Physical Environment

2.8 Hydrology and Floodplain

2.8.1 Regulatory Setting

2.8.1.1 Federal

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. FHWA requirements for compliance are outlined in 23 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."

2.8.1.2 State

The Central Valley Flood Protection Plan provides the comprehensive new framework for systemwide flood management and flood risk reduction in the Sacramento and San Joaquin River Basins. The Central Valley Flood Projection Board is the agency responsible for the implementation of this plan. Projects are required to apply for a Central Valley Flood Protection Board encroachment permit if any of the following apply to project or work plan.

- Project is within an Adopted Plan of Flood Control, as defined by the California Code of Regulations, Title 23, Section 4;
- Project is within the flood control right of way for levees;
- Project is near or on a regulated Central Valley stream;
- Project may impact the current or future State Plan on Flood Control.

2.8.2 Affected Environment

The affected environment and subsequent analysis in this section is based on the following reports.

- *Bridge Design and Location Hydraulic Study Report* (WRECO 2015a)
- *Drainage Impact Summary Report* (WRECO 2015b)

The project site falls within the Sacramento River Hydrologic Region, and the project limits cross two hydrologic sub-areas (HSAs), Lower American (HSA #519.21) and Pleasant Grove (HSA #519.22) within the Hydrologic Unit: Valley-American. See Section 2.9, "Water Quality and Storm Water Runoff" for further discussion of surface hydrology and a table of creeks and streams crossing the project site.

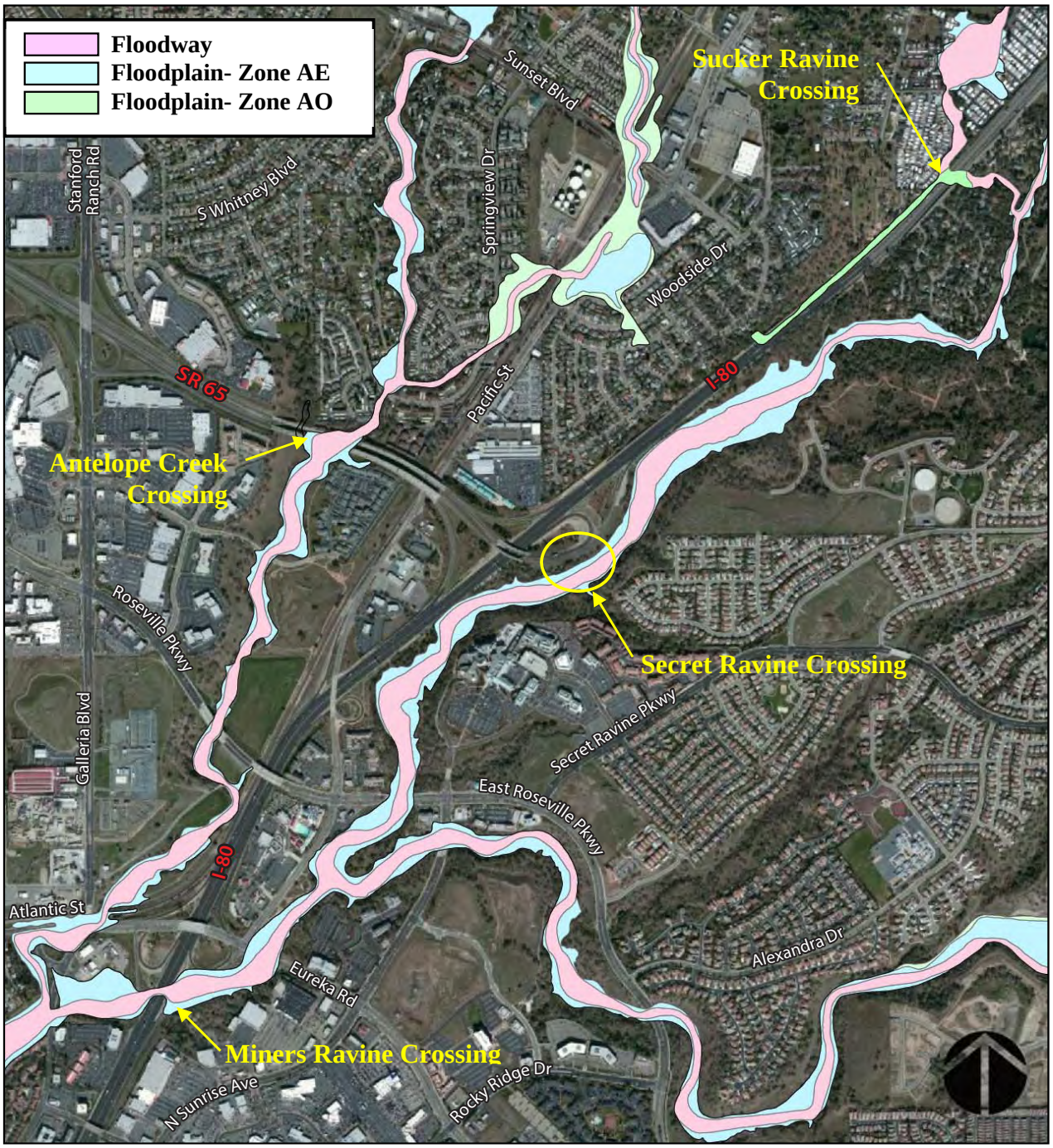
Existing drainage within the project site consists of a series of cross culverts, bridge crossings over major creeks, concrete ditches, urban vegetation, storm drains along roads, unlined ditches, and roadside asphalt concrete gutters. Many of the culverts were built in 1985 and should be in fair condition, assuming a 50-year design life. Inspections will be performed during the final engineering design phase to confirm the condition of the culverts. There are 15 storm water crossings greater than 24 inches in diameter, including four bridges in the project site that drain to receiving water bodies.

