

RESTORING STORAGE

Recycling an Existing Storage Tank

Michelle L. Johnson, P.E.

2018 PNWS AWWA Conference



J·U·B ENGINEERS, INC.



**THE
LANGDON
GROUP**



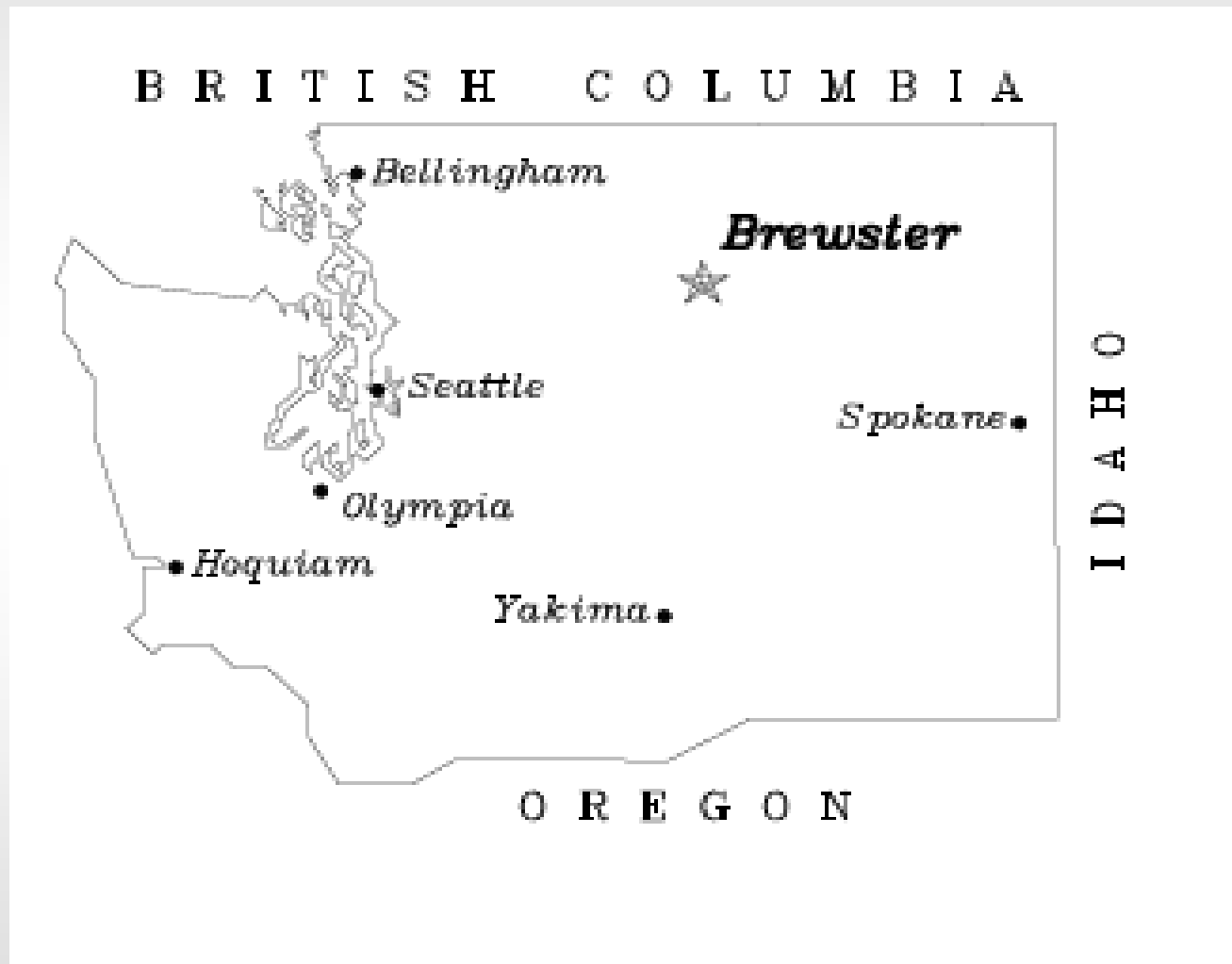
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OTHER J-U-B COMPANIES

Outline

- Background
- How we got to the decision to recycle the tank
- Design considerations
- Construction
- Lessons learned

