72 - Stormwater Monitoring or Stormwater-Related Studies

In accordance with S8.A, this summary provides a brief description of the stormwater monitoring or related monitoring studies conducted during 2017 by or for the City outside of the permit required monitoring.

Water Quality

Pollutant Source Control Sampling. This monitoring was conducted by SPU in support of and associated with the Water Quality Hotline, IDDE, and business inspections for source control from existing development.

Lower Duwamish source sediment samples. In 2017, SPU continued to collect source sediment samples (i.e., catch basins, inline sediment traps, and inline grab samples) to support the source control program for the Lower Duwamish Waterway superfund site. In 2017, SPU took samples which were analyzed for the LDW contaminants of concern, including TOC, SVOC's, TPH-Dx, select Metals, PCB's, Grain Size and occasionally site specific parameters, such as pH, additional metals, VOC's.

Street Sweeping

The objective of the Street Sweeping for Water Quality Program (SS4WQP) is to cost-effectively reduce the pollutant load carried by stormwater runoff from Seattle's streets to receiving water bodies. The purpose of the monitoring program is to collect & evaluate performance metric data in order to (A) provide information for regulatory requirements for solids disposal, (B) to track program performance, and (C) for developing a baseline for future effectiveness studies. Performance metrics currently being collected include mileage swept (street curb miles within a combined [sanitary] basin, and miles within an MS4 basin), sweeping velocity, solids load removed, cost, and sweeping solids chemistry (metals, SVOCs, PCBs, BTEX, grain size, total solids, Nutrients (Tot Phosphorous, TKN), total organic carbon, pH, NWTPH-Dx/Gx, BOD/COD, Fecal coliform).

Thornton Creek, Pipers Creek, Fauntleroy Creek, and Taylor Creek

Efforts were conducted to locate and address sources of bacteria in Thornton Creek, Pipers Creek, Fauntleroy Creek, and Taylor Creek. The source identification efforts are testing for *E. coli*, conductivity, temperature, and *Bacteroides*.

Structural Controls

Capitol Hill Water Quality Project (AKA the Swale on Yale). Flow data was collected in 2017.

Temporary Potable Water Discharge

A Temporary Potable Water Discharge was issued by Ecology under the Phase I Municipal Stormwater Permit #WAR044503 on August 19, 2016. Ecology allowed the discharge of potable water from a City of Seattle water line into the Lake Washington Ship Canal as part of a planned drinking water transmission line repair and improvement project. Ecology recommended routine and documented visual inspections of the discharge location to assess potential turbidity into the receiving water created by the discharge and that information should be described in the Annual Report. The project was conducted in 2017. Attached is a description of the inspections.

430 Pipeline Inspection Work 2017

Dewatering Pipeline to Ship Canal Tunnel and then to Ship Canal after Dichlorination

March 14, 2018

By: Charles Oppelt, PE

Senior Operations Engineer

Seattle Public Utilities

Table of Contents:

Summary

This document covers the work done in March and April of 2017 as part of the SPU internal inspection of our 430 ft head pipeline (a 1911 steel lock-bar transmission main which is part of Cedar River Pipeline #2, but intown is referred to as the 430 Pipeline). This work required us to dechlorinate and drain approximately 1.05 Million Gallons of drinking water first into the tunnel that the 430 Pipeline is in, and then sample and pump the water out and into the ship canal. This was done under the Phase I Municipal Stormwater Permit #WAR044503, per our agreement with DOE in 2016.

Highlights: Discharge was controlled to eliminate any stirring of sediment in the ship canal by floating our discharge line on a raft and tethering it to a bridge column. The discharge was directed up through a diffuser at a 30-degree angle at the column for discharge to the bridge column that sits on a large concrete pad which was clear of sediment giving a good landing for water running down the column as well. Drinking water was always put into the concrete tunnel while being dechlorinated and then tested before pumping out of the tunnel into the ship canal. Chlorine residual testing was done on all water (both drinking water and groundwater in the tunnel) before pumping to the canal and all readings of this water were below 0.1 ppm chlorine before any pumping was allowed.

Overview of water pipeline draining

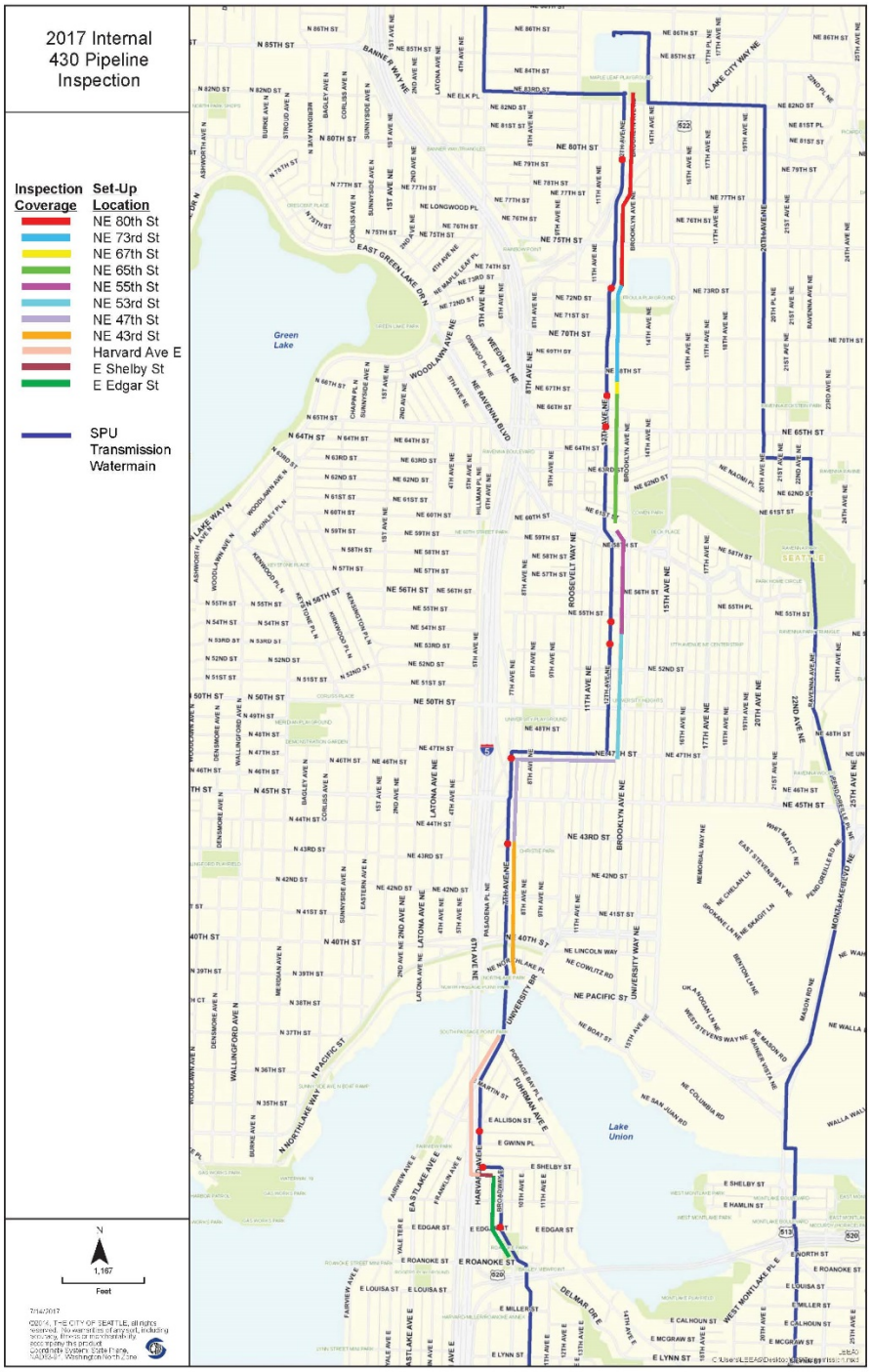
For this inspection the water in an SPU 42" transmission main had to be drained from the pipeline into the SPU 430 pipeline ship canal tunnel crossing at the University bridge, this water was dechlorinated as it was drained into the tunnel (see Appx C which describes our plan). After draining the pipeline into the tunnel the water was sampled (by testing with a Hatch Pocket Colorimeter II test machine) and found to have 0 ppm (No detect) of chlorine remaining, so no further treatment in the tunnel was required (this was the case both for the initial draining of the pipeline and the one pipeline volume flush into the tunnel that was performed after the inspection was completed (as outlined in Appx C). Note that only some of the flush water was actually pumped into the ship canal (about 300,000 Gal) as the rest was left in the tunnel to speed up the filling of the tunnel crossing, all drinking water entering the tunnel was dechlorinated as it entered the tunnel. The tunnel normally fills with groundwater (likely ship canal water) and this keeps pressures on the tunnel walls balanced, which reduces the potential for damage to the tunnel. Overall about 1.05 Million Gallons of drinking water were dechlorinated and discharged into the ship canal, this was slightly less than 1.5 pipe volumes for the segment inspected.

