Section 4.11
Flood and Dam
Inundation Hazards
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4.11.1 Introduction

This section assesses the potential flood and dam inundation hazards that could affect future development accommodated by the proposed project, General Plan Amendment No. 960 (GPA No. 960). It also describes the potential impacts on people and property that could arise from future development and disturbances within areas at risk for flooding. Much of the hazard and background data in this section comes from Appendix H of the General Plan, “Natural Hazard Mapping, Analysis and Mitigation: A Technical Background Report in Support of the Safety Element of the New Riverside County 2000 General Plan” (Earth Consultants International, August 2000). Where such information is summarized, this study can be referenced for further details. Also, hydrology, water quality and storm drainage issues are discussed in Section 4.19 (Water Resources) rather than here.

A. Background

In the simplest sense, a flood occurs when water temporarily covers land that is not normally covered with water. For most rivers and streams, flooding is a natural and recurring event. Natural flooding typically occurs when heavy or continuous rainfall exceeds the absorptive capacity of soil and the flow capacity of the river, stream or lake. This causes the watercourse to overflow its banks onto adjacent lands. Floodplains are those lands most subject to recurring floods, situated adjacent to rivers and streams (the floodways). Floodplains are therefore “flood prone” and can be hazardous to development activities, particularly vulnerable ones, for example hospitals and houses.

1. Flooding Probability

Floods are usually described in terms of their statistical frequency. A “100-year flood” or “100-year floodplain” describes a flood event subject to a 1% (one in a hundred) probability of being equaled or exceeded in the given year. It should be remembered that this concept does not mean such a flood will occur only once in a hundred years. Whether or not it occurs in a given year has no bearing on the fact that there is still a 1% chance of a similar occurrence in the following year. The statistical frequency of a flood event expresses the degree of risk evaluated, e.g., 5-year, 20-year, 50-year, 500-year floodplain. A 10-year flood, for example, is the discharge that will exceed a certain volume which has a 10% (one in ten) probability of occurring each year.

2. Flooding and Related Terminology

In addition to the above, a number of terms that address various aspects of flooding are defined below to aid in the understanding of this section.
**Floodplain:** Most simply, any land areas, such as the lowland and relatively flat areas adjoining inland and coastal waters, susceptible to being inundated by water from any source.

**Floodway:** As defined by Riverside County Ordinance No. 458, it is the “channel of a river or other watercourse and adjacent land areas necessary to discharge the waters” from a 100-year flood without increasing the water’s surface elevation “more than one foot at any one point.” (Note, a different definition applies to the Colorado River for the purposes of Ordinance No. 458.) In common parlance, the floodway often refers to the active channel portion of a floodplain in which water flows on a regular basis.

**Floodway Fringe:** Refers to the area subject to inundation by floods generated from a watercourse, up to and including the floodway flow, but which is not required for safe conveyance of floodway flow.

**Base Flood:** Essentially equivalent to a 100-year flood. Delineated by a Base Flood Elevation (BFE) that indicates the water surface elevation that a 100-year flood would reach.

**Flood Hazard:** The potential for inundation by water that involves the risk to life, health, property and natural floodplain values. Generally, three physical characteristics with the greatest bearing on a floodplain’s relative hazard are topography or slope (especially flatness), geomorphology (the type of soils and their characteristics) and hydrology (the amount and speed of water flow, as well as past flooding history, in particular). Flooding itself can cause three types of effects (primary, secondary and tertiary; see discussion under “Effects”).

**Development:** As defined pursuant to Riverside County Ordinance No. 458 (and as generally used herein), this means “any man-made change to improved or unimproved real estate, including but not limited to, building or other structures, mining, dredging, filling, grading, paving, excavation, drilling operations, [or] storage of equipment or materials.”

**Special Flood Hazard Areas (SFHAs):** Generally refer to areas within a floodplain subject to a 1% or greater chance of flooding in any given year. More specifically, however, Riverside County Ordinance No. 458, Section 3, includes a list of studies that encompass the “floodplains, flood boundaries and flood hazards” defined as SFHAs for the purposes of the ordinance. Note the “flood hazard areas” addressed by the County of Riverside in the General Plan and Ordinance No. 458 are only based in part on Federal Emergency Management Agency (FEMA) maps and are not synonymous with FEMA terms.

**Flood Insurance Rate Map (FIRM):** The official map on which FEMA or the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

**Floodproofing:** Riverside County Ordinance No. 458 defines this as “any combination of structural and nonstructural additions, changes or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.”

**Channel / Canal:** A channel is a linear, incised watercourse; a canal is an artificial linear watercourse.

**Dam:** Any artificial barrier impounding (holding) or diverting water. Dams 25 feet and taller above the natural stream bed are regulated by the State of California pursuant to the California Water Code (CWC) Section 6002 et seq. Barriers (dams) below six feet in height or with storage capacity of under 15 acre-feet are not regulated by the State of California.
**Flood and Dam Inundation Hazards**

**Dam Inundation Zone:** The area downstream from any dam or impounded water; for large bodies of water, this can extend a very great distance. Formally defined in CWC Section 6000. The State of California designates areas of “potential flooding in the event of sudden or total failure of any dam...[that] would result in death or personal injury” should it fail (California Government Code [CGC], Section 8589.5(a)).

**Reservoir:** A natural or man-made area containing water impounded by a dam.

**Seiche:** Seiche is a standing wave that forms in an enclosed or partially enclosed body of water. The creation of seiche have been observed on lakes, reservoirs, swimming pools, harbors and seas. The effect is caused by resonances in the (at least partially) confined body of water. Most often these disturbances are caused by wind and are imperceptible. However, in the event of an earthquake, the ground movement (lateral and/or vertical) can be enough to create a large standing wave (seiche) that causes the “slosh” of the waterbody onto its shores at levels higher than expected.

**Levee / Dike:** Both of these structures are designed to hold back water. A “levee” normally refers to structures that only hold back floodwater or stormwaters (thus are only in use during these events). A dike is a linear construction that holds back water continuously, for example, the famous dikes of Holland that hold back the sea from the country’s reclaimed lowlands. In the U.S., however, the term “levee” is also often used to refer to dikes; for example, the extensive system of dikes that hold back the tidal waters of the Sacramento-San Joaquin Delta create farmable islands of land within the Delta.

**Sheetflow:** The unconstrained flow of water across flat lands, typically at shallow depths (and as opposed to flow through a watercourse, which is delineated by bed and bank features).

**Mudflow:** Movement of earth (soil) caused by water, usually rain. Can be a hazard for certain types of loose (unconsolidated) soils, steep slopes (15 degrees or greater) and areas lacking vegetation (denuded by fire or grading, for example).

**Alluvial Fan:** An alluvial fan is a fan- or cone-shaped deposit of sediment crossed and built up by streams. These flows come from a single point source at the apex of the fan, most typically where a stream exits a canyon and transitions from bank-confined to unconfined sheetflow or meandering channels. Thus, alluvial fans are typically found where a canyon draining from mountainous terrain emerges out onto a flatter plain, especially along fault-bounded mountain fronts.

**Stormwater:** Stormwater is simply water that originates from a precipitation or snow event (i.e., rain, hail, sleet or snowfall, or snow melt).

**Runoff / Urban Runoff:** Runoff generally refers to stormwater discharged from developed areas, such as residential, commercial, industrial or public facilities, as well as construction areas (but not dairies, farms, feedlots or open space). “Urban runoff” may also include other water sources, such as irrigation flows/runoff and water flowing off of impervious surfaces, such as roofs, sidewalks and pavement. (Urban runoff may pick up various contaminants, such as fertilizers and pesticides from lawns, oils and other petrochemicals from roads, trash and debris from parking lots, etc., and can be a substantial source of water pollution if not adequately controlled.) Runoff will flow (drain) along the path of lowest elevation until reaching an area large enough to impound it or a discharge point that allows it to enter a storm drain, watercourse or other water conveyance feature.

When it does not soak into the ground, it becomes surface runoff and either flows directly into surface waterways or is channeled into storm sewers, which themselves eventually discharge to surface waters. Urban runoff may contain pathogens, sediment, trash, fertilizers, oxygen-demanding substances, pesticides, heavy metals and
petroleum products. If not properly managed and controlled, urbanization may adversely impact water quality and quantity in the receiving waters.

**Scour:** Scour is the powerful and concentrating clearing and digging action of flowing air or water, especially the downward erosion by stream water in sweeping away mud and silt on the outside curve of a bend, or during flooding.

### 3. Hydrology

The western one-third of Riverside County lies within the California Department of Water Resources South Coast Region, west of the San Jacinto Mountains, and the eastern two-thirds of Riverside County lie within the Colorado River Region. Designated watershed areas are included within each region, several of which partially lie within Riverside County. See EIR Section 4.19 for more information on hydrology; in particular, Section 4.19.2.B and Figure 4.19.3, show the major watersheds within Riverside County.

**B. Baseline Data Sources**

Pursuant to CEQA, the descriptions of the physical environmental conditions provided in this EIR are as they exist at the time of the issuance of the Notice of Preparation (NOP), that is, April 13, 2009. This environmental setting constitutes the baseline physical conditions by which Riverside County, as Lead Agency under CEQA, determines whether an impact is significant.

Because of the countywide scope and nature of this project and its programmatic EIR, much of the data presented herein cannot all be said to represent a single point in time (i.e., April 13, 2009). In such cases, the data set that is best supported by substantial evidence is used. For the flood and dam inundation baseline data used herein, the following sources were determined to be the best-supported substantial evidence available and were used for the reasons stated. Land use data and other environmental data sets are described in their respective sections elsewhere.

The data used herein is a compilation of project GIS (Geographical Information Systems) data derived from spatial analysis of the project performed by the Riverside County GIS Department. The project data was compared to County of Riverside 100-year floodplain and dam inundation maps. Riverside County’s 100-year floodplain maps are updated based on information provided by FEMA, the U.S. Army Corps of Engineers (Army Corps), the California Department of Water Resources (DWR) and the Riverside County Flood Control and Water Conservation District (FCWCD). Dam and dam inundation maps are updated based on information obtained from the federal Bureau of Reclamation, the California Division of Safety of Dams and from FCWCD. (Note: Neither FEMA nor the County of Riverside has jurisdiction over dam inundation areas.) Additional analysis included within the section has been based on various sources cited in the text.

### 4.11.2 Existing Environmental Setting – Flood and Dam Inundation Hazards

Three principal types of flood hazards must be taken into account in the effort to protect people and property: main-stream flooding (including flash flooding) which are generally precipitation based, dam inundation and earthquake-induced flooding (i.e., tsunamis and seiche). The nature of each of these risks is described here. The relative susceptibility of the project’s expected future development to each is discussed later in this section.
A. Precipitation-Related Flooding Hazards

1. Main-Stream Flooding

Main-stream flooding is the most basic type of flooding encountered. It occurs when water rapidly builds up in a drainage feature, such as a stream or river, and then surges downstream towards an outlet. When the flow level exceeds the capacity of the drainage's banks, flooding of lands outside the watercourse will result. This type of flooding process typically takes days or even weeks to arise, although in arid Southern California, floods set off in the space of hours are not unknown. At its most extreme, flashfloods are a type of main-stream flooding in which storm flows build up in less than 6 hours, often with little to no warning. During major floods, flood water carries heavy debris loads and causes considerable damage from deposition. For example, during a storm in 1969, the Santa Ana River carried a total load of more than 11 million tons of sediment.

The precipitation that leads to most main-stream floods that affect Riverside County can be attributed to three types of storm events. The first is a general winter storm that combines high-intensity rainfall and rapid melting of mountain snow pack. The second is a tropical storm out of the southern Pacific Ocean that can cause prolonged periods of heavy rainfall which saturates soils, increasing runoff. The third type is a summer thunderstorm which can lead to brief but heavy localized rainfall. In desert areas in particular, this third type of rainfall can lead to flash-flooding.

Historical stream flow data collected by the U.S. Geological Survey (USGS) indicate that in Riverside County peak stream flows typically occur in January, February and March. Riverside County’s average precipitation varies from more than 30 inches per year in the San Jacinto Mountains to less than 5 inches per year in the Blythe region. According to the 2008 FEMA Flood Insurance Study for Riverside County, most major floods in the county occurred as a result of general winter storms. However, serious flooding, including potentially lethal flash-flooding, also occurred as a result of summer thunderstorms. Historical stream flow data for locations within the county is provided in Section 5.4 of the 1999 Existing Settings Report prepared for the 2003 RCIP General Plan.

According to FEMA, the major rivers in western Riverside County are dry or nearly dry most of the year and generally only pose flood threats to developments within the floodplain during general storms of long duration. When a major storm moves into the area, water collects rapidly and becomes surface runoff. The resultant flood flows have predominantly short durations and sharp peaks. Increased urbanization further increases flood potential by increasing the amount of impervious surfaces from which water will run off, instead of absorbing into the ground or puddling.

2. Historical Flooding Sources and Events

Historically, during the 20th century floods were the leading natural disaster in the United States in terms of number of lives lost and property damage. Since 1965, there have been 17 Gubernatorial and Presidential flood disaster declarations for Riverside County. The most recent declaration occurred in January 2011 after late January’s severe winter storms and the resultant flooding led the governor and president to issue a disaster declaration covering ten counties in California, including Riverside County. Details on the historical flood events in Riverside County may be found in the 1999 Existing Setting Report. Also, see Appendix H of the General Plan for additional details. For details on the flood-controlling properties of dams and other structures along these rivers, see Section 4.11.2.

Santa Ana River: The Santa Ana River has been the source of the region’s most notable floods in the last 150 years, including the Great Flood of 1862 in which flows exceeded an estimated 300,000 cubic feet per second.
San Jacinto River: The 730-square mile San Jacinto River watershed drains into Lake Elsinore in western Riverside County. The San Jacinto River originates in the San Jacinto Mountains and passes through the cities of San Jacinto, Perris, Canyon Lake and Lake Elsinore. The river is an important regional resource that provides water supply, wildlife habitat, drainage and recreational opportunities to the region. The only major flood control structures on the river are levees in the City of San Jacinto built by the Army Corps in the early 1960s. Within the 30-mile reach of the river between Lake Elsinore and San Jacinto, only minor channelization exists. The river is characterized by expansive overflow areas, including the Mystic Lake area. The river has caused major flooding damage to agricultural areas and rendered Interstate 215 and several local arterial transportation routes impassable several times. The San Jacinto River flooded in 1916, 1927, 1931, 1937, 1938, 1966, 1969, 1980 and 1993. Its largest flood of record occurred on February 16, 1927, with a peak discharge of 45,000 cfs near San Jacinto. Agricultural uses, railways and highways were extensively damaged. The flooding in 1980 accompanied failure of the river’s levee system, resulting in extensive additional damage.

Santa Margarita River, Temescal and Murrieta Creeks: Murrieta Creek passes through the cities of Murrieta and Temecula in southwest Riverside County, and then joins with Temecula Creek to form the upper reach of the Santa Margarita River. The Santa Margarita River flows southwesterly into San Diego County, through the Camp Pendleton Marine Base and then empties into the Pacific Ocean. Murrieta and Temecula experienced severe flood damage, estimated in excess of 10 million dollars, from Murrieta Creek overflow in January 1993. Camp Pendleton also suffered extensive flood damage, estimated at $88 million, to facilities and aircraft due to Santa Margarita River overflow.

An Army Corps Feasibility Study addressing flood control, environmental enhancement and recreation for Murrieta Creek was prepared in April 1998. Major floods have been reported nine times for Murrieta Creek: in 1862, 1884, 1916, 1938, 1943, 1969, 1978, 1980 and 1993.

San Gorgonio River: Flooding on the San Gorgonio River caused damage in 1938, 1965, 1966 and 1969. During the 1969 flood, the San Gorgonio River attained an estimated peak discharge of 17,000 cfs, which resulted in loss of life and extensive damage in the Cabazon area.

Whitewater River: The Whitewater River is the principal drainage course through the Coachella Valley. It is typically dry, but flows southeasterly when it carries water. The Whitewater has a total drainage area of approximately 850 square miles and drains areas as far away as the summit of San Gorgonio Pass and the steep southern and eastern slopes of Mount San Gorgonio. Although the mean annual precipitation on the floor of the Coachella Valley is low (4 inches), high and intense precipitation in the tall, steep surrounding mountains poses flood hazards. Floods that affect the Coachella Valley are typically of short duration with high peak volumes and carry large amounts of debris. In the Whitewater River basin, a major flood occurs on average every ten years. The largest flood on record was in March 1938, with peak discharge estimated at 42,000 cfs, almost twice the peak of the second largest flood, which reached 24,000 cfs in 1965.

Colorado River: Due to the long history of water storage in the Southwestern U.S., hydroelectric dams and other flood control facilities now span the multi-state expanse of this major river to channel water to the region’s cities to reduce natural flooding risks. Today, water flow in this river is subject to extensive and elaborate plans designed to balance a variety of competing needs, such as supplying water, protecting the environment and ensuring adequate recreational opportunities on the river, to name a few. Further details are provided under the dam inundation hazards sub-section below.
3. **Floodprone Areas in Riverside County**

In Riverside County, the three largest drainages of concern for main-stream flooding are the Santa Ana River, San Jacinto River and Whitewater River. In the western portion of Riverside County, the large rivers are dry most of the year and only pose flood threats to developments within the floodplain during general storms of long duration. In western Riverside County, these include the Santa Ana, San Jacinto, San Gorgonio and Santa Margarita Rivers, as well as Temescal and Murrieta Creeks. Lake Elsinore and other lakes, as well as various alluvial fans throughout the county, are also susceptible to flooding, for example Millard Canyon. Major floods along the San Jacinto River resulting from intense rainfall have been shown typically to peak in approximately 1.5 days with a total duration of flooding of four days.

Eastern Riverside County, being marked by extensive desert, does not possess as many major flood-prone drainages; the Whitewater and Colorado Rivers being the two principal ones. Rather, because of the arid climate and extremely porous (sandy) soils, water flows tend to pass rapidly through the region. Tributaries to the major rivers present additional flood hazards, mostly caused by local thunderstorms. Within Coachella Valley, there are many smaller washes that run out of the surrounding mountains and down into the valley floor, in some cases emptying into Whitewater River to the northwest or the Salton Sea to the southeast. The desert areas extending to the east from the Palm Springs area are also susceptible to sheet flow flooding, with flow depths of generally less than 2 feet. These types of flows leave the mouths of canyons and often follow unpredictable paths. Lastly, the desert also contains numerous washes (for example, Morongo Wash) and alluvial fans that are susceptible to flooding (see discussion below).

Additionally, many of the smaller drainages throughout the county, particularly those running through the alluvial fans that flank Riverside County’s hillsides, are susceptible to smaller-scale floods and also flash-flooding. Figure 4.11.1 (100-Year Flood Hazard Zones Within Riverside County) shows the areas of Riverside County considered potentially at risk for flooding based on information from FEMA mapping, plus DWR and County of Riverside data. Key waterbodies are described below; a list of all potential flooding sources studied by FEMA is provided in Table 4.11-A (Potential Flooding Sources Studied in Riverside County).

<table>
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<tr>
<th>Water Source Studied</th>
<th>Water Source Studied</th>
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<tbody>
<tr>
<td>Acacia Creek Drain</td>
<td>Lincoln Avenue Drain</td>
<td>San Sevaine Channel</td>
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<tr>
<td>Alessandro Wash</td>
<td>Little Morongo Wash</td>
<td>Santa Ana River</td>
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<td>All American Canal</td>
<td>Long Canyon Wash</td>
<td>Sheet Flow along Ocotillo Road</td>
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<tr>
<td>Arlington Canal</td>
<td>Macomber Palms Channel</td>
<td>Smith Creek</td>
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<tr>
<td>Arroyo Del Toro</td>
<td>Magnessia Falls Road</td>
<td>Smith Creek West Tributary</td>
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<tr>
<td>Bear Creek</td>
<td>Magnesia Springs Channel</td>
<td>South Norco Channel and Trib.s A and B</td>
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<tr>
<td>Beaumont Channel</td>
<td>Main Street Drain</td>
<td>Spring Brook</td>
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<tr>
<td>Bedford Canyon Wash</td>
<td>Mangular Channel</td>
<td>Spring Brook Wash</td>
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<tr>
<td>Big Morongo Wash</td>
<td>Marshall Creek</td>
<td>Stetson Avenue Channel</td>
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<tr>
<td>Biskra Palms Channel</td>
<td>McVicker Canyon Wash</td>
<td>Stovepipe Canyon Creek</td>
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<tr>
<td>Blind Canyon Channel</td>
<td>Metz Road Basin</td>
<td>Stream A (Vicinity of Des. Hot Springs)</td>
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<td>Bly Channel</td>
<td>Mirage Indian Trail Wash</td>
<td>Sun City Channels A-A, C-C, H-H and X-X</td>
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<td>Box Springs Wash</td>
<td>Mission Creek</td>
<td>Sun City Southeast Tributary</td>
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<td>Calimesa Channel</td>
<td>Mockingbird Canyon Wash</td>
<td>Sunny Slope Channel</td>
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<td>Carrizo Alluvial Fan</td>
<td>Montgomery Creek</td>
<td>Sunnymead Storm Channel</td>
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<td>Mountain Avenue Wash</td>
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<td>Coachella Valley Stormwater Channel</td>
<td>North Cathedral Channel</td>
<td>Temescal Wash</td>
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<td>Country Club Creek and North Tributary</td>
<td>North Norco Channel and Trib.s A, B and C</td>
<td>Teguesquite Arroyo</td>
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<td>Day Creek Santa Ana River</td>
<td>North Palm Springs Wash</td>
<td>The Veldt</td>
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<tr>
<td>Dead Indian Alluvial Fan</td>
<td>North Side Wolf Valley Creek</td>
<td>Third Street Basin</td>
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a. Western Riverside County

As reported in the 2008 FEMA study (pages 15-16), extensive commercial and residential development has occurred within the floodplain of the Santa Ana River in the Rubidoux area and on Murrieta Creek in the communities of Murrieta and Temecula. Extensive residential development has encroached upon the floodplains of San Sevaine and Salt Creeks in the Mira Loma area. San Sevaine Channel was constructed to divert flows away from development along San Sevaine Creek, but with minimal effect on large floods. Some degree of improvement has been constructed on the Santa Ana River, Murrieta Creek and Salt Creek in these high-hazard reaches as well. Moderate industrial, commercial and residential development exists along the Temescal Wash floodplain, primarily adjacent to the Corona corporate limits along Sixth Street. Moderate residential development exists in the floodplains of the following streams: Day Creek in the community of Sunnymead; Edgemont B North Fork in the Edgemont area; portions of Noble Creek and Little San Gorgonio Creek; numerous small tributaries in the Lakeland Village area; the Romoland and Homeland areas; the east side of the City of Hemet; and along San Gorgonio Creek in the Cabazon area. In most cases, some improvement to the watercourse has occurred along with the progress of development.

