Upper Santa Ana River Watershed

Integrated Regional Water Management Plan





November 2007

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1 Introduction

1.1 Background

In 2005, the Upper Santa Ana Water Resources Association (Association) members met and agreed to develop an Integrated Regional Water Management Plan (IRWM Plan) to address water management issues for the communities of the Upper Santa Ana River (SAR) watershed. The Association is composed of agencies in the Upper SAR watershed that share a common concern for the region's water resources. The list of Association member agencies is presented in Appendix D. San Bernardino Valley Municipal Water District (Valley District), a major regional water agency, agreed to lead the planning effort and applied for and received a grant from the California Department of Water Resources (DWR) to prepare this plan. An objective of developing the proposed IRWM Plan is to identify, define, and establish strategies to capitalize on all water management opportunities that are present today or may become available in the region in the future. With careful and thoughtful integrated planning, the participation of water managers and stakeholders, and the development of robust water management strategies and implementation tools, the region's water entities can improve their water supply reliability and self-reliance for future water supplies. Implementation of the IRWM Plan will help the fast-growing region, which is dependent upon the San Bernardino Basin and imported water from the State Water Project (SWP) to reduce its dependence on imported water, while providing reliable, good quality water for economic growth and enhancing the wellbeing of the residents of the Upper SAR region.

1.1.1 Overview of Plan Area

1.1.1.1 Santa Ana River Watershed

The Santa Ana River System originates high in the San Bernardino Mountains. (Photo by Ryan Gilmore).

The SAR is the largest stream system in Southern California. It begins high in the San Bernardino Mountains where snowmelt and rainfall flow more than 100 miles southwesterly to

discharge into the Pacific Ocean between Newport Beach and Huntington Beach. The SAR watershed covers over 2,650 square miles of urban, rural, agricultural, and forested terrain and the more populated urban areas of San Bernardino, Riverside, and Orange Counties, as well as a small portion of Los Angeles County. Figure 1-1 depicts the SAR watershed and its relationship to the IRWM Plan Area.

The IRWM Plan Area is the Upper SAR watershed and encompasses Big Bear Lake and the headwaters of the SAR until it reaches the Riverside Narrows and includes the cities and communities of San Bernardino, Yucaipa, Redlands, Beaumont, Cherry Valley, Calimesa, Highland, Rialto, Colton, Fontana, Grand Terrace, and Loma Linda. Figure 1-2 shows the region. The region covers 824 square miles, approximately 32 percent of the total SAR watershed, and is located in San Bernardino and Riverside Counties. The climate in the region is characterized by relatively hot, dry summers and cool winters with intermittent precipitation.

There are numerous tributaries that contribute flow to the main stem of the SAR in the Plan Area including Bear Creek, Keller Creek, Plunge Creek, Mill Creek, San Timoteo Creek, Yucaipa Creek and Mission Zanja Creek (tributaries to San Timoteo Creek), City Creek, East Twin Creek (a tributary to City Creek), Lytle Creek, Cajon Wash (a tributary to Lytle Creek), and Warm Creek (a tributary to Lytle Creek) (see Figure 1-2).

Figure 1-1
Santa Ana River Watershed

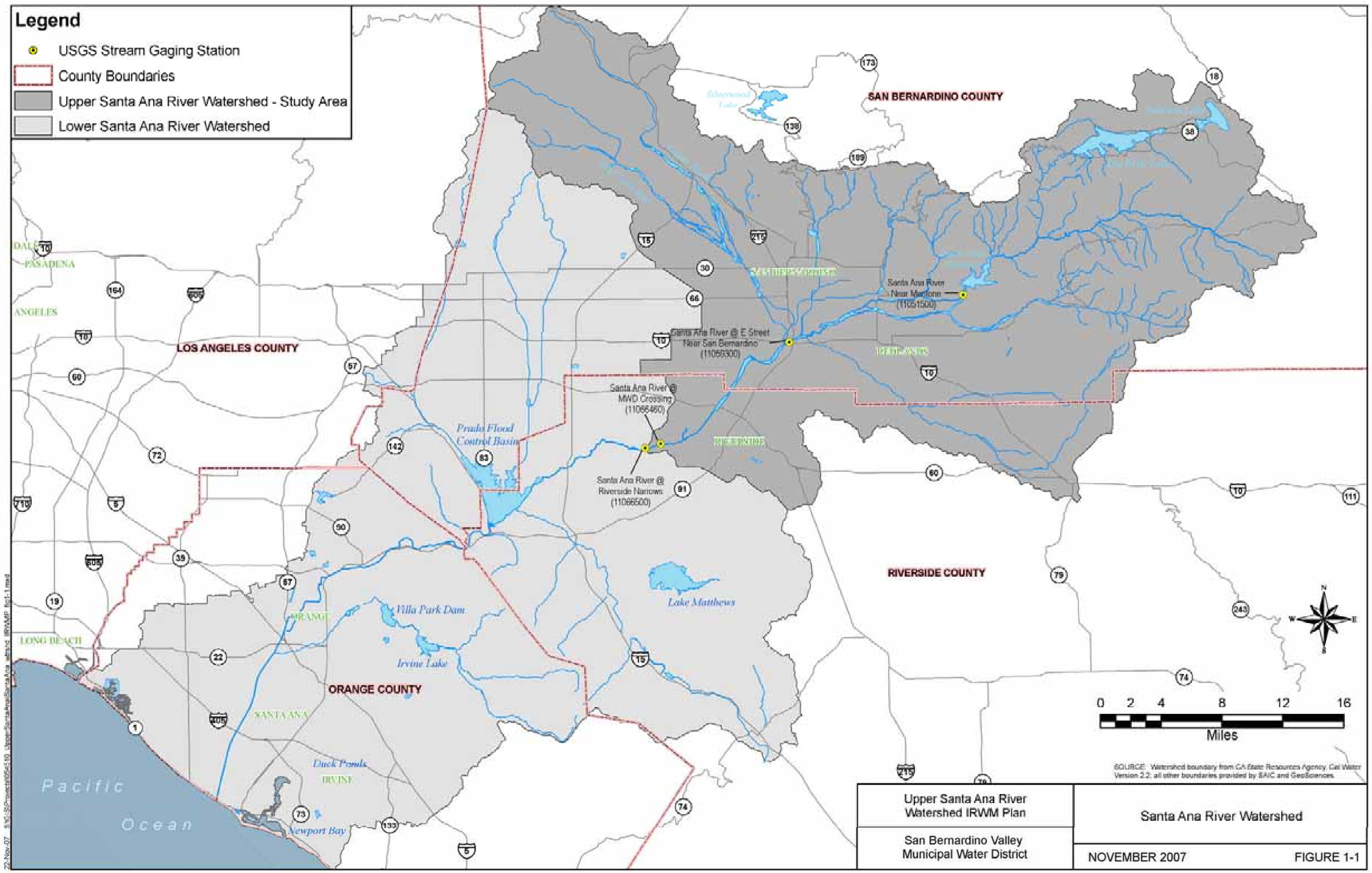
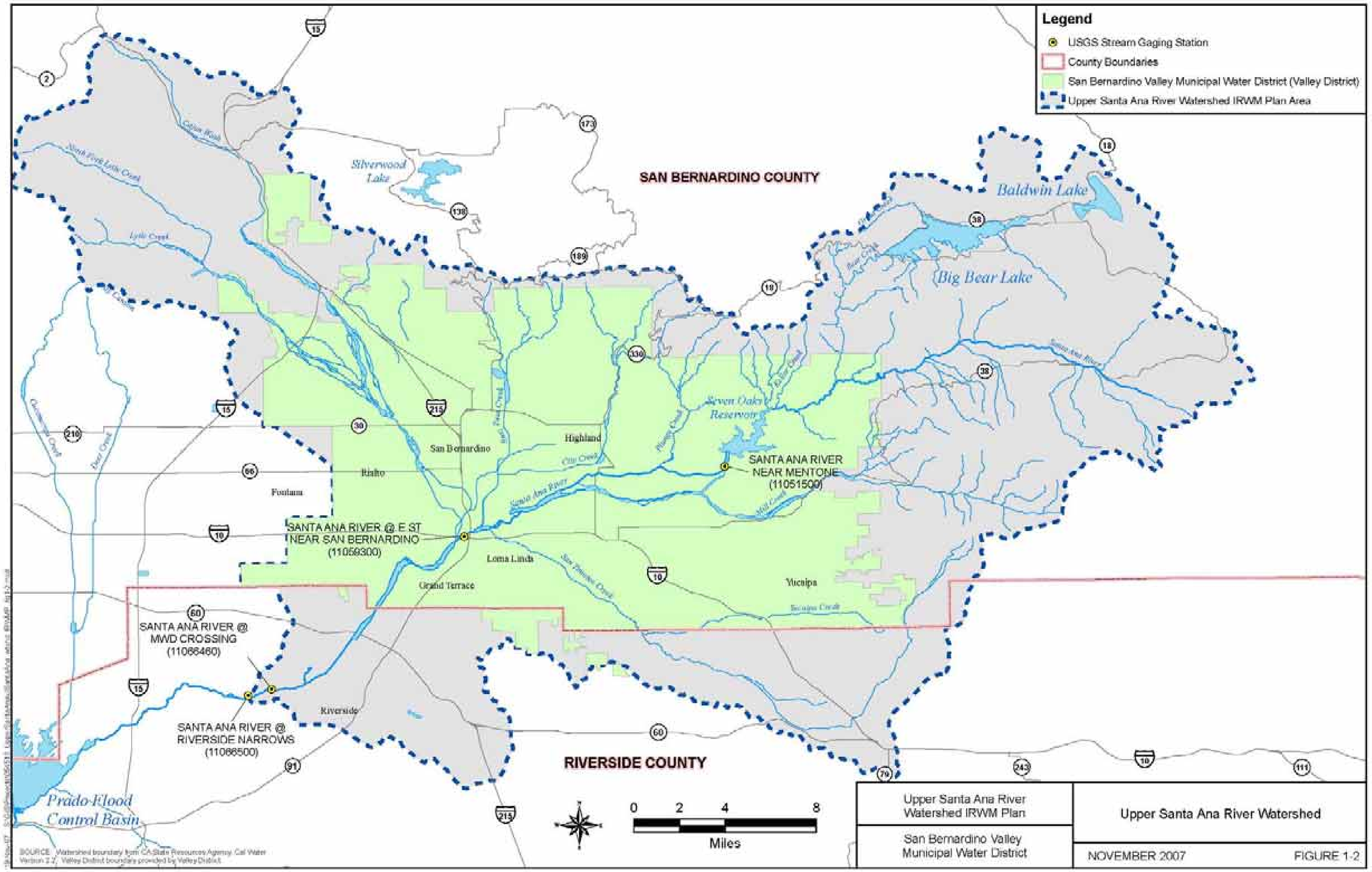


Figure 1-2
Upper Santa Ana River Watershed



1.2 Integrated Regional Water Management Plan

Management of water resources in the region takes place within a complex legal and institutional framework. Development of the IRWM Plan, a comprehensive and coordinated regional water management plan for the Upper SAR, involves the cooperation of many parties interested in water management, including water purveyors in the region. The development of an IRWM Plan is initiated by encouraging all stakeholders to participate in the planning process. The planning process includes stakeholder participation; consideration of historic plans; and compliance with institutional constraints, orders, accords, and government laws and judgments.

In 2005, nine members of the Association met and formed a Regional Water Management Group for the purpose of developing an IRWM Plan. The Regional Water Management Group is now called the Technical Advisory Group (TAG), with the regional lead agency, Valley District, coordinating development of the IRWM Plan. The TAG members actively participated in development of the IRWM Plan. Members of the TAG include:

- Valley District – Lead Agency
- City of Big Bear Lake Department of Water and Power
- City of Redlands Municipal Utilities Department
- City of Riverside Public Utilities Department
- East Valley Water District
- San Bernardino Municipal Water Department
- San Bernardino Valley Water Conservation District (SBVWCD)
- San Bernardino County Flood Control District
- San Gorgonio Pass Water Agency
- West Valley Water District
- Yucaipa Valley Water District
- Water Resource Institute, California State University, San Bernardino
- San Timoteo Watershed Management Authority (STWMA)
- Fontana Union Water Company

In the initial stages of the planning process for the IRWM Plan, the TAG identified a list of stakeholders. In general, the stakeholders for this planning process are described by four categories: (1) members of the TAG as listed above, (2) other regional stakeholders and water agencies located in the Upper SAR watershed region, (3) watershed-based stakeholders located in the SAR watershed that are part of the larger integrated planning for the region discussed in the Santa Ana Watershed Project Authority (SAWPA) Plan, and (4) federal and State of California (State) agencies that were encouraged to participate throughout development of the IRWM Plan.

The TAG has encouraged local agencies to be active in the development of the IRWM Plan and to participate in the planning process. Specific steps taken by the TAG to inform and encourage stakeholders' participation are discussed below.

Early in the planning process, the TAG assembled a list of stakeholders and a letter was sent to each one informing them of the planning process and encouraging them to participate. Stakeholders were invited to participate in the TAG's bi-monthly face-to-face meetings and by conference calls. The TAG meetings focused on discussion of regional water management issues of the basin. TAG members and other participating agencies reviewed the work in progress and provided comments on the development of the plan. The agendas for the TAG meetings were posted on Valley District's website in advance so all agencies, other stakeholders, and interested parties could participate throughout the planning process in discussion of the issues in which they were interested. A copy of the draft IRWM Plan was sent to all stakeholders for review and comment.

This IRWM Plan was developed in coordination with Western, San Jacinto River Watershed Council, and SAWPA

Other Regional Water Agencies and Stakeholders

- San Bernardino County Board of Supervisors
- Riverside County Board of Supervisors
- Beaumont-Cherry Valley Water District
- Bear Valley Mutual Water Company
- Big Bear Municipal Water District
- City of Beaumont
- City of Calimesa
- City of Colton
- City of Fontana
- City of Loma Linda
- City of Rialto
- Marygold Mutual Water Company
- Muscoy Mutual Water Company
- Regents of the University of California (Regents)
- Riverside Highland Water Company
- Riverside Flood Control and Water Conservation District
- South Mesa Water Company
- Orange County Flood Control District
- Terrace Water Company
- Western Heights Mutual Water Company
- Fontana Water Company

Watershed-Based Stakeholders

- SAWPA and its member agencies (Eastern Municipal Water District, Inland Empire Utilities Agency, Orange County Water District (OCWD), Valley District, and Western Municipal Water District (Western))
- Beaumont Basin Watermaster
- Western-San Bernardino Watermaster
- California Resource Connections, Inc.

State and Federal Stakeholders

- California Department of Fish and Game
- California Department of Public Health
- California Department of Toxic Substances Control
- California Department of Water Resources
- Regional Water Quality Control Board (RWQCB)
- Southern California Edison
- State Water Resources Control Board (SWRCB)
- U.S. Army Corps of Engineers (USACE)
- U.S. Forest Service

and will become part of the SAWPA regional plan for the SAR watershed. A representative from SAWPA participated in the TAG meetings and actively engaged in the discussions. A representative from Western was also invited and attended the regular meetings of the TAG. The San Jacinto Watershed Council, although not an active participant in the TAG, has been briefed on the development of the plan and received a copy of the draft IRWM Plan for their review and comment.

1.2.1 Santa Ana Watershed Project Authority

SAWPA is a regional agency that has a major role in water resources planning in the SAR watershed. SAWPA was formed in 1968 as a planning agency and was transformed in 1972 through a change in its mission to plan and build facilities that would protect the water quality of the SAR watershed. SAWPA is a Joint Powers Authority, classified as a Special District (government agency) in which it carries out functions useful to its member agencies. SAWPA's vision is to have a sustainable SAR watershed that supports economic and environmental vitality as well as an enhanced quality of life. Its regional leadership is a model of collaboration and cooperation utilizing integrated solutions. To that extent, SAWPA has developed an IRWM Plan for the entire SAR watershed as well as a regional groundwater management plan and an urban water management plan (UWMP).

SAWPA's planning activities generally address water management and water supply reliability issues for the ever-growing population of the watershed. SAWPA works with planners, water experts, and other government agencies to identify issues and challenges of the region. To resolve the many water-related problems, SAWPA works with water planners to ensure there is enough water in the future; with regulators to ensure that the water is safe and clean; and with all other stakeholders (including the concerned public) to develop collaborative, regional solutions to the area's water needs.

SAWPA is working with its member agencies to update its IRWM Plan for the entire SAR watershed and is an active participant in the planning process for the Upper SAR Watershed IRWM Plan. The information from the Upper SAR Watershed IRWM Plan will be incorporated into SAWPA's integrated regional plan for the watershed.

1.3 Other Integrated Regional Water Management Activities in the Watershed

Integrated regional water management activities occurred in the SAR watershed as early as the 1960s. In 2002, SAWPA developed an Integrated Watershed Plan (IWP) for the Santa Ana watershed that was updated in 2005 as an IRWM Plan (IWRMP June 2005). In 2006, Western also prepared an IRWM Plan for its service area. SAWPA's IRWM Plan, Western's IRWM Plan, and the San Jacinto Watershed Component of the Santa Ana IWP are particularly related to the development of this IRWM Plan. In 2002, STWMA developed the San Timoteo Watershed Management Program (STWMA 2002). It was updated in 2005 as an IRWM Plan for the San Timoteo watershed (STWMA 2005). These plans are described below.

1.3.1 Santa Ana Watershed Project Authority IRWM Plan

Water users in the SAR watershed have worked together for decades to develop an integrated regional approach to water management for the entire watershed. In 2002, SAWPA developed a phased planning process called the *Santa Ana Integrated Watershed Plan (IWP)*. In 2005, the IWP was updated as an IRWM Plan (SAWPA Plan) to cover the entire SAR watershed. This broad planning document is the framework for water management in the watershed and is largely based upon the planning efforts of its member agencies. The SAWPA Plan is a "macro-level" plan that is consistent with DWR's California Water Plan Update (Bulletin 160) and State Water Resources Control Board's (SWRCB) Strategic Plan, Watershed Management Initiative, and the basin planning process. The SAWPA Plan builds upon local agencies' initiatives and programs and emphasizes integrated regional water management.

The IRWM Plan for the Upper SAR watershed is a complementary planning process that will be incorporated into the SAWPA Plan. "Zooming" in on a "micro-level" reveals that the Upper SAR watershed has several unique water management challenges and issues. The purpose of this planning process is to focus on these local issues and to assess water management opportunities in greater detail. This collaborative "grassroots" process will address some of the long-term water management strategies of the Upper SAR watershed and will greatly contribute to protecting and enhancing reasonable and beneficial uses of the watershed's water resources. This planning process is a part of the overall SAR water management planning process and is in agreement with past and current SAWPA regional planning initiatives.

1.3.2 Western Municipal Water District IRWM Plan, November 2006

Western's area consists of a 510-square-mile area primarily in western Riverside County with a population of over 500,000 people. Western relies on SWP and Colorado River water to augment its local water supplies. During drought years, these imported water sources will suffer from increased demands and increasingly poor water quality. Colorado River water may have salinity in excess of 800 milligrams per liter (mg/L) in dry years. Such water quality will not meet the water quality objectives of the Regional Water Quality Control Board (RWQCB) and will thus make Colorado River water unsuitable for use without desalination treatment. Western's IRWM Plan is focusing on putting water from all sources to maximum beneficial use. This includes storage of imported water, when it is available, to augment its dry year supplies.

It is the mission of Western to provide water supply, wastewater disposal, and water resource management to the public in a safe, reliable, environmentally sensitive, and financially responsible manner. Given the significant loss of water wells in the region due to water quality issues and the uncertainty of supplemental supplies flowing from the Colorado River, implementing an IRWM Plan is imperative to Western. The objectives of the plan are built on the identification of the water management issues and solutions and refinement of the plan through a consensus of appropriate stakeholders. A number of water management strategies have been considered to meet the objectives defined for Western's IRWM Plan.

Western has already started identifying and implementing regional projects that will create cleaner, more reliable water supplies and optimize the use of imported water to reduce reliance on imported water during drought periods. The projects include the recently completed Arlington desalter enhancement to provide 6,000 acre-feet of drinking water to the city of Norco; March Air Reserve Base Wastewater Treatment Plant improvement to enhance treatment capacity and improve conveyance lines to deliver reclaimed water for irrigation purposes; and the non-potable water conveyance system, which will bring 6,000 acre-feet of surplus water from the Riverside groundwater basin annually, redirecting it to beneficial uses. Western and Valley District share a long history of working cooperatively to address the imbalance between available water supplies and the demands of a growing population in the Inland Empire area of Southern California (the urbanized portions of San Bernardino and Riverside Counties). Valley District and Western sit on the Watermaster Committee for the Orange County Judgment (Orange County Water District v. City of Chino, et al., Case No. 117 628), and together make up the two-member Watermaster Committee for the Western Judgment (Western Municipal Water District of Riverside County v. East San Bernardino County Water District, Case No. 78426).

Western is a stakeholder in the Upper SAR region because of its share in managing the water resources of the Bunker Hill Basin.

