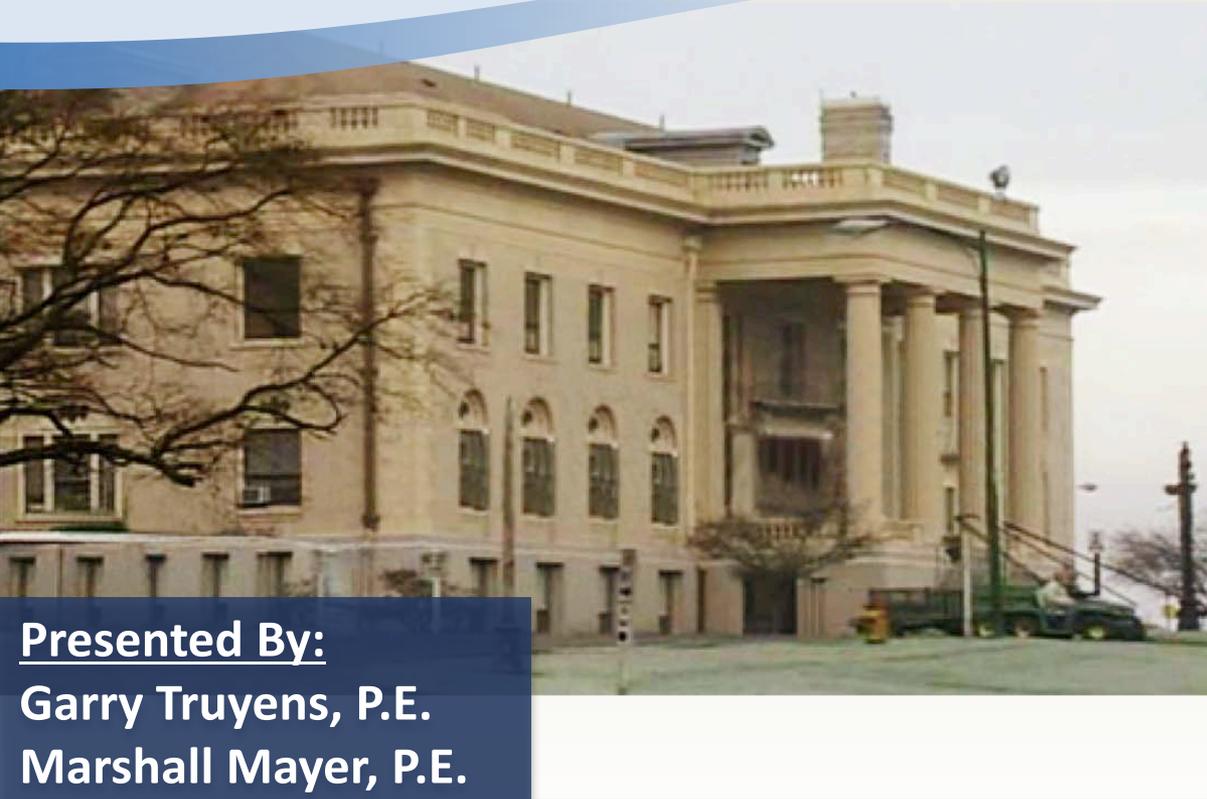


Behind the Fence - Replacing Old Water Main in Confined Spaces of a Prison



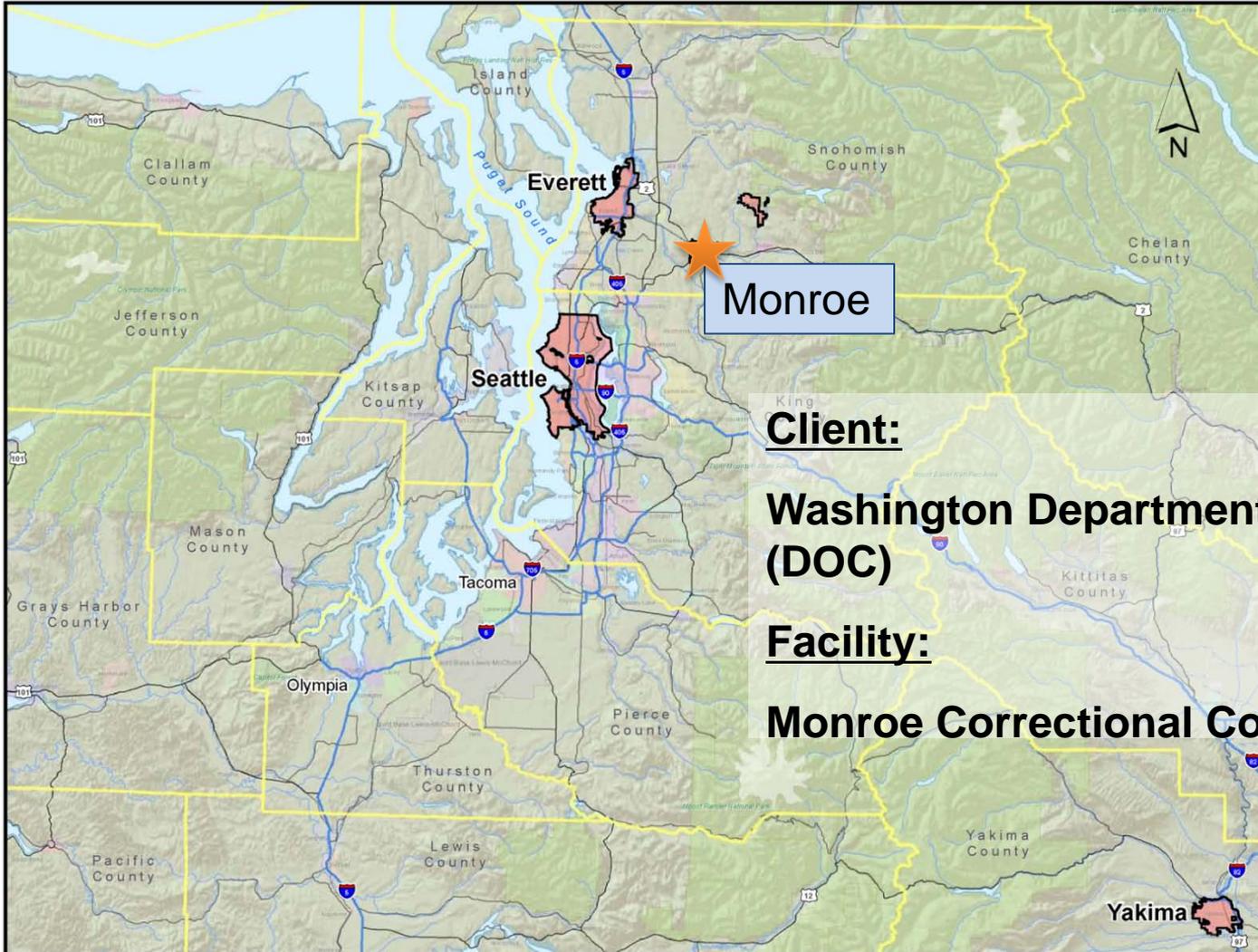
May 3, 2012



Presented By:
Garry Truyens, P.E.
Marshall Mayer, P.E.



INTRODUCTION



Client:

**Washington Department of Corrections
(DOC)**

Facility:

Monroe Correctional Complex (MCC)

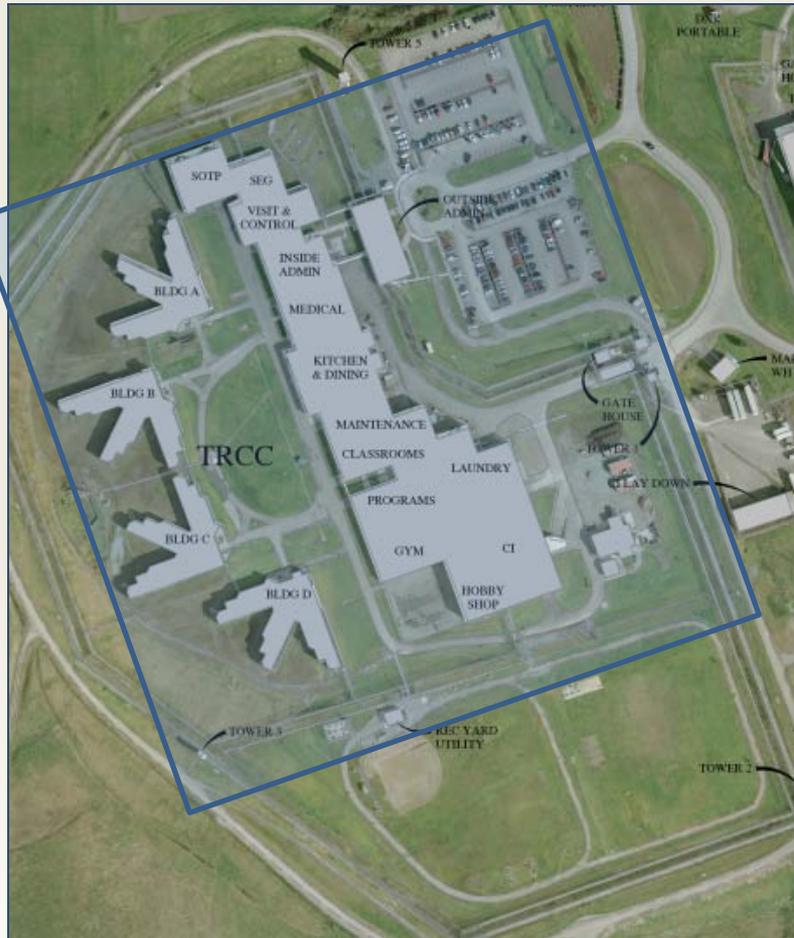
SPECIAL OFFENDERS UNIT



- Special Offenders Unit (SOU)
- Constructed in 1981
- Operating capacity of 114 beds
- Housing Special Needs Offenders



TWIN RIVERS UNIT



- Twin Rivers Unit (TRU)
- Constructed in 1994
- Maximum Security
- 500 bed capacity
- Housing Sex Offenders



MINIMUM SECURITY UNIT

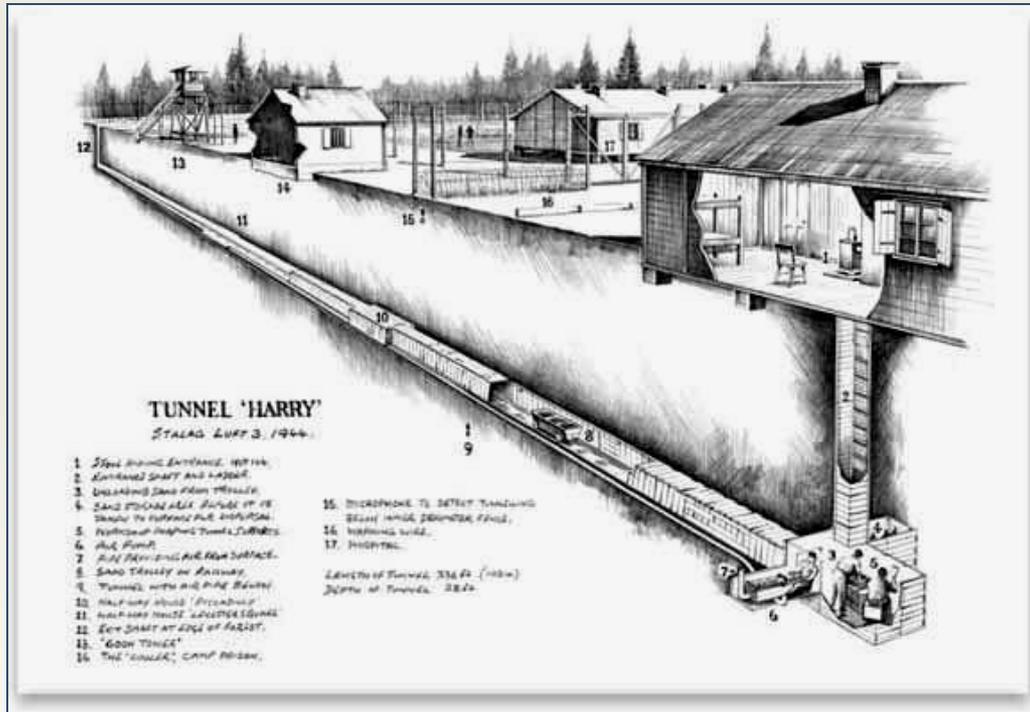


- Minimum Security Unit (MSU)
- Constructed in 1997
- 400 Bed Capacity



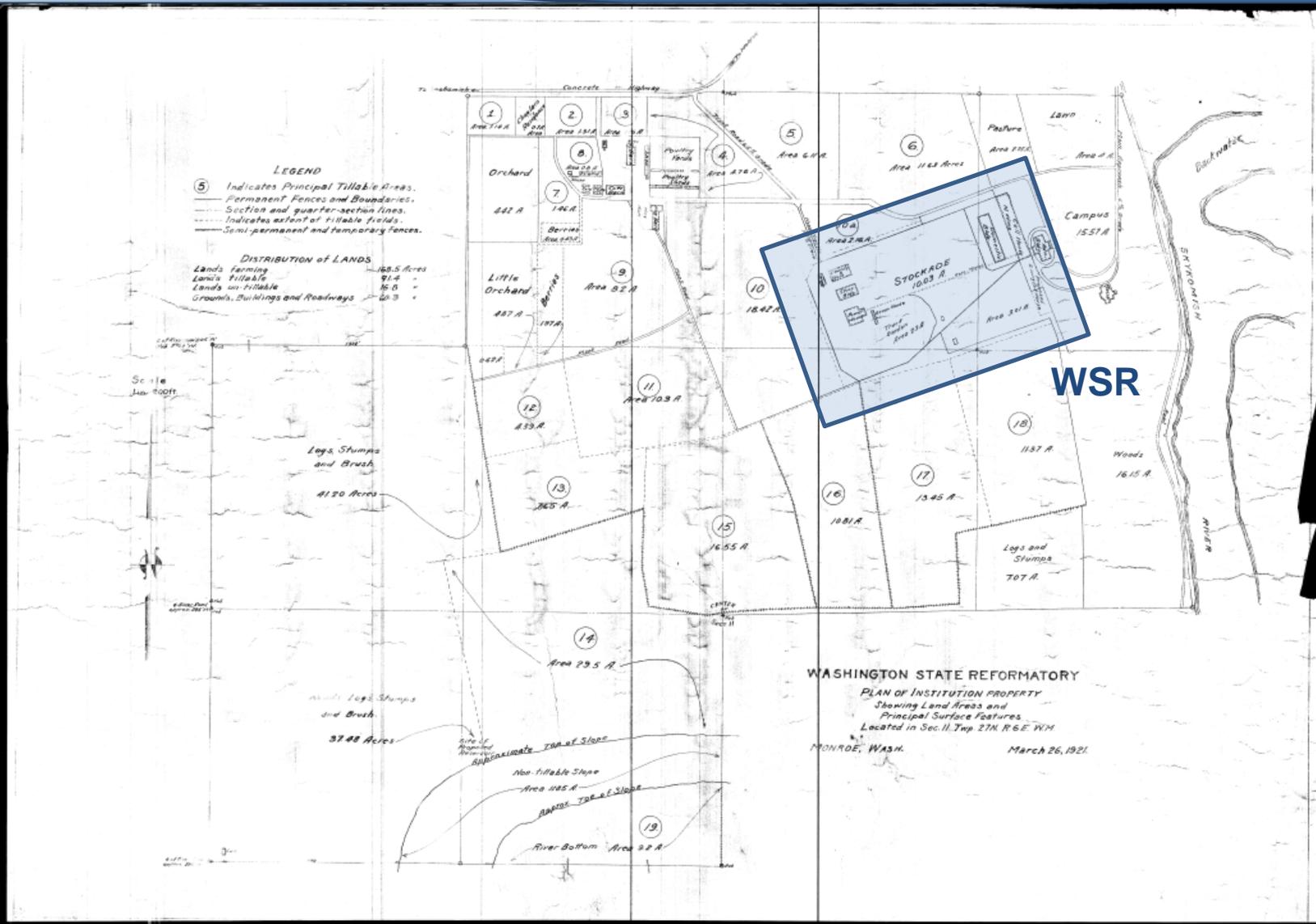
PROJECT BACKGROUND

- The Washington State Department of Corrections (DOC) had been having problems with regular water line breaks
- Majority of breaks happening along asbestos cement (AC) lines. Portions of which are located in utility tunnels or have restrict access
- Leading to severe service interruptions
- Minimal records exist on the water system at the facility
- MSA was hired in 2009 to develop the facilities first comprehensive water plan and a Capital Improvements Plan

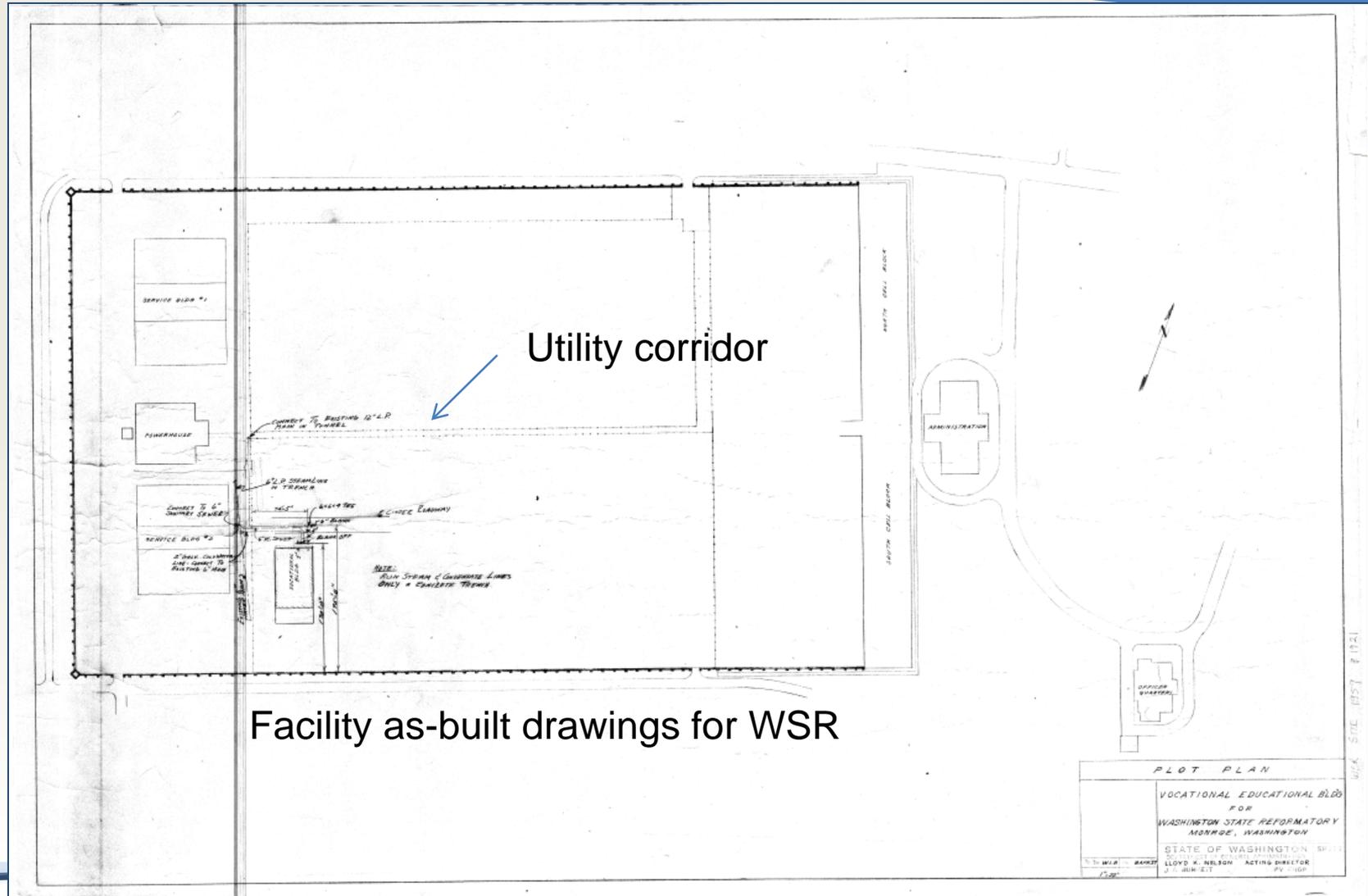


- Facility Record Drawings
- Existing System mapping
- Employee Interviews
- Field Work
- Potholing
- Develop System mapping
- Review with Facility Employee's

SYSTEM RECORD DRAWINGS

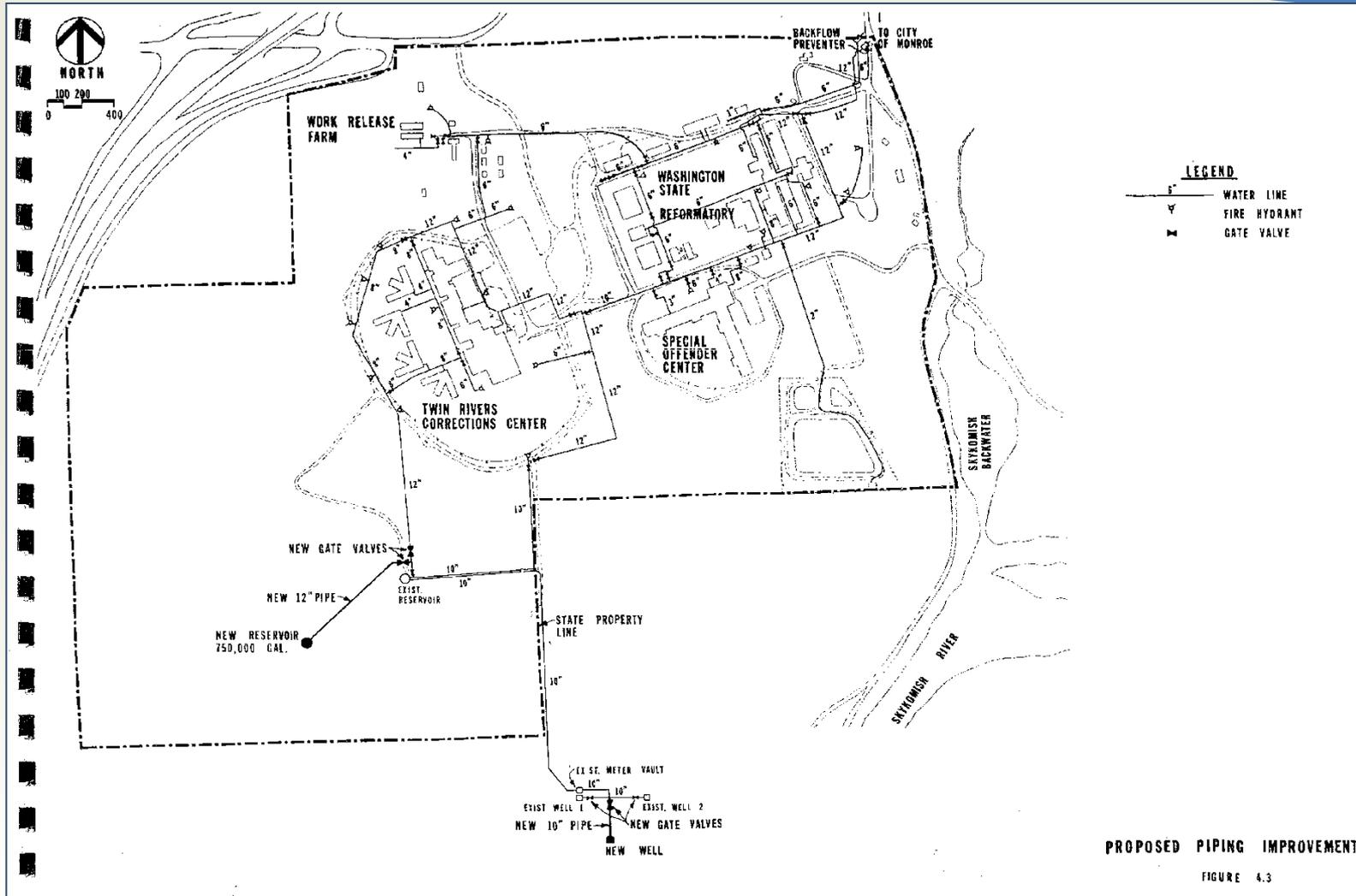


SYSTEM RECORD DRAWINGS



Facility as-built drawings for WSR

EXISTING SYSTEM MAPPING



FIELD WORK



Attempting to match existing facility mapping with the real world system



POTHOLING



TEST HOLE DATA SHEET

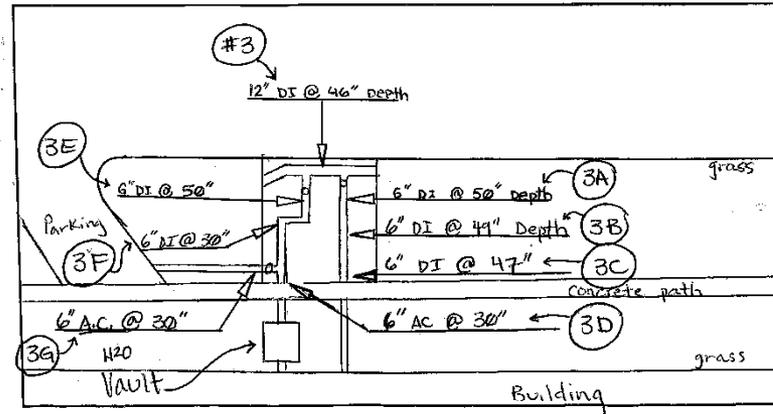
APS Job # 2226 Date: 2-11-10

Applied
Professional
Services, Inc.

Pothole#: <u>3</u>	Asphalt Thickness: _____ inches.	Utility type: <u>H2O</u> <small>(gas, water, etc.)</small>
Utility Size: <u>12" & 6"</u> inches	Utility Material: <u>DI & AC</u>	Soil Cond. <u>Rocky</u>
Dug <u>13</u> Pot holes to determine what Pipe Direction (circle one) Top of utility from grade: _____ inches.		
E & W	<u>& where H2O lines are</u>	
N & S	Bottom of utility from grade: _____ inches.	
SW & NE	<u>Some potholes being 3' x 3' x 50"</u>	
SE & NW	Width of Structure if necessary: _____ inches.	

Additional utilities found in same location:

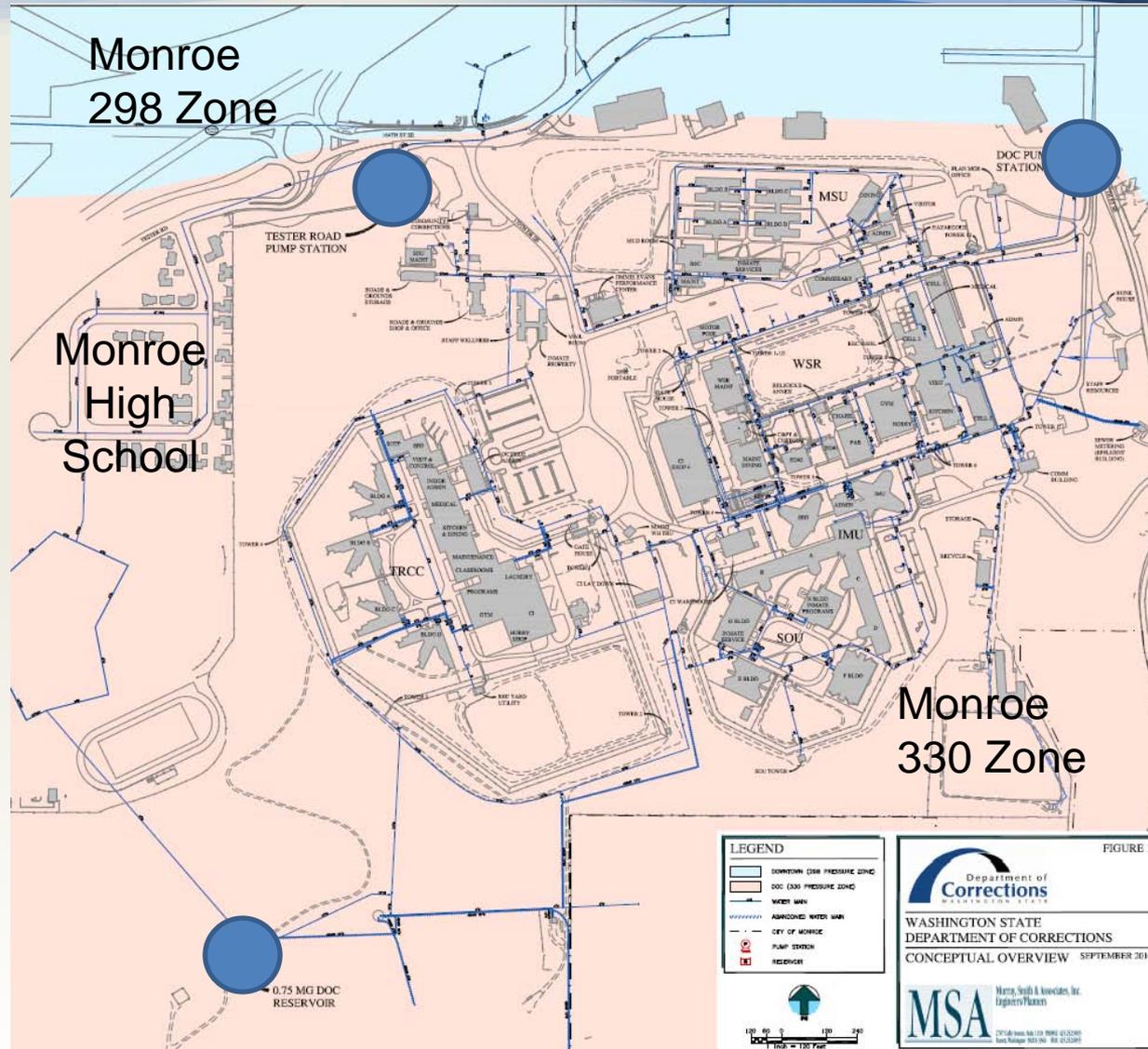
Test hole# _____	Vac Crew
Utility Type: _____ Top: _____ Bot: _____ Size: _____ Ut Material _____	Lead: <u>Allen</u>
Test hole# _____	Assistant: <u>Mike</u>
Utility Type: _____ Top: _____ Bot: _____ Size: _____ Ut Material _____	



Sketch to include street name(s), North arrow, distance to (2) permanent markers & distance to fogline or centerline.
Be sure to include a description of each permanent marker
Any known building address, or side street address in the vicinity should be included



WATER SYSTEM OVERVIEW



- In the City's 330 Zone along with Monroe High School
- Supplied from City of Monroe 298 Zone by 2 pump stations
- 330 Zone pressures established by 0.75 MG Tank

LEGEND

- SHOWNOWN (298 PRESSURE ZONE)
- DOC (330 PRESSURE ZONE)
- WATER MAIN
- ABANDONED WATER MAIN
- CITY OF MONROE
- PUMP STATION
- RESERVOIR

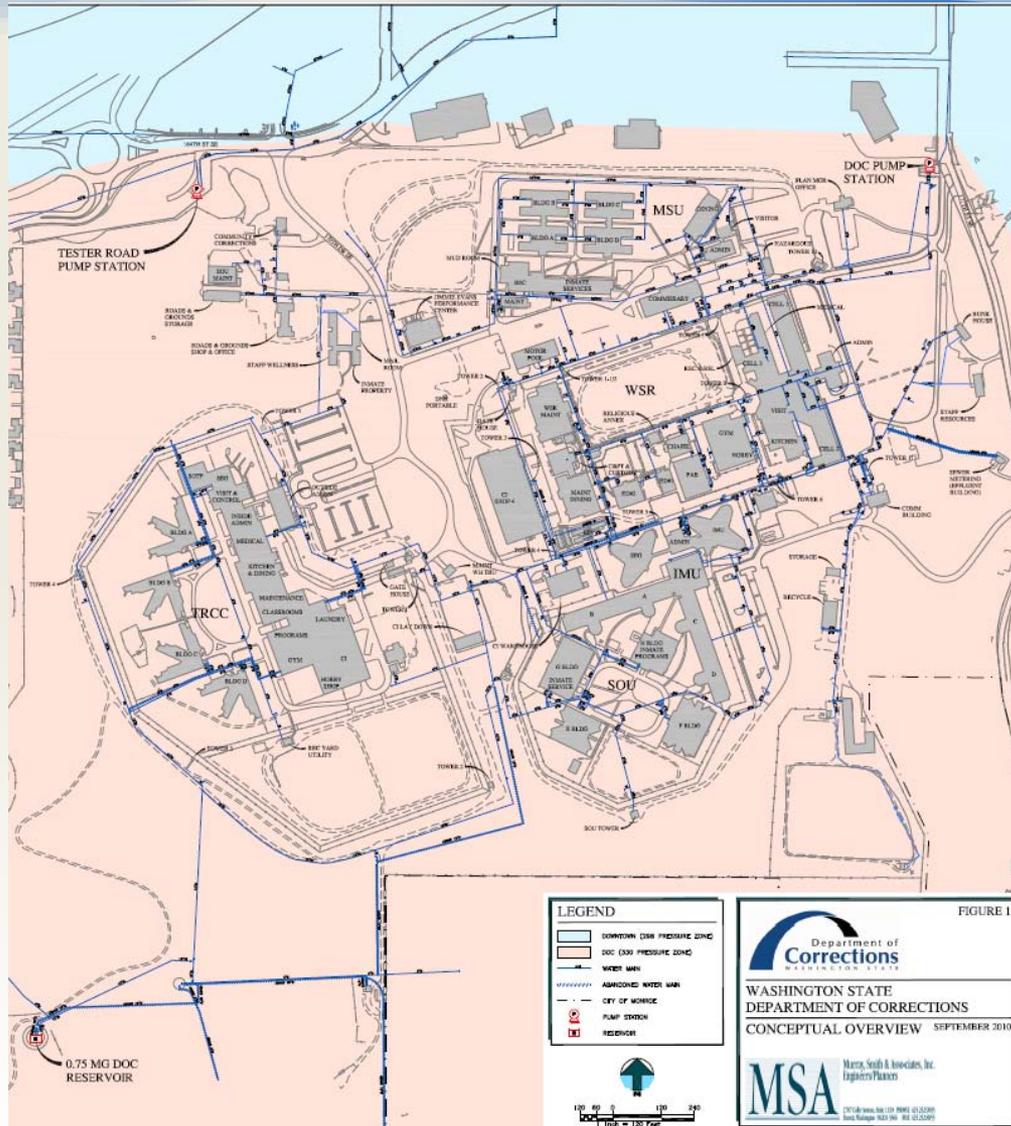
FIGURE 1

Department of Corrections
WASHINGTON STATE
DEPARTMENT OF CORRECTIONS
CONCEPTUAL OVERVIEW SEPTEMBER 2010

