Oregon Highway Bridge Maintenance

A Pilot Training Course /Workshop

Bridge Scour

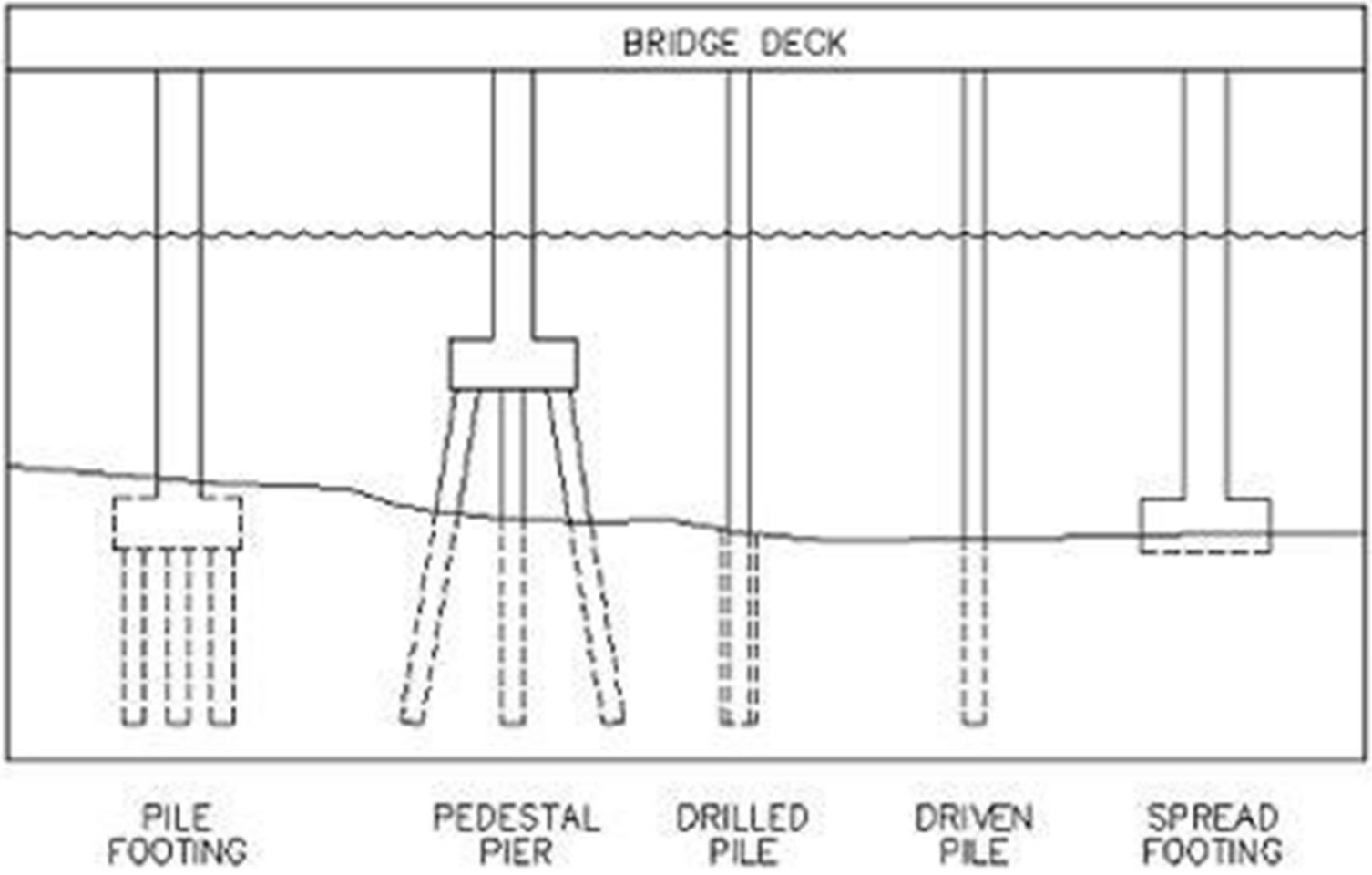
Doug McLain
Clackamas County

Bridge Scour

Scour is the number 1 cause of bridge failure in the United States


Jack
CLACKAMAS
COUNTY


DEC • 64



Above: Common Bridge Foundation Types

Aggradation

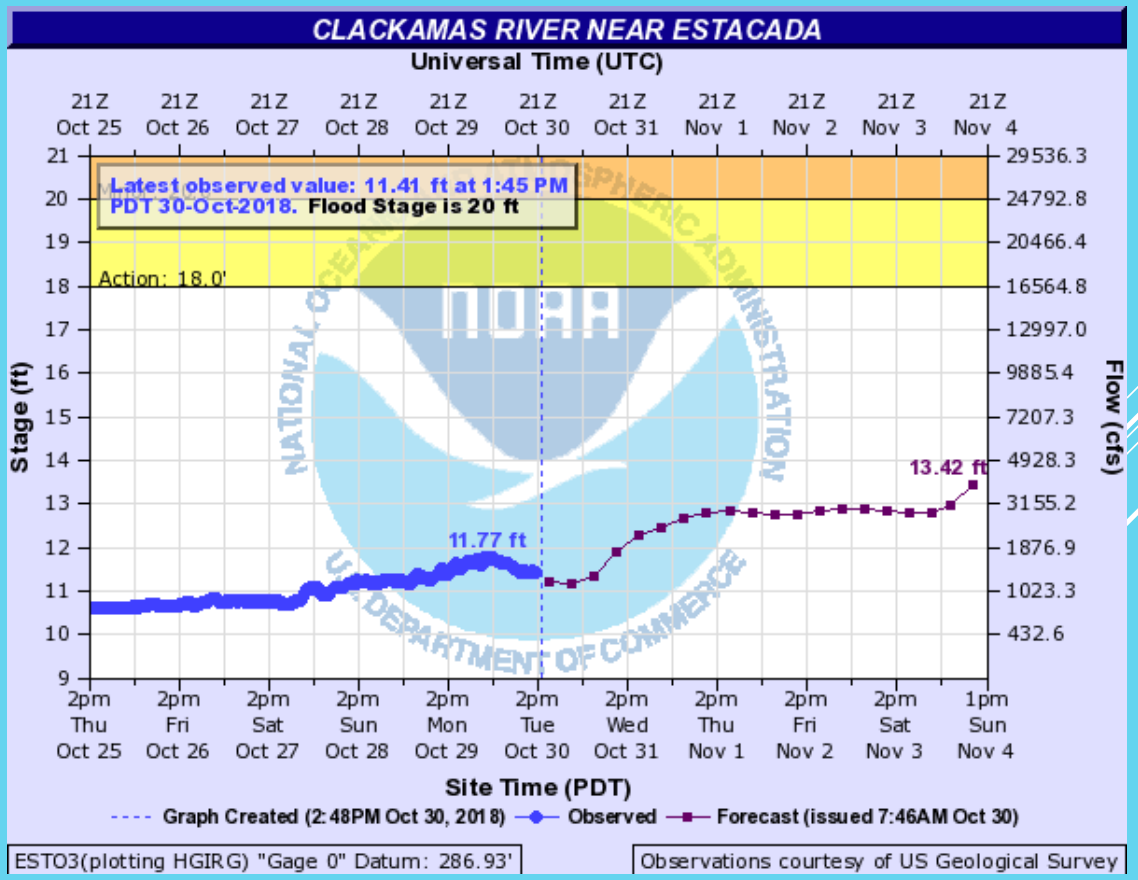
Degradation

Lateral Stream Migration

Angle Of Attack

High Water Events

When and how often to monitor?

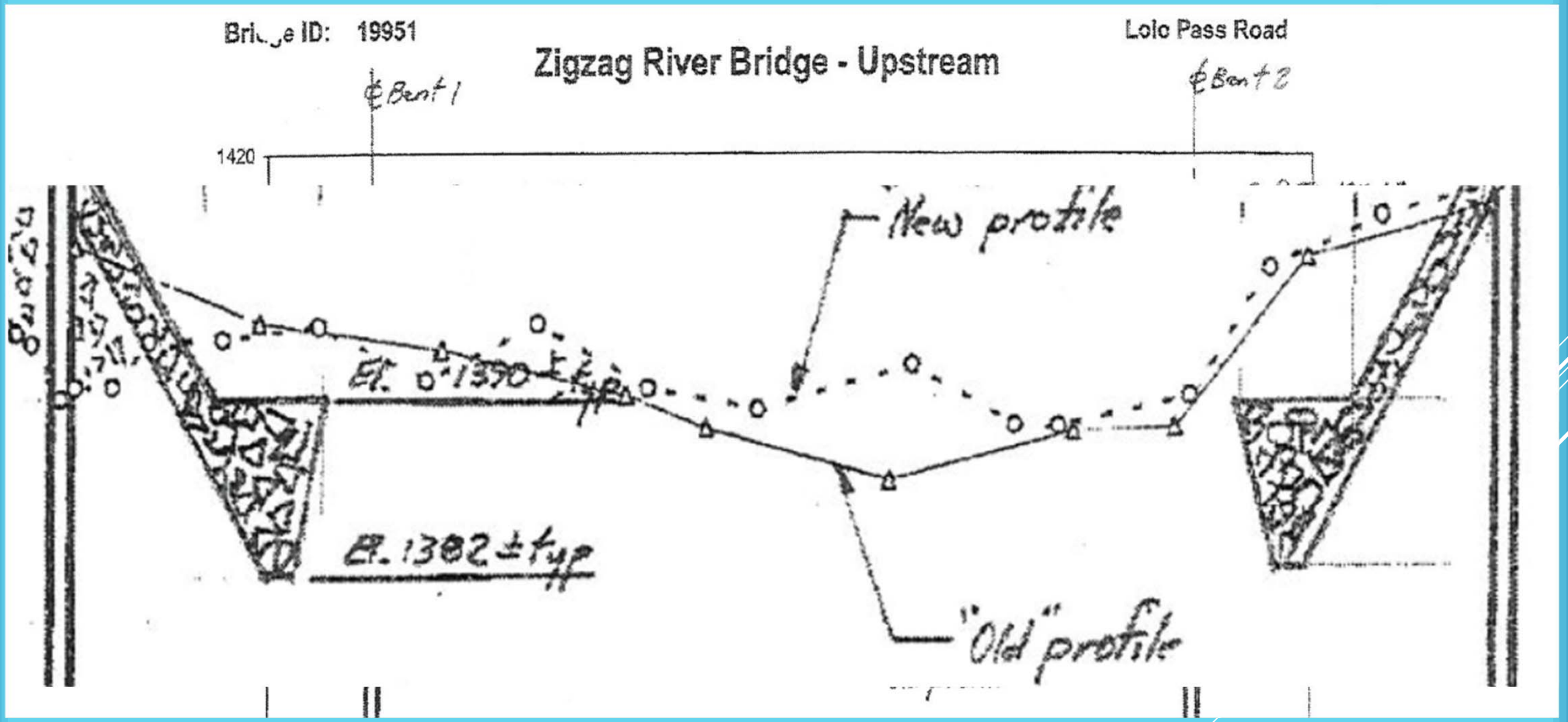


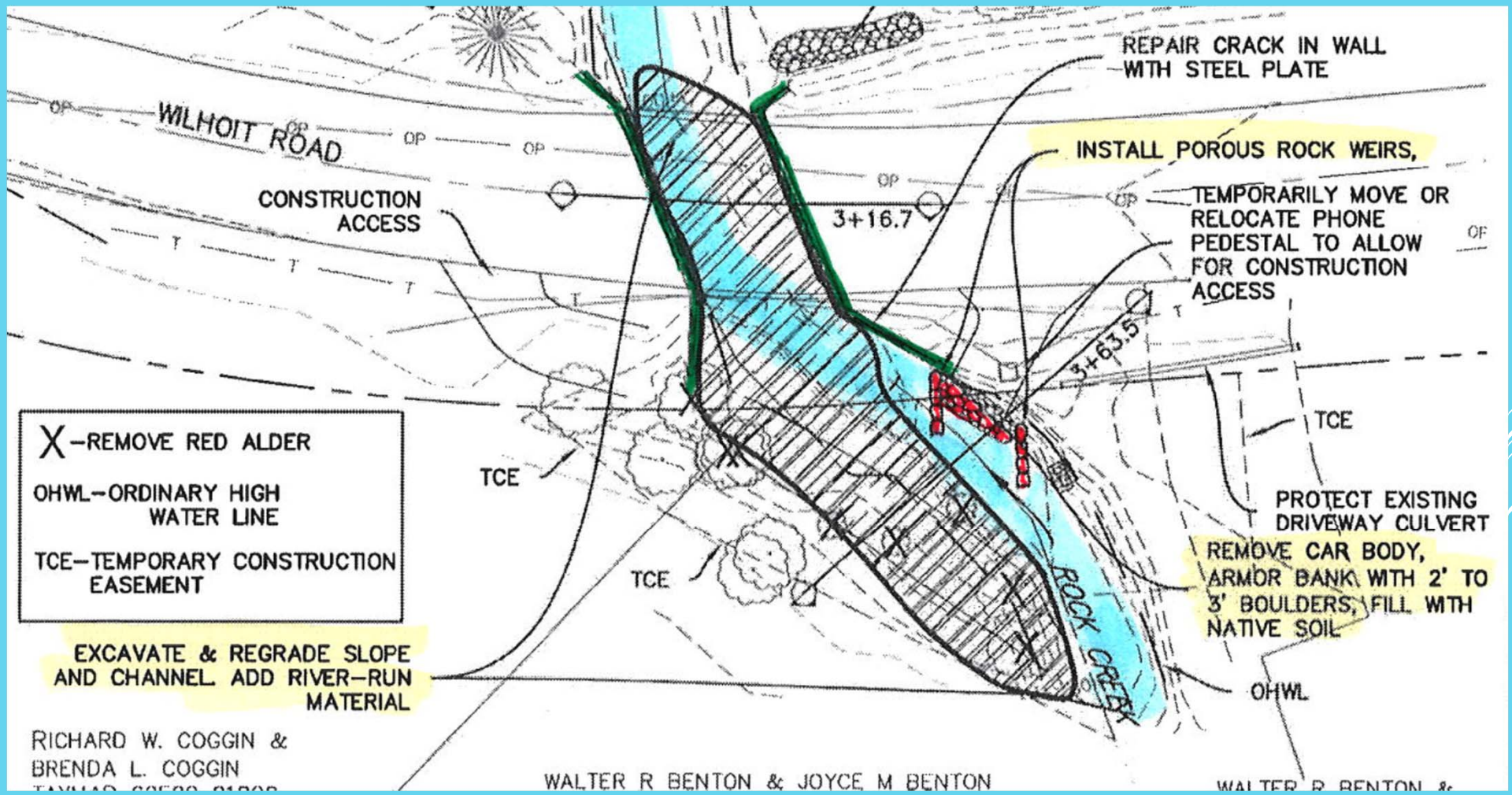
What are we looking for?

