

REPORT



SEISMIC RESILIENCE REPORT

2020 UPDATE



The Metropolitan Water District of Southern California
700 N. Alameda Street, Los Angeles, California 90012



Report No. 1551-1
February 2020

Seismic Resilience Report 2020 Update

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PUBLICATION HISTORY:

Initial Release (First Biennial Report No. 1551)	February 2018
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Cover Photo: Test setup for large diameter seismic-resilient ductile-iron pipe to be used on Metropolitan's Casa Loma Siphon

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EXECUTIVE SUMMARY

In February 2018, the Metropolitan Water District of Southern California (Metropolitan) published *Report No. 1551, Seismic Resilience First Biennial Report*, which defined Metropolitan's Seismic Resilience Strategy and identified a number of near-term goals to improve Metropolitan's seismic resilience. The *2020 Seismic Resilience Report Update* is a supplement to the *Seismic Resilience First Biennial Report* (2018 Report). The purpose of the update is to document revisions to Metropolitan's Seismic Resilience Strategy, document seismic-resilience-related studies completed since publication of the 2018 Report, list the achievements related to the seismic performance objectives and near-term goals identified in the 2018 Report, and communicate new performance objectives and goals that will further increase the seismic resilience of Metropolitan's system.

Since the publication of the 2018 Report, Metropolitan has initiated multiple studies that will improve planning for earthquake response. Completed studies include an evaluation of Metropolitan's emergency storage requirements and an evaluation of the susceptibility of the conveyance and distribution pipelines to liquefaction. Staff is also nearing completion of an assessment of the potential damage to the conveyance and distribution pipelines from different earthquake events.

In the last two years, Metropolitan has also completed construction for seismic upgrades to 17 structures. Additionally, Metropolitan substantially completed the initial round of seismic evaluations for above-ground structures constructed pre-1990, which in general pose an elevated seismic risk. Evaluation of above-ground structures built post-1990 has been initiated as well as evaluation of hydraulic structures (e.g., reservoir outlet towers) to assess their seismic risk when compared to current design practices.

Finally, Metropolitan conducted over 100 emergency response exercises, workshops, and seminars since February 2018, including two large functional exercises. These exercises help to ensure that Metropolitan staff is prepared for when an eventual earthquake occurs. Metropolitan also started a new five-year exercise plan in 2019 that will allow all of its member agencies to participate in at least one of Metropolitan's annual emergency exercises during the next five years.

Overall, Metropolitan has achieved many of the near-term goals that were proposed in the 2018 Report and is continuing the efforts to complete the few items that are still outstanding. The strategy outlined in the 2018 Report to develop the seismic resilience of the system is an ongoing process that will continue to evolve and adapt as new information becomes available.

Staff recommends changing the frequency of written update reports from its current two-year cycle to a frequency of a written report every five years, with the next written report to the Board in 2025. Staff will continue to provide annual oral updates on Metropolitan's Seismic Resiliency Strategy to the Board.

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SECTION 1 PURPOSE

The Metropolitan Water District of Southern California (Metropolitan) owns and operates a complex conveyance, storage, treatment, and distribution system that serves a 5,200-square-mile service area within an active seismic region. Over its approximate 90-year history, Metropolitan has been proactive in mitigating seismic risk posed to the system, as well as improving its ability to maintain or quickly restore water deliveries following a major earthquake.

In February 2018, Metropolitan published *Report No. 1551, Seismic Resilience First Biennial Report* (2018 Report), which summarized Metropolitan’s historical approach to mitigating seismic risk and defined the organization’s current Seismic Resilience Strategy and the core components of that strategy. The report also identified performance objectives and near-term goals of the Seismic Resiliency Strategy. The 2018 Report is available on Metropolitan’s website using the link below:

http://mwdh2o.com/PDF_About_Your_Water/SRS%20Report%201551_Final_030518A_Submit_Reduced.pdf

The *2020 Seismic Resilience Report Update* is a supplement to the 2018 *Seismic Resilience First Biennial Report*. The purpose of the update is to document recent revisions to Metropolitan’s Seismic Resilience Strategy regarding emergency storage requirements, document seismic-resilience-related studies completed since publication of the 2018 Report, and list the achievements related to Metropolitan’s Seismic Resilience of Structures Program, emergency response planning, and the seismic performance objectives and near-term goals identified in the 2018 Report. The report also identifies new performance objectives and goals that will further increase the seismic resilience of Metropolitan’s system.

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SECTION 2 BACKGROUND

Seismic Risk

Southern California is crossed by numerous faults of varying levels of activity that are capable of generating large earthquakes and causing widespread damage. The 2018 Report listed six earthquakes that occurred within or near Metropolitan's service area in southern California since 1900 - four strong earthquake events (M6.0 – 6.9) and two major earthquake events (M7.0 to M7.9).

In 2019, two significant earthquake events occurred in the region. On July 4, 2019, a M6.4 earthquake occurred near Ridgecrest, approximately 122 miles north/northeast of Los Angeles. Then on July 5th, a M7.1 earthquake occurred in the same vicinity. While the earthquakes caused major damage to Ridgecrest and the surrounding communities, the earthquakes only caused mild shaking in the Los Angeles region due to the distance from the epicenter. However, these earthquakes are a reminder that earthquake risk is always present and that the region must take steps to prepare and respond.

A map showing significant (M6.3 and greater) earthquakes that have occurred in the southern California region since 1900 is provided in Appendix A.

Seismic Resilience Strategy

Metropolitan's Seismic Resilience Strategy is comprised of four components that encompass the various functions that promote the organization's seismic resilience objectives.

Planning – Developing and maintaining a diversified water portfolio, system flexibility, and emergency storage supplies

Engineering – Evaluation and mitigation of seismic risks of infrastructure and the water system as a whole

Operations – Maintain effective emergency planning and response capabilities

Reporting – Increase accountability and transparency of seismic resilience programs

Metropolitan's Seismic Resilience Strategy was described in detail in the 2018 Report, and the overall structure of the strategy is unchanged. A detailed breakdown of Metropolitan's Seismic Resilience Strategy is provided in Figure 2-1. The figure provides an overview of the comprehensive actions taken to mitigate impacts from large earthquakes, to quickly respond following an earthquake event, and to provide transparency regarding seismic risk and preparedness.