1.3.3 The San Jacinto Watershed Component of the Santa Ana Integrated Watershed Plan

The San Jacinto IRWM Plan focuses on specific water management issues that address the unique and complex needs of the 732-square-mile San Jacinto watershed. The plan is a component of the Santa Ana IWP. The proposed San Jacinto Component Plan is a complementary planning effort that will build upon the work already completed by stakeholders participating in the SAWPA planning process. SAWPA's Santa Ana IWP adequately addresses management issues within the Santa Ana watershed as a whole. The San Jacinto Creek watershed component would carefully consider unique water quality, habitat, National Pollutant Discharge Elimination System (NPDES) projects, need for additional reclaimed water management, and potential impacts of total maximum daily load (TMDL) requirements that specifically affect the residents (human, avian, animal, fish, plant, or insect) of the San Jacinto Creek sub-watershed. This planning effort will address issues that are specific to the San Jacinto Creek watershed and integrate the solution strategies with the Santa Ana IWP. The sheer size of the SAR watershed and the array of water resources naturally lend themselves to a large regional solution that integrates a number of watershed issues.

Riverside County has been identified as one of the fastest growing counties in the United States. This growth caused Riverside County to revise its General Plan in 2002. Further integration of water management strategies and coordination between competing interests would benefit the watershed as a whole and would allow for more orderly development in Riverside County and overall protection of the San Jacinto watershed consistent with the proposed IRWM Plan for the San Jacinto Creek watershed.

1.3.4 The San Timoteo Watershed Management Authority IRWM Program

The STWMA was formed in January 2001 by the Beaumont-Cherry Valley Water District (BCVWD), the City of Beaumont (Beaumont), the South Mesa Water Company, and the Yucaipa Valley Water District (YVWD). The purpose of the STWMA is to prepare and implement a water resources management program for the San Timoteo watershed and the waters tributary thereto in order to conserve local water supplies, improve surface and groundwater quality and quantity, protect and enhance groundwater storage and recreational resources, preserve open space, protect wildlife habitat and wetlands, protect and enhance agriculture, and develop and enhance the region's water resources for the benefit of the public. The water resources management program is to include watershed and basin monitoring; groundwater storage, banking, and conjunctive use; stormwater capture and management; recycled water programs and projects; wetlands, wildlife, and open space protection; water quality protection and enhancement; and water conservation and efficiency.

The STWMA formed a stakeholder group to develop a watershed-scale integrated water resources management program that will provide a safe and reliable water supply for all water users in the watershed. The San Timoteo Watershed Management Program (STWMP) was completed in March 2002 and was documented in the San Timoteo Watershed Management Program, Phase 1 Report (March 2002). The Phase 1 investigation inventoried the water resources in the STWMA service area and described the occurrence and quality of these waters. The current and future water demands of the member agencies were described based on planning information provided by the STWMA member agencies and the City of Banning (Banning). The water and recycled water master plans and the UWMPs of the agencies were reviewed to assess how STWMA member agencies and Banning were planning to meet their water demands and dispose of or reuse their recycled water. This research revealed daunting water resource management challenges and opportunities.

Currently, the proven local water supplies for the area are about 32,000 acre-feet per year and ultimate demand will be about 99,000 acre-feet per year; that is, the STWMA service area will need to develop 67,000 acre-feet per year of new supplies. The STWMP was designed to ensure that the additional 67,000 acre-feet per year of water will be there when it is needed.

The STWMP accomplishes consideration and integration of multiple management strategies through eight management initiatives or program elements that are as follows:

- Program Element 1 – Develop and Implement a Comprehensive Monitoring Program for Groundwater Level, Groundwater Quality, Production and Diversion, Subsidence, Surface Water Discharge, and Surface Water Quality. Status – developed and implemented.

- Program Element 2 – Develop and Implement a Comprehensive Surface Water Management and Recharge Program. Status – program developed with some facilities implemented.

- Program Element 3 – Develop and Implement a Regional Supplemental Water Master Plan for the STWMA Area. Status – Plan is in early development.

- Program Element 4 – Develop and Implement a Salt Management Program. Status – developed and implemented.

- Program Element 5 – Establish a Groundwater Management Entity. Status – developed and implemented.
- Program Element 6 – Develop Conjunctive-Use Programs. Status – no progress.
- Program Element 7 – Develop and Implement a Habitat and Recreation Program for the San Timoteo Creek Watershed. Status – no progress.
- Program Element 8 – Develop and Implement a Financial Plan to Enable the STWMP. Status – no progress.

The water resources management program and projects within the STWMP include improved water supply reliability, water quality protection and improvement, groundwater management, flood management, stormwater capture and management, water recycling, recreation and public access, environmental and habitat protection and improvement, wetlands enhancement and creation, and ecosystem restoration, as part of implementing the above program elements. These program elements and projects will enhance recharge of native and recycled water, maximize the direct use of recycled water, and optimize the use of imported water for direct use, recharge, and conjunctive use. The estimated cost of STWMP implementation ranges from $200 to $300 million.

STWMA updated the STWMP in 2005 to conform to the then IRWM Plan requirements. STWMA and its member agencies continue to work together and with adjacent water management entities to implement its IRWM Plan. The STWMA IRWM Plan is available for review at www.stwma.org.

1.4 Previous Related Work

1.4.1 State Water Resources Control Board Orders

In 1989 (WR 89-25) and again in 1998 (WR 98-08), the SWRCB included the SAR in its Declaration of Fully Appropriated Streams (Declaration). Per this Declaration, the river was considered fully appropriated year-round. In 1989, the California Water Code prevented the SWRCB from accepting any new applications to appropriate water from watercourses listed in the Declaration.

In 1991, Valley District submitted an application on behalf of itself and Western to appropriate up to 100,000 acre-feet annually from the SAR (First Application). At that time, the river was categorized as fully appropriated. However, in May 1995, the SWRCB adopted procedures for reviewing the fully appropriated stream status and Valley District subsequently submitted a petition to revise the Declaration (First Petition) together with the 1991 First Application.

The First Petition was followed in 1999 by a similar petition by Orange County Water District (OCWD). The SWRCB held hearings on the petitions in December 1999. Valley District provided evidence that demonstrated that urbanization, the resultant increased runoff, and increased releases of treated wastewater had increased flows in the SAR. Additionally, the operation of Seven Oaks Dam would increase the availability of water for diversion during wet years. Based on evidence in the hearing record, the SWRCB amended the Declaration in Order WR 2000–12 and allowed the water right applications submitted by Valley District and OCWD to be processed (SWRCB 2000). Order WR 2000-12 did not determine the specific amount of water available for appropriation by petitioners.

In May 2001, Valley District and Western jointly submitted a second application to appropriate another 100,000 acre-feet of water annually (Second Application) in addition to the 100,000 acre-feet per year previously requested under the First Application, along with a second petition to revise the Declaration (Second Petition). The Second Petition and Second Application were based on updated hydrologic analyses submitted during the 1999 hearings. These analyses indicated that in certain years more than 200,000 acre-feet of water is available for appropriation in the SAR. Based on the hydrologic evidence, the SWRCB issued Order WR 2002-06, which revised the Declaration pursuant to the Second Petition (and similar petitions by other parties) and accepted the following applications for processing:

- The Valley District and Western application (the Second Application) requesting a right to use a maximum of 100,000 acre-feet annually for direct delivery, recharge, or exchange;

- The Chino Basin Watermaster application requesting a right to divert 97,000 acre-feet per year to groundwater storage;

- The City of Riverside application proposing direct diversion of 75 cubic feet per second (cfs) throughout the year for a total maximum direct diversion of 41,400 acre-feet per year; and

- Four minor applications for diversions of up to 102 acre-feet annually throughout the year from the west and east forks of Cable Creek within the SAR watershed.

Order WR 2002-06 did not determine the specific amount of water available for appropriation or whether the amount of water available for appropriation is sufficient to approve the applications. As in Order WR 2000-12, prior to any potential approval of the applications, the SWRCB requires that applications meet all necessary obligations under the California Environmental Quality Act (CEQA).

1.5 Overview of Governing Laws, Judgments, and Agreements

This section briefly describes some of the governing laws, judgments, and agreements that are in place and have significant influence on water management in the region. The intent of these brief descriptions is to provide the readers a general overview of these documents. For a complete understanding of the agreements and judgments, please see the actual documents, which have been reproduced in Appendix A.

1.5.1 Integrated Regional Water Management Planning Act

In 2002, the California Legislature passed Senate Bill 1672, the Integrated Regional Water Management Planning Act, and the Governor signed it into law. The Bill added Part 2.2 (commencing with Section 10530) to Division 6 of the Water Code: Conservation, Development and Utilization of State Water Resources.

The Integrated Regional Water Management Planning Act authorized a "regional water management group" to prepare and adopt a regional plan in accordance with certain procedures that addresses programs, projects, reports, or studies relating to water supply, water quality, flood protection, or related matters, over which any local public agency that is a participant in that group has authority to undertake.

The law requires DWR, the SWRCB, and the State Department of Health Services to include in any set of criteria used to select the projects and programs for grant funding "…a criterion that provides a benefit for qualified projects or programs."

To comply with the requirements of the law, DWR and SWRCB prepared standards (also referred to as IRWM Guidelines) for preparation of IRWM Plans. In addition, they established set criteria for selection of the projects and programs to be funded under Chapter 8 of Proposition 50, the Integrated Regional Water Management Implementation Grant Program. The guidelines state that, "The intent of the IRWM Grant Program is to encourage integrated regional strategies for management of water resources and to provide funding, through competitive grants, for projects that protect communities from drought, protect and improve water quality, and improve local water security by reducing dependence on imported water."

This IRWM Plan is prepared in compliance with the Integrated Regional Water Management Planning Act and DWR and SWRCB Guidelines and the intent of the grant program.

1.5.2 Groundwater Management Planning Act

In 2002, Senate Bill 1938, Groundwater Management Planning Act of 2002, was enacted into law. This law amended AB3030, which authorizes a local agency to prepare and implement a groundwater management plan. This law requires a local agency that elects to develop a groundwater management plan to follow specific requirements, including public notification and public involvement process as summarized below.

- Make available to the public a written statement describing the manner in which interested parties would be allowed to participate in the development of the plan.

- For the purposes of qualifying as a groundwater management plan and for receiving State funds administered by DWR for the construction of groundwater projects or groundwater quality projects, prepare and implement a plan that includes certain basin management objectives (BMOs) and components and adopt certain monitoring protocols.

- The law requires the local agency to submit a copy of the plan to DWR, in an electronic format, if practicable, approved by the DWR, and DWR would be required to make copies available to the public.

- Prior to adopting a resolution of intention to draft a groundwater management plan, a local agency shall hold a hearing after publication of notice on whether to adopt a resolution of intention to draft a groundwater management plan pursuant to this part for the purposes of implementing the plan and establishing a groundwater management program. At the conclusion of the hearing, the local agency may draft a resolution of intention to adopt a groundwater management plan pursuant to this part for the purposes of implementing the plan and establishing a groundwater management program. Upon written request, the local agency shall provide any interested person with a copy of the resolution of intention.

- The local agency shall prepare a groundwater management plan within two years of the date of the adoption of the resolution of intention. If the plan is not adopted within two years, the resolution of intention expires, and no plan may be adopted except pursuant to a new resolution of intention adopted in accordance with this chapter.

- After a groundwater management plan is prepared, the local agency shall hold a second hearing to determine whether to adopt the plan. Notice of the hearing shall be given pursuant to Section 6066 of the Government Code. The notice should include a summary of the plan and shall state

> that copies of the plan may be obtained for the cost of reproduction at the office of the local agency. At the second hearing, the local agency shall consider protests to the adoption of the plan. At any time prior to the conclusion of the hearing, any landowner within the local agency may file a written protest or withdraw a protest previously filed.

Senate Bill 1938 does not require local agencies to prepare a groundwater management plan for the basins that are managed through adjudications. These long-standing adjudications govern the water rights and management of the basins. Any groundwater management planning would need to conform with the provisions of those adjudications and would require agreement and approval of the parties in those adjudications. The basins in the Upper Santa Ana watershed are adjudicated "in gross." The agencies in the region, however, decided to prepare the plan because they strongly support the intent of the law that states, "It is the intent of the Legislature to encourage local agencies to work cooperatively to manage groundwater resources within their jurisdictions. The preparation of certain basin management objectives will assist local agencies in optimizing local resources while protecting groundwater and surface water resources. The preparation of basin management objectives also will facilitate an understanding of the basin or subbasin, thereby allowing local agencies, individually and cooperatively, to meet local, regional, and state water needs through conjunctive management, while ensuring that no particular water supply is jeopardized."

A purpose of this IRWM Plan is to meet the intent and requirements of Senate Bill 1938.

1.5.3 Orange County Judgment

In 1963, the OCWD filed suit against substantially all water users in the area tributary to Prado Dam seeking adjudication of water rights on the SAR. The litigation ultimately involved over 4,000 served water users and water agencies, the four largest of which were OCWD, Valley District, Western, and the Chino Basin Municipal Water District (now the Inland Empire Utilities Agency). Given the magnitude of the potential litigation, these four districts and other parties developed a settlement that was approved by the Orange County Superior Court in a stipulated judgment entered on April 17, 1969 (Orange County Judgment). The Orange County Judgment imposes a physical solution that requires parties in the Upper SAR watershed to deliver a minimum quantity and quality of water to points downstream, including Riverside Narrows and Prado Dam. A provision of the Orange County Judgment related to conservation establishes that once the flow requirements are met, the upper area parties "…may engage in unlimited water conservation activities, including spreading, impounding, and other methods, in the area above Prado reservoir." The Orange County Judgment is administered by the five-member SAR Watermaster that reports annually to the court and the four representative agencies. Valley District, Inland Empire Utilities Agency, and Western nominate one member each to the Watermaster; OCWD nominates two members; and members are then appointed by the court.

1.5.4 Western Judgment

The Western Judgment, entered simultaneously with the Orange County Judgment, settled rights within the Upper SAR watershed in part to ensure that those resources upstream of Riverside Narrows would be sufficient to meet the flow obligations of the Orange County Judgment at Riverside Narrows. Toward this end, the Western Judgment generally provides for the following:

- A determination of safe yield of the San Bernardino Basin Area (SBBA),
- Establishment 64,872 acre-feet rights that can be extracted from the SBBA by plaintiff parties. This is equal to 27.95 percent of safe yield,
- An obligation of Valley District to replenish any extractions from SBBA by non-plaintiffs in aggregate in excess of 167,228 acre-feet(equal to 72.05 percent of safe yield),
- An obligation of Western to replenish the Colton and Riverside Basins if extractions for use in Riverside County in aggregate exceed certain specific amounts, and
- An obligation of Valley District to replenish the Colton and Riverside basins if water levels are lower than certain specific water level elevations in specified wells.

Like the Orange County Judgment, the Western Judgment identifies regional representative agencies to be responsible, on behalf of the numerous parties bound thereby, for implementing the replenishment obligations and other requirements of the judgment. The representative entities for the Western Judgment are Valley District and Western. Valley District and Western are principally responsible for providing replenishment of the groundwater basins if extractions exceed amounts specified in the judgment or as determined by the Watermaster. For the purposes of this replenishment obligation, Valley District acts on behalf of all defendants (Non-Plaintiffs) dismissed from the Western Judgment and, similarly, Western acts on behalf of the Plaintiffs and other dismissed parties within Western. Plaintiff parties with specific rights to produce 27.95 percent of the safe yield from the SBBA are the City of Riverside, Riverside Highland Water Company, Meeks & Daley Water Company, and the Regents of the University of California (Regents). The Western Judgment is administered by the two-person Western-San Bernardino Watermaster—one person nominated each by Valley District and Western, and both appointed by the court.

Like the Orange County Judgment, the Western Judgment contemplates that the parties will undertake “new conservation,” which is defined as any increase in replenishment from natural precipitation resulting from operation of works and facilities that did not exist in 1969. The Western Judgment specifies that the parties to the judgment have the right to participate in any new conservation projects and, provided their appropriate shares of costs are paid, rights under the judgment are increased by the respective shares in new conservation (72.05 percent by Valley District and 27.95 by Western).

1.5.5 The Beaumont Basin Judgment

In February 2003, the STWMA filed suit in Riverside County Superior Court to adjudicate pumping and storage rights in the Beaumont Basin. The STWMA and the major pumpers developed a Stipulated Agreement to resolve the lawsuit. In February 2004, the Stipulated Agreement was approved by the Court.

This Stipulated Agreement established pumping rights among the two major classes of pumpers—overlying and appropriative pumpers. The overlying pumpers were assigned fixed rights with some flexibility to vary their maximum use during any five-year period. The safe yield established in the Stipulated Agreement is 8,650 acre-feet per year. The total of the overlying producers’ rights is equal to the safe yield. Collectively, the overlying pumpers produce substantially less than their aggregate rights. Appropriators’ rights are stated as a percentage or fraction of water in the safe yield that is not used by the overlying pumpers. The Stipulated Agreement provides for the orderly transition of land use and associated water uses through detailed provisions that require the assignment of rights from an overlying pumper to an appropriator when the appropriator provides service to the lands of the overlying pumper.

The Stipulated Agreement declares that there is a temporary surplus of water in the basin of 160,000 acre-feet. The temporary surplus can be used by the appropriators during the first ten years of the Stipulated Agreement. The appropriators will store the unused portion of the temporary surplus for use in subsequent years. The intent of removing the temporary surplus is to create additional evacuated storage space in the basin for use in storing supplemental water. The Stipulated Agreement gives control of the evacuated storage space in the basin and the overall management of storage to the Watermaster.

1.5.6 1961 Rialto Basin Judgment

The Rialto-Colton Basin was adjudicated in the Lytle Creek Water & Improvement Company vs. Fontana Ranchos Water Company, et. al., San

Bernardino County Superior Court Action 81264, entered on December 22, 1961. Limits on groundwater extractions are based on the average of the spring-high water level elevations of three wells within the basin. The pro rata water productions by each party (City of Colton, City of Rialto, Fontana Union Water Company, Citizen Land and Water Company, and Lytle Creek Water Improvement Company) are based on the "spring-high water level" in the three index wells as described below:

Above 1002.3 feet	Unlimited
Between 1002.3 and 969.7 feet	As imposed by the judgment
Below 969.7 feet	Reduced by 1% for every foot the average is below 969.7

At the request of the stipulating parties, Valley District monitors compliance with the decree and has since the early 1990s.

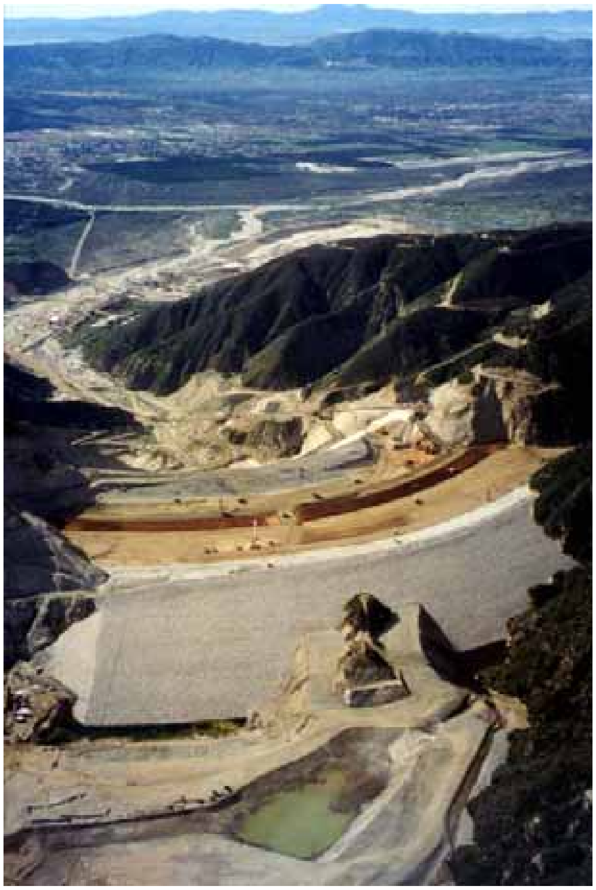
1.5.7 Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin

Water agencies within the Santa Ana River watershed recognize the importance of protecting the quality of its groundwater resources. In July 2007, many of these agencies (Parties) entered into an agreement with the RWQCB for purposes of monitoring and improving water quality within the SAR Region. The agreement is limited in scope and specifically addresses Salinity Objectives.

Generally, the agreement requires that the Parties analyze the effects on water quality of recharging imported water into groundwater basins. This analysis will be compiled into a report and submitted to the RWQCB every three years (Triennial Water Quality Report). In addition, any new project that will include the recharge of imported water must analyze its effects prior to implementation. A copy of this agreement is provided in Appendix A.

1.5.8 Seven Oaks Accord

On July 21, 2004, Valley District, Western, the City of Redlands, East Valley Water District, Bear Valley Mutual Water Company (Bear Valley Mutual), Lugonia Water Company, North Fork Water Company, and Redlands Water Company signed a settlement agreement known as the Seven Oaks Accord (Accord). The Accord calls for Valley District and Western to recognize the prior rights of the water users for a portion of the natural flow of the SAR. In exchange, the water users agree to withdraw their protests to the water right application submitted by Valley District on behalf of itself and Western. All the parties to the Accord have agreed to support the granting of other necessary permits to allow Valley District and Western to divert water from the SAR. By



View from upstream of Seven Oaks Dam under construction

means of the Accord, Valley District agreed to modify its water right applications to incorporate implementation of the Accord. Additionally, the Accord calls for Valley District to develop and manage a groundwater spreading program that will maintain groundwater levels at a number of specified wells owned and operated by the other parties. This integrated management of the basin will be adopted within five years of SWRCB approval of the water right applications. A copy of the Accord is shown in Appendix A.

