Appendix K

Water Supply, Hydrology, and Water Quality Analysis

Hauled Water Ordinance

Water Supply, Hydrology, and Water Quality Analysis

Supporting Document for the Single Family Residential Hauled Water Initiative EIR

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Introduction

An Environmental Impact Report (EIR) is being prepared for Los Angeles County Hauled Water Task Force for a project ordinance titled the Single Family Residential Hauled Water Initiative. The Project is residential development that consists of approximately 42,872 parcels across 285,500 acres of existing agricultural and open space land to facilitate single-family residential uses. The Project is located in unincorporated Los Angeles County, north of Santa Clarita and south of Kern County. The Project will develop low-density single-family homes that will be spread throughout the Project Area. For evaluation purposes, development is estimated to take place over a 20-year period and the maximum population growth is expected to be approximately 7,000 people per development year for an estimated total project population of 149,370 at build-out.

Project Summary

This report is a supporting document for the Project's EIR and serves as an evaluation of the Project's effects on the existing environmental conditions within the Project area. An analysis of the Project's impact on the area's water supply, hydrology, and water quality is presented in this report. Key aspects of the Project are as follows:

- The Project Area does not have an available potable water supply and all developments within the Project Area will depend on hauled water from potable water retailers, who obtain some or all of their water from groundwater basins.
- Potable water retailers, in response to new potable water demand could pump groundwater from existing wells or, possibly, install new wells into groundwater basins to which they have pumping rights.
- The Project does not include the modification of existing groundwater well regulations or an evaluation of utilizing hauled water for existing developments.
- The average per capita water use of 191 gallons per day (gpd) was estimated based on reported per capita water use by water retail agencies within the vicinity of the Project (SWRCB, 2014).
- Only contractors licensed by California Department of Public Health (CDPH) will deliver hauled water to the Project and all water will be required to meet CDPH's standards for hauled drinking water.
- A projection of the rates for the hauled water is not included in this report as the rates will vary by a myriad of factors, such as the amount of available water at the time, hauling distance, and contract fees with retailers and water haulers.

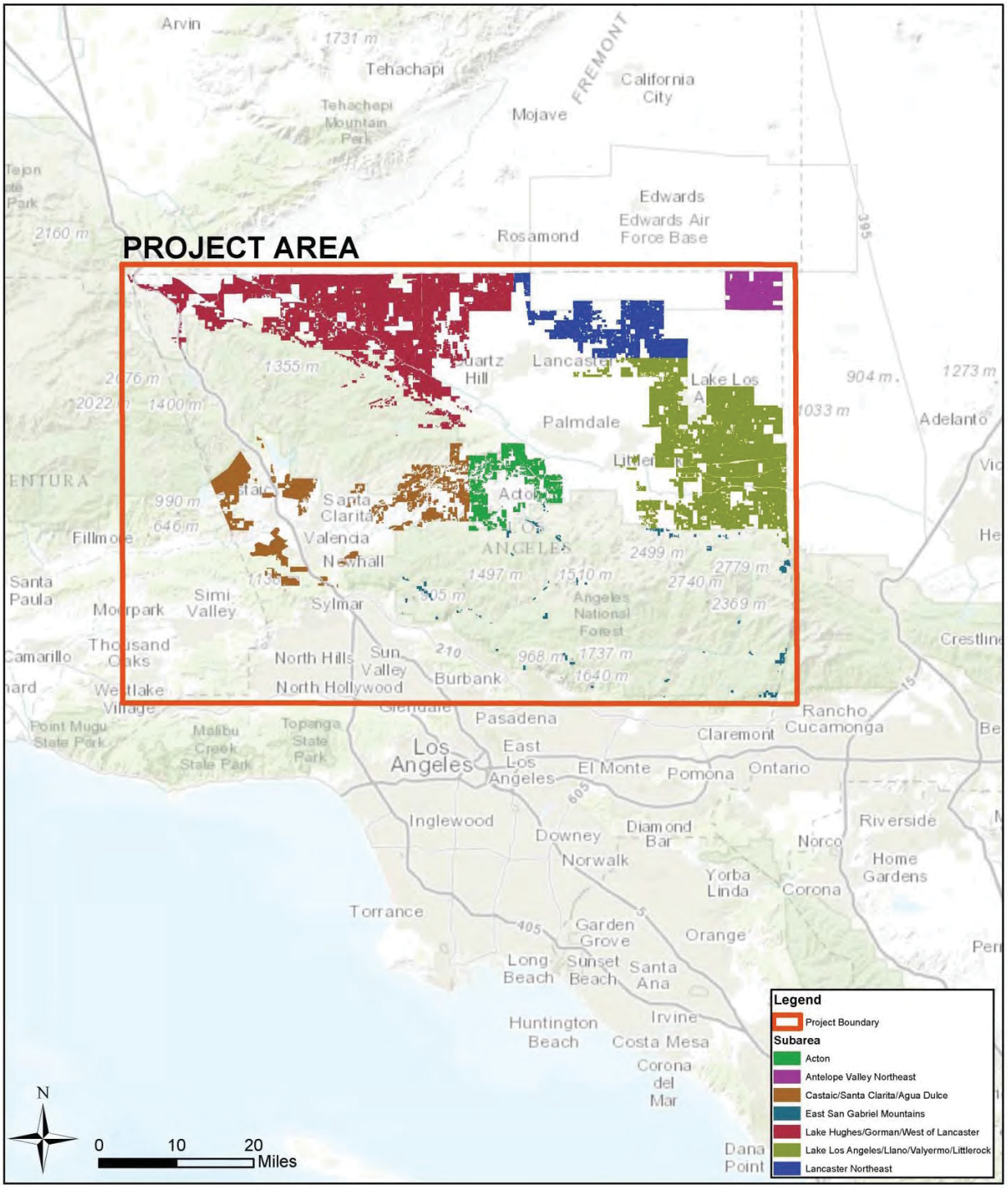
Water Supply Analysis

The developable parcels within the Project are not within retail water agency service areas and, therefore, unable to connect to existing potable water distribution systems. Additionally, the developable parcels within the Project do not have access to suitable groundwater wells. The Project will obtain its water supply from licensed water haulers, who will purchase their water from retail water suppliers with a surplus supply or the haulers will act as retail water suppliers themselves. It is assumed that hauled water for the Project will not be obtained from water retailers that are projected to have a shortage in its water supplies and do not have adequate supplies to meet the Project's demands and fire suppression requirements. The water supply for the Project will come from multiple sources and will depend on a retailers' availability of water.

Costs for water hauled longer distances will be higher. At some distance, the parcel owner's willingness to pay will not match the costs for hauling water from those distances. This study does not assess the maximum hauling distance based on a willingness to pay criteria. This study assesses the impacts of hauling water on the water supplies within proximity of the Project.

The Project encompasses a large area and different sections of the development can receive hauled water from different sources depending on proximity. A map showing the location of the project and the existing water purveyors in the region is shown on Figure 1.

Figure 1. Project Area



I. Existing Water Supply

The water retailers within Antelope Valley and Santa Clarita obtain their water from various supplies, such as allocations from the State Water Project (SWP), imported water, recycled water, and ground water. This section provides a summary of the source of supply for the water retailers.

A. State Water Project Supplies

In Antelope Valley, there are two SWP contractors: Antelope Valley-East Kern (AVEK) and Palmdale Water District (PWD). The SWP contractor for retailers within Santa Clarita Valley is the Castaic Lake Water Agency (CLWA). AVEK and CLWA are water wholesalers that supply retailers with water.

The California Department of Water Resources (DWR) has agreements with Contractors, such as AVEK and CLWA, to provide them with specific allocations of water from the SWP each year. A maximum allocation is set for each year and the actual percentage of the allocation a Contractor receives depends on the current supply of the SWP. In dry years, Contractors' allocation percentages decrease.

AVEK has a maximum allocation from the SWP of 141,400 acre-feet per year (AFY). In AVEK's 2010 Urban Water Management Plan (UWMP), they projected to receive about 62% of the allocated amount each year from 2015 – 2035 in an average year scenario. CLWA has a maximum SWP allocation of 95,200 AFY. In an average weather year, CLWA projects that it will receive 61% of its allocation and in a single-dry year, it projects its allocation will decrease by 10-13%.

Due to the current drought conditions in California (2014), SWP allocations have decreased for all SWP Contractors. AVEK and CLWA's actual SWP allocation decreased between 2013 and 2014 to percentages much lower than projected in the 2010 UWMP and is shown in the Table 1 below. Since the actual SWP allocations are lower than expected, the projections made in the 2010 UWMP are higher estimates of AVEK and CLWA's actual supply. Since the 2012-2014 SWP allocations were not included in the wholesalers' 2010 UWMPs, the available water supply evaluated in this study does not factor in the amounts presented in Table 1. Table 1 serves as a reference and shows that projections made in an agency's 2010 UWMP may not be exact reflections of an agency's actual water supply.

Table 1. Actual SWP Allocations

Agency	2012		2013		2014	
	Initial Request	Approved Allocation	Initial Request	Approved Allocation	Initial Request	Approved Allocation
AVEK	141,400	(65%) 91,910	141,400	(35%) 49,490	144,844	(5%) 7,242
CLWA	95,200	(65%) 61,880	95,200	(35%) 33,320	95,200	(5%) 4,760

DWR 2014

B. Other Imported Water

AVEK does not import water from any agencies other than the SWP. It relies on other types of supplies to account for decreased SWP allocations.

