Trenchless Construction Lessons Learned

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American Waterworks Association
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Trenchless Technologies

- Pipeline Rehabilitation
- New Installation Techniques
  - Microtunneling
  - Horizontal Directional Drilling
  - Pipe Ramming
  - Auger Boring
  - Pipe Bursting

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Lessons Learned

- Apply to Specific Trenchless Technology
  - Globally
  - Pacific Northwest
- General Trenchless Lessons
  - Apply to All Trenchless New Installation Techniques

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Microtunneling

- Pipe Jacking
- Remote Controlled (no person in the tunnel)
- Laser Guided (precise grade control)
- Positive Face Support => Excavation Below Water
- Tunnel from Launch Shaft to Reception Shaft

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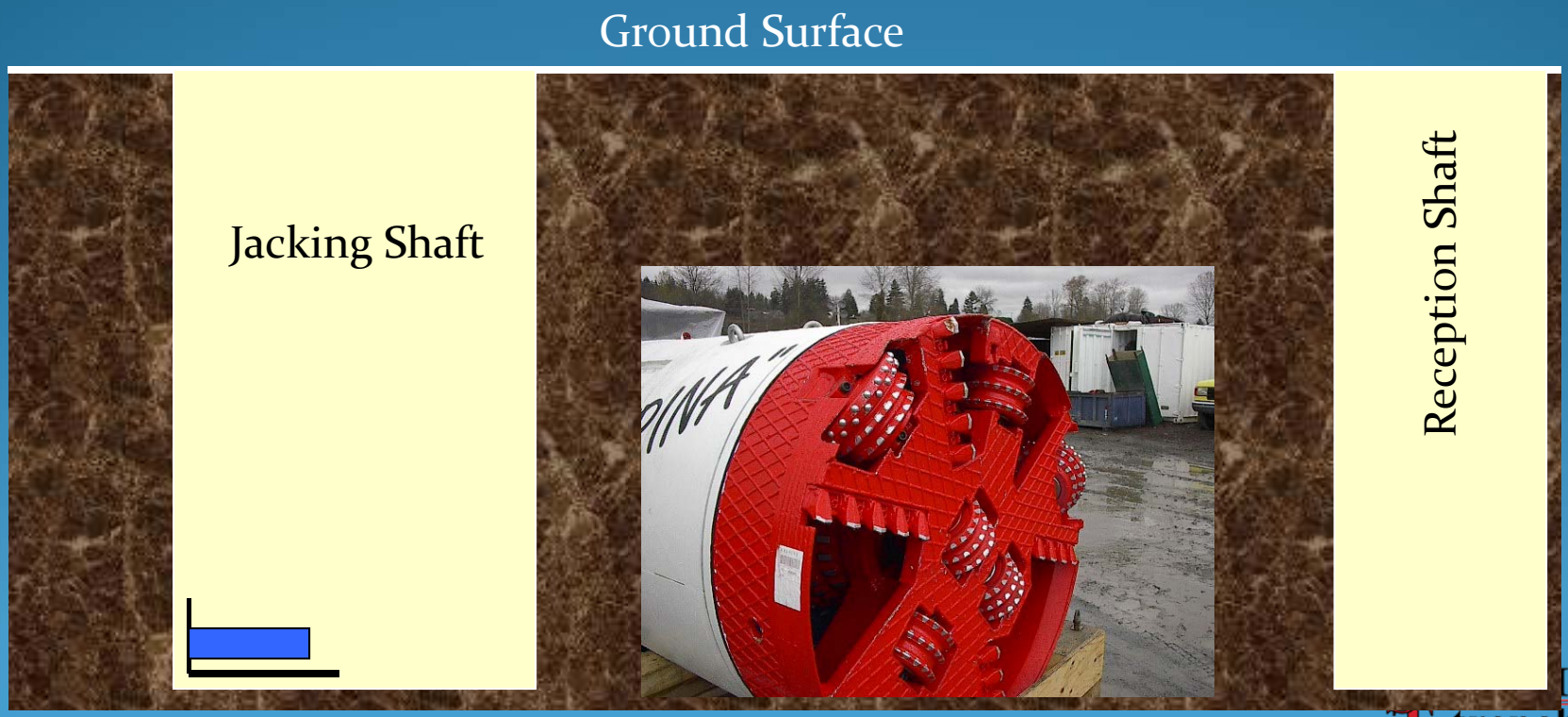
Microtunneling

- Remote controlled
- Pipe jacking operation
- Positive support to face
- Laser guided
- Slurry excavation
- No people in the tunnel



