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F 800 OPERATION AND MAINTENANCE OF SEWER COLLECTION SYSTEM

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F 800 GENERAL

Operation and maintenance of a wastewater collection system means making sure that the system is kept in good operating condition. It requires that the facilities be adequately maintained, so that the system can efficiently accomplish its intended function of collecting and conveying wastewater to the treatment plant in a sanitary manner.

Provision of an adequate operation and maintenance of a wastewater collection system extends beyond that of the operation. An efficient system involves joint responsibility of the planners, the designers, the construction managers and the administration, acting homogeneously. The operator can only function on the basis of available resources provided to him. The greater part of the responsibility lies with those who plan and build the system.

F 801 PURPOSE AND SCOPE

The purpose of this chapter is to outline the procedures, practices, and policies in the operation and maintenance of a wastewater collection system. The intent is to serve as a guide for sewer designers, planners and program managers.

The chapter discusses the various aspects of operation and maintenance, and is divided into the following topics:

a. Sound basic policy guidelines;

b. Operations;

c. Inspection and testing;

d. Maintenance;

e. Failures;

f. Remedial measures;

g. Records and logistics;

h. Emergency operations, maintenance and repairs; and

i. Safety.

F 802 THE NEED FOR ADEQUATE OPERATION AND MAINTENANCE

A wastewater collection system is subject to a variety of operational problems. Depending on the wastewater flow characteristics, surrounding soils condition, and quality of construction, the pipeline can suffer from clogging, scouring, corrosion, collapse, and, ultimately, the system's deterioration. The collection system is designed to serve for a specific useful life. Hence, it is incumbent for the City to provide adequate operation and maintenance to maximize the benefit throughout its designed useful life.

F 803 POLICY GUIDELINES

It is the policy of the City to protect the public from potential health hazards arising from wastewater discharges. To achieve this objective, the following guidelines are set forth:

a. Adoption of a preventive maintenance program to maintain the integrity of the wastewater collection and treatment system.

b. Regular facilities inspection for physical damage followed by immediate and adequate repairs.

c. Immediate response to all sewer-related complaints followed by prompt correction of defective condition.

d. Implementation of a sound safety program.

e. Respect for public ownership in the pursuit of sewer maintenance work.

f. Maintenance of good public relations through community participation in the planning process.

F 804 DESIGN CONSIDERATIONS FOR OPERATIONAL CONTROL

Operation and maintenance is, and properly should be, a major concern of the design engineer. A properly-designed wastewater collection system will minimize operation and maintenance problems as well as keeping construction costs at a minimum. While maintenance problems can be expected, there are recognizable ones that are design-related. For a complete discussion on design standards, refer to Chapters F200 and F400.

As a general rule, design engineers should adhere, as closely as practicable, to accepted design standards and codes of practice. Any deviation from these standards should always be done in consultation with operating and maintenance personnel.

F 805 SEWER COLLECTION SYSTEM MANAGEMENT

The City charter empowers the City Council to provide sewers and appurtenance for sanitary purposes in order to promote the peace, health, safety and welfare of the public. The Department of Public Works is responsible for managing the City's wastewater collection and treatment system.

F 805.1 BUREAU OF ENGINEERING

The Bureau of Engineering is responsible for the planning, preparation of environmental assessment, preliminary designs, final plans and specifications and estimates for all storm drains, sewers and wastewater treatment facilities and other public works infrastructure projects.

F 805.11 WASTEWATER PROGRAM MANAGEMENT DIVISION (WPMD)

The WPMD provides centralized advance planning, scheduling, financial management, technical overview and administrative
support for the entire Wastewater Program. These responsibilities include coordinating and monitoring:

a. The implementation of an operation and maintenance management system;

b. The timely submittal by contractors of operation and maintenance manuals; and

c. The training of operation and maintenance personnel.

F 805.12 WASTEWATER SYSTEMS ENGINEERING DIVISION (WSED)

WSED is responsible for the planning and design of all wastewater system facilities, except that of the Hyperion Treatment plant. The planning team functions within the Bureau's Wastewater Systems Engineering Division. The Division is comprised of professionals with backgrounds in sewer, pump station, wastewater treatment plant, and sewer designs, hydraulics, environmental analysis and financial reporting.

F 805.13 HYPERION ENGINEERING DESIGN DIVISION (HEDD)

The HEDD is responsible for the planning and design of the Hyperion Treatment facilities.

F 805.2 BUREAU OF SANITATION

The Bureau of Sanitation is principally responsible for the operation and maintenance of all facilities required for the conveyance and treatment of wastewater, including industrial wastes. Within this Bureau, the Wastewater Collection Systems Division performs all routine inspection, cleaning, and repair, including emergency maintenance, on both the sanitary and local storm drain systems, and on the wastewater pumping stations. The Division is headed by a Wastewater Collection Manager II.

The Wastewater Treatment Division is responsible for the operation and maintenance of the upstream treatment facilities only. The Hyperion Treatment Plant Division, on the other hand, is responsible for the Hyperion Treatment facilities only.

F 805.21 FUNCTIONAL RESPONSIBILITIES

Functionally, the Wastewater Collection Systems Division is divided into three sections: (1) Pipeline Maintenance, (2) Mechanical and

Electrical Maintenance and Operation, and (3) Administrative Sections.

For jurisdictional control, the Pipeline Maintenance Section is subdivided into Zone I and Zone II, each one headed by a Wastewater Collection Manager I. The Mechanical and Electrical Maintenance and Operation Section operates City-wide and is designated as Zone III. It is also headed by a Wastewater Collection Manager I. Figure F 805.1A shows the organizational chart of the Division.

F 805.22 PIPELINE MAINTENANCE

This Section is responsible for ensuring that the sanitary sewer and storm drain systems are operating properly. The Sewer Work Group is responsible for the operation and maintenance of the sanitary sewer system.

The City-wide Unit cleans and maintains large sewer lines, operates large equipment, chemically treats sewers for root control, performs insect and rodent abatement programs, and performs night and weekend emergency functions.

A City-wide Night Unit performs a night maintenance program and works principally in areas where heavy daytime traffic precludes effective maintenance work during the regular work hours.

F 805.23 MECHANICAL AND ELECTRICAL MAINTENANCE AND OPERATION

This Section is subdivided into Mechanical, Electrical and Operation groups. The Section operates Division-wide with the Mechanical and Electrical Groups responsible for the maintenance and repair of equipment. The Operation Group operates and maintains the sewage pumping plants and the ventilation stations.

F 805.24 ADMINISTRATIVE SERVICES

This Section is responsible for all administrative tasks, including the procurement and distribution of parts and supplies. It is also responsible for the personnel training program as well as the operation and maintenance of the Division's computer system.

F 805.3 FIXED FACILITIES

The City's wastewater conveyance system consists of about 6,400 miles of mainline sewers, including four major interceptors tributary to the Hyperion Treatment Plant and four major outfalls, namely: North, Central, North Central, and the Coastal Interceptor sewers.

There are approximately 100,000 maintenance holes, 70 pumping stations, 7 ventilation stations and various siphons and diversion structures. To maintain this system, the Division operates eight sewer maintenance yards which are spread out around the City.

F 805.4 MOBILE EQUIPMENT

The City uses a variety of both heavy and light mobile equipment in sewer system operation and maintenance work. These include heavy-duty trucks, light pickups, and a host of sewer cleaning equipment that include hydroflushers, rodding and balling machines, and catch basin vacuum machines. It also employs Closed Circuit Television (CCTV) equipment for sewer inspection. CCTV sewer inspection is the responsibility of the Survey Division. All requests for CCTV inspection should be directed to that division.

F 806 REVIEW OF PLANS AND SPECIFICATIONS

Generally, the Wastewater Collection Systems Division review function covers only the major sewer lines, such as interceptors, relief sewers, and outfalls. The review process is limited to the construction plans and does not include the specifications. The design of the local and main sewers is usually done by the district offices. However, if they include special structures, such as siphons, diversion, etc., the construction plans should be reviewed by WCSD.

The nature of the operation and maintenance of a pumping plant requires that O&M personnel be consulted during the planning and design stages. It is, therefore, important that WCSD be involved in the review of plans and specifications for pumping plants.

In reviewing the plans, the reviewers should look into the following:

a. size of sewers to handle expected flows and maintenance equipment;

b. sewer route alignment as it relates to pipe sizes, depth of excavation, and maintenance equipment access;

c. ease of operating and maintaining the system;

d. ability to control potential problems for industrial discharges; and

e. Adequate safeguards against potential accident hazards.

F 807 CONTRACTUAL FLOWS

The City currently provides sewage transport and treatment services on a wholesale basis to 29 municipalities, districts or agencies pursuant to Sewage Disposal Contracts (SDC) executed and in force with each agency. While the terms and conditions vary, each contract, in general, requires payment of operation and maintenance expenses and capital costs attributable to those components of the sewer system used by the agency. The volume of flow discharged into the City's sewer system is used as the basis for sewer charges.

The wastewater collection systems serving the Terminal Island Treatment Plant (TITP) fall under the jurisdiction of four separate entities: (1) the City of Los Angeles; (2) the Los Angeles County Sanitation District; (3) the Los Angeles Harbor Department, and (4) the United States Department of the Navy. Most of the area is served by the wastewater system of the City of Los Angeles.

A section of the City is served by the Los Angeles County Sanitation Districts (LACSD). Two pocket areas of Los Angeles County are located within the TITP service area, and wastewater from these areas drain into the collection system of the City.

A portion of the City of Los Angeles is tributary to the City of Long Beach sewer system. Wastewater from this area is ultimately conveyed to the LACSD joint treatment plant. While a contract between the Cities of Los Angeles and Long Beach permits the City of Los Angeles to discharge a maximum of 3.2 mgd to the Long Beach system, the contract is currently inactive.

F 807.1 CONTRACTUAL AGENCIES

Table F 807.1A lists the contractual agencies discharging their wastewater to the City's sewer system. The list shows the locations of these agencies.

F 808 EMERGENCY SEWER REPAIR WORK

As a matter of policy on public health hazards, the City is committed to employ the services of private contractors to perform emergency sewer repair work on failed sewer lines in case the City forces are unable to respond to or handle the scope of work.

As adopted by the City Council on October 17, 1984, and concurred in by the Mayor on October 25, 1984, a sewer failure is, by definition, a matter of urgent necessity as defined in the Los Angeles City Charter, Section 386.

F 808.1 PROCEDURE FOR EMERGENCY SEWER REPAIR WORK

The revised procedure for utilizing a private contractor in emergency sewer repair is spelled out in the Bureau of Engineering Special Order No. 5009-0687 dated June 8, 1987 shown as Appendix F 808.1A. Appendix F 808.1B is a standard construction order letter authorizing the contractor to proceed with the emergency repair work.

F 808.2 ON-CALL CONTRACTORS FOR EMERGENCY SEWER REPAIR WORK

The authority to establish a list of on-call contractors for emergency sewer repair work is contained in the Bureau of Engineering, Bureau of Sanitation, Bureau of Contract Administration, Office of Contract Compliance joint Report No. 1 shown as Appendix

F 808.2A dated October 16, 1987 and adopted by the Board of Public Works of the City of Los Angeles on the same date.

A rational list of on-call contractors for emergency sewer repair work is shown as Exhibit A of said Special Order No. 5009-0587. This is continuously updated after each emergency condition.

TABLE F 807.1
CONTRACTUAL AGENCIES

NAME OF AGENCY	HTP CONTRACTED FLOW RIGHTS AVG FLOW(MGD)	1979-80 FLOW [a] (MGD)
Aneta St. MD	Floating Rate	Negligible
Barrington P.O.	Flat Rate	Negligible
Beverly Hills	7.2610	5.95
Burbank	10.00	6. 67
Ca. Nat'l Guard	Flat Rate	Negligible
Co.San.Dist.No 2[b]		
Co.San.Dist.No.4	6. 60	5. 25
Co.San.Dist.No.5	1. 661 [b]	0. 75
Co.San.Dist.No.9	0.35 [d]	Negligible
Co.San.Dist.No.11	[c]	Negligible
Co.San.Dist.No.16	0.4903	0.43
Co.San.Dist.No.27	0.30	0.16
Culver City	6.706	4.72
El Segundo	2.750	2.42
Fed. Off. Bldg. WLA	0.13	Negligible
Glendale	19.15	13.02
Hughes Tool Co.	Rental Fee	0.26
Inglewood	Flat Rate	Negligible
Las Virgenes MWD	Rental Fee	Negligible
Marina Del Rey	3.00	1.71
San Fernando	1.1375	1.79
Santa Monica	11.0000	11.42
Universal City	0.1616	0.16
U.S. Air Reserve	Flat Rate	Negligible
U.S. Army Reserve	Flat Rate	Negligible
USNavy,Terminal Is.	1.600 [d]	0.49
V.A. Sawtelle	1.36 [e]	0.29
WLA College	0.70	Negligible

[a]Flows less than 0.1 mgd are considered negligible.
[b]Effective January 1976, no longer tributary to Hyperion System.
[c]Rights in sewers only.
[d]Contractual Flow Rights in Terminal Island Treatment Plant. [e]Approximation - no specified rights.

F 810 OPERATIONS

Operations refers to activities related to managing the City's sewer collection system. This involves 6,500 miles of pipeline network, 58 pumping plants and four treatment facilities. Operating such a system requires a well-organized and highly trained technical, semi-skilled, skilled and administrative staff to ensure that the system is in continuous operation.

F 811 PIPELINE OPERATIONS

For administrative purposes, pipeline operation has been divided into three working groups. These groups are designated as Zone III, responsible for all mechanical and electrical maintenance, as well as pumping plant operation. The Administrative Division is responsible for all administrative matters.

F 812 FLOW MEASUREMENTS

The ability to measure wastewater flows is of fundamental importance in the planning and design of wastewater management facilities. Maintenance planning for a specific pipeline may also require a knowledge of discharge and flow velocity.

F 812.1 RESPONSIBILITY

The Survey Division of the Bureau of Engineering is responsible for conducting flow measurements.

