

Storage Facility Inspection and Maintenance - Tools and Tips

AWWA-PNWS Section Conference, May 2019

Agenda

- Storage facilities
- Inspection and maintenance
- Tools and tips
 - Tried and true methods
 - Newer technology

Storage Inventory (Includes Plant Clearwells)

TYPE	NUMBER	TOTAL MG
Open (uncovered) reservoirs – emergency storage	2	71
Concrete reservoirs, floating cover	2	81
Concrete reservoir & cover	13	258
Steel standpipes	10	10.6
Steel elevated tanks	7	8.5
TOTAL	34	429

Inspection & Maintenance Activities

Sanitary inspection	Performed regularly, 2-3x / year (ground-level and entire exterior)
Cleaning	Performed every 3-5 years or as needed
Structural / coating inspection	Performed after cleaning
Spot repairs	As needed based on inspections
Re-coating	Needed every ~15-20 years, usually by contractor

Basic Inspection Tools

- Checklists, PPE, cameras, reports



Ground Level Hatches

1. Are the hatches unlocked?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
2. Are the hatch seals leaking?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
3. Is there evidence of vandalism?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

Roof Level Hatch

1. Is the tank ladder easily accessible or unlocked?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
2. Is the hatch unlocked?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
3. Is there evidence of vandalism?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
4. Is rainwater leaking through the hatch into the tank?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
5. Is rainwater leaking into the tank around the edges of the hatch?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

Tank Roof

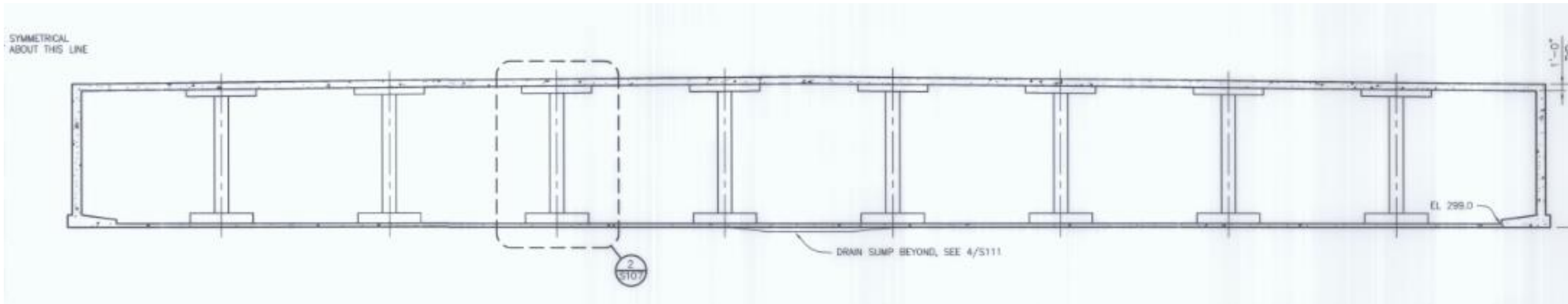
1. Is there evidence of vandalism?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
2. Is the roof in poor condition?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
3. Are there holes rusted in the roof? Can water leak in?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
4. Can anything else get in or be thrown in?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
5. Are there bird or bat nests?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
6. Is the mesh screening missing from any vent?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
7. Are there holes in the vent screens?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
8. Is the screening loose on any edge?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
9. Is there any debris blocking the vents?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
10. Are there many insects around the vents?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

Sample Tap

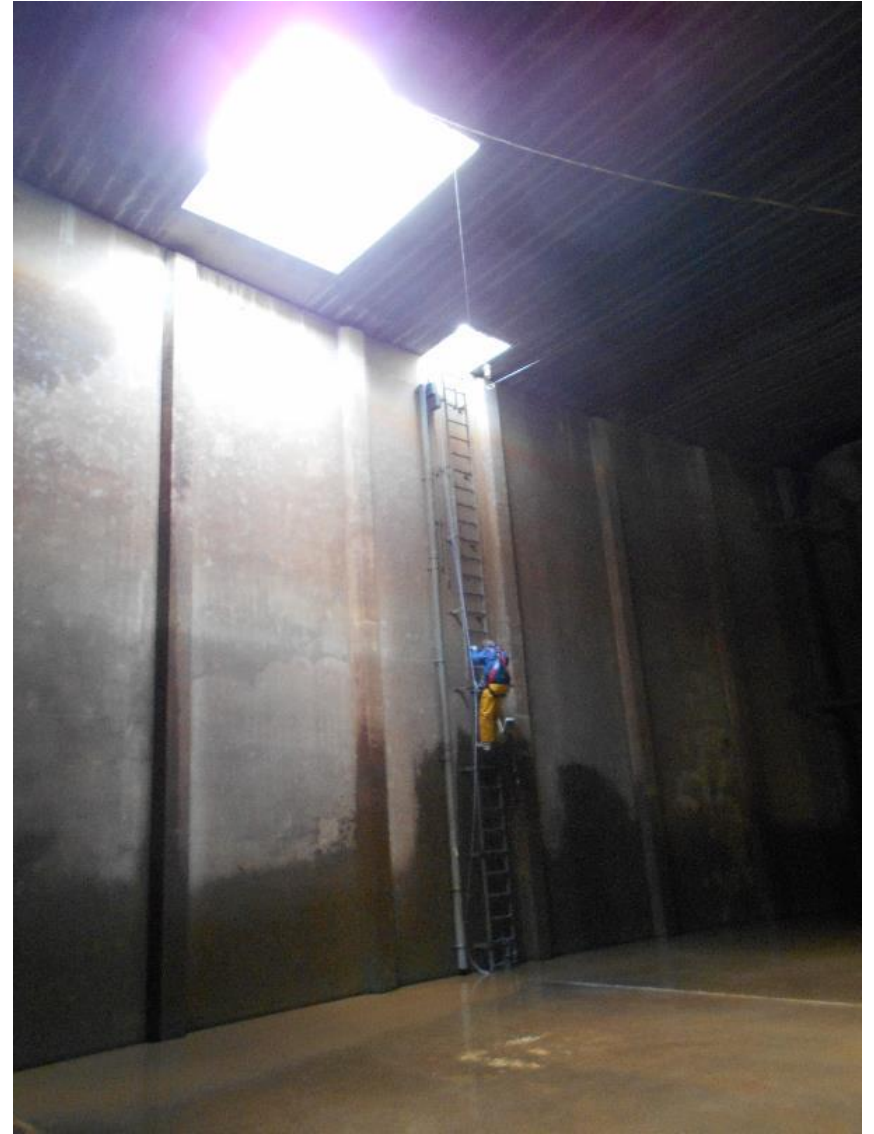
1. Was the sample cabinet unlocked?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
2. Is the tap leaking?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
3. Is the sample tubing dirty?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
4. Can rainwater leak into the sample cabinet?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
5. Are there insects in the sample cabinet?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
6. Does the sample cabinet need insulation to prevent freezing?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

How To Inspect It All?

