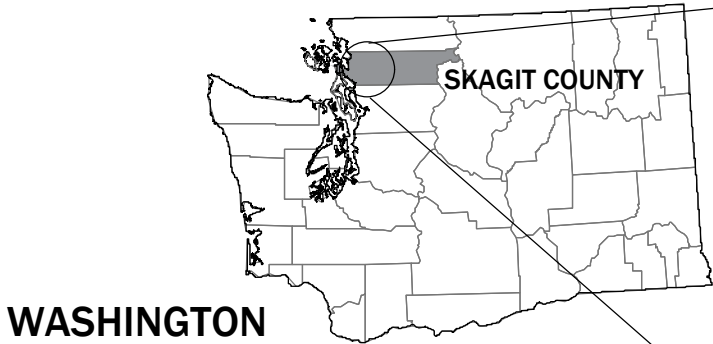


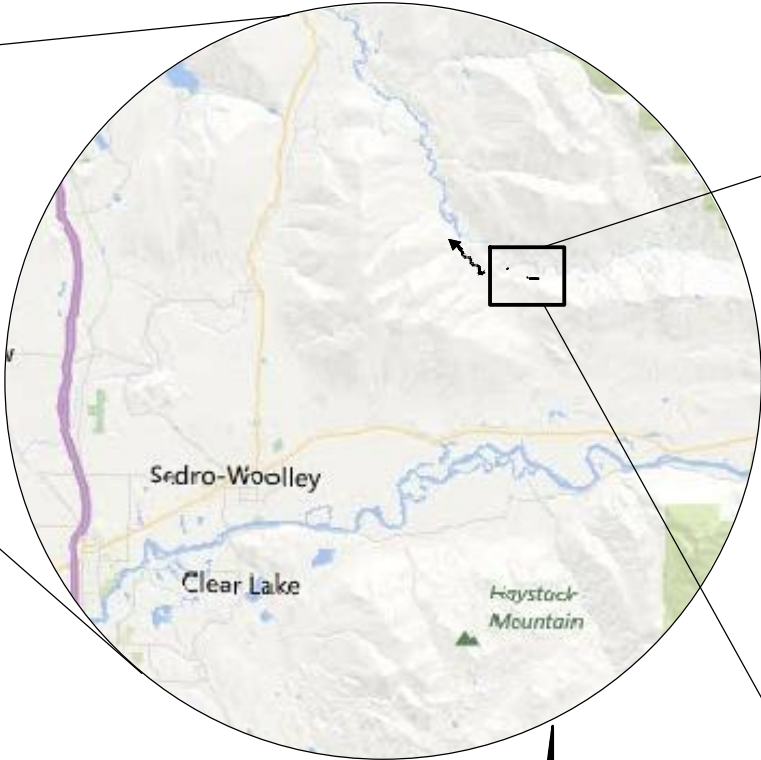
ELK FLATS CHANNEL RESTORATION

SOUTH FORK NOOKSACK RIVER

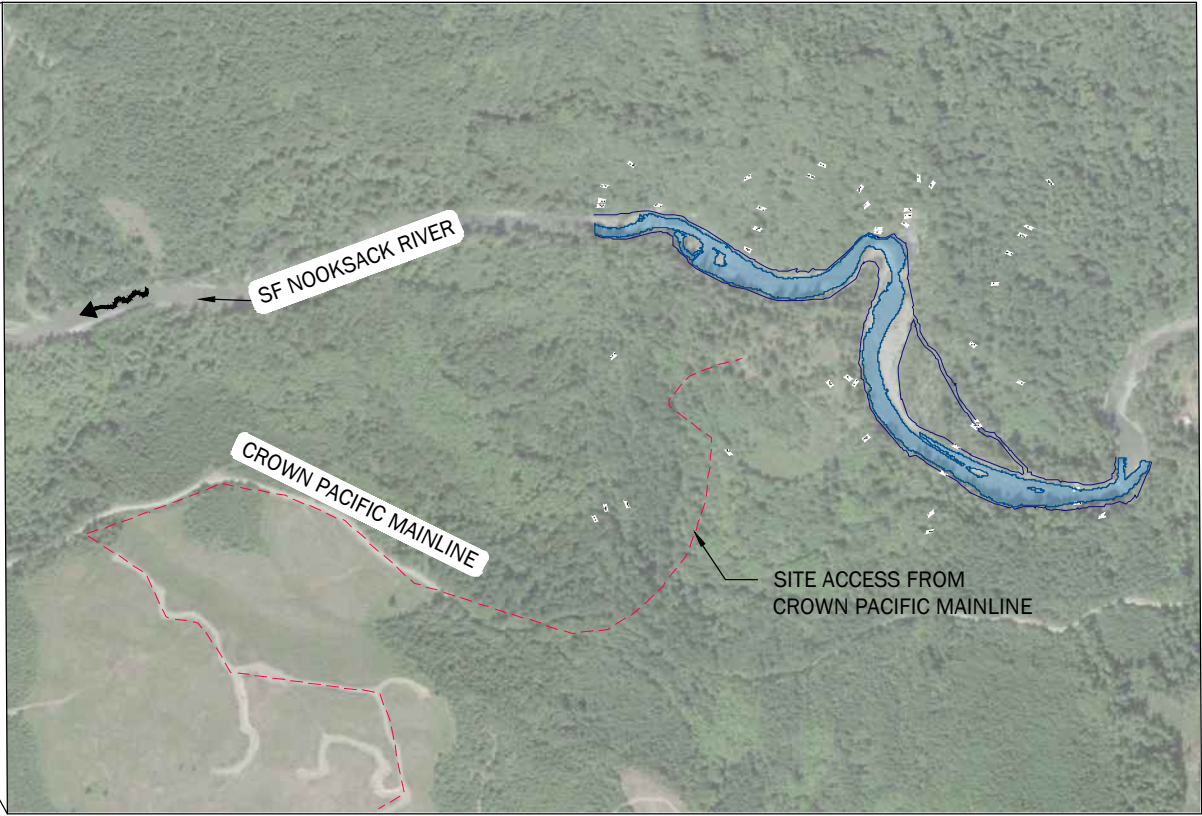
FINAL DESIGN - RELEASE FOR CONSTRUCTION



- PROJECT LOCATION
- FROM SEDRO-WOOLLY, WASHINGTON, HEAD EAST ON WA-20 E FOR 11.3 MILES.
 - TAKE A SLIGHT LEFT ONTO CROWN PACIFIC MAIN LINE ROAD, THEN TURN LEFT AT THE 2ND CROSS STREET ONTO SCOTT PAPER ROAD.
 - FOLLOW FOR 0.4 MILES THEN TURN RIGHT ONTO CROWN PACIFIC MAINLINE.
 - FOLLOW CROWN PACIFIC MAINLINE FOR 5.8 MILES. REFER TO INSET AND SHEET 2.2 FOR SITE ACCESS FROM CROWN PACIFIC MAINLINE ROAD.



VICINITY MAP
NTS



SITE ACCESS



SHEET LIST TABLE

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2	1.2	Notes and Quantities
3	2.1	Existing Conditions
4	2.2	Site Access, Staging and Sequencing
5	2.3	TESC Notes and Details
6	3.1	Proposed Conditions Overview
7	3.2	Proposed Wood Structures Plan RM 22.5 to 22.6
8	3.3	Proposed Wood Structures Plan RM 22.6 to 22.7
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10	3.5	Proposed Wood Structures Plan RM 22.8 to 22.9
11	3.6	Proposed Wood Structures Plan RM 22.9 to 23.0
12	3.7	Proposed Wood Structures Plan RM 23.0 to 23.1
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26	5.10	WOOD DETAILS - BANK ATTACHED JAM
27	5.11	WOOD DETAILS - BANK ATTACHED JAM SEQUENCING
28	5.12	WOOD DETAILS - CONNECTION DETAILS
29	6.1	REVEGETATION PLAN

CONTACT INFORMATION

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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

COVER

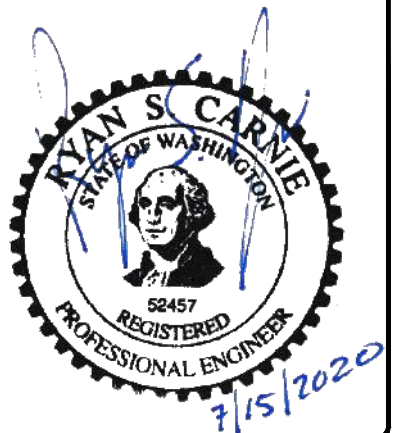
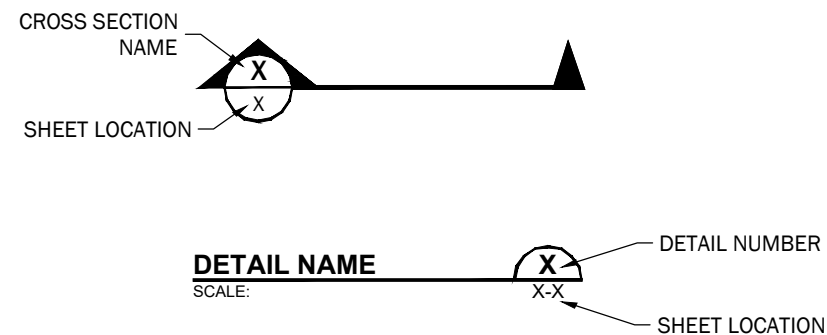
DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 1 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	1.1

1. THESE FINAL DESIGNS AND DRAWINGS HAVE BEEN PREPARED FOR THE EXCLUSIVE USE OF THE LUMMI NATION NATURAL RESOURCES (LNNR) AND THEIR AUTHORIZED AGENTS. NO OTHER PARTY MAY RELY ON THE PRODUCT OF OUR SERVICES UNLESS GEOENGINEERS INC. (GEOENGINEERS) AGREES IN WRITING IN ADVANCE OF SUCH USE.
2. THE DRAWINGS CONTAINED WITHIN SHOULD NOT BE APPLIED FOR ANY PURPOSE OR PROJECT EXCEPT THE ELK FLATS REACH OF SOUTH FORK NOOKSACK RIVER (PROJECT REACH) AS SHOWN IN THE PROJECT AREA LOCATED ON SHEET 1.1.
3. THESE DESIGNS AND DRAWINGS ARE COPYRIGHTED BY GEOENGINEERS, INC. ANY USE, ALTERATION, DELETION, OR EDITING OF THIS DOCUMENT WITHOUT EXPLICIT WRITTEN PERMISSION FROM GEOENGINEERS, INC. IS STRICTLY PROHIBITED. ANY OTHER UNAUTHORIZED USE OF THIS DOCUMENT IS PROHIBITED.
4. LNNR IS ADVISED TO CONFIRM THAT ALL NECESSARY PERMITS AND APPROVALS HAVE BEEN OBTAINED PRIOR TO CONSTRUCTION.
5. GEOMORPHIC CONDITIONS CAN CHANGE AND THESE DESIGNS ARE BASED ON CONDITIONS THAT EXISTED AT THE TIME THE DESIGN WAS PERFORMED. THE RESULTS OF THESE DESIGNS MAY BE AFFECTED BY THE PASSAGE OF TIME, BY MANMADE EVENTS SUCH AS CONSTRUCTION ON OR ADJACENT TO THE SITE, OR BY NATURAL EVENTS SUCH AS FLOODS, EARTHQUAKES, SLOPE INSTABILITY OR GROUNDWATER FLUCTUATIONS. ALWAYS CONTACT GEOENGINEERS BEFORE APPLYING THESE DESIGNS TO DETERMINE IF THEY REMAIN APPLICABLE.
6. ALL RIVERS, STREAMS, ROCKS AND WOODY HABITAT STRUCTURES ARE POTENTIALLY DANGEROUS. THESE PROPOSED IMPROVEMENTS ARE INTENDED TO ADDRESS A WIDE VARIETY OF CONSTRAINTS WHICH TARGET MORE NATURALLY FUNCTIONING STREAM SYSTEMS AND HABITAT. LNNR AND THE PROPERTY OWNER SHOULD ADDRESS SAFETY CONCERNS APPROPRIATELY.
7. POTENTIAL REGULATORY CHANGES TO FLOOD ELEVATIONS AND FLOOD EXTENTS RESULTING FROM THE PROPOSED ENHANCEMENTS HAVE NOT BEEN ADDRESSED BY GEOENGINEERS AS PART OF THIS PROJECT.
8. CHANNEL EROSION, CHANNEL MIGRATION AND/OR AVULSIONS CAN BE EXPECTED TO OCCUR OVER TIME. THESE CHANNEL PROCESSES ARE NATURAL AND APPROPRIATE FOR THESE STREAM SYSTEMS.
9. DESIGN SPECIFICS FOR STRUCTURES SHALL BE CONFIRMED AND/OR VERIFIED BY A QUALIFIED REPRESENTATIVE OF GEOENGINEERS PRIOR TO OR DURING CONSTRUCTION AT EACH PROPOSED STRUCTURE LOCATION.
10. THESE FIGURES WERE ORIGINALLY PRODUCED IN COLOR.
11. SHEETS ARE PROJECTED IN WASHINGTON STATE PLANE, NORTH, US FT. NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
12. AERIAL IMAGERY FROM GOOGLE EARTH PRO DATED 7/28/2016.
13. EXISTING TOPOGRAPHY FROM LUMMI NATION NATURAL RESOURCES DEPARTMENT, COLLECTED IN 2017 BY QUANTUM SPATIAL.
14. EXISTING WETLAND BOUNDARIES PROVIDED BY LUMMI NATION NATURAL RESOURCES DEPARTMENT AND DELINEATED IN OCTOBER, 2018 BY NORTHWEST ECOLOGICAL SERVICES, LLC.
15. HYDRAULIC MODEL RESULTS EXPORTED FROM HEC-RAS VERSION 5.0.7. THE 1-YEAR DISCHARGE IS 2,503 CFS, 2-YEAR DISCHARGE IS 7,231 CFS, AND THE 100-YEAR DISCHARGE IS 17,238 CFS.

WSEL	WATER SURFACE ELEVATION
TYP	TYPICAL
FT	FEET
ELEV	ELEVATION
Horiz.	HORIZONTAL
Vert.	VERTICAL
MIN	MINIMUM
MAX	MAXIMUM
NTS	NOT TO SCALE
AC	ACRES
℄	CHANNEL THALWEG (SECTION VIEW)
ACW	ACTIVE CHANNEL WIDTH
OHW	ORDINARY HIGH WATER
SQ-FT	SQUARE FEET
CY	CUBIC YARDS
DBH	TREE AT DIAMETER BREAST HEIGHT
DIA	DIAMETER
D ₅₀	MEDIAN PARTICLE DIAMETER

Bid Item List			
Specification Number	Item Description	Units	No. of Units
1	MOBILIZATION	LS	1
2	TEMPORARY ACCESS ROAD	LS	1
3	TESC MEASURES	LS	1
4	TEMPORARY STREAM DIVERSION AND DEWATERING	LS	1
5	CHANNEL EXCAVATION	CY	4230
6	APEX JAM INSTALLATION	EA	3
7	FLOW DEFLECTION JAM INSTALLATION	EA	7
8	VERTICAL ARRAY JAM INSTALLATION	EA	4
9	BANK ATTACHED JAM INSTALLATION	EA	4
10	ROADSIDE CLEANUP	FA	1

LOG SCHEDULE FOR LARGE WOOD STRUCTURES			QUANTITY PER STRUCTURE TYPE				TOTAL
MATERIAL ID	DESCRIPTION	Units	Apex	Flow Deflection	Vertical Post Array	Bank Attached	
A - HORIZONTAL MEMBER	40' LOG NO ROOTWAD (24-30" DBH)	EA			12		12
B - HORIZONTAL MEMBER	40' LOG WITH ROOTWAD (20-24" DBH)	EA		14			14
C - HORIZONTAL MEMBER	30' LOG WITH ROOTWAD (18-24" DBH)	EA	51	21	72		144
D - HORIZONTAL MEMBER	30' LOG WITH ROOTWAD (12-18" DBH)	EA				8	8
E - HORIZONTAL MEMBER	30' LOG NO ROOTWAD (12-18" DBH)	EA				8	8
F - VERTICAL PILE	25' VERTICAL PILE WITH ROOTWAD (18-22" DBH)	EA	30				30
G - VERTICAL PILE	15' VERTICAL PILE NO ROOTWAD (18-22" DBH)	EA		42	72	12	126
RACKING	RACKING MATERIAL (8-16'; 6"-10" DIA)	EA	150	105		16	271
SLASH	BRANCHES AND OTHER WOODY DEBRIS	CY	60	21			81

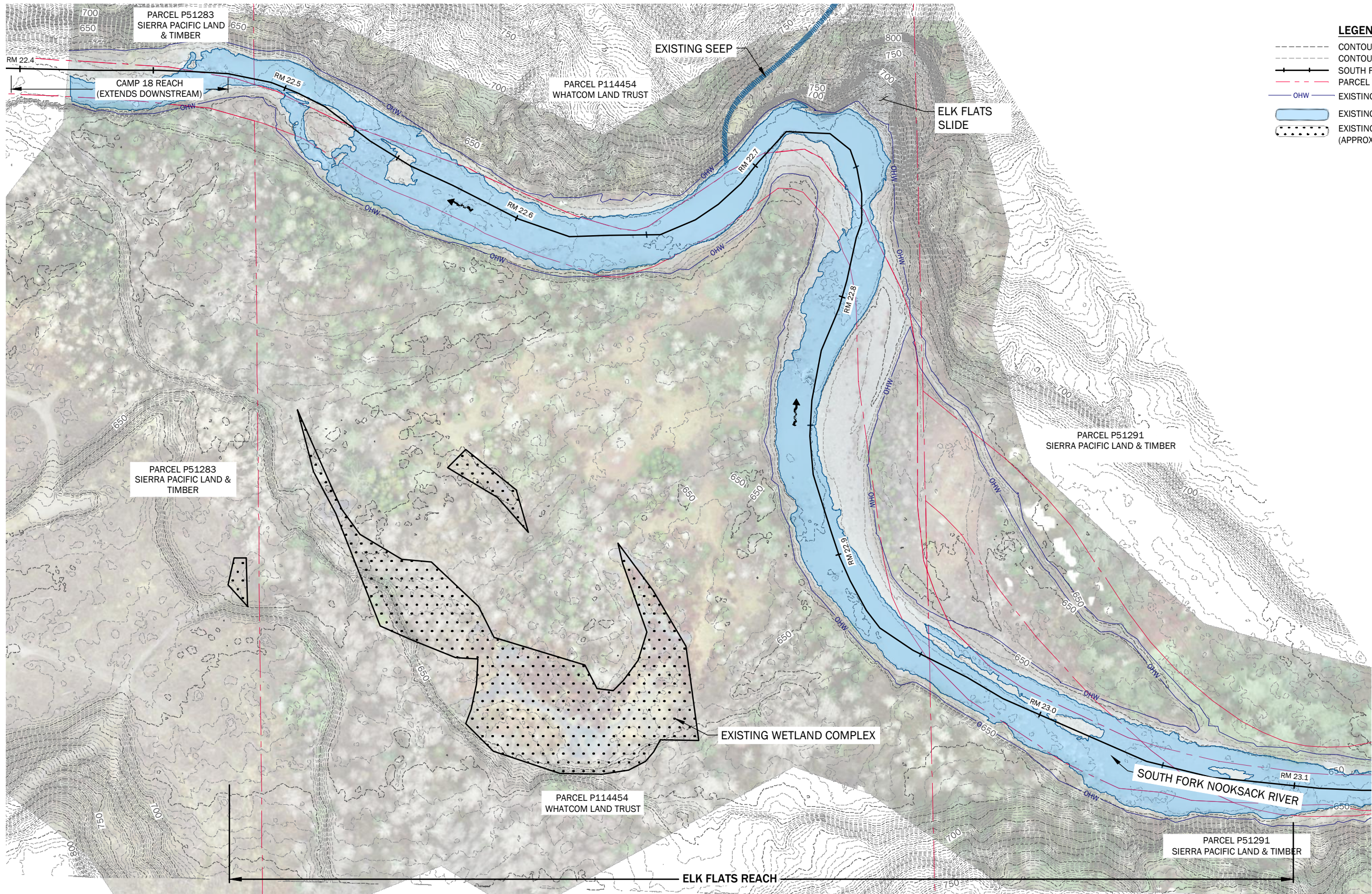
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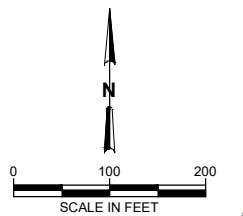
NOTES AND QUANTITIES

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 2 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	
1.2	

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- LEGEND**
- CONTOUR LINE - MAJOR (10-FOOT)
 - - - CONTOUR LINE - MINOR (2-FOOT)
 - SOUTH FORK NOOKSACK RIVER ALIGNMENT
 - PARCEL BOUNDARY
 - OHW
 - EXISTING OHW (2-YR INUNDATION)
 - EXISTING LOW FLOW CHANNEL
 - EXISTING WETLAND (APPROXIMATE BOUNDARY)



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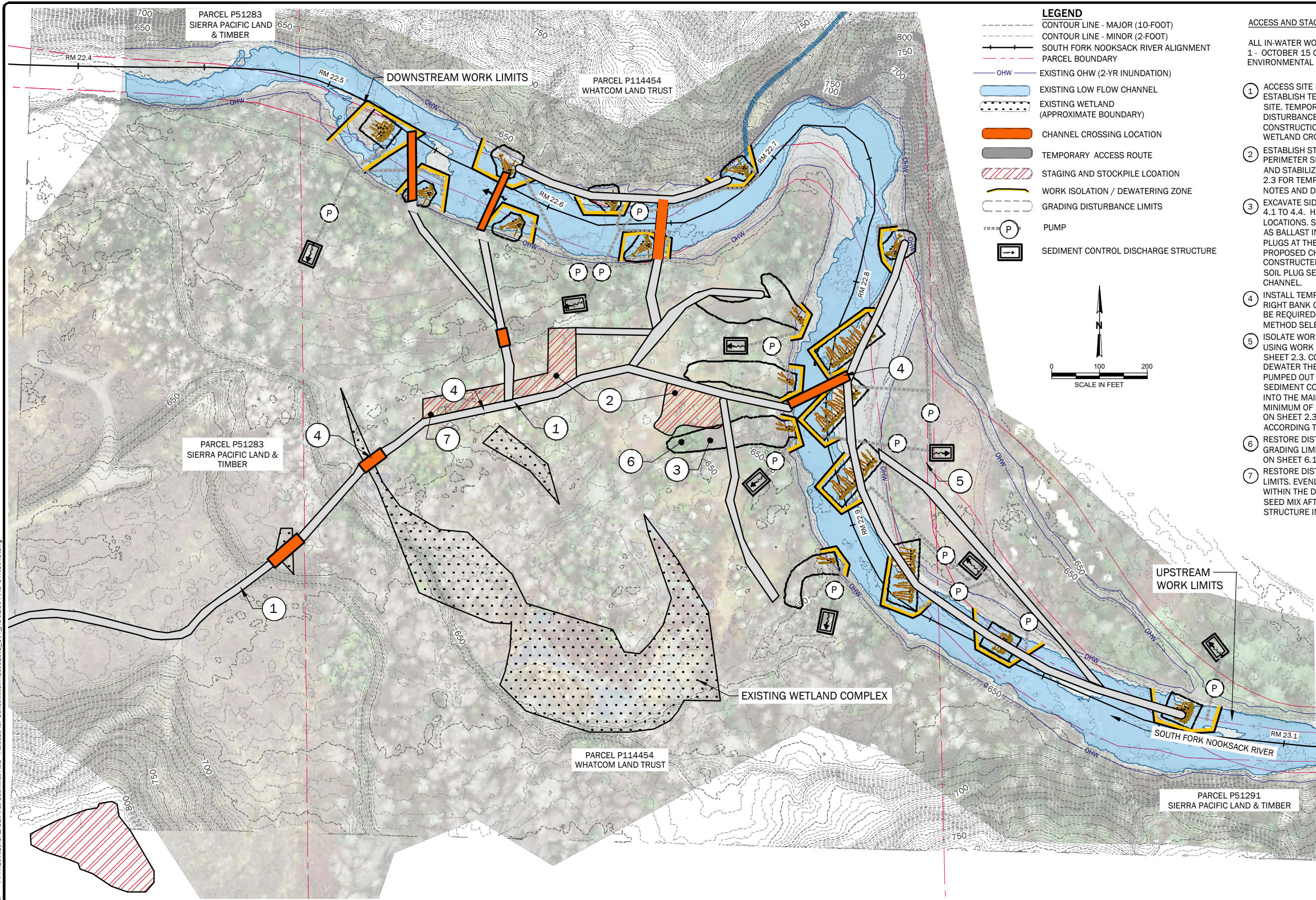


ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

EXISTING CONDITIONS

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 3 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	2.1

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User: lumiller



LEGEND

- CONTOUR LINE - MAJOR (10-FOOT)
- CONTOUR LINE - MINOR (2-FOOT)
- - - SOUTH FORK NOOKSACK RIVER ALIGNMENT
- - - PARCEL BOUNDARY
- - - OHW - EXISTING OHW (2-YR INUNDATION)
- - - EXISTING LOW FLOW CHANNEL
- - - EXISTING WETLAND (APPROXIMATE BOUNDARY)
- - - CHANNEL CROSSING LOCATION
- - - TEMPORARY ACCESS ROUTE
- - - STAGING AND STOCKPILE LOCATION
- - - WORK ISOLATION / DEWATERING ZONE
- - - GRADING DISTURBANCE LIMITS
- - - P PUMP
- - - SEDIMENT CONTROL DISCHARGE STRUCTURE

ACCESS AND STAGING GENERAL NOTES

- ALL IN-WATER WORK SHALL OCCUR BETWEEN JULY 1 - OCTOBER 15 OR AS OTHERWISE SPECIFIED IN ENVIRONMENTAL PERMITS.
- 1 ACCESS SITE FROM CROWN PACIFIC MAINLINE ROAD. ESTABLISH TEMPORARY ACCESS ROUTES THROUGHOUT THE SITE. TEMPORARY ACCESS ROUTES SHALL MINIMIZE DISTURBANCE TO NATIVE VEGETATION. TEMPORARY CONSTRUCTION BRIDGE SHALL BE PLACED OVER ANY WETLAND CROSSINGS, AS SHOWN.
 - 2 ESTABLISH STAGING AND STOCKPILE LOCATIONS. INSTALL PERIMETER SEDIMENT CONTROLS AROUND STAGING AREAS AND STABILIZE ANY TEMPORARY STOCKPILES. SEE SHEET 2.3 FOR TEMPORARY EROSION AND SEDIMENT CONTROL NOTES AND DETAILS.
 - 3 EXCAVATE SIDE CHANNELS INLETS AS SHOWN ON SHEETS 4.1 TO 4.4. HAUL EXCESS MATERIAL TO STOCKPILE LOCATIONS. STOCKPILED GRAVEL AND COBBLE TO BE USED AS BALLAST IN LARGE WOOD STRUCTURES. LEAVE SOIL PLUGS AT THE INTERFACE BETWEEN THE EXISTING AND PROPOSED CHANNEL. METER THE FLOW INTO THE NEWLY CONSTRUCTED CHANNEL BY GRADUALLY EXCAVATING THE SOIL PLUG SEPARATING THE EXISTING AND PROPOSED CHANNEL.
 - 4 INSTALL TEMPORARY CHANNEL CROSSINGS TO ACCESS THE RIGHT BANK OF THE MAIN CHANNEL. FISH EXCLUSION MAY BE REQUIRED DEPENDING ON TEMPORARY CROSSING METHOD SELECTED.
 - 5 ISOLATE WORK ZONES FOR LARGE WOOD INSTALLATION USING WORK AREA ISOLATION STRUCTURE PER DETAIL ON SHEET 2.3. CONDUCT FISH SALVAGE PRIOR TO DEWATERING. DEWATER THE ISOLATED WORK AREA. DISCHARGE SHALL BE PUMPED OUT OF THE WORK AREA AND TREATED WITH A SEDIMENT CONTROL BAG BEFORE BEING RELEASED BACK INTO THE MAIN CHANNEL OR INFILTRATED ON SITE A MINIMUM OF 50 FEET FROM THE MAIN CHANNEL PER DETAIL ON SHEET 2.3. CONSTRUCT LARGE WOOD STRUCTURES ACCORDING TO SHEETS 5.1 TO 5.7.
 - 6 RESTORE DISTURBED AREAS WITHIN THE FLOODPLAIN GRADING LIMITS ACCORDING TO THE REVEGETATION PLAN ON SHEET 6.1.
 - 7 RESTORE DISTURBED AREAS OUTSIDE FLOODPLAIN GRADING LIMITS. EVENLY DISTRIBUTE EXCESS MATERIAL ON SITE WITHIN THE DISTURBANCE LIMITS. STABILIZE WITH NATIVE SEED MIX AFTER CHANNEL EXCAVATION AND LOG STRUCTURE INSTALLATION IS COMPLETE.



