Guide for Conducting Evaluations
of
Municipal Wastewater Collection System
Operation and Maintenance Management Programs

Introduction

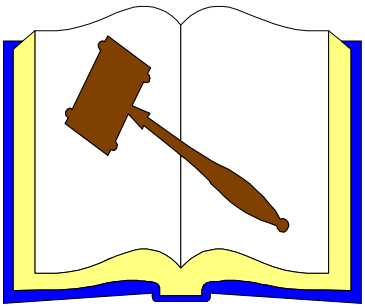
This document has been developed for inspectors tasked with the evaluation of municipal wastewater collection systems. It is not meant to replace more detailed texts available on the following subjects that will be discussed only briefly. The reader is referred to the Appendix for a list of references.

Many collection systems have received minimal maintenance for many years. This has resulted in deteriorated sewers with subsequent overflows, cave-ins, hydraulic overloads at treatment plants, etc. There are many reasons for conducting an evaluation of a municipal collection system.

Public and Environmental Health

Sanitary sewer overflows (SSO's) are a frequent cause of water quality violations. Beach closings, flooded basements, closed shellfish beds and overloaded water treatment plants are some symptoms of an inadequate collection system. Streams influenced by frequent overflows support only the hardiest of species.

Legal Considerations

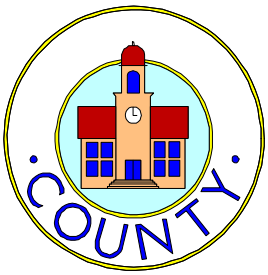


An NPDES permit requires that the "permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit."

A sanitary sewer overflow may be an unpermitted, point discharge of pollutants as defined in the Clean Water Act.

The goal of this inspection is to discover if a utility is plagued by overflows/bypasses of their collection system. If so, what are the impacts? Is the utility aware of the problem? Are they taking appropriate steps to address the problem in a timely manner?

Administration



The first stop on any inspection should be the "home office". These "Administration" office(s) include such functions as management, financial, engineering, planning, procurement, warehousing, personnel, legal, etc. In a large city, this work may be split between different departments. A small town may have only one or two people doing some of these things. Much of the information contained here can be obtained before inspection by written request. Areas of interest should include:

✔Financial

EPA and others have published much guidance on the financial aspects of operating a wastewater utility. Some of this information is listed in the reference list. This is the single most important aspect of utility operation. Inadequate funding diminishes the chances for success.

User Rate/User Charge

! What are the utility's current rates?

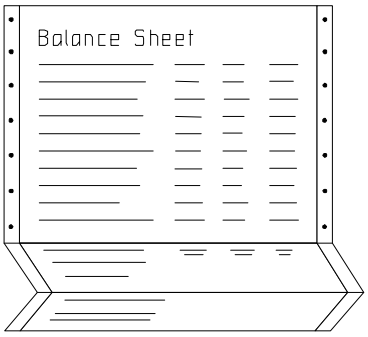
! How are user rates calculated?

! How often are user charges evaluated and adjusted based on that evaluation?

! Does the utility receive full funding from its revenue?

! Are utility funds used for other government activities?

Budget



The utility should be operating on an annual budget that details funding for the various functions.

! Does the utility budget for annual operating costs?

! Does the budget provide sufficient itemization?

! Does the utility maintain a fund for future equipment and infrastructure replacement?

! Does the budget provide for sufficient funding?

! How is new work typically financed?

Public Education/Outreach

The utility should be talking with the public on issues such as user rates/user charges. It is up to the utility to educate the public on wastewater treatment, its impact on water resources and the importance of keeping the user rates current. By maximizing resources and operating facilities efficiently, the utility can delay increases in user rates for a short time. This should be done before approaching the public on these issues.

! What type of public education/outreach programs does the utility have about user rates?

! Do these programs include communication with several groups such as local governments, community groups, the media, young people (schools, youth organizations)?

✔Personnel

Organization

! Is an organizational chart available which shows the various positions budgeted and filled?

! Are position descriptions available?

Operator Safety Program

A utility can have several levels of a safety program. It should consist of top administration, a safety department, a safety committee, and field personnel. For a small utility, top administration could be the mayor while a large utility could employ a personnel manager. All utilities should have a safety program that includes a safety policy, safety training and promotion, and accident investigation and reporting.

! Is there a documented safety program supported by the top administration official?

! Is there a safety department that provides training, equipment, and an evaluation of procedures?

! Are all operators required to follow safe work procedures, such as the use of protective clothing and headgear, confined spaces, lock out policies, etc. ?

! Is there a confined space entry procedure for manholes, wetwells, etc.?

! How often are safety procedures reviewed and revised?

! How does the safety department communicate with field personnel on safety procedures memo, direct communication, video, etc.?