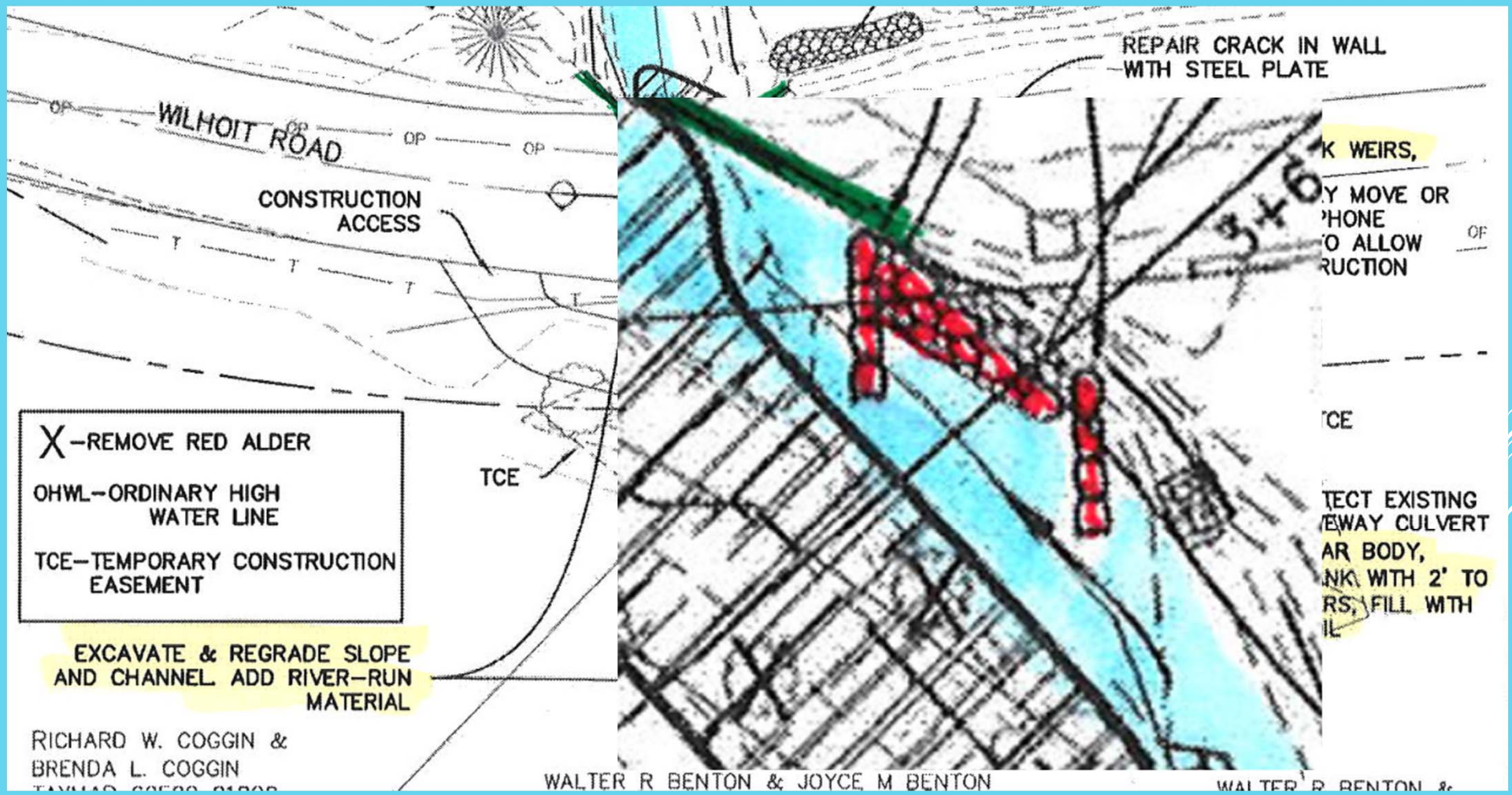
- Overtopping of the bridge deck or approach roadway
- Pressure flow at the bridge (the low chord mostly or fully submerged)
- Vertical or lateral displacement of the superstructure
- Excessive horizontal or vertical separation at bridge deck joints
- Visible damage to the bridge deck, low chord, or substructure
- Sinkholes in the roadway behind the abutments
- Massive debris buildup, especially if near the low chord

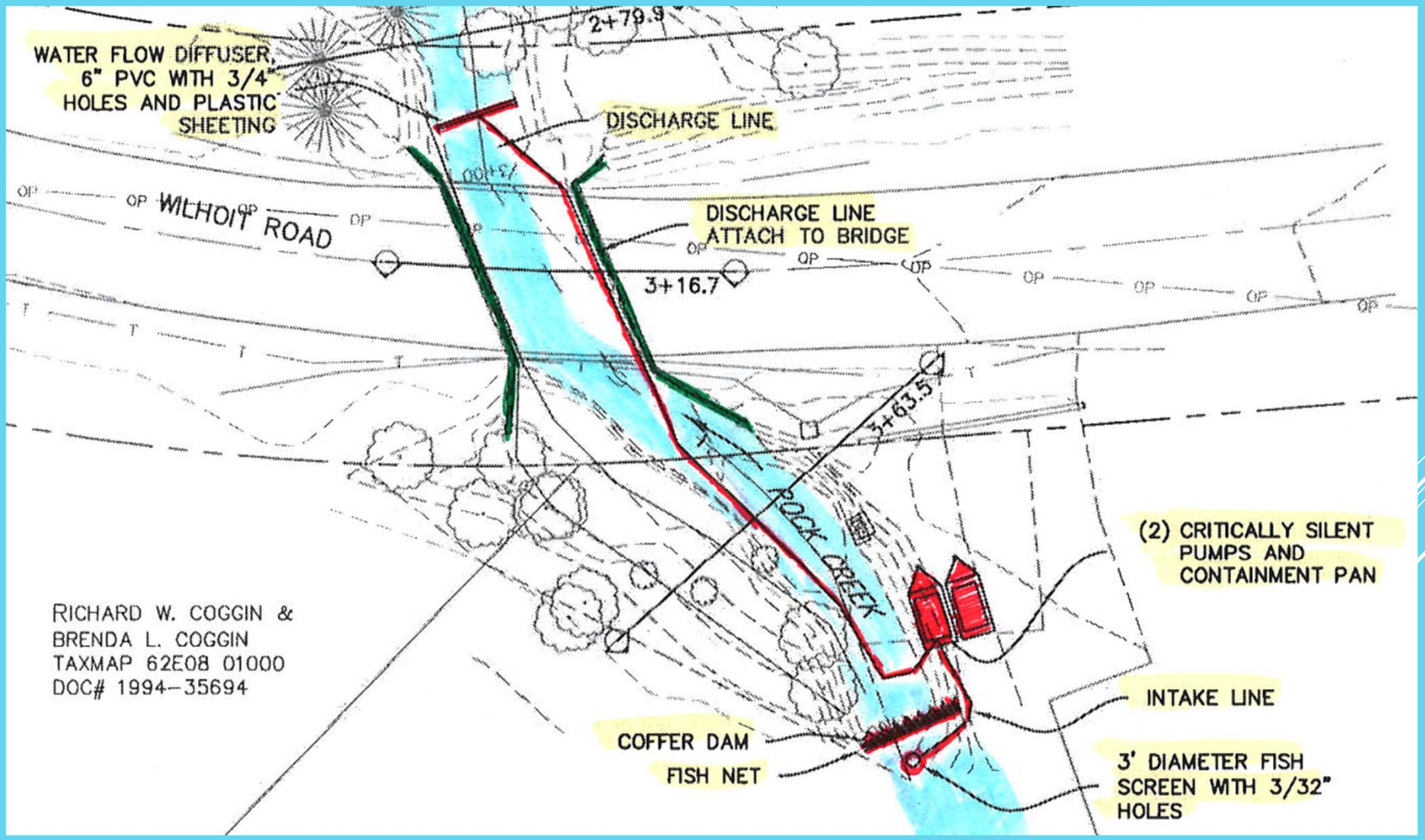
Rt. #	Drainage	Sub Drainage	Br. #	Br. Alias	SCR	Affected Areas (Piers,Beams,Abutments,Approaches)	Foundation Type	High Water Mark	Date / Time / Comments	Inspectors
	Clackamas Rv.	Eagle Creek	03060A	Eagle Creek / Old State Hwy.	3	Bttm of PW steel encasement is 3' above crk. bttm. expsng 4 piles (channel side of PW). US rock bar directs flows on to bnt 2 steel encasement.	Spread fting col. bnts except bnt 2. Bnt 2 is PW on piles.			
	Clackamas Rv.	Eagle Creek	05244	Kitzmiller Rd. / Bear Cr.	4	US NE bank scoured & undercut. N BW: Top of ftng xpsd &covered w/ lrg rocks. SE WW ftng xpsd. No undermining present.	Spread footings			
	Clackamas Rv.	Eagle Creek	05246	Kitzmiller Rd. / N. Fk. Eagle Cr.	4	N. Abutment: Ftng & 20"-30" of vert. face are expsd. S. Abutment: Ftng & 1' of vert face (on the US & DS corners) are expsd. Ftng undermined @ BW- WW jct. (small area 4"-6" deep undermined). SE WW undermined (4"	Spread footings poured on rock			
	Clackamas Rv.	Eagle Creek	05295	Heiple Road West			Spread footings			
	Clackamas Rv.	Eagle Creek	05296	Heiple Road East			Spread footings			
	Clackamas Rv.	Rock Creek	06040	Foster Road						
	Clackamas Rv.	Rock Creek	06287	172nd	3	Footings are exposed on both abutments with 4"of vertical footing face exposed on NE WW. Up to 8" of vert. ftng face xpsd on S. abut. @ mid pt. (no undermining present). US & DS banks eroding especially behind wingwalls.	Spead Footing			
	Clackamas Rv.	Deep Creek	06299	Deep Cr.		US & DS S. bank scour. Shear vert. bank wall w/in feet of S. abutment. Bnt 2 col. undermined ftngs filled w/ lrg rock counter measures	End bents on piles. Int column bnts; spread ftngs			
	Clackamas Rv.		06364	Sailing Rd.		Channel scour holes @ NW and SE wingwalls. No footings are expsd. Creek flows against US NW wingwall.	Spread ftings			
	Clackamas Rv.	Eagle Creek	06424	North Fork Eagle Cr.	8	US & DS bank scour. Hvy abrasion on int. bnts. S. int bnt: PW is undermined 1" deep full length on bank side & 6" deep @ US end on creek side. Bridge over topped with lrg debris, 2008.	Spread ftngs; End & int. bents pour on rock.	Deck overtop-ped. Apprch GR backfill eroded. (09)		
	Clackamas Rv.	Eagle Creek	06466	Snuffin Rd.	8	S. abutment: US half of the BW ftng & 6"- 8" of vert ftng face expsd. N. abutment: Ftng & 4"- 2' of ftng face expsd from US WW- BW jct to end of DS WW. A 6' L x 1' D x 9" H section of the DS WW is undermin-ed, 4' DS from the BW-WW	Spread footings			
	Clackamas Rv.	Clear Creek	06505	Fishers Mill	8	Bnt 2: DS col; overpour undermined back to col. Bnt 3: US col overpour exposd & undermined. Channel & bank scour (scour hole 3'-5' deep 2' out from US col.in bnt 3). No ftngs expsd on either int bnt. (ftngs 1.5' vert.)	End bents on piles. Int bnts; spread ftngs			
	Clackamas Rv.	Clear Creek	06508	Viola	3	Channel scour holes @ bnt 2 col (no ftngs expsd). Bent 3 col. ftngs & 3.5"-24" of ftng faces exposed. Some ftng bttms exposd but, not undermined. Spn 4: Hvy S. bank erosion @ bnt	Spread footings end and int. bents.			

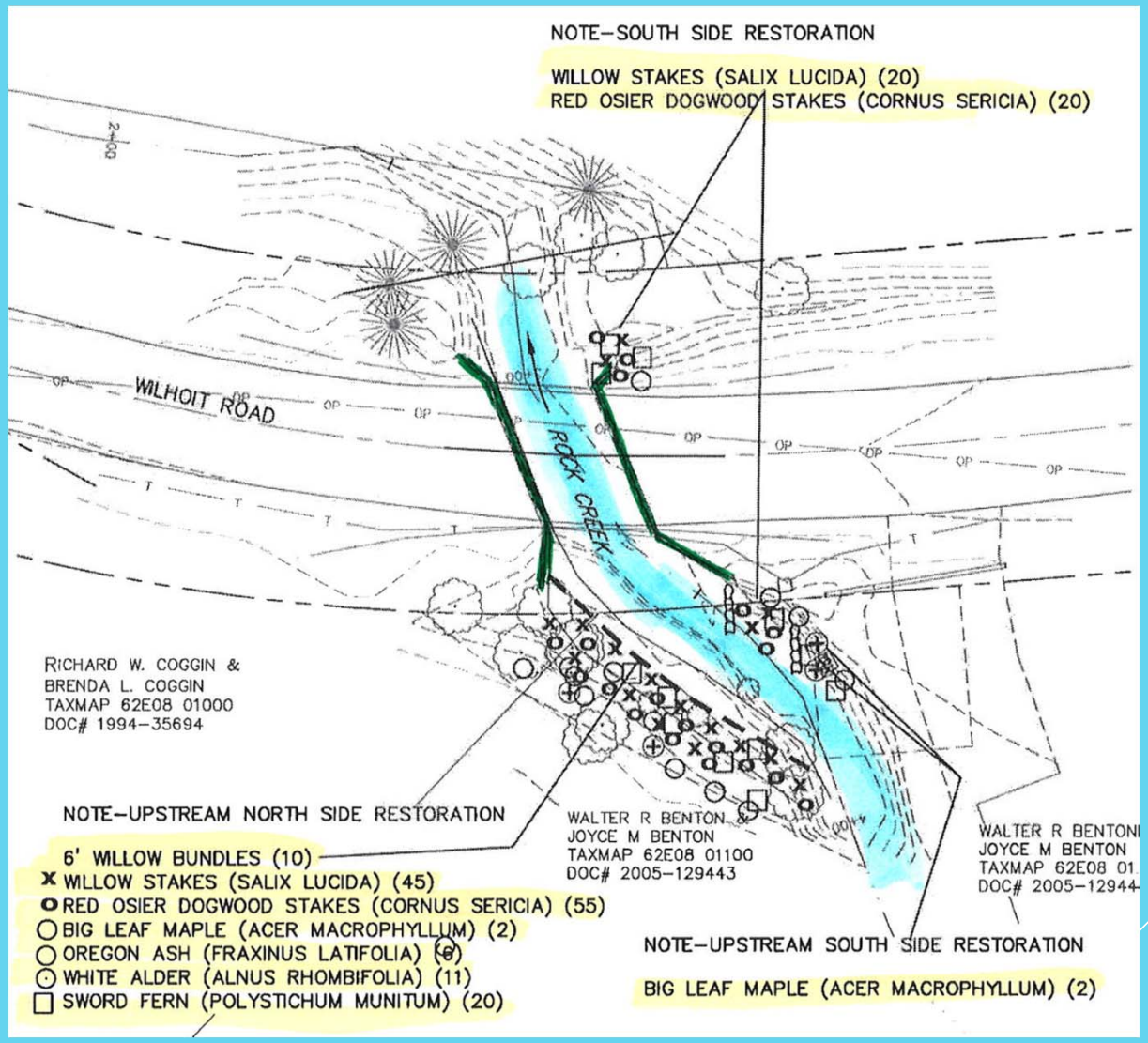
Drainage	Sub Drainage	Br. #	Br. Alias	SCR	Affected Areas (Piers,Beams,Abutments,Approaches)	Foundation Type
Clackamas Rv.	Rock Creek	06287	172nd	3	Footings are exposed on both abutments with 4"of vertical footing face exposed on NE WW. Up to 8" of vert. ftng face xpsd on S. abut. @ mid pt. (no undermining present). US & DS banks eroding especially behind wingwalls.	Spread Footing


