Technical Memorandum 4

NSMCSD Collection System Capacity Evaluation/Assurance, Management and Improvement Plan

Subject:	**Task 4: Condition Assessment and Rehabilitation Program Recommendations**
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This Technical Memorandum (TM) presents the findings and recommendations of Task 4, Refine Condition Assessment and Rehabilitation Program, for the North San Mateo County Sanitation District (NSMCD, District) Collection System Capacity Evaluation/Assurance, Management, and Improvement Plan project. The objectives of this task are to identify near-term sewer system rehabilitation needs based on existing available information, and to develop a methodology and procedures for an on-going condition assessment program to be used to update and refine the District's future sewer system rehabilitation program. The approaches and information presented in this TM will support the District in standardizing sewer inspection activities, condition assessment, and rehabilitation prioritization. The TM also includes a schedule that prioritizes system-wide sewer inspection activities and a long-term projection of renewal/replacement needs. The condition assessment approach and proposed inspection and rehabilitation programs described in the TM have also been referenced in the updated Measures and Activities (Operation and Maintenance Program) element of the District's Sewer System Management Plan (SSMP).

Note that the District is also responsible, under contract, for maintenance of sewers in the Town of Colma and Westborough Water District. However, the information and discussions in this TM are focused on the sewers in the NSMCSD system only.

This TM is divided into the following sections:

1. Existing Condition Assessment and Rehabilitation Programs
2. Recommended Condition Assessment Methodology
3. Proposed CCTV Inspection Program
4. Near-term Sewer Rehabilitation Needs
5. Long-term Sewer Renewal/Replacement Needs

1 Existing Condition Assessment and Rehabilitation Programs

The NSMCSD owns and operates a wastewater collection system consisting of 141 miles of sewer pipelines and nine pump stations. The District conducts various ongoing activities focused on maintenance of the sanitary sewer system and repair or replacement of facilities that are known to be in poor condition, lack adequate capacity, or create recurring maintenance problems. The following is a brief summary of existing programs and activities, focused primarily on the gravity sewer system.

- **Sewer Cleaning.** Sewer cleaning is considered the District's top maintenance priority. All gravity sewers in the system less than 10 inches in diameter and/or with flat slopes are hydroflushed every 6 to 18 months. Pipes greater than 12 inches in diameter are outsourced for cleaning when required. In addition, approximately 37,000 feet of sewers identified as chronic maintenance problems ("hot spots") are cleaned on an average 4-month cleaning cycle. **Figure 1** shows the locations of the pipes included in the hot spot cleaning program. A list of these pipes is included in **Attachment A** to this TM.
- **Root Control.** Root control throughout the District is performed by an outside contractor on approximately 10,000 feet of pipe annually using chemical root treatment.
- **Maintenance Data Management.** The District manages maintenance work orders and maintenance history data in a computerized maintenance management system (CMMS) called Munibase, a customized program that has been in use for many years. While the program has been effective for day-to-day management of maintenance activities, it utilizes out-of-date software technology, does not allow access to the data using standard database queries or linkage to GIS, and therefore does not provide tools for effective data analysis or information retrieval that could be used to analyze program effectiveness and better optimize maintenance practices and priorities. The District plans to implement a more up-to-date CMMS in the future, but definitive plans for this conversion have not yet been developed.
- **Television Inspection.** Closed-circuit television (CCTV) inspection is scheduled when backups are reported, when a street is scheduled for paving or repair (in order to confirm the condition of the underlying pipes), or when requested by engineering. The District has one CCTV truck; however, it has been expensive to operate and maintain due to equipment problems. The District has the capability to inspect approximately 60,000 feet of pipe per year. Approximately 12,000 feet were inspected during 2006 and 2007 within the District's system (additional sewers were inspected in Westborough Water District where District has maintenance responsibility but does not own the pipes). The locations of the inspected sewers are also shown in Figure 1. A list of these pipes is included in **Attachment B**.
- **CCTV Data Management.** CCTV video has historically been recorded on VHS cassette tapes, and CCTV observations recorded on paper logs (a copy of the log is included as **Attachment C** to this TM) and input to individual Excel spreadsheets after completion. The data is input to Munibase but cannot easily be retrieved nor used to generate condition ratings. The District is in the process of purchasing and installing CCTV software that can be used to electronically capture and record CCTV observations and video.
- **Sewer Repairs.** The District performs spot repairs as needed on manholes and pipe segments with localized failures. Mainline spot repairs are accomplished by both localized pipe replacement as well as by localized liner installation. Spot repairs are limited to areas having only localized failures. Segments having major or numerous structural issues are candidates for full-scale rehabilitation or replacement. **Attachment D** includes a list of mainline spot repairs completed over the ten-year period 1998 through 2007.
- **Sewer Rehabilitation.** Based on known problem areas, the District has identified seven sewer rehabilitation projects, primarily consisting of replacement of 500 to 1,200-foot sections of 6- through 12-inch pipe and associated manholes. These projects are currently scheduled for construction over the next five years.

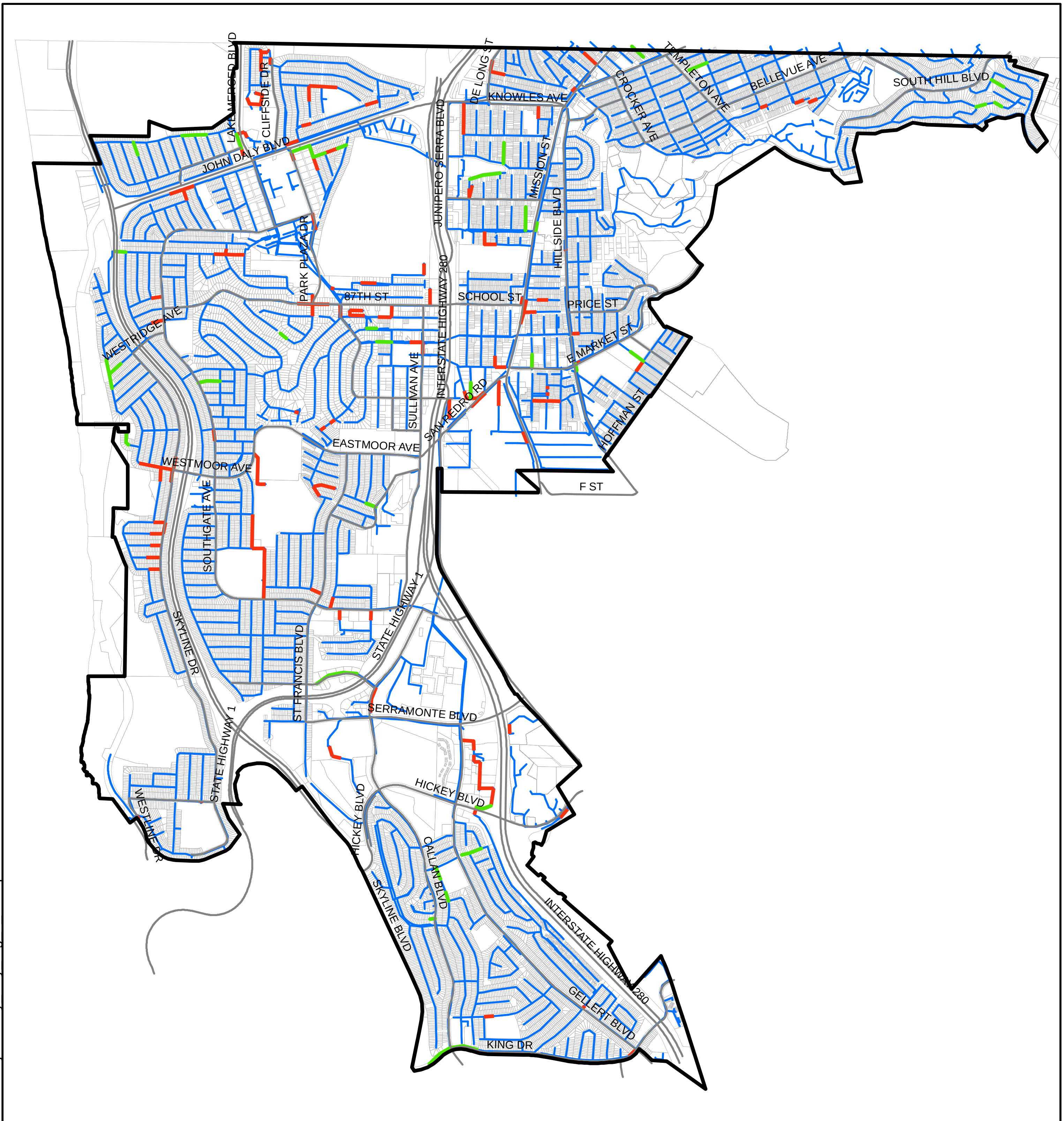


Figure 1: Location of Inspected Pipes and Pipes Included in the Hot Spot Cleaning Program

Legend

- NSMCSD Service Area
- Inspected
- "Hot Spot"
- NSMCSD Gravity Sewer

N
W E
S

0 2,500 5,000 Feet

Created by: RMC Water and Environment
October 15, 2008

Data Source: NSMCSD, City of Daly City

File: C:\GIS\0221_001_00_Daly_City_NSMCSD\Project\Daly_City_Fig_1_HotSpots.mxd

2 Recommended Condition Assessment Methodology

Accurate identification and prioritization of sewer rehabilitation and replacement needs depend on obtaining accurate and complete data about the condition of the sewer system. Current industry best practices for sewer system management call for conducting a baseline inspection of the entire system, typically over a 5- to 10-year period, as a basis for assessing its overall condition and identifying both short-term and long-term sewer rehabilitation and replacement needs. The results of the baseline inspection also serve to determine the frequency and priority for subsequent inspections, and provide data with which to assess long-term trends in sewer condition. Implementation of an effective condition assessment methodology is key to being able to use sewer inspection data to achieve these objectives.

CCTV inspection is the basic method used to assess sewer condition. This section of the TM provides guidelines for CCTV inspection and condition assessment, including establishing standardized CCTV observation codes, data documentation procedures, condition scoring approach, and interpretation and use of CCTV results and condition ratings to prioritize maintenance and inspection. The proposed schedule for the baseline CCTV inspection of the NSMCSD system is presented in a subsequent section of this TM.

2.1 CCTV Data Documentation Procedures

Effective use of CCTV data requires that the data recorded be consistent, complete, and of high quality, and that it is captured in a format that can be readily accessed for analysis. Historically, NSMCSD has captured CCTV inspection data using MS Excel spreadsheets with a separate electronic file for each inspection. Disadvantages of this approach include:

- Data is not centralized and cannot be easily analyzed on a system-wide basis.
- Coding is not standardized and severity rating is not mandatory, leading to incomplete and less useful inspection information.

Current industry best practice is to use inspection software (examples include WinCan, Granite XP, Flexidata, etc.) to capture inspection data as video and pictures are recorded. The benefits of using this approach include:

- Inspection software has fields that require standardized codes. This ensures that inspection coding will be consistent. In addition, all currently available software is pre-loaded with the standardized defect codes developed by the National Association of Sewer Service Companies (NASSCO), which are considered the standard of the industry.
- Data is collected in a standard data format. In addition, most currently available software packages will export inspection data in the standard NASSCO database format that can be combined into one data repository for review, analysis, and archiving.
- Most currently available software packages will collect inspection video in digital format and will automatically time-stamp documented defect codes with corresponding time-stamp location on digital video. This enables a user to navigate directly from a particular defect to the point in time on the inspection video where the defect was recorded. The software also enables users to navigate directly to digital pictures recorded of particular defects.

In addition to CCTV software and standard observation codes, having standards for CCTV inspection quality and data documentation is important in assuring that inspections result in high quality work products that can be utilized to support condition assessment activities as well as have value to the maintenance operation.

2.1.1 CCTV Quality Standards

It is important for all CCTV inspections to be completed to a uniform standard of performance. The District should train its staff on proper CCTV inspection procedures and coding protocol. In addition, they should hire contractors who have been certified as having received proper training on coding and inspection procedures. This will ensure consistent coding and assessment grading of pipeline defects.

A thorough and consistent quality assurance/quality control (QA/QC) program during CCTV inspection work is also a valuable method to ensure operator and contractor performance, consistent coding methodology, and video quality on an on-going basis. The following are items that should be considered to ensure adequate QA/QC standards during CCTV inspection.

- **Counter Calibration.** The footage counter for the camera should be calibrated weekly during CCTV operations. The calibration is performed by checking the cable counter against a measured length (typically about 400 feet). The date of last calibration should be recorded for every CCTV report.
- **Lighting.** Lighting in the pipe should be such that the pipe is illuminated and there is a minimum amount of glare. Lighting should be adjusted as needed according to the size of the pipe to provide a clear picture of the entire periphery of the pipe for all conditions encountered.
- **Flow Level.** The flow level requirements for CCTV inspection vary depending on the type of inspection being performed. Generally, the more pipe visible, the more data are obtained. The following guidelines for maximum flow depth should be followed to the extent possible:

6- to 10-inch pipe:	20% of pipe diameter
12- to 24-inch pipe:	25% of pipe diameter
27-inch and larger pipe:	30% of pipe diameter

- **Camera Travel Speed.** The camera travel speed should be a uniform rate of no more than 30 feet per minute. The camera speed should be slower when recording features and defects. The camera should stop and pan over defects and features noted and zoom in where appropriate.
- **Video Clarity.** All video and still picture images should be clear and sharp. The camera operator should adjust focus, iris, zoom, and lighting as needed to obtain a satisfactory image. The recorded image from the CCTV inspection camera should be free of fog or haze in the pipe. If the camera lens becomes obscured with condensation, grease, scum, or debris, the camera should be removed from the pipe, cleaned, and reinserted to continue inspecting the pipe.

2.1.2 CCTV Data Documentation Standards

CCTV data documentation standards describe the format in which the CCTV data should be captured.

- **CCTV Video Files.** The full CCTV video should be captured in an acceptable format as specified by the District. Each individual pipe segment should be included in a single file, except if a reverse set up is required due to an obstruction, in which case the reverse CCTV should be contained in a separate file. The files should be named in accordance with a standard convention that identifies the pipe reach inspection (by upstream and downstream structure IDs), the date of the inspection, and the camera direction. An example file naming convention is:

  Upstream Node ID-Downstream Node ID-mmddyy-F/R.mpg

  where:

  - Upstream/Downstream Node ID is the node (manhole) identification number
  - mmddyy is the date of the inspection

  - F or R indicates whether the CCTV direction is upstream-to-downstream (Forward) or downstream-to-upstream (Reverse)

- **Still Picture Capture.** Still images should be captured for all observed defects, or at a minimum for more severe defects, e.g., those with NASSCO grades of 4 or 5 (see discussion of NASSCO codes and grading in Sections 2.2 and 2.3 of this TM). If possible, a similar file naming convention as used for video files should be used for still images, by adding the footage location (to the nearest foot).

- **Startup Screen.** Immediately before the insertion of the camera into the manhole, a startup screen containing key information about the inspection should be displayed on the video. The information should include

  - Upstream and downstream node numbers
  - Direction of camera travel
  - Purpose of CCTV
  - Location
  - Date and time of day
  - Job number and/or project name
  - CCTV contractor (if applicable)
  - Operator's name

  Note: If the CCTV software being used can only display the "from" and "to" manhole numbers rather than upstream and downstream numbers (as in the case of a reverse inspection), then the upstream and downstream manhole numbers should be clearly stated in the startup video narration.

- **Running Screen Text.** During CCTV, the running screen should include the running footage (distance traveled from start of inspection) and, if possible, the upstream and downstream (or "from" and "to") node numbers of inspected pipe segment. The display of this information should in no way obscure the central focus of the pipe being inspected.

- **Startup Narration.** A voice narration should be included in the video recording. The narration at the beginning of each pipe segment should include the information on the startup screen, as well as the pipe size and material.