MSA Murray, Smith & Associates, Inc.
Laguna Hills, CA

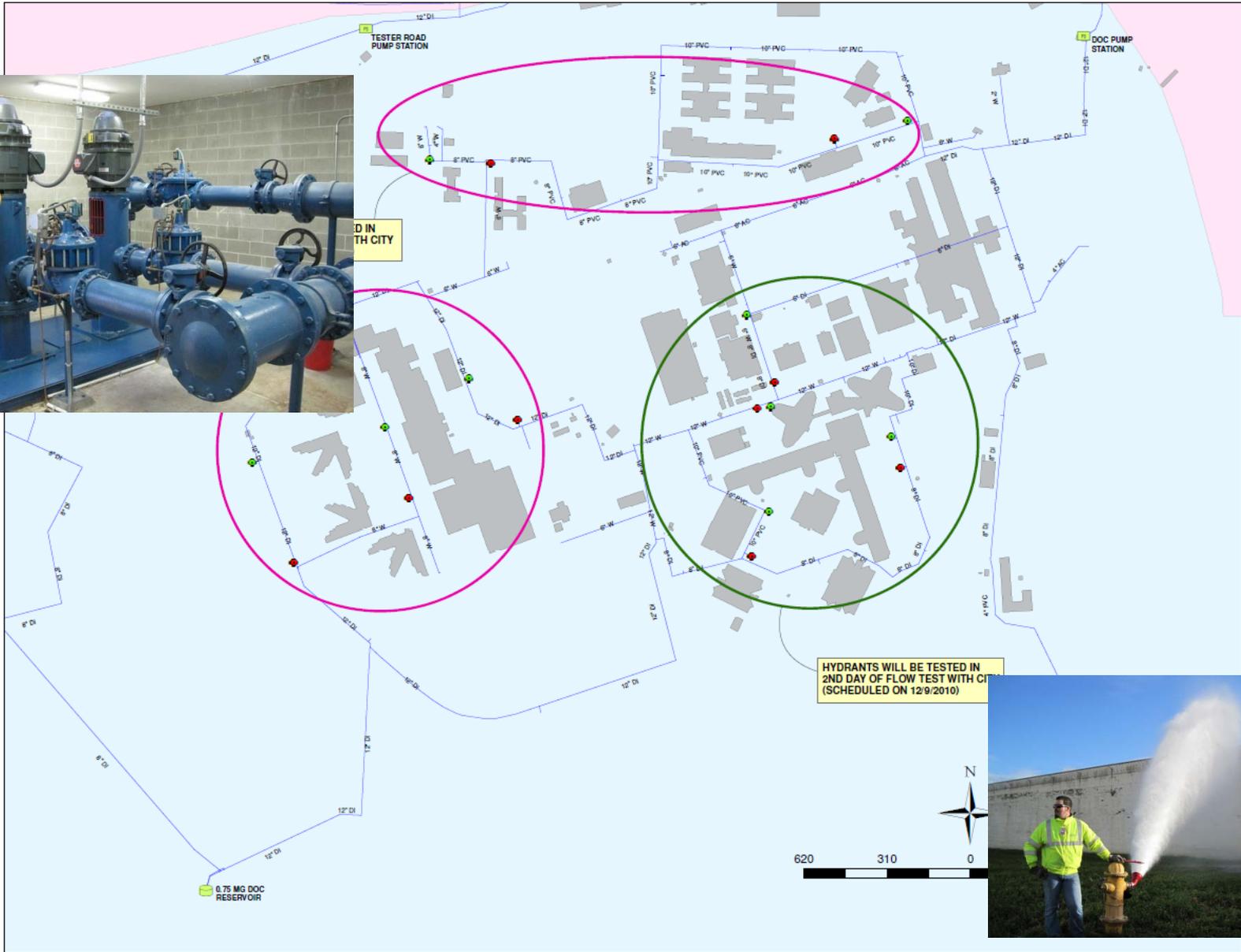
1" = 100' Feet

DEVELOPING MODEL

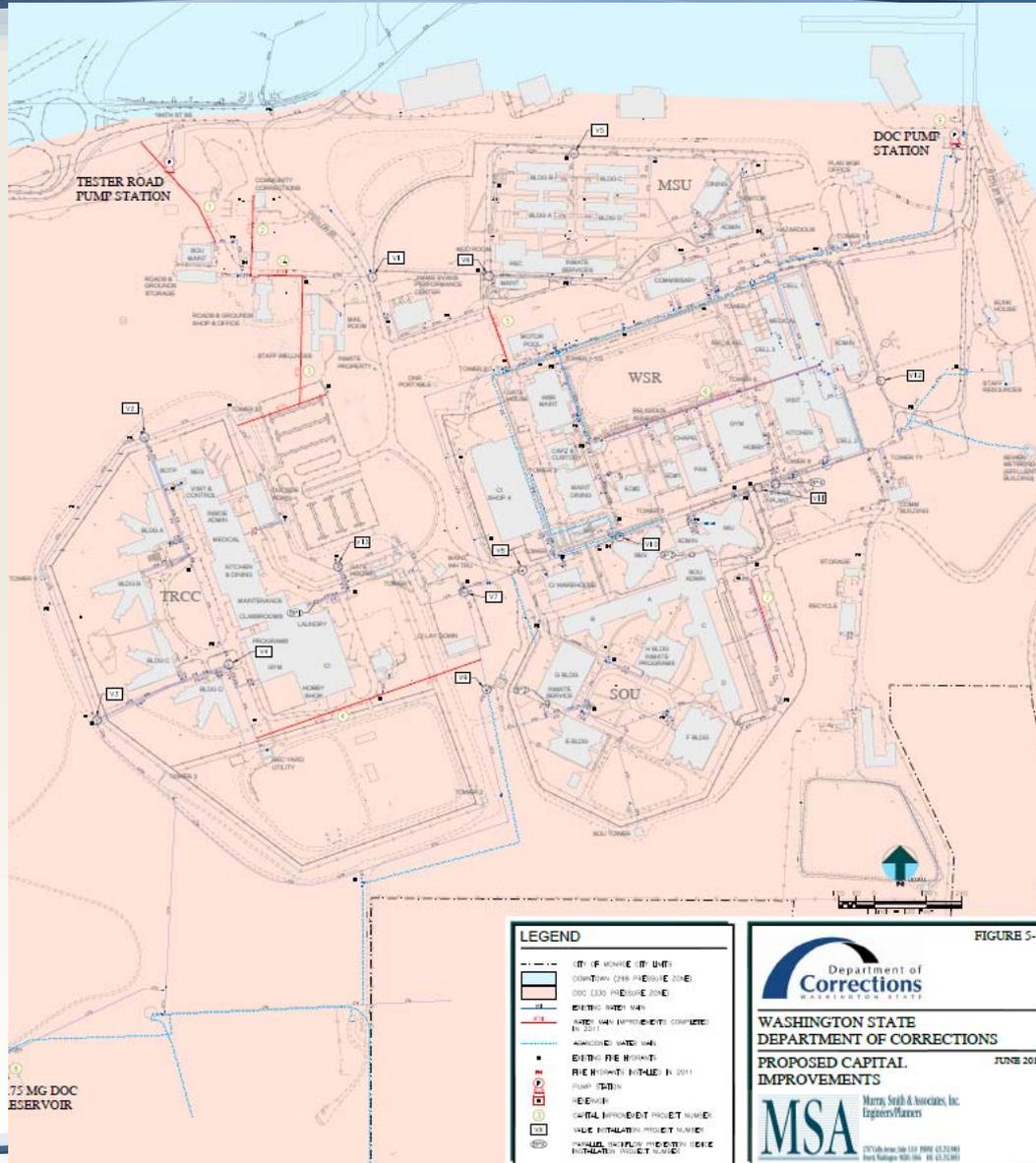


- Combined existing hydraulic models for City and MCC, different formats
- Updated model to reflect extensive field work
- Conducted facility visits to determine supply and storage facility settings
- Reviewed historical water bills and population sizes to determine demands per inmate
- Worked with City to determine fire flow requirements for each structure

CALIBRATING THE MODEL



CAPITAL IMPROVEMENT PLAN



Planning & Design Considerations:

- System redundancy
- System shut down
- Impacts to daily operations of facility
- Security impacts to work

SYSTEM DEFICIENCIES



Numerous fire hydrants without foot valves or not working



Aging and highly corroded valves



PROJECT SELECTION



WATER MAIN IMPROVEMENTS

PROJECT ID (CIP No.): 5
 PRIORITY: 2
 PROPOSED PROJECT: Pipeline Looping

Location: Near Motor Pool Building

Project Description: Installation of approximately 225 linear feet of 12-inch diameter ductile iron (DI) piping to create a loop between Jimmie Evans Performance Center and Motor Pool building to increase waterline looping to complete a loop for MSU and improve fire flows in this area.

Existing Pipe Diameter: NA Proposed Pipe Diameter: 12 in.

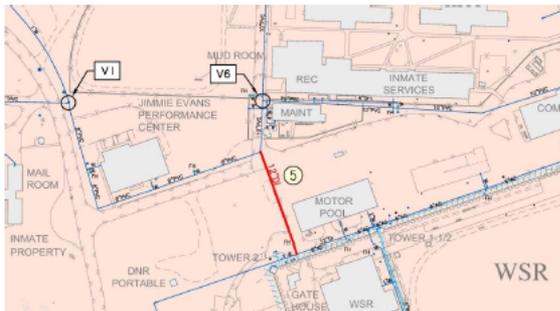
Existing Pipe Material: DI Proposed Pipe Material: DI

COST

Unit Cost: \$220

Estimated Project Cost: \$107,400 (in 2011 dollars)
 No additional cost for security escort is included.

Project Area Map:

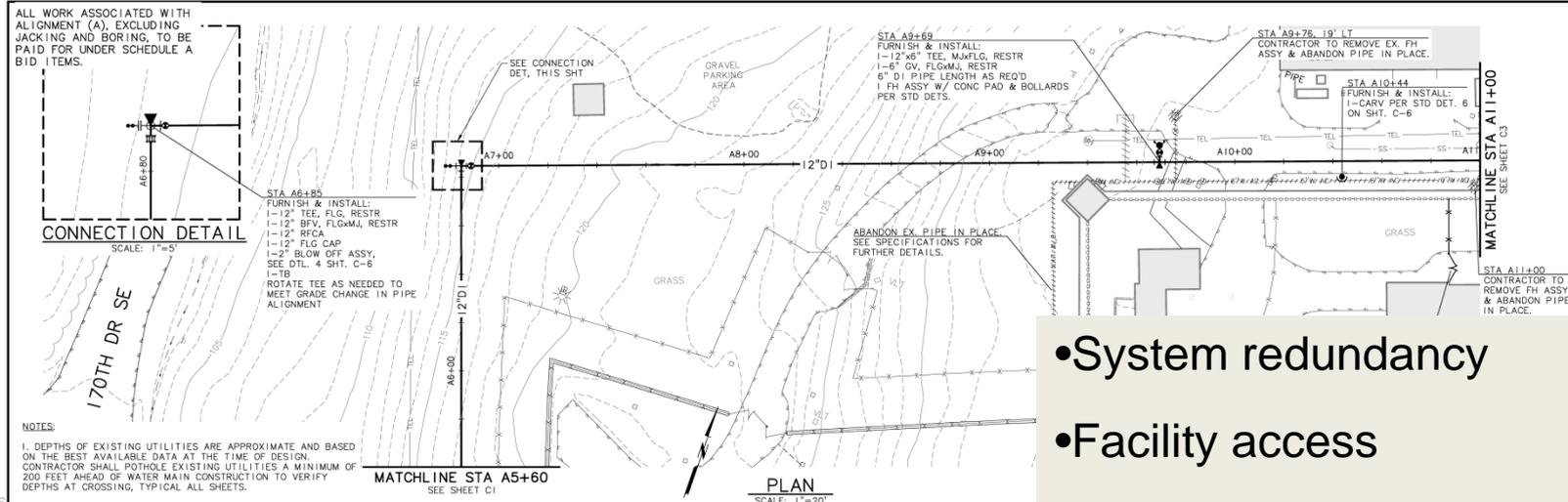


Washington State Department of Correction Capital Improvements Plan

Water Main Improvements Priority Ranking Criteria

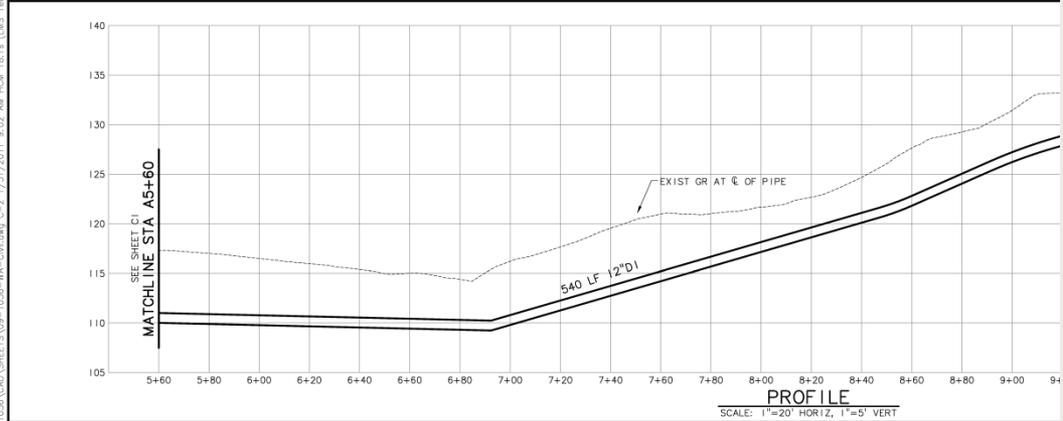
Points	Category	Weight Factor	Weighted Points
Water System Reliability			
3	Ability to provide water through an alternate route to the DOC system when either a portion or all of the supply line is out of service	5	15
Existing Water Main Fire Flow Capability			
3	Available Fire Flow is 69% or Less of Target Fire Flow	4	12
2	Available Fire Flow is 70% or 80% of Target Fire Flow	4	8
1	Available Fire Flow is 90% or 100% of Target Fire Flow	4	4
Existing Water Main Year of Installation			
3	1979 & Before	3	9
2	1980 - 1999	3	6
1	2000 & after	3	3
Existing Water Main Material			
3	Asbestos Cement & Galvanized Steel	2	6
2	Cast Iron	2	4
1	HDPE or Ductile Iron	2	2

PROJECT DESIGN CONSIDERATION



NOTES:
1. DEPTHS OF EXISTING UTILITIES ARE APPROXIMATE AND BASED ON THE BEST AVAILABLE DATA AT THE TIME OF DESIGN.
CONTRACTOR SHALL POT-HOLE EXISTING UTILITIES A MINIMUM OF 200 FEET AHEAD OF WATER MAIN CONSTRUCTION TO VERIFY DEPTHS AT CROSSING, TYPICAL ALL SHEETS.

- System redundancy
- Facility access
- Minimize system down time
- Improved hydrant spacing and location
- Ease of bidding



NO.	DATE	BY	REVISION

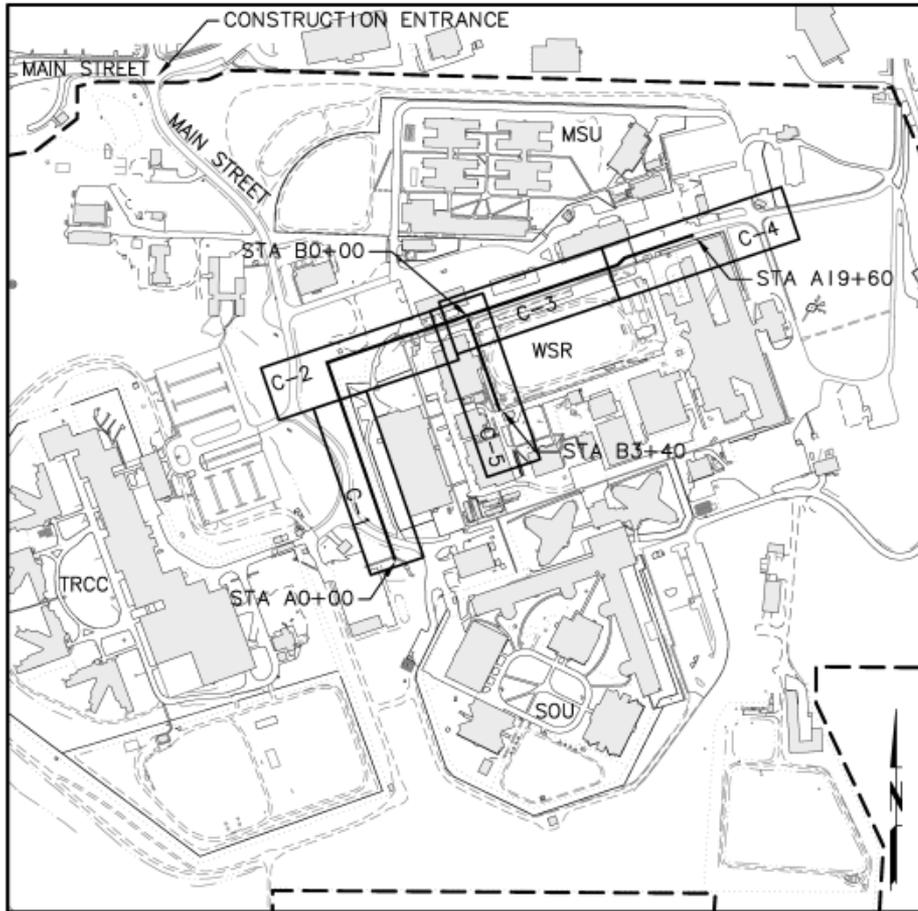
NOTICE
IF THIS BAR DOES NOT MEASURE TO THIS DRAWING IS NOT TO SCALE

QNT DESIGNED
HCM DRAWN
CEB CHECKED

MSA Murray Smith & Associates, Inc.
Engineers/Planners
2797 Colby Avenue, Suite 1110
Everett, Washington 98201-5666
PHONE 425.252.8000
FAX 425.252.8003

WASHINGTON DEPARTMENT OF C MONROE CORRECTIC WATER LINE REP PROJECT 1C

PROJECT BIDDING



- Contract 10-304H was broken into 2 bid sections to account for difference in security levels
- Mandatory pre-bid walk through to ensure that interested contractors are aware of the working conditions
- All pre bid walk through attendee's must pass a background check

2 Construction Contracts Completed in 2010

Project 10-304H

Contractor: Taylor Excavating

Approx. 2500 LF of pipe installed

500 LF of pipe installed in secured area



Project 10-304I

Contractor: Builders Supply

Approx. 700 LF of pipe installed

2 Fire hydrants installed in secured area



Monroe Correctional Complex
CONTRACTOR WORKER INFORMATION

NOTE: Do not leave any spaces blank; failure to provide all information requested will result in denial of access.

Unit: _____ <small>(Location where work to be performed)</small>	<p><i>Do Not Write in this Space Facility use only</i></p> Badge #: _____ NCIC : _____ Issued: _____ Maintained at: _____
Project: _____ <small>(Contract number or work description)</small>	
Name: _____ <small>(printed legibly as it appears on your photo ID)</small>	
Date of Birth: _____; Social Security No.: _____	

Name: _____
(printed legibly as it appears on your photo ID) LAST First Middle

Date of Birth: _____; Social Security No.: _____

Gender: ____; Hair Color: ____; Eye Color: ____; Height: ____; Weight: ____

Address: _____
House Number Street Apt./Space No. City/State/Zip

Employer/Firm Name: _____

Your Position/Job: _____

Have you been convicted of a felony or drug related misdemeanor within the past twenty years in any jurisdiction? _____. Are you currently under active supervision (in any state? (If monetary only, so indicate) _____. Do you have any felony or drug related misdemeanor charges pending? _____.

To the best of your knowledge, are you acquainted with/related to any person who is incarcerated in a Washington Department of Corrections facility? _____ (If yes, who? _____; incarcerated where? _____)

The above information is true and correct: _____
(Signature) (Date)

The information supplied on this form will be used to conduct an NCIC (National Crime Information Center) check. This process is required for all persons prior to entering a correctional facility security perimeter.

My signature below affirms that I have received a copy of the rules and facts sheet for persons working on DOC facility grounds and my agreement to abide by the stipulations outlined therein.

(Signature)

bg.07/00

- Background checks
- Tool Inventory and security ID badges
- Work hours / Inmate count
- Work interruptions
- Cell phone and camera use
- Dress code
- Contraband
- Chain gang access



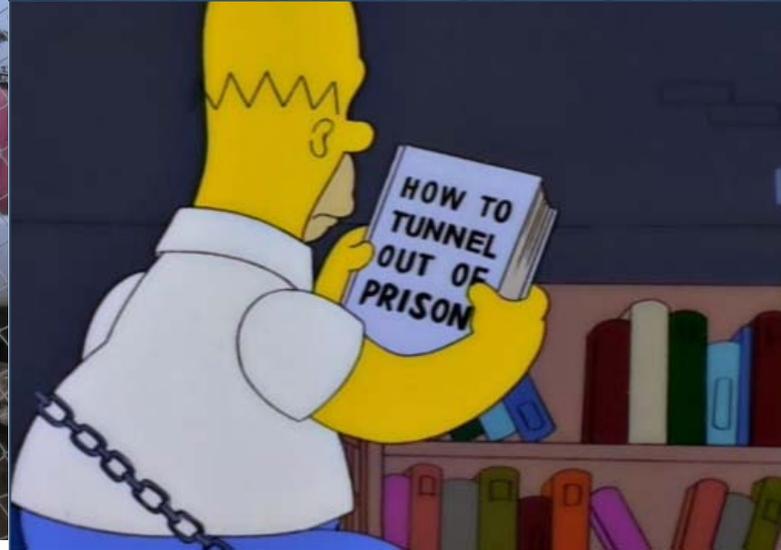
WORKING AROUND THE PERIMETER



- Fairly typical construction procedures
- Morning inventory and check in
- Afternoon inventory and check out



WORKING AROUND THE WALLS AND FENCES



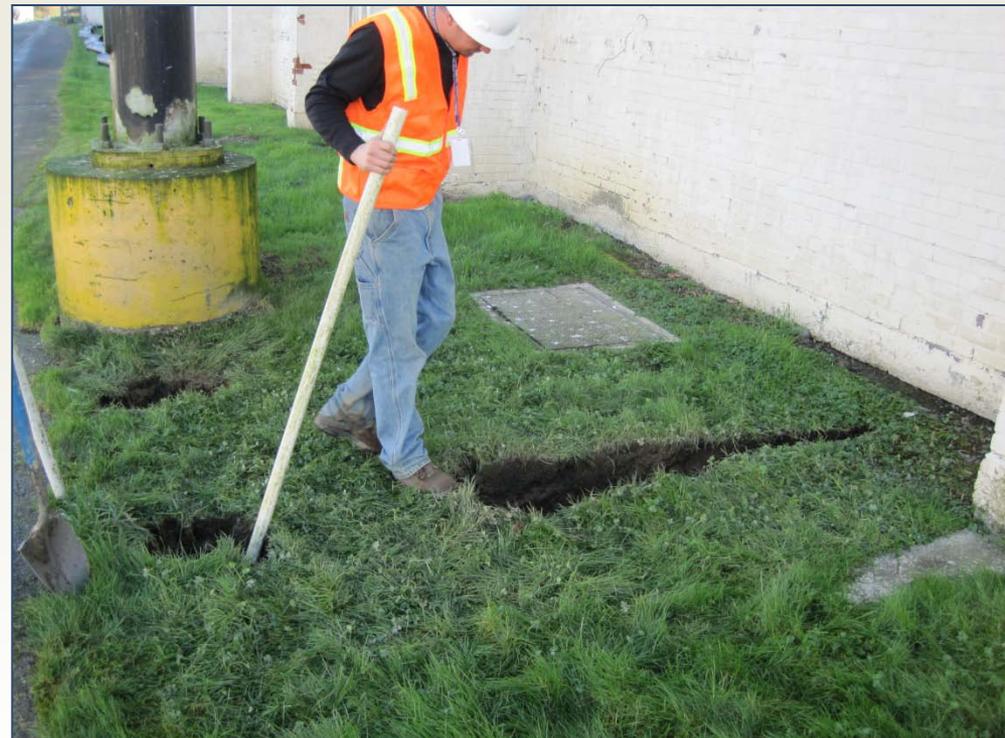
UNFORESEEN CONDITIONS



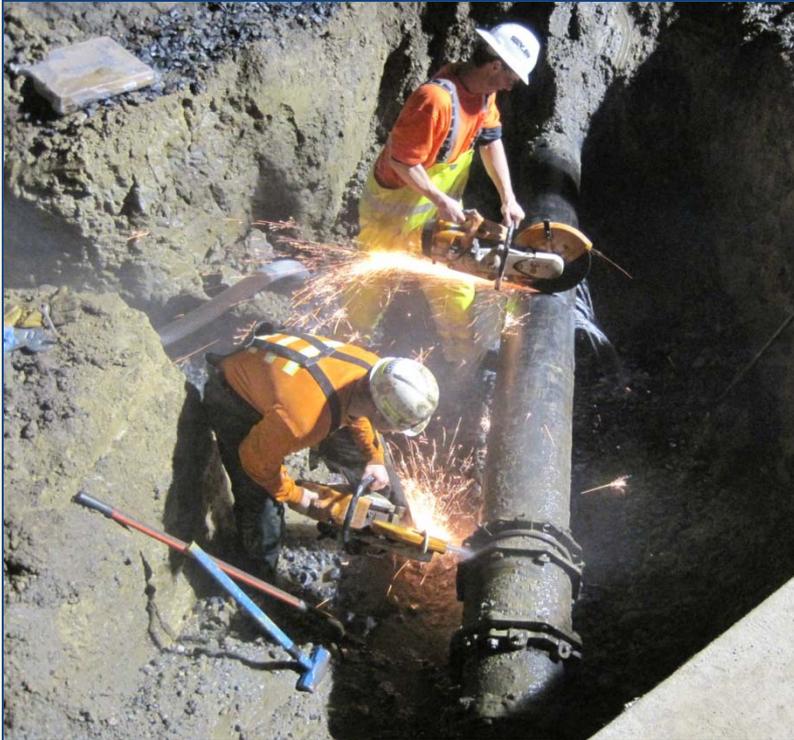
EXPLORATORY WORK



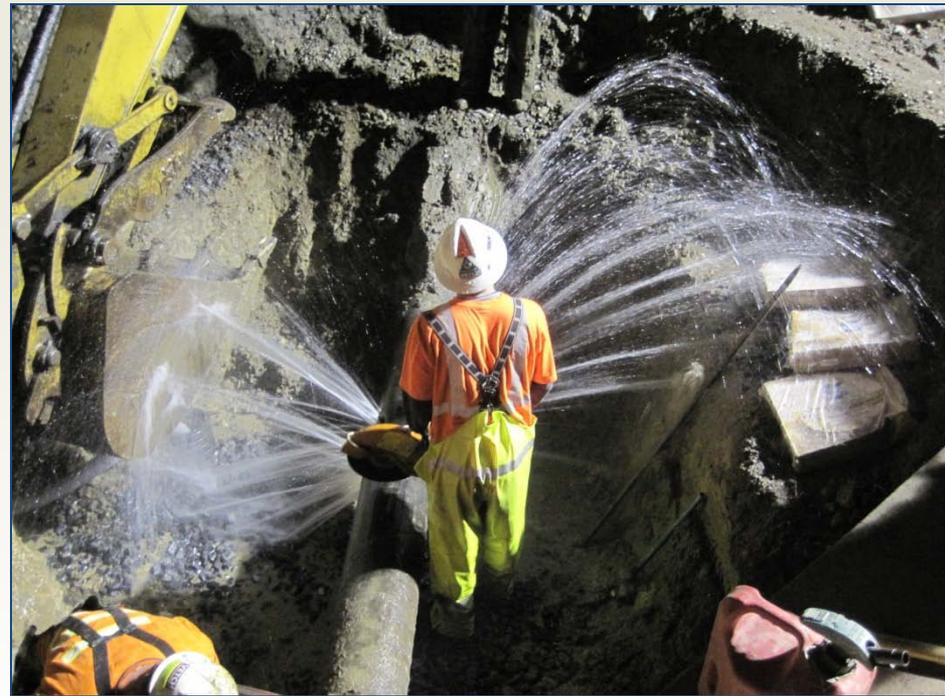
Potholing around the WSR perimeter wall to avoid any conflicts with electrical and communication lines required by the corrections officers



NIGHT WORK



In an effort to minimize shut down times, both contractors performed system connections on the same night



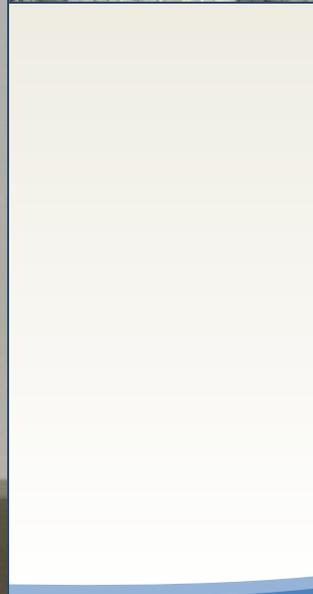
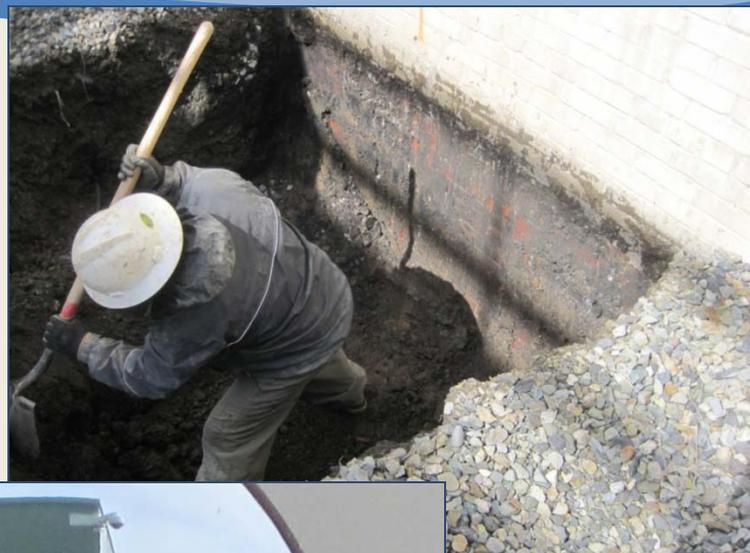
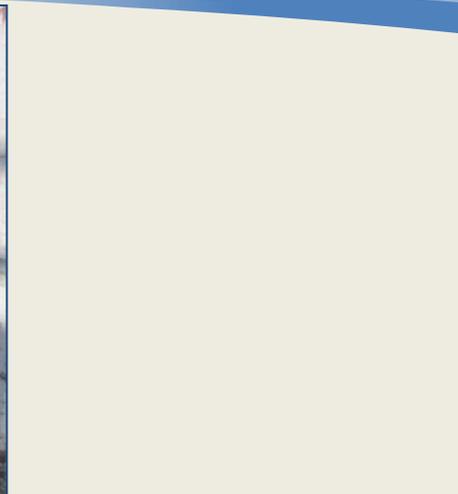
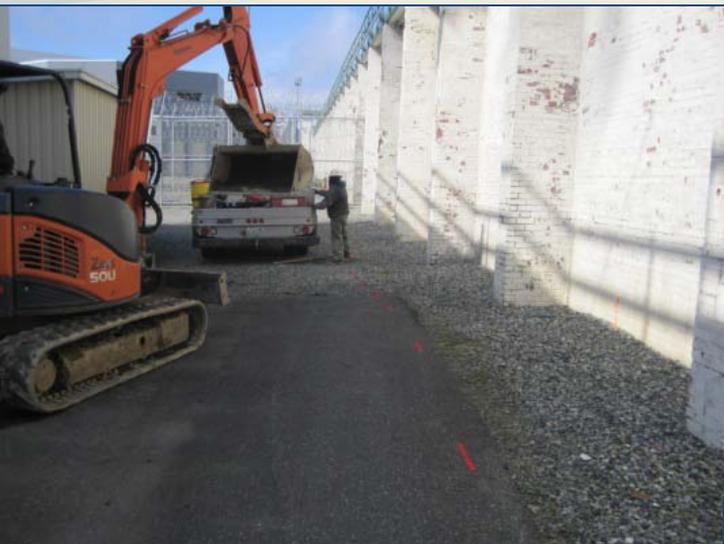
NIGHT WORK



BURIED VALVES



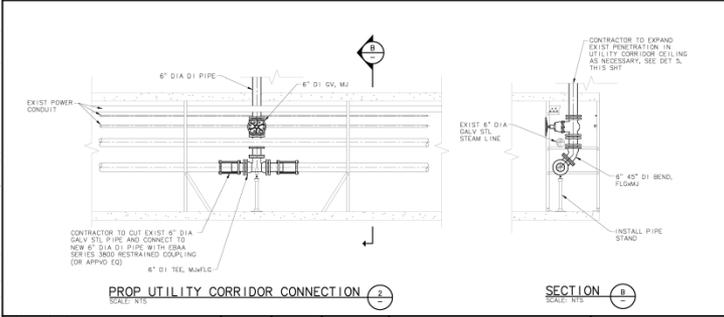
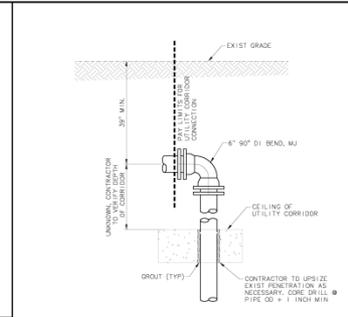
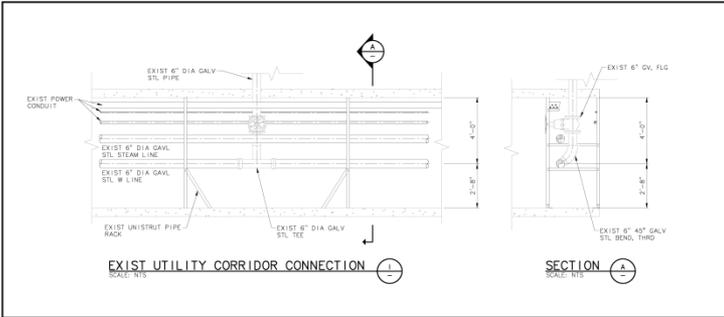
WORKING INSIDE THE WALLS



