4.0 SYSTEM VULNERABILITY ASSESSMENTS

4.1 INTRODUCTION

This section discusses evaluation of system vulnerability. The objective of a system assessment is to see if the system will perform to the expected level for OBE and DBE events. Based on the discussion in the preceding section, system owners and operators should be able to quantify performance of their system components in categories of high, moderate, and low vulnerability. Using this information, an assessment of system performance can be developed.

In general, each system component should be evaluated before the system is evaluated as a whole. System vulnerability assessments are typically conducted in accordance with the following task list. Previous sections of this document have focused on tasks 1, 2, and 5.

1. Define System Objectives
2. Assess Hazards
3. Inventory System
4. Visit Sites
5. Assess Component Vulnerability
6. Assess System Vulnerability
7. Develop Mitigation Alternatives
8. Prioritize Mitigation Alternatives
9. Implement Mitigation Program

This section focuses on task 6, assess system vulnerability.

The following subsections discuss evaluation of the system by function such as source and transmission. Those functions are then related to system performance objectives. The use of seismic hazard information for system evaluation is considered, followed by evaluation techniques using the computer. Finally, mitigation through a multi-use approach is discussed.

4.2 EVALUATION BY FUNCTION

The first step beyond assessing system components is assessing specific functions required for the system to perform as a whole including supply, transmission, treatment, pumping, storage, and distribution.

After the vulnerability of each of the supplies is assessed, group them together, and look at the overall system supply reliability. Are all supplies vulnerable to the same damage mechanism? Is there supply redundancy, or will failure of any one of the system supplies put the system out of operation? Is there flexibility in using different supplies independent of one another, or are the supplies interdependent?

In one example in Baguio, Philippines, landslides increased the water turbidity to as high as 2,400 NTU, making it usable only intermittently. To supplement their supply they reactivated wells that had been moth-balled in previous years. Ultimately, they developed an alternative groundwater source in another area to supplement their supply. Had they had these alternative sources in place at the time of the earthquake, they would have been better able to quickly restore system operation.

After each transmission line has been evaluated, consider the overall system capability to move water from the source to terminal reservoirs and/or the distribution system. Is the transmission system dependent on a single pipeline, or are there multiple pipelines connecting the source with the distribution system? Are the transmission pipelines aligned in the same corridor, and subject to common earthquake hazards, or are they independent? If one of the transmission lines is inoperable, what portion of the system can be served with the remaining lines operable? What effect does demand have on serviceable areas? It may be acceptable to operate at winter demands until the system can be restored. Emergency water conservation measures can be invoked following a disaster.

Treatment capability should be evaluated from the perspective of level of treatment as well as hydraulic capacity of the treatment facility. There might be four categories of operation including:

- Full treatment, full hydraulic capacity.
- Full treatment, partial hydraulic capacity
- Partial treatment, full hydraulic capacity
- Partial treatment, partial hydraulic capacity.

Consider what minimum level of treatment is required to meet operating objectives. For example, unit process for removal of trace contaminants having only long-term health impacts may not be required to stay in operation for short periods following an earthquake. Similarly, less efficient/more expensive plant operational approaches might be employed for short periods of time. Again in Limon, operations staff were able to operate their treatment plant at one-half capacity using a high dosage of polymer until the turbidity subsided. At the Rinconada Water

Treatment Plant following the Loma Prieta earthquake, they went to direct filtration at lower loading rates after the flocculator/clarifiers were damaged. Consideration of alternative treatment strategies should be made before the earthquake.

Group pumping capability together by function. Is there a pump station with low vulnerability available to serve each service area? Electrical power is crucial for most pump stations to remain operable. Reliability of commercial electric power is questionable. Are there emergency generators available for operation of key pump stations?

Group storage facilities together by service area. Systems usually depend on in-system storage to meet demands for fire suppression, and not transmission capacity. How much storage redundancy is available in each service area/pressure zone? Does each service area have multiple feeds from either a storage facility in the zone, or a higher zone? How much storage is there downstream of transmission lines that are highly vulnerable and would take an extended period to repair? In one large community in California, the purveyor is constructing a large reservoir downstream of the San Andreas Fault so they will have water during the recovery period when they are repairing the transmission line.

Typically, little redundancy is provided in a distribution system other than looping of pipelines.

Evaluation by function can be conducted in a workshop format, including system operations staff, and engineers familiar with system component seismic vulnerability. Alternatively, the pipeline evaluation can be accomplished using a computer model.

4.3 FUNCTIONS REQUIRED TO MEET POST-EARTHQUAKE PERFORMANCE OBJECTIVES

System performance objectives described in Chapter 1.0 focused on system requirements for fire flow, water quality, and demand levels corresponding with time periods after the earthquake. Each of these system requirements is related to the system functional assessment in this subsection. General system performance objectives are more difficult to relate to specific system components, and are not discussed.

Fire flow availability is usually dependent on water stored within the system and the distribution system to deliver the water to the fire. This capability is not dependent on the source and transmission system. Therefore, the more stringent requirements for fire flow can be focused on storage and distribution system components.

Water quality is dependent on source water quality, treatment plant functionality, and distribution system contamination. Vulnerability of treatment plant unit processes can be controlled, implementing upgrades if required. Contamination of the distribution system by groundwater/leaking sewage is more difficult to control if system pressure is lost.

Overall system demand can be controlled to some degree by implementing an emergency conservation program. On the supply side, supply will be impacted by the source and transmission system capability to deliver water. An evaluation can be made of the system components required to deliver the demand required by the system performance objectives.