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Microtunneling Process

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Microtunneling Process

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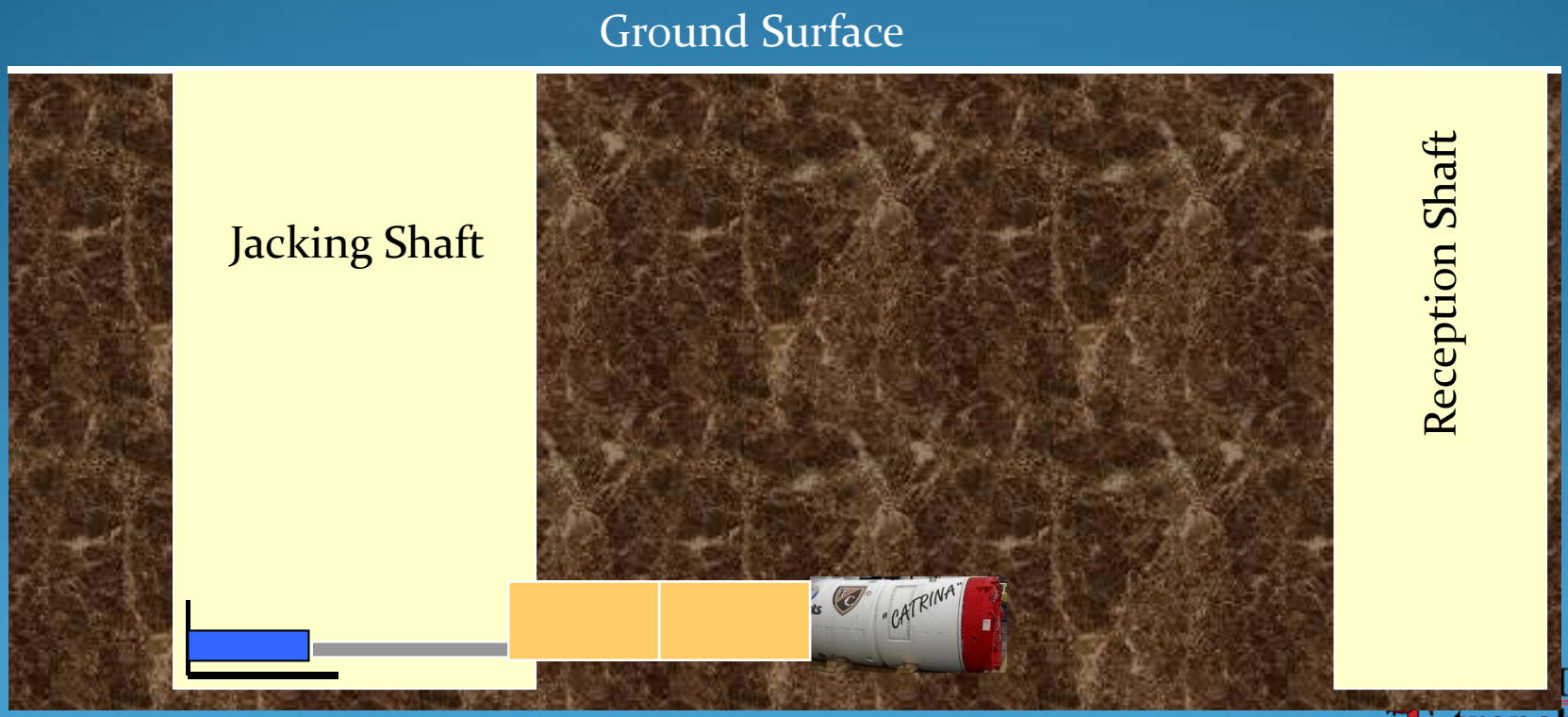
Microtunneling Process