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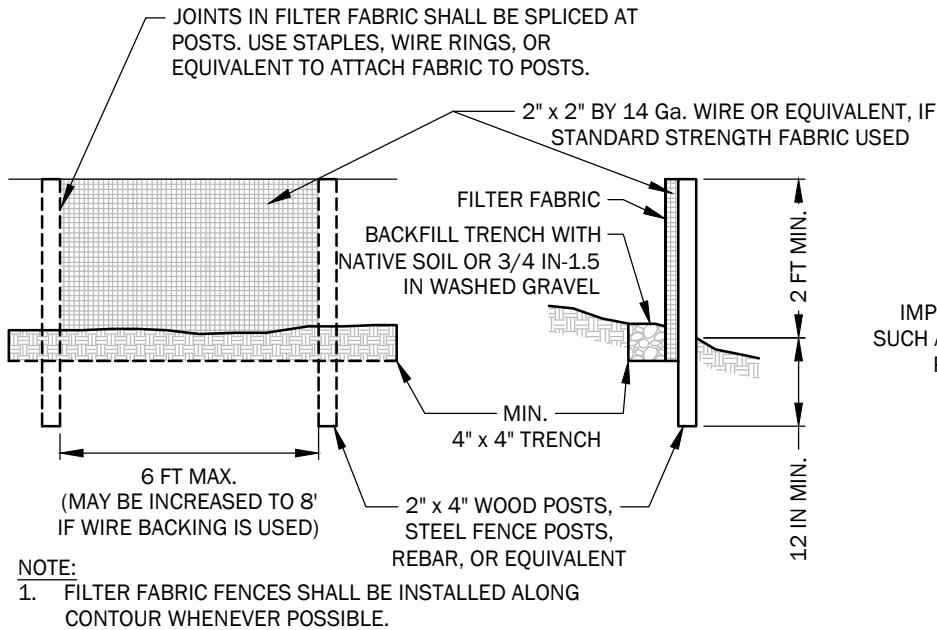
ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

SITE ACCESS, STAGING AND SEQUENCING

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 4 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	2.2

EROSION SEDIMENT CONTROL NOTES:

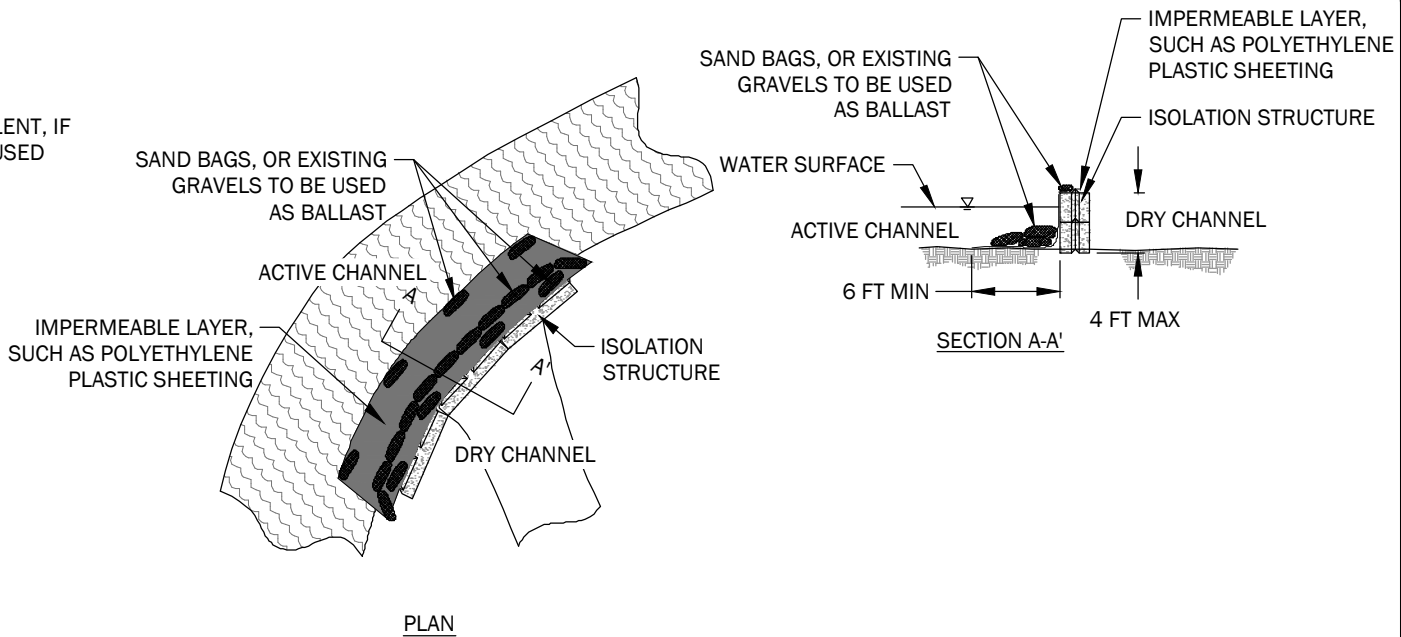
1. THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THE EROSION AND SEDIMENT CONTROL (ESC) STRUCTURES IS THE RESPONSIBILITY OF THE LEAD ESC CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETE AND APPROVED.
2. ANY EQUIPMENT REFUELING AND PLACEMENT OF STATIONARY MOTORIZED EQUIPMENT SHALL BE LOCATED AT LEAST 150FT AWAY FROM THE ACTIVE CHANNEL MARGIN.
3. ESC FACILITIES SHOWN ON THIS SHEET ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE ESC FACILITIES SHALL BE UPGRADED AS NEEDED FOR UNEXPECTED STORM EVENTS TO ENSURE THAT WATER MEETS WASHINGTON STATE WATER QUALITY STANDARDS.
4. THE ESC FACILITIES SHALL BE INSPECTED BY THE CONTRACTOR DAILY AND MAINTAINED AS NECESSARY TO ENSURE THEIR PROPER PERFORMANCE THROUGHOUT THE DURATION OF CONSTRUCTION. ANY DAMAGE SHALL BE REPAIRED IMMEDIATELY.
5. IF SILT FENCES ARE INSTALLED, IT IS IMPORTANT TO CHECK THE UPHILL SIDE OF THE FENCE FOR SIGNS OF THE FENCE CLOGGING AND ACTING AS A BARRIER TO FLOW AND THEN CAUSING CHANNELIZATION OF FLOWS PARALLEL TO THE FENCE. IF THIS OCCURS, REPLACE THE FENCE OR REMOVE THE TRAPPED SEDIMENT. SEDIMENT DEPOSITS SHALL EITHER BE REMOVED WHEN THE DEPOSIT REACHES APPROXIMATELY ONE-THIRD THE HEIGHT OF THE SILT FENCE, OR A SECOND SILT FENCE SHALL BE INSTALLED.



SILT FENCE

SCALE: NOT TO SCALE

1
2.3

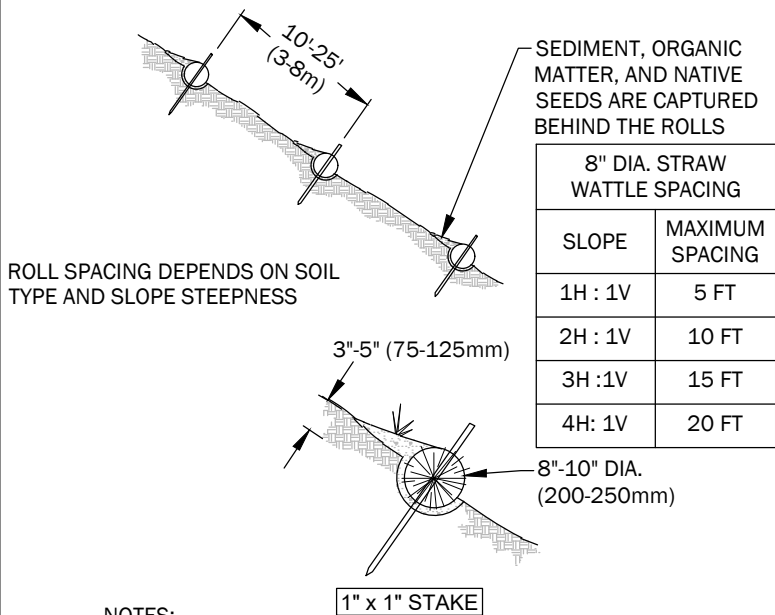


PLAN

WORK ZONE ISOLATION STRUCTURE

SCALE: NOT TO SCALE

2
2.3



ROLL SPACING DEPENDS ON SOIL TYPE AND SLOPE STEEPNESS

SEDIMENT, ORGANIC MATTER, AND NATIVE SEEDS ARE CAPTURED BEHIND THE ROLLS

8" DIA. STRAW WATTLE SPACING	
SLOPE	MAXIMUM SPACING
1H : 1V	5 FT
2H : 1V	10 FT
3H : 1V	15 FT
4H : 1V	20 FT

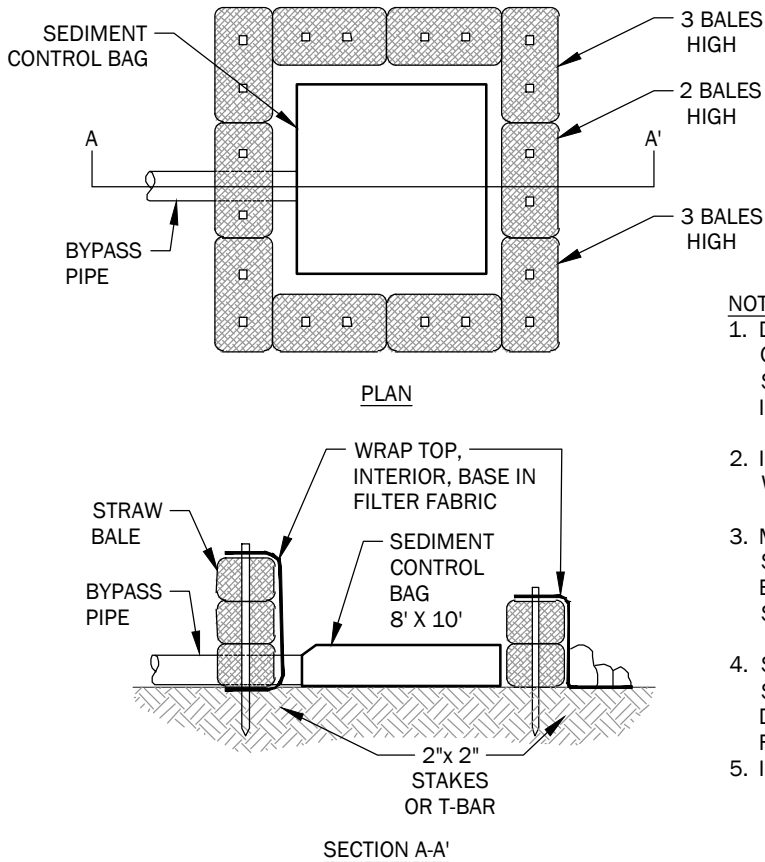
NOTES:

1. PREPARE THE SLOPE BEFORE INSTALLING STRAW WATTLES.
2. INSTALL PERPENDICULAR TO THE SLOPE, PARALLEL TO THE SLOPE CONTOUR.
3. STRAW ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3" x 5" (75-125mm) DEEP, DUG ON CONTOUR.
4. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

STRAW WATTLES

SCALE: NOT TO SCALE

3
2.3



PLAN

SECTION A-A'

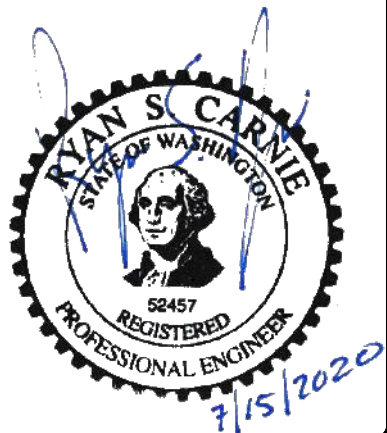
SEDIMENT CONTROL DISCHARGE STRUCTURE

SCALE: NOT TO SCALE

4
2.3

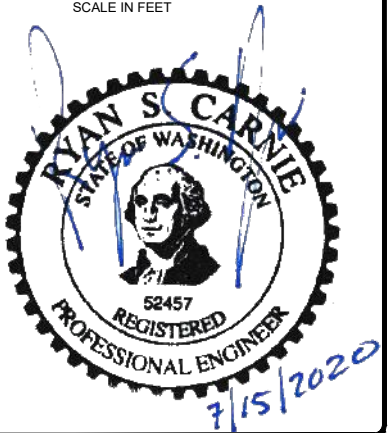
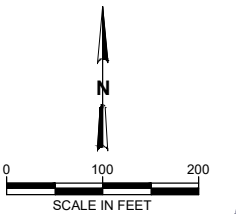
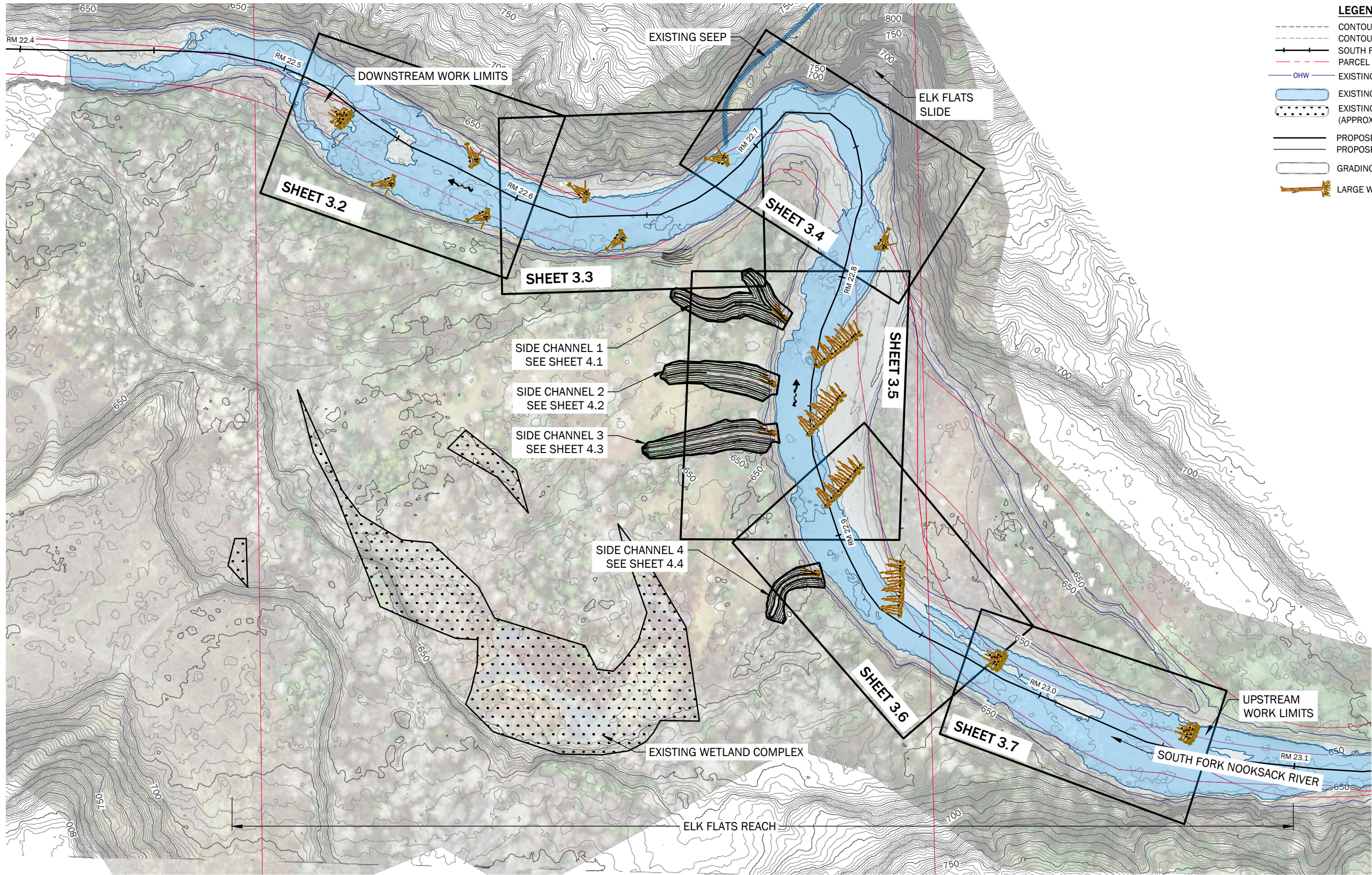
NOTES:

1. DO NOT PLACE DISCHARGE STRUCTURE ON STEEP SLOPES OR WHERE SATURATED SOIL CONDITIONS MAY CAUSE SOIL INSTABILITY.
2. INSTALL ON A MILD SLOPE TO ALLOW WATER TO DRAIN THROUGH THE BAG.
3. MONITOR THE SEDIMENT CONTROL STRUCTURE THROUGHOUT USE. REPLACE BAG WHEN IT CAN NO LONGER FILTER SEDIMENT OR PASS WATER.
4. SIZE AND MAINTENANCE OF THE SEDIMENT CONTROL STRUCTURE IS DEPENDENT ON THE PUMP SIZE AND FLOW RATE.
5. INSTALL OUTSIDE OF OHWM.



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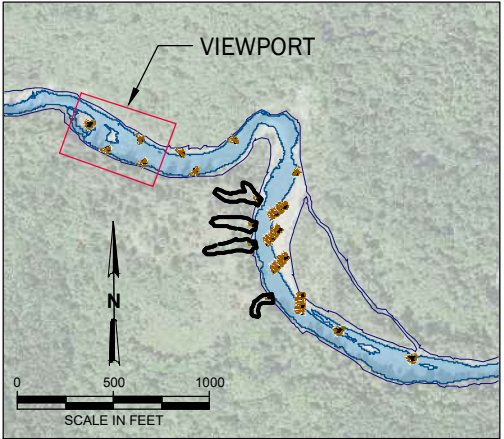
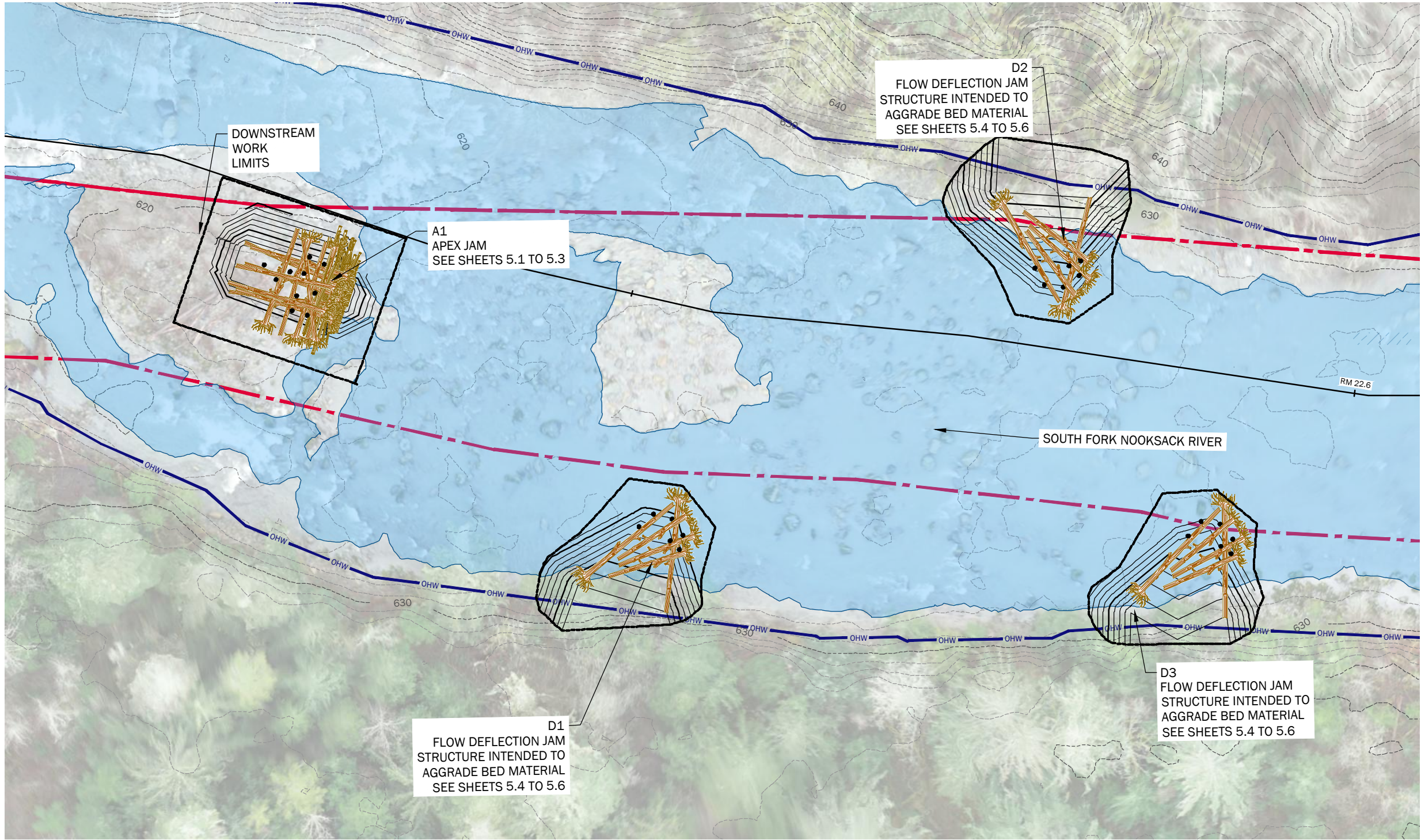


ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

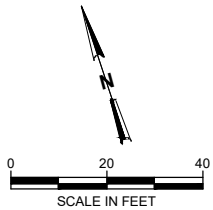
PROPOSED CONDITIONS OVERVIEW

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 6 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	3.1

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- LEGEND**
- CONTOUR LINE - MAJOR (5-FOOT)
 - CONTOUR LINE - MINOR (1-FOOT)
 - SOUTH FORK NOOKSACK RIVER ALIGNMENT
 - PARCEL BOUNDARY
 - OHW --- EXISTING OHW (2-YR INUNDATION)
 - EXISTING LOW FLOW CHANNEL
 - EXISTING WETLAND (APPROXIMATE BOUNDARY)
 - PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
 - PROPOSED CONTOUR LINE - MINOR (1-FOOT)
 - GRADING DISTURBANCE LIMITS
 - LARGE WOOD KEY MEMBER



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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

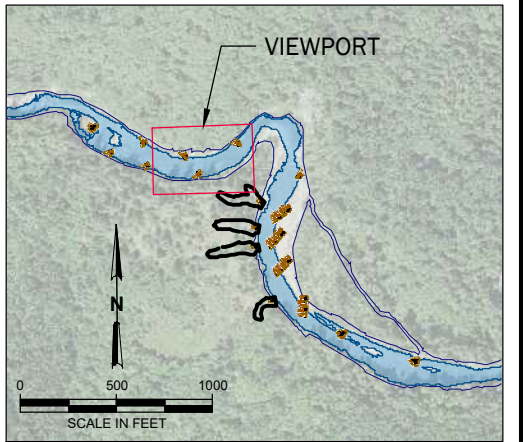
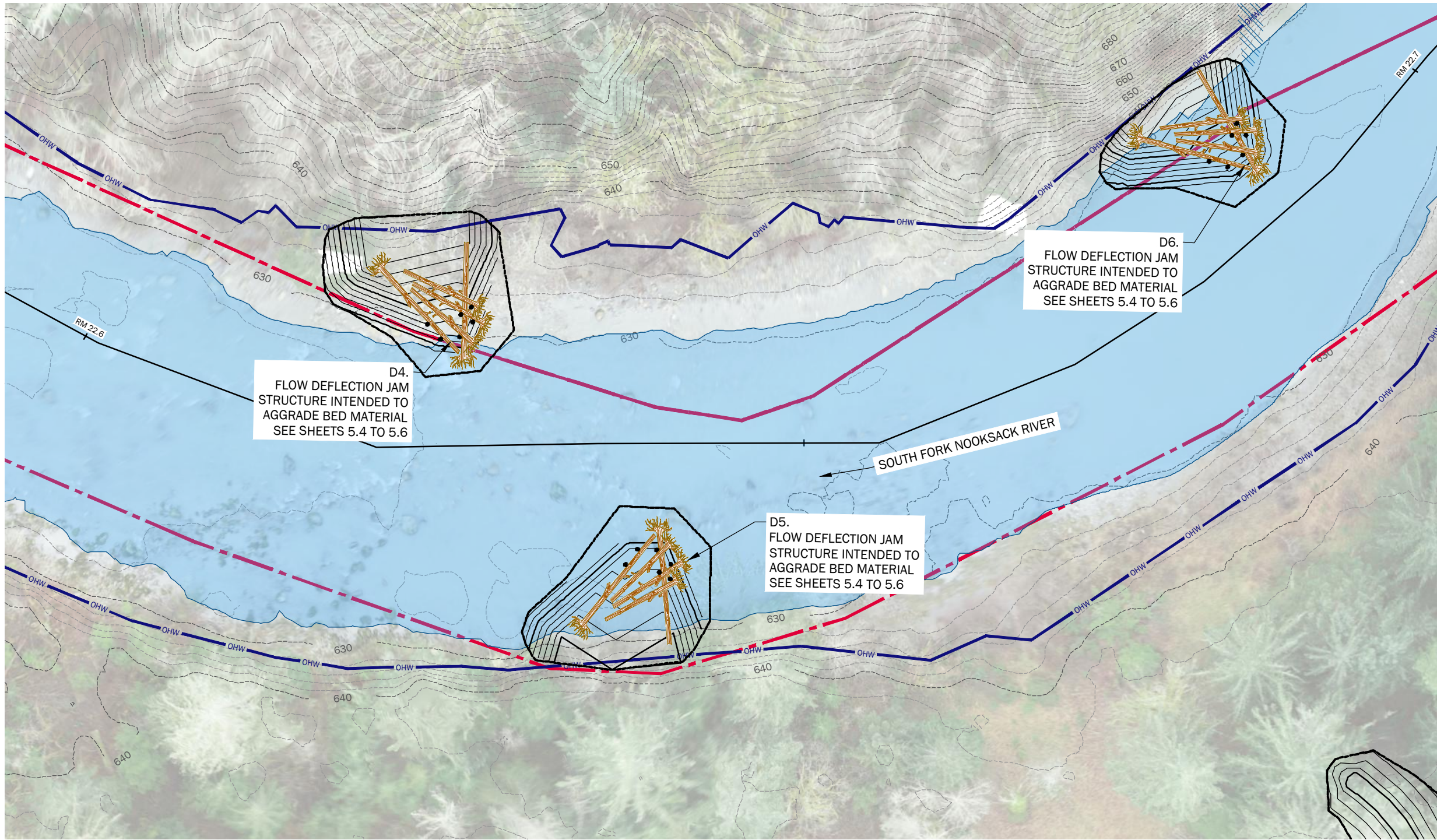
PROPOSED WOOD STRUCTURES PLAN
River Mile 22.5 to 22.6

DRAWN: BHM/HCM
DESIGN: BHM
CHECKED: RSC/JTM
SHEET NO.