- **Running Narration.** All observations along the length of the pipe should also be narrated, with a description of the observation and clock position, if applicable. For example:

  - "Lateral at 10 o'clock at 56 feet; factory wye"
  - "Severe roots at 23 feet, all around crown of pipe"
  - "Medium grease and scum at flow line starting at 45 feet"… "End grease at 85 feet"

- **Ending Narration.** At the conclusion of the inspection of a pipe segment, the operator should state the final CCTV footage and indicate that the CCTV inspection of the pipe segment is complete. For example:

  - "TV inspection of sewer mainline from manhole D07-19 to manhole D07-20 is complete at 222 feet"

  If the inspection had to be abandoned before reaching the ending manhole, then a statement to this effect should be made as part of the ending narration with a reason given as to why the inspection could not be completed.

- **CCTV Database.** CCTV data should be captured in a database format (this is standard if one of the commonly used CCTV software is employed). The database should contain two primary tables: one that contains information about the inspections, and the other that contains the detailed observations. The inspection table should contain the upstream and downstream manhole IDs of the inspected pipe; pipe diameter, material, and location (street or easement description); date and time of inspection; camera direction (forward/downstream or reverse/upstream); operator's name; total footage inspected; and other relevant information required by the District. The observation table includes the CCTV codes (see Section 2.2) and associated footage locations of the observation plus other relevant information such as the clock position of the defect or other value that indicates its magnitude (percentage of diameter). Comments should be recorded to augment the defect data as needed.

2.2 CCTV Observation Codes

The purpose of using CCTV inspection codes to capture observations from CCTV inspection is to provide a standardized format that enables valid comparison of results of inspections that may be done by different CCTV operators or contractors. The use of codes also facilitates capture of the CCTV information in a database format that can readily be used to perform quantitative analysis of the inspection data and generate objective condition ratings.

Typically, CCTV observation codes are used to identify defects in sewer pipelines (e.g., cracks, offset joints, sags, grease accumulation, root intrusion, etc.), as well as construction features (manholes, lateral connections, changes in pipe material, etc.). Sewer defects are also usually given a relative severity (e.g., minor, moderate, severe). The code is recorded at the associated footage location (distance from the beginning manhole of the inspection) at which the observation is made.

2.2.1 Current District CCTV Observation Codes

The District has historically used a set of very basic CCTV observation codes and severity ratings, as listed in **Table 1** below.

Table 1: Current NSMCSD CCTV Inspection Codes

Code	Description	Severity*
G	Grease	1 to 5
OJ	Offset Joint	1 to 5
R	Roots	1 to 5
BP	Broken Pipe	1 to 5
CP	Cracked Pipe	1 to 5
BJ	Bad Joint	1 to 5
SC	Service Connection	N/A
MH	Manhole	N/A
LH	Lamphole	N/A

* 1=minor, 5=severe

These codes generally serve to describe most of the common structural and maintenance defects and construction features encountered in the smaller diameter pipes in the system. Observations that do not fit one of these codes, or specific comments about the recorded defect or construction feature (e.g., *protruding* service connection) can be noted in the "remarks" portion of the CCTV inspection log.

2.2.2 NASSCO Inspection Codes

The National Association of Sewer Service Companies (NASSCO) has developed a standardized set of CCTV inspection codes that is coming to be widely used in the industry. The advantage to using an accepted standardized system such as NASSCO is that the District can readily find contractors that are trained in the system, and the coding system is also standardized for use in many available CCTV software and CMMS programs that are commonly used in the sewer industry.

The benefits of using the NASSCO system of codes include:

- Comprehensive and standardized defect coding system for both sewer pipes and manholes.
- Most, if not all, CCTV inspection contractors are training in NASSCO and have NASSCO codes programmed into their inspection software.
- There is a standard database format used for the NASSCO codes, which is an important consideration when consolidating CCTV inspection data collected by in-house crews and CCTV inspection contractors into one system.
- Training programs and materials available by third parties can alleviate the need for the District to develop their own coding system, training materials, and trainers.
- NASSCO has also developed a Pipeline Assessment Certification Program (PACP) and Manhole Assessment Certification Program (MACP) that include a scoring and rating system that can be used to rate the condition and severity of sewer pipes and manholes based on the standard observation codes.

The NASSCO system includes 180 separate observation codes intended to be a comprehensive sewer inspection coding system including a wide array of possible types of observations for all possible types of sewer systems. Although the NASSCO system uses a large number of observation codes, most of the observations found in the NSMCSD system can be documented using a smaller subset of these codes, while the remaining codes would be used to a much lesser degree only if necessary.

Structural Defects versus Maintenance Defects

NASSCO inspection codes are divided into several families including: Structural defects, O&M defects, Construction Features, and Other Observations. Construction features describe a physical feature of the system such as a manhole, cleanout, or service lateral. Other Observations include miscellaneous codes such as change in pipe material or joint length. The codes primarily used to support condition assessment are the Structural defect codes (e.g., cracks, offset joints, etc.). Operations and maintenance (O&M) codes are primarily used to make maintenance decisions such as corrective work orders to address a critical maintenance issue (e.g., heavy roots or grease) or to support a decision to modify a preventive maintenance frequency. Structural defects have a Structural Grade with a value of 1 to 5. O&M defects have an O&M Grade with a value of 1 to 5 as well. The CCTV inspection code family, Structural Grades, and O&M Grades are indicated in the NASSCO defect code table in **Attachment E.**

One important inspection coding issue that routinely surfaces is missing structural codes at the location of maintenance defects. If a severe root issue is identified on a pipe, it should be logged along with a structural defect that allowed the root to enter the pipe in the first place (e.g., an open or offset joint, defective connection, etc.). These types of issues should be identified and addressed as part of the inspection QA/QC process.

Point Defects versus Continuous Defects

Defects observed during inspection are primarily logged as point defects occurring at one location. Defects that occur continuously along the length of the pipe can be logged either as a series of point defects or as one continuous defect with a starting point and an ending point. To translate a continuous defect to a total number of point defects, the length of the continuous defect is divided by 5.

> Example: 15 feet of continuous Crack Longitudinal (CL) defect is equivalent to 3 CL defects (15 divided by 5).

Some defects are not continuous but recurring, e.g., roots that occur at each joint; these defects should be logged at each occurrence and not as continuous observations.

2.3 Condition Scoring and Grading Approach

Gathering inspection data is the step towards understanding the condition of a sewer system on an asset by asset basis. At this point in the process, a large volume of data will exist, yet in a form that is not easily comparable between assets. Further analysis must be performed to translate this data into information that can be used to compare the relative condition of one asset versus another. Using a condition scoring and grading approach, formulas and weighting factors are used to convert the descriptive data developed as part of the pipeline coding system described in Section 2.2.2 into general categories of pipe condition. These categories focus attention on the sewer segments that need further evaluation and consideration for renewal and replacement. The condition rating of a pipe is based on the defect codes recorded during CCTV inspection and provides a means to compare all inspected pipes.

Procedures for converting the descriptive data into numerical representations of the overall condition of a pipe reach are detailed in this section. A method for using this grading system to develop criticality ratings for each sewer reach within the system is presented in Section 2.4. The methods described in this section are largely based on the NASSCO Pipeline Assessment and Certification Program (PACP), but with some additional rating methods that are designed to assist the District in prioritizing future rehabilitation and inspection needs.

2.3.1 NASSCO Defect Grades

Each pipeline defect code for both structural and O&M types of defects is assigned a condition grade of 1 to 5, representing its relative severity rating. NASSCO grades are assigned based on potential for further deterioration or pipe failure. Pipe failure is defined as when the pipe can no longer convey its design capacity. The grades are defined as follows:

- 5 – Immediate: Defects requiring immediate attention.
- 4 – Poor: Severe defects that are likely to become Grade 5 defects within the foreseeable future.
- 3 – Fair: Moderate defects that will continue to deteriorate.
- 2 – Good: Defects that have not begun to deteriorate.
- 1 – Excellent: Minor defects.

2.3.2 Structural Pipe Rating and O&M Pipe Rating

For each pipeline reach, the defect grade values are multiplied by the number of occurrences of the associated defect code to obtain a defect score. A separate pipe condition rating based upon structural defects vs. O&M defects should be developed for each reach of pipe. A structural pipe rating would be calculated by using Structural defect scores. O&M pipe rating would be calculated using only O&M defect scores.

An example of the scoring system for a Structural Pipe Rating is provided below:

> A sample 8-inch diameter pipe has one occurrence of a circumferential crack (CC), three large offset joints (JOL), 3 defective factory taps (TFD), and 5 defective hammer taps (TBD). Therefore,

1 CC x 1 = 1
3 JOL x 2 = 6
3 TFD x 2 = 6
<u>5 TBD x 3 = 15</u>
Structural Pipe Rating = 28

2.3.3 Normalized Pipe Ratings

Normalized pipe ratings, while not strictly part of the PACP method, are useful for comparing the condition of pipes of different lengths in order to prioritize them for further evaluation or rehabilitation. Normalized Structural Pipe Ratings and Normalized O&M Pipe Ratings for a pipe reach are obtained by dividing the Structural Pipe Rating or O&M Pipe Rating by the inspected length of the pipeline reach to "normalize" the score. The normalized value is then multiplied by 100 in order to scale up the value. This is referred to as the normalized pipe rating. The higher the normalized pipe rating, the worse shape the pipeline segment is in.

A separate normalized pipe rating based upon structural defects vs. O&M defects should be developed for each reach of pipe. A Normalized Structural Pipe Rating would be calculated by using Structural defect grades. A Normalized O&M Pipe Rating would be calculated using only O&M defect grades.

An example of the scoring system for a structural defect rating is provided below:

> The sample 8-inch diameter pipe described in the previous section had a Structural Pipe Rating of 28. The existing length of pipe is 350 feet. Therefore,

Normalized Structural Pipe Rating = 28/350 feet x 100 = 8

It should be noted that long reaches of pipeline with one serious defect may not receive a high condition rating. These would be more apparent when looking at the Quick Rating described below. Typically, spot repairs are used to correct these deficiencies.

2.3.4 Quick Rating (Peak Defect Score)

This is a quick way of assessing the highest defect grades in the pipe segment, regardless of segment length or number of defects. The Quick Rating is a combination of the number of occurrences of the two highest grade ratings in a pipe segment for either structural or O&M defects. For example, if the pipe has three Grade 5 defects and eight Grade 4 defects, the Quick Rating would be calculated as 5384. If there are more than 9 defects of a given grade, then alpha characters are used (A = 10 to 14, B = 15 to 19, etc.). Overall, the pipe may be in fair or excellent condition, but a high Quick Rating indicates that a pipe segment may have significant localized problems that could potentially lead to failure.

2.3.5 Pipe Rating Index (Mean Defect Score)

This is the average of all defect ratings in the pipe segment and is calculated by dividing the pipe rating by the total number of defects. As with the pipe rating, separate structural and O&M rating indices can be calculated. A higher pipe rating index signifies that the defects (as a group) trend to a more severe nature. As with the peak defect score, pipe length is not considered.

2.3.6 Repair/Renewal Decisions

All of the above pipe ratings should be evaluated to determine when several point repairs should be made to a line (as opposed to rehabilitating or replacing the entire line) and/or when to combine multiple line segments into a single project. This decision process should be tailored toward NSMCD's specific needs and requirements, and is not part of the scope of this TM.

2.4 Condition Grading and Criticality Rating Approach

In Section 2.3 of this TM, formulas were identified to convert the descriptive coding data developed during CCTV inspection into numerical representations of the overall relative condition of a pipe reach within the sewer system. The condition and criticality rating methodology as presented in this section will place the rating numbers into general categories of pipe condition that will help the District to prioritize sewers based on their condition and focus attention on the sewer segments that need further evaluation and consideration for renewal or replacement. Information regarding O&M condition ratings will also provide a source for development of preventive maintenance work activities and recurrence intervals for cleaning in order to avoid blockages and the resultant sanitary sewer overflows.

2.4.1 Structural Condition Grading of Sewers

The Structural Condition Grading of a sewer is based on the Normalized Structural Pipe Rating and is assigned based on potential for further deterioration or pipe failure. Grades are based upon consultant and industry experience. Pipe failure is defined as when the pipe can no longer convey its design capacity. Peak and mean defect scores as discussed in Section 2.3 of this TM augment the Structural Condition Grade determined for each sewer reach and can be used by the individual evaluator in conjunction with the Structural Condition Grading to determine relative rehabilitation priority within a given system. The categories defined below are intended to be used to evaluate pipes for potential manhole-to-manhole rehabilitation or replacement or prioritization for subsequent inspection. Pipes with high peak defect scores may require more immediate spot repairs, even if their overall condition is good.

A proposed condition rating categorization is shown below. These categories may need to modified in the future as more inspection data are collected for NSMCSD's system and to reflect District-specific rehabilitation decision and prioritization philosophy.

Category A:	Pipe reach has received a Normalized Structural Pipe Rating of 0 – 4. Pipe is in excellent to good condition, and failure is unlikely in the foreseeable future. No action required.
Category B:	Pipe reach has received a Normalized Structural Pipe Rating of 5 – 9. Pipe is in fair to poor condition and pipe may fail within the next 10 to 20 years. Pipe should be rehabilitated or replaced in the near-term.
Category C:	Pipe reach has received a Normalized Structural Pipe Rating of 10 or more. Pipe is in poor to very poor condition and has failed or is likely to fail within the next 5 years. This pipe reach is in need of immediate attention.

2.4.2 Criticality of Sewers

In addition to providing a Structural Condition Grade to sewer reaches within a sewer system, sewer pipes should also be classified based on criticality issues. Criticality defines the "risk" of failure, which reflects both the probability of failure (a reflection of sewer condition and other factors such as age, material, and soil and groundwater conditions) and the consequences of failure. Factors affecting criticality include sewer size (which indicates the relative size and number of customers in the area served by the sewer), and location (busy streets, hospitals, areas with access difficulties, sewers located within or close to an environmentally sensitive area, etc.). Determining the criticality of sewers is a subjective process that should be used to augment the condition assessment and grading process of the District's sewer system. The use of impact factors as described below help to provide some structure to this subjective process.

Impact Factors

Impact factors reflect an assessment of the "consequences of failure" for any particular sewer reach. Suggested categories of impact factors are:

- **Community/Environmental Impact.** This factor reflects the "sensitivity" of the area in which the pipe is located with respect to environmental or social impacts. Sewers assigned community impact factors include those adjacent to drainage channels, streams, or wetlands, or located in the vicinity of hospitals, schools, parks, or other community facilities.
- **Construction Impact.** This factor reflects the relative difficulty of construction and maintenance due to access limitations or traffic concerns. Sewers assigned construction impact factors include those located in easements and along streets or in intersections with high traffic volume.
- **Critical Crossings.** This factor is assigned to sewers that cross (or are located very close to) flood control channels and major or critical utilities. The impact of these crossings is associated with the potential damage to the above listed with the resulting loss or interruption of service.
- **Pipe Diameter.** The diameter of the pipe is indicative of the size of the tributary area that is served by the sewer. Larger diameter pipe are assigned higher impact factors because of the larger area and number of people that would be affected should the pipe fail or be temporarily out of service. However, six-inch pipes are assigned a slightly higher factor than eight-inch pipes because of the greater likelihood of problems such as overflows or backups should a blockage occur in the sewer.

Each pipe is assigned an impact factor for each of the above four categories. Suggested impact factor values, and the maximum total value for each category, are shown in **Table 2**.

