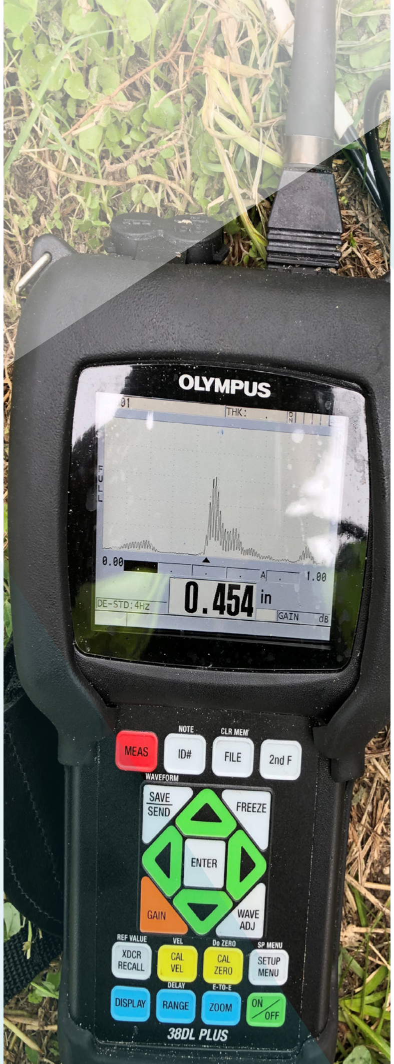

CITY OF NEW PORT RICHEY

FINAL REPORT

WATER RECLAMATION FACILITY GRAVITY MAIN CONDITION ASSESSMENT

APRIL 2020

REISS ENGINEERING

CITY OF NEW PORT RICHEY

WATER RECLAMATION FACILITY GRAVITY MAIN CONDITION ASSESSMENT

FINAL REPORT

Prepared For:

CITY OF NEW PORT RICHEY

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REI Project No. 3202

REISS ENGINEERING

April 2020

Document	New Port Richey WWTF Influent Gravity Main Condition Assessment
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This report is intended for review by the City of New Port Richey and other parties as considered necessary by the City of New Port Richey and Reiss Engineering, Inc. This report has been prepared under the supervision of Weston T. Haggen, FL P.E. Lic. 77777.

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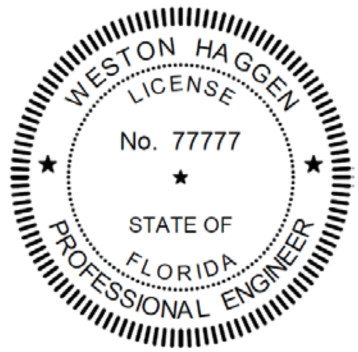

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EXECUTIVE SUMMARY

The City of New Port Richey (City) owns and operates the largest Water Reclamation Facility (WRF) in Pasco County, capable of up to 7.5 million gallons per day (MGD) of wastewater treatment. In May of 2019, the WRF experienced a wastewater discharge release due to failure of a gravity feed main from the headworks structures of the facility. One (1) of the gravity mains, a 20-inch ductile iron (DI) main installed in 1988, ruptured causing a spill of wastewater. Due to the pipe failure experienced at the WRF in 2019, the City has expressed concerns regarding the condition of other ductile iron (DI) gravity feed mains which transfer wastewater from the WRF headworks structures. Reiss Engineering, Inc. (Reiss) was contracted by the City in late 2019 to complete condition assessment testing on three (3) gravity mains of concern using non-destructive testing (NDT) of pipe wall thickness, and prepare recommendations based on the results. The total length of all segments assessed under this project is approximately 800 linear feet (LF),

Conclusions

The results of the three (3) gravity main assessments are presented below. The results are also summarized and presented graphically on **Figure ES-1**.

1. The UTT data collected for DI pipe segments from the headworks structures to Oxidation Ditch #3, Oxidation Ditch #4, and the Schreiber Plant all indicate that current pipe wall thicknesses all meet or exceed a minimum pressure rating of 250 psi.
2. The UTT results at UTT-3 and UTT-4 for the below-grade pipe segments to Oxidation Ditch #3 and Oxidation Ditch #4, respectively, indicate a slight reduction in pipe wall thickness compared to the standard pipe wall thickness for a Class 51 DI pipe. No additional UTT were conducted for the below-grade pipe segments to Oxidation Ditch #3 or Oxidation Ditch #4; however, CCTV videos provided by the City adds additional evidence of some existing internal corrosion within these pipe segments.
3. Visual inspection during UTT showed signs of some exterior pipe corrosion at various locations for each gravity main pipe segment. It is unknown at this time whether this corrosion is due to contact between the pipe exterior and potentially corrosive soils, a high groundwater table, etc.
4. The UTT results at UTT-3 and UTT-4 for the below-grade pipe segments to Oxidation Ditch #3 and #4, respectively, indicate a pipe wall thickness slightly lower than the standard pipe wall thickness for a Class 51 DI pipe. CCTV videos provided by the City adds additional evidence of some existing internal corrosion within these pipe segments.
5. The UTT results at UTT-1, UTT-5 and UTT-6 completed on pipe segments for Oxidation Ditch #3, and Oxidation Ditch #4 indicate a minimum pipe wall thickness that exceeds the standard pipe wall thickness for a Class 53 DI pipe by 5%, 6%, and 3%, respectively. These slight exceedances in UTT readings may be attributed to a variance in the actual constructed pipe wall thickness versus minimum standards.
6. The results at UTT-7 through UTT-10 completed on the above-grade and below grade pipe segments for the Schreiber Plant indicate a minimum wall thickness that is within the standard range for minimum thickness with margin of error, and any differences observed can be considered negligible.
7. In summary, it was observed that below grade pipes were slightly corroded, whereas the above grade pipes did not show evidence of corrosion.

Recommendations

Based on the information obtained in this study, the tested sections of the gravity main piping have a remaining thickness of 86% or greater, and therefore have adequate wall thickness to operate at a minimum pressure of 250 psi. The following is recommended based on the results of this condition assessment.

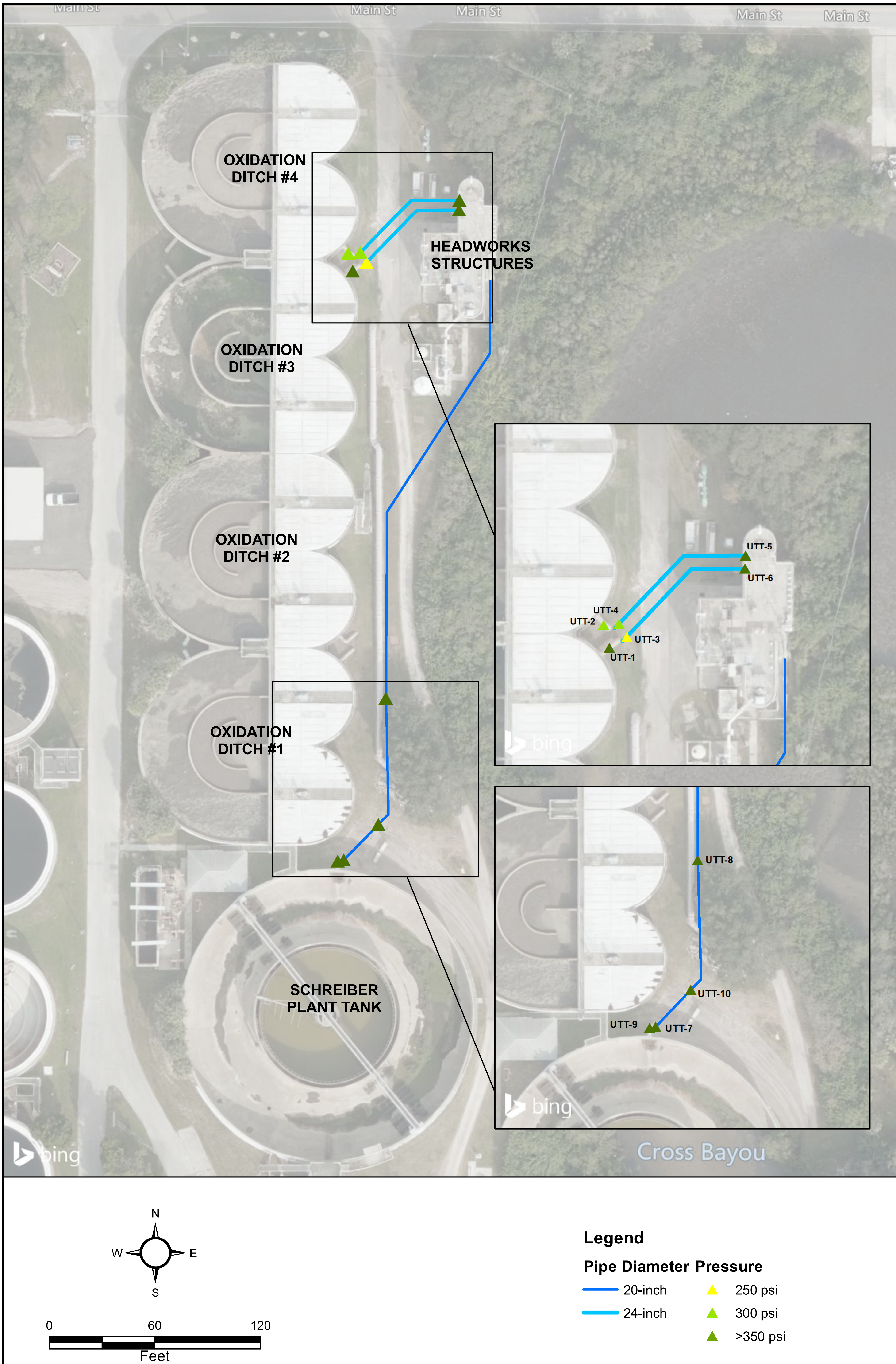
1. ***Near Term – Completion of future pipe condition assessments and pipe condition monitoring for each of the three (3) gravity mains without near term rehabilitation or replacement.*** The City has indicated that they would like to consider a more conservative approach for recommended actions, and that continued monitoring without rehabilitation or replacement of the gravity mains is not the preferred option. At a minimum, continued monitoring is recommended on an annual basis until any further repair or replacement of the gravity mains has occurred.

   OPCC - $40,000

2. ***Long Term – Replacement of two (2) existing DI gravity mains from the WRF headwork structures to Oxidation Ditch #3 and Oxidation Ditch #4; rehabilitation of interior lining for the 20-inch gravity main to the Schreiber Plant.*** Based on the observations made from CCTV and UTT, the two (2) 24-inch gravity mains have evidence of exterior and interior corrosion, and have a minor reduction in pipe wall thickness. It is recommended that replacement of these gravity mains be considered with potential relocation of the pipes during replacement. It is recommended that Oxidation Ditch #3 be placed offline first when replacement of the two (2) 24-inch gravity mains occurs, as UTT results indicate that the 24-inch DI gravity main pipe to this oxidation ditch has experienced the largest below-grade reduction in pipe wall thickness. The 20-inch gravity main did not show any signs of reduced pipe wall thickness, and it is recommended that this pipe be rehabilitated via CIPP lining replacement. The lining of this gravity main will provide necessary repairs to the interior lining of the pipe, reducing the risk of interior corrosion. Due to the uncertainty surrounding the cause of exterior corrosion observed during visual assessment of the exposed pipe along each gravity main segment, it is recommended that if rehabilitation of the gravity main CIPP lining be the selected remediation option, additional pipe condition assessment and monitoring be completed. This monitoring should be completed one (1) year after rehabilitation of the CIPP lining to provide additional data regarding the possible progression of any exterior corrosion, or a verification of reduced corrosion from the CIPP lining rehabilitation.

   OPCC - $1,164,000 to $1,246,000 (active vs. bypass)

3. When replacement of the 24-inch gravity mains are considered, it is recommended that minor re-designs to the pipe alignment of the 24-inch gravity mains to Oxidation Ditch #3 and Oxidation Ditch #4 be completed in order to improve accessibility for future maintenance, repair or replacement. Potential re-designs to consider include relocation of the 24-inch gravity mains in order to provide adequate distance for separate concrete encasements, or to avoid the need for concrete encasement at all.