After testing for chlorine residual, the water was pumped at a rate of between 400-600 GPM (depending on water elevation in the tunnel and shafts) into the ship canal. To pump out the water a temporary pump line was floated in a raft out to one of the University Bridge columns where it was roped to the column. The pump lines diffuser port was pointed at the column for pump discharge the column sits on a 20'by 20' pad of concrete, See attached photos of discharge pipe and raft. The canal water at this location was greater than 8 ft deep and the concrete pad

was clear of debris. The diffuser was set to spray the water up at about a 30-degree angle onto the column. While discharging no sediment was observed to be stirred up by the pumping.

During all pumping to the ship canal the discharge was checked every hour visually for any sediment stirring and checked for a change in chlorine residual (by samples tested with the Hatch Pocket Colorimeter II test machine), no sediment was observed, and all chlorine tests showed 0 ppm (No detect) chlorine present.

The map below shows the pipeline segment that was inspected:



Other Documents Describing the Overall work (Inspection)

Pipeline inspection procedures are written up in Appx B. This includes information on draining the pipeline and inspecting it with a CCTV camera. It also includes some information on the procedure for disinfecting the CCTV equipment and any parts of the pipeline that were entered for the inspection.

In Appx C, you will find the plan that the crews used to drain and fill the pipeline using the tunnel, this includes testing notes, instructions for discharging into the canal noting not to stir up the bottom of the canal. All crew data collected was entered into the SPU work management system as notes attached to the work orders (MAXIMO).

In Appx D you will find the water supply plan for taking the pipeline out of service and for putting it back into service after the inspection and all testing was complete.

Description of the dichlorination of 430 PL water

The tunnel is normally full of ground water, most of which we believe comes from the ship canal. During the inspection of the tunnel it was estimated that water infiltrates into the tunnel through seams in the tunnel wall at a rate of approximately 50-60 GPM, estimated by observation and time to fill tunnel sump. This water was tested to be sure there was no chlorine present, test reading was non-detect (to be noted as 0 ppm in our testing). A sample testing of chlorinated water was done from a hydrant to show that the test equipment was working correctly, before testing the ground water in the tunnel.

Once the water was tested and found to have no chlorine the tunnel was pumped out in same way that the dechlorinated drinking water would be later pumped from the tunnel (See above in the Overview).

Then an inspection of the tunnel and its shafts was conducted to look for damage to the tunnel or the pipelines in the tunnel (there is the 430 PL and a 24” distribution main in this tunnel).

After draining the groundwater from the tunnel and inspecting the tunnel system, the 430 PL was isolated from the rest of the SPU system and then drained into the tunnel through a 4” blow-off (4” BO) mounted in the top section of the tunnel. During the draining which took about one day, draining while under gravity only, the water was dechlorinated using Ascorbic Acid (vitamin C). This was done by loading 5 lbs. of AA to a 55-gallon water barrel with a faucet at the bottom of the barrel. The flow was set to about ½ GPM using a marked bucket. The dechlor was dripped into the tunnel while the pipeline water was filling it. This was recharged as needed every two to three hours until the tunnel was drained.

After the 430 PL was drained the pipeline inspection was performed (Appx B). While this was occurring the 430PL water drained into the tunnel was tested for Chlorine residual and once found to be 0 ppm was pumped to the ship canal to prepare for flushing the pipeline after the 430 PL inspection and filling were completed.

Once the inspection was completed the pipeline was first filled with drinking water, and all air and vacuum valves were checked for proper function. After this the next step was to flush the 430 PL, with the PL full and the North valve open the 4” BO was opened under full system pressure to flush one volume of water from the North main segment.

Dichlorination was done again while flushing the pipeline (though the flow rate was increased for the flushing since the flushing time under pressure was much shorter than the draining time with no pressure on the system). During flushing the crews used the barrel and added Ascorbic Acid (AA) with a scoop (about 16 oz each scoop) every 10 min. directly dumped into the tunnel shaft at the 4" BO. Also the flushing flow rate was high enough to spray water off the base plate at the BO (at the top of the tunnel shaft) across the entire tunnel shaft which further aeriated the water and reduced chlorine levels.

This flushing was a bit of an issue as the expected flow rate was exceeded and so the tunnel was filled more than anticipated, this required pumping out about 300,000 gal of dechlorinated drinking water to the ship canal to ensure we did not over fill the tunnel while flushing the south end of the 430 PL as the North had just been done. We had planned on only pumping 100,000 gals but the calculations were off when the water level in the tunnel was checked after flushing. This required an extra 8 hours of pumping. Note: The rate of ground water infiltration was up to 60 gpm (or 86,400 Gal per day), so when we are not pumping the tunnel is filling this needed to be accounted for in the time between flushing North and South as well as before the first flushing (while filling the PL).

