TECHNICAL MEMORANDUM

Jordan Road Area CCTV Inspection Analysis

PREPARED FOR:	Honorable Lynn Eisentrout, Mayor Councilmember Brian Wolf, Chair – Service Committee
COPY TO:	
PREPARED BY:	CH2M
DATE:	March 31, 2017
PROJECT NUMBER:	690666
REVISION NO.:	

Inspection Results

The CCTV inspection covered 21 segments and 3,869 feet of 8" VCP sewer pipeline during the 2016 inspection program.

In the field, wastewater collection system CCTV observation information was collected in the form of video recordings and an electronic data log. These electronic logs were reviewed and compiled. The inspectors in the field used the NASSCO Pipeline Assessment & Certification Program (PACP) coding system to record observations.

Typical defects found within the Minerva Park collection system during the 2016 inspections are detailed below.

Structural Issues

Broken Pipe – One type of structural problem observed was broken pipe segments with visible voids behind the break. A broken pipe section seen during CCTV inspection is shown in Figure 1. Breaks may be the result of excessive loading, improper installation, or pipe deterioration. These defects may allow leakage of raw sewage into the ground and significant inflow of groundwater which may cause sinkholes.

Figure 1
Broken Pipe in Segment MH 54 to MH 53

Fractured Pipe –

Figure 2 shows a fractured pipe section. Fractures are defects where there is a clear separation between the fragments, but no hole has yet been formed. Like breaks, fractures may be the result of excessive loading, improper installation, or pipe deterioration. Left unabated, fractures can worsen over time to cause pipe deflection and collapse.

Figure 2
Fractured Pipe in Segment MH 49 to MH 48

Cracked Pipe – Figure 3 shows a crack in a pipe segment wall. Cracks are less severe than fractures, and do not have visible separation between the pieces. Over time, however, cracks can worsen into fractures and breaks.

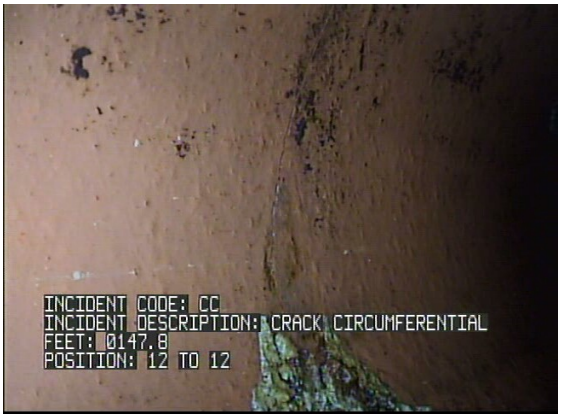

Figure 3
Cracked Pipe in Segment MH 53 to MH 52

Offset Joints – Offset joints between pipe segments can allow groundwater infiltration to occur, will contribute to uneven stresses on the pipe, and can cause further cracks and damage. This defect is considered structural and is evaluated accordingly. Figure 4 shows an example of a separated joint

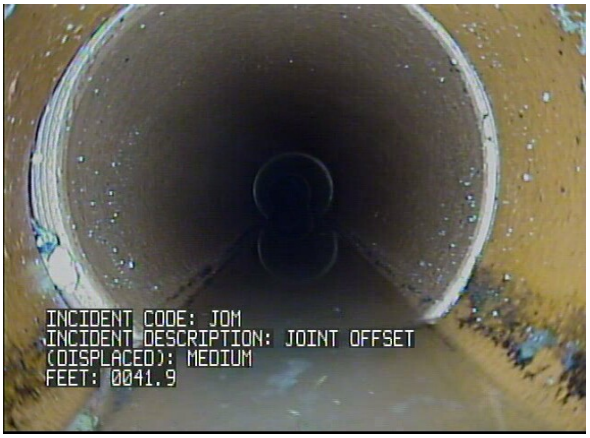

Figure 4
Offset Joint in Segment MH 68 to MH 65

Vertical Alignment Defects – Several severe vertical alignment defects were recorded during the inspection process. This type of defect creates hydraulic bottlenecks which reduce the system's hydraulic carrying capacity and causes high water levels within the pipe segment. Some of the abandoned inspections were associated with this type of defect. Figure 5 shows flow conditions prior to a survey being abandoned because of a vertical alignment defect.