WORKING INSIDE THE WALLS



WORKING IN THE UTILITY CORRIDOR



NOTES:

1. ALL WORK DEPICTED ON THIS SHEET IS TO BE COMPLETED IN THE EXISTING UTILITY CORRIDOR.
2. ALL WORK REQUIRING THE ISOLATION OF THE EXISTING 8-INCH DI/AMC (COORD)



WASHINGTON STATE
DEPARTMENT OF CORRECTIONS
MONROE CORRECTIONAL COMPLEX
WATER LINE REPLACEMENT
PROJECT 10-304H



WORKING IN THE UTILITY CORRIDOR



UTILITY CORRIDOR



LOOPING THE SYSTEM





THANK YOU



TRIPAC

SPECIALIZING IN WATER, WASTE
WATER AND CONSTRUCTION
INDUSTRIES



TRIPAC

Waterworks Fasteners

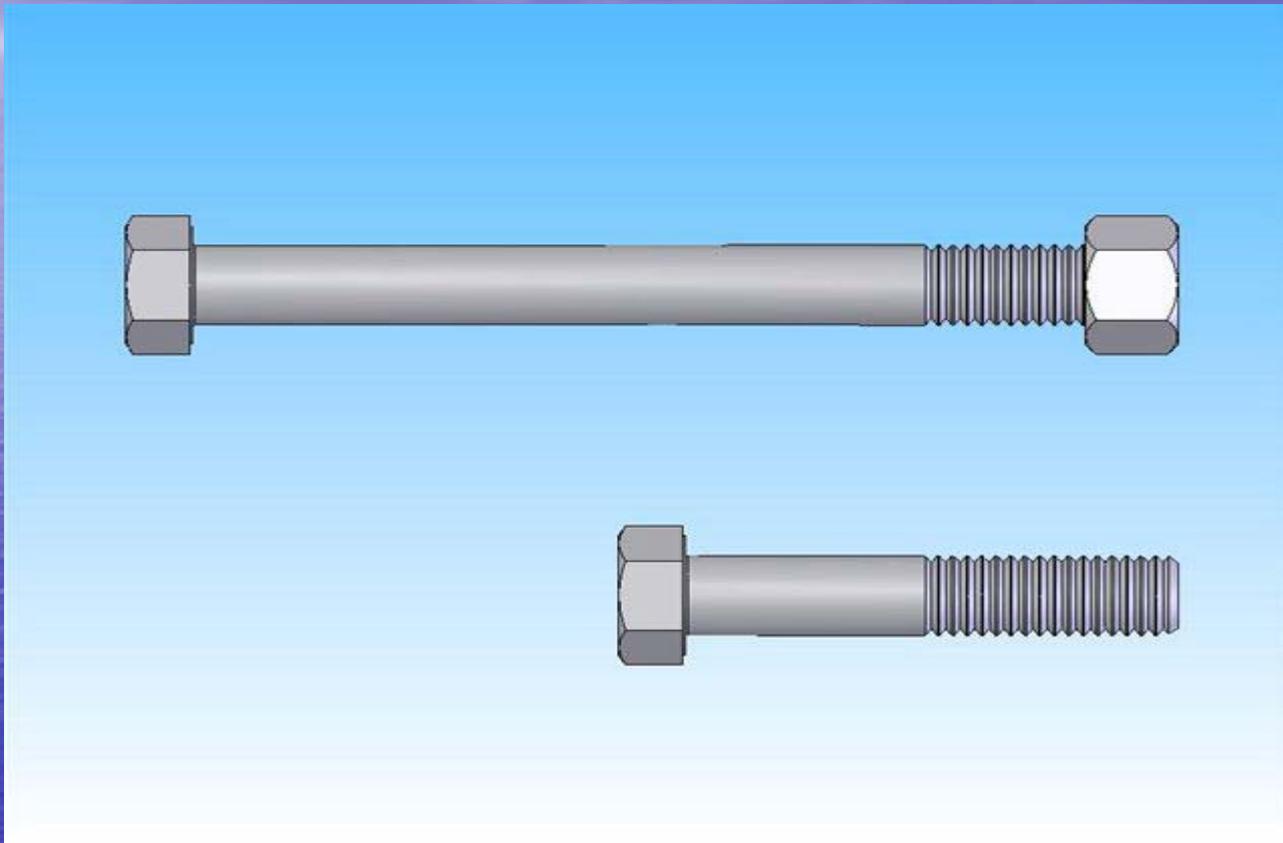
TRIPAC

THIS IS A SCREW



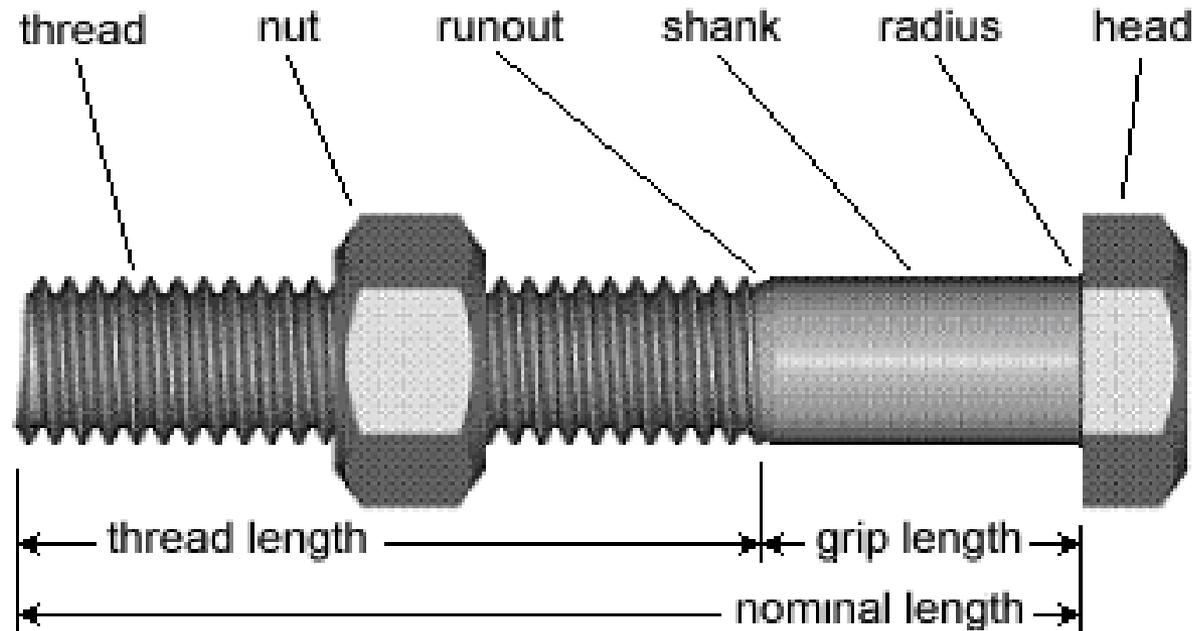
TRIPAC

THROUGH BOLT & CAPSCREW



TRIPAC

Bolt Terms

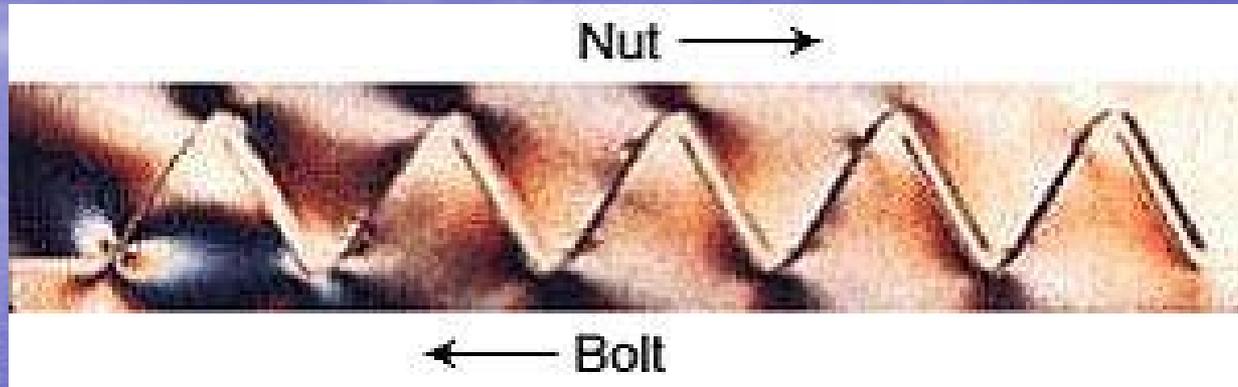


A Bolt is a Spring!



TRIPAC

Thread Loading



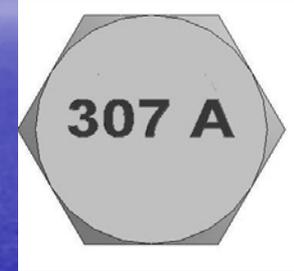
Thread	Load	Sum
1	34%	34%
2	23%	55%
3	16%	71%
4	11%	82%
5	9%	91%
6	7%	98%

TRIPAC

Grade 2

- **ASTM 307A – Finished**

- Mild Steel
- Minimum Tensile 60k
- No Max Tensile



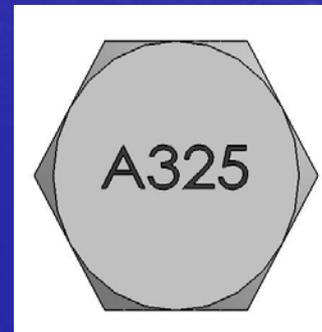
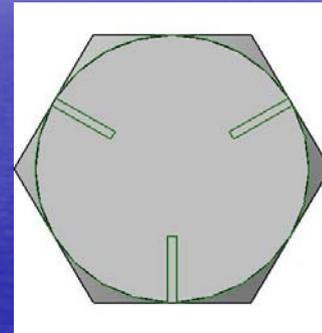
- **ASTM 307B - Heavy**

- AWWA General Specification
- 1/8 larger across the flats
- Requires 1 wrench size larger
- 100ksi Max Tensile

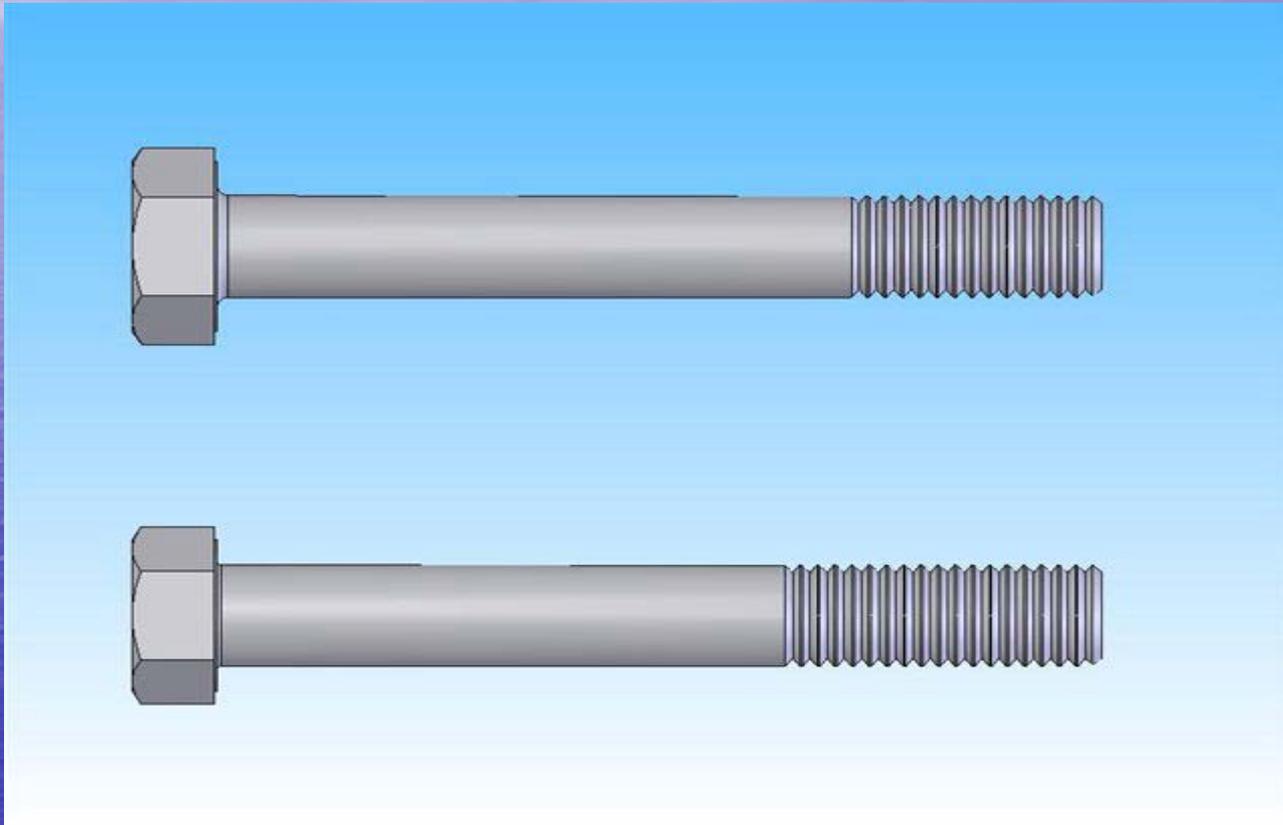


Grade 5

- SAE J429 - Finished
 - Structural Grade Bolt
 - Min tensile 105 k
 - ASTM A325 - Heavy
 - Buildings
 - Less Threads
 - Longer Shank
- _Min Tensile 105 K



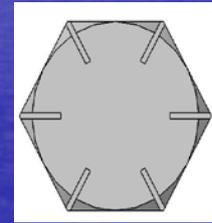
A325 SHORT THREADS / GR 5 LONG THREADS



TRIPAC

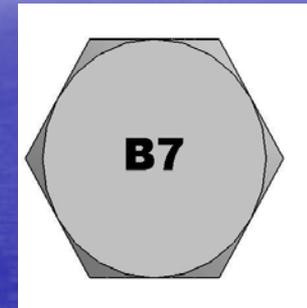
Grade 8 / A354 BD

- Automotive
- Off Road /
Suspension
- Large Diameter
Connections
- 72" & Above
- Min tensile 150 k



TRIPAC

- GRADE B-7
- Min Tensile 125k
- .02 Molybdenum
- Common in the Oil Industry
- 8-pitch threads above 1" diameter



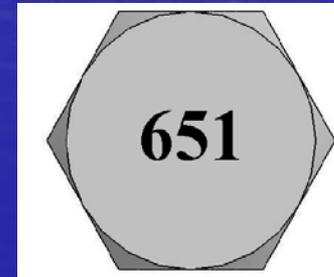
TRIPAC

Break-away Bolts

- Wet or Dry?
- LADWP 100% Silicon Filled
- Proper orientation
- 6 hole - 5/8"
- 8 hole - 3/4"
- Bolt up or down?

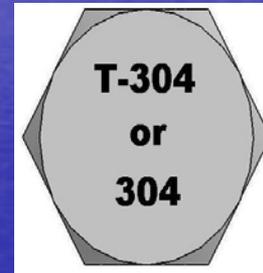
Red Brass (silicon bronze)

- For meters - no galvanic corrosion
- Soft
- Fully Threaded
- Alternate is SS w/ blue nut

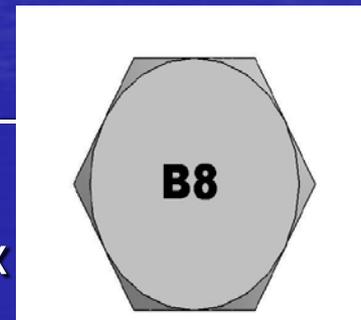


T-304 Stainless Steel

- ASTM F593 / F594 – Finished Hex
 - T-304
 - No Molybdenum

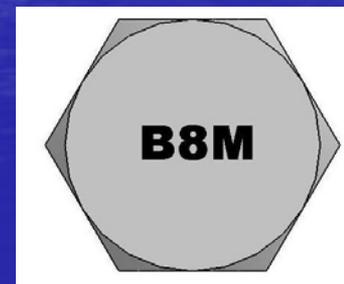
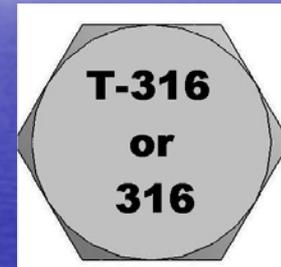


- ASTM A193 / A194 – Heavy Hex
 - B8 – Heavy hex version of 304



T-316 Stainless Steel

- ASTM F593 / F594 – Finished Hex
 - T-316
 - More MD & NI - Higher yield
- ASTM A193 / A194 – Heavy Hex
 - B8M – Heavy hex version of 316



304 STAINLESS STEEL

ASTM F593 C ¼ TO 5/8

ASTM F593 D ¾ TO 1-1/2

316 STAINLESS STEEL

ASTM F593 G ¼ TO 5/8

ASTM F593 H ¾ TO 1-1/2

F593, F594 - ASTM F593 is a specification for stainless hex head cap screws: ASTM F594 is for stainless nuts. Compared to regular (18-8) stainless fasteners, F593 and F594 call for: (a) tensile requirements about 20% higher than that of commercial 18-8 or stainless hex caps and nuts to MS Specifications (MS35307-8, MS34649-50); (b) both a minimum and a maximum tensile and hardness requirements while commercial and MS fasteners do not have a maximum; (c) chemical requirements that (eliminate) many commonly used mixtures of 300 or 18-8 stainless while allowing others. (courtesy Star Stainless Screw) F593C, F593D, F593G, and F593H are commonly seen spec's in this group.

Stainless Alloy Group	Condition	Alloy Mechanical Property Marking	Nominal Diameter	Full Size Tests			Machined Specimen Tests		
				Tensile Strength ksi c	Yield Strength ksi c/d	Rockwell Hardness	Tensile Strength ksi d	Yield Strength ksi c/d	Elongation in 4D %
303, 304, 305, 384, XM1, XM7, 302Se	CW1	F593C	1/4 to 5/8	100 to 150	65	B95 to C32	95	60	20
	CW2	F593D	3/4 to 1-1/2	85 to 140	45	B80 to C32	80	40	25
316	CW1	F593G	1/4 to 5/8	100 to 150	65	B95 to C32	95	60	20
	CW2	F593H	3/4 to 1-1/2	85 to 140	45	B80 to C32	80	40	25

Condition - CW - Hardened and rolled from annealed stock, thus acquiring a degree of cold work, sizes .75 in and larger may be hot worked

<c> Yield Strength is the stress at which an offset of .2% gage length occurs

<d> Machined from strain hardened stock

Extra Note - The industry standard of thread length of twice the diameter + 1/4 or 1/2 (depending on the length) does not necessarily apply on the F593 spec. If thread length is important, be sure to cover this with your supplier)

Stainless Benefits / Issues

- Galling -
Anti-seize
- Anti-seize
not required
with Blue
nut
- "Burning"
- Stretching –
re-torque
- Corrosion
Protection

Stainless and Blue Nut



- No Anti-Seize
- Higher Tension Without Over Stressing The Bolt
- Rarely a Need for Re-tightening

FLANGE BOLT TORQUE GUIDELINES

WEB DATA 10.03-2

June 2005

Supersedes January, 2005

DeZURIK Water Controls

Nominal Valve Size	Flange Bolting		Compressed Non-asbestos Hard Gasket		
	Number of Bolts	Flange Bolt Size	Recommended Bolt Load	Bolt Torque Non-lubricated	Bolt Torque Lubricated
4	8	5/8 x 11	3,980	94	29
6	8	3/4 x 10	4,810	136	42
8	8	3/4 x 10	6,860	193	60
10	12	7/8 x 9	6,210	209	68
12	12	7/8 x 9	9,570	321	105
14	12	1 - 8	11,700	468	147

Torque & Lubrication

- Cad 25%
- Zinc 15%
- Oiled 15%
- Xylan 50-70%
- Common Practice is Oiled
- Who provides Torque Values

T-Head Bolts



- Available in low alloy, Corten & Stainless Steel

TRIPAC

Coatings

- Cadmium
- Zinc
- Hot-dip Galvanized
- TRIPAC 2000

TRIPAC FASTENERS
FOR THE WATER WORKS AND CONSTRUCTION INDUSTRIES

TRIPAC 2000 BLUE COATING SYSTEM



TRIPAC 2000 BLUE PLAIN STEEL ZINC PLATED HOT DIP GALVANIZED

ASTM A307, GR A BOLTS AFTER 1,000 HOURS OF SALT SPRAY TESTING

Bolts protected with **TRIPAC 2000 BLUE COATING SYSTEM** show no signs of corrosion after 1,000 hours of salt spray testing (ASTM-B-117). Plain steel, zinc plated, and hot dip galvanized bolts all show significant degrees of corrosion and rust.

Tripac's unique coating system encompasses careful surface preparation which includes abrasive blasting prior to being treated with a baked aerocote nickel primer. All fasteners are then electrostatically sprayed with multiple coats of **TRIPAC 2000 BLUE**, and baked at 425 degrees.

TRIPAC 2000 BLUE is a fluoropolymer coating which combines a wide range of mechanical and chemical properties ideally suited to the wide range of fasteners used in water works applications. It offers low friction, abrasion resistance, corrosion and chemical protection. Fasteners are easily tightened and removed.

Safety is improved and costs are lowered because in most cases the fasteners can be removed with a wrench instead of using a cutting torch. Even after 3,000 hours in salt spray testing, nuts are still easily removed.

TRIPAC FASTENERS, A DIVISION OF TRIPAC MARKETING, INC.
475 Klug Circle, Corona, CA 92880 (951) 280-4488 Fax (951) 272-4445 www.tripaconline.com

TRIPAC

Salt Spray



1000 Hours

TRIPAC

FASTENERS FOR CORROSIVE ENVIRONMENTS

	<i>Brass and Naval Bronze</i>	<i>Silicon Bronze</i>	<i>Monel Metal</i>	<i>Stainless Types 410, 416 and 430</i>	<i>Stainless Types 302, 303, 304 and 305</i>	<i>Stainless Type 316</i>	<i>Copper</i>	<i>Aluminum</i>	<i>Nylon</i>
Carbon Dioxide (Wet & Aqueous)	Fair ¹¹	Good ¹¹	Good ¹¹	Excel ¹¹	Excel	Excel	Good ¹¹	Excel	Excel
Carbon Disulfide	Fair	Poor	Fair	Good	Excel	Excel	Poor	Excel	Excel
Carbon Tetrachloride ¹²	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Good	Excel
Chlorine (Dry)	Good	Good	Excel	Good	Good	Good	Good	Poor	Poor
Chlorine (Wet)	Poor	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Poor
Chromic Acid	Poor	Poor	Fair	Fair	Good	Excel	Poor	Poor	Poor
Citric Acid	Fair ¹	Good	Good	Fair	Good	Excel	Good	Good	Good
Coke Oven Gas	Fair	Fair	Good	Excel	Excel	Excel	Fair	Good	Fair
Copper Sulfate	Poor	Fair	Fair	Excel	Excel	Excel	Fair	Poor	Fair
Core Oils	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel
Cottonseed Oil	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel
Creosote	Fair	Good	Excel	Excel	Excel	Excel	Good	Good	
Ethers	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel
Ethylene Glycol	Good	Excel	Excel	Excel	Excel	Excel	Excel	Good	Good
Ferric Chloride	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Ferric Sulfate	Poor	Fair	Fair	Excel	Excel	Excel	Fair	Good	Poor
Formaldehyde	Good	Good	Excel	Excel	Excel	Excel	Good	Good	Good

Galvanic Scale

- **ANODIC / LESS NOBLE / CORRODED END**
 - Zinc
 - Aluminum
 - Galvanized Steel
 - Cadmium
 - Mild Steel, Wrought Iron
 - Cast Iron
 - Lead
 - Brass, Bronze
 - Copper
 - Stainless T-304 F593 C or D
 - Stainless T-316 F593 G or H
 - **CATHODIC / MORE NOBLE / PROTECTED END**

Corrosion Costs

- U.S. Federal Highway Admin - Mandated by Congress
 - in conjunction with NACE
- Direct Annual Cost \$276 B
 - Utilities \$47.9 B
 - Drinking Water & Sewer - \$36 B



**TWO YEAR STUDY BY NACE FOR THE US
GOVERNMENT: 36 BILLION DOLLARS ANNUAL
CORROSION COSTS**

- **UNFORTUNATELY, THERE IS A LACK OF COMPLETE AND UP TO DATE INFORMATION ON ALL WATER SYSTEMS, WITH LIMITED COMMUNICATION AMONG WATER UTILITIES, AND THUS, LIMITED AWARENESS AND IMPLEMENTATION OF AVAILABLE CORROSION CONTROL TECHNOLOGIES**



Construction Specifications

Signatory Agencies



Helix Water District

7811 University Avenue
La Mesa, CA 91941-4927



Lakeside Water District

10375 Vine Street
Lakeside, CA 92040



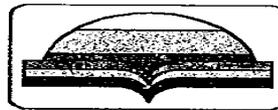
Otay Water District

2554 Sweetwater Springs Blvd.
Spring Valley, CA 91978-2096



Padre Dam Municipal Water District

10887 Woodside Avenue
PO Box 719003
Santee, CA 92072-9003



Riverview Water District

11769 Waterhill Road
Lakeside, CA 92040-2998



San Diegoito Water District

505 Vulcan Avenue
Encinitas, CA 92024

Visit The Website At: www.sdwas.com

ANSI/NSF-61

TRIPAC

ANSI/NSF-61

- NSF-61 - The AMERICAN NATIONAL STANDARD FOR HEALTH EFFECT OF ALL DRINKING WATER SYSTEM COMPONENTS
- IT ESTABLISHES THE REQUIREMENTS FOR CHEMICAL CONTAMINANTS AND IMPURITIES THAT ARE INDIRECTLY IMPARTED TO DRINKING WATER FROM PRODUCTS, COMPONENTS AND MATERIALS USED IN DRINKING WATER SYSTEMS
- COMPLIANCE WITH ANSI/NSF-61 IS REQUIRED FOR ALL DRINKING WATER PIPE AND FITTINGS IN ALL U.S. MODEL PLUMBING CODES AND IS A REQUIREMENT IN THE 2007 CALIFORNIA PLUMBING CODE.
- FULL COMPLIANCE REQUIRED BY 2012 ?

ANSI/NSF-61 GASKETS

- CURRENTLY TO THE BEST OF OUR KNOWLEDGE THERE ARE ONLY 4 FLANGE GASKET MATERIALS AVAILABLE WITH THE NSF-61 APPROVAL
- EPDM STYLE #98206 MANUFACTURED BY GARLOCK
- GYLON STYLE #3505 MANUFACTURED BY GARLOCK
- STRESS SAVER XP MANUFACTURED BY GARLOCK
- FLANGE TYTE MANUFACTURED BY US PIPE

EPDM STYLE #98206

- MANUFACTURED BY GARLOCK
- EPDM WITH SULFUR CURE
- 85 DUROMETER
- MAX TEMP = 275° F
- MAX PRESSURE = 150 PSI
- SHEET MATERIAL IS 48" WIDE
- GASKETS LARGER THAN 36" WILL BE DOVETAILED & GLUED
- CURRENTLY SPECIFIED IN SAN FRANCISCO

GYLON # 3505

- MANUFACTURED BY GARLOCK
- PTFE WITH GLASS MICROSPHERES
- MAX OPERATING TEMP = 500°F
- OPERATING PRESSURE = 800 PSI
- CAN BE BONDED TO PRODUCE 1-PC LARGE DIAMETER GASKETS

STRESS SAVER XP

- MANUFACTURED BY GARLOCK
- PROPRIETARY BLENDS OF FLUOROELASTOMERS (70 DURO)
- MAX TEMP = 400°F
- MAX PRESSURE = 250 PSI
- MOLDED RUBBER GASKET WITH MOLDED RINGS FOR BETTER SEAL

TRIPAC

FLANGE TYTE

- MANUFACTURED BY US PIPE
- AVAILABLE IN SBR, NBR, NEOPRENE AND EPDM
- MOLDED GASKET WITH MOLDED RINGS FOR A BETTER SEAL
- MAX TEMP = 150 – 212°F
- WATER WORKING PRESSURE:
 - 4" – 24" = 350 PSI
 - 30" – 48" = 250 PSI
 - 54" – 64" = 150 PSI

ANSI/NSF-61 DIELECTRIC GASKET

- ONLY TWO APPROVED DIELECTRIC GASKETS
- BOTH ARE G10 MATERIAL WITH EPDM SEALING ELEMENTS
- MANUFACTURERS:
 - PSI – PIPELINE SEAL & INSULATOR
 - APS – ADVANCED PRODUCTS & SYSTEMS

Questions



TRIPAC

Rev. 02

Bolts and Nuts for Flanged Connections

Bolts and nuts shall be as indicated below (select the appropriate specification **and** finish):

Specification: (select one)

307 A

Bolts and nuts shall be carbon steel with a minimum 60,000 PSI tensile strength conforming to ASTM A307, Grade A. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. Nuts shall conform to ASTM A563 and be standard ANSI B1.1, Class 2A coarse threads. All bolt heads and nuts shall be hexagonal. Identification on the head of the bolt shall be *A 307 A*.

307 B

Bolts and nuts shall be carbon steel with a minimum 60,000 PSI tensile strength conforming to ASTM A307, Grade B. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. Nuts shall conform to ASTM A563 and be standard ANSI B1.1, Class 2A coarse threads. All bolt heads and nuts shall be heavy hexagonal for greater bearing area. Identification on the head of the bolt shall be *A 307 B*.

Grade 5 Carbon Steel Bolts

Bolts shall be carbon steel with a minimum 105,000 PSI tensile strength conforming to SAE J429. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. Nuts shall conform to ASTM A563 and be standard ANSI B1.1, Class 2A coarse threads. All bolt heads and nuts shall be hexagonal. Identification on the head of the bolt shall be *three slash marks*.

T-316 Stainless Steel (Finished Pattern)

Bolts and nuts shall be stainless steel conforming to ASTM F593 for bolts and ASTM F594 for nuts. Bolts shall be threaded to conform to ANSI B 18.2.1, page C-1 for finished hex bolts. Nuts shall conform to ANSI B 18.2.2, page D-1. Nuts shall be finished with TRIPAC 2000 coating system to minimize galling and ensure proper torque. Anti-seize compound shall not be utilized with the blue nuts. All bolt heads and nuts shall be hexagonal. Identification on the head of the bolt shall be *T-316, 316, F593G or F593H*.

B8M T-316 Stainless Steel (Heavy Pattern)

Bolts and nuts shall be stainless steel conforming to ASTM A193 Grade B8M for bolts and ASTM A194 Grade 8M for nuts. Bolts shall be threaded to conform to ANSI B 1.1, Class 2A coarse threads. Nuts shall conform to ASTM A194. Nuts shall be finished with TRIPAC 2000 coating system to minimize galling and ensure proper torque. Anti-seize compound shall not be utilized with the blue nuts. All bolt heads and nuts shall be heavy hexagonal. Identification on the head of the bolt shall be *B8M*.

Finish: (select one)

Bolts and nuts shall be plain finish.

Bolts and nuts shall be Zinc plated to reduce the effects of corrosion.

Bolts and nuts shall be provided with a hot dipped or mechanically galvanized finish to reduce the effects of corrosion. "Overtapped" nuts and holes may be required when hot dipped bolts are specified.

Bolts and nuts shall be finished with the **TRIPAC 2000** coating system to significantly reduce the effects of corrosion. A multi-step process shall be utilized to chemically clean, abrasive blast and prime with zinc/nickel phosphate primer prior to application of the Xylan fluoropolymer. Wear resistance (K-Factor) shall be in the range of 6 to 8 (excellent) and minimal effects should be seen after a 3000 hour Salt Spray test conforming to ASTM B-117.

Mechanical Joint T-Head Bolts

A242 Steel Bolts

Bolts shall be ASTM A242 weathering steel with minimum yield strength of 45,000 PSI. All T-Bolts & nuts shall be threaded in accordance with ANSI/ASME B1.1, Class 2A fit, with coarse-thread series. Heavy hex nuts shall be used. Bolt heads shall be in accordance with the dimensions of ANSI/AWWA C111 / A21.11-95.

Hydrant Break-Off Bolts

307A Break-Off Bolts

Bolts and nuts shall be carbon steel with a minimum 60,000 PSI tensile strength conforming to ASTM A307, Grade A. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. Nuts shall conform to ASTM A563 and be standard ANSI B1.1, Class 2A coarse threads. All bolt heads and nuts shall be hexagonal. Identification on the head of the bolt shall be *A 307 A*. *5/8" diameter break-off bolts shall have an 11/32" hole drilled in the shank 2 3/8" deep. 3/4" diameter break-off bolts shall have a 13/32" hole drilled in the shank 2 3/8" deep. The bored out holes shall be 100% filled with silicon to prevent moisture from corroding the bolt internally.*

Meter Bolts

Silicon Bronze Bolts

Bolts and nuts shall be silicon bronze conforming to ASTM F 468. Material shall meet UNS Alloy number C65100, Alloy 651, low silicon bronze B. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. All bolt heads and nuts shall be hexagonal. Washers shall be of the same material as the bolts and nuts. Identification on the head of the bolt shall be *651, SB or unmarked*.

INDUSTRY STANDARDS

MECHANICAL PROPERTIES

When strength requirements are moderate, low-carbon steel is used. High-strength fasteners are made from medium-high carbon or alloy steels and are heat treated to develop desired properties.

Most fasteners are covered by specifications that define required mechanical properties such as tensile strength, yield strength, proof load and hardness.

- **Tensile Strength:** The maximum tensile stress in pounds per sq in. which a material is capable of sustaining, as developed by a tension test.
- **Yield Strength:** The stress at which a material exhibits a specified deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain, and in the offset method, usually a strain of 0.2% is specified.
- **Proof Load:** The point to which a material may be stressed without evidence of permanent deformation.
- **Hardness:** The resistance of a material to plastic deformation. Usually measured in steels by the Brinell, Rockwell, or Vickers indentation-hardness test methods.

HEAT PROPERTIES

Heat treatment covers various techniques that may be used to develop certain end-product characteristics. Customary procedures for fasteners include:

- **Stress Relieving:** A thermal cycle involving heating to a suitable temperature, usually 1000/1200 °F, holding long enough to reduce residual stresses from either cold deformation or thermal treatment, and then cooling slowly enough to minimize the development of new residual stresses.
- **Annealing:** A thermal cycle involving heating to and holding at a suitable temperature and then cooling at a suitable rate, for such purposes as reducing hardness, improving machinability, facilitating cold working, producing a desired microstructure, or obtaining desired mechanical or other properties.
- **Case Hardening:** A term descriptive of one or more processes of hardening steel in which the outer portion, or case, is made substantially harder than the inner portion, or core.
- **Quenching and Tempering:** Quenching is a thermal process used to increase the hardness and strength of steel. Tempering improves ductility and toughness but reduces the quenched hardness.

