APPENDIX K

Hydrology and Water Quality Technical Report

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HYDROLOGY AND WATER QUALITY TECHNICAL REPORT

NORTH HAIWEE DAM NO. 2 PROJECT

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October 2016

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1 Introduction

The Hydrology and Water Quality Technical Report was prepared by California Watershed Engineering (CWE) for the Los Angeles Department of Water and Power (LADWP) to assess potential impacts associated with the North Haiwee Dam No. 2 Project (Proposed Project). As the lead agency under the National Environmental Policy Act (NEPA), the Bureau of Land Management (BLM) is required to determine the potential for the Proposed Project to result in adverse effects and to implement avoidance measures or develop alternatives where potentially significant effects occur. As the lead agency under the California Environmental Quality Act (CEQA), LADWP is required to determine the potential for the Proposed Project to result in significant impacts, to implement mitigation measures where potentially significant impacts occur, and to develop alternatives to reduce significant impacts. The results of the Hydrology and Water Quality Technical Report, and environmental analysis as a whole, will be taken into consideration as part of the decision-making process whether to approve the Proposed Project.

2 Project Description

LADWP proposes to improve the seismic reliability of the North Haiwee Reservoir (NHR), which is located in the Owens Valley, California, approximately 150 miles north of Los Angeles. LADWP has prepared this draft joint Environmental Impact Report/Environmental Assessment (EIR/EA) in cooperation with the BLM. The purpose of the Proposed Project is to construct North Haiwee Dam No. 2 (NHD2 or new Dam) to the north of North Haiwee Dam (NHD or existing Dam) which impounds NHR. Seismic studies have found that NHD would have potential to fail during a Maximum Credible Earthquake (MCE) event, the largest possible earthquake which could happen. NHD2 would serve to improve the seismic reliability of NHR in the event that the existing Dam is damaged or breached by an earthquake event, thereby ensuring public health and safety and securing the City’s water source. The Proposed Project would provide sufficient seismic reliability for NHR, maintain the function of an essential water conveyance infrastructure component for the City of Los Angeles, and protect local populations from a hazardous flooding event. The Proposed Project would also create a Basin between NHD2 and NHD, allowing LADWP to divert water from the Los Angeles Aqueduct (LAA), through the basin, and through a notch in NHD into NHR.

This technical report includes the evaluation of the No Project Alternative, as well as two Build Alternatives: the Cement Deep Soil Mixing (CDSM) Alternative and the Excavate and Recompact Alternative). The Proposed Project consists of the following components, which are common to both Build Alternatives:

- Construction of the NHD2 components: NHD2, the east and west berms, and grading of the basin area between NHD and NHD2;
- Realignment of Cactus Flats Road;
- Realignment of the LAA and construction of the diversion structure and temporary bridge;
- Construction of the diversion channel and NHD modifications;
- Excavation of materials at Borrow Site 10[1]; and
- Purchase and hauling of materials from Borrow Site 15.

The differentiating component between the two Build Alternatives is the method of construction of the foundation of NHD2, which affects the timeline and construction efforts of the NHD2 components and use of Borrow Sites 10 and 15. Construction of the remaining Proposed Project components is the same

[1] Borrow Site 10 refers to the LAA Excavation Area and Borrow Site 15 refers to the existing mine in Keeler in the Draft EIR/EA.

between the two Build Alternatives, except for the timeline of the diversion channel and NHD modifications.

Refer to Chapter 1.0 Introduction and Chapter 2.0 Project Description and Alternatives of the Draft EIR/EA for the full description of the Proposed Project, including purpose and need, objectives, regulatory requirements, alternatives, construction, and operations. Borrow Site 10 refers to the LAA Excavation Area and Borrow Site 15 refers to the existing mine in Keeler in the Draft EIR/EA.

NHD2 will be constructed on LADWP property north of the existing Dam. The NHD2 axis will be located approximately 800 feet north and roughly parallel to the existing Dam axis. NHD2 will be designed to retain water in NHR in the event of failure of NHD. The proposed NHD2 location provides a basin and a new accessible length of aqueduct channel between the existing Dam and NHD2 that may be utilized for water quality and sediment management purposes or storage. The new Dam would be a zoned embankment dam comprised of shell, core, filter, and drain materials based on design specifications, hydrogeological conditions of the surrounding area, and the type of borrow material available. Seepage control would be provided by the core, filter, and drain zones.. NHD2 would be constructed per the design plans and specifications of Division of Safety of Dams (DSOD) guidelines and the operational requirements of the NHR.

The basin would hold water that would travel from the realigned LAA into the basin, and then through a notch in NHD into the existing NHR. The diversion structure, diversion channel, and notch would match the design parameters for the LAA Realignment, allowing the basin to handle the LAA system's flow rate of 900 cubic feet per second. The diversion channel would be approximately 675 feet long. Soil generated during construction of these Proposed Project components would be used onsite.

The existing LAA is an open flow channel that flows continuously. The westerly abutment of NHD2 would encroach upon a portion of the existing LAA. In order to construct NHD2 and maintain operations of the LAA, the Proposed Project would realign approximately 1,900 feet of the existing LAA. The existing LAA and realigned LAA are located on LADWP-owned and BLM-managed land. A BLM right-of-way (ROW) permit amendment would be required for the realignment of the LAA.

The LAA Realignment's cross-section would match the existing LAA's cross-section. Once the realigned LAA is constructed, the flow of water through the existing LAA would be halted temporarily to connect the newly built segment to the existing LAA. Construction of the realigned LAA would include installation of a diversion structure. After the LAA is reconnected, the obsolete existing LAA segment would be demolished and backfilled. Any excess soil from the excavation would be analyzed for potential use as material for the new Dam. LADWP construction crews and/or a licensed and bonded contractor would construct the new section of the LAA. The realigned LAA would consist of a trapezoidal concrete channel, with an approximate width of 32 to 35 feet and approximate depth of 12 to 15 feet. The concrete liner would be approximately 6 to 10 inches thick with steel reinforcement.

As with the existing LAA, construction of NHD2 would intersect the existing Cactus Flats Road, directly blocking the roadway. Cactus Flats Road, which falls under the jurisdiction of Inyo County, is not a primary roadway, but is used by mining vehicles traveling to and from local mining sites, LADWP personnel, and other motorists. In order to maintain access to this public road, the existing Cactus Flats Road would need to be realigned to accommodate the new Dam. Realignment of Cactus Flats Road would not require the acquisition of additional ROW because the realignment would take place within LADWP-owned land. Cactus Flats Road is under the jurisdiction of Inyo County, and would require an encroachment permit for the existing Cactus Flats Road and a grading permit for the realigned Cactus Flats Road. Inyo County would relinquish a portion of the existing Cactus Flats Road to LADWP for the construction of NHD2. LADWP will grant a ROW to Inyo County for the realigned Cactus Flats Road.

The preliminary design parameters for the realigned portion of Cactus Flats Road are an approximate length of 5,000 feet and width of 20 feet. The realigned Cactus Flats Road would have a grade of up to eight percent (dependent on final design), and would incorporate compacted base material along the roadway and drainage system. The realigned Cactus Flats Road would be paved, and drainage purposes, two reinforced concrete culverts would be installed. LADWP would construct the new road.

The construction of NHD2 would require various materials to construct the new earthen dam. These materials would be sourced from two “Borrow Site,” locations identified as sources of riprap (cobbles and boulders), gravel, and/or sand which would be used to construct the new Dam. There are two proposed borrow sites for the Proposed Project. Borrow Site 10 is located within and around the area where excavation for, and construction of, the realigned LAA would occur. Borrow Site 10 is proposed as a source of sand and gravel for materials for the new Dam. The other materials from the dam will be brought in from an existing quarry near the Project Site, Borrow Site 15. As this borrow site is existing, Proposed Project activities related to Borrow Site 15 would be limited to the purchase and hauling of materials between Borrow Site 15 and the Project Site.

3 Methodology

3.1 Hydrology

A hydrological study of the Project Site was performed to determine if there would be any significant environmental impacts due to the Proposed Project and its alternatives. The study included a review of readily available background information, the development of hydrologic models, and pertinent flow rate and volume calculations as shown in the following section.

An analysis was performed to evaluate the Proposed Project and its alternatives’ effects on the existing drainage patterns, flood control, surface runoff, erosion and siltation, and surface hydrology. Models were developed using the Watershed Modeling System (WMS) software for the Proposed Project. WMS was developed by Aquaveo and has the ability to automatically delineate watersheds and sub watersheds based on digital terrain data. Watersheds and sub watersheds representing run-on and run-off from each of the Proposed Project components and Borrow Site 10 were delineated by assigning outlet points along the defined flow lines at the boundaries of each of the Proposed Project components. Drainage patterns associated with the Project Site, including Borrow Site 10, were determined for both the existing and the proposed conditions (under both Build Alternatives). The results were then compared to identify if the drainage patterns would be altered through implementation of the Proposed Project or its alternatives. The proposed conditions delineation followed the same process as the existing conditions, except the terrain was altered to reflect the design of the Proposed Project and its alternatives.

The County of San Bernardino Hydrology Manual was used as a reference for the hydrologic calculations based on guidance from the Inyo County Public Works Department. Rainfall data was gathered from the National Oceanic and Atmospheric Administration (NOAA) for the Project Site to determine the rainfall intensities (TABLE 3-1).

TABLE 3-1
RAINFALL INTENSITIES FROM NOAA

Partial Duration Series Based Precipitation Frequency Estimates with 90% Confidence Intervals (inches)										
Duration	**Average recurrence interval (years)**									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	0.08	0.11	0.15	0.18	0.24	0.28	0.33	0.38	0.47	0.54
10-min	0.12	0.16	0.21	0.26	0.34	0.40	0.47	0.55	0.67	0.77
15-min	0.15	0.19	0.26	0.32	0.41	0.48	0.57	0.66	0.81	0.93
30-min	0.20	0.26	0.35	0.43	0.55	0.66	0.77	0.90	1.10	1.26
60-min	0.27	0.35	0.47	0.58	0.74	0.88	1.04	1.21	1.47	1.69
2-hr	0.38	0.49	0.66	0.80	1.01	1.19	1.39	1.61	1.93	2.19
3-hr	0.46	0.60	0.80	0.97	1.22	1.44	1.67	1.92	2.29	2.60
6-hr	0.62	0.82	1.10	1.34	1.70	2.00	2.31	2.66	3.16	3.58
12-hr	0.79	1.09	1.50	1.86	2.39	2.83	3.30	3.82	4.58	5.21
24-hr	1.01	1.44	2.06	2.59	3.38	4.03	4.74	5.52	6.67	7.63
2-day	1.20	1.75	2.53	3.20	4.18	5.00	5.88	6.85	8.27	9.46
3-day	1.31	1.92	2.79	3.54	4.63	5.53	6.51	7.58	9.15	10.50
4-day	1.38	2.02	2.94	3.73	4.89	5.85	6.89	8.04	9.73	11.10
7-day	1.56	2.25	3.24	4.11	5.41	6.51	7.71	9.05	11.00	12.70
10-day	1.63	2.33	3.35	4.25	5.61	6.77	8.05	9.49	11.70	13.50
20-day	1.85	2.64	3.80	4.84	6.43	7.79	9.31	11.00	13.60	15.80
30-day	2.10	3.01	4.35	5.56	7.39	8.96	10.70	12.70	15.60	18.20
45-day	2.41	3.47	5.02	6.41	8.51	10.30	12.30	14.50	17.80	20.70
60-day	2.74	3.94	5.69	7.26	9.62	11.60	13.80	16.30	19.90	23.00

Source: NOAA National Weather Service, 2015

It was assumed that the sub watersheds associated with the Project Site is 100 percent pervious with negligible impervious areas. The LAA is concrete lined and impervious; however, it accounts for less than one percent of the total area and will remain lined for all Project alternatives. The existing Cactus Flats Road is unpaved and is considered pervious for the analysis. Hydrologic calculations, evaluating the 2-year, 24-hour event for determining water quality parameters, and the 10-, 25-, 50-, and 100-year peak runoff rates for the 3-hour, 6-hour, and 24-hour rainfall events, were performed based on the Modified Rational Method (equation shown below).

$$Q = CIA$$

Where Q equals peak flow rate in cubic feet per second (cfs), C equals a dimensionless runoff coefficient representing the ratio of runoff depth to rainfall depth, I equals the time-averaged rainfall intensity for a storm duration equal to the time of concentration in inches per hour, and A equals the drainage area (sub watershed area) in acres.

The 10- through 100-year peak runoff rates for the various durations were analyzed to determine if the drainage patterns alter significantly and to assess the system sensitivity for debris production. The 100-year event was analyzed because it is used to designate floodplains zones based on hazard analyses documented by the Federal Emergency Management Agency (FEMA). Flood Insurance Rate Maps (FIRMs) are developed using the 100-year storm event based on the FEMA methodology.

The runoff coefficient for each sub watershed is dependent on several different factors including the rainfall intensity, drainage area slope, type and amount of vegetative cover, and infiltration capacity of the ground surface. These factors are summarized in TABLE 3-2 for each of the Proposed Project components based on the San Bernardino County Hydrology Manual. Antecedent moisture condition (AMC) is an index of a soil's wetness or dryness. AMC II describes soils with antecedent infiltration, and some water in soil pores resulting in moderate runoff potential. It is an average study condition for a basin. The curve number (CN) is selected for a particular soil cover type and also depends on the AMC. Soil group is defined by the soil type. Group A soils have low runoff potential and high infiltration rates.

Group B soils have moderate infiltration rates when thoroughly wetted. Group C soils have slow infiltration rates when thoroughly wetted. Group D soils have high runoff potential and slow infiltration rates when thoroughly wetted. These soils also have high swelling potential. AMC III represents a soil that has reached saturated conditions with infiltration regulated by hydraulic conductivity of the soil. This AMC represents basins that have received significant rainfall for several days and is generally used for extreme event rainfall/runoff analysis.

TABLE 3-2
SITE CONDITIONS

Location	Soil Group	Soil Type	Cover Type	CN for AMC II	Infiltration Rate for AMC I	Infiltration Rate for AMC II	Infiltration Rate for AMC III
Project Site	C	Sandy clay loam	Open Brush (Fair)	93	0.30	0.14	0.04
Borrow Site 10	A	Sandy loam	Open Brush (Fair)	93	0.30	0.14	0.04

Note: Where CN is the Curve Number and AMC is the Antecedent Moisture Condition
Source: County of San Bernardino Hydrology Manual, 2015

The infiltration rate associated with each sub watershed was determined from the Soil Conservation Service (SCS) CN using FIGURE 3-1 from the County of San Bernardino Hydrology Manual. The CN for each sub watershed is the same and was determined based on the hydrologic soil group, land uses, and vegetative cover for the Proposed Project (FIGURE 3-2). The CN ranges between 0 – 98, where a low CN indicates low runoff potential and a high CN indicates high runoff potential with low infiltration. The hydrologic soil group associated with the Project Site and the Borrow Site was determined based on the United States Department of Agriculture Natural Resources Conservation Service (NRCS) Gridded Soil Survey Geographic (gSSURGO) Database. Although the Project Site and Borrow Site 10 have some vegetation (determined from available aerial imagery), the cover type was assumed to be open brush which represents sage brush covered areas for calculation purposes given the different cover types. The cover type is used to determine the infiltration rates, F_m in inches per hour (in/hr).

Available aerial imagery and topographic data were used to identify existing stream lines and slopes within the Project area and surrounding Borrow Site 10. Natural streams were identified so that drainage patterns could be assessed along with the impact associated with altering those patterns.

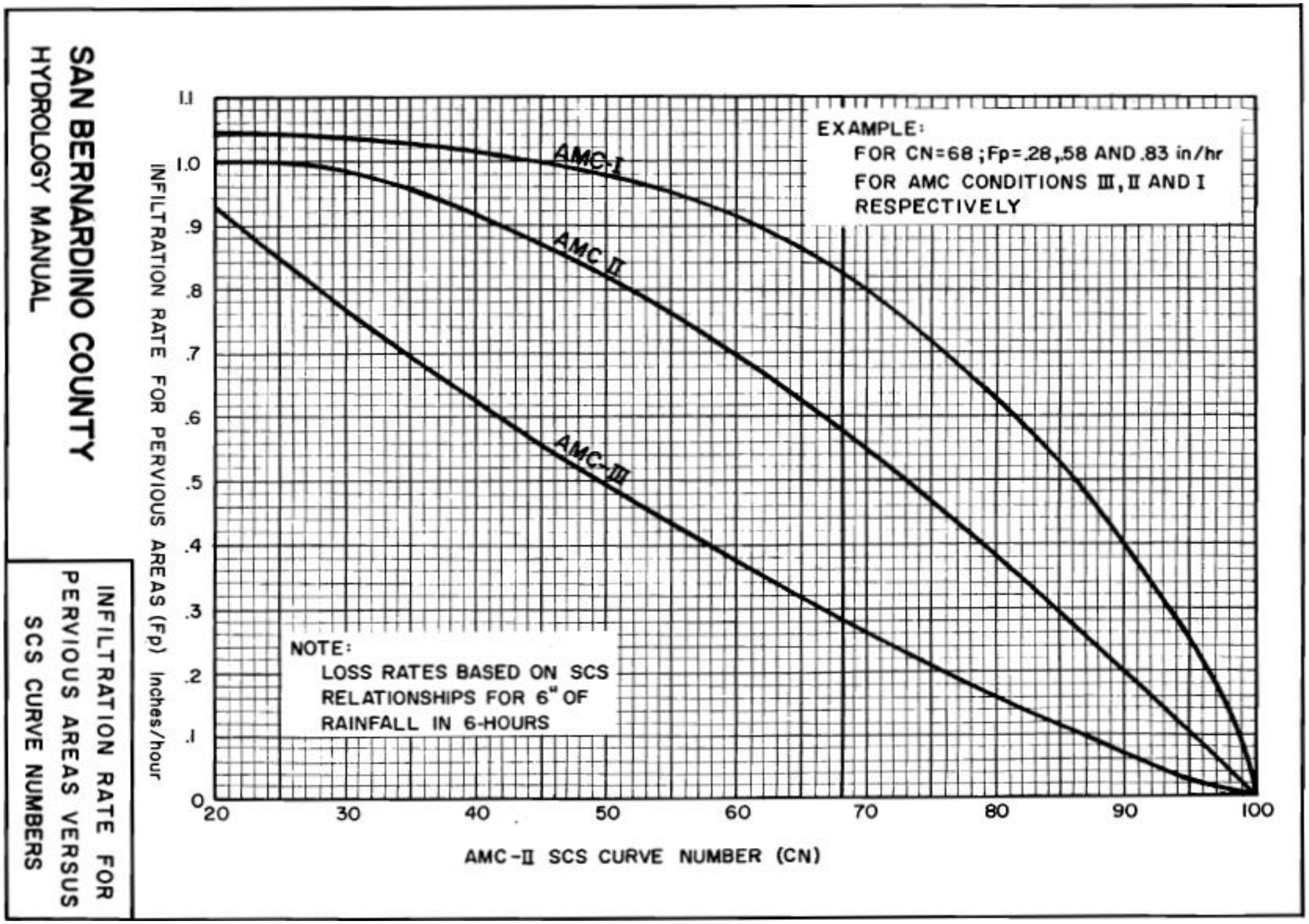

FIGURE 3-1
INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	Soil Group B	Soil Group C	Soil Group D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush Project Site	Poor	62	76	84	88
(Soft wood shrubs - buckwheat, sage, etc.)	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

FIGURE 3-2
CURVE NUMBERS FOR PERVIOUS AREAS

3.2 Water Quality

An analysis of the water quality associated with the Project Site was performed to determine if there would be any environmental impacts due to Proposed Project implementation. The study included a review of readily available background information.

Surface water quality within the Project Site is overseen by the Lahontan Regional Water Quality Control Board (RWQCB). The natural quality of most high elevation waters is assumed to be very good or excellent. Water quality is influenced by snowmelt and runoff from the eastern Sierra Nevada.

Although high elevation waters are of excellent quality, the main water quality problems in the region are largely related to nonpoint sources (including erosion from construction, timber harvesting, and livestock grazing), stormwater, acid drainage from inactive mines, and individual wastewater disposal systems (Lahontan RWQCB, 1995). The water quality objectives in the Lahontan Basin Plan (Lahontan RWQCB, 1995) are intended to protect the public health and welfare, and to maintain or enhance water quality in relation to the existing and/or potential beneficial uses of the water. Water quality objectives are both numerical and narrative and define the upper concentration or other limits that the Lahontan RWQCB considers protective of beneficial uses (FIGURE 3-3).

The water quality objectives shown in FIGURE 3-3 include water released from Haiwee Reservoir. Water that does not meet these standards may require treatment. Water pumped and discharged during construction may be required to meet these limits before it is discharged into the LAA or used for other on-site purposes. According to the 1995 Water Quality Control Plan for the Lahontan Region, these levels were developed using numerical objectives for specific water bodies where sufficient data was available. Utilizing the annual averages, 90th percentile confidence intervals are provided in the figure below to demonstrate the variability of the data and expected values of water quality parameters.

Beneficial uses define the resources, services, and qualities of aquatic systems. Water quality standards must also include an anti-degradation policy to protect high-quality waters (Lahontan RWQCB, 1995). Whenever the existing quality of water is better than the quality of water established in the Basin Plan as objectives (both narrative and numerical), such existing quality shall be maintained unless appropriate findings are made under the anti-degradation policy. The anticipated water quality under existing conditions, during construction, and during operation was assessed based on available information to determine how the quality changes based on implementation of the Proposed Project and its alternatives.

WATER QUALITY OBJECTIVES FOR CERTAIN WATER BODIES OWENS HYDROLOGIC UNIT

See Fig. 3-10	Surface Waters	Objective (mg/L)[1,2]							
		TDS	Cl	SO_4	F	B	NO_3-N	Total N	PO_4
18	South Lake	12 20	3.7 4.3	-	0.10 0.10	0.02 0.02	0.1 0.1	0.2 0.4	0.03 0.04
19	Bishop Creek (Intake 2)	27 29	1.9 3.0	-	0.15 0.15	0.02 0.02	0.1 0.2	0.1 0.4	0.05 0.09
20	Bishop Creek (at Hwy 395)	59 105	2.4 6.0	7.2 12.0	0.12 0.30	0.04 0.10	0.5 0.9	0.7 1.0	0.09 0.18
21	Big Pine Creek (at Hwy395)	55 93	2.0 4.0	6.0 10.0	0.06 0.20	0.03 0.07	0.6 0.9	0.7 1.0	0.03 0.04
22	Fish Springs (above Hatchery)	174 219	-	-	-	-	0.7 0.8	0.8 1.0	0.17 0.23
23	Owens River (Tinemaha River Outlet)	207 343	17.9 42.0	26.8 59.0	0.57 0.90	0.61 1.50	0.6 1.1	0.9 1.5	0.32 0.56
24	Black Rock Springs	114 123	6.3 8.0	24.0 27.0	0.54 0.60	0.11 0.14	0.2 0.4	0.7 0.9	0.13 0.20
25	Oak Creek (above hatchery)	72 88	1.8 1.8	-	0.14 0.14	0.06 0.06	0.1 0.2	0.2 0.4	0.08 0.12
26	Independence Creek (gaging station)	80 114	6.5 11.0	15.0 23.0	0.10 0.20	0.12 0.26	0.4 0.8	0.6 1.0	0.05 0.09
27	Hogback Creek	45 48	2.5 3.6	-	0.10 0.10	0.03 0.06	0.2 0.3	0.4 0.6	0.02 0.04
28	Lone Pine Creek (Whitney Portal)	22 25	0.5 1.1	-	0.10 0.10	0.05 0.07	0.3 0.5	0.4 0.6	0.02 0.04
29	Lone Pine Creek (at gaging station)	56 81	4.0 8.0	4.6 7.0	0.12 0.20	0.06 0.11	0.3 0.4	0.4 0.5	0.01 0.01
30	Cottonwood Creek (Los Angeles Aqueduct)	66 91	1.9 4.0	7.4 11.0	0.20 0.40	0.05 0.10	0.1 0.4	0.4 0.6	0.11 0.17
31	Haiwee Reservoir (outlet)	215 315	19.5 38.0	27.0 62.0	0.60 0.90	0.56 0.91	0.5 1.0	0.8 1.5	0.23 0.36

1 Annual average value/90th Percentile Value.

2 Objectives are as mg/L and are defined as follows:

B	Boron	NO_3-N	Nitrogen as Nitrate
Cl	Chloride	SO_4	Sulfate
F	Fluoride	PO_4	Dissolved Orthophosphate
N	Nitrogen, Total	TDS	Total Dissolved Solids (Total Filterable Residue)

FIGURE 3-3
WATER QUALITY OBJECTIVES FOR HAIWEE RESERVOIR

3.3 Groundwater Quality and Levels

Soil boring logs, groundwater depths, and flow patterns were determined through the review of previous geotechnical investigations. The information in previous reports was used to assess the environmental impacts during construction and operation. The reports and available studies include information for the Project vicinity. Groundwater information for the surrounding area has been taken from the various references identified below:

- *North Haiwee Dam No. 2 Project: Geotechnical Data Report Working Draft (July 16, 2015), Volume I Text, Tables, and FIGUREs and Volume II Appendices* (LADWP, 2015)
- Aquifer Pumping Tests (Black and Veatch, 2014)
- Final Report on the Owens Lake Groundwater Evaluation Project (MWH, 2012a)
- Owens Lake Groundwater Evaluation Project: Groundwater Model Documentation (MWH, 2012b)
- Owens Lake Groundwater Evaluation Project: Updated Conceptual Model Report (MWH, 2011a)
- Owens Lake Groundwater Evaluation Project: Evaluation of Geophysical Data (MWH, 2011b)
- *Summary of Construction, Analyses, and Long Term Monitoring: Fault Test Site, Owens Lake, Inyo County, California* (Sierra GeoSciences, 2002)

The *North Haiwee Dam No. 2 Project Geotechnical Data Report* (LADWP, 2015) was considered the most relevant and contains the most applicable information, as it was conducted specifically for the Proposed Project. However, the NHD2 Geotechnical Data Report only covers the groundwater information in the vicinity of the NHD, NHD2, LAA, and the Cactus Flats Road; therefore, other references were used to assess the groundwater conditions near the Proposed Project components and Borrow Site 10 as necessary. The Aquifer Pumping Tests (Black and Veatch, 2014) focused on the NHD2 area specifically. The area studied as part of the Owens Lake Groundwater Evaluation Project includes the northern end of NHR and extends north past the intersection of the State Route (SR) 136 and US Highway (US) 395 (see Appendix III). It is anticipated that additional geotechnical evaluations will be performed at Borrow Site 10. LADWP notes the fluctuation in current groundwater levels correlate with weather conditions in the region. Periods of drought have lower groundwater levels than periods with higher than average rainfall. These differences will influence the groundwater levels during construction of NHD2. If additional information on groundwater levels and quality become available, the results from the analysis will be updated as applicable for the respective sites.

The groundwater depths near the Proposed Project components were calculated based on the studies described above and were used to determine if construction or operation of the Proposed Project would impact groundwater levels or water quality though direct interaction with groundwater.

3.4 Flood Hazard

3.4.1 FEMA Flood maps

Floods are short-lived incidents related to events such as dam failure, storm events, or spring snowmelts, while floodplains are the areas that experience flooding during periods of high discharge, which generally include water bodies and the adjacent areas. Floodplains generally lack the environmental sensitivity of riparian areas, seasonal or perennial wetlands, and springs. Structures located within a flood hazard area may be subject to damage related to flooding. Federal Executive Order 11988 (Floodplain Management) requires federal agencies to prepare floodplain assessments for proposed projects located within or affecting floodplains. If a federal agency proposes to conduct an action within a floodplain, it must consider alternatives to avoid adverse effects and incompatible development of the floodplain. If the only practicable alternative involves siting structures in a floodplain, the agency must minimize potential harm to, or within, the floodplain and explain why the action is proposed in the floodplain.

FEMA identifies flood hazards, assesses flood risks, and partners with states and communities to provide accurate flood hazard and risk data. Flood hazard mapping is an important part of the National Flood Insurance Program (NFIP), as it is the basis of the NFIP regulations and flood insurance requirements. FEMA maintains and updates data through FIRMs and risk assessments. FIRMs include statistical information such as data for river flow, storm tides, hydrologic/hydraulic analyses, and rainfall and topographic surveys. FEMA uses the best technical data to create the flood hazard maps that outline flood risk areas (FEMA, 2015a).

The FIRMs near the Project Site were referenced to assess the flood hazard and to determine if the Proposed Project or its alternatives would impact the surrounding environment in relation to the floodplain. FIRM Map Numbers 06027C3350D and 06027C225D were referenced. The FEMA FIRMs referenced are included in Appendix I. Geographic Information System (GIS) data, identical to the maps, was used to determine the flood zone in which each of the Proposed Project components are located. The FIRMs identify hazard zones A, AE, and X within Inyo County near the Proposed Project.

- Zone A areas are identified as having a one percent chance of flows being equaled or exceeded in any given year.
- Floodway areas in Zone AE are defined as the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the one percent annual chance flood can be carried without substantial increase in flood heights. The base flood elevations have been determined in Zone AE areas.
- Zone X areas are determined to be outside the 0.2 percent chance floodplain. The flood zones were identified for each of the Proposed Project components so that impacts related to the floodplain could be assessed.

