Submittal Table 8-3: Supply Augmentation and Other Actions			
Shortage Level	Supply Augmentation Methods and Other Actions by Water Supplier ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*
Add additional rows as needed			
Permanent	Water Waste Enforcement	Can range from 2000-5000 AF, depending on level of enforcement and public messaging.	PWP enforces its Water Waste Ordinance by responding to all water waste reports, and actively patrolling for water waste, and issuing notifications and fines.
Permanent	Expand Public Information Campaign	Can range from 2000-5000 AF when combined with Water Shortage Supply Level enactment and increased Water Waste enforcement.	PWP continually expands public outreach to increase awareness of water shortages as they occur
Permanent	Provide Rebates and Direct Installation on Plumbing Fixtures and Devices	892 AF Lifetime Savings	Rebates are offered on an ongoing basis in collaboration with MWD
Permanent	Provide Rebates for Landscape Irrigation Efficiency	62 AF Lifetime Savings	Rebates are offered on an ongoing basis in collaboration with MWD
Permanent	Provide Rebates for Turf Replacement	519 AF Lifetime savings	Rebates are offered on an ongoing basis in collaboration with MWD
Permanent	Use of behavioral software such as WaterSmart	278 AF	Use of software to educate customers on their water use compared to similar sized households, with targeted / customized recommendations to increase efficiency.
Permanent	Other actions (describe)		The general manger may require all CII customers using 25,000 billing units per year to submit a water conservation plan and submit quarterly reports on progress towards conservation goals.
NOTES:			

Submittal Table 10-1 Retail: Notification to Cities and Counties		
City Name	60 Day Notice	Notice of Public Hearing
Add additional rows as needed		
California-American Water Company	Yes	Yes
City of Alhambra	Yes	Yes
City of Arcadia	Yes	Yes
City of Sierra Madre	Yes	Yes
City of South Pasadena	Yes	Yes
East Pasadena Water Company	Yes	Yes
Foothill Municipal Water District	Yes	Yes
Huntington Library and Art Gallery	Yes	Yes
Kinneloa Irrigation District	Yes	Yes
La Canada Irrigation District	Yes	Yes
Las Flores Water Company	Yes	Yes
Lincoln Avenue Water Company	Yes	Yes
Los Angeles County Public Works	Yes	Yes
Los Angeles County Sanitation Districts	Yes	Yes
Metropolitan Water District of Southern California	Yes	Yes
Pasadena Cemetery Association	Yes	Yes

Urban Water Supplier: *Pasadena Water and Power*

Water Delivery Product (If delivering more than one type of product use Table O-1C)

Retail Potable Deliveries

Table O-1A: Recommended Energy Reporting - Water Supply Process Approach

Enter Start Date for Reporting Period: 1/1/2020

End Date: 12/31/2020

☐ Is upstream embedded in the values reported?

	Water Volume Units Used	Urban Water Supplier Operational Control							
		Water Management Process						Non-Consequential Hydropower (if applicable)	
		Extract and Divert	Place into Storage	Conveyance	Treatment	Distribution	Total Utility	Hydropower	Net Utility
Volume of Water Entering Process		*11230*	*1920*	*0*	*3702*	*16650*	*16650*	*0*	*16650*
Energy Consumed (kWh)	*N/A*	*9335300*	*38*	*0*	*1073600*	*7652700*	*18061638*	*0*	*18061638*
Energy Intensity (kWh/vol.)	*N/A*	*831*	*0*	*0*	*290*	*460*	*1085*	*0.0*	*1085*

Quantity of Self-Generated Renewable Energy

682,880 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

Data is based on actual billing for the the electrical accounts and the actual water use for calendar year 2020. All energy consumed by wells is reported as "Extract and Divert", which also includes the energy produced by solar panels at Windsor well site; "Placed in Storage" includes the energy to spread stormwater at Arroyo Seco (AS) spreading grounds; No energy is associated with "Conveyance" as the water is treated on-site; "Treatment" includes the energy used by Ventura booster to pump water from two wells to the Monk Hill Water Treatment Plant (MHTP); "Distribution" includes the energy used by all booster stations in Pasadena, except Ventura Booster Station, and the energy used by the two boosters outside the City of Pasadena's boundary, Allen and Santa Anita, is calculated from the SCE invoices.

Narrative:

PWP water supply consists of imported water from MWD, groundwater, and stormwater from the Arroyo Seco and Eaton Canyon streams spread by PWP in the Arroyo Seco spreading grounds, and by LA County in the Eaton Canyon spreading grounds. Stormwater is not used directly as PWP receives pumping credits for infiltrating the water. "Extract & Divert" includes Arroyo, Well 52, Windsor, Bangham, Sunset, Chapman, Woodbury, Twombly, and Wadsworth wells; "Place in Storage" includes water infiltrated by PWP in the Arroyo Seco spreading grounds; "Treatment" includes water pumped by Arroyo Well and Well 52 to the MHTP; "Distribution" includes Allen, Annandale, Arroyo, Atlanta, Craig, Eagle Rock, Glorietta, Jones, Linda Vista, Lida, Murray, Ross, Rutherford, Santa Anita, San Rafael, Thomas, and Wilson boosters stations.

APPENDIX C

PUBLIC HEARING AND COMMENTS

Proof of publication will be provided following the May 6 and May 13, 2021 publishing of the public hearing notice. No comments have been received to date regarding the Public Draft UWMP and WSCP.

APPENDIX D

RESOLUTION OF ADOPTION

RESOLUTION NO. _____

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF PASADENA, CALIFORNIA ADOPTING THE 2020 URBAN WATER MANAGEMENT PLAN AND THE WATER SHORTAGE CONTINGENCY PLAN

WHEREAS, the California Legislature enacted the Urban Water Management Planning Act (California Water Code, Sections 10610 through 10656) during the 1983-1984 Regular Session, and as amended subsequently, which requires that every urban water supplier that provides water to more than 3,000 customers or supplies more than 3,000 acre-feet of water annually shall prepare and adopt an urban water management plan every five years; and

WHEREAS, the City of Pasadena ("City") is an urban supplier of water providing water to a population of 170,400; and

WHEREAS, the City has prepared, and the City Council has approved the adoption of the 2020 Urban Water Management Plan ("UWMP") and the Water Shortage Contingency Plan ("WSCP") on June 7, 2021; and

WHEREAS, the City's 2020 UWMP and WSCP must be adopted after public review and hearing, and submitted to the California Department of Water Resources by July 1, 2021; and

WHEREAS, the City has therefore, prepared and circulated for public review a draft UWMP and WSCP, and a properly noticed public hearing regarding said UWMP and WSCP was held by the City Council on June 7, 2021.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF PASADENA AS FOLLOWS:

1. The 2020 Urban Water Management Plan ("UWMP") submitted concurrently herewith is hereby adopted and ordered filed with the City Clerk.
2. The 2020 Water Shortage Contingency Plan (WSCP), provided as Chapter 8 within the UWMP, is hereby adopted and ordered filed with the City Clerk.
3. The City Manager is hereby authorized and directed to file the 2020 UWMP and WSCP with the California Department of Water Resources by July 1, 2021, on behalf of the City.
4. The City Clerk is directed to attest his signature and affix the corporate seal of the City to said UWMP and WSCP.

Adopted at the regular meeting of the City Council of the City of Pasadena on the _____day of _____, 2021, by the following vote:

AYES:

NOES:

ABSENT:

ABSTAIN:

_____
Mark Jomsky, CMC
City Clerk

APPROVED AS TO FORM:

_____
Lisa Hosey
Assistant City Attorney

APPENDIX E

SB X7-7 COMPLIANCE FORMS

SB X7-7 Table 0: Units of Measure Used in 2020 UWMP* *(select one from the drop down list)*
Acre Feet
**The unit of measure must be consistent throughout the UWMP, as reported in Submittal Table 2-3.*
NOTES:

SB X7-7 Table 2: Method for 2020 Population Estimate	
Method Used to Determine 2020 Population (may check more than one)	
☑	**1. Department of Finance** (DOF) or **American Community Survey** (ACS)
☐	**2. Persons-per-Connection Method**
☐	**3. DWR Population Tool**
☐	**4. Other** DWR recommends pre-review
NOTES:	

SB X7-7 Table 3: 2020 Service Area Population	
2020 Compliance Year Population	
2020	170,400
NOTES:	

SB X7-7 Table 4: 2020 Gross Water Use							
Compliance Year 2020	2020 Volume Into Distribution System *This column will remain blank until SB X7-7 Table 4-A is completed.*	2020 Deductions					2020 Gross Water Use
		Exported Water *	Change in Dist. System Storage* (+/-)	Indirect Recycled Water *This column will remain blank until SB X7-7 Table 4-B is completed.*	Water Delivered for Agricultural Use*	Process Water *This column will remain blank until SB X7-7 Table 4-D is completed.*	
	29,346	56		-		-	**29,290**
* **Units of measure (AF, MG , or CCF)** must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.							
NOTES:							

SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment

Complete one table for each source.

Name of Source	Groundwater
This water source is *(check one)* **:**	
☑	The supplier's own water source
☐	A purchased or imported source

Compliance Year 2020	Volume Entering Distribution System [1]	Meter Error Adjustment [2] *Optional (+/-)*	Corrected Volume Entering Distribution System
	11,230	-	11,230

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES

SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s) Meter Error Adjustment

Complete one table for each source.

Name of Source	Imported water from MWD
This water source is *(check one)* **:**	
☐	The supplier's own water source
☑	A purchased or imported source

Compliance Year 2020	Volume Entering Distribution System [1]	Meter Error Adjustment [2] *Optional (+/-)*	Corrected Volume Entering Distribution System
	17,940		17,940

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment

Complete one table for each source.