CITY OF NEW PORT RICHEY
GRAVITY MAIN CONDITION ASSESSMENT
ULTRASONIC THICKNESS TESTING RESULTS

FIGURE ES-1

G:\0gis\3202 - New Port Richey WWTF Influent Gravity Condition Assessment_MXDs\Figure ES-1 Ultrasonic Testing Results.mxd

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LIST OF ABBREVIATIONS

AIM	AIM Engineering & Surveying
ANSI	American National Standards Institute
AWWA	American Water Works Association
CCTV	Closed-Circuit Television
CIPP	Cured-in-Place Pipe
City	City of New Port Richey
DI	Ductile Iron
HDPE	High Density Polyethylene
H_2S	Hydrogen Sulfide
H_2SO_4	Sulfuric Acid
IN	Inches
LF	Linear Foot (Linear Feet)
MGD	Million Gallons Per Day
NDT	Non-Destructive Testing
OD	Outer Diameter
OPCC	Opinion of Probable Construction Cost
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
Reiss	Reiss Engineering, Inc.
UTT	Ultrasonic Thickness Testing

1.0 INTRODUCTION

1.1 Background

Figure 1-1: City of New Port Richey Water Reclamation Facility

The City of New Port Richey (City) owns and operates the largest Water Reclamation Facility (WRF) in Pasco County, capable of treating up to 7.5 million gallons per day (MGD) of wastewater. The portion of the flow train evaluated at the WRF for this project consists of intake headworks structures with four (4) independent gravity feeds; one to each of the four (4) oxidation ditches which transfer a mixed liquor suspended solid wastewater composition. In May of 2019, the WRF experienced a wastewater discharge due to failure of a gravity feed main from the headworks structures of the facility. One (1) of the gravity mains, a 20-inch ductile iron (DI) main installed in 1988, ruptured causing a spill of wastewater. A failure of pipe in this manner is typically indicative of corrosion due to the build-up of corrosive hydrogen sulfide (H_2S) gas within the pipe, or the presence of corrosive soils on the exterior of the pipe. The buildup of sewer gasses inside of pipes can result in the formation of sulfuric acid (H_2SO_4) within the pipe that leads to corrosions and an eventual breakdown of the pipe's structural characteristics. Likewise, aggressive soils can also attack and degrade the pipe externally. The failed gravity main at the City's WRF has since been repaired and has returned to operation.

Due to the pipe failure experienced at the WRF in 2019, the City has expressed concerns regarding the condition of other gravity feed mains which transfer wastewater from the WRF headworks structures to the downstream oxidation ditches, or to the WRF Schreiber Plant storage for wet season overflows. In particular, there are three (3) gravity mains of concern including one (1) 20-inch gravity main to the Schreiber Plant, and two (2) 24-inch gravity mains to either Oxidation Ditch #3 or Oxidation Ditch #4. These three (3) gravity mains were installed in 1988 and 1993 for the 20-inch and 24-inch gravity mains, respectively, and range from ~175 to ~450 linear feet (LF). Reiss Engineering, Inc. (Reiss) was contracted by the City in late 2019 to complete condition assessment testing on the three (3) gravity mains using non-destructive testing (NDT) of pipe wall thickness, and prepare recommendations based on the results.

The total length of all segments assessed under this project is approximately 800 linear feet (LF), as shown on **Figure 1-3** and as described below.

- ~450 LF of existing 20-inch diameter DI gravity main from the WRF headworks structures to the Schreiber Plant to the west.
- ~175 LF of existing 24-inch diameter DI gravity main from the WRF headworks structures to Oxidation Ditch #3 to the north.
- ~175 LF of existing 24-inch diameter DI gravity main from the WRF headworks structures to Oxidation Ditch #4 to the north.

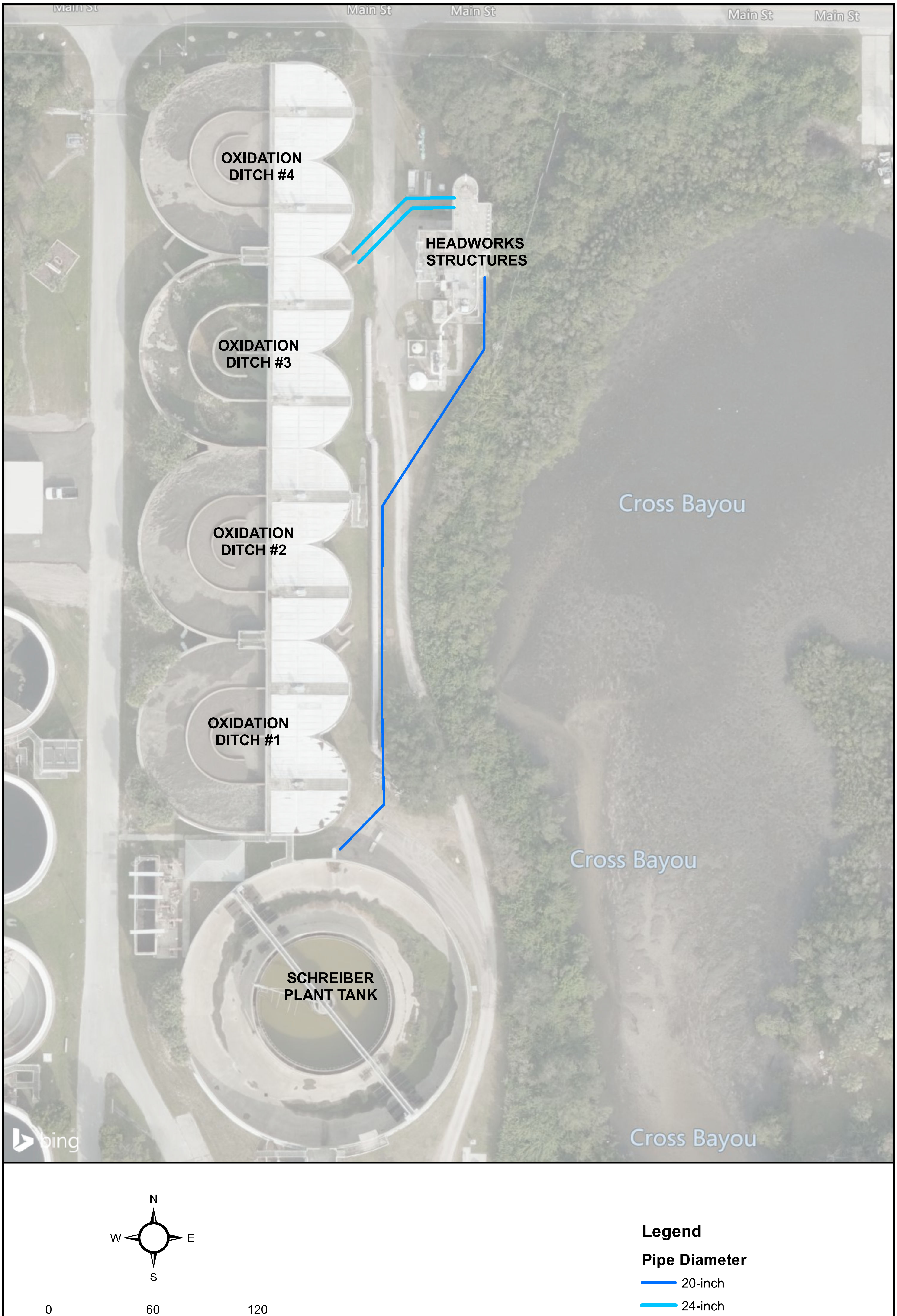
The current exterior condition and wall thickness of each gravity main were obtained using visual inspection and ultrasonic testing. This report summarizes the condition assessment findings, including the results of the ultrasonic thickness testing, and sets forth conclusions and recommendations for corrective actions.

1.2 Purpose

The purpose of this report is to document the condition of the three (3) gravity main pipes from the headworks facility to: two (2) to the facilities' oxidation ditches, Oxidation Ditch #3 and Oxidation Ditch #4, and one (1) to the Schreiber Plant.

Assessing the conditions of the gravity mains will help to identify potential failure points, based on exterior pipe wall thickness testing and associated pipe wall thicknesses, for repair or continued monitoring in order to safeguard against potential pipe failures, enabling the City to continue to provide reliable service to the community.

Figure 1-2: Exposed Interior of 24-inch Ductile Iron Gravity Main Pipe.



CITY OF NEW PORT RICHEY
GRAVITY MAIN CONDITION ASSESSMENT
CITY OF NEW PORT RICHEY WATER RECLAMATION FACILITY GRAVITY MAINS

FIGURE 1-3

G:\0gis\3202 - New Port Richey WWTF Influent Gravity Condition Assessment_MXDs\Figure 1-3 WRF Gravity Mains.mxd

2.0 ULTRASONIC THICKNESS TESTING

2.1 Ultrasonic Thickness Testing

UTT is a non-destructive form of materials testing most commonly used to measure thickness and identify degradation (typically corrosion) in various metals. The ultrasonic technology measures and displays the thickness of the metallic portion of the pipe, as well as its coating, using a 'single backwall echo'. An Average/Min mode setting on the ultrasonic equipment saves the average or minimum of several successive thickness measurements, and an overall pipe wall thickness is calculated based on these results. UTT is not performed on plastic pipe materials (i.e. PVC or HDPE).

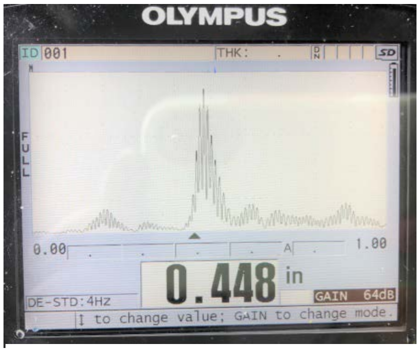


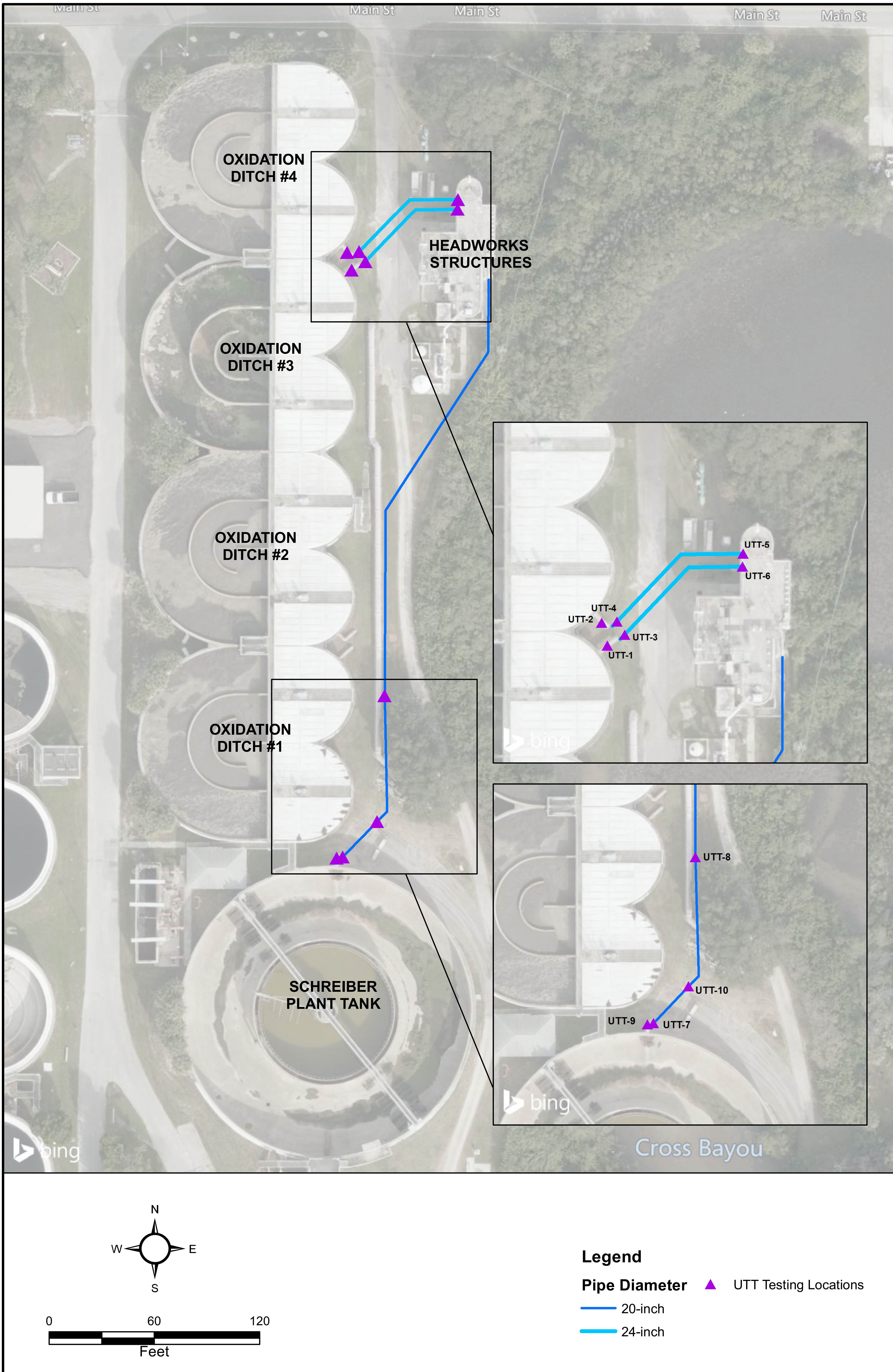
Figure 2-1: Sample of UTT Reading on Olympus 38-DL Plus