ASTM & SAE HEAD MARKINGS FOR BOLTS

	ASTM—A307 GR A	• Low or Medium Carbon Steel
	ASTM—A307 GR B	• Low or Medium Carbon Steel
	ASTM—A449 GR B	• Medium Carbon Steel Quenched & Tempered
	ASTM—A193 GR B7	• Chrom-Moly Steel Quenched & Tempered
	ASTM—A325 Type 1	• Medium Carbon Steel Quenched & Tempered
	18-8 18 Chromium 8 Nickel	• “300” Series Stainless Steel Same Material as T-304
	ASTM—T 304 or ASTM F 593	• “300” Series Stainless Steel • Either Marking May Appear
	ASTM—T 316 or ASTM F 593	• “300” Series Stainless Steel • Either Marking May Appear
	ASTM—A193 Gr B8	• Solution Treated 304 - 304L Stainless Steel
	ASTM—A193 GR B8M	• Solution Treated 316 - 316L Stainless Steel

TRIPAC

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A DIVISION OF TRIPAC MARKETING, INC.

WRENCH SIZE CHARTS

This chart may be used for
HEX Bolts & Nuts A307 Gr. A, Gr. 5,
 ASTM F593/F594 Type 304 & 316

BOLT AND NUT DIAMETER	WRENCH SIZE	
1/4	7/16	0.4375
5/16	1/2	0.5000
3/8	9/16	0.5625
7/16	5/8	0.6250
1/2	3/4	0.7500
9/16	13/16	0.8125
5/8	15/16	0.9375
3/4	1 1/8	1.1250
7/8	1 5/16	1.3125
1	1 1/2	1.5000
1 1/8	1 11/16	1.6875
1 1/4	1 7/8	1.8750
1 3/8	2 1/16	2.0625
1 1/2	2 1/4	2.2500
1 5/8	2 7/16	2.4375
1 3/4	2 5/8	2.6250
1 7/8	2 13/16	2.8125
2	3	3.0000
2 1/4	3 3/8	3.3750
2 1/2	3 3/4	3.7500
2 3/4	1 1/8	4.1250
3	4 1/2	4.5000
3 1/4	4 7/8	4.8750
3 1/2	5 1/4	5.2500
3 3/4	5 5/8	5.6250
4	6	6.0000

This chart may be used for
HEAVY Hex Bolts & Nuts A307 Gr. B,
 A325, A193 B7, B8 (304), B8M (316) Stainless

BOLT AND NUT DIAMETER	WRENCH SIZE	
1/2	7/8	0.8750
5/8	1 1/16	1.0625
3/4	1 1/4	1.2500
7/8	1 7/16	1.4375
1	1 5/8	1.6250
1 1/8	1 13/16	1.8125
1 1/4	2	2.0000
1 3/8	2 3/16	2.1875
1 1/2	2 3/8	2.3750
1 5/8	2 9/16	2.5625
1 3/4	2 3/4	2.7500
1 7/8	2 15/16	2.9375
2	3 1/8	3.1250
2 1/4	3 1/2	3.5000
2 1/2	3 7/8	3.8750
2 3/4	4 1/4	4.2500
3	4 5/8	4.6250
3 1/4	5	5.0000

FLANGE BOLTING CHARTS

**AWWA C110
DUCTILE AND GRAY IRON
125/150**

**ASME/ANSI B16.1
CAST IRON
250/300**

NOM PIPE SIZE	NO. BOLTS	DIAMETER & LENGTH
2"	4	5/8 X 2 1/4
2 1/2"	4	5/8 X 2 1/2
3"	4	5/8 X 2 1/2
4"	8	5/8 X 3
6"	8	3/4 X 3 1/4
8"	8	3/4 X 3 1/2
10"	12	7/8 X 3 3/4
12"	12	7/8 X 3 3/4
14"	12	1 X 4 1/4
16"	16	1 X 4 1/2
18"	16	1 1/8 X 4 3/4
20"	20	1 1/8 X 5
24"	20	1 1/4 X 5 1/2
30"	28	1 1/4 X 6 1/4
36"	32	1 1/2 X 7
42"	36	1 1/2 X 7 1/2
48"	44	1 1/2 X 7 3/4

NOM PIPE SIZE	NO. BOLTS	DIAMETER & LENGTH
2"	8	5/8 X 2 3/4
2 1/2"	8	3/4 X 3 1/4
3"	8	3/4 X 3 1/2
4"	8	3/4 X 3 3/4
6"	12	3/4 X 4
8"	12	7/8 X 4 1/2
10"	16	1 X 5 1/4
12"	16	1 1/8 X 5 1/2
14"	20	1 1/8 X 6
16"	20	1 1/4 X 6 1/4
18"	24	1 1/4 X 6 1/2
20"	24	1 1/4 X 6 3/4
24"	24	1 1/2 X 7 3/4
30"	28	1 3/4 X 8 1/2
36"	32	2 X 9 1/2
42"	36	2 X 10
48"	40	2 X 10



**AWWA C110
MECHANICAL JOINTS
T-HEAD BOLT CHART**

NOM PIPE SIZE	NO. BOLTS	DIAMETER & LENGTH
2"	2	5/8 X 3
3"	4	5/8 X 3
4"	4	3/4 X 3 1/2
6"	6	3/4 X 3 1/2
8"	6	3/4 X 4
10"	8	3/4 X 4
12"	8	3/4 X 4
14"	10	3/4 X 4 1/2
16"	12	3/4 X 4 1/2
18"	12	3/4 X 4 1/2
20"	14	3/4 X 4 1/2
24"	16	3/4 X 5
30"	20	1 X 6
36"	24	1 X 6
42"	28	1 1/4 X 6
48"	32	1 1/4 X 6

TRIPAC FASTENERS IS A MEMBER OF THE AWWA AND HAS THE TECHNICAL EXPERTISE TO ASSIST YOU IN SELECTING THE PROPER MATERIALS FOR YOUR NEEDS. CALL OR FAX FOR QUOTES, ADDITIONAL INFORMATION, SPECIAL ORDERS OR FOR TECHNICAL ASSISTANCE.

Electromotive Series

	Potential Neg. to Saturated CuSO4 Half Cell (Volts)
*Magnesium(H-1 alloy)	1.550
*Zinc	1.106
*Aluminum (ALCLAD 3S)	1.016
Cast Iron (fresh)	.686
Carbon Steel	.686
Ni-Resist Cast Iron, 20% Ni	.616
Ni- Resist Cast Iron, 30% Ni	.566
Ni -Resist Cast Iron, 20% Ni + Cu	.536
Naval Rolled Brass	.476
Yellow Brass	.436
Red Brass	.406
G. Bronze	.386
Admiralty Brass	.366
90:10 Cu-Ni + .8% Fe	.356
70:30 Cu-Ni + .06% Fe	.346
70:30 Cu-Ni + .47% Fe	.326
Stainless Steel Type (2) 430, 17% Cr	.296
Nickel	.276
Inconel	.246
Titanium (commercial)	.226
Stainless Steel type (2) 410, 13% Cr	.226
Silver	.206
Titanium (high purity)	.176
Stainless Steel Type(2) 304, 18% Cr, 8% Ni	.156
Hastelloy C	.156
Monel	.156
Stainless Steel Type (2) 316, 18% Cr, 8% Ni, 3% Mo	.126

* These metals sacrifice themselves more easily for metals down below (ex: ss, monel)

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475 KLUG CIRCLE • CORONA, CA 92880-5406
(951) 280-4488 • FAX (951) 272-4445



*Leaders in Corrosion Prevention
and Sealing Technology.*



Presented by
Rich Varalla

History of Denso Tape

- ◆ Petrolatum Wax Tape was originally developed by Denso in London, England in 1929 for the long-term corrosion protection of steel pipe.

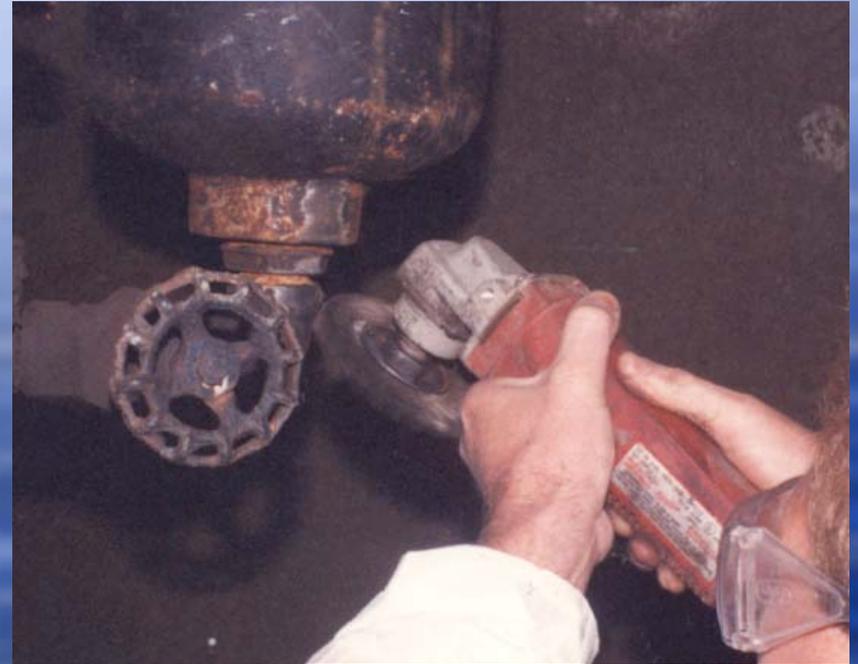
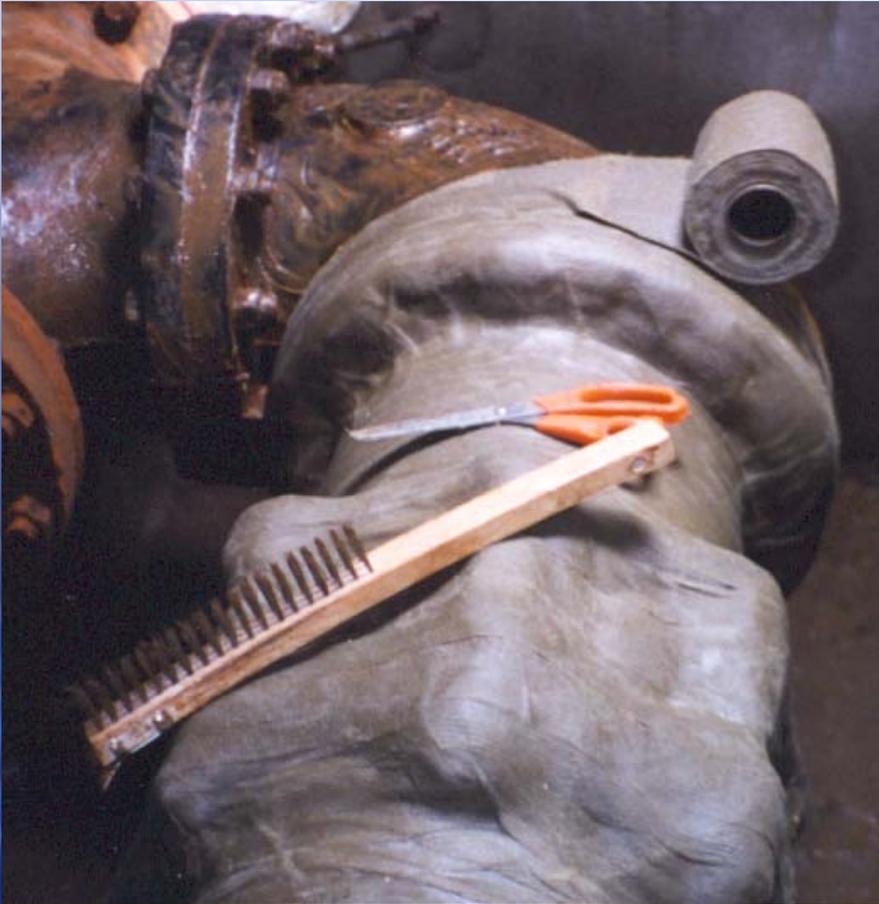
Truly surface tolerant feature allowed for easy, quick protection of buried gas lines in London that were rapidly corroding from stray electric current.

How Denso Petrolatum Tapes Work

- ◆ Densyl Tape effectively seals out water and oxygen, therefore stopping corrosion. At a minimum, it will reduce oxygen content significantly, thus greatly reducing the corrosion rate.

Features of Densyl Tape

- ◆ Can be applied to marginally prepared surfaces
- ◆ Conforms to irregular shapes and profiles
- ◆ Can be applied to cold, wet surfaces
- ◆ Meets AWWA C-217 Standard
- ◆ Contains no solvents
- ◆ Environmentally friendly
- ◆ UV stable
- ◆ Encapsulation of lead paint
- ◆ Over 80 years of proven history



Tools required for petrolatum tape application and surface preparation.

Denso Paste (petrolatum tape primer)

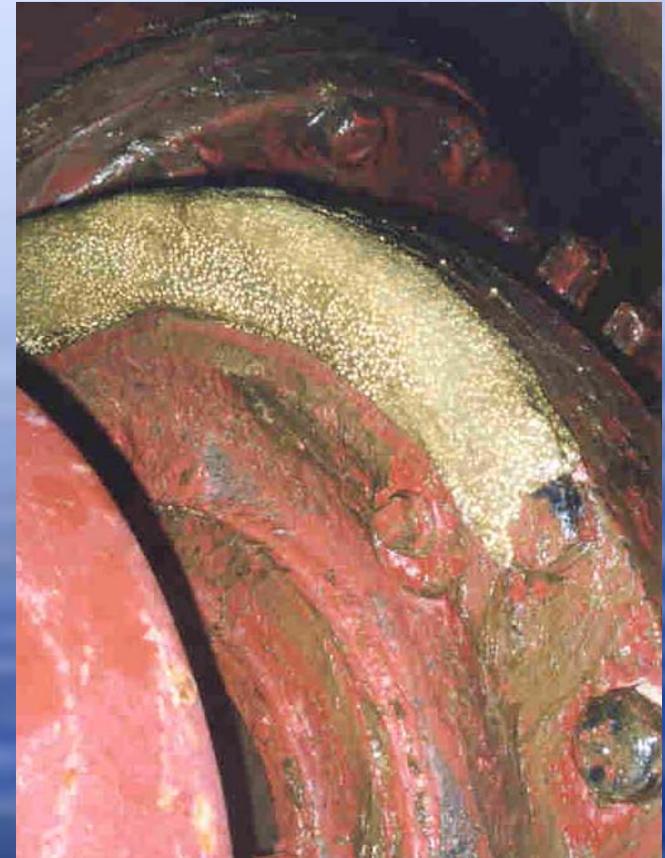
- ◆ Is a priming paste used to displace surface moisture, penetrates existing rust, fills small irregularities in surfaces, pacifies the surface and aids in adhesion for surfaces to be wrapped with Densyl Tape.



Thin Layer of
Denso Paste
applied to surface.

Denso Profiling Mastic (petrolatum molding mastic)

- ◆ Petrolatum molding mastic is a filler for areas to be Densyl taped wrapped by easing contours and filling voids on pipe joints, flanges, bolts and irregular shapes, provides a smooth profile. It is a cold applied self-supporting petrolatum molding compound



Denso Profiling
Mastic used for
irregular profiles.

El Paso Corporation



Denso Profiling and
Densyl Tape applied
to flange pair.

U.S. Navy Splash Zone Test



Pipe sample wrapped
with Densyl Tape in May
1977.



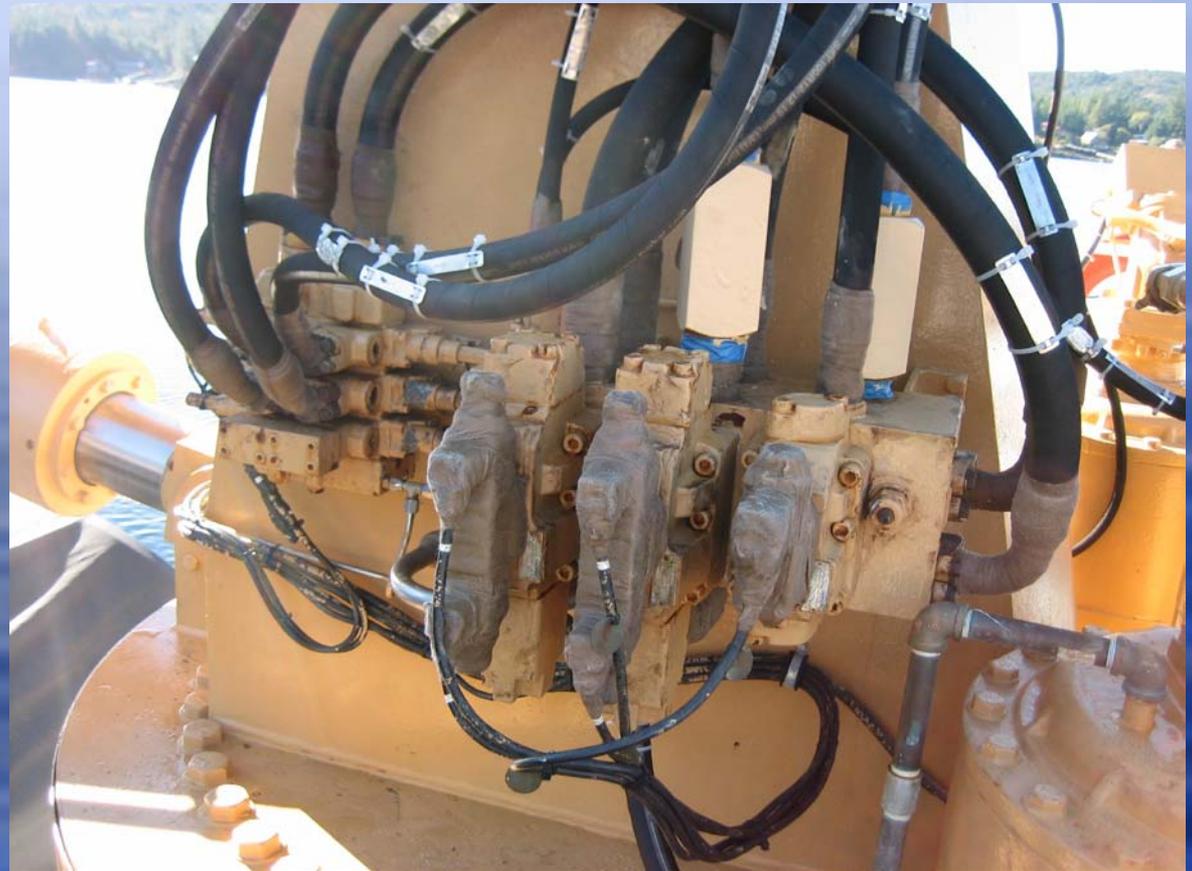
Cutting open and
inspecting in
December 1986.

U.S. Navy

Splash Zone Test



Pipe sample inspected and solvent cleaned and proved to be in excellent condition after 10 years in the splash zone.



Hydraulic fittings protected with Densyl Tape on US Coast Guard vessel.

Denver International Airport



Over 200 vaults protected with the Denso Petrolatum System.



Denver International Airport



Protection of over 200 vaults with petrolatum tape system.

Dow Pipeline



Densyl Tape applied to above-ground river crossing.

Phillips Pipeline



Wind line/ground interface protection with Densyl Tape.

Shell Pipeline - St. James, LA



Denso Paste, Densyl
Tape and Butyl 20 Tape
application.

Shell Pipeline - St. James, LA



Denso Paste, Densyl
Tape and Butyl 20 Tape
application.



Denso ColorTape -
Applied on an over ditch pipeline crossing.



Denso Petrolatum Tape System
Applied to ductile iron pipe and flanges.

U.S. Navy

San Diego, CA



Underdeck piping that has been in service for over 18 years.



Denso Petrolatum Tape System
Applied to underdeck piping.



Densyl Tape applied to cooling tower piping, valves, flanges, etc.



Before



After

Cooling tower structural steel beams protected with Denso Hi-Tack Tape.



Cooling tower structural steel beams protected with Denso Hi-Tack Tape.

US Department of Energy (DOE) Strategic Oil Reserves



Structural steel beams and columns protected with Densyl & Denso Hi-Tack Tape.

US Department of Energy (DOE) Strategic Oil Reserves



Densyl Tape & Denso Hi-Tack Tape in
service since 1999.

Denso Glass Outerwrap



Remove roll from hermetically sealed foil pouch.



Place roll in water for 20 to 30 seconds.



Spirally wrap with a 50% + overlap.

CenterPoint Energy - Houston, TX



Densyl Tape and
Glass Outerwrap on
soil to air interface.

TEPPCO Pipeline



Wind line area protected with Densyl Tape and Glass Outerwrap.





Densyl Tape being applied underwater.

LaGuardia Airport



Over 2,000 16" and 18" dia. steel piles protected with SeaShield Series 100. In service since 1991.

U.S. Navy - Nuclear Sub Facility



SeaShield Series 100 with 5052 aluminum marine grade strapping.
In service since 1998.

U.S. Coast Guard Ketchikan, AK



Steel piles protected
with SeaShield
Series 100. In service
since 1996.

U.S. Coast Guard

Ketchikan, AK



Installed **Series 100** in 2007 on bracing and piles – inspection on piles below water found to be in excellent condition after 11 years.



Exxon - Pecan Island, LA



SeaShield Series 100
in service since 1989.

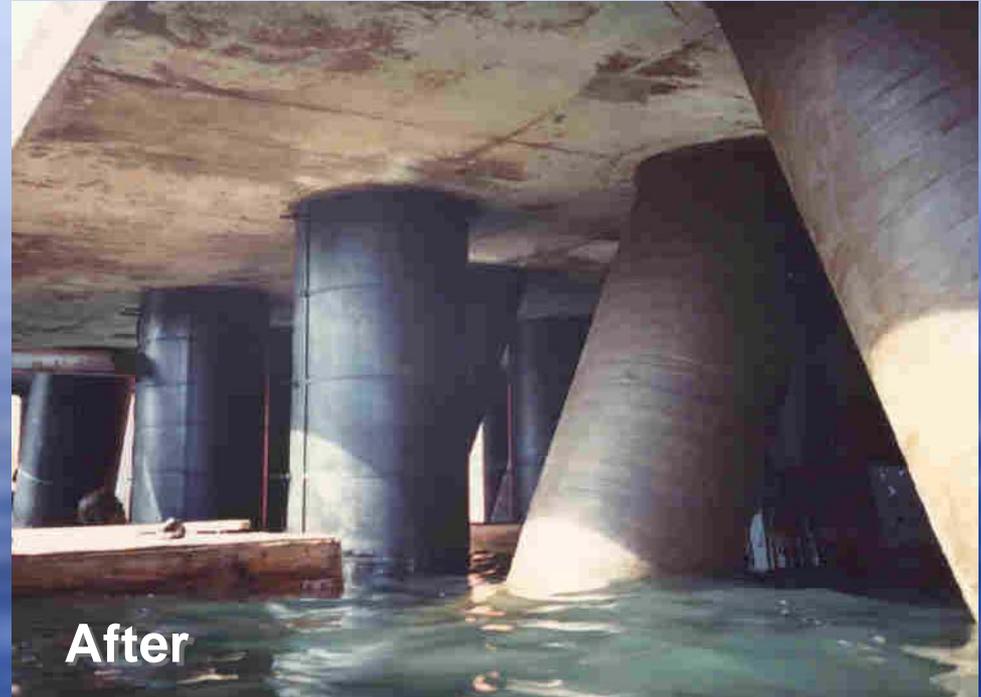
Samsung Floating Storage Facility – S. Korea



SeaShield Series 100 w/
Aluminum Outercovers

TEPPCO

Texas City, TX



SeaShield Series 100
in service since 1990.

TEPPCO- Texas City, TX



Inspection of pile after 10 years of service... no further corrosion.

BP Cherry Point - Blaine, WA



SeaShield Series 2000 HD

BP Cherry Point - Blaine, WA



SeaShield Series 2000 HD

BP Cherry Point - Blaine, WA



Installing Jacket



Ratcheting tight with air tool

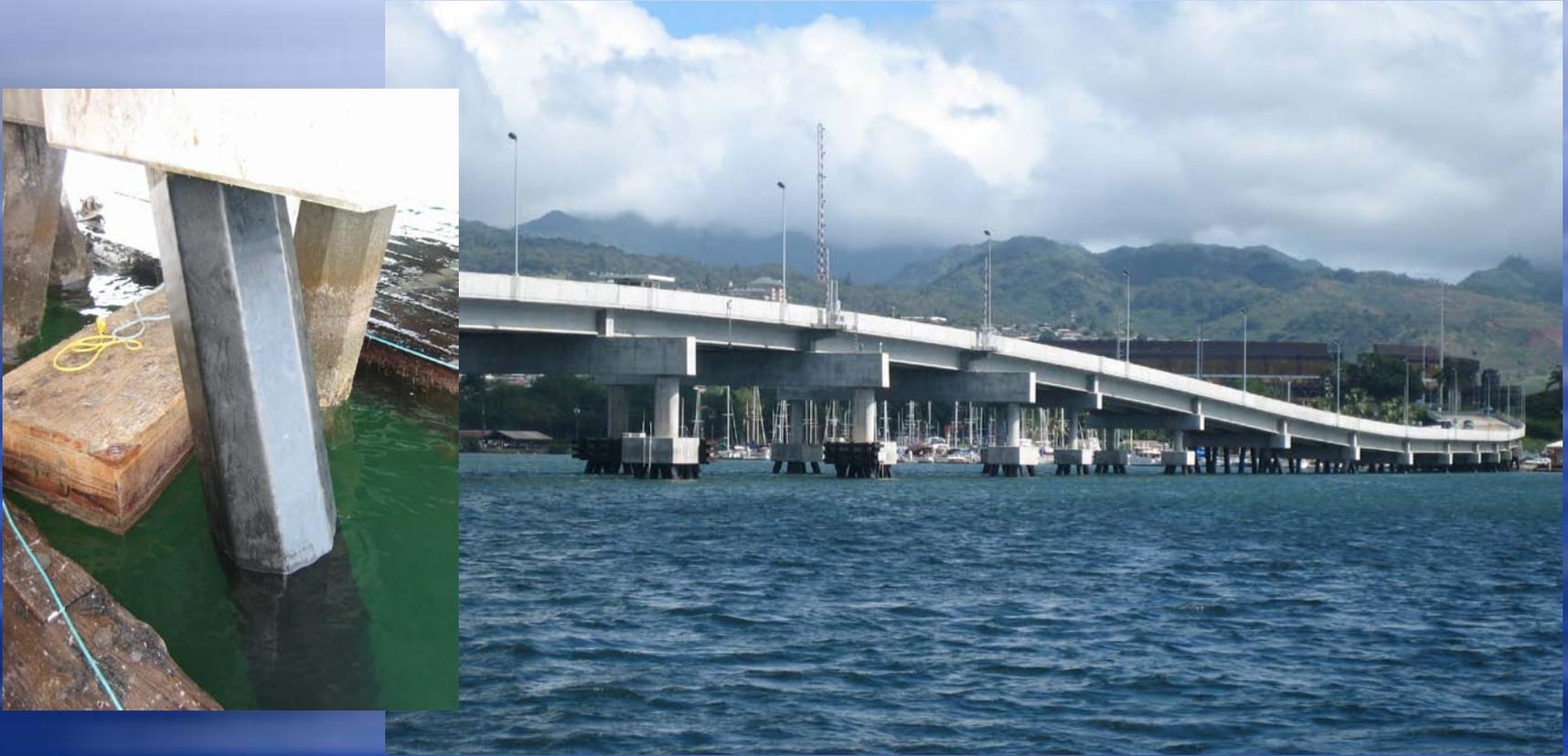
SeaShield Series 2000 HD

BP Cherry Point - Blaine, WA



SeaShield Series 2000 HD

US Navy Ford Island Bridge - Hawaii



SeaShield Series 2000 HD -
applied to octagonal concrete piles.

US Navy Ford Island Bridge - Hawaii



SeaShield Series 2000 HD -
marine petrolatum tape & jacket being applied.



Thank You

**DO'S AND DON'TS
OF TRACER
WIRE SYSTEMS
Presentation**

Rich Varalla

TRIPAC



DO'S WHEN WRITING A TRACER WIRE SPECIFICATION

- WIRE SIZE OR GAGE
- JACKET COLOR
- JACKET/COATING
- WIRE TYPES-COPPER, COPPER CLAD STEEL, STAINLESS
- PROPER CONNECTIONS
- PLACEMENT OF WIRE IN REGARDS TO PIPE
- TERMINATION METHOD FOR WIRE, TEST STATIONS



DO'S CONTUNED

- ANODE TO ENHANCE SIGNAL
- SPECIFICATION FOR OPEN DITCH
- DIRECT BURY
- PIPE BURSTING
- DIRECTIONAL BORING
- ***INSPECTION AND TESTING
UPON COMPLETION OF NEW
SYSTEM



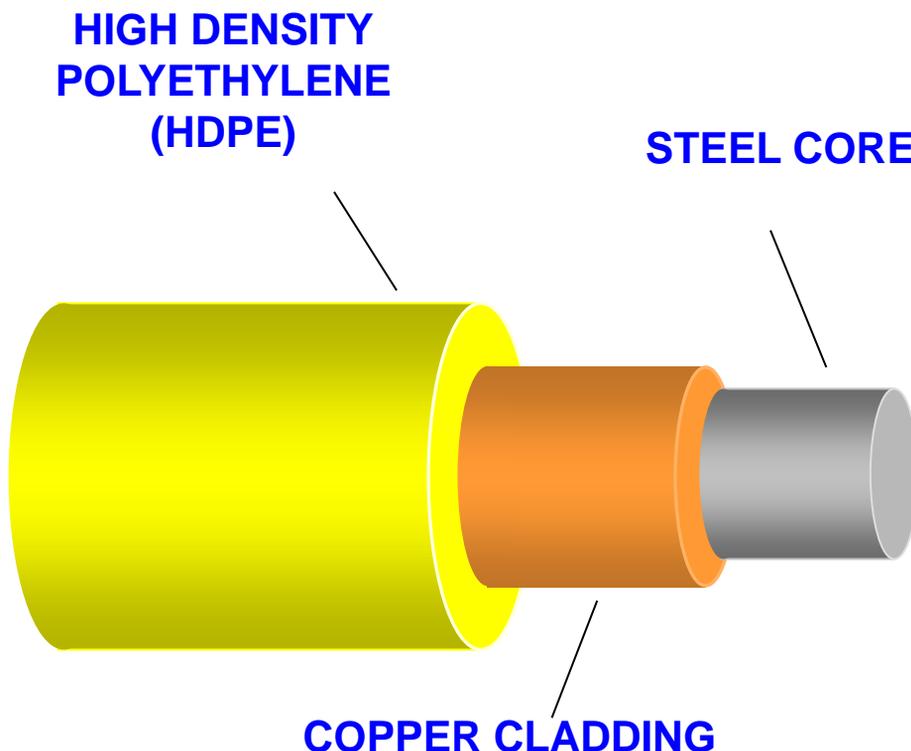
DON'TS

- WRITE A SPECIFICATION THAT IS TOO BROAD
- THHN IS NOT MADE FOR DIRECT BURY



Copperhead® Product Description

- Copperhead® Copper-Clad Steel (CCS) wire has a steel core with a copper covering. The two metals are metallurgically bonded with heat and pressure. CCS offers the strength of steel with the conductivity of copper for tracer wire applications.





Copperhead Advantages over Solid Copper

- More durable, longer lasting performance
- Twice the breaking strength of solid copper
- Reduced material cost
- More stable, longer term pricing
- Reduced threat of theft due to lack of after-market value
- Lighter weight, resulting in reduced shipping and handling costs
- Fewer breaks during installation, fewer breaks over time



Several things we need to consider when deciding on what Tracer Wire to use .

- **Color**
- **Impact Strength**
- **Corrosion Resistance**
- **Conductivity & Grounding (Anodes)**
- **Wire Gauge/AWG**



UNIFORM COLOR CODE

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials

ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

PURPLE - Reclaimed Water, Irrigation and Slurry Lines

GREEN - Sewers and Drain Lines

Impact Testing



- The Copperhead® Impact Tester was designed to simulate a shovel impact per the ASTM D5420 standard. As noted in the chart below, Copperhead® Reinforced Tracer Wire has twice the impact strength of strength of solid copper wire.
- There are several things to keep in mind when using the impact tester:
- The tester was originally designed to provide enough impact force to dramatically sever # 12 solid copper wire while leaving Copperhead wire intact (approx 60 in-lbs).

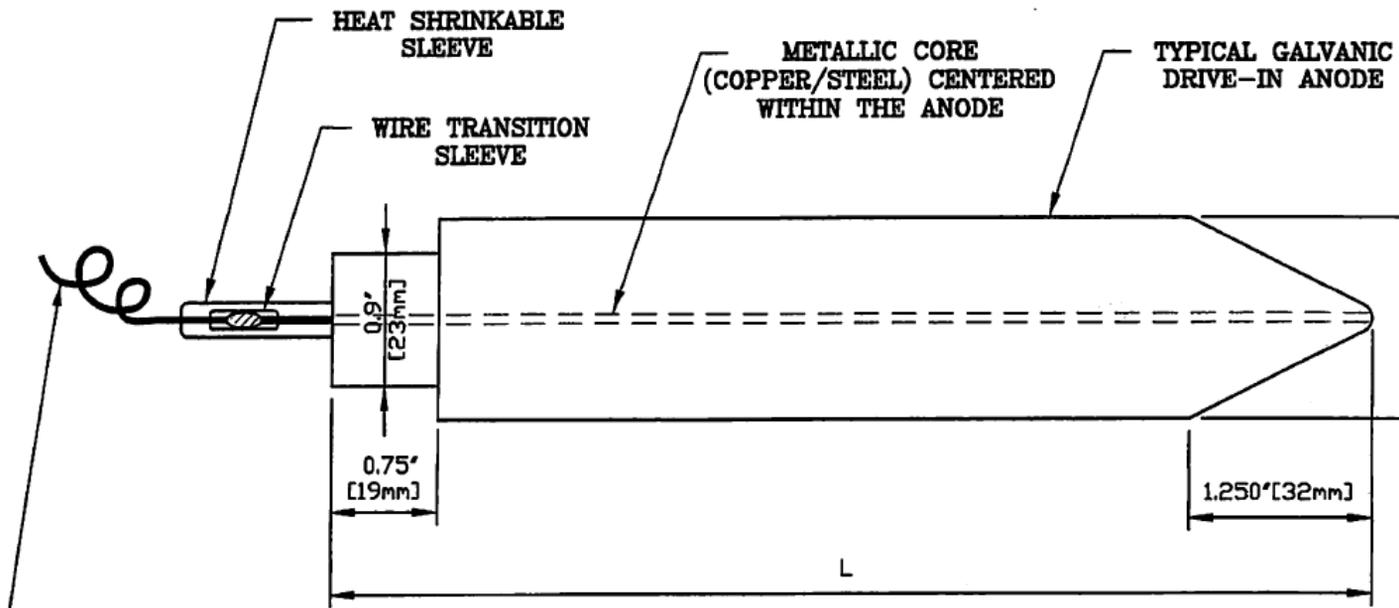
Corrosion



- Testing at Copperweld has been monitored by a comprehensive five year corrosion study by South West Research in San Antonio, Texas and the collected results audited by CC Technologies.
- Based on the test results Copperhead wire will meet and exceed utility requirements for tracer wire. The copper cladding remains completely functional with minimal corrosion.
- It should be noted that the force required to expose the steel in CCS far exceeds the force required to completely sever solid copper wire.