4.4 USE OF HAZARD INFORMATION

Hazard information is crucial in seismic evaluation of system components and the system as a whole. Site specific information on ground shaking, liquefaction susceptibility, and vulnerability to landslide is required to make a reasonable assessment. Hazard mapping becomes very important when evaluating pipelines. In particular, pipeline vulnerability is closely related to liquefaction susceptibility and lateral spread.

The typical approach is to overlay hazard mapping information on pipeline drawings to identify vulnerable areas. This information is then coupled with the specific pipe material vulnerability as discussed in Chapter 3.0 to make an assessment on pipeline vulnerability.

Vulnerability to liquefaction can be taken one step further by estimating the PGD of liquefiable material and estimating the impact on the buried pipe structure. Youd's methodology provides a mechanism to estimate PGD. O'Rourke (1992) presents a method to calculate the effect varying levels of PGD have on pipelines. This approach has been used for pipeline evaluation projects in Vancouver, B.C., East Bay Municipal Utility District, San Francisco, and San Diego.

4.5 COMPUTER SYSTEM EVALUATION TECHNIQUES

Computer models have been developed that can relate earthquake hazard information, water system component vulnerability information, and water system operation. Use of a geographic information system (GIS) interface particularly for pipeline system inventory and hazard information mapping is very efficient.

Computer systems are usually designed to model various earthquake damage scenarios representing various earthquakes. For example, earthquakes from different sources, subduction earthquakes, intraplate earthquakes, and crustal earthquakes, each of a given size and location can be modeled.

With a given location and depth, and fault length, the computer first uses earthquake energy attenuation relationships to estimate the shaking at each location in the study area. Figure 4-1 shows a map of MMI for a portion of Seattle for a magnitude 7.5 earthquake scenario (Kennedy/Jenks/Chilton

1990b). Site amplification is then calculated giving the level of shaking at the ground surface for each site.

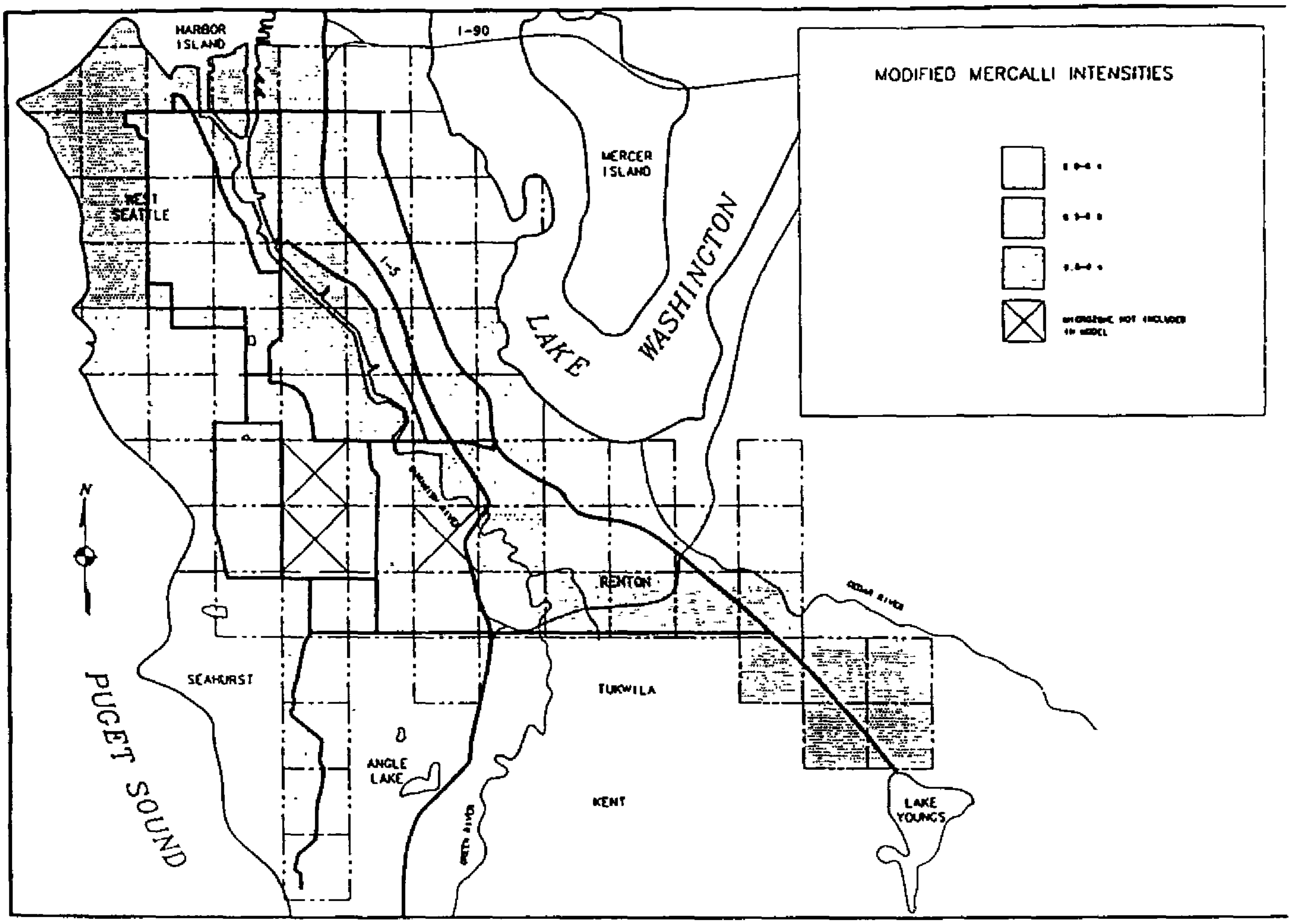


Figure 4-1. Modified Mercalli Intensity map for the southern half of Seattle for a magnitude 7.5 earthquake.