Background



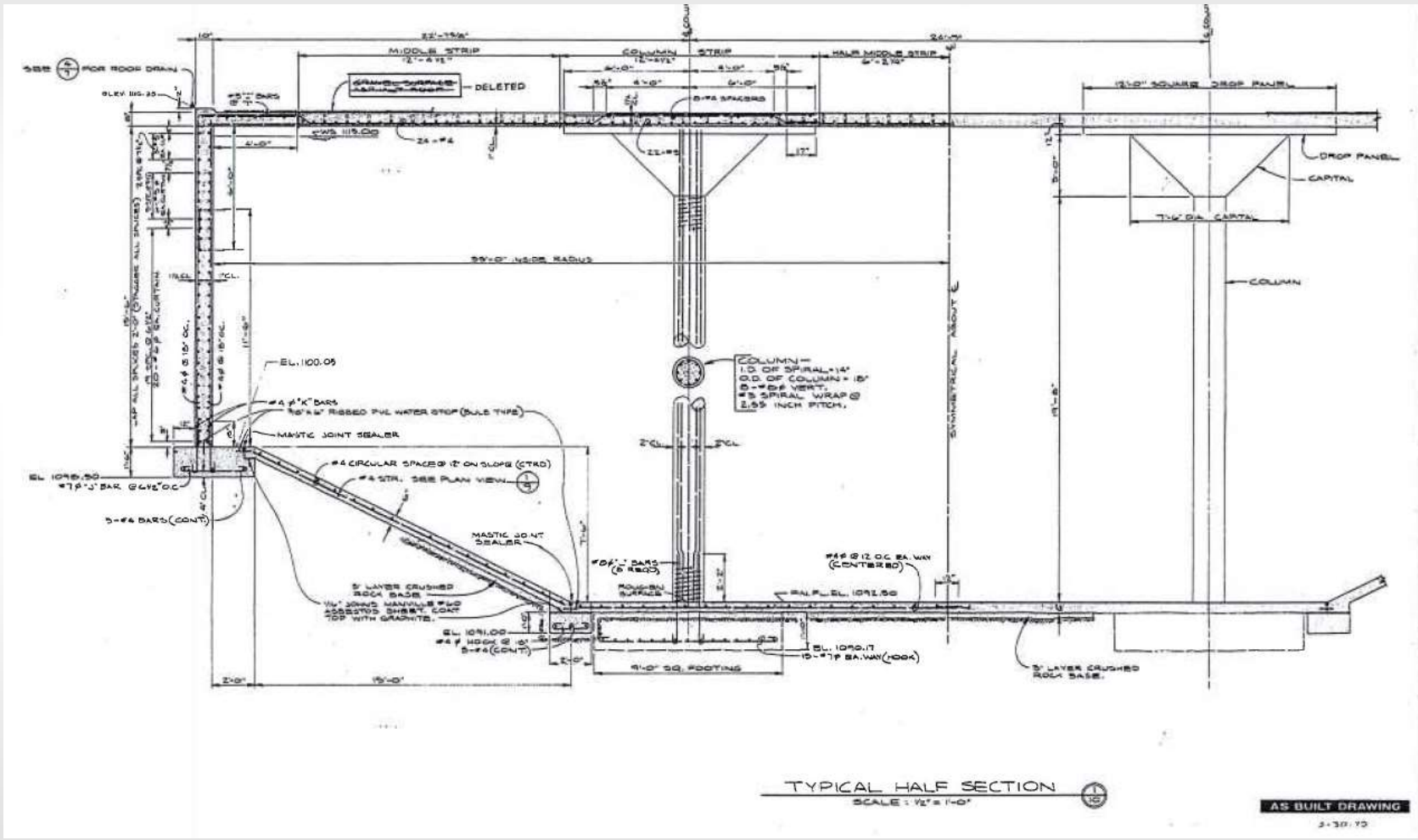
Background

- Water System
 - 753 physical connections
 - Three supply wells
 - Three storage tanks in two pressure zones
 - Lower Zone
 - 200,000 gal – Constructed in 1949
 - 300,000 gal – Constructed in 1963
 - Upper Zone
 - 500,000 gal - Constructed in 1975
 - One booster pump station

Background



Background



Background

- Tank inspection in 2008 identified cracks
- “Live” repairs were made



Background

- Comprehensive Water System Plan in 2013
 - Documented 2008 tank inspection identifying leaks and potential voids under slab.
 - Recommended repairing cracks and voids in 500,000 gal tank.
 - Recommended lining lower tanks.
- No real motivator for additional storage



And then...

Thank You To Our Firefighters

SERVING WASHINGTON'S OKANOGAN VALLEY SINCE 1905

GAZETTE-TRIBUNE

WWW.GAZETTE-TRIBUNE.COM | THURSDAY, AUGUST 27, 2015 | 75 CENTS NEWSSTAND PRICE **SOUND**

Largest Fire in State History



Okanogan Complex burns 258,399 acres

Thousands of firefighters, local efforts to help evacuate and those who lost homes

More than 100 firefighters are battling the Okanogan Complex fire, which is the largest in Washington state history, burning 258,399 acres in the Okanogan Valley.

The fire, which started on Tuesday, has spread to the Okanogan National Forest and is threatening several communities.

Firefighters from across the state and neighboring states are working to contain the fire. The fire is burning in the Okanogan Valley, which is a major agricultural area.



BY GARY A. SMITH
gsmith@gazette-tribune.com

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Resources in place for victims of recent fires

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J-U-B ENGINEERS, Inc.

And then...



And then...



And then...

Carlton Complex Fire

Started: July 14 by lightning

Contained: Aug. 25

Acres burned: 256,108

Lives lost: Rob Koczewski, 67, on July 19, 2014 from a heart attack; John "Danny" Gebbers, 84, on Oct. 21, 2014 from a head injury

Homes lost: 277 primary, 50 cabins

Other losses: 900 to 1,000 cattle; 500 miles of fencing; millions of board feet of timber

Power outage: 3,602 customers for more than a week; 156 for more than 20 days

Damage claims against DNR: More than \$75 million

Suppression cost: \$100 million

Source: Capital Press research
Dan Wheat and Alan Kenaga/Capital Press



Post Fire

- Fires caused strain on system
 - Need more storage
- Increase in unaccounted for water
 - More damage to the tank?



Post Fire Repairs

- Experiencing losses of 115,000 gpd
- Tank Inspection and Repair
 - Evaluate condition post fire storm condition August 2014
 - “Live” repairs were made
- Losses reduced to under 60,000 gpd



Post Fire Repairs

■ Identified Deficiencies

- "360"- A video inspection done around the entire perimeter of the inside wall, this crack would be around the ground level on the outside of the crack.
- "floorcrack"- A video of a very large crack that is feeding water from the floor. This crack begins on the wall and continues down the floor right up to a supporting column. In this video, one can see that sediment is flowing straight into the crack. This is most likely the main feeder causing most of the water loss, but certainly not all of it.
- "floorcrack_2"- a second crack that appears to also have been addressed but is failing. This split, like "floorcrack," is approximately 18' long.
- "rootmass_1" is a video of "d1_1" rootmass growing out of the floor. Evidence that water has been flowing freely from the tank for some time. notice the sediment flowing straight into the crack?
- "d1_2" is a picture of the rootmass in "d1_1" coming up from the floor.
- "d2_1" is a picture of another rootmass coming out of the wall in another area. This crack is still below grade and is also allowing water to flow freely out of the tank.