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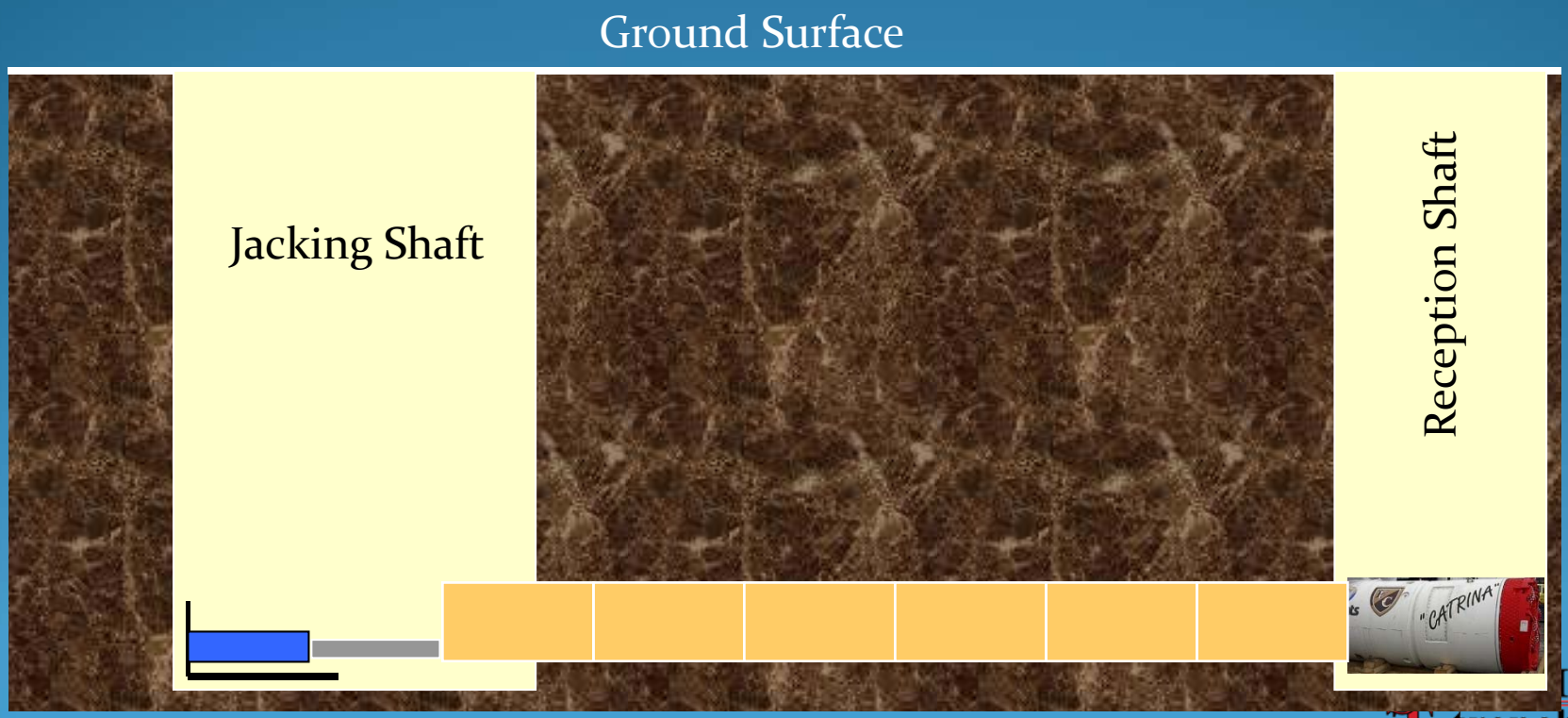
Microtunneling Process