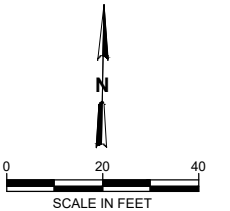
PROJ NO: 1209-028-02
SHEET 7 OF 29
DATE: 07.15.2020

3.2

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- LEGEND**
- CONTOUR LINE - MAJOR (5-FOOT)
 - CONTOUR LINE - MINOR (1-FOOT)
 - SOUTH FORK NOOKSACK RIVER ALIGNMENT
 - PARCEL BOUNDARY
 - OHW --- EXISTING OHW (2-YR INUNDATION)
 - EXISTING LOW FLOW CHANNEL
 - EXISTING WETLAND (APPROXIMATE BOUNDARY)
 - PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
 - PROPOSED CONTOUR LINE - MINOR (1-FOOT)
 - GRADING DISTURBANCE LIMITS
 - LARGE WOOD KEY MEMBER



NO.	DATE	BY	REVISION

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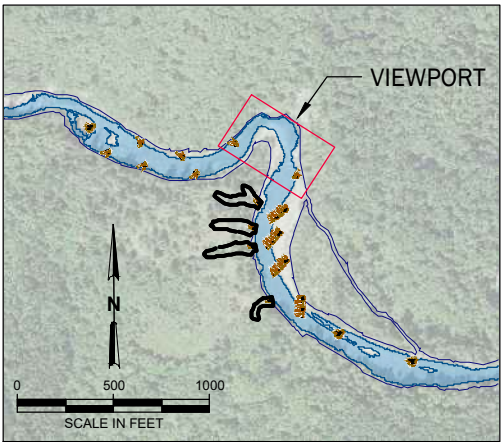
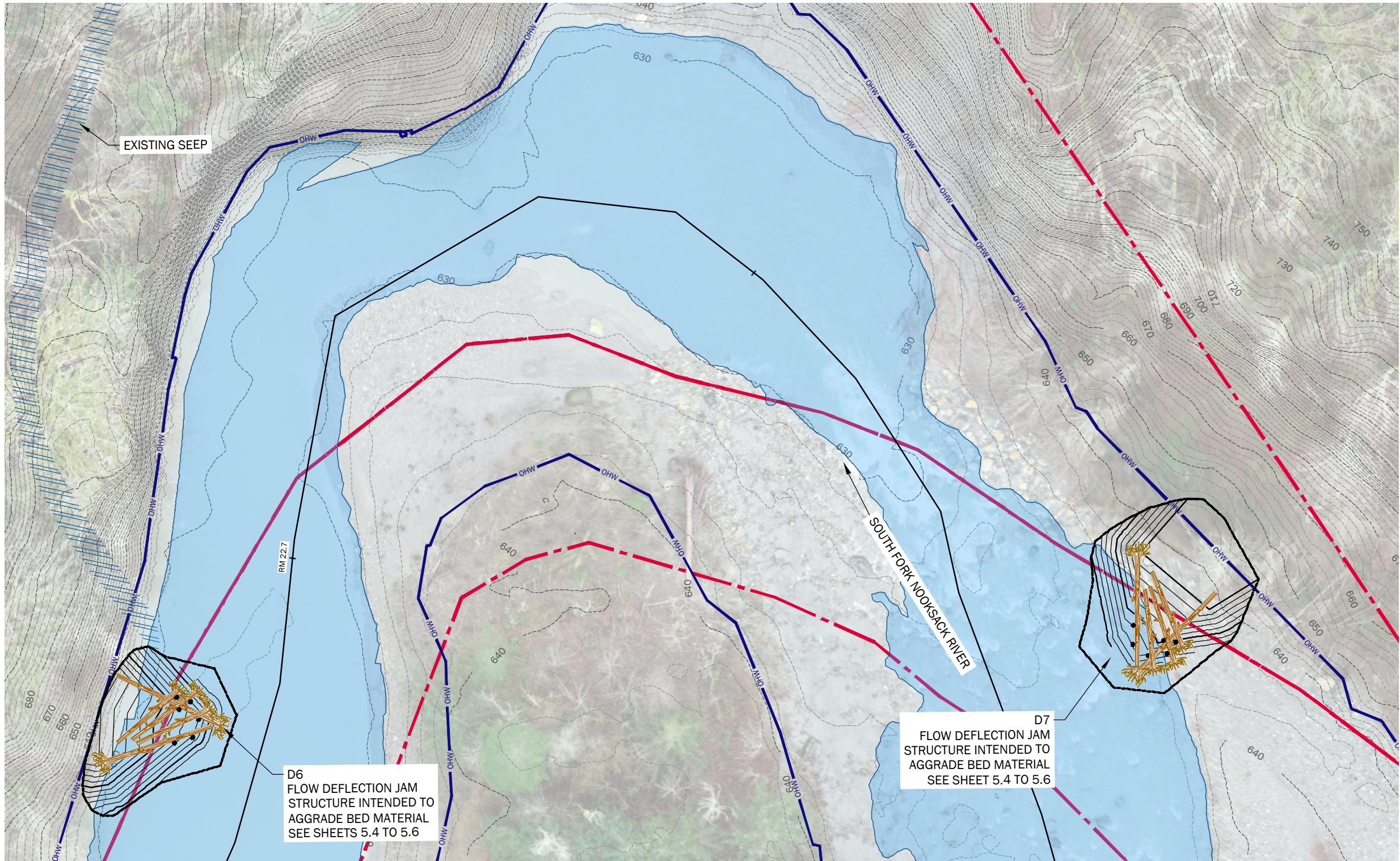


ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

PROPOSED WOOD STRUCTURES PLAN
River Mile 22.6 to 22.7

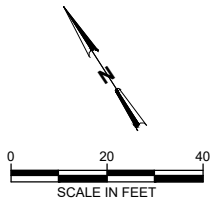
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DESIGN: BHM	SHEET 8 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	3.3

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LEGEND

- CONTOUR LINE - MAJOR (5-FOOT)
- CONTOUR LINE - MINOR (1-FOOT)
- SOUTH FORK NOOKSACK RIVER ALIGNMENT
- PARCEL BOUNDARY
- OHW --- EXISTING OHW (2-YR INUNDATION)
- EXISTING LOW FLOW CHANNEL
- EXISTING WETLAND (APPROXIMATE BOUNDARY)
- PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
- PROPOSED CONTOUR LINE - MINOR (1-FOOT)
- GRADING DISTURBANCE LIMITS
- LARGE WOOD KEY MEMBER



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SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

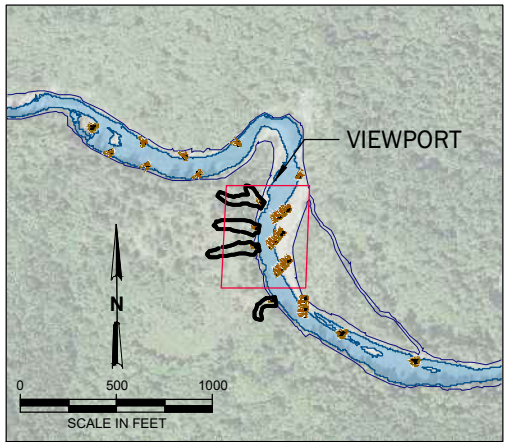
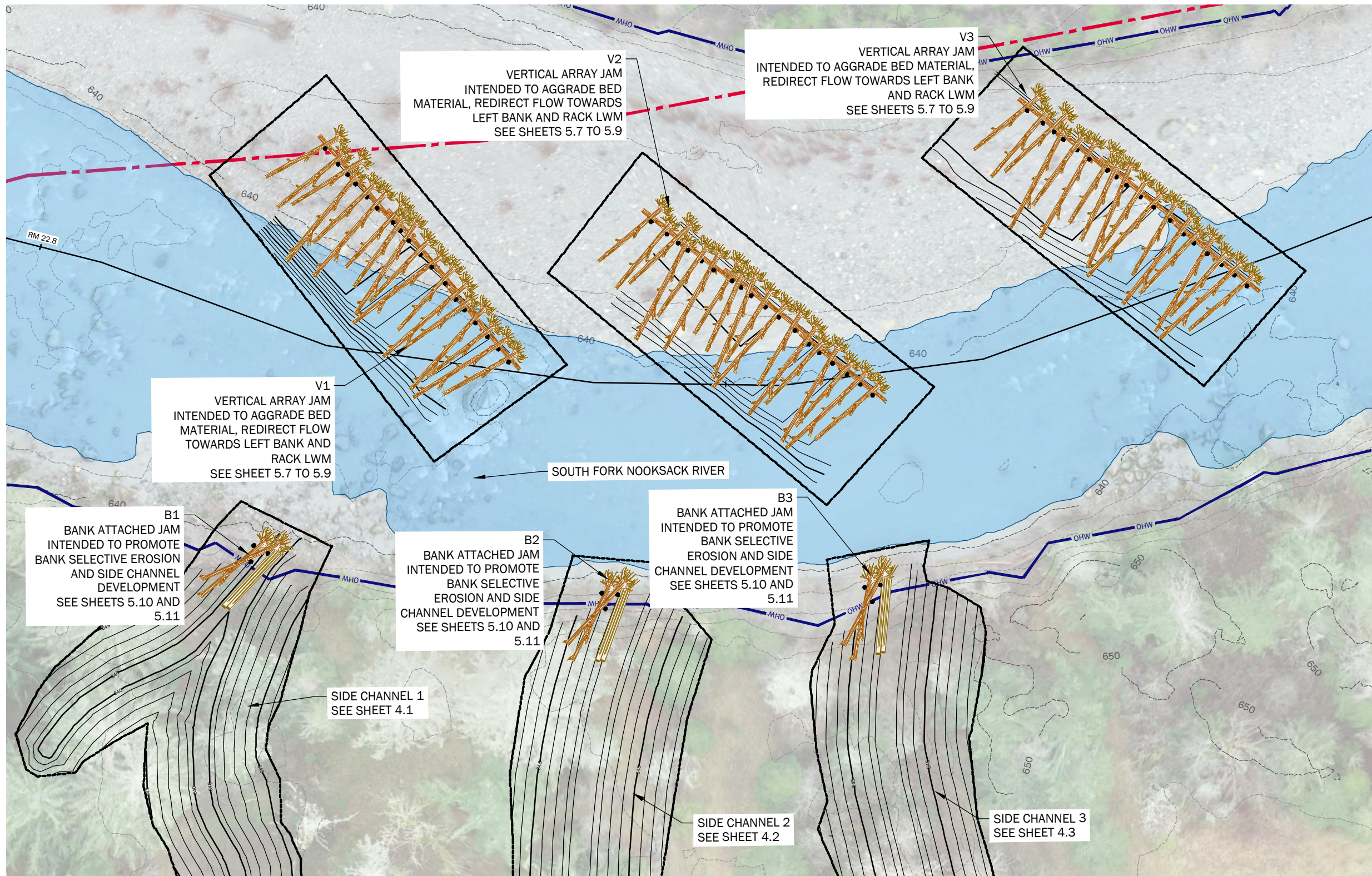
PROPOSED WOOD STRUCTURES PLAN
River Mile 22.7 to 22.8

DRAWN: BHM/HCM
DESIGN: BHM
CHECKED: RSC/JTM
SHEET NO.

PROJ NO: 1209-028-02
SHEET 9 OF 29
DATE: 07.15.2020

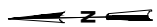
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Plotted: 07/15/2020, 14:57
User: lumiller



LEGEND

- CONTOUR LINE - MAJOR (5-FOOT)
- CONTOUR LINE - MINOR (1-FOOT)
- SOUTH FORK NOOKSACK RIVER ALIGNMENT
- PARCEL BOUNDARY
- OHW
- EXISTING OHW (2-YR INUNDATION)
- EXISTING LOW FLOW CHANNEL
- EXISTING WETLAND (APPROXIMATE BOUNDARY)
- PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
- PROPOSED CONTOUR LINE - MINOR (1-FOOT)
- GRADING DISTURBANCE LIMITS
- LARGE WOOD KEY MEMBER



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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

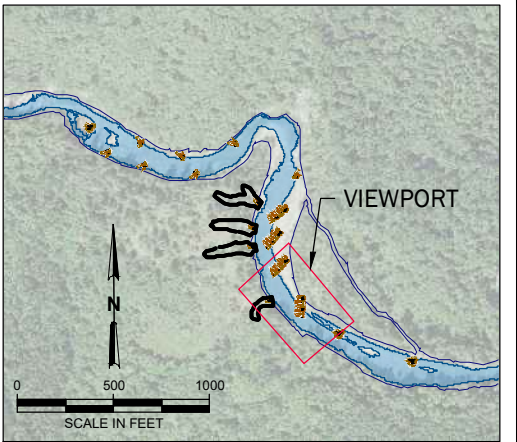
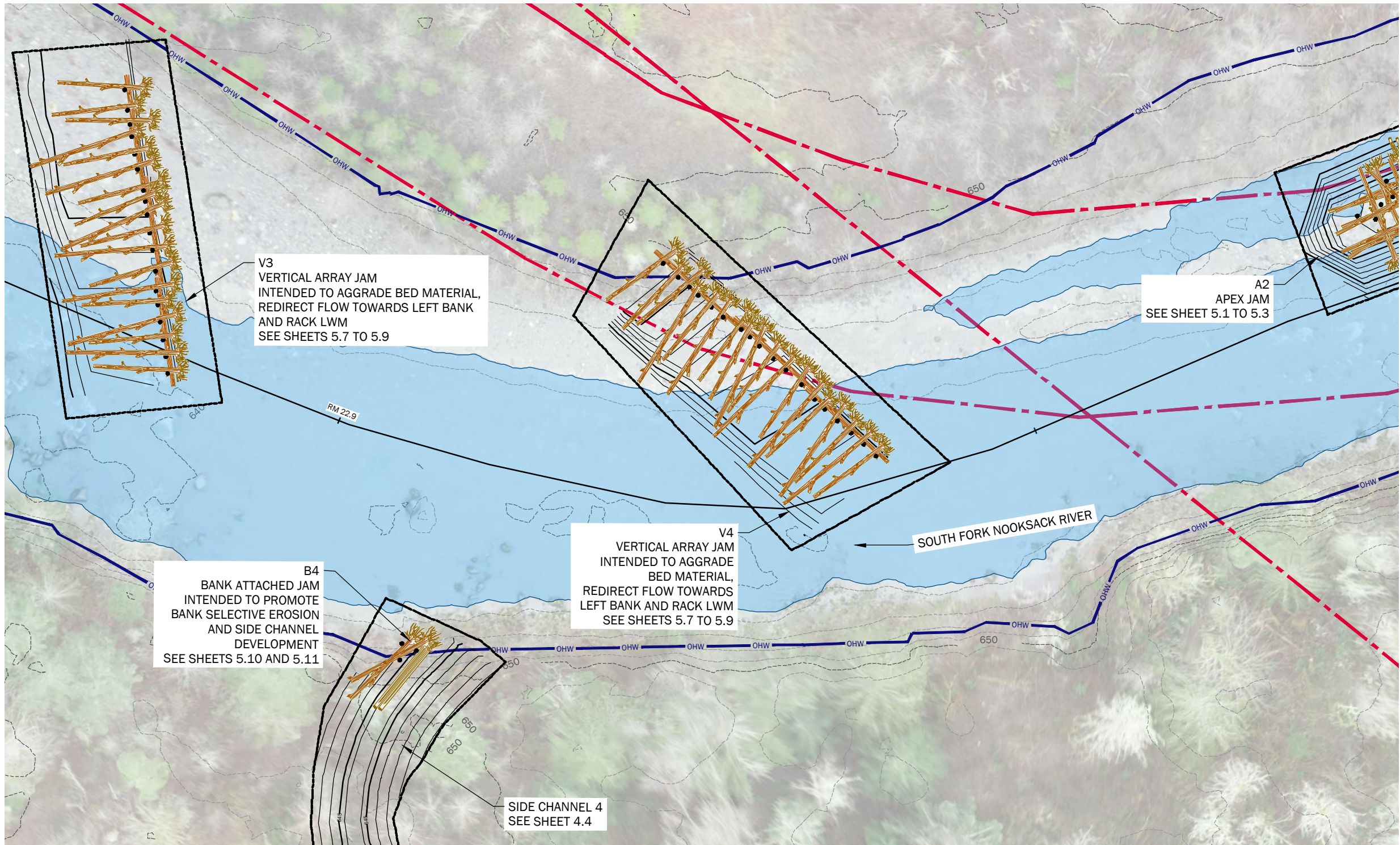
PROPOSED WOOD STRUCTURES PLAN
River Mile 22.8 to 22.9

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SHEET NO.

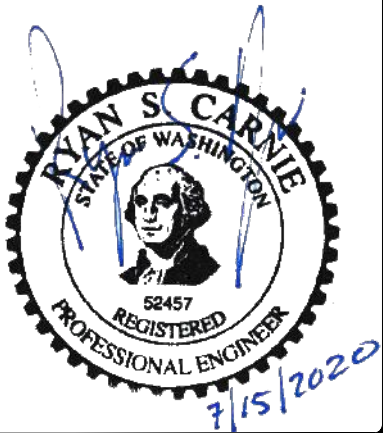
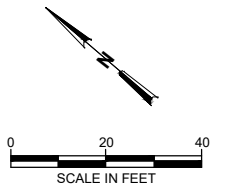
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3.5

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Lumiller



- LEGEND**
- CONTOUR LINE - MAJOR (5-FOOT)
 - CONTOUR LINE - MINOR (1-FOOT)
 - SOUTH FORK NOOKSACK RIVER ALIGNMENT
 - PARCEL BOUNDARY
 - OHW --- EXISTING OHW (2-YR INUNDATION)
 - EXISTING LOW FLOW CHANNEL
 - EXISTING WETLAND (APPROXIMATE BOUNDARY)
 - PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
 - PROPOSED CONTOUR LINE - MINOR (1-FOOT)
 - GRADING DISTURBANCE LIMITS
 - LARGE WOOD KEY MEMBER



NO.	DATE	BY	REVISION

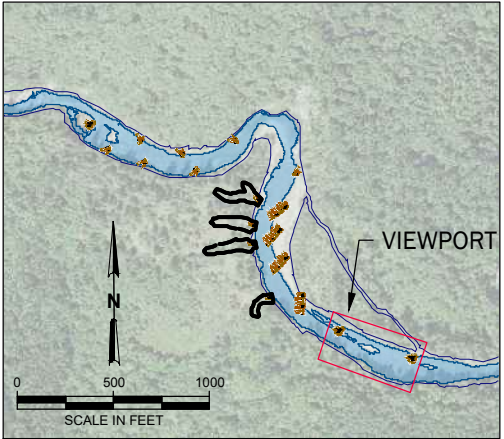
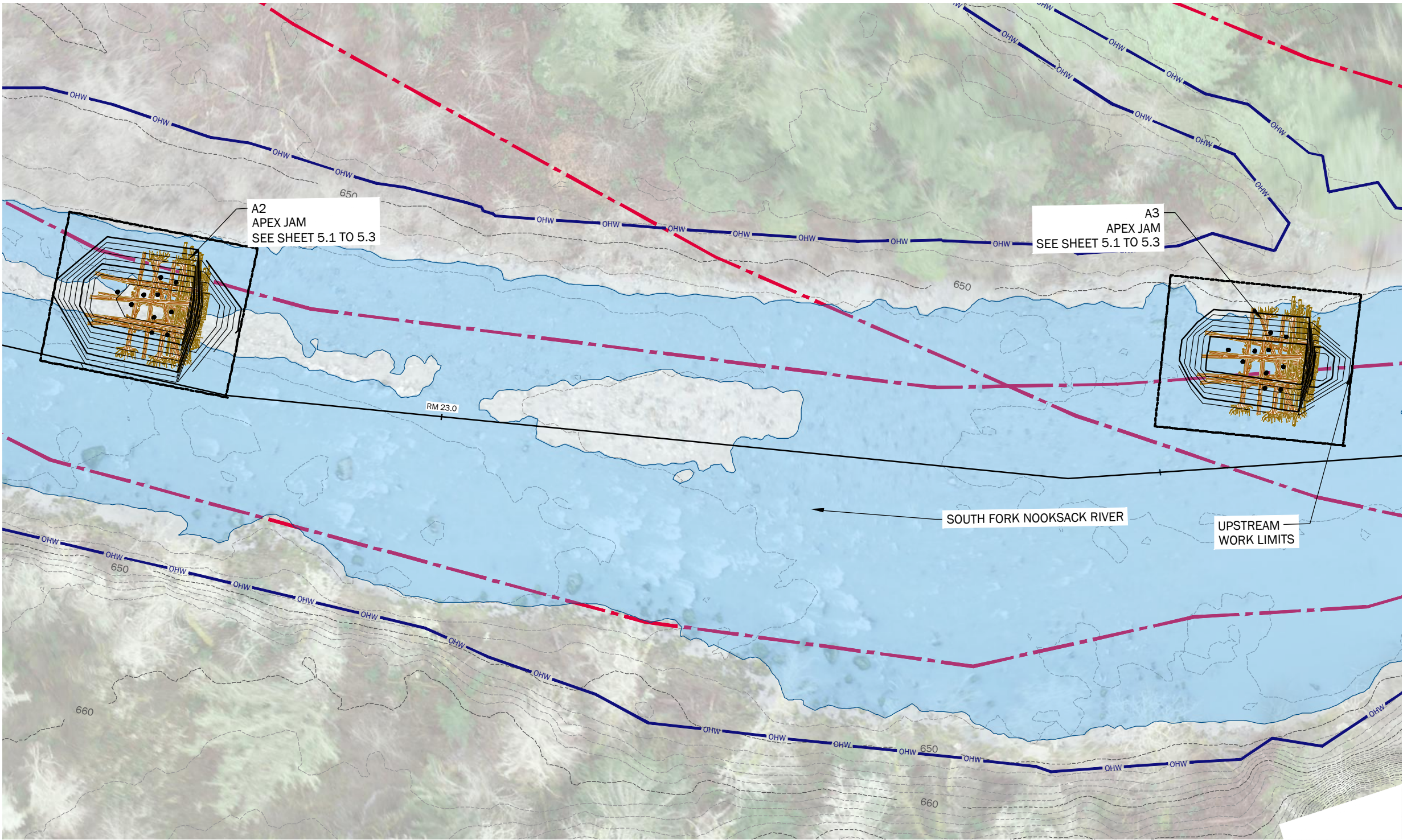


ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

PROPOSED WOOD STRUCTURES PLAN
River Mile 22.9 to 23.0

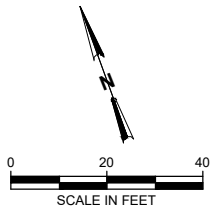
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SHEET NO.	3.6

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LEGEND

- CONTOUR LINE - MAJOR (5-FOOT)
- CONTOUR LINE - MINOR (1-FOOT)
- SOUTH FORK NOOKSACK RIVER ALIGNMENT
- PARCEL BOUNDARY
- OHW --- EXISTING OHW (2-YR INUNDATION)
- EXISTING LOW FLOW CHANNEL
- EXISTING WETLAND (APPROXIMATE BOUNDARY)
- PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
- PROPOSED CONTOUR LINE - MINOR (1-FOOT)
- GRADING DISTURBANCE LIMITS
- LARGE WOOD KEY MEMBER



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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

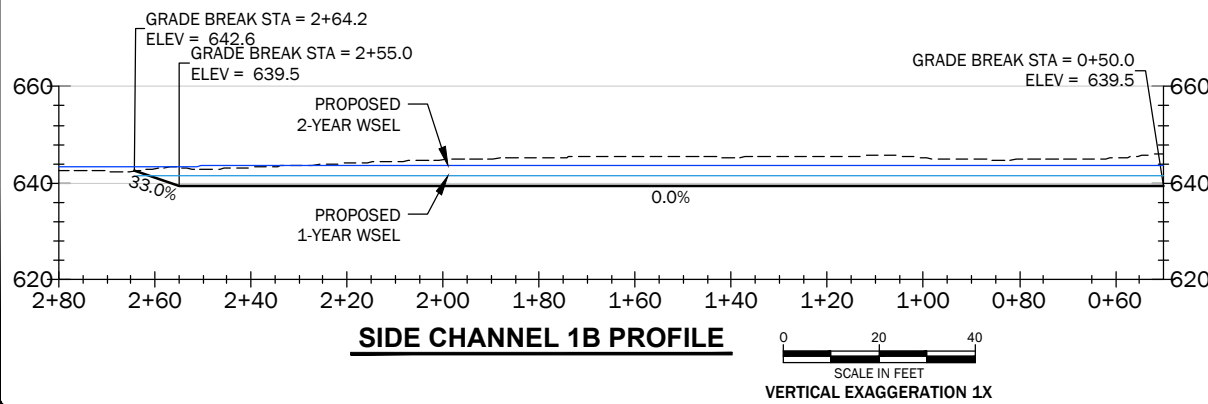
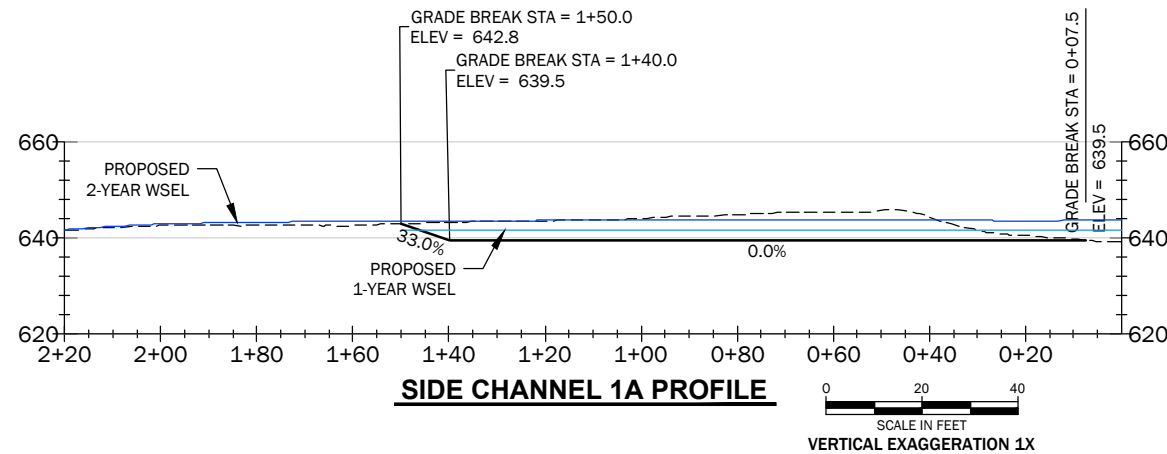
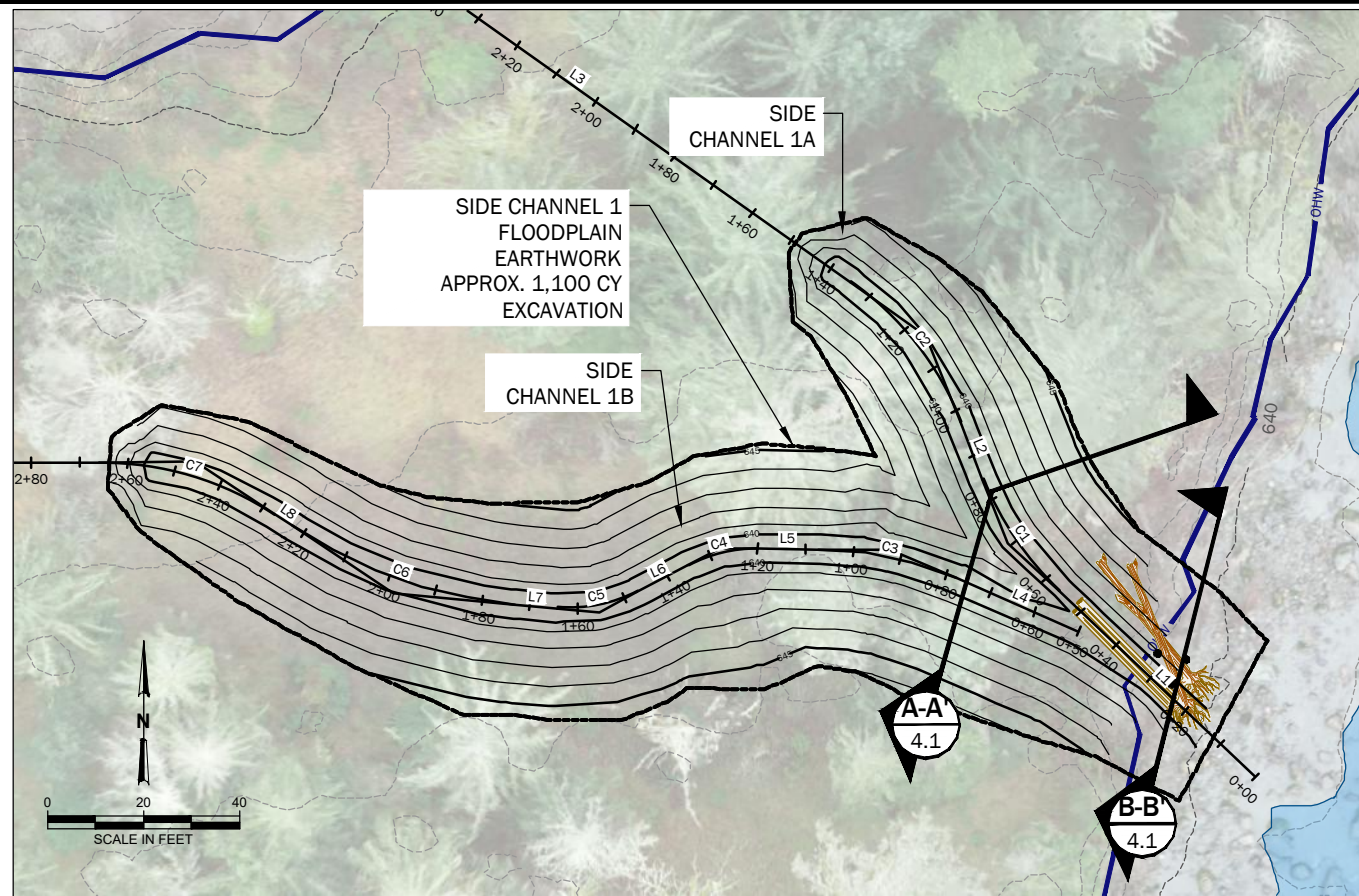
PROPOSED WOOD STRUCTURES PLAN
River Mile 23.0 to 23.1

