0$
$C_M = 0.85$

$F_b = 1300\ psi\ (1.0)(1.15)(1.0)(0.85) = 1271\ psi$

$M_{ALLOW} = F_b S_x = \frac{1271\ psi\ (7.15\ IN^3)}{12\ IN/FT} = 757.3\ LB \cdot FT$

$W_{ALLOW} = \frac{8 M_{ALLOW}}{\ell^2} = \frac{8(757.3\ LB \cdot FT)}{(7.5\ FT)^2} = 107.7\ LB/FT$

$P_{ALLOW} = \frac{W}{BEAM\ DEPTH} = \frac{107.7\ LB/FT\ (12\ IN/FT)}{3.5\ IN} = 369.2\ LB/FT^2$

$MAX\ DEPTH = \frac{P_{ALLOW}}{62.4\ LB/FT^3} = \frac{369.2\ LB/FT^2}{62.4\ LB/FT^3} = 5.92\ FT$

| 4×4 STOPLOGS ARE USEABLE TO A DEPTH OF 5.92 FT |
|---|

6×6 STOPLOGS

(AITC TABLE 8.6) $F_b = F_b' \cdot C_F \cdot C_M \cdot C_H$

ADJ. FACTORS
$C_F = 1.0$
$C_M = 1.0$
$C_H = 1.0$

$F_b = 850\ psi\ (1.0)(1.0)(1.0) = 850\ psi$

$M_{ALLOW} = F_b S_x = \frac{850\ psi\ (27.73\ IN^3)}{12\ IN/FT} = 1964.2\ LB \cdot FT$

$W_{ALLOW} = \frac{8 M_{ALLOW}}{\ell^2} = \frac{8(1964.2\ LB \cdot FT)}{(7.5\ FT)^2} = 279.4\ LB/FT$

$P_{ALLOW} = \frac{W}{BEAM\ DEPTH} = \frac{279.4\ LB/FT\ (12\ IN/FT)}{5.5\ IN} = 609.6\ LB/FT^2$

$MAX\ DEPTH = \frac{P_{ALLOW}}{62.4\ LB/FT^3} = \frac{609.6\ LB/FT^2}{62.4\ LB/FT^3} = 9.77\ FT$

| 6×6 STOPLOGS ARE USEABLE TO A DEPTH OF 9.77 FT |
|---|

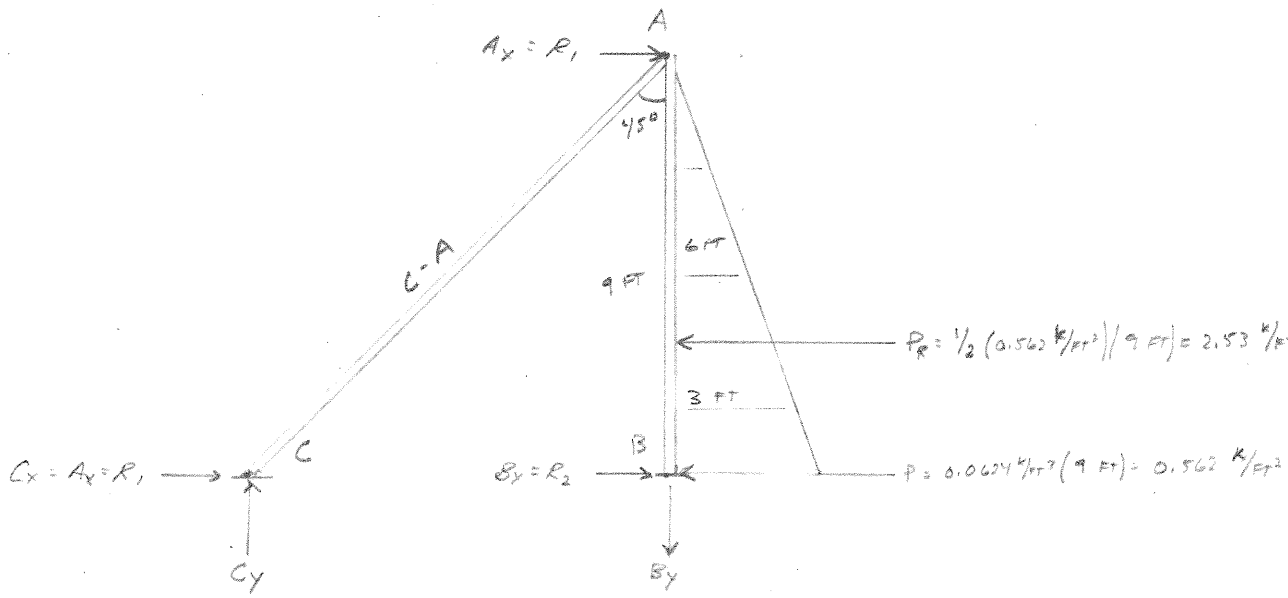
* TABLES PROVIDING MATERIAL PROPERTIES & ADJ. FACTORS ARE INCLUDED IN ATTACHMENT "A"

II.) DESIGN FRAME

GIVEN: 1.) SPAN BETWEEN FRAMES: 7.5 FT
2.) MAXIMUM DEPTH REQUIRED = 9.0 FT

FIND: 1.) DETERMINE REACTIONS @ 9.0 FT DEPTH
2.) DESIGN VERTICAL MEMBER
3.) DESIGN STRUT

REACTIONS




REACTIONS / FORCES

$$P_R = 2.53\ ^k/_{FT}\,(7.5\ FT) = 19.0^k$$

$$R_1 = C_x = A_x = \frac{P_R}{3} = \frac{19.0^k}{3} = 6.33^k$$

$$R_2 = B_x = \frac{2P_R}{3} = \frac{2(19.0^k)}{3} = 12.67^k$$

$$C\text{-}A = \frac{R_1}{\sin 45} = \frac{6.33^k}{\sin 45} = 8.95^k \text{ (COMPRESSION)}$$

$$C_y = B_y = \cos 45\,(C\text{-}A) = \cos 45\,(8.95^k) = 6.33^k$$

II.) DESIGN FRAME (CONT.)

VERTICAL MEMBER

(AISC TABLE 3-23) $M_{MAX} = 0.128\,w\ell = 0.128\,(2.53^{k}/FT\,(7.5\,FT)(9\,FT)) = 21.86\ k\cdot FT$

TRY W8×18
$Z_x = 17.0\ IN^3$
$S_x = 15.2\ IN^3$
$L_p = 4.34\ FT$
$L_r = 13.50\ FT$

– CHECK LTB WHERE $L_b = 9.0\ FT$

(AISC F2-1) $M_p = F_y Z_x = 50\ ksi\,(17.0\ IN^3) = 850\ k\cdot IN$

(AISC F2-2) $M_n = 1.0\left[M_p - (M_p - 0.7F_yS_x)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \leq M_p$

$M_n = 1.0\left[850\ k\cdot IN - (850\ k\cdot IN - 0.7(50\ ksi)(15.2\ IN^3))\left(\frac{9\ FT - 4.34\ FT}{13.5\ FT - 4.34\ FT}\right)\right] = 688.22\ k\cdot IN$

(AISC F2-1) $M_{ALLOW} = \frac{M_n}{\Omega_b} = \frac{688.22\ k\cdot IN}{12\ ^{IN}/_{FT}\,(1.67)} = 34.34\ k\cdot FT$

21.86 k·FT < 34.34 k·FT ∴ OK
USE W8×18 FOR VERT. MEMBERS

– CHECK COMBINED FLEXURE & TENSION OF W8×18

$T_{MAX} = 6.33^{k}$ (FROM REACTIONS, PG. 3)

(AISC D2-1) $T_{ALLOW} = \frac{P_n}{\Omega_t} = \frac{F_y A_g}{\Omega_t} = \frac{50\ ksi\,(5.26\ IN^2)}{1.67} = 157.5^{k}$ O.K.

– INTERACTION

$\frac{P_r}{P_c} = \frac{T_{MAX}}{T_{ALLOW}} = \frac{6.33^{k}}{157.5^{k}} = 0.04 < 0.2 \therefore$ USE $\frac{P_r}{2P_c} + \left(\frac{M_r}{M_c}\right) \leq 1.0$ (AISC H1-1b)

$\frac{6.33^{k}}{2(157.5^{k})} + \left(\frac{21.86\ k\cdot FT}{34.34\ k\cdot FT}\right) = 0.66$

0.66 < 1.0 ∴ W8×18 IS OK
IN COMBINED FLEXURE & TENSION

W8×18 TO BE USED FOR DEPTHS 9 FT OR LESS

## II.) DESIGN FRAME (CONT.)

### STRUT

* FROM REACTION SECTION, $P_{MAX} = 8.95^k$

| |
|---|
| TRY 3" STD. PIPE |
| WT/FT = 7.58 LB |
| $A_g = 2.08\ IN^2$ |
| $r = 1.17\ IN$ |

$$\frac{KL}{r} = \frac{1.0\,(12.73\ FT)(12\ ^{IN}/_{FT})}{1.17} = 130.6$$

$$4.71\sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29000\ ksi}{35\ ksi}} = 135.6$$

$$130.6 < 135.6 \ \therefore\ F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right]F_y$$

AISC (E3-4) $$F_e = \frac{\pi^2(29000\ ksi)}{(130.6)^2} = 16.8\ ksi$$

(E3-3) $$F_{cr} = \left[0.658^{\frac{35}{16.8}}\right]35\ ksi = 14.63\ ksi$$

AISC (E3-1) $$P_{ALLOW} = \frac{F_{cr}A_g}{\Omega_c} = \frac{14.63\ ksi\,(2.08\ IN^2)}{1.67} = 18.22^k$$

| |
|---|
| $8.95^k < 18.22^k \ \therefore$ OK |

- CHECK COMBINED FLEXURE & COMPRESSION IN 3" STD. PIPE

$$M_{MAX} = \frac{\text{UNIT WT OF PIPE} \cdot \ell^2}{8} = \frac{0.0076\ ^k/_{FT}\,(12.73\ FT)^2}{8} = 0.154\ K\cdot FT$$

$$M_{ALLOW} = \frac{F_y Z}{1.67} = \frac{35\ ksi\,(2.19\ IN^3)}{1.67\,(12\ ^{IN}/_{FT})} = 3.82\ K\cdot FT$$

- INTERACTION

$$\frac{P_r}{P_c} = \frac{P_{MAX}}{P_{ALLOW}} = \frac{8.95^k}{18.22^k} = 0.49 > 0.2 \ \therefore\ \frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_r}{M_c}\right) \le 1.0 \quad \text{AISC (H1-1a)}$$

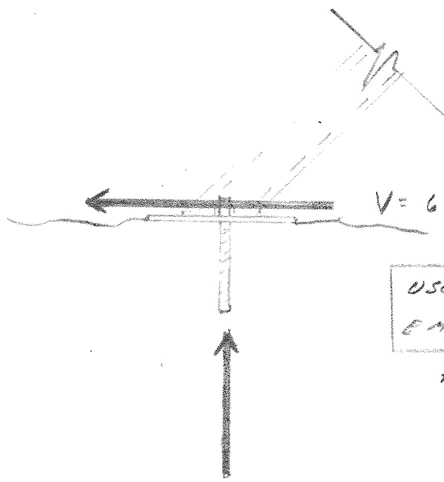
$$\frac{8.95^k}{18.22^k} + \frac{8}{9}\left(\frac{0.154\ K\cdot FT}{3.82\ K\cdot FT}\right) = 0.53$$

| |
|---|
| $0.53 < 1.0 \ \therefore$ 3" STD PIPE IS OK IN COMBINED FLEXURE & COMPRESSION |

| |
|---|
| **3 IN. STD PIPE TO BE USED FOR DEPTHS 9 FT OR LESS** |

III.) CONNECTIONS *CALCULATIONS FOR REACTIONS ON PG. 3

STRUT ANCHORING



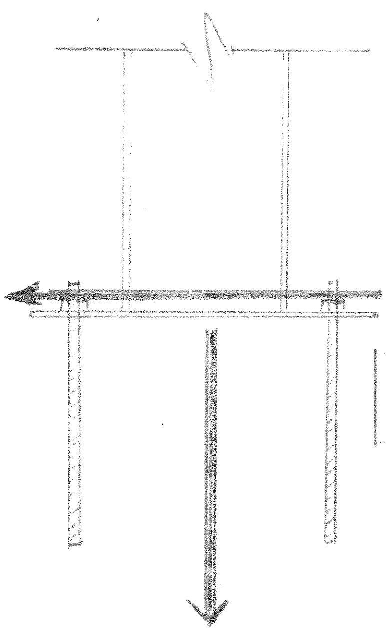
V = 6.33^K × 1.7 = 10.761^K (FACTORED SHEAR LOAD)

| |
|---|
| USE 5/8" ⌀ HAS-E B7 ROD WITH HILTI HIT-RE 500 V3 EMBED MIN. 6 IN. |

* SEE HILTI DESIGN REPORT "A"

P = 6.33^K × 1.7 = 10.761^K (FACTORED COMPRESSIVE LOAD)

VERTICAL BEAM ANCHORING



V = 12.67^K × 1.7 = 21.539^K (FACTORED SHEAR LOAD)

| |
|---|
| USE 7/8" ⌀ HAS-E B7 ROD WITH HILTI HIT-RE 500 V3 EMBED MIN. 12 IN. |

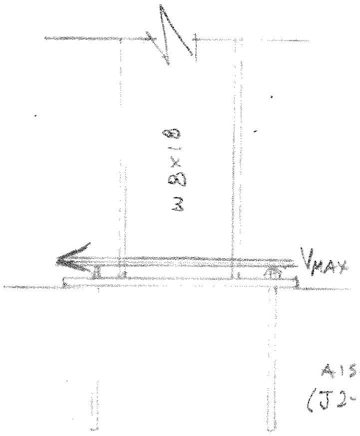
* SEE HILTI DESIGN REPORT "B"

T = 6.33^K × 1.7 = 10.761^K (FACTORED TENSILE LOAD)

| |
|---|
| ANCHORING DETAILS SHOWN ABOVE ARE TO BE USED FOR DEPTHS 9 FT OR LESS. |

III.) CONNECTIONS - WELDED JOINTS *CALCULATIONS FOR REACTIONS ON PG. 3

VERTICAL BEAM - BASEPLATE




- CHECK WELD STRENGTH VS. SHEAR

KNOWN

$V_{MAX} = 12.67^k$
$l_w = 35.3$ IN (PERIMETER OF W8x18)
$F_{EXX} = 70$ ksi
$t_{min} = 1/4''$ (WEB OF W8x18)

- TRY 1/4" FILLET WELD (ALL-AROUND)

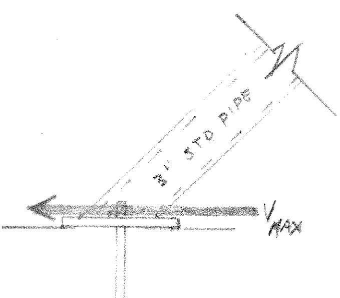
AISC (J2-3)

$$\frac{R_n}{\Omega} = \frac{F_w A_w}{\Omega} = \frac{0.6 F_{EXX}(0.707)(D)(l_w)}{2.00\ (16)}$$

$$= \frac{0.6(70\text{ ksi})(0.707)(4)(35.3\text{ IN})}{2.00\ (16)} = 131^k$$

$12.67^k < 131^k$ ∴ OK
- USE 1/4" FILLET WELD FOR VERT. BEAM - BASEPLATE

STRUT - BASEPLATE




- CHECK WELD STRENGTH VS. SHEAR

KNOWN

$V_{MAX} = 6.33^k$
$l_w = 11.0$ IN (EXCLUDES CONSIDERATION OF ANGLE)
$F_{EXX} = 70$ ksi
$t_{min} = 0.201$ IN (WALL OF PIPE)

- TRY 3/16" FILLET WELD (ALL-AROUND)

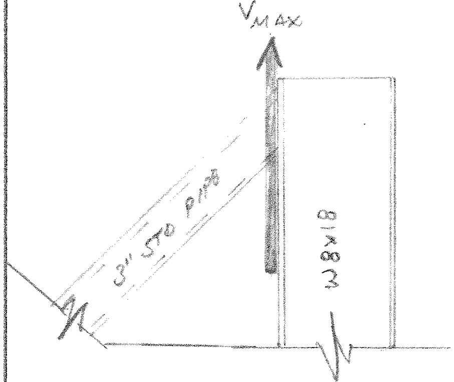
AISC (J2-3)

$$\frac{R_n}{\Omega} = \frac{0.6(70\text{ ksi})(0.707)(3)(11.0\text{ IN})}{2.00\ (16)} = 30.6^k$$

$6.33^k < 30.6^k$ ∴ OK
- USE 3/16" FILLET WELD FOR STRUT - BASEPLATE

III.) CONNECTIONS - WELDED JOINTS (CONT.)

STRUT - VERTICAL BEAM




- CHECK WELD STRENGTH VS. SHEAR

KNOWN

$V_{MAX} = 6.33^k$

$l_w = 11.0$ IN (EXCLUDES CONSIDERATION OF ANGLE)

$F_{EXX} = 70$ ksi

$t_{min} = 0.201$ IN (WALL OF PIPE)

- TRY 3/16" FILLET WELD (ALL-AROUND)

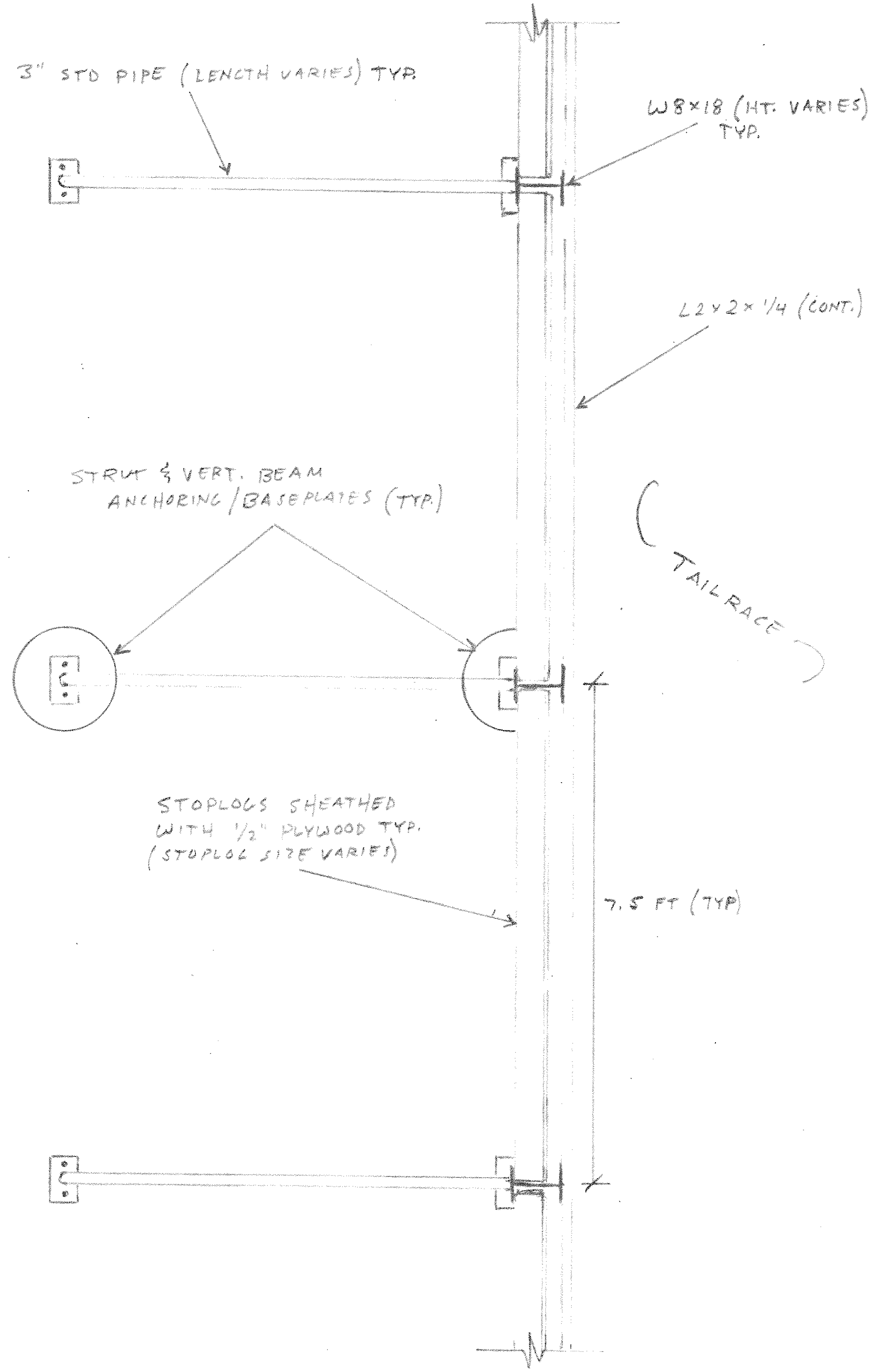
AISC (J2-3) $\frac{R_n}{\Omega} = \frac{0.6(70 \text{ ksi})(0.707)(3)(11.0 \text{ IN})}{2.00(16)} = 30.6^k$

$6.33^k < 30.6^k$ ∴ OK

- USE 3/16" FILLET WELD FOR STRUT - VERT. BEAM

IV.) SKETCHES

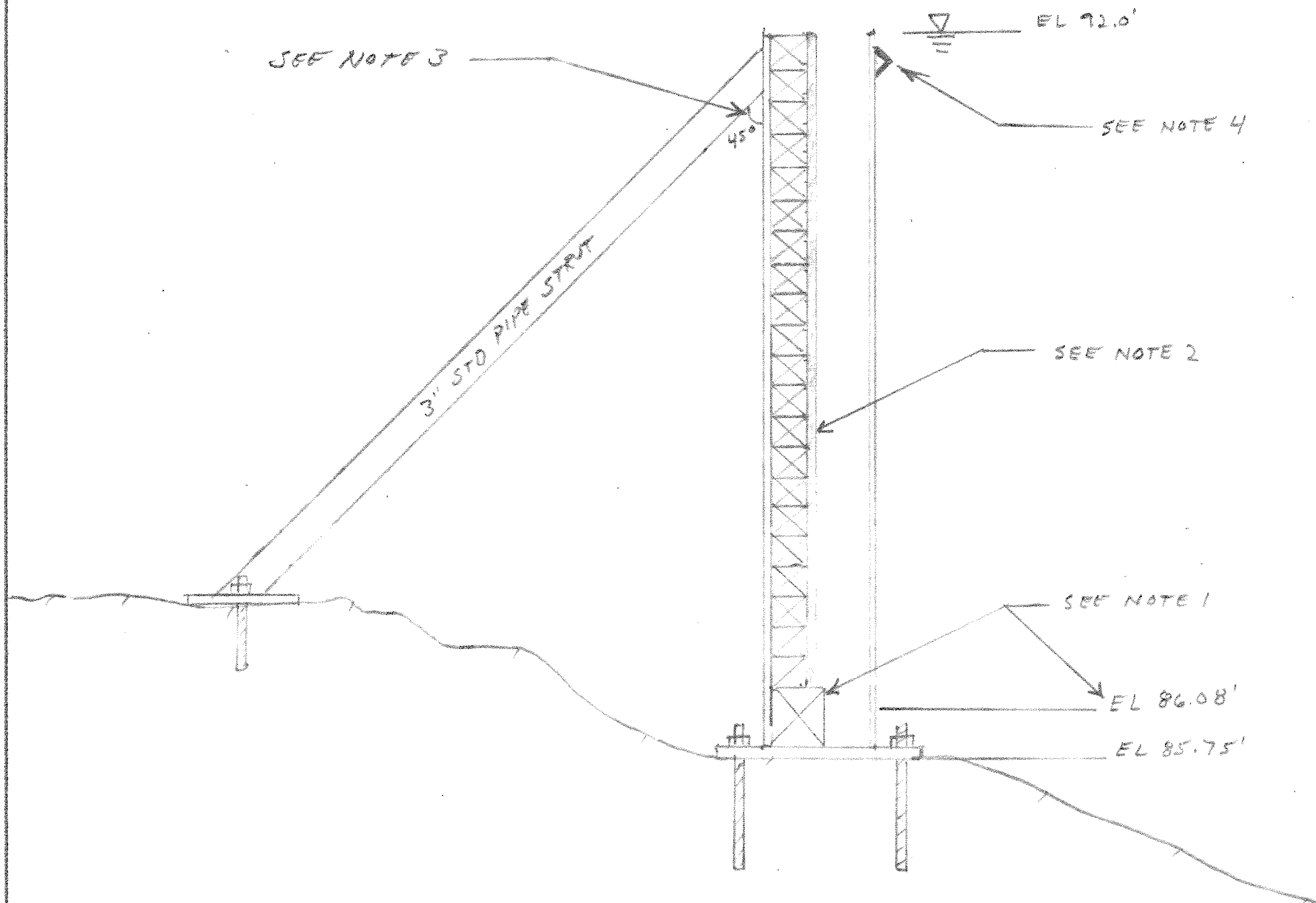
TYPICAL PLAN



SKETCHES

- EXAMPLE OF INSTALLATION OF BRACED COFFERDAM

SECTION




NOTES

1.) EL. 86.08' PROVIDES THE MAXIMUM DEPTH (ASSUMING A DESIGN ELEV. OF 92.0') WHERE 4X4 LOGS ARE SUITABLE. AT A MINIMUM, 6X6 WOULD BE REQUIRED UP TO THIS ELEVATION PRIOR TO SWITCHING OVER TO 4X4 LOGS

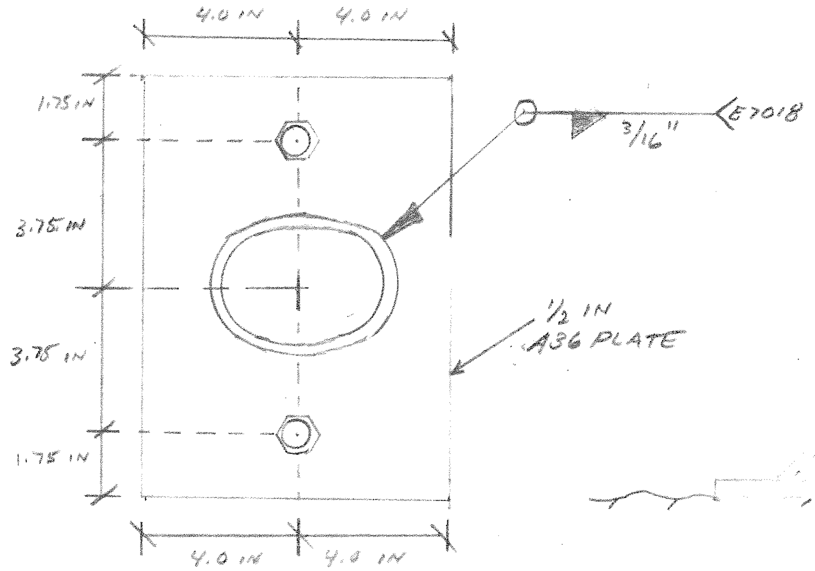
2.) 4X4 STOPLOGS ARE TO BE SHEATHED WITH 1/2" PLYWOOD. 6X6 ARE NOT REQUIRED TO BE SHEATHED.

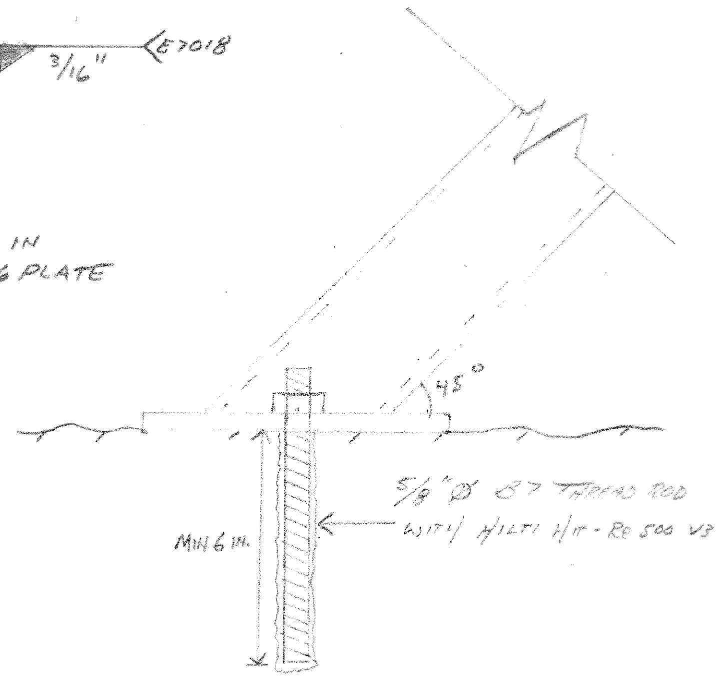
3.) 45° ANGLE TO BE CONSISTENT FOR ALL STRUT INSTALLATIONS