- Machine retrieval
- Pipe in place



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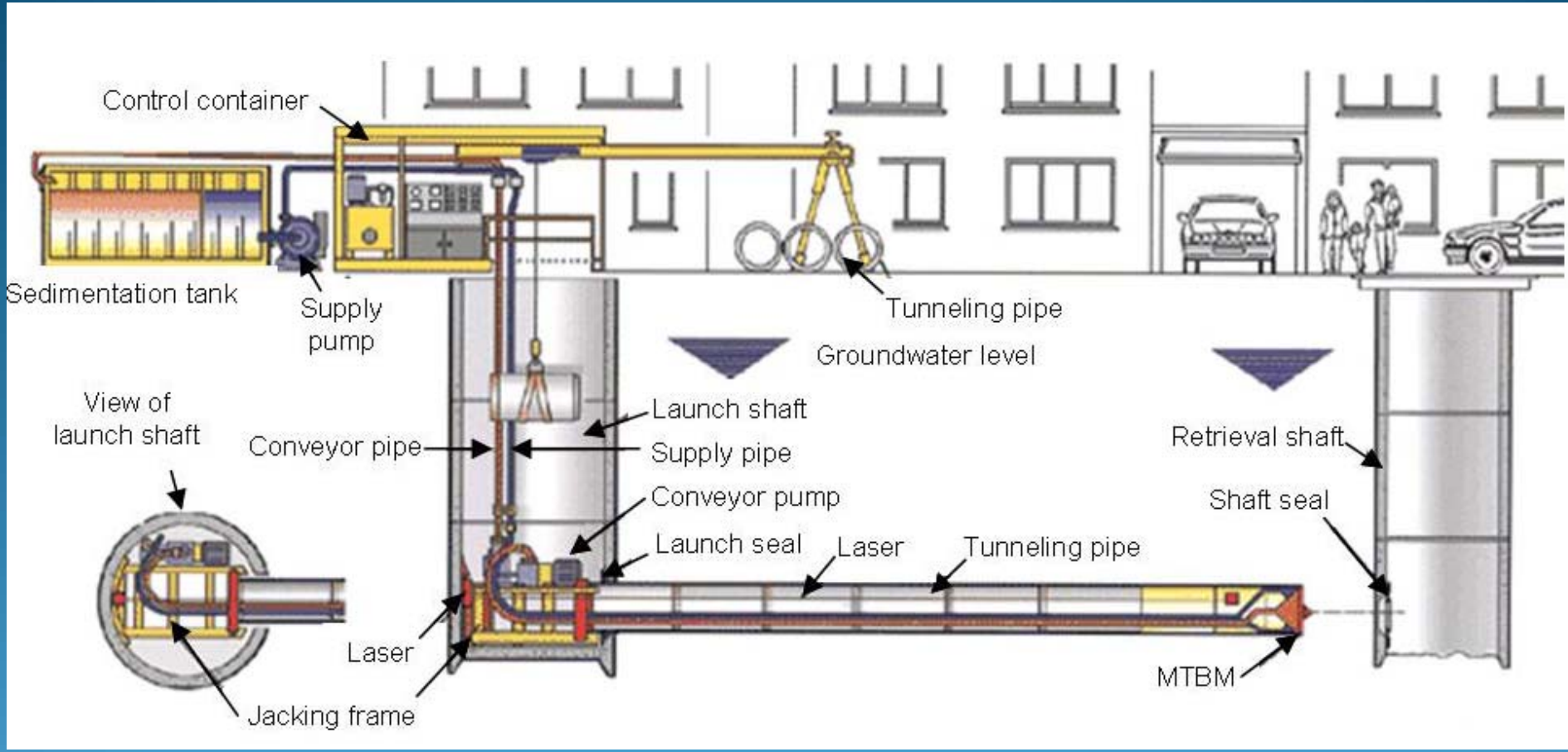

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Microtunneling

- Generally in Straight Lines
- Curves are Coming!
- Machines in the U.S. are 30-110 inches

Microtunneling Lessons Learned

- Machines do not perform well in solid rock
  - Can use a Robbins SBU attachment
- In Glacial Soils – Need a 48-inch Base Machine
- Gravel/Cobbles are a problem
- Soft soils (blow counts < 4 blows/foot) can result in bearing capacity problems

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Rock Microtunneling Machines

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Use of Robbins SBUs

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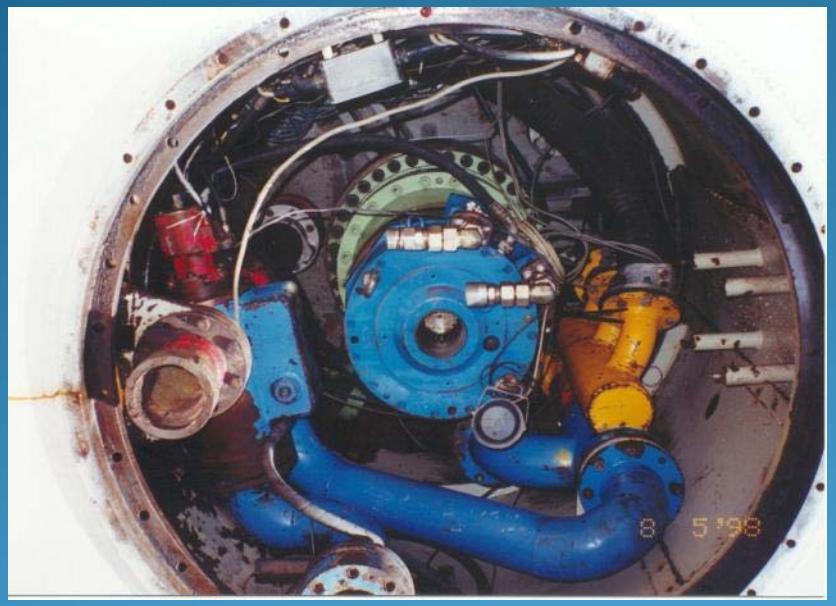
Glacial Soils – 48” Base Machine



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Gravel and Cobbles

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The Fix for Gravel and Cobbles

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Soft Soils

- Blow Counts < 4 Blows/Foot = Machine Can Sink
- Ground Modification
  - Jet Grouting
  - Compaction Grouting
  - CSM Panels
- Is Microtunneling the Answer???