The Sewer Planning, Monitoring and Special Projects Section, Wastewater System Engineering Division, coordinates all requests for flow measurements. It is also charged with the responsibility of compiling and keeping flow measurements data for all special flow gaging requests and for the routine monitoring program.

F 812.2 TYPES OF FLOW MEASUREMENTS

There are three types of flow measurements. Depending on what type, gaging period can last from eight hours to seven days. In general,

most flow measurements for special gaging request are conducted for 24 hours.

F 812.21 ANNUAL FLOW MEASUREMENTS PROGRAM

This type of flow measurements is categorized as routine gaging. Flow measurements are taken from a network of wastewater sewer maintenance holes covering the City's wastewater collection system.

Flow measurements are taken for eight continuous hours at 30-minute intervals. The frequency varies from one to four times a year for each gaging station, depending on the planning requirement.

F 812.22 REGULAR MONITORING OF CONTRACTUAL FLOWS

The City maintains flow gaging stations for contract agencies and cities discharging to the City's wastewater collection system.

Flow measurements are taken at each gaging station for seven continuous days on a quarterly basis. All data are sent to the Financial Management and Control Group, Wastewater Program Management Division (WPMD).

F 812.23 SPECIAL GAGING REQUESTS

These are requests initiated by various City offices. In general, the majority of requests originate from the Bureau of Engineering district offices and from the Wastewater System Engineering Division (WSED).

Flow measurements are generally conducted for 24 hours, but can extend to seven days depending on need and flow variations.

F 812.3 METHODS OF MEASUREMENTS

There are 2 principal methods of measuring flow: (1) direct discharge method, and (2) velocity-area method. For direct discharge method, the rate of discharge relates to one or two easily measurable variables.

The Survey Division employs the direct discharge method for flow measurements. Two types of flow measuring devices, the F-3000A Manning flowmeter and an Ultra Sonic System are used. Both devices measure directly the depth of flow. For routine gaging, and for pipe sizes eight inches and smaller, the handgaging method is used.

F 812.4 PROCEDURE FOR REQUESTING FLOW MEASUREMENTS

All requests for sewer gagings shall be directed to the Survey Division. Such requests are to be completed on the Standard Survey Division field request forms. The requests shall be accompanied by a copy of that portion of the sewer "Y" maps that includes all of the maintenance holes to be gaged; each maintenance hole shall be circled on the "Y" map(s) for easy identification.

All sewer maintenance holes to be gaged shall be physically located in the field and inspected as to their suitability to be gaged, prior to making the sewer gaging request. Any unusual problems that may be involved, such as heavy traffic, unusual peak hours for sewage flow, large size or tarred maintenance hole covers, or maintenance holes not located in City streets or easements should also be noted on the sewer gaging request. If the maintenance hole is not located in a City street or easement, permission to gauge shall be obtained by the requesting office.

Where feasible, requests for sewer gaging information required for high priority work or emergencies, may be transmitted by telephone, but must be immediately followed by written field work request to that effect.

The Survey Division shall send copies of the resulting gaging information to the requesting office and to WSED. However, for jobs of high priority or emergencies, the results of the sewer gaging may first be made available by the Survey Division to the requesting office by telephone.

F 813 PUMP STATION OPERATION

The main function of a pump station, sometimes called lift station, is to raise wastewater from a lower to a higher elevation. A pump

station discharges into a long force main whereas a lift station has a relatively short discharge line immediately preceding the downstream gravity sewer. As used in this manual, pump station includes lift stations.

The ideal operation of a pump station would be when the discharge rate is nearly equal to the inflow rate. This would occur with the highest use of equipment and energy efficiency possible. Consequently, operational and maintenance problems would be minimized.

For discussion on pump station design considerations, refer to Chapter F700.

F813.1 RESPONSIBILITY

The operations group in the Mechanical, Electrical and Operation Section is responsible for the operation and general upkeep of the pump stations and the ventilation stations. A senior electrical plant operator supervises the whole operation, and is responsible for scheduling the work on a monthly basis.

F813.2 MODE OF OPERATION

There are three modes of operation used in the operation of the pump stations. Each one is described below:

a. Automatic Control Operation. This is the normal mode of operation. This consists of the activation and deactivation of a series of pumps depending on the wastewater level in the wet well.

   Primary controls, such as floats, air bubbles or pressure sensitive devices, measure the level of water in the wet well. Secondary controls convert the measurement from the primary controls into a signal for a pump to start, stop, or change speed.

b. Constant Speed Operation. This mode is used as an alternate to the automatic control type of operation.

The pumps may be set manually to operate at a desired constant speed. This mode is used under one of the following conditions:

(1) When the normal mode of operation fails;

(2) When testing any section of the pump operating system;

(3) During any unique situation when the pumps maybe operated in order to regulate the wastewater inflow;

(4) During any unusual or emergency situation.

c. Fill and Draw Operation. This mode of operation serves as a backup system when the "automatic control" mode fails due to malfunction in the wastewater level gaging system in the wet well. During such failure, and if no personnel is available to activate the "constant speed" system, the "Fill and Draw" mode of operation is automatically activated by means of a switch at a predetermined wastewater level in the wet well. When such situation occurs, an emergency situation is telemetered to the plant main headquarters in Venice. Maintenance personnel is then notified so that corrective action can be initiated.

In every case, after corrective action has been taken, the maintenance personnel needs to restore the mode of operation to the normal "automatic control" system.

F813.3 PUMP STATION VISIT

Depending on the type (e.g., package type), size, and capacity of a pump station, the facility maybe fully-manned 24 hours a day or operated unattended except for regular periodic visits. A fully manned pump station does not pose as much maintenance problem as an unattended one since an operator is always present to take care of any breakdown.

For the unattended pump station, the frequency of inspection varies depending on the following:

a. Design of the facilities and type of equipment installed. Some recorder's charts need to be replaced once every three days, whereas others can run unattended for as long as a week.

b. Condition of equipment, which could be one that has been temporarily repaired and waiting for replacement parts.

c. Adequacy of preventive maintenance program.

d. Availability of operating and maintenance personnel.

In general, most of the pump stations are visited every 72 hours for operational needs. During such visit, the Pump Operator performs all operational checks, including the replacement of recording charts, making sure that all the pumps are operational, and that the pumps are not "airbound".

For general upkeep, the stations are visited once a week or as manpower availability allows.

F813.31 SAFETY

One rule that should apply to all pump station visits is that for safety precautions, there must always be two operators making the station visit.

Safety precautions regarding the presence of hazardous gases apply not only on the wet well, but in the dry well area of the station, too. This rule must be followed, particularly during off duty hours such as night time, weekends, and holidays when operators are responding to pump station telemetry alarms.

For safety procedures in confined space, refer to Section F880.

F813.32 SIGN-IN LOG

Every pump station should have a sign-in log. Everyone who enters the station should sign the plant log book, including the date and time of arrival and departure. This allows for monitoring every activity that takes place inside the station. The sign-in log should be kept inside the station and turned into the office when the last space on the sign-in sheet is exhausted.

F813.4 RESPONDING TO STATION ALARMS

The responsibility of responding to "Red" alarms for unattended stations lies with the operator on duty in the central receiving station at the Venice Pump Station. This station is manned 24 hours a day and all stations are connected to it by telemetry.

The unmanned pump stations are continuously monitored for any signal which will indicate any change from normal condition. An hourly check is made of the overview display to ensure that all stations are operating normally.

F813.5 TYPES OF ALARM CONDITION

There are eight types of alarm condition that could warrant emergency responses. Each one of these indicates an abnormal condition where the alarm originates.

F813.51 POWER FAILURE

This condition indicates electric power outage at the station where the signal originates. Loss of electric power for an unextended period results in a complete shutdown of the pumps. When this occurs, a signal is automatically transmitted to the central receiving station at Venice Pumping Plant.

F813.52 HIGH WATER WET WELL

There are several possible causes that could result in this condition. A high water alarm could be due to:

a. Power failure;

b. Improper arrangement of electric controls;

c. Failure of automatic control;

d. Obstruction in a pump;

e. Obstruction in the piping system;

f. Improper arrangement of valves; or

g. Hydraulic overload due to excessive inflow and/or infiltration as a result of an intense rainfall.

F813.53 WATER ON DRY WELL

This condition could be due to:

a. Breakdown of the sump pump;

b. Excessive bleed-off from the pump packing; or

c. Leak from the piping system.

F813.54 COMMUNICATION FAILURE

This condition occurs when the scanning equipment at the Venice Pumping Plant is not receiving any signal from the unattended stations. While this could be caused by a failure of the leased telephone line serving the particular station, it could also be the result of a complete failure of the remote station's transmitting equipment. Such failure would most likely be caused by the inability of the emergency battery to function during a power outage from the regular power source.

F813.55 PLANT ABNORMAL

This condition indicates the failure of the wastewater level gaging system in the wet well to function properly. Under normal

condition, the station will start operating off the Murphy switch, sending in high water level wet alarms when the wet well level reaches a pre-determined elevation.

F813.56 DEVICES CYCLING

This condition indicates that a pump is cycling on and off. The alarm comes in each time the pump has cycled for the fourth time in the preset time period.

F813.57 DOOR OPEN

This condition simply indicates that the door to the pump station is open. When this condition occurs at any time other than regular working hours, it should be reported.

F813.58 MESSAGE 1 OR 2

This condition indicates that an electrician (Message 1) and/or mechanic (Message 2) is at the plant. If this condition occurs at any time other than regular working hours, it should be reported on the following working day.

F813.59 ALL ALARMS CONDITION

This condition is usually caused by a malfunction of the telemetry equipment at that particular station. When this happens, all the alarm functions (i.e., power failure, high water in wet well, water in dry well, communication failure, plant abnormal, device recycling, and door open) are set in motion and telemetered to the central receiving station.

F813.6 GENERAL RESPONSE PROCEDURE

Response procedure may vary depending on the type of alarm received. However, in general, the operator on duty at the Venice Pumping Plant is required to:

a. Notify the appropriate WCSD Supervisor;

b. Continue monitoring the station; and

c. Notify the supervisor previously notified when the "alarm" status ends.

The operator on duty is also required to record in the Log Book the following data: Date, time, location, nature of the alarm, and the name of the person notified.

F 814 TREATMENT PLANT OPERATION

The City operates four major wastewater treatment facilities with a combined wastewater design flow treatment capacity of 510 mgd. These facilities include the Hyperion Treatment Plant (HTP), Terminal Island Treatment Plant (TITP), Los Angeles-Glendale Water Reclamation Plant (LAGWRP), and the Tillman Water Reclamation Plant (TWRP). TITP, LAGWRP, and TWRP are referred to as the upstream facilities.

All four treatment facilities are of the conventional activated sludge process, providing secondary treatment, except LAGWRP and TWRP, which have the added feature of a tertiary treatment process.

The purpose of this section is to provide an overview of the operational features of these facilities, including capacity, type, effluent and sludge disposal methods.

F 814.1 HYPERION TREATMENT PLANT (HTP)

The Hyperion Treatment Plant, located in Playa Del Rey, is the largest of the four treatment facilities. It has a primary treatment capacity of 420 mgd. Currently, 150 mgd undergoes secondary treatment. It also provides solids handling for incoming sludge transported in the wastewater collection system from upstream facilities.

A unique feature of the HTP is the energy recovery system, otherwise called HERS. This system is designed to digest, dewater, dry, and then combust the sludge, resulting in the recovery of energy. This makes the plant self-sufficient in energy requirement,

with the capabilities of being able to sell surplus power. The effluent is discharged into the ocean by a five-mile outfall.

F 814.2 TERMINAL ISLAND TREATMENT PLANT (TITP)

The Terminal Island Treatment Plant has a daily average full secondary design capacity of 30 mgd. Currently, the plant provides full secondary treatment for a daily average flow of 20 mgd serving the industrialized Los Angeles Harbor area. The effluent is discharged into the harbor through a 6,000 foot outfall.

There are three major factors that differentiate this plant from the other two upstream facilities.

a. The plant handles a high proportion of industrial waste.

b. It has its own solids handling facilities.

c. It is completely exposed to a corrosive environment, being located in a saltwater surrounding, sited just 12 feet above sea level.

F 814.3 TILLMAN WATER RECLAMATION PLANT (TWRP)

This plant serves the San Fernando Valley area and is designed to treat 40 mgd. The plant is being expanded to an additional 40 mgd. This is scheduled to be operational by 1991.

The plant is a model facility, with state-of-the-art instrumentation and control, and a landmark Japanese garden.

The treatment system includes a tertiary process, producing an effluent to irrigation water standards. A portion of the reclaimed water is used for landscape irrigation and in the lakes of the Japanese garden. The remainder is discharged into the Los Angeles River. The plant does not have solids handling facilities; it conveys the sludge by sewer line to the Hyperion Treatment Plant.

F 814.4 LOS ANGELES-GLENDALE WATER RECLAMATION PLANT (LAGWRP)

This plant is designed to treat 20 MGD and serves the northeastern section of the City, including a portion of the Cities of Glendale and Burbank. This facility is jointly-owned and financed with the City of Glendale.

The treatment system includes a tertiary process which treats the secondary effluent to irrigation water standards. Part of the reclaimed water is used for industrial cooling and golf course and freeway irrigation. The remainder is discharged into the LA River. The plant does not have solids handling facilities. Instead, it conveys the sludge by sewer line to the Hyperion Treatment Plant.

F 820 INSPECTION AND TESTING

An effective way of establishing good public relations is to ensure the proper functioning of the wastewater collection system. Hence, it is important that the operation and maintenance personnel continuously monitor the condition of the collection system. Inspection and testing provide the means for the monitoring activity.

F 820.1 OBJECTIVES

The objectives of sewer inspection and testing are:

a. To identify existing or potential problems in the collection system;

b. To pinpoint the location of the problems;

c. To evaluate the seriousness of the problems;

d. To correct the problem; and

e. To provide accurate and meaningful reports regarding the problems.

