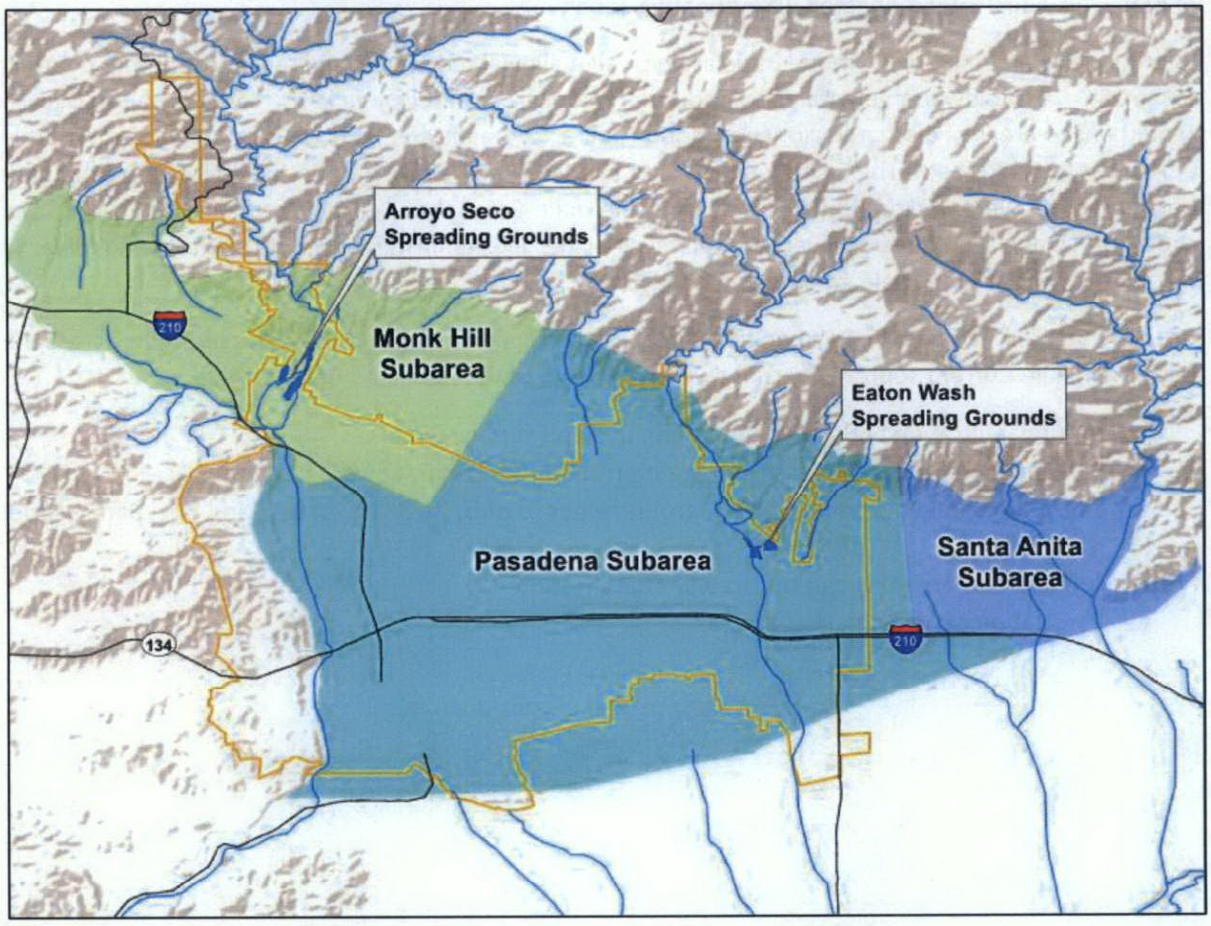
Figure 6-2: Raymond Groundwater Basin Subareas



6.2.2 Raymond Basin Judgement

Raymond Basin was the first groundwater basin adjudicated in California, in December 1944, to resolve conflicts between pumping entities. Under the adjudication, it was determined that 16 parties had the right to extract water. The court allocated the rights to each party. The decision is based on a judgment of "safe yield". The safe yield was determined to be 21,900 AFY but was modified in 1955 to 30,662 AFY. The authority to administer the Basin and resolve future disputes and make binding judgments is vested in a Basin Watermaster. The Watermaster is the RBMB, which is the representatives of the parties (pumpers) of the Judgement.

PWP's decreed right was set at 12,807 AFY, divided between the Monk Hill (4,464 AFY) and Pasadena (8,343 AFY) subareas. These decreed rights were set in 1955 for recent wet weather and not reevaluated from time to time as then suggested. As such, the RBMB implemented a resolution on July 1, 2009 that voluntarily reduced pumping from the Pasadena subarea to address declining water levels. As a result, PWP's water pumping from the Raymond Basin was decreased by 2,503 acre-feet (AF) to 10,304 AFY.

6.2.3 Surface Runoff Spreading Credits

PWP has pre-1914 rights to divert up to 25 cubic feet per second (cfs) of surface water from the Arroyo Seco and Millard Canyon streams and up to 8.9 cfs from the Eaton Wash. This surface water is currently used to recharge the Raymond Basin. The Judgment allows each pumper to take the surface water directly, or recharge the Basin and then pump a portion of the recharged volume in addition to their decreed rights.

Pumping credits from the infiltration of surface water provided PWP an average of 1,675 AFY from 2001 to 2020, ranging from approximately 300 AF in dry years to 5,115 AF in wet years. PWP receives a pumping credit of 60 to 80 percent of the water recharged at the Arroyo Seco Spreading Grounds, and a credit of 80 percent of the water recharged at the Eaton Wash Spreading Grounds.

6.2.4 Groundwater Production

For the past five years, PWP's annual groundwater production has averaged approximately 11,000 AFY, which includes decreed rights and surface water spreading credits. Currently PWP has six active wells with an additional two wells that are temporarily inoperable. An additional nine wells are inactive due to contamination and other factors. Most of the operational wells are approaching 100 years old with conditions which reduce the capacity or reliability. They are also influenced by contamination which requires treatment or a sequence of blending with imported water to dilute contamination levels low enough to comply with State and federal requirements. Table 6-2 provides the pumping history for all wells that produced groundwater between 2016 and 2020.

Table 6-2: Groundwater Volume Pumped

Submittal Table 6-1 Retail: Groundwater Volume Pumped						
☐	Supplier does not pump groundwater. The supplier will not complete the table below.					
☐	All or part of the groundwater described below is desalinated.					
Groundwater Type	Location or Basin Name	2016	2017	2018	2019	2020
Alluvial Basin	Raymond Basin	10,650	11,150	10,690	7,481	11,230
	TOTAL	10,650	11,150	10,690	7,481	11,230
NOTES: As CY 2019 was wet with approximately 32" of annual rain, PWP purchased 2,000 AFY of water from MWD at discounted price and turned of its wells to replenish the groundwater basin.						

6.2.5 Long-Term Storage

In 1992 and 1993, long-term storage policies were adopted that determined Basin groundwater storage capacity and allocated a storage volume of 96,500 AF to Basin pumpers. PWP's share of this storage volume is 38,500 AF. Current long-term storage for PWP is approximately 13,400 AF in the Monk Hill and 20,600 AF in the Pasadena subareas of the Raymond Basin. PWP can also lease storage to and from other

agencies in the Basin. Long-term storage is the key underpinning Pasadena's water supply resiliency. New management policies are being explored to improve storage as a tool to recover water levels in the basin.

6.2.6 Groundwater Quality

Water quality and operational challenges at many of PWP's wells are responsible for underproduction of the combined operating yield rights and spreading credits in recent years. Although water quality issues have been discovered at individual wells, PWP uses a combination of removing wells from service, blending, and treatment to ensure water delivered to customers does not exceed the Maximum Contaminant Levels (MCLs) established by the State Board and the United States Environmental Protection Agency. Water quality issues identified at the wells and managed to avoid MCL exceedances include perchlorate, volatile organic compounds, nitrates, and 1,2,3,-trichloropropane.

JPL paid for construction of the Monk Hill Water Treatment Plant (Monk Hill Plant) to remove volatile organic compounds (VOCs) and perchlorate from wells in the Monk Hill Basin, which was contaminated by past releases of rocket fuel and other chemicals to the environment. The Monk Hill Plant is designed to treat four wells (capacity of 7,000 gpm). However, due to declining groundwater levels, high nitrate levels and other factors, generally only two wells are in service. The quantity of treated water at the Monk Hill facility has not reached the level needed to produce the plume containment described in the Record of Decision by the State Board.

6.3 Surface Water and Stormwater

6.3.1 Surface Water Diversion

Surface runoff from the San Gabriel Mountains is a water supply source for PWP. PWP has water rights to divert instantaneous runoff from the Arroyo Seco up to 25 cfs and from the Eaton Canyon up to 8.9 cfs. The full amount of water available from PWP's diversion rights from the Arroyo Seco and Eaton Canyon is not typically realized due to stream flow variability, damage to PWP's existing diversion infrastructure, and capacity limitations of the infiltration basins.

Runoff from the Arroyo Seco is highly variable due to weather patterns. In wet years, runoff may exceed 40,000 AFY, most of which flows past Devil's Gate Dam to the Pacific Ocean. In dry years, runoff is less than 1,000 AFY. Runoff in the Arroyo Seco also is highly seasonal. On average, PWP's current recharge of approximately 2,500 AFY in the Arroyo Seco Spreading Grounds produces 1,500 AFY of water supply after RBMB credits are applied. Comparing historical data indicates that approximately 1,000 AFY of PWP's water pumping rights is underutilized due to damage to PWP's existing stream water diversion and the capacity of the infiltration basins.

PWP measures flow for Eaton Canyon and collects data monthly at PWP's diversion point. RBMB provides a spreading credit based on metered outflows from Eaton Reservoir and flow downstream of the Eaton Canyon Spreading Grounds. The 10-year average spreading credits from Eaton Wash rights is approximately 750 AFY, ranging from 139 AFY in 2015 to 2,521 AFY in 2006.

6.3.2 Surface Water Quality

The 2009 Station Fire in the Angeles National Forest in the upper Arroyo Seco watershed, and the 2010 and 2011 rainstorms that followed damage and destroyed PWP's diversion facilities. Prior to the fire, the

headworks structure diverted stream flows to adjacent sedimentation basins which provided less turbid water for the infiltration basins. The storms brought debris from the watershed damaging the headworks and reducing the available flows and degraded the water quality. As a result, PWP has reduced the spreading at Arroyo Seco until the facilities are repaired. PWP is in the process of preparing an environmental impact report for the Arroyo Seco Canyon Project that would restore the intake and improve the infiltration basins. Los Angeles County is currently removing the sediment from the Station Fire retained at Devil's Gate Dam and should be complete by 2022. In general, fires negatively impact water quality due to the elimination of shrubs and organic material that serve to filter and slow runoff.

Spreading operations in Eaton Canyon are not as vulnerable to fires because Eaton Dam is upstream of the diversion intake structure. Most of the debris and sedimentation is captured at the dam and does not reduce diversion. The spreading of surface flows allows for natural treatment through infiltration into the groundwater aquifer.

While the Eaton Wash drainage area (9.5 square miles) is smaller than the Arroyo Seco drainage area (31.9 square miles), the capacity of the Eaton Wash Spreading Grounds is 10 times larger than the Arroyo Seco Spreading Grounds capacity.

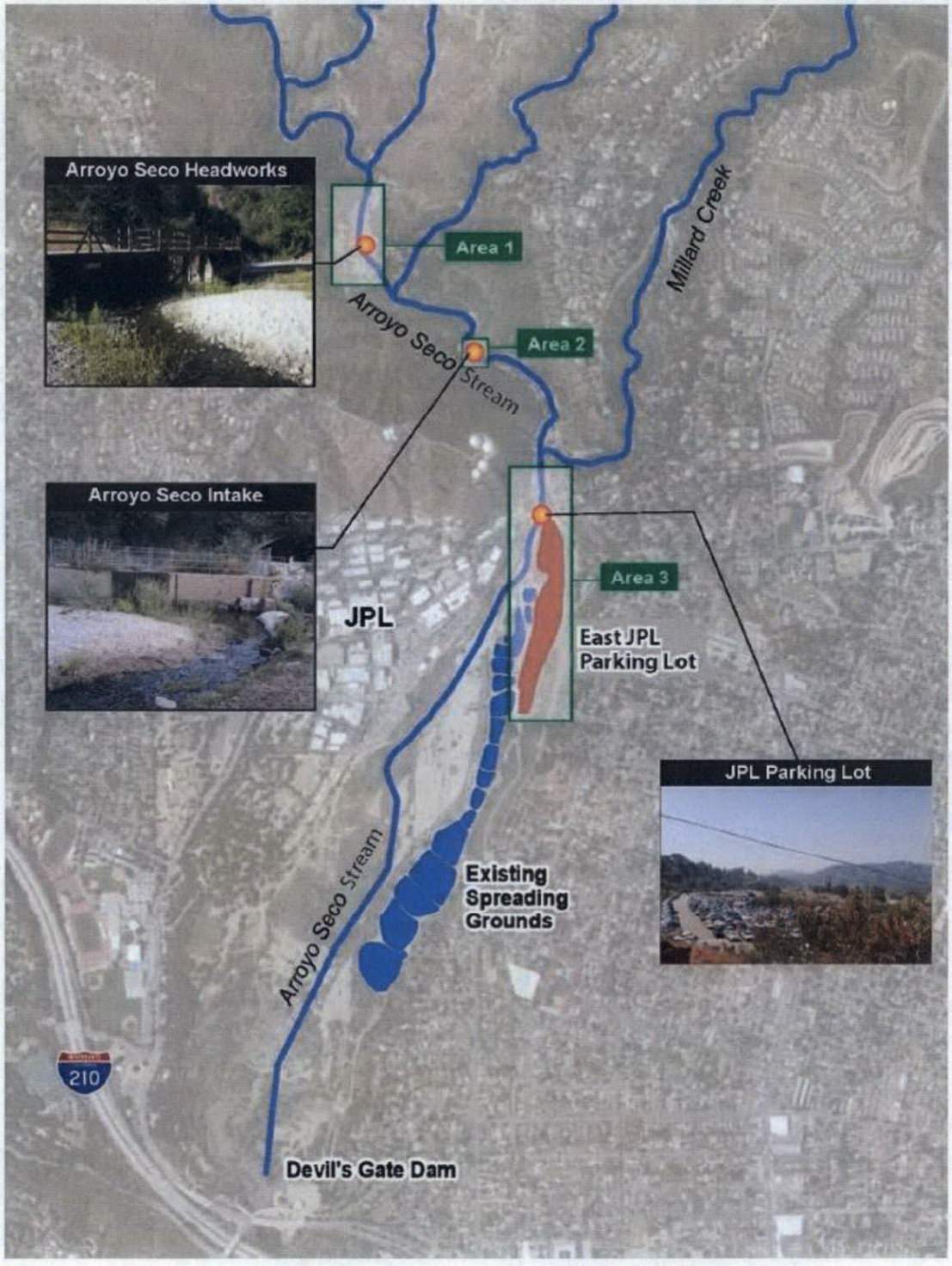
6.3.3 Surface Water Projects

The following projects were identified in the WSRP to emphasize the Raymond Basin as an asset for recharge and potable production.