Name of Source	Purched water from neighboring water agencies
This water source is *(check one)* **:**	
☐	The supplier's own water source
☑	A purchased or imported source

Compliance Year 2020	Volume Entering Distribution System [1]	Meter Error Adjustment [2] *Optional (+/-)*	Corrected Volume Entering Distribution System
	176		176

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.* [2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

SB X7-7 Table 5: 2020 Gallons Per Capita Per Day (GPCD)		
2020 Gross Water *Fm SB X7-7 Table 4*	**2020 Population** *Fm SB X7-7 Table 3*	**2020 GPCD**
29,290	170,400	**153**
NOTES:		

SB X7-7 Table 9: 2020 Compliance							
Actual 2020 GPCD[1]	Optional Adjustments to 2020 GPCD Enter "0" if Adjustment Not Used			TOTAL Adjustments[1]	Adjusted 2020 GPCD [1] *(Adjusted if applicable)*	2020 Confirmed Target GPCD [1, 2]	**Did Supplier Achieve Targeted Reduction for 2020?**
	Extraordinary Events[1]	Weather Normalization[1]	Economic Adjustment[1]				
153	-	-	-	-	153	169	**YES**

[1] *All values are reported in GPCD*

[2] ***2020 Confirmed Target GPCD*** *is taken from the Supplier's SB X7-7 Verification Form Table SB X7-7, 7-F.*

NOTES:

APPENDIX F

WATER SUPPLY RELIABILITY ANALYSIS

Appendix C: Water Supply Reliability Analysis

Appendix C provides a detailed description of the GoldSim modeling framework and the methodology used to conduct the water supply reliability analysis for the PWP Water System and Resources Plan (WSRP).

1. GOLDSIM MODEL

A water resources assessment was conducted for Pasadena Water and Power (PWP) using GoldSim software, a graphical platform used for visualizing and dynamically simulating complex systems that evolve over time. Models in GoldSim are built by drawing a diagram of the system with various "elements" that represent the components of the system being modeled, data, and relationships between the data. One of the main advantages of GoldSim is that it provides probabilistic simulation features to quantitively represent the inherent variability and uncertainty present in the system, allowing the user to evaluate how the system is likely to change over time. The model is also capable of comparing alternative scenarios and portfolios, effectively allowing users to preemptively quantify risks and to make strategic decisions that minimize that risk.

1.1 PWP Supply Reliability and Resiliency GoldSim Model

Though GoldSim is not specifically a water resources modeling tool, it is well suited for water resources and commonly applied to water resources settings. A GoldSim model was used to quantify the Supply Reliability and Resiliency of future water supplies available to PWP, as identified in the PWP WSRP. The modeling platform was selected to enable PWP to simulate the baseline conditions and various water resources options and full WSRP portfolios and use the simulation results to evaluate the most cost-effective portfolio that will meet the supply reliability and resiliency needs of PWP. The model simulated the WSRP portfolios for a 25-year planning horizon.

1.1.1 Questions the Model is Programmed to Answer

The PWP Supply Reliability and Resiliency GoldSim Model informed the PWP WSRP. Specifically, the model was used to answer questions related to the current and expected water supply reliability and resiliency. The model determined the future operational yield and reliability of the system under baseline conditions and nine portfolios that implement various water supply projects and programs. The model simulated expected water supplies with dynamic hydrologic factors and various projected demands on a monthly basis.

1.1.2 Modeling Method

The model utilized an index sequential method to quantify long-term reliability. In other words, the model imposed existing hydrology data to the 26-year planning period (2020 to 2045) until each recorded hydraulic year was applied to each planning year. The model incorporated imported water reliability projections and water allocations provided by

MWD's 2015 Integrated Water Resources Plan, which also uses an index sequential method. These projections were revised under the assumption that the California Water Fix will be replaced by implementation of the Delta Conveyance project.

To determine how much water enters the underlying groundwater basin, the model simulated the local hydrology of the region. Limitations such as historical Arroyo Seco and Eaton Wash stream flows, PWP's surface water diversion rights, pumping rights in the Monk Hill and Pasadena subareas, groundwater recharge and associated pumping credits, and system capacity constraints for existing wells, diversions, and other facilities were all accounted for in the model.

Key to index sequential simulation is the definition of a future period onto which the historical period is imposed. In the WSRP assessment, the planning period corresponds to 2020 to 2045 and the historical period runs from 1922 to 2018. The simulation model uses local hydrological data from 1922 to 2018 and imposes it on the 25-year planning period (2020 to 2045) until each recorded hydrology year is applied to each planning year. This allows the model to account for the inherent variability and uncertainty present in the system and predicts how likely the system is to change over time. Each sequence of 2020 to 2045 under a specific hydrology history is called a "realization". The model thus has 96 realizations.

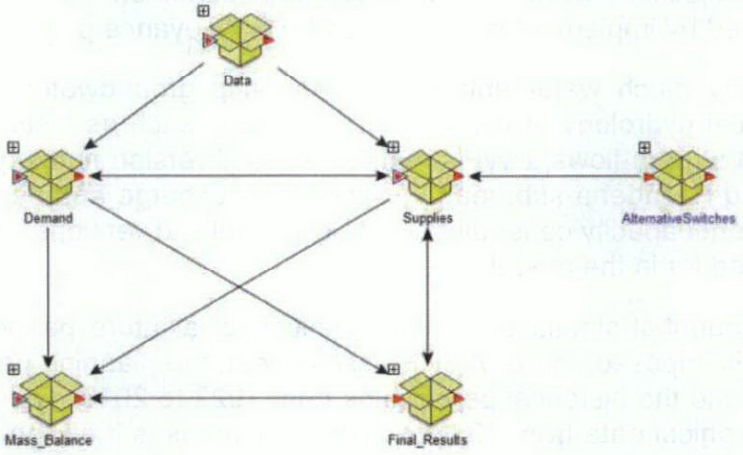
Model results are probabilistic, meaning that output results show 1) How many years will have a supply deficit, and 2) What is the extent of the water supply deficit. The percent of time demand is met and average shortage under the baseline conditions and each of the six water supply portfolios are shown in Chapter 7.

2. MODEL ORGANIZATION

2.1 GoldSim Model Elements

The systems model is organized into six containers. A container is an element that acts like a "box" or a "folder" into which other elements can be placed. It can be used to create hierarchical models, "top-down" models and organize models in which the level of detail increases farther into the containment hierarchy. The GoldSim model uses containers to organize PWP's water supplies in discrete and manageable sectors. The model is divided into six containers: Data, Water Demand ("Demand"), Water Supplies ("Supplies"), Alternative Project Switches ("AlternativeSwitches"), Supply Reliability and Resiliency Final Results ("Final_Results"), and a Mass Balance ("Mass_Balance") to ensure that all water supply inputs equal all water supply outputs. A general model diagram showing the relationship between the containers is shown Figure C-1.

Figure C-1: PWP Supply Reliability and Resiliency GoldSim Model Diagram



GoldSim offers a wide variety of elements from which the user can construct models. The major elements used to construct this specific model within the various containers identified in Figure C-1 include:

- **Data Elements**: Elements intended to represent a constant input. A Data element can represent both values and conditions (i.e. True/False), and can represent a single scalar value, an array (1-dimensionsl), or matrix (2-demensional) data. This model extensively uses this element for constants, rates, capacities, etc.
- **Time Series Elements:** Data elements with time histories of data. This element is used for historical demand and hydrology. Data can be both time shifted or run in an index-sequential mode over multiple realizations.
- **Reservoir Elements:** GoldSim includes reservoirs elements with pre-programmed rules for operating simple systems. Reservoirs allow the user to specify simple or dynamic values for the upper and lower levels, and the withdrawal rate. The spreading basins, groundwater basins, and long-term water storage in this model use this element.
- **Integrator Elements:** Elements that integrate rates. These are used to integrate and track information, such as accumulated flows for mass balance calculations. This GoldSim model uses this element for mass balance calculations.
- **Expression Elements:** A function element produces a single output by calculating user-specified mathematical expressions or equation. Expression elements are used extensively for model logic.
- **Allocator Elements:** Allocate an incoming signal to a number of outputs according to a specified set of demands and priorities. Typically, the signal will be a flow of water, distributed among a series or prioritized demands. This model uses this element in all of the spreading basin outflow elements to preserve the mass balance.

- **Lookup Table Elements:** A function element that allows the user to create a 1, 2, or 3-dimensional lookup table. Used, for example, for lake election-capacity tables. This model uses this element for some of the model logic, such as the pump curves.

2.2 Model Components

2.2.1 Data Container

The Data Container provides the basis for the model. Elements within the container identify the start year ("Start_Year") and simulation year ("Sim_Year") for the model. These elements are not intended to be modified by the model user.

2.2.2 Water Demand Container

The Water Demand Container identifies the current and projected water needs for PWP. Because water consumption is variable and dependent on the existing environment, the model incorporates all the possible conditions that could impact water consumption in the future. The "Demand_Proj" element defines the "Baseline Demand", "High Demand", and "Low Demand" projections developed as part of the PWP WSRP (see Section 2). The model user can alternate the demand scenario by modifying the demand series element ("Demand_Series") that specifies which scenario the model will simulate. This container also applies weather variability factors that influence demands both on a monthly basis ("Monthly_Demand_Factor") and on an annual basis ("WeatherFactor"). Monthly factors cause demands to peak in dry months, and annual factors cause demands to peak in drought years. These factors are applied to both potable ("D_Weather") and nonpotable ("D_NonPotable_Weather") demands. The weather factors were obtained from MWD for Pasadean with similar characteristics in southern California and are not intended to be modified by the user. The model user may turn on the Water Use Efficiency (WUE) program that reduces demand projections for both the potable (i.e. indoor) and nonpotable (i.e. outdoor) water demands (see Section 2).