Table 2: Recommended Impact Factors

IMPACT FACTORS		
Impact Description	**Condition**	**Impact Factor**
Community/Environmental Impact (Max = 2)	Creek, Marsh, Drainage Channel	2
	Hospital	2
	School	1
Construction Impact (Max = 2)	Easement	1
	Traffic	2
Critical Crossings (Max = 3)	Flood Control Channel or Creek	3
	Major Buried Utilities	2
	Major Overhead Utilities	1
Pipe Diameter (Max = 3)	>30-inch	3
	15- to 30-inch	2
	10- to 12-inch	1
	8-inch	0
	<8-inch	1

Based on the individual impact factors, the overall total impact factor for the pipe is calculated by the following formula:

$$\text{Total IF} = \text{sum(IF)}$$

Where sum(IF) is the sum of the four individual impact factors. The maximum value for the Total IF would be 10. The Total IF is then added to the Normalized Structural Pipe Rating as defined in Section 2.3.3 of the TM to determine a modified condition rating, or "critical rating" for the sewer. The critical rating would therefore elevate the condition category (as defined in Section 2.4.1) and relative priority for rehabilitation or subseq uent inspection for more critical facilities.

2.5 Condition Assessment Recommendations

NSMCSD should adopt CCTV data documentation procedures and quality standards as described in this TM for use by its own staff and required for CCTV contractors doing work in the District's sewer system. The District should adopt the NASSCO CCTV observation codes and grading system and obtain NASSCO certification for operators who will be inspecting pipelines. NASSCO has a Pipeline Assessment and Certification Program (PACP) which trains operators on the use of the NASSCO inspection codes as well as with the PACP condition grading system.

3 Proposed CCTV Inspection Program

This section describes the methodology for developing the sewer pipe CCTV inspection program for the NSMCSD service area. The goal of this process is to define a multi-year program for inspection of the entire sewer system and to prioritize the inspection schedule based on available pipe attribute and maintenance history data.

3.1 CCTV Frequency and Schedule

NSMCSD has elected to plan its CCTV inspections around a 10-year inspection cycle, meaning that all pipes will be inspected within a 10-year period. The program presented below establishes the initial 10-year schedule. Most pipelines will be inspected only once in 10 years. Pipelines that warrant more frequent inspections due to deteriorated condition will be identified during the initial CCTV cycle, and the program should be updated to include more frequent inspections of these pipes. Conversely, for pipes found to be in very good condition, a frequency of greater than 10 years may be acceptable for subsequent inspection.

To develop the CCTV inspection schedule, sewer pipes in the NSMCSD service area were divided into ten groups based on the following criteria:

1. Equalize Annual Inspection Length
   The target length for inspection each year is one tenth of the total system length. The cost associated with a CCTV program is directly proportional to the length inspected. Distributing the total system length evenly over the inspection period equalizes the year to year cost of the program.

   The total length of gravity sewer pipes in the NSMCSD is approximately 726,000 feet. The total pipe length was divided by 10 to derive the pipe length that would be inspected by CCTV each year. Therefore, each area to be CCTV inspected would contain approximately 72,600 ft.

   It should be noted that the total pipeline length identified above does not include any pipelines in the Westborough Water District. If a similar inspection program is desired for Westborough, these pipes could be added to the inspection schedule. Inspection of Westborough sewers is not addressed in this TM.

2. Prioritize the Oldest Pipes
   The oldest pipes would be prioritized first for CCTV inspection, progressing on to newer pipes further on in the inspection period.

3. Prioritize Areas with High Infiltration/Inflow (I/I)
   Areas identified as having high I/I based on the results of flow monitoring in the 2007/08 wet weather season would have high priority for inspection. These areas include the areas tributary to flow meters 1, 2, and 6, as presented in the draft TM on Flow Monitoring Results dated June 4, 2008.

4. Prioritize Known Trouble Spots
   The area prioritized for CCTV inspection in Year 1 would contain all identified maintenance trouble spots and segments that were identified as needing potential repairs or rehabilitation, re-evaluation, and/or re-CCTV. These areas were identified based on maintenance information and CCTV records from 2006 and 2007 provided by NSMCSD.

5. Group Pipes Regionally
   The pipelines for all years were grouped such that pipeline inspected in a given year were in close proximity. This reduces mobilization costs and leads to higher efficiency in program implementation.

Based on the methodology presented above, the schedule presented in **Figure 2** will allow for complete system inspection within 10 years. The characteristics for each area are summarized in **Table 3** and **Figure 3**. A list of all pipe segments to be inspected in the first year of the program is included as **Attachment F.**

The oldest sewers (1920-1939) are included in the pipe segments identified for CCTV inspection in the first three years (see Figure 2). The combination of pipe ages in Year 3 was based on proximity of pipes surrounding the oldest pipes (1920-1939) in the area. Sewers to be CCTV inspected from Year 4 to Year 8 consist mainly of pipe segments that were constructed between 1940 to 1959. In Years 9 and 10, the majority of the pipes were constructed from 1960-1979.

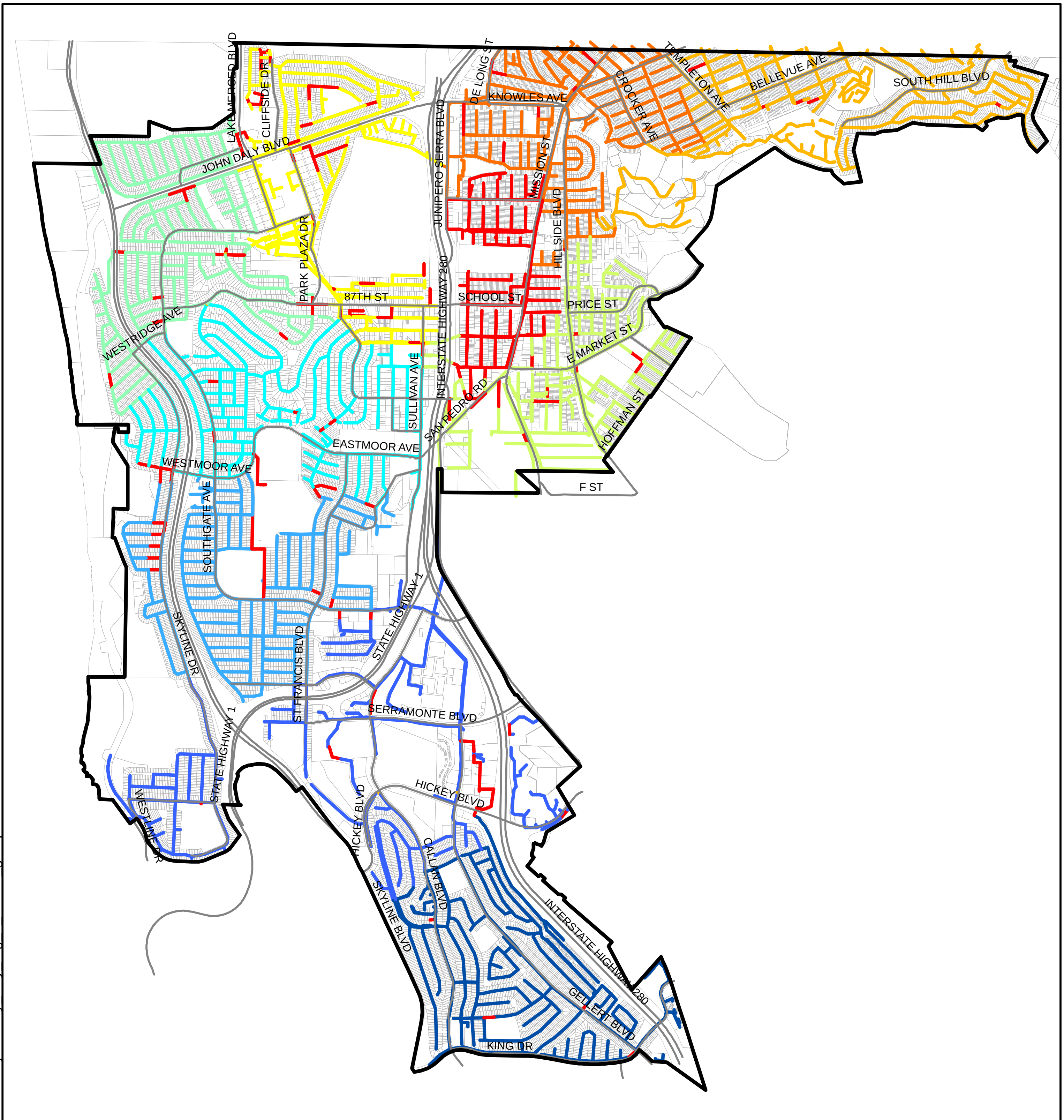


Figure 2: Projected Ten-Year CCTV Schedule

Legend

CCTV Inspection schedule (Year)

Y1	Y6
Y2	Y7
Y3	Y8
Y4	Y9
Y5	Y10

NSMCSD Boundary

N
W E
S

0 2,500 5,000 Feet

Created by: RMC Water and Environment
October 15, 2008

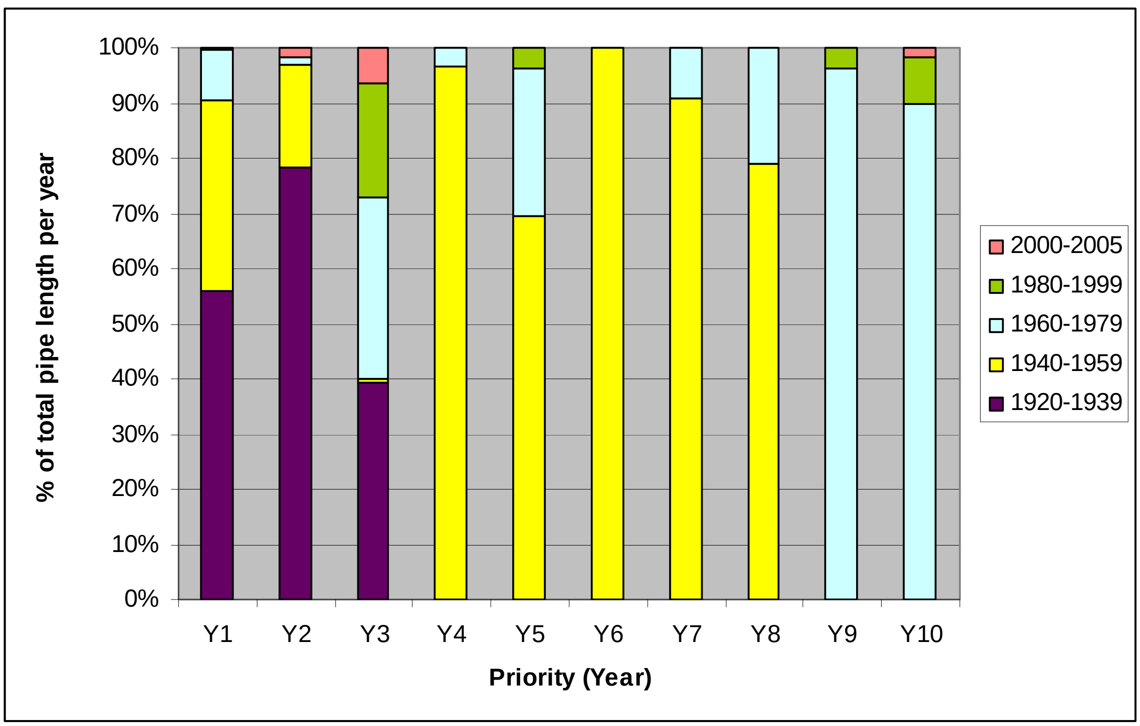
File: C:\GIS\0221 001 00 Daly City NSMCSD\Project\Daly City Fig 2 CCTV groups.mxd

Data Source: NSMCSD, City of Daly City

Table 3: Characteristics of CCTV Areas

Priority Area	Pipe Year of Construction					
	1920-1939	1940-1959	1960-1979	1980-1999	2000-2005	Total Length
Y1	40,696	24,966	6,731	225	0	72,618
Y2	56,749	13,525	1,047	0	1,205	72,526
Y3	28,290	501	23,485	14,978	4,517	71,771
Y4	0	69,235	2,340	0	0	71,575
Y5	0	50,681	19,345	2,756	0	72,782
Y6	0	72,084	0	0	0	72,084
Y7	0	66,141	6,685	0	0	72,826
Y8	0	57,297	15,367	0	0	72,664
Y9	0	0	71,675	2,696	0	74,371
Y10	0		65,555	6,170	1,175	72,900
Total	125,735	354,430	212,230	26,825	6,897	726,117

Figure 3: Composition of Pipe Ages for CCTV Areas



3.2 Estimated Cost of CCTV Inspection Program

An average cost of $3.50 per foot has been assumed for this CCTV program, which includes field inspection as well as data analysis (condition assessment). This number represents an average "turnkey" application, including all of the elements shown in **Table 4** below.

Table 4: Estimated Cost of CCTV Inspection Program

CCTV Program Element	Estimate Cost ($/ft)
Video Inspection	$1.50*
Data Analysis and Preparation of Report(s)	$1.20
Contractor Management (15% of inspection cost)	$0.225
Quality Control (15% of construction cost)	$0.225
Total	**$3.50**

* Unit costs may vary depending on quantity of work and site conditions. Bids as low as $1.00/ft are not uncommon.

Video inspection costs assume that the pipes in the area to be inspected have been flushed prior to inspection. No cleaning costs were included in addition to the City's regular cleaning program. It should also be noted that the costs shown assume that an outside contractor is retained to complete the inspection and a consultant to perform the data analysis. Data analysis includes CCTV data and video review, condition coding, and other tasks as described in Section 2 of this TM.

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Based on an average cost of $3.50 per foot, the CCTV inspection program is projected to have an average annual cost of approximately $255,000 (2008 dollars). Because the annual pipeline lengths were kept approximately equal, this cost would be fairly consistent over the 10-year program cycle, although costs during the first year could be somewhat higher due to the need to put new software and data management systems in place. It should also be noted that all or a portion of the work could be performed by City staff, which could reduce the cost of the program.

4 Near-Term Sewer Rehabilitation Needs

The District has identified a number of sewer rehabilitation needs based on known maintenance, structural, and capacity problems in the system. These identified near-term projects are list in **Table 5**. Additional sewer rehabilitation and replacement projects may be identified from CCTV inspection as that program proceeds.

Table 5: Near-Term Rehabilitation Projects

Project Name	Length (ft.)	Exist. Pipe Dia.	Replace-ment Pipe Dia.	Year Sched.	Est. Capital Cost *
Mission/Parkview Sewer	375	2"	8"	2009	$ 246,000
Skyline Force Main Reroute	600	6"	6"	2010	$ 220,000
Garibaldi Street Sewer	700	6"	6"	2010	$ 249,000
San Pedro/Washington St. Sewer	900	6"	8"	2010	$ 502,000
Chester Street/Sylvan St. Sewer	525+	6"	6"	2011	$ 594,000
Citrus Avenue Sewer	1,250	6"	8"	2011	$ 913,000
Washington/San Pedro/Junipero Serra Sewer	700	12"	18"	2013	$ 700,000
Station Avenue Sewer	470	6"	8"	2013	$ 207,000
Delong Street Sewer	500	8"	8"	2013	$ 377,000

* Costs estimated by District.

5 Long-Term Sewer Renewal/Replacement Projections

This section presents an estimate of long-term system renewal and replacement (R/R) needs for the NSMCSD gravity sewer system. As the District implements its system-wide inspection and condition assessment program, specific information on the condition of the pipes that can be used to project long-term R/R needs will gradually be developed. However, until the time that this system-wide data becomes available, sewer attribute information (e.g., age and material) coupled with reasonable assumptions can be used to develop a first cut at long-term needs. Therefore, using sewer inventory information and assumptions on sewer useful lives and rehabilitation and replacement methods, a budgetary cost estimate for long-term R/R of the NSMCSD wastewater collection system was developed for this TM.

5.1 System Inventory

Basic information with which to project long-term R/R needs was derived from the District's sewer inventory data contained in GIS. Using GIS files provided by the District, data for existing gravity sewer facilities were analyzed for accuracy and completeness with respect to pipe diameter, length, material, and installation date. In general, data for pipe diameters and length were substantially complete. The District was able to establish installation date information (in 20-year increments) from original as-built or subdivision plans, or based on proximity to parcels with known original structure construction dates. In the limited areas where pipe material was missing from the GIS data, it was assumed to be similar to adjacent pipes.