Lake Elsinore is situated in the southwestern corner of Riverside County in the Santa Ana River basin. The total drainage area of the lake is 770 square miles, of which all but about 50 square miles come from the San Jacinto River watershed. Located in a natural sink, the lake’s only outlet is via the Elsinore Spillway Channel and Temescal Wash. Under current conditions, the lake level must exceed an elevation of 1,260 feet (the highest point along the spillway channel) before any outflow will occur. Since 1965, Colorado River water has been brought in via the San Jacinto River, as needed to maintain a lake surface of approximately six square miles. Prior to this importation scheme, the lake was intermittent, occasionally being dry for several consecutive years. Development around the lake is concentrated on the urbanized northern shore, within the corporate limits of the City of Lake Elsinore. Moderately dense residential development can be found in unincorporated areas around much of the lake perimeter, but is generally less dense than within the city.
100-Year Flood Hazard Zones

Data Source: Riverside County Flood Control (2013)

Disclaimer: Maps and data are to be used for reference purposes only. Map features are approximate and are not necessarily complete or accurate by surveying standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.

December 16, 2013
Throughout its history, Lake Elsinore has been subject to flooding and drying, depending on runoff amounts. The lake loses an average of 15,000 acre-feet a year to evaporation, dropping its surface level more than 4.5 feet. In wet years, runoff from the San Jacinto River watershed pours into Lake Elsinore, which is the lowest point in the watershed. Currently, natural runoff is the only source of water for the lake. In the past, when runoff caused upstream reservoirs to spill, Lake Elsinore often filled, but rarely discharged.

The Lakeview Wash study area, as identified by FEMA, is situated on an alluvial fan, positioned at the base of the Lakeview Mountains and adjacent to the floodplain of the San Jacinto River. The upper portion of the study area is largely undeveloped and the wash has eroded an entrenched path in the lightly vegetated natural fan surface. Below Tenth Street, the wash enters residential areas of moderate density and flow becomes subject to control by buildings and paved roads. Floods on Lakeview Wash are usually produced by orographically-induced thunderstorms (that is, caused by moisture interacting with mountains).

The Bautista Wash watershed, which includes Park Hill Drain, is located on the western flank of the San Jacinto Mountains in west-central Riverside County. Flooding from Park Hill Drain and Bautista Wash affects portions of the cities of Hemet and San Jacinto, as well as unincorporated Riverside County areas. Before reaching the San Jacinto River, the streams flow over the relatively smooth surfaces of an alluvial fan and apron. The lack of topographic relief allows floodwaters to spread out (sheet flow) over wide areas. The residential and commercial area is moderately dense and further development is expected in the area.

The Pechanga Creek/Wolf Valley area studied by FEMA is a wide alluvial wash in southwestern Riverside County. The topography of the valley indicates that the floodwater of Pechanga Creek formerly affected wide areas. At present, the creek is largely confined to the southern edge of Wolf Valley due to its own encroachment and the influence of Pechanga Road. The transfer of some flow from the creek to the northern portion of the valley appears possible; an occurrence which would augment the flood hazard potential posed by the smaller tributary streams now threatening the north side of Wolf Valley. Runoff from Wolf Valley enters Temecula Creek and finally the Santa Margarita River. Within the Pechanga Indian Reservation, yearly mining of the bottom of Pechanga Creek as a source of sand causes alterations in the natural configuration of the channel.

b. Eastern Riverside County

In addition to major rivers (Whitewater and the Colorado), the watersheds of the desert create a number of alluvial fans in the many canyons and mountains that cross the desert. Alluvial fans studied near Thousand Palms and Desert Hot Springs are located on the northeastern side of the Coachella Valley at the bases of the Indio Hills and the Little San Bernardino Mountains, respectively. Coachella Valley is a northwest/southeast trending valley lying between the Little San Bernardino and Santa Rosa Mountains. The major settlements of Palm Springs and Palm Desert are located on the southwestern side of the valley on alluvial fans along the Santa Rosa Mountains. The detailed FEMA study areas (on the opposite side of the Coachella Valley) are affected by floodwater that originates in both the Indio Hills and the Little San Bernardino Mountains. Runoff from the large drainage basins of Thousand Palms Canyon, Pushawalla Canyon and Thousand Palms Main Channel have formed two sets of alluvial fans: between the Indio Hills and Little San Bernardino Mountains and at the base of the Indio Hills. Runoff from the Little San Bernardino Mountains spreads out over the initial fan area, then re-concentrates before flowing through or around the Indio Hills and opening out again onto the fans.

The intervening set of alluvial fans helps to reduce peak discharges from the larger watersheds by promoting the spreading and infiltration of runoff from the Little San Bernardino Mountains. The remaining basins are much smaller in size and represent watersheds draining only the Indio Hills. All of the streams carry water and sediment into the general areas of Desert Hot Springs or Thousand Palms, forming numerous coalescent alluvial fans. Many desert locations are subject to flood hazards from more than one flooding source due to the wide
areas threatened by each of the streams as they flow over the debris cones. In addition, the Interstate 10 freeway was constructed at the base of the alluvial fans adjacent to the Indio Hills, in what appears to be an abandoned channel of Big Morongo Wash.

The principal drainage course through the Coachella Valley from the City of La Quinta southward, the Whitewater River passes through the developed portion of Coachella Valley via channelization within the Coachella Valley Stormwater Channel. This man-made channel flows northeast and eventually empties into the Salton Sea. The Coachella Valley Water District maintains the channel.

The Salton Sea was formed accidentally in 1905 when floods eroded a cut in a bank of the Colorado River made during construction of the All-American Canal. As a result, water was diverted from the Colorado River into the Salton Trough forming the sea. Presently, the western six miles of Salton Sea lie within Riverside County; the remainder lies in Imperial County. Because of the Sea's relatively flat shoreline, even a slight increase in water levels can flood the recreational facilities along the water's edge. In the late 1970s and early 1980s, major flash-flooding in the Imperial and Coachella Valleys and flood control releases from Colorado River dams negated local conservation efforts to control the rising sea. Coachella Valley Water District (2000) reports that improved irrigation practices and a reduction in California's use of Colorado River water after completion of the Central Arizona Project have subsequently contributed to an on-going gradual decrease in the Salton Sea's elevation.

4. Flood Maps for Riverside County

The Federal Insurance Rate Map (FIRM) is the official map created and distributed by FEMA as part of the National Flood Insurance Program (NFIP). (See Section 4.11.3 (Policies and Regulations Addressing Flood and Dam Inundation) for more information). It delineates Special Flood Hazard Areas, those areas subject to inundation by the base flood, for every county and community that participates in NFIP. FIRMs contain flood risk information based on historic, meteorological, hydrologic and hydraulic data, as well as open space conditions, flood control works and development. Figure 4.11.1 shows mapped floodways and floodplains for unincorporated Riverside County (from several sources, as specified in Riverside County Ordinance No. 458). In addition to FEMA FIRMs, Riverside County has developed its own flood maps that account for additional areas of known risk. The Riverside County Planning Department and Riverside County Flood Control and Water Conservation District worked in continued coordination to ensure the flood safety of new development within the County. Riverside County flood maps delineate 1% annual chance (100-year) flood boundaries and elevations for areas not studied by FEMA.

As noted above, Riverside County Ordinance No. 458 (Regulating Flood Hazards and Implementing the National Flood Insurance Program) specifies the sources of flood hazard mapping applicable in the County of Riverside. The ordinance applies to “all the special flood hazard areas within the following unincorporated areas and within the jurisdiction of the County of Riverside on file at [Riverside County Flood Control and Water Conservation District] headquarters and shown on the Public Flood Hazard Determination Interactive Map found at http://rcflood.org. These special flood hazard areas incorporate”:

- The flood hazard areas shown on the maps prepared by the Federal Insurance Administration entitled, “The Flood Insurance Study for the County of Riverside,” effective August 28, 2008, with accompanying Flood Insurance Rate Maps and Flood Hazard Boundary Maps, including any amendments, revisions or additions that go into effect pursuant to the provisions of applicable Federal law.

- The flood hazard areas shown on the maps prepared by the U.S. Army Corps of Engineers entitled:
  - San Gorgonio River and Smith Creek, June 1973.
The ordinance goes on to state that “notwithstanding the provisions of any other ordinance to the contrary,” within the special flood hazard areas shown on the maps referred to above, “no structure, including flow-obstructing structures, shall be constructed, located or substantially improved and no land shall be graded, filled or developed, and no permit or approval shall be granted therefore, unless it complies with all the applicable requirements” of Ordinance No. 458 and all other applicable county ordinances. This strict prohibition is the principal means Riverside County has for ensuring new development is not constructed in, or affected by, 100-year flood hazards or exposed to flood risks.
B. Dam Inundation Hazards

The second type of flood hazard, dam inundation, can also result in downstream flood damage. However, where main-stream flooding occurs as a result of precipitation (rain or snow) runoff, dam inundation flows are a result of the failure of a dam. As defined in the State’s Multi-Hazard Mitigation plan, page 330, dam failure is the “uncontrolled release of impounded water from behind a dam.” Causes of dam failure include flooding, earthquake, blockage, landslide, lack of maintenance, improper operation, poor construction, vandalism and terrorism.

The Multi-Hazard Mitigation Plan (page 331) also notes: “The term ‘dam failure’ encompasses a wide variety of circumstances. Situations that would constitute a dam failure vary widely, from developing problems to a partial or catastrophic collapse of the entire dam. Potential causes of a dam failure are numerous and can be attributed to deficiencies in the original design of the dam, the quality of construction, the maintenance of the dam and [functioning] of the appurtenances [during dam operation], and acts of nature including precipitation in excess of the designed capacity, flood and damage from earthquakes. Water over-topping the dam crest is a common cause of failure in earthen dams. Overtopping will cause erosion of the dam crest and eventual dam breach. Piping of earth dams is another common form of failure. Piping is a form of erosion that occurs underground caused by rodent burrowing and the presence of extensive root systems from vegetation growing on and around the dam.” Dam failures can also arise from the earthquake-induced effects of liquefaction, lateral spreading or primary fault rupture. See Section 4.12 (Geology and Soils) for further details on these.

A dam failure event is extremely hazardous, as it will typically occur quickly and with little warning. Areas directly below the dam are at the greatest risk. The area downstream of a dam potentially at risk to flooding should the dam fail is called the “dam inundation zone.” The zone is defined by a number of factors including downstream topography, soils and the volume of water impounded by the dam on its upstream side in the associated reservoir. As water moves farther downstream and decreases in velocity and depth, the magnitude of the damage and potential risk to life and property decreases.

In addition to structural failure, dam inundation can also occur by overtopping, i.e., when the level of the water being held on the dam’s upstream side (in its reservoir) exceeds the height of the dam itself. When this happens, water ends up flowing over the top of the dam (instead of through it) in an uncontrolled manner, possibly resulting in flooding downstream depending on the volume. This type of flow can also lead directly to failure of the dam itself with additional flooding the result. However, since dam reservoir heights are closely monitored and controlled, this type of dam inundation is quite rare in the U.S. For levees and canals (which can be considered a type of dam that line a river course), this scenario is a common cause of flooding hazard, particularly for large rivers.

1. Major Facilities With Dams in Riverside

Under the California Water Code, dam safety is regulated by the DWR, which delegates the program to the Division of Safety of Dams. Neither Riverside County nor FEMA have jurisdiction over dam inundation areas. Among other duties, the California Emergency Management Agency runs a Dam Safety Program (established by CGC Section 8589.5 in 1972), which collects and reviews dam failure inundation maps and evaluated waivers from the inundation mapping requirement. It is also the designated repository of the official dam failure inundation maps used in California’s Natural Hazard Disclosure statement for real estate transactions, pursuant to Civil Code Section 1103.

The following locales/facilities represent major flood risk management efforts in Riverside County or affect downstream lands within Riverside County. Also covered are water storage facilities (reservoirs) that have one or
more dams associated with them that could cause dam inundation damage within Riverside County in the unlikely event it failed. For dams, only the largest ones in or affecting Riverside County, i.e., those over 100 feet high or impounding over 100,000 acre-feet, are described in detail below. See Table 4.11-B for the full list of regulated dams (i.e., dams meeting the size for falling under state DWR jurisdiction pursuant to CWC Sections 6000-6008) within Riverside County. Note: Dams and reservoirs owned by the federal government are generally not subject to state jurisdiction.

a. Dams and Levees

**Seven Oaks Dam:** The Seven Oaks Dam is located on the Santa Ana River in San Bernardino County, approximately four miles northeast of Redlands, in the southern San Bernardino Mountains. The dam was completed in 1999 by the Army Corps, Los Angeles District, as part of the Santa Ana River Mainstem Project. Operating in tandem with Prado Dam 40 miles downstream, it is an important flood control structure for the Santa Ana River channel through northwestern Riverside County. Historical flood flows on the Santa Ana have exceeded 300,000 cfs. Together, these dams protect the burgeoning populations of western San Bernardino and Riverside counties, as well as northern Orange County.

The Seven Oaks Dam consists of a zoned, earth-filled embankment that is 40 feet wide at its crest and over 2,200 feet wide at the base. In total, the dam is 550 feet high and nearly 3,000 feet long. There is also a spillway, outlet tunnel, air shaft, gate chamber and intake structure tower. Seven Oaks is the 12th highest dam in the country and also the 10th largest earthen dam. It has a reservoir capacity of just under 148,000 acre-feet. During the early part of each flood season, runoff is stored behind the dam in order to build a debris pool to protect the outlet works. Small releases are made on a continual basis to maintain the downstream water supply. During a flood, Seven Oaks Dam stores water destined for Prado Dam for as long as the reservoir pool at Prado Dam is rising. When the flood threat at Prado Dam has passed, Seven Oaks releases its stored flood water at a rate not exceeding the downstream channel capacity. At the end of each flood season, the reservoir at Seven Oaks gradually drains and the Santa Ana River flows through unhindered. The Army Corps reports that Seven Oaks is designed to completely contain a flood of up to 85,000 cfs, which corresponds to a 350-year flood event. Also, in view of its location in proximity to the San Andreas Fault, to ensure its safety, the dam was designed to withstand an 8.0-magnitude earthquake.

**Prado Dam:** Prado Dam (frequently recognized by its now-defaced Bicentennial mural) is a flood control and water conservation structure located at the upper end of Lower Santa Ana River Canyon, a natural constriction controlling 2,233 square miles of the 2,450-square mile Santa Ana River watershed. The dam embankment is approximately two miles west of the City of Corona. Portions of the reservoir are in both Riverside and San Bernardino counties. The 106-foot high dam impounds runoff from uncontrolled upstream drainage areas along with water released from other storage facilities and can store over 295,000 acre-feet. The Prado Reservoir is owned by the Army Corps. Historically, water releases above 5,000 cfs have damaged downstream improvements.

In January 2005, heavy rain lead to water seeping through an earthen extension to the dam, necessitating water release to relieve pressure on the facility. As a safety precaution, over 3,000 downstream residents were evacuated for roughly 24 hours. In 2009, downstream channel improvements were made to increase downstream channel capacity from 5,000 cfs to over 30,000 cfs as part of a three-phase improvement plan for Prado Dam that also increased freeboard height and overall reservoir capacity. The Prado Flood Control Basin (in which the dam is located) lies within the 2,000-acre Prado Regional Park, in Chino (San Bernardino County). The park offers fishing, a shooting range (site of the 1984 Olympic shooting events), archery, camping and a golf course.
Dams Along the Colorado River: The easternmost border between Riverside County and Arizona is formed by a stretch of the Colorado River. There is only one major dam along the segment of river abutting Riverside County. Lands along the Colorado River corridor could suffer from catastrophic failure of dams that are located far outside the borders of Riverside County. These dams include Palo Verde Diversion Dam, Headgate Rock Dam, Parker Dam, Davis Dam and Hoover Dam. For additional details on the dams along the Colorado River, see Appendix H of the General Plan.

In 1993, the U.S. Bureau of Reclamation evaluated inundation potential along the Colorado River by modeling failure of combinations of Hoover, Davis and Parker Dams. Relevant results, data and mapping from this study are presented in General Plan Appendix H and also reflected in the dam inundation mapping shown in Figure 4.11.2 (Dam Inundation Failure Zones in Riverside County). To summarize, the evaluation determined that the City of Blythe, with roughly 21,000 people, the main population concentration along the Colorado River within Riverside County, sits roughly 207 feet above sea level. This is well within the elevation under the water surface levels predicted for a catastrophic failure of any combination of Colorado River dams. However, in the event of such a catastrophic dam failure, FEMA has estimated that it would take a minimum of 23 hours before the floodwaters reach Blythe allowing ample time for any necessary evacuation efforts. Thus, these dams do not pose immediate inundation risks.

Lake Elsinore: Located at the southern end of Temescal Canyon, at roughly six miles long and one and a half miles wide, Lake Elsinore is the largest natural freshwater lake in Southern California. It is classed as the terminal lake of a partially closed basin, located at the extreme northwestern end of Temecula Valley and cut off from the Santa Margarita River watershed by a slight ridge running between the Sedco Hills and Elsinore Mountains, south of the lake. The lake lies at the lowest point in the 750-square-mile San Jacinto River watershed and is fed by that river. Leach and McVicker Canyons also contribute inflows to the lake. The lake’s primary outlet is via Temescal Wash, although flows only occur under exceptionally rainy conditions. In total, the lake spans roughly 3,000 acres at normal fill levels, with depths averaging 27 feet (42 feet maximum).

Lake Elsinore’s northwestern shore rises to the surrounding foothills, running along the foot of the slopes to the Alberhill Creek outlet, which passes through downtown Lake Elsinore (the city). The lake south of the outlet lies in an open area at the mouth of the San Jacinto River, although a long flood control levee running along the southeast end of the lake cuts it off from the river. As a result, the isolated section only fills after an extremely large rainfall event. Seismically, Lake Elsinore is the largest sag pond (body of water collected in the lowest parts of a depression formed between two strands of an active strike-slip fault) in the Elsinore Fault Zone.

b. Water Reservoirs

These water features were designed to function as reservoirs for Southern California’s water supplies. They are listed here since each has one or more dams associated with them.

Diamond Valley Lake: Diamond Valley Lake was created by the Metropolitan Water District of Southern California (MWD) in Domenigoni Valley, four miles southwest of the City of Hemet. Built at a cost of nearly $2 billion, excavation for the three earthen dams necessary to create the lake was begun in 1995 and completed in 2002. It is reported to be the largest earth-and-rock fill project ever constructed in the United States. The reservoir’s west dam is 1,200 feet long at its base and reached 285 feet high; the east (Eastside) dam is 10,500 feet long and 185 feet high; and the saddle dam is 2,300 feet long and 130 feet high along the ridgeline. Together, the reservoir created by these dams runs between 160 to 260 feet deep and has a storage capacity of 800,000 acre-feet (261 billion gallons).
Diamond Valley Lake forms Southern California’s largest reservoir for storing surface water. It almost doubles Southern California’s surface storage capacity and is intended to ensure a six-month water supply in the event of an emergency. The reservoir also provides additional water for drought protection and peak summer needs. Water stored at Diamond Valley comes from the Colorado River Aqueduct through the San Diego Canal and from the State Water Project through the new 12-foot diameter, 45-mile Inland Feeder Project. The lake is also used for recreational activities, including boating and fishing (for stocked bass, bluegill, crappie, catfish, shad and trout). Adjacent to the lake is a recreation park, an aquatic center and a visitor center, plus the Western Science Center (displaying fossils uncovered during the dams’ construction). Other extensive plans for recreational uses have yet to be accomplished by MWD.