What Now?

- Storage Needs
 - More emergency storage!
 - Newest water tank has potential structural issues.
 - And, it is the only tank for the Upper Zone.
 - One lower zone tank is undersized and in poor condition.
 - Second lower zone tank is in acceptable condition, but will need to be replaced at some point.

Now What?

- Engineering services
- Funding
 - Funding in place for a project by mid 2015!
 - Funding Sources
 - Community Development Block Grant
 - State Revolving Fund Grant and Loan
 - State Appropriation

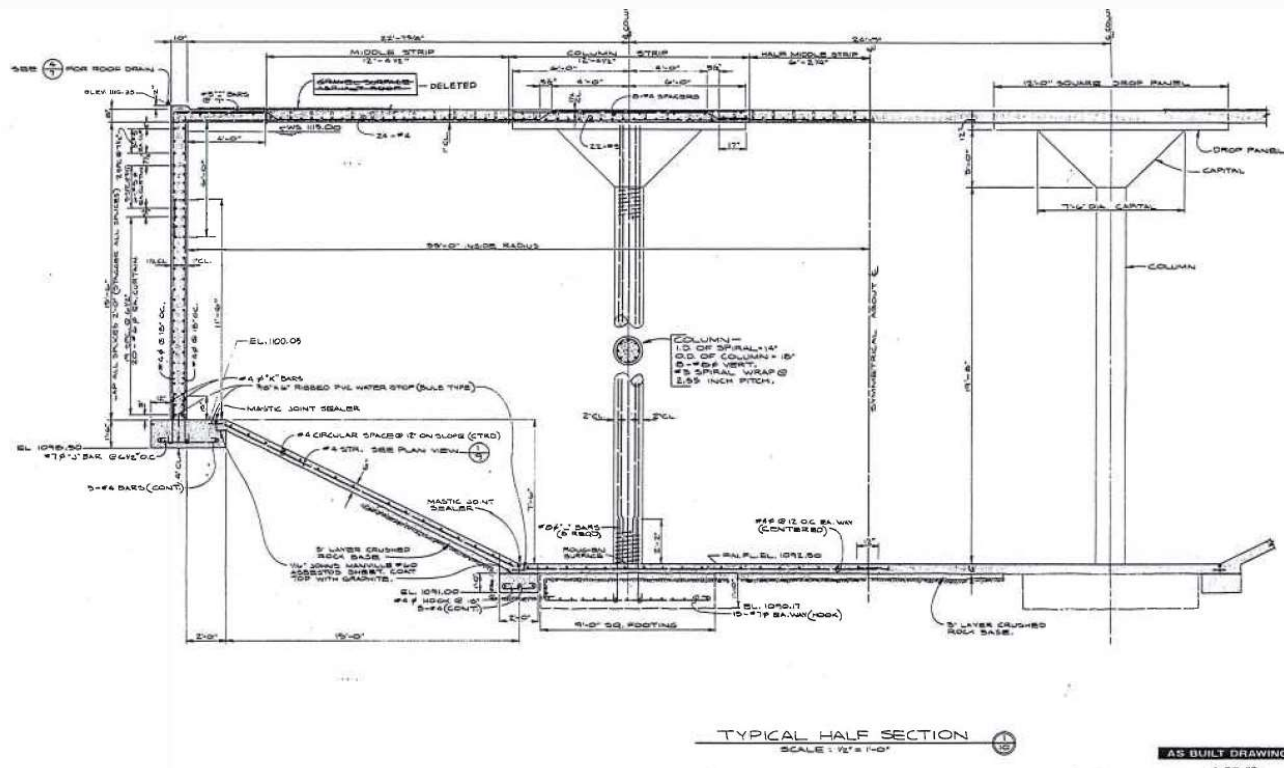


Design Considerations

- Project Development
 - Need to maintain service during construction
 - The leaky tank is the newest tank
 - Weighed cost of replacing
 - Potential rehabilitation
- Rehabilitation
 - Liner?
 - Coating like Sprayroq?
 - Other options?

Design Considerations

- What about building a tank inside the tank?
 - Existing walls are 10-inches
 - Floor is 6-inches



