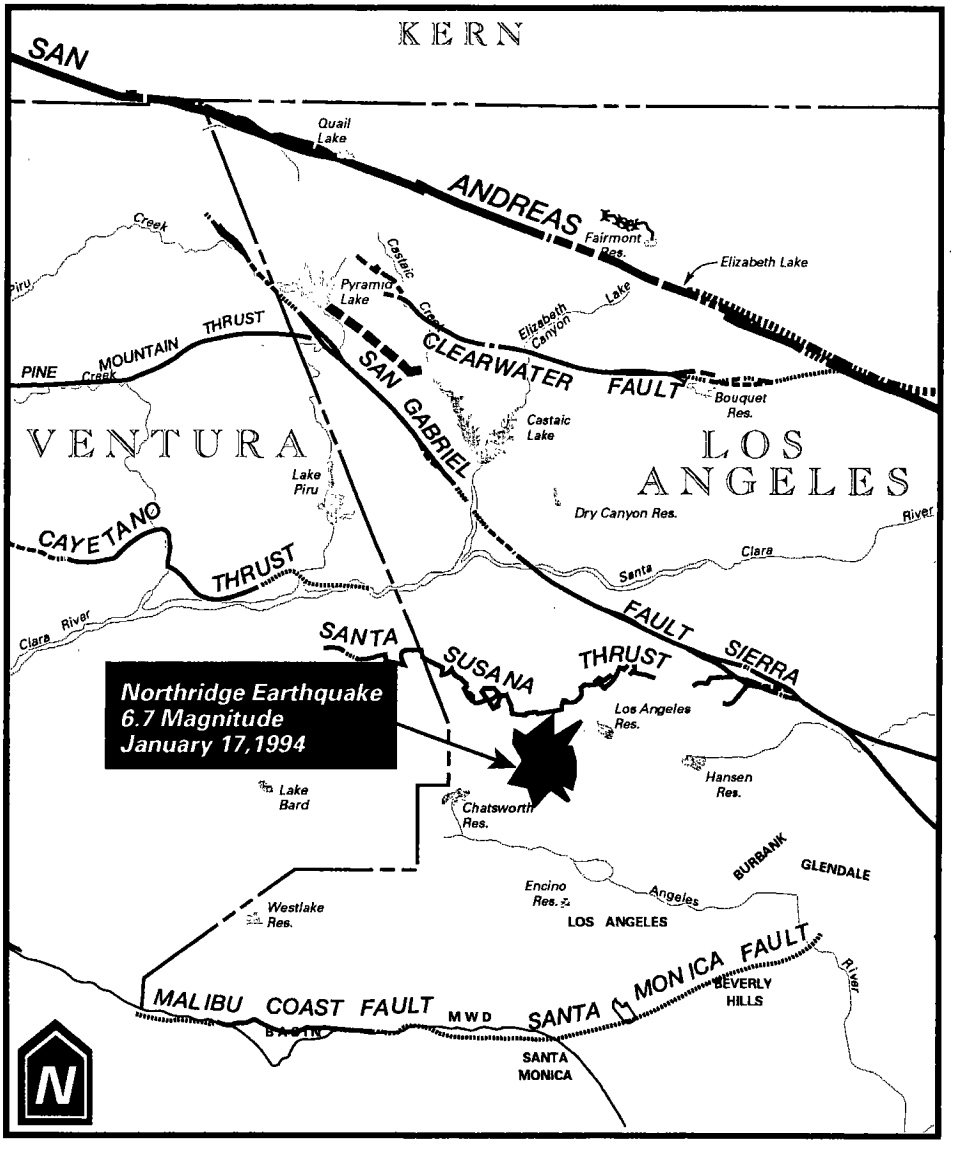
NORTHRIDGE EARTHQUAKE ASSESSMENT REPORT



MAJOR FAULT ZONES WITHIN THE GREATER LOS ANGELES AREA

LEGEND

- KNOWN FAULT LOCATIONS
- INFERRED FAULT LOCATIONS
- CONCEALED FAULT LOCATIONS

October, 1994

Report Number 1087

NORTHRIDGE EARTHQUAKE ASSESSMENT REPORT

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CONTENTS

APPENDICES

ACKNOWLEDGMENT

This is to acknowledge and commend the dedicated efforts of the men and women who contributed to the timely and effective recovery of critical district facilities damaged during the January 17, 1994 earthquake.

Metropolitan wishes to thank each of you for your outstanding performance.

EXECUTIVE SUMMARY

PURPOSE AND REPORT OVERVIEW

A preliminary assessment of Metropolitan's response to the January 17, 1994 Northridge earthquake was presented to the Board of Directors on March 8, 1994. The report advised that a detailed assessment would follow after a series of debriefing meetings with Member Agencies, to include: an analysis of Metropolitan's response to the Northridge earthquake, damage sustained by District facilities, repair methods, and costs for repair and identified needed improvements.

On March 10, 1994 the Northridge Earthquake Assessment Task Force (Task Force) was formed to prepare a report of the impact of the Northridge earthquake and identify areas to improve the District's emergency preparedness. During the evaluation process it became evident that an assessment of the District's coordination efforts with member agencies would be necessary, therefore, the duties of the Task Force were expanded to include an assessment of interagency coordination.

The report assesses Metropolitan's response to the Northridge earthquake and includes findings and recommendations from sixteen District departments, divisions, functions and programs having a role in the emergency response and recovery process; these include:

- Emergency Preparedness Program;
- Emergency Operation Center;
- Operations;
- Engineering;
- Environmental Compliance;
- Protective Services;
- Information Systems;
- Administrative Services;
- Water Quality;
- Public Affairs;
- Human Resources;
- Finance;
- Planning;
- Business Resumption Plan;
- Legal;
- Interagency Coordination.

The report also contains five appendices, including:

- Metropolitan Water District Emergency Response Organization;
- Member Agency Response System (MARS) Communications Chart;
- Damage Assessment and Repair;
- Cost Section;
- Photographs of Damaged Areas.

Report information, including details of damages, repairs, and costs was compiled from written assessments by Divisions involved in the response and recovery process, personal interviews, debriefings with District staff following the repair effort, and meetings with member agency representatives. Many of the findings and recommendations presented in this report were identified by more than one division. However, in an effort to present the information in an easy to follow format and prevent duplication, each finding and recommendation has been listed in the chapter of the department, division or group having responsibility for those emergency response activities.

Metropolitan's Response

District work units' overall performance was very good. The prompt response of patrollers and damage assessment teams contributed greatly to the timely recovery process. (Appendix C) Repair crews worked around the clock, resulting in damaged facilities being returned to service within 72 hours. Personnel from Environmental Compliance and Engineering were available to repair crews 24 hours a day for assistance with technical and safety issues. The Employee Earthquake Assistance Program, formed on an ad hoc basis, was very successful; employees throughout the District offered cash, supplies, equipment and their time to help victims of the disaster.

Primary Areas of Concern

Although District staff responded effectively following the earthquake, an objective review of Metropolitan's overall emergency preparedness identified a number of areas needing improvement. The primary areas of concern are:

- The Emergency Preparedness Program must be expanded to include a more active role for Metropolitan with its member agencies;
- The District's Emergency Response Plan is not consistently reviewed, modified, or updated;
- The District is currently operating without a Business Resumption Plan for critical office operations;
- Training and drills for emergency response personnel and member agencies are not scheduled on a regular basis;
- Communications systems and procedures including, the Member Agency Response System 2-way radio network, must be reviewed and updated to meet present needs of emergency response personnel and member agencies;

- Lack of appropriate equipment to facilitate timely repairs is needed;
- A formal Earthquake Employee Assistance Program has not been established;
- In the future to be eligible for reimbursement of emergency response related costs under state disaster assistance programs, the District's Emergency Response Plan and associated programs must comply with the Standardized Emergency Management System (SEMS), Senate Bill 1841 by December 1, 1996.

Planned Improvements

Metropolitan proposes to improve its emergency preparedness and response and meet specific Strategic Plan goals by initiating the following changes:

- Revise and maintain the District's Emergency Response Plan and associated programs;
- Ensure that applicable program improvements comply with the Standardized Emergency Management System (SEMS), Senate Bill 1841 by December 1, 1996;
- Establish a Member Agency Coordinator function to evaluate the roles and responsibilities of Metropolitan and its member agencies with respect to emergency preparedness and response;
- Develop and conduct drills/exercises at appropriate District facilities annually in coordination with member agencies and other appropriate agencies;
- Development and implementation of a formal Business Resumption Plan for critical office operations;
- Purchase necessary equipment to facilitate emergency repair and recovery efforts;
- Review and revise the Member Agency Response Systems (MARS) 2-way radio system procedures to meet the needs of Metropolitan and its Member Agencies.

Costs

To date, earthquake related damage and hazard mitigation costs total nearly $11.5 million. (Appendix D) Metropolitan has applied to FEMA and OES for public disaster assistance. The District is eligible to apply for up to 97½ percent reimbursement of earthquake damage repair and mitigation costs. The final amount of reimbursement will be determined after repair work is completed.

The resources and costs for many of the improvements recommended in the report are still being evaluated by staff. Projects and equipment, where costs have been identified, total $996,400.

Conclusion

As a result of Metropolitan's commitment to emergency preparedness, the District's emergency response programs and plans are continually evolving to respond to the ever present potential for disaster. The 1994 Northridge earthquake provided an invaluable opportunity for MWD to again evaluate its overall emergency preparedness and response activities and incorporate the changes necessary to improve the District's readiness.

PREFACE

Metropolitan has long recognized the potential for significant damage to its water distribution system resulting from seismic activity along the San Andreas fault. Although this fault is approximately 30 miles from downtown Los Angeles, it runs directly underneath the Rialto pipeline and Colorado River Aqueduct (CRA), and is in close proximity to many other District installations.

Seismologists and geologists have traced historical earthquake activity on the San Andreas, revealing that another large temblor of 7.5 magnitude or greater has a 50 percent probability of occurring before the turn of the century and almost 100 percent within 30 years. Some scientists believe the next large earthquake on the San Andreas is overdue. The 1857 San Andreas earthquake produced a 220 mile rupture from Cholame (in San Luis Obispo County) to the Cajon Junction (in San Bernardino County) and caused up to 20 feet of horizontal fault displacement. The shaking was reported to have lasted for up to a minute.

Although the San Andreas fault is the most widely known fault in the region, there are other lesser faults in Metropolitan's service area, Elysian Park, Sierra Madre, Santa Monica, Newport Inglewood, and Hollywood faults, are a few examples. Recent events such as the Sylmar, Whittier Narrows, Landers, and on January 17, 1994, the Northridge earthquake, are leading to a reevaluation of the nature and impacts of less prominent faults. The 6.7 magnitude Northridge earthquake occurred on a previously unrecognized thrust fault beneath the heavily populated San Fernando Valley. Earthquakes with magnitudes of 6.0 and greater occur on an average of every four years in Southern California.

Following the 1971 Sylmar earthquake, Metropolitan realized how vulnerable its facilities were and established a committee to develop an emergency preparedness program to respond to floods, earthquakes, fire or civil unrest which would always pose a threat to Metropolitan's water system. In 1976 a formal plan was adopted which provides procedures for mitigation, damage assessment, guidelines for immediate action to protect life and property in case of facility failure, and establishes lines of authority.

The Northridge earthquake impacted portions of Metropolitan's facilities and distribution system and a substantial number of employees living in the San Fernando Valley and surrounding areas. The Joseph Jensen Filtration Plant (Jensen), Sepulveda, Calabasas, Foothill Feeder, Magazine Canyon Shaft, and the East and West Valley Feeders were within 15 miles of the epicenter, which was in the Reseda/Northridge area in the City of Los Angeles.

Metropolitan's earthquake planning is based on the assumption that disruptive earthquakes will continue to occur in areas that affect portions of MWD's water distribution system and other District facilities. Neither Metropolitan nor other public or private entities can ever be 100 percent prepared for a cataclysmic event such as a large magnitude earthquake. However, in order to provide its service area with reliable supplies of high quality water following a major disaster, it is necessary to maintain a viable emergency preparedness program that meets the needs of Metropolitan and its member agencies.

CHAPTER 1

EMERGENCY PREPAREDNESS PROGRAM

Metropolitan has long understood that a viable emergency preparedness program was vital to its mission of delivering water to the Southern California region. In the early years, when the population was much less than today, and technology less advanced, there were fewer ways to prepare for emergencies, and an informal agreement between water agencies to assist one another was sufficient. However, as the population increased and Metropolitan's water delivery system grew to meet the ever increasing demand for water, this informal fragmented mutual aid arrangement was insufficient. Additionally, advances in technology allowed more options in the area of emergency preparedness.

It is understood that all failures or damage to a system cannot be prevented. To meet this ever present threat, Metropolitan developed its current Emergency Response Program designed to prepare District forces to respond to aqueduct and water distribution system disruptions caused by earthquakes or other emergencies. The program objective is to keep the systems functioning during and after emergency events, and if interruptions do occur, to facilitate a timely recovery process.

An Earthquake Committee was formed in 1974 to develop a comprehensive emergency preparedness program. A formal Emergency Response Plan was adopted in 1976. It is updated as changes in the District take place. Metropolitan's current emergency preparedness program provides guidelines and procedures to institute readiness, response, and recovery in all catastrophic events that threaten its water delivery system.

In the Plan, the overall response to an emergency is directed by the Chief of Operations, who assumes the role of Incident Commander and is supported by an Emergency Support Team that assists in the decision making process, provides expert assistance, and interfaces with outside agencies.

The Incident Commander, or designee, activates the Emergency Operations Center (EOC) according to the mobilization chart (page 3). During non-working hours, all emergency response personnel are required to call the Emergency Call Center to receive reporting instructions. The Emergency Call Center also provides employees and their families with an 800 number as a means of communication during the emergency.

In 1983 the Member Agency Response System (MARS) was organized between Metropolitan and its member agencies. MARS, a two-way radio communications system, has been generally successful over the years. This system is used to broadcast status reports to member agencies and coordinate mutual aid. The MARS procedures manual

is being revised to improve radio communications between Metropolitan and its member agencies and other emergency response agencies.

The Cal Tech US Geological Survey Broadcast of Earthquakes (CUBE) system was incorporated into the emergency preparedness program in January 1991. CUBE was established to provide early earthquake information (e.g., location and magnitude) to Cal Tech's earthquake research affiliate members. Metropolitan now receives rapid source parameter information for Southern California earthquakes through the CUBE pager system.

Metropolitan formed the Emergency Preparedness Management Committee, comprised of senior management staff, to oversee the District's Emergency Preparedness Program. In addition, a task force was established, comprised of mid-level managers, to identify and recommend changes to the program. Approved program changes are incorporated into Metropolitan's Emergency Response Plan (ERP). The Operations Division's Emergency Preparedness section is responsible for program administration and ongoing maintenance of the Plan.

The Plan provides guidelines and procedures to institute readiness for, response to, and recovery from a major disaster. It is divided into three distinct parts:

a. Basic plan, organization and strategy for emergency response;
b. Specific emergency elements; each field section's ERP, guidelines, and procedures;
c. Emergency operations data; emergency telephone numbers and EOC activation procedures.

The Emergency Response Plan is designed to be a living document, always expanding as Metropolitan adds facilities and personnel and changing as technology advances and lessons are learned through adversity such as the Northridge earthquake.

The District's present emergency response management organization may not include all of the requirements of Senate Bill 1841, the Standardized Emergency Management System (SEMS) Bill which became law in 1992. This bill requires emergency response agencies, local governments, and special districts to comply with SEMS by December 1, 1996, in order to be eligible for funding of emergency response related costs under state disaster assistance programs. There is the potential for legal action for negligence, if the requirements of the bill are not followed.

The requirements of the SEMS are still being developed by a special Advisory Committee comprised of approximately 30 representatives from various California public agencies. Metropolitan's committee member represents the interests of the water entities of Southern California. Metropolitan will comply with the full requirements of SEMS when the procedures are completed, and assist member agencies with compliance requirements by sponsoring seminars to desiminate the information obtained from the Advisory Committee.

The District's Emergency Response Plan focuses on recovery of District water operations. It does not provide for aid or assistance for employees impacted by a disaster. In an effort to assist District employees impacted by the Northridge earthquake, the Employee Earthquake Assistance Program (EEAP) was implemented by District management the day following the earthquake. This program established an employee assistance center, and a help desk staffed by District employees operated 24 hours a day for

two weeks. This program provided employees with a central location to receive general information and assistance. The help desk staff assisted employees with housing needs, transportation, loan applications, child-care issues, and FEMA questions and applications. The EEAP was positively received and responded to an average of 65 calls per day during the first week, and approximately 35 calls per day during the second week. In addition to the EEAP, the Treasurer's Office, Rideshare staff, and Credit Union responded quickly to help employees with related issues and promptly initiated changes, where necessary, to enable as many employees as possible to benefit from the assistance available.

The Northridge earthquake was the first disaster to seriously impact a major operating District facility and a substantial number of employees. Consequently the EEAP was the District's first "formal" attempt to provide employee assistance on a personal level. Considering the lack of experience and preparation the program was deemed beneficial by all District employees. The areas of concern listed below are being evaluated and appropriate policies and procedures will be developed, and where appropriate, incorporated into the Emergency Response Plan.

- Identify responsible organization to receive and distribute donations of cash, food, bedding or clothing;
- Provide counseling services through the Employee Assistance Program, for employees seriously impacted by disasters;
- Update and maintain employee data (address, telephone number and emergency contact) and authorize designated emergency response personnel access to information during emergency situations.

The District's initial response to the earthquake was to determine the level of mobilization necessary. The Northridge 6.7 magnitude level III earthquake was an event that necessitated full mobilization as defined in the chart below.

Mobilization levels have been defined as follows:

	Richter Scale	Mercalli Scale	Level of Mobilization	Response Phase
LEVEL I:	less than 5.5	I-VI	Limited Mobilization required (no damage or minor damage occurred)	Phase I implemented
LEVEL II:	5.5 to 6.1	VI-VII	Intermediate Mobilization required (moderate damage occurred)	Phase I-IV implemented (and Phase V, in part)
LEVEL III:	6.1 to 8.0	VIII-IX	Full Mobilization required (major damage occurred)	Phases I-V implemented

Metropolitan performed well during the emergency. However, a thorough assessment was made and staff is evaluating emergency preparedness and response improvements.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
The District's ERP may not include all of the requirements of the Standardized Emergency Management Systems (SEMS), as required by SB-1841.	Revise the ERP for compliance with SB-1841.
The emergency call list of member agencies operations personnel was not complete.	Expand the member agency emergency call list of key operations personnel.
An up-to-date list of emergency response personnel's pager, cellular telephone, and radio call numbers was not available.	Maintain an up to date list of emergency response personnel's pager, cellular and radio call numbers and place in the EOC and all Field Command Centers.
Some emergency response personnel do not have a clear understanding of emergency reporting instructions and their designated duties.	Review emergency response plan with emergency response personnel and schedule training and drills as needed.
Some emergency response personnel did not have knowledge of alternate routes to District facilities.	Prepare maps identifying locations and alternate routes to all critical District facilities and distribute to emergency response personnel.
Purchasing staff are not designated as Emergency Response Personnel.	Revise Emergency Response Plan to designate members of purchasing staff as emergency responders.
Emergency Response Plan call lists are not updated when personnel, telephone numbers, or other pertinent information change.	Develop a plan to update emergency call lists in a more timely manner.
In some instances, Emergency Response Plan procedures were not followed.	Train assigned personnel on defined procedures.
Drills/exercises are not scheduled on a regular basis at all District facilities in conjunction with member agencies.	Develop a program to design and conduct drills/exercises with major District facilities, interested member agencies, and other appropriate agencies.