Management of water resources in the Valley District/Western service area takes place within a complex legal and institutional framework as will be discussed in the next section. Development of a comprehensive, coordinated regional water management plan will involve the cooperation of many parties interested in water management in addition to the signatories of the Accord. The Accord provides the framework and a cooperative environment for major water entities in the Upper SAR watershed to prepare a plan for the integrated management of the region's surface water and groundwater resources. This IRWM Plan enhances and refines the current management and planning activities within the region and develops regional water management strategies and the framework for their implementation.

1.5.9 Agreement Relating to the Diversion of Water from the Santa Ana River System Among Western Municipal Water District of Riverside County, Valley District and City of Riverside

In July 2004 a Settlement Agreement Relating to the Diversion of Water from the Santa Ana River System (the Seven Oaks Accord) was signed. The agreement requires Valley District and Western to develop a groundwater spreading program in cooperation with other parties, "That is intended to maintain groundwater levels at the specified wells at relatively constant levels, in spite of the inevitable fluctuations due to hydrologic variation." Other requirements of the Seven Oaks Accord are as follows:

i) The groundwater management plan shall identify target water-level ranges in the specified "index wells" subject to the requirement that such spreading will not worsen high groundwater levels in the Pressure Zone.

ii) Thresholds of significance in terms of SAR water diverted by Valley District and Western and spreading by all parties should be observed. See Appendix I of the Accord (sidebar).

iii) The determination as to whether a certain groundwater management action will "worsen" high groundwater levels in the Pressure Zone is made through the use of the integrated surface and groundwater models.

iv) An "integrated management program" must be "adopted" within five years of the date the SWRCB grants a permit to Valley District/Western to divert water from the SAR. Valley District and Western have presented their data to the SWRCB and were told that any permit "terms" would be available in late 2007.

v) Water users agree to limit spreading to conform to an annual management plan.

1.5.10 Local Institutional Considerations

1.5.10.1 Santa Ana River-Mill Creek Cooperative Water Project Agreement

The SAR-Mill Creek Cooperative Water Project Agreement (informally known as the Exchange Plan) is an agreement among 9 agencies and water companies in eastern San Bernardino Valley executed in May 1976. The 9 parties to the Exchange Plan are as follows:

- Redlands Water Company, Bear Valley Mutual, Crafton Water Company, North Fork Water Company [East Valley Water District], Lugonia Water Company, City of Redlands, San Bernardino Water Conservation District (SBVWCD), YVWD, and the Valley District;

In an effort to avoid pumping costs and to lower the overall cost of water, the parties have agreed to the exchange of water from the SAR, Mill Creek, and the SWP. The agreement is described as a "bucket-for-bucket exchange," whereby a party to the agreement provides a "bucket" of their water to a second, higher elevation party, and the second party provides a "bucket" of water from an alternate, lower elevation source back to the original party. To facilitate exchanges, parties to the agreement share their existing facilities. However, specific facilities (called Cooperative Water Project facilities) were built and are operated by Valley District in part to accommodate Exchange Plan deliveries. Given the three water sources and the available facilities, there are multiple delivery possibilities. Examples of exchanges that occur under the Exchange Plan include two-level exchanges, three-level exchanges, and water banking with

DWR. In a two-level exchange, two water sources are used; for example, SAR water is delivered to Mill Creek water users, and, in return, an equal amount of SWP water is delivered to SAR water users. In a three-level exchange, three sources are used. For example, Mill Creek water is delivered to the Yucaipa area, an equal amount of SAR water is then delivered to Mill Creek water users, and finally SWP water is delivered to SAR water users. To bank water within the SWP, a party entitled to local water exchanges their water when the local water is available and then takes SWP water at a later date.

1.5.10.2 Big Bear Lake Operations

Bear Valley Dam, which forms Big Bear Lake, is the only major dam that affects runoff into Seven Oaks Dam. Big Bear Lake is a water conservation reservoir presently owned by the Big Bear Municipal Water District (Big Bear Municipal). Big Bear Lake is located on Bear Creek, a tributary to the SAR. The lake has a drainage area of about 38 square miles.

Bear Valley Mutual and its predecessors constructed, owned, and operated Big Bear Lake as a supplemental water supply reservoir to meet the irrigation water supply demand within the Bear Valley Mutual service area in the easterly end of the San Bernardino Valley. Historical irrigation releases during dry periods sometimes caused low water levels in Big Bear Lake.

As recreation uses of Big Bear Lake became more important, Big Bear Municipal sought to control the water levels in the lake. On February 4, 1977, a stipulated judgment was entered in San Bernardino County Superior Court for Case No. 165493 *Big Bear Municipal Water District vs. North Fork Water Co. et al.* Big Bear Municipal obtained the opportunity to furnish “in-lieu” water from several other named sources other than Big Bear Lake to meet the water supply demands of Bear Valley Mutual. Big Bear Municipal was allowed to retain an amount of water in Big Bear Lake equal to the amount of water furnished in-lieu to Bear Valley Mutual. Big Bear Municipal explored and implemented the alternate sources. Providing water from these alternate in-lieu sources resulted in water being retained in Big Bear Lake to stabilize the water levels in the lake.

On May 1, 1987, Big Bear Municipal adopted operating criteria for Big Bear Lake that contain conditions regarding when Big Bear Municipal will release water from Big Bear Lake and when Big Bear Municipal will acquire in-lieu water for Bear Valley Mutual.

On February 16, 1995, the SAR Water Quality Control Board adopted Order No. 95-4, which requires that Big Bear Municipal make releases from Big Bear Lake through Bear Valley Dam to provide water for preservation of fish in Bear Creek.

On February 1, 1996, Big Bear Municipal and Valley District entered into an agreement that provides for Valley District to furnish all in-lieu water that Big Bear Municipal needs to meet the water supply demands of Bear Valley Mutual.

As a result of the stipulated Judgment, Big Bear Lake is now maintained at higher levels for recreational uses. The lake will spill (i.e., need to release water because the reservoir is full) more often than occurred under the historic irrigation supply operation. However, inflow to the SAR during irrigation months may be less than historic irrigation releases. Inflow to the SAR during winter months may be greater than under the historic operation of Bear Valley Dam. The changes in the operation of Big Bear Lake from an irrigation water supply reservoir to a recreation reservoir result in changes in the timing and amounts of water Big Bear Lake and Bear Creek contribute to the SAR.

1.5.10.3 Settlement Agreement with San Bernardino Valley Water Conservation District

Within the settlement agreement dated August 9, 2005, Valley District, Western, and the SBVWCD have agreed to work cooperatively to develop an annual groundwater management plan. A copy of the agreement is provided in Appendix A.

1.5.10.4 Memorandum of Understanding (MOU) with the City of Riverside

In September 2005, Valley District, Western, and the City of Riverside entered into an MOU. The MOU stated that the intent of Valley District/Western is to work cooperatively with the City of Riverside to devise institutional and physical arrangements through which the city could directly benefit from “new conservation” undertaken as part of the Western Judgment and the pending Valley District/Western water right applications. The MOU states, “The Parties (Valley District, Western, and the City of Riverside) shall engage in good-faith negotiations with the goal of reaching a long-term agreement relating to the purchase, storage, and sale to Riverside by Western of imported water stored in the SBBA, and relating to storage, transport and delivery of conservation water from the Seven Oaks Dam...”

1.5.10.5 Institutional Controls and Settlement Agreement (ICSA)

The City of San Bernardino Municipal Water Department (SBMWD) is a party to a consent decree lodged with the United States District Court, Central District of California, Western Division (Court), on August 18, 2004. The Consent Decree obligates SBMWD to operate and maintain a system of wells and treatment plants known as the Newmark Groundwater Contamination Superfund Site (Newmark Site). The Newmark Site specifically treats groundwater contaminated with trichloroethylene (TCE) and perchloroethylene (PCE). The

SBMWD is required by the terms of the Consent Decree, entered on March 23, 2005, to enact institutional controls and implement an ordinance providing for the protection and management of the Interim Remedy set forth in the Record of Decisions and Explanation of Significant Differences prepared by the U.S. Environmental Protection Agency.

The City of San Bernardino Ordinance No. MC-1221, approved in March 2006, establishes the management zone boundaries within the City of San Bernardino for water spreading and water extraction activities. The Consent Decree requires the City of San Bernardino to implement an ordinance to ensure that activities occurring in the management zone do not interfere or cause pass-through of contaminants from the Newmark and Muscoy Operable Units. The Interim Remedy requires the extraction of contaminated groundwater from the Bunker Hill Groundwater Basin and within the Newmark and Muscoy Operable Units, and treatment of the groundwater to meet all State and federal permits and requirements for drinking water. A permit by the SBMWD pursuant to the provisions outlined in the ordinance should first be obtained for any spreading (artificial recharge) or extracting (well pumping) within the Management Zones, as defined in the ordinance.

An ICSA has been executed to develop and adopt a successor agreement, titled Institutional Controls Groundwater Management Program (ICGMP), between the following parties:

(1) City of San Bernardino Municipal Water Department

(2) Valley District

(3) Western Municipal Water District

(4) City of Riverside

(5) West Valley Water District

(6) East Valley Water District

(7) City of Colton

(8) Riverside Highland Water Company

The parties listed above will not be subject to the provisions of City of San Bernardino Ordinance No. MC-1221 as long as each is a party to the ICSA and, subsequently, the ICGMP Agreement.

1.5.10.6 Settlement Agreement between City of San Bernardino and City of Riverside and Riverside Water Company

In November 1922, after a Supreme Court of the State of California decision, the City of San Bernardino (Plaintiff) and the City of Riverside and Riverside Water Company (Defendants) negotiated a settlement agreement to take, divert, and use water from the "San Bernardino Artesian Basin," Lytle Creek, Warm Creek, and Devil Canyon Creek. The agreement was approved by the San Bernardino County Superior Court in a stipulated judgment that constituted authorities and rights of the parties for taking, diverting, and using the water. The court also established a provision for daily record keeping of all the diversions and use of water by all said parties.

1.6 Purpose and Need for the IRWM Plan

The primary purpose of this IRWM Plan is to assist local agencies with developing tools for optimizing management and the use of the region's water resources while protecting the groundwater basins from water quality degradation and the threat of liquefaction. The implemented IRWM Plan will reduce reliance on imported water during the drought periods and optimize the use of both native and imported supplies to help meet water demands even during extended periods of below-average precipitation. Basin management objectives, an integral component of the IRWM Plan, will facilitate formulation of specific strategies and projects to meet local and regional drought-year water needs through conjunctive management, while ensuring that no particular water supply resource is jeopardized. The purpose of the plan as stated above is consistent with the intent and requirements of the Integrated Regional Water Management Planning Act and Groundwater Management Planning Act of 2002 described in Section 1.5. Below are the specific needs for developing this plan.

1.6.1 Uncertainty of Imported Water Alone to Meet Long-Term Needs

The water purveyors within the region will rely on imported water from the SWP to meet a portion of their water needs through groundwater recharge and direct deliveries into the future. Valley District's annual entitlement to SWP water is 102,600 acre-feet. Other SWP contractors in the region include SGPWA. There is uncertainty of SWP delivery capability in dry years and the expected SWP water deliveries are less than anticipated when the contracts were signed. In November 2005, DWR released the "Public Review Draft" of "The State Water Project Delivery Reliability Report 2005." This report presents water delivery capability of the SWP under various hydrologic conditions. Modeling was used to estimate the SWP water delivery capabilities. Table 1-1 summarizes the results of the SWP modeling efforts conducted for the report.

Table 1-1
SWP Dry Year Delivery as a Percentage of SWP Table A Entitlement

Study	Average 1922-94	Lowest Single-Year Delivery 1977	Lowest Two Consecutive Year Delivery 1976-77	Lowest Six Consecutive Year Delivery 1987-92
– 2005 Level of Demand	68%	4%	41%	42%
– 2030 Level of Demand	77%	5%	40%	42%
Public Draft of the State Water Project Delivery Reliability Report, 2005.				

The modeling results indicate that in a six-year dry period, SWP delivers less than half of its contractors' entitlements and in a 1977 drought-year type, SWP can deliver only about five percent of its contractors' entitlements. Based partly on these projected SWP deliveries, the water purveyors within the region desire to improve their local and regional water supply reliability during future droughts and, therefore, have prepared this plan to manage their groundwater basins conjunctively with other sources in an effort to optimize their use.

The California Aqueduct conveys water from Northern California into the Region.

In addition, the Seven Oaks Accord calls for Valley District/Western to cooperatively develop an integrated groundwater management plan that is intended to maintain groundwater levels at a number of specified wells owned and operated by the other parties. The Accord requires that this integrated management program be adopted within five years of SWRCB approval of the Valley District/Western water right applications. This IRWM Plan will satisfy these requirements of the Accord for preparation and adoption of an integrated groundwater management plan for the SBBA.

1.6.2 Threat of Liquefaction in the Pressure Zone

Liquefaction is a form of seismically induced ground failure. In cohesionless, granular material having low relative density, such as loose sandy sediment, seismically induced vibrations can disturb the particle framework, leading to increased compaction of the material and reduction of pore space between the grains. If the sediment is saturated, water occupying the pore spaces resists this compaction and exerts pore pressure that reduces the contact stress between the sediment grains. With continued shaking, transfer of intergranular stress to pore water can generate pore pressures great enough to cause the sediment to lose its strength and change from a solid state to a liquid state, called liquefaction. This mechanical transformation can cause various kinds of ground failure at or near the ground surface.

The liquefaction process typically occurs at depths less than 50 feet below ground surface. Diminished susceptibility to liquefaction as depth increases is caused by an increase in overburden pressure and induration of sedimentary deposits. The depth to groundwater and distance to the causative fault affect the relative susceptibility to liquefaction. Much of the San Bernardino Valley is located in an area of liquefaction susceptibility. The most likely scenario for significant liquefaction to occur in the San Bernardino Valley would be as a result of an earthquake on the adjacent San Andreas, San Jacinto, or Cucamonga faults (Matti and Carson 1991).

The main zones of elevated liquefaction susceptibility within the San Bernardino Valley are associated with shallow groundwater that occurs under the modern floodplains of Cajon Creek, Warm Creek, and the SAR. Recently deposited Holocene sediments that would be expected to have lower penetration resistance and higher susceptibility than older sediments underlie these areas. However, even the older Holocene and uppermost Pleistocene sediments have elevated susceptibilities comparable to those in the younger deposits. This fact accounts for zones of high and moderately high susceptibility that extend away from the modern floodplains and into adjacent areas underlain by older deposits (Matti and Carson 1991).

In the southern part of the SBBA, on the northeast side of the San Jacinto fault, there are approximately 1,200 feet of unconsolidated and partly consolidated water-bearing deposits. In the area between Warm Creek and the SAR, the upper confining member of this aquifer acts to restrict vertical flow, causing semi-confined conditions in the upper 50 to 100 feet of saturated materials (Dutcher and Garrett 1963). This area is considered the Pressure Zone of the SBBA and is also referred to as the Area of Historic High Groundwater. Historically, this scenario resulted in perched, very shallow groundwater conditions, at times rising to ground surface level, which increased the potential for liquefaction and locally flooded buildings in the City of San Bernardino. Groundwater pumping since the early 1900s increased the minimum depth to groundwater in this area to 50 feet by the 1960s but, during the 1970s and 1980s, groundwater was locally within 10 feet of the ground surface beneath the City of San Bernardino (CDMG 1976, Matti and Carson 1991).

In the past, groundwater levels in the Pressure Zone rose high enough under these semi-confined conditions to cause rising water and increase the potential for liquefaction. High groundwater levels in this area have damaged building foundations, flooded basements and utility structures, and increased the potential for liquefaction in this seismically active region. The Pressure Zone is located wholly within the City of San Bernardino. In the 1930s and 1940s, some wells in the Pressure Zone flowed artesian as shown below. Over the long-term, however, groundwater levels in the Pressure Zone are dropping with the depth to groundwater increasing.

The San Bernardino Basin area has unusually high groundwater levels in its history. This photo shows an artesian well.

High groundwater in the Pressure Zone is further aggravated by the direction of groundwater flow in the Bunker Hill Basin, which is generally in a southwesterly direction from the San Bernardino Mountains to the San Jacinto fault. The fault zone generally runs perpendicular to the groundwater flow and acts as a barrier, or partial barrier, causing the groundwater to "dam up" behind the fault and rise upward toward the land surface.

An objective of this IRWM Plan is to develop tools that might be used by water agencies to manage the groundwater levels in the Pressure Zone to reduce the risk of liquefaction in the area. Specific BMOs will be developed to manage the basin in order to reduce the associated risks.

1.7 IRWM Plan Planning Process

As the lead agency, Valley District facilitates meetings and coordinates preparation of the draft and final IRWM Plan. The district is organizing meetings and facilitating exchange and sharing of data and information among its members. Valley District has also signed a contract with DWR to receive a grant for preparation of the IRWM Plan and to provide contract administrative functions. Members of the Association who participate in the planning process and develop the IRWM Plan represent their respective agencies and provide comments on the planning process, studies, and the draft IRWM Plan. They also provide status reports to their agency boards. The final IRWM Plan will be presented to each agency's governing board or council for adoption.

1.7.1 Technical Advisory Group Member Agencies

In 2005, the TAG was formed to act as the "Regional Management Group" for preparing the IRWM Plan. The TAG consists of 14 members (see Section 1.2). Descriptions of each of the member agencies participating in the IRWM Plan preparation and their water management activities in the region are provided in Section 1.8.

1.7.2 Public Participation

The TAG developed and implemented the public involvement process to ensure that the public was also informed about the development of the IRWM Plan. This process included regularly scheduled meetings of the TAG throughout the IRWM Plan process that allowed the public recurring opportunities to provide its input. The public was given the opportunity to participate in the planning process in the following ways:

- Attending public meetings of the TAG. TAG meetings were designed to be public meetings. Notice was given in local publications about the meetings and how to get timely and up-to-date information about the planning process.

- Availability of the public draft of the plan was announced in local newspapers. The draft plan was made available to the public for review and comment. Comments were reviewed by the TAG and were incorporated as appropriate.

- The public was invited to provide written comments to Valley District throughout the planning process.

- The public was invited to attend all of the public hearings conducted during the planning process. Notice of these hearings was published in two local newspapers prior to the scheduled meeting time. Each hearing notice included an agenda and the time and location of the hearing. Members of the TAG were at the hearings to answer questions, solicit input, and increase public awareness of the proposed IRWM Plan. Proof of Publication for each hearing can be found in Appendix D. Meeting minutes and board resolutions relating to the IRWM Plan development and adoption process are also included in Appendix D.

- The TAG held four public hearings, as follows:

  1. On May 9, 2005, Valley District, as the lead agency, conducted a public hearing to brief the public of its intent to act as the lead agency on behalf of the Association for purposes of submitting applications and entering into an agreement(s) to receive a planning grant and/or an implementation grant pursuant to the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, Water Code Section 79560 *et seq.,* (Proposition 50).

  2. On March 15, 2006, Valley District, as lead agency, held a public hearing and adopted a resolution of intent to prepare an IRWM Plan.

  3. On April 5, 2006, Valley District, acting as the lead agency, held a public hearing (after publication of a notice that included the schedule and location of the hearing) to inform the public of its adoption of a resolution of intent to prepare an IRWM Plan. The focus of the meeting was to brief the public and interested parties about the planning process, schedule, content, and how the public could provide input in developing the water management plan. Interested parties and the general public were encouraged to attend the hearing and provide comments to Valley District. At this hearing, the lead agency also described the manner in which interested parties could participate in developing the IRWM Plan.

  4. In December 2007, Valley District, acting as the lead agency, will hold a public hearing after publishing a notice of intent to hold a hearing to receive comments on the public draft of the IRWM Plan and the intent to adopt the plan. The notice will include a summary of the plan and state the means of providing copies of the plan to interested parties. Member agencies of the TAG will participate in this hearing.

- Each agency who participated in the TAG published a notice informing the public of its intention to participate in the planning process and held a public meeting to determine whether to adopt a resolution to engage in preparation of the agency's IRWM Plan, as documented in Appendix D.

- Throughout the development of the IRWM Plan, members of the TAG presented quarterly, or more frequent, status updates to their governing boards or board subcommittees at regularly scheduled meetings. These public meetings included a posted agenda item for the IRWM Plan. The public was encouraged to participate in these meetings.

- The governing bodies of the participating agencies scheduled a discussion of the draft plan in their regular meetings, provided information to the public regarding the content of the draft plan, and received comments prior to adopting the IRWM Plan. The TAG also coordinated the development of the IRWM Plan with SWRCB and DWR. The final IRWM Plan will be submitted to DWR and SWRCB, pursuant to the guidelines.

- The San Bernardino Valley Municipal Water District Advisory Commission on Water Policy (Advisory Commission) has been established to advise Valley District on water policy issues within its service area. The water purveyors and governmental entities in Valley District's service area have representatives on the Advisory Commission. During the preparation of the IRWM Plan, the Advisory Commission met on a regular basis, and the staff and consulting team briefed the Advisory Commission on development of the IRWM Plan. The Advisory Commission members showed a great level of interest in development of the IRWM Plan and provided guidance on the issues. The public was invited to these meetings and participated in the discussions.

SBVMWD Advisory Commission on Water Mission Statement

"It shall be the function of the Commission to study and make recommendations to the Board of Directors on matters of water policy for the District. The Commission shall study such matters of water policy as are submitted to it by the Board for Consideration and may study such other matters of water policy as the Commission deems appropriate." SBVMWD Ordinance No. 61, July 6, 1987.