3.4.2 Dam Inundation Map

To evaluate the inundation in case of a dam failure, the Inundation Map of the NHD provided by LADWP was used (LADWP, n.d.). The locations of all Proposed Project components, including haul routes, were carefully compared to the inundation map to identify the regions with the potential of being flooded if the existing Dam fails. The inundation map of NHD2 has not been developed as of yet. The analysis for the potential flooding in case of the failure of NHD2 is therefore qualitative rather than quantitative based on existing topography, the NHD inundation map, and the design concept plans of the NHD2.

3.4.3 Tsunami and Seiche

A tsunami is a sea wave that results from a large-scale seafloor displacement associated with an earthquakes, major submarine slide, or volcanic eruption. Tsunamis most often happen in oceans and are caused by large, undersea earthquakes at tectonic plate boundaries. When the ocean floor at a plate boundary rises or falls suddenly it displaces the water above it and launches the rolling waves that will become a tsunami. The Project Site is 150 miles from the ocean coast and is not subject to ocean tsunamis.

Seiches are standing waves typically caused by strong winds, earthquakes, or landslides pushing water from one end to another within a body of water. When the wind stops, the water bounces back to the other side of the enclosed area and continues to oscillate back and forth.

Impacts of a seiche were assessed by calculating seiche parameters based on the conditions of the Project Site. NHR was considered as a long and narrow rectangle, which is a conservative assumption. In reality, the natural shape of the reservoir (NHR in this case) would dissipate some of the wave energy due to friction and flow blockage. Only NHR was considered since the dam between the two will limit the length of unobstructed wind flow. The change in the water surface elevation due to wind is calculated based on the interaction of the wind induced sheer stress and the hydrostatic pressure.

The natural period (the period of one complete oscillation of a body, T_n) of the reservoir (NHR in this case) is calculated based on Merian's formula (United States Army Corps of Engineers [USACE], 1997) as in Equation 3.4-1:

$$T_n = 2L/n\sqrt{gh} \qquad \text{(Equation 3.4-1)}$$

Where L is the length of the reservoir (NHR in this case), h is the average water depth and n is number of nodes in the wave. For the Proposed Project, n=1 was used to calculate the simplest mode of oscillation of a water body at its fundamental oscillation period.

The wind shear stress (τ_w) at the water surface is expressed in Equation 3.4-2.

$$\tau_{\ w} = \rho k U^2 \text{ (Dean and Dalrymple, 1984)} \qquad \text{(Equation 3.4-2)}$$

Where ρ is the density of water, U is the wind speed at 33 feet above the water, and k is a friction factor defined as (van Dorn, 1953) Equation 3.4-3.:

$$k = \begin{cases} 1.2 \times 10^{-6} \; U \le U_c \\ 1.2 \times 10^{-6} + 2.25 \times 10^{-6}\,(1 - \frac{U}{U_c})^2 \; U > U_c \end{cases} \qquad \text{(Equation 3.4-3)}$$

In which the critical wind speed, U_c= 12.53 miles per hour.

This wind shear is balanced by the shear stress at the bottom of the reservoir (NHR in this case) as a result of hydrostatic pressure as in Equation 3.4-4:

$$\frac{\partial \eta}{\partial x} = \frac{n\tau_w}{\rho g h} \qquad \text{(Equation 3.4-4)}$$

Here η is the water surface elevation and n is the bottom friction factor typically changing from 1.15 to 1.3 (USACE, 1977).

Some alternative methods to calculate shear is presented by Kalff (2002). According to Kalff (2002), when the wind blows on the surface water, the water surface rises. The rise depends on the strength and duration of the wind along with the fetch (the length of exposed surface). The wave height can be approximated by the following empirical equations, Equation 3.4-5 and 3.4-6:

Hmax (meters) (crest to trough) = *0.332* √*F* in meters (Equation 3.4-5)

Hmax (centimeters) (crest to trough) = *0.105* √*F* in centimeters (Equation 3.4-6)

Where *F* is the fetch in kilometers and *Hmax* is wave height.

Also, wind blowing over an enclosed basin produces a displacement of the surface. The increased elevation at the leeward end of a lake is given (approximately) by Equation 3.4-7.

$$S_h = (3.2 \times 10^{-6})/(gz_m)(U^2 l) \qquad \text{(Equation 3.4-7)}$$

Where S_h is the set-up (surface level increase), L is the length of the lake, z_m is mean depth, g is gravity, and U is the wind speed. The water surface level increase can also be calculated using Equation. 3.4-7.

To study the possibility of a seismic seiche, or a seiche due to excessive wind, geotechnical studies were reviewed to identify the faults in the Project vicinity. The period of the earthquakes will not potentially be the same as the period of a seiche with the highest set up. Some earthquakes have the potential to cause waves within a waterbody. The recent study of faults near the Project Site indicates that there are several active faults within the region.

There are two major active faults located within Owens Valley in the vicinity of the Project area: the Owens Valley Fault Zone (OVFZ) and the Sierra Nevada Frontal Fault Zone (SNFFZ). The OVFZ is located about 5 kilometers (3 miles) to the east of the proposed NHD2 and is considered capable of generating a maximum earthquake of M7.5 (Black & Veatch, 2014b). The SNFFZ is located about 1.5 kilometers (~1 mile) to the west of the proposed NHD2 and is considered capable of generating a maximum earthquake of M7.75 (Black & Veatch, 2014b).

However it is not anticipated that an earthquake outside of the reservoir would cause a substantial seiche. Therefore, seiche generation due to future fault displacement through the Project Site is not likely. There are several faults in the area and a fault rupture on these faults may cause some disturbance in the lake water levels. However, these disturbances are not expected to be larger than the wave induced seiches since there will be no fault displacement within the reservoir as discussed above.

3.4.4 Mudflow

Mudflow (debris flow) is the flow of water that contains large amounts of suspended particles and silt. These water saturated masses of soil travel rapidly down slopes carrying rocks, brush, and other debris. It has a higher density and viscosity than streamflow. Mudflow most often is generated on steep slopes with limited vegetation or in areas that experienced a large fire within the last five years. Mudflow can also occur on gentle slopes when heavy precipitation is experienced over short periods of time, and when the surface material is easily erodible. Mudflow can happen in any climate, but is more susceptible to arid and semi-arid climates. Mudflow can run down a mountainside at speeds up to 60 miles per hour and can cause great damage to life and property. The most significant events within the region in recent history include the Oak Creek mudflows of 2008 (Wagner, 2010), which occurred northwest of Independence and the Haiwee Creek mudflow of 2010 (Lancaster 2013) which crossed the US-395 about four miles southwest of South Haiwee Dam. These events have occurred within areas adjacent to streams that have been impacted by wildfires. A smaller mudflow caused by a monsoonal rain event occurred in the immediate vicinity of NHD on June 28, 2006 (URS, 2007). The mudflow issued from a southwest flowing drainage of the northern Coso Range and into the west side of the valley. The distal edge (southern termination) of the mudflow was located approximately 700 feet north of the proposed NHD2.

There are different methods to calculate the amount of the mudflow. In this report, the USACE method is used.

USACE Method

The USACE Los Angeles District developed several regression models to estimate sediment yield accounting for various watershed sizes (USACE, 2000). Equation 2 in the Los Angeles District Method (Equation 3.4-8 in this report) is the appropriate model to estimate the sediment yield for drainage basins with areas from three to ten square miles and less than three square miles when the peak flow data is available.

$$log(DY) = 0.85\, log(Q) + 0.53\, log(RR) + 0.04\, log(A) + 0.22(FF) \quad \text{(Equation 3.4-8)}$$

If the basin area is 10 to 29 square miles, the USACE requires use of Equation 3 (Equation 3.4-9 in this report).

$$log(DY) = 0.88\, log(Q) + 0.48\, log(RR) + 0.66\, log(A) + 0.20(FF) \quad \text{(Equation 3.4-9)}$$

These regression equations use geometric and hydrologic variables to compute the sediment yield in cubic yards per square mile (yd^3/mi^2), where DY is unit debris yield in yd^3/mi^2, Q is unit peak runoff in cubic feet per second per square mile ($ft^3/s/mi^2$), RR is Relief Ratio in feet per mile (ft/mi), A is drainage area in acres, and the non-dimensional Fire Factor (*FF)* is a coefficient related to watershed recovery after a fire.

For Equations 3.4-8 and 3.4-9, RR must be determined (RR in ft/mi, defined as the ratio of the height difference and distance between the highest and lowest point in the watershed). The FF can be determined from the Fire Factor Curves provided by USACE (2000). The *FF* is dependent on the watershed size and number of years since a wildfire burned 100 percent of the basin if it is larger than three square miles (FIGURE 3-4). *FF* for smaller basins is a function of the number of years since the watershed was burned by a 100 percent wildfire (FIGURE 3-5). Mudflow was analyzed for the Project using the 2-, 10-, 25-, 50-, and 100-year, 24-hour, storm event. Unit peak flows corresponding to design rainfall events were determined from the hydrologic frequency analysis. Sediment yield rate was computed using Equations 3.4-8 and 3.4-9.

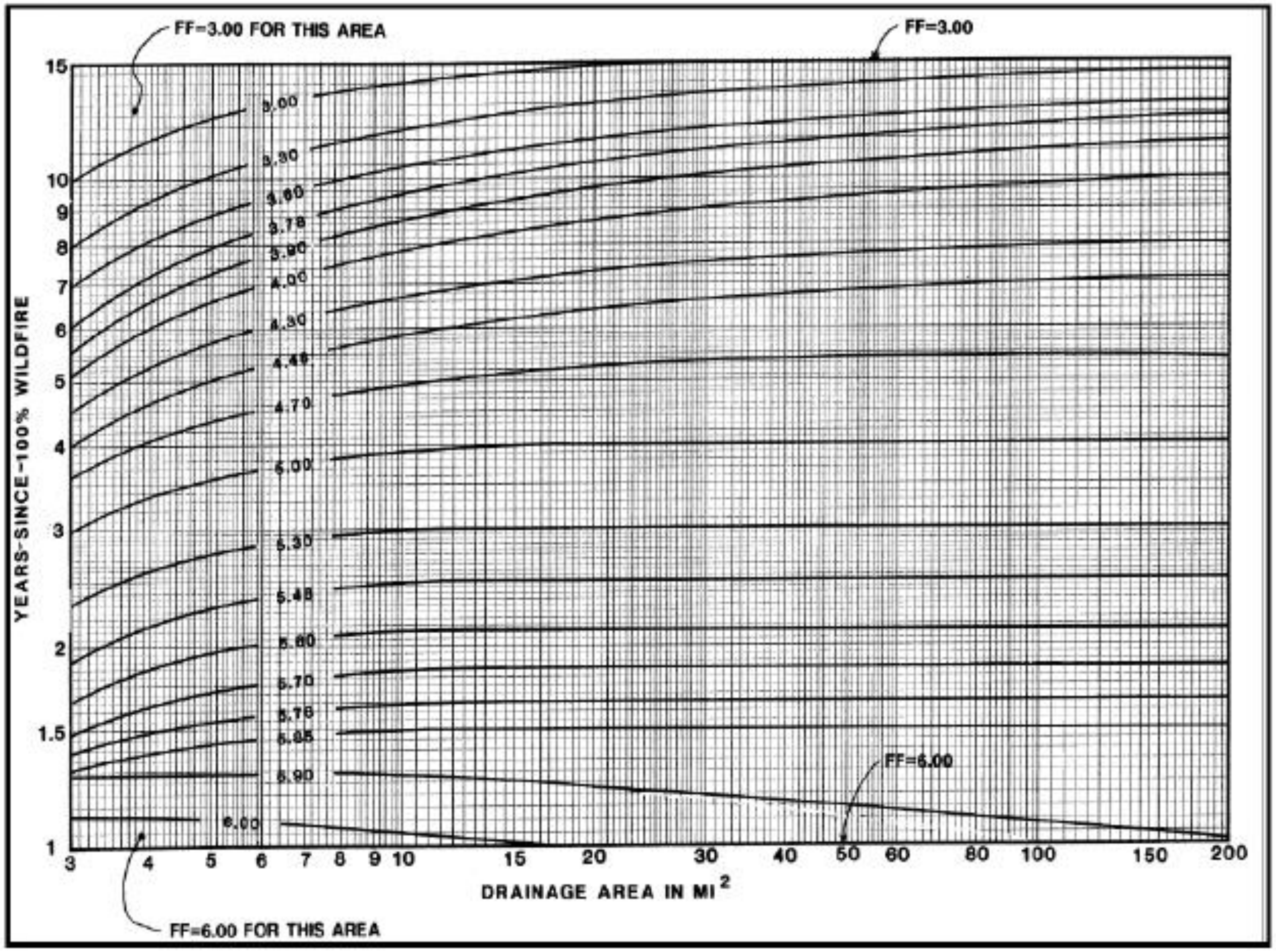

FIGURE 3-4
FIRE FACTOR CURVES FOR WATERSHEDS 3.0 TO 200 MI^2 (USACE, 2000)

Figure A-1: Fire Factor Curve for Watersheds 0.1 to 3.0 mi²

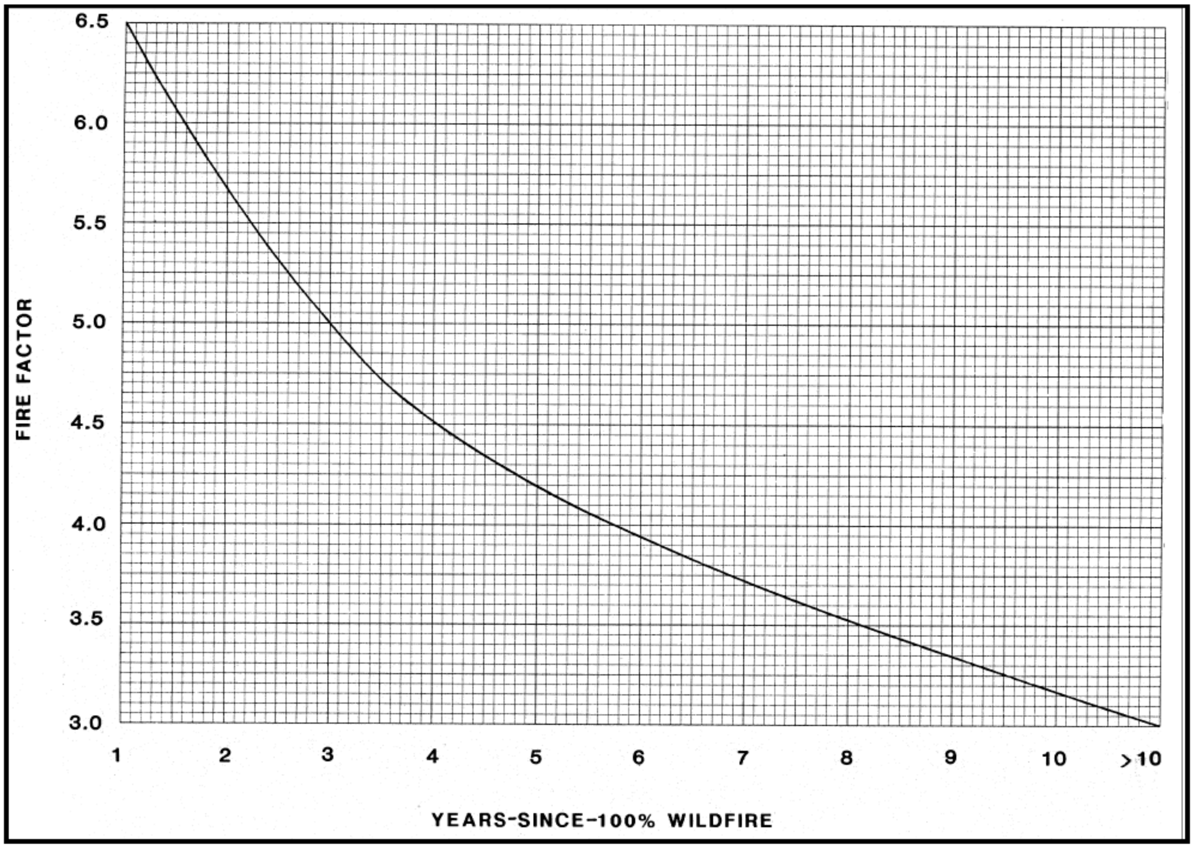

FIGURE 3-5

FIRE FACTOR CURVES FOR WATERSHEDS SMALLER THAN 3.0 MI^2 (USACE, 2000)

Sediment yield rates derived from Equations 3.4-8 and 3.4-9 are applicable to watersheds within the San Gabriel Mountains, but often overestimate yields for areas which are not as prolific at producing sediment. The results of the equation must be modified to be applied in areas with less erosive environments than the San Gabriel Range. Since the sediment yield information for the Project area and the neighboring basins is not available, the Project Site is compared to the Antelope Valley curves developed by the Los Angeles County Department of Public Works (LACDPW) and found in the LACDPW Sedimentation Manual (LACDPW, 2006). The Antelope Valley curves are applicable to the Proposed Project and its alternatives as there are similar yield characteristics based on their topography, climate, and geology. The Los Angeles County Flood Control District developed sediment production curves from data collected at dams and debris basins within the San Gabriel Mountains and foothills within the County. The debris production curves were tied to maps showing debris production zones or areas (DPA). DPA 1 produced the highest volumes of sediment per square mile. Debris production per square mile tapers off as watershed size increases due to sediment trapping within the watershed. The curves can be used if the DPA and watershed area are known. The DPA maps and curves are provided in the LACDPW Sedimentation Manual (LACDPW, 2006). FIGURE 3-6 illustrates the DPA curves for the Antelope Valley watershed.

Use of the DPA 8 curve is appropriate for the Project Site since the topography is closer to an alluvial fan terrain rather than the steep slope characteristic of DPA 1. To correct the debris production rates from Equations 3.4-8 and 3.4-9, the debris yields determined with the equations are divided by the ratio of the debris yields for Antelope Valley DPA 8 to DPA 1, using the same size basin.

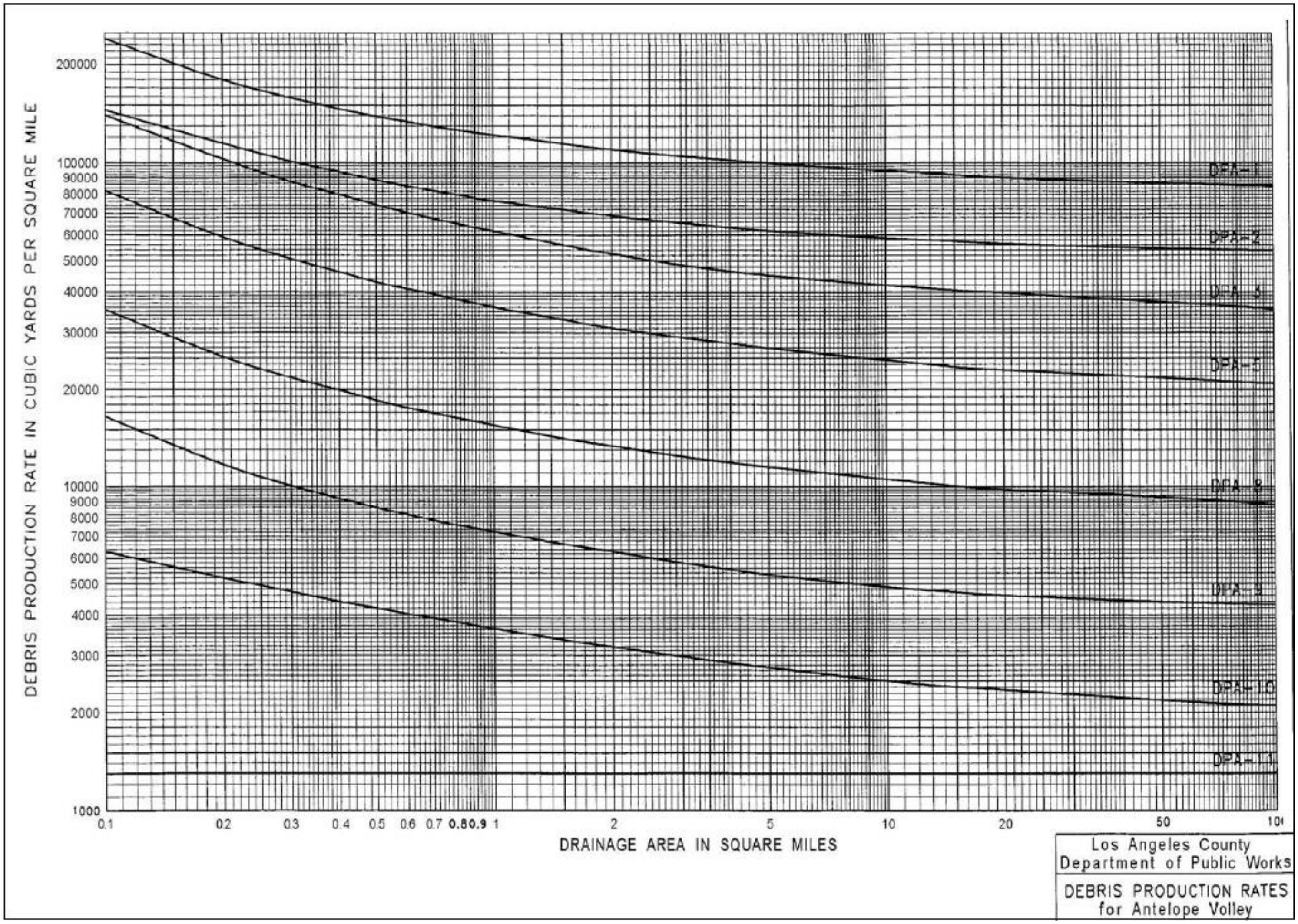

FIGURE 3-6
DEBRIS PRODUCTION RATES FOR ANTELOPE VALLEY

3.5 Method for Evaluating Impacts under NEPA

Pursuant to NEPA regulations (40 CFR 1500-1508), the effects due to a project are evaluated based on their affected environment and the severity of the effect. The severity of the effect is determined in terms of its location and extent, duration, and the sensitivity of the resources involved.

Under NEPA, the adverse and beneficial effects of the project are also identified.

These criteria should be considered together to define the significance of an impact to be negligible, moderate or substantial.

These levels of significance are defined as follows:

- Effects with negligible intensity cause little change in elements of the environment (e.g. ground water, floodplains, etc.) resulting in new conditions that are very similar to the existing condition.
- Effects with moderate intensity change elements of the environment (e.g. ground water, floodplains, etc.) but do not violate any regulatory standard.
- Effects with high intensity change elements of the environment (e.g. ground water, floodplains, etc.) to an extent greater than their capacity by violating the regulatory standard.

3.6 CEQA Significance Criteria

CEQA identifies criteria for conditions that might be deemed to have a substantial or potentially substantial adverse change in physical conditions. Appendix G of the CEQA Statute and Guidelines (Environmental Checklist Form) lists various issues under different categories for which a project may impact the environment. The following issues are presented within the Hydrology and Water Quality category in the Environmental Checklist Form, and the project impact would be considered significant if the project does the following:

- Violate any water quality standards or waste discharge requirements (Hyd-1).[2]
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted) (Hyd-2).
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site (Hyd-3).
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site (Hyd-4).
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantially additional sources of polluted runoff (Hyd-5).
- Substantially degrades water quality (Hyd-6).
- Place housing within a 100-year flood hazard area as mapped on a Federal Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map (Hyd-7).

[2] For organizational ease, we have added a code to each CEQA Guidelines Appendix G threshold in this report. For example, the first threshold is Hyd-1 or Hydrological Threshold 1. These codes are not from the CEQA Guidelines.

- Place within a 100-year flood hazard area structures which would impede or redirect flood flows (Hyd-8).
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a dam or levee (Hyd-9).
- Inundate by seiche, tsunami, or mudflow (Hyd-10).

If significant impacts are identified, this document provides and describes feasible mitigation measures that could be implemented to avoid or substantially reduce the adverse change in any of the physical conditions within the area affected by the Proposed Project. The mitigation measures identified will reduce (in magnitude) the impacts to a level that is below the defined standard of significance. Where feasible, mitigation measures are presented for all impacts determined to be potentially significant. Where implementation of the mitigation measures would reduce the magnitude of the impact to below the defined standard of significance, the impact is determined to be less than significant with mitigation. When implementation of the mitigation measures is not feasible, or would not reduce the magnitude of the impact below the defined standard of significance, the impact is determined to be significant and unavoidable.

Cumulative impacts are defined in the State CEQA Guidelines (§15355) as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." A cumulative impact is "the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor, but collectively significant, projects taking place over a period of time." Potentially significant cumulative impacts are discussed in this report, consistent with state CEQA Guidelines §15130[a].

4 Regulatory Framework

There are several federal, state, and local laws, ordinances, and regulatory programs relating to hydrology and the enhancement of water quality. The purpose of these regulations is to reduce the adverse effects of construction on sensitive environmental resources and deliver guidance on protecting these valuable resources. Many of these programs overlap. Construction activities affecting water quality, hydrology, and the surrounding environment are heavily regulated by state and local authorities. Local agencies are responsible for issuing permits and enforcing regulations to control pollutants and contaminated runoff to storm drains and local waters. Included below is a summary of regulatory provisions related to the Proposed Project and its alternatives.

4.1 Federal

4.1.1 Clean Water Act of 1972

The 1972 Federal Clean Water Act (CWA) established and implemented the National Pollutant Discharge Elimination System (NPDES) Permit Program to regulate and control the discharge of pollutants into waters of the United States. National goals were set to regulate point-source and non-point-source discharges into receiving waters and achieve water quality standards suitable for fish, wildlife, and recreation. The CWA provides authority for establishing these water quality standards and specific technology-based effluent limitations that are enforceable as permit conditions. In California, issuance of NPDES Permits has been delegated, through a process referred to as primacy, to the State Water Resources Control Board (SWRCB) and nine RWQCBs who implement and enforce the requirements of the CEQA. The CWA also is administered and enforced by the United States Environmental Protection Agency (USEPA). Key CWA provisions are discussed below in greater detail and include the following:

- Section 303 – Impaired Waters List
- Section 401 – Water Quality Certification or Waiver
- Section 402 – NPDES Permits
- Section 404 – Discharge of Dredged or Fill Material

Clean Water Act Section 303

Section 303(d) of the CWA (USEPA, 1972) requires states to identify water bodies that do not meet, or are not expected to meet, water quality standards. States are required to establish Total Maximum Daily Loads (TMDLs) for impaired water bodies based on the severity of pollutants in the water. Each state also needs to establish a priority ranking for impaired waters, taking into account the severity of the pollution and the uses of these waters. The TMDL is a calculation for the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs also define an allocation of that load among the various sources of that pollutant (i.e., municipalities, other permitted entities, etc.). The TMDL can also act as a plan to reduce pollutant loading, which improves water quality. The total maximum daily thermal load is also required to assure the protection of indigenous populations of shellfish, fish, and wildlife. After implementation of a TMDL, it is anticipated that the problems that led to placement of a given pollutant on the Section 303(d) List would be remediated. In California, SWRCBs and RWQCBs are responsible for assessing water quality monitoring data for surface waters every two years to determine if they contain pollutants exceeding the levels established in water quality standards. It is then their responsibility to add these water body pollutant combinations to the Section 303(d) List and establish TMDLs as applicable.

Clean Water Act Section 401

Section 401 of the CWA states that any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities which may result in any discharge into the navigable waters of the United States, shall provide the licensing or permitting agency a Water Quality Certification from the State (USEPA, 2012a). After receiving the certification, applicants are required to meet effluent limitations and monitoring requirements necessary to ensure compliance with the Federal license or permit. The 401 certification provides for the protection of the physical, chemical, and biological integrity of waters. In California, the authority to either grant water quality certification or waive the requirement is delegated by the SWRCB to the nine RWQCBs.

Clean Water Act Section 402

Section 402 of the CWA establishes the NPDES permit program to regulate the discharge of pollutants from point sources (storm drains, ditches, etc.) into waters of the United States. NPDES permits regulate specific discharge limits for point sources, including stormwater, and establish monitoring and reporting requirements (USEPA, 2012b). The NPDES permit is required for construction activities larger than one acre and prohibits discharges not allowed under the permit. Section 402 of the CWA also requires municipal, industrial, and commercial facilities discharging wastewater and/or stormwater directly from a point source to obtain coverage under the NPDES permit.

Clean Water Act Section 404

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include, but are not limited to, fill for development and water resource projects, including the construction of dams and levees (USEPA, 2012c). A permit is required before dredged or fill materials can be discharged into waters of the United States. The basic premise of the program is that no discharge of dredged or fill material may be permitted if a practical, less damaging alternative exists, or if United States waters will be significantly degraded. An applicant must demonstrate that steps have been taken to avoid adverse impacts to wetlands, streams, and other aquatic resources, that potential impacts have been minimized, and that compensation will be provided for any remaining unavoidable impacts. The USACE reviews all individual permits and evaluates applications based on public interest review and environmental criteria set forth by the CWA. However, for most discharges that will have only minimal adverse effects, a general permit may be suitable. General permits are issued on a national, regional, or state basis for specific categories of activities. The general permits eliminate individual review and allow certain activities to proceed with little or no delay, provided that the general or specific conditions for the general permit are met.