2.2.3 Water Supplies Container

For organization purposes, the Water Supplies Container is further subdivided into seven sub-containers that allow the model user to better manipulate each of the discrete water supplies available to PWP. The seven sub-containers include: groundwater supplies ("Groundwater Supplies"), imported water supplies ("ImportedSupplies"), alternative direct non-potable water supplies ("Alt_DirectNonPotableSupplies"), alternative direct potable water supplies ("Alt_DirectPotableSupplies"), alternative banked and water transfers ("Alt_BankedTransfer"), alternative WUE ("Alt_WUE"), and additional local storage programs ("Alt_AdditionalLocalStorage").

2.2.3.1 Groundwater Supplies Container

The Groundwater Supplies Container simulates current and projected groundwater supplies in the Raymond Basin and is further subdivided into the Pasadena and Monk Hill Subarea containers. Though these two Subareas are modeled in two different containers, the general structure for modeling these two Subareas is very similar. Elements that are

designated with an "MH" or "AS" refer to Monk Hill Subarea or Arroyo Seco, and elements that are designated with a "P" or "EW" refer to Pasadena Subarea or Eaton Wash.

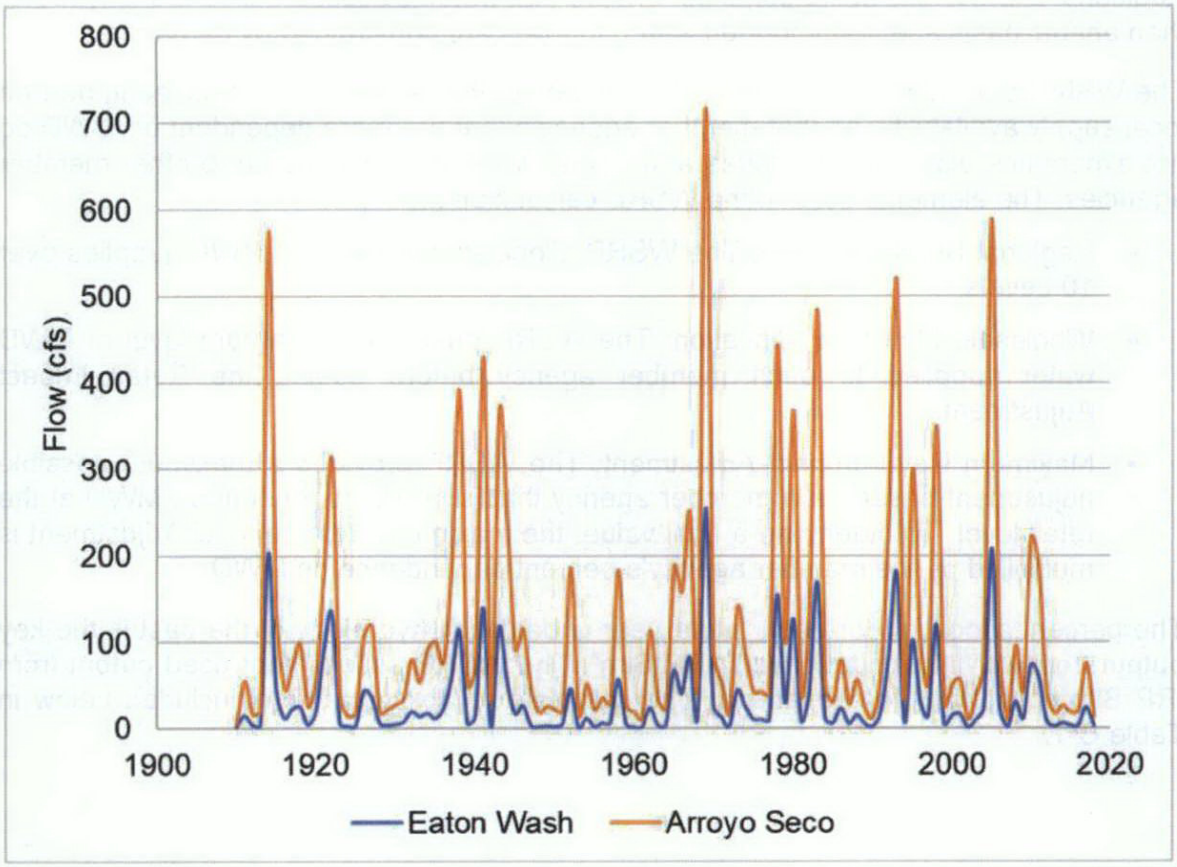
Within each subarea, PWP is entitled to: 1) an adjudicated groundwater right, 2) additional groundwater extraction credits from spreading of surface water diversions, and 3) long-term storage credits. Total groundwater extractions from these three rights and credits are constrained by the sum of the pumping capacity of the active wells in the Subarea. Three pumping capacity expression elements constrain pumping in each Subarea, with priority given to adjudicated rights, then spreading credits, followed by long-term storage. No additional pumping is possible once the pumping capacity has been met.

The adjudicated right ("*Subarea*_Adjudication") is a static data element determined by the adjudication judgement that is replenished every year. Adjudication groundwater rights are modeled as a reservoir ("*Subarea*_Adjudication_Pool"). Pumping from this pool is constrained by the total pumping capacity ("*Subarea*_Avg_AnnualPumpingCapacity") in the subarea and the total water demand in the PWP service area.

Following the adjudicated right, PWP is entitled to spreading credits that are determined by surface water diversions and spreading. For the Pasadena Subarea, Eaton Wash surface flows are diverted and spread in the Eaton Wash Spreading Grounds. For the Monk Hill Subarea, Arroyo Seco surface flows are diverted and spread in the Arroyo Spreading Grounds. Available surface water diversions are projected with an expression element that incorporates historical surface water flows for each stream ("*Stream*_Flow"), and is constrained by PWP's diversion rights ("*Stream*_DiversionRights"), the structural diversion capacity ("*Stream*_DiversionCapacity"), and spreading capacity ("*SpreadingBasin*_SpreadingCapacity"). Each spreading basin is modeled by a reservoir with inflows defined as the surface water diversions and outflows defined as the infiltration rate and evaporation rate. The infiltration rate ("*SpreadingBasin*_InfiltrationRate") is then used as an input to the credit pool expression element that calculates the spreading credits available to PWP after applying a predetermined administrative groundwater loss ("*SpreadingBasin*_Admin_Losses") for the subarea. The remaining credits ("*SpreadingBasin*_CreditPool") are the inflow to the spreading credits pool reservoir element ("*SpreadingBasin*_SpreadingCreditsPool"). Pumping from this pool is constrained by 1) the pumping capacity in the subarea minus the volume pumped in the adjudicated right; and 2) the total water demand in the PWP service area minus the adjudication water supplies.

Arroyo Seco flow data were obtained from the United States Geological Survey (USGS) for the years 1910 through 2018 (Station 1109800). Eaton Wash flow data were also obtained from USGS for the years 1918 through 1966 and extrapolated through 2018 (Station 11101000). Figure C-2 shows the historical Arroyo Seco and Eaton Wash hydrographs.

Figure C-2: Arroyo Seco and Eaton Wash Hydrographs



Finally, the long-term groundwater storage is a reservoir element ("*Subarea*_LongTerm_Storage") constrained by the remaining water demand and pumping capacity after the groundwater extractions earned from the spreading credits. The long-term groundwater storage was provided by PWP.

Alternative water supply projects that either maintain or rehabilitate existing pumping facilities or augment pumping capacity are all elements that directly modify the annual pumping capacity expression element ("*SpreadingBasin*_Avg_AnnualPumping Capacity"). Alternative water supply projects that either 1) increase capacity for groundwater recharge, or 2) increase water supplies for recharge (either through surface water diversions or recycled water) directly modify inflows to or recharge within the Arroyo Seco or Eaton Wash Spreading Grounds ("Alt_GW_EW_Recharge" or "Alt_GW_AS_Recharge"). Some projects also increase the surface diversion flows from Arroyo Seco or Eaton Wash.

2.2.3.2 Imported Water Supplies Container

The Imported Water Supplies container simulates PWP's imported water supplies. It calculates monthly imported water supplies using an imported water allocation expression ("InitialMnAllocation") and an imported water reliability matrix obtained from MWD and