4.) L2X2X1/4 TO BE CONTINUOUS ALONG SECTIONS OF BRACED COFFERDAM

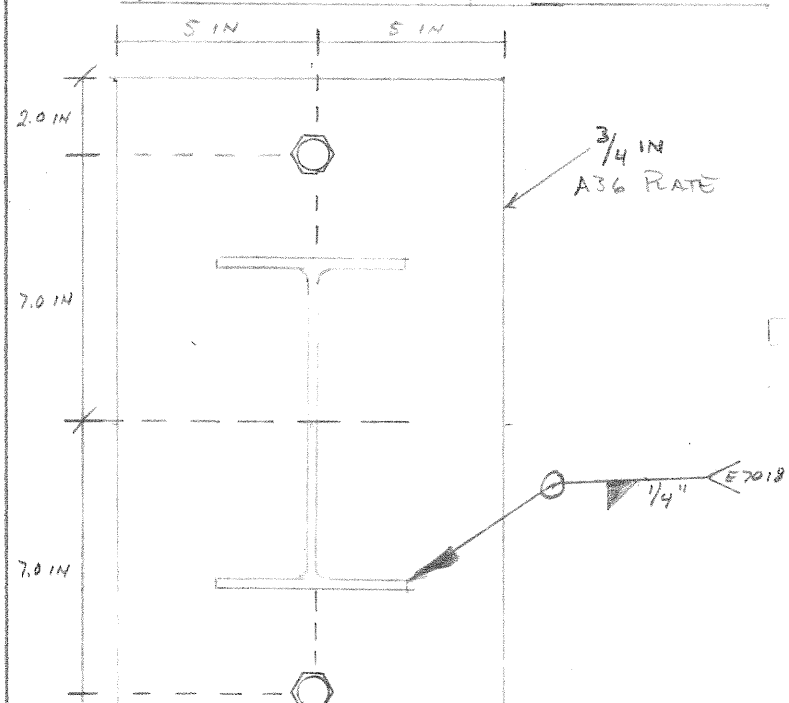
## SKETCHES

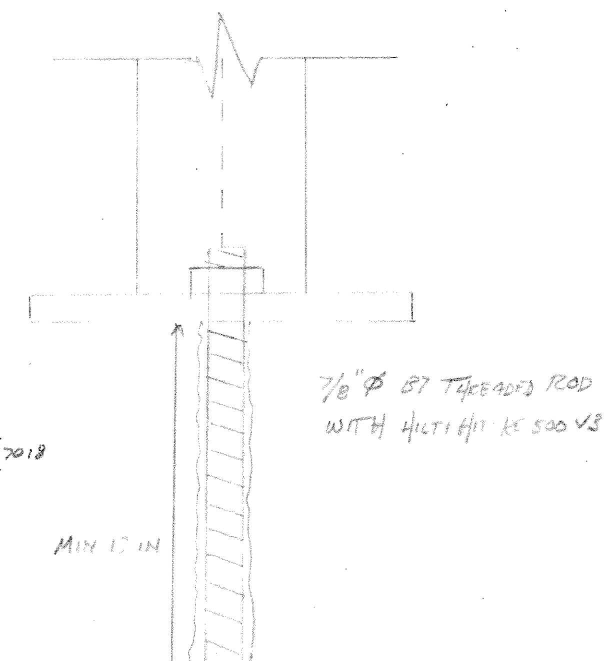
### STRUT ANCHORING & BASEPLATE



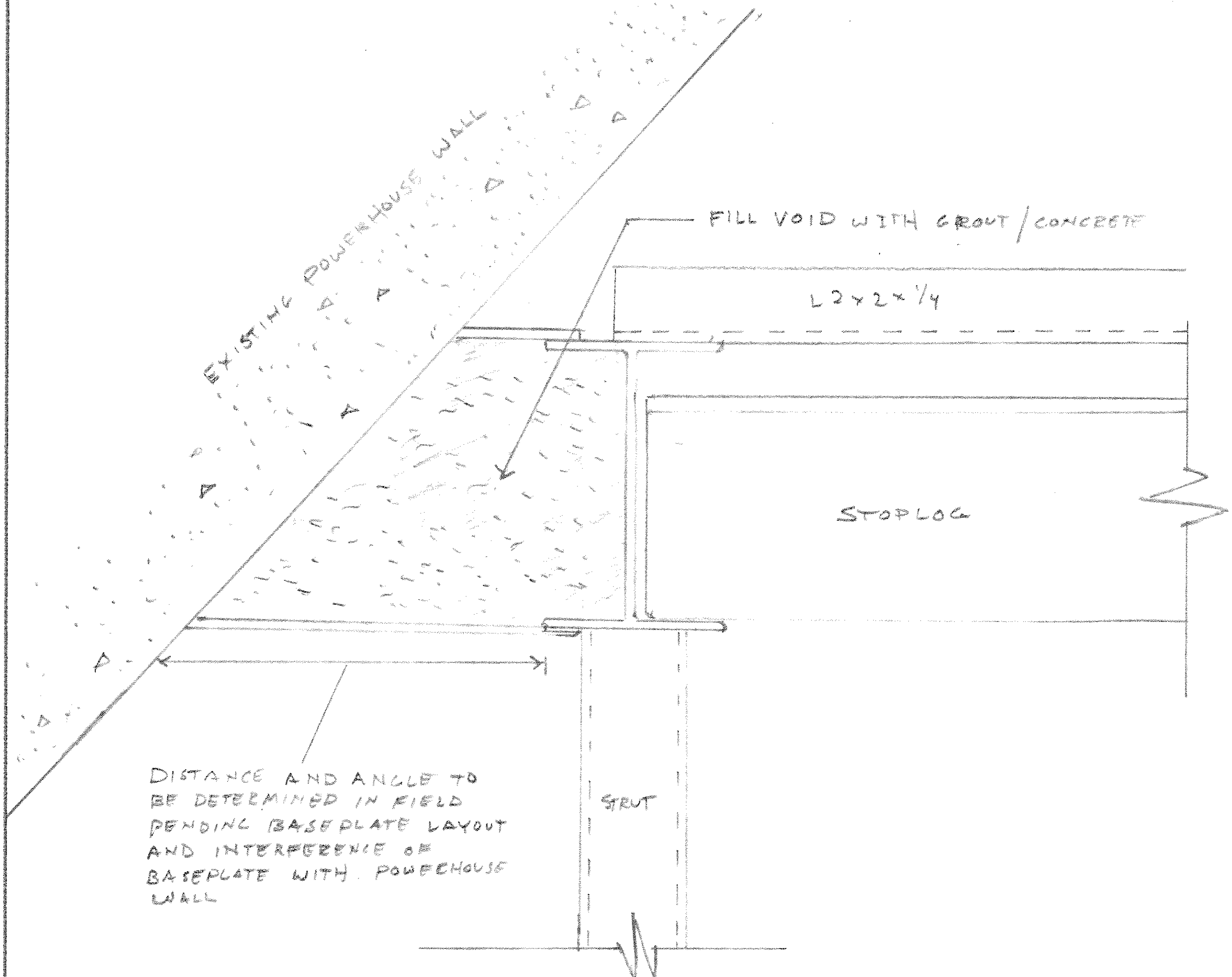

### VERTICAL BEAM ANCHORING & BASEPLATE



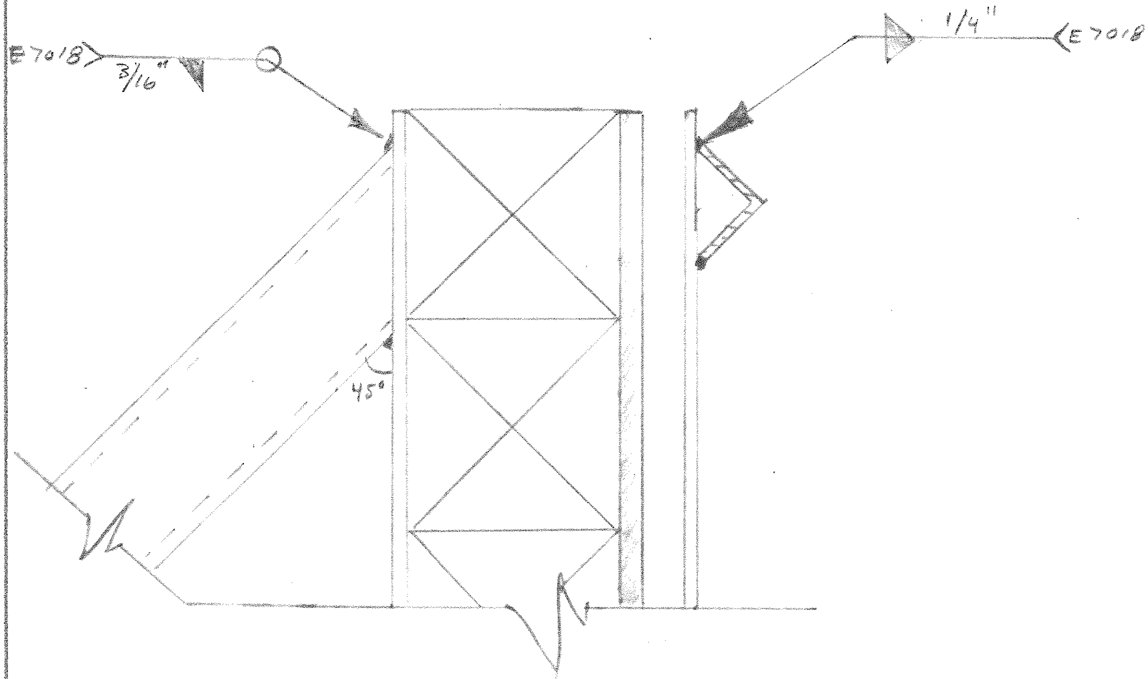
SKETCHES

CONNECTION AT UNIT #1-#6 POWERHOUSE WALL



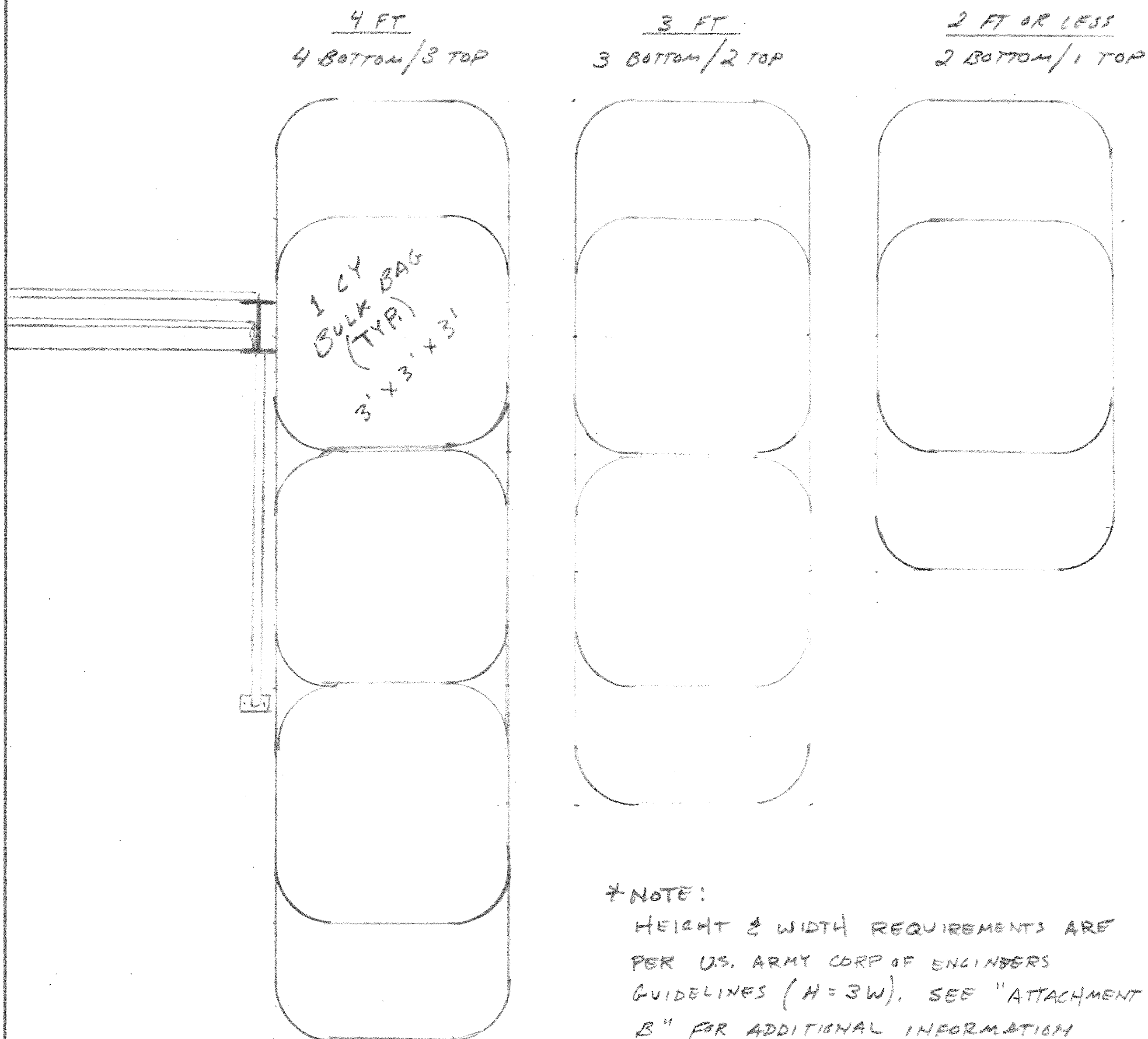
SKETCHES

CONNECTIONS AT TOP OF VERTICAL BEAM



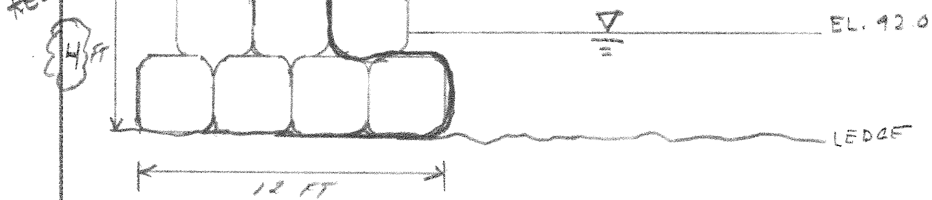
SKETCHES

SANDBAG COFFERDAM FOR DEPTHS UP TO 4 FT




*NOTE:
HEIGHT & WIDTH REQUIREMENTS ARE PER U.S. ARMY CORP OF ENGINEERS GUIDELINES (H = 3W). SEE "ATTACHMENT B" FOR ADDITIONAL INFORMATION

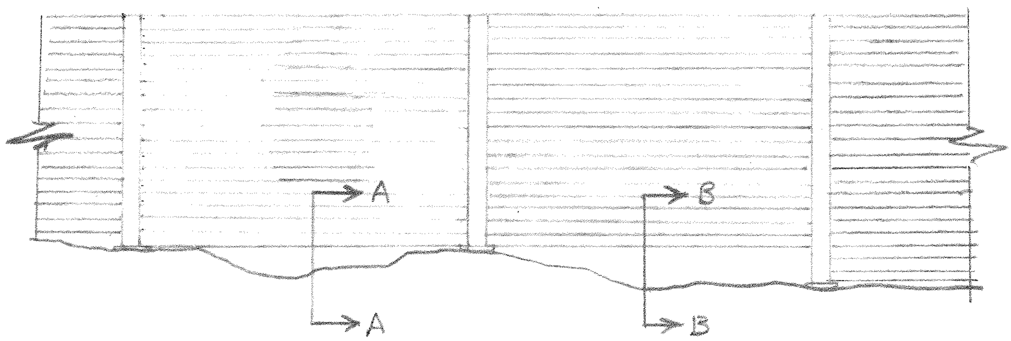
TYPICAL SECTION FOR 4 FT DEPTH



SKETCHES

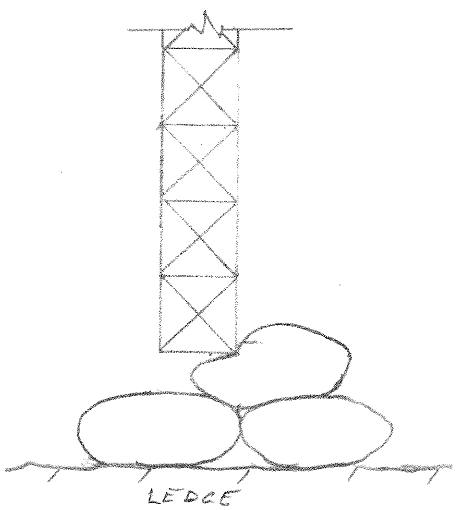
METHOD FOR SEALING STOPLOGS ON UNEVEN LEDGE

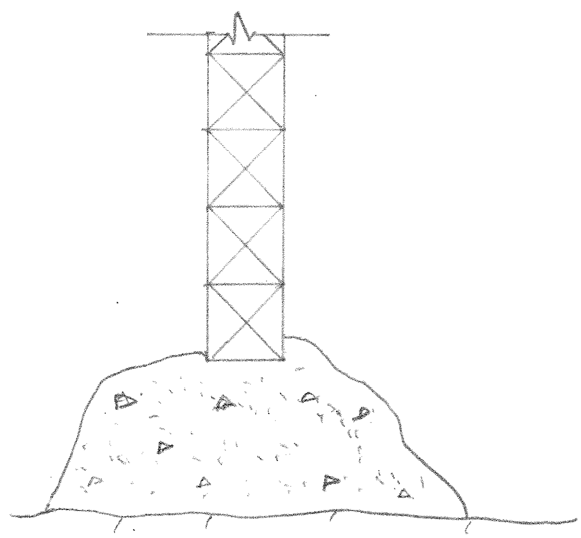
- EXAMPLE SECTIONS




SECTION A-A

SECTION B-B



* DEPEND ON DEPTH OR SIZE OF GAP BETWEEN STOPLOGS AND LEDGE, SANDBAGS AND/OR A TREMIE CONCRETE PLACEMENT ARE TO BE USED FOR SEALING

# I.) MATERIAL LIST

BRACES/FRAMES

| ITEM | SIZE | $F_y$/GRADE |
|---|---|---|
| VERTICAL BEAM | W8×18 | 50 ksi |
| STRUT | 3" STD PIPE | 35 ksi |

BASEPLATES/ANCHORING

| | | |
|---|---|---|
| VERT BEAM BASEPLATE | 3/4"×10"×18" | 36 ksi |
| STRUT BASEPLATE | 1/2"×8"×11" | 36 ksi |
| THREADED ROD - B7 | SEE SKETCH | 105 ksi |
| EPOXY | N/A | HILTI HIT-RE500 V3 |

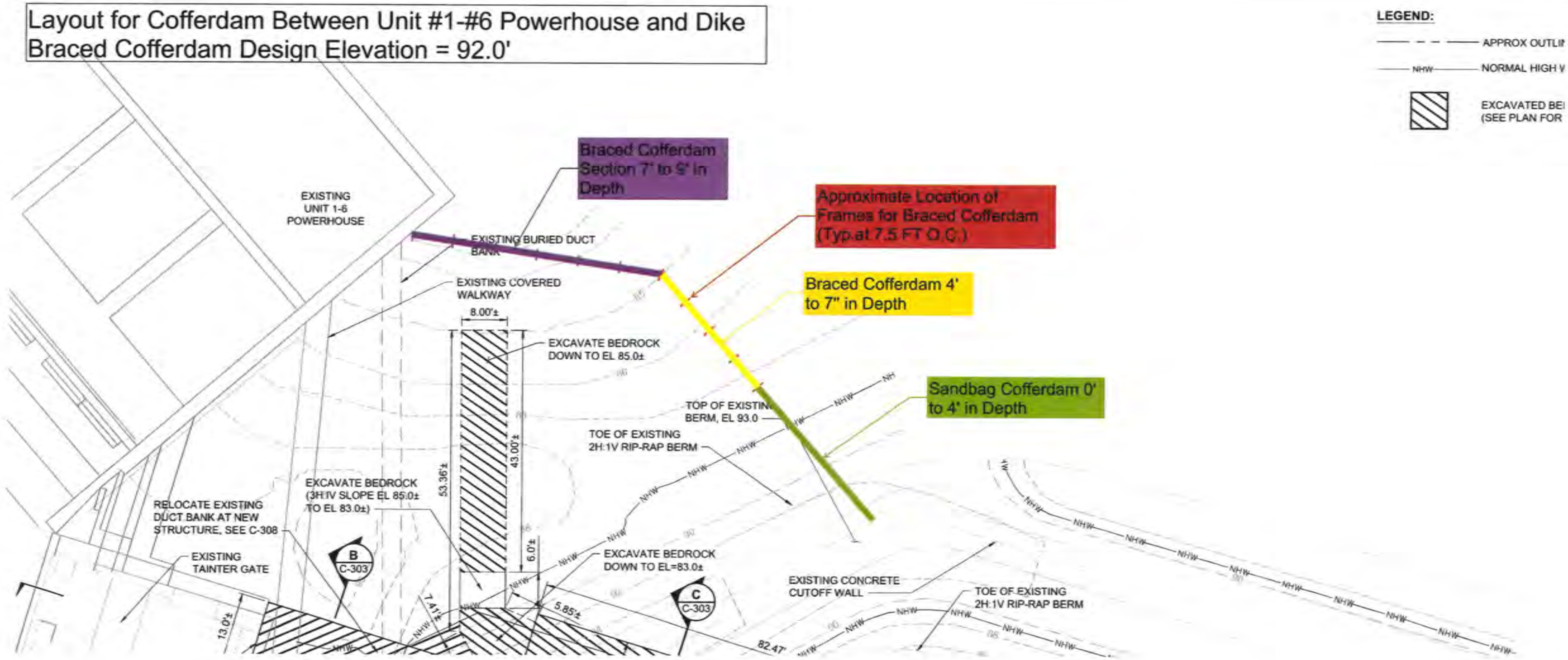
STOPLOGS

| | | |
|---|---|---|
| STOPLOGS - BELOW 5.92 FT | NOM. 4×4 | NO. 2 MIXED S. PINE |
| STOPLOGS - ABOVE 5.92 FT | NOM. 6×6 | NO. 2 MIXED S. PINE |
| SHEATHING - PLYWOOD | 1/2 IN. | N/A |

MISC.

| | | |
|---|---|---|
| WELDING ELECTRODES | N/A | 70 ksi |

Layout for Cofferdam Between Unit #1-#6 Powerhouse and Dike
Braced Cofferdam Design Elevation = 92.0'




VI.) GENERAL LAYOUT

7/24

18/24

VII.) ATTACHMENT "A"



**TABLE 8.4**

**Design Values for Visually Graded Southern Pine Dimension Lumber**
**(Tabulated design values are for normal load duration and dry service conditions, unless specified otherwise. See NDS 2.3 for a comprehensive description of design value adjustment factors.)**
**Use with Adjustment Factors**

| Species and commercial grade | Size classification | Bending $F_b$ | Tension parallel to grain $F_t$ | Shear parallel to grain $F_v$ | Compression perpendicular to grain $F_{c\perp}$ | Compression parallel to grain $F_c$ | Modulus of Elasticity E | Grading Rules Agency |
|---|---|---|---|---|---|---|---|---|
| | | Design values in pounds per square inch (psi) | | | | | | |
| **MIXED SOUTHERN PINE** | | | | | | | | |
| Select Structural | 2"-4"thick | 2050 | 1200 | 100 | 565 | 1800 | 1,600,000 | SPIB |
| No.1 | | 1450 | 875 | 100 | 565 | 1650 | 1,500,000 | |
| No.2 (4x4) | | 1300 | 775 | 90 | 565 | 1650 | 1,400,000 | |
| No.3 | 2"-4" wide | 750 | 450 | 90 | 565 | 950 | 1,200,000 | |
| Stud | | 775 | 450 | 90 | 565 | 950 | 1,200,000 | |
| Construction | 2"-4"thick | 1000 | 600 | 100 | 565 | 1700 | 1,300,000 | |
| Standard | | 550 | 325 | 90 | 565 | 1450 | 1,200,000 | |
| Utility | 4" wide | 275 | 150 | 90 | 565 | 950 | 1,100,000 | |
| Select Structural | 2"-4"thick | 1850 | 1100 | 90 | 565 | 1700 | 1,600,000 | |
| No.1 | | 1300 | 750 | 90 | 565 | 1550 | 1,500,000 | |
| No.2 | | 1150 | 675 | 90 | 565 | 1550 | 1,400,000 | |
| No.3 | 5"-6" wide | 675 | 400 | 90 | 565 | 875 | 1,200,000 | |
| Stud | | 675 | 400 | 90 | 565 | 875 | 1,200,000 | |
| Select Structural | 2"-4"thick | 1750 | 1000 | 90 | 565 | 1600 | 1,600,000 | |
| No.1 | | 1200 | 700 | 90 | 565 | 1450 | 1,500,000 | |
| No.2 | 8" wide | 1050 | 625 | 90 | 565 | 1450 | 1,400,000 | |
| No.3 | | 625 | 375 | 90 | 565 | 850 | 1,200,000 | |
| Select Structural | 2"-4"thick | 1500 | 875 | 90 | 565 | 1600 | 1,600,000 | |
| No.1 | | 1050 | 600 | 90 | 565 | 1450 | 1,500,000 | |
| No.2 | 10" wide | 925 | 550 | 90 | 565 | 1450 | 1,400,000 | |
| No.3 | | 525 | 325 | 90 | 565 | 825 | 1,200,000 | |
| Select Structural | 2"-4"thick | 1400 | 825 | 90 | 565 | 1550 | 1,600,000 | |
| No.1 | | 975 | 575 | 90 | 565 | 1400 | 1,500,000 | |
| No.2 | 12" wide | 875 | 525 | 90 | 565 | 1400 | 1,400,000 | |
| No.3 | | 500 | 300 | 90 | 565 | 800 | 1,200,000 | |
| **SOUTHERN PINE** | | | | | | | | |
| Dense Select Structural | 2"-4"thick | 3050 | 1650 | 100 | 660 | 2250 | 1,900,000 | |
| Select Structural | | 2850 | 1600 | 100 | 565 | 2100 | 1,800,000 | |
| Non-Dense Select Structural | | 2650 | 1350 | 100 | 480 | 1950 | 1,700,000 | |
| No.1 Dense | | 2000 | 1100 | 100 | 660 | 2000 | 1,800,000 | |
| No.1 | | 1850 | 1050 | 100 | 565 | 1850 | 1,700,000 | |
| No.1 Non-Dense | 2"-4" wide | 1700 | 900 | 100 | 480 | 1700 | 1,600,000 | |
| No.2 Dense | | 1700 | 875 | 90 | 660 | 1850 | 1,700,000 | |
| No.2 | | 1500 | 825 | 90 | 565 | 1650 | 1,600,000 | |
| No.2 Non-Dense | | 1350 | 775 | 90 | 480 | 1600 | 1,400,000 | |
| No.3 | | 850 | 475 | 90 | 565 | 975 | 1,400,000 | |
| Stud | | 875 | 500 | 90 | 565 | 975 | 1,400,000 | |
| Construction | 2"-4"thick | 1100 | 625 | 100 | 565 | 1800 | 1,500,000 | |
| [illegible] | | [illegible] | 350 | 90 | 565 | 1500 | 1,300,000 | |

19/24

## SIZE FACTOR, $C_F$

Appropriate size adjustment factors have already been incorporated in the tabulated design values for most thicknesses of Southern Pine and Mixed Southern Pine dimension lumber. For dimension lumber 4" thick, 8" and wider (all grades except Dense Structural 86, Dense Structural 72 and Dense Structural 65), tabulated bending design values, $F_b$, shall be permitted to be multiplied by the size factor, $C_F = 1.1$. For dimension lumber wider than 12" (all grades except Dense Structural 86, Dense Structural 72 and Dense Structural 65), tabulated bending, tension and compression parallel to grain design values for 12" wide lumber shall be multiplied by the size factor, $C_F = 0.9$. When the depth, d, of Dense Structural 86, Dense Structural 72 or Dense Structural 65 dimension lumber exceeds 12", the tabulated bending design value, $F_b$, shall be multiplied by the following size factor:

$$C_F = (12/d)^{1/9}$$

## REPETITIVE MEMBER FACTOR, $C_r$

Bending design values, $F_b$, for dimension lumber 2" to 4" thick shall be multiplied by the repetitive member factor, $C_r = 1.15$, when such members are used as joists, truss chords, rafters, studs, planks, decking or similar members which are in contact or spaced not more than 24" on centers, are not less than 3 in number and are joined by floor, roof or other load distributing elements adequate to support the design load.

## FLAT USE FACTOR, $C_{fu}$

Bending design values adjusted by size factors are based on edgewise use (load applied to narrow face). When dimension lumber is used flatwise (load applied to wide face), the bending design value, $F_b$, shall also be multiplied by the following flat use factors:

**FLAT USE FACTORS, $C_{fu}$**

| Width | Thickness | |
|---|---|---|
| | 2" & 3" | 4" |
| 2" & 3" | 1.0 | --- |
| 4" | 1.1 | 1.0 |
| 5" | 1.1 | 1.05 |
| 6" | 1.15 | 1.05 |
| 8" | 1.15 | 1.05 |
| 10" & wider | 1.2 | 1.1 |

## WET SERVICE FACTOR, $C_M$

When dimension lumber is used where moisture content will exceed 19% for an extended time period, design values shall be multiplied by the appropriate wet service factors from the following table (for Dense Structural 86, Dense Structural 72 and Dense Structural 65 use tabulated design values for wet service conditions without further adjustment):

**WET SERVICE FACTORS, $C_M$**

| $F_b$ | $F_t$ | $F_v$ | $F_{c\perp}$ | $F_c$ | E |
|---|---|---|---|---|---|
| 0.85* | 1.0 | 0.97 | 0.67 | 0.8** | 0.9 |

* when $(F_b)(C_F) \leq 1150$ psi, $C_M = 1.0$
** when $F_c \leq 750$ psi, $C_M = 1.0$

20/24



**TABLE 8.6 (Continued)**

| Species and commercial grade | Size classification | Bending $F_b$ | Tension parallel to grain $F_t$ | Shear parallel to grain $F_v$ | Compression perpendicular to grain $F_{c\perp}$ | Compression parallel to grain $F_c$ | Modulus of Elasticity E | Grading Rules Agency |
|---|---|---|---|---|---|---|---|---|
| | | Design values in pounds per square inch (psi) | | | | | | |
| **MIXED OAK** | | | | | | | | |
| Select Structural | Beams and Stringers | 1350 | 800 | 80 | 800 | 825 | 1,000,000 | NELMA |
| No.1 | | 1150 | 550 | 80 | 800 | 700 | 1,000,000 | |
| No.2 | | 725 | 375 | 80 | 800 | 450 | 800,000 | |
| Select Structural | Posts and Timbers | 1250 | 850 | 80 | 800 | 875 | 1,000,000 | |
| No.1 | | 1000 | 675 | 80 | 800 | 775 | 1,000,000 | |
| No.2 | | 575 | 400 | 80 | 800 | 350 | 800,000 | |
| **MIXED SOUTHERN PINE** | | (Wet Service Conditions) | | | | | | |
| Select Structural | 5"x 5" & larger | 1500 | 1000 | 110 | 375 | 900 | 1,300,000 | SPIB |
| No.1 | | 1350 | 900 | 110 | 375 | 800 | 1,300,000 | |
| 6×6 No.2 | | 850 | 550 | 95 | 375 | 525 | 1,000,000 | |
| **MOUNTAIN HEMLOCK** | | | | | | | | |
| Select Structural | Beams and Stringers | 1350 | 775 | 85 | 570 | 875 | 1,100,000 | WCLIB |
| No.1 | | 1100 | 550 | 85 | 570 | 725 | 1,100,000 | |
| No.2 | | 725 | 375 | 85 | 570 | 475 | 900,000 | |
| Select Structural | Posts and Timbers | 1250 | 825 | 85 | 570 | 925 | 1,100,000 | |
| No.1 | | 1000 | 675 | 85 | 570 | 800 | 1,100,000 | |
| No.2 | | 625 | 400 | 85 | 570 | 550 | 900,000 | |
| **NORTHERN PINE** | | | | | | | | |
| Select Structural | Beams and Stringers | 1250 | 850 | 65 | 435 | 850 | 1,300,000 | NELMA NSLB |
| No.1 | | 1050 | 700 | 65 | 435 | 725 | 1,300,000 | |
| No.2 | | 675 | 350 | 65 | 435 | 450 | 1,000,000 | |
| Select Structural | Posts and Timbers | 1150 | 800 | 65 | 435 | 900 | 1,300,000 | |
| No.1 | | 950 | 650 | 65 | 435 | 800 | 1,300,000 | |
| No.2 | | 550 | 375 | 65 | 435 | 375 | 1,000,000 | |
| **NORTHERN RED OAK** | | | | | | | | |
| Select Structural | Beams and Stringers | 1600 | 950 | 105 | 885 | 950 | 1,300,000 | NELMA |
| No.1 | | 1350 | 675 | 105 | 885 | 800 | 1,300,000 | |
| No.2 | | 875 | 425 | 105 | 885 | 500 | 1,000,000 | |
| Select Structural | Posts and Timbers | 1500 | 1000 | 105 | 885 | 1000 | 1,300,000 | |
| No.1 | | 1200 | 800 | 105 | 885 | 875 | 1,300,000 | |
| No.2 | | 700 | 475 | 105 | 885 | 400 | 1,000,000 | |
| **NORTHERN WHITE CEDAR** | | | | | | | | |
| Select Structural | Beams and Stringers | 900 | 600 | 60 | 370 | 600 | 700,000 | NELMA |
| No.1 | | 750 | 500 | 60 | 370 | 500 | 700,000 | |
| No.2 | | 500 | 250 | 60 | 370 | 325 | 600,000 | |
| Select Structural | Posts and | 850 | 575 | 60 | 370 | 650 | 700,000 | |

2'/24

## TABLE 8.6—Adjustment Factors

### SIZE FACTOR, $C_F$

When the depth, d, of a beam, stringer, post or timber exceeds 12", the tabulated bending design value, $F_b$, shall be multiplied by the following size factor:

$$C_F = (12/d)^{1/9}$$

### WET SERVICE FACTOR, $C_M$

When timbers are used where moisture content will exceed 19% for an extended time period, design values shall be multiplied by the appropriate wet service factors from the following table (for Southern Pine and Mixed Southern Pine use tabulated design values without further adjustment):

**WET SERVICE FACTORS, $C_M$**

| $F_b$ | $F_t$ | $F_v$ | $F_{c\perp}$ | $F_c$ | E |
|---|---|---|---|---|---|
| 1.00 | 1.00 | 1.00 | 0.67 | 0.91 | 1.00 |

### SHEAR STRESS FACTOR, $C_H$

Tabulated shear design values parallel to grain have been reduced to allow for the occurrence of splits, checks and shakes. Tabulated shear design values parallel to grain, $F_v$, shall be permitted to be multiplied by the shear stress factors specified in the following table when length of split, or size of check or shake is known and no increase in them is anticipated. When shear stress factors are used for Redwood, Southern Pine and Mixed Southern Pine, a tabulated design value of $F_v$ = 80 psi shall be assigned for all grades of Redwood and a tabulated design value of $F_v$ = 90 psi shall be assigned for all grades of Southern Pine and Mixed Southern Pine. Shear stress factors shall be permitted to be linearly interpolated.

**SHEAR STRESS FACTORS, $C_H$**

| Length of split on wide face of 5" (nominal) and thicker lumber | $C_H$ | Size of shake* in 5" (nominal) and thicker lumber | $C_H$ |
|---|---|---|---|
| no split | 2.00 | no shake | 2.00 |
| 1/2 x narrow face. | 1.67 | 1/6 x narrow face | 1.67 |
| 3/4 x narrow face | 1.50 | 1/4 narrow face | 1.50 |
| 1 x narrow face | 1.33 | 1/3 x narrow face | 1.33 |
| 1-1/2 x narrow face or more | 1.00 | 1/2 x narrow face or more. | 1.00 |

*Shake is measured at the end between lines enclosing the shake and perpendicular to the loaded face.

# Flood Fighting: How To Use Sandbags

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

**Sandbag Construction –** The use of sandbags is a simple, but effective way to prevent or reduce flood water damage. Properly filled and placed sandbags can act as a barrier to divert moving water around, instead of through, buildings. Sandbag construction does not guarantee a water-tight seal, but is satisfactory for use in most situations. Sandbags are also used successfully to prevent overtopping of streams with levees, and for training current flows to specific areas.

Untied sandbags are recommended for most situations. Tied sandbags should be used only for special situations when pre-filling and stockpiling may be required, or for specific purposes such as filling holes, holding objects in position, or to form barriers backed by supportive planks. Tied sandbags are generally easier to handle and stockpile. However, sandbag filling operations can generally be best accomplished at or near the placement site, and tying of the bags might be a waste of valuable time and effort. If the bags are to be pre-filled at a distant location, due consideration must be given to transportation vehicles and placement site access.