Figure 5
Sag in Pipe Segment MH 49 to MH 48

Roots – Another observed problem was light to heavy root intrusion. In some cases, heavy roots impeded the travel of the CCTV camera. Roots are a maintenance problem and must be removed through cleaning and cutting activities or chemical treatment. Roots may also cause structural damage to pipe joints and walls by growing and forcing cracks to open, requiring pipe replacement. Intrusion of roots at joints is shown in Figure 6.

Figure 6
Root Intrusion in Segment MH 66 to MH 65

The majority of the pipe segments inspected in 2016 were in good condition. Evaluation, analysis, and recommendations for the defects that were observed are described below.

Data Analysis

The goal of the Minerva Park condition assessment was to provide data necessary to make decisions on sewer repairs and improvements for the inspected pipe segments by quantifying the presence of defects in a pipe segment. The CCTV inspection process described previously was the first step in determining the need for improvements. The CCTV observations of pipe defects were subsequently translated into a pipe condition grade which in turn permitted prioritization and recommendations for each asset. Table 1 below summarizes the pipe condition grades used.

Table 1
Pipe Condition Grades

Condition Grade	Description
A	Pipe in sound condition. Perform routine inspection.
B	Pipe in generally good condition. Perform maintenance activities (e.g., routine inspection and cleaning) on infrequent basis.
C	Point repairs should be carried out to extend pipe life and reduce likelihood of problems. Perform routine maintenance activities.
D	Major repairs necessary to maintain service in structurally-damaged pipes. Pipe replacement or relining should be considered. Proactive maintenance required until repairs are made.
F	Imminent Failure. Replace or rehabilitate pipe as soon as possible in order to maintain service. Proactive maintenance required until repairs are made.

Source: National Association of Sewer Service Companies (NASSCO) Pipeline Assessment & Certification Program (PACP) defect coding system

The percentages of pipe segments in each of the condition grades for the pipes inspected in 2016 are listed below. Figure 7 shows the graphical representation of the distribution of the pipe segments based on overall condition grade.

Inspected Pipe Segments in 2016

- 19 percent of pipes are in Grade A condition
- 38 percent of pipes are in Grade B condition
- 38 percent of pipes are in Grade C condition
- 5 percent of pipes are in Grade D condition

The calculated pipe grades and defect information for all the inspected pipe segments in 2016 are provided in the summary table in Appendix A.

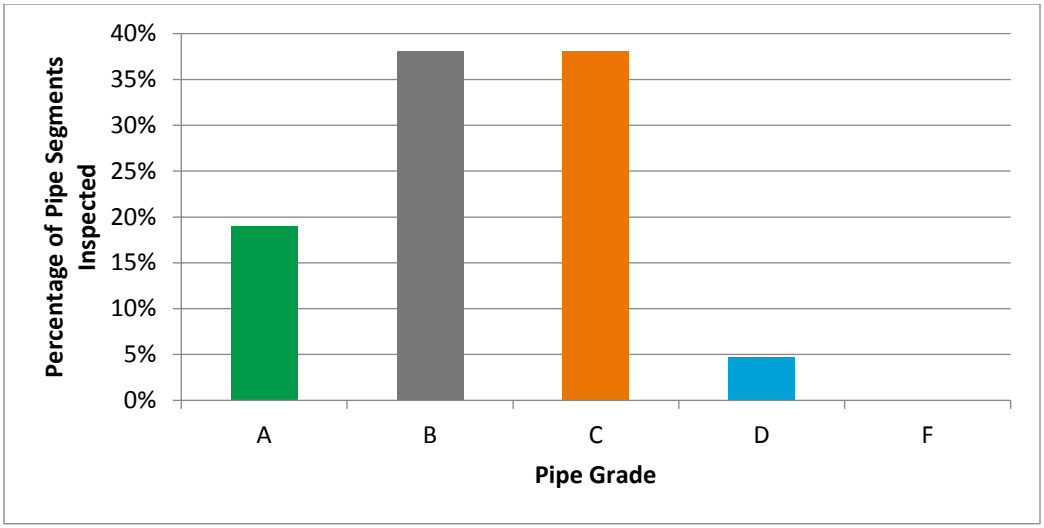

Figure 7
Pipe Grade Distribution

Pipeline Recommendations

The plan to address some of the issues present in the sewer collection system is based on the prioritization criteria listed in Table 2.

Table 2
Prioritization Criteria

Priority	Description
1	Address safety issues that may be present as a result of the poor condition of the sewer system.
2	Restore the original hydraulic carrying capacity of the sewer system.
3	Reinspect the pipe segments whose inspection was abandoned due to maintenance, structural issues or CCTV camera limitations in the field.
4	Address minor pipe maintenance issues as resources are available.
0	No direct action required until next regular inspection cycle.