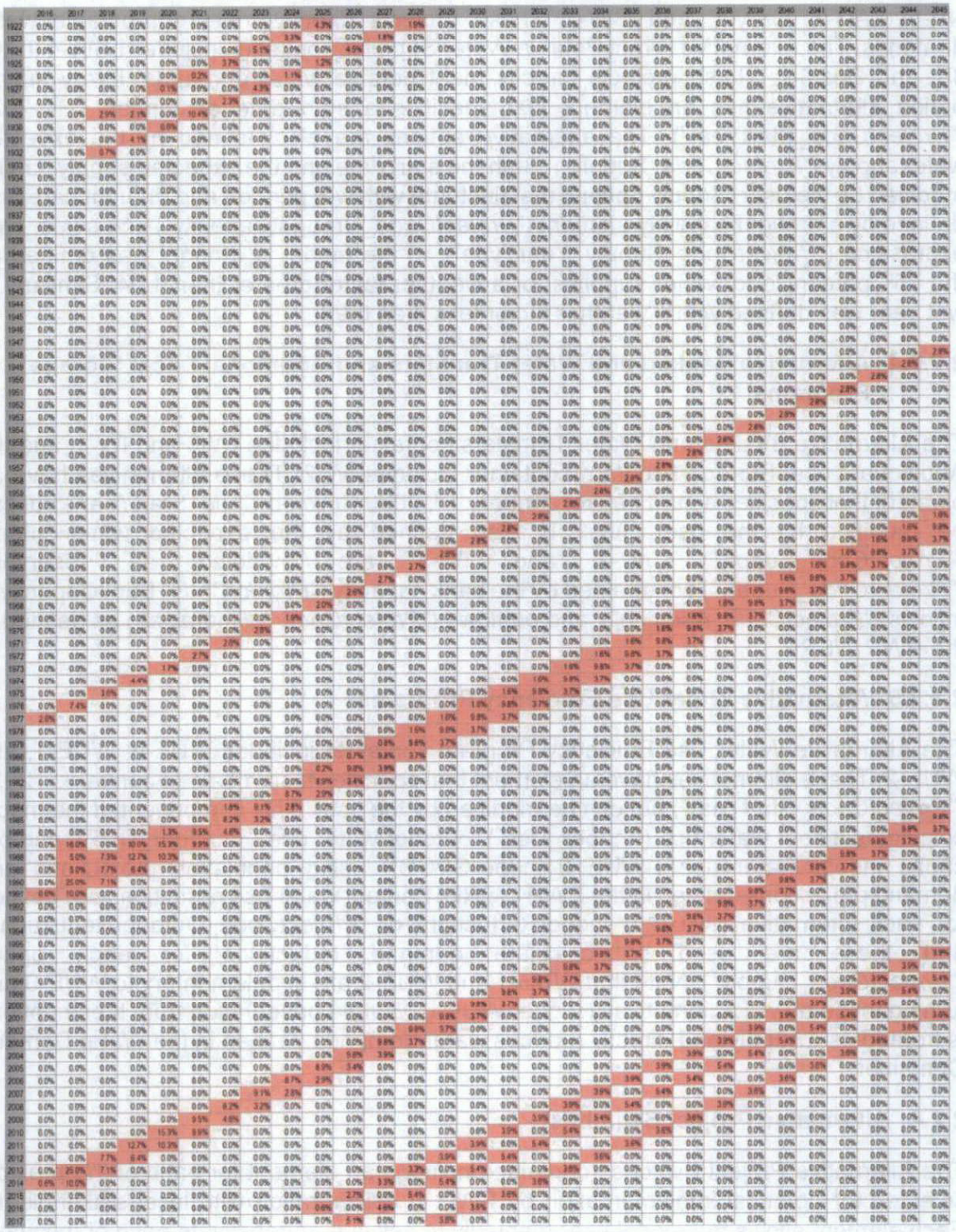
modified to account for recent events with the CalWater Fix project ("IRP_Reliability"). Additional expressions in the container ensure that water is allocated on a monthly rather than annual basis and that imported water supplies are constrained by demands.

The WSRP is a "needs based" allocation, meaning that allocations are based in part on local supply availability, so that member agencies that are more dependent on MWD do not experience disparate shortages at the retail level when compared to other member agencies. The elements used in the WSRP calculation are:

- Regional Shortage Level: The WSRP allocates shortages of MWD supplies over 10 Levels.
- Wholesale Minimum Allocation: The WSRP provides a minimum level of MWD water supplied to each member agency before adding the Retail Impact Adjustment.
- Maximum Retail Impact Adjustment: The WSRP provides a maximum possible adjustment based on a member agency that is 100% dependent on MWD at the retail level. To determine a final value, the maximum Retail Impact Adjustment is multiplied by the member agency's percent dependence on MWD.

The percent allocation for each future year under each hydrology of the past is the key output from MWD's model called "IRP Sim". The WSRP assessment used output from IRP Sim specifically for Pasadena. The complete reliability matrix is included below in Table C-1.

Table C-1: Reliability Matrix from MWD for Pasadena, Extended to 2018, Without California Water Fix



2.2.3.3 Alternative Direct Non-potable and Potable Water Supplies

The Alternative Direct Non-potable Water Supplies container includes NP-1, NP-2, NP-3, NP-6, LAG-1, Grey-1, and GW-3. These projects directly meet non-potable water demands. The Alternative Direct Potable Water Supplies container includes LSW-4, LAG-3b, and Desal-1. These projects directly meet potable water demands. Every supply option alternative has an element that specifies a start date of January 1st, 2020 ("*ProjectCode*_StartYear"). The alternative options are also defined by the expected water supply ("*ProjectCode*_Supply"). Both the start date and the expected supply can be modified by the user. Supply options that fluctuate with wet periods and droughts are also defined by a drought capacity element ("*ProjectCode*_DroughtCapacity") and a year type expression ("*ProjectCode*_Supply_YearType"). In the model, a drought was defined as the 75th percentile for water supplies, or a weather factor greater than 1.04. Similarly, a wet year was defined with a weather factor less than 0.98.

2.2.3.4 Alternative Banked and Water Transfers and Additional Local Storage Programs

The Alternative Banked and Water Transfers container includes IW-3 and IW-1, and the Additional Local Storage Program container includes IW-2. These alternatives have an element that specifies a start date of January 1st, 2020 ("*ProjectCode*_StartYear") but can be modified by the user. IW-1 is also defined by the expected water supply ("*ProjectCode*_Supply"). IW-2 and IW-3 are modeled as reservoirs ("*ProjectCode*_Supply") constrained by the bank capacity ("*ProjectCode*_BankCapacity"), inflows ("*ProjectCode*_Addition"), and outflows ("*ProjectCode*_Withdrawal") as defined in the PWP WSRP.

2.2.3.5 Alternative Water Use Efficiency Programs

The Alternative Water Use Efficiency Program container includes WUE-0, WUE-1, and WUE-2. These alternatives have an element that specifies a start date of January 1, 2020 ("*ProjectCode*_StartYear") but can be modified by the user. This component of the model calculates indoor water use ("Indoor_Use"), outdoor water use ("Outdoor_Use"), and per capita indoor water use ("WUE_0_IndoorGPCD") using population projections and demand projections defined in the PWP WSRP. Percent water use reductions are defined for each alternative ("WUE_0_IndoorReduction" or "*ProjectCode*_OutdoorReduction"), and these are used to calculate demand reductions for each option ("*ProjectCode*_Supply"). Note that WUE-1 and WUE-2 are supplementary to WUE-0 and turning these on will automatically trigger WUE-0. Water conservation from these options is treated as a supply and directly reduces water demands defined in the Water Demand Container.

2.2.4 Alternative Project Switches

The Alternative Project Switches container includes an element for each of the projects selected for potential implementation by PWP in collaboration with local stakeholders. Each element allows the model user manually to activate or deactivate each of the water resources options alternatives identified as part of the PWP WSRP. Each project element

is a binomial element where a "0" will deactivate the water supply project, and a "1" will activate the water supply project. Note that because of the nature of the projects, exceptions apply for GW-0 and GW-00. Portfolios that only select GW-0 should indicate a "1" for GW-0 and a "0" for GW-00, portfolios that identify both GW-0 and GW-00 should denote a "0" for both projects, and portfolios that neither select GW-0 nor GW-00 should indicate a "1" for both projects.

2.2.5 Supply Reliability and Resiliency Final Results Container

The Final Results container calculates water supply shortages based on the simulated water demands and supplies. The total demand is reduced by each project's expected water supply ("Final_*ProjectCode*") in a successive manner to calculate the remaining demand ("D_After_*ProjectCode*"). Water supply use is constrained by the remaining water demand, meaning that water supply use does not exceed water demands. The predetermined order of water supplies employed to meet demands are as follows: 1) water use efficiency projects, 2) nonpotable water supply projects, 3) groundwater adjudication allocation supplies, 4) Eaton Wash groundwater spreading credits, 5) Arroyo Seco groundwater spreading credits, 6) nonpotable groundwater supplies, 7) long-term groundwater storage supplies, 8) direct potable water supply projects excluding imported water projects, 9) imported water supply allocation, and 10) alternative imported water supply projects. The remaining demand is equal to the supply shortage.

3. MODEL SIMULATIONS

For the PWP WSRP, the model simulated expected supply reliability using the baseline demand projection and realization #66. A realization is a single model run within a Monte Carlo simulation that represents one possible path the system could follow through time. In this model, realization #66 represents the path with the highest expected supply shortages. It represents the hydrology sequence from 1987 to 2016 and includes the 1987-1992 drought and the 2011-2016 drought. The Supply Reliability and Resiliency derived from the simulated supply shortages are summarized in Chapter 4 of the PWP WSRP.

APPENDIX G

WATER WASTE ORDINANCE

Introduced by Councilmember Gordo

ORDINANCE NO. 7298

AN ORDINANCE OF THE CITY OF PASADENA AMENDING PASADENA MUNICIPAL CODE TITLE 13, CHAPTER 13.10, WATER WASTE PROHIBITIONS AND WATER SUPPLY SHORTAGE PLANS

The People of the City of Pasadena ordain as follows:

SECTION 1. This ordinance, due to its length and the corresponding costs of publication, will be published by title and summary as permitted by Section 508 of the City Charter. The approved summary of this ordinance reads as follows:

"**SUMMARY**

The purpose of Ordinance No. 7298 is to amend Title 13, Chapter 13.10 of the Pasadena Municipal Code to modify the requirements of the ordinance to align with current state requirements, incorporate conservation measures previously adopted by the City Council to address water shortages, promote more efficient water use on a permanent basis, and provide additional clarity and reflect prior City council direction when implementing Water Supply Shortage Plans.

This ordinance shall take effect upon its publication."

SECTION 2. Title 13, Chapter 13.10, Section 13.10.020 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.020 - Definitions.

The following words and phrases whenever used in this chapter shall have the meanings defined in this section:

A. "Billing unit" means the unit of water used to apply water rates for purposes of calculating water charges for a customer's water usage and equals one hundred cubic feet (HCF) or 748 gallons.

B. "Customer" means any person, persons, association, corporation, or governmental agency supplied and billed for water service by the department.