Liquefaction susceptibility information such as grain size, density, and groundwater level information is input. The model will estimate liquefaction probability based on liquefaction susceptibility and ground shaking information. Figure 4-2 shows a liquefaction susceptibility map for a portion of the Seattle water system.

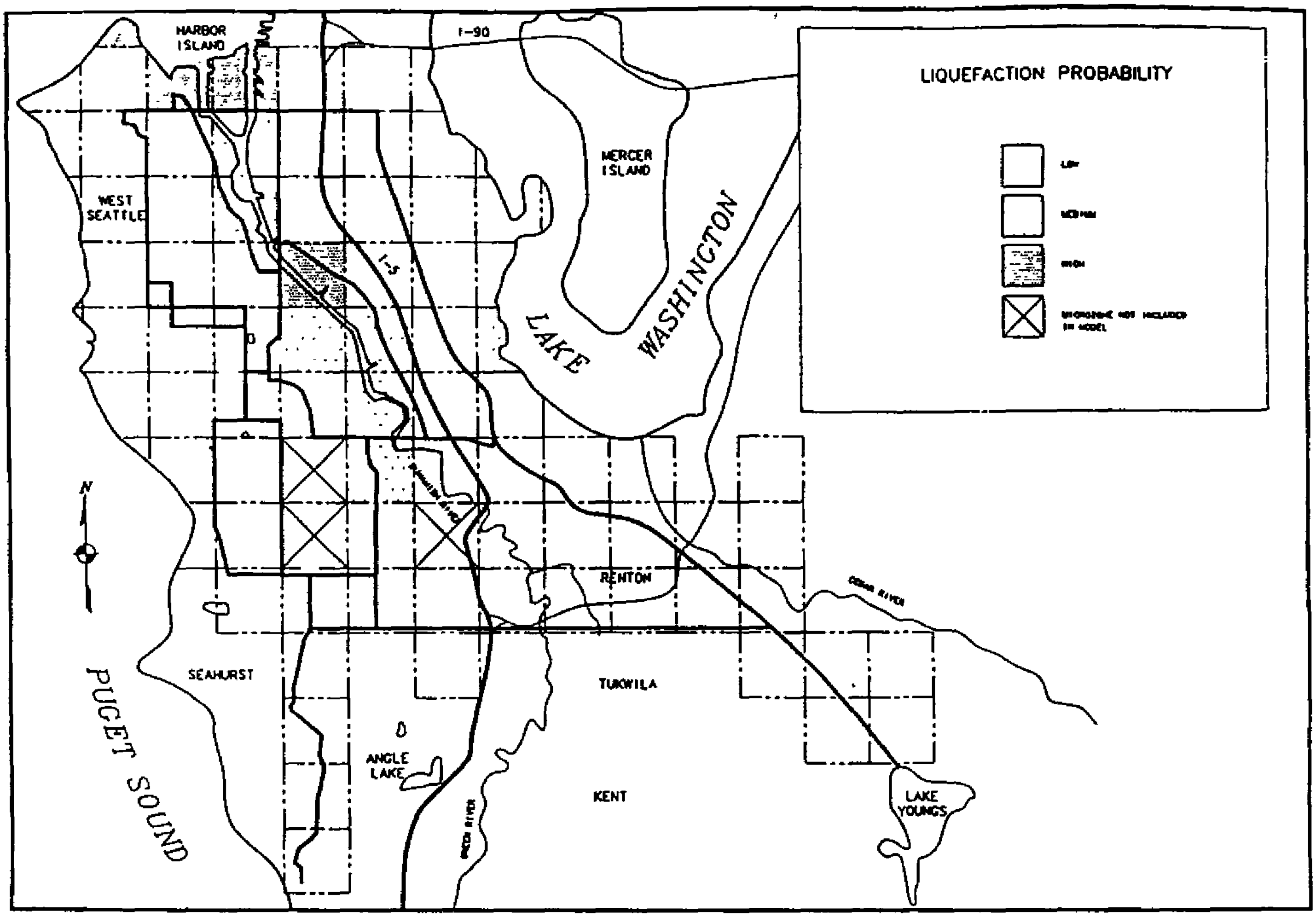


Figure 4-2. Liquefaction susceptibility map for the southern half of Seattle for a magnitude 7.5 earthquake.

Pipeline information and related vulnerability is input in GIS format. Damage relationships for ground shaking, liquefaction, and landslide is input based on damage information gathered from previous earthquakes, pipe geometry, and structural analyses. Figures 4-3 and 4-4 show pipeline damage relationships for shaking and liquefaction PGD, respectively. The model then estimated the extent of damage to each pipeline segment.