Before any pumping was allowed into the ship canal (including the ground water in the tunnel) sampling for chlorine residual was required.

Sampling requirements included:

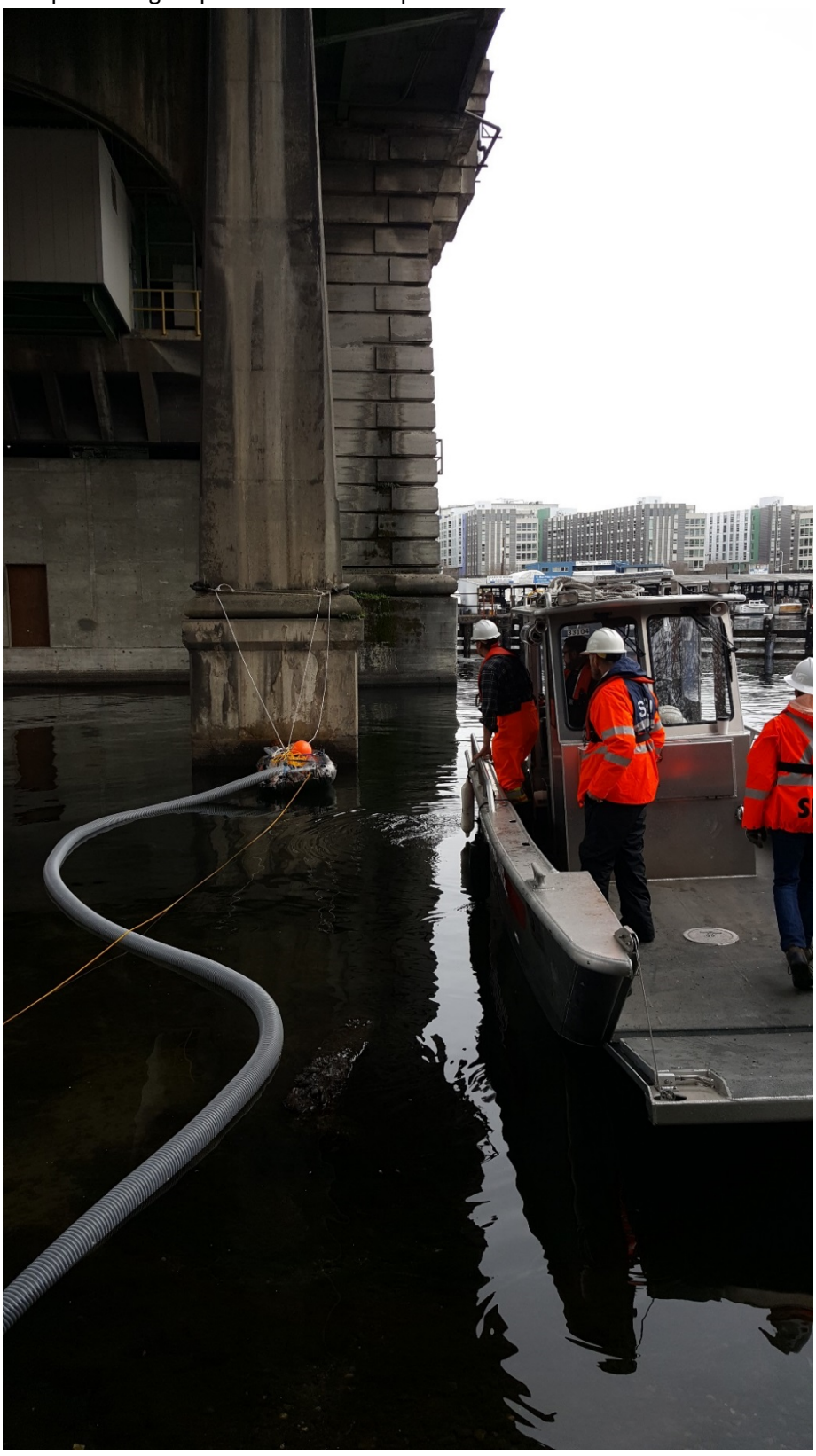
- Using equipment that was calibrated and issued from SPU water quality
- Cleaning the equipment and using new test vials
- Checking equipment on site using a water source known to have chlorine residual and then checking one known to have been neutralized
- Taking three separate samples of the water in the tunnel and requiring that all results match for the test.

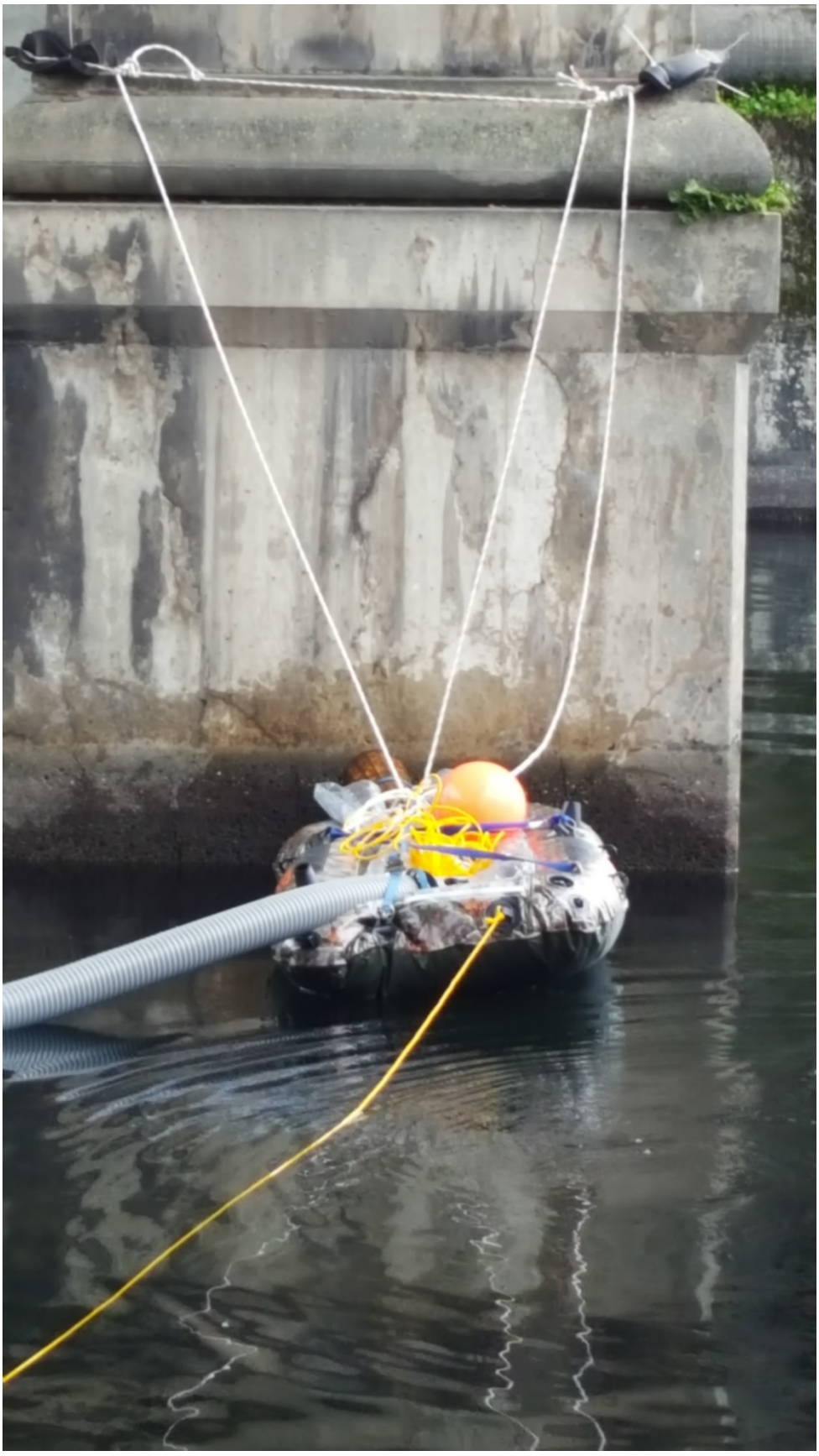
If results did not match for all three samples or if a Chlorine residual of more than 0.1 ppm was found, then more Ascorbic Acid would be added to the tunnel and the pump system would be setup to recirculate the water from the bottom of the tunnel back up to the top and drop it back in. After recirculation for one hour and adding at least 5 lbs more AA a new test would be taken. This was planned to be done until the chlorine was neutralized. This procedure was not used as no chlorine residual was found in any of the tunnel sampling.

