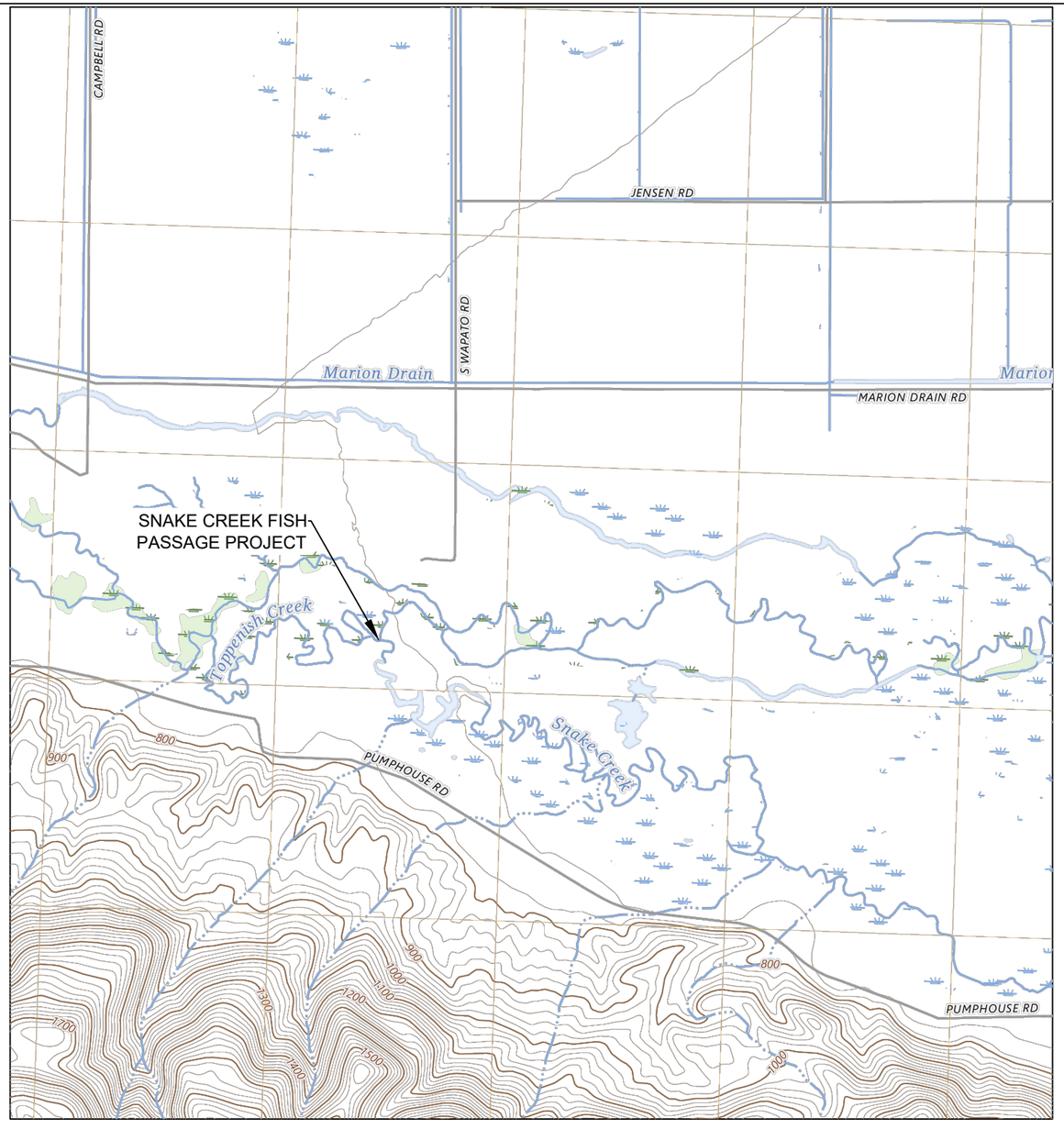

Location for Snake Creek Fish Passage Project about 7 miles southwest of Toppenish, Washington. In N½ Section 34, T10N, R19E. Latitude 46.315°, Longitude 120.422°. Toppenish, Washington.

Map scale: 1" = 2,000'.

Snake Creek Fish Passage Project

Yakama Nation
P.O. Box 151/401 Fort Road
Toppenish, WA 98948

Audrey Scott, Project Manager
509-790-8596 cell
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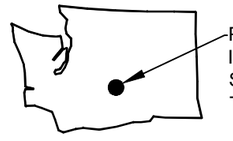
Drawing List



Summary of Fish Passage Project

The primary objective of this project is to divert downstream passage of native fish in Snake Creek from this dead-end route, and back into Toppenish Creek which is a tributary to the Yakima River. A secondary objective is to provide unrestricted upstream and downstream fish passage via an existing historic meander channel between Toppenish Creek and Snake Creek. A new stainless steel fish screen meeting NMFS, WDFW, and YN requirements will be placed in a reinforced concrete structure across Snake Creek. A stainless steel trashrack, upstream of the screen, will minimize aquatic vegetation possibly plugging the screen. Fish bypass from the screen will be into a pipe leading to a historic meander channel that drains back to Toppenish Creek. Other objectives of the project are: 1) Construct a roughened channel within an existing meander connecting Snake Creek with Toppenish Creek; and 2) Continue to deliver up to 15 cfs to the Toppenish National Wildlife Refuge downstream along Snake Creek.

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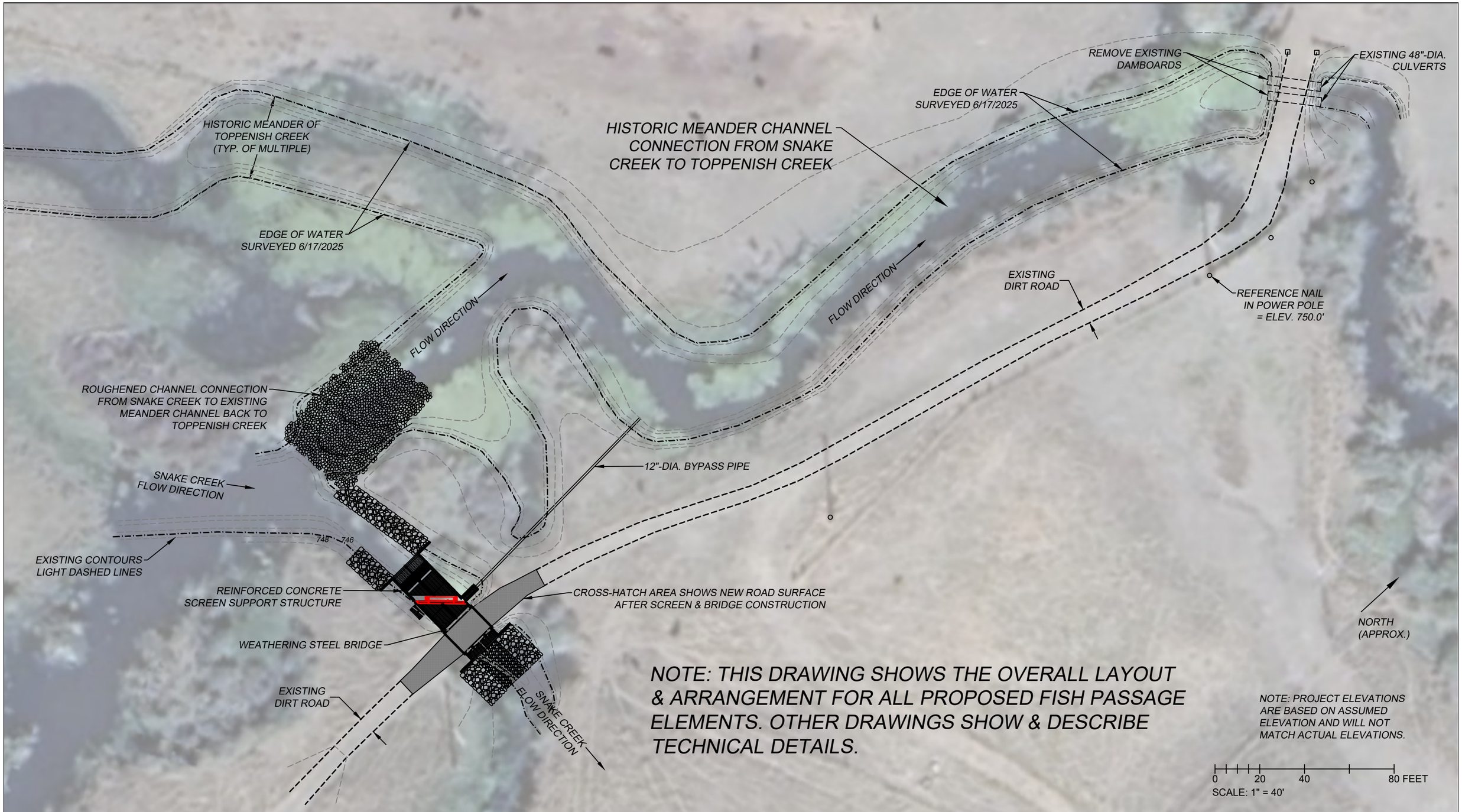
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

PROJECT LOCATION & DRAWING LIST

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C1**



NOTE: THIS DRAWING SHOWS THE OVERALL LAYOUT & ARRANGEMENT FOR ALL PROPOSED FISH PASSAGE ELEMENTS. OTHER DRAWINGS SHOW & DESCRIBE TECHNICAL DETAILS.

NOTE: PROJECT ELEVATIONS ARE BASED ON ASSUMED ELEVATION AND WILL NOT MATCH ACTUAL ELEVATIONS.

0 20 40 80 FEET
SCALE: 1" = 40'

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

OVERALL PROJECT SITE PLAN

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C2**

ROUGHENED CHANNEL TO CONNECT SNAKE CREEK WITH MEANDER CHANNEL TO TOPPENISH CREEK

SNAKE CREEK FLOW DIRECTION

TYPICAL RIPRAP BANK w/ 12" TO 24"-SIZE BROKEN ROCK. PLACE RIPRAP LAYER 24"-THICK x 10'-LONG APPROX. SLOPE AS DIRECTED ON-SITE BY THE ENGINEER

12"-DIA. x 105'-LONG PVC PIPE (CLASS 100 IPS) BURIED FISH BYPASS

RIPRAP BANK 45'-LONG FROM CONCRETE WINGWALL TO ROUGHENED CHANNEL

EXISTING CONTOURS LIGHT DASHED LINES

746

748

EDGE OF WATER SURVEYED 6/17/2025

RIPRAP BANK 20'-LONG

TRASHRACK

REINFORCED CONCRETE SCREEN SUPPORT STRUCTURE

EXTEND BYPASS OUTLET 7' FOR BYPASS TRANSITION TO BURIED 12"-DIA. PIPE

EXISTING ROAD

BYPASS

12"-DIA. PIPE INVERT ELEV. 744.0'

CROSS-HATCH AREA SHOWS NEW ROAD SURFACE AFTER SCREEN & BRIDGE CONSTRUCTION

30'

FISH SCREEN LOCATION

WEATHERING STEEL BRIDGE

12"-THICK QUARRY SPALL COVER OVER SNAKE CREEK TO 15' DOWNSTREAM OF WINGWALLS, FOR ENERGY DISSIPATION FROM SLIDE GATE FLOW RELEASES

748

746

TYP. RIPRAP BANK TO 20' DOWNSTREAM OF STRUCTURE BOTH SIDES SNAKE CREEK

SNAKE CREEK FLOW DIRECTION

STAFF GAGE TO BE INSTALLED IN SNAKE CREEK (SUPPLY BY YAKAMA NATION)

SLIDE GATES

PLACE 6"-THICK BROKEN ROCK (2" TO 4"-SIZE) SCREEN ACCESS AND PARKING AREA

NOTES:

AFTER PROJECT CONSTRUCTION, SPREAD 4 lb. EROSION CONTROL SEEDS OVER DISTURBED SOILS, THEN SPREAD 12 BALES STRAW MULCH.

NORTH (APPROX.)

NOTE: PROJECT ELEVATIONS ARE BASED ON ASSUMED ELEVATION AND WILL NOT MATCH ACTUAL ELEVATIONS.

0 5 10 20 FEET

SCALE: 1" = 10'

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

FISH SCREEN, BRIDGE & BYPASS SITE PLAN

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	C3

Fish Passage Project Basis Of Design

Project Introduction

For review of the proposed Snake Creek Fish Passage Project, it is important to note that the subject project is along a distributory channel of Toppenish Creek (named Snake Creek), within a long distributory network somewhat analogous to an alluvial fan but with very low channel gradient; there are multiple braided sinuous channels, cutoff meanders, etc. in this unusual fluvial system. Also, peak flow events submerge the entire broad "valley" to a depth of 1' to 2', which will completely submerge the proposed fish screen (except electrical controls), bridge and roughened channel.

The Snake Creek Fish Passage Project includes the following major elements, which are inherently interdisciplinary and combined into a moderately complex project proposal.

- **Fish Screen** – A stainless steel vertical plate fish screen meeting criteria from NMFS, WDFW, and Yakama Nation (YN) is required to divert all native fish from Snake Creek back into Toppenish Creek. YN has determined that further movement of fish downstream in Snake Creek results in loss of these fish to the native fish community.
- **Fish Bypass From Screen** – The proposed fish bypass is unconventional because it diverts fish from the original channel (Snake Creek) into a historic meander channel for return to Toppenish Creek. Fish bypass from the screen includes a vertical slot transitioning to a buried 12"-dia. PVC pipe leading directly to a 500'-long meander channel that returns to Toppenish Creek.
- **Roughened Channel For Meander From Snake Creek to Toppenish Creek** – An existing ineffective "check structure" will be replaced with a roughened channel (60'-long @ 4% gradient) to connect Snake Creek with Toppenish Creek; the roughened channel will also maintain existing water levels in Snake Creek (for irrigation and the wildlife refuge).
- **Maintain Flow To Toppenish National Wildlife Refuge** – Flow control and discharge elements are integrated into the fish screen structure to maintain adequate flow down the existing Snake Creek channel to the wildlife refuge.
- **Bridge For Land Access** – A weathering steel bridge is proposed to span across the reinforced concrete structure supporting the fish screen and flow control elements, for continued access to private land.

Fish Screen Functional Design

Snake Creek Fish Passage drawings, including these technical notes, comprise a Functional Design (NMFS 2011 and NMFS 2022a) for the subject fish screen and flow control structure. This Functional Design is intended for review by fisheries agencies, funding entities, and/or others interested in this fish passage and screen project. Paramount design variables such as maximum screen flow rate (25 cfs), hydraulic design for screen including approach velocity (V_a) and sweeping velocity (V_s), screen material and cleaning system, fish bypass, and flow control for Snake Creek are described herein, and shown on drawings. Specific references to NMFS (2022a) fish screen criteria are listed by number (e.g. 8.1.1 for 100% flow screening) where the design complies with NMFS (2022a) criteria.

Snake Creek is one of multiple distributary meandering channels originating from Toppenish Creek within a broad and relatively flat floodplain area. Downstream of the project site, Snake Creek flows into multiple floodplain and/or wildlife areas, but without any downstream outlet leading eventually to the Yakima River; Snake Creek is a one-way dead end for fish.

Fish Screen and Flow Control Arrangement

Drawings C3 and C6 show the proposed layout and alignment of trashrack, fish screen, bypass, and slide gate elements all supported in a single reinforced concrete structure (cast-in-place); additional screen and bypass details are shown on Drawings C7 thru C10. As previously noted, the screen support structure will be spanned with a weathering steel bridge to maintain existing access to private land north of the screen location. Two proposed slide gates are shown downstream of the proposed screen, to maintain upstream water surface elevations for gravity-flow into the bypass pipe leading back to Toppenish Creek, and to discharge as much as 26 cfs down Snake Creek to the wildlife area. All flow released through slide gates to downstream reaches of Snake Creek will be screened to exclude fish (8.1.1).

Large ground areas Elevation 749' (+/-) surrounding the proposed screen location are overtopped by peak flows and floods of Toppenish Creek. Widespread flooding above this elevation indicated that it would be impractical to design any fish screen or flow control elements above Elevation 751.5'; this is the proposed top elevation for all fish screen structures.