The average age of the collection system is 55 years old, with sewers ranging from new to over 80 years old. The predominant pipe material is vitrified clay pipe (VCP), which comprises approximately 99 percent of the system, with some polyvinyl chloride (PVC), reinforced concrete pipe (RCP), and ductile iron pipe (DIP).

Table 6 summarizes the length distribution of the sewers, and **Table 7** summarizes the length and average age of the various pipe materials in the NSMCSD gravity sewer system.

Table 6: Distribution of Sewer Length by Pipe Diameter

Diameter (inches)	Length (feet)	Percent of System
<6	2,057	0.03%
6	462,008	63.6%
8	128,186	17.7%
10	25,704	3.5%
12	31,700	4.4%
14	2,137	0.3%
15	34,598	4.8%
16	233	0.0%
18	12,012	1.7%
20	66	0.0%
21	12,049	1.7%
24	5,499	0.8%
27	1,516	0.2%
30	7,042	1.0%
33	620	0.1%
36	574	0.1%
42	117	0.02%
Total	726,119	100%

Table 7: Length and Average Age of Pipe Material

Pipe Material	Average Age (years)	Length (feet)	Percentage of System
VCP	54	716,585	98.7%
PVC	49	7,011	0.97%
RCP	51	2,124	0.29%
DIP	64	399	0.05%
TOTALS	**55**	**726,119**	**100%**

5.2 Material Service Life

The basis for projecting long-term R/R needs is the estimated service lives (useful lives) of the sewers. For the purposes of this study, service life is considered to be the age at which deterioration and defect accumulation result in a decision to perform a corrective action on the sewer in the form of a repair, rehabilitation, or replacement project.

Service life is assumed to vary by pipe material. The NSMCSD collection system inventory identified four types of materials in the gravity collection system. Materials are identified in **Table 8** along with the assumed average service life of each material. The estimated average service lives are based on generally accepted values derived from manufacturers' estimates and the current consensus of the industry. The assumed average service lives for different materials presented in Table 8 should be used as a general guide only.

Table 8: Assumed Average Service Life of Sewer Pipe Materials

Pipe Material	Average Service Life (yrs)
Ductile Iron (DIP)	50
Polyvinyl Chloride (PVC)	100
Reinforced Concrete (RCP)	50
Vitrified Clay (pre-1960)*	80
Vitrified Clay (1960 and newer)**	100

* VCP sewers constructed before 1960 are assumed to have rigid joints.
** VCP sewers constructed from 1960 on are assumed to have rubber-gasketed joints.

The actual service life experienced for particular assets will vary. Some assets will require repair, rehabilitation, or replacement before the average service life is reached while others will fail long after. The probability that an asset will reach a particular service life is expressed using a probability density function. The probability density function indicates the percentage of the total population that would be expected to "fail" at different points in time. (In the context of this TM, "failure" simply means that some type of repair, rehabilitation, or replacement would be required to maintain the pipe in adequate condition in order for it to provide continued reliable service.) Probability density functions are shaped similarly to "bell" curves. For purposes of this analysis and in the absence of an analyzable set of failure data, a probability density function based on assumed average service life was assumed. The assumed probability density function, shown in **Figure 4**, indicates the percentage of asset class failure at seven points over the life of the asset class. **Table 9** shows the age at which different levels of failure are experienced by pipe material class, based on the seven-point probability density function in Figure 4 and the average services lives shown in Table 8.

Figure 4: Assumed Probability Density Function at 7 Points of Failure

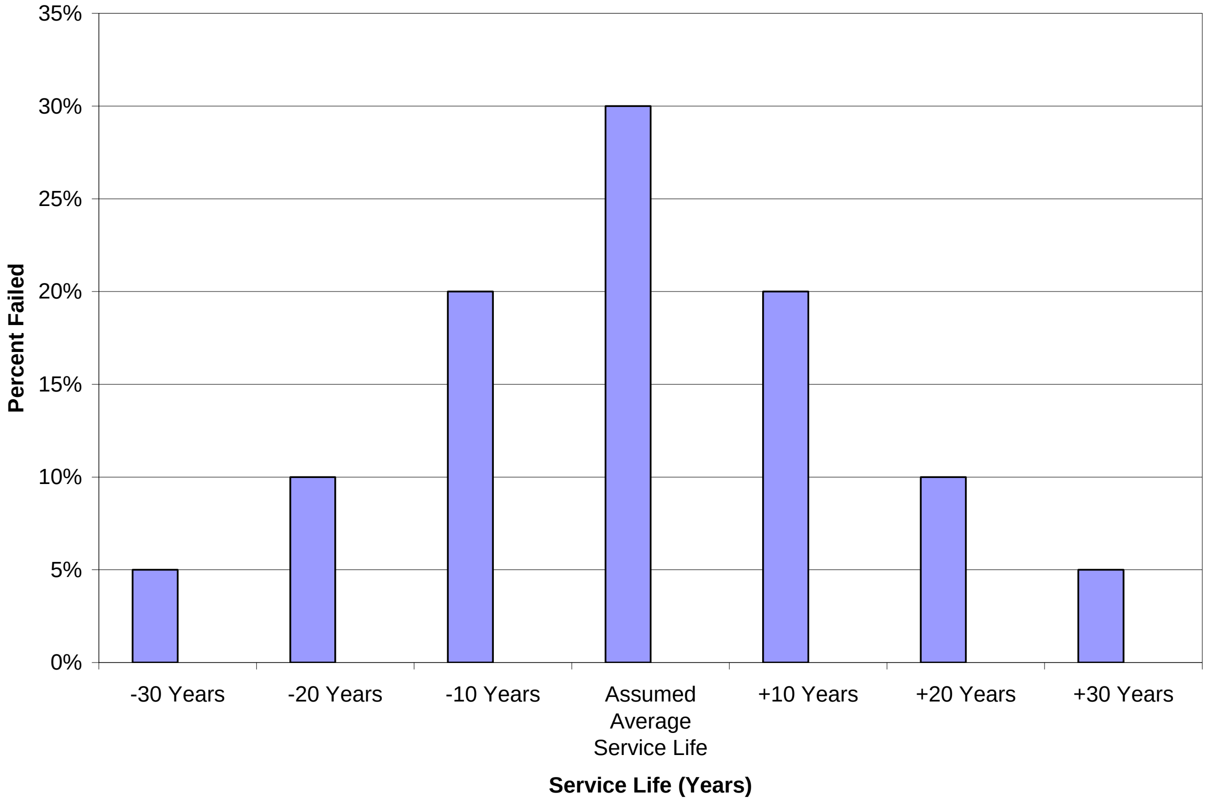


Table 9: Estimated and Calculated Material Class Age At 7 Points of Failure

Material	5% Failure	15% Failure	35% Failure	65% Failure	85% Failure	95% Failure	100% Failure
DIP	20	30	40	50	60	70	80
PVC	70	80	90	100	110	120	130
RCP	20	30	40	50	60	70	80
VCPRJ*	50	60	70	80	90	100	110
VCPRG**	70	80	90	100	110	120	130

* VCP constructed before 1960 (rigid joints)
** VCP constructed from 1960 (rubber-gasketed joints)

5.3 Long-term Renewal/Replacement Projection

The long-term R/R projection analysis uses system attribute data such as pipe diameter, material, and age along with a set of assumptions to project future amounts of repair, rehabilitation, and replacement. Projection assumptions include:

1. Material asset classes failure versus age can be defined by probability density functions discussed in Section 5.2 and defined at seven points of time in Table 9.
2. At the end of the useful life, the pipe will be either be spot repaired, lined, or replaced by pipe bursting or open-cut replacement
3. The percentage of assets that are repaired, lined, or replaced will vary by diameter. These percentages are defined in **Table 10**.
4. The unit cost per foot of renewal will vary by diameter. These costs are also shown in Table 10.
5. A 6-inch or smaller pipe requiring replacement will be replaced with an 8-inch diameter sewer.

Table 10: Allocation and Unit Construction Costs of R/R Methods

Sewer Diameter	Spot Repair		Lining Rehabilitation		Replacement*	
(in.)	Percent	$/LF	Percent	$/LF	Percent	$/LF
<8	85	45	-		15	225
8	85	45	10	230	5	225
10	85	46	10	240	5	230
12	55	47	30	250	15	235
14	25	48	50	250	25	310
15	25	49	50	250	25	310
16	25	50	50	270	25	335
18	10	53	60	270	30	335
20			80	290	20	360
21			80	290	20	360
24			80	310	20	385
27			80	330	20	410
30			80	360	20	450
33			80	400	20	500
36			80	440	20	550
39			80	460	20	575
42			80	480	20	600
48			80	560	20	700

Note: Costs include mobilization, demobilization, excavation, backfill, shoring, pavement, lower lateral replacement and installation of property line cleanouts on 12-inch and smaller pipes, traffic control, dewatering, bypass pumping, and all other costs associated with pipe construction.

* It is assumed that 70 to 80 percent of pipe replacement for 6- through 12-inch pipes would be by pipe bursting, and all pipe less than 8 inches in diameter would be replaced with 8-inch pipe.

Using these assumptions, estimates of the long-term repair, rehabilitation, and replacement needs for the NSMCSD wastewater collection system are presented in Figures 5 through 7. **Figure 5** shows the projected annual and cumulative length of pipe projected to be repaired, lined, or replaced. **Figure 6** shows the projected annual and cumulative construction costs of pipe renewal corresponding to the annual footages in the previous figure. **Figure 7** shows the projected annual and cumulative capital costs of pipe renewal. For this TM, capital costs assume an allowance of 25 percent of construction costs for engineering and other administrative and legal costs.

It should be noted that the approach to forecasting long-term R/R needs used in this TM is based on the assumption that spot repairs will allow for the deferral of major renewal actions (e.g., complete pipe lining or replacement) into the future for the majority of the pipes in the NSMCSD system. This assumption is based on recent analysis of data for the Union Sanitary District, which has collected CCTV data for almost all of its sanitary sewer system and has analyzed that data to identify required R/R requirements. In the future, NSMCSD would need to track the average life of spot repairs to determine when further, major renewal would be needed. For this reason, the cost projections in Figures 6 and 7 are shown only through year 2050.

5.4 Summary

The purpose of the long-term R/R estimate is to provide the District with guidance on the level of revenue accrual necessary to fund future system repair, rehabilitation, and replacement needs. System renewal needs and costs will steadily escalate through 2030 as the large majority of VCP pipe installed 50 years ago on average begins to require renewal. Note that that the projections shown in the figures also indicate that the District may have as much as a $13 million (capital cost) backlog of deferred sewer renewal and replacement, as indicated by the cumulative footage and costs in year 2009. The average annual capital expenditure over the next 20 years needed to meet the long-term R/R forecast presented in Figure 7 (including deferred costs) is approximately $1.8 million.

5.5 Future Projection Refinements

The projections presented in this TM were calculated based on a set of assumptions derived from the best available information. Several potential refinements could be performed based on the data collected during the first few years of the CCTV program to improve the accuracy of the projections and calibrate the projections to more closely align with the actual inspection and renewal results experienced by NSMCSD. Condition assessment results should be used to determine more accurate assumptions regarding the useful life and failure probability distribution of various materials for this specific system and the types of renewal methods needed to extend the useful lives of the sewer pipelines.

It is recommended that, as part of its continuing condition assessment program, the District consider conducting further analyses of pipe failure rates, repair/renewal decisions, and costs, as described above. Implementing a more robust database system will greatly enhance the District's ability to complete these tasks.