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Horizontal Directional Drilling

- Surface to Surface installation
- Uses pressurized mud to cut a hole
- Stabilizes the hole with drilling mud
- Up-sizes the hole with a reamer
- Cuts a hole 1.5 times or 12-inches greater than the pipe
- Fully assembles pipe on surface
- Pulls fully assembled pipe into prepared bore in one continuous pull.

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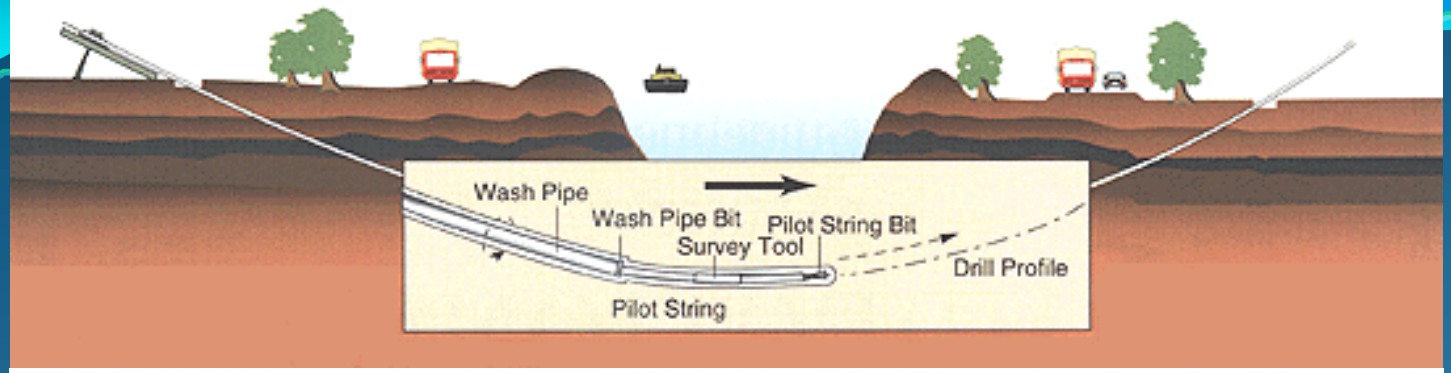
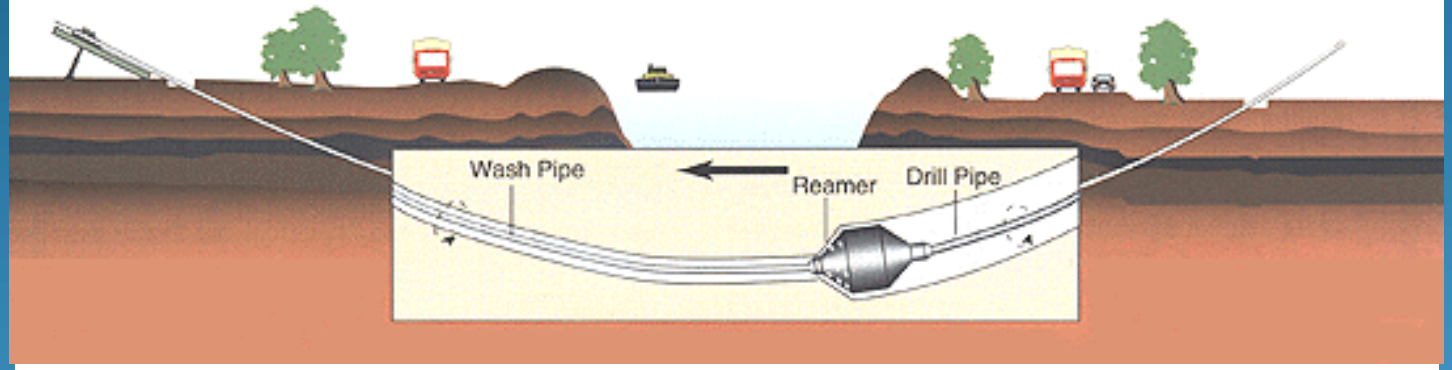
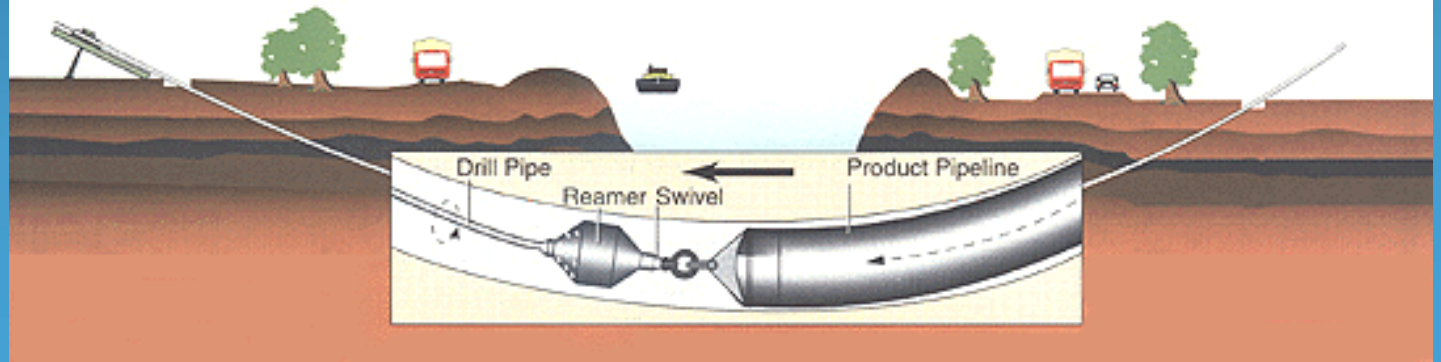
I.D.1. Pilot Hole