DRAWN: BHM/HCM
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CHECKED: RSC/JTM
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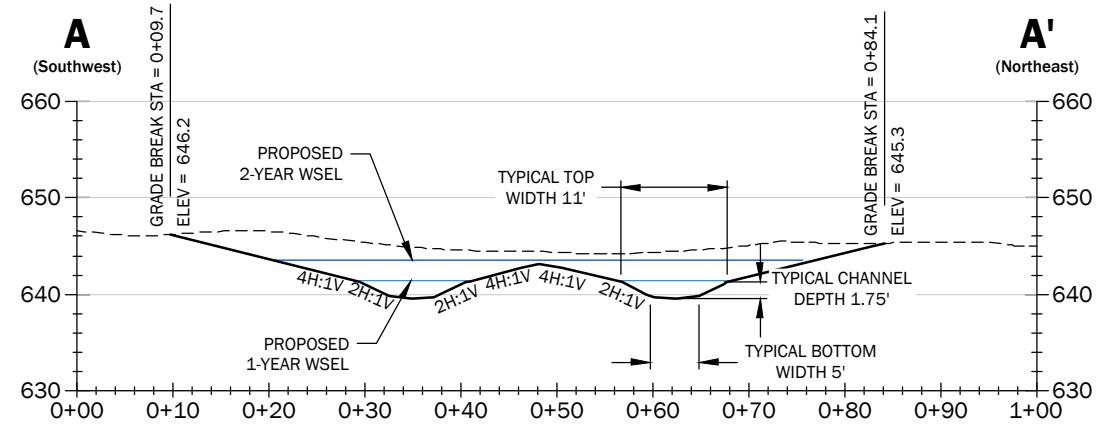
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3.7

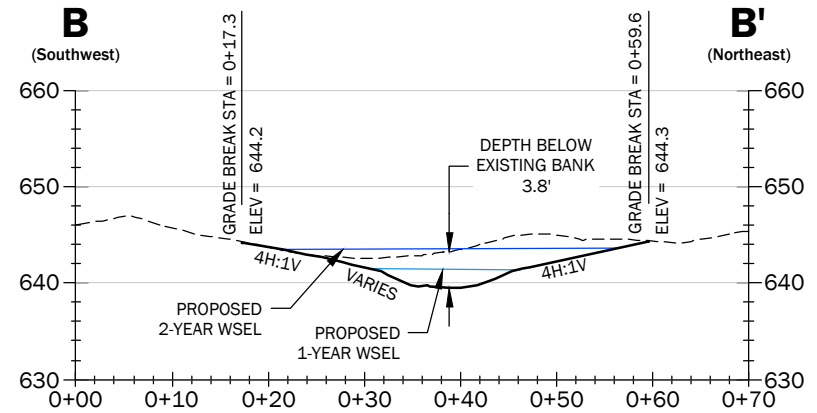
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Plotted: 07/15/2020, 14:59 1.miller



- LEGEND**
- CONTOUR LINE - MAJOR (10-FOOT)
 - CONTOUR LINE - MINOR (2-FOOT)
 - SIDE CHANNEL ALIGNMENT
 - PARCEL BOUNDARY
 - OHW
 - EXISTING OHW (2-YR INUNDATION)
 - PROPOSED LOW FLOW CHANNEL
 - PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
 - PROPOSED CONTOUR LINE - MINOR (1-FOOT)
 - GRADING DISTURBANCE LIMITS
 - LARGE WOOD KEY MEMBER



SIDE CHANNEL 1 SECTION A-A'
SCALE: 4.1
SCALE IN FEET
VERTICAL EXAGGERATION 1X

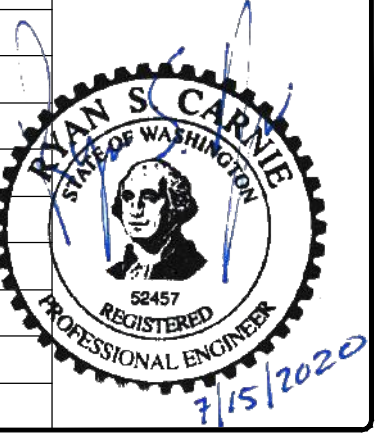


SIDE CHANNEL 1 INLET SECTION B-B'
SCALE: 4.1
SCALE IN FEET
VERTICAL EXAGGERATION 1X

NOTE:
TYPICAL DIMENSIONS ARE
APPLICABLE OVER THE
ENTIRE STATION RANGE.

Side Channel 1a							
Number	Start Station	Start Northing (FT)	Start Easting (FT)	Line/Chord Direction	Curve Radius	Length	End Station
L1	0+00	585805.0	1345802.2	N46° 43' 30.53"W		56.3	0+56
C1	0+56	585843.6	1345761.2	N34° 11' 38.27"W	65	28.4	0+85
L2	0+85	585867.0	1345745.3	N21° 39' 46.01"W		12.8	0+97
C2	0+97	585878.8	1345740.6	N38° 09' 29.67"W	65	37.7	1+35
L3	1+35	585908.0	1345717.7	N54° 39' 13.32"W		141.6	2+77

Side Channel 1b							
Number	Start Station	Start Northing (FT)	Start Easting (FT)	Line/Chord Direction	Curve Radius	Length	End Station
L4	0+50	585835.3	1345765.4	N66° 45' 48.10"W		27.8	0+78
C3	0+78	585846.3	1345739.9	N78° 03' 03.17"W	75	29.6	1+07
L5	1+07	585852.4	1345711.1	N89° 20' 18.24"W		12.8	1+20
C4	1+20	585852.5	1345698.3	S76° 25' 25.86"W	30	14.9	1+35
L6	1+35	585849.0	1345684.0	S62° 11' 09.96"W		12.0	1+47
C5	1+47	585843.4	1345673.4	S78° 39' 47.78"W	30	17.3	1+64
L7	1+64	585840.1	1345656.7	N84° 51' 34.39"W		8.8	1+73
C6	1+73	585840.9	1345647.9	N70° 37' 11.73"W	100	49.7	2+23
L8	2+23	585857.2	1345601.5	N56° 22' 49.08"W		4.3	2+27
C7	2+27	585859.6	1345597.9	N73° 25' 30.45"W	65	38.7	2+66
L9	2+66	585870.5	1345561.3	S89° 31' 48.18"W		240.7	5+07



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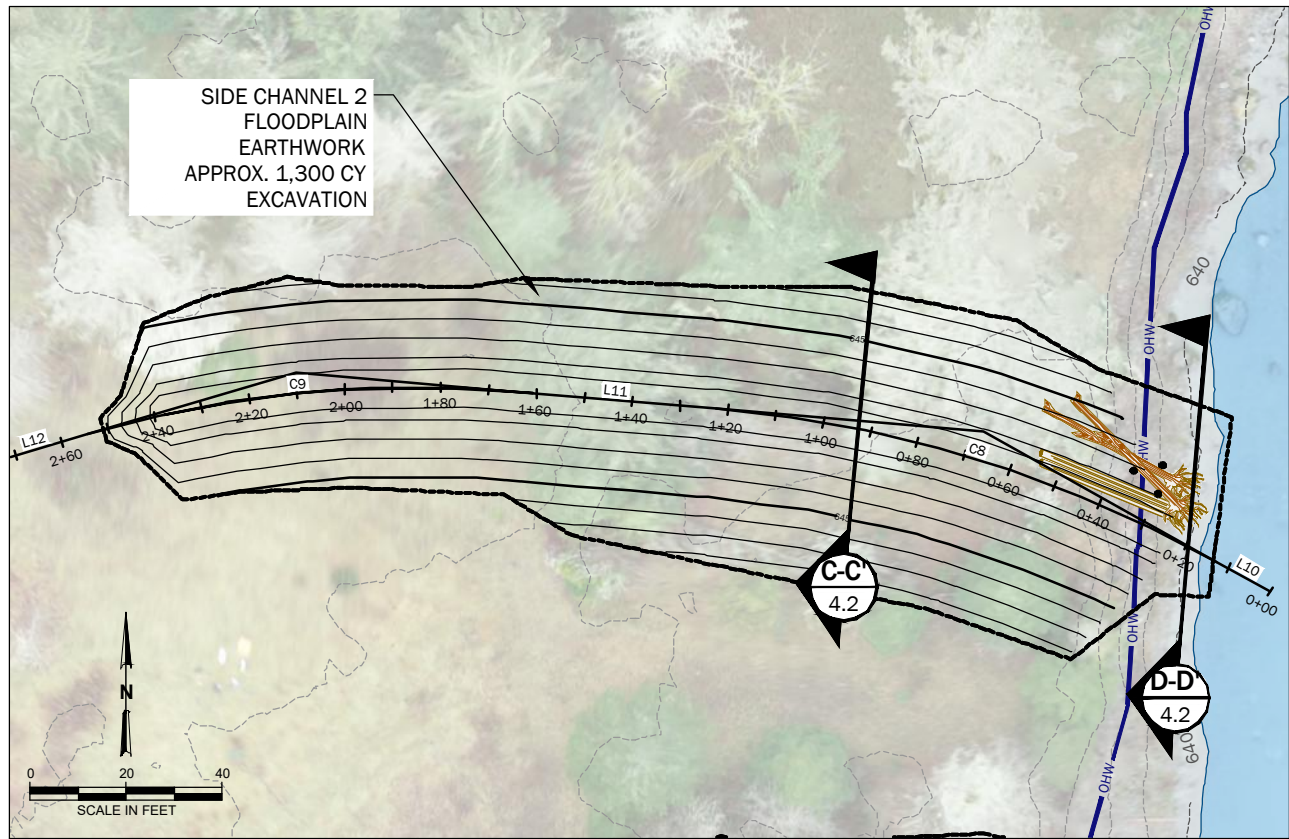
ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

SIDE CHANNEL 1 PLAN AND PROFILE

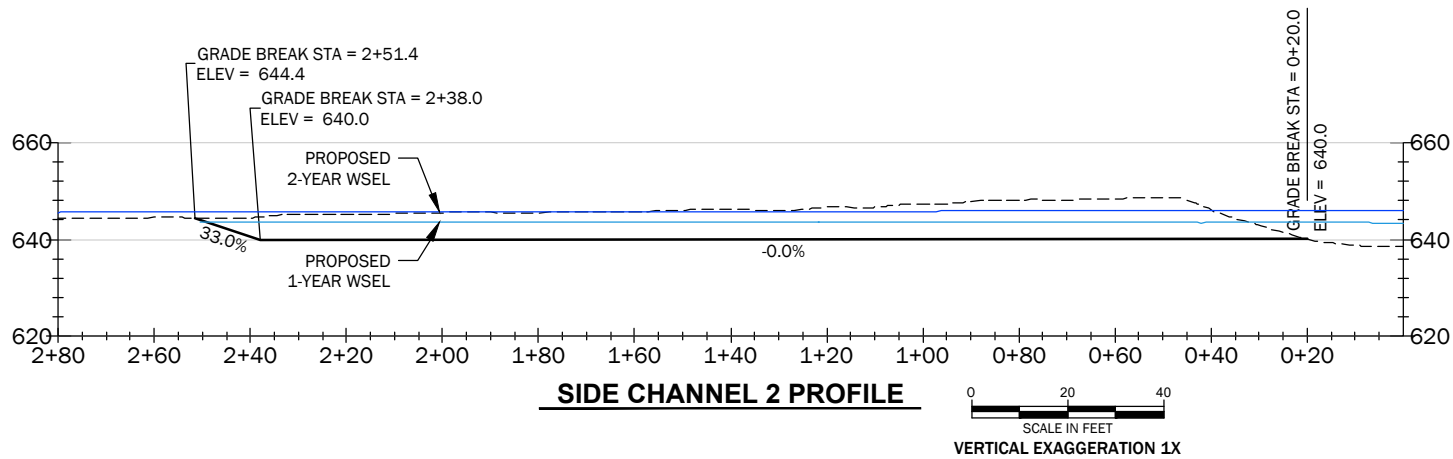
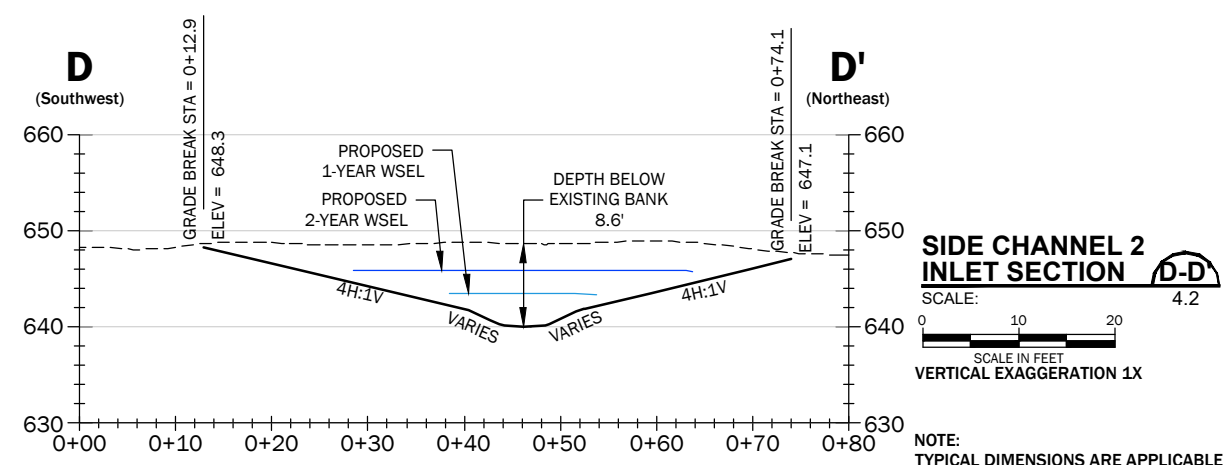
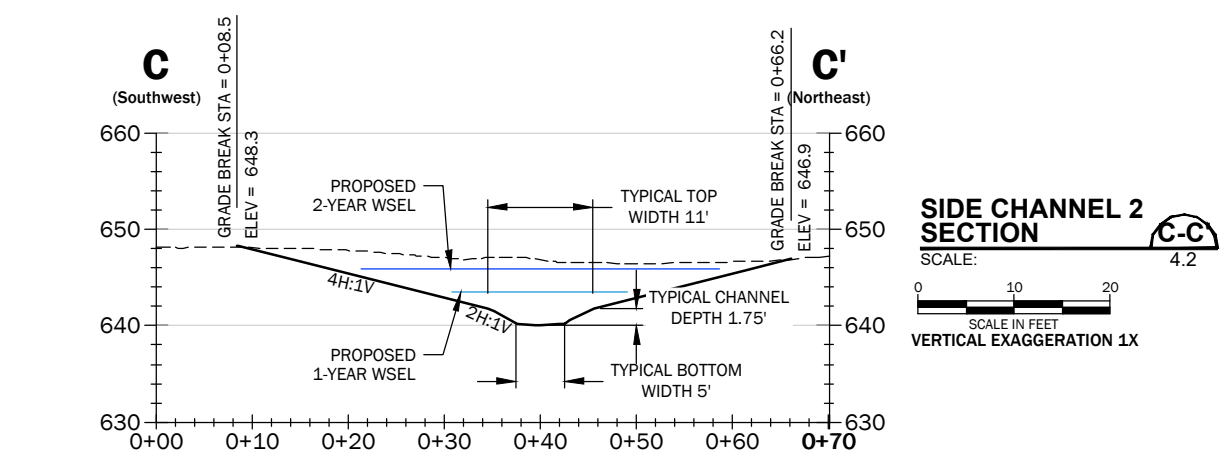
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CHECKED: RSC/JTM
SHEET NO. 4.1

PROJ NO: 1209-028-02
SHEET 13 OF 29
DATE: 07.15.2020

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Plotted: 07/15/2020, 15:00 Lmiller



- LEGEND**
- CONTOUR LINE - MAJOR (10-FOOT)
 - - - CONTOUR LINE - MINOR (2-FOOT)
 - - - SIDE CHANNEL ALIGNMENT
 - - - PARCEL BOUNDARY
 - OHW EXISTING OHW (2-YR INUNDATION)
 - EXISTING LOW FLOW CHANNEL
 - PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
 - PROPOSED CONTOUR LINE - MINOR (1-FOOT)
 - GRADING DISTURBANCE LIMITS
 - LARGE WOOD KEY MEMBER



Side Channel 2							
Number	Start Station	Start Northing (FT)	Start Easting (FT)	Line/Chord Direction	Curve Radius	Length	End Station
L10	0+00	585673.6	1345786.9	N60° 55' 16.35"W		12.8	0+13
C8	0+13	585679.8	1345775.7	N73° 00' 26.20"W	260	109.7	1+22
L11	1+22	585711.6	1345671.6	N85° 05' 36.04"W		42.4	1+65
C9	1+65	585715.3	1345629.3	S84° 13' 59.02"W	240	89.4	2+54
L12	2+54	585706.3	1345540.9	S73° 33' 34.07"W		22.3	2+77



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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

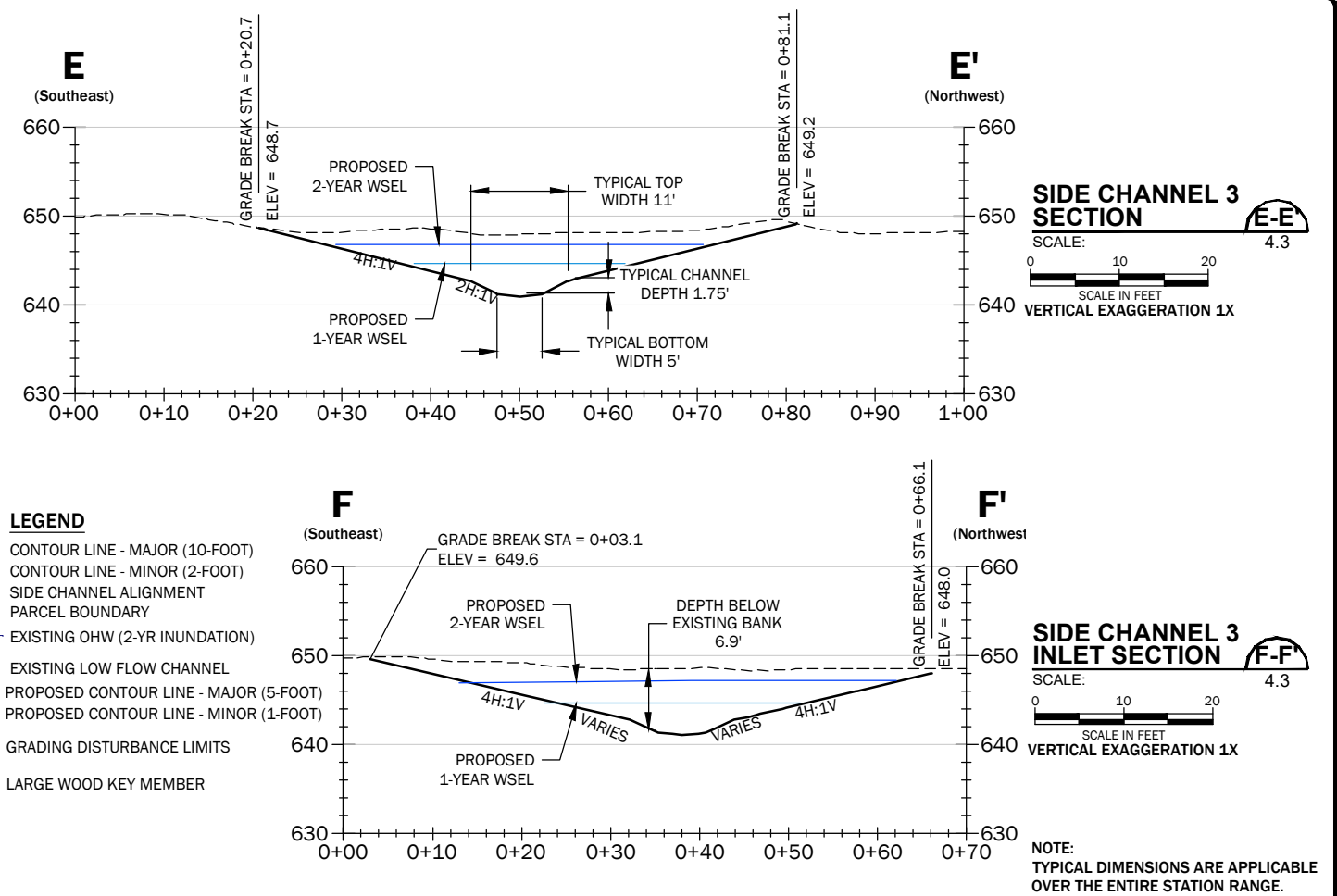
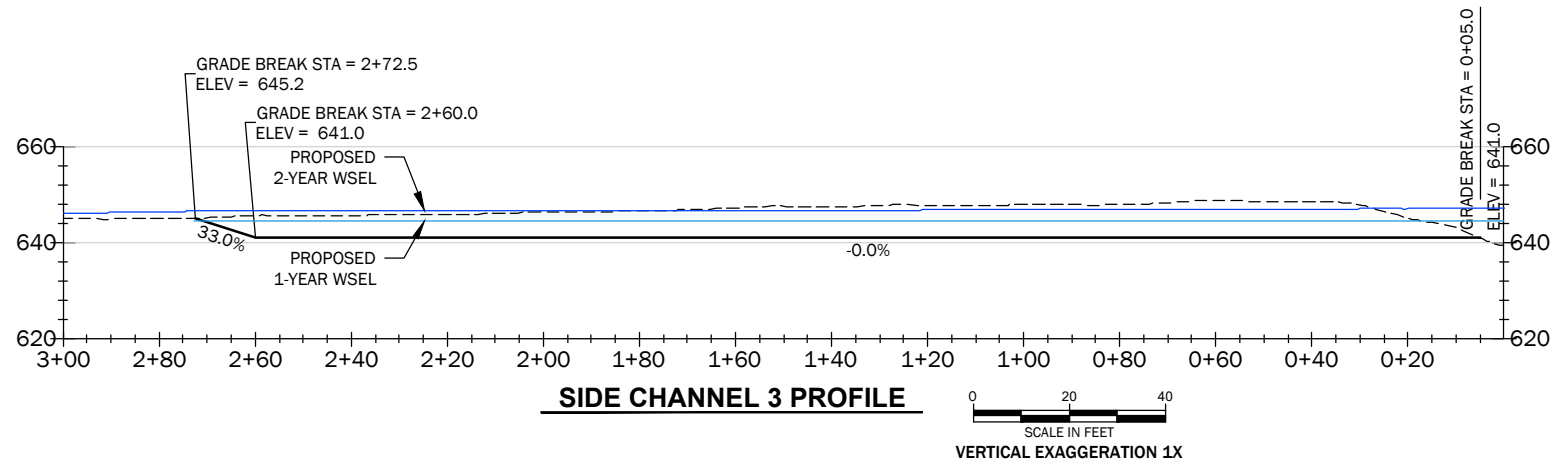
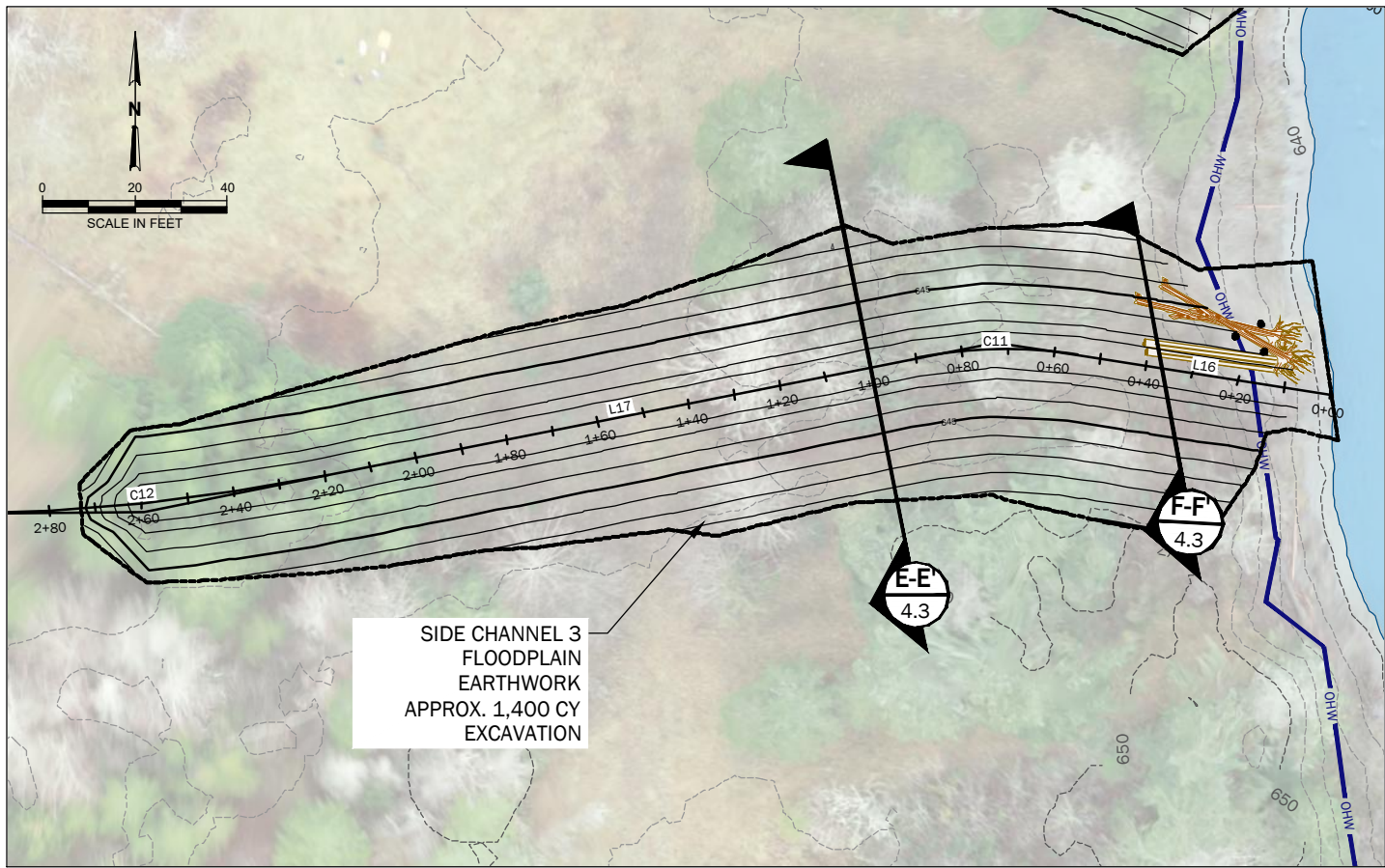
SIDE CHANNEL 2 PLAN AND PROFILE

DRAWN: BHM/HCM
DESIGN: BHM
CHECKED: RSC/JTM
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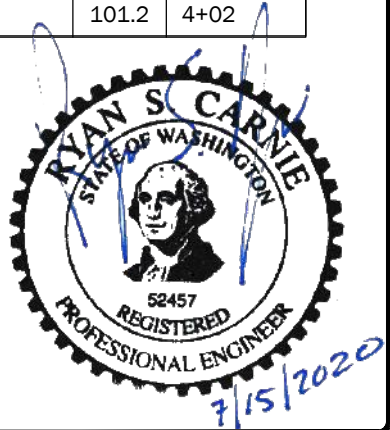
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SHEET 14 OF 29
DATE: 07.15.2020