4.1.2 Executive Order 11988 and the Federal Emergency Management Agency

Executive Order 11988 requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative (FEMA, 2015b). The order requires USACE to minimize the impacts of floods and to restore and preserve beneficial values to floodplains. FEMA is responsible for overseeing the NFIP to provide subsidized flood insurance to communities that comply with FEMA regulations limiting development in floodplains. FIRMs are issued by FEMA and identify flood-prone areas. These maps also identify flood hazard zones in the community.

4.1.3 Federal Anti-degradation Policy of 1968

The Federal Anti-degradation Policy was established in 1968 and aims to protect and regulate water quality standards based on a three-tiered program. Tier 1 maintains and protects existing uses and water quality conditions to support such uses, and is applicable to all surface waters (USEPA, 2013a). Tier 2 maintains and protects “high quality” waters that support fishing and swimming. Tier 3 maintains and protects water quality in outstanding national resource waters, such as waters of national and state parks, wildlife refuges, and waters of exceptional recreational or ecological significance. The federal policy directs the states to adopt a statewide policy that includes the provisions identified in the three-tiered program.

4.1.4 Safe Drinking Water Act of 1974

The Safe Drinking Water Act of 1974 (USEPA, 1974) regulates the nation’s drinking water supply and protects public health by authorizing the USEPA to set national health-based standards for drinking water. Standards protect against both naturally-occurring and man-made contaminants. Protected drinking water sources include rivers, lakes, reservoirs, springs, and groundwater wells. Contaminants of concern relevant to domestic water supply are defined as those that pose a public health threat or that alter the aesthetic acceptability of the water. These types of contaminants are regulated by the USEPA primary and secondary Maximum Contaminant Levels that are applicable to treated water supplies delivered to the distribution system. In California, the State Water Resources Control Board has the primary enforcement authority to enforce federal and state safe drinking-water acts.

4.1.5 National Environmental Policy Act of 1970

The National Environmental Policy Act of 1970 (NEPA) requires federal agencies to assess the environmental, social, and economic effects of their proposed actions prior to making decisions. It established the Council on Environmental Quality to oversee NEPA implementation, ensure federal agencies meet their obligations, and issue regulations to federal agencies regarding NEPA compliance (USEPA, 2015a). Projects resulting in significant environmental impact require an Environmental Impact Statement (EIS) that analyzes water quality, endangered species, noise impacts, transportation impacts, and cultural resources. The EIS is an assessment of the likelihood of impacts from alternative courses of action.

4.1.6 Resource Conservation and Recovery Act of 1976

The Resource Conservation and Recovery Act (RCRA) gives the USEPA authority to control the generation, transportation, treatment, storage, and disposal of hazardous waste (USEPA, 2015b). The main objectives are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner. Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Compliance monitoring is delegated to states and local authorities. The California Department of Toxic Substances Control has been delegated by the USEPA to implement and enforce the RCRA requirements in California.

4.1.7 National Toxics Rule

The National Toxics Rule promulgates for 14 states, including California, the chemical-specific numeric criteria for priority toxic pollutants as needed to bring all states into compliance with the requirements of Section 303(c)(2)(B) of the CWA. States determined by the USEPA to fully comply with Section 303(c)(2)(B) requirements are not affected by this rule (USEPA, 2013b).

The rule addresses two situations. For a few states, the USEPA is promulgating a limited number of criteria which were previously identified as necessary in disapproval letters to such states, and which the states have failed to address. For other states, Federal criteria are necessary for all priority toxic pollutants for which the USEPA has issued Section 304(a) water quality criteria guidance and that are not the subject of approved State criteria. When these standards take effect, they will be the legally enforceable standards in the affected states for all purposes and programs under the CWA, including planning, monitoring, NPDES permitting, enforcement, and compliance.

4.1.8 Executive Order 11990 Protection of Wetlands

Under the NEPA, Executive Order 11990 requires federal agencies to prohibit construction or management practices that would adversely affect wetlands unless there is either no practicable alternative, or that a proposed action has considered all practical measures to minimize harm to the wetlands (USEPA, 2015c). Federal agencies shall minimize the destruction, loss, or degradation of wetlands, and preserve the natural and beneficial values of wetlands by (1) acquiring, managing, and disposing of federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

4.2 State

4.2.1 California Environmental Quality Act of 1970

CEQA was enacted in response to NEPA and helps to guide state and local agencies during issuance of permits and approval of projects (California Natural Resources Agency, 2014). Courts have interpreted CEQA to afford the fullest protection of the environment within the reasonable scope of the states. CEQA applies to all discretionary projects proposed to be conducted or approved by a California public agency, including private projects requiring discretionary governmental approval. It publically discloses environmental effects of a proposed project through an initial study, negative declaration, or environmental impact report, and encourages public participation through meetings, notices, reviews, hearings, and the judicial process. It encourages agencies to prevent or minimize damage to the environment through development of project alternatives, mitigation measures, and mitigation monitoring. A public agency must comply with CEQA when public or private activities receive some discretionary approval from a government agency which may cause a direct or indirect physical change to the environment. Public agencies are entrusted with CEQA compliance and enforcement.

4.2.2 State Water Resources Control Board

The SWRCB was established in 1967 by the California State Legislature and has the authority over water resources allocation and water quality protection within the State (SWRCB, 2015). The SWRCB allocates water rights, adjudicates water right disputes, develops statewide water protection plans, establishes water quality standards, and guides the nine RWQCBs. The SWRCB also regulates stormwater from construction, industrial, and municipal activities; dredge and fill activities; the alteration of any federal water body; and several other activities with practices that could degrade water quality. The mission of the SWRCB is "to preserve, enhance, and restore the quality of California's water resources, and ensure their proper allocation and efficient use, for the benefit of present and future generations."

4.2.3 Construction Stormwater NPDES Permit

California's Construction General Permit for Stormwater Discharges Associated with Construction and Land Activities (Construction General Permit [CGP]) Order No. 2009-0009-DWQ as amended by Order No. 2010-0014-DWQ and 2012-0006-DWQ issued by the SWRCB is required for construction or demolition activity resulting in land disturbance of equal to or greater than one acre. Construction activities, including grading, trenching, excavation, stockpiling, and disturbances to the ground, are covered under the CGP. Dischargers must file Permit Registration Documents (PRDs) to the SWRCB via the Stormwater Multi Application and Report Tracking System (SMARTS) by the Legally Responsible Person (LRP). PRDs consist of a Notice of Intent, risk assessment, site map, Stormwater Pollution Prevention Plan (SWPPP), signed certification statement, and first annual fee. As part of the PRDs, RWQCB may require a risk assessment when the site poses a significant risk to water quality.

Under the CGP, a Qualified Storm Water Developer (QSD) must address pollutants and their sources, including sources of sediment associated with construction in order to prepare the SWPPP and a Qualified Storm Water Practitioner (QSP) installs effective site Best Management Practices (BMPs) that result in the reduction or elimination of pollutants in stormwater discharges. In addition, all non-stormwater discharges must be either eliminated, controlled, or treated. BMPs are designed to reduce impacts to the Maximum Extent Practicable (MEP).

4.2.4 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) was established to protect water quality in the State of California and is responsible for creating the State's extensive regulatory program for water pollution control. Pursuant to the Porter-Cologne Act, the responsibility for protection of water quality in California rests with the SWRCB. In turn, the SWRCB has delegated the regulation of the hydrologic basin to the nine RWQCBs to regulate nine hydrologic basins in the State. The Porter-Cologne Act gives the SWRCB broad authority to establish water quality standards and discharge requirements, adopt water quality control plans, and implement provisions under the CWA, with the goal of protecting beneficial uses of existing water bodies. Under the Porter-Cologne Act, the RWQCBs have the authority to specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.

Under the authority of the Porter-Cologne Act, the RWQCBs require persons who discharge or propose to discharge waste that could affect the quality of waters in the State to file a Report of Waste Discharge (ROWD) with the appropriate RWQCB. The RWQCB then issues or waives waste discharge requirements (WDRs) for the discharge or requires the discharger to enroll under the NPDES permit or WDR order.

4.2.5 Colbey-Alquist Flood Control Act

The Colbey-Alquist Flood Control Act states that a large portion of land resources are subject to recurrent flooding by overflow of streams and watercourses causing loss of life and property (California Water

Code Section 8400-8401). The public interest necessitates sound development of land use, as land is a limited, value, and irreplaceable resource, and the floodplains of the state are a land resource to be developed in a manner that will prevent loss of life and economic loss caused by excessive flooding. Local governments have the primary responsibility for planning, adoption, and enforcement of land use regulations to accomplish floodplain management. It is a State of California policy to encourage local levels of government to plan land use regulations to accomplish floodplain management and to provide state assistance and guidance.

4.2.6 California State Non-degradation Policy

The California State Non-degradation Policy under SWRCB Resolution No. 68-16 is incorporated into all regional water quality control plans for the purpose of maintaining the highest water quality, and requires that existing high quality waters be maintained to the maximum extent possible (SWRCB, 2008). Resolution No. 68-16 states that the disposal of wastes into State waters shall be regulated to achieve the highest water quality consistent with maximum benefit to the people of the State, and to promote the peace, health, safety, and welfare of the people of the State. High water quality can lower if (1) change is consistent with maximum benefit to people of the State and will not result in water quality lower than applicable standards and (2) waste discharge requirements for proposed discharge will result in the best practicable treatment or control of the discharge necessary to assure no pollution or nuisance. California uses qualitative standards to determine if activities negatively impact water quality.

4.2.7 California Water Code

The California Water Code establishes laws relating to water, including the use of water, the acquisition and regulation of water rights, the control and utilization of water, the distribution of water, the supervision of dams, the use of and rights in streams, wells, pumping plants, and conduits, and the establishment and operation of public districts relating to water. Section 13260 of the California Water Code states that persons discharging or proposing to discharge waste that could affect the quality of the waters of the State, other than into a community sewer system, shall file a ROWD, if applicable. The RWQCB adopts the WDRs specifying water quality limitations for the waste discharge reported (California Water Boards, 2014). Pursuant to California Water Code 13267, a Monitoring and Reporting Program may be required by the RWQCB as a condition of the WRD.

4.2.8 California Department of Public Health Drinking Water Regulations

The California Department of Public Health (CDPH) serves as the primary responsible agency for drinking water regulations. CDPH must adopt drinking water quality standards at least as stringent as federal standards, and may also regulate contaminants to more stringent standards than the USEPA, or develop additional standards. CDPH regulations cover over 150 contaminants, including microorganisms, particulates, inorganics, natural organics, synthetic organics, radionuclides, and disinfection byproducts.

4.2.9 California Toxics Rule of 2000

In 2000, the USEPA approved the California Toxics Rule (CTR), establishing numeric water quality criteria for priority toxic pollutants, including approximately 130 priority pollutant trace metals and organic compounds (USEPA, 2012d). The CTR also establishes other provisions for water quality standards to be applied to waters in the State of California. The CTR is consistent with Section 303(c)(2)(B) of the CWA, declaring that states must adopt numeric criteria for the priority toxic pollutants listed under Section 307(a), if those pollutants could be reasonably expected to interfere with the designated uses of States' waters. The SWRCB adopted its State Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries (SIP). The SIP outlines procedures for NPDES permitting for toxic-pollutant objectives that have been adopted in Basins Plans and in the CTR.

4.2.10 California Fish and Game Code, Sections 1600-1616, as Amended

Sections 1602 of the California Fish and Game Code (California Department of Fish and Wildlife [CDFW], 2015a) states that activities may not substantially divert or obstruct the natural flow or otherwise substantially change the bed, channel, or bank of any river, stream, or lake, or that would deposit or dispose of debris, waste, or other material where it may pass into waters that support fish or wildlife resources. Although there are several conditions that trigger authority and how it is acted upon, the California Fish and Game Code states that all streams and lakes are subject to this regulation (Section 1600 et seq.). The CDFW also has jurisdiction over riparian habitats that are associated with watercourses (CDFW, 2015a). The CDFW is responsible for regulating this code and must receive written notification if activities will substantially divert or obstruct the natural flow, or substantially change the bed or channel of water bodies (Section 1602). A Lake or Streambed Alteration Agreement is required when activities substantially and adversely affect existing fish or wildlife resources.

4.2.11 California Fish and Game Code, Sections 5650-5656, as Amended

Sections 5650-5656 of the California Fish and Game Code (CDFW, 2015b) states that it is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of the State any substance or material deleterious to fish, plant life, mammals, or bird life. This section does not apply to a discharge that is authorized and in compliance with the terms and conditions of a WDR (pursuant to Section 13263 of the California Water Code), or a waiver issued pursuant to subdivision (a) of Section 13269 of the California Water Code issued by the SWRCB or a RWQCB after a public hearing, or that is authorized and in compliance with the terms and conditions of a federal permit for which the SWRCB or a RWQCB has, after a public hearing, issued a water quality certification pursuant to Section 13160 of the California Water Code.

4.2.12 Executive Order W-59-93

The primary objectives of Executive Order W-59-93 are (1) to ensure no overall net loss and long-term net gain in the quantity, quality, and permanence of wetland acreage and values in California in a manner that fosters respect for private property, (2) to reduce procedural complexity in the administration of State and Federal wetlands conservation programs, and (3) to encourage partnerships to make restoration, landowner incentive programs, and cooperative planning efforts the primary focus of wetlands conservation (SWRCB, 2015a&b). As directed by the SWRCB in Resolution No. 2008-0026, the Wetland and Riparian Area Protection Policy is being implemented in three phases which allow for necessary infrastructure and program development. The current Phase 1 effort is now called the “Wetland Area Protection and Dredge and Fill Permitting Policy.” The purpose of Phase 1 is to protect all waters of the State, including wetlands, from dredge and fill discharges. It includes a wetland definition and associated delineation methods, an assessment framework for collecting and reporting aquatic resource information, and requirements applicable to discharges of dredged or fill material. Phases 2 and 3 are not under consideration at this time.

4.3 Regional and Local

4.3.1 Lahontan Regional Water Quality Control Board

The Project Site is located within Inyo County, which is governed by the Lahontan RWQCB. The Lahontan Region has a Water Quality Control Plan, also referred to as the Basin Plan, which sets water quality standards for surface and ground waters in the Lahontan Region. The Basin Plan includes State standards along with federal water quality standards for certain toxic pollutants, including the National

Toxics Rule and CTR. It also identifies general types of water quality problems that can threaten beneficial uses in the Lahontan Region, and then identifies control measures for these problems. Water quality control measures include TMDLs, which are often, but not always, adopted as Basin Plan amendments (Lahontan RWQCB, 1995). Water quality objectives are intended to protect the public health and welfare, and to maintain or enhance water quality in relation to the existing and/or potential beneficial uses of the water, which are also identified in the Basin Plan.

4.3.2 Inyo County General Plan

The Inyo County General Plan (County of Inyo, 2001) oversees development and must address elements of land use, circulation, housing, open-space, conservation, safety, and noise. The Land Use sub-element establishes goals and policies for residential, commercial, industrial, public services and utilities, and other land uses in the County. The Inyo County General Plan aims to protect and restore environmental resources from the effects of export and withdrawal of water resources. Policies relevant to the Project Site are listed below in Table 4-1:

TABLE 4-1
INYO COUNTY GENERAL PLAN

Policy	Description
Policy PSU-1.2	**On-Site Infrastructure**. The County shall require all new development, including major modifications to existing development, to construct necessary on-site infrastructure to serve the project in accordance with County standards.
Policy PSU-5.1	**Project Design**. The County shall encourage project designs that minimize drainage concentrations and coverage by impermeable surfaces.
Policy PSU-5.2	**Maintenance.** The County shall require the maintenance of all drainage facilities, including detention basins and both natural and manmade channels, to ensure that their full carrying capacity is not impaired.
Policy PSU-5.4	**Runoff Quality**. The County shall improve the quality of runoff from urban and suburban development through the use of appropriate and feasible mitigation measures including, but not limited to, artificial wetlands, grassy swales, infiltration/sedimentation basins, riparian setbacks, oil/grit separators, and other best management practices.
Policy FLD-1.1	**Floodplain Limitations.** The County shall regulate development of habitable structures within floodplain areas (as established by FEMA), and areas within dam inundation zones (as recorded by California Office of Emergency Services).
Policy FLD-1.2	**Development in Floodplain.** Prior to approval of any development in a floodplain area, the project applicant shall demonstrate that such development will not adversely impact downstream properties.
Policy FLD-1.3	**Mudflow Constraints**. Discourage development within known or potential courses of mudflows.
Policy FLD-1.4	**Channelization**. The natural condition of watercourses is to be maintained whenever feasible. The County shall discourage the channelization of watercourses unless necessary for the protection of public safety. If alterations of a watercourse are found to be necessary, the alterations shall be engineered to preserve or restore the natural characteristics of the watercourse to the greatest extent possible.
Policy FLD-1.6	**Stormwater Retention/Detention and Groundwater Recharge**. Develop stormwater retention/detention ponds and groundwater recharge areas to make efficient use of stormwater and to direct water away from hazard areas.
Policy S-2.1	**Soil Erosion**. Minimize soil erosion from wind and water related to new development.
Policy S-2.2	**Soil Instability.** In areas of unstable soils and/or steep terrain, the County shall limit the intensity of development in order to minimize the potential for erosion and landform instability.
Policy MER-1.1	**Resource Extraction and the Environment.** Support the production of mineral resource where it would not significantly impact sensitive resources as defined by CEQA and the Inyo County General Plan.
Policy MER-1.2	**Minimize Land Conflicts**. New mining operations shall be designed to provide a buffer between existing or likely adjacent uses to minimize in compatibility with nearby uses, and adequately mitigate their environmental and aesthetic impacts.
Policy MER-1.4	**Environmental Contamination**. All mining operations will be required to take precautions to avoid contamination from wastes or incidents related to the storage and disposal of hazardous materials, or general operating activity at the site.
Policy WR-1.4	**Regulatory Compliance.** Continue the review of development proposals and existing uses pursuant to the requirements of the CWA, Lahontan RWQCB, and local ordinances to reduce polluted runoff from entering surface waters.

TABLE 4-1
INYO COUNTY GENERAL PLAN

Policy	Description
Policy WR-2.1	**Restoration.** Encourage and support the restoration of degraded water surface and groundwater resources.
Policy WR-2.2	**Watercourse Alterations**. Encourage the preservation of existing natural conditions of watercourses when considering flood control projects.
Policy WR-3.1	**Watershed Management**. Protect, maintain, and enhance watersheds within Inyo County.

Note: Acronyms include Public Services and Utilities (PSU), Flood Hazards (FLD), Soils (S), Mineral and Energy Resources (MER), Water Resources (WR)
Source: Inyo County General Plan (County of Inyo, 2001)

4.3.3 Inyo County Ordinance No. 1004

In 1998, the Inyo County Board of Supervisors adopted Resolution No. 1004 to govern sales and transfers of groundwater to another groundwater basin outside of the County, including sales and transfers to Los Angeles by another party (Inyo County Water Department, 1998).

4.3.4 Inyo-LADWP Long-Term Water Management Plan

In 1972, Inyo County filed a suit against the City of Los Angeles and the LADWP claiming that increased groundwater pumping was harming the environment of Owens Valley, and that the practice should be analyzed in an EIR in accordance with the provisions of the CEQA. After several years of litigation, Inyo County and the City of Los Angeles formed a unique long-term surface water and groundwater management plan for the Owens Valley. In 1991, a long-term water resources management agreement was approved with an overall goal "to avoid certain described decreases and changes in vegetation and to cause no significant effect on the environment which cannot be acceptably mitigated while providing a reliable supply of water for export to Los Angeles and for use in Inyo County" (County of Inyo, 1972).

5 Existing Conditions

This section describes the existing conditions of the Proposed Project components: NHD2, basin, LAA Realignment, Cactus Flats Road Realignment, and Borrow Site 10. The hydrology, water quality, groundwater, and flood hazard associated with each of these components is discussed.

5.1 Project Site

5.1.1 North Haiwee Dam No. 2 Site

Hydrology

Haiwee Reservoir is located in the Lower Owens Hydrologic Area (603.30). The NHD2 site resides within the HUC-12 (hydrologic unit code with 12 digits) boundaries of North Haiwee Reservoir Watershed (180901030503) and the Carroll Creek-Owens Lake Watershed (180901030407). The area west-southwest of the NHD2 site drains towards the LAA. Once flows reach the LAA, they are conveyed along the LAA western parapet wall on surface parallel to the LAA until they reach Loco Creek just upstream of NHR, where they are discharged into the LAA. If LAA overtops, flows would be conveyed towards the north within Haiwee Valley. The additional flow capacity that the LAA can carry is calculated based on the assumption that the LAA begins with one foot of freeboard and there are two additional feet of capacity to the top of the parapet walls on either side of the LAA. The additional flow capacity is 172 cfs. For each storm event, flows that exceed the 172 cfs capacity are allowed to bypass the system and drain to the north. Everything less than 172 cfs drains from the southwest and into the LAA.

The NHD2 site drainage area is approximately 5,683 acres and flows are conveyed through surface drainage paths such as rills and gullies**.** FIGURE 5-1 shows the entire drainage area which flow off-site and to the north. FIGURE 5-2 shows a more detailed view of the NHD2 site and the flow coming from the east and west. The elevation near the NHD2 site is 3,749 feet and the elevation gradually decreases towards the north. The topography downstream of NHD2 is relatively flat, characterized by small slopes and terrain with sage brush and grass, or bare earth for cover. TABLE 5-1 shows the combined flowrates south of the NHD2 site from Basins 21, 22, 24 and 25, which all flow toward the NHD2 site. Flowrates from Basins 20, 23, 26, 27, 28, and 29 were not included in the total flowrate because runoff from these basins drains north of the NHD2 site instead of towards it. The flowrates for Basins 21, 22, 24, and 25 were adjusted to show the flowrates only for the NHD2 site determined by area weighting. For example, the NHD2 flowrate for Basin 22 was calculated using the proportion of the area draining towards the NHD2 site versus the entire basin area. This ratio was then multiplied to the total flowrate of Basin 22 that was calculated from WMS. The adjusted flowrate for Basin 22 was combined with the adjusted flowrates from Basins 21, 24, and 25 to determine the total flowrate for NHD2, which is reflected in the table below. The flowrates are based on the 2-, 10-, 25-, 50-, and 100-year return periods and the 24-hour rainfall duration. These flow rates are used for design of various system components based on the applicable hydrologic requirements of Inyo County.

TABLE 5-1
FLOOD FLOW RATE AT THE NHD2 PROJECT SITE

Frequency (year)	Flow Rate (cfs)
2	125
10	267
25	345
50	419
100	503

Note: cfs = cubic feet per second
Source: CWE, 2016

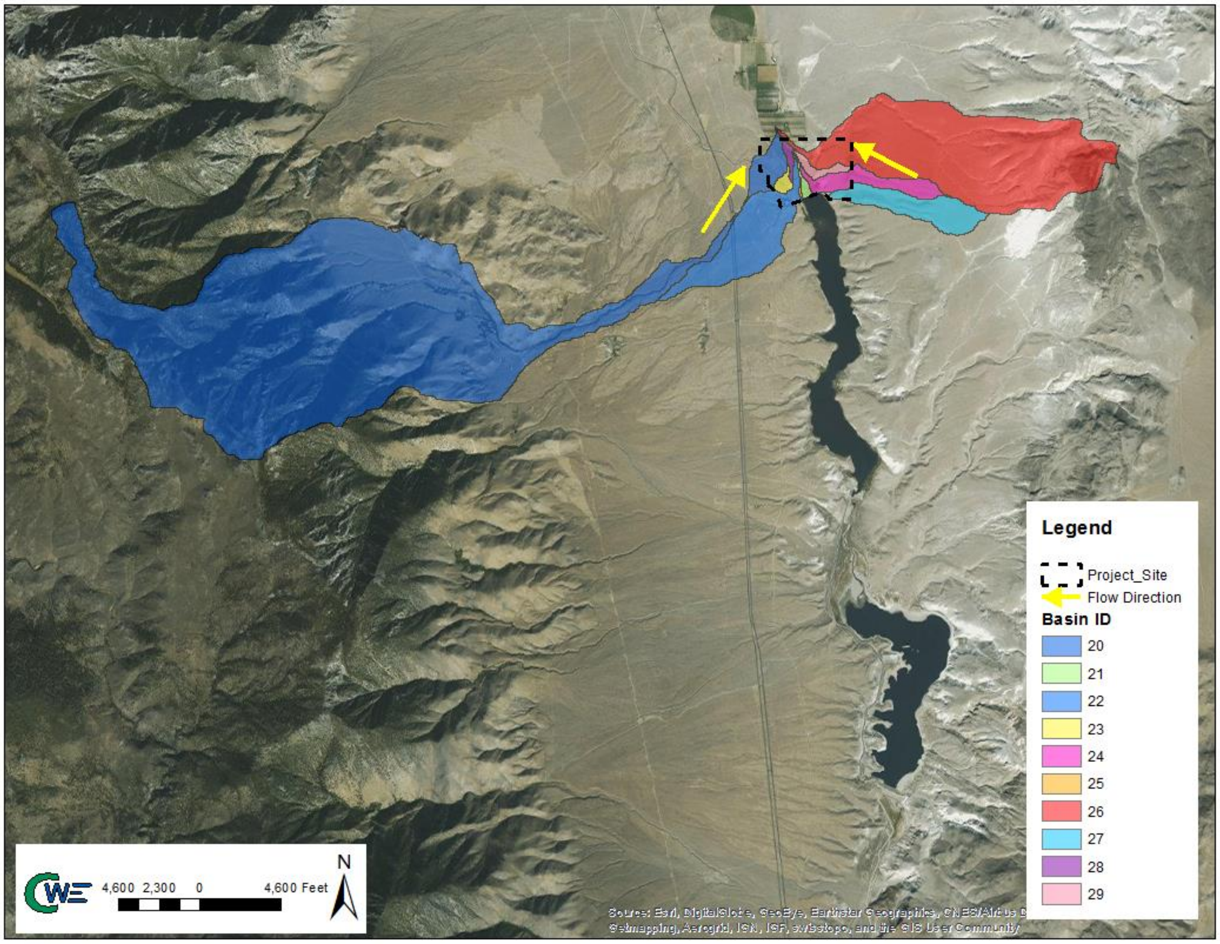

FIGURE 5-1
ENTIRE PROJECT SITE DRAINAGE AREAS

LADWP has records of flow data in Loco Creek from 1977 through 2006. These records were evaluated to determine how the hydrologic analysis above matched with flows measured in Loco Creek just before it flows into the LAA. TABLE 5-2 provides a summary of the recurrence intervals based on the Weibull distribution analysis of recurrence interval.

TABLE 5-2
FLOOD FLOW RATE AT THE NHD2 PROJECT SITE

Frequency (year)	Flow Rate (cfs)
2	0
10	1.78
25	4.96
50	6.04
100	N/A

Note: cfs = cubic feet per second
Source: LADWP, 2016

Analysis of this data set, and the data from Braley Creek, another nearby stream, indicate that the estimated runoff values for Loco Creek are significantly higher than what is measured at the LAA. The difference in the flow rate is attributed to the alluvial fan and dry soils located within the Loco Creek watershed. The peak flows that have been measured in Loco Creek occurred in 1983 and 2005, which coincides with historically wet years with significant runoff throughout Southern California. Flows from the mountains must cross the alluvial fan upstream of the highway. Based on the flow measurements, it is apparent that larger flows from the mountain spread out on the alluvial fan, infiltrate or flow along other flow paths before entering NHR or the Owens Valley. Smaller rainfall events are absorbed into the sandy soils before runoff is generated. Flow rates related to Loco Creek have been adjusted based on measured flow rates. Based on regional relationships, the 100-year flow is estimated to be approximately 7 cfs. The flow rates for Braley Creek, which is nearby, has a 40-year flow rate of 11.8 cfs and a 100-year flow rate of approximately 13 cfs.