✔Equipment and Tools

The amount and types of equipment and tools held by a utility depend on the size, age, and condition of the system. The decision as to type and number of equipment to have on hand is a difficult one. A small utility may find it hard to justify the purchase of expensive, specialized equipment. The utility must identify the problems in the collection system and purchase tools and equipment accordingly. An alternative to purchasing is leasing ,contracting, or sharing costs with other communities.

! Is there a list of equipment and tools used for operation and maintenance?

! Do personnel feel they have access to the necessary equipment and tools to do all aspects of operation and maintenance of its collection system?

! Is there access to suitable equipment if the utility's equipment is down for repair?

! Does the utility own or have access to portable generators?

! Where does the utility store its equipment?

Whether by contract or in-house, a utility should have a proactive equipment maintenance program to maximize resources.

! Is a detailed equipment maintenance log kept?

! Are written equipment maintenance procedures available?

! What is the procedure for equipment replacement?

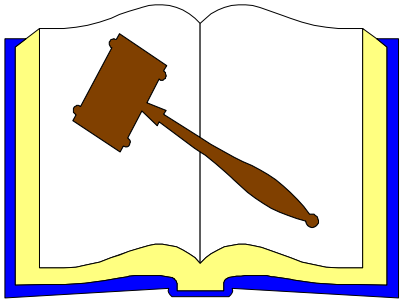
! Are the services of an in-house motor pool used?

! What is the typical turnaround time of the motor pool?

Equipment that has reached its useful life should be replaced. To reduce the financial burden of equipment replacement, a fund should be established for equipment replacement. A utility should keep detailed records on the cost of operating the equipment to make good decisions about equipment replacement.

✔LEGAL

Sewer Ordinance



The utility should have a legal document to protect its collection system. Typically, sewer ordinances exist to satisfy Clean Water Act pretreatment regulations and to assure the utility's compliance with its NPDES permit. A legally sound sewer ordinance will give the utility retribution when corrosive and/or toxic materials are introduced into the collection system. In addition, another important element is a grease ordinance. Greases traps should be inspected by the utility for compliance.

! Is there a sewer use and a grease ordinance?

! Is there a system in place for enforcing sewer and grease ordinances?

! Are all grease traps inspected regularly?

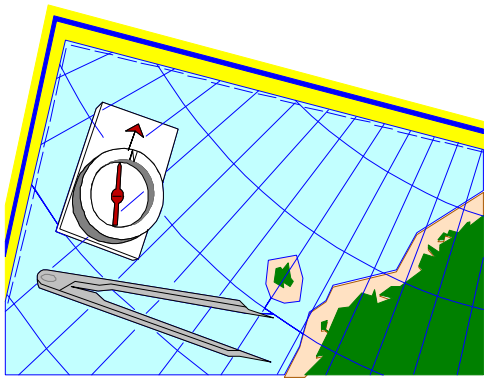
! How does the utility learn of new or existing unknown grease traps?

! Who is responsible for enforcing the sewer ordinance and grease ordinance? Does this party communicate with the utility department on a regular basis?

! Are there any significant industrial dischargers to the system?

! Is there a pretreatment program in place? If so, please describe.

✔Engineering



System Mapping and As-Built Plans

The utility should have an overall map of the collection system with sufficient detail to allow easy interpretation. There should be a collection system inventory organized by plant service areas that include the following information:

Gravity Lines:	Lineal Feet by Diameter
Manholes:	Number
Pump Stations:	Number by Type
Force Mains:	Lineal Feet by Diameter
Air Release Valves:	Number and Location
Inverted Syphons:	Number and Location
Other Major Appurtenances:	Number and Location
Service Population	by Facility Service Area

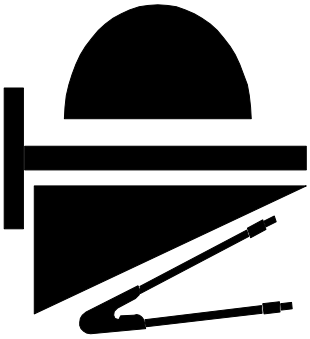
A sewer atlas detailing the location of the above items should be available. The type of sewer atlas used by the utility will depend on their needs and resources. A large. metropolitan utility may find that a sophisticated, computerized mapping system is required. A small community may be satisfied with a hand drafted version.

- What type of mapping/inventory system is used?

- Is there a procedure for recording changes and updating the mapping system?

Revision should occur when there are changes in the collection system, such as additions or repairs. Current, overall maps of the system should be printed annually for large systems. Utilities of significant size will require a staff of "mappers" to keep the maps up to date. Often utilities will contract out map services. This is especially true if much catch-up work is required.

Design



Through interview and document review, the inspector should evaluate design procedures and criteria for new work. In particular, the inspector should discover how the utility evaluates the adequacy of the existing system for transmitting and treating future flows. The inspector should discover what control the utility has over new connections to the system.