Bridge ID: 19951
Lolo Pass Road
Zigzag River Bridge - Upstream
℄ Bent 1
℄ Bent 2
1420
New profile
El. 1390 ± typ
El. 1382 ± typ
"Old" profile


WILHOIT ROAD
CONSTRUCTION ACCESS
3+16.7
3+63.5
REPAIR CRACK IN WALL WITH STEEL PLATE
INSTALL POROUS ROCK WEIRS,
TEMPORARILY MOVE OR RELOCATE PHONE PEDESTAL TO ALLOW FOR CONSTRUCTION ACCESS
TCE
PROTECT EXISTING DRIVEWAY CULVERT
REMOVE CAR BODY, ARMOR BANK WITH 2' TO 3' BOULDERS, FILL WITH NATIVE SOIL
OHWL
ROCK CREEK
X-REMOVE RED ALDER
OHWL-ORDINARY HIGH WATER LINE
TCE-TEMPORARY CONSTRUCTION EASEMENT
EXCAVATE & REGRADE SLOPE AND CHANNEL. ADD RIVER-RUN MATERIAL
RICHARD W. COGGIN & BRENDA L. COGGIN
WALTER R BENTON & JOYCE M BENTON

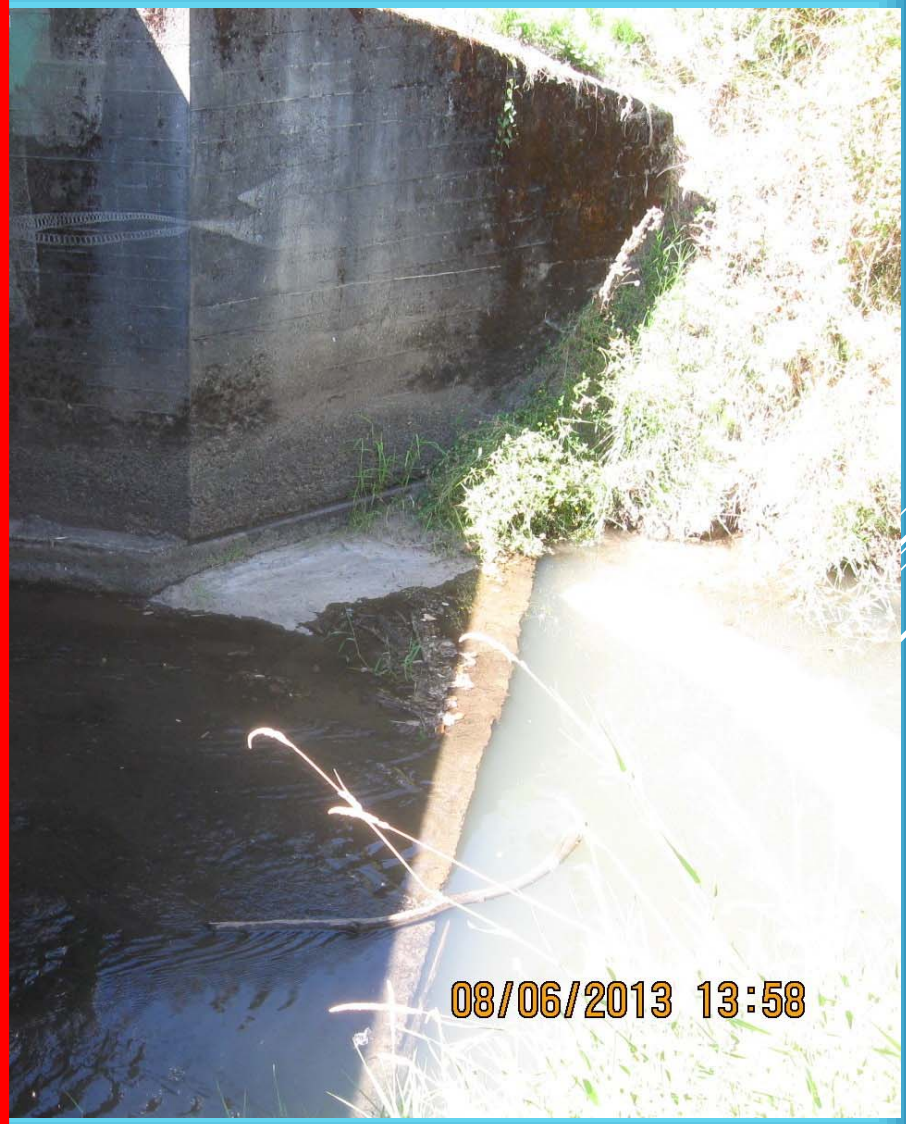

WILHOIT ROAD
CONSTRUCTION ACCESS
X–REMOVE RED ALDER
OHWL–ORDINARY HIGH WATER LINE
TCE–TEMPORARY CONSTRUCTION EASEMENT
TCE
EXCAVATE & REGRADE SLOPE AND CHANNEL. ADD RIVER–RUN MATERIAL
RICHARD W. COGGIN &
BRENDA L. COGGIN
REPAIR CRACK IN WALL WITH STEEL PLATE
3+6
WALTER R BENTON & JOYCE M BENTON
K WEIRS,
Y MOVE OR
HONE
O ALLOW
RUCTION
CE
ECT EXISTING
WAY CULVERT
AR BODY,
NK WITH 2' TO
RS, FILL WITH


WATER FLOW DIFFUSER, 6" PVC WITH 3/4" HOLES AND PLASTIC SHEETING
2+79.9
DISCHARGE LINE
WILHOIT ROAD
DISCHARGE LINE ATTACH TO BRIDGE
3+16.7
3+63.5
ROCK CREEK
(2) CRITICALLY SILENT PUMPS AND CONTAINMENT PAN
RICHARD W. COGGIN &
BRENDA L. COGGIN
TAXMAP 62E08 01000
DOC# 1994-35694
INTAKE LINE
COFFER DAM
FISH NET
3' DIAMETER FISH SCREEN WITH 3/32" HOLES


NOTE–SOUTH SIDE RESTORATION
WILLOW STAKES (SALIX LUCIDA) (20)
RED OSIER DOGWOOD STAKES (CORNUS SERICIA) (20)
WILHOIT ROAD
ROCK CREEK
RICHARD W. COGGIN &
BRENDA L. COGGIN
TAXMAP 62E08 01000
DOC# 1994–35694
NOTE–UPSTREAM NORTH SIDE RESTORATION
6' WILLOW BUNDLES (10)
WILLOW STAKES (SALIX LUCIDA) (45)
RED OSIER DOGWOOD STAKES (CORNUS SERICIA) (55)
BIG LEAF MAPLE (ACER MACROPHYLLUM) (2)
OREGON ASH (FRAXINUS LATIFOLIA) (6)
WHITE ALDER (ALNUS RHOMBIFOLIA) (11)
SWORD FERN (POLYSTICHUM MUNITUM) (20)
WALTER R BENTON &
JOYCE M BENTON
TAXMAP 62E08 01100
DOC# 2005–129443
WALTER R BENTON
JOYCE M BENTON
TAXMAP 62E08 01
DOC# 2005–12944
NOTE–UPSTREAM SOUTH SIDE RESTORATION
BIG LEAF MAPLE (ACER MACROPHYLLUM) (2)


DRIVE


Edge of
Concrete Floor
Undermined Area
08/06/2013 13:5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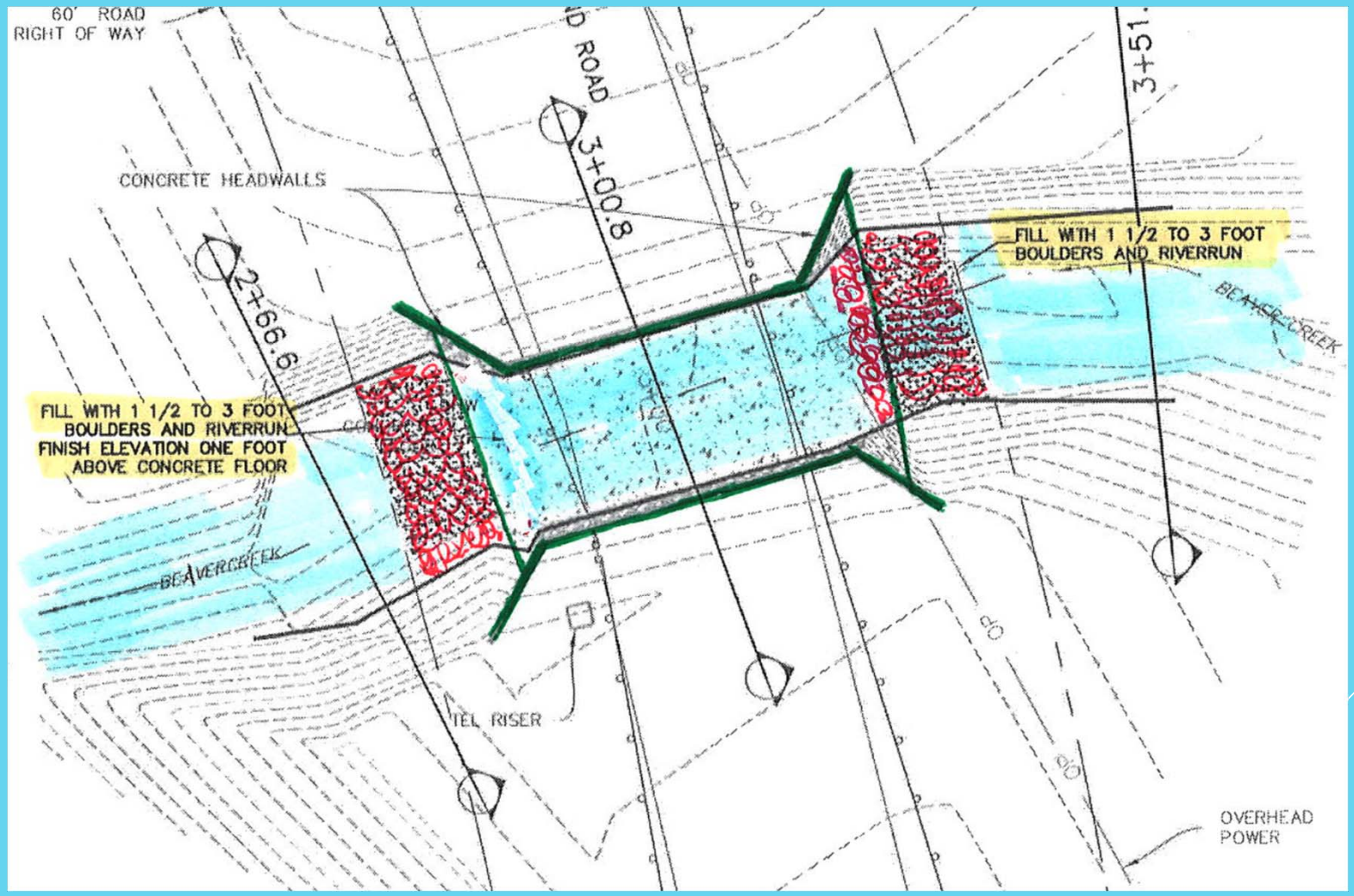
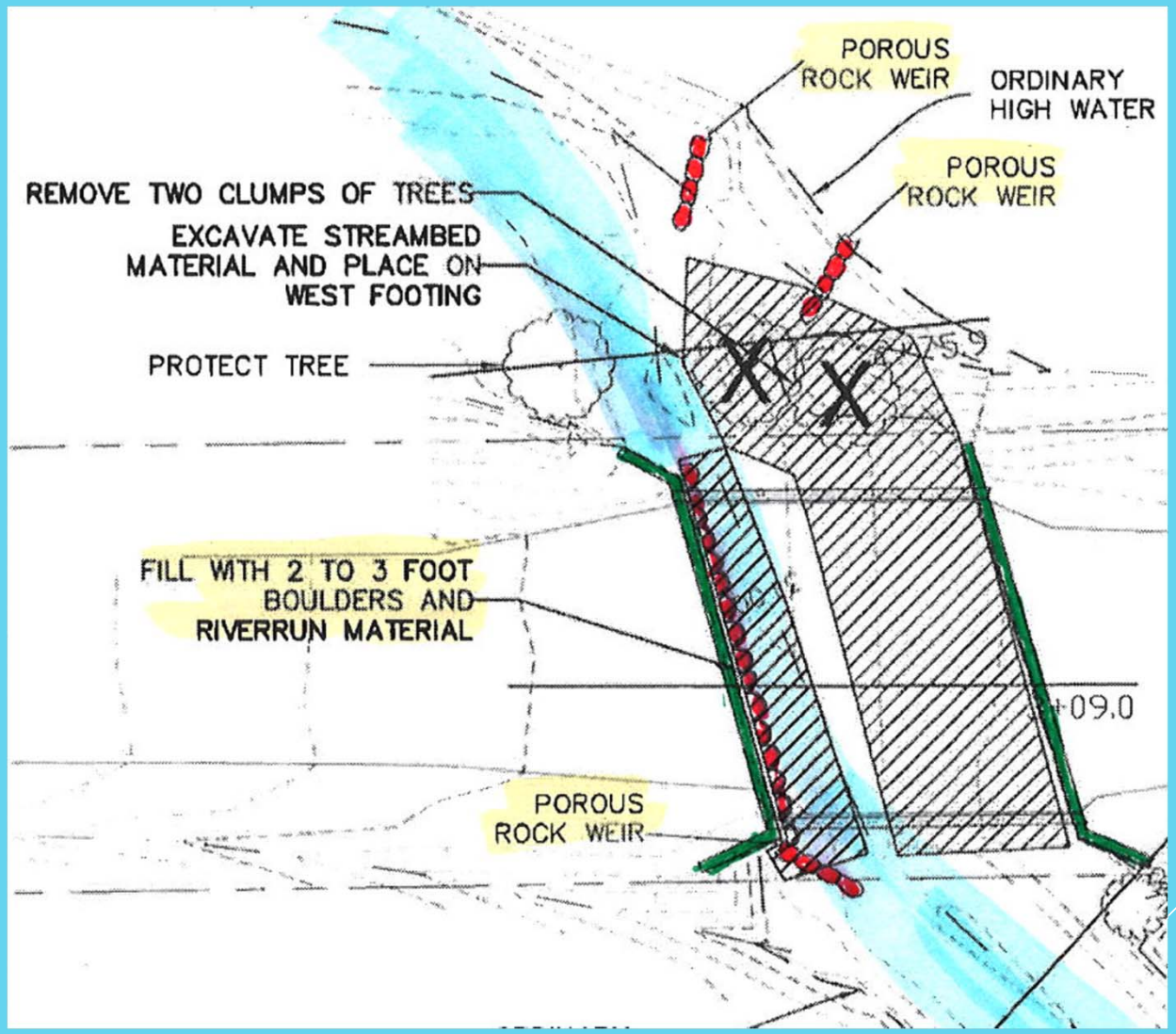
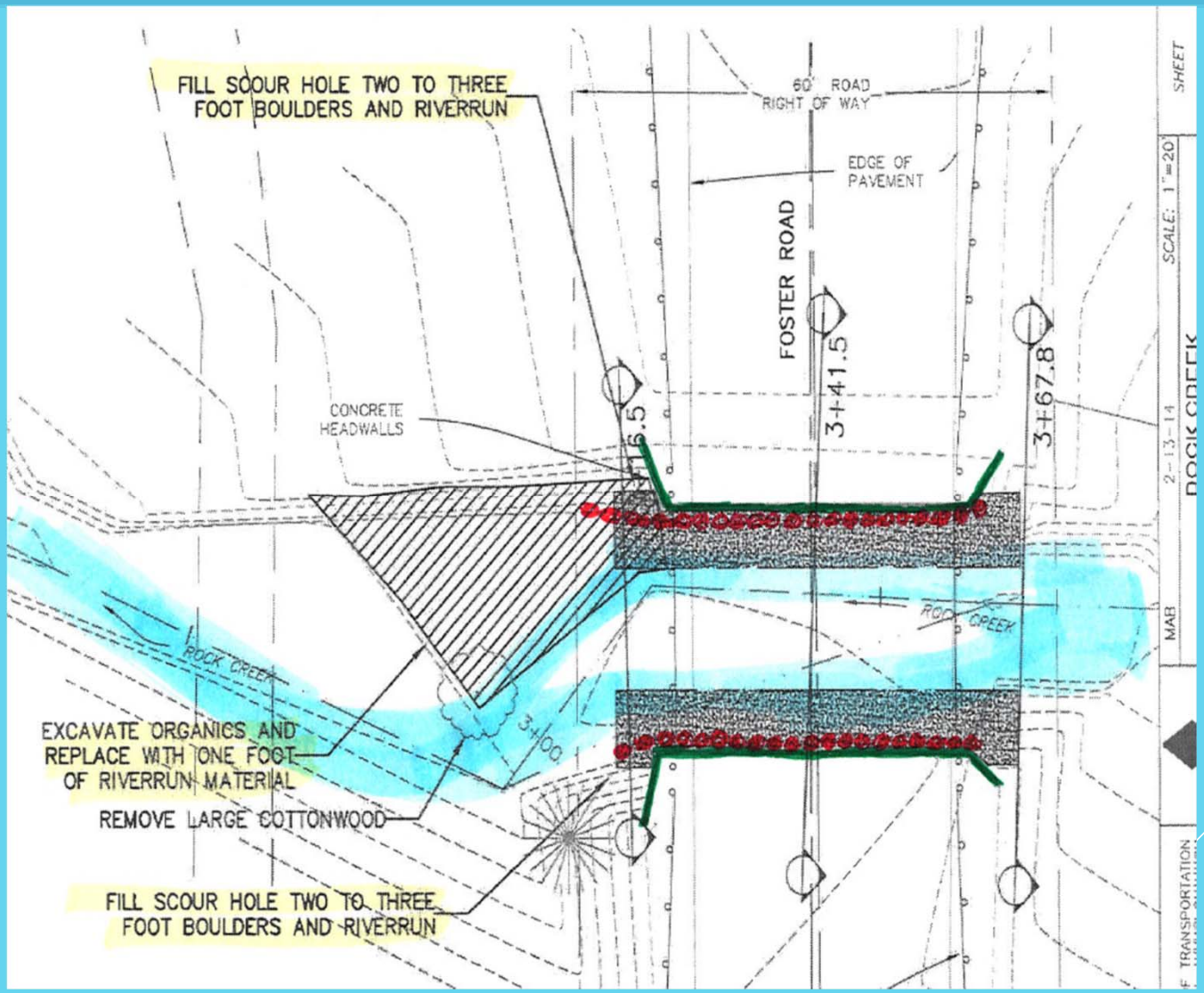
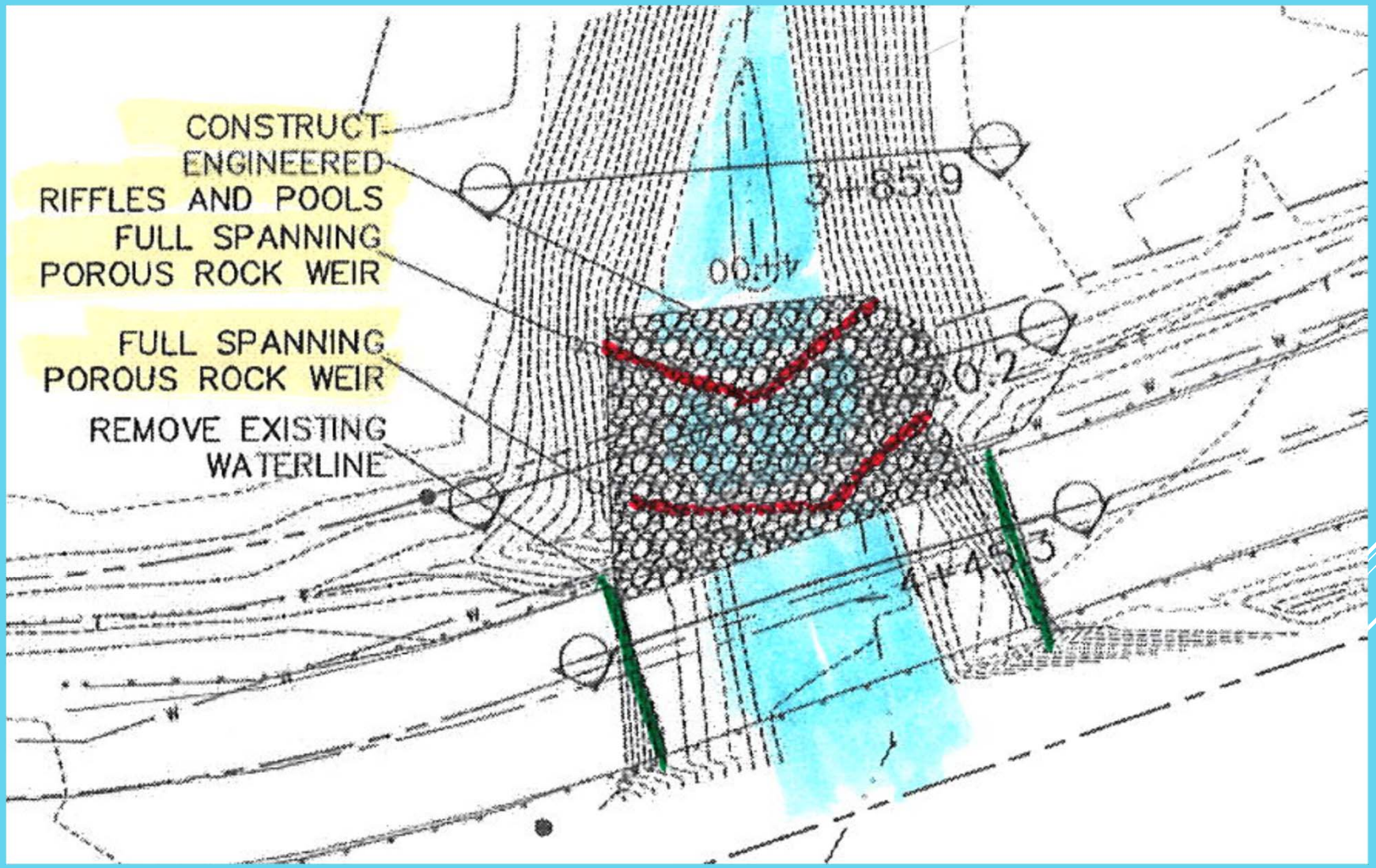
08/06/2013 13:59