- The Advisory Commission held a public meeting on October 18, 2007, to receive public comments on the Draft IRWM Plan.

In summary, the Advisory Commission and the TAG encouraged public participation in preparation of the IRWM Plan to ensure the public's comments were considered in decisions about water management in the region.

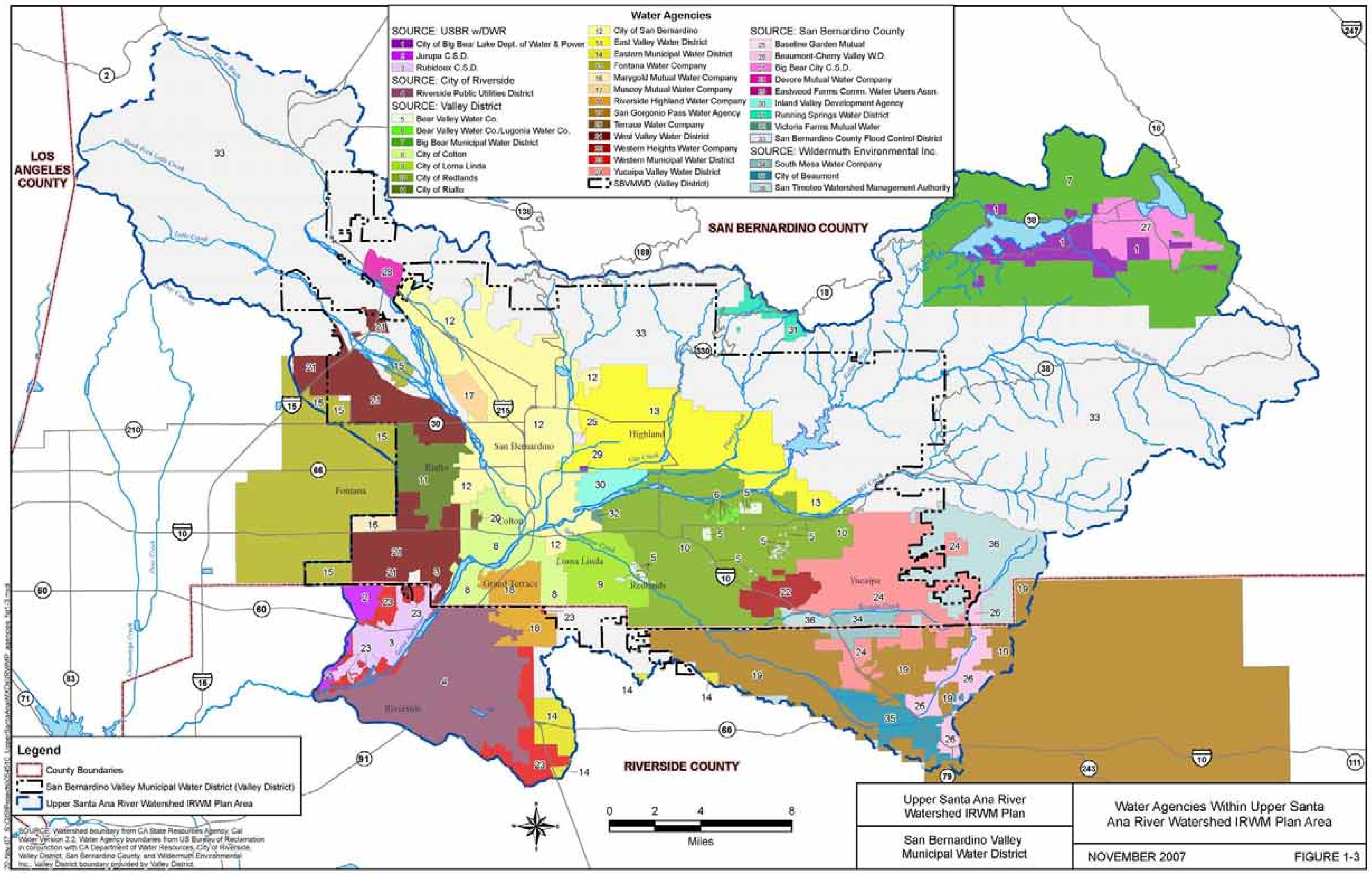
1.7.3 Dispute Resolution Process

The TAG was effectively used as a tool for the resolution of water management issues in the basin. Discussion of issues in the TAG meetings, an open and transparent process, resulted in a cooperative relationship between water users of the basin. The management process for the SBBA involves the creation of the Basin Technical Advisory Committee (BTAC). It is anticipated that the BTAC will provide a forum for discussion and early resolution of water issues in the region. If the dispute cannot be resolved at this level, it will be elevated to the policy level (Advisory Commission, Board of Directors, City Councils, etc.).

1.8 Water Agencies in the Region

Numerous agencies provide water services to communities within the IRWM Plan Area. Figure 1-3 shows the boundaries of water agencies within the region. A brief description of each member of the TAG as well as other water purveyors in the region is presented below.

Figure 1-3
Water Agencies in the Region



1.8.1 San Bernardino Valley Municipal District

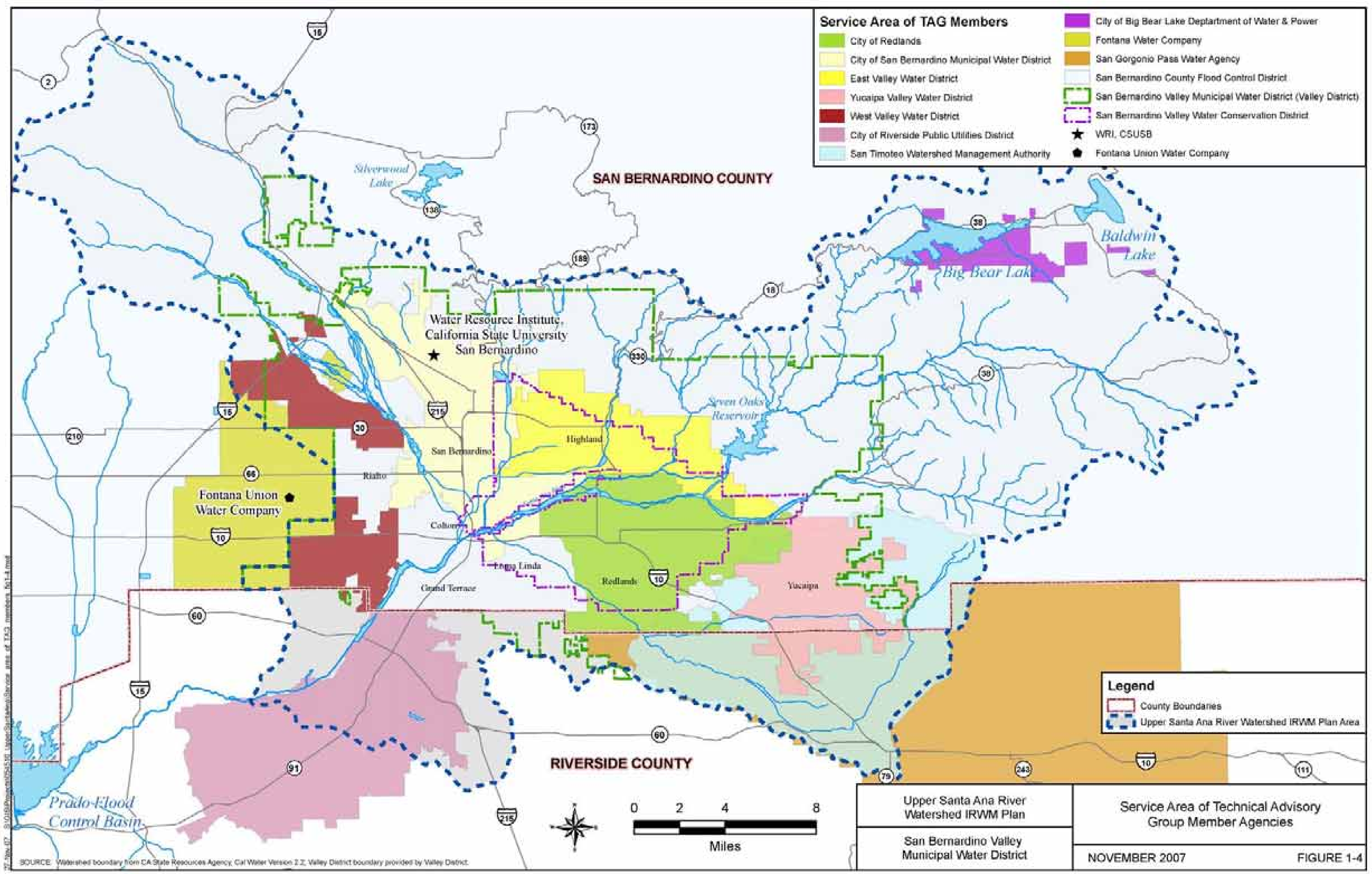
Valley District was formed in 1954, under the Municipal Water District Act of 1911 (California Water Code Section 71000 et seq.) as a regional agency to plan a long-range water supply for the San Bernardino Valley. It imports water into its service area through participation in the SWP and manages groundwater storage within its boundaries. Its enabling act includes a broad range of powers to provide water, wastewater and stormwater disposal, recreation, and fire protection services. Valley District does not deliver water directly to retail water customers.

Valley District covers about 325 square miles mainly in southwestern San Bernardino County, about 60 miles east of Los Angeles, and has a population of about 600,000. It spans the eastern two-thirds of the San Bernardino Valley, the Crafton Hills, and a portion of the Yucaipa Valley and includes the cities and communities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Fontana, Bloomington, Highland, East Highland, Grand Terrace, Mentone, and Yucaipa. A map illustrating Valley District's service area and the locations of other members of the TAG are shown in Figure 1-4.

Valley District is responsible for long-range water supply management, including importing supplemental water, and is responsible for most of the groundwater basins within its boundaries and for groundwater extraction over the amount specified in the aforementioned judgments. It has specific responsibilities for monitoring groundwater supplies in the San Bernardino and Rialto-Colton Subbasin and maintaining flows at the Riverside Narrows on the SAR. It fulfills its responsibilities in a variety of ways, including importing water through the SWP for direct delivery and groundwater recharge and coordinating water deliveries to retail agencies throughout its service area.

Valley District cooperates in a program to help replenish groundwater, using both SWP water and local runoff. It takes delivery of SWP water at the Devil Canyon Power Plant Afterbay, which is located just within its northern boundary. Water is conveyed 17 miles eastward to various spreading grounds and agricultural and wholesale domestic delivery points in the San Bernardino Basin. Water is also conveyed westward for direct delivery in the Colton-Rialto Subbasin.

Figure 1-4
Service Area of Technical Advisory Group Member Agencies



In the 1960s, the over-commitment of water in the SAR watershed led to lawsuits between water users in the upper and lower watersheds regarding the use of both surface flows and groundwater. The lawsuits culminated in 1969 in the Orange County and Western Judgments as they were previously described. Under the terms of the settlements, Valley District became responsible for providing a specified SAR base flow to Orange County and maintaining the safe yield of the SBBA. If the conditions of either judgment are not met by the natural water supply, including new conservation, Valley District is required to deliver supplemental water to offset the deficiency. The judgments resolved the major water rights issues that had prevented the development of long-term, region-wide water supply plans and established specific objectives for the management of the groundwater basins.

Valley District is legally required to maintain a flow equivalent to approximately 15,250 acre-feet per year at the Riverside Narrows on the SAR. This requirement is currently met with about 25,000 acre-feet per year of treated wastewater from the Cities of San Bernardino, Colton, and Rialto that is discharged to the SAR. Valley District has contracts with the Cities of San Bernardino and Colton that obligate a portion of their treated wastewater flows to meet this requirement. As a result of this discharge and normal streamflow in the SAR, Valley District has never had to use imported water to augment flows in the SAR. In addition, under terms of the adjudication, as of the end of the 2003-2004 water year, Valley District had 275,423 acre-feet in credit for flows in excess of requirements during prior years. It could, if needed, use these water credits to meet this part of its legal obligation during dry years, subject to a minimum annual flow of 12,420 acre-feet at the Riverside Narrows.

In March 2006, Valley District and DWR entered into an agreement and signed a contract to receive funding for the preparation of the IRWM Plan. Valley District, as the regional lead agency, is responsible for the IRWM Plan completion.

1.8.2 San Bernardino Valley Water Conservation District

The mission of the SBVWCD is to ensure that recharge of the Bunker Hill groundwater basin is accomplished in an environmentally and economically responsible way using local native surface water to the maximum extent practicable.

The SBVWCD and its predecessors have conducted water conservation (groundwater recharge) activities since 1912 or earlier in two areas that overlie the Bunker Hill groundwater basin in the San Bernardino Valley. These areas are at the upper end of the SAR wash area and on Mill Creek just upstream of the confluence with the SAR (collectively, the wash area). The SBVWCD diverts surface water flows during both storm and normal runoff from the SAR and Mill Creek and channels the flows into two separate systems of recharge basins where it percolates into the groundwater basin for later pumping and use by local entities and private producers.

The SBVWCD's boundaries encompass more than 78.1 square miles and include portions of the communities of San Bernardino, Loma Linda, Redlands, and Highland, as well as the unincorporated county area of Mentone and various county "islands" within the incorporated cities.

1.8.3 City of Redlands

For more than 90 years, the City of Redlands has been providing high-quality drinking water to the Redlands and Mentone areas. Currently, the city has 21,000 water service connections. The city completed and adopted an UWMP in 2005.

More than 75,000 residents in Redlands, Mentone, parts of Crafton Hills and San Timoteo Canyon, and a small part of San Bernardino depend on the Redlands Municipal Utilities Department to provide water service to their homes and businesses. By supplying a blend of local groundwater, local surface water, and water imported from the SWP, the Redlands Municipal Utilities Department meets its customers' daily demands, which average 25 million gallons per day and peak at 48 million gallons per day.

The city also owns and operates a sewer collection system and a six million-gallon-per-day water reclamation plant that produces water for use at the Southern California Edison Mountainview Power Plant and by other irrigation users.

1.8.4 West Valley Water District

West Valley Water District (West Valley) is located mainly within southwestern San Bernardino County and to a lesser amount within northern Riverside County. It is part of the greater San Bernardino-Riverside-Ontario metropolitan area. It is situated in the San Bernardino Valley and within the SAR watershed.

The principal service area of West Valley is approximately 29.5 square miles, with an additional 5.2 square miles within its sphere of influence. The majority of its service area lies within Valley District's boundaries. West Valley currently has 18,000 water service connections. West Valley completed and adopted an UWMP in 2005.

1.8.5 East Valley Water District

East Valley Water District is a special district formed in 1954 through an election by local residents who wanted water service by a public water agency. Originally called the East San Bernardino County Water District, it was formed to provide domestic water service to the then unincorporated and agriculturally based communities of Highland and East Highland. Later, as the population increased, the need for a modern sewer system to replace the septic tanks became apparent. The residents voted to give East Valley Water District the responsibility for their sewer system, as they had done earlier with their water service.

Over the years, some of the service area was annexed to the City of San Bernardino, but water service remained with the district, primarily due to logistics and cost. In 1987, the City of Highland incorporated. Now, the district's previously agriculture-dominated area is urbanized, and few orange groves remain. Before September 2000, the service area was approximately 28.5 square miles. An annexation in September 2000 increased the service area by approximately five square miles and includes the Greenspot area. The district services approximately 65,000 persons. All services are financed solely by rates; customers pay only for the benefits and services they receive. The district currently has 21,827 water service connections.

The forefathers of the East Valley Water District, anticipating a higher demand and a larger customer base, obtained water rights that date back over 100 years for the use of surface water from the SAR. Today, this surface water meets one-quarter of the district's water needs. The district completed and adopted an Urban Water Management Plan in 2005.

1.8.6 San Bernardino Municipal Water Department

SBMWD meets its customers' needs by providing high-quality service in water supply, water reclamation, and geothermal heating.

SBMWD produces all of its own water, using 60 wells located in 45 square miles of water service area and delivering it to more than 40,000 service connections through 551 miles of water mains. The City of San Bernardino reclaims over 30 million gallons of water each day, using innovative and cost-effective methods to make the reclaimed water safe for the environment and for reuse. The city completed and adopted an UWMP in 2005.

1.8.7 Yucaipa Valley Water District

YVWD is a special district that provides water supply, treatment, and distribution; recycled water supply and distribution services; and wastewater collection and treatment. Formed in 1971, it acquired many of the private water companies serving the Yucaipa Valley. Its most recent consolidations of water services occurred with the acquisition of the Harry V. Slack Water Company in 1987 and the Wildwood Canyon Mutual Water Company in 1992. YVWD currently satisfies the majority of its water demands from groundwater supplied through district-owned wells located throughout the service area. An extensive distribution system provides water storage and transmission throughout YVWD's 18 pressure zones. The only supply of surface water is provided through the Oak Glen Water Filtration Plant. Additional water sources that are expected to be available to the district in the near future include imported water through the SWP and recycled water from its wastewater treatment plant. The district completed and adopted an UWMP in 2005.

1.8.8 City of Riverside

The City of Riverside Public Utilities (RPU) Department provides potable water, non-potable water, recycled water, and electricity to the City of Riverside and was established in 1895 (electricity) and 1913 (water). The City of Riverside currently serves water to a population of 287,800 through 62,985 service connections within an area of 73.9 square miles. RPU is committed to providing the highest quality water and electric services at the lowest possible rates to benefit the community. RPU completed and adopted a Water Supply Plan in 2004 and an UWMP in 2005.

RPU produced 79,275 acre-feet of water between July 2005 and June 2006. As of 2005, RPU's annual water export rights in Bunker Hill basin were about 52,033 acre-feet. Export rights may increase with acquisition of additional rights in mutual water companies. RPU produces water from other basins – Rialto-Colton, Riverside North, and Riverside South. Annual total water demand is expected to increase from 77,767 acre-feet in 2005 to an estimated 104,374 acre-feet by 2030. RPU plans to develop additional water resources to meet future growth in demand. By 2030, available and planned water resources to meet demand would total about 116,421 acre-feet per year.

1.8.9 Water Resources Institute /California State University, San Bernardino

The Water Resources Institute /California State University San Bernardino (WRI-CSUSB) was established by the faculty senate in 1999. The senate and the university administration recognized that water is one of the most precious resources in its service area (San Bernardino and Riverside Counties) and set out to make water an area of distinction at this campus.

The WRI-CSUSB operates an extensive water resource archive that includes maps; aerial photographs; newspaper articles; water and environmental reference books; and federal, State, and local government documents, studies, and reports. This archive is gradually being digitized to make it more accessible to users. It also includes water and environmental data and metadata, thus expanding the concept of an archive beyond the original concept of hard copies of old documents.

The WRI-CSUSB is an interdisciplinary center for research, policy analysis, and education. The full-time staff is engaged in a variety of partnerships providing technical assistance to public and private water stakeholders. The WRI-CSUSB specializes in integrated watershed projects promoting land use practices that minimize the impact of development on watershed functions. The WRI-CSUSB manages the Alluvial Fan Task Force for DWR by working with stakeholders in the watershed on resource-efficient guidelines for developing on alluvial fan floodplains. The WRI-CSUSB assists the Local Government Commission with presenting the Ahwahnee Water Principles for Resource Efficient Land Use to elected officials and developers on the connection between land use and water. The WRI-CSUSB partners with California Resources Connection, Inc. on the Inland Empire Sustainable Watershed Program developing Green Building Practices and Model Ordinances to overcome obstacles in resource-efficient land use.

1.8.10 San Bernardino County Flood Control District

The San Bernardino County Flood Control District (SBCFCD) was formed as a special district in April 1939 after the 1938 floods in the County of San Bernardino. The SBCFCD's functions include flood protection from major streams, flood control planning, storm drain management, debris removal programs, right-of-way acquisition, flood hazard investigations, and flood operations. The SBCFCD has numerous Master Plans of Drainage (MPD) for various areas within the county. An MPD is a coordinated plan of flood control improvements for an area based on its future planned development. It identifies existing flood control facilities that are inadequate to convey the 100-year peak storm flows, including needed improvements to existing facilities and new facilities that need to be constructed to provide an adequate level of flood protection. Since its inception, the SBCFCD has worked with United States Army Corps of Engineers (USACE) to develop federally funded major flood control facilities in the county. It manages its activities through six physical flood control zones. The budget projections are also determined for each zone through an annual budget study with most of the zones also having a 10-year plan. SBCFCD is also participating with Inland Empire Utilities Agency and Chino Basin Water Conservation District on the Chino Basin Recharge Improvement Project.

1.8.11 San Gorgonio Pass Water Agency

The San Gorgonio Pass Water Agency (SGPWA) was established in 1961 by the California State Legislature. Its boundaries extend through the cities of Calimesa, Beaumont, and Banning, and the Riverside County areas from Cherry Valley to Cabazon. The service area includes the incorporated cities of Calimesa, Beaumont, and Banning, and the communities of Cherry Valley, Cabazon, and the Banning Bench.

SGPWA, one of 29 State Water Contractors, purchases water from the State of California and sells it to local retail water agencies. Water is imported into the service area by the California Aqueduct. The final link of the SWP to the Pass region, the East Branch Extension, was completed in 2003. Phase 2 of the East Branch Extension is expected to be completed by 2011. Phase 2 will bring the capacity of the Extension to 17,300 acre-feet, which is the Agency's official allotment of SWP water. 17,300 acre-feet of water is enough to supply approximately 35,000 families each year.

