Peace River Regional District Friesen Assessment

October 29, 2021 | Revision 1

Submitted to: Peace River Regional District
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Our file: 3111-26522-00

Your Challenge.
Our Passion.

Our File: 3111-26522-00

October 29, 2021

Peace River Regional District
1981 Alaska Avenue
Dawson Creek, BC V1G 4H8

Peace River Regional District Friesen Sewer Assessments

McElhanney performed CCTV inspection on approximately 900 metres of sanitary gravity sewer in the Friesen subdivision located west of the City of Dawson Creek.

The gravity sewer was found to be generally in good condition, with an estimated 30+ years of service remaining. There are some areas of repair required to eliminate sags in the sewer that are difficult to inspect and that may accelerate pipe deterioration; the repairs required have an estimated cost of $93,500. Long-term, the pipe should be flushed and reinspected every 5 to 10 years to continuously monitor structural stability; once pipe replacement is required, the replacement cost for the gravity sewer system is an estimated $819,000 (in 2021 dollars).

Sincerely,
McElhanney Ltd.

[redacted]

PERMIT TO PRACTICE
McElhanney Ltd.
PERMIT NUMBER: 1003299
Engineers and Geoscientists of BC

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1. Introduction

As part of its 2021 operations and maintenance plan, the Peace River Regional District (PRRD) contracted McElhanney Ltd. (McElhanney) to conduct a condition assessment of their Friesen subdivision sanitary sewer system. Located just outside the City of Dawson Creek (the City), the Friesen subdivision sanitary sewer system conveys flows from the subdivision into the City's system, which leads to their wastewater treatment facility. The goals of the assessment were to determine the current condition and remaining service life of the system and to identify required system repairs and upgrades along with associated costs.

1.1. BACKGROUND

The Friesen sewer servicing system was originally constructed in 2005, with approximately 900m of 200mm PVC SDR35 gravity sanitary sewer installed along Highway 97 and the Friesen subdivision. A map of the area and the sanitary system can be seen in *Figure 1*.

Figure 1: Map of the Friesen Gravity Sanitary Sewer Network

The gravity main pipe is sloped at 1.5% to 3.0% with approximately 2.5m of cover. The sanitary sewer was constructed on the boulevard outside of the roadway, with an as-constructed cross-section as shown in *Figure 2*. According to as-built drawings, pipe bedding is primarily Class "B" bedding consisting of fine granular material (sand and gravel) above and below the pipe, compacted to 95% SPD.

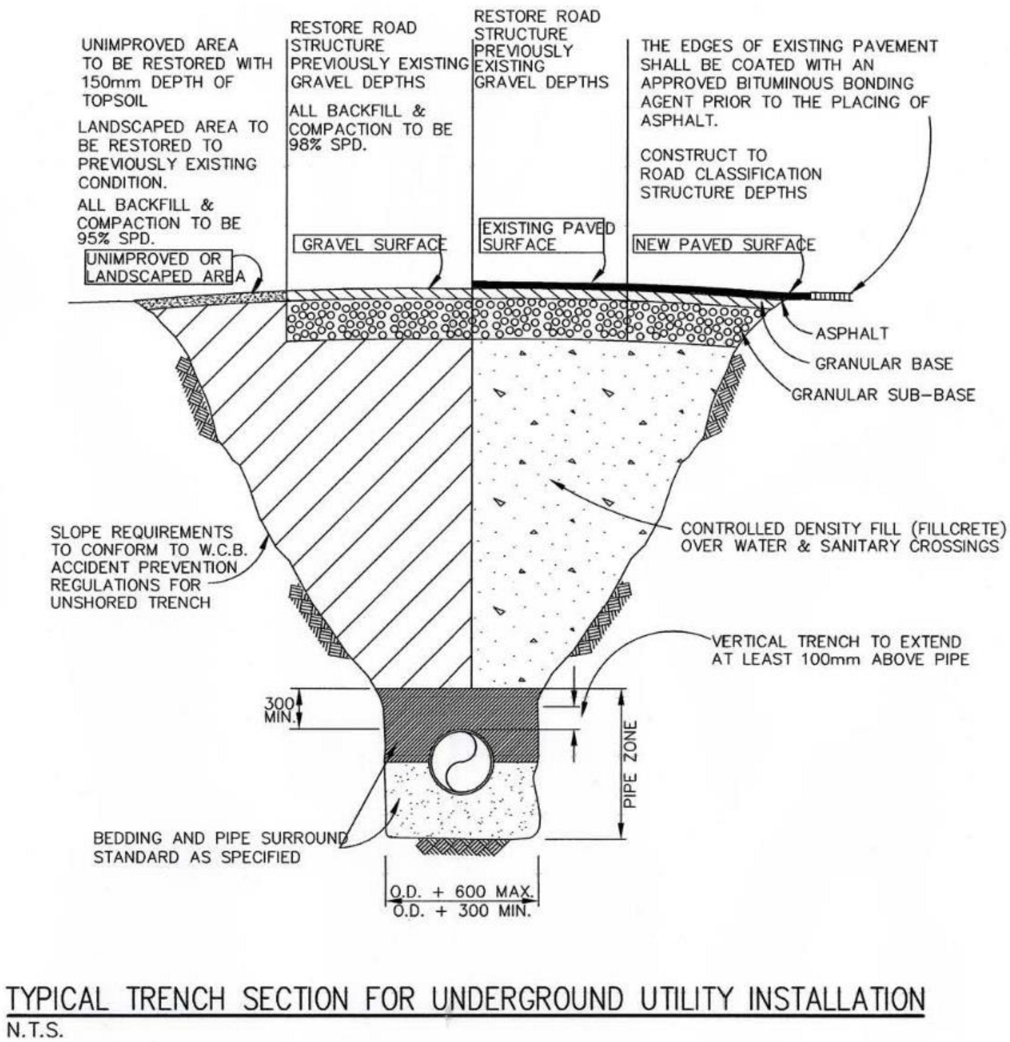

Figure 2: Typical Trench Detail for Friesen Gravity Sewer Installation

2. CCTV Inspection Assessment

This section summarizes the findings and recommendations for the gravity sanitary sewer main of the Friesen subdivision based on Closed-Circuit Television (CCTV) inspection. The analysis will assist the PRRD with determining the current condition, identifying required repairs, estimating the remaining service life, providing a cost estimate for repairs that are required immediately, and to estimate the replacement cost for the whole system in 2021 funds.

2.1. METHODOLOGY

McElhanney contracted Northern Lites Technologies to inspect each section of sanitary sewer in the Friesen subdivision. The pipe segments were flushed when necessary and video was recorded using a CCTV camera mounted on a remote operated tractor. The operator stopped the camera and noted defects based on the National Association of Sewer Service Companies (NASSCO) defect codes during the inspection. When surveys needed to be abandoned due to water levels or other obstructions, an attempt would be made to send the camera from the opposite direction. The collected videos were then watched, verified, and scored according to the NASSCO Pipeline Assessment Certification Program (PACP) rating guidelines.