! Is there a document which details design criteria and standard construction details. for gravity sewers, force mains, and pump stations?

! Is there a document that describes the procedures that the utility follows in conducting design review? Are there any standard forms that guide the utility?

! What procedures are used in determining whether the existing sewer system is adequate for new connections?

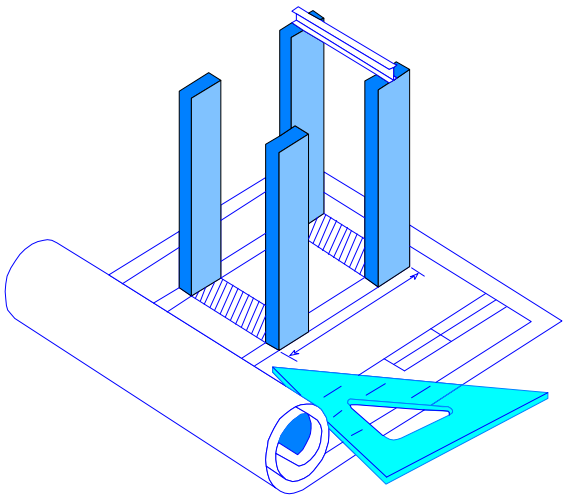
! Is any metering of flow accomplished prior to allowing new connections?

! Is there a model of the system used to predict the effects of new connections?

! Is any certification as to the adequacy of the sewer system to carry additional flow from new connections required?

Construction

Through interview and document review, the inspector should determine what procedures the utility uses for the inspection and testing of new construction. This is important in ensuring that new facilities do not contribute to future operation and maintenance problems. Excessive infiltration and inflow problems can exist with new construction if not properly built.



! Is there a document that describes the procedures that the utility follows in conducting their construction inspection and testing program? Are there any standard forms that guide the utility in conducting their construction inspection and testing program?

! Is new construction inspected by the utility or others?

! What are the qualifications of the inspector(s)?

! Is inspection supervision provided by a registered professional engineer?

! How is the new construction tested? (Air, water, weirs, etc.)

! Is new construction televised?

! Is new construction built to standard specifications established by the local utility and/or the State?

! Is there a warranty for new construction? If so, is there a warranty inspection done at the end of this period?

Sewer System Evaluation Survey (SSES) and Rehabilitation

An SSES and sewer rehabilitation program is a structured methodology for finding the holes in a system, and fixing them (rehabilitation). Cost analysis is the major factor in determining the scope of rehabilitation. Due to the requirements of EPA's Construction Grants Program, many systems did SSES's as a condition of their grant. Some systems also received grant funds for rehabilitation.

An SSES is a two phase operation. The first preliminary phase consists of information and data gathering. Flow monitoring, record and mapping evaluation, and system inspection are some of the tasks in this phase. Prioritization of areas for further evaluation concludes this phase.

In the analysis phase, further testing of the subsystems identified in the preliminary phase are conducted. Rehabilitation recommendations based on a cost effective analysis concludes the SSES.

The rehabilitation phase consists of a variety of techniques designed to reduce inflow and infiltration into the system. Many methods are available with highly variable costs and service lives. Rehabilitation costs are usually significantly less than replacement costs.

SSES and rehabilitation are intensive operation and maintenance. Because many utilities have neglected their system, this process is used to "catch-up' to a level which can be maintained on a regular basis. These SSES and rehab techniques, described in the Operation and Maintenance section of this manual, should be a major element in the operation and maintenance of a wastewater collection system.

Questions that should be asked include:

! Have SSES's been performed in the past?

! If so, is documentation available?

! Has any sewer rehab work been done in the past 15 years?

! If so, please describe?

! How many sanitary sewer overflows have occurred in the last year?

! Is there a record?

✔Water Quality Monitoring

The monitoring of streams in the service areas can help in identifying problems in the collection system such as leaking pipes, washed-out stream crossings, and other overflows of the system. Fecal Coliform is a good parameter to monitor on a regular basis.

! Is there a water quality monitoring program in the service areas?

! If so, what parameters are monitored and at what frequency?

! How many locations are monitored?

✔Management Information Systems

A management information system uses data from operator prepared work reports to optimize the operation and maintenance of the collection system. A powerful tool, it is used as an aide to scheduling work on the system. It can also be used to measure efficiency, and track and develop costs.

! What types of work reports are prepared by the operators?