Based on the number and degree of defects in each pipe segment, a priority rating was assigned. Table 3 below summarizes the pipe counts for each grade and corresponding prioritization, and Figure 8 displays the results graphically.

Table 3
Grade and Priority Summary Pipe Counts

	Priority				
Pipe Grade	**0**	**4**	**3**	**2**	**1**
A	4	0	0	0	0
B	0	7	1	0	0
C	0	0	0	8	0
D	0	0	0	1	0
F	0	0	0	0	0
TOTAL	**4**	**7**	**1**	**9**	**0**

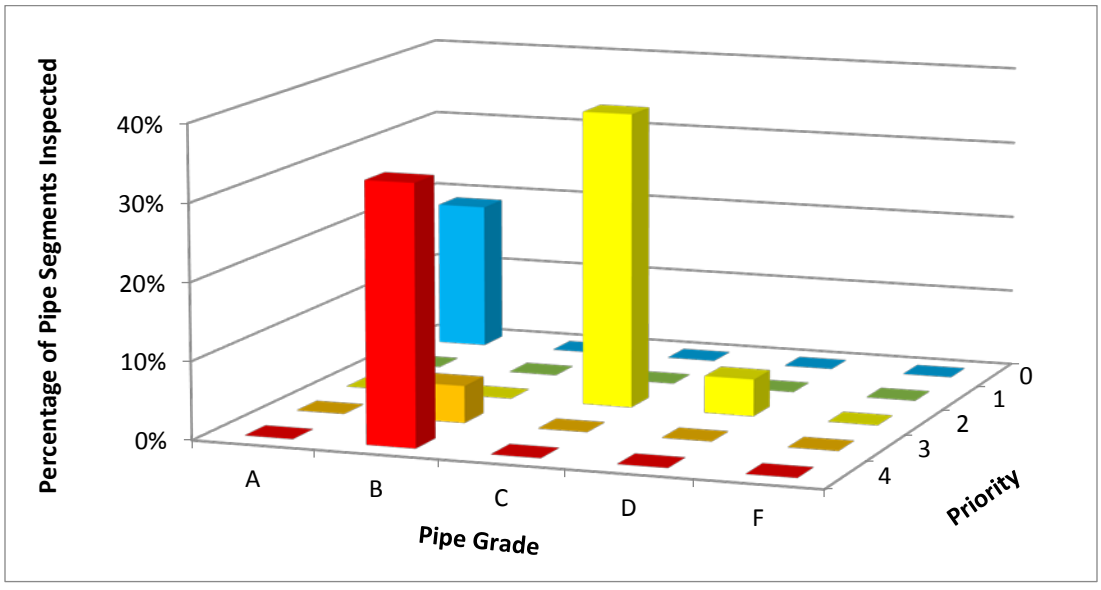

Figure 8
Grade and Priority Summary

Recommendations for each pipe segment were based on the number and severity of defects observed during each inspection. For pipes where cleaning and re-inspection was recommended, further remedial action may be necessary after review of the completed inspection. Recommendations can be summarized into the following groups:

- **Maintain** – No action required outside of routine operations and maintenance activities.
- **Increase Inspection Frequency** – More frequent inspections for pipes that display signs of potential future defects such as moderate (but passable) debris, or sags.
- **Cleaning and Root-Cutting** – Removal of debris and roots from an otherwise structurally sound sewer.
- **Complete Inspection** - Complete inspections of pipes in which inspections were either truncated as a result of pipe alignment, surcharge conditions, or debris.
- **Line or Replace** - Rehabilitation lining is the restoration or improvement of the functional service of an existing pipeline system. Some of the rehabilitation methods include cured in place pipe, sliplining and plastic lining. Replacement refers to the construction of a new sewer, on or off the line of an existing sewer. The function of the new sewer will incorporate that of the old, but may also include other improvements or development work. This can be carried out by open cut, or trenchless methods.
- **Point Repair & Clean/Re-CCTV** – Rectify damage to the structural fabric of the sewer, but reconstruction of a whole pipeline is not necessary. Robotics or mechanical methods are used to perform localized point repairs.

Table 4 and Figure 9 summarize the recommendations for all of the pipe segments inspected in 2016. A complete listing of each pipe segment, and its associated grade, priority, and recommendation may be found in Appendix A.

