3.2 Physical Environment

3.2.1 Hydrology and Floodplain

Regulatory Setting

Executive Order (EO) 11988 (Floodplain Management) directs all federal agencies to refrain from conducting, supporting, or allowing actions in floodplains unless it is the only practicable alternative. The Federal Highway Administration (FHWA) requirements for compliance are outlined in 23 *Code of Federal Regulations* (CFR) 650 Subpart A.

To comply, the following must be analyzed:

- The practicability of alternatives to any longitudinal encroachments.
- Risks of the action.
- Impacts on natural and beneficial floodplain values.
- Support of incompatible floodplain development.
- Measures to minimize floodplain impacts and to preserve/restore any beneficial floodplain values affected by the project.

The base floodplain is defined as "the area subject to flooding by the flood or tide having a one percent chance of being exceeded in any given year." An encroachment is defined as "an action within the limits of the base floodplain."

Affected Environment

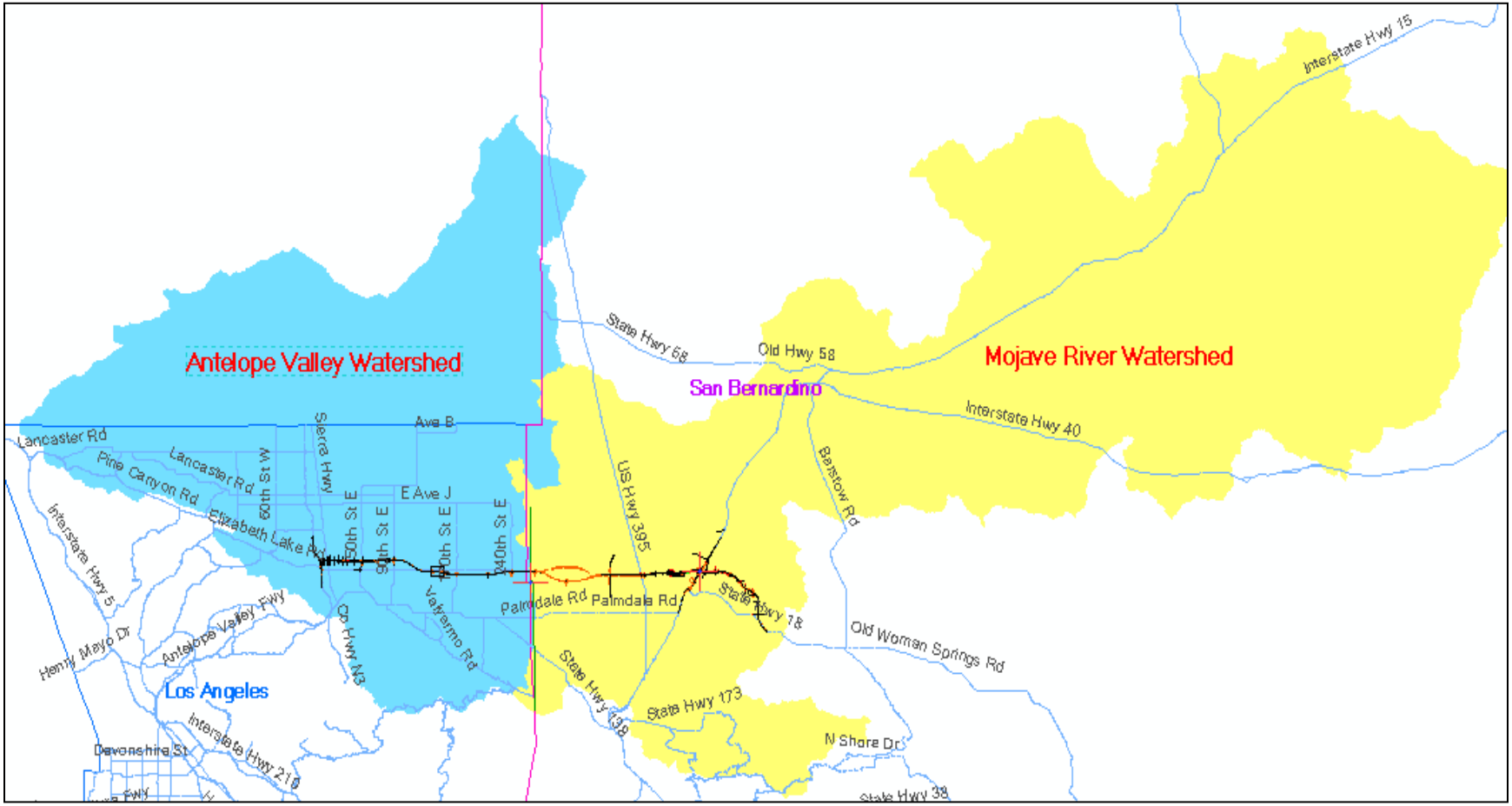
Existing data sources used to prepare this section were taken from the *Preliminary Hydrology and Hydraulics Report* (Parsons, 2014) and the *Final Preliminary Geomorphology Report* (Parsons, 2014).

The HDC traverses two watersheds (Antelope Valley and Mojave River) (see Figure 3.2.1-1).The west portion of the project area is located in the Antelope Valley watershed. This watershed encompasses approximately 1,220 square miles within Los Angeles County and 143 square miles in San Bernardino County. Numerous streams originating in the mountains and foothills flow across the valley floor and eventually pond in several dry lakes to the north, including Rosamond Lake and Rogers Lake.