As shown in Figure 2-1, in addition to the activities conducted under the Planning, Engineering, Operations, and Reporting components of the Seismic Resilience Strategy, Metropolitan has continued its involvement with the Seismic Resilient Water Supply Task Force. The Seismic Resilient Water Supply Task Force is a collaboration between Metropolitan, the Department of Water Resources (DWR), and the Los Angeles Department of Water and Power (LADWP) to improve the seismic resilience of the imported water supply aqueducts.

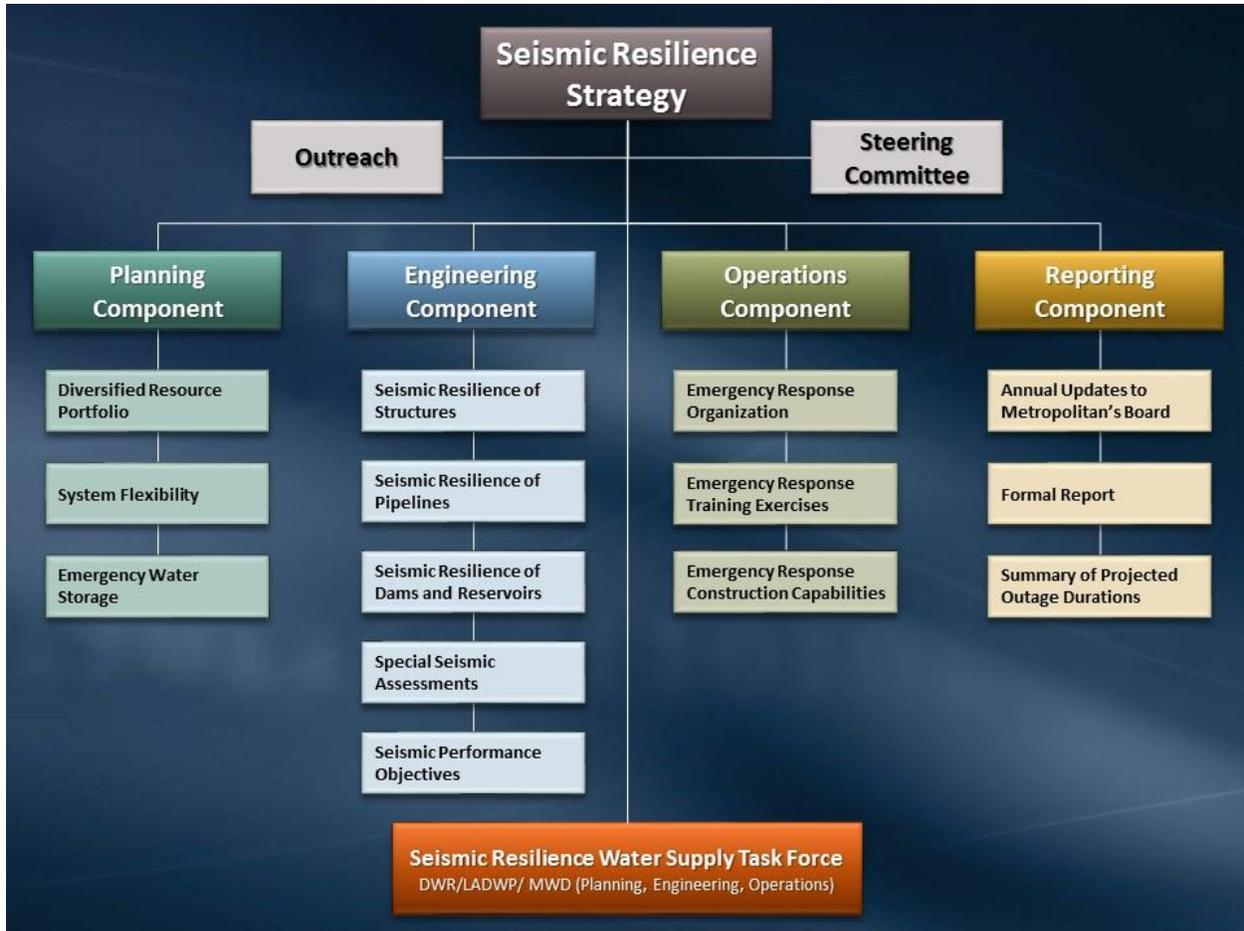


Figure 2-1: Detailed Breakdown of Metropolitan’s Seismic Resilience Strategy

SECTION 3 SEISMIC RESILIENCE STRATEGY UPDATES/REVISIONS

Planning Component

Emergency Storage

Beginning in February 2018, Metropolitan and its member agencies convened a workgroup to evaluate regional storage, including the size and management of Metropolitan’s emergency storage program. The goal of the emergency storage program evaluation was to update the emergency criteria and develop a revised methodology to determine emergency storage needs. The methodology and recommendation of the workgroup were described in a draft white paper, “2018 Evaluation of Regional Storage Portfolio: Draft Evaluation of Metropolitan’s Emergency Storage Objective,” and presented to Metropolitan’s Board in May 2019¹.

The update of the emergency criteria was based on 1) newly revised potential outage durations for the region’s imported water supplies – the Colorado River Aqueduct (CRA), the Los Angeles Aqueduct, and the State Water Project east and west branches – following a seismic event, and 2) a revisit of retail water demand and locally available supplies within the service area. The revised outages were developed as part of the Seismic Resilience Water Supply Task Force. The workgroup took into account the capabilities of member agencies when identifying reduction of retail water demand and local production during an emergency outage of imported supplies. This is a critical change in that the previous storage calculation assumed 100 percent local production during the outage period.



Diamond Valley Lake

The new emergency storage criteria considered various combinations of local demand reduction and supply production to develop an envelope of scenarios designed to prevent a shortage during an outage. Based on the range of potential scenarios, the workgroup recommended 750,000 acre-feet for the emergency storage program target, an increase from the previous planning target of 630,000 acre-feet.