6.3.3.1 Arroyo Seco Canyon Project

This project will remove the existing Arroyo Seco headworks, restore the area, and replace the diversion structure to allow PWP to fully utilize its surface water rights. The project includes a new sedimentation basin and four acres of new infiltration basins. The project is expected to recharge an additional 1,000 AFY of surface water. The location of this project is shown in Figure 6-3.

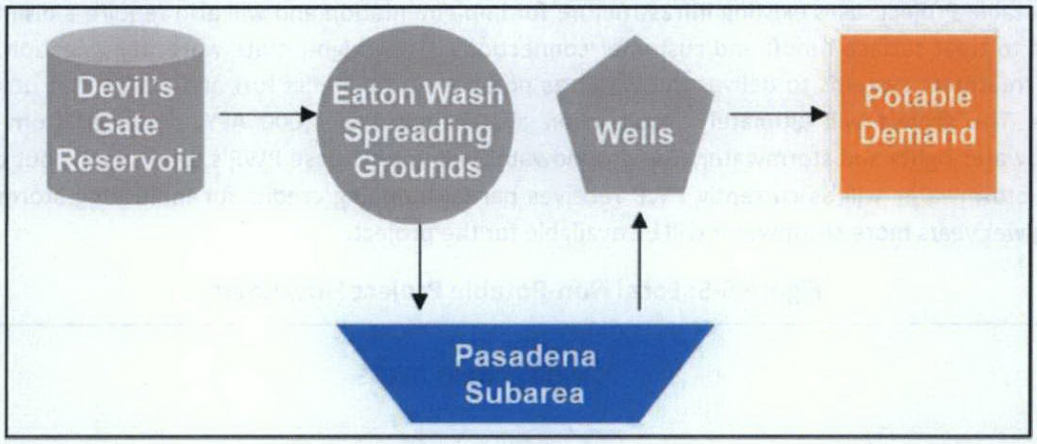
Figure 6-3: Arroyo Seco Canyon Project



6.3.3.2 Arroyo Seco to Eaton Canyon Raw Water Pipeline

This project proposes to use existing and new pipelines and pump station, to convey Arroyo Seco stream water following storm events from the reservoir pool behind Devil's Gate Dam to the Eaton Wash Spreading Grounds, as shown in Figure 6-4. This project was originally proposed by Los Angeles County. As proposed, the project may recharge approximately 1,070 AFY in the Pasadena subarea.

Figure 6-4: Arroyo Seco to Eaton Canyon Raw Water Pipeline Flow Chart



6.3.3.3 Arroyo Seco Pump Back Project

This concept proposes to recharge the Monk Hill subarea with surface water from the Arroyo Seco stream collected from behind Devil's Gate Dam. The concept includes installation of a new pumping system and controls at the dam and a new pipeline to the Arroyo Seco spreading basins. Implementation of this project could result in an average 1,000 AFY of surface water recharged in the Monk Hill subarea. This project can be implemented after Los Angeles County completes the Devil's Gate Dam Sediment Removal Project.

6.3.3.4 Natural Infrastructure

This project seeks to increase stormwater recharge in the watershed 5% by implementing Arroyo Seco watershed management improvements. This option includes removing invasive species, planting native plants and sediment control. Native plants consume less water and are typically more fire resistant than invasive species. Fires negatively affect stream flow. This project does not require new infrastructure. PWP intends to partner with local non-profit organizations and LA County to better manage vegetation in the watershed. Implementation of this project is expected to recharge up to 200 AFY of stormwater in the Monk Hill subarea. PWP is currently preparing a plan for regular maintenance and management of the watershed, including removal of non-invasive species and habitat enhancement.

6.4 Non-Potable Water

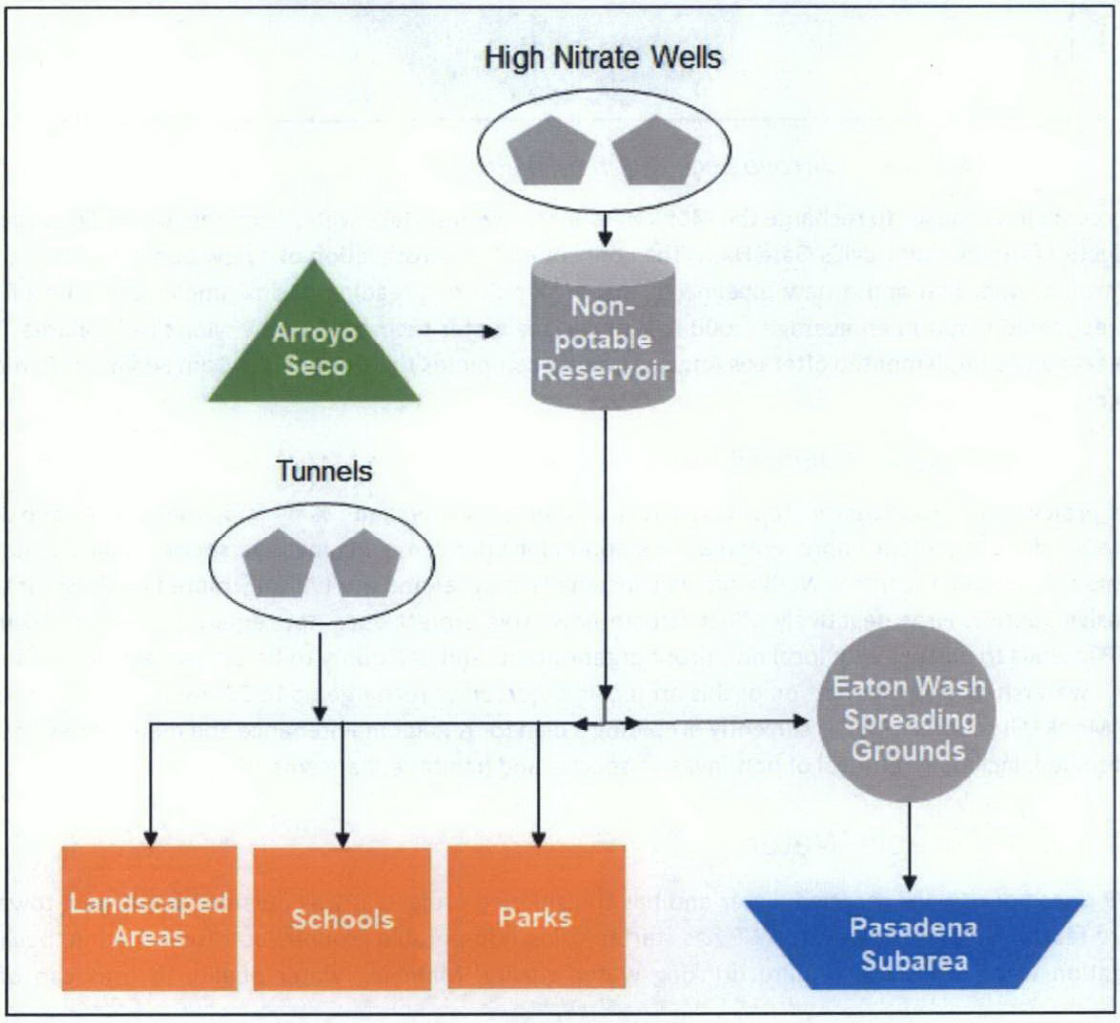
PWP does not use any recycled water and has transitioned projects it was pursuing in the past towards more feasible efforts. However, PWP has started using non-potable groundwater for irrigation, because irrigation water does not require drinking water quality. Matching water quality to uses can often

eliminate excess water treatment. Also, PWP has been using tunnel water and greywater as additional non-potable water sources for irrigation purposes.

6.4.1 Local Non-Potable Project

PWP has been delivering high-nitrate groundwater to John Muir High School since December 2020 as a pilot program. This project is in the process of being expanded to include additional high-nitrate sources to be delivered to schools, parks, golf courses and other landscaped areas. The project, called the Local Non-Potable Project, uses existing infrastructure for implementation and will also require a disinfection system to treat surface runoff and customer connections. Using high-nitrate water for irrigation avoids costly treatment systems to deliver the water as potable, and benefits turf and plants that utilize the nitrate. The project will ultimately result in an average yield of 1,000 AFY, produced from PWP's groundwater rights and stormwater. The groundwater will not increase PWP's total supply, but portion of the stormwater will as currently PWP receives partial pumping credits for infiltrating stormwater. During wet years more stormwater will be available for the project.

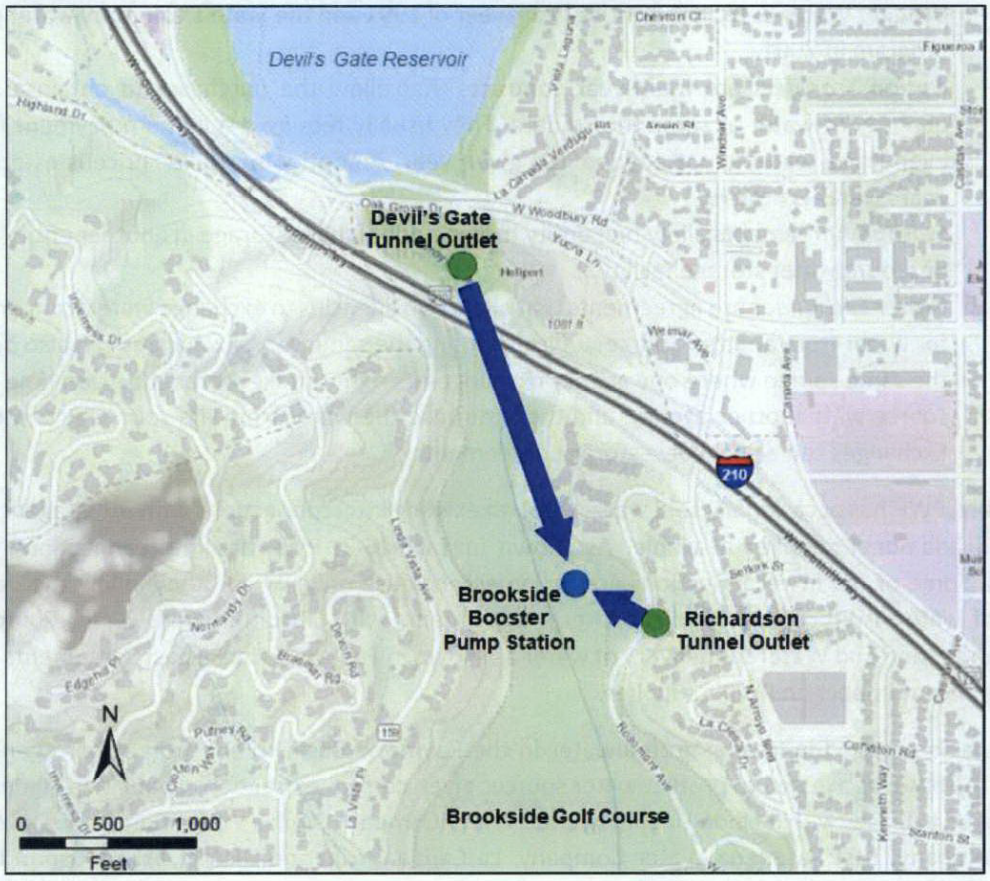
Figure 6-5: Local Non-Potable Project Flow Chart



6.4.2 Tunnel Water

Devil's Gate, Richardson and Wilson tunnels were constructed in the 1880's to capture water that seeps into the ground from the Arroyo Seco stream. Currently, Richardson tunnel water when available is being delivered for irrigation at Brookside Golf Course. Tunnel water has historically stopped flowing during droughts. A project is still considered for expansion to include two existing tunnels, a new booster pump station, new pipeline, and water storage. Tunnel water would produce 433 AFY, which would offset Brookside's water demand currently met with potable water.