CHAPTER 2

EMERGENCY OPERATIONS CENTER

The District's Emergency Operations Center (EOC), located at the Los Angeles Sunset facility, was activated at 5:10 a.m., approximately 40 minutes after the Northridge earthquake occurred. The EOC was manned by the Assistant Chief of Operations, Chief Engineer, a representative from Public Affairs Division, and designated support staff. Volunteers also reported to provide assistance as needed.

The main function of the EOC is to provide a location from which centralized emergency management can be coordinated. The EOC contains communications systems and equipment to direct emergency repair operations through contact with the District's field staff. The EOC staff also contacts member agencies, the County EOC, and the Department of Water Resources, to advise them of the District's status regarding water supply and repair efforts.

It was apparent after the first two hours of operation that the EOC was not adequately provisioned for extended operation. Normal water and sewer services were not interrupted at the EOC; however, it was noted there were insufficient water or sanitary supplies to last for an extended period. Also, there was not a designated rest area with cots or food supplies for the EOC staff. Also, there was not a clear understanding of when or how the initial EOC response personnel would be relieved of duty. Management of the EOC went well considering that a number of support staff did not report for duty because of damage to their homes, road closure, and/or they did not understand their emergency response assignments. The EOC management organization, as shown in the District's response plan *(Appendix A)*, was followed as near as possible with a minimum staff.

Established communications procedures were followed by the District's radio operator during the EOC operation. The Member Agency Response System (MARS) radio was activated and broadcasts were made to all member agencies advising of the damages to Metropolitan facilities and asking for status reports of their water distribution systems. Other agencies such as the Department of Water Resources were contacted to determine if they had sustained damage to their facilities. All radio frequencies were continuously monitored. The licensed ham operators assigned to the EOC did not report; however, the system was monitored. Minimal information was broadcast to Member Agencies through the MARS.

The EOC essential service telephones worked intermittently and some EOC staff were not trained on how to use the emergency telephone system. Emergency response communications technicians did not report to the EOC and operation of the system developed into a major problem. Also, there was not an up-to-date emergency call list and EOC staff could not contact a technician to correct the problem.

Cal Tech's USGS Broadcast of Earthquakes (CUBE) system, television, and public radio were used to receive updated earthquake information. These updates and status reports were not broadcast over the MARS radio, and/or essential service telephones. This resulted in member agencies not having up to date earthquake information.

The Sunset facility lost commercial power but the emergency power system was automatically activated and operated properly during EOC operations. The secondary trailer-mounted EOC generator was available, but was not needed.

Office supplies were adequate during EOC operations. Reference materials for EOC staff use included the District's Emergency Response Plan, distribution system manuals, emergency response patrol route maps, water distribution system maps and plan and profile drawings, MARS operators manual, a large scale Thomas Guide, and other radio operations instruction manuals. There is no FAX machine or a personal computer available in the EOC which slows written communication.

Although emergency food rations were on site, the EOC staff sent out for food and coffee. The coffee maker normally stored in the EOC had been removed and coffee was made and transported to the EOC from homes of personnel who lived nearby.

The location of the EOC has been under study for some time because of structural concerns at the Sunset facility. The EOC withstood the Northridge earthquake with little damage and will continue to be used until the EOC currently under construction at the Eagle Rock Control Center is completed. If the Sunset facility is sold before construction is completed the EOC will be located at the Weymouth facility. The alternate EOC is a mobile communications van maintained at the Weymouth filtration plant in La Verne. The mobile EOC was not activated in response to the Northridge earthquake.

Following are specific findings and recommendations to improve emergency preparedness and response:

Finding	Recommendation
The Sunset facility EOC is in a structure not sufficiently resistant to seismic motion.	Relocate the Sunset facility EOC to the Weymouth Filtration Plant until the Eagle Rock Control Center is completed.
The mobile communications trailer is currently the only alternate EOC.	Establish additional back-up EOCs.
Facilities at the filtration plants are not equipped to serve as field command centers.	Establish field command centers at major District facilities and install necessary equipment.
The District's existing EOC management organization does not include all of the SB 1841 (SEMS) requirements.	Revise the District's EOC management organization to comply with SB 1841 (SEMS) when the requirements are finalized.

Finding	Recommendation
Duties and responsibilities of EOC staff are not clearly defined.	Review duties and responsibilities of EOC staff and schedule training as needed.
The EOC is not provisioned for extended operation.	Provision the EOC with supplies necessary for extended operations.
There is no rest area for EOC staff.	Designate a room near the EOC as a rest area.
Minimal information was sent from the EOC to member agencies, through the MARS.	Review and revise the MARS and EOC radio broadcasting procedures.
Once a decision to suspend operations of the EOC was made, telephone calls were still being received at the EOC without the proper personnel being available to respond to the calls.	A recorded message should be placed on EOC phones to advise callers the EOC has ceased operations. Callers should be referred to the regular office phone numbers for assistance.

CHAPTER 3

OPERATIONS

Operations Division personnel are responsible under the Emergency Response Plan (ERP) for responding to emergencies in their primary job duties, and assisting other work disciplines as needed. Operations distribution system personnel are responsible for inspecting filtration plants, pump plants, canals, distribution systems, power plants, reservoirs and related facilities. Other technical personnel respond to electrical, electronic, mechanical, automotive, and water quality emergencies.

Immediately following the Northridge earthquake, the emergency response plan was initiated according to Mobilization Level III. Patrollers were dispatched to their assigned patrol routes to inspect for damage to District facilities. Reports on the status of feeders, pipelines, treatment plants, reservoirs, aqueduct system, power plants and pump plants were transmitted to the Plant Operator and the Eagle Rock Operations Control Center (OCC). The reports were then relayed from the OCC to the Emergency Operations Center (EOC). Major damage in the distribution system occurred in the Valley Branch, which is located in the northwest end of Los Angeles County.

The headquarters for the Valley Branch is the Joseph Jensen Filtration Plant. Within one hour, plant employees began reporting to work and within two hours, approximately 95% of the plant personnel were on site. Four employees, on duty at the time of the earthquake, checked all control system alarms resulting from the earthquake and loss of electrical power, and reported the status to the OCC.

Although there was substantial earthquake damage to freeways and surface streets Operations, Engineering and other support personnel met at the Jensen plant, in accordance with the ERP, to evaluate damage reports and formulate plans for the repair and recovery process. In some instances, materials, supplies and personnel were delayed several hours due to road closures and resulting traffic congestion. During the assessment process, staff noted that a more severe earthquake could interrupt travel between facilities for several days. Staff concluded that the use of a helicopter for emergency response would facilitate the delivery of equipment and key personnel to the damaged areas, thereby, ensuring the timely repair of District water systems.

Personnel were divided into work groups and schedules were established to provide two 12-hour shifts each day to expedite repairs. Personnel and equipment were borrowed from other branches in Operations and other Divisions to facilitate system recovery. Temporary and permanent repairs were made to critical facilities and the Jensen plant was returned to service within 72 hours. Remaining repair work will be completed during scheduled plant shutdowns.

Over 90% of the Construction Services Branch personnel reported to work at Lake Mathews within one hour after the earthquake. Emergency reports were monitored by office personnel while equipment was readied for mobilization and on site materials were reinventoried for accuracy (i.e. shoring material, lumber, traffic control, etc.). Following a visual assessment by field management personnel, crews were established for around the clock excavation and repairs. The 892 Excavator, D7 Dozer, trucks loaded with 3, 4, and 6 inch submersible pumps, 250 CFM air compressor and a 150-KW generator were transported to Jensen. Equipment and personnel were on site and began work within 6 hours after the earthquake. During the next two days, the Construction Services office coordinated the fabrication, transportation, and when necessary, procurement of materials and supplies needed for system repairs.

Special Services personnel reported to the Weymouth facility to evaluate damage to Special Services shop areas and to prepare material for any needed repairs. Personnel fabricated all pipe sections and plates necessary to repair the 84" influent pipeline and service connections for the East and West Valley feeders. In addition, personnel reported to Jensen to assist in the repair of a hydroelectric power plant, heating and air-conditioning systems, and cracks in concrete structures and pipelines.

Personnel from the Los Angeles, La Verne, Orange County, Riverside, Lake Skinner, and Desert Branches responded to their assigned locations. After reporting, patrollers were dispatched to assess damage. All areas reported no major damage to facilities in their service area. Minor damage was discovered at the Sunset, Commerce Warehouse and Soto Street office facilities.

Inspection of the centralized control equipment revealed the equipment was undamaged and operating properly, except for a failure in the Valley Branch system. The Valley Branch lost telemetering communication to several remote terminal units (RTU) due to flooding in structures. Several turbine generators went into shutdown mode. However, the backup systems efficiently transferred flows to pressure regulating valves. Repairs were made quickly to the centralized control system computer, restoring the Valley Branch control system.

Technical Services personnel reported to the Jensen plant and assisted with damage assessment by taking photos of damaged areas. Information gathered during this period was documented and a report submitted to FEMA for reimbursement.

To facilitate emergency preparedness a detailed list of all emergency response equipment is maintained in the Emergency Response manual. Weekly updates of available heavy equipment, generators and pumps, identified as emergency response equipment, are distributed to various Divisions and Branches throughout the District. Additionally, supplies for emergencies are maintained at various District facilities (i.e. shoring material, cement, lumber, steel, sandbags, sand, gravel, epoxies, and fuel for equipment). Heavy shoring materials such as steel and lumber are maintained at Construction Services (Lake Mathews), Special Services (La Verne), and the Jensen facility.

Following the 1971 Sylmar earthquake a post-earthquake committee was formed with members from the Operations and Engineering divisions. The purpose of the committee was to review, analyze and implement seismic mitigation measures to reduce Metropolitan's vulnerability to earthquakes. Some examples of changes incorporated to

better prepare facilities for seismic events and improve emergency response are:

- Reviewed and incorporated new seismic codes and standards into the District's design standards;
- Established patrol routes at major facilities;
- Strengthened structures, systems and equipment;
- Created an inventory of materials required to facilitate repairs and recovery;
- Remote regulating and monitoring of control structures;
- Installed automatic shutoff valves on chlorine railcars;
- Inspection of all pipelines to identify weak links, in order to respond to these areas.

Modifications made specifically at the Jensen plant to lessen the effects of an earthquake include:

- Relocation of the influent channel;
- Installed 1097 stabilization wells;
- Used engineered backfill;
- Equipment and machinery secured with seismic restraints, where possible;
- Installed remote shut-off valves on chlorine railcars.

Changes in engineering design criteria and the work completed to strengthen District facilities directly contributed to lessening the damaging effects of the 1994 Northridge earthquake.

Operations and Engineering staffs are currently evaluating the impact of the 1994 earthquake and are in the process of introducing additional measures to further reduce Metropolitan's vulnerability to earthquakes. Some of the immediate improvements include:

- Overexcavation of questionable building sites for new facilities at Jensen;
- Evaluation of different expansion joint material;
- Evaluation of the benefit of installing stabilization wells following the 1971 Sylmar earthquake to determine if the wells minimized damage to the main central building;
- Establish a field command center at locations other than plant control rooms.

Dedicated efforts by field management and repair crews, working around the clock, are responsible for the timely restoration of operations at the Jensen plant and Valley Branch facilities. Other accomplishments by staff include:

- Rapid activation of EOC;
- Timely response of field patrollers and other emergency response personnel;
- Establishing work/repair priorities to facilitate restoration of service;
- Inter-divisional coordination was excellent;
- High percentage of personnel reported to work on a holiday;
- Damage reports from the Damage Assessment Teams (DAT) and Engineering were accurate;
- Personnel on duty responded appropriately;
- Work was completed without injuries.

Operations personnel have submitted detailed information on damages sustained and the repair and recovery process, which is provided in Appendix C.

Following are specific findings and recommendations to improve emergency preparedness and response:

Finding	Recommendation
Drawings of facilities are not updated and are not available in the field.	Inventory drawings at local facilities and update as needed.
No local lodging or food service available.	Establish contracts with local vendors to provide lodging and food services for employees responding to an emergency.
Insufficient fuel storage facilities on site to sustain equipment operation.	Purchase Fuel/Lube Truck with storage capacity to maintain equipment and vehicle operation.*
Difficulty in establishing relief shifts because all employees reported to their headquarters as required by the response procedure.	Establish two response teams to report at alternate times.
Information from patrollers was not well documented.	Use pre-prepared earthquake inspection lists.
Metropolitan's ability to mobilize emergency personnel, materials and supplies was impacted by damage to streets, freeways and bridges and resulting traffic congestion.	Evaluate replacing the aging Cessna 210 fixed wing aircraft with a helicopter to facilitate District operations and improve emergency response.
Additional excavation equipment is needed.	Purchase a larger wheel type backhoe.
Difficulty was experienced in mobilizing weld trucks in time to install the new pipe sections.	Purchase 8-pack inverter type welding machine to be powered by District portable generators.*
Reporting area was not clearly identified and work assignments for some emergency response personnel were not well coordinated.	Identify location for field command center and follow established ICS procedures.
Access bridges to piping headers collapsed.	Bridge assembly to remain in the up position except when access to manway is necessary.
Radio channels are not designated for specific functions.	Evaluate the benefit of designating radio channels for specific functions.

* ***Equipment has been purchased.***

CHAPTER 4

ENGINEERING

The Engineering Division's responsibility, with respect to the Emergency Response Plan (ERP) is to aid the Operations Division with operating the Emergency Operations Center (EOC), and in conjunction with the Operations Division, assess the damage to the system and initiate and assist in the recovery process.

The EOC is staffed with key engineering personnel, including the Chief Engineer and two Assistant Chief Engineers. The Engineering Division has seven Damage Assessment Teams (DAT), organized geographically, with ten members on each team. One DAT is assigned to each of the seven regions of Metropolitan's system to assess damage within that region

Depending on the magnitude of the earthquake, DAT members either report automatically or call the Emergency Call Center (ECC) for reporting instructions. If the DATs cannot contact the ECC, they report directly to their pre-designated area. On arrival at their respective sites, the team members report to the Area Superintendent. The teams proceed with the inspection of their designated regions, assess and record the damage, and report the damage to the site Incident Commander, usually the Area Superintendent, and the EOC. After the damage has been assessed and reported, the required engineering personnel, which usually includes DAT members, report to the damaged facilities to begin the recovery phase.

Following the Northridge earthquake, 80% of Valley Branch DAT reported. However, of the total DAT members, 50% reported to their assigned sites. An additional 14% were excused from reporting when they called in for instructions, but would have reported had they been instructed to do so. Of the remaining 36% who did not report for duty, 14% had problems at home or with roads which prevented them from reporting, 13% were unexcused, and the unresponsiveness of 9% was questionable. Some team members, after reporting to their assigned area, were instructed to report to Jensen and assist with the inspections.

Shortly after the earthquake, a Home Inspection Program was established for Metropolitan employees that had experienced structural damage to their homes. A registered structural engineer was designated as the program coordinator. Upon the request of employees, engineers inspected their homes to assess and clarify the damage, and provide an overall sense of security to employees and their families. This program was <u>not</u> intended to replace the official L. A. City Building Department earthquake damage inspection program. Approximately 30 homes were inspected under this program.

Engineering personnel from the Structural, Pipeline and Construction Branches, working two 12-hour shifts, provided around-the-clock technical support to staff involved in the recovery process. The performance of Engineering Division personnel in response to the Northridge earthquake was very good. The following illustrates instances where the Division performed well:

- Adequate Engineering Division staff was available to deal with the required inspections and damage repair design;
- Engineering Division staff reported promptly to their assigned locations;
- Engineering and Operations Division personnel worked well together to find timely, reasonable, logical, and practical solutions for required repairs;
- Staff was empowered to make decisions.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
Some members of the Valley Area DAT were unable to communicate with Jensen or immediately report to the site.	Review the practice of Damage Assessment Team members living close to their reporting site and investigate options available to improve emergency response communications.
Some DATs leaders called the Headquarters' EOC on arrival at their assigned site,which proved to be helpful.	Revise the Emergency Response Plan (ERP) to have DAT leaders call the EOC on arrival at their assigned site.
On site communications between DATs and other emergency response personnel was difficult.	Improve communications of DAT's by expanding the use of portable two-way-radios, cellular telephones and pagers.
DAT members had a difficult time finding each other on arrival at the Jensen Plant.	Designate an Incident Command Center at each site where the Damage Assessment Team will assemble.
Some DAT members were not familiar with sites in their designated areas.	Schedule regular meetings and training exercises with the Damage Assessment Teams and the Area Superintendent at each site.
DAT members from other areas, re-assigned to Jensen, were unfamiliar with alternate routes into the area.	Provide DAT members with maps showing alternate routes to all seven primary sites.

Finding	Recommendation
DAT members were not assigned to keep inspection records or develop historical documents.	Assign a member of each DAT and an alternate to keep inspection records. Develop procedures to ensure that proper inspection records and historical documents are prepared.
The Area superintendent was difficult to contact because he was directing repair efforts at various locations.	Have the Incident Commander, or designee, remain in the command center at all times to direct inspection and repair operations and provide a clear chain of command.
Engineering site drawings are not up to date and are not available for DAT's and Operations Division's inspectors.	Update the sites' record drawings files to include all the latest revisions. Have half-size drawings available for use of DAT's and Operations Division inspectors.
The ERP does not identify Engineering Records personnel.	Revise the ERP to include Engineering Records personnel.

CHAPTER 5

ENVIRONMENTAL COMPLIANCE

The Environmental Compliance Division's (ECD) responsibilities with respect to the Emergency Response Plan (ERP) include: providing technical support on health, safety and environmental requirements to Operations, and other divisions who respond to emergency incidents; providing support at the EOC; conducting environmental assessments; and identifying, evaluating and assessing suspected hazardous materials releases. Other responsibilities include:

- Assessment of potential safety hazards, and identifying required procedures, personal protective equipment, and other controls;
- Coordinate hazardous materials clean-up and remediation efforts;
- Coordinate required verbal or written notifications to necessary Federal, State and/or local agencies;
- Conduct industrial hygiene monitoring.

In addition, ECD is charged with ensuring a safe, healthful work environment for District employees assisting in the recovery process. Following the Northridge earthquake, ECD personnel reported to the Jensen facility and the Sunset EOC. Environmental Branch personnel reported to the Jensen Plant to investigate damages to the chemical tank farms, chemical feed lines and the chlorine unloading dock. The chlorine rail car received damage to the bearing housing. Union Pacific was contacted and necessary inspections and repairs were made. The adjustable bridges used to access the piping headers from the rail car collapsed and chlorine rail cars moved one to two feet from the impact of the earthquake. After this was observed, new railcar wheel chocks were purchased and placed on both the staged and the in-use railcars.

In 1993, the Jensen Plant installed a flexible metal "Monel" hose for chlorine transfer, replacing the previously used copper "pigtail." This change-out was based on a recommendation in the Jensen Risk Management and Prevention Program. Installation of the flexible metal hose may well have contributed to avoiding a chlorine release during the earthquake.

ECD Workplace Health and Safety personnel also reported to the EOC and Jensen. At Jensen, staff coordinated with field personnel to ensure that health and safety requirements were factored into response efforts, including assessing for earthquake damage. Additionally, ECD staff transported the emergency response trailer to the Jensen site, and ensured that sufficient safety equipment was on-hand.

Generally, emergency response personnel conducting inspections of District facilities followed proper safety procedures when responding to the earthquake and repairing damaged facilities. In most instances, established procedures for pipeline entry were followed.

Although response personnel handled most aspects of the repair effort very well, there were some areas of concern, with respect to adherence to safety procedures for

confined spaces and lockout/tagout that were noted. Some employees entered areas without signing in or before appropriate monitoring or lock/blockout was completed, which could have endangered their own personal safety or the safety of others. Employees responded quickly to clean-up debris in the Administration Building at Jensen and at the Sunset facility, but some employees were not aware of the inherent dangers in dry sweeping debris that has asbestos-containing material.