The emergency storage is assumed to be distributed among the available capacities of existing Department of Water Resources and Metropolitan surface reservoirs located on the coastal side of the San Andreas Fault. Since member agency demands for supplemental water will be met through deliveries of supplies from storage, evaluation of spatial distribution of storage and most effective operation of the

¹ The Metropolitan Water District of Southern California, Water Planning and Stewardship Committee, Board Item 9-3, “Update of Metropolitan’s Emergency Storage Objective,” May 2019.

<http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2019/05-May/Letters/064883968.pdf>

distribution system will be accomplished as part of Metropolitan’s continued efforts and coordination within Metropolitan’s storage portfolio evaluation or other regional planning processes.

System Flexibility

In July 2019, Metropolitan’s Board of Directors authorized an amendment to the Administrative Code to enable delivery of member agency water supplies in Metropolitan’s system in an emergency subject to the General Manager’s approval². The amendment is an effort to enhance water delivery reliability after a serious emergency in which 1) Metropolitan is unable to make deliveries to a member agency due to physical damage to Metropolitan’s system resulting from a natural disaster or other emergency and 2) there are no alternate means for Metropolitan or the member agency to provide service to an area without the use of a portion of Metropolitan’s system. The Administrative Code change clarifies the conditions of these emergency deliveries in a proactive way, instead of a reactive way in response to damaged infrastructure following a natural disaster or serious emergency.

Engineering Component

Seismic Resilience of Structures

Metropolitan has developed an ongoing program for evaluating and upgrading its above-ground facilities with the goal of protecting life safety and critical infrastructure to minimize water delivery interruptions following a seismic event. The initial round of evaluations focused on structures that were deemed likely to be more susceptible to damage from earthquakes – buildings constructed prior to 1990. Structures built after 1990 were constructed in accordance with the 1988 or later versions of the Uniform Building Code, which provides reasonable assurance of withstanding a design-level earthquake without catastrophic failure. The program procedure for the seismic resilience of Metropolitan’s above-ground structures was described in the *Seismic Resilience First Biennial Report* and the program status as of January 2018 was provided. Since publication of that report, an additional 17 seismic upgrades have been completed. Figure 3-1 provides the overall status for the pre-1990 structures as of November 2019. Of the 311 pre-1990 structures identified, 63 percent were found to be acceptable and 37 percent (116 structures) potentially deficient following the rapid evaluation process. Of the 116 structures, 85 have either been seismically upgraded or are in design or construction. The remaining are largely structures that are not related to water delivery.

The program for seismically upgrading the above-ground structures is meant to be a continuous program, with the intent of reevaluating structures periodically. Structures found to be acceptable during the initial evaluation round may undergo a reevaluation, if warranted by new information such as a significant increase in seismic design force or displacement due to code revisions or newly discovered ground conditions, damage of structural components, severe material deterioration, and/or changes of occupancy.

² The Metropolitan Water District of Southern California, Engineering and Operations Committee, Board Item 8-4 “Authorize Amendments to the Administrative Code Regarding Deliveries of Member Agency Supplies in Metropolitan’s System in an Emergency; the General Manager has determined that the Proposed Action is Exempt or Otherwise Not Subject to CEQA”, July 2019. <http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2019/07-July/Letters/07092019%20BOD%208-4%20B-L.pdf>

As shown in Figure 3-1, evaluation of the pre-1990 structures related to water delivery has been substantially complete and the deficient structures are being addressed. Following the 1994 Northridge earthquake, and subsequent earthquakes in Taiwan, Japan, and New Zealand, substantial research in seismic design and code revisions has taken place. Post-1990 structures may or may not meet the current seismic performance standards, which has prompted Metropolitan to expand the seismic evaluation to post-1990 structures, a process which was initiated in early 2019 to further improve its seismic resilience. Twenty-six structures have been identified as part of the post-1990 structure list. Rapid evaluations have been completed on six structures, and none have been identified as seismically deficient.

As Metropolitan begins its evaluation of the post-1990 above-grade structures, staff is also initiating a process to identify and systematically evaluate below-ground structures such as vaults and manholes. Similar to the evaluation of above-ground structures, the prioritization of these facilities will consider potential impacts to water delivery and potential for loss of life.

