Best Management Practices for Sanitary Sewer Overflow (SSO) Reduction Strategies

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Central Valley Clean Water Association
and
Bay Area Clean Water Agencies
A Joint Powers Public Agency
Leading the Way to Protect our Bay

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Best Management Practices (BMPs) for Sanitary Sewer Overflow (SSO) Reduction Strategies

Best Management Practices (BMPs) for Sanitary Sewer Overflow (SSO)

List of Acronyms

AAR	After Action Reviews
ABS	Acrylonritile Butadiene Styrene, that black plastic pipe plumbers use.
AMWA	Association of Metropolitan Water Agencies
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
BACWA	Bay Area Clean Water Agencies
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CAD	Computer-Aided Design
CCI	Construction Cost Index
CCSCBG	California Collection System Collaborative Benchmarking Group
CCTV	Closed-Circuit Television
CCW	Counterclockwise
CDO	Cease and Desist Order
CIP	Capital Improvements Program
CIWQS	California Integrated Water Quality System
CMMS	Computerized Maintenance Management System
CSU	California State University
CVCWA	Central Valley Clean Water Agencies
CW	Clockwise
CWEA	California Water Environmental Association
CY	Calendar Year
DWQ	Department of Water Quality (of the State Water Resources Control Board)
ENR	Engineering News Record
ES	Executive Summary
FOG	Fats, Oils, and Grease
FSE	Food Service Establishments
GIS	Geographic Information System
GSC	Grease Source Control
GWDR	Statewide General WDR for Wastewater Collection Agencies
GWI	Groundwater Infiltration
I&C	Instrumentation and Controls
I/I	Infiltration and Inflow
IICRC	Institute of Inspection, Cleaning and Restoration Certification
ISTT	International Society of Trenchless Technology
LS	Lift Station
LS PM	Lift Station (and Force main) Preventative Maintenance
MOP	Manual of Practice
MUD	Municipal Utility District
NACWA	National Association of Clean Water Agencies
NASSCO	National Association of Sewer Service Companies
NASTT	North American Society of Trenchless Technology

NGO	Non-Government Organization
NOV	Notice of Violation
O&M	Operations & Maintenance
OJT	On-The-Job Training
OSHA	Occupational Safety and Health Administration
PACP	Pipeline Assessment and Certification Program (Part of NASSCO)
PLCO	Property Line Clean-Out
PM	Preventive Maintenance
POTW	Publicly Owned Treatment Works
PVC	Polyvinyl Chloride
PW	Public Works
PWMW	Public Works Maintenance Worker
QA/QC	Quality Assurance/Quality Control
R/R	Rehabilitation/Replacement
RDI/I or RDII	Rain-Dependent Infiltration and Inflow
RQWCB	Regional Water Quality Control Board
RTU	Remote Terminal Unit
SASD	Sacramento Area Sewer District
SCADA	Supervisory Control and Data Acquisition
SECAP	System Evaluation and Capacity Assurance Plan
SOP	Standard Operating Procedure
SSMP	Sewer System Management Plan
SSO	Sanitary Sewer Overflow
SSO WDR	Statewide General WDR for Wastewater Collection Agencies
SSORS	Sanitary Sewer Overflow Reduction Strategies
SWRCB	State Water Resources Control Board
TVI	Television Inspection
UBC	Uniform Building Code
UD	Utility District
UPC	Uniform Plumbing Code
USA	Underground Service Alert (Dig Alert)
USEPA	United States Environmental Protection Agency
VCP	Vitrified Clay Pipe
WDR	Waste Discharge Requirements
WEF	Water Environment Federation
WPCF	Water Pollution Control Federation (previous name of WEF)
WWTP	Wastewater Treatment Plant

Glossary of Terms on State Water Resources Control Board Website
April 14, 2009

Collection System – Generic term for any system of pipes or sewer lines used to convey wastewater to a treatment facility.

Drainage Channel – For the purposes of complying with the Statewide Sanitary Sewer Order, (1) a man-made canal used to transport storm water as part of a municipal separate storm sewer system, or (2) an intermittent or perennial stream bed.

Enrollee – A public entity that owns or operates a sanitary sewer system and has submitted a complete and approved application for coverage under Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (WQO No. 2006-0003-DWQ)

Event ID – A unique identifier assigned by the SSO database to each reported SSO or private lateral sewage discharge.

Integrated Root Control – A collection of practices for dealing with root intrusion. This approach t root control stresses the application of biological, mechanical, and cultural root control techniques. Chemicals are used only when necessary to achieve acceptable levels of control with the least possible harm to non-target organisms and the environment.

Lateral – Segment of pipe which connects a home or building to a sewer main, which is usually located beneath a street or easement. The responsibility for maintaining a lateral can be solely that of the sewerage agency or private property owner; or it can be shared between the two parties. Local communities dictate lateral responsibility and the basis for a shared arrangement, if it applies.

Lower Lateral – Portion of a lateral (usually from the property line to the sewer main) that the sewerage agency is responsible for maintaining. This term only applies if overall lateral maintenance responsibility is shared with the private property owner.

Miles of Gravity Sewer – Amount of gravity sewer lines/pipes in an Enrollee's sanitary sewer system, expressed in miles.

Miles of Laterals – Amount of laterals in an Enrollee's sanitary sewer system, which the Enrollee is responsible for maintaining, expressed in miles.

Miles of Pressure Sewer– Amount of pressurized sewer lines/pipes in an Enrollee's sanitary sewer system, expressed in miles.

Miles of Private Laterals – Amount of private laterals tributary to an Enrollee's sanitary sewer system, which private property owners are responsible for maintaining, expressed in miles.

Percent Reached Surface Water – Volume of sewage discharged from a sanitary sewer system or private lateral or collection system that reached surface water divided by the total volume of sewage discharged.

Percent Recovered – Volume of sewage discharged that was captured and returned to the sanitary sewer system or private lateral or collection system divided by the total volume of sewage discharged.

Private Lateral – Privately owned lateral.

Private Lateral Sewage Discharge (PLSD) – Sewage discharges that are caused by blockages or other problems within privately owned laterals or collection systems which are tributary to the reporting Enrollee's sanitary sewer system. Reports of these events are submitted by Enrollees on a voluntary basis but are not their responsibility. This type of sewage discharge is the responsibility of the private lateral or collection system owner.

Sanitary Sewer Overflow (SSO) – Any overflow, spill, release, discharge or diversion of untreated or partially treated wastewater from a sanitary sewer system. SSOs include:

i. Overflows or releases of untreated or partially treated wastewater that reach waters of the United States;
ii. Overflows or releases of untreated or partially treated wastewater that do not reach waters of the United States ; and
iii. Wastewater backups into buildings and on private property that are caused by blockages or flow conditions within the publicly owned portion of a sanitary sewer system.

Sanitary Sewer System – Any system of pipes, pump stations, sewer lines, or other conveyances, upstream of a wastewater treatment plant head works and which is comprised of more than one mile of pipes and sewer lines, used to collect and convey wastewater to a publicly owned treatment facility.

Spill – Generic term referring to any sewage discharge (i.e., SSO or private lateral sewage discharge) resulting from a failure in a sanitary sewer system or privately owned lateral or collection system.

SSO Category 1 – All discharges of sewage resulting from a failure in an Enrollee's sanitary sewer system that:

A. Equal or exceed 1000 gallons, or
B. Result in a discharge to a drainage channel and/or surface water; or
C. Discharge to a storm drainpipe that was not fully captured and returned to the sanitary sewer system.

SSO Category 2 – All discharges of sewage resulting from a failure in an Enrollee's sanitary sewer system not meeting the definition of Category 1.

SSO Database – Online reporting system developed, hosted, and maintained by the State Water Resources Control Board for compliance with the Monitoring and Reporting Program contained in Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (WQO No. 2006-0003-DWQ).

Storm Drainpipe – For the purposes of complying with the Statewide Sanitary Sewer Order, any pipe that is part of a municipal separate storm sewer system used for collecting or conveying storm water.

Total # of PLSDs per 100 miles of Sewer – Broad metric used to compare the relative performance of privately owned laterals tributary to an Enrollee's sanitary sewer system. This metric expresses the number of Private Lateral Sewage Discharges, for which the reporting Enrollee is not responsible, for every 100 miles of privately owned laterals tributary to an Enrollee's sanitary sewer system. Due to the large variation in community specific characteristics, this metric should only be viewed as a rough comparison of the operation and maintenance performance for privately owned laterals. The metric is calculated as described below:

Total # of PLSDs per = _Total # of PLSDs (100)___

100 miles of Sewer Miles of Private Laterals

Total # of SSOs per 100 miles of Sewer – Broad metric used to compare the relative performance of Enrollees and their sanitary sewer systems. This metric expresses the number of SSOs, for which the reporting Enrollee is responsible, for every 100 miles of pipe or sewer lines in an Enrollee's sanitary sewer system. Due to the large variation in facility specific characteristics, this metric should only be viewed as a rough comparison of the operation and maintenance performance of Enrollees and their sanitary sewer systems. The metric is calculated as described below:

Total # of SSOs per = _____Total # of SSOs (100)_____

100 miles of Sewer Miles of Pressure Sewer + Miles of Gravity Sewer + Miles of Public Laterals

Total Volume of PLSDs Reached Surface Water per 100 miles of Sewer – Broad metric used to compare the relative performance of privately owned laterals tributary to an Enrollee's sanitary sewer system. This metric expresses the volume of Private Lateral Sewage Discharges, for which the reporting Enrollee is not responsible, that reached surface water for every 100 miles of privately owned laterals tributary to an Enrollee's sanitary sewer system. Because sewage discharges that reach surface water pose a greater threat to public health and the environment, this metric reflects some accounting of the threat posed by PLSDs. Due to the large variation in community specific characteristics, this metric should only be viewed as a rough comparison of the operation and maintenance performance for privately owned laterals. The metric is calculated as described below:

Total Volume of PLSDs Reached = _Total Volume of PLSDs Reached Surface Water (100)_

Surface Water per 100 miles of Sewer Miles of Private Laterals

Total Volume of SSOs Reached Surface Water per 100 miles of Sewer – Broad metric used to compare the relative performance of Enrollees and their sanitary sewer systems. This metric expresses the volume of SSOs, for which the reporting Enrollee is responsible, that reached surface water for every 100 miles of pipe or sewer lines in an Enrollee's sanitary sewer system. Because sewage discharges that reach surface water pose a greater threat to public health and the environment, this metric reflects some accounting of the threat posed by SSOs. Due to the large variation in facility specific characteristics, this metric should only be viewed as a rough comparison of the operation and maintenance performance of Enrollees and their sanitary sewer systems. The metric is calculated as described below:

Total Volume (gal) of SSOs Reached = _____Total Volume of SSOs Reached Surface Water (100)_____

Surface Water per 100 miles of Sewer Miles of Pressure Sewer + Miles of Gravity Sewer + Miles of Laterals

Total Volume Reached Surface Water – Amount of sewage discharged from a sanitary sewer system or private lateral or collection system that reaches a surface water.

Total Volume Recovered – Amount of sewage discharged that was captured and returned to the sanitary sewer system or private lateral or collection system.

Upper Lateral – Portion of a lateral (usually from the building foundation to the property line) that the private property owner is responsible for maintaining. This term only applies if overall lateral maintenance responsibility is shared with the sewerage agency.

WDID – Waste Discharge Identification number which is a unique identifier assigned by the State Water Board to each Enrollee for regulatory record and data management purposes.

INTRODUCTION

Dear Wastewater Collection System Colleagues:

This Sanitary Sewer Overflow Reduction Strategies (SSORS) Best Management Practices (BMP) manual was developed as a guideline only. The purpose of the SSORS BMP manual is to assist public agencies in developing their own plans to minimize and eliminate preventable Sanitary Sewer Overflows (SSOs). The manual represents the Central Valley Clean Water Association's (CVCWA) and Bay Area Clean Water Association's (BACWA) collection systems committee's joint effort to interpret the current regulatory requirements and strategies for preventing SSOs in California.
Table ES-1 lists the people who prepared the individual sections of this manual and the agencies or firms that supported their efforts.

The use of these best practices alone or in conjunction with previous best practices is the sole responsibility of the implementing agency. There is no representation, express or implied, that the information contained in this document is suitable for any particular situation. These practices are intended as guidance and need to be evaluated and tailored for site-specific needs and conditions of each agency and system, as well as any mandatory regulatory requirements specific to an Agency. The individual authors and contributing agencies of this best practices make no warranties and /or guarantees, express or implied, as to the fitness, application and/or use of these best practices. This document should not be construed as legal advice to BACWA or CVCWA members or others who may refer to it. This manual is not intended to be used as an enforcement tool or in the course of litigation. BACWA and CVCWA do not assume any liability resulting from the use or reliance upon any information, guidance, suggestions, conclusions, or opinions in this manual. A decision by an agency not to implement these recommendations should not be construed to constitute noncompliance with the SSO WDR.

BACWA and CVCWA encourage the use of this manual for training and educational purposes. The manual is available at no charge on the BACWA and CVCWA websites. This manual is protected by copyright owned by BACWA and CVCWA and may not be reproduced or distributed in any form or by any means for a profit without the express written consent of BACWA and CVCWA. If used as a training tool, associated costs may include only the cost of reproduction.

BACWA and CVCWA encourage users of this manual to submit suggested corrections, additions and deletions to either organization. We especially would like additional reference locations for each section. Send suggestions to eofficer@cvcwa.org or to achastain@bacwa.org . We expect to issue updated versions of this document as significant changes are identified.

Purpose

The purpose of this document is to provide strategies, methods and approaches to improve construction, operation, and maintenance of wastewater collection systems to reduce and minimize SSOs. In doing so, an agency helps to protect public health and the environment and reduce the risk of fines and lawsuits.

Goals:

- Assist agency managers to identify the causes of problems that will impact the performance of their wastewater collection and conveyance systems
- Provide strategies and plans to overcome these problems
- Reduce the occurrence of preventable and chronic SSOs
- Improve operational efficiency
- Reduce adverse impacts to public health and safety, the environment, waterways of the State, and their beneficial uses
- Reduce mitigation costs

Objectives:

- Reduce preventable SSOs
- Minimize adverse impacts of SSOs
- Ensure corrective action is taken in a timely manner to identify and implement measures to reduce the occurrence of preventable and chronic SSOs in a Corrective Action Plan

Table ES-1 Contributors to SSORS BMP Manual

Section	Primary Author (s)	Agency
Executive Summary	Bob Woodhouse	CH2M HILL
Failure Analysis	Andy Morrison	Union Sanitary District
Pre Ownership	Warren Tellefson	Placer County
Preventive Maintenance for Gravity Sewers – (Sewer Cleaning and Root Control)	Andy Morrison	Union Sanitary District
CCTV Inspection	Lenny Rather	Oro Loma Sanitary District
Training and Competency Assessment of Personnel	Marilyn Harang	City of Redwood City
Legal Authority and Enforcement	Laura Lazzelle	City of Stockton
Condition Assessment, Life Cycle Costs, and Capital Improvement Programs	Mike Fisher Joe Ziemann	Water Works Engineers
Service Laterals	Jody Allen	South Placer M.U.D.
Infiltration and Inflow (I/I)	Melissa Lee Casey Yearout	ECOLOGIC ECOLOGIC

FOG	Ken Holmes Patrick Hassey	Holmes International Holmes International
Pressure Systems	Sergio Ramirez Andy Morrison	City of Foster City Union Sanitary District
SSO Emergency Response	Vaughn Fleischbein Jody Allen	City of Folsom South Placer M.U.D.
Post SSO Response	Dave Meir Andy Morrison Ken Holmes	Sacramento Area Sewer District Union Sanitary District Holmes International
System Evaluation and Capacity Assurance	Marcie Bodeaux	Fairfield-Suisun Sewer District
Communications	Bob Woodhouse	CH2M HILL
Recordkeeping	Jody Allen, Warren Tellefson, Rich Cunningham	South Placer M.U.D. Placer County UD City of Albany
Cover Page Design	Michelle Powell	Union Sanitary District
Flow Charts and Graphs	Paulette Roberson	Union Sanitary District
Formatting		ECO: LOGIC
Final Editing	Andy Morrison Warren Tellefson Laura Lazzelle Ken Holmes	Union Sanitary District Placer County City of Stockton Holmes International
Facilitator	Donna Weis	Union Sanitary District
Web Site Host		Kimley Horn and Associates

Table ES-2 Peer Reviewers

A special thanks to the following persons who provided Peer Review of the draft of this document:

Reviewer	Agency/Company
Ron Boyd-Snee	Jamestown Sanitary District
Paul Causey	Causey Consulting
Mike Dixon	Delta Diablo Sanitation District
Vincent Falzon	City of Burlingame
Joe Flores	City of Victorville
Monica Oakley	Oakley Water Strategies
Mark Rowney	Mariposa Public Utility District

- Identify and implement measures to reduce the occurrence of preventable and chronic SSOs in a Corrective Action Plan
- Ensure compliance with current regulatory requirements
- Document and define procedures to address SSO prevention
- Provide uniform, clear, and consistent SSO prevention

Key Messages to Users of this manual

This manual is intended to be used by collection system managers to reduce SSOs in their collection systems. The following key messages are provided to convey the authors' intentions on the best use of this manual:

1. If the agency governing Board or Council, or Manager makes the decision to reduce SSOs, then this manual provides methods and best practices to reduce SSOs. The challenge of the collection system manager will be to address the following issues:
   - What steps are being taken to reduce SSOs in the collection system?
   - Are the things that are being done to reduce SSOs working?
   - Are the things that are being done getting the desired results?
   - If the desired results are not being achieved, what changes should be made to the approach to more effectively reduce SSOs in the Agency's collection system?
   - This manual will provide the Agency with alternative approaches to become more effective at reducing SSOs. If these approaches require additional resources then the collection system manager needs to take on the responsibility of communicating those additional resource needs to upper management and or the Governing Board/Council that allocates the funding for resources.
2. The key is to understand the underlying causes of SSOs in the Agency's collection system. If the causes of SSOs are understood, then the approach taken will likely solve the problem that caused the SSO. If the cause is not understood then the responses will not address the underlying problem and will likely fail to solve the problem that has caused the SSO.
3. Local conditions, including resource constraints, may dictate the approach or strategy used by each agency.
4. It is important to "Develop the Plan", then "Share the Plan", "Work the Plan" and then revise the Plan. Each phase is described below:
   - **Develop the Plan** – To develop the plan the Agency begins with the underlying cause and failure analysis. Failure analysis is a structured approach to SSO data collection and analysis. It is used to identify and prioritize system deficiencies in order to develop a corrective action plan to prevent future SSOs. For more details refer to the section on Failure Analysis. The Plan should also include a proactive approach to find problems in

the system, such as implementation of a system wide inspection/assessment plan. See the Sections on TV Inspection and Condition Assessment for more information

- **Share the Plan** – Sharing the plan is an important step for the collection system manager to communicate the plan with the operations and maintenance staff who will be the ones to implement the plan in the field. The two elements that need to be shared are:
    - The specific steps of the corrective action plan and who will be responsible for each element of the plan
    - The results of the work measured against the goals for SSO reduction.
- **Work the Plan** – Working the plan involves the commitment of the necessary resources to complete each task and confirmation of the success of each task prior to moving on to the next task. Closed circuit television inspection can be used to confirm the effectiveness of cleaning or repair work. As with any plan, make adjustments as necessary to achieve the desired results of preventing SSOs.
- **Revise the Plan** – Once you begin to Work the Plan, improvements to the plan will become apparent. The plan should therefore be revised or improved on a regular basis and then you go back to Share the Plan.

SSO Reduction Plan Flowchart

Shown on Figure ES-1 is the SSO Reduction Flow chart that presents the process and steps to reduce SSOs. The top of the chart begins with the completion of the underlying cause and failure analysis. Based upon the results of the failure analysis, the collection system operator will then develop a corrective action plan that may include maintenance strategies, focused prevention strategies, rehabilitation prevention strategies, or a combination of these strategies for different time periods. For example, a typical corrective action plan may have the following maintenance strategies:

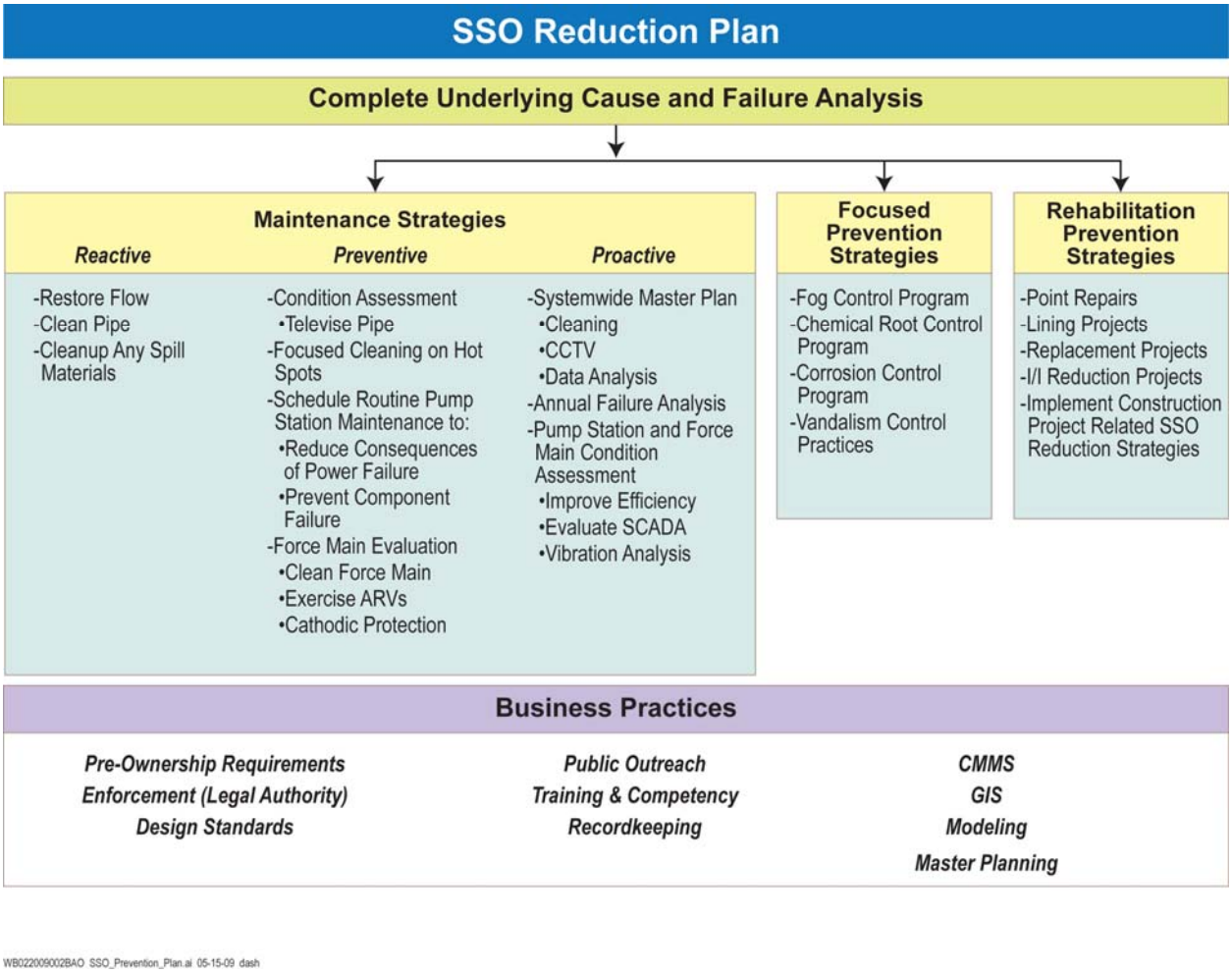
- **Reactive Maintenance** is used to respond to the SSO, to stop the SSO, restore the flow, and cleanup spill materials. Reactive maintenance can be used to stop the SSO and reduce the impact of the SSO on the local community and environment. Understand that effective reactive maintenance begins with a well documented and understood SSO response and mitigation plan.
- Determine the underlying cause or actual problem that caused the SSO by televising the sewer to determine cause of blockage. Either preventive or proactive maintenance strategies are then used to address the problem that has been identified in the root cause analysis.
    - **Preventive Maintenance** can reduce or eliminate SSOs through condition assessments using closed circuit television inspection, routine pump station maintenance, and force main evaluation.
    - **Proactive *Maintenance*** includes system-wide collection and conveyance system condition assessments and master-planning.

- If it is found that standard maintenance practices are not cost effective then the best approach may be to implement focused **Prevention Strategies** to fix the problem by reducing FOG, controlling roots, controlling corrosion, and preventing vandalism.
- Areas where standard maintenance activities or focused prevention practices do not solve the problem are then scheduled for the development of **Rehabilitation Prevention Strategies** that are then used in turn to prepare a CIP project to rehabilitate or replace the pipe, pump station, or force main that is causing the SSO.

Choose only the strategies presented in this section that could improve collection system performance in terms of eliminating/reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Supporting this corrective action plan are the agency's standard business practices. These business practices include Pre-Ownership Requirements, Overflow Emergency Response Plan, Enforcement, Design Standards, Public Outreach, Training and Competency, Recordkeeping, CMMS, GIS, Modeling, and Master Planning.

Figure ES-1 - SSO Reduction Flowchart



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SECTION 1

FAILURE ANALYSIS AND CORRECTIVE MEASURES

1.1 Introduction

This section is intended to be an overview of the thought processes involved in preventing Sanitary Sewer Overflows (SSOs) recurrence, which addresses the main intent of the State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP) Elements i, iv, ix, and x ;

1.2 Problem Statement – Why Is This Needed?

The primary reason to conduct a failure Analysis on a Gravity Sewer or Pressure System that has experienced an SSO is to obtain a true assessment of the cause for the spill. Failure to identify the true problem may result in wasted time and effort applying an ineffective solution. It is understood that not all SSOs can be prevented. However, many can be prevented, especially when an agency knows 'why' an SSO happened.

1.3 Benefits – Why Is This A Good Thing?

Selecting and implementing the appropriate corrective measure(s) that prevent SSOs from recurring is important because planned and effective activities are less costly than reactive and ineffective activities. Additionally, planned and effective activities are generally less costly than reactive and ineffective activities. It is a better use of an agency's time and resources to plan work versus reacting to an emergency or unplanned event. Further, if the problem(s) is (are) corrected, then no additional activities may be required. In other words, spending a little more time and effort identifying the real problem and choosing the correct solution could save a lot of headaches and money later. Finally, it is important to remember that the money an agency uses to perform work comes from the rate payers. The public expects agencies to be good stewards of their money and keep the sewage in the pipe.

Example 1

Let's say on Monday morning the field crew reports that the SSO that occurred over the weekend was caused by a grease blockage. At this point, the person deciding what action should be taken to prevent a recurrence of the SSO simply does not have enough information to make an informed decision on what follow up measures should be taken to prevent a recurrence of the SSO. There are several problems that can cause a grease blockage such as; a sag, an offset joint, an obstruction in the line, root intrusion, excessive discharge of grease upstream, or an illegal dumping from a grease hauler. Each of these scenarios will have a different solution. Solutions that work in one scenario may not work in another. Each solution varies in effectiveness and efficiency.

1.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Failure Analysis should focus on understanding the underlying cause of the problem, so that the right solution can be developed and executed. An agency should not waste valuable time and resources cleaning sewers that should be repaired or maintaining a pump that should be replaced. An evaluation should be performed to determine whether a maintenance or construction solution is the most cost effective answer. There are two types of Failure Analyses, Post SSO Failure Analysis, and SSO Trends Failure Analysis, which are described below:

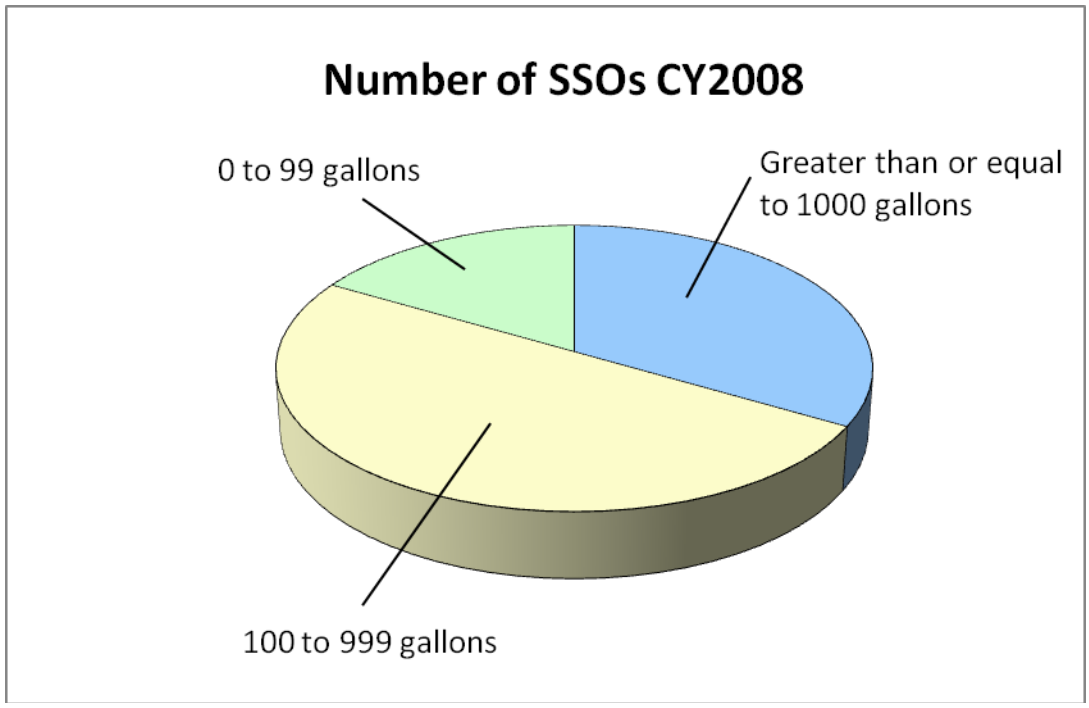
A Post SSO Failure Analysis is a detailed effort conducted after each SSO to determine what the underlying cause of the SSO was before deciding on a corrective measure to be taken to prevent recurrence. The best way to determine the underlying cause of a blockage or failure in a gravity sewer is to conduct a video inspection (TVI) and a careful review of the history of the affected sewer. The TVI will clearly show any sags, offsets, root intrusions, or any other obstructions. If the TVI reveals any of these conditions, then it is not a grease problem. If the TVI finds none of these, then it may be an excessive grease discharge or illegal dumping problem. At this point, about half of the Post SSO Failure Analysis is complete. The next thing to be done is to review the historical record of the sewer main that experienced the blockage. Identify any past problems that have occurred and corrective actions that have been taken. This helps predict the interval of the next likely occurrence of an SSO. A flowchart illustrating the Post SSO Failure Analysis process is included as Figure 3-1 in Section 3, Preventive Maintenance for Gravity Sewers (Sewer Cleaning and Root Control).

Historical Records can be used to check upstream dischargers to see if uses have changed, such as an office converting to a restaurant.

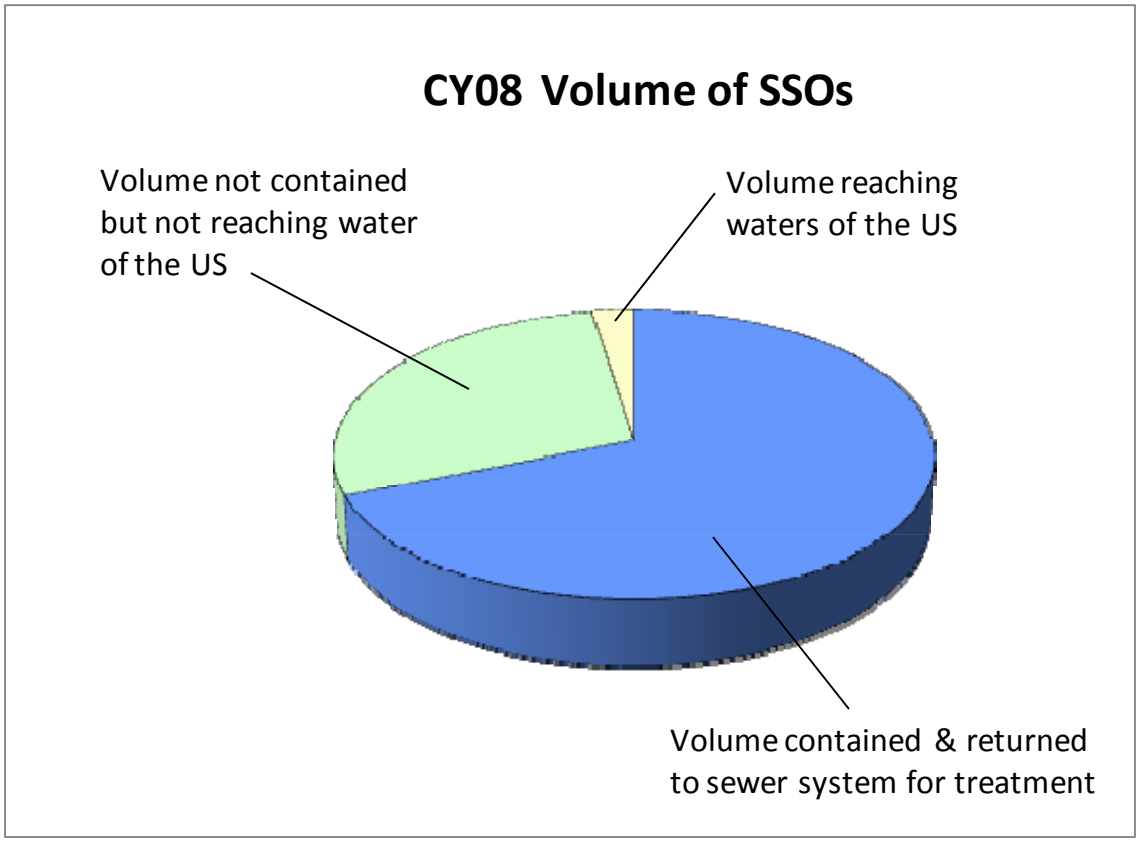
An SSO Trends Failure Analysis is a review of all SSOs and corrective measures conducted periodically (typically annually). This review should include reports that graphically display SSOs by the total number of Category 1 and 2 SSOs, cause, volume, and average response time. The review should highlight any repeat SSOs with a detailed review and revision of the *Post SSO Failure Analysis corrective measures taken to prevent SSOs.* If the Trend shows any cause as predominant then a more focused effort should be made to address that cause. In other words, if the trend is roots, then a more focused approach to Root Control should be made. If the trend is grease, then a more focus effort on Grease Control should be made. If the trend indicates repeat SSOs continue, then the *Post SSO Failure Analysis and/or Corrective measures taken* may need to be revised.

Shown below are some examples of how to tabulate and chart the results of the post SSO Failure Analysis, and the SSO Trends Failure Analysis.