The east portion of the project area is located in the Mojave River Watershed. The Mojave River includes perennial low-flow channels along the streambed, and it supports extensive riparian vegetation along its banks and adjacent areas.

In general, the hydrologic regime along the entire corridor exhibits the characteristics of an alluvial fan, with several incised streams and channels that cross the project alignment, including Mojave River, Bell Mountain Wash, Fremont Wash, Mescal Wash, Big Rock Creek, and Little Rock Creek. These are considered the largest waterways within the project area and, with the exception of Bell Mountain Wash, generally flow northerly across the HDC site.

Figure 3.2.1-1 Antelope Valley and Mojave River Watersheds



The HDC area has a High Desert-type climate, characterized by long, dry, hot summers and cold and windy winters. Most of the precipitation occurs between October and May. Primarily, precipitation occurs as rainfall, with snow common in the high mountains. The proposed project crosses the following hydrologic areas/hydrologic subareas: Lancaster/626.50, Rock Creek/626.80, El Mirage/628.10, and Upper Mojave/628.20. Lands within the project watersheds are largely undeveloped, and most of the terrain is brush-covered. Some of the undeveloped land is used for rangeland or agricultural purposes. Sand and gravel deposits are found extensively in floodplains and stream channels located north of the San Gabriel Mountains in the Little Rock and Big Rock wash areas.

Soils are classified into four hydrological soil groups: A, B, C, and D, where Type A is the most pervious with low runoff potential (e.g., sand and gravel), and Type D is the least pervious with high runoff potential (e.g., clay soils). In the project area, Types A and B generally follow the alluvial deposits along the creeks and along the alluvial fan of major streams such as Little Rock Wash, Big Rock Wash, and the Mojave River. Types C and D are generally located along the hillsides, in the upper watersheds of Little Rock, Big Rock, Mescal, and Fremont washes and in the vicinity of the Mojave River. Along the alignment, most of the soil is characterized as Type A or B.

Flood Insurance Rate Map (FIRM) panels are provided in the *Preliminary Hydrology and Hydraulics Report* and are summarized in Table 3.2.1-1.

Table 3.2.1-1 Flood Insurance Rate Map Panels within the HDC

Flood Map No.	General Area	Flood Zone
06037C0700F, 06037C0659F, and 06037C0657F	Division Street to Sierra Highway, and between Avenue P-4 and Avenue P-8	AO
06037C0701F	70th Street E and east of Little Rock Wash	A
06037C0750F	East from E. Palmdale Boulevard to Big Rock Wash	A
06037C775H and 06071C5750H	East of the Los Angeles/San Bernardino county line to Richardson Road	D
06071C5805H	Adelanto Airport Road to Phantom E.	D
	Turner Wash and Ossam Wash	A
	The Mojave River	AE
06071C5810H	Bell Mountain Wash to the west of I-15	A
06071C5820H	Mojave River in the vicinity of I-15	AE
06071C5830H	I-15 to Waalew Road	D
06071C5845H	South of S Road to Candlewood Road	A
	Joshua Road to where the project terminates at SR-18	D

Source: HDC Preliminary Hydrology and Hydraulics Report, 2014.

Near the western terminus of the project, the proposed roadway is located in Flood Zone AO (i.e., an area inundated by shallow 100-year flooding usually in the form of

sheet flow on sloping terrain), for which average depths have been determined (see Figure 3.2.1-2). Flood depths range from 1 to 3 feet from Division Street to Sierra Highway and between Avenue P-4 and Avenue P-8. At these locations, the project alignment would be elevated more than 6 feet above grade.

The alignment between SR-14 and Division Street is located within Zone X. The alignment from Sierra Highway east to 53rd Street E also traverses Zone X. As shown in Figure 3.2.1-3, the project alignment between 70th Street E and east of Little Rock Wash is within Flood Zone A (an area inundated by 100 year flooding, for which no base flood elevations [BFEs] have been established). The alignment is located within Zone X from Little Rock Wash to 90th Street E.

As shown in Figure 3.2.1-4, the project alignment extending east from south of E. Palmdale Boulevard to Big Rock Wash is located within Zone A. The alignment east of the Los Angeles/San Bernardino county line to Richardson Road is within Zone D (i.e., an area of undetermined but possible flood hazards).

The alignment from Richardson Road to Adelanto Airport Road is within Zone X. The alignment from Adelanto Airport Road to Phantom E is within Zone D. As shown in Figure 3.2.1-5, the project alignment crosses Turner Wash and Ossam Wash, designated as Zone A. The area where the alignment crosses the Mojave River is designated as Zone AE (i.e., a Special Hazard Area inundated by 100-year flooding, for which base flood elevations [BFEs] have been established). As shown in Figure 3.2.1-6, the project alignment from the Bell Mountain Wash to the west of I-15 is within Zone A. Figure 3.2.1-7 shows the project alignment along I-15 where direct connectors would be constructed as part of the proposed freeway-to-freeway interchange. The alignment crosses the Mojave River within Zone AE in the vicinity of I-15. The alignment from I-15 to Waalew Road is within Zone D.

At the eastern terminus of the project, the alignment from south of S Road to Candlewood Road (west of Joshua Road) encroaches upon the north side of Apple Valley Lake, a closed basin designated as Zone A (see Figure 3.2.1-8). The alignment from Joshua Road to where the project terminates at SR-18 is within Zone D.