Grounding of your Tracer Wire System is important! Copperhead offers drive-in anodes to complete your system...



ANODE LEAD WIRE: COPPERHEAD TRACER WIRE (CUSTOMER SUPPLIED; LENGTH SPECIFIED)

- ITEM 1: #14 AWG SOLID HS WIRE C/W 30 MIL HDPE YELLOW INSULATION
- ITEM 2: #12 AWG SOLID HS WIRE C/W 30 MIL HDPE YELLOW INSULATION
- ITEM 3: #10 AWG SOLID HS WIRE C/W 30 MIL HDPE YELLOW INSULATION
- ITEM 4: #14 AWG SOLID SF WIRE C/W 30 MIL HDPE INSULATION
- ITEM 5: #12 AWG SOLID SF WIRE C/W 30 MIL HDPE INSULATION





COPPERHEAD COMPARISON SHEET

Copperhead Reinforced Tracer Wire (Copper Clad Steel) vs. Solid Copper

SIZE	#14 AWG		#12 AWG		#10 AWG	
	CCS	Solid CU	CCS	Solid CU	CCS	Solid CU
Conductor Construction	0.0641	0.0641	0.0808	0.0808	0.1091	0.1091
Conductor OD	HDPE	THHN (nylon)	HDPE	THHN (nylon)	HDPE	THHN (nylon)
Insulation Material	.030"	.012"	.030"	.012"	.030"	.012"
Insulation Thickness	.124"	0.088	.141"	0.105	.162"	0.133
Nominal OD	8.4140	2.5241	5.2954	1.5885	3.3294	0.9987
Resistance per 1000 feet (Ohms)	15.5	16.8	22	25.4	32.5	38.9
Weight per 1000 feet (lbs)	250	112	380	180	600	285
Breaking Load in lbs	42		67.4		107.5	
Impact Force in - lbs*	1430HS		1230HS		1030HS	
Copperhead Part Number	500', 1000', & 2500'		500', 1000', & 2500'		500', 1000', & 2500'	
Spool sizes available	* Measured with a falling weight (shovel simulation) tester; modeled from Gardner Impact Tester (ASTM D5420)					





Directional Drilling



SoloShot™ EHS (Extra High Strength) pulls through the first time, every time!

Minimize costly re-bores due to tracer wire breakage with SoloShot EHS, the reinforced directional drilling tracer wire.



Made specifically to withstand the rigors of directional drilling!

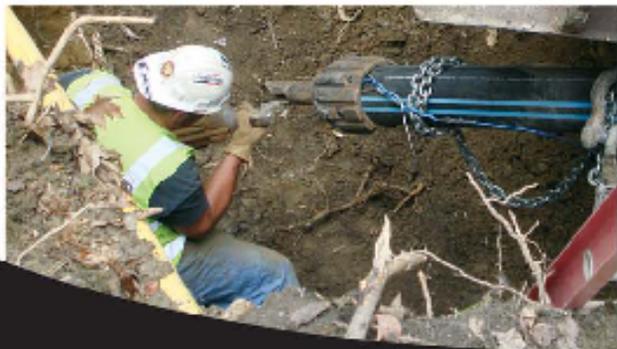
Broken tracer wire means expensive re-boring. SoloShot EHS is a reinforced composite tracer wire that has been tested to have **6 times the breaking strength of solid copper wire** in directional drilling applications. A special metallurgical process bonds the high-strength, high-carbon steel core to a layer of copper, which provides corrosion resistance and conductivity. This is covered with tougher, more durable, high density polyethylene insulation.

Copper
Steel Core
High Density Polyethylene (HDPE)

The result is a composite tracer wire that is both more cost effective and more reliable!

- 6 times the break load of solid copper, which practically eliminates costly re-bores
- Minimal re-bores means reduced material/time costs
- Weighs less, which means reduced shipping costs
- Reduced threat of theft due to virtually no after-market value

See performance comparison chart on back



SoloShot

COPPERHEAD INDUSTRIES, LLC

Pulls through the first time, every time!



www.copperheadwire.com

Copperhead Industries, LLC
P.O. Box 1081, Monticello, MN 55362
Ph: 877-726-5644 • Fx: 763-271-3694

Copperhead

INDUSTRIES, LLC

Copperhead® SoloShot™ Directional Drill Wire

- In the past, directional drill operators installing plastic pipe were required to pull back multiple strands of copper or costly stainless steel for locating wire. Copperhead Industries SoloShot™ Extra High Strength tracer wire was developed specifically to address this problem. Copperhead's EHS wire is about 1/2 the cost and has virtually the same tensile strength as Stainless

DIRECTIONAL DRILL WIRE COMPARISON

AWG	Break Load (lbs)	Spool Weight per 1000 ft (lbs)	Insulation Thickness (mil)
#12 solid copper	180	29.4	30
#10 solid copper	285	40.5	30
#12 stainless steel	1,200	40.0	45
Copperhead #12 SoloShot™	1,150	26.5	45





Pipe Bursting



*PipeBursting 6" HDPE
Replacing 6" Ductile
Iron Minnetonka
Minnesota May 2009*



*PipeBursting New
6" HDPE replacing 6"
ductile iron*



Not Good Practice





Designed for use with tracer lines, the SnakeBite Direct Bury Lug eliminates the need to cut the main line and installs in less than a minute. Instructions: 1. Strip $\frac{1}{4}$ " jacket off main to tap conductor. 2. Place stripped conductor into slotted lug. 3. Turn till screw makes contact with wire, turn an additional $\frac{1}{4}$ turn or 35lb-In. 4. Repeat on lateral run(s). 5. Remove sealant cover and discard. 6. Close housing, aligning conductors until housing lid is fully latched.

PRODUCT SPECIFICATIONS & MEASUREMENTS Max. Voltage: 50V Connector Size: 1.138" x 1.285" Wire Range: #14-10 solid and stranded copper, #12 steel core tracer wire (380 and 1150 pound) Silicone Sealant Temperature Rating: -45°F to 400°F. Part # CHSCB01

SnakeBite Splicer instructions: 1. Strip wires $\frac{1}{2}$ ". 2. Align conductors. 3. No-pre-twisting needed, hold stripped wires together with even ends. 4. Push wires firmly into connector when starting. 5. Twist connector onto wires pushing firmly until tight.

PRODUCT SPECIFICATIONS & MEASUREMENTS: Max. Voltage: 600V (1,000V in fixtures and signs) Connector Size: 13/16" x 2" Wire Type: Copper/Steel core tracer wire Range: Min #22/Max #8 Temperature Rating: 75°C (167°F) Silicone Sealant: -45°F to 400°F Max 4- #12 wires. Part # CH10666



Copperhead Industries, LLC – P.O. Box 1081– Monticello, MN 55362 Ph (877)-726-5644 Fax (763)-271-3694





No need to remove jacket!

**Connector
Enclosed
with
Moisture
Displacement
Silicone**





This is why we
recommend
SnakePits

Tracer wire





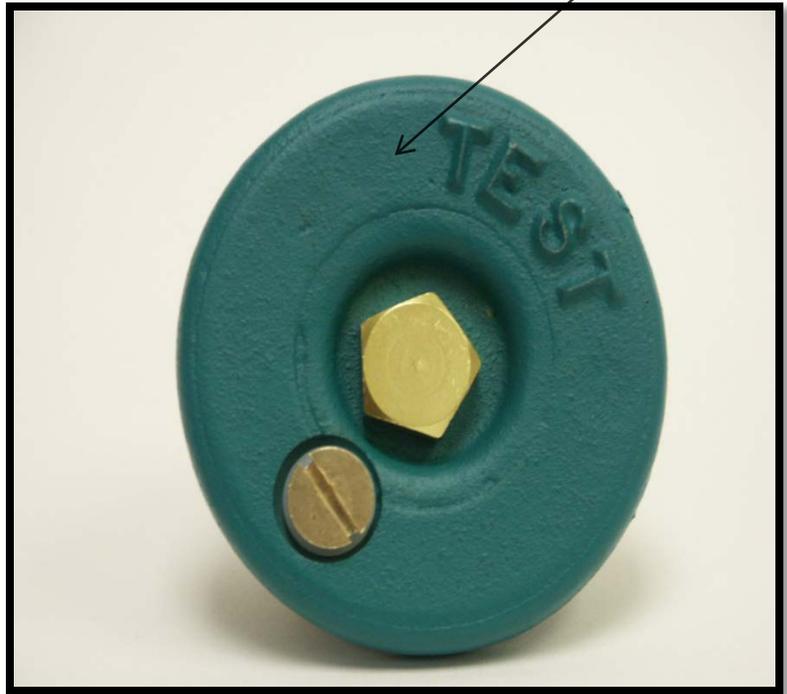
Tracer
Wire

Savanna Georgia

Features

- **Color Coded Cast Iron Lids**

- Conforms to APWA Uniform Color Code
- Instant identification of utility your are tracing



Green= Sewer & Drain Lines

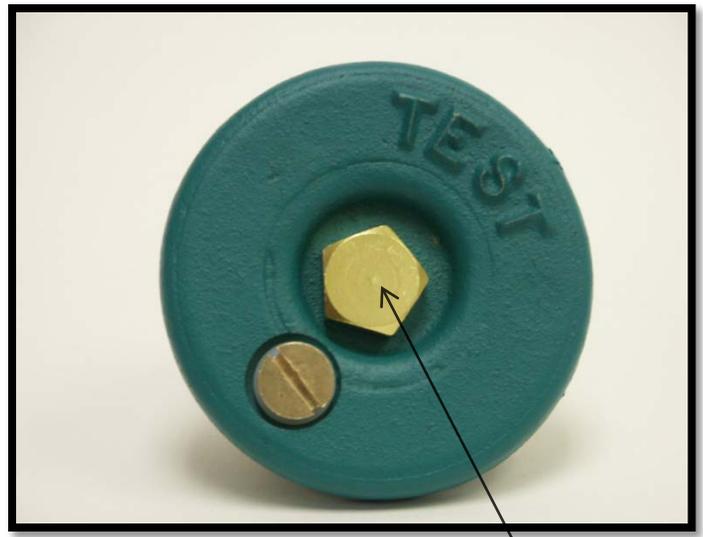
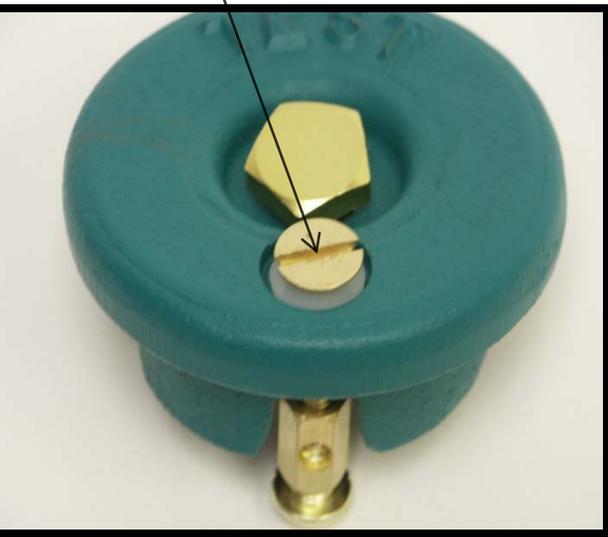
Magnet

- Amplifies signal
- Quickly locate box even if buried



Insulated Direct Connection

Never remove lid! Lug is connected to **isolated** brass tracer wire lug underground. Sound corrosion resistant connection underground for long lasting traceability. Hook up transmitter and away you go!



Tamper Resistant Pentagon Nut





Open Cut Applications

Copperhead High Strength Tracer Wire Part# (1430B HS-*)

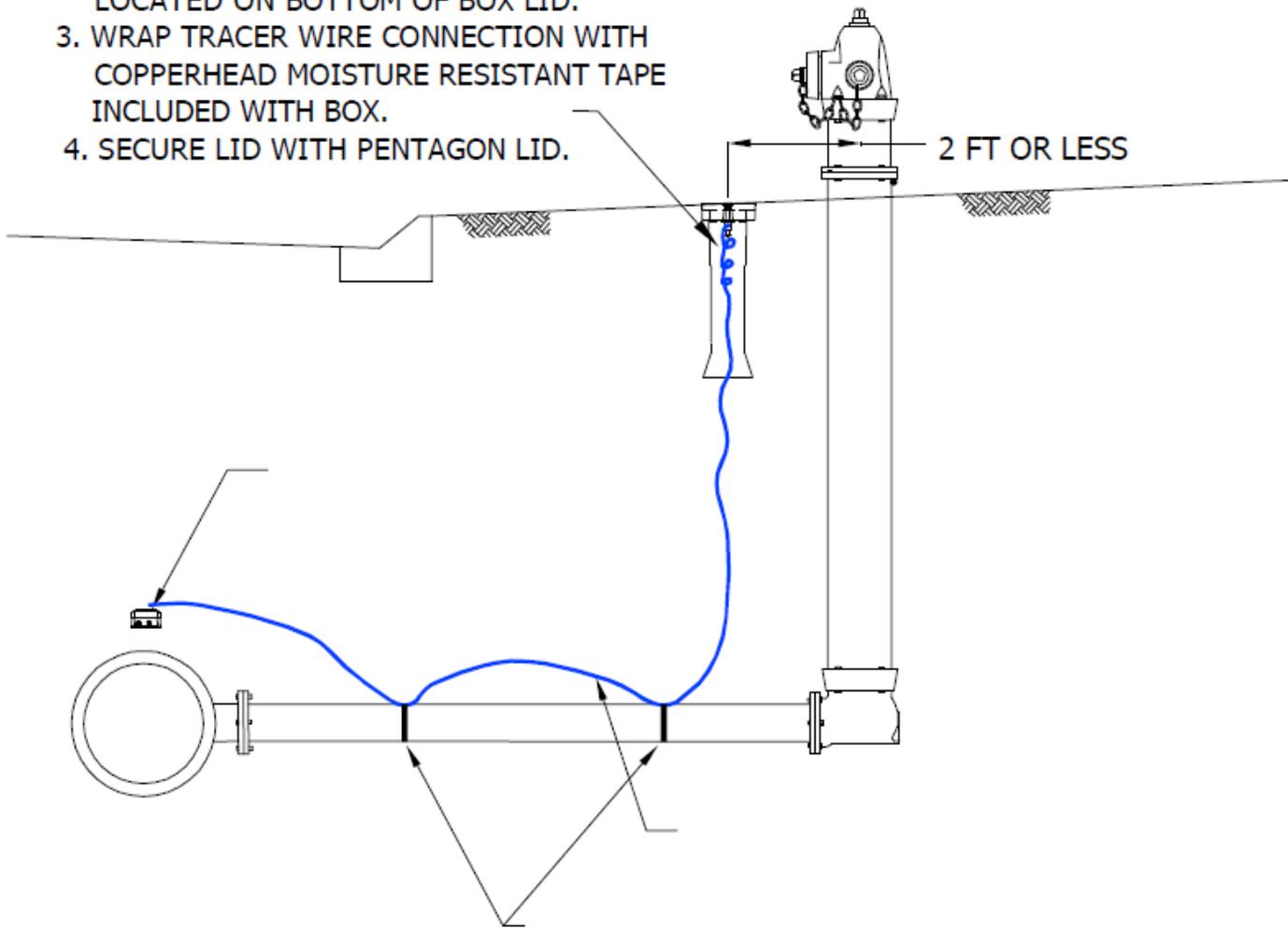
*=Spool Size- 500', 1000', 2500'

Tracer wire shall be a #14 AWG HS-CCS high-strength copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. HS-CCS conductor must be a 21% conductivity for locatability purposes, Break load 250# minimum. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Tracer wire shall be Copperhead™ HS-CCS HDPE 30 MIL or Pre-Approved equal and made in the USA.



COPPERHEAD SNAKEPIT MAGNETIZED TRACER BOX

1. CURL 18"-24" EXTRA TRACER WIRE IN BOX.
2. CONNECT COPPERHEAD TRACER WIRE TO BRASS TERMINAL LOCATED ON BOTTOM OF BOX LID.
3. WRAP TRACER WIRE CONNECTION WITH COPPERHEAD MOISTURE RESISTANT TAPE INCLUDED WITH BOX.
4. SECURE LID WITH PENTAGON LID.



COPPERHEAD #12 AWG WITH HDPE INSULATION,
ANCHOR TRACER WIRE ON TOP CENTER



1-719-668-8799



Colorado Springs Utilities
It's how we're all connected



COPPERHEAD TRACER SYSTEM FOR FIRE HYDRANT

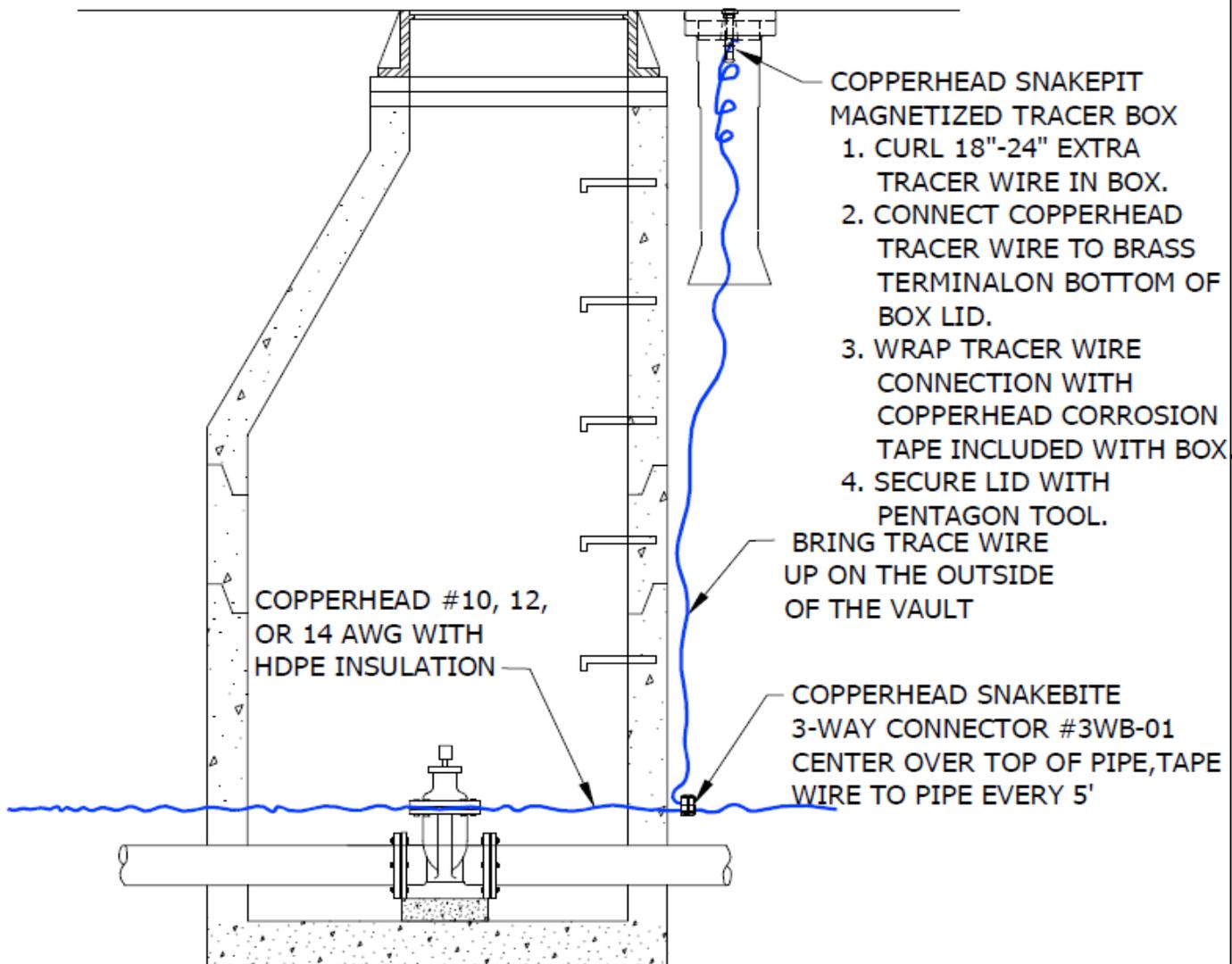
STANDARD DETAILS

COLORADO SPRINGS

Last Revision:
OCT. 2008



2 FT OR LESS



1-877-726-5644



Colorado Springs Utilities

It's how we're all connected

COPPERHEAD TRACER SYSTEM FOR MANHOLE

STANDARD DETAILS

COLORADO SPRINGS

Last Revision:
OCT. 2008



2 FT OR LESS

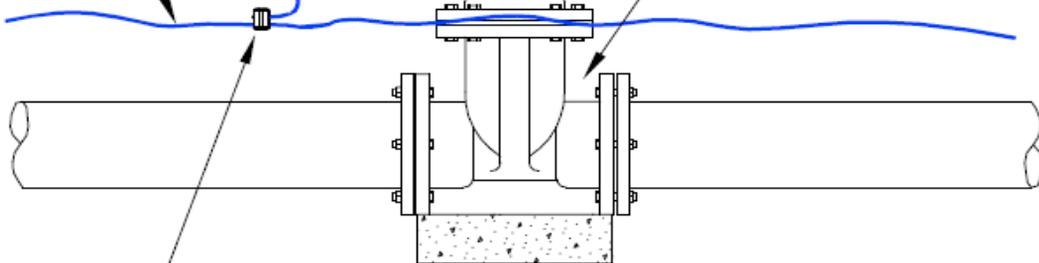


**COPPERHEAD SNAKEPIT[®]
MAGNETIZED TRACER BOX**

1. CURL 18"-24" EXTRA TRACER WIRE IN BOX.
2. CONNECT COPPERHEAD TRACER WIRE TO BRASS TERMINAL ON BOTTOM OF BOX LID
3. WRAP TRACER WIRE CONNECTION WITH COPPERHEAD CORRIOSION RESISTANT TAPE INCLUDED W/ BOX.
4. SECURE LID WITH PENTAGON TOOL.

COPPERHEAD #10, 12,
OR 14 AWG JACKETED WITH
HDPE INSULATION

GATE VALVE



**COPPERHEAD SNAKEBITE
3-WAY CONNECTOR #3WB-01**
CENTER OVER TOP OF PIPE, TAPE WIRE CENTER TOP
OF PIPE EVERY 5'



Colorado Springs Utilities

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1-719-668-8799



COPPERHEAD TRACER SYSTEM FOR GATE VALVE

STANDARD DETAILS

COLORADO SPRINGS

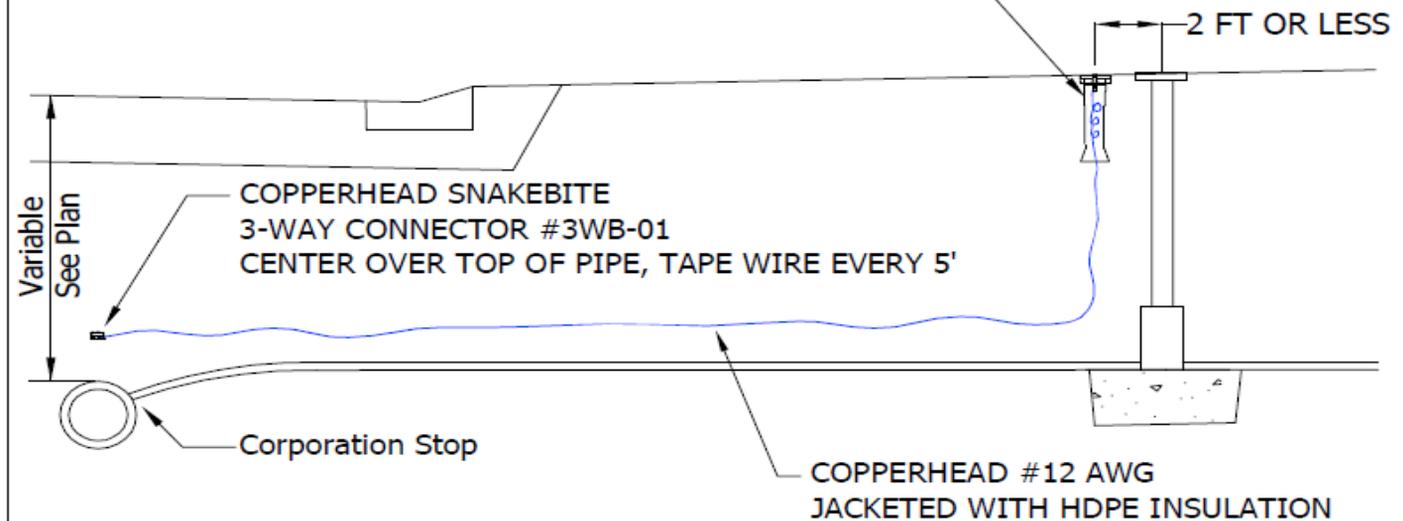
Last Revision:
OCT. 2008





COPPERHEAD SNAKEPIT[®] MAGNETIZED TRACER BOX

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4. SECURE LID WITH PENTAGON TOOL.



Colorado Springs Utilities

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1-719-668-8799



APWA UNIFORM COLOR CODE		
■	RED	[electric]
■	YELLOW	[gas]
■	ORANGE	[communication]
■	BLUE	[potable water]
■	GREEN	[sewer]
■	PURPLE	[reclaimed water]

**COPPERHEAD TRACER SYSTEM
FOR WATER SERVICE/CURB BOX
STANDARD DETAILS**

COLORADO SPRINGS

Last Revision:
OCT. 2008





Colorado Springs Utilities

It's how we're all connected

APWA UNIFORM COLOR CODE

	RED	— [electric]
	YELLOW	— [gas]
	ORANGE	— [communication]
	BLUE	— [potable water]
	GREEN	— [sewer]
	PURPLE	— [reclaimed water]

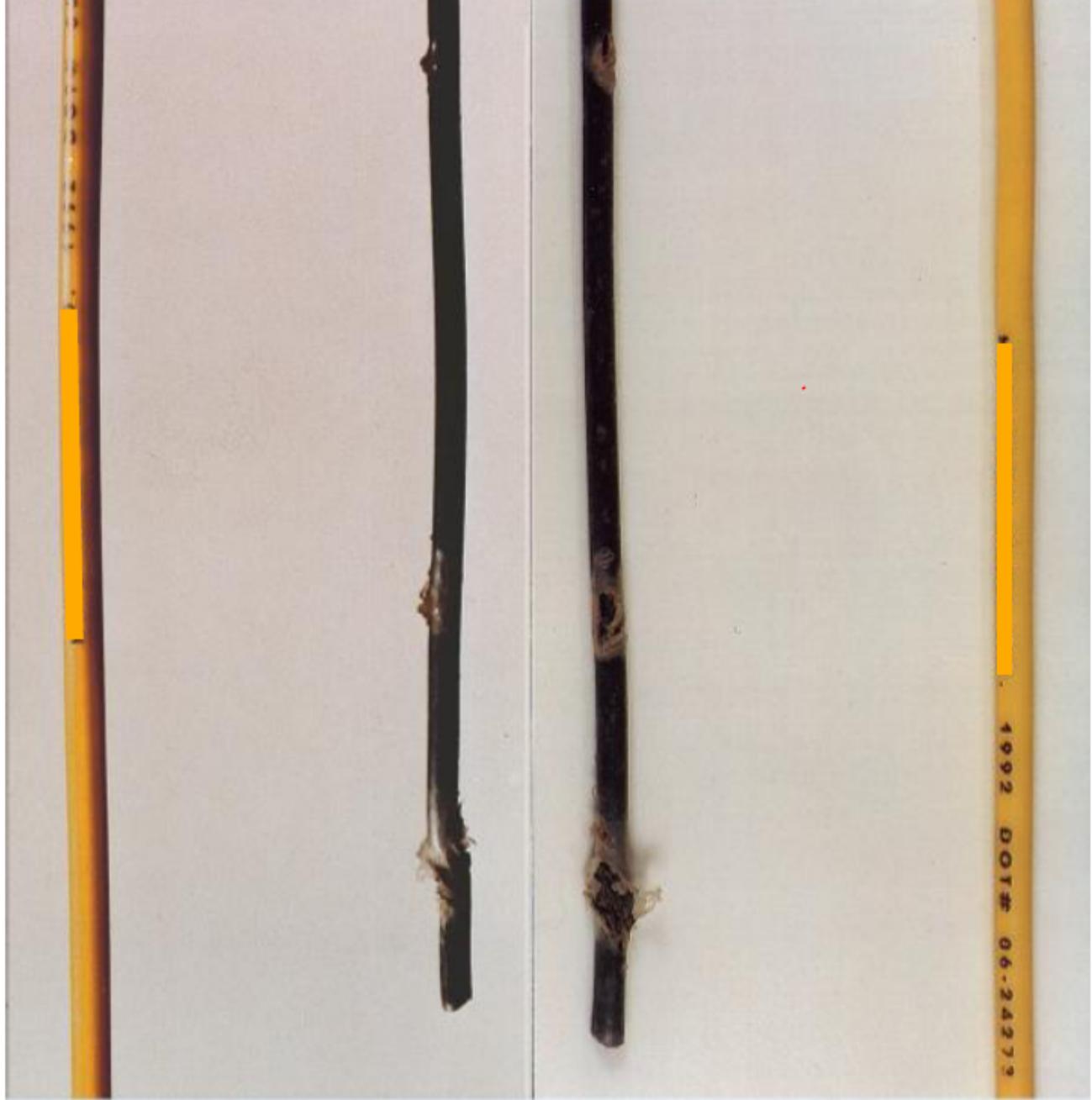
Tracer Wire System Notes:

1. Tracer wire to be Copperhead® Steel Core Copper Wire #10, 12 or 14 AWG, with High Density Polyethylene coating.
2. Tracer wire shall be brought to the surface by Fire Hydrants, Curb boxes and Manholes/Vaults and connected to SnakePit® Magnetized Tracer Boxes. Optional Tracer wire Curb Box termination kits, part #CBC-01, can be used.
3. Wire to be #10, 12 or 14 AWG continuous strand. If wire splicing is absolutely avoidable, use Copperhead SnakeBite® Splicer filled Moisture Displacement Silicone for Corrosion Resistant Protection, part #SCB-01.
4. Tracer wire shall be installed over all waterlines, and Sewer Force mains and laterals whether or not telemetry wire is buried with the pipe.
5. For Pipe Depths greater than 8' Tracer wire shall be placed centerline above pipe at max 8' depth.
6. Contractor shall schedule a Conductivity/Locate Test (Conducted by City) upon completion.
7. Termination box will be SnakePit® Magnetized Tracer Box with Anti Corrosion Technology, Ease of Locate ability, Exterior Direct Connection Point, and Tamper Proof Cover. (Lite Duty Box #LD14, Lite Duty Adjustable #LD14-A, Roadway Box #RB14, Concrete/Driveway Box #CD14, Lite Duty XL Box #LDXL36) Add "B" for blue lid (Water), "G" for green (Sewer), "P" for purple (Recl
8. Loop 18-24 inches of wire inside SnakePit® install within two feet of Hydrant, Curb Box, or Manhole/Vault.
9. 3-Way wire Connections from main to Hydrant, Valve Box or Manhole/Vault will be made with SnakeBite® Direct Bury Connector with Moisture Displacement Silicone filled Cap for Corrosion Resistant Protection. Part #3WB-01.
10. If directional drilling or boring is required, only Copperhead® Extra High Strength (EHS), #1245B with 45 mil High Density Polyethylene (HDPE) jacket

**St Paul Minnesota
residential location of
natural gas line
directionally drilled
through 50 year old
Sewer Lateral**







HDPE

THHN

THHN

HDPE

THHN (Thermoplastic High Heat-resistant Nylon) Coated vs. HDPE (High Density Polyethelene) Coated

Tracer wire coating reactions after 24 months in ground.

Get the skinny: tracer/locating wire vs. THHN

Tracer wire (also known as locating wire) is without question an underrated and underused product. Used mainly by gas, water, fiber-optic, and sanitation companies, its main use is for locating buried plastic pipes and fiber optics. Many contractors will mistakenly use THHN for this function, although this is a poor choice for many reasons.

Many times plastic pipes or fiber optics are buried underground, leading to houses and buildings due to their strong flexibility under adverse conditions such as excess heat or cold, rainstorms, etc. When one of these are used underground, you must have a wire that is durable, flexible, and has strong insulation side-by-side with the plastic pipe or fiber optics in case you ever need to locate them (hence the name locating wire).

Potential problems

Imagine there is a gas leak of some kind. The gas company will have to dig up the pipe in order to find the exact location of the problem. Here is where THHN is potentially problematic.

THHN does not have the insulation necessary to hold up over time. Typical underground installations are expected to last up to 30 years. Nylon, the main covering of THHN, is very susceptible to water and moisture, causing additional breakdowns in the wiring under adverse conditions. All of

these will cause THHN to wear down and erode, rendering itself useless over the course of several years. In all likelihood, THHN will often need to be replaced once or twice over the course of a building project's life span.

This is where tracer wire comes into play. With 30 MIL of Polyethylene, tracer wire has all the flexibility of THHN, but with far better insulation and protection against underground conditions. Polyethylene offers a very strong insulation, often double or even triple that of THHN, meaning it can withstand even the toughest of underground conditions. Just as important, companies will save thousands of dollars and hundreds of valuable labor hours because they will not have to dig up and replace the locating wire the way they will with THHN.

The only real case for using THHN for direct burial (even though it is not rated for it) is that it is inexpensive. However, when you consider future costs to repair and replace THHN, over the long haul costs often end up skyrocketing. In addition, tracer wire/locating wire is much more durable than you may have been led to believe.