In addition to importing water from the SWP, CLWA has agreements with Buena Vista and Rosedale Water Districts in Kern County to receive a set amount of 11,000 AFY regardless of the weather year. Also, CLWA has a water transfer set up with Nickel Water, another Kern County district, which will provide a set supply of about 1,600 AFY. This additional source is intended to supply water to a planned development in Newhall Ranch. Newhall Ranch is a proposed master-plan development along the Santa Clara River and will include approximately 20,000 homes. The first two phases of the Newhall Ranch Development, Landmark Village and Mission Village, have been approved and the homes will be constructed within the next several years. CLWA's additional supply for the Newhall Ranch Project may be a potential supply for the Project. In dry weather years, CLWA has an agreement with DWR that it can utilize water from Castaic Lake as an additional source.

C. Recycled Water

In the 2010 Integrated UWMP, Los Angeles County Waterworks District (LACWWD) No. 40 and Quartz Hill Water District (QHWD) describe a plan to add a non-potable recycled water distribution system that will be routed through Lancaster, Palmdale, and the unincorporated communities of LA County (IRUWMP AV, 2010). The first phase of construction for the system, known as the AV Backbone, began in 2009 and is expected to be online by 2015. The AV Backbone is intended to provide recycled water for non-potable uses, such as irrigation of parks, schools, and golf course. Lancaster Water Reclamation Plant (LWRP) will supply secondary treated water to the AV Backbone. LWRP was recently upgraded to a treatment capacity of 18 mgd and is planned to undergo another expansion to 21 mgd as described the 2006 Recycled Water Master Plan.

With the increased treatment capacity and the construction of the AV Backbone, the availability of recycled water in the area will increase. The IRUWMP AV states that the amount of water provided by the AV Backbone will depend on the amount of development in the area. Based on the area's current growth predictions, the recycled water supply will be 5,400 AFY in 2015 and will increase to 8,200 AFY in 2020. By 2035, it is expected that the recycled water will make up about 12% of the area's supply. In an average weather year, the IRUWMP AV projects that its water supplies will remain constant between 2015 and 2035 and its demand will increase by about 43% due to a population increase. The planned recycled water supply is expected to account for the area's projected population growth by offsetting potable consumption for non-potable uses, but the growth projections do not account for the development of the Project. The Project is not accounted for in the IRUWMP because it was not a known development when the evaluation for the IRUWMP was done. The recycled water development is expected to offset consumption of potable water supplies, which could make the potable supplies available for sale to water haulers. However the

projected population growth within the district may utilize those freed up potable water supplies.

D. Ground Water

The Project Area is situated above three groundwater basins: Antelope Valley Basin, Santa Clara River Basin, and Acton Valley Basin. Antelope Valley Basin and Acton Valley Basin underlie the AVEK service area and Santa Clara River Basin underlies the CLWA service area. The information below shows that the groundwater in Antelope Valley Basin is fully utilized and will not be able to support new groundwater wells. While there are no formal pumping limits set for Santa Clara River Basin and Acton Valley Basin, the available ground water within these basins is already accounted for by existing users. Water purveyors with existing groundwater wells can potentially increase their pumping amounts to supply water to water haulers for the Project.

Antelope Valley Basin

The majority of the Project's proposed parcels are above the Antelope Valley Basin. A water right adjudication process is being completed to identify which users have the legal authority to withdraw groundwater and how much they can pump each year. The safe yield of the basin is stated to be 110,000 AFY in the Antelope Valley IRUWMP and for the report for Phase III of the adjudication. While the adjudication is still in process, the IRUWMP has made projections on the allocations based on historical groundwater pumping use. LACWWD No. 40 is projected to have a constant groundwater pumping rate of 23,200 AFY and Quartz Hill Water District is projected to have a constant pumping rate of 2,500 AFY from 2015-2035. These projections are presented in Table 2 and are subject to change after the adjudication has been finalized.

Table 2. Approximate Groundwater Pumping Allocations - Antelope Valley Basin

District/Agency	Estimated Pumping
District 40 - Estimated Adjudication 2015	23,200
QHWD - Estimated Adjudication 2015	2,500
PWD 2015	12,000
Cal Water Antelope Valley District - 2015	1,000
Rosamond CSD - 2015	4,600
To Be Determined	66,700

The projected pumping allocations presented in Table 2 do not account for the entire annual safe yield of the Antelope Valley Groundwater Basin. In addition to the agencies listed, there are other parties involved in the adjudication and their pumping allocations have not been determined at this time. The basin will be closed to new groundwater pumping once the adjudication is completed. In order to obtain ground water from Antelope Valley Basin, the water haulers will have to develop contracts with members that have pumping rights.

The amount of available water in the basin is also limited by the groundwater quality. A 2008 USGS publication on groundwater quality in the Antelope Valley found the following from its testing:

- Perchlorate is a compound with potential impacts to human health. In the 2008 USGS study, perchlorate was detected in 49 samples and none of the samples exceeded the CA-MCL of 6-µg/L and 94% of those samples had levels lower than one-third of the CA-MCL.

Elevated concentrations of metals and trace elements occur in places that may limit groundwater use for drinking water because of public health concerns or issues with taste, color and odor. In the 2008 USGS study, there were 17 trace elements at or above human-health thresholds and four, arsenic, boron, chromium VI and vanadium, were found to be over the drinking water limits. Arsenic was found to be over its maximum contaminant level as set by the EPA and adopted by CDPH (MCL-US) in five samples and three samples contained levels of boron that exceeded its notification level (NL-CA). Four out of 19 wells sampled in the Antelope Valley Basin had concentrations of chromium VI that exceeded its MCL-CA of 10-ug/L.

Santa Clara River Basin

The Santa Clara River Basin is not adjudicated, but a Groundwater Management Plan (GWMP) for the Basin was adopted in 2003. The GWMP establishes planning and monitoring of the basin's supplies, but it does not set formal restrictions on groundwater pumping.

The Basin has an upper and lower aquifer from which ground water can be extracted. The upper aquifer, the Alluvium formation, has a maximum depth of 200 feet and the lower aquifer, the Saugus formation, has an approximate depth of 2,000 feet (CLWA 2010). The available ground water from this basin is limited due to the historical contamination issues.

The CLWA 2010 UWMP lists that a maximum of 40,000 AFY can be extracted from the Alluvium formation and a maximum of 15,000 AFY can be extracted from the Saugus formation. Table 3 below lists the projected groundwater pumping amounts from each agency within CLWA.

Table 3. Projected Groundwater Pumping Amounts - Santa Clara River Basin

Groundwater Pumping from Alluvium Formation	
Agency	**Projected Pumping Amounts 2015**
NCWD	1,825
SCWD	10,500
VWC	11,675
Agricultural & Other	14,500
Unknown/Unaccounted For	**1,500**
Groundwater Pumping from Saugus Formation	
LACWWD	500
NCWD	4,400
SCWD	2,850
VWC	2,850
Agricultural & Other	900
Unknown/Unaccounted For	**3,500**

CLWA 2010 UWMP

As shown in Table 3, the Basin can adequately supply the projected demands of the local agencies before the Basin's maximum yield is reached. Based on available information, Santa Clara River Basin has approximately 5,000 AFY of ground water that is not projected to be used by an existing agency. A portion of this ground water may be used by private well owners or it may be unused. Since the Basin is not adjudicated and is not expected to be in overdraft, the Project could potentially lead an agency with existing ground water wells to decide to increase its pumping amounts and supply the additional supply to the Project.

The Basin's water supply capacity is limited due to previous contamination issues. Between 1997 and 2005, six wells had levels of perchlorate that were high enough to shut down pumping from those wells. These wells are all located near a former manufacturing site, Whittaker- Bermite Property, with perchlorate contamination that is being cleaned by California Department of Toxic Substances Control (DTSC). Table 4 lists the pumping capacity and status of contaminated wells in the Santa Clara River Basin.

Table 4. Status of Contaminated Wells in Santa Clara River Basin

Well Name	Original Pumping Capacity (gpm)	Status
Saugus 1 & 2	2,600 (each)	Both have returned to service with a reduced pumping capacity of 1,200 gpm (each) (CLWA, 2011)
NCWD-11	1,200	Removed from service and has not been returned to service (CLWA, 2011)
VWC-Q2	1,200	Returned to service.
SCWD-Stadium	778	Sealed and replaced by a new well with a projected pumping capacity of 800 gpm (CLWA, 2005)
VWC-157	1,500	Replaced by a new well, VWC-206, with a capacity of 1,500 gpm (CLWA, 2011)

The contamination of wells Saugus 1 & 2 and NCWD-11 resulted in a decrease in groundwater pumping capacity of 4,000 gpm. As the Whittaker-Bermite Property is cleaned, there is a possibility that wells near the property will also be contaminated and further reduce the Basin's pumping capacity.

Acton Valley Basin

Acton Valley Basin is a small groundwater basin with a total storage capacity of about 40,000 AFY, an annual natural recharge of 7,200 AFY, and a safe yield of 1,540 AFY (DWR Bulletin 118, 2003). LACWWD No. 37 has three wells that pump approximately 2,200 AFY from the basin (Acton-Agua Dulce Master Plan, 2004). Although the Basin is not adjudicated, most of its ground water is already utilized by existing groundwater pumpers.