2.2 Methodology

Non-destructive ultrasonic testing was performed at various locations along the project corridor for each of the three (3) DI gravity mains. Field ultrasonic testing locations were established based on locations determined via subsurface utility location by AIM Engineering & Surveying (AIM) along each gravity main. Locations were selected based on segments of the pipe which are more easily accessible by the field survey crew and Reiss staff for testing. Ten (10) UTT locations were tested as outlined below and shown in **Figure 2-3**.

- Three (3) locations along the gravity main from the WRF headworks structures to Oxidation Ditch #3 were tested. Gravity main locations tested include one (1) above-grade vertical pipe segment at the headworks structures, one (1) below-grade pipe segment directly southeast of Oxidation Ditch #3, and one (1) above-grade pipe segment upstream of the gate valve at Oxidation Ditch #3.
- Three (3) locations along the gravity main from the WRF headworks structures to Oxidation Ditch #4 were tested. Gravity main locations tested include one (1) above-grade vertical pipe segment at the headworks structures, one (1) below-grade pipe segment directly southeast of Oxidation Ditch #4, and one (1) above-grade pipe segment upstream of the gate valve at Oxidation Ditch #4.
- Four (4) locations along the gravity main from the WRF headworks facility to the Schreiber Plant were tested. Gravity main locations tested include one (1) above-grade vertical pipe segment at the Schreiber Plant and three (3) below-grade pipe segments; two (2) below-grade pipe segments were located directly east of the Schreiber Plant and southwest of Oxidation Ditch #1, and one (1) below-grade pipe segment was located southeast of the Schreiber Plant and southeast of Oxidation Ditch #1.

Figure 2-2: View of Exposed Pipe during UTT



CITY OF NEW PORT RICHEY
GRAVITY MAIN CONDITION ASSESSMENT
ULTRASONIC THICKNESS TESTING OVERVIEW

FIGURE 2-3

G:\0gis\3202 - New Port Richey WWTF Influent Gravity Condition Assessment_MXDs\Figure 2-3 Ultrasonic Thickness Testing Overview.mxd

Pipe thickness testing locations were compiled, and the extents of corrosion identified for the various piping segments that were tested in the study. At each test location, ultrasonic readings were conducted at the top of pipe and along an array of angles at the specific cross-section of pipe being tested. Generally, testing was performed at roughly, 0°, 45°, 90°, 135°, and 180°, respectively from left to right based on the direction of flow, as shown to the right. In some areas below-grade fewer pipe angles were accessible for testing, and only the 45°, 90°, or 135° angles were tested. In other areas above-grade, particularly with vertical pipe segments assessed, additional angles were accessible and the 225°, 270° and 315° angles were tested. An average thickness was obtained from the three measurements per degree position and the lowest average thickness of all positions was used to measure the percent remaining based on DI pipe thickness class. In order to accurately calculate the quantity (or percentage) of pipe wall remaining at the test location, the original thickness of the pipe must be known. The City has provided construction specification documents for both the installed piping to the oxidation ditches and Schreiber Plant as shown in **Table 2-1** .

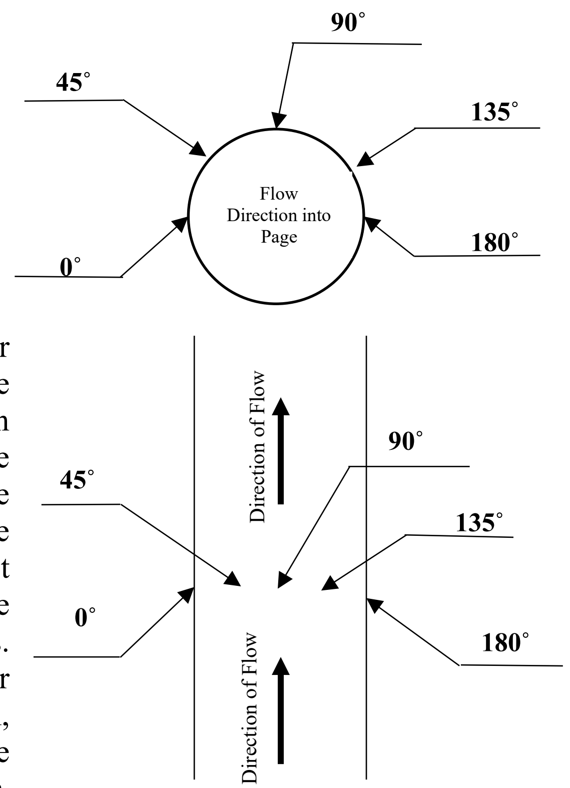


Figure 2-4: Location of Angles of Testing- Section and Plan Views

Table 2-1: WRF Gravity Main Pipe Classification

Pipe Identifier	Pipe Location[1]	Pipe Type	Pipe Class
Oxidation Ditch 3	Above-Grade	Ductile Iron, Flanged End	Class 53
		Ductile Iron, Mechanical Joint	
	Below-Grade	Ductile Iron, Flanged End	Class 51
		Ductile Iron, Mechanical Joint	
Oxidation Ditch 4	Above-Grade	Ductile Iron, Flanged End	Class 53
		Ductile Iron, Mechanical Joint	
	Below-Grade	Ductile Iron, Flanged End	Class 51
		Ductile Iron, Mechanical Joint	
Schreiber Plant	Above-Grade	Ductile Iron, Flanged End	Class 53
		Ductile Iron, Mechanical Joint	Class 51
	Below-Grade	Ductile Iron, Flanged End	Class 52
		Ductile Iron, Mechanical Joint	

[1]Pipe location is defined as either "above-grade" or "below-grade" for the purpose of pipe class determination.

The minimum pipe wall thickness associated with each pipe class specified above are provided in **Table 2-2** and are based on the standard pipe wall thicknesses as defined in ANSI/AWWA C151/A21.51, *Ductile-Iron Pipe, Centrifugally Cast*.

Table 2-2: WRF Gravity Main Minimum Pipe Thickness[1]

Pipe Class	Pipe Size (inches)	Pipe Thickness (inches)[2]
Class 51	20	0.34 – 0.44
	24	0.36 – 0.46
Class 52	20	0.37 – 0.47
	24	0.39 – 0.49
Class 53	20	0.40 – 0.50
	24	0.42 – 0.52

[1]Minimum pipe wall thickness based on ANSI/AWWA C151/A21.51: *Ductile Iron Pipe, Centrifugally Cast.*
[2]Pipe thickness ranges are based on an outer diameter (OD) tolerance of ±0.05 inches.

Remaining thickness was also compared to ANSI/AWWA C150/A21.50, *Standard Thickness for Pressure Classes*, as summarized in **Table 2-3**. The table defines the minimum wall thickness in inches (in) required to meet an associated pressure class in pounds per square inch (psi).

Table 2-3: Nominal Pipe Thickness per Pressure Class[1]

Nominal Thickness (in)		Pressure Class (psi)
20-inch	24-inch	
0.23	0.25	50
0.26	0.28	100
0.28	0.31	150
0.33	0.37	250
0.38	0.43	350

[1]Pressure classes 50 and 100 were calculated by interpolation based on ANSI/AWWA C150/A21.50, Table 5.

2.3 Ultrasonic Testing Equipment Calibration

Figure 2-5: UTT Calibration Thickness Blocks

The ultrasonic testing equipment used in this analysis was the Olympus 38DL Plus, which is an advanced non-destructive ultrasonic thickness gage that combines measurement features with data acquisition and output capabilities. The equipment can be used on numerous system elements such as piping, tanks, and other metal structures subject to internal corrosion or erosion. The equipment sends an ultrasonic wave through the pipe material, and the velocity of the wave is determined. The velocity is saved in the testing equipment and then calibration is performed by using a section of the same type of pipe material, which has been machined and incrementally measured in tenths of an inch for calibration. As velocity readings are relative to the type of pipe material, calibration blocks (shown above) were created from DI force main coupons to confirm the accuracy of the measurements of the Olympus 38DL Plus. Portions of those coupons were machined down to make calibration pieces; various thicknesses of the desired metal are required to determine the correlation between the material and the velocity at which the ultrasonic waves travel through the metal.

In addition, calibration was also verified by measuring the sample block with testing equipment and comparing the readings to a digital caliper. The thickness measurements were consistent with one another, thus indicating that the Olympus 38DL Plus was recording the correct material thicknesses and the testing procedure was being accurately performed. During field measurements the results from the Olympus 38DL Plus was compared with the manufactured coupons to confirm equipment accuracy.

2.4 Utility Coordination and Field Testing

Utility coordination with the City was conducted prior to performing the UTT condition assessment. This coordination was necessary to avoid impacts to existing utilities and current utility operations in the area. The testing equipment requires a clean surface in order to establish contact with the piping material to get an accurate reading of the pipe wall thickness to register on the equipment. Subsurface utility excavation was performed by AIM such that the soil surrounding the top portion (spring line to spring line) of the DI pipe surface was vacuumed out to sufficiently expose the piping. The gravity main was then air blasted to remove loose debris from the pipe surface, followed by a wire brush to gently scrape off any debris remaining on the outer surface of the pipe. Following testing, the holes were backfilled and restoration completed. An example ultrasonic testing data sheet used during field testing is provided in **Appendix A**.

Figure 2-6: Field Work at the City's WRF.

2.5 Closed-Circuit Television (CCTV)

A concrete encasement currently surrounds a portion of the gravity main pipe segments between the WRF headwork structures and Oxidation Ditch #3 and #4. This concrete encasement was installed in order to protect the gravity main piping from structural damage due to inbound and outbound vehicular traffic at the facility. In order to further evaluate the condition of the gravity main pipe segments from the WRF headworks structures to Oxidation Ditch #3 and Oxidation Ditch #4, the City elected to utilize closed-circuit television (CCTV) for visual inspection of the DI pipe interior within the encased portion of the main. The CCTV inspections were conducted from the headworks structures to the below-grade 45-bend fittings located approximately 30 to 40 feet from the headworks structures. Videos for the two (2) pipe segments were provided to Reiss for consideration when completing the condition assessment and preparing final recommendations based on collected data. Additional CCTV information is provided in **Appendix B**.