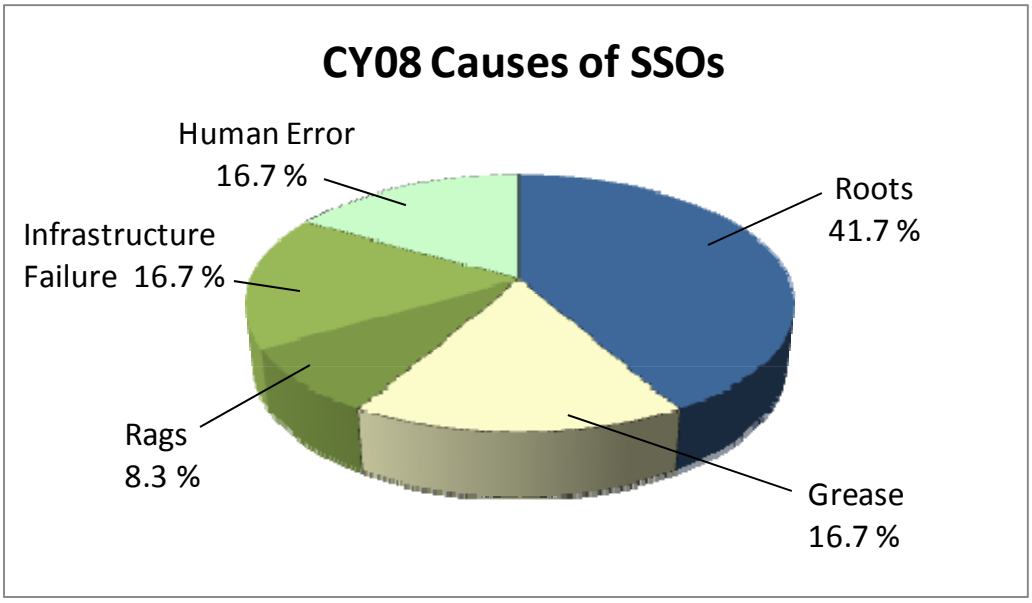
Number of SSOs CY 2008		
Size of SSO (gallons)	**Number**	**Percent of Total**
Greater than or equal to 1,000	4	33.3%
From 100 to 999	6	50.0%
From 0 to 99	2	16.7%
Total	12	100.0%



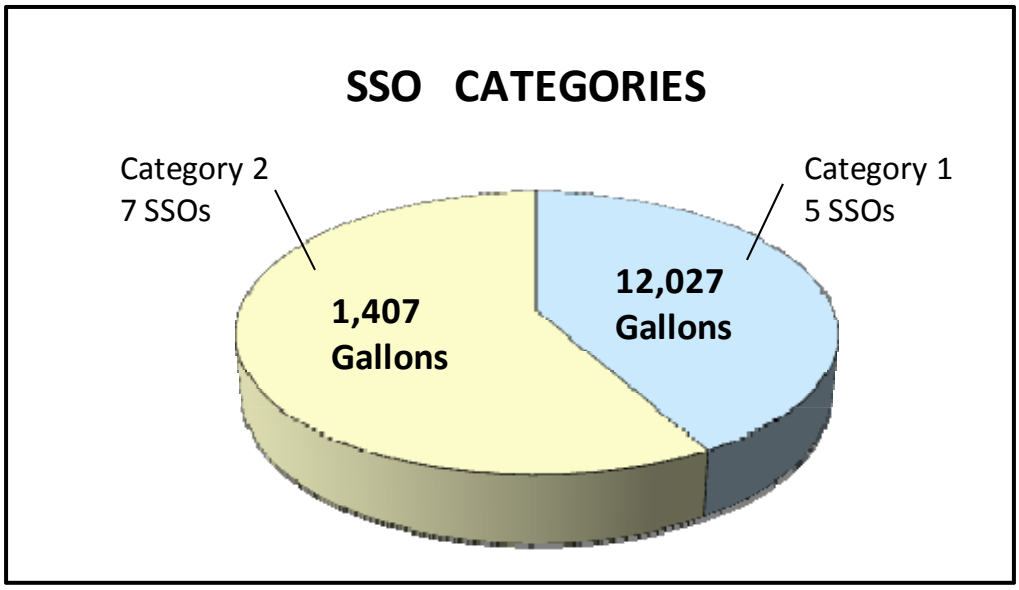
Volume of SSOs CY 2008		
Description	**Volume**	**Percent of Total**
Volume contained & returned to sewer system for treatment	9,264	69.0%
Volume reaching waters of the State	3,835	28.5%
Volume not contained but not reaching waters of the State	335	2.5%
Total	13,434	100.0%



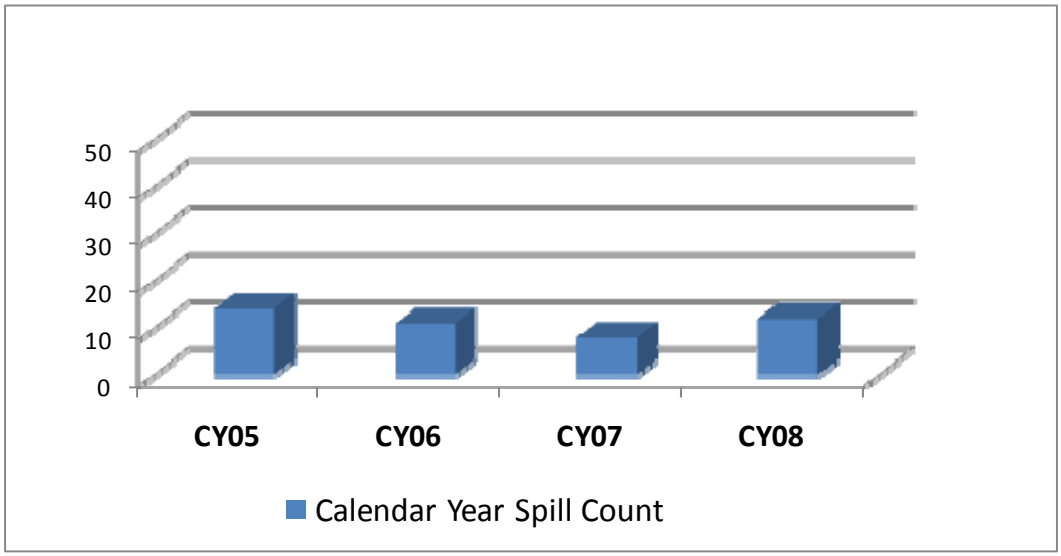
Causes of SSOs CY 2008		
Cause of SSO	**Number**	**Percent of Total**
Blockage:		
Roots	5	41.7%
Grease	2	16.7%
Rags	1	8.3%
Debris from Laterals	0	0.0%
Vandalism	0	0.0%
Animal Carcass	0	0.0%
Construction Debris	0	0.0%
Multiple Causes	0	0.0%
Subtotal for Blockage	8	66.7%
Infrastructure Failure	2	16.7%
Inflow & Infiltration	0	0.0%
Electrical Power Failure	0	0.0%
Flow Capacity Deficiency	0	0.0%
Natural Disaster	0	0.0%
Bypass	0	0.0%
Cause Unknown	0	0.0%
Human Error	2	16.7%
Total	12	100.0%



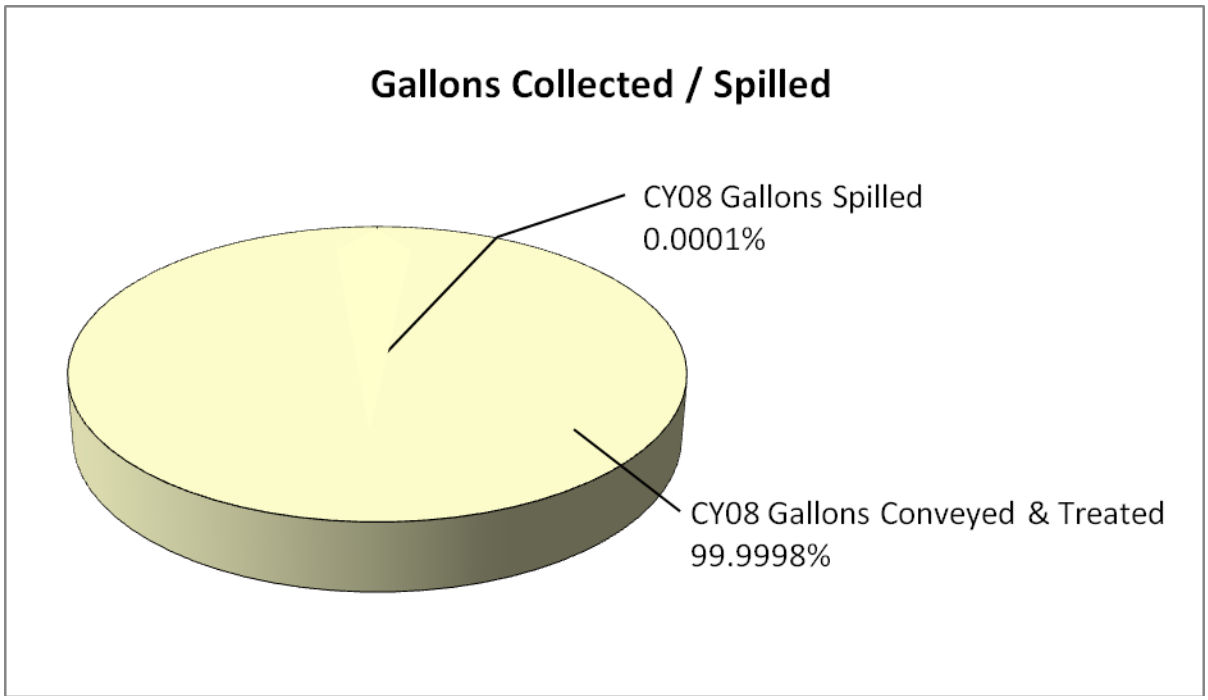
SSOs By Category			
Category Description	**Number**	**Gallons**	**% Gallons**
Category	5	12,027	89.5%
Category	7	1,407	10.5%
Totals	12	13,434	100.0%



Calendar Year SSO Trend				
Calendar Year	CY05	CY06	CY07	CY08
Calendar Year Spill Count	14	11	8	12



Gallons Collected / Spilled		
Description	**Gallons**	**Percentage**
CY08 Gallons Conveyed & Treated	9,460,800,000	99.9998%
CY08 Gallons Spilled	13,434	0.0001%
CY08 Not Recovered, That Did Not Reach Waters of the US	335	0.0000%
CY08 Reached Waters of the US	3,835	0.0000%



Development of Corrective Measures

Now that a little extra time has been taken to identify what the underlying cause of the problem is/was, the next step is to develop a corrective measure that will likely prevent recurrence of an SSO. Corrective measures could include, but are not limited to;

- **Preventive Maintenance (PM)** for sewers that can't be repaired, rehabilitated, or replaced before another blockage occurs or when it is simply more effective or efficient than other options. Not all PM methods are of equal value. Some are more effective or efficient at solving a given problem.
- **Periodic TVs** to monitor line condition
- **Source Control (including enforcement)** for excessive or illicit discharges and illegal dumping of grease
- **Integrated Root Control** to remove and prevent root intrusion
- **Point repairs** for sags, offsets, protruding laterals, other utilities bored through sewer pipe, or removing obstructions that can't be removed by other means
- **Rehabilitation or Replacement** for sewers that are at or near the end of their useful life

In addition, a properly trained operator is just as important to ensuring satisfactory results as selecting a PM strategy to prevent recurring SSOs.

Cost Effectiveness and Efficiency

Considering effectiveness and efficiency when selecting a corrective measure has to be a factor, because there are limits to an agency's resources. Here are some things to consider when deciding on a course of action;

- When too many sewers are on a high frequency PM schedule (for example less than 6 months), a lot of the agencies resources are tied up in these activities and the cost per foot per year on those sewers becomes too high. A more permanent rehabilitation or repair solution may be more cost effective.
- The sewer may be at the end of its useful life. PM activities may actually make matters worse. For example, if the pipe is badly cracked, PM activities can remove pipe and soil creating a void and potentially a sink hole and additional SSOs.
- Not all cleaning devices produce the same results and there is no maintenance activity (nozzle or attachment) that is the best for all PM activities. The use of a TVI is the best way to determine the effectiveness of any device. In addition, it is the best tool in providing meaningful training and feedback to operators of the equipment. Furthermore, nozzles and devices that are ineffective should be destroyed to prevent their use.

- Selecting an option that is more expensive initially may actually be cheaper in the long run.

Shown below are some examples of how to evaluate the cost-effectiveness of alternative approaches.

Example 2

If it costs $0.38/ft to mechanically remove roots and the conditions require that this has to happen every 12 months to prevent SSOs, at the end of 3 years an agency will have spent $1.14/ft. When the conditions require that this has to happen every 6 months, then at the end of 3 years an agency will have spent $2.28/ft. If an agency can cut and chemically treat to prevent root intrusion on a 3 year cycle for $1.10/ft., then it makes sense to spend more money up front (cut and treat) and free up the resources of the agency on the 12 month scenario and more so on the 6 month scenario.

Example 3

Assume an agency uses the "free" nozzle that came with the jetter or combination unit, and the effectiveness of the "free" nozzle requires that sewer mains must be cleaned every month because of grease build up that is never really removed from the pipe. The agency could spend a few thousand dollars and purchase a high powered chain flail that will remove all of the grease buildup which may allow the agency to change the PM frequency from monthly to annually or twice per year. The reduced cleaning frequency will likely result in a cost savings for the agency. .

Example 4

If a sewer needs many spot repairs, there is a point when it is better to schedule the sewer for replacement or rehabilitation. As costs can vary, agencies will need to do a side by side comparison and also consider the impacts to the street or surface area with open cuts.

1.5 Measurements – How Is This Measured?

The following are a list of benchmarking statistics for which an agency may set goals and track from year to year to measure performance:

- # of repeat SSOs
- Cause of SSOs
- Volume of SSOs
- # of SSOs per year trend compared to previous years

1.6 Links and References – Where Can More Information Be Found?

- Office of Water Programs CSU Sacramento – *Operation and Maintenance of Wastewater Collection Systems Volume 1and II*
- SWRCB Order No. 2006-0003-DWQ
  http://www.waterboards.ca.gov/resdec/wqorders/2006/wqo/wqo2006_0003.pdf
- California Collection System Collaborative Benchmarking Group-CCSCBG Best Practices Manuals;
  - ✓ *Hydroflush Cleaning of Small Diameter Sewers Feb. 2001*
  - ✓ *Sanitary Sewer Overflow Prevention and Response Plan June 2002*
  - ✓ *Sanitary Sewer Integrated Root Control Best Management Practices March 2005*

SECTION 2

PRE-OWNERSHIP

(Design, Construction and Inspection)

2.1 Introduction

Section 5a and 5b of the Sewer System Management Plan requires each public sewer agency to provide adequate design, construction and inspection standards for the construction of new and rehabilitated public sewers. Section 3, among other requirements, requires agencies to adopt the legal authority to require these standards. Pre-ownership uses this authority and standards to make sure new and rehabilitated sewers are constructed properly before they are accepted by public agencies for operation and maintenance. Pre-Ownership is the practice of "owning" the sewer from planning, through construction, to completion, not just taking ownership of the finished product.

This section will present the following with regards to pre-ownership of a Public Sewer System:

- If needed, how to develop Legal Authority to be able to require proper design and construction standards.
- If needed, how to develop Design Standards that provide direction to engineers that are designing new public sewer systems.
- If needed, how to develop construction standards that require contractors to construct the new public sewers correctly.
- If needed, how to develop inspection standards to make sure the contractor is constructing the sewers correctly.

2.2 Problem Statement – Why Is This Needed?

If a new public sewer is not designed correctly, constructed correctly or adequately inspected, a public agency could end up owning, after the warranty is over, a major problem. An improperly constructed sewer could require frequent maintenance, could be the cause of sewer system overflows, could create property damage, and cause environmental and public health issues. This might result in fines, lawsuits, increased maintenance costs and additional construction costs to correct the problem. All of that could require higher user fees to the sewer customers.

2.3 Benefits – Why Is This A Good Thing?

A sewer system that has been properly designed and constructed typically requires less maintenance and reduces the number of sewer system overflows, resulting in lower life cycle costs to the utility and the user. Other benefits include:

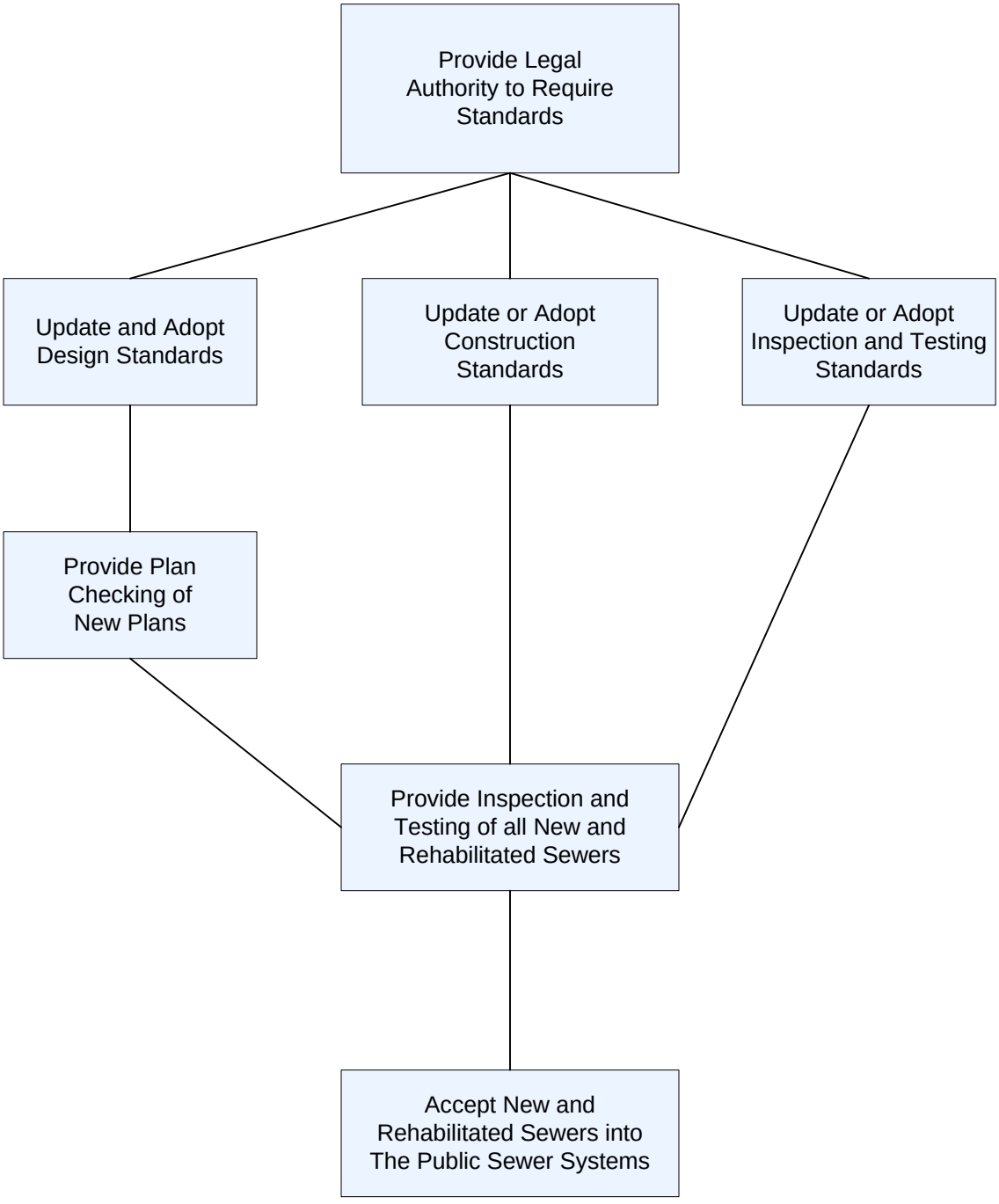
- They make Operation and Maintenance easier.
- They make sure issues are dealt with before new infrastructure is in place.
- They assure an agency gets what is required.
- Regularly updated standards that ensure each agency's infrastructure reflects the latest technology and industry trends including input from operations and maintenance crews.
- They insure a full and useful life of the new pipes.

2.4 Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a strategy that will better address the specific situation.

To implement adequate design, construction, rehabilitation and inspection standards, an agency may use the following general strategy:

PRE-OWNERSHIP STRATEGIES



Legal Authority

The legal authority for an agency to require proper design, construction, testing and inspection of a sewer system could be contained in that agency's ordinance or governing documents.

Design Standards

Many agencies have adopted detailed design standards for sewers mains, sewage pump stations and force mains. Often these standards are contained in stand alone publications; however for cities and counties, these standards are often a portion of a larger publication containing design standards for other Public Works facilities such as roads, storm drains, erosion control, etc. These standards are often called "Design Standards" or possibly a "Land Development Manual". If an agency does not have design standards, or an agency's design standards need updating, consider looking into other publications. Standards can be found on agency web sites and often agencies will provide an electronic version of the document if asked. These documents can then be used to update existing standards or develop new design standards.

Another possibility for smaller agencies would be to simply adopt a nearby agency's design standards by reference, eliminating the needs to maintain agency specific standards. This might be useful for an agency which experiences little new sewer construction. The Links and References below list a number of design standards available on the web.

Plan Checking

A sewer agency must check all new plans for sewer construction and eventually approve them as meeting that agency's design standards. Plan checking costs can be charged to the developer and could be provided in the following ways:

- Having properly trained agency employees do the plan check.
- Having another agency provide the inspection. An example of this would be having a County plan checker provide the service while they also check the road design.
- Having a consulting engineer provide the plan check.

Construction Standards

Like design standards, many agencies have detailed construction standards for contractors to follow while building new sewer systems. As noted above, current standards used by other agencies may be used to develop or update an agency's own construction standards or simply be adopted by reference.

Testing Standards

Testing standards require a sewer contractor to provide testing of new sewer systems before they are turned over to a sewer agency. Testing standards may include, but are not limited to, the following:

- Pressure testing of new sewers. (An Air Test is the best way to ensure that sewers are not penetrated by roots)
- Factory Acceptance Testing
- Vacuum testing of new manholes.
- Televising of new sewer systems.
- Performance testing of new sewage lift stations.
- Pre-installation testing of construction materials and products delivered to the job site to ensure compliance with agency and manufacturer standards.
- Mandreling of new sewers if plastic.
- Ball and flushing of new sewers.

These requirements are often contained in the same publication as construction standards and are important to ensure the sewer system is constructed properly. TVing, Mandreling and Ball and Flushing are completed after bedding and trench backfill to ensure damage does not occur during those operations.

Inspection Standards

In order to ensure proper construction of an agency's sewer system, each agency should provide proper inspection. Inspectors should be present during much of the construction work and should witness all testing of the completed product. Inspections can be charged to the developer and provided by the following methods:

- Having properly trained agency employees do the inspection.
- Having another agency provide the inspection. An example of this would be having a County inspector provide the service while they also inspect the road construction.
- Having a consulting engineer provide the inspection.

Acceptance into the Public Sewer System

Once a sewer is designed correctly, constructed correctly and inspected and tested, it is then ready to be accepted into the public sewer system. Three things are important here:

- The contractor or developer of the sewer should provide an unconditional guarantee of the construction, usually for a period of one year or more.

- A television inspection could be made near the end of the warranty period to determine if any components can be repaired before the warranty expires.
- The new sewer system should be accepted by the governing board of the agency.

Once this is done, the new sewer is ready for use and can be put into the agency's operation and maintenance system. See Sections 3, 4 and 16 for more details

2.5 Links and References – Where Can More Information Be Found?

This section provides links and references to additional design and construction standards. However, an agency should first look to its surrounding neighbors. Consulting engineers and sewer contractors often do a lot of work in a general area and are familiar with the standards of the prominent sewer agencies in the region. By referencing or using those standards, a more uniform product can be designed and built resulting in less time in plan check, inspection and testing.

The following are provided as examples of design and construction standards:

General References

- US EPA Region 4 (east coast, not California) has developed extensive SSMP guides and information to help the sewer agencies in their region. The following is a link to their web site where you can download most of that information: http://www.epa.gov/region4/water/wpeb/momproject/index.html.
- American Society of Civil Engineers, 1982, *Gravity Sanitary Sewer Design and Construction*, ASCE Manual and Report on Engineering Practice No. 60 and WPCF Manual of Practice No. FD-5.
- Sanks, 1998, *Pumping Station Design*, second edition.
- USEPA, 1985, Design Manual for Odor and Corrosion Control in Sanitary Sewerage Systems and treatment Plants, Document No. EPA/625/1-85/018.
- USEPA, 1992, Detection, Control and Correction of Hydrogen Sulfide Corrosion in Existing Wastewater Systems, Document No. EPA-832-R-92-001.
- Water Environment Federation, 1993, Design of Wastewater and Stormwater Pumping Stations, MOP FD-4
- SWRCB Order No. 2006-0003-DWQ: http://www.waterboards.ca.gov/resdee/wqorders/2006/wqo/wqo2006_0003.pdf

Some standards may not address sewer system rehabilitation methods. Resources that may provide standards to use as a starting point include:

- Pipe Users Group in Northern California (www.norcalpug.org)
- North American Society for Trenchless Technology (www.nastt.org)
- Water Environment Federation (www.wef.org)

Other sources are engineering consultants and manufacturers that produce standards that can be tailored and adopted to each agency's specific needs.

Specific Design Standards

- Placer County Land Development Manual
- City of Roseville
  http://www.roseville.ca.us/pw/engineering/land_development/design_construction_standards.asp
- Sacramento Area Sewer District
  http://www.sacsewer.com/devres.html#standards

Specific Construction and Inspection Standards

- Placer County General Specs
  http://www.placer.ca.gov/Departments/CommunityDevelopment/Eng/PlanCheck.aspx
- City of Roseville
  http://www.roseville.ca.us/pw/engineering/land_development/design_construction_standards.asp
- County of Sacramento (SASD) http://www.saccountyspecs.net
- Greenbook Standard Specifications for Public Works Construction
  http://www.greenbookspecs.org/

SECTION 3

Sewer Cleaning and Root Control

3.1 Introduction

This section addresses State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP) Elements:

- (iv) Operation and Maintenance Program (b)
- (vii) FOG Control Program (f) 2nd part
- (ix) Monitoring, Measurement, and Program Modifications (c)

3.2 Problem Statement – Why Is This Needed?

The primary reason to do Preventive Maintenance on a Gravity Sewer is to reduce the potential of blockages, which can cause SSOs. Even though gravity sewers are *supposed* to be *self-cleaning* when they are designed with proper scouring velocities, there are several factors that may require the sewer to be cleaned periodically anyway.

Among the main reasons to clean sewers periodically are:

- Poor alignment resulting in a sag
- Root intrusion
- FOG (Fats, Oil and Grease)
- Debris build-up
- Foreign objects
- Construction related negligence
- Vandalism

3.3 Benefits – Why Is This A Good Thing?

Preventing the blockage that could have resulted in an SSO is the obvious advantage. Additionally, planned maintenance is less costly than reactive maintenance. It is always a better use of time and resources when work is planned versus reacting to an emergency or unplanned event.

3.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If

SSOs are not reduced, choose a different strategy that will better address the specific situation.

Effective Strategies for Preventive Maintenance of gravity sewers include:

- **Accurate History Of All Individual sewers** (information from field reports and TV inspections) so that the proper course of action can be developed to prevent blockages and recurrence of blockages. It is not likely that an employee will remember everything about a particular sewer's past performance and that information will be lost anyway with employee turn over. In addition new employees will not know anything about the history of a sewer without some historical record. That's why it is critical to have **unique identifiers** (i.e. ID numbers) for each individual sewer main, lateral and manhole; and a separate historical inventory of their performance and attributes, as well as the maintenance and repair activities performed on them. For smaller systems, this can be done simply by using a card system (paper files such as index cards). When card systems become too difficult to manage, it is more efficient to use a database system or a Computerized Maintenance Management System (CMMS) to keep track of all of the historical information and planned preventive maintenance activities for each sewer system component. See Section 16 of this manual for additional information on Record Keeping and CMMS.
- **A Work Order System** so that the preventive maintenance activities can be planned in advance. The frequency and the method of cleaning should be defined; the unique identifiers and the location of the sewer should be clear, as well as any special instruction for the field crew should be included in the Work Order. Field Crews should be required to note their findings and the results of their activities in the Work Order, when it is completed. The field report findings and results should then be entered into the historical record of the sewer for future decision making.
- **Accurate Maps** so that the field crews can differentiate one sewer system component from another. The maps need to have the same identifiers as the historical inventory. When the field crews provide information, such as the cause and location of a blockage, it is important that it is attributed to the correct sewer system component's historical record. It is equally important that when a work order is generated for the field crews to clean a sewer in order to prevent blockage, that the crew actually cleans the sewer that is scheduled to be cleaned. Maps can be either drawn by computer or by hand, but they should be to scale and include a legend. Maps should be updated periodically, and notations made in the CMMS whenever discrepancies are found. If the maps are maintained by another section or division of an agency, there should be a defined procedure to note and correct any mistakes found on the map.
- **Training and Quality Assurance/Quality Control (QA/QC)** so that effectiveness of the methods used and work performed can be ensured. There are numerous options available for cleaning sewers, removing and controlling FOG, and controlling root intrusion; however, not all methods are equal. Some are more effective and efficient than others. Operators of the cleaning equipment need to be

properly trained. An effective way to educate operators is the use of a section of clear PVC pipe (as shown below in Figure 1) or video during the operation. They also need feedback on their effectiveness on cleaning sewers. This feedback is better received when they are shown a video of the results of their work after the cleaning operation. Most people want to do a good job, however a Collection System Worker cannot see the effectiveness of the cleaning action while the cleaning operation is being performed.

Figure 3-1, Nozzle in Clear Pipe

- **A Strategy and a Plan** so that effectiveness and efficiency can be optimized. There are different solutions to the various problems encountered (i.e. FOG, roots, foreign objects etc.) The best way to evaluate the type and severity of the problems that exist in the system is to inspect the sewers with a Closed Circuit Television (CCTV).

Here is an example:

The field crews report that there was a grease blockage. They know that it was grease because after the blockage was broke, large amounts of grease appeared at the downstream manhole. But, until the sewer is televised, there is no way to tell if the underlying problem is a sag, an offset joint, root intrusion, a protruding lateral, a plumbers snake, another utility bored through, or just too much FOG from an illicit upstream discharge.

Each of the scenarios mentioned in the example can cause a grease blockage, but the solutions are very different. The solution might be source control, repair, or preventive maintenance activities. The solution that will work best depends on what the particular problem is. Also, the frequency and method of preventive

maintenance should be based on the field conditions and historical record of the sewer main.

- ✓ **Strategy for FOG** – For more details on FOG control, refer to the Section 10 of this Manual, entitled FOG. If the defect that is contributing to the buildup cannot be fixed soon and economically, or the source cannot be controlled, then preventive maintenance must be preformed to prevent a recurrence of a blockage. The Work Order should stipulate that the sewer to be cleaned is a grease line, and should indicate which method of cleaning should be used (i.e. chain flail, hydro-saw, or cutter blade).
- ✓ **Strategy for Roots** – For more details on a Root Control Program refer to the California Collection System Collaborative Benchmarking Group-CCSCBG Best Practices Manual titled *Sanitary Sewer Integrated Root Control Best Management Practices March 2005.* Root Control is a collection of practices for dealing with root intrusion. This approach to root control stresses the application of biological, mechanical, and cultural root control techniques. Chemicals are used only when necessary to achieve acceptable levels of control with the least possible harm to non-target organisms and the environment to prevent roots in new sewers. A good strategy is to require an air test prior to acceptance. A water test or video inspection is insufficient to ensure the prevention of root intrusion after construction. After roots are in the sewer, cutting the roots out of the pipe will remove the obstruction, but cutting roots actually encourages root growth on live trees and shrubs, and then the roots grow back more dense and damage the pipe. Eventually, the use of chemicals to control and inhibit root growth will likely need to be a part of the solution. In the long run, it likely more efficient and effective to have an integrated root control program, because the re-growth will be managed, and the frequency of activities will be significantly reduced.

- ➢ **Ongoing evaluation of the program and the system** so that an agency makes the most of its resources and prevent recurrence of blockages, which can cause SSOs.

3.5 Measurements – How Is This Measured?

The following are a list of benchmarking statistics for which an agency may set goals and track from year to year to measure performance:

- ➢ # of repeat SSOs
- ➢ # of days between scheduled and actual cleaning date
- ➢ # of SSOs per 100 miles
- ➢ Daily, weekly, monthly and annual cleaning footages
- ➢ Cleanliness of the sewer

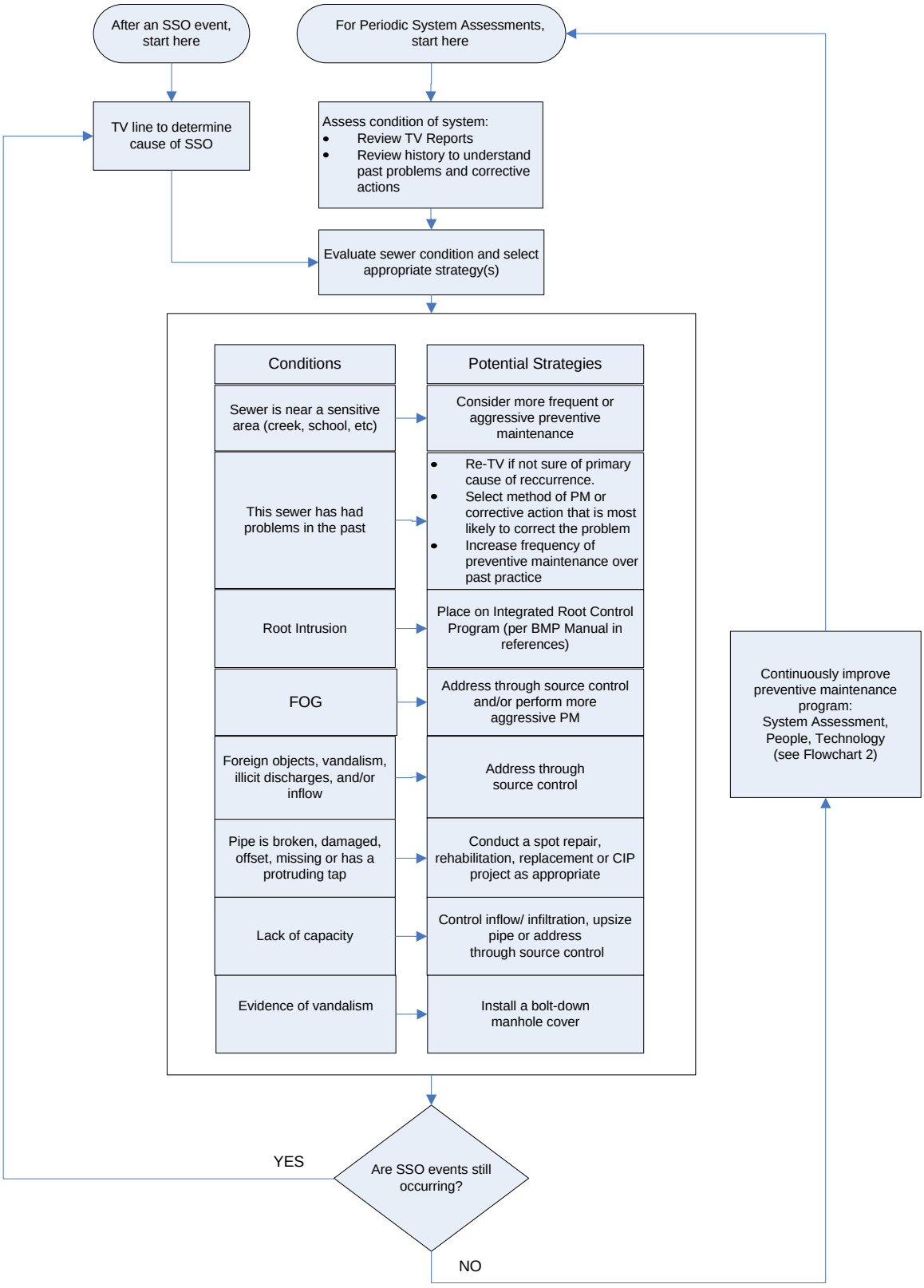
3.6 Links and References – Where Can More Information Be Found?