Staff also noted that support personnel arriving at Jensen from other facilities were not familiar with reporting areas, were unsure of specific work assignments, and were not familiar with certain safety procedures related to pipeline entry before inspection. Some staff reporting to the EOC were also unclear as to their duties and responsibilities, and directions to EOC support staff were not clearly communicated.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
Chlorine railcars were not secured, and moved 1-2 feet on tracks.	Install railcar wheel chocks.*
Non-field employees were unfamiliar with established safety procedures.	Provide training for managers, supervisors, and their designated emergency response personnel on applicable safety practices and procedures.
Some breakdowns occurred in communications regarding Jensen work schedules and need for health and safety support.	Establish schedules for work, identify associated hazards and health/safety requirements, and disseminate initial schedule and revisions to ECD designees for coordination of their response efforts.
Safety procedures for lockout/tagout and confined spaces regarding access to hazardous areas were not consistently followed.	Investigate and document "near miss" incidents where safety procedures were not followed, to prevent potential future incidents.
Pipeline repair crews were not equipped with proper equipment at all times.	Ensure equipment crews have the required monitoring, equipment, ventilation, and radio communication equipment for utilization along pipeline routes. Review established safety procedures with inspection and repair crews.
Some employees involved in office and warehouse clean-up efforts were not aware of the potential for debris to be asbestos-containing material.	Distribute periodic reminders and conduct retraining to increase awareness of asbestos requirements and hazards.

* ***Equipment has been purchased.***

CHAPTER 6

PROTECTIVE SERVICES

It is Protective Services' responsibility to provide security for District facilities, employees, visitors, and guests. These responsibilities are provided by Protective Services staff, contract security and public safety agencies. Additionally, when an emergency occurs, staff provides support for the Emergency Operations Center (EOC), and assists in establishing field command posts in the affected area.

Immediately following the Northridge earthquake all available Protective Services special agents responded to their assigned areas and reported to the senior manager on site. Each agent called the Chief Special Agent and gave an initial assessment of security needs. The Chief Special Agent initially reported to Lake Skinner and later to the San Dimas facility. The agent assigned to the Headquarters Section responded to the Sunset facility and assisted in the activation of the EOC. Special agents monitored various assessment activities throughout the District's service areas and made periodic reports to the Chief Special Agent. Security efforts were concentrated in the San Fernando Valley and Los Angeles areas since preliminary reports indicated these areas sustained the most damage.

Contract security officers remained at their posts until relieved, and other officers were posted at the Sunset and Jensen facilities. Additional officers were placed on call and made available for immediate response. The Special Agent assigned to the Headquarters Section continued to support the EOC until a field command center was established at the Jensen filtration plant. Special agents responding to Orange County, La Verne, Riverside, and Lake Skinner Branches remained within their respective areas until it was determined there were no additional security issues. The Special Agent assisted in the transport of personnel, equipment and materials to and from the Jensen Plant area and stationed contract security personnel within the plant and at plant entrances. The Chief Special Agent at the San Dimas facility maintained communications with agents in the primary response areas.

Each Special Agent has a District vehicle equipped with a two-way radio, cellular telephone, and emergency response kit containing food, water, medical/first aid supplies and other materials necessary to sustain the agent in an extended emergency situation. Agents assigned to areas other than Headquarters have 4-wheel drive vehicles that are outfitted with generators and lights, and are equipped to be set up as field command posts.

Agents are responsible for maintaining up-to-date emergency call lists of public safety agencies serving their respective areas. Agents periodically meet with representatives from these agencies to maintain an effective working relationship. Emergency plans,

maps, and plot plans of facilities, hazardous materials storage inventories, access control procedures, and critical District employee notification lists, are shared with fire and police agencies.

Following are specific findings and recommendations to improve emergency preparedness and response:

Finding	Recommendation
Access to District facilities was difficult due to public safety closures of streets and highways, and MWD emergency identification cards were not accepted by some law enforcement agencies.	Meet with state and local agencies to establish an accepted Emergency ID card for emergency response personnel. Provide magnetic placards for District vehicles denoting them as emergency response vehicles. Provide dash-board placards for personnel not assigned District vehicles identifying them as authorized emergency responders.
Agents worked for extended periods without relief.	Establish schedule to provide relief personnel.

CHAPTER 7

INFORMATION SYSTEMS

It is the responsibility of the Information Systems Division with respect to the Emergency Response Plan (ERP) to provide voice, data, and two-way radio communications to support the operational and business needs of the District. Staff also operates and maintains the mainframe computer to provide necessary computer systems to assist in the procurement of business and emergency response supplies and equipment.

When an emergency situation occurs, technical staff facilitate the restoration of communications and computer systems, and designated emergency response personnel report to assigned locations.

Immediately following the earthquake, remote test calls were made to verify the operation of the District's microwave communications system. Communications personnel also inspected remote communications sites to determine the status of the microwave stations. All key locations were undamaged.

Remote test calls were placed to Sunset and Jensen facilities to verify that the ROLM CBX (computerized telephone switching equipment) was operational. Both systems were on emergency generator power due to a loss of commercial power, but were operating efficiently.

Inspection of the two-way radio network was not initiated because there were no problems reported. However, it was later determined the Jensen filtration plant radios were not operating due to the loss of a commercial telephone link connecting Jensen with Mount Lukins. Also, the Jensen radio base station was unplugged to power other equipment. Two-way radio communication in the Jensen area was impacted for approximately 24 hours.

Communications technicians were dispatched to the Sunset and Cal Plaza facilities to inspect the ROLM CBXs. The Cal Plaza CBX was on battery back-up only. Emergency generator power is not currently available at Cal Plaza due to problems regarding venting, which precluded city authorization to operate the system. The batteries are designed to support the system for eight hours; by shutting down non-critical components, battery life was extended until commercial power was restored, approximately nine hours after the earthquake.

Data Center personnel were dispatched to inspect the District's mainframe computer, located on the seventh floor of the Sunset facility. Computer components moved several feet from their installed locations and were repositioned. Mainframe service was not disrupted.

Areas of concern are as follows:

- The on-site radio base station at Jensen is only effective for a short distance due to the height of the antenna;
- The Cal Plaza telephone equipment room air conditioner is not connected to emergency power, and during the power outage the temperature rose critically close to the thermal overload point;
- Emergency Operations Center (EOC) response personnel experienced difficulty using the emergency telephones and no Communications Technician was available to provide assistance;
- Emergency response personnel reported the number of available telephones was inadequate;
- Due to commercial telephone network congestion, many employees were unable to access the Emergency Call Center;
- Many employees are not familiar with using the Emergency Call Center;
- The District is not designated as a high priority customer for essential telephone lines with the local telephone companies;

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
The two-way radio system link to the repeater site on Mt. Lukens was inoperative due to interruption of service on commercial telephone lines.	Expedite installation of the digital microwave system to link the Jensen facility to the District's microwave communications network.
The Jensen on-site radio base station is effective for only a short distance due to the height of the antenna, which is located on the highest point at the facility.	Expedite installation of the digital microwave system.
Power to the on-site radio base station was disconnected in order to power other equipment.	Permanently connect power to the on-site radio base stations.
The Telecommunications Branch emergency call-out roster was not up to date.	Regularly update the emergency call-out roster and distribute to EOC and other appropriate emergency response personnel.
EOC response personnel reported difficulty using the emergency telephones.	Evaluate current system and upgrade or reconfigure as needed. Schedule training and monthly tests of EOC communications systems.

Finding	Recommendation
Emergency response personnel reported the number of telephones available at the Jensen field command center was inadequate.	Install additional telephones in appropriate locations to accommodate emergency response personnel.
Commercial telephone lines are blocked and/or interrupted following an earthquake.	Initiate action, through legal council if necessary, to have the District's essential service lines designated as a Health and Safety priority.
Due to commercial telephone service interruption, key personnel were unable to contact the Emergency Call Center for reporting instructions.	Evaluate alternative methods for emergency response personnel to receive reporting instructions.
Many employees are not aware of, or do not understand the purpose of the Emergency Call Center.	Establish and distribute Emergency Call Center procedures to all employees and post instructions in the OCC and EOC.
A 24-hour Employee Assistance help line was established at Cal Plaza.	Install a dedicated "800" number for the employee assistance help line.
Communications technicians did not report to the EOC.	Assign alternate emergency response personnel to each EOC function.
The EOC essential service telephone system did not function properly.	Regularly schedule inspection and maintenance of the EOC telephones and radios.
Current computer technology is not being used to obtain rapid retrieval of District and member agencies system information.	Develop a software application, using GIS, to store and retrieve reference maps and drawings.
Absence of a facsimile (FAX) machine and personal computer (PC) in the EOC prevents timely distribution of written notifications to appropriate agencies.	Install a FAX machine and PC in the EOC.
Existing data base servers have limited capacity and cannot accommodate the addition of GIS software.	Evaluate feasibility of installing GIS software on District network for access by all divisions.

CHAPTER 8

ADMINISTRATIVE SERVICES

Administrative Services Division's responsibilities under the Emergency Response Plan include four main areas: Central Stores, Fleet Management, Records Services, and Emergency Operations Center (EOC) support. Central Stores is responsible for receiving, warehousing, and distributing Emergency Response Container supplies, District specification materials, and other supplies and equipment. Fleet Management is responsible for coordinating and tracking District pool vehicles, vans, and providing drivers. Records Services is responsible for maintaining, microfilming (drawings only), retrieval and distribution of Engineering drawings, specifications, and documents pertaining to the design and construction of all District facilities, pipelines, reservoirs, etc. EOC support includes: transportation coordination; placement of back-up emergency generator (if needed); resolution of electrical problems; and message courier services.

Within minutes of the earthquake, Central Stores staff reported to the Weymouth warehouse and visually inspected for damage and chemical leaks, verified that communications had not been interrupted and reported the findings to the Weymouth filtration plant Control Room. Staff remained on site awaiting information from the Headquarters EOC regarding the extent of damage, to District facilities. At 10:00 a.m., Operations personnel working at the Jensen Filtration Plant called Central Stores for delivery of materials. Based on the early damage assessment, the Central Stores Manager assigned stores personnel to 12-hour shifts in order to remain open 24 hours a day during the repair effort. All materials and supplies necessary for the repair effort were delivered as needed. Storekeepers were sent to Jensen to help unload, distribute supplies, and inventory what materials and supplies had been removed from the local warehouse. Other responsibilities included the coordination of pick-up and delivery of required equipment and/or supplies from several District warehouse locations. Some areas of concern noted during Central Stores earthquake response included:

- Delivery of materials was often delayed hours due to fire and police personnel refusing District employees access to the entry roads;
- Drivers did not know or have information available regarding alternate routes;
- Purchasing staff are not required to respond following an emergency. Stores personnel procure their own supplies and materials using Local Authority Authorization. Purchasing staff could support central stores employees or field storekeepers by providing necessary vendor information and assisting with procurement;

- Emergency Response Plan communications procedures were not followed, many emergency response personnel are not familiar with defined procedures.

Fleet Management responded to assess service availability of the Headquarters garage and provide additional pool vehicles to the Jensen site. Areas of concern include:

- Delivery of pool vehicles to the impacted area took over five times as long as normal. Damage to freeways created extreme congestion on available roads and highways, and once close to the filtration plant, local fire and police personnel would not allow access to the area;
- An earthquake occurring closer to the Sunset facility could damage the garage or surrounding roadways. If District pool vehicles could not be moved, there are no car rental agreements established for temporary replacement of pool vehicles.

The Office Services Manager was contacted and provided copies of Engineering drawings and documentation pertaining to the affected facilities. This information is required by Engineering prior to beginning any repair effort. Areas of concern include:

- Although the District's system for storage and retrieval of Engineering drawings is effective, it is worth noting the drawings on microfilm are specification (Bidder's) drawings, not "as built" or otherwise known as contractor's drawings. Design for repair work must be based on the "as built" drawings; therefore, all documentation pertaining to the building of a specific site, pipeline, etc. must be retrieved and all changes from the original bid specifications noted;
- The emergency call list does not have a designated "back-up" in the event the Office Services Manager cannot be reached. This could impede the timely repair of damaged facilities.

The Emergency Response Plan designates four Administrative Services' employees to provide Emergency Operations Center (EOC) support. Two of the designated employees reported to the EOC. One employee was not aware that his position was designated as part of the EOC support team and one employee was removed from the response list and a replacement had not been designated. In assessing the division's most recent emergency response the following areas of concern were identified:

- The emergency call lists are not updated on a regular basis. In some instances, employees listed as primary contact or "back-up" have changed jobs, left the company or are deceased;
- Some Emergency Response personnel are not aware of their specific duties following a disaster;
- There was little, if any, communication between EOC management and support team members.

Administrative Services Division has specific responsibilities following a disaster that are not part of the District's formal Emergency Response Plan. These responsibilities include: Facilities Management and Telecommuting.

Facilities Management personnel are responsible for ensuring utilities service and office availability at Headquarters. The Telecommuting Coordinator is responsible for program administration, distribution of pool hardware, expense claims for home office telephone equipment, and employee/manager training.

Recent seismic activity has emphasized the need for the District to expand its Emergency Preparedness Program to include a formal business resumption plan for the recovery of critical business office operations. Under this plan, Administrative Services would be responsible for providing immediate office facilities for key personnel to resume core business functions, such as treasury activities, payroll, accounts payable, procurement and strategic planning by executive staff. In the event business office operations are impacted for an extended period, office facilities could be needed for over 1,000 employees.

Staff responded to the Cal Plaza and Sunset facilities to assess the service availability of the premises. Assessments are not structural, they are for the purpose of confirming the amount of damage to offices and equipment in order to determine if clean-up crews, electricians, etc. are required to make repairs before employees can return to the workplace and adequately perform their job functions. Staff did not inspect the Pasadena facility.

Administrative Services staff, in a joint effort with the Information Systems Division, provided assistance to employees entering the Telecommuting Program as a result of the earthquake. District management eliminated the formal evaluation process for new telecommuters and encouraged employees traveling from the affected areas to arrange with their managers/supervisors, where possible, to work from home. However, employee participation was minimal and may have been impacted by the problems identified below:

- Employee and manager notification of the "emergency policy" was not sent until eleven days after the earthquake;
- Adequate computer hardware and software was not readily available;
- The majority of District managers and employees are not trained or prepared to deal with the "home office" environment.

Following are specific findings and recommendations to improve emergency preparedness and response:

Finding	Recommendation
HDQ's pool vehicles may be inaccessible following a disaster.	Establish emergency agreements with local car rental agencies.
Changes in Los Angeles City building requirements prevented the use of the emergency generator to provide back-up power for District owned equipment located in the Communications room.	Resolve venting problems in order to use the emergency generator at Cal Plaza.
The Telecommuting Program policy was temporarily changed following the earthquake.	Establish formal " Emergency Telecommuting Policy."
District managers and employees are not fully prepared to work effectively from home or satellite offices.	Train managers and employees to work by objectives. Plan "work at home days" often enough for key personnel to become comfortable and productive in a remote office.
It is unknown at the present time how to deal with the collection, storage and distribution of food, clothing, and supplies for District emergency victims.	Establish District policy for the collection, storage and distribution of donations for emergency victims.
Desktop computer equipment is not seismically secure.	Develop an RFP for award of contract to install seismic restraints for desktop computer equipment.
Computer hardware and software was not readily available to allow employees to work productively from their homes.	Procure and maintain an appropriate equipment pool for telecommuting.

CHAPTER 9

WATER QUALITY

It is the responsibility of the Water Quality Division (WQD) with respect to the Emergency Response Plan (ERP) to: assist the Operations Division in evaluating water quality conditions following an emergency, ascertain if all Federal and State water quality regulatory requirements are being met, report pertinent findings to the California Department of Health Services (CDHS), and determine if public notices are necessary.

If required by CDHS, the WQD will coordinate needed system changes and prepare any necessary notifications to the public and member agencies. The WQD may also initiate special sampling and monitoring programs.

Response duties have been outlined for all WQD employees in the District's Emergency Response Plan. The supervisors have reviewed these duties with their staff. Employees who do not have specific field duties have been instructed to call the District's Emergency Call Center for reporting information. All employees with emergency earthquake response assignments must report to their primary or secondary response location, depending on the magnitude of the earthquake.

The WQD Assessment Team emergency personnel are assigned primary and secondary response locations to ensure WQD representation at all essential District facilities including: the Weymouth, Diemer, Mills, Skinner, and Jensen filtration plants, Los Angeles Headquarters, and the La Verne Water Quality Laboratory.

On the morning of the Northridge earthquake, most emergency response personnel immediately reported to their assigned location. Some field response personnel contacted the Emergency Call Center and/or the Emergency Operation Control Center for Reporting instructions. Other personnel were unable to respond due to personal property damage and road closures.

The WQD Emergency Assessment Team evaluates the immediate water quality conditions of affected facilities.

Evaluation of the conditions in the District's system showed no damage to Mills, Skinner, Diemer, Weymouth or the La Verne Water Quality Laboratory. Several WQD personnel reported to the Jensen Filtration Plant to assess water quality conditions. All others were requested to stand by and respond as necessary. District radio communication with the Jensen Filtration Plant was established. To protect against possible water quality degradation in the distribution system, the Jensen plant immediately switched to free chlorine disinfection. Distribution system interconnections made it necessary for

the Weymouth and Diemer plants to also switch to free chlorine, and a letter was immediately faxed to all member agencies regarding the change in disinfectants. Member agencies were closed due to the holiday, and many sub-agencies did not receive the notice until Tuesday.

The observations made and actions taken upon arrival of Water Quality personnel at the Jensen plant included:

- Staff observed the plant had shut down because of a major leak in the influent pipeline;
- Bacteriological samples were collected throughout the Valley Branch distribution system and analyzed at the La Verne Water Quality Laboratory;
- The microbiological results from the samples analyzed indicated no adverse water quality conditions existed within Metropolitans' distribution system;
- The Director of Water Quality contacted CDHS and determined that public notification was not necessary.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
Member and sub-member agencies need immediate accurate information on water quality conditions.	Provide updates on water supply conditions, particularly regarding water quality, on an 800 telephone number for member and sub-member agencies.
Member and sub-member agencies did not have sufficient resources to determine water quality conditions within their systems.	Evaluate the feasibility of establishing a "mutual aid type" program to provide water quality assistance to areas impacted by the earthquake.
WQD personnel were not included in the emergency response assessment team inspections.	Evaluate the inclusion of WQD personnel in the assessment process.

CHAPTER 10

PUBLIC AFFAIRS

The primary responsibility of the Public Affairs Division (PA) following a major disaster is to provide the public with information pertaining to the status of the water supply provided by Metropolitan and the condition of District facilities. Staff also has assigned duties and responsibilities as members of the Emergency Operations Center (EOC) support team.

On January 17, 1994, a PA representative reported to the EOC at the Sunset Building within 45 minutes of the earthquake. Another staff member, a resident of Orange County, reported to the Diemer Plant in Yorba Linda where that County's water agencies have established a local emergency center. This individual remained in contact with the Sunset EOC by telephone until the Orange County operation suspended activities later that morning.

After it was determined that most of the damage to MWD's system occurred in or around the Jensen plant, the Director of PA, who resides near that location, reported immediately to the plant. During the next two days, he maintained contact with the EOC and conducted many media interviews from the damaged area. This allowed Engineering and Operations personnel at the plant to focus on repairing the system without interruptions from the media. PA staff provided around the clock coverage at the EOC, which remained activated for the next two days.