Figure 6-6: Expanded Tunnel Water for Irrigation to Brookside Golf Course Project



6.4.3 Greywater

Residential wastewater is comprised of greywater and sewage. Sewage is the wastewater that comes from toilets, dishwashers and other sources with high organic content, whereas residential greywater comes from washing machines, bathtubs, showers, and bathroom and kitchen sinks. PWP has incentivized greywater system installations for use in onsite drip irrigation systems. Currently, 194 greywater systems have been installed for a total lifetime savings of 105 AF.

6.5 Water Exchanges and Transfers

The general types of transfers or exchanges available to PWP, are summarized below:

- ***Core Transfers*** make water available through multi-year contracts that convey a specific amount of water to the purchaser each year. The specific conditions depend on the agencies involved and contract terms. An example would be a transfer of SWP long-term water supply contract water from an agricultural contractor to urban uses.
- ***Spot Transfers*** make water available for a limited duration (typically one-year or less) through a contract executed during the year of delivery. Some examples of spot transfers are the State Drought Water Bank in the critically dry year of 1991 and the State's voluntary water purchase program in 2001.
- ***Option Transfers*** are multi-year contracts that allow the purchaser to obtain a specified quantity of water at some future date. They usually require a minimum payment for water even if the water is not needed in a given year. An option or "take" price is established in years water is drawn.
- ***Storage Agreements*** allow one entity to lease or purchase storage in another entity's surface or groundwater storage facility.
- ***Water Exchanges*** are agreements that allow two agencies to exchange water from one source for water from another source, typically during the same year. Exchanges can also occur with the same source where one agency exchanges its right to take water at a given time from the source with another agency, and then can take the water from the source at another time. Exchanges can also involve storage agreements.

Historically, PWP has occasionally sold water through existing interconnections with other agencies when PWP had additional supplies available. As shown in Table 6-3, PWP has interconnections with ten agencies. Some of the interconnections are for emergency use only, while others allow the delivery or receipt of water. PWP recently had short-term agreements with Lincoln Avenue Water Company and Rubio Cañon Land and Water for delivery of water as shown in Table 6-8. These past agreements have not had a significant impact on PWP's supplies.

PWP has also engaged in leasing groundwater in the Raymond Basin to and from other agencies with rights in the basin as a lessee to protect water sources given current extraction capabilities. Agencies PWP has engaged in leases with include Lincoln Avenue Water Company, Valley Water Company, Cal-American Water Company, East Pasadena Water Company, La Cañada Irrigation District, Rubio Cañon Land and Water, and Kinneloa Irrigation District.

Table 6-3: PWP Interconnections

General Location	Water Sources	Water User
Cal Trans Yard	PWP	FMWD
Cal Trans Yard	FMWD	PWP
Foothill Municipal Water District (FMWD)	PWP	FMWD
Linda Vista/FMWD	FMWD	PWP
Rosemead Blvd	PWP	East Pasadena Water Co
Ranch Top Rd	PWP	Kinneloa Irrigation District
Lamada Reservoir-East	PWP	Cal-American Water Co
Lamada Reservoir-South	Cal-American Water Co	PWP
Oak Knoll Dr	PWP	Cal-American Water Co
Calaveras Reservoir	Lincoln Avenue Water Co	PWP
Loma Alta Dr	Rubio Cañon Land and Water	PWP
Murray Reservoir Pkwy	Kinneloa Irrigation District	PWP
Canyon Crest Dr 6"	Lincoln Avenue Water Co	PWP
Canyon Crest Dr 4"	Lincoln Avenue Water Co	PWP
Columbia St	PWP	City of South Pasadena
La Cañada/Pasadena	Valley Water Co	PWP
Kinneloa & Outpost-East	Kinneloa Irrigation District	PWP
Kinneloa & Outpost-West	PWP	Kinneloa Irrigation District
Michillinda & Mariposa	PWP	City of Sierra Madre
Michillinda & Grandview	City of Sierra Madre	PWP

6.6 Desalinated Water

PWP is not planning to use desalinated water as part of its water supply portfolio. PWP is located too far inland to feasibly desalinate ocean water, and there is no readily available supply of brackish groundwater or surface water within PWP's service area. However, there is a potential to develop a partnership in the future to construct a desalination facility. To participate in such a project, PWP would partner with a coastal agency or agencies that have the ability to construct a desalination plant. Once the plant is constructed, PWP would pay a purchase cost for the desalinated water. It is likely that PWP would enter into an exchange agreement with partnering agencies, whereby the partner agencies would agree to exchange a portion of their MWD imported water for the desalinated water. Given that this is a long-term, undeveloped option, the potential for future desalinated water is not included in PWP's overall future water supply portfolio. Without a direct connection to a desalination facility this option does not enhance reliability in the event of a wholesale water interruption.

6.7 Future Water Projects

In addition to the aforementioned non-potable water and surface water projects (see Sections 6.3 and 6.4), the following capital improvement projects are planned in order to maintain a reliable, sustainable, and resilient water system.

6.7.1 Sunset Reservoir Replacement

Sunset Reservoirs 1 and 2 were constructed in 1898 and 1900, respectively. The combined storage of 15 million gallons (MG) allows for operational flexibility within the Sunset pressure zone. However, the corrugated metal rooftops are rusted, resulting in numerous holes throughout. In addition, both reservoirs have cracks in the concrete floors and walls, causing water leakage at a rate estimated between 3 and 7 gpm. These holes and cracks can result in water loss and potential contamination. In addition, the reservoirs are not seismically sound. As such, Sunset Reservoir 1 was taken out of service in September 2019 and Sunset Reservoir 2 in June 2020.

The construction of a new 24-inch water main in 2019 and the hydraulic capacity of an existing 36-inch steel pipeline satisfies system demands and provides reliability without the Sunset reservoirs. However, to allow for long-term reliability and resiliency, two new reservoirs and a clear well are being planned with a storage capacity of up to 11 MG. Design for centralized treatment for perchlorate and VOCs on the reservoir site are included. The treatment plant will have a capacity of up to 3,000 gpm and the project will be completed by spring 2025.

6.7.2 Wadsworth Treatment Plant

A new groundwater treatment plant is being designed to remove 1,2,3-trichloropropane (1,2,3-TCP) from three wells in the Pasadena groundwater basin. 1,2,3-TCP, a VOC, is a manmade chemical that has been used as a cleaning and degreasing solvent and also is associated with pesticide products. Because of the chemical's carcinogenic risk at low-level exposures, the State Board set the MCL at 5 parts per trillion in 2017. Although PWP can blend the well water with imported water to avoid MCL exceedance, it is taking the pro-active approach to install a treatment plant to remove the contaminant and incorporate resiliency in the system. The plant will be located at the Wadsworth Well site and also treat Woodbury Well and Craig Well. The capacity of the plant will be approximately 2,500 gpm and is expected to be online by December 2022.

6.7.3 Ross Booster Station Improvements

PWP's Ross Booster Station pumps from the P-5 MWD connection to Eagle Rock Reservoir. The booster station was originally constructed in 1958 and much of the original structure, piping, pumps and electrical equipment remain in service. PWP is planning to upgrade the booster station to address wear due to aging and reliability concerns. The two 50-hp pumps both operate continuously during peak summer demand periods. During 2018 efficiency testing, Pump 1 delivered approximately 669 gpm at 207 ft total dynamic head and Pump 2 delivered approximately 619 gpm at 209 ft total dynamic head. PWP would like to increase firm capacity to approximately 1,120 gpm - 1,350 gpm. The goal is to construct upgrades by spring 2022, outside the peak summer demand period.

6.7.4 New Explorer Well

A new Monk Hill Treatment System production well is proposed that will improve the effectiveness of NASA's cleanup efforts of the groundwater contaminated by past waste management practices. The new well will be located in the former JPL East Parking Lot and is designed for 1,600 gpm. The well will provide PWP with flexibility in operating its system and will allow increased production from the Monk Hill Subarea, which will be in line with PWP's existing decreed rights. Production from the new well can be considered additional supply when taking into account the losses that result from the transfer of pumping rights to the Pasadena Subarea.

6.7.5 Garfield Replacement Well

PWP is preparing to drill and construct a replacement water supply well in Villa Parke (formerly Villa Reservoir site) early in 2021. The existing Garfield Well (drilled in 1921), near the basketball courts and children's playground on Garfield Avenue, reached the end of its useful service life and was removed from service in 2015 and destroyed/abandoned in December 2020. The existing control building and fenced perimeter will remain and be used for the above ground equipment with the new well. The replacement well site is approximately 100 feet northwest of the existing well but will be a submersible pump which significantly reduces the noise and above-ground impacts.

6.8 Summary of Existing and Planned Sources of Water

Pending the ability to pump its groundwater rights as described in Section 6.2.4, PWP prioritizes this source over purchasing imported water due to cost and the State direction to reduce dependency upon the Sacramento/San Joaquin Delta. Imported water is purchased to subsequently meet water demands. Since December 2020, PWP has also been delivering high-nitrate non-potable water for irrigation purposes under a pilot program to eliminate excess water treatment. Table 6-4 shows the actual water supplies in 2020, which corresponds to DWR Submittal Table 6-8.

Table 6-4: Actual Water Supplies (AFY)

Submittal Table 6-8 Retail: Water Supplies — Actual			
Water Supply	Additional Detail on Water Supply	2020	
		Actual Volume	Water Quality
Purchased or Imported Water	Water purchased from MWD	18,120	Drinking Water
Groundwater (not desalinated)	Raymond Basin	11,230	Drinking Water
Other	Sold to others	-60	Drinking Water
	Total	29,290	

6.8.1 Special Conditions for Projected Water Supplies

Moving forward, PWP will continue efforts to diversify its supply, but focus primarily on sustaining its existing sources. As described in Chapter 10 Climate Change, the combined impact of temperature and

precipitation could impact the rate of recharge to the Raymond Basin. Therefore specific capital improvement projects discussed throughout this chapter are planned to enhance groundwater infiltration for the benefit of the basin, while also improving upon dysfunctional groundwater wells for the ability to pump PWP's groundwater rights. MWD's 2015 IRP Update is the foundation for the imported water supply forecasts in this plan. That document concluded that MWD has sufficient supplies to meet projected demands from 2020 through 2040 under single dry-year and multiple dry-year conditions. As such, Table 6-5 shows the projected water supplies through 2040.

Table 6-5: Projected Water Supplies (AFY)

Submittal Table 6-9 Retail: Water Supplies — Projected					
Water Supply	Additional Detail on Water Supply	Projected Water Supply *Report To the Extent Practicable*			
		2025	2030	2035	2040
		Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume
Purchased or Imported Water	Available Metropolitan Water District	19,248	19,362	19,454	19,527
Groundwater (not desalinated)	Includes decreed groundwater, spreading credits, and non-potable water	11,830	11,830	11,830	11,830
	Total	31,078	31,192	31,284	31,357

Chapter 7 Water Service Reliability and Drought Risk Assessment

7.1 Water Service Reliability Assessment

Assessing water service reliability is the fundamental purpose for an UWMP. Water reliability is impacted by numerous factors, including population, economic activity, land use, hydrologic fluctuations, water quality, climate change, constraints on distribution facilities, aging water systems, more stringent policies and regulations, natural disasters, and emergencies. These factors have all been presented in previous chapters in this 2020 UWMP. An assessment of water supply reliability measures the extent to which a water system effectively meets current and projected water demands. The conclusions drawn about water service reliability affect PWP's short-term and long-term water management decisions.

The WSRP, in the December 2020 version, analyzed the water reliability elements using a systems model that was developed to simulate water supply and demand balance and to quantify the long-term reliability of existing water supplies available to PWP through year 2040. The analysis and conclusions from the WSRP is presented below.

7.1.1 Analysis Approach

Comparing water supply and demand under variable conditions requires expanded analysis. Non-average conditions in the context of baseline assessment are related to hydrologic and weather variability impacting demand and most supplies. MWD-imported water supplies have historically been reliable but some levels of shortage do occur during extended droughts and the vulnerabilities disrupting the delta exports and the long aqueducts are increasingly probable. Local surface water varies significantly and impacts the consistency of recharge into infiltration basins and spreading credits for pumping. Demand also varies with weather; hotter and drier years result in higher demand compared to cooler years. MWD's own simulations of supplies and reliability account for these non-average conditions and were used as the basis of this WSRP's analysis.

The PWP simulation model was developed using GoldSim software, an object-oriented platform used for visualizing and dynamically simulating complex systems. This system model accounted for uncertainty and risk regarding future water supplies and helped evaluate PWP's ability to meet future service area needs.

Projected water demand identified in Chapter 4 served as the basis for this analysis. Using the annual water demand estimates, the model simulated monthly water demands. Monthly demand factors were applied to characterize water consumption throughout the year, with water demands peaking during dry summer months. The monthly demand factors are based on total historical production data for PWP from 2010 to 2018. The model also applied annual weather factors obtained from MWD's model database, which scales demands slightly up and down according to local weather. Key to the reliability assessment is analysis of supply and demand under multiple hydrologic/weather conditions. The analysis uses historical data from 1922 to 2018 to evaluate future years under multiple hydrologic conditions. This allows the model to account for inherent variability and uncertainty in the system, which can occur at any time over the planning horizon. The method used applies to possible combinations of historical weather

factors and future planning years, resulting in 86 future demand sequences. Climate change variables were not applied to future years.

Imported water supply availability was modeled from MWD's databases and simulation models. MWD also uses a method of multiple hydrology simulation in their reliability analysis and provided a matrix of reliability under each historical year applied to each future planning year.

To determine local supply availability, the model simulated local hydrology using historical data from the Arroyo Seco and Eaton Wash and accounted for diversion rights, spreading credits and adjudicated pumping rights as well as capacity constraints on existing facilities in the region. This analysis was used to quantify the reliability of groundwater and surface water and determine the ability of the existing water supply portfolio to meet future water demands.