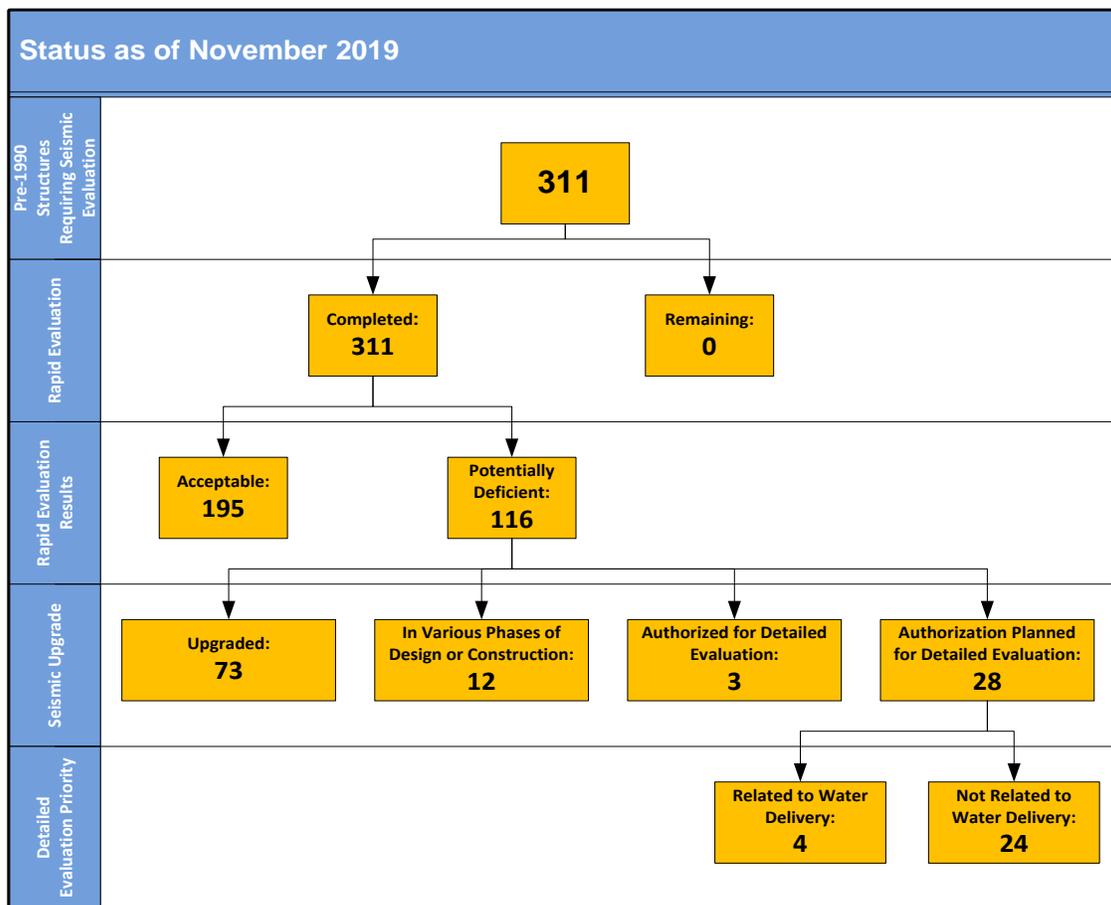


Figure 3-1: Status of Seismic Assessment and Upgrades of Pre-1990 Structures

Seismic Resilience of Pipelines

Metropolitan’s pipelines have been constructed in conformance with standards of practice at the time of design. Historically, there have been very few prescriptive code requirements for seismic design of pipelines. Only recently have there been developments in mitigation options for large diameter pipelines, including improved techniques to analyze the response of structures and pipelines within the ground from

shaking, increased post-earthquake data collection of ground motions and damage observations, and demonstrated performance of earthquake-resistant pipeline products.

In keeping with the goals of the Seismic Resilience Strategy, Metropolitan is developing seismic design criteria for new pipelines based on current state of practice, geotechnical and seismicity criteria, operating conditions, and asset management strategies. The planned design approach for new pipelines will be to establish performance criteria, identify seismicity and ground conditions along the alignment, and design the pipeline to resist damage from ground shaking and deformation. Specialized pipe joints and sections can be designed to accommodate ground deformation from fault displacement or liquefaction. For existing pipelines, seismic resilience will be incorporated as a component of pipeline rehabilitation projects. Metropolitan will evaluate each upgrade individually to balance risk, performance, and cost. See the Seismic Performance Objectives in this section for more information on the pipeline seismic design.

Metropolitan is in the early years of a 20-year program to rehabilitate its prestressed concrete cylinder pipelines (PCCP), which, at 163 miles, makes up approximately 20 percent of Metropolitan's conveyance and distribution system. The initial phase of the program will focus on the Second Lower Feeder, which will be upgraded with an interior steel liner. The new steel lining and the welded joints are designed to improve the seismic performance of the pipeline. For Reach 9 of the Second Lower Feeder, Metropolitan is investigating alternatives for realigning the portion of the pipeline that crosses the Newport-Inglewood Fault. One alternative being evaluated is to use specialized large-diameter earthquake-resistant steel pipe to accommodate fault displacement while maintaining structural integrity of the pipe for water conveyance.

Following this strategy, Metropolitan is completing the final design for rehabilitation of the Casa Loma Siphon Barrel No. 1 on the CRA in 2020. The Casa Loma Siphon Barrel No. 1 crosses the San Jacinto Fault Zone and is subject to long-term subsidence-induced deformation from groundwater pumping. The project will replace 800 feet of the existing 148-inch diameter concrete pipeline with two parallel barrels of 104-inch diameter earthquake resistant ductile iron pipe (ERDIP). The ERDIP joints are designed to accommodate ground displacements without failure, which will allow for uninterrupted service following a major earthquake.



Earthquake-Resistant Pipe

Seismic Resilience of Dams and Reservoirs

Metropolitan's ongoing strategy for managing the safety of its 24 dams includes five major components: (1) Detailed Inspections; (2) Monitoring & Reporting; (3) Facility Assessments; (4) Emergency Action Plans, including Inundation Maps; and (5) Capital Projects for dam improvements and upgrades.

Consistent with the goals of the Seismic Resilience Strategy, Metropolitan performs cyclical assessments of its facilities that include: 1) developing dam seismic performance criteria based on current state of practice, geotechnical and seismicity criteria, and operating conditions, 2) selecting design or safety evaluation earthquakes, 3) characterizing ground motions, 4) analyzing seismic performance of the dams

and foundations, and 5) evaluating structural adequacy of dam appurtenant structures for earthquake loading.

Finally, Metropolitan has an ongoing Dam Safety Initiatives Program that has initiated several plans to improve Metropolitan's dam seismic safety and earthquake readiness. These initiatives are being coordinated with the California Division of Safety of Dams (DSOD) and Office of Emergency Services and include the following:

- Ongoing preparation of Emergency Action Plans, including inundation maps
- Performing training exercises at the dam site to test processes during a seismic event
- Providing training and guidance on overall dam safety
- Reviewing operation and maintenance methods for reservoir drawdown and operations after a seismic event
- Updating guidelines and procedures on protection against seismic risk
- Establishing a strong communications system on seismic information
- Performing structural strengthening of dams, including rehabilitation and improvement of spillways and inlet/outlet towers such as Lake Skinner Outlet Tower
- Improving dam safety instrumentation, monitoring, and reporting capabilities

Special Seismic Assessments

Metropolitan conducts studies to further the organization's understanding of the vulnerability of the system to seismic hazards. The studies support emergency response training and planning for future earthquake events by estimating the magnitude of damage that may occur from various seismic events. Recently completed and ongoing studies are described below.

Completed Study:

Report 1625 - Liquefaction Susceptibility Mapping for the Metropolitan Water District of Southern California's Feeder System (Carollo Engineers, Inc., 2019). The liquefaction susceptibility mapping study provides a relative scale of liquefaction susceptibility of deposits along Metropolitan's conveyance and distribution system, given sufficient earthquake ground motions. Existing liquefaction maps available from the California Geological Survey provide a conservative overview of potentially liquefiable areas without any delineation for relative susceptibility. Areas are marked as either liquefiable or not liquefiable. The study utilized available geologic mapping data as well as publicly available groundwater data to map the relative liquefaction susceptibility of Metropolitan's conveyance and distribution pipelines for historical high and modern (1999 to 2019) groundwater depths providing five levels of relative scaling of susceptibility from very high to very low. The results of the study will be used to identify specific locations that may be targeted for future site-specific detailed liquefaction analyses, help prioritize pipeline replacement projects, and assess alternative pipeline alignments.