Examples include:

- Main Sewer Construction
- Main Sewer Maintenance
- Main Sewer Repair
- Structure Maintenance
- Structure Repair or Abandonment
- Building Sewer Maintenance
- Building Sewer Repair

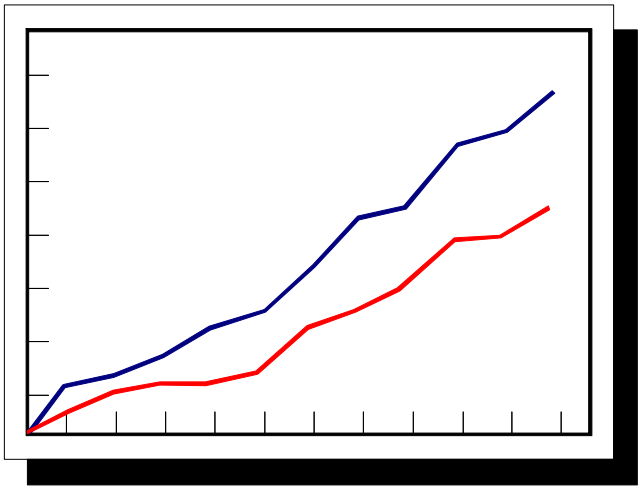
! Do the work reports include enough information? (See example report forms)

! How are records kept?

! Does the facility use computer technology for its management information system? If so, what type of system(s) does the utility use?

! What kind of reports are generated from work report data?

Examples include:
- Payroll
- Production
- Work Costs
- System Inventory
- Main line maintenance history
- Service line maintenance history
- Main and service line repair history



Performance Indicators

Performance indicators are used to determine the condition of the system. These factors are not absolutes. There can be other reasons for certain factors to indicate a less than adequate system. If several of the factors indicate possible problems however, further investigation is warrented.

! What is the per capata wastewater flow for the maximum month and maximum week or day?

EPA considers Infiltration/Inflow (I/I) nonexcessive if the total daily flow during periods of high groundwater does not exceed 120 gpcd, and during a storm event does not exceed 275 gpcd.

! What is average annual Influent BOD?

Influent BOD's much less than 200 mg/l may be an indicator of excessive I/I.

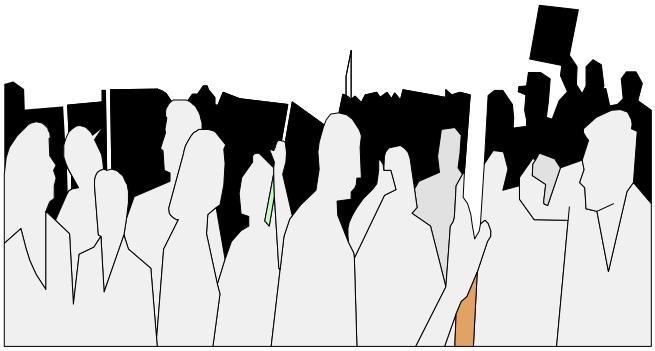
! What is the ratio of maximum wet weather flow to average dry weather flow?

A review of 10 case studies by EPA found that peak wet weather flow ranged from 3.5 to 20 times the average dry weather flow. The ratio of peak weather flow to average dry weather flow can be used as a parameter to determine whether a particular area of sewer system will overflow. Typically, as the ratio approaches 4 to 5, the likelihood of surcharge and overflow increaseses.

! What is the annual number of overflows, and what is the cause (i.e. blockage, pump malfunction, overloaded sewer, construction damage, etc.)?

! What is the annual number of sewer cave-ins? What was the cause (i.e. pipe corosion, leaks, etc.)

✔Complaints



! How are public complaints handled?

! What are the common complaints received?

! How often are these complaints reported?

! Is there a record?

! Does the utility have a procedure in place to evaluate and respond to complaints?

✔Public Relations

! Is there a public relations program in place?

! Are the employees of the utility trained in public relations?

! What type of public notification is given for treatment plant upsets or collection system overflows?

! Is the public notified prior to major construction or maintenance work?

! How often does the utility communicate with other municipal departments?

✔Emergency Maintenance and Contingency Plans

! What type of Emergency maintenance plan does the utility have?

! What type of Emergency maintenance equipment does the utility have available to them? How quickly can the utility access that equipment in case of an emergency?

✔Spare Parts Inventory Management

! Does the utility have a central location for the storage of spare parts?

! Have critical spare parts been identified?

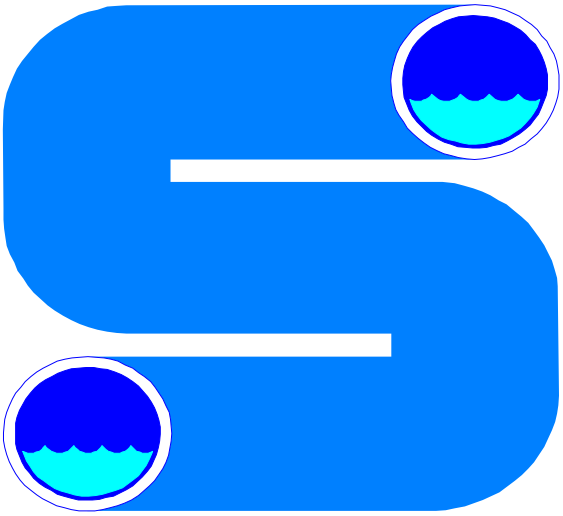
! Does the utility maintain a stock of spare parts on its maintenance vehicles?