F 820.2 RESPONSIBILITY

The responsibility of inspecting and testing the wastewater collection system lies with WCSD. Sewer inspection crews within the Pipeline Maintenance Section regularly inspect the pipeline to ensure that the system is in good working condition.

F 821 SURFACE INSPECTION

The inspection program is primarily a visual one made from street level. The inspection crews look for flooded or sunken areas, surface cracks on the ground along the sewer line route, signs of vandalism, damage to special structures and maintenance holes, maintenance hole covers higher or lower than the pavement level in the streets, and evidence of flooding or seepage from sewers.

F 822 MAINTENANCE HOLE INSPECTION

As an integral part of the sewer collection system, maintenance holes require the same degree of inspection and maintenance as the rest of the sewer network. WCSD has established an annual maintenance hole inspection schedule as part of the sewer inspection and maintenance program. The purpose is to check for defects. All maintenance holes in the City are inspected on a cyclical basis. The inspection is generally visual, with the inspection crew checking the maintenance hole cover, ring, barrel, steps, and the bottom surface for any defective condition.

F 822.1 OBJECTIVES

Maintenance holes are inspected for the following purpose:

a. To check for obstruction, debris in line & maintenance hole, grease, etc.;

b. To ensure that the maintenance hole lid is in proper grade or elevation;

c. To ensure that the lid has not been buried by street resurfacing work; and

d. To maintain the structural integrity of the maintenance hole (i.e., by checking for the presence of cracks.)

F 822.2 FREQUENCY OF INSPECTION

Existing maintenance holes should be inspected once every year to ensure that they are in good condition. Old maintenance holes must be inspected as often as possible to detect leaks that create inflow/infiltration problems.

Under the WCSD maintenance hole inspection program, each maintenance hole is inspected at least once every 10 months within the year.

New maintenance holes need to be thoroughly inspected in the same manner as the rest of the sewer line before acceptance.

F 823 PIPELINE INSPECTION

WCSD employs both visual and closed circuit television in its pipeline inspection program. Routine sewer inspection procedure has been developed for use by the sewer inspection crew.

F 823.1 DIRECT VISUAL INSPECTION

Visual inspection involves a sewer inspection crew walking through large diameter pipelines (36-inch diameter and larger) to check for cracks, pipe or joint separations, corrosion, root intrusion, obstruction, and other pipeline defects not normally visible from on-surface inspection. Extreme care should be taken to provide adequate safety measures as discussed in Section F 880, Safety. Inspectors can use manually operated cameras for detailed pictures or illustrations for reports, instructions, or maintenance work.

F 823.2 CLOSED CIRCUIT TELEVISION INSPECTION (CCTV)

Closed circuit television inspection provides the most positive and reliable information on the internal condition of a small diameter sewer line. Permanent records of the inspection can be made by photographing the TV screen or by using video tape. CCTV inspection capability extends to pipes of all sizes, down to 4-inch diameter pipes. Knowledge of the TV equipment and its capabilities, as well as the operator's skill in interpreting the recorded information, are very important.

Basically, a CCTV unit would consist of the following components:

a. Television camera
b. Floodlight
c. Camera carrying skids
d. Multi-conductor power and video cable
e. TV picture monitor
f. System power control center or module
g. Portable power source, usually a portable generator

h. Pulley assembly with two winch stands
i. Cable reel and footage meter
j. Service truck containing the TV power control and picture monitor
k. Sound-powered telephone system
l. Video tape recording equipment (optional)
m. Polaroid camera for still picture (optional)
n. Overnight cable

Figure F 823.2A shows a set-up of a basic CCTV system.

A detailed description on how a closed circuit TV inspection operates is given in Appendix F-I.

F 824 TESTING

Testing is one of the methods used to gather information to develop a sewer operation and maintenance program. It is also used to detect leaks in the sewer line (e.g., smoke testing). There are several methods of testing a sewer line. Each has its own applicability.

F 824.1 SMOKE TESTING

Smoke testing consists of blowing smoke through a section of pipelines isolated from the rest of the system by plugging the pipes at both ends of three successive maintenance holes. Smoke testing is best applicable when the groundwater is low, so that any crack will leak smoke.

F 824.11 OBJECTIVES

Smoke testing is used in wastewater collection system to determine:

a. Points of entry of surface inflow to the collection system;

b. Location of illegal connections (e.g., down-spouts, drains, industrial drains, etc.) to the wastewater collections system; and

c. Location of broken sewers due to settling of foundations, maintenance holes and other structures.

F 824.12 EQUIPMENT

The following is standard equipment in a smoke testing operation:

a. Smoke blower unit. The blower is usually a gasoline belt-driven unit, with average blower capacity between 1,700 CFM and 3,000 CFM. The blower will have a base with a rubber gasket underneath the base that allows it to set over and force a blast of air into an open maintenance hole.

b. Pipe plugs to isolate two sections of pipe between three successive maintenance holes. The plugs may either be mechanical or inflatable.

c. Smoke bombs. These are available in up to 15-20 minute durations.

F 824.13 STAFFING

The average smoke testing crew will consist of five persons. One will be in charge and four will serve as observers and recorders.

F 824.14 THE NEED FOR PUBLIC NOTICE

Smoke testing of a sewer line could adversely affect the occupants of buildings connected to the sewer line being tested. There are a number of ways smoke could enter the building. These include defects in the building sewer system, dry taps, defective wax ring under the commodes, vents terminating in an attic, or missing clean-out plugs from the building sewer system. To avoid panic or undue alarm, the residents of the area to be smoke-tested should be advised of the scheduled testing ahead of time. A minimum of three days lead time should be allowed.

The City Fire and Police departments should also be notified at the start of each day of the scheduled testing. It is advisable to have

a fire vehicle from the Fire Department accompany the testing operation.

F 824.2 DYE TESTING

Dye testing consists of applying dye to a sewer line and tracing its movement as it flows through the sewer system. Typical applications of the dye testing include the following:

a. Buildings that may not show smoke at vents during the smoke test due to dips or traps in the service connection pipes;

b. Where a yard drain or storm drain is suspected of being tied to the building sewer or a lateral sewer;

c. Any suspected surface inflow to the wastewater collection system;

d. Testing for infiltration and exfiltration; and

e. Flow velocity measurements.

F 824.21 EQUIPMENT

There are two types of safe and harmless but effective dyes available for dye testing. The dye comes in either powder or tablet forms. The tablet type is slower to dissolve than the powder form, but is less messy.

The State Water Resources Control Board (SWRCB) should be contacted to determine if there are any regulations regarding the use of dyes. SWRCB should also be notified anytime dye gets into the storm drain.

F 824.22 STAFFING

Two workers are required to conduct a dye test. One operator applies the dye to the suspected location while another maintains a watch at the next downstream maintenance hole from the location.

F 824.3 PIPELINE LAMPING

Pipeline lamping consists of looking directly through a section of the sewer line or by the aid of a mirror. The purpose is to determine whether or not the section of the sewer line being lamped is straight and open. It also allows an inspector to visually examine the condition of the pipe within viewing distance of the maintenance hole.

Lamping, while providing only limited information, has considerable value in collection system maintenance. It is an economical and fast method of determining if a line is straight and clear; otherwise, it will expose imperfections in the line. Lamping is fast and cheap, if it can be used. However, lamping should never be used for any purpose other than for alignment. The existence of cracks, infiltration or other pipe problems are difficult to detect by this method.

As a word of caution, lamping can be hazardous anytime a worker enters a maintenance hole. Hence, there should always be two people working on top of a maintenance hole.

F 830 MAINTENANCE

Maintenance of the wastewater collection system is one of the major tasks of the Wastewater Collection Systems Division. The objective of a good maintenance program is to keep the system in good operating condition so that it can function efficiently throughout its design life. Lack of good maintenance can result in serious health hazards to the public. It can also cause damage to private property due to sewer backups and overflows. Additionally, it could expose the City to liability suits arising from such hazards and property damage.

F 831 TYPES OF MAINTENANCE

Maintenance can be categorized into preventive and corrective maintenance. Preventive maintenance involves inspection of the collection system and analysis of existing data to identify trouble areas. This can provide guidance in developing the type, degree, and frequency of preventive maintenance required.

Corrective maintenance refers more to emergency maintenance. This can be an actual collapse of an existing sewer; stoppage due to roots, grease, or other foreign materials; or excessive inflow or infiltration. These conditions require immediate action to correct the problem. The objectives are to improve service, reduce emergency occurrences, and to minimize the cost of the preventive maintenance program.

In general, the greater the amount of preventive maintenance performed, the less the amount of corrective maintenance that will be required. However, there should be a reasonable balance between the cost of preventive maintenance and the corresponding benefit derived. While no precise method is available to determine just exactly how much preventive maintenance should be undertaken, a review of historical maintenance costs on similar facilities can serve as a useful guide to planners and designers.

F 832 PIPELINE MAINTENANCE

WCSD has developed a year-round pipeline maintenance program. The emphasis is on preventive maintenance. Under the program, sewers, including maintenance holes, pumping plants, and special structures, are regularly inspected. Known trouble locations are checked at more frequent intervals.

Pipeline maintenance crews, operating City-wide, clean and maintain large sewer lines, chemically treat sewers for root control, and perform insect and rodent abatement work.

F 833.1 CAUSES AND TYPES OF BLOCKAGES

The most frequently received complaints about sewers are blockages. A blockage is confined principally to small diameter sewers not accessible for a maintenance worker to enter.

Blockages or obstructions can be caused by sand and gravel deposits, garbage from garbage grinders, disposable diapers, personal hygiene products, grease build-up, heavy settled debris, debris held by a line break, a slipped joint, illegal taps that protrude into the sewer pipe, or any other condition that reduces or restricts the flow.

The recommended methods for cleaning blockages or obstructions depend on the nature and causes of the problems. A table listing types of blockages and obstructions, effective methods of removal, and evaluation of each method is given in Appendix F 832A.

F 834 MAINTENANCE METHODS

Pipeline cleaning and maintenance methods depend on the wastewater characteristics, fluctuations in flows, sewer alignment and grade, pipe material, condition of the sewer, the type of area being served, and most importantly, past history of sanitary sewer performance.

An effective preventive maintenance program can only be achieved with a complete set of records. The records should indicate the

causes of all blockages, size of the sewer, history of past blockages and corresponding preventive maintenance, including the type of maintenance equipment used to perform the maintenance work.

Blockages can be cleared or prevented and sewers cleaned by either hydraulic or mechanical methods. Chemicals are also a tool used to help control root growth in sewer lines.

Hydraulic methods consist of cleaning sewers with water under pressure that produces high water velocities. These velocities are usually high enough to break up the blockage and flush most grit, grease, and debris.

Mechanical methods consist of using equipment that scrapes, cuts, pulls or pushes the material out of the pipeline.

The following briefly describes the most commonly used cleaning methods, including their applicabilities and limitations.

F 834.1 RODDING

The equipment may either be a power rodding machine (may be truck or trailer-mounted) or hand rods.

Power rodding involves applying a torque to a steel rod as it is pushed through the line, rotating the cleaning device attached to the lead end of the rod.

This method can be used for routine preventive maintenance, such as breaking up of grease deposits, cutting roots, loosening debris, threading cable for bucket machines or TV inspection equipment, and for emergency removal of blockages.

The method is fairly efficient in lines up to 12 inches in diameter but is less useful in larger lines. The method is ineffective for removing sand and grit accumulations, but may loosen the material so it can be flushed out of the sewer. The rod has a tendency to coil and bend when used in large diameter sewers. Electrically-powered power rodding machine is also available and can be used in smaller lines.

F 834.2 BALLING

This equipment consists of an assortment of various sizes of sewer balls to fit different diameters of sewers, a tag line, winch, cable, reels, a water source, and a dump pick-up.

The method utilizes the pressure of a water head to create high-velocity water flow around the ball. It is very effective in removing heavy concentrations of sand, grit, rock, and grease from the sewers. Balls are available in sizes from 6 to 48 inches. This method is not recommended for locations with basement fixtures and in steep-grade hilly areas because of possible flooding of connected buildings. It cannot be used effectively when sewers have bad offset joints or protruding service connections because the ball can become lodged in the pipe, becoming distorted, thereby preventing it from doing an effective cleaning job.

F 834.3 FLUSHING

This is an inefficient hydraulic method that can be used at the upstream location of a collection system where low or sluggish flow results in deposition of solids. It is now rarely used since the introduction of the high-pressure water jet cleaners. A fire hydrant is normally used for this procedure. However, if a fire hydrant is not accessible, the equipment may consist of a water tank and a fire hose.

The method is effective in removing floatables and some sand and grit. It is useful in combination with mechanical operations such as rodding or bucket machine cleaning.

The method is not very effective in removing heavy debris and grit. It is not recommended for use in locations with basement fixtures and steep-grade hilly areas because of possible flooding of connected buildings.

F 834.4 JETTING

This is a hydraulic method of cleaning sewers which directs high velocity streams of water against the pipe walls at various angles.

The equipment consists of a truck-mounted high velocity water machine, maintenance hole hose guide, debris traps, and a dump pick up or debris trailer.

The method is very effective in cleaning flat, slow flowing sewers. It is very efficient in removing grease, sand, gravel, and debris deposits in small sewers. It is also effective in breaking up solids in maintenance holes, and in washing structures. The effectiveness in removing debris, however, decreases as the size of the pipe increases.

F 834.5 SCOOTER

This is a hydraulic method of cleaning a sewer line. The equipment consists of a scooter assembly, water tank truck, dump pick-up truck, tag line and a power winch.

The scooter itself is a steel framework on small wheels with a rubber-rimmed, round metal shield at one end. The top half of the shield is hinged and is controlled by a chain-and-spring system; the lower half is rigidly attached to the scooter frame. In operation, the shield acts as a plug to build a head of water. The pressure of the water behind the shield moves the scooter downstream, but the cable restrains it, allowing slow smooth progress downstream while the water forces past the shield rim and scours the pipe wall in somewhat similar manner as the balling method. The high turbulence forces loosened debris to move downstream to be caught by the trap at the next maintenance hole.

