



## **Appendix F: Integrated Flood Management Summary Document**

Page Intentionally Left Blank

# Final Draft Technical Memorandum



## Antelope Valley IRWMP 2007 Update

**Subject:** Task 2.3.7 Integrated Flood Management Summary Document  
**Prepared For:** Antelope Valley State Water Contractors Association  
**Prepared by:** Paul Glenn  
**Reviewed by:** Brian Dietrick  
**Date:** December 31, 2013

## Table of Contents

1	Purpose .....	2
1.1	Definition of Integrated Flood Management .....	2
2	Existing Environment .....	3
2.1	Watershed Characteristics .....	3
2.1.1	Floodplain/Geomorphology .....	4
2.1.2	Drainage Infrastructure .....	5
2.1.3	Meteorologic / Hydrologic Response.....	6
2.2	Flood Mapping .....	8
2.2.1	Definition of Flood Hazard Risks .....	9
2.2.2	Existing Floodplain Hazard Mapping – Antelope Valley .....	9
2.2.3	Flood Hazard Mapping Compared to Land Use .....	11
2.3	Existing and Historical Flooding .....	13
2.3.1	Lancaster .....	13
2.3.2	Palmdale.....	14
2.3.3	Unincorporated Los Angeles County.....	15
2.3.4	Unincorporated Kern County.....	16
2.4	Existing Plans and Projects.....	17
2.4.1	Existing Plans .....	17
2.4.2	Existing Projects .....	20
2.5	Planned Projects.....	22
3	Potential Opportunities, Constraints, and IFM Strategies .....	26
3.1	Valley Opportunities and Constraints .....	26
3.2	Potential IFM Strategies.....	28
3.3	Community Rating System (CRS) Participation .....	36
3.3.1	Cost and Benefits for Participation in CRS.....	38
4	Conclusions and Recommendations .....	40
4.1	Recommended Stakeholder Collaboration.....	41
4.2	Recommendations for CRS Participation .....	41

---

4.3	Recommendations for Flood Control and Stormwater Quality Projects .....	44
-----	---	----

## 1 Purpose

The purpose of this technical memorandum (TM) is to compile the previous related TMs into one complete Integrated Flood Management Summary Document. The previous TMs include:

- Task 2.3.1-- Flood Management Document Matrix
- Task 2.3.2--Flood Protection Needs
- Task 2.3.3-- Methodology to Catalog and Prioritize Flood Projects
- Task 2.3.4--Regional Vision for Multi-Benefit Flood Protection - Recommended Actions to Implement Integrated Flood Management
- Task 2.3.5--NFIP Community Rating System (CRS) Participation
- Task 2.3.6--Coordination Between Flood Protection and Stormwater Quality

### 1.1 Definition of Integrated Flood Management

Integrated Flood Management (IFM) is an integrated approach to flood management that focuses on maximizing the net benefits of a floodplain and infrastructure developed to manage flooding. The integrated approach considers water resources management, land use planning, environmental stewardship, and sustainability along with flooding issues when developing policies, plans and projects. Typical benefits that can be obtained through an integrated approach include improvements in water quality, increases in water supply, and enhancements in riparian habitat and wildlife corridors.

## 2 Existing Environment

The existing environment consists of a closed groundwater basin that does not discharge to outside receiving water bodies. Within the basin are three counties, three cities and a large U.S. Air Force base, which include:

- Kern County
- Los Angeles County
- San Bernardino County
- City of Palmdale
- City of Lancaster
- California City
- Edwards Air Force Base

This section presents the watershed characteristics, flood mapping, existing and historical flooding, existing projects, and planned projects.

### 2.1 Watershed Characteristics

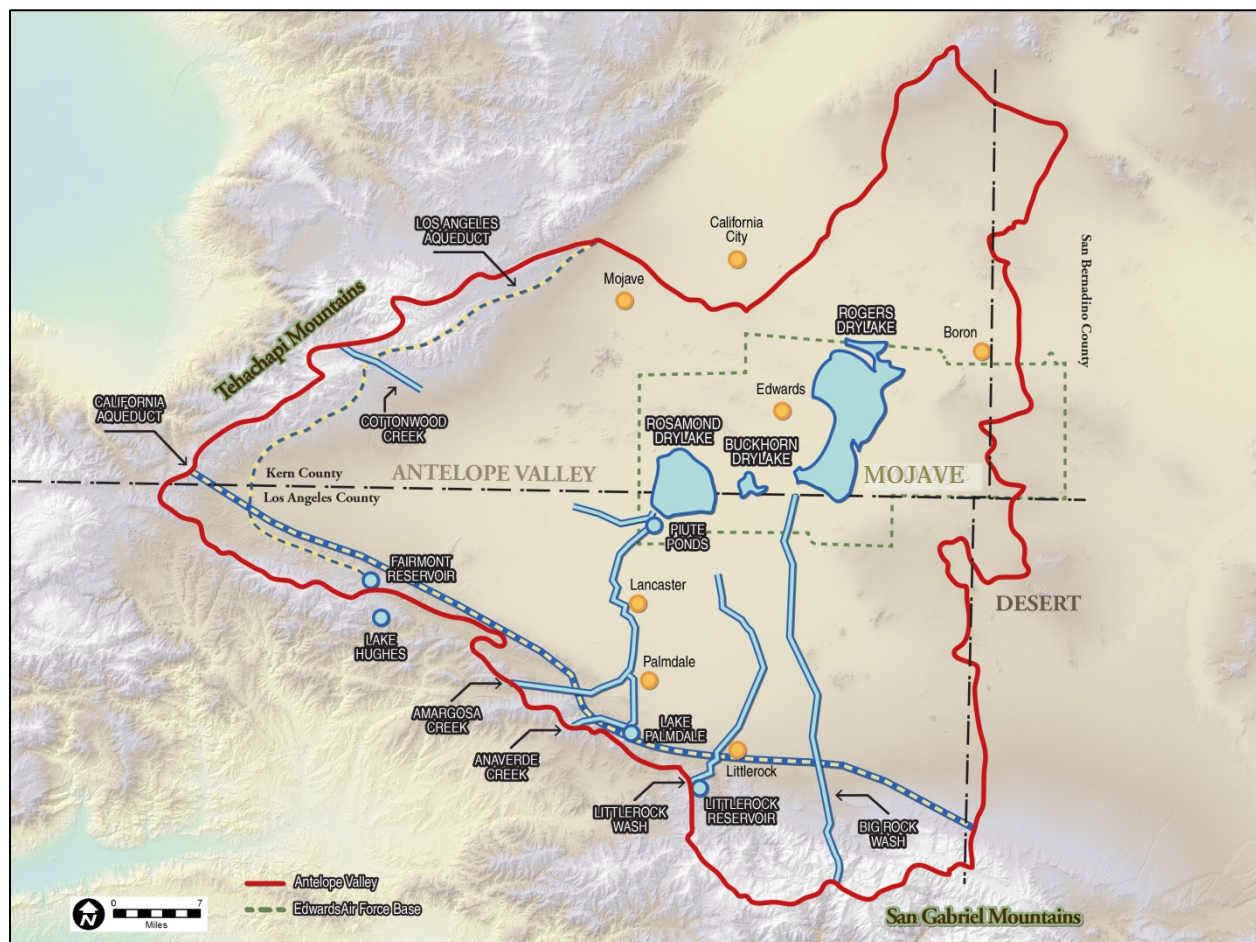
Major characteristics of the Antelope Valley Watershed are shown in Figure 2-1 and include:

- Closed basin - encompasses approximately 2,400 square miles; no regional outflow of surface or groundwater
- Bounded by the peninsular Tehachapi Mountains on the Northwest, together with the San Gabriel and the San Bernardino Mountains on the Southwest
- Terminal dry lakes/playas are predominantly clay - little groundwater recharge; significant losses to evaporation
- Four playas are all located on Edwards Air Force Base; the corresponding surface areas include Rosamond (21 square miles), Rich (3 square miles), Buckhorn (10 square miles), and Rogers (35 square miles)
- Approximately 80 percent of watershed is characterized by a low to moderate slope (0-7 percent); and the remaining 20 percent consists of foothills and rugged mountains which reach up to 3,600 feet in elevation
- Watershed boundaries and surface drainage patterns are difficult to define within the low-relief terrain lakebed portions of the watershed
- Mostly rural; sparsely populated in many areas; however the western and southern parts of the Antelope Valley along the foothills/alluvial fan have been urbanized
- High desert climate
- Three major watersheds are tributary to Rosamond Lake including (1) Cottonwood Creek (drainage area = 373 square miles), (2) Amargosa Creek (drainage area = 256 square miles), and (3) Little Rock Wash (drainage area = 144 square miles)
- Watershed area tributary to Rogers Lake is approximately 708 square miles primarily through Big Rock Creek; and the tributary watershed area to Rich Lake is 376 square miles
- Buckhorn Lake tributary area includes portions of Rosamond and Rogers watersheds



- Little Rock Reservoir provides some limited flood storage within the upper portion of the watershed (surface area = 150 acres, elevation 3,200, original storage capacity = 4,300 acre-feet and currently has a useable storage capacity of 3,000 acre-feet of water)

**Figure 2-1: Boundary of Antelope Valley Watershed and Major Flood-Related Features**

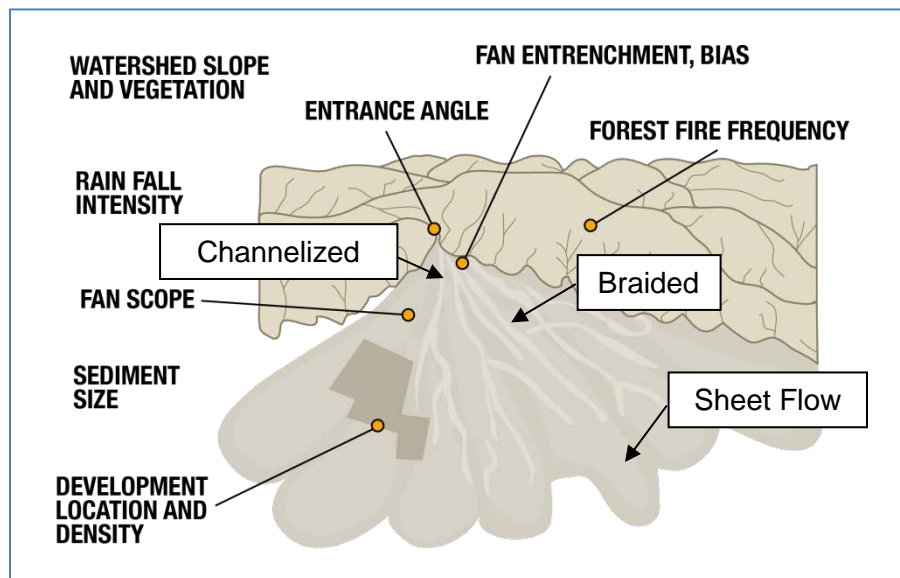


### 2.1.1 Floodplain/Geomorphology

Details of the floodplain/geomorphology of the watershed include:

- Much of the valley floor is subject to inundation and shallow flooding with unpredictable flow paths
- Floor of the Antelope Valley Watershed is formed by coalescing alluvial fans below the foothills which generally lacks defined natural channels and is subject to unpredictable sheet flow patterns
- Alluvial fans are an erosional feature - unpredictable flow paths/braided patterns; not channelized, difficult to provide control structures, sheet flows are common, development exists on the alluvial fans themselves
- Flood dynamics of an idealized alluvial fan can be characterized by several zones which are defined beginning from the apex as: (1) channelized zone (foothills), (2) braided zone (upstream fan areas), and (3) sheet flow zone (downstream fan areas) as shown in Figure 2-2.

Figure 2-2: Alluvial Fan Geomorphology and Flood Features



- Multiple alluvial fans coalesce or overlap below the foothill canyons (known as bajadas) and create complex flooding patterns
- Most of the surface waters are ephemeral streams due to arid conditions and only flow in direct response to precipitation
- Existing roadways may modify and concentrate flows in the shallow floodplain areas
- Channels experience migration/erosion/sediment deposition
- Location of the stream channel on a fan is often erratic due to the rapid expansion of the width and highly variable sediment load
- Dry lakebeds or playas are essentially flat surfaces with little topographic relief
- Shallow flooding often occurs along highly unpredictable flow paths because the source of the flow may be variable, topographic relief may be low, channels may shift or may be nonexistent, or sediment and debris may be deposited or removed during or after a flood
- Sheet flooding on the lower valley floor (i.e., the lower fringes of the alluvial fans) occurs due to limited topographic relief and this makes it difficult to define the level of flood hazards

## 2.1.2 Drainage Infrastructure

Details of the drainage infrastructure within the watershed include:

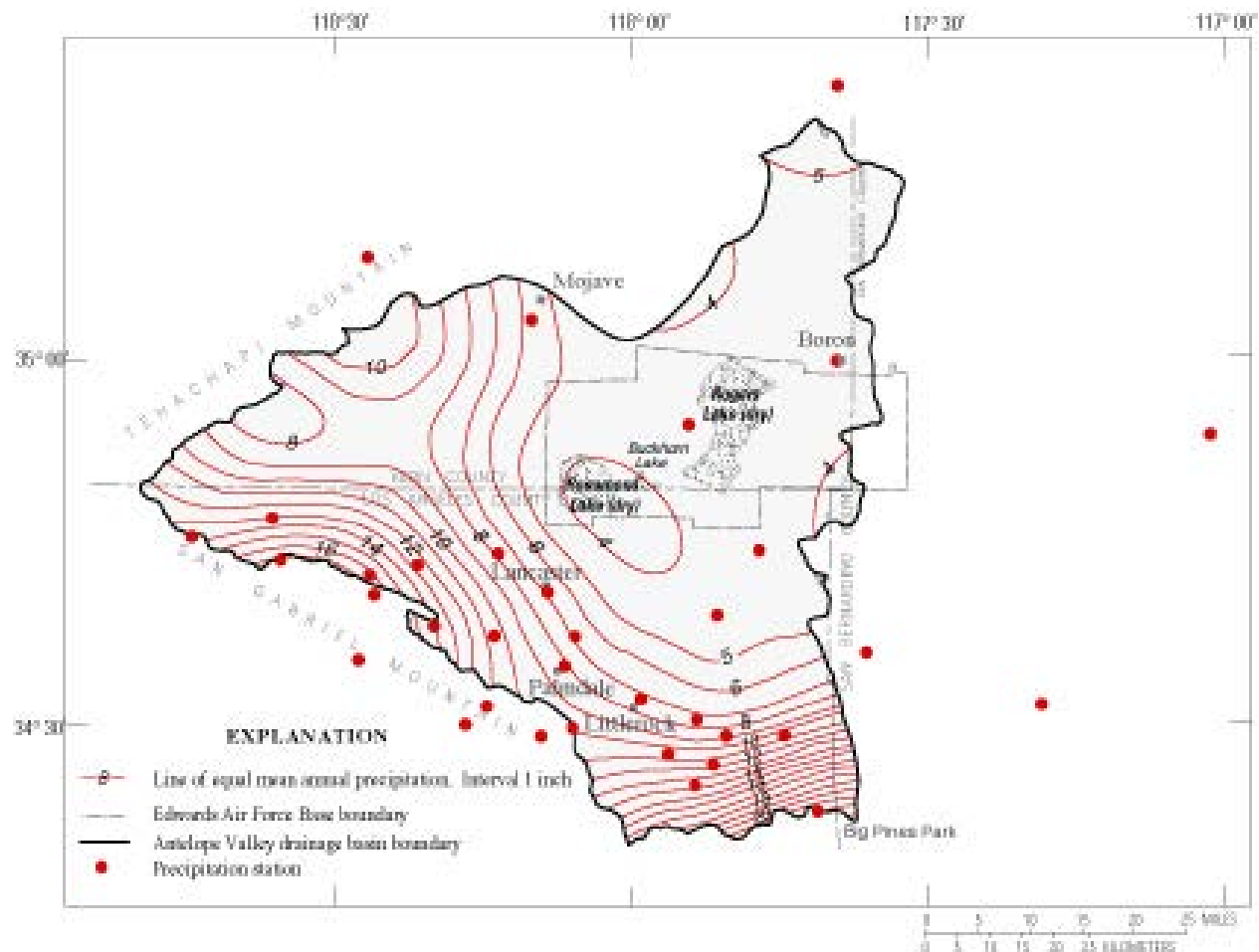
- Not a significant amount of regional flood infrastructure compared with other, more-densely urbanized areas of Los Angeles County; primarily natural drainage paths and patterns
- The limited regional flood control facilities are generally located in urban areas and include some channelized reaches of creeks, stream bank revetments of different types, and localized protective structures
- Urban drainage facilities have limited hydraulic capacity and are not designed to accommodate regional overland flooding that exceeds the smaller urban watershed
- Urban drainage facilities generally consist of local retention/detention basins, street drainage inlets, underground storm drain pipes, and culverts

### 2.1.3 Meteorologic / Hydrologic Response

Details of the meteorologic/hydrologic response of the watershed include:

- Precipitation can vary considerably within the watershed based on elevation as shown in Figure 2-3; average annual precipitation in the Antelope Valley ranges from about 20 inches in the mountains to less than 4 inches on the valley floor

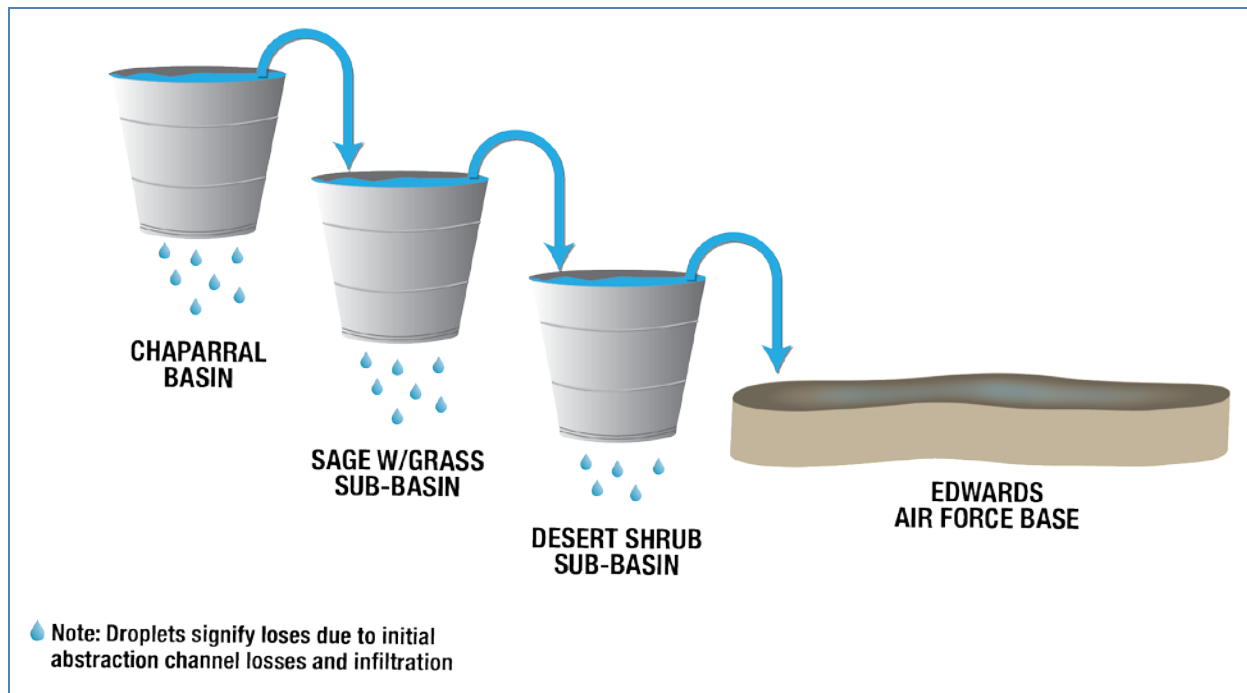
**Figure 2-3: Average Rainfall (Isopluvial Contours) for Antelope Valley Region**



- Rainfall-runoff watershed response varies based on elevation within the watershed and corresponding soil types
- Watershed response is conceptually described as a series of “leaky buckets” representing different elevation intervals which are interconnected and once the threshold amount of rainfall exceeds the initial soil losses then water cascades down to the next level in the watershed, ultimately the lakebed, as shown in Figure 2-4



Figure 2-4: “Leaky Bucket” Concept for Antelope Valley Watershed

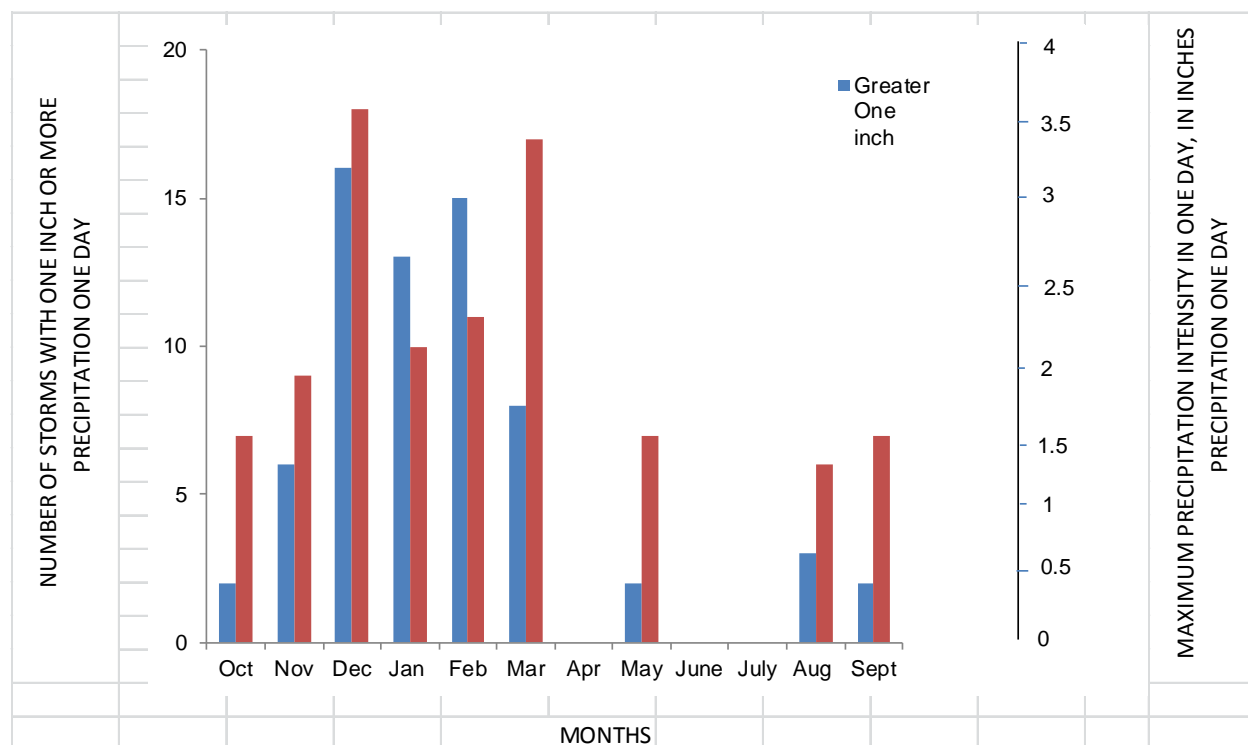


- Larger storm events may result in magnified flood flows generated from “cascading” watersheds where watershed boundaries may coalesce and combine because of limited hydraulic capacity or undefined floodplains
- It has been previously estimated that 70 percent of the runoff volume to the dry lake beds is generated from the lowest mountain watershed area and 15 percent of the runoff volume is associated with rainfall falling directly on the lake
- Typically, frequent wildfires in Southern California result in burn conditions that can change the surface soil layer and dramatically reduce infiltration while increasing runoff
- Flashy storms occur - high flow volumes, low frequency, high volumes of sediment transfer
- The historical average estimated 100-year 24-hour rainfall varies within the Antelope Valley from 3.55 inches at EAFB to higher amounts in the mountainous area similar to the average rainfall distribution shown above in Figure 2-3. This reflects the orographic lifting effects of the mountains on rainfall as well as west-to-east rain shadow<sup>1</sup> across the valley floor.
- Rainfall is caused by three types of storms in the Valley which include (1) low-pressure systems originating in the Gulf of Alaska or near the Hawaiian Islands, (2) low pressure systems originating from the tropics during the late summer and early fall, and (3) cloudbursts<sup>2</sup> or thunderstorm covering small areas and originating from convective uplifting during the summer and early fall.
  - Most storms greater than 1-inch of precipitation in one day are from frontal or low-pressure systems that are most prevalent during December through March as shown in Figure 2-5.

<sup>1</sup> “Rain shadow” refers to a region in the lee of mountains that receives less rainfall than the region windward of the mountains.

<sup>2</sup> A “cloudburst” is an extreme amount of precipitation, sometimes with hail and thunder, which normally lasts no longer than a few minutes but is capable of creating flood conditions.

Figure 2-5: Seasonal Distribution of Storms in Palmdale (1932-1992)



## 2.2 Flood Mapping

Regional mapping of the existing flood hazards for the Antelope Valley has been prepared by FEMA as part of the National Flood Insurance Program (NFIP). NFIP requires each community to identify 100-year recurrence interval flood prone areas as part of adopting floodplain management regulations. The minimum federal flood protection goals and requirements are administered by FEMA as part of the NFIP. The NFIP, originally established in 1968, provides low-cost federally subsidized flood insurance to those communities that participate in this program. Participation in the program requires that the community adopt floodplain regulations which meet the requirements of the NFIP defined in 44CFR Chapter 1 Part 59, including mapping of existing flood hazards.

Hydrologic and hydraulic studies are required to analyze the delineation of the 100-year recurrence interval floodplain envelope. However, flooding and sedimentation within the Antelope Valley do not occur in a typical riverine system. These processes occur in alluvial fans that are difficult to simulate numerically. The published FEMA flood hazard maps provide an approximation of the regional floodplain limits based on the standards for FEMA alluvial fan hazards. The mapped flood hazards focus on regional flood hazards and do not evaluate localized flooding, particularly in urbanized areas; so there could be areas that flood in small storm events that are not captured within a mapped flood hazard zone under FEMA.

Alluvial fan flooding presents unique problems in terms of quantifying flood hazards, assessing sediment transport characteristics, devising reliable flood protection schemes, and evaluating impacts of various projects on flow and sediment dynamics. Standard one-dimensional (1-d) methods developed for flow and sediment routing in confined streams with simple channel geometry are usually inadequate for alluvial fan applications. This makes the accuracy of regional flood hazard delineation questionable since the mapping is based on fixed channel geometry without erosion and does not necessarily consider (1) shallow flooding and unknown redistribution of flows, (2) complex hydraulics, (3) loss of channel

hydraulic capacity because of sedimentation/deposition, and (4) additional flow contributions from upstream cascading watersheds. These are just a few of the issues that should be understood when reviewing the flood hazard mapping on alluvial fans and desert valley floor areas. However, even with these identified issues, the published flood hazard maps provide an initial approximation of the general flooding boundaries.

### **2.2.1 Definition of Flood Hazard Risks**

The FEMA flood hazard zones shown represent the areas susceptible to the 1 percent annual chance flood (commonly referred to as the “100-year flood”), and the 0.2 percent annual chance flood (“500-year flood”). The 1 percent annual chance flood has at least a 1 percent chance of occurring in any given year. FEMA designates these areas as Special Flood Hazard Areas (SFHA) and requires flood insurance for properties in these areas as a condition of any mortgage backed by federal funds.