The pipe segments were analyzed using the NASSCO PACP Condition Grading System. For each segment of pipe, a list of defects and a score associated with that defect was identified. The scores vary from 1 to 5, with 5 being the most severe; separate scoring is completed for structural defects as well as operational and maintenance defects. The full table can be seen in *Appendix B*.

The PACP Quick Scoring method has four (4) digits and represents the two most severe defects and their number of occurrences. For example, a PACP Quick Score of 3224 identifies that the segment of pipe has two (2) grade 3 defects and four (4) grade 2 defects. Using such a system allows quick identification of pipe that may require closer scrutiny.

The Index Rating method takes a sum of all the defect scores and divides it by the number of defects, essentially calculating an average defect score for the segment of pipe. This method is to be applied with caution, as a severe defect can become diluted by many less severe defects; hence, the two rating systems are used in conjunction to allow the review to focus on pipe segments that may need more attention and closer scrutiny.

The pipe rating system used is in accordance with the NASSCO Pipeline Assessment and Certification Program, Version 6.0.1, dated November 2010. Refer to *Appendix C* for an excerpt from the PACP training manual that describes the rating methods described above. Also included are two pages taken from the PACP training manual that briefly describe the reasons for CCTV inspection, the information needed from CCTV inspection data, reasons for standardization in CCTV inspection reporting and the origin of condition codes.

Manholes were assessed using a remote camera suspended from a tripod that was capable of taking 3D scans of the interior of the manhole. The camera was lowered to different heights and a 360° view of the manhole was then compiled at each depth. From these 3D views, the manholes were assessed using the NASSCO MACP system. The MACP system collects information on the manhole and is divided into Level 1 and Level 2 assessments. Level 1 MACP assessments gather information for a general condition assessment with observations and helps to determine whether a more comprehensive inspection (Level 2) is required. If a Level 2 inspection is warranted, the MACP uses coded defect ratings similar to the NASSCO PACP rating system.

2.2. NASSCO PIPE AND MANHOLE ANALYSIS

The following sections provide a summary of the defects found in each of the branches assessed. The sections below identify the sewer segments with any structural defect, any operational defect of severity 4 or higher, or any other defect of note. Defects of a lower severity are associated with minor infiltration or deposits in the main, which could be addressed by flushing as part of a regular maintenance program.

2.2.1.Pipe Segment CCTV Inspection

The Friesen segment of the CCTV assessment generally had PVC sanitary sewer main in good to very good structural condition for the segments able to be viewed by CCTV. Typically, laterals were installed using inserta-tees and manufactured wyes, with services largely in good condition. Pipe installed to specifications is typically expected by manufacturers to have a lifespan of 100+ years, but repair costs may begin to mount near the end of the pipe's lifespan, leading to the conservative useful lifespan of 75 years used for this report.

Some segments in this area had encrustation and settled gravels but, unless otherwise noted, maintained minimum 80% pipe cross-section. Below is a summary of each segment; details are in *Appendix B*.

- SMH-01 to SMH-02; 200mm PVC: Pipe is in fair condition, one instance of underwater camera with the pipe 80% full of water (with water level at 30% before and after) indicating sag in the pipe grade. Pipe also shows early signs of structural failure, with several circumferential cracks, as seen in *Figure 3*. These circumferential cracks may also be PVC repair couplings from past maintenance. The cracks are uniform and lack the characteristic longitudinal crack propagation that PVC pipe usually exhibits under stress failures, so these likely aren't a current cause for concern but should be monitored.

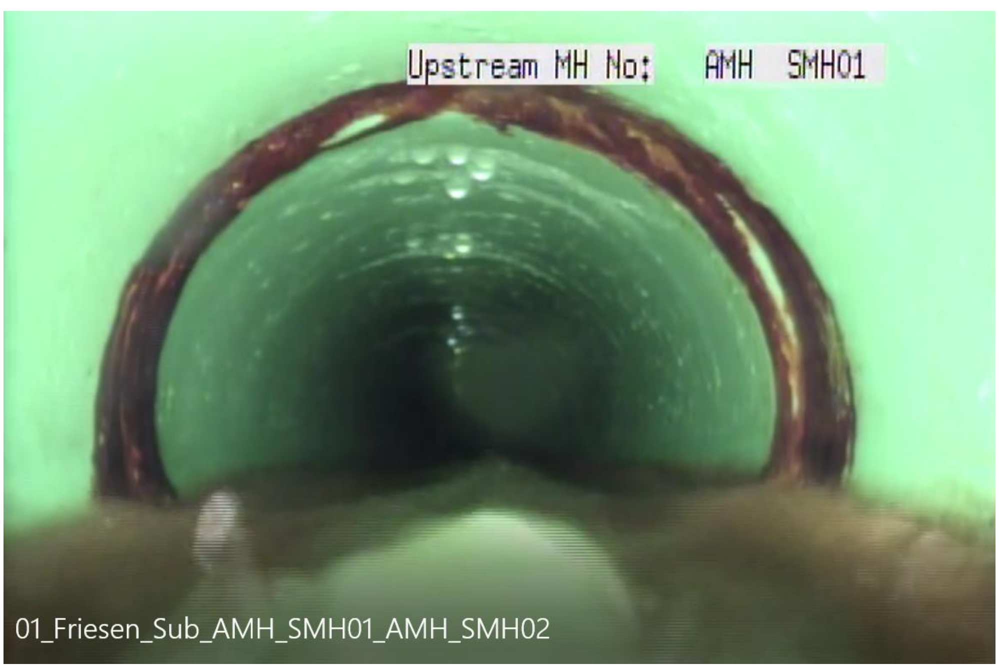

Figure 3: Circumferential Crack with Minor Infiltration

- SMH-02 to SMH-03; 200mm PVC: Pipe is in fair condition, one instance of underwater camera with pipe 80% full of water (with water level at 30% before and after) possibly indicating sag in the pipe grade. Note that this instance of the camera going underwater was within a short distance of the manhole with the sewer having approximately 30% flow (*Figure 4*), so the underwater camera may have been due to a hydraulic jump at the manhole interface.

Figure 4: CCTV Image Taken During Period of Moderate Flow
Flow may have led to a hydraulic jump condition causing an instance of underwater camera

- SMH-03 to SMH-04, 200mm PVC: Pipe in good condition, no defects of note.
- SMH-04 to SMH-05, 200mm PVC: Pipe in good condition, no defects of note.
- SMH-05 to SMH-06; 200mm PVC: Pipe in poor condition, one location of a circumferential crack combined with moderate mineral encrustation. Survey also showed an instance of underwater camera, indicating possible pipe failure and/or collapse beyond the surveyed extent. Note that this pipe is installed in a steel encasement pipe across Highway 97, as shown in *Figure 5*.