SGPWA operates the Little San Gorgonio Creek Recharge Facility on Orchard Street in Cherry Valley. The facility includes six ponds in which SWP water is placed to percolate into the ground to recharge the Beaumont groundwater basin. The facility was partially funded by a Prop 13 grant from the State and SAWPA. SWP water is pumped to the facility via the East Branch Extension. The Cherry Valley Pump Station, located at the corner of Orchard Street and Taylor Street, is the terminal pump station on the Extension.

1.8.12 City of Big Bear Lake Department of Water and Power

The City of Big Bear Lake Department of Water and Power (BBLDWP) is nestled in the San Bernardino Mountains at approximately 6,750 feet above sea level. With more than 15,000 customers, BBLDWP is dedicated to providing the City of Big Bear Lake, Moonridge, Fawnskin, Sugarloaf, Lake William, and portions of Erwin Lake and Rimforest with a safe, reliable source of water for public health and safety.

BBLDWP's water supplies come from snow and rain that percolates into the groundwater basin. As of 2006, the BBLDWP service area is in its sixth year of drought and water efficiency is more important than ever for meeting water demands of the service area. BBLDWP does not use lake water for public health and safety and no additional water is imported into the Big Bear Valley.

Key components of the water system include adequate source capacity (wells) and storage capacity (reservoirs) to meet peak holiday and weekend demands; replacement of old, leaky, undersized steel mainlines to provide adequate fire flow; and ongoing/recurring rehabilitation of older system components (buildings, reservoirs, pumps, motors, etc.) to ensure reliable service.

BBLDWP maintains 50 wells, 13 booster stations, 17 reservoirs, 16 chlorination stations, 20 sample stations, approximately 170 miles of water main pipeline, and a complex pressure-reducing network.

BBLDWP has an aggressive water conservation program that has significantly reduced summertime consumption over the past several years. Community outreach programs keep customers informed on current water conditions, and the Technical Review Team monitors, evaluates, and analyzes well and water consumption data on a continual basis. BBLDWP's five-member Board of Commissioners is appointed by the City of Big Bear Lake's City Council and is made up of policy makers committed to safeguarding its water resources. BBLDWP is dedicated to fiscal responsibility while focusing its resources on improving the infrastructure and ensuring that the current and future water needs of the community are met. BBLDWP prepared an UWMP that was adopted in April 2006.

1.8.13 Fontana Union Water Company

Fontana Union Water Company (Fontana Union) is a mutual water company and does not directly deliver water to domestic customers. Fontana Union has long-standing adjudicated vested rights to Lytle Creek surface and subsurface flows and Lytle Creek Basin groundwater, as well as groundwater rights in Rialto Basin and "No Man's Land." It delivers its available water to its shareholders in accordance with its Articles of Incorporation, Bylaws, and mutual water company law. Fontana Union is 97 percent owned by Cucamonga Valley Water District and San Gabriel Valley Water Company. Fontana Water Company, a division of San Gabriel Valley Water Company, diverts and produces water pursuant to its rights as Fontana Union's agent in accordance with a court-approved agreement. Under that court-approved agreement, Fontana Union allocates its Chino Basin pumping rights to Cucamonga Valley Water District, and Cucamonga also retains the option of taking delivery of its share of Fontana Union's other water sources.

1.8.14 San Timoteo Watershed Management Authority

STWMA was formed in January 2001 by BCVWD, Beaumont, the South Mesa Water Company, and the YVWD. The purpose of the STWMA is to prepare and implement a water resources management program for the San Timoteo watershed and the waters tributary thereto in order to conserve local water supplies, improve surface and groundwater quality and quantity, protect and enhance groundwater storage and recreational resources, preserve open space, protect wildlife habitat and wetlands, protect and enhance agriculture, and develop and enhance the region's water resources for the benefit of the public. The water resources management program is to include watershed and basin monitoring; groundwater storage, banking and conjunctive use; stormwater capture and management; recycled water programs and projects; wetlands, wildlife, and open space protection; water quality protection and enhancement; and water conservation and efficiency.

1.8.15 Bear Valley Mutual Water Company

Bear Valley Mutual was formed in 1903 by the citrus growers of the Redlands/Highland area to give them a dependable water supply under their control. Bear Valley Mutual has pre-1914 water rights to the first 88 cfs of surface flow of the SAR. Bear Valley Mutual has appropriative rights on Bear Creek and a storage right in Big Bear Lake, as well as ownership of all the water inflow to the lake.

1.8.16 Beaumont-Cherry Valley Water District

BCVWD was formed in 1919 under the Wright Act of 1897 (Water Code Section 20000,et seq.) The District serves approximately eight square miles located in Riverside and San Bernardino Counties. BCVWD owns approximately 2,800 acres along Little San Gorgonio and Noble Creeks and holds pre-1914 water rights to both streams, which amounts to 3,000 miner's inches of water (approximately 45,000 acre-feet of right). The District has 20 wells in the Beaumont and Edgar Canyon Basins and currently serves about 30,000 consumers through 9,000 metered connections.

1.8.17 Big Bear Municipal Water District

Big Bear Municipal was formed in 1964 by the people of Big Bear Valley with the express purpose of stabilizing the level of Big Bear Lake. In January 1977, as a result of a stipulated judgment, Big Bear Municipal purchased title to the dam, reservoir lands lying beneath the lake, and the surface recreation rights to Big Bear Lake. As discussed above, Bear Valley Mutual has ownership rights to all water entering Big Bear Lake.

Big Bear Municipal is responsible for the following:

- Stabilization of the level of Big Bear Lake by managing the amount of water released to Bear Valley Mutual,
- Watershed/water quality management,
- Recreation management,

- Wildlife habitat preservation and enhancement, and
- Bear Valley Dam and Reservoir maintenance.

The judgment allows Big Bear Municipal to maintain a higher water level in the lake by delivering water to Bear Valley Mutual from an alternate source of water instead of from the lake. This alternate source of water is sometimes referred to as "in-lieu" water and mainly comes from the SWP. If Big Bear Municipal does not wish to purchase “in-lieu” water, it must deliver water from the lake to satisfy Bear Valley Mutual’s demands. Studies performed for Bear Valley Mutual have estimated average lake releases to be 4,279 acre-feet per year.

1.8.18 City of Colton Public Utilities Department

The City of Colton’s Public Utilities Department (Colton Public Utilities) provides water service within the City of Colton along with electric and wastewater service. Water sources include groundwater from the SBBA and the Rialto-Colton subbasin. Colton Public Utilities serves water to approximately 9,000 customers.

1.8.19 City of Loma Linda

The City of Loma Linda obtains groundwater from within the Bunker Hill subbasin area. Production facilities include six production wells, four above-ground steel reservoirs, and two in-ground pre-stressed concrete storage reservoirs, with a combined storage capacity of 14 million gallons. The reservoirs provide storage to the city's five different pressure zones. There are six pressure-reducing stations in the distribution system that lower water pressure from one zone to another to provide constant regulated pressure. To transfer water between zones, there are six booster stations located in the different zones. Loma Linda also has an “emergency” connection to the City of San Bernardino to meet its supplemental needs. The city’s population is approximately 20,000. Loma Linda also provides wastewater service.

1.8.20 City of Rialto

Residents of the City of Rialto obtain water from three purveyors: the Utilities Department of the City of Rialto (Rialto), West Valley, and Fontana Water Company (FWC). Rialto provides water service for approximately 12,000 connections. Generally, these are the more developed portions of the city (West Valley provides the water in the remaining areas).

Rialto obtains water from the Rialto-Colton groundwater subbasin, Lytle Creek Groundwater subbasin, SBBA, and the “Chino wells” (these wells are not located within the adjudicated boundaries of Chino Basin). In recent years, most of these sources have been impacted by groundwater contamination (most significantly, perchlorate contamination of the Rialto-Colton subbasin and the Chino wells). Rialto has adopted a “zero tolerance” policy for perchlorate, meaning that they will not serve water with any perchlorate even if it meets all of the public health standards. Rialto has installed treatment systems on some wells and is pursuing installation of additional treatment systems. In 2003, the City of Rialto declared a water shortage emergency in accordance with California Water Code Sections 350-359. Rialto operates wastewater service within the city and has recently initiated deliveries of recycled water to the California Department of Transportation. Rialto also produces and transports water to Marygold Mutual Water Company (Marygold) under a cooperative agreement that expires in 2008. Surface water treatment of Lytle Creek water is provided by a treatment plant operated by West Valley. Rialto owns a portion of the capacity of that plant.

1.8.21 Fontana Water Company

FWC, a division of San Gabriel Valley Water Company, is a public utility regulated by the California Public Utilities Commission. FWC’s service area covers approximately 52 square miles with boundaries including the San Gabriel Mountains to the north and the Riverside County Line to the south. FWC serves most of the City of Fontana and parts of Rancho Cucamonga, Ontario, and Rialto. FWC serves a population of approximately 158,000 with over 45,000 active service connections. Each year FWC produces between 45,000 – 50,000 acre-feet of water from water supply sources that include surface water from Lytle Creek and State Water Project water, which is treated at FWC’s Sandhill Water Treatment Plant and groundwater from the Lytle, Rialto, No-Mans Land, and Chino Basins. FWC diverts and receives Lytle Creek surface water and produces groundwater in the Lytle, Rialto, and No-Mans Land Basins as an agent for Fontana Union, which holds extensive water rights to these sources of supply pursuant to longstanding court judgments.

1.8.22 Marygold Mutual Water Company

Marygold serves customers generally located in the unincorporated community of Bloomington. Marygold obtains water from the Chino Basin (Marygold has rights to the appropriative pool of Chino Basin) and the SBBA. Water from the SBBA is currently produced and transported by Rialto under a cooperative agreement that expires in 2008.

1.8.23 Muscoy Mutual Water Company

Muscoy Mutual Water Company (Muscoy) serves the majority of the unincorporated community of Muscoy. The SBMWD serves the remainder of the Muscoy community. The community is located between the cities of San Bernardino and Rialto. All water produced by Muscoy is from the SBBA.

1.8.24 Regents of the University of California

The Regents have rights to water from the SBBA, which is used by the University of California Riverside (UCR). The water is delivered to UCR by the Riverside Public Utilities Department.

1.8.25 Riverside Highland Water Company

The Riverside Highland Water Company (Riverside Highland) serves both domestic and irrigation water in San Bernardino and Riverside Counties. Riverside Highland provides water to over 3,800 customers in the community of Grand Terrace located on the Riverside Mesa south of the SAR and a portion of the Highgrove area of Riverside County. RPU owns shares in Riverside Highland and has export rights to 333 acre-feet per year of Bunker Hill groundwater through those shares. Riverside Highland obtains water from the Lytle Creek subbasin, the SBBA, the Rialto-Colton subbasin, and the Riverside North Basin.

1.8.26 Other Water Purveyors in the Region

Other water purveyors in the region include the following:

- South Mesa Water Company serves water to part of the City of Calimesa.

- Terrace Water Company services an area located between the service areas of Colton Public Utilities and West Valley.

- Western Heights Mutual Water Company serves the southeast portion of the City of Redlands and a portion of the City of Yucaipa.

- Eastwood Farms Community Water Users Association provides water to a small portion of the City of Highland.

- Arroyo Verde Mutual Water District provides water to a small portion of the City of Highland.

- Victoria Farms Mutual Water Company serves a population of approximately 1,000.

- Inland Valley Development Agency is a joint powers authority comprised of San Bernardino County and the Cities of San Bernardino, Colton, and Loma Linda. Formed in 1990, the agency is responsible for the redevelopment of the non-aviation portion of the San Bernardino International Airport. A water integration agreement between the agency and the City of San Bernardino calls for the city taking over ownership and operation of the agency's water system.

- Devore Mutual Water Company serves an area near the intersection of Interstate 15 and Interstate 215.

- Running Springs Water District serves the community of Running Springs.

- Arrowhead Park County Water District serves an area adjacent to the Running Springs Water District.

- Big Bear City Community Services District provides water service for unincorporated areas near Big Bear Lake.

- The City of Riverside owns stock in several mutual water companies including the Meeks & Daley Water Company. Ownership interests in the Meeks & Daley Company entitle the City of Riverside to export rights of about 3,000 acre-feet from the Bunker Hill Basin. As of December 2007, the City of Riverside owns about 38.642 percent of the total shares of the Meeks & Daley Water Company. Meeks & Daley Water Company was incorporated on September 1, 1885, and is the successor company to three Mutual Water Companies - Meeks & Daley Water Company, Agua Mansa Water Company, and the Alta Mesa Water Company. Meeks & Daley Water Company provides water to the stockholders for agricultural purposes. To fund operating expenses, the company assesses all shareholders twice per year based on the number of shares owed on the date of the assessment.

  The company owns water rights in the Bunker Hill Basin and pumps water from a series of wells located within that basin, transporting this water through the Riverside and Gage Canals. At the end of the canal systems, Meeks & Daley Water Company operates a pipeline and pump station to deliver irrigation water to users in the southern portion of the City of Corona.

  With the construction of additional delivery facilities in 1996, Meeks & Daley Water Company began delivering water to OCWD under the Orange County Water Transfer Project, with water delivered to the SAR for storage behind Prado Dam and subsequent release and groundwater recharge downstream. Riverside owns 59 percent of the Gage Canal Company stock. This company owns surface water rights to the SAR.

1.9 Contents of the IRWM Plan

Chapter 1, **Introduction**, presents the background of the IRWM Plan, explaining the plan area and why it was selected, and describing the relationship between the IRWM Plan and other planning efforts occurring within the plan area or region. Previous water resources planning work that has influenced the plan is briefly reviewed along with the laws, judgments, and agreements that shape the existing conditions and institutional arrangements found in the region. Finally, this chapter lays out the purpose, need, and intent of the IRWM Plan, and the planning process used by the primary water agencies in the region to develop the plan.

Chapter 2, **Description of the Integrated Regional Water Management Plan Area,** provides a description of the existing physical and institutional conditions in the plan area. This chapter describes the water-related infrastructure, physical (climate, hydrology, groundwater, environment, water quality), and socioeconomic conditions that shape the region and influence plan development and implementation.

Chapter 3, **Water Budget for Integrated Regional Water Management Plan Region**, provides an overview of the published water budgets for the region, describes the data source(s), presents water demands and supplies, and anticipated future water demands and supplies conditions for each of the subareas within the region.

Chapter 4, **Develop Integrated Regional Water Management Plan,** describes the process used to develop the IRWM Plan and how the IRWM Plan is intended to serve as a roadmap for the management of water resources to ensure long-term, reliable water supplies. It defines the water management objectives and the water management strategies along with the specific projects and programs that will be required to help the region meet the stated objectives. This chapter also presents a process for actively managing the SBBA, the largest underground storage “reservoir” in the region.

Chapter 5, **Integrated Regional Water Management Plan Implementation**, describes implementation of the IRWM Plan including the identification of specific capital facilities, projects, and management actions to be implemented to help meet the established water management objectives. This chapter provides a realistic discussion of the obstacles that are likely to be encountered when implementing the IRWM Plan, and also discusses the impacts and benefits for the IRWM Plan and what is likely to occur if the plan is not put into place. The sources of funding and the institutional structures to be used to implement the plan are presented.

The report concludes with Chapter 6, **Data Management and Monitoring, Technical Analyses, and Plan Performance,** which describes the existing tools and techniques for data management and technical analyses conducted to evaluate planning alternatives, and determine the technical and scientific merit of the recommended actions. It also describes how data will be collected, managed, and reported in the future and how this information will be used to track the performance for each of the proposed projects and the overall IRWM Plan. The chapter discusses how the information and subsequent technical analysis will be used to update the plan as circumstances change and how the community will adopt the IRWM Plan.

Chapters 7 and 8 provide a glossary of terms and references, respectively. To keep the plan succinct and readable, much of the more detailed or technical information is presented in the appendices and the reader is directed to these materials for more information.

1.10 Meeting DWR Integrated Regional Water Management Plan Standards

DWR in collaboration with SWRCB has developed standards for preparation of IRWM Plans. Table 1-2 shows how the Upper Santa Ana River Watershed Integrated Regional Water Management Plan meets these standards.

Table 1-2
Upper Santa Ana IRWMP and State IRWM Plan Standards

Item from Minimum IRWM Plan Standards	Reference (Chapter, Section, Figure, Table #s of the IRWM Plan)
Adopted IRWM Plan	Plan will be adopted in December 2007
Regional Description, Study Period, and Appropriateness of Area for IRWM Plan	Sections 2.1 and 2.11
Formation of a Regional Water Management Group (TAG)	Section 1.7.1
Water Management Objectives and How They Were Developed	Sections 4.1, and 4.2
Water Management Strategies and How They Were Developed	Section 4.2
Integration of Water Management Strategies	Section 5.1
Regional Priorities and How They Were Developed	Section 5.3.5
Implementation Plan and Responsible Agencies	Sections 5.3.1 through 5.3.3
Impacts and Benefits of Regional Effects.	Section 5.6
Impacts and Benefits to Disadvantaged Communities and Other Resources.	Section 2.5.1
Technical Analysis to Develop IRWM Plan and Monitoring Systems to Measure Plan Performance	Chapter 6 and Section 4.2.1.6
Data Management, Data Dissemination, and Integration into SWAMP and GAMA	Section 6.2
Financing for Project Implementation and O&M	Section 5.4
Relationship between Local Planning and IRWM Plan	Sections 2.3, 2.4, 2.5, and 4.2.3.3
Plan Implementation Schedule	Section 5.3.4
Stakeholder Involvement and Coordination among Participating Agencies and with State and Federal Agencies	Sections 1.7.1.and 1.7.2
Public Outreach Activities Specific to Individual Stakeholder Groups	Sections 1.7.1 and 1.7.2
Processes that have been or will be Used to Facilitate Stakeholder Involvement and Communication during Plan Implementation	Sections 4.2.1.3.5 and 1.7.3
Partnerships Developed during the Planning Process Discussed	Sections 4.1, 4.2.1.3.2, and 4.2.1.3.5
Disadvantaged Communities were Identified and Environmental Justice Concerns Addressed.	Section 2.5, Table 2-4, and Figure 2-3

2 Description of the Integrated Regional Water Management Plan Area

2.1 Location

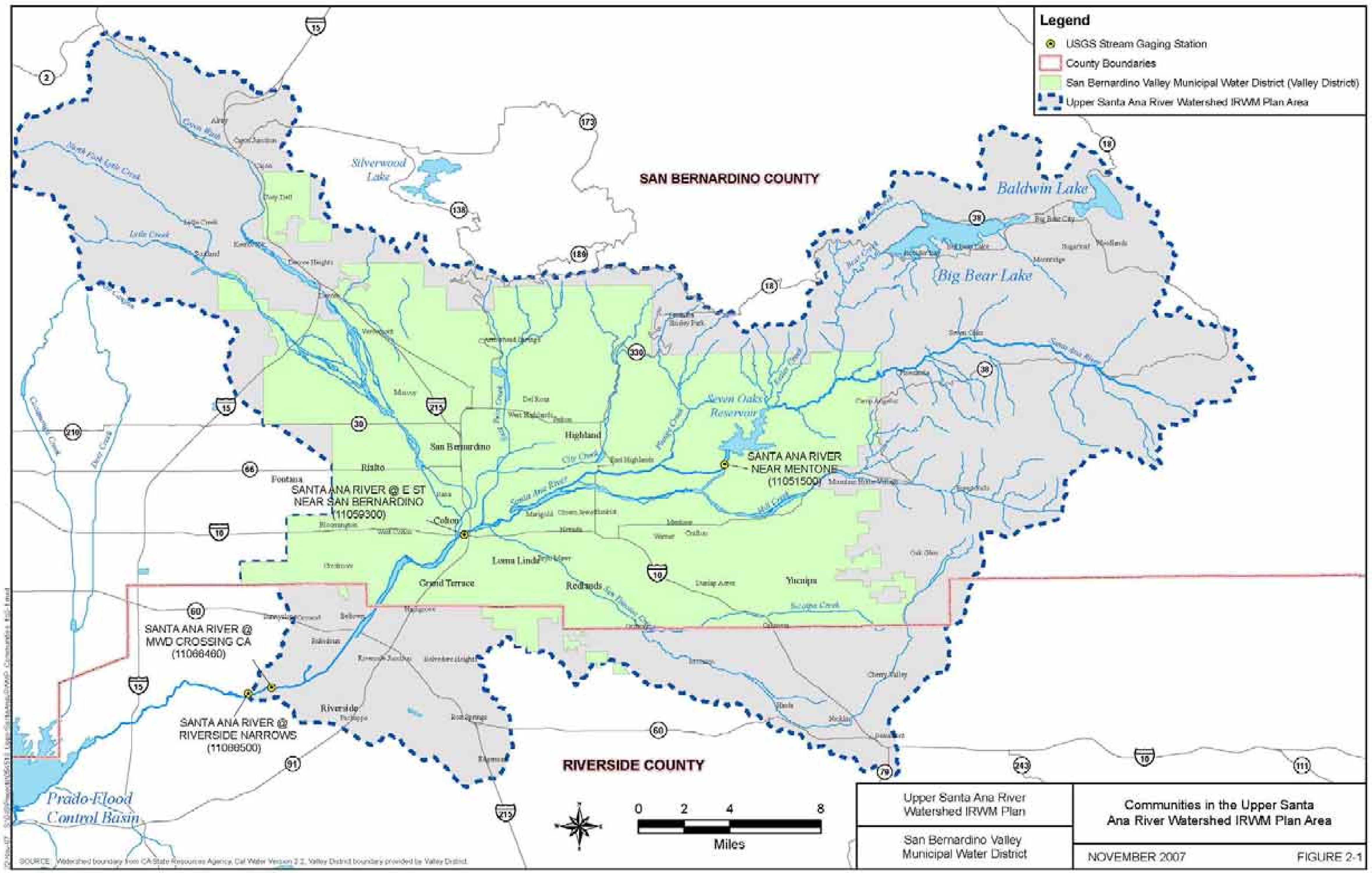
The Santa Ana River (SAR) is the largest stream system in Southern California. The headwaters originate in the San Bernardino Mountains and are discharged to the Pacific Ocean approximately 100 miles to the southwest between Newport Beach and Huntington Beach. The SAR watershed covers over 2,650 square miles of widely varying forested, rural, and urban terrain and covers the more populated urban areas of San Bernardino, Riverside, and Orange Counties, as well as a lesser portion of Los Angeles County. Disputes over the use of water in the SAR led to the subdivision of the watershed into the Upper SAR watershed and Lower SAR watershed at Prado Dam.