**Lake Hemet:** Located in the San Jacinto Mountains above western Riverside County, Lake Hemet serves as a water storage reservoir, impounding just over 19,000 acre-feet behind 135-foot tall Hemet Dam. When completed in 1895, at a height of 122.5 feet, Hemet Dam was the largest solid masonry dam in the world until surpassed in 1911 by construction of the Roosevelt Dam in Arizona. Lake Hemet drains an area of roughly 67 square miles. The reservoir is owned and operated by the Lake Hemet Municipal Water District. It is available for recreational uses, including fishing (from stocked trout, catfish, bluegill and bass) and boating.

**Lake Mathews:** Lake Mathews is located approximately five miles south of the City of Riverside and is the terminal reservoir of the Colorado River Aqueduct. It is owned and operated by MWD and provides drinking water for approximately 15 million people. The dam forming the reservoir is 264 feet high and impounds 222,400 acre-feet of water. In collaboration with MWD, FCWCD is in the process of obtaining funding for a Drainage Water Quality Management Plan for the Lake Mathews Watershed Project. The objective is to reduce non-point source pollution in Lake Mathews and Cajalco Creek, which drains into Lake Mathews, through the construction of a series of wetlands. It also aims to reduce the seismic vulnerability of Lake Mathews outlet facilities to ensure a reliable supply of water following a major earthquake.

**Lake Perris:** Situated in a valley between the cities of Perris and Moreno Valley, the reservoir at Lake Perris was formed in 1973 with the construction of a 130-foot high and nearly two-mile long dam in Bernasconi Pass. Its main function is as the southern terminus of the State Water Project (which conveys water from the Sierra Nevada Mountains across the state). It also impounds a roughly 10-square mile watershed and holds nearly 155,000 acre-feet. At roughly three miles long and two miles across, the lake offers approximately 10 miles of accessible shoreline.

The area immediately around the lake is owned by DWR and managed by the California Department of Parks and Recreation, although DWR owns and operates the State Water Project facilities on site, including the dam and outlet facilities. The California Department of Fish and Wildlife owns the areas below the dam and manages them for habitat conservation value. The roughly 6,000-acre area surrounding the lake forms the popular Lake Perris State Recreation Area (SRA), offering a variety of recreational uses including fishing (the stocked lake offers bass, bluegill, trout, catfish, crappie, sunfish and carp), boating and swimming. The north shore of the lake includes park facilities, such as campgrounds, offices, the Regional Indian Museum, parking lots, a marina, group picnic areas, a horse camp and a bike trail. Along the south shore of the lake is Bernasconi Beach and picnic areas, plus camping and rockclimbing areas. The area surrounding the SRA is mainly open space, particularly conservation (OS-CH) lands. The Perris Fairgrounds operate on 108 acres at the corner of Ramona Expressway and Lake Perris Drive, west of the Lake Perris SRA. Nearly one million people visit the fairgrounds annually. The fairgrounds are home to an 8,000-seat speedway track, a BMX track, a skate park and an equestrian arena, among other attractions.

According to an extensive study conducted by the State (DWR) in 2005, there are fears that an earthquake of magnitude 7.5 or larger could breach the dam. This engineering study, combined with the reservoir’s location
within a few miles of the San Jacinto Fault, makes it a key concern for seismically triggered dam failure and inundation hazards. In 2011, the State of California issued the Perris Dam Remediation Program outlining how repairs to the dam would be performed to assure its safety. According to the DWR, the program consists of remediation (upgrading roughly 700,000 cubic yards of the dam face with “cement-deep soil mixing” and a reinforcement berm), outlet tower replacement and emergency outlet extension. The construction phase is set to begin in 2014 and be completed by the end of 2015. In the interim, however, the DWR reports that there is “no imminent threat to public safety.”

**Lake Skinner:** This large reservoir was created in 1973 along Tucalota Creek at the foot of Bachelor Mountain in the Auld Valley, northeast of Temecula. After expansion in 1991, the Skinner Clearwell Dam that created the reservoir measures 109 feet high and impounds just under 63,000 acre-feet. The lake is operated by the Riverside County Regional Park and Open-Space District (County Parks) under lease from MWD. It offers a number of recreational uses, including sailing, fishing and swimming (in an off-reservoir area), as well as horseback riding, hiking, picnicking and camping in the surrounding 1,400-acre park. The reservoir is supplied by water from both the Colorado River Aqueduct and the State Water Project, and is a source of drinking water (after treatment) for 2.5 million people in Riverside and San Diego counties.

**Vail Lake:** Located on Temecula Creek in the Santa Margarita River watershed, the reservoir of Vail Lake was created in 1948 by a 152-foot tall dam. The reservoir drains an area of 306 square miles and can hold 62,000 acre-feet. It has been owned and operated by the Rancho California Water District since 1978. The lake is supplied by Kolb, Temecula and Wilson creeks. The property surrounding Vail Lake is privately owned and recreational access to the lake is privately controlled. A members-only resort facility has been operated off and on at the site of a former park over the years. Seismic studies of the region show that roughly nine local faults and lineaments converge in the vicinity of Vail Lake. Little development, however, lies in the immediate vicinity downstream of the dam.

2. **Dam Inventory and Failure Risks**

As shown in Figure 4.11.2, within Riverside County more than 20 dam failure inundation zones have been identified for existing dams and reservoirs. Data for Riverside County dams was obtained from the National Inventory of Dams (NATDAM) 2000 based on 1998-99 data submitted by local agencies. A summary of the dam inventory data from NATDAM is presented in Table 4.11-B, below.

The NATDAM hazard classifications included in Table 4.11-B are based entirely on the downstream hazard potential. Ratings are set by FEMA and confirmed with site visits by engineers. A dam is considered a “high” hazard potential if it stores more than 1,000 acre-feet of water, is higher than 150 feet tall and has the potential for downstream property damage and/or causing downstream evacuation. These are dams where failure or mis-operation would likely cause loss of human life. Dams are considered to be of “significant” hazard potential where failure or mis-operation would result in no probable loss of human life, but could cause economic loss, environmental damage, disruption of lifeline facilities or affect other concerns. These dams are often located in predominately rural or agricultural areas, but could also be located in areas with population and significant infrastructure. Lastly, dams with “low” hazard potential are those where failure or mis-operation would not be likely to result in loss of human life, economic or environmental losses. Losses are principally limited to the owner’s property.
## Section 4.11

**Flood and Dam Inundation Hazards**

### Table 4.11-B: National Inventory of Dam (NATDAM) Data for Riverside County

<table>
<thead>
<tr>
<th>Dam Name</th>
<th>River</th>
<th>Nearest City</th>
<th>Dam Height (feet)</th>
<th>Reservoir Storage (acre-feet)</th>
<th>Year Built</th>
<th>Drainage Area (sq. miles)</th>
<th>NATDAM Canyon Hazard Design</th>
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<td>Vail</td>
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<td>Lake Elsinore</td>
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Footnotes:
1. An acre-foot is the amount of water it takes to cover one acre to the depth of one foot. One acre-foot equals approximately 325,900 gallons.
2. NATDAM Hazard Potentials: H = High; S = Significant; L = Low. See text for further details.
3. Earthquake Hazards for Dams

Several California dams have been tested by earthquakes. Experience has shown that dams must be made safe before earthquakes occur. After an earthquake strikes, there are many obstacles that hinder the quick detection and treatment of earthquake-damaged dams or implementation of evacuation plans. After recent earthquakes, analysis of the emergency response efforts found that key response personnel were not available, communications were blocked, equipment and operators were in short supply, helicopters were not available for inspections and access to repair materials and dams was difficult.

In 1971, the San Fernando earthquake damaged the Lower San Fernando Dam. The reservoir had to supply a large portion of the water for Los Angeles for two weeks while severe damage to the supply aqueducts was repaired. This scenario could be repeated in Riverside County following a major earthquake, as many of Riverside County’s aqueduct systems cross major faults at numerous locations.

A wide variety of creative solutions have been used to improve the seismic stability of dams in California. Although there have been major advances in analysis techniques, rehabilitations have not changed radically. Multiple arch dams are still being stiffened and embankment dams buttressed. Reservoir storage restrictions are effective ways to rapidly increase dam safety, but can prove troublesome in the long term. To improve the seismic safety of dams and other flood control structures, a variety of state and federal agencies have projects planned or underway in California.

In a review of seismic dam safety, the DWR found seismic safety hazards in a portion of the Lake Perris Dam foundation. While DWR noted that there is currently no imminent threat to life or property, the State of California has taken actions to lower the lake’s water level in an effort to ensure public safety. DWR has developed a plan to repair the dam and is currently awaiting certification of the Final Environmental Impact Report. DWR anticipates that construction for the repairs will begin in mid-2013 and be completed by 2016.

C. Seiche and Tsunami Hazards (Earthquake-Induced Flooding)

Seiche is simply an underwater wave that oscillates through a body of water. Small rhythmic seiche only a few inches high are almost always present on larger lakes as a result of the water body’s depth, contours and water temperature. They are often imperceptible to the eye, noticeable only in periods of unusual calm. However, when an event, such as an earthquake or landslide, causes a reverberating wave or waves to form in an enclosed body of water, the motion is akin to the rocking of water in a bowl that has been moved. The resultant “slosh” when these waves reach the lake’s shore can cause localized flooding. In a severe case within a man-made reservoir such waves could damage the reservoir’s dam. Typically, the more shallow and elongated the waterbody, the more pronounced the seiche effect. Flooding outside the banks of the waterbody is the result of an underwater wave emerging along shallow shorelines. A big seiche on Lake Superior in 1995 caused water to fall and rise again by three feet within 15 minutes.

Larger seiche can be caused by high winds, earthquakes or underwater landslides. The magnitude of seiche caused by landslides or surface fault rupture depends on the amount of water and ground displacement. For example, modeling data produced for Lake Tahoe indicate that its deep water in conjunction with underlying fault placement and geology play large roles in seiche potential.
Dam Hazard Zones

Highways
Area Plan Boundary
City Boundary
Waterbodies


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Figure 4.11.2
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Tsunamis are a related phenomenon in which the water waves are caused by an up-and-down movement, rather than side-to-side as in seiche. They are most commonly associated with oceans, which can generate waves of massive and devastating height upon hitting coastlines. Since Riverside County has no ocean frontage, there is no oceanic tsunami risk within the county. For the inland water bodies within the county, the discussion under ‘seiche’ addresses all types of waterbody wave hazards, regardless of source or type. In terms of seiche hazards within Riverside County, the region’s semi-arid climate makes naturally occurring enclosed water bodies uncommon. Most enclosed water bodies in the county are reservoirs built by local municipalities and water districts to provide water service to local customers. Typically, all land surrounding the reservoirs’ shorelines are in public holdings which restrict private land development and thus limit the risk of inundation from seiche. Public land holdings, such as by cities, public water agencies or the state, are not within the jurisdiction of unincorporated Riverside County. Only two waterbodies, Lake Perris and Lake Elsinore, are of any concern relative to potential hazards from seismically induced seiche.

**Lake Perris:** As noted previously, Lake Perris SRA surrounds the lake and draws thousands of visitors each year. Its active use, plus the very popular Perris Fairgrounds below the reservoir (with roughly a million visitors a year), make it of concern for seiche risks. The lake’s fully enclosed shores makes it potentially subject to seiche, but its rounded shape (two miles by three miles) reduces the likelihood of standing wave propagation. The longer axis of the lake lies roughly northeast by southwest. The large dam stretches across the southwest end, with the Perris Fairgrounds (including the Perris Auto Speedway) located roughly a half-mile beyond and open space surrounding it all. Aside from risk of damage to the dam itself, there is no other development or vulnerable structures at the southwest end of the lake. The northeast end of the lake consists of open land (open space) that is part of the Lake Perris SRA but not developed with any specific recreational facilities (campgrounds, swimming areas, docks, etc.), although a sand-covered beach lies further to the north. Alessandro Island also lies at this end of the lake. Beyond this end of the lake lie additional expanses of conserved open space. In general, the large expanses of mostly open space surrounding the shore and lack of development at this end of the lake limit the potential seiche risks to property and human lives.

**Lake Elsinore:** Because of its partially enclosed basin and long, narrow shape (six miles long by 1.5 miles wide), this lake may have the potential for seismically induced seiche. If a standing wave becomes propagated on the long-axis of the lake (roughly northwest-southeast), it could lead to sudden, higher than expected, waves at these two ends of the lake, both of which have development present. The north end of the lake is within the City of Lake Elsinore and contains mostly open space and vacant lands, with the exception of the Butterfield Village Mobile Home Park at the western edge of the northwest lake end, beyond the levee consists mainly of open space and vacant land, plus the Links at Summerly golf course. These areas are almost entirely within the City of Lake Elsinore also. All of the city areas are outside Riverside County’s jurisdiction. The proposed changes for Lakeland Village along Grand Avenue and its vicinity are mainly located on the southwest side of the southern end of the lake. These are not directly within the long-axis path of potential seiche waves, but close enough to that end to be possibly at risk.

**D. Mudflow and Debris Flow Hazards**

Mudflows, (or mudslides), are shallow water-saturated landslides that travel rapidly down slopes in a river of liquid and flowing mud on the surfaces of normally dry land areas. The earth is carried by a current of water and deposited along the path of the current. Debris flows are similar to mudflows, except they contain a high percentage of non-soil material, such as rocks, brush, trees or other debris. A mudflow occurs naturally as a result of heavy rainfall on a slope that contains loose soil or debris. Two forces are at work on slopes: driving forces that combine to cause a slope to move and resisting forces act to stabilize the slope. When the combined driving forces exceed the resisting forces, a mudslide mudflow or landslide occurs.
There is a high potential for mudflow to occur in some areas of Riverside County as a result of large amounts of precipitation in a relatively small time frame. Areas with steep slopes or mountains are potentially subject to mudflows in the event of large amounts of precipitation. This risk is often intensified in burned areas where soil-retaining vegetation has been lost. Such areas are particularly susceptible to flashfloods and debris flows during rainstorms. Narrow canyons, arroyos and desert channels are also susceptible to flashfloods which can cause flooding damage directly or indirectly through mudflows. Human activity can also induce a slide, such as when soil becomes saturated from a broken water pipe or the improper diversion of runoff from a developed area.

Mudflows predominantly occur in mountainous areas underlain by geologic formations that produce sandy soils. Weathered gabbroic soils contain large amounts of clay that shrink and expand with exposure to water and also have a high potential for instability and sliding. Mudflows can be initiated on slopes as low as 15 degrees but more frequently occur on slopes as steep as 45 degrees. The path of a mudflow is determined by local topography and will typically follow existing drainage patterns. The fluidity and depth of the water/soil/debris mixture and the steepness of a channel are all variables that influence the rate of movement of a mudflow. At the foot of a long steep slope, a flow may move at avalanche speed (approximately 40 feet per second, that is, 27 miles per hour) and contain tremendous force capable of destroying buildings and roadways.

Debris flows, particularly when associated with alluvial fans and mountain canyons, can result from the presence of a large percentage (up to 70-90% of flow by weight) of fine sediment, such as silt and clay, in steeply-flowing floodwaters. This enables the muddy flow to transport sand, gravel, boulders and dislodged timber and brush from the surrounding watershed into the floodplain or alluvial fan’s surface. Conditions favoring the formation of debris flows are: available unconsolidated silt, clay and larger rock in the basin watershed (due to minimal vegetation), heavy or sustained rainfall in the basin and the presence of a steep basin and/or alluvial fan slopes. In desert areas with finer soils, such flows create alluvial fans (see below). In mountains and other areas with heavy debris, the flow activity can result in the creation of a ‘debris fan.’ Such debris fans are found in areas where mountain systems are subject to tectonic forces of uplift, including parts of California.

Areas recently burned by wildfires are particularly susceptible to flashfloods and debris flows during rainstorms. Just a short period of moderate rainfall on a burn scar can lead to flashfloods and debris flows. Rainfall that is normally absorbed or intercepted by vegetation can run off almost instantly, causing creeks and drainage areas to flood much sooner during a storm and with more water than normal. Additionally, the soils in a burn scar are highly erodible so flood waters can contain high amounts of mud, boulders and vegetation. The powerful force of rushing water, soil and rock both within the burned area and downstream can destroy culverts, bridges, roadways and structures, placing people and property at risk.

In 2003, post-fire debris flows occurred in San Bernardino County resulting in the tragic loss of 16 people on Christmas Day. As a result, Governor Schwarzenegger signed Assembly Bill 2141 to direct the DWR to seek federal funding for the establishment of a stakeholder-driven Alluvial Fan Task Force to develop a model ordinance and planning tools (e.g., design guidelines for development on alluvial fans) to mitigate flood hazards associated with alluvial fan flooding, a type of flooding that is prevalent after wildfires where areas remain vulnerable for five years after an incident. See the discussion on alluvial fan flood hazards, below, for more information on this hazard.

### 1. Warning Signs

Slope failure problems are caused by any combination of water saturation and flow, weak or heavy earth materials and steep slopes. Of these, water is the most common trigger of slope failure. There are a number of warning signs and indicators of the potential for a mudslide or landslide that may be identified or visible before an incident occurs.
Section 4.11  Flood and Dam Inundation Hazards

**Steep Slopes:** Problems occur on steep slopes, especially when a slope of 1-to-1 (one foot vertical to two feet horizontal) is exceeded.

**Debris:** Soils and vegetation deposited at the base of a slope may be signs of erosion, flow and creep from above.

**Vegetation:** Vegetative characteristics reflect slope conditions. Bare slopes may show erosion and sliding. Trees tilting uphill may show deep rotational land sliding. Trees that bend downhill show creep of upper soils. Patches of newer vegetation may show former slope failure. Horsetail ferns, willow shoots or other moisture-loving plants often indicate saturated ground and springs.

**Deformed Structures:** Deformations, such as foundation cracks, doors and windows out of line or sticking, tilted floors, sagging decks, cracks in masonry and chimneys, cracks in driveways, curbs and roads, gaps between floors and walls, falling retaining walls and tilted power poles, can all be warnings of slope instability.

**Loose Fill:** Loose fill at the top of a slope due to yard waste, cut-and-fill land grading or other processes can aggravate slope instability.

**Undercut Toe of Slope:** When supporting material has been removed from the toe of a slope, the potential for sliding and erosion is increased.

**Suspect Landforms:** Landforms, such as steep slopes, are common at the top (head) of landslides. Rounded, conical mounds or lumpy ground often indicates a deposit of slide or debris material.

The National Flood Insurance Program will pay for covered damages that occur during or as a result of a qualifying mudflow event. However, the NFIP does not cover losses that result from land shrinkage, landslide, destabilization or movement of land resulting from the accumulation of water in subsurface land areas, gradual erosion or any other earth movement, except mudslides.

**2. Avoiding Mudslides Mudflows**

To prevent mudflows on a property, the discharge of concentrated water must be directed to a safe, non-erodible site, such as a storm drain, street gutter or rock stream bed. On an emergency (temporary) basis, sandbags can be used to divert water from uncontrolled spilling, such as over curbs, from gutters and downspouts, or from washing into buildings.

For major problems, more permanent solutions are necessary. The best and easiest cure is to avoid hazardous sites. Urban population pressures increase the uses of marginal building sites requiring greater investment in soil and slope stabilization measures. Steep, weak hill slopes require increased measures under the Building Code and building ordinance during site planning, building design and construction, to reduce risk to future homeowners and occupants. Professional site investigations by an engineering geologist are typically required as part of the siting and design process. A site investigation, analysis and design by a licensed professional can provide solutions to most problems. Incorporating the recommendations from the site study has been shown to reduce landslide risks and damages according to FEMA. In general, the geological survey will define and analyzed site conditions, including factors such as:

- Soil and rock types present and their characteristics (strength, stability, etc.).
- Distribution of soil types.
Subsurface configuration (geological structure and slip plane configuration).

Ground and surface water conditions.

Active processes and rates of recurrence.

Analysis of suitability of the site for the intended use.

Specific recommendations for development.

Further investigations required, if any.

For sites with existing issues, or where new issues arise, for example due to new development adjacent to the site or due to a wildfire, remediation efforts may be needed, as recommended by a geotechnical professional (licensed engineer, engineering geologist, etc.). Several key types of remediation are as follows:

- Drainage improvements: Providing surface protection and vegetation; installing surface drainage ditches and storm drains, curtain or French drains, perforated plastic pipe; or subsurface drains, such as wells or horizontal drains.

- Retaining structures: Applying soil stabilization materials; installing buttress fills, retaining walls with drainage, piling or riprap (rock cladding).

- Reengineering slopes: Via grading; slope contouring or terracing; removal and compaction or replacement of material; or reduction of the slope.