Portions of the project site are located within a 100-year floodplain designated by the Federal Emergency Management Agency (FEMA) (Zone AE) at Antelope Creek, Secret Ravine, and Miners Ravine. The Sucker Ravine crossing I-80 is designated as a Zone AO. Zone AO represents areas with a 1 percent or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. Antelope Creek, Secret Ravine, Sucker Ravine, and Miners Ravine are designated as floodways. The remaining project area is located within a Zone X region, which is a designation pertaining to areas of flood with a recurrence interval of 500 years or more. (Figure 2.8-1) The project is within the jurisdiction of the Central Valley Flood Protection Board and Secret Ravine is a regulated Central Valley stream. The project is also located within the jurisdictional boundaries of the Placer County Flood Control and Conservation District (PCFWCD).

2.8.3 Environmental Consequences

The analysis for this Project is based partially on the *Bridge Design and Location Hydraulic Study Report*, which assumed that standard piers would be spaced evenly apart, to support the eastbound I-80 to northbound SR 65 connector (Alternative 1) and collector-distributor system ramps (Alternatives 2 and 3). The initial geometry and spacing assumptions required that piers be placed in the wetted portions of the channel.

Concurrent with the development of the *Bridge Design and Location Hydraulic Study Report*, the project design and environmental team consulted with Caltrans' engineers and relevant resource agencies to identify design options that would minimize or avoid impacts on listed species and riverine habitat within Secret Ravine. Based on these meetings, the project team



Source: WRECO, 2014.

Figure 2.8-1
Project Flood Zone Delineation Map

designed an outrigger concept and/or shifted the bent spacing, which enables placement of the bridge foundation outside of the channel. A separate analysis was not conducted for this design change because the revised design would result in a condition similar to that analyzed or an improved condition over that analyzed.

2.8.3.1 Build Alternatives

The potential risks associated with implementation of all of the build alternatives include, but are not limited to, change in the amount of impervious area, fill inside the floodplain, and change in the 100-year water surface elevation.

All build alternatives would realign the eastbound I-80 loop on-ramp from Eureka Road into the Miners Ravine floodplain. Alternative 2 would require a new ramp to diverge from the existing eastbound Eureka Road off-ramp and would require a new bridge over Miners Ravine. Alternative 3 would widen the eastbound Eureka Road off-ramp bridge by approximately 11.8 feet at the upstream face of the existing bridge.

All build alternatives would place fill and encroach upon the Miners Ravine floodplain, cause longitudinal encroachments on the Secret Ravine and Miners Ravine base floodplains/floodways, and add impervious surface area. The highest of the 100- and 50-year discharge values of those reported by FEMA and PCF CWCD were used in the hydraulic modeling and floodplain assessment of bridge structures proposed for improvement and replacement by the project.

Water Surface Elevation

Hydraulic modeling was conducted to determine whether fill and encroachment upon the Miners Ravine floodplain and longitudinal encroachments on the Secret Ravine and Miners Ravine base floodplains/floodways would cause a significant increase in water surface elevation. This modeling was conducted assuming that bridge components would be placed in the channel; however, current design avoids placement of bridge components in the channel. Thus, impacts would be less than those indicated by the model. Model results indicate that under all alternatives water surface elevation would increase minimally (less than 0.1 feet); these changes are considered minor.

Runoff from Added Impervious Surfaces

All build alternatives would increase the area of impervious surfaces (Table 2.8-1). Alternative 1 would result in the largest increase in impervious area. Increased impervious surface area would increase the rate and volume of storm water runoff to downstream drainages, with the potential to result in localized flooding in surrounding areas.