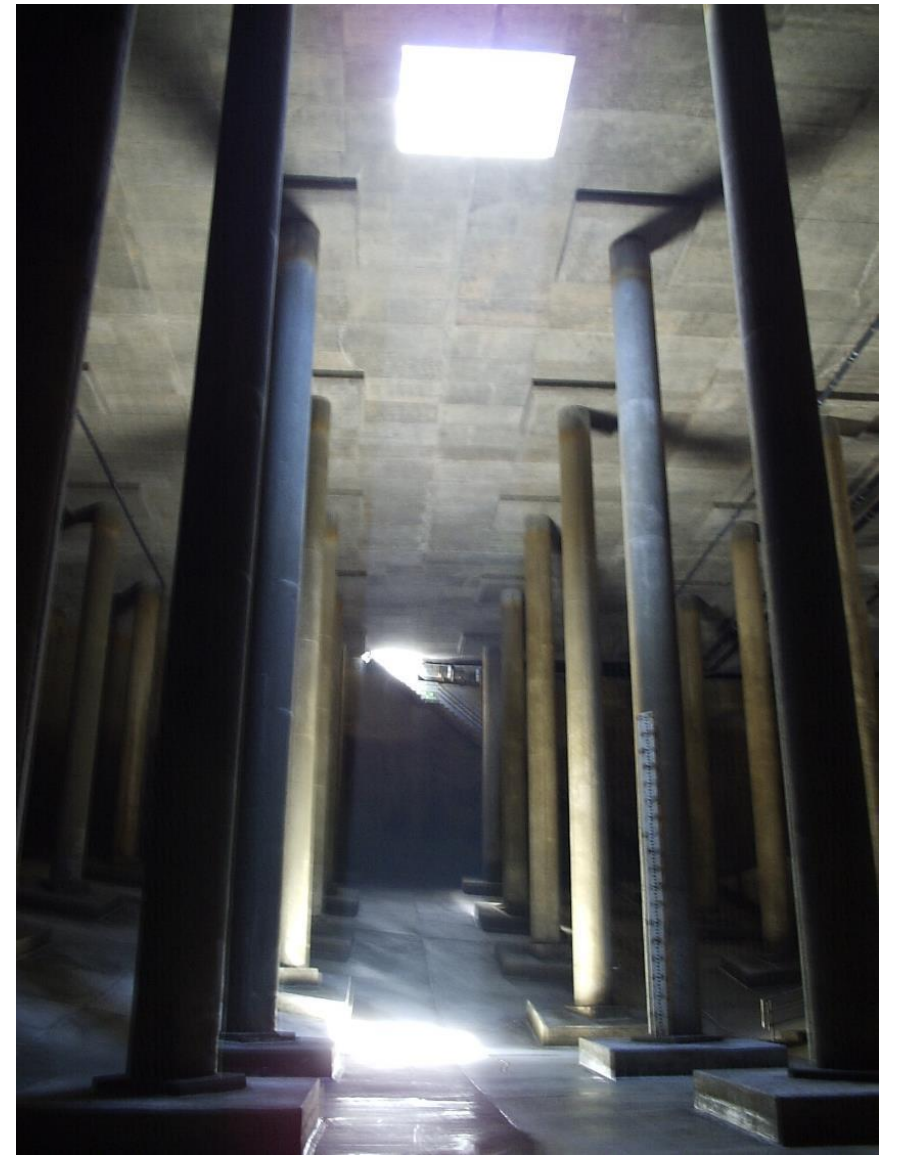
- Foundation/floor, walls, roof, piping
- Interior and Exterior