E. Alluvial Fan Flooding Hazards

As mentioned earlier, an alluvial fan is a gently sloping, fan-shaped landform created over time by deposition of water-eroded sediment built up by streams. These flows come from a single point source (most often a canyon or other narrow opening between hills) at the apex of the fan and can over time move to occupy many positions on the fan surface as the flows drain out onto a flatter plain. As a stream’s gradient decreases, it drops coarse-grained material (the source of the “alluvial” in the name). This reduces the capacity of the channel and forces it to change direction and gradually build up a slightly mounded or shallow conical fan shape (the “fan” in alluvial fan). The deposits are usually poorly sorted due to recurrent flood action moving existing strata.

1. Alluvial Fan Floodplains

In California, alluvial fan floodplains occur most prevalently in Southern California (from San Luis Obispo and Kern counties southward). On its Alluvial Fan Task Force website, DWR estimates that as growth fuels additional development in Southern California, up to 60% of the next century’s new development will occur in or on communities with alluvial fans. Given that alluvial fans tend to occur in the apparently dry conditions of arid and semiarid regions (including throughout Riverside County), homeowners are often shocked to find that they can be the sites of destructive floods. Alluvial fans are often found in desert areas subject to periodic flash floods from nearby thunderstorms in local hills, for example, many of the hills and mountains in eastern Riverside County.
The typical watercourse in an arid climate has a large, funnel-shaped basin at the top, leading to a narrow defile (pass or gorge between mountains or hills), which opens out into an alluvial fan at the bottom. Multiple braided streams are usually present and active during water flows. Although, in locations where water flows or the upstream basin have been modified through human disturbance, for example orchards or groves, the resultant flows may be more stable, resulting in the creation of a single heavily incised channel or set of braided channels. In flooding events on alluvial fans, FEMA (in FEMA Report No. 165, “Alluvial Fans: Hazards and Management,” February 1989; page 4) identifies the following hazards that may be encountered:

- High-velocity flow (as high as 15-30 feet per second) producing significant hydrodynamic forces (pressure against buildings caused by the movement of flowing water).
- Erosion and scour (to depths of several feet).
- Deposition of sediment and debris (depths of 15-20 feet have been observed).
- Debris flows and impact forces.
- Mudflows.
- Inundation, producing hydrostatic/buoyant forces (pressure against buildings caused by standing water).
- Flash flooding (little, if any, warning times).

2. Historical Alluvial Fan Floods

In the book *Alluvial Fan Flooding* (Commission on Geosciences, Environment and Resources, 1996) an account by C.B. Beatty summarizes a “rare eyewitness account” of a mud and debris flow that occurred in Cottonwood Canyon in Bishop, California, in July 1952. Beatty reports that “Two hours after a heavy thunderstorm in the White Mountains to the east, a large flow of debris advanced down the alluvial fan. At and below the apex, the flow was in a pre-existent, defined channel leading from the 3.7-square mile basin. Debris spilled over channel walls and spread laterally to widths of 100 to 400 feet. One large distributary channel of debris was formed by concentrated overflow on the outside of a gradual bend. The debris deposit was about 4.3 miles long with a deposit of mud over half a mile (0.6 miles) long followed by 8 to 10 inches of silt deposits for at least a half mile near the fan toe above [the canyon]. Much of the deposited debris was remobilized by subsequent water flow during the event.” (Note, all measurements translated from metric to English for consistency.)

Closer to Riverside, a number of accounts document historic alluvial fan flooding in the Cucamonga region. These include floods in Cucamonga Creek and across the large alluvial fans at the base of the San Gabriel Mountains in February 1927, the winter of 1938 and January 1969. Day Creek and Deer Creek in the Etiwanda region also flooded onto alluvial fans at levels found to be greater than the 100-year-flood level in January 1969. The capacity of a levee and several channels were exceeded by these storm flows and the structures were breached during the event. Flooding was only minimized by the construction of flood control structures, including detention dams and percolation basins, which were fully in place by 1989, according to accounts. Lytle Creek and surrounding streams in San Bernardino also flooded and affected alluvial fans in 1927 and 1969, resulting in bank erosion that led to the failure of a bridge. In total, throughout Southern California the floods of 1969 resulted in the loss of 73 lives and over 30 million dollars in damage.
A major flood occurred in Riverside County in July of 1979 at Magnesia Spring Canyon in the Rancho Mirage area, breached a levee at the alluvial fan apex and flooded urban development in the city. This event was triggered by a massive summer thunderstorm that dumped extreme amounts of precipitation over concentrated areas in very short time frames. According to reports, the peak discharge from the roughly four-square mile mountainous drainage basin was 170 cubic meters per second, which equals just under 45 thousand gallons a second, nearly three times the magnitude of the 100-year flood. One death and 7 million dollars in damage resulted.

Lastly, alluvial fan flooding caused by heavy rains (3-4 inches in 12 hours) contributed to mudflows that took the lives of 16 people (14 at a church camp in Waterman Canyon near Crestline and two additional people in a separate incident in Devore) in San Bernardino County on Christmas Day in 2003. These mudflows resulted after two severe wildfires earlier in the year (in particular, the Old Fire) that dramatically increased the risk of debris flows from alluvial fans in the burned hillsides. The force of the mudflow was so great that, according to a report in the Press-Enterprise (October 12, 2010), one deceased victim was found 15 miles away four months after the flood. The powerful Waterman Canyon mudslide also knocked camp buildings completely off their foundations.

As a result of that tragedy, the State of California instituted the Alluvial Fan Task Force which developed a model ordinance and recommendations for an integrated development approach that provides a suite of methods for local communities to use at their discretion to assist in reducing flooding risks on alluvial fans.

3. Alluvial Fan Habitat Associations

In Riverside County, particularly the western third, alluvial fan sage scrub habitat (alluvial scrub) frequently occurs in and around alluvial fans. The key trait of such vegetation is the development of “phreatophytes,” plants with long tap roots (up to 30 to 50 feet deep) that have evolved to be able to access water that has seeped through the fan and hit an impermeable layer. These stands of shrubs cling to the fan soil at their bases and often form islands of habitat for many animals as erosion moves the surrounding soil away. Also, such shrubs may be flood-adapted to survive flooding, erosion and the scouring (striping away) of their surface or crown vegetation. The anchor provided by the long, intact tap root and the energy stored in the rootstock below ground permits plant regrowth from the base. California scalebroom (Lepidospartum squamatum) is species of shrub very well-adapted to the extreme hydrology of alluvial fans. It has rootstock (underground stems) supported by a vigorous taproot adapted to regrow after heavy scouring and also to survive being buried under sediment as the result of flooding. So strong is this regrowth, in fact, that home foundations in Corona were damaged (uplifted and cracked) by recovering scalebroom bushes where the taproots were not completely removed during grading. The plant has even been reported to regrow through the asphalt surface of new roads.

4. Flood Risk Management on Alluvial Fans

Even though typically shallow, flooding in alluvial fans can be even more dangerous than in the upstream canyons that feed them. Floods within alluvial fans can strike with little warning, travel at extremely high speeds and carry tremendous amounts of sediment and debris. Further, the slightly convex perpendicular surfaces of the fans cause water to spread widely until there is no zone of refuge. If the gradient is steep, active transport of materials down the fan creates a moving substrate (i.e., akin to a flash flood) that is dangerous to travelers on foot or in a vehicle. As the gradient diminishes downslope, water comes down from above faster than it can flow away downstream leading to ponding to potentially hazardous depths. These factors can also make it difficult to engineer controls to contain peak flows inside man-made embankments. Often large debris basins and water retention structures are needed upstream to prevent serious flooding hazards on major alluvial fans.
As with other types of serious flooding, FEMA also designates areas as subject to alluvial fan flooding (as opposed to ordinary riverine flooding). Specifically, NFIP regulations define alluvial fan flooding to be “flooding occurring on the surface of an alluvial fan or similar landform which originates at the apex and is characterized by high-velocity flows; active processes of erosion, sediment transport and deposition; and, unpredictable flow paths.” Despite the distinction, alluvial fan flooding is also based on the 100-year flood interval (i.e., a 1% probability of occurrence in a given year).

Key elements to the hazards associated with alluvial fan flooding are the uncertainty of the flow path down the fan, the slope and topography; and, the abrupt deposition and extensive erosion of sediment in the fan. Combined, these traits make the use of fill to raise a building site out of the floodplain unsuitable for alluvial fans. Rather, alluvial fan flood hazards can only be reliably offset by use of major structural flood control measures (e.g., the aforementioned large upstream debris and detention basins) or by complete avoidance of the affected area.

Should development occur on or near an alluvial fan, extra care must be taken to avoid applying flood control engineering measures that inadvertently create new flood hazards at other sites. For example, because of the variability and unpredictability of the stream path within the fan, any channelization or conveyance designs would have to take into account the entire span of the potential watercourse and all of the 100-year flows for adequate capture. The key to avoiding, reducing or minimizing alluvial fan flooding risks is site-specific evaluation (hydrological study) of conditions and the implementation of site-specific soils, slope and hydrology design and engineering recommendations to ensure flows are handled properly.

In terms of engineering flooding protections, two basic approaches are useful for alluvial fans. The first is to provide whole-fan protection via large-scale structural measures. These include the following (used either individually or in combination): levees, channels, detention basins and debris basins/fences/deflectors/dams. Such structures generally intercept upstream watershed flow and debris and transport water and sediment around the entire (usually urbanized) fan. Structures must be designed to withstand scour, erosion, sediment deposition, hydrostatic and hydrodynamic forces and high flow velocities.

At a more localized level, for example for individual subdivisions or tracts, smaller-scale measures may be used to safely trap debris and route water and sediment around or through individual residential developments. Such measures include: drop structures to reduce flow velocity; debris fences; local dikes or channels; site plans to convey flow; street design and/or alignment to convey flow; elevation on armored fill. In these cases, a combination of elements are often the most effective strategy for ensuring flood protection. If necessary, protective measures can also be introduced for single lots or structures. The most cost-effective of these include: elevation on properly designed foundations (piles, columns or armored fill); floodwalls and berms; and reinforcement of uphill walls, windows and doors against debris impact (or avoid these features on uphill walls entirely, if possible).

F. Flood Hazard Reduction Efforts

1. Surface Runoff Hazards

The conversion of undeveloped, natural areas to urbanized uses throughout Riverside’s watersheds have increased flooding potential by increasing the rate and amount of runoff in watersheds and altering drainage patterns. Construction of impervious surfaces such as rooftops, roads and driveways reduces the amount of rainfall that can infiltrate the ground surface and percolate into the subsurface. As a result, the volume of surface water runoff increases within a watershed. Subsequently, artificial conveyances such as gutters, storm pipes and natural channel improvements to accommodate additional volume also accelerate the rate of flow in the watershed. This faster-
moving, higher-volume surface water runoff results in a higher probability and increased severity of flooding within a watershed, if facilities are not adequately maintained or constructed to carry peak flow capacity.

Any alteration to natural drainage patterns by modifying landforms controlling the conveyance of surface water can increase the potential for flooding. Grading or other modifications, including directly altering the course of a stream or river by excavation or embankment, can increase velocities of floodwaters, which increases the potential for flooding downstream of the modification. A reduction in the capacity of the watercourse can also increase the potential for flooding at the site of the modification as well as upstream from the activity, if flood waters backup as a result.

Drainage facilities, including storm drains, culverts, inlets, channels or other such structures, are designed to prevent flooding by collecting stormwater runoff and directing flows away from urban development to either a natural drainage course or man-made one as part of a storm drain system. The capacity of a drainage structure can typically be adequately determined by a hydrology and drainage study. However, if drainage facilities are not adequately designed, built and maintained, the facilities can overflow or fail, resulting in flooding.

2. Master Drainage Plans in Riverside County

In urban and built-up areas, precipitation, irrigation and their runoff from impermeable surfaces must be managed and controlled to avoid flooding-related problems, such as erosion, water damage and water contamination, both at the location the runoff is generated, as well as offsite / downstream. As discussed extensively in Section 4.19, the federal Clean Water Act and one of its implementing programs, the National Pollution Discharge Elimination System (NPDES) protect water quality by regulating sources of runoff that could pollute waterbodies. Among other things, under NPDES cities and counties are required to comply with the conditions of both general and municipal separate storm sewer (MS4) permits. Within western Riverside County, FCWCD oversees implementation and compliance of both general and MS4 permits. Within the Coachella Valley, this function is maintained by the Coachella Valley Water District (CVWD). In addition, these agencies also oversee Riverside County’s municipal storm drain systems for conveying stormwater flows. This is done via two main planning instruments: the master drainage plan (MDP) and the area drainage plan.

According to Riverside County Flood, a master drainage plan addresses the current and future drainage needs of a given community. The boundary of the plan usually follows regional watershed limits. The facilities proposed or covered by a MDP may include channels, storm drains, levees, basins, dams, wetlands or any other conveyance capable of economically relieving flooding problems within the plan area. The plans also include estimates of facility capacities, sizes and costs. MDPs are prepared for a variety of purposes. First, the plans provide a guide for the orderly development of Riverside County. Second, they provide an estimate of costs to resolve flooding issues within a community and are used by Riverside County to determine capital project expenditures for each budget year. In addition, the MDPs can be used to establish Area Drainage Plan fees for a given community, which prevent existing taxpayers from having to shoulder the burden of land development costs. As discussed further in Section 4.19 (and, in particular, as shown in Figure 4.19.9 and listed in Table 4.19-E), there are presently 48 Master Drainage Plans within Riverside County, encompassing areas from the western edge of the county all the way out through the Coachella Valley region to the east and encompassing both incorporated city and unincorporated county territories.

3. Capital Improvement Projects Related to Flooding

As noted above, the FCWCD designs, constructs, manages and maintains an extensive network of flood control and storm drain infrastructure in western Riverside County. The list below outlines some of the capital
improvement projects the County of Riverside (or other agency) has recently completed or proposes to construct in the next 1-2 years to provide flood water management as per the Riverside County Capital Improvement Plan (CIP).

a. Under Construction (As of January 2013)

Murrieta Creek: The Murrieta Flood Control, Environmental Restoration and Recreation Project is a flood control master plan to provide 100-year flood protection to the cities of Murrieta and Temecula by deepening and channelizing Murrieta Creek and its major tributaries using several concrete-lined open channels and a small network of underground storm drains. The proposed system will carry storm runoff through the rapidly developing Murrieta Valley to the valley’s south end, where Murrieta Creek and Temecula Creek converge to form the Santa Margarita River. The project includes a 250-acre detention basin as well as a recreational park and 160 acres of wetlands and wildlife habitat. The Army Corps is in charge of construction and Phase 1 of the four-phase project was completed in 2005. Work on Phase 2 was slated to begin April 2013. Completion of the remaining phases will depend on financial constraints.

Calimesa – Avenue L Storm Drain: This project occurs in the City of Calimesa, just south of the boundary between Riverside and San Bernardino counties. It runs from the upstream end of stage 1 at 4th Street almost 1.5 miles easterly to Douglas Street and includes laterals at cross streets.

Day Creek Channel: Construction of Phase 1 (from Limonite Avenue to 700 feet downstream) is complete. Phase 2 runs from Lucretia Street to 700 feet south of Limonite Avenue. The existing interim channel is to be upgraded with approximately 2,700 linear feet of rectangular concrete-lined channel. It will connect to 1,100 linear feet of riprap outlet channel within Goose Creek Golf Club.

Day Creek Master Drainage Plan - Line J: This project is a developer-driven project to complete the last link in Master Drainage Plan line. It consists of 2,000 linear feet of storm drain discharging at the Caltrans culvert where the 68th Street overpass crosses Interstate 15.

Eagle Canyon Dam: Located southwesterly of Canyon Plaza Drive and East Palm Canyon Drive. The project is dependent on the cleanup of an existing dump at the site by others, including the cities of Palm Springs and Cathedral City. Riverside County Flood CIP costs are based on the premise that the $1,500,000 needed for the cleanup effort will be incorporated into dam construction contract, although the funding will come from the cities. The project will provide flood detention and flood hazard mitigation for the developed portion of Cathedral City located downstream via construction, operation and maintenance of an earthen dam, debris catchment and underground storm drain.

Mira Loma – Beach Street Storm Drain: Working upstream from the proposed outlet just south of 58th Street, this storm drain proceeds northerly through private property and then along Beach Street to just north of 55th Street where it again splits property lines to 54th Street. It branches off twice, once at 55th Street and once between 55th and 54th Streets. Lines then run east to sump in Cedar Street and west to sump in Rutile Street.

b. To Begin Construction In or Around 2013

Arroyo Del Toro Channel: A 40-foot wide earthen channel is proposed from the Elsinore Outlet Channel downstream of State Highway 74, northwesterly approximately 3,800 feet to I-15. It runs around two sides of the Elsinore Valley Cemetery.
Corona Master Drainage Plan – Line 52: This proposes an underground storm drain beginning near Third Street and Grand Blvd., extending north along East Grand Blvd. then under the 91 freeway to discharge into the Temescal Creek Channel. The City of Corona is to design and build the project with Riverside County Flood funds.

Gilman Home Channel Lateral A: For this project, approximately 1,000 linear feet of reinforced concrete pipe will be run from Eighth Street westerly in Cottonwood Road to the existing channel at George Street between 10th and 12th Streets in the City of Banning.

Hemet Master Drainage Plan – Lines C and D: Line C provides an underground storm drain in Whittier Boulevard extending nearly 7,000 linear feet from the existing storm drain at Palm Avenue east to Santa Fe Street. Line D provides an underground storm drain in Stetson Avenue running 1,400 linear feet from Meridian Street to Hemet Street.

Monroe Master Drainage Plan – Monroe Channel: At request of the City of Riverside, its existing open channel will be replaced with an underground reinforced concrete box with the capacity to carry ten-year storm flows. The project will run under Monroe Street from California Avenue upstream to Magnolia Avenue.

Norco Master Drainage Plan – Lateral N1-D and Spirit Knoll Court Storm Drain: Project will construct two North Norco Channel lateral storm drains, one in Spirit Knoll Court and one in Rose Court. These facilities will outlet to existing interim channel and will drain sumps along Temescal Avenue.

Palm Canyon Wash – Cherley Creek Levee Restoration: Major construction under this project will bring the existing levee serving small tributary upstream of South Palm Canyon Wash into compliance with FEMA certification guidelines. The existing channel will be upsized and the north bank levee will be restored. The project will use a combination of rock slope protection (i.e., rip-rap) and soil-cement lined channel for the levee.

Palm Springs Master Drainage Plan – Lines 43 and 43A: This project will connect the Eagle Canyon Dam outlet (described above) to West Cathedral Canyon Channel. The storm drain will begin south of East Palm Canyon Drive and run southwesterly to discharge into the North Cathedral Canyon Channel. The 42-inch drainage pipeline will run roughly 3,300 linear feet in total.

Pyrite Channel Bypass: This will be a cooperative project with the Riverside County Economic Development Agency (EDA). A storm drain will run in Pyrite Street from Jurupa Road north to discharge into the existing Jurupa Channel. The project will not convey the entire 100-year storm flows, but will provide substantial relief to properties between Pyrite Street and Jurupa Avenue.

Romoland Master Drainage Plan – Line A: This project is to construct an open (interim) channel for 4,000 linear feet from west of Interstate 215, north parallel to Barnett Road and west along Ethanac Road to discharge at an interim outlet near San Jacinto River.

San Jacinto Master Drainage Plan – Lines C, B and C-5: This project proposes 8,150 linear feet of storm drains. Line C will run from Esplanade Avenue south and to east along Midway Street to San Jacinto Street, with short Lines C-4 and C-5 branching off along the way. At San Jacinto Avenue, it joins Line B, which runs south to Menlo Avenue.

Southwest Riverside Master Drainage Plan – Lines G, G-1 and F-1: A total of 4,200 linear feet of storm drain in Meyers Street and laterals in Victoria Avenue will be constructed under this project. Line G runs southeasterly along Meyers Street to a T-split at Victoria Avenue. Along Victoria Avenue, Lateral G-1 runs
northeasterly towards Van Buren Boulevard and Lateral F-1 runs southwesterly to Harrison Street. The City of Riverside is to design and build the project.

**Sunnymead Master Drainage Plan – Line P-6:** Consists of the construction of 600 feet of storm drain in Eucalyptus Avenue from Perris Boulevard to Shirebourn Road in Moreno Valley.

**Sycamore Dam – Outlet Structure Modifications:** Located in the City of Riverside, east of the intersection of Central and Chicago Avenues, this project will install an access road, replace the inlet tower and reconstruct and armor the outlet structure of Sycamore Dam to prevent blockage by debris accumulation. The effort is a pilot project to develop a solution for the six other reservoirs in Riverside.

**Temescal Creek – Foster Road Storm Drain:** An underground storm drain in Foster Road will be constructed from I-15 to Temescal Creek. Project also includes environmental enhancement adjacent to Temescal Creek.

**West End Moreno Master Drainage Plan – Line LL:** This project involves construction of approximately 2,000 linear feet of underground storm drain within the road right-of-way along Dracaea Avenue approximately 500 feet west of Edgemont Street, then southerly 750 feet and southwesterly 1,200 feet along Old I-215 Frontage Road.

c. **To Begin Construction In or Around 2014**

**Banning Master Drainage Plan – Line H:** Located south of Banning Municipal Airport, this project proposes to construct approximately 3,400 feet of reinforced concrete pipe from an outlet at Smith Creek Channel running west towards Wesley Street. The storm drain will then run north along Hathaway Street to Barbour Street, for a total of 3,925 linear feet.