- Office of Water Programs CSU Sacramento – *Operation and Maintenance of Wastewater Collection Systems Volume 1* *www.owp.csus.edu/*
- CWEA web site book store http://www.cwea.org/book.shtml
- SWRCB Order No. 2006-0003-DWQ:
  - ✓ http://www.waterboards.ca.gov/resdec/wqorders/2006/wqo/wqo2006_0003.pdf
- California Collection System Collaborative Benchmarking Group-CCSCBG Best Practices Manuals;
  - ✓ *Hydroflush Cleaning of Small Diameter Sewers Feb. 2001(cwea.org)*
  - ✓ *Sanitary Sewer Overflow Prevention and Response Plan June 2002(cwea.org)*
  - ✓ *Sanitary Sewer Integrated Root Control Best Management Practices March 2005 (copies can be obtained from the following agencies: Central Contra Costa County Sanitary District, City of Los Angeles, Parde Dam Municipal Water District, City of San Diego, Orange County Sanitation District, County of Sacramento and Union Sanitary District)*

Section 3 Attachment A

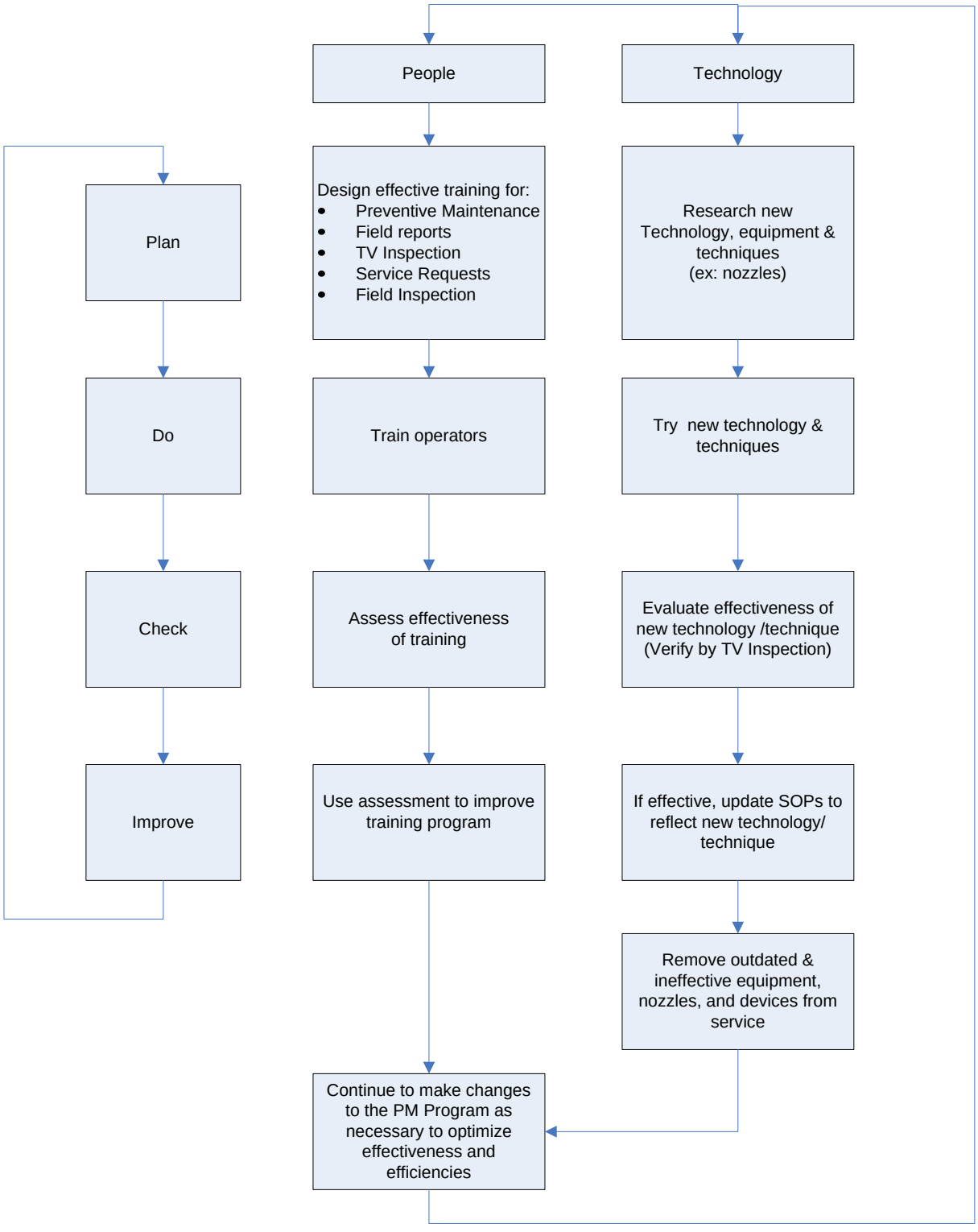
Preventive Maintenance Strategies Flow Chart

Flowchart 1: SSO Prevention



Flowchart 2

Continuous Improvement of the Preventive Maintenance Program



SECTION 4

CCTV - OPERATION AND MAINTENANCE

4.1 INTRODUCTION

This section addresses the following State Water Resources Board Order No. 2006-0003-DWQ Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP) Elements;

- (i) Goal: "The goal of the SSMP is to provide a plan and schedule to properly manage, operate and maintain all parts of the sanitary system."
- (iv) Operation and Maintenance: "The program should include regular visual and TV inspections of manholes and sewer pipes, …"
- (v) Design and Performance Provisions: (b) "Procedures and standards for inspecting and testing the installation of new sewers, …"
- (vii) FOG Control Program: (f) "An identification of sanitary sewer system sections subject to FOG blockages…."
- (ix) Monitoring, Measurement, and Program Modifications: (a) "Maintain relevant information that can be used to establish and prioritize appropriate SSMP activities." (c) "Assess the success of the preventative maintenance program".

This section of the SSO reduction BMP manual will provide strategies to reduce potential SSOs through the use of Closed Circuit Television (CCTV) equipment, inspections and collected information.

4.2 PROBLEM STATEMENT – WHY IS THIS NEEDED?

In order for agencies to reduce potential SSOs, they need to have a full understanding of what is happening inside of their pipes. Before the widespread use of CCTV equipment, SSO reduction was based mainly on historical information collected and the experience of those maintaining the system. Today's CCTV equipment takes the guesswork out of the job and puts actual information in the hands of those making the decisions. For those agencies that are initiating their inspection program, there are some initial questions to be addressed, and certain decisions that must be made before proceeding including the following:

- Should we purchase the CCTV equipment and perform the work in house or contract out CCTV work?
- Where and how much?
- How to manage the CCTV data and videos collected

- What software packages for collecting CCTV data should be purchased
- What training is necessary for staff

These questions are critical for an agency, but typically require more in-depth attention and may require a consultant help to figure out, as they differ widely from agency to agency. In addition, you can copy other agencies programs and specifications.

4.3 Benefits – Why Is This A Good Thing?

- Assumptions about what is happening in your sewers will be replaced with facts.
- Facts can be used to help prevent SSOs from recurring.
- Justifying funds for capital improvement projects and maintenance programs may become easier.
- Information collected may help meet the requirements set in your SSMP.
- The type and quality of records requested by EPA or RWQCB inspectors during an audit may be produced.
- Employees may be better informed leading to an increased sense of ownership.
- Additional benefits are listed in Section 7 of this manual.
- Reactive maintenance costs are significantly reduced
- Information is available when needed

4.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Develop a goal to CCTV inspect your entire collection system

Your agency may decide to develop a schedule to CCTV inspect the collection system. Many agencies' inspection frequencies range from anywhere between 5 and 20 years. Select a frequency that makes sense for your agency, and fits into your operation and maintenance budget. If your agency has had an above average number of spills in a certain area (a problem area), you may want to consider going with a higher inspection frequency in that area to more proactively identify and alleviate the cause of SSOs in the future. You may then want to move on to older pipe areas. If your agency has had a below average number of spills in the past, a more relaxed frequency may be acceptable.

If your agency has not completed any CCTV condition assessment of your system, start by using a map of your entire system to create a strategic plan and schedule to complete

CCTV inspection within the frequency you have selected. You can use the following general guidelines to produce the plan and schedule.

- Look at Historical records and hold a staff brainstorming meeting to develop a list of critical pipes known to have caused SSOs or blockages in the past, or believe to be in exceptionally poor condition based on documentation of field work or institutional knowledge. Make CCTV inspection of these assets the top priority.
- Try to divide the remainder of the collection system into defined sub-basins or areas based on factors such as age, material of construction, or geographic boundaries.
- Prioritize inspection of those defined areas based on the considerations of both perceived condition as well as importance relative to the impacts of potential spills to the public and the environment.

If your agency has set a timeframe for which you intend to CCTV inspect your entire collection system, daily, weekly, monthly and annual productivity goals can be set to support meeting that goal. It may be helpful to produce a written schedule defining the productivity goals and actual areas to be inspected in upcoming timeframes, and provide a way to track actual progress so that the schedule may be updated as work is completed.

For SSO reduction, the sooner you have completed the CCTV inspection of problem sewers the better. CCTV inspections can then be used to verify cleaning methods and frequencies, cleaning tools used for specific line segments and whether spot repairs or line replacements are needed.

CCTV inspections of new installations, Part I- Tracts and line replacements

Your agency may choose to have procedures in place to CCTV inspect all new installations prior to acceptance (see Section 2). New installations can be anything from new tract developments to new lateral installations. New installations typically go through routine inspections; they are visibly inspected from above ground and are air tested. CCTV inspections will show defects that occur after the backfilling of trenches has been done. CCTV inspection crews should make sure no pipe joints have become offset or separated, there are no sags in the pipe and service connections are still sound. Also, many agencies require that new sewer pipe be CCTV inspected a second time just before the normal one year warranty expires.

If an agency does not have the capabilities of doing a lot of CCTV inspections themselves, before a sewer is accepted it can be a requirement that the contractor hire an outside CCTV company to inspect the sewer and an agency inspector can watch the CCTV work or review the videos afterwards.

Many new installations get put on extended cleaning schedules because it is presumed they will not experience any problems due to the fact they are new. Gone unchecked, a separated pipe could quickly lead to a pipe stoppage or SSO. Additionally, if a pipe

defect is discovered after warranties have expired; it may become difficult to require the developer to perform the repair.

Pictured below, Figures 1 and 2 show tight joints with no offsets or sags. Figure 3 shows an offset.

Figure 1

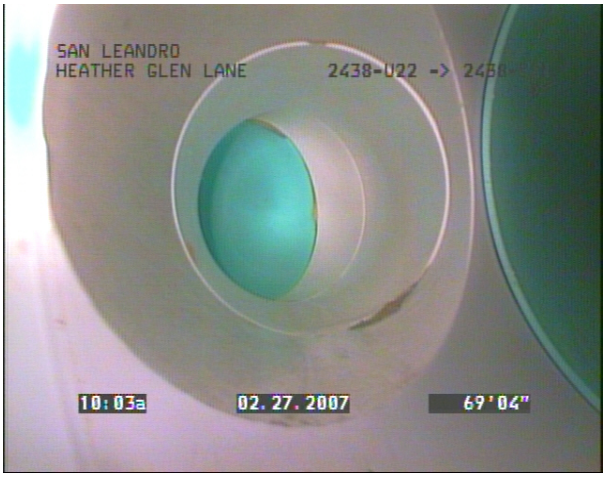


Figure 2

CCTV inspections of new installations, Part II- Service connections (wyes and tees)

Another area of new installations needing CCTV inspection is when a service connection (wye or tee) is replaced during a lateral repair. As previously mentioned, new service connections on existing mains will look good during initial inspections, but can develop problems during compaction. Additionally, repairs of any nature may allow for broken pieces of pipe and soil to enter the live main. SSOs may occur when "construction debris" enters a live main unchecked. A CCTV inspection of all repairs, checking for offsets, settlement or construction debris may help prevent an SSO. When performing this type of CCTV inspection, it is advised to inspect the entire line, manhole to manhole, to ensure debris did not wash down stream out of immediate view.

Pictured below is an example of a failed wye installation found by CCTV inspection. Figure 3 shows a one-inch offset caused by trench compaction. Figure 4 shows infiltration coming through the joint. Figures 5 and 6 show the same location after being repaired.

Figure 3

Figure 4

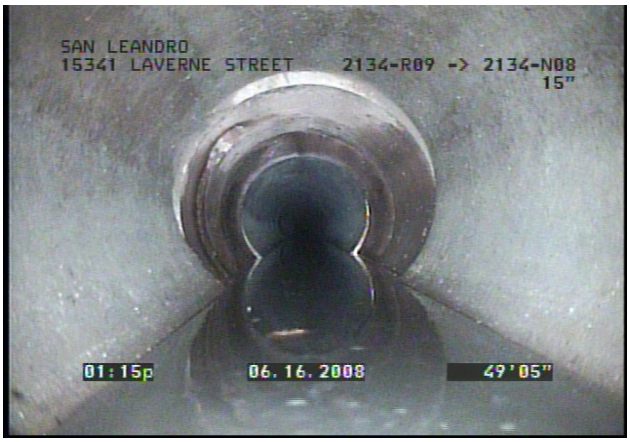


Figure 5

Figure 6

It may seem hard to imagine how a small offset could potentially cause a SSO and why CCTV inspections are so critical on new sewer installations. Figures 7 and 8, pictured below, show how even the smallest offset can snag an object that will catch paper or solids. In these cases, a toothbrush and stick provided the opportunities.

Figure 7

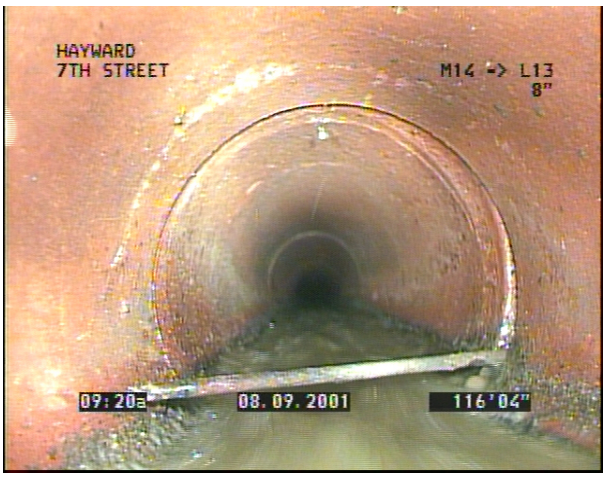


Figure 8

CCTV inspections of new installations, Part III- Completed spot repairs

Spot repairs, where short portions of the sewer are dug up and repaired, fall under another category for CCTV inspections. The issues discussed regarding the inspection of service connections similarly apply to spot repairs, but there is one major difference. When service connections are repaired, many times they replace the whole service line. The contractor can excavate the old connection and replace it under controlled circumstances. In the case of spot repairs, many times the pipe being excavated is badly cracked or may even have missing pieces where soil is visible. When a contractor excavates these repairs, it is possible pieces of pipe and soil may be knocked into the pipe where the flow can take them down stream.

Some agencies CCTV inspect all excavations as soon as possible to ensure construction debris did not enter the pipe and possibly cause a future SSO. Pictured below is an example where construction debris caused an SSO. Figure 9 shows where a contractor excavated to repair a pipe. Due to time, the pipe was temporarily covered with a patch. Over the weekend, an SSO occurred and crews removed the piece of 8-inch pipe shown in Figure 10. When performing CCTV inspections for this reason, it is recommended to televise as far down stream as your experience deems necessary.

Figure 9

Figure 10

CCTV inspections of service calls

Service calls from the public are an excellent early warning system that agencies can use to help reduce SSOs. Some agencies even go to the extent of conducting a CCTV inspection of every sewer related service call. A CCTV inspection will show that the caller's problem is either in the main or in the lateral. It may also catch early problems that would not be identified by checking upstream and downstream flows and it provides picture evidence the caller can use when speaking with a plumber or contractor.

When a CCTV inspection crew can respond to a caller, televise the sewer and save the video or inspection report incase the owner wants to see it. Without this type of service, your agency can be drawn into a "blame game" with plumbers who, based on their information, tell callers their problems are on the public side. Having an initial video of a service call also helps in the event a plumber clears a lateral by pushing roots and grease into the agency's main that may cause a stoppage or SSO. If your CCTV crew feels this may happen, they can ask the caller to inform your agency when they have been cleared so a follow-up cleaning or CCTV inspection can be scheduled.

Pictured below, Figure 11 shows a plugged sewer main resulting from a service lateral clearing. Figure 12 is an example of how CCTV inspection during a service call can help. In this case, the service connection was broken and offset, so trying to clear it with a mechanical snake would have been a waste of time. Giving this information with pictures to the caller allows them to direct their efforts to fixing their problem. Figure 13 shows a ¾-inch PVC pipe extending into the agency's main. Figure 14, like Figure 13, shows lateral clearing attempts that resulted in a negative consequence to the public agency. In this case, a mechanical snake with cutter blade had broken off and was also extending into the agency's main. In both cases, paper products had wrapped around the pipe and snake and the mains were running half-full. It was only after jetting the main that the CCTV crew could see the obstruction causes. The homeowners were notified to remove the obstructions or be held responsible for any SSO that may occur.

Figure 11

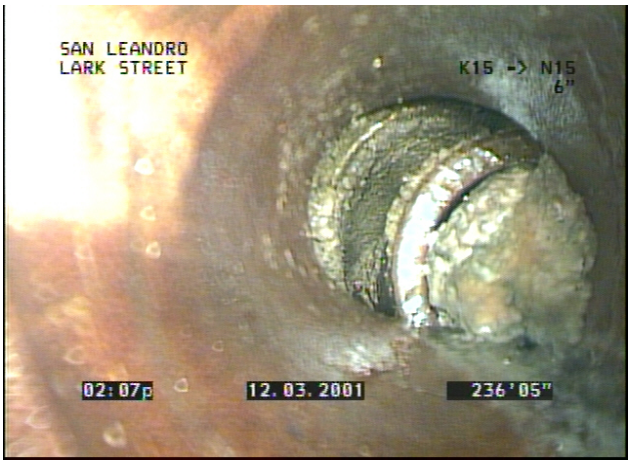


Figure 12

Figure 13

Figure 14

CCTV inspections for your FOG program (refer to Section 11 for details on FOG)

As your agency CCTV inspects the entire collection system, locations with high FOG concentrations may be identified. When these locations are identified, your source control inspector, or whoever works in that capacity, should be notified. Maintaining these locations is a critical part of SSO reduction. Follow-up CCTV inspections may be required to confirm the grease was properly removed and that compliance with pretreatment standards is being followed. Below are examples of FOG related issues that would have contributed to a SSO if not discovered and removed.

Figure 15 shows the condition of a collector sewer discharging into an agency's manhole. This information and picture was given to the agency's source control inspector. The inspector's finding was that an existing donut shop on this sewer had changed owners and the new owner was not properly maintaining the grease traps. The property manager for this shopping mall was instructed to clean the sewer, recover the grease and inform the

agency when they were finished. Once notified the job was completed, the CCTV inspection crew returned to inspect the main line. Upon arrival, the crew found the main surcharged due to the fact the grease was not recovered, but flushed into the downstream main. Had this agency's internal procedures not been followed, an SSO may have occurred.

Figure 16 shows the sewer for a shopping center with two eating establishments and one supermarket after they called the agency reporting that they were backed-up. The CCTV inspection crew responding to the call found the agency's main clear. The same internal procedures mentioned above were followed to prevent an SSO from occurring.

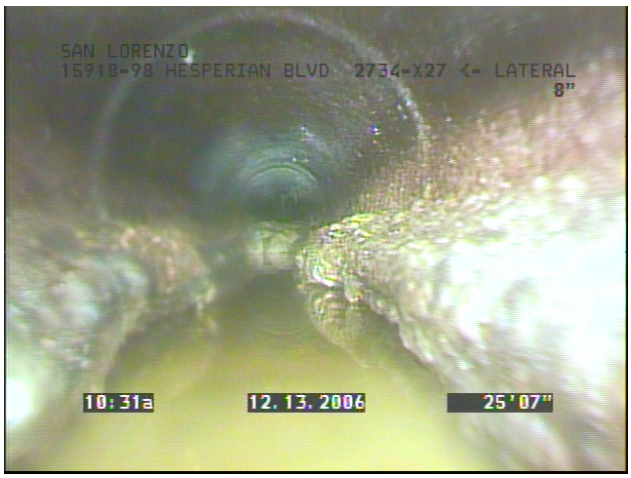


Figure 15

Figure 16

CCTV inspections based on USA requests

As a member of Underground Service Alert (USA), your agency receives prior notice of underground work in your service area. These notifications are for the purpose of marking your subsurface structures and being aware or the work going on. If your sewer mains have been marked, that does not eliminate the chance that your pipe may be hit during excavations or borings.

One agency goes as far as performing a CCTV inspection of sites that their agency's USA locator identifies as "being in close proximity" of their main. In these cases, a pre-inspection would be good to have, but a post-work inspection is more beneficial. Pictured below are examples of why this is important and how this kind of CCTV inspection can be a factor in reducing SSOs.

Figure 17 shows an old excavation that more than likely cracked the agency's main. Jetting this main pulled the broken pieces and surrounding soil exposing the electric line and created a cavity outside the sewer. Figure 18 shows where horizontal boring caved in the side of the main, the CCTV inspection found the broken pipe and soil in the main, and the pipe starting to surcharge. Figure 19 shows a horizontal boring that crossed the

agency's main perpendicular. Figure 20 shows what happens when a telephone pole is relocated too close to your main.

Figure 17

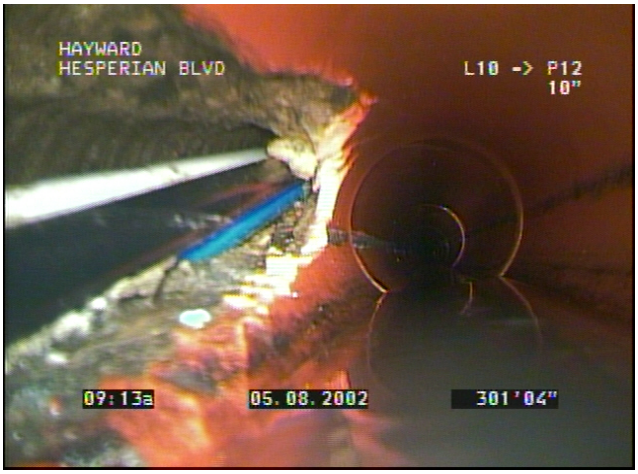


Figure 18

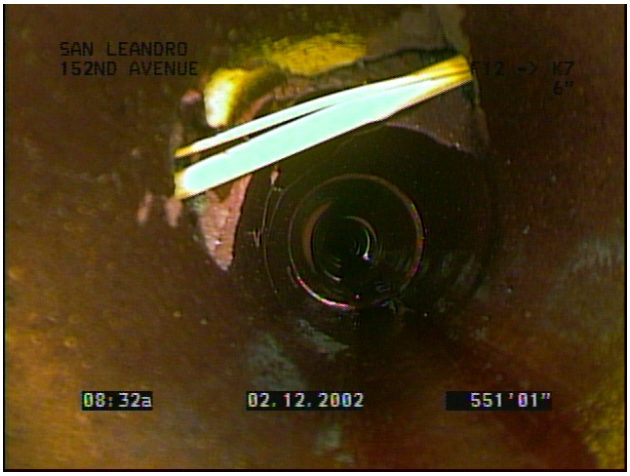


Figure 19

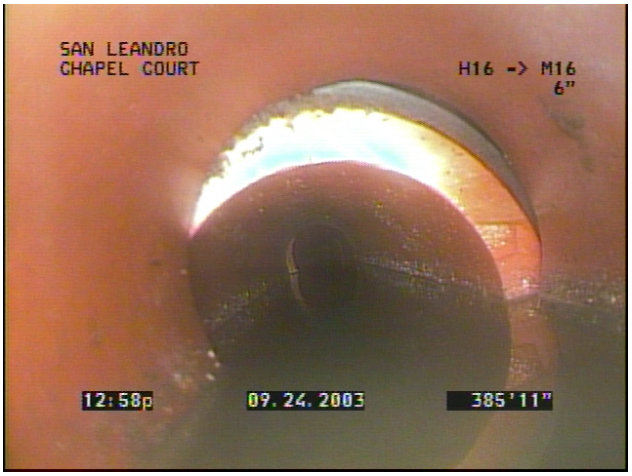


Figure 20

CCTV inspections after acts of vandalism

A common cause of SSOs is vandalism. A typical type of vandalism is when an agency's manhole is opened and debris such as rocks, wood or trash is thrown into the manhole channel. When these types of vandalism are found, it is a good practice to, once all debris is removed from the manhole, perform a CCTV inspection as far down stream as is needed to confirm no smaller pieces washed down potentially causing a repeat SSO.

Recently, another type of vandalism has become more prevalent. The stealing of manhole covers is now on the rise and this opens a new area for SSO prevention. When a manhole cover has been reported stolen, it may not be enough to just go out and replace the cover. As mentioned above, your agency may choose to perform a CCTV inspection

of the main as far down stream as you feel necessary since there is no way to know if debris was thrown in the manhole while it was uncovered.

Pictured below, Figure 21 shows a SSO being cleared. The cause of this SSO was the two aluminum cans shown in Figure 22. Two weeks before this SSO occurred; a manhole cover was reported missing from a sidewalk nearly ¼ mile upstream of this location. When the manhole cover was replaced, crews did not notice any irregularities to the flow. It is now known that while the manhole was uncovered, vandals threw these cans into the flowing sewer where they were carried down stream to a point were they lodged in an outside drop manhole.

Figure 21

Figure 22

These strategies were developed by a mid-size agency with 280 miles of mainline sewers and no lateral responsibilities. This agency does its inspections in-house using one CCTV crew comprised of two workers, one TV van and one support vehicle. All of these strategies were developed as a result of experiencing an SSO and have been refined over a ten year period. Similar tasks can be developed for agencies having service lateral responsibilities. An agency should make every effort to learn from their SSOs and implement their own strategies as needed.

4.5 Measurement – How Is This Measured?

The following are a list of benchmarking statistics for which your agency may set goals and track from year to year to measure performance:

- Daily, weekly, monthly and annual CCTV inspection footages
- Percentage of collection system CCTV inspected annually
- Number of new installations CCTV inspected annually
- Number of service calls from the public CCTV inspected annually
- Comparisons between increased CCTV inspections and SSO reductions
- Number of defects found and corrected before they became an SSO

- Time it took to complete identified spot repairs
- CCTV inspection cost per linear foot

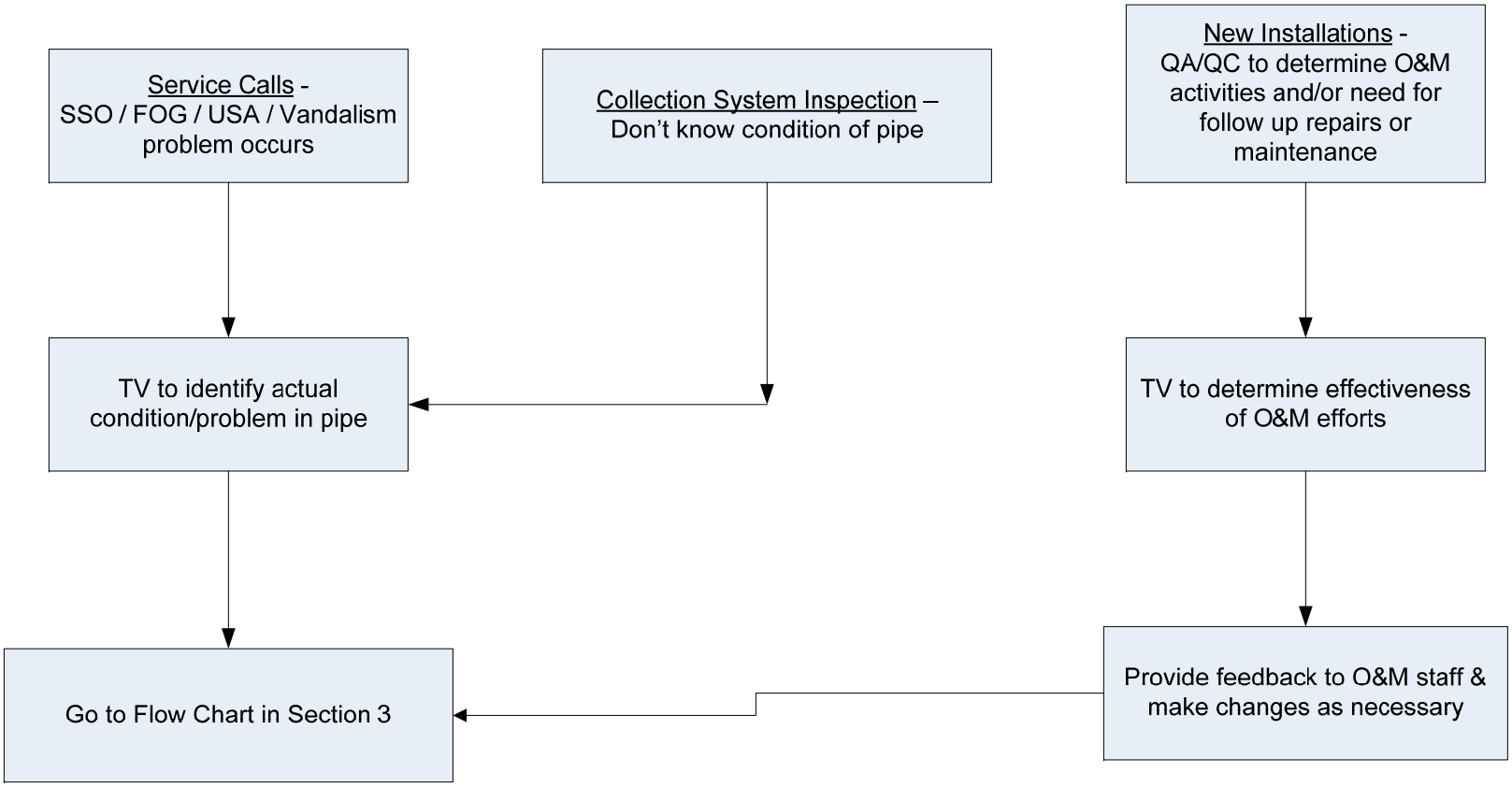
4.6 Links and References – Where Can More Information Be Found?

- State Water Resources Control Board Order No. 2006-0003-DWQ
- Operation and Maintenance of Wastewater Collection Systems, Volumes 1-2
- NASSCO, Manual of Practices, Wastewater Collection Systems, Second Edition
- http://www.waterboards.ca.gov/resdec/wqorders/2006/wqo/wqo20060003.pdf

Section 4 Attachment A

CCTV Flow Chart

CCTV Flow Chart



SECTION 5

TRAINING AND COMPETENCY ASSESSMENT OF PERSONNEL

5.1 Introduction

This section addresses the State Water Resources Control Board Order No. 2006-0003-DWR Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP) element, 13 (iv)(d) *Training* -

"Provide training on a regular basis for staff in sanitary sewer system operations and maintenance, and require contractors to be appropriately trained."

This section provides agencies guidance on the role and importance of regular training. Further, this Section will cover alternative approaches for assessing the competency of agency personnel.

5.2 Problem Statement – Why Is This Needed?

A well-trained staff is a tremendous asset. Lack of proper training may compromise worker safety, jeopardizes public health and safety, and threatens agency infrastructure investments. Training is a logical and integral component of any sewer system operation. The need for training is a constant driven by such things as personnel turnovers, technological advancements, and shifting legislative and regulatory requirements. A competent, well-trained staff is essential to the safe and effective operations and maintenance of any sewer collection system.

5.3 Benefits – Why Is This A Good Thing?

An established, on-going training and assessment program is the best approach to assuring that personnel are qualified to manage sewer system operations and maintenance safely. The following benefits are derived from regular training

;

- Helps build a competent work force to:
  - ✓ Identify and correct problems in the collection system before they result in a SSO.
  - ✓ Respond properly to and clean up SSOs and mitigate the impacts
- Protects the capital investment the agency has made in building and improving the sewer system infrastructure

- Reduces an agency's risk and liability exposure by documenting the efforts to maintain a high level of workforce competence
- Ensures compliance with Federal and State OSHA and EPA safety requirements
- Reduces accident and injury claims and lost time absences
- Provides for an effective and efficient use of ratepayers' money

5.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Begin with the development of a detailed training and assessment program that includes the environmental, safety and health risk (to workers and the public), related regulatory agencies requirements, i.e. EPA, OSHA, and equipment operations for each individual worker, and worker job classifications.

- Assess current workforce skills and abilities, and measure against current and future needs. (1) Are skills and abilities adequate for the job requirements? And (2) what will it take to get there? Start by addressing the following:
  - ✓ Determine the skills needed to do the job
  - ✓ Assess the current capability levels of present staff measured against the requirements
  - ✓ Identify skill requirements and needs for future hires
  - ✓ Incorporate the needs for upgraded and refresher training
  - ✓ After acquisition of new equipment, evaluate needed training
- Budget the resources needed to implement an effective training program for managers and workers.
- Develop time and space for training
  - ✓ On-the-Job Training – have competent veteran employees provide direct field training and guidance to new employees; and track progress and performance through field observation and review.
  - ✓ Peer Assessments – have competent employees perform assessments to ensure that trainees are fully trained. In other words, make sure that the training worked.
  - ✓ Tailgate Safety Meetings – use regular tailgate safety meetings

- ✓ Classroom Training
  - Webinars
  - On-site Workshops
  - Off-site Workshops
- ✓ Drills
- ✓ An After Action Reviews (AAR) is a process for professional discussion of an event or operation, focused on performance standards, that enables the workforce to discover: what happened, why it happened, and how to sustain strengths and improve on weaknesses. It is a tool leaders and workers can use to get maximum benefit from every event or task. The AAR method has been adapted to the needs of businesses and industries to improve on performance.

5.5 Measurement – How Is This Measured?

Establishing an identifiable, well-structured measuring system is an integral part of any training program. It is the means for determining the results and effectiveness of the training program and will help identify problems, as well as adapt to changing circumstances, i.e., staffing turnover, technology, legislation and regulations.

Track and document all training for all employees. These records will be needed for compliance with Federal and State regulations. A simple EXCEL file or ACCESS database may be used to document type of training, instructor, date, and time, length of training class, subject and attendees. Training sessions should have a sign in sheet with employee signature and printed name on file. A binder may be kept of the sign in sheets for the training classes.

Attachment A to this section contains a sample form "New Employee Checklist" for tracking individual employee development and training of new hires.

- ➢ Competency Assessments – should include observing trainees as they perform their job, along with an interactive assessment to determine competency level achieved in the various facets of their job. A combination of approaches can be used to gather meaningful input to the competency assessment process, including:
  - ✓ Informal comments from trainees
  - ✓ Workforce review sessions with all workers
  - ✓ On-the-job observation
  - ✓ Reports from customers, peers and other managers
  - ✓ Follow-up CCTV inspections
- ➢ Certificate Programs – Earned certifications are one method for documenting acquired competency. The certification preparation process and the associated study materials can be used to reinforce workers' field experience and knowledge about safety hazards and the correct procedures to follow at all times and under all

circumstances. Obtaining a certification is evidence that workers know how to do their jobs in a safe and competent manner. Voluntary certification programs for Maintenance and Collections are offered through California Water Environment Association (CWEA). See the Links and References for more information

Being able to demonstrate a real and significant benefit to the organization from the training can help gain more resourceS from important decision-makers.

5.6 Links and References – Where Is There More Information?

- ArmyStudyGuide.Com. The After Action Review Process: To Develop a Common Understanding of the After Action Review Process, It's Intent, Key Elements And the Application of the Process to Training and Operations. Website: http://www.armystudyguide.com/content/powerpoint/Training_the_force_presentations/the-after-action-review-p-2.shtml
- Business Performance, Training Management. Evaluating Training Effectiveness http://www.businessperform.com/html/evaluating_training_effectiven.html
- California State University, Sacramento, Office of Water Programs. Manage for Success: Effective Utility Leadership Practices, First Edition, 2005.
- California State University, College of Engineering and Computer Science, Sacramento. Utility Management: A Field Study Training Program, *Second Edition*, 2004.
- California Water Environment Association. Website: www.cwea.org
- San Francisco Bay Regional Water Quality Control Board in cooperation with Bay Area Clean Water Agencies, "Sewer System Management Plan (SSMP) Development Guide," July 2005.
- Kirkpatrick, D. L. (1959) Evaluating Training Programs, 2nd ed., Berrett Koehler, San Francisco, CA.
- Kirkpatrick, D. L. (comp.) (1998) Another Look at Evaluating Training Programs, ASTD, Alexandria, VA
- United States Army. Training Circular 25-20, A Leader's Guide To After-Action Reviews
- Union Sanitary District's Training Module Program

Section 5 Attachment A

Sample New Hire Training Checklist

How to Use Sample Checklist

This checklist is an aid for new hires. The checklist is designed for the employee to take responsibility for keeping track of progress in completing the core training for sewer collection system maintenance. It is the agency's responsibility to schedule each employee for training opportunities.