Interior Walls and Roofs



Interior Walls and Roofs



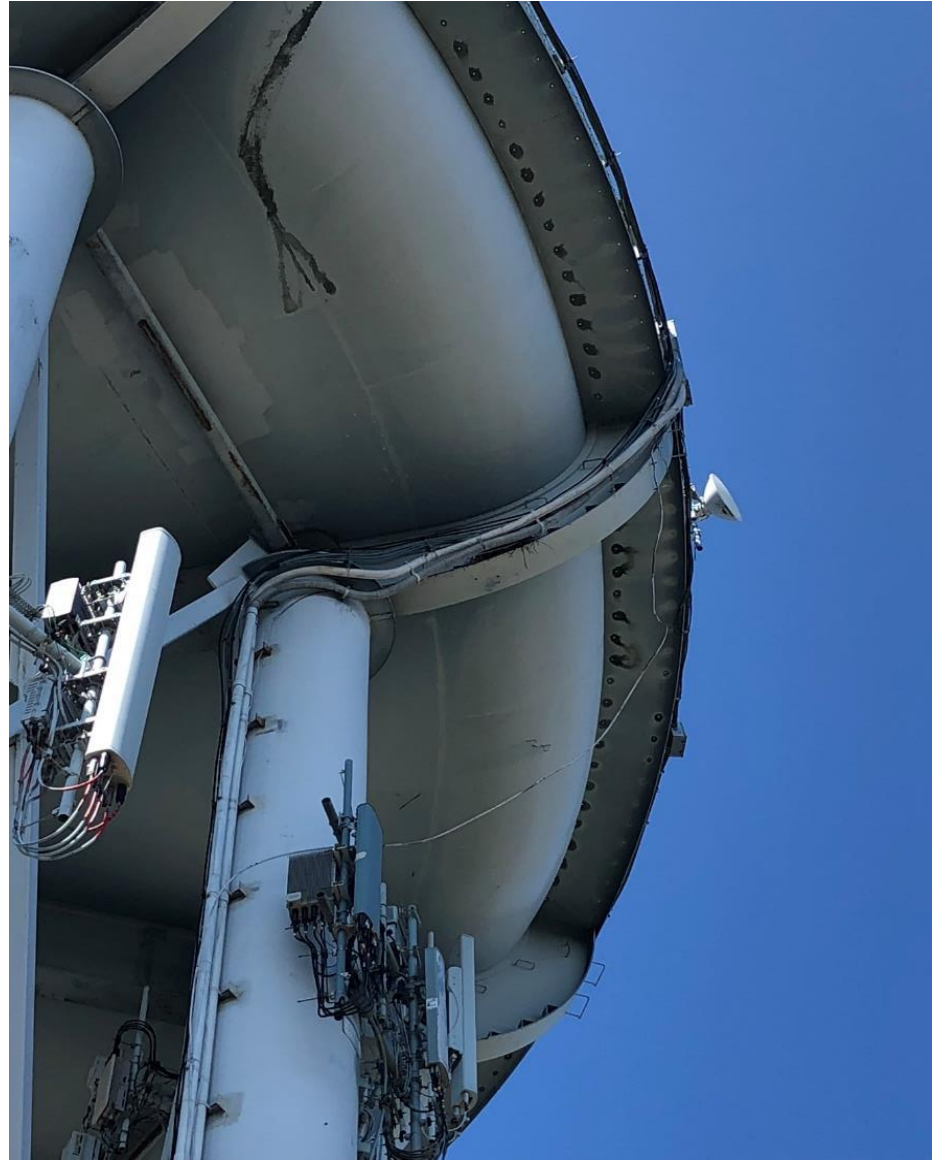
Interior Piping



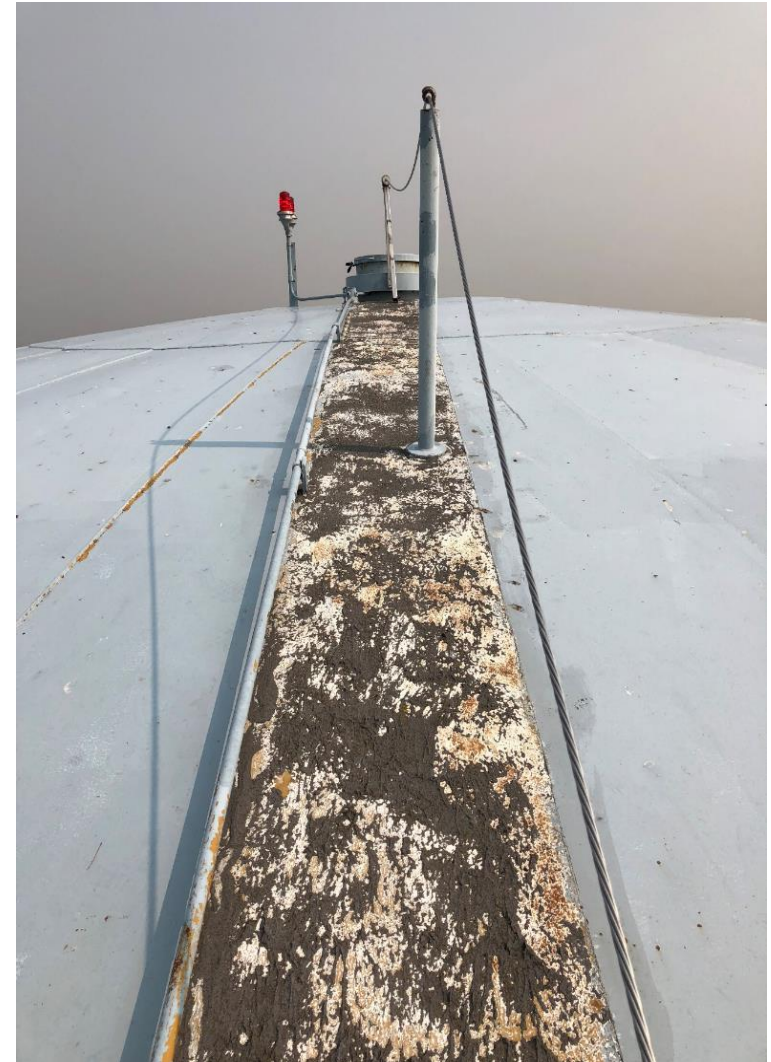
Exterior Walls



Exterior Walls



Exterior Roofs



Inspection Methods

Common Equipment/Methods

- Ladder
- Bucket Truck
- Scaffolding

Specialized Methods

- Float Inspection
- Dive Inspection

Utilizing Technology

- Drone
- GoPro
- Laser scan
- Ground penetrating radar
- Other Tools
 - Water CCTV Camera
 - Pit Gauge
 - Ultrasonic Thickness (UT) Gauge

Tank Ladder and Bucket Truck

- Paint Condition
 - Chalking
 - Blistering
- General Exterior Condition
 - Exposed Metal
 - Corrosion
 - Bird Block Screen



Scaffolding

- Interior
 - Portable
 - Installation
 - Roll Around
 - Inexpensive
- Exterior
 - Turn Off Cellular Antennas



Scaffolding - Exterior

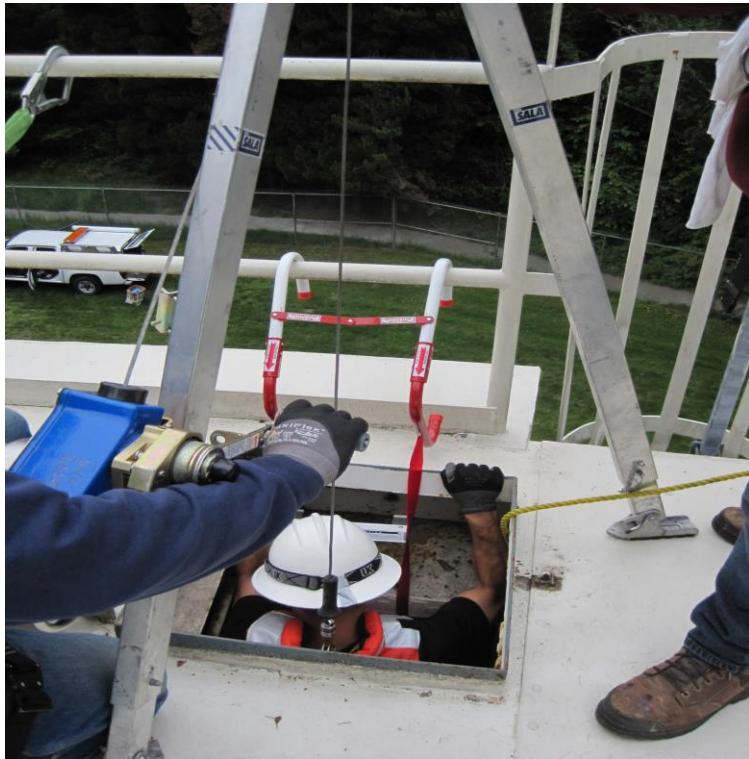


Float Inspections

- Elevated Tanks, Reservoirs, and Standpipes
- Desired water elevation - full
- Water Quality Requirements
- Safety
 - Communication protocol
 - Tethered off at all times
 - Lifejackets