The combination of adding the Vitamin C, the concrete walls of the tunnel with groundwater in the bottom of the tunnel, and the spraying of the water first across the tunnel shaft and then dropping it 60+ ft to the bottom of the open tunnel shaft all contributed to removing the chlorine from the water.

Photos from the Project

Pump Discharge Pipe Photos and site photos:





Tunnel Doghouse – Column behind center of doghouse is where discharge raft was located.

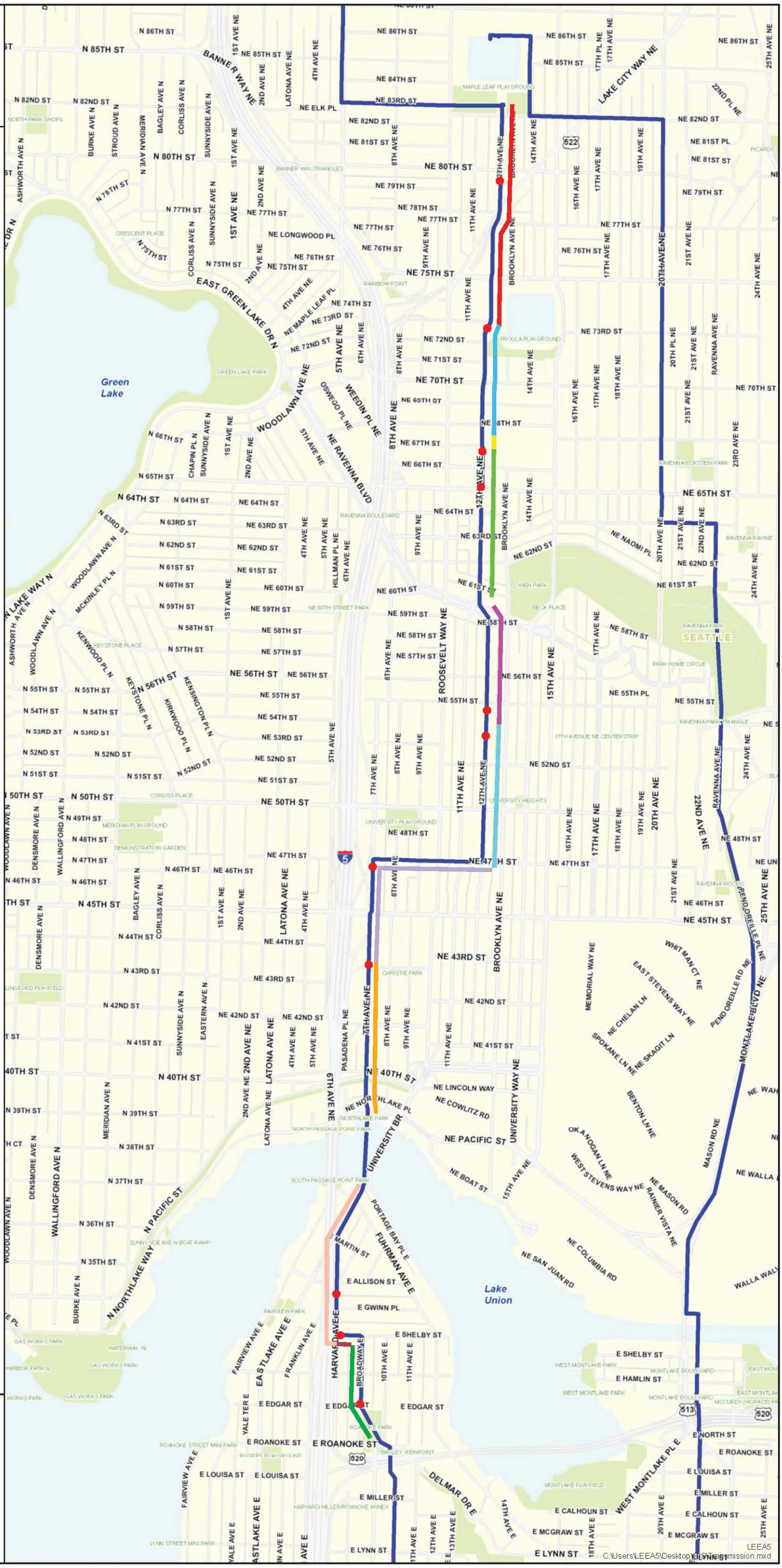
Tunnel Inspection picture showing leakage from tunnel walls and inspection team

Appendix A – 2017 – 430 PL Inspection Map

2017 Internal 430 Pipeline Inspection

Inspection Coverage	Set-Up Location
	NE 80th St
	NE 73rd St
	NE 67th St
	NE 65th St
	NE 55th St
	NE 53rd St
	NE 47th St
	NE 43rd St
	Harvard Ave E
	E Shelby St
	E Edgar St

SPU Transmission Watermain



N

1,167

Feet

7/14/2017

Coordinate System: State Plane, NAD83-91, Washington North Zone

LEEA5
C:\Users\LEEA5\Desktop\GIS\Transmission.mxd

Appendix B – 430 Pipeline CCTV Inspection Plan – south and north segments

430 Pipeline CCTV Inspection Plan
South and North Sections
Winter/Spring 2017
Updated 3/9/2017

Purpose: use a CCTV camera to inspect the interior of the 430 Pipeline for extent and limits of mortar failure at the lockbar joints on each side of the pipe to define the scope of the repair work needed for the 430 Water Transmission Pipeline CIP Construction Contract.