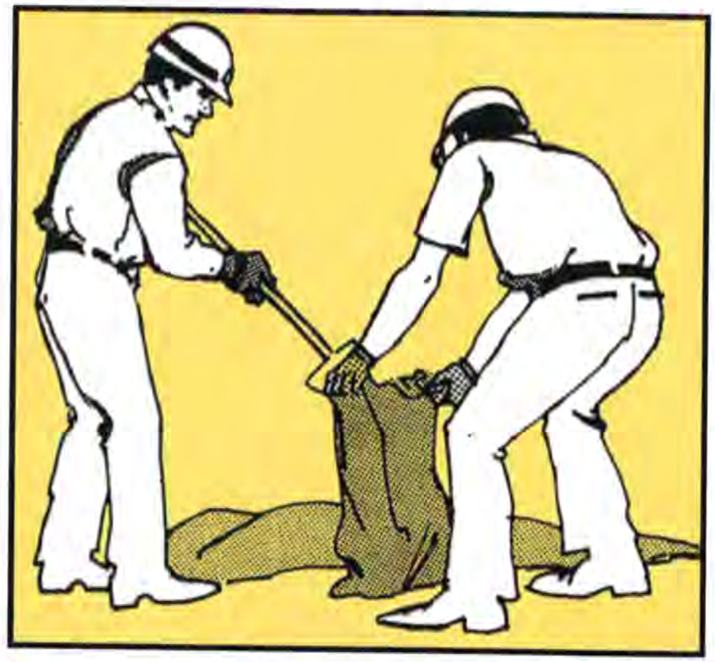
Commercial plastic sandbags, made from polypropylene, are available from most bag suppliers and hardware stores. These will store for a long time with minimum care, and are not biodegradable. Thus, they have to be disposed of after use, or will remain around for a long time. Another option is untreated burlap sacks, often available at feed or hardware stores. Empty bags are biodegradable, and can be stockpiled for several years, if properly stored. Filled burlap bags of earth material will deteriorate quickly. In either case, rodent control is strongly recommended during storage.

Do not use garbage bags, as they are too slick to stack. Avoid the use of feed or seed sacks, as they are too large to handle when filled even half full. If they must be used, keep the weight of filled bags down to what can be handled by one or two people (no more than 60 pounds). Where possible, use bags about 14-18" wide, and 30-36" deep.

A heavy bodied or sandy soil is most desirable for filling sandbags, but any usable material at or near the site has definite advantages. Coarse sand could leak out through the weave in the bag. To prevent this, double bag the material. Gravelly or rocky soils are generally poor choices because of their permeability.

Sandbag barriers are best built by a group of people working as a team. Insure that the individuals have the physical capability to carry or drag a sandbag weighing approximately 30-50 pounds (depending on dampness and type of sand). They should wear work clothing and gloves.

**How to Fill a Sandbag –** Filling sandbags is usually a two-person operation. The use of safety goggles and gloves is recommended. One member of the team places the empty bag between or slightly in front of widespread feet with arms extended. The throat of the bag is folded to form a collar, and held with the hands in a position that will enable the other team member to empty a rounded shovel full of material into the open end. The person holding the sack stands with knees slightly flexed, and head and face as far away from the shovel as possible.



The shoveler carefully releases the rounded shovel full of soil into the throat of the bag. Haste in this operation can result in undue spillage and added work. Bags should be filled between one-third (1/3) to one-half (1/2) of their capacity. This keeps the bag from getting too heavy, and permits the bags to be stacked with a good seal.

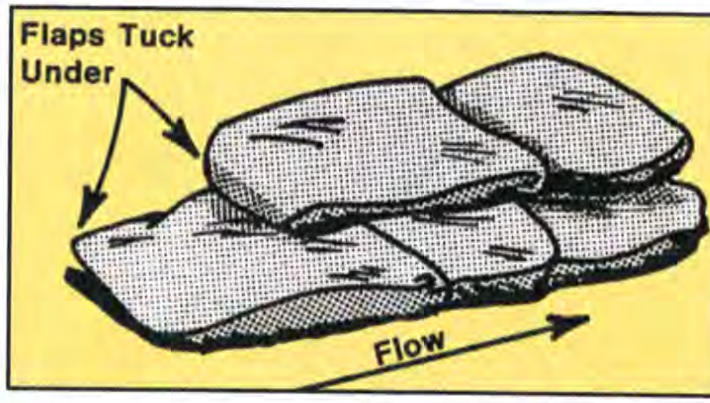
For large scale operations, filling sandbags can be expedited by using bag-holding racks, funnels, or power loading equipment. The special equipment required is not always available during an emergency, but can be fabricated using available materials, and should be identified in local flood response plans.

**Sandbag Placement –** Remove any debris from the area where the bags are to be placed.

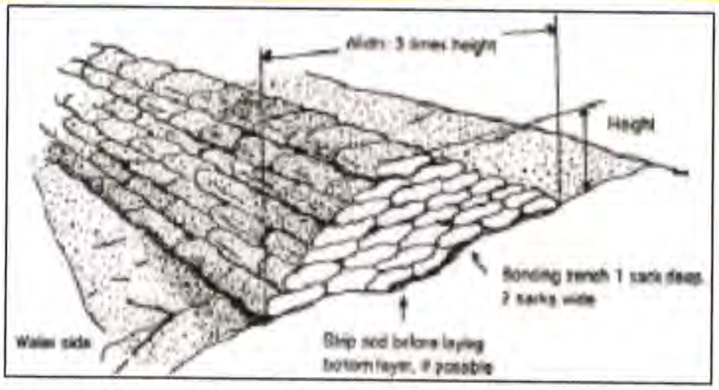
Fold the open end of the unfilled portion of the bag to form a triangle. If tied bags are used, flatten or flare the tied end.

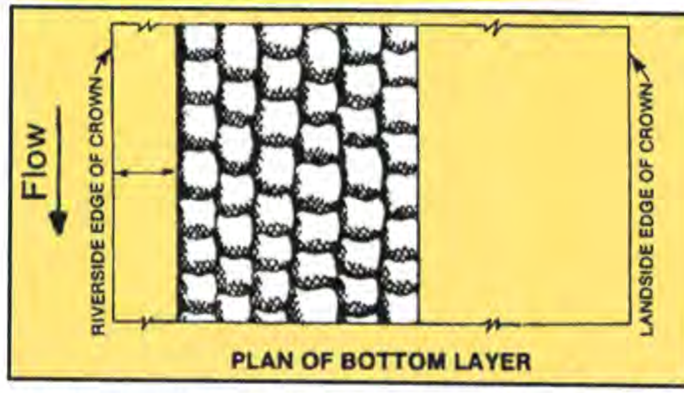
Place the partially filled bags lengthwise and parallel to the direction of flow, with the open end facing against the water flow. Tuck the flaps under, keeping the unfilled portion under the weight of the sack.

Place succeeding bags on top, offsetting by one-half (1/2) filled length of the previous bag, and stamp into place to eliminate voids, and form a tight seal.




Stagger the joint connections when multiple layers are necessary. For unsupported layers over three (3) courses high, use the pyramid placement method (below).






**Pyramid Placement Method –** The pyramid placement is used to increase the height of sandbag protection. Place the sandbags to form a pyramid by alternating header courses (bags placed crosswise) and stretcher courses (bags placed lengthwise). Stamp each bag in place, overlap sacks, maintain staggered joint placement, and tuck in any loose ends.

**Estimating materials –** Use the table below, and assume 40 pounds of sand per bag. A 3 foot levee, 500 feet long, requires 22,500 bags, so you need (40 * 22,500) ÷ 2000 = 450 tons of sand. The weight of sand varies locally.

| DIKE HEIGHT | 50 FT | 100 FT | 200 FT | 250 FT | 300 FT | 350 FT | 400 FT | 450 FT | 500 FT |
|---|---|---|---|---|---|---|---|---|---|
| 1 Foot | 300 | 600 | 1,200 | 1,500 | 1,800 | 2,100 | 2,400 | 2,700 | 3,000 |
| 2 Feet | 1,050 | 2,100 | 4,200 | 5,250 | 6,300 | 7,350 | 8,400 | 9,450 | 10,500 |
| 3 Feet | 2,250 | 4,500 | 9,000 | 11,250 | 13,500 | 15,750 | 18,000 | 20,250 | 22,500 |
| 4 Feet | 3,900 | 7,800 | 15,600 | 19,500 | 23,400 | 27,300 | 31,200 | 35,100 | 39,000 |

**Ringing boils –** A boil is a condition where water is flowing through or under an earth structure (such as a levee) that is retaining water. Free flowing water wants to move to lower elevations. If a levee is stopping floodwaters, the water may be able to find weak points to enter. This action is called "piping". If the water finds a large enough path, the flow will become visible, and is a serious threat to the integrity of the levee. Most boils occur in sand, silt, or some combination.

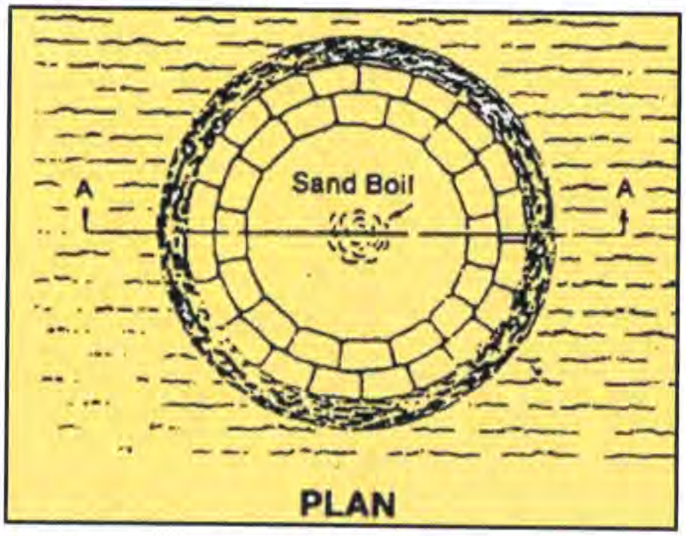
A boil is found on the landward side of the levee, or in the ground past the levee toe (the exact distance varies with local conditions). Possible boil sites can be identified by free standing or flowing water (other than culverts, pumps, etc). A boil can be found only by close inspection. A prime indicator is water bubbling (or "boiling"), much like a natural spring. Another is obvious water movement in what appears to be standing water.

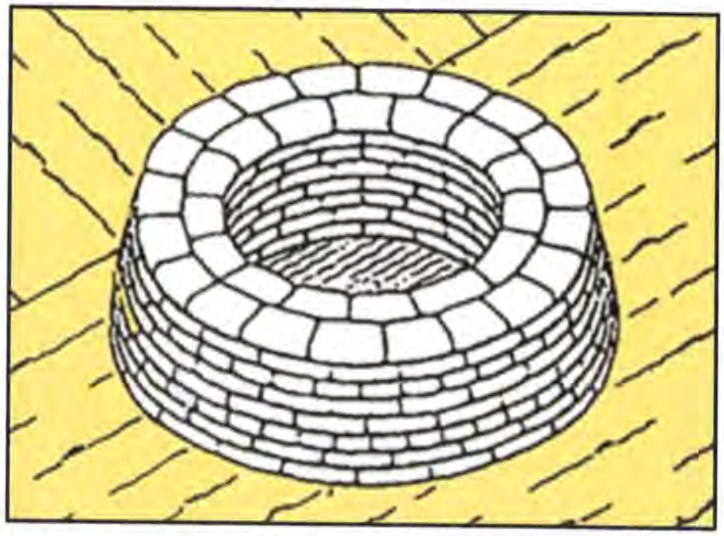
Carefully examine the water for movement. Boils will have an obvious exit (such as a rodent hole), but the water may be cloudy from siltation, or the hole very small. If there is any movement in the water, carefully approach the site, disturbing the water as little as possible. Let the water settle, and look at the suspected site. If you see the hole, examine it carefully. If the water flow is clear, there are no problems as yet. If there is no distinct hole, the water flow is not a threat. Monitor the site regularly for changes, and take no other actions.

A dirty water flow indicates that the soil is being eroded by the water, and that could mean failure of the levee. A boil ring is the best solution. The idea is to reduce the water flow until the water is flowing clear, but not to stop the water flow. This acts as a relief valve for the water pressure; the water continues to flow, but is not eroding the material. If the water flow is stopped, the pressure will remain, and another boil will form. Ring the boil with sandbags, with the first bags back 1-2 feet from the boil. More, if the soil is unstable.

Build the first layer in a circle, 2-4 bags across, and then build up, bringing each layer in. If possible, keep the interior face straight. Build the ring wall with the means for water to flow out, leaving a gap in the wall, or using pipes. Adjust the flows until the water slows, and becomes clear.

Monitor the ring wall constantly. Raise or lower the height of the wall as necessary, maintaining a slow, clear flow. The height should be only enough to slow flow such that no more material is displaced, and the water runs clear.



**Notes:**

Do not sack a boil which does not put out material.

The entire base should be cleared of debris and scarified.

Tie into the levee if the boil is near a toe.

Use loose earth between all of the sacks.

All joints must be staggered.

Be sure to clear the sand discharge.

Never attempt to completely stop the flow through a boil.

**Corps of Engineers Sandbag Policy –** Non-federal governments are responsible for maintaining a supply of sandbags adequate to cover anticipated immediate needs. At the discretion of the District Commander, a portion of the District's stockpile may be loaned to meet a specific local flood emergency. The Walla Walla District maintains a limited sandbag stockpile to augment local jurisdictions during actual flood emergencies, but can access a national contract for additional supplies. We will issue only to agencies or governments, through the designated emergency manager. Individual citizens requesting sandbags will be directed to their local government.

Unused stocks must be returned to Walla Walla District as soon as the emergency is over, unless otherwise released to the supported jurisdiction. Consumed stocks must be replaced in kind, or paid for by the local interests, unless the District Commander directs otherwise This applies only to those jurisdictions within the Walla Walla District's area of operation, the Snake River basin.

**For Further Information –** Refer to the Walla Walla District Flood Fight Handbook: Preparing For a Flood, available for download at the link below. Contact the District Readiness Office, as noted below, for a copy.

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**U.S. ARMY CORPS OF ENGINEERS – WALLA WALLA DISTRICT**
**READINESS OFFICE**
201 North Third Avenue; Walla Walla, WA 99362-1876
509-527-7146 business hours
1-509-380-4538 emergencies (include 1-509- when calling)
cenww-eoc@usace.army.mil ¤ www.nww.usace.army.mil/Missions/Flood-Assistance/

December 2018

www.hilti.com

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corp. | Page: | 1 |
| Address: | 23 Phillips Rd. | Specifier: | Peter Poor |
| Phone I Fax: | (207) 743-8946 \| (207) 890-0636 | E-Mail: | ppoor@bancroftcontracting.com |
| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

**Specifier's comments:** HILTI DESIGN REPORT "A" - STRUT ANCHORING & BASEPLATE

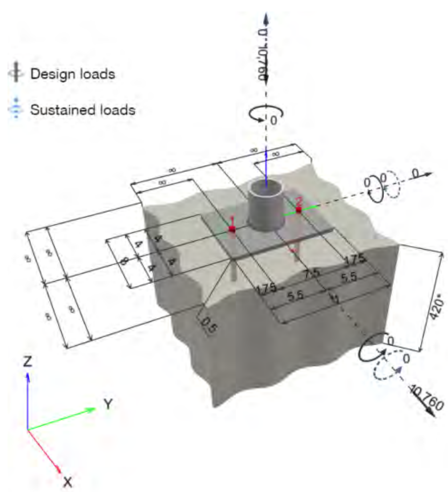
# 1 Anchor Design

## 1.1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 5/8** |
| Item number: | 333783 HAS-E B 5/8"x7 5/8" (element) / 2123401 HIT-RE 500 V3 (adhesive) |
| Effective embedment depth: | $h_{ef,act}$ = 6.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design Method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.500 in. |
| Anchor plate[CBFEM] : | $l_x$ x $l_y$ x t = 8.000 in. x 11.000 in. x 0.500 in.; |
| Profile: | Steel pipe, PIPE3STD; (L x W x T) = 3.500 in. x 3.500 in. x 0.216 in. |
| Base material: | cracked concrete, 2500, $f_c$' = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Water filled** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

[CBFEM] - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

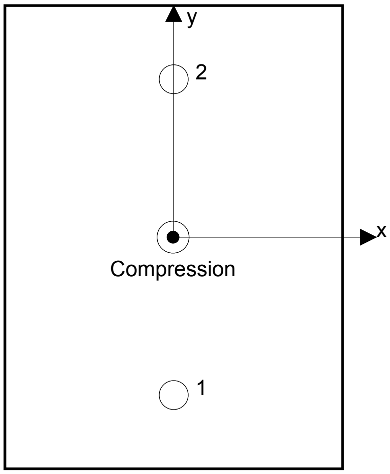
**Geometry [in.] & Loading [lb, in.lb]**



### 1.1.1 Design results

| Case | Description | Forces [lb] / Moments [in.lb] | Seismic | Max. Util. Anchor [%] |
|---|---|---|---|---|
| 1 | Combination 1 | $N = -10{,}760$; $V_x = 10{,}760$; $V_y = 0$;<br>$M_x = 0$; $M_y = 0$; $M_z = 0$;<br>$N_{sus} = 0$; $M_{x,sus} = 0$; $M_{y,sus} = 0$; | no | 49 |

### 1.2 Load case/Resulting anchor forces




**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 0 | 5,380 | 5,380 | -16 |
| 2 | 0 | 5,380 | 5,380 | 16 |

resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-0.016/0.000): 10,888 [lb]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

### 1.3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | N/A | N/A | N/A | N/A |
| Bond Strength** | N/A | N/A | N/A | N/A |
| Sustained Tension Load Bond Strength* | N/A | N/A | N/A | N/A |
| Concrete Breakout Failure** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (anchors in tension)

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corp. | Page: | 3 |
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### 1.4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi$ $V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi\ V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 5,380 | 11,017 | 49 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength (Bond Strength controls)** | 10,760 | 23,110 | 47 | OK |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (relevant anchors)

#### 1.4.1 Steel Strength

$V_{sa}$ = ESR value refer to ICC-ES ESR-3814
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] | $\alpha_{V,seis}$ |
|---|---|---|
| 0.23 | 125,000 | 1.000 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 16,950 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 16,950 | 0.650 | 11,017 | 5,380 |

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### 1.4.2 Pryout Strength (Bond Strength controls)

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ ACI 318-11 Eq. (D-41)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-11 Table (D.4.1.1)

$A_{Na}$ see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ ACI 318-11 Eq. (D-20)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ ACI 318-11 Eq. (D-21)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N'}{c_{Na}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-23)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-25)

$\psi_{cp,Na} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-27)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ ACI 318-11 Eq. (D-22)

#### Variables

| $k_{cp}$ | $\alpha_{overhead}$ | $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|---|
| 2 | 1.000 | 1,660 | 0.625 | 6.000 | ∞ |

| $\tau_{k,c}$ [psi] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|---|
| 940 | 0.000 | 0.000 | 9.302 | 1.000 |

#### Calculations

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 7.643 | 348.32 | 233.67 | 1.000 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 1.000 | 1.000 | 1.000 | 11,074 |

#### Results

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 33,015 | 0.700 | 23,110 | 10,760 |

## 1.5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- The present version of the software does not account for special design provisions for overhead applications. Refer to related approval (e.g. section 4.1.1 of the ICC-ESR 2322) for details.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- The anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."

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## 1.6 Installation data

Profile: Steel pipe, PIPE3STD; (L x W x T) = 3.500 in. x 3.500 in. x 0.216 in.

Hole diameter in the fixture: $d_f$ = 0.688 in.

Plate thickness (input): 0.500 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

5/8 Hilti HAS Carbon steel threaded rod with Hilti HIT-RE 500 V3

Anchor type and diameter: HIT-RE 500 V3 + HAS-E B7 5/8

Item number: 333783 HAS-E B 5/8"x7 5/8" (element) / 2123401 HIT-RE 500 V3 (adhesive)

Installation torque: 720 in.lb

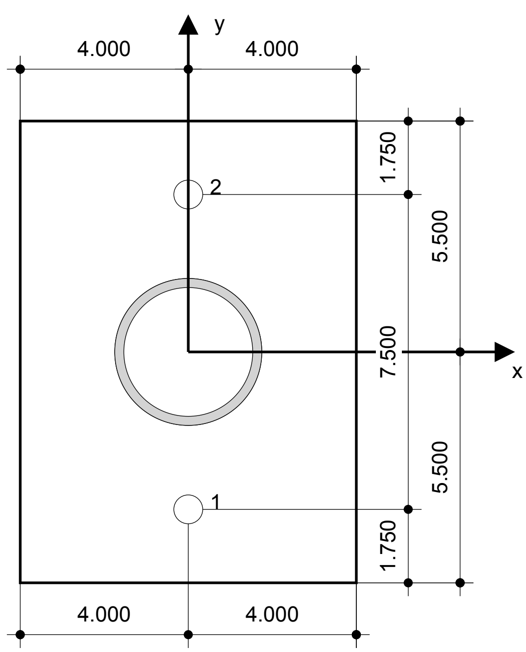
Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 6.000 in.

Minimum thickness of the base material: 7.500 in.

### 1.6.1 Recommended accessories

| Drilling | Cleaning | Setting |
|---|---|---|
| • Suitable Rotary Hammer<br>• Properly sized drill bit | • Compressed air with required accessories to blow from the bottom of the hole<br>• Proper diameter wire brush | • Dispenser including cassette and mixer<br>• Torque wrench |




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | 0.000 | -3.750 | - | - | - | - |
| 2 | 0.000 | 3.750 | - | - | - | - |

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## 2 Anchor plate design

### 2.1 Input data

| | |
|---|---|
| Anchor plate: | Shape: Rectangular<br>$l_x$ x $l_y$ x t = 8.000 in x 11.000 in x 0.500 in<br>Calculation: CBFEM<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00% |
| Anchor type and size: | HIT-RE 500 V3 + HAS-E B7 5/8, $h_{ef}$ = 6.000 in |
| Anchor stiffness: | The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results. |
| Design method: | AISC and LRFD-based design using component-based FEM |
| Stand-off installation: | $e_b$ = 0.000 in (No stand-off); t = 0.500 in |
| Profile: | PIPE3STD; (L x W x T x FT) = 3.500 in x 3.500 in x 0.216 in x -<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00%<br>Eccentricity x: 0.000 in<br>Eccentricity y: 0.000 in |
| Base material: | Cracked concrete; 2500; $f_{c,cyl}$ = 2,500 psi; h = 420.000 in |
| Welds (profile to anchor plate): | Type of redistribution: Plastic<br>Material: E70xx |
| Mesh size: | Number of elements on edge: 8<br>Min. size of element: 0.394 in<br>Max. size of element: 1.969 in |

| | | | |
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**2.2 Summary**

| | Description | Profile | | Anchor plate | | | Welds [%] | Concrete [%] |
|---|---|---|---|---|---|---|---|---|
| | | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Hole bearing [%] | | |
| 1 | Combination 1 | 36,013 | 0.05 | 15,134 | 0.00 | 17 | 51 | 8 |

**2.3 Anchor plate classification**

Results below are displayed for the decisive load combinations: Combination 1

| Anchor tension forces | Equivalent rigid anchor plate (CBFEM) | Component-based Finite Element Method (CBFEM) anchor plate design |
|---|---|---|
| Anchor 1 | 0 lb | 0 lb |
| Anchor 2 | 0 lb | 0 lb |

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

### 2.4 Profile/Stiffeners/Plate

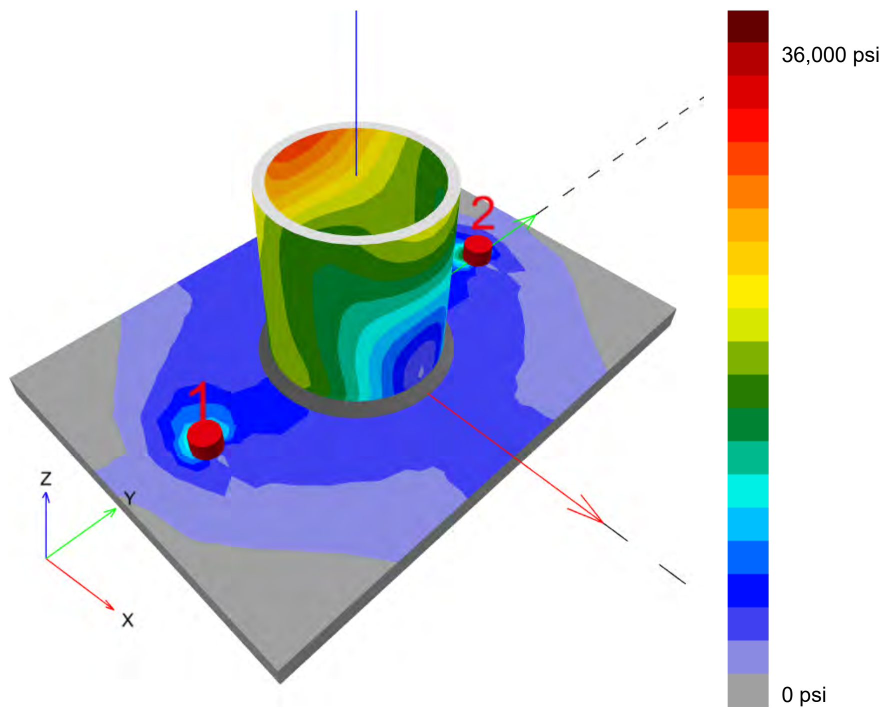
Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

#### 2.4.1 Equivalent stress and plastic strain

| Part | Load combination | Material | $f_y$ [psi] | $\varepsilon_{lim}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Status |
|---|---|---|---|---|---|---|---|
| Plate | Combination 1 | ASTM A36 | 36,000 | 5.00 | 15,134 | 0.00 | OK |
| Profile | Combination 1 | ASTM A36 | 36,000 | 5.00 | 36,013 | 0.05 | OK |

##### 2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Combination 1



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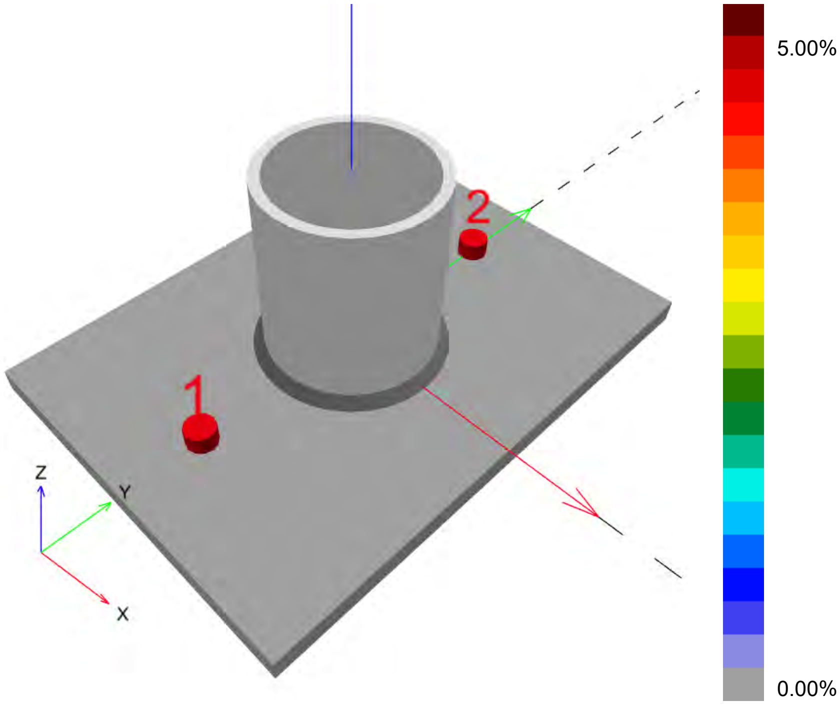
#### 2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Combination 1




#### 2.4.2 Plate hole bearing resistance, AISC 360-16 Section J3

Decisive load combination: 1 - Combination 1

**Equations**

$R_n$ = $\min(1.2\ l_c\ t\ F_u\ ,\ 2.4\ d\ t\ F_u)$ (AISC 360-16 J3-6a, c)

$\Phi R_n$ = $0.75\ R_n$

$V \leq \Phi R_n$

**Variables**

| | $l_c$ [in] | t [in] | $F_u$ [psi] | d [in] | $R_n$ [lb] |
|---|---|---|---|---|---|
| Anchor 1 | 3.656 | 0.500 | 58,000 | 0.625 | 43,500 |
| Anchor 2 | 3.656 | 0.500 | 58,000 | 0.625 | 43,500 |

**Results**

| | V [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Anchor 1 | 5,380 | 32,625 | 17 | OK |
| Anchor 2 | 5,380 | 32,625 | 17 | OK |

| | | | |
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## 2.5 Welds

Profiles are modeled without taking the corner radius into account. Special rules for welding (e.g. for cold-formed profiles ...) are not taken into account by the software.