Studies currently underway:

Earthquake Damage Assessment of Metropolitan Water District Conveyance and Distribution Feeder System (ABS Consulting, Inc.). The study utilizes proprietary modeling software to estimate the potential number of pipeline breaks that may occur from various extreme earthquakes such as a Magnitude 7.8 earthquake on the South San Andreas Fault. The damage assessment model takes into account pipeline material and joint type, distance from earthquake source, and regional geologic conditions when developing the damage estimate. The results of the study will provide input into Metropolitan's earthquake emergency response planning and training activities, and help prioritize future pipeline seismic resilience enhancements. Anticipated completion is March 2020.

Seminars and Workshops

Metropolitan has recognized the importance of providing awareness of the seismic hazards and risks to Metropolitan, its member agencies, and sub-agencies and encouraging a transfer of knowledge of assessment and mitigation strategies to reduce seismic risk. Metropolitan ensures that risk awareness and knowledge transfer are promoted through active participation at various workshops.

In October 2019, Metropolitan co-hosted with LADWP the 11th Water System Seismic Conference. The conference is a bi-annual event that brings together utility, consulting, and academic professionals from the United States, Japan, and Taiwan to share knowledge in research, design practices, and construction technologies to prepare for and respond to seismic events. Conference topics included emerging design techniques, innovative construction practices, seismic damage assessments, seismic mitigation measures, and emergency response and recovery. In addition to co-hosting the conference, Metropolitan staff delivered four presentations on the organization's seismic resilience efforts. The papers and authors are listed in Appendix B.



Metropolitan Chief Engineer Providing Opening Remarks at 11th Water System Seismic Conference

In December 2019, Metropolitan co-sponsored the Earthquake Resilience Workshop for Water and Wastewater Utilities in Southern California. The workshop was a partnership with the United States Environmental Protection Agency and local utility and emergency management organizations to provide guidance and information to drinking water and waste water utilities to enhance their ability to enhance their resilience approach.

Staff also presented Metropolitan's seismic strategy and goals at the Member Agency Managers Meeting in August 2019. Staff described the various activities that Metropolitan conducts to understand the seismic risk and improve the overall resilience of the system. They also used the opportunity to promote the defense-in-depth approach to seismic resilience for the member agencies. This approach is a layered

strategy of system hardening, emergency water supply diversification, and increased system flexibility, including potential interties between member agencies.

Seismic Performance Objectives

Structures

Metropolitan's facilities are categorized as either an essential facility or regular facility, depending on performance requirements of the structure in accordance with code requirements. The structures are then designed or rehabilitated to meet the design criteria specified in the applicable seismic codes.

Essential facilities are those that are required for Metropolitan's core business-water delivery. All structures that are directly or indirectly related to water conveyance, storage, treatment and distribution are considered essential. Additionally, structures that contribute to Metropolitan's business continuity are also considered essential. The performance objective for an essential facility is to allow for continuous operation of the structure with limited damage after a maximum considered seismic event. These essential facilities are designed or improved to allow for immediate occupancy or continuous operation after a major seismic event. As an owner/operator of essential lifeline facilities, Metropolitan's water-related facilities will remain functional for disaster relief and fire suppression following a seismic event.

For regular facilities, the objective is to allow safe evacuation of occupants with possible structural and non-structural damage. The performance objective is to ensure life safety and prevent collapse of the structure. A facility designed as a regular facility may require significant repair following a major seismic event.

Pipelines

Metropolitan's conveyance and distribution pipelines are considered essential pipelines that are required for post-earthquake response and recovery. The pipelines are intended to remain functional and operational during and following a maximum considered earthquake. No uncontrolled release of a substantial amount of water is permitted under this design scenario.

Metropolitan continuously improves its techniques to analyze the response of pipelines to a seismic event to improve its assessment and prediction of earthquake damage to these facilities. Post-earthquake data of ground motion and damage information are used to improve earthquake resilience design methodologies. The data collected is used in advanced seismic pipeline analysis that relies on finite element techniques for soil-structure 3d modeling. Innovation in the development of earthquake-resistant pipeline products contributes to better seismic performance.

For new pipeline seismic design, the performance objective is to ensure the pipeline, pipe joints, and pipe-to-structure connections are capable of resisting the seismic shaking resulting from earthquake wave propagation without permanent damage. As the pipeline crosses known earthquake faults, the system will be designed to accommodate the maximum anticipated ground movement from fault displacement using specialized joints or pipe sections. Automatic shutoff valves may be added on either side of the fault to increase system flexibility.

For existing pipeline seismic design, a comprehensive risk assessment of the system using the latest seismicity and pipeline fragility data will be performed. The vulnerabilities of each pipeline segment will be used to determine the priority and schedule of seismic rehabilitation. Seismic resilient design to resist

shaking and accommodate fault displacement will be incorporated as components of the rehabilitation program. Each upgrade will be evaluated individually to balance risk, consequence, performance, and cost to define an economical long-term approach.

Operations Component

Emergency Response Training Exercises

In addition to training emergency response staff on National Incident Management System procedures, Metropolitan regularly conducts emergency response training exercises which have often been based upon a postulated seismic event.

Recent examples include:

- “ShakeOut“ Full-Scale Emergency Operations Center (EOC)/Incident Command Post (ICP) Exercise, October 17, 2019
- “Joint Infrastructure Security Exercise”- Tabletop Exercise with various Federal, State, and Local emergency management partner agencies- April 10, 2019
- “Operation Nomad”- Functional EOC/ICP and member agencies, November 14, 2018

In 2019, Metropolitan started a new five-year emergency exercise plan that will allow all of its member agencies to participate in at least one of Metropolitan’s annual emergency exercises. The first of these exercises was a tabletop exercise for the Orange County member agencies on August 29, 2019, which focused on a hypothetical incident at the Diemer Water Treatment Plant.