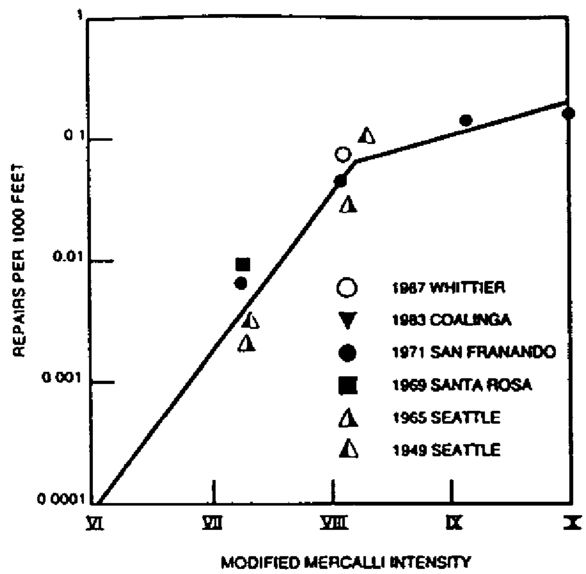


Figure 4-3. Pipeline damage algorithm for shaking showing repairs per 1,000 feet as a function of MMI.

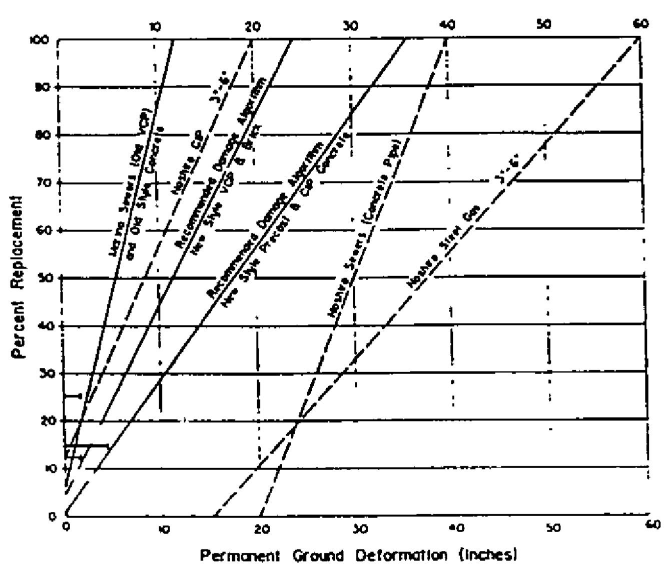


Figure 4-4. Pipeline damage algorithm for liquefaction/lateral spread showing pe·cent replacement as a function of permanent ground deformation.

With this information, the computer can model the system hydraulically using a modified network analysis model such as KYPIPE. The model includes demands from pipe leakage and breaks, and takes into account system pressures when delivering system "demands." The model will consider system connectivity, whether each node is connected to adjacent nodes. The resulting hydraulic pressures are calculated. Figure 4-5 shows the resulting system pressure map for the Seattle magnitude 7.5 scenario.