Float Inspections - Trenton Tank



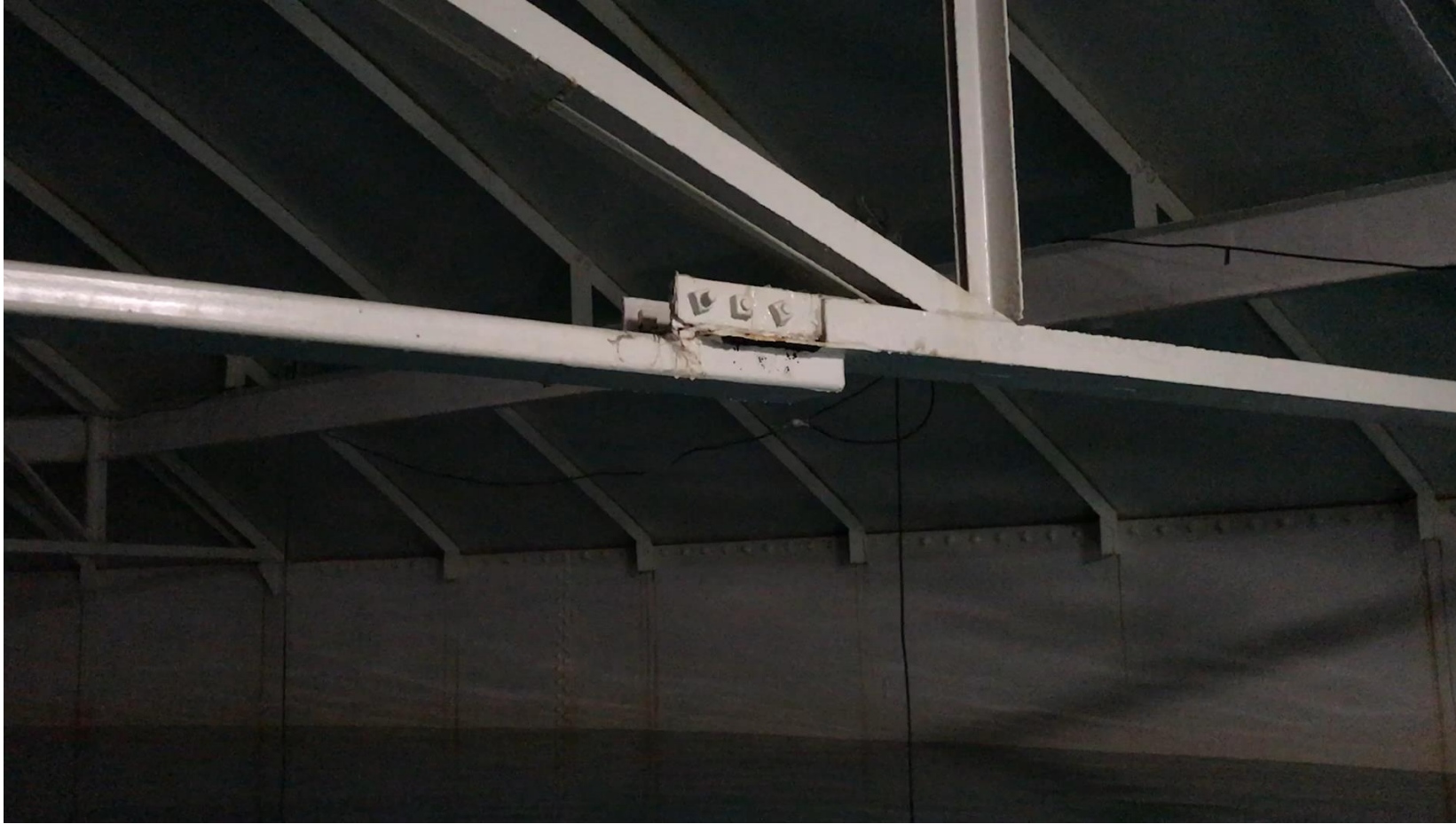
Float Inspections - Trenton Tank Overflow Pipe