Because the San Fernando Valley-Simi Valley water systems were severely damaged, news media interviews regarding the disruption of water service to these areas preoccupied the time of media staff for the first 24 hours after the earthquake. The first interview given by the PA representative at the EOC that morning was by telephone to NBC network news in its New York studios. This interview was picked up by Cable News Network as part of its earthquake coverage which relayed the interview world-wide. Hundreds of other local, regional, national and international interviews were done with print and electronic media about earthquake-related matters for the next several weeks.

During the recovery process, media interest focused on the manufacturing, transportation and installation of the pipe section required to put the Jensen plant back on line. A member of the media relations unit was dispatched to La Verne where the pipe was being fabricated, and assisted with news coverage there until the pipe sections were transported to Jensen. Once the pipes reached their destination, the Director of PA assisted news media there. Requests for interviews were coordinated from the Cal Plaza Los Angeles Headquarters facility.

During the first 48 hours following the earthquake, staff also prepared and distributed by facsimile, status reports to Directors, Management and Member Agencies. Once repairs to the Jensen influent line were completed, a news release was issued announcing that the plant was back in operation.

The EOC telephone system continues to be a constant source of frustration, and telephone operations should be improved. The instruments are unlike those used during normal business and it takes time to relearn how to use them. There were no telephone technicians available to resolve these problems or help with leaving messages for the public on the 800 number.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
The Public Affairs Division had relocated to Cal Plaza and the EOC is in the Sunset facility. As a result, many of the resources used by this unit were unavailable. Directories and phone numbers needed were at Cal Plaza, where access to offices was prohibited by building security personnel.	Establish a kit containing a directory of media numbers, member agency FAX numbers, directors' FAX numbers and other important information.
The boil water advisory issued by the Department of Water and Power did not clearly identify affected areas.	Offer assistance to the agency issuing the order to help the media better define boundaries of order.

CHAPTER 11

HUMAN RESOURCES

The responsibilities of the Human Resources Division with respect to emergency preparedness and response include: serving on the Emergency Preparedness Task Force, reporting to the Emergency Operations Center (EOC) and acting as the primary liaison with employee bargaining units regarding any changes in emergency policies or procedures affecting District employees.

On the first work day after the earthquake, the Human Resource Systems staff checked all computer systems operated by the division to ensure they were operational and staff could perform needed duties and functions. All computers and systems were operational by 9:00 am. The division has a number of portable computers and printers which can be utilized in the event network systems are damaged, or divisional office space is unavailable for normal business.

The Human Resources Division provided staff assistance to the Employee Earthquake Assistance Center. The primary purpose of the center was to provide a "one stop" center for MWD employees to contact in the event they needed assistance in finding and paying for shelter, restoring their homes to livable conditions, solving commuting and child care problems, and providing support and counseling.

Human Resources staff also assisted in the drafting of new policy to provide emergency paid leave, emergency extended leave, flexible work schedules and an increase in the subsidy for Rideshare participants. Emergency leave policy did not extend to temporary or contract employees.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
Issues arose concerning leaves of absence during this emergency.	Clarify emergency leave policy and inform all employees and management.
Although the Human Resource Systems Section had computer access to the most current addresses and names available to the District, this group was not initially contacted for the information, resulting in delays in contacting employees. Further, the information on file with the District was often found to be outdated.	Annually notify District employees to update their addresses and telephone numbers.
It was difficult to determine exactly which employees were living in the most severely impacted areas.	Develop a computerized system which provides a way to pinpoint the home location of every district employee by specific geographic locations.
Employee information, such as home telephone numbers and addresses are confidential.	Establish a policy that allows designated personnel access to specific employee information during emergency situations.
Many employees were unaware of counseling services available through the District's Employee Assistance Program.	Develop an annual communications program that informs employees about all services available through the Employee Assistance Program.

CHAPTER 12

FINANCE

The Finance Division does not have formal responsibilities designated within the District's Emergency Response Plan. However, the Director of Finance is a member of the District's Emergency Preparedness Management Committee, which oversees the Emergency Preparedness Program.

In response to the Northridge earthquake, the Finance Division established procedures and program changes to facilitate timely cash transactions and emergency leave for employees impacted by the earthquake.

Petty cash on hand at the Jensen Filtration Plant was increased from $3,000 to $10,000 to provide check cashing service to earthquake-affected employees and to pay per-diem expenses for repair crews reporting from other field locations. Petty cash on hand at the Cal Plaza headquarters location was increased from $4,000 to $10,000 to provide check cashing service to earthquake-affected employees working at the headquarters facility.

A special work order was established to charge emergency leave of up to 32 hours for employees who required time off to deal with personal earthquake damage. An additional work order was established for extended earthquake leave for employees who had used their emergency leave and needed additional time off for earthquake damage, but did not have annual or sick leave available. No costs have been charged to this work order.

The Finance Division is considering new procedures to improve preparedness to manage potential financial problems resulting from future disasters.

Currently emergency payroll procedures involve maintaining a back-up tape of the previous payroll cycle off site to operate payroll deposits. However, this procedure would only be effective for those employees participating in the automatic payroll deposit program.

Following the earthquake, numerous offers of large cash donations were received to assist earthquake victims. Policy has not been established to administer donations, therefore, personnel recommended cash donations be forwarded to the Red Cross; other offers of assistance were declined.

Following are specific findings and recommendations to improve emergency preparedness and response.

Finding	Recommendation
During a major disaster the District could lose communications with banks and other investment agents and be unable to direct the reinvestment of its funds.	Finalize arrangements with the Bank of America to provide for automatic reinvestment of District funds should the Treasurer be unable to communicate investment instructions.
A major disaster could cause an outage of the District's payroll system.	Develop an emergency payroll procedure to ensure employees are paid if the payroll system fails.
The District's draft system is limited to issuance of drafts not exceeding $500.	Establish emergency policy authorizing designated employees to issue drafts in excess of the current $500 limit.
Following a disaster, key Finance personnel may be unable to travel to the headquarters building to conduct critical financial business.	Designate key personnel to report to alternate locations to ensure continuity of the District's critical financial operations.
The District's check-writing system was recently converted to an electronic laser-printed system and stock of blank checks was eliminated.	Store blank check stock off-site so that checks can be prepared manually, if needed.
Not all District employees participate in the automatic payroll deposit program.	Market program to increase employee participation.
There are currently no policies and procedures to accept cash donations made by outside agencies and employees.	Establish procedures for the acceptance and distribution of cash donations offered for employee assistance and repairs.
Standard limits for petty cash are insufficient following a disaster.	Increase petty cash limits at facilities impacted by an emergency while in the recovery phase.*

* ***Completed***

CHAPTER 13

PLANNING

The Planning Division does not have a direct response role in Metropolitan's Emergency Response Plan. However, the Planning Division does participate in emergency preparedness through long range planning and coordination with member agencies for the development of contingency plans for alternate water supplies and emergency water allocation to member agencies.

Following the Northridge earthquake the Planning Division staff assisted in the recovery efforts by:

- Making preliminary inspections for structural damage to the residences of Metropolitan employees;
- Consulting, assisting, and reporting at the Emergency Team meetings relative to Federal Emergency Management Agency (FEMA) assistance;
- Volunteering to help with mapping and analysis at the State and Federal Disaster Field Office (DFO);
- Using the Geographic Information System (GIS) to prepare a map showing the location of Metropolitan employee residences in the earthquake area.

As compensation for the four days assistance at the DFO, staff was given access to earthquake-related data belonging to State and Federal agencies. Using this data, maps were produced showing Modified Mercalli Intensities and earthquake epicenters superimposed on Metropolitan's facilities in the western portion of the distribution system. These maps together with the employee-residence map were presented to the Engineering and Operations Committee of the Board of Directors.

One application for which GIS is especially well suited is transportation routing for critical response personnel. Many agencies are currently using this technology (911, law enforcement, fire, and ambulance). With GIS, an emergency dispatch operator can use geocoding to enter an address, determine who should respond, and route emergency vehicles and personnel to the address. The available transportation network includes surface streets, freeways, and public transit (rail and bus). GIS can analyze these networks for breaks and bottlenecks and determine the optimum route and transportation type(s) between two points. To date, Metropolitan has purchased the Thomas Brothers transportation network for only three of the counties (Los Angeles, Orange, and Ventura) within our service area.

A related area of application is an analysis of the proximity of employee's residences and their worksites. This information could be used to create emergency ridesharing and van pools as well as pooling and routing of personnel in emergency vehicles.

Additional GIS data layers are needed to permit continued improvement and expansion of Metropolitan's mapping and analysis capabilities. Such layers include an expanded street network, public transportation networks, additional detail on Metropolitan facilities, more and improved seismic-related information, and such other data as available from our peer agencies.

Metropolitan's emergency water supply planning has been predicated on a major seismic event on the San Andreas fault. The District's goal has been to have sufficient supplemental water supplies available south of the San Andreas fault to meet 75% of normal demands for the six month period it could take to repair the damaged aqueducts. The remaining 25% would be offset by mandatory reductions in water use. Critical to Metropolitan's planning is that local groundwater will continue full production during the emergency. Supplemental water would then be provided by Metropolitan through surface storage or additional groundwater storage to meet 75% of normal demands.

When completed and filled, Metropolitan's Domenigoni Valley Reservoir will provide an additional 800,000 acre-feet of surface water storage located south of the San Andreas fault. Approximately one half or 400,000 acre-feet of the reservoir's total capacity could be reserved for emergency supply.

The Northridge earthquake demonstrated that Metropolitan's and the member agencies' distribution systems are vulnerable to seismic events along numerous faults that run throughout the service area. Damage from these earthquakes would be more localized, leaving the major aqueducts intact. Emergency supply planning for these events should focus more on providing alternate sources of water for these local areas. Alternate sources of water could include interconnections with other water agencies so water could be wheeled through a neighboring agency's system in an emergency. It could include additional or redundant groundwater production capacity to make up for lost imported supplies to the local area in an emergency. Or it could include redundant or looped distribution systems that provide more than one "source" of water to an area.

The Integrated Resources Planning process recognized the importance of additional groundwater storage in meeting the region's supply reliability goal. The Strategic Assembly set minimum resource goals of an additional 300,000 acre-feet per year of production and 1,000,000 acre-feet of storage volume. To meet these goals, Metropolitan is aggressively pursuing additional groundwater storage in the service area. New facilities may be required to achieve the additional groundwater production and may include local system interconnections and new wells. The additional production would increase both water supply and system reliability.

Metropolitan is also pursuing other pipeline projects to increase supply reliability in the region. Projects such as the West Valley project would increase system, as well as supply reliability, for Ventura and West Los Angeles counties.

Following is a specific finding and recommendation to improve emergency preparedness and response.

Finding	Recommendation
Many additional GIS data layers are needed so that Metropolitan can continue to improve and expand mapping and analysis capabilities.	Continue to develop GIS data layers with specific emphasis on purchasing and installing transportation network overlays for Riverside, San Bernardino, and San Diego Counties.

CHAPTER 14

BUSINESS RESUMPTION PLAN

Business resumption planning has been a part of Metropolitan's strategy since its first facilities opened in the 1940's. However, the focus of business resumption has been on water operations and delivery, and not the recovery of critical business office functions.

Scientists unanimously agree on the inevitability of future major earthquakes in Southern California. Recent increased seismic activity on the Sylmar, Sierra Madre, Landers, and Northridge faults has emphasized the necessity for a formal business resumption plan for its office facilities. Because of the increasing threat of earthquakes, the District developed a formalized Emergency Response Plan for the resumption of water delivery after a disaster affects its service area, (e.g., earthquake, fire, flood, bomb threat).

The consolidation of headquarters office facilities has increased the need for the development and maintenance of a resumption plan for its critical functions. Immediately after the Northridge earthquake, the Cal Plaza facility, which on January 17 housed 838 District employees, was without power for nine hours. Due to the holiday, the impact on the District's Headquarters operations was minimal. However, alternate work locations for Headquarters employees were not pre-designated, which would have presented a problem if the damages had been severe enough to limit access to the building for an extended period of time. Since the earthquake, 208 additional employees have been relocated to the Cal Plaza facility.

The District has been fortunate that neither the Northridge earthquake, nor any other major disaster in the Southern California area, significantly disrupted the normal business operations of its office facilities. If the Northridge earthquake had disrupted normal office functions for an extended period, ad hoc procedures and policies would have been utilized to resume critical functions. Operating without policies and procedures that provide for recovery operations places the District at risk.

Development of a formal Business Resumption Plan (BRP) has been delayed for two years due to personnel and budget constraints. Recent seismic activity and a reaffirmation from management has resulted in a realigning of staff and approval of funding to address this critical need. Funds have been requested, under Professional Services, in the 1994-1995 budget to continue the development of the BRP. In order to be effective, the Plan will be a living document, requiring updates and revisions to stay current with Metropolitan's strategic planning. Responsibility for maintenance and administration of the Plan is assigned to the Emergency Preparedness section. Staffing requirements for maintaining the Plan have not been determined.

The proposed business resumption plan will establish comprehensive policies and procedures to address the resumption of business operations after a disaster, outline standard guidelines to ensure that each department and division establishes non-conflicting business resumption procedures, and address the District's critical office functions and supporting resources necessary to resume business activities after a disaster. The Plan will address three levels of business recovery:

- Immediate - 72-hours;
- Short-range - Four days to four weeks;
- Extended - 30 days or longer.

Failure to develop a comprehensive Business Resumption Plan could hinder recovery of critical business functions after a disaster, or at the very least, delay an efficient recovery.

Following is a specific finding and recommendation to improve emergency preparedness and response.

Finding	Recommendation
The District has not established a formal Business Resumption Plan for critical office operations.	Develop and implement a formal Business Resumption Plan for critical office operations.

CHAPTER 15

LEGAL

The Legal Department's responsibilities with respect to the Emergency Preparedness Program include: providing legal advise and counsel; serving on the emergency support team; and serving on the Emergency Preparedness Management Committee and Task Force.

Following a major disaster Legal counsels executive staff on a wide range of issues, including:

- The General Manager's authority in time of emergency;
- Contracting issues;
- Federal and State Labor Laws;
- Interpretation of MOUs;
- Human Resources issues;
- Interpretation and advice regarding MWD's Administrative Code and internal emergency operating procedures;
- Ensure that emergency policies and/or procedures meet statutory and regulatory requirements.

Shortly after the Northridge earthquake the General Counsel reported to the Jensen Plant in order to assist in the initial damage assessment and to provide legal assistance. Other members of staff attended the emergency team meetings held in the days following the earthquake to advise on a variety of legal issues arising from the District's response and recovery efforts. In the meetings, many issues regarding employee assistance were discussed and emergency policy established. Of particular concern was child care and the District's liability regarding children in the work place.

By participating and providing input on financial, human resource and liability issues the Legal staff assisted in Metropolitan's recovery process.

CHAPTER 16

INTERAGENCY COORDINATION

To ensure that Metropolitan Water District (MWD) provides its Southern California service area with reliable supplies of high quality water following a major disaster, it is necessary to maintain a viable emergency preparedness program that meets the needs of Metropolitan and its 27 member agencies.

Metropolitan has had an informal mutual aid understanding with its member agencies since 1941. This informal understanding has generally been a mutually beneficial arrangement. During the past 53 years, mutual aid has been provided among member agencies whenever needed, and associated costs were only considered after the need for aid had passed.

The informal relationship was enhanced by the Member Agency Response System (MARS) indemnification agreement in 1983. The MARS provides two-way radio communication among member agencies during an emergency. The MARS agreement established general ground rules for providing mutual aid among member agencies. Two agencies, Santa Monica and Pasadena, are not signatories, but are in general accord with the provisions of the agreement and like the signatories may provide materials, equipment, and personnel assistance in disaster situations. Metropolitan maintains the MARS Radio Operators Manual and Directory which is provided to all member agencies. The manual contains transmitting and operating procedures, member agency telephone numbers, radio call signs, emergency call lists and a copy of the indemnification agreement. Communication with member agencies can be a problem during emergencies and MARS was implemented to mitigate that concern. Minimal information was broadcast to member agencies, through, MARS following the earthquake.

When the MARS organization was formed, a primary purpose was to facilitate the flow of information and coordinate distribution of equipment and manpower within Metropolitan's service area in the event of a disaster. At the time of the Northridge earthquake, no drills or exercises had been scheduled or conducted with member agencies. Metropolitan's Strategic Plan mandates that beginning in June 1993, drills and emergency exercises would be conducted among its member agencies. However, a lack of resources has prevented District staff from scheduling the drills/exercises.

Following the Northridge earthquake, MWD immediately implemented emergency response procedures. After receiving reports from the Damage Assessment Teams and Patrollers, Emergency Operations Center (EOC) personnel broadcast the status of Metropolitan's system to member agencies over the MARS radio network. The procedures for broadcasting general information do not require member agencies to activate

their radios and/or verify that information was received. Therefore, Metropolitan is unaware of which agencies have received notification or if an agency is in need of assistance. Some agencies did not activate their radio and many stopped monitoring the broadcasts after receiving early damage reports. As a result, many of the member agencies and sub-agencies did not receive information on where assistance was needed, water quality conditions, status of Metropolitan's recovery process and closure of the Sunset EOC.

Metropolitan was advised that the Los Angeles City Department of Water and Power (DWP) sustained substantial damage to its San Fernando Valley water system during the earthquake. In response to these problems, MWD dispatched water, utility and weld trucks, and personnel needed for assistance. Metropolitan continued this support for several days until DWP systems were restored. Although this form of assistance has been provided on many occasions over the years, the widespread damage resulting from the Northridge earthquake has increased mutual aid awareness, and the need for more formal agreements is of greater concern.