Portions of the watershed tributary to the HDC are located upstream of the California Aqueduct, which traverses the south side of the Antelope Valley. This facility is generally placed above grade, which causes it to act as a dam to some of the flows generated upstream. During the assessment of the sub-basin areas, however, it was determined that sufficient culvert and channel crossings under the aqueduct (and railroad tracks) exist to prevent flow diversions and impeded flows within the sub-basins. Therefore, the hydrology calculations will disregard the physical impacts of the California Aqueduct.

Figure 3.2.1-2 Flood Maps – City of Palmdale

Figure 3.2.1-3 Flood Map – Little Rock Wash

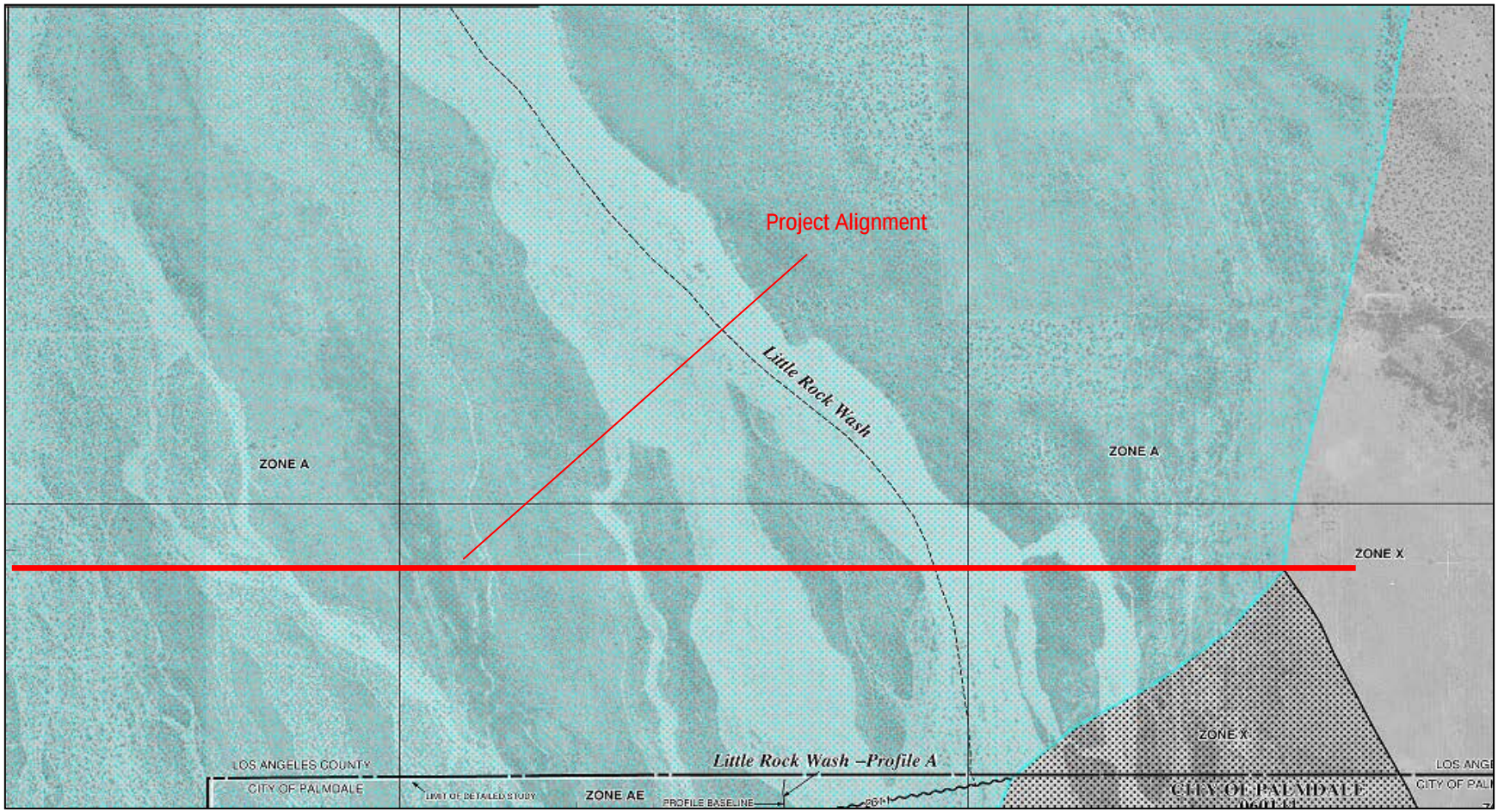


Figure 3.2.1-4 Flood Map – Big Rock Wash

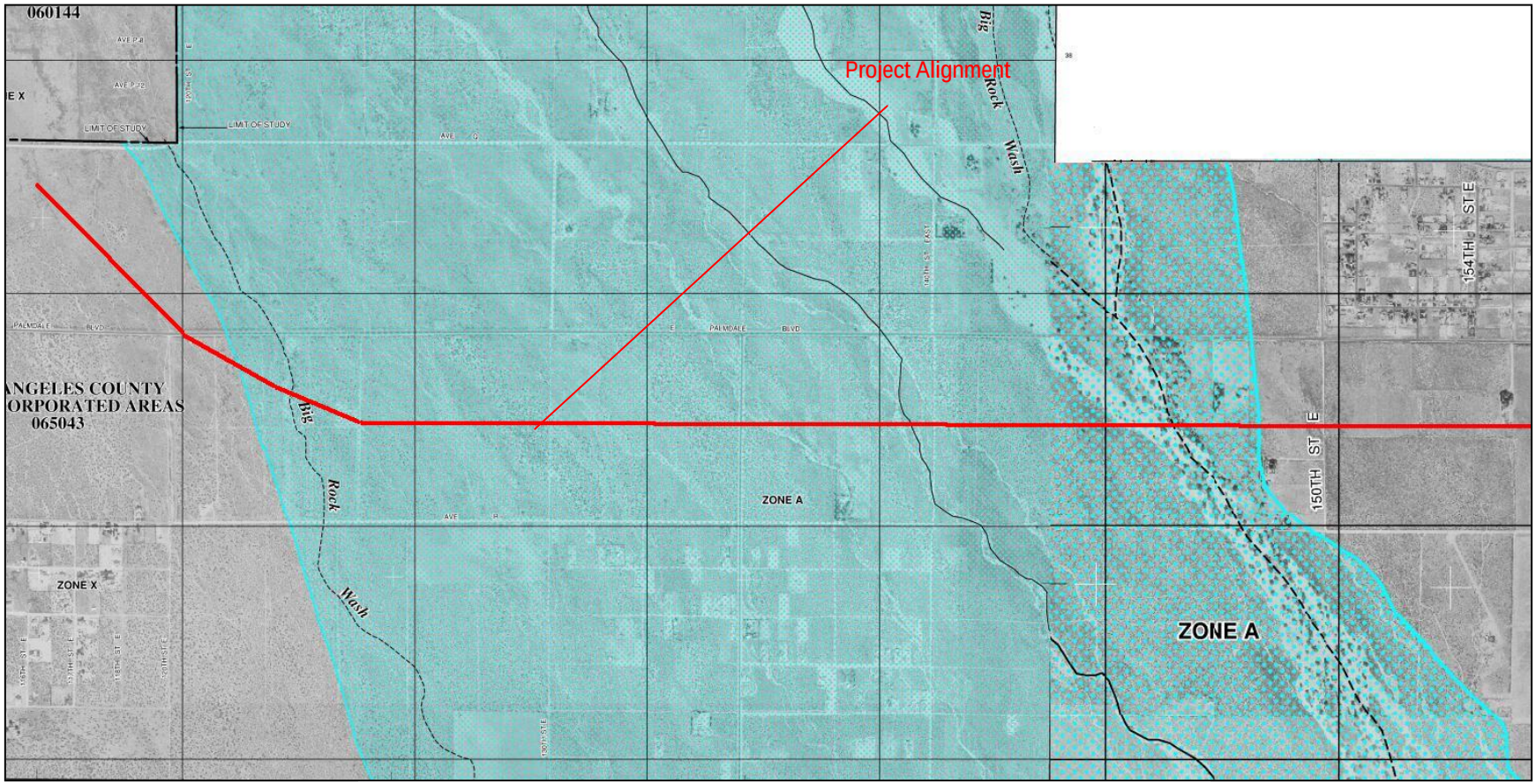


Figure 3.2.1-5 Flood Map – Mojave River and Tributaries