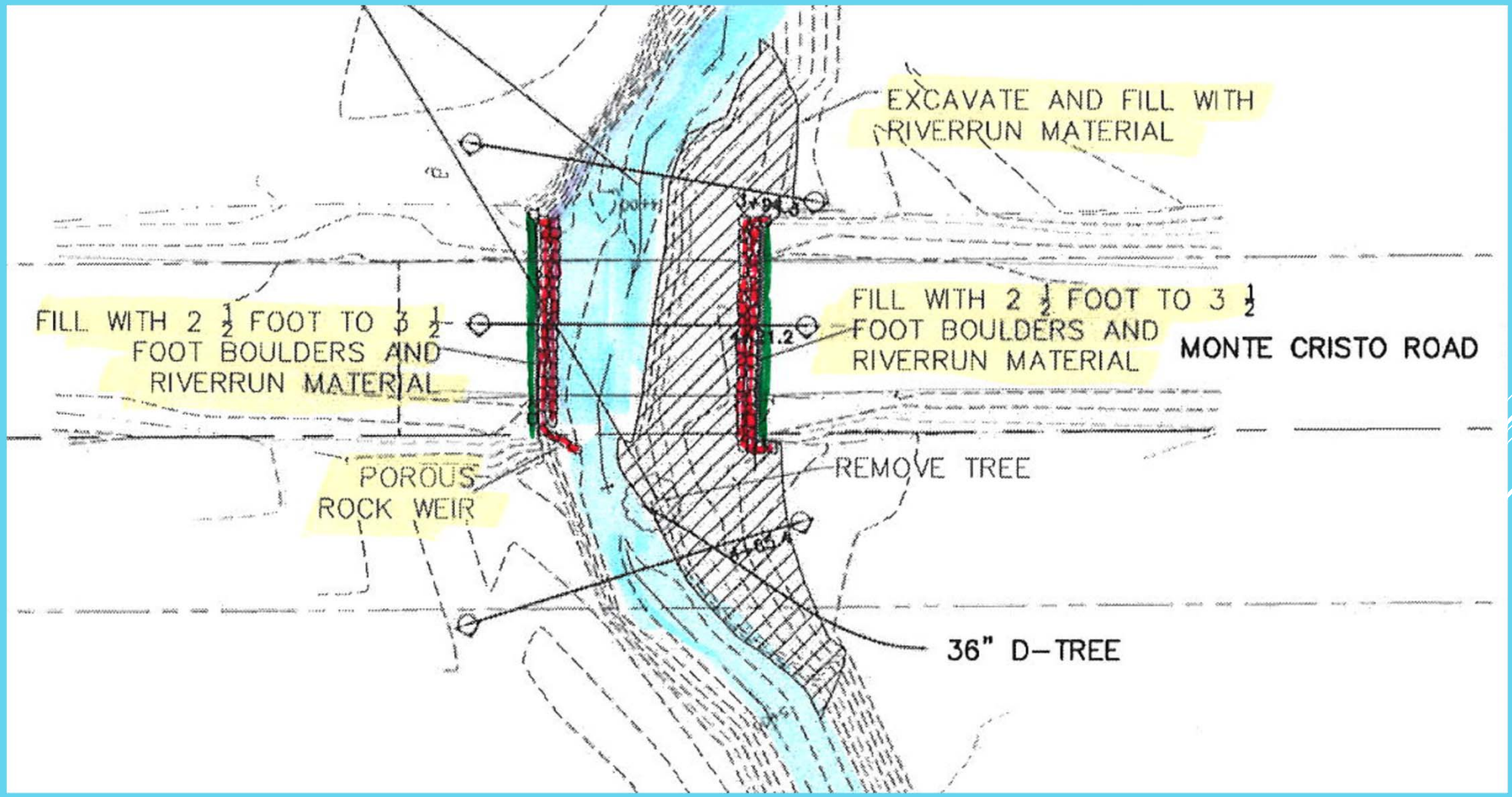

60' ROAD
RIGHT OF WAY
CONCRETE HEADWALLS
2+66.6
3+00.8
3+51.
FILL WITH 1 1/2 TO 3 FOOT
BOULDERS AND RIVERRUN
FILL WITH 1 1/2 TO 3 FOOT
BOULDERS AND RIVERRUN
FINISH ELEVATION ONE FOOT
ABOVE CONCRETE FLOOR
BEAVER CREEK
BEAVER CREEK
TEL RISER
OVERHEAD
POWER

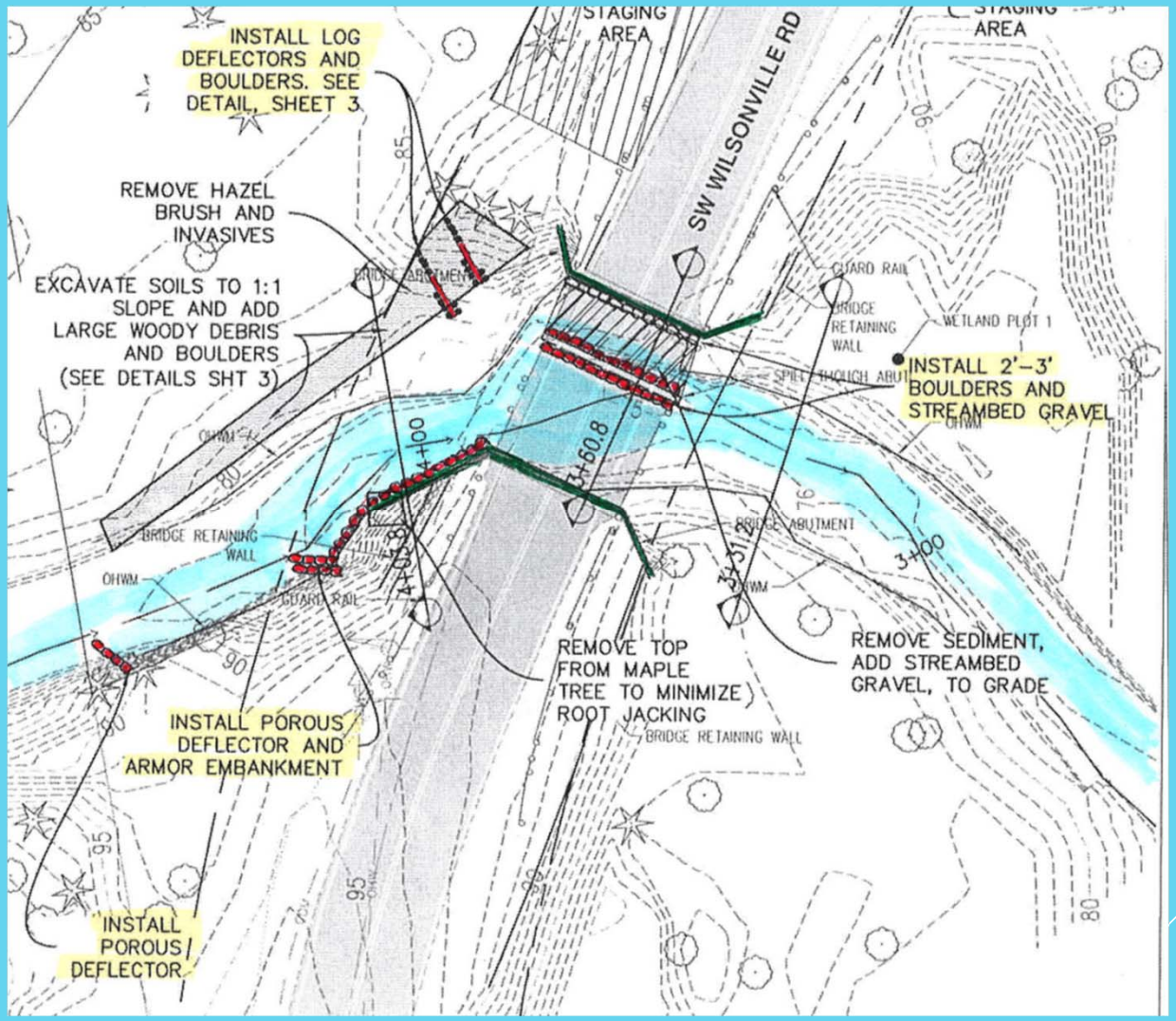

POROUS
ROCK WEIR
ORDINARY
HIGH WATER
POROUS
ROCK WEIR
REMOVE TWO CLUMPS OF TREES
EXCAVATE STREAMBED
MATERIAL AND PLACE ON
WEST FOOTING
PROTECT TREE
75.9
FILL WITH 2 TO 3 FOOT
BOULDERS AND
RIVERRUN MATERIAL
09.0
POROUS
ROCK WEIR