3.0 RESULTS

The results of the three (3) gravity main assessments are presented below. The results are also summarized in **Table 3-2** and presented graphically on **Figure 3-4**. Photos taken during field testing are provided in **Appendix C**.

1. UTT was performed at ten (10) locations within the project area as follows:
    - Four (4) UTT were completed on ~450 LF of the 20-inch DI gravity main between the headworks structures and the Schreiber Plant. Three (3) testing locations were below-grade and one (1) test location was above-grade.
    - Three (3) UTT were completed on ~175 LF of the 24-inch DI gravity main between the headworks structures and Oxidation Ditch #3. Two (2) testing locations were above-grade and one (1) test location was below-grade.
    - Three (3) UTT were completed on ~175 LF of the 24-inch DI gravity main between the headworks structures and Oxidation Ditch #4. Two (2) testing locations were above-grade and one (1) test location was below-grade.
2. A summary of the UTT testing is shown below in **Table 3-1**. The UTT data collected for DI pipe segments from the headworks structures to Oxidation Ditch #3, Oxidation Ditch #4, and the Schreiber Plant indicate that current pipe wall thicknesses meet or exceed a minimum pressure rating of 250 psi on average at each location tested.
3. The UTT results at UTT-3 and UTT-4 for the below-grade pipe segments to Oxidation Ditch #3 and Oxidation Ditch #4, respectively, indicate a pipe wall thickness slightly lower than the standard pipe wall thickness for a Class 51 DI pipe. CCTV videos provided by the City adds additional evidence of some existing internal corrosion within these pipe segments (**See Appendix B**).
4. The UTT results at UTT-1, UTT-5 and UTT-6 completed on pipe segments for Oxidation Ditch #3, and Oxidation Ditch #4 indicate a minimum pipe wall thickness that exceeds the standard pipe wall thickness for a Class 53 DI pipe by 5%, 6%, and 3%, respectively. These slight exceedances in UTT readings may be attributed to a variance in the actual constructed pipe wall thickness versus minimum standards.
5. The results at UTT-7 through UTT-10 completed on the above-grade and below grade pipe segments for the

Figure 3-1: Schreiber Plant Piping.

Figure 3-2: Exterior Pipe Corrosion.

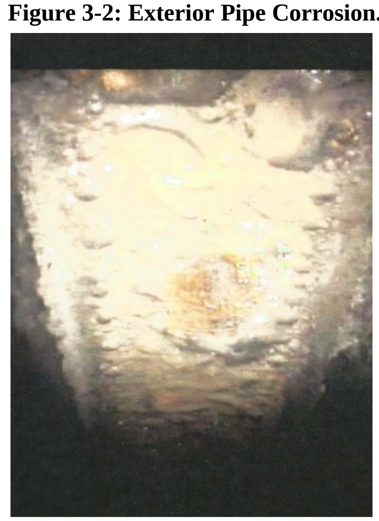


Figure 3-3: Interior Pipe Corrosion.

Schreiber Plant indicate a minimum wall thickness that is within the standard range for minimum thickness with margin of error, and any differences observed can be considered negligible.

6. Visual inspection during UTT showed signs of some exterior pipe corrosion (**See Figure 3-2**) at various locations for each gravity main pipe segment. It is unknown at this time whether this corrosion is due to contact between the pipe exterior and potentially corrosive soils, a high groundwater table, etc.
7. In summary, it was observed that below grade pipes were slightly corroded, whereas the above grade pipes did not show evidence of corrosion.

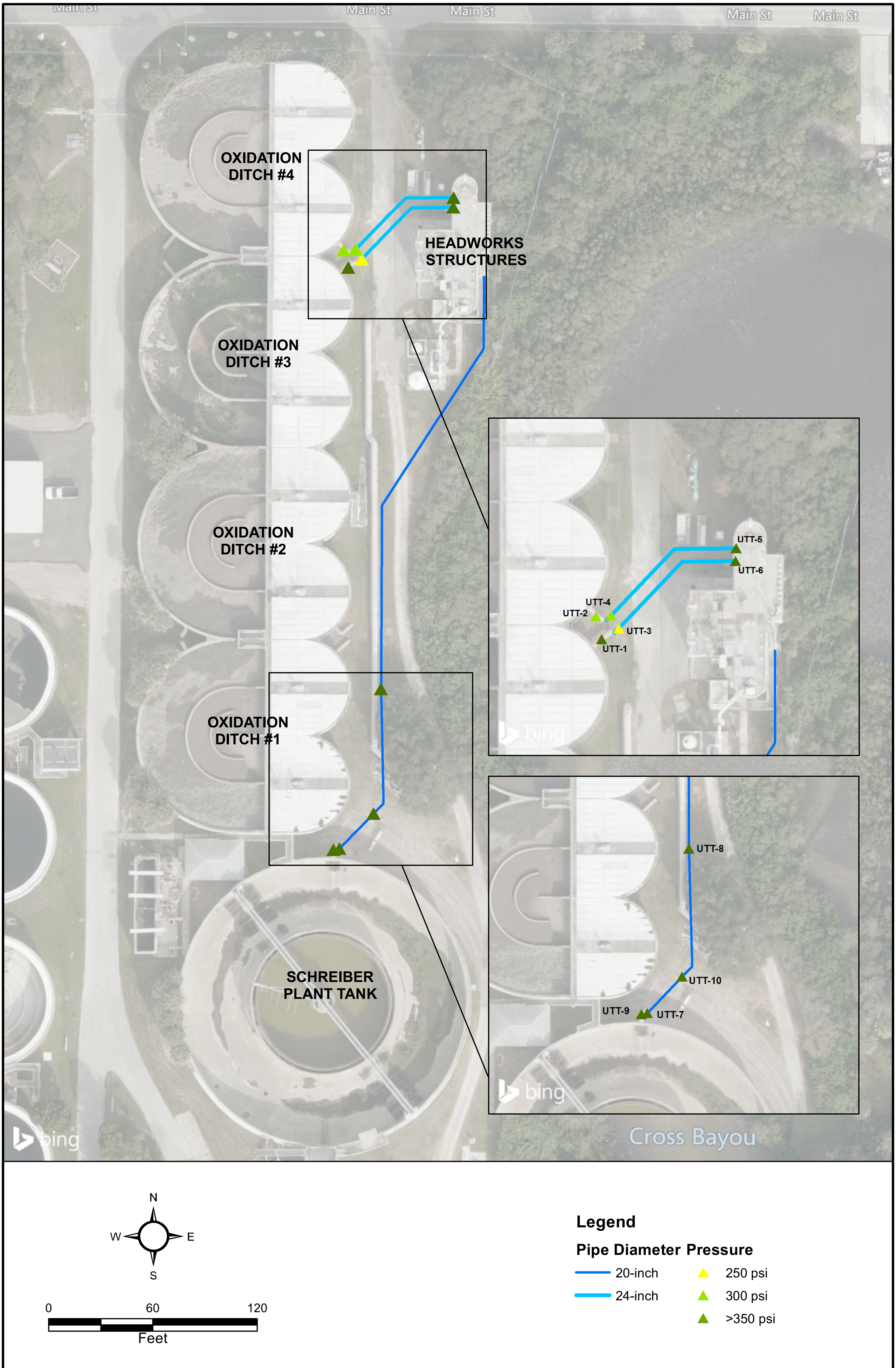
Table 3-1: Summary of Ultrasonic Testing

Pressure Class (psi)	Nominal Thickness		Number of UTT
	20-inch	24-inch	
0-50	< 0.24	< 0.26	0
50-100	0.24 - 0.26	0.26 - 0.28	0
101-150	0.27 - 0.28	0.29 - 0.31	0
151-250	0.29 - 0.36	0.32 - 0.37	0
>250	> 0.36	> 0.37	10

Table 3-2: Ultrasonic Thickness Testing Results

UTT ID	Pipe Location	Physical Location[1]	Size/Class[2]	Wall Thickness (inch)								Thickness Average (inch)	Minimum	Standard	Wall Thickness Remaining	Minimum Pressure Class[3]
				0º	45º	90º	135º	180º	225º	270º	315º					
1	Oxidation Ditch 3	Tank/AG	24-inch/Class 53	0.559	0.565	0.547	0.552	0.555	-	-	-	0.556	0.547	0.42 – 0.52	100%	≥350
3		Grass/BG	24-inch/Class 51	-	0.422	0.354	0.393	0.411	-	-	-	0.395	0.354	0.36 – 0.46	86%	250
6		Headworks/AG	24-inch/Class 53	0.536	0.568	0.586	0.588	0.584	0.535	0.565	0.548	0.564	0.535	0.42 – 0.52	100%	≥350
2	Oxidation Ditch 4	Tank/AG	24-inch/Class 53	0.458	0.474	0.495	0.474	0.411	-	-	-	0.462	0.411	0.42 – 0.52	87%	300
4		Grass/BG	24-inch/Class 51	0.429	0.423	0.447	0.397	-	-	-	-	0.424	0.397	0.36 – 0.46	97%	300
5		Headworks/AG	24-inch/Class 53	0.562	0.569	0.560	0.566	0.568	0.549	0.549	0.559	0.560	0.549	0.42 – 0.52	100%	≥350
7	Schreiber Plant	Tank/AG	20-inch/Class 53	0.466	0.466	0.484	0.487	0.478	0.488	0.490	0.477	0.480	0.466	0.40 – 0.50	100%	≥350
8		Grass/BG	20-inch/Class 52	-	-	0.453	0.424	-	-	-	-	0.439	0.424	0.37 – 0.47	100%	≥350
9		Grass/BG	20-inch/Class 52	-	0.456	0.429	0.432	-	-	-	-	0.439	0.429	0.37 – 0.47	100%	≥350
10		Grass/BG	20-inch/Class 52	-	0.455	-	-	-	-	-	-	0.455	0.455	0.37 – 0.47	100%	≥350

[1]AG = "Above-Grade", BG = "Below-Grade"
[2]Pipe classifications for each DI pipe segment based on historical construction specifications provided to Reiss by the City as a reference; it is assumed that these gravity mains were installed as indicated.
[3]Pressure classes below 150 psi and above 350 psi were calculated by interpolation and extrapolation based on ANSI/AWWA C150/A21.50, Table 5.



CITY OF NEW PORT RICHEY
GRAVITY MAIN CONDITION ASSESSMENT
ULTRASONIC THICKNESS TESTING RESULTS

FIGURE 3-4

G:\0gis\3202 - New Port Richey WWTF Influent Gravity Condition Assessment_MXDs\Figure 3-4 Ultrasonic Testing Results.mxd

4.0 REMEDIATION ALTERNATIVES

Results of the condition assessment indicate that the effective pipe wall thickness for each of the three (3) gravity mains evaluated has been slightly reduced in the below-grade pipe segments from the headworks structures to Oxidation Ditch #3 and Oxidation Ditch #4, and that during visual inspection, some minor corrosion was present on both exterior and interior surfaces at several UTT locations tested. Due to recent failures and replacement of the gravity mains to Oxidation Ditch #1 and #2, the City has concerns regarding the structural integrity of the three (3) DI pipe segments described in this report. Although only minor corrosion and reduction in pipe wall thickness were observed, remediation options were evaluated to provide the City with a proactive approach to addressing the DI pipe segments of concern. Reiss has determined four (4) potential alternative options for action in order to address the remediation of the gravity mains as shown in **Table 4-1**, and described further in this Section.

4.1 Gravity Main Pipe Replacement

Figure 4-1: Oxidation Ditch Above-Grade Tank Piping.

Remediation via replacement of the DI gravity mains will provide the best solution to any issues of exterior or interior corrosion that may be occurring within the existing pipes; however, due to some constructability constraints this option would be costly. The WRF's permit requires the active operation of at least three (3) out of four (4) oxidation ditches at any given time. There is an existing concrete encasement containing both 24-inch gravity main pipe segments from the headwork structures to Oxidation Ditch #3 and Oxidation Ditch #4. Due to both gravity mains being located within this concrete encasement, constructability concerns exist, and replacement of these gravity mains will require special care so to avoid potential disruption of service or unnecessary wastewater discharges, as pipe replacement will likely be within confined spaces near active mains. The 20-inch DI gravity main from the headworks structures to the Schreiber Plant is located within close proximity to a variety of above-grade and buried utilities, increasing the complexity surrounding replacement.