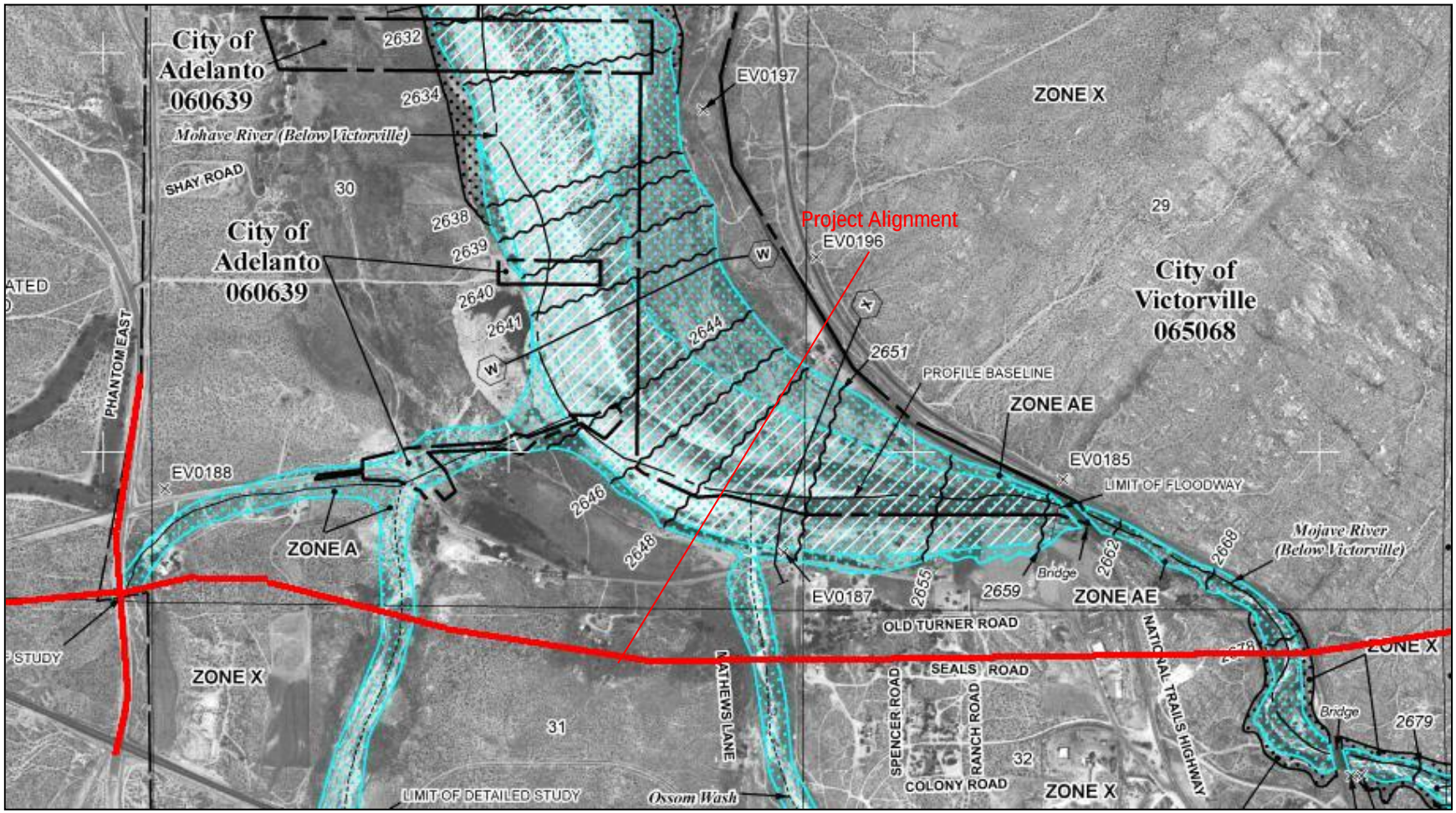


Figure 3.2.1-6 Flood Map – Bell Mountain Wash

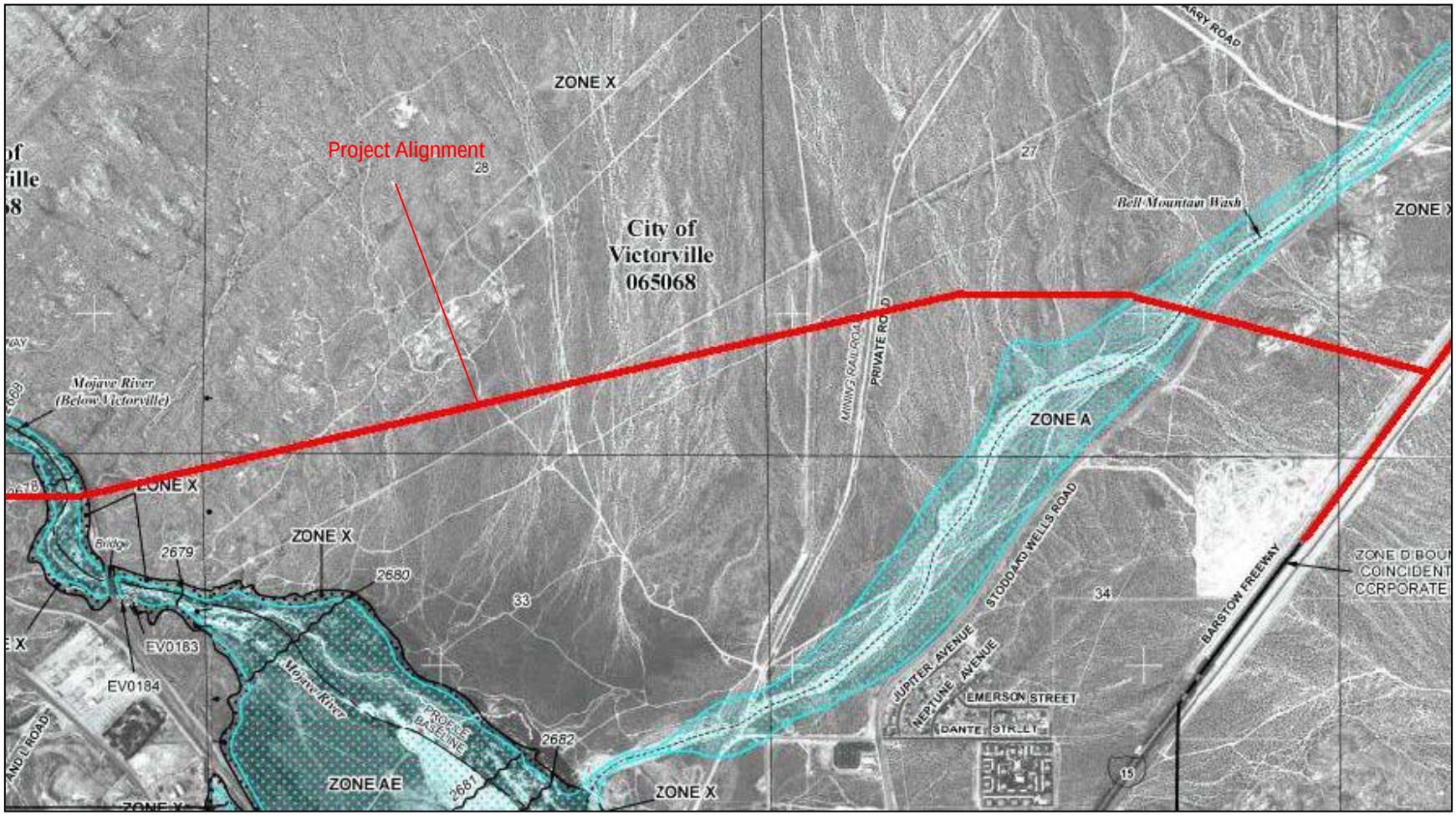


Figure 3.2.1-7 Flood Map – I-15 Connectors at Mojave River

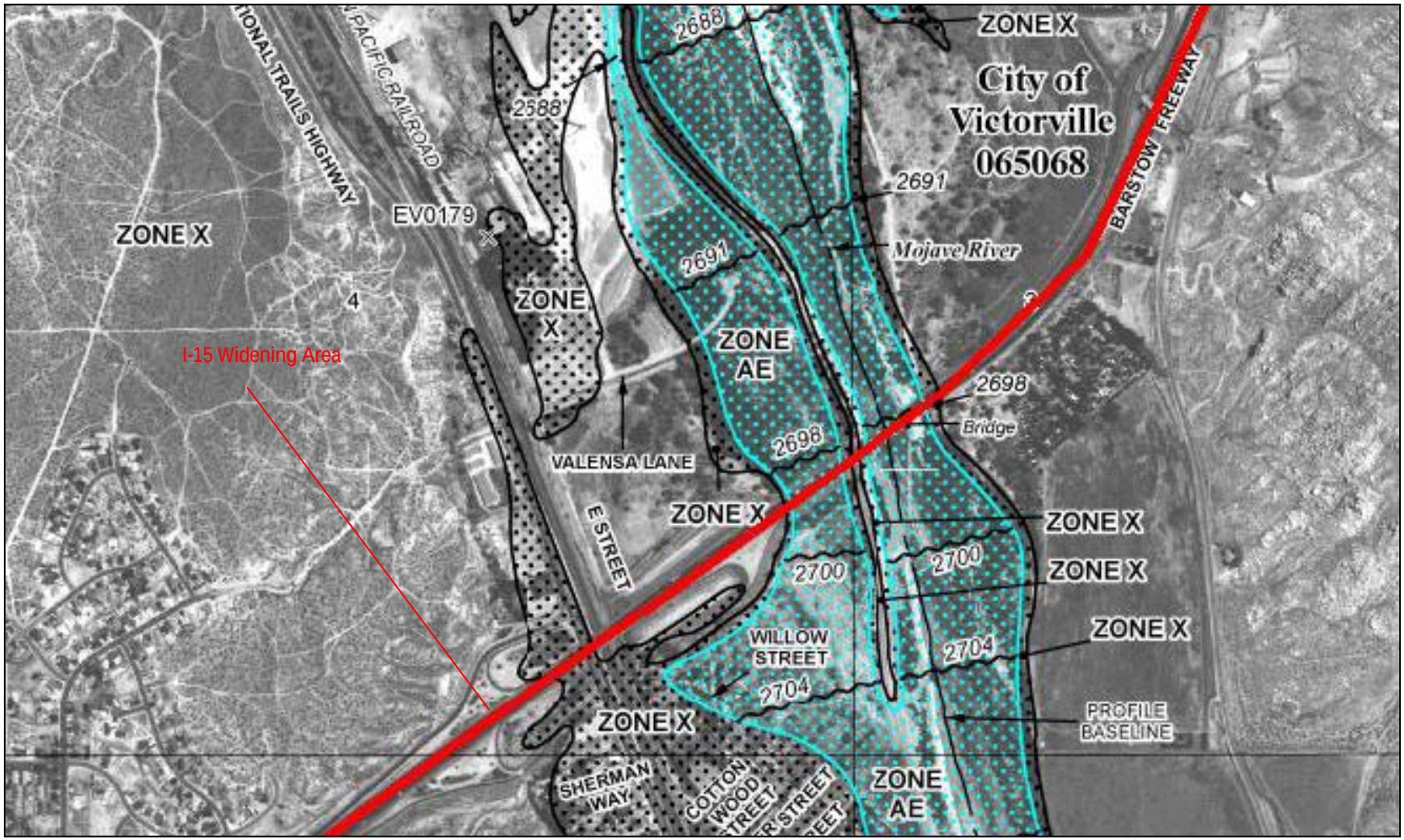
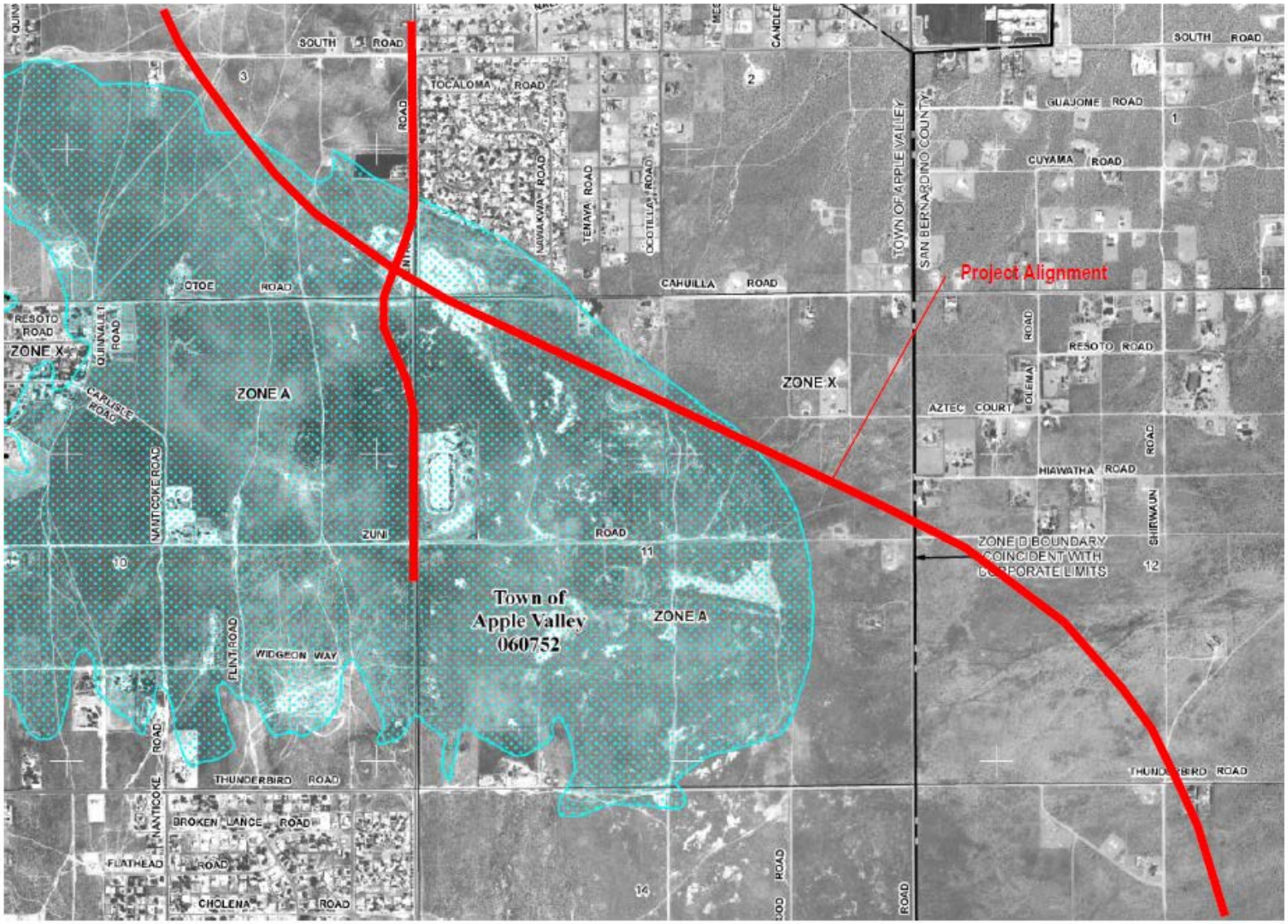