! What method(s) does the utility employ to keep track of the location, usage, and ordering of spare parts? Are parts logged out when taken by maintenance personnel for use?

! Does the utility salvage specific equipment parts when equipment is placed out-of-service and not replaced?

! How often does the utility conduct a check of the inventory of parts to ensure that their tracking system is working?

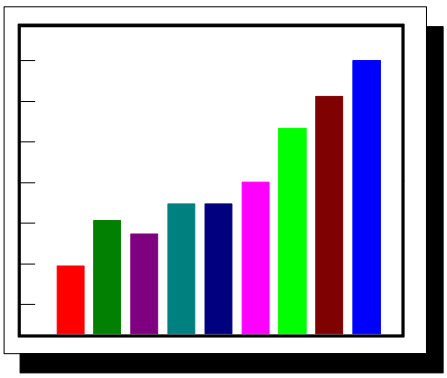
! Who has the responsibility of tracking the inventory?



OPERATION AND MAINTENANCE

The operation and maintenance of a wastewater collection system is a difficult undertaking. Besides keeping the system in good working order, a proper O&M program should convey all wastewater to the treatment plant. A well operated system will employ many if not all of the techniques described below.

✔Maintenance Scheduling



! Does the utility schedule its maintenance activities?

! How are priorities determined?

! How is the effectiveness of the maintenance schedule measured?

✔Sewer Cleaning

This is something sewer utilities have been doing for a long time. Most sewer cleaning programs have been directed towards emergency situations which occur due to stoppages. A better O&M program will have regular cleaning schedules for the system.

! Is there a routine schedule for cleaning sewer lines on a system wide basis, *e.g.*, at the rate of once every seven to twelve years or a rate of between 8% and 14% per year?

! Is there a program to identify sewer line segments that have chronic problems and should be cleaned on a more frequent schedule?

Cleaning Equipment

Mechanical cleaning equipment such as rods and bucket machines has been the mainstay of utility cleaning operations for a long time. Though still in use, hydraulic cleaning equipment which uses water pressure directed through a nozzle to clean the interior of the sewer line, has replaced much of the former need for mechanical equipment.

! What type of cleaning equipment does the sewer utility use?

! How many cleaning units of each type does the utility have?

! How many cleaning crews and shifts does the utility employ?

! How many cleaning crews are dedicated to routine cleaning?

! How many cleaning crews are dedicated to emergency cleaning?

! What has the utility's experience been regarding pipe damage caused by mechanical equipment?

! Where is the equipment stationed?

Chemical Cleaning and Root Removal

A major cause of stoppages in many systems, root removal and control is an important utility operation.

! Does the utility have a root control program?

! Are chemical cleaners used?

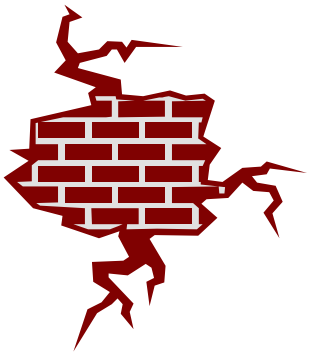
! What types of chemical cleaner are used?

! How often are they applied?

! How are the chemical cleaners applied?

! What results are achieved through the use of chemical cleaners?

✔Hydrogen Sulfide Monitoring and Control



The presence of hydrogen sulfide gas in gravity and pressure sewer lines can, and often does, lead to the serious and sometimes catastrophic corrosion of concrete pipes and the metallic components of sewer systems. Hydrogen sulfide corrosion is usually a problem in areas having little topographic relief where there may be long travel times. Hydrogen sulfide corrosion can also be a problem downstream from pump stations having long wet-well holding times.

! Are odors a frequent source of complaints?

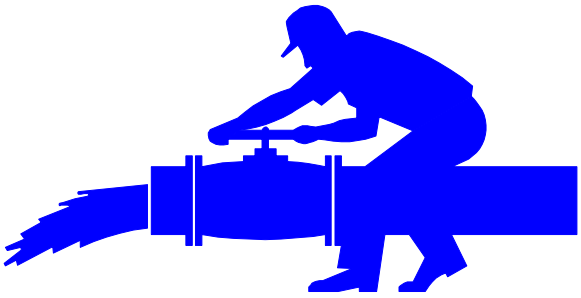
! Does the sewer utility have a hydrogen sulfide problem, and if so, does it have in place corrosion control programs?