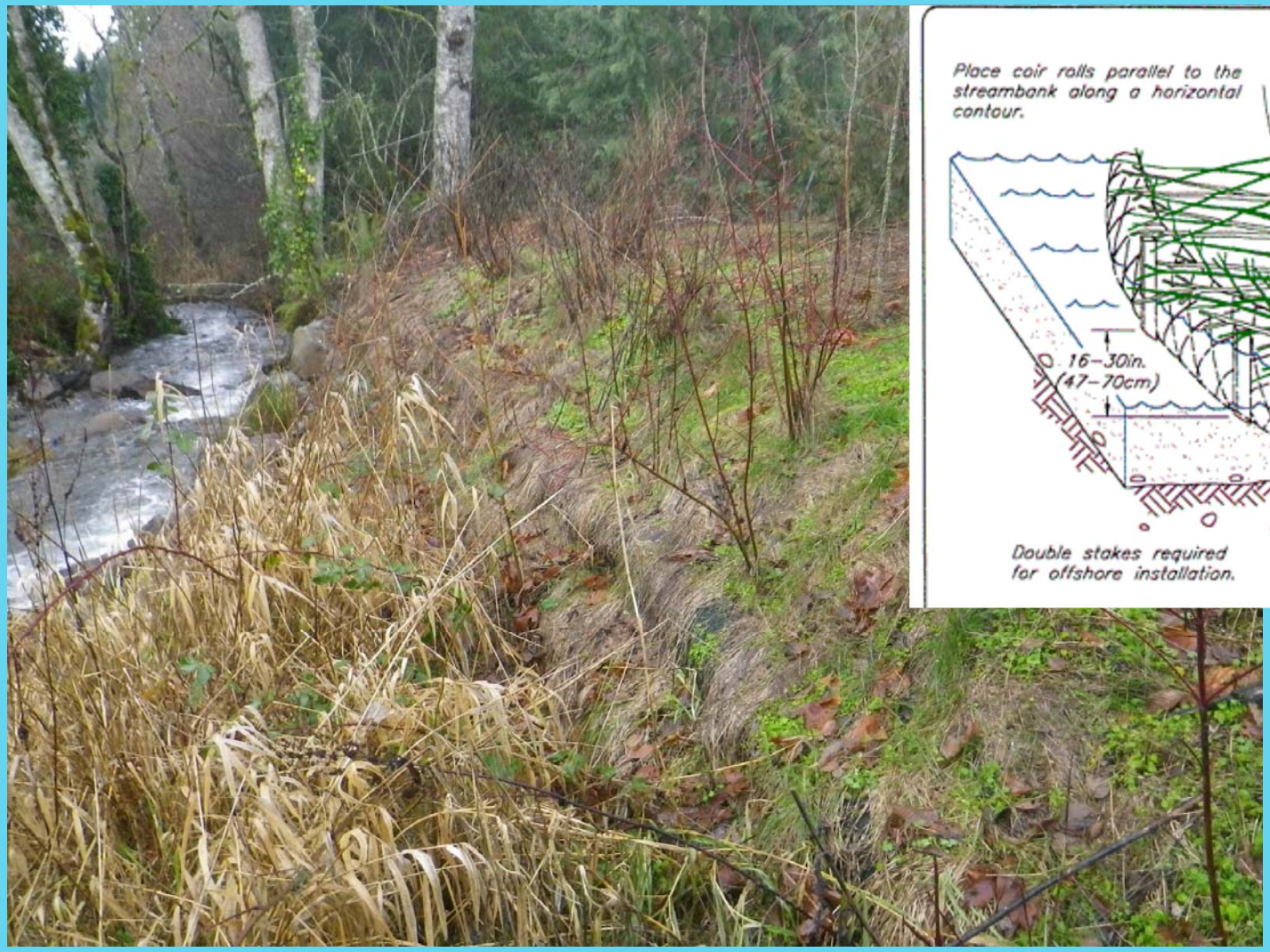

FILL SCOUR HOLE TWO TO THREE FOOT BOULDERS AND RIVERRUN
60' ROAD RIGHT OF WAY
EDGE OF PAVEMENT
FOSTER ROAD
3+41.5
3+67.8
CONCRETE HEADWALLS
ROCK CREEK
ROCK CREEK
EXCAVATE ORGANICS AND REPLACE WITH ONE FOOT OF RIVERRUN MATERIAL
REMOVE LARGE COTTONWOOD
FILL SCOUR HOLE TWO TO THREE FOOT BOULDERS AND RIVERRUN
SHEET
SCALE: 1"=20'
2-13-14
MAB
ROCK CREEK
F TRANSPORTATION

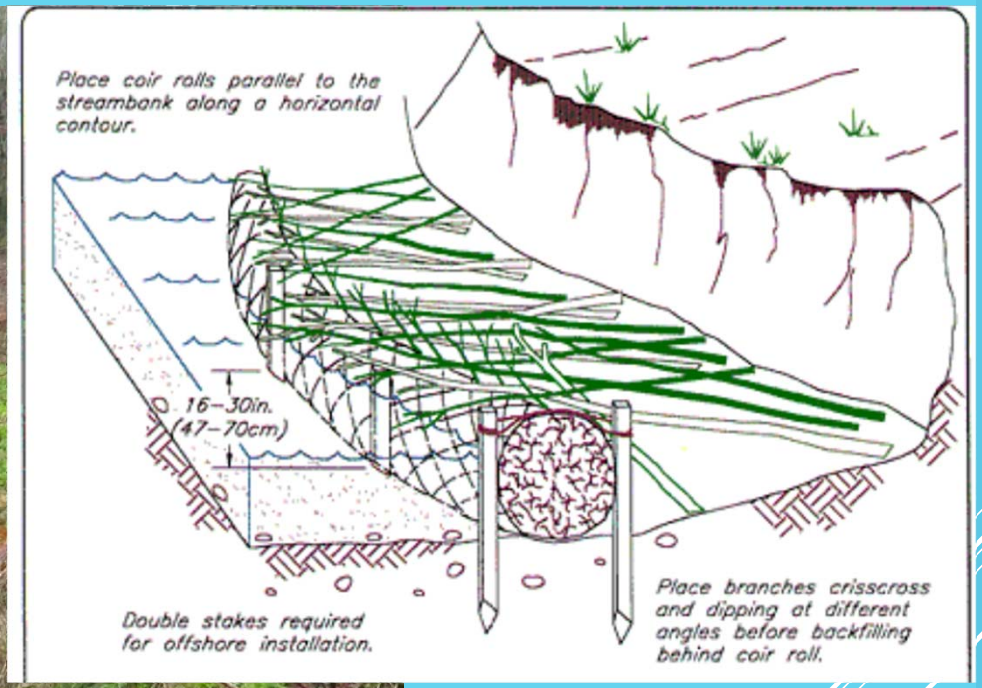

CONSTRUCT ENGINEERED RIFFLES AND POOLS
FULL SPANNING POROUS ROCK WEIR
FULL SPANNING POROUS ROCK WEIR
REMOVE EXISTING WATERLINE
3+85.9
4+00
4+45.3


DEERE


EXCAVATE AND FILL WITH RIVERRUN MATERIAL
FILL WITH 2 ½ FOOT TO 3 ½ FOOT BOULDERS AND RIVERRUN MATERIAL
FILL WITH 2 ½ FOOT TO 3 ½ FOOT BOULDERS AND RIVERRUN MATERIAL
MONTE CRISTO ROAD
POROUS ROCK WEIR
REMOVE TREE
36" D-TREE


INSTALL LOG DEFLECTORS AND BOULDERS. SEE DETAIL, SHEET 3
REMOVE HAZEL BRUSH AND INVASIVES
EXCAVATE SOILS TO 1:1 SLOPE AND ADD LARGE WOODY DEBRIS AND BOULDERS (SEE DETAILS SHT 3)
INSTALL POROUS DEFLECTOR AND ARMOR EMBANKMENT
INSTALL POROUS DEFLECTOR
REMOVE TOP FROM MAPLE TREE TO MINIMIZE ROOT JACKING
INSTALL 2'-3' BOULDERS AND STREAMBED GRAVEL
REMOVE SEDIMENT, ADD STREAMBED GRAVEL, TO GRADE
STAGING AREA
STAGING AREA
SW WILSONVILLE RD
BRIDGE RETAINING WALL
GUARD RAIL
BRIDGE ABUTMENT
WETLAND PLOT 1
OHWM
4+00
3+60.8
3+31.2
3+00




Place coir rolls parallel to the streambank along a horizontal contour.
16–30in.
(47–70cm)
Double stakes required for offshore installation.
Place branches crisscross and dipping at different angles before backfilling behind coir roll.

AVG. HIGH WATER
AVG. LOW WATER
24"
12"

Meadowbrook Bridge Over Milk Creek

Undermining found 2006

Temporary Mitigation installed 2007

Permit Application process started June, 2007

Work started July, 2008

Underwater Inspection Report

UNDERWATER INSPECTION REPORT

BRIDGE NAME:	Milk Creek Beaver Creek Road			REGION:		BRIDGE NUMBER:	06198
RIVER NAME:	Milk Creek	OWNER:	County	DISTRICT:	2C	INSPECTION DATE:	6/2/2006
STATE HWY #:		ROUTE NUMBER:		MILE POINT:	0.17	CURRENT:	Low
COUNTY:	Clackamas	ROAD NAME:	Beaver Creek Road			VISIBILITY (Ft.):	1.5
FOUNDATION TYPE:				ACCESS:	3	WATER TEMP:	55
DIVERS:	Shorb, James, Nelson			INS. INTERVAL:	1	MAXIMUM DEPTH:	5
Water Elevation	Bent #2 from bottom of steel girder down 8.4-ft.					Constructed In	1959

UNDERWATER ELEMENT CONDITION STATES:

Elem.	Description:	Environment	Qty	Units	CONDITION STATES 1	2	3	4	5	Temp
215	Concrete Abutment	Moderate	2	LF	0%	100%	0%	0%	0%	N
361	Scour Smart Flag	Moderate	1	each	0	1	0	0	0	N

NBI Ratings

Item	Description:	Condition Rating
60	Substructure Condition Assessment	4
61	Channel and Channel Protection Condition Assessment	4
113	Scour	3

GENERAL NOTES:

This is a single-span structure, supported with concrete abutments.

ELEMENT REMARKS:

Elem. Description:

215 361 **Bent #1:** Concrete Abutment has some heavy abrasion and is in Condition State 2. The upstream end of the abutment is in the dry. The downstream corner is in 5.1-ft. of water. The downstream corner is undermined 0.8-ft. vertical and 2.5-ft. horizontal for a distance along the abutment of 16.5-ft. See sketch. The streambed consists of silty/gravel.

215 361 **Bent #2:** Concrete Abutment has some heavy abrasion and is in Condition State 2. The downstream end of the abutment is in the dry. The upstream corner is in 4.6-ft. of water. The upstream corner is undermined 0.5-ft. vertical and 2.5-ft. horizontal for a distance along the abutment of 8.5-ft. See sketch. The streambed consists of silty/gravel.

Maintenance Recommendations:

Elem. Description:

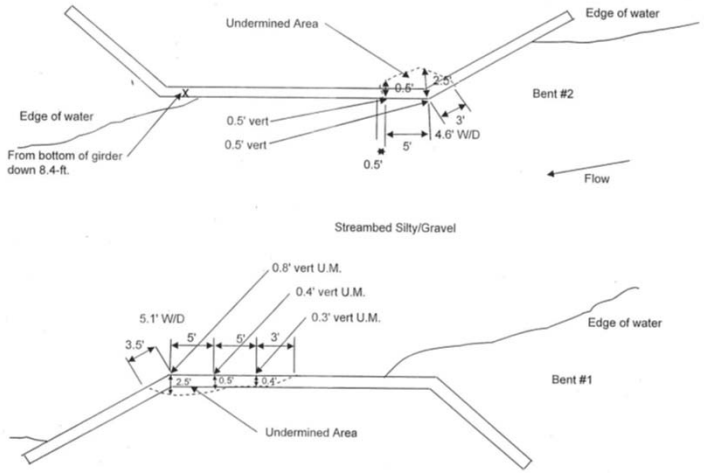
215 ***Bent #1 & Bent #2 repair undermined abutment walls.***