The analysis ultimately evaluates local demands, local supply and imported supply under variable conditions of hydrology and demand to determine reliability. Using this approach, reliability concerns can be presented as the percent of simulated years with shortage, as well as the average and maximum shortage that occurs.

7.1.2 Groundwater Supply

In the Monk Hill and Pasadena subareas of the Raymond Basin, PWP has adjudicated groundwater rights, additional groundwater pumping credits from infiltration of surface water, and long-term storage credits. Total groundwater pumping is constrained by the pumping capacity of the active wells. The baseline analysis assumes that only the wells that are currently operating will be in operation in the future. Currently, the Monk Hill subarea has a pumping capacity of approximately 2,800 AFY. The Pasadena subarea estimated pumping capacity is approximately 9,030 AFY. To meet groundwater pumping objectives, wells with capacity of 20% greater than pumping rights are required.

PWP's total adjudicated groundwater rights in the Basin are 12,807 AFY: 8,343 AFY in the Pasadena subarea and 4,464 AFY in the Monk Hill subarea (prior to the voluntary reduction described in Chapter 4).

To meet water demand in PWP's service area, the model prioritizes the use of groundwater rights, followed by spreading credits from surface water in the Arroyo Seco and Eaton Canyon, and finally imported water from MWD.

The model uses historical flow data for Eaton Wash, PWP's surface water diversion right of 8.9 cfs, and the existing structural diversion capacity of 200 cfs to simulate the water available for recharge in the Eaton Wash Spreading Grounds into the Pasadena subarea. This model applies an evaporation rate from the California Irrigation Management Information System (CIMIS) as shown in Section 3.2.

A 20 percent administrative loss is applied to the volume of water recharged in Eaton Wash Spreading Grounds to calculate the spreading credits available to PWP.

Similarly, the model uses historical flow data for Arroyo Seco stream, PWP's surface water diversion right of 25 cfs, and the existing structural diversion capacity of 18 cfs to simulate the water available for recharge in the Arroyo Seco Spreading Grounds into the Monk Hill subarea. The model incorporates an

evaporation rate estimated by CIMIS and an infiltration rate of 2.7 feet per day[8]. PWP receives spreading credits of 60 to 80 percent of the diverted water spread in the basins in the Monk Hill subarea. To calculate this, a 30 percent administrative loss was used for spreading credits available to PWP in the Monk Hill subarea.

In addition to the groundwater rights and spreading credits, PWP has long-term storage of groundwater in the Monk Hill and Pasadena sub-areas. PWP's current long-term storage is approximately 30,000 AF.

The model can be run under two separate scenarios as follows:

- Model assumes current wells are maintained during the planning period, preserving existing pumping capacity
- Model assumes existing operational wells deteriorate over time with the corresponding capacity loss

For more information regarding the model inputs and data used in the GoldSim model, refer to Appendix F.

7.1.3 Imported Water Supply

Demands that are not met with groundwater are then met with imported water from MWD. The model incorporated a matrix of imported water reliability projections provided by MWD's 2015 IRP Update. Reliability of MWD's imported water has been less certain in recent years due to intense droughts and environmental restrictions. The imported water reliability matrix projections first estimated by MWD assumed that California WaterFix would be implemented. In 2018, DWR withdrew proposed permits for California WaterFix as a result of nine appeals alleging the project was inconsistent with the Delta Plan's coequal goals of providing a more reliable water supply for California and protecting, restoring and enhancing the Sacramento-San Joaquin Delta ecosystem. DWR is now pursuing a new environmental review and planning process for the proposed Delta Conveyance Project, which is now a single-tunnel solution to upgrade Sacramento-San Joaquin Delta conveyance. For WSRP modeling, California WaterFix was excluded from MWD's reliability matrix, resulting in decreased imported water reliability. The reliability matrix showing forecast reliability for future planning years and for historical hydrology years is presented in Appendix F.

The results of the GoldSim model indicate that during most modeled years, MWD's supply is expected to be fully reliable. During significantly dry years, MWD's supply will result in some shortage. During a drought-related cutback, MWD allocates available imported water according to the Water Supply Allocation Plan (WSA Plan). For the WSRP, a simplified version of the WSA Plan (Plan) was programmed into the model. Per the Plan MWD will allocate a specific reduction to each of its member agencies based on their level of need.

As shown in Appendix F, imported water will have full reliability (i.e., no allocation) in 91 percent of the years considered. During the remaining 9 percent of modeled years, imported water would experience various levels of shortage, from 0.6 to 15.3 percent of MWD's total available supplies.

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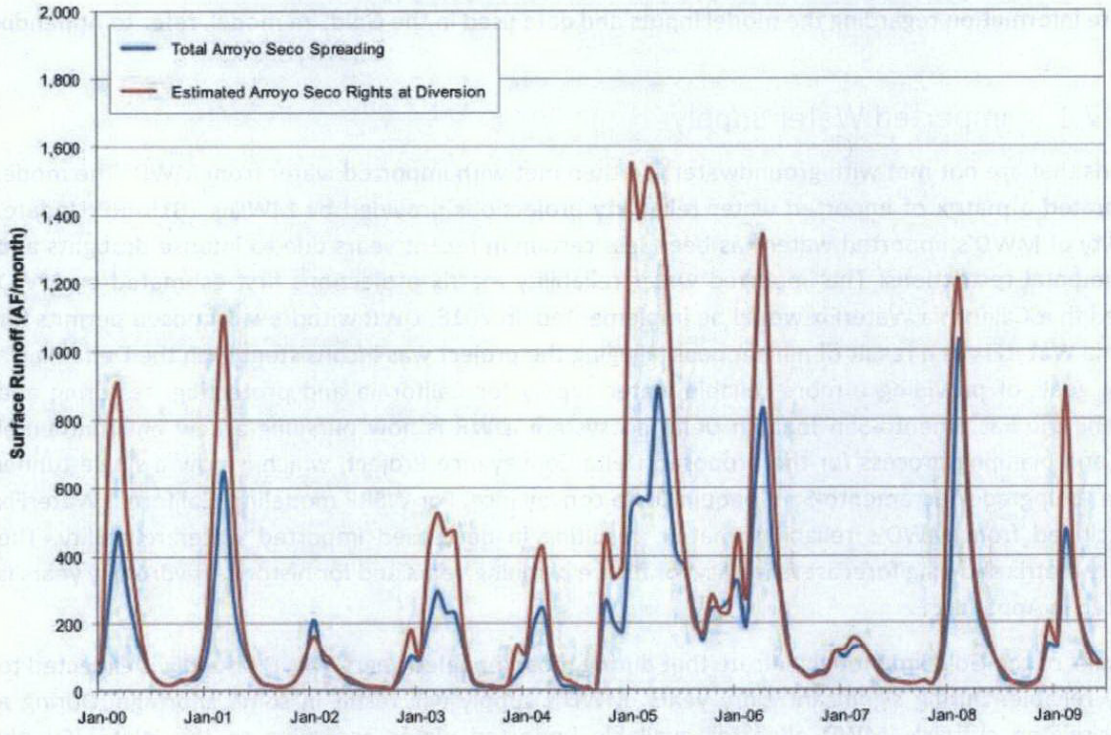
[8] Pasadena Water & Power. 2011. *Water Integrated Resources Plan.* January. Available: https://ww5.cityofpasadena.net/water-and-power/wp-content/uploads/sites/54/2017/08/PasadenaWIRPFinalApproved013111.pdf

7.1.4 Surface Water Supply

Surface water is a supplemental inflow to the Basin, and therefore a significant asset. Arroyo Seco and Eaton Wash diversion rights can be used for groundwater recharge. Arroyo Seco surface flows have also been used in the past as drinking water supply with treatment at PWP's John L. Behner Water Treatment Plant (Behner), which was constructed to treat 8 cfs of Arroyo runoff. The plant was shut down in 1993 due to surface water treatment regulations.

The local hydrology of Arroyo Seco and Eaton Wash was also evaluated. To maximize diversion rights from Arroyo Seco additional projects were identified and to be implemented. Figure 7-1 shows a 9 year period of actual diversions and available flow up to PWP's water rights from Arroyo Seco, illustrating that higher diversions are possible.

Figure 7-1: Arroyo Seco Historical Spreading and Available Flows



Stormwater is another potential future source of local supply. Stormwater as a supply option depends on many factors, such as location of the retention, infiltration or diversion structures in the urban watershed, and the number of these structures. In general, stormwater is highly contaminated and expensive to treat to useable standards. Protecting groundwater from contaminates contained in stormwater is an objective of the Wellhead protection program.

7.1.5 Reliability Results

Water supply reliability is evaluated in terms of potential deficits under multiple hydrologic and weather conditions. Demands in the PWP service area are not increasing over the planning period. Thus, potential deficits are the result of shortages during extended droughts or disruptions to the imported water supply.

7.1.5.1 *Reliability Under Non-Emergency Conditions*

Groundwater was assessed as a resource by comparing its current production to potential production based on water rights. The limiting factor in groundwater production is the total capacity of the wells currently in operation. Current capacity is approximately 11,830 AFY assuming year-round consistent pumping, while the adjudicated rights under voluntary reduction are 10,304 AFY. At this capacity, only about 1,500 AFY of spreading credits (or long-term storage) could be pumped in any year above the adjudicated rights. A modeling scenario was run with an increased pumping capacity to approximately 17,500 AFY to explore the potential for additional spreading credits. Results consistently showed the potential to use 1,000 AFY more spreading credits in 12 out of 25 years of the planning period, 2,000 AFY more in seven out of 25 years, and 4,000 AFY more spreading credits in five out of 25 years.

Totaling groundwater (including spreading credits from surface water diversions) and imported water compared to demand (scaled by weather) revealed the reliability under non-emergency conditions. Model results indicate Pasadena will experience no supply deficits in average or non-drought years.

The model projects that between 2020 and 2045, PWP will meet its service area water demand approximately 91 percent of the time. For the remaining 9 percent of the time the projected water supply shortage will be approximately 1,000 to 1,500 AFY.

Most agencies are able to manage supply shortages of 10 percent with temporary conservation measures. Additional investment needed to pursue additional supply and production solutions based on these forecasted deficits needs to be accomplished in the context of level of service discussions.

This reliability analysis assumes existing wells are maintained and that investment in replacement production capacity is sustained over the planning period.

7.1.5.2 *Reliability Under Regional Seismic Emergency Conditions*

This analysis considered a 7.8 magnitude earthquake along the southern San Andreas Fault (U.S. Geological Survey [USGS] 2008), which is assumed to cut imported supply for 12 to 24 months. An event of this magnitude could damage the CRA and the SWP and cause interruptions in supplies. It would require at least six months of work to restore some capacity to the CRA and an additional three to five years to restore the CRA to full capacity. An earthquake of this magnitude would also impact the SWP East Branch, causing a 12- to 24-month interruption in SWP deliveries. SWP deliveries would be reduced by 50 percent in the first year under this scenario, and 20 percent in the subsequent four years.

This WSRP assumes a seismic emergency scenario with a one-year or larger interruption of imported supply. The estimated deficit of 12,000 AFY assumes the earthquake happens around year 2030 under average weather conditions. An earthquake occurring after 2030 under hot or dry year conditions would create a higher deficit. During this condition, Pasadena would need additional ground water production from wells which are not constructed.

7.2 Year Type Characterization

The average rainfall in Pasadena is approximately 20 inches per year. There are thee year types that are included in the water service reliability assessment:

- ***Normal Year***. This condition represents the water supplies PWP considers available during normal conditions. PWP chose 2012 with 22 inches of rainfall as the year that most closely represents the average water supply available to PWP.
- ***Single Dry Year.*** The lowest water supply available to PWP was in 2018 with approximately 12 inches of rainfall.
- ***Five-Consecutive-Year Drought.*** The driest five-year historical sequence with the lowest supply available for PWP are the years from 2014 through 2018.

Table 7-1: Basis of Water Year Data

Submittal Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment)			
Year Type	**Base Year** If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 2019-2020, use 2020	**Available Supplies if Year Type Repeats**	
		☐	Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location _____
		☑	Quantification of available supplies is provided in this table as either volume only, percent only, or both.
		Volume Available *	**% of Average Supply**
Average Year	2012	36,700	100%
Single-Dry Year	2018	33,700	92%
Consecutive Dry Years 1st Year	2014	34,100	93%
Consecutive Dry Years 2nd Year	2015	35,000	95%
Consecutive Dry Years 3rd Year	2016	33,700	92%
Consecutive Dry Years 4th Year	2017	34,200	93%
Consecutive Dry Years 5th Year	2018	33,700	92%
Supplier may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If a Supplier uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table.			
***Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*			
NOTES: In 2012 pumped groundwater was 13,700 AFY, available imported water was 23,000 AFY. In 2018, pumped groundwater was about 10,700 AFY, available imported water was 23,000 AFY. For the 5 consecutive historic dry years pumped groundwater was from about 10,700 to 12,000 AFY, the available imported water from MWD was 23,000 AFY.			

7.2.1 Water Service Reliability – Normal Year

In normal water year conditions, the supplies are those as enumerated in *Chapter 6, System Supplies*. The total demands are those anticipated as a result of the demand analysis explained in *Chapter 4, Water Use Characterization*. Comparing the figures from the two aforementioned sections, total supplies exceed demands in all years from 2020-2040. However, any additional supplies that would exceed demands would be placed in groundwater storage for future use. Therefore, in normal conditions there is no surplus or deficit of water supplies.