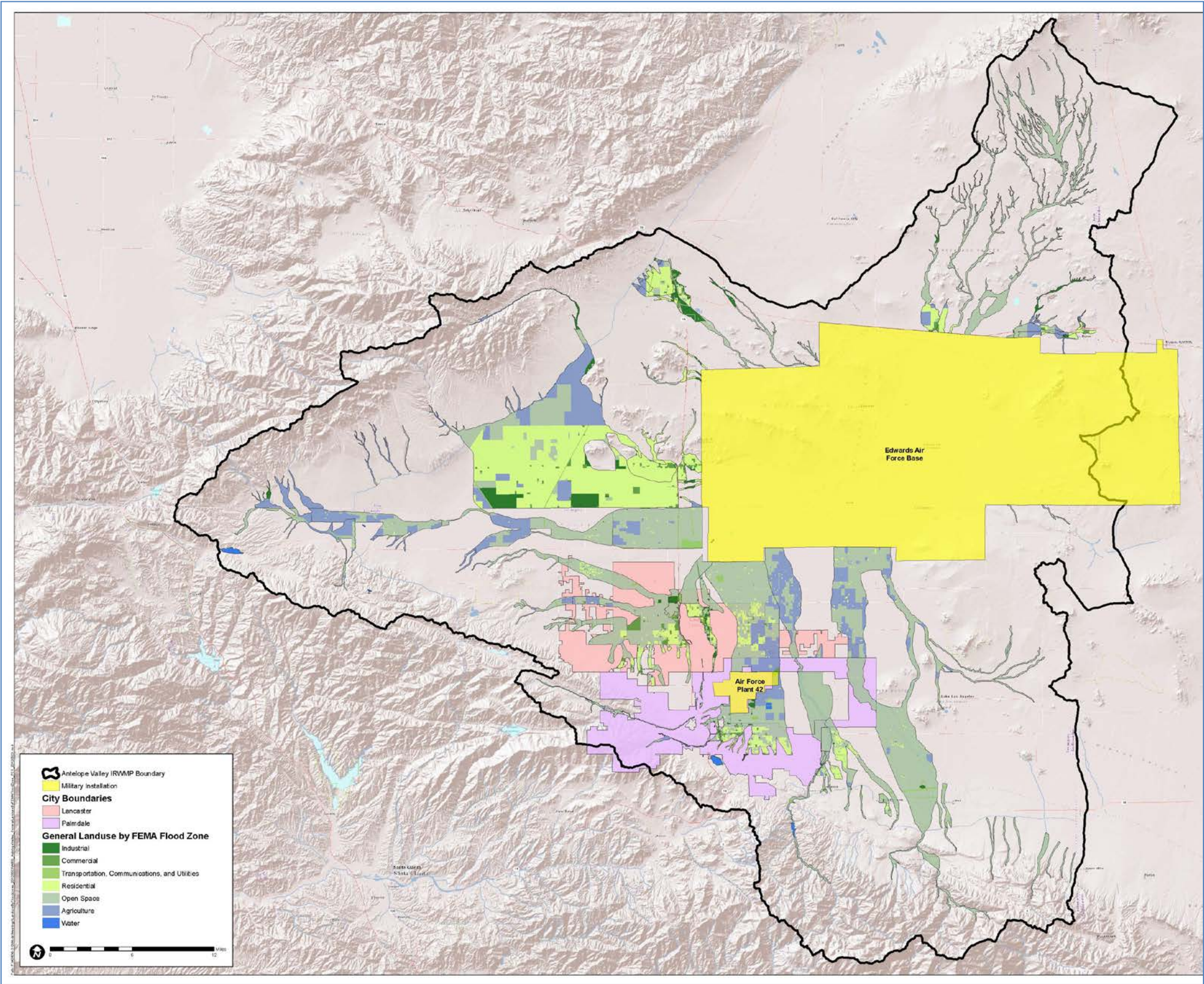
### **2.2.2 Existing Floodplain Hazard Mapping – Antelope Valley**

The existing published FEMA flood hazard mapping illustrates general characteristics of the floodplain and provides an understanding of the extent of the existing flood potential within the valley (Figure 2-6). A key item that is immediately apparent from the floodplain mapping is that the entire EAFB and Air Force Plant 42 areas are not part of the published mapping. This does not mean that the areas are not associated with flood hazards, only that mapping is not provided because it is located on federal lands and those areas are not mapped. Other general trends regarding the floodplain that can be deduced from the mapping include: (1) floodplains are very well-defined in the lower mountains/foothill areas where there are incised streams; (2) valley floor and alluvial fan areas result in wide floodplains with patterns of flow that redistribute and split to other channels downstream; (3) linear floodplain boundaries for locations of shallow flooding are present in several locations, but this appears to be associated with political boundaries and not necessarily with physical boundaries (this reflects different time periods when the mapping was performed); (4) shallow flooding floodplains encompass urbanized portions of Palmdale and Lancaster; (5) all the floodplains illustrate the general surface drainage patterns that are directed to the playas at EAFB. It is apparent that uncertainties and discrepancies exist in the flood hazard mapping, particularly near local government boundaries where there are minimal hydraulic influences. The mapping should be used cautiously because of its approximate nature and because it does not necessarily define the magnitude of flooding.

Page Intentionally Left Blank



Figure 2-6: Antelope Valley General Land Use by FEMA Flood Zone





Page Intentionally Left Blank



## 2.2.3 Flood Hazard Mapping Compared to Land Use

An initial assessment of the magnitude of the existing “flood risk” (which correlates directly to the potential flood damage) can be developed through quantifying encroachments upon different types of land-use within the floodplain. Any area located within a 100-year floodplain flood hazard area is considered to be at “high risk” of flooding. An overlay of the land use plan with the mapped flood hazard zones is shown in Figure 2-6. This generalized mapping overlay can be utilized as an effective planning tool. The land use areas which have a high dollar value for damages within flood hazard zones represent locations to target and prioritize for projects.

The magnitudes of general land-use designations within the flood hazard zones have been summarized for both Los Angeles County and Kern County in Table 2-1 and Table 2-2, respectively. The FEMA flood hazard zone “A” designates the 100-year floodplain, although there are various different types of flood hazards within zone “A” for insurance purposes, some of which are defined by FEMA as follows:

- Zone A: Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies.
- Zone AE: Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods.
- Zone AH: Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between one and three feet.
- Zone AO: Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone.

The mapping indicates that the majority of the areas have land use zoning that is compatible with the floodplain being zoned primarily for “open space.” However, it is important to note the other general land uses within the floodplain, particularly the more urban type of uses which would result in more extensive flood damage.

**Table 2-1: LA County Land Use Designations and FEMA Flood Hazard Zones**

Los Angeles County – Land Use Designation with Mapped FEMA Flood Hazard Zone		
FEMA Flood Zone	General Land Use	Total (ac)
<b>1 Pct Annual Chance Flood Hazard Contained in Channel</b>	Commercial	3
	Open Space	13
	Residential	1
	Transportation, Communications, and Utilities	43
	Water	28
<b>1 Pct Annual Chance Flood Hazard Contained in Channel Total</b>		<b>89</b>
<b>A</b>	Agriculture	13,459
	Commercial	65
	Industrial	83
	Open Space	53,966
	Residential	802
	Transportation, Communications, and Utilities	1,453
	Water	609
<b>A Total</b>		<b>70,436</b>
<b>AE</b>	Agriculture	17
	Industrial	18
	Open Space	3,756
	Residential	19

Los Angeles County – Land Use Designation with Mapped FEMA Flood Hazard Zone		
FEMA Flood Zone	General Land Use	Total (ac)
	Transportation, Communications, and Utilities	7
	Water	4
<b>AE Total</b>		<b>3,821</b>
<b>AH</b>	Commercial	5
	Industrial	206
	Open Space	620
	Transportation, Communications, and Utilities	99
<b>AH Total</b>		<b>930</b>
<b>AO</b>	Agriculture	25
	Commercial	80
	Industrial	42
	Open Space	2,612
	Residential	93
	Transportation, Communications, and Utilities	92
<b>AO Total</b>		<b>2,944</b>
<b>Grand Total</b>		<b>78,219</b>

Table 2-2: Kern County Land Use Designations and FEMA Flood Hazard Zones

Kern County – Land Use Designation with Mapped FEMA Flood Hazard Zone		
Flood Zone	General Land Use Category	Total Area (ac)
<b>A</b>	Agriculture	13,476
	Commercial	872
	Industrial	5,657
	Open Space	25,885
	Residential	37,746
	Transportation, Communications, and Utilities	376
<b>A Total</b>		<b>84,011</b>
<b>AE</b>	Agriculture	53
	Commercial	12
	Industrial	11
	Residential	74
<b>AE Total</b>		<b>149</b>
<b>AH</b>	Agriculture	549
	Commercial	180
	Industrial	5
	Open Space	513
	Residential	708
	Transportation, Communications, and Utilities	2
<b>AH Total</b>		<b>1,958</b>
<b>AO</b>	Agriculture	447
	Commercial	138
	Industrial	486
	Open Space	131
	Residential	381

Kern County – Land Use Designation with Mapped FEMA Flood Hazard Zone		
Flood Zone	General Land Use Category	Total Area (ac)
	Transportation, Communications, and Utilities	44
<b>AO Total</b>		<b>1,627</b>
<b>Grand Total</b>		<b>87,746</b>

## 2.3 Existing and Historical Flooding

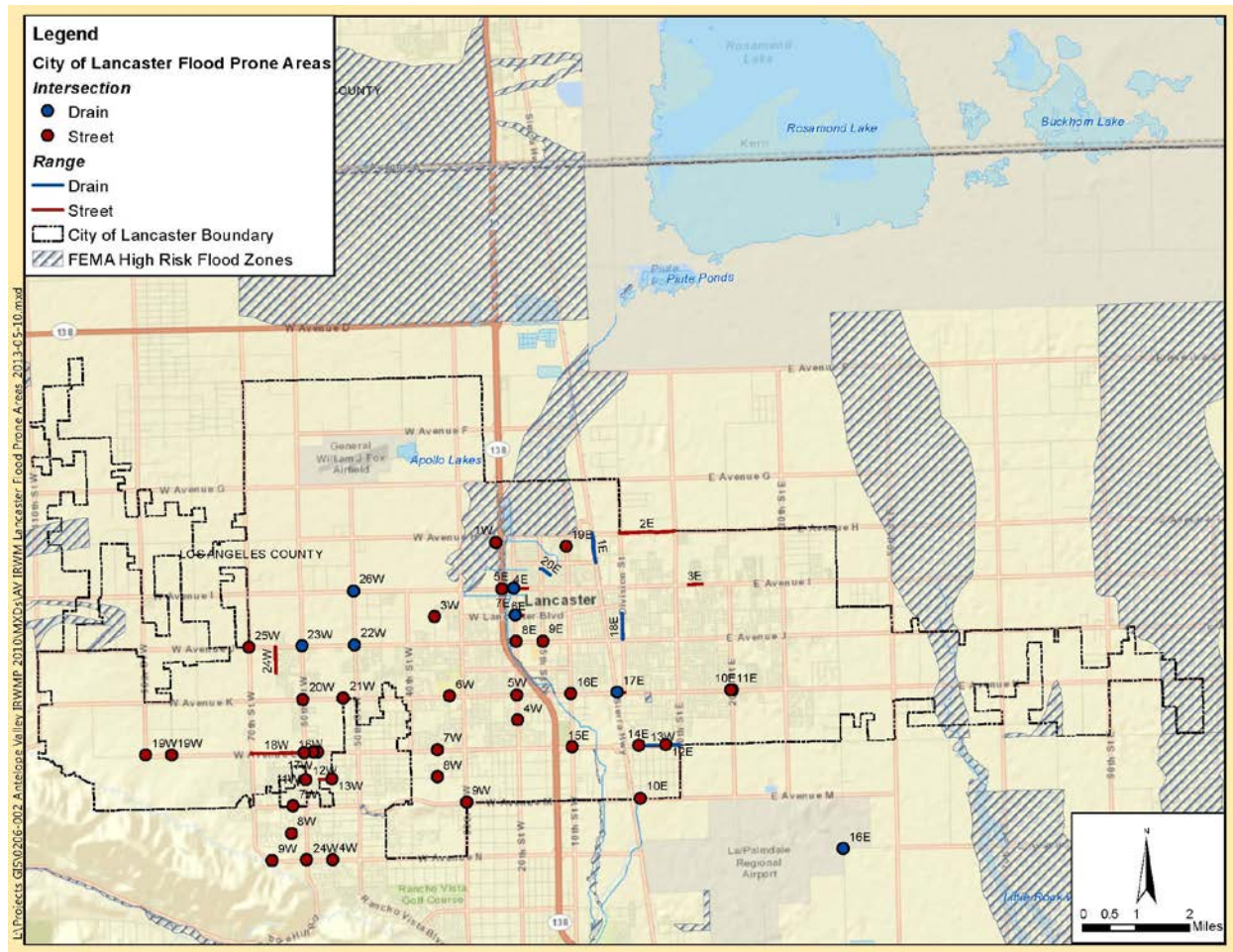
Information was collected on current, ongoing flood problems in the Cities of Lancaster and Palmdale, and in unincorporated areas of Los Angeles and Kern Counties. Each of these areas is discussed below. Information for EAFB, which includes parts of both unincorporated Los Angeles and Kern Counties, was not available at the time of this document.

For the municipalities and unincorporated county areas, localized problems are associated with historical chronic flooding that generally occurs after major storms. They are identified as locations of known flooding which require maintenance, including sediment removal. Generally, these problems occur at locations where existing drainage facilities are insufficient or not present.

### 2.3.1 Lancaster

Localized flooding areas in the City of Lancaster are shown in Figure 2-7 as documented by city maintenance staff. This figure also indicates the FEMA high risk flood zones (Zone A). It is important to note that areas of local flood concern do not necessarily correlate to FEMA's high-risk flood zones.