! What are the major elements of the utility's program?

A corrosion control program uses chemicals or aeration to prevent the formation of hydrogen sulfide. Pipe materials which resists corrosion are also effective. Often, several of these methods will be included in a program.

✔Lift Stations

Lift stations are an important part of most wastewater systems. In areas with little topographical relief such as coastal areas, lift stations are a major O&M item. The effects of a deteriorated collection systems can often be seen at lift stations as severe overflows during rain events.



Operation

! How many personnel are detailed to pump station operations and maintenance?

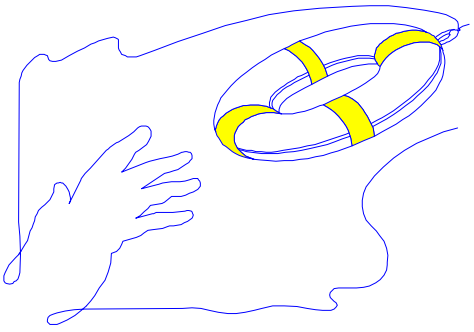
! Are these personnel assigned full-time or part-time to pump station duties?

! Is there suficient redundancy of equipment?

Emergencies

! Who responds to lift station overflows? How are they notified?

! How is loss of power at a station dealt with? (i.e. on-site electrical generators, alternate power source, portable electric generator(s))



Alarms and Monitoring

! How are lift stations monitored?

The answer to this will depend on the station size, and the size and complexity of the system. Often times, a small system will utilize audible alarms or flashing lights to indicate a problem at the station. Neighbors will usually notify someone if an alarm is noticed. In larger more sophisticated systems, alarm conditions are remotely monitored at some central location, particularly for the larger stations. SCADA (Supervisory Control and Data Acquisition)

systems allow for control, monitoring and record keeping from remote locations.

Inspection

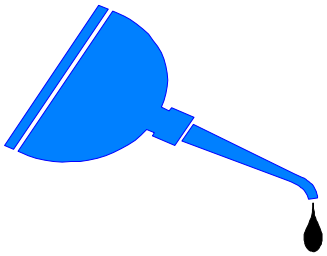
! How often are lift stations visited?

! What is inspected during these visits?

! Is there a checklist?

Preventative and Routine Maintenance

! Is there a preventative maintenance program for lift stations and if so, what is involved in this program?



! Is an adequate parts inventory maintained for all equipment?

! Is there a sufficient number of trained personnel to properly maintain all stations?

Record keeping

! Are maintenance and operations logs maintained for all pump stations?

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! Are manufacturer's specifications and equipment manuals available for all equipment?

! Are pump run times maintained for all pumps?

! Are elapsed time meters used to assess performance?

Force Mains and Air/Vacuum Valves

Force mains and air/vacuum valves are an integral part of lift stations. Force mains receive the lift station effluent and convey it to the gravity system or treatment plant. Air/vacuum valves are installed at the high points of the force main.

The route of force mains should be inspected regularly in order to determine if any leaks are present. This is particularly true where the route is through remote areas. Air/vacuum valves should receive regular maintenance. Malfunctions of these valves can lead to overflows and/or reduced hydraulic capacity of the force main.

! Does the utility regularly inspect the route of force mains?

! Does the utility have a regular maintenance/inspection program for air/vacuum valves?

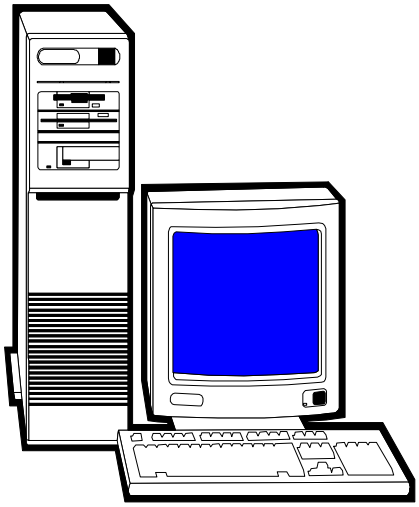
✔Sewer System Evaluation

As was previously discussed, many of the techniques, which are in use in SSES work, should be a part of a utility's operation and maintenance program. Larger utilities can justify the cost of much of the equipment typically used in this effort.

Flow Monitoring

An important element in any SSES effort, flow monitoring and evaluation should be an important part of a good O&M program. A well-designed flow monitoring program will give a snapshot of the current condition of the system. By isolating the portions of the system that are making the greatest contribution to the problem, scarce resources can be directed where they will be of greatest benefit.

Techniques in use include continuous flow monitoring, nighttime flow monitoring, quantification of pump run times, and treatment plant flow measurements. Continuous flow measurement at key locations throughout the system will give the most accurate indication of system integrity. Other techniques mentioned can be used to some advantage in smaller systems.