The Basin's water quality was found to have high levels of total dissolved solids, sulfate, and chloride in 1989. DWR's Bulletin 118 states that only one of the fourteen sampled wells was found to have a nitrate concentration greater than the maximum contaminant level (MCL). Based on results from studies done on this basin, it does not have a major contamination issue that would reduce the amount of available water.

The research for this study shows that the majority of the area's available ground water is already being pumped by local users. This is based on the safe yield of the three basins and projected pumping rates in various weather years. The Project could result in ground water purchase agreements between water haulers and agencies that have existing wells and the available amount is dependent on each agency.

II. Project Water Demand

The estimated water demand from the Project was calculated based on the historical annual average number of building permits issued in the area. In this study, three cases with different amounts of developments per year were analyzed. Case 1 is based on the average number of

building permits for single-family homes issued between 2000 and 2014 by County of Los Angeles Building and Safety. Case 2 is based on the reasonable case scenario for the issuance of building permits based on data from LA County building permit data. Case 3 assumes a maximum of 2,000 building permits per year in order to reach Project build-out of 42,872 parcels in 20 years.

- Case 1 (Low): 184 building permits per year
- Case 2 (Medium): 384 building permits per year
- Case 3 (High): 2,000 building permits per year

The estimated average water use per capita used for this analysis was determined based on the surrounding water districts usage rates in 2014. The average residential gallons per capita day (R-GPCD) water use of surrounding districts is 191 R-GPCD. Table 5 lists the average residential water use per district over a year period.

Table 5. Average Water Use in Region

Supplier	Water Use (R-
Castaic Lake Water Agency Santa Clarita Water Division	196
Castaic Lake Water Agency Santa Clarita Water Division	199
Castaic Lake Water Agency Santa Clarita Water Division	170
Castaic Lake Water Agency Santa Clarita Water Division	155
Los Angeles County Public Works Waterworks District 40	236
Los Angeles County Public Works Waterworks District 40	233
Los Angeles County Public Works Waterworks District 40	250
Los Angeles County Public Works Waterworks District 40	186
Newhall County Water District	160
Newhall County Water District	190
Newhall County Water District	166
Newhall County Water District	178
Palmdale Water District	208
Palmdale Water District	201
Palmdale Water District	163
Palmdale Water District	163
Average	**191**

State Water Resources Control Board, 2014

Based on the expected development of each year, Table 6 presents the projected cumulative water demand for each Project Case over the next 20 years. Water demand was calculated based on the estimated average water use per person per day and the area's average household size in 2012 of 3.5 people.

Table 6. Projected Cumulative Water Demand from Development (AFY)

	2015	2020	2025	2030	2035
Case 1 (Low)	138	689	1,378	2,067	2,756
Case 2 (Medium)	288	1,438	2,876	4,313	5,751
Case 3 (High)*	1,498	7,489	14,977	22,466	32,105

**Case 3 is projected to reach build out by 2035 for a total of 42,872 developed parcels*

The values in Table 6 do not account for water required for fire suppression. Fire hydrants will not be accessible to the developments because they are located outside of water district service areas. Each development will need its own potable water storage tank on its parcel to store domestic and fire suppression water. Since LA County does not have a standard fire suppression water volume storage requirement, a volume of 5,000 gallons per household is used for this analysis. Storage tanks will have a total capacity of 10,000 gallons: 5,000 gallons for domestic water and 5,000 gallons for fire suppression. The fire suppression water would be in a separate chamber of the tank and only consumed through a fire suppression system. The fire suppression supply will likely need to be flushed and replenished once a year. The values presented in Table 7 include the water demand for domestic and fire suppression purposes.

Table 7. Projected Cumulative Water Demand from Development with Fire Suppression Water Storage (AFY)

	2015	2020	2025	2030	2035
Case 1 (Low)	141	703	1,406	2,109	2,812
Case 2 (Medium)	293	1,467	2,935	4,402	5,869
Case 3 (High)*	1,528	7,642	15,284	22,926	32,763

III. Supply and Demand Projections of Potential Water Purveyors for Project

The availability of water was determined based on a comparison of the water demand and supply projections described in the 2010 UWMPs of the water agencies nearby the project.

For the water supply analysis, the Project development is divided into two sections based on location and underlying groundwater basin. The development east of the San Gabriel Mountains is located within the Antelope Valley and above the Antelope Valley Groundwater Basin. The majority of the development west and in the San Gabriel Mountains is located within the Santa Clarita Valley and above the Santa Clara River Basin. For the purposes of

this analysis, the primary water suppliers for the development in the Antelope Valley are assumed to be the retail agencies that are supplied by AVEK and the primary water suppliers for the development in the Santa Clarita Valley are the water retailers who are supplied by the Castaic Lake Water Agency. A detailed description of the two wholesale suppliers is provided below. Although the evaluation of water supply is divided into two regions, the Project can obtain its supply from either of the wholesalers depending on availability.

The Castaic Lake Water Agency UWMP accounts for the entire water supply for the retail agencies in its region. The AVEK UWMP accounts for the SWP project supply for the retail agencies in its region. These two UWMPS account for most of the water supply in the Project Area. Additional water supply used in the AVEK region consists of ground water directly pumped by retail water agencies or others with minor pumping rights. This ground water is accounted for in this analysis in a separate table from the water supply referenced from the UWMPS. The UWMPs prepared by these two wholesale water agencies present estimated supplies and demands for their service areas based on historical water use and planned projects for three different scenarios: average weather year, single-dry year, and multiple-dry years. The demands and supplies projected by an agency in each of those scenarios will vary depending on the agency's conservation and drought measures.

A. Future Water Supply and Demand Projections – Antelope Valley

Table 8 below shows that AVEK can only meet the projected demand of its existing clients in an average-year based on information presented in its 2010 UWMP. The demand projections in Table 8 do not include the Project. This is shown in Section C. In a single-dry year and after the third year in a multiple-dry year scenario, AVEK is projected to be in a deficit and will not be able to meet the demand of its clients.

AVEK's expected water demand is based on projected population growth. Based on population data from Southern California Association of Government (SCAG), the population within AVEK's service area is projected to grow by approximately 40% between 2015 and 2030. This projected growth does not include the additional population from the Project. The Project was not included in the development plan for the AVEK's service area; therefore, AVEK could not include the Project's estimated water demand in its 2010 UWMP. Although the region's population will grow during 2015-2030, AVEK does not project an increase in its sources of water supply during that time.

Table 8. AVEK Supply and Demand Projections (AFY)

Average Year	2015	2020	2025	2030	2035
Supply Total	107,688	107,688	107,688	107,688	107,688
Demand Total	91,075	92,828	94,530	96,558	115,870
Surplus/Deficit	16,613	14,860	13,158	11,130	-8,182
Single Dry Year					
Supply Total	37,000	37,000	37,000	37,000	37,000
Demand Total	91,075	92,828	94,530	96,558	115,870
Surplus/Deficit	-54,075	-55,828	-57,530	-59,558	-78,870
Multiple Dry Years					
Supply Total	72,601	72,601	72,601	72,601	72,601
Demand Total	91,075	92,828	94,530	96,558	115,870
Surplus/Deficit	-18,474	-20,227	-21,929	-23,957	-43,269

2010 AVEK UWMP. Values for 2035 were estimated based on previous years' projections. Negative values indicate a deficit.

AVEK projects to have a higher supply in the multiple-dry year scenario than it does in the single dry year scenario because it plans to use additional sources, such as ground water, to supplement its allocation in dry years. In the single dry year scenario, AVEK projects that its only supply will be its minimum allocation from the SWP. The shortages projected by AVEK do not account for its customers' additional water supply sources, such as increased ground water pumping or recycled water. The water retailers within AVEK's district are aware of the shortages and included additional water supply sources to make up for decreased allocations from AVEK's SWP source.

AVEK Customers

Los Angeles County Waterworks District (LACWWD) No. 40 and Quartz Hill Water District (QHWD) developed an integrated UWMP titled Antelope Valley 2010 UWMP. LACWWD supplies water to multiple areas within Antelope Valley, such as Lancaster, Palmdale, Pearblossom, Littlerock, Sun Village, Rock Creek, Northeast Los Angeles County, and Lake Los Angeles. The Antelope Valley UWMP projects a surplus in an average year and to exactly meet its demands in a single- and multiple-dry years scenario.

California Water Service Company – Antelope Valley District (CW-AV) is a smaller district in the northern Antelope Valley and obtains the majority of its water from six active groundwater wells. In CW-AV's 2010 UWMP, it projects to provide exactly enough supply to meet demand in an average, single-dry, and multiple-dry years.

B. Water Supply and Demand Projections – Santa Clarita Valley

In CLWA's 2010 UWMP, it projects the available supplies and expected demand between 2015 and 2035. The demand projections are based on historical use and expected population growth. It is assumed that the planned growth within CLWA's service area does not include the Project; therefore, all developments from the Project are additional demands on the

system. A surplus is projected for the average, single-dry, and multiple-dry years for this region, as shown in Table 9 below. Table 9 demand projections do not include the Project. These are shown in Section C.