**Figure 2-7: Localized Flooding Areas in the City of Lancaster**

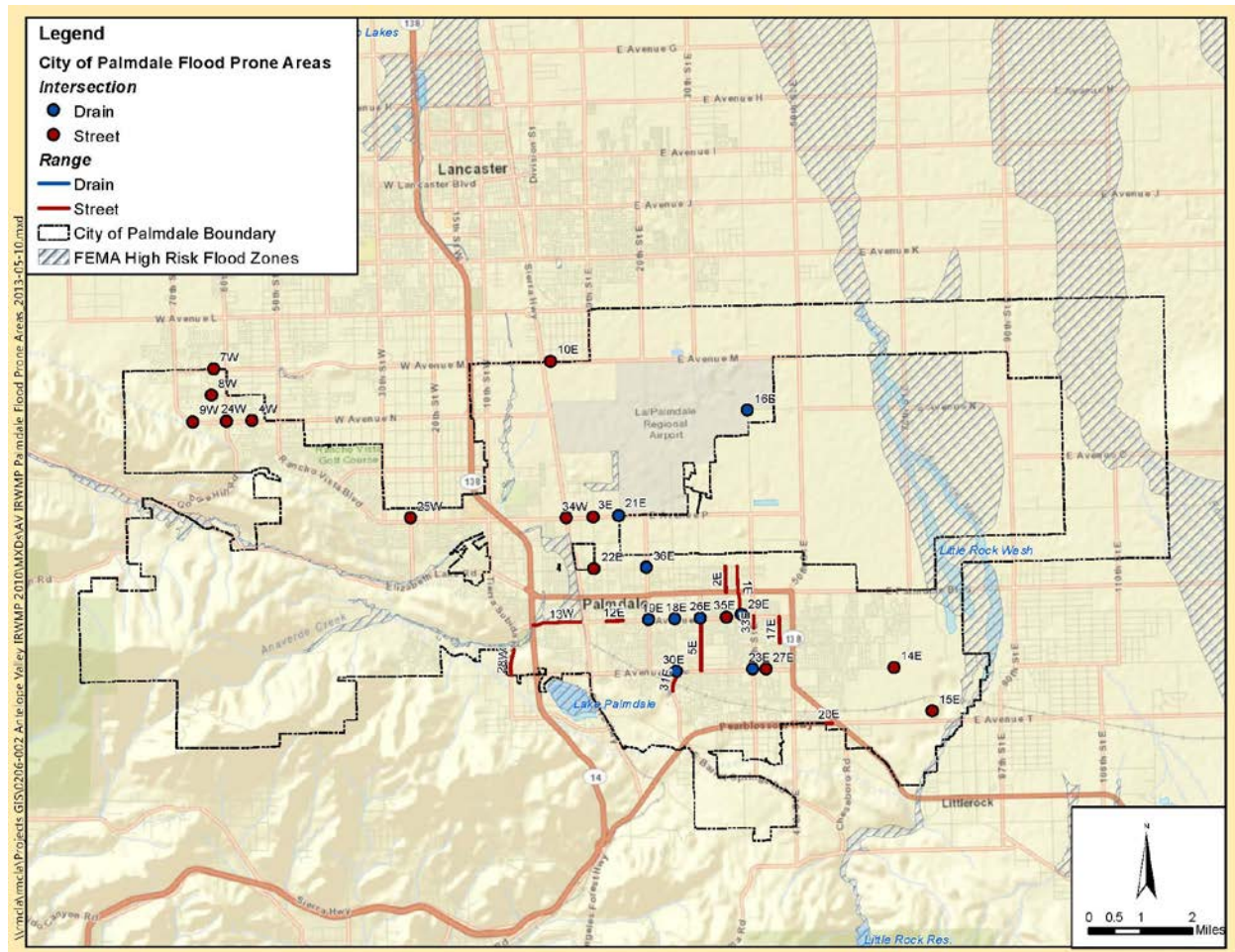


### 2.3.2 Palmdale

Localized flooding areas in the City of Palmdale are shown in Figure 2-8 as documented by city maintenance staff. This figure also indicates the FEMA high risk flood zones (Zone A). It is important to note that areas of local flood concern do not necessarily correlate to FEMA's high-risk flood zones.



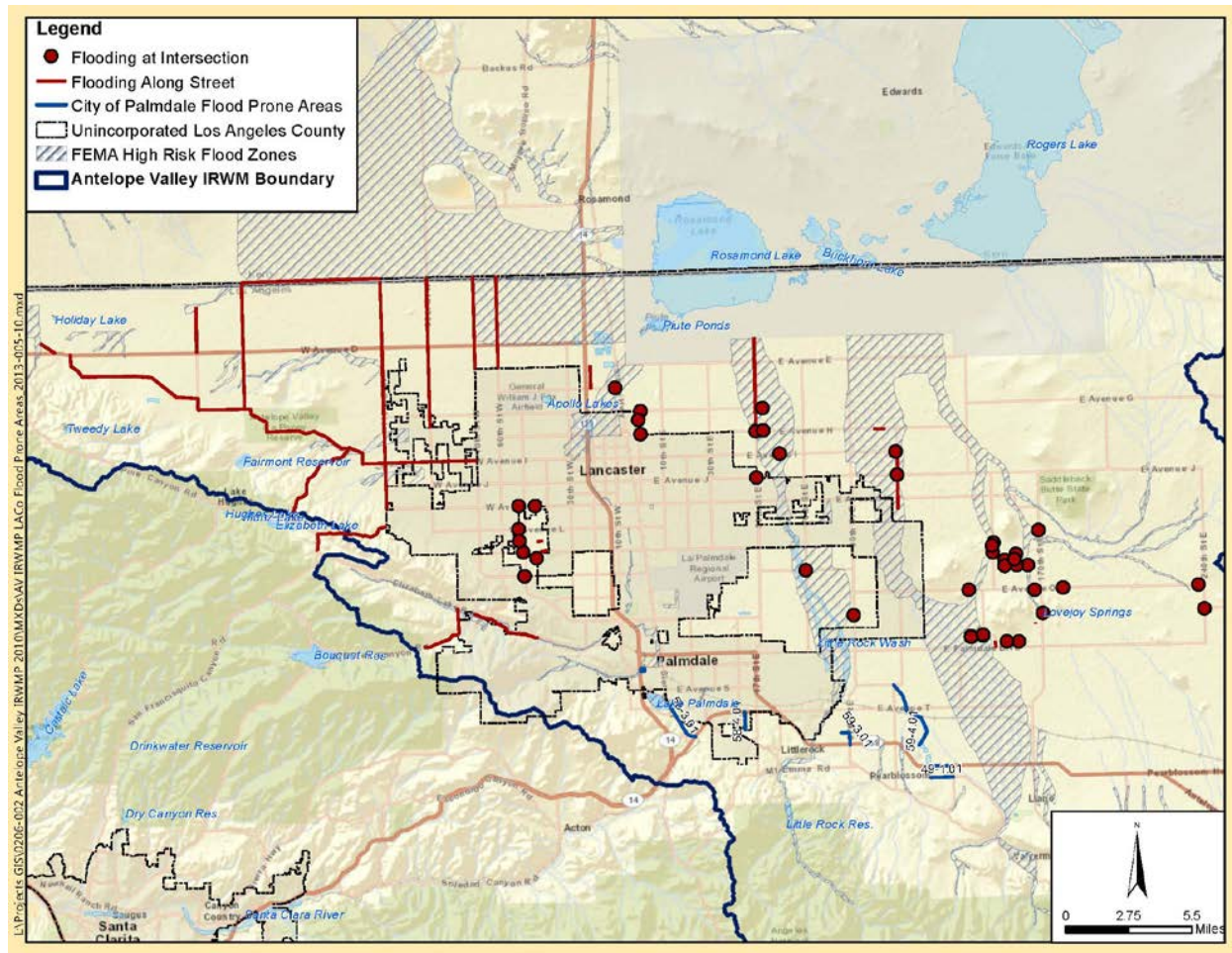
Figure 2-8: Localized Flooding Areas in the City of Palmdale



### 2.3.3 Unincorporated Los Angeles County

Localized flooding areas in unincorporated Los Angeles County are shown in Figure 2-9 as documented by county maintenance staff. This figure also indicates the FEMA high risk flood zones (Zone A). It is important to note that areas of local flood concern do not necessarily correlate to FEMA's high-risk flood zones.

Figure 2-9: Localized Flooding Areas in Unincorporated Los Angeles County

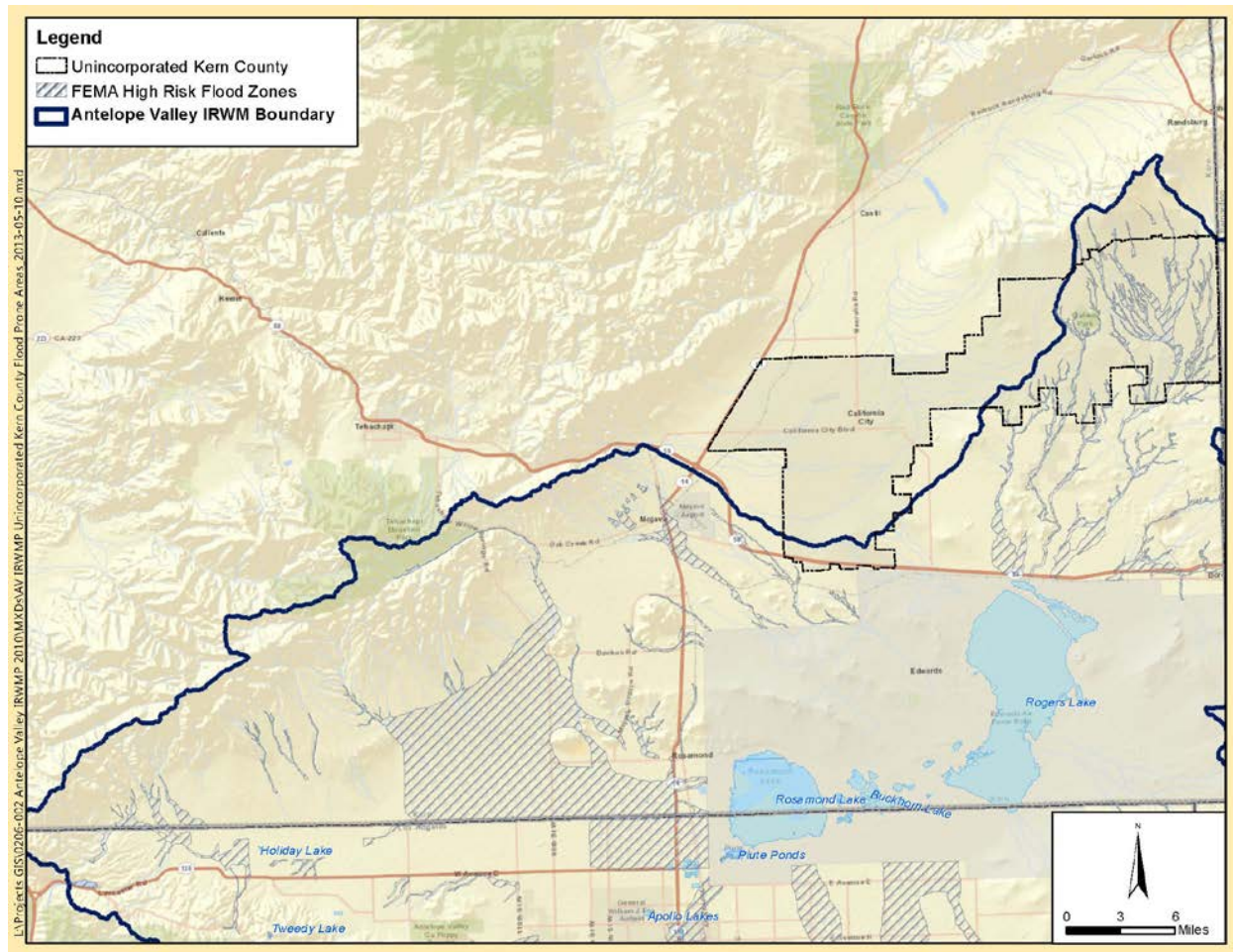


### 2.3.4 Unincorporated Kern County

Localized flooding areas have not been identified for unincorporated Kern County. Figure 2-10 indicates the FEMA high risk flood zones. Localized flooding areas should be identified for these portions of the Region.



Figure 2-10: Localized Flooding Areas in Unincorporated Kern County



## 2.4 Existing Plans and Projects

The existing plans and projects in the Region that are considered as IFM are described below.

### 2.4.1 Existing Plans

#### Model Water Efficient Landscape Ordinance

The Water Conservation in Landscaping Act of 2006 requires cities, counties, and charter cities and charter counties to adopt landscape water conservation ordinances by January 1, 2010. Pursuant to this law, the Department of Water Resources (DWR) has prepared a Model Water Efficient Landscape Ordinance (Model Ordinance) for use by local agencies. The Model Ordinance became effective on September 10, 2009.

Under the Model Ordinance, all local agencies must adopt a water efficient landscape ordinance by January 1, 2010 or may adopt the state Model Ordinance. In addition, local agencies may collaborate and craft a region-wide ordinance. The adopted ordinance must be as effective as the Model Ordinance in regards to water conservation.

The objectives of the existing DWR Model Water Efficient Landscape Ordinance are:

- Promote the values and benefits of landscapes while recognizing the need to invest in water and other resources as efficiently as possible.
- Establish a structure for planning, designing, installing, maintaining and managing water efficient landscapes in new and rehabilitated projects.
- Establish provisions for water management practices and water waste prevention for established landscapes.
- Use water efficiently without waste by setting a Maximum Applied Water Allowance as an upper limit for water use and reduce water use to the lowest practical amount.