Float Inspections - Myrtle Tank



Float Inspection - Myrtle Tank



Dive Inspections

- Disinfection requirements
- Access
- Safety
- Plan for what you might find

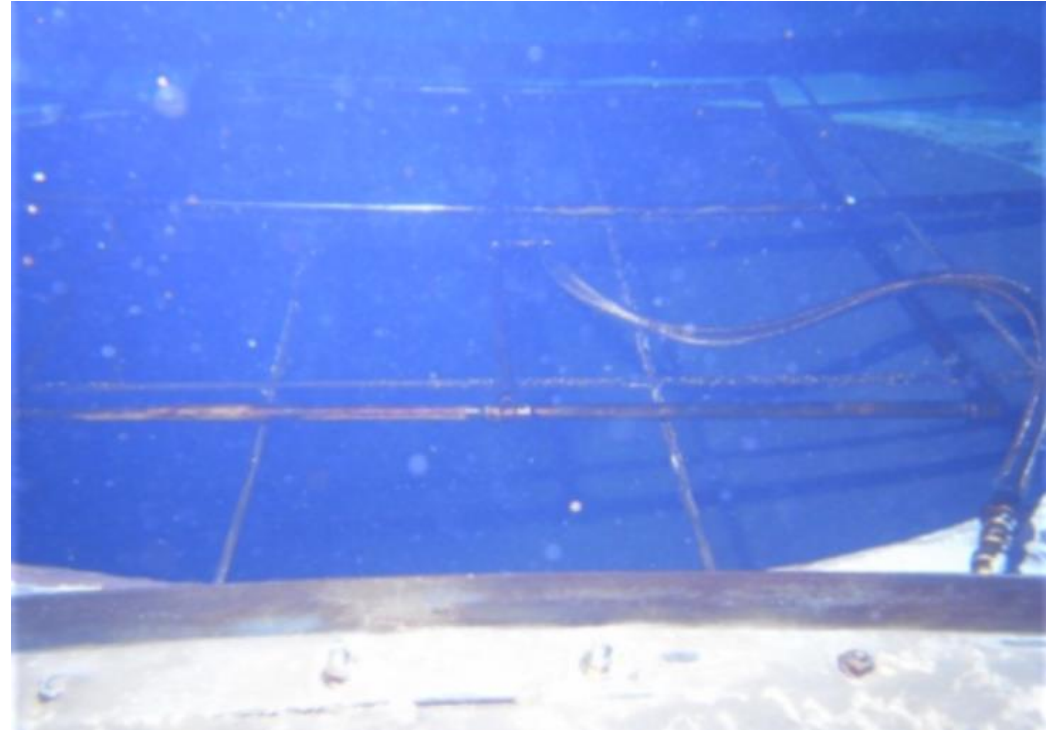


Dive Inspections

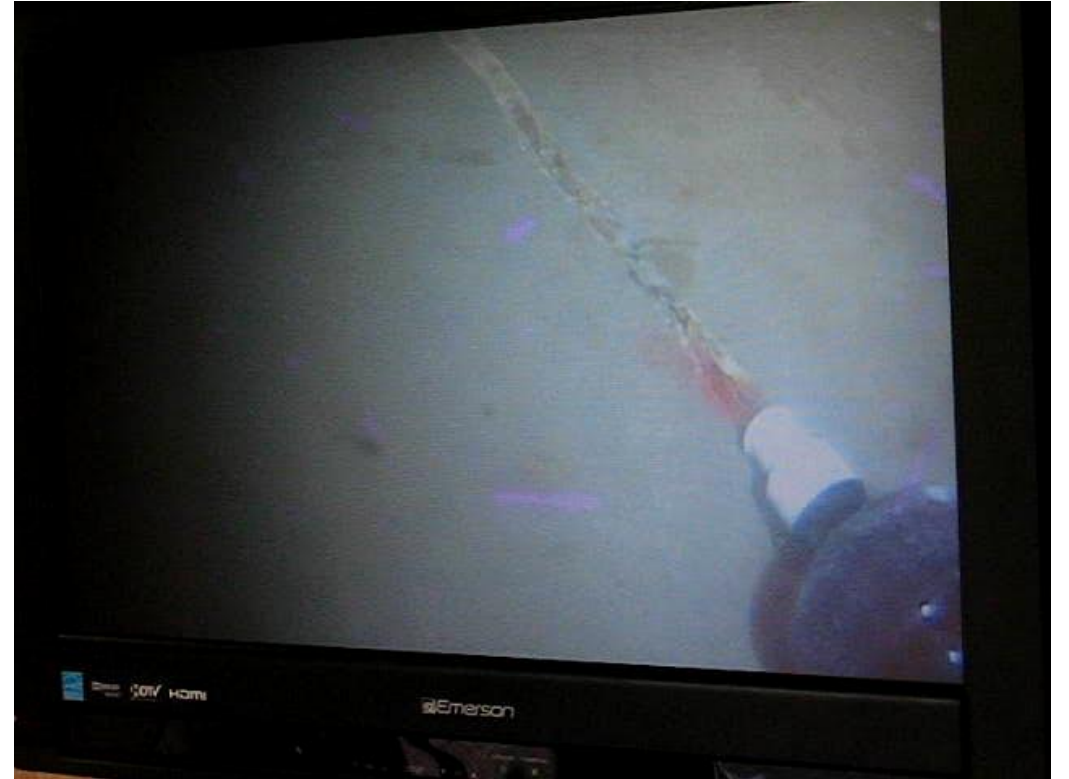
- Communications protocol
- Support staff in the trailer



Dive Inspections



Dive Inspections - Dye Testing

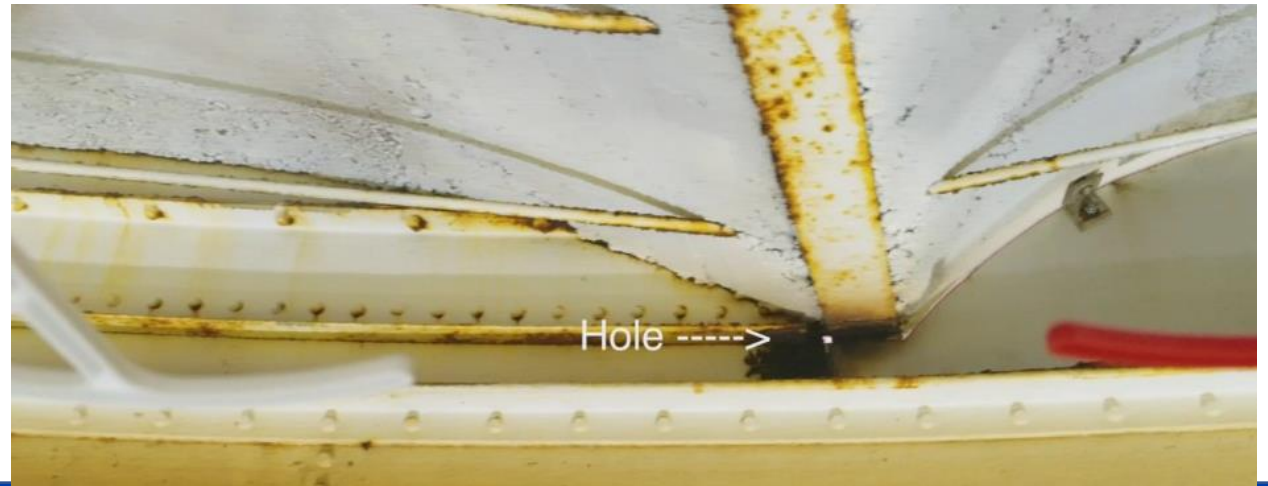
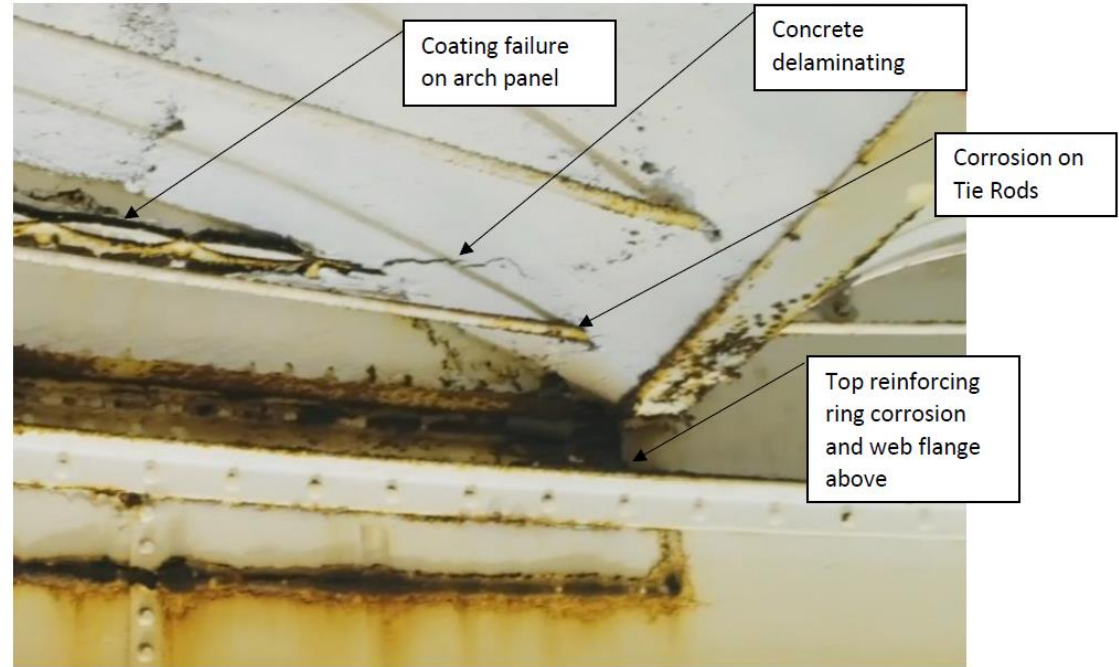