Hydraulic Design for Fish Screen

Toppenish Creek (and therefore Snake Creek) receive supplemental flow from several sources during irrigation season, which results in relatively constant water surface elevations during irrigation season (except during peak flows and flooding). The fish screen and bypass systems are designed to function from the existing Snake Creek channel thalweg (i.e. zero flow) thru high flows up to Elevation 751.5' at the screen site.

With V_a required to be 0.4 feet per second (fps) or less (8.5.1), a vertical flat plate screen (8.5.7.1) length = 16' was calculated (8.5.2) for adequate screen area at the highest screen flow rate (26 cfs at water Elev. 748.0'). Several profile and section views of the proposed screen and flow control facility are shown on drawings following this Functional Design narrative.

Bypass flow will exit the screen structure thru an 18"-wide opening spanning from the screen bottom to the top of the screen (8.6.2.4). Seven feet downstream of the bypass vertical slot opening, the bypass channel bottom will transition into a 12"-dia. PVC pipe (8.6.3.3) for fish bypass directly to an existing meander alignment back to Toppenish Creek.

Bypass pipe hydraulic design is relatively complicated and included the following variables:

- Flow rating curves were developed for Snake Creek at the screen site, and for the Meander Channel at bypass pipe discharge.
- Manning's equation was used to estimate bypass flows for open-channel flow, if water surface elevation in the screen structure = 745.0' (crown for bypass pipe) or lower.
- For bypass pressure-flow, the Hazen-Williams and velocity head equations were used to estimate bypass flow rate per water surface elevation drop (i.e. head loss) from the screen structure (Snake Creek) to the Meander Channel.
- Drawing C10 provides additional hydraulic design data and relationships for the 12"-dia. bypass pipe.
- Hydraulic calculations showed that an 18"-dia. bypass pipe would result in essentially zero flow to the downstream reach of Snake Creek if Snake Creek flows less than 10 cfs +/-.
- All bypass flowlines will converge into the bypass pipe near concrete slab level. Quantification of flow convergence from screen sweeping flows to the 12"-dia. bypass pipe would require a Froude Number hydraulic model. It is assumed the flow convergence will be relatively gradual along the 18"-wide x 7'-long bypass slot extension (see Drawings C6 and C10).

Trashrack

The proposed trashrack (8.4.2.2) will have $^3/_8$"-thick stainless steel flat bars with 8" openings for interception of floating and submerged debris. The rack will be inclined 30° from vertical, an aluminum rake with the same on-center spacing will be provided to YN, access grating is included in the design just downstream of the rack, and all small debris (e.g. leaves) will be directly transferred with the rake, from the trashrack surface into a 48"-wide concrete walkway to be pushed downstream (Drawing C7, reference NMFS (2022a) 5.8).

Fish Screen

Screen surface will be stainless steel sheet (16 gauge) with $^3/_{32}$" holes punched in a staggered pattern (8.5.8.1); screen open area will be 33% (8.5.8.2). Overall screen size will be 16'-long x 4'-high as shown on drawings, and to meet V_a requirements (8.5.1) at maximum flow discharge to downstream Snake Creek.

Screen Cleaning System

A brush system for continuous screen cleaning is included in the design for the fish screen (8.5.5.1). The fish screen and cleaning assembly will be designed and fabricated by AquaSystems 2000, a Canadian company with extensive knowledge and experience with design and installation of similar fish screen systems (see as2i.net). Electrical power for the screen cleaning system will be provided via an off-grid solar power system with battery backup.

Slide Gates

Slide gates will be stainless steel bottom-opening gates fabricated by a commercial supplier, e.g. Waterman. A walkway across the screen structure will be included for YN access to the handwheel operators. Handwheels will be locked (with chains) to stainless steel brackets to limit operation to YN staff. Two slide gates are proposed to spread water flow across the screen structure, which will balance V_a through all screen surfaces better than a single slide gate (8.5.4).

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

BASIS-OF-DESIGN & SCREEN FUNCTIONAL DESIGN

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	C4

Bridge and Roughened Channel Functional Designs

Overview for Functional Designs

Functional Design narratives included herein, and illustrated with multiple drawings, are for direct comparison with NMFS fish passage criteria (NMFS 2022a, 2022b). Guidelines and criteria published by WDFW (2013) are also included for cross-reference where useful to demonstrate conformance with broadly applied fish passage design criteria.

Bridge Functional Design

Bridges are preferred over culverts for water crossing structures (NMFS 2022b – 3.2.2 and WDFW 2013). At the proposed fish screen site (see Drawing C3), the proposed fish screen support structure will span the entire distributory channel (Snake Creek) so all flow released downstream will be screened to exclude fish. A 16'-6" span x 12'-wide deck weathering steel bridge is proposed to span across the reinforced concrete screen support structure, to maintain access to private land on both sides of the Snake Creek channel. The current water crossing structure at the proposed bridge location is a 48"-diameter corrugated steel pipe (culvert). Although the proposed bridge could be considered a culvert replacement associated with a fish passage project (which it is), NMFS (2022b) and WDFW (2013) guidelines and criteria for bridge design are not considered relevant except to support design of a durable bridge that will withstand flood and hydraulic forces without damage.

As noted in the Fish Passage Project Basis of Design (Drawing C4), Toppenish Creek and Snake Creek water levels will completely submerge the entire fish passage site during peak flow events and floods (typically peak snowmelt every spring). Bridge design follows previous examples (4 each in Skagit River floodplain) for weathering steel bridges at locations that will be entirely submerged during peak flows and floods. Steel beam height will be limited to 18"-high, and wood curbs along each bridge side will replace higher guardrails to present a minimal cross-section for interception of floating debris. Bridge beam ends will be securely anchored to the reinforced concrete walls of the screen support structure. Water overtopping the bridge will be low velocity, almost to the point of "standing water" due to the broad floodplain very gradually sloping towards the Yakima River. Collectively, these site conditions and design parameters will result in a bridge capable of submergence by a 100-year flood (or higher event) without damages (NMFS 2022b and WDFW 2013).

Roughened Channel Functional Design

The primary objectives for the roughened channel proposed as part of the Snake Creek Fish Passage Project are to: 1) Provide unrestricted fish passage upstream and downstream within the existing meander channel connecting Snake Creek to Toppenish Creek, for all native fish species and life-stages; and 2) Maintain water level in the Snake Creek channel sufficient for delivery of flow to downstream irrigation intakes and the Toppenish National Wildlife Refuge.

Comparison of the roughened channel design to written criteria and guidelines (NMFS 2022a and WDFW 2013) is necessarily "generic" because the roughened channel design follows an independent development of design parameters by Paul Tappel over the last 30 years, which differ moderately from these references. Since 1998, Tappel has designed 90+ roughened channels state-wide Washington; 70+ have been constructed and all have been successful for fish passage, channel stability, simulation of natural riffle habitat, etc. Channels have been up to 300'-long, up to 12% channel slope, with energy dissipation factors (EDF) as high as 42 $ft*lb/ft^3/sec$ which in some cases substantially exceeded criteria published by NMFS or WDFW during previous years.

The foundational basis-of-design for Tappel's roughened channel development is knowledge that native fish species thrive in fluvial systems with channel gradients up to (about) 15%; all life-history requirements are met even though published technical criteria (e.g. average velocity or EDF) may be exceeded. This understanding is paramount to acceptance of roughened channel design protocol developed by Tappel and routinely implemented state-wide.

NMFS 2022a defines roughened channels as "Nature-Like Fishway" (Section 5.10), and the chapter provides substantially less technical guidance than WDFW (2013) or Tappel's extensive experience. The proposed roughened channel will "simulate the form and roughness of a reference reach" (5.10.2) although channel gradients of 4% (i.e. reference reach) are substantially higher in the watershed than the subject site.

NMFS (2022a) 5.10.3.1 specifies that maximum average channel velocity should not exceed 5 feet per second (fps), and 5.10.3.4 specifies that maximum channel slope should be 5%; the proposed channel will meet these NMFS criteria.

NMFS (2022a) 5.10.3.5 requires that Nature-Like Fishways (roughened channels) have beds and banks that will be stable at all flows. Over decades, Tappel has developed a routine and straight-forward hydraulic design method to determine the size range of particles that will be stable in a very wide range of fluvial systems (state-wide Washington). The method directly integrates the peak design flow (100-year flood), channel slope, and other factors; for the Snake Creek sites, it was determined that 9" to 18"-size cobbles and boulders will remain stable in the meander channel regardless of flood flow rate. Tappel's method for design of stable roughened channels has been verified by many projects (70+ as-built). At the Taneum Creek channel (near I-90 freeway), the state's largest roughened channel (300'-long, 5% slope, 8,000 tons of rock 36" to 72"-size class) withstood a Flood-Of-Record (3,000 cfs) that substantially exceeded the estimated 100-year flood (2,000 cfs). WDFW (2013) shows Bryan Tappel standing next to the Taneum Creek roughened channel during this Flood-Of-Record (Figure 6.7, page 132).

References

NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

NMFS. 2022a. NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Manual. NMFS, WCR, Portland, Oregon.

NMFS. 2022b. NOAA Fisheries Guidelines for Salmonid Crossings in WA, OR and ID – 2022. NMFS, WCR, Portland, Oregon.

WDFW (Washington Department of Fish and Wildlife). 2013. Water Crossing Design Guidelines. WDFW, Olympia, Washington.

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

BRIDGE & CHANNEL FUNCTIONAL DESIGNS

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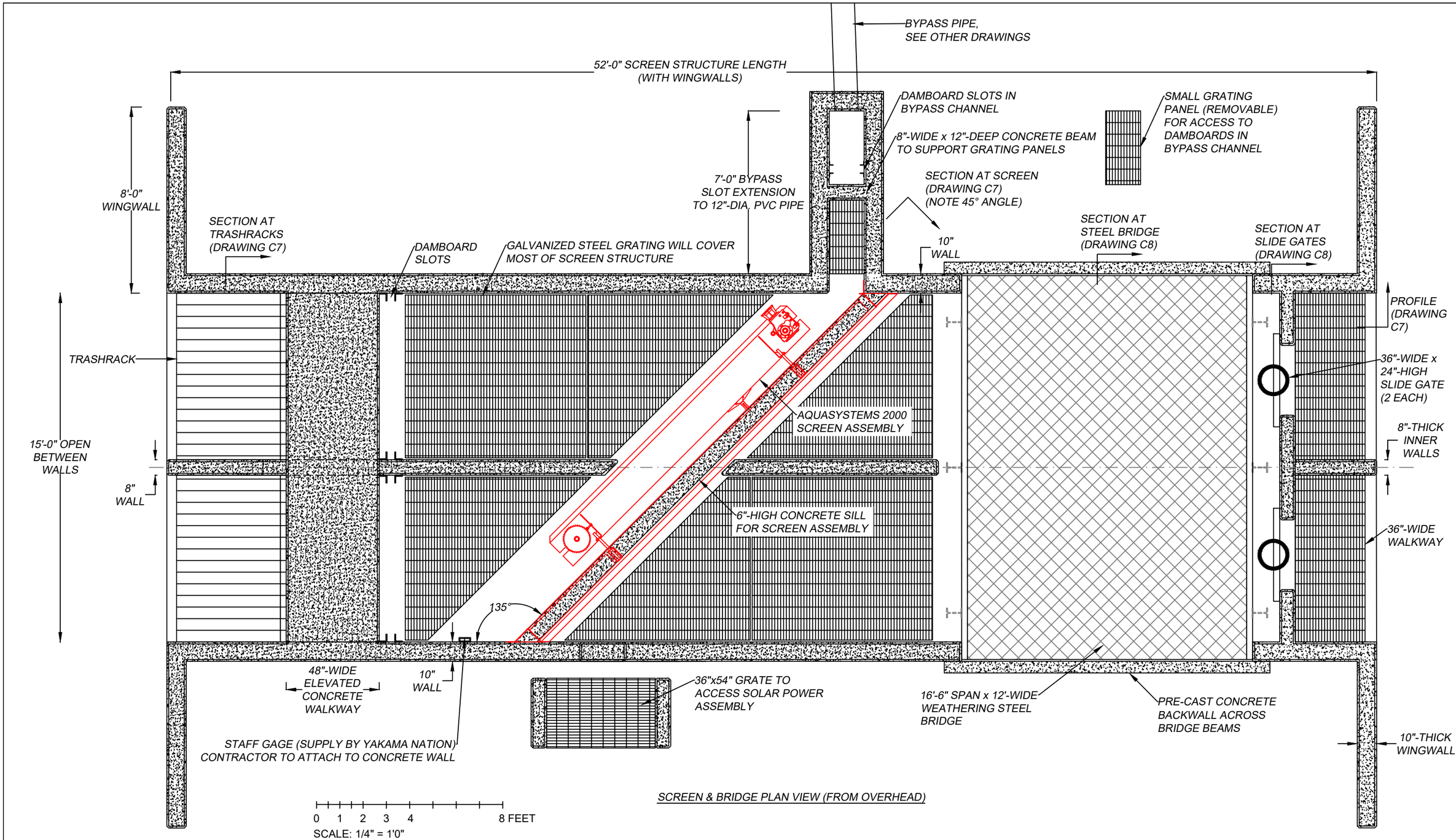
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	C5



SCREEN & BRIDGE PLAN VIEW (FROM OVERHEAD)

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

SCREEN & BRIDGE PLAN

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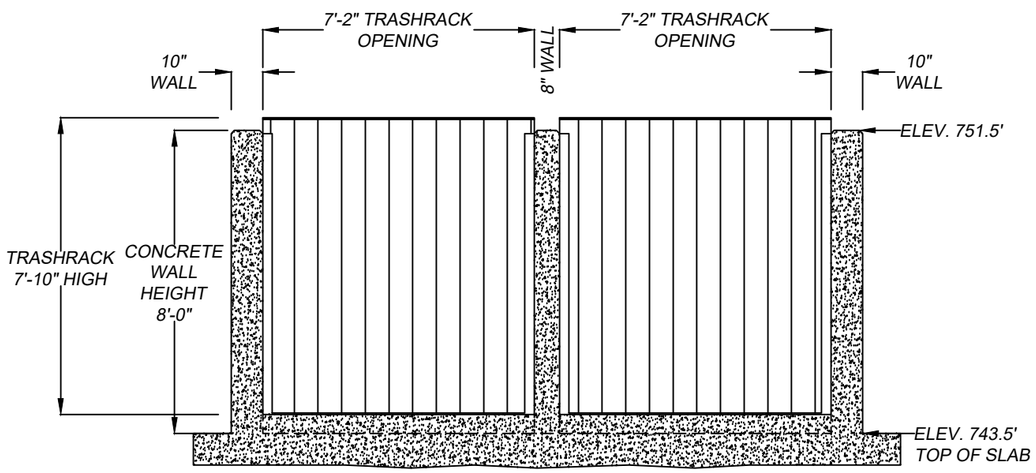
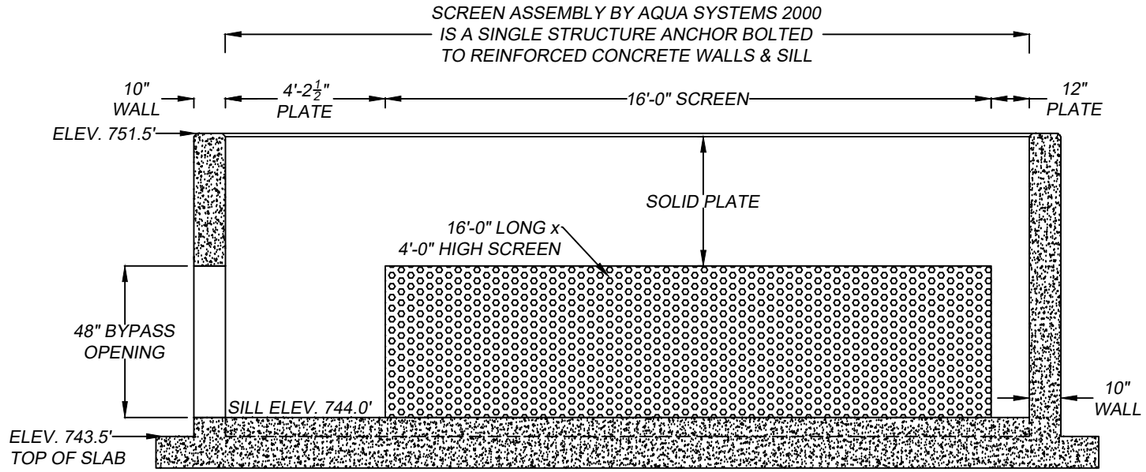
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C6**