Even with all the added benefits, tracer wire costs a mere fraction more than THHN, with a tremendous savings in terms of increased insulation, heat-resistance, and durability. For example #14 THHN may run around \$25/MFT. Tracer wire/locating wire would likely run only in the \$10-\$30/MFT range, a terrific investment given its substantial benefits. Tracer wire can save fiber-optic, gas, water, and sanitation companies thousands of dollars in not only the replacement of wire, but also valuable time and energy in the form of labor hours and wasted material. With the wire's increased durability over 30-plus years in an underground setting, it is by far the better choice over the long haul for any underground wiring project. ◆



After two years underground, buried THHN (bottom) shows much deterioration. The PE insu-

Author ID.

TED
THE ELECTRICAL DISTRIBUTOR MAGAZINE

This special product section is provided by The Electrical Distributor Magazine

Thank You!

QUESTIONS



Yakima, Washington
May 3, 2012

Tulalip Water Pipeline Project: Trenchless Design and Construction of a Major Water Transmission Pipeline



Daniel R. Williams, P.E.
Gregory S. Harris, P.E.



MWH

BUILDING A BETTER WORLD

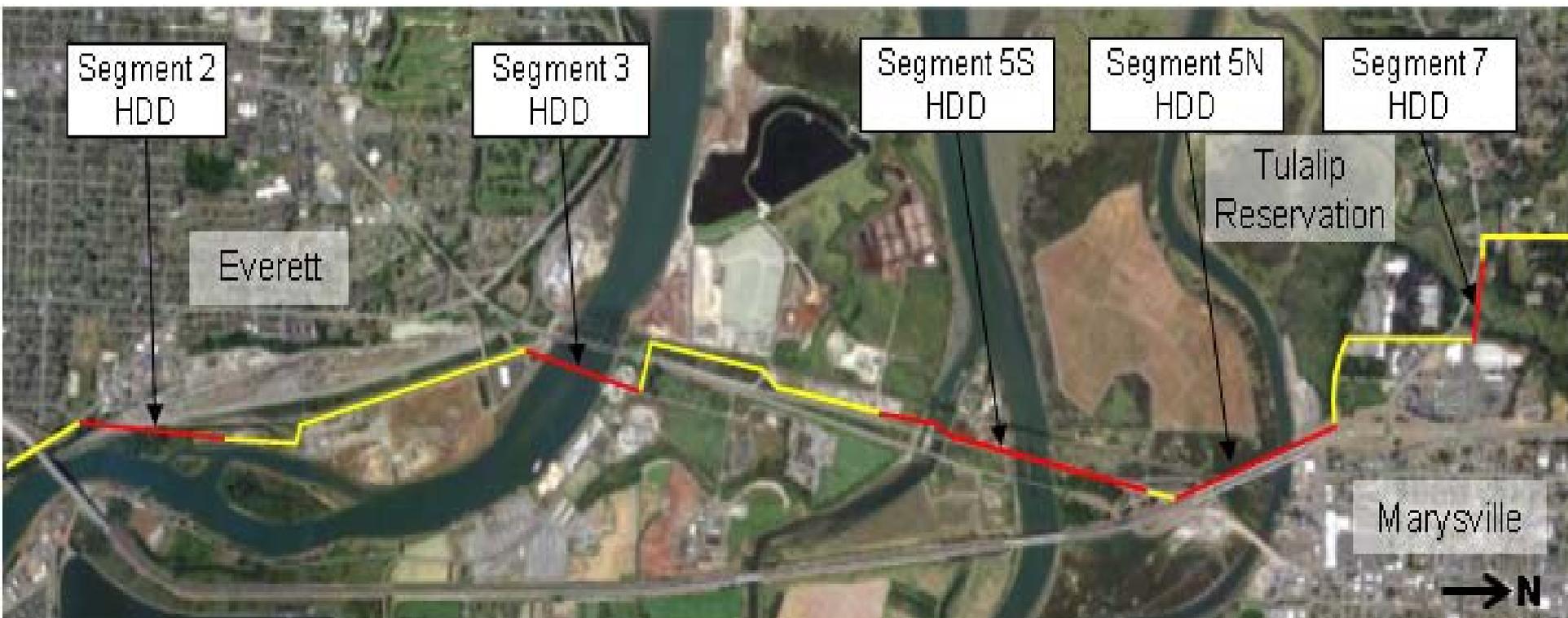
Introduction

Tulalip Water Pipeline Project

- 7.6 miles long
- 36-inch and 48-inch-diameter welded steel pipe
- Crosses underneath Railroad Yard and River Delta
- Five trenchless (HDD) crossings:
 - Segment 2 – BNSF RR Yard – 2,040 feet
 - Segment 3 – Snohomish River – 2,000 feet
 - Segment 5S – Union & Steamboat Sloughs – 3,680 feet
 - Segment 5N – Ebey Slough – 2,760 feet
 - Segment 7 – Quil Ceda Creek – 1,200 feet

Overview – Tulalip Water Pipeline Project

- 12,000 feet of 36-inch Steel HDD installation
- 20,600 feet of 48-inch Steel open Cut installation
- 7,500 feet of 30-inch DI open cut installation



Current Status

Tulalip Water Pipeline Project

- Segment 1 – Design expected to begin this year
- Segment 2 – Design expected to begin this year
- Segment 3 – Under Construction
- Segment 4 – Final design/bidding expected this year
- Segment 5 – Under Construction
- Segment 6 – Complete
- Segment 7 – Complete
- Segment 8 – Complete

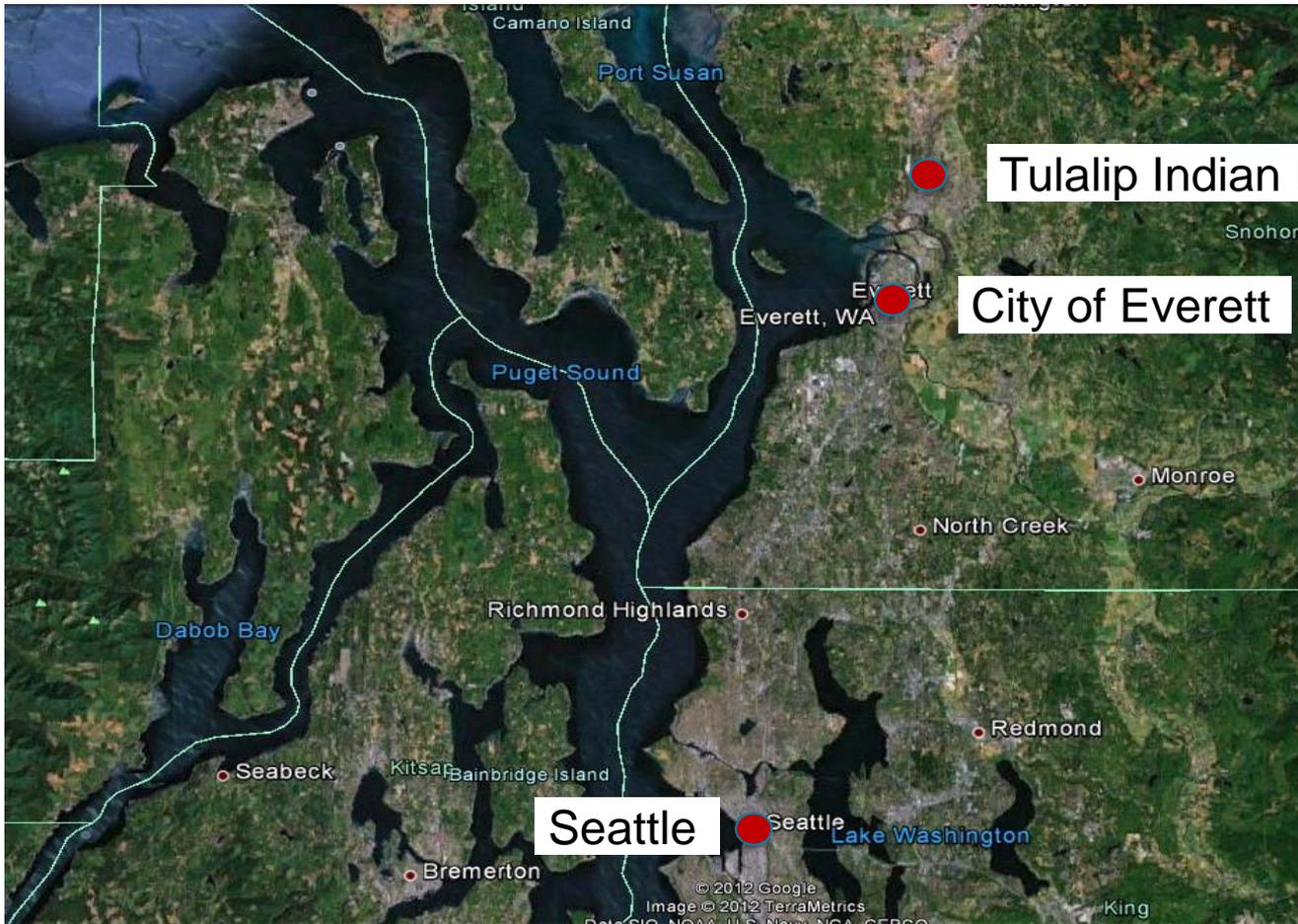
S1 – 6,000 feet of 48" OC

S2 – 2,040 ft of 36" HDD

5,700 ft of 48" OC

S4 – 4,600 ft of 48" OC

Project Location



Project Partners -- Everett

City of Everett, Washington

- 25 miles north of Seattle
- Population 104,000
- Large Regional Water Purveyor
- Owns and Operates
 - Two Surface Water Reservoirs
 - Water Treatment Plant
- Regional Water Supply System can deliver 200+ MGD

Project Partners – Tulalip Tribes

Tulalip Indian Reservation

- 32 miles north of Seattle
- Growing population of 4,000 members
- 3,000 members reside within Reservation boundaries
- 7,600 non-members reside within Reservation boundaries
- Capacity of groundwater aquifer is limited
- Demand for Everett Water (through Marysville) will soon exceed Supply Allocation

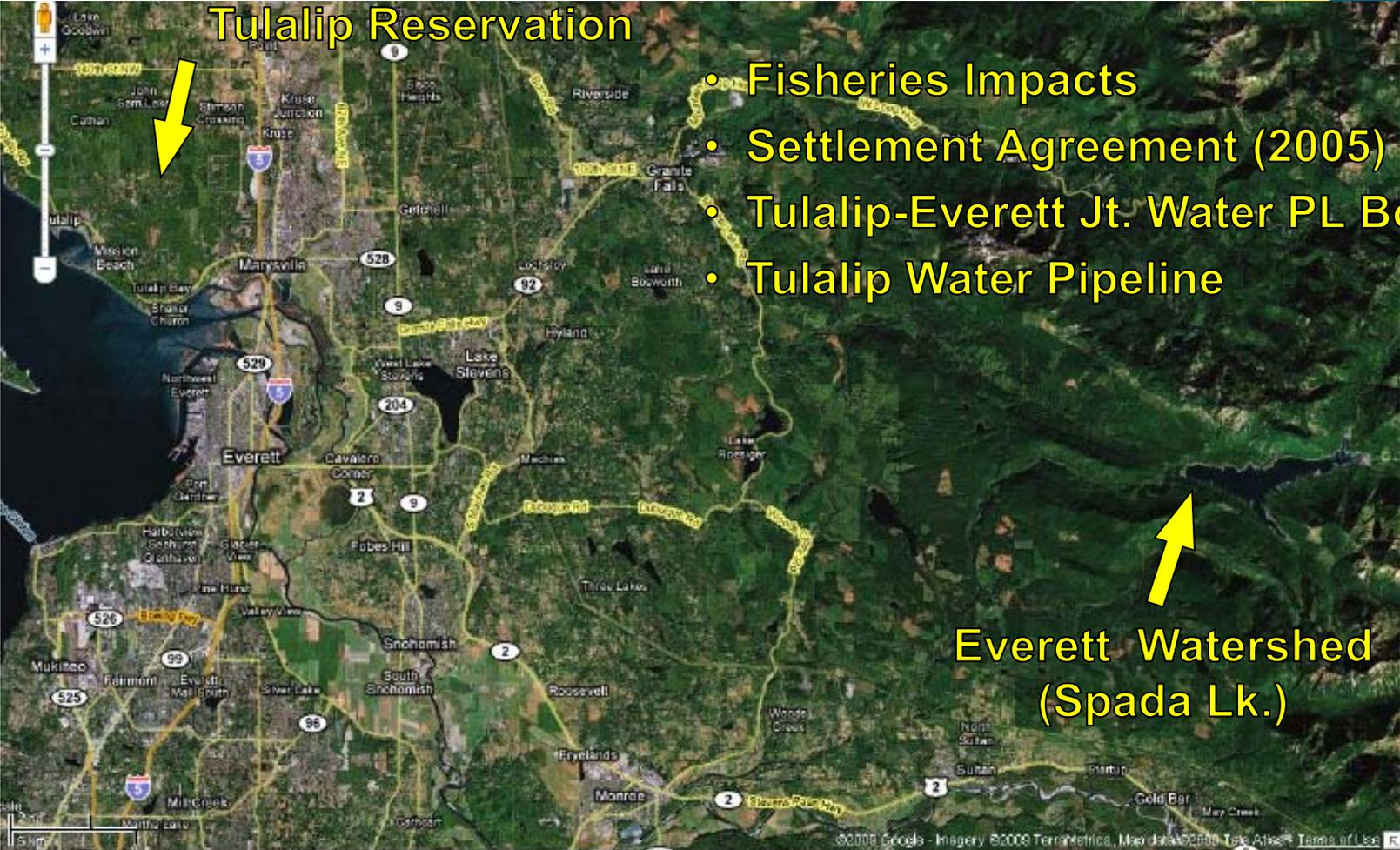
Project Partners – Joint Board

Tulalip-Everett Joint Water Pipeline Board

- Design Water Transmission Pipeline known as *Tulalip Water Pipeline*
- Serve long-term needs of the Reservation
- Serve Everett's Smith Island (small portion)
- Ensure permanent 36 MGD water supply
- Meet Reservation demands for next 50 to 100 years

PRE-DESIGN / DESIGN

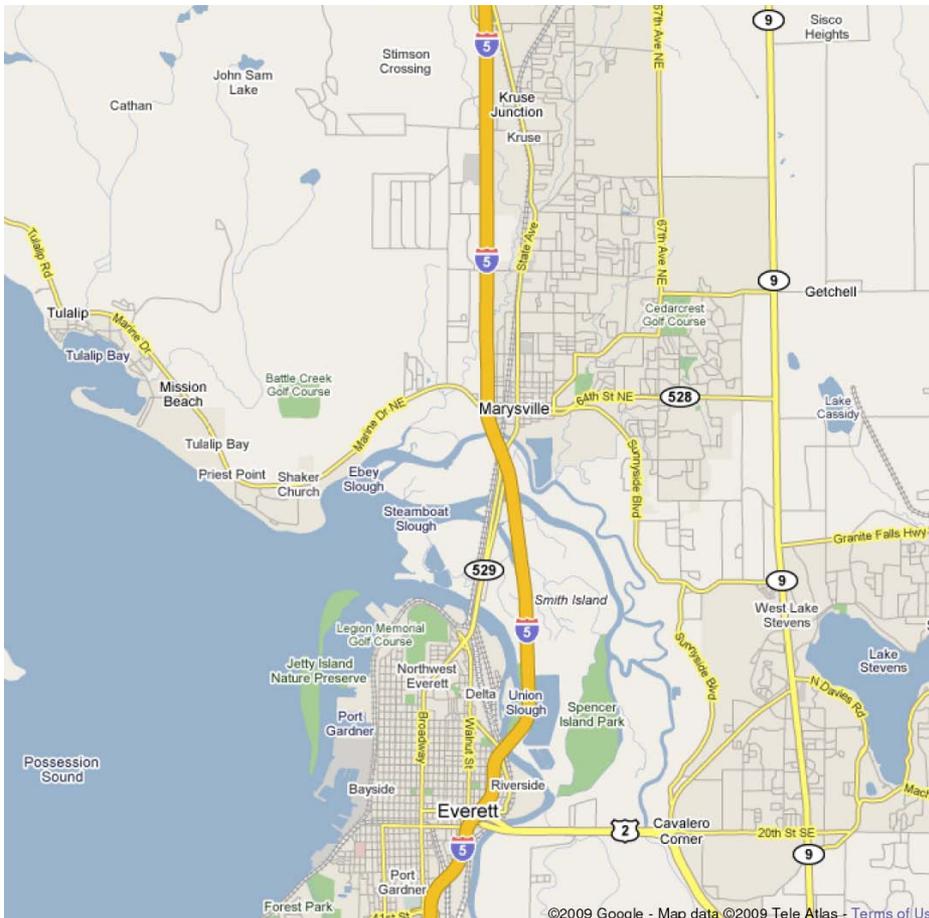
Project Background



- Fisheries Impacts
- Settlement Agreement (2005)
- Tulalip-Everett Jt. Water PL Board
- Tulalip Water Pipeline

Everett Watershed
(Spada Lk.)

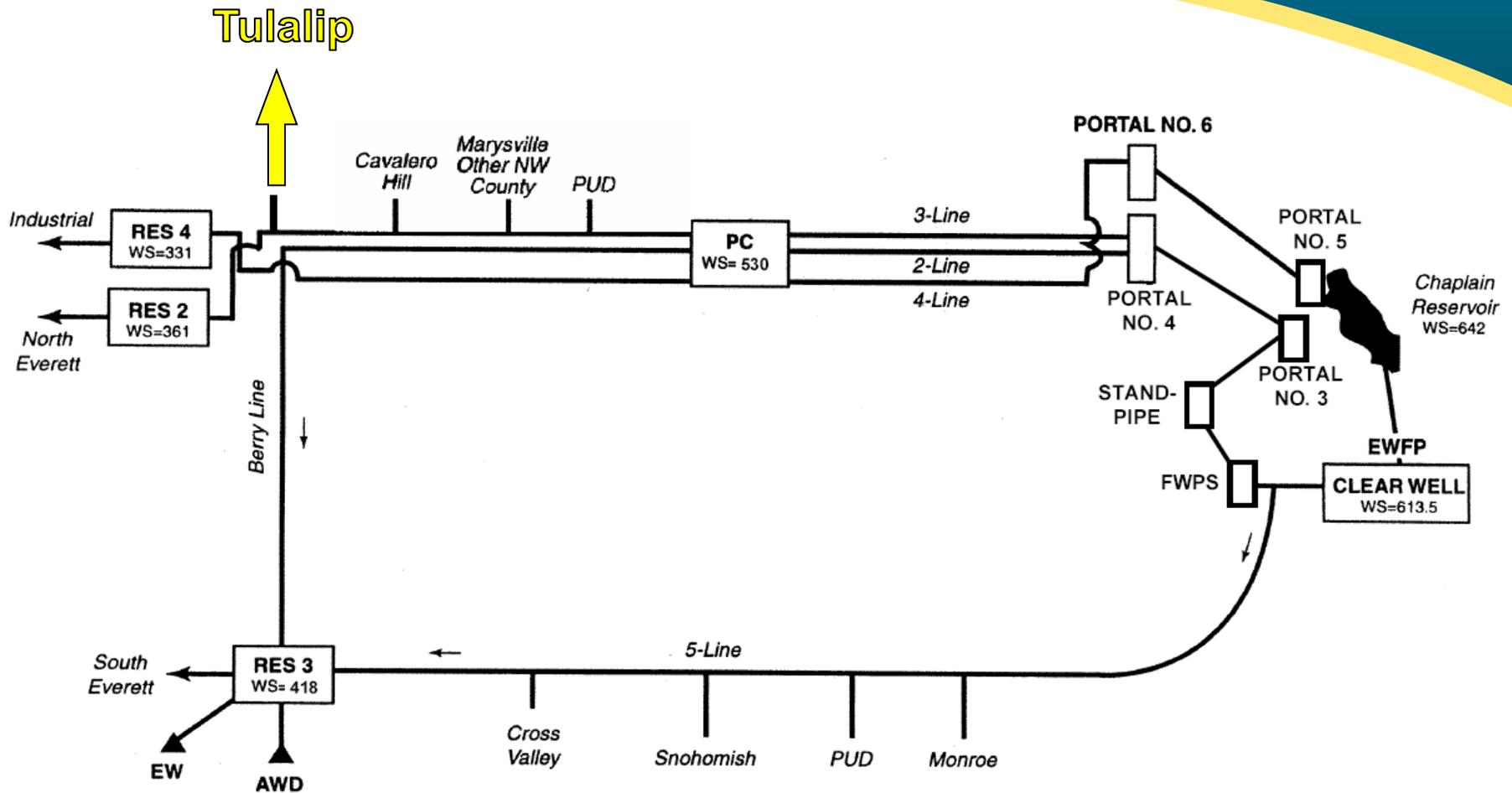
Pre-design Project Purpose



- Long-term Water supply:
 - 36 mgd to Tulalip Reservation
 - 2 mgd to Smith Island
- Determine how best to deliver:
 - From Everett's Regional System
 - Consistent with Agreement between Everett / Tribes
- Pre-Design Report & Dwg's
- Develop Implementation Plan

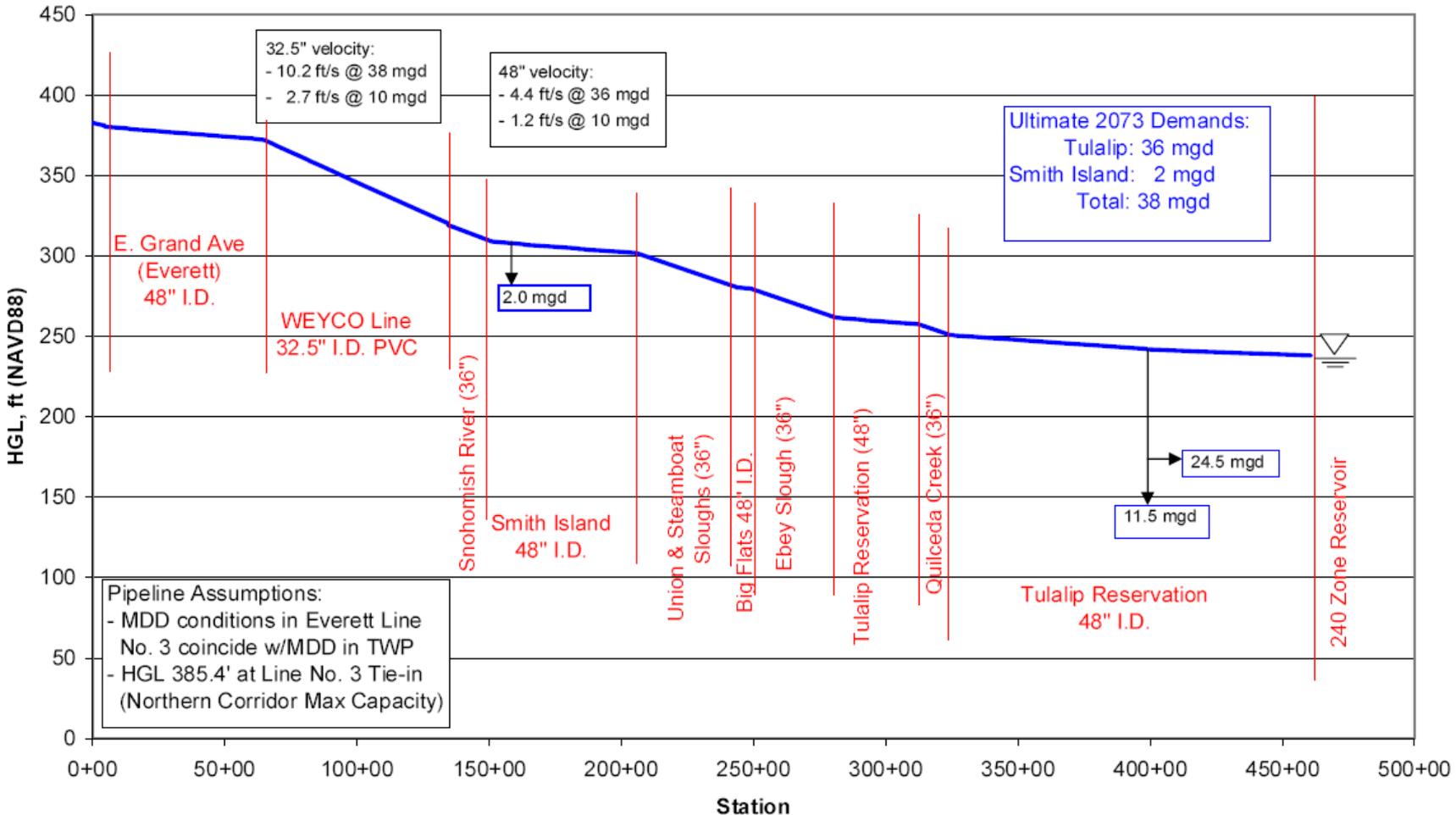
Pipeline Hydraulics

Source - Everett's T L No. 3 (TL No. 2 as reliable backup)



Pipeline Hydraulics & Sizing (Gravity Option)

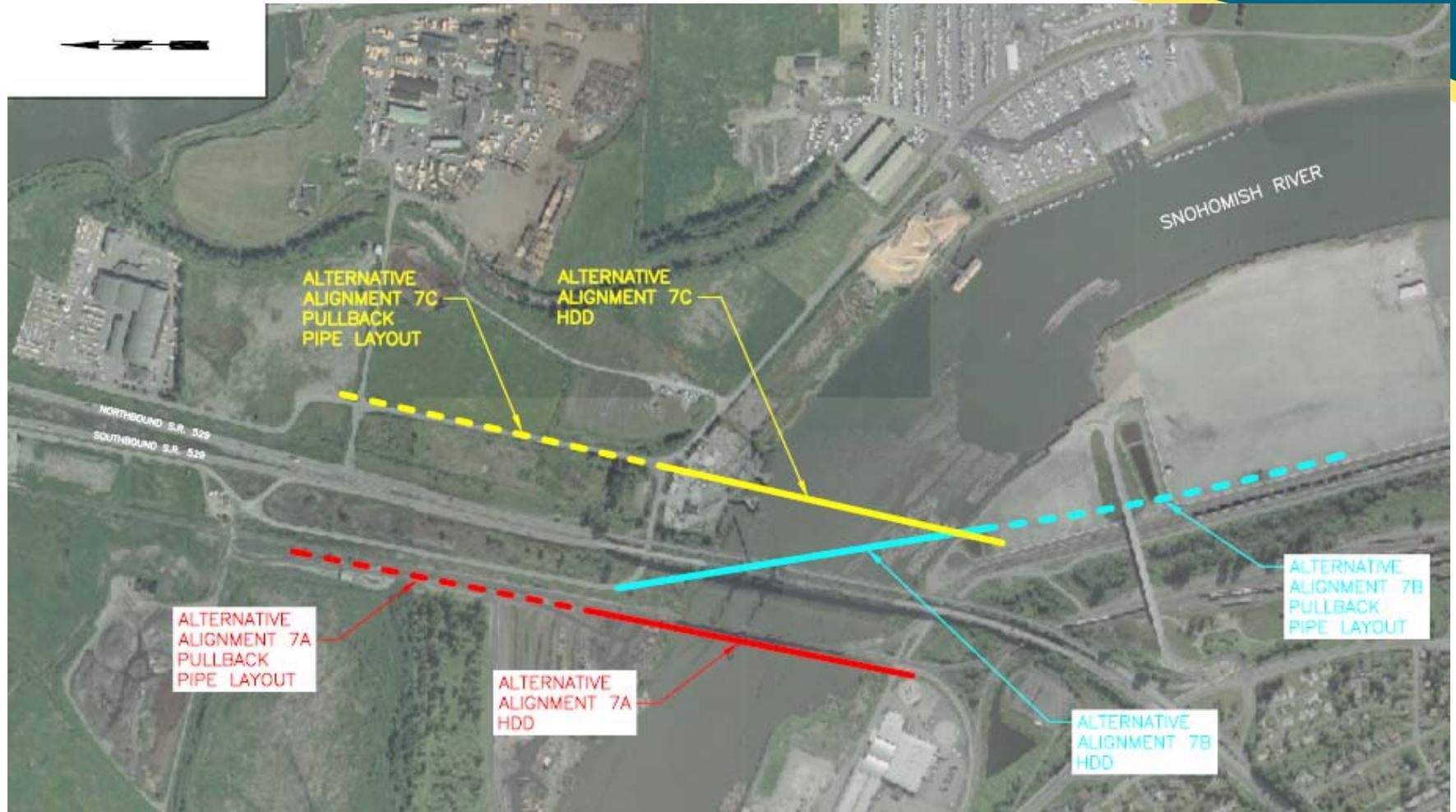
Option 2A: Tulalip Water Pipeline Hydraulic Profile
48" Pipe and 36" Waterway Crossings



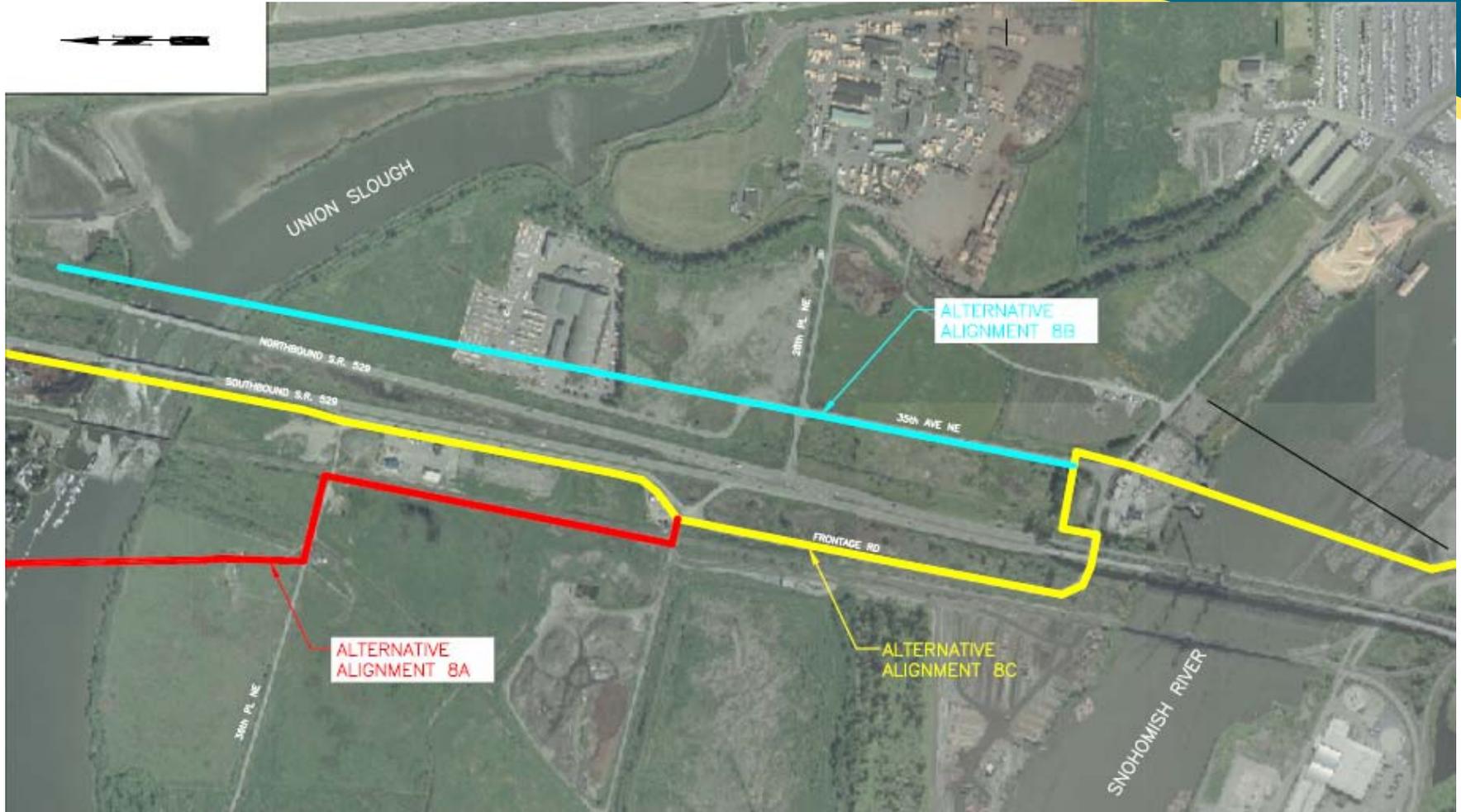
Pipeline Route Analysis – Evaluated Numerous Alternatives



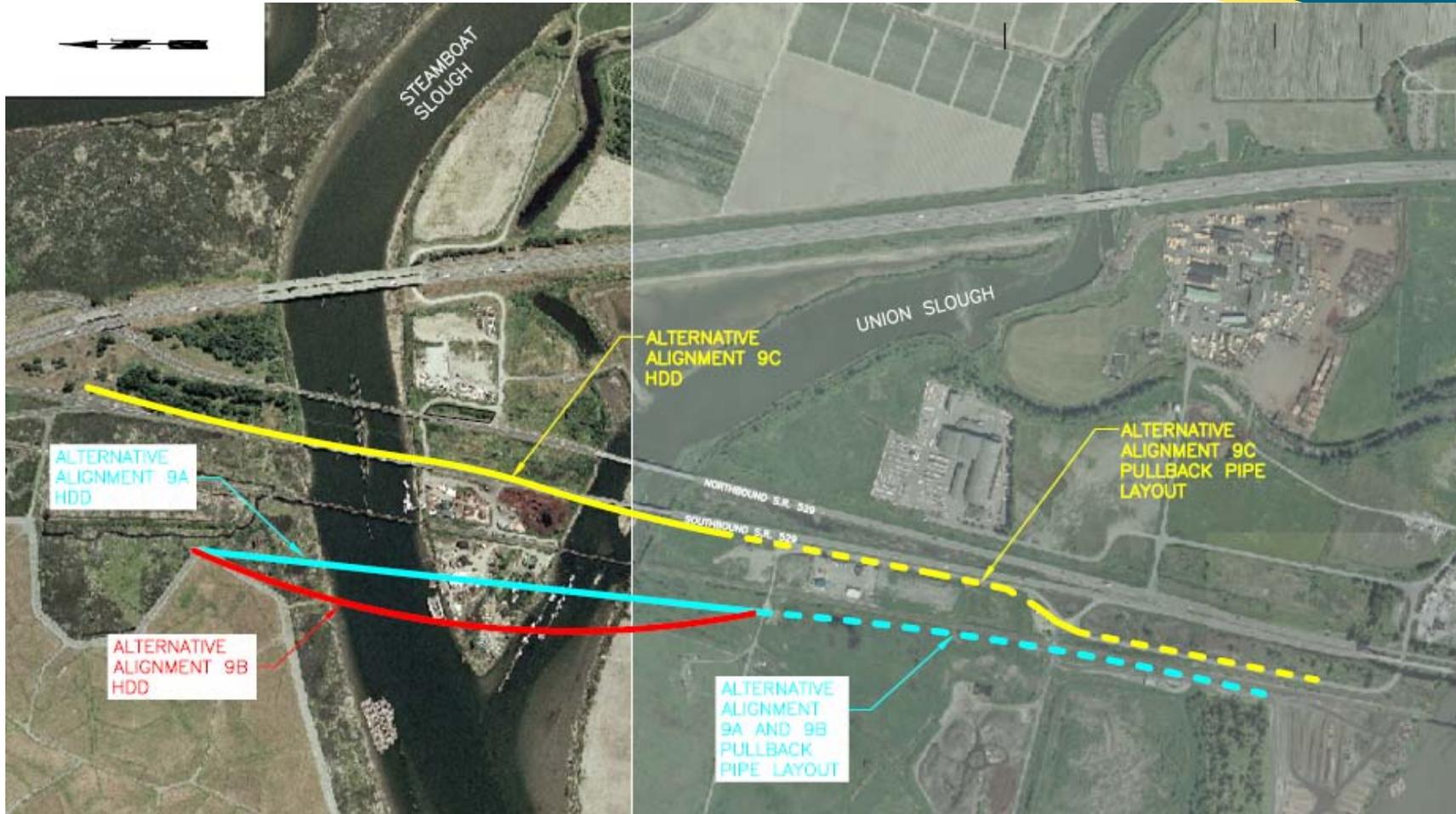
Pipeline Route Analysis – Evaluated Numerous Alternatives