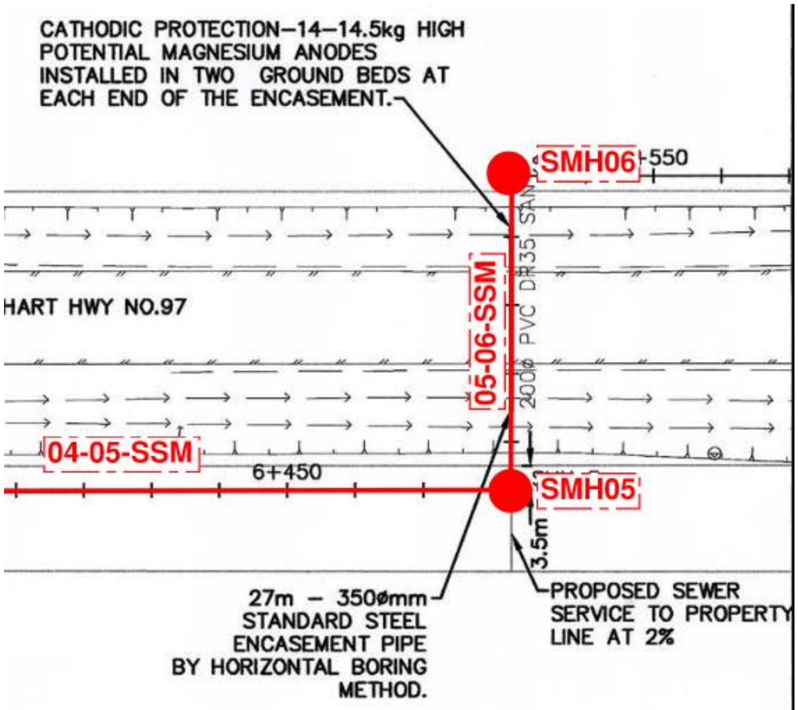

Figure 5: SMH-05 to SMH-06 Installed in 350mm Steel Carrier Pipe to Cross Highway 97

- SMH-21 to SMH-04, 200mm PVC: Pipe in good condition, no defects of note.
- SMH-22 to SMH-21, 200mm PVC: Pipe in good condition, no defects of note.
- SMH-23 to SMH-22, 200mm PVC: Pipe in good condition, some gravel deposits.

Table 1 provides an overview of the pipe conditions and the PACP ratings for the surveys conducted.

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Table 1: NASSCO PACP Pipe Segment Rating and Index

Upstream MH	Downstream MH	PACP Quick (Structural)	PACP Quick (O&M)	Structural Index	O&M Index	Overall Index	Rating per m	Defects per m
SMH-01	**SMH-02**	1300	4212	1	2.5	1.86	0.092	0.050
SMH-02	**SMH-03**	0000	4100	0	4	4	0.028	0.007
SMH-03	**SMH-04**	0000	0000	0	0	0	0.000	0.000
SMH-04	**SMH-05**	0000	0000	0	0	0	0.000	0.000
SMH-05	**SMH-06**	1100	4221	1	3.33	2.75	2.391	0.870
SMH-21	**SMH-04**	0000	0000	0	0	0	0.000	0.000
SMH-22	**SMH-21**	0000	3100	0	3	3	0.023	0.008
SMH-23	**SMH-22**	0000	3200	0	3	3	0.039	0.013

2.2.2. Manhole 3D Scan Inspection

The Friesen manhole assessment indicated that the manholes were generally in good condition. The manholes are all precast manufactured concrete with aluminum stepladder rungs, manufactured benching, and cast-iron manhole covers. Manholes of this type installed to specifications are expected to have a lifespan of 50+ years but can last for significantly longer in low corrosivity environments.

Several manholes exhibited some minor infiltration, typical of all manholes, and a few exhibited some encrustation around the manhole benching and manhole base. All assessments were completed to NASSCO MACP Level 1 standards. Below is a summary of each manhole; details can be found in *Appendix B*.

- SMH-01, 1050mm concrete manhole: Manhole in good condition.
- SMH-02, 1050mm concrete manhole: Manhole in good condition. Some minor infiltration staining and encrustation near the manhole base joint, as seen in *Figure 6*.

Figure 6: Infiltration Stains and Minor Encrustation Near Base Joint of SMH-02

- SMH-03, 1050mm concrete manhole: Manhole in good condition. Some minor infiltration staining.
- SMH-04, 1050mm concrete manhole: Manhole in good condition. Some minor infiltration staining and encrustation near a service on top of the benching.
- SMH-05, 1050mm concrete manhole: Manhole in good condition.
- SMH-06, 1050mm concrete manhole: Manhole in good condition. Some minor infiltration staining.
- SMH-21, 1050mm concrete manhole: Manhole in good condition.
- SMH-22, 1050mm concrete manhole: Manhole in good condition. Some minor infiltration and encrustation near the manhole benching, as seen in *Figure 7*.

Figure 7: Encrustation Around Benching of SMH-22

- SMH-23, 1050mm concrete manhole: Manhole in good condition.

2.3. RECOMMENDATIONS

McElhanney recommends the following:

- Continuing the monitoring and maintenance program, with flushing every 5 years (or more often as required) and reinspection and assessment every 10 years.
- Locating and replacing the segments of pipe exhibiting sagging between SMH-01 and SMH-02, SMH-02 and SMH-03. This work could be performed as point repairs to the system with disturbance only required in the vicinity of the repair. This may require work to reconnect service connections at the new grade if services are located at the underwater sections.
- Replacing the SMH-05 to SMH-06 segment. This segment is exhibiting some structural defects in addition to a large, sagged section with settled gravels. This pipe segment is also located in a casing pipe under the highway, which makes repairs difficult without full replacement. McElhanney recommends locating and reusing the casing pipe to avoid highway disturbance. Reusing the casing pipe may require some modifications to the existing manholes on either side of the highway to match grades. After removal of the carrier pipe, the casing pipe should be inspected by CCTV for defects. Cleaning of all manholes by pressurized water and/or mechanical tools, with attention paid to manholes with encrustation. After cleaning is completed, any deficient manhole construction causing infiltration and encrustation should be noted and repaired with concrete patching.

2.4. COST ESTIMATE

The system has defects that require attention, but is in good condition, with an estimated lifespan of another 30+ years with proper maintenance. All costs are listed as 2021 dollars with a 30% contingency. *Table 2* provides an overview of the repairs, on-going maintenance, replacement costs, and the estimated lifespan for each asset.