Metropolitan has conducted over 100 exercises since February 2018. This included two large functional emergency exercises for the EOC and multiple tabletop exercises, workshops, and seminars for the 12 Incident Command Posts located at the water treatment plants, conveyance and distribution facilities, and other strategic locations in Metropolitan’s service area.

The Metropolitan EOC also conducts monthly communication tests, which include Metropolitan’s emergency two-way radio system, on-line WebEOC system, Met-Alert mass notification system, and satellite phones. These monthly tests reach out to the member agencies, Treatment Plant Control Centers, ICPs, Metropolitan management, and the Department of Water Resources. These regular exercises help prepare Metropolitan and its member agencies to respond to future emergencies.

Emergency Response Capability

Metropolitan continues to maintain the necessary staffing, materials, and equipment to respond to two simultaneous pipeline breaks. The Machine Shop and Coating Shop at La Verne are available to fabricate pipe sizes up to 12 feet in diameter, and Metropolitan’s construction forces have the necessary equipment and expertise to make the repairs in-house. In addition, Metropolitan has upgraded its satellite phones to ensure communication ability following a seismic event and is in the process of installing high frequency radios at all Incident Command Posts (formerly Incident Command Centers) and the Emergency Operations Center.

Reporting Component

Formal Report

The interval for development of a formal report will be changed to every five years from the original two-year interval. Increasing the time interval between report updates will allow for a full Capital Investment Plan cycle to complete and for projects to move through concept, design, and construction.

Seismic Resilience Water Supply Task Force

The Seismic Resilience Water Supply Task Force (Task Force) is a collaborative effort involving Metropolitan, DWR, and LADWP to improve the seismic resilience of the imported water supplies to southern California. Following a major earthquake that disrupts the imported water supplies, the agencies would coordinate resources to repair the imported water supply aqueducts to ensure that deliveries are restored as quickly and to as many people as possible.

In March 2018, Metropolitan, DWR, and LADWP convened an aqueduct workshop to discuss lessons learned from recent large earthquakes in New Zealand, Japan, and Mexico; share each agency's approach to conducting seismic assessments; and discuss potential interties that may assist with recovery of water supply to the region. The group also had initial discussions on development of an emergency response plan specific to the Task Force.

The Task Force also conducted two tabletop emergency exercises in 2018 and 2019. These exercises were used to give substance to some of the ideas in the Joint Agency Emergency Response Plan (ERP).

Metropolitan, DWR, and LADWP are developing a Water Mutual Assistance Agreement (WMUA), which will formalize the Task Force and define the reporting and accounting requirements for mutual assistance following a major seismic event that impacts imported water supplies. A draft of the Joint Agency ERP has also been completed. The Joint Agency ERP will be finalized along with the WMUA. The plan defines the scenarios that would trigger the deployment of the Multi-Agency Coordination Group, which enhances the collaboration in operation, reporting, and plan maintenance.



**Seismic Resilience Water Supply Task Force
Aqueduct Workshop – March 2018**

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SECTION 4 SEISMIC RESILIENCE NEAR-TERM GOALS

Status of 2018 Listed Goals

The 2018 Seismic Resilience First Biennial Report identified near-term goals to further Metropolitan’s seismic resilience objectives. The near-term goals are listed below along with an update of the work done to date.

System Level Goals

Goal	Conduct Rialto Pipeline Alternative Supply Needs Study
<p>Status: Metropolitan completed an initial study to identify the near-term and long-term emergency supply needs for member agency demand from the Rialto Pipeline. The Rialto Pipeline is exclusively supplied from the California Aqueduct East Branch and is susceptible to extended disruption from an earthquake on the San Andreas Fault. The study also identified options to meet emergency supply needs. Metropolitan is currently working with member agencies to expand on the emergency supply options.</p>	

Goal	Complete a Re-evaluation of Metropolitan’s Emergency Storage Needs
<p>Status: Metropolitan, in coordination with member agencies, completed a re-evaluation of Metropolitan’s emergency storage needs and presented the recommendations to increase storage from 630,000 acre-feet to 750,000 acre-feet to Metropolitan’s Board in May 2019. A description of the emergency storage re-evaluation is provided in Section 3.</p>	

Goal	Complete a Comprehensive Evaluation of Metropolitan’s Storage Programs
<p>Status: Metropolitan, in coordination with member agencies, will complete the 2020 Integrated Water Resources Plan (IRP). Metropolitan will use newly developed demand and supply forecasts to analyze its entire supply portfolio, including all storage programs, in assessing regional reliability.</p>	

Facility Level Goals

Goal	Complete Construction of Approved Seismic Upgrade Projects
<p>Status: Construction has been completed for the listed projects.</p> <ul style="list-style-type: none"> • Carbon Creek Pressure Control Structure • Ten Control Structures along the Allen-McColloch Pipeline • Diemer Administration Building • CRA Pump Plants Switch Houses (Five Buildings) • Weymouth West Wash Water Tank 	

Goal	Conduct Studies, and Complete Design of Approved Upgrade Projects
	<p>Status:</p> <ul style="list-style-type: none"> • Assessment of potential seismic-induced damage to Metropolitan’s water conveyance and distribution pipelines <i>Studies to estimate damage from shaking and at fault crossings from large earthquakes and liquefaction susceptibility of pipelines are in progress with an estimated completion date of March 2020. See Special Seismic Assessments under Section 3.</i> • Seismic upgrade for Diemer West Filter Building <i>Completed design and construction of seismic upgrades is ongoing with an estimated completion date of December 2020.</i> • Complete evaluation of options, design, and construction contract to strengthen CRA Whitewater Tunnel No. 2 <i>Preliminary design is underway.</i> • Investigate options to improve emergency raw water bypass capabilities at treatment plants <i>Study is ongoing.</i> • Vulnerability Study of CRA electric transmission and distribution systems <i>Completed CRA Electric Transmission System Towers Reliability Study, which considered seismic vulnerability in addition to other hazards.</i> • Seismic Upgrade of Water Quality Lab in La Verne <i>Project is currently in design.</i> • Seismic Upgrade of Weymouth Administration Building <i>Project is currently in design.</i> • Seismic Study of Lake Skinner Outlet Tower <i>Completed voluntary seismic assessment of the tower which considered current dam safety criteria</i>