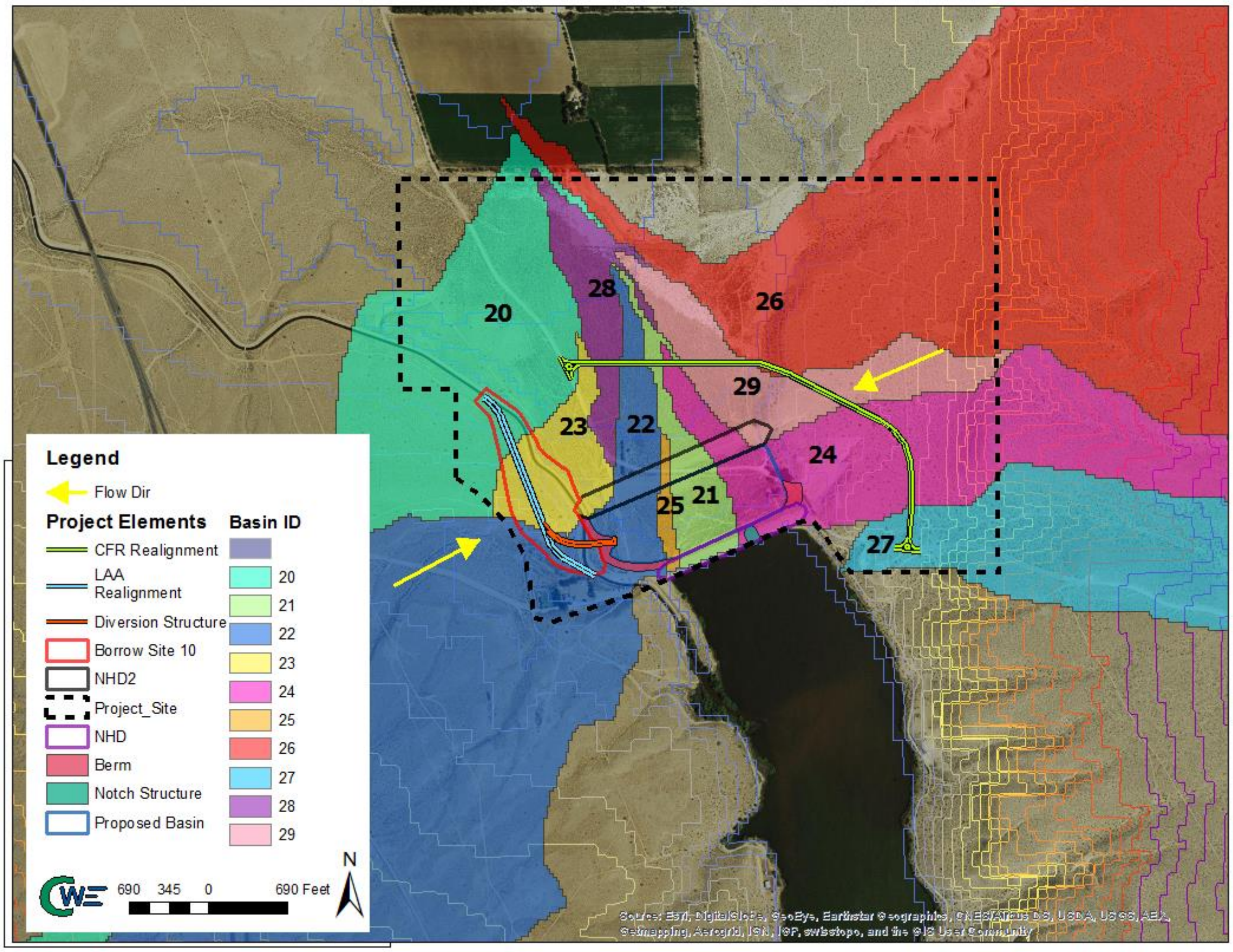

FIGURE 5-2
PROJECT SITE DRAINAGE AREAS

Water Quality

NHR is located adjacent to the existing Dam. LADWP has applied copper sulfate to NHR when necessary in order to control toxic algae blooms. In 1991 and 1994 an excess application of copper sulfate resulted in fish kills, prompting the Lahontan Regional Board to add NHR to the 303(d) list. LADWP has since modified and reduced its application of copper sulfate within the NHR; as a result, no other fish kills have occurred. In addition, copper is not a pollutant that is discharged by the existing land uses; therefore, overtopping at NHD would not be considered a water quality issue.

NHR contains sediments that were deposited by the LAA where it enters NHR. These sediments contain naturally occurring arsenic which has been transported through the LAA system. Under the 1999 Interim Arsenic Management Plan, LADWP is managing arsenic concentrations in the aqueduct water through the addition of ferric chloride (FeCl3), which traps arsenic in sediments that are then deposited in NHR. This treatment method brings arsenic concentrations in the reservoir water to safe levels at Merritt Cut (just south of NHR), and the aqueduct water is further treated at the Los Angeles Aqueduct Filtration Plant (LAAFP). The sediment delta has primarily formed at the mouth of the LAA inlet to NHR, roughly 1,300 feet south of NHD. Sediments typically show small and large desiccation cracks, with a light floc layer on the surface, when exposed and dried. Sediments show a very high percentage of fines, with many samples 60 to 95 percent comprised of silt and clay.

Groundwater

The NHD2 site is over the Range Basin Fill Aquifers that are made up of unconsolidated sand and gravel. Groundwater information has been collected near the NHD2 site as part of various studies, mostly pertaining to the Owens Valley. These sources are identified in Section 3.3. Based on the *North Haiwee Dam No. 2 Project Geotechnical Data Report* (2015), the most recent and relevant study, the groundwater depth under the NHD2 site was measured in 2006 in exploratory trenches as 13 feet below ground surface (bgs) at the base of the slope that forms the NHD2 east abutment, and at 16 feet bgs at the base of the slope that forms the NHD2 west abutment. The groundwater depth in 2013 was measured in observation wells at 19 feet near the proposed east abutment and 37 feet near the proposed west abutment.

The Proposed Project overlays the Owens Valley Groundwater Basin No. 6-12. This groundwater basin is one of the largest in the South Lahontan Hydrologic Region, with numerous stream flows servicing the basin throughout Owens Valley (see Appendix II).

Flood Hazard

The NHD2 site is within a flood hazard area designated as Zone X based on the FEMA FIRM, Map No. 06027C3350D, dated August 16, 2011. NHR is designated as a Zone A flood hazard and is in close proximity to the NHD2 site. Additionally, the existing Dam is located along the Zone A flood hazard area.

Dam Inundation

LADWP has identified that NHD is seismically unstable and there is a risk of failure during the MCE seismic event due to the potential for liquefaction of the underlying alluvium and the Dam itself (LADWP, 2001). Since NHD is the nearest dam to the NHD2 site, its failure would inundate the area behind NHD2 in less than two minutes based on the NHD Inundation Map (LADWP, n.d.). The area surrounding the NHD2 site is generally vacant. Less than two miles north from the Project Site are six homes with adjacent structures and large plots of land. Adjacent to the west side of the NHD, there are two facilities that are part of the reservoir keeper's residence; however, these facilities are located outside of the flooding area if the dam fails. Other areas surrounding the Project Site are vacant.

Seiche

A seiche is a standing wave formed in an enclosed or partially enclosed body of water. Seiches have been observed on lakes, reservoirs, swimming pools, bays, harbors and seas. Seiches require the body of water to be at least partially bounded to allow the formation of the standing wave. A seiche event could occur within NHR during a very strong wind storm or an extreme seismic event. Using Equations 3.4-4, 3.4-5, 3.4-6 and 3.4-7, identified in Section 3.4, the maximum water surface rise was calculated. The fetch is approximately 17,000 feet, measured at the northern part of NHR. Based on the *Complete Report of Construction of the Los Angeles Aqueduct by the Department of Public Service of the City of Los Angeles* (LADPS, 1916), the maximum height of NHD rises to elevation 3,767.4 feet and has a crest length of approximately 1,500 feet long. The current maximum restricted water level against the dam rises to elevation 3,757.5 feet. The highest record of the wind speed in area is 104 miles per hour in the community of Olancha. This level of wind speeds are not expected to be sustainable for over an hour, which is the time required to create a seiche wave. Another source of wind data is from the CalClim center from the Owens Lake South station. Their record shows a maximum mean daily wind speed of 40.5 miles per hour. For the purpose of this study, the maximum wind speed that is predicted to be sustainable for at least one hour is assumed to be an average of 75 miles per hour. Using the methodology discussed in Section 3.4, the maximum wave height was determined to be 2.5 feet, making the water surface elevation, including the wave, less than 34 feet. The water surface rise would not overtop the existing Dam.

A study recently completed by Black and Veatch (2015) presents the results of the freeboard analysis conducted for NHD2 based on wave run-up and the potential for wave overtopping of the dam. The report also evaluated the size of rip-rap required to protect the dam during these events. The analysis was conducted for the critical design conditions of maximum high water elevation plus 100-year winds. The Automated Coastal Engineering System (ACES) model was used to calculate wave growth, wave run-up and overtopping. The required inputs for the wave prediction module are the speed and duration of winds, fetch distance, and water depth. The wave height and wave period were calculated by ACES using formulas for deep water waves. Wave characteristics predicted by the wave prediction module of ACES were used as inputs to the wave run-up module to calculate wave run-up and overtopping rates. Wave run-up will occur when waves encounter the dam. The required inputs include wave type, breaking criteria, wave height, wave period, structure slope, structure height, water depth, slope type, and roughness coefficient.

The wave height for the significant wave would be 4.2 feet. For a smooth surface, the wave run-up was calculated to be 5.0 feet corresponding to an elevation of 3,769 feet. The overtopping rate is in the range of the start of damage. For a rip-rap surface, the wave run-up was calculated to be 3.2 feet corresponding to an elevation of 3,767.2 feet. Overtopping by larger waves would not occur. The ACES model was also used to evaluate rip-rap sizes for the dam. Required inputs include wave height and wave period, water depth at the toe of the structure, slope, unit weight of rock, permeability damage level, and coefficient. Model runs were made for damage levels of 2, 1, and 0 and for the two wave conditions described above. For a damage level of 2, the initiation of damage, the D_{50} size is approximately 1.1 feet. For a damage level of 0, no movement of any rock, the D_{50} size is approximately 1.9 feet (Black and Veatch, 2015).

There are two major active faults located within Owens Valley in the vicinity of the Project area: the Owens Valley Fault Zone (OVFZ) and the Sierra Nevada Frontal Fault Zone (SNFFZ) therefore there is the potential of generating a seismically induced seiche. A large earthquake on these or other faults may cause some seismically induced seiche waves. However, these disturbances are not expected to be larger than the wave induced seiches.

Mudflows

Various areas within the Owens Valley feature younger alluvium deposits with desert vegetation. Due to the existing terrain and ground cover condition, mudflows may have the potential to occur within the Project area.

Mudflow for the NHD2 site is calculated based on the USACE method mentioned in Section 3.4 for the five occurrence intervals of 2-, 10-, 25-, 50-, and 100-year events. The drainage area for the NHD2 site, which includes the portions of the watershed that reach the site, is approximately 5,683 acres. For storm events with frequencies of less than 50 years, the drainage west of the LAA will not contribute to the flow since it will be captured by the LAA. As shown in FIGURE 3-5 above, a *FF* value of 5 is used for this drainage basin based on three years of recovery after a 100 percent burned watershed event. The sediment yield for this site is shown in TABLE 5-3. The mudflow was calculated from Basins 22 and 24. Basins 21 and 25 would not contribute to the total sediment yield because they are flat areas. The mudflow from the west will mostly deposit the heavier sediments once it reaches the alluvial fan areas between the mountains and the highway as it approaches the Project Site. This flatter area is located between the mountains and the LAA in Basin 22 and is approximately 663 acres. Lighter sediments, including sand, silts, clays, and small gravels may be transported by the flows, but most of the heavier sediments will settle before reaching the Project Site. Flows may also infiltrate or be distributed over the fan. This deposition and the area transposition factor accounts for the large difference between the sediment yield and adjusted debris yield in TABLE 5-3. The west berm will also lessen the impact of the mudflow. It is anticipated that most of the sediments will settle to the ground before entering the basin. This would potentially impact the LAA on the western side of the reservoir.

The proposed east berm will cause some of the sediments to settle and allow water and lighter materials to enter the proposed basin. However, it is expected that most of the heavier materials will most likely be deposited once it reaches near the proposed east berm.

TABLE 5-3
SEDIMENT YIELD AT PROPOSED NHD2 SITE

Recurrence Interval (years)	Flow (cfs)	Sediment Yield		Adjusted Debris Yield (cy)
		(cy/mi²)	(cy)	
2	125	51,369	11,847	1,673
10	267	97,161	23,438	3,278
25	345	120,331	30,439	4,217
50	419	141,895	35,782	4,961
100	503	165,426	42,236	5,841

Notes: cfs = cubic feet per second; cy = cubic yard; mi^2 = square miles
Source: CWE, 2016

5.1.2 Basin Components

Hydrology

The site of the basin and its components is located between the existing Dam and NHD2. The topography in this area is relatively flat. The area southwest of the basin drains toward the LAA. Once flows reach the LAA, they are conveyed along the LAA western parapet wall on surface parallel to the LAA until they reach Loco Creek just upstream of NHR, where they are discharged into the LAA. FIGURE 5-2 above shows the drainage areas for the basin, which convey flows to the west and then to the north. The drainage area for the basin is the same as the drainage area (5,683 acres) for NHD2, therefore, the flowrates are the same. The flows are conveyed through surface drainage paths such as rills and gullies.

The elevation in the basin area is currently 3,753 feet. The topography downstream of NHD2 is relatively flat, characterized by small slopes and terrain with sage brush and grass cover, or bare earth.

TABLE 5-1 shows the combined flowrates south of NHD2 from Basins 21, 22, 24 and 25, which all flow toward the basin. The basin and NHD2 site have the same flowrates because they are located in the same area. The runoff currently drains between NHD and NHD2 into the basin area. TABLE 5-4 and TABLE 5-5 show the flowrates for the west and east berms, respectively. The flowrate for the west berm is calculated from Basin 22 and the flowrate for the east berm is calculated from Basin 24, as shown in FIGURE 5-2 above. The west berm flowrates were determined from the area southwest of the berm. The flowrate for Basin 22 was adjusted to show the flowrate only for the west berm by area weighting. The proportion of the area draining towards the west berm versus the entire Basin 22 area was multiplied by the total flowrate that was calculated from WMS. The area northeast of the west berm was excluded from the flowrates shown in TABLE 5-4 because this area does not drain towards the berm. The east berm flowrates were determined from the area east of the berm. The flowrate for Basin 24 was adjusted to show the flowrate only for the east berm by weighing the area, similar to the method used for the west berm. The area west of the east berm was excluded from the flowrates shown in TABLE 5-5 because this area does not drain towards the berm.

TABLE 5-4
FLOOD FLOW RATE AT WEST BERM

Frequency (year)	Flow Rate (cfs)
2	0
10	1.78
25	5.50
50	6.40
100	9.00

Note: cfs = cubic feet per second
Source: CWE, 2016

TABLE 5-5
FLOOD FLOW RATE AT EAST BERM

Frequency (year)	Flow Rate (cfs)
2	122
10	258
25	331
50	402
100	481

Note: cfs = cubic feet per second
Source: CWE, 2016

Water Quality

NHR is located just south of the basin. LADWP has applied copper sulfate to NHR when necessary in order to control toxic algae blooms. In 1991 and 1994 an excess application of copper sulfate resulted in fish kills, prompting the Lahontan RWQCB to add NHR to the 303(d) list. LADWP has since modified and reduced its application of copper sulfate within NHR; as a result, no other fish kills have occurred. In addition, copper is not a pollutant that is discharged by the existing land uses; therefore, overtopping at

NHD would not be considered a water quality issue. The basin is also located on a portion of the existing Cactus Flats Road. The water quality related to Cactus Flats Road is currently unknown due to a lack of water quality data at the site. However, given that the partially paved road receives very little traffic, it is reasonable to conclude that the potential for runoff contaminated by vehicle pollutants is very low. Some of these pollutants could include heavy metals, fuels, oils, and hazardous fluids. Well data for 2016 showed elevated levels of arsenic, iron, and manganese in the area near the NHD2 components; these levels exceed the Basin Plan requirements.

Groundwater

Groundwater information has been collected near the Project Site as part of various studies, mostly pertaining to the Owens Valley, which are identified in Section 3.3. Based on the *North Haiwee Dam No. 2 Project Geotechnical Data Report* (LADWP, 2015), the groundwater depth under the basin is approximately at elevation 3,718 feet based on apparent depth in borings OW-8, OW-9, and OW-10. However, the groundwater elevation will fluctuate depending on the season and the amount of rainfall received during the year.

Flood Hazard and Mudflow

Based on the FEMA FIRM, Map No. 06027C3350D, dated August 16, 2011, the site of the basin and its components is located within an area designated as Zone X. The site is also in close proximity to NHR, which is designated as a Zone A flood hazard area.

Potential mudflow for the basin is calculated based on the USACE method mentioned in Section 3.3. Flow is calculated for intervals of 2, 10, 25, 50 and 100 years. Results are shown in the same table as NHD2 (TABLE 5-3**)** since they are located in the same area. An *FF* value of 5 is used for the basin based on a three-year recovery after a 100 percent burn wildfire. TABLE 5-6 and TABLE 5-7 show the sediment yield for the west and east berm, respectively. Flows from Basin 22 and 24 will pass over the west and east Berm, respectively, as shown in FIGURE 5-2. As explained in Section 5.1.1, sediment deposition in the flatter region in Basin 22 is expected before flows reach the basin. Most of the heavier sediments will settle before reaching the basin area. This also accounts for the large difference in the sediment yield and adjusted debris yield in TABLE 5-6.

TABLE 5-6
USACE LOS ANGELES DISTRICT SEDIMENT YIELD CALCULATION METHOD FOR THE WEST BERM

Recurrence Interval	Flow (cfs)	Sediment Yield		Adjusted Debris Yield (cy)
		(cy/mi²)	(cy)	
2	0	-	-	-
10	1.78	122	1,055	118
25	5.5	319	2,754	309
50	6.4	363	3,132	352
100	9	486	4,185	470

Notes: cfs = cubic feet per second, cy = cubic yards, mi^2 = square miles
Source: CWE, 2016

TABLE 5-7
USACE LOS ANGELES DISTRICT SEDIMENT YIELD CALCULATION METHOD FOR THE EAST BERM

Recurrence Interval	Flow (cfs)	Sediment Yield		Adjusted Debris Yield (cy)
		(cy/mi²)	(cy)	
2	122	52,617	11,296	1,595
10	258	99,524	21,367	2,398
25	331	123,058	26,419	2,965
50	402	145,098	31,151	3,497
100	481	168,889	36,258	4,070

Notes: cfs = cubic feet per second, cy = cubic yards, mi^2 = square miles
Source: CWE, 2016

5.1.3 LAA Realignment Site

Hydrology

The LAA flows from north to south as it carries water to the Los Angeles area through the Owens Valley. Generally, the LAA curves through the existing landscape and flows from north to south. The topography surrounding the channel cut in this area has a steep bank on the western side and the Haiwee valley on the eastern side. The drainage areas determined from WMS illustrate the streams lead to the LAA (FIGURE 5-1 and FIGURE 5-2). The LAA Realignment site is located in the same area as Borrow Site 10. The highest elevation at this site is 3,810 feet and is located at the center of Borrow Site 10. The lowest elevation is 3,765 feet near the west bank of the LAA. The drainage area is approximately 5,504 acres from Basin 22. Basin 20 and 23 cover the LAA Realignment site, but it would not generate a significant portion of the mudflow and therefore, were excluded from the drainage and mudflow calculations. Basin 23 is located in a relatively flat area and would not have a significant impact on the LAA Realignment site. A large portion of Basin 20 is relatively flat and will allow most of the mudflow generated in this basin to settle on the alluvial fan before reaching the ridge above NHD2. Runoff from the drainage areas to the east of the LAA Realignment site will continue to flow towards the north. Therefore, they were excluded from the flowrate calculations. Runoff from the sub watersheds flows towards the existing LAA from the west. A part of the Loco Creek flow would enter the LAA from the west and flow into the NHR with the LAA flows. The flow from the northern part of the LAA Realignment site would either pass the LAA through existing pipes, or would run along the parapet wall and enter at Loco Creek. The barren landscape contains sparse desert vegetation. TABLE 5-8 shows flood flows based on different return periods and rainfall durations.

TABLE 5-8
FLOOD FLOW RATE (cfs) AT THE LAA REALIGNMENT SITE

Frequency (year)	Flood Flow Rate (cfs)
2	0
10	1.78
25	5.50
50	6.40
100	9.00

Note: cfs = cubic feet per second
Source: CWE, 2016

Water Quality

LADWP has applied copper sulfate to NHR when necessary in order to control toxic algae blooms. Although an excess application occurred in 1991 and 1994, sampling has shown that copper levels have returned to normal, and therefore there are no longer any issues regarding copper pollution. Existing land uses in the vicinity of the LAA Realignment site are not known to be contributors of copper pollution.

The water quality of the surface runoff is expected to be of excellent quality, except for the inclusion of natural sediments and potential metals or bacteria that are naturally occurring. These pollutants are natural and unavoidable, and the water requires treatment for these chemicals prior to use as drinking water. Water from NHR is treated before use and likewise, groundwater would require treatment before being released if it does not meet Basin Plan objectives.

Groundwater

Groundwater information has been collected near the Project Site as part of various studies, mostly pertaining to the Owens Valley, which are identified in Section 3.3. Based on the *North Haiwee Dam No. 2 Project Geotechnical Data Report* (LADWP, 2015), the groundwater under the LAA Realignment site ranged from elevation 3,709 to 3,748 feet based on apparent soil moisture during drilling of in borings RW01, RW26, and RW30.

Flood Hazard and Mudflow

Based on the FEMA FIRM, Map No. 06027C3350D, dated August 16, 2011, the proposed site of the LAA Realignment is within an area designated as Zone X. The LAA discharges into NHR in close proximity to the Project Site, which is designated as a Zone A flood hazard area.

Potential mudflow for the LAA Realignment site is calculated based on the USACE method mentioned in Section 3.4. The potential mudflow is calculated for the three occurrence intervals of 2, 10, 25, 50 and 100 years. As shown in FIGURE 3-4, an *FF* value of 5.3 is used for Basin 22 based on a three-year recovery after a 100 percent burn wildfire. The flowrate and sediment yield for this site is shown in TABLE 5-9.

The potential mudflow for the Project Site may discharge from Loco Creek or from the hillsides adjacent to the LAA. Mudflows may settle behind the parapet wall next to the LAA. Once the area behind the parapet wall fills, the mudflow will spill into the LAA.

TABLE 5-9
USACE LOS ANGELES DISTRICT SEDIMENT YIELD CALCULATION METHOD FOR LAA SITE

Recurrence Interval	Flow (cfs)	Sediment Yield		Adjusted Debris Yield (cy)
		(cy/mi²)	(cy)	
2	0	-	-	-
10	1.78	41	357	40
25	5.50	108	932	105
50	6.40	123	1,060	119
100	9.00	313	2,695	303

Notes: cfs = cubic feet per second, cy = cubic yards, mi^2 = square miles
Source: CWE, 2016

5.1.4 Cactus Flats Road Realignment Site

Hydrology

Under existing conditions, Cactus Flats Road does not have a well-developed drainage system. During the wet season, water flows over the road and is infiltrated into the surrounding landscape. This road crosses several unnamed drainage paths and follows the contours of the existing landscape. The site of the Cactus Flats Road Realignment is relatively flat downstream of NHD with small slopes, and receives sheet flows from the east. There is a steep section where the road comes off the bluff that will be part of the realignment. The Cactus Flats Road Realignment site also receives runoff from the area just north of NHD, which continues to flow north towards Cactus Flats Road. The highest elevation of 3,840 feet is located at the southeast end of the site of the Cactus Flats Road Realignment. The lowest elevation of 3,730 feet is located at the northwest end of the site of the Cactus Flats Road Realignment. The Cactus Flats Road Realignment site has a drainage area of approximately 860 acres. The drainage area is a combination of Basins 21, 22, 23, 24, 27, 28, and 29 as shown in FIGURE 5-1 and FIGURE 5-2. Basins 24 and 27 have the largest contributions to the total flood flowrate shown in TABLE 5.1-10 because they have larger areas compared to the other basins. The basin areas were adjusted to reflect the areas flowing towards the Cactus Flats Road Realignment. The areas north of the Cactus Flats Road Realignment were excluded from the flowrate calculation since the runoff flows north and away from the road. The flowrates were determined by weighing the areas using the same method described in Section 3, Methodology. Based on the discussion in Section 3, for some storm events, the flow draining from the southeast will be captured by existing LAA. TABLE 5-10 shows flood flows based on different return periods and rainfall durations.

TABLE 5-10
FLOOD FLOW RATE (cfs) AT THE REALIGNED CACTUS FLATS ROAD SITE

Frequency (year)	Flood Flow Rate (cfs)
2	349
10	744
25	956
50	1,162
100	1,389

Note: cfs = cubic feet per second
Source: CWE, 2016

Water Quality

Water quality related to Cactus Flats Road is currently unknown due to a lack of water quality data at this site. However, given that the partially paved road receives very little traffic, it is reasonable to conclude that the potential for runoff contaminated by vehicle pollutants is low. Nevertheless, even with a low potential, pollutants typically associated with vehicles could be present at the site, including heavy metals, fuels, oils, and hazardous fluids. Sediments from unpaved portions of the existing road also contribute to polluted runoff. The USEPA lists sediment as the most common pollutants in waterbodies with most of the sediment originating from erosion as a result of human land use (USEPA, 2015d). Sediment is considered a pollutant when it degrades the quality of water for drinking, wildlife, and prevents natural vegetation from growing in water. Nutrients transported by sediment can activate toxins in algae (USEPA, 2015d).

The water quality of the surface runoff is expected to be of excellent quality, except for inclusion of natural sediments and potential metals or bacteria that are naturally produced. Natural contaminants are unavoidable and only require treatment when the water is used for drinking water. The excellent surface water quality is expected due to the lack of traffic and sources of potential man-made pollutants in the area.

Groundwater

Groundwater information has been collected near the Project Site as part of various studies, mostly pertaining to the Owens Valley, which are identified in Section 3.3. Based on the *North Haiwee Dam No. 2 Project Geotechnical Data Report* (LADWP, 2015), the groundwater depth under the proposed western portion of the Cactus Flats Road Realignment in 2013 and 2014 ranged from 19 to 37 feet bgs.

Flood Hazard and Mudflow

Based on the FEMA FIRM, Map No. 06027C3350D, dated August 16, 2011, the site of the Cactus Flats Road Realignment is within an area designated as Zone X. The site of the Cactus Flats Road Realignment is in close proximity to NHR, which is designated as a Zone A flood hazard area.

Potential mudflow for the Cactus Flats Road Realignment site is calculated based on the USACE method mentioned in Section 3.4. The flow is calculated for the intervals of 2, 10, 25, 50 and 100 years. For the storm events with frequencies up to the 100-year event, the drainage area west of the existing LAA will not contribute to the flow since it will be captured by the LAA. Basins 24, 27 and 29 contribute to the mudflow. The sediment yields for Basins 24, 27 and 29 were calculated separately and then combined to find the total sediment yield as shown in TABLE 5-11. The mudflow will flow towards the Cactus Flats Road Realignment site from the west and sediment would deposit in the flatter region between the Cactus Flats Road area and NHD. Although Basins 21, 22, 23, and 28 contribute to the drainage area, they do not contribute to the total sediment yield because these areas are relatively flat. Based on the occurrence of mudflow from summer 2006 (URS, 2007), it is anticipated that the mudflows issuing from the southwest flowing drainage that enters the east side of the Haiwee valley may flow over and cover a portion of the Cactus Flats Road Realignment site. An *FF* value of 5 is used for this drainage basin based on a three-year recovery after a 100 percent burn wildfire.

TABLE 5-11
USACE LOS ANGELES DISTRICT SEDIMENT YIELD CALCULATION METHOD AT CACTUS FLATS ROAD REALIGNMENT SITE

Recurrence Interval	Flow (cfs)	Sediment Yield		Adjusted Debris Yield (cy)
		(cy/mi²)	(cy)	
2	105	12,247	45,706	5,105
10	352	32,421	126,733	17,717
25	502	43,593	171,288	23,945
50	661	54,844	216,500	30,266
100	736	62,631	235,492	32,916

Notes: cfs = cubic feet per second, cy = cubic yards, mi^2 = square miles
Source: CWE, 2016Source: CWE, 2015

5.1.5 Borrow Site 10

The construction of NHD2 requires the use of several materials, some of which will be sourced from Borrow Site 10 (FIGURE 5-3). Borrow material would be hauled within the Project Site and may include rip-rap, gravel, and/or sand. Borrow Site10 is located west to southwest of the NHR on LADWP and BLM-managed lands. Borrow material would be hauled within the Project Site and Borrow Site 10 would generally be accessed using existing roads to reduce the impact on undeveloped lands. Borrow Site 15 is privately owned.