C. "Department" means the City of Pasadena Water and Power Department.

D. "Groundwater" means any water extracted through an excavation or structure created in the ground within the City of Pasadena.

E. "Newly Planted Drought Tolerant Landscape" means a landscape area which has been planted or replanted with native plants with relatively low water requirements or plants that are well adapted to arid climate, within the prior six (6) months.

F. "Person" means any individual person or persons, corporation, public or private entity, governmental agency or institution, including all agencies and departments of the City of Pasadena, or any other user of water provided by the department.

G. "Potable water" means water that is suitable for drinking.

H. "Recycled water" means the reclamation and reuse of non-potable water for beneficial use.

I. "Single pass cooling systems" means equipment where water is circulated only once to cool equipment before being disposed.

J. "Water conservation target" means the necessary percentage reduction in the department's total water sales to eliminate or mitigate a water supply shortage."

SECTION 3. Title 13, Chapter 13.10, first clause of Section 13.10.030 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.030 - Application.

The provisions of this chapter apply to any person in the use of groundwater or any potable water provided by the department, except for the following water uses:"

SECTION 4. Title 13, Chapter 13.10, Section 13.00.032 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.032 - Permanent water conservation requirements.

The following water conservation requirements are effective at all times and are permanent. Violations of this section constitute waste and an unreasonable use of water.

A. Limits on Watering Days: Watering or irrigating of lawn, landscape or other vegetated area is limited to 3 days per week year round, on a schedule to be determined by the Department General Manager, except by use of a hand-held bucket or similar container, a hand-held hose equipped with a water shut-off nozzle or device, or for very short periods of time for the express purpose of adjusting or repairing an irrigation system.

B. Limits on Watering Hours: Watering or irrigating of lawn, landscape or other vegetated area is prohibited between the hours of 9:00 a.m. and 6:00 p.m. on any day, except by use of a hand-held bucket or similar container, a hand-held hose equipped with a water shut-off nozzle or device, or for very short periods of time for the express purpose of adjusting or repairing an irrigation system.

C. No Watering During Periods of Rain: Watering or irrigating of lawn, landscape or other vegetated area during and within 48 hours after periods of rain is prohibited.

D. No Water Flow or Runoff: Watering or irrigating any lawn, landscape or other vegetated areas in a manner that causes or allows runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots or structures is prohibited.

E. No Watering Turf on Public Street Medians: Watering ornamental turf on public street medians with potable water is prohibited.

F. No Washing Down Hard or Paved Surfaces: Washing down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking areas, tennis courts, patios or alleys, is prohibited except as follows: (i) where necessary to alleviate safety or sanitary hazards and then only by use of a hand-held bucket or similar container, a hand-held hose equipped with a water shut-off nozzle or device; or (ii) when using a low-volume high-pressure cleaning machine equipped to recycle any water used, or a low-volume high-pressure water broom.

G. Obligation to Fix Leaks, Breaks or Malfunctions: Loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system for any period of time after such escape of water should have reasonably been discovered and corrected and in no event more than 7 days of receiving notice from the Department is prohibited.

H. Recirculating Water Required for Water Fountains and Decorative Water Features: Operating a water fountain or other decorative water feature that does not use re-circulated water is prohibited.

I. Limits on Washing Vehicles: Using water to wash a vehicle, including but not limited to any automobile, truck, van, bus, motorcycle, boat or trailer, whether motorized or not, is prohibited, except by use of a hand-held bucket or similar container or a hand-held hose equipped with a water shut-off nozzle or device. This subsection does not apply to any commercial car washing facility.

J. Drinking Water Served Upon Request Only: Eating or drinking establishments, including but not limited to a restaurant, hotel, cafe, cafeteria, bar or other public place where food and drinks are sold, served or offered for sale, are prohibited from providing drinking water to any person unless expressly requested by the patrons.

K. Restaurants Required to Use Water Conserving Dish Wash Spray Valves: Food preparation establishments, such as restaurants, cafes and cafeterias, are prohibited from using non-water conserving dish wash spray valves.

L. Commercial Lodging Establishments Shall Provide Guests Option to Decline Daily Linen Services: Hotels, motels and other commercial lodging

establishments must provide customers the option of not having towels and linens laundered daily. Commercial lodging establishments must prominently display notice of this option in each guestroom using clear and easily understood language.

M. No Installation of Single Pass Cooling Systems: Installation of single pass cooling systems is prohibited in buildings requesting new water service.

N. No Installation of Non-recirculating equipment in Commercial Car Wash and Laundry Systems: Installation of non-recirculating water systems is prohibited in new commercial conveyor car washes and new commercial laundry systems.

O. Commercial Car Wash Systems: All commercial conveyor car wash systems must have installed operational re-circulating water systems or must have secured a waiver of this requirement from the city of Pasadena.

P. Multifamily Properties: All master-metered Multifamily properties with four or more dwelling units are required to certify (through a process determined by the Department) that showerheads and aerators are retrofitted to meet current California Green Building Code standards."

SECTION 5. Title 13, Chapter 13.10, Section 13.10.035 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.035 - Water shortage plan implementation.

The department shall monitor and evaluate the projected supply and demand for water by its customers. In the event of a water shortage, the department shall recommend that the city council make a determination that a water shortage exists and which water shortage level as provided in this chapter permits the department to prudently plan for and supply water to its customers. Prior to implementation of a water shortage level as provided in this chapter, the city council shall hold a public hearing for the purposes of determining: (i) whether a water shortage exists; (ii) the water conservation target that is necessary; and, (iii) which level of water supply shortage provided in this chapter is appropriate to address the water shortage. Notice of the time and place of said public hearing shall be published not less than 10 days before the hearing in a newspaper of general circulation within the city. The city council's determination shall be made by public proclamation and shall become effective immediately upon such publication. The City Council may during the period of the declared water shortage take actions to modify the water conservation target, implement a different level of water supply shortage, or order the implementation or discontinuation of any additional water conservation measures appropriate to address the water shortage by motion, and without conducting a public hearing.

SECTION 6. Title 13, Chapter 13.10, Section 13.10.036 of the Pasadena Municipal Code is hereby added to read as follows:

"13.10.036 - Water shortage termination.

During the course of a water shortage declared pursuant to this chapter, the department shall continuously reevaluate water supply availability. When adequate supplies are available, the department shall recommend that the city council make a determination that a water shortage no longer exists. Prior to terminating a declared water shortage as provided in this chapter, the city council shall hold a public hearing for the purposes of determining whether: (i) the water shortage no longer exists; or (ii) a water shortage plan implementation shall continue. Upon a finding by the city council that a water shortage no longer exists, any water shortage level then in effect shall terminate."

SECTION 7. Title 13, Chapter 13.10, Section 13.10.037 of the Pasadena Municipal Code is hereby added to read as follows:

"Section 13.10.037 - Exemptions from Watering Day Limitations

The following uses of potable water, as determined by the Department in its sole discretion, are exempt from the more restrictive watering day limitations set forth in sections 13.10.040 through 13.10.052 of this chapter (Water Supply Shortage Levels 1 through 4):

A. Landscape irrigation zones that exclusively use low flow drip type irrigation systems where no emitter produces more than 2 gallons of water per hour;
B. Watering or irrigating by use of a hand-held bucket or similar container, or a hand-held hose equipped with a water shut-off nozzle or device;
C. Watering for very short periods of time for the express purpose of adjusting or repairing an irrigation system;
D. Maintenance of trees as necessary to sustain their health and viability;
E. Maintenance of vegetation, including fruit trees and shrubs, intended for consumption;
F. Maintenance of landscape for fire protection;
G. Maintenance of landscape for soil erosion control;
H. Maintenance of plant materials identified to be rare or essential to the well-being of protected species;
I. Maintenance of landscape within active public parks and playing fields including playing fields on school grounds and at day care centers, provided that such irrigation is for the express purpose of maintaining the landscape in a condition required for recreation playing fields and athletic events, and does not exceed 3 days per week;
J. Establishment of newly planted drought tolerant landscape consisting of drought tolerant plants, shrubs, and/or native plants; and
K. Actively irrigated environmental mitigation projects."

SECTION 8. Title 13, Chapter 13.10, Section 13.10.040 Subsection B.1 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.040 - Level 1 water supply shortage.

B. Water Conservation Measures: The following water conservation requirements apply during a declared level 1 water supply shortage:

1. Limits on Watering Days: Watering or irrigating of lawn, landscape or other vegetated area is limited to 3 days per week from April 1 through October 31, and no more than 1 day per week from November 1 through March 31, on a schedule established and posted by the department. This subsection does not apply to categories of use determined to be exempt under Section 13.10.037 of this chapter."

SECTION 9. Title 13, Chapter 13.10, Section 13.10.045 Subsections B.1 and B.3 of the Pasadena Municipal Code are hereby amended to read as follows:

"13.10.045 - Level 2 water supply shortage.

B. Water Conservation Measures: The following water conservation requirements apply during a declared level 2 water supply shortage:

1. Limits on Watering Days: Watering or irrigating of lawn, landscape or other vegetated area with water is limited to 2 days per week from April 1 through October 31, and no more than 1 day per week from November 1 through March 31, on a schedule established and posted by the department. This subsection does not apply to categories of use determined to be exempt under Section 13.10.037 of this chapter.
3. Limits on Filling Ornamental Lakes or Ponds: Filling or re-filling ornamental lakes or ponds is prohibited, except to the extent needed to sustain aquatic life, or for lakes and ponds that may be used for wildfire suppression."

SECTION 10. Title 13, Chapter 13.10, Section 13.10.050 Subsections B.1 and B.3 of the Pasadena Municipal Code are hereby amended to read as follows:

"13.10.050 - Level 3 water supply shortage.