The South Segment extends from the LV at Roanoke to the LV at NE 53rd St.

The North Segment extends from the LV at Ne 53rd St to the MLGH.

The segment of the 430 pipeline south of Roanoke to the Volunteer Reservoir is not included.

There will be no manned entry into the pipeline beyond the immediate vicinity of the access hatches to facilitate launching and receiving of the CCTV camera, except for 50 feet at the NE 47th St location and at the Shelby access for the purpose of assisting the CCTV camera around bends. CCTV inspections will be performed continuously at each location until that location is complete, which may require overtime.

Equipment and Personnel Disinfection Requirements

Disinfect the CCTV camera and cable as it is fed into pipe, and the outer clothing of personnel entering the pipeline each day prior to entry. Wipe down the cable with disinfectant again as it is recoiled.

Timeline

The southern segment between the LV at NE 53rd St and the LV at E Roanoke St will be inspected in March 2017.

The northern segment between the LV at NE 53rd St and the Maple Leaf Gate House will be inspected after the south segment and after the area around the pipe near NE 53rd St has thawed enough that the effects of pipe settlement from Sound Transits freeze operation can be verified. The northern segment should be inspected in the spring or early summer of 2017.

South Segment Access MH locations

1. S7: NE 52nd St
2. S6: NE 47th St
3. S5: NE 43rd St
4. S4: Harvard Ave E
5. S3: E Shelby St
6. S2: E Edgar St

   S1: E Roanoke St - there is no planned access at Roanoke (Access MH on the other side of the closed LV)

North Segment Access MH locations

1. N6: NE 80th St
2. N5: NE 73rd St
   N4: NE 67th St (No planned set up at NE 67th)
3. N3: NE 65th St
   N2: NE Ravenna Blvd (No planned set up at Ravenna)
4. N1: NE 55th St

Most of the Access MHs are existing. FOM installed a new Access MH at the intersection of 7th Ave NE and NE 47th St in Dec 2016. FOM will install a new Access MH near NE 73rd Ave.

Prep Tasks

- Obtain Street Use Permits
- Rent or obtain pumps and hoses
- Obtain generator and provide insulation for noise abatement
- Restore Pavement

430 Pipeline South Segment

Drain Ship Canal Tunnel

- Drain approx. 1.5MG of groundwater from the Lake Union Tunnel into the Ship Canal by pumping through a temporary discharge pipe with the outlet nozzle located to avoid turbidity and scour.

Day 0 - Isolate pipeline segment

- Close LVs at Roanoke and at Louisa St.
- Close southern Gate LV at NE 53rd St.
- Close valves on lateral OT pipes at NE 42nd St, NE 45 St and NE 50th St. The services off these laterals will be supplied by another zone.

Days 1-5 – Drain Pipeline

- Drain approx. 1MG water from 430 pipeline into the Ship Canal Tunnel.
- Test to make sure there is no chlorine residual and dechlorinate as needed.
- Continue pumping water from tunnel into the Ship Canal.
- Drain 115,000 gallons from the sag at the 11th Ave BO. Dechlorinate as needed.
- Cut pipe opening at the new Access MH at 47th Ave and spray disinfect immediate area.
- Drain 144,000 gallons from the sag between Edgar and Roanoke at the BO in the park.
- Drain 79,000 gallons from the sag at the Northlake Ave BO.

Continue to pump out the Ship Canal Tunnel

Days 2-7 - Inspection Sequencing Plan for South Segment

Day	Set-up Location	Direction	Approx Distance (feet)	Inspect Towards	Notes*
2	NE 52nd St	north	42	To LV at NE 53rd St	
		south	1480	To 90 Bend at NE 47th St	
3	NE 47th St	east	1300	To 90 Bend at 12th Ave	5% grade between 11th&12th Ave
		west & south	1370	To 90 bend, then downhill to NE 43rd	Enter pipe to assist cable around bend. Spray disinfect.
4	NE 43rd St	south only	1830	To Ship Canal tunnel shaft	Camera will reach approx. 330 feet short
5	Harvard Ave	north only	1440	To Ship Canal tunnel shaft	Camera may not reach all the way
6	Shelby Ave	west	540	To 90 bend, then downhill on Harvard	Enter pipe to assist cable around bend. Spray disinfect.
		east	270	To 90 Bend at Broadway Ave	
7	Edgar Ave	north	860	To 90 Bend at Shelby Ave	
		southeast	660	To LV at Roanoke Ave	
			9,792 ft		

*Spray disinfect the pipe and Access MH cover at the end of each inspection setup.

Day 8 – Refill pipeline

- Open bypass valves at 53rd St and also at Roanoke St to fill south segment from the north and south ends.

Day 9 – Flush pipeline

- Push a minimum of 1 pipe volume into the Ship Canal Tunnel

Day 10 – Take Bact Samples

- 47th Ave Access MH
- Ship Canal Tunnel south shaft
- LVs at NE 53rd and at Roanoke St
- All AVs
- All BOs

Day 11 - Return South Segment to Service

- Open southern LV at NE 53rd St.
- Open valves on lateral OT pipes at NE 42nd St, NE 45 St and NE 50th St. The services off these laterals will be supplied by another zone.
- Open LVs at Roanoke and at Louisa St.

430 Pipeline North Segment

Day 0 - Isolate pipeline segment

- Close GV in MLGH.
- Close northern LV at NE 53rd St.
- Close valves on lateral OT pipes at NE 63rd St, NE 80th St. The services off these laterals will be supplied by another zone.

Day 12 Drain Pipeline

- Drain pipeline from the sag at the NE 61st St BO. Dechlorinate as needed.

Day 3-6 - Inspection Sequencing Plan for North Segment

Day	Set-up Location	Direction	Approx Distance (feet)	Inspect Towards	Notes*
3	NE 80th St	north	840	Maple Leaf Gate House	
		south	1500	Downhill towards NE 73rd St	Will be about 440 feet short from Access MH at 73rd
4	NE 73rd St	north	440	Uphill towards NE 80th St	
		south	1500	Downhill to NE 67th St	
					No set up needed at NE 67th
					No inspection needed on new pipe between NE 67th and NE 65th
5	NE 65th St	south	1430	Downhill to Ravenna	
					No set up needed at Ravenna
6	NE 55th St	north	1310	Downhill to Ravenna	
		south	420	LV at NE 53rd St	
			7,440 ft		

*Spray disinfect the pipe and Access MH cover at the end of each inspection setup.