### 2.5.1 Anchor plate to profile

Decisive load combination: 1 - Combination 1

**Equations**

$F_{nw} = 0.6\, F_{EXX}\, (1.0 + 0.5\sin^{1.5}\Theta)$

$\Phi R_n = \Phi\, F_{nw}\, A_w$

$\text{Utilization} = \dfrac{F_n}{\Phi\, R_n}$

**Variables**

| Edge | $X_u$ | $T_h$ [in] | $L_s$ [in] | L [in] | $L_c$ [in] | $F_{EXX}$ [psi] | Θ [°] | $A_w$ [in²] |
|---|---|---|---|---|---|---|---|---|
| Member 1 | E70xx | 0.157◣ | 0.223 | 10.300 | 0.322 | 70,000 | 21.3 | 0.05 |

**Results**

| Edge | $F_n$ [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Member 1 | 898 | 1,771 | 51 | OK |

| | | | |
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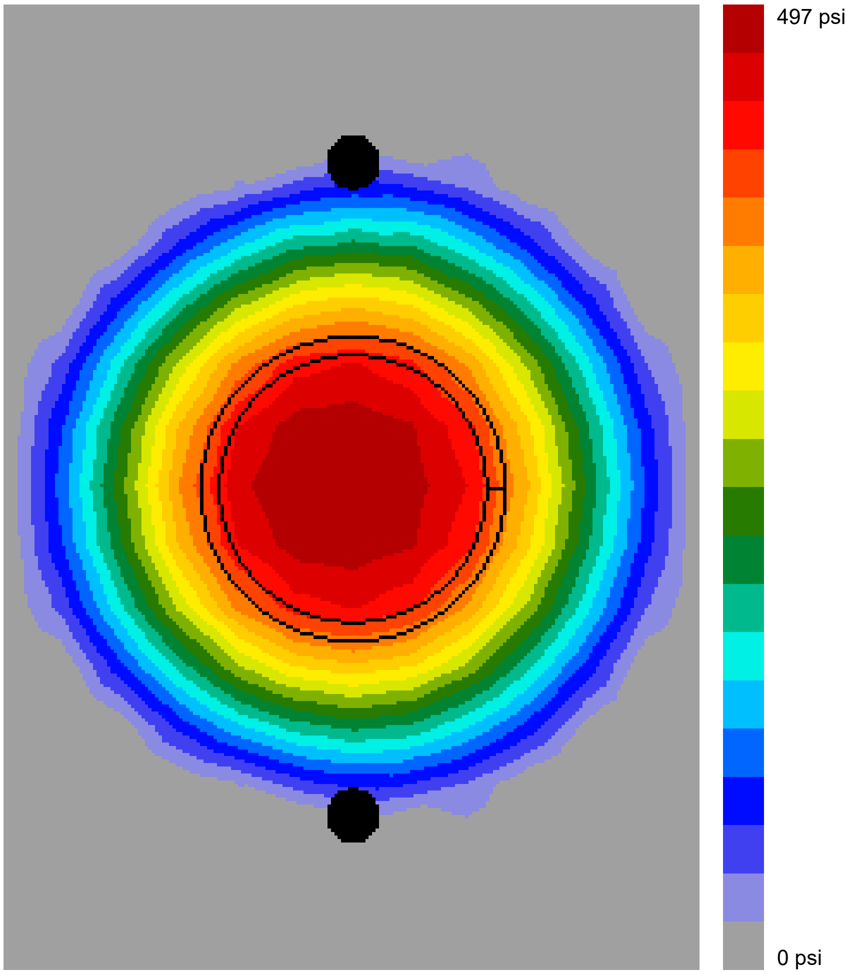
**2.6 Concrete**

Decisive load combination: 1 - Combination 1

**2.6.1 Compression in concrete under the anchor plate**




**2.6.2 Concrete block compressive strength resistance check, AISC 360-16 Section J8**

**Equations**

$$F_p = \Phi f_{p,max}$$

$$f_{p,max} = 0.85 f_c' \sqrt{\left(\frac{A_2}{A_1}\right)} \le 1.7 f_c; \quad \sqrt{\left(\frac{A_2}{A_1}\right)} \le 2$$

$$\sigma = \frac{N}{A_1}$$

$$\text{Utilization} = \frac{\sigma}{F_p}$$

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**Variables**

| N [lb] | $f_c'$ [psi] | Φ | $A_1$ [in²] | $A_2$ [in²] |
|---|---|---|---|---|
| 10,888 | 2,500 | 0.65 | 55.79 | 541,848.55 |

**Results**

| Load combination | $F_p$ [psi] | σ [psi] | Utilization [%] | Status |
|---|---|---|---|---|
| Combination 1 | 2,762 | 195 | 8 | OK |

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### 2.7 Symbol explanation

| | |
|---|---|
| $A_1$ | Loaded area of concrete |
| $A_2$ | Supporting area |
| $A_w$ | Effective area of weld critical element |
| d | Nominal diameter of the fastener |
| $\varepsilon_{lim}$ | Limit plastic strain |
| $\varepsilon_{Pl}$ | Plastic strain from CBFEM results |
| $f_c$ | Concrete compressive strength |
| $f_c'$ | Concrete compressive strength |
| $F_{EXX}$ | Electrode classification number, i.e. minimum specified tensile strength |
| $F_u$ | Specified minimum tensile strength of the connected material |
| $F_n$ | Force in weld critical element |
| $F_{nw}$ | Nominal stress of the weld material |
| $F_p$ | Concrete block design bearing strength |
| $f_{p,max}$ | Concrete block design bearing strength maximum |
| $f_y$ | Yield strength |
| $l_c$ | Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material |
| L | Length of weld |
| $L_c$ | Length of weld critical element |
| $L_s$ | Leg size of weld |
| N | Resulting compression force |
| $\sigma$ | Average stress in concrete |
| $\sigma_{Ed}$ | Equivalent stress |
| $\Phi$ | Resistance factor |
| $\Phi R_n$ | Resistance |
| t | Thickness of the anchor plate |
| $\Theta$ | Angle of loading measured from the weld longitudinal axis |
| $T_h$ | Throat thickness of weld |
| V | Resultant of shear forces Vy, Vz in bolt. |
| $X_u$ | Filler metal tensile strength |

### 2.8 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

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## 3 Summary of results

Design of the anchor plate, anchors, welds and other elements are based on CBFEM (component based finite element method) and AISC.

| | Load combination | Max. utilization | Status |
|---|---|---|---|
| Anchors | Combination 1 | 49% | OK |
| Anchor plate | Combination 1 | 43% | OK |
| Welds | Combination 1 | 51% | OK |
| Concrete | Combination 1 | 8% | OK |
| Profile | Combination 1 | 100% | OK |

**Fastening meets the design criteria!**

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## 4 Remarks; Your Cooperation Duties

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**Specifier's comments:** HILTI DESIGN REPORT "B" - VERTICAL BEAM ANCHORING & BASEPLATE

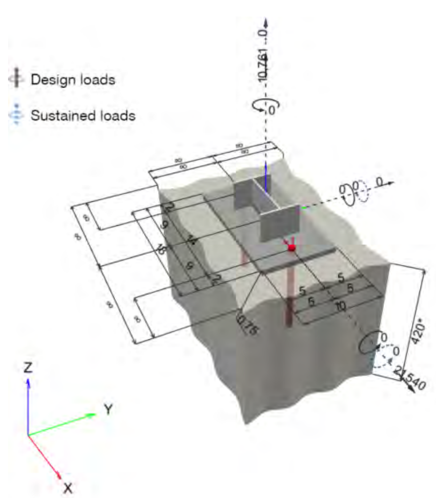
# 1 Anchor Design

## 1.1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 7/8** |
| Item number: | not available (element) / 2123401 HIT-RE 500 V3 (adhesive) |
| Effective embedment depth: | $h_{ef,act}$ = 12.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design Method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.750 in. |
| Anchor plate[CBFEM] : | $l_x$ x $l_y$ x t = 18.000 in. x 10.000 in. x 0.750 in.; |
| Profile: | W shape (AISC), W8X18; (L x W x T x FT) = 8.140 in. x 5.250 in. x 0.230 in. x 0.330 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

[CBFEM] - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

**Geometry [in.] & Loading [lb, in.lb]**



### 1.1.1 Design results

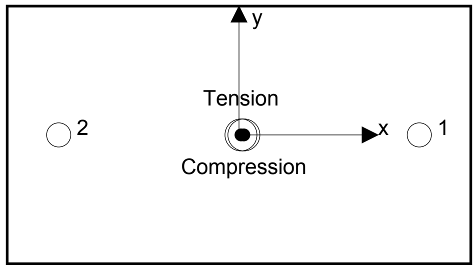
| Case | Description | Forces [lb] / Moments [in.lb] | Seismic | Max. Util. Anchor [%] |
|---|---|---|---|---|
| 1 | Combination 1 | $N = 10{,}761$; $V_x = 21{,}540$; $V_y = 0$;<br>$M_x = 0$; $M_y = 0$; $M_z = 0$;<br>$N_{sus} = 0$; $M_{x,sus} = 0$; $M_{y,sus} = 0$; | no | 78 |

### 1.2 Load case/Resulting anchor forces

**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 6,966 | 10,740 | 10,740 | 0 |
| 2 | 6,817 | 10,800 | 10,800 | 0 |




resulting tension force in (x/y)=(0.076/0.000): 13,783 [lb]
resulting compression force in (x/y)=(0.189/-0.001): 3,823 [lb]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

### 1.3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi\ N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 6,966 | 43,282 | 17 | OK |
| Bond Strength** | 13,783 | 21,439 | 65 | OK |
| Sustained Tension Load Bond Strength* | N/A | N/A | N/A | N/A |
| Concrete Breakout Failure** | 13,783 | 31,764 | 44 | OK |

* highest loaded anchor **anchor group (anchors in tension)

| | | | |
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**1.3.1 Steel Strength**

$N_{sa}$ = ESR value — refer to ICC-ES ESR-3814

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

**Variables**

| $A_{se,N}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.46 | 125,000 |

**Calculations**

| $N_{sa}$ [lb] |
|---|
| 57,710 |

**Results**

| $N_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ N_{sa}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 57,710 | 0.750 | 43,282 | 6,966 |

### 1.3.2 Bond Strength

$N_{ag} = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ ACI 318-11 Eq. (D-19)

$\phi\ N_{ag} \geq N_{ua}$ ACI 318-11 Table D.4.1.1

$A_{Na}$ = see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ ACI 318-11 Eq. (D-20)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ ACI 318-11 Eq. (D-21)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e_N'}{c_{Na}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-23)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ ACI 318-11 Eq. (D-25)

$\psi_{cp,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-27)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ ACI 318-11 Eq. (D-22)

**Variables**

| $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] | $\alpha_{overhead}$ | $\tau_{k,c}$ [psi] |
|---|---|---|---|---|---|
| 1,400 | 0.875 | 12.000 | ∞ | 1.000 | 850 |

| $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|
| 0.076 | 0.000 | 18.112 | 1.000 |

**Calculations**

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 9.827 | 661.41 | 386.26 | 1.000 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 0.992 | 1.000 | 1.000 | 28,039 |

**Results**

| $N_{ag}$ [lb] | $\phi_{bond}$ | $\phi\ N_{ag}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 47,643 | 0.450 | 21,439 | 13,783 |

| | | | |
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### 1.3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ACI 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

$A_{Nc}$ see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

**Variables**

| $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] | $\psi_{c,N}$ |
|---|---|---|---|---|
| 12.000 | 0.076 | 0.000 | ∞ | 1.000 |

| $c_{ac}$ [in.] | $k_c$ | $\lambda$ | $f_c'$ [psi] |
|---|---|---|---|
| 18.112 | 17 | 1 | 2,500 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 1,800.00 | 1,296.00 | 0.996 | 1.000 | 1.000 | 1.000 | 35,334 |

**Results**

| $N_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi\ N_{cbg}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 48,868 | 0.650 | 31,764 | 13,783 |

### 1.4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi\ V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi\ V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 10,800 | 22,506 | 48 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength (Bond Strength controls)** | 21,540 | 67,217 | 33 | OK |
| Concrete edge failure in direction ** | N/A | N/A | N/A | N/A |

* highest loaded anchor    **anchor group (relevant anchors)

#### 1.4.1 Steel Strength

$V_{sa}$ = ESR value    refer to ICC-ES ESR-3814

$\phi\ V_{steel} \geq V_{ua}$    ACI 318-08 Eq. (D-2)

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] | $\alpha_{V,seis}$ |
|---|---|---|
| 0.46 | 125,000 | 1.000 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 34,625 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 34,625 | 0.650 | 22,506 | 10,800 |

| | | | |
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## 1.4.2 Pryout Strength (Bond Strength controls)

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ ACI 318-11 Eq. (D-41)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-11 Table (D.4.1.1)

$A_{Na}$ see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ ACI 318-11 Eq. (D-20)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ ACI 318-11 Eq. (D-21)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ ACI 318-11 Eq. (D-23)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-25)

$\psi_{cp,Na} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ ACI 318-11 Eq. (D-27)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ ACI 318-11 Eq. (D-22)

### Variables

| $k_{cp}$ | $\alpha_{overhead}$ | $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|---|
| 2 | 1.000 | 1,400 | 0.875 | 12.000 | ∞ |

| $\tau_{k,c}$ [psi] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|---|
| 850 | 0.000 | 0.000 | 18.112 | 1.000 |

### Calculations

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 9.827 | 661.41 | 386.26 | 1.000 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 1.000 | 1.000 | 1.000 | 28,039 |

### Results

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 96,024 | 0.700 | 67,217 | 21,540 |

## 1.5 Combined tension and shear loads

| $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|
| 0.643 | 0.480 | 5/3 | 78 | OK |

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

## 1.6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- The present version of the software does not account for special design provisions for overhead applications. Refer to related approval (e.g. section 4.1.1 of the ICC-ESR 2322) for details.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- The anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2018, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."

### 1.7 Installation data

Profile: W shape (AISC), W8X18; (L x W x T x FT) = 8.140 in. x 5.250 in. x 0.230 in. x 0.330 in.

Hole diameter in the fixture: $d_f$ = 0.938 in.

Plate thickness (input): 0.750 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-RE 500 V3 + HAS-E B7 7/8

Item number: not available (element) / 2123401 HIT-RE 500 V3 (adhesive)

Installation torque: 1,500 in.lb

Hole diameter in the base material: 1.000 in.

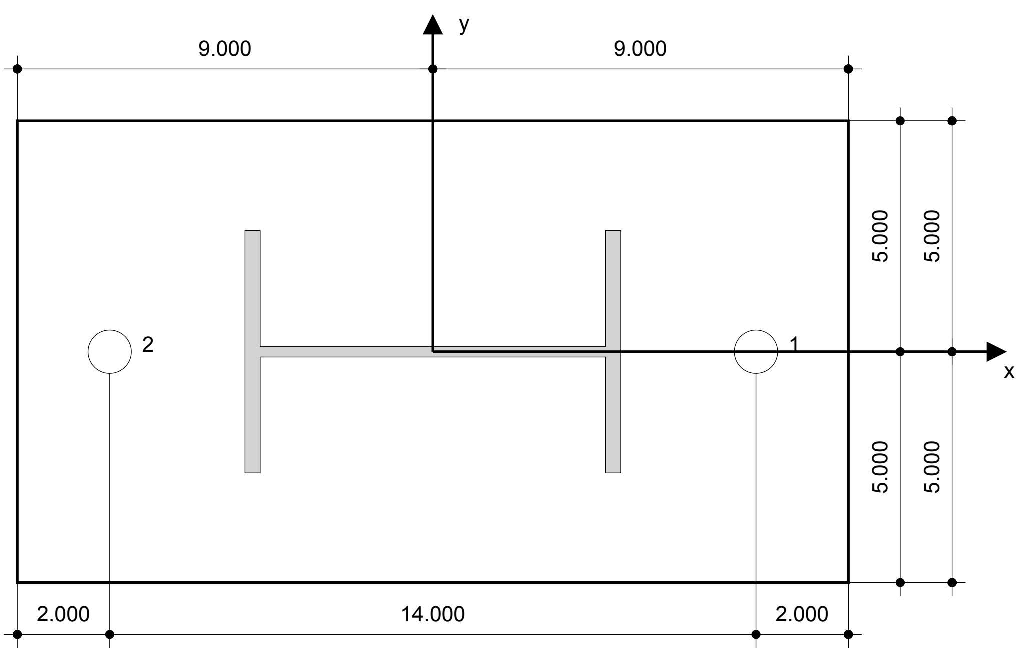
Hole depth in the base material: 12.000 in.

Minimum thickness of the base material: 14.000 in.

7/8 Hilti HAS Carbon steel threaded rod with Hilti HIT-RE 500 V3

#### 1.7.1 Recommended accessories

| Drilling | Cleaning | Setting |
|---|---|---|
| • Suitable Rotary Hammer<br>• Properly sized drill bit | • Compressed air with required accessories to blow from the bottom of the hole<br>• Proper diameter wire brush | • Dispenser including cassette and mixer<br>• Torque wrench |




**Coordinates Anchor in.**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|
| 1 | 7.000 | 0.000 | - | - | - | - |
| 2 | -7.000 | 0.000 | - | - | - | - |

## 2 Anchor plate design

### 2.1 Input data

| | |
|---|---|
| Anchor plate: | Shape: Rectangular<br>$l_x$ x $l_y$ x t = 18.000 in x 10.000 in x 0.750 in<br>Calculation: CBFEM<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00% |
| Anchor type and size: | HIT-RE 500 V3 + HAS-E B7 7/8, $h_{ef}$ = 12.000 in |
| Anchor stiffness: | The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results. |
| Design method: | AISC and LRFD-based design using component-based FEM |
| Stand-off installation: | $e_b$ = 0.000 in (No stand-off); t = 0.750 in |
| Profile: | W8X18; (L x W x T x FT) = 8.140 in x 5.250 in x 0.230 in x 0.330 in<br>Material: ASTM A992; $F_y$ = 50,000 psi; $\varepsilon_{lim}$ = 5.00%<br>Eccentricity x: 0.000 in<br>Eccentricity y: 0.000 in |
| Base material: | Cracked concrete; 2500; $f_{c,cyl}$ = 2,500 psi; h = 420.000 in |
| Welds (profile to anchor plate): | Type of redistribution: Plastic<br>Material: E70xx |
| Mesh size: | Number of elements on edge: 8<br>Min. size of element: 0.394 in<br>Max. size of element: 1.969 in |

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| Fastening point: | | | |


### 2.2 Summary

| | Description | Profile | | Anchor plate | | | Welds [%] | Concrete [%] |
|---|---|---|---|---|---|---|---|---|
| | | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Hole bearing [%] | | |
| 1 | Combination 1 | 33,051 | 0.00 | 20,937 | 0.00 | 19 | 62 | 6 |

### 2.3 Anchor plate classification

Results below are displayed for the decisive load combinations: Combination 1

| Anchor tension forces | Equivalent rigid anchor plate (CBFEM) | Component-based Finite Element Method (CBFEM) anchor plate design |
|---|---|---|
| Anchor 1 | 5,411 lb | 6,966 lb |
| Anchor 2 | 5,350 lb | 6,817 lb |

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

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| Fastening point: | | | |

#### 2.4 Profile/Stiffeners/Plate

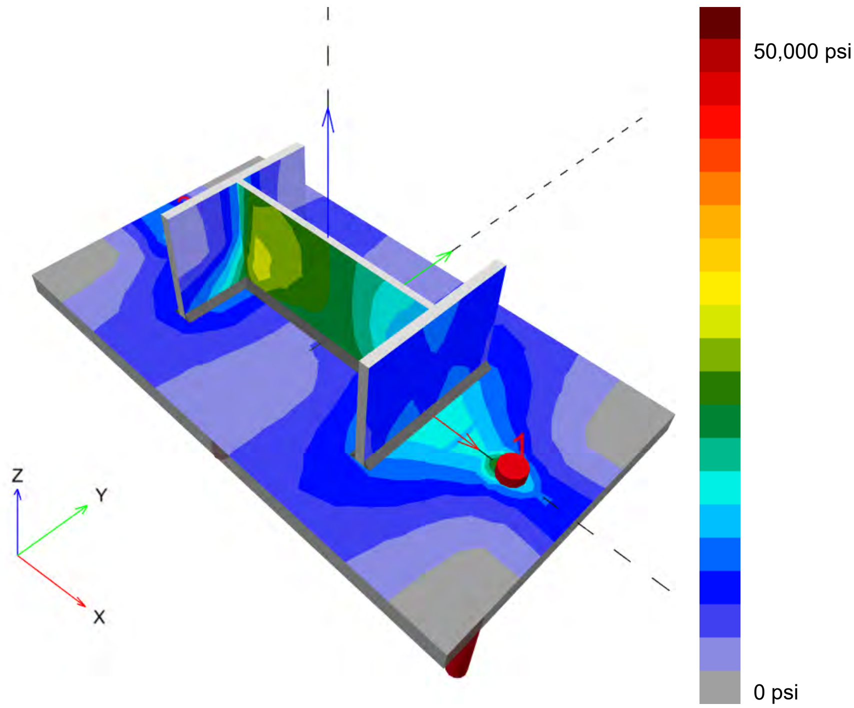
Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

#### 2.4.1 Equivalent stress and plastic strain

| Part | Load combination | Material | $f_y$ [psi] | $\varepsilon_{lim}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Status |
|---|---|---|---|---|---|---|---|
| Plate | Combination 1 | ASTM A36 | 36,000 | 5.00 | 20,937 | 0.00 | OK |
| Profile | Combination 1 | ASTM A992 | 50,000 | 5.00 | 21,132 | 0.00 | OK |
| Profile | Combination 1 | ASTM A992 | 50,000 | 5.00 | 25,059 | 0.00 | OK |
| Profile | Combination 1 | ASTM A992 | 50,000 | 5.00 | 33,051 | 0.00 | OK |

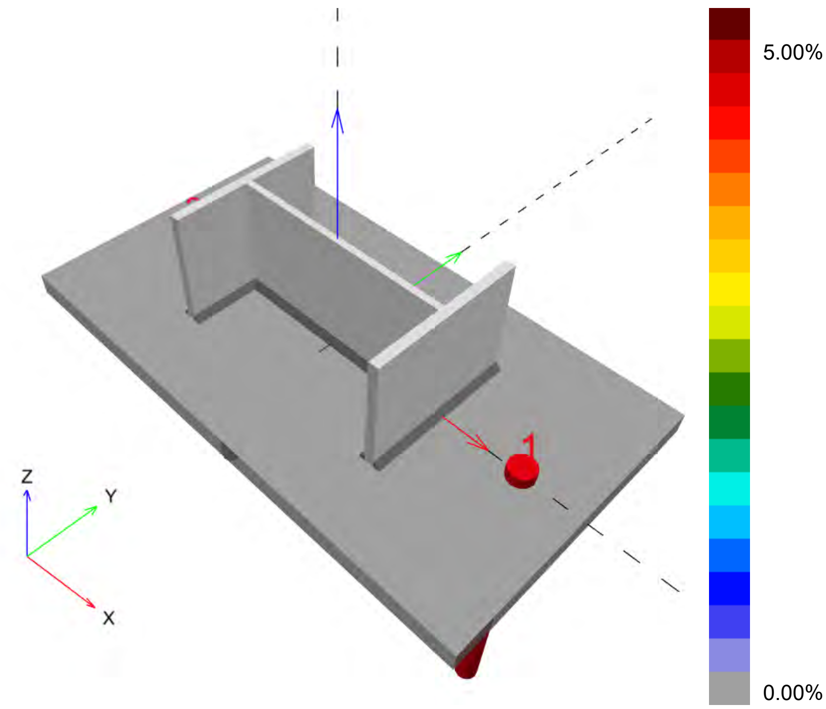
#### 2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Combination 1



### 2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Combination 1




### 2.4.2 Plate hole bearing resistance, AISC 360-16 Section J3

Decisive load combination: 1 - Combination 1

**Equations**

$R_n = \min(1.2\ l_c\ t\ F_u\ ,\ 2.4\ d\ t\ F_u)$ (AISC 360-16 J3-6a, c)

$\Phi R_n = 0.75\ R_n$

$V \leq \Phi R_n$

**Variables**

| | $l_c$ [in] | t [in] | $F_u$ [psi] | d [in] | $R_n$ [lb] |
|---|---|---|---|---|---|
| Anchor 1 | 13.063 | 0.750 | 58,000 | 0.875 | 91,350 |
| Anchor 2 | 1.531 | 0.750 | 58,000 | 0.875 | 79,931 |

**Results**

| | V [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Anchor 1 | 10,740 | 68,513 | 16 | OK |
| Anchor 2 | 10,800 | 59,948 | 19 | OK |

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## 2.5 Welds

Profiles are modeled without taking the corner radius into account. Special rules for welding (e.g. for cold-formed profiles ...) are not taken into account by the software.

### 2.5.1 Anchor plate to profile

Decisive load combination: 1 - Combination 1

**Equations**

$F_{nw} = 0.6\, F_{EXX}\, (1.0 + 0.5 \sin^{1.5} \Theta)$

$\Phi R_n = \Phi\, F_{nw}\, A_w$

$\text{Utilization} = \dfrac{F_n}{\Phi R_n}$

**Variables**

| Edge | $X_u$ | $T_h$ [in] | $L_s$ [in] | L [in] | $L_c$ [in] | $F_{EXX}$ [psi] | Θ [°] | $A_w$ [in²] |
|---|---|---|---|---|---|---|---|---|
| Member 1-bfl 1 | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 90.0 | 0.16 |
| Member 1-bfl | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 89.6 | 0.16 |
| Member 1-tfl 1 | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 89.7 | 0.16 |
| Member 1-tfl | E70xx | ◢0.157◣ | 0.222 | 5.230 | 1.046 | 70,000 | 90.0 | 0.16 |
| Member 1-w 1 | E70xx | ◢0.157◣ | 0.222 | 7.794 | 0.974 | 70,000 | 19.5 | 0.15 |
| Member 1-w | E70xx | ◢0.157◣ | 0.222 | 7.794 | 0.974 | 70,000 | 19.5 | 0.15 |

**Results**

| Edge | $F_n$ [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Member 1-bfl 1 | 4,766 | 7,760 | 62 | OK |
| Member 1-bfl | 1,811 | 7,760 | 24 | OK |
| Member 1-tfl 1 | 1,389 | 7,760 | 18 | OK |
| Member 1-tfl | 3,429 | 7,760 | 45 | OK |
| Member 1-w 1 | 1,890 | 5,282 | 36 | OK |
| Member 1-w | 1,889 | 5,282 | 36 | OK |

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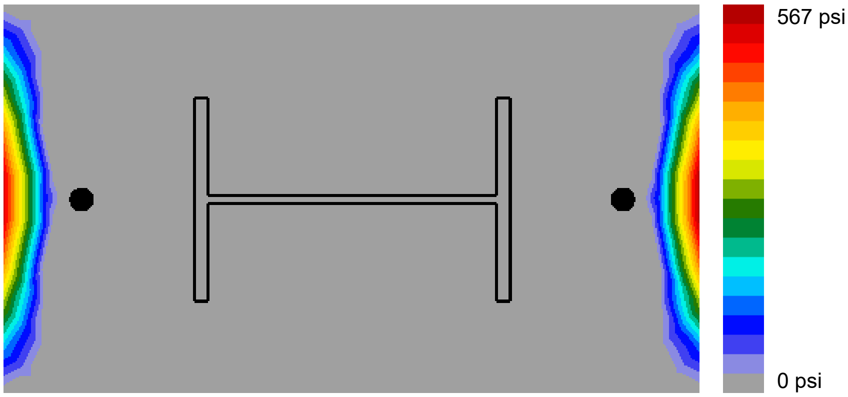
## 2.6 Concrete

Decisive load combination: 1 - Combination 1

### 2.6.1 Compression in concrete under the anchor plate




### 2.6.2 Concrete block compressive strength resistance check, AISC 360-16 Section J8

**Equations**

$F_p = \Phi f_{p,max}$

$f_{p,max} = 0.85 f_c' \sqrt{(\frac{A_2}{A_1})} \leq 1.7 f_c; \quad \sqrt{(\frac{A_2}{A_1})} \leq 2$

$\sigma = \frac{N}{A_1}$

$\text{Utilization} = \frac{\sigma}{F_p}$

**Variables**

| N [lb] | $f_c'$ [psi] | $\Phi$ | $A_1$ [in²] | $A_2$ [in²] |
|---|---|---|---|---|
| 3,823 | 2,500 | 0.65 | 23.95 | 541,696.74 |

**Results**

| Load combination | $F_p$ [psi] | $\sigma$ [psi] | Utilization [%] | Status |
|---|---|---|---|---|
| Combination 1 | 2,762 | 160 | 6 | OK |

| | | | |
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| Fastening point: | | | |


### 2.7 Symbol explanation

| | |
|---|---|
| $A_1$ | Loaded area of concrete |
| $A_2$ | Supporting area |
| $A_w$ | Effective area of weld critical element |
| d | Nominal diameter of the fastener |
| $\varepsilon_{lim}$ | Limit plastic strain |
| $\varepsilon_{Pl}$ | Plastic strain from CBFEM results |
| $f_c$ | Concrete compressive strength |
| $f_c'$ | Concrete compressive strength |
| $F_{EXX}$ | Electrode classification number, i.e. minimum specified tensile strength |
| $F_u$ | Specified minimum tensile strength of the connected material |
| $F_n$ | Force in weld critical element |
| $F_{nw}$ | Nominal stress of the weld material |
| $F_p$ | Concrete block design bearing strength |
| $f_{p,max}$ | Concrete block design bearing strength maximum |
| $f_y$ | Yield strength |
| $l_c$ | Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material |
| L | Length of weld |
| $L_c$ | Length of weld critical element |
| $L_s$ | Leg size of weld |
| N | Resulting compression force |
| $\sigma$ | Average stress in concrete |
| $\sigma_{Ed}$ | Equivalent stress |
| $\Phi$ | Resistance factor |
| $\Phi R_n$ | Resistance |
| t | Thickness of the anchor plate |
| $\Theta$ | Angle of loading measured from the weld longitudinal axis |
| $T_h$ | Throat thickness of weld |
| V | Resultant of shear forces Vy, Vz in bolt. |
| $X_u$ | Filler metal tensile strength |

### 2.8 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corp. | Page: | 17 |
| Address: | 23 Phillips Rd. | Specifier: | Peter Poor |
| Phone I Fax: | (207) 743-8946 \| (207) 890-0636 | E-Mail: | ppoor@bancroftcontracting.com |
| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

## 3 Summary of results

Design of the anchor plate, anchors, welds and other elements are based on CBFEM (component based finite element method) and AISC.

| | Load combination | Max. utilization | Status |
|---|---|---|---|
| Anchors | Combination 1 | 78% | OK |
| Anchor plate | Combination 1 | 59% | OK |
| Welds | Combination 1 | 62% | OK |
| Concrete | Combination 1 | 6% | OK |
| Profile | Combination 1 | 67% | OK |

**Fastening meets the design criteria!**

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corp. | Page: | 18 |
| Address: | 23 Phillips Rd. | Specifier: | Peter Poor |
| Phone I Fax: | (207) 743-8946 \| (207) 890-0636 | E-Mail: | ppoor@bancroftcontracting.com |
| Design: | Concrete - Apr 7, 2020 | Date: | 4/10/2020 |
| Fastening point: | | | |

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

BANCROFT Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 006
Contract/Project No. TBD
BCC Job No. 2002036

Attn: Gerry Mitchell

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Unit 7-8 Powerhouse Tailrace Aquadam |

Supplier

Bancroft Contracting Corp.
Subcontractor

Stamp

Remarks:

Submitted by: Peter Poor (Name) Peter Poor (Signature) 4/24/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks:

Reviewed by: Name Signature Date

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

Shawmut Unit 7 & 8 Cofferdam (Aquadam)
Location: Tailrace of Unit 7 & 8 Powerhouse
April 15, 2020

Reviewed By: Gagnon Engineering

APRIL 24, 2019

# *Bancroft Contracting Corporation*

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

April 15, 2020

Gagnon Engineering
10 Solomon Dr.
Gorham, ME 04038

Mid-December 2020

Attention: Roger Gagnon, PE

Reference: Shawmut Upstream Fish Passage Project – Unit 7 & 8 Aquadam

Mr. Gagnon,

Please find attached documents providing information on the aquadam product we intend to use for dewatering the tailrace of the Unit 7 & 8 Powerhouse for installation of a new Fish Bypass Structure.

The current schedule for this area of work and duration required is from Mid-July 2020 to Mid-December 2021.

Relevant Information

1.) 16' Aquadam Effective Depth – El. 91.0' (Based on 132" or 11' as provided in Attachment C)
    a. We feel this elevation is conservative based on existing record drawings (Attachment A) showing the potential for a higher effective depth due to increases in ledge elevation as you move downstream.
2.) Design Elevation – El. 90.5' (See Attachment B)
    a. Our current schedule shows this area being complete by the end of 2020 (prior to runoff).

Attachment Summary

1.) Attachment A - Proposed location for the Aquadam and temporary access road, and elevations for installed and effective height of Aquadam.
2.) Attachment B – Site plan drawing indicating tailrace low, normal and design tailpond elevations
3.) Attachment C – Aquadam User's Guide (effective depths, installation instructions, etc.)
4.) Attachment D – Aquadam Tube Fabric Mill Certification
5.) Attachment E – Aquadam Specifications

If you have any questions or require additional information, please feel free to contact me.

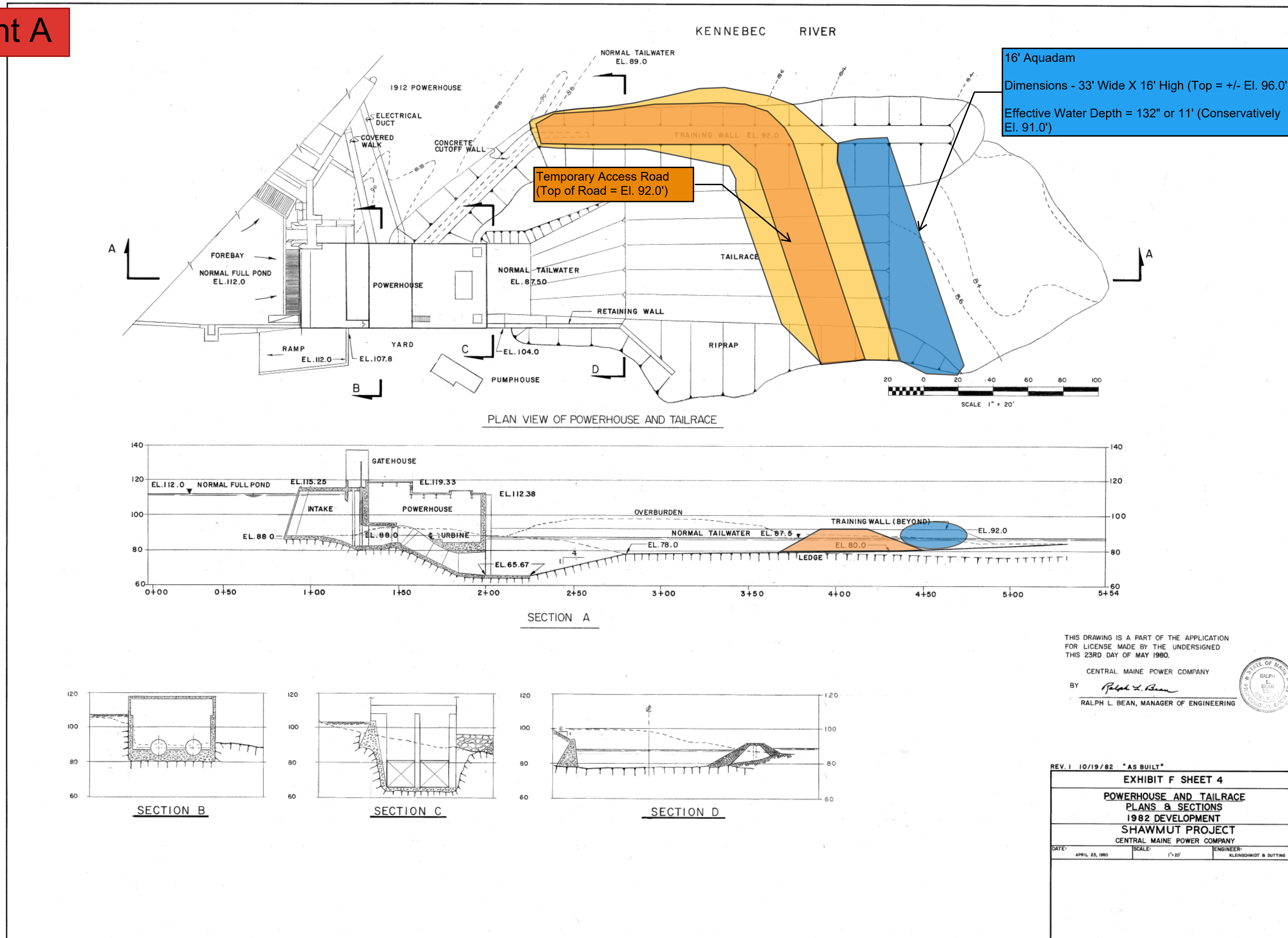
Regards,

Bancroft Contracting Corp.

Peter Poor
Project Manager
o. (207) 743-8946
c. (207) 890-7317
ppoor@bancroftcontracting.com

183-234 Sheet 4

Attachment A




183-234 m - 1/10/84 F.E.R.C. NO. 2322-29


| | |
|---|---|
| ALDEN RESEARCH LABORATORY, 30 SHREWSBURY ST, HOLDEN, MA 01520, TEL: (508) 829-6000 www.aldenlab.com | |
| REVISION | 12/13/2019 |
| DESCRIPTION OF ISSUE / REVISION | FINAL FOR BID - NOT FOR CONSTRUCTION |
| REVISED BY | M. GRAESER |
| VERIFY SCALE | BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY |
| Stamp | STATE OF MAINE, MARK DANIEL GRAESER, No. 39328, LICENSED PROFESSIONAL ENGINEER, 12/13/2019 |
| | SHAWMUT HYDROELECTRIC STATION<br>UPSTREAM FISH PASSAGE<br>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 |

DWG: C:\Users\agrogan\documents\autocad sheet sets\131009-alden mea 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:

Attachment C

# AquaDam®
# User's Guide ~ 2004

***(Includes Material Specifications)***


## *"Water Controlling Water"*™

LOW-IMPACT, ENVIRONMENTALLY FRIENDLY WATER FILLED COFFERDAMS FOR STREAM DIVERSIONS, FLOOD CONTROL, HAZ-MAT CONTAINMENT, AND DEWATERING STRUCTURES.