AS BUILT DRAWING

J-30-75

Design Considerations

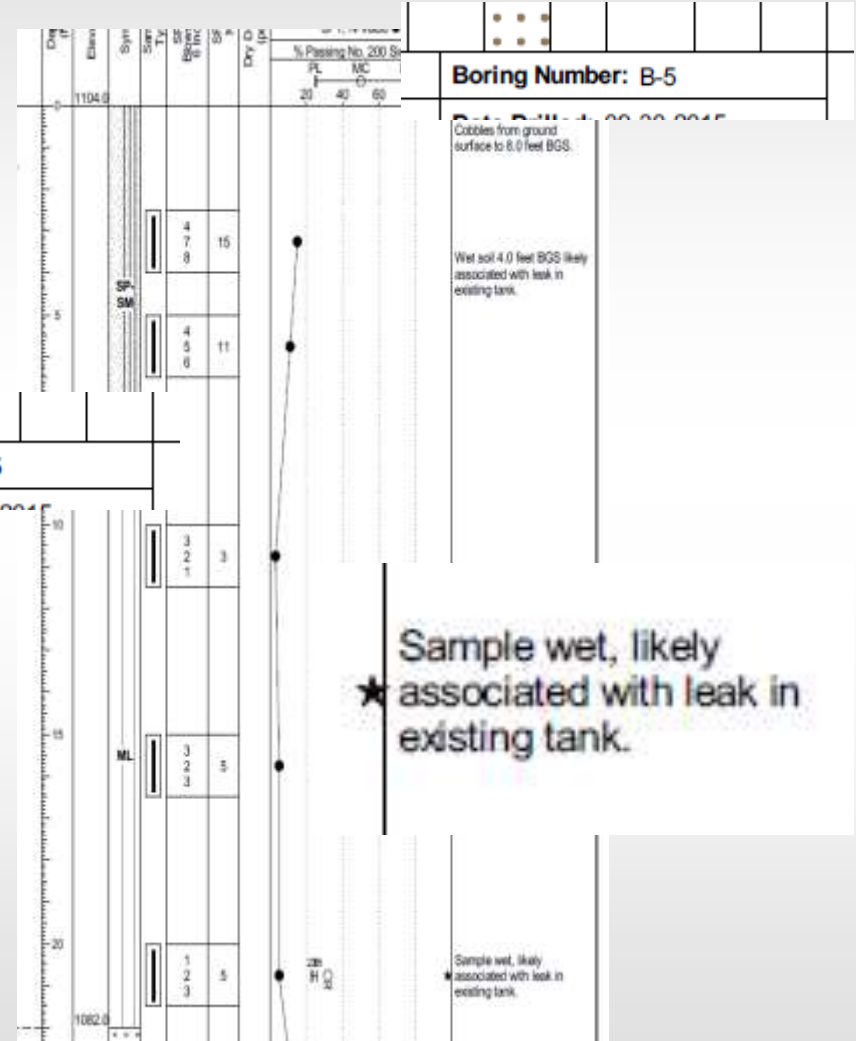
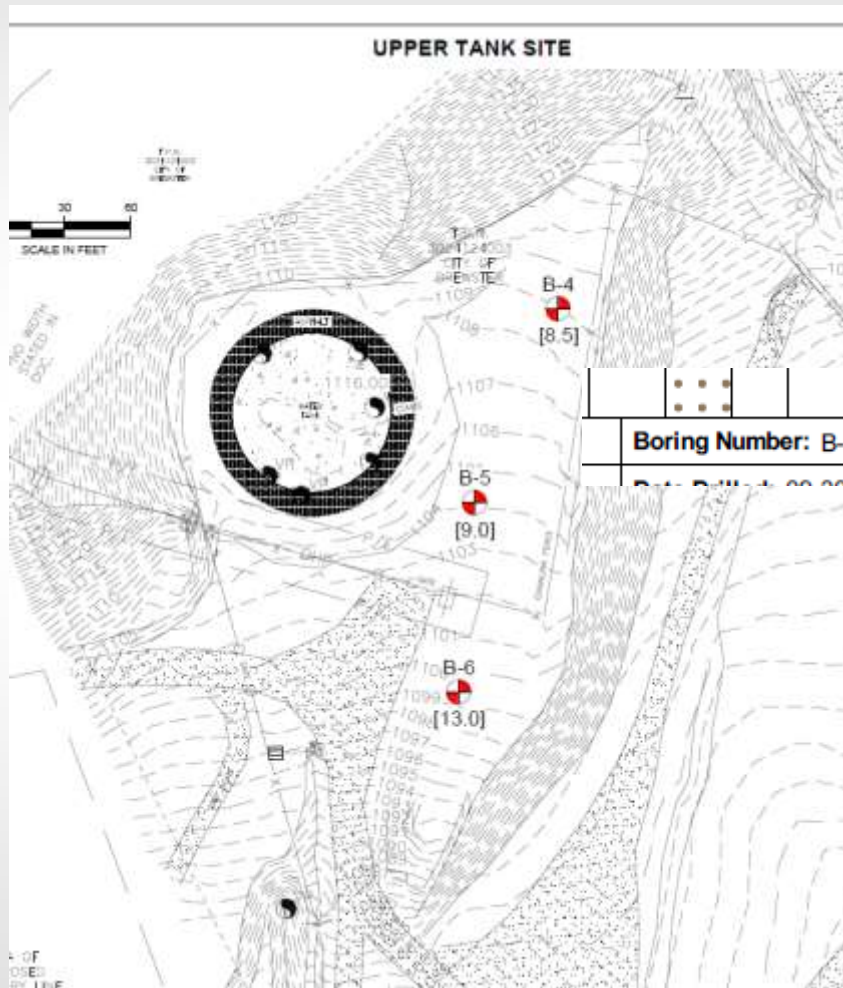
- Cost opinions:
 - Rehab is a viable option
- Proposed Project:
 - Rehab of existing tank
 - Parallel tank of equal volume
 - Replace 200,000 gallon tank at lower site