Drone Inspections

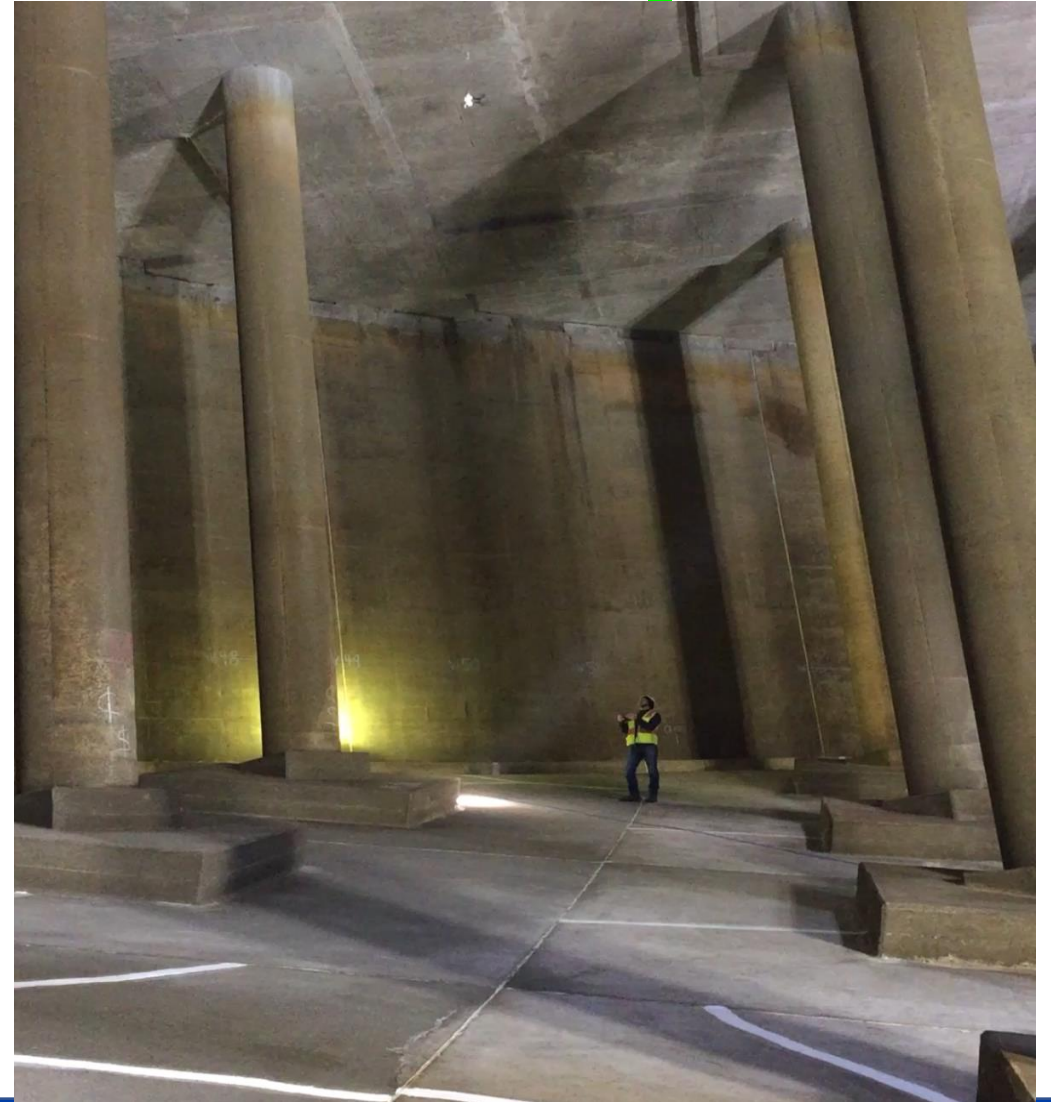
- Standpipes, Buried Reservoirs, Tolt Dam Overflow Structure
- Lighting
- Applicable Regulations/ Ordinances and SPU Security
- Edited Video
- Cost Effective