0 1 2 3 4 8 FEET

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



SECTION AT TRASHRACKS
WINGWALLS NOT SHOWN



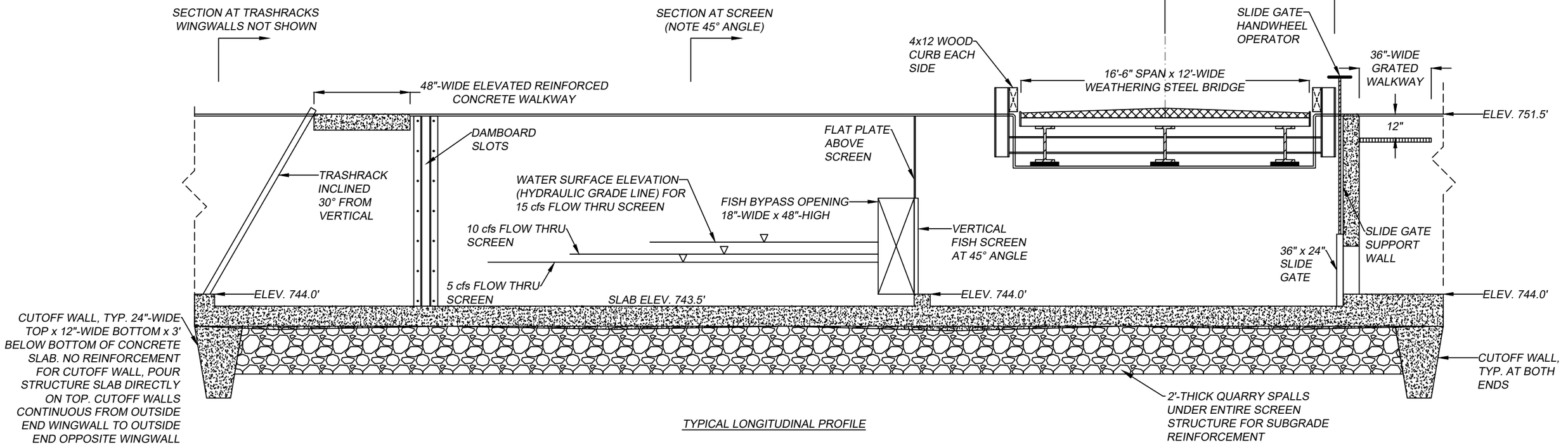
SECTION AT SCREEN
(NOTE 45° ANGLE)

SECTION AT TRASHRACKS
WINGWALLS NOT SHOWN

SECTION AT SCREEN
(NOTE 45° ANGLE)

SECTION AT STEEL BRIDGE
(DRAWING C8)

SECTION AT SLIDE GATES
(DRAWING C8)



TYPICAL LONGITUDINAL PROFILE

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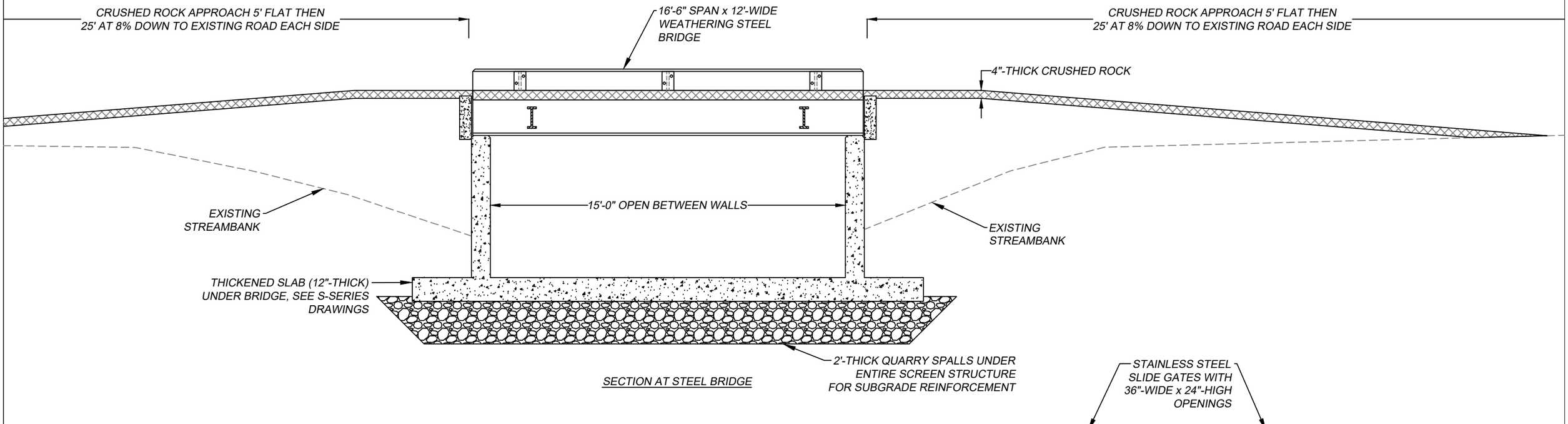
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

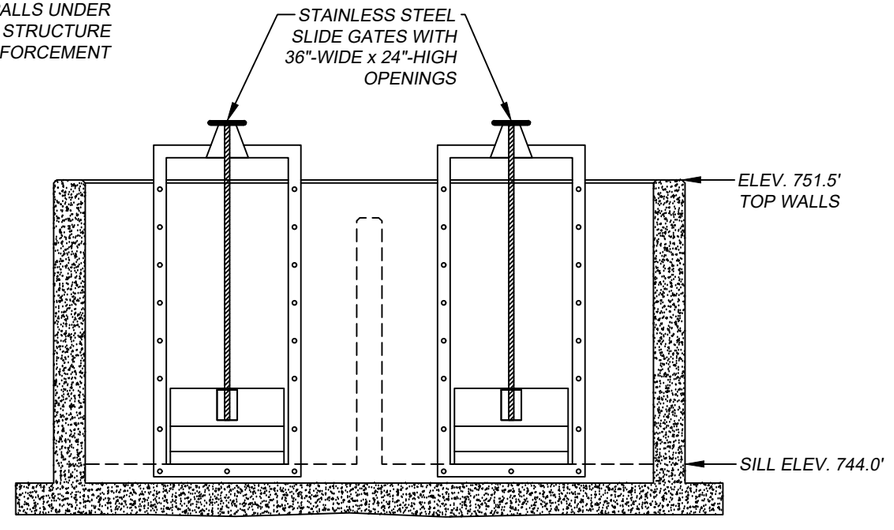
SCREEN PROFILE & SECTIONS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C7**



SECTION AT STEEL BRIDGE



SECTION AT SLIDE GATES

0 1 2 3 4 8 FEET

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

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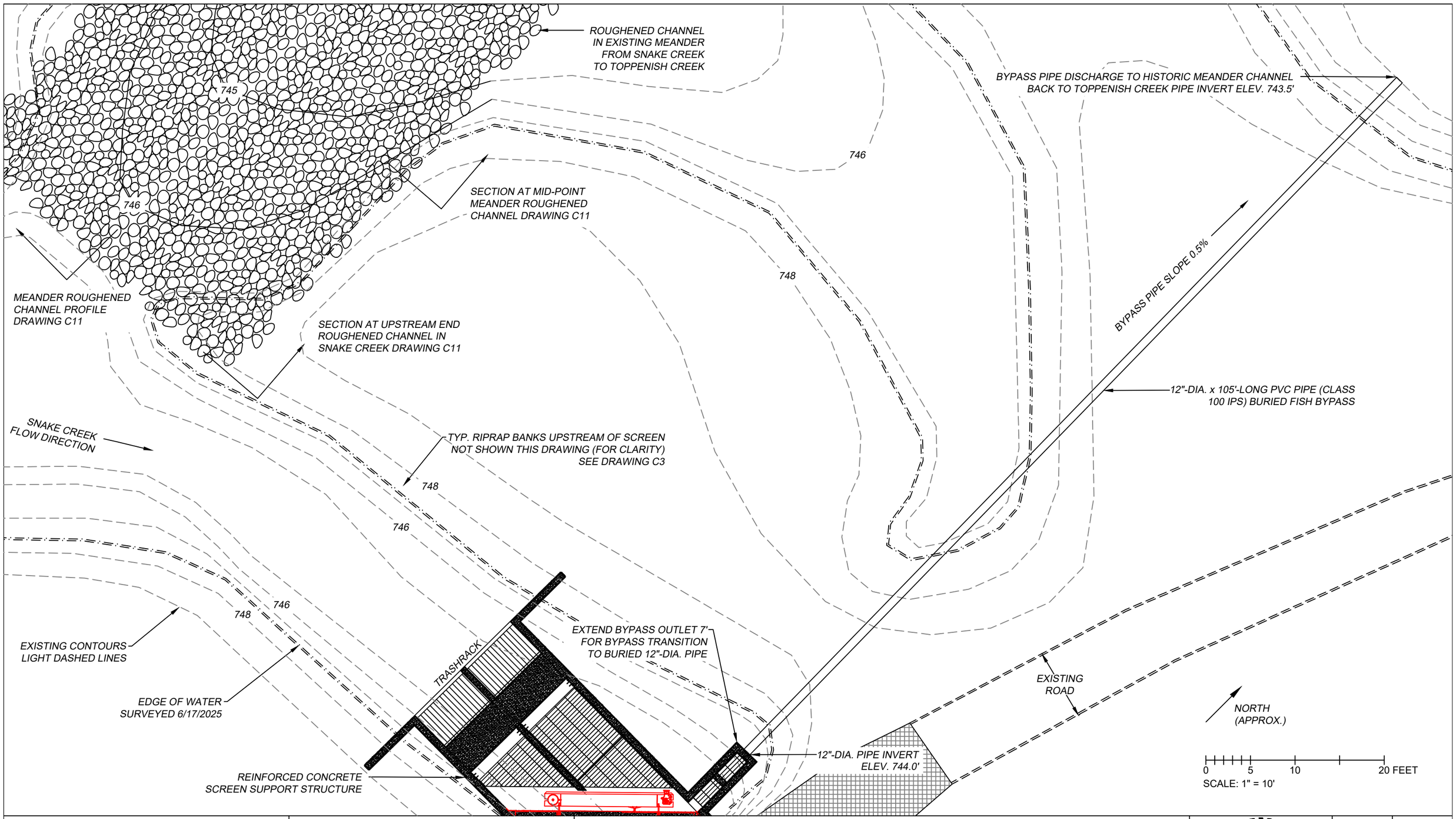
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

SCREEN STRUCTURE SECTIONS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C8**



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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

ROUGHENED CHANNEL & BYPASS SITE PLAN

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C9**

Fish Screen Bypass Summary:

For all fish screen operations, the bypass flow rate will increase as increased flow rates are screened for downstream conveyance into Snake Creek; see Figure 1 this drawing. The bypass pipe invert will slope down 0.5% (+/-) from Elev. 744.0' at the screen structure to Elev. 743.5' at the existing meander channel back to Toppenish Creek. Hydraulic calculations included rating curves for Snake Creek flow and the downstream meander channel, plus head loss calculations for the 12"-diameter PVC bypass pipe (Hazen-Williams, minor loss calcs). These calculations showed that bypass flow will be about 100% of screened flow for low screen flows (e.g. 2 to 5 cfs), and the percentage of bypass flow will decrease to about 25% of screened flow for high screened flows 20 cfs to 25 cfs.

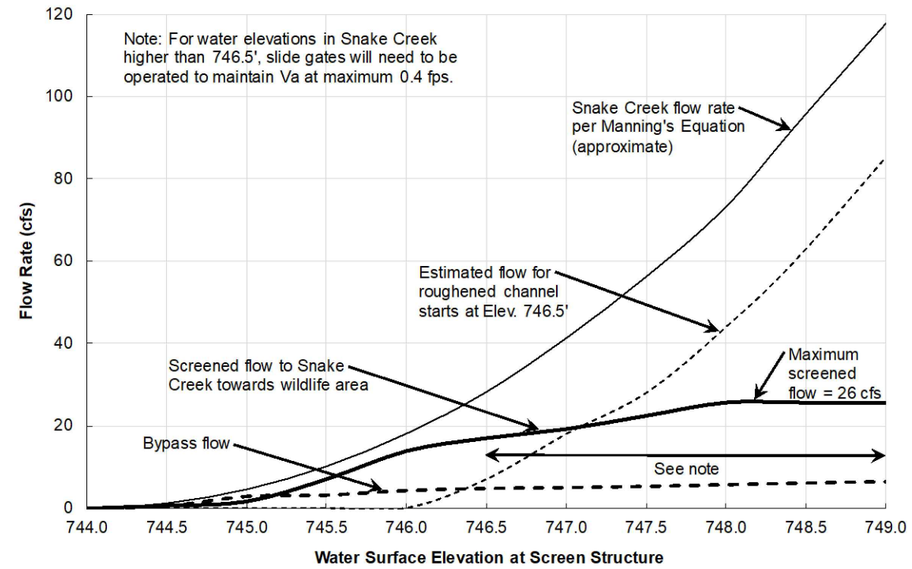

Figure 1. Snake Creek flow rate vs proposed flow thru fish screen, bypass flow and flow down the proposed roughened channel with 12"-dia. bypass pipe.

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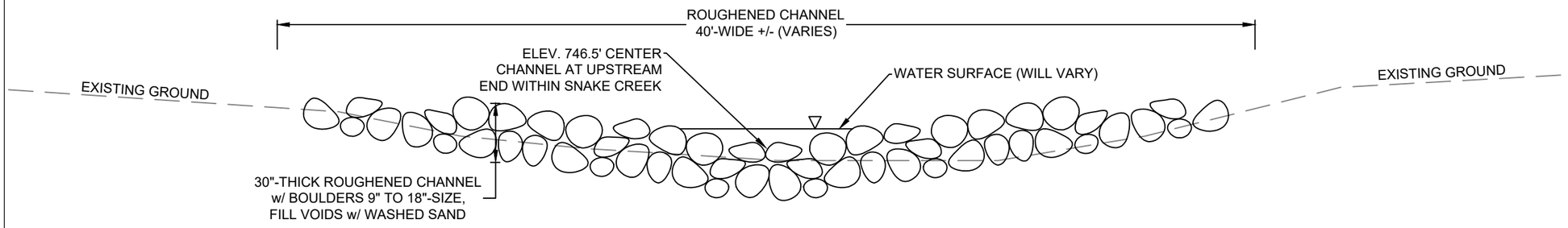
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

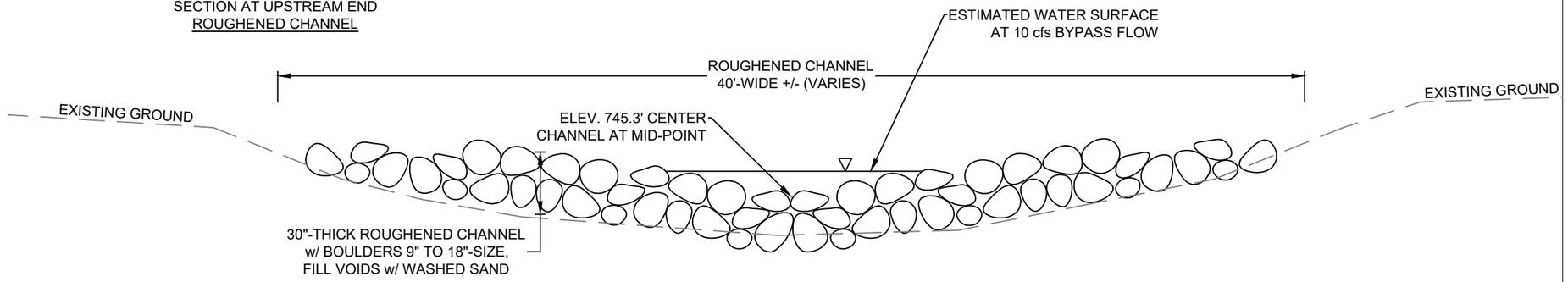
BYPASS CHANNEL PROFILE & SECTIONS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C10**



SECTION AT UPSTREAM END
ROUGHENED CHANNEL



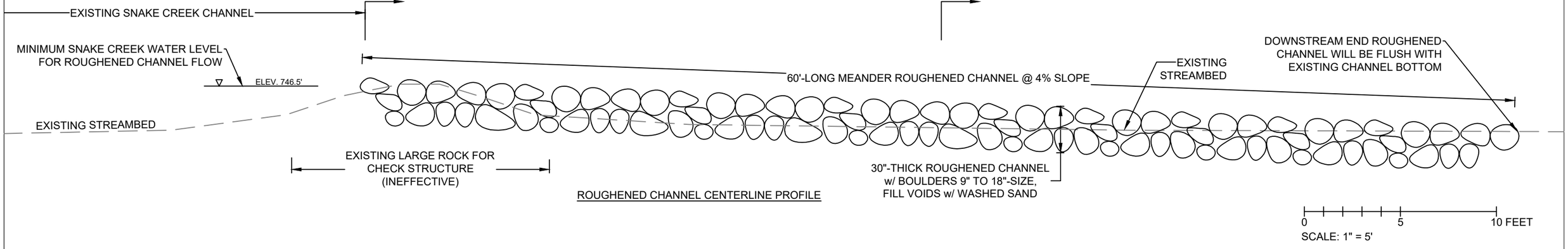
SECTION AT MID-POINT MEANDER
ROUGHENED CHANNEL

Roughened Channel Notes:

- Channel to be excavated to bottom of boulder layer, then first 1' (+/-) layer of boulders to be placed. Prior to placement full 30"-depth of boulders, washed sand to be sluiced into first layer of boulders to fill all voids.
- Second layer of boulders to be placed (1'-thick +/-) to final roughened channel top elevations shown this drawing, then washed sand to be sluiced into boulder voids until water "ponds" on the roughened channel surface.
- The downstream end of roughened channel will be countersunk into existing silty streambed deposits. Roughened channel flows from Snake Creek will naturally meander thru these streambed sediments to maintain a continuous flow channel to Toppenish Creek.