Day 7 – Refill pipeline

- Open bypass valves at 53rd St and also at MLGH to fill north segment from the north and south ends.

Day 8 – Flush pipeline

- Push a minimum of 1 pipe volume

Day 9 – Take Bact Samples at as many locations as possible

- LVs at NE 53rd and at MLGH
- All AVs
- All BOs

Day 10 - Return North Segment to Service

- Open GV in MLGH
- Open bypass valve at 53rd St.
- Open northern LV at NE 53rd St.
- Open valves on lateral OT pipes at NE 63rd St, NE 80th St.

Appendix C – 430 Pipeline Draining and Filling Plan at Ship Canal Tunnel Process

430 Pipeline Draining and Filling Plan at Ship Canal Tunnel

March 2017

Documents to refer to:

- Shutdown of CRPL#2 Between LV#3 @ E. Roanoke and LV#4 @ NE 53rd St Plan
- 430 PL CCTV Inspection Plan South and North Sections

Tunnel Inspection

- Drain tunnel of ground water
    - Put pump outlet diffuser on raft tied to bridge column make sure flow strikes column and all stays on 20x20 pad at bottom of column when it falls (DO NOT STIR UP SEDIMENT IN CANAL!!!) Sample tunnel water for Chlorine notify Crew Chief and Engineer if result is not Zero before starting to dewater tunnel.
    - Approximate volume of the tunnel is 1.5 MG
- Setup confined space entry – setup rented blower, lights, and fall protection.
    - Go over safety plan
    - Test air
    - Setup for entry
    - Fill out entry forms
- Perform inspection of ladder system by SE
- Full inspection crew entry after ladder system approved
    - Inspect Tunnel shaft
    - Inspect Tunnel walls
    - Inspect Water mains (24" and 42")

Setup for 430 PL shutdown and draining into tunnel (see shutdown doc ref above)

- Crews follow shutdown plan
- Remove pipe section on 4" BO in tunnel to allow draining of main into tunnel
- Drain 430 PL into tunnel (~10,000 ft or 750,000 Gal)
- Declor with Ascorbic Acid – use 55 gal barrel with tap on bottom filled with water and 5 lb AA run with continuous drip
    - Check drip every hour while draining pipeline into tunnel (want slightly less than ½ GPM)
    - Refill barrel as needed (likely 3-4 times during draining)

Prepare to drain dechlorinated water into ship canal

- Once pipeline is drained into tunnel Test Chlorine residual (crew chief or leads to oversee testing) Use the **Hatch Pocket Colorimeter II** test machine
    - Test by dropping a clean bucket into tunnel for sample (first clean bucket at hydrant, test here to show Positive result, then clean in declor barrel test to show neg result)

    - Next rinse bucket in water in tunnel 2-3 times
    - Take three samples from tunnel all must show less than 0.1 ppm on test machine if not add more AA to tunnel and run pump back into tunnel to stir water
    - Repeat this until results are less than 0.1ppm.
- Pump out water with pump system
    - Just like with draining the canal/ground water out of the tunnel pump water our of the tunnel and through the diffuser onto bridge column and onto the columns pad below (DO NOT STIR UP SEDIMENT IN CANAL!!!)
    - Inspect pumping every hour – Check for turbidity, check for chlorine in discharge, if either are noted STOP PUMPING. - Call Crew chief and Engineer to determine what the issue is and how to correct it.

Pipeline inspection

- Follow 430 Pipeline CCTV Inspection plan

Fill Pipeline

- Open Ball valve at NE 53rd 5-20 turns to fill pipeline
- Once all air valves have seated at the valve shut Ball valve

Flush North Segment of 430 PL to the Tunnel

- Valve crew opens Ball vale at NE 53rd (LV #4) 30 turns
- Then tunnel crew opens 4" BO in tunnel to allow water from North of Tunnel to flow into the tunnel. Open 4" valve completely this will flow ~ 4000 GPM at PL head into tunnel. At this flow the Valve crew at the Ball valve will need to monitor the Air/Vac valve and if the ball drops (we are at the high point here) then they need to open the ball valve more use 10 turn increments up to 75 turns. If you get to 75 turns valve crew will call tunnel crew to partially close 4" BO.
- North flush at full open will take 3.75 hours (extra 30 min to insure one turnover of the north segment).
- Declor with Ascorbic Acid – use 55 gal barrel with tap on bottom filled with water and 5 lb AA run with continuous drip
    - Check drip every hour while draining pipeline into tunnel (want slightly less than ½ GPM)
    - Refill barrel as needed (likely 3-4 times during draining)
- Close valves after allotted time for one turn over of water in pipeline

Prepare to drain dechlorinated water into ship canal

Note, this is only required if level in tunnel gets higher than 5 ft from bottom. We do not want to overfill the tunnel! This could happen if we fill too much from the North, remember we have some amount of inflow through the tunnel walls.

- Once pipeline is drained into tunnel Test Chlorine residual (crew chief or leads to oversee testing) Use the **Hatch Pocket Colorimeter II** test machine
    - Test by dropping a clean bucket into tunnel for sample (first clean bucket at hydrant, test here to show Positive result, then clean in declor barrel test to show neg result)
    - Next rinse bucket in water in tunnel 2-3 times
    - Take three samples from tunnel all must show less than 0.1 ppm on test machine if not add more AA to tunnel and run pump back into tunnel to stir water
    - Repeat this until results are less than 0.1ppm.
- Pump out water with pump system
    - Just like with draining the canal/ground water out of the tunnel pump water our of the tunnel and through the diffuser onto bridge column and onto the columns pad below (DO NOT STIR UP SEDIMENT IN CANAL!!!)
    - Inspect pumping every hour – Check for turbidity, check for chlorine in discharge, if either are noted STOP PUMPING. - Call Crew chief and Engineer to determine what the issue is and how to correct it.

Flush South Segment of 430 PL to tunnel

Note: This water and any other water in tunnel will be left in the tunnel unless Pipeline Bac T samples fail.

- Check that tunnel level is at 6ft or less from bottom
- Valve crew opens Gate vale at E Roanoke St (LV#3) 30 turns
- Then tunnel crew opens 4" BO in tunnel to allow water from North of Tunnel to flow into the tunnel. Open 4" valve completely this will flow ~ 4000 GPM at PL head into tunnel. At this flow the Valve crew at the Ball valve will need to monitor the Air/Vac valve and if the ball drops (we are at the high point here) then they need to open the ball valve more use 10 turn increments up to 75 turns. If you get to 75 turns valve crew will call tunnel crew to partially close 4" BO.
- North flush at full open will take 2.5 hours (extra 30 min to insure one turnover of the South segment).
- Declor with Ascorbic Acid – use 55 gal barrel with tap on bottom filled with water and 5 lb AA run with continuous drip
    - Check drip every hour while draining pipeline into tunnel (want slightly less than ½ GPM)
    - Refill barrel as needed (likely 3-4 times during draining)
- Close all valves and stand down until water quality has take pipe samples and we get results.