It is imperative that any Contractor selected for replacement of the gravity main pipe segments be experienced and capable of working at a facility that requires no disruption to service, and working in confined spaces while ensuring no interruptions in service or structural damage occur to the active operations at the facility. Note that the City has indicated that for all gravity main replacement options considered, the newly installed DI pipe should include a Protecto 401 lining, or equivalent. PVC or HDPE may also be an applicable material of installation, as these pipes do not corrode.

Three (3) potential replacement options for replacement of the 20-inch and two (2) 24-inch DI gravity mains while maintaining compliance with the WRF's operating permit conditions are described further below.

- ***Option 1A – Replace two (2) 24-inch DI gravity main pipe segments while maintaining active operation of at least one (1) 24-inch gravity main to either Oxidation Ditch #3 or***

Oxidation Ditch #4 during replacement. This option consists of maintaining active operation of one (1) 24-inch gravity main, either to Oxidation Ditch #3 or Oxidation Ditch #4, during replacement of the adjacent, inactive 24-inch gravity main. Upon completion of replacement of one 24-inch gravity main, the main will be placed into operation while the previously active 24-inch gravity main is replaced. This option involves careful consideration and will require an experienced Contractor capable of working at a facility that requires no disruption to service, and working in confined spaces while ensuring no interruptions in service or structural damage occur to the active gravity main.

- ***Option 1B – Replace two (2) 24-inch DI gravity main pipe segments through the bypass of wastewater flows around the two (2) 24-inch gravity mains to maintain active operation of either Oxidation Ditch #3 or Oxidation Ditch #4.*** This option consists of the use of a permanent or temporary wastewater flow bypass pipe during the replacement of the 24-inch gravity mains to Oxidation Ditch #3 and Oxidation Ditch #4, with both existing 24-inch gravity mains to be taken offline during replacement. The bypass would transfer wastewater via a pump directly from the headworks structures to either Oxidation Ditch #3 or Oxidation Ditch #4. The intent of the bypass would be to maintain active operation of one (1) of these oxidation ditches via the piping and pumping bypass system while keeping the below-grade gravity main pipe segments for each oxidation ditch inactive for replacement. Replacement of the 24-inch gravity mains via bypass flows to Oxidation Ditch #3 or Oxidation Ditch #4 would reduce the complexity of replacement compared to Option 1A due to the removal of risk in causing damage to an active gravity main during replacement of the adjacent, inactive gravity main. Bypass method can be either permanent or temporary. If a permanent bypass is selected, further consideration should be given to the design of the bypass with consideration to the gravity mains to Oxidation Ditch #3 and Oxidation Ditch #4 including the possibility of a below-grade bypass pipe with valve connections to the two (2) oxidation ditches for maintenance shutoff of the 24-inch mains. This option will require a Contractor capable of working at an active facility and working in confined spaces.

For both Option 1A and Option 1B, relocation of the two (2) existing 24-inch DI gravity mains during replacement would provide the ability to avoid constructability concerns regarding the concrete encasement that extends along a portion of the gravity mains for traffic protection. Replacement of the gravity mains could be achieved through full abandonment of the portion of each gravity main with concrete encasement, with the new segment of gravity main to be relocated to a more practical location. These gravity mains can be relocated either north or south of their existing location via the use of fittings, providing adequate spacing between each main for future assessment, maintenance access and/or repairs.

- ***Option 2 – Replace one (1) 20-inch DI gravity main pipe segment from the headworks structures to the Schreiber Plant.*** This option consists of the replacement of the 20-inch DI gravity main. The 20-inch gravity main to the Schreiber Plant is not typically in operation and is used as a wet-season overflow storage; however, replacement of this pipe should be completed with care given to the various utilities located throughout the existing pipeline corridor. A Contractor completing the replacement of this pipe should have experience and be capable of working at an active facility, working in confined spaces, and working around existing utilities.

4.2 Gravity Main CIPP Lining Rehabilitation


Figure 4-2: Interior Pipe Lining Deterioration.

The City has indicated that rehabilitation of the existing CIPP lining is the preferred remediation option due to the constructability concerns and the potentially high cost of replacement. CCTV and visual inspection of the pipe interiors of the gravity mains to Oxidation Ditch #3 and Oxidation Ditch #4 indicated that the existing pipe lining was worn and is likely in need of replacement. Although no inspection was completed on the interior of the 20-inch gravity main to the Schreiber Plant, this pipe was installed in 1988 and likely has similar or increased wearing compared to the two (2) 24-inch gravity mains installed in 1993. Rehabilitation of the CIPP lining in each of the DI gravity main pipe segments would not require any interruptions to active operation of service to Oxidation Ditch #3 or Oxidation Ditch #4, and one (1) gravity main may be active while another is inactive for CIPP lining replacement. Another point of concern is related to the potential for exterior pipe failure, as rehabilitation of the CIPP lining will provide additional structural support for the interior of the pipe but does not necessarily address any concerns related to exterior corrosion, or exterior pipe integrity. The results of this condition assessment confirmed the presence of some exterior corrosion along each of the three (3) gravity main pipe segments at several locations that were tested, and it is currently unknown whether a CIPP lining would provide effective structural support in the case of exterior pipe failure.

Two (2) potential options for rehabilitation of the 20-inch and two (2) 24-inch DI gravity mains are described further below.

- ***Option 3 – Rehabilitation of two (2) 24-inch DI gravity main pipe segments via replacement of CIPP lining while maintaining active operation of at least one (1) 24-inch gravity main to either Oxidation Ditch #3 or Oxidation Ditch #4.*** This option consists of replacement of the existing CIPP lining for the two (2) 24-inch DI gravity main pipe segments. One (1) constructability concern associated with this option includes installation of a CIPP lining in a gravity main with fittings, as this is atypical and can present risks of failure due to improper installation, though it has been discussed with and indicated by Layne, a CIPP lining company, that lining a main with fittings is possible and can be completed without an increased risk of failure. The two (2) pipe segments showed minor indications of pipe wall thickness reduction and some exterior corrosion and although these results are not indicative of an increased risk of failure, these pipes were installed in 1993 and the original lining has been worn and should be replaced.
- ***Option 4 – Rehabilitation of one (1) 20-inch DI gravity main pipe segment from the headworks structures to the Schreiber Plant.*** This option consists of replacement of the existing CIPP lining for the 20-inch DI gravity main pipe segment. Rehabilitation of the 20-inch gravity main would not require any interruptions to service, as this pipe is typically not active and is only used for wet-season overflows. This pipe segment did not show any indication of pipe wall thickness reduction; however, the pipe was installed in 1988 and the original liner has likely worn and is due for replacement.

4.3 Additional Pipe Condition Assessment and Monitoring


Figure 4-3: Pipe Condition Assessment Field Testing.

Completion of addition pipe condition monitoring for each of the three (3) gravity mains. This option consists of no repair or replacement of any of the three (3) gravity mains, and instead will consider additional condition assessment and pipe condition monitoring in one (1) year to evaluate any changes in pipe wall thickness or structural integrity from corrosion. This option does not address any potential concerns related to the presence of exterior or interior corrosion along each of the three (3) gravity mains. Spot UTT results and visual inspection results showed evidence of minor reduction in pipe thickness and some exterior corrosion, so it is important that monitoring be included should any option but replacement be considered.

Table 4-1: Gravity Main Remediation Options

Option	Remediation Type	Description
1A	Replacement	Replace two (2) 24-inch DI gravity main pipe segments while maintaining active operation of at least one (1) 24-inch gravity main to either Oxidation Ditch #3 or Oxidation Ditch #4 during replacement.
1B	Replacement	Replace two (2) 24-inch DI gravity main pipe segments through the bypass of wastewater flows around the two (2) 24-inch gravity mains to maintain active operation of either Oxidation Ditch #3 or Oxidation Ditch #4.
2	Replacement	Replace one (1) 20-inch DI gravity main pipe segment to the Schreiber Plant.
3	Rehabilitation	Repair two (2) 24-inch DI gravity mains through the replacement of the existing cured-in-place pipe (CIPP) lining.
4	Rehabilitation	Repair one (1) 20-inch DI gravity main through the replacement of the existing cured-in-place (CIPP) lining.

5.0 COST

Opinion of probable construction costs (OPCC) have been completed for each remediation option and are summarized in **Table 5-1** through **Table 5-6**.

Table 5-1: Option #1A – Replacement of Basin No. 3 and 4 Gravity Main Pipes (Active)

Item	Description	Quantity	Unit	Unit Price	Cost
1	Mobilization and Demobilization (5%)	1	LS	$30,000	$30,000
2	General Conditions (3%)	1	LS	$18,000	$18,000
3	Abandonment of Existing Pipe	350	LF	$10	$3,500
4	Asphalt Removal and Replacement	120	SY	$70	$8,400
5	Sitework and Erosion Control	1	LS	$25,000	$25,000
6	Landscaping Restoration	1	LS	$20,000	$20,000
7	24-inch DI Piping and Fittings	450	LF	$1,200	$540,000
	Subtotal				**$645,000**
8	Contractor Overhead and Profit (15%)	1	LS	$103,000	$97,000
9	Contingency (30%)	1	LS	$236,700	$223,000
	Total				**$965,000**

Table 5-2: Option #1B – Replacement of Basin No. 3 and 4 Gravity Main Pipes (Bypass)

Item	Item	Quantity	Unit	Unit Price	Cost
1	Mobilization and Demobilization (5%)	1	LS	$33,000	$33,000
2	General Conditions (3%)	1	LS	$20,000	$20,000
3	Abandonment of Existing Pipe	350	LF	$10	$3,500
4	Bypass of Wastewater Flows	1	LS	$50,000	$50,000
5	Asphalt Removal and Replacement	120	SY	$70	$8,400
6	Sitework and Erosion Control	1	LS	$25,000	$25,000
7	Landscaping Restoration	1	LS	$20,000	$20,000
8	24-inch DI Piping and Fittings	450	LF	$1,200	$540,000
	Subtotal				**$700,000**
9	Contractor Overhead and Profit (15%)	1	LS	$111,000	$105,000
10	Contingency (30%)	1	LS	$255,300	$242,000
	Total				**$1,047,000**

Table 5-3: Option #2 – Replacement of Schreiber Plant Gravity Main Pipe

Item	Description	Quantity	Unit	Unit Price	Cost
1	Mobilization and Demobilization (5%)	1	LS	$26,000	$26,000
2	General Conditions (3%)	1	LS	$16,000	$16,000
3	Abandonment of Existing Pipe	450	LF	$10	$4,500
4	Asphalt Removal and Replacement	120	SY	$70	$8,400
5	Sitework and Erosion Control	1	LS	$25,000	$25,000
6	Landscaping Restoration	1	LS	$20,000	$20,000
7	20-inch DI Piping and Fittings	450	LF	$1,000	$450,000
	Subtotal				**$550,000**
8	Contractor Overhead and Profit (15%)	1	LS	$89,000	$83,000
9	Contingency (30%)	1	LS	$203,400	$190,000
	Total				**$823,000**

Table 5-4: Option #3 – CIPP Lining of Basin No. 3 and 4 Gravity Main

Item	Item	Quantity	Unit	Unit Price	Cost
1	Mobilization and Demobilization (5%)	1	LS	$6,000	$6,000
2	General Conditions (3%)	1	LS	$4,000	$4,000
3	Bypass of Wastewater Flows	1	LS	$30,000	$30,000
4	Rehabilitation of 24-inch CIPP Lining	350	LF	$210	$74,000
5	Medium Jet Cleaning	350	LF	$10	$4,000
6	CCTV (Post-Cleaning, Post-Lining)	700	EA	$3	$3,000
	Subtotal				**$121,000**
7	Contractor Overhead and Profit (15%)	1	LS	$19,000	$19,000
8	Contingency (30%)	1	LS	$42,000	$42,000
	Total				**$182,000**

Table 5-5: Option #4 – CIPP Lining of Schreiber Plant Gravity Main Pipe

Item	Item	Quantity	Unit	Unit Price	Cost
1	Mobilization and Demobilization (5%)	1	LS	$5,000	$5,000
2	General Conditions (3%)	1	LS	$3,000	$3,000
3	Rehabilitation of 20-inch CIPP Lining	450	LF	$200	$90,000
4	Medium Jet Cleaning	450	LF	$10	$5,000
5	CCTV (Post-Cleaning, Post-Lining)	900	EA	$3	$3,000
	Subtotal				**$106,000**
6	Contractor Overhead and Profit (15%)	1	LS	$16,000	$16,000
7	Contingency (30%)	1	LS	$4	$37,000
	Total				**$159,000**

Table 5-6: Additional Condition Assessment and Monitoring

Item	Item	Quantity	Unit	Unit Price	Cost
1	Additional Condition Assessment	1	LS	$40,000	**$40,000**

6.0 RECOMMENDATIONS

Based on the information obtained in this study, the tested sections of the gravity main piping have a remaining thickness of 86% or greater, and therefore have adequate wall thickness to operate at a minimum pressure of 250 psi. The following is recommended based on the results of this condition assessment.