SECTION AT UPSTREAM END
ROUGHENED CHANNEL

SECTION AT MID-POINT
MEANDER ROUGHENED
CHANNEL



ROUGHENED CHANNEL CENTERLINE PROFILE

SCALE: 1" = 5'

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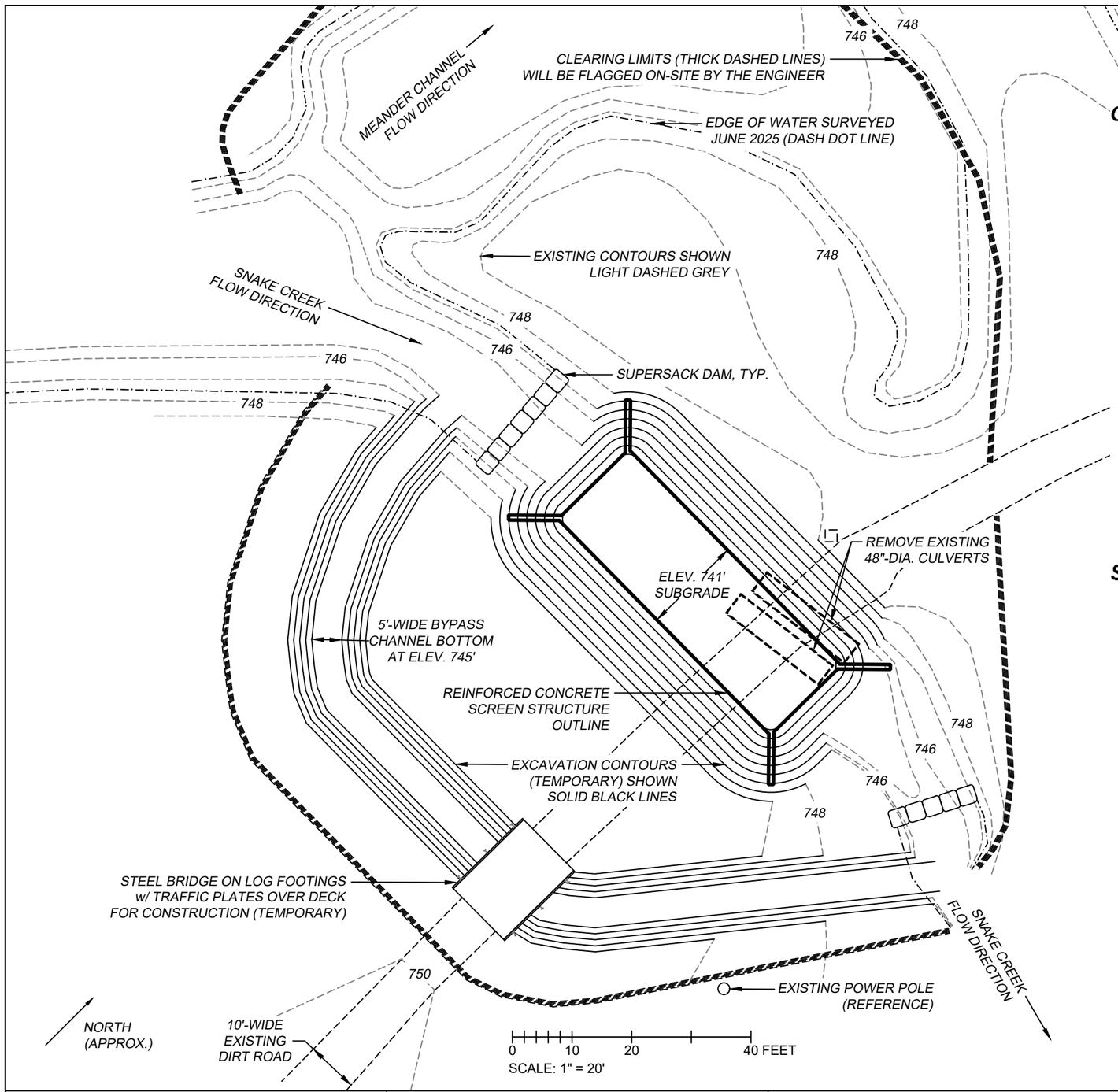
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

ROUGHENED CHANNEL PROFILE & SECTIONS

BRYAN DAVID TAPPEL
STATE OF WASHINGTON
21019228
REGISTERED
PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C11**



Overall Sequence of Construction:

- The first on-site work will be to remove wood blocks (if in place) on the upstream ends of culverts in the existing meander channel back to Toppenish Creek (i.e. at the proposed aluminum box culvert location), to lower the upstream water levels at least 2'.
- With water level lower in the meander channel, all site clearing shall be completed. All clearing debris shall be hauled a short distance south of the screen location, piled near the existing road and mashed down for natural decomposition (YN will select the site for clearing debris disposal).
- Third stage of construction will be excavation of a channel for complete bypass of Snake Creek around the proposed fish screen, as shown this drawing. Then the modular steel bridge will be placed over the excavated channel to maintain access for screen construction.
- Install supersacks across Snake Creek, to divert all flow into the temporary bypass channel. Streambed mix may be needed to fill outside of each supersack dam for complete bypass of flow into the temporary channel.
- Build the reinforced concrete screen structure including all interior elements (e.g. trashrack, screen). After one week concrete cure time, backfill to top of screen structure wall and relocate bridge modules to span over the screen structure as shown on other drawings.
- Build the roughened channel to connect Snake Creek with the existing meander back to Toppenish Creek. Then, construct the fish screen bypass system.
- Remove supersacks from Snake Creek channel to restore flow, then fill the temporary bypass channel to original ground contours.

Site Preparation & Water Control Notes:

- Site clearing for all project work (including new culvert location) will be about ½-acre in size. All brush, grass, and other plants shall be completely removed including grubbing of soils to shallow depth.
- Soils excavated for bypass channel construction to be side-cast south of the bypass channel, to maintain the staging area north of bypass channel.
- Yakama Nation Fisheries staff to be on site for fish rescue and relocation prior to diversion of Snake Creek into the excavated bypass channel.
- Supersacks placed across the Snake Creek channel will probably need to be sealed to minimize water infiltration into the work site. Streambed mix as listed below shall be placed to seal supersack dams.

  Streambed Mix – mix ½ (by volume) washed gravel (1" to 2"-size) and ½ washed sand. Just before supersack removal, most of the streambed materials to be removed from Snake Creek channel and scattered over adjacent ground.
- Contractor to supply and operate 2"-diameter submersible electric pumps (as needed), with electric generator power source, to remove water leaking past supersack dams into the work area. Turbid water to be discharged on nearby upland areas for infiltration into the ground.
- Water control work required for construction of the roughened channel will depend on water elevation in the meander after removal of downstream checkboards (unknown). It is expected that water level in the meander channel will be low enough that required water control will be minimal for example a short sandbag dam in Snake Creek to isolate the meander channel. If substantial water control work is required for construction of the roughened channel, this will be considered a differing site condition for construction i.e. change order.

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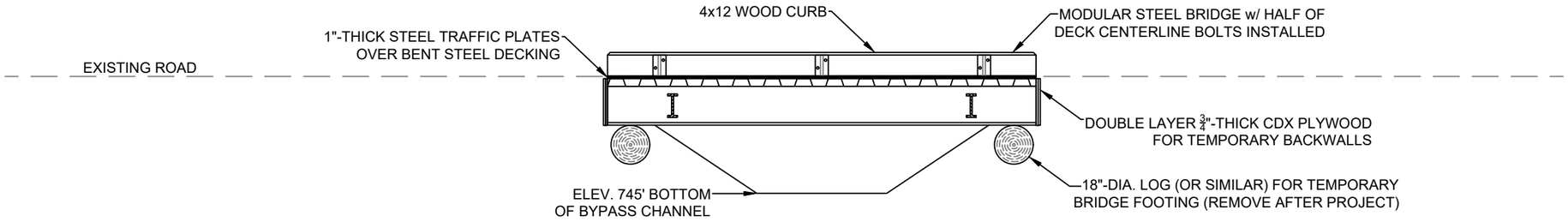
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

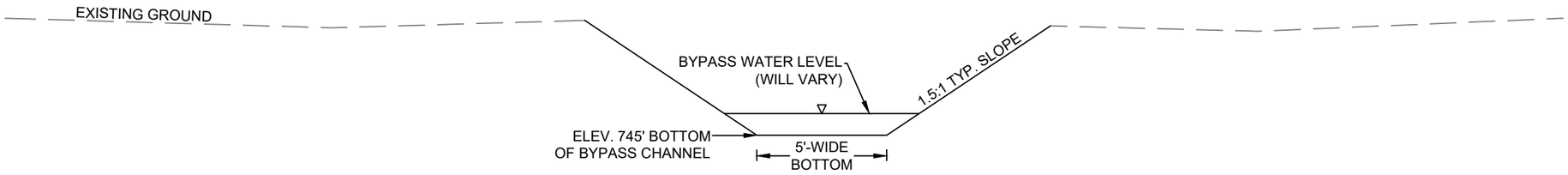
FISH SCREEN SITE PREP & WATER CONTROL

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

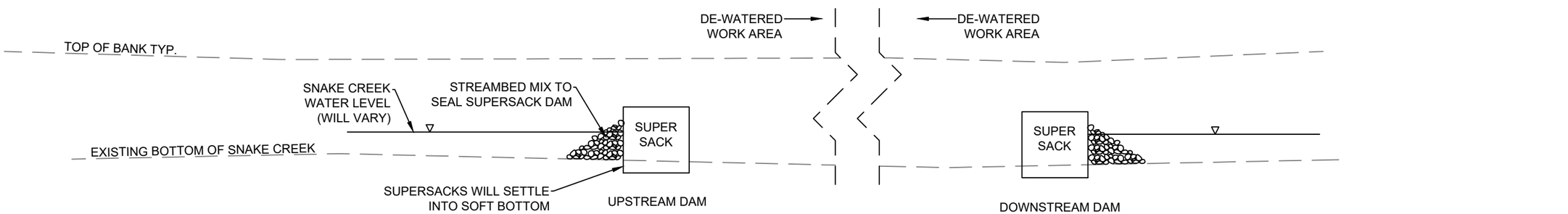
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	C12



STEEL BRIDGE CROSSING OF BYPASS CHANNEL



TYPICAL BYPASS CHANNEL SECTION



SUPERSACK DAM TYPICAL DETAILS

0 5 10 FEET
SCALE: 1" = 5'

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

SITE PREP SECTIONS & DETAILS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**C13**

Bid Form
Snake Creek Fish Passage Project

Contractor: Date:

Item No.	Spec.	Item	Qty	Unit	Unit Cost	Total Cost
1	1-09	Mobilization	1	LS		
2	1-50	Surveying (most will be done by engineer)	1	LS		
3	2-01	Clearing (at screen site)	1	LS		
4	2-09	Excavation (stockpile all, includes site prep)	870	CY		
5	2-09	Backfill & Compact (track and bucket compact)	570	CY		
6	2-09	Dispose Excess Soils (on-site)	300	CY		
7	2-15	Water Control (supersacks, trashpumps)	1	LS		
8	2-15	Temporary Install Steel Bridge	1	LS		
9	6-02	Concrete for Cutoff Walls (unreinforced)	14	CY		
10	6-02	Cast-In-Place Reinforced Concrete Slabs	42	CY		
11	6-02	Cast-In-Place Reinforced Concrete Walls	51	CY		
12	6-02	Pre-Cast Concrete (platform, bridge backwalls)	2	CY		
13	6-03	Weathering Steel Bridge Supply	1	LS	Supply by YN	
14	6-03	Steel Bridge Assembly & Install	1	LS		
15	6-03	Wood Curbs for Bridge (4x12)	1	LS		
16	6-03	Stainless Steel Allthread (bridge)	12	EA		
17	7-80	12"-dia. PVC Class 100 Pipe (IPS)	120	LF		
18	7-80	12"-dia. PVC Tee (Class 100 IPS)	1	EA		
19	8-40	Aqua Systems 2000 Screen Supply	1	LS	Supply by YN	
20	8-40	Install Aqua Systems Screen Supply	1	LS		
21	8-40	Install Aqua Systems Solar Power Assembly	1	LS		
22	8-40	Electrician & Aqua Install & Start-Up	2	DAY		
23	8-50	Stainless Steel Slide Gate	2	EA		
24	8-60	Stainless Steel Fabrication & Install	1,180	LB		
25	8-60	Aluminum Fabrication & Install	200	LB		

Bid Form
Snake Creek Fish Passage Project

Contractor: Date:

Item No.	Spec.	Item	Qty	Unit	Unit Cost	Total Cost
26	8-60	Galvanized Steel Fabrication & Install	1,090	LB		
27	8-60	Galvanized Steel Grating (includes clips)	300	SF		
28	8-60	Galvanized Steel Bolts (for grating clips)	1	LS		
29	8-70	Stainless Steel Anchor Bolts (3/8"-dia.x5"-long)	40	EA		
30	8-70	Stainless Steel Anchor Bolts (1/2"-dia.x5"-long)	190	EA		
31	8-80	Wood Damboards (4x8 lumber)	1	LS		
32	8-90	Staff Gauge Supply & Installation	2	EA		
33	8-95	Erosion Control Seed	4	LB		
34	8-95	Straw Mulch	12	BALE		
35	9-03	Streambed Mix (to seal supersacks)	30	TN		
36	9-03	Boulders (9" to 18"-size)	295	TN		
37	9-03	Washed Sand (sluice into boulder voids)	140	TN		
38	9-03	Crushed Rock (1-1/4"-minus)	30	TN		
39	9-13	Broken Rock (2" to 4"-size)	45	TN		
40	9-13	Quarry Spalls (4" to 8"-size)	160	TN		
41	9-13	Riprap (12" to 24"-size)	110	TN		