Examples of projects included under DWR's Model Water Efficient Landscape Ordinance are:

- Irrigation weather control/soil moisture sensing irrigation controllers
- Rain shutoff sensors
- Graywater systems
- Rainwater collection--**flood mitigation**
- Green roofs--**flood mitigation**
- Restoration/protection of native vegetation--**flood mitigation**

Existing landscape ordinances in the Region include:

- *City of Palmdale Landscape Ordinances* – The City of Palmdale has a Landscape Ordinance (Ordinance No. 1176) and a Water Conservation Ordinance (Ordinance No. 1362). The Water Conservation Ordinance includes stormwater management. It is highly recommended to implement stormwater best management practices (BMPs) into the landscape, irrigation, and grading design plans to minimize runoff and increase on-site retention and infiltration, **which aid in the reduction of flooding**. The City of Palmdale's Water Conservation Ordinance is provided in Appendix B.
- *Palmdale Water District* - The Palmdale Water District currently provides rebates and programs for weather-based irrigation controls and turf removal programs for residential and commercial customers. Additional information is available on their website (<http://www.palmdalewater.org/Rebate.aspx>).
- *California Water Service Company* – The 2010 California Water Service Company (CWSC) Urban Water Management Plan contains guidelines for Water Efficient Landscapes that CWSC uses at its properties, including renovations. For the efficient use of water, grading of a project site shall be designed to minimize soil erosion, runoff, water waste and follow the grading design criteria, **which aid in the reduction of flooding**. Ordinances for the City of Lancaster portions in the CWSC service area can be found on their website (<https://www.calwater.com/conservation/ordinances.php>).
- *City of Lancaster* – The City of Lancaster has landscape and water wasting ordinances in place for the efficient use of water in the City.

### Informational Websites/Public Outreach

Informational websites and public outreach efforts educate the public about water quality measures that can have an impact on flood control through the encouragement of infiltration and vegetation treatment of runoff. Programs that specifically encourage water conservation improve stormwater quality by preventing stormwater runoff from carrying materials away from irrigation sites. Water quality and water conservation programs within the Region include:

- *Antelope Valley Water Partners Outreach* - The Antelope Valley Water Partners (<http://dpw.lacounty.gov/wwd/web/avlinks.aspx>) consists of four water districts: Los Angeles County Waterworks District 40, Palmdale Water District, Quartz Hill Water District and

Rosamond Community Services District. The Antelope Valley Water Partners provide information on water savings and water saving improvements to make residential homes and irrigation systems more water efficient. The partners offer the following programs to help customers conserve water throughout the year:

- Rebates for water saving devices (e.g. rain shut-off irrigation sensor)
  - Free in-home water use audits
  - Free water saving devices at community events
  - Free drought tolerant plant guides
- *S/N Management Plan Website and Outreach*
  - The Antelope Valley Integrated Regional Water Management Plan website ([www.avwaterplan.org](http://www.avwaterplan.org)) provides information on projects, stakeholders and outreach. It also includes information specific to the salt and nutrient (S/N) management planning process for the Region. The Antelope Valley Integrated Regional Water Management Plan is a multi-county collaborative effort developed to address regional concerns about water supply reliability, water quality, flood protection, environmental resources, land use management and climate change impacts in the Antelope Valley. The scope of work for the S/N Management Plan is located on the website where the final version of the S/N Management Plan will also be available when complete in 2014.
  - The Association of California Water Agencies (ACWA), a coalition of 450 public water agencies, has launched a statewide public education program, entitled “California’s Water: A Crisis We Can’t Ignore,” to educate Californians about critical challenges now confronting the State’s water supply and delivery system. The ACWA website ([www.acwa.com](http://www.acwa.com)) also provides information for salt and nutrient management plans by organizing and posting webinars on S/N information.
- *Council for Watershed Health (CWH) Website and Outreach* - Since 1996, the CWH has been Southern California’s hub for essential watershed research and analysis. CWH’s programs are focused on four major areas: improving water quality, increasing water supplies through sustainable landscapes and stormwater reuse, facilitating integrated planning and management, and educating decision-makers about water issues. The CWH’s urban stormwater program uses research, planning and education to achieve quality and reliability of local water resources through increasing conservation, recycling, and the use of local water resources. Although CWH’s focus areas are the Los Angeles River and the San Gabriel River watersheds, CWH’s urban stormwater research and studies are applicable to other regions (<http://www.watershedhealth.org/programsandprojects/urbanstormwater.aspx>).
- *Environmental Protection Agency (EPA)* – The EPA’s website provides additional stormwater information regarding the NPDES Stormwater Program, urban polluted runoff, managing wet weather with green infrastructure, and LID (<http://cfpub.epa.gov/npdes/stormwater/swbasicinfo.cfm>).

### **Stormwater Management Plans**

Prior to March 10, 2003, Los Angeles County and the Los Angeles County Flood Control District were governed by the Phase I Municipal Separate Storm Sewer Systems (MS4) permit in the Los Angeles Basin Area. The Phase I MS4 permit required all County facilities to comply with the Model Program “Public Agency Activities”. This program required specific BMPs for the reduction of stormwater pollutant intrusion to the storm drain system. The County requires all field yards, including those located within the Antelope Valley, to comply with the Phase I requirements that became effective February 1, 2003.

As of August 2003, Stormwater Management Plans (SWMPs)<sup>3</sup> were mandated to be developed to address the requirements of the Phase II General Municipal National Pollutant Discharge Elimination System (NPDES) Permit for regulated small MS4s. According to federal regulations, the purpose of the Phase II permit is to regulate stormwater discharges from small MS4s. The General permit requires regulated small MS4s to develop and implement a SWMP to effectively prohibit non-stormwater discharges and reduce the discharge of pollutants to the “Maximum Extent Practicable”.

The City of Palmdale, City of Lancaster and unincorporated Los Angeles County areas were automatically designated as a small MS4 by the U.S. Environmental Protection Agency because they are located within an urbanized area defined by the Census Bureau. Unincorporated Los Angeles County areas that are designated as urbanized are the communities of Littlerock, Pearlblossom and Quartz Hill. Each agency filed a notice of intent to comply with the State Water Resources Control Board Small MS4 General Permit and submitted a SWMP in 2003. Communities in the Kern County portion of the Region were not designated as small MS4s, but instead fall under Kern County’s NPDES permit obtained in 2001.

### 2.4.2 Existing Projects

The Antelope Valley Region has already implemented projects that provide flood protection, groundwater recharge, water supply, and/or habitat restoration benefits. Other potential projects are in development now and are being tracked by the IRWM process. All of these projects provide multiple benefits that include flood protection. Table 2-3 summarizes IFM Projects in the Antelope Valley Region that were previously submitted for acceptance into the IRWM Plan. The list is not intended to be a comprehensive or definitive list, and it reflects projects that are in various stages of development.

**Table 2-3: IFM Projects in the Antelope Valley Region**

Project Description	Proponents	Benefits
Local retention/detention basins, street drainage inlets, underground storm drain pipes, and culverts	City of Palmdale	Flood: peak flow reduction
	City of Lancaster	
	Quartz Hill	Quality: sedimentation reduction
Wastewater, recycled water, surface water, imported water and groundwater monitoring	Antelope Valley-East Kern	Quality: water quality data collection
	Los Angeles County Sanitation Districts	
	Edward Air Force Base	
	Rosamond Community Services District	
	Palmdale Water District	

<sup>3</sup> [http://www.swrcb.ca.gov/water\\_issues/programs/stormwater/swmp/la\\_county\\_swmp.pdf](http://www.swrcb.ca.gov/water_issues/programs/stormwater/swmp/la_county_swmp.pdf)



Project Description	Proponents	Benefits
Adopted Model Water Efficient Landscape Ordinances: <ul style="list-style-type: none"> <li>- City of Palmdale               <ul style="list-style-type: none"> <li>o Landscape ordinances that require implementation of irrigation weather control, rain shutoff sensors, etc.</li> </ul> </li> <li>- Palmdale Water District               <ul style="list-style-type: none"> <li>o ET/Smart, SWAT tested, controller rebate program</li> </ul> </li> <li>- California Water District – City of Lancaster               <ul style="list-style-type: none"> <li>o Irrigation design plan (weather based irrigation controllers)</li> <li>o Grading design plan (Capture of runoff for 10-year event required for landscape areas greater than 5,000 square feet)</li> </ul> </li> <li>- City of Lancaster               <ul style="list-style-type: none"> <li>o Landscape ordinance that require implementation of dedicated landscape water meters, weather-based irrigation controllers, soil management plans, etc.</li> <li>o Water wasting ordinance that prohibits irrigation runoff from properties, requires leaks be remedied, etc.</li> </ul> </li> </ul>	City of Palmdale Palmdale Water District California Water Service Company – City of Lancaster City of Lancaster	Flood: peak flow reduction  Quality: sedimentation, urban runoff loading reduction
Informational Websites/Public Outreach <ul style="list-style-type: none"> <li>- SNMP website and outreach:  <a href="http://www.avwaterplan.org">www.avwaterplan.org</a>  <a href="http://www.acwa.com">www.acwa.com</a> </li> <li>- Council for Watershed Health website and outreach:  <a href="http://watershedhealth.org/Default.aspx">http://watershedhealth.org/Default.aspx</a> </li> <li>- EPA:  <a href="http://cfpub.epa.gov/npdes/stormwater/swbasiciinfo.cfm">http://cfpub.epa.gov/npdes/stormwater/swbasiciinfo.cfm</a> </li> </ul>	LA County Waterworks District No. 40 LACSD Council for Watershed Health Environmental Protection Agency	Flood: peak flow reduction  Quality: sedimentation, urban runoff loading reduction
Stormwater Management Plans	City of Palmdale City of Lancaster Los Angeles County (Little Rock, Pearlblosson and Quartz Hill)	Flood: peak flow reduction  Quality: pollutant reduction

## 2.5 Planned Projects

Potential projects submitted for acceptance to the 2013 Integrated Regional Water Management Plan (IRWMP) include planned flood control projects for the Region that may provide both flood control and stormwater quality benefits. The projects put forward are summarized in Table 2-4 and are further described after the table.

**Table 2-4: Planning Projects that Provide Both Flood Control and Stormwater Quality Benefits**

Project Name	Proponent	Description of Benefits
45th Street East Groundwater Recharge and Flood Control Basin	City of Palmdale	Flood: peak flow reduction Quality: sedimentation
Antelope Valley Watershed Surface Flow Study	Edwards Air Force Base	Flood: assess impacts of stormwater and upstream flood management projects Quality: assess impacts of sediment load
Avenue Q and 20th Street East Groundwater and Flood Control Basin (Q-West Basin)	City of Palmdale	Flood: peak flow reduction Quality: sedimentation
Avenue R and Division Street Groundwater Recharge and Flood Control Basin	City of Palmdale	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment
Barrel Springs Groundwater Recharge and Flood Control Basin	City of Palmdale	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment
Big Rock Creek In-River Spreading Grounds	Los Angeles County Department of Public Works (LACDPW)	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment
Hunt Canyon Groundwater Recharge and Flood Control Basin	City of Palmdale	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment
Little Rock Creek In-River Spreading Grounds	LACDPW	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment
Littlerock Creek Groundwater Recharge and Recovery Project	Palmdale Water District	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment
Littlerock Dam Sediment Removal	Palmdale Water District	Flood: peak flow reduction Quality: sedimentation
Lower Amargosa Creek Recharge Project	City of Palmdale	Flood: peak flow reduction Quality: sedimentation, soil aquifer treatment



Project Name	Proponent	Description of Benefits
Stormwater Harvesting	Leona Valley Town Council	Flood: peak flow reduction, volume reduction  Quality: urban runoff loading reduction
Upper Amargosa Creek Flood Control, Recharge, and Habitat Restoration Project	City of Palmdale	Flood: peak flow reduction, channel stabilization  Quality: sedimentation, soil aquifer treatment, arsenic reduction

#### **45th Street East Groundwater Recharge and Flood Control Basin**

The 45th Street East Groundwater Recharge and Flood Control Basin Project is located in the City of Palmdale and includes the construction of a new approximately 2,083 acre-feet (AF) drainage basin near 45th Street East and Avenue P-8 on property currently owned by Los Angeles World Airports. By reducing contaminated stormwater runoff and capturing peak flows, both flood control and water quality benefits would be provided. The project will also add approximately 208 acres of new wildlife habitat.

#### **Antelope Valley Watershed Surface Flow Study**

The Antelope Valley Watershed Surface Flow Study will characterize the Antelope Valley surface water flow from the San Gabriel and Tehachapi Mountains to Rosamond and Rogers Lakes. The study will determine the amount of flow in the tributaries, determine health of lakebeds, and determine how much water is required to either keep them healthy or make them healthy. The study will also determine the impacts of implementing current and future proposed water diversion/removal projects and impacts of continued retention basin development. The study will quantify potential effects of future flood management projects and consider the influence of sediment loads to the dry lake beds. By assessing the impacts of stormwater, upstream flood management projects and sediment loads both water quality and flood control benefits would be provided.

#### **Avenue Q and 20th Street East Groundwater and Flood Control Basin (Q-West Basin)**

The Q-West Basin project is located in the City of Palmdale and entails the acquisition and construction of an approximately 1,612 AF detention basin located between Avenue P-12 and Avenue Q from 20th Street East to 30th Street East. This project would create approximately 161 acres of new wildlife habitat and improve water quality as a result of reducing contaminated stormwater runoff. By capturing peak flows and reducing sediment loads, the project would provide both flood control and water quality benefits.

#### **Avenue R and Division Street Groundwater Recharge and Flood Control Basin**

The City of Palmdale proposes to construct a 950 AF basin on 93 acres located at the northeast corner of Avenue R and Division St. including all necessary and associated grading, inlet/outlet structures, spillway, and storm drain piping as part of its stormwater collection and conveyance system. The project has the ability to provide for wildlife habitat, conservation, and stormwater capture. By capturing peak flows and reducing contaminated stormwater runoff, both flood control and water quality benefits would be provided.

#### **Barrel Springs Groundwater Recharge and Flood Control Basin**

The Barrel Springs Groundwater Recharge and Flood Control Basin Project is located in the City of Palmdale and consists of construction of an 878 AF detention basin in the Barrel Springs area upstream of Old Harold Road and 25th Street East, on a 40-acre, City-owned property. The project would provide

flood control and water quality benefits for the City of Palmdale by capturing peak flows, reducing contaminated stormwater runoff and increasing soil aquifer treatment. The project will also create approximately 40 acres of habitat.

### **Big Rock Creek In-River Spreading Grounds**

The Big Rock Creek drainage area is 23 square miles. The creek runs from the San Gabriel Mountains north into the Antelope Valley. The Los Angeles County Flood Control District (part of the LACDPW) proposes to develop a spreading ground facility near the San Gabriel Mountain foothills in order to increase groundwater recharge. The facility will include earthen levees in and adjacent to the creek to capture and recharge stormwater from the creek into the groundwater basin. By capturing peak flows, reducing contaminated stormwater runoff and increasing soil aquifer treatment, both flood control and water quality benefits would be provided.