The EOC's coordination of emergency response efforts between District facilities and member agencies has been generally successful. Although MWD's response to the earthquake was considered to be timely and effective, several areas involving interagency coordination were identified as needing improvement. Debriefing meetings were held for all member agencies following the earthquake and it was the consensus of agencies attending, that Metropolitan should take a lead role in coordinating emergency response activities among the agencies. This role would include: the study of alternative emergency communications methods; revision of existing procedures; development of a generic emergency response plan that could be tailored to member agency needs; establishment of formal Mutual Aid Agreements; and regular scheduling of drills and exercises. Additionally, a number of other concerns were raised and requests made which include:

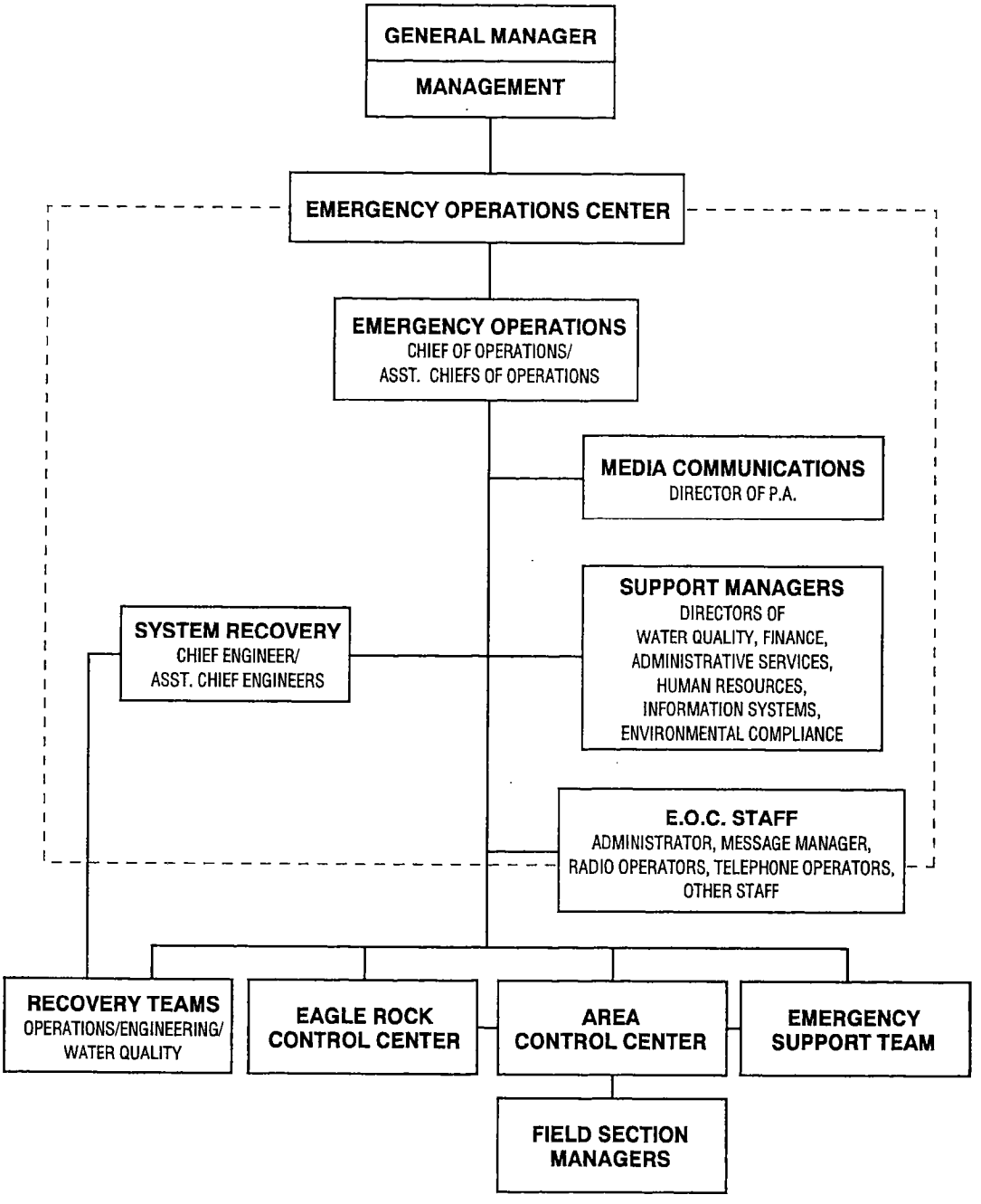
- The impact of Senate Bill 1841 which requires adoption of a Standardized Emergency Management Systems (SEMS);
- A need for detailed information on emergency water allocation;
- Development of an inventory for emergency response supplies and equipment for use by all member agencies;
- The MARS Radio Operators Manual and Directory does not clearly define procedures on using the system and the emergency call lists are out of date;
- MWD's policy on EOC activation should be revised to include all disasters, with the potential of interrupting water delivery, within Metropolitan's service area;
- Establish formal policy stating that debriefing meetings will be held with member agencies following a disaster;
- The MARS Steering Committee has been inactive for over two years;
- Broadcasts over the MARS system regarding damage and system status were infrequent;
- The absence of a recognized emergency ID card presented problems for all agencies in crossing police lines when attempting to respond to damaged facilities; and
- Emergency response information is not disseminated on a regular basis throughout the year.

Following are specific findings and recommendations to improve emergency preparedness and response:

Finding	Recommendation
Two member agencies are not signatories to the MARS agreement.	Meet with agencies to discuss signing of MARS agreement.
Some member agencies turned off their MARS radios once they determined their service area and the Metropolitan plants serving them were not adversely affected by the earthquake.	Advise member agencies to maintain radio contact with MWD's EOC, until they inform EOC staff they are signing off.
Some member agencies have not developed emergency response plans.	Assist member agencies to develop a general emergency response plan that conforms to SEMS and meets member agency needs.
MARS Steering Committee has not held meetings for over two years.	Re-establish MARS Steering Committee and schedule regular meetings.
Metropolitan's policy on activation of its EOC does not meet the needs of member agencies.	Review and evaluate Metropolitan's policy on activation of its EOC when a disaster occurs withing its service area that has the potential of interrupting water delivery.
The District has not assumed a leadership role in coordinating emergency response activities between Metropolitan and its member agencies.	Establish a Member Agency Coordinator function. Schedule meetings with member agencies on a regular basis to discuss emergency response activities, issues, problems, and planning of drills and exercises, as specified in Metropolitan's Strategic Plan.
The MARS system was under-utilized. Communication between the District and its member agencies was limited to initial broadcasting of damages to the District's water delivery system.	Revise and update MARS manual to meet Metropolitan's and member agency needs, including the requirement of regular broadcasts after an emergency.
Some member agencies are not familiar with the procedures contained in the MARS manual.	Provide training as needed.

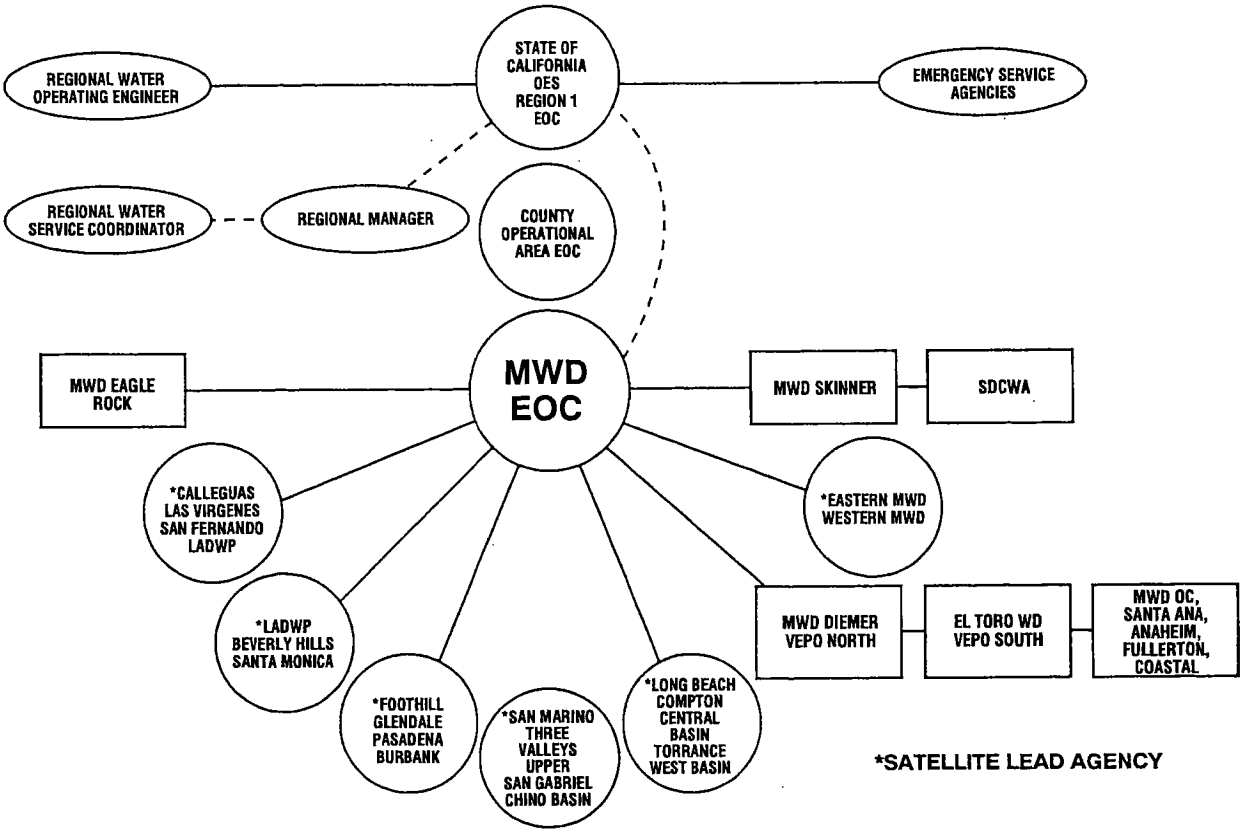
APPENDIX A

METROPOLITAN WATER DISTRICT EMERGENCY RESPONSE ORGANIZATION



APPENDIX B

MEMBER AGENCY RESPONSE SYSTEM (MARS) COMMUNICATIONS CHART



The MARS organization is divided into geographical satellite areas. The satellite lead agency is assigned to coordinate mutual aid within its geographical area. When mutual aid requirements extend beyond the capability of the MARS participants within a satellite area, the lead agency communicates the situation to the MARS operator at Metropolitan's EOC.

MARS operates on two radio frequency assignments and is used only in an emergency and during periodic radio testing. There are two mountain top radio repeaters located on Pleasants Peak and Saddle Peak, a main control base station located at Metropolitan's Sunset EOC, and one or more portable control base stations for each participating member agency.

All agencies, except Las Virgines MWD and San Diego County Water Authority (SDCWA), operate on frequency 1 (F1). Due to topographical interference Las Virgines MWD operates on frequency 2 (F2), and SDCWA relays its radio transmissions through Metropolitan's Control Center at Lake Skinner.

APPENDIX C

DAMAGE ASSESSMENT AND REPAIR

The Northridge earthquake caused extensive damage to Valley Branch facilities located in the San Fernando Valley area. This assessment was compiled by staff directly involved in the recovery process. It includes identified damage and details on the repair and recovery process.

A list of earthquake damage work is on file, and repairs will continue until all work is completed. Completion of some of the work will require shutdown of the Jensen plant. The work will be performed during scheduled shutdowns for the plant expansion contractor, and as sections of the plant can be removed from service.

Response to the earthquake by District personnel was exceptional. Dedicated efforts by the repair crews are responsible for restoring the facilities within 72 hours after the earthquake.

Inspection of facilities was accomplished by damage assessment teams consisting of two engineers and one photographer. All damage was logged and photographed to establish permanent records.

The following is a list of areas that sustained damage:

JENSEN PLANT

- Cracks in asphalt and concrete;
- Office and storage areas had bookcases and storage bins turned over;
- Office ceiling tiles fell;
- Break in 84-inch influent pipeline, leaks in box section of influent conduit, and leaks in influent channel;
- Platform to chlorine rail cars damaged;
- Dresser couplings damaged at washwater tank and backwash line, filter building No. 1;
- Tank #33 shifted;
- Fissure cracks and earth movement near main electrical power center;
- Electrical conduit loose;
- Flocculator baffle boards damaged;
- Leaks in settling basin #3;
- Break in influent chlorine solution line;
- Erosion of slopes near LA-35T service connection;
- Broken chemical feed lines;
- Metal covers for the electrical bus-bars loose;
- Damage to railcar delivery spur track.

Finished Water Reservoir

- Corrugated baffle boards fell;
- Cracks along recessed drain trench;
- Cracks in the effluent channel.

Pressure Control Structures, Hydroelectric Power Plants, and Pipelines

- Flooded structure on West Valley Feeder #1 (W.V. #1);
- Electrical motors in W.V. #1 structure;
- Centralized control equipment on W.V. #1;
- Air release and vacuum valve on W.V. #1;
- Victualic coupling on W.V. #1;
- Breaks in pipeline on W.V. #1;
- Damaged air release & vacuum valves on W.V. #2;
- Breaks in pipeline on East Valley Feeder;
- Flooded structure on East Valley Feeder;
- Electrical motor in East Valley Structure;
- LA-25 Service Connection;
- LA-35T Service Connection;
- Insulator on A-phase at Foothill power plant;
- Magazine Canyon Tunnel Liner;
- Rail on bridge crane at Sepulveda Pressure Control Structure.

Other District Facilities

The Sunset, Commerce and Soto Street facilities sustained minor damage, the repair of which included:

- Asbestos removal;
- Architectural repairs;
- Repair of minor water damage.

Description of Damage and Repair at the Jensen Plant

General Site

There are settlement and cracks in the asphalt and concrete throughout the plant. Repairs will consist of removal of damaged asphalt and concrete, compacting of the subgrade, and placement of new asphalt and concrete. This project is being deferred until the plant expansion contractor completes his work ***(Figures 1-4)***.

Office Area

There was extensive damage to the office areas in the main building and service center. Ceiling tile fell, bookcases and file cabinets toppled over, and some computer equipment was damaged. Glass and frame were broken in the lobby of the main building ***(Figures 5 & 6)***.

Influent Conduit Repair

Division personnel from Engineering and Operations inspected the 50 gpm leak at the Jensen plant influent venturi. It was determined the pipeline had to be excavated before the full extent of damage could be determined. A survey crew established alignment of the two influent pipelines.

The Construction Branch was given responsibility for repairing the damaged influent pipeline. A schedule was developed to support continuous work using 12-hour shifts. On January 17, 1994, at approximately 10:00 a.m., excavation to expose the influent venturi lines began. Excavation of this area was performed jointly using District and contract personnel. The area where the leak on the influent pipeline originated was exposed on January 17, 1994 at approximately 10:00 p.m. *(Figures 7 & 8)*. The damaged pipe was inspected internally and from the excavated area. Upon completion of the inspection, a recommendation was made to have a section of pipe fabricated at La Verne Special Services. Excavation of the pipeline allowed removal of a 10-foot section of pipe.

On January 19, 1994, at approximately 4:00 p.m., the fabricated section of pipe was delivered to the job site at Jensen plant. Time required to fabricate two 5-foot long sections of pipe was approximately 14 hours *(Figures 9 - 12)*. Installation of the pipe began immediately using two welding crews. The welding operation continued around-the-clock, with emphasis placed on completing internal welding so the pipeline could be released for filling. The remaining welding on the external pipe was completed while the pipeline was being filled. The welding operation was completed on January 20, 1994, at approximately 9:00 p.m.

Gunite was placed on the external surface of the pipe to protect the metal. Backfill was placed around the pipe up to springline using concrete sand slurry. The excavated area was left open to allow personnel to inspect the pipe for further leakage that might develop due to aftershocks from the earthquake.

Leakage from the box section of the influent conduit was approximately 1 cfs. There were cracks along the top of the bulkhead and along both sides of the influent channel for a distance of approximately 80 feet. Because leakage in this area was minimal, plans for repair focused on injection with Hydracure from inside the influent conduit. Hydracure was injected into the box section of the conduit to seal the leaks. Repair work was only partially successful, because there is still leakage of approximately 5 gpm. This area will be excavated and additional repairs performed on the exterior of the conduit.

Chlorine Railcar

The chlorine railcar moved approximately 18 inches in various directions, causing damage to the platform and handrails on the railcar. There were no leaks in the chlorine system as a result of the earthquake. The platform for access to the railcars has been repaired.

Because of the violent movement experienced by the railcar, and the damage to the access ramp, take-up reels have been installed to support the chlorine line. Also, ramps to the chlorine railcars are left in the up position to eliminate the potential for damage to railcars and the access ramp during future earthquakes ***(Figure 13)***.

Tanks

The 1.8-MGD backwash water storage tank at Jensen plant was in service with approximately 1.2-MGD of water. This tank was lifted from its base during the earthquake. Verification of lift is based on finding an extension cord under the tank that previously was along the base of the tank. There was no damage to the tank during the earthquake ***(Figures 14 & 15)***.

There are a total of 10 large chemical tanks in the tank farm area. These tanks are not secured to the concrete foundation. Some tanks had chemicals in them, and others were empty. Only one tank (No. 33) moved on its base. Tank No. 33 is used for storage of caustic soda. It moved approximately three inches eastward on its foundation ***(Figures 16 & 17)***. This tank had 37,279 gallons of chemical at the time of the earthquake. Connecting pipelines to this tank were not damaged. Repair work consisted of disconnecting pipelines to the tank and lifting the tank with a crane to re-position it on its base.

Main Electrical Power Center

Inspection of the electrical power center and attached conduits showed significant movement. Due to its existing condition and the potential for further damage, approval was granted to relocate the power center to a stable area near Module No. 3. This project was assigned to the construction inspection group responsible for plant expansion. Relocation work was started on January 18, 1994, and completed on January 27, 1994. Work consisted of installing conduit, placing concrete, and relocating the main power building and the transformer. Shasta Electric, and various other contractors, including the Department of Water and Power (DWP) were used to perform this work ***(Figures 18 & 19)***.

Settling Basins

Baffle boards were dislodged from fixtures in Basins No. 1, 2 & 4. Loss of these boards caused disruption in the treatment process in the Flocculation area. Boards must be in place to provide resistance to water flowing through the basin. Resistance must be provided for energy to be induced into the water for coagulation to be effective. Repair consists of retrieving boards from basins and reinstalling support columns, and baffle boards ***(Figures 20 & 21)***.

There was leakage from the floor in Basin No. 3. Leaks were repaired using Hydracure and hypalon tape.

Break in Chlorine Line

There was a leak in the influent chlorine solution line. The leak was repaired by excavating the area, and replacing a four foot section of 4-inch PVC pipe.

Erosion of Slope Near LA-35T, Service Connection

There are numerous fissure cracks along the embankment near LA-35T. Repairs consist of backfilling with concrete sand slurry and track rolling with a bulldozer *(Figures 22 & 23).*

Metal Covers for Bus-bars

Metal covers for electrical bus-bars on Basin No. 1. were jarred from fasteners, causing damage to the covers. Covers will be repaired and reinstalled.

Railroad Bridge

Inspection of the railroad bridge revealed several deficiencies. Ballast needs adjustment, rails were not properly supported, and spikes were loose. Engineering conducted a follow-up inspection on January 25, 1994, and recommended that repairs be made by an experienced contractor. Recommended work was completed on January 28, 1994, by J.A. Placek Construction Company.

FINISHED WATER RESERVOIR NO. 1

Panels in Reservoir No. 1

Inspection of the reservoir revealed loss of virtually all corrugated panels used to direct the flow of water through the reservoir. Corrugated sections of baffle boards were removed from the floor of the reservoir, and shipped to a disposal site.

Cracks in Reservoir No. 1

There were cracks adjacent to a recessed drain channel in the floor of the reservoir near the outlet gates. Cracks adjacent to the recessed drain near the outlet gates were repaired using Oakum and Hydracure.

Cracks in Reservoir Effluent Channel

There were numerous cracks in the rectangular section of the effluent channel. Repairs were made on the rectangular channel using Hydracure and stainless steel plates. However, when the effluent channel was pressurized, leakage was substantial. Because of the leakage, the channel was removed from service to make additional repairs and to allow Engineering to examine the conduit for permanent repairs. Engineering determined that the damaged section of conduit must be replaced, due to extensive cracks throughout a 40 - 60 foot section of the channel. Also, three pipe joints were repaired downstream of the outlet gates using speed crete.

DISTRIBUTION SYSTEM

Inspection and Report of Patrol Routes

Patrollers immediately made damage reports to the Area Control Center. Reports received were sent to Eagle Rock, who forwarded them to the EOC. The Supervisor of the Distribution System Operations Group who was in radio contact with patrollers, reported to the damaged sites and summoned repair crews to stop leaks and make repairs. This procedure was very effective, because it allowed the patrollers to continue inspection of their assigned routes.

West Valley Feeder No. 1

- Sectionalizing valve structure was flooded, damaging the centralized control equipment, electrical motors for the valves and the blower;
- An 8-inch victaulic coupling was broken due to water hammer resulting from the earthquake.

On January 17, 1994, two submersible pumps and a generator were used to dewater the sectionalizing valve structure for West Valley Feeder No. 1. The centralized control equipment and electrical motors were used to operate the sectionalizing valves that were damaged. The electrical motor and computer equipment have been removed for repair ***(Figures 24 & 25)***.

Flow sensing lines to the mainline meter for Sepulveda Feeder were severed underground, resulting in removal of the meter from service. New lines will be installed through the manhole shaft.

The sudden surge in the pipeline, on West Valley #1, forced a victaulic blind flange from a pump well connection, causing a stream of water to be discharged approximately 300 feet into the air. Water elevation on West Valley No. 1 was adjusted to reduce flow on the pipeline to allow repair work to be performed on the 8-inch victaulic blind flange. A slip-on flange was welded on the pipe, and a bolt-on blind flange was installed. The feeder was returned to service after repairs were made.