The goal is to ensure safe and competent performance of sewer system maintenance and operations. The On-The-Job Training (OJT) is an assignment for lead workers and lift station specialists to pass on institutional knowledge of the system and to oversee the competent development of each new hire. Overall, the supervisor monitors and guides the training to give the employee every opportunity to meet the minimum requirements of employment in the sewer collection system maintenance unit.

At pre-determined milestones set with the employee at the time of hire, the supervisor meets with the leader worker and specialist to assess the new hire's progress. Then the supervisor meets with the employee to review progress in completing the checklist and to discuss strengths and areas for improvement.

- SEWER COLLECTION SYSTEM MAINTENANCE

  Some items may appear redundant; however, the entry-level worker must learn the fundamentals of the Operation and Maintenance of the Wastewater Collection System, as well as the unique characteristics of the agency's specific collection system and operations.

- SEWER LIFT STATION MAINTENANCE

  The objective of OJT for sewer lift station maintenance is to provide proficiency and understanding of lift station maintenance and operations in support of the Utilities Specialist. The worker functions as a helper to the specialist and does not perform the journey level functions of the specialist position.

SAMPLE FORM

EMPLOYEE NAME		HIRE DATE:	

New Employee Checklist

PERFORMANCE & TRAINING TRACKING

This checklist is for the employee to track his/her progress in completing the necessary requirements. The employee must demonstrate proficiency and knowledge of the following standard policies, procedures, rules, forms and processes to pass the 12-month probationary period and to be promoted from PWMW I to PWMW II (All requirements completed in 18-month , except where otherwise noted).

TASK (General Department Requirements)	*SIGN OFF DATE*	*OJT Trainer (Initial)*	*COMMENTS*
Class "A" driver's license (6 months of hire, due: mm/dd/yyyy)			
Knowledge & use of Wastewater Quality Standards			
Confined Space training and certification program			
Work zone safety training certification			
DOT training and certification			
Pre- and post-trip vehicle inspections procedures			
Department Rules of Conduct			
Procedures for Underground Service Alert (USA)			
Accident reporting procedures			
Geography of service area			
First aid (CPR) training & certification			
TASK (Sewer System Maintenance)	***SIGN OFF DATE***	***OJT Trainer (Initial)***	***COMMENTS***
SEWER COLLECTION SYSTEM MAINTENANCE			
*CWEA Grade I level training using Operation and Maintenance of Wastewater Collection Systems (Field Study Training Program)			
Knowledge of city's sewer collection system and its component parts, i.e. lateral lines, mains (including force mains, trunk lines, etc.)			
Proficiency performance maintenance functions, i.e. main line jetting and rodding operations & procedures; and sewer main and lateral repairs			
Use of sewer system O&M , and repair tools			
OSHA trench shoring requirements & setup			
Use of sewer block book			
SSO emergency response & response plan			
Lockout / Tagout Training			
SEWER LIFT STATION MAINTENANCE			
Know geographic locations of all sewer lift stations			
Submersible pumps installation and removal			
Perform lift station Motor Control Panel operations			
Knowledge of generator operation			
Perform basic lift station inspections			
Perform basic lift station preventative maintenance			
Perform lift station pump sequencing procedures			
SCADA system basics			

*The section supervisor manages CWEA certification training in support of OJT and regular in-house performance assessments. Course work for certification is used as a training tool however testing and obtaining a CWEA grade certification is voluntary.

The OJT Trainers and Section Supervisor certify the successful completion of all training tasks prior to promotion.

Date	Initials / Title		Date	Initials / Title:

Date	Initials / Title		**Authorization for promotion –Supervisor**	**Date**

SECTION 6

LEGAL AUTHORITY AND ENFORCEMENT

6.1 Introduction

Section 13 (iii) of the Statewide General Order WDR Order No. 2006-0003-DWQ requires each agency's Sanitary Sewer Management Plan (SSMP) to demonstrate that it possesses the necessary legal authority to:

- Prevent illicit discharges,
- Require that sewers and connections be properly designed and constructed,
- Ensure access for maintenance, inspection, or repairs,
- Limit the discharge of Fats, Oils and Grease (FOG) and other debris that may cause blockages, and
- Enforce any violation of its sewer ordinances.

In addition section 13 (vii) (e) of the Statewide General Order, under FOG control Program, requires the agency's SSMP to include:

- Authority to inspect grease producing facilities, enforcement authorities and whether the Enrollee has sufficient staff to inspect and enforce its FOG control ordinance.

This section presents the following information with regards to legal authority to enforce local ordinances and codes relating to SSOs:

- Why enforcement is required.
- How enforcement can be a valuable tool to reduce SSOs and recover costs.
- How to structure a progressive enforcement policy.
- Suggested fine structure (in attachments).

6.2 Problem Statement – Why Is This Needed?

In order to comply with Federal, State and local requirements, it is incumbent upon the agency to establish local sewer use ordinances to ensure that builders, developers, industry, commercial and private property owners all meet certain minimum standards, provisions and requirements for the design, construction, maintenance, repair and use of the sewers.

These requirements are necessary to ensure local sewer Agencies have the necessary authority to meet Federal and State requirements for the portions of the sewer system

owned by the Agency to protect public health, the environment, waters of the State, and to protect the sewer infrastructure and the POTW from contaminants that may interfere with its operation, or its ability to meet its discharge requirements.

Enforcement of the local Sewage Use Ordinance and FOG Ordinance can provide cost recovery for agency response and cleanup as well as reduce SSOs by ensuring that non-compliant entities and individuals are brought into compliance through education and enforcement.

6.3 Benefits – Why Is This A Good Thing?

Public Health Protection

Enforcement serves many purposes. First and foremost it protects public health. Water-borne disease outbreaks like typhoid and cholera are now rare in our cities, but just 125 years ago were recurring threats to public health.

Compliance; Reduce SSOs

Enforcement's main objective is to return the entity or individual to compliance with the applicable regulation. It also helps to reduce repeat violations if the enforcement is public, swift, and consistent. Monetary fines not only help the agency with cost recovery for clean up and mitigation of the violation, but help ensure that the violator does not gain an economic advantage from their violation. Enforcement can also serve as a deterrent to future violators, both to specific entities or individuals, and to the public when enforcement actions are published in a local newspaper. No industry or commercial establishment likes "bad press"; it is in the business's own economic interest to comply with local ordinances. An agency's enforcement plan can also help reduce or prevent future SSOs with comprehensive standards for construction of public sewers, a consistent process for reviewing construction plans, comprehensive construction inspection and testing procedures, clear delineation of responsibility between the agency and the property owner, and clearly defined consequences for the sewer user's noncompliance.

Cost Recovery

One of the basic tenets of environmental protection is that the polluter pays. Those who violate a local code or ordinance should pay for the agency's costs in responding to those violations. These costs include expenses incurred in taking action to end or control the violation or address noncompliance. These costs are in addition to any damages or fines that may be assessed. In addition, third parties may be damaged and may seek recovery of economic damages. Agency response may include site visits, inspections, cleanup, sampling, and monitoring. Total costs are calculated as the direct costs for personnel, equipment, materials, mileage, contractual services and other response costs, and indirect costs.

6.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Regulatory Process

An agency derives its authority from State and Federal laws, statues and regulations, but should codify the agency's local requirements according to local rule. Most agencies use Ordinances (also called Municipal Code or City Code in some instances) to codify their requirements. The requirements in the Sewer Use Ordinance should be clear and specific. All terms and acronyms should be defined. The Ordinance should incorporate by reference the Uniform Building Code (UBC) and Uniform Plumbing Code (UPC) provisions. The Ordinance is a public document (published) and must be available to those entities and individuals affected. The agency should follow their local public outreach requirements to educate those affected by any changes or updates to their ordinance. Printed copies of the ordinance should be available upon request from the agency and on the agency's web site if available.

Consequences for noncompliance with the ordinance should be clearly spelled out. Enforcement actions should be transparent, predictable and fair. Each agency should make sure to spell out the agency's inspection authority including right of entry onto private property to enforce the agency's code provisions and/or verify compliance, and the right to copy documents, take pictures and interview employees and the public. The funding for ordinance enforcement should be specified and if possible should be self supporting through agency, permit and user fees and fines.

New requirements can be self-implementing or require permitting. Self-implementing requirements should have a compliance deadline and spell out how entities and individuals can achieve compliance with the new regulation on their own, usually through a survey, documentation, or inspection by the agency. The affected entity or individual may be required to file a "Notice of Intent" with the agency, indicating they understand the new requirement and intend to be in compliance. New requirements that include permitting require affected party(s) to apply for and be granted a permit to meet the regulation. The difference with this process is the burden is placed on the affected entity or individual to capture the data necessary for the permit. This allows the agency the opportunity to review the permit, evaluate the probability of success in meeting the requirement, and collect any permit fees.

Enforcement for SSOs may include:

- Cost recovery for private SSOs that use agency resources for cleanup, mitigation, or investigation:

Most community sewer systems have large property owners that include mobile home parks, campus schools or industries, or separate business or home owner associations who are responsible for the sewer lines on their property. If the SSO is large enough to escape to the agency's system, and enter the storm water system or receiving water, the agency may be required to respond and provide cleanup, mitigation and sampling of the receiving water. Less likely, but still possible, a single family home may have a break in the privately owned portion of the sewer lateral that may escape to the storm water system and require agency response.

- Public outreach and education for high-density housing, multi-family units, or other residential sources of FOG should be helpful in reducing the FOG load to the sewer and the subsequent enforcement actions.

- Educations and training of limited segments of the community like food service establishments and the like.

- Enforcement of Food Service Establishments (FSE) that have grease interceptors that fail to operate properly and produce an SSO:

  Most of these types of SSOs can be prevented with a system of mandatory installation at grease generating FSEs, proper design, Best Management Practices (BMPs), public and FSE owner awareness, inspection by the local agency and routine maintenance by the FSE. See Section 9, FOG, for more information.

- Enforcement of willful violators of local codes or ordinances:

  There will always be individuals, establishments or industries that short circuit the system and take the "easy way out". For example individuals who are caught pumping their household waste to the gutter (storm drain) rather than pay to get a broken sewer pipe fixed.

- Accidents happen, but if construction, demolition, yard work, tree removal or planting results in a break of a sewer line, the individual is responsible, especially if they did not call 811, the free service for utility line marking through Underground Services Alert (USA/Dig alert).

Enforcement should not be used where:

- A pipe breaks or fails due to earthquake, subsidence, or washout from a storm event, i.e. there is no responsible party.

- The agency is the responsible party.

6.5 Measurement – How Is This Measured?

Evaluate Compliance

Compliance with the ordinance is verified through inspections by properly trained inspectors. Construction compliance can be determined through building permits, plan

checking and engineer review. For smaller agencies, oversight by another agency, the local Health Department for example, may be possible. For continuing compliance with use ordinances, larger users (commercial and industrial) may be self-reporting. Specific measures may include:

- Number of sewer lines on high frequency cleaning schedule
- Number of blockages and SSOs where FOG was a contributing factor
- Number of NOVs issued
- Number of required re-inspections

The agency may also monitor adjacent waterways for sewage indicators: Total Coliform, Fecal Coliform, *E. coli*, Enterococcus, ammonia-nitrogen, BOD, localized pH, or temperature spikes to detect illegal, hidden connections. The agency may monitor the sewers for compliance by using TV-inspection of lines for grease, roots, breaks, illegal connections, and cross connections with storm lines. The agency can also do smoke testing of the lines to detect hidden breaks and illegal connections.

Noncompliance

If an entity or individual is known to be in noncompliance with an ordinance or code, and enforcement action is determined to be necessary, the enforcement action should be prompt, uniform, impartial and effective and result in the return of the entity or individual to compliance. The enforcement response should be appropriate to the violation, and take into account the severity, impact and frequency of the violation. There should be a form of progressive enforcement to escalate enforcement actions/consequences for those individuals and entities who are consistent violators or who do not respond to initial enforcement actions.

Types of Enforcement:

Enforcement actions can be of two kinds: those that address future compliance, and those that address current or past violations. Examples of enforcement actions that address future compliance are:

- Time schedule orders/directives. These may include physical infrastructure changes, i.e. adding a grease trap/interceptor to a FSE with a deadline date for compliance; or requiring the installation or adoption of other BMPs to meet a compliance deadline. They may include Correction Orders, Clean Orders, Abatement Orders, Cease and Desist Orders, and Notice to Comply depending on circumstances. These are especially used for new requirements with a compliance deadline.

- Limitations on future development/building. These are especially important if the physical infrastructure is nearing capacity. These may apply to any type of user: a campus-type industry or large industrial or commercial user, or be wider in scope and apply to a region or subdivision of the agency. These include building

moratoria, zoning changes, lot-size restrictions and other methods to limit or restrict users being added to the sewer system.

- Increased accountability for those entities with more complex systems or more risk of noncompliance. These may include more frequent reporting to the agency.

- Increased inspection frequency by the agency, especially if the entity or individual has had a record of noncompliance.

Examples of enforcement actions that address current or past violations include:

- Stop Work Orders. These may include Correction Orders, Clean Orders and Notices to Comply depending on circumstances. In extreme circumstances this may be included in the discontinuation of water and/or sewer service.

- Civil Penalties, including fines, may be included in Notice of Violation (NOV), or other Administrative Orders.

Progressive Enforcement

Progressive enforcement is an important tool for providing a fair and equitable approach to bringing an entity or individual into compliance with code requirements. Enforcement actions should progress from issuance of verbal warnings, Notices of Violations, administrative citations, to stop work orders. For repeat offenders or egregious violations of code, referral policy may include notification of the local Regional Water Quality Control Board (RWQCB) and legal actions.

- Verbal warning. In non-emergency situations this first step may be used to educate the regulated parties about noncompliance in an attempt to correct or prevent violations. This gives them a chance to correct violations, prevent recurrence and perform adequately in the future. Typically a 30-day time period is provided for the party to achieve compliance. If compliance is not achieved, the matter progresses to a letter of warning.

- Letter of Warning. The letter of warning is a formal, written notification issued for certain first-time violators. The letter should contain a description of the code being violated, a statement of the seriousness of the violation in terms of potential penalty or other relief that may be sought, a listing of the unsatisfactory conditions causing the letter of warning, one or more deadline(s) for the party receiving the letter to take appropriate action, and agency contact information to help the violator in obtaining compliance assistance. Deadlines should reflect the time typically needed to complete the work involved. The letter should clearly spell out the consequences of continued failure to comply and a compliance date. The Letter of Warning does not require a formal response from the violator.

- Notice of Violation (NOV). A NOV is a formal, written notification usually sent with a cover letter. The NOV is issued for violations of law, regulations, permits, certifications, licenses or registrations that warrant legal action if not corrected. A NOV alerts the violator that serious, potentially serious or repeated violations

exist and that the violator is or will be requested to take certain steps to address the violation. NOV should be sent by certified mail, return receipt requested. The NOV should include thorough documentation of the violation, including citation of the ordinance violated, any fees or fines associated with noncompliance, a time order for response and correction. If the entity or individual does comply within the time period specified in the NOV, the agency should issue a "Return to Compliance" letter to document compliance. The NOV usually requires a formal response from the violator within two weeks of the mailing date. The NOV should also outline appeal procedures for the regulated entity or individual.

- Administrative Citations, Notices and Orders, are written notifications of an infraction of the Code or Ordinance. Usually those classified as "citations" include fines and penalties for noncompliance. Notices and Orders usually do not have fines as a penalty, but may have administrative fees. Administrative orders direct violators to undertake or to cease specific actions/activities. Administrative Orders may incorporate compliance schedules, timeframes, administrative penalties and termination of service orders. Types of Administrative orders may include:
  - ✓ Finding of Noncompliance – a written notice to identify and correct causes of noncompliance.
  - ✓ Consent Order – a written notice that directs the violator to achieve or restore compliance by a date specified in the order. This is often a stipulated agreement that may include the compliance schedule, the payment of monetary penalties, cost-recovery and imposition of fines when milestones are not met.
  - ✓ Cease and Desist Order – directs a non-compliant user to cease illegal or unauthorized discharge immediately or to terminate discharge altogether.
  - ✓ Termination of Service or Permit Revocation – a notice delivered to a violator serving notification of the intent to revoke the permit or terminate water and or sewer service.
- Criminal Enforcement Action. By definition, most agencies make an infraction of a Code or Ordinance a misdemeanor, so the agency may have recourse to the courts for additional enforcement. In the case of major violators or repeat offenders, the RWQCB will most likely be copied on all correspondence. Some violations are knowing, intentional or negligent and are criminal in nature. Criminal violations are not subject to administrative action, but are managed though the judicial system.

Fines & Penalties

Fines should be progressive, fair and objective. They should realistically reflect the seriousness of the violation, yet avoid being excessive and unfair. Fines may be progressive with a minimum fine for a first violation, and increasing amounts for continued violations. The fine should take into account the seriousness and duration of

the violation, the degree of responsibility of the violator, actions taken by the violator to mitigate the effects of the violation, the history of past violations, the economic benefit obtained through the violation, and the ability to pay.

See Attachment A for an example of an objective penalty assessment, a penalty assessment matrix, proposed for use by the City of Seattle. See Attachment B for an example of an escalating enforcement guide (progressive enforcement structure).

6.6 Links and References – Where Can More Information Be Found?

- Mark Bradley, California State Water Control Board, CWEA PowerPoint presentation of SSO Enforcement (from State view and Local view) from September, 2008 can be obtained from him: mark.bradley@swrcb.ca.gov office telephone (916) 341-5891
- The City of Seattle (draft) Ordinance from February, 2008 contains the objective fee structure (penalty assessment matrix) in Attachment A, it can be found at: http://www.seattle.gov/dpd/static/Vol4%20Enforcement_LatestReleased_DPDP_021202.pdf
- The Missouri State Department of Natural Resources has a "Department Compliance Manual" that had good information about enforcement policy and procedures: http://www.dnr.mo.gov/compliancemanual/ the end of the manual also lists some Word forms for NOV and Return to Compliance letters.
- Other examples of NOV, Cease & Desist Orders, etc. can be found at: www.docstoc.com see for example the "Notice of Violation User's Guide" produced by the Coast Guard: http://www.docstoc.com/docs/628042/NOTICE-OF-VIOLATION-USERS-GUIDE
- Municipal Codes for many cities can be found at: http://www.qualitycodepublishing.com/codes.htm or at http://www.codepublishing.com/ or at: http://ordlink.com/
- The USA/Dig Alert website is at: http://www.call811.com/ or http://www.digalert.org/index.asp

Section 6 Attachment A

Penalty Assessment Matrix

PENALTY ASSESSMENT MATRIX

The City of Seattle has a (draft) matrix to determine compliance fines. By assigning points to the criteria, an objective monetary fine can be assessed.

Enforcement Evaluation Criteria	**No** (0 points)	**Possibly** (1 point)	**Probably** (2 points)	**Definitely** (3 points)
1. Public Health risk?				
2. Environmental damage or adversely impacting infrastructure?				
3. Willful or knowing violation?				
4. Unresponsive in correcting action?				
5. Improper Operation or Maintenance?				
6. Failure to obtain necessary Permit and approval?				
7. Economic benefit to Noncompliance?				
8. Repeat violation?				
Total of points in this column:				
Total points for table:				
Corresponding Penalty:				

Penalty Points Rating and Corresponding Penalty Amount

Rating	**1-2**	**3-4**	**5-8**	**9-11**	**12-14**	**15**	**16**	**17**	**18**	**19**	**20+**
Penalty	$250	$500	$1,000	$1,500	$2,000	$2,500	$3,000	$3,500	$4,000	$4,500	$5,000

For each of the eight (8) questions above, check the relevant probability box (No, Possibly, Probably, Definitely), then add up the number of points for each box and assign the corresponding monetary penalty. See the original ordinance at City of Seattle website for additional information. (Listed in References)

Section 6 Attachment B

Escalating Enforcement Guide

ESCALATING ENFORCEMENT GUIDE

Example: Illegal Discharge of Sewage

Violation	Enforcement Response	Notes
Isolated	NOV & Fine	Fines for isolated violations may be imposed depending on the severity of the violation, recent history of noncompliance, duration of noncompliance, and good faith and commitment to resolve noncompliance.
Recurring	NOV & Fine	Fines for all recurring violations should escalate in accordance with the severity of violation, harm to the environment, and economic benefit to violator, up to the maximum amount allowed by state and local laws.
Chronic	Administrative Order & Fine Compliance Schedule Show Cause & Fine Cease & Desist and Fine Temporary Suspension Termination Civil Action	In increasing order of enforcement, these enforcement actions may be used.

Definitions

Administrative Order – A formal order that describes the violation of the Ordinance or Code and defines what penalties or fines may be imposed.

Cease and Desist - A formal order requiring a party to stop violating an Ordinance or Code limit.

Fine - Monetary penalty assessed by the agency.

NOV - Notice of Violation.

Show Cause - Formal meeting requiring the noncompliant party to appear and demonstrate why the agency should not take a proposed enforcement action against it. The meeting may also serve as a forum to discuss corrective actions and compliance schedules.

Temporary Suspension - The temporary suspension of sewer service until compliance is demonstrated by successful completion, installation and/or payment of fines for the violation.

Termination of Service - A formal order requiring a user to stop discharging wastewater to the sanitary sewer (May include shut-off of sewer line and/or potable water line).

SECTION 7

CONDITION ASSESSMENT, LIFE CYCLE COSTS, AND CAPITAL IMPROVEMENT PROGRAM

7.1 Introduction

Section iv-c of the SWRCB Order No. 2006-003-DWQ Statewide General WDR for sanitary sewer systems requires each agency to develop a "rehabilitation and replacement plan" that should include the following activities:

- Regular visual and TV inspections of manholes and sewer pipes
- A system for ranking the condition of sewer pipes
- A time-scheduled capital improvement plan that addresses proper management and protection of infrastructure assets
- A plan for developing the funds needed for the capital improvement plan

This section of the SSO reduction BMP manual presents the reader with strategies to meet these requirements and establish a rehabilitation and replacement plan with a goal of identifying and repairing infrastructure deficiencies before they cause an SSO or result in a more costly response.

7.2 Problem Statement – Why Is This Needed?

As a collection system's overall condition deteriorates, frequencies of blockages and SSOs due to root intrusion, pipe collapses, lift station failure and other reductions in asset performance increase. These events can translate into unwanted and unexpected life cycle costs to an agency, including:

- More time spent performing preventive maintenance and emergency response work
- Emergency repair costs
- Fines from the RWQCB or other regulatory agencies
- Costs associated with lawsuits from private property owners and/or Non-Government Organizations (NGOs)
- Enforcement compliance costs

The cost to conduct an emergency repair on an asset that has already failed is typically greater than the planned cost to repair the asset prior to failure. Emergency repairs may incur the additional costs of overtime pay to complete repairs faster, higher material costs

due to rush orders and express shipping, and the costs of fines and enforcement action should a spill occur. Additionally, unplanned expenses due to emergency repairs may force agencies to raise ratepayer fees on an accelerated time schedule to provide necessary funding, which is often met with resistance from ratepayers and causes headaches for the agency.

7.3 Benefits – Why is This A Good Thing?

By implementing an effective condition assessment and capital improvement program, an agency will have the ability to:

- Understand the condition of the collection system and identify trouble spots
- Address trouble spots before structural failures and SSOs occur
- Maintain the condition of sewer collection system infrastructure at an acceptable level over time
- Plan in advance for capital improvement expenditures rather than be forced to obtain emergency funding
- Reduce emergency and unplanned workload "call-outs".
- Justify funding needs for future infrastructure replacements.
- Optimize the life cycle of sewer infrastructure.

7.4 SSO Reduction Strategies – How Is This Accomplished?

To implement a proactive condition assessment and capital improvement approach to managing sewer collection system infrastructure assets as opposed to relying on a purely reactive emergency response approach, an agency may use the general strategy outlined in Attachment A. The tasks outlined in the flow chart are developed in more detail later in this section.

All of the tasks described in this section of the manual may not be applicable to each agency. The complexity and scope of each element of a condition assessment and capital improvement program can vary widely, and will depend on the size of the collection system managed, the availability of financial and staffing resources to carry out the program, and the estimated benefit or value of the program, among a number of other possible factors. The core purpose of the program should be to reduce the occurrence of preventable SSOs, and minimize the cost of maintaining the overall condition and level of service of the collection system over a long period of time. The program should be reviewed and adjusted over time to ensure the goals are being accomplished, and to improve the efficiency with which resources, data, and finances are used.

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If

SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Task I – Assess and Document Collection System Condition

IA - Develop a Written CCTV Inspection Schedule and Lift Station & Force Main Inspection Plan (see Section 11):

An agency may decide to develop a schedule and written plan to CCTV inspect the sewer collection system. Depending on the level of available resources to conduct CCTV inspections, some agencies prefer to inspect the entire collection system at a specific frequency. Doing so allows the agency to have a relatively accurate, comprehensive, and current picture of the condition and functionality of the entire system. However, some agencies may prefer to concentrate their resources on areas of known deficiencies, based on asset age, planned and emergency work order history, results of past condition assessments, or institutional knowledge. Focus may also be placed on areas of critical importance, such as those where spills may be prone to affect Waterways of the U.S. or high profile public areas. Typically, the most valuable CCTV inspection data is obtained from inspection of assets with the worst deficiencies. An agency should make sure it has information on the age of the sewer and the expected service life, and that if such information in unknown, a conservative estimate should be made.

The cost of the condition assessment program increases with the scope and frequency of inspections. More comprehensive programs typically result in lower risk for an agency, because they can reduce the chances of an SSO occurring due to a problem that went undetected. However, the law of diminishing returns applies, in that the value of the data collected and reduction in risk of SSO occurrence does not increase continuously with increases in the scope and frequency of inspections. No one condition assessment schedule or program can apply to every agency and each should develop a program specific to their system. For more information regarding CCTV program development, see Section 4 of this manual.

Each agency should also have a regular schedule for inspecting and maintaining sewer lift stations (see Section 11 of this manual). Lift stations should be regularly maintained in accordance with the manufacturer's operation and maintenance manual. For all major components of the lift station (i.e. pumps, valves, controls, wet well, odor control equipment, etc.) an expected maintenance interval and equipment repair or replacement interval should be developed, if not explicitly stated within the operation and maintenance manual, around which regular maintenance and capital improvement can be planned. Every component of the lift station requires a major overhaul or replacement at some frequency, and the agency should be prepared to complete that work. Keeping a written log that lists all required maintenance and repair / replacement activities and documents completion of those activities can help to make sure the maintenance and inspection program is completed in a timely manner.

IB – Develop a CCTV Data Collection Method and Asset Condition Rating System:

Whether CCTV inspection work is completed internally or contracted it out, it is useful to establish a quantitative system by which pipeline defects are documented. This system should allow for quantitative comparisons of overall pipeline condition to be made among assets across the collection system. Establishing a documented system allows various agency staff members or contractors to collect and analyze data in a uniform manner that produces consistent results over time. A standardized defect coding and severity rating provides the following advantages:

- Standard identification codes and numerical rankings assigned to all defect types
- Well documented methodology, which provides consistent results and minimization of operator judgment
- Assessment of numerical ranking to each pipe that has been inspected, which may be used to quantifiably assess pipe condition

Several standardized condition assessment systems have been established that can provide similar uniform and quantitative results. The system being used by a number of agencies was developed by the National Association of Sewer Service Companies (NASSCO). Other systems have been developed by some of the major cities in California including the Sacramento Area Sewer Districts and the Union Sanitary District. Training for a selected condition assessment system for agency personnel and outside contractors is highly recommended. Outside contractors should be required to follow any CCTV data collection format that has been adopted by the agency when performing work for the agency.

Agencies managing small collection systems may prefer the use of a more simplistic system and many of them are available. Regardless of the condition assessment system employed, a standard report form should be used that lists observed defects and the pipeline footage at which each defect was observed. Each pipe that is inspected should be assigned a rating based on the number and types of defects observed. Numerical rankings, described in more detail below, or more qualitative condition rankings (e.g. good, fair, poor) should be assigned to each inspected pipe. The agency may develop a written description of the methodology used to assign pipe condition rankings based on the defects observed to be included as part of a written CCTV inspection program to help guide capital improvement decision making.

Each agency should also consider conducting manhole condition assessments, and documenting results. Manhole condition assessment may be completed in conjunction with pipeline condition assessments. NASSCO has developed the Manhole Assessment Certification Program (MACP), which can be used to document manhole condition in a format similar to PACP. Other manhole condition assessments have also been developed. If an agency is looking for alternatives, they should consider contacting neighboring communities for ideas.

Task II – Implement a Prioritization System to Schedule Capital Improvement Projects

IIA - Determine Consequences of Asset Failure Criteria:

Once condition assessment data have been collected, the agency may identify potential capital improvement projects than can be completed within a short timeframe, or with respect to immediate capital improvement project funding levels. If this is the case, identified projects should be prioritized, and a plan developed to complete the highest priority projects first. Prioritizing projects with respect only to assigned condition rankings of assets based on the methodology established in Task I-B may be adequate for smaller collection systems with a relatively low inventory of pipe and manageable amount of identified capital improvement projects. If an agency begins to develop a large backlog of significant capital improvement projects, it may be helpful to supplement the prioritization process with a consideration of the overall "risk" each project presents to the agency should the assets associated with those projects fail before the project can be completed. This process helps to ensure that capital improvement funds are spent in a way that is most valuable to the agency. Risk is typically defined according to the equation below:

Risk = Probability of Failure x Consequences of Failure

The collection system assets that should receive top priority are those with the highest probability of failing (e.g. worst "condition" ranking) and that may cause the most undesirable results should they fail (e.g. worst "consequences" ranking). Factors to consider that relate to the consequences of failure for a given asset may include:

- Public Impact
  - ✓ Is the asset located in a densely populated area, or very near to a sensitive receptor such as a school or medical facility?
  - ✓ Would an asset failure (and the associated repair work) disrupt transportation or recreation?
  - ✓ Would an SSO at that location present a significant public health hazard?
  - ✓ Public lost time dealing with the disruption.
- Environmental Setting
  - ✓ Is the asset located near a waterway?
  - ✓ Is the asset located near an environmentally sensitive area?
  - ✓ Would it be difficult to know if a failure occurred do to a remote location.
- Cost of Failure
  - ✓ What is the magnitude of potential spill volume (related to average flow rate of the asset)?
  - ✓ Would asset failure significantly affect surrounding infrastructure?

- ✓ Would emergency repair costs be relatively high?

IIB - Develop a System for Quantifying Asset Consequences of Failure:

Quantifiable rankings may be assigned to assets to document the consequences of failure for each asset for which a rehabilitation and/or capital improvement project has been identified. For example, a consideration of public impact could be made by assigning a ranking of 1-10 to each asset, with a 10 representing assets located in major arterial streets or freeways at one end of the spectrum, and a 1 representing assets on minor local streets at the other end. An agency may consider one or more factors of the "consequences of failure" to assign rankings for each asset.

The overall number of consequences of failure criteria evaluated, and the level of detail with which they are evaluated will vary depending on the agency's level of overall project "backlog". More comprehensive evaluations may be warranted where an agency has identified a large number of high-priority projects that must be completed over a long-term planning period to increase the level of confidence in the results. The agency may choose to complete these evaluations only for assets which have had condition assessments completed, or may complete evaluations for all assets and use the results to prioritize future condition assessment work.

IIC - Determine "Risk of Failure" and Prioritize Capital Improvement Projects:

Once quantitative rankings of asset condition and consequences of failure have been developed, an overall "risk ranking" may be calculated by multiplying the condition and consequences of failure rankings together. The resulting "risk ranking" may be used to sort capital improvement projects and schedule them chronologically. An example of a simplified risk assessment table, using the NASSCO "quick rating" for probability of failure criteria (refer to NASSCO PACP reference manual) and a 1-10 rating system for consequences of failure criteria is included in Attachment B.

Another possible method of performing a risk analysis using probability and consequences of failure is to express risk in monetary terms. This approach requires an assessment of the possible response costs associated with the unexpected failure of each asset. Those response costs may include clean-up costs, emergency response costs, possible fines, and administrative costs that would be incurred to repair a failed asset beyond the construction cost if the asset rehabilitation or repair was planned prior to asset failure. To determine a "risk of failure cost", the estimated cost of failure can be multiplied by an estimated probability of failure, tied to condition assessment data. For example, NASSCO provides the following guidelines for general pipe structural condition in the PACP manual:

- Any Grade 5 Defect – Pipe has failed or may likely fail within next five years
- Any Grade 4 Defect – Pipe may fail in 5 to 10 years
- Any Grade 3 Defect – Pipe may fail in 10 to 20 years
- Any Grade 2 Defect – Pipe unlikely to fail for at least 20 years
- Grade 1 Defects Only – Failure unlikely in the foreseeable future

Using condition-based failure timelines such as those shown above, a current-year failure probability may be assigned to each pipe, and multiplied by the estimated cost of failure to determine a current-year "risk of failure cost". An example cost-based risk assessment example is also provided in Attachment B.

While this type of approach requires more effort initially to develop cost of failure data, it provides a benefit by allowing the agency to rank projects by risk reduction per dollar spent. In this way an agency can ensure that their capital improvement money is providing the largest financial risk reduction possible.

It should be noted that the risk assessment methods described above are only examples of a wide range of possible strategies that could be developed to prioritize collection system capital improvement projects. Each agency should evaluate the potential level of effort to collect the necessary data, and perceived value of the information that can be developed using a given condition assessment system, and ensure that it is compatible with available agency resources and collection system level-of-service goals. As noted previously, focusing available resources for conducting condition assessments on areas of known deficiencies based on existing available information and selecting a risk analysis method with a level of detail consistent with the number and estimated construction cost of identified capital improvement projects will improve the efficiency of the program.

Task III – Establish a Long Term and Short Term Capital Improvement Plan

IIIA - Schedule Capital Improvement Projects Chronologically Based on Prioritization:

Ultimately, each agency should make a decision as to what level of asset condition is acceptable and what level requires action from a capital improvement standpoint. Typically, agencies will conduct immediate emergency repairs or schedule repair on a very short timeline when significant defects are observed such as collapses, voids, severe joint offsets, extensive root intrusion, etc. A general agency "action" for specific asset condition or risk rating ranges may be developed. See Attachment B for possible actions related to the example score-based rating system.

For agencies managing a small collection system with a relatively low number of asset deficiencies who employ a more simplified qualitative condition assessment ranking system, capital improvement projects should be scheduled such that agency operators and managers are comfortable that projects are being completed before assets reach critical or extremely deteriorated conditions. If a qualitative condition ranking system is used, the written rehabilitation and replacement plan should include a discussion of the types of defects that the agency considers significant, along with a discussion of specific time-sensitive actions to be taken in the form of capital improvement projects for specific defect types. Allowing assets to operate continuously in an extremely deteriorated state presents an agency with a significant risk of SSO occurrence, and defeats the purpose of having a capital improvement program. If a quantitative project scheduling system is not utilized, supplementing the schedule with a written narrative supporting the decisions made provides valuable documentation for the future if an evaluation of the program is required or changes to decision making schemes are desired.

Planned repairs and upgrades to sewer lift stations should also be integrated into the capital improvement project schedule. It is important that repairs and upgrades are completed at time intervals as recommended by the manufacturer or as stated according to the maintenance and repair schedule established as part of Task 1A. Any delays to lift station repairs or maintenance should be documented, including justification as to why delays are considered acceptable.

Each agency should decide how condition assessment and risk assessment data should be stored. The simplest format would be a spreadsheet that lists all pipeline assets, with columns established for various rankings, and may include formulas for automatically calculating data such as "risk rankings". If GIS or CMMS software is available, an agency may consider setting up custom tables or fields in those databases for storing data.

If an agency has a large backlog of capital improvement projects, proper documentation of capital improvement project prioritization methodology may provide the agency with a defensible position if a SSO does occur and a regulatory agency questions decision making regarding capital improvement.

It should be stressed that each agency should carefully examine any numerical method utilized to prioritize capital improvements, and thoroughly test the method with actual field data to ensure that capital improvement recommendations generated by the method are congruent with agency expectations.