Table 2: Cost Estimate for Friesen Sanitary Sewer Repairs, Maintenance, and Replacement

Asset		Cost of Current Repairs Required	Cost of Maintenance (Yearly)	Cost of Replacement	Estimated Lifespan (Years)
PIPES	**SMH01 to SMH-02**	$15,000	$200	$146,000	59
	SMH02 to SMH-03	$15,000	$200	$146,000	59
	SMH03 to SMH-04	$0	$200	$94,000	59
	SMH04 to SMH-05	$0	$200	$113,000	59
	SMH05 to SMH-06	$59,000	$200	$59,000	59
	SMH21 to SMH-04	$0	$200	$140,000	59
	SMH22 to SMH-21	$0	$200	$138,000	59
	SMH23 to SMH-22	$0	$200	$158,000	59
MANHOLES	**SMH-01**	$500	$100	$12,000	34
	SMH-02	$500	$100	$12,000	34
	SMH-03	$500	$100	$12,000	34
	SMH-04	$500	$100	$12,000	34
	SMH-05	$500	$100	$12,000	34
	SMH-06	$500	$100	$12,000	34
	SMH-21	$500	$100	$12,000	34
	SMH-22	$500	$100	$12,000	34
	SMH-23	$500	$100	$12,000	34

2.4.1. Repairs

Pipes

McElhanney recommends carrying out point repairs on the sagging areas of the sewers to MMCD standards, including new sections of PVC SDR35 sanitary sewer installed with new bedding and repair couplings. While repairs are carried out, the subgrade should be inspected for suitability and removed if unsuitable or if deleterious materials are found, as soft ground may be the cause of the pipe sags. Once repaired, the pipes should be re-inspected. McElhanney also recommends full replacement of the segment of pipe from SMH-05 to SMH-06 in the existing casing pipe, if the casing pipe is in good condition.

Estimated Cost of Repairs: $89,000

Manholes

Cleaning all manholes to clear encrustation is recommended. Once complete, perform concrete patching as required.

Estimated Cost: $500 per manhole, $4,500 total

2.4.2. Maintenance

Pipes

Flushing and reinspecting every 5 to 10 years to watch for signs of pipe failure is recommended. Pipes showing signs of early failure (cracking, root intrusion, additional sagging) should be repaired as necessary until full replacement is warranted. Pricing assumes that the entire system is cleaned and inspected together. Individual segments inspected more frequently would lead to a higher overall maintenance cost.

Estimated Cost: $200 per segment per year with an expected $16,000 total per inspection and flushing cycle.

Manholes

Cleaning and reinspecting every 5 to 10 years to watch for signs of structural failure is recommended. Manholes showing signs of early failure (cracking, root intrusion, major encrustation) should be repaired as necessary until full replacement is warranted.

Estimated Cost: $100 per manhole per year with a total expected spend of $9,000 total every inspection cycle.

2.4.3. Replacement

Once replacement is warranted, the entire gravity system should be removed and replaced. Services should be scoped as the replacement takes place, with deficient services being replaced and transferred at property line. Replacement is usually required when the cost of on-going repairs is too high or when the pipes begin to exhibit excessive structural failures in the NASSCO PACP ratings system. Full replacement is not warranted at this time. The system condition is consistent with the age of the assets. The system should be expected to last 30+ years with proper maintenance and repairs.

Estimated Cost for Total Replacement: $1,107,000

Appendix A

Statement of Limitations

Statement of Limitations

Use of this Report. This report was prepared by McElhanney Ltd. ("McElhanney") for the particular site, design objective, development and purpose (the "Project") described in this report and for the exclusive use of the client identified in this report (the "Client"). The data, interpretations and recommendations pertain to the Project and are not applicable to any other project or site location and this report may not be reproduced, used or relied upon, in whole or in part, by a party other than the Client, without the prior written consent of McElhanney. The Client may provide copies of this report to its affiliates, contractors, subcontractors and regulatory authorities for use in relation to and in connection with the Project provided that any reliance, unauthorized use, and/or decisions made based on the information contained within this report are at the sole risk of such parties. McElhanney will not be responsible for the use of this report on projects other than the Project, where this report or the contents hereof have been modified without McElhanney's consent, to the extent that the content is in the nature of an opinion, and if the report is preliminary or draft. This is a technical report and is not a legal representation or interpretation of laws, rules, regulations, or policies of governmental agencies.

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Information from Client and Third Parties. McElhanney has relied in good faith on information provided by the Client and third parties noted in this report and has assumed such information to be accurate, complete, reliable, non-fringing, and fit for the intended purpose without independent verification. McElhanney accepts no responsibility for any deficiency, misstatements or inaccuracy contained in this report as a result of omissions or errors in information provided by third parties or for omissions, misstatements or fraudulent acts of persons interviewed.

Effect of Changes. All evaluations and conclusions stated in this report are based on facts, observations, site-specific details, legislation and regulations as they existed at the time of the site assessment and report preparation. Some conditions are subject to change over time and the Client recognizes that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site may substantially alter such evaluations and conclusions. Construction activities can significantly alter soil, rock and other geologic conditions on the site. McElhanney should be requested to re-evaluate the conclusions of this report and to provide amendments as required prior to any reliance upon the information presented herein upon any of the following events: a) any changes (or possible changes) as to the site, purpose, or development plans upon which this report was based, b) any changes to applicable laws subsequent to the issuance of the report, c) new information is discovered in the future during site excavations, construction, building demolition or other activities, or d) additional subsurface assessments or testing conducted by others.

Independent Judgments. McElhanney will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions of the Client, or others, who may come into possession of this report, or any part thereof. This restriction of liability includes decisions made to purchase, finance or sell land or with respect to public offerings for the sale of securities.

Construction Cost Estimates. This construction cost estimate has been prepared using the design and technical information currently available, and without the benefit of Geotechnical, Environmental, and Archaeological information. Furthermore, McElhanney cannot predict the competitive environment, weather or other unforeseen conditions that will prevail at the time that contractors will prepare their bids. The cost estimate is therefore subject to factors over which McElhanney has no control, and McElhanney does not guarantee or warranty the accuracy of such estimate.