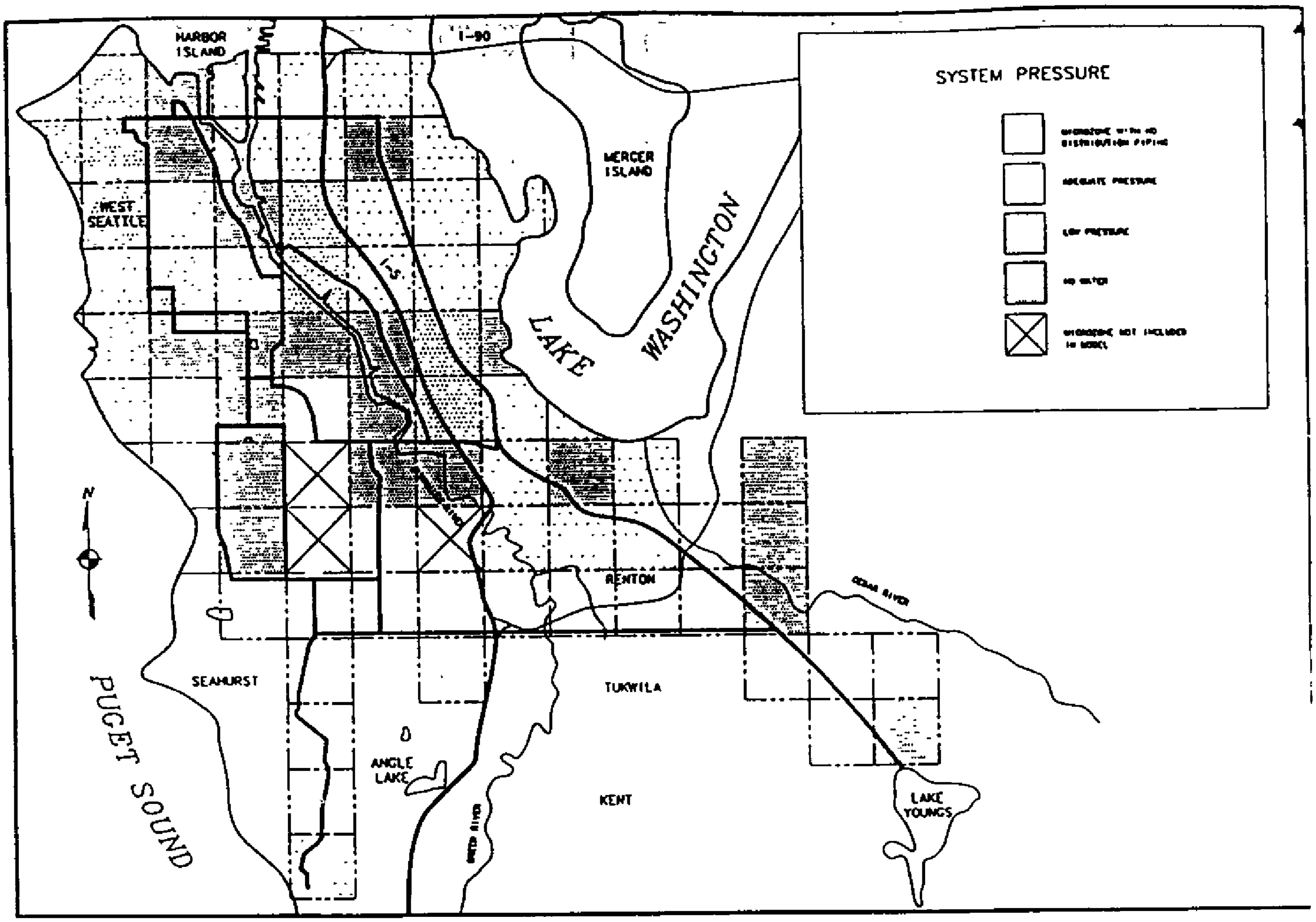


Figure 4-5. System pressures in the southern half of Seattle after a magnitude 7.5 earthquake scenario developed using a loss estimation model.

Models have been developed to estimate the time to put the system back into operation based on estimated repair times for the estimated damage. Preliminary estimates have also been made on the economic impact water system damage would have on the community. This information can be used for justification of earthquake mitigation programs.

4.6 MITIGATION PRIORITIZATION AND IMPLEMENTATION USING MULTI-USE APPROACH

Based on the system evaluation, seismically deficient system components are identified, and can be prioritized based on criticality for system performance.

This information should then be melded with other planning, capital improvement, and maintenance information to develop an multi-use program that incorporates earthquake mitigation. Planning information might identify water quality issues leading to interconnection of multiple sources. Additionally, increasing system demands may be identified requiring the addition of a new source or transmission line. Road resurfacing projects might be projected for specific highway segments; the cost of new pipeline construction costs would be reduced when incorporated in a road project. A replacement program for pipelines with a high maintenance history may be in place.

With this information, a comprehensive improvement plan can be developed to address growth and maintenance issues while incorporating seismic mitigation considerations

5.0 EARTHQUAKE HAZARD INFORMATION

Earthquake hazard information has been developed by federal, state, and local agencies. The availability of information will vary depending on location. The most useful information is in the form of seismic hazard mapping. Mapping may be available for liquefaction susceptibility, landslide probability, and/or fault locations. In areas where specific seismic hazard information has not been developed, federal or state agricultural soil mapping and/or geologic mapping may be useful to identify areas susceptible to liquefaction.

Selected hazard mapping and other information currently available or work underway is listed below. More detailed information on local hazard information and local seismology will be provided at each workshop, and may be obtained by contacting the respective state office.

- Idaho Geological Survey
  Merrill Hall, Room 332
  University of Idaho
  Moscow, Idaho 83843-4199
  (208) 885-7991

  Material Available - from the 1993 List of Publications Information Circular 50
  - *Seismic Intensities in Idaho*, Kenneth Sprenke and Roy Breckenridge, 1992
  - Various Geologic and Landslide Maps of Idaho and Idaho quadrangles
  - *Seismicity Map of the State of Idaho*, C.W. Stover, B.G. Reagen, and S.T. Algermissen, 1986, USGS Map MF-1857

- Oregon Department of Geology and Mining Industry
  800 NE Oregon Street, No. 28
  Portland, Oregon 97323
  (503) 731-4100
  Ian Madin
  Mathew Mabey

  Material Available
  - *Relative Earthquake Hazard Maps of the Portland, Oregon 7.5 Minute Quadrangle*, DOGAMI and Metro, January 1993

  Work Underway
  - Earthquake hazard maps for Linton, Beaverton, Lake Oswego, Vancouver, and Orchards quadrangles

- Washington State Department of Natural Resources
  Division of Geology and Earth Resources
  P.O. Box 47007
  Olympia, Washington 98504-7007
  (206) 902-1450
  Steve Palmer - Principal Earthquake Geologist
  Tim Walsh

  Material Available
  - *Preliminary Maps of Liquefaction Susceptibility for the Renton and Auburn 7.5 Minute Quadrangle* - Steve Palmer - Open file report 92-7

  Work Underway
  - Liquefaction mapping for Burien and Des Moines Quadrangles; see DOGAMI for Vancouver and Orchards quadrangles

- U.S Geologic Survey
  West 904 Riverside Avenue
  Room 135
  Spokane, Washington 99201-1087
  (509) 353-2524

  Material Available
  - *Evaluation of Liquefaction Potential, Seattle, Washington* - W. Paul Grant, USGS Open File Report 91-441-T

  Work Underway
  - Liquefaction mapping for Tacoma North, Tacoma South, Poverty Bay, Puyallup, and portions of Gig Harbor and Steilacom Quadrangles.