Construction Total (Bid):

CY = cubic yard LB = pound SF = square foot
EA = each LS = lump sum TN = ton

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SNAKE CREEK FISH PASSAGE PROJECT
YAKAMA NATION

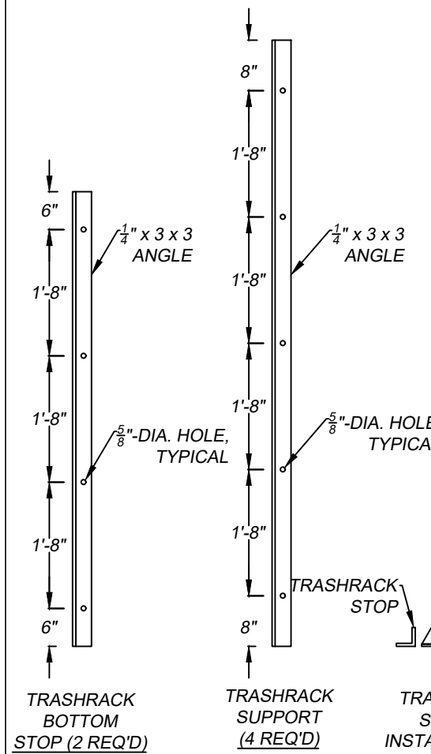
CONSTRUCTION QUANTITIES & COSTS

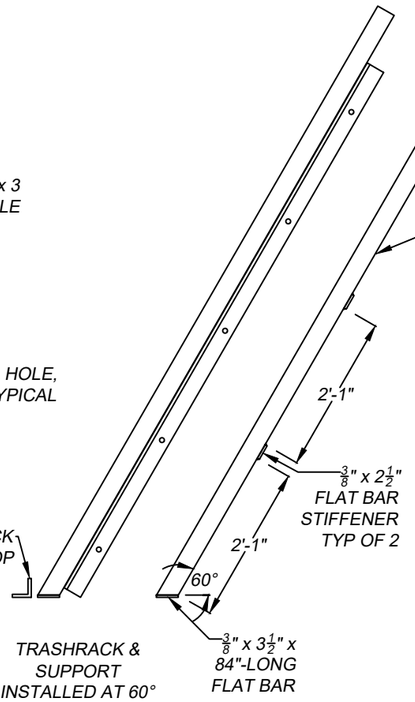
BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

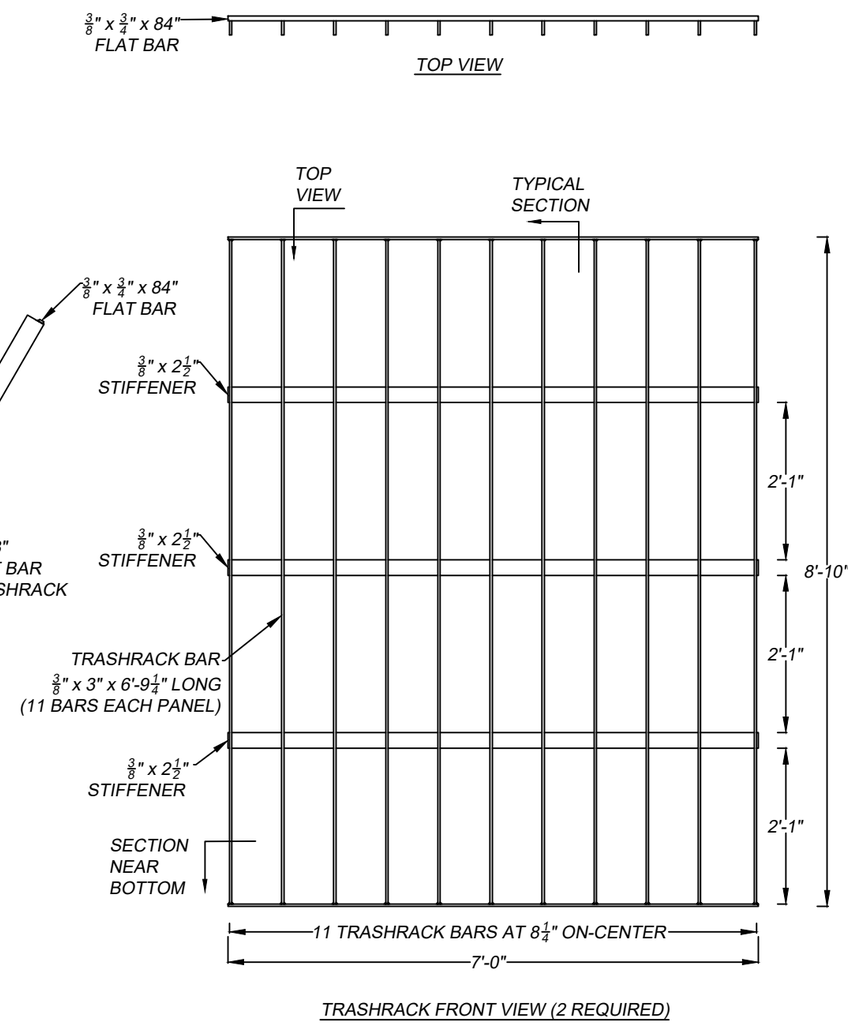
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	C14

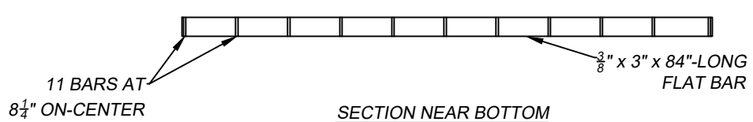
Trashrack Notes:

1. All metal for trashrack and trashrack supports stainless steel alloy 304.
2. Assemble all pieces with 1/8" continuous fillet welds at each joint between pieces.
3. Two trashrack assemblies required as shown, including rack and top channel.
4. Six stainless steel angles required for trashrack supports and stops, see details this sheet. Stainless steel anchor bolts to be 1/2"-diameter x 5"-long (28 required).



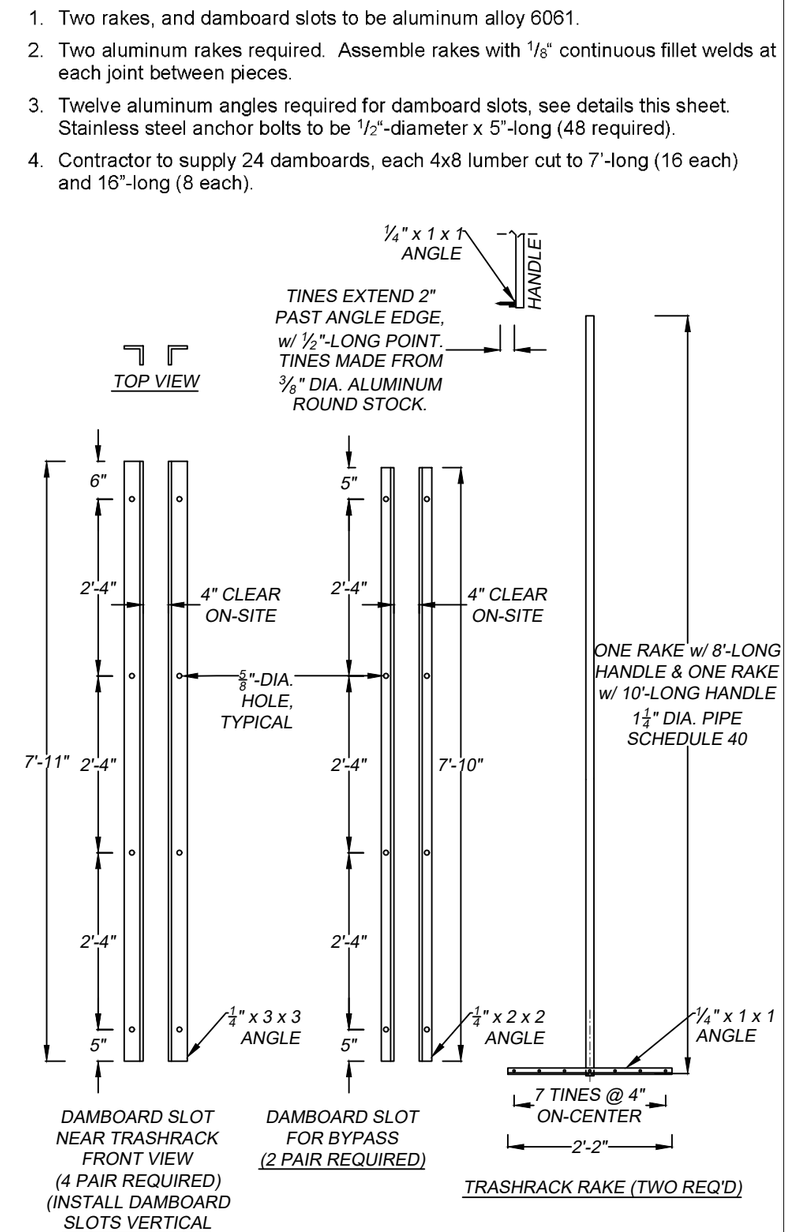






Trashrack Rakes & Damboard Slot Notes:

1. Two rakes, and damboard slots to be aluminum alloy 6061.
2. Two aluminum rakes required. Assemble rakes with 1/8" continuous fillet welds at each joint between pieces.
3. Twelve aluminum angles required for damboard slots, see details this sheet. Stainless steel anchor bolts to be 1/2"-diameter x 5"-long (48 required).
4. Contractor to supply 24 damboards, each 4x8 lumber cut to 7'-long (16 each) and 16"-long (8 each).



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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

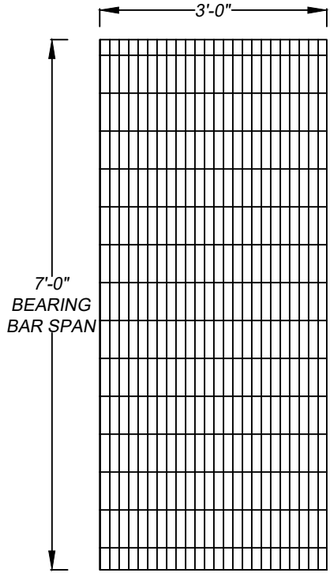
TRASHRACK & RAKE DETAILS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

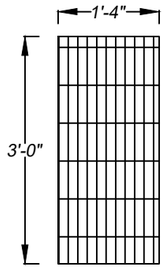
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**F1**

Galvanized Steel Grating Notes

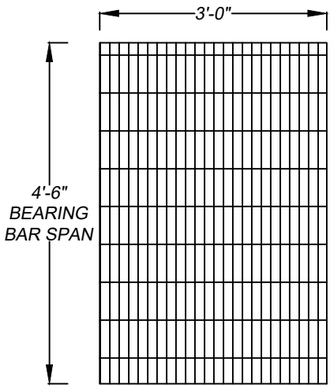
1. All grating to be fabricated into panels as shown this drawing, using stock lengths cut and banded along all cut ends of bearing bars. All fabricated panels to be hot-dipped galvanized after fabrication.
2. Grating stock to be 19-W-4 with 2" x $^{3}/_{16}$" bearing bars and serrated tops. Dimensions listed on this drawing are outside dimensions for all grating areas, including banding.
3. Banding to be ¼" x 2" steel bar. Welding for banding bars to be at least $^{1}/_{8}$"-thick continuous fillet weld on one side of every third bearing bar.
4. Grating to be supported with galvanized steel angles and channel shown on Drawing F3.
5. Galvanized steel saddle clips to be supplied by grating company (100 clips required). Saddle clips to be installed near outside corners each grating panel and at no more than 24" on-center spacing along banded edges to be attached to galvanized steel supports. Use ¼"-dia. x 2½"-long galvanized steel bolts to attach grating to galvanized steel supports. Drill steel angles and channels on site for saddle clip attachments.
6. Top of all grating to be at same elevation as top of concrete walls.



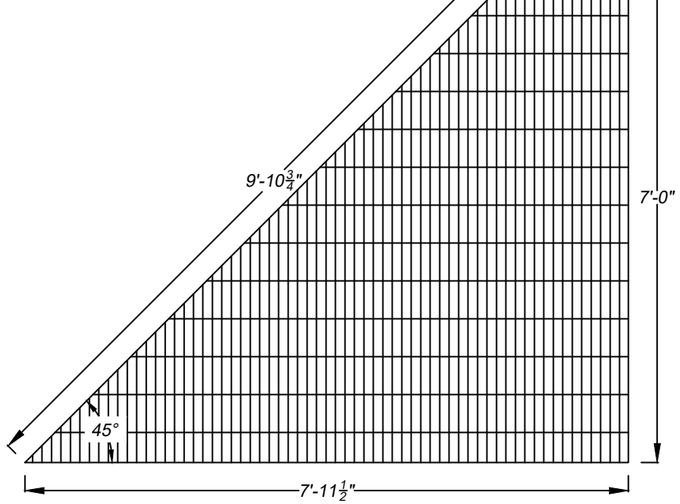
GRATING PANEL
FOR WALKWAY
(2 PANELS REQUIRED)



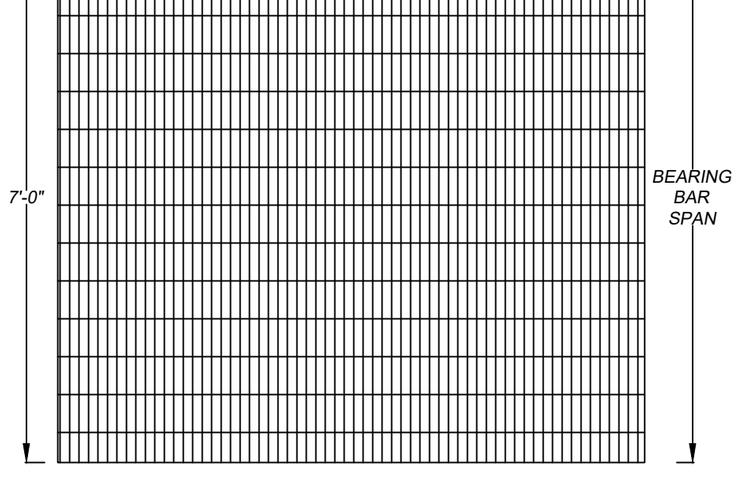
GRATING PANEL
FOR BYPASS CHANNEL
(2 PANELS REQUIRED)



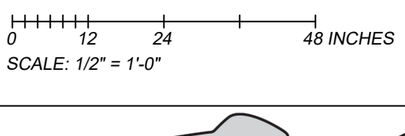
GRATING PANEL FOR
SOLAR CONTROL ACCESS
(1 PANEL REQUIRED)



GRATING PANEL FOR
SCREEN STRUCTURE COVER
(4 PANELS REQUIRED)



GRATING PANEL FOR
SCREEN STRUCTURE COVER
(2 PANELS REQUIRED)



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

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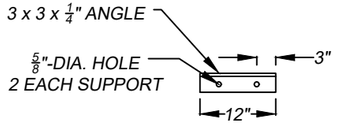
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

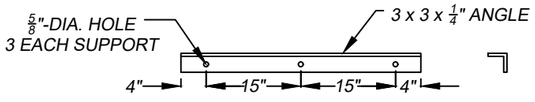
GALVANIZED STEEL GRATING

BRYAN DAVID TAPPEL
STATE OF WASHINGTON
21019228
REGISTERED
PROFESSIONAL ENGINEER

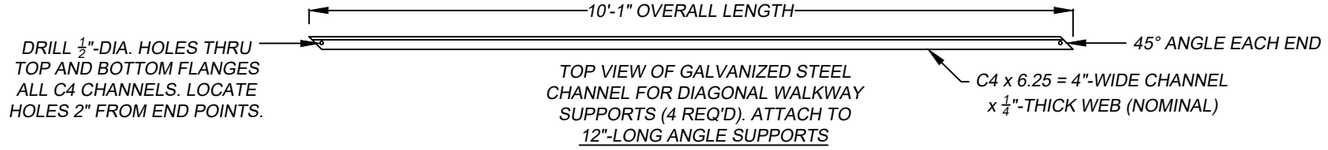
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**F2**