**Desert Hot Springs Master Drainage Plan – Line E-5:** Line E-5 involves the construction of approximately 3,700 linear feet of a reinforced concrete pipe storm drain in Eighth Street from the existing Line E, easterly to Mesquite Avenue.

**Little Lake Master Drainage Plan – Line B:** Line B provides an underground storm drain under Meridian Street that runs approximately 4,055 linear feet from just south of Florida Avenue to Whittier Avenue in Hemet. Another 4,600 linear feet of Line B will run from north of Berkley Avenue to Florida Avenue, also under Whittier Avenue.

**Valle Vista Channel Extension:** This project is to construct a 700-foot extension to Valle Vista channel along Acacia Avenue. The rectangular channel and inlet works will connect into the existing channel at the intersection of Acacia and Georgia Avenues.

**Woodcrest Dam – Outlet Structure Modifications:** As with the Sycamore Dam project, this project proposes to reconstruct the Woodcrest Dam outlet structure to prevent blockage by debris accumulation. It is also a pilot project to develop a solution for Riverside’s six other reservoirs.
4.11.3 Policies and Regulations Addressing Flood and Dam Inundation

Many urban areas in California are located in historic floodplains. To reduce the risk of loss of life and property, local, state and federal agencies implement a number of programs and regulations. These include the following.

A. State and Federal Regulations

There are several federal agencies tasked with protecting people and property from flood hazards. Chief among these is the Army Corps, which both constructs and operates federal flood risk management projects and also issues permits for disturbances to “waters of the United States” and associated wetlands pursuant to the federal Clean Water Act. This aspect of the Army Corps’ duties is further described in Section 4.8 (Biology) of this EIR. Another key flood management program, the National Flood Insurance Program is administered by FEMA. FEMA is also responsible for disaster planning and recovery programs at the national level.

National Flood Insurance Program: In 1968, Congress created the NFIP in response to the rising cost of taxpayer-funded disaster relief for flood victims and the increasing amount of damage caused by floods. Administered by FEMA, the NFIP makes federally backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. As a voluntary, incentive-based federal program, the NFIP requires that new or replacement buildings in flood hazard areas be constructed to limit future flood damage. For participating areas, a series of flood insurance rate maps have been issued to delineate areas of special flood hazards. The program also requires that local governments regulate development in designated floodplains through the adoption of floodplain management ordinances that meet minimum NFIP requirements. The County of Riverside enacted a floodplain management ordinance and policies; see description below.

National Flood Insurance is available in the County of Riverside. In order to participate in the program, FEMA requires that Riverside County and its incorporated cities maintain the carrying capacity of all flood control facilities and floodways. Communities that fail to meet their maintenance responsibilities are subject to expulsion from the NFIP, loss of other federal aid or even exposure to suits by FEMA for recovery of flood insurance and disaster payments.

In 1994, the NFIP was revised under the National Flood Insurance Program Reform Act. Changes addressed how flood insurance is offered and funded for structures within designated floodplains, increased flood insurance limits and eliminated the 1962 buy-out program. It also clarified flood insurance purchase requirements as a condition of receiving federal disaster assistance. If the flood insurance policy were not maintained, in the event of another disaster no disaster assistance would be made available for that structure.

Owners of all structures within a projected 100-year flood inundation area (also called a “Special Flood Hazards Area,”) are required to purchase and maintain flood insurance as a condition of receiving a federally-related mortgage or home equity loan on that structure. Such insurance mitigates flood-related impacts by rectifying any damage that occurs.

FEMA Floodplain NFIP Mapping Program: As part of its role in protecting communities from flood hazards, FEMA issued Flood Hazard Boundary Maps for more than 19,000 flood-prone communities nationwide. These maps provide approximate delineations of areas subject to inundation by 100-year floods, aka Special Flood Hazard Areas. Data based on past floods, regional flood depth/drainage area relationships, floodplain maps published by other federal agencies and simplified hydrologic and hydraulic calculations all go
Section 4.11  

Flood and Dam Inundation Hazards

into the development of these maps and their approximate floodplain boundaries. Subsequently, these maps are further refined through a Flood Insurance Study which more closely examines a variety of data and engineering analyses for the floodplain. The results are used to create a FIRM depicting 100- and 500-year floodplain boundaries, flood insurance risk zones, base flood depths and other data. Alternatively, a FIRM may be developed without the first step of a Flood Hazard Boundary Map being prepared. In such cases, the information provided is less detailed, but still sufficient for community flood hazard planning.

When a revision to a NFIP map is warranted, FEMA will revise and republish the affected map panels (e.g., a Physical Map Revision), to show the appropriate changes. Or they will issue a letter referred to as a Letter of Map Revision (LOMR) that describes the changes and officially revises the effective FIRM map.

Another action by FEMA is the making of “conditional determinations,” based upon their review of how designated floodplains would be affected by proposed projects. Project activities such as floodplain modification or simply the placement of fill to elevate one or more structures or parcels of land might be proposed. When such conditional determinations are warranted, they are issued in letters referred to as Conditional Letters of Map Revision (CLOMRS) or Conditional Letters of Map Revision Based on Fill (CLOMR-Fs) that describe the effect the proposed project or fill would have on the effective NFIP map. A conditional determination does not actually revise an effective NFIP map.

The County of Riverside participates in the NFIP and uses FIRMs as the basis for county flood risk management planning. These maps were used to provide the general boundaries of the 100-year flood inundation areas, as further developed by FCWCD, and shown in Figure 4.11.1.

Executive Order 11988 Floodplain Management: This federal Executive Order, originally issued in 1977 by President Jimmy Carter, requires federal agencies to provide leadership in the long- and short-term potential adverse impacts associated with the modification and potential occupancy of floodplains and to take action to avoid floodplain development when other practical alternatives exist through the following:

- Avoid development in existing 100-year floodplains, unless such development is the only practicable alternative.
- Reduce hazards and risk associated with floods.
- Minimize the impact of floods on human health, safety and welfare.
- Restore and preserve the natural and beneficial values of existing floodplains.

To comply with Executive Order 11988, it is the Army Corps’ policy to formulate projects that, to the extent possible, avoid or minimize adverse effects associated with use of the floodplain and avoid inducing development in an existing floodplain unless there is no practicable alternative.

Federal Water Pollution Control Act of 1972 (aka the Clean Water Act): Under the federal Clean Water Act (CWA) (Title 33, U.S. Code [USC], Section 1251 et seq.), three separate permits, as outlined below, are required to operate and maintain flood control systems. See Section 4.19 for more detailed discussion of these water quality-related issues:

- A NPDES Municipal Stormwater Permit is required to discharge stormwater to “waters of the United States.” (See below for more.)
A Dredge and Fill Permit must be obtained from the Army Corps pursuant to CWA Section 404 for any project that discharges fill to “waters of the United States.” As the agency tasked with primary implementation of the CWA, the U.S. Environmental Protection Agency (EPA) retains veto power over any permit issued by the Army Corps.

A water quality certification or waiver must be obtained pursuant to CWA Section 401 before any given Section 404 permit becomes valid. This process has been delegated by the U.S. EPA to the State Water Resources Control Board.

Cobey-Alquist Floodplain Management Act: This law (Public Resources Code [PRC] Section 8400 et seq.) states that the State of California will not appropriate money to support projects within federally designated floodway boundaries unless affected local governments (such as the County of Riverside) have enacted floodplain regulations meeting certain minimum requirements. Thus, the primary responsibility for planning, adoption and enforcement of land use regulations to accomplish floodplain management rests at the local government level. It is the State of California’s policy to provide state assistance and guidance and to encourage local levels of governments to employ land use regulations to accomplish floodplain management and to provide state assistance and guidance. Riverside County has used the guidelines established by this legislation to produce ordinances, such as the Flood Hazard Regulation Ordinance, No. 458, that promote public health, safety and general welfare, and minimize public and private losses due to flood conditions in Riverside County.

Assembly Bill 162 (2007): AB 162 established new requirements for general plans to consider flood management. The land use element of the general plan is required to identify and annually review areas subject to flooding, as identified on FEMA or DWR floodplain maps. The conservation element is required to identify land and water resources that can accommodate floodwater for purposes of “groundwater recharge and stormwater management.” And, the safety element must identify flood hazard zones and provide policies to protect against unreasonable flooding risks. The Riverside County General Plan does provide the requested information. See Section 4.11.3.E, below, for policies that fulfill these requirements.

California Water Code: CWC Section 8100 et seq. states that county boards of supervisors may appropriate and expend money from the county’s general fund for any of the following purposes in connection with streams or rivers in the county:

- The construction of works, improvements, levees or check dams to prevent overflow and flooding.
- The protection and reforestation of watersheds.
- The conservation of the floodwaters.
- The making of all surveys, maps and plans necessary to carry out any work, construction or improvement authorized.
- The carrying out of any work, construction or improvement authorized outside the county if the rivers or streams affect flow in or through more than one county.

National Pollution Discharge Elimination System Permit Program: In California, the State Water Resource Control Board (SWRCB) and its Regional Water Quality Control Boards (RWQCBs) administer the NPDES permit program. The NPDES permit system was established under the CWA to regulate both point and nonpoint source discharges to surface waters of the U.S. The NPDES program encompasses characterizing receiving water quality, identifying harmful constituents, targeting potential sources of pollutants and implementing comprehen-
sive water management programs. Construction and industrial activities are typically regulated under statewide general permits that are issued by the SWRCB. The RWQCB also issues Waste Discharge Requirements that serve as NPDES permits for impacts to waters of the State under the authority delegated to the RWQCBs.

Water quality is overseen by a separate set of State agencies, chiefly, the SWRCB. The SWRCB has divided the state’s 10 major watersheds into a number of regions, based on major local watersheds. In western Riverside County, which is within the state’s South Coast Hydrological Region, two RWQCBs have jurisdiction: Region 8 (Santa Ana) and Region 9 (San Diego). The eastern two-thirds of Riverside County are in the state’s Colorado River Hydrological Region which is under the jurisdiction of RWQCB Region 7 (Colorado River Basin). As detailed in Section 4.19, the County of Riverside is a permittee for three MS4 permits covering extensive portions of the Santa Ana River, Santa Margarita River and Whitewater River watersheds. See Section 4.19 for additional details on these permits and on the hydrology of Riverside County.

B. Local Authorities

In California, state law makes local governmental agencies responsible for flood risk management. CWC Section 8401 states: “The primary responsibility for planning, adoption and enforcement of land use regulations to accomplish floodplain management rests with local levels of government,” the land use element of the plan must identify areas that are subject to flooding.

The FCWCD is the primary agency in Riverside County that is responsible for flood risk management, including most of the western county. In eastern Riverside County, this function is performed by the Coachella Valley Water District. During Riverside County Flood’s 70-year history, it has developed an extensive flood control system in western Riverside County that includes 61 dams, debris basins and detention basins, 32 miles of levees, 253 miles of open channel and 397 miles of underground storm drains. Proper operation and maintenance of the system is critical to protect the lives and properties of the residents of Riverside County and is essential to ensuring economic activity and transportation corridors are not disrupted during flooding.

Table 4.11-C, below, summarizes agencies with local flood risk management responsibilities in Riverside County. Local governments are authorized to appropriately zone river basin lands within their jurisdictions. However, state and federal agencies (DWR, Army Corps and FEMA) often provide assistance to local planning agencies by determining the probability of flooding and the potential flood damage.

C. Riverside County Regulations

The County of Riverside has adopted a number of ordinances that provide flood risk management, both directly and indirectly, as follows:

**Ordinance No. 348 - Land Use:** This is the master zoning ordinance for Riverside County. As such, it dictates the types of land uses and development suitable for various conditions. It includes a “W-1 Zone,” for watercourses, watersheds and conservation areas. Land zoned W-1 is generally associated with “present conditions not suited for permanent occupancy or residency by persons” because they are subject to periodic flooding and other hazards. Among other reasons, this zone can be applied to lands in which there is no approved drainage and stormwater control plans or for which significant flooding hazards exist. As an example, in 2007 interim W-1 zoning was applied to portions of the communities of Lakeview and Nuevo until appropriate master drainage plans could be approved. Use of this ordinance and the W-1 zone mitigate potential flood impacts by preventing development in areas where which people, property or structures would be at risk for harm due to flooding.
Table 4.11-C: Local Flood Risk Management Agencies in Riverside County

<table>
<thead>
<tr>
<th>Agency and Contact Information</th>
<th>Territory/Area Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside County Flood Control and Water Conservation District</td>
<td>Western Riverside County</td>
</tr>
<tr>
<td>Coachella Valley Water District</td>
<td>Majority of Coachella Valley</td>
</tr>
<tr>
<td></td>
<td>Palo Verde Valley (northeastern-most Riverside County) and a portion of Imperial County</td>
</tr>
<tr>
<td>Imperial Irrigation District ¹</td>
<td>Imperial Valley, including portions of south eastern-most Riverside County plus Imperial County</td>
</tr>
<tr>
<td>County Service Areas 103 and 121 ²</td>
<td>CSA 103 serves Wildomar in southwest Riverside County</td>
</tr>
<tr>
<td></td>
<td>CSA 121 serves Thousand Palms in Coachella Valley</td>
</tr>
<tr>
<td>Desert Water Agency</td>
<td>Portions of Riverside County east of Coachella Valley, and excluding the Whitewater River system</td>
</tr>
<tr>
<td>San Gorgonio Pass Water Agency ³</td>
<td>Portions of northern Riverside County, generally between Moreno Valley to the southwest and Beaumont to the east</td>
</tr>
</tbody>
</table>

Footnotes:
1. This district manages agricultural / local drainage facilities rather than regional flood control structures.
2. The two County Service Areas maintain local retention basins.
3. While the agency has authority to acquire and control stormwater, its actions in this regard have been limited to using “runoff” water from local rivers and streams to replenish the groundwater on lands within the agency’s jurisdiction.

Source: California Department of Finance, Inventory of Flood Control Agencies, 1997.

Ordinance No. 457 - Building Codes and Fees: This ordinance specifies the various state and/or professional society building and construction standards by which all development approved within unincorporated Riverside County must comply. It includes specifications for use of the California Building Code, the Uniform Housing Code, the California Plumbing Code, the California Mechanical Code and the California Electrical Code, among others. Use of these codes ensures that any development or construction within the county meets the necessary standards for suitability, durability, safety and so on; ensuring that occupants of such structures and facilities are not placed at undue risk. In terms of flood risk management and safety, the codes include requirements for the structural integrity of buildings and other facilities for withstanding precipitation, inundation and water flow. They also specify standards for grading, lot, roadway and drainage design to ensure that water flows (particularly runoff) are directed or channeled appropriate ways. The ordinance also imposes minimum standards for permanent erosion control and associated landscaping. It includes requirements for preparation of a Storm Water Pollution Prevention Plan (SWPPP) for construction sites, implementation of year-round best management practices (BMPs) on such sites and the monitoring and maintaining of the BMPs to ensure they continue to provide adequate stormwater flow / runoff protections, erosion protection and sediment controls, both during and after construction activities on a site. As a result, it ensures adequate measures are in place to prevent significant adverse impacts due to construction and urban runoff, stormwater flows and water erosion on lands subject to development.

Ordinance No. 458 - Regulating Flood Hazard Areas and Implementing the National Flood Insurance Program: This ordinance was adopted pursuant to the requirements of the National Flood Insurance Program (Title 42, USC, Section 4001 et. seq., as amended). Its purpose is to protect the public’s health, safety and welfare from flooding hazards. It does so by regulating development within flood hazard areas and establishing a variety of land use and construction standards for such development.

The ordinance includes construction standards that apply to all new structures and substantial improvements to existing structures within Riverside County’s mapped Special Flood Hazard Areas and floodplains, as shown in Figures 4.11.1 and 4.11.2. Among other requirements, these types of construction are required to: use materials resistant to flood damage; be anchored to prevent flotation, collapse or lateral movement of the structure resulting from water movement or loading, including the effects of buoyancy; use construction methods and practices that minimize flood damage; and have electrical, heating, ventilation, plumbing and air conditioning...
equipment and other service facilities designed and located to prevent water from entering or affecting them during flooding.

Further, all subdivision proposals and other proposed new development, including manufactured home parks or subdivisions greater than 50 lots or 5 acres, whichever is less, are required to identify the base flood elevation (that is, 100-year flood extent) and be reviewed by Riverside County Flood District to ensure the project would be reasonably safe from flooding. This includes ensuring that: all utilities and facilities such as sewer, gas, electrical, propane tanks and water systems are located and constructed to minimize or eliminate flood damage; adequate drainage is provided to reduce flooding potential; and, that all other required state and federal permits have been obtained. All new and replacement water supply systems must be designed to minimize or eliminate infiltration of floodwaters into the systems. New and replacement sanitary sewage systems must also be designed to minimize or eliminate infiltration of floodwaters into the systems and discharges from the systems into flood waters and onsite waste disposal systems must be located to avoid impairment or causing contamination during flooding. Lastly, all manufactured homes must be installed using methods and practices which minimize flood damage.

New construction and substantial improvements of residential structures are required to have their lowest floor, including basement, located at or above the base (100-year) flood elevation. All new construction and substantial improvements of nonresidential structures must meet this standard or, together with attendant utility and sanitary facilities, be designed so that the portion of the structure below the base flood level is watertight. This means walls must be substantially impermeable to the passage of water and structural components must have the capability of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy.

For new structures and substantial improvements within Riverside County’s mapped Special Flood Hazard Areas and floodplains, specific flood mapping conditions are required to be met prior to grading or building occupancy. For example, prior to grading, a Conditional Letter Map of Revision (LOMR) must be issued by FEMA and prior to inspection for occupancy, a LOMR must be issued by FEMA for areas shown as floodplain on the effective FIRM. These mean, in essence, that the development must document proof that it has engineered the site or its structures so that it is either out of the floodplain or watercourse, or that the flood hazard no longer exists for stated reasons.

Pursuant to Ordinance No. 458, no structure shall be constructed, located or substantially improved and no land shall be graded, filled or developed in the areas designated as floodways, except upon approval of a plan which provides that the proposed development will not result in any increase in flood levels during the occurrence of the base flood discharge. If a proposed permit qualifies for approval in the floodway, it shall then meet all the requirements necessary for approval of a permit in a Special Flood Hazard Area or floodplain. Until such time that a regulatory floodway is adopted, no new construction or other development (including fill) shall be permitted within Zones A, A1-30 and AE, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other development, will not increase the water surface elevation of the base flood more than 1 foot or as determined by Riverside County Flood or the CVWD at any point along the floodplain.

For proposed alterations within a watercourse or mapped floodplain, the flood carrying capacity of the altered or relocated portion of the watercourse or mapped floodplain shall be maintained. Manufactured slopes that encroach into a floodplain and are subject to erosive velocities are considered flood control facilities and must be maintained by a public entity. Within certain zones (AH and AO) on Flood Insurance Rate Maps, adequate drainage paths around structures on slopes must be provided, to guide floodwaters around and away from proposed structures. Ordinance No. 458 also specifically requires that all new buildings and/or substantial improvements located within the 500-year floodplain limits of Lake Elsinore shall have their lowest floor elevated
a minimum of 3 feet above the Lake’s 100-year water surface elevation. Maps of the 100-year and 500-year floodplains for Lake Elsinore can be obtained through the City of Lake Elsinore’s website; all Riverside County areas can be viewed online at www.rcflood.org.

In summary, the specifications, standards and requirements contained in Ordinance No. 458 establish and implement measures that mitigate potential flood hazards within Riverside County. Collectively, these serve to ensure that flooding risks, water flows and runoff are managed appropriately to prevent hazards and undue risk of damage or harm to people, property, structures and facilities within Riverside County. By requiring specific standards for development and establishing a program for the approval, implementation and verification of such measures, this ordinance mitigates potential hazards that could arise from flooding hazards and its effects on people, property and structures.

**Ordinance No. 461 - Road Improvement Standards:** While not addressing flooding directly, this ordinance does set forth standards for roads, bridges and other transportation-related facilities, including those aspects of flood risk management associated with them. Because of their linear and impervious nature, paved roadways typically act as conduits for water flow, particularly stormwater (urban) runoff from developed areas. In addition, they often may function informally as barriers (dams, dikes or levees) to water flow or cause water channelization when constructed on raised beds or with tall curbs or crowns. Also, roadways often cross rivers, streams, drainage, floodplains and similar features. All crossings must be sufficiently engineered to withstand the potential impacts of flood flows. Hence, Ordinance No. 461 imposes standards and engineering specifications that reduce these potential flood impacts to ensure the safety and integrity of the roadway or improvement. As such, this ordinance serves to mitigate potential flooding hazards to people, property and structures by ensuring that roads and associated improvements and features are designed, constructed and maintained in a manner appropriate for the water flow potential and flooding hazard.