6.0 SEISMIC CITY WATER SYSTEM VULNERABILITY ASSESSMENT

EXAMPLE

6.1 WATER SYSTEM DESCRIPTION

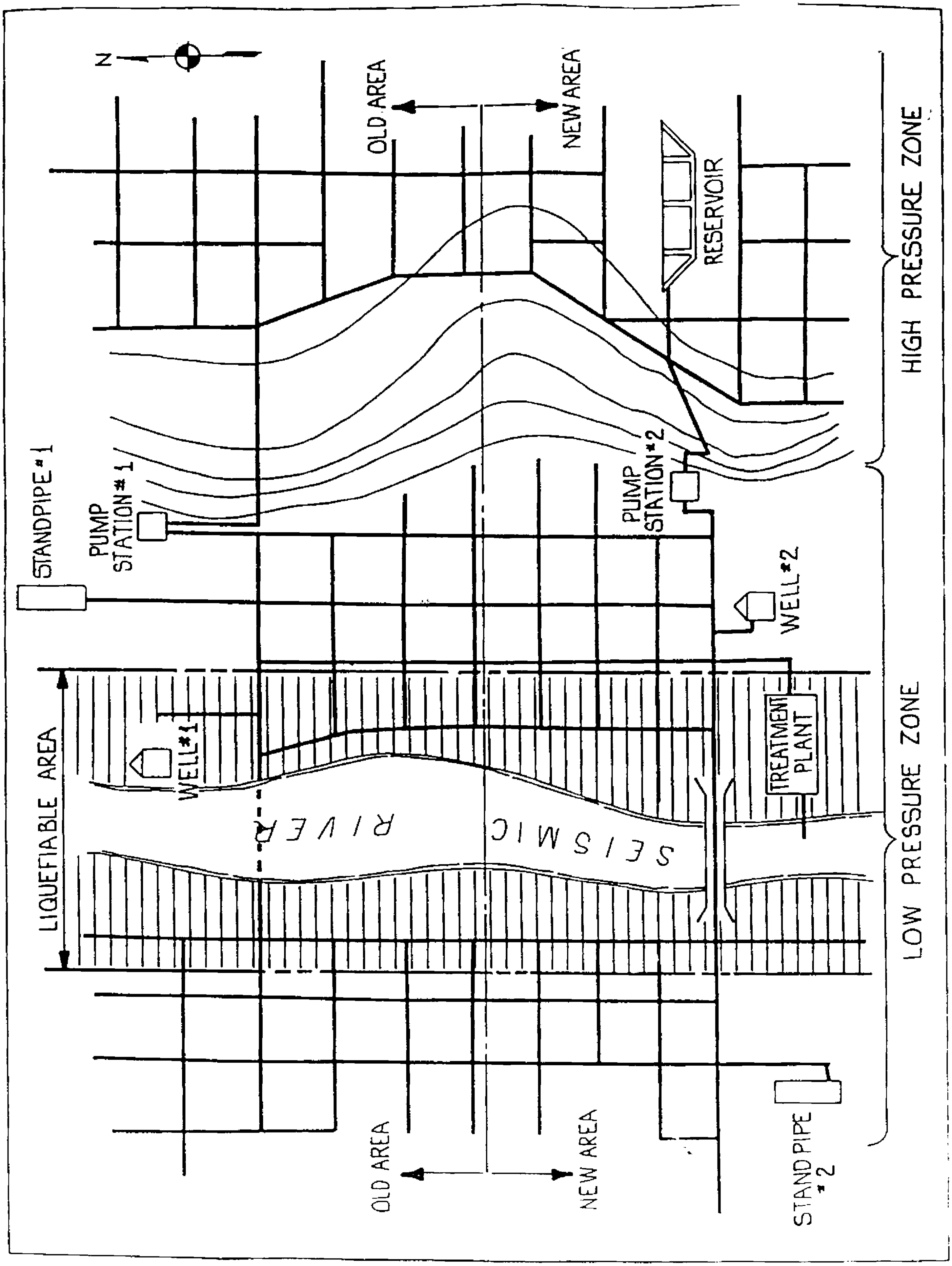
Water is supplied primarily by the water treatment plant that draws raw water from the Seismic River. During peak demand periods in the summer, Wells 1 and 2 are operated. Standpipes 1 and 2 float on the low pressure system. Both pump stations 1 and 2 pump the water up to the high pressure system. The reservoir floats on the high pressure system. Water is delivered to the west side of the Seismic River through two river crossings; one buried and one hung on a bridge. The average daily system demand is 10 million gallons per day (mgd), and peaks at 18 mgd during the summer. The treatment plant has a capacity of 13 mgd. Each well has a capacity of 4 mgd. The system is shown in Figure 6-1.

6.2 GEOLOGIC SETTING

Seismic City is located in the Pacific Northwest. Until recently, magnitude 7.2 earthquakes 50 km under the city were considered to be the maximum credible earthquake. Recent studies have raised the concern for a magnitude 8.5 earthquake centered 100 km to the west. The Seismic River has left alluvial deposits along its course that has meandered across a significant part of the valley through the years. The soils nearer the valley walls and east hill are of glacial origin, and are competent materials.