The Water Research Foundation (formally AWWARF) has a CIP planning tool that is available to small agencies called "Capital Planning Strategy Manual #2520" It is noted in references section 7.6.

IIIB – Use CCTV Inspection Data to Schedule Preventive Maintenance:

CCTV inspection data is very helpful for identifying operation and maintenance issues such as grease buildup, debris accumulation, and roots which are the cause of many SSOs. Each agency should regularly review CCTV inspection data and be on the lookout for operation and maintenance related defects. When these types of defects are observed, assets should be placed on the appropriate preventive maintenance schedules (refer to Section 3 of this manual), which may include activities such as regular hydro-flushing or scheduled application of root control chemicals. Performing regular preventive maintenance can be as crucial in preventing SSOs as completing necessary capital improvement projects.

IIIC – Determine Capital Improvement Project Construction Methods and Estimate Cost:

Once a prioritized list of assets in need of repair has been generated, the most cost effective rehabilitation, repair, or replacement method for each defect should be determined, and planning level costs associated with those activities estimated. A competent person should review CCTV inspection videos for assets that have been selected for rehabilitation or replacement (R/R) based on an initial risk assessment conducted by an agency. There are many trenchless R/R methods available, and the most applicable method for a given situation depends on a wide range of factors. That person

should recommend a preferred R/R method for each selected asset and prepare cost estimates.

IIID – Create Preliminary Project Bid Packages:

Once cost estimates have been prepared and R/R methods have been selected for each asset on the priority project list, asset rehabilitations or replacements should be bundled into project groups. It is to an agency's advantage to put out to bid projects with the following characteristics:

- Highest amount of total footage possible, resulting in a lower overall cost per foot
- A single construction methodology (or at least closely related methodologies) to increase contractor efficiency
- Close proximity to reduce mobilization costs
- Coordinated with other local projects such as utility repairs, street repaving, etc.

Task IV – Develop a Funding Plan & Communicate with Utility Managers and the Public

IVA – Conduct Capital Improvement Project Cost and Funding Analysis:

Scheduling capital improvement projects can be an iterative process. Capital improvements should be bundled into logical bid packages and scheduled in time based on priority associated with risk of failure. In one regard, capital improvement project planning should not be constrained by current budgeting limitations. If the agency is confident that projects have been prioritized and scheduled in a way that accurately addresses failure risks, the argument could be made that if funding is not provided for those projects, emergency funding greater than the estimated capital improvement project costs is likely to be required when those assets fail and require emergency repair. On the other hand, funding of the capital improvement plan should be achievable and realistic. These two sometimes competing interests may be balanced using an iterative procedure:

Step 1: Create an initial project schedule (Task IIIA)

Step 2: Create a future capital improvement cost curve of expected capital improvement project expenditures in each future year based on your project schedule and project cost estimates (Task IIIA, IIIC)

Step 3: Develop a funding curve of desired capital improvement funding contributions in each future year to provide adequate funding

Step 4: Considering the feasibility and possible methods of obtaining the funds shown in the funding curve

Step 5: Adjust your project schedule or funding curve accordingly until it becomes feasible to adequately fund the plan

Example capital improvement program cost and funding analysis are provided in Attachment C.

IVB – Model Long Term Life Cycle Costs:

In addition to planning for the short term costs quantified within the capital improvement plan (based on completed condition assessments), it may be useful for an agency to understand the future costs involved with ultimately rehabilitating or replacing the entire collection system over the useful life of the system. All infrastructure has a limited useful life, and eventually deteriorates to the point of needing rehabilitation or replacement. To model the long term costs associated with rehabilitation and replacement, a useful life (in years) can be assigned to every type of asset in the collection system (i.e. lift stations, gravity pipelines, force mains, manholes, etc.). The useful life assigned to each asset type should be consistent with the agency's experience with asset failures and issues observed in the collection system. To develop life cycle cost curves, the following tasks are required:

- Assemble complete asset inventory in spreadsheet or database format
- Determine installation dates and material types for all assets
- Determine rehabilitation or replacement time intervals (useful life)
- Assume standard rehabilitation / replacement costs
  - ✓ standard cost per inch diameter per foot for pipeline rehabilitation / replacement
  - ✓ standard cost for manhole rehabilitation / replacement
  - ✓ standard costs for lift station repairs or complete replacement (as percentage of original lift station construction cost)
- For each asset, project future costs based on the installation date (step 2), selected rehabilitation / replacement time interval (step 3), and rehabilitation / replacement cost (step 4).
- Compile a composite life cycle cost curve for the entire collection system. The curve will be formed by the replacement costs for all collection system assets being distributed in future years based on their differing installation dates and rehabilitation / replacement intervals.

The effort required to assemble a complete asset inventory, including installation dates, material types, and other asset information that has a significant effect on service life (specific construction methodologies, contractor, etc.) can be daunting for an agency which does not already have comprehensive mapping or asset databases in place. If an agency does not have the resources to complete these tasks as a concentrated effort over a short period of time, asset information may be collected systematically over a longer period of time, concurrent with a condition assessment program which may include prioritized condition assessment and data collection for assets believed to have the highest risk of asset failure by the agency.

An example life cycle system cost curve is included in Attachment D. After completing a life cycle cost projection for the collection system, the agency may realize that there are large spikes, which may be due to a large group of assets installed in the same year requiring rehabilitation or replacement, or a single high cost asset nearing the end of its useful life. Realizing this in advance allows the agency to establish a baseline capital improvement funding rate which can help to build reserves prior to the rehabilitation / replacement cost spikes and reduce the potential that the agency will have to suddenly and drastically raise rates. A life cycle cost curve (long term costs) may be combined with the capital improvement project cost curve (short term costs) to give the agency a more accurate picture of future costs against which funding can be planned. Completing this type of analysis can be extremely valuable for any size collection system, and helps the agency plan to maintain the overall condition of the collection system over long periods of time.

IVC - Communicate the Capital Improvement Program:

A key to developing an acceptable project schedule and funding plan is communication with the governing board of the agency, or the entity responsible for coordinating finances to gain support for the rehabilitation and replacement program. It may take significant effort to communicate the logic behind a plan, and present the fact that it is designed to ultimately increase the efficiency with which capital improvement funds are used. Once support has been gained from utility mangers, a public outreach campaign can help to explain to the public the need to change rates, and the overall financial benefits of implementing the rehabilitation and replacement program (see Section 15 of this manual). Based on the level of the rate change and the agency's anticipation of the public reaction to any rate change that requires approval via Proposition 218, public outreach may or may not be beneficial prior to initiating the Proposition 218 process.

7.5 Measurement – How Is This Measured?

The following are a list of benchmarking statistics for which an agency may set goals and track from year to year to measure performance:

- Actual CCTV inspection footage completed vs. planned footage completion
- Overall average asset condition ranking
  (based on selected condition assessment system)
- Average annual capital improvement spending as a percentage of total system value (based on construction or replacement cost)
- Annual footage of pipeline capital improvement projects

7.6 Links and References – Where Can More Information Be Found?

- References for Information on Trenchless Technology

  North American Society of Trenchless Technology: http://www.nastt.org/

  International Society of Trenchless Technology: http://www.istt.com/

- References for Information on CCTV Condition Assessment Methods

  National Association of Sewer Service Companies: http://www/nassco.org

  LA County: http://dpw.lacounty.gov/smd/SMD/CAPdefectgradedescrp.pdf

  Contact South Placer Municipal Utilities District: http://www.spmud.ca.gov/

- References for Sewer Collection System Useful Life Assessments

  Abraham, Dulcy. "Water and Sewer Infrastructure Management: The Life Cycle Approach", 2002.

  Available at: http://eebookstore.com/pd_water_and.cfm

  Grigg, Neil. "Life Cycle Cost Integration for the Rehabilitation of Wastewater Infrastructure", 2003.

  Available at: http://cedb.asce.org/cgi/WWWdisplay.cgi?0300873

- References for Infrastructure Construction Costs

  http://www.epa.gov/OWM/mtb/pipe_construction.pdf

  http://www.epa.gov/OWM/mtb/rehabl.pdf

  http://www.epa.gov/OWM/mtb/force_main_sewers.pdf

  http://www.epa.gov/OWM/mtb/sewers-lift_station.pdf

- References for Asset Management

  Utility Infrastructure Management: http://www.uimonline.com/

  AMWA, NACWA, WEF. "Implementing Asset Management, A Practical Guide", 2007.

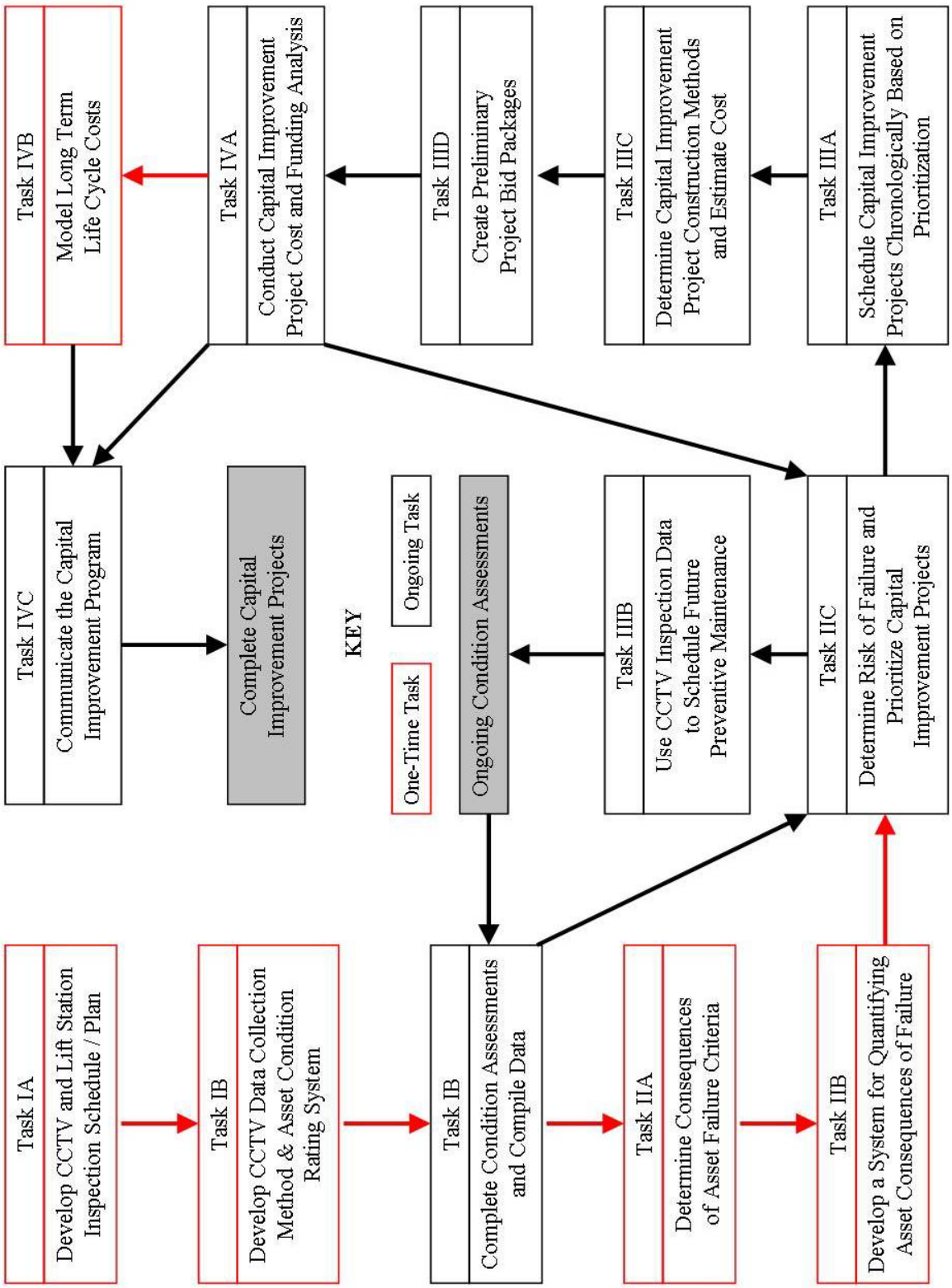
- References for Capital Improvement Programs

  Water Research Foundation, *Capital Planning strategy Manual #2520, www.waterresearchfoundation.org/*

Section 7 Attachment A

Work Flow Diagram

CONDITION ASSESSMENT AND CAPITAL IMPROVEMENT APPROACH



Section 7 Attachment B

Risk Assessment Examples

EXAMPLE SCORE-BASED RISK ASSESSMENT TABLE

Pipe ID	*Probability of Failure*	*Consequences of Failure*				*Risk*	
	NASSCO PACP Quick Rating	*Public Impact*	*Enviro. Setting*	*Cost of Failure*	*Avg. Consequences of Failure Rating*	*Risk Score*	*Risk Rating*
A-1	*3325*	*10*	*2*	*10*	*7.3*	*243*	*2*
A-2	*2512*	*3*	*2*	*2*	*2.3*	*58*	*1*
A-3	*4432*	*5*	*5*	*5*	*5*	*222*	*2*
A-4	*5143*	*2*	*5*	*5*	*4*	*206*	*2*
A-5	*3526*	*1*	*10*	*1*	*4*	*141*	*1*
A-6	*4136*	*8*	*10*	*10*	*9.3*	*385*	*4*

Risk Score = (NASSCO PACP Quick Rating x Average Consequences of Failure Rating) / 100

Example Risk Rating Key

Risk Score Range: 0-150 Risk Rating = 1 (lowest rating, least risk)
Risk Score Range: 151-250 Risk Rating = 2
Risk Score Range: 251-350 Risk Rating = 3
Risk Score Range: 351-451 Risk Rating = 4
Risk Score Range: 451-600 Risk Rating = 5 (highest rating, most risk)

Example Capital Improvement "Actions" Associated with Calculated Risk Ratings

- *Any Structural Failure (i.e. collapse, voids) – Schedule for Emergency Repair ASAP*
- *NASSCO Quick Rating > 5000 – Schedule Repair Within Next 2 Years*
- *Risk Rating 5 (highest) – Schedule Repair Within Next 3 Years*
- *Risk Rating 4 – Schedule Repair Within Next 5 Years*
- *Risk Rating 3 – Schedule Repair Within Next 10 Years (if necessary)*
- *Risk Rating 2 – Re-Inspect Within Next 10 Years and Re-evaluate Later*
- *Risk Rating 1 (lowest) – No Action Required*

EXAMPLE FINANCIALLY-BASED RISK ASSESSMENT TABLE

Pipe ID	*Probability of Failure*		*Consequences of Failure*	*Risk*
	NASSCO PACP Quick Rating	*Estimated Failure Probability*	*Estimated Excess Cost of Emergency Response / Repair*	*Risk of Failure Cost*
A-1	*3325 (Grade 3)*	*7%*	*$5,000*	*$350*
A-2	*2512 (Grade 2)*	*3%*	*$15,000*	*$450*
A-3	*4432 (Grade 4)*	*15%*	*$10,000*	*$1,500*
A-4	*5143 (Grade 5)*	*30%*	*$5,000*	*$1,500*
A-5	*3526 (Grade 3)*	*7%*	*$10,000*	*$700*
A-6	*4136 (Grade 4)*	*15%*	*$7,500*	*$1,125*

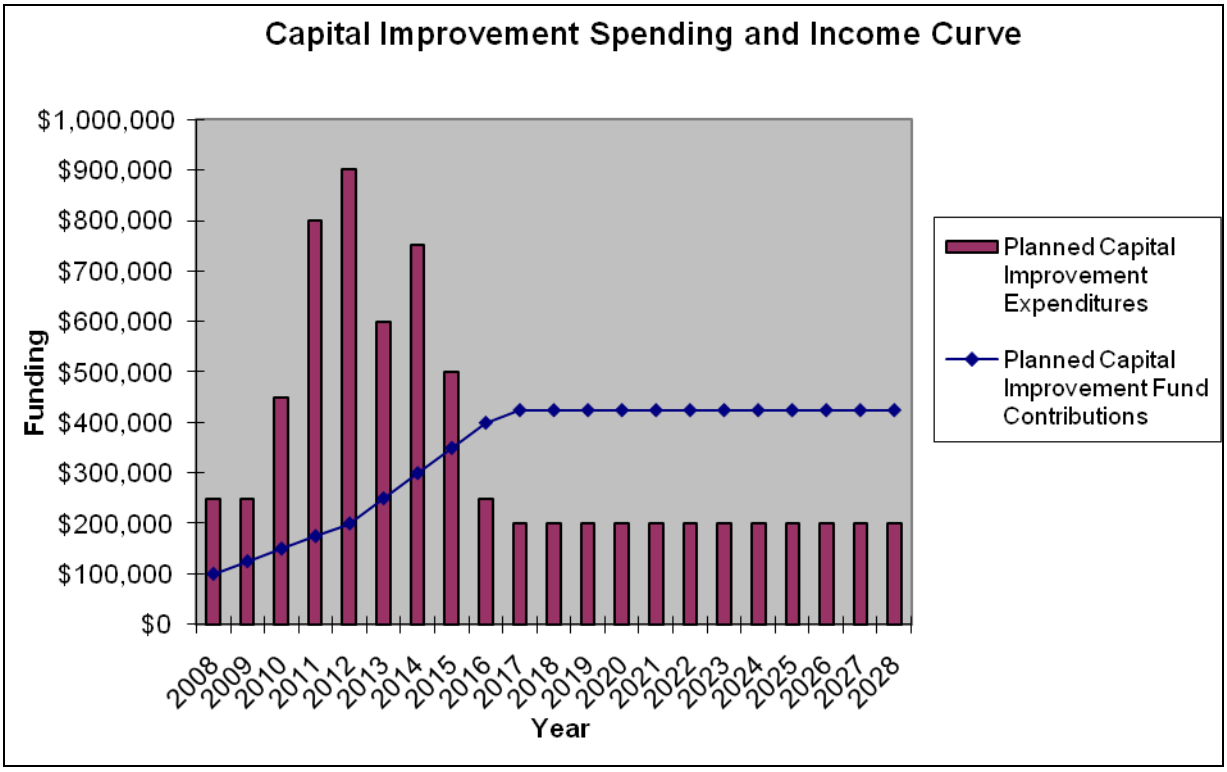
Note: The NASSCO PACP Manual offers the following warning regarding assigning failure probabilities based on condition ratings: "The mechanisms and rates of pipeline deterioration are highly dependent on the local conditions. However the following general guidelines are provided to estimate the amount of time before the defect causes complete line failure. These guidelines should be verified by actual research under prevailing local conditions". The above is only a simplified example, not intended to represent any form of industry standard assessment.

Section 7 Attachment C

Capital Improvement Project Cost Analysis Examples

Below are two examples of capital improvement project cost and funding curves. The "Planned Capital Improvement Expenditures" represents the estimated construction cost of capital improvement projects scheduled for future years based on the capital improvement plan. The "Planned Capital Improvement Fund Contributions" curve represent funds raised to pay for capital improvement projects, which for most agencies consists primarily of funds contributed from ratepayers. When the "Planned Capital Improvement Fund Contributions" curve has a higher dollar amount in any year than the "Planned Capital Improvement Expenditures" dollar amount, capital improvement fund reserves would be built in that year. When the "Planned Capital Improvement Fund Contributions" curve has a lower dollar amount in any year than the "Planned Capital Improvement Expenditures" dollar amount, capital improvement fund reserves would be diminished in that year.

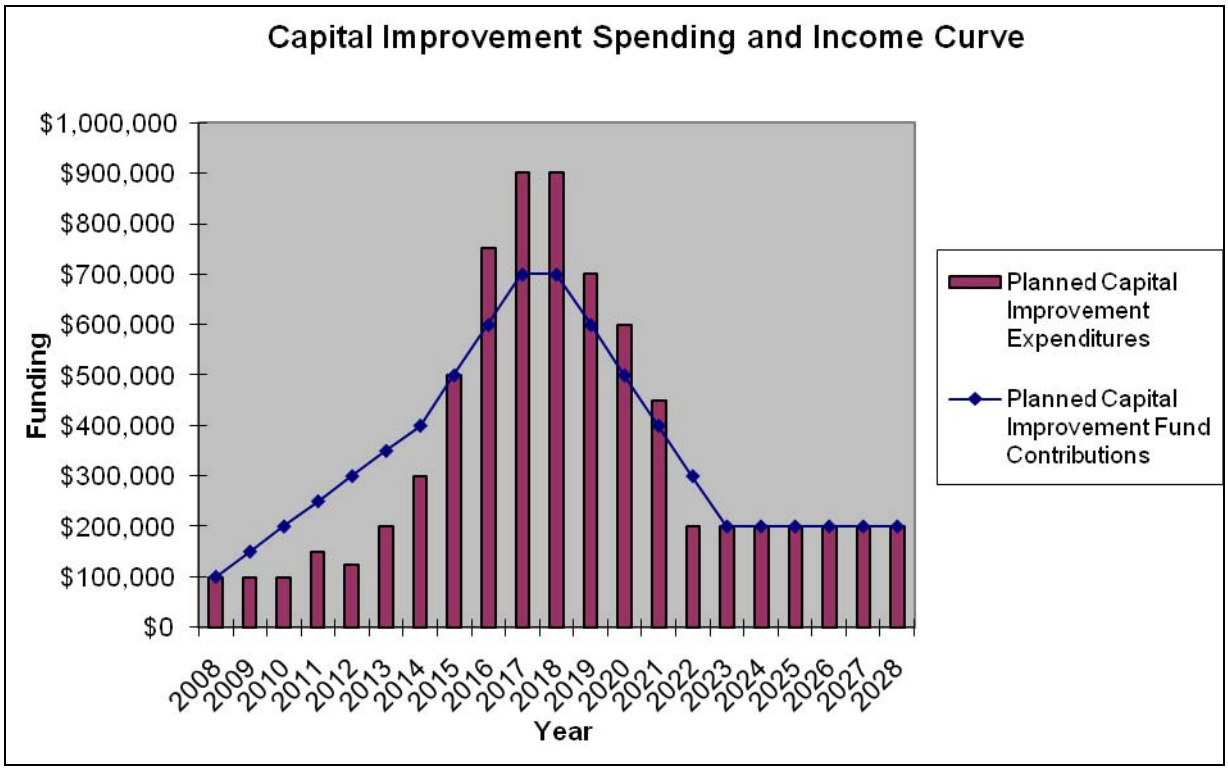
Example Capital Improvement Funding Case 1



This first example is a case of an agency that just began its rehabilitation and replacement program. This agency has identified many high priority projects with very high failure risks that should be completed within the next 10 years. The agency is currently receiving annual capital improvement funding that is well below the levels required to complete the scheduled capital improvements. This agency has decided to issue bonds to complete the work in the short term, and implement a progressively increasing rate schedule over the next 10 years that allows the agency to repay the bond over time. This strategy allows the agency time to gain support for the program and

slowly increase ratepayer fees while completing important rehabilitation work in the near term.

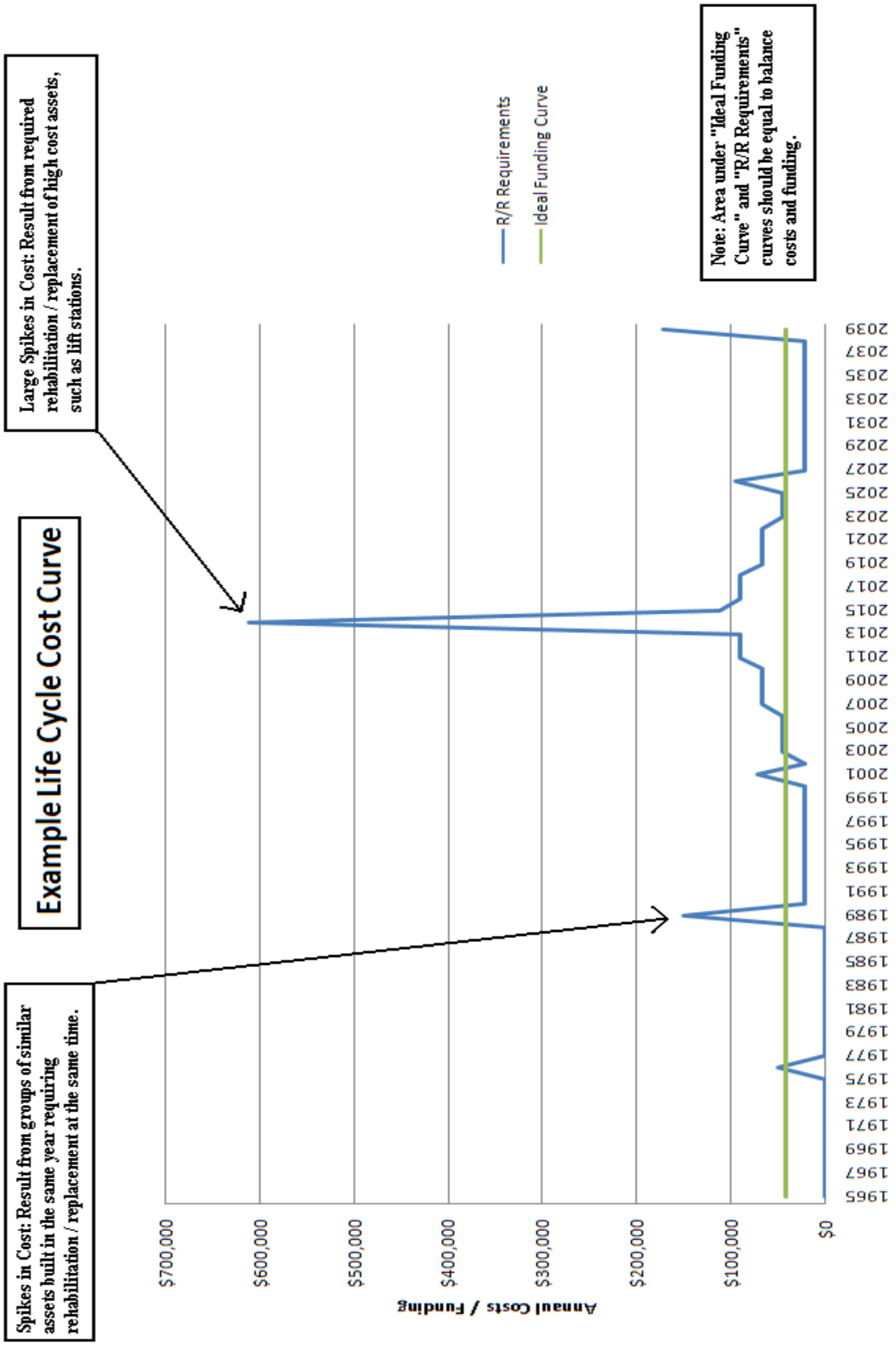
Example Capital Improvement Funding Case 2



This second example is a case where an agency has identified a manageable level of high priority projects over the next 5 years, and a large amount of medium to high level projects that can be safely scheduled up to 10 years into the future. This agency has decided to implement a progressive rate schedule in advance of the years where the bulk of their rehabilitation work will take place to build reserves and avoid issuing a bond or exploring other outside sources of funding.

Section 7 Attachment D

System Life Cycle Cost Example


Example Life Cycle Cost Curve
Large Spikes in Cost: Result from required rehabilitation / replacement of high cost assets, such as lift stations.
Spikes in Cost: Result from groups of similar assets built in the same year requiring rehabilitation / replacement at the same time.
Note: Area under "Ideal Funding Curve" and "R/R Requirements" curves should be equal to balance costs and funding.
R/R Requirements
Ideal Funding Curve
Annual Costs / Funding
$0
$100,000
$200,000
$300,000
$400,000
$500,000
$600,000
$700,000
1965
1967
1969
1971
1973
1975
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1981
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SECTION 8

SERVICE LATERALS

(AGENCY OWNED)

8.1 Introduction

This section addresses the following State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP) Elements;

- (iv) Operation and Maintenance Program (b)
- (iv) Operation and Maintenance Program (c)

Section 13(iv)b of the SSMP requires each agency's sanitary sewer system operators to describe preventive operation and maintenance activities, the system for scheduling regular maintenance, and targeted cleaning activities for areas known to require frequent cleaning. This Preventive Maintenance (PM) program should have a system to document scheduled and conducted activities, such as work orders. Further, section 13(iv)c of the SSMP requires the development of a rehabilitation and replacement plan to identify and prioritize system deficiencies and implement short-term and long-term rehabilitation actions to address each deficiency. In addition, this section of the SSMP states that rehabilitation and replacement should focus on sewer pipes that are at risk of collapse or prone to more frequent blockages due to pipe defects.

These two elements are applicable to all parts of the collection system, including any portion of a service lateral owned by a public agency.

8.2 Problem Statement – Why Do I Need This?

Service Laterals have more sanitary sewer overflows (SSOs) proportionally than the rest of the Collection System. Even though the SSOs related to services are typically less severe than a mainline spill, they are still costly to operations and public perception. The pro-active resource expenditure to perform preventive maintenance *may* cost more up-front than reacting to call-outs related to interrupted service, possibly resulting in SSOs. It takes valuable resources to provide PM to service lines. However, once developed and implemented, a PM program for laterals can be cost effective for your agency, a value to your customers, and could result in reduced fines, should your agency be scrutinized by regulators or third parties. In addition, once developed, the information captured in your lateral PM program can feed into a rehabilitation program; potentially extending the useful life of these small diameter pipes for many decades.

8.3 Benefits – Why Is This A Good Thing?

A Collections Systems Operator whose agency owns the lower lateral and abides by the intent of the Order, treats service laterals with the same attention as the main collectors of their system, will ultimately experience fewer call-outs related to interrupted service and SSOs. The time and effort spent in developing and implementing a comprehensive Operations and Maintenance Schedule, and a Rehabilitation and Replacement program dedicated to service laterals will ultimately pay large dividends by reducing unplanned/reactive work and improving public relations and customer satisfaction. Further, many times the service laterals are the severity indicators for the mainlines they are tied to, with respect to roots, cracked pipe, or sags. The defects found in service laterals causing call-outs or SSOs should be looked at as early indicators as to the age and condition of the systems they feed.

8.4 SSO Reduction Strategies – How is this Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

If a Collection System Operator has jurisdiction over the laterals serving the homes and businesses within their boundaries, several important pieces of data should be recorded and kept readily accessible: Service Line Inventory, Service Line History, Service Line CCTV inspections, and a "No Clean-outs List".

Service Line Inventory

Usually each lateral should serve only one home or business; the address for that structure can act as the unique identifier for the piping. Based on the concept of a unique identifier, a profile can be established containing the most pertinent information for that structure: Address, unique identity number, Assessors Parcel Number, lot number, subdivision, upstream manhole number, connection distance (mainline connection point), use type (residential or commercial), size of pipe, type of pipe, length of service, date the pipe was installed (age), property line clean-out location and depth, and a comments section for anything out of the ordinary (see example).

Service Line History

All work associated with each service lateral should be captured in a service request and/or work order. The service request should include the date, time the call was received, time the call was responded to, the nature of the call, if there was a stoppage (and who was the responsible party; the agency of the property owner), what work was performed, duration of the work, and any follow-up work.

Prior to acceptance, testing procedures need to be enforced to get the best product possible. Documentation of the testing procedures may initiate the first service line work order. At the very least, a service line work order should be initiated at the time of acceptance, when the billing begins. This would act as a "born on" date to capture all of the pertinent information relevant to Service Line Inventory (see Attachment A).

Service Line CCTV Inspections

Work orders associated with CCTV inspections of service laterals can be a sub-set of the Service Line History data. Typically the acceptance work order discussed above should include a CCTV inspection. The first TV inspection establishes that there is no construction debris in the lateral, and that it has proper grade, with no sags, misaligned joints, or cracked pipe. CCTV work orders should include: address, date, recorded –yes/no) (DVD, videotape or paper CCTV log), media ID, recorded from (property line clean-out, manhole, or two way at house), operator, pipe size, pipe type, pipe length, property line clean-out location and remarks. The actual CCTV log should include: distance, problem code(s), severity rating, and comments fields. The information tabulated from a CCTV should be used to establish history, record any changes to the structure or make-up of the lateral, and be input in such a fashion that it can be queried for report purposes (see Attachment A).

No Clean-outs list(s)

The most critical component of the service lateral is a Property Line Clean-Out (PLCO). Just as manholes allow access to the mainline piping, the property line clean-out allows the sanitary sewer crew the availability to access and assess the condition of the piping. The PLCO should be installed and inspected at the time of acceptance. As dictated by Uniform Plumbing Code (UPC), the clean-out should be of the same size piping as the service line, have an access box raised to grade, and be a one way clean-out in the direction of flow, going into the mainline. In the event of a stoppage, this will ensure that a cleaning tool will travel the correct way towards the main, not in the direction of the structure. Nearly every collection system has service laterals that don't have clean-outs at the public right of way (or the designated point of connection). One of the first steps in establishing a preventive maintenance program for service laterals is to make an assessment of how many cleanouts are in recorded history, and conversely, which laterals need PLCO's. At the time of the clean-out install, the service line should be assessed. Two work orders should be generated, along with an update of the service line inventory: a work order capturing the clean out install, and a CCTV work order capturing the condition assessment (see Attachment A). PLCO locations need to be stored in a data-base.

The information gathered above can entered into a service line data management system, to facilitate the pro-active approach to laterals. Assuming that your agency has property line clean-outs for all structures in your jurisdiction and reliable service line history, you can put together a service line program. Using histories of problem lines (unless they are in danger of collapse), services with root intrusion can be maintained by power rodding

or added to a root control program (see Section 3). Service lines with sags severe enough to cause stoppages need to be dug-up and repaired; slight sags can be kept serviceable through rodding and flushing, or flushing with a mini-hydro.

One component that should be mentioned, are back-flow prevention devices. During the course of ensuring all of the service laterals have PLCO's, it may become evident that certain homes are situated below the rim level of the upstream manhole of the mainline that serves their property. In these instances, an accepted back-flow prevention device should have been installed near the point of connection at the house. Your agency may need to implement a waiver system that allows you to enter the homeowner's property to install a back-flow prevention device. Once the device has been installed, the property owner is responsible to maintain the device in proper working order. Should a mainline blockage occur, the backflow prevention device could help to prevent a costly flooded home claim?

Basic components of a proactive preventive maintenance program are:

- **ROOTS at Joint**
  - ✓ Identify and group problem services into basins. By grouping into basins, you can work more efficiently.
  - ✓ CCTV the service line to check status.
  - ✓ Power rod as needed to clear roots. – re-TV or use a proofing tool to ascertain cleanliness.

Note: If possible, add to root control program as described in the *Sanitary Sewer Integrated Root Control BMP March 2005*. If not treated, each time the roots are cut, they will continue to grow back stronger. Your agency may decide to perform chemical root control for service laterals. Every agency should determine if chemical application is a cost effective root control method in their system

- **SAGS**
  - ✓ Identify and group problem services into drainage sheds.
  - ✓ CCTV the service line to check status.
  - ✓ Rod if applicable to move solids into main, and flush (both service and mainline).
  - ✓ Re-TV to ascertain the correct footage of the start and stop of the sag area.
  - ✓ Dig and repair as needed – replace if applicable.

Note: Even with education to the property owner, a line with a sag will grease up over time; sometimes not from the cooking practices of the homeowner, but from the residuals of the soaps used for laundry and dishes.

Training

Training should include correct documentation of service lateral CCTV's, proper usage of rodding equipment, how to dig-up and install a property line clean-out, correct documentation of clean-out locations, proper assemblage of work orders relative to service work, and comprehensive documentation of repair/ replacements. Scheduling of lines to be rodded or CCTV'd, should be grouped in sheds to increase efficiency.

Rehabilitation

As stated in the introduction to this section, methodologies for service line rehabilitation need to be established. Several options are available to rehabilitate services: dig and replace, cured-in-place lining, pipe burst, slip-lining, and other, or a combination of several.

Dig and Replace: Most often, a service line with a sag(s) will need to be dug up and repaired. Dependent upon the overall condition of the piping, a complete dig and replace may be warranted. The decision will depend on several factors: length of sag, depth of service, overall grade (from clean-out to mainline), utility conflicts, traveled usage of the roadway under which it resides, cost of asphalt replacement, and the availability to utilize employed staff or contracted labor. Sometimes a combination of these criteria will help to make the decision to replace the whole service line, or perhaps repair the sag area and if warranted, line the service.