Design Considerations

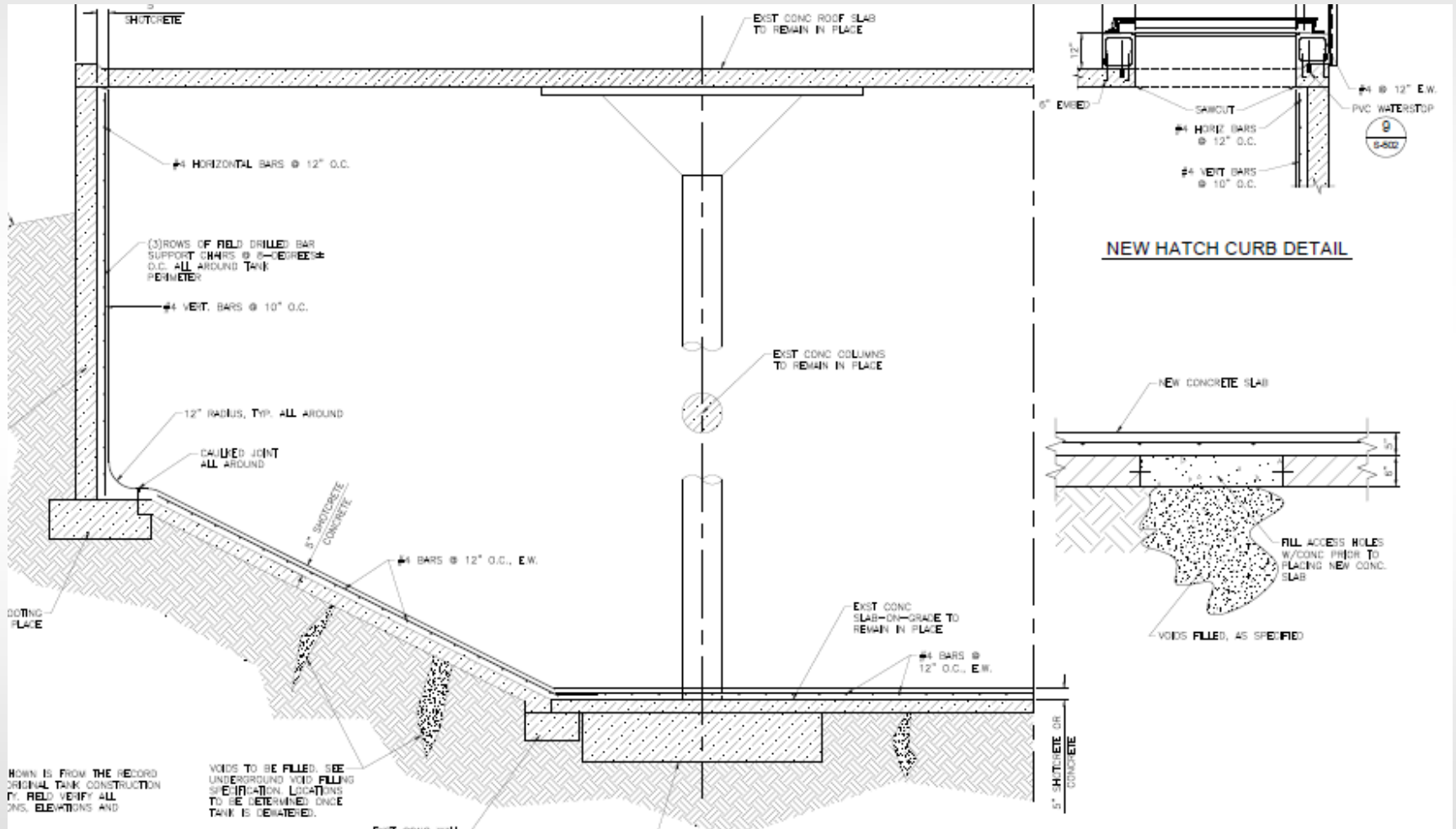
- Locate new tank
 - Wet layers near tank bottom
 - Raised concerns about voids under slab
 - Complicates location of adjacent tank



Design Considerations



Design Considerations



Design Considerations

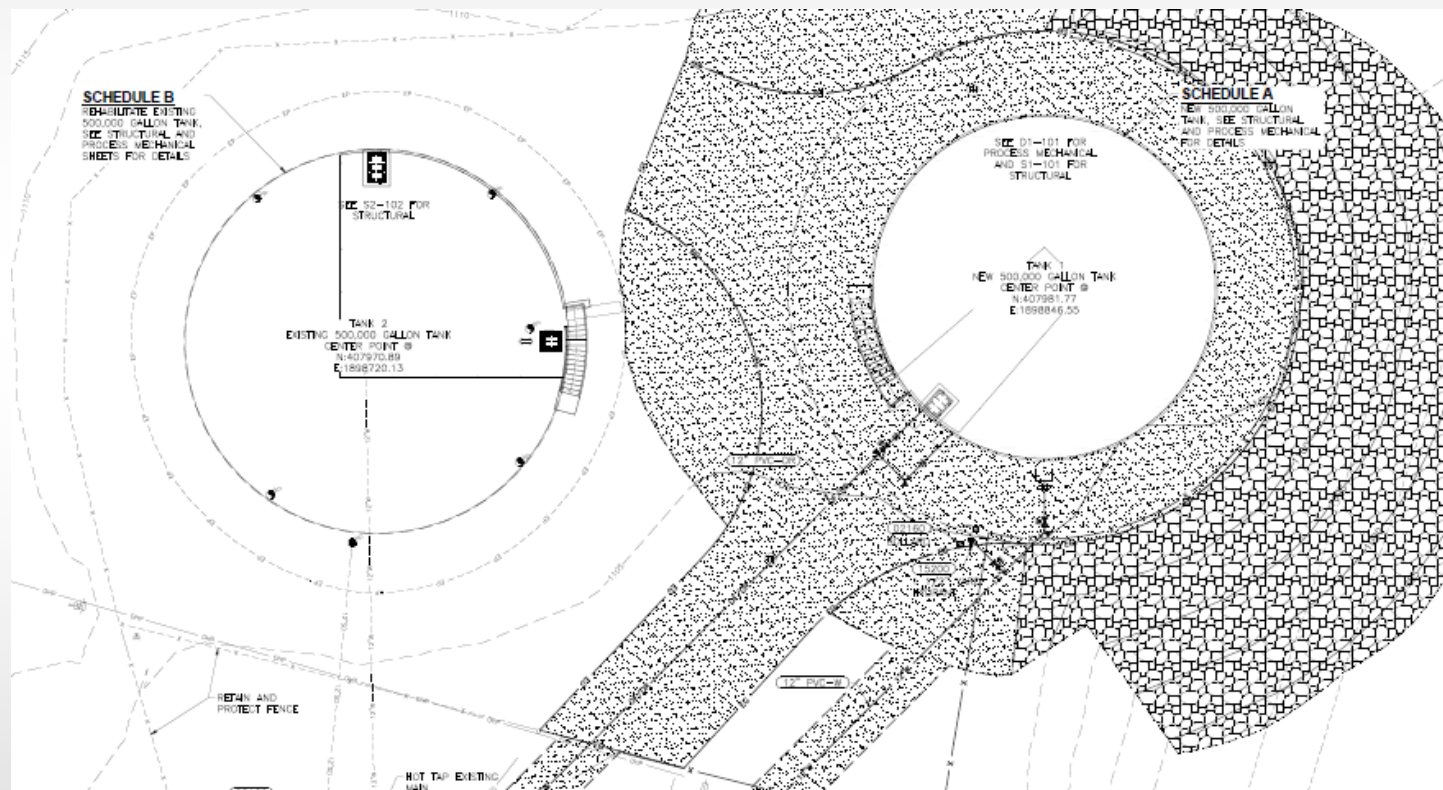
- Plan to fill voids
 - Grout injection
- Bid documents
 - Plan to evaluate a certain number of areas
 - Two line items:
 - 1 to 10 cubic yards
 - 11 to 100 cubic yards
- Evaluate slab before and after