Appendix B

Pipe Condition Tables

File: 3111-26522-00CIV-RPT-002 Friesen CCTV Table

Date: September 16, 2021

Pipe Segment	U/S MH#	D/S MH#	Pipe Size (mm)	Material	Length (m)	Grade (%)	Report #	Report Date	Video #	Total Number of Defects	Structural Rating Index	O&M Rating Index	Overall Index
1	AMH_SMH 01	AMH_SMH 02	200	PVC	140.6	-	31112652200	Jun-21	01_Friesen_Sub_AMH_SMH01_AMH_SMH02	7	1.0	2.5	1.9
2	AMH_SMH 02	AMH_SMH 03	200	PVC	140.8	-	31112652200	Jun-21	02_Friesen_Sub_AMH_SMH02_AMH_SMH03	1	0.0	4.0	4.0
3	AMH_SMH 3	AMH_SMH 4	200	PVC	89.7	-	31112652200	Jun-21	03_Friesen_Sub_AMH_SMH3_AMH_SMH4	0	0.0	0.0	0.0
4	AMH_SMH 04	AMH_SMH 05	200	PVC	114	-	31112652200	Jun-21	04_Friesen_Sub_AMH_SMH04_AMH_SMH05	0	0.0	0.0	0.0
5	AMH_SMH 05	AMH_SMH 06	200	PVC	4.6	-	31112652200	Jun-21	05_Friesen_Sub_AMH_SMH05_AMH_SMH06	4	1.0	3.3	2.8
6	AMH_SMH 21	AMH_SMH 4	200	PVC	135.8	-	31112652200	Jun-21	06_Friesen_Sub_AMH_SMH21_AMH_SMH4	0	0.0	0.0	0.0
7	AMH_SMH 22	AMH_SMH 21	200	PVC	131.8	-	31112652200	Jun-21	07_Friesen_Sub_AMH_SMH22_AMH_SMH21	1	0.0	3.0	3.0
8	AMH_SMH 23	AMH_SMH 22	200	PVC	153.7	-	31112652200	Jun-21	08_Friesen_Sub_AMH_SMH23_AMH_SMH22	2	0.0	3.0	3.0

Pipe Segment	Station	Defect: Group	Descriptor	Modifier	Defect	Defect (Input)	Continuous (Match Codes)	Numeral Mod	Percent/Count	Structural Rating	O&M Rating	# of Structural Defects Count	# of O&M Defects Count
1	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	20	Tap	Factory_Made	Activity	TFA			0		0	0	0	0
	34.3	Tap	Factory_Made	Activity	TFA			0		0	0	0	0
	54.7	Crack	Circumferential		CC			0		1	0	1	0
	58.7	Crack	Circumferential		CC			0		1	0	1	0
	58.7	Infiltration	Stain		IS			0		0	0	0	0
	94.8	Tap	Factory_Made	Activity	TFA			0		0	0	0	0
	95.4	Tap	Factory_Made	Activity	TFA			0		0	0	0	0
	107.6	Crack	Circumferential		CC			0		1	0	1	0
	107.6	Infiltration	Stain		IS			0		0	0	0	0
	111.8	Tap	Saddle	Activity	TSA			0		0	0	0	0
	127	Miscellaneous	Camera Underwater		MCU			0		0	4	0	1
	127	Line	Up		LU			OM_Degree	<=10	0	1	0	1
	132	Miscellaneous	Water Level		MWL			0		0	0	0	0
	132	Line	Down		LD			OM_Degree	<=10	0	1	0	1
	138.3	Tap	Factory_Made	-	TF			0		0	0	0	0
	138.3	Miscellaneous	Water Level		MWL			0		0	0	0	0
	139.1	Miscellaneous	Camera Underwater		MCU			0		0	4	0	1
	140.6	Access_Points	Manhole		AMH			0		0	0	0	0
	Total									**3**	**10**	**3**	**4**
	Quick									**1300**	**4212**		
2	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	29.4	Tap	Factory_Made	-	TF			0		0	0	0	0
	88.1	Tap	Factory_Made	Activity	TFA			0		0	0	0	0
	135	Miscellaneous	Camera Underwater		MCU			0		0	4	0	1
	140.8	Miscellaneous	Water Level		MWL			0		0	0	0	0
	140.8	Access_Points	Manhole		AMH			0		0	0	0	0
	Total									**0**	**4**	**0**	**1**
	Quick									**0000**	**4100**		
3	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	35.3	Tap	Saddle	-	TS			0		0	0	0	0
	43	Tap	Saddle	Activity	TSA			0		0	0	0	0
	89.7	Access_Points	Manhole		AMH			0		0	0	0	0
	Total									**0**	**0**	**0**	**0**
	Quick									**0000**	**0000**		
4	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	69.5	Tap	Saddle	Activity	TSA			0		0	0	0	0
	114	Access_Points	Manhole		AMH			0		0	0	0	0
	Total									**0**	**0**	**0**	**0**
	Quick									**0000**	**0000**		
5	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	1.1	Crack	Circumferential		CC			0		1	0	1	0
	1.6	Deposits	Deposits_Attached	Encrustation	DAE			OM_Percent	<=10	0	2	0	1
	3.3	Miscellaneous	Camera Underwater		MCU			0		0	4	0	1
	4.5	Deposits	Deposits_Settled	Gravel	DSGV			OM_Percent	<=30	0	4	0	1
	4.6	Miscellaneous	Survey Abandoned		MSA			0		0	0	0	0
	Total									**1**	**10**	**1**	**3**
	Quick									**1100**	**4221**		
6	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	135.8	Access_Points	Manhole		AMH			0		0	0	0	0
	Total									**0**	**0**	**0**	**0**
	Quick									**0000**	**0000**		
7	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	0	Deposits	Deposits_Attached	Encrustation	DAE			OM_Percent	<=20	0	3	0	1
	1	Miscellaneous	Water Level		MWL			0		0	0	0	0
	2	Miscellaneous	Water Level		MWL			0		0	0	0	0
	128.4	Tap	Saddle	Activity	TSA			0		0	0	0	0
	131.8	Access_Points	Meter		AM			0		0	0	0	0
	Total									**0**	**3**	**0**	**1**
	Quick									**0000**	**3100**		
8	0	Access_Points	Manhole		AMH			0		0	0	0	0
	0	Miscellaneous	Water Level		MWL	5		0		0	0	0	0
	1.9	Miscellaneous	General Observation		MGO			0		0	0	0	0
	3	Deposits	Deposits_Settled	Gravel	DSGV			OM_Percent	<=20	0	3	0	1
	19.4	Deposits	Deposits_Settled	Gravel	DSGV			OM_Percent	<=20	0	3	0	1
	153.7	Access_Points	Manhole		AMH			0		0	0	0	0
	Total									**0**	**6**	**0**	**2**
	Quick									**0000**	**3200**		

Appendix C

NASSCO PACP Rating Guidelines

PACP© Condition Grading System

The Pipeline Assessment and Certification Program (PACP) developed by NASSCO provides a mechanism for creating reliable descriptions of pipe conditions. NASSCO has also developed a system based on the PACP codes to assign a condition rating to pipelines. Requirements of the grading system were as follows:

1. Like the PACP, the grading system should be direct and objective.

2. Provide the ability to qualitatively identify differences in pipe condition between one inspection and subsequent inspections, and to prioritize based on the significance of the defects different pipe segments.

Many other approaches to sewer pipe grading have been used in the United States as well as in other parts of the World. These approaches generally use some type of defect grading that is then used to calculate an overall pipe rating.

It is problematic to develop a single pipe segment rating that fully describes all of the important aspects of a pipe. Therefore the PACP Condition Grading System uses more than one method of rating pipe segment condition including a rating that considers the number of total defects within the pipe segment and a rating that considers the most severe defects within the pipe segment.