2.1.1 General Integrated Regional Water Management Plan Region

The Upper Santa Ana River Watershed Integrated Regional Water Management Plan (IRWM Plan) Area (Region) covers 852 square miles, approximately 32 percent of the total SAR watershed, and is primarily located in San Bernardino and Riverside Counties. The Region includes Big Bear Lake, the cities and communities of San Bernardino, Yucaipa, Redlands, Highland, Rialto, Mentone, Colton, Grand Terrace, Loma Linda, Beaumont, and Riverside (Figure 2-1). This region was selected for the IRWM Plan in large part because of the following factors:

- Rapid population growth in the area and the potential for continued rapid growth in the future.
- Significant institutional issues, hydrological characteristics, and court judgments separate the Upper SAR watershed from the downstream portion of the watershed at the Riverside Narrows just upstream from Prado Dam. The Orange County Water District v. City of Chino, et al., Case No. 117628 (Orange County Judgment) and the Western Municipal Water District of Riverside County v. East San Bernardino County Water District, Case No. 78426 (Western Judgment), which were discussed in more detail in Chapter 1, have significant influence on water management of the Upper SAR and dictate, to some degree, how water resources should be managed in the Upper SAR watershed.

Figure 2-1
Communities in the Upper Santa Ana Region



- The Upper SAR watershed is a region with unique physical characteristics. The Upper SAR has a widely variable hydrology, a demography that includes a high rate of population growth and urban development, and challenging water management issues, including the need to make use of local water supplies to make the region self-sufficient. The agencies in the Region plan to coordinate and manage among them the groundwater spreading and pumping and to establish a cooperative, integrated plan that will reduce or eliminate historical water right conflicts among the water agencies in the Upper SAR watershed.

- Groundwater basins in the Upper SAR watershed are generally separated from the lower basin. The groundwater basin in which most Region-related activities take place is the San Bernardino Basin Area (SBBA), which is composed of the Bunker Hill and Lytle Creek subbasins. A discussion of groundwater basins within the Region is presented later in this chapter.

The Region is defined by the area that contributes surface runoff to the Riverside Narrows at U.S. Geological Survey (USGS) Gage 11066500. The USGS has operated this site as a continuous record gaging station since March 1970. Specific conductance, temperature, and total dissolved solids (TDS) are collected bi-monthly. There are numerous tributaries that contribute flow to the main stem of the SAR in the region, including Mill Creek, City Creek, Plunge Creek (a tributary of City Creek), Mission Zanja Creek (located just upstream of the San Timoteo Creek), San Timoteo Creek, East Twin Creek, Warm Creek, and Lytle Creek.

2.2 Climate

Climate in the Region is characterized by relatively hot, dry summers and cool winters with intermittent precipitation. The largest portion (73 percent) of average annual precipitation occurs during December through March and rainless periods of several months are common in the summer. Precipitation is nearly always in the form of rain in the lower elevations and mostly in the form of snow above about 6,000 feet mean sea level (msl) in the San Bernardino Mountains. Mean annual precipitation ranges from about 12 inches in the vicinity of Riverside, to about 20 inches at the base of the San Bernardino Mountains, to more than 35 inches along the crest of the mountains. The long-term (water years 1883-84 through 2001-02)[1] mean annual precipitation recorded at the San Bernardino County Hospital Gage is 16.4 inches. The historical record indicates that a period of above-average or below-average precipitation can last more than 30 years, such as the recent dry period that extended from 1947 to 1977. Historical streamflow statistics for the SAR at the Metropolitan Water District of Southern California (Metropolitan) Crossing (located near the Riverside Narrows) show that flows vary widely from year to year. The median annual flow for SAR at Metropolitan Crossing is 75,900 acre-feet per year. During water years 1969-1970 through 2000-2001, annual flows have ranged from a high of 301,000 acre-feet to a low of 9,800 acre-feet. These data are indicative of highly variable streamflows.

Three types of storms produce precipitation in the SAR Basin: general winter storms, local storms, and general summer storms. General winter storms usually occur from December through March. They originate over the Pacific Ocean as a result of the interaction between polar Pacific and tropical Pacific air masses and move eastward over the basin. These storms, which often last for several days, reflect orographic (i.e., land elevation) influences and are accompanied by widespread precipitation in the form of rain and, at higher elevations, snow. Local storms cover small areas, but can result in high intensity precipitation for durations of approximately six hours. These storms can occur any time of the year, either as isolated events or as part of a general storm, and those occurring during the winter are generally associated with frontal systems (a “front” is the interface between air masses of different temperatures or densities). General summer storms can occur in the late summer and early fall months in the San Bernardino area, although they are infrequent.

The Region has an annual precipitation that ranges from 12 inches in low areas to 40 inches along the crest of the mountains.

1 A water year runs from October through September of the following year. For example, water year 2000- 2001 begins on October 1, 2000, and ends on September 30, 2001.

2.3 Population

2.3.1 Historic Population and Housing Growth in the Plan Area

The Region covers part of the two-county area of San Bernardino and Riverside. Population figures for 1990 and 2000 for Riverside and San Bernardino Counties are presented in Table 2-1. Over the decade of the 1990s, both counties experienced substantial increases in population—32.6 percent for Riverside County (with an average rate of 3.3 percent annually) and over 21 percent for San Bernardino County (2.1 percent annually). The population of the two-county Region increased by over 681,400 persons or over 26 percent (2.6 percent annually) during this time period.

Table 2-1
Riverside and San Bernardino County Population, 1990 and 2000

Area	Population		Change: 1990-2000	
	1990	2000	Number	Average Annual Percent
Riverside County	1,170,413	1,551,943	381,530	3.3%
San Bernardino County	1,418,380	1,718,312	299,932	2.1%
Source: U.S. Census 1990 and 2000.				

In the period from 1990–2000, housing units in Riverside and San Bernardino counties grew 15.6 percent.

The number of housing units contained in the two counties grew from about 1,026,200 in 1990 to 1,186,000 in 2000. This increase of 15.6 percent took place at an average annual rate of 1.5 percent.

Population of the San Bernardino Valley Municipal Water District's (Valley District) service area between 2000 and 2005 grew by 56,000 or 10.5 percent, which is about a 2 percent growth annually. Population of the IRWM Plan Area grew by 21,200 from 2000 to 2005.

2.3.2 Future Population Growth in the Region and Valley District Service Area

The Southern California Association of Governments (SCAG) adopted the "2001 RTP Socioeconomic Forecast" in November 2006 that includes population projections for consecutive five-year increments from 2000 to 2025 for various geographic areas (SCAG 2001). Table 2-2 presents these data for Riverside and San Bernardino Counties. The counties are projected to experience average annual growth rates of 3.4 percent and 2 percent, respectively, between 2000 and 2025.

Table 2-2
SCAG County Population Projections, 2010-2025

Area	Population						Change: 2000-2025		
	2000[a]	2005	2010	2015	2020	2025	Number	Percent	Average Annual Percent
Riverside	1,551,943	1,842,690	2,077,800	2,347,300	2,620,500	2,876,300	1,324,357	85%	3.4%
San Bernardino	1,718,312	1,919,145	2,059,400	2,229,700	2,397,700	2,558,700	840,388	48.9%	2%
[a]Based on 2000 U.S. Census information.									

Estimates of future populations were developed for this plan using U.S. Census 2000 block-level data. The service area boundaries were overlaid digitally on census maps using a Geographic Information System (GIS). Where census blocks were split by service area boundaries, the proportion of the census block contained in the service area was calculated and used to prorate the population of the particular census block to the respective service area.

The Valley District service area had a population of 585,000 in 2000, of which approximately 583,482 lived in San Bernardino County. The remaining persons lived in Riverside County. The population contained in the Valley District service area comprises about 34 percent of the population of San Bernardino County and less than 0.1 percent of the Riverside County population.

Over the period 2000 to 2025, and using SCAG county-level population projections, the number of residents in the service areas of Valley District and the IRWM Plan area is projected to increase by approximately 199,500 and 297,800, respectively (Table 2-3).

Table 2-3
Population of Plan Area and Valley District Service Area, 2000-2025

Service Area	2000[a]	2005	2010	2015	2020	2025	Change: 2000-2025	
							Number	Percent
Valley District	585,003	641,004	680,100	719,800	751,200	784,500	199,497	34.1
San Bernardino County	1,718,312	1,919,145	2,059,400	2,229,700	2,397,700	2,558,700	840,388	48.9
IRWM Plan Area	870,866	892,048	958,400	1,034,400	1,101,700	1,168,700	297,834	34.2

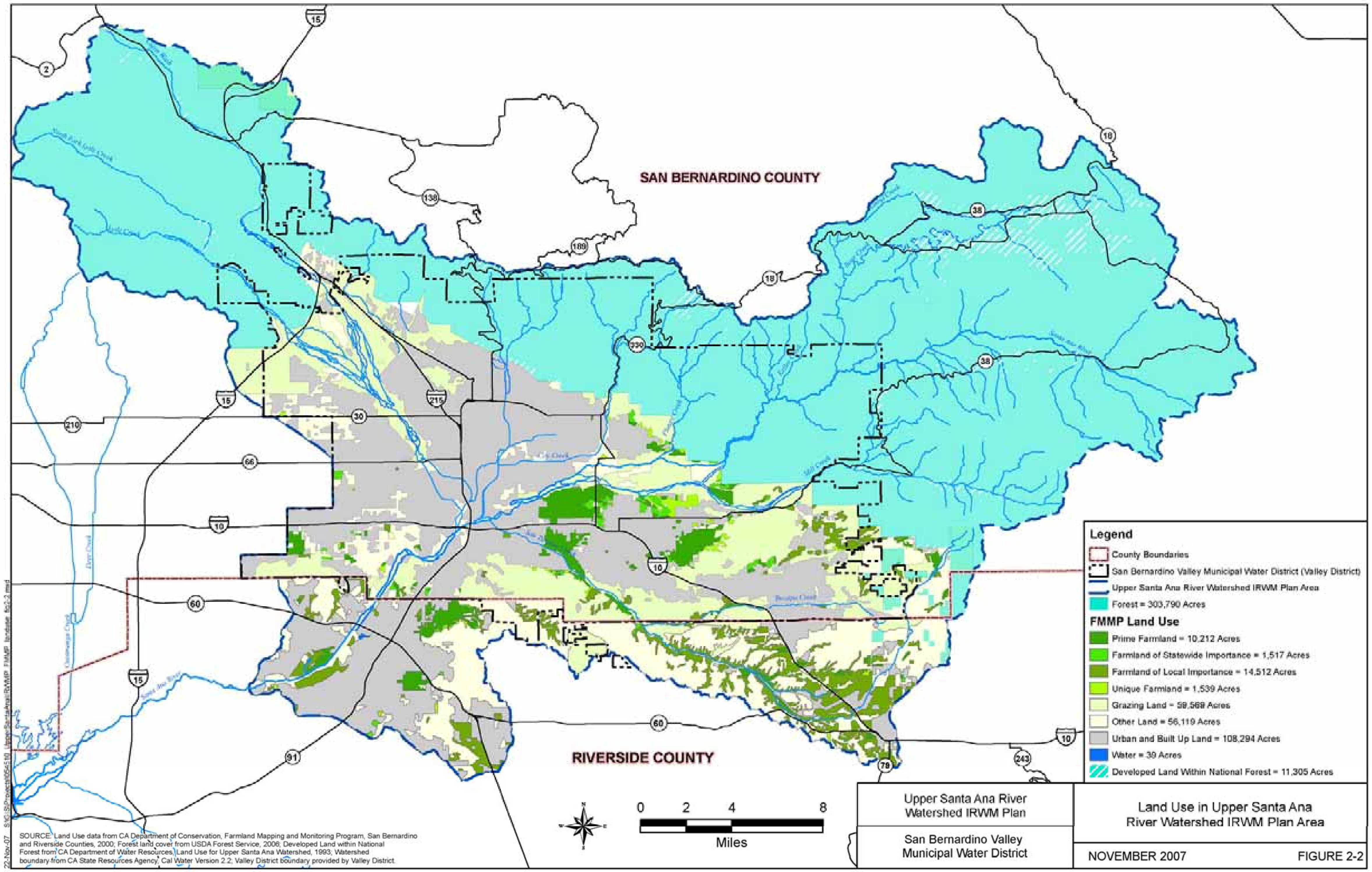
[a.] Based on 2000 U.S. Census information for the service area populations as of April 2000.

2.4 Land Use and Agricultural Lands Stewardship

Figure 2-2 presents the 2005 land use within the Region. The total area of the Region is 549,570 acres, of which 303,790 acres, or about 55 percent, are covered by the national forest located in the easterly and northerly areas of the Region. In addition to the national forest, native vegetation covers about 86,400 acres or about 16 percent of the Region. Agriculture acreage is being replaced by urban areas, and agriculture only represents a little over two percent of the land use of the Region today. Urban areas are about 15 percent of the Region. The large areas of agricultural land use are south of the SAR.

A number of local land use agencies have approved general plans and specific plans in the Region. These plans are relevant to this IRWM Plan. These local land use planning agencies play a major role in zoning and land use decisions in the Region. The California Government Code contains statutes addressing the subject of the applicability of local land use controls on planning and construction of public water facilities. However, it is generally the practice of Valley District and other local agencies to voluntarily comply with the standards specified in applicable local land use and building code regulations.

Figure 2-2
Land Use



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2.5 Economic Condition and Social and Cultural Composition of the Region

Food preparation and service, teaching, and construction jobs are the fastest growing employment opportunities in the Region.

Like most communities in Southern California, the Upper Santa Ana region has seen a continued increase in population and change in the economic base as agricultural and vacant land is replaced with residential housing, leading to urban and service sector jobs. The fastest growing jobs projected between 2001 and 2008 include food preparation and service, teaching, and construction, all generally showing more than a 25 percent increase. Services, retail trade, government, and manufacturing constitute the majority of jobs in the area, followed by construction, transportation, and wholesale trade. Employment growth in San Bernardino County is the third highest in the State of California (State), with a relatively low current unemployment rate of about 4.6 percent. Population estimates doubled between 1970 and 1990, increased better than 20 percent between 1990 and 2000, and continued to rise at a 14 percent rate from 2000 to 2005. San Bernardino County and Riverside County now rank fourth and fifth in county population in California, respectively. Continued residential and job growth is expected in the area.

Much of the population growth of the Upper Santa Ana region since the 1970s is linked with the economies of Los Angeles and Orange Counties because they are within commuter range, and the housing prices in the Upper Santa Ana region are more affordable. Also, population growth over the past three decades is attributed to a marked increase in immigration from Mexico, Latin America, and the Pacific Rim.

2.5.1 Composition of Population and Tribe

Most of the Region is considered economically disadvantaged. An economically disadvantaged community is defined by the State as a community with a median annual household income of 80 percent or less than the State median annual household income. In 2000, the State's annual median family income was $47,493. Figure 2-3 shows the economically disadvantaged communities in the Region. Table 2-4 presents median annual family incomes in service areas for various water purveyors. Communities within the service areas of the City of Rialto, City of San Bernardino, East Valley Water District (East Valley), and a number of mutual water companies are considered economically disadvantaged. Water management strategies evaluated and considered for the IRWM Plan are designed to improve water supply reliability and water quality for these communities in the Region. The disadvantaged communities are dispersed throughout the Plan Area, and are served water by different water purveyors. The location of disadvantaged communities relative to project locations determines the range and extent of benefit a given project provides to an individual disadvantaged community.

Figure 2-3
Economically Disadvantaged Communities

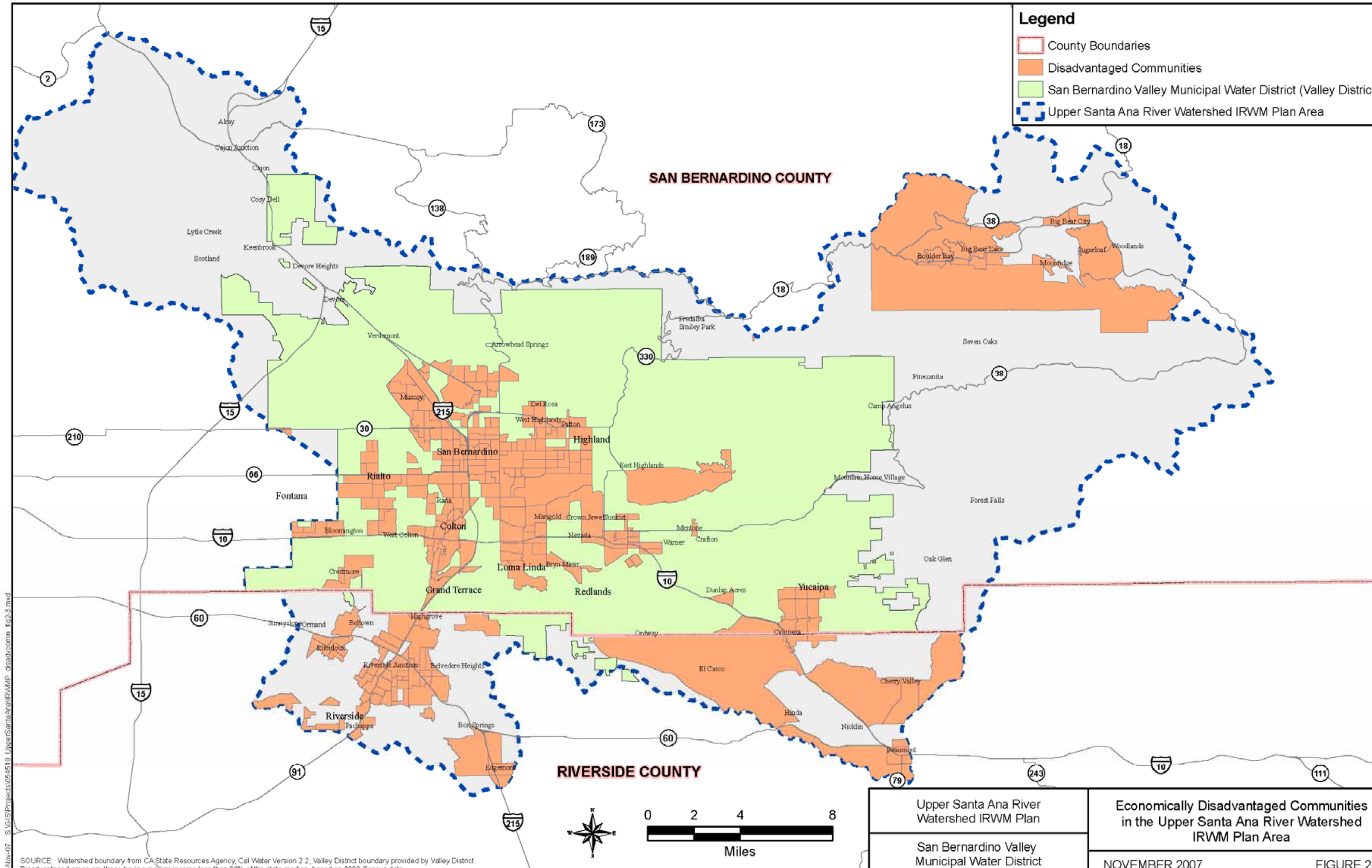


Table 2-4
Median Annual Household Income for Water Purveyor and Water Agency Service Areas

Service Area	Median Income 2000	Percent of State Median 2000
Baseline Garden Mutual	24,274	51%
Bear Valley Mutual Water Company	48,838	103%
Bear Valley Mutual Water Co./Lugonia Water Company	51,717	109%
Beaumont-Cherry Valley Water District	44,004	93%
Big Bear City Community Services District	38,165	80%
Big Bear Municipal Water District	32,764	69%
City of Beaumont	34,543	73%
City of Big Bear Lake Department of Water and Power	37,044	78%
City of Colton	41,506	87%
City of Loma Linda	43,353	91%
City of Redlands	53,413	112%
City of Rialto	39,072	82%
City of San Bernardino	38,310	81%
Devore Mutual Water Company	63,074	133%
East Valley Water District	54,337	114%
Eastern Municipal Water District	49,717	105%
Eastwood Farms Community Water Users Association	20,334	43%
Fontana Water Company	54,256	114%
Inland Valley Development Agency	22,917	48%
Jurupa Community Services District	53,679	113%
Marygold Mutual Water Company	30,160	64%
Muscoy Mutual Water Company	28,328	60%
Riverside Highland Water Company	51,834	109%
Riverside Public Utilities District	46,349	98%
Rubidoux C.S.D.	41,827	88%
Running Springs Water District	64,330	135%
San Gorgonio Pass Water Agency	39,091	82%
San Timoteo Watershed Management	50,849	107%
South Mesa Water Company	37,683	79%
Terrace Water Company	43,299	91%
Victoria Farms Mutual Water	36,069	76%
West Valley Water District	51,961	109%
Western Heights Water Company	73,029	154%
Western Municipal Water District	47,277	100%
Yucaipa Valley Water District	61,135	129%
Valley District	**39,354**	**83%**
State	**47,493**	**100%**

Source: U.S. Census Bureau, Census 2000

For example, the larger, regional projects provide water supply reliability and/or water quality benefits to a water provider's service area or the Plan Area in total. While these projects do not specifically target disadvantaged communities, the benefits of the project may extend to one or more disadvantaged communities.