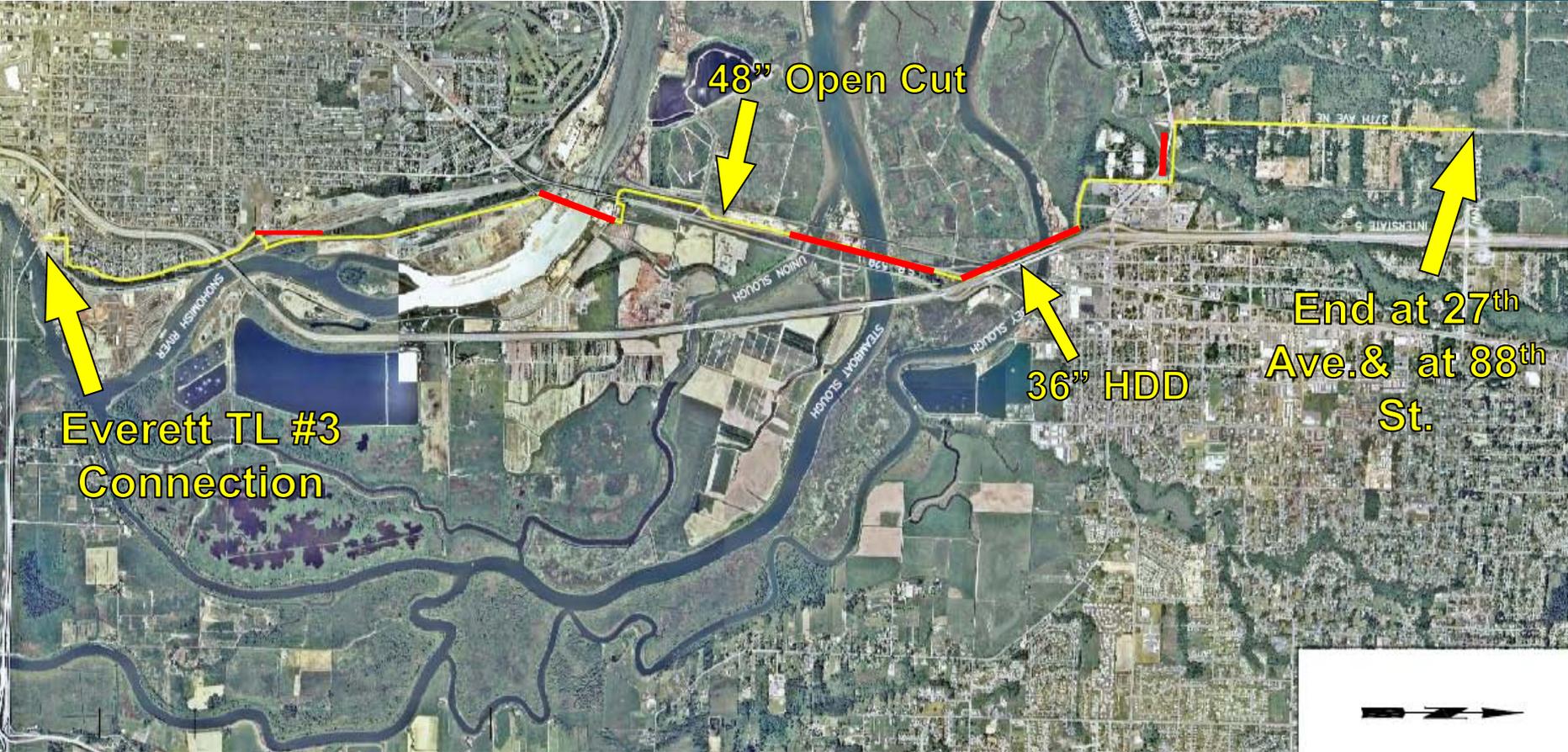
Pipeline Route Analysis – Evaluated Numerous Alternatives



Pipeline Route Analysis – Evaluated Numerous Alternatives



Final Pipeline Route and HDD Crossings



Pipeline Route - ROW / Easements

- Utilizing existing ROW where feasible
- Approx 9 permanent easements off-Reservation
- Confirm ROW/easements for the portions on-Reservation



Pipeline Facilities and Design Criteria

- Welded steel pipe with 170 to 200 psi
- Interties on Smith Island, the Quil Ceda Village 240 Zone
- Future Tribal interties: Big Flats, 31st Avenue at Marine Drive, and at Marine Drive at 27th Avenue



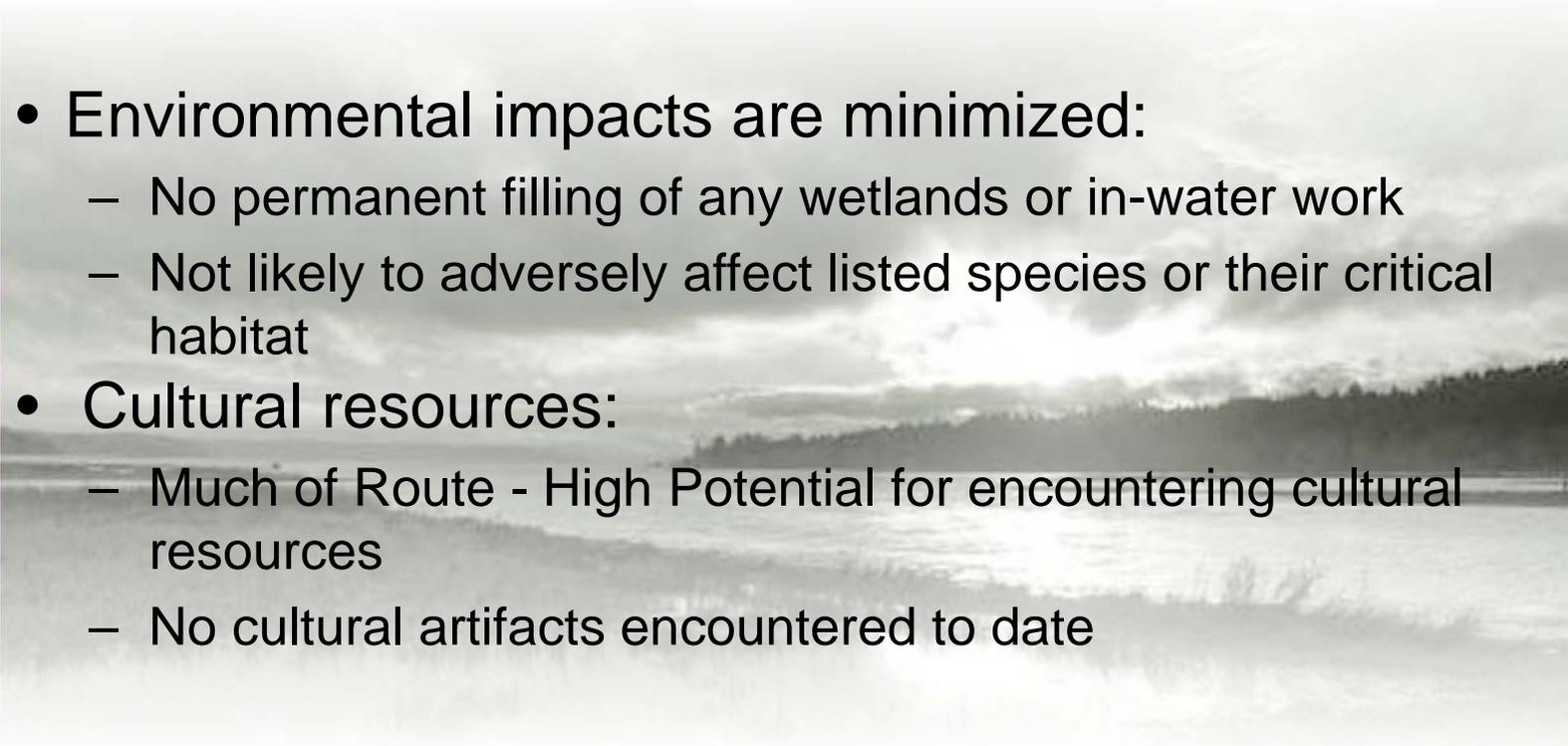
Geotechnical Considerations

- Geotechnical conditions generally suitable
- Soft soil conditions and high groundwater anticipated
- Welded steel pipe will help mitigate the potential for damage from seismic events



Environmental and Cultural Resources

- Environmental impacts are minimized:
 - No permanent filling of any wetlands or in-water work
 - Not likely to adversely affect listed species or their critical habitat
- Cultural resources:
 - Much of Route - High Potential for encountering cultural resources
 - No cultural artifacts encountered to date



Permits and Approvals

- Local, Tribal, State, and Federal Regulatory Agencies
- 12 key permits or approvals acquired during pre-design
- Other construction-specific permits obtained
 - WSDOT and BNSF
- Compliance with the NEPA and SEPA
 - Work on Reservation and potential Federal funding
 - Environmental Assessment (Finding of No Significant Impact)

Pre-design Project Cost Opinion

Exhibit 18

Estimated Total Project Cost Summary with Costs Escalated to Year of Expenditures
Tulalip Water Pipeline Project (48-Inch Pipeline with 36-Inch Waterway Crossings)

DESCRIPTION	YEAR IMPLEMENTED ²	TOTAL COST (\$ MILLIONS)
Pre-Design	2007/2008	2.00
Final Design and Final Permits/Environmental	2009/2010	5.68
ROW and Easement Acquisition and Permit Fees	2008/2009/2010	0.97
Construction (with 10% Estimating and 10% Scope Contingency) ¹	2012/2013	66.35
Sales Tax and TERO Fee	2012/2013	4.32
Construction Observation	2012/2013	5.97
Administration	2012/2013	1.99
Total Project Costs:		87.3

Notes:

¹ Construction costs escalated annually at 5%.

² When work is to be conducted over a two-year period, half is escalated to the first year and half is escalated to the second year.

Project Implementation Plan



- Preferred Delivery: Design-Bid-Build
- Base Case Schedule:
 - Design, ROW and easement acquisition completed by end of 2010
 - Additional year to secure funding (2011)
 - Construction in 2012 and 2013
- Project is on or ahead of schedule



CONSTRUCTION

Current Construction Segments 3, 5 (North and South) and 7

- Bid as a Single Contract – Primarily HDD
 - 4 HDD Crossings
 - Approximately 10,000 feet of 36-inch HDD
 - Only approximately 500 ft of Open Cut in contract
- Tulalip Tribe – lead contracting agency
 - Parametrix lead CM with MWH Americas as a Sub
 - *Staheli Trenchless Consultants* subconsultant
 - *GeoEngineers* subconsultant

Contractor / Subcontractors

Prime: *Don Kelly Construction, Bozeman, MT*

HDD: *Southeast Directional Drilling, Casa Grande, AZ*

Pipe: *Northwest Pipe Company, Portland, OR*

Steel Pipe Fabrication – Portland, OR



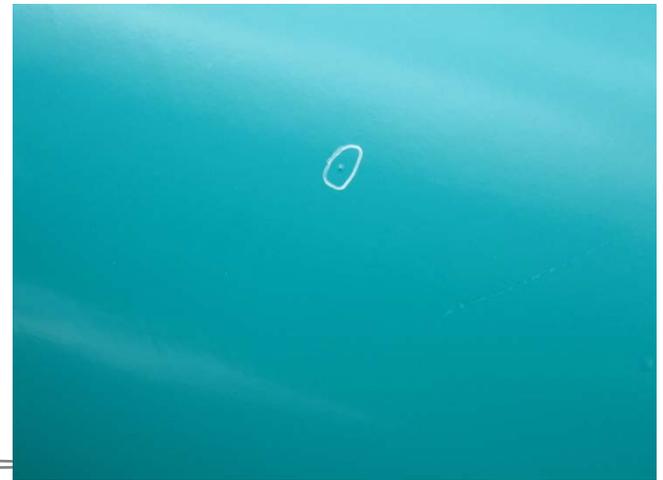
Steel Pipe Fabrication – Portland, OR



Fusion Bonded Epoxy (FBE) Coatings Shop



FBE Coatings – Shop – QA/QC



FBE Coatings – Field – Interior Joints



FBE Coatings – Field – Exterior Joints



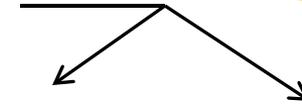
FBE Coatings – Field – QA/QC



Settlement Monitoring

- Inclinometers
- Extensometers (*Sondex*)
- Piezometers (Vibrating Wire)
- 30 to 50 feet deep
- Required by WSDOT
- Surface Settlement Points (Washers / PK Nails)

Interstate 5



Welding

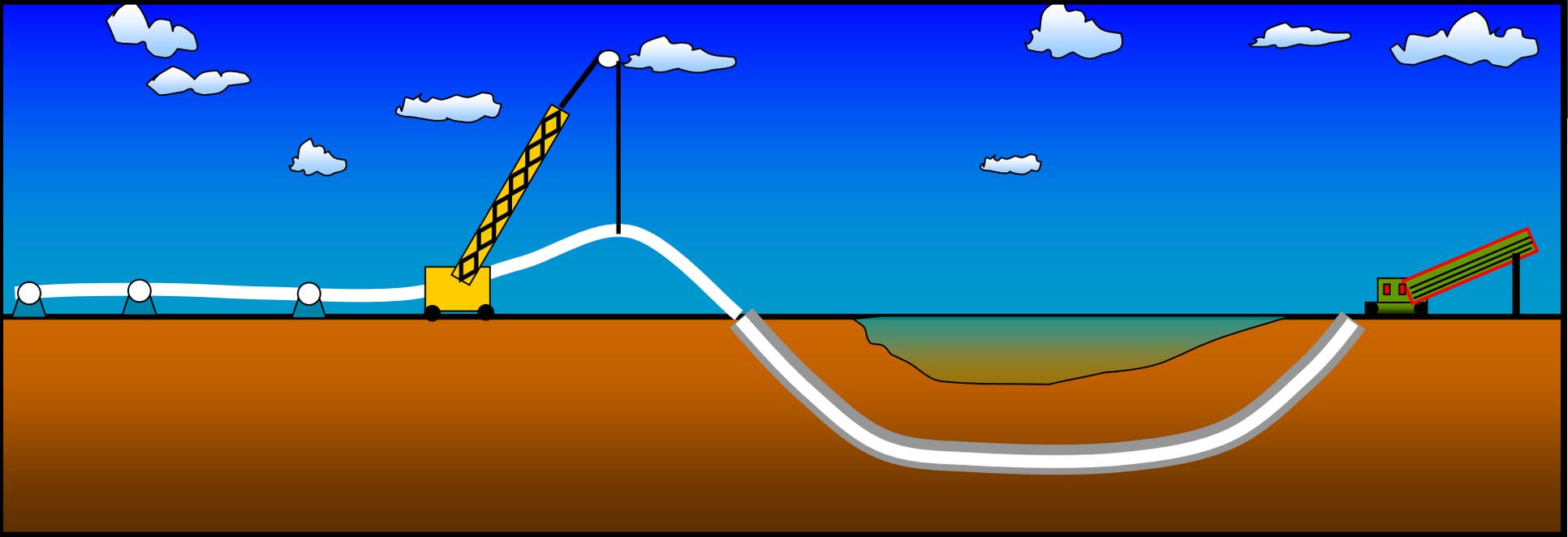


AWS D1.1
Structural Welding Code
CWI full time on-site



SEGMENT 5 NORTH

HDD Construction

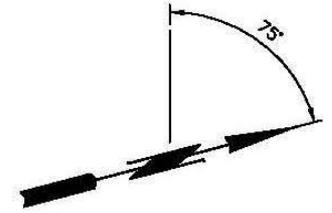


Segment 5 North Crossing

- 2,760 feet in length
- Traverses beneath Ebey Slough
- Beneath a south-bound off-ramp of Interstate 5



Segment 5 North Plan View

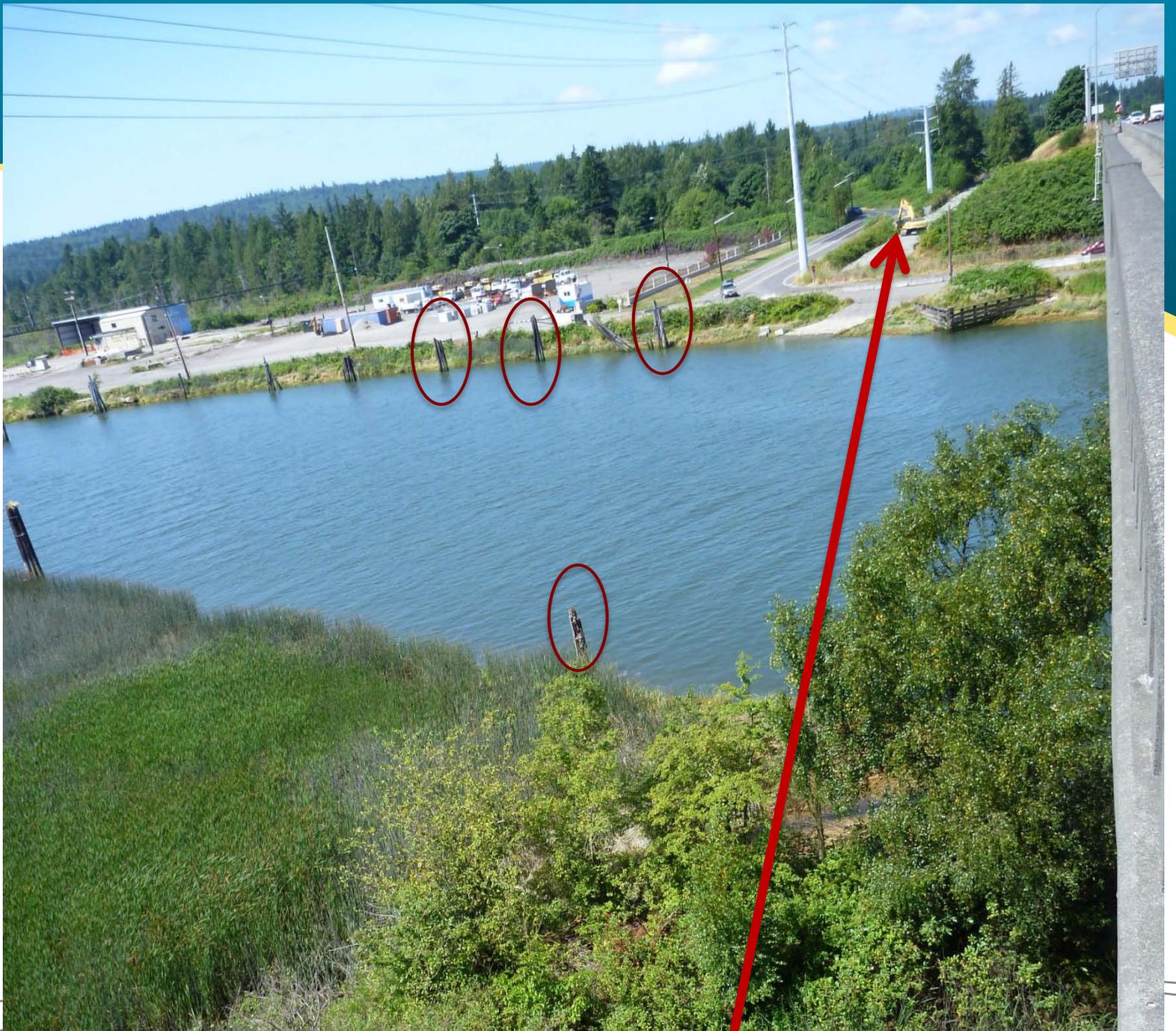


Segment 5N

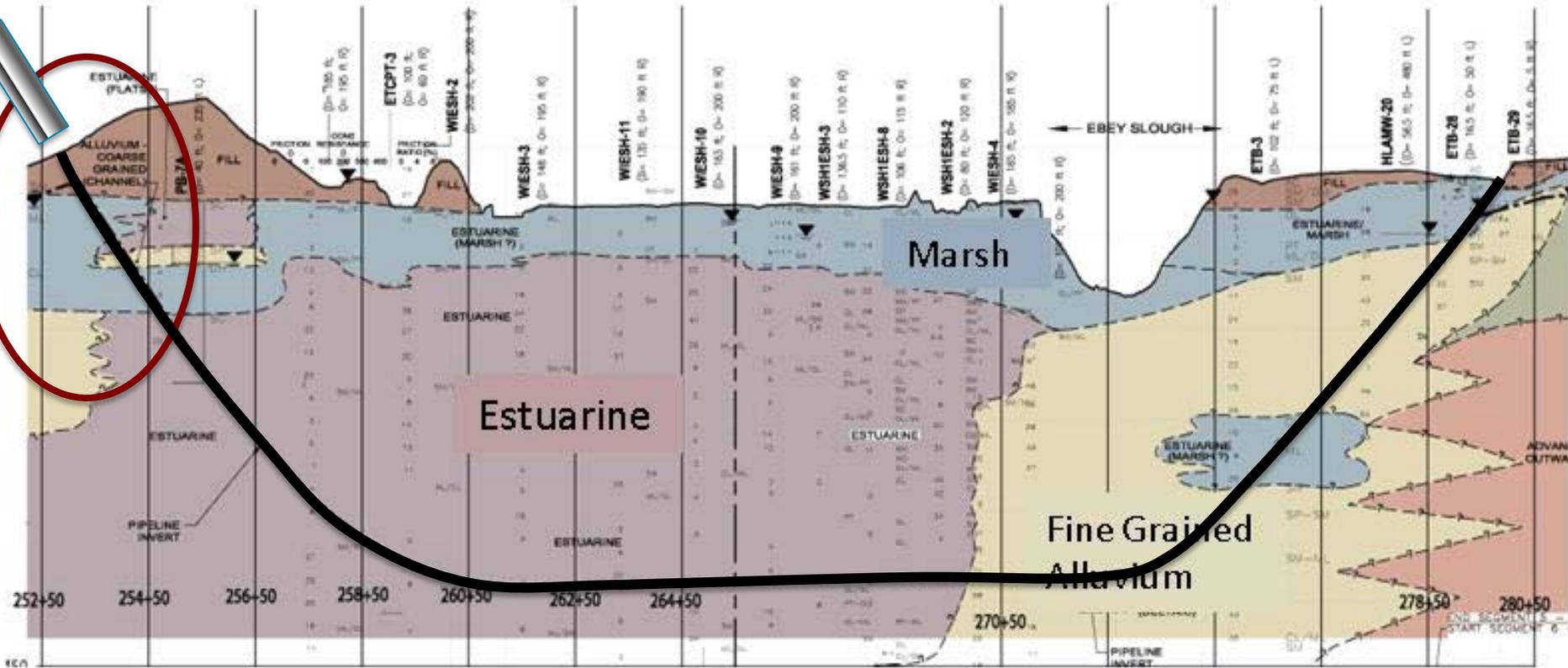




Exit 198
N Broadway
Part Of Everett



Geotechnical on 5-North



American Augers DD-625



Segment 5N Site Layout



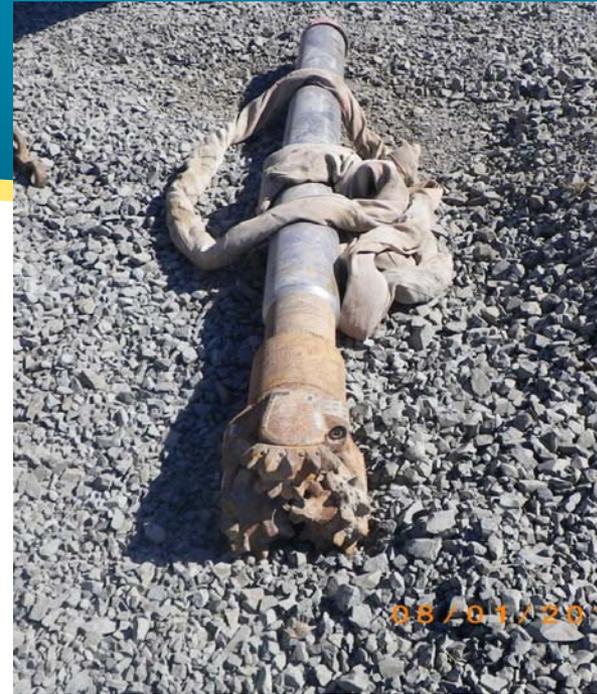
Conductor Casing



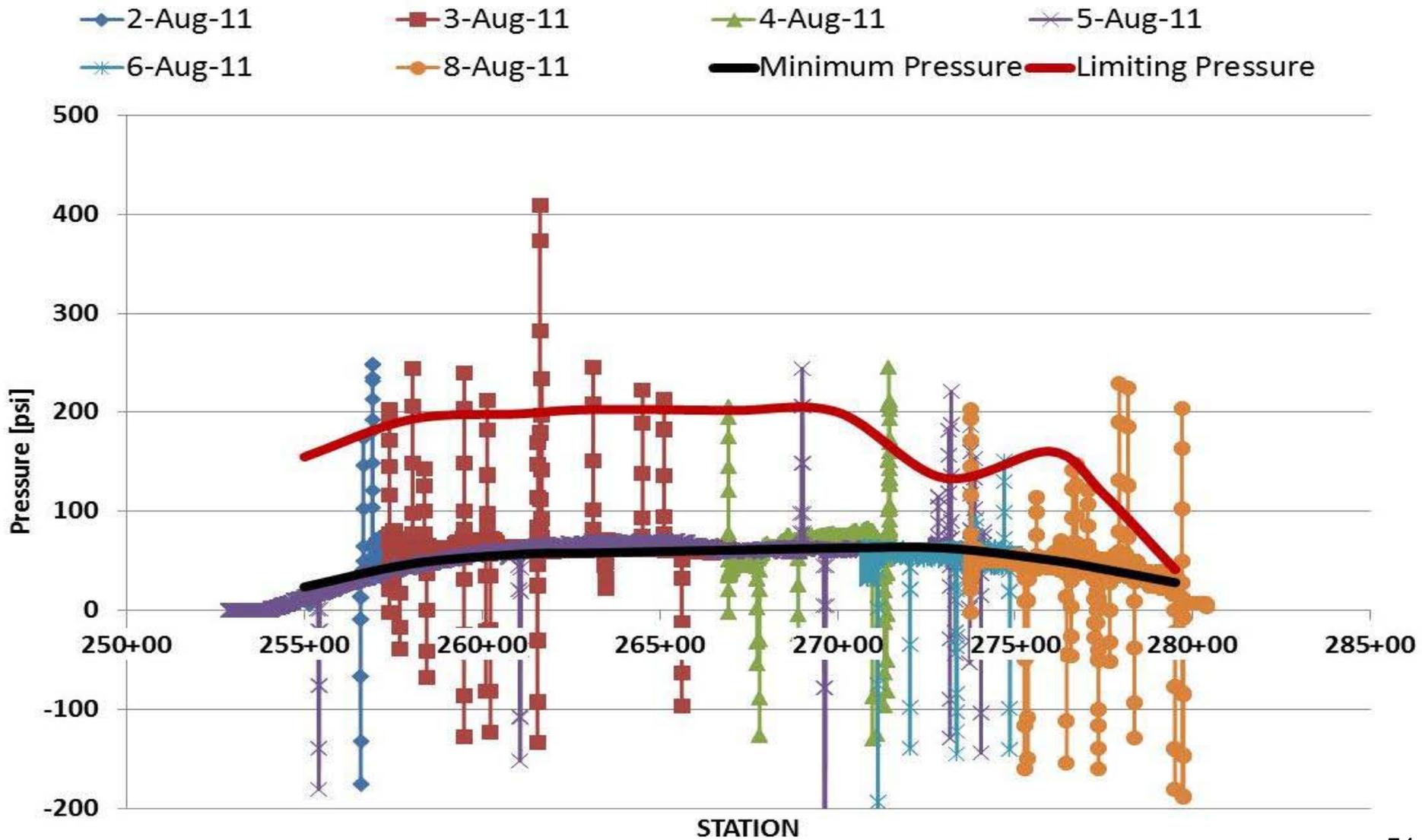
Conductor Installation



Segment 5 North – Drilling



5 North Pilot Bore - STA vs Down-hole Pressure



Reaming



- From 10-3/8 to 36-inch in Single Pass
- Back Ream from Exit to Entry



48-inch
Barrel
Reamer





390 ft from complete (13 drill pipe).....