4.2

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Plotted: 07/15/2020, 15:01 Lmiller



Side Channel 3							
Number	Start Station	Start Northing (FT)	Start Easting (FT)	Line/Chord Direction	Curve Radius	Length	End Station
L16	0+00	585586.3	1345777.1	N81° 10' 01.39"W		55.1	0+55
C11	0+55	585594.7	1345722.6	S88° 47' 42.22"W	100	35.0	0+90
L17	0+90	585594.0	1345687.8	S78° 45' 25.83"W		129.0	2+19
C12	2+19	585568.8	1345561.2	S84° 02' 29.43"W	440	81.2	3+00
L18	3+00	585560.4	1345480.6	S89° 19' 33.03"W		101.2	4+02



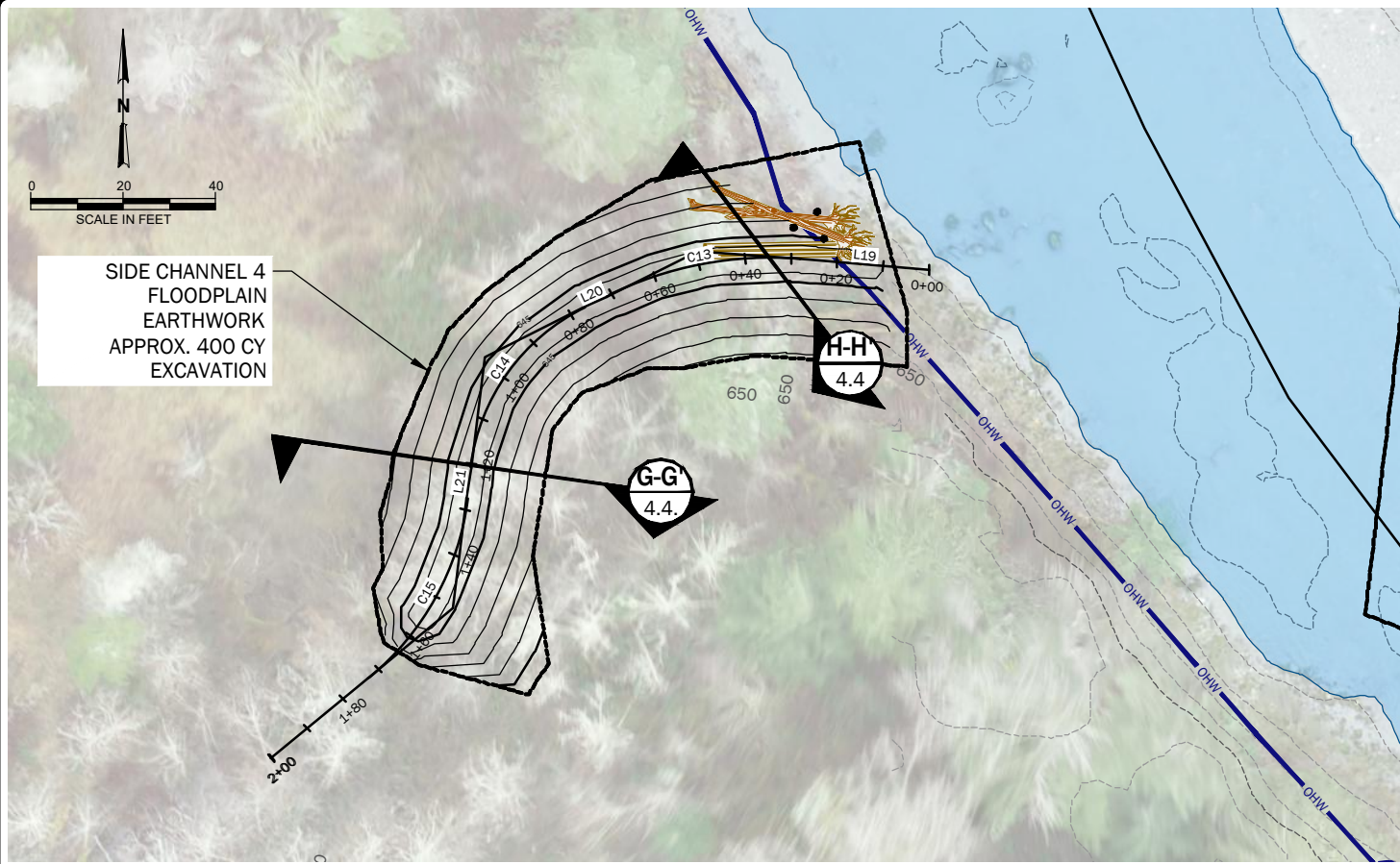
NO.	DATE	BY	REVISION



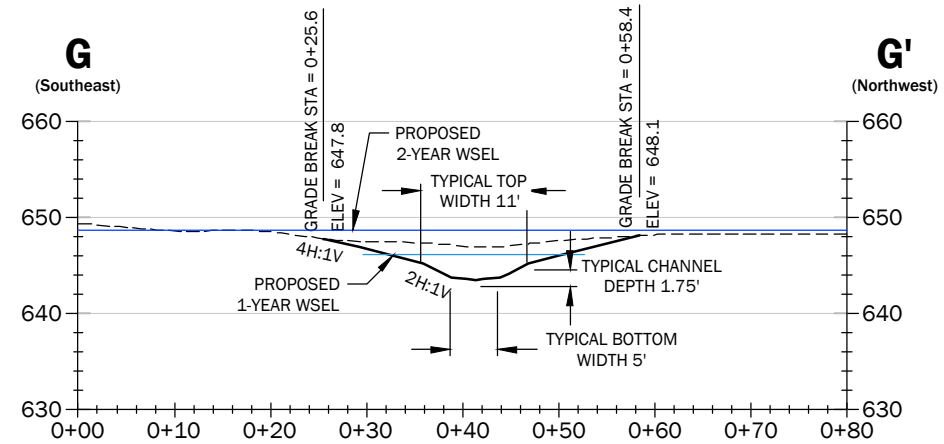
ELK FLATS CHANNEL RESTORATION SOUTH FORK NOOKSACK RIVER FINAL DESIGN
SIDE CHANNEL 3 PLAN AND PROFILE

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 15 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	4.3

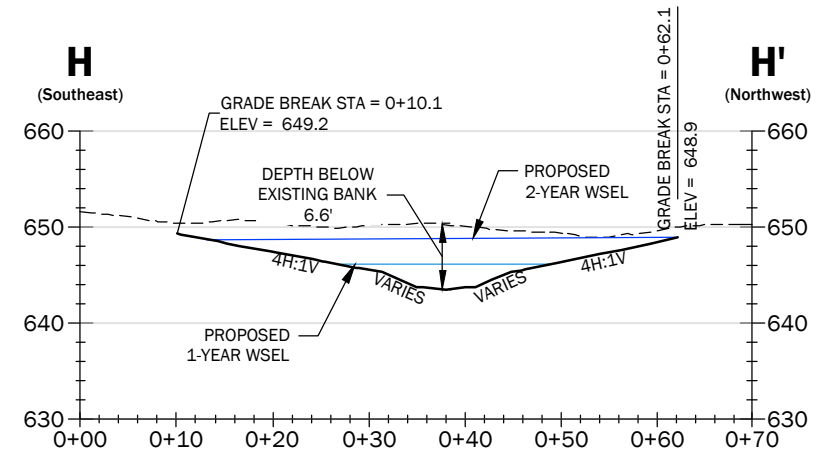
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Plotted: 07/15/2020, 15:01
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- LEGEND**
- CONTOUR LINE - MAJOR (10-FOOT)
 - CONTOUR LINE - MINOR (2-FOOT)
 - SIDE CHANNEL ALIGNMENT
 - PARCEL BOUNDARY
 - OHW
 - EXISTING OHW (2-YR INUNDATION)
 - EXISTING LOW FLOW CHANNEL
 - PROPOSED CONTOUR LINE - MAJOR (5-FOOT)
 - PROPOSED CONTOUR LINE - MINOR (1-FOOT)
 - GRADING DISTURBANCE LIMITS
 - LARGE WOOD KEY MEMBER

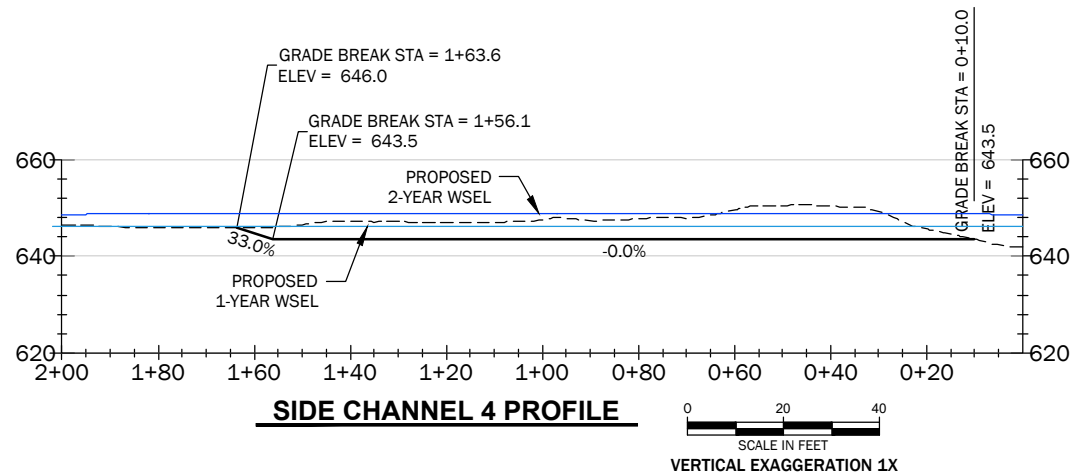


SIDE CHANNEL 4 SECTION
SCALE: 4.4
0 10 20
SCALE IN FEET

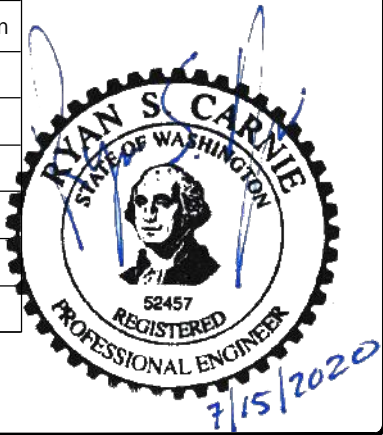


SIDE CHANNEL 4 INLET SECTION
SCALE: 4.4
0 10 20
SCALE IN FEET

NOTE:
TYPICAL DIMENSIONS ARE APPLICABLE
OVER THE ENTIRE STATION RANGE.



Side Channel 4							
Number	Start Station	Start Northing (FT)	Start Easting (FT)	Line/Chord Direction	Curve Radius	Length	End Station
L19	0+00	585311.2	1345873.0	N85° 24' 00.93"W		28.0	0+28
C13	0+28	585313.5	1345845.1	S79° 09' 16.29"W	80	43.1	0+71
L20	0+71	585305.4	1345803.2	S63° 42' 33.51"W		5.3	0+76
C14	0+76	585303.1	1345798.5	S35° 27' 56.62"W	45	44.4	1+21
L21	1+21	585268.4	1345773.8	S07° 13' 19.73"W		6.8	1+28
C15	1+28	585261.7	1345772.9	S28° 50' 21.15"W	60	45.3	1+73



NO.	DATE	BY	REVISION



ELK FLATS CHANNEL RESTORATION SOUTH FORK NOOKSACK RIVER FINAL DESIGN
SIDE CHANNEL 4 PLAN AND PROFILE

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 16 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	4.4

PURPOSE:

- | STRUCTURE QUANTITIES | | | | | |
|--|--|------------------|---------------------|-----------------|---|
| LOG TYPE C | PILE TYPE F | RACKING MATERIAL | SLASH MATERIAL (CY) | PIN CONNECTIONS | APPROX. STRUCTURE BACKFILL (FROM SIDE CHANNEL EXCAVATIONS) (CY) |
| 30' MIN. LOG WITH ROOTWAD 18" TO 24" DBH | 25' MIN. LOG WITH ROOTWAD 18" TO 22" DBH | | | EA. | |
| 17 | 10 | 50 | 20 | 14 TO 22* | 220 |

Diagram illustrating the proposed scour pool and pile layout. The layout shows a central area with a diameter of 40' (indicated by a horizontal dimension line at the bottom). The vertical extent of the scour pool is 40' (indicated by a vertical dimension line on the left). The layout includes:

- PROPOSED BACKFILL NATIVE COBBLE AND GRAVEL**: Indicated by a stippled pattern in the upper portion of the diagram.
- "C" LOG (TYP.)**: Indicated by a label pointing to a horizontal log structure.
- "F" PILE (TYP.)**: Indicated by a label pointing to a vertical pile structure.
- RACKING (TYP.)**: Indicated by a label pointing to a horizontal structure near the bottom of the scour pool.
- APPROXIMATE EXTENTS OF SCOUR POOL**: Indicated by a label pointing to the boundary of the scour pool.
- FLOW**: Indicated by an arrow pointing downwards, representing the direction of water flow.
- Section Lines**: Section lines A-A' and B-B' are shown, indicating the locations of cross-sections A-A' and B-B' respectively.

**APEX JAM
PLAN VIEW**



"C" LOG (TYP.)

RACKING (TYP.)

APPROXIMATE 2-YR WSEL (TYP)

FLOW

EXCAVATED SCOUR HOLE 5' BELOW EXISTING GRADE

EMBED PILES 16' BELOW EXISTING GRADE

PILES EXTEND APPROXIMATELY 8' TO 9' ABOVE EXISTING GRADE

PROPOSED BACKFILL NATIVE COBBLE AND GRAVEL

4' MIN.

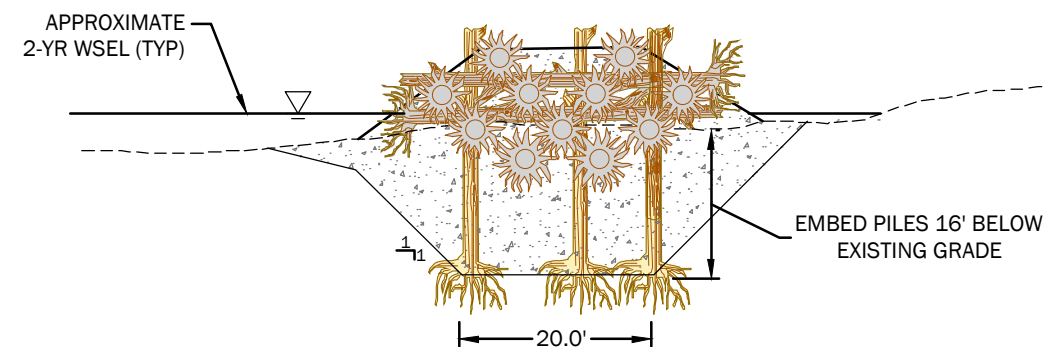
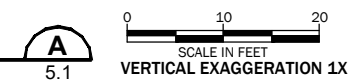
EXISTING GRADE

APPROX. 5'

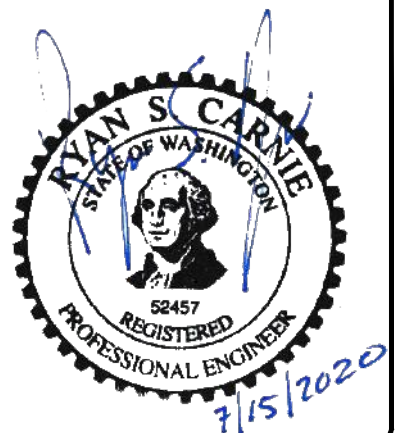
APPROXIMATE LIMITS OF EXCAVATION

"F" PILE (TYP.)

APEX JAM SECTION VIEW



**APEX JAM
SECTION VIEW**

[illegible]

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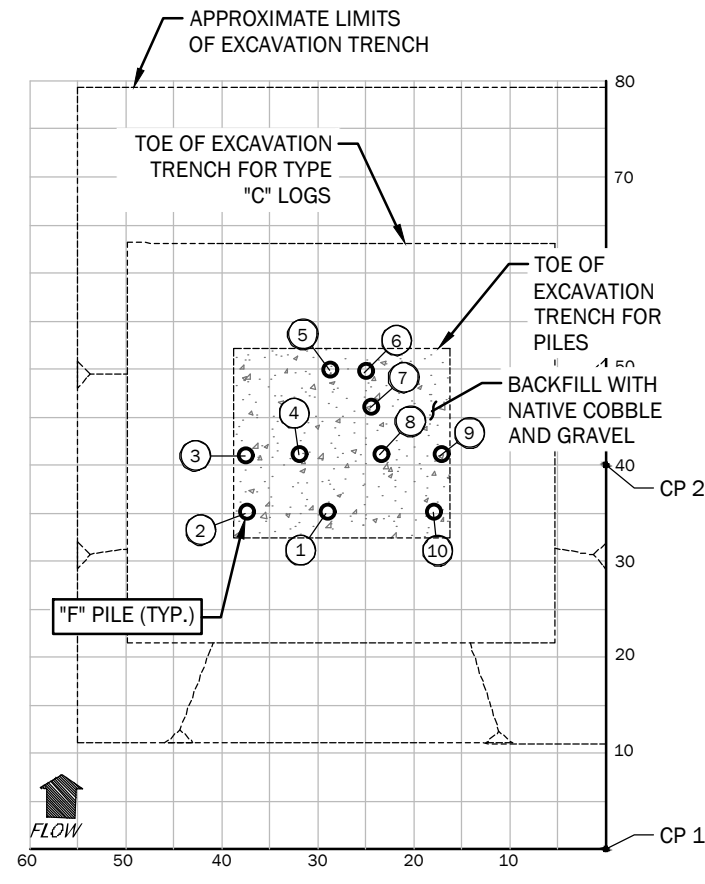


WOOD DETAILS - APEX JAM

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 17 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	

5.1

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Lumiller

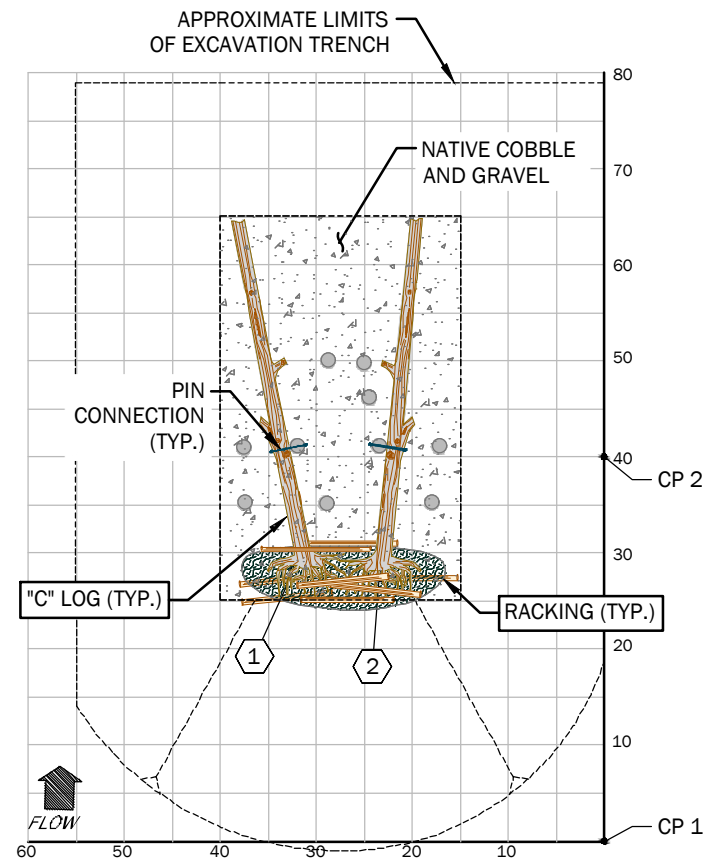


1. INSTALL WORK ISOLATION STRUCTURES AND DEWATER THE WORK AREA.
2. EXCAVATE THE INSTALLATION TRENCH. TRENCH EXTENDS 5.0 FEET BELOW EXISTING GRADE. EXCAVATE HOLES FOR TYPE F VERTICAL PILES (PILES 1 - 10). VERTICAL PILES SHALL BE A MINIMUM OF 16 FEET BELOW EXISTING GRADE.
3. PLACE VERTICAL PILES PER OFFSET TABLE AND BACKFILL WITH NATIVE MATERIAL TO BOTTOM OF EXCAVATION TRENCH, 5.0 FEET BELOW EXISTING GRADE.

TYPE	PILE NO.	OFFSET FROM ORIGIN, X (FT)	OFFSET FROM ORIGIN, Y (FT)	OFFSET FROM CP 1 (FT)	OFFSET FROM CP 2 (FT)	EMBEDDED DEPTH (FT)
Vertical PILES	1.0	29.0	35.0	45.5	29.4	-16.0
	2.0	37.5	35.0	51.3	37.8	-16.0
	3.0	37.5	41.0	55.6	37.5	-16.0
	4.0	32.0	41.0	52.0	32.0	-16.0
	5.0	28.8	50.0	57.7	30.5	-16.0
	6.0	25.0	49.5	55.5	26.7	-16.0
	7.0	24.5	46.0	52.1	25.2	-16.0
	8.0	23.5	41.0	47.3	23.5	-16.0
	9.0	17.0	41.0	44.4	17.0	-16.0
	10.0	18.0	35.0	39.4	18.7	-16.0

NOTES:

1. NEGATIVE VALUES INDICATE DISTANCE VERTICALLY BELOW EXISTING GRADE
2. PILE NUMBERS ARE INDICATED BY CIRCLE CALLOUTS.
3. LOG NUMBERS ARE INDICATED BY HEXAGON CALLOUTS.
4. CONTRACTOR IS RESPONSIBLE FOR ALL SHORING AND SHORING DESIGN, SEE 2018 WSDOT STANDARD SPECIFICATIONS 2-09.

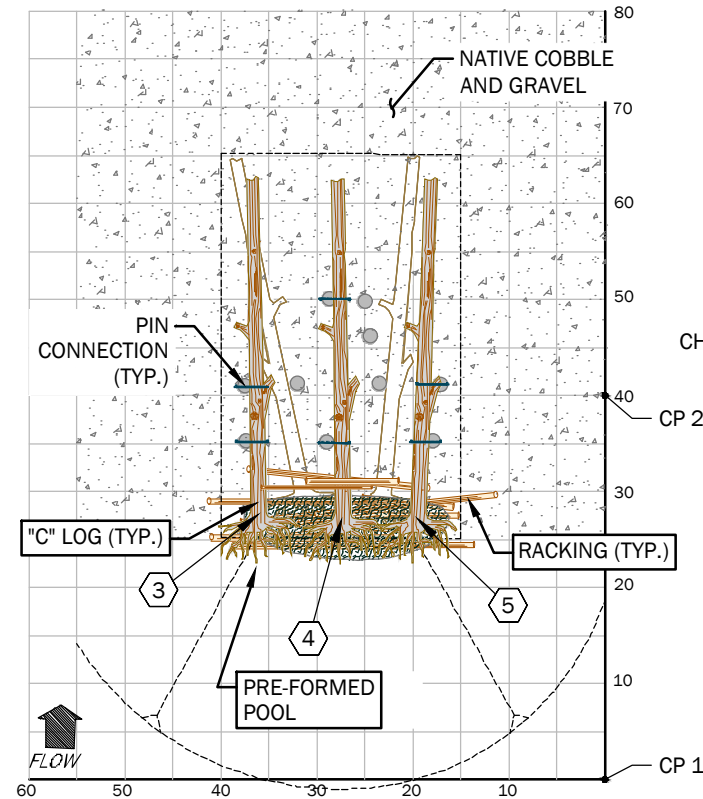


4. PLACE TYPE C LOGS 1 AND 2 PER OFFSET TABLE. PIN EACH TO AN ADJACENT PILE PER PINNING DETAIL.
5. PLACE RACKING MEMBERS AND A LAYER OF SLASH BETWEEN EXPOSED ROOTWADS.

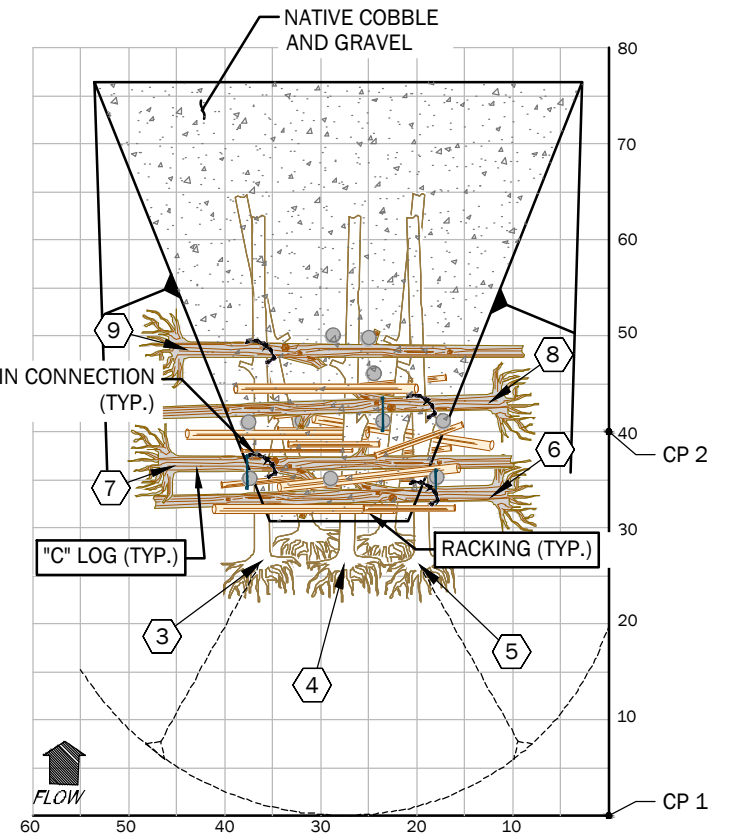
PLAN VIEW



TYPE	LOG NO.	OFFSET FROM ORIGIN, X (FT)	OFFSET FROM ORIGIN, Y (FT)	OFFSET FROM CP 1 (FT)	OFFSET FROM CP 2 (FT)	DISTANCE BETWEEN TOP OF LOG AND EXISTING GRADE (FT)
HORIZONTAL KEY LOGS	1.0	31.5	29.0	42.8	33.4	-2.6
	2.0	23.0	29.0	37.0	25.5	-2.6
	3.0	36.5	26.5	45.1	38.9	0.4
	4.0	27.5	26.5	38.2	30.6	0.4
	5.0	19.5	26.5	32.9	23.7	0.4
	6.0	11.5	33.0	34.9	13.5	1.7
	7.0	45.0	36.5	57.9	45.1	1.7
	8.0	11.5	43.0	44.5	11.9	1.7
	9.0	45.0	48.0	65.8	45.7	1.7



6. PLACE LOGS 3, 4 AND 5 PER OFFSET TABLE.
7. PIN EACH LOG TO TWO ADJACENT VERTICAL PILES.
8. WEAVE RACKING MEMBERS BETWEEN EXPOSED ROOTWADS AND PILES.
9. BACKFILL EXCAVATION TRENCH BUT LEAVE ROOTWADS EXPOSED IN PRE-FORMED SCOUR POOL.

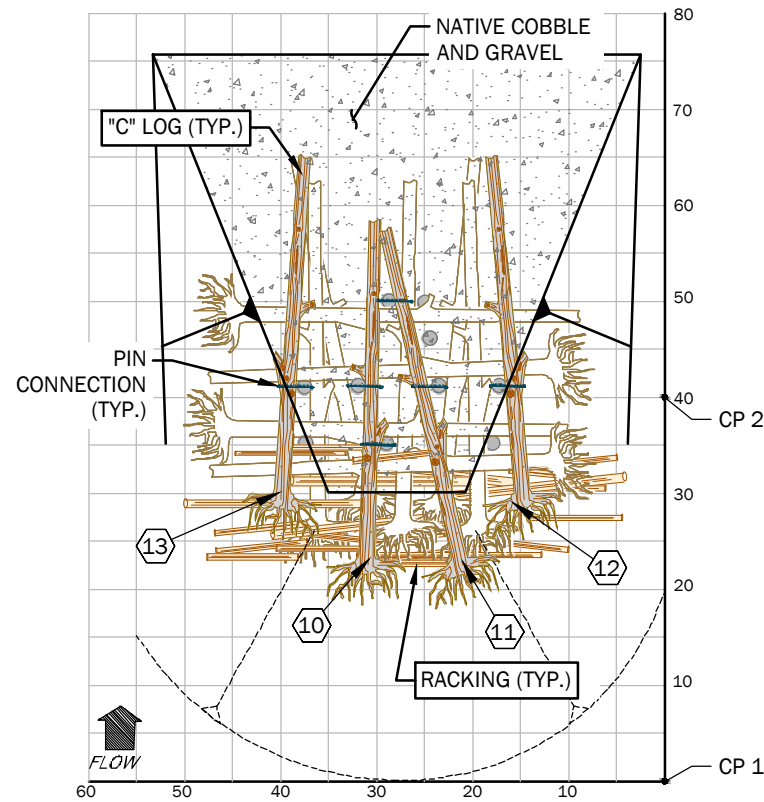


10. PLACE LOGS 6, 7, 8, AND 9. PIN OR CHAIN EACH LOG TO AN ADJACENT PILE OR LOGS 3, 4, AND 5.
11. WEAVE RACKING MEMBERS BETWEEN LOGS.
12. PLACE NATIVE COBBLES AND GRAVEL ON TOP OF THE LOGS, LEAVING ROOTWADS EXPOSED.