Cured-in-place liner: If the service line has bad root intrusion, cracked or missing pipe, infiltration at joints, or a combination of items and the criteria mentioned above preclude a complete dig and replace, a cured in place liner may need to be installed. Typically the liner is a resin impregnated sock, which is rolled into place in the service line, inflated to form fit to the host pipe, and allowed to cure. A thorough cleaning needs to occur before the liner is installed. This can be tricky, if the pipe is cracked or missing. Depending on the length of the service, the lining contractors usually can perform two to three services a day. There is an interruption of service while the line cures. The liner can be installed through the PLCO, or if needed, at an insertion pit where the clean-out needs to be. With regards to full lining, it is very important to verify the type of pipe the liner is to be inserted into (service line pipe type). Using the correct liner for the host pipe will help ensure a wrinkle free product.

Pipe Burst: Pipe bursting (and service replacement) entails an insertion pit at the PLCO location and a receiving pit at the tie-in point (mainline or manhole). A cable is strung through the service line and a cone shaped ramming head is pulled through the line, with a new pipeline in tow. The new service needs to be flexible enough to be pulled in, yet rigid enough to replace the original service. Pipe bursting works best on services that don't have sags, as the new line typically seeks the path of least resistance, and pre-existing sags will usually be exacerbated.

Slip-Lining: Slip-lining is similar to pipe bursting, in that an insertion pit and a receiving pit are needed and the existing service is strung with a pulling cable. A new, smaller diameter service is pulled through the host pipe. Again, original pipe sizing, and the correct choice of new piping are critical. To accommodate the flows of the home or

business, the new pipe should be able to handle the hydraulic loading, should the host pipe disintegrate completely.

Note: Most agencies require a 4" pipe for service laterals. An exception to the Agency's Standards would need to occur to accommodate a smaller diameter pipe. Based on UPC code, the smallest pipe that could be used to serve a single family dwelling would be a 3" pipe. If a pipe is Slip Lined from a 4" to a 3" it is critical that it is noted in Service Line Inventory and Service Line History, so the proper sized cleaning tool would be used in the event of interrupted service.

Maintenance versus Rehabilitation: Many agencies perform a cost analysis as a decision tool to determine if rehabilitation versus continued maintenance is cost effective. Costs to rehabilitate a service lateral can range from $1500.00 to $5000.00 depending on the methodology and depending on whether the work is contracted out or is performed in-house. Conversely, life cycle costs to maintain a lateral may range from $100.00 to $300.00 per year (or more, if it needs special attention). A conscious decision needs to be made at the Management level to establish the goals of your program, and the annual Rehabilitation budget to upgrade your system.

Another factor that may come into play, which compounds the decision severely, is the possibility of structure damage associated with sewer back-ups into homes. Agencies that operate and maintain service laterals typically bear the cost burden of mitigation, in instances where no clean-out exists, a stoppage occurs (in the Agencies portion of the lateral), and the home experiences a sewer back-up into the structure. This problem can be further exacerbated when two structures are connected to one service lateral. One homeowner can unwittingly flood his neighbor, if a stoppage occurs on the agency's portion of the sewer lateral.

For portions of the lateral that an agency does not have jurisdiction, that agency could develop an ordinance requiring property owners to maintain the lateral correctly. For example an agency could adopt a regulation to require, at the time of property transfer, lot line adjustment or major building permit, that the owner inspect and tests the existing service line on the property. If the line is found deficient, the property owner would be required to complete upgrades prior to completion of the event that prompted the inspection.

8.5 Measurement – How Do I Measure This?

Many agencies have realized that ownership of service laterals raises the level of reportable spills exponentially. Measurement can be call-outs that are the agencies responsibility, SSOs caused by blockages in the service laterals per number of laterals in system, what percentage of reportable SSOs are caused by blockages in service laterals or repeat call-outs at the same residence, repeat callouts and repeat SSOs. Each agency needs to determine what metrics are suitable for their area. Once identified, these metrics need to be analyzed to identify trends. The ultimate goal is to provide un-interrupted service to your customers and SSOs caused by pipe defects.

8.7 Links and References – Where Can I Find More Information?

- Definitions of piping
- Green Book references
- CCTV Protocols
- Sanitary Sewer Integrated Root control Best Management Practices –collection System Collaborative Benchmarking Group march 200

SECTION 9

INFILTRATION AND INFLOW

9.1 Introduction

This section of the SSO Reduction Strategies Best Practices Manual looks at methods of reducing Infiltration and Inflow (I/I) within a wastewater collection system. I/I reduction consists of the following tasks:

- Mapping and Planning
- Flow Monitoring
- Sanitary Sewer Base Flow Estimation
- I/I Analysis
- Hydraulic Modeling
- Cost Effectiveness Analysis
- Source Detection
- Sewer Rehabilitation
- I/I from Laterals

Within this section there is a brief statement of each bullet above, including differing levels of I/I reduction strategies and references to expand on the information presented.

Elements of an I/I program can be used to fulfill portions of the Statewide General WDR for Wastewater Collection Agencies; specifically, an Operations and Maintenance Program (parts of Section 13 (iv)), the SECAP (Section 13 (viii)), and the Monitoring and Measurement Program (Section 13 (ix)).

9.2 Problem Statement – Why Is This Needed?

There are three major contributors to wastewater flows. These include:

- Sanitary or base flow generated by residences and businesses
- Rain-dependent infiltration and inflow (RDI/I), and
- Groundwater infiltration (GWI) caused by high groundwater levels (or tidal action in areas near coastlines).

Base flow is wastewater generated by residences, businesses, and industrial applications. Wastewater flows measured in the summer tend to be composed primarily of base flow, unless they are influenced by groundwater levels.

Infiltration is an indirect introduction of water into the sewer through leaky joints, pipe cracks, damaged lateral connection or manhole walls, etc. **Groundwater infiltration (GWI)** depends on the depth of the groundwater table in relation to the sewer pipes. Groundwater level fluctuates seasonally and/or tidally and can be affected by water levels in nearby water bodies. Infiltration from rainfall depends on the size and duration of the storm event and saturation of the soil and is only sustained for a short period of time during and after the rain event.

Inflow is caused by a direct connection to the sewer system such as open cleanouts, leaky manholes lids, roof or basement drains, etc. and is usually associated with a rain event. Since it is a direct connection, inflow is seen in peak hourly wastewater flows. Since inflow doesn't exist on its own, peak hourly flows also include an element of infiltration (as described above).

Peak hourly flows can be defined by peaking factors (peak hourly flow divided by average dry weather flow). Sewers can be sized using peaking factors and peak hourly flows. Peak wet weather flows can also be generated using a hydraulic model (which estimates peak flows during an appropriate storm event), or flow equations based on the contributing area, number connections, length of pipe, and/or other factors. Peak wet weather flows can also be considered in the sizing of sewer facilities.

Significant amounts of infiltration and inflow are of concern because they:

- Can reduce the capacity and capability for the sewer system to convey the intended design flow;
- May be the cause of or contributor to wet weather-related sanitary sewer overflows;
- May require construction of facilities with added capacities which may otherwise not be required; and
- May increase operational costs for the conveyance system and at the wastewater treatment plant.

9.3 Benefits – Why Is This A Good Thing?

Reducing infiltration and inflow within the system frees up capacity in both the sewer system and at the wastewater treatment plant. In addition, less I/I may less chance of sanitary sewer overflows (SSOs) and lower operational costs.

9.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

There are two general methods of dealing with Inflow and Infiltration (I/I):

- Reducing the sources of I/I through rehabilitation of the sewer system and tracking down illegal connections, and
- Design for the anticipated peak wet weather volume by over-sizing the collection system and treatment facilities.

It is unrealistic to completely eliminate I/I from a collection system. However, experience has shown that a reduction in I/I can be achieved cost effectively in some cases and the remainder of the I/I to be managed. A successful I/I program may maximize capacity, identify where capacity enhancements are needed, delay capacity-related capital improvements, and reduce operational costs. The intent of this strategy guide is to provide a general overview on quantifying I/I and locating I/I sources in a collection system, determining capacity issues in the system related to I/I, methods of reducing I/I in sewer systems, and determining the cost effectiveness of various solutions.

These I/I reduction strategies are outlined by level of effort, which is defined by funding constraints. Funding constraints may be determined on an individual basis.

Mapping and Planning

All systems should have a complete map of their wastewater collection system consisting of current, accurate information on component locations and attributes pertinent to maintenance activities. The map should also be in an electronic format (such as AutoCAD or ArcView) and contain information that can be easily utilized for a hydraulic capacity analysis (described later in this section). Hand drawn maps, which are not easy to update, should eventually be convert to an electronic format.

For the purposes of I/I analyses, map information needs to facilitate identification of distinct sewer shed areas for flow monitoring and assessment of the success of rehabilitation projects to reduce I/I. Similar to a watershed with creeks and rivers, a sewer shed (or “shed”) has networks of smaller pipes leading to larger conveyances. Mapping these sheds allows for clearly identifying where flows are going and which smaller lines feed which large lines.

Procedures should be in place to support regular inspection of system components, monitoring of system performance, and documentation of information obtained (See Section 16). The resulting database should be evaluated as a routine activity in planning rehabilitation and improvement projects addressing I/I reduction.

Flow and Rainfall Monitoring

Flow monitoring is needed for quantifying and locating sources of I/I, setting benchmark conditions prior to I/I rehabilitation improvements, determining the impact of I/I improvements, and conducting a capacity analysis of the wastewater collection system.

Flow monitoring conducted for an I/I analysis should occur during both dry and wet weather periods. Ideally, dry season flow monitoring should occur when the influence of I/I (including GWI) is minimal, typically during the late summer or early fall, unless seasonal or tidal groundwater fluctuations are a factor. Wet weather flow monitoring should occur during winter months that typically experience a high incidence of rainfall intensities. Sewer systems are evaluated and designed using peak hourly wet-weather flows.

Flow monitoring placement is a key component to I/I reduction. To gather data that is most representative of the system's response to storm events, care should be taken in planning the number and specific location of temporary and/or permanent flow monitors as well as considering manufacturer's recommendations. Monitors may be placed, when appropriate, upstream of pump stations to avoid flow attenuation effects, away from bends that introduce turbulence affecting accuracy of measurements, and in manholes or structures which have only one inlet and outlet to enable isolating measurements to a single tributary area. Doing so may help alleviate any anomalies in the data that may be present due to improperly placed flow monitors. In addition, flow monitors should be placed at a site where they are accessible to whoever is maintaining them.

One strategy for conducting flow monitoring could include hourly flow monitoring at pump stations and wastewater treatment plant influent flow meters. If budget allows, it is recommended that additional temporary flow monitors be placed in the winter to monitor areas of suspected high I/I (e.g. areas with aging sewer pipe). This data should be hourly at a minimum. Dry weather data can be determined from pump stations and the wastewater treatment plant (WWTP) and during time periods with minimal I/I influence for the temporary monitors. Hourly rainfall data does not necessarily need to be monitored with this level of effort. If available, it can instead be collected from a number of online resources such as:

- California Department of Water Resources California Data Exchange Center (http://cdec.water.ca.gov)
- California Irrigation Management Information System, Department of Water Resources, Office of Water Use Efficiency (http://wwwcimis.water.ca.gov/cimis/data.jsp)
- University of California Integrated Pest Management Online (http://www.ipm.ucdavis.edu/WEATHER/wxretrieve.html)
- NOAA Satellite and Information Service (available for purchase) (http://www.ncdc.noaa.gov/oa/climate/stationlocator.html)

A second flow monitoring strategy could include flow monitoring at the WWTP and pump stations, with the addition of temporary flow monitoring in areas of suspected high I/I. The number of monitoring sites will depend on the characteristics of each individual system. This level of effort allows for monitoring of tributary areas generally containing no more than 100,000 linear feet of sewer (excluding service laterals). Hourly or more frequent flow monitoring could be conducted during the wet season. Rainfall data during the monitoring period should be collected by placing and maintaining at least one rainfall

gauge during the flow monitoring period. Rainfall data can be obtained from other sources, where available.

A third flow monitoring strategy could consist of conducting on-going flow monitoring with dedicated staff to properly perform sewer shed and sub-shed investigations in areas of suspected high I/I. This effort may involve comprehensive documentation of flow monitoring calibration and data QA/QC measures. Weather stations can be set up at multiple locations. Groundwater elevation data may be monitored in areas with suspected GWI influence.

Sanitary Sewer Base Flow Estimation

Base flow is wastewater generated by residences, businesses, and industrial applications. Base flow is the measure of predictable diurnal (daily) sewer flow variability during the time of year when average daily flow is at a minimum (typically during late summer/early fall). The purpose of measuring base flow is to determine (1) how much of peak flow in winter is due to RDI/I and (2) how much of winter dry weather flow is due to GWI (for those sewers sheds whose lines are located within the groundwater table).

One strategy to estimate base flow is from flow data at pump stations and the WWTP, preferably during dry weather flows during late summer/early fall. Dry weather data can also be determined to some extent from dry periods during winter flows monitoring, although this data may be influenced by GWI.

A second strategy includes the same level of effort as the previous strategy, but also to determine base flows from temporary flow monitoring.

A third strategy includes using on-going flow monitoring data to establish base flow data available from late summer/early fall or when groundwater monitoring indicates groundwater levels are lowest.

I/I Analysis

Flow monitoring data is utilized to evaluate severity of I/I within individual flow monitoring basins. The results of this analysis, along with possible source detection inspection results, can then be used to identify the sheds possessing the greatest potential for I/I reductions and narrow the field for targeted investigations.

It may be important to be able to determine the effect of I/I reduction efforts regardless of the size of storm that occurs. There are two possible ways of normalizing the data in this analysis so that the results can be compared between different sizes of storm events. These include: (1) calculating R-values (approximate percentage of rainfall entering the system during a storm event), peaking factors (peak hourly flow divided by average flow), gallons per day/inch-diameter-mile (gallons per day of I/I entering the system per inch-diameter-mile of pipe) and gallons per day/acre (gallons per day of I/I entering the system per acre of tributary area) factors, etc. and (2) projecting results to a design storm and directly comparing volumes. A design storm is typically selected by each agency

individually. However, many municipalities, especially in the Central Valley, seem to be moving toward a 10-year return period design storm.

Hydrographs (a graph showing flow over a period of time) of flow during storm events can also be useful in determining RDI/I types. For instance, inflow is typically characterized by a rapid peak during the storm event. A slow drop off tends to indicate the presence of rainfall-dependent infiltration. It is important to distinguish between infiltration and inflow because the investigation techniques and subsequent rehabilitation projects are different for each one. Both are often present in the same basin.

One strategy involves using hourly flow monitoring data from pump stations and the WWTP to normalize the data for a minimum of one significant storm event using R-values, peaking factors, gpd/idm (gallons per day per inch diameter of pipe per mile) factors, etc. Both base flows, as developed in the previous step, and peak flows from at least one storm event are required for this effort. Hydrographs should also be developed to determine whether inflow and/or infiltration are the main contributors. Flow monitoring basins should be prioritized for further investigation and potential rehabilitation based on these results.

A second strategy involves all of the steps of the previous strategy, but includes these steps for all significant storm events during the flow monitoring period. A design storm can be developed here and used to project any significant rainfall events during the flow monitoring period to the design storm level.

A third strategy includes analyzing any significant storm events that have occurred during the continuous flow monitoring period and creating correlations between normalized I/I rates and sizes of storm events. Volumes of I/I from these storms should be estimated. A design storm should be developed and volumes for existing storms should be projected to the design storm to directly compare I/I volume contributions. Groundwater data should be incorporated to determine if there is a correlation with infiltration within the system.

Hydraulic Modeling (also see Section 14)

I/I studies are often paired with a hydraulic model of the sewer system. Modeling analyses are typically used to enable identification of relief and rehabilitation improvements to correct current capacity deficiencies and prospective additions that may be needed to accommodate future service area growth. The model is commonly employed as part of a sewer system master plan and/or to comply with the System Evaluation and Capacity Assurance Plant (SECAP) requirement of the WDRs.

One strategy includes using a spreadsheet model limited to include known problem areas. One thing to consider when using this type of model is that it is not as easy to take a big picture look at the results. In addition, it is a static model that does not necessarily accurately account for the time it takes for flow to go from one point in the system to another. These models may work best for small systems.

A second strategy involves the use of a static or dynamic computer model rather than a spreadsheet model. Examples of these types of models include SewerCAD (static) and InfoWorks CS (dynamic). Larger systems may consider using a dynamic model rather than a static model. A model may target main sewers (typically 8- to 12-inches in diameter or greater, depending on the size of the system). Model calibration is limited by the number of flow monitors in the system. Collection system modeling strategies are discussed in more detail in Section 14 of this guide.

A third strategy involves creating a dynamic hydraulic model of the collection system. The modeled portion of the system will again be determined by the number of flow monitors in the monitoring program. With this level of effort, it may be appropriate to model specific areas of the system that are smaller than typical main sewers (i.e. less than 8- to 10-inches in diameter).

I/I Source Detection

Specific areas for investigation of I/I sources may initially be determined by the results of the flow monitoring and the I/I analysis. **Sources of inflow** are located in different ways than infiltration because their means of entry into the collection system are different (as described in the Problem Statement). That is, inflow sources are typically located using methods such as smoke testing while CCTV and wet weather isolations tend to be used to locate **infiltration sources**.

A successful I/I source detection program may include a routine source detection inspection effort that is incorporated into a comprehensive annual maintenance program. Findings should also be incorporated into a permanent database and be analyzed to prioritize I/I sources for rehabilitation.

One strategy involves visual inspections of manholes to assess physical conditions and unusual flow sources, and smoke testing to identify any direct connections to the sewer system such as a cross connection to a storm drain or roof drains from buildings. For this level of effort, inflow sources should be targeted as they produce peaks, which can dramatically reduce capacity in the sewer system. Findings should be documented using photographs and field reports.

Smoke testing consists of placing smoke in a sewer line, usually by placing a smoke bomb in a manhole, and then forcing the smoke up the sewer system with a blower. The smoke then goes up the pipe and house laterals and exits at locations where inflow may enter the sewer. Smoke testing can find roof drains and yard drains connected to the sewer system as well as broken pipe where the smoke comes out through the soil. Smoke testing should be done with a certain amount of public outreach to prevent calls to the fire department.

A second strategy includes the strategy mentioned above plus performing CCTV inspections of pipelines which are shown or suspected to significantly contribute to infiltration.

A third strategy incorporates flow isolation studies, visual and CCTV inspections, and smoke testing. Under this effort, an ongoing CCTV program is recommended to be incorporated into the system's proactive O&M plan. Further discussion of CCTVing is included in Section 4.

Cost Effectiveness Analysis

Using the information gathered from the data analysis and subsequent hydraulic model, I/I investigations for all levels of effort may need to include an analysis to determine the most cost effective solution. The cost effectiveness analysis should consider various combinations of partial I/I source reduction together with resulting downstream flow accommodation costs. Complete I/I elimination is an impractical objective and, therefore, estimating its costs is not possible. Therefore, efforts typically involve a combination of sewer rehabilitation to reduce I/I and some degree of increasing the capacity of existing facilities.

Rehabilitation costs should include the cost to perform source detection tasks as well as rehabilitation tasks described in further detail in Section 7.

Sewer Rehabilitation

As noted under the Cost Effectiveness Analysis section, complete elimination of I/I is unrealistic. Experience has shown that I/I reduction is most effectively achieved through an on-going maintenance program consisting of cleaning, inspection, flow monitoring, testing, and rehabilitation. Rehabilitation takes many forms of repair whether it be cleaning, grouting, lining or completely replacing a pipeline segment.

Selection of rehabilitation methods for consideration in an I/I reduction analysis or for actual implementation depend on the nature of the I/I source and the cost and collateral implications of its reduction or elimination. Specific rehabilitation methods with current technologies may include any of the following:

- Grouting – Chemical grouting of isolated cracks and open joints in pipelines and manholes that are point sources of infiltration (this is a short term fix).
- Pipe Slip lining – Lining of short or long reaches of pipelines that demonstrate multiple infiltration sources.
- Manhole lining – Lining of manhole interiors that demonstrate infiltration sources.
- Pipe Bursting – A pipe replacement inserted through the existing conduit.
- Reconstruction – Complete reconstruction with a new pipe section over a short or long reach.

Reliance on rehabilitation methods alone as the primary means of long term I/I control may be more costly and less effective than a comprehensive maintenance and repair program.

I/I from Laterals

Numerous studies have confirmed that sewer laterals can be a significant source of infiltration and inflow, sometimes more than 50% of the total I/I... Ownership of these laterals can vary. Some agencies own all parts of the collection system, including the laterals. In other cases, the owner of the property may own the lateral from the residence to the point of connection on the main line. Alternatively, the agency and land owner may each own a piece of the lateral.

Regardless of ownership, since laterals can be a significant source of I/I, it is important that the agency has a way to regulate these laterals. Private property lateral programs can range from the agency taking responsibility for lateral repair/replacement to a partial incentive program to simply imposing regulatory requirements to maintain/repair/replace laterals. Incentive programs can consist of grants or low interest loans to property owners when they are required to repair or replace their service lateral. A number of agencies around the State now have such programs and they are significantly reducing I/I.

Further information regarding how communities have implemented private property lateral programs and how successful they have been are being compiled by the Water Environment Federation (WEF). See Section 7.

9.5 Measurements – How Is This Measured?

It is important to track the progress of an I/I reduction program to test its effectiveness. To do this, flow should be monitored before and after the rehabilitation project. These flow results should either be normalized or projected to a design storm level as mentioned previously, so they can be compared relatively directly.

Agencies should also be aware that rehabilitation in one area can cause problems in another area, especially if an agency ignores sources such as privately owned laterals.

9.6 Links and References – Where Can More Information Be Found?

- Water Environment Federation (WEF) website: http://www.wef.org/apps/PPVL_Site/wef/ppvl_main_page.asp
- Bible, David. Unique Performance-Based I/I Reduction Contract Exceeds Goal. Water Environment Federation (WEF). Collection Systems Conference, 2007.
- Calamita, F. Paul. Keeping the Sharks Out of Your Laterals: Fearless Private Lateral Rehabilitation. Water Environment Federation (WEF). Collection Systems Conference, 2008.
- Cohen, Davidson, Carter, Chase, and McLamarrah. Private Property Virtual Library, Where We've Been and Where We're Going. Water Environment Federation (WEF). Collection Systems Conference, 2008.

- Huber, M. and T. Luking. Wet Weather Automated Metering and Evaluation for I&I Removal. Water Environment Federation (WEF). Collection Systems Conference, 2007.
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- Scarano, J. and M. Adams. 70 Percent I/I Reduction – Sweet Home, Oregon Aims High with Collection System Management Best Practices. Water Environment Federation (WEF). Collection Systems Conference, 2007.
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- Water Environment Federation (WEF). 1999. Prevention and Control of Sewer System Overflows, WEF Manual of Practice FD-17, Second Edition. Alexandria, Virginia.
- Water Environment Federation (WEF). 1999. Wastewater Collection System Management, WEF Manual of Practice No. 7, Fifth Edition. Alexandria, Virginia.
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SECTION 10

FATS, OILS, AND GREASE (FOG) CONTROL

10.1 Introduction

This section addresses the following State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP), Section D.13 (v) - Legal Authority and Section D.13 (vii) - FOG Control Program as follows:

Section D.13 (iii) **Legal Authority:** Each Enrollee must demonstrate, through sanitary sewer system use ordinances, service agreements, or other legally binding procedures, that it possesses the necessary legal authority to:

(d) Limit the discharge of fats, oils, and grease and other debris that may cause blockages,

Section D.13 (vii) **FOG Control Program:** Each Enrollee shall evaluate its service area to determine whether a FOG control program is needed. If an Enrollee determines that a FOG program is not needed, the Enrollee must provide justification for why it is not needed. If FOG is found to be a problem, the Enrollee must prepare and implement a FOG source control program to reduce the amount of these substances discharged to the sanitary sewer system. This plan shall include the following as appropriate:

(a) An implementation plan and schedule for a public education outreach program that promotes proper disposal of FOG;

(b) A plan and schedule for the disposal of FOG generated within the sanitary sewer system service area. This may include a list of acceptable disposal facilities and/or additional facilities needed to adequately dispose of FOG generated within a sanitary sewer system service area;

(c) The legal authority to prohibit discharges to the system and identify measures to prevent SSOs and blockages caused by FOG;

(d) Requirements to install grease removal devices (such as traps or interceptors), design standards for the removal devices, maintenance requirements, BMP requirements, record keeping and reporting requirements;

(e) Authority to inspect grease producing facilities, enforcement authorities, and whether the Enrollee has sufficient staff to inspect and enforce the FOG ordinance;

(f) An identification of sanitary sewer system sections subject to FOG blockages and establishment of a cleaning maintenance schedule for each section; and

(g) Development and implementation of source control measures for all sources of FOG discharged to the sanitary sewer system for each section identified in (f) above.

10.2 Problem Statement – Why Is This Needed?

The discharge of fats, oils and grease (FOG) can be a problem for many sewer systems and a major problem for some sewer systems. FOG discharged from grease producers including Food Service Establishments (FSEs) can generate high volume spills which can be very expensive to mitigate. In contrast FOG discharged from residential areas typically results in a high number of low volume spills.

Agencies that have FOG problems and do not control them may experience:

- A higher number of blockages and SSOs
- Increased operation and maintenance costs
- Enforcement actions including fines from regulatory agencies
- Lawsuits from non-governmental organizations (NGOs) or from private citizens

10.3 Benefits - Why Is This A Good Thing?

- Reduced number of FOG blockages and SSOs
- Reduced exposure for compliance/enforcement actions
- Reduced exposure for lawsuits
- Reduced reactive maintenance costs
- Reduced potential for increased user fees

10.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

If an agency experiences FOG or grease blockages, the agency should identify the manhole to manhole pipeline segments of the sewer system where grease has caused blockages. Next, the agency should determine if the source of the grease problem is residential, commercial or industrial. The pipeline segments should then be inspected with closed circuit television (CCTV) equipment to determine if there are structural or maintenance problems such as sewer sags, offset joints, or root intrusion that should be corrected or if the problems are simply caused by too much grease being discharged into the pipeline segments. If there are no structural or maintenance problems that should be fixed, or if the corrective action cannot be implemented immediately, the agency should establish a cleaning maintenance schedule for each pipeline segment. The list of priority maintenance areas can be called a grease or FOG high frequency pipeline cleaning list, or FOG hotspot list, or another name that is useful too the agency..

The cleaning maintenance schedule and cleaning method should be set to clean these sections frequently enough and with the right equipment so that accumulated grease will not cause blockages and/or SSOs between cleaning cycles. As discussed under "Preventative Maintenance for Gravity Sewers" (see Section 3), the scheduled cleaning frequency and cleaning methods may vary between agencies and may even vary between different areas of the community being served. If cleaning the pipelines on a regular schedule keeps the blockage rate low and FOG SSOs are not occurring, the agency may not need to implement any other FOG control measures. However, all agencies must establish the legal authority to impose source control requirements even if a FOG control program is not warranted.

If cleaning the pipelines in residential areas or high density residential neighborhoods with large apartment complexes is not enough to prevent FOG related SSOs, or if the cost is too high, then the agency should consider implementing residential Best Management Practices (BMPs) and institute a concentrated and targeted outreach program to help reduce FOG discharges to the collection system.

If cleaning cost in commercial/industrial areas is too high and/or the FOG blockages and SSOs cannot be prevented by frequently cleaning the pipelines in these areas, the agency will need to implement a regulatory Grease Source Control program.

The agency might want to begin with a voluntary approach as shown in Figure 10-1 and 10-2. If a voluntary approach is successful, then the agency may be able to avoid implementing a Grease Source Control (GSC) program until conditions change that warrant a source control program. If a voluntary approach using Best Management Practices (BMP) does not provide acceptable performance, then the agency may need to regulate grease dischargers by implementing a GSC program. As part of this process, it is often useful to create a stakeholders group consisting of representatives from food service establishments (FSEs) and other commercial and residential areas that may be affected by new grease source control requirements.

Elements of a regulatory approach include:

- FOG ordinance

- Requirements to install grease removal devices (such as traps or interceptors),
- Design standards for the removal devices
- Maintenance requirements
- BMP requirements
- Record keeping and reporting requirements
- Manifests for grease haulers to ensure they do not illegally dump their waste into the agency's sewer system
- Authority to inspect grease producing facilities
- Compliance standards
- Adequate authority to enforce the FOG ordinance;
- Conditional wavier criteria for individual dischargers
- A plan and schedule for the disposal of FOG generated within the sanitary sewer system service area.
- A list of acceptable grease disposal facilities.

An effective approach for an agency's GSC program should be similar to progressive discipline. An agency should take steps that get progressively more restrictive for the FOG dischargers until the desired performance is achieved. To implement a GSC program an agency might want to follow the steps and strategy shown in Figures 10-1 and 10-2.

10.5 Measurement – How Is This Measured?

Good sewer maintenance should include monitoring a number of performance measures. Performance measurements or metrics related to FOG include amount of sewer line cleaning, and amount of CCTV measures which are included in Sections 2 and 3 of this manual. Table 10-1 presents FOG specific metrics:

Table 10-1
Performance Metrics – FOG

Metric	Measure
Total number unscheduled FOG work orders	#/yr
Total number of FOG related SSOs per year	Spills
Total volume of FOG related SSOs per year	Gallons
Percent of SSOs caused by FOG	%
Number of Inspections of FSEs or other FOG dischargers	Number
Number or repeat SSOs caused by FOG	Number

Percent of work orders for FOG lines cleaned on schedule	%
Percent of work orders for FOG lines cleaned within x number of days	%

10.6 Links and References – Where Can More Information Be Found?

- Visit Cal-FOG web-site @ http://www.calfog.com/programs.html for examples of various FOG program approaches for residential, commercial and industrial customers that are currently implemented in California and other States including the Cal FOG Program Development Guide.
- Section 7 of the SSMP Development Guide, prepared by the CVCWA Collection System Committee, © CWEA.
- SWRCB Order No. 2006-0003-DWQ: http://www.waterboards.ca.gov/resdec/wqorders/2006/wqo/wqo2006_0003.pdf

Figure 10-1
Fats, Oils and Grease (FOG) SSO Reduction Strategies

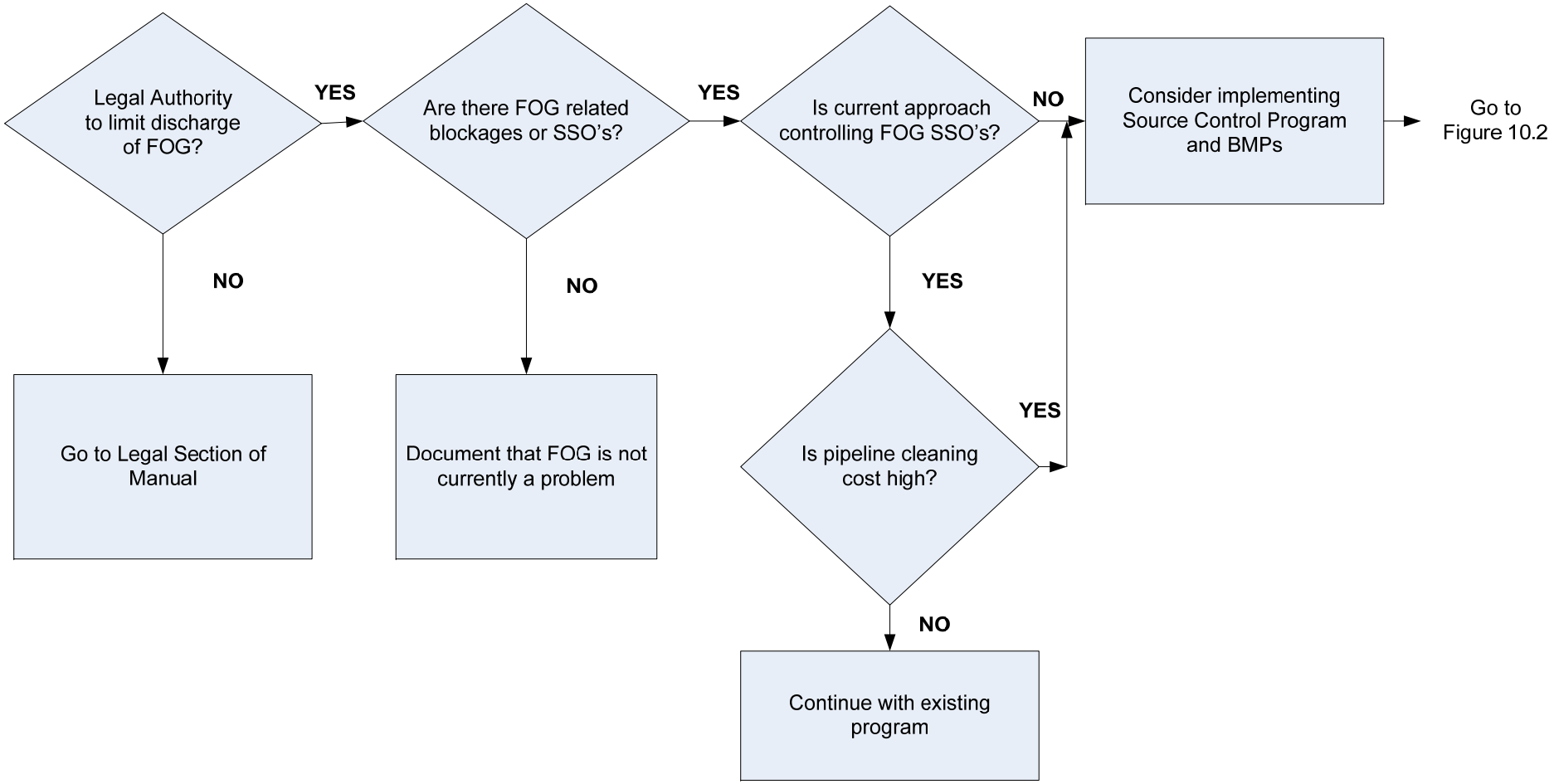
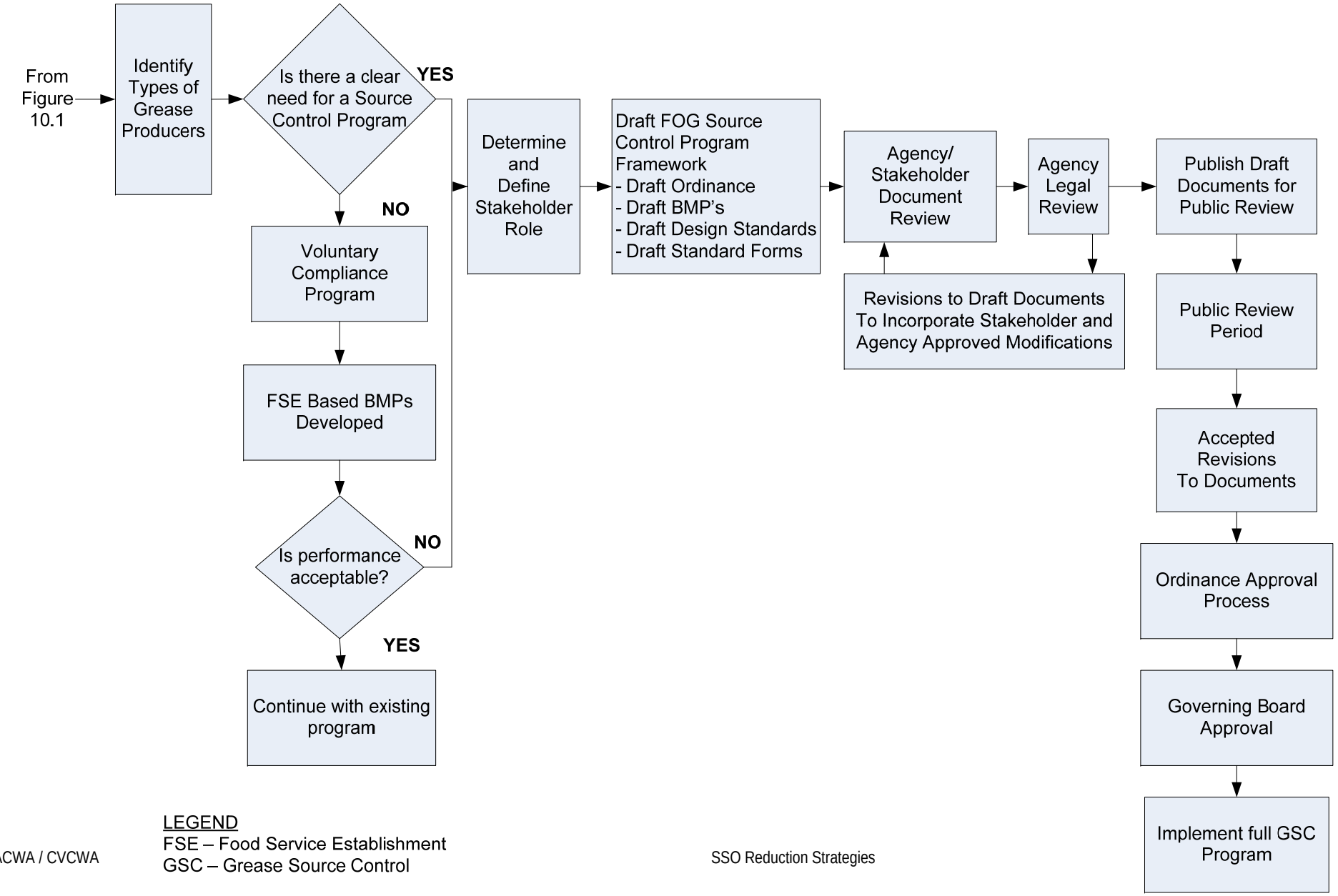


Figure 10-2
FOG SSO Reduction Strategies - continued



LEGEND
FSE – Food Service Establishment
GSC – Grease Source Control

SECTION 11

PRESSURE SYSTEMS
(Lift Station and Force Main Preventive Maintenance)

11.1 Introduction

WDR Sections 5 and D.13 and SSMP element iv (b, c, and e) as required of each public agency in order to adequately maintain their collection system which includes lift stations and force mains (pressure systems). A pressure system comprises of three parts of a collection system they include lift stations (LS), force mains and air release valves.