### **Hunt Canyon Groundwater Recharge and Flood Control Basin**

The Hunt Canyon Groundwater Recharge and Flood Control Basin Project is sponsored by the City of Palmdale and entails construction of a new 3,000 AF detention/ recharge basin, located south of Pearblossom Highway at 57th Street East. The basin would be used to store aqueduct water to allow recharge into the aquifer, and it would act as a detention basin during severe storms thus providing flood control benefits. Approximately 300 acres of new wildlife habitat would be created by construction of this project. The project would also provide water quality benefits by reducing contaminated stormwater runoff.

### **Littlerock Creek In-River Spreading Grounds**

The Littlerock Creek In-River Spreading Grounds is sponsored by LACDPW and consists of a spreading ground facility near the San Gabriel Mountain foothills in order to increase groundwater recharge. The facility will include earthen levees in and adjacent to the creek to capture and recharge stormwater from the creek into the groundwater basin. Developing an in-stream groundwater recharge facility will increase groundwater recharge by an estimated 7,600 AF per wet-year. This project will improve the health and long-term sustainability of the basin, increase local groundwater supplies, reduce the Region's reliance on water imports, and provide flood control and water quality benefits.

### **Littlerock Creek Groundwater Recharge and Recovery Project**

The Littlerock Creek Groundwater Recharge and Recovery Project (LCGRRP) is sponsored by Palmdale Water District and involves groundwater recharge using imported water, local stormwater runoff, and recycled water from the Palmdale WRP. The Littlerock Creek Groundwater Recharge and Recovery Project would be a run-of river recharge project, utilizing the existing active natural channel system and a series of shallow recharge basins in the adjacent floodplain to recharge State Water Project water, stormwater, and recycled water. The recharge and recovery capacities of the project are projected to be about 43,000 AF per year (AFY) and 14,000 AFY, respectively. Preliminary groundwater modeling studies have demonstrated that the LCGRRP will substantially reduce drawdown of the aquifer in the Palmdale Water District's service area and in areas surrounding the project. The recharge project will provide flood control and water quality benefits by capturing peak flows, reducing contaminated stormwater runoff and increasing soil aquifer treatment.

### **Littlerock Dam Sediment Removal**

The Littlerock Dam Sediment Removal Project will remove up to 900,000 cubic yards of sediment that has been accumulated from runoff into Littlerock Reservoir, and up to 40,000 cubic yards on an annual basis after the initial sediment is removed. The project would provide water quality and flood control benefits by reducing sediment and increasing peak flow capture during certain times of year. The project

also includes a grade control structure that will protect the identified habitat of the endangered Arroyo toad.

### **Lower Amargosa Creek Recharge Project**

The Lower Amargosa Creek Recharge Project is located in City of Palmdale and consists of development of in-stream recharge of water from the State Water Project blended with recycled water. The project would provide more than 1,000 AF of detention basin. The detention basin will capture peak flows, reduce contaminated stormwater runoff and increase soil aquifer treatment, providing flood control and water quality benefits.

### **Stormwater Harvesting**

The Stormwater Harvesting Project includes the construction of stormwater collection and conveyance facilities, water filtration devices, and cisterns and collection tanks. Through advanced filtration methods, this project can be expanded to create potable water for residential uses. Once fully implemented, it is estimated that water conservation of up to 25 AFY could be realized. The project will provide flood control and water quality benefits by capturing peak flows and reducing urban runoff loading.

### **Upper Amargosa Creek Flood Control, Recharge, and Habitat Restoration Project**

This project's proposed improvements include: expanding the size and capacity of the natural recharge area; developing and preserving an ephemeral stream habitat; channelization of Amargosa Creek (soft bottom); and providing a grade separation of 20th Street West over Amargosa Creek. The project will increase capture of 14,600 to 53,600 AFY and provide 20 acres of flood protection capacity. The project will also create 25 acres of open space/habitat. By capturing peak flows, providing channel stabilization, reducing stormwater runoff and increasing soil aquifer treatment, flood control and water quality benefits will be provided.

### 3 Potential Opportunities, Constraints, and IFM Strategies

The characteristics of the region provide background into understanding the potential opportunities as well as constraints for developing IFM solutions for the Region. Flood management projects are planned and implemented to reduce risk to public safety and property while maximizing other benefits like water supply and environmental restoration. For every “problem”, which can be thought of as an undesirable condition, there are “opportunities” that offer chances for improvement and “constraints” that limit implementation. The Antelope Valley includes flat valleys with numerous alluvial fans that have urban development surrounded by rainfall-collecting steep terrain. The geographic as well as meteorologic conditions are conducive to sudden flooding. The semi-arid climate, wherein total rainfall is typically concentrated in a few short months, adds to the uncertainty of flood prediction. In addition, the unique issues associated with the watershed conditions limit the application of conventional flood management solutions. The Region’s flood management opportunities/constraints may be divided into four major categories: (1) physical conditions, (2) regulatory, (3) land-use, and (4) environmental/biological.

#### 3.1 Valley Opportunities and Constraints

##### Physical

Different physical features define the types of flooding issues since they greatly influence the response of the watershed. The nature of the flooding created by the topography also results in different constraints and limits the ability to apply different conventional solutions for flood hazard mitigation.

**Table 3-1: Physical Flood Management Opportunities and Constraints**

Opportunity/Constraint	Relevance
Closed watershed system with no outlet to the ocean such that stormwater is recharged in foothills or evaporated from dry lakebeds	<ul style="list-style-type: none"> <li>Limits suitable locations for recharge</li> <li>Planning is difficult because watershed has a unique response relative to rainfall events that is difficult to predict</li> </ul>
Existing roadway and utility crossings create hydraulic conveyance limitations (e.g., California aqueduct, Highway 14, etc.)	<ul style="list-style-type: none"> <li>Hydraulic limitations represent potential target areas for fixes that may reduce flooding and sedimentation</li> </ul>
Existing facilities and structures are located within the floodplain	<ul style="list-style-type: none"> <li>Need to define existing flood risk from existing facilities/uses within the floodplain</li> </ul>
Sediment delivery occurs with flood flows from foothill areas	<ul style="list-style-type: none"> <li>Excessive sediment delivery causes deposition at downstream locations with flatter slopes</li> <li>High sediment yields “bulk” the flood waters and increase depth of flooding</li> </ul>
Limited topographic relief/slope that limits hydraulic conveyance	<ul style="list-style-type: none"> <li>Conveyance channel sizes will increase further downstream within the watershed because of reduced slopes</li> </ul>
Soils/geology are primarily alluvial deposits that are highly erodible	<ul style="list-style-type: none"> <li>Channel migration routinely occurs</li> <li>Erosion hazards for development adjacent to channels</li> </ul>

Specialized geographic/geomorphic features which include alluvial fans, bajadas, and playas	<ul style="list-style-type: none"> <li>Hydraulic conditions are unique (i.e., as compared to riverine systems) and conventional flood management solutions are not applicable</li> </ul>
Topographic features result in steep slopes in the mountains/foothills and extremely flat slopes on the valley floors	<ul style="list-style-type: none"> <li>Changes in hydraulic conveyance and sediment delivery because of the change in slopes</li> </ul>

### Regulatory

The existing regulations related to floodplain management and flood control influence the existing level of flood protection provided to the community.

**Table 3-2: Regulatory Flood Management Opportunities and Constraints**

Opportunity / Constraint	Reference
No regional flood agencies exist other than LA & Kern Counties	<ul style="list-style-type: none"> <li>Flooding problems within Antelope Valley are unique to the valley and different from the coastal areas which are influenced primarily by riverine flood sources</li> <li>Comprehensive master plan required that reflects the regional and integrated thought process for flood management and environmental considerations</li> </ul>
FEMA/NFIP requirements for community floodplain regulations apply	<ul style="list-style-type: none"> <li>NFIP requirements have the most influence on floodplain restrictions</li> </ul>
No specialized design standards for desert drainage or flood protection/flood management	<ul style="list-style-type: none"> <li>Different standards are required for the valley types of flood hazards and the potential available solutions</li> <li>Specialized manual of criteria and standards should be developed for desert drainage which encompasses the hydrology, sediment/erosion, and unique hydraulic conditions (based on design work in similar desert areas of the Southwest)</li> </ul>
Accuracy of flood hazard mapping for valley floor and alluvial fans has uncertainty	<ul style="list-style-type: none"> <li>Flooding and sedimentation on alluvial fans are complex processes that are difficult to simulate numerically (model)</li> <li>Alluvial fan flooding presents unique problems in terms of quantifying flood hazards, assessing sediment transport characteristics, devising reliable flood protection schemes, and evaluating impacts of various projects on flow and sediment dynamics</li> </ul>
Water quality limitations and restrictions are based on the Basin Plan and identified TMDLs	<ul style="list-style-type: none"> <li>Water quality restrictions should be implemented as part of the regional planning solution</li> </ul>

### Land Use

Existing land use and future proposed development should be closely coordinated with the existing mapped flood hazards. Land use restrictions are one of the primary tools for floodplain management in order to reduce flood risks.

**Table 3-3: Land Use Management Opportunities and Constraints**

Opportunity/Constraint	Relevance
Various urban/commercial land use and additional manmade encroachments are located within the floodplain	<ul style="list-style-type: none"><li>• Limitations of development and land use restrictions are needed within active flood hazard zones</li></ul>

### Environmental/Biological

Existing biological resources within the floodplain corridor present an opportunity to integrate the preservation of these resources into regional planning efforts. However, these resources can also represent constraints in terms of the types of solutions that can be used for flood mitigation and in terms of higher costs.

**Table 3-4: Environmental/Biological Flood Management Opportunities and Constraints**

Opportunity/Constraint	Relevance
Environmental permitting limitations for activities/structures within the floodplain (i.e., endangered species)	<ul style="list-style-type: none"><li>• Additional costs and/or limitations on the potential solutions available</li></ul>
An Antelope Valley Significant Ecological Area (SEA) is located within the central portion of the Antelope Valley, primarily east of the cities of Palmdale and Lancaster; it includes the tributary creeks to Little Rock and Big Rock Creeks (partially within U.S. Forest Service land) downstream to the valley floor and northward across the historic floodplain zones to Rosamond, Buckhorn, and Rogers dry lakes on the Los Angeles/Kern County boundary	<ul style="list-style-type: none"><li>• Existing floodplains and streams, particularly inside the SEA, are valuable biological resources</li></ul>

## **3.2 Potential IFM Strategies**

Commonly-utilized IFM strategies that are applicable to Antelope Valley are presented below.



**Strategy Application No.1 - Watershed Management Planning****IFM Objectives / Principles:**

- Land use planning
- LID policies
- Natural resource preservation
- Sustainable development
- Water quality
- Runoff management

**Description of Representative Actions / Elements:**

Apply core underlying watershed management planning guidelines in developing the proposed strategies and infrastructure for future development. These guidelines would ensure that development (i) mimics existing runoff and infiltration patterns within the project area, (ii) does not exacerbate peak flow rates or water volumes within or downstream of the project area, (iii) maintains the geomorphic structure of the major tributaries within the project area, (iv) maintains coarse sediment yields, storage and transport processes, (v) uses a variety of strategies and programs to protect water quality, and (vi) acknowledges downstream beneficial uses. The principles refine the planning framework and identify key physical and biological processes and resources at both the watershed and sub-basin level. The Watershed Planning Principles focus also on the fundamental hydrologic and geomorphic processes of the overall watersheds and of the sub-basins. These principles can be utilized to guide the initial planning of the development program relative to watershed resources and to minimize impacts thereto through careful planning by integrating the initial baseline technical watershed assessments. Non-structural watershed protection planning principles would include minimization of impervious areas/preservation of open spaces and dependent natural habitats, prioritization of soils for development and infiltration, and establishment of riparian buffer zones. Examples of watershed planning principles that can be used include:

*Principle 1 – Recognize and account for the hydrologic response of different terrains at the sub-basin and watershed scale.*

*Principle 2 – Emulate, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground cover.*

*Principle 3 – Address potential effects of future land use changes on hydrology.*

*Principle 4 – Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks and important creek tributaries.*

*Principle 5 – Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains.*

*Principle 6 – Maintain coarse sediment yields, storage and transport processes.*

*Principle 7 – Protect water quality by using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas and application of Best Management Practices within development areas to assure comprehensive water quality treatment prior to the discharge of urban runoff into the floodplain corridor*

**Potential Benefits:**

- Integrated land planning process with watershed functions
- Managed runoff from development and commercial watershed activities
- Maintain natural runoff process
- Minimize long term maintenance costs within floodplain
- Protect downstream beneficial natural biological processes

**Strategy Application No.2- Floodplain Management****IFM Objectives / Principles:**

- Integrated land use planning
- Natural floodplain corridor preservation
- Sediment management / stream stability
- Natural streambed groundwater recharge

**Description of Representative Actions / Elements:**

Facilitating improved alignment and coordination between land use and flood management would result in better understanding of flood risk and potential impacts to proposed developments, as well as improved decision making. Specifically, flood risk information has the potential to influence land use policy decisions related to developing and expanding communities within a floodplain, which would result in reductions to flood damage claims and long-term O&M costs on projects. At the planning stage, additional measures might be incorporated into the initial proposed projects that could provide community benefits, such as setback areas that act as greenways or trails, and greatly reduce the need to retrofit or replace undersized infrastructure in the future. Too often, regional and land use policymakers realize flood risk and economic losses only after a damaging flood event. Some of the additional actions associated with this item include defining increased floodways to limit development along the floodplain fringe, floodplain retreat through purchase of properties within the floodplain, and ensuring that different land uses are compatible with the floodplain risks.