Figure 5: Total Projected Length of Annual Pipe Renewal

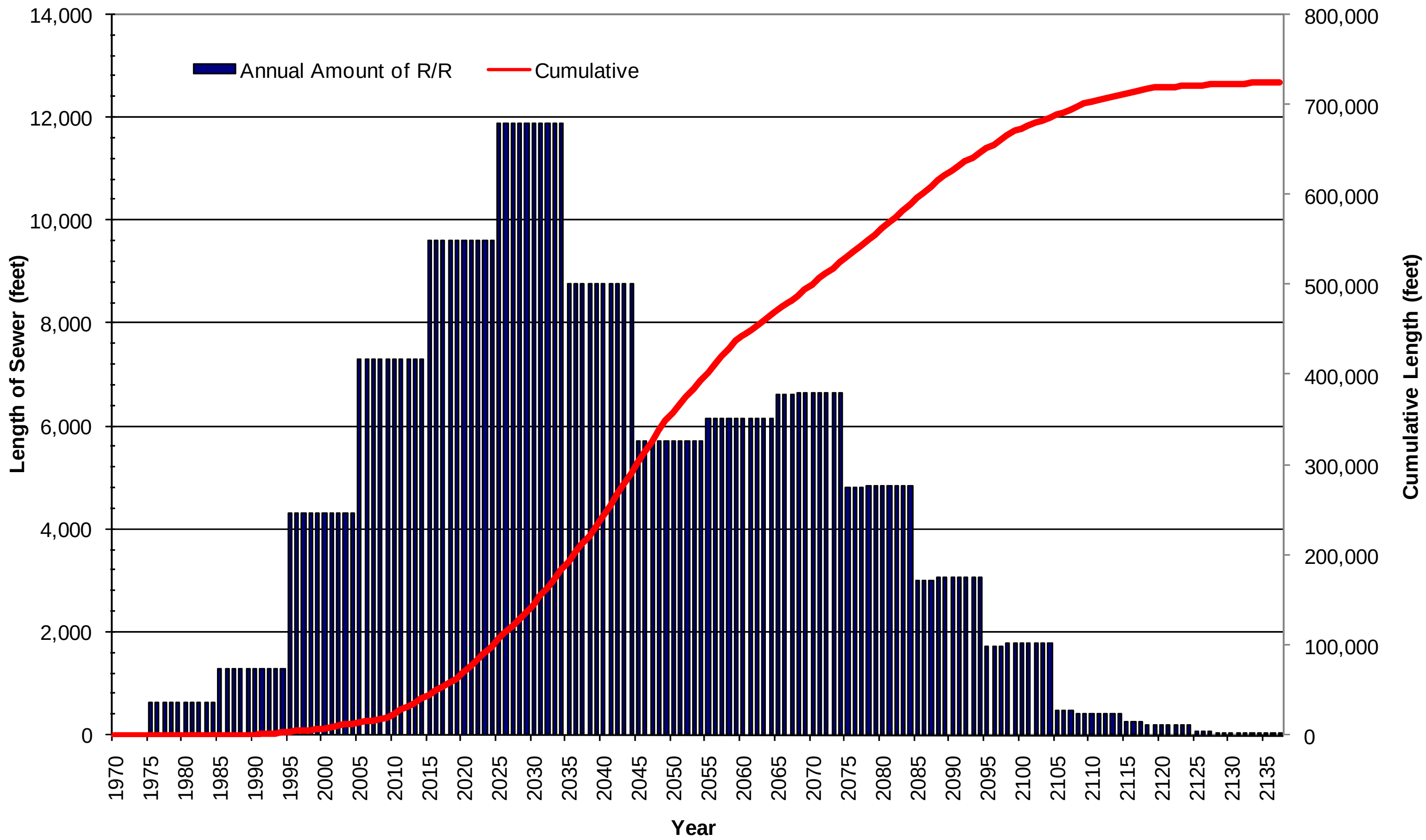


Figure 6: Total Projected Annual and Cumulative Construction Costs

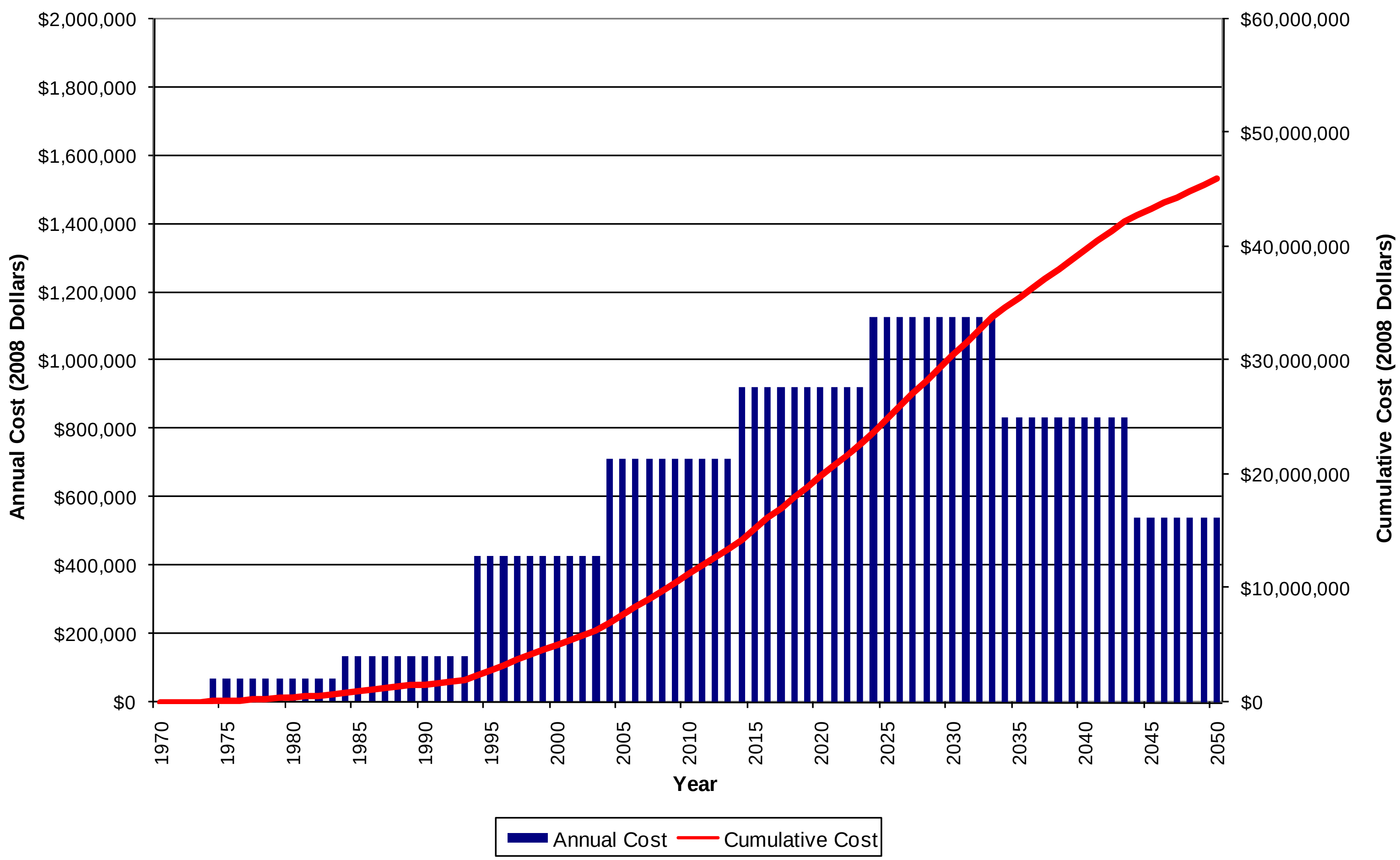
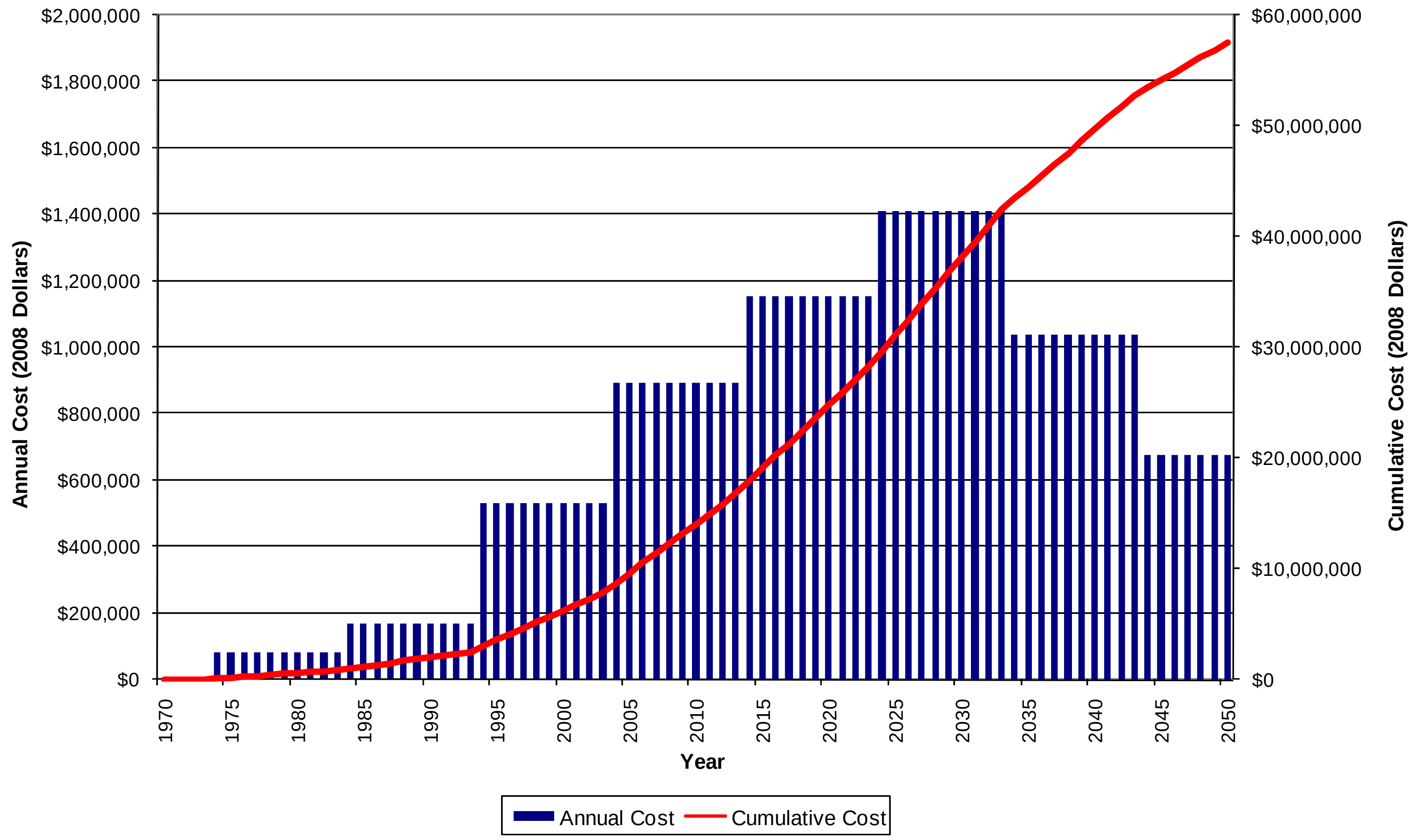


Figure 7: Total Projected Annual and Cumulative Capital Costs



ATTACHMENTS

Attachment A
Sewers in Hot Spot Cleaning Program

Upstream MH	Downstream MH	Length (ft.)	Dia. (in.)	Material	Location (street or closest street)
MH-B04-050	MH-B04-051	302	6	VCP	JOHN DALY BLVD
MH-B04-051	MH-B04-052	246	6	VCP	JOHN DALY BLVD
MH-B04-058	MH-B04-051	239	6	VCP	DORCHESTER DR
MH-B05-050	MH-B05-046	242	8	VCP	CRESTON AVE
MH-B07-010	MH-B07-011	205	6	VCP	WESTMOOR AVE
MH-B07-011	MH-B07-020	259	8	VCP	WESTMOOR AVE
MH-B07-020	MH-B07-027	265	8	VCP	WESTMOOR AVE
MH-B07-021	MH-B07-020	300	8	VCP	AVALON DR
MH-B07-028	MH-B07-027	286	6	VCP	SKYLINE DR
MH-B07-048	MH-B07-027	36	12	VCP	SKYLINE DR
MH-B07-049	MH-B07-048	234	12	VCP	SKYLINE DR
MH-B08-002	MH-B08-001	254	8	VCP	NORTHRIDGE
MH-B08-008	MH-B08-009	282	6	VCP	CARMEL
MH-B08-009	MH-B08-001	244	8	VCP	SKYLINE DR
MH-B08-011	MH-B08-010	240	6	VCP	HIGHLAND AVE
MH-B08-015	MH-B08-016	305	6	VCP	EATON AVE
MH-B08-018	MH-B08-017	255	6	VCP	NORTHRIDGE DR
MH-B10-006	MH-B11-017	32	8	VCP	BELCREST AVE
<no US MH>	MH-B11-002	92	8	VCP	SKYLINE DR
MH-C03-012	MH-C03-011	210	6	VCP	PARKSIDE AVE
MH-C03-013	MH-C03-012	169	6	VCP	PARKSIDE AVE
MH-C03-014	MH-C03-015	143	6	VCP	PARKSIDE AVE
MH-C03-022	MH-C03-028	295	6	VCP	LAKEVIEW DR
MH-C03-026	MH-C03-027	67	6	VCP	LAKEVIEW DR
MH-C03-027	MH-C03-030	136	6	VCP	EL PORTAL WAY
MH-C03-028	MH-C03-027	113	6	VCP	LAKEVIEW DR
MH-C03-032	MH-C03-031	42	8	VCP	EL PORTAL WAY
MH-C03-034	MH-C03-033	156	8	VCP	CLIFFSIDE DR
MH-C03-052	MH-C03-051	271	10	VCP	WESTLAWN AVE
MH-C03-053	MH-C03-052	332	6	VCP	WESTLAWN AVE
MH-C03-063	MH-C03-051	332	6	VCP	LAKE FOREST DR
MH-C03-084	MH-C03-085	178	10	VCP	LAKE MERCED BLVD
MH-C03-085	MH-C04-014	137	8	VCP	LAKE MERCED BLVD
MH-C03-092	MH-C03-091	215	6	VCP	LAKE VISTA AVE
MH-C04-009	MH-C04-010	172	6	VCP	LAKE MERCED BLVD
MH-C04-010	MH-C03-084	305	8	VCP	LAKE MERCED BLVD
MH-C04-030	MH-C04-028	297	6	VCP	JOHN DALY BLVD
MH-C04-044	MH-C04-060	192	6	VCP	CASTLEMONT
MH-C04-055	MH-C04-056	302	8	VCP	FOREST GROVE DR
MH-C04-056	MH-C04-066	249	8	VCP	FOREST GROVE DR
MH-C04-057	MH-C04-056	258	6	VCP	CASTLEMONT
MH-C04-060	MH-C04-057	287	6	VCP	CASTLEMONT
MH-C04-115	MH-C04-068	191	8	VCP	PARK PLAZA DR
MH-C04-165	MH-C04-074	368	6	VCP	PARK PLAZA DR
MH-C05-010	MH-C05-165	104	8	VCP	WILDWOOD AVE
MH-C05-012	MH-C05-028	204	8	VCP	WILDWOOD AVE
MH-C05-013	MH-C05-012	240	8	VCP	WILDWOOD AVE
MH-C05-028	MH-C05-029	205	8	VCP	WILDWOOD AVE
MH-C05-107	MH-C05-106	82	6	VCP	GARDEN VILLAGE SCHOOL
MH-C05-119	MH-C05-116	275	6	VCP	WASHINGTON ST
MH-C05-122	MH-C05-121	28	6	VCP	88TH ST
MH-C05-125	MH-C05-122	101	6	VCP	88TH ST
MH-C05-127	MH-C05-126	353	6	VCP	87TH ST

Attachment A
Sewers in Hot Spot Cleaning Program

Upstream MH	Downstream MH	Length (ft.)	Dia. (in.)	Material	Location (street or closest street)
MH-C05-128	MH-C05-127	210	6	VCP	NIMITZ DR
MH-C05-130	MH-C05-127	325	6	VCP	87TH ST
MH-C05-147	MH-C05-127	256	6	VCP	NIMITZ DR
MH-C05-165	MH-C05-166	29	8	VCP	WILDWOOD AVE
MH-C06-052	MH-C06-051	93	6	VCP	GILMAN DR
MH-C07-010	MH-C07-005	258	6	VCP	SOUTHGATE AVE
MH-C07-045	MH-C06-141	129	6	VCP	SWEETWOOD DR
MH-C07-048	MH-C07-046	129	6	VCP	ZITA MANOR
MH-C07-067	MH-C07-068	245	6	VCP	ALTA CT
MH-C07-069	MH-C07-068	170	5	VCP	ST JAMES CT
MH-C07-070	MH-C07-069	312	5	VCP	ST JAMES CT
MH-C07-101	MH-C08-023	354	6	VCP	EDGEMONT DR
MH-C07-P01	MH-C07-P07	68	6	VCP	WESTMOOR HIGH SCHOOL
MH-C07-P02	MH-C07-P01	72	6	VCP	WESTMOOR HIGH SCHOOL
MH-C07-P03	MH-C07-P02	41	6	VCP	WESTMOOR HIGH SCHOOL
MH-C07-P06	MH-C07-018	123	8	VCP	WESTMOOR HIGH SCHOOL
MH-C07-P07	MH-C07-P06	552	8	VCP	WESTMOOR HIGH SCHOOL
MH-C08-018	MH-C08-028	261	6	VCP	LAKESHIRE DR
MH-C08-023	MH-C08-024	362	6	VCP	EDGEMONT DR
MH-C08-024	MH-C08-025	264	8	VCP	LINCOLN AVE
MH-C08-025	MH-C08-026	265	8	VCP	LAKESHIRE DR
MH-C08-026	MH-C08-027	260	8	VCP	LAKESHIRE DR
MH-C08-027	MH-C08-028	284	8	VCP	LAKESHIRE DR
MH-C08-048	MH-C08-049	261	8	VCP	MIDVALE AVE
MH-C08-068	MH-C08-071	260	6	VCP	EL DORADO DR
MH-C09-061	MH-D10-021	238	8	VCP	ESCUELA DR
MH-C10-040	MH-C10-039	222	8	VCP	CAMPUS DR
MH-C10-041	MH-C10-040	188	8	VCP	CAMPUS DR
MH-D03-015	MH-D03-014	288	6	VCP	LAKE VISTA AVE
MH-D03-046	MH-D03-072	671	12	VCP	NIANTIC AVE
MH-D03-060	MH-D03-033	253	8	VCP	DE LONG ST
MH-D04-050	MH-D04-051	159	6	VCP	NIANTIC AVE
MH-D04-051	MH-D04-052	42	10	VCP	NIANTIC AVE
MH-D04-077	MH-D04-052	276	6	VCP	NIANTIC AVE
MH-D05-012	MH-D04-093	274	8	VCP	WILLITS ST
MH-D05-014	MH-D05-012	252	6	VCP	JEFFERSON UNION HS
MH-D05-051	MH-D05-094	341	6	VCP	GARDEN LANE
MH-D05-059	MH-C05-125	278	6	VCP	88TH ST
MH-D05-060	MH-C05-122	309	5	VCP	88TH ST
MH-D05-066	MH-D05-065	289	6	VCP	88TH ST
MH-D05-067	MH-D05-066	251	6	VCP	EDGEWORTH AVE
MH-D05-071	MH-D05-072	180	6	VCP	JUNIPERO SIERRA BLVD
MH-D05-072	MH-D05-070	180	6	VCP	JUNIPERO SIERRA BLVD
MH-D05-P04	MH-D05-044	251	6	VCP	LAKE MERCED GOLF AND COUNTRY CLUB
MH-D06-026	MH-D06-023	279	15	VCP	90TH ST
MH-D06-026	MH-D06-131	21	6	VCP	90TH ST
MH-D06-035	MH-D06-177	172	15	VCP	SULLIVAN AVE
MH-D06-085	MH-D06-084	238	6	VCP	MATEO AVE
MH-D06-095	MH-D06-098	203	6	VCP	SAN PEDRO RD
MH-D06-096	MH-D06-099	201	6	VCP	SAN PEDRO RD
MH-D06-098	MH-D06-099	33	6	VCP	SAN PEDRO RD
MH-D06-099	MH-D06-101	147	6	VCP	WASHINGTON ST
MH-D06-100	MH-D06-098	220	6	VCP	SAN PEDRO RD