This method is very effective in removing heavy debris. The method is used for large diameter pipes, usually storm drains. Caution must be used in locations with basement fixtures and steep-grade hilly areas because of possible flooding of connected buildings.

F 834.6 KITES, BAGS, TIRES AND POLY PIGS

Kites, bags, tires, and poly pigs are devices more suited for hydraulically cleaning larger sanitary sewers in a manner similar to the balling method.

The basic equipment includes a water tank truck, dump pick-up truck, and a power drum machine. The rigid rims of bags and kites cause the scouring action. The kite's shape creates a forward jet of water that scours the pipe wall. A tire, approximately two inches smaller in diameter than the pipe, rigged to a restraining line, will respond to two feet or more head of water like a sewer ball. The poly pig is used for very large sanitary sewers and is not restrained by a line, but moves through the pipe segment with the water pressure built up behind it. Poly pigs are frequently used for cleaning force mains.

The devices are very effective in moving accumulations of decayed debris and grease downstream. They are also capable of washing ahead of it a full pipe of deposits, including roots.

Caution must be used in locations with basement fixtures and steep-grade hill areas because of potential flooding of connected buildings.

F 834.7 BUCKETING

A power bucket machine is a mechanical cleaning device used primarily to remove debris from a break or an accumulation that cannot be cleared by hydraulic means. An example is where the use of hydraulic cleaning equipment would damage the pipe or joint. This method can also be used when, because of the amount of debris build-up, the use of a hydraulic cleaning equipment becomes impractical.

The equipment consists of a power bucket machine, power bucket truck loader, dump truck, and maintenance hole jacks.

This method is particularly effective in partially removing large deposits of silt, sand, gravel and some type of solid waste. The line still needs to be cleaned, though, by other methods after being cleared with a bucket machine.

This method has the disadvantage of potentially damaging the sewers. Also, setting up the equipment is a tedious and time-consuming job.

F 835 CONTROL OF OTHER PROBLEMS

In addition to common clogging problems, pipeline maintenance work involves control of other problems, such as root intrusion, odors, corrosion, and insect and rodent infestations.

F 835.1 CHEMICAL DOSING

Chemicals can be very helpful aids for cleaning and maintaining the wastewater collection system. Proper application of the right chemicals can be very effective to control root intrusion, odors, corrosion, and rodent and insect infestations. A chemical dosing program must be developed for this purpose.

There should be thorough evaluation and planning in preparing a chemical dosing program. The planner should be aware of the following facts:

a. Chemicals cannot clear stoppages or blockages in sanitary sewer lines.

b. Chemical costs are high and increasing; hence, cost effectiveness must be considered.

c. Chemicals may be hazardous to employees, treatment process, and the environment.

d. Some vendors make elaborate claims for chemicals unproven in actual sewer cleaning situations. Hence, it is important that field demonstrations be required from prospective suppliers.

F 835.11 ODOR CONTROL

Odors have long been associated with wastewater collection systems and treatment plants and are primarily caused by the production of hydrogen sulfide. Odors may also originate from some industrial discharges.

Most odors can be controlled in a properly designed, cleaned and maintained collection system. Usual causes are low velocity flows, long transmission lines in the collection system, high temperatures, and poorly maintained collection systems. If these problems can be corrected, odor problems can be solved.

There are a variety of methods for controlling the odor problem in a wastewater collection system. An odor masking agent, usually consisting of a water base and an oil carrier of a perfume scent, can be used to mask the objectionable odor. However, it does nothing to eliminate the dangerous gas or decrease its production and may, in fact, increase the hazard because the presence of toxic gas is disguised. Also, it has not been found to work satisfactorily.

Aeration and dosage of hydrogen peroxide are two of the most effective means of controlling hydrogen sulfide generation, but are not always feasible. Chemical treatment of the wastewater can also be effective for short periods, but is expensive. Zinc and iron salts will precipitate the sulfide. Lime dosage of about 8000 mg/l for an hour will kill the slimes for periods of one day to about two weeks, depending on the condition. The use of lime, however, will produce large quantities of lime sludge, creating disposal problems.

The most widely-used chemical for hydrogen sulfide control has been chlorine, which can be injected into the wastewater flow at various points along the collection system. Pump stations, where power and utilities are normally available, often serve as chlorine injection sites. Chlorine is effective but expensive; chlorine doses of 10 to 20 mg/l have been effective in controlling the production of hydrogen sulfide in wastewater collection systems. Doses of chlorine at these levels are toxic to most organisms in the wastewater. In addition, chlorine is a hazardous material and is very corrosive. It could be as great a hazard as hydrogen sulfide, and in larger doses, could be detrimental to the treatment process.

Hydrogen peroxide, in concentrations of from 35% to 50% has proven beneficial for control of hydrogen sulfide and odors. Wastewater can be kept aerobic by the application of large amounts of hydrogen peroxide. Unlike chlorine, excessive hydrogen peroxide is not

detrimental to the wastewater treatment plant, merely wasteful and expensive.

There are other chemical additives (e.g., potassium permanganate, ozone, ammonia, etc.) that are effective but may not be cost effective. Frequent and effective cleaning to prevent the growth of slimes and deposition of solids is still the best maintenance method.

F 835.12 INSECT AND RODENT CONTROL

Effective control of insect and rodent infestations requires assistance from the Public Health Department or the Vector Control Department. These agencies are experienced in developing a disease vector control program and can recommend the types of chemicals (insecticides) to use.

From the standpoint of design and construction, the best control method is to build a tight collection system (e.g. , one that is provided with proper fixture traps and connections, sealed joints, and high quality maintenance holes).

F 835.13 ROOT CONTROL

The best root control method is the use of tight construction joints and the prompt repair of cracks and breaks. Most roots enter lines (often microscopically) through the tops of joints. Where root intrusion has occurred, chemical treatment can be an effective control. However, it is recommended that only chemicals proven effective be used. Television inspection before treatment is useful to determine the condition of the sewer. The sewer line should again be TV-inspected after treatment to evaluate the results.

F 835.14 GREASE DEPOSITS CONTROL

There are a number of chemicals, such as bioacids, enzymes, bacterial cultures, caustics, hydroxides, and neutralizers, available to control grease and soap deposits in wastewater collection systems.

However, based on past experience, mechanical or hydraulic cleaning combined with strict enforcement of local ordinances on discharges to public sewer, are most effective for grease deposit control.

F 836 MAINTENANCE OF SPECIAL STRUCTURES

Special structures refer to siphons, diversion structures, junction structures, ventilation structures, gaging structures and tide gates. They are usually constructed to overcome some conditions imposed by the local topographic characteristics or to serve a specific need. These structures require regular maintenance in much the same way as the rest of the wastewater collection system facilities.

F 836.1 SIPHONS

Siphons refer to inverted siphons or depressed sewers which would stand full even with no flow. The purpose of a siphon is to carry the flow under an obstruction (e.g., a stream or a depressed highway) and to regain as much pressure head as possible after the obstruction has been passed.

Potential maintenance problems associated with siphons are clogging and hydrogen sulfide generation. Other design-related maintenance problems include lack of provision for effectively draining the pipes for cleaning, inadequate access to the site, limited working space to clean and maintain the pipe barrels, and difficulty in replacing corroded metallic plate used in flow diversion.

Regular inspection and frequent flushing assure removal of obstructions. Flushing maybe accomplished in several ways:

a. by bucketing;
b. by balling;
c. by rodding;
d. by jetting; or
e. by the use of kites, bags and poly pigs.

For ease of maintenance, the following shall be considered in designing a siphon:

a. Provide air jumpers for hydrogen sulfide control;

b. Provide acid-resistant lining on inlet and outlet structures;

c. Provide adequate working space inside the inlet and outlet maintenance holes for cleaning the pipe barrels. The use of automated cleaning equipment requires a minimum amount of clearance at both ends of the pipe for the equipment to be set up and to operate properly;

d. If feasible, provide blowoff or cleanout at the low point of the siphon to enable complete draining and cleaning of the barrels. The blowoff should be fitted with a gate valve, preferably of bronze material for durability, and a blank flange for drawing off the wastewater during maintenance work. If this is not feasible, provide a sump at the inlet end of the siphon to allow draining of the siphon prior to cleaning and inspection;

e. When constructed across a stream, provide a pressure-type maintenance hole to prevent river water from flowing into the cleanout vault during maintenance; and

f. Use redwood for stop log. Redwood is more resistant to decay from exposure to moisture and is easy to demolish and replace.

F 836.2 JUNCTION STRUCTURES

Junction structures are required when one or more branch sewers join or enter a main sewer. On small sewers, ordinary maintenance holes may serve as the junction structures. For large size sewers, junctions are generally built in cast-in-place reinforced concrete chambers provided with maintenance hole shafts for access.

The maintenance problem associated with junction structures is the accumulation of sludge and debris. Such problems can be attributed to poor design that can cause eddies and poor flow patterns resulting in sludge or debris deposition.

Maintenance of junction structures generally consists of regular removal of any debris deposition employing the same maintenance equipment used in sewer maintenance work.

To reduce maintenance problems, the following shall be considered in the design of diversion structures:

a. Avoid excessive widening of the main channel at the junction; and

b. Set the invert of the branch line higher than the invert of the main channel where the two join in such a way that the normal flow lines of the intersecting sewers should coincide at the junction.

F 836.3 GAGING STRUCTURES

Gaging structures are used for measuring wastewater flows for planning, for design or for monitoring purposes. Ordinary maintenance holes can serve as a gaging station. However, where payments from discharging agencies are based on flow, a more permanent gaging station is often required on trunk sewers.

A typical gaging structure would generally consist of a gaging chamber housing the measuring device (e.g., Parshall flume, weir, Venturi meter, Palmer-Bowlus flume), a water level recorder stilling well with an inlet pipe, an instrument housing that can be installed above ground or inside the chamber. Access is through a maintenance hole which can be fitted with step ladder or entered into by the use of a portable one.

Depending on the type of measuring device used and the degree of maintenance work done, maintenance problems can vary from a clogged inlet pipe, sludge deposit in the stilling well, to a corroded weir plate.

Maintenance of gaging structures involves regular flushing of the stilling well and the connecting pipe leading to the well.

Corroded weir plate should also be replaced when it is found to affect the measurements.

F 836.4 TIDE GATES

Tide gates or flap gates are installed at or near sewer outlets to prevent backflow to the sewer system during high stages in the receiving stream or by high tides.

Maintenance of tide gates requires regular inspection and removal of debris or sand deposit from the pipe and outlet chamber, lubrication of hinge pins, and cleaning of the seating surfaces.

F 836.5 DIVERSION STRUCTURES

Diversion structures, also called overflow structures, are used to divert flow from one sewer to another. The diversion can be from one interceptor to another interceptor or to a relief sewer.

Maintenance problems associated with diversion structures include debris accumulation, inadequate access, and difficulty in replacing corroded or rusted steel gates.

Maintenance work involves regular removal of debris, keeping the steel gate threaded stem always oiled or greased, and operating the gate regularly to prevent it from being stuck.

For ease of maintenance, the following shall be considered in the design of diversion structures:

a. Maintenance hole must be designed large enough to provide adequate access to the stop log;

b. Specify redwood material for stop log for durability, ease of replacement and demolition;

c. Consider providing alternate diversion when sluice gate is under repair; and

d. Provide a cable hook-up bracket on the gate frame so that the gate can be raised in case it breaks loose causing it to slide down.

F 836.6 VENTILATION STRUCTURES

When force draft ventilation is needed, ventilation structures are usually provided. Ventilation stations may or may not be provided with an air blower. In the case of a siphon, for example, ventilation may be accomplished by means of an airline jumper which connects the inlet and outlet structures. In the case of a pump station or a treatment plant, an air blower is usually provided to supply the required draft ventilation.

Maintenance of ventilation structures involves regular lubrication of the air fan bearing and replacement of the fan belt.

The City's wastewater collection system has four ventilation structures, none of which is in operation. The City is phasing out these structures due to public complaints arising from odor problem and noise nuisance.

F 837 PUMP STATION MAINTENANCE

F 837.1 GENERAL

A well-operated plant depends to a large extent on preventive maintenance. Corollary to this, a duplication of plant equipment and functions provides the flexibility necessary for continued operation during shutdowns due to scheduled maintenance or from emergencies.

This section outlines the guidelines and procedures for developing an effective maintenance program. Detailed instructions regarding the maintenance and repair of each individual piece of equipment are normally provided in the manufacturer's manuals.

F 837.2 RESPONSIBILITY

Maintenance of the City's wastewater pumping plants is the respon-

sibility of the Mechanical and Electrical Maintenance Groups in the Mechanical Maintenance and Operation (MM&O) Section of WCSD.

Several mechanical crews are responsible for the regular inspection and preventive maintenance work. The heavy duty repair crew is responsible for the removal, overhaul, major repairs, and reinstallation of heavy equipment. The Electrical Maintenance Group is responsible for the maintenance and repair of all electrical systems, including instrumentation and controls.

F 837.3 DEVELOPING PREVENTIVE MAINTENANCE WORK

The following factors must be considered in developing a pumping plant preventive maintenance program:

a. Recommendations of equipment manufacturers;

b. Requirements of the pump station; and

c. Experience gained by operating agency.

Due consideration should be taken during design to include provisions for submittal of comprehensive operations and maintenance manuals, and for training of personnel to assure the City operations and maintenance personnel will be able to perform the work upon beneficial occupancy. WPMD has developed procedural guidelines for the preparation, submittal, processing, and approval of O&M manuals as well as start-up training specifications. These are contained in Volume III of the Procedural Memoranda of the Clean Water CIP Management Plan.

F 837.31 RECOMMENDATIONS OF EQUIPMENT MANUFACTURERS

Equipment manufacturers normally provide maintenance and overhaul recommendations for each piece of equipment they install in a pump station. Information includes frequency of oil changes, lubrication of bearings, types of lubricants, operating temperature ranges, pressures, flow rates, and disassembly, overhaul and assembly procedures for specific equipment maintenance or parts replacement.