AquaDams® are water filled barriers that can be used as dams or cofferdams for stream diversions and dewatering boat ramps, boat docks, and pond liners for repairs.Also excellent for flood protection, they are more effective than sandbags and other water control devices.

**Aqua Dam Inc.**
P.O. Box 144 / 121 Main St.
Scotia, CA 95565
(800) 682-9283
www.AquaDam.net
email: matthew@aquadam.net

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## INTRODUCTION

AquaDam Inc® manufactures AquaDams®, a low-impact alternative to temporary earthen fill cofferdams (barriers). The Clean Water Act demands the use of alternatives to fill discharges to achieve Best Management Practices. On site mitigation is mandatory. Alternative protective devices, such as water filled cofferdams, are the ideal tools for water management programs that protect the aquatic environment. The US Army Corps of Engineers has and is presently approving the use of AquaDams® as a viable, environmentally acceptable method of diverting or containing water.

The following is an overview of Aqua Dam Inc; the various applications of AquaDams®; site and size requirements; equipment and manpower requirements; installation techniques; safety, maintenance, and removal.

## ABOUT THE COMPANY

AquaDam Inc was incorporated in 2003, after 20 years of using the idea created in the late 1980's to offer a new concept for managing water diversions, dewatering, flood control barriers, levee toppings, and water storage by using AquaDam Inc® offers installation services and free consulting services regarding the installation and implementation of a water filled cofferdam. The most important features of AquaDams® are the ease and speed at which they can be installed (especially in emergency situations). They consist almost entirely of onsite water, and are reusable.

## PATENTS

Aqua Dam Inc uses patents on the design and utilization of multiple chambered AquaDams® that use water and air as the inflation media, and the technique used in connecting multiple AquaDams® together to achieve any necessary length.

US Patent No. 5059065
US Patent No. 5125767
US Patent No. 6481928

Several other patents are currently pending.

# CONCEPT

AquaDams® are portable dams filled with onsite water that can be installed wherever needed to cofferdam, contain, or divert the flow of water. AquaDams® consist of two basic parts: an outer or "master tube" (**C**) made of a heavy duty geotextile woven polypropylene which holds the two inner tubes (**A & B**) in contact when filled with water. The outer and inner tubes combine to form an AquaDam® as shown in Figure 1, a cut away section illustrating the relationship between the inner and outer tubes of a typical filled AquaDam®.

**Figure 1: A TYPICAL FILLED AQUADAM®**

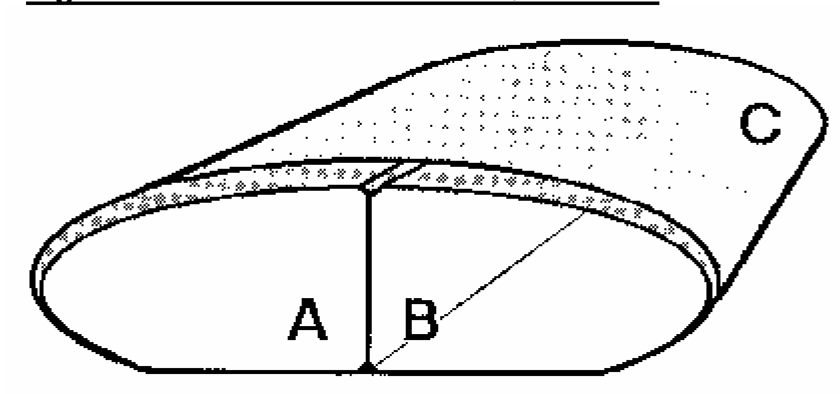



**Figure 1.** A cross section of a typical AquaDam®, illustrating the relationship between the two inner tubes which contain the water and the "master" tube that keeps the inner tubes parallel and in contact with each other.

**A** and **B** illustrates the two inner tubes inflated with water.
**C** is the outer or "master" tube made of very tough polypropylene woven geotextile fabric which confines the water filled inner tubes, making the AquaDam® a solid wall of water. These two confined columns of water provide the mass, weight, and pressure that gives the AquaDam® its stability.

To install an AquaDam®, onsite water is pumped into the two inner tubes during the installation process. The durable woven outer tube confines the water-inflated inner tubes. The counter friction / hydraulic pressure between the inner tube and the outer tube, along with the mass and weight of the water, creates pressure and stabilizes the AquaDam® when lateral water pressure is exerted against it. Due to the inherent flexibility of the materials used to confine the water, AquaDams® will conform to most surfaces, providing an excellent seal and keeping water seepage to a minimum.

AquaDams® come in a variety of sizes, ranging from 1 to 16 feet in height when inflated. AquaDams® come in standard lengths of 50 or 100 feet, and are available for immediate shipment. Any length can be fabricated. Shorter, longer, or irregular lengths are available with notice. Using attachment collars, two or more AquaDams® can be joined together to form a continuous cofferdam of any necessary length. AquaDams® are joined together by a patented coupling collar connection (standard with each AquaDam®). Large and small AquaDams® can be used in conjunction with each other. The possible configurations are almost endless. They can be used in a straight line, to form an arc, or to encircle a building. AquaDams® can also be connected at angles to each other, as may be required by the job requirements.

AquaDams® are usually assembled at the factory and shipped rolled and ready for use at the job site. However, it is not unusual to assemble larger AquaDams® on site. A typical AquaDam® consists of the "master tube" and a pair of inner tubes rolled up on a wooden or metal core as shown in Figure 2. In many instances, the core also plays an important part in the installation, rerolling for future use, and transportation of AquaDams®.

**Figure 2:**

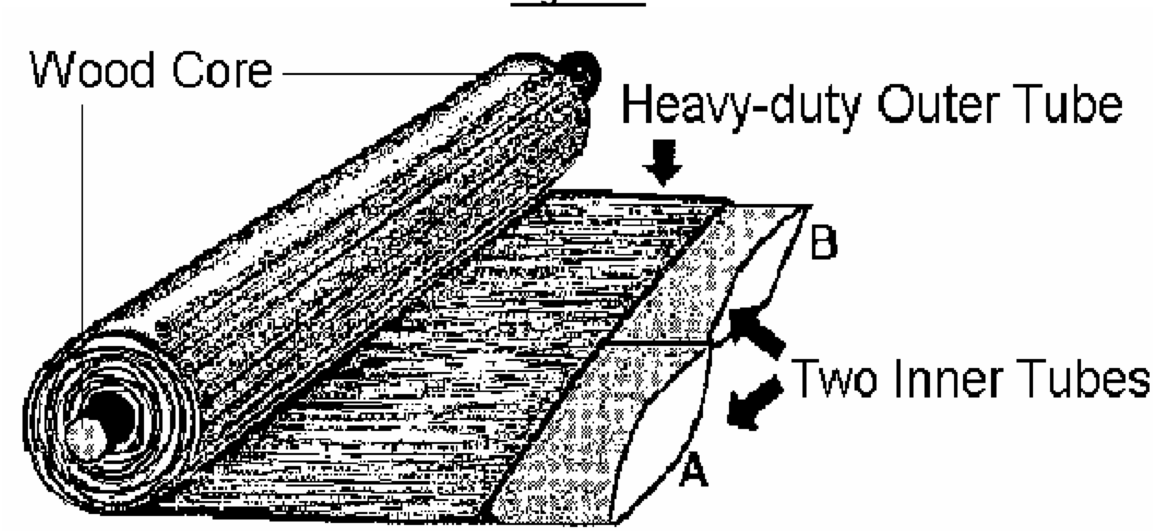



*Figure 2. A typical factory assembled AquaDam® prior to inflation, showing the inner and outer tubes rolled up around the core. The AquaDams'® tubes (A & B) are left open for filling purposes. This end will be elevated up the stream bank (the starting point) which has to be higher than the height of the AquaDam® when fully inflated. The other end is sealed and has an attached coupling collar used for joining a second AquaDam®.*

## APPLICATIONS

AquaDams® can be used in a wide range of applications. Listed below are some of the more common applications of AquaDams®:

| | |
|---|---|
| • Cofferdams for dewatering construction sites<br>• Water diversion in rivers and wetlands<br>• Water containment<br>• Flood control<br>• Erosion control through diversion or containment of flowing water<br>• Water storage<br>• Boat ramp dewatering<br>• Pond liner repair dewatering<br>• Bridge pier repair<br>• Pipeline crossings | • Water intake structures for municipalities<br>• Water discharge structures<br>• Fish habitat improvement<br>• Silt containment, sediment collection, or settling ponds<br>• Levees, levee toppings<br>• Hazardous material or chemical spills (containment)<br>• Temporary foot causeway through environmentally sensitive areas<br>• Wetlands management |

The old ways of earthen fill discharges and expensive sheet piling have been the historic ways of working in waterways. These methods are environmentally detrimental, time consuming, and expensive because of their reliance on heavy equipment.

Water filled cofferdams make the ideal water control structure for construction sites. Onsite water is pumped into an AquaDam®, which unrolls due to the water pressure inside it and can be installed in hours in most applications, without causing damage to the aquatic environment. Complete dewatering of the work site can be achieved to form and pour concrete, remove sediments, and install geotextiles.

When used for flood control and augmenting levees, for example, AquaDams® are much more effective than sandbags. They can be installed far quicker, at a fraction of the cost, without all the foot traffic associated with labor-intensive sandbagging, and best of all AquaDams® are reusable.

The amount of water that can be stored in a standard 4 foot AquaDam®, with a width of 10 feet and a length of 100 feet (filled to capacity), is about 25,000 gallons. AquaDams® are durable, long lasting, and with proper installation and removal can be stored and used again and again. Should an inner tube develop a leak, patching tape is available. If necessary, replacement tubes are available from Aqua Dam Inc.
AquaDams® are relatively easy to install, requiring only a couple of portable pumps, an onsite water supply, and two or more laborers depending on the size of the AquaDam®.

# AQUADAM® HEIGHT SELECTION AND SIZE CRITERIA

AquaDam® height selection is determined by work site conditions, the water depth to be contained or diverted, and to a lesser degree, stream bed slope and water velocity. Maximum projected changes in water depth are very important during the life of the diversion project. Table 1 lists sizes of AquaDams® and their recommended water depth usage. Customized dams of any length can be ordered.

**TABLE 1: STANDARD AQUADAM® SIZES AND RECOMMENDED USE**

| INFLATED HEIGHT (FEET) | INFLATED WIDTH (FEET) | CONTROLLED WATER DEPTH (INCHES) |
|---|---|---|
| 1 | 2 | 9 |
| 1.5 | 3 | 14 |
| 2 | 4 | 18 |
| 3 | 7 | 30 |
| 4 | 9 | 38 |
| 5 | 11 | 44 |
| 6 | 13 | 56 |
| 8 | 17 | 74 |
| 10 | 23 | 90 |
| 12 | 27 | 104 |
| 16 | 33 | 132 |

*This chart represents maximum water depths to be controlled on flat surfaces. The slope and topography of the streambed needs to be accounted for as well as water depths.*

## Water Depth:

The height of water to be contained by the AquaDam® is the most important factor when selecting the proper size. A good rule of thumb for determining the water height after diversion is as follows:

Add:

1.) the maximum water depth along the installation site,

2.) the average depth of water at the installation site,

3.) and the difference in elevation (water levels) between the installation and diverted water sites.

These three numbers equal the height of water that will be found at the installation site after the AquaDams® have been installed and water is flowing through the diversion channel.

The importance of determining the correct projected maximum water depths after installation and diversion of the stream cannot be taken too lightly. Too small of an AquaDam® will fail. **The depth of water to be retained by an AquaDam® is often underestimated, resulting in an AquaDam® that is too small for the project. This results in delays, increased costs and potentially unsafe work conditions!**

## Water Velocity:

When an AquaDam® is used to dam or divert flowing water, water velocity is a concern. During installation, the AquaDam® is being filled with water, causing it to unroll across the stream channel. This causes water flow to back up and increase in water depth. The water velocity around the end of the AquaDam® is increased. Depending on the firmness of the river bed, some undercutting might occur around the end of the AquaDam® as it is being installed. This results in an increase in the depth of water to be retained and should be factored into the analysis. Velocity of current is also a factor. The water head will build up on the upstream side and water on the downstream side flows away before the completion of the installation.

## Installation Site:

AquaDams® can be installed on top of most types of soils or fluvial materials, including: flat lying bed rock, mud, sand, gravel, small rocks, and vegetation. Select a site that is flat, and void of: wire, rebar, sharp objects, garbage, glass or dead vegetation containing tree branches, or other rip-rap. The slope of the riverbed should also be relatively flat or inclined in the direction of the upstream or contained water. Make sure to check the installation course for holes, obstructions or washed out areas that may cause problems during installation.

## Weather / Spring Run-off:

Local wet seasons and thunderstorms affect water levels in rivers, lakes, and wetlands and are important to understand during your construction Project. Projects that have flexible construction dates should be coordinated with favorable weather conditions that avoid high water levels. Water depth being retained by the AquaDam® should never exceed the recommended maximum water depth during the life of the project, not just the day you install it.

## Other Site Criteria:

All of the previous factors are important considerations once the site has been selected. The following are additional factors that may influence the site selection:

### Width of the River:

A location on a wide, shallow river is easier to cofferdam than a narrow river channel. Wide rivers will allow a diversion with only minor increases in water depth. A narrow river will quickly increase in water depth. The larger and wider the diversion channel, the less water depth will increase.

### Rough River Bed:

An extremely rugged alpine river bed (such as the Eagle River) with large angular boulders within the stream bed is a difficult area, since a good tight seal can only be accomplished through the removal of said boulders by hand or heavy equipment. In the case of the Eagle River, the boulders were scraped into a line, and the AquaDam® was installed directly upstream so that the boulders would help support it. Using four ropes was also important in the installation.

# INSTALLATION

## SMALL AQUADAMS® (1'- 4' high)

### ≋ Equipment List:

- We recommend that you use at least two portable gasoline water 2"-3" discharge pumps or one gasoline discharge pump switched from fill tube to fill tube during inflation; any available water supply will work. Anything from fire hydrants to garden hoses is acceptable; it all depends on the speed at which you want to install the AquaDam®. *
- Two discharge and suction hoses, one each per pump; no fitting is required on the end of the discharge hoses.
- A roll of duct tape to secure and constrict the size of the fill tubes when coupling AquaDams® together.
- For safety reasons, each laborer should carry a utility knife.

**The Aqua Dam Inc® crew uses 5.5HP Honda-powered 3" Volume Pumps which provide a maximum flow rate of 16,200 GPH. They are available from your local distributor for sale or rental. They can also be ordered from Great Plains Manufacturers and Distributors 1-800-525-9716;** using two of these, you can inflate: A 1' high by 100' long AquaDam® in less than 15 minutes; a 2' high by 100' long AquaDam® in 30 minutes; a 3' high by 100' long AquaDam® in under an hour; and a 4' high by 100' long AquaDam® in under an hour and a half.

### Manpower:

Two to four laborers are required to install the smaller AquaDams®. Plan out the installation beforehand and discuss it with your work party. The number of AquaDams® to be installed, time constraints, and access to the installation sites may dictate the need for additional help.

### Rock removal:

Someone will have to remove rocks by hand from the path of the AquaDam® to assure that a good seal is achieved (see the Lemhi River installation on our website). The laborers installing the AquaDam® are already committed, and cannot be the rock picking crew. Please see the Installation Section of our web site. Rocks should be picked out from directly in front of the AquaDam® as it is being installed. The rocks can be stacked on the downstream side of the AquaDam® to provide additional support (see the Williams Transco Gas Pipeline installation project in Williamsport, PA. on our website).

## LARGE AQUADAMS® (6' – 16’ high)

### ≋ Equipment List:

- ≋ At least two discharge pumps are required; using larger or more numerous pumps will inflate the AquaDam® faster; the fill tubes can be opened to accommodate any size discharge hose.
- ≋ One discharge and suction hose per pump; discharge hoses do not require fittings.
- ≋ A roll of duct tape for securing the fill tubes.
- ≋ For safety reasons, each laborer should have a utility knife.
- ≋ In moving water, restraining ropes need to be used to assist the installation; at the very least, each 100 foot AquaDam® that is installed requires 250 feet of ½ inch rope. A four rope setup is strongly recommended on the installation of AquaDams® 6' high or larger in fast-moving rivers and streams (please see the Eagle River Crossing under the Installation section of our web site).

### Manpower (for installation in non-moving water):

Three to five laborers are needed to install the larger AquaDams® in non-moving water. Ropes are usually not needed to restrain the AquaDam® from unrolling during the installation process, but can be used to pull the AquaDam® around if water depths are too great for a laborer to stand. Non-moving water conditions require the fewest number of laborers.

### Manpower (for installation in moving water):

Five to seven laborers are needed to install the larger AquaDams®; the exact number of laborers is related to the size and number of AquaDams® to be installed, terrain, water velocity, water depths, and time constraints. Table 2 better describes the manpower needs during a typical installation of AquaDams® 6' or more in height in moving water.

Table 2: RECOMMENDED MANPOWER REQUIREMENTS DURING INSTALLATION IN MOVING WATER

| AQUADAM® SIZE | ROPE ASSISTED INSTALLATION | NUMBER OF LABORERS IN WATER | NUMBER OF LABORERS ON PUMPS |
|---|---|---|---|
| 1-3 FEET | NO | 2-4 | 0-1 |
| 4 FEET | NO | 3-5 | 1 |
| 4 FEET | YES-2 | 2-4 | 1 |
| 6 FEET | YES-3 | 2-3 | 1 |
| 8 FEET | YES-4 | 2-3 | 1 |

**Table 2 (cont.):**
Manpower requirements are based on a particular size of AquaDam® in moving water. The chart also provides the number of ropes commonly used with a specific size AquaDam®. Note that 4, 6, and 8 foot structures are commonly installed with the aid of ropes to prevent them from unrolling prematurely. Only in standing water would rope assisted installations not be used on larger size AquaDams®.

Strong water velocities or currents require more manpower to insure proper installation, and to secure the safety of those installing the AquaDam®. The above list does not address personnel that might be operating heavy equipment, such as an excavator. An AquaDam Inc® supervisor who oversees the installation procedure is also recommended.

In most installations, very little site preparation work is required, but to obtain a good seal, rock picking is a must. The area should also be policed for objects that might puncture the AquaDam® during installation.

This Guide assumes that all Federal, State, County, and City Permits have been obtained from the appropriate government authority. Aqua Dam Inc also recommends that the buyer (Prime Contractor, Company Supervisor, etc.) have an understanding of the necessary permits and what can or cannot be done within the river bed (lake) should the use of heavy equipment be necessary.

## AquaDam® Installation Procedures

Installation can be broken down into two categories: Moving water (rivers and streams) and nonmoving water (lake shores).

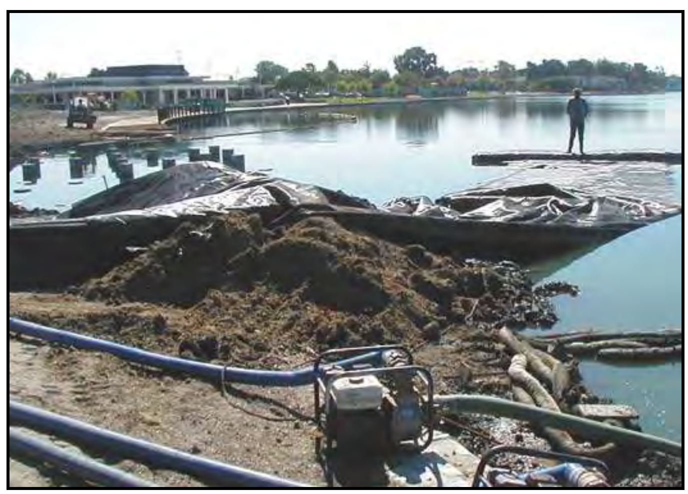
### Step 1-Transport:

Transport the AquaDam® to the installation starting point. Smaller AquaDams® can be easily moved into position by hand.

Carrying straps are provided on larger AquaDams®. Just hook or tie the straps to a piece of heavy equipment for transportation. Unpack the AquaDam® by carefully removing the protective wrap from the outside after cutting the packing ropes and carrying straps with a knife.

## Step 2-Starting Point:

The end of the AquaDam® will have long fill tubes to start with (usually 2-6 foot long). These are for connecting one AquaDam® to another using a collar. They are not the start of the AquaDam®. The AquaDam® starts at the outside (usually black or white) master tube that confines the two inside fill tubes (see Figure 1). Position the end of the outer tube up the bank at least as high as the AquaDam® will be when fully inflated (i.e., a 3 foot high AquaDam® would have at least 4 feet in elevation up the bank. The bank slope will have to be calculated in, and the end will have to be higher than the water level inside the AquaDam® after inflation. The AquaDam® will only achieve a height of 3+ feet at the lowest point along its path.).



If the bank is not steep enough to achieve the necessary starting height, a small amount of fill material can be placed at the waters edge to create a false bank or berm. This is the least expensive way to make a good starting point.

## Step 3-Preparing the AquaDam® for Inflation:

Insert a discharge hose into each inside fill tube. Excess fill tubes can be cut off if not desired for future use. Wrap duct tape or tie packing rope tightly around the fill tubes to keep the discharge hose from slipping out. The corners at the end of the AquaDam® can be tied to a tree or rock to prevent it from slipping down the bank slope. For smaller dams (3 feet and under), laborers are needed to stand in back of the AquaDam® roll at the foot of the slope along the waters edge. The pumping begins by pumping into both inside tubes at the same rate. The rolled portion of the AquaDam® will try to unroll, and will push up against the laborers' legs. The laborers' will wait for the water level to rise and build pressure inside the AquaDam®. When the height of the AquaDam® is great enough, the laborers should take a step back. Then they must wait until the height builds up again before taking another step backwards. All laborers must step backwards in unison and cooperate so that a foot does not get caught while unrolling it®. Water levels inside the AquaDam® must be kept at a level higher than the upstream water side of the AquaDam® (see the Pacific Gas and Electric and other installations on our website). This water depth will increase as the unrolling AquaDam® begins to constrict (cut off) the stream flow.

## Step 4-Moving Rocks and Debris:

When installing an AquaDam®, you must not only remove rocks from its path to ensure a good seal, you must remove all debris. Sharp, angular objects are often located under the water level, and usually the only way to find them is to walk around in the water until you step on them. Not only will these obstructions cause a greater amount of leakage, there is always the possibility that they may cause damage to the AquaDam®. **Never take it for granted that your work area is free from debris! ALWAYS CHECK FIRST!**

*THIS IS YOUR ENEMY…*

*This shopping cart was completely invisible during high tide.*

## Step 5-Restraining Ropes:

### Large AquaDams®

AquaDams® that are four or more feet in height commonly require restraining ropes to restrain the unrolled portion of the AquaDam® during the installation process in live streams. Without these lines or ropes the pressure of the water in the inner tubes would cause the AquaDam® to unroll before the proper inside head pressure is achieved. Preventing this pressure from prematurely unrolling the AquaDam® is very important. The pressure of the water mass inside the AquaDam® has to overpower the pressure of the water on the upstream side (compared to the downstream side). In lake water, the pressure will be the same on both sides of the AquaDam® (until dewatering begins by pumping).

The number of ropes (lines) required by a particular sized AquaDam® is discussed in Table 2 and Figure 3. If ropes are to be used in the installation process, they should be placed under the AquaDam® before water is added. The ropes are attached to the base of the metal posts or trees, then run under the AquaDam®, over the top, and back to the starting point. They should be held in a manner that will allow the rope to be let out as the AquaDam® unrolls across the stream. The rope should be twice as long as the AquaDam® when inflated, plus an extra 50 feet.

## Standing Water Applications:

Standing water or lake installations are much simpler than those using AquaDams® or in live streams. The AquaDam® will unroll itself with a minimum number of laborers to assist in the installation. Ropes can be used to turn the AquaDam® in places where it is too deep for laborers to stand. Water pressure from one side of the AquaDam® to the other should stay equal, making it unnecessary to maintain head pressure inside the unit. Laborers just need to guide it in the right direction.

## Step 6-Determine Height & Elevation:

The rolled AquaDam® should start at the top of the riverbank or berm. The end of the AquaDam® must be raised higher up the starting bank than the estimated height of the fully inflated AquaDam®. Gravity keeps the water used to fill the AquaDam® from flowing back out the elevated end. (Actually, we recently began offering double closed-ended AquaDams® which no not need to have the end elevated to hold water. However, the start of the AquaDam® must still tie into something like a bank or berm or water would just go around the end.)

**Figure 3: LARGE AQUADAM® INSTALLATION ACROSS A FLOWING STREAM**

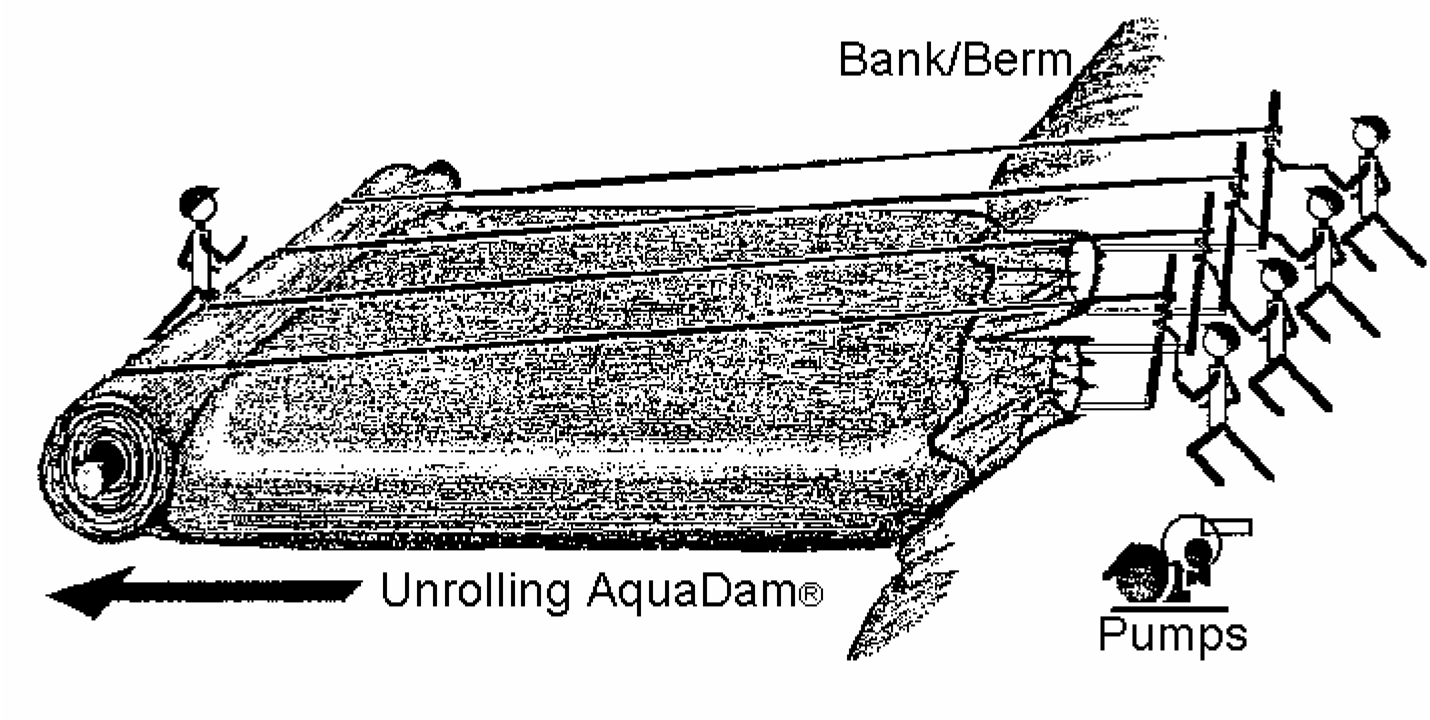



*Figure 3. shows the location of the ropes, posts, laborers and the inflating AquaDam®.*

## Step 7-Inflating the AquaDam®:

Figure 3 represents the most difficult installation scenario, such as a flowing stream where ropes must be used. The onsite conditions can change quickly in live streams because water depths will change from one side of the AquaDam® to the other. This difference in pressure will make the AquaDam® move downstream unless head pressure is maintained inside the AquaDam® during all phases of the installation. An AquaDam® that is unrolled too quickly and is not allowed to inflate above the level of the surrounding water will move downstream with the water flow. The workers on the bank slowly let the ropes out to allow the AquaDam® to unroll when inside water pressure and mass are achieved. Unroll 2-3 feet at a time, then wait for head pressure to build again, repeating this process until the AquaDam® is fully unrolled (see the Eagle River installation in Vail, CO on our website). Timing is everything. **Do not get in a hurry! Let your pumps work!** A requirement of using ropes is that the AquaDam® must be installed in a straight line. Head pressure must be maintained inside the AquaDam® to prevent it from moving. Ropes tend to move to the outside of the unrolling AquaDam®. The worker at the end of the unrolling AquaDam® adjusts the ropes and keeps them in the center by slackening and moving one rope at a time while the other ropes maintain the necessary inside pressure to keep the AquaDam® from moving downstream. On site rock that needs to be moved to assure a good seal should always be moved to the downstream side and used for support.

**Figure 4:**

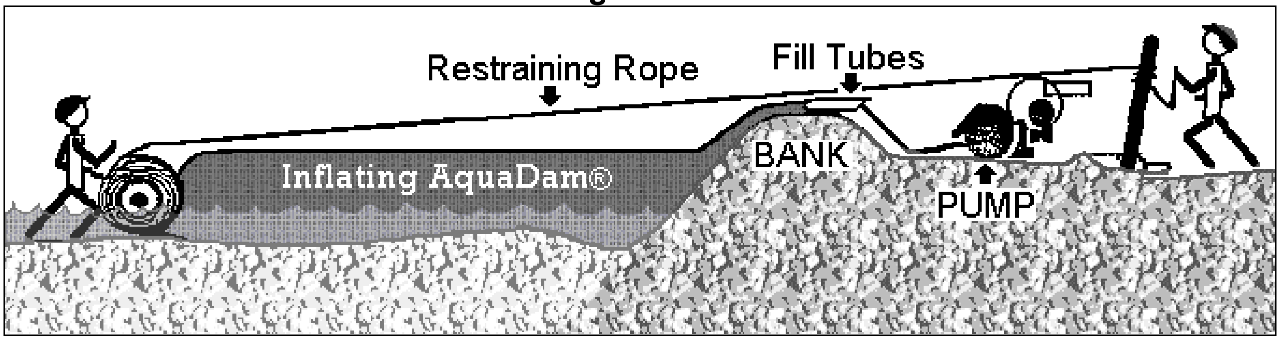



*Figure 4. A cross section of a large AquaDam® being installed in flowing water, illustrating the location of the berm, pumps, ropes, laborers and the inside water head pressure, compared to the outside water levels.*

## Manning the Ropes:

Once the ropes are manned, the pumps are primed, and the AquaDam® is aimed in the proper direction (at a right angle to the starting point on the bank), the pumps can be turned on and the inflation process can begin. Figure 5 shows a picture of restraining ropes used during installation of a large AquaDam® in a fast moving river. The small diversion channel in this project demands that a large AquaDam® be used despite the low water level, because of the anticipated increase in water depth (above 6 feet). The AquaDam® should be unrolled at a rate of about 1 to 3 feet every time the ropes are slipped and maintain a 12-24 inch (or greater) head of water pressure inside the AquaDam® ,compared to the upstream water depth, which will be increasing. Each foot of installed AquaDam® requires 2 feet of additional rope. The AquaDam® has to overcome imbalances of water head displacements happening in the river during the installation process. **Only experienced installation personnel should attempt to install large AquaDams® in moving water.** Smaller AquaDams® can be installed more easily and require less expertise.

**Figure 5: USING ROPES TO INSTALL AN AQUADAM® IN FLOWING WATER**

*Figure 5.: A large AquaDam® being installed on the Saddle River in northeastern New Jersey. Only one laborer is needed in the water to keep the ropes in position. Using ropes require that the AquaDam® only be installed in a straight line. Connections can be made at a later date if turns are required. Coupling collars are placed underneath the first AquaDam® as it is being unrolled( if connections are necessary).*

## Lateral Movement:

An AquaDam® being installed in flowing water can be vulnerable to moving downstream during the installation process. Maintaining internal head pressure is very important. To give support along the side of the AquaDam® a small mound of fill material can be placed directly downstream so that the AquaDam® rests against it. A small mound every 20-30 feet provides a tremendous amount of support. Of course, turbidity is kept to a minimum because the flow has already been diverted by the AquaDam® as it is being installed.