Table 9. CLWA Supply and Demand Projections (AFY)

Average Year	2015	2020	2025	2030	2035
Supply Total	106,607	110,157	113,35	117,707	121,207
Demand Total	72,343	71,908	80,23	88,564	96,892
Surplus/Deficit	34,264	38,249	33,12	29,143	24,315
Single Dry Year					
Supply Total	116,417	126,887	124,38	128,437	141,937
Demand Total	80,350	80,757	89,92	99,096	108,265
Surplus/Deficit	36,067	46,130	34,46	29,341	33,672
Multiple Dry Years					
Supply Total	124,517	134,252	133,85	138,802	149,802
Demand Total	80,350	80,757	89,92	99,096	108,265
Surplus/Deficit	44,167	53,495	43,92	39,706	41,537

CLWA 2010 UWMP

CLWA projects to have adequate supply to meet its projected growth, not including the Project. The surplus projected in the single-dry year scenario is higher than the multiple-dry years scenario because CLWA plans to increase its pumping from the Santa Clara River Basin's Saugus formation. CLWA has analyzed the estimated impact of the increased pumping and has found that it will not decrease the levels in the Basin to levels lower than what is allowed in the GWMP.

C. Water Supply and Demand Projections – Project Area

When the Project is evaluated as a single development project, the combined supply from CLWA and Antelope Valley will be utilized to provide for the development, as water haulers can purchase water from retailers in both areas. The total supplies and demands from CLWA and Antelope Valley account for a majority of the region, but may not include all supplies and demands.

The supply and demand of potential purveyors that could supply water to the Project was compared to the Project demand to determine if there is available supply for the Project. The results are shown on Table 10-Table 12. The addition of the Project to the existing demand will leave a surplus in the average year scenario for the low- and medium-development cases. In the dry- and multiple-dry years scenarios, the projected shortages will be increased by the development.

Table 10. Projected Supply and Demand for Total Development - Average Year (AFY)

SUPPLIES	2015	2020	2025	2030	2035
CLWA	106,607	110,157	113,357	117,707	121,207
AVEK	107,688	107,688	107,688	107,688	107,688
Antelope Valley	101,200	105,800	117,300	128,700	141,000
AV-CW	1,187	1,153	1,188	1,225	1,263
Total Supply	210,075	214,641	226,176	237,613	249,951
Total	316,682	324,798	339,533	355,320	371,158
EXISTING DEMAND					
CLWA	72,343	71,908	80,236	88,564	96,892
AVEK	91,075	92,828	94,530	96,558	115,870
Antelope Valley	98,400	103,900	116,300	128,700	141,000
AV-CW	1,187	1,153	1,188	1,225	1,263
Total Demand	190,662	197,881	212,018	226,483	258,133
Total	263,005	269,789	292,254	315,047	355,025
Total Surplus or Deficit	53,677	55,009	47,279	40,273	16,133
REMAINING WATER AFTER PROJECT					
Case 1 (Low)	53,536	54,306	45,873	38,164	13,321
Case 2 (Medium)	53,384	53,542	44,344	35,871	10,264
Case 3 (High)	52,149	47,367	31,995	17,347	-16,630

Negative values indicate a deficit.

Table 11. Projected Supply and Demand for Total Development - Single-Dry Year (AFY)

SUPPLIES	2015	2020	2025	2030	2035
CLWA	116,417	126,887	124,387	128,437	141,937
AVEK	37,000	37,000	37,000	37,000	37,000
ANTELOPE VALLEY	98,400	103,900	116,000	128,700	140,800
ANTELOPE VALLEY - CW	1,183	1,149	1,184	1,221	1,258
Total Supply	136,583	142,049	154,184	166,921	179,058
Total	253,000	268,936	278,571	295,358	320,995
EXISTING DEMAND					
CLWA	80,350	80,757	89,926	99,096	108,265
AVEK	91,075	92,828	94,530	96,558	115,870
ANTELOPE VALLEY	98,400	103,900	116,000	128,700	140,800
ANTELOPE VALLEY - CW	1,183	1,149	1,184	1,221	1,258
Total Demand	190,658	197,877	211,714	226,479	257,928
Total	271,008	278,634	301,640	325,575	366,193
Total Surplus or Deficit	-18,008	-9,698	-23,069	-30,217	-45,198
REMAINING WATER AFTER DEVELOPMENT					
Case 1 (Low)	-18,149	-10,401	-24,475	-32,326	-48,010
Case 2 (Medium)	-18,301	-11,165	-26,004	-34,619	-51,067
Case 3 (High)	-19,536	-17,340	-38,353	-53,143	-77,961

**Negative values indicate a deficit.*

Table 12. Projected Supply and Demand for Total Development - Multiple-Dry Years (AFY)

SUPPLIES	2015	2020	2025	2030	2035
CLWA	124,517	134,252	133,852	138,802	149,802
AVEK	72,601	72,601	72,601	72,601	72,601
Antelope Valley	98,800	103,900	116,300	128,700	141,100
AV-CW	1,059	1,053	1,085	1,118	1,153
Total Supply	172,460	177,554	189,986	202,419	214,854
Total	296,977	311,806	323,838	341,221	364,656
EXISTING DEMAND					
CLWA	80,350	80,757	89,926	99,096	108,265
AVEK	91,075	92,828	94,530	96,558	115,870
Antelope Valley	98,400	103,900	116,300	128,700	141,100
AV-CW	1,059	1,053	1,085	1,118	1,153
Total Demand	190,534	197,781	211,915	226,376	258,123
Total	270,884	278,538	301,841	325,472	366,388
Total Surplus or Deficit	26,093	33,268	21,997	15,749	-1,732
REMAINING WATER AFTER DEVELOPMENT					
Case 1 (Low)	25,952	32,565	20,591	13,640	-4,544
Case 2 (Medium)	25,800	31,801	19,062	11,347	-7,601
Case 3 (High)	24,565	25,626	6,713	-7,177	-34,495

**Negative values indicate a deficit.*

The supply projections for the multiple-dry years scenario are higher than the supply projections in a single-dry year because some of the agencies plan to increase their groundwater pumping or obtain water from additional sources during a drought.

For the average year (Table 10), this analysis projects that Case 1 will have a surplus of 13,321 AF by 2035. At build-out in 2035 (Case 3), the area is projected to have a surplus of 16,133 AF based on projected demand of the service area, but the addition of the Project will result in a deficit of 16,630 AF.

In a single-dry year (Table 11), the Project is expected to result in a deficit in 2035 for all cases of development. Without the Project, the area is estimated to have a deficit of 45,198 AF by 2035. The inclusion of the Project will result in a deficit of 48,010 AF is for Case 1 and a deficit of 77,961 AF at build-out (Case 3) by 2035.

For the multiple-dry years scenario (Table 12), a deficit of 1,732 AF is expected in 2035 before the Project. The area's deficit is expected to increase after the Project has been added. A deficit of 4,544 AF is projected for Case 1 and a deficit of 34,495 AF is projected at build-out (Case 3).

Note that historical building permit data in the area suggests that by 2035, significantly less than build-out is likely to occur. In the Case 1 scenario (184 homes per year), by 2035, for the average year there would still be a surplus of 13,321 AF. For the dry year, there will be a deficit of 48,010 AF, for the multiple-dry years, a deficit of 4,544 AF.

The Project can obtain its water supply from other surrounding suppliers or retailers, such as Kern County, if the parcel owners are willing to pay for the longer haul distances. Estimated water hauling costs are not included in this study. Impacts from longer haul distances from districts outside the Project area are not included in this study.

Additional Sources

KERN COUNTY

The 2010 UWMPs for West Kern Water District (WKWD), Kern County Water Agency Improvement District No. 4 (ID4), and North of the River Municipal Water District (NORMWD) estimate that these districts will meet or exceed their projected water demands. WKWD obtains its water supply from the SWP, groundwater extractions, and transfers between surrounding districts. The population within WKWD is projected to grow by 10 percent between 2015 and 2035 and is in-line with WKWD's projected water supply increases. ID4 and NORMWD rely on imported water from SWP and banked ground water to meet their supplies. The population within the two districts is expected to grow at a rate of about 1.5 percent. Based on the projections from the districts' 2010 UWMPs, the districts are projected to have sufficient water supply to meet the increased demand from their projected population growth and can potentially supply excess water to the Project.

Water haulers can purchase water from the districts in Kern County. WKWD & ID4 are approximately 70-80 miles from the City of Castaic where a portion of development is proposed.

D. Conclusion

After review of the 2010 UWMPs of surrounding agencies, there will be sufficient water supply

for the build-out of the project by 2035 for the average weather year scenario at the Case 1 and 2 development rates. In the single-dry and multiple-dry years scenarios, there will not be sufficient water supply for the existing customers and the Project. The impact of the area's supplies at build-out is presented in Table 13. These values were determined from the local water purveyors' 2010 UWMPs.

Table 13. Remaining Supply at Project Build-Out (AFY)

	Average Year	Single Dry Year	Multiple Dry Year
Case 1 (Low)	13,321	-48,010	-4,544
Case 2 (Medium)	10,264	-51,067	-7,601
Case 3 (High)	-16,630	-77,961	-34,495

In order to meet the demand of the Project in dry weather years, water haulers can develop water purchase agreements with districts in Kern County, if they have adequate supply. The source of water supply for the Project can be different for the developments within Antelope Valley and Santa Clarita Valley.