During the warranty period of operation of new equipment, the manufacturer's recommendation must be strictly followed to maintain equipment warranties.

F 837.32 PUMP STATION REQUIREMENTS

Each individual pump station has its own requirements. These differences result from the design and location of the station. Thus, certain maintenance tasks may have to be modified to meet the needs of a particular pump station. Pump station operators should be involved during O&M manual preparation in making decisions regarding the frequency and types of maintenance tasks required by a pump station. These operators are familiar with the station, notice changing conditions, and are capable of comparing conditions and operational characteristics with other pump stations.

F 837.33 EXPERIENCE GAINED BY OPERATING AGENCY

A very important factor in maintenance scheduling is the knowledge and experience gained by the City's O&M personnel on how to deal with local conditions, ability of operators to perform tasks and the reliability of existing equipment. It should be pointed out here that sometimes procedures other than those recommended by the manufacturer appear better. In such cases, always keep in mind that the manufacturer prepared the manual for universal use and not for local conditions and problems. The best approach is to use your best judgement, tempered with prudence.

F 837.4 EQUIPMENT MAINTENANCE

A variety of equipment, ranging from the simplest mechanical, electrical, to the most complex instrumentation and control, are present in a pump station installation. This equipment requires regular preventive maintenance to keep it in optimum operating condition.

F 837.41 PUMPS

Sewage pumps are probably the most important equipment in the sewage pumping plant. In many instances, the causes for a breakdown

of pumping equipment cannot be immediately diagnosed. Therefore, a complete understanding of pump construction and operation is essential to provide proper maintenance. Regular inspection should be performed, taking special attention to the following:

a. Bearings. For small horsepower pumps, bearings are a major source of problems. Close coupled pumps have no bearings because the impeller is mounted directly on the motor shaft. With vertical open shaft pumps, the pump is constructed differently and does have bearings.

The plant operator must be able to recognize and report the presence of noise and unusual heat.

Considering the minimal cost of bearings compared to the cost of taking out and overhauling a pump, it is more advantageous to replace bearings every time the pump is overhauled.

b. Seals. There are two types of seals in use, the packing gland box type and the mechanical type. The City does not use mechanical seals except on submersible-type pumps. The City's experience with mechanical seals is that, when they fail, they fail catastrophically.

The packing of a pump is very important. Its function is to seal the pump while allowing some shaft deflection. Packing gland boxes are lubricated with a small amount of wastewater leaking through the packing gland or with an external source of clean water known as a water seal. A seal water connection for packing boxes serves to cool and lubricate the packing.

The City does not allow the use of fresh water for water seals because of possible cross-connection.

Packing gland boxes should be watched for leakage of sealing water. If there is too much leakage or no leakage, the gland should be tightened or loosened as required. All packing should be renewed on a regular

schedule to prevent scouring of the shaft or shaft sleeve.

All maintenance and repair should be as directed by the manufacturer. An adequate supply of spare parts should be kept on hand, as mechanical seal failure is sometimes abrupt with no prior warning.

c. Lubrication. Lubrication is, without doubt, the most important function of a preventive maintenance program. Pumps should be oiled and greased at predetermined intervals in strict accordance with the recommendation of the manufacturer.

F 837.42 ELECTRICAL EQUIPMENT

Pumping station equipment requires a continuous electrical preventive maintenance program. Cleaning should be scheduled on a routine basis. When large equipment is taken off the line for mechanical overhauls, some advantage can be gained by doing the electrical maintenance "out of turn."

a. Electrical control and protective devices. Because of the nature of their construction and operation, they tend to malfunction through long periods of non-use. Hence, it is important that these controls be checked regularly, at least every six months.

b. Motors. Electrical motors are the machines most commonly used to convert electrical energy into mechanical energy. Motors are of several types, such as squirrel cage induction motors, wound rotor motor, and synchronous motors. The most common of these is the squirrel cage induction motors. Some pumping stations use wound rotor induction motors when speed control is required.

Modern electric motors are reliable, trouble-free pieces of equipment. If they are properly maintained, i.e., kept clean, free from moisture, lubricated [but not over-

lubricated], and isolated from vibration, they yield long and useful service.

F 837.43 INSTRUMENTATION AND CONTROLS

Maintenance of instrumentation and controls for a pump station requires the services of a highly trained technical unit. Maintenance manual and in-service training are provided by the manufacturers. All pumping units should be equipped with running hour meters. Water level sensors are of primary importance, because they control the function of the pumping station itself.

Control floats have a tendency to become clogged with grease, or weighted down with rags and debris. Sometimes, they develop holes, fill with water, and sink. One of the biggest disadvantages of the float system is the frequent maintenance required to remove grease and other debris that accumulate in a wet well.

The purged air type (bubble tube level sensor) is one of the most reliable and universally accepted level sensors. Maintenance consists of checking the function of the system from the dry well and draining condensate from the system. Therefore, this type of sensor should be specified in design, whenever possible.

Ultrasonic equipment is becoming competitive in this type of service. The ultrasonic transducer is a sealed unit and is installed in the wet well above the liquid level. The level variations are converted to an electrical signal and transmitted to a control panel in the dry well. A high level of technical skill, though, is required to maintain and install this type of equipment.

Alarms are used to alert the maintenance and operational unit of some malfunction. In manned stations, buzzers or flashing lights would suffice. However, for a remote unattended station, a telemetering and remote alarm system is used.

Regular maintenance (e.g., signal level, circuit response, etc.) is required for this system. Maintenance should be performed in accordance with the manufacturer's recommendations to insure reliability of the system.

F 837.5 GENERAL PLANT STRUCTURE

Maintenance of the pump station facility should not be limited to the equipment. Plant appurtenances and the structure itself need to be regularly maintained.

F 837.51 WET WELLS

One of the major operation and maintenance problems is the build-up of grit in the wet well. Such build-up may result in reduced flow to the pump as well as reduced wet well capacity.

There are several methods of grit removal in wet wells. One method is flushing the grit to the pump's suction with high-pressure hoses. This has the disadvantage, though, of causing additional wear on the pump's internal parts. Another method involves manual removal by the use of a bucket. A clam shell or a bucket machine can also be employed.

The wet wells require periodic attention and cleaning, as grease and other material usually build up causing odors and impairing the
operation of float controls.

One of the most effective methods of removing grease and associated material is by the use of a truck or trailer-mounted vacuum unit.

F 837.52 SCREENING DEVICES

There are two types of screens used in pump stations, the manually-cleaned and the mechanically-cleaned screen devices.

Manually-cleaned screens are usually of the basket or bar-rack type. Cleaning this type of screen entails many hours, hence the frequency of cleaning depends on the availability of personnel. The use of hoists, wheeled containers, steam cleaners or high-pressure water washers can help reduce the labor demand on this often tedious maintenance job.

Mechanically cleaned bar screens require greater maintenance attention. The use of automatic controls such as timers and differential

pressure sensors helps reduce operational time. In any case, it is important that a daily inspection and adjustment of this type of screen be made as part of the maintenance schedule. Because practically all of the City's pumping plants are unattended, the City does not use this type of screen.

F 837.53 COMMINUTORS

Comminutors perform screening and shredding in a single operation. For maximum utilization, a continuous operation is recommended. Maintenance consists of lubrication, cleaning the comminutor, its housing and basin at frequent intervals. The teeth sheath bars, cylinder and combs also need to be inspected frequently. All cutting parts should be kept sharp. For the same reason that all City pumping plants are unattended, the City does not use comminutors.

F 837.54 VENTILATING SYSTEM

Ventilating systems in wastewater pump stations require regular maintenance. To drain off accumulated moisture, valves should be provided at low points in the duct work. Similarly, non-corrosive materials should be specified in the fan and duct work. The use of plastic fans originally designed for lab fume hoods can be a good alternative.

F 837.55 SUMP PUMPS

Dry wells are normally provided with sump pumps to remove accumulated moisture. Sump pumps need regular maintenance work. The float controls that actuate the pumps should be kept clean and inspected regularly. The pump strainer and sump should be cleaned of debris.

For unattended stations, provision of a sensor switch located in the dry well and connected to the alarm system gives added security from flooding.

F 837.6 HOUSEKEEPING

Good housekeeping helps keep a pump station in workable condition,

reduces potential hazards (e.g., slippery floor, scattered tools, etc.) and prolongs the life of the structure. It is, therefore, important that adequate provisions be included in the design of a pump station to serve the housekeeping needs.

Built in-place pump stations should include a storage area for housekeeping supplies, electrical and mechanical supplies and spare parts, and related tools. Large stations, even if generally unattended, shall include a shower stall, toilet facilities, a lavatory with antiseptic soap dispenser, and first aid emergency equipment. Water and electricity should be available for all stations. The exterior area should have easy access to a hose bib and an electric outlet connection. There should be a driveway to allow delivery and removal of equipment.

Generally, maintenance of the facility's exterior and landscaping is included in the normal schedule of operation and maintenance of the pump station. Complete cleaning of all the stations should be scheduled regularly, along with the physical maintenance of the structure, equipment, and property in general.

F 838 TREATMENT PLANT MAINTENANCE

Treatment plant maintenance involves a wide array of mechanical and electrical equipment, instrumentation and controls, as well as the maintenance of the buildings and other structures comprising the plant facility.

Maintenance procedures are normally developed, organized and put together in a bound volume called Maintenance Manual. Information is derived from the technical literature and shop drawings submitted by the equipment manufacturers/suppliers. It is important that this information is reviewed for accuracy and completeness, then organized and compiled in a systematic and easy to use format.

Design engineers should also be aware of design-related problems in buildings and other structural maintenance. Such problems include ventilation, effect of hydrogen sulfide corrosion on paint, concrete and certain types of metals, and potential breeding places for mosquitoes and other insects.

F 840 FAILURES

Another major activity of the maintenance crew is responding to pipeline failures. Even a well designed wastewater collection system will, through passage of time, suffer some form of failure due to a variety of causes. Some of these can be traced back to defective construction, pipe material deterioration, root intrusion, or ground movement.

F 841 TYPES AND CAUSES OF PIPELINE FAILURES

The following sections describe the most common types and causes of pipeline failures.

F 841.1 IMPROPER PIPE BEDDING

Pipe failure can occur due to the lack of proper or due to improper bedding when a sewer pipe is laid in a trench with undesirable material. Such failure could be caused by a rock bottom trench or where rocks are present, causing concentrated loads to develop on some sections of the pipe rather than being uniformly distributed around the entire pipe. Hence, it is important that proper pipe bedding material and correct installation procedures be specified.

F 841.2 FAILURE DUE TO LIVE LOADS

Pipe failure can occur from the impact of surface load imposed by traffic or heavy equipment. This condition occurs when a pipe is laid with insufficient cover. A minimum cover of three feet over the top of the pipe is desirable. If this depth is not attainable, or if the pipe will be subject to unusual live loads, the pipe should be encased in concrete. A better alternative is to use a pipe with material having higher crushing resistance.

F 841.3 FAILURE DUE TO EARTH MOVEMENT

Pipe failure due to earth movement can occur as a result of a poor foundation, a landslide, a cave-in, or an earthquake. The use of flexible joints, such as a rubber gasket or a mechanical joint, and ductile iron pipe, can minimize this type of damage.

F 841.4 FAILURE DUE TO INTERNAL CORROSION

Pipe corrosion is due primarily to hydrogen sulfide. The mechanism of its production is well-described in most wastewater engineering textbooks (see reference nos. 6 and 15). As hydrogen sulfide collects on the sewer pipe or maintenance hole walls, it is biologically oxidized to sulfuric acid. This creates a corrosive environment and affects cement-bonded pipe materials, such as concrete and asbestos cement, and ferrous pipe materials, such as ductile iron, cast iron, and steel.

Using a good understanding of sulfide generation, proper design can, in many cases, accomplish the control of sulfide release, resulting in the control of corrosion and odor. A design procedure outlined by Dr. R.D. Pomeroy and K.K. Kienow (reference no. 12) provides a good reference in the design of corrosion pipe.

F 841.5 FAILURE DUE TO MATERIAL SELECTION AND AGE

Pipe failure can also result from poor selection of pipe material. Certain pipe material, such as cement and certain metallic types, are subject to corrosion, and when used in a corrosive environment without adequate protection, can result in eventual pipe collapse. Porous pipe material can cause an infiltration or exfiltration problem.

F 841.6 OPENING IN SEWER LINE

Openings in a sewer line can occur through construction oversight, such as a wye being left open or joint slippage. This results in exfiltration which could wash soil from around the line leading to caving of the surrounding cover. Such failure can also cause infiltration or exfiltration problems.

F 841.7 FAULTY BUILDING SEWER CONNECTIONS

Faulty building sewer connections result from poor construction. One example is a building connection with the pipe, called a "pipe" tap protruding into the mainline sewer. Such protrusions catch and hold debris and grease that will eventually result in a blockage.

F 843 PUMP STATION FAILURE

F 843.1 MECHANICAL FAILURES

Faulty installation and/or poor preventive maintenance program are generally the causes of most mechanical failures in a pump station. It is, therefore, important to maintain a complete and accurate record of preventive maintenance work to ensure that all equipment is properly maintained.

Proper equipment installation is of critical importance. Pumps and shafts should be aligned properly in accordance with the manufacturer's recommendation. The alignment must be maintained correctly. Vibration from misalignment, loose bearing boxes, or worn bearings will often cause a shaft to wear "out-of-round" which could result in serious bearing damage.

F 843.2 ELECTRICAL FAILURES

In general, electrical failures may be caused by any or a combination of the following:

a) Loss of electrical power to the station itself;
b) Failure of the motor driving the pump; and/or
c) Failure of the control system that activates the pumping system.

Whenever feasible, pump station designs should consider providing an alternate power source. This could be in the form of an emergency generator, a dual engine drive, or an auxiliary line from the power company feeding the station from a different transformer.