1. ***Near Term – Completion of future pipe condition assessments and pipe condition monitoring for each of the three (3) gravity mains without near term rehabilitation or replacement.*** The City has indicated that they would like to consider a more conservative approach for recommended actions, and that continued monitoring without rehabilitation or replacement of the gravity mains is not the preferred option. At a minimum, continued monitoring is recommended on an annual basis until any further repair or replacement of the gravity mains has occurred.

   OPCC - $40,000

2. ***Long Term – Replacement of two (2) existing DI gravity mains from the WRF headwork structures to Oxidation Ditch #3 and Oxidation Ditch #4; rehabilitation of interior lining for the 20-inch gravity main to the Schreiber Plant.*** Based on the observations made from CCTV and UTT, the two (2) 24-inch gravity mains have evidence of exterior and interior corrosion, and have a minor reduction in pipe wall thickness. It is recommended that replacement of these gravity mains be considered with potential relocation of the pipes during replacement. It is recommended that Oxidation Ditch #3 be placed offline first when replacement of the two (2) 24-inch gravity mains occurs, as UTT results indicate that the 24-inch DI gravity main pipe to this oxidation ditch has experienced the largest below-grade reduction in pipe wall thickness. The 20-inch gravity main did not show any signs of reduced pipe wall thickness, and it is recommended that this pipe be rehabilitated via CIPP lining replacement. The lining of this gravity main will provide necessary repairs to the interior lining of the pipe, reducing the risk of interior corrosion. Due to the uncertainty surrounding the cause of exterior corrosion observed during visual assessment of the exposed pipe along each gravity main segment, it is recommended that if rehabilitation of the gravity main CIPP lining be the selected remediation option, additional pipe condition assessment and monitoring be completed. This monitoring should be completed one (1) year after rehabilitation of the CIPP lining to provide additional data regarding the possible progression of any exterior corrosion, or a verification of reduced corrosion from the CIPP lining rehabilitation.

   OPCC - $1,164,000 to $1,246,000 (active vs. bypass)

3. If replacement of the 24-inch gravity mains are considered, it is recommended that minor re-designs to the pipe alignment of the 24-inch gravity mains to Oxidation Ditch #3 and Oxidation Ditch #4 be completed in order to improve accessibility for future maintenance, repair or replacement. Potential re-designs to consider include relocation of the 24-inch gravity mains in order to provide adequate distance for separate concrete encasements, or to avoid the need for concrete encasement at all.

Appendix A

ULTRASONIC FIELD TESTING SHEETS

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APPENDIX A
ULTRASONIC FIELD TESTING SHEETS

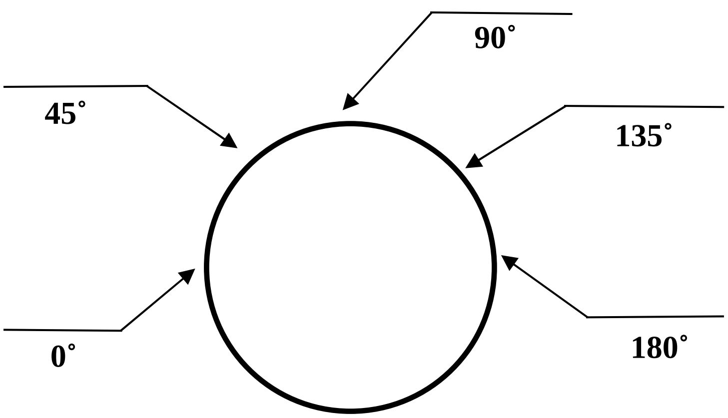
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-1 (Oxidation Ditch #3) Date: 2-19-2020

Client Project Number: REI Project Number: 3202

Line Type: Raw Intake Size: 24-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	0.563	0.559
	0.572	
	0.542	
45	0.545	0.565
	0.578	
	0.572	
90	0.554	0.547
	0.592	
	0.496	
135	0.554	0.552
	0.555	
	0.546	
180	0.543	0.555
	0.557	
	0.565	

Velocity: N/A

Total Average 0.556

Notes: UTT sample located on above-grade pipe upstream of Oxidation Ditch #3 tank.

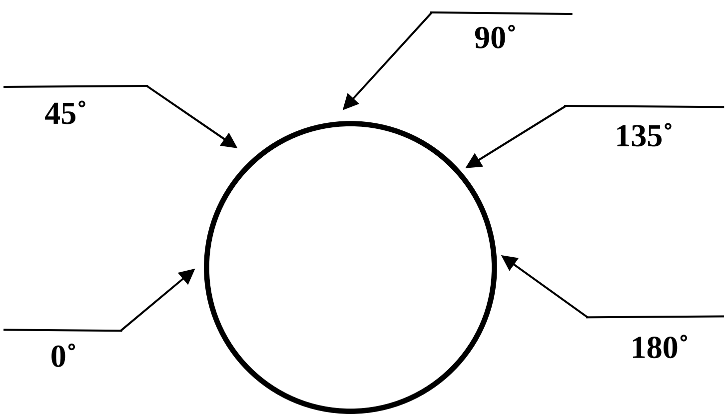
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-2 (Oxidation Ditch #4) Date: 2-19-2020

Client Project Number: ______ REI Project Number: 3202

Line Type: Raw Intake Size: 24-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	0.479	0.458
	0.465	
	0.429	
45	0.473	0.474
	0.493	
	0.455	
90	0.522	0.495
	0.470	
	0.493	
135	0.468	0.474
	0.476	
	0.479	
180	0.472	0.411
	0.498	
	0.477	

Velocity: N/A

Total Average 0.462

Notes: UTT sample located on above-grade pipe upstream of Oxidation Ditch #4 tank.

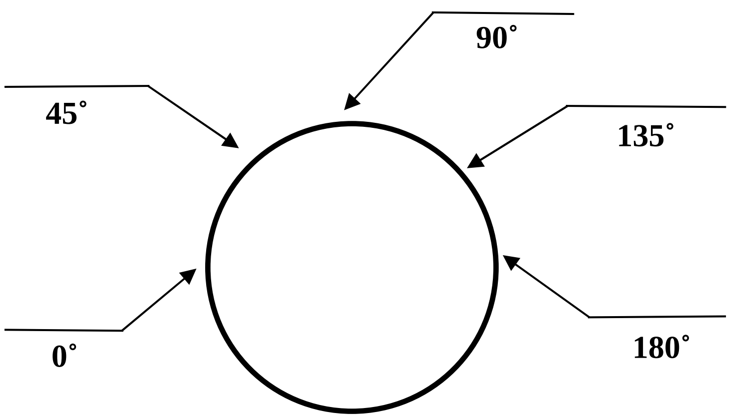
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-3 (Oxidation Ditch #3) Date: 2-19-2020

Client Project Number: ______ REI Project Number: 3202

Line Type: Raw Intake Size: 24-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	-	-
	-	
	-	
45	0.445	0.422
	0.398	
	0.423	
90	0.344	0.354
	0.367	
	0.352	
135	0.409	0.393
	0.394	
	0.375	
180	0.458	0.411
	0.386	
	0.388	

Velocity: N/A

Total Average 0.395

Notes: UTT sample located on below-grade pipe upstream and to the southeast of Oxidation Ditch #3 tank.

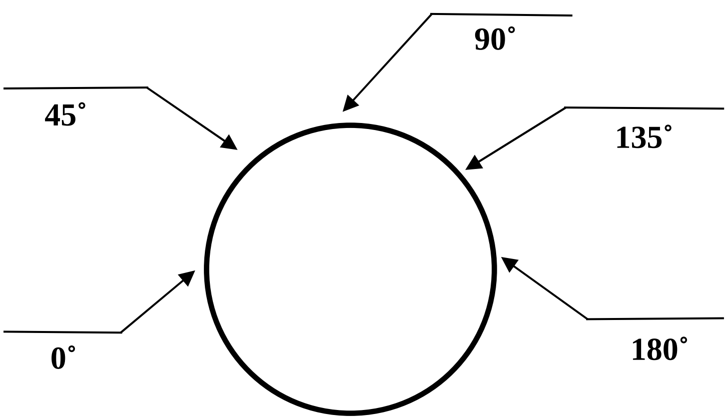
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-4 (Oxidation Ditch #4) Date: 2-19-2020

Client Project Number: ______ REI Project Number: 3202

Line Type: Raw Intake Size: 24-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	0.432	0.429
	0.425	
	0.430	
45	0.431	0.423
	0.411	
	0.427	
90	0.454	0.447
	0.441	
	0.447	
135	0.404	0.397
	0.372	
	0.415	
180	-	-
	-	
	-	

Velocity: N/A

Total Average 0.424

Notes: UTT sample located on below-grade pipe upstream and to the southeast of Oxidation Ditch #4 tank.

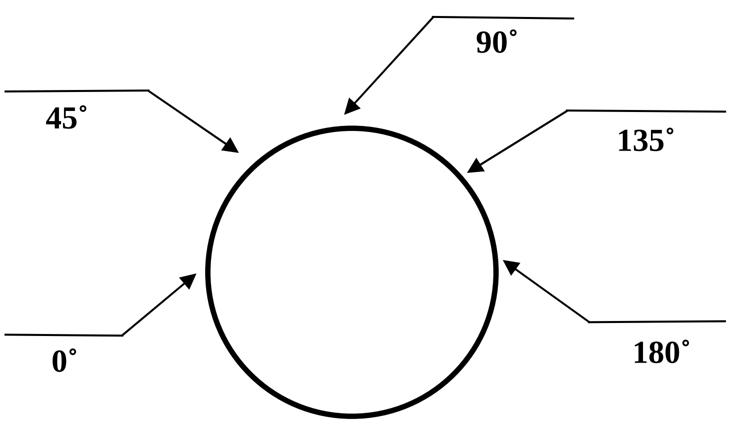
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-5 (Oxidation Ditch #4) Date: 2-19-2020

Client Project Number: REI Project Number: 3202

Line Type: Raw Intake Size: 24-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	0.545	0.562
	0.561	
	0.580	
45	0.576	0.569
	0.582	
	0.548	
90	0.545	0.560
	0.556	
	0.579	
135	0.552	0.566
	0.567	
	0.578	
180	0.549	0.568
	0.584	
	0.572	

Velocity: N/A

Total Average 0.560

Notes: UTT sample located on above-grade pipe to Oxidation Ditch #4 directly downstream of the headworks facility structures.