Figure 3.2.1-8 Flood Map – East End of Corridor at Apple Valley



Runoff in Little Rock Wash is generated from the San Gabriel Mountains and its northern foothills that outlet into Antelope Valley. The wash conveys flow to a closed basin at Rosamond Lake. Northeast of Rosamond Lake is Rogers Lake, which is also a closed basin located east of Rosamond Lake in the northern part of Antelope Valley. A hydraulic feature associated with Little Rock Wash is the Little Rock Dam. The Little Rock Dam, with a tributary drainage area of 49.2 square miles, is located 8 miles upstream of the alignment and 3 miles south of the California Aqueduct. The Little Rock Dam plays a role in reducing peak flows, as well as serving as a storage feature in the watershed.

The proposed alignment would cross Big Rock Wash east of Little Rock Wash. The alignment curves to the northeast past Lovejoy and Alpine buttes, and it eventually forms a common hydrologic system with its sister drainage, flowing to the Rosamond and Rogers Dry Lake Basin. Big Rock Wash is approximately 7.5 miles downstream of the California Aqueduct.

The proposed alignment would cross Turner Wash east of Phantom E, before it drains to the Mojave River. Ossam Wash crosses the alignment east of Turner Wash before it drains to the Mojave River.

The Mojave River is, for the most part, an intermittent river that conveys runoff northerly from the eastern San Bernardino Mountains into the Mojave Desert in San Bernardino County. The Mojave River is the largest drainage system in the Mojave Desert. A small section of the river, referred to as the "Narrows," is a perennial stream where groundwater outcrops in the narrow valley adjacent to Victorville throughout the entire year. This is the location of the proposed crossing of the HDC.

Environmental Consequences

No Build Alternative

No impacts to hydrology and floodplain would occur under the No Build Alternative.

Freeway Expressway and Freeway/Tollway Alternatives

In general, the roadway would be constructed on fill and the proposed alignment would be elevated approximately 6 feet above grade and act as a dam to upstream runoff. In Palmdale, the alignment would pass the floodplain at the connection with SR-14. Within this area, the roadway profile is significantly higher than 6 feet above grade.

To evaluate the hydraulics of the drainage area within the project site, the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System (HEC-RAS) model was used. The HEC-1 hydrologic computer model was employed to develop flow rates used for hydraulic modeling and for sizing of flood control and flow conveyance facilities proposed. The HEC-1 program is designed to simulate the surface runoff response of a watershed to precipitation by representing the watershed as an interconnected system of hydrologic and hydraulic components. The hydrologic

methodology is based on the U.S. Natural Resource Conservation Service (NRCS) curve number method.

Drainage subbasins were delineated using U.S. Geological Survey (USGS) topographic mapping superimposed on aerial photogrammetric mapping provided for the HDC Project area. A total of 77 subbasins were delineated, each showing areas that cross the proposed alignment corridor at different locations.