Drone Inspections



Drone Inspections - Eastside Reservoir



Drone Inspections - Eastside Reservoir



Drone Inspections - Safer and better accessibility

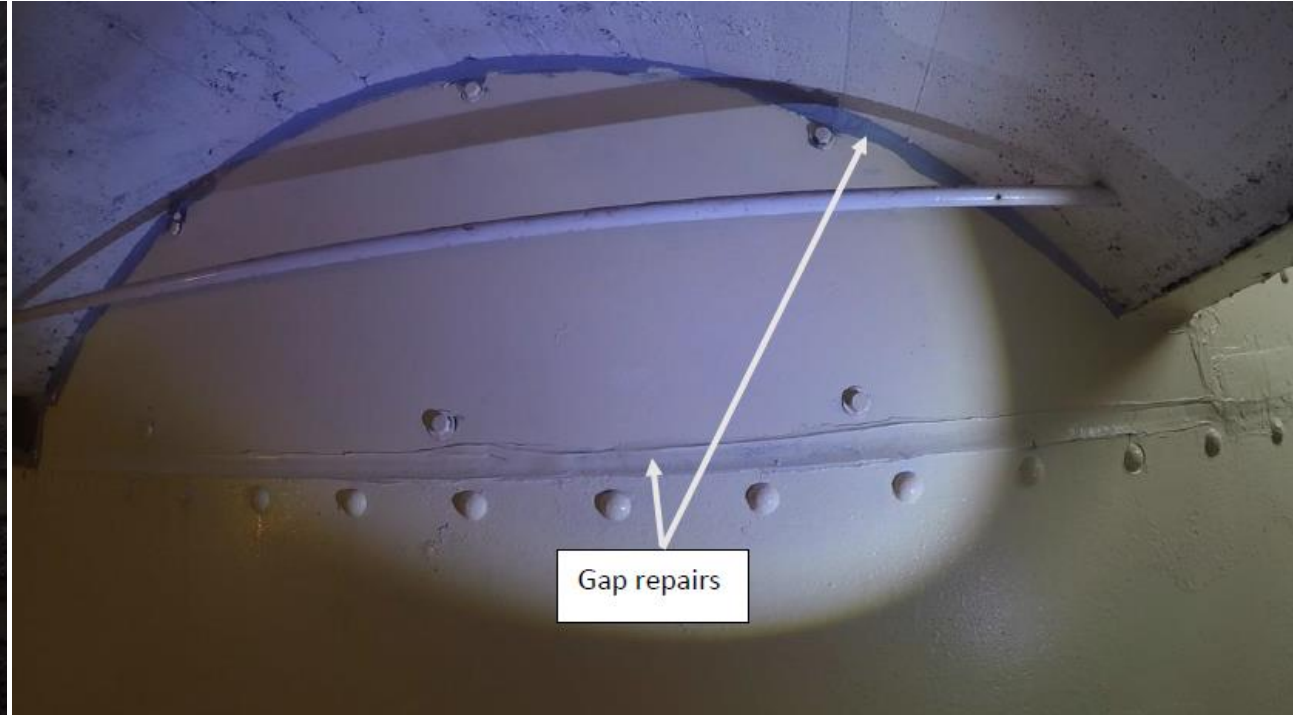


GoPro Inspection

- Video Recording
- Bluetooth to iPhone Display
- GoPro has a Protective Case (Also Waterproof)



GoPro Inspection - Volunteer Reservoir

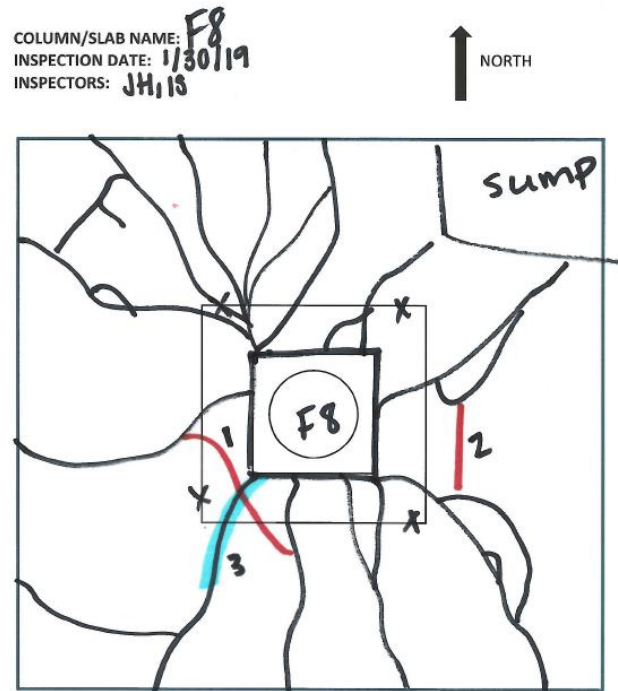


GoPro Inspection



Laser Scanning

- Replaces Point Survey Data
 - Settlement Monitoring
- Useful for Contour Mapping
- Crack Monitoring
 - More Efficient Future Inspections

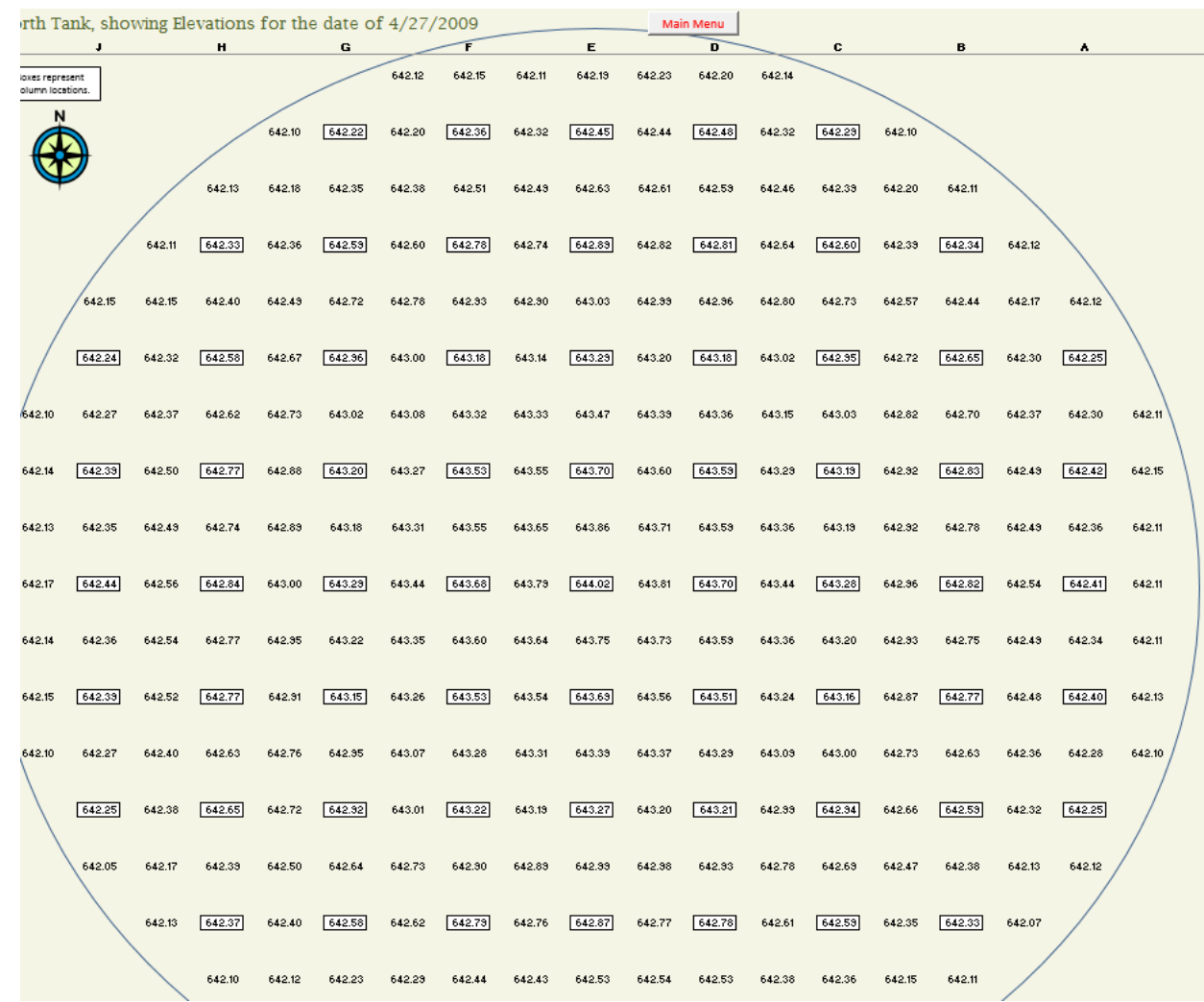


KEY

- EXISTING CRACK
- NEW CRACK
- EXISTING CRACK RE-OPENED (HAIRLINE CRACK UNLESS NOTED OTHERWISE)