B. Water Conservation Measures: The following water conservation requirements apply during a declared level 3 water supply shortage:

1. Limits on Watering Days: Watering or irrigating of lawn, landscape or other vegetated area is limited to 1 day per week, according to a schedule established and posted by the department. This subsection does not apply to categories of use determined to be exempt under Section 13.10.037 of this chapter.
3. Limits on Filing Ornamental Lakes or Ponds: Filling or re-filling ornamental lakes or ponds is prohibited, except to the extent needed to sustain aquatic life, or for lakes and ponds that may be used for wildfire suppression."

SECTION 11. Title 13, Chapter 13.10, Section 13.10.052 Subsections B.1, B.3 and B.4 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.052 - Level 4 water supply shortage — Emergency condition.

B. Water Conservation Measures: The following water conservation requirements apply during a declared level 4 water supply shortage:

1. No Watering or Irrigating: Watering or irrigating of lawn, landscape or other vegetated area is prohibited. This restriction does not apply to categories of use determined to be exempt under Section 13.10.037 of this chapter.
3. Limits on Filling Ornamental Lakes or Ponds: Filling or re-filling ornamental lakes or ponds is prohibited, except to the extent needed to sustain aquatics life, or for lakes and ponds that may be used for wildfire suppression.
4. Limits on Filling Single Family Residential Swimming Pools and Spas: Refilling of more than 1 foot and initial filling of single family residential swimming pools or outdoor spas is prohibited."

SECTION 12. The first sentence of Title 13, Chapter 13.10, Section 13.10.075 of the Pasadena Municipal Code is hereby amended to read as follows:

"13.10.075 - Right to hearing—Stay.

Any customer receiving a notice of violation with a monetary fine, potential flow restrictor or service disconnection shall have a right to a hearing by the general manager of the department, or his or her designee, on the merits of the alleged violation upon that customer's written request to the department."

SECTION 13. The City Clerk shall certify the adoption of this ordinance and shall cause this ordinance to be published by title and summary.

SECTION 14. This ordinance shall take effect upon its publication.

Signed and approved this 13th day of March, 2017.

Terry Tornek
Mayor of the City of Pasadena

I HEREBY CERTIFY that the foregoing Ordinance was adopted by the City Council at its meeting held this 13th day of March, 2017, by the following votes:

AYES: Councilmembers Hampton, Kennedy, Madison, McAustin, Wilson, Mayor Tornek

NOES: None

ABSENT: Councilmember Gordo, Vice Mayor Masuda

ABSTAIN: None

Date Published: March 15, 2017

Mark Tomsky, CMC
City Clerk

APPROVED AS TO FORM:

3/9/17
Lisa Hosey
Deputy City Attorney

Ordinance Fact Sheet

TO: CITY COUNCIL DATE: FEBRUARY 27, 2017

FROM: CITY ATTORNEY

SUBJECT: AMENDMENT OF WATER WASTE PROHIBITIONS AND WATER SUPPLY SHORTAGE PLANS ORDINANCE

TITLE OF PROPOSED ORDINANCE:

AN ORDINANCE OF THE CITY OF PASADENA AMENDING PASADENA MUNICIPAL CODE TITLE 13, CHAPTER 13.10, WATER WASTE PROHIBITIONS AND WATER SUPPLY SHORTAGE PLANS

PURPOSES OF THE ORDINANCE:

The purpose of this Ordinance is to revise Title 13, Chapter 13.10 of the Pasadena Municipal Code to: align it with current state requirements, incorporate conservation measures previously adopted by the City Council to address water shortages, promote more efficient water use on a permanent basis, and provide additional clarity to reflect prior City council direction when implementing Water Supply Shortage Plans.

REASONS WHY LEGISLATION IS NEEDED:

In 2015, Governor Edmund G. Brown, Jr. called for a 25 percent reduction in urban water use and, as a result, the Pasadena City Council called for increased water conservation in the City by implementing the Level 2 Water Supply Shortage Plan on June 1, 2015. More recently, on May 9, 2016, Governor Brown built upon the State's conservation success and signed Executive Order B-37-16 to establish long-term water conservation measures and improve planning for more frequent and severe droughts. The proposed amendments to the ordinance enhance the City Council's ability to make timely adjustments to an ongoing water shortage, reduce administrative burden and costs, and provide additional clarity and alignment with State requirements.

03/13/2017

MEETING OF ~~02/27/2017~~

AGENDA ITEM NO. ~~20~~ 19

CALIFORNIA ENVIRONMENTAL QUALITY ACT:

On February 6, 2017, the City Council found that the proposed revisions to the ordinance to encourage water conservation and prevent water waste are categorically exempt from the California Environmental Quality Act ("CEQA") pursuant to State CEQA Guidelines Section 15307 (Actions by Regulatory Agencies for the Protection of Natural Resources).

PROGRAMS, DEPARTMENTS OR GROUPS AFFECTED:

The Pasadena Water and Power Department, its customers and the general public will be impacted by this Ordinance.

FISCAL IMPACT:

There is no fiscal impact as a result of this action. The recommended actions are not expected to substantially change water sales or administrative costs associated with water conservation and waste enforcement activities. Any outreach costs will be absorbed in the FY2017 budget for water conservation programs.

POLICY CHANGES:

The proposed actions are consistent with the Water Integrated Resource Plan, the 2015 Urban Water Management Plan, the Urban Environmental Accords Goal to reduce potable water use, and the City Council Strategic Planning Goals to increase conservation and sustainability.

Respectfully submitted,

Michele Beal Bagneris
City Attorney

Prepared by:

2/23/17

Lisa Hosey
Deputy City Attorney

Concurrence:

Steve Mermell
City Manager

Introduced by Councilmember Gordo

Ordinance No. 7298

AN ORDINANCE OF THE CITY OF PASADENA AMENDING PASADENA MUNICIPAL CODE TITLE 13, CHAPTER 13.10, WATER WASTE PROHIBITIONS AND WATER SUPPLY SHORTAGE PLANS

The People of the City of Pasadena ordain as follows:

SECTION 1. This ordinance, due to its length and the corresponding costs of publication, will be published by title and summary as permitted by Section 508 of the City Charter. The approved summary of this ordinance reads as follows:

"SUMMARY

The purpose of Ordinance No. 7298 is to amend Title 13, Chapter 13.10 of the Pasadena Municipal Code to modify the requirements of the ordinance to align with current state requirements, incorporate conservation measures previously adopted by the City Council to address water shortages, promote more efficient water use on a permanent basis, and provide additional clarity and reflect prior City council direction when implementing Water Supply Shortage Plans.

This ordinance shall take effect upon its publication."

SECTION 2. The City Clerk shall certify the adoption of this ordinance and shall cause this ordinance to be published by title and summary.

SECTION 3. This ordinance shall take effect upon its publication.

Signed and approved this 13th day of March, 2017.

Terry Tornek
Mayor of the City of Pasadena

I HEREBY CERTIFY that the foregoing ordinance was adopted by the City Council at its meeting held this 13th day of March, 2017, by the following vote:

AYES: Councilmembers Hampton, Kennedy, Madison, McAustin, Wilson, Mayor Tornek

NOES: None

ABSENT: Councilmember Gordo, Vice Mayor Masuda

ABSTAIN: None

Date Published: March 15, 2017

Mark Jomsky, CMC
CITY CLERK

Approved as to form:

3/9/17

Lisa Hosey
Deputy City Attorney

APPENDIX H

SEISMIC VULNERABILITY ASSESSMENT RANKING

Seismic Vulnerability Assessment
City of Pasadena
Ranking

Prepared for:
City of Pasadena

Prepared by:

G&E Engineering Systems Inc.
6315 Swainland Rd
Oakland, CA 94611
(510) 595-9453 (510) 595-9454 (fax)

G&E Report 81.01.11, Revision 0
December 11, 2006

Table of Contents

1.0 Findings

A Seismic Vulnerability Assessment has been performed for the City of Pasadena water system. The findings have been document in (G&E, 2006).

The Seismic Vulnerability Assessment developed a Seismic Improvement Program (SIP) that includes upgrades for different components of the water system. These upgrades are called grouped into four packages. Not all seismic upgrades are equally critical, so the SIP is organized into four levels:

- P1 (Package 1, highest priority). Includes those items that address a material life-safety aspect, and those items which have very high benefit-to-cost.
- P2 (Package 2, high priority). Includes all the items in P1, plus those items which will improve system performance and greatly reduce damage to infrastructure in the more probable earthquakes.
- P3 (Package 3, moderate priority). Includes all the items in P2, plus those items which will improve system performance and greatly reduce damage to infrastructure in design-basis (code-based 475-year return period) earthquakes.
- P4 (Package 4, lower priority). Includes all the items in P3, plus those items that could reasonably be done to upgrade facilities to withstand very rare earthquakes (2,475-year return period), should the consequences in the very rare earthquakes be particularly hazardous.

Table 1-1 summarizes the costs for the SIP. The costs throughout this report (unless otherwise noted) are in year 2005 dollars, and include construction, engineering, planning, and inspection.

Item	P1	P2	P3	P4
Reservoirs	$1,380,700	$4,793,000	$7,449,000	$16,401,400
Pumping Plants	$102,425	$189,425	$306,925	$470,925
Wells	$635,825	$896,825	$969,825	$969,325
Total	$2,118,950	$5,879,250	$8,725,250	$17,841,650
Total (rounded)	$2,120,000	$5,880,000	$8,730,000	$17,840,000

Table 1-1. SIP Costs

Given the seismic vulnerabilities in the existing water system, we recommend that SIP package P3 be adopted. The P3 package addresses the primary seismic vulnerabilities at each reservoir, pump station and well, and is geared to upgrading the water system to be more resilient to withstand earthquakes that might occur once every 475 years (10% chance in 50 years). The P4 package includes additional reservoir upgrades to make them more resilient to withstand earthquakes that might occur once every 2,475 years (2%

chance in 50 years); but the extra cost in P4 (about double the P3 cost) is not considered cost effective relative to the small chance of such rare earthquakes.