Table 4

Recommendation Summary Table

Recommendation	Footage	% Total
Increase inspection frequency	1,210	31%
Maintain	824	21%
Point repair	583	15%
Point repair & Clean/Re-CCTV	172	4%
Root cut line	122	3%
Point repair & complete inspection	64	2%
Point repair & Root Cut/Clean	894	23%
TOTAL	**3,869**	**100%**

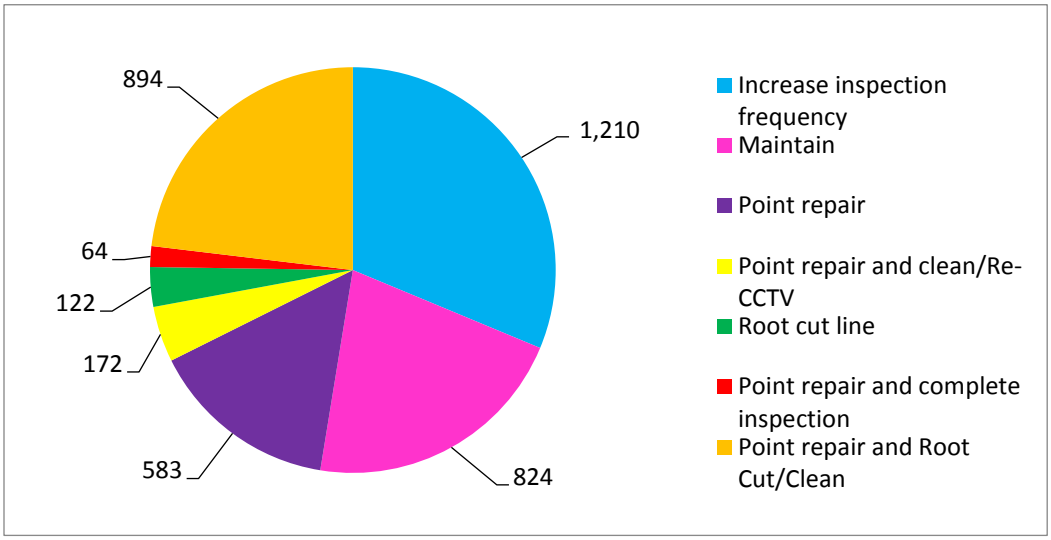

Figure 9

Recommendation Summary

(Numbers indicate linear feet of pipe in the recommended category)

It is recommended that the Village of Minerva Park implement a pipe line rehabilitation program to repair deficiencies found during CCTV inspection. Improvements have been categorized as Priority 2 or 3. No defects were identified as Priority 1 requiring immediate repair. All pipe line point repairs were identified as Priority 2 and should be scheduled for repair within 1-2 years. Pipe line rehabilitation should include thirteen (13) point repairs on nine (9) pipe lines at an estimated cost of $188,500. In addition to structural pipe repairs, six (6) pipes require removal of roots, cleaning and completion of CCTV inspection at an estimated cost of $4,300. Total planning level cost to implement the recommended improvement program is $192,800. A summary of pipe line improvement cost is shown in Table 5. Detailed recommendations are provided in Appendix A.

Table 5

Recommendation Pipe Line Improvement Summary

Recommendation	**Quantity**	**Cost ($)**
Priority 2		
Point Repairs	13	$130,000
20% Legal, Administration, and Design		$26,000
25% Contingency		$32,500
Sub-Total		$188,500
Priority 3		
Root Cut/Clean/CCTV	1,189 LF	$3,000
20% Legal, Administration, and Review		$600
25% Contingency		$750
Sub-Total		$4,300
TOTAL		**$192,800**

Appendix A – Pipe Segment CCTV Inspections Summary

APPENDIXA A

Pipe Segment CCTV Inspections Summary Table	
A	No defects
B	Maintenance defects (clean and inspect regularly)
C	Defects noted (Line or point repairs)
D	Major structural defects (repair, line or replace)
F	Pipe failed or obstructed (repair or replace)

Priority	
1	Immediate action: Safety issues may be present due to poor condition
2	First phase project: Restore hydraulic capacity
3	Second phase project: Clean/re-CCTV incomplete inspections or repair
4	Address as resources are available