Table 7-2: Normal Year Supply and Demand Comparison

Submittal Table 7-2 Retail: Normal Year Supply and Demand Comparison				
	2025	2030	2035	2040
Supply totals *(autofill from Table 6-9)*	31,078	31,192	31,284	31,537
Demand totals *(autofill from Table 4-3)*	26,750	25,000	25,320	25,630
Difference	4,328	6,192	5,964	5,727

7.2.2 Water Service Reliability – Single Dry Year

In the single dry-year scenario, the amount of groundwater for pumping would be reduced, because there would be less surface water available to use as spreading credits; however, PWP's total decreed groundwater would remain consistent at 10,304 AFY In addition to the decreed right, PWP anticipates that during dry years approximately 1,526 AFY of groundwater will be available from spreading credits. This estimate is based on an assessment of historic hydrologic conditions. The decreed right and anticipated spreading credits results in an estimated total groundwater availability of 11,830 AFY during dry years. This analysis assumes that imported water would remain the same as normal year conditions, given that the supply assessment from MWD shows a 0% risk of supply allocation in the single dry-year scenario. In its analysis, MWD has assumed that demands from its member agencies (including PWP) for imported water would increase in a single dry-year hydrologic scenario. Therefore, the imported water demands shown in Table 7-3 are lower than the demands that MWD has assumed, and expects to meet, for PWP's service area in a single dry year. Total demands would remain the same, but there would be less excess water available for groundwater storage.

Table 7-3: Single Dry Year Supply and Demand Comparison

Submittal Table 7-3 Retail: Single Dry Year Supply and Demand Comparison				
	2025	2030	2035	2040
Supply totals	31,886	32,003	32,098	32,172
Demand totals	26,750	25,000	25,320	25,630
Difference	5,136	7,003	6,778	6,542
NOTES: MWD's projections for single dry-year estimated supply and demands for the City of Pasadena dated February 2021.				

7.2.3 Water Service Reliability – Five Consecutive Dry Years

In the multiple dry-year scenario, the major supply that would be impacted would be surface water available to use as spreading credits (groundwater). However, in the selected multiple dry-year scenario (2014-2018), surface water available for spreading credits was fairly consistent with the single dry-year conditions. PWP's total groundwater supply would remain consistent at 11,830 AFY with decreed groundwater equal to 10,304 AFY and the remaining 1,526 AFY derived from spreading credits. This analysis assumes that imported water would remain the same as normal year conditions, given that the supply assessment from MWD shows a 0% risk of supply allocation in the multiple dry-year scenario. Similar to the single dry-year scenario, imported water demands shown in Table 7-4 are lower than the single dry-year demands that MWD has forecasted, and expects to meet, for PWP in its analysis. Total demands would remain the same, but there would be less excess water available for groundwater storage.

Table 7-4: Five Consecutive Dry Years Supply and Demand Comparison

Submittal Table 7-4 Retail: Multiple Dry Years Supply and Demand Comparison					
		2025	2030	2035	2040
First year	Supply totals	31,533	31,943	32,047	32,130
	Demand totals	26,750	25,000	25,320	25,630
	Difference	4,783	6,943	6,727	6,500
Second year	Supply totals	31,533	31,943	32,047	32,130
	Demand totals	26,750	25,000	25,320	25,630
	Difference	4,783	6,943	6,727	6,500
Third year	Supply totals	31,533	31,943	32,047	32,130
	Demand totals	26,750	25,000	25,320	25,630
	Difference	4,783	6,943	6,727	6,500
Fourth year	Supply totals	31,533	31,943	32,047	32,130
	Demand totals	26,750	25,000	25,320	25,630
	Difference	4,783	6,943	6,727	6,500
Fifth year	Supply totals	31,533	31,943	32,047	32,130
	Demand totals	26,750	25,000	25,320	25,630
	Difference	4,783	6,943	6,727	6,500
NOTES: Based on MWD's draft 5-consecutive drought years projections for the City of Pasadena, dated February 2021.					

7.3 Drought Risk Assessment

The water supply reliability assessment shown in Table 7-2, Table 7-3, and Table 7-4 presents comparisons of water supply and demand for three categories of hydrologic conditions: normal, single dry year, and five consecutive dry years. Groundwater is based on the most recent RBMB resolution on water rights from the Raymond Basin. Natural replenishment to the groundwater basin varies with hydrology, but the ability to extract the water from the ground is more a function of long-term average recharge and is less subject to hydrologic variability from year to year. However, surface water diversions will vary depending on hydrology and the groundwater category includes surface water credits. It should be noted that while surface water is not available at a consistent level, groundwater is available at a consistent level in single and five consecutive dry year scenarios.

Given that the majority of PWP's supplies are derived from imported water sources, the single-dry year would be the year within with the lowest available supply to MWD, who in turn supplies PWP. Similarly, the multiple dry year period is the period that represents the lowest average imported water supply availability to MWD, as the main source of water to PWP, for a consecutive multiple year period. As described in Section 7.1.3, MWD has completed an analysis through its 2015 IRP Update process that modeled water supply reliability and availability of imported water supplies in both a single dry year (1977) and multiple dry year (1990-1992) hydrologic scenario. The year 1977 is the single lowest SWP allocation to MWD in history, with the exception of 2015. The SWP deliveries to MWD represent the largest source for MWD on a historic basis. Furthermore, SWP supplies have had significantly more variability than the Colorado River. Because of these factors, MWD bases its determination of "lowest supply available" on the availability of SWP allocations. The year 2015 cannot be used, however, since MWD's model results are required to assess the reliability of future years under the repeat of the driest year condition, and 2015 hydrology has not been modeled by MWD (MWD's modeling includes 1922 to 2012 hydrology). The years 1990 to 1992 represent the lowest SWP allocation to MWD in history for a 3-year period.

PWP has chosen to use the same dry year hydrologic scenarios as selected by MWD, which will allow PWP to use information about imported water supply reliability derived from modeling completed through the 2015 IRP Update process. Due to MWD's investments in continued reliability and sustainability programs that consider climate change issues discussed in Chapter 10, the projections shown in Table 7-5 do not vary.

Even though Table 7-2, 7-3 and 7-4 show available MWD supply to meet PWP's demands, based on MWD's IRP model simulations for the future under different hydrology conditions, it is possible that some extreme dry years could result in MWD allocations. MWD's model does in fact show some potential years in which allocations would be applied, reducing supply to PWP. For the years in which MWD supply could be reduced, a WSCP is in place, and is described in Chapter 8. Table 7-5 below provides the data for a five year drought risk assessment with and without the WSCP in place.

Table 7-5: Drought Risk Assessment Table

Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)	
2021	**Total**
Total Water Use	28,500
Total Supplies	29,290
Surplus/Shortfall w/o WSCP Action	790
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	182
WSCP - use reduction savings benefit	56
Revised Surplus/(shortfall)	1,028
Resulting % Use Reduction from WSCP action	0%
2022	**Total**
Total Water Use	28,065
Total Supplies	31,533
Surplus/Shortfall w/o WSCP Action	3,468
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	182
WSCP - use reduction savings benefit	1,129
Revised Surplus/(shortfall)	4,779
Resulting % Use Reduction from WSCP action	4%
2023	**Total**
Total Water Use	27,625
Total Supplies	31,533
Surplus/Shortfall w/o WSCP Action	3,908
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	182
WSCP - use reduction savings benefit	1,129
Revised Surplus/(shortfall)	5,219
Resulting % Use Reduction from WSCP action	4%
2024	**Total**
Total Water Use	27,200
Total Supplies	31,533
Surplus/Shortfall w/o WSCP Action	4,333
Planned WSCP Actions (use reduction and supply augmentation)	

Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)	
WSCP - supply augmentation benefit	182
WSCP - use reduction savings benefit	1,129
Revised Surplus/(shortfall)	5,644
Resulting % Use Reduction from WSCP action	4%
2025	**Total**
Total Water Use	26,750
Total Supplies	31,533
Surplus/Shortfall w/o WSCP Action	4,783
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	182
WSCP - use reduction savings benefit	1,129
Revised Surplus/(shortfall)	6,094
Resulting % Use Reduction from WSCP action	4%

Chapter 8 Water Shortage Contingency Plan

The WSCP is a detailed proposal for how PWP intends to act in the case of an actual water shortage condition. The WSCP anticipates a water supply shortage and provides pre-planned guidance for managing and mitigating a shortage. This plan requires a public hearing and adoption independent of the UWMP and shall be made available to its customers no later than 30 days after adoption.

Despite best planning efforts, there remains the risk that an unforeseen catastrophic supply interruption caused by a large earthquake or a power outage, or a period of extended extreme drought, may significantly decrease the availability of water supplies to the region. The WSCP describes five specific response actions that align with six standard water shortage levels, with the fundamental goal of maintaining adequate water supply to protect human health and safety, and for the purpose of minimizing the effect and hardship of water shortage to the greatest extent possible. The WSCP also contains PWP's procedures for conducting an annual water supply and demand assessment, which is the written decision-making process for determining supply reliability each year, along with data and methods used to evaluate reliability.

8.1 Water Supply Reliability Analysis

The Act requires suppliers to conduct three key planning analyses to evaluate supply reliability. The first is a water service reliability assessment that compares the total water supply sources available to the water supplier for a normal water year, a single dry water year, and a drought lasting five consecutive water years. The second is a drought risk assessment that evaluates a drought period that lasts five consecutive water years starting from the year following when the assessment is conducted. And third is the WSCP.

To meet its water demands, PWP currently relies on a supply that consists of approximately 39% of local groundwater from the Raymond Basin and 61% from the purchase of imported water from Metropolitan Water District of Southern California (MWD). MWD is the regional water wholesaler to 26 member agencies, including Pasadena. MWD's primary sources of water are from the State Water Project and the Colorado River Aqueduct.

In the reliability assessment, the single and multiple dry years were selected to be consistent with MWD's UWMP since the agency did extensive hydrological modeling and Pasadena is dependent on MWD for imported water supplies. As shown in Section 7.2, the analysis demonstrated that there will be sufficient water to meet Pasadena's demands under the studied scenarios.

8.2 Annual Water Supply and Demand Assessment Procedures

Beginning July 1, 2022, PWP shall prepare and submit an annual water supply and demand assessment (referred to as an Annual Assessment). The Annual Assessment, due July 1 of every year, will be conducted based on the procedures described herein. As required by Water Code Section 10623(a), the WSCP shall include its specific procedures that describe annual steps and timing to complete the Annual Assessment,

such that it can be consistently followed year-after-year, regardless of changing staff. The Annual Assessment shall include:

- Decision making process
- Key data inputs and assessment methodologies
    - Evaluation criteria
    - Water supply
    - Unconstrained customer demand
    - Planned water use for current year considering dry subsequent year
    - Infrastructure considerations
    - Other factors

8.2.1 Decision Making Process

The Annual Assessment will be based on the monthly report submitted to the Raymond Basin Management Board (RBMB) and MWD's Monthly Supply and Operation updates. Planning activities involve examination of developing demand and supply conditions for the calendar year, as well as considerations of potential actions when the RBMB and MWD exhibit shortages. These monthly analyses provide key information for PWP to manage resources to meet a range of estimated demands and adjust to changing conditions throughout the year.

8.2.2 Data Inputs and Assessment Methodology

The Annual Assessment determination will be based on considerations of available core water supplies, unconstrained water demand, and infrastructure considerations. The balance between projected core water supplies and anticipated unconstrained demand will be used to determine what, if any, shortage stage is expected under the WSCP framework. The WSCP's standard shortage stages are defined in terms of shortage percentages. Shortage percentages will be calculated by dividing the difference between core supplies and unconstrained demand by total unconstrained demand. This calculation will be performed separately for anticipated current year conditions and for assumed dry year conditions.

8.3 Six Standard Water Shortage Stages

The Act requires water agencies to plan for varying levels of temporary or prolonged shortages of up to and greater than 50% of normal supplies. A water shortage means that the water supply available is insufficient to meet the normally expected customer water use at a given point in time. Drought, regulatory action constraints, and natural and man-made disasters may occur at any time. The water shortage stages or levels described in this section provide pre-planned guidance for managing and mitigating shortage conditions.

The City adopted its water supply shortage plan on June 1, 2009, and most recently on February 6, 2017. The City's WSCP is located in the City of Pasadena's municipal code in Chapter 13.10 titled "Water Waste Prohibitions and Water Supply Shortage Plans". Appendix G contains a copy of the ordinance. The WSCP provides for four levels of implementation and establishes both permanent standards for water efficiency, and four levels of increasing restrictions in response to water supply shortages.

The permanent water waste prohibitions are intended to eliminate water wasting activities and increase public awareness of the need to conserve water. Additionally, programs, incentives, public information and education to promote water conservation are continuously provided by PWP regardless of water supply availability (see Chapter 9 Demand Management Measures for more information). The permanent standards for water efficiency in the WSCP include the following sixteen restrictions:

1. Restricts landscape irrigation to three days per week in the summer time and once a week in the winter time;
2. Prohibits landscape irrigation between 9:00 AM and 6:00 PM (with specified exceptions for hand watering, and drip irrigation);
3. Prohibits landscape irrigation during periods of rain;
4. Prohibits water from landscape irrigation to runoff onto streets, sidewalks, driveways, etc.;
5. Prohibits watering turf on public street medians;
6. Prohibits washing paved or hard surfaces unless with a pre-approved device;
7. Obligates water users to fix leaks and breaks in plumbing within seven (7) days;
8. Requires water recirculating for fountains and decorative water features;
9. Prohibits washing vehicles unless with a pre-approved device;
10. Eating or drinking establishments may only serve water upon request;
11. Requires restaurants to use water conserving dish wash spray valves;
12. Commercial lodging establishments must offer guests the option to refuse linen service;
13. Prohibits the installation of single-pass cooling systems;
14. Prohibits the installation of non-recirculating equipment at car washes and laundromats;
15. Requires all commercial car washes to install recirculating water systems; and
16. Requires all master-metered multifamily properties with four or more dwelling units to certify that showerheads and aerators are retrofitted to meet current California Green Building code standards.