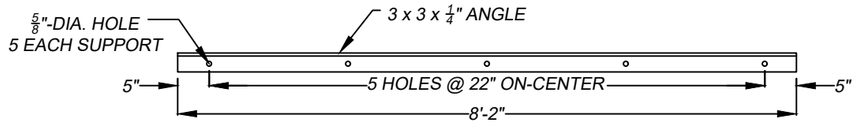
GALVANIZED STEEL ANGLE TO SUPPORT DIAGONAL CHANNEL BEAMS (8 REQ'D). ATTACH TO CONCRETE WALLS w/ 1/2"-DIA. x 5"-LONG STAINLESS STEEL ANCHOR BOLTS (16 REQ'D)



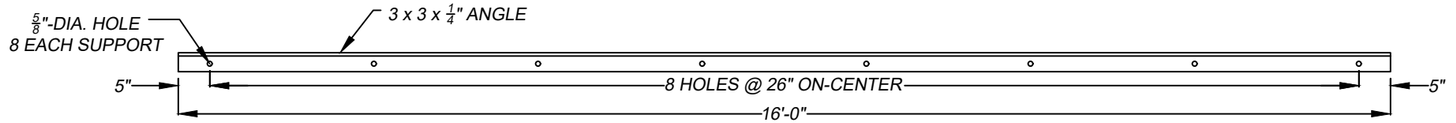
GALVANIZED STEEL ANGLE FOR 36"-WIDE WALKWAYS (10 REQ'D). ATTACH TO CONCRETE WALLS w/ 1/2"-DIA. x 5"-LONG STAINLESS STEEL ANCHOR BOLTS (30 REQ'D)



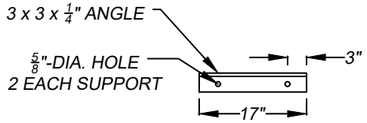
TOP VIEW OF GALVANIZED STEEL CHANNEL FOR DIAGONAL WALKWAY SUPPORTS (4 REQ'D). ATTACH TO 12"-LONG ANGLE SUPPORTS



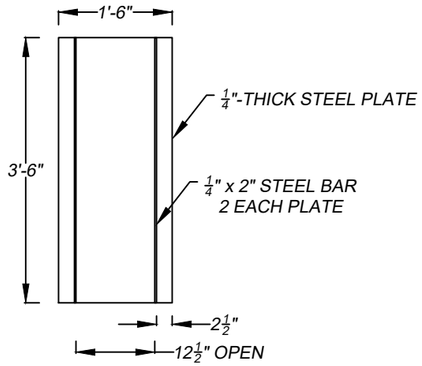
GALVANIZED STEEL ANGLE FOR WALKWAY SUPPORTS ALONG INTERIOR WALLS (2 REQ'D). ATTACH TO CONCRETE WALLS w/ 1/2"-DIA. x 5"-LONG STAINLESS STEEL ANCHOR BOLTS (10 REQ'D)



GALVANIZED STEEL ANGLE FOR WALKWAY SUPPORTS ALONG OUTSIDE WALLS (2 REQ'D). ATTACH TO CONCRETE WALLS w/ 1/2"-DIA. x 5"-LONG STAINLESS STEEL ANCHOR BOLTS (16 REQ'D)



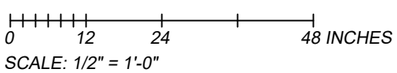
GALVANIZED STEEL ANGLE TO SUPPORT GRATING FOR SCREEN BYPASS CHANNEL (4 REQ'D). ATTACH TO CONCRETE WALLS w/ 1/2"-DIA. x 5"-LONG STAINLESS STEEL ANCHOR BOLTS (8 REQ'D)



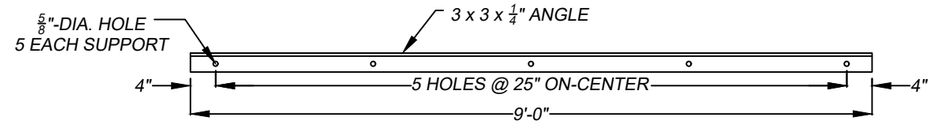
BOTTOM VIEW

TYPICAL SECTION

GALVANIZED STEEL PLATE TO COVER DAMBOARD SLOTS (4 PLATES REQ'D)



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



GALVANIZED STEEL ANGLE FOR WALKWAY SUPPORTS ALONG INTERIOR WALLS (2 REQ'D). ATTACH TO CONCRETE WALLS w/ 1/2"-DIA. x 5"-LONG STAINLESS STEEL ANCHOR BOLTS (10 REQ'D)

Galvanized Steel Notes

1. Use A36 steel. For damboard cover plates, attach bar to plate with 1/8" skip fillet welds (1"-long weld x 4" skip).
2. All steel materials shown this drawing to be hot-dip galvanized after fabrication.

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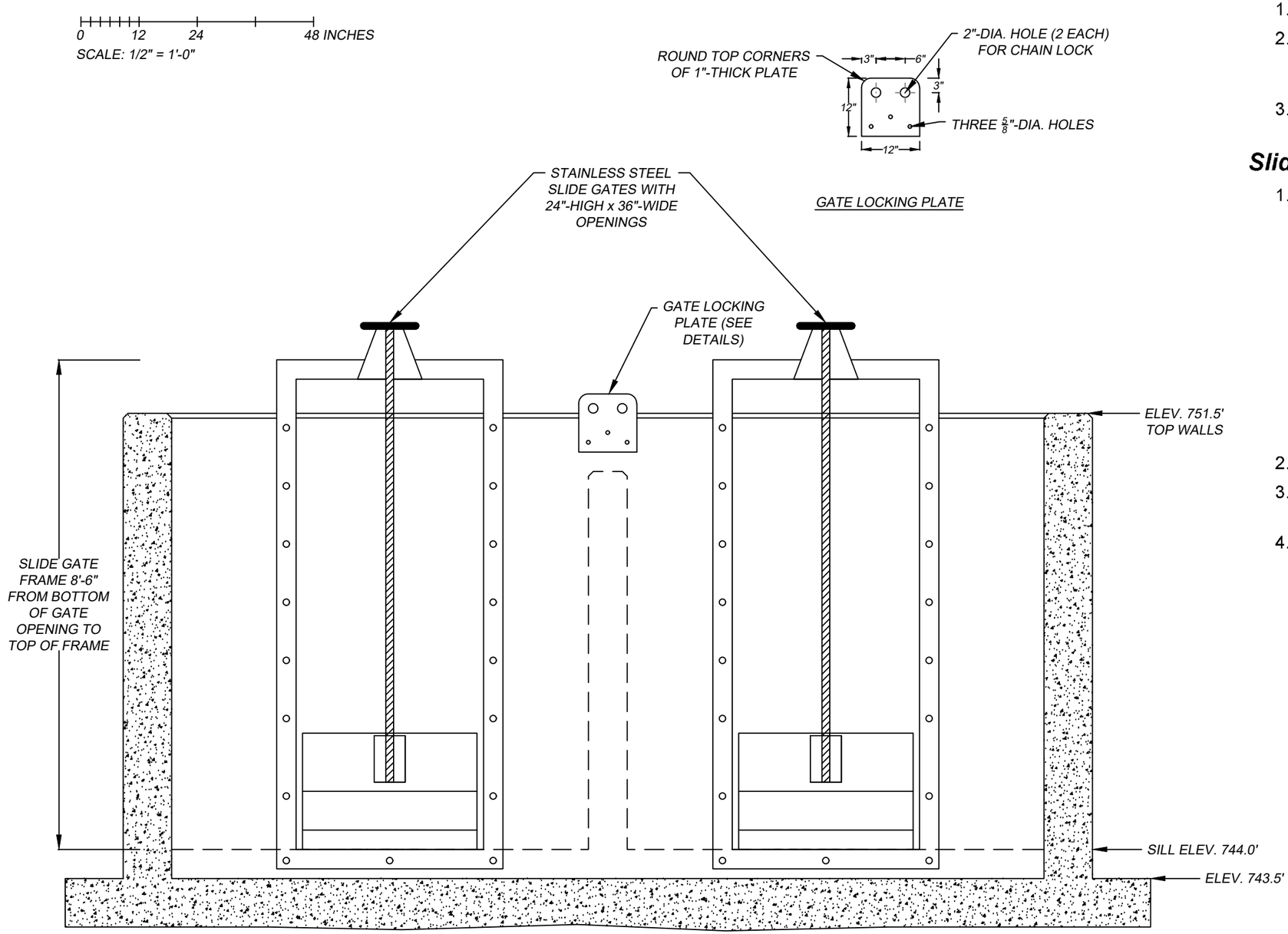
SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

GALVANIZED STEEL SUPPORTS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	F3



SECTION AT SLIDE GATES

Gate Locking Plate

1. Build gate locking plate with 1”-thick stainless steel plate (alloy 316).
2. Install plate with bottom of 2”-diameter holes at same elevation as top of concrete wall. Attach to concrete with three ½”-dia. x 5”-long stainless steel anchor bolts. Spot weld nuts to bolts to prevent plate removal.
3. Tribe to install chains from 2”-dia. holes thru hand wheel operators with locks.

Slide Gate Requirements (shown schematically)

1. Slide gates (2 each) to be Waterman stainless steel gate No. SS-251-1-Y-36x24-10. See this drawing for overall gate dimensions. McWane MPI (https://mcwanepi.com) is a recommended supplier of Waterman slide gates.

   SS = stainless steel, alloy 316

   251 = standard (upward) opening

   1 = Series 1

   Y = self-contained gate

   36x24 = gate opening 36”x24”

   10 = 10’ seating head (no unseating head)
2. UMHW guides for gate, seats and seals all around.
3. Manual wheel operator. Wheel operator to be just above top of concrete wall to minimize exposure to floating debris during floods.
4. Contractor to install each gate with 3/8”-diameter x 5”-long stainless steel anchor bolts to concrete at each hole in gate flanges. Total 20 to 30 anchor bolts (approx.) required for installation of two gates. Seal between gate flanges and concrete walls with non-shrink grout (<1/2”-thick).

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

SLIDE GATE DETAILS

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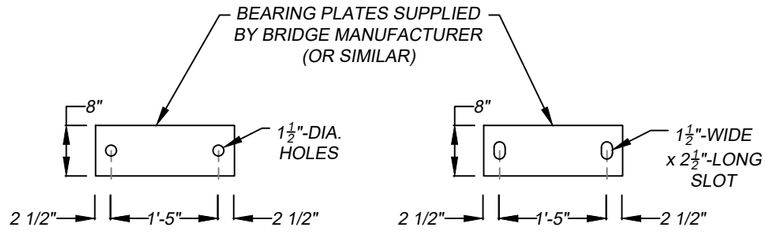
DRAWING	F4



BEARING PLATE w/ HOLES (3 REQUIRED)

NOTE: TIGHTEN NUTS TO BEARING PLATES AFTER BRIDGE PLACEMENT

BEARING PLATE w/ SLOTS (3 REQUIRED)

NOTE: LEAVE 1/8" GAP BETWEEN NUTS AND BEARING PLATES

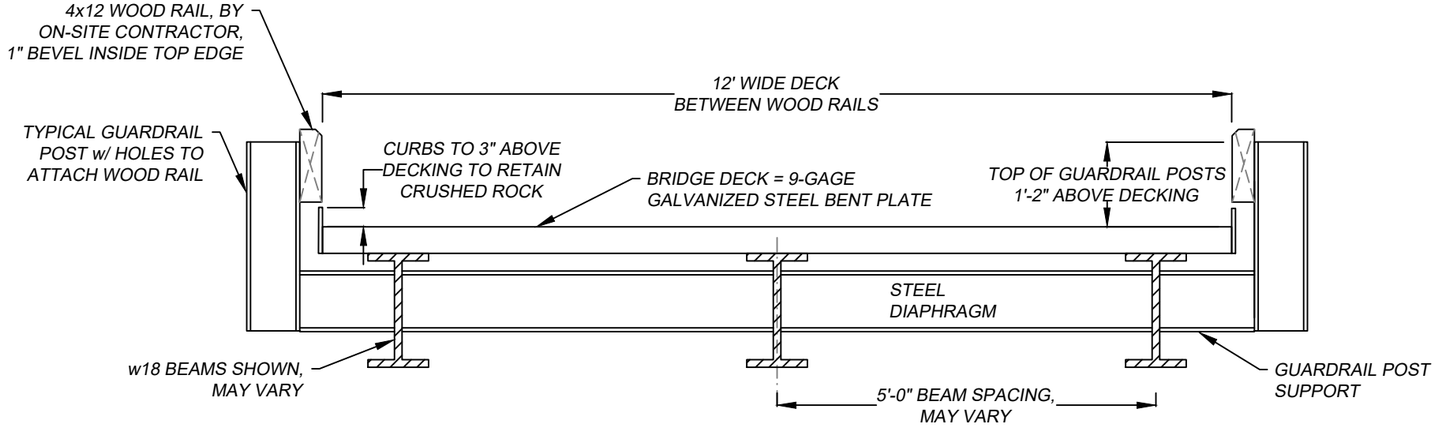
STEEL BRIDGE REQUIREMENTS:

1. 16'-6"-SPAN (BEAM END-TO-END) BY 12'-WIDE (DECK WIDTH) MODULAR WEATHERING STEEL BEAM BRIDGE TO BE PRE-FABRICATED AND SHIPPED TO THE PROJECT SITE. ACCESS VIA PUMPHOUSE ROAD ALONG HIGHWAY 97, ABOUT 7 MILES SOUTHWEST OF TOPPENISH, WA, w/ SITE ACCESSIBLE BY ROAD.

2. AFTER CONSTRUCTION OF WEATHERING STEEL SUPERSTRUCTURE, BUT PRIOR TO INSTALLATION OF DECK PLATE, ALL SURFACES SHALL BE BLASTED SP-6 COMMERCIAL BLAST TO REMOVE ALL MILL SCALE, GREASE, DIRT, RUST AND OTHER FOREIGN MATERIAL. BLASTING SAND TO BE BLOWN OFF ALL SURFACES PRIOR TO TRANSPORT.

3. ALL ON-SITE WORK INCLUDING LIFTING THE BRIDGE OFF TRANSPORT TRUCK, PLACING BRIDGE ON BEARING PLATES, WELDING BEAMS TO PLATES, AND ASSEMBLY OF GUARDRAIL POSTS WILL BE ACCOMPLISHED BY ON-SITE CONTRACTOR.

4. BRIDGE SUPPLIER TO PROVIDE BRIDGE SUPERSTRUCTURE PRE-FABRICATED WITH DECK MATERIAL ATTACHED, BEARING PLATES, ELASTOMERIC (OR SIMILAR) BEARING PADS, AND ALL ASSEMBLY HARDWARE (NUTS AND BOLTS).