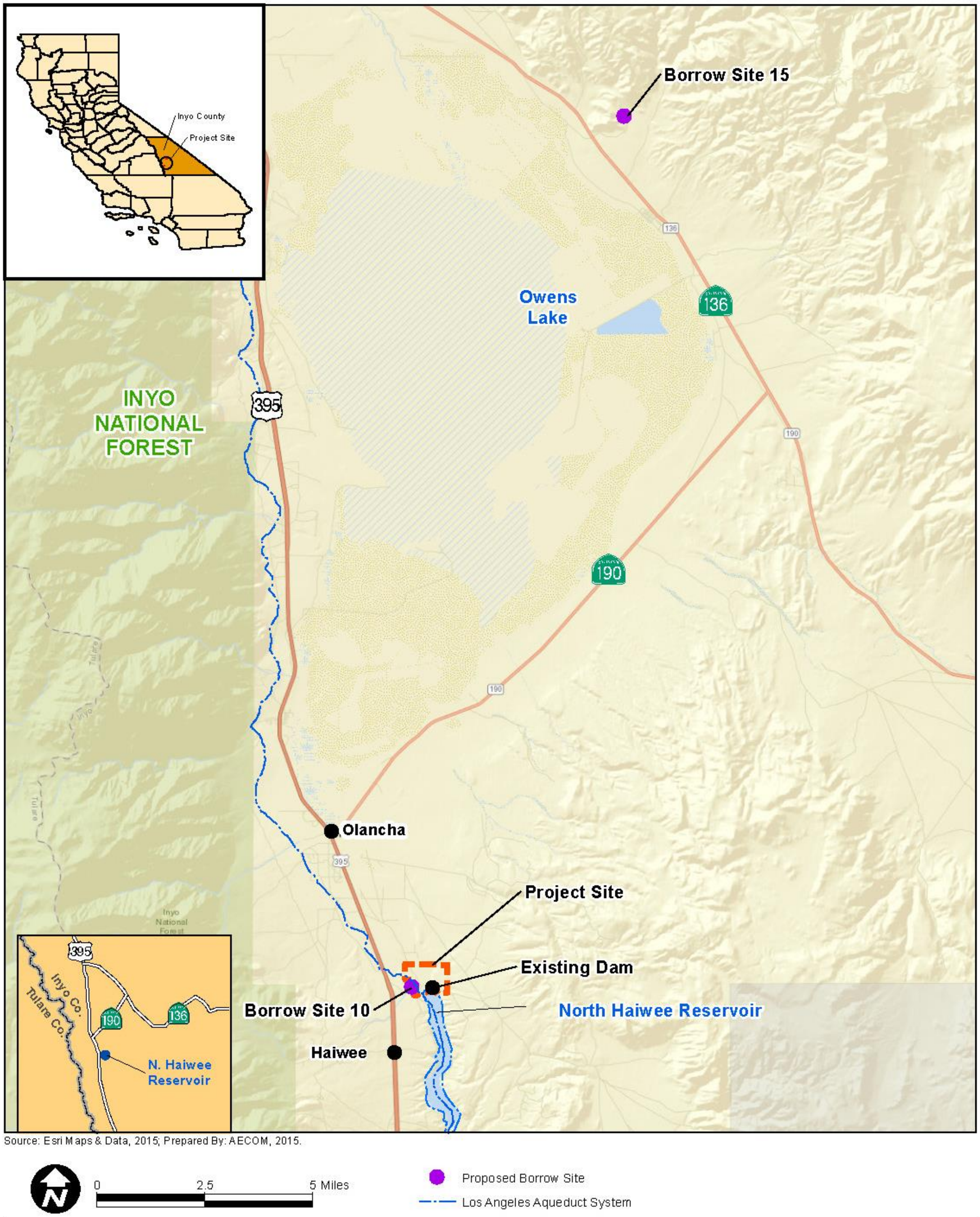

FIGURE 5-3
PROJECT SITE AND BORROW SITE LOCATIONS

Hydrology

Borrow Site 10 is approximately 13.7 acres and located on an elevated plane adjacent to and west of the existing LAA, just north of NHR (FIGURE 5-2). Borrow Site 10 slopes towards the LAA and is at a higher elevation than the existing LAA. Borrow Site 10 contains the LAA Realignment site. Therefore, the drainage area for the LAA Realignment site is the same as the drainage area for Borrow Site 10. According to the Digital Elevation Model (DEM) from USGS, the highest elevation at Borrow Site 10 is 3,810 feet and is located at the center of the borrow site. The lowest elevation is 3,765 feet and is located near the west bank of the existing LAA. The drainage area is approximately 5,504 acres. This site has the same hydrologic characteristics as the LAA Realignment site in Section 5.1.3. Stormwater runoff from construction of the Proposed Project would collect from the sub watersheds and sheet flow towards the LAA. An existing stream path is located on the southern portion of Borrow Site 10. The stream path also drains into the LAA with flows from the west. The landscape contains sparse desert vegetation. TABLE 5-12 shows flood flows based on different return periods and rainfall durations.

TABLE 5-12
FLOOD FLOW RATE (cfs) AT BORROW SITE 10

Frequency (year)	Flood Flow Rate (cfs)
2	0
10	1.78
25	5.5
50	6.4
100	9

Note: cfs = cubic feet per second
Source: CWE, 2016

Water Quality

The water quality associated with runoff near Borrow Site 10 is currently unknown due to a lack of water quality data at this site, with the exception of copper (SWRCB, 2010). Sediments from the desert landscape and nutrients from the sparse vegetation are anticipated pollutants. Copper sulfate was added to the reservoir by LADWP to control algae blooms (Lahontan RWQCB, 2001). Existing land uses in the vicinity of the borrow site are not known to be contributors of copper pollution. Water quality of the surface runoff is expected to be excellent, except for inclusion of copper, sediments, and potential metals or bacteria that are naturally produced. These contaminants are unavoidable and would only require treatment when water is to be used for drinking water. The excellent water quality is due to the lack of traffic and sources of potential man-made pollutants in the area.

Groundwater

Borrow Site 10 is located where the realigned portion of the LAA would flow, and as a result has similar groundwater conditions. Based on the *North Haiwee Dam No. 2 Project Geotechnical Data Report* (LADWP, 2015), the groundwater elevation at this location ranged from 3,709 to 3,748 feet in 2013.

Flood Hazard and Mudflow

Based on the FEMA FIRM, Map No. 06027C3350D, dated August 16, 2011, Borrow Site 10 is located within an area designated as Zone X. Borrow Site 10 is located approximately 440 feet northwest of NHR, which is designated as a Zone A flood hazard area. Most of Borrow Site 10 has a higher elevation compared to the average topographic elevation, which reduces the risk of flooding.

Mudflow for Borrow Site 10 is calculated based on the USACE method mentioned in Section 3.4. The flow is calculated for the three occurrence intervals of 10, 25, 50 and 100 years. As shown in

FIGURE 3-4, a FF value of 5.3, for the LAA Realignment, is used for this drainage basin based on a three-year recovery after a 100 percent burn wildfire. The results from the debris yield calculations are the same as the results for the LAA Realignment, as shown in TABLE 5-9.

Debris flow towards Borrow Site 10 starts from the mountains and the Sierra Nevada located west of the Project Site. Flowing down from the mountains, the flows must cross a large, flatter alluvial fan where the debris would settle before it reached Borrow Site 10. Therefore, the actual amount of debris yield would be much less than the calculated values.

6 Impact Analysis

6.1 CEQA Analysis

Based on Section 3.6, Project alternatives are analyzed based on their environmental impact. The analyses for hydrologic concerns are evaluated for the individual sites considering the Build Alternatives and the No Project Alternative.

6.1.1 No Project Alternative

Under the No Project Alternative, both the adverse and beneficial impacts of NHD2 would not occur. This alternative would avoid any significant impact to the Project Site, but since the existing Dam is not seismically stable, consideration of the No Project Alternative is not recommended.

6.1.2 Build Alternatives

The two Build Alternatives would result in the construction of NHD2, realignment of a portion of the LAA and of Cactus Flats Road, and excavation of Borrow Site 10 as well as hauling of materials from Borrow Site 15. These activities impact the environment in terms of water quality, drainage patterns, etc. These impacts are analyzed and discussed below. The two Build Alternatives differ in how NHD2 would be constructed, through either the CDSM approach or the Excavate and Recompact approach.

Hyd-1 Would the project violate any water quality standards or waste discharge requirements?

The Proposed Project would be covered by the NPDES CGP and therefore, it would be required to implement stormwater BMPs to control onsite runoff. The requirements of the current CGP are based on the SWRCB Order No. 2009-0009-DWQ, as amended by 2010-0014-DWQ and 2012-0006-DWQ. Complying with the requirements identified in the CGP would prevent, or reduce the amount of, pollutants from being washed or discharged into Waters of the United States. The Proposed Project would comply with the requirements of the CGP during construction and would stabilize the Project Site once construction is completed.

Additionally, the dam and basin may come in contact with groundwater (as identified in Sections 5.1.1 and 5.1.2), which could potentially require dewatering; where dewatering is required, a dewatering permit would need to be obtained from the Lahontan RWQCB. A Waste Discharge Application/Report would need to be submitted to the Lahontan RWQCB. This Project would require an amended water quality certification, waste discharge requirements, and an NPDES permit for the groundwater pumping and discharge.

Construction Impacts Common to All Build Alternatives

Construction activities generally create pollutant sources which could affect water quality. During the construction of the Proposed Project, excavation, grading, mining, compaction, trenching, and other construction activities would occur within the Project Site and Borrow Site 10. These activities would involve the disturbance of soil which could introduce contaminants to stormwater runoff and affect water quality in local water bodies, including groundwater. Heavy machinery and large vehicles are often used during construction and could also introduce contaminants into stormwater runoff. A centrally located on-site (at the Project Site) fueling station is anticipated due to the number of trips expected between the Borrow Sites and the Project Site. This could also be a source of polluted stormwater runoff, if proper maintenance procedures and inspections are not followed. Fuels and hazardous materials from the machinery and fueling station can pollute groundwater and stormwater runoff through accidental leaks and spills; however, a spill prevention control and countermeasure plan will be implemented to reduce or avoid these risks. With effective BMPs, as identified in the CGP, potential water quality impacts could be minimized or avoided. Additionally, control measures would be used as necessary when dewatering is required, compliant with the dewatering permit.

North Haiwee Dam No. 2

During the construction of NHD2, anticipated pollutants generated would include sediments from excavation, grading, and dirt stockpiles, heavy metals, oils, grease, lubricants, fuels from accidental equipment leaks, and trash and debris. An on-site fueling station is anticipated for vehicles and heavy equipment. Water quality standards may be affected if water is contaminated by runoff infiltrates through soil to the groundwater, especially during wet periods when the groundwater level rises. Groundwater contamination due to contact with the water table may be a concern during the construction of NHD2, as the groundwater has historically been higher than the proposed bottom excavation limits of the new Dam. The Proposed Project would comply with the dewatering permit requirements to alleviate potential water quality violations. The fueling station is not anticipated to adversely affect water quality if proper procedures from the CGP are followed and inspections and maintenance are conducted on a regular basis. This would minimize or avoid accidental spills or leaks to the maximum extent possible. Construction activities have the potential to introduce sediments into the LAA because a small portion of the NHD2 site is located directly adjacent to the LAA. Implementing BMPs, such as earthen berms, silt fences, gravel bag barriers, diversion dikes, and interceptor swales, as identified in the CGP, could reduce or avoid this possibility. Therefore, NHD2 construction impacts related to the violation of water quality standards or waste discharge requirements would be less than significant.

Basin Components

During the construction of the basin and its components, construction activities, including excavating, grading, dirt stockpiling, dewatering, and concrete form work, could introduce sediments, concrete and concrete solvents, and vehicle fuels to stormwater runoff and into the basin. These activities could introduce trash and debris on- and off-site. Earthwork for the east and west berms and activities related to the construction of the notch could loosen sediments and introduce them into NHR. Concrete form work for the notch could also introduce concrete solvents into NHR. If dewatering is required, groundwater quality could also be affected during dewatering activities if the groundwater becomes exposed to sediments and vehicle pollutants generated from construction. Appropriate BMPs, such as silt fences, sediment control, and diversions dikes, as identified in the CGP, could reduce or avoid the possibility of introducing excess contaminants into the basin or NHR. Control measures compliant of the necessary dewatering permit would be implemented to prevent violations of the water quality standards associated with groundwater. In addition, with implementation of Mitigation Measure Hyd-1, a Sediment Management Plan, impacts related to the sediment in NHR would be less than significant. Therefore, the constructions impacts from the basin and its components related to the violation of water quality standards or waste discharge requirements would be less than significant.

LAA Realignment

During the construction of the LAA Realignment and the diversion channel and bridge, construction activities, including excavating, grading, dirt stockpiling, and concrete form work, could introduce sediments, concrete and concrete solvents, and vehicle fuels into the LAA, and eventually into NHR. These activities could also introduce trash and debris on- and off-site. Appropriate BMPs, such as earthen berms, silt fences, gravel bag barriers, diversion dikes, and interceptor swales, as identified in the CGP, would minimize or avoid potential impacts to water quality. Additionally, good housekeeping procedures and waste management would also be implemented on site. Therefore, the LAA Realignment and diversion structure and bridge construction impacts related to the violation of water quality standards or waste discharge requirements would be less than significant.

Cactus Flats Road Realignment

During the construction of the Cactus Flats Road Realignment, including realignment of the access road and construction of the four-foot wide drainage ditch, activities including vegetative clearing, grading, stockpiling, and paving would disturb soil and could introduce contaminants to stormwater runoff. Runoff near the existing Cactus Flats Road would drain to the northeast, and ultimately infiltrate the surround area. Installing BMPs, such as earthen berms, silt fences, gravel bag barriers, diversion dikes, and interceptor swales, as identified in the CGP, could reduce or avoid the possibility of introducing excess contaminants into stormwater runoff. Therefore, construction impacts related to the violation of water quality standards or waste discharge requirements would be less than significant.

Construction Impacts – CDSM Alternative

During the construction of NHD2 under the CDSM Alternative, mining activities at Borrow Site 10, would involve the disturbance of soil that could introduce contaminants to stormwater runoff. However, the types and amounts of contaminants depend on the final plans, which would specify the site configuration and material quantities. Use of construction best management practices required under the CGP will limit the impacts to less than significant.

Borrow Site 10

Borrow Site 10 would be a source of sand and gravel for construction of NHD2. During mining, contaminants including minerals, heavy metals, sediments, and vehicle fuels may be introduced to stormwater runoff and ultimately discharge to the LAA. The potential for generating contaminants from construction has not been determined, and would depend on the exact location of the borrow site, the excavation depth, and the stockpile configuration. Installing effective BMPs, such as earthen berms, silt fences, gravel bag barriers, diversion dikes, and interceptor swales, as identified in the CGP, would reduce the potential of violating water quality standards and waste discharge requirements. A SWPPP would be developed and implemented on-site to address water quality. Therefore, construction impacts related to the violation of water quality standards or waste discharge requirements at Borrow Site 10 would be less than significant.

Construction Impacts – Excavate and Recompact Alternative

The Excavate and Recompact Alternative also includes Borrow Site 10. Per the analysis above in CDSM Alternative, the potential construction impacts related to the violation of water quality standards or waste discharge requirements would be less than significant for the borrow site.

Operational Impacts

Project Site

During operation of NHD2, the basin and its components, and the LAA Realignment, no water quality standards or waste discharge requirements are expected to be violated. NHD2 would be similar to the existing Dam in terms of operation and maintenance. The existing Dam does not violate water quality standards or waste discharge requirements. Therefore, there would be no impacts related to its operation because there are no activities during the operation/maintenance that would generate contaminants that violate water quality standards or waste discharge requirements. The basin between the existing Dam and NHD2 would allow water from the eastern watershed to collect and settle out sediments, improving downstream water quality. The basin components, including the diversion channel, and diversion structure would not have an adverse impact on water quality standards. The diversion channel would divert water from the realigned LAA to the basin. The diversion channel and the realigned LAA would be similar to the existing LAA in terms of operation and maintenance. The existing LAA does not violate water quality standards or waste discharge requirements. Therefore, there would be no impacts related to the operation of the diversion channel or the LAA Realignment because there are no activities during its operation or maintenance that would generate contaminants that violate water quality standards or waste discharge requirements.

During the operation of the Cactus Flats Road Realignment, no water quality standards or waste discharge requirements are anticipated to be violated as routine activities would be conducted per all applicable standards. Cactus Flats Road receives very little traffic, so the potential for runoff contaminated by vehicle pollutants would be low and would not differ greatly as compared to the existing conditions. Therefore, there would be no operational impacts related to the violation of water quality standards or waste discharge requirements.

Borrow Site 10

After the Proposed Project's construction is complete, Borrow Site 10 would be restored to prevent violations of water quality standards or waste discharge requirements. A topsoil salvage revegetation plan would be developed prior to the start of construction, and would identify procedures to stabilize the borrow site once mining is completed. Implementation of the topsoil salvage and revegetation plan is required to restore the borrow site such that water quality standards would not be violated once stabilized. Therefore, no operational impacts related to violation of water quality standards and waste discharge requirements are anticipated for Borrow Site 10.

Cumulative Impacts

During the construction of the Proposed Project, the existing topography would be affected by excavation, grading, mining, compaction and trenching. These activities would involve the disturbance of soil that could introduce contaminants to stormwater runoff and affect water quality in the LAA or NHR. All Project-related sites would be stabilized post-construction to avoid loose sediments from polluting stormwater runoff and water in NHD2, as required by the CGP. The basin between the NHD2 and the existing Dam would provide additional storage from the realigned LAA and allow sediments to settle before entering NHR. There are currently no foreseeable future projects that would violate water quality standards. BMPs and SWPPP requirements would reduce the potential for impacts to water quality. Therefore, there would be no cumulative impacts related to the violation of water quality standards or waste discharge requirements.

Hyd-2 Would the project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?

The Proposed Project components overlay the Owens Valley Groundwater Basin. Construction and operation of NHD2 and other Project components would not create a net deficit in the existing aquifer volume or lower the groundwater table level. A reduction in the aquifer volume, or lowering of the groundwater table would typically be a result of excessive pumping or diverting water outside of the boundaries of the underlying aquifer. These types of activities would not take place on-site during operation of the Proposed Project. During construction of the Excavate and Recompact Alternative, dewatering would be required for NHD2 and may be required for the basin. During construction of the CDSM Alternative, dewatering may be required for NHD2 and the basin. Dewatering is not anticipated for the LAA Realignment, Cactus Flats Road Realignment, or Borrow Site 10. The groundwater pumped for dewatering would likely be diverted to NHR, which recharges the same aquifer being pumped.

Disturbed streams would need to be reestablished to maintain percolation into the local aquifer. Construction activities at Borrow Site 10 would have no, or minimal, impact on groundwater levels.

Construction Impacts Common to All Build Alternatives

Local groundwater recharge would not be impacted by construction activities, as the State of California's Groundwater Bulletin 118 (California Department of Water Resources, 2003) states groundwater recharge is mainly from percolation of stream flow from surrounding mountains, and the Proposed Project would not impact the stream flow from surrounding mountains. The Proposed Project overlays the Owens Valley Groundwater Basin. This groundwater basin is one of the largest in the South Lahontan Hydrologic Region, with numerous stream flows servicing the basin throughout Owens Valley. Dewatering operations may be required for the construction of NHD2 under the CDSM Alternative and would be required for the construction of NHD2 under the Excavate and Recompact Alternative. In addition, dewatering may be required for the basin components under both alternatives. The water being pumped would likely be diverted back to NHR, where the same aquifer would be recharged, having a less than significant impact on recharge, groundwater levels, or depleting the aquifer.

North Haiwee Dam No. 2

The construction of NHD2 may require groundwater pumping associated with dewatering operations under the CDSM Alternative and would require groundwater pumping under the Excavate and Recompact Alternative associated with dewatering operations because, as discussed in Section 5.1, the excavation required for the construction of NHD2 may come into contact with the groundwater table. The highest pumping rates expected (for the Excavate and Recompact Alternative) would dewater approximately 1.16 billion gallons of water, over a period of 18 months, pumping 24 hours a day. Should dewatering be required for the CDSM Alternative, the highest pumping rates expected would dewater approximately 670 million gallons of water, over a period of 18 months, pumping 24 hours a day. Effects from dewatering would temporarily impact the groundwater table in the vicinity of the excavation as shown, during an aquifer pumping test, in FIGURE 6-1 (Black & Veatch and URS, 2014). The construction impacts for each alternative are discussed below.

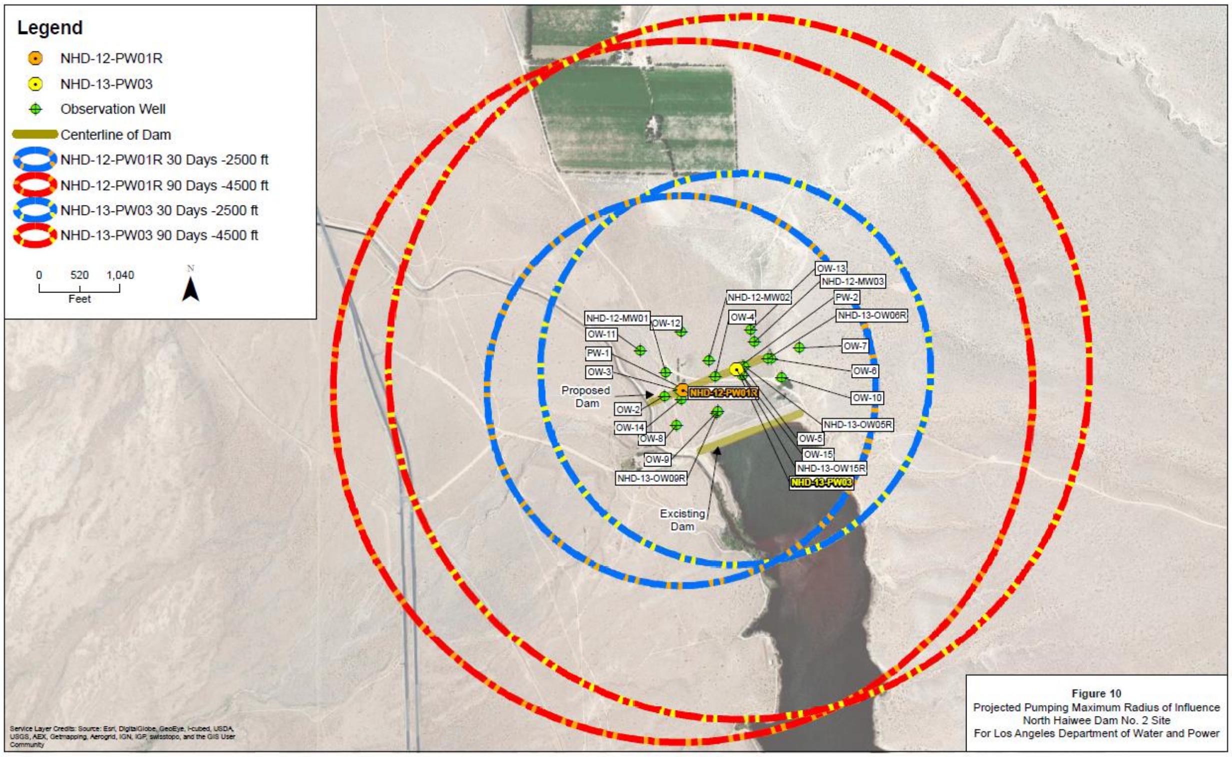

FIGURE 6-1
EXPECTED EXTENTS OF PUMPING INFLUENCE
Black & Veatch and URS, 2014

Once dewatering activities cease, groundwater levels are expected recover in a short period of time, as it is likely that the pumped groundwater would be diverted to NHR, which infiltrates into the same aquifer being pumped. The water would also be expected to be released to the surrounding areas where it would infiltrate and recharge the aquifer. The volume of water being pumped out of the ground would be more than the water returning to the aquifer. However, these effects are temporary and would only last for 18 months of the construction period. For these reasons, the overall aquifer volume would not be significantly depleted, and there would be no net reduction of the groundwater table depth post-construction. Therefore, the construction impact of NHD2 on the groundwater levels would be less than significant.

Basin Components

The construction of the basin and its components may require dewatering which could consist of 30 pumping wells on the south side of NHD2. As mentioned in the introduction, the groundwater is approximately 30 feet below the existing ground surface and as described in Chapter 2.0 of the Draft EIR/EA, an estimated volume of 1.16 billion gallons will be pumped during the 18 months. Effects from dewatering would temporarily impact the groundwater table in the vicinity of the pumping; however, once dewatering activities cease, groundwater levels are expected to recover in a short period of time. Groundwater from dewatering may be diverted into NHR where it could then be moved out of NHR using the existing Merritt Spillway. The pumping associated with dewatering would not deplete the local aquifer or significantly impact the groundwater table depth since the local aquifer would be recharged from NHR, and the rate of extraction would be the same as the rate of seepage from NHR. Therefore, the construction impact of basin and its components would be less than significant.

LAA Realignment

It is not anticipated that groundwater would be encountered during construction of the LAA Realignment, given that groundwater is expected to be deeper than the depth of excavation. Therefore, the construction impact of the LAA Realignment on groundwater levels would be less than significant.

Cactus Flats Road Realignment

As discussed in Section 5.1.4, the groundwater depth near the Cactus Flats Road Realignment ranges from 15 to 35 feet based on wells south of the alignment. The grade along the Cactus Flats Road Realignment is very similar to the existing Cactus Flats Road and minimal excavation would be required for the construction of most of the Cactus Flats Road Realignment. Grading the road down the hillside would require significant grading, but this is not expected to encounter groundwater due to the elevations. As such, dewatering is not anticipated and, the aquifer volume would not be impacted. Furthermore, major stream diversions are not anticipated and the few first order streams that would cross the Cactus Flats Road Realignment would likely be diverted to a temporary basin or off-site. The diverted flows would infiltrate into the local aquifer as they currently do, but the infiltration may occur in a different area. Therefore, the construction impact of the Cactus Flats Road Realignment on groundwater depths and recharge is less than significant.

Borrow Site 10

NHD2 would be constructed from materials sourced from Borrow Site 10. Large excavations would be required at Borrow Site 10 and the source area and quantity would depend on the final design of NHD2, based on geotechnical reports specific to the borrow site. Excavations at the site are not expected to reach groundwater depth as excavation would be designed to avoid contact with any groundwater. The local groundwater aquifer would not be impacted for Borrow Site 10 because groundwater would not be pumped and infiltration would still occur. Therefore, the construction impacts of Borrow Site 10 on groundwater depths would be less than significant.

Construction Impacts – CDSM Alternative

CDSM involves creation of boreholes with a large auger. As the drill digs, it injects cement and/or other admixtures and mixes these with soil to create a strengthened column. The contractor would excavate the foundation of NHD2 to 15 feet bgs and then would install a grid of overlapping CDSM columns under the NHD2 footprint. Columns would be approximately six feet wide, and would be 55 to 80 feet bgs, depending on location. Once the columns are installed and the excavated area is refilled and recompacted, NHD2 would be constructed.

Dewatering may be required, but would be substantially less than under the Excavate and Recompact Alternative. The CDSM Alternative may require approximately 670,000,000 gallons of water to be dewatered over 18 months. If the groundwater levels are within the excavated area at the time of construction, dewatering would be used to divert the exposed groundwater, and groundwater would be extracted at the same rate as existing seepage from NHR. Butterworth Ranch, located north of the Project Site, will not be impacted by dewatering activities. The well at the reservoir keeper’s residence would be impacted by dewatering activities; however, as the resident is a LADWP employee, LADWP would provide potable water for the residence for the duration of dewatering activities. The need for dewatering would depend on the conditions during construction, along with the season, as groundwater levels tend to fluctuate.

Construction Impacts – Excavate and Recompact Alternative

The construction of NHD2 for the Excavate and Recompact Alternative would require groundwater pumping associated with dewatering operations because, as discussed in Section 5.1, the excavation required for the construction of NHD2 may come into contact with the groundwater table. This alternative would dewater approximately 1.16 billion gallons of water, over a period of 18 months, pumping 24 hours a day. If the groundwater levels are within the excavated area at the time of construction, dewatering would be used to divert the exposed groundwater, and groundwater would be extracted at the same rate as existing seepage from NHR. Butterworth Ranch is not expected to be impacted by dewatering activities as it is located on the border of the cone of depression, or area where the water levels would decrease, depending on the pumping rate. The well at the reservoir keeper's residence would be impacted by dewatering activities; however, as the resident is a LADWP employee, LADWP would provide potable water for the residence for the duration of dewatering activities. The need for dewatering would depend on the conditions during construction, along with the season, as groundwater levels tend to fluctuate. Effects from dewatering would temporarily impact the groundwater table in the vicinity of the excavation as shown, during an aquifer pumping test, in FIGURE 6-1 (Black & Veatch and URS, 2014).

Operational Impacts

Project Site

The operation of NHD2, the basin and its components, LAA Realignment, and Cactus Flats Road Realignment would not include groundwater pumping, and would not significantly impact infiltration in the area, with the exception of the basin. The change in topography and the increase in impervious area from the LAA Realignment, the basin, the top of NHD2, and the Cactus Flats Road Realignment may affect infiltration in those areas. Following construction, the basin between NHD2 and the existing Dam would be used to store water from the realigned LAA and allow sediments to settle before entering NHR. The basin's liner would decrease the site's permeability. Rainfall above the basin will be captured instead of infiltrated. This water captured in the basin would be used in NHR. The water from the basin can pass through the notch to NHR where it also recharges the local aquifer. Therefore, the operational impact of the Proposed Project on groundwater depths would be less than significant.

Borrow Site 10

Upon completion of the construction phase of the Proposed Project, Borrow Site 10 would be restored based on the approved topsoil salvage and revegetation plan. Therefore, the impact of operation for Borrow Site 10 on groundwater depths would be less than significant.

Cumulative Impacts

The impact of dewatering at each of the Project-related sites would be less than significant. If all Project-related sites are dewatered at the same time, the impact would still be less than significant, as the water being pumped would be returned to NHR and recharge the same aquifer being pumped. The effects from dewatering would be localized and short-lived. Additionally, once constructed, the Proposed Project would not have any impact on lowering the groundwater table, or reducing the volume of the underlying aquifer. Therefore, there would be no cumulative impacts due to the Proposed Project construction and operation.