The projections listed in Table 13 are based on average water use data from water retailers near the Project area. The estimated deficits can be reduced by including residential conservation methods in the Project. A Best Management Practice (BMP) that can be included with the Project ordinance is to require residences to have water-efficient landscapes, which are landscapes that use drought-tolerant plants. In an EPA publication, it is estimated that 30 percent of the water use by households in the United States is for outdoor use. Enforcing water-efficient landscapes can decrease each household's water use by up to 30 percent or possibly more and, using the 30 percent estimate, could decrease the average household demand from 669 GPD to 468 GPD. As shown in Table 14, this would still result in a deficit in the single- and multiple-dry years scenarios, but the deficit would be lower. In an average year, the surplus will be about 9 percent greater for Case 1.

Table 14. Remaining Supply at Project Build-Out with Conservation

	Average Year	Single Dry Year	Multiple Dry Year
Case 1 (Low)	14,204	-47,127	-3,661
Case 2 (Medium)	12,107	-49,224	-5,758
Case 3 (High)	-4,835	-66,166	-22,700

The Project Ordinance could require that all households within the Project implement water conservation best practices in order to prevent a deficit in the area's projected supply. Without conservation best practices, the Project is expected to have a significant impact on the area's existing and planned water supply. From this evaluation, it is expected that the development of all 42,872 parcels in 20 years will result in a large deficit in water supply that could impact the area's water purveyors and their existing customers.

Hydrology Analysis

A hydrology analysis was completed to determine the Project's impact on the area's existing hydrology. The existing area is undeveloped and produces minimal runoff. With the Project, the area's runoff is expected to increase. The Project's impact on hydrology was analyzed by looking at a typical parcel and then for each subarea. Since the Project is the development of single-family homes over a phased period, there are no existing stormwater regulations that require the Project to limit its runoff. The Project may have to include stormwater management techniques as a way to decrease its impact on the area's existing flood zones and waterways.

I. Existing Hydrology

The majority of the Project is located in a dry area and experiences minimal rainfall throughout the year. The Project extends from the San Gabriel Mountains to the eastern end of Antelope Valley. The Project has been divided into two primary zones, Antelope Valley and Santa Clarita Valley, and one small zone, East San Gabriel Mountains. The different zones account for the differing soil and rainfall properties. The developments in the East San Gabriel Mountains are spread throughout the Mountains and will have rainfall and soil characteristics that are much different than the developments in Antelope and Santa Clarita Valley. Stormwater runoff in Antelope Valley flows from the San Gabriel Mountains and percolates into the groundwater basin or flows into one of the three low-lying playas near Edwards Air Force Base. In Santa Clarita Valley, runoff flows into Castaic Lake or into Santa Clara River, which outlets at the Pacific Ocean. Runoff from the developments in East San Gabriel Mountains will flow to several different streams within the Mountains based on their locations. Several parcels are located along San Antonio Creek which flows into Santa Ana River.

The Project Area is comprised of a distributed development pattern of generally non-adjacent parcels. Increases in impervious surface will be distributed throughout the Project Area and not be concentrated in one location. Therefore, increases in peak flow due to increased imperviousness will be distributed across several receiving streams.

II. Hydrology by Parcel

The parcel data provided to HDR by Sapphos Environmental was used to determine the characteristics of a general parcel. Additional data on impervious percentage, rainfall depth, and soil type were obtained from the Los Angeles County Hydrology Manual. Assumptions reflected in the hydrology calculations presented in Table 15 and Table 16 are provided below:

- Average size of a parcel within the Project is 6.6 acres
- Average length of a parcel is 1,000 feet (ft)
- Slope of 0.02 ft/ft was used as the average flow slope of a parcel
- Soil Type of 120 for Antelope Valley was used, per Appendix C of LA County

Hydrology Manual

- Soil Type of 97 for Santa Clarita Valley was used, per Appendix C of LA County Hydrology Manual
- Soil Type of 50 for East San Gabriel Mountains was used, per Appendix C of LA County Hydrology Manual
- Impervious Percentage, per Appendix D of LA County Hydrology Manual
  - o Pre-Development: Vacant Undifferentiated 10%
  - o Post-Development: Low Density Residential 21%
  - o Post-Development: Low Density Residential with Paved Roads 50%
- An impervious percentage of 50% was used to account for the development of single- family homes and access roads.

Table 15. Hydrology Calculations Input

Area	Impervious Percentage	Area (ac)	Slope (ft/ft)	Soil Type	Impervious Percentage (%)
Antelope Valley	Pre-Development	6.25	0.02	120	10
	Post-Development (21%)	6.25	0.02	120	21
	Post-Development (50%)	6.25	0.02	120	50
West of Mountains - Castaic/Santa Clarita	Pre-Development	6.85	0.02	97	10
	Post-Development (21%)	6.85	0.02	97	21
	Post-Development (50%)	6.85	0.02	97	50
East San Gabriel Mountains	Pre-Development	6.22	0.02	50	10
	Post-Development (21%)	6.22	0.02	50	21
	Post-Development (50%)	6.22	0.02	20	50

Table 16. Rainfall Depth

Area	Storm	Rainfall Depth (in)
Antelope Valley Planning Area	2 year/ 24 hour	1.44
	5 year/ 24 hour	1.99
	10 year/ 24 hour	2.36
	25 year/ 24 hour	2.86
	100 year/ 24 hour	3.67
Santa Clarita Planning Area	2 year/ 24 hour	1.91
	5 year/ 24 hour	2.89
	10 year/ 24 hour	3.53
	25 year/ 24 hour	4.35
	100 year/ 24 hour	5.56
East San Gabriel Mountains	2 year/ 24 hour	3.97
	5 year/ 24 hour	5.60
	10 year/ 24 hour	6.49
	25 year/ 24 hour	8.68
	100 year/ 24 hour	10.95

The Modified Rational Method specified in the LA County Hydrology Manual was used to calculate the peak flow rate and runoff volume for a generic parcel pre- and post-development. The results of the hydrologic analysis are presented in Tables 17 through 19.

Table 17. Hydrology Calculations Results by Parcel - Antelope Valley

Scenario	Storm	Time of Concentration	Peak Flow Rate	24-Hour Runoff Volume
		Minutes	Cubic feet/second	Acre-feet
Pre-Development	2 year	30	0.42	0.13
Post-Development (21%)		30	0.62	0.2
Post-Development (50%)		30	1.16	0.37
Pre-Development	5 year	30	0.57	0.18
Post-Development (21%)		30	0.86	0.28
Post-Development (50%)		30	1.59	0.51
Pre-Development	10 year	30	0.69	0.22
Post-Development (21%)		30	1.03	0.33
Post-Development (50%)		27	2.00	0.61
Pre-Development	25 year	30	1.06	0.27
Post-Development (21%)		30	1.48	0.4
Post-Development (50%)		21	3.1	0.74
Pre-Development	100 year	22	2.79	0.38
Post-Development (21%)		20	3.35	0.54
Post-Development (50%)		16	5.16	0.97

Table 18. Hydrology Calculation Results by Parcel - Santa Clarita Valley

Scenario	Storm	Time of Concentration	Peak Flow Rate	24-Hour Runoff Volume
		Minutes	Cubic feet/second	Acre-feet
Pre-Development	2 year	30	1.21	0.21
Post-Development (21%)		30	1.44	0.31
Post-Development (50%)		27	2.17	0.55
Pre-Development	5 year	23	2.93	0.36
Post-Development (21%)		21	3.44	0.49
Post-Development (50%)		19	4.41	0.85
Pre-Development	10 year	18	4.65	0.46
Post-Development (21%)		17	5.01	0.63
Post-Development (50%)		15	6.39	1.05
Pre-Development	25 year	15	8.17	0.60
Post-Development (21%)		14	7.45	0.81
Post-Development (50%)		13	8.76	1.33
Pre-Development	100 year	12	10.55	0.85
Post-Development (21%)		12	11.00	1.10
Post-Development (50%)		11	12.55	1.73

Table 19. Hydrological Calculations by Parcel - San Gabriel Mountains

Scenario	Storm	Time of Concentration	Peak Flow Rate	24-Hour Runoff Volume
		Minutes	Cubic feet/second	Acre-feet
Pre-Development	2 year	14	6.99	0.59
Post-Development (21%)		13	7.51	0.75
Post-Development (50%)		13	7.89	1.15
Pre-Development	5 year	10	12.89	0.98
Post-Development (21%)		10	13.04	1.18
Post-Development (50%)		10	13.19	1.70
Pre-Development	10 year	9	16.28	1.25
Post-Development (21%)		9	16.28	1.46
Post-Development (50%)		9	16.46	2.04
Pre-Development	25 year	7	24.74	2.00
Post-Development (21%)		7	24.74	2.25
Post-Development (50%)		7	24.74	2.91
Pre-Development	100 year	6	33.59	2.85
Post-Development (21%)		6	33.59	3.12
Post-Development (50%)		6	33.59	3.84

Based on the analysis, there will be increased peak flows from each parcel due to the Project. The development of single-family homes on vacant land is estimated to increase a parcel's impervious percentage from 10 percent to 20 percent. This is expected to increase the runoff volume from each parcel by 1.3-1.5 times the original runoff volume. If access roads are included in the development, then the impervious percentage of the area is estimated to increase to 50 percent, which could result in a large increase in runoff. This can result in increased soil erosion in undeveloped areas and increased sedimentation of local receiving waters. This impact will be significant even with the implantation of BMPs. BMPs that could be applied to the developments could include the preparation of a site-specific drainage plan and the incorporation of retention and infiltration- type structures, such as porous pavement.