We recommend that the P3 seismic improvements be implemented in 15 years, to be complete by the end of the year 2020. Section 2 of the report ranks the relative importance of each of the 46 facilities (18 reservoir projects, 28 pumping plant and well projects) that should be upgraded. The ranking considers the seismic vulnerability of each facility, the life safety consequences should the facility be damaged, the facility's post earthquake and normal operational functions, and the cost effectiveness of each upgrade.

A fifteen year schedule is provided to implement the upgrades. In developing he schedule, the main focus was to upgrade higher priority facilities in the early years. Additional considerations were made to balance the schedule to allow for approximately an even rate of expenditure in each year, all upgrades at individual facilities should be done at the same time, similar-style upgrades at multiple facilities are grouped together. The actual schedule may be modified to consider concurrent non-seismic improvements as needed at each facility.

1.1 Abbreviations

EQ	Earthquake
G&E	G&E Engineering Systems Inc.
P1, P2, P3, P4	Package numbers
PGA	Peak Ground Acceleration (g)
SIP	Seismic Improvement Program

2.0 Prioritization and Scheduling

Given the findings in the Seismic Vulnerability Assessment report (G&E, 2006), we recommend that SIP package P3 be adopted. The P3 package addresses the primary seismic vulnerabilities at each reservoir, pump station and well, and is geared to upgrading the water system to be more resilient to withstand earthquakes that might occur once every 475 years (10% chance in 50 years). The P4 package includes additional reservoir upgrades to make them more resilient to withstand earthquakes that might occur once every 2,475 years (2% chance in 50 years); but the extra cost in P4 is not considered cost effective relative to the rare chance of such rare earthquakes.

In prioritizing all the upgrades in P3, Section 2 does not specifically address other concurrent work that might take place at the facilities. Other concurrent work might include non-seismic maintenance or other system upgrade activities that might be required. It is recommended that the work items in this report be combined with other maintenance and system upgrades.

2.1 Reservoirs

Table 2-1 ranks the relative importance of seismic upgrade for each reservoir.

Reservoir	Cost	EQ Risk	EQ Life Safety	EQ System Operability	Normal Operations and Maintenance	Cost Effectiveness	Total Points	Resrvoir Ranking	Overall Ranking
Weight		3	3	5	1	1			
Lida	$151,000	3	2	3	4	2	38	13	34
Mirador	$94,000	7	1	3	4	3	49	7	18
Annandale	$75,400	0	1	1	6	3	20	15	42
Eagle Rock	$75,400	0	1	1	5	1	15	18	46
Gould 1	$19,000	2	1	1	4	0	18	16	44
Gould 2	$19,000	2	1	1	4	0	18	17	45
Windsor	$636,400	3	3	7	2	3	61	2	2
Sheldon 1	$422,200	4	1	6	0	2	49	8	19
Sheldon 2	$251,300	8	1	5	0	3	58	4	4
Sunset 1	$822,000	6	1	6	0	3	57	5	5
Sunset 2	$648,300	5	1	7	0	3	59	3	3
Calaveras	$405,300	8	2	6	5	3	71	1	1
Allen	$1,119,700	3	5	5	0	2	53	6	7
Santa Anita	$1,084,000	3	5	4	0	2	48	9	20
DonBenit.1	$1,426,000	4	2	3	2	3	41	11	30
DonBenit.2	$1,426,000	5	2	3	2	1	40	12	33
Thomas	$200,000	3	1	2	2	1	26	14	39
Jones	7,638,820	2	4	6	0	0	48	10	21
Total	$15,087,820								

Table 2-1. Reservoir – Seismic Mitigation Ranking

Description of columns in Table 2-1.

Reservoir. The name of the reservoir. If there are two basins (or tanks) at a site, each basin (or tank) is listed on its own row. The Murray reservoir is not listed as it is not recommended for seismic upgrade, given its current inactive status.

Cost. The cost reflects the seismic upgrade cost for the P3 upgrades from (G&E 2006) (year 2005 dollars). The cost for Jones reservoir upgrade is based on work by Parsons (2004).

EQ Risk. The earthquake risk is rated from 0 (none) to 10 (highest). By earthquake risk, it is meant the likelihood that serious damage will occur at the reservoir, given earthquakes likely to be felt in the planning horizon. For example, a facility that is extremely fragile is given an 8, where as a facility that is just somewhat fragile is given a 2. A facility that would be expected to have serious damage in modest size earthquakes (PGA about 0.20g), as felt in Pasadena, would be given a 10.

EQ Life Safety. The life safety ranking is rated from 0 (no chance of killing anyone, even if the damage occurs) to a high of 10 (certain to kill people if the damage occurs). A value of 1 indicates that there is a small chance of fatality, given damage. None of the facilities is ranked as high as 10, as even in the worst case, the life safety risk is relatively modest, mostly owing to the relatively low chance that the reservoir would be occupied at the time of the earthquake.

EQ System Operability Ranking. The values range from 0 (no impact on system operation) to as high as 7. The higher values are applied to the largest reservoirs. In pressure zones with multiple reservoirs, a slightly lower value is set.

Normal Operations and Maintenance Ranking. In a few situations, the recommended seismic upgrade effort will have some day-to-day impact on normal operations. For example, if an upgrade repairs minor erosion, then nuisance damage is reduced.

Cost Effectiveness. The value listed corresponds (roughly) to the benefit cost ratio of the upgrade, in consideration of the actual cost of the upgrade versus the overall benefit.

Total. This is the total value of the points provided in the prior five columns, adjusted per the weighting factors. A value of 60 to 70 suggests that the upgrade is very important relative to others, and should be prioritized to be completed in the 2006 to 2008 time frame. A value of 50 to 60 is a relatively high priority project. A value of 40 to 50 is a relatively "average" priority project. A value of 30 to 40 is a relatively lower priority project. A value of 15 to 30 is a lower priority project that can be completed at near the end of the overall upgrade program.

Reservoir Ranking. This is the ranking of the reservoirs from 1 to 18. The reservoirs ranked 1, 2, 3, ... should be prioritized for early completion. The reservoirs ranked ... 16, 17, 18 can be prioritized for later completion.

Overall Ranking. This is the ranking of the reservoir along with pumping plant and wells, from 1 to 49.

2.2 Pumping Plants

Table 2-2 ranks the relative importance of seismic upgrade for each pumping plant.

Pumping Plant	Cost	EQ Risk	EQ Life Safety	EQ System Operability	Normal Operations and Maintenance	Cost Effectiveness	Total Points	Pumping Plant Ranking	Overall Ranking
	Weight	3	3	5	1	1			
Ross	$33,350	4	0	6	1	5	53	1	8
Linda Vista	$20,300	4	0	3	1	5	38	8	35
Santa Anita	$16,675	4	1	5	1	5	51	3	14
San Rafael	$58,000	3	2	3	0	4	38	9	36
Glorietta	$34,075	2	0	5	1	5	42	6	29
Murray	$14,500	2	0	1	1	5	22	13	41
Atlanta	$18,175	4	1	4	0	6	47	4	22
Jones	$31,175	2	0	6	1	4	45	5	23
Eagle Rock	$17,400	4	0	2	1	5	33	10	37
Allen	$17,400	2	0	2	1	5	27	11	38
Annandale	$14,500	1	0	2	1	5	24	12	40
Wilson	$23,925	4	0	6	1	5	53	2	9
DevilsGate	$1,450	2	0	2	0	2	20	14	43
SCADA	$6,000	3	0	4	0	6	41	7	31
Total	$306,925								

Table 2-2. Pumping Plant – Seismic Mitigation Ranking

Description of columns in Table 2-2:

Pumping Plant. The name of the pumping plant. Pumping plants with no recommended seismic upgrades are not listed. The SCADA battery restraint effort is listed on its won line, as it includes restraint of small batteries and modems at all pumping plant and well sites.

Cost. The cost reflects the seismic upgrade cost for the P3 upgrades from Section 5 of G&E (2006) (year 2005 dollars).

EQ Risk. The earthquake risk is rated from 0 (none) to 10 (highest). By earthquake risk, it is meant the likelihood that serious damage will occur at the pumping plant, given earthquakes likely to be felt in the planning horizon. For example, a facility with unanchored transformers is given a 4, where as a facility that is just needs additional anchorage on an items that is already partially anchored is given a 2. A facility that would be expected to have serious damage in modest size earthquakes (PGA about 0.20g), as felt in Pasadena, would be given a 10.

EQ Life Safety. The life safety ranking is rated from 0 (no chance of killing anyone, even if the damage occurs) to a high of 10 (certain to kill people if the damage occurs). A value of 1 indicates that there is a small chance of fatality, given damage. None of the

facilities is ranked as high as 10, as even in the worst case, the life safety risk is relatively modest, mostly owing to the relatively low chance that the building would be occupied at the time of the earthquake.

EQ System Operability Ranking. The values range from 0 (no impact on system operation) to as high as 6. The higher values are applied to the pumping plants that will be most important in the first 24 hours after an earthquake, in particular Ross (to bring in MWD water in case the Upper Feeder is damaged) and Wilson and Jones (to supply the eastern portions of Sheldon and Calaveras zones).

Normal Operations and Maintenance Ranking. In a few situations, the recommended seismic upgrade effort will have some day-to-day impact on normal operations. For example, if a Quick Connect is recommended, than some additional flexibility is provided to operate the pumping plant in case of a regional power outage.

Cost Effectiveness. The value listed corresponds (roughly) to the benefit cost ratio of the upgrade, in consideration of the actual cost of the upgrade versus the overall benefit.