Hyd-3 Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?

Erosion is the process by which the ground surface gets worn down. Erosion can be caused by natural elements such as wind or water. Natural streams are highly susceptible to erosion, as flows can move particles downstream and change the stream bank configuration. Siltation is the pollution of water by fine particulate that is often picked up as a result of erosion. There are various natural first order streams (small tributaries) within the Project Site, including Loco Creek, which could be susceptible to erosion and siltation. The Project Site is generally flat, which results in sheet flows rather than intensely concentrated flows, reducing the potential for erosion and siltation. The design of the Proposed Project would change the grade and therefore drainage pattern. Additionally, the requirements of the CGP would be implemented during construction and would minimize the potential for erosion and siltation.

Construction Impacts Common to All Build Alternatives

Construction activities generally increase the potential for erosion and/or siltation on- and off-site. The CGP requires that construction sites greater than one acre develop and implement a SWPPP, and that sites less than one acre develop and implement an erosion control plan. The Proposed Project is greater than one acre and would be required to develop and implement a SWPPP. The SWPPP would identify the sources of pollution, erosion, and siltation and specify necessary BMPs to combat those issues. Implementing the BMPs identified in the SWPPP, and as required by the CGP, would result in a less than significant impact due to change in drainage patterns.

North Haiwee Dam No. 2

The construction of the NHD2 embankment approximately 800 feet north of the existing Dam would alter the existing drainage pattern. The existing drainage flows from the east and west toward the Project Site. When NHD2 is built, the east and west berms will isolate the area between NHD2 and NHD (basin). North of the new Dam, flows continue north. Under the Proposed Project, the flows from the east directly north of the existing Dam would be diverted around the east and west Berms, and the flows from the west that are north of NHD2 would continue north. The Loco Creek drainage patterns that currently exist would remain as they are, draining to the LAA. Loco Creek, flowing at 9 cfs for the 100-year flow, will not exceed the capacity of LAA during the wet season, and flows would continue to enter the LAA in the same or a similar location. Implementation of a SWPPP would be compliant with the CGP, and would reduce the impact to the change in drainage patterns due to construction activities. Therefore, construction impacts related to erosion and siltation on- or off-site due to a change in drainage patterns would be less than significant.

Basin Components

The basin components include the basin, diversion structure (during construction), diversion channel and bridge (after construction), notch, and the east and west berms. Construction of the basin and its components would alter the existing drainage pattern. The existing drainage flows from the east and west toward the Project Site. When NHD2 is constructed, the east and west berms would isolate the basin between NHD and NHD2. Under the Proposed Project, the flows from the east, directly north of the existing Dam, would be diverted around the east berm, and the flows from the west that are north of NHD2 would continue north. The Loco Creek drainage patterns that currently exist would remain as they are, draining to the LAA. Earthwork, including grading and excavation, would loosen the soil, making it susceptible to siltation and wind and water erosion. Implementation of a SWPPP would be compliant with the CGP and would reduce the impact to the change in drainage patterns due to construction activities. BMPs or soil stabilizers would be used to reduce erosion on slopes, especially during the construction of the proposed east and west berms. Therefore, construction impacts related to erosion and siltation on- or off-site due to a change in drainage patterns would be less than significant.

LAA Realignment

The LAA Realignment construction would involve cutting into the existing slope and include the demolition of the existing section of the LAA, excavation, grading, compaction, trenching, and concrete work. These activities would alter the topography and existing drainage patterns along the slope. Under existing conditions, the slope drains downhill to the southeast towards the existing LAA. Once the hillside is cut for the realigned portion of the LAA, the drainage would be conveyed to the new channel. Earthwork would disturb the soil, making soil transport easier and more likely. Wind and water have the potential to erode these surfaces. Effective BMPs would be installed based on the SWPPP and CGP requirements, reducing the potential for erosion and siltation. There is one stream at this location (Loco Creek), and in the existing condition, it drains into the LAA and eventually to NHR. The new alignment will not change the course of this creek which will continue to drain into the LAA Realignment and eventually to NHR. Therefore, construction impacts related to erosion and siltation on- and off-site due to a change in drainage patterns would be less than significant by incorporating the SWPPP and the CGP requirements.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment includes the partial demolition and clearing of the existing Cactus Flats Road as well as excavation, grading, concrete work, and construction of a four foot wide ditch for drainage improvement. Construction activities would alter the existing drainage patterns during construction. Earthwork would expose loose soil to wind and water, increasing the potential for erosion and siltation. Along the proposed Cactus Flats Road Realignment, the drainage would be conveyed on surface as sheet flow from south to north. Flows may also follow engineered structures and will need to be collected and allowed to pass over or under the structures. The site of the realigned portion of Cactus Flats Road is relatively flat, so most of the water is transported as sheet flows. There are a few minor first order streams that cross the proposed realigned portion of Cactus Flats Road. The SWPPP developed for the Proposed Project would be implemented on-site and BMPs would be used so that erosion and siltation are not a concern. The SWPPP would also address drainage and would ensure that adequate drainage is able to occur during construction. The Proposed Project would comply with the CGP requirements; therefore, construction impacts related to erosion and siltation on- and off-site due to a change in drainage patterns would be less than significant.

Construction Impacts – CDSM Alternative

The CDSM Alternative includes only Borrow Site 10. Per the analysis above, the potential construction impacts related to the violation of the change in drainage pattern and substantial erosion or siltation on- or off-site would be less than significant for the Project site.

Construction Impacts – Excavate and Recompact Alternative

The Excavate and Recompact Alternative includes only Borrow Site 10. Per the analysis above, the potential construction impacts related to the violation of the change in drainage pattern and substantial erosion or siltation on- or off-site would be less than significant for the borrow site.

Borrow Site 10

The construction of NHD2 and the LAA Realignment requires the use of sand and gravel from Borrow Site 10. Borrow Site 10 would be accessed using the North Haiwee Road to reduce its impact on undeveloped lands. The east side of Borrow Site 10 is adjacent to the existing LAA. Borrow Site 10 is located in a relatively flat area. As discussed in Section 5.1.5, the drainage in the Borrow Site 10 area flows from southwest to northeast. Under existing conditions, regional scale flows likely are conveyed by a drainage ditch along the LAA until they can cross at US-395. Excavation would not significantly change the drainage pattern at Borrow Site 10 drastically, as Borrow Site 10 is located in the upper portion of the sub watershed. Mining, excavation, vegetative clearing, and hauling within the borrow site would alter existing drainage patterns and topography. These activities would disturb the existing soil and expose the surface to wind and water. Exposing loose soil, removing vegetation, and altering the characteristics of drainage patterns would increase the potential for erosion and siltation at Borrow Site 10. The SWPPP developed for the Proposed Project would be implemented on-site to address erosion, siltation, and drainage. The Proposed Project would comply with the CGP requirements; therefore, construction impacts related to erosion and siltation on- and off-site due to a change in drainage patterns would be less than significant.

Operational Impacts

Project Site

During operation of the NHD2, the LAA Realignment, the basin and its components, and the Cactus Flats Road Realignment, erosion and siltation is not expected to exceed existing on-site conditions. The basin between the existing Dam and NHD2 would not change Loco Creek drainage patterns. The Cactus Flats Road Realignment would have culverts to accommodate stream paths and existing drainage patterns. The operational impact of the Project components would be similar to the operational components of the existing LAA, NHD, and Cactus Flats Road. Currently, there are no erosion or siltation problems associated with these existing components. Therefore, operational impacts related to erosion and siltation on- or off-site due to a change in drainage patterns would be less than significant.

Borrow Site 10

After the Proposed Project's construction, Borrow Site 10 would be restored. Drainage patterns would not return to pre-construction conditions; however, Borrow Site 10 would be adequately compacted and replanted with native vegetation to reduce on-site erosion and siltation with implementation of an approved topsoil salvage and revegetation plan. The topsoil salvage and revegetation plan would be developed for the borrow site before construction occurs. The topsoil salvage and revegetation plan would address the contouring of the land, placement of topsoil, and other aspects pertaining to stabilizing the borrow sites after construction. The topsoil salvage and revegetation plan would be developed such that erosion and siltation would not be a concern following construction. Therefore, operational impacts related to erosion and siltation on- or off-site due to a change in drainage patterns would be less than significant.

Cumulative Impacts

All Project-related sites would be stabilized post-construction. The Proposed Project is not expected to contribute to erosion and siltation. Post-construction conditions would be similar to existing conditions. The impact during construction and operation related to each of the Proposed Project components would be less than significant, and collectively the impact would remain less than significant. Due to the remoteness of the Project Site, future construction projects are not anticipated with the exception of maintenance or modification activities to NHR, the LAA, NHD and NHD2, the basin, and the realigned Cactus Flats Road, which would not cause or contribute to a more significant impact. Therefore, cumulative impacts related to erosion and siltation on- or off-site due to a change in drainage patterns would be less than significant.

Hyd-4 Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

Construction activities including clearing, grading, excavation, road construction, vegetation removal, etc. would cause land disturbance and disrupt drainage patterns. The drainage in the Proposed Project area is relatively flat. Flows are conveyed by sheet flow and first order unnamed streams. The structural components of the Proposed Project (NHD2, LAA Realignment, Cactus Flats Road Realignment, and diversion channel and NHD modifications) would not alter the existing drainage patterns of Loco Creek. The Project is not expected to contribute to flooding on- or off-site through alteration of the existing drainage patterns.

Construction Impacts Common to All Build Alternatives

Construction activities associated with the Proposed Project would involve the disturbance of soil and the use of construction materials (often in stock piles) that can alter existing drainage patterns and stream paths. All components of the Proposed Project would be affected by earthwork, which could alter the existing topography and drainage patterns. The impact during construction is expected to be minimal, as the Proposed Project would comply with the CGP, and a SWPPP would be developed and implemented. The SWPPP would include flow control measures, and the Proposed Project would be set up such that the Project Site drains appropriately and flooding does not occur.

North Haiwee Dam No. 2

NHD2 would consist of a new embankment dam 800 feet north of the existing Dam, which would alter the existing drainage pattern. The anticipated drainage patterns during construction are detailed in Section 6.1.2- Hyd-3. The drainage patterns that currently exist would be altered during construction based on the progress of construction and placement of stockpiles. Stockpiles would be placed outside of the natural flow paths. The Project does not alter the Loco Creek drainage pattern, therefore, the change related to the project would be insignificant as the Project Site is vacant and the construction materials would not cause significant changes in the impervious area. Overall, the Project Site's permeability will decrease due to basin lining but all rainfall will be captured in the basin and NHD. The altered drainage patterns would not cause flooding on- or off-site. Therefore, construction impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Basin Components

The Basin components include the basin, diversion structure (during construction), diversion channel and bridge (after construction), notch, and the east and west berms. Construction of the proposed Basin and its components would alter the existing drainage pattern on the eastern portion of the Project Site. The existing drainage flows from the east toward the Project Site and then flows north. The east berm would prevent runoff from flowing into the basin as the berm would be located between the small canyon entering the basin area and the basin itself. The diversion channel and realigned LAA would allow flows from travelling west to reach the basin as there would be an opening allowing water to enter the basin. The impervious area would slightly increase due to the diversion channel and the basin. The basin would have a geomembrane liner to prevent the stored water from infiltrating the ground. As previously discussed, earthwork activitieswould not alter the existing drainage patterns of Loco Creek. Earthwork, including grading and excavation, would loosen the soil in the basin area, making it susceptible to siltation and wind and water erosion. Therefore, temporary stockpiles should be placed outside of any natural flow paths or slopes. Construction impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

LAA Realignment

The LAA Realignment would include the demolition of the existing section of the LAA, excavation, grading, compaction, and concrete work. These activities would alter the existing drainage patterns. The anticipated drainage patterns during construction are detailed in Section 6.1.2- Hyd-3. The extent of the alteration would depend on the construction progress and the stockpile configuration. Stockpiles would be situated on-site such that the existing drainage is preserved to the maximum extent practicable. The alteration in the drainage patterns would be insignificant, as the impervious area would not be significantly different from existing conditions. Therefore, construction impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment would include demolition of a portion of the existing Cactus Flats Road, excavation, and grading. These activities would alter the existing drainage patterns. The anticipated drainage patterns during construction are detailed in 6.1.2- Hyd-3. The extent of the alteration would depend on the construction progress and the stockpile configuration. Stockpiles would be situated on-site such that the existing drainage is preserved to the maximum extent practicable. Drainage conduits could also be installed to allow flows to travel through the stockpiles instead of around them. The alteration in the drainage patterns would be insignificant, as the impervious area would not be significantly different from existing conditions. Therefore, construction impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Construction Impacts

The anticipated drainage patterns during construction are detailed in 6.1.2- Hyd-3. During excavation, the alterations in the drainage patterns would be minimal and the rate and quantity of runoff is not expected to change, as the soil material would remain the same. Additionally, a SWPPP would be implemented for the Proposed Project, which would control flows on the Project Site. Therefore, construction impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Borrow Site 10

Borrow Site 10 would provide sand and gravel materials for NHD2. Mining within Borrow Site 10 would alter existing drainage patterns, as flows would likely need to be routed around the borrow pit. South of Borrow Site 10, Loco Creek eventually drains into the LAA. The SWPPP for the Proposed Project would identify necessary flow routing to prevent the pit from filling with water. Therefore, construction impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Construction Impacts – Excavate and Recompact Alternative

The Excavate and Recompact Alternative does not change drainage patterns. The potential construction impacts related to the violation of the change in drainage pattern and causing flooding would be less than significant for Borrow Site 10.

Operational Impacts

Project Site

During operation of the NHD2, the LAA Realignment, the basin and its components, and the Cactus Flats Road Realignment, flooding is not expected to occur on-site. The basin between the existing Dam and NHD2 has been designed to collect water from the realigned LAA and allow sediments to accumulate before entering NHR. Dredging would be required periodically to remove accumulated sediments. The existing drainage pattern of Loco Creek would continue to drain to the LAA and NHR. The realigned portion of Cactus Flats Road would be designed to reduce flooding and maintain current flow paths by utilizing culverts. The realigned portion of the LAA is not expected to contribute to on- or off-site flooding. Therefore, operational impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Borrow Site 10

After the Proposed Project’s construction, Borrow Site 10 would be restored to an approximate natural state and revegetated. A topsoil salvage and revegetation plan would be developed for the borrow site before construction would occur, and the plan would address the contouring of the land, placement of topsoil, and other aspects pertaining to stabilizing the borrow site after construction. The topsoil salvage and revegetation plan would be developed such that on-site and off-site flooding would not be a concern following construction. The drainage patterns may be altered, but the rate and quantity of runoff would not change significantly as the drainage would be modified as needed and the area would be revegetated in compliance with the topsoil salvage and revegetation plan. Therefore, operational impacts related to flooding on- or off- site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Cumulative Impacts

All Project-related sites would be stabilized post-construction. The Proposed Project is not expected to substantially increase the rate or amount of surface runoff. Post-construction conditions would be similar to existing conditions. The impact during construction and operation related to each of the Proposed Project components would be less than significant, and collectively the impact would remain less than significant. Due to the remoteness of the Project Site, future construction projects are not anticipated with the exception of maintenance or modification activities to NHR, NHD and NHD2, the basin and its components, the realigned Cactus Flats Road, and the realigned LAA, which would not cause or contribute to a more significant impact. Therefore, cumulative impacts related to flooding on- or off-site due to a change in drainage patterns or an increase in the rate or amount of surface runoff would be less than significant.

Hyd-5 Would the project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantially additional sources of polluted runoff?

The Proposed Project is located in a remote area that does not have a stormwater system to manage runoff. Instead, runoff infiltrates into the subsurface, evaporates, or runs off into local water bodies. The Proposed Project involves constructing NHD2 upstream of the existing Dam, so that if the existing Dam fails during seismic activity, there would not be an uncontrolled release. The Proposed Project would increase the capacity of NHR. The Proposed Project would not provide substantial increases in the amount of runoff or additional sources of polluted runoff. During construction, a SWPPP would be developed and implemented in compliance with the CGP, which would control runoff and water quality from the Project Site. Once the Proposed Project is in operation, the Project Site conditions would be similar to the existing condition and additional sources of polluted runoff would be insignificant.

Construction Impacts Common to All Build Alternatives

Construction activities typically do not cause a substantial increase in runoff, but water quality is generally a bigger issue, as sediments are disturbed and other construction materials are brought on-site. A SWPPP would be developed and implemented for the Proposed Project in compliance with the requirements set forth in the CGP. The CGP requires that discharges from construction sites are in compliance with defined standards, and that BMPs are utilized to control runoff. The Project Site does not have a stormwater drainage system, as the site is located in a remote area. The nearest capture area is NHR, which would have an increased capacity once construction is completed.

North Haiwee Dam No. 2

The construction of NHD2 would address seismic stability issues associated with the existing Dam by containing an uncontrolled release of water from NHR should NHR be subjected to a MCE event. During the construction of NHD2, the activities conducted on the Project Site could potentially expose the area and NHR to additional pollutants. A SWPPP would be developed and implemented in compliance with the CGP, and would include BMPs that address water quality on-site. Therefore, construction impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Basin Components

The basin components include the basin, diversion structure (during construction), diversion channel and bridge (after construction), notch, and the east and west berms. Construction of the basin and its components could potentially expose the area and NHR to erosion or airborne dust and pollutants from vehicles and equipment. A SWPPP would be developed and implemented in compliance with the CGP, and would include BMPs that address water quality on-site. Therefore, construction impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

LAA Realignment

Construction of the realigned portion of the LAA has the potential to generate polluted runoff from exposed, loose soil. A SWPPP would be developed and implemented in compliance with the CGP, and would include BMPs that address water quality on-site. Therefore, construction impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment would involve a variety of construction activities, all of which would potentially expose the downstream areas to polluted runoff. A SWPPP would be developed and implemented in compliance with the CGP, and would include BMPs that address water quality on-site. Therefore, construction impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Construction Impacts – CDSM Alternative

Construction using the CDSM Alternative may provide additional sources of polluted runoff, as excavation activities would disturb the soil in the area. A SWPPP would be developed and implemented in compliance with the CGP, and would include BMPs that address water quality on-site. These requirements would reduce impacts to less than significant.

Borrow Site 10

Borrow Site 10 would not cause an exceedance in the capacity of existing or planned stormwater drainage systems. It is located in a remote, undeveloped area away from existing drainage systems. The borrow site may provide additional sources of polluted runoff. Runoff contaminated by sediments would be mitigated through effective BMPs. Therefore, construction impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Construction Impacts – Excavate and Recompact Alternative

Excavate and Recompact Alternative only includes Borrow Site 10. Per the analysis above, the potential construction impacts related to exceeding the capacity of existing or planned stormwater drainage systems or provide substantially polluted runoff would be less than significant for Borrow Site 10.

Operational Impacts

Project Site

Once construction is completed, NHD2 will provide an additional safety measure in case the existing Dam fails during seismic activity and would provide an increased capacity to NHR. The basin would be utilized for water quality treatment methods for water storage. There is not an existing, nor is there a planned, stormwater drainage system within the Project Site, as the site is located in a remote area. Drainage improvements, such as culverts, would be constructed as part of the Cactus Flats Road Realignment, and would be sized based on anticipated flows; thus, there would be no issues regarding capacity. During operation of NHD2, the LAA Realignment, the basin and its components, and the Cactus Flats Road Realignment, there would not be substantial additional sources of polluted runoff as compared to the existing conditions. The proposed land uses are similar to those that currently exist, only in a different configuration. The basin would be layered with a geomembrane to prevent infiltration into the ground. Therefore, operational impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Borrow Site 10

Once construction is complete, Borrow Site 10 would be restored based on the approved topsoil salvage and revegetation plan. Runoff from Borrow Site 10 following construction would be nearly the same as existing conditions, as the groundcover would likely remain the same. Potential pollutants and runoff quantity would be comparable to the current conditions. Additionally, there are no existing or planned stormwater drainage facilities in the vicinity. Therefore, operational impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Cumulative Impacts

All of the Project components would be stabilized post-construction. There are no existing stormwater drainage systems in the vicinity; therefore, changes in the flow quantity would not adversely impact capacity. The Proposed Project is not expected to substantially increase or contribute to polluted runoff, as the land uses under the proposed conditions are comparable to the existing conditions. Individually, each Project component has a less than significant impact in regards to exceeding a stormwater drainage facility capacity, and creating or contributing to polluted runoff. Collectively, the Proposed Project would have a less than significant impact. There are no other proposed projects at this location or in the nearby area; therefore, cumulative impacts related to an exceedance of the capacity of existing or planned stormwater drainage systems or a substantially greater contribution of polluted runoff would be less than significant.

Hyd-6 Would the project otherwise substantially degrade water quality?

Refer to Section 6.1.2, Hyd-1 for explanations of the impact determination during construction and operation, along with the cumulative impacts. Impacts related to substantially degrading water quality would be less than significant.

Hyd-7 Would the project place housing within a 100-year flood hazard area as mapped on a Federal Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?

As described in the Project Description, the Proposed Project would not include the construction of housing. Therefore, there would be no impacts related to the placement of housing within a 100-year flood hazard area as mapped on the FEMA Flood Insurance Rate Map.

Hyd-8 Would the project place within a 100-year flood hazard area structures which would impede or redirect flood flows?

The Proposed Project includes construction of new structures, including NHD2, the realigned portion of Cactus Flats Road, the basin and its components, and the realigned portion of LAA. The potential for these structures to impede or redirect the flood flows based on the placement of structures is evaluated based on floodplain maps prepared by the FEMA in populated regions for floods that statistically have a one percent chance of occurring each year (i.e., 100-year flood events). NHR is located in a Zone A flood zone. The Project Site is delineated as Zone X (outside of the 0.2 percent chance of flooding each year) based on the FEMA FIRM, Map Numbers 06027C3350D and 06027C2225D, dated August 16, 2011.

Construction Impacts Common to All Build Alternatives

Construction of the Proposed Project would be located outside of 100-year flood hazard areas.

North Haiwee Dam No. 2

Although the existing Dam is listed in the Kern County inundation mapping program due to concerns of the existing Dam's stability during seismic events, NHD2 is intended as a seismic improvement project. NHD2 would serve to improve the seismic reliability of NHR, providing flood protection to the Project area. NHD2 would be located within what is currently classified as a Zone X flood zone, where flood hazards would be minimal. During construction of NHD2, structures would not be placed within the 100-year flood zone. Therefore, there would be no impacts related to the placement of structures within a 100-year flood hazard area during the construction of NHD2 which would impede or redirect flows.

Basin Components

The basin would be constructed in a Zone X flood zone. The construction of the basin and its components would not occur within the 100-year flood hazard area. Therefore, there would be no impacts related to the placement of structures within a 100-year flood hazard area during construction of the basin and its components.

LAA Realignment

The LAA Realignment would be constructed in a Zone X flood zone. During construction of the realigned portion of the LAA, structures would not be placed within the 100-year flood zone. Therefore, there would be no impacts related to the placement of structures within a 100-year flood hazard area during the construction of the LAA Realignment.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment would be constructed in a Zone X flood zone. During the construction of the realigned portion of Cactus Flats Road, structures would not be placed within the 100-year flood zone. Therefore, there would be no impacts related to the placement of structures within a 100-year flood hazard area during the construction of the Cactus Flats Road Realignment.

Borrow Site 10

Borrow Site 10 is located in outside of a 100-year flood hazard area, and would not have permanent structures erected during construction. Therefore, there would be no impacts related to the placement of structures within a 100-year flood hazard area during the construction phase of the Project for Borrow Site 10.

Operational Impacts

Project Site

The NHD2, basin and its components, LAA Realignment, and the Cactus Flats Road Realignment are all in a Zone X flood zone, and are outside of a 100-year flood hazard area as currently delineated. Once in operation, no structures would be located within the 100-year floodplain associated with the LAA and Cactus Flats Road Realignments. Once constructed, if a FEMA FIRM study would be performed, it is anticipated that the Zone A flood zone associated with NHR would extend to NHD2. NHD2 would be placed in the Zone A flood zone and would impede flows, which would have a positive impact, as it would provide flood protection to the Project area. Therefore, during operation, impacts related to the placement of structures within a 100-year flood hazard area would be less than significant.

Borrow Site 10

Once construction is completed, Borrow Site 10 would be restored based on the approved topsoil salvage and revegetation plan, and would be partially outside of the 100-year flood zone. Therefore, there would be no impacts related to the placement of structures within a 100-year flood hazard area due to Borrow Site 10 once the Project is in operation.

Cumulative Impacts

The Project Site is in a remote and mostly vacant area. The impact due to the Proposed Project's construction and operation regarding the placement of structures within a 100-year flood hazard area would have no impact, or would be less than significant, as the Proposed Project does not occur within a currently delineated 100-year flood hazard area. Additionally, once constructed, NHD2 will control flows, and provide additional capacity. Therefore, cumulative impacts in concert with other past, present, or reasonably foreseeable future actions or projects would be less than significant.

Hyd-9 Would the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a dam or levee?

NHD is the nearest dam to the Project Site. LADWP has identified that, per DSOD standards, the existing Dam is seismically unstable and has the potential to fail during the MCE seismic event due to the potential for liquefaction of the underlying alluvium and NHD itself (LADWP, 2001). The area surrounding NHD is generally vacant. Less than two miles north from the Project Site are five to six homes with adjacent structures. Adjacent to the west side of the existing Dam is the reservoir keeper's residence and a couple of structures related to NHD maintenance. Other parts around the Project Site are vacant. If the existing Dam were to fail, flow would travel northward based on the existing topography and the land north of NHD towards Owens Lake would be inundated. The mapped inundation area includes part of the existing Cactus Flats Road, which runs upstream of NHD. According to the Inundation Map of North Haiwee Dam (LADWP, n.d.), the ranch and agricultural land less than one mile north of NHD would be inundated in approximately 15 to 20 minutes, and parts of the community of Olancha, located east of US-395, would be inundated in approximately 40 minutes (LADWP, n.d.). There is also a section of SR-190 located south of the Owens Lake, which would be inundated in approximately 50 minutes after the failure of NHD (LADWP, n.d.).

Construction Impacts Common to All Build Alternatives

Project Site

All of the haul routes dedicated to transporting construction material from the borrow sites to the NHD2 construction site are partially located in the inundation area associated with the failure of NHD. If NHD fails, workers delivering materials along the proposed haul routes may be at risk of loss, injury, or death, depending on the extent of the inundation and their location at the time of the failure. However, the DSOD has directed LADWP to operate NHR at a restricted maximum surface water elevation of 3,757.5 feet in order to prevent an uncontrolled release of water and flooding in the event of dam failure resulting from an MCE, thereby reducing the risks of loss, injury, or death associated with NHD failure. Emergency response plans would also be developed to address the safety of the Project Site during construction and would identify actions to be taken if NHD fails. Therefore, construction impacts related to the exposure of people or structures to a significant risk of loss, injury, or death involving flooding, resulting from a dam or levee failure would be less than significant.

Borrow Site 10

Borrow Site 10 is located outside of the inundation area associated with the failure of NHD. The haul routes associated with the borrow sites utilize Cactus Flats Road near the Project Site. An approximately two mile segment of the existing Cactus Flats Road nearest to the existing Dam would be inundated if NHD were to fail. Inundation would occur within seconds to the portion of Cactus Flats Road nearest NHD and would spread approximately two miles north within 20 minutes. The haul route from Borrow Site 15 to the Project Site includes a portion of SR-190, which is partially located within the inundation area. Flood flows would reach this portion of SR-190 approximately 45 minutes after the failure of NHD. However, the DSOD has directed LADWP to operate NHR at a restricted maximum surface water elevation of 3,757.5 feet in order to prevent an uncontrolled release of water and flooding in the event of dam failure resulting from an MCE, thereby reducing the risks of loss, injury, or death associated with NHD failure. Emergency response plans would also be developed to address the safety of the Project Site during construction and would identify actions to be taken if NHD fails. Therefore, construction impacts related to the exposure of people or structures to a significant risk of loss, injury, or death involving flooding, resulting from a dam or levee failure would be less than significant.

Operational Impacts

Project Site

The primary objective and fundamental purpose of the Proposed Project is to improve the seismic reliability of NHR through construction of a new Dam, NHD2, to the north of NHD, in order to maintain the function of an essential water conveyance infrastructure component for the City, and protect local populations from a hazardous flooding event. The proposed NHD2 would serve to improve the seismic reliability of NHR in the event the existing Dam is damaged or breached by an earthquake event, thereby ensuring public health and safety. NHD2 would be constructed per DSOD requirements, and would be designed to withstand an MCE event. By incorporating the required design standards and complying with all applicable regulations and ordinances, flows would be controlled, flooding hazards would be reduced, and the risk of injury, loss of life, and property damage associated with hazards would be minimized. As a result, people or structures would not be exposed to flooding impacts, including flooding as a result of dam failure, and impacts would be less than significant.

Borrow Site 10

Upon completion of the construction phase of the Proposed Project, the structures and construction personnel would be removed from Borrow Site 10. Therefore, no impacts related to the risk of loss, injury, or death involving flooding as a result of dam or levee failure would occur.