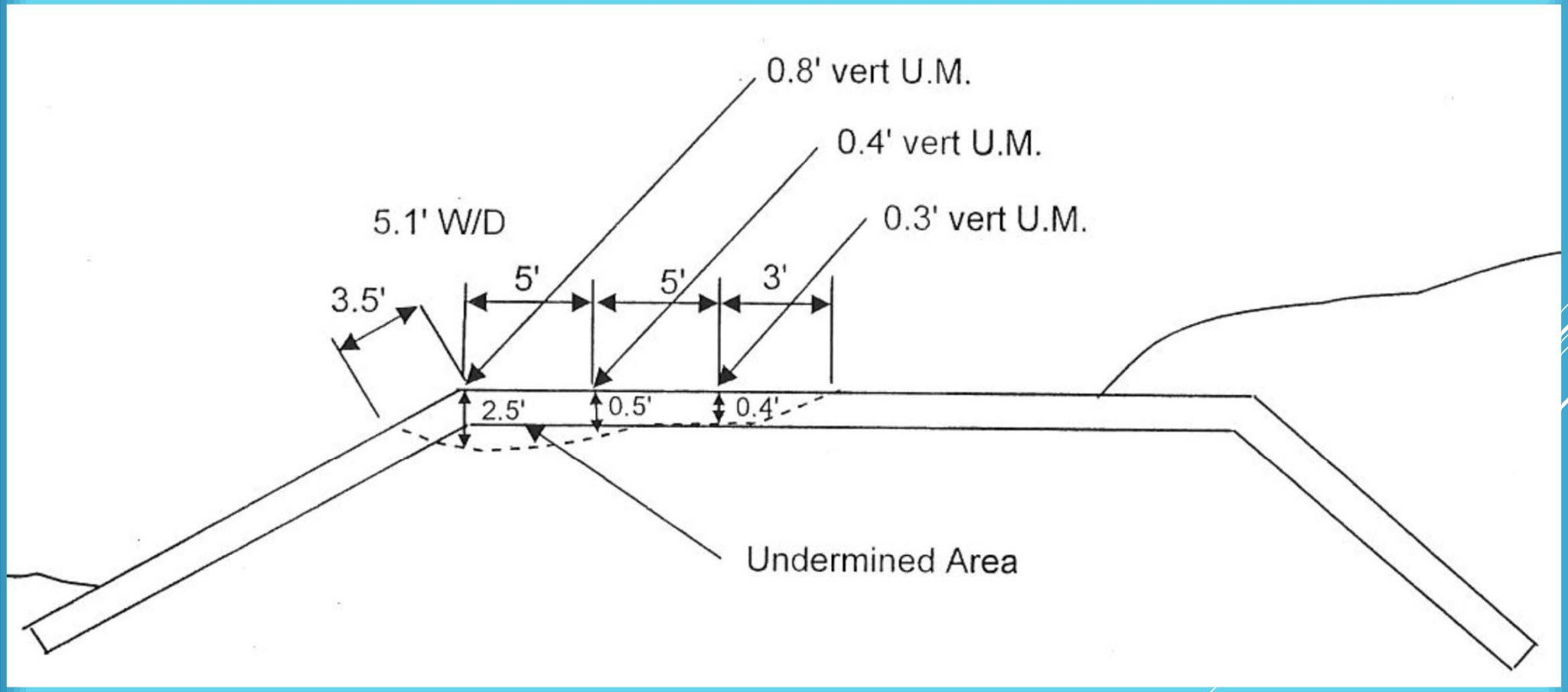
Rick L Shorb

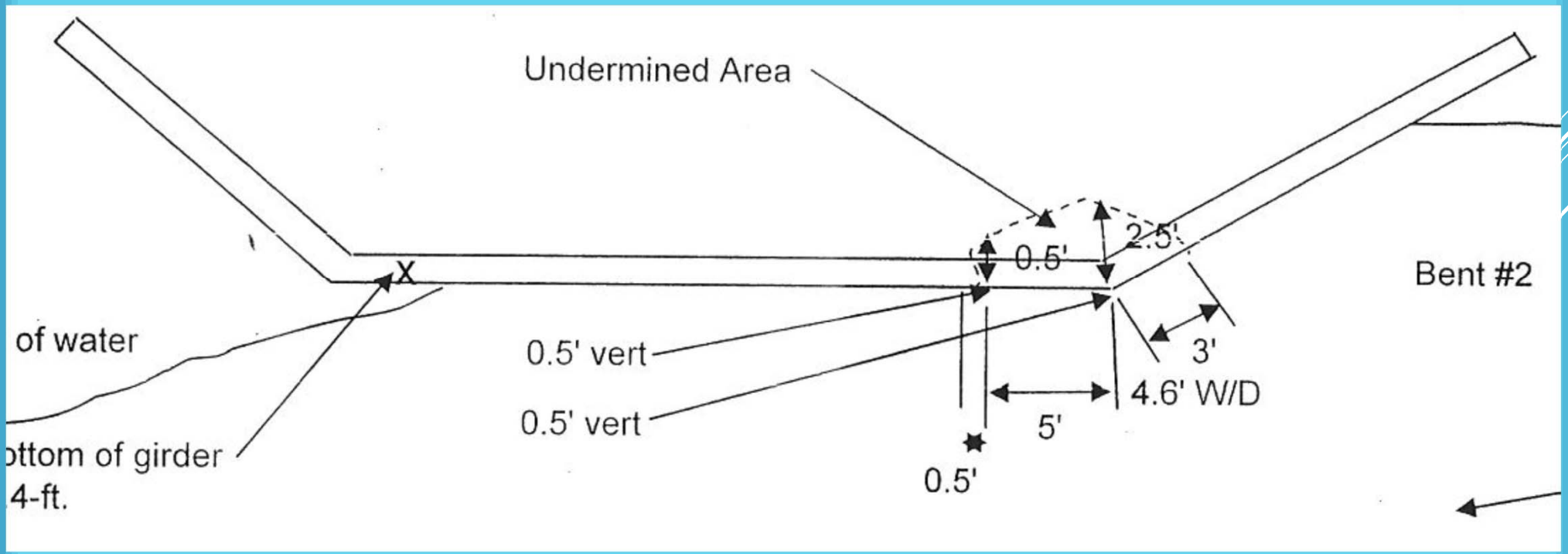
Rick Shorb, P.E.
Underwater Operations Engineer
(503) 986-2979

cc: Clackamas County Public Works
Bridge Operations

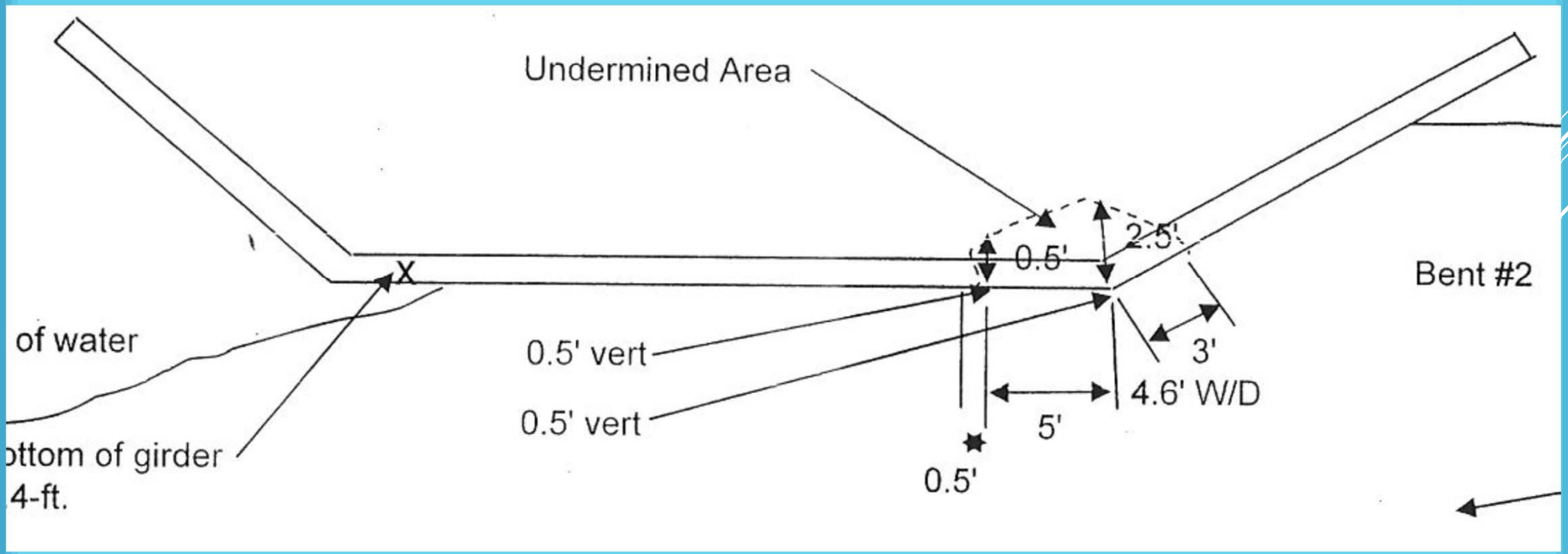
06-22-06P12:33 RCVD

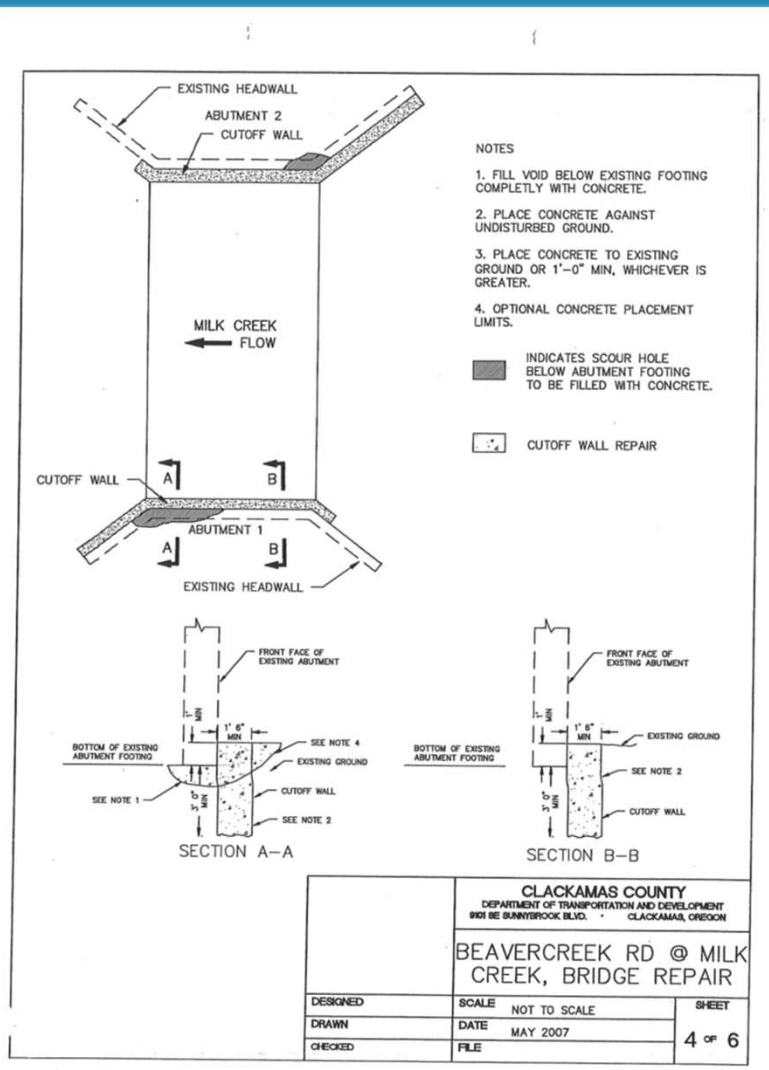



0.8' vert U.M.
0.4' vert U.M.
0.3' vert U.M.
5.1' W/D
3.5'
5'
5'
3'
2.5'
0.5'
0.4'
Undermined Area


Undermined Area
0.5'
2.5'
Bent #2
X
of water
0.5' vert
0.5' vert
3'
4.6' W/D
5'
0.5'
ttom of girder
4-ft.

Engineering Required?

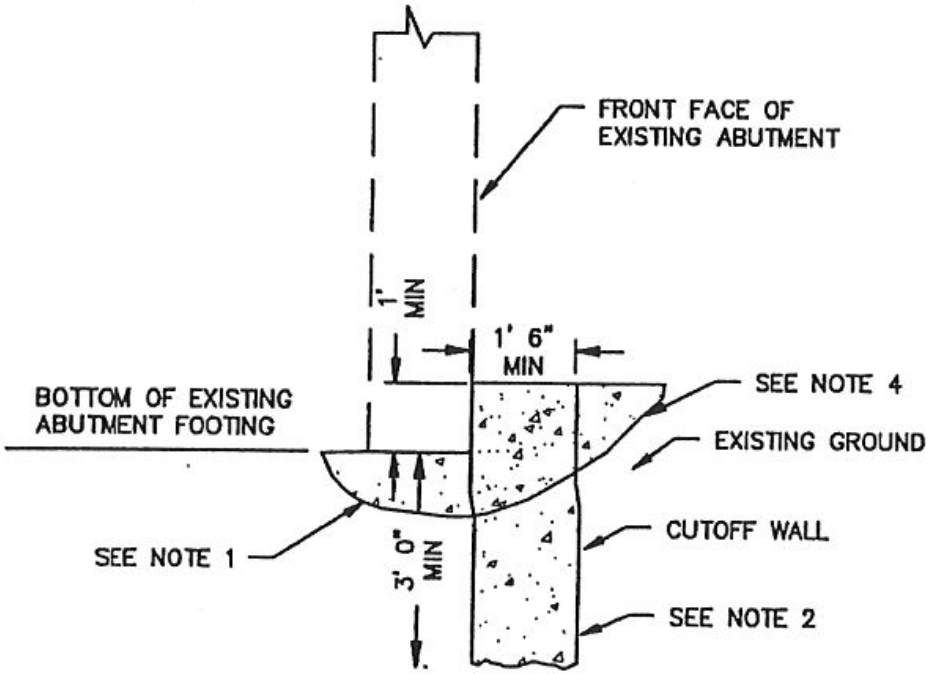




1. FILL VOID BELOW EXISTING FOOTING COMPLETLY WITH CONCRETE.

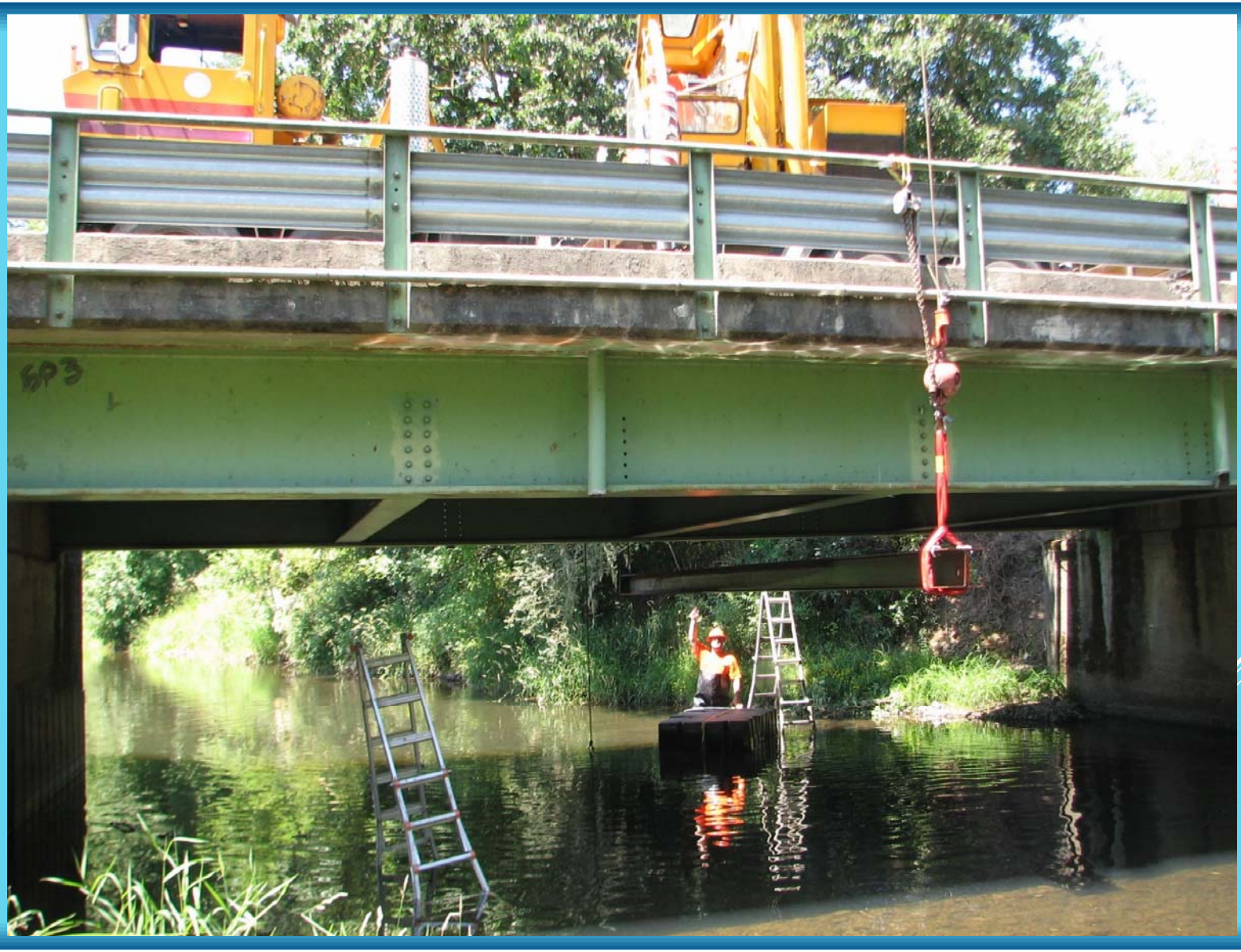
2. PLACE CONCRETE AGAINST UNDISTURBED GROUND.