III. Hydrology by Subarea

The Project Area was separated into seven subareas to find the post-development impact on the 24-Hour Runoff Volume. For each subarea the 24-Hour Runoff Volume was calculated for an average parcel and multiplied by the number of parcels within the subarea to provide a conservative estimate. The calculation was done for a 25-year and 100-year storm for an impervious percentage of 10 percent for pre-development and 21 percent for post-development. The input data used to calculate the runoff volume can be found in Table 20 and Table 21. Additional data on impervious percentage, rainfall depth, and soil type were found from Los Angeles County Hydrology Manual.

Table 20. Hydrology Calculation Input Information for Proposed Project Area

Subarea	Total Project Area (acres)	Total Number of Project Parcels	Average Area Per Parcel (Acre)
Acton	18,067	1,245	15
Antelope Valley Northeast	14,528	1,938	8
Castaic/Santa Clarita/Agua Dulce	37,594	2,249	17
East San Gabriel Mountains	4,092	658	6
Lake Hughes/Gorman/ West of Lancaster	125,041	15,166	8
Lake Los Angeles/ Llano/ Valyermo/Littlerock	108,067	14,822	7
Lancaster NE	35,325	6,794	5
Total	**342,715**	**42,872**	

Table 21. Hydrology Calculation Input Information 2

Subarea	Average Area per Parcel (acres)	Average Length (feet)	Slope (feet/ feet)	Soil Type	Rainfall Area
Acton	15	2,997	0.02	120	Antelope Valley
Antelope Valley Northeast	7	2,002	0.02	120	Antelope Valley
Castaic/Santa Clarita/Agua Dulce	17	2,683	0.02	97	Santa Clarita Valley
East San Gabriel Mountains	6	1,401	0.02	50	Antelope Valley
Lake Hughes/ Gorman/ West of Lancaster	8	1,997	0.02	120	Antelope Valley
Lake Los Angeles/ Llano/ Valyermo/ Littlerock	7	2,029	0.02	120	Antelope Valley
Lancaster Northeast	5	1,814	0.02	120	Antelope Valley

LA County's Modified Rational Method was used to calculate the runoff volume for a generic parcel per subarea for pre- and post-development then multiplied by the number of parcels within that subarea to get the total runoff volume of a subarea. The results of the hydrologic analysis are presented in Table 22.

Table 22. Pre- vs Post-Development Runoff Volumes by Subarea

Subarea	Storm	Impervious Percentage	24-Hour Total Runoff Volume	Total Increased 24-Hour Runoff Volume
			(acre-feet)	(acre-feet)
Acton	25-Year	10%	809	349
		20%	1,158	
	100-Year	10%	1,096	436
		20%	1,531	
Antelope Valley Northeast	25-Year	10%	581.40	252
		20%	833.34	
	100-Year	10%	794.58	329
		20%	1,124.04	
Castaic/Santa Clarita/Agua Dulce	25-Year	10%	3,351	990
		20%	4,341	
	100-Year	10%	4,700	1,237
		20%	5,937	
East San Gabriel Mountains	25-Year	10%	1,316	145
		20%	1,461	
	100-Year	10%	1,842	184
		20%	2,027	
Lake Hughes/ Gorman/ West of Lancaster	25-Year	10%	5,156	2,275
		20%	7,431	
	100-Year	10%	7,128	2,882
		20%	10,010	
Lake Los Angeles/ Llano/ Valyermo/ Littlerock	25-Year	10%	4,447	1,927
		20%	6,373	
	100-Year	10%	6,077	2,520
		20%	8,597	
Lancaster NE	25-Year	10%	1,495	611
		20%	2,106	
	100-Year	10%	1,970	815
		20%	2,786	

Based on the results presented in Table 22, each subarea is projected to have an increase in runoff volume in a 25- and 100-year design storm. The Project area is undeveloped and has no existing stormwater drainage facilities. The development of the Project will create additional flow that may require the construction of new stormwater drainage facilities..

IV. Effects of Project Stormwater on Existing Stormwater Drainage System

The Project Area will be in unincorporated communities of LA County and there are minimal or no existing stormwater drainage facilities in those areas. The developments in the East San Gabriel Mountains, Lake Hughes/Gorman/West of Lancaster, and Lancaster North East Subareas do not have existing LA County stormwater drainage facilities. These areas were not developed and only produced minimal runoff prior to the Project.

New stormwater drainage facilities that connect to existing drainage facilities may have to be constructed to convey the additional runoff from the Project. There may be a need for stormwater drainage infrastructure for developments in highly sloped areas or areas susceptible to erosion. Developments in the Antelope Valley Northeast Subarea would produce runoff that could flow to the Rosamond, Rogers, and Buckhorn Dry Lakes. Rosamond and Rogers Dry Lake are prone to flooding since they are the lowest points in Antelope Valley. There is no existing development within the dry lakes. Therefore, there would be no immediate damage of residential or critical buildings if flooding were to occur in this area. Although the extent of the flood plain is expected to increase as a result of the development, this increase is not expected to cause major damage to structures since the area is mostly undeveloped.

V. Existing Flood Zones

Several developments in the Project are located in the boundaries of 100-year flood zones. The subareas of Lake Hughes/Gorman/West of Lancaster, Lancaster North East, and Lake Los Angeles include over 1,000 parcels within Federal Emergency Management Agency (FEMA) Flood Zone A, which are areas that will be inundated by the one percent-annual-chance flood event (100-year storm). The flood zone within the Lake Hughes Subarea has an approximate volume of 967,680-AF and the estimated additional runoff generated from a 100-year design storm from the Lake Hughes Subarea of 2,880-AF, which is about 0.2 percent of the flood zone volume, is not expected to have a significant impact on the existing flood zone.

Parcels within the Lancaster North East and Lake Los Angeles Subareas are located within two large flood zones that are east of Palmdale and follow Rock Creek Wash from the San Gabriel Mountains to Edwards Air Force Base. The flood zones are about 20-25 miles long and vary from 0.5- 2.5 miles in width. An estimate of the flood zones volumes was done by determining their areas and average depth in GIS based on National Park Service's USA

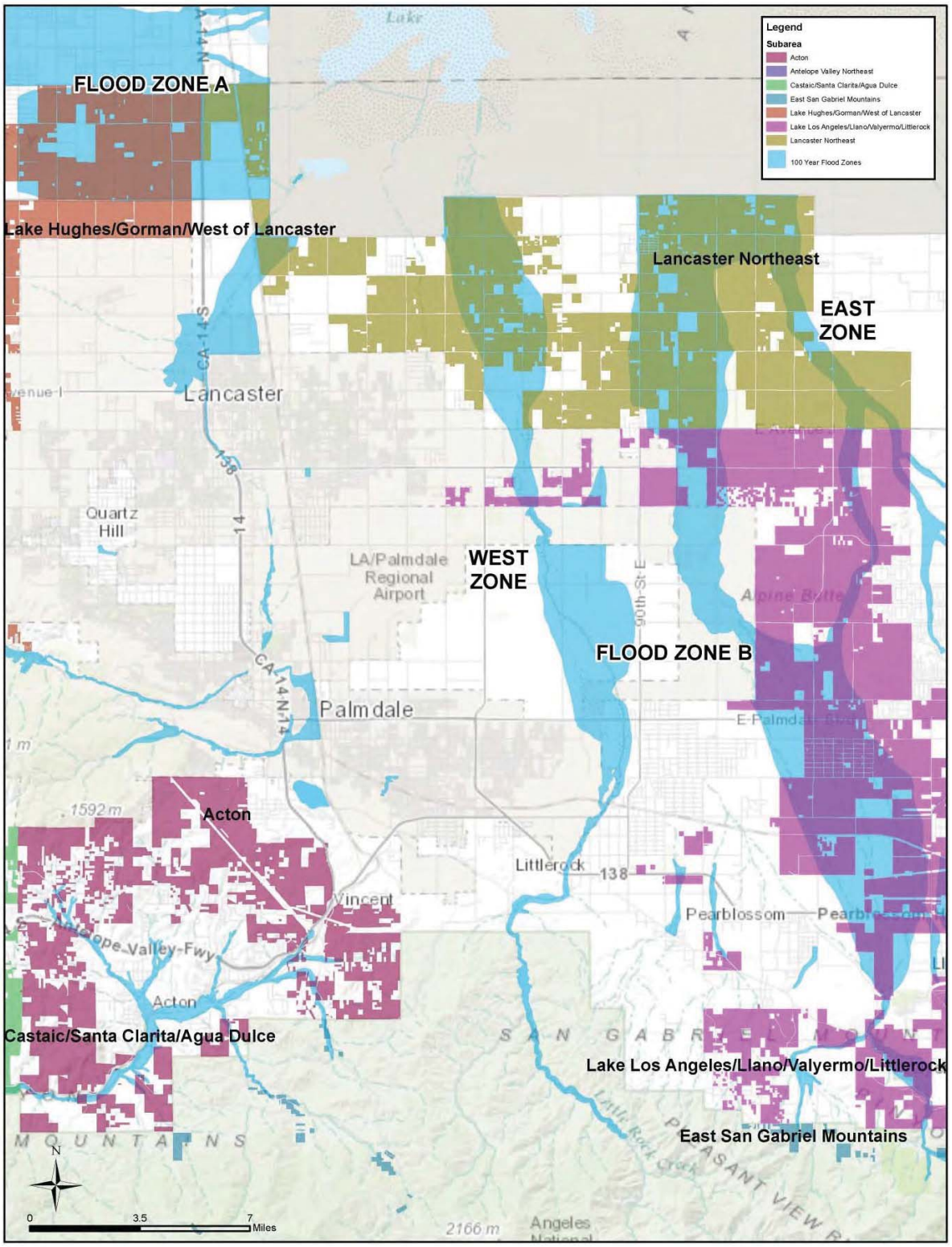
topography data set.