The four levels of increasing water-use restrictions in the City's WSCP are intended for application in response to worsening drought conditions and decreased supplies. Table 8-1 describes the progressive restrictions and the estimated water savings that would result from implementing each level.

Table 8-1: PWP's Water Supply Shortage Restrictions by Level

	Level 1	Level 2	Level 3	Level 4
Watering Days	3 summer* 1 winter	2 summer* 1 winter	1 summer* 1 winter	No watering or irrigating
Obligation to Fix Leaks, Breaks or Malfunctions	72 hours after notification	48 hours after notification	36 hours after notification	24 hours after notification
Additional Prohibitions	None	No filling ornamental lakes/ponds	Same as Level 2	Same as Level 3 and no filling residential pools and spas; No new water services
Estimated Water Use Reduction	10%	20% to 30%	40%	50% and >50%
UWMP Standard Water Shortage Level	Level 1	Levels 2 and 3	Level 4	Levels 5 and 6

**For the water shortage plans, the "summer" season is defined as April 1 to October 31*

The Act has six standard water shortage levels, and Water Code Section 10632(a)(3) allows for cross-referencing relating PWP's existing categories to the six standard water shortage levels. This cross-referencing is provided in Table 8-1 above. Table 8-2 provides a description of the progressively increasing estimated shortage conditions that are the Act six standard water shortage levels.

Table 8-2: Standard Water Shortage Contingency Plan Levels

Submittal Table 8-1 Water Shortage Contingency Plan Levels		
Shortage Level	Complete Both	
	Percent Shortage Range[1] *Numerical value as a percent*	Water Shortage Condition *(Narrative description)*
1	Up to 10%	This level corresponds to PWP's Level 1 Shortage Plan, and includes all permanent water waste prohibitions, plus incremental prohibitions as follows: 1) Limits watering to one day per week from November 1 through March 31, and 3 days per week from April 1 through October 31; and 2) Requires leaks to be repaired within 72 hours of notification.
2	Up to 20%	This level corresponds to PWP's Level 2 Shortage Plan and includes all permanent water waste prohibitions, plus incremental prohibitions as follows: 1) Limits watering to one day per week from November 1

Submittal Table 8-1 Water Shortage Contingency Plan Levels		
Shortage Level	Complete Both	
	Percent Shortage Range[1] *Numerical value as a percent*	Water Shortage Condition *(Narrative description)*
		through March 31, and 2 days per week from April 1 through October 31; 2) Requires leaks to be repaired within 48 hours of notification; and 3) Prohibits the filling or re-filling of ornamental lakes or ponds.
3	Up to 30%	This level corresponds to PWP's Level 2 Shortage Plan and includes all permanent water waste prohibitions, plus incremental prohibitions as follows: 1) Limits watering to one day per week from November 1 through March 31, and 2 days per week from April 1 through October 31; 2) Requires leaks to be repaired within 48 hours of notification; and 3) Prohibits the filling or re-filling of ornamental lakes or ponds. This Shortage Level also includes enhanced enforcement through water waste patrols deployed during the day, evenings, weekends and nighttime; increased use of violation notices and fines; and enhanced marketing and outreach to customers.
4	Up to 40%	This level corresponds to PWP's Level 3 Shortage Plan and includes all permanent water waste prohibitions, plus incremental prohibitions as follows: 1) Limits watering to one day per week; 2) Requires leaks to be repaired within 36 hours of notification; and 3) Prohibits the filling or re-filling of ornamental lakes or ponds. This Shortage Level also includes enhanced enforcement through water waste patrols deployed during the day, evenings, weekends and nighttime increased use of violation notices and fines; and enhanced marketing and outreach to customers.
5	Up to 50%	This level corresponds to PWP's Level 4 Shortage Plan and includes all permanent water waste prohibitions, plus incremental prohibitions as follows: 1) Prohibits watering or irrigating; 2) Requires leaks to be repaired within 24 hours of notification; 3) Prohibits the filling or re-filling of ornamental lakes or ponds; 4) Limits the filling of single family residential swimming pools and spas; and 5) Limits the provision of new water services. This Shortage Level also includes enhanced enforcement through water waste patrols deployed during the day, evenings, weekends and nighttime; increased use of violation notices and fines; and targeted outreach to customers.

Submittal Table 8-1 Water Shortage Contingency Plan Levels		
Shortage Level	Complete Both	
	Percent Shortage Range[1] *Numerical value as a percent*	Water Shortage Condition *(Narrative description)*
6	>50%	This level corresponds to PWP's Level 4 Shortage Plan and includes all permanent water waste prohibitions, plus incremental prohibitions as follows: 1) Prohibits watering or irrigating; 2) Requires leaks to be repaired within 24 hours of notification; 3) Prohibits the filling or re-filling of ornamental lakes or ponds; 4) Limits the filling of single family residential swimming pools and spas; and 5) Limits the provision of new water services. This Shortage Level also includes enhanced enforcement through water waste patrols deployed during the day, evenings, weekends and nighttime; through increased use of violation notices and fines; and targeted outreach to customers.
[1] One stage in the Water Shortage Contingency Plan must address a water shortage of 50%.		

8.4 Shortage Response Actions

Water Code Section 10632(a)(4) specifies the types of shortage response actions to align with shortage levels to meet the severity of impending shortages. PWP's WSCP provides for four levels of implementation as described in Section 8.3 and shown in Table 8-1. These stages of action assume that there may be reduced supply availability from any of PWP's normal sources, and that the shortage may last for any given amount of time.

Table 8-3 provides information about restrictions and prohibitions associated with each level of PWP's WSCP. Regardless of the presence of a water shortage, the sixteen water waste prohibitions are in effect at all times and included in the table. Further, restrictions may vary based on use; where applicable, information is provided on whether the restriction applies to residential or commercial-industrial-institutional (CII) customers.

Table 8-3: Demand Reduction Actions

Submittal Table 8-2: Demand Reduction Actions				
Shortage Level	Demand Reduction Actions	How much is this going to reduce the shortage gap? *Include volume units used.*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement?
Permanent	Provide Rebates on Plumbing Fixtures and Devices	829 AF Lifetime Savings		No
Permanent	Offer Water Use Surveys		To recommend to the customer measures to enhance conservation and efficiency and identify possible indoor or outdoor leaks	No
Permanent	Provide Rebates for Turf Replacement	519 AF Lifetime Savings		No
Permanent	Landscape - Restrict or prohibit runoff from landscape irrigation			Yes
Permanent	Provide Rebates for Landscape Irrigation Efficiency	62 AF Lifetime Savings		No
Permanent	Expand Public Information Campaign	278 AF Savings	Use of behavioral efficiency software such as WaterSmart for providing information to customer on their water use	No

Submittal Table 8-2: Demand Reduction Actions				
Shortage Level	Demand Reduction Actions	How much is this going to reduce the shortage gap? *Include volume units used.*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement?
Level 1	Increase Water Waste Patrols	Up to 10% GPCD Savings from SB X7-7 Baseline = 715 AF	Increase Water Waste Patrols to actively patrolling areas showing high water use	Yes
Level 1	Reduce System Water Loss	Up to 10% GPCD Savings from SB X7-7 Baseline = 715 AF	Leaks must be repaired within 72 hours	Yes
Level 1	Expand Public Information Campaign	Up to 10% GPCD Savings from SB X7-7 Baseline = 715 AF		
Level 2	Increase Water Waste Patrols	Up to 30% GPCD Savings from SB X7-7 Baseline = 8,696 AF	Increase patrols shifts to cover a 24 hour period with 50% coverage across city neighborhoods	Yes
Level 2	Reduce System Water Loss	Up to 30% GPCD Savings from SB X7-7 Baseline = 8,696 AF	Leaks Must be repaired within 48 hours	Yes
Level 2	Other Actions	Up to 30% GPCD Savings from SB X7-7 Baseline = 8,696 AF	Limits on filling ornamental lakes and ponds	Yes

Submittal Table 8-2: Demand Reduction Actions				
Shortage Level	Demand Reduction Actions	How much is this going to reduce the shortage gap? *Include volume units used.*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement?
Level 2	Expand Public Information Campaign	Up to 30% GPCD Savings from SB X7-7 Baseline = 8,696 AF		
Level 3	Reduce System Water Loss	Up to 40% GPCD Savings from SB X7-7 Baseline = 12,753 AF	Leaks must be repaired within 36 hours.	Yes
Level 3	Increase Water Waste Patrols	Up to 40% GPCD Savings from SB X7-7 Baseline = 12,753 AF	Increase patrol shifts to cover a 24 hour period with 75% coverage across city neighborhoods.	Yes
Level 3	Other Actions	Up to 40% GPCD Savings from SB X7-7 Baseline = 12,753 AF	Limits on filling ornamental lakes and ponds	Yes
Level 3	Expand Public Information Campaign	Up to 40% GPCD Savings from SB X7-7 Baseline = 12,753 AF		
Level 4	Moratorium or Net Zero Demand Increase on New Connections	Up to 50% GPCD Savings from SB X7-7 Baseline = 16,758 AF	No new potable water service	Yes

Submittal Table 8-2: Demand Reduction Actions				
Shortage Level	Demand Reduction Actions	How much is this going to reduce the shortage gap? *Include volume units used.*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement?
Level 4	Expand Public Information Campaign	Up to 50% GPCD Savings from SB X7-7 Baseline = 16,758 AF		
Level 4	Other Actions	Up to 50% GPCD Savings from SB X7-7 Baseline = 16,758 AF	No watering or irrigation of landscape	Yes
Level 4	Other Actions	Up to 50% GPCD Savings from SB X7-7 Baseline = 16,758 AF	Limits on filling ornamental lakes and ponds; and swimming pools	Yes
Level 4	Reduce System Water Loss	Up to 50% GPCD Savings from SB X7-7 Baseline = 16,758 AF	Leaks must be repaired within 24 hours	Yes

8.4.1 Supply Augmentation

Consumption reduction methods are part of the WSCP, given that the purpose of the various actions listed in Table 8-2 is to reduce water use in response to a water supply shortage. PWP's consumption reduction methods that are part of the WSCP are detailed in Table 8-4.

Table 8-4: Supply Augmentation and Other Actions

Table 8-3: Supply Augmentation and Other Actions			
Shortage Level	Supply Augmentation Methods and Other Actions by Water Supplier	How much is this going to reduce the shortage gap? *Include volume units used.*	Additional Explanation or Reference *(optional)*
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.

8.4.2 Demand Reduction

PWP uses multiple methods to account for water use under normal conditions. Water supply conditions are recorded on a daily basis. Well production, MWD imported water, and surface water that is converted into spreading credits (see Chapter 5, System Supplies for more information) are calculated and recorded by the Water Engineering Division of PWP. Data is rolled into monthly production totals and submitted to the Water Engineering Manager, and these numbers are added to the water supply report. All data is stored on PWP's network and is accessible by all employees with access to the network. PWP also has a Supervisory Control Data and Acquisition (SCADA) system that produces instantaneous data and logs data in the system.

During water shortage scenarios, a spreadsheet is used to compare current weekly production with projected weekly base demand. The spreadsheet is provided to the Water Engineering Manager for analysis and verification of demand reduction. Monthly reports, similar to normal operating conditions, are presented to the General Manager for review. If the General Manager determines water demand reduction goals are not being met, the General Manager will notify the City Council. Ultimately, the City Council will take corrective actions, as necessary, to adjust the water shortage emergency level to increase conservation. If dictated by the type of emergency situation, production figures can be reported to the Water Engineering Manager on an hourly basis, and the General Manager and subsequently the City Council, on weekly basis.

8.4.3 Operational Changes

During a water shortage scenario, operational changes are implemented to enhance water waste enforcement and increase outreach to customers. Staff is augmented with temporary workers who are deployed to enforce the water waste restrictions throughout the city. Staff works in shifts over 24 hours to ensure that any water waste is documented and customers notified. A spreadsheet is used to track all reports and execute the appropriate level of action from a 1st violation notice, to a 4th notification and subsequent fine. Administrative staff is assigned to track all reports and issue notifications and fines. Additionally, staff time and funding is dedicated to create more marketing collateral, to educate and inform customer of the water waste shortage and restrictions.

8.4.4 Additional Mandatory Restrictions

PWP is prepared to enact additional mandatory restrictions during water shortage declarations. During the previous drought PWP recommended to City Council to enact a mandatory requirement for all Multi-Family properties to retrofit their showerheads and faucet aerators to comply with code. City Council approved the recommendation and it became a part of the revised Water Waste Ordinance.

8.4.5 Catastrophic Supply Interruption Plan

PWP is also prepared for a catastrophic event that would result in complete loss of supply from its normal sources. It is likely that a complete loss of supply would be short-term in nature, lasting from a day to a week or so, until some reduced supply is restored from normal sources. Major catastrophic events that may affect PWP's major water sources are extreme (worst case) drought, earthquake, region-wide power outage, contamination, or loss of imported water due to imported water system unplanned shutdowns. To prepare for potential catastrophic events, PWP has developed an emergency response plan and contingency plan to respond to supply interruptions, operates a water quality control laboratory to ensure

rapid testing of water quality, continuously implements security upgrades, has back-up power and communications equipment, and has developed points of contacts and chains of command during emergency situations. Because PWP has its own Power Department and also maintains emergency generators, power can quickly be restored during catastrophic interruptions.