There were two leaks in the section of West Valley No. 1 leased to the Los Angeles Department of Water and Power. One leak was caused by a valve which broke during the earthquake. A new valve was installed and a small structure built to house the valve. The other leak was caused by a circumference break in one section of pipe. The pipe was repaired using a band which was fabricated at La Verne Special Services ***(Figures 26 & 27)***.

West Valley Feeder No. 2

Several structures on the West Valley Feeder No. 2 experienced failures of the air release and vacuum valves which flooded the structures. All were dewatered and the valves isolated. All damaged air release valves were removed and repaired. Upon disassembling the valve, it was discovered that the stainless steel floats in the valves were crushed due to extreme pressure/water hammer ***(Figure 28)***. Repairs to the valves have been completed.

East Valley Feeder

The East Valley Feeder sustained damage in the following locations:

- Sectionalizing valve structure was flooded;
- Break in pipeline at Odessa and Rinaldi;
- Break in pipeline at Woodley and Rinaldi;
- Street asphalt was damaged due to leakage from pipelines.

The sectionalizing valve on the East Valley Feeder was flooded, causing damage to all electrical equipment in the structure, an electrical motor on the sectionalizing valve and the motor for an electrical blower. The structure was dewatered using submersible pumps and a generator, allowing pipeline personnel to enter the structure to reduce the

flow on this feeder. The feeder remained in-service to provide water to member agencies for three days with a leak of approximately 500 gpm. Electrical motors have been removed for repair.

On January 20, 1994, the East Valley Feeder was shut down and dewatered for repair of leaks in the pipeline at Odessa and Rinaldi, and at Woodley and Rinaldi. The pipeline was dewatered using blow-off structures, and submersible pumps to remove water in low areas of the pipeline. The dewatering operation was completed on January 21, 1994, at approximately 11:00 p.m. The pipeline was inspected at each of the sites, and found to have a clean break near the bell and spigot at each location.

After evaluating the location of the break in the pipeline, engineering gave approval to use an internal band with "O" rings to repair the leaks. Repair work was started on January 22, 1994. Use of the internal band was successful at Woodley and Rinaldi. However, the internal band could not be used at Odessa and Rinaldi because the pipe was not uniform. There was a difference in the height of the pipe of approximately two-inches, thus the band could not be properly installed and would not have sealed the damaged area. The damaged pipe joint at Odessa and Rinaldi was repaired using flat stock, as filler material, and welding the seam. Pipe joints at these locations were filled with mortar before the inside band was installed at the leak at Woodley, and after the pipe was welded at Odessa. A concrete encasement will be installed at the aforementioned leak sites.

Refilling of the East Valley Feeder was started on January 23, 1994, at approximately 9:30 a.m. and completed at approximately 3:00 p.m. This pipeline was placed in-service after refilling was complete.

Street asphalt was damaged at the intersection of Woodley and Rinaldi due to leakage from a pipeline. There was a section of asphalt that was undermined, leaving a hole in the street measuring 25' long by 15' wide by 4' deep. On January 22, 1994, the damaged section of asphalt was removed, and the area was repaired using base rock with compaction, after which asphalt was placed and finished with an asphalt roller. Also, some asphalt patch work was performed at Odessa and Woodley.

LA-25 Service Connection

There was extensive damage to ten pipe joints, and to two breaks in the double box section of the pipeline which connects to the transition structure of the service connection. Engineering recommended replacement of mortar in the pipe joints and placement of steel plates in the box section of the conduit. Repair work was started on January 19, 1994, at approximately 10:00 p.m. and completed on January 20, 1994, at approximately 8:00 p.m. Ten pipe joints were repaired with speed crete and two broken/separated areas were repaired in the double box section that attaches to the transition structure using steel plate. The areas behind the plates were pressure grouted to fill the void created when backfill material fell through the cracks ***(Figures 29-32).***

LA-35T Service Connection

Two dresser couplings were dislocated as a result of shifting in the pipe. Engineering recommended welding one dresser coupling to the pipe, and modification of the pipe to realign the dresser coupling at the other location. Repair work was started on January 20, 1994, and completed on January 21, 1994. The dresser coupling in the valve structure was welded solid, and the dresser coupling in Bull Creek was modified with an off-set because the pipe shifted horizontally and vertically during the earthquake.

Foothill Hydroelectric Power Plant and Switchyard

Foothill Hydroelectric Power Plant tripped off-line on January 17, 1994 due to the earthquake. Damage sustained consisted of a broken insulator on A-phase of the transformer. The damaged insulator was repaired by Special Services Hydroelectric Group.

Magazine Canyon

There is a bulge in the steel liner approximately 40 feet long on the north side of the pipe at approximately one-thirty o'clock. The damaged area is approximately 250 feet from the shaft at Magazine Canyon. An as-built was made of the bulge to allow engineering to evaluate the damage and provide a recommendation for repair *(Figures 33 & 34)*.

Sepulveda Pressure Control Structure

There was damage to the track for the bridge crane, and the decorative block on the wall of the valve structure at Sepulveda Pressure Control Structure. The rail for the bridge crane has been replaced. Damage to the decorative block does not affect the integrity of this facility.

DAMAGE TO PLANT EXPANSION WORK

Construction work to expand the Joseph Jensen Filtration Plant was approximately 87% complete when the Northridge Earthquake struck on January 17, 1994. There was damage to expansion facilities, which could be classified as moderate, considering the magnitude of the earthquake. Damage or defects in adjustment of equipment, was caused in the following areas:

- New finish water reservoir lining;
- Overflow weir for the new finish water reservoir;
- Disturbed bearing alignment on horizontal flocculators;
- Alignment problems on sludge thickeners;
- Alignment problems on traveling bridges;
- Five precast concrete weirs for filter beds;
- Damage to three 30-inch butterfly valves.

New Finish Water Reservoir Lining

Approximately 800 linear feet of cracks occurred in the asphalt composition liner. These cracks vary in width and depth. Repair recommendation consists of routing out the cracks to a depth of 2.5-inches, and a width of 1.25-inches, and filling the crack with asphalt sealant.

Overflow Weir for the New Finish Water Reservoir #2

Support columns for the decking over the overflow structure were fractured. Repair work consists of demolishing existing supports, adding rebar, and increasing the size of columns. Also, stainless steel bracing has been installed horizontally across the overflow channel to eliminate loading problems on the exterior walls.

Bearing Alignment on Rotating Equipment

The contractor has been directed to re-check all rotating equipment, because of potential alignment problems. Failure to check and verify correct alignment of this equipment could result in the vendor not honoring the warranty.

Butterfly Valves

Five 30-inch butterfly valves fell from their support stands causing the gear housing to break. Valves will be sent to the vendor for repair/replacement.

General

There was damage to numerous other areas in the plant expansion work. The contractor has been issued change orders to make repairs as determined by the Senior Engineer in charge of the construction project.

APPENDIX D

COST SECTION

The purpose of this section is to identify costs resulting from the Northridge earthquake; recommended equipment and supplies; and project costs for proposed program expansion and improvement. Costs are presented in four categories which include:

- Facility Damage
- Hazard Mitigation;
- Equipment and Supplies;
- Proposed Projects.

FACILITY DAMAGE

Jensen Filtration Plant/Valley Branch Distribution System

Repair of Administration Building and Parking Lot
Relocation of Power Supply Center
Inspection and Repair of Pipelines
Repair on Expansion Project

	Sub Total	$ 5,036,000

Sunset Facility

Asbestos Clean-up;
Repair of Ceiling Tiles, Fixtures, Walls
Water Damage — Reprographics

	Sub Total	$ 60,000

Commerce Warehouse

Architectural Repair
Asbestos Clean-up

	Sub Total	$ 19,400

Soto Street Facility

Asbestos Clean-up

	Sub Total	$ 4,100
	Total	**$ 5,119,500**

HAZARD MITIGATION

Valley Branch

Newhall Tunnel Project

	Sub Total	$ 6,300,000
	Damage and Hazard Mitigation Total	**$ 11,419,500***

* *The majority of costs listed above are eligible for reimbursement from the Federal Emergency Management Agency (FEMA) and the State Office of Emergency Services (OES). A disaster assistance request has been filed; grant approval is pending. Damage and hazard mitigation cost analysis is continuing. The actual reimbursement total to the District may vary depending on the results of ongoing engineering studies.*

RECOMMENDED EQUIPMENT AND SUPPLIES

Wheel Type Back Hoe	$	110,000
Seismic Restraints for Desktop Computer Equipment (includes installation)		100,000
Personal Computer - EOC		4,000
FAX Machine - EOC		1,000
EOC Provisions		4,000
Toll-free 800 Telephone Service		600*
Disposable Cameras		1,200
Emergency Identification Equipment for Vehicles and Emergency Response Personnel		20,000
Fuel/Lube Truck		109,000**
Welding Machine		32,000**
Digital Microwave System		2,000,000***
Total	**$**	**240,800**

* Annual Expense
** Emergency Out-of Budget Purchase (not included in Total)
*** Approved Capital Project (not included in Total)

EMERGENCY PREPAREDNESS/RESPONSE IMPROVEMENT PROJECTS

Review, Revise and Maintain Emergency Response Plans and Programs	$ 75,000*
Expansion of Telecommuting Program	100,000
Equip Field Command Centers	150,000
Establish Back-up EOC (Weymouth)	25,000
Update Facility Engineering Drawings	250,000
Member Agency Coordination, drills/exercises, training and assistance	100,000
DAT Training Program	25,000
17 Miscellaneous Projects (costing less than $5,000)	31,400
Business Resumption Plan	250,000**
Total	**$ 756,400*** **

* Annual Expense

** Funded under 1994-95 Budget (not included in Total)

*** The costs for some the recommendations identified in this report are not included in the total, as they are still being compiled.

Note: Costs shown in this section are estimates only.

FIGURES 1 AND 2

Damaged Concrete

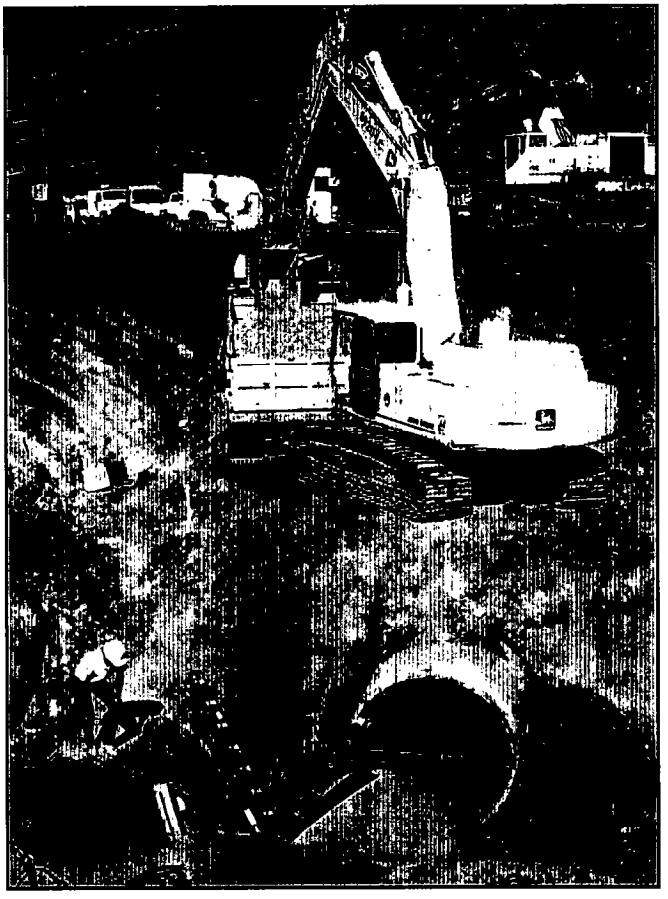
FIGURES 3 AND 4

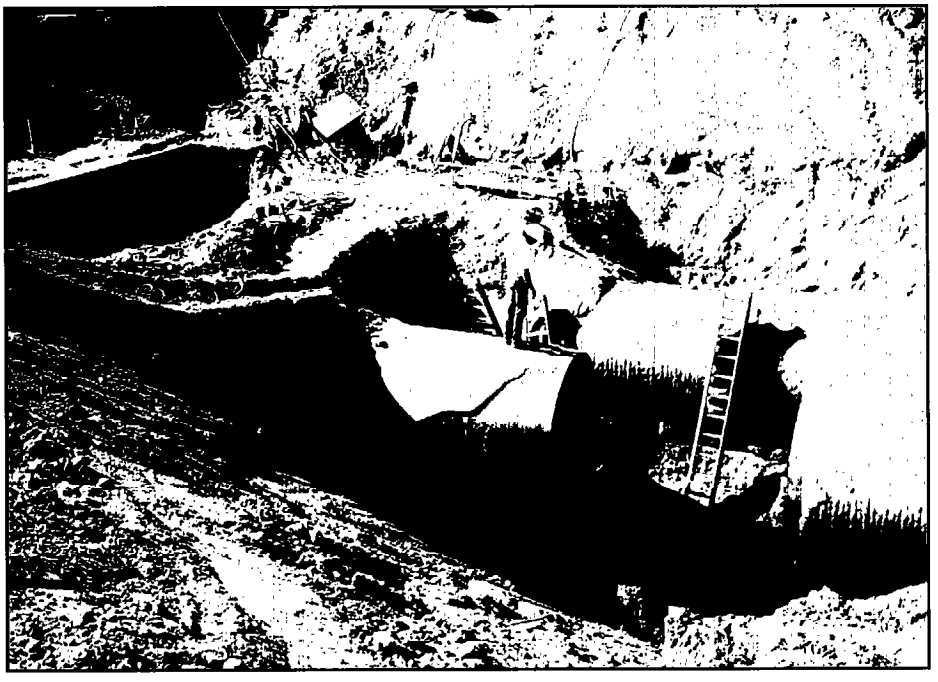
Cracks and separation in asphalt

FIGURES 5 AND 6

Damage to Office Areas

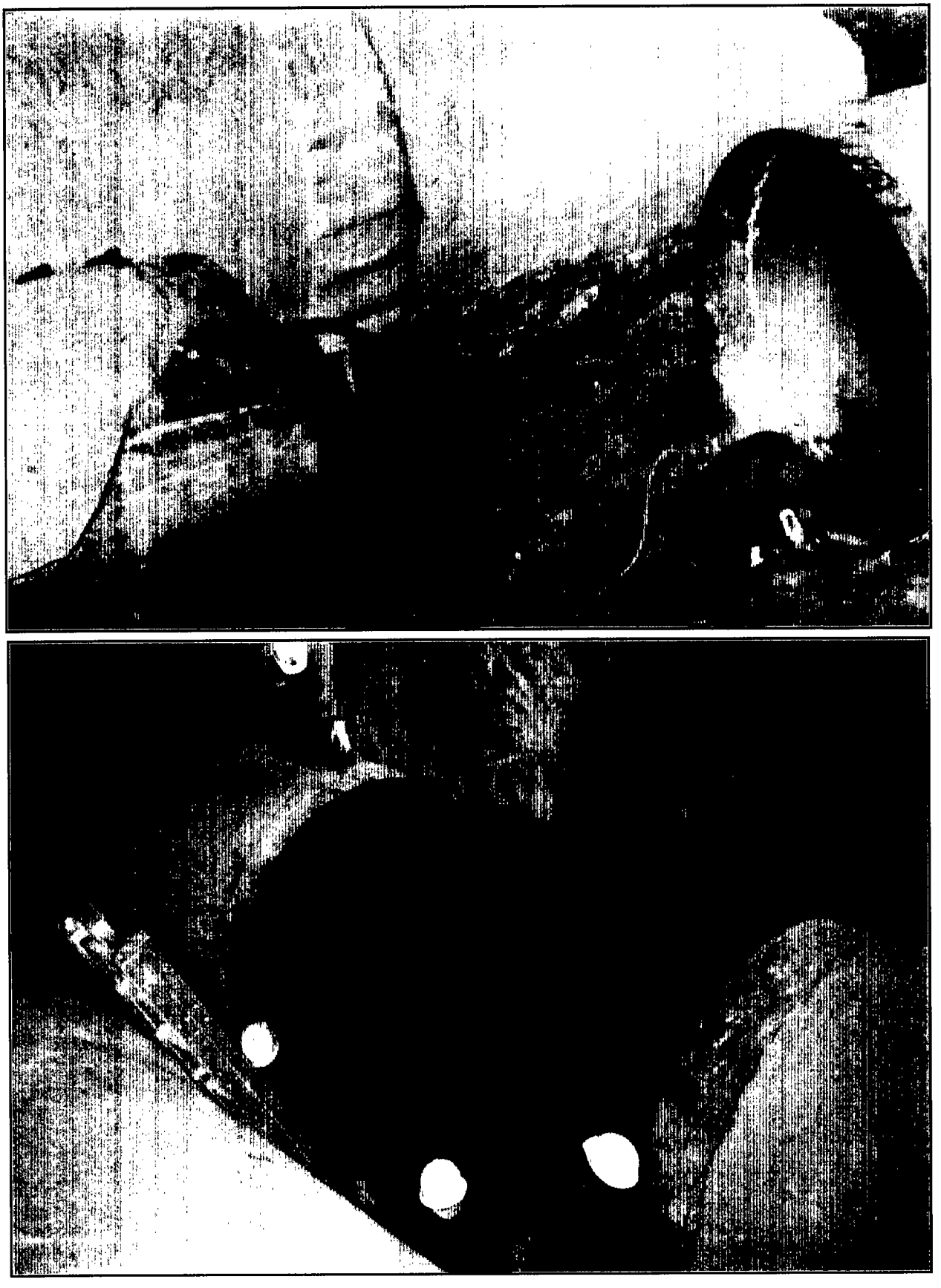
FIGURES 7 AND 8





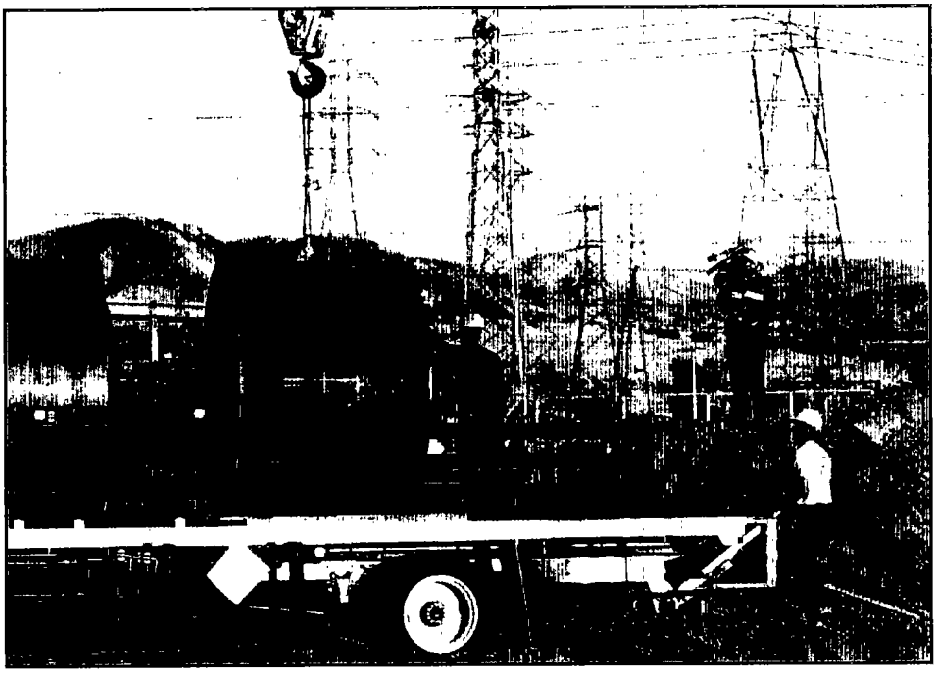
Damaged section of 84-inch influent pipeline removed