This Section will present the following:

- The importance of having a good preventive maintenance (PM) on your pressure system and the benefits associated with the PM.
- A four part description on how to strategically reduce the possibility of an SSO.
- Identify measurable actions, including constant monitoring, to ensure good performance of the pressure system.
- Suggested forms to assess and obtain all specific asset details and perform a thorough inspection using a non-traditional concept.

11.2 Problem Statement – Why Is This Needed?

A public agency needs this information because it is your environmental responsibility and it will help you maintain a reliable system with minimal failures. The benefits to a reliable system are that it allows you to perform more proactive maintenance rather than spending unnecessary staff time on emergencies and SSO mitigation. It is important to note SSOs associated with lift stations (LS) and force mains can be large in scale, difficult to mitigate and are likely to be near water ways.

A good LS and force main preventive maintenance (LS PM) will at a minimum:

- Reduce the likelihood of an SSO
- Help ensure the protection of pubic health and the environment
- Prolong the life of the pressure system.
- Provide fiscal responsibility to the community

11.3 Benefits – Why Is This A Good Thing?

Having an effective preventive maintenance program is a good thing because not only is it a State requirement, it ensures that your agency is being responsible for its assets and the public's money, community, environment and above all its health and well being.

11.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

A lift station and force main preventive program begins with having a good inventory of what systems and components are in place at the lift station. (See Attachment A) A good strategy to address SSO reduction can be described into four parts which include:

Constant Monitoring

- Constant monitoring using Supervisory Control and Data Acquisition commonly known as SCADA, is a great way to constantly monitor the Lift Station's operation.
- SCADA also can allow the agency to diagnose pumps and predict failures before they occur.
- Other less comprehensive telemetry systems using automatic dialers should be used at a minimum and still provide constant monitoring. However, they are limited in that they typically send alarms after a failure.
- Receiving alarms in a timely manner can help provide a quick response to avoid SSOs.

Routine Inspection and Testing

- Regular preventive maintenance inspections should be conducted with an emphasis on "Preventive" and not just "checking the meter readings/hours" but really diagnosing its performance and condition.
- It is good to periodically inspect and change oils and wear rings.
- A vibration analysis can be performed to ensure proper balancing and operation of pumps.
- A force mains O&M program could consist of periodic inspections, preventive maintenance, and corrective maintenance activities.

- Force main right-of-ways should be inspected, at a minimum, yearly to identify leakage and potential incursions associated with nearby construction. Air relief valves are inspected and maintained quarterly or annually at a minimum.
- Routine inspection and cleaning of air release valves will minimize failures and help assure force mains are adequately relieving air to avoid degradation of the pipes and joints.
- The Agency should be a member of Underground Service Alert and mark the location of its force mains to prevent damage by others during underground construction.

Repair and Replacement

- Repairs and replacements should be predicted and fixed before failures occur.
- When ever possible standardization of pumps can be beneficial for spare parts and replacements. One spare pump may be able to be used at various locations.
- Critical operational parts and hard to get parts should be in inventory.
- A well funded; pumps, valves and other components replacement fund and replacement program should be in place.
- A capital improvement fund should be funded to ensure that the lift station is rehabilitated on a set life cycle of 30 to 50 years depending on the agency's set criteria. Some components may have a shorter life span.

Redundancy Systems

- Emergency stand by generators with enough fuel to last until it can be refilled.
- Where stand by generators are not feasible, at a minimum, quick connections for portable generators may be needed.
- Portable generators and or portable engine driven pumps should be readily available.
- Based on manufacturer's recommendations, generators and portable engine driven pumps should be tested on a regular basis.
- On-site storage tanks, vaults, or storage pipes may be a cost effective method of avoiding an SSO in the event of a pump station or force main failure.
- Overflow emergency response procedures should be in place and practiced during non-emergency situation. The practice is great for personnel training and equipment inspection.
- By pass capabilities at Lift Station including quick coupler connections to force mains.
- Procedures to ensure prompt lift station failure notification and staff response.

- Emergency phone list including all critical contractors, regulatory agencies, vendors, etc.

- A force main emergency repair kit should be readily available (a patch kit for local damage and pipe & couplings to replace a section of damaged pipe)

11.5 Measurement – How Is This measured?

Several measures may be taken to monitor the effectiveness of the LS PM program. They include the following:

- Thorough, non-traditional, by-annual lift station facility inspections comprised of three Agency personnel, two of which should preferably be from other departments. This concept will allow you to monitor the over all condition of the lift station facility with a "fresh set of eyes". A form should be used to ensure thoroughness and consistency between inspections. (See Attachment B) Careful consideration should be given to the selection of staff for this purpose. The chosen individuals should not be biased by current or past practices, but they must possess enough technical expertise to be able to accurately and thoroughly evaluate the condition of the facility.
- Adequacy informed agency Boards or Councils on the importance and intricacy of Lift Stations and regularly report on their performance and improvements.
- Monitor the number and types of failures at the lift station and impose goals that include for example: 15% less failures the following year.
- For larger systems or numerous facilities a Supervisory Control Data Acquisition (SCADA) will assist in monitoring, reporting and help with analyzing failures to prevent their reoccurrence.
- # of gallons pumped vs. # of gallons spilled
- % of gallons pumped
- % of gallons spilled
- Number of emergency responses per year
- Number of after hour emergency responses per year
- Hours spent on emergency responses per year

11.6 Links and References – Where Can More Information Be Found?

Some of your best references could be near your agency. We encourage everyone to seek help and share ideas with your neighboring agencies and their vendors.

- *Operation and Maintenance of Wastewater Collection Systems Volume II* by Office of Water Programs CSU Sacramento

- A great source for a good LS PM to refer to effective senior Staff with a proven track record that can train others and provide with historical knowledge of the facility.
- Next is the Operation and Maintenance Manual for each facility and its components.
- Followed by a procedure that requires your staff to conduct thorough inspections and to look for problems before they become serious.

Section 11 Attachment A

Lift Station Details Form

Lift Station Details Form

LIFT STATION NO. _____ Date: _____

Location: _____ Cross Street: _____

Dry Deck Station: (circle) Yes No Number of Pumps: _____

Type of Pumps: _____ Horsepower: _____

Pump 1 Rotation Pump 2 Rotation Pump 3 Rotation

(circle) (circle) (circle)
CW CCW CW CCW CW CCW

Variable Frequency Drive: (circle) Yes No

Motor Type: _____ Amperage: _____ Voltage: _____

Starter Size: _____ Heater Rating: _____ amps

Controller: _____ RTU: _____

Motor Control Enclosure Type: _____ L _____ W _____ D _____

Level Indicator Type: _____ Compressor (circle) Yes No

Quick Electrical Connection: (circle) Yes No

Stationary Generator: (circle) Yes No

Generator Kw Rating _____ Fuel Type: (circle) Gas Diesel

Fuel Capacity: _____ Fuel Running Time on Tank: _____

Wet Well Capacity: _____ gallons

Wet Well Dimensions: _____ ft. Length: _____ ft. Width: _____ft. Depth: _____ ft.

Wet Well Storage Time: _____hours typical

This station flows to Lift Station: _____

This Station gets flow from Lift Station or Manholes _____; _____; _____; _____; _____; _____.

Gravity Overflow: (circle) Yes No Bypass: (circle) Yes No

Inflow Size: _____ Outfall Force Main Size: _____

Comments: _____

_____

Section 11 Attachment B

Lift Station Inspection Form

Lift Station Inspection Form

Inspection Information

Inspection date	
Inspection participants	
Facility name	
Facility address	
Comments	

Summary of Recommended Actions (in Priority Order)

Recommended Action(s)	Priority

Background Information (Prior 12 Months)

SSOs	
Equipment failures	
Alarm history (attach copy)	
Major maintenance activities completed (attach list if applicable)	
Pending work orders (attach copies)	
Operating problems (attach copy of operating log)	
Comments	

Security Features

Fence and gate	
External lighting	
Visibility from street	
Doors and locks	
Intrusion alarm(s)	
Signs with emergency contact information	
Other security features	
Comments	

Safety Features and Equipment

Signage (confined space, automatic equipment, hearing protection, etc.)	
Fall protection	
Emergency communication	
Equipment hand guards	
Hand rails and kickboards	
Platforms and grating	
Tag out and lock out equipment	
Hearing protection	
Eye wash	
Chemical storage	
Comments	

External Appearance

Fence	
Landscaping	
Building	
Control panels	
Other external features	
Comments	

Building/Structure

Pump station building	
Control room	
Dry well	
Wet well	
Other structures	
Comments	

Instrumentation and Controls (I&C), including SCADA Facilities

Control panel	
Run time meters	
Flow meter	
Wet well level	
Alarms	
SCADA	
Other I&C	
Comments	

Electrical and Switch Gear

Power drop	
Transformers	
Transfer switches	
Emergency generator and generator connection	
Starters	
Variable frequency drives	
Electrical cabinets	
Conduit and wireways	
Other electrical	
Comments	

Motors

Lubrication	
Insulation	
Operating current	
Vibration and alignment	
Comments	

Pumps

Lubrication	
Vibration and alignment	
Seals	
Indicated flow and discharge pressure	
Shutoff head	
Corrosion and leakage evidence	
Drive shaft	
Casing wear (thickness)	
Other	
Comments	

Valves and Piping

Valve operation	
Valve condition	
Pipe condition	
Pipe support	
Other	
Comments	

Other

Lighting	
Ventilation	
Support systems (air, water, etc)	
Signage	
Employee facilities	
Sump pump	
Overhead crane/lift points	
Portable pump connections	
Portable pumps	
Comments	

Aerial Photo of Pump Station Site (from Google Maps)

Photos of Major Equipment/Condition Issues

SECTION 12

SSO EMERGENCY RESPONSE

12.1 Introduction

In the event of a Sanitary Sewer Overflow (SSO), it is important to limit the liability, severity of damage, and protect human health and the environment. The SSO should be stopped, contained, and returned to the Collection System as soon as possible. In addition to cleanup procedures, each agency is responsible for notifying affected residents, property owners, and agencies (Office of Emergency Services, Regional Water Quality Control Board, etc) that could be impacted by an SSO. An Overflow Emergency Response Plan is intended to provide agencies with procedures to be followed for SSO response and notification. All staff involved in the response, mitigation, and notification process should be trained in a simulated situation prior to implementation.

Section vi of the Sanitary Sewer Management Plan (SSMP) requires each agency to have an Overflow Emergency Response Plan as follows:

- SWRCB Order No. 2006-0003-DWQ:
  - ✓ Sewer System Management Plan (SSMP – pg 10 of 20)
    - (vi) Overflow Emergency Response Plan (pg 12 of 20)
- SWRCB Order No. WQ 2008-0002-EXEC:
  - ✓ Adopting Amended Monitoring and Reporting Requirements for Statewide General Waste Discharge Requirements for Sanitary Sewer Systems

12.2 Problem Statement – Why Is This Needed?

It is required within each agency's SSMP to develop and implement an overflow emergency response plan that identifies measures to protect public health and the environment, reduces potential volume of SSOs, limits liability, and limits the severity of the damage caused by SSOs.

12.3 Benefits – Why Is This A Good Thing?

- Protects public health and the environment
- Reduces potential volume of SSOs
- Limits liability
- Limits the severity of the damage and reduces odors
- Ensures timely corrective action is taken
- Avoids or mitigates non-compliance with RWQCB and SWQCB requirements

12.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

When a wastewater spill occurs, it is important to recognize the procedures for corrective action, and notify the authorities. The general flow of activities and division of responsibilities is illustrated in Attachment A.

SSO Notification/Chain of Communication

Each agency should identify all possible pathways by which SSOs may be detected and reported, which would be detailed on a written "chain of communication", as required by section ii of the SSMP. The "chain of communication" should be distributed to all parties involved in SSO response. This should include the local 911 operator since many SSO are initially reported via 911. Each agency should ensure that maintenance personnel can be notified of events after regular business hours, and that at least one employee is "on-call" 24 hours a day. Each agency should make an attempt to inform the public of the proper entities that need to be contacted in the event of an SSO, either by using flyers, or the agency's website. Each agency should also evaluate its sewage lift stations to ensure that the level of backup power and alarming is appropriate to the size and importance of the lift station. Regardless of the lift station size, all stations should have some form of telemetry (i.e. SCADA, dial-out, etc)

Initial Assessment/Investigation

The assessment and investigation should be performed by the site supervisor or the person in charge at the site. The initial evaluation is used to determine the underlying cause (i.e. blockage, collapse/failure, pump station failure or significant rain event) and severity of the spill, and what resources will be needed to contain and clean up the spill. At this point, the site should be assessed to determine if the spill poses an immediate threat to the health and safety of the public. If there are indications that the spill contains hazardous waste (i.e. strong chemical odors), all personnel should back away from the area and call 911, but remain at the site at a safe distance until the hazmat team arrives and takes command of the site. Pictures should be taken, and the events should be documented, unless doing so would hamper efforts to restore normal flow or clean up the spill.

Notification of SSO Response Personnel

A competent person on site will make an initial assessment of the resources and equipment needed to restore flow and contain and clean up the spill. The wastewater collection systems team is notified and mobilized as soon as possible. The wastewater collection systems team is a group of staff trained in responding to SSO situations. Personal protective equipment is used as needed. Smaller agencies that lack typical SSO

response equipment such as a hydro-jet, vactor truck, and bypass pumping may consider establishing emergency response "on-call" agreements with contractors that can provide spill response services. The agency should ensure that the contractor can provide rapid response times (typically less than one hour) and follow documented procedures developed by agency staff.

Stop and/or Contain Overflow

When responding to an SSO, the primary goals are to protect public health and prevent the overflow from reaching surface waters or causing property damage. There are three primary components to responding to an SSO:

- Stop the source/remove the cause of the overflow
- Contain and return any wastewater that has overflowed from the system
- Mitigate any effects that were caused by the spill

The person in charge at the site is responsible for determining the most effective method for stopping, containing, and mitigating the effects of the SSO. Each agency should evaluate the types of spills that have occurred in the past, or could occur in the future, and consider the equipment and strategies that work best to stop and contain overflows. A list of required SSO response equipment should be generated, and all equipment should be obtained and stored in a central location. Some agencies have dedicated SSO response trucks or trailers that have the necessary equipment to contain and mitigate SSOs. The equipment may include small bypass pumps and hoses, sandbags, and other spill containment equipment.

Initial Notification

Initial notification procedures and requirements vary depending upon the nature and magnitude of the SSO. Notification of staff is for operational support of the cleanup and shall occur as soon as possible, without substantially impeding cleanup or other emergency measures.

Pursuant to Order No WQ 2008-0002-EXEC, the Discharger shall, as soon as possible, but no later than two (2) hours after becoming aware of a sewage discharge to a drainage channel or surface water, notify the State Emergency Management Agency (formally Office of Emergency Services or OES), the local health officer or director of environmental health with jurisdiction over affected water bodies, and the appropriate Regional Water Quality Control Board. As of September 2009, the State Water Resources Control Board has defined, on their web site, a drainage channel. That resource should be checked if its definition is questionable.

As soon as possible, but no later then twenty-four (24) hours after becoming aware of a sewage discharge to a drainage channel or a surface water, the Discharger shall submit to the appropriate Regional Water Quality Control Board a certification that the State Office of Emergency Service and the local health officer or director of environmental health with jurisdiction over the affected water bodies have been notified of the discharge.

Once initial notification is complete, staff should proceed with complying with the SSO reporting timeframes. SSO Reporting timeframes vary depending upon the nature and magnitude of the SSO, and are discussed in detail in the sections to follow.

Sample Collection

Samples of the wastewater discharge and affected receiving waters are not required by the WDR. However, an agency may want to consider collecting samples for SSOs reaching surface waters that may endanger human health, or potentially cause a fish kill, or is of a magnitude that warrants sampling. In addition, it is important to only sample when it is feasible and safe to do so. There are two types of samples: samples that require laboratory analysis and testing that can be performed in the field. If samples are collected, they should be analyzed for some or all of the following:

- Dissolved oxygen (measured in the field)
- Total ammonia (not an immediate result)
- Bacteria indicator as follows: *If receiving water is fresh water*: E-coli – (not an immediate result), *If receiving water is salt water and/or tidal*; Fecal coliform or Enterococcus (not an immediate result)
- pH (measured in the field)
- Electrical Conductivity (measured in the field)
- Temperature (measured in the field)
- Biochemical Oxygen Demand (BOD or CBOD) (not an immediate result)

As a guideline, if a spill enters receiving water, samples should be taken at the point where the spill discharges into the receiving water (D-1), approximately 50 feet upstream of the spill (R-1), and approximately 300 feet downstream of the spill (R-2). A diagram of the sampling locations is provided in Figure 12-1. If an SSO has been ongoing for a long period of time, the agency may decide to perform additional sampling downstream in the waterway, to determine the extent of contamination. Field water sampling and testing can provide indications of sewage contamination, and can assist SSO response personnel in determining an appropriate location for containment.

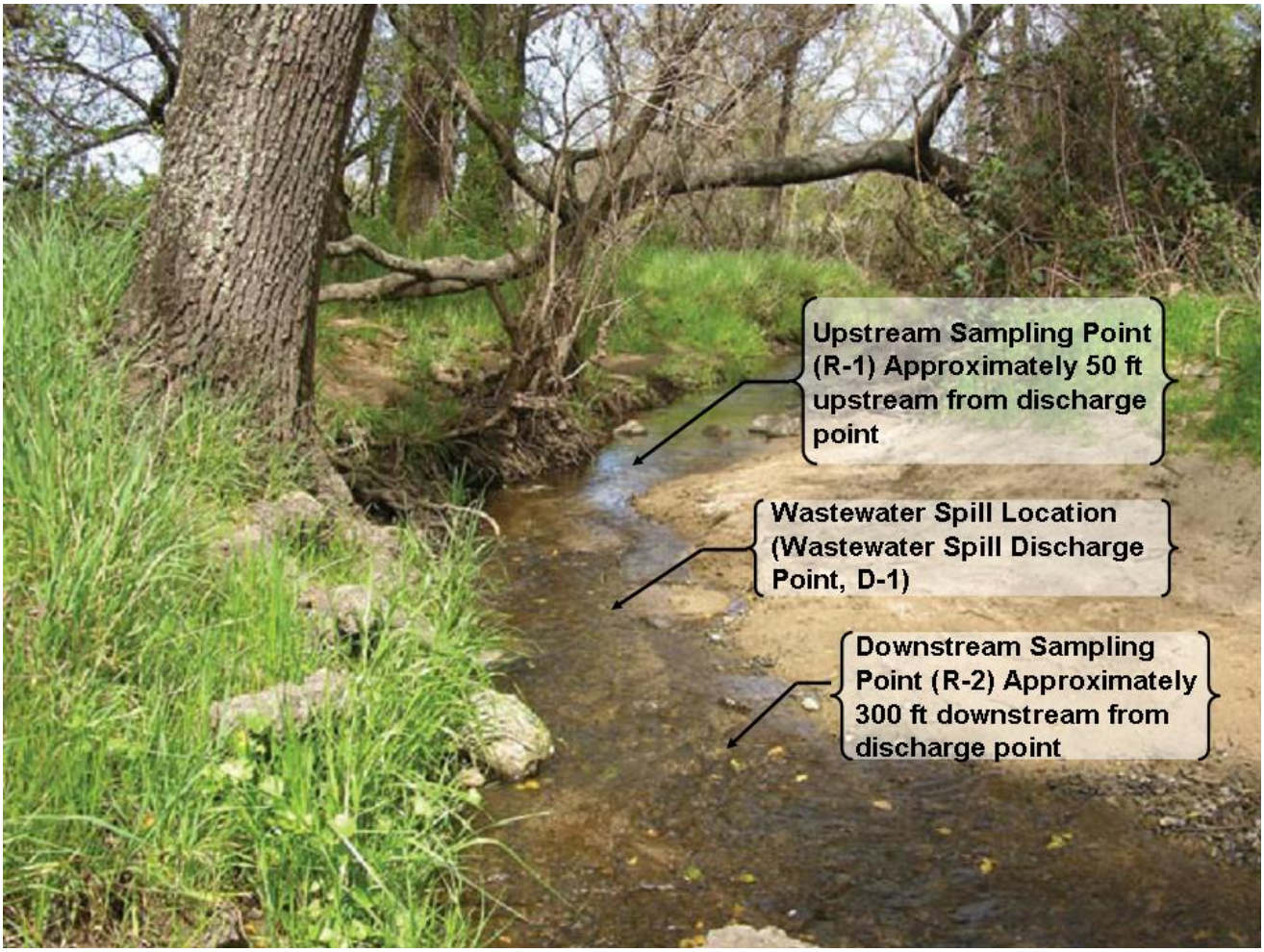


Figure 12-1
Sampling Location Diagram

SSO Standard Operating Procedure (SOP)

The SSO SOP is a written script or procedure of all tasks to be performed as part of an SSO response. By following the SOP, adverse impacts of SSOs will be minimized, corrective actions will be taken in a timely manner, compliance with current regulatory requirements will be documented, and a consistent response to SSOs will be achieved.

Documentation of SSO

During a spill event, a competent person on site is required to record information and events associated with the SSO. A complete SSO report consists of three primary components:

- the written report including information from the office and field
- photographic documentation
- sampling and analysis (if samples are collected)

- Interviews and reports of office personnel receiving calls and customers in the field who have witnessed the event.

Each agency should have as part of the SSO Response Plan a typical SSO Field Report Form, used to document spill data and response activities performed. The SSO Field Report form should, at a minimum, be designed to collect all of the data that is required to be reported through the CIWQS online system to the SWRCB. Each agency can design a form to collect additional data and information that the agency finds useful. Due to the time it takes to complete the laboratory analysis of the samples taken, it will be necessary to submit this information as an amendment to the SSO Report. An SSO report file shall be completed for all spill events.

Digital photos should be taken for all SSOs. Photos should document the source and extent of the SSO, containment and clean-up efforts, location that the SSO entered surface waters, and the effects to surface waters, if any. If possible, photos should be taken documenting any sampling locations in the receiving waters, as depicted in Figure 12-2 – Sampling Location Diagram. Photos should also document when there are no adverse effects to surface waters or areas surrounding the spill. Printed copies of photos, with their respective descriptions, should be attached to the completed SSO Report Form.

Assess Best Clean-Up Method and Begin Mitigation Activities

The competent person on site or the person in charge at the site will assess and be responsible for the best clean-up method. This may include:

- Vacuum truck or pump recovery of sanitary sewer overflows and wash down water,
- Use of portable aerators when complete recovery of the sanitary sewer overflow is not practical, and severe oxygen depletion in the impacted surface waters is expected, to prevent fish kill,
- Cleanup of sewage at the overflow site,
- Disinfection of contaminated area (only when required),
- Use of masking agents to control odors,
- Use of contractors to assist in clean up and mitigation effort,
- Determine location for sampling, and what test should be conducted,
- Smaller agencies may need to call in help from surrounding agencies or specialty contractors to assist with mitigation,
- Property restoration.

Post Public Health Warnings as Needed

If directed by the local public health agency, public health warnings should be posted to ensure land or receiving waters contaminated with sewage are protected from public use. The signs should be removed as soon as allowed.

Final Notification

Once the clean up and mitigation have been completed, a competent person on site should complete the notification process, and ensure that all the involved persons or agencies have been contacted.

Complete Sanitary Sewer Overflow Report Form

The appropriate person, also known as a "Data Submitter" by the State, is responsible for completing the Sanitary Sewer Overflow Report Form.

Complete as follows:

- On-Line Report: State Water Resources Control Board (SWRCB) – California Integrated Water Quality System (CIWQS) – https://ciwqs.waterboards.ca.gov/ (details below)
- Original Report: File (should include all field reports and notes)

Complete draft documentation includes:

- Sanitary Sewer Overflow Report Form
- Photos
- Lab sample documentation (if applicable)
- Any sketches and drawings (if applicable)

On-Line Spill Reporting to the SWRCB

On-line spill reporting must be submitted to the SWRCB as follows:

- Category 1 SSO - ≥ 1,000 Gallons or reached surface waters, or reached drainage channel, or reached storm drain and was not fully captured:
  - ✓ Draft Report: 3 Business Days
  - ✓ Final Certified Report: 15 Days after conclusion of response activities
- Category 2 SSO -l < 1,000 Gallons that do not reach surface waters:
  - ✓ Within 30 Days after the end of the month in which the overflow occurred
- Private Laterals: Report at agencies discretion
- No SSOs during a month: Report no SSOs within 30 days of end of month (this is required)

Online spill reporting must be certified by a legally responsible official or appointed staff.

Debriefing Procedure

An important final step for SSO response (following an incident) is to assemble the members of the response team to discuss the effectiveness of the process. The desired outcomes of this program are to minimize the impacts on the environment, while complying with current regulations, and to consistently perform at the highest level possible. A non-punitive debriefing to re-live the incident response can be an effective tool to ascertain what worked well, and identify areas to improve. This debriefing should be memorialized in writing, used as a component of the Training Program, and appropriate changes made to the SSO Response SOP.

Training Program

Initial training on the procedures contained in the agency's Overflow Emergency Response Plan needs to be implemented and documented. It is recommended that training occur twice per year with all staff involved in SSO notification, response, mitigation, and SSO response plan implementation. Further, if regulations change, the person in charge of updating this program will have to disseminate the appropriate updates to the entire response team. The program manager should review debriefing notes to determine how best to construct the training model for simulation purposes. Dependent upon the size of the agency, staff members may perform a variety of tasks involved in this program. During the course of training, it is recommended that team members physically perform different functions to better understand their role in time of emergency, and the criticality of each team member's role in the process. This can include field simulations.

Additional Consideration for SSOs into Buildings

Agency staff should be properly trained when responding to SSOs that occur within buildings. If an SSO occurs within a building, the primary objective of the agency is to mitigate the damages promptly. Each agency needs to ensure that contamination due to the SSO is not spread throughout other parts of the building that were not initially affected by keeping people and pets from the affected area. Once this has been accomplished, the agency should take photographs of both damaged areas as well as undamaged areas prior to helping with initial cleanup. The agency should not try to do restoration work, but rather assist with some quick initial help. For example, moving furniture out of the flooded area to the driveway or garage and wiping and cleaning the legs of the furniture. Once initial cleanup has been performed, the agency should get written statements from all agency personnel who were involved in the SSO. Depending on the extent of the damage caused by an SSO, an agency may need to make arrangements to place the residents in a nearby hotel for a few days while the SSO is being mitigated.

In consultation with agency counsel, each agency should appoint a single spokesperson to handle all questions or concerns regarding SSOs that enter buildings. The spokesperson should have good interpersonal skills and needs to remain in contact with the property

owner, property manager and residents until the issue is resolved. A good communication strategy is important for several reasons:

- The agency can demonstrate that it is being responsive to the property owner's concern
- The agency can maintain a contemporaneous account of events related to the SSO
- Direct communication can allow the agency some time to investigate and to verify accounts of the SSO event from the residents and other sources.

In cases where restoration or clean up activities may be required, the property owner should also be provided with a list of reputable and reliable restoration companies. Each agency should maintain a list of competent restoration companies that are readily available. A professional restoration company should be able to:

- Be prepared to deliver emergency response 24/7/365
- Have trained and uniformed staff
- Have staff that is certified by the Institute of Inspection, Cleaning and Restoration Certification. (IICRC) http://www.certifiedcleaners.org
- Arrive when promised
- Have the proper tools and equipment
- Have standard checklists to assure that all necessary items are covered
- Recognize and follow the IICRC standards S-500 for water and sewage damage and S-520 for mold remediation

In addition to the restoration company, an independent hygienist should do any testing to demonstrate that the area is habitable..

12.5 Measurement – How Is This Measured?

The following is a list of performance indicators for which an agency may track from year to year to measure performance.

- Track and compare # of SSOs per 100 miles of pipe per year
- Track SSO response time and evaluate how to improve that response time
- Percentage of staff trained and/or training hours
- Percentage of volume of SSO recovered
- Average size of SSO
- Dollar value of claims paid annually
- Total number of claims per year

12.6 Links and References – Where Can More Information Be Found?

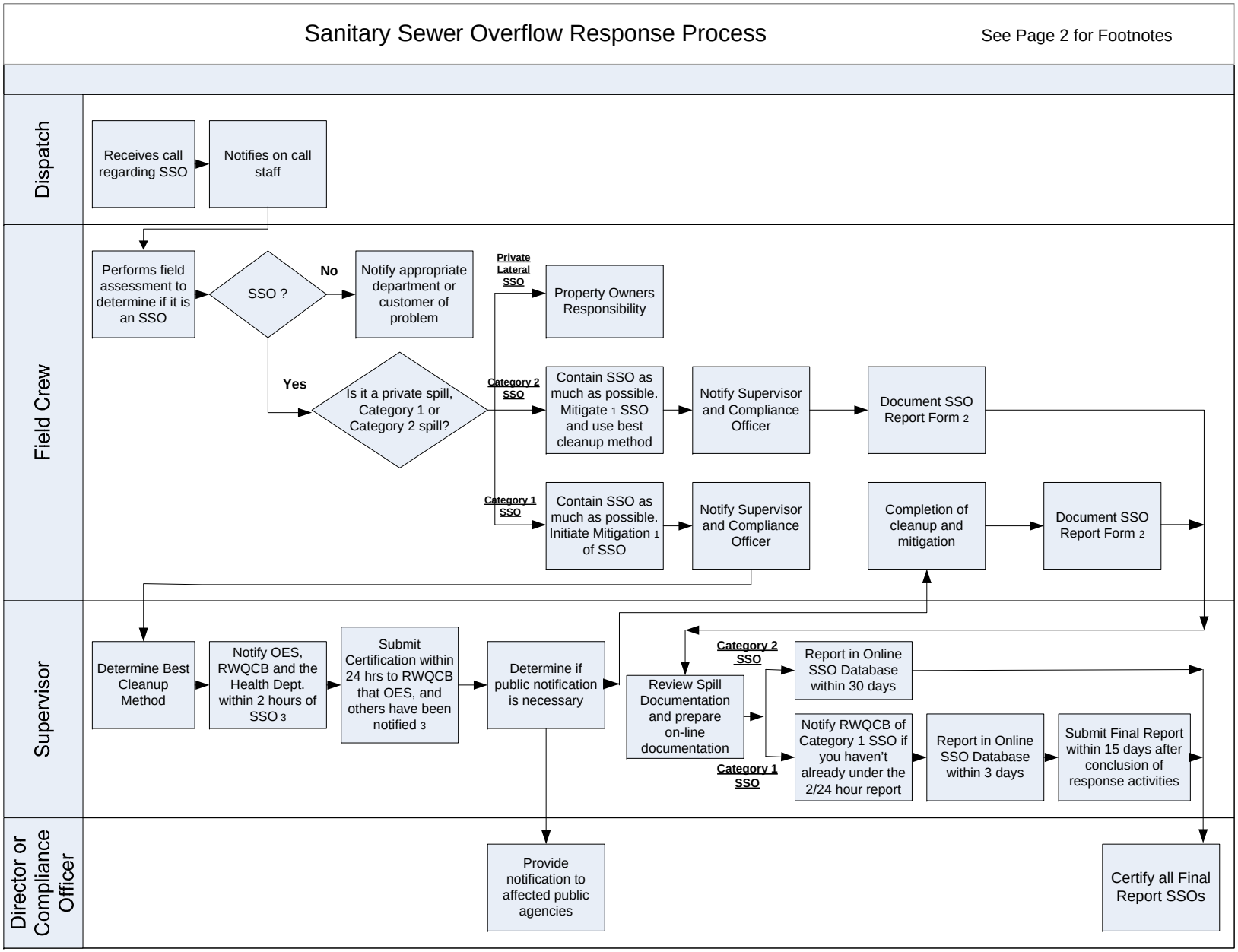
- SWRCB Order No. 2006-0003-DWQ:
  - ✓ http://www.waterboards.ca.gov/resdec/wqorders/2006/wqo/wqo2006_0003.pd
- SWRCB Order No. WQ 2008-0002-EXEC:
  - ✓ http://www.swrcb.ca.gov/board_decisions/adopted_orders/water_quality/2008/wqo/wqo2008_0002_exec.pdf
- CIWQS:
  - ✓ http://www.swrcb.ca.gov/ciwqs/
- "Preparing Sewer Overflow Response Plans", APWA, 1998
- "Best Practices for Sanitary Sewer Overflow Prevention and Response Plan", Collection System Collaborative Benchmarking Group, 2004
  - ✓ http://www.cwea.org/book_ocb.shtml
- Template Response Plan: http://www.dec.ny.gov/docs/water_pdf/modelsorp.pdf
- SSO Response Manual Preparation Guides
- Institute of Inspection, Cleaning and Restoration Certification (IICRC).
  - ✓ www.certifiedcleaners.org
- IICRC standard S-500 – for water and sewer damage
- IICRC standard S-520 – for mold remediation

Section 12 Attachment A

SSO Emergency Response

Sanitary Sewer Overflow Response Process

See Page 2 for Footnotes



1	Mitigate: At a minimum wash down affected area, then capture and return as much wastewater as possible to the Collection System.
2	Procedures for SSO documentation should include: taking pictures of affected areas before and after mitigation efforts, as well as drawing a sketch of the affected area on a location map. In flooded buildings, also take pictuures of area that were not affected by SSO.
3	Not all Category 1 SSOs need to be reported under the 2/24 hour requirements. For example, 1,000 gallons that did not reach water or a drainage channel and was fully recovered. Category 1: An SSO greater than 1,000 gallons, an SSO that has discharged into a drainage channel and/or surface water, or an SSO that discharges to a storm drainpipe which was not fully captured and returned to the sanitary sewer system. Category 2: An SSO resulting from a failed sewer system which does not meet the criteria for a Category 2 SSO. If final destination of SSO is a waterway that supports aquatic life, aeration may be required to prevent an algae bloom and a fish kill.

SECTION 13

POST SSO – OVERFLOW EMERGENCY RESPONSE

13.1 Introduction

After an SSO has been contained and recovered, failure analysis should be performed on the pipe or pump station to minimize the chance of the SSO occurring again. For additional information on Failure Analysis, see Section 1.