Use of meters which measure depth of flow and velocity will allow accurate results, even under surcharged conditions. Meters are available which allow continuous data recording which can either be downloaded locally or transmitted to a remote location. Coupled with appropriate software, this is a powerful tool for sewer system evaluation.

! Does the utility have a flow monitoring program? If so, please describe.

Manhole Inspection

This is an important part of any maintenance system. Often utilities are unaware of the location of many of their manholes. Manholes are an important source of I/I. They are also good indicators of problems in the system. Missing tops and offset cones are

often the result of sewer overflows. Manhole inspection can reveal frequent surcharged conditions from observations of debris on manhole steps, or high waterlines. Valid questions to ask include:

- Does the utility have a routine manhole inspection program?
- Is there a data management system for tracking manhole inspection activities?
- What triggers whether a manhole needs rehabilitation?

Sewer Cleaning Related to I/I Reduction

- Are sewers cleaned prior to flow monitoring?
- Are sewers cleaned prior to internal T.V. inspection?

Internal T.V. Inspection

This is a powerful tool not only for inspection, but I/I reduction. Leaking joints observed during inspection can be sealed at the time of inspection using various grouts. This is also a good method for inspection of new work.

- Does the utility use internal T.V. inspection? If so please describe the program.

Smoke Testing and Dyed Water Flooding

These are two important techniques for locating defects in the system and illegal connections.

- Does the utility have a smoke testing program to identify sources of inflow into the system? If so please describe.
- Does the utility have a dyed water flooding program to identify suspected sources (indirect connections) of inflow into the system when smoke testing yields inconclusive results? If so please describe.
- Is there a data management system for tracking these activities?

! Is there a document that describes the procedures that the utility follows? Are there any standard forms?

✔Rehabilitation

Several important techniques are available for sewer rehabilitation. The types used are best determined by an economic analysis after a sewer evaluation.

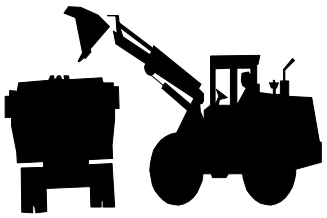
Mainline Repairs

Point and Replacement Repairs

Point repairs consist of repairing cracked, corroded, or broken gravity sewers and force mains. This work typically includes excavation to the location of the break, removal of the broken pipe section(s) and replacement with new pipe.

Joint Testing and Grouting

Joint testing and grouting are done on sewer line sections with leaking joints but no structural defects. This work can be done in conjunction with the routine televising of lines. Grouting has a limited life and must be repeated every 5-10 years.



Sewer Lining

Sewer lining is a technique which returns pipe to new condition. Many of the current systems can be used where pipe is structurally deficient. Due to the limited excavation required for these techniques, they are good choices where surface construction would cause much disruption.

! What type of main line repairs has the utility used in the past?

! Does the utility currently use any of above techniques for main line repairs?

Manhole Repairs

Manhole repairs consist of repairing structural defects or leakage in individual manholes and castings. The structural repair work may include:

- replacement of castings (lid and frame)
- replacement of defective adjusting rings or top sections
- complete manhole replacement
- relining the existing manhole
- grouting to eliminate leakage
- Manhole inserts

A manhole insert is a small, tub-shaped plastic device installed at the top of the manhole and held in position by the manhole lid. Its purpose is to catch water that enters the manhole via holes in the lid or via the access pick holes. Some utilities use the inserts to reduce inflow to the system.

- What rehabilitation techniques are used for manhole repairs?

- What type of documentation is kept?

- Does the utility use manhole inserts?

- Are they used system wide or only on low lying manholes?

✔Service Laterals

Service laterals can contribute to a large portion of a system's I/I problem. Structural damage, as well as the taps and joints, are sources for the introduction of I/I into the system. Some utilities have jurisdiction over the tap only, while some have jurisdiction to the property line, while others have jurisdiction all the way to the building. The utility itself may not have control over installation of new service laterals. Typically the municipality's building inspectors have this job. What is important is whether or not there is communication and a consistency of standards between the two departments

- To what degree does the utility have responsibility for service laterals?

- Does the utility have a written procedure for the approval and inspection of new construction service laterals?

- Does the utility require service laterals to meet certain standards of construction? How are these standards made available to builders?

- Does the utility have a procedure for discovering illegal tap-ins?