FIGURES 9 AND 10



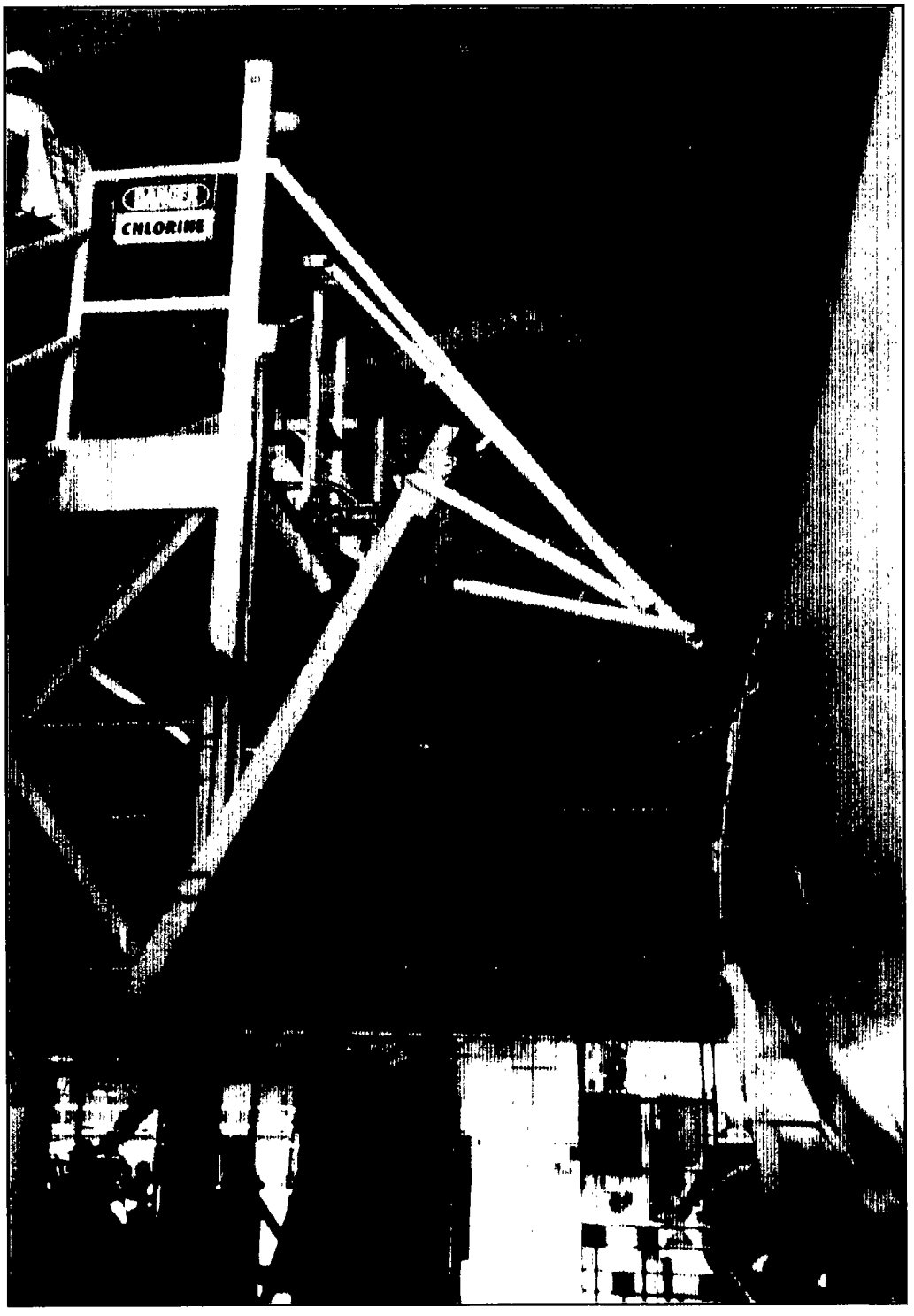
Work in progress to repair 84-inch influent pipeline to Jensen Filtration Plant

FIGURES 11 AND 12



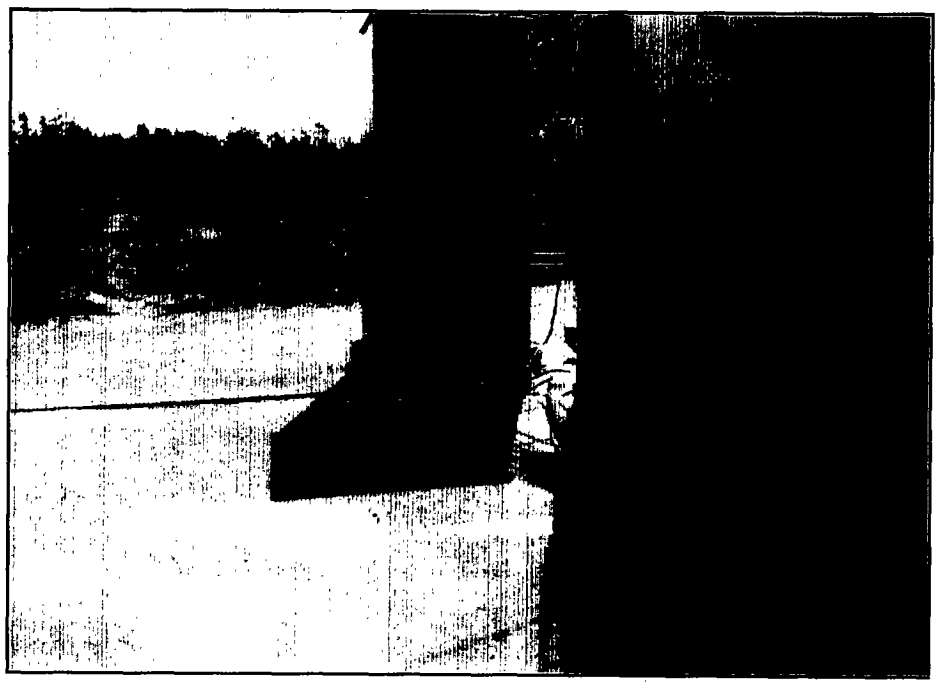
Two five-foot sections of 84-inch pipe

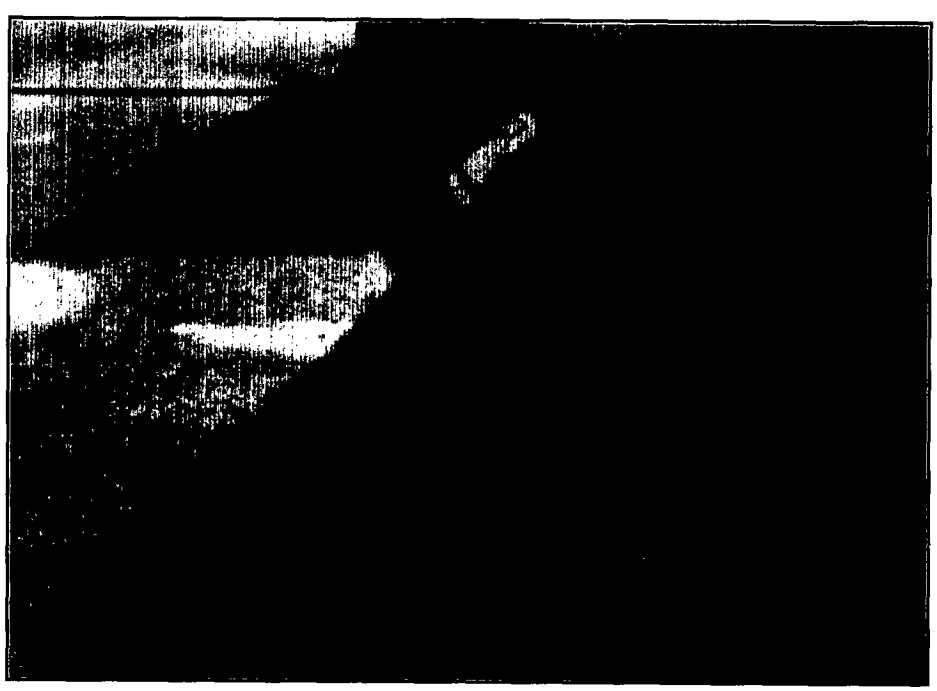
FIGURE 13



Damaged platform at chlorine railroad car

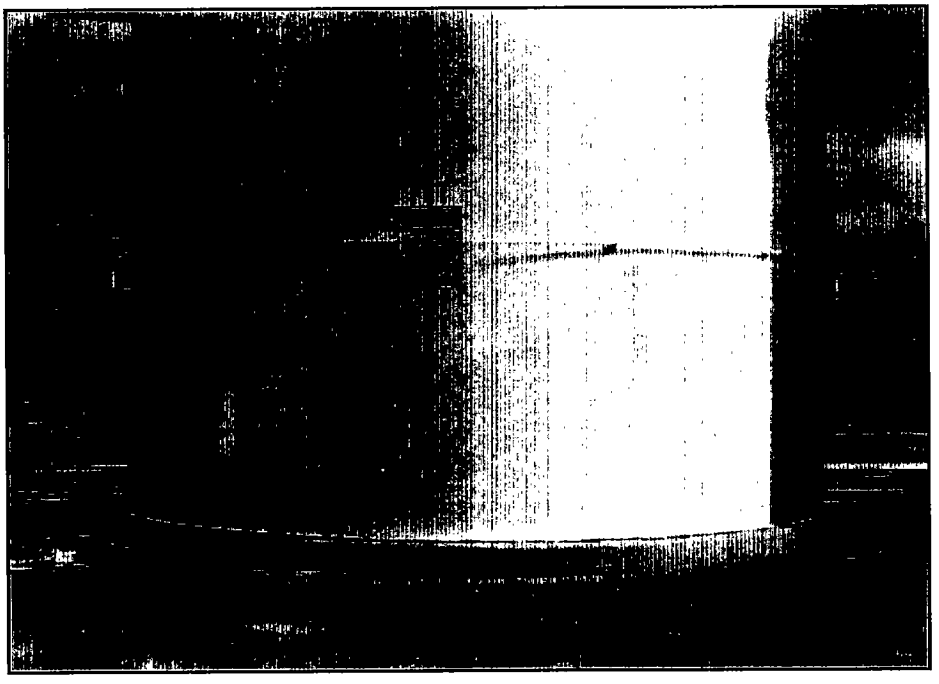
FIGURES 14 AND 15





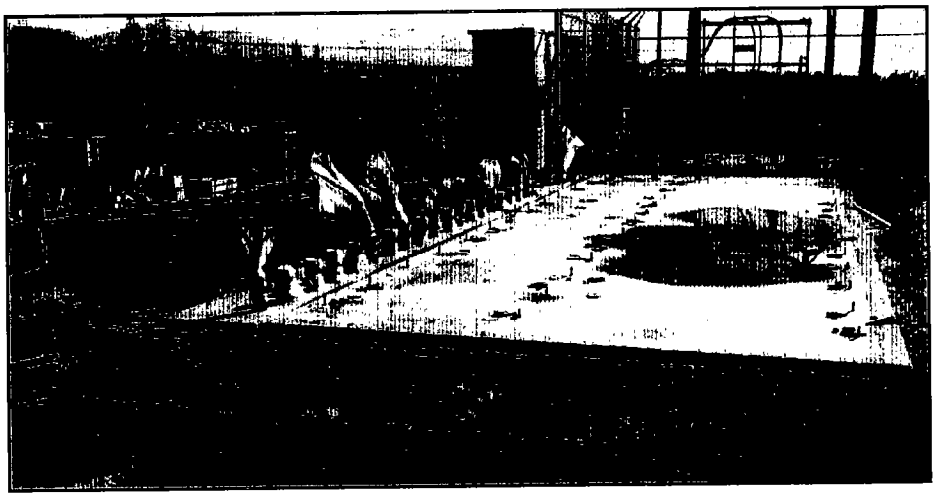
Washwater storage tank (photo shows extension cord under tank)