Table 2.8-1. Area of Added Impervious Surface

	Added Impervious Surface (acres)
Alternative 1	30
Alternative 2	28
Alternative 3	26

Increased storm water runoff is anticipated to result in minimal impacts on Secret Ravine and Miners Ravine because they are at a low point along their waterways, and their surrounding neighborhoods are built up to a much higher elevation. Furthermore, added impervious area at the Miners Ravine bridge would result in minor effects to the total watershed runoff, given that the total hydrologic unit area is 136,960 acres and the Miners Ravine sub-watershed is approximately 12,800 acres (20 square miles). Similarly, added impervious area at the east-to-north and south-to-east connectors would result in minor effects to the overall watershed runoff given that the total hydrologic unit area is 136,960 acres and the Secret Ravine sub-watershed is approximately 13,820 acres (21.6 square miles). Finally, increases in impervious area at the East Roseville Viaduct would result in minor effects to the total watershed runoff given that the total hydrologic unit area is 136,960 acres and the Antelope Creek sub-watershed is approximately 9,020 acres (14.1 square miles). Therefore, the impacts from added impervious surfaces are considered minor.

Onsite Drainage Systems

New onsite drainage systems would be installed as part of the project. The drainage systems would be designed to route flows to and from the permanent storm water treatment BMPs in order to reduce storm water velocity to no greater than existing conditions. New drainage features would be designed to limit the design water surface elevations and to maintain the existing drainage patterns. Several existing culverts would require lengthening, and existing systems would be evaluated to determine compliance with current design standards. Therefore, the proposed project would maintain or improve upon existing drainage conditions.

Scour

Scour analyses were conducted according to criteria set by the FHWA's Hydraulic Engineering Circular No. 18, *Evaluating Scour at Bridges,* for the 100-year design storm (Federal Highway Administration 2012).

Geotechnical analysis at the East Roseville Viaduct at Antelope Creek indicates that soils that would be affected by the Project are expected to be scour-resistant. However, sufficient information was not available to determine channel bed elevation changes. Therefore, a conclusion could not be made about the rate of change of the channel bed. The bridge should be monitored in the future for stream bed stability.

Based on geotechnical analysis, the east-to-north and south-to-east connectors are expected to be underlain by scour-resistant rock and possibly granitic rock. However, existing embankment fill located adjacent to the creek bed would have a high scour potential. Because there is no Caltrans Bridge Inspection Report or Foundation Recommendation Memorandum for the location at the east-to-north and south-to-east connectors, a conclusion could not be made about the rate of change of the channel bed. The connectors should be monitored in the future for stream bed stability.

Geotechnical analysis at the Miners Ravine bridge indicates that soils generally will be resistant to scour. Hydraulic analysis determined the bridge not to be scour-critical. The bridge foundations were determined stable for calculated scour conditions and scour within the limits of footings or piles.

Floodplain Development

The proposed project primarily would include widening of the existing roadways and bridge structures. New connectors proposed to be constructed at the I-80/SR 65 interchange will serve only to connect the I-80 and SR 65 roadways, which would follow the existing alignments. Therefore, the project would not create new access to developed or undeveloped land and would not support incompatible floodplain development.

Traffic Interruptions from Flooding

Caltrans requires 2 feet of freeboard[1] above the 50-year flood flow or conveying the 100-year flood flow; the Central Valley Flood Protection Board freeboard requirement is 2 feet above the 100-year flood flow. Modeling for the proposed project indicates that all bridges associated with the project have been designed with sufficient freeboard to accommodate a 100-year flood. Therefore, the risk of traffic interruptions from flooding on bridges as a result of the proposed project is low.

2.8.3.2 No Build Alternative

The No Build Alternative would not place fill in floodplains or encroach upon floodplains and, therefore, would not affect floodplains or hydrology.

2.8.4 Avoidance, Minimization, and/or Mitigation Measures

None of the proposed alternatives would result in a significant encroachment; therefore, no measures are necessary. An encroachment permit from the Central Valley Flood Protection Board would be obtained as part of the permitting process.

2.8.5 References Cited

Federal Highway Administration. *Evaluating Scour at Bridges. Fifth Edition.* Hydraulic Engineering Circular No. 18. (Publication No. FHWA-HIF-12-003). Fort Collins, CO. Available: http://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif12003.pdf. Accessed: December 7, 2014.

WRECO. 2015a. *Bridge Design and Location Hydraulic Study Report*. Prepared for Placer County Transportation Planning Agency and CH2M HILL. Sacramento, CA. January.

WRECO. 2015b. *Drainage Impact Summary Report*. Prepared for Placer County Transportation Planning Agency and CH2M HILL. Sacramento, CA. January.

[1] Freeboard is the vertical distance from the design water surface elevation to the top of the channel or to the top of the channel lining.