Runoff generally crosses the proposed project corridor in a northerly direction. Facilities would be designed for the 100-year storm event to prevent flooding of the proposed roadway and potential flooding upstream and downstream of the roadway. Two design options enabling flood flows to cross the freeway are to: (1) mimic existing flow conditions by placing cross culverts at existing flow concentration points along the alignment and, where applicable, construct infiltration basins upstream to reduce runoff through the culvert; or (2) place longitudinal channels along the alignment to divert existing flow to crossings. Because flow diversion would exacerbate downstream flooding conditions and cause associated erosion, the first design option (i.e. mimic existing flow conditions) was chosen as the recommended concept for flood and erosion control along most of the project alignment.

The Freeway/Expressway and the Freeway/Tollway alternatives, which include the variations and options, would add approximately 995 acres to the existing 80-acre impervious surface area. The proposed project would replace sections of roadway along SR-18 in Apple Valley at the east end of the proposed project corridor and sections of roadway within Palmdale at the west end of the corridor. As a result of the increased impervious area, a nominal increase in runoff would be exhibited within the various watersheds traversed by the corridor. Because the soils are relatively pervious and groundwater is relatively deep, the installation of infiltration basins or detention basin facilities is practical.

Bridges are proposed over the deeper streams, such as Little Rock Wash, Big Rock Wash, Turner Wash, Ossam Wash, and Mojave River. Cross culverts are proposed at the other waterways traversed by the project alignment, including Grandview Canyon Creek, Graham Canyon Creek, Mescal Creek, Fremont Wash, and Bell Mountain Wash.

Cross culverts will be placed to minimize flow diversions and to mimic existing flow conditions along the project alignment. The culverts would enable runoff to cross the freeway without inundating the paved surface and without flooding upstream and downstream properties. Each culvert would be designed with inlet/outlet headwalls. Energy dissipaters, in the form of vegetated riprap pads, would be incorporated at the downstream ends of the cross culverts to slow flows to nonerosive levels where necessary.

At the FEMA-designated floodplain in Apple Valley, the highway would be designed for the 100-year storm event to prevent flooding in coordination with the County of

San Bernardino Flood Control District. The area affected within Apple Valley Lake would be less than one percent of the total basin area. Given these considerations, water surface elevation impacts on the floodplain would not be substantial and no Letter of Map Revision or Conditional Letter of Map Revision (LOMAR/CLOMAR) would be required for improvements placed within the floodplain at this location.

Infiltration basins are proposed at most intersections within the ROW to treat and partially contain the onsite pavement runoff of the roadway. The infiltration basins treat runoff by retaining the water quality volume (WQV) and enough flow volume to ensure flow rates mimic existing conditions. Along the western portion of the alignment, the City of Palmdale has developed a Drainage Master Plan (DMP) that incorporates a network of storm drains and detention facilities for flood control within Palmdale. After construction of the DMP, the outflow from the infiltration basins would be tied to the proposed drainage network. In this way, installation of the infiltration basins would alleviate water quality and hydromodification impacts related to the roadway.

Freeway/Expressway and Freeway/Tollway with HSR Alternatives

The Freeway/Expressway and Freeway/Tollway with HSR Alternatives which include the variations and options, would add approximately 1,365 acres to the existing 80-acre impervious surface area. High-Speed Rail (HSR) facilities would be constructed within the HDC ROW. The hydrologic modeling analysis conducted for the Freeway/ Expressway and the Freeway/Tollway Alternatives would also apply to the proposed Freeway/Expressway and Freeway/Tollway with HSR Alternatives. Similarly, the drainage facilities (e.g., bridges, cross culverts, infiltration basins) and BMPs proposed would also address potential hydrology and hydraulic impacts associated with construction and operation of any future Freeway/Expressway and Freeway/Tollway with HSR alternative. The impact of the Freeway/Expressway and Freeway/Tollway with HSR Alternatives, as it relates to drainage facilities, were analyzed. Cross culvert locations, infiltration basin sizes, and roadway crossings were modified to accommodate the Freeway/Expressway and Freeway/Tollway with HSR alternatives. Culverts were designed with concrete bottoms to withstand structural and vibratory issues related to the Freeway/Expressway and Freeway/Tollway with HSR Alternatives.

Due to clearance requirements for the Freeway/Expressway and Freeway/Tollway with HSR Alternatives, and its variations and options, local roads and US 395 would be required to cross beneath the HDC. Local roads would be graded to allow positive drainage beyond the undercrossing. Positive drainage means a drainage going in a direction downhill and away from the structure to protect from water damage. In a few locations, positive drainage is either not possible or infeasible. At these locations, construction of retention basins is recommended.

Although the rail component of these alternatives does not extend east to encroach on the basin at Apple Valley Lake, the highway portion would need to be designed for the 100-year storm event to prevent flooding in coordination with the County of San

Bernardino Flood Control District, similar to that described under the Highway/Tollway alternatives above.

Avoidance, Minimization, and/or Mitigation Measures

The drainage patterns and flow rates across the proposed project corridor would remain unchanged with the incorporation of drainage facility controls into the proposed project. Given this consideration, no significant geomorphologic impacts are anticipated as a result of HDC Project construction or operation. Furthermore, with the proper use of Temporary BMPs during construction, erosion and associated downstream sediment deposition would also be controlled.

The standard conditions provided in Section 3.6, Construction Impacts, would minimize impacts to hydrology and floodplain.

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