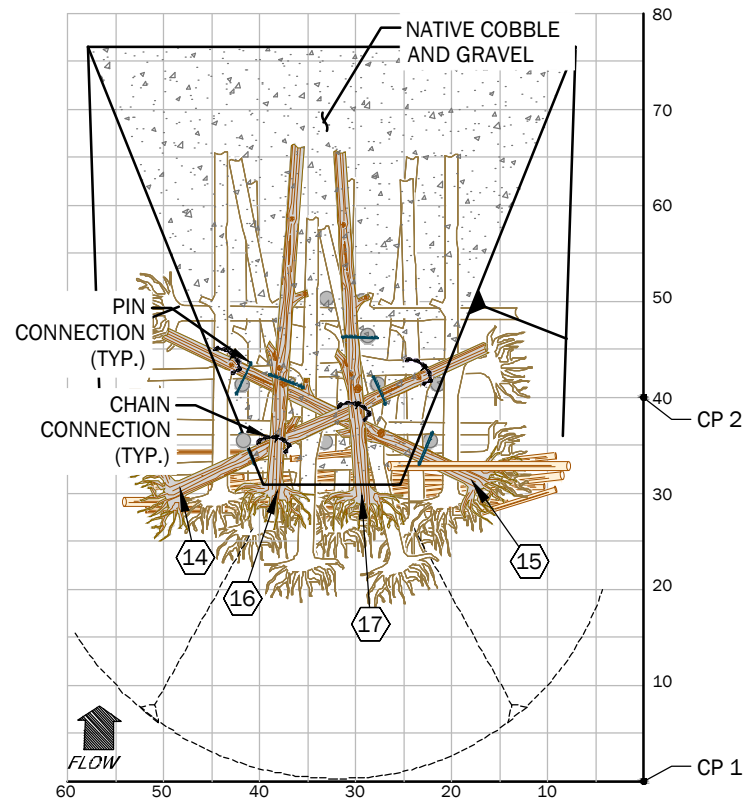


NO.	DATE	BY	REVISION

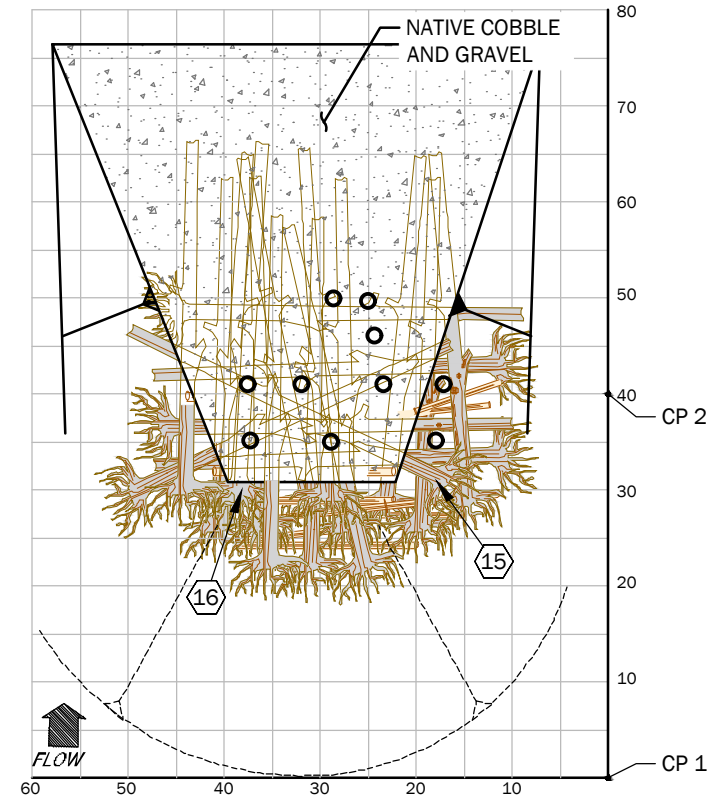
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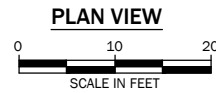
13. PLACE LOGS 10, 11, 12, AND 13.
14. PIN EACH LOG TO AN ADJACENT PILE.
15. PLACE RACKING MEMBERS BETWEEN EXPOSED ROOTWADS AND PILES.
16. PLACE NATIVE COBBLES AND GRAVEL ON TOP OF THE LOGS, LEAVING ROOTWADS EXPOSED.



17. PLACE LOGS 14, 15, 16, AND 17.
18. PIN OR CHAIN EACH LOG IN TWO LOCATIONS ALONG THE LOG TO A LOWER HORIZONTAL MEMBER AND TO ONE ADJACENT VERTICAL PILE.
19. PLACE RACKING MEMBERS BETWEEN EXPOSED ROOTWADS.

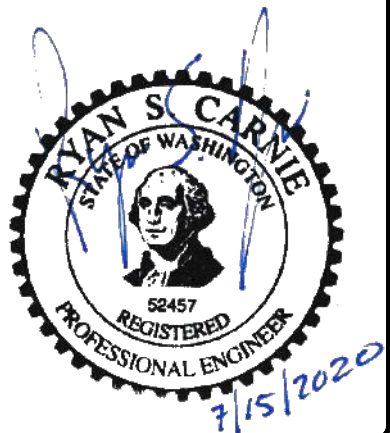


20. PLACE NATIVE COBBLES AND GRAVEL ON TOP OF THE LOGS, LEAVING ROOTWADS EXPOSED. A MINIMUM OF 4.0 FEET OF BACKFILL SHALL BE PLACED OVER THE CUT END OF LOGS 16 AND 17.
21. REMOVE DEWATERING AND FLOW ISOLATION STRUCTURE.



TYPE	LOG NO.	OFFSET FROM ORIGIN, X (FT)	OFFSET FROM ORIGIN, Y (FT)	OFFSET FROM CP 1 (FT)	OFFSET FROM CP 2 (FT)	DISTANCE BETWEEN TOP OF LOG AND EXISTING GRADE (FT)
HORIZONTAL KEY LOGS	10.0	31.0	23.0	38.6	35.4	4.0
	11.0	21.5	22.5	31.1	27.7	4.0
	12.0	14.5	29.5	32.9	17.9	4.0
	13.0	40.0	29.5	49.7	41.4	4.0
	14.0	48.5	29.5	56.8	49.6	5.5
	15.0	17.5	31.5	36.0	19.5	5.5
	16.0	38.0	30.5	48.7	39.2	7.8
	17.0	30.0	30.0	42.4	31.6	7.8

- NOTES:
1. NEGATIVE VALUES INDICATE DISTANCE VERTICALLY BELOW EXISTING GRADE
 2. PILE NUMBERS ARE INDICATED BY CIRCLE CALLOUTS.
 3. LOG NUMBERS ARE INDICATED BY HEXAGON CALLOUTS.
 4. CONTRACTOR IS RESPONSIBLE FOR ALL SHORING AND SHORING DESIGN, SEE 2018 WSDOT STANDARD SPECIFICATIONS 2-09.

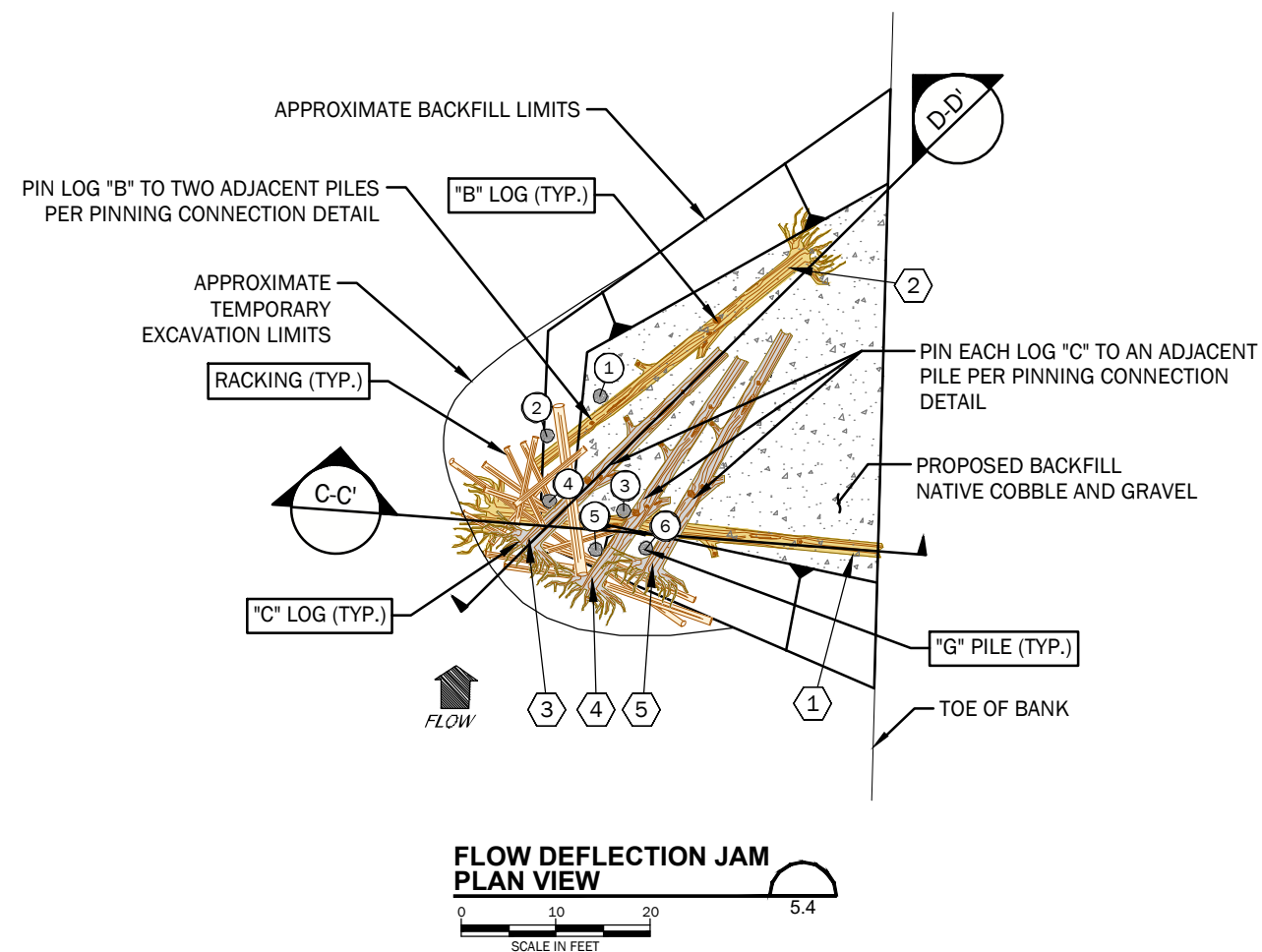


NO.	DATE	BY	REVISION



ELK FLATS CHANNEL RESTORATION SOUTH FORK NOOKSACK RIVER FINAL DESIGN
WOOD DETAILS - APEX JAM SEQUENCING

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 19 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	5.3

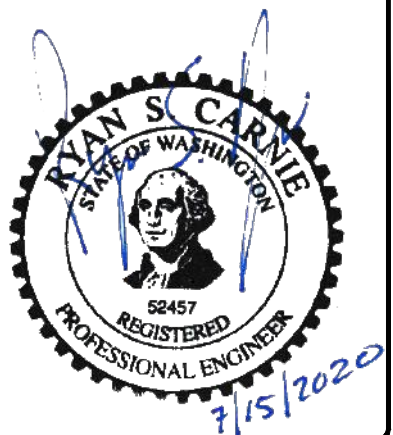
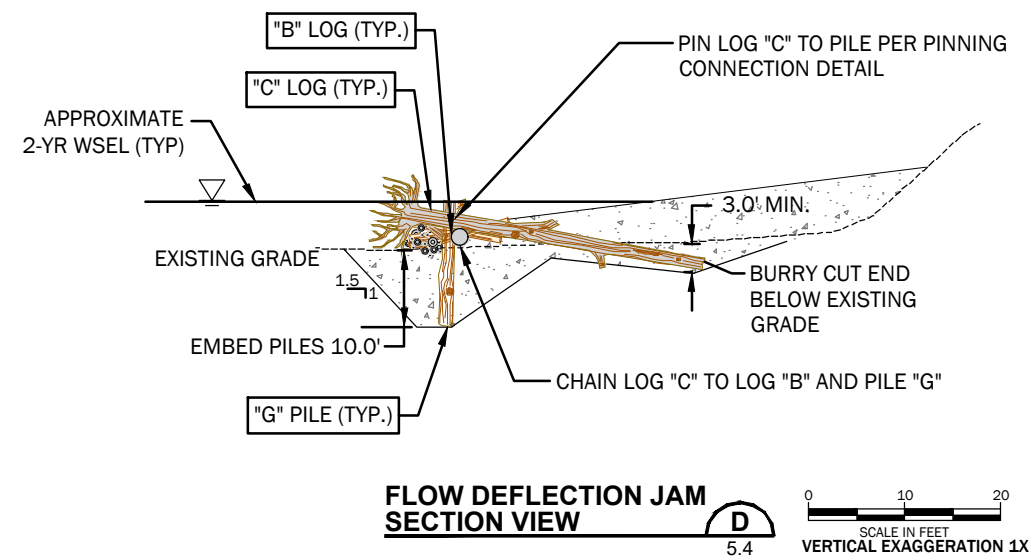
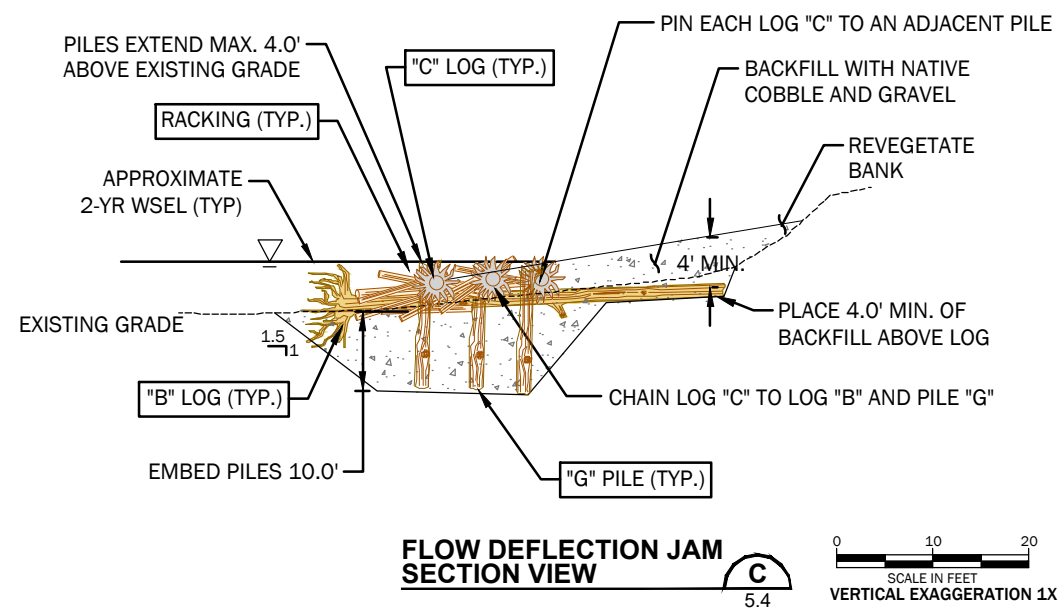


FLOW DEFLECTION JAM

PURPOSE:

- PROVIDES INCREASED HYDRAULIC ROUGHNESS THROUGHOUT THE REACH
- REDIRECTS FLOWS TO OPPOSITE BANK, RESULTING IN CHANNEL WIDENING AND FLOODPLAIN ACTIVATION
- OVER TIME ACCUMULATES ADDITIONAL LARGE WOOD MATERIAL

STRUCTURE QUANTITIES						
LOG TYPE B	LOG TYPE C	PILE TYPE G	RACKING MATERIAL	SLASH MATERIAL (CY)	PIN CONNECTIONS	APPROX. STRUCTURE BACKFILL (FROM SIDE CHANNEL EXCAVATIONS) (CY)
40' MIN. LOG WITH ROOTWAD 20" TO 24" DBH	30' MIN. LOG WITH ROOTWAD 18" TO 24" DBH	15' MIN. NO ROOTWAD 18" TO 22" DIA.			EA.	
2	3	6	10 TO 20	3	6	250

[illegible]

ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

WOOD DETAILS - FLOW DEFLECTION JAM

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 20 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	

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User: lumiller

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D1_CP1	586057.8	1345015.4
D1_CP2	586066.3	1344997.4

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D2_CP1	586147.5	1345207.8
D2_CP2	586158.4	1345191.0

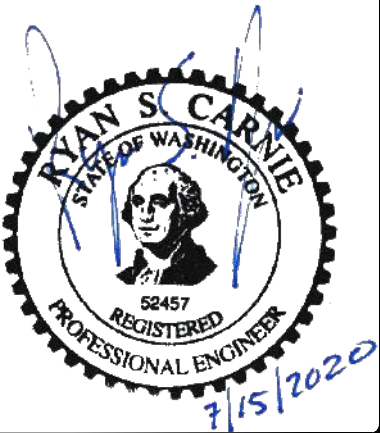
Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D3_CP1	585992.6	1345207.0
D3_CP2	585998.9	1345188.0

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D4_CP1	586096.3	1345413.9
D4_CP2	586096.5	1345393.9

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D5_CP1	585956.9	1345489.1
D5_CP2	585954.7	1345469.3

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D6_CP1	586173.2	1345671.2
D6_CP2	586162.8	1345654.3

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
D7_CP1	585952.3	1346015.0
D7_CP2	585971.7	1346010.5



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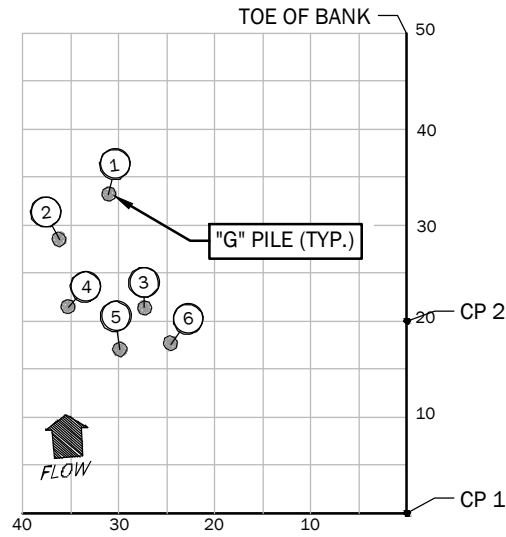
Lummi Nation
Lhaq'emish
People of the Sea

ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

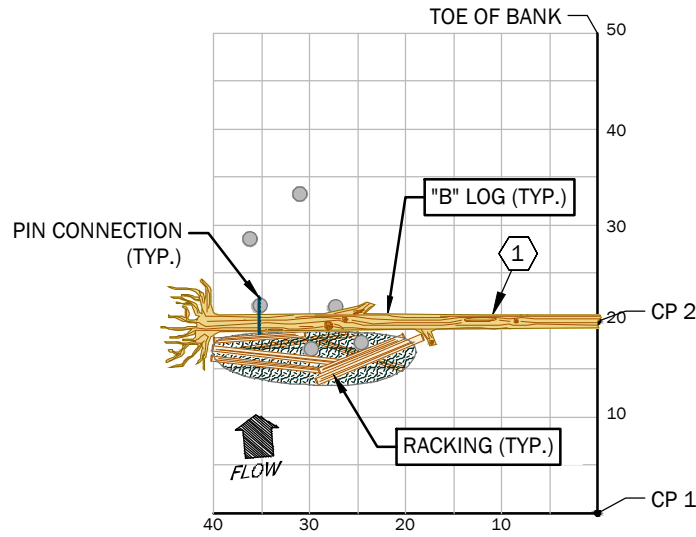
WOOD DETAILS - FLOW DEFLECTION JAM CONTROL POINTS

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 21 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO. 5.5	

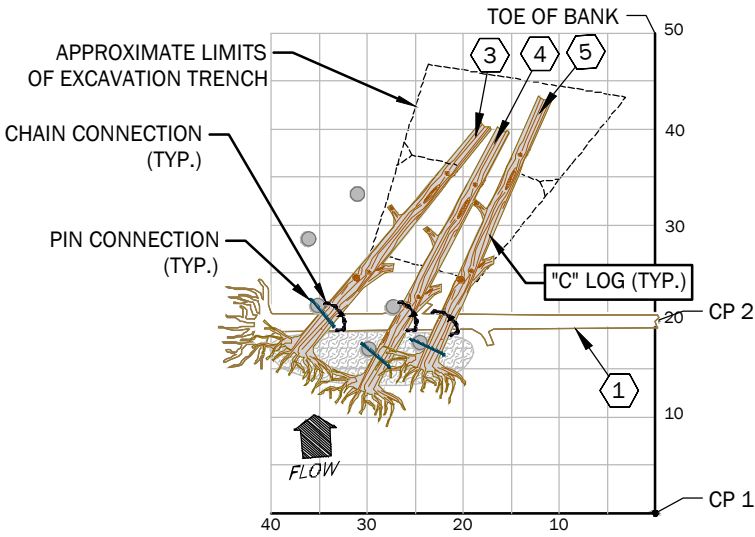
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User: lumiller



INSTALL WORK ISOLATION STRUCTURES AND DEWATER THE WORK AREA.
INSTALL PILES ACCORDING TO OFFSET TABLE.
PILES SHALL BE EMBEDDED 10 FEET.



PLACE LOG 1 (TYPE B) PERPENDICULAR TO THE LINE THAT CONNECTS CONTROL POINTS 1 AND 2 WITH ROOTWAD EXTENDING AWAY FROM THE BANK. PLACE A LAYER OF RACKING MATERIAL AND SLASH ON THE UPSTREAM SIDE OF THE LOG 1.

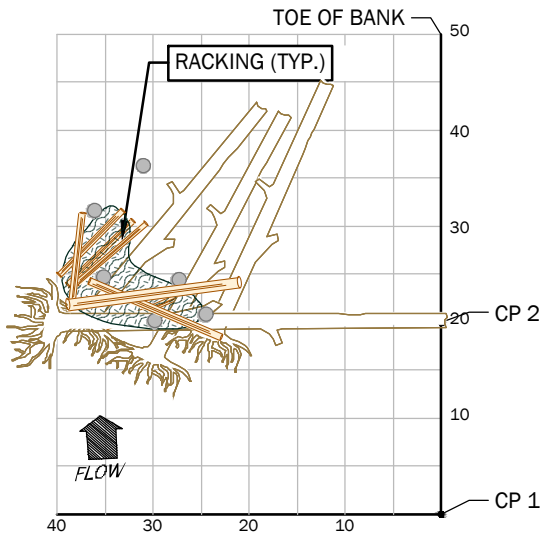


PLACE LOGS 3, 4, AND 5 (TYPE C) PER OFFSET TABLE AND ON TOP OF LOG 1. EMBED THE CUT ENDS OF THE LOGS APPROXIMATELY 3 FEET BELOW THE EXISTING CHANNEL GRADE. CHAIN EACH TYPE C LOG TO THE LOWER TYPE B LOG. PIN EACH TYPE C LOG TO AN ADJACENT PILE PER PINNING CONNECTION DETAIL.

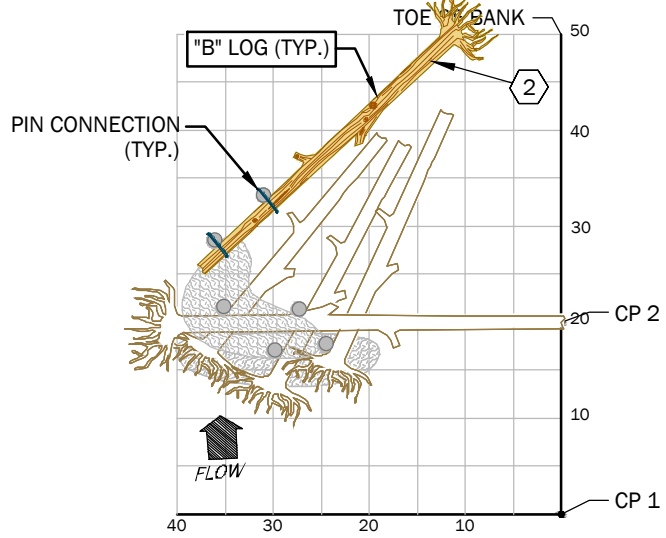
TYPE	PILE NO.	OFFSET FROM ORIGIN, X (FT)	OFFSET FROM ORIGIN, Y (FT)	OFFSET FROM CP 1 (FT)	OFFSET FROM CP 2 (FT)	EMBEDDED DEPTH (FT)
Vertical PILES	1.0	31.0	33.2	45.4	33.7	-10.0
	2.0	36.2	28.5	46.1	37.2	-10.0
	3.0	27.4	21.4	34.8	27.4	-10.0
	4.0	35.3	21.5	41.3	35.3	-10.0
	5.0	29.9	17.0	34.4	30.1	-10.0
	6.0	24.6	17.7	30.3	24.7	-10.0

TYPE	LOG NO.	ROOTWAD OFFSET FROM ORIGIN, X (FT)	ROOTWAD OFFSET FROM ORIGIN, Y (FT)	OFFSET FROM CP 1 (FT)	OFFSET FROM CP 2 (FT)	MIN. COVER OVER CUT END OF LOG (FT)
HORIZONTAL KEY LOGS	1.0	40.0	20.0	44.7	40.0	4.0
	2.0	11.5	50.0	51.3	32.1	6.5
	3.0	37.0	17.5	40.9	37.1	6.5
	4.0	30.0	14.0	33.1	30.6	6.5
	5.0	23.5	16.5	28.7	23.8	0.0

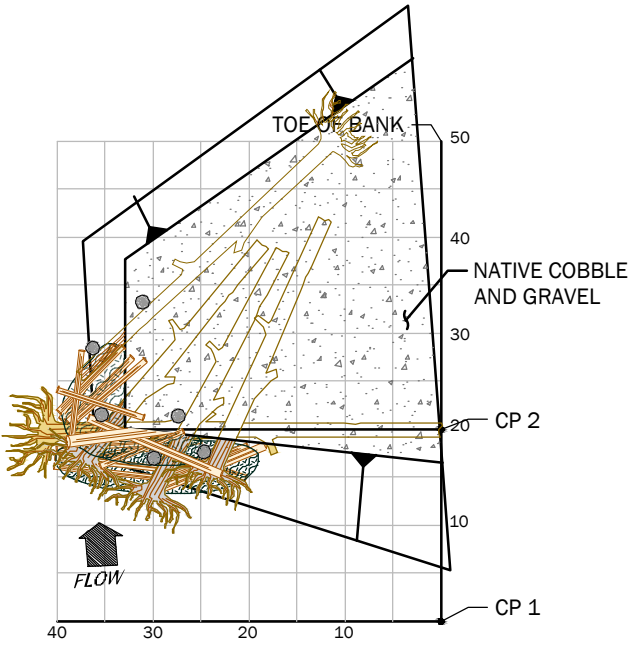
- NOTES:
1. NEGATIVE VALUES INDICATE DISTANCE VERTICALLY BELOW EXISTING GRADE.
 2. PILE NUMBERS ARE INDICATED BY CIRCLE CALLOUTS.
 3. LOG NUMBERS ARE INDICATED BY HEXAGON CALLOUTS.



WEAVE THE REMAINING RACKING MATERIAL AND SLASH BETWEEN THE ROOTWADS AND PILES.