In addition there are individual projects located within the disadvantaged communities that directly benefit those areas by improving water supply reliability and/or water quality to the targeted disadvantaged community.

Various tribes of Native Americans inhabited the Region in the past. Today, the San Manuel Band of Mission Indians and Morongo Band of Mission Indians are present in the region. Ethnic data for 2000 (Source: 2000 Census PL94) include 44 percent White, 39.2 percent Hispanic, 8.8 percent African American, 0.57 percent Native American, and 7.43 percent others.

2.6 Major Water-Related Infrastructure in Region

The water-related infrastructure of the Upper SAR watershed reflects the complex water history of the Region. The predecessors of many of the water agencies that are participating in this plan were constructing ditches in the 1800s. The water rights and facilities established at that time have helped determine the structure of today's water agencies and the arrangement of today's infrastructure. After State Water Project (SWP) facilities were extended into the Region in the early 1970s, State Water Contractors receiving deliveries from the East Branch, Valley District, San Gorgonio Pass Water Agency (SGPWA), and Metropolitan constructed pipelines to take advantage of the imported water. Figure 2-4 shows the major water-related infrastructure in the Region.

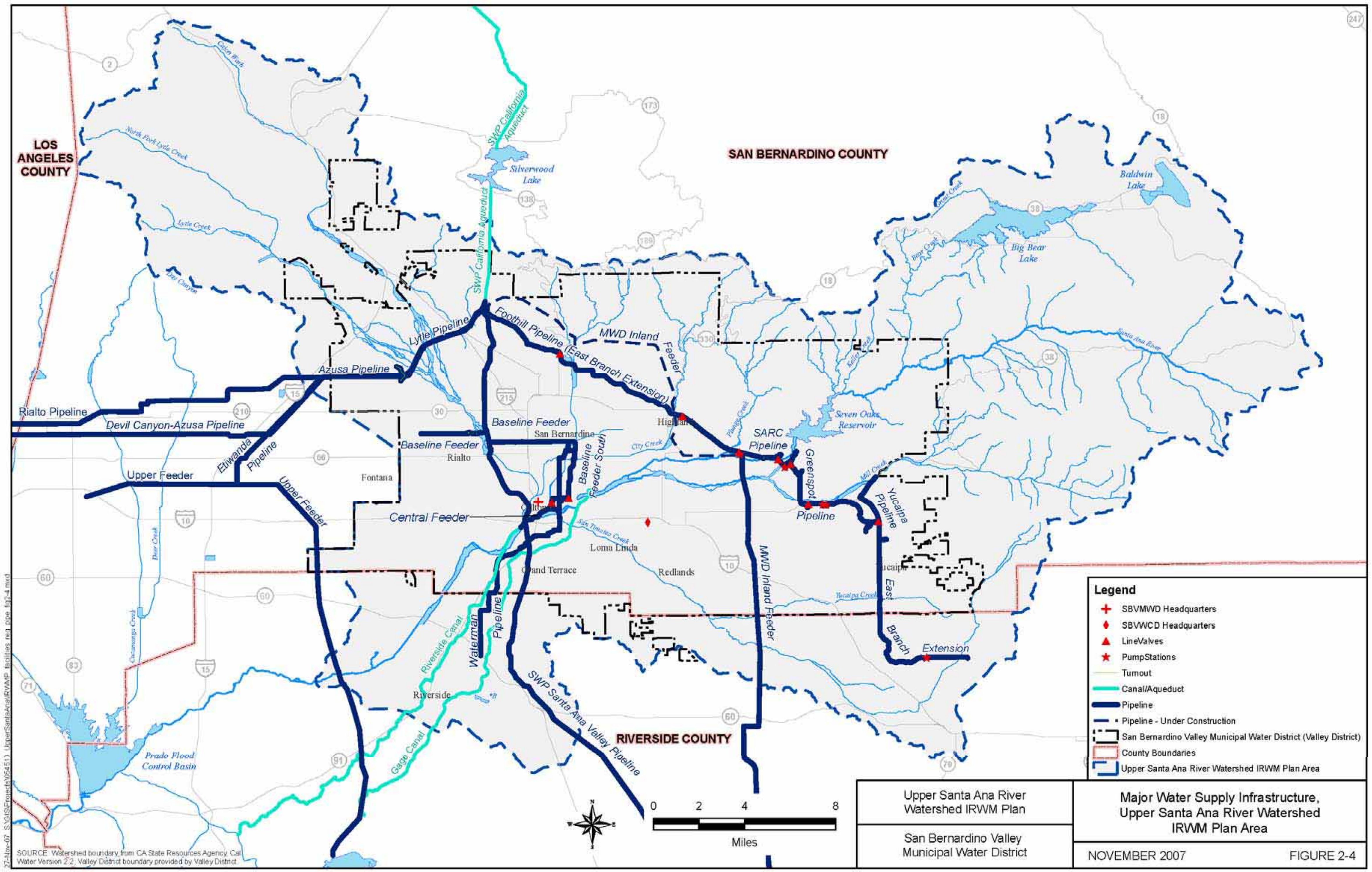
2.6.1 State Water Project Facilities

SWP water is imported into the Upper SAR watershed via the East Branch of the California Aqueduct. At the Devil Canyon Power Plant, located at the foot of the San Bernardino Mountains near Interstate 215, SWP water can be delivered in several directions in State facilities or in transmission systems belonging to three State Water Contractors.

The SWP Santa Ana Pipeline extends south, roughly paralleling Lytle Creek and on to Lake Perris. Deliveries can be made to Metropolitan member agencies including Western Municipal Water District (Western), Eastern Municipal Water District, and the San Diego County Water Authority.

The East Branch Extension of the SWP is a combination of facilities built by the Valley District and the State and funded by Valley District and SGPWA. Valley District operates these facilities for the State and for SGPWA. The East Branch Extension makes deliveries from Devil Canyon east along the foothills of the San Bernardino Mountains and as far as SGPWA. Portions of the East Branch Extension, including the Foothill Pipeline, are used to implement the Santa Ana River-Mill Creek Cooperative Water Project Agreement (Exchange Plan). This agreement provides for a three-level exchange that allows Valley District to deliver water to the Yucaipa area by exchanging SAR and Mill Creek water among ten agencies. In the past, the Foothill Pipeline was also used to deliver local water to Devil Canyon Afterbay and on to Metropolitan, the West Valley Water District (West Valley), and Fontana Water Company (FWC). The State is currently evaluating an increase in the capacity of the East Branch Extension.

Figure 2-4
Major Water-Related Infrastructure



2.6.2 State Water Contractors Facilities

Four State Water Contractors have facilities in the Region: Valley District, SGPWA, Metropolitan, and the San Gabriel Valley Municipal Water District.

Metropolitan's Inland Feeder will ultimately extend from Devil Canyon to Diamond Valley Lake when the tunnels within the San Bernardino Mountains are complete. Currently, the Foothill Pipeline is being used to make deliveries of SWP water to the completed portions of the Inland Feeder for delivery to Diamond Valley Lake.

Metropolitan's Rialto Pipeline is used to make deliveries from Devil Canyon to Metropolitan's F.E. Weymouth Treatment Plant in the San Gabriel Valley and to its Robert B. Diemer Treatment Plant, which supplies treated water to Western and Eastern Municipal Water District . In addition, the Rialto Pipeline makes deliveries to surface water treatment plants owned by Metropolitan's member agencies and to groundwater recharge facilities.

The San Gabriel Valley Municipal Water District's Devil Canyon-Azusa Pipeline is used primarily to make deliveries for replenishment of the Main San Gabriel Basin for the accounts of Alhambra, Azusa, Monterey Park, and Sierra Madre. Valley District owns capacity in this pipeline. Through this pipeline, Valley District can deliver SWP water to the western portion of its service area including West Valley and FWC as well as the Cactus Spreading Basins.

Many of Valley District's facilities have been integrated into the SWP and were described in the previous section. In addition, Valley District has three pipelines that are not integrated into the SWP. These are the Baseline Feeder, Baseline Feeder Extension South, and the Central Feeder.

The Baseline Feeder is a 48-inch pipeline that serves potable water from the San Bernardino Basin Area (SBBA) to the City of Rialto, West Valley, and Riverside-Highland Water Company. It is possible that the current hydraulic grade of this pipeline (1370 msl) will be reduced to match the Lower Zone (1249 msl) of the City of San Bernardino. The Baseline Feeder Extension South Pipeline is a 78-inch pipeline that was constructed north/south in alignment from the vicinity of 9th Street and Waterman Avenue in San Bernardino, south past the Antil area where there is a major concentration of production wells, and on to the vicinity of the SAR. This pipeline has been integrated into the Lower Zone of the City of San Bernardino and will ultimately serve water from the SBBA throughout Valley District's service area and on to Riverside County.

Valley District is currently constructing a portion of the Central Feeder, in an east/west alignment in San Bernardino Avenue from Opal Avenue Westerly to Texas Street in Redlands. The Central Feeder Pipeline may eventually be extended and connected to the Baseline Feeder Extension South Pipeline and possibly to the Santa Ana Valley Pipeline.

2.6.3 Regional Water Supply Infrastructure

The SBBA is a major source of water supply for agencies in San Bernardino and Riverside Counties. The three major transmission systems used to deliver water to the City of Riverside are the Gage Canal, Waterman Pipeline, and the Riverside Canal. The Gage Canal is owned by the Gage Canal Company. As of 2005, the City of Riverside owned approximately 59 percent of the Gage Canal Company. The canal extends from the SAR near Loma Linda to the Arlington Heights area. The Gage Canal is used to deliver both potable and irrigation water.

The Riverside Canal is a 12-mile canal extending from the City of Colton to Jefferson Street in the City of Riverside. Non-potable water from Colton and Riverside North Groundwater Basin is conveyed in the Flume Pipeline to the Riverside Canal.

2.6.4 Regional Flood Control Infrastructure

The Upper SAR watershed consists of many tributaries flowing to the SAR. These tributaries are in various states of development from natural stream to concrete-lined channels. Many of the streams flow through heavily developed areas. The San Bernardino County Flood Control District (SBCFCD) operates and maintains many of these tributary systems deemed "regional" (750 cubic feet per second or greater of flow and/or 640 acres or greater of watershed) as well as portions of the SAR.

The San Timoteo flood channel is a concrete-lined flood channel.

2.7 Surface Hydrology

Surface hydrology of the Region is comprised of the SAR and its tributaries. A number of surface reservoirs in the Region are operated primarily for agricultural and urban water use, but are also regulated for instream flows and recharge of groundwater basins. The following sections describe the surface hydrology of the Region.

2.7.1 Natural Runoff

Runoff records provide information on the characteristics of flow in the SAR and its tributaries. Such records are available for a number of stream gaging stations located on the mainstem of the SAR and throughout the SAR watershed. The SAR runoff records demonstrate the highly variable nature of river flow, with large floods and long periods of extremely low flow. Three gaging stations provide streamflow data for the Upper SAR. Mentone Gage (USGS record 11051500) is representative of SAR flow near Seven Oaks Dam. There are two other USGS gaging stations located downstream of Seven Oaks Dam, but within the Upper SAR basin—the "E" Street Gage (USGS Gage 11059300) located in the City of San Bernardino at river mile (RM) 57.69 and the Metropolitan Water District Crossing Gage (Metropolitan Crossing) (USGS Gage 11066460) located at RM 45.7 near Riverside Narrows. Table 2-5 provides the annual median,[1] maximum, and minimum streamflow recorded at the River Only Mentone, "E" Street, and Metropolitan Crossing gages. (See Figure 2-1.)

Flow in the SAR is highly variable from year to year. Flow in the SAR increases downstream due to inflows from tributaries, rising water,[2] and treated water from wastewater treatment plants (WWTPs). SAR flows at the "E" Street Gage include flows from Mill Creek and San Timoteo Creek but not from Lytle and Warm Creeks, which enter the SAR below the "E" Street Gage. SAR flows at the Metropolitan Crossing include inflows from Lytle and Warm Creeks, two large public WWTPs, and rising water.

Flows in excess of about 70,000 acre-feet per year have a frequency of occurrence of only 10 percent at the River Only Mentone Gage, whereas this same flow has a frequency of occurrence of over 60 percent at the Metropolitan Crossing Gage. Additionally, in the upstream areas, minimum annual streamflows are generally much smaller than minimum annual flows in the downstream areas.

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1 Median is a measure of central tendency, as is mean (average). The median represents the 50th percentile, i.e., if data are sorted from highest value to lowest value, the median value is the value in the exact center of the range. The median is a more appropriate measure of central tendency than the mean when data are highly skewed.

2 Rising water is used to describe noticeable increases in streamflow in reaches where a subsurface restriction forces groundwater to the surface.

Table 2-5
Upper SAR Median, Maximum, and Minimum Annual Flow (in acre feet)

	Median Annual Flow	Maximum Annual Flow	Minimum Annual Flow
River Only Mentone [a]	7,991	204,812	9
"E" Street [b]	25,525	319,976	0
Metropolitan Crossing [c]	75,934	301,004	9,979

Source: USGS gage data.
a. USGS Gage 11051500. Period of record is WY 1911-12 through WY 1999-00.
b. USGS Gage 11059300. Period of record is WY 1938-39 through WY 1953-54, WY 1966-67 through WY 2000-01.
c. USGS Gage 11066460. Period of record is WY 1969-70 through WY 2000-01.

The largest monthly flows typically occurred in February and March, and the lowest monthly flows typically occurred between August and October. Although streamflow increases downstream, the timing of flows (i.e., when the monthly maximums and minimums occur) is similar to the timing of flows observed at the Mentone Gage.

There are numerous tributaries that contribute flow to the mainstem of the SAR in the Region, including Mill Creek, City Creek, Plunge Creek (a tributary of City Creek), Mission Zanja Creek (located upstream of San Timoteo Creek), San Timoteo Creek, East Twin Creek, Warm Creek, and Lytle Creek. The flow (under 100-year flood conditions[1]) contributed by each of these tributaries is provided in Table 2-6. As a reference, during a 100-year flood event, Seven Oaks Dam would release up to 5,000 cubic feet per second (cfs) (U.S. Army Corps of Engineers (USACE) 1988).

Table 2-6
Tributary Flow Contribution to the SAR (100-Year Flood Event Discharge in cfs)

Tributary	Inflow	River Mile
Mill Creek	19,500	68.67
City Creek & Plunge Creek (Combined)	5,000	62.87
Mission Zanja Creek	3,500	59.08
San Timoteo Creek	15,500	58.44
East Twin Creek	18,000	58.14
Lytle Creek & Warm Creek (Combined)	70,000	56.74

Source: USACE 2000.

1 A flood as defined under the Standard Flood Insurance Policy is a general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters or from the unusual and rapid accumulation of runoff of surface waters from any source. A 100-year flood refers to a flood level with a 1 in 100 percent chance of being equaled or exceeded in any given year.

Urbanization taking place in the valley areas of the SAR Basin has resulted in increased responsiveness of the basin to rainfall. The increase in impervious surfaces (such as roofs, roads, parking lots, etc.) and constructed drainages to remove surface water from urban areas has resulted in decreased groundwater infiltration and increased runoff from urban areas. These actions have reduced the lag time between peak rainfall and peak runoff (i.e., constructed drainage systems move water from the urban areas to the river faster than this water would move if the land was not developed).

Compared to a basin without the influence of urbanization, the same rainfall occurring over an urbanized segment of the basin will result in higher peak discharges, a shorter lag-time to the peak discharge, and an overall larger volume of water entering the local drainage channels. Because the SAR Basin is experiencing rapid growth, increased urbanization of the basin is expected to continue; therefore, this trend in increased discharge and decreased lag times between peak rainfall and peak streamflow is expected to continue in the future.

2.7.2 Imported Water

Imported water from the SWP is available to the study area through Valley District and the SGPWA. Valley District is the fifth largest State Water Contractor, with an annual entitlement of 102,600 acre-feet. Valley District lies on the East Branch of the California Aqueduct and takes delivery of SWP water at the Devil Canyon Power Plant. From this location, Valley District can deliver water to the west via the San Gabriel Valley Municipal Water District Pipeline (Valley District owns capacity in this pipeline) or to the east through the East Branch Extension of the SWP. SGPWA is downstream of Valley District on the East Branch of the California Aqueduct.

Water availability through the SWP is intermittent and subject to frequent shortages. As a result, Valley District's "Rules for Service" require that all of its customers have a 100 percent backup for any amount of water they order from the SWP.

Redlands Wastewater Treatment Plant

2.7.3 Wastewater

There are 14 publicly owned WWTPs located above Prado Dam downstream of the Narrows (SAR Watermaster 2003). Nine of these plants contribute to surface flow of the SAR. Between 1970 and 2000, the total volume of treated wastewater contributions to SAR flows increased from 44,000 acre-feet per year to 169,000 acre-feet per year (SAR Watermaster 2003).

Three wastewater treatment plants (Redlands, Beaumont, and Yucaipa) discharge to the SAR and its tributaries upstream of the

City of San Bernardino, but these discharges generally do not flow continuously to the SAR at "E" Street (SAR Watermaster 2003). Two plants, the Rapid Infiltration and Extraction (RIX)[1] WWTP in the City of Colton and the Rialto WWTP in the City of Rialto, discharge directly to the SAR via a discharge channel at RM 53.46. Wastewater discharges from these plants have hydraulic continuity to the SAR above Riverside Narrows. Combined wastewater discharge from these two plants has risen from around 22,000 acre-feet per year in water year 1970-1971 to 57,750 acre-feet per year in water year 2000-2001 (SAR Watermaster 2003). The combined wastewater discharge is expected to increase to about 59,000 acre-feet per year, with both facilities operating at their respective design capacities. (See Table 2-7.)

Table 2-7
Treated Wastewater Discharged Directly to the SAR above Riverside Narrows

Facility	Current Discharge (acre-feet per year)	Potential Future Discharge (acre feet per year)
RIX	49,407 [a]	44,900
Rialto	8,346 [a]	14,200
Total Discharges Directly to the SAR in the Project Area	57,753	59,000

Notes:
[a] Based on 2000-2001 water year data reported in the Thirty-Second Annual Report of the SAR Watermaster (SAR Watermaster 2003).

Despite the likelihood that WWTP discharges will increase in the future, not all of the treated water may enter the SAR. Several cities and utilities are in the process of developing plans to recycle water, which could decrease discharges to the river. For example, the City of San Bernardino is currently evaluating a program to sell approximately 18,000 acre-feet per year of tertiary effluent (of a total potential discharge of approximately 44,900 acre-feet per year) from the RIX facility. Valley District contracted with the City of San Bernardino to ensure that the RIX facility continues to release quantities of treated effluent to the SAR adequate to fulfill Valley District's obligations to provide 15,250 acre-feet of baseflow each year at the Riverside Narrows as called for in the Orange County Judgment.

[1] The RIX WWTP went into operation in 1996 and provides tertiary treatment to all of the effluent from the Colton and San Bernardino Water Reclamation Plants. Prior to 1996, effluent from these plants entered the SAR just above and just below "E" Street, respectively.

2.7.4 Surface Water Quality

The SAR Basin is within the boundaries of the Santa Ana Regional Water Quality Control Board (SARWQCB). The SARWQCB has divided the mainstem of the SAR into six reaches. Reaches 1 through 6 have reach numbers beginning at the Pacific Ocean and increasing upstream. Reaches 3 through 6 are located in the Upper SAR Basin. These reaches are described in more detail below, from upstream to downstream.

2.7.4.1 Reach 6 (RM 70.93 and Above)

This reach includes the river upstream of Seven Oaks Dam where flows consist largely of snowmelt and storm runoff and water tends to be of excellent quality (SARWQCB 1995).

2.7.4.2 Reach 5 (RM 70.93 to RM 57.68)

This reach extends from Seven Oaks Dam to the Bunker Hill Dike (San Jacinto fault), which marks the downstream edge of the Bunker Hill groundwater basin. This reach tends to be dry except during storm flows. The lower end of this reach sometimes has rising groundwater and San Timoteo Creek flows on an intermittent basis (SARWQCB 1995).

2.7.4.3 Reach 4 (RM 57.68 to RM 49.00)

This reach includes the SAR from Bunker Hill Dike downstream to Mission Boulevard Bridge in Riverside. The bridge is the upstream limit of rising groundwater resulting from the constriction at Riverside Narrows. Until about 1985, most water in the reach percolated to the local groundwater leaving the lower part of the reach dry. However, flows in the lower end of this reach may now intermittently contain rising groundwater and flows from San Timoteo Creek.