CRACK OBSERVATIONS		
#	NEW (N) OR EXISTING (E)	LENGTH (FT)
1	N	4
2	N	6
3	E	7

TOTAL CRACK LENGTH (FT)	
EXISTING	7
NEW	10
TOTAL	17

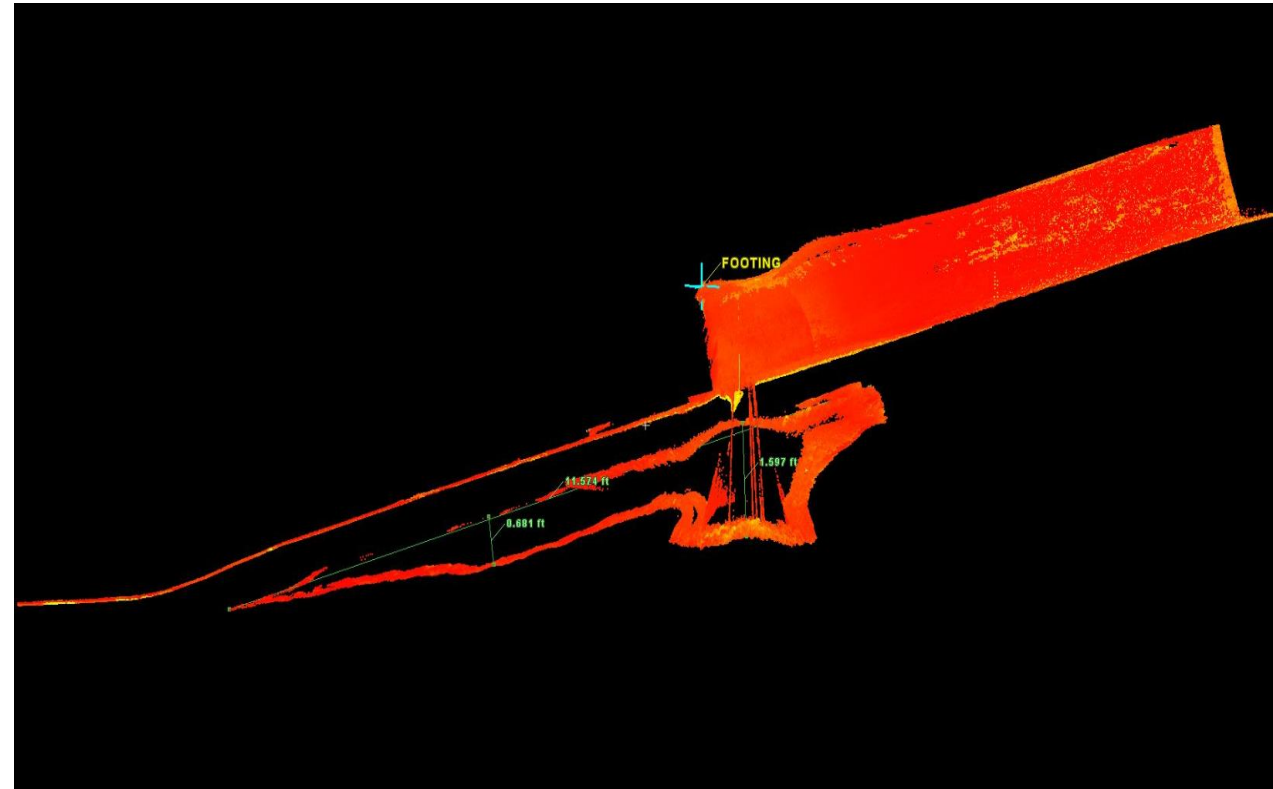
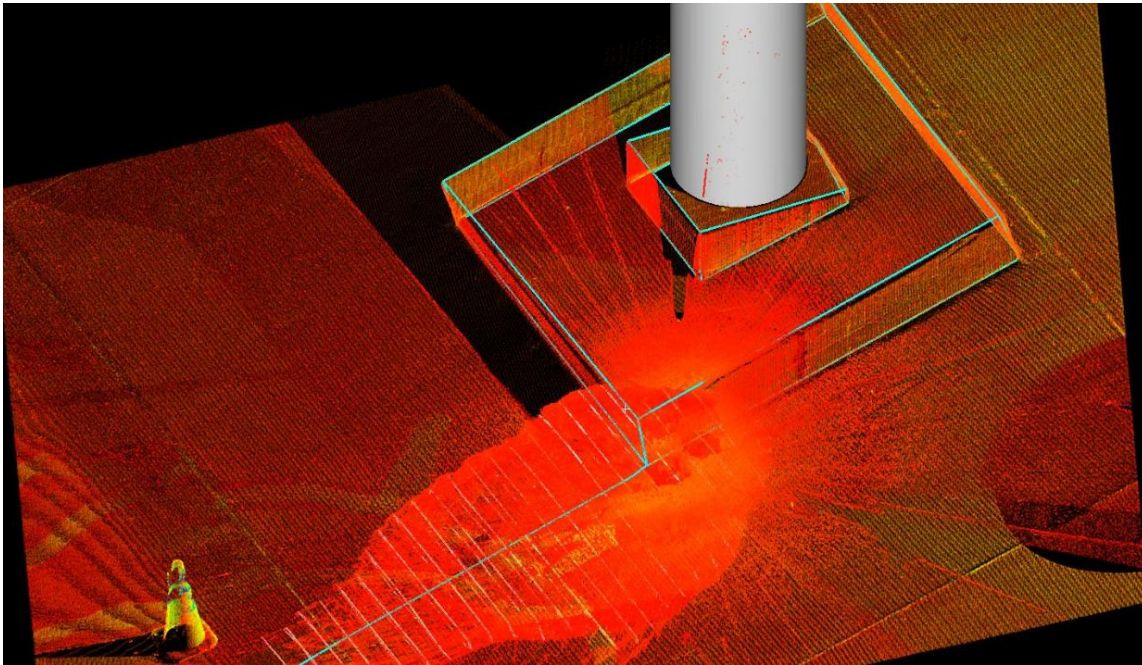


Laser Scanning



Laser Scanning - Void in Reservoir Footing

- Void Extents
- Estimate Volume Void/Repair



Ground Penetrating Radar

- For locating voids under floor



Other Tools - CCTV Water Camera



Other Tools - Pit Gauge and UT Gauge



Summary

- Keep up with inspections and maintenance – It is Important work
- Use available inspection tools to suit your needs
 - Create efficiencies with appropriate inspection tools/methods
 - New technologies can be cost effective
 - Continued advancements in technology
 - Drone Sprayer
 - Drone Protective Cage

Questions?

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