Hyd-10 Would the project inundate by seiche, tsunami, or mudflow?

A tsunami is a very large ocean wave caused by an underwater earthquake or volcanic eruption. The Project Site is located inland, approximately 150 miles from the Pacific Ocean at an average elevation of 3,700 feet. There is no risk of a tsunami during the construction and operation of the Proposed Project.

A seiche is the resonant oscillation of water generated in an enclosed body of water. A seiche event could occur if water is present in NHR or basin during a very strong wind storm or seismic event. Any oscillation of water within NHR or the basin would likely not inundate the vicinity due to the operating standards regulated by DSOD.

Mudflows are shallow water-saturated masses of soil and fragmented rock that travel rapidly down slopes. Typically, mudflows occur during or soon after periods of heavy rainfall on slopes that contain loose soil or debris. The Project Site is located in a basin area covered mostly by native soil. Detailed site investigations in the Geology Soils and Seismicity Technical Report suggests that the Project area is not prone to landslides. The Project Site is located within the basin of the Owens Valley, which is generally comprised of alluvial soils. Surrounding Owens Valley is the Sierra Nevada and Inyo Mountain. Younger alluvial fans located at the base of these ranges have resulted in mudflows type events along the foothills and perimeter of the Owens Valley. The most significant event in recent history was the Oak Creek mudflows of 2008 (Wagner, 2010), which occurred northwest of Independence in Inyo County and approximately 40 miles north of the Project Site. Other smaller events, such as the Haiwee Creek debris flow event in 2010 (Lancaster, 2013) located approximately seven miles south of the Haiwee Reservoirs, have also occurred within the region. These events have historically occurred within areas adjacent to streams that have been impacted by recent wildfires and recent flows near the Project Site. Calculations from Section 5.1 show the existing sediment values for the Project Site during different storm events.

Construction Impacts Common to All Build Alternatives

North Haiwee Dam No. 2

As described in Section 5.1, if a strong wind storm occurred near NHR, the maximum water surface rise due to wind would be less than three feet along the existing Dam. There is no risk of a seiche causing inundation to the Project Site during construction, as sufficient freeboard is provided in NHR, as required by DSOD. Additionally, the construction activities would not impact the existing risks. Therefore, construction impacts related to inundation by seiche would be less than significant.

TABLE 5.1-3 shows the range of the volume of the debris yield based on the different flood frequencies if mudflow was to occur near NHD2. The construction of NHD2 would not cause any additional inundation to the Project area as compared to the existing conditions. Therefore, construction impacts related to inundation by mudflow would be less than significant.

Basin Components

The basin would not be filled with water until the NHD2 and LAA Realignment have been deemed fully operational. If a strong windstorm occurred near NHR, the maximum water surface rise due to wind would be less than three feet along the existing Dam. There is no risk of a seiche causing inundation to the Project Site during construction, as sufficient freeboard is provided in NHR, as required by DSOD. Therefore, construction impacts related to inundation by seiche would be less than significant.

Due to the existing terrain and ground cover conditions, mudflow may occur near the basin both during construction and operation, potentially causing inundation. TABLE 5.1-3 shows the range of the volume of the debris yield based on the different flood frequencies if mudflow was to occur near NHD2. The construction of the basin and its components would not cause any additional inundation to the Project area as compared to the existing conditions. Therefore, construction impacts related to inundation by mudflow would be less than significant.

LAA Realignment

As described in Section 5.1, if a strong wind storm occurred near NHR, the maximum water surface rise due to wind would be less than three feet along the existing Dam. There is no risk of a seiche causing inundation to the Project Site during construction, as sufficient freeboard is provided in NHR, as required by DSOD. If an occurrence of seiche manifested in NHR due to a strong wind storm, Borrow Site 10 will most likely not be at risk, as it is significantly higher in elevation than NHR or NHD. Additionally, the construction activities would not impact the existing risks. Therefore, construction impacts related to inundation by seiche would be less than significant.

Due to the existing terrain and ground cover conditions, it is unlikely mudflow will occur near the LAA Realignment, both during construction and operation. TABLE 5.1-9 shows the range of the volume of the debris yield, based on four different flood frequencies if mudflow was to occur near the Project Site. The inundation of the LAA would be extremely costly, as flows to the City of Los Angeles would need to be halted pending remediation. The construction of the LAA Realignment would not cause any additional inundation to the Project area as compared to existing conditions. Therefore, construction impacts related to inundation by mudflow would be less than significant.

Cactus Flats Road Realignment

As described in Section 5.1, if a strong wind storm occurred near NHR, the maximum water surface rise due to wind is less than three feet along the existing Dam. There is no risk of a seiche causing inundation to the Project Site during construction, as sufficient freeboard is provided, as required by DSOD. Therefore, construction impacts related to inundation by seiche would be less than significant.

Due to the existing terrain and ground cover conditions, mudflow may occur near the Cactus Flats Road Realignment, both during construction and operation, potentially causing inundation. TABLE-5.1-11 shows the range of the volume of the debris yield, based on four different flood frequencies if mudflow was to occur near the Project Site. The construction of the Cactus Flats Road Realignment would not cause any additional inundation to the area as compared to existing conditions. Therefore, construction impacts related to inundation by mudflow would be less than significant.

Construction Impacts – CDSM Alternative

The CDSM Alternative only includes Borrow Site 10. Change in terrain and groundwater condition might result in mudflow at Borrow Site 10; however, it is very unlikely. Borrow Site 10 is not susceptible to seiche since they are located away from NHR. The borrow site is not close to an ocean and therefore, there is no potential of a tsunami.

Borrow Site 10

Borrow Site 10 would most likely not be at risk if a seiche occurred in NHR due to a strong wind storm, as it is located along the northwest side of NHR and at a significantly higher elevation than NHR or NHD. While excavation at Borrow Site 10 would lower the elevation of the site, it is anticipated that it would remain substantially higher than the NHR level. The maximum water surface rise due to wind in NHR is less than three feet along the existing Dam. There is no risk of a seiche causing inundation to the site during construction, as sufficient freeboard is provided, as required by DSOD. Therefore, construction impacts related to inundation by seiche would be less than significant.

Due to the existing terrain and ground cover conditions, it is unlikely that mudflow will occur near Borrow Site 10 during construction. TABLE 5.1-9 shows the range of the volume of the debris yields, based on four different flood frequencies if mudflow were to occur. The use of Borrow Site 10 during construction would not cause any additional inundation to the area as compared to existing conditions. Therefore, construction impacts related to inundation by mudflow would be less than significant.

Construction Impacts – Excavate and Recompact Alternative

The Excavate and Recompact Alternative only includes Borrow Site 10. Per the analysis above, the potential construction impacts related to flooding due to seiche, tsunami, and mudflow would be less than significant for the borrow site.

Operational Impacts

Project Site

Once construction is completed, NHD2 and the basin would protect a portion of the LAA Realignment as well as the Cactus Flats Road Realignment from being inundated due to a seiche in NHR. A seiche event could occur if water is present in the basin or NHR during a very strong wind storm or seismic event. Any oscillation of water within the NHR would most likely not inundate the vicinity, as sufficient freeboard would be provided, as required by DSOD. Therefore, operational impacts related to inundation by seiche would be less than significant.

Mudflow may occur near the Project Site, both during construction and operation. However, it is very unlikely the mudflow will cause inundation to the new Dam, basin, and the LAA Realignment. There is some potential that the distal edge of mudflows could reach and partially cover the portion of the Cactus Flats Road Realignment that is on the east side of the Haiwee valley as debris flows were observed to approach this area in 2006. However it is not anticipated that any mudflows reaching this area would result in catastrophic damage to the Cactus Flats Road Realignment and debris could be removed by routine repair operations. The risk of inundation due to mudflow would be comparable to the risks identified for the construction phase. The operation of the Proposed Project components would not cause any additional inundation to the area as compared to existing conditions. Therefore, operational impacts related to inundation by mudflow would be less than significant.

Borrow Site 10

Upon completion of the construction phase of the Proposed Project, the structures and construction personnel would be removed from Borrow Site 10, and the impact of inundation by seiche, tsunami, or mudflow would be less than significant.

Cumulative Impacts

Both during construction and operation, the Project Site would be exposed to the risk of inundation by mudflow. The cumulative impacts would not worsen or lessen the anticipated impacts. The cumulative impacts in concert with other past, present, or reasonably foreseeable future actions or projects would remain less than significant, and would not worsen due to other Project components.

6.2 Summary of CEQA Analysis

6.2.1 No Project Alternative

Under the No Project Alternative, the NHD2, LAA Realignment, proposed Basin and its components, and Cactus Flats Road Realignment would not be constructed. The water quality, groundwater, and drainage systems would remain the same as under existing conditions. NHD2 is proposed due to the seismic hazard associated with NHD. If an MCE earthquake were to occur, there would be the risk of dam failure and inundation for the communities that are north of NHD. The No Project Alternative would not reduce existing hazards related to potential dam failure. Therefore, the No Project Alternative is not recommended.

6.2.2 Build Alternatives

Cement Deep Soil Mixing Alternative

The CDSM Alternative would only source material from Borrow Site 10. Under this Alternative, the impacts for Hyd-1, Hyd-2, Hyd-3, Hyd-4, Hyd-5, Hyd-6, Hyd-7 (during operation), Hyd-8, Hyd-9, and Hyd-10 would be less than significant, and there would be no impact for Hyd-7 (during construction).

Excavate and Recompact Alternative

The Excavate and Recompact Alternative would only source material from Borrow Site 10. Under this Alternative, the impacts for Hyd-1 Hyd-2, Hyd-3, Hyd-4, Hyd-5, Hyd-6, Hyd-7(during operation), Hyd-8, Hyd-9 and Hyd-10 would be less than significant, and there would be no impact for Hyd-7 (during construction).

7 Mitigation Measures and Best Management Practices

7.1 Mitigation Measures during Construction

As described in Hyd-1, impacts related to water quality would be significant. Mitigation Measure Hyd-A is proposed in order to reduce the potential for water quality issues during construction of the notch.

Hyd-A Prior to any sediment disturbing activities in and around Haiwee Reservoir, the soils must be sampled and characterized so that proper handling and disposal methods can be adequately evaluated. LADWP will prepare a Sediment Management Plan for construction of the notch in NHD, demonstrating compliance with all applicable regulations related to disturbance, removal, treatment, and/or transport and disposal of these sediments.

Implementation of Mitigation Measure Hyd-A would reduce impacts related to water quality to less than significant.

As described in Hyd-2 through Hyd-9, no mitigation measures related to hydrology, groundwater, or flood hazard would be required.

7.2 BMPs during Construction

The Project would be required to comply with the NPDES permit for stormwater discharges, including the preparation of a SWPPP and the implementation of appropriate BMPs. The BMPs listed in the SWPPP would be implemented for the Project Site and Borrow Site 10 to reduce erosion and siltation impacts and address pollutants and their sources.

7.2.1 Hydrology

Erosion control plans with site-specific control measures shall be implemented for both the Project Site and Borrow Site 10. Erosion control shall be applied to exposed slopes prior to predicted storm events. All soil stockpiles shall be protected or stabilized with sheeting for the duration of the Project. Increased runoff as a result of the Project would be mitigated using detention basins placed throughout the Project area. The detention basins would be designed to meet the additional runoff created during a 100-year storm event. Other example BMPs are as follows:

- Non-toxic soil stabilizers shall be applied according to manufacturers' specifications to all inactive construction areas (previously graded areas inactive for 10 days or more).
- Stabilize exposed, loose soil on slopes using plastic sheeting, geotextile fabric, jute matting, erosion control blankets, soil binders, straw mulch, hydro-mulching, revegetation, or other similar measures (prior to the onset of precipitation).
- Existing dirt roads should be used for the haul routes to reduce activities on undeveloped lands.
- Temporary construction fencing shall be installed around the borrow sites to divert flows around disturbed or exposed areas and mining pits.

7.2.2 Water Quality

Borrow Site 10 is located southwest of the LAA. Borrow Site 10 has the potential to affect water quality during construction if pollutants contaminate stormwater runoff and drain into NHR and the LAA. BMPs would be installed during construction to prevent contaminants and sediments from entering NHR. Construction activities shall implement good housekeeping methods to keep all sites clean. There shall be continual inspection and maintenance of all specified BMPs through the duration of construction. Other example BMPs are as follows:

- Monitor water quality throughout the Project.
- Place drip-pans under all idle equipment on construction sites.
- Minimize hazardous materials stored at the construction site.
- Cover stockpiles and locate them away from the LAA and NHR.
- All construction equipment shall be maintained in proper working condition with regular inspections for leaks.
- Trash receptacles shall be available on-site to manage waste and debris generated from construction workers and activities.

- All construction materials shall be stored, used, and disposed of properly and be placed outside of areas prone to flooding.
- When rainfall is forecast, the construction schedule shall be adjusted to implement soil stabilization and sediment controls on all disturbed areas prior to the onset of rain.
- If necessary, provide secondary containment systems around material storage areas to prevent contaminated run-off/run-on from leaving storage area(s).
- Construct concrete washout station for tools and other equipment.
- Do not apply asphalt, concrete paving, seal coat, tack coat, slurry seal, or fog seal if rain is expected during the application or curing period.
- Locate sanitary facilities away from watercourses and waterbodies.
- Routinely inspect on-site sanitary/septic facilities for leaks.
- Implement appropriate measures to prevent any debris, soil, rock, or other materials associated with construction from entering waterways.
- Manage runoff using perimeter sediment controls: temporary desilting basins, silt fences, fiber rolls, gravel bag barriers, temporary soil stabilization with mattresses and mulching, temporary drainage inlet protection, diversion dikes, and interceptor swales.
- All vehicles should be fueled and maintained in a designated area with good housekeeping and appropriate BMPs to prevent spills, leaks, and contaminated runoff. A Spill Prevention Control and Countermeasure plan should be prepared for the Project Site to identify spill cleanup procedures for cases of accidental spills. Fuels should be stored in regulated containers on a level surface and properly labeled and maintained at all times. Spills and leaks should be prevented at the maximum extent practicable.

7.2.3 Groundwater

Dewatering may occur during construction of NHD2 under the CDSM Alternative and would occur during construction of NHD2 under the Excavate and Recompact Alternative. In addition, the basin may require dewatering if groundwater is encountered. On-going groundwater monitoring should be conducted during construction dewatering activities.

7.2.4 Flood Hazard

Prior to construction, safety measures and evacuation routes will be developed in an emergency response plan. The emergency response plan will be implemented during construction to reduce the risk of flood hazards to people and property. Therefore, no BMPs related to flood hazard are required.

7.3 Mitigation Measures and BMPs during Operations

Operational impacts related to hydrology, water quality, groundwater, and flooding would be less than significant; therefore, no mitigation measures are required.

7.4 Mitigation Measures and BMPs Related to Cumulative Impacts

There are no significant impacts related to cumulative hydrology impacts of the Proposed Project; therefore, no mitigation measures are required. BMPs implemented during construction would serve to further reduce cumulative impacts.

8 CEQA Significance Conclusions

This report is prepared pursuant to the CEQA to aid in the evaluation of the environmental impact of the Proposed Project (CEQA Guidelines Section 15064). Implementation of BMPs would reduce potential impacts based on CEQA thresholds of significance to a level considered less than significant. Based on the analysis presented in this report and according to CEQA Statutes Section 21083 (Significance Guidelines) and CEQA Guidelines Section 15065, impacts due to Hyd-2 to Hyd-10 would not occur, or be less than significant. Impacts due to Hyd-1 would be less than significant with mitigation.

9 NEPA Impacts Summary

The affected environment would be altered due to this Project, but the Project Area will still be a natural hydrologic system.

9.1 Summary of Impacts

Under the No Project alternative, the existing Dam is at risk of failure due to seismic instability. In case of the failure of the existing Dam, communities upstream of NHD would be flooded and people's lives will be at risk. NHD failure may cause interruption in the proper functioning of the LAA, which provides water for the greater Los Angeles area.

9.2 Significance under NEPA

The Proposed Project Alternatives would result in construction of NHD2, the LAA Realignment, the basin and its components, and the Cactus Flats Road Realignment. The Proposed Project would result in the direct and indirect contribution of cumulative impacts that are described above. Impacts would be reduced with implementation of BMPs. The Project and the Action Alternatives would additionally comply with all federal, State, and local laws and regulations.

The Project has been designed to minimize the impacts due to a dam failure. Proposed conditions in terms of drainage patterns and surface and groundwater quality and quantity would be very similar to the existing conditions.

10 References

Black & Veatch, 2013, North Haiwee Dam No. 2 Seismic Improvement Project Technical Memorandum – Fault Consideration Report

Black & Veatch and URS. 2014a. Aquifer Pumping Tests: Proposed North Haiwee Dam No. 2 Site, Inyo County, California. August 2015.

Black & Veatch, 2014b, Ground Motion Hazard Analysis North Haiwee Dam Number 2, October 2013

Black & Veatch, 2015, North Haiwee Dam No. 2 Seismic Improvement Project Technical Memorandum – Wave Generation and Run-up, Performed for the Los Angeles Department of Water and Power, January 2015

Bryant, W., E.W. Hart, 2007, Fault-Rupture Hazard Zones In California, Alquist-Priolo Earthquake Fault Zoning Act With Index to Earthquake Fault Zones Maps.

California Department of Fish and Wildlife, 2015 (2015a), California Fish and Game Code, Sections 1600-1616, Available: https://www.dfg.ca.gov/wildlife/nongame/regcode.html.

California Department of Fish and Wildlife, 2015b, California Fish and Game Code, Sections 5650-5656, Available: https://www.dfg.ca.gov/wildlife/nongame/regcode.html.

California Natural Resources Agency, 2014, California Environmental Quality Act, Available: http://resources.ca.gov/ceqa/.

California Regional Water Quality Control Board Lahontan Region (Lahontan RWQCB) June 2001, Total Maximum Daily Load For Copper, Haiwee Reservoir, Inyo County, California, Draft Progress Report. Available at http://www.waterboards.ca.gov/lahontan/water_issues/programs/tmdl/haiwee/docs/haiwee_tmdl_all.pdf.

California Regional Water Quality Control Board Lahontan Region (Lahontan RWQCB), 1995, Water Quality Control Plan for the Lahontan Region, Available at http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml.

California Water Code, Part 2. State Flood Control, Chapter 4. Colbey-Alquist Floodplain Management Act, Available: http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=wat&codebody=&hits=20.

California Water Boards, 2014, Statutory Water Rights LAW and Related Water Code Sections, Available: http://www.waterboards.ca.gov/laws_regulations/docs/wrlaws.pdf,

County of Inyo, California, 2015, Inyo County Planning Department, Goals and Policies Report. Available: http://inyoplanning.org/general_plan/goals.htm,

County of Inyo, California, 1972, Agreement Between the County of Inyo and the City of Los Angeles and Its Department of Water and Power on a Long Term Groundwater Management Plan for Owens Valley and Inyo County. Available: http://www.inyowater.org/documents/governing-documents/water-agreement/

Dean, R.G. and R.A. Dalrymple, 1984, Water Wave Mechanics for Engineers and Scientists, Prentice-Hall, New Jersey, 353 pp.

Federal Emergency Management Agency (FEMA), United States Department of Homeland Security, 2015 (2015a), FEMA's Flood Map Service Center. Available: https://msc.fema.gov/portal.

Federal Emergency Management Agency (FEMA), United States Department of Homeland Security, 2015 (2015b), Executive Order 11988: Floodplain Management. Available: https://www.fema.gov/executive-order-11988-floodplain-management#.

Hromadka II, T.V., 1986. County of San Bernardino Hydrology Manual, San Bernardino County, California.

Ichinose, G.A., Bryant, W. A. and Hart, E. W., 2007, Fault-Rupture Hazard Zones in California: California Geological Survey Special Publication 42 (Interim Revision 2007), 42 p, (digital version only, electronic document, available at ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf).

Kalff, J., 2002, Limnology, 2nd edition.

Lancaster, J.T. ,2013, Observations Demonstrating The Runoff Initiation of The August 26, 2010 Postfire Debris Flows, Haiwee Creek, Inyo County, California, California Geological Survey. The Geological Society of America, 109th Annual Meeting.

Los Angeles Department of Public Service (LADPS), 1916, Complete Report on Construction of the Los Angeles Aqueduct With Introductory Historical Sketch

Los Angeles County Department of Public Works (LACDPW), 2006, Sedimentation Manual, 2nd Edition, March 2006.

Los Angeles Department of Water and Power (LADWP), n.d., North Haiwee Dam Inundation Map, Inyo County California (No Date Available on Map)

Los Angeles Department of Water and Power (LADWP), 2015, North Haiwee Dam No. 2 Project: Geotechnical Data Report Working Draft, Volume I Text, Tables, and FIGUREs and Volume II Appendices, Inyo County, California, July 2016

Los Angeles Department of Water and Power (LADWP), 2001, North Haiwee Dam Seismic Stability Evaluation Volume I and II, July 2001.

MWH. (2012a), Final Report on the Owens Lake Groundwater Evaluation Project.

MWH. (2012b), Final Owens Lake Groundwater Evaluation Project Model Documentation

MWH (2011a), Owens Lake Groundwater Evaluation Project: Updated Conceptual Model Report.

MWH. (2011b), Groundwater Evaluation Project: Evaluation of Geophysical Data.

Sierra GeoSciences LLC, November 2002, Summary of Construction, Analyses, and Long Term Monitoring: Fault Test Site, Owens Lake, Inyo County, California. Prepared for Great Basin Unified Air Pollution Control District, Bishop, California.

State Water Resources Control Board (SWRCB), 2015 (2015a), Clean Water Act Section 401: http://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.shtml.

State Water Resources Control Board (SWRCB), 2015 (2015b), Water Quality Construction Best Management Practices Manual. December 2002. Available at http://www.waterboards.ca.gov/water_issues/programs/cwa401/docs/certifications/snrse_h.pdf , assessed August 31, 2015

State Water Resources Control Board (SWRCB), 2010, Integrated Report (Clean Water Act Section 303(d) List/ 305 (b) Report, Available: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml.

State Water Resources Control Board (SWRCB), 2008, California Antidegradation Policy, Available: http://www.waterboards.ca.gov/academy/courses/wqstandards/materials/mod14/14caantidegpolicy.pdf.

Inyo County Water Department. 1998, Groundwater Ordinance. Available: http://www.inyowater.org/documents/governing-documents/groundwater-ordinance/, assessed July 30, 2015.

U.S. Army Corps of Engineers (USACE), Los Angeles District, 2000, Debris Method- Los Angeles District Method for Prediction of Debris Yield, February 2000.

U.S. Army Corps of Engineers (USACE), 1997, Shore Protection Manual, 3rd edition, Coastal Engineering Research Center, Washington, D.C.

U.S. Geological Survey (USGS), 2011, Susceptibility to Deep-Seated Landslides in California, C.J. Wills, F.G. Perez and C.I. Gutierrez.

U.S. Geological Survey (USGS), 2013, Department of the Interior, Final Technical Report: Refining the Southern extent of the 1872 Owens Valley earthquake rupture- Paleosesmic investigations at Sage Flat and Haiwee Meadow, California.

United States Environmental Protection Agency (USEPA), 2015 (2015a), National Environmental Policy Act, Available: http://www2.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act.

United States Environmental Protection Agency (USEPA), 2015 (2015b), Recourse Conservation and Recovery Act (RCRA), Available: http://www2.epa.gov/laws-regulations/summary-national-environmental-policy-act.

United States Environmental Protection Agency (USEPA), 2015 (2015c), Protection of Wetlands, Available: http://water.epa.gov/lawsregs/guidance/wetlands/eo11990.cfm.

United States Environmental Protection Agency (USEPA), 2015 (2015d), What is Sediment Pollution, Available: https://cfpub.epa.gov/npstbx/files/ksmo_sediment.pdf.

United States Environmental Protection Agency (USEPA), 2013 (2013a), Water Quality Standards Handbook- Chapter 4: Antidegradation (40 CFR 131.12). Available: http://water.epa.gov/scitech/swguidance/standards/handbook/chapter04.cfm.

United States Environmental Protection Agency (USEPA), 2013 (2013b), Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliances, Available: http://water.epa.gov/lawsregs/rulesregs/ntr/.

United States Environmental Protection Agency (USEPA), 2012 (2012a), Clean Water Act Section 401, Certification. Available: http://water.epa.gov/lawsregs/guidance/wetlands/sec401.cfm.

United States Environmental Protection Agency (USEPA), 2012 (2012b), Clean Water Act Section 402, National Pollutant Discharge Elimination System. Available: http://water.epa.gov/lawsregs/guidance/wetlands/section402.cfm.

United States Environmental Protection Agency (USEPA), 2012 (2012c), Clean Water Act Section 404, Permitting, Discharge of Dredged or Fill Material. Available: http://water.epa.gov/lawsregs/guidance/cwa/dredgdis/, Assessed: 2012.

United States Environmental Protection Agency (USEPA), 2012 (2012d), Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California Factsheet, Available: https://www.epa.gov/wqs-tech/water-quality-standards-establishment-numeric-criteria-priority-toxic-pollutants-state.

United States Environmental Protection Agency (USEPA), 1974, Safe Drinking Water Act (SDWA). Available: http://water.epa.gov/lawsregs/rulesregs/sdwa/index.cfm

United States Environmental Protection Agency (USEPA), 1972, Clean Water Act Section 303, Water Quality standards and Implementation Plans. Available at: http://water.epa.gov/lawsregs/guidance/303.cfm

URS, 2007, Preliminary Local Fault Investigation for Proposed North Haiwee dam Number 2, Inyo County, California, report prepared for the Los Angeles Department of Water & Power dated December 20, 2007

Van Dorn, W.G., 1953, Wind Stresses on an Artificial Pond, Journal of Marine Research, v.12, no.3.

Wagner, David L., 2010 California Geological Survey, Cordilleran Section - 106th Annual Meeting, and Pacific Section, American Association of Petroleum Geologists, Paper No. 50-9, May 27-29, 2010. Available at https://gsa.confex.com/gsa/2010CD/finalprogram/abstract_172797.htm, accessed February 25, 2014.