Total. This is the total value of the points provided in the prior five columns, adjusted per the weighting factors. A value of 60 to 70 suggests that the upgrade is very important relative to others, and should be prioritized to be completed in the 2006 to 2008 time frame. A value of 50 to 60 is a relatively high priority project. A value of 40 to 50 is a relatively "average" priority project. A value of 30 to 40 is a relatively lower priority project. A value of 15 to 30 is a lower priority project that can be completed at near the end of the overall upgrade program.

Pumping Plant Ranking. This is the ranking of the wells from 1 to 14. The pumping plants ranked 1, 2, 3, ... should be prioritized for early completion. The pumping plants ranked ... 12, 13, 14 can be prioritized for later completion. However, as most of the pumping plant projects are very similar, it would make sense to upgrade all the pumping plants in one concentrated effort, probably in conjunction with upgrades of the wells.

Overall Ranking. This is the ranking of the seismic upgrade for the pumping plant along with reservoirs and wells, from 1 to 46.

2.3 Wells

Table 2-3 ranks the relative importance of seismic upgrade for each well.

Well	Cost	EQ Risk	EQ Life Safety	EQ System Operability	Normal Operations and Maintenance	Cost Effectiveness	Total Points	Pumping Plant Ranking	Overall Ranking
	Weight	3	3	5	1	1			
Chapman	$34,800	4	0	6	1	5	53	2	10
Jourdan	$2,900	4	0	6	0	7	56	1	6
Woodbury	$121,075	3	1	6	1	4	51	6	15
Monte Vista	$91,350	3	1	6	1	4	51	7	16
Craig	$111,650	3	1	4	1	4	41	14	32
Arroyo	$92,075	3	1	6	1	4	51	8	17
52 Well	$31,900	4	0	6	1	5	53	5	11
Ventura	$65,250	4	1	4	1	4	44	12	25
Copelin	$145,000	4	2	4	1	3	45	9	24
Garfield	$92,075	4	1	4	1	4	44	10	26
Villa	$34,075	4	0	6	1	5	53	4	12
Sunset	$92,075	4	1	4	1	4	44	11	27
Windsor	$36,250	4	0	4	1	5	43	13	28
Bangham	$18,850	4	0	6	1	5	53	3	13
Total	$969,325								

Table 2-3. Wells– Seismic Mitigation Ranking

Description of columns in Table 2-3:

Well. The name of the well.

Cost. The cost reflects the seismic upgrade cost for the P3 upgrades from Section 6 of (G&E, 2006) (year 2005 dollars).

EQ Risk. The earthquake risk is rated from 0 (none) to 10 (highest). By earthquake risk, it is meant the likelihood that serious damage will occur at the well, given earthquakes likely to be felt in the planning horizon. For example, a facility with a weak structure is given a 4, where as a facility that is just needs additional anchorage is given a 3.

EQ Life Safety. The life safety ranking is rated from 0 (no chance of killing anyone, even if the damage occurs) to a high of 10 (certain to kill people if the damage occurs). A value of 1 indicates that there is a small chance of fatality, given damage. None of the facilities is ranked as high as 10, as even in the worst case, the life safety risk is relatively modest, mostly owing to the relatively low chance that the building would be occupied at the time of the earthquake.

EQ System Operability Ranking. The values range from 0 (no impact on system operation) to as high as 6. The higher values are applied to the wells with larger rated flow capacity per Table 2-3.

Normal Operations and Maintenance Ranking. In a few situations, the recommended seismic upgrade effort will have some day-to-day impact on normal operations. For example, if a Quick Connect is recommended, than some additional flexibility is provided to operate the well in case of a regional power outage.

Cost Effectiveness. The value listed corresponds (roughly) to the benefit cost ratio of the upgrade, in consideration of the actual cost of the upgrade versus the overall benefit.

Total. This is the total value of the points provided in the prior five columns, adjusted per the weighting factors. A value of 60 to 70 suggests that the upgrade is very important relative to others, and should be prioritized to be completed in the 2006 to 2008 time frame. A value of 50 to 60 is a relatively high priority project. A value of 40 to 50 is a relatively "average" priority project. A value of 30 to 40 is a relatively lower priority project. A value of 15 to 30 is a lower priority project that can be completed at near the end of the overall upgrade program.

Well Ranking. This is the ranking of the wells from 1 to 14. The wells ranked 1, 2, 3, ... should be prioritized for early completion. The wells ranked ... 12, 13, 14 can be prioritized for later completion. However, as most of the well projects are very similar, it would make sense to upgrade all the wells in one concentrated effort, probably in conjunction with upgrades of the pumping plants.

Overall Ranking. This is the ranking of the seismic upgrade for the well along with reservoirs and pumping plants, from 1 to 46.

2.4 Schedule

A master schedule for all the seismic upgrades is presented in Table 2-4. For each project, the following information is provided:

- Design and bid time (months)
- Construction time (months)
- Year complete (year)
- For the years from 2006 to 2020, the annual expenditure (in thousands of 2005 dollars) for each project.

In developing the schedule, the large cost of the Jones reservoir required it to be done more-or-less on its own, if Pasadena wishes to balance out its annual expenditures. Some slack time is provided in years 2013, 2014, 2018, 2019 and 2020, in order to assure completion by the year 2020.

Project (Seismic Upgrades Only)	Design and Bid Time (Months)	Construction Time (Months)	Year Complete	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Reservoirs																		
Annandale	12	6	2019	0	0	0	0	0	0	0	0	0	0	0	0	25	50	0
Gould 1	12	6	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	2	17
Gould 2	12	6	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	2	17
Lida	16	12	2019	0	0	0	0	0	0	0	0	0	0	0	0	40	111	0
Eagle Rock	12	6	2020	0	0	0	0	0	0	0	0	0	0	0	0	0	8	67
Mirador	16	12	2019	0	0	0	0	0	0	0	0	0	0	0	0	20	74	0
Don Benito 1	16	16	2013	0	0	0	0	30	150	260	22	0	0	0	0	0	0	0
Don Benito 2	16	16	2013	0	0	0	0	30	120	600	214	0	0	0	0	0	0	0
Allen	16	20	2009	0	135	456	528	0	0	0	0	0	0	0	0	0	0	0
Calaveras	16	16	2008	50	210	145	0	0	0	0	0	0	0	0	0	0	0	0
Santa Anita	16	16	2011	0	0	0	120	525	439	0	0	0	0	0	0	0	0	0
Sheldon 1	16	16	2014	0	0	0	0	0	25	75	242	80	0	0	0	0	0	0
Sheldon 2	16	16	2009	15	45	150	41	0	0	0	0	0	0	0	0	0	0	0
Sunset 1	16	16	2010	0	0	137	370	315	0	0	0	0	0	0	0	0	0	0
Sunset 2	16	16	2009	15	45	480	108	0	0	0	0	0	0	0	0	0	0	0
Jones	16	24	2017	0	0	0	0	0	0	0	0	500	1500	2989	2650	0	0	0
Thomas	16	12	2019	0	0	0	0	0	0	0	0	0	0	0	0	60	140	0
Windsor	16	12	2007	240	396	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumping Plants				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ross	6	1	2010	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0
Linda Vista	6	1	2011	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
Santa Anita	6	1	2010	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0
San Rafael	9	6	2011	0	0	0	0	5	53	0	0	0	0	0	0	0	0	0
Glorietta	6	1	2012	0	0	0	0	0	0	34	0	0	0	0	0	0	0	0
Murray	6	1	2011	0	0	0	0	0	5	10	0	0	0	0	0	0	0	0
Atlanta	6	3	2012	0	0	0	0	0	0	2	16	0	0	0	0	0	0	0
Jones	6	1	2012	0	0	0	0	0	0	31	0	0	0	0	0	0	0	0
Eagle Rock	6	1	2013	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0
Allen	6	1	2012	0	0	0	0	0	7	10	0	0	0	0	0	0	0	0
Annandale	6	1	2012	0	0	0	0	0	5	10	0	0	0	0	0	0	0	0
Wilson	6	1	2010	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0
Devils Gate	6	1	2012	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
SCADA Batteries	6	1	2012	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Wells				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chapman	6	1	2011	0	0	0	0	10	25	0	0	0	0	0	0	0	0	0
Jourdan	6	1	2010	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Woodbury	16	6	2011	0	0	0	10	75	36	0	0	0	0	0	0	0	0	0
Monte Vista	16	6	2011	0	0	0	10	45	36	0	0	0	0	0	0	0	0	0
Craig	16	6	2012	0	0	0	0	0	52	60	0	0	0	0	0	0	0	0
Arroyo	16	6	2011	0	0	0	40	52	0	0	0	0	0	0	0	0	0	0
52 Well	6	1	2010	0	0	0	12	20	0	0	0	0	0	0	0	0	0	0
Ventura	16	6	2010	0	0	5	40	20	0	0	0	0	0	0	0	0	0	0
Copelin	16	6	2012	0	0	0	0	35	80	30	0	0	0	0	0	0	0	0
Garfield	16	6	2012	0	0	0	0	25	55	12	0	0	0	0	0	0	0	0
Villa	6	1	2011	0	0	0	0	10	24	0	0	0	0	0	0	0	0	0
Sunset	16	6	2012	0	0	0	0	5	47	40	0	0	0	0	0	0	0	0
Windsor	6	1	2012	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0
Bangham	6	1	2010	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0
Total - All Elements				320	831	1373	1279	1298	1178	1219	511	580	1500	2989	2650	145	387	101

Table 2-4. Project Schedule

3.0 References

G&E, 2006. Seismic Vulnerability Assessment, City of Pasadena, G&E Report 81.01.08, Revision 1, December 10, 2006.

Parsons, 2004, Structural and Seismic Evaluation of Jones Reservoir, prepared for the City of Pasadena, draft final report, December 2004.