Another technique used to install large AquaDams® in flowing water is to install a shorter, sometimes smaller dam in a straight line using ropes (this is sometimes referred to as a “buffer”), and then place the bigger AquaDam® directly upstream, allowing it to rest against the smaller AquaDam®. In this fashion, the pressure in the larger upstream AquaDam® can be lowered to allow it to turn around the end of the smaller AquaDam®, without it having to be kept in a straight line with ropes. You can see an example of this on the Williams Transco Gas Pipeline project in McComb, MS on our website.

## How Lateral Movement Occurs:

Lateral movement of an AquaDam® during installation occurs when there is insufficient water mass inside the AquaDam® to overcome the difference in water pressure on the upstream side of the AquaDam® (compared to the downstream side, which will always be less). The difference in water depth must be compensated for by the amount of pressure inside the AquaDam® during and after installation. Water levels will rise rapidly during installation and should be monitored continuously by the crew in the water.

Sometimes lateral movement is hard to detect, but usually the following are indications:

- Visual lateral movement of the AquaDam®.
- The seams on the AquaDam® are straight for some distance but appear bent in the middle.
- The AquaDam® is no longer pointed in the direction originally taken.

If lateral movement begins to take place or evidence of rolling can be detected, then steps should be taken to correct it. A 6-12 inch change in water level could wipe out all of the installed AquaDams® if the proper amount of head pressure is not kept inside. One step that can be taken to prevent lateral movement is to increase the internal water volume that creates the internal pressure. Fill material can be placed directly on the downstream side in small amounts, allowing the AquaDam® to rest on it. All rocks moved for seepage control should be used to shore it up during installation. Often, fill material has to be excavated from the channel. This is placed behind the AquaDam® for storage, and allows the AquaDam® to rest on it so that more water depth can be controlled than what our User's Guide suggests.

AquaDams® should always be filled with the maximum amount of water possible. Always fill your AquaDams® to their recommended height.

Other solutions to moving or sliding are to install a smaller AquaDam® directly behind the main AquaDam® on the dewatered side. In standing water, stop dewatering and allow the bodies of water on either side of the AquaDam® to equalize.

**Figure 6: SHORING-UP CROSS SECTION**

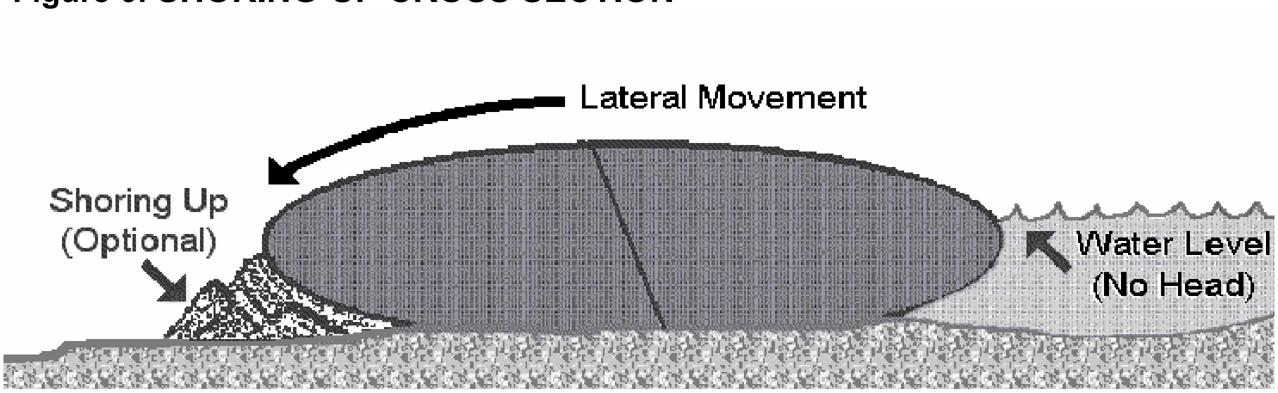



*Figure 6. A cross section showing the placement of earthen fill material to shore up an AquaDam® that shows signs of lateral movement.*

## CONNECTING AQUADAM® SECTIONS USING COUPLING COLLARS:

**Step 1:** Certain applications require two or more sections to be coupled together to form a longer, continuous water-filled cofferdam. The following illustrates how this is accomplished (the procedure assumes that the AquaDams® are being joined in a straight line end to end). All standard closed-ended AquaDams® come with a coupling collar on the closed end. The other end has the fill tubes, and has been designed to fit snugly into the coupling collar. Before a second AquaDam® can be attached, step one is to install an AquaDam® fitted with a coupling collar.

**Step 2:** Position the second AquaDam® directly behind and in-line with the filled AquaDam® and unroll about 10 feet of the new section, plus the length of the fill tubes *(see Figure 7a).*

**Step 3:** Gather up the end of one fill tube, gently twist or bunch it up, and wrap with duct tape. Do the same thing to the other tube. This will allow the inner tubes to be easily inserted and pulled through the round holes cut into the top of the coupling collar at the end of the installed AquaDam® *(see Figure 7b)*

**Step 4:** Carefully cut two round holes 6 inches in diameter in the top of the collar attached to the filled AquaDam® master tube. Each hole should be large enough to accommodate the bunched inner fill tube of the AquaDam® that is being attached. The two holes should be positioned midway between each side of the AquaDam®.
They should be about 1-2 feet apart on a four foot AquaDam® and 4 feet apart on a six foot high AquaDam®.

**Step 5:** Insert the wrapped right inner tube through the hole on the right side of the coupling collar, and the wrapped left inner tube through the hole on the left side of the coupling collar. This is done by working your way inside the coupling collar, pushing the inner tube toward the hole and having a second person reach through the hole from the outside, grab the tube, and pull it through the hole (about four feet of fill tube should be pulled on top for a four foot high AquaDam®). Pull the outer tube of the AquaDam® being connected inside the coupling collar and around the inner tubes as well as possible. The new section should be totally enclosed by the coupling collar, and the master tube of the AquaDam® being installed should be pulled up so as to be in contact with the end of the water-filled AquaDam®. Pull all excess fill tube material up on top through the holes.
*(see Figure 7c).*

**Step 6:** The 4'X8'X ½" sheet of plywood described in the equipment list is for the pumps to sit on, should they need to be placed on an inflated AquaDam®. When two AquaDams® are coupled or attached together, pumps are generally set on the previously filled AquaDam®, about 15-20 feet away from the end of the AquaDam®. The plywood will prevent damage to the AquaDam®, but it is not necessary by any means.

**Step 7:** Remove the tape or string from around the bunched inner fill tubes and insert the discharge hoses deep inside them, making sure that they extend past the coupling collar. Removal of fittings on the discharge hoses is recommended. If they cannot be removed, cover metal ones with duct tape. To keep the fill hoses from sliding back out, bunch the fill tubes up around them and secure with duct tape

(see Figure 7d).

**Step 8:** At this point the new section is ready to be filled in the same manner as the first section. Follow all of the instructions previously presented to install the first AquaDam®. Figure 8 is a drawing of two AquaDams®, one filled and the other ready to be filled.

**Figure 7: CONNECTING AQUADAMS® USING COUPLING COLLARS**

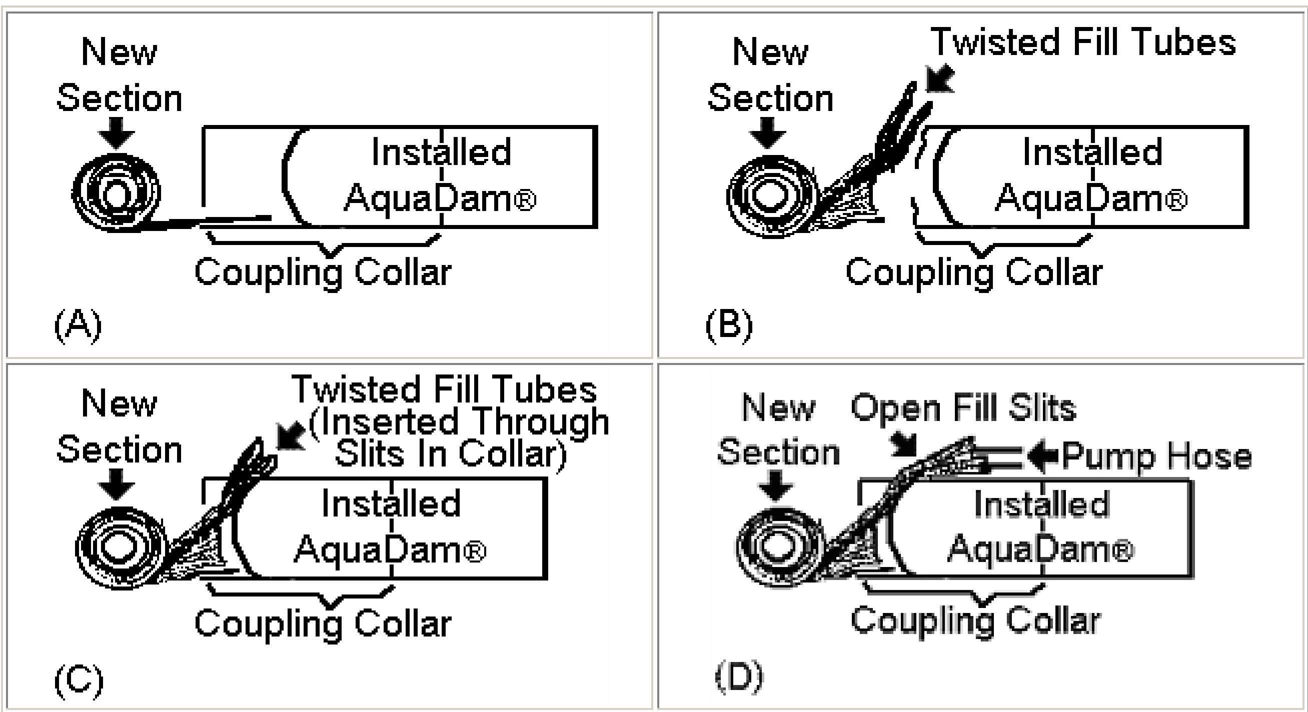



*Figure 7, illustrations a, b, c, and d show the different steps taken in the process of joining two AquaDams® together using a collar.*

**Figure 8: TWO AQUADAMS® COUPLED TOGETHER:**

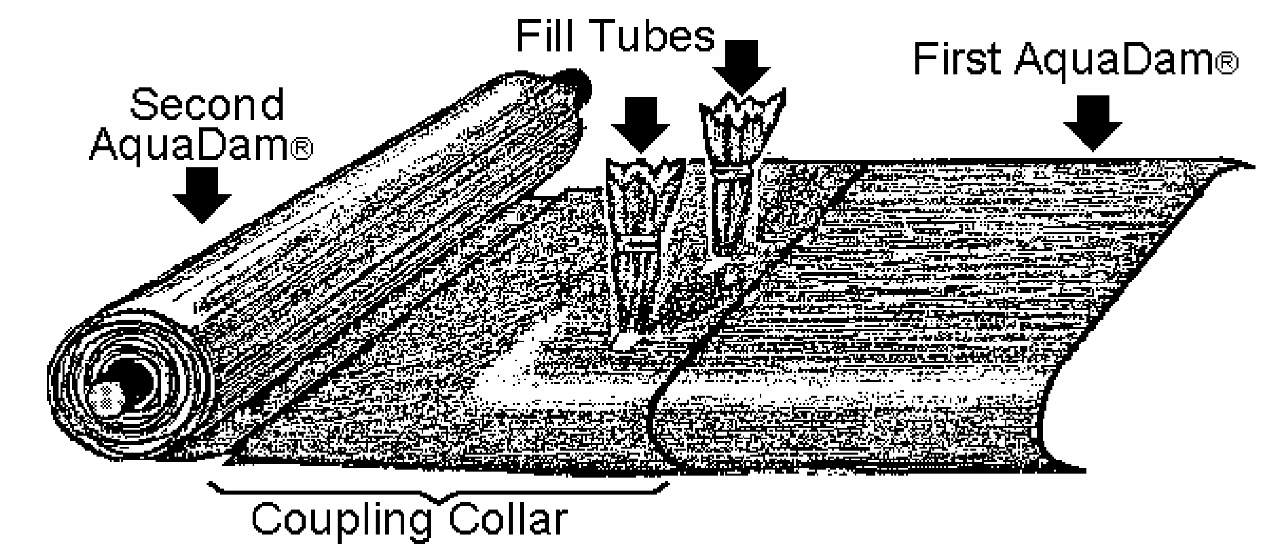



*Figure 8: Two AquaDams® are joined together by a coupling collar and ready to be inflated. The two inner tubes stick out and up from the middle portion of the coupling collar. These are the extra fill tubes located at the open end of each AquaDam®.*

**Step 9:** When the second section is filled, the water hoses can be removed from the inner tubes. The fill tubes are rewrapped with duct tape tightly and in such a manner that the tubes will stand up by themselves (see the Woodlawn Lake Sediment Removal project in San Antonio, TX on our website). If possible, use duct tape to attach the two upright inner tubes together, making them even more stable and preventing water from leaking out. Gravity will keep the water from rising above the height of the fill tubes.

## MAINTENANCE PROCEDURES

Installed AquaDams® are durable and will last a long time. Each installed section should be monitored regularly for leaks. The easiest way to deal with a leak without removing the AquaDam® is to pump more water into it. Small leaks can be patched with special repair tape

There are four important observations that should be made on a regular basis.

- Leaks in the AquaDams®
- Seepage under the AquaDams®
- Inner fill tubes that have fallen over and are draining water
- Lateral movement of the AquaDam®



Most leaks are of such a nature that they can be resolved simply by pumping additional water into the AquaDams® on a periodic basis. Identify which of the tubes is leaking, untie and unwrap the inner tube and insert the discharge hose from the water pump and fill it. Sometimes, a leak is large enough to require a patch. To repair such a leak, first identify and isolate the area around it. Then, using a sharp knife, cut a 'cross' or X through the master tube and pull the material apart to expose the leak, being careful not to further damage the inner tube. Then, using tape provided by AquaDam Inc
, apply
the patch to the inner tube. Once the leak is repaired, cover the 'cross' cut in the master tube with the same repair tape. In most cases it is best to just add water on a regular basis, until the AquaDam® can be taken out of service and patched properly from the inside or the inner tubes can be replaced.

## AQUADAM® REMOVAL USING REROLLING BRACKETS

Rerolling a small AquaDam® after use in a small stream. When two or more AquaDams® are connected together the downstream AquaDam® is removed first by pumping out the inside water, or allowing the fill tubes to drain the AquaDam® down to a level where the connection can be disassembled, allowing the water to pass out freely once rewinding begins at the other end. This forces the water to the open end and out.

Note: in some cases, it may be a better idea to hook the closed end to an excavator or other piece of equipment, lift it up, and simply let gravity drain the water out *(see below)*.

## LARGE AQUADAM® REMOVAL

For larger AquaDams® that are too big to reroll in place, equipment such as an excavator or backhoe can be used to pull the AquaDam® from the lake (in standing water). Pump out or drain as much of the water as you can, and put a strap around the closed end of the AquaDam®. Place the strap as close to the end as possible or water will remain trapped inside. **Do not pull on the collar.** Very slowly lift up on the strap. The water should drain out the open end. Make sure that the fill tubes are draining, they might need to be pulled further off the bank. Go slowly so that you do not lift the water any higher than is necessary for it to drain. Pull the deflated AquaDam® out of the water. It can now be blown up with air for inspection and rerolling. After the AquaDam® has been inspected and any holes have been patched, make sure that the coupling collar is still in place. It is now time to reroll the AquaDam® for storage and reuse. AquaDams® can be reused over and over again, depending on the application. They can also be used on a one-time basis and be destroyed when they are removed, or if they become contaminated with a hazardous material. It is difficult to remove large AquaDams® used to block off flowing streams and rivers. Sometimes, there is no way to remove the AquaDam® and maintain the internal water pressure necessary to hold it in place at the same time.

As the AquaDam® is being emptied, it will be forced out of the way by the difference in water depth from the upstream side of the AquaDam® to the downstream side.

There are many applications where an AquaDam® can be saved and rerolled for use at a later date. All smaller AquaDams® can be rerolled. Rerolling requires brackets to fit over the ends of the wooden beams that the AquaDams® come assembled on. A 3/4" drive ratchet can then be attached to the bracket. A 5' long section of pipe is slid over the handle of the ratchet (a cheater bar) to achieve maximum torque. Water can be pushed to the open end and out.

# SAFETY

## Emergency Removal:

Laborers should stay out of harm's way and be aware that standing at the end of the unrolling AquaDam® is dangerous, and they should stand clear whenever possible. The number of personnel in this position should be kept to a minimum. Should the laborers holding the ropes let go of them, the AquaDam® will rapidly unroll, and a laborer could be pinned underneath. That is why **all laborers should carry safety knives**, so that the AquaDam® can be slit open on the upstream side to relieve inside water pressure so that the AquaDam® will immediately drain, allowing it to move off of the trapped worker. The best way to do this is with a single long, lateral slice down the side of the AquaDam®. You must be standing on the upstream side. The downstream side is the direction that the AquaDam® and all of the water behind it will move in. It is very important that everyone works together!

## Obstacles & Debris:

The beds of rivers and streams are rough and can have holes and other obstacles that should be avoided in them. The easiest way to avoid them is to just go around. Removing something large that is silted into the riverbed will leave a large hole. This leaves you worse off than you were before. Going over this type of area will have more seepage, and it will also affect the height of the AquaDam®.

## Cold Weather:

In cold water, neoprene chest waders are highly recommended. All OSHA rules and guidelines should be followed closely. Personal Flotation Devices (PFDs) should be also used.

## Walking on the AquaDam®

The woven geo-textile fabric that the master tube is made of is puncture and UVI resistant. Heavy foot traffic on top of the AquaDam® is okay. The only time you might curtail foot traffic is during cold weather, when ice occurs within the inner tubes, but they can still be walked on. The ice may cut the polyethylene when it cracks or breaks from foot traffic.

# AquaDam Specifications

| Dimensions (completely full) | Controllable Mud/Water Depth | Specifications of Inner and Outer Tubes | Capacity in Gallons (gal per ft.) | Empty Weight (lbs per ft.) |
|---|---|---|---|---|
| **1' H x 2' W*** (0.3m high) | **9”** (23 cm) | Same material thickness and strength as 4' high AquaDam | 12 | 0.75 lbs |
| **1.5' H x 3' W*** (0.5m high) | **14”** (36 cm) | Same material thickness and strength as 4' high AquaDam | 25 | 0.95 lbs |
| **2.5' H x 5' W*** (0.76m high) | **24”** (61 cm) | Same material thickness and strength as 4' high AquaDam | 88 | 1.85 lbs |
| **3' H x 7' W** (1m high) | **30”** (77 cm) | Same material thickness and strength as 4' high AquaDam | 120 | 2.5 lbs |
| **4' H x 9' W** (1.2m high) | **38”** (97 cm) | 12 mil polyethylene inside tube.<br><br>300 lb/in² burst strength woven polyethylene geotextile outside tube. | 240 | 4.25 lbs |
| **5' H x 11' W** (1.5m high) | **44”** (112 cm) | Same material thickness and strength as a 8' high AquaDam | 320 | 6.4 lbs |
| **6' H x 13' W** (1.8m high) | **54”** (137 cm) | Same material thickness and strength as a 8' high AquaDam | 400 | 8.5 lbs |
| **8' H x 17' W** (2.4m high) | **74”** (188 cm) | 12 mil polyethylene inside tube.<br><br>2 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 500 | 12 lbs |
| **10' H x 21' W** (3m high) | **90”** (229 cm) | 8 mil polyethylene inside tube.<br><br>3 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 800 | 25 lbs |
| **12' H x 25' W** (3.7m high) | **104”** (264 cm) | 2 plys of 8 mil polyethylene inside tube<br>1 ply shroud surrounding inside tubes<br>4 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 900 | 31 lbs |
| **16' H x 33' W** (4.8m high) | **132”** (335 cm) | 2 plys of 5 mil polyethylene inside tube<br>1 ply shroud surrounding inside tubes<br>5 plys of 300 lb/in² burst strength woven polyethylene geotextile outside tube. | 1250 | 45 lbs |

All AquaDams 3' and taller are manufactured with an internal baffle for added stability. Smaller AquaDams can be special ordered with a baffle. Call for pricing.

Aqua Dam Inc
*“Water Controlling Water”*
www.aquadam.net
1.800.682.9283
+1.707.764.1999
matthew@aquadam.net

Attachment D

**TUBE FABRIC MILL CERT**

**PRODUCT:** AQ-105LF

**CONSTRUCTION:** Woven geotextile of consisting of strong, rot resistant, chemically stable long chain synthetic polymer materials, dimensionally stable with each other. The plastic yarn or fibers used in this geotextile consist of at least 95% percent by mass of polyolefins, polyesters, or polymides; and contain stabilizers and inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure.

**CERTIFIED MARV VALUES:**

GRAB TENSILE MD (ASTM D 4632): 315 POUNDS
GRAB TENSILE CD (ASTM D 4632): 315 POUNDS
ELONGATION MD (ASTM D 4632): 15 %
ELONGATION CD (ASTM D 4632): 15 %
PUNCTURE (ASTM D 4833): 140 POUNDS
TRAP TEAR MD (ASTM D 4533): 135 POUNDS
TRAP TEAR MD (ASTM D 4533): 135 POUNDS
AOS* (ASTM D 4751): 40 US SIEVE
PERMITTIVITY (ASTM D 4491): 0.05 PER SEC
FLOW RATE (ASTM D 4491): 4.2 GPM/SF
UV STRENGTH AT 2500 HOURS (ASTM D 4355): 80%

* ASTM D 4751, AOS is a Maximum Opening Diameter Value

**Manufacturers Name:** VANTAGE PARTNERS, LLC **Date:** ___________
**Manufacturer's Official:** Randy DeMao **Title:** President

386 East Plaza Drive * Mooresville, NC 28115 * (704) 871-8700 * (704) 871-9700 Fax

Attachment E

# AquaDam Specifications

| Inflated Dimensions | Controllable Mud/Water Depth* | Specifications of Inner and Outer Tubes | Capacity** per linear ft | Dry Weight per linear ft |
|---|---|---|---|---|
| **1' H x 2' W** (0.3m tall) | **9”** (23 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 12 gal/LF 45 liters/LF | 0.75 lbs/LF 0.34 kg/LF |
| **1.5' H x 3' W** (0.45m tall) | **14”** (36 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 25 gal/LF 95 liters/LF | 0.95 lbs/LF 0.43 kg/LF |
| **2' H x 4' W** (0.61m high) | **18”** (45cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 50 gal/LF 189 liters/LF | 1.5lbs/LF 0.68kg/LF |
| **2.5' H x 5' W** (0.76m tall) | **24”** (61 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 88 gal/LF 333 liters/LF | 1.85 lbs/LF 0.84 kg/LF |
| **3' H x 7' W** (0.9m tall) | **30”** (77 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 120 gal/LF 454 liters/LF | 2.5 lbs/LF 1.1 kg/LF |
| **4' H x 9' W** (1.2m tall) | **38”** (97 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 1 ply, 300 lb/in² burst strength PP | 210 gal/LF 795 liters/LF | 4.3 lbs/LF 1.9 kg/LF |
| **5' H x 11' W** (1.5m tall) | **44”** (112 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 2 plys of 300 lb/in² burst strength PP | 320 gal/LF 1,211 liters/LF | 6.4 lbs/LF 2.9 kg/LF |
| **6' H x 13' W** (1.8m tall) | **54”** (137 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 2 plys of 300 lb/in² burst strength PP | 450 gal/LF 1,703 liters/LF | 8.5 lbs/LF 3.9 kg/LF |
| **8' H x 17' W** (2.4m tall) | **74”** (188 cm) | **Inner Tubing:** 1 ply, 12 mil, Polyethylene **Outer Sleeve:** 2 plys of 300 lb/in² burst strength PP | 700 gal/LF 2,650 liters/LF | 12 lbs/LF 5.4 kg/LF |
| **10' H x 21' W** (3m tall) | **88”** (223 cm) | **Inner Tubing:** 2 plys, 8 mil, Polyethylene **Shroud:** 1 PP woven shroud around both inner tubes **Outer Sleeve:** 4 plys of 300 lb/in² burst strength PP | 1,000 gal/LF 3,785 liters/LF | 25 lbs/LF 11.3 kg/LF |
| **12' H x 25' W** (3.7m tall) | **100”** (254 cm) | **Inner Tubing:** 2 plys, 8 mil, Polyethylene **Shroud:** 1 PP woven shroud around each inner tube. **Outer Sleeve:** 5 plys of 300 lb/in² burst strength PP | 1,700 gal/LF 6,435 liters/LF | 35 lbs/LF 15.9 kg/LF |
| **16' H x 33' W** (4.8m tall) | **126”** (320 cm) | **Inner Tubing:** 3 plys, 5 mil, Polyethylene **Shroud:** 2 PP woven shrouds between inside tubes **Outer Sleeve:** 7-plys of 300 lb/in² burst strength PP | 3,000 gal/LF 11,356 liters/LF | 51 lbs/LF 23 kg/LF |

*This number is based on the friction of a rocky bottom. Slick mud, poly pond liners, and other slick surfaces may require the use of a taller primary AquaDam and/or a support dam installed behind the primary AquaDam.

** Capacity is based on installation on flat ground. Slopes will reduce internal volume of AquaDam.

BANCROFT Contracting Corp.
23 Phillips Road South Paris, ME 04281
Phone: (207) 743-8946 Fax: (207)743-0636

# SUBMITTAL

To: Brookfield Renewable Energy Group
150 Main St.
Lewiston, ME 04240

Submittal No. 007
Contract/Project No. TBD

Attn: Gerry Mitchell

BCC Job No. 2002036

Project: Shawmut Hydroelectric Station Upstream Fish Passage

The following is submitted for:

☐ Approval ☑ Information ☐ Substitution Request ☐ Resubmittal of No. ______

| Copies | Reference (Drawing, Specification, Etc) | Description |
|---|---|---|
| 1 | 31.23.19 | Downstream Fish Lift Braced Cofferdam |

Supplier

Bancroft Contracting Corp.
Subcontractor

Stamp

Remarks: This submission is for informational purposes only.

Submitted by: Peter Poor (Name) — *Peter Poor* (Signature) — 5/3/2020 (Date)

☐ No Exceptions Taken. Work May Proceed.

☐ Approved As Noted. Work May Proceed.

☐ Approved As Noted. Resubmission Required. Work May Proceed.

☐ Not Approved. Resubmission Required. Work May Not Proceed.

☐ Review Not Required.

Stamp

Remarks:

Reviewed by: ______ Name ______ Signature ______ Date

**_Bancroft Contracting Corporation_**
23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

# Shawmut Fish Lift Cofferdam Downstream
# April 22, 2020

Reviewed By: Roger Gagnon – Gagnon Engineering

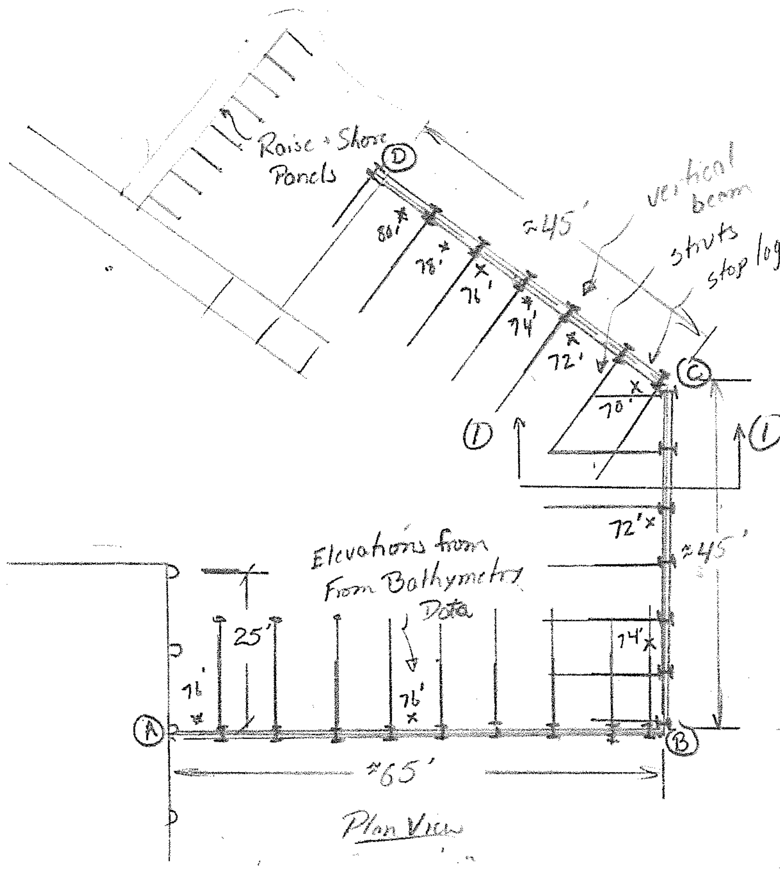
STATE OF MAINE
ROGER R.
GAGNON
No. 3409
LICENSED
PROFESSIONAL ENGINEER

Garrick Frost
Bancroft Contracting Corp
April 8, 2019

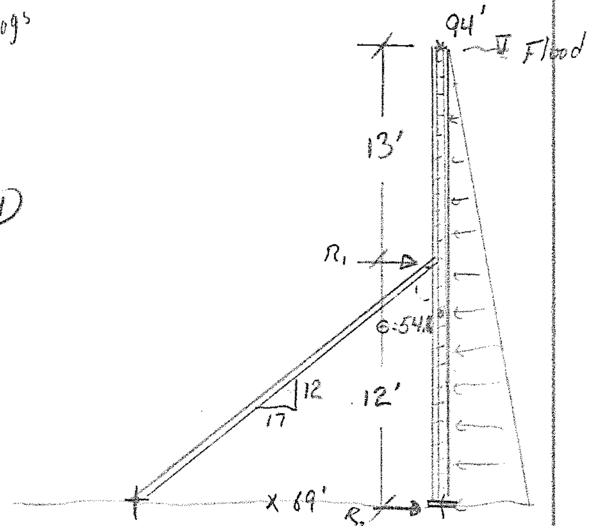
# Shawmut Fish Lift Downstream Cofferdam

given: The Following Sketch
$F_y$ = 50 ksi (sheets & Braces)
Hilti Hit RE500V3 Epoxy
Top of Cofferdam = 94'
Deepest Location = 69' (comparing 2 sets of data)

find
A - Intermediate Frames
I - Design Vertical Beams
II - Design Strut
III - Design Stop Logs
IV - Design Connections
B - End Frames
I - Check Beam / strut Loads for strut angle = 58°
II - Design connections to resist strut angle = 54.8° and 58.3°
C - Spreadsheet Showing Loads / depth
D - Sketches



Plan View

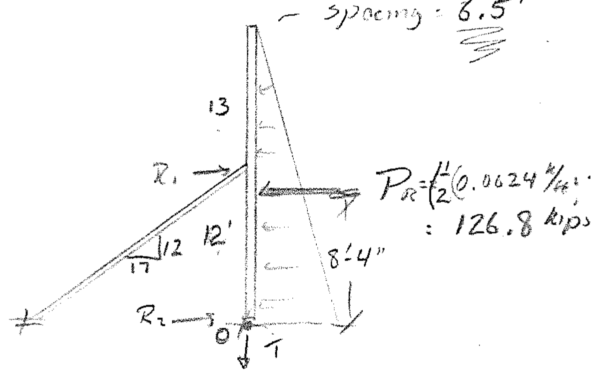


Elevation View
3/32" = 1'-0"

## A - Intermediate Frames

### I - Design Vertical Beams

– spacing = 6.5'




$P_R = \left(\frac{1}{2}(0.0624\ k/ft^3 \cdot 25')\,25'\right) 6.5'$ o.c.
$= 126.8$ kips

$\Sigma M_O = 0$
$126.8^k(8'4") = 12 R_1$
$R_1 = 88.1$ kips

$\Sigma F_x = 0$
$88.1^k + R_2 = 126.8^k$
$R_2 = 38.7$ kips

$\frac{88.1}{17} = \frac{T}{12}$
$T = 62.2^k$

$M_{max}$ @ $V=0$ : Det. depth "d", where $V=0$

$$\left(\frac{1}{2}(0.0624\ ^{k}/_{ft^2}\times d)\ d\right)6.50' - 88.1^{kips} = 0$$
$$0.2028d^2 = 88.1$$
$$d = 20.8'$$

$M_{max}$ at depth = 20.8'

$$M_{max} = (88.1^k \times 7.8') - \left(\tfrac{1}{2}(0.0624\cdot 20.8)20.8')6.5'\right)\times\tfrac{1}{3}\cdot 20.8'$$
$$M_{max} = 78.9\ ft\cdot kip$$

for $M_{max}$ = 78.9 ft·kip and $l_b$ = 25'

use W12×50 per AISC 9th ed. pg 2-208

$M_{allow}$ = 91.5 ft·kip > 78.9 ft·kip

ok

Checking Combined Tension and Bending by interaction equation

$$\frac{M_{app}}{M_{allow}} + \frac{T_{applied}}{T_{allow}} \le 1.0$$

$$\frac{78.9}{91.5} + \frac{62.2^k}{0.6(14.7_{in^2})50^{ksi}} \le 1.0$$

$$0.88 + 0.14 \le 1.0$$

$$1.0 \le 1.0 \quad \text{for W12×50}$$

ok

$M_{max}$ at depth = 13'

$$M_{max} = \left[\tfrac{1}{2}(0.0624\ ^{k}/_{ft^2}\times 13'\times 6.5'o.c.)\ 13'\right]\frac{13'}{3}$$
$$= 148.5\ ft\cdot kips$$