3. PLACE CONCRETE TO EXISTING GROUND OR 1'-0" MIN, WHICHEVER IS GREATER.



Critical Path Document

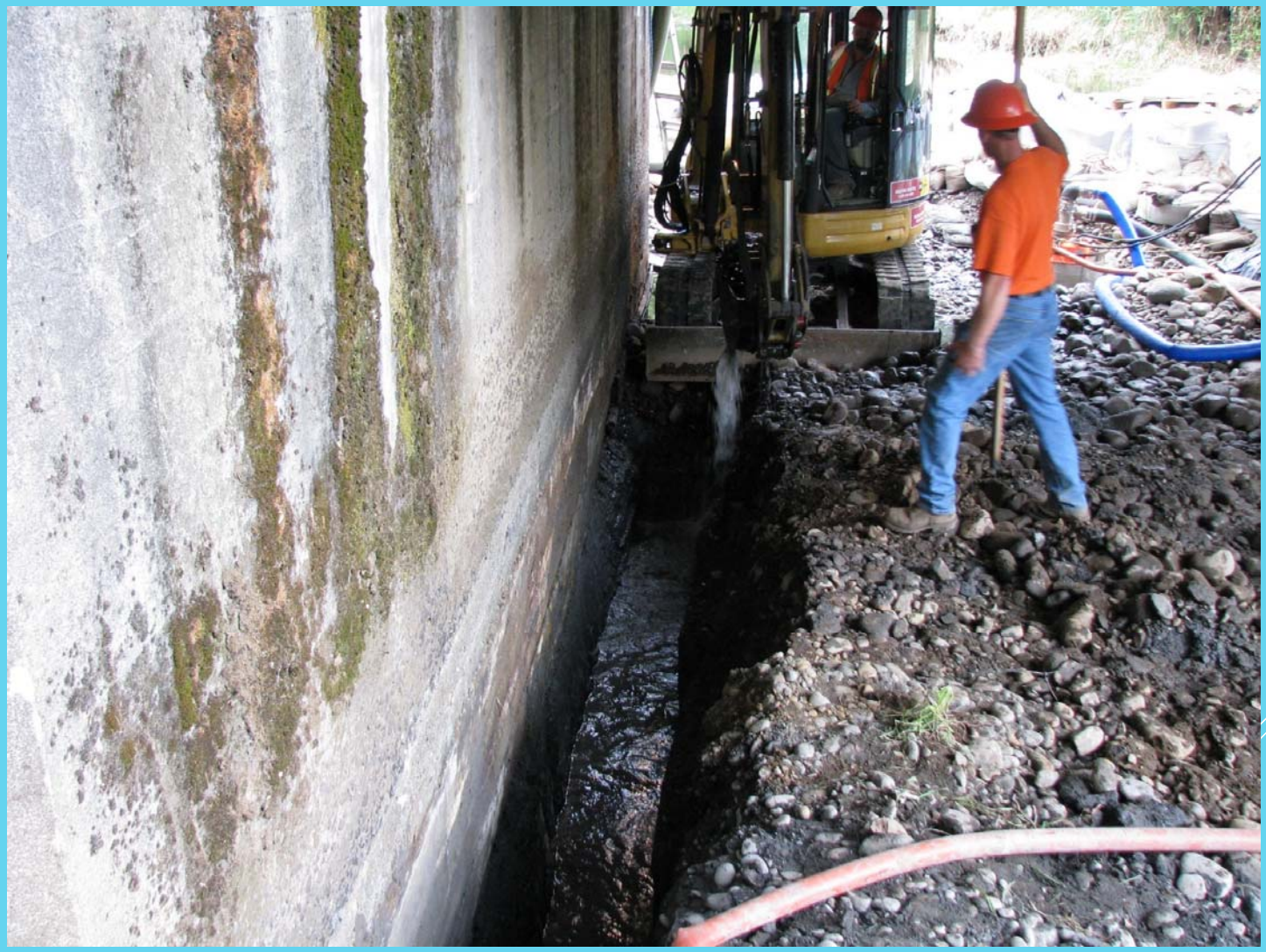
Task	Sub-Task	Start Date	Materials	Mtl Status	Special Tools	Tool Stat	Equipment	Eqp Status	Manpower
Install Dam(s)			14 Large Sandbags	CCBM	3" x 16' Slings	CCBM	Excavators	CCBM	
			200 Small Sandbags	CCBM	Pallet Forks	CCBM	461	CCBM	
			plastic sheeting						
Install Fish Nets			2 - Nets	Devin	T Post Driver	CCBM			
			16 - T Posts	CCBM					
Install Pump System									
	Place 3" minus for Pump Pads		6yds 3" minus	CCBM					
			Pump System, Hauled to site by Xylem		2-Electric 2" Pumps	CCBM			
			2 - Containment Tubs with Brackets	CCBM	200' - 2" Hose	CCBM			
			100' roll Plastic Sheeting						
			Sediment Bag	Xylem					
			Pump Screen	CCBM					
			100 Large Zip Ties	CCBM					
			6 Bio Bags	CCBM					
			1 bag Oil Containment Booms	CCBM					
			1 Box Oil Diapers	CCBM					
			6 Waddles	CCBM					
			6 Hay Bales	CCBM					




Respect


NI ORE


CAT



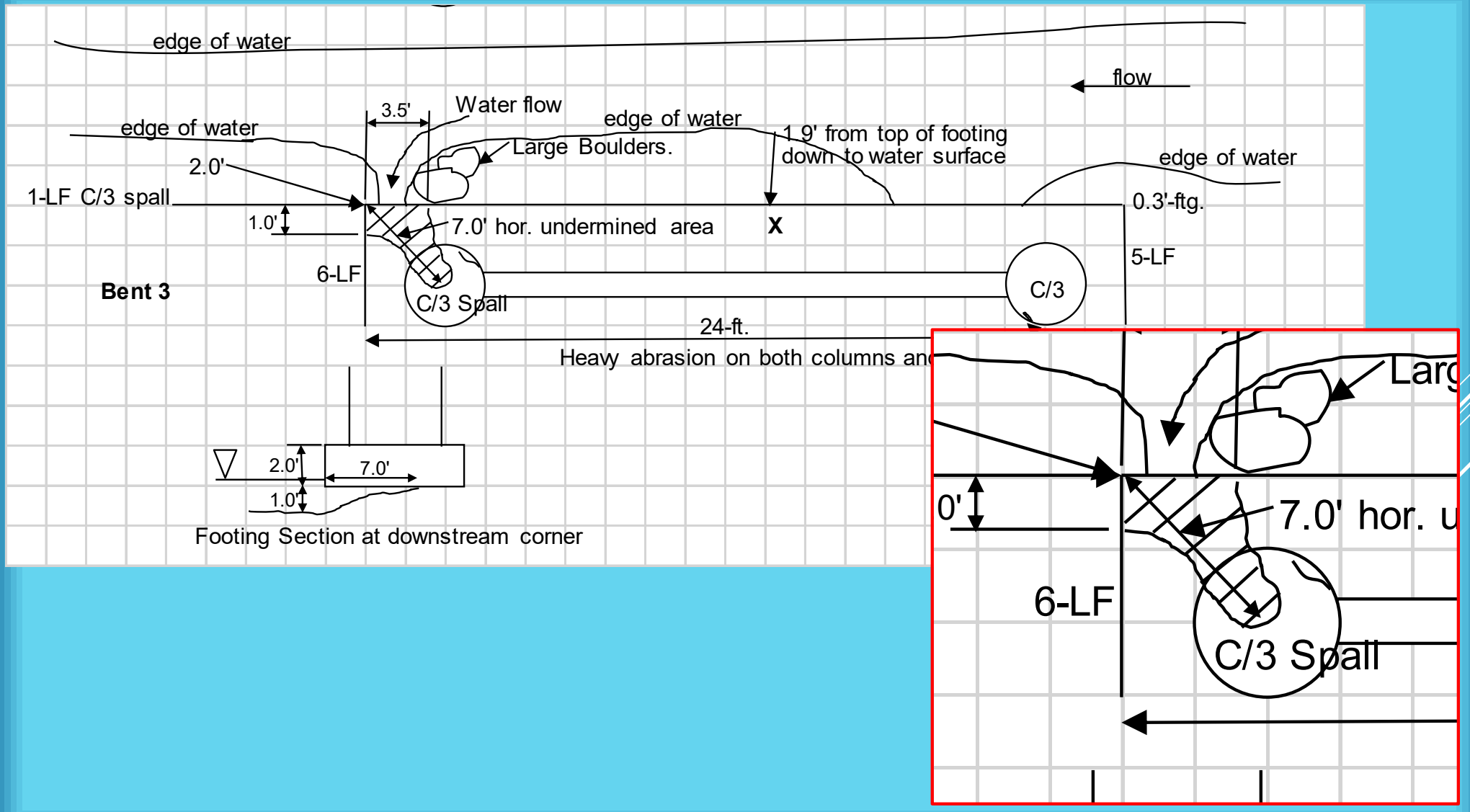

14
13
12
11
10
9
8
7

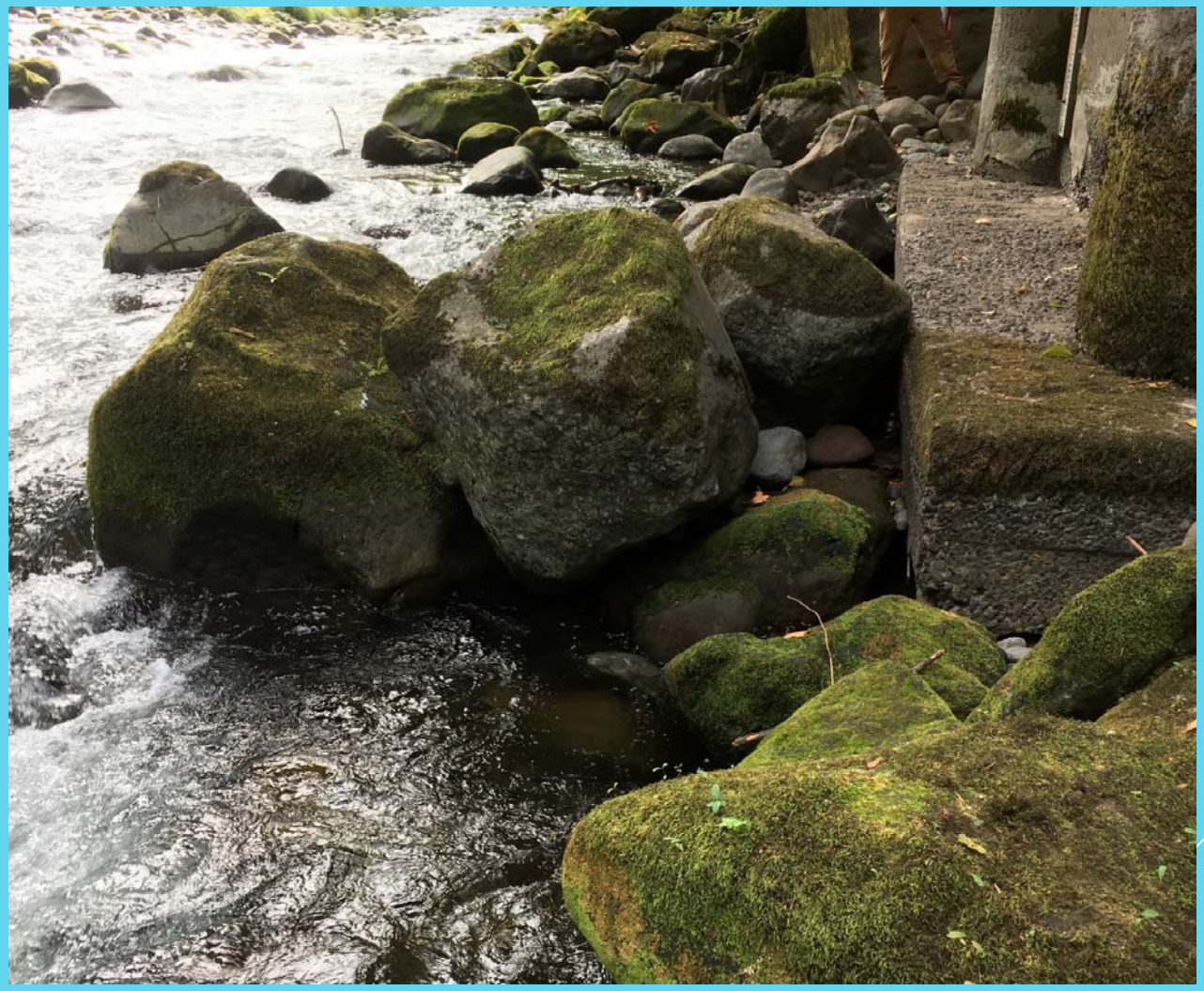
Salmon River Bridge
Brightwood Loop Road