A second type of failure may also occur when the motor itself burns out. To minimize such failure, the pump and motor should be designed to handle flows with any possible discharge head condition. The most common causes of electrical failure of the motor are an extraneous surge of power to the station, single phasing of a three-phase motor, or a short that develops within the motor itself. These problems may generally be prevented by better design, such as providing additional protectionagainst power surges.

Another type of electrical failure affects the pump control system. This should have a minimum effect on the pump station itself. If the control fails, the pumps can be operated manually to handle the flow and keep the station in service. An alarm system should be incorporated in the pump station design so that such failure can alert the operator and a corrective action instituted. City policy requires a totally redundant alarm system (back-up) under emergency conditions. Such a system should react with the liquid level independent of the air system.

F 843.3 CLOGGING

It is common for a pump impeller to become clogged with rags, stringy material, or large solids of various sizes and shapes. These materials could also affect the flap of a check valve resulting in loss of pumping capacity. Hence, it is necessary to specify check valves with outside levers to facilitate removal of materials that may hang on the valve and could cause trouble.

The problem of scum accumulation, especially for a wastewater pump station that allows the pumps to operate intermittently, can be handled by applying caustic chemicals that will liquify the scum and allow it to be pumped with the wastewater. Solid accumulation in the bottom of the wet well can be removed by operating one pump while holding open the check valve on a non-operating pump. This recirculates the contents of the wet well until all the solids are in suspension.

Floating material must be removed manually; vacuum devices designed for removal of debris from sanitary sewers are very effective in removing grease and scum from the wet well.

F 843.4 GATES AND VALVES

Failures in gates and valves occur when, due to lack of proper maintenance or corrosion, they become blocked or cannot be closed to provide the needed isolation of the line. To facilitate servicing, check valves should be equipped with an exterior arm and a lever or weight.

F 850 REMEDIAL MEASURES

There are a number of remedial measures that can be adopted to keep the existing sewer collection system functional. These range from local rehabilitation to complete replacement of the sewer section. In some cases, the alternative of providing a relief sewer might be the better solution.

The following is a general discussion of some of the remedial measures employed in rehabilitating or upgrading an existing sewer collection system. For a complete discussion of this subject, the reader is referred to Chapter F 900, Sewer Rehabilitation.

F 851 REHABILITATION

Rehabilitation is employed when a section of the sewer collection system fails, resulting in excessive infiltration/exfiltration problem. There are several repair methods available. The choice of method or combination of methods depends on the physical condition of the sewer system components (i.e., pipeline sections, maintenance holes, and service connections) and the nature and magnitude of the problems. If the problem does not involve the structural integrity of the system's components or the need to increase the capacity of the existing system, rehabilitation can be an effective way of restoring the utility of the failed system component. Some of the rehabilitation methods available are:

a. Sealing
b. Slip-lining
c. Inversion lining
d. Coatings and linings

Each of these methods has its own applicability, advantages and disadvantages. The design engineer should recognize these factors in specifying which particular method to employ.

F 852 REPLACEMENT

This method involves the removal of the existing damaged pipes or maintenance holes and replacing them with new ones. The cost of

this method, however, is generally much higher than other rehabilitation alternatives, and it takes a longer time to do the job.

This method is applicable under the following conditions:

a. For pipes or maintenance holes that have lost their structural integrity, (e.g. , collapsed sewers or maintenance holes);

b. When pipe size enlargement, change in grade and/or line realignment are needed, in addition to correcting the pipe deficiencies; and

c. In cases where replacing the damaged pipes or maintenance holes with better quality and greater strength ones would prevent the recurrence of existing problems due to corrosion, soil movement, or increased traffic loads.

The advantages of this method include the following:

a. It increases the service life of the replaced pipeline. With the types of material and construction techniques currently in use, a useful service life of as long as 50 years can be expected.

b. It provides an opportunity to correct misalignment of line or grade; and

c. It increases the hydraulic capacity of the replaced section.

The main drawback of this method is the high cost involved. Therefore, a careful analysis should be done to determine the cost effectiveness of pipe replacement. The costs should include all costs associated with the replacement, such as pavement removal and replacement, excavation, possible substitution of select backfill to replace poor quality existing material, dewatering and shoring (as required), pipe materials and couplings, and traffic control. The presence of interfering underground utilities could further increase this cost. Consideration should also be given to the need

for temporary diversion of flow to maintain sewer service to upstream connections and for special measures needed to minimize interruption of service along the affected line segment.

F 853 RELIEF

A relief sewer may be necessary if a blockage occurs during replacement of a section of the sewer line. In such a case, a pump is used to pump from the line above the repair directly to a tank truck for holding or to the next downstream maintenance hole through a relief sewer.

F 854 SPOT REPAIRS

Spot repairs may be required on a short length of pipe as it enters the maintenance hole. When such conditions arise, it is recommended that a flexible compression type coupling be used at the point where the pipeline connects to the maintenance hole. The installation of this type of coupling often requires extensive excavation of the area near the maintenance hole base. In such a case, it is important to sufficiently compact the bedding material surrounding the pipe and maintenance hole base. Failure to do so could result in differential settlement beyond the capacity of the flexible coupling or transfer of joint separation to points farther downstream. Another condition requiring spot repair is infiltration through maintenance hole sidewalls and bases, around pipe entrances and drop structures, and under maintenance hole frames. Chemical grouting is the primary method used to eliminate this problem. Chemical grouting is generally less costly than replacement or lining systems. However, grouting should not be considered when a structural solution is required. Superficial deterioration of the maintenance hole wall can eventually lead to structural deterioration due to exposure to the corrosive environment. One of the spot repair procedures used is applying a lining or coating to provide a barrier between the concrete and corrosive atmosphere. The choice of materials depends on the chemistry of the particular situation. Some of the available linings which are suited for this type of repair are plastic and epoxy. Others include the inversion lining

process, and the use of precut PE or fiberglass sheets, which are fastened to the wall using caulked lap joints studded into the maintenance hole.

F 855 MAINTENANCE HOLE REPAIRS AND COVER ADJUSTMENT

Maintenance hole repairs are required to correct structural deficiencies, effects of corrosion on the internal surface, and to eliminate the entrance of surface or groundwater infiltration.

There are several methods available to repair maintenance holes. The choice of methods depends on the type or types of problem and the physical characteristics of the structure, such as the condition, age, and type of original construction. For example, the methods used for repairing brick maintenance holes usually are different from those for precast concrete maintenance holes. Similarly, failures from corrosion will demand a different method of repair than an inflow problem from the maintenance hole cover frame.

A common problem with maintenance hole covers and frames is the entry of surface water. Surface water enters through holes in the lid, through spaces around the lid between the frame and the cover, and under the frame if it is poorly sealed. One solution is to install bolts through the holes. Stainless steel bolts used with caulking compound or neoprene washers installed on the bottom of the cover can be used. Other materials include oil and gasoline resistant lid plugs manufactured from hard rubber and other synthetic materials.

Deteriorated maintenance hole frame and grade adjustment joints can also be a significant source of inflow. Seals are quite often damaged by road work and heavy traffic. The need for repair materials and techniques depends on whether the frame must be raised. If a maintenance hole frame is sound and properly graded but is poorly sealed to the maintenance hole, one of the several in-place rehabilitation methods can be used. None of these methods requires the expense and inconvenience of excavation. One of the best alternatives to minimize inflow through the cover, frame, or both is to raise the frame. To do this, maintenance hole adjusting

rings normally are used, although frame extension rings can also be used. The exposed exterior portion of the maintenance holes also may be coated with cement mortar or a bituminous material.

F 856 PUMP STATION REPAIRS

In the course of a pump station operation, even with the best of care and maintenance, there will be breakdowns in operation due to equipment malfunctions. Such malfunctions could range from mechanical and electrical equipment, to instrumentation and control system failures.

Mechanical failures are mostly associated with the pump and motor assembly. These may involve breakdown of bearings, poor shaft alignment, vibrations, mechanical seal failure, check valve malfunction, or clogging of the pump impeller.

Electrical failures may be caused by a short circuit in the motor winding, short circuit wiring in the control system, motor overload due to mechanical malfunction or plug in the impeller, or unscheduled power outages in the pumping plant.

Pumping plant repairs are normally done in-house, according to priority. Mechanical repairs are performed at the WCSD mechanical shop. Electrical repairs are undertaken at the pumping stations. In general, the City maintains in stock a recommended list of spare parts. Repairs requiring outside job contracts are those considered major or complex in nature such as control systems, motors, variable speed drives, and valves.

For ease of operation and maintenance, the design engineer should consider the following design considerations:

a. Provide sufficient number of lifting hooks and a permanent hoist for easier removal of equipment;

b. Provide adequate catwalks for safe and easier access to check valves and drive shaft couplings;

c. Provide adequate ventilation for the safety and comfort of the operator and the maintenance crew;

d. Use variable frequency drives (VFD) instead of clutches;

e. Provide a secondary back-up control system (i.e. , ultra sonic level detector in addition to the bubbler level control units) capable of operating pumps in case of a control system failure; and

f. Provide redundancy stand-by individual pumps capable of handling the flow. Stand-by pumps should be designed to start upon failure of the in-line pumps.

F 860 RECORDS AND LOGISTICS

Records and logistics are important elements in the planning and design of a wastewater collections system. Records constitute an important basis for the following:

a. Determining the system's operating and maintenance costs;

b. Determining future budgetary requirements;

c. Preparing preventive maintenance schedules as part of the O&M manual; and

d. Scheduling repairs.

Logistics provides the necessary support services to ensure the timely procurement and availability of replacement parts and materials as part of the O&M activities.

F 861 RECORDS AND FILES

Records of service, maintenance and repair which indicate, in addition to other information, the time and cost required to perform the work, should be maintained in order to develop historical data vital for planning purposes.

There should be a standard procedure in recording and record keeping for easy filing and retrieval during the day-to-day operation.

It will be helpful to the O&M workers if the design engineer could develop some forms for record-keeping as part of the O&M manual preparation.

F 861.1 PREVENTIVE MAINTENANCE SCHEDULE

Preventive maintenance is the most effective and efficient type of maintenance program. However, a good preventive maintenance program requires the availability of complete and accurate maps (e.g., sewer maps, wye maps, etc.), plans, good records, and an under-

standing of how to apply and use them.

For a maintenance schedule to be effective, it must be flexible. That is, it must be capable of being revised periodically to reflect the effectiveness of previous schedules.

F 861.2 MAPS, PLANS AND CONSTRUCTION DRAWINGS

A complete set of sanitary sewer maps, including wye maps, as-built plans, and construction drawings, is a basic requirement in the operation and maintenance of a wastewater collection system. The design engineer should see to it that this is included in developing the O&M manual.

The sewer map should show the location of the sewer lines, maintenance holes, cleanouts, wye branches, depths to sewer invert, pipe sizes and pipe materials, and the direction of flow. Locations of pump stations, appurtenances, special structures (e.g., siphons, diversion structures, etc.) and wastewater treatment plants should also be clearly identified.

F 861.3 MAINTENANCE RECORDS

The Wastewater Collection Systems Division (WCSD) uses the following forms to keep records of preventive maintenance and repair service.

F 861.4 PUMP STATION RECORDS

Pump station equipment is similar to most of the equipment at treatment plants. Hence, the same type of records and applicable forms used in a treatment plant can be adopted with very little or no modification at all.

The following equipment maintenance forms are used by WCSD for pump station maintenance and service records.

a. Equipment Data. This form is used to record each individual piece of equipment in the plant. The data includes equipment manufacturer, model, serial number, cost, and

equipment specifications, such as capacity, horsepower, power rating, voltage, etc. Other information includes date of installation, location in the plant, and local supplier. Sample forms are shown in Appendix F 861.4A.

b. Equipment Service Record. This form is used to record the service history of each piece of equipment. The data include the various critical parts that need to be serviced regularly, type of lubricant used, frequency and actual date of servicing. A sample is shown in Appendix F861.4B.

c. Equipment Repair Records. This form is used to record repairs made during equipment servicing. Information includes type of maintenance performed, parts replaced, replacement part cost, and labor hours. A sample is shown in Appendix F 861.4C.

d. Motor Service Records. This form is used to record servicing of electric motors. The form includes motor specifications, test data, and date of servicing. A sample is shown in Appendix F 861.4D.

e. Spare Parts Inventory Card. This form is used to monitor the availability of spare parts. The form provides information on description, dates of order and actual receipt, including quantity issuance, and current inventory.

F 861.5 WRITTEN REPORTS

Planners, design engineers, and project managers should be aware of and become familiar with various types of reports concerning wastewater facilities administration. Some of these reports may have a direct impact on the operation and maintenance of a wastewater collection system.

The following are some of the reports which design engineers, planners, and project managers may be required to provide input to and/or to prepare themselves. It is important that they be familiar with the format, organization, and submittal process.

F 861.51 COUNCIL REPORTS

Council members need to know sewer-related projects affecting their respective districts. Similarly, technical information for a proposed City ordinance concerning wastewater discharges (e.g., sewer connection limitations, industrial discharge limitations, etc.) may have to be provided to the Council members. The role of the design engineer, planner, and project manager is to provide the necessary technical data and information in drafting the proposed ordinance.

F 861.52 BOARD OF PUBLIC WORKS REPORTS

A Board report is a brief report requesting certain actions from the Board on some administrative matters (e.g., approval of a contract to construct a sewer improvement project, etc.) or informing the Board of the results of some technical study or investigations. These reports can be initiated by any of the bureaus under Board supervision.

F 861.53 BUREAU OF ENGINEERING REPORTS

The Bureau of Engineering prepares and issues technical reports varying in subject matter from advance planning, project pre-feasibility, feasibility studies, to a design report.

F 861.54 BUREAU OF SANITATION REPORTS

The Bureau of Sanitation may occasionally issue technical reports that are of interest to the operation and maintenance of wastewater facilities.

F 861.55 OTHER AGENCIES REPORTS

Other types of reports that should be of concern are those originating from other agencies. Of particular importance are reports and regulatory requirements issued by the federal, state and regional environmental agencies and by the office of CAL/OSHA.