**Ordinance No. 659 - Development Impact Fee Program:** This ordinance sets a range of development impact fees to be used “in order to effectively implement the Riverside County General Plan, manage new residential, commercial and industrial development and reduce impacts caused by such development.” It is intended to mitigate growth impacts (particularly those arising from population growth) on public facilities within the county to ensure residents are not placed into conditions perilous to their health, safety, comfort or welfare.

The ordinance establishes the process for (and nexus to) the construction or acquisition of various types of public facilities, as well as the preservation of open space, wildlife and their associated habitats. The DIF program ensures that “all new development bear its fair share cost of providing the facilities, open space and habitat reasonably needed to serve that development.” Hence the program applies to all new residential, commercial and industrial development, as well as to surface mining. Fees are assessed on the basis of regional location within the county, land use type (per dwelling unit for residential units and per acre for all other uses) and the applicable categories of facilities to be provided. The services covered by the fee include: public facilities, fire facilities, regional parks, community parks and centers, regional multi-purpose trails and library services. Fees associated with these services are based on estimates of Riverside County’s needs for the subsequent ten years. For transportation and flood risk management, fees are based on forecast development needs for the subsequent 20 years. In regards to flood control facilities, the DIF program ensures fees are collected and expended to provide necessary facilities commensurate with the ongoing levels of development in specific areas not already subject to, or in addition to, Area Drainage Plan fees as under Ordinance No. 458. These areas include the Upper San Jacinto Valley, Mead Valley/Good Hope and the San Gorgonio Pass.

This ordinance provides mitigation for development impacts on flood control facilities and future needs for flood risk management by ensuring that funds are collected and utilized to provide needed facilities as development
progresses within the county. The provision of these facilities ensures new development does not expose people, property or structures to undue flooding risks from urban runoff.

**Ordinance No. 754 - Stormwater / Urban Runoff Management and Discharge Controls:** Among other things, the ordinance requires that all discharge to storm drain systems be confined to stormwater runoff discharged pursuant to a NPDES permit or as otherwise authorized by the Santa Ana, San Diego or Colorado River Basin RWQCB or the SWRCB in compliance with the federal Clean Water Act. This ordinance also establishes a variety of standards and BMPs associated with controlling stormwater runoff.

Although focusing on the pollution-control aspects of the NPDES program, in conjunction with Ordinance No. 457 and Ordinance No. 460, this ordinance establishes a range of standards and permit requirements that collectively serve to ensure that stormwater flows and runoff in developed areas are managed appropriately to prevent hazards or undue risk of damage or harm to people, property, structures and facilities within Riverside County. By requiring specific standards for development and establishing a program for the approval, implementation and verification of such measures, this ordinance mitigates potential hazards that could arise from stormwater flows and runoff, including flooding and erosion, and its effects on people, property and structures.

**D. Existing Riverside County General Plan Policies**

The following policies are already part of the General Plan and are not part of the project, GPA No. 960. Rather, these policies are considered to play a role in ensuring any potential environmental effects are avoided, reduced or minimized through their application on a case-by-case basis. The County of Riverside has existing programs in place that ensure applicable policies are imposed once a development proposal triggers a specific policy or policies. The need for specific policies is determined through subsequent CEQA analysis performed for site-specific projects. These measures are implemented, enforced and verified through their inclusion into project Conditions of Approval. The following existing and proposed General Plan Safety (S) Element polices reduce impacts related to flooding, dam inundation and related hazards.

**Policy S 4.1:** For new construction and proposals for substantial improvements to residential and non-residential development within 100-year floodplains as mapped by FEMA or as determined by site-specific hydrologic studies for areas not mapped by FEMA, Riverside County shall apply a minimum level of acceptable risk; and disapprove projects that cannot mitigate the hazard to the satisfaction of the Building Official or other responsible agency.

**Policy S 4.3:** Prohibit construction of permanent structures for human housing or employment to the extent necessary to convey floodwaters without property damage or risk to public safety. Agricultural, recreational or other low intensity uses are allowable if flood control and groundwater recharge functions are maintained.

**Policy S 4.4:** Prohibit alteration of floodways and channelization unless alternative methods of flood control are not technically feasible or unless alternative methods are utilized to the maximum extent practicable. The intent is to balance the need for protection with prudent land use solutions, recreation needs and habitat requirements, and as applicable to provide incentives for natural watercourse preservation, including density transfer programs as may be adopted.

a. Prohibit the construction, location or substantial improvement of structures in areas designated as floodways, except upon approval of a plan which provides that the proposed development will not result in any significant increase in flood levels during the occurrence of a 100-year flood discharge.
b. Prohibit the filling or grading of land for nonagricultural purposes and for non-authorized flood control purposes in areas designated as floodways, except upon approval of a plan which provides that the proposed development will not result in any significant increase in flood levels during the occurrence of a 100-year flood discharge.

**Policy S 4.5:** Prohibit substantial modification to watercourses, unless modification does not increase erosion or adjacent sedimentation, or increase water velocities, so as to be detrimental to adjacent property, nor adversely affect adjacent wetlands or riparian habitat.

**Policy S 4.6:** Direct flood control improvement measures toward the protection of existing and planned development.

**Policy S 4.8:** Allow development within the floodway fringe, if the proposed structures can be adequately flood-proofed and will not contribute to property damage or risks to public safety.

**Policy S 4.9:** Within the floodway fringe of a floodplain as mapped by FEMA or as determined by site-specific hydrologic studies for areas not mapped by FEMA, require development to be capable of withstanding flooding and to minimize use of fill. However, some development may be compatible within flood plains and floodways, as may some other land uses. In such cases, flood-proofing would not be required. Compatible uses shall not, however, obstruct flows or adversely affect upstream or downstream properties with increased velocities, erosion backwater effects or concentrations of flows.

**Policy S 4.10:** Require all proposed projects anywhere in the county to address and mitigate any adverse impacts that it may have on the carrying capacity of the local and regional storm drain systems.

**Policy S 4.11:** Encourage neighboring jurisdictions to require development occurring adjacent to the county to consider the impact of flooding and flood control measures on properties within unincorporated Riverside County.

**Policy S 4.12:** Require certain existing essential, dependent care and high-risk facilities that are not in conformance with the provisions of county zoning to upgrade or modify building use to a level of safety consistent with the inundation risk.

**Policy S 4.16:** Utilize power of public land acquisition and other land use measures to create open space zoning of inundation zones in areas that are destined for redevelopment; when this is not feasible, low density land uses should be employed.

**Policy S 4.17:** Continue to assess and upgrade inundation risk and protection in the county.

**Policy S 4.18:** Require that the design and upgrade of street storm drains be based on the depth of inundation, relative risk to public health and safety, the potential for hindrance of emergency access and regress from excessive flood depth, and the threat of contamination of the storm drain system with sewage effluent. In general, the 10-year flood flows shall be contained within the top of curbs and the 100-year flood flows within the street right-of-way.

**Policy S 4.19:** Encourage periodic re-evaluation of 500-year, 100-year and 10-year flood hazard in the county by state, federal, county and other sources, and use such studies to improve existing protection, to review protection standards proposed for new development and redevelopment, and to update emergency response plans.
**Policy S 4.20:** Balance flood control mitigation with open space and environmental protection.

**Policy S 4.21:** Encourage the use of specific plans to allow increased densities in certain areas of proposed development; or apply Transfer of Development Credits to encourage the placement of appropriate land uses in natural hazard areas, including open space, passive recreational uses, or other development capable of tolerating these hazards.

**Policy S 4.22:** Take an active role in acquiring property in high-risk flood zones and designating the land as open space for public use or wildlife habitat.

### E. Proposed New or Revised Riverside County General Plan Policies

The following proposed revised General Plan policy addresses impacts related to flooding and dam inundation hazards.

#### 1. Safety (S) Element

**Policy S 4.2:** The county shall enforce provisions of the Building Code in conjunction with the following guidelines:

- **a.** All residential, commercial and industrial structures shall be flood-proofed from the mapped 100-year stormflow, and this may require that the finished floor elevation shall be constructed at such a height as to meet this requirement. Non-residential (commercial or industrial) structures may be allowed with a “flood-proofed” finished floor below the Base Flood Elevation (i.e., 100-year flood surface) to the extent permitted by State, federal and local regulations. New critical facilities should be constructed above grade to the satisfaction of the Building Official, based on federal, state, or other reliable hydrologic studies. To the extent that residential, commercial or industrial structures cannot meet these standards, they shall not be approved.

- **b.** Critical facilities shall not be permitted in floodplains unless the project design ensures that there are two routes for emergency egress and regress, and minimizes the potential for debris or flooding to block emergency routes, either through the construction of dikes, bridges, or large-diameter storm drains under roads used for primary access.

- **c.** Development using, storing, or otherwise involved with substantial quantities of onsite hazardous materials shall not be permitted within a 100-year floodplain or dam inundation zone, unless all standards for evaluation, anchoring and flood-proofing have been satisfied; and hazardous materials are stored in watertight containers, not capable of floating, to the extent required by state and federal laws and regulations.

- **d.** Specific flood-proofing measures may require: use of paints, membranes, or mortar to reduce water seepage through walls; installation of water tight doors, bulkheads, and shutters; installation of flood water pumps in structures; and proper modification and protection of all electrical equipment, circuits, and appliances so that the risk of electrocution or fire is eliminated. However, fully enclosed areas that are below finished floors shall require openings to equalize the forces on both sides of the walls.

**Policy S 4.7:** Any substantial modification to a watercourse shall be done in the least environmentally damaging manner possible practicable in order to maintain adequate wildlife corridors and linkages and maximize groundwater recharge.
2. Circulation (C) Element

NEW Policy C 20.4: New crossings of watercourses by local roads shall occur at the minimum frequency necessary to provide for adequate neighborhood and community circulation and fire protection. Wherever feasible, new crossings shall occur using bridging systems that pass over entire watercourses and associated floodplains and riparian vegetation in single spans. Dip or culvert crossings shall be avoided, but, where their use is unavoidable, they shall be designed to minimize impacts on watercourses.

NEW Policy C 20.5: In order to protect the watershed, water supply, groundwater recharge, and wildlife values of watercourses, the county will avoid siting utility infrastructure and associated grading, fire clearance, and other disturbances within or adjacent to watercourses, if there are feasible alternatives available, and discourage special districts and other governmental jurisdictions outside of the county’s authority, from doing so. Where such watershed utility siting locations cannot be avoided, the impacts on watercourses shall be minimized.

4.11.4 Thresholds of Significance for Flood and Dam Inundation Hazards

The proposed project would result in a significant flood or dam inundation impact if it would:

A. Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map.

B. Place within a 100-year flood hazard area structures which would impede or redirect flood flows.

C. 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 levee or dam.

D. 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.

E. Expose people or structures to a significant risk of inundation due to seiche, tsunami or mudflow.

4.11.5 Effect of GPA No. 960 on the General Plan and on Flood and Dam Inundation Hazards

The proposed project, GPA No. 960, would have spatial effects where it involves a variety of specific General Plan Land Use Designation (LUD) corrections and changes, several Policy Area, Study Area and overlay changes, proposals for new trail and road alignments and standards, and an incidental commercial policy for rural areas. In addition, GPA No. 960 includes a number of updates to proposed roadway alignments and intersection locations, as well as functional classifications (widths, number of lanes, level of service targets, etc.), where needed throughout unincorporated Riverside County. In this section, the flood-related changes to the General Plan are outlined and the effects of proposed changes relative to flood and dam inundation hazards are discussed. Specific impacts and mitigation for the project are then evaluated according to identified significance thresholds in the subsequent section.
A. Proposed Changes to the General Plan

As part of the project review process, data and map related to flooding and dam inundation hazards in the General Plan were updated and associated policies reviewed and revised where necessary. The existing General Plan addresses flooding hazards in the Safety Element with the multipurpose open space element also containing riparian and flood plain policies. Texts of relevant existing and revised General Plan policies are provided in Sections 4.11.3E and F.

Flooding Hazard Maps: As part of the GPA No. 960 update, text was added and policies updated to accommodate new 100-year flood mapping released by FEMA and as adopted by Riverside County pursuant to Riverside County Ordinance No. 458 after review and acceptance by FCWCD. Several related Safety policies were revised as part of this and related exhibits were also updated: Figure S-9, 100-year Flood Hazard Zones (and related “Flood Hazard” maps in the Area Plans), and Figure S-10, Dam Failure Inundation Zones.

Land Use Changes: Several proposed changes would affect future development potential within areas at risk for flooding, dam inundation and/or seiche. In particular, this includes the proposed changes to the Lakeland Village area around Lake Elsinore. Changes around the Salton Sea could also occur on lands affected by that waterbody, however, the LUD changes proposed are from higher density/intensity developed uses (including residential) to AG (the Agriculture Foundation) to better recognize and accommodate aquaculture activities along the sea’s shores. Such changes would actually decrease potential flooding risks associated with the Salton Sea.

The key changes in proximity to flood potential areas are those for Lakeland Village. However, the whole purpose of the proposed GPA No. 960 changes to the area is to better accommodate known flood boundaries. Specifically, in the past few years, the 100-year flood boundaries surrounding Lake Elsinore were adjusted to reflect more recent hydrology data. As a result, more precise LUD assignments can be made, particularly for the long, narrow lake-front lots that lie on the lakeside of Grand Avenue. Although these changes improve flood safety through better definition and accommodation of the lake’s floodplain, they also remove existing barriers to growth by providing more suitable LUDs on some parcels formerly with split designations. Paradoxically, the changes may also increase flood risks by exposing more people, property and structures to flood hazards, as well as potentially seiche risks at the southeastern-most end of the lake.

The variety of LUD and policy area changes proposed, as per the descriptions in Section 3.0 (Project Description) of the EIR and associated Figure 3-1 (as well as the corresponding maps within each Area Plan) may indirectly affect flooding hazards, including dam inundation threats. Such changes would lead to either an increase or decrease in development potential (density or intensity); the risks associated with introducing new people and property into areas potentially subject to the various flooding hazards outlined herein would be increased correspondingly.

GPA No. 960 also includes new and revised policies to be implemented at locations not foreseeable at present; for example, the new incidental rural Retail-Commercial policy, Indian fee land policies and others, as described in Section 3.0 of the EIR. Similarly, new maps for trails and county roads (GP Figures C-7 and C-1, respectively, plus corresponding maps within each Area Plan) indicate general road and trail alignments, but not specific locations since specific design and construction sites must be determined based on site topography, existing development and timing, as well as both existing and future levels of service to be met. Actual locations for these improvements will be determined based on site assessment of and geotechnical suitability to determine environmentally preferred alignments to minimize adverse effects. Likewise, other infrastructure and utilities, such as power transmission lines, water and sewer lines and area drainage plans, are also developed based on the agency’s priorities, including existing and future levels of service and need assessments and forecasts; typically
based on five-year capital improvement plans. Generally, however, such improvements are not proposed until either specific new developments or overall growth within an area triggers their need.

Accordingly, specific locations and timing of future infrastructure, including power transmission lines, water and sewer lines, roads, flood risk management projects and other public services are not presently foreseeable beyond the five-year master plan level. These improvements will require site-specific analyses and mitigation when proposed as part of (or to serve) future development as the General Plan builds out (over the next 50-plus years). As such, future impacts and mitigation would be assessed programmatically pursuant to the performance standards outlined in this EIR, as well as EIR No. 441, with project-specific analysis and mitigation developed later at the individual project stage.

**B. Analysis of GPA No. 960 Effects on Flooding and Dam Inundation Hazards**

The General Plan is concerned mainly with the physical build out of the county; many of the changes associated with GPA No. 960 would affect planned land usage. In particular, proposed changes affect land use overlays, land use designations and policies that affect the conversion of rural, semi-rural, agricultural and vacant lands to suburban or urban uses in various parts of Riverside County.

For land use policy changes without currently assigned locations (Indian fee lands, incidental rural commercial, etc.), hazards cannot be delineated at present. Likewise, the potential for future development occurring within the proposed revised policy areas and overlays has been generalized for this EIR, but due to the large scale of Riverside County and these policy areas, site-specific flooding hazards cannot be accurately assessed at this time. More generally, future development accommodated by the updated General Plan could be affected by a variety of geologic hazards depending upon location. These include 100-year floods, flash floods, dam inundation, seiche and mud flows. Where not foreseeable at this time, such affects are addressed programmatically, as per the section below.

**Floodplains:** Spatial analysis performed for the project indicates that a number of land use-related changes with the potential for introducing or intensifying future development are proposed for areas within an existing 100-year floodplain. Within western Riverside County, these areas include land within the floodplains of Prado Basin on the Santa Ana River; within the Airport Land Use Policy Area for Flabob Airport (also adjacent to the Santa Ana River); land within or just off the Temescal Wash floodplain, between Lake Elsinore and Prado Basin; land within the proposed Lakeland Village Policy Area, adjacent to Lake Elsinore; small areas within the proposed Meadowbrook and Good Hope Rural Village Overlays (which are within 100-year flood zones associated with Lake Elsinore or Canyon Lake to the southwest); land associated with Lake Skinner; and, land associated with the proposed Northeast Dairy Business Park Policy Area (which is within the floodplain of the San Jacinto River). Within the Pass and Eastern Riverside County, these areas include: land along the Big Morongo Wash north of Palm Springs; land along washes associated with the hills and canyons of the Little San Bernardino Mountains along the northeast edge of Coachella Valley, including East and West Wide Canyon, Pushawalla, Thousand Palm, Berdoo and Rockhouse Canyons; and other drainages trending southwesterly into Coachella Valley and towards the Whitewater River. And, lastly, a number of areas associated with the floodplain around the Salton Sea.

**Dam Inundation Zones:** Not all dams within Riverside County have designated dam inundation areas. Although there has never been a historical dam failure in Riverside County, the risk of dam failure, no matter how remote, should be assumed to exist. Figure 4.11.2 shows mapped potential dam inundation areas within the county. Development of areas affected by GPA No. 960 in these areas is assumed to be at risk in the event of a structural dam failure or a dam failure as a result of an earthquake, unless engineering (such as pad elevation), levees, dikes or features exist to prevent flooding damage.
Spatial analysis performed for the project indicates a number of land use-related changes with the potential for introducing or intensifying future development are proposed for areas within existing dam inundation zones. In western Riverside County, these areas include: land along the Santa Ana River outside of the Prado Dam basin; land along Temescal Wash downstream from Lake Elsinore and the reservoir at Hemet (Lee) Lake; land along Lake Elsinore within the proposed Lakeland Village RVO; land downstream from the reservoirs at Diamond Valley and Lake Skinner; and, land along the San Jacinto River and associated with Lake Perris. Due to the sandy soils and lack of reservoirs, there are no dam inundation zones affecting the project in eastern Riverside County.

**Seiche Hazards:** In terms of seiche hazards, there is no significant potential for any of the waterbodies within Riverside County. For the proposed project, resultant future development along or near lakes and reservoirs is considered minimal. Along the large, man-made reservoirs, such as Diamond Valley Reservoir and Prado Dam, the facilities have been engineered to reduce seiche risks and these facilities are further buffered by public lands along their shores, adding an additional layer of protection from localized flooding. For Lake Elsinore and the Salton Sea, their shallowness and extensive shorelines both tend to minimize seiche potential. Due to its inland location, there are no oceanic tsunami risks in Riverside County. None of the other land use-related changes proposed under GPA No. 960 are within areas affected by either 100-year flooding risks, dam inundation hazards or seiche risks.

**Mudflow Hazards:** In terms of mudflow hazards, areas of proposed land use-related changes with the potential for introducing or intensifying future development are generally at risk for mudflow hazards if they are: on or below a steep or unstable slope; within a steep-sided canyon; within an area with flashflood potential; or, in an area denuded of vegetation by recent wildfire, particularly if any of the other factors also occur. Flashflooding potential generally exists along any canyon, swale or other low-lying area in which heavy precipitation fall may be channeled rapidly and unexpectedly. Risks to future development as a result of flashflooding are reduced through the various regulatory floodplain and drainage flow control measures. See discussion under Section 4.11.6 (Flood and Dam Inundation Hazards – Impacts and Mitigation), below.

**Alluvial Fan Flooding Hazards:** It is beyond the scope of this project to analyze and determine whether or not a given site or parcel of land is located on an alluvial fan.

### C. Generalized Flooding Effects

Hazards associated with flooding can be divided into primary hazards that occur due to contact with water, secondary effects that occur because of the flooding, such as disruption of services, health impacts such as waterborne disease and increase in vectors (e.g., mosquitoes), and tertiary effects, such as changes in the position of river channels.

**Primary Effects:** These effects arise from direct contact with flood waters and the high water velocities commonly associated with flood conditions.

- With higher velocities, streams are able to transport larger particles as suspended load. In addition to rocks and sediment, during a flood, forces may also carry large objects, such as trees, automobiles, houses and bridges. This deposition can cause considerable damage. And, even in storms of lower intensity, if enough water carries sediment into a flood control structure (channel or storm drain, for example), the ability of the structure to convey flood flows could be overwhelmed, leading to additional flooding downstream.