13.2 Problem Statement – Why Do I Need This?

SSOs can occur at the same location if the cause of the SSO is not addressed.

13.3 Benefits – Why Is This A Good Thing?

A follow-up SSO plan can help identify the cause of the stoppage, determine the condition of the pipe, and develop a preventive maintenance schedule or corrective measure to mitigate the risk of another SSO occurring at the same location. This should enhance future responses and improve an agencies overall handling of these events.

13.4 SSO Reduction Strategies – How Do I Do This?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Stoppage in a Gravity Line

- Clean the Entire Line Segment – After breaking the initial stoppage, cleaning the entire line segment can help reduce the likelihood of another stoppage in the pipe.
- Clean Line Segments Upstream and Downstream – Cleaning upstream and downstream of the line with the stoppage can reduce the likelihood of stoppages in nearby pipes if debris or grease are a problem in the immediate area.
- Assign Line Segment to a Preventive Maintenance (PM) Schedule – A preventive maintenance schedule utilizing the correct maintenance activity and appropriate frequency can help prevent another stoppage in the future. Reviewing the stoppage history may help determine the cleaning interval.

- Television Inspection (TVI) – A TVI should determine the condition of the pipe. CCTV can be used to adjust the PM frequency or provide quality control for the cleaning activity.
- Source Control – If stoppage is due to grease or other ordinance violations, outreach programs can educate property owners about the proper disposal of waste.
- System Wide Evaluation **–** System wide evaluations can be developed for areas experiencing multiple SSOs. For example, if there are multiple SSOs due to roots in the main lines, a root control project for the area can be investigated instead of cleaning each line individually.

Structural Failure (gravity and pressure systems)

- Repair – Repair the pipe for any structural defects (offset joint, cracks, protruding tap, etc) that may have contributed to an overflow and that cannot be mitigated cost effectively with maintenance.
- Rehabilitate/Replace – Investigate cost effective options to rehabilitate the line. Options may include structural lining, lining patches, or replacement.
- Television Inspection (TVI) – A TVI may help determine the condition of the pipe. CCTV can be used to provide quality control for the repair or rehabilitation activity.

Pump Station Failure

- Alarms in SCADA – Configuring alarms in a SCADA system to send an alert when situations occur such as (1) the wet well levels are approaching the low manhole elevation, (2) power failure alarms, or (3) pumps not starting will allow a crew to investigate the problem before an overflow occurs.
- Preventive Maintenance – Assign equipment at the pump station to a preventive maintenance schedule. A regular inspection of the equipment may allow crews to replace a piece of equipment before it causes the station to fail.
- Response Time – Determine the amount of time a pump station can stay out of operation under normal and peak flow conditions. Longer downtimes will give crews ample time to respond to any alarms. If downtimes are very short, a generator or other backup system may be necessary to keep the station in operation during power failures.

Capacity

- Flow Monitoring – Install flow meters in areas where capacity issues may be an issue due to new development or evidence of inflow and infiltration. If flow meters show surcharging in the manholes then capacity may be an issue or there could be a stoppage downstream.

- Hydraulic Modeling – Modeling the collection system could predict where overflows could occur due to lack of capacity. These areas could then be monitored with flow meters to verify if capacity is a problem

13.5 Measurement – How Do I Measure This?

Measurements should also be in place to determine if the preventive maintenance schedule is effective at reducing SSOs. These performance indicators should have a target level that the public agency is trying to meet. A following is a list of performance indicators that the public agency can use to measure their progress.

- Number of stoppages on lines with an active preventive maintenance program
- Number of stoppages per 100 mile of lower lateral (if the agency owns the lower lateral)
- Number of stoppages per 100 mile of main line
- Number of feet of pipe on a preventive maintenance schedule
- Number of feet of pipe cleaned per month
- Number of overflows of the same main line (repeat SSOs)

13.6 Links and References – Where Can I Find More Information?

- http://www.sacsewer.com
- http://www.cwea.org/book.shtml

SECTION 14

SYSTEM EVALUATION AND CAPACITY ASSURANCE

14.1 Introduction

This section of the SSO Reduction Strategies Best Practices Manual looks at tools to address portions of the sewer system that may be capacity deficient. These tools can help to assess system capacity and plan for system improvements to handle peak flows from existing development and projected peak flows from future development. The information can be a resource for responding to the State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General WDR for Sanitary Sewer Systems – Sewer System Management Plan:

- (viii) System Evaluation and Capacity Assurance Plan

The following topics will be discussed:

- Developing a Capital Improvements Program (CIP)
- Identifying capacity related problem areas
- Evaluating System Capacity
- Estimating peak flows
- Developing design criteria
- Collection system modeling
- Prioritizing hydraulic improvements
- Cost estimating capital improvements

The Statewide General WDR for Sanitary Sewer Systems states that specific elements of the SSMP that require professional evaluation and judgments shall be prepared by or under the direction of appropriately qualified professionals, and shall bear the professional(s)'signature and stamp. The majority of the strategies identified in this section fall into this category.

14.2 Problem Statement – Why Is This Needed?

Insufficient capacity for peak wet weather flows can result in SSOs that may reach waters of the United States and may threaten public health or adversely impact aquatic habitat. The WDR for sanitary sewer systems requires that agencies take a proactive approach to system evaluation and provide adequate capacity to handle peak dry weather flows as well as peak flows resulting from the appropriate design storm event.

14.3 Benefits – Why Is This A Good Thing?

- Reduces potential of SSOs
- Protects public health and the environment
- Aids in compliance with State and regional regulations

14.4 SSO Reduction Strategies – How Is This Accomplished?

Choose only the strategies presented in this section that could improve sewer system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a strategy that will better address the specific situation.

Developing a Capital Improvements Program (CIP)

Collection system master planning is a process of comparing current and projected future peak flows to the sewer system capacity to identify where hydraulic deficiencies may occur. Once system deficiencies are identified and confirmed, the process involves evaluating alternatives for addressing these deficiencies, developing cost estimates and setting priorities and timelines to implement system improvements. The result is a capital improvements program that will address system deficiencies and provide adequate capacity for existing and future needs. Because of the time and technical issues that must be addressed, this process is usually performed by engineers or consulting firms that specialize in sewer system master planning.

Identifying Capacity Related Problem Areas

The Statewide General WDR for Wastewater Collection Agencies (SSO WDR), under element viii, calls for the evaluation of "key system components" (sewers and pump stations) experiencing or contributing to capacity related SSOs. The evaluation would also extend to those facilities that could experience future capacity deficiencies due to future growth or may have problems with excessive inflow and infiltration (I/I).

The process of identifying capacity deficiencies within the collection system can be a focused effort on specific known problem areas or it can involve a system-wide evaluation, depending on the extent of potential capacity problems. For smaller systems with only a few smaller (10-inch or less) diameter trunk sewers, a focused approach may be sufficient. A focused effort can start with talking to workers familiar with system performance. Maintenance workers familiar with sewers prone to overflows are a good source of information about system performance and can help identify capacity related problem areas. The larger lines, 10-inches and larger, may be potential candidates for capacity problems; this can be especially true if new development has been allowed to tie-in upstream without analysis of downstream impacts, or if the upstream system is deteriorated and subject to significant infiltration and inflow. A review of historical SSO files and maps or spot maps can also be of value. Smaller sewers, 8-inches and smaller, typically serve finite areas, and unless the sewers are severely degraded or their service

area has expanded significantly since they were originally installed, these smaller sewers generally have the capacity to handle the development they were designed to serve.

Evaluating System Capacity

If capacity problems are limited, spreadsheet tools can be adequate to assess the capacity of key sewers that serves known areas of land. Wastewater flows can be estimated based on land-use, population, water usage or a combination of this information, along with peaking factors for daily and seasonal fluctuations in flow. Projected flows are compared to pipe capacities to identify potential deficiencies or to document that adequate capacity is available.

Whether an agency can assess system capacity by spreadsheet analysis or by use of system modeling software depends on factors such as the size of the system, the extent of capacity deficiencies and the portion of the service area that will be developed in the future. Agencies with built-out service area, small collection systems (only a few trunk sewers) and limited capacity problems may be able to achieve adequate assessment and capacity planning using spreadsheet tools alone. For larger systems or service areas with future development, sewer system computer modeling and flow monitoring may be necessary to assess the broader impacts of peak flows throughout the system.

The capacity of existing pump stations is often well documented by the pump curves and system curves used in the original design or by the pump manufacturer. If documentation is lost, sometimes the pump manufacturer will retain customer records and can provide the original pump curves and system curves. A pump station drawdown test can be performed to determine the pump station's actual field capacity. A good reference for understanding pump stations is the WEF publication "Design of Wastewater and Stormwater Pumping Stations Manual of Practice FD-4".

Estimating Peak Flows

Peak flows in an existing sewer system are usually directly related to rain storm events; however, in some areas with relatively low rainfall or in newer systems, the highest system flows may occur due to seasonal increases in population or industrial activities. Peak flows are comprised of base sanitary wastewater flow, diurnal peaking factors, groundwater infiltration and rain dependent inflow and infiltration (RDII). Estimating peak flows for an existing sewer system generally involves some type of rainfall analysis method to evaluate the sewer system response to rain events. A rainfall analysis approach recognizes that rain dependent inflow and infiltration (RDII) is the main source of flow that causes wet weather SSOs. Section 9 discusses inflow and infiltration in more detail. There are several methods for calculating RDII that use site specific rain data and flow data. The EPA document titled "Review of Sewer Design Criteria and RDII Prediction Methods" provides a literature review of RDII prediction methods and includes an evaluation of the pros and cons of commonly used methods.

Estimating flows for future development is similar to assessing flows from existing development except that the RDII component will be based on typical values for new

development or based on observed RDII rates for newer existing development within the service area. WEF publication "Gravity Sanitary Sewer Design and Construction – Manual of Practice (MOP) FD-5", 2nd Edition provides unit flow factors for estimating sanitary sewer flows for existing and new development.

Selecting a Design Storm

A design storm is a storm of a given duration and return frequency. Consider regulatory requirements, if any, when selecting a design storm. For example, the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) refers to wastewater flows for storm return periods of 1, 5, and 20 years. The Basin Plan does not make reference to storm duration, but a 6-hour and 24-hour storm durations are commonly used. In selecting the storm duration, best professional judgment should be used when considering the size of the system, topography, and surface cover, all of which will affect the time it takes to see a response to a rain event. Steeper terrain and pipe slopes will result in quicker response to rain events. Another consideration in selecting storm duration is the type of rain typically seen in the area, shorter more intense rain events versus longer steadier rain events.

Consult the hydrology manual for your jurisdiction or county to obtain local rain data. Local hydrology manuals will typically contain historical rain data for several return interval storms.

Design Criteria for New Facilities

The use of sound design criteria and construction standards is critical to long term performance of sewer facilities. MOP FD-5 is a good resource for design criteria and construction standards for sanitary sewers and manholes. Check with other agencies who have developed design criteria and construction standards; many agencies post design and construction standards on their websites and this information can be found by a simple internet search.

Sewer System Modeling

The need for sewer system modeling will vary from agency to agency. If a service area is built-out and no wet weather capacity issues are known to exist, modeling may not produce more useful information than a simple spreadsheet approach. Models can assess system capacity for larger trunk sewer systems and can be used to determine the impact of future development and peak flows on the existing downstream collection system. Models can also be useful in projecting future infrastructure needs and identifying a long-term capital improvements program. The process is highly technical and often requires the help of a consultant with modeling expertise.

Equally important as the selection of a model is the selection of a qualified consultant or in-house staff to perform the work. Collection system models are available in a wide range of sophistication, capabilities and price. In selecting a model, consider what model will be used for, who will use it (staff or consultants), what data is available and what

form or format is the data in (digital or paper land use, sewer atlas in GIS or paper maps, with or without pipe inverts)?

Building a model from scratch can be labor intensive. Most models are GIS or CAD-based and usually require a manhole numbering system. Setting up a model requires enough information to define the system such as upstream and downstream manhole identification, pipe length, pipe diameter, upstream and downstream pipe inverts and manhole inverts. The model needs to reflect how the pipes are connected so that sub-basins and flow routing match reality. Pump stations can be modeled using information such as wet well size, operating levels and pump curves.

Land use that is tributary to the various collection system sub-basins is defined so that flows can be estimated and input into the model. Once the model is built, it should be "calibrated" which requires some flow monitoring data. Measured flows from both dry and wet weather periods are compared to the flows predicted by the model for the same conditions. The modeled and measured flows will ideally match to within about 10% for both peak flow and volume to establish a reasonably representative model.

Prioritizing Capital Improvements

Hydraulic or capacity improvements may need to be prioritized due to time and budget constraints. Establishing a level of risk posed by a capacity deficient pipe segment can help set the priority of addressing the problem. Some factors to consider in establishing the risk level are the severity of the capacity deficiency (peak flow versus pipe capacity); structural defects; the location of the potential spill with respect to public exposure (industrial area versus residential area or residential area with school nearby); and site conditions such as topography to provide quick drainage and minimize opportunity for human exposure or proximity to sensitive habitat. While some of these considerations require using professional judgment, establishing relative risk can provide a justification of sequencing projects when a program of improvements will be implemented over time. Projects driven by future development can be coordinated with the timing of new development projects with input from the city planning department.

Cost estimating capital improvements

Establishing a capital improvement plan budget requires developing cost criteria or unit costs for infrastructure components such as pipelines, force mains, manholes and pump stations. These unit costs can be used to estimate the cost of sewer infrastructure projects. Tables 2, 3 and 4 show basic unit costs in 2009 dollars for installed improvements. It is assumed that average conditions exist for soil stability, groundwater, pavement, traffic and utility interference. These costs are based on a San Francisco Bay Area costs. Engineering News Record (A McGraw Hill publication) Construction Cost Index, ENR-CCI can be used to project future costs.

Table 1*

Installed Cost $/ft., Depth < 10 feet. For installations > 10 ft. add 25%

Gravity Sewer			Force Main		
Diameter, inches	Clay	PVC	Diameter, inches	PE	STEEL
8	150	157	8	141	199
10	160	158	10	146	211
12	180	171	12	164	239
15	190	183	14	177	264
18	215	199	16	185	276
21	245	213	18	205	308
24	280	231	20	228	329
27	310	250	24	278	411
30	340	269	30	*	490
36	450	338	36	*	574

Table 2*

Manhole Installed Cost, $

Diameter	Shallow, < 15 ft.	Deep, > 15 ft.
4-ft	9,000	15,000
5-ft	12,000	17,000
6-ft	15,000	20,000

Table 3*

Pump Station Installed Cost

Capacity, mgd	Construction Cost, $	Cost, $/gallon
<0.5	300,000	0.60
1	500,000	0.50
2	800,000	0.40
5	1,750,000	0.35
>10	3,000,000	0.30

* 2009 Dollars

14.5 Measurement – How Is This Measured?

The following performance indicators that can be used to track capacity related performance of a collection system:

- Number of wet weather SSOs
- Number of repeat capacity related SSOs
- Volume of SSOs
- Annual rain data
- Size of rain events that result in SSOs

14.6 Links and References – Where Can More Information Be Found?

- Water Environment Federation (WEF), Design of Wastewater and Stormwater Pumping Stations Manual of Practice (MOP) FD-4, 1993
- WEF, Gravity Sanitary Sewer Design and Construction – Manual of Practice (MOP) FD-5, 2nd Edition, 2007
- McGraw Hill Construction: Engineering News Record (ENR), a weekly magazine
- San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan), January 18, 2007
- EPA, Review of Sewer Design Criteria and RDII Prediction Methods, January 2008
- AWWARF's Capital Planning Strategy Manual #2520, http://www.waterresearchfoundation.org/
- Water Research Foundation, *Capital Planning strategy Manual #2520*, *www.waterresearchfoundation.org/*

SECTION 15

COMMUNICATIONS

15.1 Introduction

This section provides guidelines for developing a communications plan that could be used to communicate the key messages an agency's SSO Reduction Program of the Agency to stakeholders. Stakeholders may include but are not be limited to an agency's governing body, rate payers, regulatory agencies, or other local agencies that may be part of a regional system with satellite agencies.

This section also provides a description of the benefits of a communications plan, an example list of key messages to be delivered, and some communications tactics that could be used to deliver key messages to stakeholders.

15.2 Problem Statement – Why is this Needed?

Many aspects of a SSO Reduction Program (or SSMP) may require the approval or cooperation from stakeholders. An agency's governing board must certify the program. If the program requires funding and an agency must raise rates to accommodate program funding, it is mandated to comply with California Proposition 218. Under this proposition, ratepayers have the option to legally protest a rate increase. Should an agency receive protests from the majority of its customers, the rate increase will not be approved by an agency's governing body. Residents and businesses should also be educated about the agency's FOG program (see Section 10). In summary:

- Effective communications promotes cooperation and support from stakeholders and makes it easier to implement an agency's SSO Reduction Program.
- Communications is the key to elected official's and the public's acceptance of an SSO Reduction Program and the key to obtaining the funds to develop and implement that program.
- A communications plan is required by the General Waste Discharge Requirements and is intended to provide an opportunity for interested stakeholders to provide input to an agency's SSMP.
- Agencies should also, on a regular basis, communicate with satellite or neighboring agencies to share information and data.

15.3 Benefits – Why Is This A Good Thing?

Nobody welcomes changes that come without warning, especially when they require effort or money without input from the individual. Effective communication with stakeholders involved with a SSO Reduction Program will ensure that a program is met

with a minimum amount of resistance. Communications should take place during the development of a program to solicit input from stakeholders and inform them of the value of the program, as well as during the implementation process to collect suggestions for improvement to gain support for the program.

A communications plan should achieve the following objectives:

- Communicate with enough frequency and information so that the SSO Reduction Program is supported by an agency's governing body, the ratepayers, as well as other agencies.
- Inform internal and external stakeholders of strategies to reduce SSOs.
- Inform an agency's governing body and the ratepayers of the success of the SSO Reduction Program.
- Increase public outreach to inform the community of the work the Agency is doing to reduce SSOs.

The following benefits can be realized from a good communications plan:

- Increased public outreach to the community informing them of the work the Agency is doing to reduce SSOs.
- Informed rate-payers that are more supportive of rate increases because they understand and trust the agency to spend their money wisely.
- Communicating with the stakeholders shows transparency in how the Agency manages the collection system.
- A systematic approach for communicating SSO Reduction processes, progress, and performance provides measureable results.

Key Messages

For a SSO Reduction Program, key messages should focus on the actions taken by an agency to reduce the number and volume of SSOs. An agency needs to invest time and resources to understand the causes of SSOs in their system and then develop a way to track their performances in preventing problems that lead to SSOs.

The following are examples of key messages that should be conveyed to the public:

- The SSO Reduction Program protects public health, the environment, and the water quality of the region.
- Wastewater collection system improvements are continually needed to replace existing infrastructure and to construct new infrastructure.
- Wastewater collection systems that are properly operated, maintained, and consistently improved to reduce the risk of spills.

- Preventive maintenance activities lead to reductions in the number and volume of SSOs.
- The Agency has adopted a process of continuous improvement to reduce SSOs.
- Adequately maintaining the system of sewer pipes and pump stations is critical to homeowners and businesses economic viability in the area served by the Agency.

15.4 SSO Reduction Strategies – How is This Accomplished?

Choose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

With effective communication, the public will be more willing to accept a program and/or elected officials will be more willing to support the funding for such programs. Communication with the stakeholder can happen in several ways and there is no one 'right' way to do it. The Agency should choose a plan that meets the needs of the agency and stakeholders at a reasonable cost. The tactics used for communication may include the following

- Press Releases
- Public Hearings
- Presentations to governing body on the status of SSO reduction measures and the formal adoption of the SSMP which is required
- Posting of information on the Agency's website.
- Providing copies of SSMP and Communications Plan at the front counter
- Preparation of Public Service spots for TV or Radio
- Preparation of reports that summarize how the Agency has performed in completing preventive maintenance activities that have led to a reduction in SSOs.
- Providing educational brochures and posters for the public.
- Providing directed outreach to segments of the community such as food service establishments or dental offices that directly affect the operation and maintenance of the collection system.
- Provide outreach in schools and public gatherings such as fairs and bazaars.

A summary of the communication tactics for each category of stakeholder is shown on Table 15-1.

Table 15-1
SSO Reduction Communications Tactics

Stakeholder	Areas of Interest	Tactic	Who	Timeline
Agency Governing Body	Environmental Stewardship	Board information updates	Management	Annually
	Rates and fees	Briefings with Board	Management	Annually
	SSO Performance Targets	Briefings to the Board and reports	Operations Staff	Semi-Annually
	Policies	Program Web Site	Communications Staff	Semi-Annually
	Ordinances	SSO Reduction Progress	Regulatory Staff	Semi-Annually
Ratepayers	SSOs Feedback to SSO Reduction process Service levels and targets Rates and fees	Agency Web Site Performance Reports or Report Cards Collateral Materials	Communications Staff, Regulatory Staff	Semi-Annually
Other Agencies				
Regional Board or State Board	Number and Volume of SSOs, Causes for SSOs	Reports	Regulatory Staff	Annually
Other Contributing Agencies and satellite agencies	Sharing of Resources	Support during large storm events	Operations and Maintenance Staff	Wet Weather Seasons
Upstream Dischargers	Excess flows	Communicate expectations	Incident staff and source control staff	As needed

Communications with the Governing Body

Agencies should provide periodic reports to their governing body. Specific examples of infrastructure deterioration, including pictures and asset failure event reports can help to educate the governing body of the importance of continued investment in the underground infrastructure. An agency should also provide periodic reports on the success of the Operations and Maintenance Program for meeting performance metrics related to SSO reduction. These may include progress on line cleaning and closed circuit television inspection activities, completion of spot repairs to fix hot spots, root control measures, FOG control measures, and response times to reduce the quantity of spills and improve customer satisfaction.

Communications with Ratepayers

An agency should provide information related to the SSO Reduction Program on their website. Then information may include the following:

- An overview of the components of the program, the reasons for each component, and the benefits of each component.
- A link for customers to provide feedback and comments on the SSO Reduction Program.
- A schedule for maintenance activities and construction projects that may affect specific areas within an agency jurisdiction.

Communications With Other Agencies

Each agency needs to develop a plan for communications with the State and regional regulatory agencies. Reports to the regional board should address the number and size of SSOs, the causes for SSOs, and what specific steps the Agency is taking to reduce SSOs.

Agencies who are part of a regional system should work with other contributing agencies (satellite) as they develop and implement their SSO Reduction Program. An agency may choose to exchange information on SSO reduction measures for review and discussion by the group.

15.5 Measurement – How Is This Measured?

The key measurement of a communications program is the public acceptance of the program. Along the way, the program's progress can be monitored by keeping track of the number of board workshops, public workshops, newsletters and Web site hits that occur.

SECTION 16

RECORD KEEPING

16.1 Introduction

This section addresses the following State Water Resources Control Board Order No. 2006-0003-DWQ Statewide General WDR for Wastewater Collection Agencies – Sewer System Management Plan (SSMP) Elements;

- (iv) Operation and Maintenance Program (b), (c), and (e)

The Order requires the Collection System operator to have a Preventive Maintenance (PM) program, including a system to document scheduled and conducted activities. Develop a rehabilitation and replacement plan, and provide equipment and replacement part inventories; specifically critical replacement parts.

16.2 Problem Statement – Why is this needed?

The primary reason to keep accurate records of your Collection System is it eliminates the necessity to rely on memory to track activities or past problems on the various components of your system. Historical data is a corner-stone of a preventive maintenance program. Pertinent information should be kept on all of the components that make up your Sanitary Sewer system; piping, manholes, lift stations and other appurtenances. If at all possible, this information should be readily accessible to the operator. At the very least, managers should have historical information available which they can interpret for decision making purposes to guide their crews to perform timely preventive maintenance. Historical data is also a key to the set up of rehabilitation and replacement programs.

16.3 Benefits – Why is this a good thing?

When accurate records are available on the history of a sewer main (or appurtenances), the correct type and frequency of preventive maintenance can be scheduled to prevent future problems and potential sewer system overflows. Furthermore, when the time arises, these records will assist in the development of the proper rehabilitation or replacement program.

16.4 SSO Reduction Strategies – How is this accomplished?

Chose only the strategies presented in this section that could improve collection system performance in terms of reducing preventable SSOs. Once a particular strategy has been implemented, it is critical to monitor and measure the effectiveness of that strategy. If SSOs are not eliminated or reduced, choose a different strategy that will better address the specific situation.

Understanding the cause of the overflow is critical to understanding what type of strategy would most probably reduce SSOs within a given collection system. The data collected at the time of the SSO needs to provide the cause of the overflow to the best ability of the operator responding to the SSO. Knowing the difference between a partial stoppage caused surcharging overflow and one in which the flow is restricted by too small of a pipe can mean the difference between starting an unnecessary capital replacement project or a repeating SSO problem – as no matter how many times a pipe is cleaned – that won't fix an undersized pipe.

First, talk to neighboring agencies to get ideas for how to organize data and have good record keeping. Most large sewer agencies and many of the medium sized agencies have computer software programs that provide a platform for collecting, storing and evaluating the information collected on their sewer systems. These range from inexpensive generic software programs, to very expensive, specialized programs.

It should be noted, that a manual record keeping system either on paper (such as field logs or a card file) or a simple EXCEL spread sheet program will suffice to meet the requirements of the SSMP and will often meet the needs of the small agencies. In whatever means the data is kept, it needs to be readily accessible and as simple as possible to maintain and utilize. For the purpose of this manual, the examples shown in the appendix are based on a computerized record keeping system.

Basic Inventory structure:

All of the infrastructure in your system should be identified uniquely. Much like any form of communication (as concisely as possible), a narrative "snapshot" of each component should include Who, What, Where, When and How. In addition, critical elements should be included if needed. Please refer to the Appendix for sewer system inventory.

Changes to your System:

Keeping an up to date inventory system is very important for the "Legally Responsible Official" for the annual updates to your agencies CIWQS questionnaire. In addition, if pipe replacements are not kept track of, it will be very difficult to properly plan a rehabilitation and replacement program. Other examples of inventories are listed in the appendix.

History of Assets:

In addition to inventory of your infrastructure, to facilitate proper maintenance and operations, and eventually rehabilitation, historical data is very valuable. The history of an asset builds on the inventory information and enables the manager to understand how the pipe, manhole, service line or lift station has performed. SSOs attributed to poor performing infrastructure are a trigger to initiate action – preferably pro-active or preventive maintenance, or rehabilitation.

Accuracy:

The old adage of garbage in /garbage out is especially true with reference to History of Assets. It is important that whoever enters the data into the record makes sure that they enter accurate and complete data to the correct record. Training staff and maintaining consistent application of terms is critical to maintaining a valuable historical record. If over the years staff starts to use terms differently this can cause the data to become less valuable. When data changes are required, try to set specific dates for these changes and document those dates so that when data is retrieved for long term trends, the data can be properly interpreted for the meaning at the time.

Please refer to Appendix for sewer system inventory examples.

16.5 Measurement

The true measurement of any record keeping system is "can you easily access all relevant information about your sewer collection system and it's appurtenances to efficiently operate and maintain the system in a reasonable amount of time". If you can do that, you have accomplished the purpose of this section.

16.6 REFERENCES

- http://www.bcua.org/Sections-read-20.html
- California State University, Sacramento. Office of Water Programs. Operation and Maintenance of Wastewater Collection Systems Volumes I & II
- California State University, Sacramento, Office of Water Programs, Manage for Success – Effective Utility Leadership Practices.
- Parcher, Michael J. Wastewater Collection System Maintenance. Technomic Publishing Company, Inc.

Section 16 Attachment A

Appendix

Appendix

Basic Inventory Structure Examples:

MANHOLE INVENTORY:

Each manhole in your system needs to be uniquely numbered. Your manholes typically are the connecting nodes depicted on your system maps. Some agencies identify their manholes based on plat maps, while others devise their own numbering system as a series of combination of alpha-numeric identifiers. The Collection System operator needs to devise a numbering system that makes sense, easy to follow, and can be documented as to how the numbering convention works. In addition to the numbering system, critical elements would be: size of manhole barrels, depth of manhole at incoming pipeline invert, lid size, locking or non-locking, location (street or easement), general condition and last time inspected for defects.

Sewer Pipeline Inventory:

Sewer pipeline inventory usually uses the upstream and the downstream manhole numbers (manhole identifier) as the unique identifier. To reduce confusion, it is best if the identifier always refers to the manholes in the same order, i.e. first the upstream manhole is listed and then the downstream manhole is listed. Sometimes this is done with a dash separating the two manhole identifying numbers. In cases where parallel pipes have been installed between the same two manholes, an additional indication will be needed. In addition to the identification of the mainline, the inventory should include critical elements: size of pipe, slope (or up and downstream invert elevations), pipe material, and length of the run. Other important information would be pipe installation date, location (street or easement), the last closed circuit television (CCTV) inspection date, along with cleaning schedule and any other information deemed important by your agency.

Lift Station Inventory:

If your agency has lift stations, a more intense inventory usually occurs. Much like manholes, the naming convention might be associated with the street address, housing development it serves, or plotted as the last downstream manhole. Critical information could include: date constructed and accepted, volume of possible capacity at peak flow, vertical lift in feet of total dynamic head, the electric account number (in case of power outage), back-up generator information, name of phone company and account number (if applicable), types of alarms for telemetry or Supervisory Control And Data Acquisition (SCADA) and back-up generator type and model (if applicable). In addition, the wet well size and depth (or dry well) should be noted, pump types and model numbers, number of pumps in rotation, horsepower ratings, typical amp draws, impellor size(s), emergency by-pass manifold size and type, force main discharge point, and emergency storage volume. Knowing the location of the pump stations' lowest upstream manhole

rim can be very helpful as this is provides the place an overflow will occur first during a pump station outage. This can change quite a bit with changes to roadways and landscaping, so needs to be regularly reviewed and updated as needed.

SERVICE LINE INVENTORY:

In theory, each lateral serves only one home or business; the address for that structure can act as the unique identifier for the piping. Based on the concept of a unique identifier, a profile can be established containing the most pertinent information for that structure: Address, unique identity number, lot number, subdivision, upstream manhole number, tap distance, use type (residential or commercial), size of pipe, type of pipe, length of service, date the pipe was installed (age), property line clean-out location and depth, and a comments section for anything out of the ordinary.

SSO History Records:

Collection system components should have a method for recording the details of events involving SSOs or problems/failures that could have resulted in an SSO. There needs to a set of agreed upon terms that describe categories of overflows and the issue that caused the overflow. It is very important to be able to separate the problems that lead to certain SSOs are able to be separated out from all the other type work that is done on the system. Emergency work to respond to SSOs needs to be collected and tracked to the component that actually had the failure causing the overflow – not the just where the overflow came out. Many main line stoppages cause overflows from the clean out on the lateral. The data collection needs to be structured so the correct asset is "credited" with the overflow.

Work associated with a specific SSO reduction strategy should be able to be separated from other work tracking systems. This will aid in determining if a new strategy is successful or cost effective.

SSO response information is very important: time of call out, time of arrival, time of breaking stoppage, amount of spill contained, amount of spill that went into a storm drain or channel, how much was captured and returned into your system, where the spill exited your system, the cause of the stoppage, how the SSO was mitigated, volume of spill, if samples were taken, and any other information related to the stoppage or spill. The information you capture regarding an SSO should match the data you input into the State Water Resources Control Board's California Integrated Water Quality System (CIWQS) database. Further, this information needs to be readily available to perform a yearly self-audit.

History of Assets Examples:

Mainline History:

Many agencies keep specific information pertaining to each sewer mainline pipe in a log separate from the inventory. Sewer mainline history information that can be useful to

keep includes: cleaning frequency, cleaning protocols and known problems or SSO information. Any activity related to the mainline should be captured: cleaning work orders, CCTV work orders, repair work orders, root foaming work orders, known sag areas, a log of changes or adjustments to the PM schedule, and any work performed related to a stoppage or a Sewer System Overflow (SSO).

MANHOLE HISTORY:

Manhole history generally contains similar information to mainline history. Manhole inspections should identify defects that require attention. Leaking joints, spalled concrete, poor bench conditions, poor channel characteristics, frame and grade ring deficiencies, and cover problems are some of the most common problems. Any activity related to the manhole should be captured: cleaning work orders, inspection work orders, repair work orders, a log of changes or adjustments to the PM schedule, and any work performed related to a stoppage or a Sewer System Overflow (SSO).

Lift Station History:

In addition to a log sheet located at the station, to document work performed, when, on what part of the station, by whom; a similar log sheet needs to be maintained off-site. In addition to the basics listed, any call-outs associated with the lift station should be documented. All preventive maintenance should be documented. The inventory should be updated, and a work order should be generated if any operating systems change or are updated on the station. All work associated with the pumps should be documented, particularly any decreases in efficiency that might require pump repair. Large agencies that run high volume stations perform vibration analysis to ascertain if the pumps require proactive preventative maintenance. Conversely, small agencies that run small low volume stations may require basic history and inventory to document pump run-times and pump rotation.

Mainline CCTV Data:

Closed circuit television (CCTV) inspection data is extremely important information for the sewer system operator and manager. See CCTV Section 3 for more information. From a record keeping perspective, the key issue with data collected from CCTV is finding a problem code system that works for the agency and be consistent. Training of staff to provide consistent repeatable reports about what the TV has found will limit multiple reviews or starting unneeded work due to discrepancies in interpretation and recording of problems.

Prior to acceptance, testing procedures need to be enforced to get the best product possible. Documentation of the testing procedures may initiate the first mainline work order. At the very least, a work order needs to be initiated at the time of acceptance. This would act as a “born on” date to capture all of the pertinent information relevant to Mainline Inventory. Most agencies have written specifications to perform a pre-acceptance CCTV, to verify alignment of joints, cracked pipe (needing repair prior to

acceptance), tap locations, deflection of alignment (sags and incorrect deflection degree), and general condition of the new piping.

SERVICE LATERAL OR SERVICE LINE HISTORY:

All work associated with each service lateral needs to be captured in a work order. The work order should include the date, time the call was received, time the call was responded to, the nature of the call, if there was a stoppage (your responsibility or the homeowners), what work was performed, duration of the work, and any follow-up work. Service line history acts to augment service line inventory, in the same fashion as mainline history augments mainline inventory.

SERVICE LINE CCTV INSPECTIONS:

Work orders associated with CCTV inspections of service laterals can be a sub-set to the Service line History data. Typically the acceptance work order discussed above should include a CCTV inspection. The first TV inspection establishes that there is no construction debris in the lateral, and that it has proper grade, with no sags, misaligned joints, or cracked pipe. CCTV work orders should include: address, date, recorded – yes/no (DVD, videotape or paper CCTV log), media ID, recorded from (property line clean-out, manhole, or two way at house), operator, pipe size, pipe type, pipe length, property line clean-out location and remarks. The actual CCTV log should include: distance, problem code(s), severity rating, and comments fields. The information tabulated from a CCTV should be used to establish history, record any changes to the structure or make-up of the lateral, and be input is such a fashion that it can be queried for report purposes. (See example)

NO CLEAN-OUTS LIST(S):

A critical component of the service lateral is a property line clean-out (PLCO). Just as a manhole allows access to the mainline piping, the property line clean-out allows the sanitary sewer manager the availability to access and assess the condition of the piping. The PLCO should be installed and inspected at the time of acceptance. As dictated by the Uniform Plumbing Code (UPC), the clean-out should be of the same size piping as the service line, have an access box raised to grade, and be a one way clean-out in the direction of flow, going into the mainline sewer pipe. In the event of a stoppage, this will ensure that a cleaning tool will travel the correct way towards the main, not in the direction of the structure. Nearly every collection system has service laterals that are missing clean-outs at the public right of way (or the designated point of connection). One of the first steps in establishing a preventative maintenance program for service laterals is to make an assessment of how many cleanouts are in recorded history, and conversely, which laterals need PLCO's. At the time of the clean-out install, the service line should be assessed. Two work orders should be generated, along with an update of the service line inventory: a work order capturing the clean out install, and a CCTV work order capturing the condition assessment. (See example) PLCO locations need to be memorialized in a data-base, with footage protocols accepted by your agency.