Attachment A
Sewers in Hot Spot Cleaning Program

Upstream MH	Downstream MH	Length (ft.)	Dia. (in.)	Material	Location (street or closest street)
MH-D06-101	MH-D06-121	86	8	VCP	WASHINGTON ST
MH-D06-102	MH-D06-101	331	6	PVC	HILL ST
MH-D06-108	MH-D06-105	224	12	VCP	JUNIPERO SIERRA BLVD
MH-D06-121	MH-D06-120	168	8	VCP	HILL ST
MH-D06-131	MH-D06-130	252	6	VCP	90TH ST
MH-D06-167	MH-D06-108	215	12	VCP	JUNIPERO SIERRA BLVD
MH-D06-177	MH-D06-026	88	15	VCP	SULLIVAN AVE
MH-D07-019	MH-D07-020	213	6	VCP	BUENA VISTA AVE
MH-D09-021	MH-D09-023	263	6	VCP	CALLAN BLVD
MH-D09-030	MH-D08-012	225	12	VCP	CERRO DR
MH-D10-002	MH-D09-021	291	6	VCP	CALLAN BLVD
MH-D10-011	MH-D10-020	470	6	VCP	GELLERT BLVD
MH-D10-022	MH-D10-021	146	6	VCP	GELLERT BLVD
MH-D10-023	MH-D10-022	134	8	VCP	GELLERT BLVD
MH-D10-024	MH-D10-023	177	8	VCP	GELLERT BLVD
MH-D10-025	MH-D10-024	214	8	VCP	GELLERT BLVD
MH-D10-026	MH-D10-028	40	8	VCP	GELLERT BLVD
MH-D10-027	MH-D10-031	41	8	VCP	GELLERT BLVD
MH-D10-028	MH-D10-025	166	8	VCP	GELLERT BLVD
MH-D10-031	MH-D10-028	300	8	VCP	GELLERT BLVD
MH-D10-043	MH-D10-027	239	8	VCP	GELLERT BLVD
MH-D11-058	MH-D10-043	91	8	VCP	GELLERT BLVD
MH-D11-059	MH-D11-058	174	8	VCP	GELLERT BLVD
MH-D11-060	MH-D11-059	140	8	VCP	GELLERT BLVD
MH-D11-061	MH-D11-060	166	6	VCP	GELLERT BLVD
MH-D12-093	MH-D12-023	109	6	VCP	HEATH CT
MH-D13-051	MH-D13-029	208	6	VCP	SKYLINE SCHOOL
MH-E03-033	MH-E03-030	294	6	VCP	SANTA BARBARA
MH-E03-060	MH-D03-033	323	8	VCP	HILLCREST DR
MH-E03-S13	MH-E03-028	116	6	VCP	SAN JOSE AVE
MH-E03-S21	MH-E03-S22	385	8	VCP	FLOU RNOY ST
MH-E04-020	MH-E04-129	493	6	VCP	MIRRIAM ST
MH-E04-122	MH-E04-123	438	6	VCP	SAN DIEGO AVE
EN-E05-001	MH-E05-024	186	6	VCP	MISSION ST
MH-E05-027	MH-E05-026	241	6	VCP	GARIBALDI ST
MH-E05-029	MH-E05-141	259	6	VCP	BRUNO ST
MH-E05-030	MH-E05-029	270	6	VCP	PRICE ST
MH-E05-121	MH-E05-044	58	6	VCP	HILLSIDE BLVD
MH-E06-026	MH-E06-025	276	6	VCP	FIRST AVE
MH-E06-043	MH-E06-018	150	6	VCP	VALLEY ST
MH-E06-044	MH-E06-043	150	6	VCP	VALLEY ST
MH-E06-046	MH-E06-044	299	6	VCP	VALLEY ST
MH-E06-069	MH-E06-068	48	15	VCP	MARKET ST
MH-E06-071	MH-E06-149	48	8	VCP	HILLSIDE BLVD
MH-E06-099	MH-F06-019	270	6	VCP	CHESTER ST
MH-E06-123	MH-E06-069	119	15	VCP	MARKET ST
MH-E06-125	MH-E06-061	163	6	VCP	CASTLE ST
MH-E06-134	MH-E06-133	75	6	VCP	SECOND AVE
MH-E06-135	MH-E06-041	75	6	VCP	SECOND AVE
MH-E06-149	MH-E06-069	134	8	VCP	HILLSIDE BLVD
MH-E06-176	MH-D06-084	241	6	VCP	MARKET ST
MH-E06-181	MH-E06-178	269	6	VCP	REINER ST
MH-E06-182	MH-E06-181	269	6	VCP	REINER ST

Attachment A
Sewers in Hot Spot Cleaning Program

Upstream MH	Downstream MH	Length (ft.)	Dia. (in.)	Material	Location (street or closest street)
MH-E07-005	MH-E07-020	268	6	VCP	EL CAMINO REAL
MH-E10-032	MH-E10-031	200	6	VCP	PHILLIP DR
MH-E11-008	MH-E11-029	238	6	VCP	HICKEY BLVD
MH-E13-070	MH-E13-091	215	6	VCP	KING DR
MH-E13-085	MH-E13-053	65	15	VCP	VERDUCCI CT
MH-F03-S53	MH-F03-S77	144	12	VCP	FRANKFORT ST
MH-F03-S78	MH-F03-S53	25	12	VCP	FRANKFORT ST
MH-G03-C14	MH-G03-C13	58	6	VCP	EDGEMAR ST
MH-G03-C15	MH-G03-C14	151	6	VCP	EDGEMAR ST
MH-G03-C16	MH-G03-S19	209	6	VCP	EDGEMAR ST

Attachment B
Sewers Inspected During 2006 and 2007

Upstream MH	Downstream MH	Length (ft.)	Dia. (in.)	Material	CCTV Date	Location (street or closest street)
MH-B03-001	MH-B03-002	260	8	VCP	7/5/07	NORTHGATE AVE
MH-B03-002	MH-B03-003	251	8	VCP	7/5/07	NORTHGATE AVE
MH-B04-004	MH-B04-028	275	6	PVC	8/7/07	FAIRMONT DR
MH-B05-065	MH-B05-064	212	8	VCP	7/26/07	WILDWOOD AVE
MH-B06-011	MH-B06-010	299	6	VCP	9/11/07	PALISADES DR
MH-B06-011	MH-B06-012	325	6	VCP	9/11/07	WESTRIDGE AVE
MH-B06-018	MH-B06-011	306	6	VCP	9/11/07	PALISADES DR
MH-B06-053	MH-B06-056	185	6	VCP	6/19/07	PALMDALE AVE
MH-B06-056	MH-C06-002	278	6	VCP	6/21/07	PALMDALE AVE
MH-B07-007	MH-B07-006	70	6	VCP	9/11/07	SEAVIEW DR
MH-B07-008	MH-B07-007	206	6	VCP	9/11/07	SEAVIEW DR
MH-C04-010	MH-C03-084	305	8	VCP	7/26/07	NORTHGATE AVE
MH-C04-044	MH-C04-060	192	6	VCP	4/24/06	CASTLEMONT
MH-C04-056	MH-C04-066	249	8	VCP	4/24/06	FOREST GROVE
MH-C04-057	MH-C04-056	258	6	VCP	4/24/06	CASTLEMONT
MH-C04-066	MH-C04-067	198	8	VCP	7/25/07	SOUTH AVE
MH-C04-067	MH-C04-068	208	8	VCP	7/25/07	SOUTH AVE
MH-C06-106	MH-C06-107	166	6	VCP	5/2/06	NIMITZ DR
MH-C09-067	MH-C09-068	308	6	PVC	7/30/07	CLARINADA AVE
MH-C09-068	MH-C09-069	303	6	PVC	8/6/07	CLARINADA AVE
MH-C09-069	MH-D09-047	288	6	PVC	8/6/07	CLARINADA AVE
MH-D04-045	MH-D04-046	299	6	VCP	8/6/07	S PARKVIEW AVE
MH-D04-046	MH-D04-047	288	6	PVC	8/6/07	S PARKVIEW AVE
MH-D06-006	MH-D06-003	204	6	VCP	7/30/07	89TH ST
MH-D06-019	MH-D06-020	305	6	PVC	7/30/07	90TH ST
MH-D06-102	MH-D06-101	331	6	PVC	8/6/07	HILL ST
MH-D07-019	MH-D07-020	213	6	VCP	10/9/06	BUENA VISTA AVE
MH-D11-039	MH-D11-038	248	6	VCP	6/6/06	SIMPSON DR
MH-D11-059	MH-D11-058	174	8	VCP	7/26/07	HICKEY BLVD
MH-D11-060	MH-D11-059	140	8	VCP	7/26/07	HICKEY BLVD
MH-D11-073	MH-D11-074	268	6	VCP	6/6/06	VICTORIA ST
MH-D11-104	MH-D11-073	163	6	VCP	6/6/06	VICTORIA ST
MH-D12-030	MH-D12-029	190	6	VCP	6/6/06	SIMPSON DR
MH-D12-093	MH-D12-023	109	6	VCP	8/21/06	HEATH CT
MH-D13-034	MH-D13-035	301	6	VCP	2/27/07	KING DR
MH-D13-036	MH-D13-037	280	6	VCP	2/27/07	KING DR
MH-D13-037	MH-D13-038	298	6	VCP	2/27/07	KING DR
MH-E04-020	MH-E04-129	493	6	VCP	12/18/06	MIRRIAM ST
MH-E04-037	MH-E04-132	157	6	VCP	3/21/06	MISSION ST
MH-E04-122	MH-E04-123	438	6	VCP	4/26/06	SAN DIEGO AVE
MH-E04-126	MH-D04-045	61	6	PVC	8/6/07	S PARKVIEW AVE
MH-E06-026	MH-E06-025	276	6	VCP	6/28/07	FIRST AVE
MH-E06-149	MH-E06-069	134	8	VCP	9/11/07	HILLSIDE BLVD
MH-F03-C12	MH-E03-S27	326	8	VCP	8/14/07	RICE ST
MH-F03-S10	MH-F03-S11	403	8	VCP	10/22/07	BRUNSWICK ST
MH-F06-019	MH-E06-104	329	6	VCP	5/1/06	CHESTER ST
MH-H03-S30	MH-H03-S13	297	12	VCP	6/21/07	SOUTH RIDGE WAY
MH-H03-S41	MH-H03-S40	203	8	VCP	7/25/07	CAROLINE WAY
MH-H03-S42	MH-H03-S43	165	8	VCP	7/26/07	CAROLINE WAY

Attachment C

City of Daly City
Department of Water and Wastewater Resources
North San Mateo County Sanitation District
2007 TV Inspection Report

Pipe Size ______________________ Cleanliness ______________________
Pipe Type VCP ______________________ Grade % ______________________
MH Depth ______________________ TV with Flow? ______________________
MH Condition ______________________ TV against Flow? ______________________
Surcharge? ______________________ Tape # ______________________
Street ______________________ Job Code # ______________________
Grid # __________ Upstream MH __________ Downstream MH __________
Length (by footage reel) ______________________ Weather ______________________
Inspectors ______________________ Date __________ Time __________

DISTANCE READINGS	QUADRANT				PHOTO #	REMARKS
	1	2	3	4		

Glossary: Grease-G, C Offset Joint-OJ, Roots-R, Broken Pipe-BP, Cracked Pipe-CP, Bad Joint-BJ, Service Connection-SC, Manhole-MH, Lamphole-LH.

Severity Code 1-5: Where 1 is minor, 5 is severe.

Attachment D
Mainline Point Repairs Completed 1998 to 2007

Date	WO#	Sewer ID#	Repair Description
4/27/98	231290	SSD06054-053	CHANNEL REPAIR
5/6/98	231293	SSF03S78-S53	CHANNEL REPAIR
7/8/98	234410	SSC04008-010	DIG TO REPAIR MAINLINE
7/8/98	234402	SSC04005-004	CERRO DR REPAIRED 8" VCP
7/27/98	234803	SSD04057-055	8" SEWER PIPE REPAIR
7/29/98	231292	SSB02014-020	CHANNEL REPAIR
8/11/98	236588	SSE04012-011	BACK FILL PROJECT
10/19/98	241386	SSC05007-032	MAINLINE REPAIR 10"
10/20/98	241388	SSC05007-032	GLENWOOD AVE REPAIR 8"VCP ON 72 FAIRLAWN CT.
10/21/98	241404	SSC05020-021	DIG TO REPAIR 6" VCP MAIN LINE
11/2/98	242816	SSC05019-018	MONTROSE AVE REPAIR 6" VCP
11/4/98	242746	SSC06009-010	DIG AND REPAIR 8"
5/17/99	253140	SSC06023-037	REPAIRED MAINLINE
5/18/99	253168	SSC06013-012	REPAIRED MAINLINE
7/15/99	259164	HM-C03-085	REPAIRED MAINLINE
10/13/99	263115	SSC06060-061	REPAIRED 6" VCP
1/8/01	292791	SSC05138-031	MAINLINE REPAIR INSTALL 5FT OF 6"
1/9/01	292674	SSC07039-140	REPAIRED MAINLINE
1/15/01	293251	SSC06140-086	REPAIRED MAINLINE
1/16/01	293250	SSE07060-187	REPAIRED MAINLINE
7/23/01	308938	SSE07051-053	REPAIRED MAINLINE
7/24/01	308939	SSE07051-053	HILLSIDEBLVD REPAIRED MAINLINE 6"
7/26/01	308937	SSE07053-057	REPAIR MAINLINE 6"VCP
8/14/01	311070	SSE07052-056	REPAIRED MAINLINE BROKEN 6"
12/11/01	315817	SSE04011-057	8" MAINLINE
2/21/02	320055	SSE03014-015	WESTLAKE AVE MANHOLE
2/22/02	320066	SSC03027-030	MANHOLE REMOVE MOST OF BASE WITH JACKHAMMER
3/4/02	321581	SSE04022-024	DIG TO REPAIR MAINLINE
3/18/02	322502	SSE04022-024	REPAIRED MAINLINE, DIG TO REPLACE SAG IN LINE
3/19/02	322501	SSD06078-069	MISSION ST REPAIR MAINLINE
5/1/02	325308	SSE04011-057	DIG TO REPAIR SEWER MAIN 6" PVC USING COUPLINGS
5/1/02	325309	SSE04011-057	WESTLAKE AVE DIG TO REPAIR SEWER MAIN REPLACE 3FT OF 6"PVC
5/3/02	3250301	SSE04011-057	DIG TO REPAIR MAINLINE, REPACED 9FT OF 6" PVC
5/6/02	325545	SSC03052-051	MANHOLE WESTLAKE AVE REPAIR AND BUILD UP CHANNEL COMING
6/26/02	329209	SSD06042-041	DIG TO REPAIR 6"SEWER MAIN
6/27/02	329210	SSD06042-041	DIG TO REPAIR 6"SEWER MAIN
9/3/03	352735	SSD06121-120	REPLACED MANHOLE
9/30/03	354310	SSC08048-049	FOUR FEET LENGTH OF EIGHT
11/23/04	376937	SSE05027-026	REPAIRED MAINLINE
11/23/04	376937	SSE05027-026	LATERAL PIPE BURST APPOX 24FT. INSTALLED SADDLE
2/2/05	380896	SSE05030-029	CAPPED OPEN LAT, REPAIR PROBLEM AREA
2/2/05	380896	SSE05030-029	CAPPED LAERAL
5/12/05	386325	SSE03056-060	E MARKET ST, MAINLINE REPAIR
5/12/05	386325	SSE03056-060	MAINLINE REPAIR, 8" 3 FT SECTION
7/26/05	390696	SSB05078-060	DELONG ST, REMOVED AND REPLACED BROKEN 6" VCP
6/21/06	410279	SSG03S38-S13	SKYLINE DR REPAIRED BROKEN SECTION OF 18" VCP
6/21/06	410279	SSG03S38-S13	SKYLINE DR. REPARIED BROKEN SECTION OF 18" VCP