Additional UTT Measurements:

225º = 0.538, 0.532, 0.578 Average = 0.549

270º = 0.548, 0.552, 0.547 Average = 0.549

315º = 0.566, 0.557, 0.553 Average = 0.559

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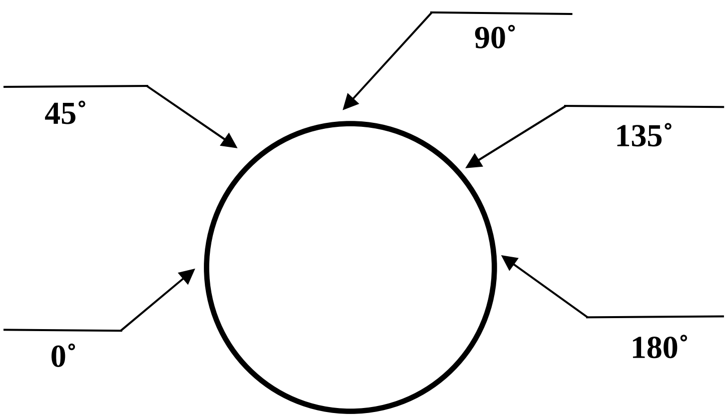
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-6 (Oxidation Ditch #3) Date: 2-19-2020

Client Project Number: ______ REI Project Number: 3202

Line Type: Raw Intake Size: 24-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	0.536	0.536
	0.531	
	0.541	
45	0.586	0.568
	0.554	
	0.564	
90	0.584	0.586
	0.596	
	0.579	
135	0.582	0.588
	0.587	
	0.594	
180	0.573	0.584
	0.580	
	0.599	

Velocity: N/A

Total Average 0.564

Notes: UTT sample located on above-grade pipe to Oxidation Ditch #3 directly downstream of the headworks facility structures.

Additional UTT Measurements:

225º = 0.532, 0.531, 0.543 Average = 0.535

270º = 0.579, 0.547, 0.569 Average = 0.565

315º = 0.528, 0.567, 0.550 Average = 0.548

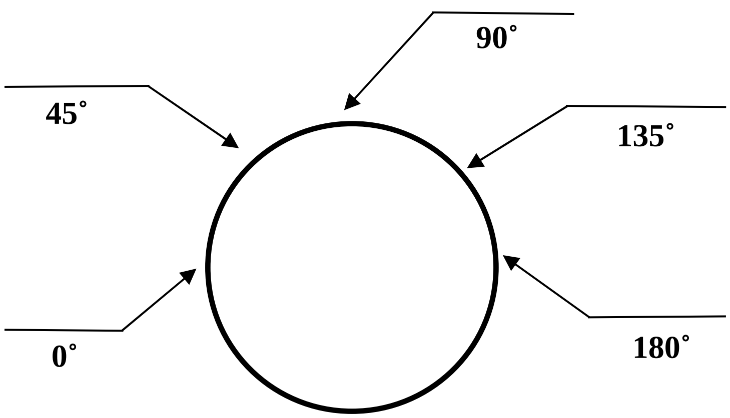
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-7 (Schreiber Plant) Date: 2-21-2020

Client Project Number: ______ REI Project Number: 3202

Line Type: Raw Intake Size: 20-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	0.467	0.466
	0.468	
	0.463	
45	0.477	0.466
	0.463	
	0.459	
90	0.486	0.484
	0.481	
	0.484	
135	0.488	0.487
	0.485	
	0.489	
180	0.484	0.478
	0.480	
	0.471	

Velocity: N/A

Total Average ______

Notes: UTT sample located on above-grade pipe to Schreiber Plant directly upstream of the tank.

Additional UTT Measurements:

225º = 0.487, 0.486, 0.490 Average = 0.488; Corrosion Point #1 = 0.447

270º = 0.487, 0.492, 0.490 Average = 0.490 Corrosion Point #2 = 0.436

315º = 0.482, 0.475, 0.474 Average = 0.477 Corrosion Point #3 = 0.445

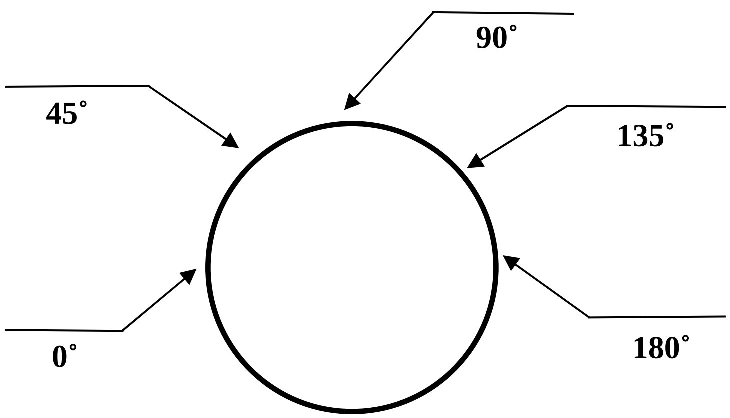
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-8 (Schreiber Plant) Date: 2-27-2020

Client Project Number: REI Project Number: 3202

Line Type: Raw Intake Size: 20-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	-	-
	-	
	-	
45	-	-
	-	
	-	
90	0.425	0.453
	0.459	
	0.482	
135	0.430	0.424
	0.418	
	0.425	
180	-	-
	-	
	-	

Velocity: N/A

Total Average 0.439

Notes: UTT sample located on below-grade pipe to Schreiber Plant upstream of the tank to the southeast.

Additional UTT Measurements:

90º = 0.457, 0.444

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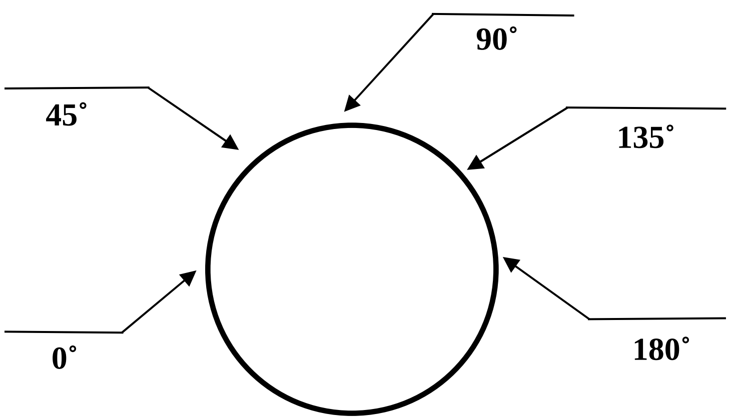
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-9 (Schreiber Plant) Date: 2-27-2020

Client Project Number: REI Project Number: 3202

Line Type: Raw Intake Size: 20-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	-	-
	-	
	-	
45	0.435	0.456
	0.440	
	0.492	
90	0.426	0.429
	0.427	
	0.435	
135	0.437	0.432
	0.430	
	0.428	
180	-	-
	-	
	-	

Velocity: N/A

Total Average 0.439

Notes: UTT sample located on below-grade pipe to Schreiber Plant directly upstream of the tank to the southeast.

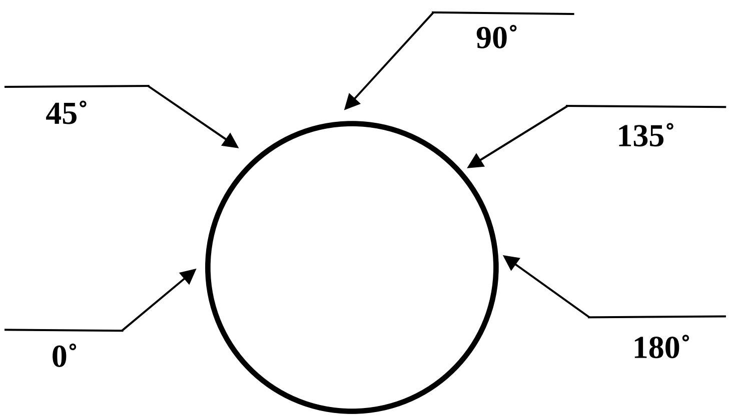
ULTRASONIC THICKNESS TESTING

Project Name: NPR Gravity Main Condition Assessment

Testing Area Location: UTT-10 (Schreiber Plant) Date: 2-27-2020

Client Project Number: ______ REI Project Number: 3202

Line Type: Raw Intake Size: 20-inch Material: Ductile Iron (DI)



Degree	Measurements	Average
0	-	-
	-	
	-	
45	0.435	0.455
	0.492	
	0.439	
90	-	-
	-	
	-	
135	-	-
	-	
	-	
180	-	-
	-	
	-	

Velocity: N/A

Total Average 0.455

Notes: UTT sample located on below-grade pipe to Schreiber Plant upstream of the tank to the southeast.

Appendix B

CCTV PHOTOS

REISS ENGINEERING

APPENDIX B
CCTV PHOTOS

OXIDATION DITCH #3

Figure B-1: CCTV Camera at Pipe Entrance of Oxidation Ditch #3.

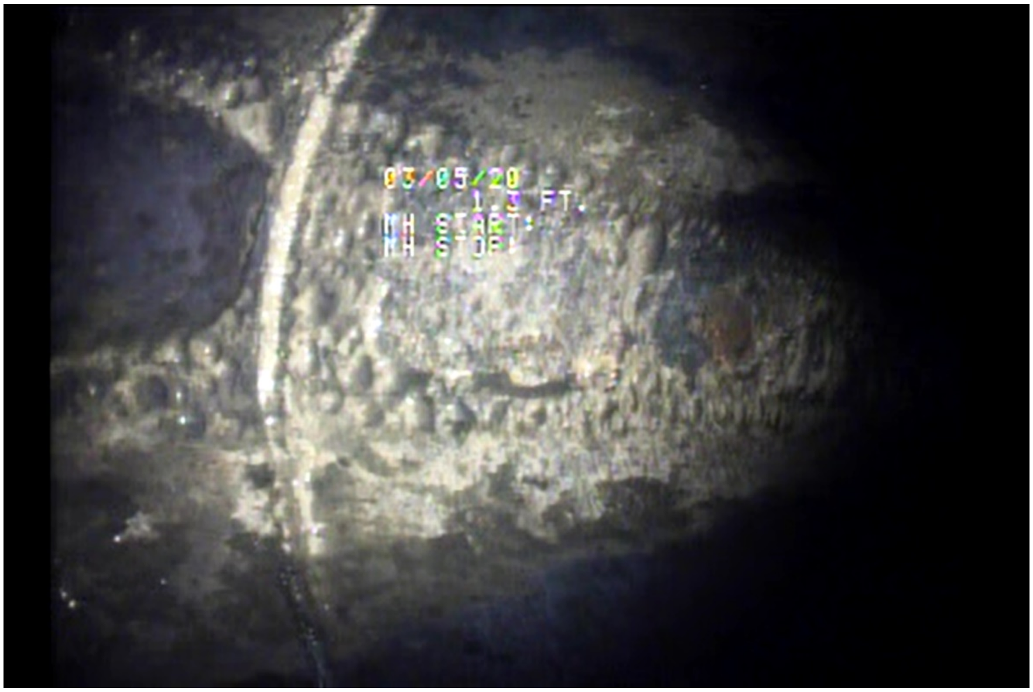


Figure B-2: Degradation of Interior Pipe Wall.

OXIDATION DITCH #3

Figure B-3: Interior corrosion and 'caking' of solids.

Figure B-4: Pipe Interior at Joints.