- The west flood zone is estimated to have a surface area of 20,400 acres and an average depth of 10 feet for a total volume of 204,000-AF.
- The east flood zone is estimated to have an approximate surface area of 47,600 acres and an approximate average depth of five feet for a total volume of 238,000-AF.

The expected increase in runoff produced by a 100-year design storm from the Lancaster North East and Lake Los Angeles Subareas is about 3,355-AF, which could result in an approximate 0.7 percent increase in the total volume of the east and west flood zones. This could increase the boundaries of the two existing flood zones, particularly where there is high concentration of development directly south of Edwards Air Force Base. The flood zones are large and the region would have to be modeled to determine the extent to which the boundaries increase. The FEMA flood zones in Antelope Valley are shown in Figure 2.

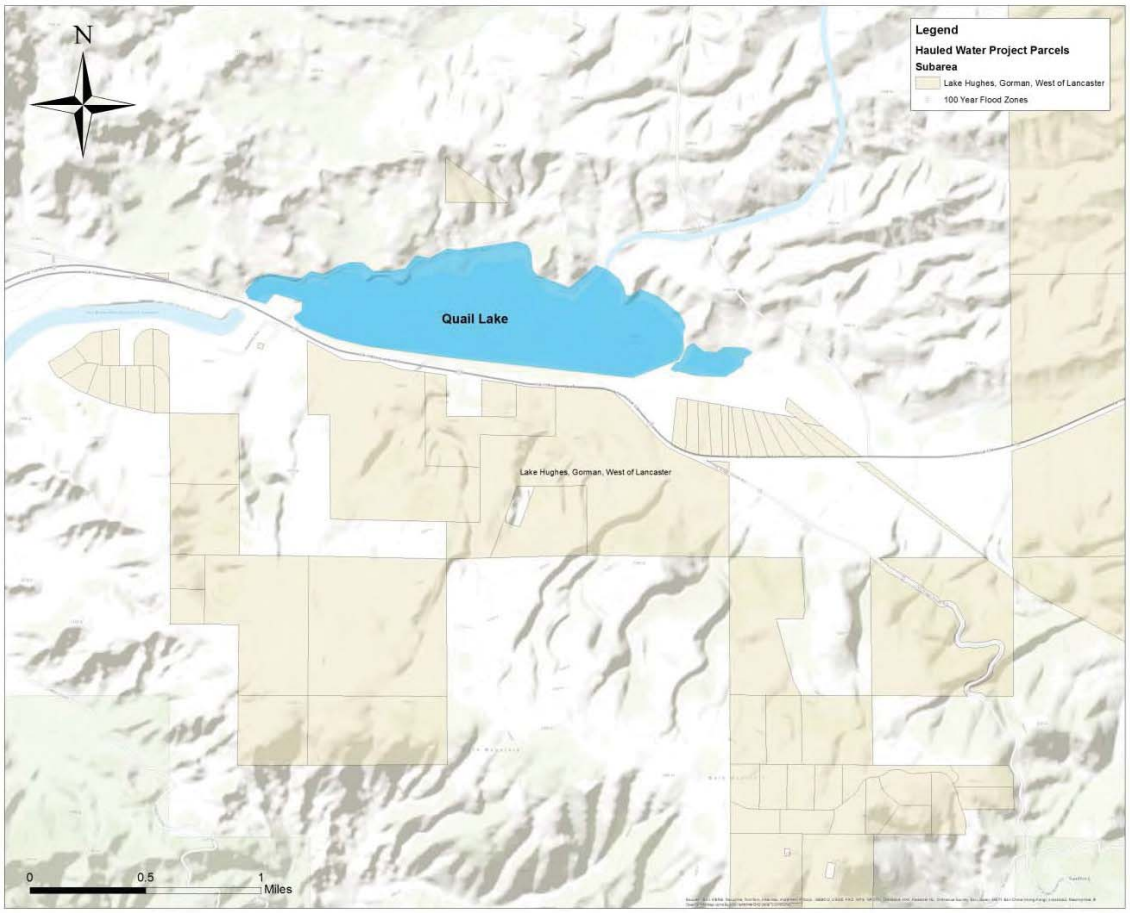
There are a few small flood zones within East San Gabriel Mountains and development in this area is not expected to significantly increase existing flood zone boundaries. Parcels in East San Gabriel Mountains are distributed throughout the area and only a few parcels are adjacent to each other. Runoff from the small clusters of parcels is expected to contribute low volumes of runoff to existing flood zones.

Figure 2. Antelope Valley FEMA Flood Zones



There are no large flood zones within the Santa Clarita Valley, but small flood zones are spread throughout the region. A flood zone exists around the flood plain of Santa Clara River and some developments of the Project are located within that flood plain. Several parcels within the Project are located north of branches of the Santa Clara River, such as those in the San Gabriel Mountains near Acton and Agua Dulce. These branches will receive additional runoff from the development. as a result of the development. A portion of the northwest section of the Lake Hughes Subarea is situated above Quail Lake, which is a designated flood zone. Quail Lake has an approximate capacity of 7,580 AF and the Project's development in this area would produce approximately 40-AF of runoff after a 100-year design storm. The projected runoff from the development is about 1 percent of the lake's total capacity; therefore, the Project could potentially result in an increase of the lake's flood zone boundary. A road exists on the south side of the lake at an elevation about 10 feet higher than the lake and the increased Project runoff is not expected to have an impact on this road. Quail Lake is a storage reservoir for the west branch of the California Aqueduct and measures should be taken to protect the lake. The Quail Lake flood zone is shown in Figure 3.

Figure 3. Quail Lake FEMA Flood Zone



Evaluation of the Project's hydrological impact on the area shows that the Project will impact the area's natural drainage and has a potential to expand existing flood zones by small amounts. The level of impact will vary by subarea. The dry lakes in Edwards Air Force Base have the highest potential to be impacted by the Project since the majority of the runoff within Antelope Valley flows toward them.

VI. Flood Risk Reduction

Los Angeles County requires that developers proposing to connect to a Los Angeles County Flood Control District system obtain a connection permit, which requires calculation of peak flows from the development and adherence to peak flow allowances as determined by Los Angeles County Flood Control engineers. Most of the Project is not likely to connect directly to a Los Angeles County Flood Control District system. Most of the Project does not have existing storm drainage or flood control infrastructure. Therefore, this Los Angeles County Flood Control District requirement is not likely to affect the site design employed by developers of the project.

To reduce the potential flood risk impacts that could arise from the cumulative impacts of the Project, Project-specific Best Management Practices can be employed. These can include detention or retention basins; scour protection along river branches to prevent erosion; and distributed stormwater retention infrastructure such as stormwater capture cisterns or green roofs to attenuate runoff flows; and green stormwater infrastructure for access roads.

VII. Conclusion

The Project will result in an increase in stormwater runoff for the area since the existing area is undeveloped. The development will consist of low-density single-family homes and is expected to increase the runoff of each developed parcel by about 26 percent to 48 percent. Developed parcels will not be concentrated in one location and there will be open space between most parcels. The open space between each parcel will not be developed and is not expected to increase runoff flow. Additional runoff produced by the development will impact the area's existing drainage patterns, but the impact could be minimized by incorporating BMP features and infrastructure protections.

The results of this evaluation indicate that the Project will have a significant impact on the existing area and the BMPs described in this section could be incorporated into the Project's ordinance to lessen its impact.

Water Quality Analysis

To further support the EIR, the Project's impact on the quality of stormwater runoff in the area was evaluated. Since the existing area is vacant, runoff is not impacted by human activities associated with development. At build-out, a maximum of approximately 42,872 single-family residences will be developed, which will increase the amount of human activity in the area. This increase would add new pollutants to the stormwater runoff, such as metals from vehicles and pesticides from landscape care. To determine the impact of the Project on existing conditions, the increased runoff from each parcel and potential impact to impaired water bodies was determined.

LA County's Low Impact Development (LID) Standards Manual requires developments manage stormwater runoff. Developments are categorized as Designated or Non-Designated. The single-family homes proposed to be developed in this Project will mostly be categorized as Small-Scale Non-Designated Projects. Small-Scale Non-Designated Projects are required to implement at least two County BMPs. The BMPs can be used to retain stormwater runoff or mitigate pollutant discharges. The County's LID ordinance does not require a specific reduction in pollutant discharges, but it does have requirements on the size of the BMPs in the manual.

BMPs listed for Non-Designated Projects are not required to meet a specific pollutant load reduction or to retain a specified amount of runoff. They are only intended to reduce a development's pollutant load, but not necessarily to reduce all pollutant loads to a pre-development condition; therefore, each development of the Project will result in an increase of pollutant discharges. Procedures from the County's LID Standards Manual were followed to determine the difference in the proposed initiative's pre- and post-development runoff volumes and potential pollutant loads.