The PACP Condition Grading System only considers internal pipe conditions obtained from TV inspection. While other factors such as pipe material, depth, soils, and surface conditions also affect pipe survivability, those factors have not been included in the PACP Condition Grading System. The PACP Condition Grading System should be used only as a tool for screening pipe segment inspections, allowing the User to quickly determine which pipe segments have significant defects. It is expected that as the PACP further develops the PACP Condition Grading System will expand to include other factors.

The PACP Condition Grading System provides condition ratings for Structural Defects and Operation and Maintenance Defects.

Approach

Using the PACP Code Matrix, Each PACP defect code is assigned a condition grade of from 1 to 5. Grades are assigned based on the significance of the defect, extent of damage, percentage of flow capacity restriction, or the amount of wall loss due to deterioration.

The PACP Condition Grading System alone is inadequate for determining if a pipe segment should be rehabilitated or replaced. Many other factors in addition to the internal condition of the segment should be considered. The fact that a segment has significant Grade 4 or Grade 5 defects does not necessarily mean the pipe segment should be immediately rehabilitated. Recent experience by PACP Users has shown that pipe segments with serious defects such as hinge failures may remain largely unchanged for many decades if no deterioration factors such as surcharging, roots, or groundwater are present.

What is needed is improved estimates of remaining life or mean time before failure that are based on close monitoring of pipe segments over time. Once we know how much change occurs in pipe segments we can better understand the relationship between defects, deterioration factors, and pipe segment life expectancy. PACP continues to be an excellent tool for benchmarking pipe condition between one inspection and subsequent inspections of the same pipe.

Grades are assigned for two categories, Structural, and O&M defects.
Grades are as follows;
5 - Most significant defect grade
4 – Significant
3 – Moderate defect grade
2 – Minor to Moderate
1 –Minor defect grade

The PACP Condition Grading System results are entirely dependent on the quality of the PACP defect coding. Errors in the coding will directly result in errors in the Grading. All utilities, engineers, and contractors should make sure the data they are using was coded by experienced technicians who have successfully demonstrated their competence through a formal or informal apprenticeship program. PACP data from inexperienced technicians should be checked and corrected as needed. Errors found in coding should be corrected and the errors brought to the attention of the technician.

Grading of Continuous Defects

The PACP continuous defect feature is used to denote where long portions of a sewer pipe are affected by the same defect, without the User having to repetitively enter point defects. However to develop a grade for the pipe segment, a mechanism is needed to translate a continuous defect into an equivalent number of point defects.

The equivalent number (quantity) of "uninterrupted" and "joint repeating" continuous defects is calculated by dividing the length of the continuous defect by 5. Example, a 6-meter long continuous defect, grade 3, should equate to four Grade 3 defects. Fractions are rounded to the nearest whole number.

Pipe Ratings

The pipe rating is based on the number of occurrences for each condition grade. Ratings are calculated separately for **Structural Defects** and **O&M Defects**. Several ways of expressing pipe segment condition are used by the PACP Condition Grading System as follows.

Segment Grade Scores - Each pipe segment will have a Segment Grade Score for each of the five grades. The number of occurrences of each pipe grade is multiplied by the pipe grade to calculate the segment grade score. Example, six Grade 5 defects would be 6 times 5 and equates to a Segment Grade 5 Score of 30. If a pipe segment had no defects of a particular grade, then the Segment Grade Score for that grade would be 0.

Overall Pipe Rating –The five Segment Grade Scores are added together to calculate the **Overall Pipe Rating. Structural Pipe Ratings** are calculated using only Structural Defect grades, while **O&M Pipe Ratings** are calculated using only O&M Defect grades.

PACP Quick Rating – The PACP Quick Rating is a shorthand way of expressing the number of occurrences for the two highest severity grades. The PACP Quick Rating is a four character score as follows:

1. The first character is the highest severity grade occurring along the pipe length.
2. The second character is the total number of occurrences of the highest severity grade. If the total number exceeds 9, then alphabetic characters are used as follows- 10 to 14 – A; 15 to 19 – B; 20 to 24 – C; etc.
3. The third character is the next highest severity grade occurring along the pipe length.
4. The fourth character is the total number of the second highest severity grade occurrences, derived as in item 2 above.

For Example

4B27

This immediately shows that no grade 5 defects or grade 3 defects, however 15 to 19 grade 4 defects and seven grade 2 defects were found.

Another Example

3224

Two grade 3 defects and four grade 2 defects, however no grade 5 or grade 4 defects were found.

If a pipe segment only has defects of one grade, the first two characters are the grade and the quantity of defects, and the last two characters are 00 (denoting no other defect grades). A pipe segment with no defects would have a Quick Score of 0000 (all zeros).

The PACP Quick Rating provides the ability to summarize the number and severity of defects found within a pipe segment. As with the Pipe Rating, Quick Structural Ratings are calculated using only Structural Defect Grades, and Quick O&M Ratings are calculated using only O&M Defect Grades.

The Quick Rating is an excellent screening tool to determine which pipe segments require closer scrutiny. If a pipe has not defects greater than Grade 1 or 2, then the pipe segment probably does not need any further investigation.

Pipe Ratings Index – This is an indicator of the distribution of defect severity. The Pipe Ratings Index is calculated by dividing the Pipe Rating by the number of defects. For example, the Structural Pipe Ratings Index would be the Structural Pipe Rating divided by the number of structural defects. Pipe Ratings Indexes are calculated for Structural, O&M, and Overall. A pipe segment with a Pipe Rating of zero (0) would have a Pipe Rating Index of zero (0).

Summary

The following procedures are used to calculate pipe segment ratings using the PACP Condition Grading System:

1. Determine the number of occurrences for each condition grade within the pipe segment. Calculate separately for Structural Defect Grades and O&M Defect Grades.
2. Calculate the Segment Grade Score by multiplying the number of occurrences by the respective grade 1 through 5. Calculate the Structural Segment Grade Score and the O&M Segment Grade Score separately, and then add together for the Overall Segment Grade Score.
3. Calculate the Pipe Rating for the pipe segment by adding the Segment Grade Scores. Add all five Structural Segment Grade Scores for the Structural Pipe Rating, and add all five O&M Segment Grade Scores for the O&M Pipe Rating. Add all five Overall Segment Grade Scores for the Overall Pipe Rating.
4. Determine the PACP Quick Rating by calculating the number of occurrences of the two highest severity grades.

5. Calculate the Pipe Ratings Index by dividing the Pipe Rating by the number of defects. If the pipe has no defects, the Pipe Ratings Index is zero.
6. Verify the PACP defect data used in accurate. The grading is a direct calculation from the defect data, and coding errors will be reflected in grading errors.