Additionally, PWP is prepared to deal with secondary effects of emergency events, such as a loss of power, decline in water quality, or a communication system shutdown. PWP's emergency planning procedures are designed to maintain safe water supplies to meet basic customer needs and reduce the impacts of any catastrophic supply interruptions to the greatest extent possible.

PWP maintains a list and contact information of all large water users in the City such as colleges, schools, parks, and golf courses. Having the large users reduce or stop water use can quickly reduce water demands during an emergency.

Emergency response plans for PWP if a catastrophic event impacts the ability of PWP to deliver water are described below in Table 8-5.

Table 8-5: Possible Actions for Catastrophic Events

Type of Catastrophe	Response Actions
Extreme Drought	1. City Council enacts Level 4 water supply shortage water conservation measures
	2. Determination by Council if additional water conservation measures are needed to achieve necessary reductions in demand.
Earthquake	1. If power is lost use alternative means of inter-PWP communications.
	2. If power is lost restore localized power to critical facilities (pumps, boosters, and water treatment facilities) with emergency generators.
	3. Inspect reservoirs, boosters, pumps, and wells for structural damage.
	4. Recommend water boiling.
	5. City council enacts Level 4 water supply shortage water conservation measures.
	6. Determination by City Council if additional water conservation measures are needed to achieve necessary reductions in demand.

	7. Check with neighboring agencies if supplies are available using emergency interconnections
	8. Establish and maintain communications with MWD.
Region-Wide Power Outage	1. Use alternative means of inter-PWP communications.
	2. Restore localized power to critical facilities (pumps, boosters, and water treatment facilities) through the PWP's Power Division and/or with emergency generators.
	3. Recommend water boiling.
	4. City council enacts Level 4 water supply shortage water conservation measures.
	5. Determination by City Council if additional water conservation measures are needed to achieve necessary reductions in demand.
	6. Check with neighboring agencies if supplies are available using emergency interconnections
	7. Establish and maintain communications with MWD.
Water Contamination	1. Recommend water boiling.
	2. Consider increasing disinfection of water.
	3. Check with neighboring agencies if uncontaminated supplies are available using emergency interconnections
	4. Establish and maintain communications with MWD.
Loss of Imported Water	1. City Council enacts Level 4 water supply shortage water conservation measures.
	2. Determination by City Council if additional water conservation measures are needed to achieve necessary reductions in demand.
	3. Check with neighboring agencies if supplies are available using emergency interconnections
	4. Establish and maintain communications with MWD.

8.4.5.1 Emergency Response Plan

America's Water Infrastructure Act of 2018 Section 2013(b) requires community water systems serving populations greater than 3,300 to develop or update an Emergency Response Plan (ERP) that incorporates findings of their risk and resilience assessment. PWP's ERP was submitted to the Environmental Protection Agency (EPA) on September 16, 2020. The plan includes:

1. Strategies and resources to improve the resilience of the system, including the physical security and cybersecurity of the system;

2. Plans and procedures that can be implemented, and identification of equipment that can be utilized, in the event of a malevolent act or natural hazard that threatens the ability of the community water system to deliver safe drinking water;

3. Actions, procedures and equipment which can obviate or significantly lessen the impact of a malevolent act or natural hazard on the public health and the safety and supply of drinking water provided to communities and individuals, including the development of alternative source water options, relocation of water intakes and construction of flood protection barriers; and

4. Strategies that can be used to aid in the detection of malevolent acts or natural hazards that threaten the security or resilience of the system.

PWP's Risk and Resilience Assessment referenced in the ERP was submitted to the EPA on March 19, 2020. The plan includes:

1. The risk to the system from malevolent acts and natural hazards;

2. The resilience of the pipes and constructed conveyances, physical barriers, source water, water collection and intake, pretreatment, treatment, storage and distribution facilities, electronic, computer, or other automated systems (including the security of such systems) which are utilized by the system;

3. The monitoring practices of the system;

4. The financial infrastructure of the system;

5. The use, storage, or handling of various chemicals by the system; and

6. The operation and maintenance of the system.

8.4.5.2 Seismic Risk Assessment and Mitigation Plan

While Pasadena is at risk from many natural and man-made hazards, an earthquake is the event with the greatest potential for far-reaching loss of life or property, and economic damage. Between 2004 and 2006, PWP performed a thorough Seismic Vulnerability Assessment of its water system and presented a Seismic Improvement Program (SIP) with the findings. PWP's consultant, G&E Engineering Systems, Inc., prepared a total of eight documents that encompass the assessments and include evaluations of the reservoirs, booster stations, groundwater wells, power supply as it supports the water system, and distribution system performance. The documents also includes analysis of post-earthquake fire ignitions, City-wide service restoration times, water quality, cost benefit analysis, hydraulics, and SCADA and instrumentation upgrades.

Not all seismic upgrades are equally critical, so the SIP, or PWP's mitigation plan, was 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.

Appendix H provides a copy of the Seismic Vulnerability Assessment Ranking document showing PWP's facilities and scheduling for maintenance and system upgrades. The WSRP also discusses the seismic vulnerability of PWP's facilities and proposes implementation of recommendations in the Seismic Vulnerability Assessment.

8.5 Communication Protocols

PWP will inform customers, the public and others regarding any current or predicted water shortages. The following outreach methods will be used to inform customers:

- Website and Social Media
- Press Releases
- Advertising and Public Radio
- Citywide Direct Mailer
- News Articles Through City/PWP Publications
- Direct Outreach to City Departments, Field Reps, Large Customers, and Community Groups
- Water Waste Hotline 744-7311

During the event of a water shortage emergency, PWP will declare the event using the above methods and coordinate with Pasadena City and Los Angeles County officials for the proclamation thereof.

8.6 Compliance and Enforcement

Violation of the water use prohibitions listed in Table 8-2 range from a written notice for a first violation to monetary penalties for subsequent violations. The various penalties that may be enforced by PWP during implementation of the WSCP are summarized in Table 8-3. Monetary penalties vary based on meter size, customer classification, and the number of fines that have been issued to the customer within a twelve-month period. Fines range from $100 to $500 for residential customers and customers with meters 1 ½-inch and less. Fines range from $200 to $1,000 for non-residential customers with meters larger than 1 ½ inch. Monetary penalties are collected by adding the fine to a customer's bill, and are payable at the same time and in the same manner as such bill or by any other method of collection and payment established by PWP. After receiving notice of an alleged violation, customers have the right to a hearing by the General Manager of PWP.

Table 8-6: Penalties for Violating Water Use Prohibitions

Number of Violations in a 12-Month Period	Penalty	
	Residential and all meters 1 ½ - inch and less	Non-Residential meters larger than 1 ½ inch
1	Written notice	Written notice
2	$100	$200
3	$200	$400
4	$350	$700
5 and subsequent violations	$500	$1,000

As an alternative to paying a fine, a customer, with the concurrence of the General Manager of PWP, may waive the right to a hearing and elect one of the following options:

1. Complete a water efficiency training class offered by PWP
2. Complete all recommendations presented in a landscape audit
3. Retrofit inefficient fixtures or irrigation systems; and/or
4. Complete other water savings programs PWP may establish for the customer in a timely fashion.

A timetable shall be established for completing the selected option jointly by the customer and PWP. If a customer fails to complete the option to the satisfaction of PWP or within the given timeframe, then the customer must pay the monetary penalty. A customer may not select the same option more than once in a twelve-month period.

If necessary to achieve compliance with the water prohibitions, the WSCP ordinance allows PWP to install flow restrictors of one gallon per minute for services up to one-inch meters, and comparably sized restrictors for larger meters with a minimum 48-hours advance notice. A customer is responsible for the cost of installation and removal of any water flow restrictors with payment due prior to removal of the restrictor. Service may be discontinued for continuing or willful violations of the ordinance, in addition to any penalties and/or the installation of a water flow restrictor.

As amended, the ordinance also allows the General Manager of PWP to request water conservation plans and quarterly follow-up reports from commercial and industrial water users using 25,000 billing units or more per year. Plans must include recommendations for conserving water and progress to date in implementing water savings.

8.7 Legal Authorities

The implementation of each stage of action is triggered by a City Council vote rather than a specific percent reduction in water supply. If a water shortage occurs, PWP staff recommends to the City Council the appropriate stage for implementation, corresponding to the degree of the shortage given projected supplies and demands. Next, a public hearing is held by the City Council to determine 1) if a water shortage exists, 2) the necessary water conservation target needed to address the shortage, and 3) the appropriate stage to implement to address the shortage. Implementation of a WSCP stage occurs immediately upon publication of the City Council's decision.

During the water shortage, the City Council may discontinue stages or implement any other stage, as necessary. After the City Council determines a water shortage is no longer in effect, the water shortage stage in effect is terminated. The percent supply reduction as presented in Table 7-1 is an estimation of the water supply reduction that would trigger City Council to implement each stage of action. Implementing the WSCP based on a City Council decision, rather than a predefined water shortage percentage, gives PWP greater flexibility to adaptively implement water shortage stages and the associated response.

8.8 Financial Consequences of WSCP

The Act requires an analysis of impacts on a water supplier's revenues and expenditures from a water shortage that reduces water use. One concern is that reduced water consumption may result in reduced revenues. Another concern is that there may be higher costs to operate the system due to the shortage (e.g., if it is necessary to hire additional staff, purchase emergency short-term supplies at higher costs than normal supplies, make computer program modifications for billing, or increased public information costs).

PWP anticipates revenues will be lower during a drought as a result of a decrease in water sales. PWP maintains a cash reserve equal to approximately 60 to 90 days-worth of revenue. During droughts PWP can also modify its rate structure to recover costs by adding a surcharge supported by a cost of service study. A cost of service study would provide justification for water rate structure revisions if the study indicated costs of providing water service during a drought were not being recovered by existing rates.

8.9 Monitoring and Reporting

PWP monitors customer compliance with the Water Shortage Level by tracking customer water use, using the WaterSmart Software, which identifies customer's usage and percent reduction and increase over previous months. During a state declared drought emergency, PWP deploys its water waste patrol to enforce the watering restrictions in shifts over a 24 hour period. Staff documents all water waste and issues notifications and fines to those violating the ordinance.

PWP collects weekly data on water production and provides monthly monitoring reports to the State Board, which identifies the water shortage level, population, total potable water production, residential use percentage, commercial industrial institutional water use and estimated residential gallons per capita per day. PWP tracks all water production by fiscal and calendar year, and tracks percentage reduction versus prior baseline years.

8.10 WSCP Refinement Procedures

WSCP refinement procedures are used to ensure shortage risk tolerance is appropriate and that water shortage mitigation tactics are implemented when required. PWP plans to refine the WSCP at least every five years in conjunction with the UWMP updates, unless a shorter time frame is deemed appropriate by PWP. Evaluation tracking will be implemented with each future WSCP deployment to evaluate the effectiveness of the water shortage response actions on demand levels. The evaluation logic model will document programmatic shortage responses and compare the expected percent demand reductions against actual reductions; by this means, the shortage response actions in the WSCP will be revised using the evaluation generated evidence. The success of customer outreach and communications will also be assessed to inform the next WSCP revision. The WSCP development will be considered a life cycle with the following steps:

1. Implementation
2. Monitoring
3. Performance Indicators
4. Assessment and Evaluation
5. Process to Refine and Improve the Plan
6. Adoption by City Council

8.11 Special Water Feature Distinction

Water Code 10632(b) requires water features that are not pools or spas be analyzed and defined separately from pools and spas in the WSCP. Non-pool or non-spa water features may use or be able to use recycled water, whereas pools and spas must use potable water for health and safety considerations. PWP has a pilot program for non-potable water for irrigating landscaped areas. Non-pool water features may use this water when available. In addition, the WSCP requires potable water recirculation for fountains and decorative water features.

8.12 Plan Adoption, Submittal, and Availability

In this section, PWP documents the processes and steps to adopt, submit, implement, and amend the WSCP, which have been described in Chapter 2. These processes will follow the processes for adopting the UWMP. However, the WSCP may be periodically amended independently of the UWMP, as needed.

Chapter 9 Demand Management Measures

Demand management is an integral part of sustainably managing water resources in California. PWP has continuously implemented a water conservation program since 1991. This chapter describes the Demand Management Measures (DMMs) that PWP have implemented, are currently implementing, and plan to implement in order to help lower demands and improve water service reliability. Reducing demands can also benefit PWP by reducing energy costs, thereby being in a better position for future water security.

Table 9-1 lists the current implementation status for each of the DMMs required by the Act.

Table 9-1: Summary of Demand Management Implementation Status

	Demand Management Measure Number and Name	Implementation Status
(i)	Water Waste Prevention Ordinances	Fully implemented
(ii)	Metering	Fully implemented
(iii)	Conservation Pricing	Fully implemented
(iv)	Public Education and Outreach	Fully implemented
(v)	Programs to Assess and Manage Distribution System Real Loss	Planning Stage for Implementation in FY22
(vi)	Water Conservation Program Coordination and Staffing Support	Fully implemented
(vii)	Other Demand Management Measures	Fully implemented

The following sections describe PWP's implementation of the DMMs listed in Table 9-1.

9.1 DMM (i): Water Waste Prevention Ordinances

The City has adopted the Water Waste Prohibitions and Water Supply Shortage Plan Ordinance (see Appendix G) as part of the City's Code of Ordinances. The prohibitions that are consistent with implementation of DMM (i), PWP's Water Shortage Procedures, were amended on July 1, 2009, and again on September 26, 2016. The amendments include permanent water waste prohibitions and prohibitions associated with four levels of water shortage conditions. Permanent water conservation requirements that apply at all times, include:

- ***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.
- ***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.