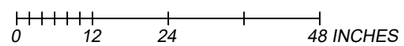
STEEL BRIDGE SCHEMATIC CROSS-SECTION

LOADS AND DEFLECTION:

1. LIVE LOAD = HS-25 (90,000 POUND VEHICLE).

2. INCLUDE 80 psf DEAD LOAD OVER ENTIRE DECK FOR SURFACING.

3. LIVE LOAD DEFLECTION < L/300.



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

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

STEEL BRIDGE REQUIREMENTS

BRYAN DAVID TAPPEL
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DATE	5/11/2026
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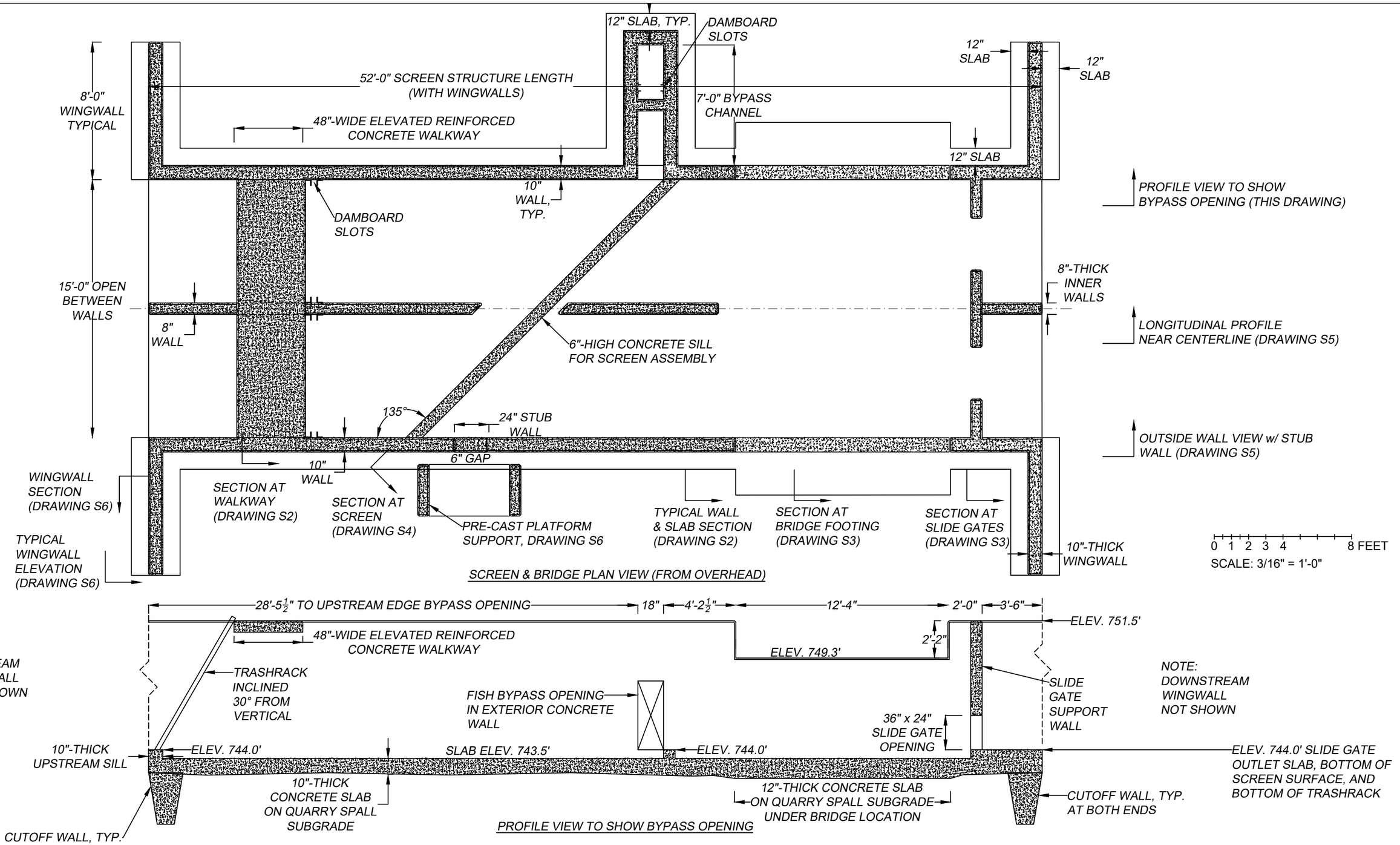
DRAFTED	BT
DRAWING	**F5**



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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

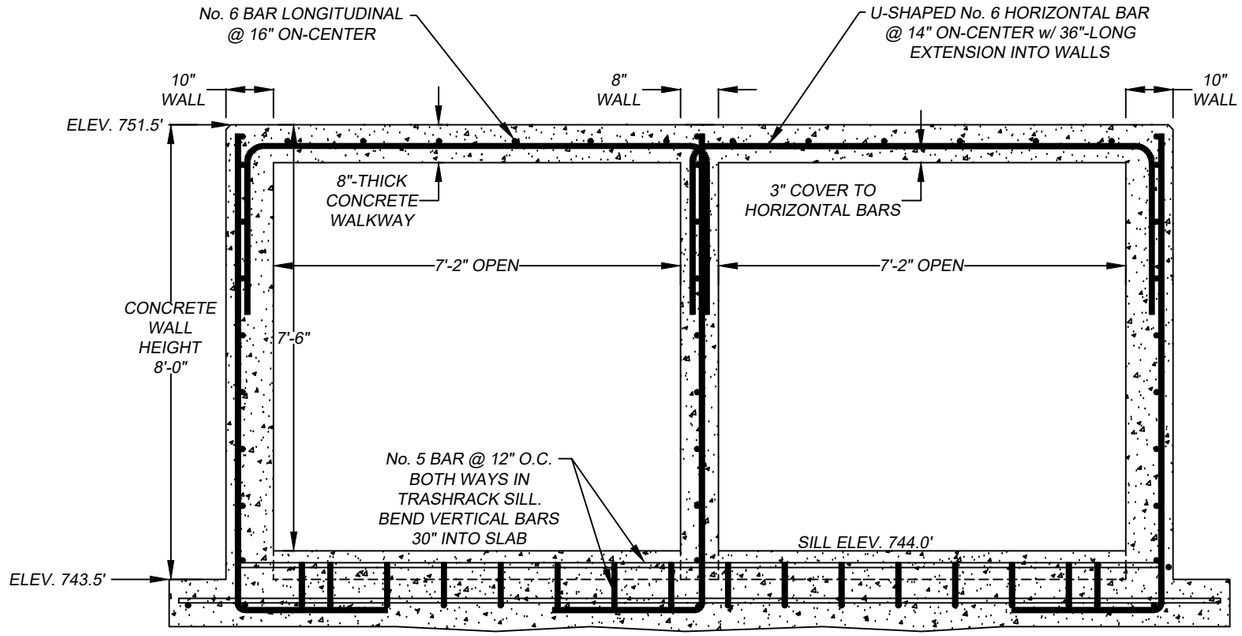
SCREEN & BRIDGE FOUNDATION PLAN

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

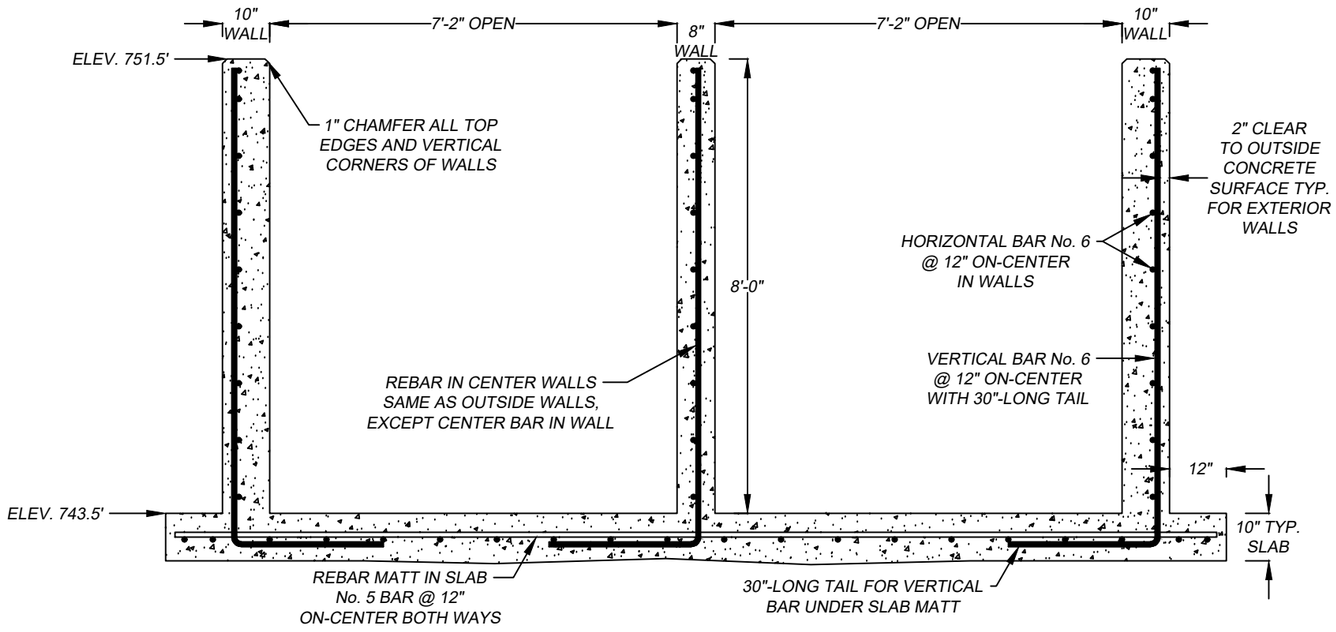
DATE	5/11/2026
DESIGNED	BT
DRAFTED	BT
DRAWING	**S1**

Reinforced Concrete Notes

1. All concrete to be cast-in-place Class 4000 WSDOT Spec. 6-02 with air entrainment.
2. All reinforcement to be Grade 60 deformed steel bars, WSDOT Spec. 9-07.
3. Concrete slabs may be poured monolithic, with tails for vertical bars (for walls) cast into slabs.
4. Lap splice length 36” for No. 6 bar and 32” for No. 5 bar.
5. Top of walls to have medium broom finish.



SECTION AT WALKWAY
WINGWALLS NOT SHOWN



TYPICAL WALL & SLAB SECTION FOR FISH SCREEN STRUCTURE

0 12 24 48 INCHES
SCALE: 3/8" = 1'-0"

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

CONCRETE STRUCTURE SECTIONS & DETAILS

BRYAN DAVID TAPPEL — STATE OF WASHINGTON — 21019228 — REGISTERED PROFESSIONAL ENGINEER

DATE	5/11/2026
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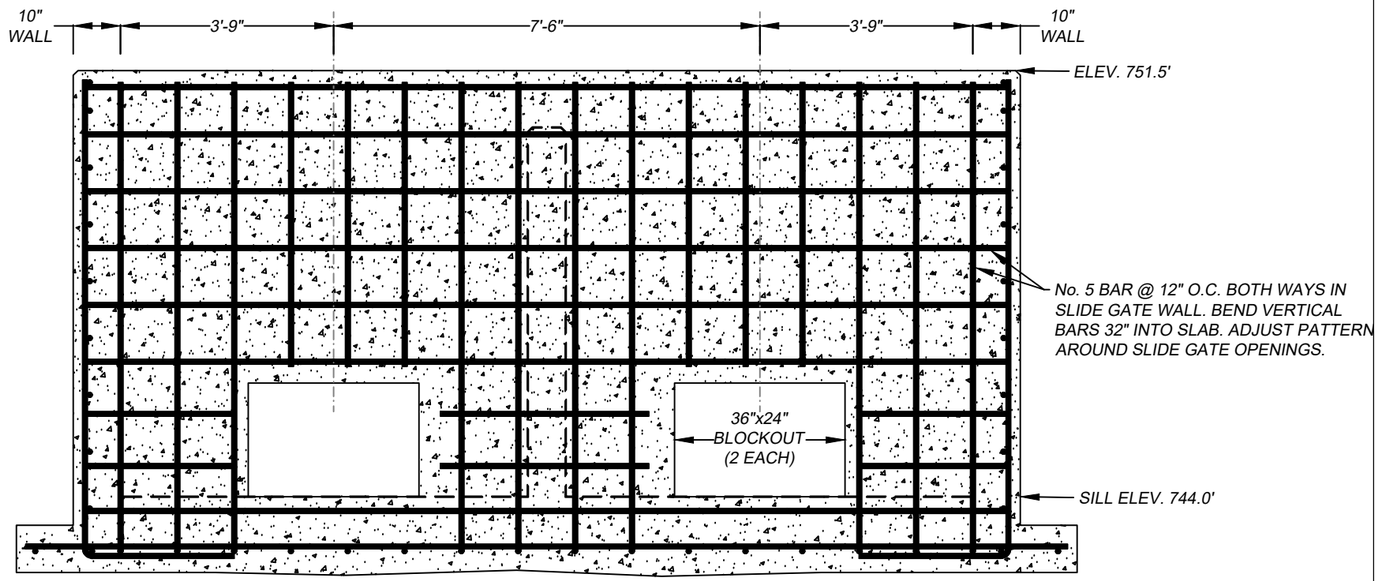
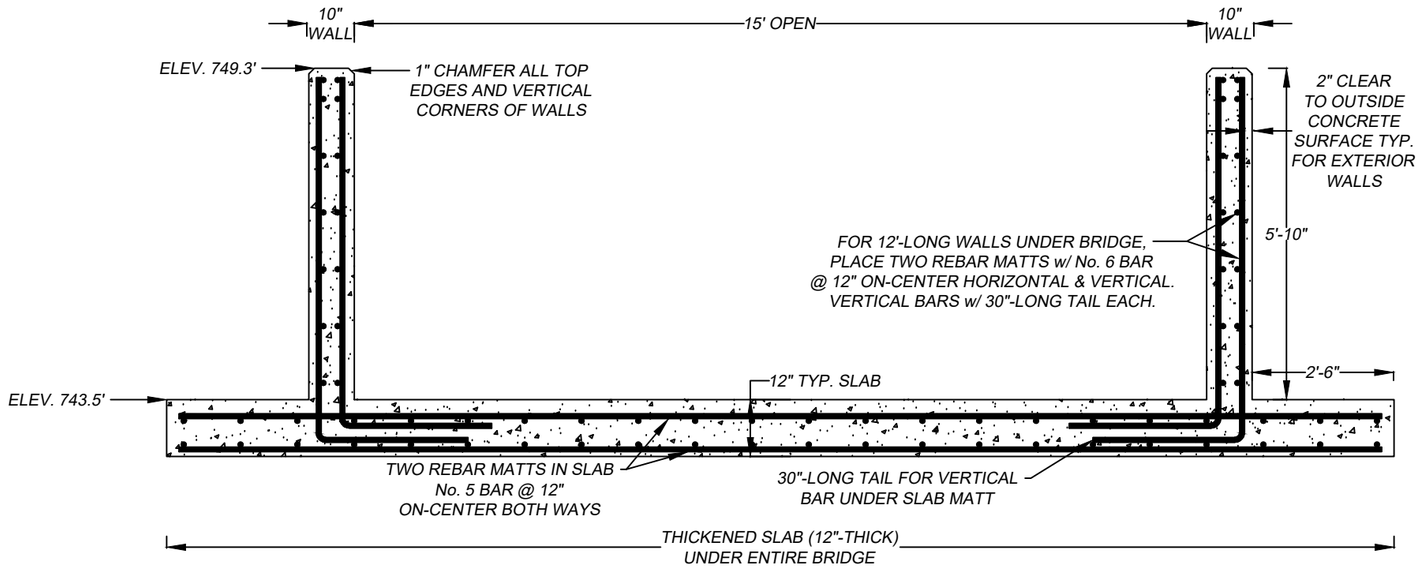
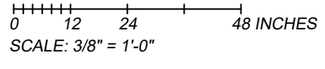
DRAWING	**S2**



SECTION AT SLIDE GATES



SECTION AT BRIDGE FOOTING



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

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DATE	5/11/2026
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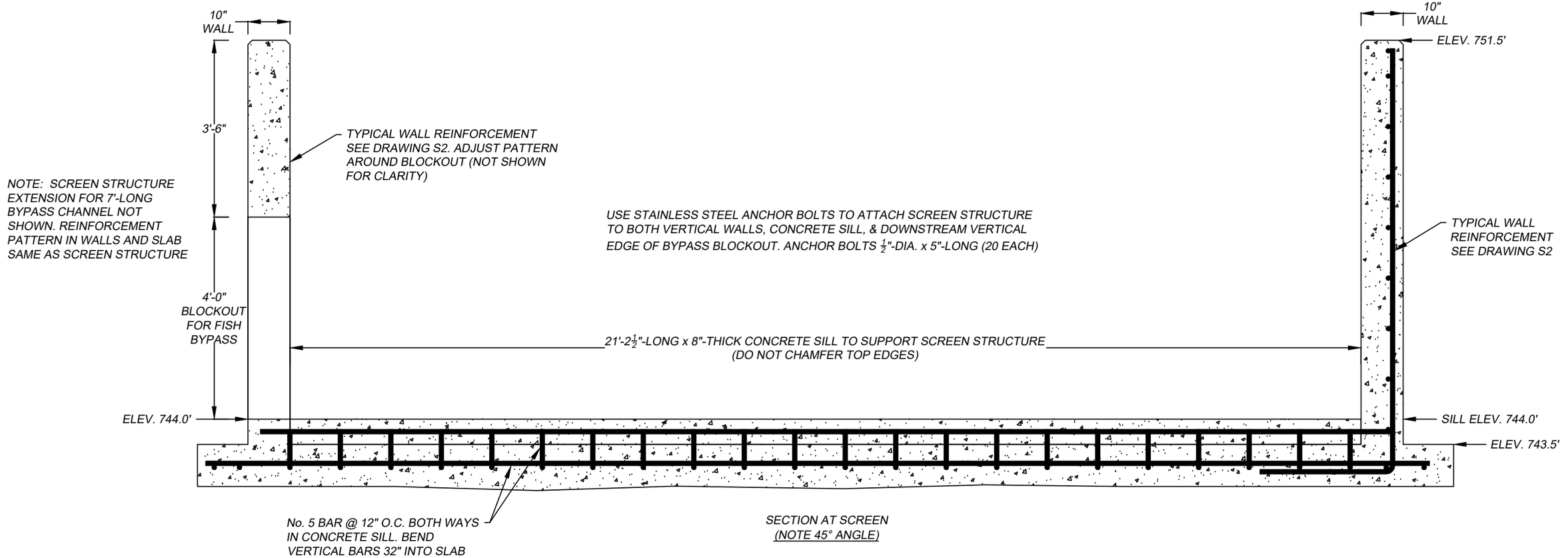
DRAWING	**S3**