Bacteriological Sampling

- Transmission crew will assist Water Quality lab with sampling the pipeline See: 430 PL CCTV Inspection Plan South and North Sections For sample locations
- Sample per standard plan 300 for taking samples distances between samples is per plan noted above.

Bac T -Samples Pass

- Put 430 PL back into service per Shutdown of CRPL#2 Between LV#3 @ E. Roanoke and LV#4 @ NE 53rd St plan

Bac T Samples Fail

- Dechlorinate the tunnel as noted above in this plan use pump to recirculate water in tunnel if needed (note tunnel and shafts are all concrete and BO discharges water to a steel plate spraying it across the 16 ft diam tunnel there will likely be NO Chlorine residual but do follow plan and check for it. The plan is here (above) to address what to do if there is residual Chlorine found.
- Pump out tunnel again per same procedure as above
- The engineer will be on site if we must flush again.
- Flush PL into tunnel again for one volume on North and South segments per the plan above
- Sample pipeline
- Repeat until Bac T samples pass…

Updates / Notes on inspection pertinent to the plan above:

4-7-2017 All Chlorine tests of drinking water drained into tunnel before pumping and during pumping to the ship canal had zero ppm of chlorine, all test times and results were recorded by the tunnel crews and entered in to our MAXIMO maintenance system as notes. Each note is tagged by the person entering the data with the time, this person was the one who took the sample.

***During the first flushing (of the north segment of the PL) it was found that actual flow rate into tunnel was about 6000 gpm. This resulted in more water in the tunnel that we wanted and required pumping out about 300,000 gal of dechlorinated water, before we could flush the south segment. Time to flush south segment was reduced by 30 min to take this into account. So two pumping cycles total were required of dechlorinated drinking water, one of the full 750,000 gal to drain the pipeline the first time and pump out the tunnel and then about 300,000 Gal the second time. If the original flow rate was correct we would have only needed to pump out a little over 100,000 gals (to account 24 hours of expected inflow through the tunnel walls). Note original expectation of 50-75 gpm inflow based on 1991 inspection of tunnel was still the same, this seems to indicate the tunnel walls are still in good shape after the 2001 EQ. Total pumped dechlorinated drinking water was ~ 1.05 MG.

Staff doing Chlorine testing included:
Charles Oppelt, PE observed all initial testing before starting pumps
Jim Volpone, SPU Crew chief, tester & spot checked his crews
Tom Eriksen, SPU Lead, tester
Sabrina Clark-Bentley, SPU Lead, tester

4-11-2017 All Bac T samples passed the first time. Pipeline was put back into service.

Appendix D – Water Supply plan for PL shutdown and startup

SHUTDOWN of CRPL#2 BETWEEN LV#3 @ E. ROANOKE ST. & LV#4 @ NE 53RD ST.

MARCH 28, 2017

SOUTH SEGMENT

OPERATION: De-water Ship Canal Tunnel in advance of shutdown for inspection/repairs. Isolate South Segment of CRPL#2 from distribution feeders & close line valves. Operate blow offs to drain pipeline: B.O.#5 south shaft of tunnel, B.O.#7 at 11th Ave, B.O.#4 S. of Roanoke Park, B.O.#6 at Northlake Pl. Monitor B.O.'s to maintain dry pipe for duration of inspection.

PURPOSE: Conduct CCTV inspection of pipeline interior

COMMUNICATION: Primary communication - 800 MHz radio, channel 1.
Secondary communication - Cellular phones (area code 206).

****All valve operations will be cleared with and coordinated by Water Supply.**

NAME	ROLE	CELL PHONE	PAGER	UNIT #
Control Center	Water Supply	386-1818 office	NA	Control Center
Tom Walker	Water Supply	399-3840	991-9738	671
Michael Langlois	Water Supply	972-0567	997-5655	675
Jim Volpone	Distribution			
Robert Smart	Mechanical	512-7999		
Jim Nilson	Water Quality	291-4937		
Paige Igoe	Water Quality			
Anthony Talbott	Valve Crew	660-7211		313
Kathy Illman	Transmission	402-2187		552
Eddy Haw	Electrical	391-2943		
Nate Green	Water Treatment	390-6336		
Joe Herold	Engineering	258-0789		
Stephanie Murphy	Project Mgr			
Jenna Rahm	Comm. Services			
Charles Oppelt	Engineer	910-3339		
Customer Service				
Vini / Dwayne	Valve Crew	300-4383		348

CHARGE # C114074-D299

Water Supply: Coordinate & direct shutdown operations

Control Center: Approve & record all valve operations in field

Customer Service: Available to respond to customer questions and/or complaints

Communications Services: Notify customers of pipeline shutdown.

Valve Crew:	Staff for opening/closing pipeline connections to zone off CRPL#2, and operation of valves as directed by Water Supply.
Engineering:	Conduct CCTV inspection of pipeline interior, inspect tunnel
Transmission:	Assist with pipeline drain, fill & flush
Distribution:	De-water tunnel, assist with pipeline drain, fill, flush and CCTV inspection
Water Quality:	Provide oversight of pipeline disinfection & flushing
Water Treatment:	Spray down of access points, assist WQ as needed
Electrical:	Generator support
Mechanical:	Pump support

PRIOR TO SHUTDOWN

SYSTEM SET UP - FIELD WORK (*Verification that all normally open/closed valves along the North Segment of CRPL2 between LV#4 @ NE 53rd St. & Maple Leaf GH are in the correct position for shutdown of the South Segment*)

▶Thursday, March 23

Water Supply:

1. Mark all valves & appurtenances necessary for pipeline shutdown

★*Map 5A* @ Maple Leaf Gatehouse

1. Verify V#2, V#3, V#4, V#5, V#6, V#8, V#13 and V#15 are Open.

★*Map 36A* @ Volunteer Reservoir

1. Verify 24" GV #35, is Open. *Note1: Bypass operating nut broken; must operate w/pipe wrench.*
2. Verify 36" GV #17,148T is Open. *Note2: Valve difficult to turn, do not close; needs repair*

PRIOR TO SHUTDOWN

SYSTEM SET UP - FIELD WORK (*Verification that all normally open/closed valves along the North Segment of CRPL2 between LV#4 @ NE 53rd St. & Maple Leaf GH are in the correct position for shutdown of the South Segment*)

Valve Crew:

✓ ***Safety equipment for confined space entry will be required.***
✓ ***Please note turn count for all valves that must be operated***