- When large amounts of precipitation fall over a short period on saturated soil or dry soil with poor absorption capacity, the result can be a flash flood. In such floods, runoff collects in gullies and streams,
which flow together creating large-volume flows, often featuring a fast-moving front of water and debris. Such floods can occur anywhere downstream from the source of the precipitation, even many miles distant. Their unexpectedness can cause loss of lives to people hiking in or driving across an affected drainage unable to escape the sudden deluge. (As little as two feet of water can carry away an SUV-sized vehicle.)

- Flood waters can cause massive amounts of erosion and scouring. Such erosion can undermine bridge structures, levees and buildings causing their collapse. Such collapse would cause further additional flood damage.
- Water entering human-built structures causes water damage. Even with minor flooding of homes, furniture is ruined, floors and walls are damaged, and anything that comes in contact with the water is likely to be damaged or lost. Flooding of automobiles usually results in damage that cannot easily be repaired.
- When the flood waters retreat, water velocity slows, causing any suspended sediment load to be deposited. Thus, after retreat of the floodwaters, affected areas are typically covered with a thick layer of stream-deposited mud, including the interior of buildings.
- Flooding of farmland usually results in crop loss. Livestock, pets and other animals are often carried away and drowned.
- Humans that get caught in the high-velocity flood waters are often drowned by the water.
- Floodwaters can concentrate garbage, debris and toxic pollutants that can cause the secondary effects of health hazards.

**Secondary Effects:** As noted above, secondary effects are those that occur because of the flooding. They can include the following:

- Contamination of drinking water supplies, especially if sewage treatment plants are flooded or delivery lines broken. This can also result in disease and other health effects when people consume improperly or inadequately purified water.
- Gas and electrical services may be disrupted due to downed lines, broken pipes, flooded transformers or transfer stations, etc. This can also lead to additional fires due to use of candles and other open-flame sources in or around homes.
- Transportation systems may be disrupted, for example, roads, bridges and railroad tracks flooded, eroded or washed away. This can lead to shortages of food and water, as well as trouble providing medical supplies and evacuating sick or injured victims, due to access difficulties by emergency services. Post-flood clean-up and recovery can also be hindered by difficulties delivering needed heavy equipment, clean-up supplies and personnel to the stricken area.

**Tertiary Effects:** Lastly, tertiary effects involve long-term changes, including:

- The location of river channels may change as a result of flooding, with new active channels developing and old channels becoming dry.
Section 4.11  

Flood and Dam Inundation Hazards

- Loss of floodplain habitat changes the composition of plants and animals occupying the area. This change can persist for many years if mature riparian woodlands were lost. The new successional vegetation that returns may not support the same species.

- Sediment deposited by flooding may destroy farm land; although silt deposited by floodwaters could also increase the agricultural productivity of the soil.

- Jobs may be lost due to the disruption of services, destruction of businesses (or loss of inventories, etc.) Jobs may also be gained in specific sectors, however, such the construction industry to help rebuild and repair flood damage.

- Insurance rates for properties in the floodplain may increase. Neighborhoods and communities may permanently change composition as some people leave rather than rebuild. Abandoned structures and vacant lots may result where the owner cannot afford to rebuild.

D. Development Effects on Flood Hazards

How the land is used and developed can affect the risks resulting from floods. While some activities can be designed to mitigate the effects of flooding, many land use practices and structures can unwittingly increase flood risk. Clearing a floodplain for agriculture permits a progressively higher percentage of a large flood discharge to be carried in the floodplain. Forest vegetation tends to absorb moisture and lessen runoff. Deforestation or logging practices reduce the vegetation and the forest’s absorption capacity thus increasing runoff. Similarly, overgrazing of grasslands and rangelands decreases the vegetation cover and exposes soil to erosion, as well as increased runoff. Also, drainage and irrigation ditches and also water diversions can alter the discharge into floodplains and the channel’s capacity to carry the discharge. Obviously, dams, dikes, levees and other flood control structures can lessen an area’s flood potential by containing or redirecting flows.

Urbanization of a floodplain or adjacent areas and its attendant construction increases runoff because it reduces the amount of surface land area available to absorb rainfall and it also channels flow into storm drains and drainage ways much more quickly. Also, artificial fill in a floodplain reduces its water capacity and can increase flood height. Thus, the risk of flooding may be increased.

In terms of land use, flood hazards are addressed through several basic means: The simplest and most effective option is avoiding the risk; i.e., redesigning a project to avoid the floodplain by designating it as a project’s open space, for example. A second option is diverting a flood hazard through channelization or blocking flow with dikes or levees. This option results in offsite or downstream effects, however, which must also be addressed. One of the most common options is elevating a site (grading pad, for example) to rise at least two feet above the floodplain elevation. This option is not always feasible for large areas and also requires a number of regulatory steps that are enforced by Riverside County (see discussion later in this section). And, lastly, when all else fails, a development or structure may resort to floodproofing in some cases (such as non-residential buildings), for which a variety of standards apply. As an example, floodproofed buildings within a FEMA Special Flood Hazard Area must be certified by FEMA and are addressed by several FEMA Technical Bulletins.
4.11.6 Flood and Dam Inundation Hazards - Impacts and Mitigation

A. **Would the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?**

**Impact 4.11.A – Result in Housing Within Flood Hazard Areas:** Future development accommodated by the project would result in encroachment into areas of mapped 100-year floods (including some alluvial fans) and other delineated flood hazard areas. Such development may increase the amount of people, structures and property at risk should a flooding event occur. These flood hazard areas are extensively regulated, however, and compliance with existing laws and regulatory programs, in particular Riverside County Ordinance No. 458, as well as General Plan policies and existing Mitigation Measures from EIR No. 441, would be sufficient to ensure that this impact is less than significant.

1. **Analysis of Impact 4.11.A**

Flooding can inundate and damage structures, bury structures, knock them off their foundations or completely destroy them through high velocity water and debris, which can include sizable boulders. Impacts from flooding include the loss of life and/or property; health and safety hazards; disruption of commerce, water, power and telecommunication services; loss of agricultural lands; and infrastructure damage.

As outlined in Section 4.11.5, future development that could result from the proposed project has the potential to introduce people, property, homes, public facilities, roads and other infrastructure into 100-year flood hazard areas. GPA No. 960 proposes parcel-specific land use changes for approximately 163 parcels, totaling 2,038 acres within existing 100-year floodplains. These parcels fall within the Western Coachella Valley, Eastern Coachella Valley, Southwest, Harvest Valley/Winchester, Eastvale, Temescal Canyon and Elsinore Area Plans. Of these, 124 parcels (totaling approximately 1,876 acres) are proposed for land use designations with the potential to introduce additional people, property, homes, public facilities, roads and other infrastructure into 100-year floodplains. If development were allowed to occur in an unregulated fashion, this impact would be potentially significant. However, compliance with a variety of existing regulations and programs, as described below, would ensure that risks associated with development within 100-year flood hazard areas are less than significant.

2. **Regulatory Compliance for Impact 4.11.A**

As detailed and explained below, compliance with existing laws, regulatory programs, General Plan policies and existing EIR No. 441 mitigation measures would be sufficient to ensure that adverse effects associated any housing placed within a 100-year flood hazard area mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map are less than significant.

a. **Compliance With Federal, State and County Regulations**

Federal, state and local regulations would reduce impacts related to placement of housing within a 100-year flood hazard zones area. These include, but are not limited to, the following: National Flood Insurance Act, which establishes flood-risk zones within floodplain areas and requires local compliance with flood proofing building standards; National Flood Insurance Reform Act, which reduces the risk of flood damage to properties by providing a means to rectify any flood-related damage; Cobey-Alquist Floodplain Management Act, which requires local governments to protect people and property from flooding hazards as a condition of the receipt of...
State funds; as well as various county ordinances. In particular, as outlined below, Riverside County Ordinance No. 458 implements the National Flood Insurance Program within Riverside County and places strict conditions on acceptable levels of development in floodplains. These items are summarized below:

Through these policies, programs and ordinance standards, development within floodplains and development with the potential to be adversely affected by flooding hazards are highly regulated and potential impacts are reduced to less than significant levels by Riverside County’s development review process.

**FEMA Floodplain NFIP Mapping Program and Riverside County Ordinance No. 458:** As discussed above, the County of Riverside participates in the NFIP and uses FIRMs as the basis for Riverside County flood risk management planning. Ordinance No. 458 establishes the official “flood hazard areas” within the county through the adoption of various FIRM maps, as well as maps from other sources. (The current list of official maps recognized by Ordinance No. 458 as of May 2013 are listed previously, above.)

When deemed necessary by Riverside County Flood, developments proposed within FEMA-mapped flood hazard areas must submit their plans to FEMA showing how the project will be elevated out of the floodplain or otherwise eliminated or safely managed. When a floodplain revision is necessary, FEMA will issue a “conditional determination” letter of map revision (CLOMR) summarizing the project’s effect on the floodplain and accepting proposed floodplain alterations associated with the project (if any). FEMA makes such determinations based on review of revisions to the designated floodplain, such as a floodplain modification project or simply the proposed placement of fill to elevate structures or parcels. By requiring agency-approved-proof via submitted engineering plans and/or hydrological study, this process ensures that no development is allowed that would cause flood impacts due to development within FEMA-mapped floodplains, or expose any people, property or structures to any significant flood risks. Specifically, Riverside County Ordinance No. 258 prohibits any development or floodway changes that would revise the base flood (i.e., 100-year flood level) elevation by more than one foot.

**Ordinance No. 458 - Regulating Flood Hazard Areas and Implementing the National Flood Insurance Program:** The specifications, standards and requirements of Ordinance No. 458 mitigate potential flood hazards within Riverside County several ways. They ensure that flooding risks, water flows and runoff are managed appropriately to prevent hazards or undue risk of damage or harm to people, property, structures and facilities within Riverside County. By requiring specific standards for development and establishing a program for the approval, implementation and verification of such measures, this ordinance mitigates potential hazards that could arise from flooding hazards and its effects on people, property and structures. It should also be noted that this ordinance specifically requires that all new buildings and/or substantial improvements located within the 500-year floodplain limits of Lake Elsinore shall have their lowest floor elevated a minimum of 3 feet above the lake’s 100-year flood level elevation.

**National Pollution Discharge Elimination System (NPDES):** The RWQCBs provide state-level water quality policy for Riverside County and oversee the Clean Water Act’s NPDES program. Under the NPDES, California’s RWQCBs oversee water quality in Riverside County for their respective regions.

**Ordinance No. 348 - Land Use:** Use of this ordinance and the “Watercourse, Watershed & Conservation Areas” (W-1) zone mitigates potential flood impacts by preventing permanent occupancy or residency in areas potentially at risk for flooding.

**Ordinance No. 457 - Adopting and Amending Various Building and Construction Codes:** Use of this ordinance establishes building standards and codes that apply in flood zones to ensure that potential flood impacts on structures and the people and property occupying them are minimized. This is accomplished in a number of ways including varying floor elevations based on recommendations from Riverside County Flood as
well as ensuring compliance with other applicable federal, state and county regulations. Potential adverse impacts due to construction, urban runoff, stormwater flows and water erosion on lands subject to development are also minimized through grading and pollution restrictions, erosion control measures and in some cases implementation of various monitoring and reporting measures.

**Ordinance No. 659 - Development Impact Fee (DIF) Program:** This ordinance sets a range of development impact fees for new residential, commercial and industrial development. For flood control facilities, the DIF program ensures fees are collected and expended to provide necessary flood facilities such as basins, canals, etc. based on the public facilities needs list which is revised based on the ongoing levels of development. The development of these facilities ensures new development does not expose people, property or structures to undue flooding risks.

**b. Compliance with Existing General Plan Policies**

The following existing Riverside County General Plan policies would help prevent significant impacts to housing within flood hazard areas. See Section 4.11.3.E for full text of each of these policies. Implementation of these General Plan policies in combination with the above existing county, state and federal regulations related to flooding hazards would reduce the effects of future growth and development consistent with GPA No. 960 in relation to flood hazards, to a less than significant level. Specifically:

**Regarding Policy S 4.1:** Compliance with this policy would reduce potential adverse impacts to new housing located within flood hazard areas by requiring that new development have a minimum level of acceptable risk that is determined through County of Riverside review in order to mitigate potential hazards. Proposals will not be approved if they cannot mitigate those potential hazards to acceptable levels which are determined by the responsible county agency.

**Regarding Policy S 4.3:** Compliance with this policy would reduce potential adverse impacts to housing located within flood hazard areas by prohibiting the construction of permanent structures in areas that would impede flood waters and potentially expose said structures to property damage or other flooding risks. The policy does allow for low intensity uses in these areas as long as flood risk management functions are maintained.

**Regarding Policy S 4.4:** This policy prohibits alteration of floodways and channelization unless other methods of flood control are not feasible, thereby maintaining and preventing the obstruction of existing flood control facilities by development proposals consistent with GPA No. 960. The policy also allows for incentive provisions, such as density transfers, to be offered in an effort to maintain natural watercourses and floodways by focusing development away from these critical features.

**Regarding Policy S 4.8:** This policy allows developments along the floodway fringe only if it has been determined that proposed structures can be flood-proofed and would not contribute to property damage or risks to public safety.

**Regarding Policy S 4.9:** This policy requires development within the floodway fringe be capable of withstanding flooding and use a minimum amount of fill for the project, thereby directly reducing potential impacts and protecting developments, such as housing projects, within floodplains and other flood areas. The policy establishes uses that may be compatible with being located in floodplains and floodways, and waives flood-proofing requirements for those uses if they do not obstruct flows.

**Regarding Policy S 4.10:** This policy requires all development proposals to mitigate their potential impacts on the capacity of regional storm drain systems.
Regarding Policy S 4.18: This policy requires the design and upgrade of street storm drains for development proposals based on the depth of inundation, relative risk to public health and safety, the potential for hindrance of emergency access and regress and the threat of contamination of the storm drain system with sewage effluent.

c. Compliance with Proposed New or Revised General Plan Policies

The following revised policy of the Riverside County General Plan would further prevent significant impacts to housing located within flood hazard areas. See Section 4.11.3.F for full text of this policy.

Regarding Policy S 4.2: This proposed policy would further reduce already insignificant flooding hazards by prohibiting projects or construction, such as housing projects, within floodplains and other flood hazard areas under various circumstances.

d. Compliance with Existing Mitigation Measures from EIR No. 441

In EIR No. 441, which was certified for the 2003 (RCIP) General Plan, it was determined that to fully minimize risks associated with the placement of habitable structures and housing within 100-year flood hazard areas, several mitigation measures were also necessary. These mitigation measures from EIR No. 441 are listed below and apply countywide, thus they also apply to GPA No. 960. They further contribute to ensuring flood impacts would be less than significant.

Existing Mitigation Measure 4.9.2A: Riverside County shall require that all structures (residential, commercial, and industrial) be flood-proofed from the 100-year storm flows. In some cases, this may involve elevating the finished floor more than 1 foot.

Existing Mitigation Measure 4.9.2B: Riverside County shall require that fully enclosed areas that are below finished floors have openings to equalize the forces on both sides of the walls.

Existing Mitigation Measure 4.9.2C: Riverside County shall require that for agricultural, recreation, or other low-density uses, flows are not obstructed and that upstream and downstream properties are not adversely affected by increased velocities, erosion backwater effects, or concentration of flows.

Existing Mitigation Measure 4.9.2D: Provided the applicant does hydrological studies, engineers structures to be safe from flooding and provides evidence that the structures will not adversely impact the floodplain, Riverside County may allow development into the floodway fringe.

3. Finding on Significance for Impact 4.11.A

Compliance with the above regulations, policies and mitigation measures would ensure that people and property are not exposed to significant 100-year flood hazards. As a result, flood hazards associated with future development consistent with the project would be less than significant.

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

Impact 4.11.B – Cause Impediment of Flows: Future development as a result of implementation of the proposed project may result in placement of structures within 100-year flood hazard areas, creating the potential
for impeding or redirecting flood flows. As a result, people, structures and property, as well as those introduced by the new development, could be exposed to increased flooding risks. Compliance with existing laws, regulatory programs, General Plan policies and existing mitigation measures from EIR No. 441, in particular County Ordinance No. 458, would be sufficient to ensure that this impact is less than significant.

1. Analysis of Impact 4.11.B

Development along stream channels and floodplains can alter a channel's capacity for conveying water and can increase the height of the water surface corresponding to a given discharge. In particular, structures such as bridges that encroach on a floodplain can increase upstream flooding by narrowing the width of the channel and increasing the channel's resistance to flow. As a result, water is higher when it flows past the obstruction, creating a backwater that could inundate a larger area upstream.

Some of the land use-related changes included in the project would allow for the construction of structures potentially within a drainage, floodway or floodplain. For example, houses would be constructed in areas designated for residential land use, factories and stores would be constructed in areas designated for commercial and industrial land uses, and roads and bridges could be constructed in areas designated as open space in order to provide public access to these areas. Thus, it is important that any structures proposed in a 100-year floodplain be properly designed, engineered and constructed to ensure that they would not impede or redirect flows within the floodway. And, in fact, the County of Riverside requires this as part of a project's Conditions of Approval issued by Riverside County Flood.

Flooding can inundate and cause water damage to structures, bury structures, knock them off their foundations or completely destroy them through high velocity water and debris flows, which can include sizable boulders. Impacts resulting from flooding include the loss of life and/or property; health and safety hazards; disruption of commerce, water, power and telecommunications services; loss of agricultural lands; and infrastructure damage.

As outlined in Section 4.11.5, future development that could result from implementation of the proposed project has the potential to introduce people, property, homes, public facilities, roads and other infrastructure into 100-year flood hazard areas. Without the application of existing regulations and requirements to prevent improper development, this impact could be potentially significant. However, compliance with a variety of existing regulations and programs, as described below, ensures that risks associated with impeding or redirecting flows would be less than significant. No project-specific mitigation is required.

2. Regulatory Compliance for Impact 4.11.B

As detailed and explained below, compliance with the following existing laws, regulatory programs, General Plan policies and existing EIR No. 441 mitigation measures are sufficient to ensure that adverse effects associated with potential impeding or redirecting of flood flows as a result of GPA No. 960 would be less than significant.

a. Compliance With Federal, State and County Regulations

Compliance with federal, state and local regulations would reduce impacts resulting from impeding or redirecting water flows. These include, but are not limited to, the National Flood Insurance Act, the National Flood Insurance Reform Act and the various Riverside County ordinances outlined under Impact 4.11.A, above.

National Flood Insurance Act and National Flood Insurance Reform Act: These acts reduce adverse impacts resulting from impeded flows by requiring development plans be submitted to and reviewed by FEMA
for floodplain effects. FEMA’s role in this process ensures that no development would be permitted if it would impede flows and cause a risk to people or property.

**Ordinance No. 458 – Regulating Flood Hazard Areas and Implementing the National Flood Insurance Program:** This ordinance reduces impacts by regulating development in regards to flooding risks and by ensuring that flood flows are managed appropriately to prevent hazards or undue risk of damage or harm to people, property, structures and facilities within Riverside County.

**Ordinance No. 461 - Road Improvement Standards:** This ordinance sets standards and engineering specifications (including flood control/risk management attributes) for roads, bridges and other transportation-related facilities. It requires engineering, construction and maintenance to ensure the safety and integrity of the roadway or improvement, thereby mitigating potential flooding hazards.

**b. Compliance with Existing General Plan Policies**

The following General Plan policies would further prevent significant impacts due to impeded flows. Implementation of these policies in combination with the above federal, state and county regulations would reduce flood hazard effects on future growth and development in Riverside County to a less than significant level. See Section 4.11.3.E for the full text of these policies.

**Policy S 4.3:** This policy reduces potential flooding hazards caused by impeding or redirecting flows by prohibiting the construction of permanent residential and employment structures in those areas that would impede flood waters and potentially expose said structures to property damage or other flooding risks. The policy does allow for low intensity uses in these areas as long as flood risk management functions are maintained.

**Policy S 4.4:** This policy prohibits alteration of floodways and channelization unless other methods of flood risk management are not feasible, thereby maintaining and preventing the obstruction of existing flood control facilities by development proposals consistent with GPA No. 960 and reducing potential adverse impacts associated with impeding flows. The policy also allows for incentive provisions, such as density transfers, to be offered in an effort to maintain natural watercourses and floodways and to focus development away from these critical resources.

**Policy S 4.5:** This policy prohibits substantial modifications to watercourses, thereby reducing potential flooding hazards caused by impeding or redirecting flows. When modifications are unavoidable, those modifications must not be detrimental to adjacent properties or adversely affect adjacent wetlands or riparian habitat.

**Policy S 4.8:** This policy allows only those proposed structures that can be flood proofed and would not contribute to the property damage or risks to public safety to be developed along the fringes of floodways. Placement along the fringe of a floodway further ensures that natural flows would not be impeded.

**Policy S 4.9:** This policy requires development within floodway fringes be able to withstand flooding and use a minimum amount of fill, thereby directly reducing potential impacts related to impeding flows and protecting developments, such as housing projects, within floodplains and other flood areas. The policy establishes uses that may be compatible with being located in floodplains and floodways, and waives the flood-proofing requirement for those uses as long as they do not impede flows.