FIGURES 16 AND 17



Caustic soda tank #33

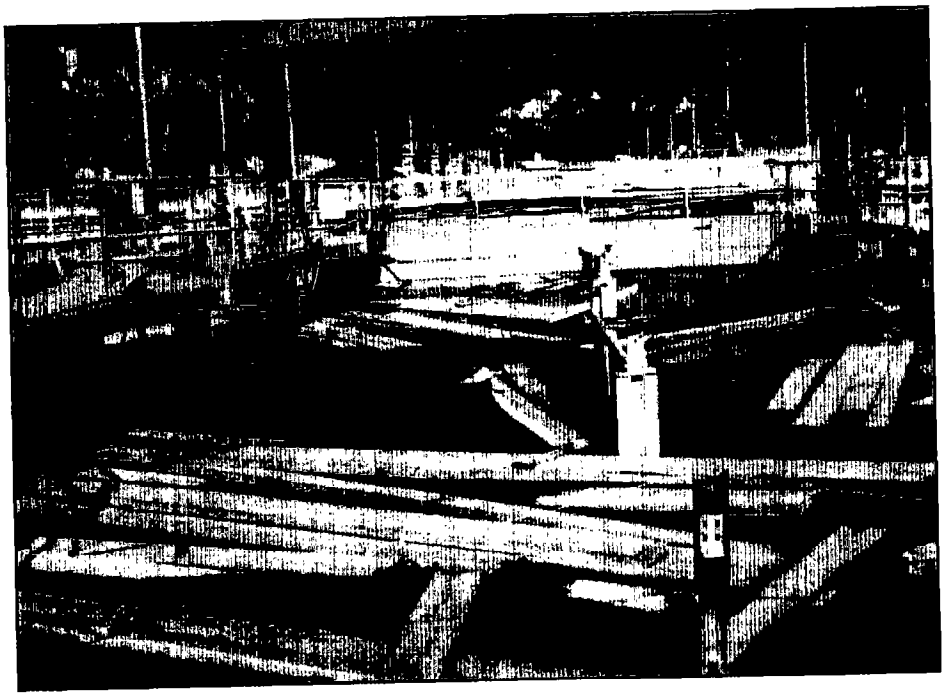
FIGURES 18 & 19

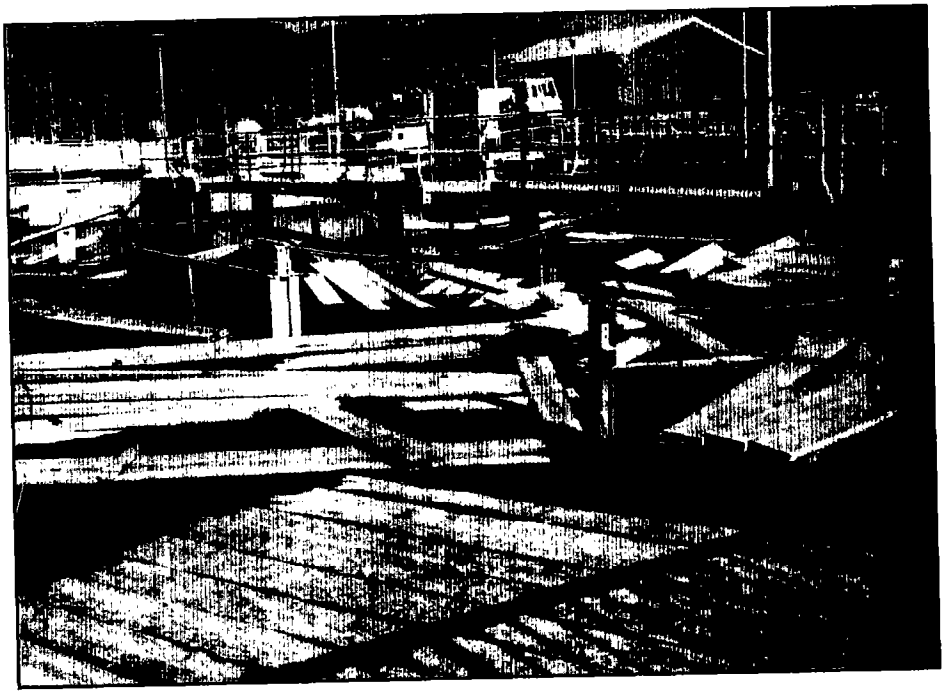


Original location of main electrical power center

Relocated main electrical power center

FIGURES 20 & 21



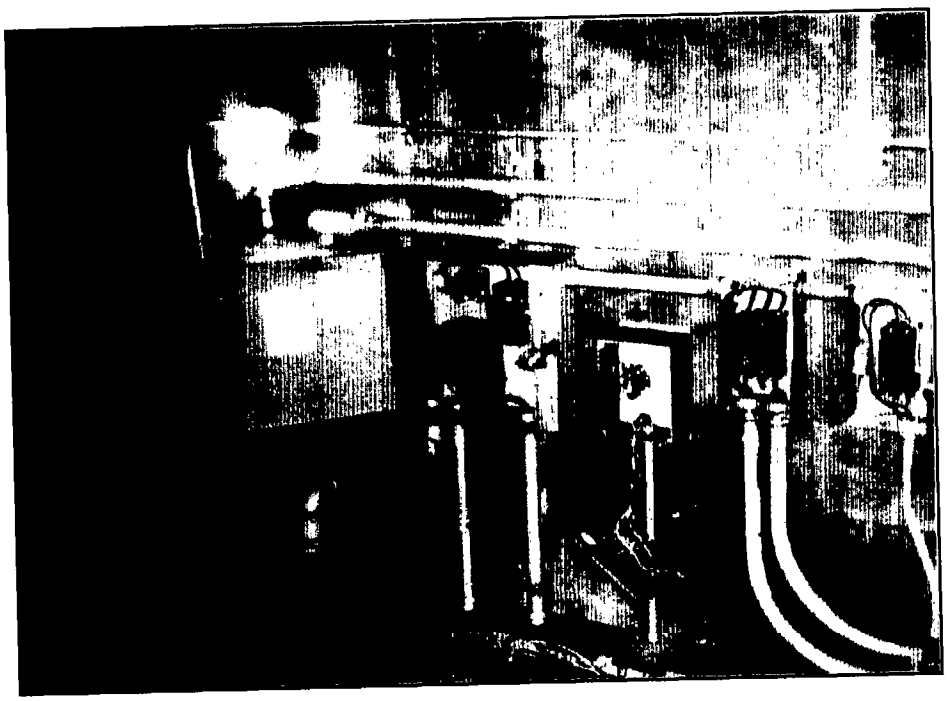


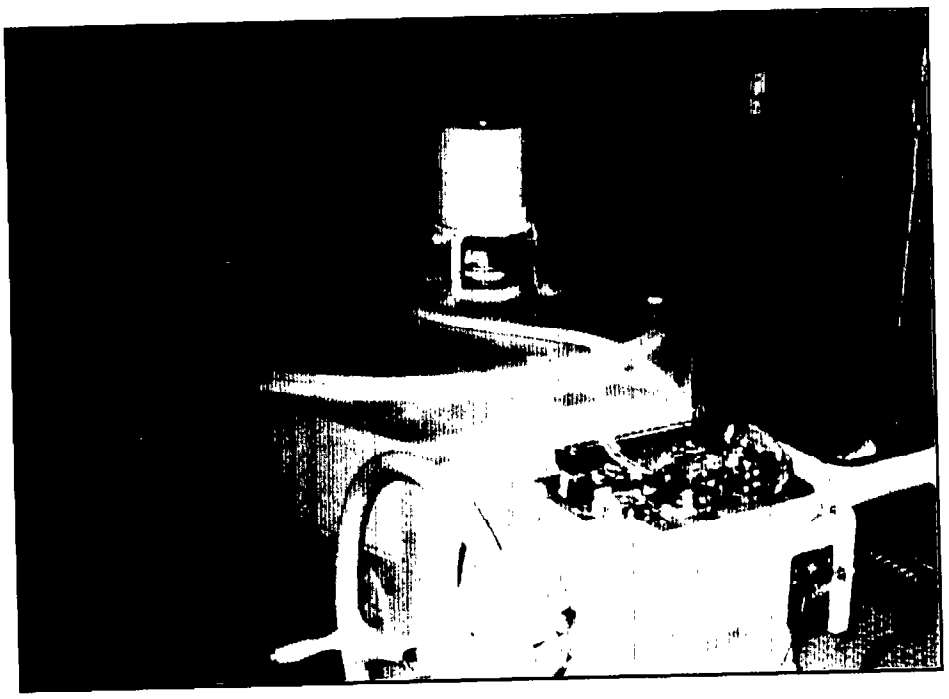
Baffle boards in settling basins

FIGURES 22 & 23

Erosion on slope near LA-35T

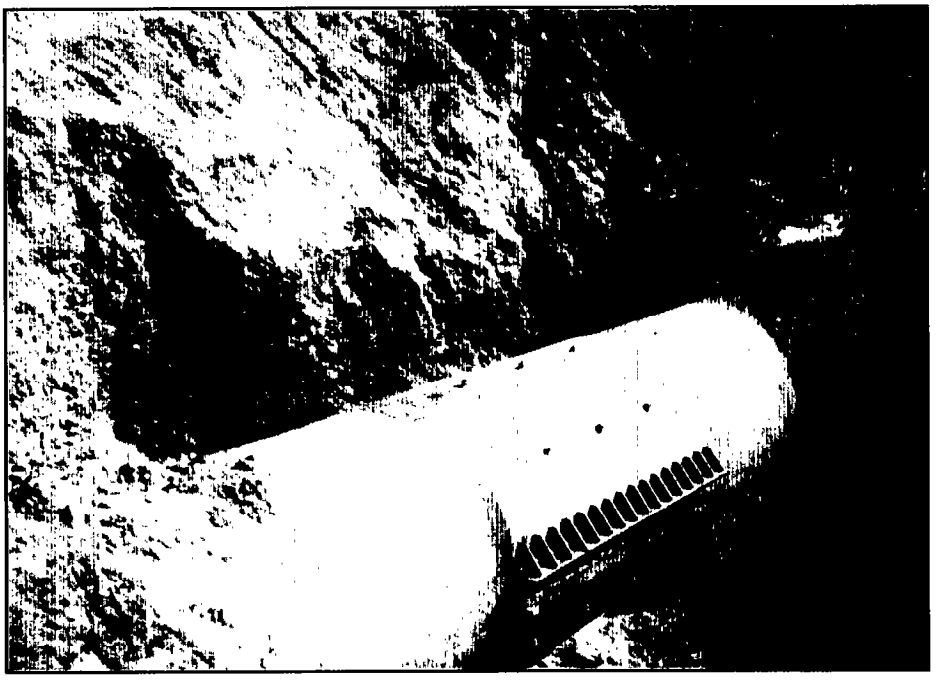
FIGURES 24 & 25

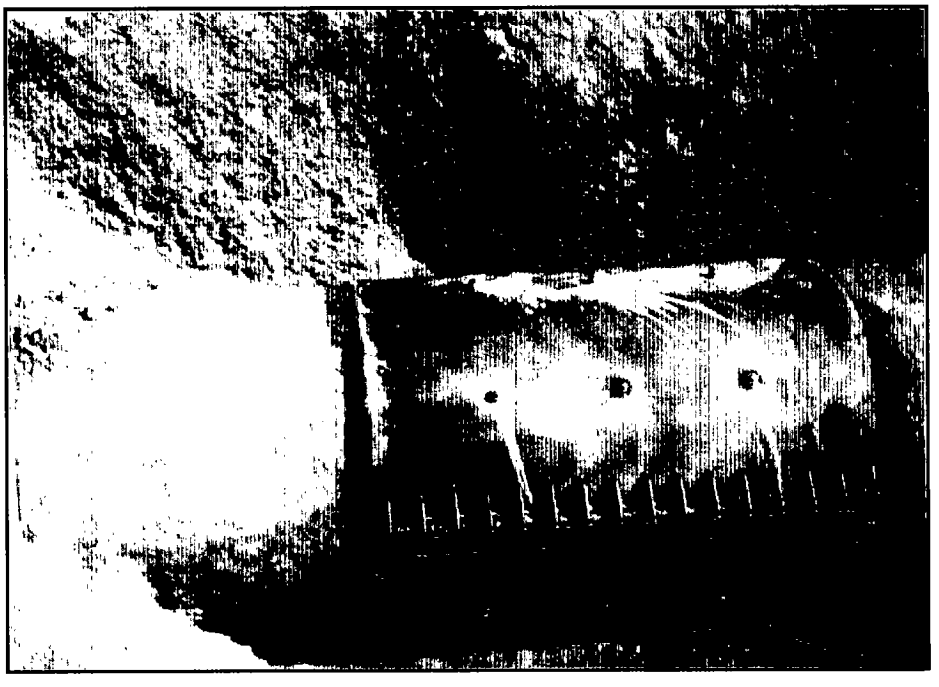




Electrical equipment damaged when West Valley Feeder No. 1 Sectionalizing Valve Structure flooded.

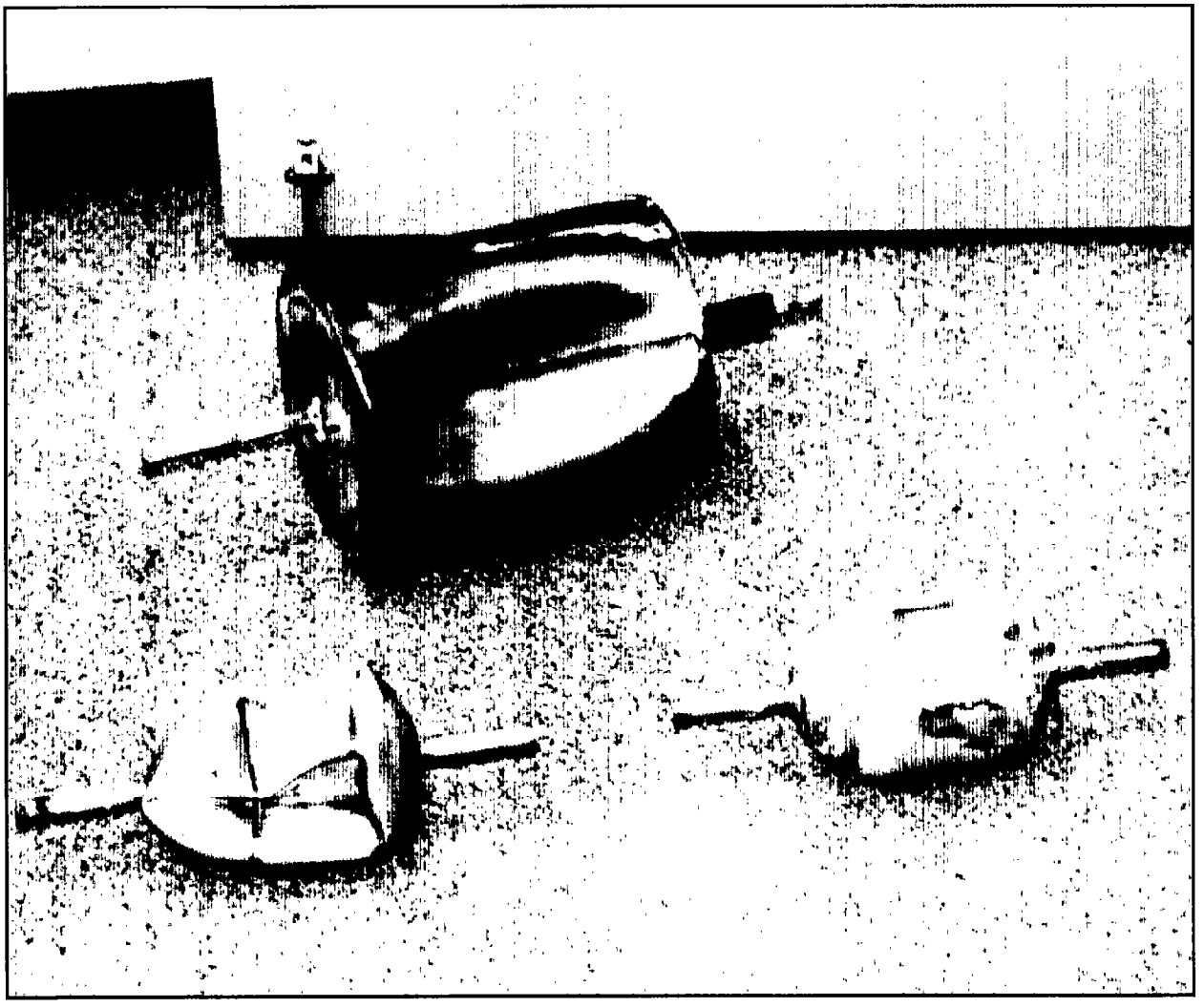
FIGURES 26 & 27





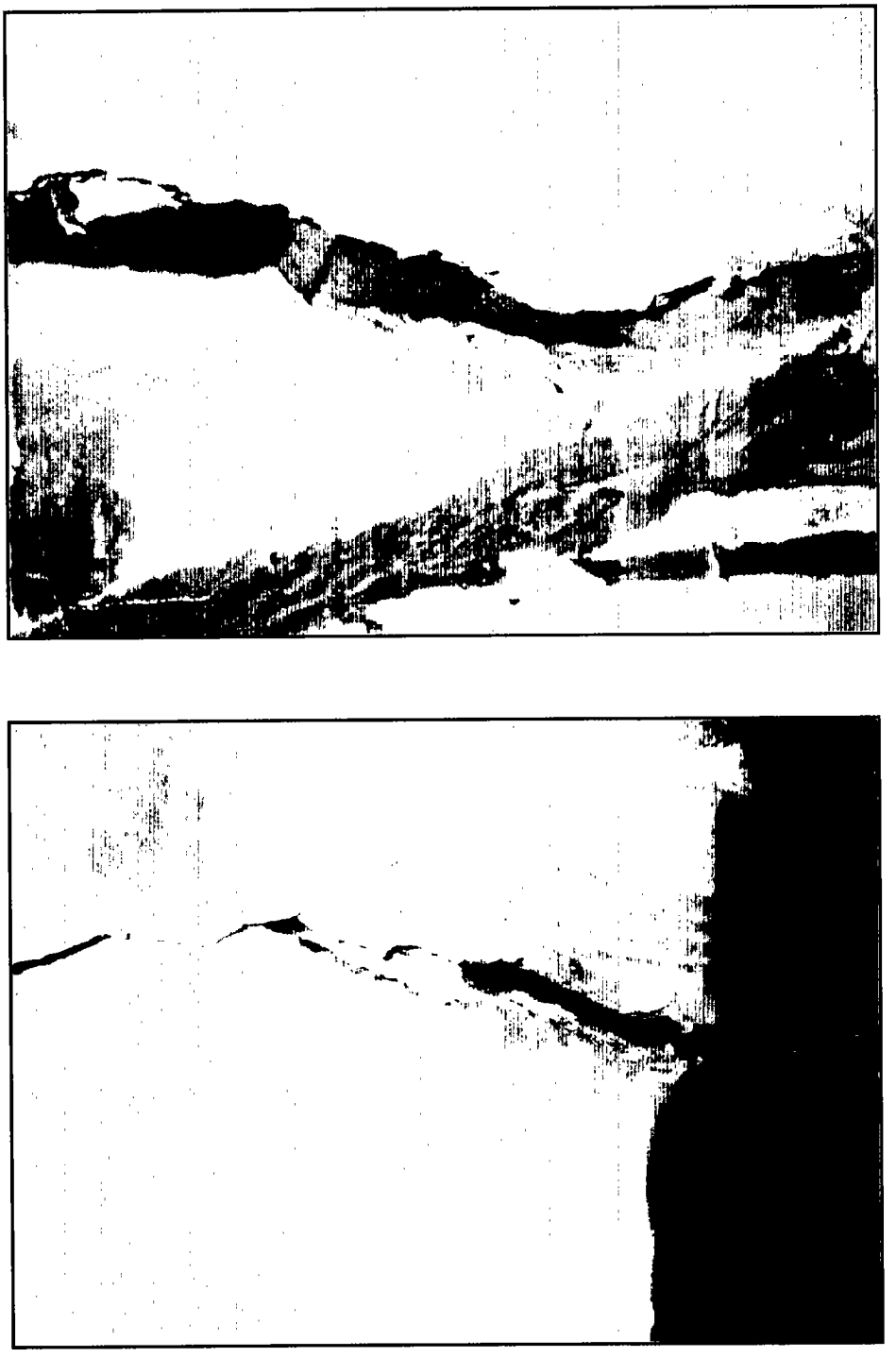
Band on pipe on West Valley Feeder #1

FIGURE 28



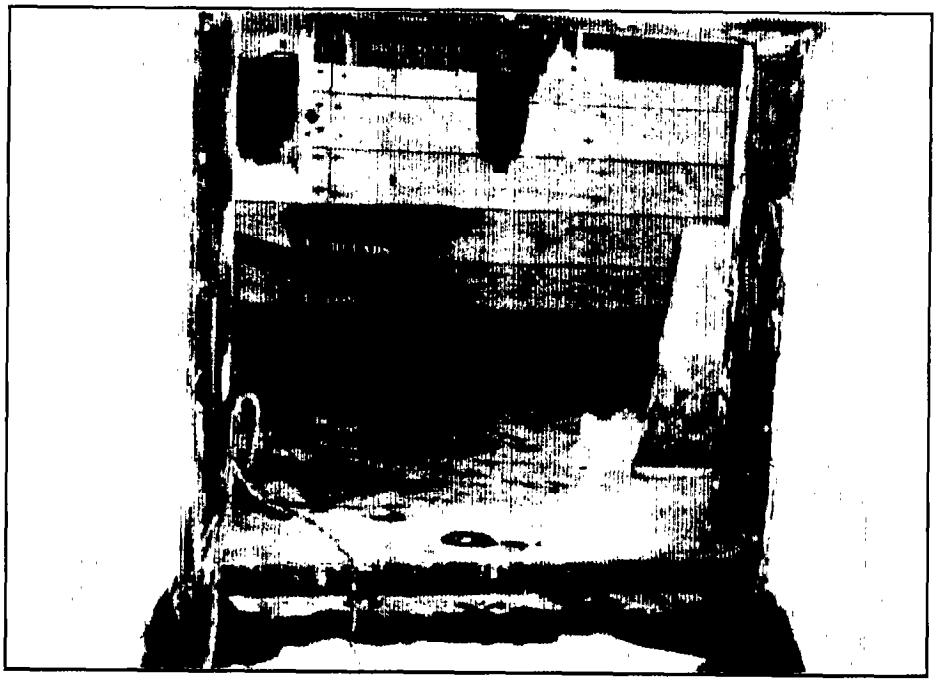
Damaged parts from air release and vacuum valves

FIGURES 29 & 30



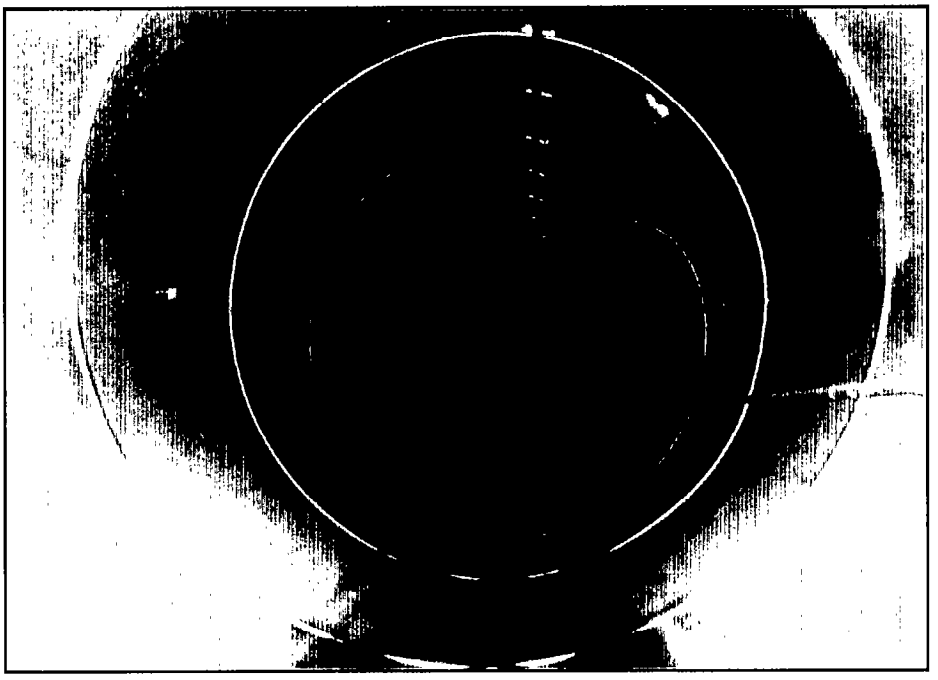
LA-25 damaged concrete in transition structure.

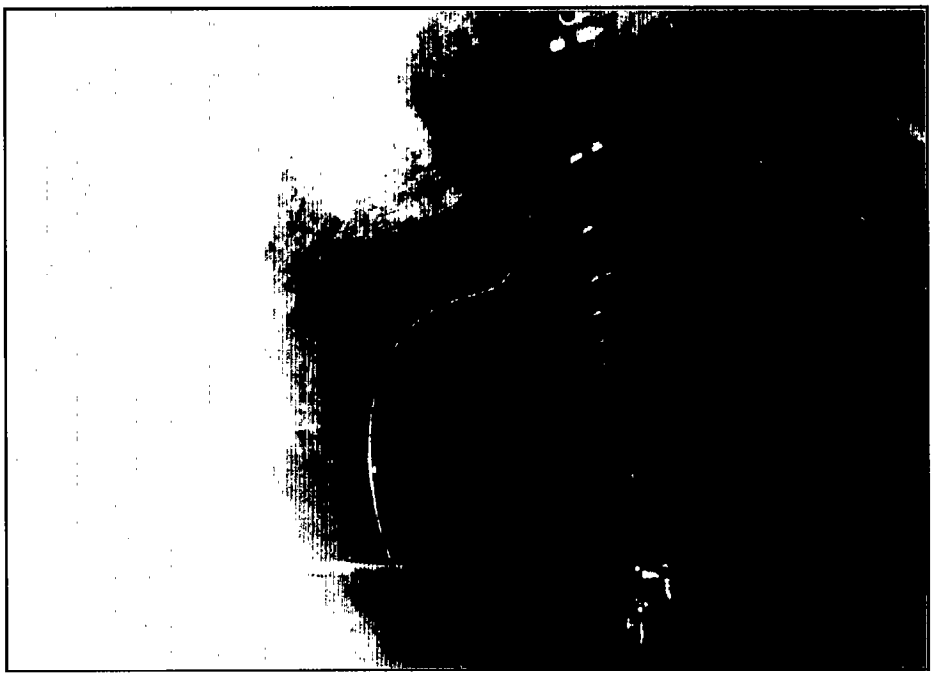
FIGURES 31 & 32



LA-25 service connection steel plate installed
to close damaged concrete in transition structure.

FIGURES 33 & 34





Bulge in Magazine Canyon Tunnel liner.