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
Structural	Crack (C)	Circumferential (C)		CC	1	
		Longitudinal (L)		CL	2	
		Multiple (M)		CM	3	
		Hinge (CH2)		CH2	4	
		Hinge (CH3)		CH3	5	
		Hinge (CH4)		CH4	5	
		Spiral (S)		CS	2	
Structural	Fracture (F)	Circumferential (C)		FC	2	
		Longitudinal (L)		FL	3	
		Multiple (M)		FM	4	
		Hinge (H2)		FH2	4	
		Hinge (H3)		FH3	5	
		Hinge (H4)		FH4	5	
		Spiral (S)		FS	3	
Structural	Pipe Failures (Silent)	Broken (B)		B	1 clock pos - 3, 2 clock pos - 4, >=3 clock pos - 5	
		Broken (B)	Soil Visible (SV)	BSV	5	
		Broken (B)	Void Visible (V V)	BVV	5	
		Hole (H)		H	1 clock pos - 3, 2 clock pos - 4, >= 3 clock pos - 5	
		Hole (H)	Soil Visible (SV)	HSV	5	
		Hole (H)	Void Visible (V V)	HVV	5	
Structural	Collapse (X)	Pipe (P)		XP	5	
		Brick (B)		XB	5	
Structural	Deformed (D)	(Pipe)		D	<=10% - 4,>10% - 5	
		(Brick)	Horizontally (H)	DH	5	
		(Brick)	Vertically (V)	DV	5	
Structural	Joint (J)	Offset (displaced) (O)	Med (M)	JOM	1	
			Large (L)	JOL	2	
		Separated (open) (S)	Med (M)	JSM	1	
			Large (L)	JSL	2	
		Angular (A)	Med (M)	JAM	1	
			Large (L)	JAL	2	
Structural	Surface Damage Chemical (S)	Roughness Increased (RI)	C	SRIC	1	
		Surface Spalling (SS)	C	SSSC	2	
		Aggregate Visible (AV)	C	SAVC	3	
		Aggregate Projecting (AP)	C	SAPC	3	
		Aggregate Missing (AM)	C	SAMC	4	

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Reinforcement Visible (RV)	C	SRVC	5	
		Reinforcement Projecting (RP)	C	SRPC	3	
		Reinforcement Corroded (RC)	C	SRCC	5	
		Missing Wall (MW)	C	SMWC	5	
		Other (Z)	C	SZC		
Structural	Surface Damage Mechanical (M)	Roughness Increased (RI)	M	SRIM	1	
		Surface Spalling (SS)	M	SSSM	2	
		Aggregate Visible (AV)	M	SAVM	3	
		Aggregate Projecting (AP)	M	SAPM	3	
		Aggregate Missing (AM)	M	SAMM	4	
		Reinforcement Visible (RV)	M	SRVM	5	
		Reinforcement Projecting (RP)	M	SRPM	3	
		Reinforcement Corroded (RC)	M	SRCM	5	
		Missing Wall (MW)	M	SMWM	5	
		Other (Z)	M	SZM	N/A	
Structural	Surface Damage Not Evident (Z)	Roughness Increased (RI)	Z	SRIZ	1	
		Surface Spalling (SS)	Z	SSSZ	2	
		Aggregate Visible (AV)	Z	SAVZ	3	
		Aggregate Projecting (AP)	Z	SAPZ	3	
		Aggregate Missing (AM)	Z	SAMZ	4	
		Reinforcement Visible (RV)	Z	SRVZ	5	
		Reinforcement Projecting (RP)	Z	SRPZ	3	
		Reinforcement Corroded (RC)	Z	SRCZ	5	
		Missing Wall (MW)	Z	SMWZ	5	
		Other (Z)	Z	SZZ	N/A	
Structural	Surface Damage (Metal Pipes)	Corrosion (CP)		SCP	3	
Structural	Lining Features (LF)	Detached (D)		LFD	3	
		Defective End (DE)		LFDE	3	
		Blistered (B)		LFB	3	
		Service Cut Shifted (CS)		LFCS	3	
		Abandoned Connection (AC)		LFAC		
		Overcut Service (OC)		LFOC	3	
		Undercut Service (UC)		LFUC	3	
		Buckled (BK)		LFBK	3	
		Annular Space (AS)		LFAS	3	
		Bulges (BU)		LFBU	3	
		Discoloration (DC)		LFDC	3	
		Delamination (DL)		LFDL	3	
		Pinholes (PH)		LFPH	3	
		Resin Slug (RS)		LFRS	3	
		Wrinkled (W)		LFW	3	
		Other (Z)		LFZ	N/A	
Structural	Weld Failure (WF)	Circumfrential (C)		WFC	2	
		Longitudinal (L)		WFL	2	

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Multiple (M)		WFM	3	
		Spiral (S)		WFS	2	
Structural	Point Repair (RP)	Localized Pipeliner (L)		RPL		
		Localized Pipeliner (L)	Defective (D)	RPLD	4	
		Patch Repair (P)		RPP		
		Patch Repair (P)	Defective (D)	RPPD	4	
		Pipe Replaced (R)		RPR		
		Pipe Replaced (R)	Defective (D)	RPRD	4	
		Other (Z)		RPZ		
		Other (Z)	Defective (D)	RPZD		
Structural	Brickwork (Silent)	Displaced (DB)		DB	3	
		Missing (MB)		MB	4	
		Dropped Invert (DI)		DI	5	
		Missing Mortar	Small	MMS	2	
			Medium	MMM	3	
			Large	MML	3	
O&M	Deposits (D)	Deposits Attached (DA)	Encrustation (E)	DAE		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Grease (G)	DAGS		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Ragging (R)	DAR		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Other (Z)	DAZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Deposits Settled (DS)	Hard/Compacted (C)	DSC		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Fine silt/sand (F)	DSF		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Gravel (G)	DSGV		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Other (Z)	DSZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Deposits Ingress (DN)	Fine silt/sand (F)	DNF		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Gravel (GV)	DNGV		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
			Other (Z)	DNZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
O&M	Roots (R)	Fine (F)	Barrel (B)	RFB		2
			Lateral (L)	RFL		1
			Connecfion (C)	RFC		1
	Roots (R) at a Joint		N/A	RFJ	in software with a J	1
		Tap (T)	Barrel (B)	RTB		3
			Lateral (L)	RTL		2
			Connecfion (C)	RTC		2
	Roots (R) at a Joint		N/A	RTJ		2
		Medium (M)	Barrel (B)	RMB		4
			Lateral (L)	RML		3
			Connecfion (C)	RMC		3
	Roots (R) at a Joint		N/A	RMJ		3
		Ball (B)	Barrel (B)	RBB		5
			Lateral (L)	RBL		4
			Connecfion (C)	RBC		4
	Roots (R) at a Joint		N/A	RBJ		4
O&M	Infiltration (I)	Weeper (W)		IW		2
		Dripper (D)		ID		3
		Runner (R)		IR		4
		Gusher (G)		IG		5
		Stain (S)		IS		
O&M	Obstacles/Obstructions (OB)	Brick or Masonry (B)		OBB		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Pipe Material in Invert (M)		OBM		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Object Intruding Thru Wall (I)		OBI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Object Wedged in Joint (J)		OBJ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Object Thru Connection (C)		OBC		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		External Pipe or Cable In Sewer (P)		OBP		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Built Into Structure (S)		OBS		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Construction Debris (N)		OBN		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Rocks (R)		OBR		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Other Objects (Z)		OBZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
O&M	Vermin (V)	Rat (R)		VR		2
		Cockroach (C)		VC		1
		Other (Z)		VZ		1
O&M	Grout Test and Seal (G)	Grout Test Pass (GTP)				
			Joint (J)	GTPJ		
			Lateral (L)	GTPL		
		Grout Test Fail (GTF)				
			Joint (J)	GTFJ		
			Lateral (L)	GTFL		
		Grout Test Unable to Test (GTU)				
			Joint (J)	GTUJ		
			Lateral (L)	GTUL		
		Grout at a Location (not a joint) (GRT)		GRT		
Construction Features	Tap (T)	Factory Made (F)		TF		
			Capped (C)	TFC		
			Abandoned (B)	TFB		
			Defective (D)	TFD		2
			Intruding (I)	TFI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Activity (A)	TFA		
		Break-In/Hammer (B)		TB		
			Capped (C)	TBC		2
			Abandoned (B)	TBB		
			Defective (D)	TBD		3
			Intruding (I)	TBI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Activity (A)	TBA		
		Saddle (S)		TS		
			Capped (C)	TSC		
			Abandoned (B)	TSB		