**Potential Multiple Water Resource Benefits:**

- Reduction in flood damage subsidies to chronic flood locations

### Strategy Application No.3 – Stream Stabilization

#### IFM Objectives / Principles:

- Sediment control
- Increased floodplain capacity
- Water quality
- Reduce negative impacts of sediment deposition downstream



#### Description of Representative Actions / Elements:

Channel erosion, with substantial stream incision, can be a large contributor of sediment to downstream receiving waters and deposition in portions of channels that reduce flood capacity. In addition, increased sediment transport will “bulk” the runoff flows in the channel and further diminish the flood conveyance capacity. Watershed based regional studies/investigations of the fluvial processes and watershed sediment yields as well as geomorphic assessments/monitoring can evaluate those critical locations within the watershed that require stabilization. Stream erosion and sedimentation adversely impact water quality beneficial uses of both the stream and the receiving waters, and sediment TMDL. Stabilization of the natural alluvial channel system to eliminate future erosion of the streambed and streambank will assist in critical channel areas as a major sediment source as well as disrupting the loss of vegetative habitat within the floodplain. Detailed streambed stability assessments provide part of the technical support for the evaluation of the benefits of and opportunities for alternative stream stabilization / restoration techniques to ensure that the natural geomorphic and fluvial processes are maintained in balance. Stream stabilization and sediment control efforts should also recognize beneficial downstream impacts of sediment transport.

#### Potential Benefits:

- Minimize maintenance in floodplains
- Reduce long term operations costs
- Reduce apparent peak discharge through reduced sediment bulking
- Reduce loss of land
- Improve recharge in streambed
- Reduce sediment deposition in riverine /estuarine habitat areas
- Recognize beneficial downstream impacts of sediment transport

**Strategy Application No. 4 – Watershed Sediment Control / Erosion Management****IFM Objectives / Principles:**

- Land use planning
- Development sustainability
- Water quality enhancement

**Description of Representative Actions / Elements:**

Soil is considered a water pollutant because it can significantly affect water used for public consumption, recreation and habitat. Therefore, the most effective way to control soil erosion is at its source. Erosion control best management practices (BMPs) are required on all land disturbance sites to provide a defense against soil erosion in addition to different commercial activities within the watershed. Watershed planning that implements different BMPs can be applied, as well as the modification of commercial activities to minimize sediment disturbances. There are also natural areas which may be de-stabilized and be a significant sediment source which require specialized treatments to reduce the amount of sediment production. Sediment control efforts should also recognize beneficial downstream impacts of sediment transport.

**Potential Benefits:**

- Receiving waters improved water quality
- Reduce flooding through reduced sediment bulking of flows
- Reduction of sediment deposition in undesirable locations within floodplain
- Recognize beneficial downstream impacts of sediment transport

**Strategy Application No.5 – Multi-Function Flood Storage / Recharge Basins****IFM Objectives / Principles:**

- Flood reduction
- Groundwater recharge
- Stormwater recycling / alternative water source

**Description of Representative Actions / Elements:**

Regional watershed evaluation and planning to provide flood peak flow attenuation through either off-channel or adjacent in-channel temporary flood volume storage. The reduction in peak flow rates will minimize downstream flooding. In addition, the stored flood runoff volumes can be recharged into the aquifer to enhance groundwater supplies. Coordination with groundwater management agencies should be performed on a watershed basis to determine the optimum location to ensure that maximum recharge can be provided to the aquifer since different areas of the watershed may not provide any benefit to groundwater supplies. Coordination of both groundwater and flood benefits is necessary as part of advance planning with multiple agencies. In addition, floodplain enlargement can result in increased habitat corridors as well as improving the in-channel flood storage capabilities.

**Potential Benefits:**

- Reduced flooding downstream



- Stormwater recycling and additional water source capture

**Strategy Application No.6 – Urban Water Quality Treatment / Retention****IFM Objectives / Principles:**

- Water reuse / recycling
- Groundwater recharge
- Natural floodplain protection
- Stream stabilization
- Water quality treatment
- Urban flood management

**Description of Representative Actions / Elements:**

Management of urban stormwater runoff and the associated water quality as well as increased runoff quantities impacting the natural floodplain corridors which result in a variety of impacts, not just increased flooding. Projects involving the capture of dry weather flows provide an opportunity to recycle this water source, often considered a waste-stream in the past

**Potential Benefits:**

- Improved water quality and reduced impacts to downstream receiving waters
- Restoration of natural floodplain functions
- Reduced impacts of urban hydromodification

**Strategy Application No. 7 – Floodplain Habitat Corridor Preservation / Buffer**

**IFM Objectives / Principles:**

- Vegetation buffer
- Habitat preservation
- Stream corridor stabilization



**Description of Representative Actions / Elements:**

Wetlands and floodplain vegetation can provide a hydrologic buffer to watershed responses through reduced velocity and increased time. The watershed vegetation can buffer the intensity of rainfall events and the corresponding watershed response, which can reduce flooding downstream. The preservation of natural vegetation reduces water flow connectivity by interrupting surface flows of water.

**Potential Benefits:**

- Reduction of streambank/streambed erosion through natural protection
- Enhanced wildlife habitat benefits
- Natural water quality biological uptake benefits

### Strategy Application No. 8 - Enhanced Floodplain Storage / Recharge

#### IFM Objectives / Principles:

- Floodplain preservation
- Flood storage / groundwater recharge
- Peak flow reduction
- Flooding reduction
- Maintenance of natural hydrologic processes



#### Description of Representative Actions / Elements:

Use of the floodplain to provide temporary in-channel storage to reduce peak flow rates downstream. The identification of potential flood storage areas within the floodplain involves integrating wetland and floodplain beneficial functions into floodplain management planning. Protection of floodplain and wetland vegetation from erosion is particularly important for high velocity areas

#### Potential Benefits:

- Enhanced groundwater supplies
- New water source
- Habitat enhancement and increased corridor width

### Strategy Application No. 9 - Coordination between programs/agencies for water management and flood management planning.

#### IFM Objectives / Principles:

- Communication between agencies within watershed
- Watershed planning guidance / regulations
- Enhanced water supplies
- Water management



#### Description of Representative Actions / Elements:

Improving coordination between regional water management and flood management planning is a key strategy to increase implementation of IFM projects. Existing planning groups and forums should be utilized to the extent possible. By coordinating water and flood management planning with balanced representation, a common understanding of flood management, water supply, water quality, environmental stewardship, public safety, and economic sustainability factors may be developed. Where possible, policy changes that promote this holistic approach to IFM should be proposed and sponsored (e.g., changes to existing IRWM legislation). In addition, coordination in the watershed planning process provides the opportunity to optimize the benefits of joint-use regional facilities to maximize water resources as well as flood mitigation benefits.

#### Potential Benefits:

- Maintaining a natural watershed response
- Increased groundwater replenishment
- Reduced flood damage
- Reduction in flood maintenance

**Strategy Application No. 10 - Watershed / floodplain information management and data exchange**

**IFM Objectives / Principles:**

- Communication between agencies within watershed
- Community involvement
- Increased watershed monitoring



**Description of Representative Actions / Elements:**

Improving the watershed database to ensure that different watershed stakeholders have access to the available information and studies being performed. The sharing and the exchange of data, information, knowledge among experts, general public, policy makers, and floodplain managers in a transparent manner is essential for comprehensive planning and effective management. Significant studies and mapping information are being developed within the watershed with single functions, but they could become a valuable regional, integrated asset if shared with other users and could help to reduce costs. Fragmentation of data is common, and providing a common data repository and manager supports the technical foundation for comprehensive planning.

**Potential Benefits:**

- Improved tracking and monitoring of watershed characteristics
- Reduction in data acquisition needs
- Enhanced community involvement in watershed, including active participation in data collection

### 3.3 Community Rating System (CRS) Participation

The National Flood Insurance Program (NFIP) Community Rating System (CRS) is a voluntary program that communities can participate in to encourage implementation of floodplain management activities that exceed the minimum NFIP standards. These minimum standards specify that communities (1) incorporate the requirements into their subdivision, zoning, and other land use ordinances or building codes or (2) adopt a separate floodplain management ordinance. The standards include the following requirements:

- Special Flood Hazard Areas (SFHAs) - development must have a permit from the community.
- V Zones - these are areas along coasts subject to inundation by the 1% annual chance flood with additional hazards associated with storm-induced waves. Development is discouraged, though not prohibited; and it is required that the lowest horizontal structural member be above the Base Flood Elevation (BFE) and be built on piles or columns or otherwise properly anchored to resist erosion. Additionally, areas below the BFE must have break away walls.

The CRS allows numerical scoring of the different floodplain management activities in addition to the above listed requirements. Scores above the minimum NFIP requirements are eligible for reductions in flood insurance premiums. CRS discounts for eligible communities on flood insurance premiums range from 5% to 45%. Those discounts provide an incentive for new flood protection activities that can help protect lives and property in the event of a flood.

Flood insurance premium rates are discounted to reward community actions that meet the three goals of the CRS: (1) reduce flood damage to property; (2) strengthen and support the insurance aspects of the NFIP; and (3) encourage a comprehensive approach to floodplain management. Based on the total

number of points earned, the CRS places a community into one of ten “Classes.” The discount on flood insurance is based on the Class. A general indication of the points required for each Class designation as well as the corresponding insurance premium reduction is illustrated in **Table 3-5**. For example, if the community earns 4,500 or more points it is placed in Class 1, and qualifying property owners in the floodplain receive a 45% discount. If a community does not apply or fails to receive at least 500 points, it is placed in Class 10, and property owners get no discount. The County of Los Angeles has been a participant in the CRS since 1991 and has qualified for a CRS Class rating of 7, for a 15% discount on flood insurance in SFHAs.

**Table 3-5: CRS Class and Insurance Premium Reduction**

Credit Points	Rate Class	Premium Reduction SFHA*	Premium Reduction Non-SFHA*
4,500+	1	45%	10%
4,000 – 4,499	2	40%	10%
3,500 – 3,999	3	35%	10%
3,000 – 3,499	4	30%	10%
2,500 – 2,999	5	25%	10%
2,000 – 2,499	6	20%	10%
1,500 – 1,999	7	15%	5%
1,000 – 1,499	8	10%	5%
500 – 999	9	5%	5%
0 – 499	10	0	0

\* SFHA = Special Flood Hazard Area

The CRS Classes are based on 19 different creditable flood management activities that are organized under four general categories which include: (1) 300-public information, (2) 400-mapping and regulations, (3) 500-flood damage reduction, and (4) 600-flood preparedness. Credit points are assigned to the different activities as shown in Table 3-6 based upon the extent to which an activity advances the three goals of the CRS. A given community can choose to undertake some or all of the 19 different CRS activities, but the community is required do Activity 310, *Elevation Certificate*, at a minimum; and if the community has designated repetitive losses then it must also do Activity 510, *Floodplain Management Planning*. All the other activities are optional.

Section 401 of the *Coordinator’s Manual* is important relative to the specific flood hazards in the Antelope Valley because this section discusses the additional credits for mapping “special flood hazards,” recognizing that the mapping and regulatory standards of the NFIP do not adequately address all flood problems. Communities may receive credits for mapping, preserving open space, and regulating new development in areas subject to the following seven special flood-related hazards: (1) uncertain flow paths, (2) closed basin lakes, (3) ice jams, (4) land subsidence, (5) mudflow hazards, (6) coastal erosion, and (7) tsunamis. Locally, the Antelope Valley is subject to the hazard of “uncertain flow paths” due to the existence of alluvial fans in the Region. Table 3-6 indicates the CRS activities and the potential points that may be awarded for implementing these activities.



Table 3-6: CRS Activities and Points Awarded

Activity	Maximum Possible Points <sup>1</sup>	Maximum Points Earned <sup>2</sup>	Average Points Earned	Percentage of Communities Credited
<b>300 Public Information Activities</b>				
310 Elevation Certificates	116	116	46	100%
320 Map Information Service	90	70	63	93%
330 Outreach Projects	350	175	63	90%
340 Hazard Disclosure	80	57	14	68%
350 Flood Protection Information	125	98	33	92%
360 Flood Protection Assistance	110	65	49	41%
370 Flood Insurance Promotion	110	0	0	0%
<b>400 Mapping and Regulations</b>				
410 Floodplain Mapping	802	585	65	50%
420 Open Space Preservation	2,020	1,548	474	68%
430 Higher Regulatory Standards	2,042	784	214	98%
440 Flood Data Maintenance	222	171	54	87%
450 Stormwater Management	755	540	119	83%
<b>500 Flood Damage Reduction Activities</b>				
510 Floodplain Mgmt. Planning	622	273	123	43%
520 Acquisition and Relocation	1,900	1,701	136	23%
530 Flood Protection	1,600	632	52	11%
540 Drainage System Maintenance	570	449	214	78%
<b>600 Flood Preparedness Activities</b>				
610 Flood Warning and Response	395	353	144	37%
620 Levees	235	0	0	0%
630 Dams	160	0	0	0%

<sup>1</sup> The maximum possible points are based on the 2013 Coordinator's Manual

<sup>2</sup> The maximum points earned are converted to the 2013 Coordinator's Manual from the highest credits attained by a community as of October 1, 2011. Growth adjustments and new credits for 2013 are not included.

### 3.3.1 Cost and Benefits for Participation in CRS

Although there is no fee charged to apply for participation in the CRS, the community still incurs costs. These costs are associated with implementing creditable floodplain management activities and the staff time needed to document those activities. The costs also include staff time to prepare for and participate in the recertification process and verification visits. These are not insignificant costs. The implementation costs should be evaluated and compared to the benefits achieved through reducing the class rating and the corresponding reduced insurance rates. Few, if any, of the CRS activities will produce premium reductions equal to or greater than the cost of their implementation. In considering whether to undertake a new floodplain management activity, a community must consider all of the benefits the activity will provide (not just insurance premium reductions) in order to determine whether it is worth implementing.

Potential benefits of participation in CRS include:

- Reduction in flood insurance premiums for residents and businesses; the dollar savings varies according to the CRS class, the number of policies, and the amount of coverage.