6.3 SYSTEM COMPONENTS

- Well 1
  - Constructed 1948
  - Founded on liquefiable ground
  - Building - masonry reinforcing ?, roof not anchored to walls
  - Buried piping - cast iron
  - Motor Control Center (MCC) cabinets unanchored
  - Well discharge piping - no lateral support
  - Engine/generator set (added 1975).
- Well 2
  - Constructed 1983
  - Constructed on glacial till
  - Building - reinforced masonry; roof anchored to walls
  - Buried pipe - ductile iron
  - Electrical cabinets, equipment, and piping adequately supported
  - No engine/generator set.
- Water Treatment Plant
  - Constructed in 1971
  - Constructed on liquefiable material
  - Structures pipe supported; yard piping, river intake - no pile support
  - Uses reactor (flocculator) clarifiers
  - Chlorine supplied in ton containers (unanchored)
  - Equipment and piping - no lateral support except as required for thrust
  - Engine/generator set provided for plant operation, raw water pumping, and pumping to the system.
- Pipelines
  - Transmission/distribution in "Old" area - constructed 1948
  - Transmission/distribution in "New" area - constructed 1971 +
  - Buried river crossing - constructed 1948
  - Bridge/bridge crossing, multispan concrete girder bridge - constructed 1973.
- Pump Station 1
  - Constructed 1957
  - Founded on glacial till
  - Building - wood frame
  - Buried pipe material?
  - Piping designed to resist thrust
  - Electrical cabinet anchorage?
  - No engine/generator set.
- Pump Station 2
  - Constructed 1971
  - Founded on glacial till
  - Building - masonry reinforcing ?; roof attachment?
  - Buried pipe material?
  - Piping designed to resist thrust
  - Electrical cabinet anchorage?
  - No engine/generator set.
- In-ground Reservoir
  - Constructed 1961
  - Soils in area competent; one side is manmade embankment
  - Concrete lined
  - Concrete roof added 1978
  - Access road constructed on unstable side hill.


N
OLD AREA
NEW AREA
RESERVOIR
HIGH PRESSURE ZONE
STANDPIPE #1
PUMP STATION #1
PUMP STATION #2
WELL #2
LIQUEFIABLE AREA
WELL #1
SEISMIC RIVER
TREATMENT PLANT
LOW PRESSURE ZONE
OLD AREA
NEW AREA
STANDPIPE #2

- **Standpipe 1**
  - **Constructed 1948**
  - **No anchorage**
  - **Foundation appears to be ring wall**
  - **90-feet high, 60-feet diameter**
  - **Outside rigid pipe connection.**

- **Standpipe 2**
  - **Constructed per 1986 AWWA D100**
  - **Anchorage**
  - **90-feet high, 80-feet diameter**
  - **Pipe connection through bottom.**

7.0 EMERGENCY PLANNING

7.1 INTRODUCTION

This section provides information to be used to improve earthquake preparedness and response planning. This section is organized in a recommended outline format of an emergency response plan developed for water purveyors. The recommended plan outline is designed to address different types of emergencies and disasters, of which earthquakes is one. Sections are followed by a brief comment on their relevance to earthquake response. While it is not critical that an emergency plan be organized in this format, each of the points included in this outline should be addressed somewhere in the plan.

To supplement this section, two references are recommended. First, the American Water Works Association M19, *Emergency Planning for Water Utility Management*. This manual is currently being updated to include more information on response to earthquakes. The second reference is *Emergency Management: Principals and Practice for Local Government*, edited by Thomas Drabek and Gerard Hoetmer, and available from International City Management Association.

Continuing training sessions are crucial to a good emergency response program. Training sessions allow trying out the emergency plan and improving it based on what is learned. New staff need to be introduced to the emergency response program, and response strategies refreshed in the minds of existing staff. Training should provided at three levels, 1) table top, 2) equipment function, and 3) system wide.

7.2 EMERGENCY RESPONSE PLAN OUTLINE

7.2.1 Introduction, Policy, and Priorities

Provide one page introduction to plan. Define service priorities to supply such items as 1) fire protection, 2) emergency facilities (hospitals), and 3) commercial and residential service.

7.2.2 Authority and Activation

Define the procedure to establish authority to activate and operate the emergency plan.

7.2.3 Emergency Response Organization

Establish overall, office operations, and field operations following a disaster.

7.2.4 Functions and Responsibilities

It is important to identify who is most likely to respond following an earthquake, and how the number of responders can be enhanced. Human nature will make most people go home to take care of their families if they are at work, or stay home if they are already at home. Staff living significant distances away from their work place may find it difficult to respond because of closed highways. It is useful to openly discuss who will be available to respond based on family commitments and proximity to the work place. Those with no families may be better able to commit to responding. Training staff to be prepared at home will assist in getting a better response.

7.2.5 Effect/Response Matrix

Refer to American Water Works Association M-19 for example.

7.2.6 Emergency Response Checklists and Inspection Forms

7.2.6.1 Command. Establish the Emergency Operations' Center (EOC), conduct roll call, dispatch search and rescue teams, and establish first aid station; all in accordance with checklists.

7.2.6.2 Communications. Inventory operable systems and open communication with the county EOC and other local jurisdictions.

7.2.6.3 Roll Call. Establish procedure.

7.2.6.4 Safety. Establish procedure.

7.2.6.5 Search and Rescue. Establish procedure.

7.2.6.6 First Aid. Establish procedure.

7.2.6.7 Public Information. Coordinate news releases.

7.2.6.8 Record Keeping. Crucial to keep in FEMA format for recovery of damage repair costs.

7.2.6.9 Operational Recovery. Operational recovery in earthquakes can be overwhelming, in that there are so many emergencies happening simultaneously. Therefore, it is important to have these various tasks well defined and understood by the people performing them, before the earthquake.

7.2.6.9.1 Assess, stabilize, and isolate damage. As leaking water can quickly drain a tank and/or cause secondary damage, quick response is crucial. One approach is to have pre-assigned facilities/pipeline alignments to check before checking into the office. People with radio-equipped vehicles can provide feedback to the office the quickest.

In developing the facility/pipeline inspection assignments, use this document to identify which facilities are the most vulnerable.