**Policy S 4.18:** This policy requires the design and upgrade of street storm drains for development proposals based on the depth of inundation, relative risk to public health and safety, the potential for hindrance of emergency access and regress and the threat of contamination of the storm drain system.
c. Compliance with Proposed New or Revised General Plan Policies

The following revised General Plan policies would further prevent significant impacts due to impeded flows. Implementation of these policies in combination with the above federal, state and county regulations would reduce flood hazard effects on future growth and development in Riverside County to a less than significant level. See Section 4.11.3.F for the full text of these policies.

**Policy S 4.2** prevents potential flooding hazards by prohibiting projects or construction within floodplains and other flood hazard areas under various circumstances that could impede or redirect flood flows.

**Policy S 4.7:** This policy requires potential modifications to watercourses to be done in a manner that is the least damaging to the environment, thereby reducing potential flooding hazards caused by impeding or redirecting flows.

d. Compliance with Existing Mitigation Measures from EIR No. 441

In EIR No. 441, which was certified for the 2003 (RCIP) General Plan, it was determined that to fully minimize risks associated with development impeding or redirecting flood flows, several mitigation measures were also necessary. These mitigation measures from EIR No. 441 are listed below and apply countywide, thus they also apply to GPA No. 960.

**Existing Mitigation Measure 4.9.1A:** LOMA and LOMR-F are documents issued by FEMA that officially remove a property and/or structure from a special flood hazard area of a Flood Insurance Rate Map (FIRM). These letters shall be accepted by Riverside County where applicable.

**Existing Mitigation Measure 4.9.1B:** Riverside County shall prohibit alteration of floodways and channelization unless alternative methods of flood risk management are found to be technically, economically and practicably infeasible.

**Existing Mitigation Measure 4.9.1C:** Riverside County shall not necessarily require all land uses to withstand flooding. These may include land uses such as agricultural, golf courses and trails. For these land uses, flows shall not be obstructed, and upstream and downstream properties shall not be adversely affected by increased velocities, erosion backwater effects, concentration of flows and adverse impacts to water quality from point and nonpoint sources of pollution.

**Existing Mitigation Measure 4.9.1D:** Riverside County shall require the 10-year flood flows to be contained within the top of curbs and the 100-year flood flows within the street rights-of-way.

3. Finding on Significance for Impact 4.11.B

Compliance with the above regulations, policies and existing mitigation measures would ensure that any potential hazards caused by impeding or redirecting flows as a result of future development would be less than significant. No project-specific mitigation is required.
C. 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 levee or dam?

Impact 4.11.C – Expose People or Structures to Flooding Risks, Including Flooding Due to Dam or Levee Failure: Future development accommodated by the project may result in placement of structures, including habitable ones, within dam inundation zones, alluvial fan flooding zones and other areas of potential flood hazard. Such development would be at greater risk of flood hazards should a dam, levee, debris basin or other critical flood control structure fail. As a result, existing people, structures and property, as well as those introduced as a result of GPA No. 960, could be exposed to increased flooding risks due to failure of flood control structures. Compliance with existing laws, regulatory programs and General Plan policies would be sufficient to ensure that this impact does not rise to the level of significance.

1. Analysis of Impact 4.11.C

Although there have been several notable floods in Riverside County over the past 10-plus years, there has never been a historical dam failure. Despite this, the risk of dam failure, no matter how remote, must be assumed to exist. In addition, there is a higher probability of failure of some of the other flood control structures, such as levees, debris basins and storm drains. These types of facilities are much more common and numerous within Riverside County than dams and require on-going maintenance to ensure safe and reliable function. And, since these types of facilities are often built on a smaller scale than major dams, they can also be more prone to being damaged or failing due to storm flows (or flooding) exceeding their design capacity.

As detailed in Section 4.11.5, some of the future development accommodated by GPA No. 960 would have the potential to introduce people, property, public facilities, roads and other infrastructure into areas potentially at risk of dam inundation or flooding due to other sources, e.g., failure of a levee or of a debris basin above an alluvial fan. Further, not all dams within Riverside County have designated dam inundation areas. In regards to known (mapped) dam inundation hazards, analysis indicates that approximately 26 parcels (462 acres total) with proposed parcel-specific land use changes would be affected under the project. These parcels fall within the Southwest, Harvest Valley/Winchester, Eastvale, Temescal Canyon and Elsinore Area Plans. Of these 26 parcels, only seven parcels (approximately 293 acres) are proposed for land use designations with the potential to introduce new people, property, roads and infrastructure into mapped dam inundation zones. The remaining designation changes would reduce development density/intensity, lowering the risks. Without measures that reduce flooding risks, this impact would be potentially significant. However, compliance with existing regulations and programs, as described below, would ensure that risks associated with development in dam inundation zones and other areas potentially prone to flooding or inundation hazards due to failure of a flood control facility would be less than significant.

2. Regulatory Compliance for Impact 4.11.C

As detailed and explained below, compliance with the following existing laws, regulatory programs and existing General Plan policies are sufficient to ensure that adverse effects associated with dam inundation risks resulting from GPA No. 960 would be less than significant. No project-specific mitigation is required.

a. Compliance With Federal, State and County Regulations

A variety of federal, state and local regulations address impacts related to dam inundation and other types of flood control improvements and safety. These include, but are not limited to, various Riverside County ordinances
outlined under Impact 4.11.A, above, including in particular Ordinance No. 458 (as it pertains to standards for flood control structures), as well as Ordinances No. 348, 457, 659 and 461, which were discussed under Impact 4.11.B.

b. Compliance with Existing General Plan Policies

Of the General Plan policies listed in Section 4.11.3, above, Policies S 4.1, 4.3, 4.4, 4.6, 4.8, 4.9, 4.16, 4.17, 4.18 and 4.19 provide mitigation for impacts related to dam inundation and flooding hazards. Implementation of these General Plan policies in combination with existing federal, state and county regulations would reduce the effects of dam inundation to a less than significant risk. Policy S 4.18 directly reduces the potential exposure of people and structures to flooding risks by requiring street storm drains be designed to handle a variety of flood conditions. Policies S 4.6 and 4.8 further reduce this potential hazard. Other General Plan policies that help reduce potential flooding, safety and other related impacts include: S 4.12, 4.17, 4.19, 4.20, 4.21 and 4.22.

c. Compliance with Proposed New or Revised General Plan Policies

The following revised policy of the Riverside County General Plan would lessen potential dam inundation hazards associated with future development. For the full text of the following policy, see Section 4.11.3.E.

Policy S 4.2: This policy prohibits projects and construction within dam inundation zones under various circumstances, thereby avoiding flooding hazards.

3. Finding on Significance for Impact 4.11.C

Compliance with the above regulations and policies would ensure that any potential dam inundation hazards associated with future development consistent with the proposed project would be less than significant. No project-specific mitigation is required.

D. Would the project substantially alter the existing drainage pattern of a 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?

Impact 4.11.D – Cause the Adverse Alteration of Drainage Patterns or Substantially Increase Surface Runoff: Development consistent with GPA No. 960 would alter drainage patterns, streams and river courses, in some cases substantially. It would also cause increases in surface runoff through the introduction of non-permeable surfaces (roofs, pavement, roads, etc.). If not properly managed, this would cause hydrological changes that could expose existing people, structures and property, as well as those introduced by the project, to increased flooding risks. Compliance with existing laws, regulatory programs and General Plan policies would be sufficient to ensure that this impact is less than significant.

1. Analysis of Impact 4.11.D

Future development accommodated by the proposed project would result in the alteration of drainage patterns during and after construction activities in some locations. This would entail land-disturbing construction activities, such as grading and excavation, construction of new building foundations, roads, driveways and trenches for utilities. In addition to direct drainage alterations, temporary ponding or flooding could also result
from such activities, reducing the water-carrying capacity of drainages, flood control facilities, storm drains, etc. Such drainage alterations and changes in runoff conditions must be reduced to prevent serious flooding risks from resulting. Siltation and debris buildup in these structures as the result of runoff could also decrease their effectiveness for stormwater management.

In addition to construction impacts, future development would also result in new land uses that would convert permeable surfaces (such as undisturbed soils and vacant lands) to impermeable surfaces, such as buildings (rooftops), parking lots and roadways. An increase in impermeable surfaces would substantially alter the existing drainage pattern of a site or area by increasing the amount and rate of surface runoff in a manner that could result in flooding on or off the site. Specific grading and project design measures, including the Best Management Practices (BMPs) required under the NPDES, are necessary to prevent runoff and flooding.

Additionally, impermeable surfaces and development would potentially divert natural runoff patterns potentially resulting in flooding. In undeveloped areas, rainfall collects and is stored by vegetation, in the soil and in surface depressions. When this storage capacity is filled, runoff filters slowly through the soil as subsurface flow. In contrast, developed areas where much of the land surface is covered by roads and buildings have less capacity to store rainfall. Impermeable surfaces such as roads, roofs, parking lots and sidewalks store little water, reduce infiltration of water into the ground and accelerate runoff to ditches and streams. Even in suburban areas where lawns and other permeable landscaping is common, rainfall can saturate thin soils and produce overland flow, which runs off quickly. As a result of accelerated runoff from development or construction activities, the peak discharge, volume and frequency of floods increase in nearby streams. To prevent this urban runoff from creating flood hazards, projects must be designed to direct and channel runoff appropriately into storm drain facilities adequately sized to handle expected flows. Such measures are, in fact, included as Conditions of Approval for implementing projects.

2. Regulatory Compliance for Impact 4.11.D

As detailed and explained below, compliance with the following laws, regulatory programs, General Plan policies and existing EIR No. 441 mitigation measures are sufficient to ensure that adverse effects associated with potential flooding resulting from urban runoff would be less than significant.

a. Compliance With Federal, State and County Regulations

Compliance with the following state, federal and county regulations would further prevent impacts due to alteration of drainage patterns, increased surface runoff and associated flooding risks. These include, but are not limited to, the federal Clean Water Act, the NPDES program and various Riverside County ordinances, as outlined under Impact 4.11.A, including Ordinance No. 457 and Ordinance No. 458. This also includes Ordinance No. 461 and Ordinance No. 754, which were outlined under Impacts 4.11.B and 4.11.C, respectively. Additional mitigating policies include the following:

Clean Water Act (CWA) Section 404: Compliance with this permitting program ensures that projects submit to the Army Corps proof that a development would not result in any illegal fill (that is, placing dirt or other materials) of waters of the U.S. This includes preventing hydrological changes that could result in scouring, vegetation destruction, flooding and other adverse effects that could “pollute” waters of the U.S., which are overseen by the Army Corps. Compliance with this process ensures that no development is allowed to cause flooding or runoff impacts due to illegal or improper fill or construction within existing jurisdictional drainages. Compliance with the 404 permitting process also requires legal and proper fill be properly designed, engineered,
constructed and maintained, including the use of storm runoff systems, to control and properly channel urban runoff.

**National Pollution Discharge Elimination System (NPDES):** Under the NPDES, programs and permits are enforced by the applicable RWQCB. In particular, the Storm Water Pollution Prevention Program (SWPPP) requires BMPs to reduce potential stormwater and urban runoff impacts, as well as erosion impacts, from construction and developed sites. Accordingly, compliance with permit requirements, including a variety of BMPs, ensures that such adverse impacts are avoid or minimized to less than significant levels. The program is further implemented and monitored by the County of Riverside pursuant to Ordinance No. 754, which was described under the previous impact (4.11.C).

Under the NPDES permit program, Stormwater Pollution Prevention Plans (SWPPP) are required, for construction sites greater than one acre. This includes the identification and implementation of a variety of BMPs to reduce the likelihood of flooding, increased runoff or related impacts. (Sites under an acre are not significant sources of runoff.) Such BMPs can include the following:

a. Clearing of land is limited to that which will be actively under construction in the near term, new land disturbance during the rainy season is minimized and disturbance to sensitive areas or areas that would not be affected by construction is minimized.

b. Temporary stabilization of disturbed soils is provided whenever active construction is not occurring on a portion of the site and permanent stabilization is provided by finish grading and permanent landscaping.

c. Outside of the approved grading plan area, disturbance of natural channels is avoided, slopes and crossings are stabilized and any increase in runoff velocity is managed (through force dissipaters or other mechanisms) to avoid erosion of slopes and channels.

d. Upstream runoff is diverted around or safely conveyed through the site and is kept free of excessive sediment and other constituents.

e. Sediment-laden waters from disturbed, active areas within the site are detained.

**b. Compliance with Existing General Plan Policies**

The following existing General Plan policies would further prevent impacts related to drainage pattern and runoff alterations that could cause flooding. See Section 4.11.3.E for the full text of these policies.

**Policy S 4.4:** This policy prohibits the alteration of floodways and channelization, thereby maintaining and preventing the alteration of existing drainage patterns. The policy also allows for incentive provisions such as density transfers to be offered in an effort to maintain natural watercourses and to focus development away from these critical resources.

**Policy S 4.5:** This policy prohibits substantial modifications to watercourses and subsequently protects existing drainage patterns. When modifications are unavoidable, those modifications must not be detrimental to adjacent properties or adversely affect adjacent wetlands or riparian habitat.

**Policy S 4.7:** This policy requires potential modifications to watercourses to be done in a manner that is the least damaging to the environment, thereby reducing potential adverse impacts related to drainage pattern and runoff alterations.
Policy S 4.8: This policy allows developments along the floodway fringe only if it has been determined that the proposed structures can be flood-proofed and would not contribute to property damage or risks to public safety, thereby reducing potential adverse impacts.

Policy S 4.9: This policy reduces potential impacts related to drainage pattern and runoff alterations that could cause flooding by requiring those proposed developments that fall within the floodway fringe be capable of withstanding flooding and use a minimum amount of fill for the project, thereby directly reducing potential impacts and protecting developments, such as housing projects, within floodplains and other flood areas.

Policy S 4.10: This policy requires all development proposals to mitigate their potential impacts on the capacity of regional storm drain systems.

3. Finding on Significance for Impact 4.11.D

Compliance with the above regulations and policies would ensure that flooding hazards associated with alterations to existing drainage patterns or increases in surface runoff as a result of future development would be less than significant. No project-specific mitigation is required.

E. Would the project result in or expose people or structures to a significant risk of inundation due to seiche, tsunami or mudflow?

Impact 4.11.E – Cause Inundation Risks Due to Seiche, Tsunami or Mudflow: Future development in areas subject to seiche has the potential to threaten people, structures and property. In terms of seiche hazards, there is no documented significant potential for any of the waterbodies within Riverside County. Based on morphology and hydrology, two waterbodies in Riverside County (Lake Perris and Lake Elsinore) may have the potential for seismically induced seiche. However, setbacks and flood hazard area regulations would be sufficient to protect against significant risks. Thus, for the proposed project, resultant future development along or near lakes and reservoirs is considered to be at minimal risk. Thus, overall, seiche impacts would be less than significant. Due to its inland location, by definition there are no tsunami risks in Riverside County. Mudflow or debris flow can occur in areas with steep slopes, particularly areas with loose soils and/or denuded of vegetation (e.g., fire burn areas) when exposed to large amounts of precipitation. Narrow canyons, arroyos and desert channels are also susceptible to flashfloods which can cause flooding damage directly or indirectly through mudflows. Human activity can also induce a slide, such as when soil becomes saturated from a broken water pipe or the improper diversion of runoff from a developed area. When addressed through proper soil engineering, site design and maintenance, these risks are less than significant.

1. Analysis of Impact 4.11.E

a. Seiche

Seiche, a standing wave in a completely or partially enclosed body of water, can in certain circumstances result in inundation (flooding) of areas located along the shoreline of a lake or reservoir. In Riverside County’s semi-arid climate, naturally occurring enclosed water bodies are not common and none have documented seiche risks. For man-made water bodies, such as reservoirs, these are typically built by local municipalities or water districts to provide water service to local residents and businesses. Accordingly, most land around the reservoirs’ shorelines is in public holdings, which restrict private land development and minimize risk of inundation from seiche. Moreover, such public land holdings are not within the jurisdiction of unincorporated Riverside County.
In terms of seiche hazards, there are no significant documented hazards for any of the waterbodies within Riverside County. However, based on morphology and hydrology, two waterbodies in Riverside County, Lake Perris and Lake Elsinore, may have the potential for seismically induced seiche (essentially creation of a standing wave that 'sloshes' back and forth along the lake's long axis causing higher than expected waves and potentially even flooding). Seiche risk at Lake Perris, however, is minor due to the lack of significant habitable structures along its shores. In addition, Lake Perris, as with most of the large, man-made reservoirs in Riverside County, has been engineered to prevent seiche risks. The larger, recreational-use lakes are also buffered by public lands and beaches along their shores, adding a further layer of protection from localized flooding.

Development does occur along the shores of Lake Elsinore, in particular the Lakeland Village community. However, seiche risks to future development would be minimized by avoidance of the 100-year floodplain limits surrounding the lake (or engineering sufficient to withstand potential flood hazards, as allowed under law for certain uses). Thus, for the proposed project, resultant future development along or near lakes and reservoirs is considered to be at minimal risk. None of the other land use-related changes proposed under GPA No. 960 are within areas affected by potential seiche hazards. There are no oceanic tsunami risks in Riverside County due to its inland location.

### b. Mudflows and Debris Flows

Mudflows and debris flows are shallow water-saturated landslides that travel rapidly down slopes carrying rocks, brush and other debris. A mudflow occurs naturally as a result of heavy rainfall on a slope containing loose soil or debris. There is a high potential for mudflows to occur in some areas of unincorporated Riverside County as a result of large amounts of precipitation in a relatively small time frame. Unincorporated Riverside County contains many areas with steep slopes and mountainous areas that could be subject to mudflows in the event of large amounts of precipitation. Narrow canyons, arroyos, alluvial fans and desert channels are also susceptible to flashfloods which can cause flooding damage directly or indirectly through mudflows. Human activity can also induce a slide, such as when soil becomes saturated from a broken water pipe or the improper diversion of runoff from a developed area.

In terms of mudflow hazards, areas of proposed land use-related changes with the potential for introducing or intensifying future development are generally at risk for mudflow hazards if they are: on or below a steep or unstable slope; within a steep-sided canyon; within an area with flashflood potential; on loose, unconsolidated soils; or in an area denuded of vegetation by recent wildfire, particularly if any of the other factors also occur. Flashflood potential generally exists along any canyon, swale or other low-lying area in which heavy precipitation fall may be channeled rapidly and unexpectedly. Risks to future development as a result of flashflood are minimized through the various regulatory floodplain and drainage flow control measures (as discussed above for Impacts 4.11.A, 4.11.B and 4.11.C, for example).

As with other types of serious flooding, FEMA also designates areas as subject to alluvial fan flooding (as opposed to ordinary riverine flooding). Specifically, NFIP regulations define alluvial fan flooding to be “flooding occurring on the surface of an alluvial fan or similar landform which originates at the apex and is characterized by high-velocity flows; active processes of erosion, sediment transport and deposition; and, unpredictable flow paths.” Despite the distinction, alluvial fan flooding is also based on the 100-year flood interval (i.e., a 1% probability of occurrence in a given year). As such, the site design and engineering requirements established for 100-year flood hazard area management, for example under Riverside County Ordinance No. 458, generally provides sufficient measures to ensure the protection of development on alluvial fans.
2. **Regulatory Compliance for Impact 4.11.E**

The analysis above and in Section 4.11.5 demonstrates that this impact would be less than significant and no project-specific mitigation is needed. Moreover, with the various regulations, programs, plans, General Plan policies and existing mitigation measures from prior EIR No. 441 summarized under the previous four, impacts will further reduce or minimize this already insignificant impact. In particular, General Plan Policy S 4.5 directly reduces potential erosion-related flood hazards, such as surface runoff and mudflow, by prohibiting watercourse modification that could result in seiche hazard. A variety of additional General Plan policies also reduce potential flooding, floodplain management, safety and other related impacts.

3. **Finding on Significance for Impact 4.11.E**

The analysis presented above indicates that development consistent with the proposed project, GPA No. 960, would have less than significant impacts due to seiche. No project-specific mitigation is required. As outlined in this section, plus section 4.12, project design, soils engineering and construction requirements, including NPDES, CWA section 404, Riverside County ordinances and others would be sufficient to ensure that mudflow hazards are less than significant. In addition, compliance with various existing regulatory programs, standards and General Plan policies, as well as existing mitigation measures from EIR No. 441 as outlined elsewhere in this section, would further reduce, minimize or avoid any impacts associated with the project.

4. **11.7 Significance After Mitigation for Flood and Dam Inundation Hazards**

Implementation of and compliance with the above existing regulations, programs, County General Plan policies and existing mitigation measures from EIR No. 441 would ensure that impacts associated with flooding and dam inundation hazards, as well as related issues outlined herein, are minimized and would prevent any impacts from rising to a potentially significant level. These measures avoid flood hazards by keeping development out of flood-prone areas and requiring adequate engineering and other protective measures be used where necessary to ensure the safety of people and property. They also ensure that any future development designs, constructs and maintains appropriate flood control and safety features. Where such avoidance or engineering is not possible, existing regulations prohibit development. In total, these measures ensure that any adverse impacts associated with flooding, dam inundation and related risks associated with the proposed project, GPA No. 960, would be less than significant. Moreover, no project-specific mitigation is required.