Condition Assessment Minerva Park OH CCTV Inspection 2016

CCTV Review Summary

US Node	DS Node	Diam (in)	Material	Inventory Pipe Length	CCTV Length	CCTV Date	CCTV Comments	Condition Grade	Recommendation	Priority	Reviewed By	Point Repairs	Units	Unit Price	Root Cut and/or Clean (ft.)	Units	Unit Price	Total Cost
49	48	8	VCP	172	172	11/8/2016	Circumferentail Fracture at 25' and 120' from MH 49. Minor roots at joint 30' from MH 9.	C	Point repair at 25' and 120' from MH 49 and clean/Re-CCTV	2	RC	2	EA	$10,000				$20,000
50	49	8	VCP	51	51	11/8/2016	Minor attached deposits at joint 15' from MH 50	B	Increase inspection frequency	4	RC							$0
51	50	8	VCP	125	64	11/8/2016	Survey abandoned due to intruding tap and broken pipe with soil visible at 64' from MH 50,	D	Point repair at 64' from MH 50 and complete inspection	2	RC	1	EA	$10,000				$10,000
52	51	8	VCP	106	106	11/8/2016	Minor attached deposits at 40% of the joints.	B	Increase inspection frequency	4	RC				106	LF	$2.50	$265
53	52	8	VCP	151	151	11/8/2016	Cracked pipe at 128' and 147' from MH 53, multiple attached deposits and roots at joints.	C	Point repair at 128' and 147' from MH 53 and Root Cut/Clean	2	RC	2	EA	$10,000				$20,000
54	53	8	VCP	271	271	11/8/2016	Broken pipe with soil visible at 25' and 162' from MH 54, fine roots at joint at 80% of pipe joints.	C	Point repair at 25' and 162' from MH 54 and Root Cut/Clean	2	RC	2	EA	$10,000				$20,000
55	51	8	VCP	207	207	11/8/2016	Broken pipe with soil visible at 15' and 88' from MH 55, fine roots at joint at 80% of pipe joints.	C	Point repair at 15' and 88' from MH 55 and Root Cut/Clean	2	RC	2	EA	$10,000	207	LF	$2.50	$20,518
56	55	8	VCP	105	105	11/8/2016	Circumferentail Fractured pipe at 100' from MH 56. Fine roots at joint at 80% of pipe joints.	C	Point repair at 100' from MH 56 and Root Cut/Clean	2		1	EA	$10,000	105	LF	$2.50	$10,263
57	56	8	VCP	82	82	11/8/2016	No Defects	A	Maintain		RC							$0
58	57	8	VCP	160	160	11/7/2016	Broken pipe with soil visible at 5' from MH 58, fine roots at joint at 40% of pipe joints.	C	Point repair at 5' from MH 58 and Root Cut/Clean	2	RC	1	EA	$10,000	160	LF	$2.50	$10,400
59	58	8	VCP	113	113	11/7/2016	Minor fine roots at pipe joints.	B	Increase inspection frequency	4	RC							$0
60	57	8	VCP	122	122	11/7/2016	Fine roots at 85% of the pipe joints.	B	Root cut line	3	RC				113	LF	$2.50	$283
61	60	8	VCP	303	303	11/7/2016	No Defects	A	Maintain		RC							$0
62	61	8	VCP	305	305	11/7/2016	Infiltration runner at pipe joint 266' from MH 62, poor line grade.	C	Point repair	2	RC	1	EA	$10,000				$10,000
63	62	8	VCP	302	302	11/7/2016	Minor fine roots at pipe joints. Poor line grade.	B	Increase inspection frequency	4	RC							$0
64	63	8	VCP	321	321	11/7/2016	No Defects	A	Maintain		RC							$0
65	64	8	VCP	118	118	11/7/2016	No Defects	A	Maintain		RC							$0
66	65	8	VCP	228	228	11/7/2016	Minor attached deposits and fine roots.	B	Increase inspection frequency	4	RC							$0
67	66	8	VCP	190	190	11/7/2016	Minor offset joint at 66' from MH 67	B	Increase inspection frequency	4	RC							$0
68	65	8	VCP	220	220	11/7/2016	Minor offset joint at 42' and minor attached deposits at 214' from MH 68.	B	Increase inspection frequency	4	RC				220	LF	$2.50	$550
69	68	8	VCP	278	278	11/7/2016	Circumferential crack at 4' from MH 69, minor attached deposits at 213' from MH 69.	C	Point repair at 4' from MH 69.	2	RC	1	EA	$10,000	278	LF	$2.50	$10,695
									Sub			**13**		**$90,000**	**1189**		**$18**	**$132,973**
									ADMINISTRATION ITEMS									
									20% Legal, Administration, and Design									$26,595
									25% Contingency									$33,243
									Administration Subtotal									$59,838
									Total Cost									**$192,810**