I.D.2. Preream



I.D.3. Pullback



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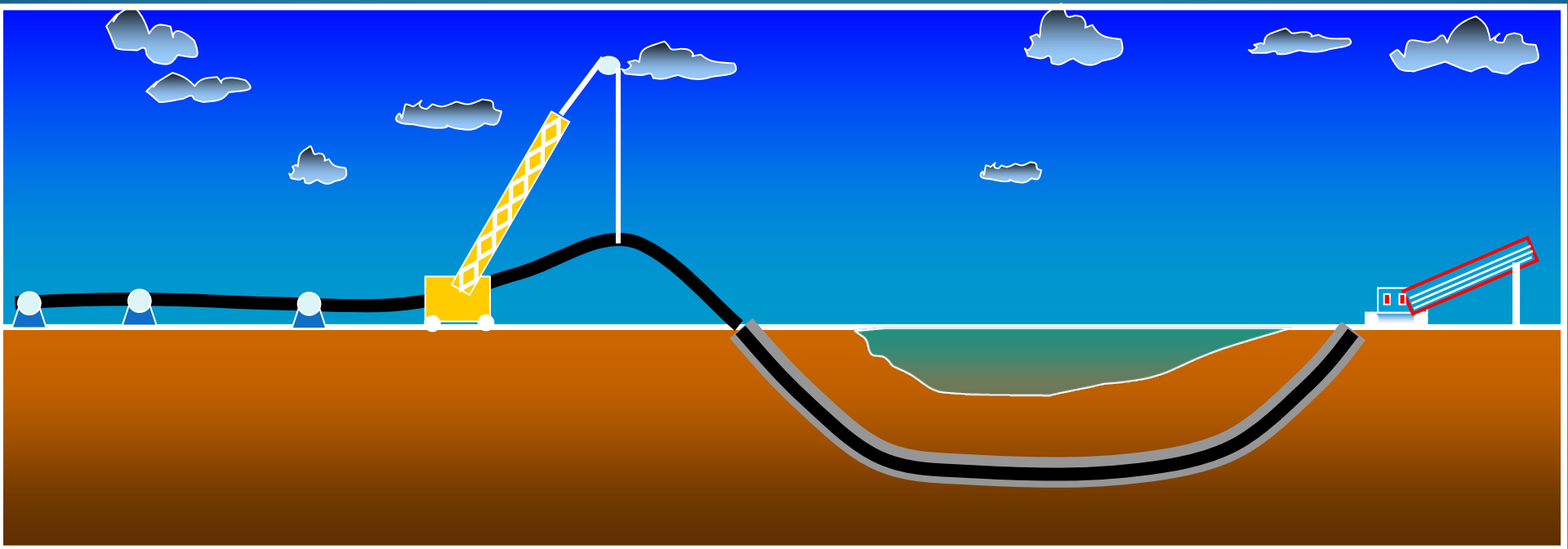
Horizontal Directional Drilling



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Horizontal Directional Drilling

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Mud Plants

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Horizontal Directional Drilling Lessons Learned

- It is all about the MUD
- Run a Hydrofracture Analysis
  - Determine appropriate clearances below critical elements such as streams
- Conductor casings – Proper Installation
- Line and Grade Installations – 2% minimum grade