Undermining found SEP, 2018

Emergency Permit Application process started SEP, 2018

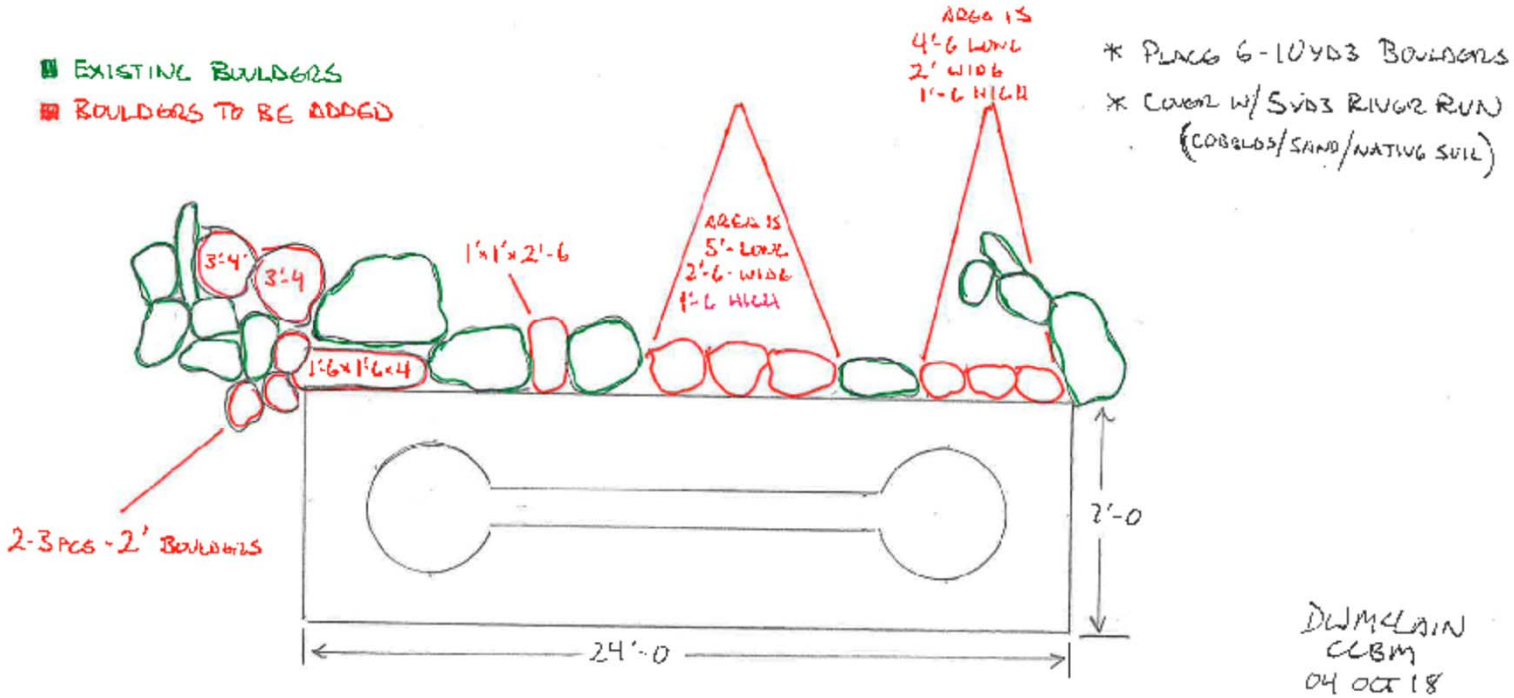
Work started FEB, 2019


edge of water
flow
3.5'
Water flow
edge of water
edge of water
Large Boulders.
1.9' from top of footing
down to water surface
edge of water
2.0'
1-LF C/3 spall
1.0'
7.0' hor. undermined area
X
0.3'-ftg.
5-LF
6-LF
Bent 3
C/3 Spall
C/3
24-ft.
Heavy abrasion on both columns an
2.0'
7.0'
1.0'
Footing Section at downstream corner
Larg
0'
7.0' hor. u
6-LF
C/3 Spall



SALMON RIVER BRIDGE, #01438

SCOUR MITIGATION PROJECT. BM2018.17



* PLACE 6-10YD3 BOULDERS
* COVER W/ 5YD3 RIVER RUN (COBBLES/SAND/NATIVE SOIL)

DWMCLAIN
CCBM
04 OCT 18

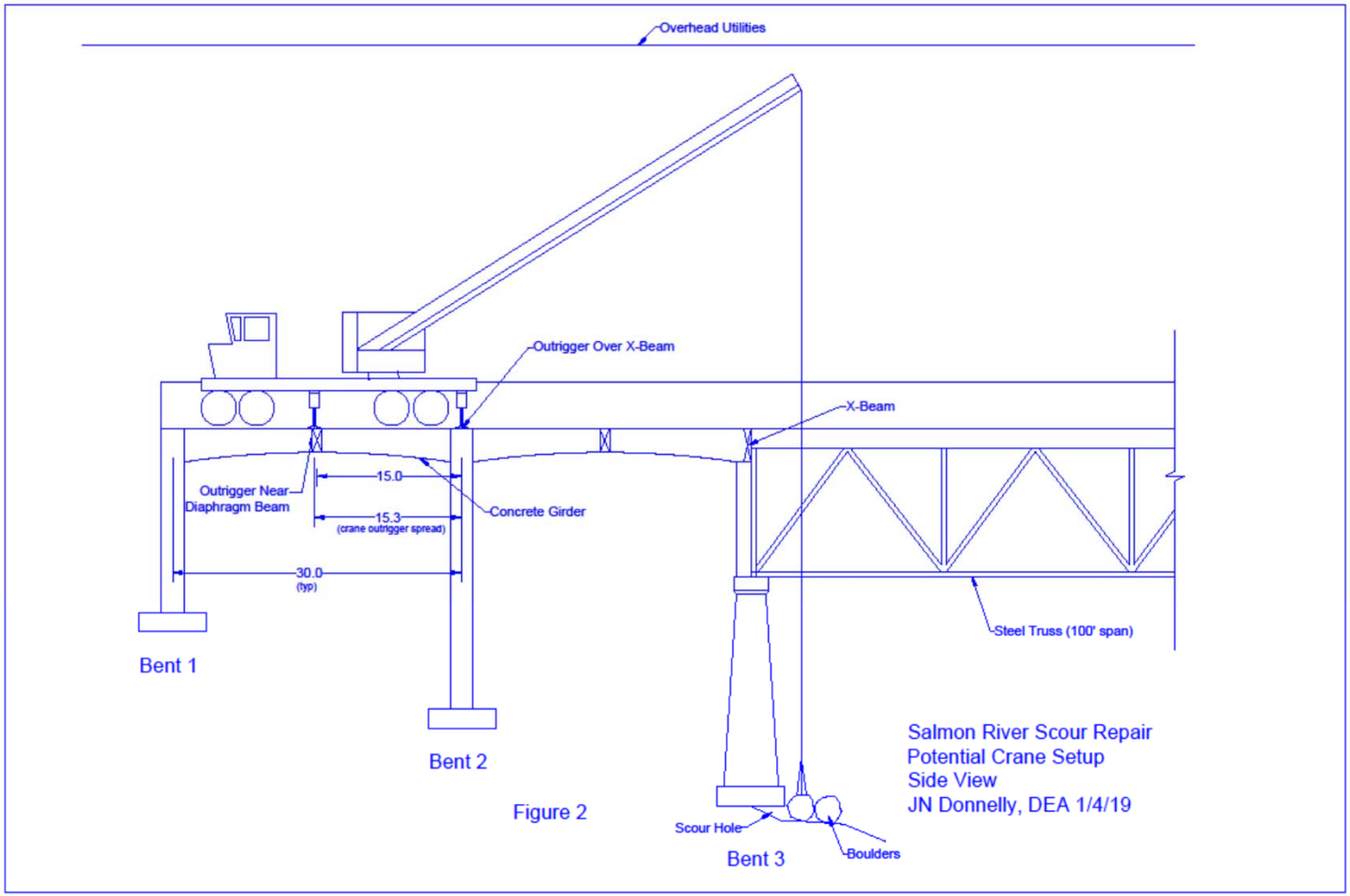
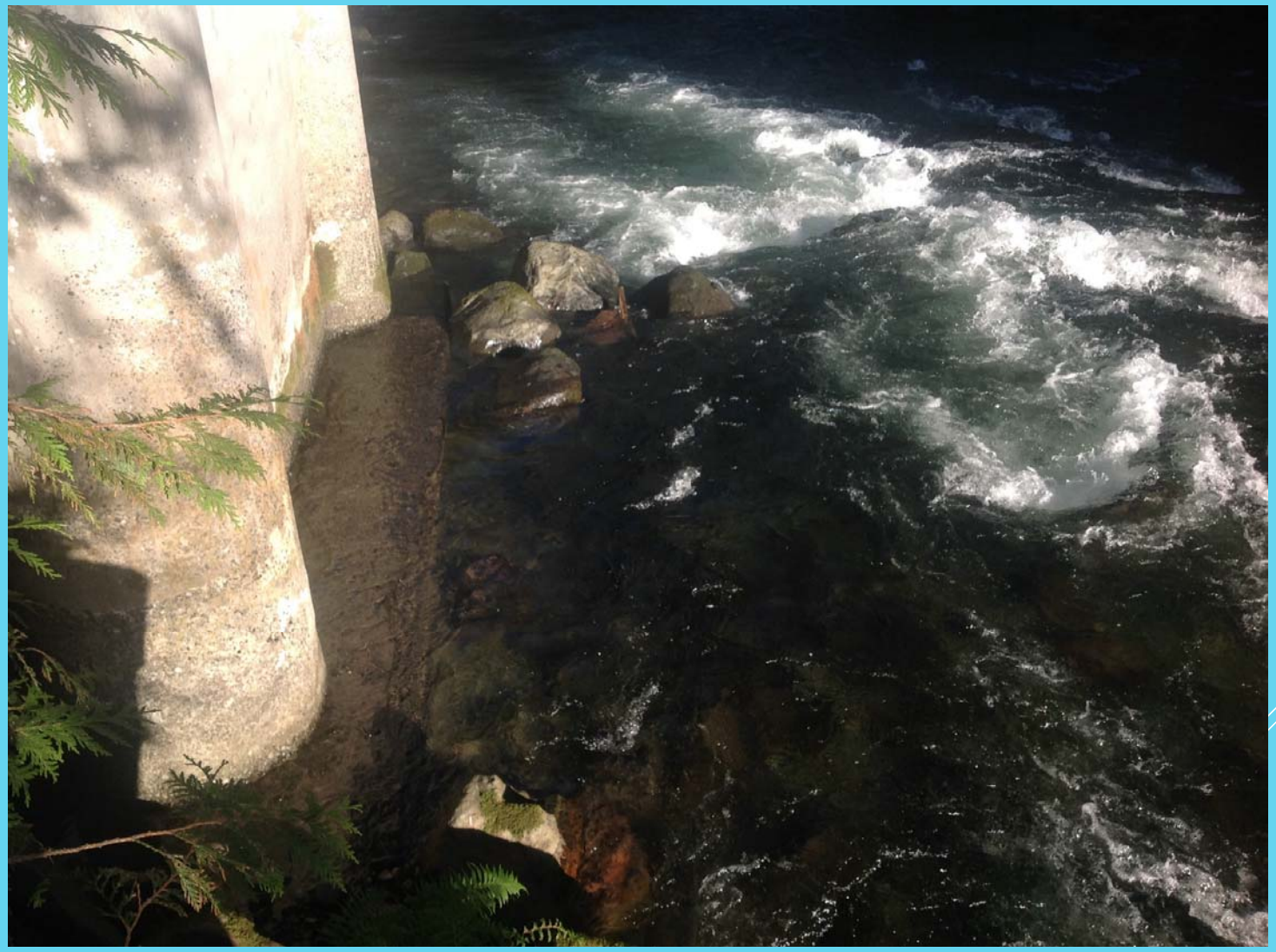

Overhead Utilities
Outrigger Over X-Beam
X-Beam
Outrigger Near
Diaphragm Beam
15.0
15.3
(crane outrigger spread)
Concrete Girder
30.0
(typ)
Steel Truss (100' span)
Bent 1
Bent 2
Bent 3
Scour Hole
Boulders
Salmon River Scour Repair
Potential Crane Setup
Side View
JN Donnelly, DEA 1/4/19

Figure 2



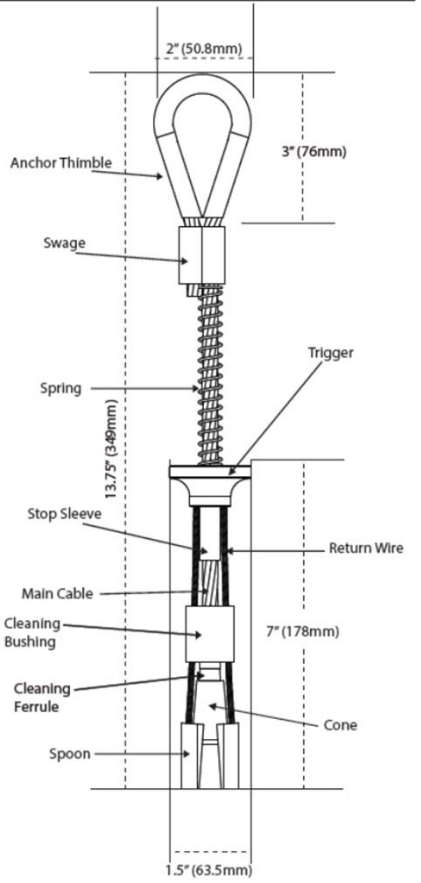
RAM100N Multi-Use Anchor

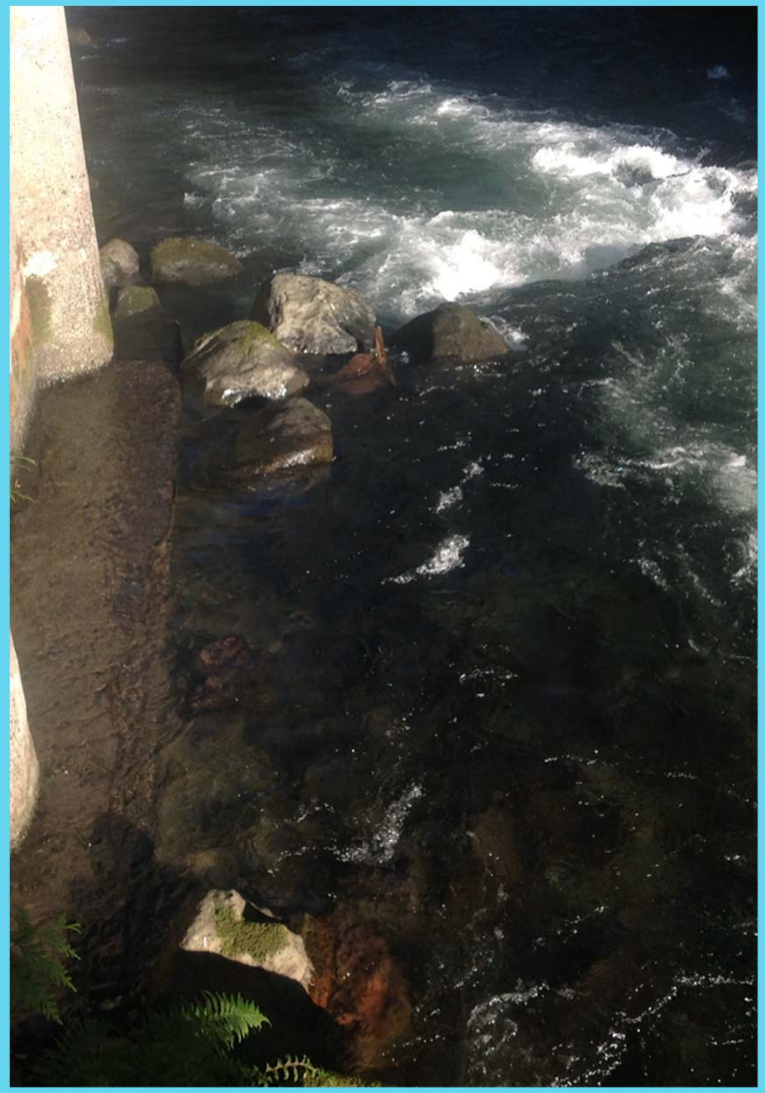
Performance:
Static tensile strength: 10,000-lbf (44kN) minimum.
Working Load Limit: 2000-lbs

Dimensions:
Weight: 0.5-lbs (.22kg)
Length: 13.75" (349mm)
Diameter: 1" (25.4mm)

Component Materials:

Main Cable: Aircraft Cable. **End Termination:** Stainless Steel. **Spoons:** Stainless Steel. **Stop Sleeve:** Stainless Steel. **Trigger:** Aluminum. **Spring:** Zinc Plated Steel. **Swage:** Zinc Plated Copper. **Return Wire:** Aircraft Cable. **Anchor Thimble:** Zinc Plated Steel.





Questions?

Comments?

Oregon Highway Bridge Maintenance

A Pilot Training Course /Workshop