$l_b$ = 25' use W10×60 $M_{allow}$ = 149.5' (pg 2-208 AISC 9th ed)

or W12×65 = 175 ft·kip

or W14×68 = 177 ft·kip

**use W14×68**

## II - Design strut

$$C = \sqrt{R_1^2 + T^2} = \sqrt{(88.1^k)^2 + (62.2)^2} = 107.8\ kips$$

$$L = \sqrt{12^2 + 17^2} = 20.8'$$

use interaction and check W12×50 $P_{allow}$ = 133.5 kip for $l_b$ = 21' (per AISC 9th ed pg 3-28)

$$f_a = \frac{P}{A} = \frac{107.8}{14.7\ in^2} = 7.33\ ksi$$

$F_a$ is a function of $\frac{KL}{R_y} = \frac{(1.0)(21\cdot 12)}{1.96} = 128.6$, from table C-50 $F_a = 9.03^{ksi}$

$$\therefore \frac{f_a}{F_a} = \frac{7.33\ ksi}{9.03\ ksi} = 0.81 > 0.15$$

∴ use eqns H1-1 and H1-2 both must be satisfied

AISCS Eqn H1-1 $\frac{f_a}{F_a} + \frac{C_{mx} f_{bx}}{(1-f_a/F'_{ex})F_{bx}} + 0 \le 1.0$

AISCS Eqn H1-2 $\frac{f_a}{0.6F_y} + \frac{f_{bx}}{F_{bx}} + 0 \le 1.0$

## II - Design Strut (Cont'd)

$f_{bx} = \frac{M_x}{S_x}$ $M_x = \frac{wl^2}{8} = \frac{0.050(21)^2}{8} = 2.76$ ft·kip

$S_x = 64.7$ in³

$f_{bx} = \frac{2.76 \text{ ft·k}(12)}{64.7 \text{ in}^3} = 0.51$ ksi

$F_{bx} = \frac{M_{allow}}{S_x}$ $M_{allow}$ from pg 2-207 AISC 9th ed = 109.5' ft·kip

$= \frac{109.5 \text{ ft·k}}{64.7 \text{ in}^3} = 20.31$ ksi

$\frac{f_{bx}}{F_{bx}} = \frac{0.51}{20.31} = 0.03$

$F'_{ex} = \frac{12\pi^2 E}{23(Kl/r_x)^2}$ from Table 8 of numerical values given $\frac{Kl}{r_x} = \frac{1.1(20.5)(12)}{5.18}$

$= 47.5$

given $\frac{Kl}{r_x} = 47.5$ $F_{bx} = 66.21$ ksi

eqn H1-1 may be rewritten as: $0.81 + \frac{(1.0)(0.51)}{(1 - 7.33/66.21)\,20.31} + 0 \le 1.0$

$0.84 \le 1.0$

ok

eqn H1-2 may be rewritten as: $\frac{7.33}{0.6(50)} + 0.03 \le 1.0$

$0.27 \le 1.0$

ok

**∴ use W12×50**

## III - Design Stop Logs

At depth = 25' w/ beam spacing @ 6.5'

$P = 62.4$ #/ft³ × 25' = 1,560 #/ft²

if using 10" (9½" dressed) timbers $w = 1560 \text{ #/ft}^2 \times \frac{9\frac{1}{2}''}{12''/\text{ft}} = 1{,}235$ #/ft

$M_{allow} = F^*b \cdot S_x$

$M_{allow} = \frac{wl^2}{8} = \frac{1235 \text{ #/ft}(6.5)^2}{8} = 6522.3$ ft-#'s

$F^*b = Fb \cdot$ Adjustment Factors

$F_b = 850\,psi$ for No 2 SYP 5×5 and larger

$C_D$ = Load Duration Factor for 1yr = 1.1 (conservative)
$C_r = 1.15$ (sheathed w/ plywood)

$F^*b = 850\,psi\,(1.1)(1.15) = 1075.25\,psi$

$M_{allow} = F^*b \cdot S_y = \left(\frac{12''}{1ft}\right)(6522.3\ ft\cdot\#'s) = 1075.25\ \frac{\#}{in^2} \cdot S_y$
$S_y = 72.8\,in^3$

∴ use 8×10 S4S No. 2 SYP to 25' depth — $S_y = 89.1 > 72.8\,in^3$ ok

At depth: 15' w/ beam spacing @ 6.5'
$P = 62.4\,\#/ft^3 \times 15' = 936.0\ \#/ft^2$
$w = 936\left(\frac{9\frac{1}{2}}{12}\right) = 741\,\#/ft$
$\frac{w\ell^2}{8} = \frac{741\#/ft\,(6.5)^2}{8} = 3913.4\ ft\cdot\#\left(\frac{12''}{ft}\right) = 1075.25\,\frac{\#}{in^2} \cdot S_y$
$S_y = 43.7\,in^3$

∴ use 6×10 S4S No 2 SYP to 15' depth — $S_y = 47.9\,in^3 > 43.7\,in^3$ ok

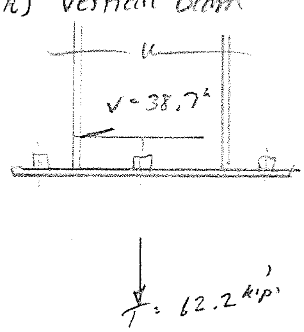
At depth = 8' w/ beam spacing at 6.5'
$P = 62.4\,\#/ft^3 \cdot 8' = 499.2\ \#/ft^2$
$w = 499.2\,\#/ft^2 \cdot \frac{7\frac{1}{2}}{12} = 312\ \#/ft$
$\frac{w\ell^2}{8} = \frac{312(6.5)^2}{8} = 1647.75\ ft\cdot\#'s = F^*b \cdot S_y$

for 4×8 timbers, see table 8.4 AITC 9th ed $F_b = 1200\,psi$
$F^*b = 1200\,psi \times 1.15 \times 1.1 = 1518\ \#/in^2$
$\left(\frac{12''}{1ft}\right) 1647.75\ ft\#'s = 1518\ \#/in^2 \cdot S_y$
$S_y = 13.0\,in^3$

∴ use 4×8 S4S No 2 SYP to 8' depth — $S_y = 14.8\,in^3 > 13.0\,in^3$ ok

## IV – Connections

A) Vertical Beam



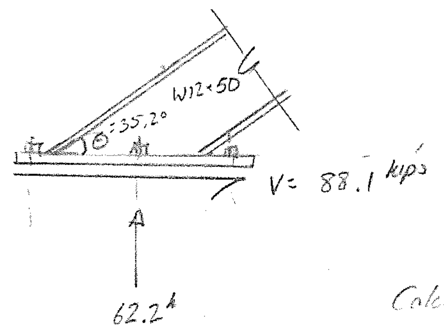

load factor
$V = 38.7 \times 1.7 = 65.8\ kips$
$T = 12.2^k \times 1.7 = 105.7\ kips$

Calculating w/ Hilti Profis Anchor 2.8.8

use 6ea, 1¼"Ø HAS E B7 rods, embed 25" and secure with Hilti Hit RE500 V3

see Hilti Design Report "A"

B) Struts




load factor

V = 88.1k × 1.7 = 149.8 kips

Calculating w/ Hilti Profis Anchor 2.8.8

use 4ea, 1¼"Ø HAS E B7 rods, embed 25"
and secure with Hilti Hit RE500 V3

See Hilti Design Report "B"

Report "A"

(6/19)



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporations | Page: | 1 |
| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

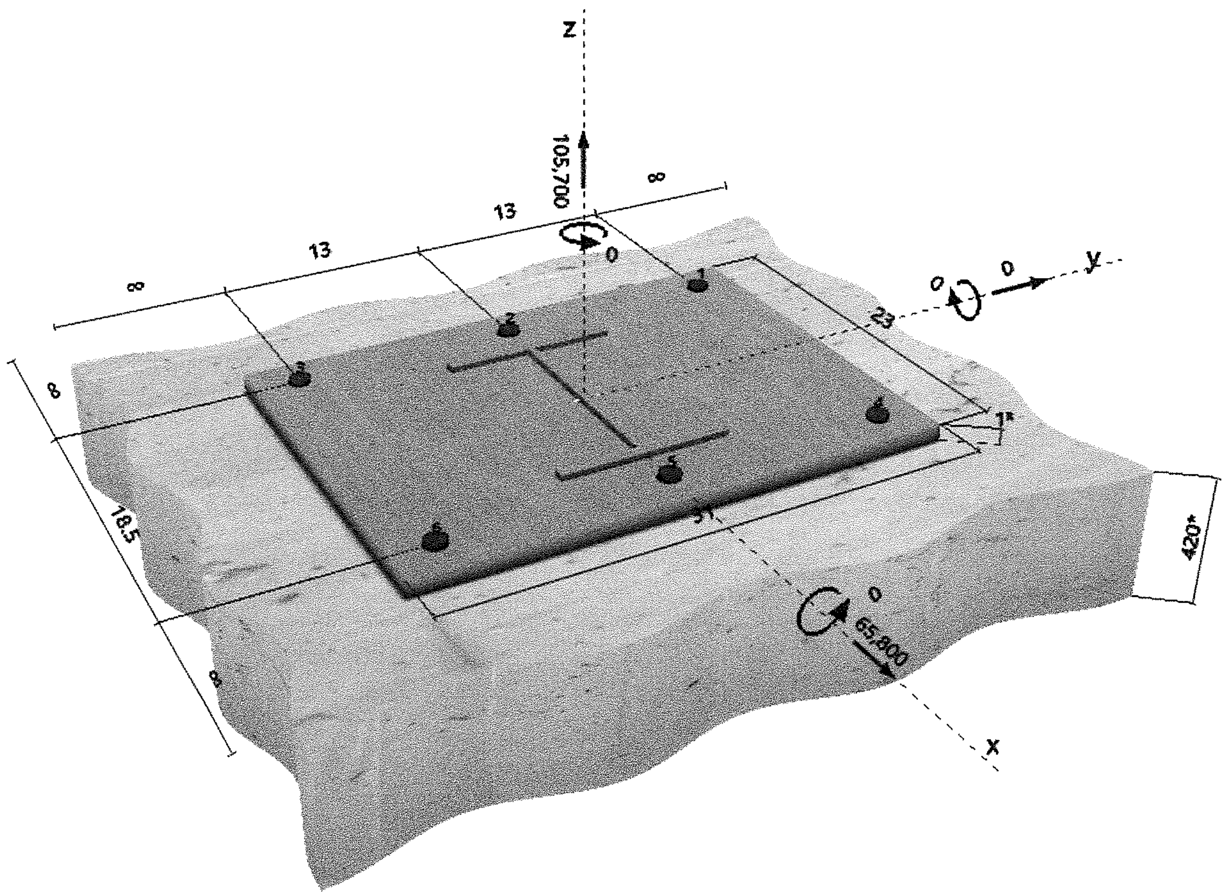
**Specifier's comments:**

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1 1/4** |
| Effective embedment depth: | $h_{ef,act}$ = 25.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 23.000 in. x 31.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W14X68; (L x W x T x FT) = 14.000 in. x 10.000 in. x 0.415 in. x 0.720 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 65/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. **4** bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporations | Page: | 2 |
| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| Loading | Proof | Design values [lb] Load | Capacity | Utilization $\beta_N$ / $\beta_V$ [%] | Status |
|---|---|---|---|---|---|
| Tension | Concrete Breakout Strength | 105,700 | 115,945 | 92 / - | OK |
| Shear | Pryout Strength (Concrete Breakout Strength controls) | 65,800 | 249,728 | - / 27 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | 0.912 | 0.263 | 5/3 | 97 | OK |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Report B

www.hilti.us

**Profis Anchor 2.8.8**

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/13/2020 |
| E-Mail: | | | |

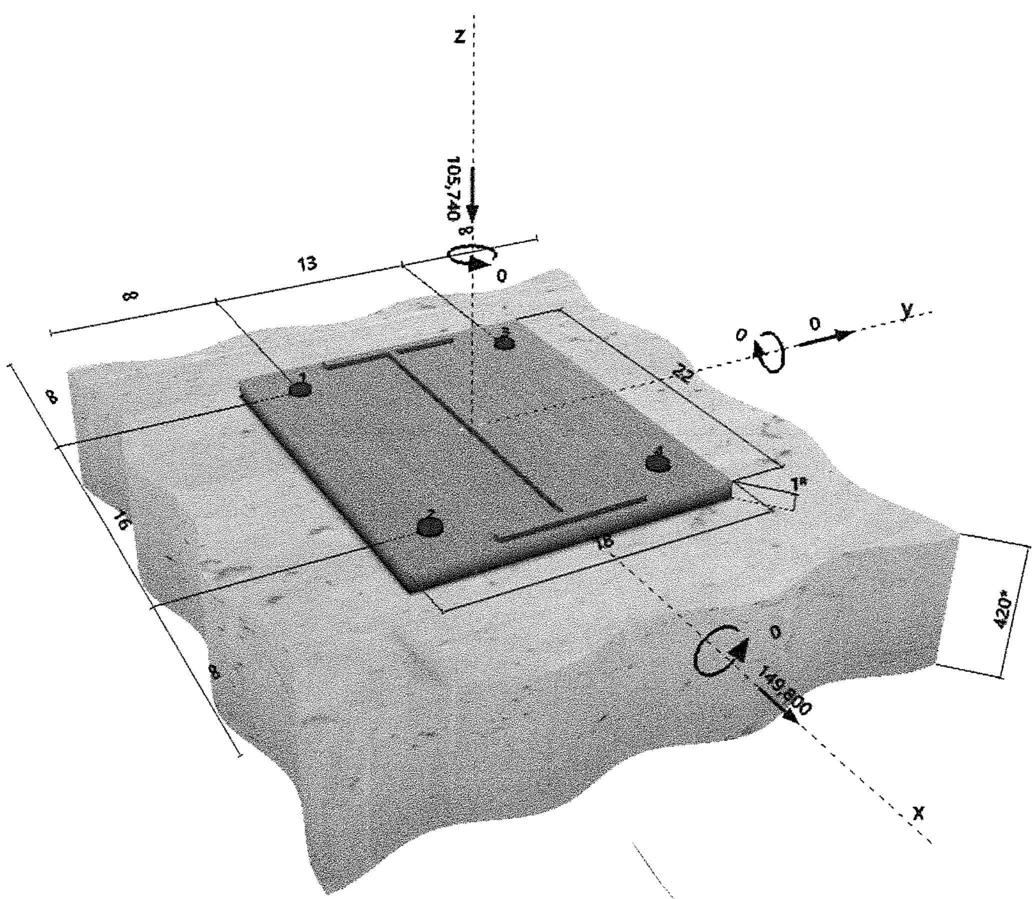
**Specifier's comments:**

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1 1/4** |
| Effective embedment depth: | $h_{ef,act}$ = 25.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 22.000 in. x 18.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W21X62; (L x W x T x FT) = 21.000 in. x 8.240 in. x 0.400 in. x 0.615 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 2 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/13/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| Loading | Proof | Load | Capacity | $\beta_N$ / $\beta_V$ [%] | Status |
| Tension | - | - | - | - / - | - |
| Shear | Steel Strength | 37,450 | 47,242 | - / 80 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

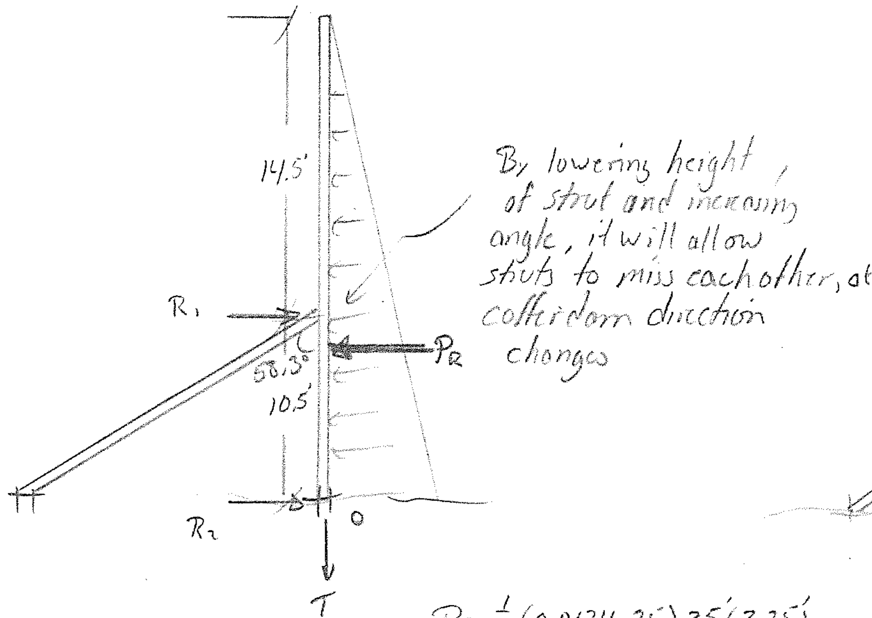
## 4 Remarks; Your Cooperation Duties

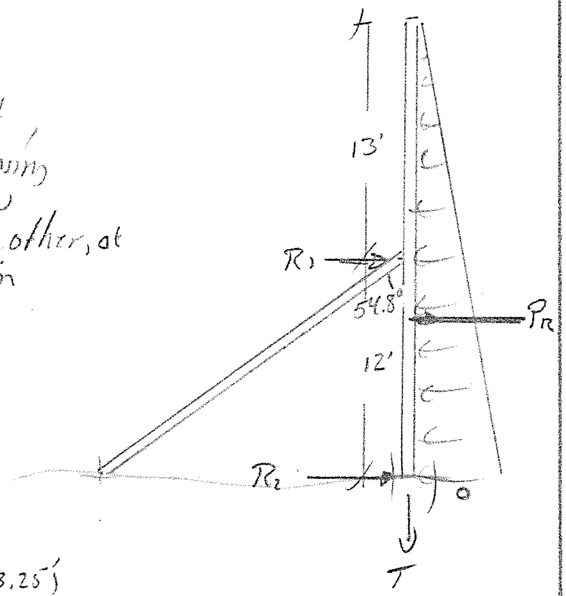
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

## B - End Frames

### I - Check Beam / Strut Loads for Strut Angle = 58.3°

Trib Area for end frames = $\frac{6.5' \text{ o.c.}}{2} = 3.25'$




$P = \frac{1}{2}(0.0624 \cdot 25')\,25'(3.25') = 63.4^k$

For 58.3 strut angle

$\Sigma M_O = 0$

$63.4^k(\frac{1}{3}(25)) = R_1\, 10.5'$

$R_1 = 50.3^k$

$R_2 = 63.4^k - 50.3^k = 13.1^{kips}$

$M_{max}$ @ $V = 0$

$V = 0$ at $\frac{1}{2}(0.0624 \cdot d)\,d \cdot 3.25' - 50.3^k = 0$

$d = 22.27$

$M_{max} = 50.3^k(10.5 - (25 - 22.27)) - 50.3(\frac{1}{3}(22.27))$

$= 17.4$ ft·kip, $M_{max}$ @ $R_1$ $((\frac{1}{2}(0.0624 \cdot 14.5)14.5)3.25)\frac{14.5}{3}$

$= 103^{ft \cdot kip}$

For 54.8° strut angle

For Half tributary area, Reactions will be half as those calculated for intermediate struts

$\therefore R_1 = \frac{88.1}{2} = 44.1^{kips}$

$R_2 = \frac{38.7}{2} = 19.4^{kips}$

$T = \frac{62.2^k}{2} = 31.1^{kips}$

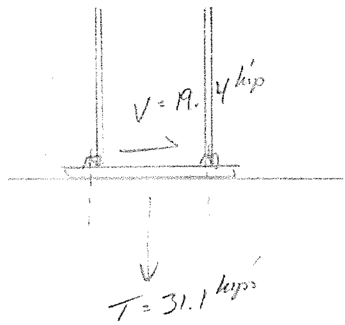
$M_{max} = \frac{78.9}{2} = 39.5^{ft \cdot kip}$

* using same member sizes as those for intermediate frames, Allowable Loads are greater than applied Loads for change of angle to 58.3°

Design End Frame Anchors per these loads:
- Max $T = 31.1^{kips}$, (at both strut angles)
- Max $R_2 = 19.4^{kips}$ (at 54.8° strut angle)
- Max $R_1 = 50.3^{kips}$ (at 58.3° strut angle)

II - Design Connections that will support end frame reactions + strut angle equal to: 54.8° and 58.3°

⇒ 1. Vertical beam




Factored Loads = V: 19.4 × 1.7 = 33.0 kips
T: 31.1 × 1.7 = 52.9 kips

use: 4 ea. 1"Ø HAS-E B7 rods, embed 20" and secure with Hilti Hit RE 500 V3

see: Hilti Design Report "C"

⇒ 2. Strut


Factored Load = V: 50.3k × 1.7 = 85.5 kips

25" 5/1/20 GAF

use: 2 ea. 1¼"Ø HAS-E B7 rod, embed ~~20"~~ and secure with Hilti Hit RE500 V3

see: Hilti Design Report "D"

| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporations | Page: | 1 |
| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

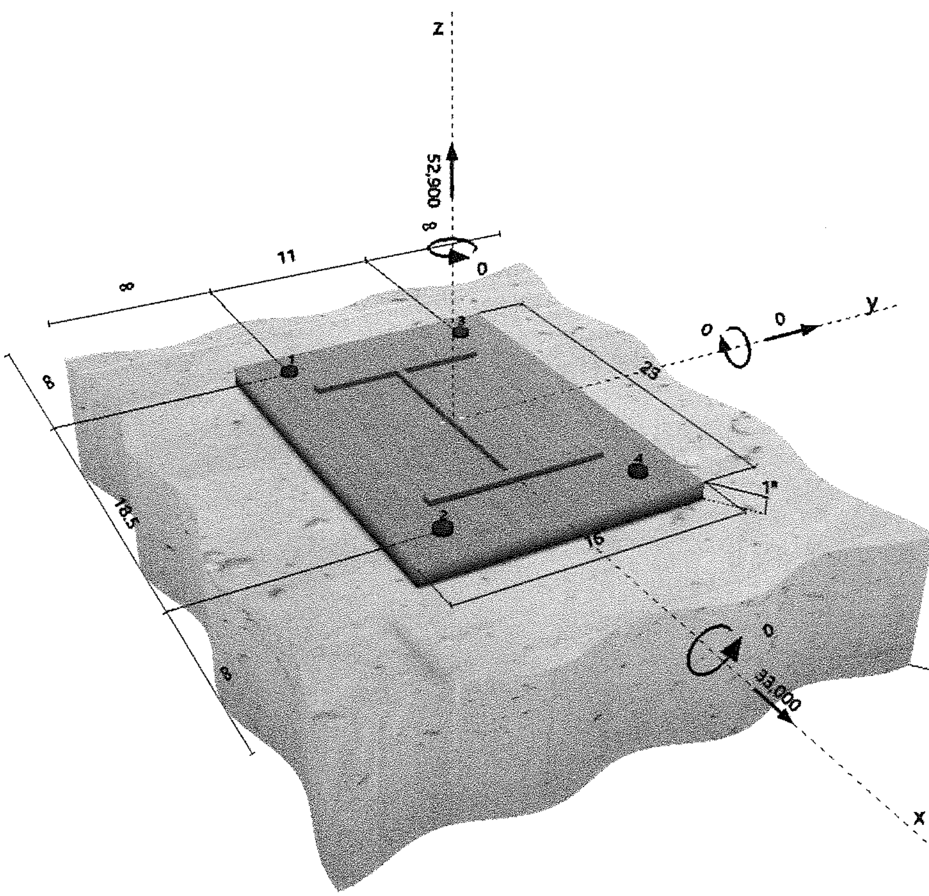
**Specifier's comments:** End Frame Anchors

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1** |
| Effective embedment depth: | $h_{ef,act}$ = 20.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 23.000 in. x 16.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W14X68; (L x W x T x FT) = 14.000 in. x 10.000 in. x 0.415 in. x 0.720 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 65/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporations | Page: | 2 |
| Specifier: | | Project: | Downstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Vertical Beam Anchors |
| Phone I Fax: | \| | Date: | 4/22/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| Loading | Proof | Load | Capacity | $\beta_N$ / $\beta_V$ [%] | Status |
| Tension | Bond Strength | 52,900 | 66,623 | 80 / - | OK |
| Shear | Steel Strength | 8,250 | 29,526 | - / 28 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | 0.794 | 0.279 | 5/3 | 81 | OK |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

## Fastening meets the design criteria!

## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

Report 'D'

14/19



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 1 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/14/2020 |
| E-Mail: | | | |

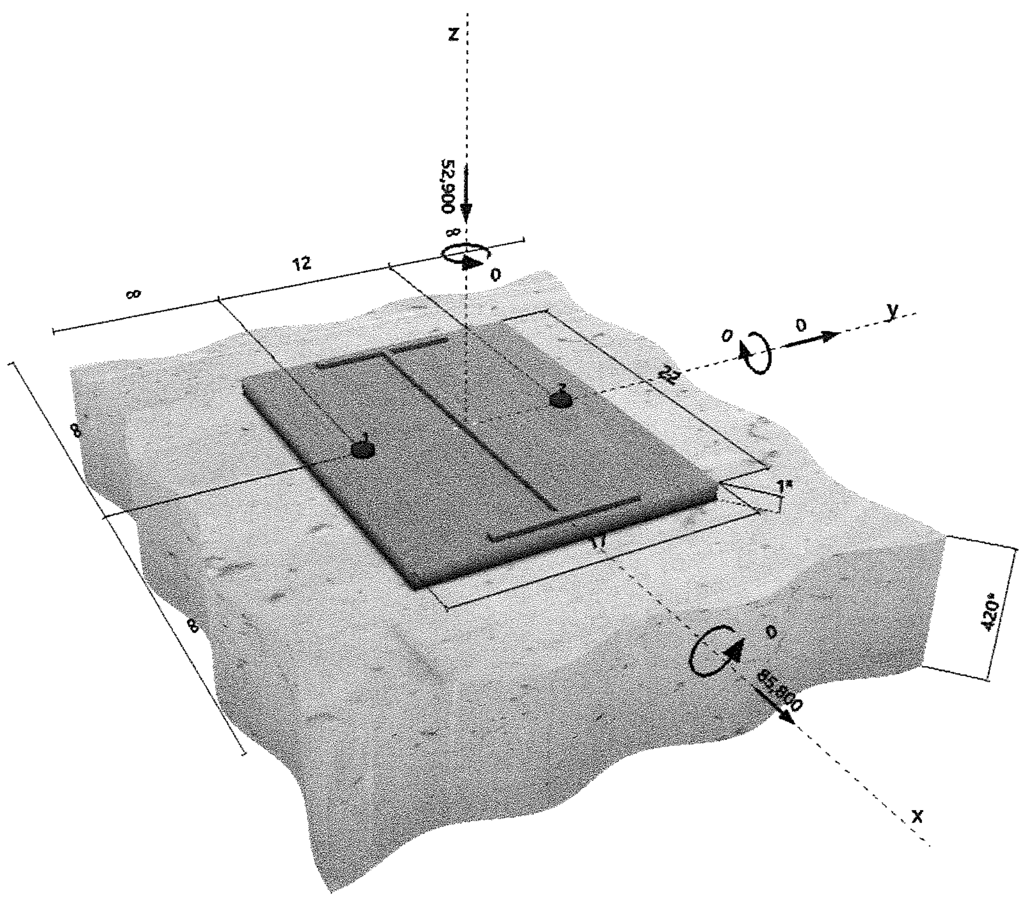
**Specifier's comments:** End Frames

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **HIT-RE 500 V3 + HAS-E B7 1 1/4** |
| Effective embedment depth: | $h_{ef,act}$ = 25.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | ASTM A 193 Grade B7 |
| Evaluation Service Report: | ESR-3814 |
| Issued I Valid: | 1/1/2019 \| 1/1/2021 |
| Proof: | Design method ACI 318-08 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 1.000 in. |
| Anchor plate: | $l_x$ x $l_y$ x t = 22.000 in. x 17.000 in. x 1.000 in.; (Recommended plate thickness: not calculated |
| Profile: | W shape (AISC), W21X62; (L x W x T x FT) = 21.000 in. x 8.240 in. x 0.400 in. x 0.615 in. |
| Base material: | cracked concrete, 2500, $f_c'$ = 2,500 psi; h = 420.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Submerged** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present<br>edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | no |

R - The anchor calculation is based on a rigid anchor plate assumption.