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DATE	5/11/2026
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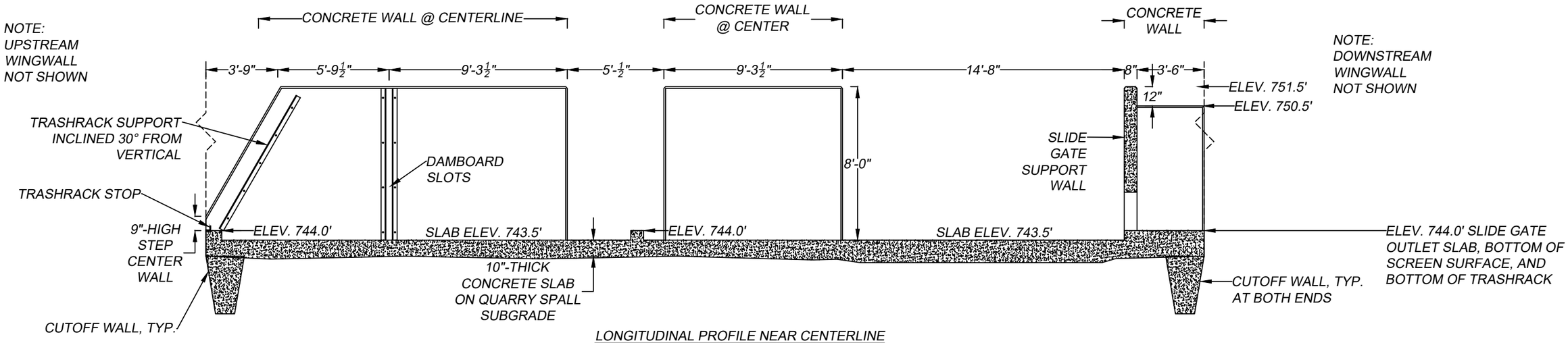
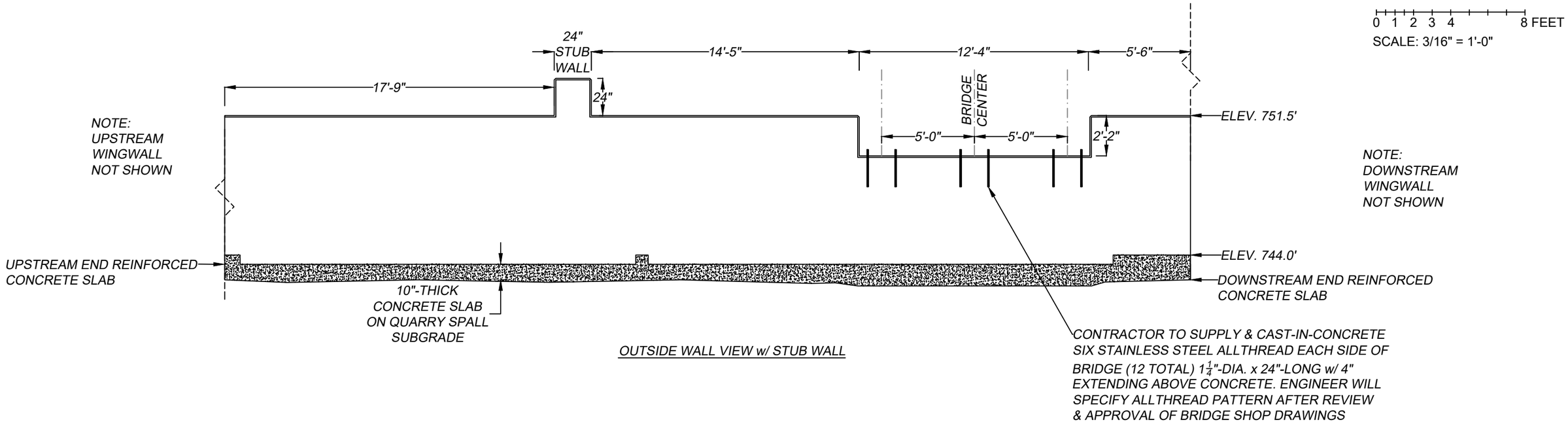
DRAWING	**S4**





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SNAKE CREEK FISH PASSAGE PROJECT

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CONCRETE STRUCTURE DETAILS

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DATE	5/11/2026
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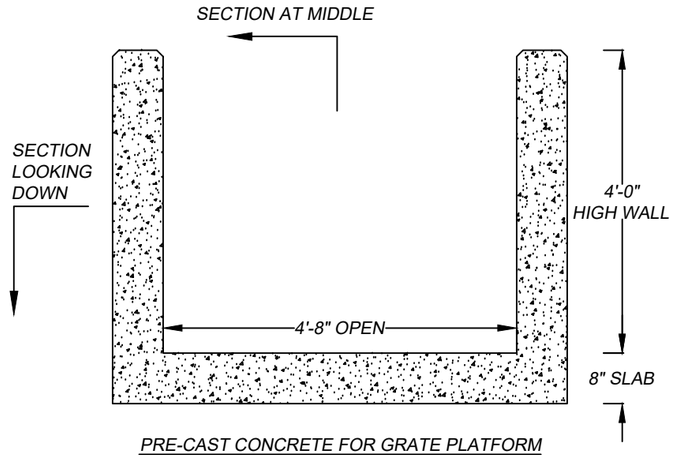
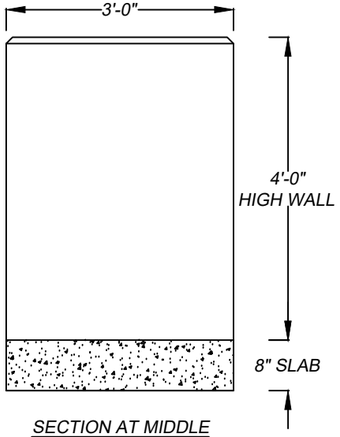
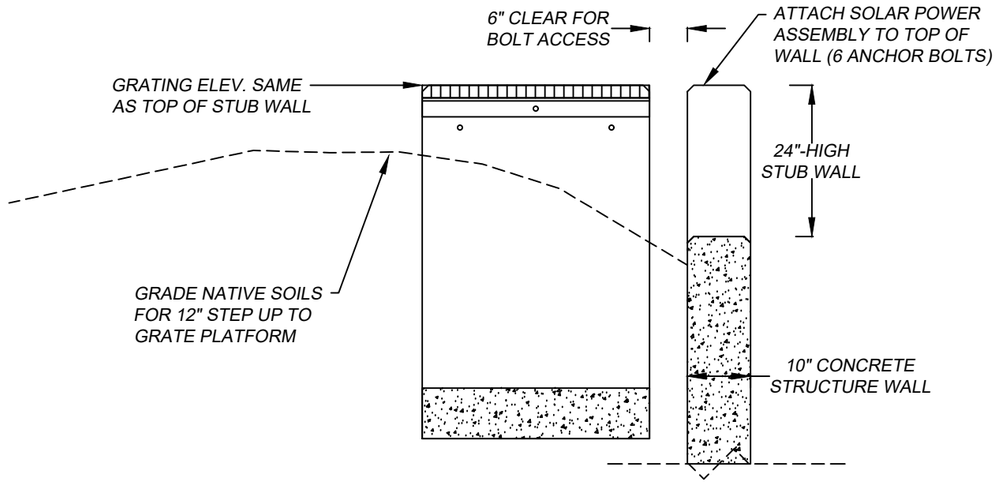
DRAWING	**S5**



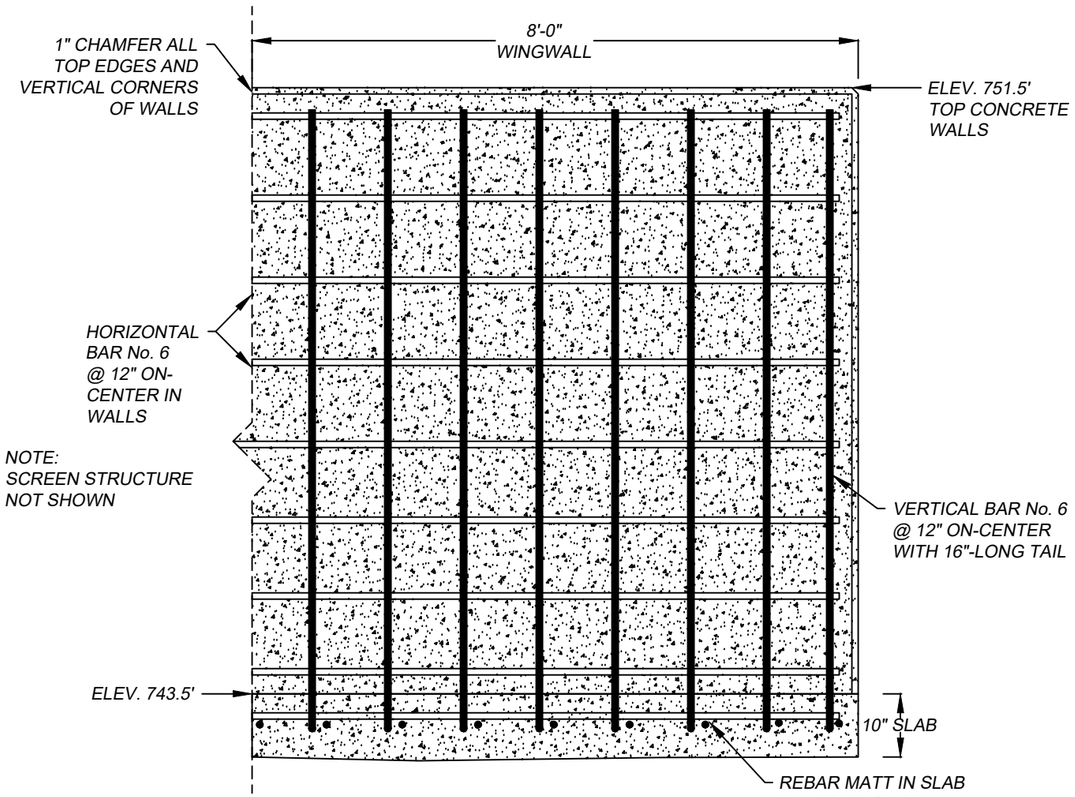
PRE-CAST CONCRETE FOR GRATE PLATFORM



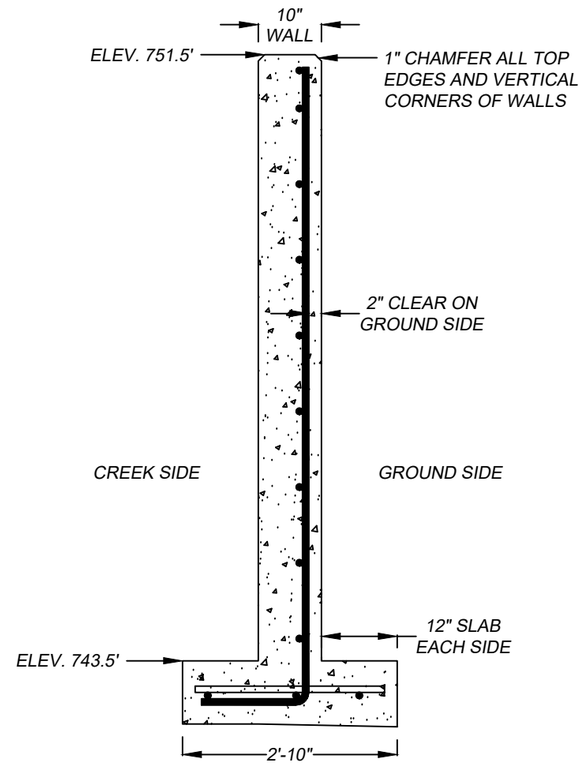
SECTION AT MIDDLE



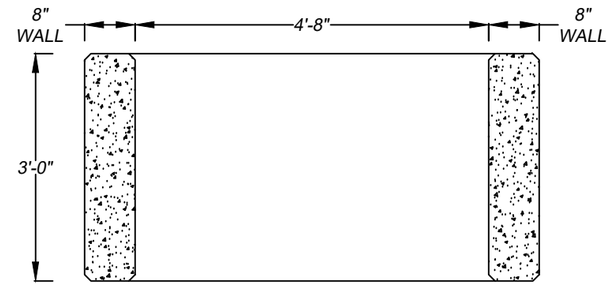
GRATE PLATFORM AT STUB WALL



TYPICAL WINGWALL ELEVATION



WINGWALL SECTION



GRATE PLATFORM
SECTION LOOKING DOWN

REBAR FOR PRE-CAST CONCRETE FOR PLATFORM TO BE No. 5 @ 12" O.C. BOTH WAYS. PLACE REBAR IN CENTER OF WALLS AND SLAB

0 12 24 48 INCHES

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

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CONCRETE STRUCTURE DETAILS

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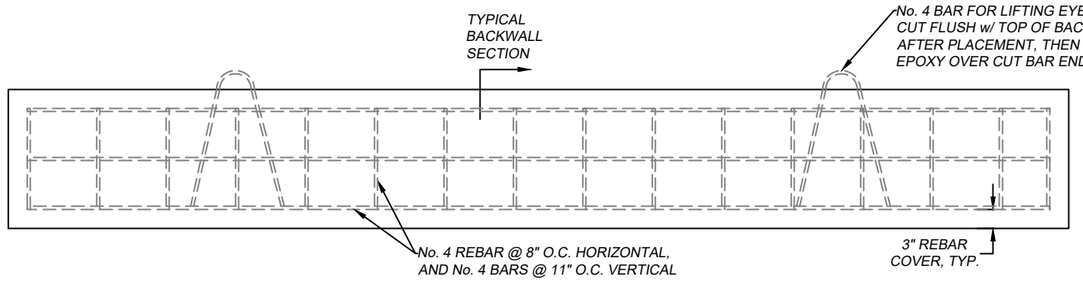
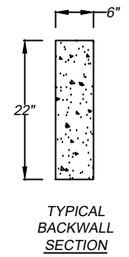
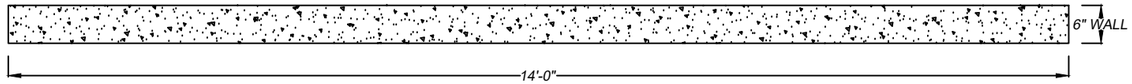
DRAWING	**S6**





TYPICAL
BACKWALL
SECTION



BACKWALL TOP VIEW

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

PRE-CAST CONCRETE BACKWALL NOTES:

1. TWO PIECES REQ'D AS SHOWN.

2. WSDOT CLASS 4000 CONCRETE w/ AIR ENTRAINMENT ADMIXTURE, GRADE 60 REBAR.

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SNAKE CREEK FISH PASSAGE PROJECT

YAKAMA NATION

BRIDGE PRE-CAST CONCRETE BACKWALLS

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