Emergency Response Goals

Goal 1:	Prepare and Conduct Emergency Exercises
<p>Status:</p> <ul style="list-style-type: none"> • Conduct a joint agency workshop to prepare a draft Joint Agency Response Plan • Conduct high-level training for DWR, LADWP, and Metropolitan staff on the Joint Agency Emergency Response Plan • Run a functional exercise on the Joint Agency Emergency Response Plan <p><i>Metropolitan conducted joint agency tabletop exercises to develop the Joint Agency Emergency Response Plan in 2018 and 2019. The functional exercise will be conducted following finalization of the Joint Agency Emergency Response Plan.</i></p>	
Goal 2:	Execute MOU to Allow for Coordinated Emergency Response
<p>Status:</p> <ul style="list-style-type: none"> • Prepare draft Memorandum of Understanding (MOU) and submit for review • Secure LADWP, Metropolitan, and DWR approval for the MOU <p><i>The Joint Agency Mutual Assistance Agreement is in the final stages of review and is expected to be signed off by all three parties in the near future.</i></p>	

Seismic Task Force Goals

2018 Goals:	Collaborative LADWP, Metropolitan, and DWR Goals
<p>Status:</p> <ul style="list-style-type: none"> • Discuss the applicability of lessons learned from seismic events in Japan, Chile, New Zealand, and Mexico <i>The organizations continue to incorporate lessons-learned from seismic events, including the July 4, 2019, M 6.4 and July 5, 2019, M 7.1 events in Ridgecrest, California</i> • Compare each agency’s approach to conducting seismic assessments <i>In development of the Joint Agency Emergency Response Plan, the organizations provided detailed presentations of their seismic assessments and the underlying assumptions to their anticipated damage and outage durations.</i> • Meet with Southern California Edison (SCE) and Southern California Gas Co. to discuss the potential vulnerabilities of aqueduct power systems <i>Metropolitan held discussions with staff from SCE and shared information on the respective systems and seismic vulnerabilities.</i> • Conduct workshops to explore potential aqueduct interties <i>DWR and LADWP continue to investigate the potential for constructing an intertie between the State Water Project East Branch and the Los Angeles Aqueduct.</i> 	

2019 Goals:	Collaborative LADWP, Metropolitan, and DWR Goals
<p>Status:</p> <ul style="list-style-type: none"> • Establish a leadership structure for a coordinated response to major events <i>The leadership structure for a coordinated response is described in the Joint Agency Emergency Response Plan</i> • Finalize a three-agency database of available emergency response resources <i>Updating list of emergency response resources for 2020</i> 	

2019 Goals:	Collaborative LADWP, Metropolitan, and DWR Goals (cont'd)
<p>Status:</p>	<ul style="list-style-type: none"> • Conduct a three-agency tabletop exercise <i>Metropolitan hosted a tabletop exercise in October 2019.</i> • Develop a ShakeOut Scenario Response and Restoration Plan <i>The ShakeOut Scenario is identified as one of the triggers that would initiate the Joint Agency Emergency Response Plan.</i> • Conduct a second three-agency functional exercise that includes energy utilities <i>Conducted a functional emergency exercise at the Robert B. Diemer Water Treatment Plant with local Sheriff and Fire Departments, SCE, City of Yorba Linda Emergency Services, Yorba Linda Water District, Orange County Emergency Management, and the Water Emergency Response of Orange County.</i>

Other Near-Term Goals

1. Develop a Standard Approach for Evaluating Non-Structural Elements:
Metropolitan is in the process of studying industry standards applicable to Metropolitan and collecting approaches taken by other agencies.
2. Establish Additional Performance Objectives for new pipelines, retrofit of pipelines, and new and existing tunnels:
Metropolitan is now designing new pipelines and tunnels and retrofitting existing pipelines and tunnels in accordance with current standards and incorporating additional seismic mitigation measures wherever practicable.
3. Investigate the Potential for Developing a Model to Prioritize Pipeline Rehabilitation:
This is being addressed through the Asset Management efforts, with input from recent seismic studies on risk from potential damage from shaking, fault rupture, and liquefaction.
4. Enhance Member Agency Planning Efforts Regarding New Facilities and Emergency Response Programs:
The Member Agency Managers Workshop was used to present the Seismic Resilience Strategy and objectives and Seismic Task Force findings.
5. Seek Approval for Detailed Seismic Studies
This is an ongoing effort. As Metropolitan completes the rapid evaluations of the Post-1990 structures, detailed studies will be recommended for those structures found to be potentially deficient.
6. Support the Delta Conveyance Project (part of the former proposed California WaterFix Project)

Metropolitan will continue to support the Delta Conveyance Project to increase the seismic resiliency of the Bay-Delta portion of the State Water Project.

2020 Update Near-Term Goals

The following section lists new near-term goals that will further Metropolitan’s objective of seismic resilience. These goals are anticipated to be completed before the next update in 2025.

System Level Goals

Goal	Conduct Special Seismic Studies
<ul style="list-style-type: none"> Update 2006 System Reliability Study, which analyzed the impacts of various single outage scenarios on Metropolitan’s ability to meet member agency demand 	

Goal	Conduct Planning Studies
<ul style="list-style-type: none"> Complete the 2020 IRP and comprehensive distribution system study under collaborative regional process. Update the emergency storage objective based on new IRP goals and forecasts. 	

Facility Level Goals

Goal	Complete Construction of Approved Projects
<ul style="list-style-type: none"> Weymouth West Wash Water Tank Seismic Upgrade Union Station Headquarters Building Seismic Upgrade Diemer West Filter Seismic Upgrade CRA Casa Loma Siphon Barrel No. 1 Replacement 	

Goal	Complete Design of Approved Seismic Upgrade Projects
<ul style="list-style-type: none"> Weymouth Administration Building Seismic Upgrade and Building Improvements La Verne Water Quality Lab and Field Engineering Building Seismic Upgrades and Building Improvements CRA Whitewater Tunnel No. 2 Seismic Upgrades Lake Mathews Disaster Recovery Facility Seismic Upgrades Upper Feeder San Gabriel Tower Seismic Upgrade Weymouth Inlet Channel Structural Upgrades 	

Goal	Seismic Upgrade of Below Ground Structures
<ul style="list-style-type: none"> Initiate evaluation of below-ground structures. Identify and list all structures. Develop a prioritization system for evaluation. 	