**Geometry [in.] & Loading [lb, in.lb]**



| | | | |
|---|---|---|---|
| Company: | Bancroft Contracting Corporation | Page: | 2 |
| Specifier: | | Project: | Dowstream Cofferdam |
| Address: | | Sub-Project I Pos. No.: | Strut Anchors |
| Phone I Fax: | \| | Date: | 4/14/2020 |
| E-Mail: | | | |

## 2 Proof I Utilization (Governing Cases)

| | | Design values [lb] | | Utilization | |
|---|---|---|---|---|---|
| Loading | Proof | Load | Capacity | $\beta_N$ / $\beta_V$ [%] | Status |
| Tension | - | - | - | - / - | - |
| Shear | Steel Strength | 42,900 | 47,242 | - / 91 | OK |

| Loading | $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|---|
| Combined tension and shear loads | - | - | - | - | - |

## 3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

**Fastening meets the design criteria!**

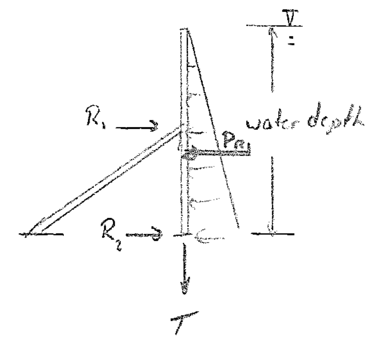
## 4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

**Intermediate Frames - Strut Angle is 12/17 , frame spacing is 6.5' o.c.**

| water depth (ft) | Pr (kips) | R1 (kips) | R2 (kips) | T (kips) | depth where V=0 (ft) | Mmax (Between R1 and R2) (ft*kips) | Mmax (at R1) (ft*kips) |
|---|---|---|---|---|---|---|---|
| 25 | 126.75 | 88.02 | 38.73 | 62.13 | 20.83 | 78.24 | 148.52 |
| 24 | 116.81 | 77.88 | 38.94 | 54.97 | 19.60 | 82.85 | |
| 23 | 107.28 | 68.54 | 38.74 | 48.38 | 18.38 | 86.09 | |
| 22 | 98.16 | 59.98 | 38.17 | 42.34 | 17.20 | 87.90 | |
| 21 | 89.43 | 52.17 | 37.26 | 36.83 | 16.04 | 88.31 | |
| 20 | 81.12 | 45.07 | 36.05 | 31.81 | 14.91 | 87.34 | |
| 19 | 73.21 | 38.64 | 34.57 | 27.27 | 13.80 | 85.09 | |
| 18 | 65.71 | 32.85 | 32.85 | 23.19 | 12.73 | 81.65 | |
| 17 | 58.61 | 27.68 | 30.93 | 19.54 | 11.68 | 77.16 | |
| 16 | 51.92 | 23.07 | 28.84 | 16.29 | 10.67 | 71.79 | |
| 15 | 45.63 | 19.01 | 26.62 | 13.42 | 9.68 | 65.69 | |
| 14 | 39.75 | 15.46 | 24.29 | 10.91 | 8.73 | 59.05 | |
| 13 | 34.27 | 12.38 | 21.90 | 8.74 | 7.81 | 52.08 | |
| 12 | 29.20 | 9.73 | 19.47 | 6.87 | 6.93 | 44.96 | |

Note: Distance between R1 and R2 is always 12' and strut angle is always 12/17




Mmax = 148.52 ft*kips at Reaction R1
Max Strut compression occurs at water depth = 25'
Max Strut Anchor Load occur at water depth = 25'
Max Vertical Beam Anchor loads occur at water depth = 25' w/ T=62.13kips

**End Frames - Strut Angle is 12/17 , tributary width is 6.5'/2**

| water depth (ft) | Pr (kips) | R1 (kips) | R2 (kips) | T (kips) | depth where V=0 (ft) | Mmax (Between R1 and R2) (ft*kips) | Mmax (at R1) (ft*kips) |
|---|---|---|---|---|---|---|---|
| 25 | 63.38 | 44.01 | 19.36 | 31.07 | 20.83 | 39.12 | 74.26 |
| 24 | 58.41 | 38.94 | 19.47 | 27.49 | 19.60 | 41.43 | |
| 23 | 53.64 | 34.27 | 19.37 | 24.19 | 18.38 | 43.04 | |
| 22 | 49.08 | 29.99 | 19.09 | 21.17 | 17.20 | 43.95 | |
| 21 | 44.72 | 26.09 | 18.63 | 18.41 | 16.04 | 44.15 | |
| 20 | 40.56 | 22.53 | 18.03 | 15.91 | 14.91 | 43.67 | |
| 19 | 36.61 | 19.32 | 17.29 | 13.64 | 13.80 | 42.54 | |
| 18 | 32.85 | 16.43 | 16.43 | 11.60 | 12.73 | 40.83 | |
| 17 | 29.30 | 13.84 | 15.47 | 9.77 | 11.68 | 38.58 | |
| 16 | 25.96 | 11.54 | 14.42 | 8.14 | 10.67 | 35.89 | |
| 15 | 22.82 | 9.51 | 13.31 | 6.71 | 9.68 | 32.84 | |
| 14 | 19.87 | 7.73 | 12.15 | 5.46 | 8.73 | 29.53 | |
| 13 | 17.14 | 6.19 | 10.95 | 4.37 | 7.81 | 26.04 | |
| 12 | 14.60 | 4.87 | 9.73 | 3.44 | 6.93 | 22.48 | |

Note: Distance between R1 and R2 is always 12' and strut angle is always 12/17

For End frames, we will be using the same vertical beam and strut sizes as those for intermediate frames. Given lesser loads, members are OK
Connections will be redesigned w/ the following loads:
Vertical beam, V=19.4kips and T=31.1kips
Strut, V = 44.0kips

(tributary width) GAF 5/1/20

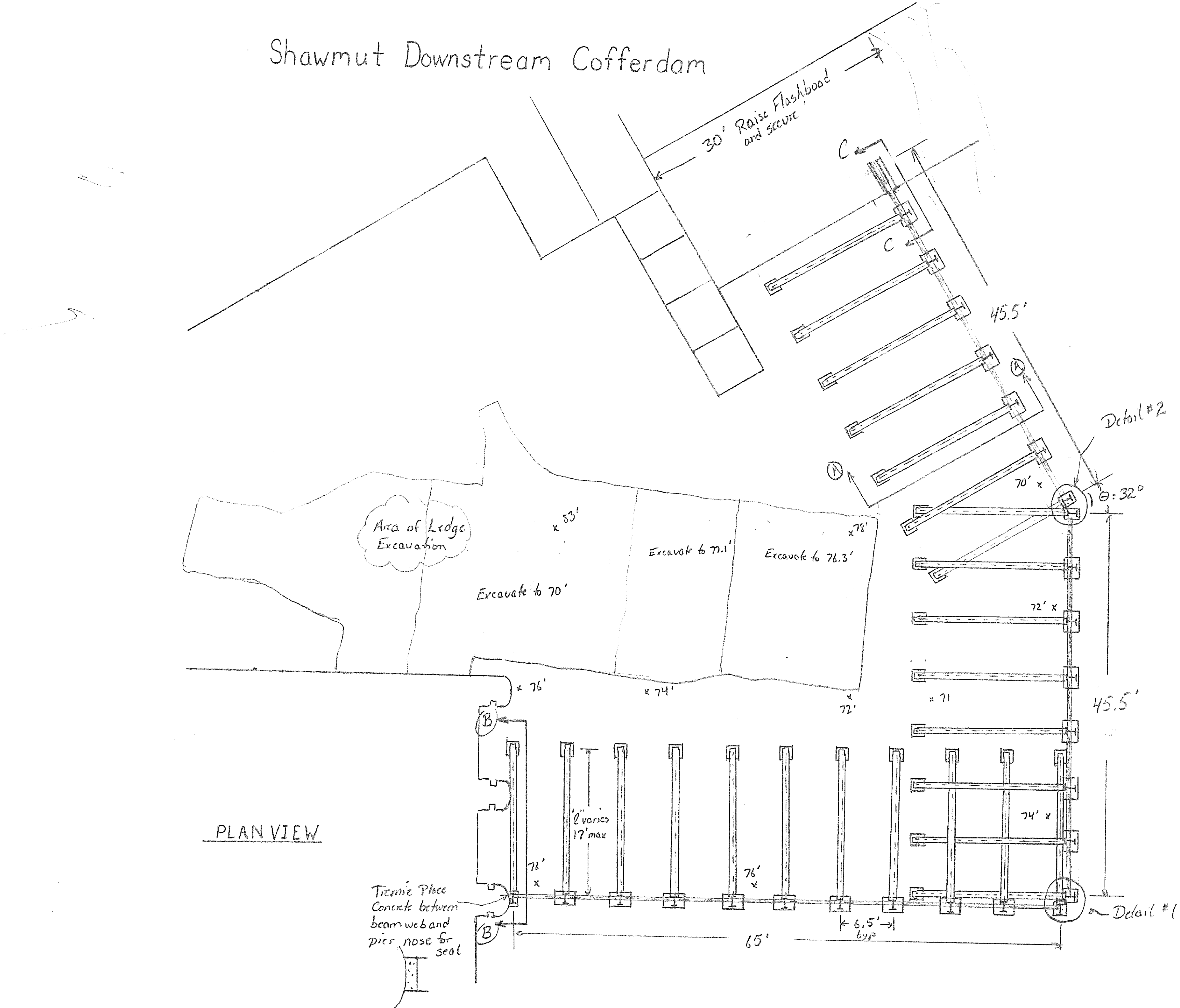
**End Frames - Strut Angle is 10.5/17 , ~~frame spacing~~ is 6.5'/2**

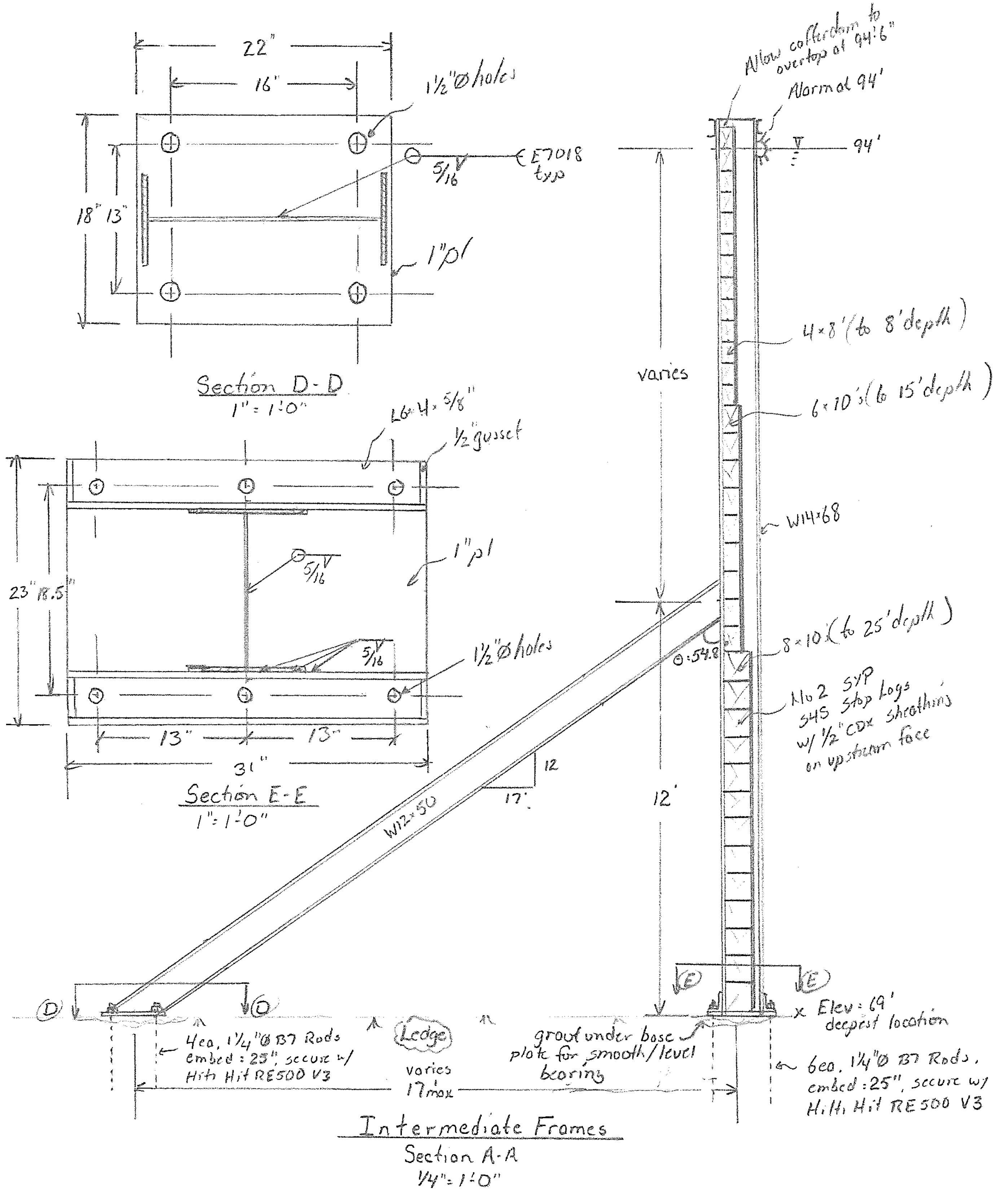
| water depth (ft) | Pr (kips) | R1 (kips) | R2 (kips) | T (kips) | depth where V=0 (ft) | Mmax (Between R1 and R2) (ft*kips) | Mmax (at R1) (ft*kips) |
|---|---|---|---|---|---|---|---|
| 25 | 63.38 | 50.30 | 13.08 | 31.07 | 22.27 | 17.50 | 103.04 |
| 24 | 58.41 | 44.50 | 13.91 | 27.49 | 20.95 | 20.73 | |
| 23 | 53.64 | 39.17 | 14.47 | 24.19 | 19.65 | 23.59 | |
| 22 | 49.08 | 34.28 | 14.80 | 21.17 | 18.39 | 25.95 | |
| 21 | 44.72 | 29.81 | 14.91 | 18.41 | 17.15 | 27.75 | |
| 20 | 40.56 | 25.75 | 14.81 | 15.91 | 15.94 | 28.95 | |
| 19 | 36.61 | 22.08 | 14.53 | 13.64 | 14.76 | 29.53 | |
| 18 | 32.85 | 18.77 | 14.08 | 11.60 | 13.61 | 29.50 | |
| 17 | 29.30 | 15.82 | 13.49 | 9.77 | 12.49 | 28.88 | |
| 16 | 25.96 | 13.19 | 12.77 | 8.14 | 11.40 | 27.72 | |
| 15 | 22.82 | 10.86 | 11.95 | 6.71 | 10.35 | 26.08 | |
| 14 | 19.87 | 8.83 | 11.04 | 5.46 | 9.33 | 24.05 | |
| 13 | 17.14 | 7.07 | 10.06 | 4.37 | 8.35 | 21.69 | |
| 12 | 14.60 | 5.56 | 9.04 | 3.44 | 7.41 | 19.12 | |

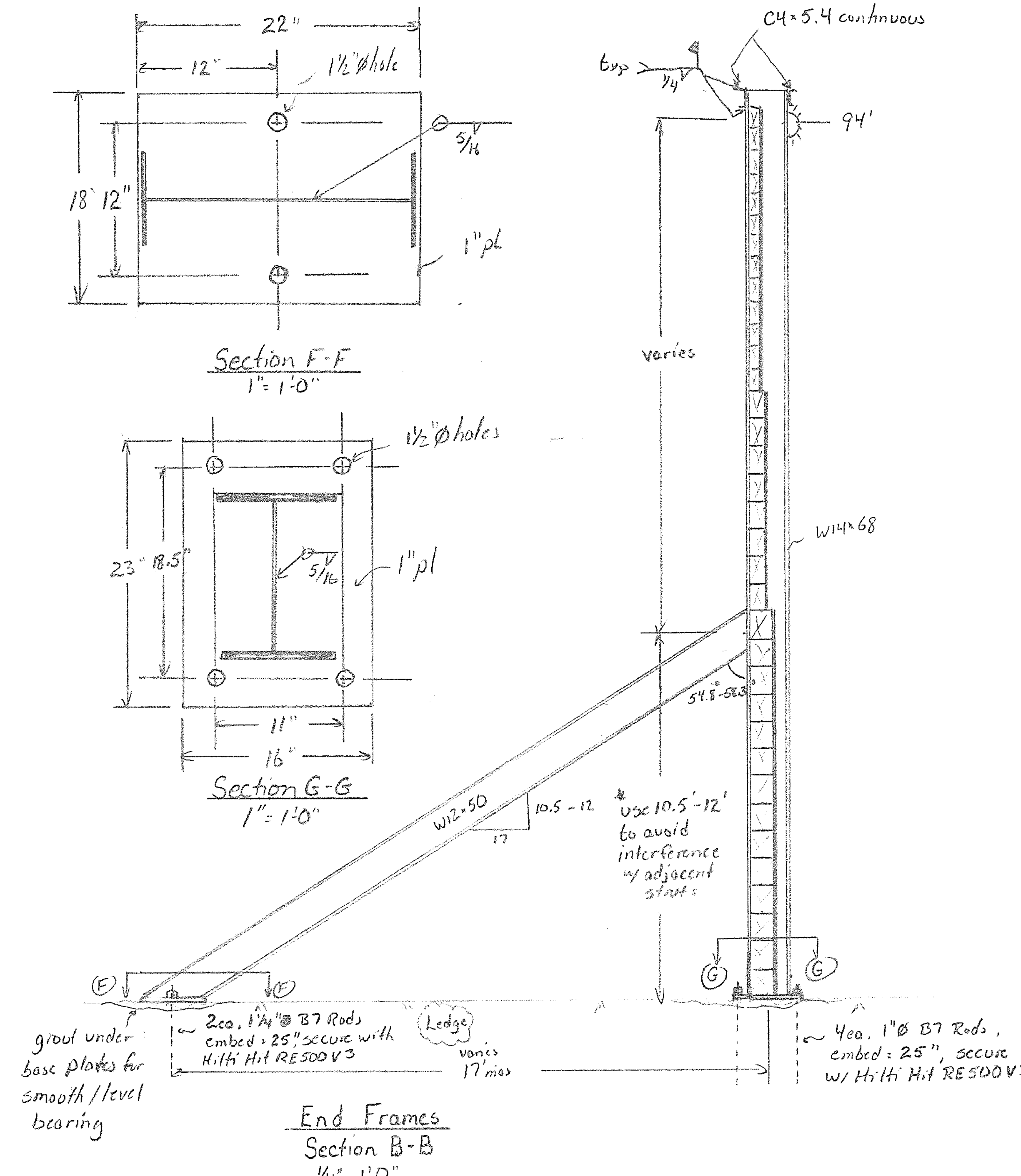
Note: Distance between R1 and R2 is always ~~12' and strut angle is always 12/17~~ (10' and strut angle is always 10.5/17) GAF 5/1/20

For End frames, we will be using the same vertical beam and strut sizes as those for intermediate frames. Given lesser loads, members are OK
Connections will be redesigned w/ the following loads:
Vertical beam, V=19.4kips and T=31.1kips
Strut, V = 44.0kips

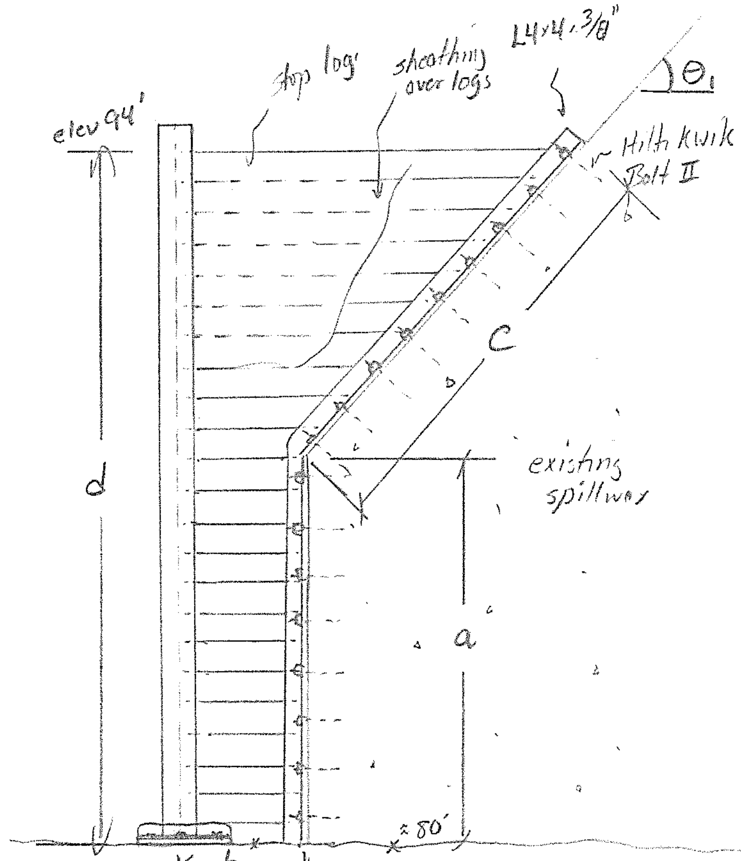
# Shawmut Downstream Cofferdam



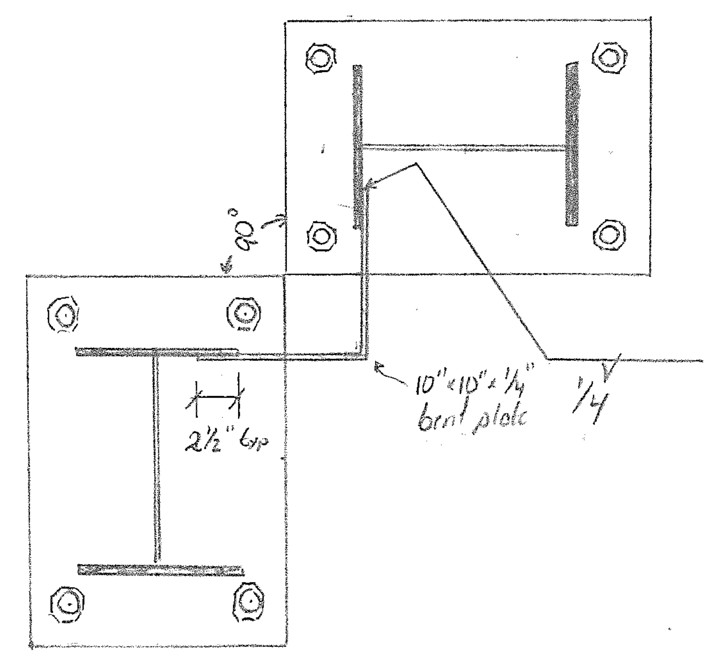

22"
16"
1½"Ø holes
18"
13"
5/16
E7018 typ
1"pl
Section D-D
1" = 1'-0"
L6×4×5/8"
½"gusset
1"pl
23"
18.5"
5/16
1½"Ø holes
13"
13"
31"
Section E-E
1" = 1'-0"
Allow cofferdam to overtop at 94'-6"
Normal 94'
94'
varies
4×8's (to 8' depth)
6×10's (to 15' depth)
W14×68
8×10's (to 25' depth)
θ=54.8°
No 2 SYP S4S Stop logs w/ ½" CDX sheathing on upstream face
12
17
W12×50
12'
E
E
D
D
Elev=69' deepest location
4ea. 1¼"Ø B7 Rods embed = 25", secure w/ Hilti Hit RE500 V3
Ledge
varies 17' max
grout under base plate for smooth/level bearing
6ea. 1¼"Ø B7 Rods, embed = 25", secure w/ Hilti Hit RE500 V3
Intermediate Frames
Section A-A
¼" = 1'-0"


22"
12"
1½"Ø hole
18"
12"
5/16
1"pL
Section F-F
1" = 1'-0"
1½"Ø holes
23"
18.5"
5/16
1"pl
11"
16"
Section G-G
1" = 1'-0"
C4×5.4 continuous
typ
¼
94'
varies
W14×68
54.8°-56.3°
10.5 - 12
17
W12×50
use 10.5'-12' to avoid interference w/ adjacent struts
G
G
F
F
grout under base plates for smooth/level bearing
2ea. 1¼"Ø B7 Rods embed = 25", secure with Hilti Hit RE500 V3
Ledge
varies 17' max
4ea. 1"Ø B7 Rods, embed = 25", secure w/ Hilti Hit RE500 V3
End Frames
Section B-B
¼" = 1'-0"

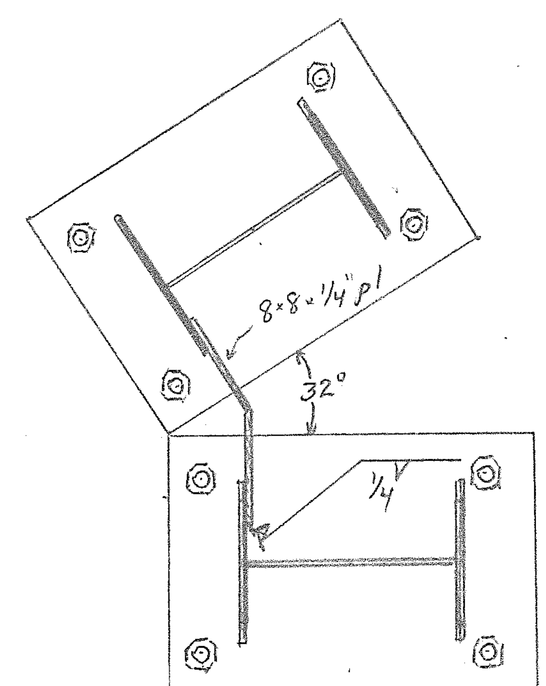
* Closure Design to be finalized upon reciept of as-found conditions including dimensions, a, b, c, d, and $\Theta_1$




Section C-C
1/4" = 1'-0"




Detail # 1
1" = 1'-0"




Detail # 2
1" = 1'-0"


**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 CONSTRUCTION**
**APRIL 10, 2020**

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

| REVISION | DESCRIPTION OF ISSUE / REVISION | REVISED BY |
|---|---|---|
| 1 | FINAL FOR CONSTRUCTION | M. GRAESER |
| 12/13/2019 | FINAL FOR BID - NOT FOR CONSTRUCTION | M. GRAESER |

STATE OF MAINE — MARK DANIEL GRAESER No. 39328 — LICENSED PROFESSIONAL ENGINEER — 4/10/2020

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 179 |
| DRAWING: | G-006 |

DWG: S:\200 Projects\131009\Holden\SHAWMUT\(Current)\900 CAD\02-SHEETS\G\G-006.dwg USER: jjenkins
DATE: Apr 15, 2020 8:57am XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

# Appendix B

**P-2322 Shawmut Hydroelectric**
**Soil Erosion and Sediment Control Plan**

## Project Description

Shawmut, LLC (BWPH), Licensee of the Shawmut Hydroelectric Project (Project) submits the following Soil Erosion and Sediment Control Plan for the construction of permanent upstream fish passage facility at the Project that will include a fish lift with integrated attraction water intake and 81-foot-long by 21-foot-high entrance flume and 93-foot-long spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse. The attraction water intake and spillway is designed to divert 340 cfs from the impoundment with 115 to 225 cfs diverted to the fish lift entrance flume and 115 to 225 cfs provided as spill adjacent to the fish lift entrance. An approximately 77-foot-long by 10.5-foot-wide fish ladder will be placed at the upstream end of the island between the two project powerhouses to provide fish egress from the Unit 7 and 8 tailrace to the Unit 1 through 6 tailrace. The discharge from the Tainter gate located between the two powerhouses will be rerouted to the Unit 7 and 8 tailrace. The fish ladder structure will be comprised of a concrete fishway channel with two baffles, entrance flap gate, and isolation gates.

## Plan Details

As indicated on the attached plan, the perimeter of any area of permanent or temporary construction activity will be protected by the measures shown or equivalent protection as chosen by the contractor. In addition, the perimeter of the site that abuts the river will be staked with hay bales to prevent sediment migration.

Four cofferdams will be utilized in the construction of the upstream fish passage at Shawmut.

A cofferdam for the attraction water intake (Cofferdam 1) will be a sheet pile bulkhead 31 ft wide extending 5 ft upstream into the impoundment with a top elevation of 115 ft located on the upstream face of the non-overflow dam section. The cofferdam will impact 155 sqft.

The cofferdam utilized to dewater the fish lift area between the Unit 1-6 powerhouse and spillway (Cofferdam 2) is a braced cofferdam consisting of steel supports and stop logs. The cofferdam will run 45 ft from the spillway turning parallel to the powerhouse for 45 ft and turning perpendicular to the powerhouse 65 ft with a top elevation of 94 ft. The cofferdam will impact 2921 sqft of area.

The cofferdam from the Unit 1-6 powerhouse to the isolation wall dike (Cofferdam 3) at the Unit 7&8 tailrace is a braced cofferdam consisting of steel supports and stop logs for depths greater than 4 ft and sand bags for depth under 4 ft. The braced coffer dam and sand bags will run from the southwest end of the Unit 1-6 powerhouse to the dike with a top elevation of 92 ft. The cofferdam will impact 6950 sqft of area.

The Unit 7 & 8 powerhouse tailrace Aquadam (Cofferdam 4) will be located about halfway down the dike from the Unit 7 & 8 powerhouse across the tailrace with a top elevation of 96 ft. Upstream of the Aquadam a temporary access road will be placed from the southwest shoreline to the dike with a top elevation of 92 ft. and will require about 2600 cubic yards of material. The cofferdam will impact 25,129 sqft of area.

An earthen filled sheet pile cell for barge loading and offloading will be located upstream of the project on the western shore. The sheet pile cell will be 30 ft. wide by 40 ft. long and earthen filled. The cell will contain 2,200 CY and impact 1,200 sqft of area.

It will be the contractor's responsibility to design the coffer dam and soil erosion and sediment control to meet their access and construction sequencing needs, to meet OSHA safety standards, State of Maine and International Building codes, and any other applicable regulations.

Erosion control will be installed around all disturbed land and staging areas. Suspended turbidity curtains will surround all cofferdams. Water from dewatering pumps will pass through filter bags or a settling basin before being reintroduced to the river.

## 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


**SITE PLAN**
SCALE: 1"=30'

**FINAL**
**FOR CONSTRUCTION**
**APRIL 10, 2020**

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

| REVISION | DESCRIPTION OF ISSUE / REVISION | REVISED BY |
|---|---|---|
| 1 | FINAL FOR CONSTRUCTION | M. GRAESER |
| 12/13/2019 | FINAL FOR BID - NOT FOR CONSTRUCTION | M. GRAESER |

STATE OF MAINE — MARK DANIEL GRAESER — No. 39328 — LICENSED PROFESSIONAL ENGINEER — 4/10/2020

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 179 |
| DRAWING: | G-006 |

DWG: S:\200 Projects\131009\Holden\SHAWMUT(Current)\900 CAD\02-SHEETS\G\G-006.dwg USER: jjenkins
DATE: Apr 15, 2020 8:57am XREFS: G-SHWMT-BD G-SHWMT-SUBMIT C-SHWMT-XSP C-SHWMT-PFW S1-SHWMT-FL-PL S1-SHWMT-SW-PL S3-SHWMT-PFP S1-SHWMT-FLUME MAINE-PE-STAMP-MDG IMAGES:

U.S. Army Corps of Engineers (USACE)

# APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

***Form Approved - OMB No. 0710-0003 Expires: 01-08-2018***



## PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned. System of Record Notice (SORN). The information received is entered into our permit tracking database and a SORN has been completed (SORN #A1145b) and may be accessed at the following website: http://dpcld.defense.gov/Privacy/SORNsIndex/DOD-wide-SORN-Article-View/Article/570115/a1145b-ce.aspx

**(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)**

| 1. APPLICATION NO. | 2. FIELD OFFICE CODE | 3. DATE RECEIVED | 4. DATE APPLICATION COMPLETE |
|---|---|---|---|
| | | | |

***(ITEMS BELOW TO BE FILLED BY APPLICANT)***

| 5. APPLICANT'S NAME | 8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required) |
|---|---|
| First - Kelly Middle - Last - Maloney | First - Greg Middle - Last - Allen |
| Company - Brookfield White Pine Hydro, LLC | Company - Alden |
| E-mail Address - kelly.maloney@brookfieldrenewable.com | E-mail Address - gallen@aldenlab.com |
| **6. APPLICANT'S ADDRESS:** | **9. AGENT'S ADDRESS:** |
| Address- 150 Main Street | Address- 30 Shrewsbury St |
| City - Lewiston State - Maine Zip - 04240 Country - | City - Holden State - MA Zip - 01520 Country - USA |
| **7. APPLICANT'S PHONE NOs. w/AREA CODE** | **10. AGENTS PHONE NOs. w/AREA CODE** |
| a. Residence b. Business 207-233-1995 c. Fax | a. Residence b. Business 508-829-6000 c. Fax 508-829-5939 |

**STATEMENT OF AUTHORIZATION**

11. I hereby authorize, Greg Allen to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

Kelly Maloney 5-20-2020

SIGNATURE OF APPLICANT DATE

**NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY**

12. PROJECT NAME OR TITLE (see instructions)
Shawmut Upstream Fish Passage Facility

| 13. NAME OF WATERBODY, IF KNOWN (if applicable) | 14. PROJECT STREET ADDRESS (if applicable) |
|---|---|
| Kennebec River | Address 68 Kennebec Street |
| 15. LOCATION OF PROJECT | |
| Latitude: ◦N 44°37'49.4"N Longitude: ◦W 69°35'01.3"W | City - Fairfield State- Maine Zip- 04937 |

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID 28/028-018 Municipality Fairfield

Section - Township - Range -

17. DIRECTIONS TO THE SITE

Take Exit 133 off US Interstate 95 for State Route 201. Take State Route 201 North for approximately 2 miles and take a right onto Kennebec Street. Continue on Kennebec Street for approximately 1,200 feet and the road dead ends at the project, 68 Kennebec Street.

18. Nature of Activity (Description of project, include all features)

The goal of this project is to provide effective, agency approved upstream passage (i.e., efficient and with minimal delay) for diadromous fish species, including those identified in the Interim Species Protection Plan (ISPP) for the Project. Fish passage facilities will be installed at Shawmut and will include a fish lift with integrated attraction water intake and spillway placed downstream of the non-overflow portion of the dam and adjacent to the Units 1 through 6 powerhouse, a short fish ladder connecting the Units 7 and 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 and 8 powerhouse.

All modifications will take place in the waterway. The fish lift, fish ladder, AWS and barge loading sheet pile cell will require modifications to the existing structures and placing of additional materials and structures in the waterway. See attached Project Description for detail description of the modifications.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

The Shawmut Project does not presently have a dedicated upstream fish passage facility. Upstream passage of Atlantic salmon in the lower Kennebec River is currently accomplished by trapping fish at the Lockwood Project (FERC No. 2574), located approximately 6.8 miles downstream of the Project. Salmon are transported via truck, above the Shawmut Project, to spawning and rearing habitat located in the Sandy River which enters the Kennebec. The FERC license for the Shawmut Project expires on January 31, 2022. To proactively address protection and enhancement of the Atlantic salmon ahead of any pending action before the Commission (such as Project relicensing), 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 provide permanent upstream fish passage at the Shawmut Hydroelectric Project for migrating Atlantic salmon and other anadromous species. The primary species of interest for upstream passage, under the ISPP, is the federally-listed Atlantic salmon. Additional species of interest include American shad and river herring (alewife and blueback herring).

**USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED**

20. Reason(s) for Discharge

The fish lift, fish ladder, and Tainter gate modifications will require modifications to the existing structures and placing of additional materials and structures in the waterway. This will require the placement of an estimated 1,884 cubic yards (CY) of concrete and 3,024 CY of structural fill. The combined footprint of the additional structures will be approximately 6590 square feet (ft2) (0.15 acre).

Placement of concrete below the Ordinary High Water Line (OWH) in the tailrace is necessitated to provide a stable entrance for the proposed fishway as well as to provide connectivity and egress between the Unit 7 and 8 and Units 1 through 6 powerhouses.

Placement of concrete below the OWH in the headpond is necessitated to provide footing for the exit flume.

Placement of 2600 CY of fill below the OHW in the tailrace is necessitated to provide access to this area for the purposes of construction of the fishways. This fill is a temporary impact and will be removed upon completion.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

| Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards | Type<br>Amount in Cubic Yards |
|---|---|---|
| Concrete 1,550 CY | Structural fill, 2,200 CY | Temporary fill, 3,510 CY |

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres 0.1 acres (Permanent), 0.3 acres ( Temporary)

or

Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

A contractor designed dewatering structure will be installed around the tailrace fishway entrance work area and in the Unit 7 and 8 and Units 1 through 6 powerhouses and another contractor designed dewatering structure will be installed around the headpond attraction water intake screen work area. Outside of all dewatering structures, turbidity curtains will be installed to prevent the potential transport of sediment into the river.

Overall, the proposed fishway constitutes mitigation for fish passage/habitat enhancement within the Kennebec River.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address- Please see Attachment C, submitted with permit application

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

| AGENCY | TYPE APPROVAL* | IDENTIFICATION NUMBER | DATE APPLIED | DATE APPROVED | DATE DENIED |
|---|---|---|---|---|---|
| MDEP | MWDCA | L-19751-33-A-M | August 1, 1997 | July 31, 1998 | |
| | | | | | |
| | | | | | |
| | | | | | |

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

| SIGNATURE OF APPLICANT | DATE | SIGNATURE OF AGENT | DATE |
|---|---|---|---|
| Kelly Maloney | 5-20-2020 | Gregory Allen | 5-20-2020 |

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.