Attachment D
Mainline Point Repairs Completed 1998 to 2007

Date	WO#	Sewer ID#	Repair Description
7/5/06	411509	SSD06036-035	APPROX 10FT OF REPAIR
7/18/06	411583	MH-D05-095	SEALED MANHOLE
7/18/06	411583	MH-D05-095	SEALED MANHOLE
6/20/07	435846	MH-B08-022	WASHED MANHOLE
7/3/07	437742	SSB02036-038	REPLACED 6"LINE AT 3155 DUBLIN DR
7/19/07	437731	MH-C04A-117	RAISED MANHOLE
7/31/07	439290	SSB03001-002	8" PVC PIPE AND TWO 8" PLASTIC TO CLA

Attachment E
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	
	Spiral (S)		CS	2	
Fracture (F)	Circumferential (C)		FC	2	
	Longitudinal (L)		FL	3	
	Multiple (M)		FM	4	
	Spiral (S)		FS	3	
Pipe Failures	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	
Collapse (X)	Pipe (P)		XP	5	
	Brick (B)		XB	5	
Deformed (D)	(Pipe) (P)		D	≤10% - 4, >10% - 5	
	Brick (B)	Horizontally (H)	DH	5	
	Brick (B)	Vertically (V)	DV	5	
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	
Surface Damage H2S (S)	Roughness Increased (RI)		SRI	1	
	Surface Spalling (SS)		SSS	2	
	Aggregate Visible (AV)		SAV	3	
	Aggregate Projecting (AP)		SAP	3	
	Aggregate Missing (AM)		SAM	4	
	Reinforcement Visible (RV)		SRV	5	
	Reinforcement Corroded (RC)		SRC	5	
	Missing Wall (MW)		SMW	5	
	Other (Z)		SZ		
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	
	Reinforcement Visible (RV)	C	SRVC	5	
	Reinforcement Corroded (RC)	C	SRCC	5	
	Missing Wall (MW)	C	SMWC	5	
	Other (Z)	C	SZC		
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 Corroded (RC)	M	SRCM	5	
	Missing Wall (MW)	M	SMWM	5	
	Other (Z)	M	SZM		
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 Corroded (RC)	Z	SRCZ	5	
	Missing Wall (MW)	Z	SMWZ	5	
	Other (Z)	Z	SZZ		
Surface Damage (Metal Pipes)	Corrosion (CP)		SCP	3	
Lining Failure (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	

Attachment E
NASSCO PACP Condition Grading System Code Matrix

Family/Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
	Wrinkled (W)		LFW	3	
	Other (Z)		LFZ		
Weld Failure (WF)	Circumfrential (C)		WFC	2	
	Longitudinal (L)		WFL	2	
	Multiple (M)		WFM	3	
	Spiral (S)		WFS	2	
Point Repair (RP)	Localized Lining (L)		RPL		
	Localized Lining (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)		RPRZ		
	Other (Z)		RPRZD		
Brickwork	Displaced (DB)		DB	3	
	Missing (MB)		MB	4	
	Dropped Invert (DI)		DI	5	
	Missing Mortar	Slight	MMS	2	
		Medium	MMM	3	
		Large	MML	3	
O&M					
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 (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)	Fines silt/sand (F)		DNF		≤10%-2, ≤20%-3, <=30%-4, >30%-5
	Gravel (GV)		DNGV		≤10%-2, ≤20%-3, <=30%-4, >30%-5
	Other (Z)		DNZ		≤10%-2, ≤20%-3, <=30%-4, >30%-5
Roots (R)	Fine (F)	Barrel (B)	RFB		2
		Lateral (L)	RFL		1
		Connecfion (C)	RFC		1
Roots (R) at a Joint		N/A	RF		1
	Tap (T)	Barrel (B)	RTB		3
		Lateral (L)	RTL		2
		Connecfion (C)	RTC		2
Roots (R) at a Joint		N/A	RT		2
	Medium (M)	Barrel (B)	RMB		4
		Lateral (L)	RML		3
		Connecfion (C)	RMC		3
Roots (R) at a Joint		N/A	RM		3
	Ball (B)	Barrel (B)	RBB		5
		Lateral (L)	RBL		4
		Connecfion (C)	RBC		4
Roots (R) at a Joint		N/A	RB		4
Infiltration (I)	Weeper (W)		IW		2
	Dripper (D)		ID		3
	Runner (R)		IR		4
	Gusher (G)		IG		5
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 Protruding 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
	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
Vermin (V)	Rat (R)		VR		2
	Cockroach (C)		VC		1
	Other (Z)		VZ		1
Construction Features					
Tap (T)	Factory Made (F)		TF		
		Capped (C)	TFC		
		Defective (D)	TFD		2
		Intruding (I)	TFI		≤10%-2, ≤20%-3, <=30%-4, >30%-5

Attachment E
NASSCO PACP Condition Grading System Code Matrix

Family/Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Active (A)	TFA		
	Break-In/Hammer (B)		TB		
		Capped (C)	TBC		2
		Defective (D)	TBD		3
		Intruding (I)	TBI		≤10%-2, ≤20%-3, <=30%-4, >30%-5
		Active (A)	TBA		
	Saddle (S)		TS		
		Capped (C)	TSC		
		Defective (D)	TSD		2
		Intruding (I)	TSI		≤10%-2, ≤20%-3, <=30%-4, >30%-5
		Active (A)	TSA		
Intruding Seal Material (IS)			IS		
	Sealing Ring (SR)		ISSR		≤10%-2, ≤20%-3, <=30%-4, >30%-5
		Hanging	ISSRH		≤10%-2, ≤20%-3, <=30%-4, >30%-5
		Broken	ISSRB		≤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
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
	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
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		
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		
	Joint Length Change (JL)		MJL		
	Survey Abandoned (SA)		MSA		
	Water Level (WL)		MWL		
	Water Level (WL)	(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

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-B04-050	MH-B04-051	6	302	1940-1959	VCP
MH-B04-051	MH-B04-052	6	246	1940-1959	VCP
MH-B04-058	MH-B04-051	6	239	1940-1959	VCP
MH-B05-050	MH-B05-046	8	242	1940-1959	VCP
MH-B05-065	MH-B05-064	8	212	1940-1959	VCP
MH-B05-082	MH-B05-081	6	280	1940-1959	VCP
MH-B06-018	MH-B06-011	6	306	1940-1959	VCP
MH-B06-056	MH-C06-002	6	278	1940-1959	VCP
MH-B07-010	MH-B07-011	6	204	1940-1959	VCP
MH-B07-011	MH-B07-020	8	259	1940-1959	VCP
MH-B07-020	MH-B07-027	8	265	1940-1959	VCP
MH-B07-021	MH-B07-020	8	300	1940-1959	VCP
MH-B07-028	MH-B07-027	6	286	1940-1959	VCP
MH-B07-048	MH-B07-027	12	36	1940-1959	VCP
MH-B07-049	MH-B07-048	12	234	1940-1959	VCP
MH-B08-002	MH-B08-001	8	254	1940-1959	VCP
MH-B08-008	MH-B08-009	6	282	1940-1959	VCP
MH-B08-009	MH-B08-001	8	244	1940-1959	VCP
MH-B08-011	MH-B08-010	6	240	1940-1959	VCP
MH-B08-015	MH-B08-016	6	305	1940-1959	VCP
MH-B08-018	MH-B08-017	6	255	1940-1959	VCP
MH-B10-006	MH-B11-017	8	32	1960-1979	VCP
MH-C03-011	MH-C03-014	6	235	1940-1959	VCP
MH-C03-012	MH-C03-011	6	210	1940-1959	VCP
MH-C03-013	MH-C03-012	6	169	1940-1959	VCP
MH-C03-014	MH-C03-015	6	143	1940-1959	VCP
MH-C03-022	MH-C03-028	6	294	1960-1979	VCP
MH-C03-026	MH-C03-027	6	67	1960-1979	VCP
MH-C03-027	MH-C03-030	6	136	1960-1979	VCP
MH-C03-028	MH-C03-027	6	112	1960-1979	VCP
MH-C03-032	MH-C03-031	8	42	1960-1979	VCP
MH-C03-034	MH-C03-033	8	156	1960-1979	VCP
MH-C03-052	MH-C03-051	10	271	1940-1959	VCP
MH-C03-053	MH-C03-052	6	332	1940-1959	VCP
MH-C03-063	MH-C03-051	6	332	1940-1959	VCP
MH-C03-084	MH-C03-085	10	178	1940-1959	VCP
MH-C03-085	MH-C04-014	8	136	1940-1959	VCP
MH-C03-092	MH-C03-091	6	215	1940-1959	VCP
MH-C04-009	MH-C04-010	6	172	1940-1959	VCP
MH-C04-010	MH-C03-084	8	305	1940-1959	VCP
MH-C04-030	MH-C04-028	6	297	1940-1959	VCP
MH-C04-044	MH-C04-060	6	192	1940-1959	VCP
MH-C04-055	MH-C04-056	8	302	1940-1959	VCP
MH-C04-056	MH-C04-066	8	249	1940-1959	VCP
MH-C04-057	MH-C04-056	6	258	1940-1959	VCP
MH-C04-060	MH-C04-057	6	287	1940-1959	VCP
MH-C04-066	MH-C04-067	8	198	1940-1959	VCP
MH-C04-115	MH-C04-068	8	191	1940-1959	VCP
MH-C04-165	MH-C04-074	6	368	1940-1959	VCP
MH-C05-010	MH-C05-165	8	104	1940-1959	VCP

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-C05-012	MH-C05-028	8	204	1940-1959	VCP
MH-C05-013	MH-C05-012	8	240	1940-1959	VCP
MH-C05-028	MH-C05-029	8	205	1940-1959	VCP
MH-C05-107	MH-C05-106	6	82	1940-1959	VCP
MH-C05-119	MH-C05-116	6	275	1940-1959	VCP
MH-C05-122	MH-C05-121	6	28	1940-1959	VCP
MH-C05-125	MH-C05-122	6	101	1940-1959	VCP
MH-C05-127	MH-C05-126	6	353	1940-1959	VCP
MH-C05-128	MH-C05-127	6	210	1940-1959	VCP
MH-C05-130	MH-C05-127	6	324	1940-1959	VCP
MH-C05-147	MH-C05-127	6	256	1940-1959	VCP
MH-C05-165	MH-C05-166	8	29	1940-1959	VCP
MH-C06-052	MH-C06-051	6	93	1940-1959	VCP
MH-C06-106	MH-C06-107	6	166	1940-1959	VCP
MH-C07-010	MH-C07-005	6	258	1940-1959	VCP
MH-C07-045	MH-C06-141	6	129	1940-1959	VCP
MH-C07-048	MH-C07-046	6	129	1960-1979	VCP
MH-C07-067	MH-C07-068	6	245	1960-1979	VCP
MH-C07-069	MH-C07-068	5	170	1960-1979	VCP
MH-C07-070	MH-C07-069	5	312	1960-1979	VCP
MH-C07-101	MH-C08-023	6	354	1940-1959	VCP
MH-C07-P01	MH-C07-P07	6	67	1940-1959	VCP
MH-C07-P02	MH-C07-P01	6	72	1940-1959	VCP
MH-C07-P03	MH-C07-P02	6	40	1940-1959	VCP
MH-C07-P06	MH-C07-018	8	123	1940-1959	VCP
MH-C07-P07	MH-C07-P06	8	552	1940-1959	VCP
MH-C08-018	MH-C08-028	6	261	1940-1959	VCP
MH-C08-023	MH-C08-024	6	362	1940-1959	VCP
MH-C08-024	MH-C08-025	8	264	1940-1959	VCP
MH-C08-025	MH-C08-026	8	265	1940-1959	VCP
MH-C08-026	MH-C08-027	8	260	1940-1959	VCP
MH-C08-027	MH-C08-028	8	284	1940-1959	VCP
MH-C08-048	MH-C08-049	8	261	1940-1959	VCP
MH-C08-068	MH-C08-071	6	260	1940-1959	VCP
MH-C09-061	MH-C08-002	8	238	1960-1979	VCP
MH-C10-040	MH-C10-039	8	221	1960-1979	VCP
MH-C10-041	MH-C10-040	8	188	1960-1979	VCP
MH-D03-015	MH-D03-014	6	288	1940-1959	VCP
MH-D03-046	MH-D03-072	12	671	1920-1939	VCP
MH-D03-060	MH-D03-033	8	253	1920-1939	VCP
MH-D04-045	MH-D04-046	6	299	1920-1939	VCP
MH-D04-046	MH-D04-047	6	288	1920-1939	PVC
MH-D04-047	MH-D04-075	6	16	1920-1939	VCP
MH-D04-050	MH-D04-051	6	159	1920-1939	VCP
MH-D04-051	MH-D04-052	10	42	1920-1939	VCP
MH-D04-052	MH-D04-068	10	36	1920-1939	VCP
MH-D04-053	MH-D04-068	10	24	1920-1939	VCP
MH-D04-054	MH-D04-055	6	343	1920-1939	VCP
MH-D04-055	MH-D04-053	8	283	1920-1939	VCP
MH-D04-056	MH-D04-057	6	407	1920-1939	VCP

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-D04-057	MH-D04-055	8	293	1920-1939	VCP
MH-D04-058	MH-D04-090	6	492	1920-1939	VCP
MH-D04-059	MH-D04-089	6	492	1920-1939	VCP
MH-D04-060	MH-D04-068	10	271	1920-1939	VCP
MH-D04-064	MH-D04-063	10	135	1920-1939	VCP
MH-D04-065	MH-D04-064	10	115	1920-1939	VCP
MH-D04-066	MH-D04-065	10	60	1920-1939	VCP
MH-D04-068	MH-D04-069	10	248	1920-1939	VCP
MH-D04-069	MH-D04-063	10	231	1920-1939	VCP
MH-D04-075	MH-D04-050	6	184	1920-1939	VCP
MH-D04-077	MH-D04-052	6	276	1920-1939	VCP
MH-D04-078	MH-D04-066	10	43	1920-1939	VCP
MH-D04-083	MH-D04-078	10	273	1920-1939	VCP
MH-D04-084	MH-D04-083	8	277	1920-1939	VCP
MH-D04-085	MH-D04-084	8	47	1920-1939	VCP
MH-D04-086	MH-D04-085	8	70	1920-1939	VCP
MH-D04-087	MH-D04-086	8	30	1920-1939	VCP
MH-D04-088	MH-D04-087	8	43	1920-1939	VCP
MH-D04-088	MH-D04-060	10	355	1920-1939	VCP
MH-D04-089	MH-D04-088	8	305	1920-1939	VCP
MH-D04-090	MH-D04-089	8	300	1920-1939	VCP
MH-D04-091	MH-D04-088	8	101	1920-1939	VCP
MH-D04-092	MH-D04-091	8	88	1920-1939	VCP
MH-D04-093	MH-D04-092	8	161	1920-1939	VCP
MH-D04-094	MH-D04-093	6	250	1920-1939	VCP
EN-D05-001	MH-D05-013	6	44	1920-1939	VCP
EN-D05-002	MH-D05-023	6	166	1920-1939	VCP
EN-D05-003	MH-D04-094	6	27	1920-1939	VCP
MH-D05-012	MH-D04-093	8	274	1920-1939	VCP
MH-D05-013	MH-D05-014	6	148	1920-1939	VCP
MH-D05-014	MH-D05-012	6	252	1920-1939	VCP
MH-D05-017	MH-D05-018	6	125	1920-1939	VCP
MH-D05-018	MH-D05-023	6	133	1920-1939	VCP
MH-D05-019	MH-D05-018	6	300	1920-1939	VCP
MH-D05-020	MH-D05-019	6	300	1920-1939	VCP
MH-D05-023	MH-D05-024	6	132	1920-1939	VCP
MH-D05-024	MH-D05-029	6	243	1920-1939	VCP
MH-D05-025	MH-D05-024	6	270	1920-1939	VCP
MH-D05-026	MH-D05-025	6	275	1920-1939	VCP
MH-D05-029	MH-D05-085	6	32	1920-1939	VCP
MH-D05-035	MH-D05-039	15	172	1920-1939	VCP
MH-D05-039	MH-D06-070	6	276	1920-1939	VCP
MH-D05-040	MH-D05-091	6	210	1920-1939	VCP
MH-D05-041	MH-D05-092	6	310	1920-1939	VCP
MH-D05-051	MH-D05-094	6	341	1940-1959	VCP
MH-D05-059	MH-C05-125	6	278	1940-1959	VCP
MH-D05-060	MH-C05-122	5	309	1940-1959	VCP
MH-D05-066	MH-D05-065	6	289	1940-1959	VCP
MH-D05-067	MH-D05-066	6	251	1940-1959	VCP
MH-D05-071	MH-D05-072	6	180	1940-1959	VCP