- ***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.
- ***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.
- ***No Watering Turf on Public Street Medians:*** Watering ornamental turf on public street medians with potable water is prohibited.
- ***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.
- ***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.
- ***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.
- ***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.
- ***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.
- ***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.
- ***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.
- ***No Installation of Single Pass Cooling Systems:*** Installation of single pass cooling systems is prohibited in buildings requesting new water service.

- ***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.
- ***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.
- ***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.

Violation of the permanent water waste prohibitions listed above are discussed in Chapter 8, WSCP of this 2020 UWMP.

9.2 DMM (ii): Metering

PWP does not have any unmetered water accounts. In addition, all newly established accounts are required to have a water meter, thereby eliminating the possibility of new unmetered accounts. In 2010, PWP completed a written plan to test, repair, and replace meters. This plan lays out the methodology that PWP employs to ensure that meters are functioning as intended and that water use is correctly measured.

9.3 DMM (iii): Conservation Pricing

PWP uses a "block" or tiered rate structure to encourage conservation: the less you use, the lower your cost. The current water rate structure has an increasing tier block rate design with four tiers of block rates. Each tier increases by between 112% and 200%, sending a strong conservation signal to customers. An overview of PWP's conservation pricing is provided in Table 9-2; prices are shown in units of price per hundred cubic feet (HCF) of water.

Table 9-2: Tiered Rate Structure

1st Block	2nd Block	3rd Block	4th Block
$1.44852	$3.07637	$3.60615	$4.37569

9.4 DMM (iv): Public Education and Outreach

PWP has an active public information program based on the premise that providing customers with pertinent information will lead to more efficient water use. PWP provides outreach to both the CII and residential customer sectors using workshops, presentations, advertising, social media, e-newsletters, In-Focus newsletter, bill inserts, school programs, special events, and maintaining an online website dedicated to conservation. PWP works closely with neighboring water agencies, Burbank and Glendale, to create consistent regional water conservation messages.

Workshops, presentations, education and outreach have provided residents, businesses and schools with hands on demonstrations and information about water conservation. Workshops are also held at demonstration sites, where residents are able to participate in building water efficient demonstration

gardens; install greywater systems; and drip irrigation systems. At all events, water conservation materials and information on PWP's programs and Water Shortage Ordinance are provided in the form of handouts. Workshop topics have included:

- Presentations to homeowners associations, neighborhood associations, and business organizations
- Sheet mulching and composting workshops
- Efficient irrigation workshops
- Turf removal and drought tolerant landscape workshops (offered in English and Spanish)
- Healthy trees and shrubs workshops
- Healthy soils and planting technique workshops
- Greywater workshops
- Organic gardening and planting with edibles
- Designing a regenerative garden
- Watershed workshops

PWP has developed an online presence to encourage its customers to conserve water via:

- A dedicated website: PasadenaSavesWater.com
- A Facebook page: facebook.com/PasadenaWaterandPower

Both sites provide water shortage and conservation news, upcoming workshops, rebate announcements, conservation tips, self-audits, a link to report water waste, and conservation tools and resources providing links to external water conservation websites.

Other methods PWP utilizes to increase water conservation awareness include bill inserts, e- newsletters, press releases, the In Focus newsletter, welcome kits for new customers, monthly customer recognition in the monthly business newsletter *The Conduit*, advertising in newspapers and magazines, radio spots, local access television, and video monitors at the City's Permit Center.

PWP first implemented school education programs in 1999. Upon request, PWP provides water-related class presentations for students in grades K through 12 and distributes educational materials to public schools. For students in 4th through 6th grade, PWP hosts an annual water awareness event. At class presentations and events, water conservation messages are distributed using age appropriate materials including coloring books, pens, pencils, and stuffed toys. PWP hosts a calendar art contest depicting water conservation messages and images for all grade levels; PWP also provides field trips to students to its water quality laboratory and reservoirs.

9.5 DMM (v): Programs to Assess and Manage Distribution System Real Loss

This DMM requires water suppliers to conduct audits of the water system consistent with guidelines from the AWWA if unaccounted-for water exceeds 10%.

PWP annually conducts system water audits by comparing the total volume of billed water use to the total supply entering the system. PWP yearly water losses range between 6% and 9%. Significant differences exceeding 10% would indicate the need for repairs. In addition, PWP spends approximately $15M to $25M

annually as part of its capital replacement/rehabilitation program for replacing aging pipelines and meters, and repairing and upgrading well and booster stations.

9.6 DMM (vi): Water Conservation Program Coordination and Staffing Support

Since 2001, PWP has had a designated water conservation manager dedicated to water conservation issues, with the assistance from other PWP employees. Currently, PWP has four employees responsible for developing and implementing PWP's conservation programs and initiatives.

9.7 DMM (vii): Other Demand Management Measures

9.7.1 Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers

PWP offers single-family residential and multi-family residential water audits. Surveys can consist of indoor and/or outdoor surveys. Indoor surveys identify opportunities for installing hardware-based water conservation devices and provide leak detection tests and an assessment/inventory of water fixtures. Low flow showerheads and aerators are also distributed when available. Outdoor surveys review irrigation schedules and practices to determine if overwatering is occurring; plant water needs and soil health; opportunities for turf removal and the planting of drought tolerant plants and/or natives. PWP reaches over 500 customers annually with water surveys, through its Home Improvement Program, which provides Single Family Residential customers with water and energy use surveys, and also the direct install of water saving measures, such as low-flow showerheads, high efficiency toilets, weather based irrigation controllers and efficient sprinklers.

9.7.2 Residential Plumbing Retrofits

The purpose of this measure is to make low-flow showerheads, aerators, and other water savings fixtures and devices available to single- and multi-family residences constructed prior to 1992. 1992 marks the implementation of building standards to require water saving fixtures in new construction; therefore, homes constructed after 1991 should already have water saving devices and fixtures in place.

PWP provides no cost plumbing retrofits through its Home Improvement Program, which reaches over 500 Single Family Residential customers annually. Customers receive the direct installation of low-flow showerheads and high efficiency toilets.

On June 1, 2015 the Pasadena City Council adopted by proclamation the requirement that all multifamily properties retrofit their showerheads and aerators to water efficient ones. Multifamily properties are inspected for compliance as part of the Planning Department's Quadrennial Inspection Program for Multifamily dwellings.

9.7.3 Large Landscape Conservation Programs

On July 15, 2015, the California Water Commission approved an update to its Model Water Efficient Landscape Ordinance (MWELO) as a standard for implementation in communities across California. The ordinance provides water conservation requirements for most new development and redevelopment projects, and retrofit requirements for existing large landscape properties with an area of one acre or

greater and cemeteries. Requirements for existing large landscape properties include, but are not limited to, irrigation water use analyses, irrigation surveys, and irrigation audits to evaluate water use and provide recommendations as necessary to reduce landscape water use to a level that does not exceed the Maximum Applied Water Allowance (MAWA) for existing landscapes.

On June 14, 2018 Pasadena City Council adopted an ordinance amending Chapter 17.44 (Landscaping) of the Zoning Code (Title 17) to update City regulations pertaining to landscaping and irrigation standards, and to incorporate the DWR Model Water Efficient Landscape Ordinance (MWELO).

PWP provides landscape surveys for large landscapes, and provides rebates for landscape irrigation system improvements. As specified in Table 8-3, landscape rebates are provided for weather based irrigation controllers (WBIC), central computer irrigation controllers, retrofit rotating nozzles for pop-up spray heads, and high efficiency nozzles for large rotary sprinklers.

9.7.4 Home Water Reports

PWP offers Home Water Reports to all Pasadena households. These personalized reports provide both current and historical water use information for each property, customized recommendations to help customers save water, and a comparison of the property's water use with similar homes. All Pasadena households have access to water usage information via the WaterSmart Customer Portal, which provides customers with an in depth look at their water usage, using colorful graphs and charts to display data.

9.7.5 Spray-to-Drip Irrigation Retrofit Program

In 2020, PWP launched a Spray-to-Drip Program, which provides eligible Single Family Residential customers with a complete kit to convert existing spray systems to efficient drip systems. Each Spray-to-Drip Retrofit Kit is valued at approximately $288, and provides enough supplies to cover 250 to 400 square feet of landscape. This kit is ideal for converting existing sprinklers to efficient drip irrigation for garden areas that have plants, shrubs and trees. Kits are provided through a grant from the United States Bureau of Reclamation.

9.7.6 Online Garden Design Guide

In 2018, PWP enhanced its online design guide which provides visitors with the ability to tour multiple garden galleries, view plant selections, and create and download a list of plants, categorized by hydro-zone, height, color and more for their garden design.

9.7.7 Greywater Program

In 2015 PWP launched a Laundry-to-Landscape ("L2L") Greywater Program, offering workshops, onsite support, and incentives for residential L2L system installations. The program was expanded in 2017 to offer the direct installation of greywater systems for income qualified single family residential customers, and in 2019 to offer the direct installation of systems to all single family residential customers.

9.7.8 Drought Tolerant Demonstration Gardens/Landscapes at City Facilities

In 2015, PWP launched a demonstration garden program, partnering with the Pasadena City Fire Department to develop drought-tolerant demonstration gardens at five Pasadena Fire Stations. This project is part of Pasadena's continuing commitment to maximize water savings throughout the City and to support water-saving opportunities at city facilities. The five fire stations were completed in 2018, and

the program was expanded to build additional demonstration gardens and landscapes at water facility sites, vacant city owned parcels and in partnership with community organizations at their sites. To date, 10 demonstration gardens/landscapes have been completed. As part of PW's commitment to invest in the Pasadena Community, all of the work was completed with support from Maintenance and Assistance to Homeowners ("MASH") employees, who received training from a professional landscaper on how to remove turf, retrofit irrigation, and install drought tolerant plants.

9.7.9 Landscape Direct Install Program

In 2015, PWP created the Landscape Direct Install Program for income qualified customers. This program offers single family residential customers the removal of existing turf and the installation of a drought tolerant landscape, efficient irrigation, and mulch.

PWP provides a Water & Energy Direct Install Program (WeDIP) to non-residential, small business customers. Participating customers will have water and energy saving equipment installed at no cost, and customers do not pay for the installation.

9.7.10 Water Waste Enforcement Program

PWPs Water Waste Enforcement Program includes active patrolling of the City to identify water waste and enforce compliance with Pasadena's Water Waste Ordinance. Information about the watering restrictions and ordinance are distributed to all Pasadena customers through Home Water Reports, e-newsletters, direct email, door hangers, community newsletters, workshops and bill inserts. Pasadena residents are also encouraged to report Water Waste 24/7 and are able to do so from any smart device using Pasadena's Citizen Service app.

9.7.11 Workshops

PWP offers quarterly workshops on topics including: soil health and planting techniques, drip irrigation, turf removal, regenerative landscape design, weather based irrigation controllers, watershed wise designs, onsite water reuse, and rainwater capture/harvesting.

9.7.12 Residential Rebate Programs

In 2008, MWD initiated the SoCal WaterSmart Program for residential water conservation replacing previous rebate programs offered by individual water service providers throughout the MWD service area. This program, sponsored by MWD, sets uniform rebate requirements across the MWD service area, and provides a clearinghouse for processing rebates for all MWD member agency customers. Local agencies have the option of increasing baseline rebate amounts to their customers through the program. PWP has increased baseline rebates for a few of the qualifying products, including high efficiency washing machines. Eligible customers include residential customers residing in single-family and multi-family homes, even if multi-family residents do not receive a water bill. Current rebates are summarized in Table 9-3.

Table 9-3: Current Residential Rebates

Device Type	Rebate Amount
Rain Barrel (50 gallon minimum)	$100
Soil Moisture Sensor System	$250 or $50 per irrigation sensor for large residential sites
Premium High Efficiency Toilets	$100
High Efficiency Clothes Washer	$300
Rotating Nozzles for Pop-up Spray Heads Retrofits (minimum of 30 per home)	$7 per nozzle
Weather-Based Irrigation Controller	$250 for under 1 acre or $50 per station for 1 acre or more
Cisterns (200-1,000+ gallons)	From $300-$600
Turf Removal	$2 per square foot; up to $10,000

9.7.13 Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts

PWP, in partnership with MWD, has implemented a commercial rebate program, designed specifically for customers in the CII sector and that includes multi-family residences. In the CII sector, the program provides rebates for water saving plumbing fixtures, medical/dental equipment, food service equipment, and landscaping equipment. Current CII rebates are listed in Table 9-4.

Table 9-4: Current Commercial/Industrial/Institutional Rebates

Device Type	Rebate Amount
High Efficiency Toilets (1.06 gallons per flush or less) or Flushometer	$100 each
Zero and Ultra Low Water Urinals	$400 each
Plumbing Flow Control Valve	$10 each
Cooling Tower pH Conductivity Controller	$3,000 each
Cooling Tower Conductivity Controller	$1,000 each
Air Cooled Ice Machine	$1,000 each
Connectionless Food Steamer	$500 compartment
Dry Vacuum Pump	$150 per 0.5 horsepower
Laminar Flow Restrictor	$15 restrictor
In-Stem Flow Restrictor	$2 regulator
Soil Moisture Sensor System	$60 sensor
Weather Based Irrigation Controller	$60 per station
Central Computer Irrigation Controller	$60 per station
Rotating Nozzles for Pop-up Spray Heads (30 minimum)	$7 each
High Efficiency Spray Nozzles for Large Rotary Sprinklers	$20 per set
Turf Removal	$2 per sq ft. / up to $100,000