On an ongoing basis, ensure that all system valves are accessible, operations, and are part of a defined and mapped isolation grid.

As part of this task, consideration should be given to developing a procedure to quickly inspect the elevated tanks, and drain them if they show signs of damage. Aftershocks could cause an already damaged tank to collapse.

7.2.6.9.2 Determine priorities. It is important to develop a complete picture of the extent of damage before dispatching repair crews. Repair crews will be a limited commodity, and should not be "wasted" on the first damage located. See Section 7.2.1, Introduction, Policy, and Priorities.

7.2.6.9.3 Operate surviving facilities. Operate remaining wells and/or pump stations to fill tanks.

7.2.6.9.4 Conserve water. Consider where water will come from before committing to its use.

7.2.6.9.5 Emergency treatment, pumping, and distribution. Use portable chlorinator, emergency generator, and/or aboveground distribution system as required.

7.2.6.9.6 Emergency water supply. Implement water delivery by tank truck or bottled water as required.

7.2.6.9.7 Repair damage. By priority.

7.2.6.9.8 Monitor supply quantity and quality.

7.2.6.10 Specific Emergencies.

- Electrical power outage.
- Earthquake.
- System contamination.
- Volcano.
- Ice/snow storm
- Flood.
- Landslide.
- Employee shortage/strike.
- Unauthorized entry/sabotage.
- Fire storm.

7.2.7 Plan Update

Make provision for updating the plan part of the plan.

7.2.8 Appendices

7.2.8.1 Emergency Contact List.

- Personnel roster, phone numbers, radio. Develop an organizational chart.
- Area jurisdictions. The county is the focus for emergency response. Special districts, such as water districts, seem to get overlooked in the county emergency planning effort. The county EOC can be key in acquiring critical equipment and materials for repairs otherwise unavailable after an earthquake.

  Fire districts and city fire departments depend on the water supply being operable. They need to know about areas where the water system is inoperable. Cities should have their own emergency response plan in operation.

  Make contact with each of these jurisdictions now. Get names of contact people, emergency phone numbers, and if appropriate, acquire radios with the same frequencies as these jurisdictions. (Note that phones will likely not be operable, primarily because of overload.)

- Equipment, supply, and service contact list. Maintain a current list of equipment, material, and available service providers. Most municipalities will do the same; many may be depending on the same contractors and/or equipment suppliers. It is suggested that critical equipment, materials, and supplies be identified, and that standing contracts be made with suppliers so that they are available when needed. Typical needs includes construction contractors including backhoes and trucks, pipe repair materials, and possibly water trucks.
- Mutual aid contact list The system may be damaged to the extent that it will overwhelm available resources. Develop mutual aid agreements with other similar water purveyors, preferably

located some distance away. A large earthquake will likely damage other districts in close proximity.

Identify requirements for assistance through contractors or vendors. Maintain letter agreements with contractors and vendors to provide specific services, equipment, personnel, or material following a damaging earthquake.

7.2.8.2 Emergency Supply List.

7.2.8.2.1 EOC. An EOC should be identified.

The EOC should be fitted with communications equipment, emergency power/heat/light, food and water for three days, a system map suitable for locating damage locations and status, copies of the emergency plan, vulnerability assessment, and facility/pipeline drawings.

7.2.8.2.2 Supplies. General supplies should include pipe repair materials, pipe, portable chlorination equipment, engine/generator set, provisions for fuel for engine/generator set, materials for making information signs to place at key locations along highway to inform customers of water supply status.

Assess material, equipment, and personnel required for damage repair. Include in the Emergency Response Plan a predetermined listing of resources needed for damage repair [e.g., specify by component and location 1) crews required, 2) potential number of pipe breaks, 3) estimated repair time, and 4) other comments]. Maintain supplies of spare fittings and pipe in staging areas located throughout the service area at sites that will remain accessible following an earthquake.

7.2.8.2.3 Communication equipment. Including radios and cellular telephones.

7.2.8.3 Personnel List. Maintain a copy of detailed personnel information in an offsite location.

7.2.8.4 Important Documents/Document Holders List. Copies of the emergency plan.

7.2.8.5 Vulnerability Assessments. Develop and maintain copies of vulnerability assessments for both earthquakes and other disasters, in several locations.

7.2.8.6 Worst-Case Planning Scenarios.

7.2.8.7 System Hydraulic Scenarios. Develop a set of system hydraulic scenarios that can be referenced to help identify pipeline failure locations.

7.2.8.8 System Maps Maintain copies in several locations.

7.2.8.9 Facility Drawings. Maintain copies in several locations.

7.2.8.10 Simplified Facility Schematics/Operating Instructions Develop simplified schematics and operating instructions ~~be prepared~~ for each facility so that they could be operated by someone not familiar with the facility.

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WORKSHOP EVALUATION FORM
EARTHQUAKE VULNERABILITY OF WATER SYSTEMS
NW OREGON SUBSECTION

24 June 1993

Please circle the number that best represents your impression.

1. Overall workshop — Poor 1 2 3 4 5 Excellent

2. Instructor — Poor 1 2 3 4 5 Excellent

   Comments for improvement: ____________________

   ____

3. Guideline Document - — Poor 1 2 3 4 5 Excellent

   Comments for improvement: ____________________

   ____

4. Which two sections were the <u>most</u> worthwhile? ____________________

   ____

5. Which two sections were the <u>least</u> worthwhile? ____________________

   ____

6. What additional topics would have been useful? ____________________

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