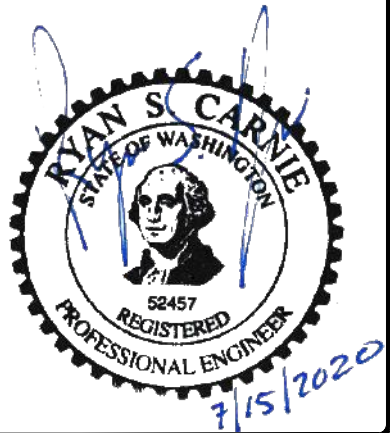


PLACE LOG 2 (TYPE B) PER OFFSET TABLE. CUT END EXTENDS AWAY FROM THE BANK. PIN LOG 2 TO TWO ADJACENT PILES PER PINNING CONNECTION DETAIL.



BACKFILL THE STRUCTURE WITH NATIVE COBBLES AND GRAVEL. CUT END OF LOGS 1 AND 2 (TYPE B LOGS) SHALL HAVE A MINIMUM OF 4.0 FEET OF BACKFILL PLACED ABOVE THE LOGS. PLACE BACKFILL IN 1.0 FOOT LIFTS AND COMPACT WITH EXCAVATOR BUCKET OR SIMILAR METHOD BETWEEN LIFTS. REMOVE DEWATERING AND FLOW ISOLATION STRUCTURE.

PLAN VIEW



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Lummi Nation
Lhaq'emish
People of the Sun

ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

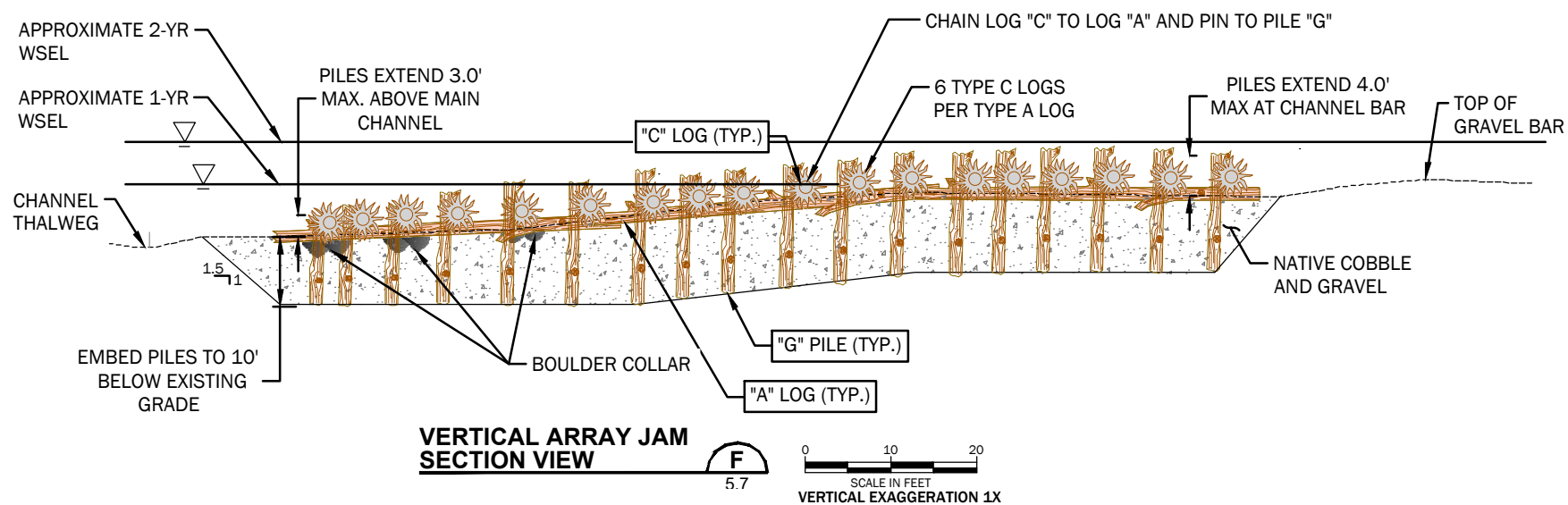
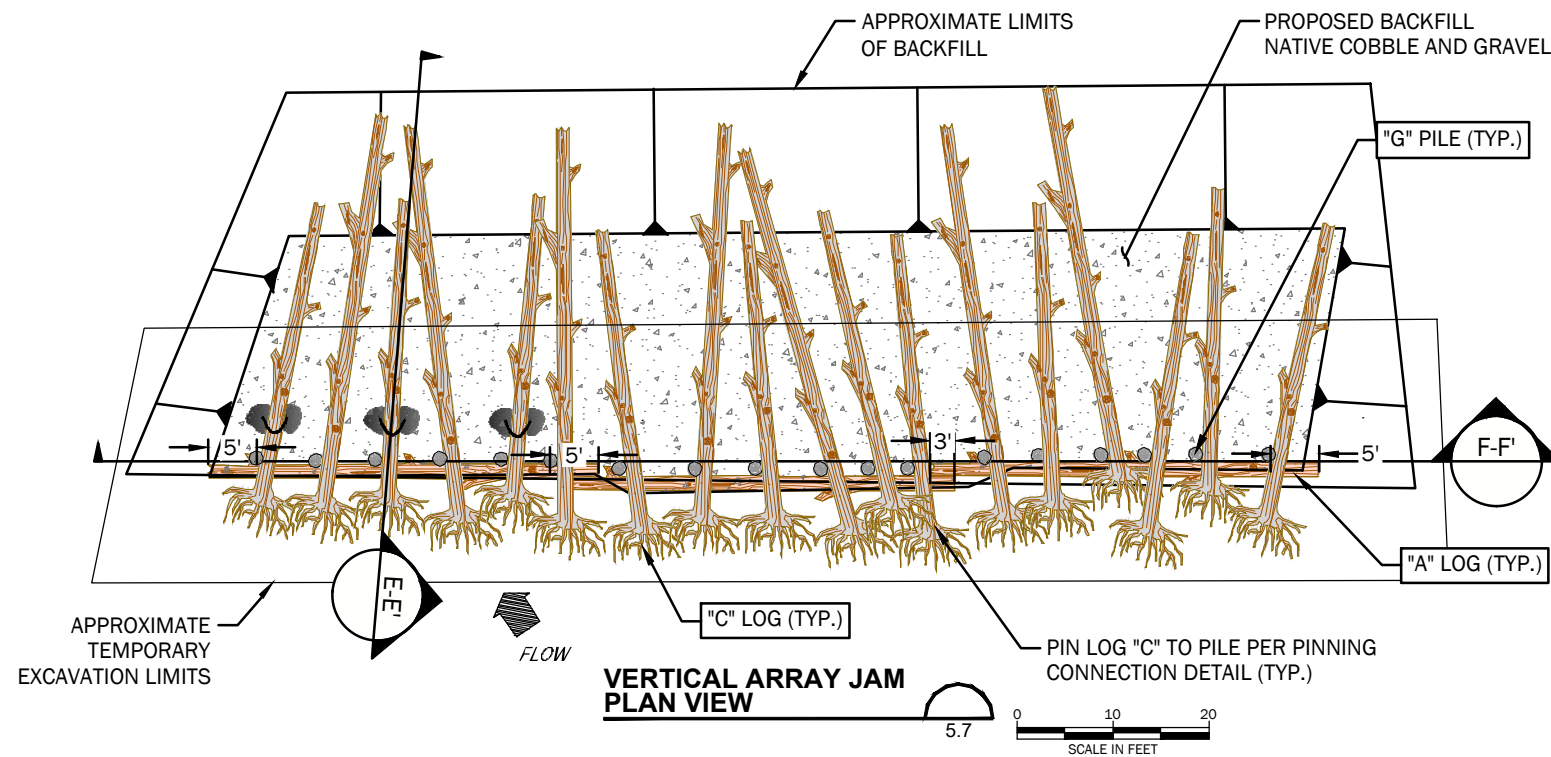
WOOD DETAILS - FLOW DEFLECTION JAM SEQUENCING

DRAWN: BHM/HCM
DESIGN: BHM
CHECKED: RSC/JTM
SHEET NO.

PROJ NO: 1209-028-02
SHEET 22 OF 29
DATE: 07.15.2020

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Lumiller

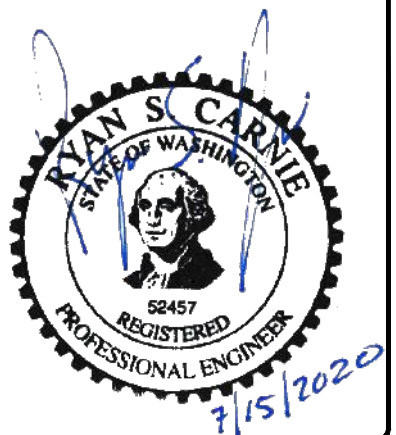
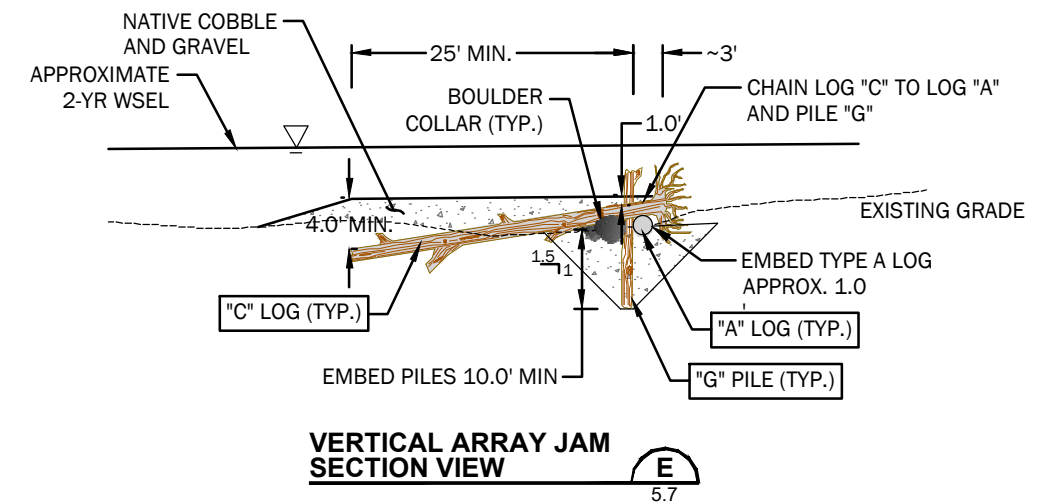


VERTICAL ARRAY JAM NOTES

PURPOSE:

- PROVIDES INCREASED HYDRAULIC ROUGHNESS THROUGHOUT THE REACH
- REDIRECTS FLOWS TO OPPOSITE BANK, RESULTING IN CHANNEL WIDENING AND FLOODPLAIN ACTIVATION
- OVER TIME ACCUMULATES ADDITIONAL LARGE WOOD MATERIAL
- REDUCES STREAM POWER AND AGGRADES BED MATERIAL

STRUCTURE QUANTITIES					
LOG TYPE A	LOG TYPE C	PILE TYPE G	PIN CONNECTIONS	BOULDER COLLAR	APPROX. STRUCTURE BACKFILL (FROM SIDE CHANNEL EXCAVATIONS) (CY)
40' MIN. LOG NO ROOTWAD 20" TO 24" DBH	30' MIN. LOG WITH ROOTWAD 18" TO 24" DBH	15' MIN. NO ROOTWAD 18" TO 22" DIA.	EA.	[2] MIN. 36" DIA. STREAMBED BOULDER	
3	18	18	12	3	360

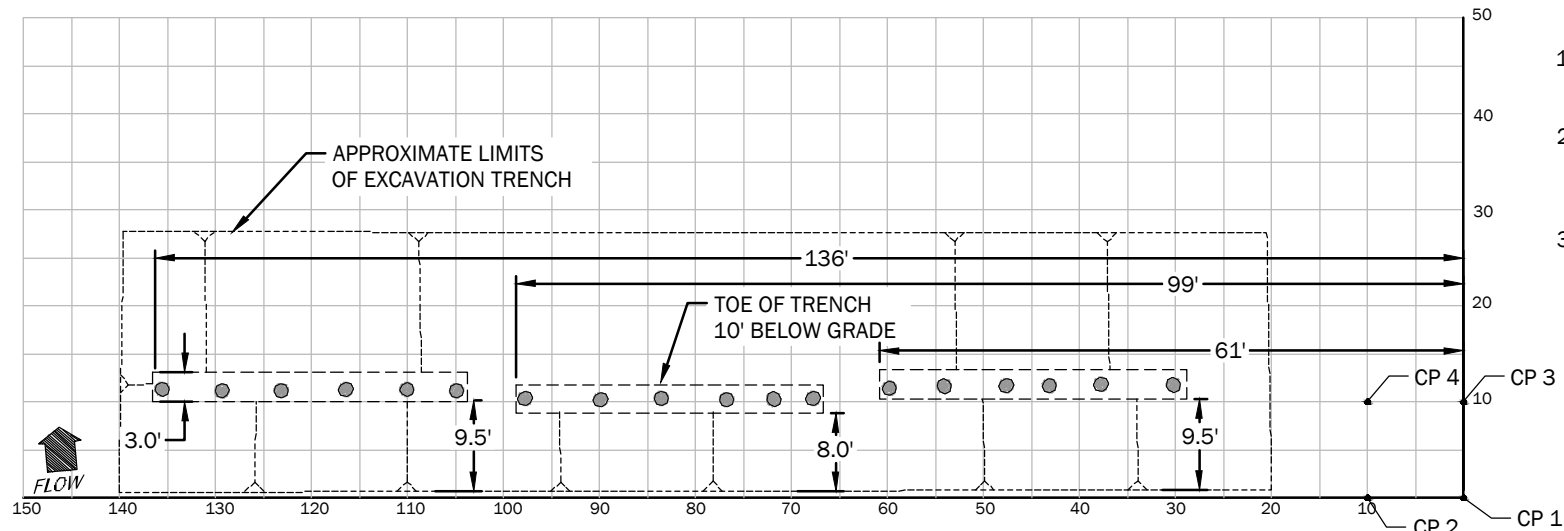


NO.	DATE	BY	REVISION

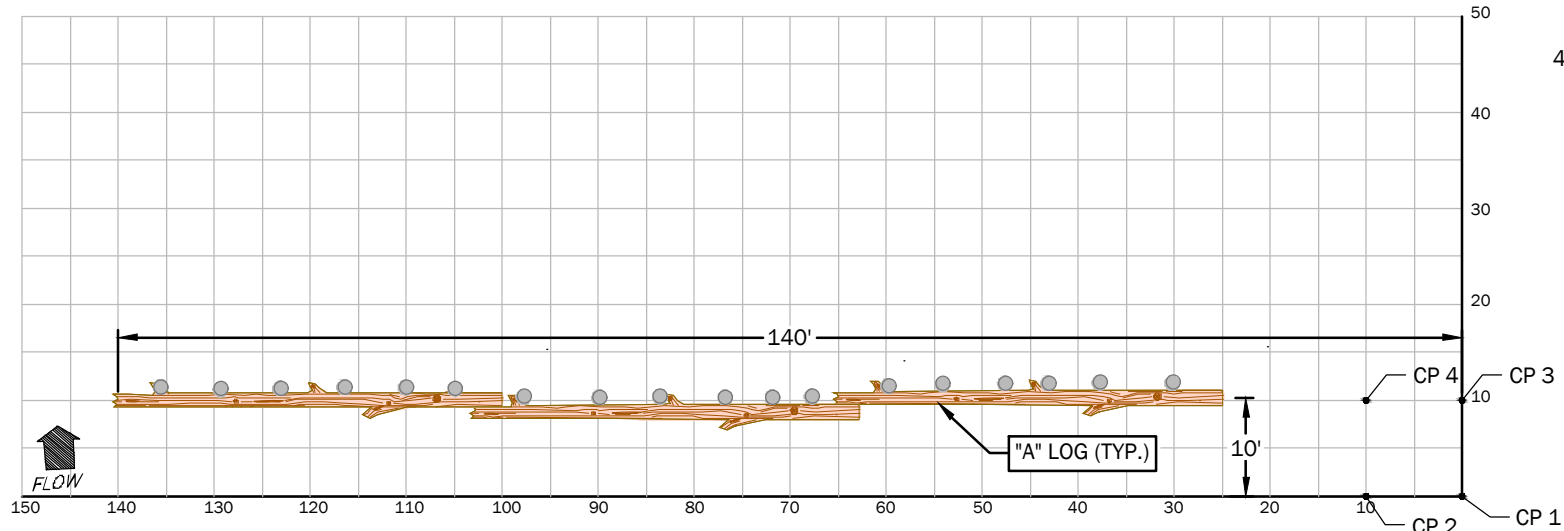


ELK FLATS CHANNEL RESTORATION SOUTH FORK NOOKSACK RIVER FINAL DESIGN
WOOD DETAILS - VERTICAL ARRAY JAM

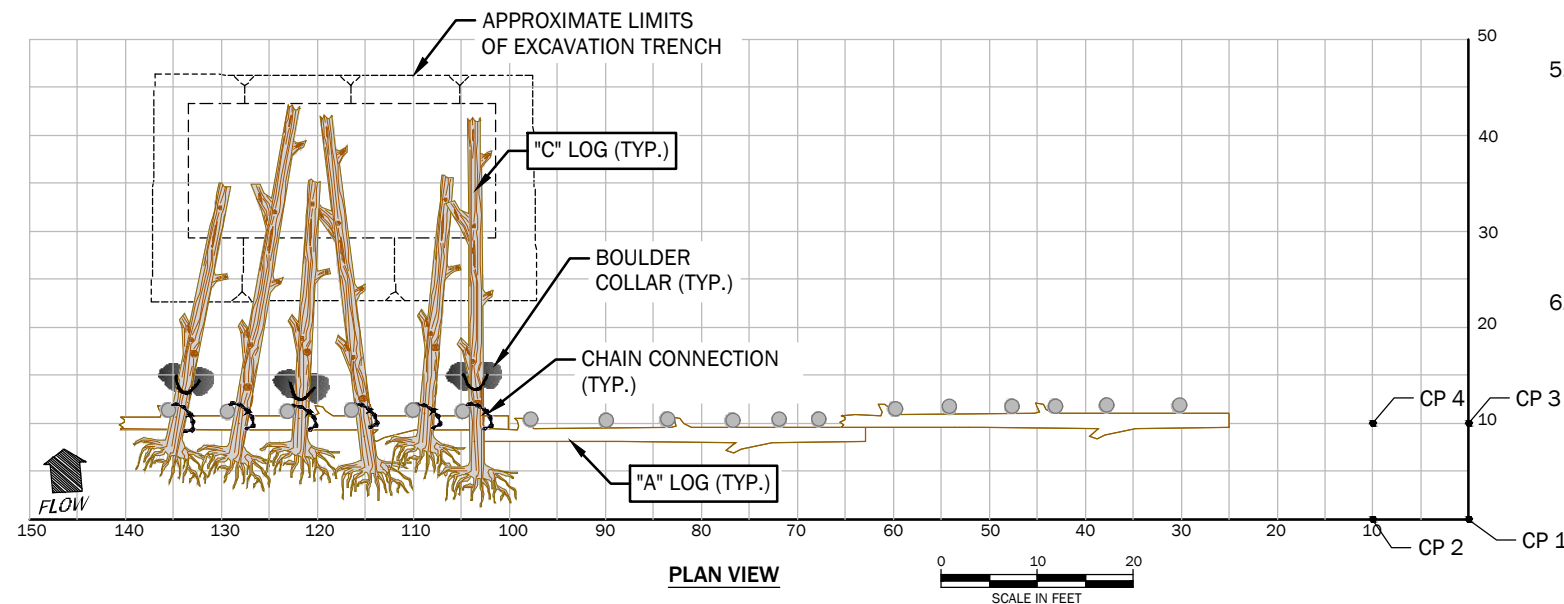
DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 23 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	5.7



1. INSTALL WORK ISOLATION STRUCTURES AND DEWATER THE WORK AREA.
2. EXCAVATE THE INSTALLATION TRENCH FOR VERTICAL PILES. PLACE PILES 10.0 FEET BELOW EXISTING GRADE.
3. BACKFILL WITH NATIVE MATERIAL.



4. PLACE TYPE A UPSTREAM OF THE VERTICAL PILES PER OFFSETS IN TABLE. THESE LOGS SHALL BE PARTIALLY EMBEDDED APPROXIMATELY 1.0 FEET AND OVERLAP BY APPROXIMATELY 3.0 FEET.



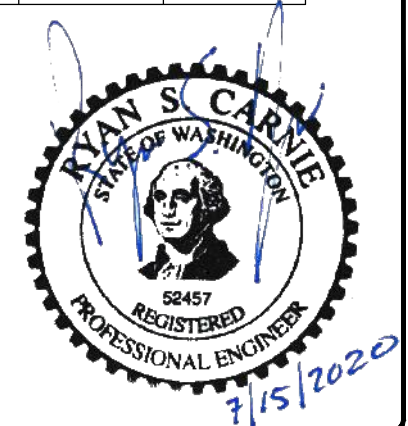
5. PLACE THE FIRST 6 TYPE C LOGS ON TOP OF THE FIRST TYPE A LOG. TYPE C LOGS SHALL BE ANGLED WITH THEIR CUT END DOWN, EMBEDDED INTO THE CHANNEL. TYPE C LOGS EXTEND APPROXIMATELY 2 TO 5 FEET IN FRONT OF THE PILES. CHAIN EACH TYPE C LOG TO AN ADJACENT PILE AND THE TYPE A LOG.
6. PLACE THREE ROCK COLLARS, AS SHOWN, ON THE END OF THE STRUCTURE LOCATED WITHIN THE MAIN CHANNEL.

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
V1_CP1	585805.4	1345966.2
V1_CP2	585799.2	1345958.4
V1_CP3	585813.3	1345960.1
V1_CP4	585807.3	1345952.4

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
V2_CP1	585690.5	1345931.2
V2_CP2	585682.9	1345924.7
V2_CP3	585697.0	1345923.6
V2_CP4	585689.4	1345917.1

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
V3_CP1	585547.7	1345966.8
V3_CP2	585540.2	1345960.2
V3_CP3	585554.3	1345959.3
V3_CP4	585546.8	1345952.7

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
V4_CP1	585370.6	1346030.1
V4_CP2	585360.6	1346029.7
V4_CP3	585370.9	1346020.1
V4_CP4	585360.9	1346019.8



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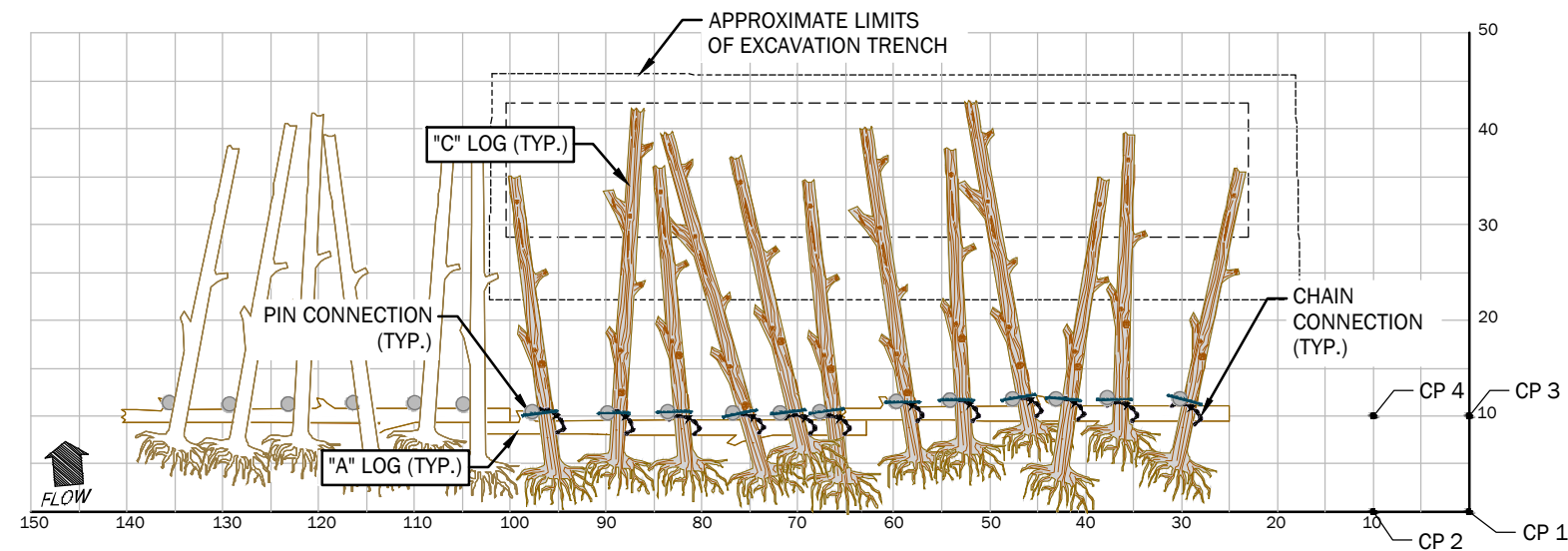
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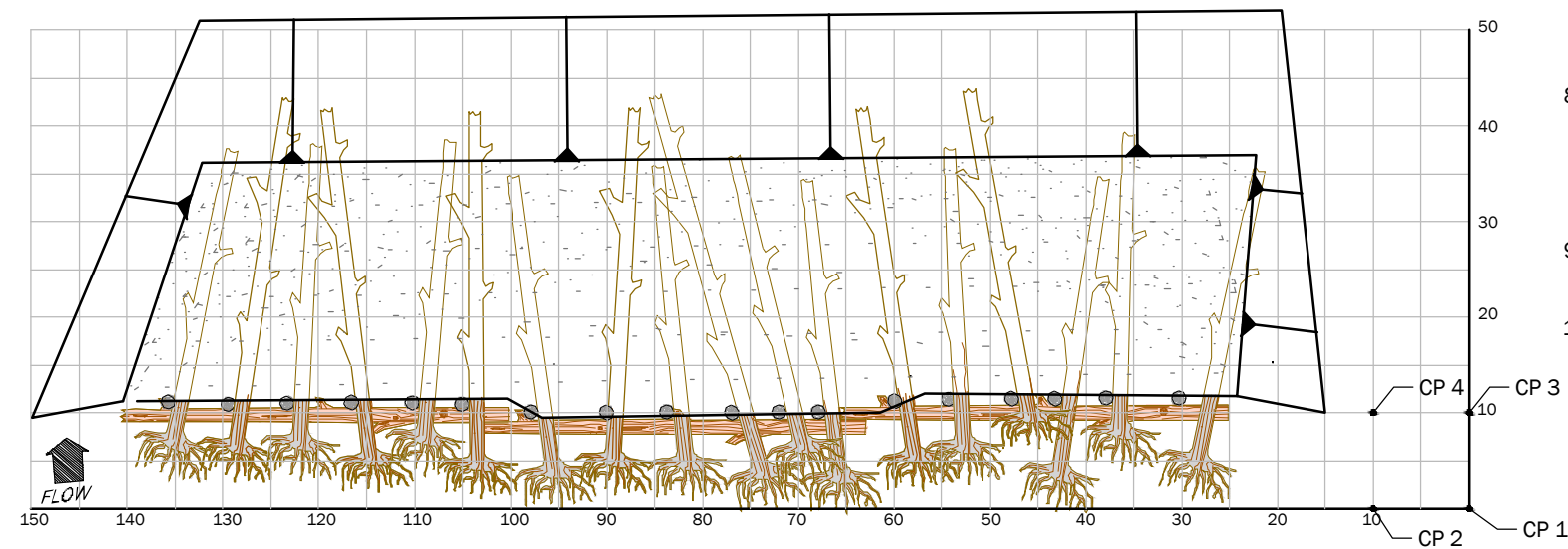
ELK FLATS CHANNEL RESTORATION SOUTH FORK NOOKSACK RIVER FINAL DESIGN
WOOD DETAILS - VERTICAL ARRAY JAM SEQUENCING

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 24 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	5.8

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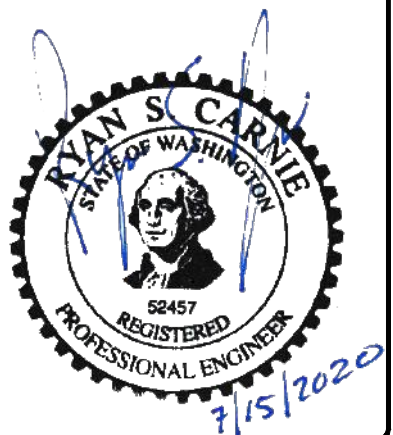
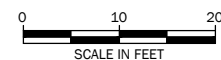


7. PLACE THE REMAINING 12 TYPE C LOGS, 6 PER TYPE A LOG. PIN EACH TYPE C LOGS TO AN ADJACENT PILE, PER PINNING CONNECTION DETAIL.