►Monday, March 27

★*Map 5* @ 12th NE & NE 80th

1. Verify 36" GV (5N, 11E) 195T is Open
2. Notify Control Center

★*Map 5* @ 5th NE & NE 80th

1. Verify 20" V (3S, 16W) 126T is Open. ***Note1: May require No Park***
   Notify Control Center

★*Map 5D* @ 12th NE & NE 73rd

1. Verify DV, 8" GV (29E, 26N) is Closed
2. Verify 8" GV to north, (20E, 33N) is Open
3. Verify NEW 8" GV to south, is Open
4. Notify Control Center

★*Map 5* @ 12th NE & NE 70th

1. Verify,16" GV (18S, 16W) 106T is Open. ***Note1: 16" GV to 16" CKV to 16"x12" red. to 12" GV***
2. Verify, 12" GV, east of 16" CKV, is Open
3. Notify Control Center

★*Map 6A* @ 20th NE & NE 65th (CRPL3 connections to 430z)

1. Verify 20" GV#7 (30S, 7W)) is Open
2. Verify 20" GV#9 (40S, 22W) 129Tis Open
3. Notify Control Center

PRIOR TO SHUTDOWN

SYSTEM SET UP - FIELD WORK (*Verification that all normally open/closed valves along the North Segment of CRPL2 between LV#4 @ NE 53rd St. & Maple Leaf GH are in the correct position for shutdown of the South Segment*)

Valve Crew:

✓ *Safety equipment for confined space entry will be required.*

✓ *Please note turn count for all valves that must be operated*

▶ Monday, March 27

★*Map 14* @ 12th NE & NE 63rd

1. Verify 20" BFV is Open. *Note1: Both valves are new; installed 9/16, need turn count - okay to operate Note2: MH lid is bolted down*
2. Verify 20" BFV (11'S, 25'E) to the east is Open *Note1: no chamber; valve is direct bury*
3. Notify Control Center

★*Map 14A* @ 12th Ave NE & NE 55th St.

1. Verify 12" GV is Open. *Note1: Vertical connection off CRPL2, 12" GV & 12" CKV*
2. Notify Control Center

★*Map 14* @ 12th NE & NE 50th

1. Close 12" GV (11S, 21W) 32T. *Note1: CKV located at 1206 NE 50th St.*
2. Close NEW 12" GV located at 1202 NE 50th St.
3. Notify Control Center

★*Map 14* @ 7th NE & NE 45th

1. Close 24" GV (5S, 83W) 232T. *Note1: Needs Traffic Control/Flagging. Note2: Not a DV.*
2. Notify Control Center.

★*Map 14* @ 5th NE & NE 45th

3. Close 24" GV (17S, 6E)
4. Notify Control Center.

PRIOR TO SHUTDOWN

SYSTEM SET UP - FIELD WORK (*Verification that all normally open/closed valves along the North Segment of CRPL2 between LV#4 @ NE 53rd St. & Maple Leaf GH are in the correct position for shutdown of the South Segment*)

►Monday, March 27

Water Supply:

★*Map 23A* @ 7th NE & NE 42nd

1. Close 12" RCBV
2. Close 12" GV#1 (50T), outlet to 326z
3. Close 12" GV#3 (50T), inlet from CRPL2

Control Center:

1. Have Maple Leaf Reservoir full
2. Close 8th & 80th RCBV - Emergency Use Only
3. Close 8th & 145th RCPR - okay to use if needed once shutdown in affect

SYSTEM SET UP COMPLETE

SHUTDOWN

SEQUENCE OF OPERATIONS

▶Tuesday, March 28

Valve Crew, North:

✓*Safety equipment for confined space entry will be required.*
✓*Please note turn count for all valves that must be operated*

★*Map 14* in 12th Ave. N.E. @ N.E. 53rd St.

✓When directed by Water Supply:

1. Slowly Close LV#4, 20" BV (24'W, 278'N) 72T, *Note1: No bypass. Note2: No Parks needed*
4. Notify Control Center

Valve Crew, South:

✓*Safety equipment for confined space entry will be required.*
✓*Please note turn count for all valves that must be operated*

★*Map 30* in Federal Ave. E. @ E. Louisa St. (South of SR 520)

✓When directed by Water Supply:

1. Close LV#2, 42" GV (354T) *Note1: Incorrectly identified as LV#4 in map book*
2. Close bypass
3. Notify Control Center

★*Map 30* in 10th Ave. E. (West of Federal Ave) @ E. Roanoke St. (North of SR 520) *Note1: Ground is soft, may need rear-mount, truck operator or hand operator to access.*

1. Close LV#3, 42" GV (354T)
2. Close bypass
3. Notify Control Center

SHUTDOWN COMPLETE

Shutdown Window: 14 Days

RE-FiLL

SEQUENCE OF OPERATIONS

Valve Crew, South

✓*Safety equipment for confined space entry will be required.*
✓*Please note turn count for all valves that must be operated*

★ *Map 30* @ E. Roanoke St. (North of SR520)

✓*When directed* by Water Supply:

1. Open LV#3, 42" GV (354T)
2. Close bypass

Valve Crew, South

★ *Map 30* @ E. Louisa St. (South of SR520)

✓*When directed* by Water Supply:

1. Open bypass around LV#2, 42" GV (354T) to begin re-fill of pipeline from the South
2. Monitor AV's
3. Notify Control Center

Valve Crew, North

✓*Safety equipment for confined space entry will be required.*
✓*Please note turn count for all valves that must be operated*

★ *Map 14*

✓*When directed* by Water Supply:

4. Slowly Open LV#4, 20" BV (72T) xx turns to begin re-fill of pipeline from the North
5. Monitor AV's
6. Notify Control Center

✓When all air valves are set, CLOSE LV#4 and bypass around LV#2

RE-FILL COMPLETE

PIPELINE FLUSH

Pipeline must be flushed a minimum of 1.5 pipe diameters before being returned to service. To achieve an adequate flush the plan to is to alternate flushing between the North and South isolation points. BO5 located in the Lk. Union Tunnel will be used to flush. Flush water will be discharged into the tunnel and pumped from the tunnel into the ship canal.

Air Valves:

AV5 @ E. Edgar St., 3", Elev. 156', MP 23

AV6 S. of NE Northlake Way, Elev.18', MP 23

AV7 @ NE 47th St.,4", Elev. 204', MP 14

AV8 @ NE 52nd St., 4", Elev. 222', MP 14

Blow Off Valves:

BO4 @ E Roanoke St. (N. of LV#3), 4", Elev. 138', MP 30

BO5 S. Shaft of Lk. Union Tunnel, 4", Elev. -50', MP 23

BO6 S. of NE Northlake Pl., Elev. 14', MP 23 (limited)

BO7 @ 11th Ave. NE, 6", Elev. 184', MP 14