11 List of Abbreviations and Acronyms

ACES	Automated Coastal Engineering System
AMC	Antecedent Moisture Condition
bgs	below ground surface
BMP	Best Management Practice
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CDSM	Cement Deep Soil Mixing Alternative
CEQA	California Environmental Quality Act
CFR	Cactus Flats Road Realignment
cfs	cubic feet per second
CGP	Construction General Permit
CN	curve number
CTR	California Toxics Rule
CWA	Federal Clean Water Act of 1972
DPA	Debris production zones or areas
DSOD	Division of Safety of Dams
EIS	Environmental Impact Statement
FLD	Flood Hazards
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FF	Fire Factor
ft/mi	feet per mile
GIS	Geographic Information System
gSSURGO	Gridded Soil Survey Geographic
HUC	hydrologic unit code
LACDPW	Los Angeles County Department of Public Works
LADWP	Los Angeles Department of Water and Power
MCE	Maximum Credible Earthquake
MER	Mineral and Energy Resources
NEPA	National Environmental Policy Act of 1970
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
OVFZ	Owens Valley Fault Zone
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
PRD	Permit Registration Documents
PSU	Public Services and Utilities
RCRA	Resource Conservation and Recovery Act
ROWD	Report of Waste Discharge
RR	Relief Ratio
RWQCB	Regional Water Quality Control Board
S	Soils
SCS	Soil Conservation Service
SIP	State Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries
SNFFZ	Sierra Nevada Frontal Fault Zone
SWPPP	Stormwater Pollution Prevention Plan

SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WDR	waste discharge requirements
WMS	Watershed Modeling System
WQO	Water Quality Order
WR	Water Resources
yd^3/mi^2	cubic yards per square mile

12 Preparer Qualifications

12.1 CWE

Vik Bapna, P.E., CPSWQ, QSD/P	Project Manager
Ben Willardson, PhD, P.E., D.WRE, QSD/P	Senior Engineer
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13 Appendices

13.1 Appendix I: FEMA Maps

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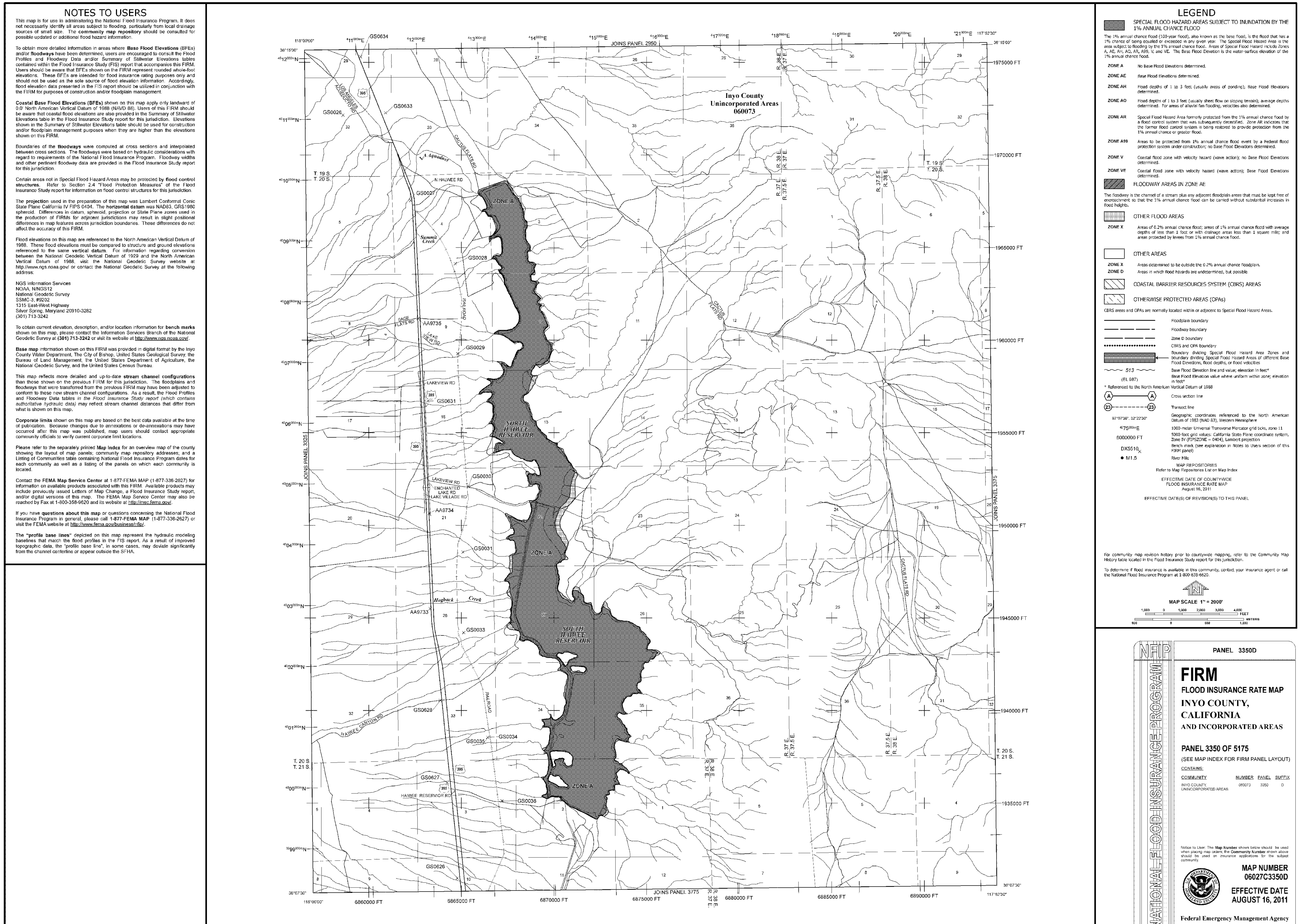

FIGURE 13-1
FLOOD INSURANCE RATE MAP
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13.2 Appendix II: NHD2 Groundwater Elevations

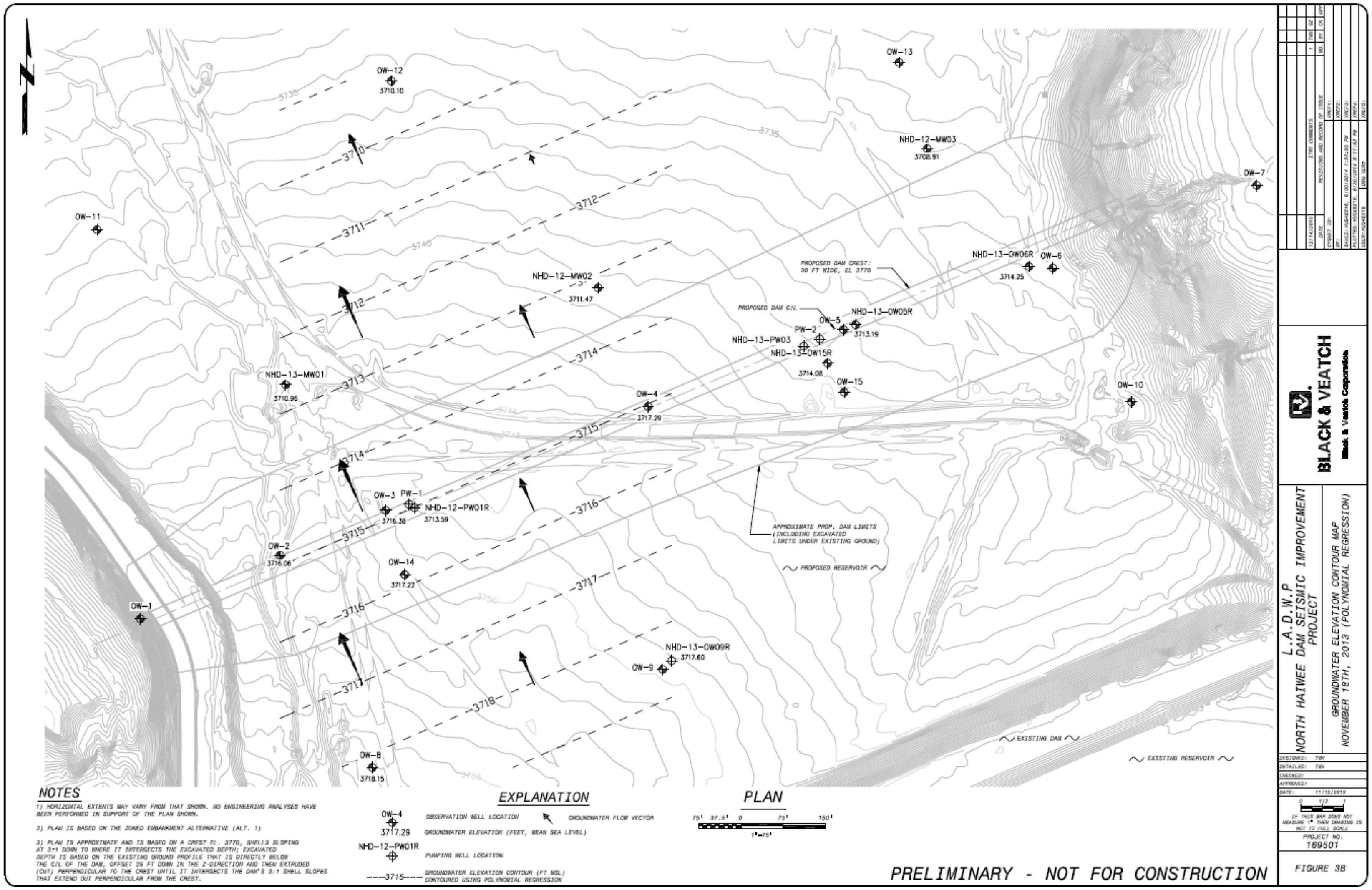

FIGURE 13-2
NHD2 GROUNDWATER ELEVATIONS

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13.3 Appendix III: Owens Lake Groundwater Evaluation Project Study Area

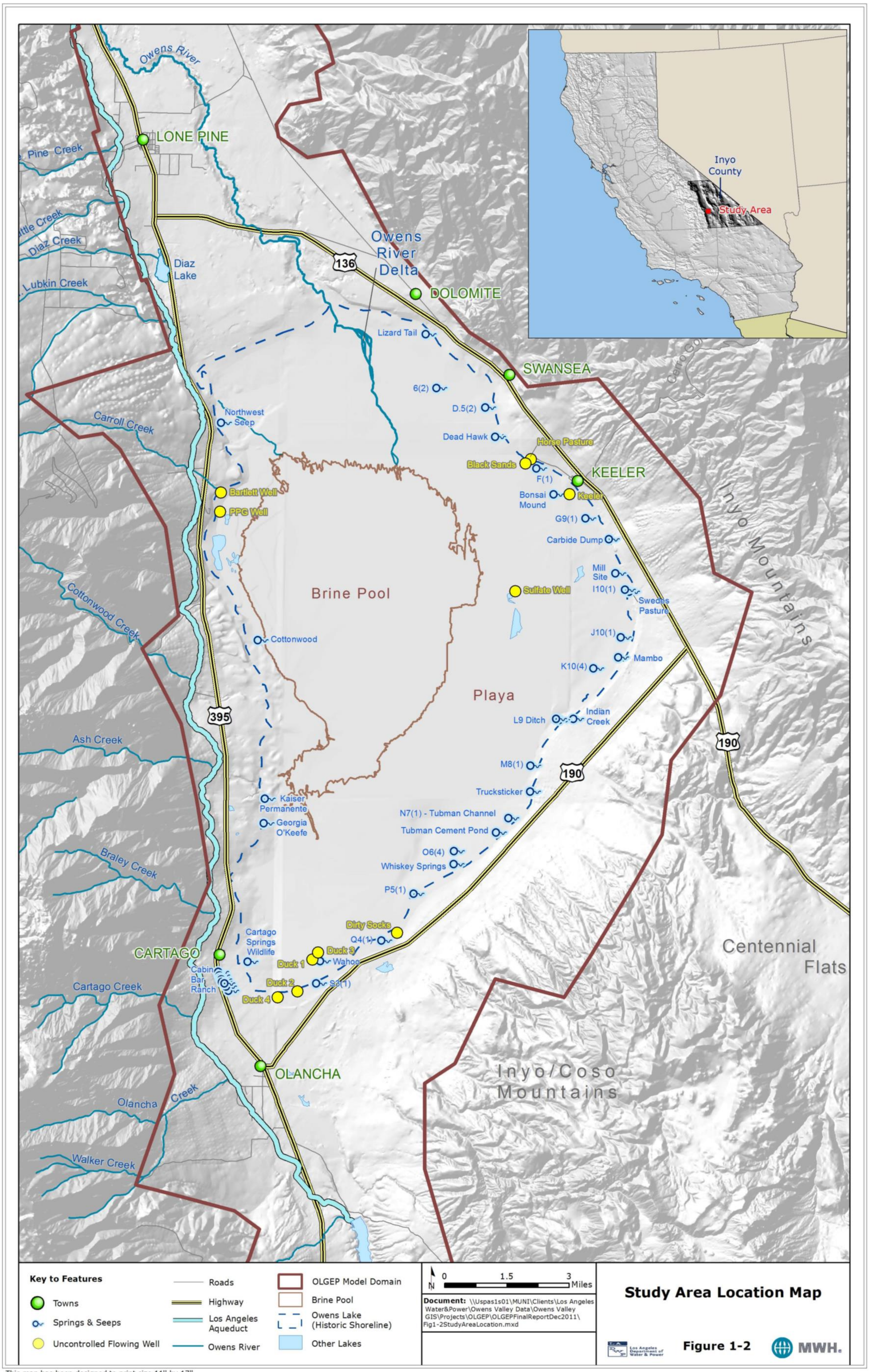

FIGURE 13-3
NHD2 GROUNDWATER ELEVATIONS

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13.4 Appendix IV: Calculations

To calculate the drainage at each project location, a WMS model is used to delineate the area and define the subareas that drain into each project element. The runoff produced by each subarea is calculated using a Rational Method based on the County of San Bernardino Hydrology Manual.

For each subarea, the time of concentration is calculated using Kirpich method for overland flow:

$$t_c = 0.00013 \times (\frac{L^{0.77}}{S^{0.385}})$$

Where:

t_c = time of concentration (hr)

L= Longest flow path (ft)

S= Slope of the longest flow path (ft/ft)

For each subarea, rainfall rate is calculated based on

TABLE 3-1 for each return period of 2-, 10-, 25-, 50- and 100-year. Using the Rational method, runoff for each subarea is calculated at each project element location and the summation of all the runoffs are used at the total drainage to that project location.

Drainage to LAA eventually flows to NHD2 site after overtopping the LAA. Therefore at each return period, the capacity of the LAA is subtracted from its drainage and the result is added to NHD2 site drainage.

Drainage to NHD2 eventually flows to the Cactus Flats Road site and therefore in calculations, for each return period, flows from NHD2 is added to the drainage to the Cactus Flats Road site.

TABLE IV-1
EXISTING LAA RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
20	50.9	2372	0.02	0.23	13.58	1.31	3.07	3.93	4.77	5.56
22	5,514.6	53,834	0.11	1.33	79.83	0.45	1.06	1.36	1.65	1.92
23	8.4	611	0.07	0.05	3.10	2.13	4.61	5.84	7.02	8.13

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-2
REALIGNED LAA RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
20	50.9	2,372	0.02	0.23	13.58	1.31	3.07	3.93	4.77	5.56
22	5,511.3	53,834	0.11	1.33	79.83	0.45	1.06	1.36	1.65	1.92
23	3.6	382	0.07	0.04	2.16	2.26	4.91	6.12	7.48	8.66

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-3
EXISTING LAA FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
20	0.3	0.14	0.04	0.69	0.86	0.87	0.87	0.89	46	134	174	212	253
22	0.3	0.14	0.04	0.30	0.78	0.81	0.82	0.88	759	4,561	6,040	7,479	9,316
23	0.3	0.14	0.04	0.77	0.87	0.88	0.88	0.90	14	34	43	52	61
Total Discharge (cfs)									820	4,729	6,257	7,744	9,630

Where Fp = Infiltration Rate, C = Runoff Coefficient, and Q = Flowrate
Source : CWE, 2016

TABLE IV-4
REALIGNED LAA FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
20	0.3	0.14	0.04	0.69	0.86	0.87	0.87	0.89	46	134	174	212	253
22	0.3	0.14	0.04	0.30	0.78	0.81	0.82	0.88	759	4,558	6,037	7,475	9,310
23	0.3	0.14	0.04	0.78	0.87	0.88	0.88	0.90	6	15	19	24	28
Total Discharge (cfs)									812	4,708	6,230	7,711	9,591

Where Fp = Infiltration Rate, C = Runoff Coefficient, and Q = Flowrate
Source : CWE, 2016

TABLE IV-5
EXISTING NHD RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
21	1.6	110	0.02	0.02	1.37	2.39	5.20	6.57	7.91	9.16
24	127.7	8,316	0.08	0.37	22.01	1.03	2.23	2.82	3.39	3.93
25	0.2	103	0.02	0.02	1.28	2.41	5.23	6.62	7.96	9.22

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-6
NHD2 RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
21	9.6	820	0.02	0.11	6.43	1.76	3.82	4.84	5.82	6.74
22	5523.4	54,000	0.11	1.33	80.02	0.45	1.06	1.36	1.64	1.91
24	147.6	9,203	0.08	0.40	23.80	0.98	2.13	2.70	3.25	3.76
25	2.3	810	0.02	0.10	6.27	1.78	3.86	4.88	5.87	6.80

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-7
EXISTING NHD FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
27	0.3	0.14	0.04	0.79	0.88	0.88	0.88	0.90	3	7	9	11	13
55	0.3	0.14	0.04	0.64	0.84	0.86	0.86	0.89	83	240	308	374	447
54	0.3	0.14	0.04	0.79	0.88	0.88	0.88	0.90	0.4	1	1	2	2
Total Discharge (cfs)									87	248	319	387	462
Total + LAA Drainage Discharge (cfs)									907	4,978	6,576	8,131	10,092

Where Fp = Infiltration Rate, C = Runoff Coefficient, and Q = Flowrate
Source : CWE, 2016

TABLE IV-8

NHD2 FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
21	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	15	32	41	49	58
22	0.3	0.14	0.04	0.82	0.78	0.81	0.82	0.88	2,048	4,558	6,040	7,476	9,316
24	0.3	0.14	0.04	0.86	0.84	0.85	0.86	0.89	125	265	340	413	494
25	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	4	8	10	12	14
Total Discharge (cfs)									2,192	4,863	6,430	7,950	9,882
Total + Realigned LAA Drainage Discharge (cfs)									3,003	9,571	12,660	15,661	19,472

Where Fp = Infiltration Rate, C = Runoff Coefficient, and Q = Flowrate
Source : CWE, 2016

TABLE IV-9
EXISTING CFR RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
20	83.5	3,337	0.02	0.29	17.66	1.15	2.70	3.46	4.20	4.88
21	9.0	820	0.02	0.11	6.43	1.76	3.82	4.84	5.82	6.74
22	5,526.4	55,025	0.11	1.35	81.18	0.45	1.05	1.34	1.63	1.90
23	10.5	1,340	0.07	0.09	5.68	1.83	3.97	5.03	6.05	7.01
24	141.3	8,316	0.08	0.37	22.01	1.03	2.23	2.82	3.39	3.93
25	2.6	879	0.02	0.11	6.68	1.74	3.78	4.78	5.75	6.66
27	253.1	9,475	0.07	0.41	24.85	0.96	2.08	2.63	3.17	3.67
28	0.7	30	0.01	0.01	0.59	2.54	5.97	7.65	9.29	10.82

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-10
REALIGNED CFR RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
21	13.6	1,790	0.02	0.20	11.72	1.40	3.05	3.85	4.64	5.37
22	5,533.5	56,013	0.11	1.37	82.30	0.44	1.04	1.33	1.61	1.88
23	20.5	1,800	0.07	0.12	7.13	1.70	3.70	4.68	5.63	6.52
24	112.8	7,163	0.08	0.33	19.62	1.09	2.37	3.00	3.61	4.18
27	248.0	9,298	0.07	0.41	24.49	0.97	2.10	2.66	3.20	3.70
28	3.8	910	0.01	0.14	8.16	1.62	3.81	4.89	5.93	6.91
29	27.1	2,470	0.05	0.17	10.45	1.47	3.46	4.44	5.38	6.27

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-11
EXISTING CACTUS FLATS ROAD FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
20	0.3	0.14	0.04	0.87	0.85	0.86	0.87	0.89	84	192	249	305	364
21	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	14	30	38	46	54
22	0.3	0.14	0.04	0.82	0.78	0.81	0.82	0.88	2,029	4,511	5,978	7,396	9,226
23	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	17	36	46	56	66
24	0.3	0.14	0.04	0.86	0.84	0.86	0.86	0.89	125	265	341	413	494
25	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	4	8	11	13	15
27	0.3	0.14	0.04	0.86	0.84	0.85	0.86	0.89	209	442	568	690	827
28	0.3	0.14	0.04	0.89	0.88	0.88	0.89	0.90	2	4	5	6	7
Total Discharge (cfs)									2,484	5,489	7,236	8,924	11,053
Total + NHD+LAA Drainage Discharge (cfs)									3,390	10,466	13,812	17,055	21,145

Source : CWE, 2016

TABLE IV-12
REALIGNED CFR ROAD FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
21	0.3	0.14	0.04	0.87	0.86	0.87	0.87	0.89	17	35	45	55	65
22	0.3	0.14	0.04	0.82	0.78	0.81	0.82	0.88	2,007	4,467	5,921	7,331	9,149
23	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	31	65	84	101	119
24	0.3	0.14	0.04	0.87	0.85	0.86	0.87	0.89	107	226	290	352	420
27	0.3	0.14	0.04	0.86	0.84	0.85	0.86	0.89	207	437	561	682	817
28	0.3	0.14	0.04	0.88	0.87	0.87	0.88	0.89	5	13	16	20	24
29	0.3	0.14	0.04	0.88	0.86	0.87	0.88	0.89	35	81	105	128	152
Total Discharge (cfs)									2,408	5,325	7,023	8,669	10,746
Total + NHD2+LAA Drainage Discharge (cfs)									5,412	14,896	19,683	24,329	30,218

Where Fp = Infiltration Rate, C = Runoff Coefficient, and Q = Flowrate
Source : CWE, 2016

TABLE IV-13
BORROW SITE 10 RAINFALL INTENSITY AND TIME OF CONCENTRATION

Basin ID	Area	L	S	t_c	t_c	I (2-yr)	I (10-yr)	I (25-yr)	I (50-yr)	I (100-yr)
	(ac)	(ft)	(ft/ft)	(hr)	(min)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(in/hr)
20	50.9	2,372	0.02	0.23	13.58	1.31	3.07	3.93	4.77	5.56
22	5,511.3	53,834	0.11	1.33	79.83	0.45	1.06	1.36	1.65	1.92
23	3.6	382	0.07	0.04	2.16	2.26	4.91	6.12	7.48	8.66

Where L = Length, S = Slope, tc = Time of Concentration, and I = Intensity
Source: CWE, 2016

TABLE IV-14

BORROW SITE 10 FLOW DATA

Basin ID	Fp (AMC I)	Fp (AMC II)	Fp (AMC III)	C (2-yr)	C (10-yr)	C (25-yr)	C (50-yr)	C (100-yr)	Q (2-yr)	Q (10-yr)	Q (25-yr)	Q (50-yr)	Q (100-yr)
	(in/hr)	(in/hr)	(in/hr)						(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
20	0.3	0.14	0.04	0.69	0.86	0.87	0.87	0.89	46	134	174	212	253
22	0.3	0.14	0.04	0.30	0.78	0.81	0.82	0.88	759	4,558	6,037	7,475	9,310
23	0.3	0.14	0.04	0.78	0.87	0.88	0.88	0.90	6	15	19	24	28
Total Discharge (cfs)									812	4,708	6,230	7,711	9,591

Where Fp = Infiltration Rate, C = Runoff Coefficient, and Q = Flowrate
Source : CWE, 2016

TABLE IV-15
LOCO CREEK PEAK DAILY FLOW

Year	1983	1978	1980	2006	2005	1986	1984	1977-2004	2007-20015
Q (cfs)	6.04	4.961	3.45	1.78	1.5	1.36	0.75	0	0

Where Q = Peak Daily Flow
Source: LADWP, 2016

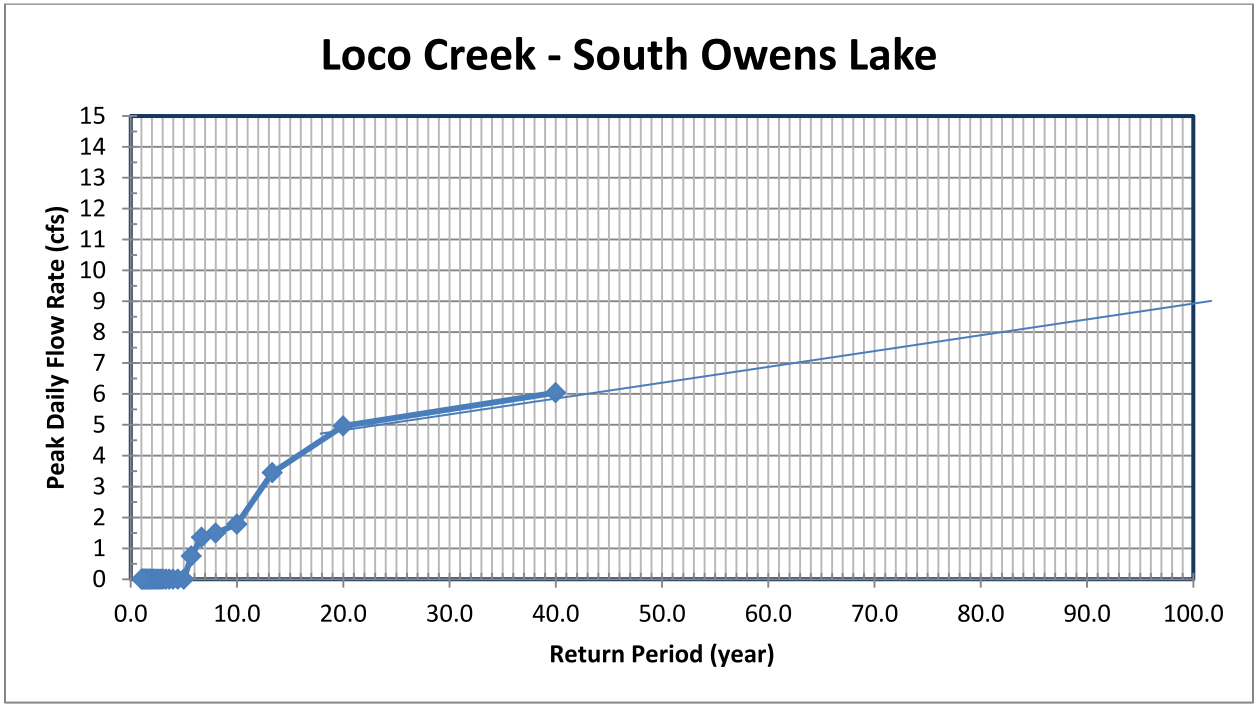

FIGURE 13-4
LOCO CREEK PEAK DAILY FLOW

TABLE IV-16
BRALEY CREEK FLOW DATA

Year	1997	1995	2002	1969	2010	1991	2005	1978	2006	1986	1983	1980	1996	1966	1998	1952	1958	1982
Q (cfs)	12.402	11.797	11.5	10.799	7.85	7.804	5.989	5.798	5.757	5.238	5.173	5.042	5.042	4.865	4.779	4.134	3.781	3.58
Year	1993	1944	2011	1984	1955	2008	2003	1970	1973	2001	1963	1985	1946	1945	1981	2004	1999	1979
Q (cfs)	3.332	3.237	3.181	3.156	3.126	3.08	3.015	2.864	2.864	2.778	2.758	2.758	2.536	2.521	2.521	2.521	2.46	2.344
Year	1987	1947	1974	1954	1962	2000	2012	1971	1989	1992	2009	1953	1967	1950	1975	2007	1957	1959
Q (cfs)	2.139	1.966	1.936	1.931	1.931	1.901	1.8	1.664	1.664	1.664	1.628	1.613	1.613	1.598	1.563	1.528	1.512	1.512
Year	1976	2013	1965	1956	1994	1948	1988	1960	1968	1977	1990	2016	2014	1949	1972	2015	1961	1951
Q (cfs)	1.512	1.502	1.497	1.492	1.381	1.361	1.311	1.17	1.16	1.16	1.119	1.112	1.108	1.074	1.059	0.857	0.832	0.807
Year	1964																	
Q (cfs)	0.655																	

Where Q = Peak Daily Flow
Source: LADWP, 2016

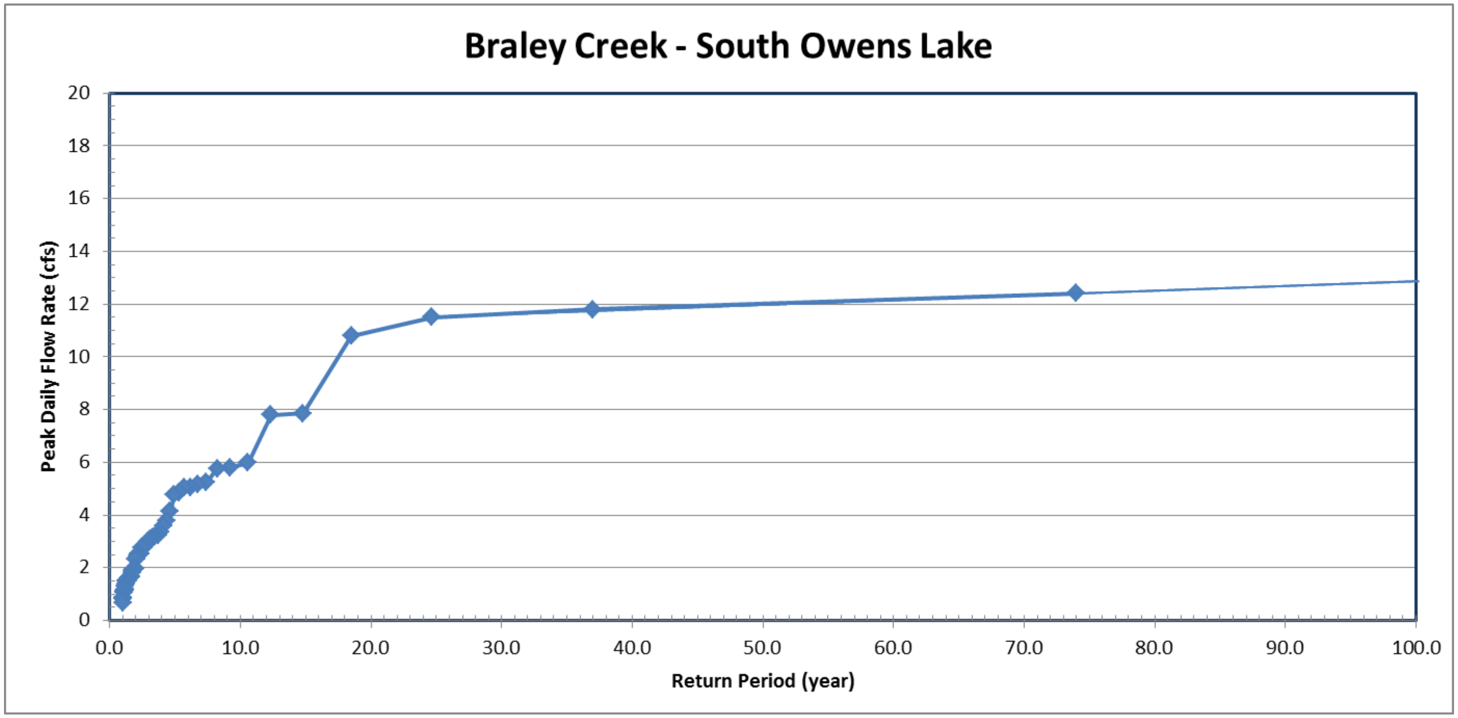

FIGURE 13-5
BRALEY CREEK PEAK DAILY FLOW