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
			Defective (D)	TSD		2
			Intruding (I)	TSI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Activity (A)	TSA		
		Rehabilitated (R)		TR		
			Defective (D)	TRD		2
			Intruding (I)	TRI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
Construction Features	Intruding Seal Material (IS)			IS		
		Sealing Ring (SR)		ISSR		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Hanging (H)	ISSRH		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Broken (B)	ISSRB		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Loose, Poorly Fitting (SRL)		ISSRL		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Grout (GT)		ISGT		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Other (Z)		ISZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
Construction Features	Line (L)	Left (L)		LL		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Left/Up (LU)		LLU		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Left/Down (LD)		LLD		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Right (R)		LR		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4

NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Right/Up (RU)		LRU		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Right/Down (RD)		LRD		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Up (U)		LU		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Down (D)		LD		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
Construction	Access Points (A)					
		Cleanout (CO)		ACO		
			Mainline (M)	ACOM		
			Property (P)	ACOP		
			House (H)	ACOH		
		Discharge Point (DP)		ADP		
		Junction Box (JB)		AJB		
		Meter (M)		AM		
		Manhole (MH)		AMH		
		Other Special Chamber (OC)		AOC		
		Tee Connection (TC)		ATC		
		WW Access Device (WA)		AWA		
		Wet Well (WW)		AWW		
		Catch Basin (CB)		ACB		
		End of Pipe (EP)		AEP		
Other	Miscellaneous (M)	Camera Underwater (CU)		MCU		4
		Dimension/Diam/Shape Change (SC)		MSC		
		General Observation (GO)		MGO		
		General Photograph (GP)		MGP		
		Material Change (MC)		MMC		
		Lining Change (LC)		MLC		
		Pipe Joint Length Change (JL)		MJL		
		Survey Abandoned (SA)		MSA		
		Water Level (WL)		MWL		
			Sag (S)	MWLS	<=30% - 2, <=50% - 3, >50% - 4	
		Water Mark (WM)		MWM		>=50% 4, >=75% 5
		Dye Test (Y)		MY		
			Visible (V)	MYV		5
			Not Visible (N)	MYN		3

Reasons for TV Inspection

We televise sewers for many different purposes, some of those purposes are:

- **Routine Operational Requirements** – Pro-active inspection to identify potential failures and for planning routine Operation and Management (O&M) and renovation programs.
- **Troubleshooting** – Investigation of problem incidents to select remedial action.
- **Compliance with Mandated Programs** – Inspection and data collection to support programs such as Capacity, Management, Operations and Maintenance (C-MOM) and Administrative Orders (AOs), Governmental Accounting Standards Board statement 34 (GASB-34), and Consent Decrees.
- **Acceptance Testing** – Inspection of new or renewed sewers to insure that construction met specifications and to document as-built conditions.
- **Infiltration/Inflow (I/I) or Capital Improvement Program (CIP) Projects** – Examples of the type projects normally conducted by specialty firms or engineering consultants.

Regardless of what purpose we televise sewers, it is important that TV inspection data is collected thoroughly and consistently. This approach insures better and more comprehensive data is collected, and will provide opportunities for a single TV inspection to serve multiple purposes. While obtaining a limited amount of information may meet the immediate data needs, it also means the information obtained as part of a comprehensive PACP inspection will not be available for other possible requirements in the future.

What We Need from TV Inspection Data

The basic information we need from TV inspection is as follows:

- Record and archive all descriptive data using standard procedures and data format
- Develop a condition rating for each line
- Provide follow-up recommendations
- Display results on a map
- Establish benchmarks to compare with future inspections of same line

Standardizing on the PACP codes as well as integration with other components of the PACP will meet the above objectives.

Why Standardization is Important

Some the benefits of standardization are as follows:

- Allows for more effort to be placed on consistency of data and utilization of data rather than development of utility-specific or project-specific standards
- Provides the capability of benchmarking sewers within a single utility as well as from one geographical area of the US to another
- Ability to detect change due to deterioration over time
- Provides better opportunities for integrating data from different software programs
- Improved confidence in the description of pipe conditions will provide cost savings during renewal
- Advances the professionalism of the TV inspection industry

Origin of Condition Codes

WRc first drafted the Manual of Sewer Condition Classification (MSCC) in 1980 for use in the United Kingdom. At that time, consistent assessment of sewer condition was needed in order to fairly set sewer rates charged to consumers by the private utility companies that operated throughout the UK, and those codes are now the mandated standard. The MSCC was most recently updated by WRc in 2004 (MSCC Fourth Edition) and are used extensively throughout the world. Other WRc-based coding systems have been implemented throughout the world including Australia, New Zealand, Southeast Asia, and Europe.

The PACP codes were developed by NASSCO and the Water Research Centre (WRc) in 2002. Prior to the development of the PACP, no standard TV inspection codes or procedures existed in the United States. While many agencies and engineering firms in the US used adaptations of the WRc codes, no single standard existed, nor was a standard training and certification program available.

Those familiar with the WRc codes will find the PACP codes very similar. Terminology has been changed to reflect terms used in the United States. Codes have been added to describe conditions found in renewed pipes and point repairs. The ability to describe pipe corrosion has been greatly improved. Coding of Operational and Maintenance problems in general has been improved. Codes have been added to describe observations and defects that otherwise would be noted in the remarks or comment section.

Contact
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