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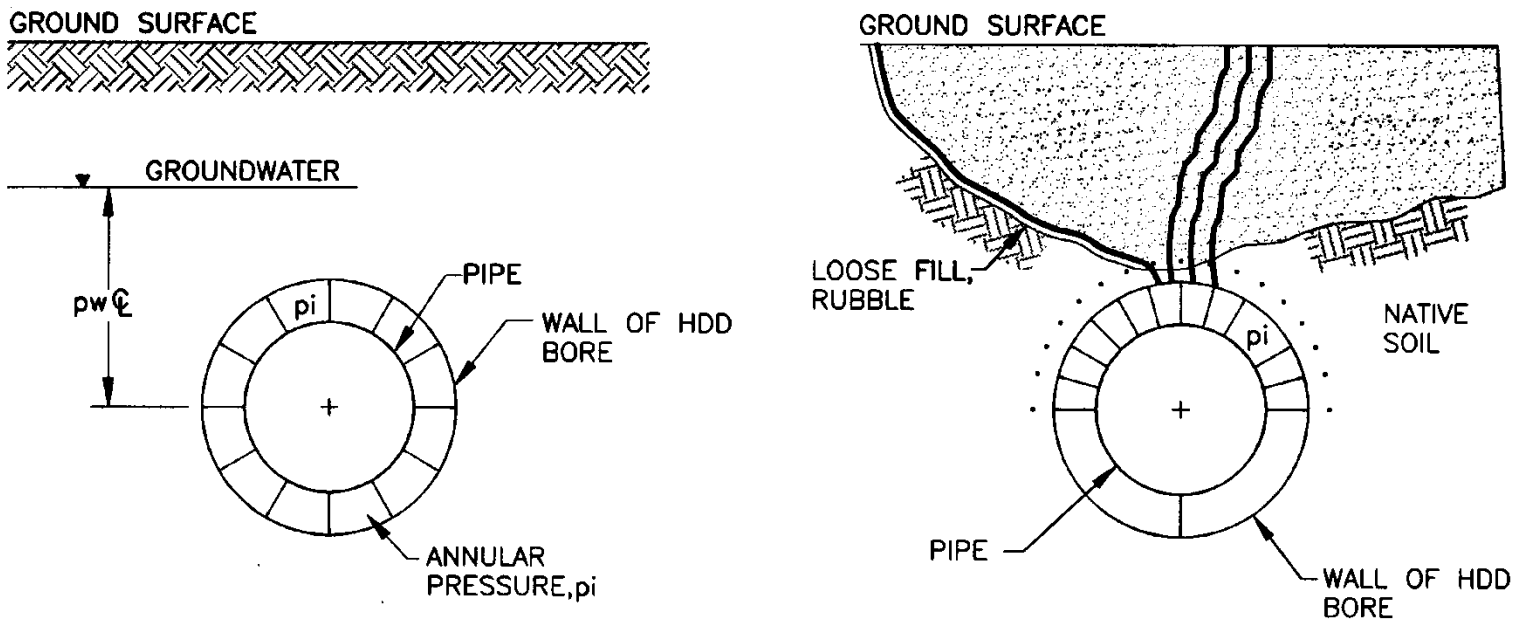
It is all about the MUD, Baby!

- Where Did My Mud Go?

Found It!!!

Hydrofracture Analysis



A. GENERAL RELATIONSHIPS

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Hydrofra elft)

$p_{max} = u + [P_f +$ $\frac{\varphi}{\varphi}$ $- c \cdot cot\, \varphi$

Where:

$p_f = \sigma_0'$ ρ

$Q =$

Those Equations Scare Me!
Keep Them Away!