Task Force Goals

Goal	Emergency Response Plan and Exercises
<ul style="list-style-type: none"> Conduct annual exercises to ensure familiarity with Joint Agency Emergency Response Plan Semi-annual verification of emergency contact list for DWR, Metropolitan, and LADWP 	

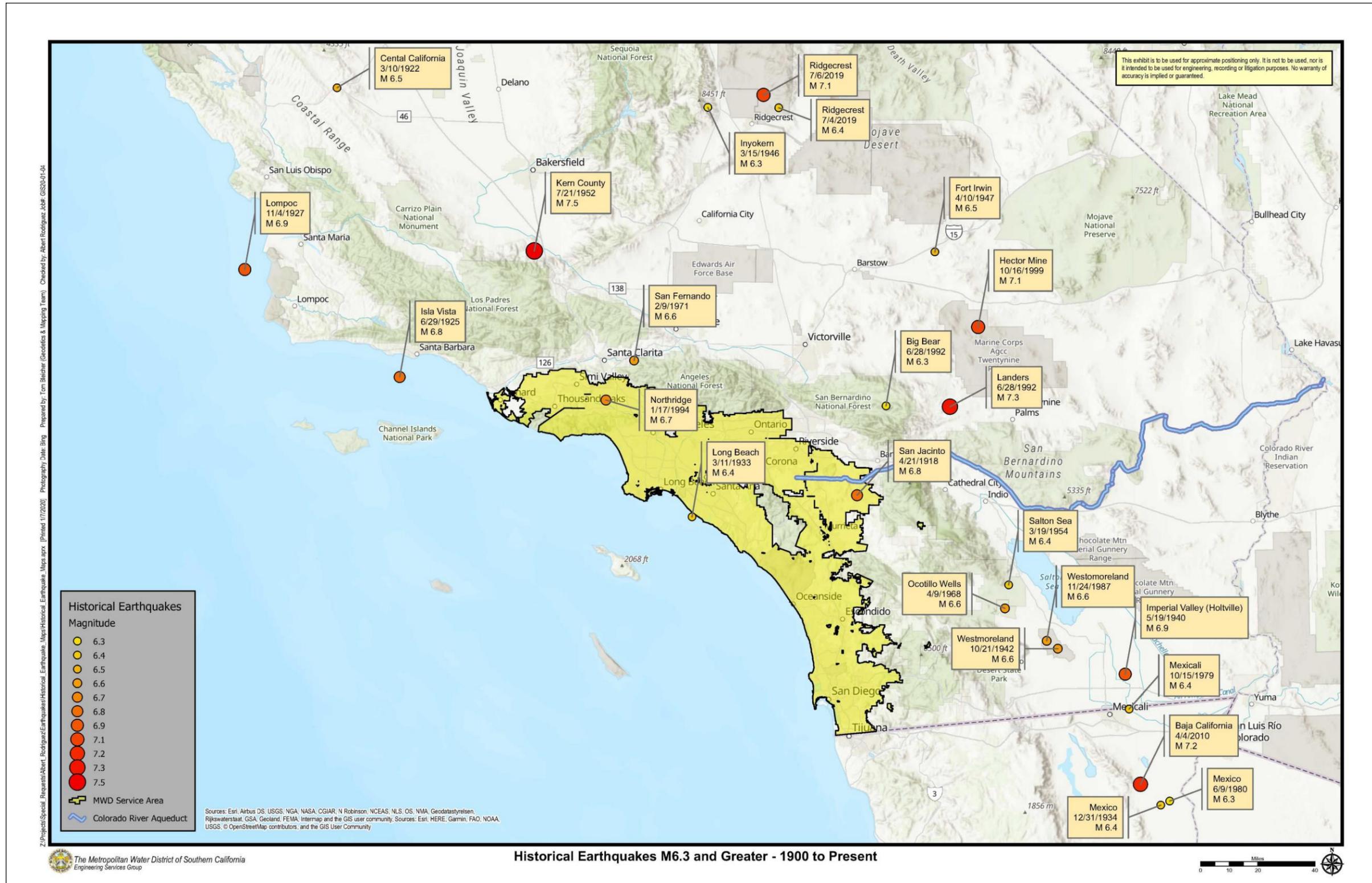
Other Near-Term Goals

- Promote to member agencies the Defense-in-Depth approach to seismic resilience as recommended in *Report 1335 – Potential Effects of Southern California Seismic Events on Metropolitan Deliveries* (January 2009).
- Continue to gain and share knowledge about seismic resilience through participation in workshops and conferences.
- Complete rapid evaluations for post-1990 above-grade structures.

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Appendix A – M6.3 or Greater Earthquakes in Southern California Region - 1900 to Present

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Appendix B – List of Metropolitan Staff Seismic Conference Papers

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Metropolitan Staff Papers Presented at the 11th JWWA/WRF/CTWWA Water Seismic Conference

Brainard, Andrew (2019), "Evaluation of Welded Joints in Steel Pipelines by Finite Element Modeling", *Proceedings of the 11th JWWA/WRF/CTWWA Water Seismic Conference*, October 9-11 2019, pp. 42-53.

Beikae, Mohsen (2019), "Monte Carlo Simulation of Probabilistic Rupture Hazard Analysis for Lifelines Crossing Active Faults", *Proceedings of the 11th JWWA/WRF/CTWWA Water Seismic Conference*, October 9-11 2019, pp. 107-119.

Chai, Winston (2019), "Seismic Rehabilitation of Upper Feeder Pipeline Santa Ana River Crossing – An Example of Metropolitan's Seismic Upgrade Program", *Proceedings of the 11th JWWA/WRF/CTWWA Water Seismic Conference*, October 9-11 2019, pp. 1-12.

Peng, Tao (2019), "Mitigation of Fault Displacement and Ground Subsidence for Large Diameter Pipeline", *Proceedings of the 11th JWWA/WRF/CTWWA Water Seismic Conference*, October 9-11 2019, pp. 217-228.