F 862 LOGISTICS

Logistics refers to the procurement, storage, and availability of replacement parts or materials when needed. Some type of inventory control system must be developed to prevent undue delay in the procurement and availability of critically needed parts. The maintenance history of equipment, normal life of wearable parts, and condition of the system should be important factors in ordering the inventory.

The lead time required to deliver a part after ordering is also a critical factor to consider. Parts that are mass produced are only manufactured after a certain number have been ordered and can take from six months to two years for delivery.

F 870 EMERGENCY OPERATIONS, MAINTENANCE AND REPAIRS

The first priority of a wastewater collection system administration is to have the capability to respond to emergency situations. Such a situation could range from sewage backup to sewage spill due to a major break in the gravity and pressure mains or from power outages in the pumping plant.

F 871 RESPONSIBILITIES

The Wastewater Collection Systems Division (WCSD) Emergency Operations Center (EOC) serves as the focal point for the Division's operations under either of the following conditions:

a. When an emergency condition has been declared by duly constituted City, County, or State authorities; or

b. When deemed appropriate by management personnel in the Bureau of Sanitation or by the Board of Public Works.

F 872 LOCATION

The WCSD Emergency Operations Center is located in the conference room of the WCSD Administration Building at 2335 Dorris Place, Los Angeles.

F 873 PERSONNEL

The WCSD EOC shall be staffed with a minimum of two persons. The Division head shall determine specific personnel and work shifts as the situation arises.

F 874 CONDITIONS REQUIRING EMERGENCY RESPONSE

There are two general types of conditions that require an emergency response. The first type refers to a general state of emergency as declared under Section F 871a. This takes the form of a major disaster, such as earthquake, fire, flood, etc. The second type refers to sewer line malfunctions and could be due to one or a combination of the following:

a. Overflow Sewers. Most emergency calls are related to sewer overflows. Blockages in the pipe are the usual cause of most gravity sewer overflows. Blockages can result from root intrusions, grease build-ups, and sediment and other depositions. Pumping plant shut down and/ or gate closure can also result in sewer backups and eventual overflows.

b. Collapsed Sewers. Collapsed sewers can be the result of old corroded pipes, inadequate cover or earth movement as in earthquake occurrence. Each of these could result in sewer overflows.

c. Power Failures and/or Equipment Breakdown. Power outages and mechanical and electrical equipment failures are the principal causes of an emergency condition at a pumping plant.

d. Other Requests. Other requests that require an emergency response include requests to retrieve valuable articles that have been lost down the drain or inadvertently flushed down the toilet, to replace a missing maintenance hole cover, or to investigate foul and/or suspicious odors that appear to be emanating from the sewer system.

F 875 EMERGENCY RESPONSE

Separate procedures have been established for notifying and responding to an emergency situation arising from an overflow in the gravity sewer collection system or from a pumping station. These procedures are described in the following sections.

F 875.1 STAFFING

The City-wide response crews are responsible for responding to complaints of an emergency nature during non-regular working hours Monday through Friday and on weekends. The District yards handle all emergency work during regular working hours.

F 875.2 RESPONSE PROCEDURE

All complaints requiring emergency services during normal operation are communicated directly to the City-wide response crews either by radio, telephone or through 646 Operator. If the situation is determined to be the responsibility of another department or agency, the Senior Sewer Worker shall advise that department or agency of the problem.

The WCSD Emergency Operation Center is activated in conjunction with the mobilization of the City's main Emergency Operation Center located at P4 floor level, City Hall East. This occurs when an emergency situation, as defined in Section F 871a, is declared.

Under this condition, the City's main EOC becomes the focal point of emergency operations. Instructions are directed to WCSD EOC, which, in turn, relays the messages to the field supervisors.

During intense storms when many calls are received for emergency responses, the WCSD EOC is also activated. The Operation Center functions independently of the City's main EOC in this instance.

F 875.21 GRAVITY SEWER OVERFLOW

Pipeline crews are on duty at each of the eight maintenance district yards for nine hours a day over a 5 day week. During normal off hours, City-wide crews work out of the North Yard, extending coverage to 18 hours a day for (two shifts) seven days a week. These crews work in areas that have high traffic volume during regular work hours and respond to emergencies throughout the City during their shift. During the period when crews are not on duty (from 12:30 to 6:30 AM), personnel are mobilized from their homes. They are notified by phone or beepers under a normal "call out".

Under standard operating procedure during normal operation, three maintenance personnel, namely, an electrician, a mechanical repairer, and a truck operator, are required to wear beepers around the clock. The supervisors, when not at home, are likewise required

to carry beepers. These personnel serve as the key personnel in responding to emergency situations, especially those involving power outages and mechanical equipment breakdown.

Under an emergency condition, such as an earthquake, when the lines of communication are out, pipeline crews are to report to the nearest yard or to the City facility nearest their home.

The crew will try to contain the spill, correct the cause of the spill, return overflow to the system as much as possible, and clean up and sanitize the area. If additional maintenance appears necessary, it becomes the responsibility of the individual maintenance district.

If the condition is beyond the capability of the City-wide crew, the supervisor in whose district the emergency exists shall be notified by telephone immediately of the need for additional help. If the district supervisor cannot be contacted, the Wastewater Collection Manager shall be notified of the problem so that additional instructions may be given to the City-wide response crew in order to tend to the emergency.

F 875.22 RAW SEWAGE PUMPING PLANTS

Each pumping plant has a telemetry monitoring system that constantly monitors the status of some key operational functions and transmits that information to the Venice Pumping Plant Control Center. The telemetry system gives an early warning of a pumping plant malfunction that, if continued, could result in an overflow. The Venice plant is staffed 24 hours a day by an operator who follows a standard operating procedure in notifying supervisors of an alarm condition. The plant operator also notifies the Department of Water and Power, if the alarm is caused by a power outage.

Pumping plant operation and maintenance personnel are normally on duty 18 hours a day (two shifts), seven days a week (6:00 AM to 12:00 Midnight). An emergency crew is on duty for 18 hours (two shifts) coverage during the off-hours. This crew, consisting of an electrician, a mechanical repairer, and a helper, is based at the North Yard.

When a pumping plant outage occurs, the primary duty of the emergency maintenance crew is to contain any overflows, restore the plant to operation, clean and sanitize the area, and to render a report on the event.

Electrical and/or mechanical failures are evaluated and repairs made to the equipment to return it to service as soon as possible.

F 876 SAFETY

Safety is always of paramount concern in the operation and maintenance of a sewer collection system. The need for safety becomes vitally important in an emergency situation when work has to be accomplished expeditiously in order to contain the damage. Section F 880 discusses the safety aspect of operation and maintenance of the sewer collection system.

As a general rule, all Emergency Crew members are cautioned to exercise the utmost care in performing emergency work. They will follow all safety rules and regulations. Experience and common sense, as well as written regulations, will guide every crew member in the performance of his job.

F 877 REPORTS

Submission of reports is an integral part of the work accomplished by the field crews. It is essential that a record of work accomplished be maintained for staffing and budgetary purposes. The reports also form a permanent record of specific work done. These records can prove particularly useful in identifying trouble spots or in answering lawsuits filed against the City. It is, therefore, essential that all reports be as complete and accurate as possible.

The Senior Sewer Worker is responsible for preparing and submitting any required reports. In addition to the following reports, the supervisor may at times request additional information about a specific location, sewer condition, or faulty sewer-related incident. Such information should always be submitted in writing, rather than orally, to ensure that all necessary details are included and that nothing is lost or changed during trasmittal.

F 877.1 SEWER MAINTENANCE TIME AND WORK REPORT (Form 1196)

The Senior Sewer Worker is required to fill out and submit Daily Form 1196. All hours worked by the crew must be accounted for in the report. The bottom portion - Work Description - is used for adding specific information concerning the work accomplished. A copy of this form is shown in Figure F 875.1A.

F 877.2 COMPLAINT MEMORANDUM (Form 4-C)

This form is used to record complaints from the public or from another governmental agency. This report becomes a permanent record and is subject to review at a later time. The field crew shall ensure that all entries that they are required to make are complete and accurate. Figure F 875.2A is a sample of Form 4-C.

F 878 STATE NOTIFICATION

Under Section 13271 of the California Water Code, the California Regional Water Quality Control Board (CRWQCB) requires that all sewage spills be reported to the Regional Water Quality Control Board (CRWQB). Spills under 500 gallons are tabulated monthly and forwarded to that Office. Spills over 500 gallons shall be reported as they occur through procedures as stated in the operating manual by way of Wastewater Collection Manager I or II.

F 880 SAFETY

The risks associated with the operation and maintenance of a wastewater collection system stress the need for safety practices. The physical, chemical, and biological hazards are a constant threat and occur with regularity. It is only through the adoption of an effective safety program and training that these may be minimized.

F 881 PURPOSE

The purpose of this section is to identify these hazards and to initiate safety policies, practices and procedures. This section will also identify the offices responsible for administering the City's safety program. The intent is to make design engineers and project managers aware of the safety program, so that proper safeguards are incorporated during the planning and design processes.

F 882 SAFETY POLICY AND PROCEDURES

The City's safety policy and procedure are spelled out in the City of Los Angeles Safety Manual issued by the Occupational Safety Office of the Personnel Department (1984). This manual is intended to assist the supervisors in meeting CAL/OSHA regulations.

The City recognizes its responsibility to provide a safe and healthful working environment for all its employees.

To achieve this objective, the following procedures are established:

a. Eliminate unsafe acts of individuals or unsafe structures, installations, shops, facilities, and working conditions.

b. Organize and supervise a program of safety information and training concerning:

   1. The correct use of tools and equipment.
   2. Safe work methods.
   3. Safety precautions.

4. Application of safety rules for accident prevention.
5. Safety orientation of new employees.

c. Maintain records of accidents and safety performance. Investigate and analyze all accidents, prepare reports for management and submit recommendations for preventive measures.

F 883 RESPONSIBILITIES

The Mayor's Executive Directive No.9 (Oct. 15, 1980) establishes responsibilities and procedures to comply with the California Occupational Safety and Health Act (CAL/OSHA) to assure a continuous healthful and safe working environment for the City's employees.

F 883.1 PERSONNEL DEPARTMENT OCCUPATIONAL SAFETY OFFICE

The Personnel Department Occupational Safety Office is responsible for overseeing the City's compliance with safety laws and serves as an advisory office. Its role is defined under Executive Order No. 9. The Occupational Safety Office is headed by a Safety Administrator. Specifically, its functions are as follows:

a. Serves in a staff capacity;
b. Coordinates safety and industrial hygiene activities;
c. Conducts supervisory educational activities;
d. Keeps and analyzes accident records;
e. Attempts to maintain an on-going interest in safety;
f. Serves on safety committees;
g. Conducts major accident investigations;
h. Conducts periodic safety and industrial hygiene inspection;
i. Checks for compliance with current regulations; and
j. Issues accident/injury reports.

F 883.2 BUREAU SAFETY COORDINATOR

The Board of Public Works assigned each Bureau or Office the responsibility for providing safety rules and regulations as

required by the State of California, Division of Industrial Safety, Construction Safety Orders, Sections 1509 and 1510.

The Engineer of Surveys has been designated as the Bureau of Engineering Safety Coordinator. The office is located at:

City Hall East
Room 1430
Extension 53077

The Division Manager of the Wastewater Collection Systems Division has been designated as the Bureau of Sanitation Safety Coordinator. The office is located at:

2335 Dorris Place
Los Angeles, 90031
Extension 55888.

The Bureau Safety Coordinator serves as the representative of the Bureau in all functions in connection with its safety program. Among the responsibilities are:

a. Serve as Chairman of the Safety Committee;
b. Review accident and injury reports;
c. Keep a record of personal injury and automobile accident reports, and logs and summaries of injuries and illnesses reported on CAL/OSHA Form No. 200;
d. Attend safety-related seminars and conferences;
e. Review and update the Safety section in the division Manual of Policies and Procedures; and
f. Maintain liaison with the Occupational Safety Office.

An Assistant Safety Coordinator assists the Bureau Safety Coordinator in administrating the Safety program. Among the important duties of the Assistant Safety Coordinator are new employee orientation, information dissemination and training.

F 883.3 WASTEWATER COLLECTION SYSTEMS DIVISION SAFETY COUNCIL

The WCSD Safety Council is comprised of the Division's Wastewater

Collection Managers and is chaired by the Division Manager. The Council reviews safety-related recommendations from the Division Task Force Safety Committee as to their appropriateness, applicability and timeliness. The Council may approve or propose alternate corrective measures on unsafe conditions and safety practices.

F 883.4 WCSD TASK FORCE SAFETY COMMITTEE

The Wastewater Collection Systems Division Task Force Safety Committee is comprised of a representative from each of the Pipeline Districts, the Mechanical and Electrical Groups, and the Pumping Plant Operations Group. Also included is a management liaison person and a representative from the Personnel Department Safety Coordination Office.

The Committee reviews accident reports, recommends corrective measures on unsafe conditions or practices, and is responsible for the overall safety program of the Division.

The Chairman of the Division's Safety Council attends the monthly Task Force meetings in an advisory capacity only. The Chairman is responsible for implementing the recommendations after approval by the Division Safety Council.

As part of its Safety Program, the Division has established the following policy and procedures:

a. Provide and require the regular use of safety equipment;
b. Provide proper job instruction;
c. Conduct frequent review of safety practices, including first aid training;
d. Hire adequate and qualified supervisors;
e. Plan the job through to completion; and
f. Develop an effective safety program.

F 884 DEPARTMENT OF PUBLIC WORKS EMERGENCY OPERATIONS

The City has established an Emergency Operations Center (EOC) to deal with emergency situations requiring immediate concerted response. The Center is located at the lowest floor level (P4) of

the City Hall East subterranean complex. It is fully equipped with communication facilities, with each department and/or bureau assigned its own radio frequency for two-way communications. A complete set of City plans, including Wye maps, is available in microfilms and/or prints.