The rainfall depth from Soledad Canyon, Gage 405 was used to estimate the 85th percentile storm depth for Santa Clarita Valley , and Little Gleason, Gage 1074, for East San Gabriel Mountains, per LA County's Spatial Distribution Analysis of the 85th Percentile 24-hr Rainfall A rainfall depth of 0.75-inches was used for the Antelope Valley since it was greater than the 85th percentile storm for that area. The total runoff volume generated by a general parcel in Antelope Valley, Santa Clarita Valley, and East San Gabriel Mountains as required by LA County's SUSMP is listed in Table 23.

Table 23. Hydrology Results for 85th Percentile of Storm Event

	Storm	Rainfall Depth	Time of Concentration	Peak Flow Rate	24-Hour Runoff Volume
Antelope Valley		inches	minutes	Cubic feet per second	acre-feet
Pre-Development	85th Percentile	0.75	30	0.24	0.08
Post-Development			30	0.35	0.11
Santa Clarita Valley					
Pre-Development	85th Percentile	0.90	30	0.28	0.09
Post-Development			30	0.41	0.13
East San Gabriel Mountains					
Pre-Development	85th Percentile	1.28	30	0.72	0.13
Post-Development			30	0.84	0.18

An increase of 0.04-AF of runoff will result for a typical developed parcel in Santa Clarita and an increase in runoff of 0.03-AF is expected from a typical developed parcel in Antelope Valley. In the East San Gabriel Mountains, a runoff volume increase of 0.05-AF is expected. Parcels within the East San Gabriel Mountains are spread out and large, and concentrated pollutant loads are not expected to result from this subarea. Each parcel is estimated to produce a slightly increased amount of runoff from the area's 85th percentile rainfall depth. A concern with increased runoff from the Project's parcels is that it will contain new or increased levels of pollutants. The common pollutants in urban stormwater runoff from single-family residential units and associated access roads are listed below.

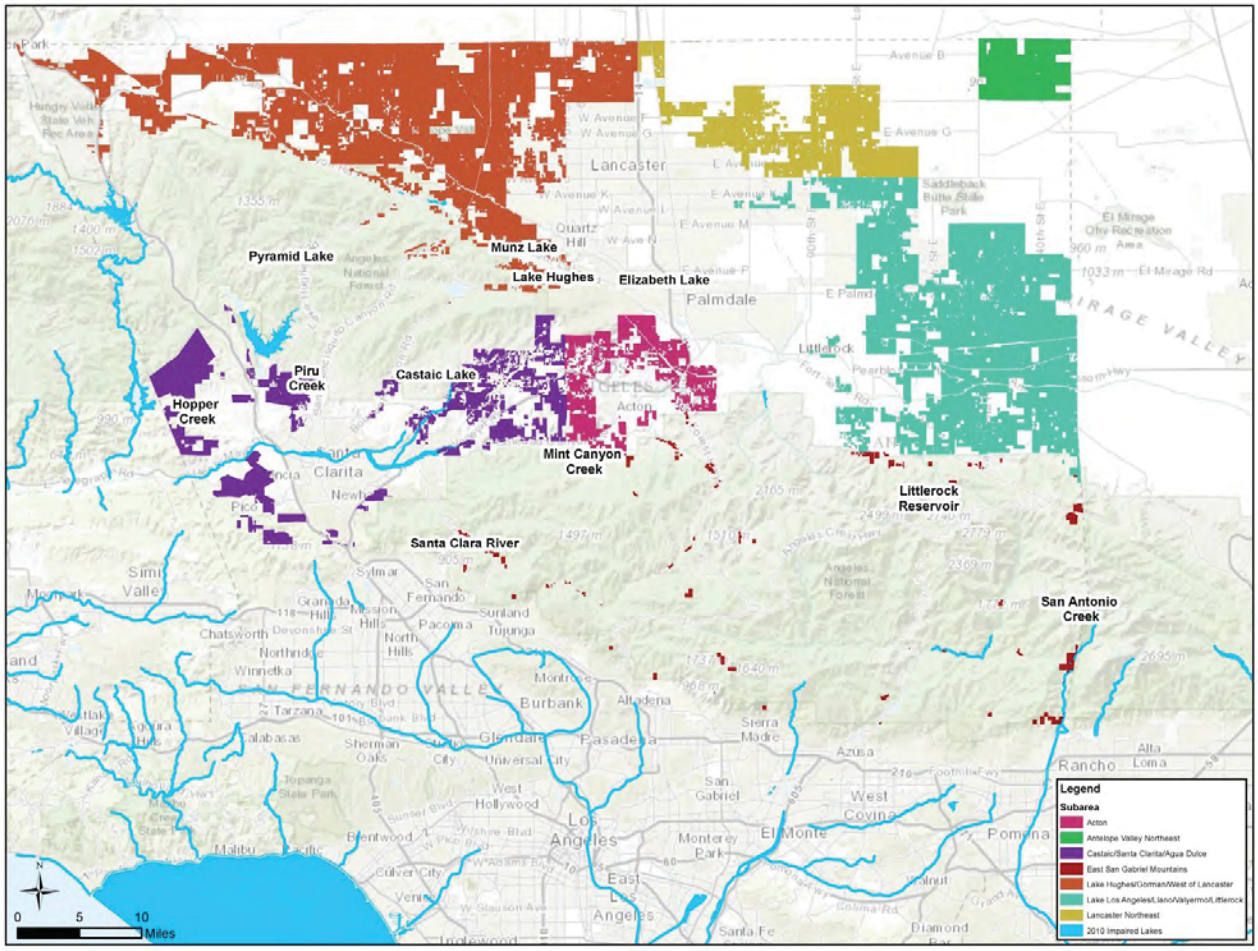
- Sediment and Floatables
- Pesticides and Herbicides
- Organic Materials
- Metals (Lead and Zinc)
- Oil and Grease
- Hydrocarbons
- Bacteria and Viruses
- Nitrogen and Phosphorus

Overall, runoff from the proposed initiative would increase relative to existing baseline, ranging from 0.02 AF to 0.05 AF per parcel developed. This increased runoff combined with typical pollutants generated on residential land uses could result in potentially significant water quality impacts to existing water bodies. While the LID ordinance requires two BMPs to treat the additional runoff, they will not remove all pollutants or provide complete on-site retention that would mimic the pre-development condition.

I. Impact to Impaired Water Bodies

Increased runoff from the developed parcels is expected to contain pollutants that, if not treated, can result in the decrease in water quality of the receiving water. Specific pollutants have discharge limits if the receiving water they are discharged to is classified as an impaired water body. If the receiving water body is an impaired water body per the Clean Water Act Section 303(d), it has pollutant discharge limits associated with it that are outlined in a National Pollutant Discharge Elimination System (NPDES) permit. Impaired water bodies near the Project are shown in Figure 4.

Figure 4. Impaired Water Bodies near Project Area



There are several impaired water bodies in the region that runoff from the Project will potentially enter, particularly Elizabeth Lake and several reaches of Upper Santa Clara River. Elizabeth Lake was recorded as an impaired water body due to trash and reaches along Upper Santa Clara River have established a Total Maximum Daily Load (TMDL) for coliform due to impairments from non-point or unknown sources (SWRCB, 2011). The impaired water bodies and their pollutants that may receive runoff from the Project are listed in Table 24.

Table 24. Impaired Waters and Pollutants

Water Body	Pollutant
Pyramid Lake	Mercury
Munz Lake	**Trash**[1]
Littlerock Reservoir	Manganese
Lake Hughes	**Trash**
Elizabeth Lake	Eurotrophic Organic Enrichment/Low Dissolved Oxygen **Trash** pH
Castaic Lake	Mercury
Mint Canyon Creek Reach 1	Nitrate and Nitrite
Piru Creek (from gaging station below Santa Felicia Dam to headwaters)	Chloride pH
Santa Clara River Reach 5 (Blue Cut gaging station to West Pier Hwy 99 Bridge)	Chloride **Coliform** Iron
Santa Clara River Reach 6 (W Pier Hwy 99 to Bouquet Cyn Rd)	Chloride Chlorphyrifos **Coliform**
Santa Clara River Reach 7 (Bouquet Canyon Rd to above Lang Gaging Station)	Chloride **Coliform** Iron

SWCRB, 2011
[1] Pollutants shown in bold are common pollutants discharged from single-family developments.

The pollutants listed in Table 24 that can be negatively impacted by human activities are trash, nitrate and nitrite, coliform, and metals. Therefore, runoff from the development will cause an impact for these pollutants listed in Table 24.

II. Water Quality BMPs

The Project will develop low-density single-family homes that will be spread throughout the Project Area. This will allow for preservation of natural areas between each parcel. Developments will have to comply with the County LID Ordinance as Small-Scale Non-Designated Projects and will be required to include two BMPs per County's LID ordinance. While the BMPs would mitigate the pollutant discharges from each site, they would not eliminate all polluted discharges from a site to mimic the pre-development condition. The impact of the individually developed parcels could potentially impact water quality of downstream water bodies. Based on the analysis completed for this study, it is expected that the Project will have a significant impact even with the implementation of BMPs.

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