8. BACKFILL THE STRUCTURE WITH NATIVE COBBLE AND GRAVELS. CUT END OF THE LOGS SHALL HAVE A MINIMUM OF 4.0 FEET OF MATERIAL PLACED ABOVE THE LOG.
9. COMPACT THE BACKFILL WITH AN EXCAVATOR BUCKET OR SIMILAR METHOD.
10. REMOVE DEWATERING AND FLOW ISOLATION STRUCTURE.

PLAN VIEW



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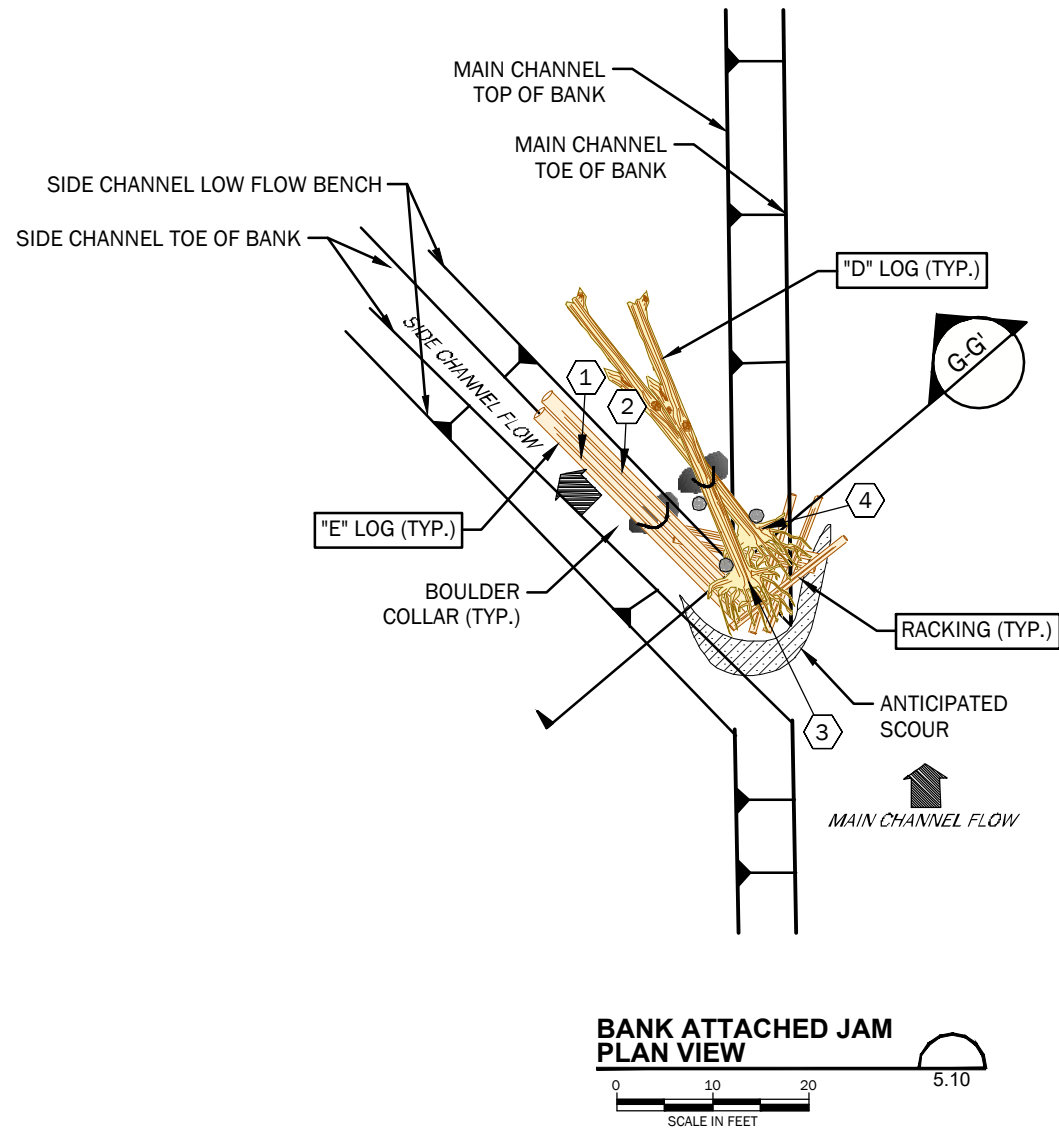


ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

WOOD DETAILS - VERTICAL ARRAY JAM SEQUENCING

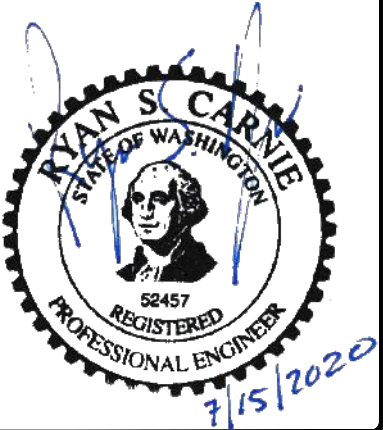
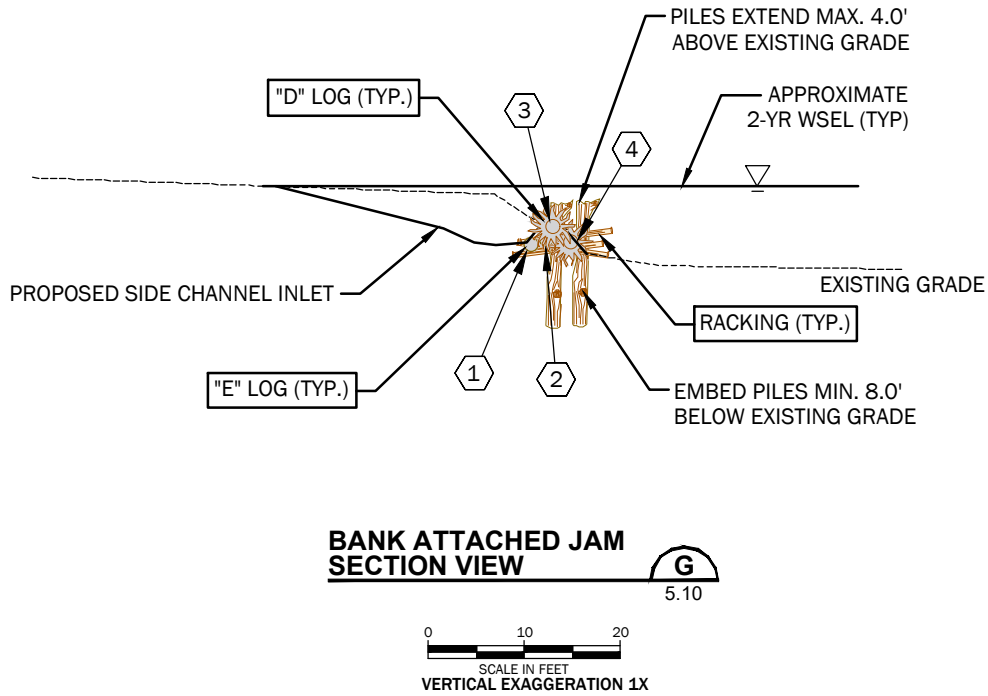
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DESIGN: BHM	SHEET 25 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	5.9

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- PURPOSE:
- CREATES LATERAL SCOUR POOL AT INLET OF SIDE CHANNEL MAINTAINING SIDE CHANNEL FLOW
 - CREATES DIVERSE FISH HABITAT AND COVER ON EDGES OF THE MAIN CHANNEL.

STRUCTURE QUANTITIES				
PILE TYPE G	LOG TYPE D	LOG TYPE E	RACKING MATERIAL	BOULDER COLLAR
15' MIN. NO ROOTWAD 18" TO 22" DIA.	30' MIN. LOG WITH ROOTWAD 12" TO 18" DBH	30' MIN. LOG NO ROOTWAD 12" TO 18" DBH		[2] MIN. 36" DIA. STREAMBED BOULDER
3	2	2	4	2

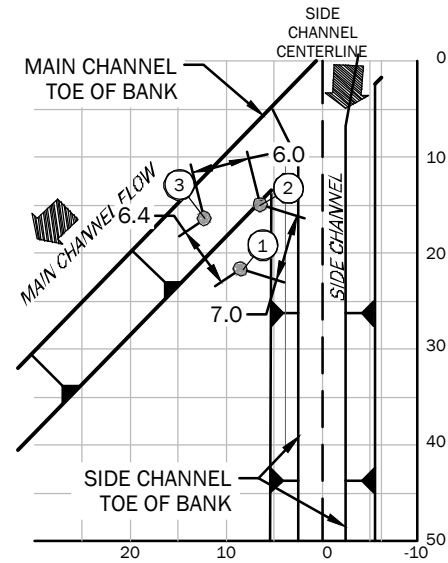


NO.	DATE	BY	REVISION

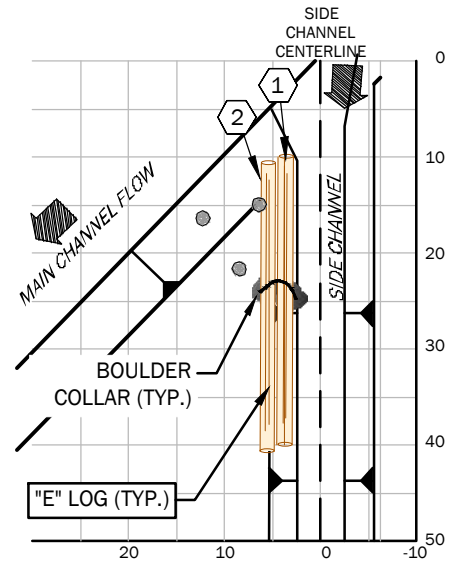


ELK FLATS CHANNEL RESTORATION SOUTH FORK NOOKSACK RIVER FINAL DESIGN
WOOD DETAILS - BANK ATTACHED JAM

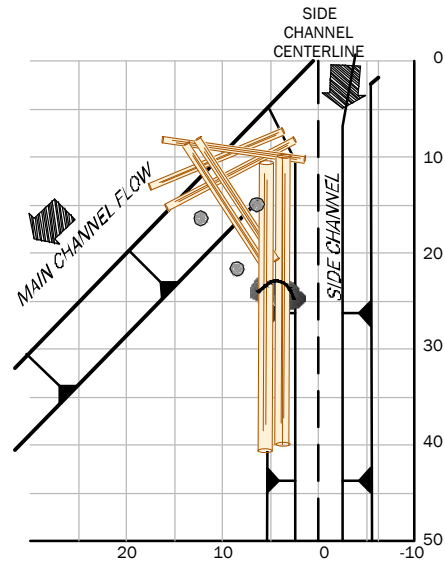
DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 26 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO.	5.10



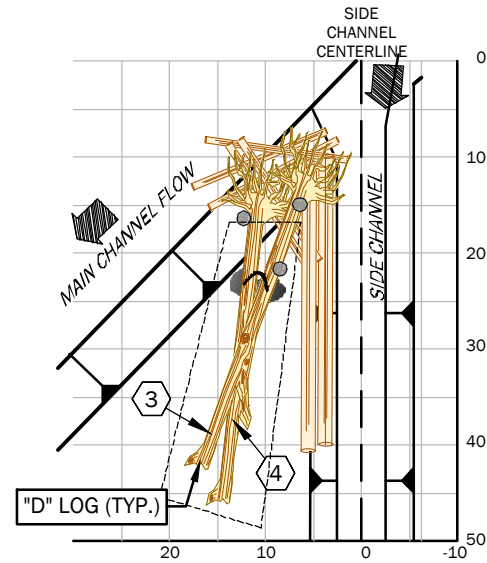
1. INSTALL WORK ISOLATION STRUCTURES AND DEWATER THE WORK AREA.
2. EXCAVATE THE INSTALLATION TRENCH FOR VERTICAL PILES. PILES SHALL BE 8.0 FEET BELOW EXISTING GRADE.
3. PLACE VERTICAL PILES AND BACKFILL WITH NATIVE GRAVEL AND COBBLES.



4. PLACE TWO TYPE E LOGS AT THE TOE OF THE SIDE CHANNEL PARALLEL TO THE SIDE CHANNEL CENTERLINE, PER OFFSET TABLE. LOGS ARE BURIED WITHIN THE TOE OF THE SIDE CHANNEL AND EXTEND INTO THE MAIN CHANNEL.
5. ATTACH A BOULDER ANCHOR (TWO BOULDERS PER ANCHOR) ACROSS BOTH TYPE E LOGS.

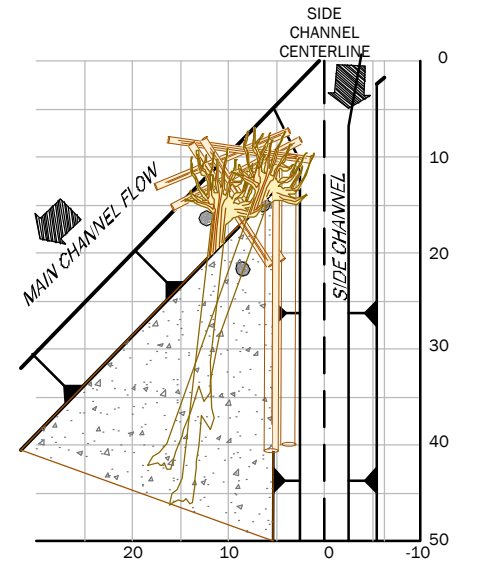


6. PLACE RACKING MEMBERS IN FRONT OF THE PILES AND WEAVE RACKING MATERIAL AND SLASH BETWEEN AND PILES.

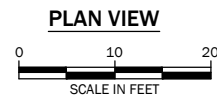


7. EXCAVATE TRENCH TO PLACE TWO TYPE D LOGS (LOGS 3 AND 4). PLACE LOG 4 FIRST. LOG 3 IS PLACED WITH THE ROOTWAD ON TOP OF LOG 2 AND LOG 4. THE ROOTWAD OF LOG 4 IS LOCATED BEHIND THE ROOTWAD OF LOG 3, PARTIALLY EMBEDDED INTO THE BANK.

8. ATTACH A BOULDER ANCHOR WHERE LOG 3 AND 4 OVERLAP. BOULDER ANCHOR SHALL BE ATTACHED TO BOTH LOGS.



9. BURRY TWO THIRDS OF EACH LOG INTO THE BANK OF THE MAIN CHANNEL.
10. BACKFILL THE STRUCTURE WITH NATIVE COBBLE AND GRAVEL.
10. REMOVE DEWATERING AND FLOW ISOLATION STRUCTURE.



TYPE	PILE NO.	OFFSET FROM SIDE CHANNEL CL (FT)	APPROXIMATE STATION (FT)	EMBEDDED DEPTH (FT)
Vertical PILES	1	11.0	21.7	-8.0
	2	8.9	15.0	-8.0
	3	14.8	16.4	-8.0

TYPE	LOG NO.	OFFSET FROM SIDE CHANNEL CL (FT)	APPROXIMATE STATION (FT)
HORIZONTAL KEY LOGS	1	6.3	10.0
	2	8.3	10.7
	3	8.3	15.5
	4	13.3	13.5

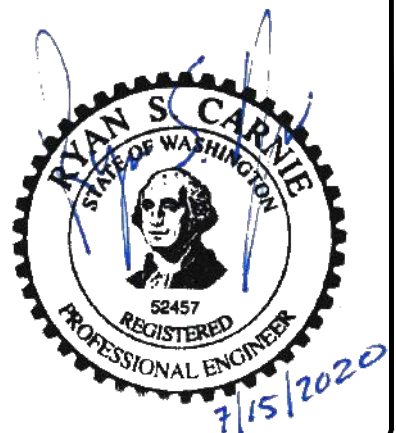
Control Point Table		
Control Point	Northing (ft)	Easting (ft)
B1_CP1	585860.8	1345786.1
B1_CP2	585850.2	1345796.6

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
B2_CP1	585728.2	1345750.6
B2_CP2	585722.5	1345764.4

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
B3_CP1	585625.2	1345741.5
B3_CP2	585623.3	1345756.4

Control Point Table		
Control Point	Northing (ft)	Easting (ft)
B4_CP1	585344.3	1345824.8
B4_CP2	585344.5	1345839.8

- NOTES:
1. NEGATIVE VALUES INDICATE DISTANCE VERTICALLY BELOW EXISTING GRADE
 2. PILE NUMBERS ARE INDICATED BY CIRCLE CALLOUTS.
 3. LOG NUMBERS ARE INDICATED BY HEXAGON CALLOUTS.



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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

WOOD DETAILS - BANK ATTACHED JAM SEQUENCING

DRAWN: BHM/HCM
DESIGN: BHM
CHECKED: RSC/JTM
SHEET NO.

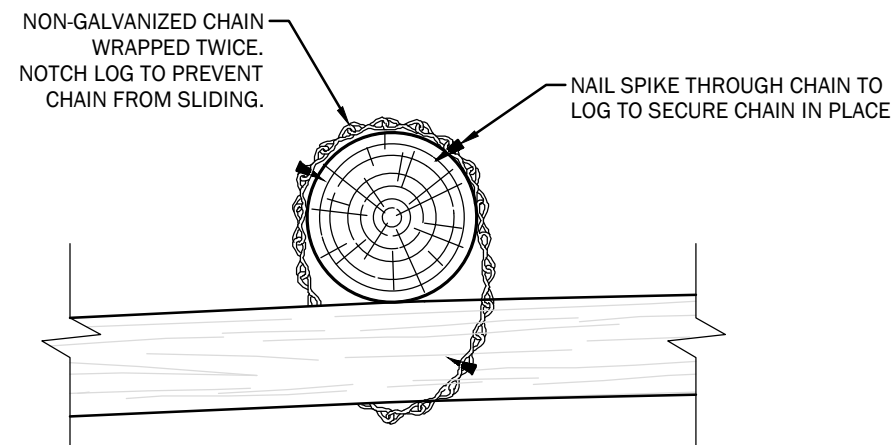
PROJ NO: 1209-028-02
SHEET 27 OF 29
DATE: 07.15.2020

5.11

Diagram illustrating the assembly of a log with a rod and nut:

- CUT TOP OF LOG SUCH THAT END OF ROD IS FLUSH WITH LOG SURFACE
- CUT ROD 1" FROM TOP OF NUT
- 3/4" THREADED NON-GALVANIZED ROD
- CUT ROD 1" FROM TOP OF NUT
- 3" X 3" X 1/4" NON-GALVANIZED SQUARE WASHERS

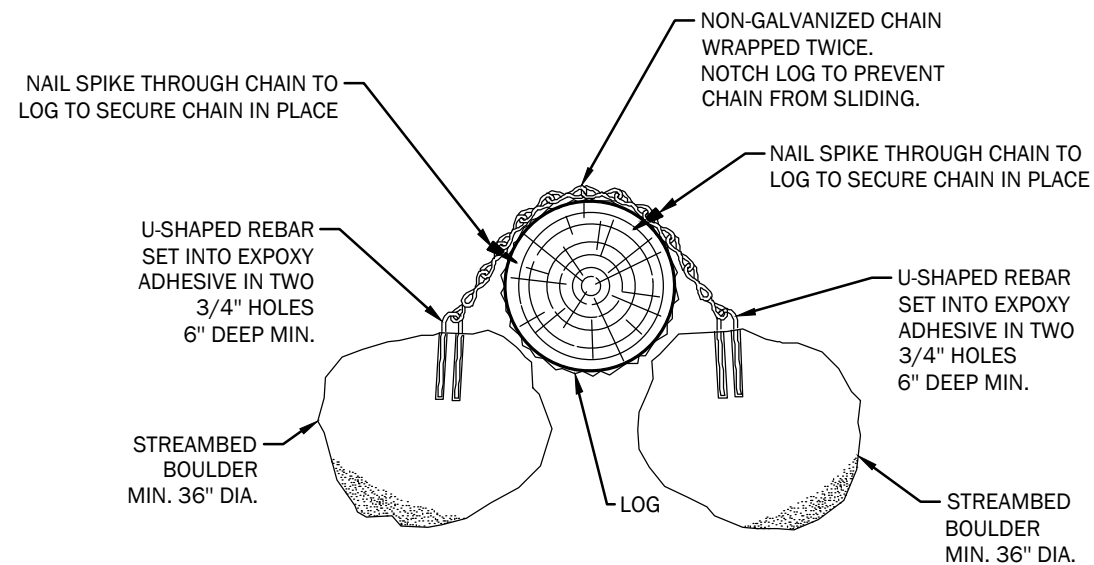
PIN CONNECTION DETAIL  5.12



CHAIN CONNECTION DETAIL

NOT TO SCALE

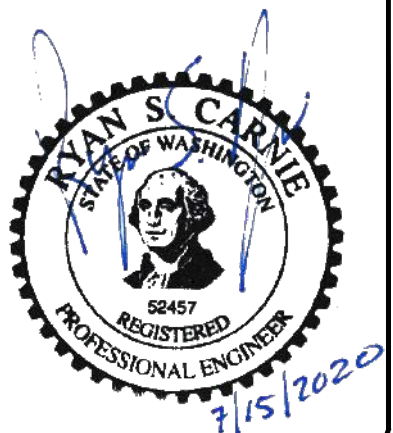
5.12



BOULDER COLLAR DETAIL

NOT TO SCALE

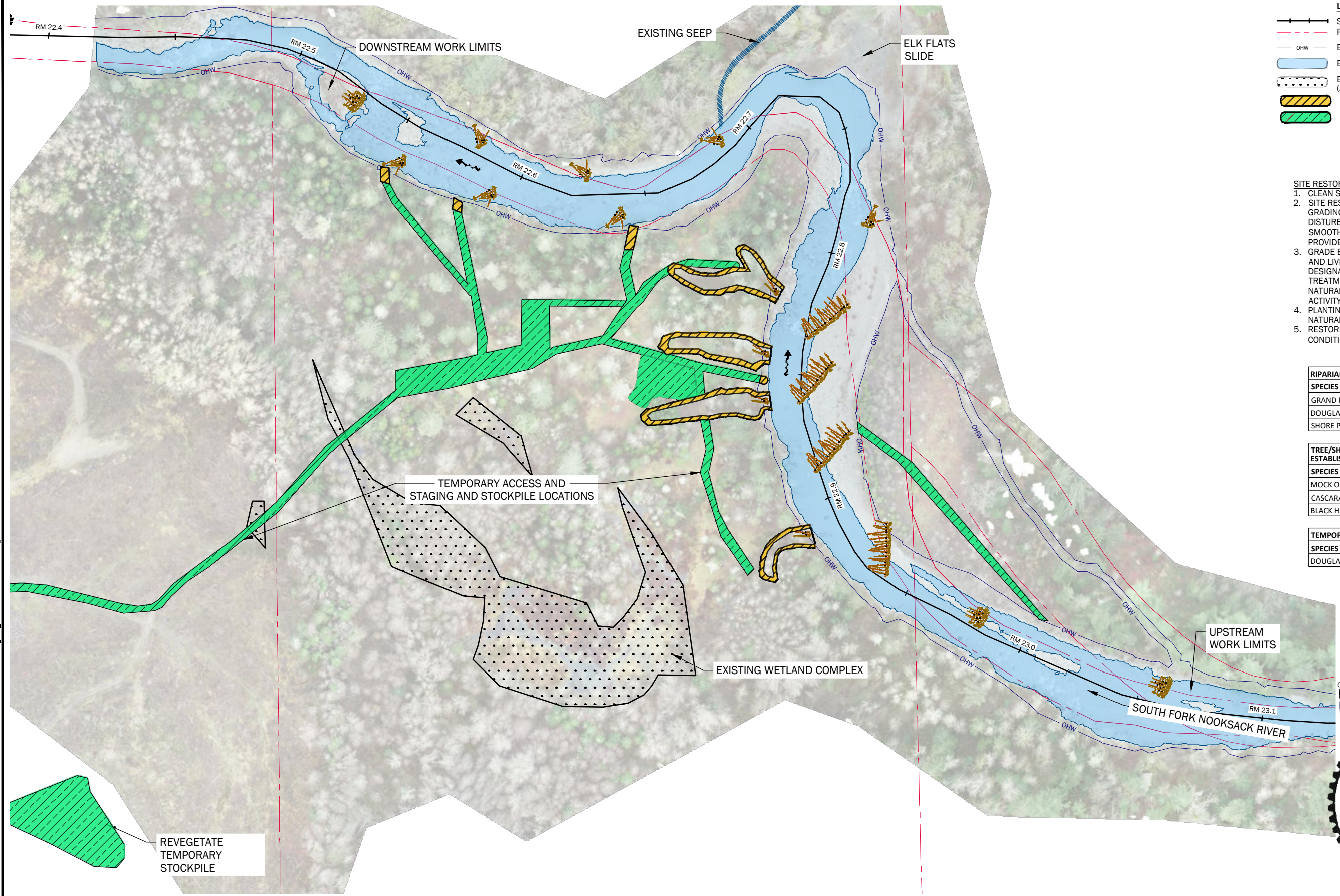
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WOOD DETAILS - CONNECTION DETAILS

DRAWN: BHM/HCM	PROJ NO: 1209-028-02
DESIGN: BHM	SHEET 28 OF 29
CHECKED: RSC/JTM	DATE: 07.15.2020
SHEET NO. 5.12	

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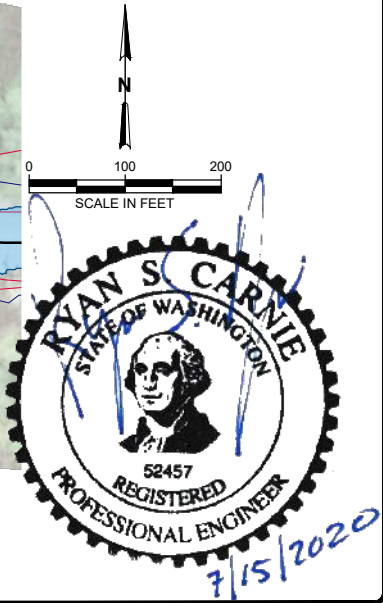
LEGEND	
	SOUTH FORK NOOKSACK RIVER ALIGNMENT
	PARCEL BOUNDARY
	OHW
	EXISTING LOW FLOW CHANNEL
	EXISTING WETLAND (APPROXIMATE BOUNDARY)
	RIPARIAN FOREST BUFFER
	TREE/SHRUB ESTABLISHMENT

- SITE RESTORATION AND REVEGETATION
1. CLEAN SITE OF ALL MATERIALS, SOILS, AND DEBRIS.
 2. SITE RESTORATION SHALL INCLUDE FINISH GRADING AND TRACK WALKING OF AREAS DISTURBED BY CONSTRUCTION TO LEAVE A SMOOTH AND UNIFORM APPEARANCE AND TO PROVIDE FOR DRAINAGE.
 3. GRADE BANKS TO APPEAR NATURAL. HYDROSEED AND LIVE STAKE DISTURBED SLOPE NOT DESIGNATED TO RECEIVE OTHER FINAL TREATMENTS, AND ALL AREAS STRIPPED OF THEIR NATURAL VEGETATION DUE TO CONSTRUCTION ACTIVITY.
 4. PLANTING TO BE COMPLETED BY LUMMI NATION NATURAL RESOURCES
 5. RESTORE ALL ACCESS ROUTES TO PRE-EXISTING CONDITIONS.

RIPARIAN FOREST BUFFER		0.4 ACRES
SPECIES	NUMBER	
GRAND FIR	100	
DOUGLAS FIR	100	
SHORE PINE	100	

TREE/SHRUB ESTABLISHMENT		2.8 ACRES
SPECIES	NUMBER	
MOCK ORANGE	200	
CASCARA	200	
BLACK HAWTHORN	200	

TEMPORARY ACCESS ROAD		0.5 ACRES
SPECIES	NUMBER	
DOUGLAS FIR	100	



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ELK FLATS CHANNEL RESTORATION
SOUTH FORK NOOKSACK RIVER
FINAL DESIGN

REVEGETATION PLAN

DRAWN: BHM/HCM
DESIGN: BHM
CHECKED: RSC/JTM
SHEET NO.

PROJ NO: 1209-028-02
SHEET 29 OF 29
DATE: 07.15.2020

6.1