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-D05-072	MH-D05-070	6	180	1940-1959	VCP
MH-D05-081	MH-D05-009	8	220	1920-1939	VCP
MH-D05-081	MH-D04-087	8	164	1920-1939	VCP
MH-D05-083	MH-D05-084	15	316	1920-1939	VCP
MH-D05-084	MH-D05-085	15	286	1920-1939	VCP
MH-D05-085	MH-D05-035	15	45	1920-1939	VCP
MH-D05-086	MH-D05-085	15	171	1920-1939	VCP
MH-D05-091	MH-D06-072	6	200	1920-1939	VCP
MH-D05-092	MH-D06-073	6	231	1920-1939	VCP
MH-D05-P04	MH-D05-044	6	251	1940-1959	VCP
MH-D06-026	MH-D06-131	6	20	1940-1959	VCP
MH-D06-026	MH-D06-023	15	279	1940-1959	VCP
MH-D06-035	MH-D06-177	15	172	1940-1959	VCP
MH-D06-069	MH-D06-068	6	171	1920-1939	VCP
MH-D06-069	MH-D06-112	10	21	1920-1939	VCP
MH-D06-070	MH-D06-069	6	173	1920-1939	VCP
MH-D06-071	MH-D06-069	6	299	1920-1939	VCP
MH-D06-071	MH-D06-113	10	16	1920-1939	VCP
MH-D06-072	MH-D06-071	6	131	1920-1939	VCP
MH-D06-073	MH-D06-071	6	300	1920-1939	VCP
MH-D06-076	MH-D06-117	8	126	1920-1939	VCP
MH-D06-077	MH-D06-076	6	177	1920-1939	VCP
MH-D06-078	MH-D06-069	6	306	1920-1939	VCP
MH-D06-078	MH-D06-077	6	175	1920-1939	VCP
MH-D06-079	MH-D06-076	6	75	1920-1939	VCP
MH-D06-080	MH-D06-079	6	227	1920-1939	VCP
MH-D06-081	MH-D06-080	6	203	1920-1939	VCP
MH-D06-082	MH-D06-071	6	250	1920-1939	VCP
MH-D06-082	MH-D06-081	6	198	1920-1939	VCP
MH-D06-083	MH-D06-080	6	92	1920-1939	VCP
MH-D06-084	MH-D06-083	6	203	1920-1939	VCP
MH-D06-085	MH-D06-084	6	238	1920-1939	VCP
MH-D06-086	MH-D06-073	6	171	1920-1939	VCP
MH-D06-086	MH-D06-085	6	245	1920-1939	VCP
MH-D06-095	MH-D06-098	6	203	1940-1959	VCP
MH-D06-096	MH-D06-099	6	201	1940-1959	VCP
MH-D06-097	MH-D06-083	6	256	1920-1939	VCP
MH-D06-098	MH-D06-099	6	33	1940-1959	VCP
MH-D06-099	MH-D06-101	6	147	1940-1959	VCP
MH-D06-100	MH-D06-098	6	220	1940-1959	VCP
MH-D06-101	MH-D06-121	8	86	1940-1959	VCP
MH-D06-102	MH-D06-079	6	330	1920-1939	VCP
MH-D06-102	MH-D06-101	6	331	1940-1959	PVC
MH-D06-108	MH-D06-105	12	224	1940-1959	VCP
MH-D06-112	MH-D06-068	15	153	1920-1939	VCP
MH-D06-113	MH-D06-112	15	306	1920-1939	VCP
MH-D06-114	MH-D06-113	15	300	1920-1939	VCP
MH-D06-116	MH-D06-162	8	22	1920-1939	VCP
MH-D06-117	MH-D06-116	8	28	1920-1939	VCP
MH-D06-121	MH-D06-120	8	168	1940-1959	VCP

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-D06-131	MH-D06-130	6	252	1940-1959	VCP
MH-D06-160	MH-D06-161	24	311	1920-1939	VCP
MH-D06-161	MH-D06-075	30	123	1920-1939	DIP
MH-D06-162	MH-D06-161	20	40	1920-1939	VCP
MH-D06-167	MH-D06-108	12	215	1940-1959	VCP
MH-D06-177	MH-D06-026	15	87	1940-1959	VCP
MH-D07-019	MH-D07-020	6	213	1940-1959	VCP
MH-D09-021	MH-D09-023	6	262	1960-1979	VCP
MH-D09-030	MH-D08-012	12	225	1980-1999	VCP
MH-D10-002	MH-D09-021	6	291	1960-1979	VCP
MH-D10-020	MH-D10-011	6	275	1960-1979	VCP
MH-D10-022	MH-D10-021	6	146	1960-1979	VCP
MH-D10-023	MH-D10-022	8	134	1960-1979	VCP
MH-D10-024	MH-D10-023	8	177	1960-1979	VCP
MH-D10-025	MH-D10-024	8	214	1960-1979	VCP
MH-D10-026	MH-D10-028	8	40	1960-1979	VCP
MH-D10-027	MH-D10-031	8	41	1960-1979	VCP
MH-D10-028	MH-D10-025	8	165	1960-1979	VCP
MH-D10-031	MH-D10-028	8	300	1960-1979	VCP
MH-D10-043	MH-D10-027	8	239	1960-1979	VCP
MH-D11-058	MH-D10-043	8	91	1960-1979	VCP
MH-D11-059	MH-D11-058	8	174	1960-1979	VCP
MH-D11-060	MH-D11-059	8	140	1960-1979	VCP
MH-D11-061	MH-D11-060	6	166	1960-1979	VCP
MH-D12-093	MH-D12-023	6	109	1960-1979	VCP
MH-D13-051	MH-D13-029	6	208	1960-1979	VCP
MH-E03-033	MH-E03-030	6	294	1920-1939	VCP
MH-E03-060	MH-D03-033	8	323	1920-1939	VCP
MH-E03-S13	MH-E03-028	6	116	1920-1939	VCP
MH-E03-S21	MH-E03-S22	8	385	1920-1939	VCP
EN-E04-001	MH-E04-015	4	250	1920-1939	VCP
MH-E04-010	MH-E04-011	6	510	1920-1939	VCP
MH-E04-011	MH-D04-057	8	296	1920-1939	VCP
MH-E04-012	MH-E04-011	6	295	1920-1939	VCP
MH-E04-013	MH-E04-012	6	117	1920-1939	VCP
MH-E04-014	MH-E04-013	6	390	1920-1939	VCP
MH-E04-015	MH-E04-013	6	165	1920-1939	VCP
MH-E04-016	MH-E04-012	6	269	1920-1939	VCP
MH-E04-017	MH-E04-016	6	406	1920-1939	VCP
MH-E04-018	MH-E04-017	6	134	1920-1939	VCP
MH-E04-019	MH-E04-128	6	490	1920-1939	VCP
MH-E04-020	MH-E04-129	6	492	1920-1939	VCP
MH-E04-030	MH-E04-033	6	232	1920-1939	VCP
MH-E04-033	MH-E04-037	6	262	1920-1939	VCP
MH-E04-037	MH-E04-132	6	157	1920-1939	VCP
MH-E04-122	MH-E04-123	6	438	1920-1939	VCP
MH-E04-125	MH-E04-126	6	110	1920-1939	VCP
MH-E04-126	MH-D04-045	6	61	1920-1939	PVC
MH-E04-126	EN-E04-005	6	110	1920-1939	VCP
MH-E04-127	MH-D04-090	8	30	1920-1939	VCP

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-E04-128	MH-E04-127	8	265	1920-1939	VCP
MH-E04-129	MH-E04-128	8	296	1920-1939	VCP
MH-E04-130	MH-E05-001	6	142	1920-1939	VCP
MH-E04-131	MH-E04-130	6	71	1920-1939	VCP
MH-E04-131	MH-E04-129	10	113	1920-1939	VCP
MH-E04-132	MH-E04-140	6	21	1920-1939	VCP
MH-E04-132	MH-E04-131	10	112	1920-1939	VCP
MH-E04-140	MH-E05-007	6	316	1920-1939	VCP
MH-E05-001	MH-E05-128	6	250	1920-1939	VCP
EN-E05-001	MH-E05-024	6	186	1920-1939	VCP
EN-E05-002	MH-E05-018	6	277	1920-1939	VCP
EN-E05-003	MH-E05-034	6	37	1920-1939	VCP
MH-E05-005	MH-E05-006	6	154	1920-1939	VCP
MH-E05-006	MH-E05-130	6	251	1920-1939	VCP
MH-E05-007	MH-E05-006	6	276	1920-1939	VCP
MH-E05-007	MH-E05-008	6	103	1920-1939	VCP
MH-E05-008	MH-E05-009	6	285	1920-1939	VCP
MH-E05-009	MH-E05-015	6	246	1920-1939	VCP
MH-E05-015	MH-E05-019	6	257	1920-1939	VCP
MH-E05-016	MH-E05-015	6	313	1920-1939	VCP
MH-E05-017	MH-E05-016	6	315	1920-1939	VCP
MH-E05-018	MH-E05-133	6	264	1920-1939	VCP
MH-E05-019	MH-E05-025	6	248	1920-1939	VCP
MH-E05-020	MH-E05-019	6	222	1920-1939	VCP
MH-E05-021	MH-E05-020	6	220	1920-1939	VCP
MH-E05-022	MH-E05-021	6	220	1920-1939	VCP
MH-E05-024	MH-E05-135	15	210	1920-1939	VCP
MH-E05-025	MH-E05-029	6	271	1920-1939	VCP
MH-E05-026	MH-E05-025	6	213	1920-1939	VCP
MH-E05-027	MH-E05-026	6	241	1920-1939	VCP
MH-E05-028	MH-E05-027	6	232	1920-1939	VCP
MH-E05-029	MH-E05-141	6	259	1920-1939	VCP
MH-E05-030	MH-E05-029	6	270	1920-1939	VCP
MH-E05-031	MH-E05-030	6	304	1920-1939	VCP
MH-E05-032	MH-E05-031	6	186	1920-1939	VCP
MH-E05-034	MH-E06-029	6	241	1920-1939	VCP
MH-E05-035	MH-E06-030	6	220	1920-1939	VCP
MH-E05-121	MH-E05-044	6	58	1940-1959	VCP
MH-E05-128	MH-D04-094	6	250	1920-1939	VCP
MH-E05-129	MH-E05-130	6	154	1920-1939	VCP
MH-E05-130	MH-D05-014	6	248	1920-1939	VCP
MH-E05-131	MH-E05-132	6	109	1920-1939	VCP
MH-E05-132	MH-D05-020	6	308	1920-1939	VCP
MH-E05-133	MH-E05-135	6	384	1920-1939	VCP
MH-E05-134	MH-D05-026	6	275	1920-1939	VCP
MH-E05-135	MH-D05-083	15	282	1920-1939	VCP
MH-E05-136	MH-E05-137	6	210	1920-1939	VCP
MH-E05-137	MH-E06-001	6	149	1920-1939	VCP
MH-E05-141	MH-E06-004	6	235	1920-1939	VCP
MH-E06-001	MH-E06-002	6	180	1920-1939	VCP

Attachment F
Pipe Segments Scheduled for Year 1 CCTV Inspection

Upstream MH	Downstream MH	Dia. (in.)	Length (ft.)	Est. Install Year	Material
MH-E06-002	MH-D06-073	6	300	1920-1939	VCP
MH-E06-002	MH-E06-146	10	22	1920-1939	VCP
MH-E06-004	MH-E06-007	6	356	1920-1939	VCP
MH-E06-004	MH-E06-145	15	123	1920-1939	VCP
MH-E06-005	MH-E06-006	6	269	1920-1939	VCP
MH-E06-006	MH-E06-176	6	325	1920-1939	VCP
MH-E06-007	MH-E06-008	6	349	1920-1939	VCP
MH-E06-008	MH-E06-176	6	58	1920-1939	VCP
MH-E06-026	MH-E06-025	6	276	1940-1959	VCP
MH-E06-028	MH-E06-128	6	10	1920-1939	VCP
MH-E06-029	MH-E06-028	6	129	1920-1939	VCP
MH-E06-030	MH-E06-031	6	145	1920-1939	VCP
MH-E06-043	MH-E06-018	6	150	1940-1959	VCP
MH-E06-044	MH-E06-043	6	150	1940-1959	VCP
MH-E06-046	MH-E06-044	6	299	1940-1959	VCP
MH-E06-069	MH-E06-068	15	48	1940-1959	VCP
MH-E06-071	MH-E06-149	8	48	1960-1979	VCP
MH-E06-099	MH-F06-019	6	270	1940-1959	VCP
MH-E06-123	MH-E06-069	15	119	1940-1959	VCP
MH-E06-125	MH-E06-061	6	163	1940-1959	VCP
MH-E06-127	MH-E06-128	12	265	1920-1939	VCP
MH-E06-128	MH-E06-004	12	297	1920-1939	VCP
MH-E06-134	MH-E06-133	6	75	1940-1959	VCP
MH-E06-135	MH-E06-041	6	75	1940-1959	VCP
MH-E06-145	MH-E06-146	15	58	1920-1939	VCP
MH-E06-146	MH-D06-114	15	295	1920-1939	VCP
MH-E06-149	MH-E06-069	8	134	1940-1959	VCP
MH-E06-175	MH-E06-128	4	97	1920-1939	VCP
MH-E06-176	MH-D06-084	6	241	1920-1939	VCP
MH-E06-181	MH-E06-178	6	269	1940-1959	VCP
MH-E06-182	MH-E06-181	6	269	1940-1959	VCP
MH-E07-005	MH-E07-020	6	268	1940-1959	VCP
MH-E10-032	MH-E10-031	6	200	1960-1979	VCP
MH-E11-008	MH-E11-029	6	238	1960-1979	VCP
MH-E13-070	MH-E13-091	6	215	1960-1979	VCP
MH-E13-085	MH-E13-053	15	65	1960-1979	VCP
MH-F03-S10	MH-F03-S11	8	403	1920-1939	VCP
MH-F03-S53	MH-F03-S77	12	143	1920-1939	VCP
MH-F03-S78	MH-F03-S53	12	25	1920-1939	VCP
MH-F06-019	MH-E06-104	6	329	1940-1959	VCP
MH-G03-C14	MH-G03-C13	6	58	1920-1939	VCP
MH-G03-C15	MH-G03-C14	6	150	1920-1939	VCP
MH-G03-C16	MH-G03-S19	6	209	1920-1939	VCP
MH-H03-S42	MH-H03-S43	8	165	1960-1979	VCP
MH-D10-021	MH-D10-020	6	195	1960-1979	VCP