OXIDATION DITCH #3

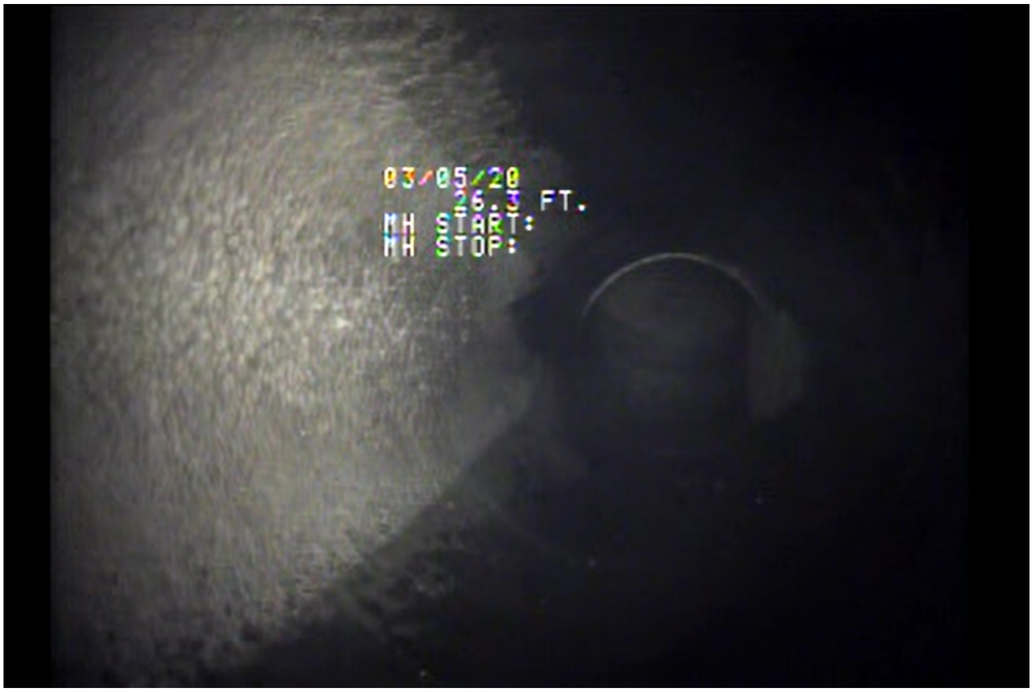


Figure B-5: White Film or 'Sheen' at Top of Pipe (left).

OXIDATION DITCH #4

Figure B-6: CCTV Camera at Pipe Entrance of Oxidation Ditch #4.

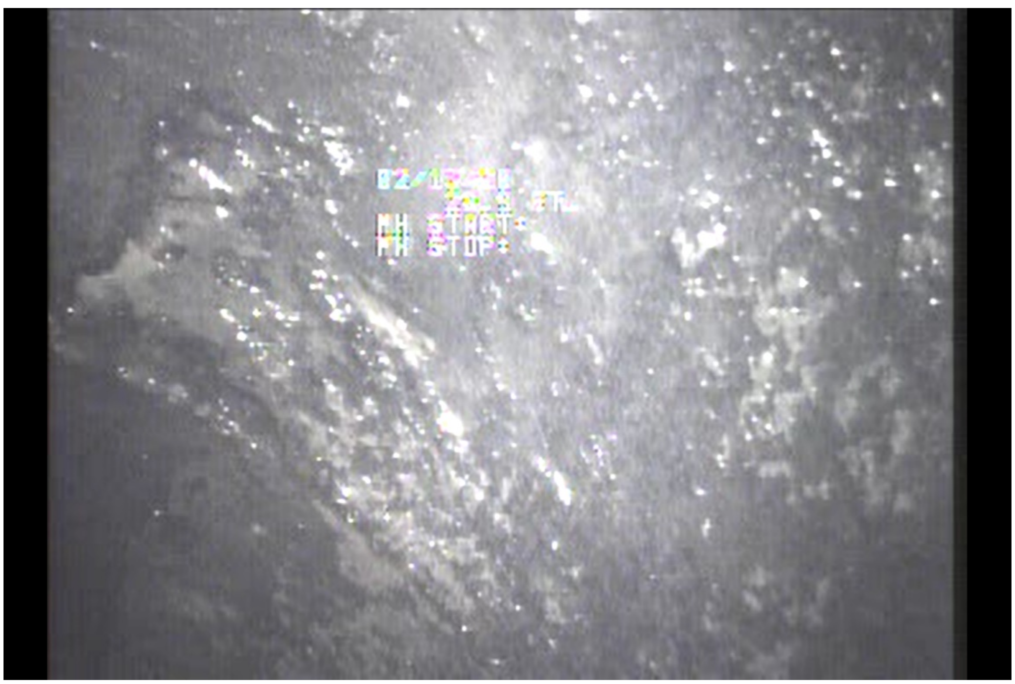


Figure B-7: Closeup on condition of 24-inch gravity main pipe interior.

OXIDATION DITCH #4

Figure B-8: White Film or 'Sheen' at Top and Bottom of Pipe (left and right).

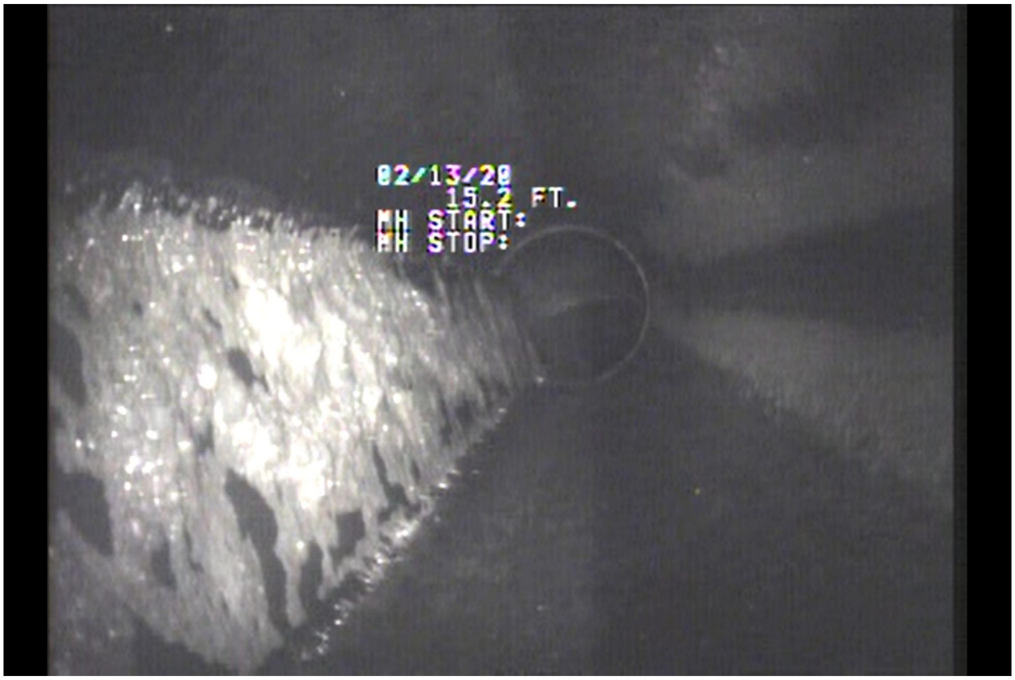


Figure B-9: Consistent White Film or 'Sheen' at Top and Bottom of Pipe (left and right).

OXIDATION DITCH #4

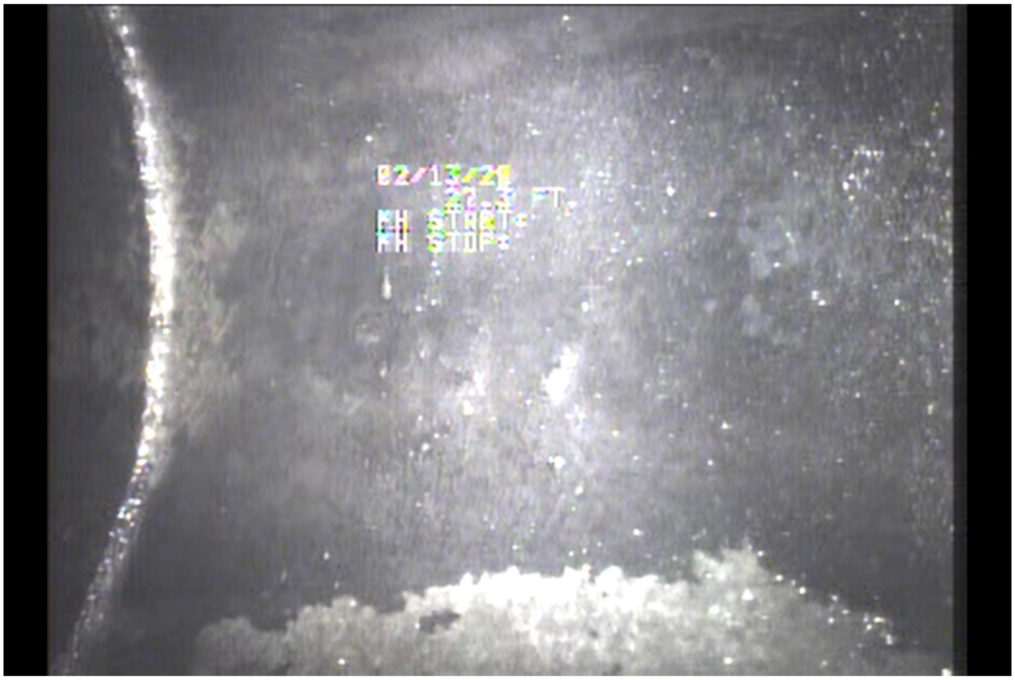


Figure B-10: Closeup of Impacts to Pipe Interior

Figure B-11: Additional Pipe Wear Along Gravity Main.

Appendix C

FIELD PHOTOS

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APPENDIX C
FIELD PHOTOS


Figure C-1: Oxidation Ditch #3 Above-Grade Piping (UTT-1)


Figure C-2: Oxidation Ditch #4 Above-Grade Piping (UTT-2)

Figure C-3: Oxidation Ditch #3 Below-Grade Piping (UTT-3)

Figure C-4: Oxidation Ditch #4 Below-Grade Piping (UTT-4)

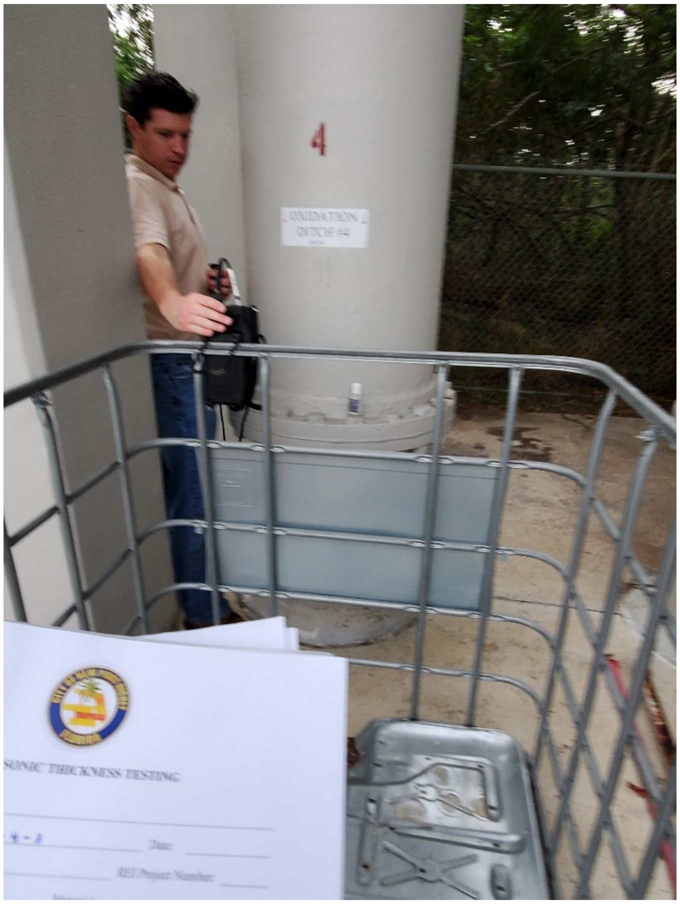

Figure C-5: Oxidation Ditch #4 Headworks Facility Piping (UTT-5)

Figure C-6: Oxidation Ditch #3 and #4 Headwork Facility Piping (UTT-5, UTT-6)

Figure C-7: Schreiber Plant Above-Grade Piping (UTT-7)

Figure C-8: Schreiber Plant Above-Grade Pipe Exterior Corrosion.

Figure C-9: Vacuum Uncovering of Schreiber Plant Below-Grade Piping (UTT-8)

Figure C-10: Schreiber Plant Below-Grade Piping (UTT-8)

Figure C-11: Schreiber Plant Below-Grade Piping and Crossing Utilities (UTT-9)

Figure C-12: Vacuum Uncovering of Schreiber Plant Below-Grade Piping (UTT-10)

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