- Pulling at 210,000 pounds
- Drill Rig Blows Seal on Motor
- Rebuild on Seal Motor
- Down approx 3 hours
- Pull 550,000 pounds
- Pipe is **NOT MOVING!!!**

Hammer Assist

**Hammer Saves the Day in
3 minutes of Ramming – Started Moving**
Pull Forces drop back to same
pull forces prior to getting stuck – 215,000 lbs



TT Technologies
Pneumatic Hammer

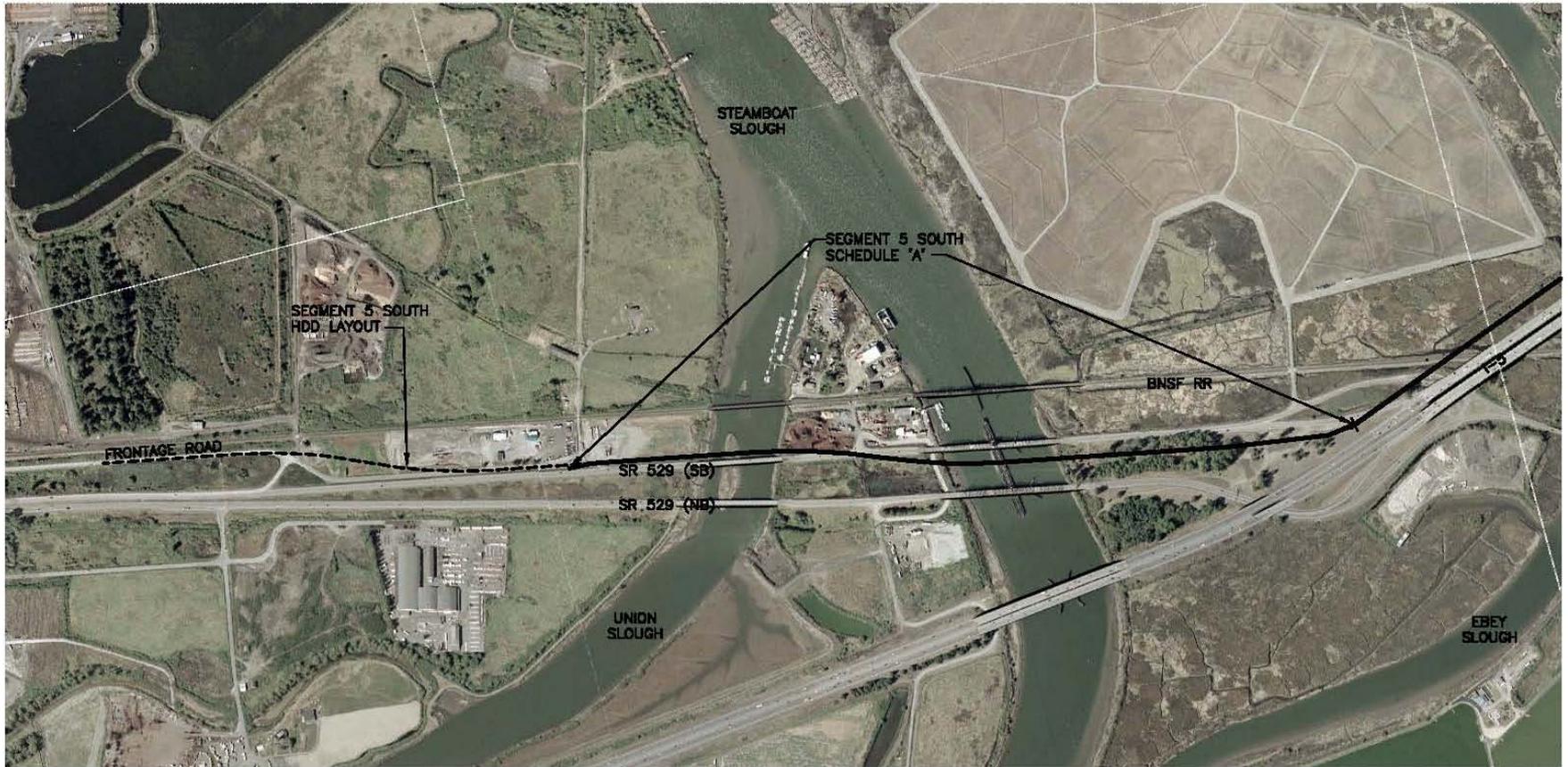
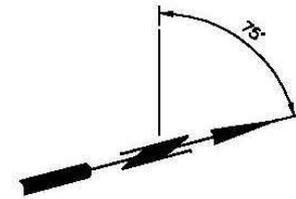


SEGMENT 5 SOUTH

Segment 5 South

- Union Slough and Steamboat Slough – 3,680 feet
- Low Bid = \$7.8M
- Vertical and horizontal curves (3,600 foot radius)
- Crosses underneath State Route 529
- Pilot bore and borehole reaming: October 2011

Segment 5 South – Plan View



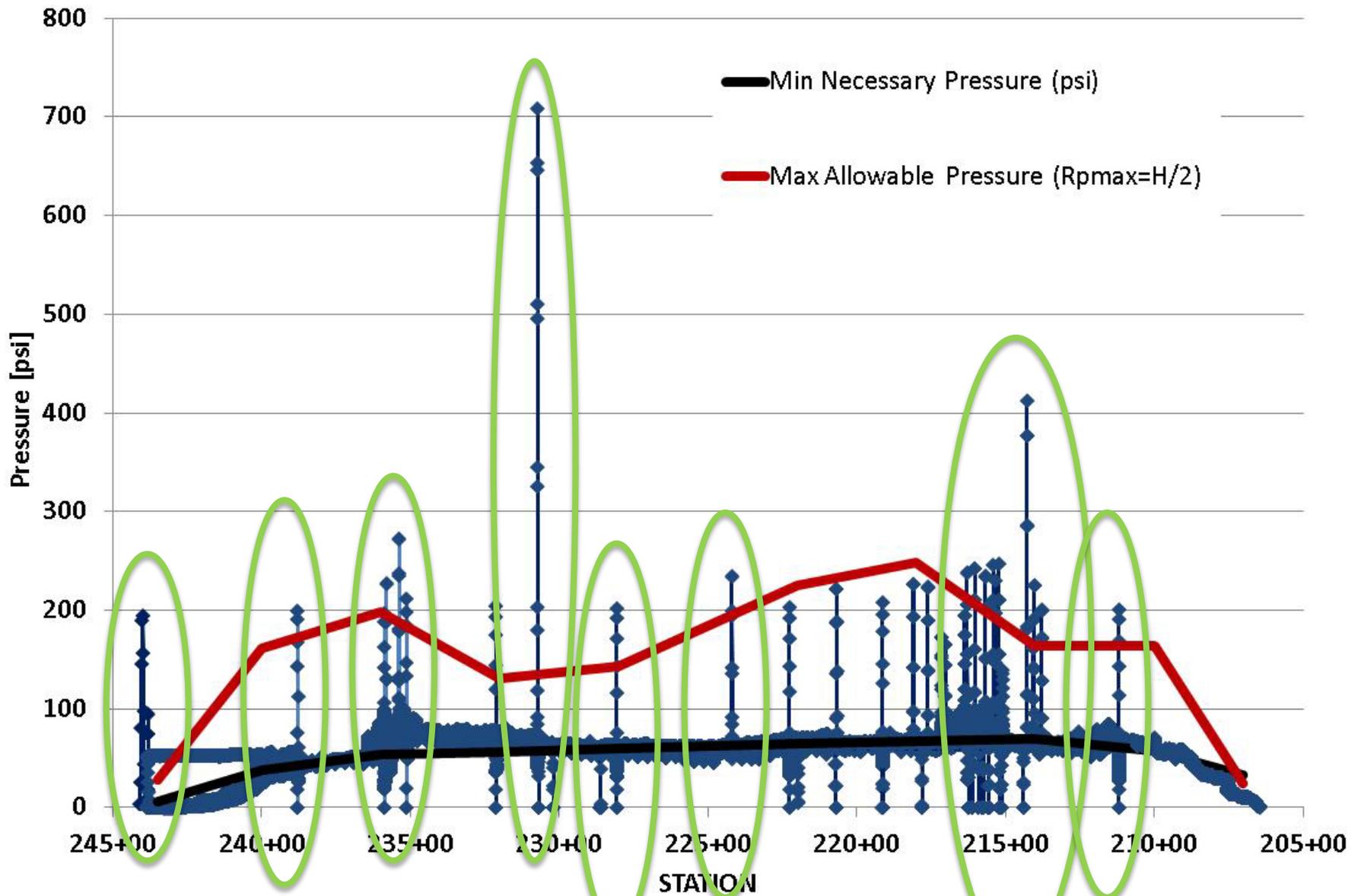
Pilot Bore No Conductor Casing



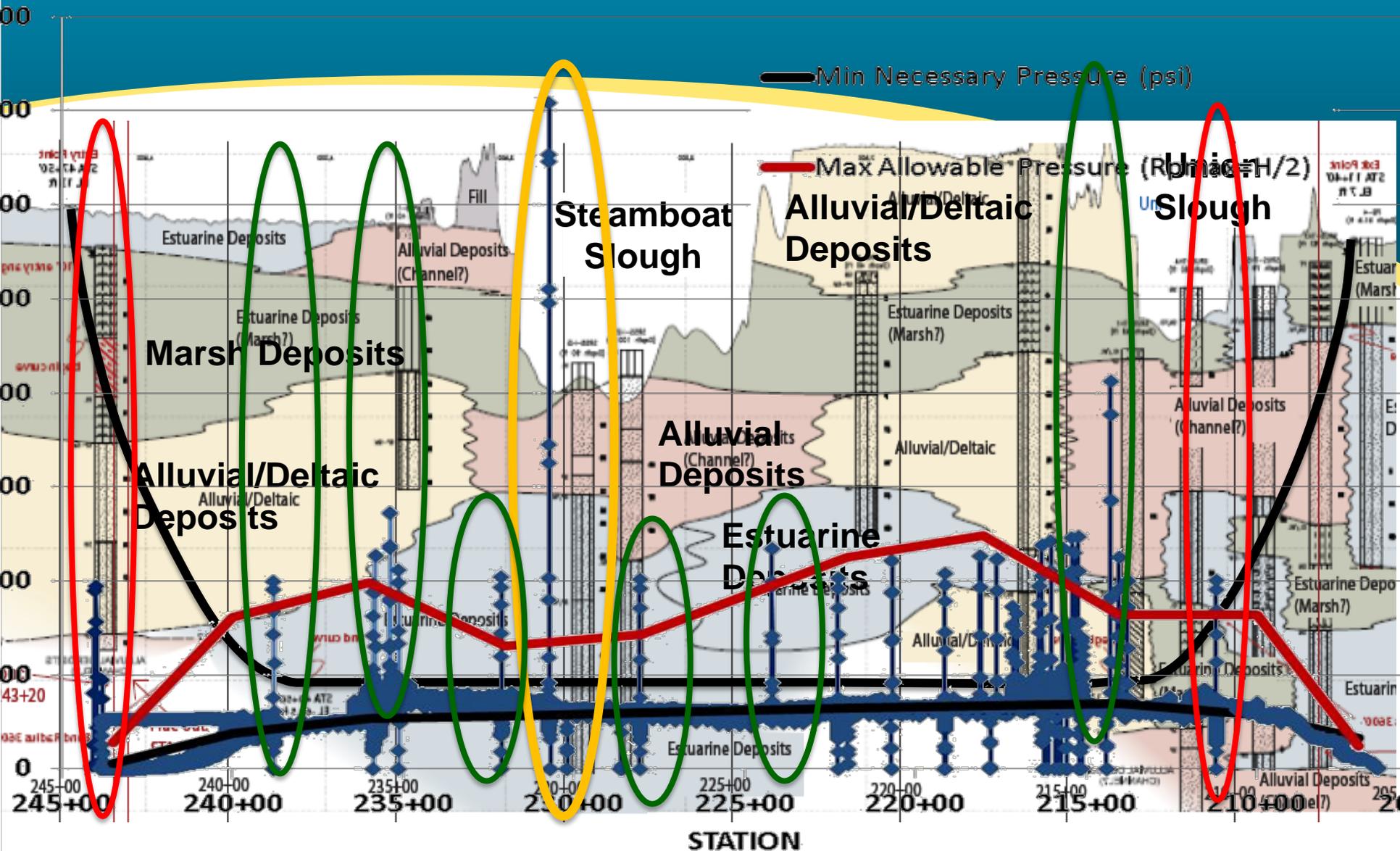
Used Wash-over Casing to Contain Mud Near Entry



5 South Pilot Bore: STA vs. Downhole Pressure



5 South Pilot Bore: STA vs. Downhole Pressure



Edge of Union Slough



Going Out



And Back In



Pipe Pullback



Segment 5 – Misc Construction



Segment 5 – Pullback Lift



Segment 5 – Pipe Laydown



Segment 5 – Pipe Laydown



Temporary roadway to keep businesses open

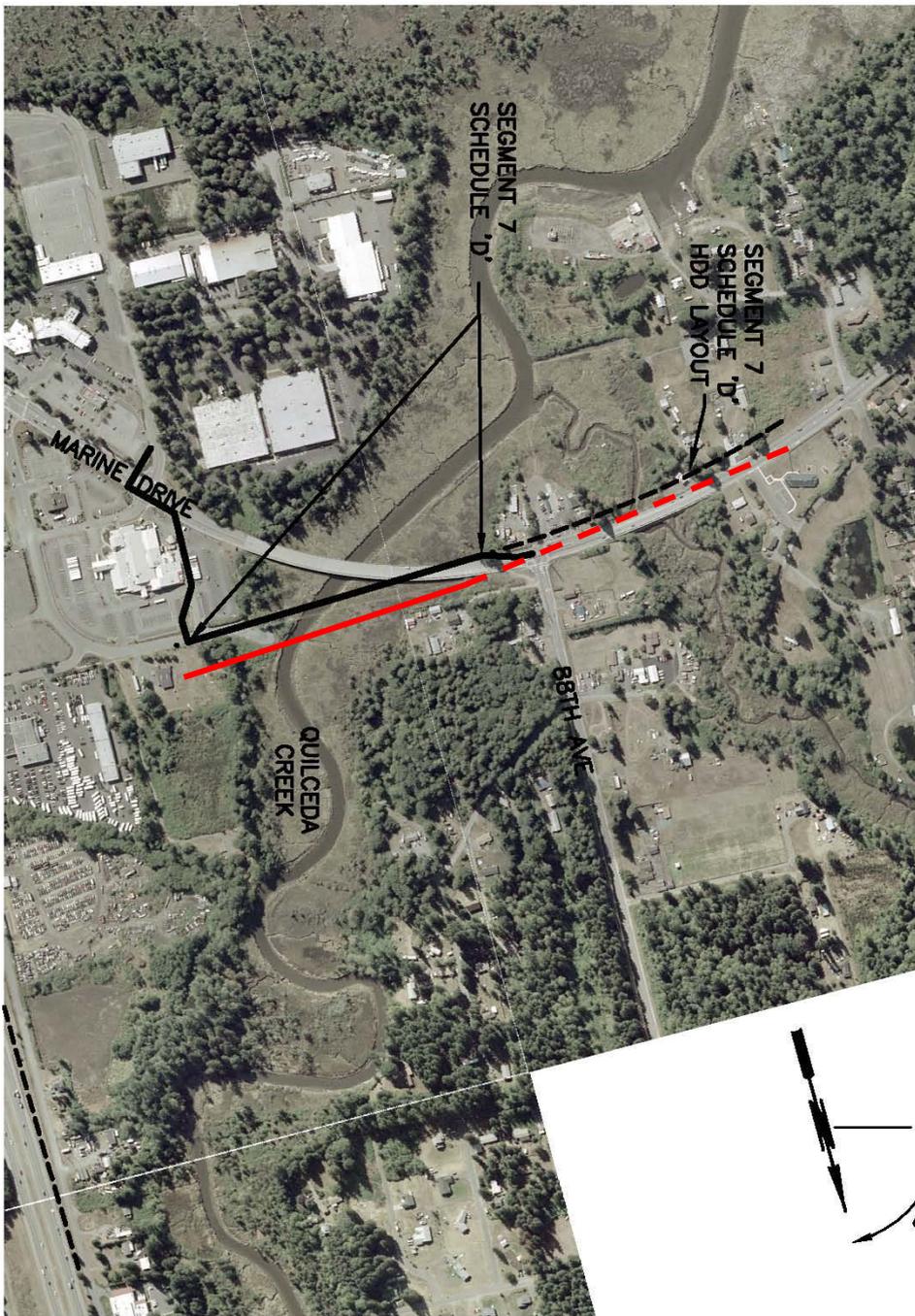


SEGMENT 7

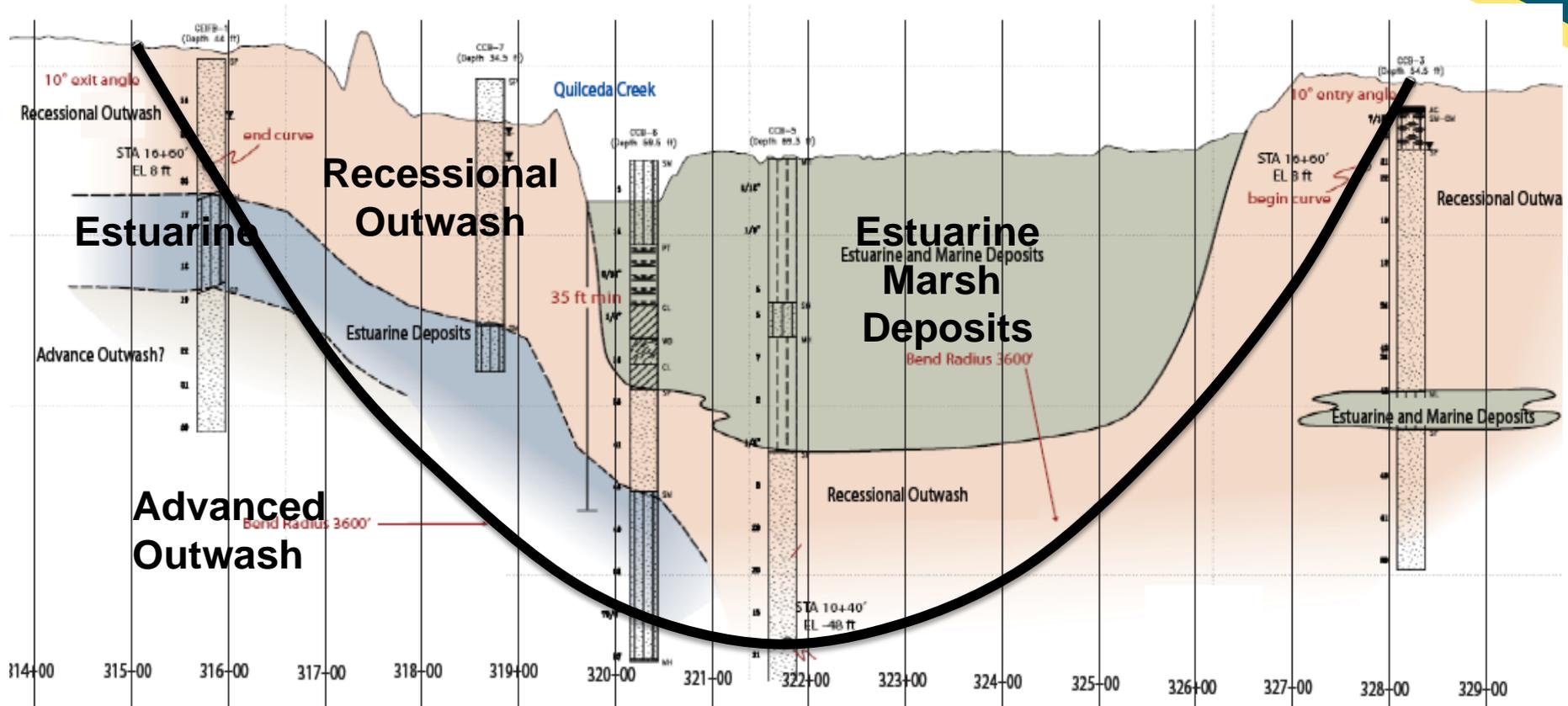
Segment 7 – Quil Ceda Creek Crossing

- Quil Ceda Creek Crossing – 1,200 feet
- Low Bid = \$2.0M

Segment 7 Plan View

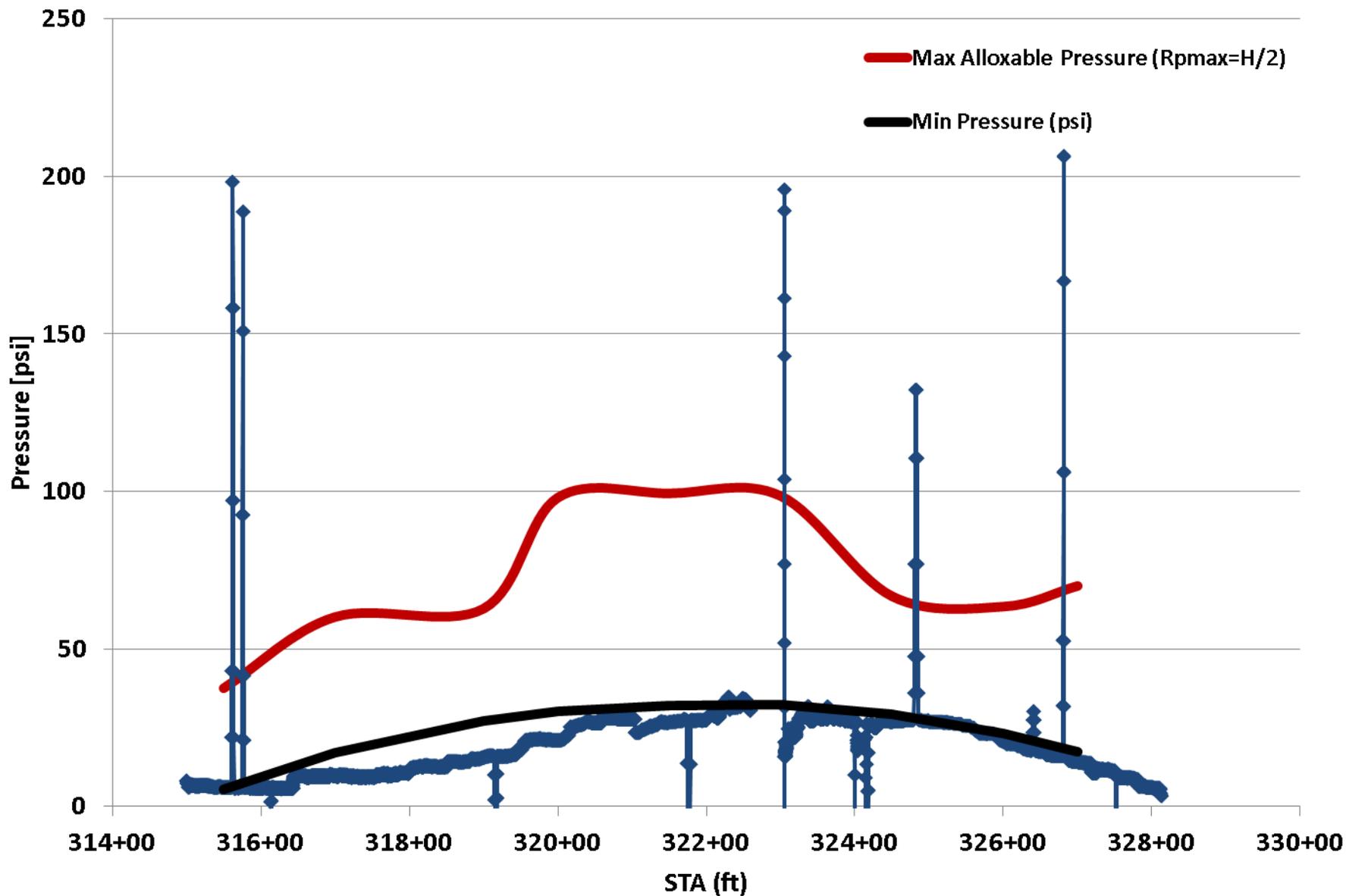


Segment 7 – Quil Ceda Creek – 1,200 feet

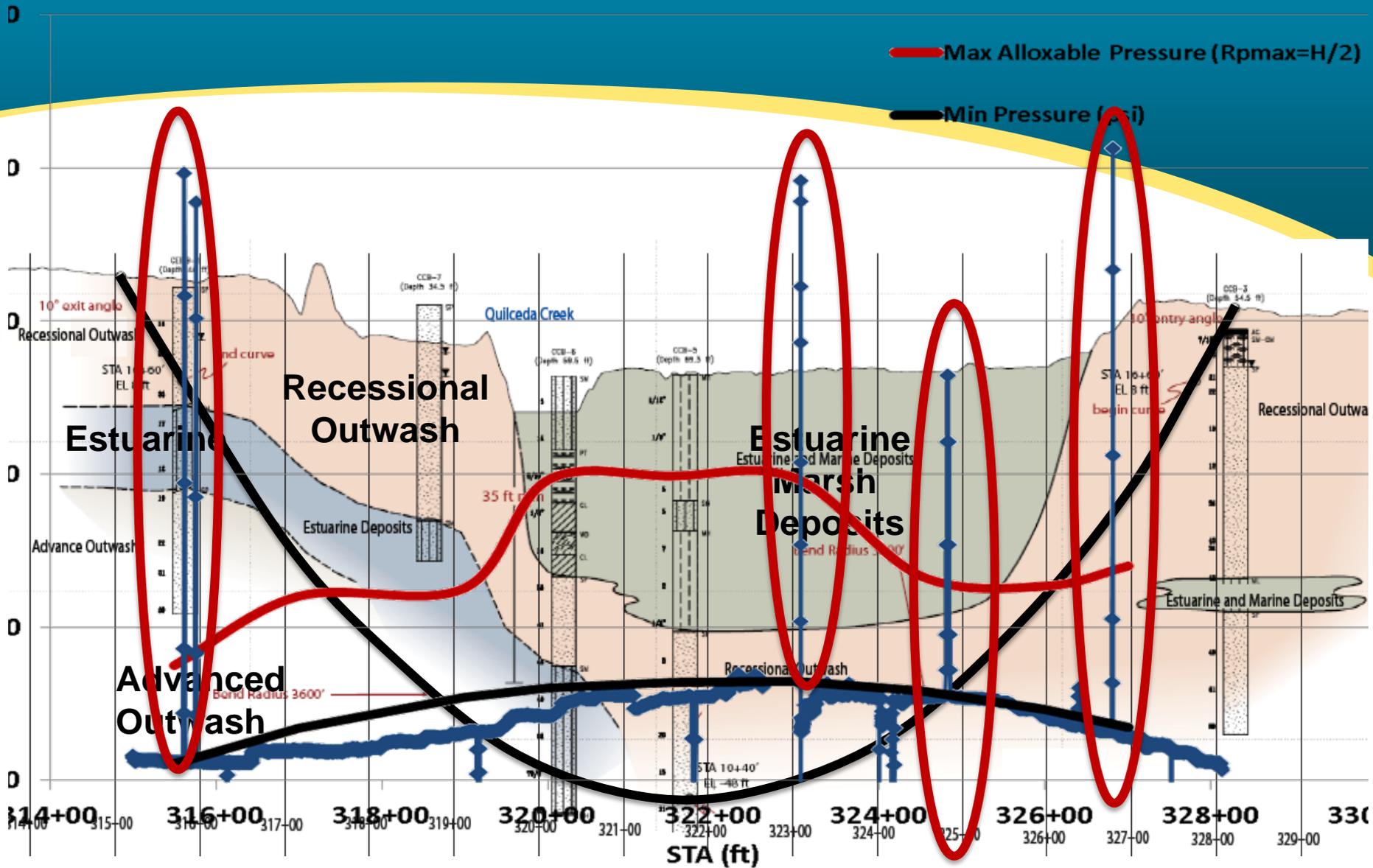




Segment 7: Quil Ceda Creek : STA vs. Downhole Pressure



Segment 7: Quil Ceda Creek : STA vs. Downhole Pressure





Oh, But Wait Until the Reaming





Soft Marshy Soils

- Insufficient strength to contain the pressurized mud
- Bore should have been significantly deeper
- This would have lengthened the bore
- No space was available

SEGMENT 3

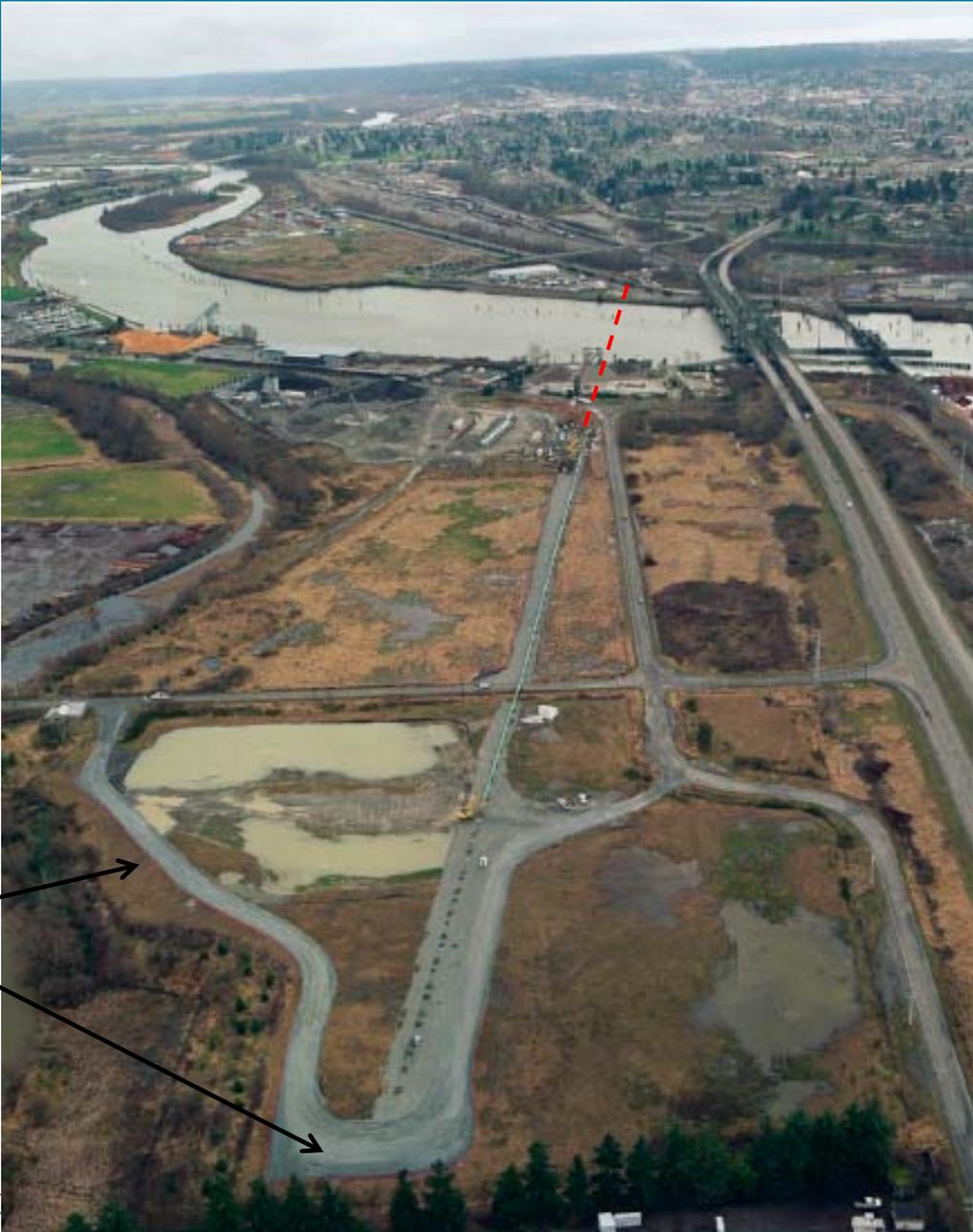
Segment 3

- Snohomish River Crossing – 2,000 feet
- Low Bid = \$4.3M
- Pilot Bore in 2.5 Days
- Reaming 400-500 feet per day

Segment 3 Layout Looking North



Segment 3 Layout Looking South



Temporary
Access
Road

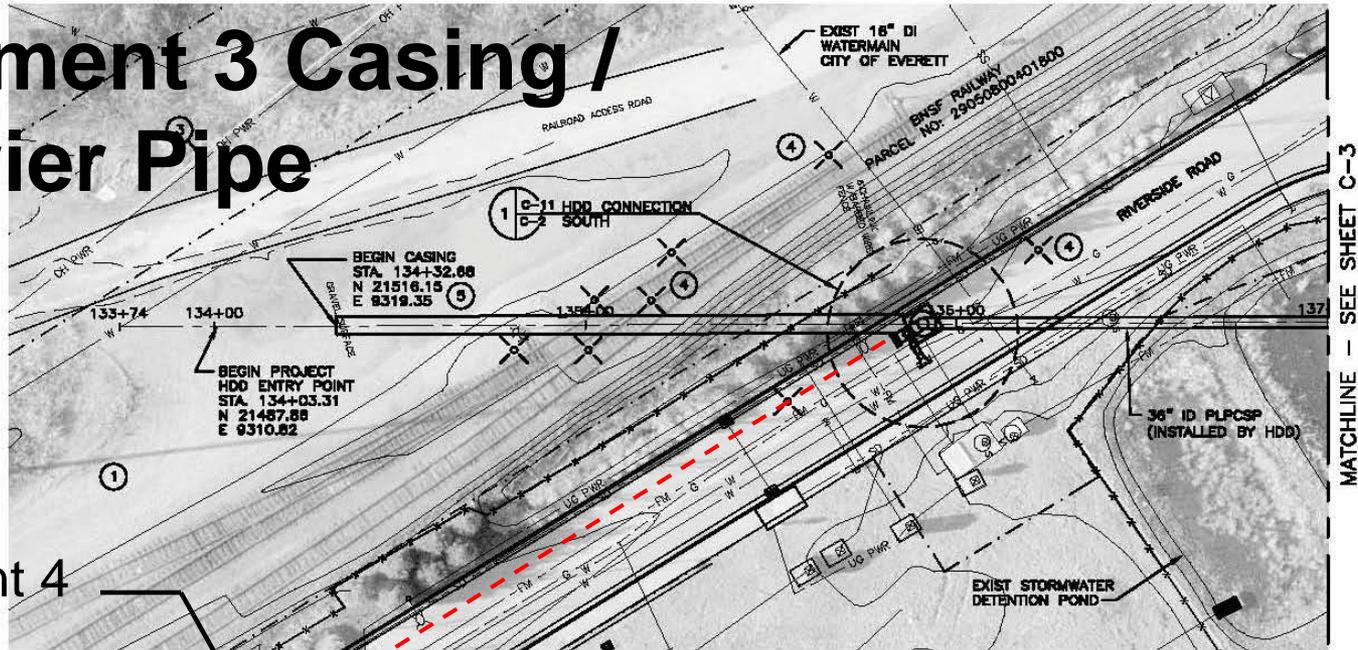
Segment 3 Pullback



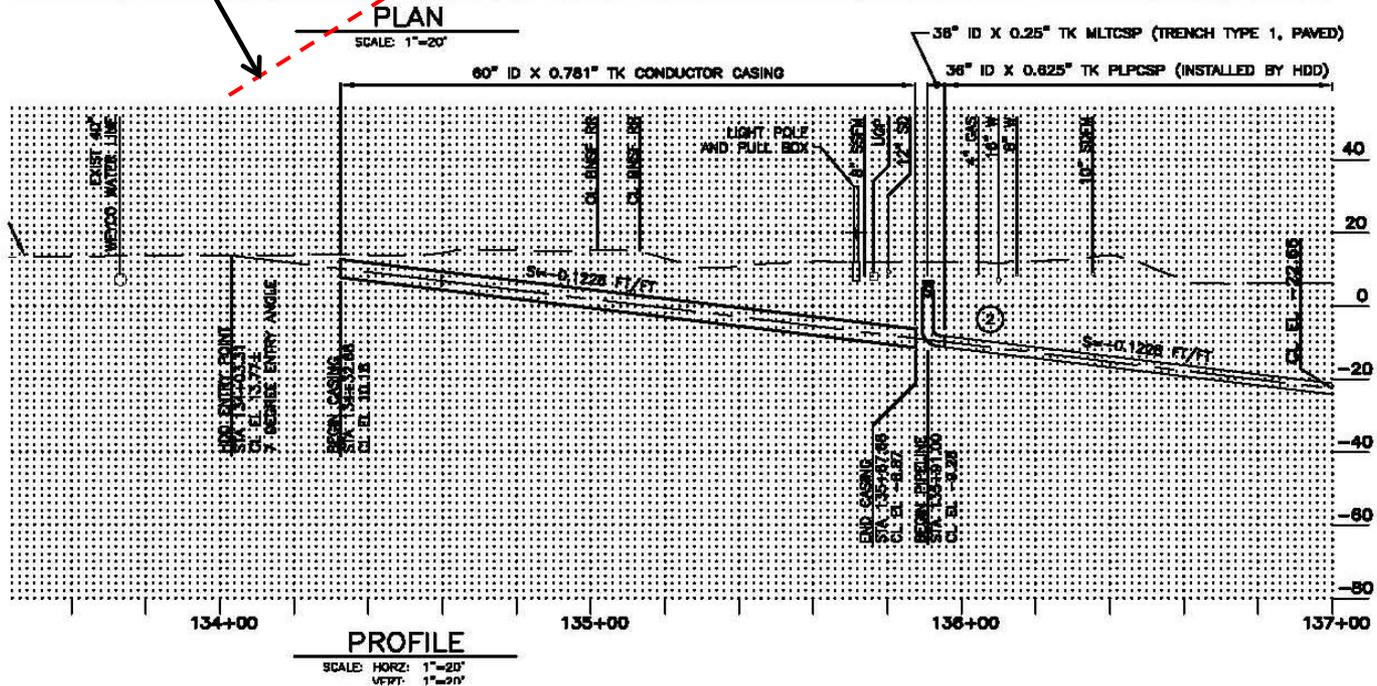
Segment 3 Layout



Segment 3 Casing / Carrier Pipe



Future Segment 4



Segment 3 – Casing Installation



Segment 3 – Work around BNSF Railroad



Segment 3 – Pullback Lift





LESSONS LEARNED

Lessons

- In Marsh Deposits
 - Be Conservative in Design
 - Then go Deeper!
- If Hydrofracture is a large concern, preclude a single ream – require incremental size increases
- Pipe laydown length – add extra 400 ft +/-
- Shoring/dewatering/geotechnical – specialized legal review

Acknowledgements

Client:

- Tulalip/Everett Joint Board
- Tulalip Tribes:
 - Gus Taylor
 - Mac McKinsey
 - Debbie Bray
- City of Everett Staff:
 - Jim Miller
 - Souheil Nasr

Consultant Team:

- MWH Americas, Inc.
- Parametrix
- Staheli Trenchless Consultants
- GeoEngineers
- Clair Olivers and Associates
- DOWL/HKM
- Northwest Archeology
- Northwest Corrosion

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 - Debbie Bray
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 - Jim Miller
 - Souheil Nasr

Consultant Team:

- MWH Americas, Inc.- Design Lead
- Parametrix - CM Lead
- Staheli Trenchless Consultants
- GeoEngineers
- DOWL/HKM
- Northwest Archeology
- Northwest Corrosion

Questions?

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