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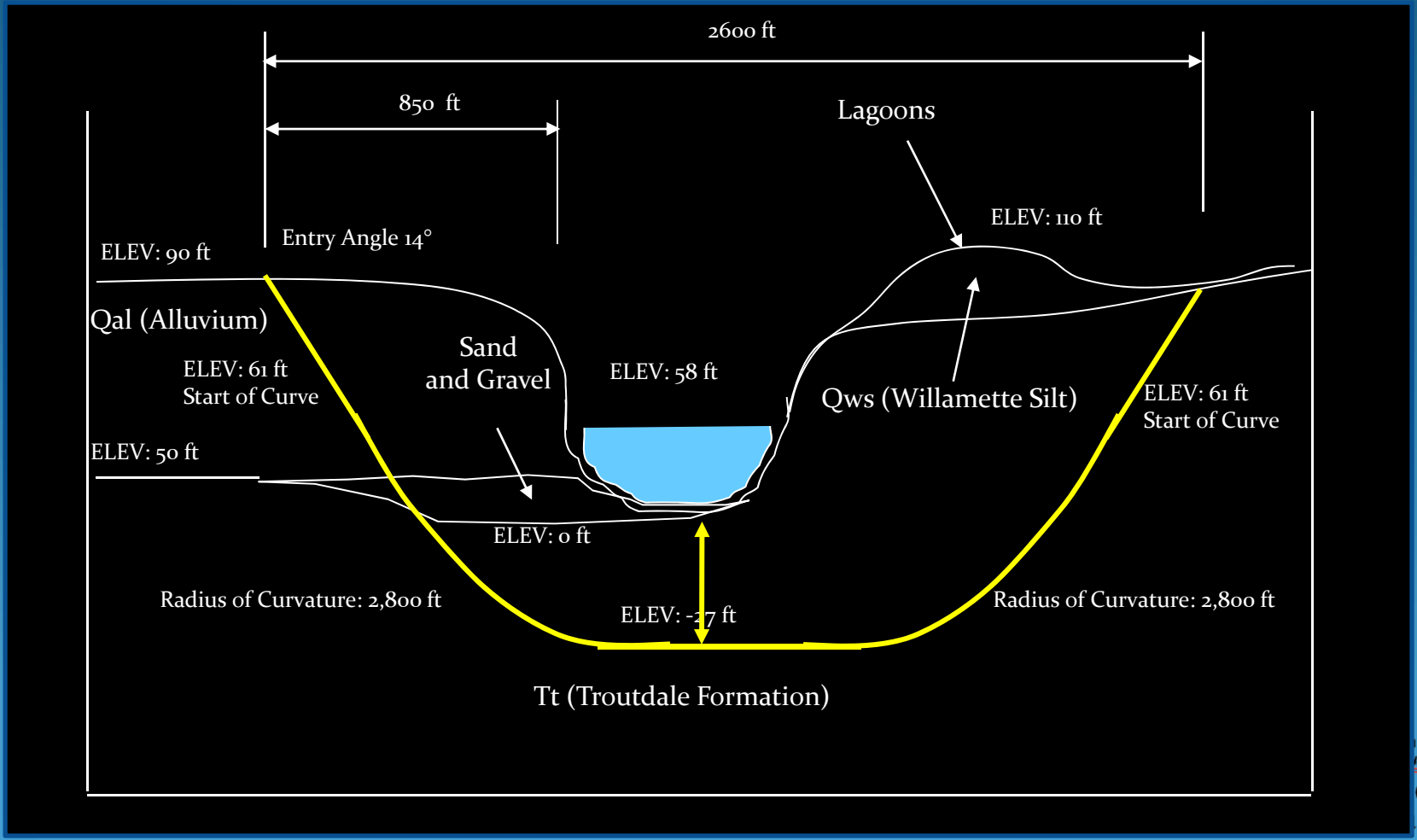
Appropriate Depth



Conductor Casings

Horizontal Directional Drilling Lessons Learned

- It is all about the MUD
- Run a Hydrofracture Analysis
  - Determine appropriate clearances below critical elements such as streams
- Conductor casings – Proper Installation
- On Grade Installations – 2% minimum grade

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Pipe Ramming

- Open Ended Casing
- Pneumatic Hammer
- Displacement of Soil
- No Steering
- Ram to Final Location
- Remove Soil Within Casing
- Length limited by Friction

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Pipe Ramming

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P g Lessons Learned

- thickness
- r and inner)
- tends the ramable length
- ized
- Use bullet bits when in glacial soils with cobbles and boulders
- Use proper size compressor for hammer
- Specify minimum hammer size

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General Lessons – All Trenchless

- Trenchless Portion of the Job
  - Generally Highest Risk Portion of the Pipeline
  - Highest Potential for a Differing Site Condition Claim
  - Design very dependent on Good Geotechnical Analysis

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Not all Trenchless Methods are Equal

- Biggest Mistake:
  - Specify Wrong Method
  - Don't specify any method – allow the wrong method to be used.
- Precise Grade Control: Microtunneling, Pilot Tube Auger Boring – not HDD or pipe ramming.
- Below Water Table: Microtunneling or HDD – but not auger boring or pipe ramming.
- Above water table: Auger boring or pipe ramming – but microtunneling likely not best choice.
- 1,000 feet: Microtunneling or HDD – but not auger boring or pipe ramming.

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Geotech, Geotech, Geotech

- Spend the $$$ during Design on Geotech to allow
  - Selection of the proper Trenchless Method
  - Analysis of the Trenchless Risk
  - The Appropriate Information to be Given to the Contractor for Preparing a Bid

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Perform a Trenchless Risk Analysis

- Identify Risks
- Quantify Risks
- Identify Mitigation Measures

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Use Experienced CM Staff

- Construction Activities
- Troubleshoot Issues
- Evaluate Potential Change Orders
- Minimize Claims

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Thank You

- Questions?

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