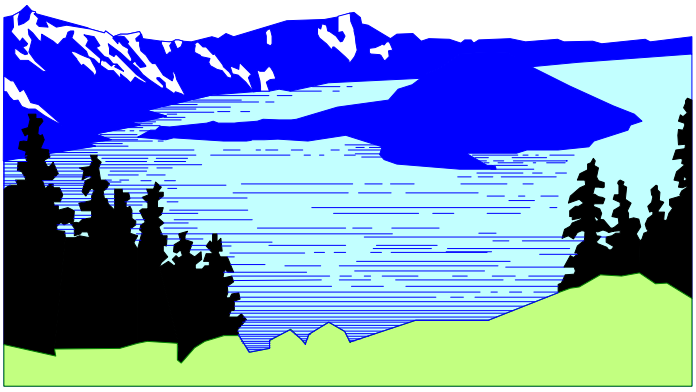
- What is the utility's jurisdiction related to repair/replacement of service laterals?

! Does the utility evaluate service lateral I/I as part of their system evaluation?

ALTERNATIVE SYSTEMS

Alternative collection systems differ significantly from the conventional gravity sewer commonly employed to convey wastewater. Alternative systems include: grinder pump pressure systems, septic tank effluent pump (STEP) systems, small diameter gravity systems and vacuum collection systems. Each has unique operation and maintenance requirements.

✔Grinder Pump Systems



These systems employ a holding tank (about 100 gal) with a small pump (usually centrifugal) with a grinder attached. Wastewater is discharged intermittently using float controls. The collection system is comprised mostly of 1 ½" and 2" PVC lines. Manholes are generally not installed, but cleanouts should be installed at the ends of all lines and at critical points. Air release valves are installed at the downstream side of high points. Pressures are low.

A system serving 500 homes would include 500 individual pump stations. A major source of problems is grease buildup in the holding tanks, resulting in failure of the floats to activate the pumps. Corrosion within the holding tank can be a problem. The grinding of the solids reduces the likelihood of solids deposition. Since septic conditions occur in the lines, hydrogen sulfide may be a problem where the pressure line discharges to the treatment plant or into a gravity collection system.

Pump maintenance is critical and adequate spare pumps should be in inventory. Pumps and grinders may require frequent replacement and overhaul. Pump life is limited and a plan to replace all pumps should be in place. Infiltration is generally not a problem, but exfiltration may occur through deteriorated joints.

✔Septic Tank Effluent Pump Systems

These systems are basically the same as the grinder pump system, with a septic tank replacing the holding tank and without grinders on the pumps. A greater range in pump types (centrifugal, progressive cavity, etc.) are common with these systems. Although the septic tank provides preliminary treatment and settling of solids, it is part of the collection system.

Significant infiltration may occur with poorly sealed and constructed septic tanks. Lines are generally sized assuming low infiltration rates. High infiltration rates will increase pump operation and may reduce pump life.

The wastewater is highly septic and can cause odor and corrosion problems where the pressure line discharges into a conventional manhole or treatment works. Proper operation and maintenance of the septic tank is essential for proper collection system O & M. Tanks should be pumped out on a set schedule.

✔Small Diameter Gravity Sewers

Like STEP systems this alternative uses septic tanks for pretreatment and solids removal. No pumps are used. The tank overflows into a small diameter (4" and up) pipe laid at a moderate grade. The lower solids concentration in the wastewater results in less deposition of solids in the pipe.

Cleanouts are generally used in place of manholes. The pipes are generally sized assuming low infiltration rates and tight septic tanks are a must. Tank O&M, as with STEP systems, is critical. Wastewater is septic.

✔Vacuum Sewer Systems

These systems have a central vacuum station which includes vacuum pumps, holding tanks and pressure pumps. The vacuum pumps provide a continuous suction on the collection line . Each residence has a holding tank and vacuum valve.

When the wastewater reaches the set point in the holding tank, the valve is opened releasing a slug of liquid into the collection pipe. A loss in vacuum in the system will generally trigger a fault condition. Major breaks may cause the system to shut down. Leaks are difficult to locate. Once the wastewater arrives at the vacuum station, it enter a holding tank, and is then pumped to the wastewater treatment facility through a force main.

Although each system operates differently and requires different maintenance, all require a similar management system. In each, appurtenances are located at each residence. A proper

management system requires that the utility have access to these appurtenances, that it should be responsible for their operation and maintenance, that adequate spare parts, whether pumps, valves, etc., should be available, and that alarm systems be in place to notify the utility of any problems.

Special questions for these systems are:

- Does the utility have control of the on-site portions of the collection system?
- Who owns the on-site systems?
- Does the utility do periodic inspections of the on-site facilities?
- What is the frequency of these inspections?
- Are pressure check valves installed on on-site pumps?
- Are clean-outs installed at the end of each branch line?
- Is a pipe locating system installed?
- Are air relief valves installed on the downstream side of high points?
- Does the system have a warning alarm system at each residence?
- How does the utility respond to the alarm system?
- What odor control systems are installed?

Other questions on inventory, pump maintenance, etc would be similar to conventional systems.