Construction Staging

- Build new tank!
- Rehabilitation
 - Drain and clean the existing tank
 - Ground Penetrating Radar (GPR) of the floor
 - Pressure grout injection
 - GPR round 2
 - Rebar and shotcrete the interior

Construction Staging

- New Tank Site



Construction – New Tank



Construction – New Tank



Construction – New Tank



Construction – New Tank



Construction - Rehab



Construction - Rehab

- Drained the tank - First visual inspection of the tank interior



Construction - Rehab



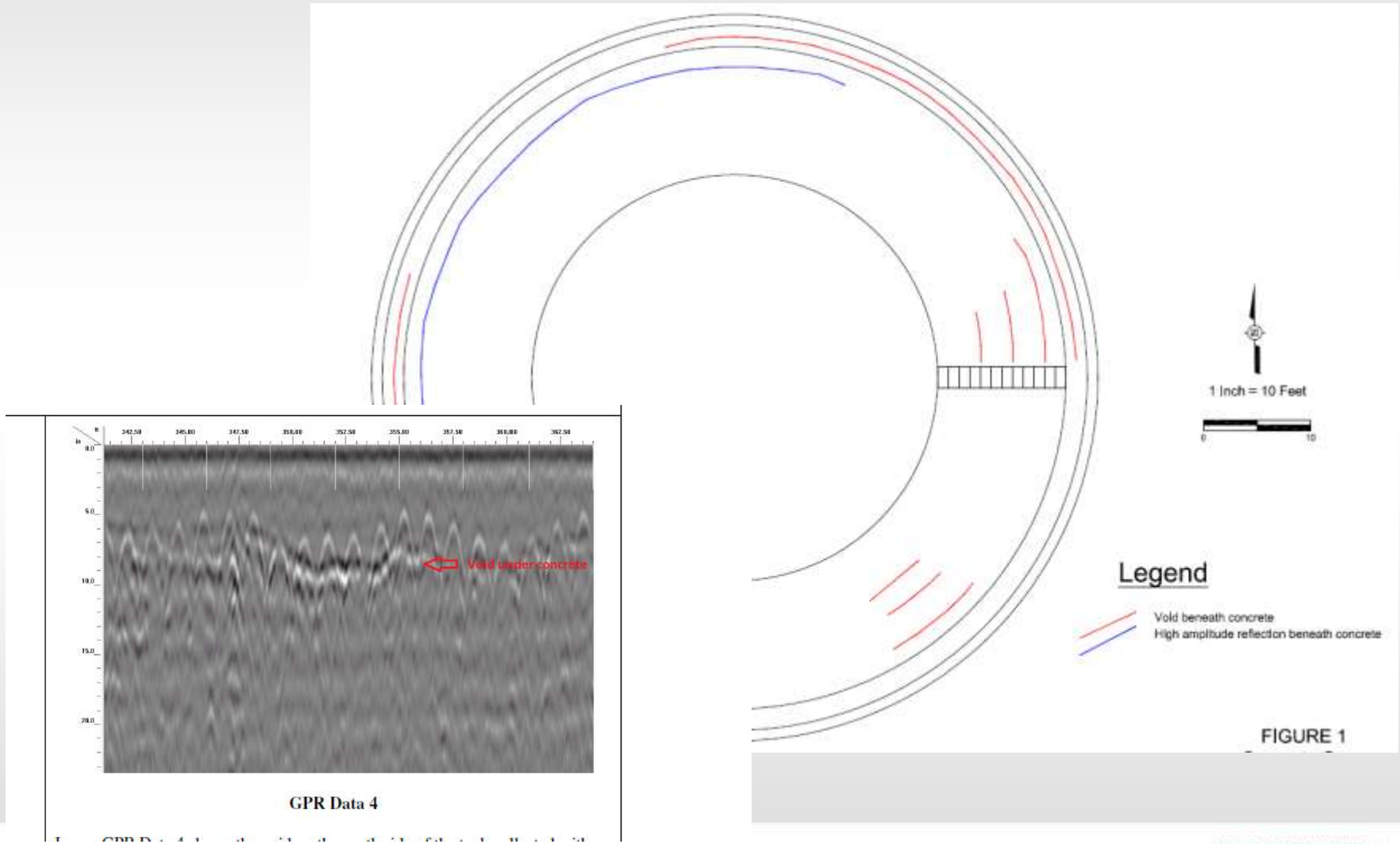
Construction - Rehab



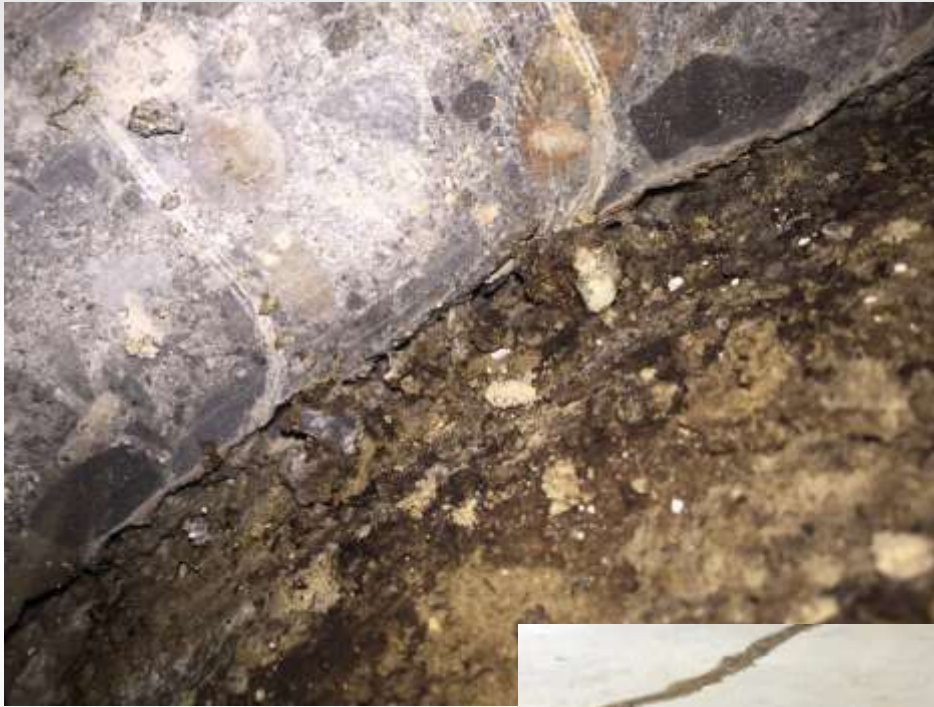
Construction - Rehab



Void Evaluation



Void Evaluation



Void Evaluation

- Determine grout injection is not needed.
- Crack repair at tank perimeter and seal floor joints.