- Enhanced public safety, reduction in damage to property and public infrastructure, avoidance of economic disruption and losses, reduction in human suffering, and protection of the environment provided by the credited activities.
- Opportunity to evaluate the effectiveness of a community's flood program against state and nationally recognized benchmarks.
- Opportunity to get training and technical assistance in designing and implementing credited flood protection activities.
- Initiation of new public information activities; these activities to build a knowledgeable constituency within the community.
- Development of an effective motivator to continue implementing flood protection programs during the "dry years."
- Mutual support among participating CRS communities.

## 4 Conclusions and Recommendations

It is clear from the discussions that precede this section that an IFM approach could be implemented in the Antelope Valley that would not only reduce flooding, but improve water quality and increase water supply. A general framework for the application of an IFM approach throughout the Antelope Valley that will maximize water resources benefits is summarized below and more specific recommendations follow.

1. **Increase collaboration/communication between agencies responsible for municipal and regional floodplain management**
  - Develop framework and process for different levels of communication between floodplain managers
  - Provide regional working forum (*Watershed/Floodplain Managers Forum*) for agencies and local government that allows increased collaboration with regular meetings
  - Provide basis for a regional work-group forum of floodplain managers and watershed stakeholders that allows increased collaboration with regular meetings. Utilize existing industry forums or planning groups, such as the Floodplain Managers Association, to establish these initial working groups.
2. **Improve understanding and accuracy of regional and local flood risks on a watershed basis**
  - Develop understanding of the different types of flooding from both regional and local levels and examine specific flood problems (i.e., inventory common “hot spots” with chronic problems)
  - Provide methodology to define the magnitude of flood risks; this will better prioritize the level of flood risk and potential flood damage
  - Review common recurring flood damage losses and evaluate the sources of these flood problems
3. **Develop regional watershed database to assist in flood management planning that will provide a data exchange of information for all watershed stakeholders**
  - Ensure that different watershed stakeholders have access to the available information and studies being performed
  - Develop community-based watershed groups to provide monitoring of floodplains and reduce costs of performing these services while increasing the active field database
  - Collect and compile watershed mapping information related to flood hazards and watershed information in a GIS format
  - Develop an updated GIS database of the existing flood control and flood management infrastructure
4. **Develop an inclusive “watershed based” planning strategy, which includes collaboration with all stakeholder groups, to minimize conflicts and define specific watershed goals**
  - Develop understanding of the different priority goals of the watershed stakeholders based on the common recurring flooding issues/problems/hazards, not necessarily based on institutional or political boundaries
  - Involve environmental groups and other agencies (e.g., Edwards Air Force Base) in the planning process

**5. Initiate understanding and awareness of IFM**

- Prepare educational material and information on the background of IFM to foster a better understanding of the approach
- Provide examples of IFM projects to assist in understanding
- Provide information to stakeholders to ensure an understanding of watershed processes from the top of the watershed to the bottom.

**6. Identify applicable IFM strategies that may be implemented on a watershed basis**

- Define common types of IFM strategies which integrate different planning principles on different scales (1) watershed level, (2) city level, and (3) neighborhood/local level
- Develop regional mapping of both opportunities and constraints related to IFM
- Develop a specialized GIS based tool which defines the locations of IFM projects at a regional scale, illustrates multiple benefits, and provides a method for prioritizing flood management projects

**7. Develop a watershed planning guidance program for implementing IFM through different land planning regulations**

- Develop a watershed planning process framework with key planning principles for implementing IFM that focuses on linking sustainability, water resource management, and land use planning to flood management
- Prepare guidance on integrating “land use planning” as a central element of IFM and explain how it can be utilized for different types of floodplain hazard issues
- Develop an overall guidance document that provides stakeholders with the basis for watershed planning with IFM

## **4.1 Recommended Stakeholder Collaboration**

The Antelope Valley is unique with regard to floodplain management administration since there are multiple county jurisdictions as well as federal lands (i.e., EAFB and Air Force Plant 42). There are a variety of stakeholders, such as the local cities and other agencies, which are directly involved with implementation of floodplain management policies. The fragmentation of floodplain management responsibility makes watershed scale planning more difficult. It is recommended that a Watershed/Floodplain Managers Forum be established that promotes collaboration with the floodplain managers and with the other water resource agencies. The current work group (i.e., the Flood Committee) established as part of the 2013 IRWMP Updates can be utilized as the initial framework for the forum. This forum would assist in defining the framework and process for different levels of communication of the different levels of flood managers and watershed stakeholders. The process will define different strategies and media for communication; it will also disseminate information about planning and management activities. In addition, the forum can engage the managers and stakeholders with workshops in order to encourage participation in the plan development and execution. This working forum is a critical element that should continue into the future after the initial plan structure has been developed. It can be used as a regular vehicle for communication and collaboration to ensure effective watershed planning and execution.

## **4.2 Recommendations for CRS Participation**

Local communities and other watershed stakeholders in the Antelope Valley can become involved in the CRS program. The County of Los Angeles is already a participant, so many of the regional floodplain

management elements are being administered through that agency. The CRS activities and program that the county has developed can be utilized to implement more specific activities that focus directly on the needs of the Antelope Valley. The following are recommendations for participating in CRS activities, based on achieving the maximum benefit to cost ratio in terms of the highest CRS points rating:

#### **Initial Activities:**

- Obtain and review the CRS documentation that Los Angeles County has developed as part their community program in the four different categories. Utilize these activities already performed by the county as a guide and foundation to build upon.
- Contact Los Angeles County and the cities of Lancaster, Palmdale, Rosamond, and Mojave to see what CRS activities, if any, are already being implemented.
- Investigate the approximate rating of the community as the scoring baseline to help quantify the benefits from additional flood management activities. A simple way to determine whether the Antelope Valley qualifies for a Class 9 credit (500 credit points) is the CRS “Quick Check,” an excel spreadsheet. By using the Quick Check spreadsheet, a community can estimate its potential CRS credit. The Quick Check uses average credits at the element level. It can be found at [www.CRSresources.org/200](http://www.CRSresources.org/200). (The CRS Quick Check spreadsheet is attached to this technical memo for reference)
- Assess “gaps” where additional items could easily be implemented using the Quick Check as an initial inventory of the floodplain management program activities
- Determine if there are any repetitive loss properties within their communities. As a basic requirement for joining the CRS, communities with properties that have received repeated flood insurance claims payments must map the areas affected, and communities with 10 or more properties must prepare, adopt, and implement a plan to reduce damage in repetitive loss areas. These steps are presented below:
  - Review and describe its repetitive loss problems
  - Prepare a map of the repetitive loss area(s)
  - Undertake an annual outreach project to the repetitive loss area(s) and submit a copy of the outreach project with each year’s recertification
  - Prepare a floodplain management plan for its repetitive loss area(s)
- Develop a Floodplain Management Plan (FMP) that assesses the flooding hazards, summarizes previous and current management programs, describes potential mitigation strategies, and presents a plan for future action. It is also intended to address concerns with Repetitive Loss (RL) properties. This is a significant work effort to develop this planning document and could result in substantial costs.

#### **Public Information (300 series) Activities:**

- Prepare public information brochures that cover the following flood protection topics:
  - Causes and extent of flooding
  - What is being done about flooding
  - What to do during a flood
  - How people can protect their homes
  - Flood insurance
  - Taking care of drainage ways
- Establish a public information outreach strategy team. It need not be a formal organization. The team must have at least three members. At least one team member must be someone familiar with the community’s floodplain management program, such as the CRS Coordinator. At least one member must be a representative from outside community government. This could be someone



from the public schools, a neighborhood association, the Red Cross, insurance agencies, utilities, or other offices involved in education or floodplain management.

- Provide the library and other offices with a list of appropriate flood protection references, government publications, internet websites, and maps. The list should include ordering or contact information for each item.
- Prepare news releases and news articles on flood protection measures and the progress of implementing flood management activities for the local newspapers at least once every quarter.
- Prepare a homeowner's property protection manual and make available for interested residents and businesses.
- Hold public outreach meetings with selected groups, including schools and teachers, to help members become familiar with flooding, flood protection measures, natural floodplain and wetland functions, and community services.
- Develop public education campaigns and materials to improve preparedness and awareness; and cooperate with local educational institutions, hospitals, media outlets, and libraries in distributing these materials.
- Meet with the local chapter of the Association of Realtors® to discuss and promote greater understanding of flood risks, flood insurance, available resources, and the importance of disclosing flood risk information to prospective renters and buyers.
- Inform and assist property owners who want to protect themselves from flooding.
  - Provide flood elevation, flood zone, and dam inundation information to inquirers.
  - Conduct site visits to review flooding and drainage problems, and provide advice to owners.

#### **Mapping and Regulations (400 series) Activities**

- Perform more detailed floodplain mapping studies of the major washes, particularly the alluvial fans, to provide a more detailed assessment of the flooding patterns. In particular, the alluvial fans result in unconfined flows which require specialized hydraulic models in order to evaluate the distribution or spread of flows. Provide improved floodplain mapping study beyond the minimum performed through the FEMA Flood Insurance Study (FIS).
- Adjust the General Plan to preserve more of the active floodplain or flood hazard areas as open space or park area. Review the different allowed land uses within the flood hazard areas and consider modifying some of these uses to restrict development within the floodplain where appropriate.

#### **Flood Damage Reduction (500 series) Activities**

- Develop program to annually or more frequently inspect channels to prevent the deposition of debris.
- Develop ordinance to prevent the dumping of debris within mapped floodplains.

#### **Flood Preparedness (600 series) Activities**

- Assist the County to establish an ongoing program to add new gages to the County's ALERT system each year. For maximum credit under the NFIP CRS, a community must have at least one stream gage for each major developed drainage basin or one gage for every 10 square miles.
- Encourage active participation of all municipalities in a countywide system to improve the overall effectiveness of flood warning in this portion of the County.
- Tie flood response actions in the Emergency Operations Plan to flood stages.
- Conduct quarterly drills to test Emergency Operations Center Activation procedures.

- Develop emergency operations and mitigation plans for each critical facility. These plans should identify tasks to be implemented by the facilities, the amount of warning time needed to complete operational and mitigation tasks, and the resources necessary to complete their assigned missions.

## 4.3 Recommendations for Flood Control and Stormwater Quality Projects

Potential planned flood control and water quality projects that could be implemented are summarized in Table 4-1 and are described in detail following the table. Many of the techniques and BMPs have demonstrated not only water quality improvements, but also documented reductions of flood flows in Los Angeles County.

**Table 4-1: Potential Projects that could Provide Flood Control and Stormwater Quality Benefits**

Project Description	Potential Proponents	Potential Benefits
<b>Stormwater BMPs</b> Types of projects include: <ul style="list-style-type: none"> <li>• Alternative Turnarounds</li> <li>• Conservation Easements</li> <li>• Eliminating Curbs and Gutters</li> <li>• Green Parking</li> <li>• Green Roofs</li> <li>• Regional Infrastructure Planning</li> <li>• Low Impact Development (LID) – see below</li> <li>• Open Space Design</li> <li>• Protection of Natural Features</li> <li>• Redevelopment</li> <li>• Riparian/Forested Buffer</li> <li>• Street Medians</li> </ul>	Counties Municipalities Water Purveyors Water Retailer Advocacy groups	Flood: peak flow reduction  Quality: sedimentation, urban runoff loading reduction
<b>Low Impact Development (LID)</b> Type of projects include: <ul style="list-style-type: none"> <li>• Bioretention Cells</li> <li>• Rain Gardens</li> <li>• Tree Boxes</li> <li>• Cisterns And Rain Barrels</li> <li>• Green Roofs</li> <li>• Permeable And Porous Pavement</li> <li>• Grass Swales</li> <li>• Depression Grading</li> <li>• Sidewalk Storage</li> <li>• Soil Amendments</li> <li>• Gutter Disconnections (retrofit)</li> </ul>	Counties Municipalities Water Purveyors Water Retailer Advocacy groups	Flood: peak flow reduction  Quality: sedimentation, urban runoff loading reduction

### **Stormwater Best Management Practices**

The Cities and towns of Lancaster, Palmdale, Littlerock, Pearlblossom and Quartz Hill each have an existing SWMP. Depending on the size of the development, new development and redevelopment projects require the implementation of the most effective combination of BMPs for stormwater/urban runoff pollution control.

BMPs address the increased volume and rate of runoff from impervious surfaces, and the concentration of pollutants in the runoff. BMPs can include site design, source control and structural BMPs such as

infiltration devices, ponds, filters and constructed wetlands. Site design and maintenance programs such as LID practices preserve/recreate natural landscape features or minimize effective imperviousness and management measures such as maintenance practices, street sweeping, public education and outreach programs. Examples of BMPs projects include:

- Alternative Turnarounds
- Conservation Easements
- Eliminating Curbs and Gutters
- Green Parking
- Green Roofs
- Regional Infrastructure Planning
- Low Impact Development (LID) – see next section
- Open Space Design
- Protection of Natural Features
- Redevelopment
- Riparian/Forested Buffer
- Street Design and Patterns

### **Low Impact Development**

Low impact development (LID) is an approach to managing stormwater and urban runoff at the source. LID allows stormwater to be captured, filtered onsite, infiltrated into the ground or be reused for landscaping. For new development and redevelopment projects in the Cities of Lancaster, Palmdale, Littlerock, Pearlblossom and Quartz Hill, LID projects can be implemented for stormwater/urban runoff pollution control. LID includes non-structural BMPs which are practices to preserve/recreate natural landscape features or minimize effective imperviousness and management measures such as maintenance practices, street sweeping, public education and outreach programs. Examples of LID projects include:

- Bioretention cells
- Rain Gardens
- Tree boxes
- Cisterns and Rain Barrels
- Green roofs
- Permeable and porous pavement
- Grass swales
- Depression grading
- Sidewalk storage
- Soil Amendments
- Gutter disconnections (retrofit)

A specific example of a successful LID program is the Stormwater Infiltration Retrofit Pilot Program sponsored by Orange County Coastkeeper, a nonprofit clean water organization in Orange County. This Pilot Program converted 10 individual residential parcels into LID demonstrations to reduce water pollution and conserve water. The total stormwater capture capacity for the program was about 15,700 gallons per year.

Page Intentionally Left Blank