All the City departments and the Red Cross are represented in the Center. The Center is under the overall command of an EOC Executive Officer, who is usually a police officer. The Public Works Department is represented by a person at the Deputy City Engineer level. Among his responsibilities are:

a. Collect and evaluate information regarding the disaster area, as they relate to public works infrastructures;

b. Contact key supervisors of the various bureaus under the Public Works Department and issue instructions as to the course of action to be instituted; and

c. Assess extent of damage to infrastructures.

The EOC is mobilized when an emergency situation is declared by the Mayor. Examples of such an event include earthquake, fire, flood, and civil disorder or rioting. During such emergency situations, representatives from each department proceed to the EOC to monitor and direct the response operations.

F 885 CAL/OSHA

The California Occupational Safety and Health Act of 1973 (CAL/OSHA) was enacted for the purpose of assuring safety and healthful working conditions for all California working men and women by authorizing the enforcement of effective standards, by assisting and encouraging employers to maintain safe and healthful working conditions, and by providing for research, information, education, training, and enforcement in the field of occupational safety and health.

The City of Los Angeles falls under the jurisdiction of CAL/OSHA. At work sites which contain both public and private sector employ-

ees, (such as many Los Angeles City construction projects), the public agency employees (City of Los Angeles) are under State safety and health standards while federal standards apply to the private sector (contractor and subcontractors). The provisions of CAL/OSHA are more stringent than those of the FED/OSHA.

F 885.1 CAL/OSHA POSTING, RECORDKEEPING AND REPORTING REQUIREMENTS

In the preparation of the O&M manual, the design engineer must be guided by the CAL/OSHA posting, recordkeeping and reporting procedures. These requirements must all be incorporated in the O&M manual. Some of these requirements are:

a. The need to post on office bulletin boards a copy of CAL/OSHA Poster No. 1000. This poster states the intent and coverage of CAL/OSHA and outlines the responsibilities of employees and employers to maintain safe and healthful working conditions.

b. Maintenance of a log of job-related illness and injuries, using CAL/OSHA Form No. 100A shown in Appendix F 885.1A.

In addition to all cases involving serious injury, illness or death, the State Division of Industrial Safety, (phone no. 213/736-3041), and the City Personnel Department's Safety Division, (phone no. 213/485-4691), need to be notified.

F 886 TYPES OF HAZARDS ENCOUNTERED

The design engineer should be aware of the various types of hazards encountered by the wastewater collection system operation and maintenance personnel. The workers are exposed to them whether they are working in maintenance holes, pump stations, or treatment plants. They include the following:

a. Physical injuries;
b. Bodily infection;
c. Dangers from noxious gases or vapors, explosive gases, or oxygen deficiency;

d. Chlorine gas from defective equipment;
e. Commercial and industrial chemicals;
f. Electrical hazards; and
g. Medical hazards (e.g., radioactive wastes from hospitals)

F 887 PREVENTIVE MEASURES

The role of the design engineer in providing a safe working environment for the sewer collection system cannot be over-emphasized. Many of the potential hazards can be minimized, if not totally eliminated, right at the design stage by incorporating appropriate safety features in the design of the sewer system. Some of the safety measures that should be considered by a design engineer are:

a. Provide adequate ventilation for sewer collection system facilities against hazardous gases. Such facilities include the following:

    1. All large trunk sewers;

    2. Sewers located in the vicinity of gas mains and gasoline storage tanks;

    3. Sewers on flat grades where solids may settle and decompose;

    4. Sewers where pressure maintenance holes covers are used and the houses connected thereto have sewer traps preventing ventilation through house stacks;

    5. All maintenance holes more than 5 feet deep, or excavations where the sewer is more than 5 feet deep;

    6. Deep tanks and pump station wet wells; and

    7. Sewers located in heavily industrialized areas, regardless of depth.

b. Require contractors to provide safety barricades and

other traffic safety control during construction.

c. Specify shoring requirements for deep excavations and/or unstable soil condition.

d. Specify a portable ladder for use in entering maintenance holes where permanent rungs are not provided.

e. Provide guard railing around all open basins, and for stairs at other openings into which a worker could fall.

f. Provide adequate lighting at points where maintenance or repair work is required, or at any point where good visibility is necessary.

g. Use explosion-proof switches and controls at any point where explosive mixtures could occur.

h. Provide safety guards for all moving parts, particularly for drive couplings and universal joints.

F 887.1 SAFETY IN CONFINED SPACES

A confined space, as defined by the National Institute for Occupational Safety and Health (NIOSH), is an area that has limited entry and exit access, unfavorable natural ventilation, and is not intended for continuous employee occupancy. Maintenance holes, sewers, pump station wet wells, and small unattended lift stations are among the identifiable confined spaces.

F 887.2 MAINTENANCE HOLE SAFETY PROCEDURE

Written, understandable operating and rescue procedures need to be developed and provided to workers entering maintenance holes. These workers should be trained in operating and rescue procedures.

Working in a maintenance hole requires three persons, two of whom shall be stationed above ground; one, the crew leader, monitors the gas detector and the blower/ventilator, the second holds the lifeline attached to the third person, who will enter the maintenance

hole. This procedure shall deal only with entering and working in one maintenance hole, with no possibility of work between two sewer maintenance holes.

F 887.3 WORK AREA TRAFFIC CONTROL

Sewer maintenance workers must always be guided by the Work Area Traffic Control Handbook (WATCH). The latest edition of this handbook needs to be kept in all the Division's vehicles and be consulted as a guide at all times.

Control of traffic, and placement of cones, high level warning devices, and other traffic control measures must be in accordance with the rules as prescribed by the current WATCH.

F 887.4 TRENCH SHORING REQUIREMENTS

CAL/OSHA requirements are the criteria in any accident litigation. Hence, sewer designers and workers alike should be familiar with CAL/OSHA shoring requirements. For trench shoring requirements, see Article 6, Reference No. 16.

F 887.5 PROTECTION FROM ELECTRICAL HAZARDS

The presence of buried power supply lines poses a danger to sewer maintenance workers. No excavation shall be allowed in public right-of-ways without first checking with the proper agencies and location maps of all underground utilities.

Only authorized personnel shall be allowed to work on electrical equipment. Safety locks and tags must be placed on all electrical circuits or equipment whenever they are out of service for repairs. Tags must indicate date of lock and signatures of persons responsible for lock out.

F 887.6 NOISE HAZARD

Loud noises from gas engines, air hammers, and other equipment can cause permanent ear damage. When the noise level exceeds 85 decibels (dB(a)), OSHA requires that operators be shielded or

protected from the source.

The U.S. Environmental Protection Agency requires that all new portable air compressors built since 1978 produce an average sound level of 76 (dB(a)) or less when measured at a distance of 23 feet.

F 887.7 RADIOLOGICAL HAZARD

The increasing use of radioactive isotopes in hospitals, research laboratories and certain industries presents a new hazard to O&M workers. Routine surveys are required to be made on the existence and level of radioactive waste in the sewer. Any violation must be reported to the County Department of Health Services.

F 887.8 WORK ON STATE HIGHWAYS

Prior to any work being performed by WCSD on City facilities which will necessitate encroaching on a State Highway, a "Standard Encroachment Permit Application" must be filed with the State of California, Department of Transportation, District 7. The Permit Engineer, located at 120 S. Spring Street, phone number 213-897-3631, will issue the permit on behalf of CALTRANS. If the work must be performed on a State Highway during an emergency, or other than during normal working hours, or when special circumstances exist, and the "Standard Encroachment Permit Application" cannot be submitted to CALTRANS until after work has begun or been completed, the application must be submitted to a CALTRANS office immediately after the opening of regular office hours.

A "Standard Encroachment Permit Application" form is shown on Figure F 887.8A.

F 888 SAFETY TRAINING PROGRAM

An effective safety training program must be established as part of CAL/OSHA training requirements. The program can range from highly organized sessions to tailgate safety meetings. The training should include job safety analysis (JSA). JSA is a procedure to identify hazards that may have been overlooked in the design of machinery, equipment, work processes and work practices.

OSHA Bulletin "Safety and Health Training Guidelines for General Industry" helps identify standards that relate to training. This bulletin is available from the Personnel Department Safety Coordinator Office.

F 889 FIRST AID

The use of first aid kits cannot be overemphasized. Prompt attention to all injuries is important. Instructions in first aid treatment are available from the State Health Department, National Safety Council, Federal Bureau of Mines, American Red Cross, and the manufacturers of first aid kits. Red Cross courses in first aid given in connection with Civil Defense provide an excellent opportunity for training.

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APPENDIX F-825A

CLOSED CIRCUIT TELEVISION SEWER INSPECTION

Manpower Requirement

The use of closed circuit television (CCTV) for inspecting a sewer line requires the employment of at least one TV system operator and two maintenance workers. The maintenance workers are to assist the operator in setting up the equipment and serving as cable winch operators. The TV system operator will serve as the crew leader.

The TV system operator must have had experience in sewer inspection and repairs. The operator must be capable of recognizing problems that appear on the TV monitor. An instruction manual for setting up and operating the TV equipment is normally included in the equipment purchase and can easily be followed. While a knowledge of electronics is not required, the operator must be able to recognize TV equipment problems, and must ensure that the equipment is properly used and maintained.

One of the maintenance workers acts as the pulling winch operator, and the other as the return winch operator to pull the camera backwards, and to wind the transmission cable back as needed.

Preparing the Sewer Lines

Before the actual televising is done, the sewer lines need to be cleaned. Cleaning may be accomplished by balling, by the use of a high velocity jet cleaner, or with a power rodder. The purpose is to eliminate grease accumulation, roots or debris that could interfere with the operation of the TV camera and inspection of the sewers for cracks, leaks and open joints.

Notifying Facility Operators and Industrial Waste Inspectors

In case the depth of flow in the sewer to be televised is such that the camera will be submerged, the upstream line will have to be plugged during the inspection operation. Precautions must be taken to ensure that the back-up wastewater flow does not cause flooding and maintenance hole overflow in the upstream section. Similarly,

plugging the upstream section could affect flow measurements, sampling, tests, and treatment processes in the downstream portion. Hence, always notify the treatment plant operators and industrial waste inspectors whose activities could be affected by the inspection operation.

Observing Safety Procedure

Safety should always be the paramount concern of the inspection crew. Be sure that all safety procedures in maintenance hole entry and trafic operation are followed.

Operating the TV Camera

As a good practice, the camera should always be pulled towards the downstream maintenance hole. Since the footage is measured and the records based from the upstream maintenance hole, this will avoid confusion and avoid digging in the wrong location for a bad joint or tap. An added advantage is that it washes any debris in front of the camera and prevents any build-up on the back of the camera.

1. The first step is to string the sewer from maintenance hole to maintenance hole. Any method that will accomplish this objective is acceptable. A simple procedure is to tie a float line to a plastic jug or other floatable object and let the flow carry the object from the upstream to the downstream maintenance hole. In case there is not enough flow, a high velocity jet cleaner or a power rodder can be used to string the line.

2. While the two winch operators are setting up the line, the TV system operator should start testing the system. It is good practice to prepare a "Check List" for items to be checked and tested before starting with the actual inspection.

3. The TV operator should attach the camera to the skid assembly for the size of pipe to be televised. The proper skid assembly is important since the TV camera needs to be as close as physically possible to the center of the pipe when the camera moves down the pipe. The tow and tag line bridles are also connected to the skid assembly.

4. In preparing the camera for operation, care must be taken so that in removing the camera lens, the lens (if fitted with a Viticon tube) is not exposed to sunlight or bright light that could enter and cause permanent damage to the tube. (Consult Manufacturer's Instruction Manual regarding this precaution.)

5. After the camera has been connected to the transmission cable and switched on, the operator focuses the camera for a pre-set distance. This distance depends on the size of the sewer to be televised. The camera is focused on an object at a distance of twice the diameter of the pipe being televised.

NOTE:

Various types of wide-angle lenses, ranging from 33, 53, 64 and 90 degrees, are available for sewer inspection television. Each one of these lenses works with a different focal distance in any selected pipe size. A 90-degree lens has a picture edge only eight and a half inches away in a 12-inch pipe. In the same pipe, a 33-degree lens must look almost two feet before a picture is available.

Where such distances are known, the user is referred to the manufacturer's manual.

6. After the equipment set-up preparation is completed (i.e., power tested, camera focused to a pre-set distance, and the line strung), the camera assembly is lowered down the sewer line from the upstream maintenance hole by one of the workers (upstream winch cable operator).

7. Once the camera is set down in the sewer line, the TV operator checks the TV monitor to see if they are getting a satisfactory picture and lighting. When the operator determines that all is ready, the inspection starts.

8. All footage readings must be estimated as closely as possible and should always start at the CENTER of the maintenance hole so the repair crews will always measure from the same point.
9. There are two essential rules that must never be violated:

a. While the camera is being moved through the line, the opeator must never stop looking at the monitor picture. Any obstruction that could wedge or damage the camera or the light must be seen in time to stop the camera's forward progress. If the picture is lost for any reason, the forward progress of the camera must be stopped. If the picture cannot be reestablished again, the camera must be pulled backwards out of the line.

b. If communications with the operator at the pull winch are lost, progress must be stopped immediately. For most crews, a shouted signal from one member indicates a loss of this communication.

10. The pull winch operator must continuously monitor the drag on the cable. If the operator finds the drag on the cable is heavy, this fact should be reported to the TV operator. Wedging is often possible when a heavy drag occurs. An out-of-round pipe can cause wedging. If a camera and skid assembly become locked or wedged in a pipe and the pull cables break, the sewer must be dug up to recover the camera.

Logging and Recording Television Inpections

A television inspection of a sewer line requires that important observations be recorded. The Survey Division has developed the attached CCTV Inspection Log form for reporting the results of the inspection. Information that is recorded includes the sewer section being televised, date, time of day, weather condition, surface material, pipe size, material and condition, structural condition, and operator's and inspector's initials.