Crack Repair



Crack Repair



Crack Repair



Crack Repair



Crack Repair



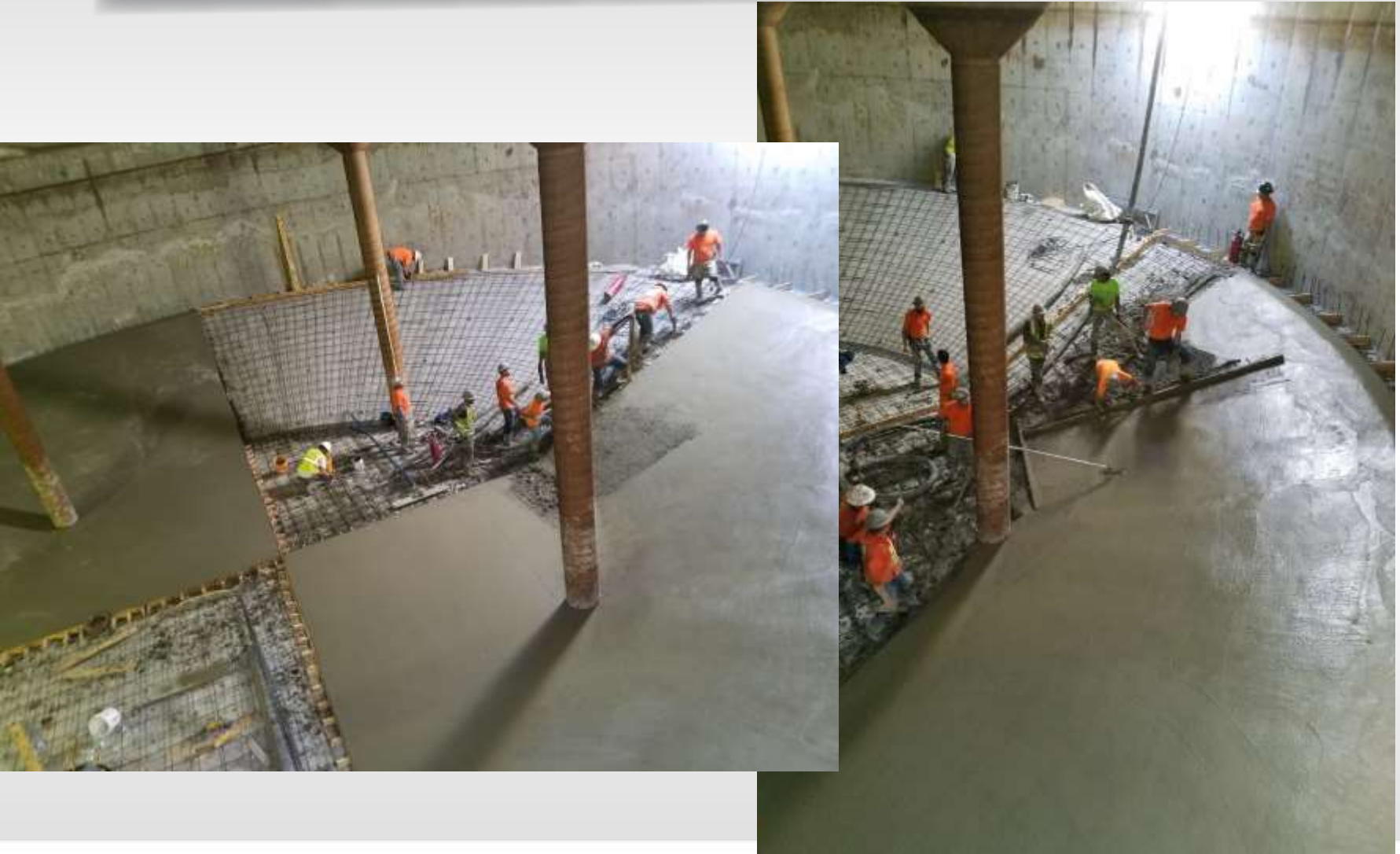
Floor Construction



Floor Construction



Floor Construction



Floor Construction



Shotcrete Prep

- Shotcrete prep was critical
 - Pre-application meeting a few days before to get testing firm and applicator on the same page.
 - Test panels led to modifying the mix.



Shotcrete Prep



Shotcrete Prep



Shotcrete Prep

- False floor and rebar curtain for shotcrete application.



Shotcrete Prep



Shotcrete Application



Shotcrete Application



Shotcrete Application



Shotcrete Application



Shotcrete Application



Shotcrete Application

- Finishing Challenges



Shotcrete Application



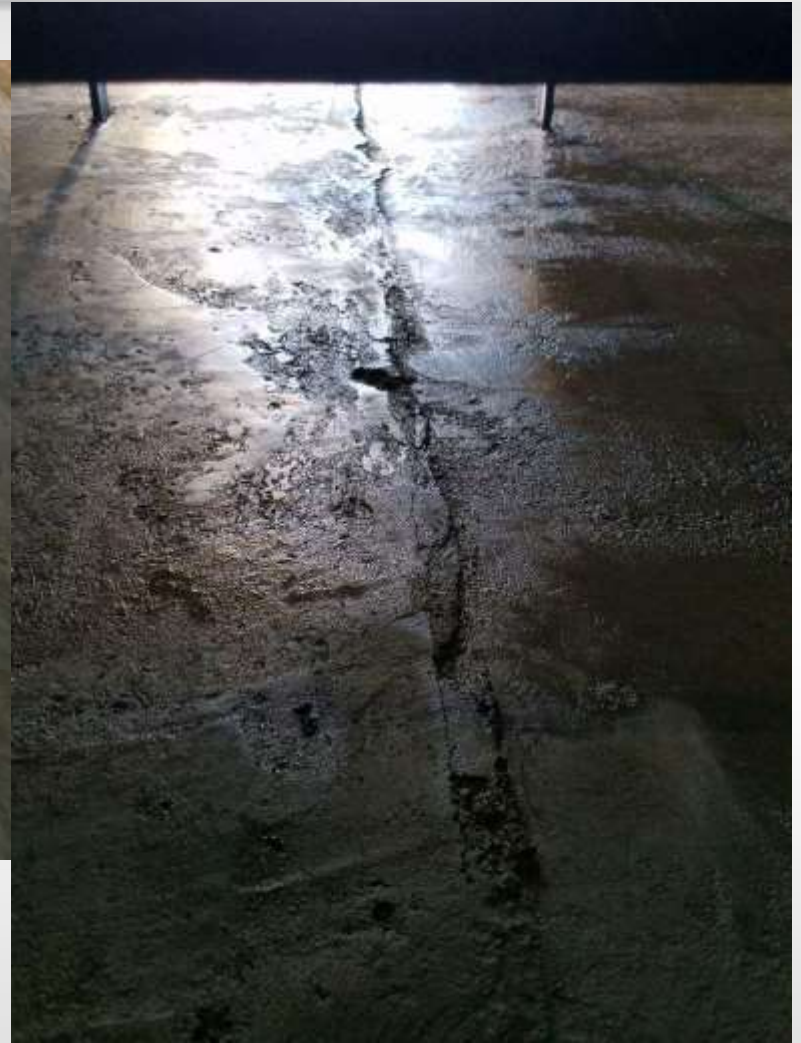
Shotcrete Application



Shotcrete



Shotcrete



Final Work



Construction Cost

- New 500,000 gallon tank
 - \$840,000

- Rehab 500,000 gallon tank
 - \$400,000

Lessons Learned

- Shotcrete prep and application were critical!
 - Prep work
 - An experienced nozzleman was key!
 - Pre-application meeting
 - Test panels
 - Application was more critical than other components

Shotcrete Application...

- Complications with finishing
 - Slow to finish – short loads of mix were helpful
 - Work from the bottom up, overspray falls down over finished work
 - Were finishing and refinishing lower wall portions
 - Cold joint finishing was challenging
- No water stop due to application – something to consider

Lessons Learned

- Thickness and tolerance:
 - Stainless steel wire – in case it has to be left in place.
 - Pins in the rebar to monitor thickness of the shotcrete application.
- Finish coat for smooth finish

Project Highlights

- Able to provide continuous water service.
- Improve the long term storage needs for the City.
- Great involvement with City and Contractor staff.
- Funding package allowed for a necessary project to be completed at a great value to the rate payers.

Thanks!

- City of Brewster
- Apollo Inc.
- STRATA
- Funding Agencies



Questions?