2.7.4.4 Reach 3 (RM 49.00 to RM 30.50)

This reach includes the SAR from Mission Boulevard Bridge in Riverside to Prado Dam. At the Riverside Narrows, rising groundwater feeds several small tributaries including Sunnyslope Channel, Tequesquite Arroyo, and Anza Park Drain (SARWQCB 1995).

The SARWQCB states that the quality of the SAR is a function of the quantity and quality of the various components of the flows (SARWQCB 1995). Three components make up the flow of the water in the SAR: (1) storm flows, (2) baseflow, and (3) non-tributary flow. The relative proportion of these components varies throughout the year.

The first component, storm flows, results directly from rainfall, usually occurring between the months of December and April. Much of the rainfall and surface water runoff from the storms is captured and percolated into the groundwater basins. The quality of storm flow water is highly variable.

Baseflow makes up the second component of water flow in the SAR, a large portion coming from the discharge of treated wastewater into the river in addition to rising groundwater in the basin. This baseflow includes the non-point source discharges as well as the uncontrolled and unregulated agricultural and urban runoff. Water quality objectives are set in relation to the baseflow in the river, not to the total flow in the river (see Table 2-8). The intent of these objectives is to protect the river's groundwater recharge beneficial use. Compliance with these objectives is verified by annual measurement of the baseflow quality.

The quantity and quality of baseflow is most consistent during the month of August. At that time of year the influence of storm flows and non-tributary flows is at a minimum and volumes of rising water and non-point source discharges tend to be low.

The major component of baseflow in August is municipal wastewater. For these reasons, this period has been selected by the SARWQCB as the time when baseflow will be measured and its quality determined. To determine whether the water quality and quantity objectives for baseflow in Reach 3 of the SAR are being met, the SARWQCB collects a series of grab and composite samples during August of each year. The results are compared with the continuous monitoring data collected by USGS and data from other sources.

The SARWQCB sets discharge requirements on wastewater discharges, the major source of baseflow in the SAR. Waste discharge requirements are developed on the basis of the limited assimilative capacity of the river. Non-point source discharges, generally from urban runoff and agricultural tailwater, are regulated by requiring compliance with Best Management Practices (BMPs), where appropriate.

The third component of flow in the SAR that influences water quality is characterized by the SARWQCB as non-tributary flow. Non-tributary flow is generally imported water released in the upper basin for recharge in the lower basin (SARWQCB 1995).

Table 2-8
SAR Basin Surface Water Quality Objectives (WQO)*

Inland Surface Streams Upper SAR Basin	Water Quality Objectives milligrams per liter (mg/L)						
	Total Dissolved Solids (TDS)	Hardness ($CaCO_3$)	Sodium (Na)	Chloride (Cl)	Total Inorganic Nitrogen (TIN) [a]	Sulfate (SO_4)	Chemical Oxygen Demand (COD)
Reach 2 - 17th Street in Santa Ana to Prado Dam	650 [b]	---	---	---	---	---	---
Reach 3 - Prado Dam to Mission Blvd. - Baseflow	700	350	110	140	10[a]	150	30
Reach 4 - Mission Blvd. in Riverside to San Jacinto Fault	550	---	---	---	10	---	30
Reach 5 - San Jacinto Fault in San Bernardino to Seven Oaks Dam	300	190	30	20	5	60	25
Reach 6 - Seven Oaks Dam to Headwaters	200	100	30	10	1	20	5

Source: SARWQCB 1995.
[a.] Total nitrogen, filtered sample.
[b.] Five-year moving average.
[*] A number of amendments to the WQOs of the Basin Plan have been proposed. However, these proposed amendments do not include changes to the WQOs applicable to Reaches 3 through 6 of the SAR (SARWQCB 2004).

2.7.4.5 Water Quality Measurement Activities

A recent USGS study conducted by the National Water Quality Assessment Program entitled, *Concentrations of Dissolved Solids and Nutrients in Water Sources and Selected Streams of the Santa Ana Basin, California, October 1998-September 2001,* examined concentrations of TDS and nutrients in selected Santa Ana Basin streams as a function of water source. The principal water sources considered in the study were mountain runoff, wastewater, urban runoff, and storm flow. The USGS study of water quality conditions in the SAR and tributaries focused on TDS and nutrient conditions representative of baseflow water of mountain sites, baseflow of the valley floor, and storm flow.

The USGS reports that streams on the Santa Ana Basin generally have increasing dissolved minerals as one goes downstream. This effect is due to the fact that water is used, recycled, and used again. The magnitude or amount of TDS concentration rises with each use of water. The USGS report notes that rising groundwater also enters basin streams in some reaches, and their sampling indicated that some of the highest TDS (and in some cases nitrates) may occur at sites on the valley floor that are dominated by rising groundwater. Nitrate concentrations are higher in Santa Ana Basin streams receiving treated wastewater than in streams without treated wastewater. The principal source of nitrate is fertilizer from historic agricultural operations.

While there are basin plan objectives for multiple constituents, water quality monitoring has focused on two constituents, TDS and nitrogen. These constituents have been reported at levels at or near regulatory standards and have thus been the focal point of regulatory activities.

Table 2-9 provides a summary of the available historical surface water quality data for TDS and nitrogen at points along the SAR.

Table 2-9
Average Historic Surface Water Quality for Locations on the SAR (1990-2001)

Water Quality Constituent	Metropolitan Crossing Gage (Reach 3)[*]	RIX-Rialto Effluent Outfall (Reach 4)[*]	Mentone Gage (Reach 5)[*]
TDS	560 [a]	520 [b]	230 [a]
TDS Basin Plan Objective by Reach	700	550	300
Total Inorganic Nitrogen (TIN)	7.3 [a]	8.5 [b]	0.3 [a]
TIN Basin Plan Objective by Reach	10 [c]	10	5

Source: USGS gage data. Data for River Only Mentone Gage begins in October 1998. Data for Riverside Narrows Gage begins in August 1997.
[a.] USGS 2004.
[b.] The TDS and TIN values assigned for RIX-Rialto are the maximum values that occurred during 2001-2002 as reported in Table 4.4-9 of the City of San Bernardino Municipal Water Department RIX Facility Recycled Water Sales Program Preliminary Environmental Impact Report (PEIR), March 2003.
[c.] Total nitrogen, filtered sample.
[*] Proposed amendments to the Basin Plan do not include changes to the water quality objectives in Reaches 3 through 6 of the SAR (SARWQCB 2004).

2.7.4.6 Imported Water Quality

Water is imported to the SAR Basin from the Colorado River via the Colorado River Aqueduct (CRA), owned and operated by Metropolitan, and from Northern California via SWP facilities. The TDS level in the CRA water averages approximately 700 mg/L and, during drought years, can increase to above 900 mg/L (Metropolitan and USBR 1999). Salinity projections for wet year conditions show TDS values between 650 and 800 mg/L (Metropolitan and USBR 1999). SWP water is suitable for most beneficial uses due to its low TDS levels of 200 to 300 mg/L (California Department of Water Resources (DWR) 2003a). However, TDS levels of SWP water can vary due to drought conditions, flood events, reservoir management practices, and salt input from local streams.

2.8 Geologic Setting and Groundwater Systems

The IRWM Plan Area lies on the south slope of the Transverse Ranges Geologic Province. The Transverse Ranges are an east-west trending series of steep mountain ranges and valleys. The east-west structure of the Transverse Ranges is oblique to the normal northwest trend of coastal California, hence the name *Transverse*. The province extends offshore to include San Miguel, Santa Rosa, and Santa Cruz Islands. Its eastern extension, the San Bernardino Mountains, has been displaced to the south along the San Andreas fault. Intense north-south compression is squeezing the Transverse Ranges. As a result, this is one of the most rapidly rising regions on earth.

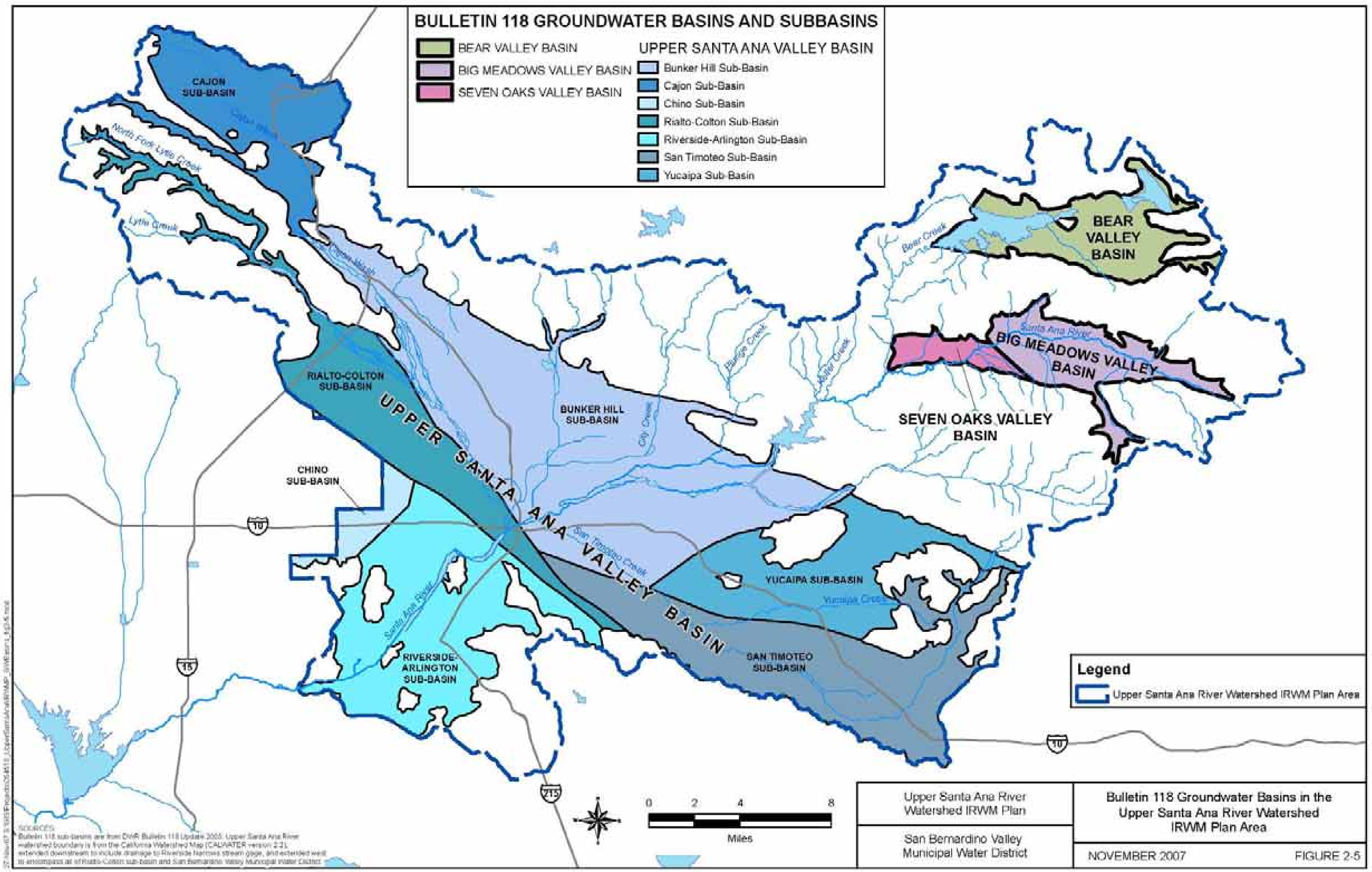
2.8.1 Groundwater Basins in the Upper Santa Ana Region

DWR Bulletin 118 shows four groundwater basins within the Region. They include Bear Valley, Big Meadows, Seven Oaks Valley, and the Upper Santa Ana Valley. The first three basins are small, with a combined storage capacity of approximately 66,000 acre-feet. The Upper Santa Ana Valley Groundwater Basin consists of nine subbasins: Bunker Hill, Rialto-Colton, Riverside-Arlington, San Timoteo, San Jacinto, Cajon, Yucaipa, Chino, and Cucamonga. Cucamonga subbasin is entirely outside this IRWM Plan Area and will not be discussed in the plan. Very small portions of the Chino and San Jacinto subbasins are within the IRWM Plan Area. Because of the small contribution of these two subbasins in overall groundwater management of the planning area, they will not be discussed in the plan. Portions of the San Timoteo and Riverside-Arlington subbasins are within the planning area. Bunker Hill, Rialto-Colton, Yucaipa, and Cajon subbasins are entirely within the Plan Area. Bunker Hill subbasin is the largest groundwater basin in the Upper SAR watershed. The storage capacity of this subbasin is 5,976,000 acre-feet (Table 2-10). A brief description of the groundwater basins and subbasins of the plan area is presented below. The basins and subbasins of the Region are mapped by DWR for Bulletin 118 as shown in Figure 2-5.

Table 2-10
Groundwater Basins in Upper Santa Ana Region

Groundwater Basin	DWR Groundwater Basin Number	Surface Area – (acres)	Groundwater Storage Capacity - 1000 acre-feet
Upper Santa Ana Valley:	8-02		
Bunker Hill Subbasin	8-02.06	89,600	5,976
Cajon Subbasin	8-02.05	23,200	—
Rialto-Colton Subbasin	8-02.04	30,100	2,517
Riverside-Arlington Subbasin	8-02.03	58,600	243
San Timoteo Subbasin	8-02.08	73,100	2,010
Yucaipa Subbasin	8-02.07	25,300	808
Bear Valley	8-09	19,600	42
Big Meadows	8-07	14,200	10
Seven Oaks Valley	8-08	4,080	14

Figure 2-5
Bulletin 118, Groundwater Basins in the Upper Santa Ana Region



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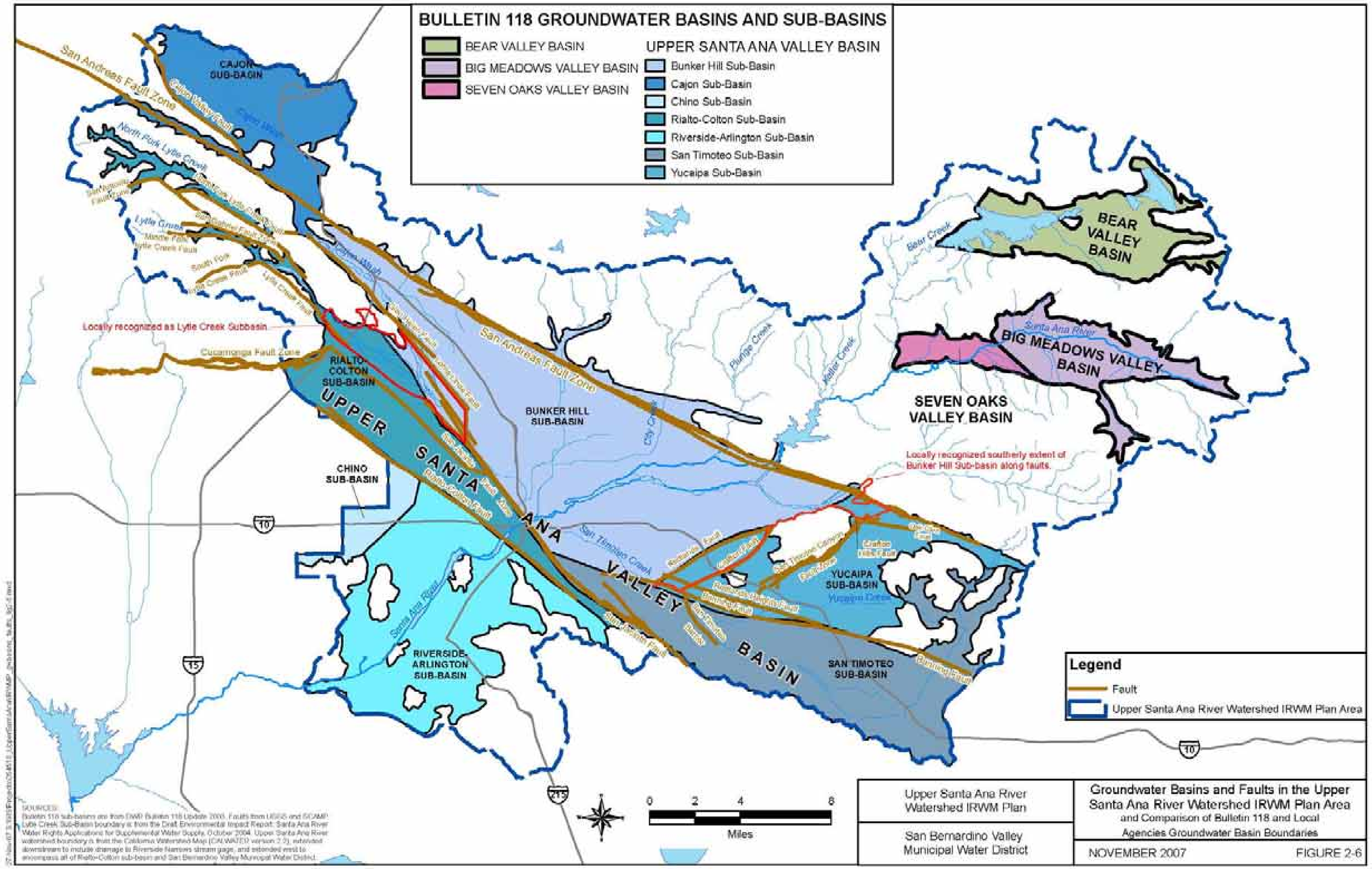
2.8.1.1 Upper Santa Ana Valley

Bunker Hill Subbasin (DWR 8-02.06)

The Bunker Hill subbasin consists of the alluvial materials that underlie the San Bernardino Valley. The basin is bordered on the northwest by the San Gabriel Mountains and Cucamonga fault zone; on the northeast by the San Bernardino Mountains and San Andreas fault zone; on the east by the Banning fault and Crafton Hills; and on the south by a low, east-facing escarpment of the San Jacinto fault and the San Timoteo Badlands (see Figure 2-6). Alluvial fans extend from the base of the mountains and hills that surround the valley and coalesce to form a broad, sloping alluvial plain in the central part of the valley. Within the central portion of the valley, relatively continuous clay produces confining conditions to underlying water-bearing sediments resulting in artesian flowing wells, high groundwater, and, historically, marshlands. The SAR, Mill Creek, and Lytle Creek are the main tributary streams in the subbasin (SBVWCD 2000). Groundwater recharge in the Bunker Hill subbasin is performed by the San Bernardino Valley Water Conservation District (SBVWCD), Valley District, and others. The Groundwater Management Plan in this IRWM Plan is the mechanism to be used to manage recharge and extractions to minimize liquefaction threats and maximize yield. The Western-San Bernardino Judgment (1969) combines the Bunker Hill subbasin with additional areas and classifies it as the SBBA. More discussion of the SBBA is included later in this report.

Figure 2-6
Groundwater Basins and Faults in the Region



Rialto-Colton Subbasin (DWR 8-02.04)

The Rialto-Colton subbasin underlies a portion of the upper Santa Ana Valley in southwestern San Bernardino County and northwestern Riverside County. This subbasin is about 10 miles long and varies in width from about 3.5 miles in the northwestern part to about 1.5 miles in the southeastern part. Figure 2-7 shows the location of the subbasin and pertinent features. This subbasin is bounded by the San Gabriel Mountains on the northwest, the San Jacinto fault on the northeast, the Badlands on the southeast, and the Rialto-Colton fault on the southwest. The SAR cuts across the southeastern part of the basin. The basin generally drains to the southeast, toward the SAR. Warm and Lytle Creek drains join near the southeastern boundary of the basin and flow to meet the SAR near the center of the southeastern part of the subbasin.

Water-bearing alluvium consists of gravel, sand, silt, and clay. Holocene-age alluvial deposits are found beneath the current courses of Lytle and Cajon Creeks. These Holocene deposits are typically less compacted and weathered than older deposits and have higher permeability (DWR 1970). Alluvial deposits of Pliocene and Pleistocene age are composed of somewhat compacted and weathered deposits of gravel, sand, silt, and clay in discontinuous lenticular bodies. The coarsest material occurs near the mouth of Lytle Creek and the material becomes finer toward the southeast where the coarsest gravels contain few cobbles.

The water-bearing units are grouped into three units—an upper, middle, and lower unit. Figure 2-8 shows the relationship of these water-bearing units. There are no distinct confining beds that separate the units. The upper unit includes the river deposits and alluvial fan deposits that grade to older river-channel deposits near the SAR. The upper unit ranges in thickness from a feather edge in the northwestern part of the basin to about 300 feet. The upper water-bearing unit was unsaturated in the northwestern part of the basin and was saturated in the southeastern part. The middle water-bearing unit exists throughout the basin and consists primarily of coarse-to-medium sand and interbedded fine sand and clay. The clay beds are more extensive in the northwestern part of the basin, southeast of Barrier J. The middle water-bearing unit is the main source of water to wells in the basin and is about 240 to 600 feet thick. The lower water-bearing unit exists throughout the basin, southeast of Barrier J and consists of interbedded sand and clay. This unit ranges from about 100 to 400 feet thick (Woolfenden 2001). Similar to the Bunker Hill subbasin, consolidated deposits underlie the lower water-bearing unit and form the base of the groundwater basin.

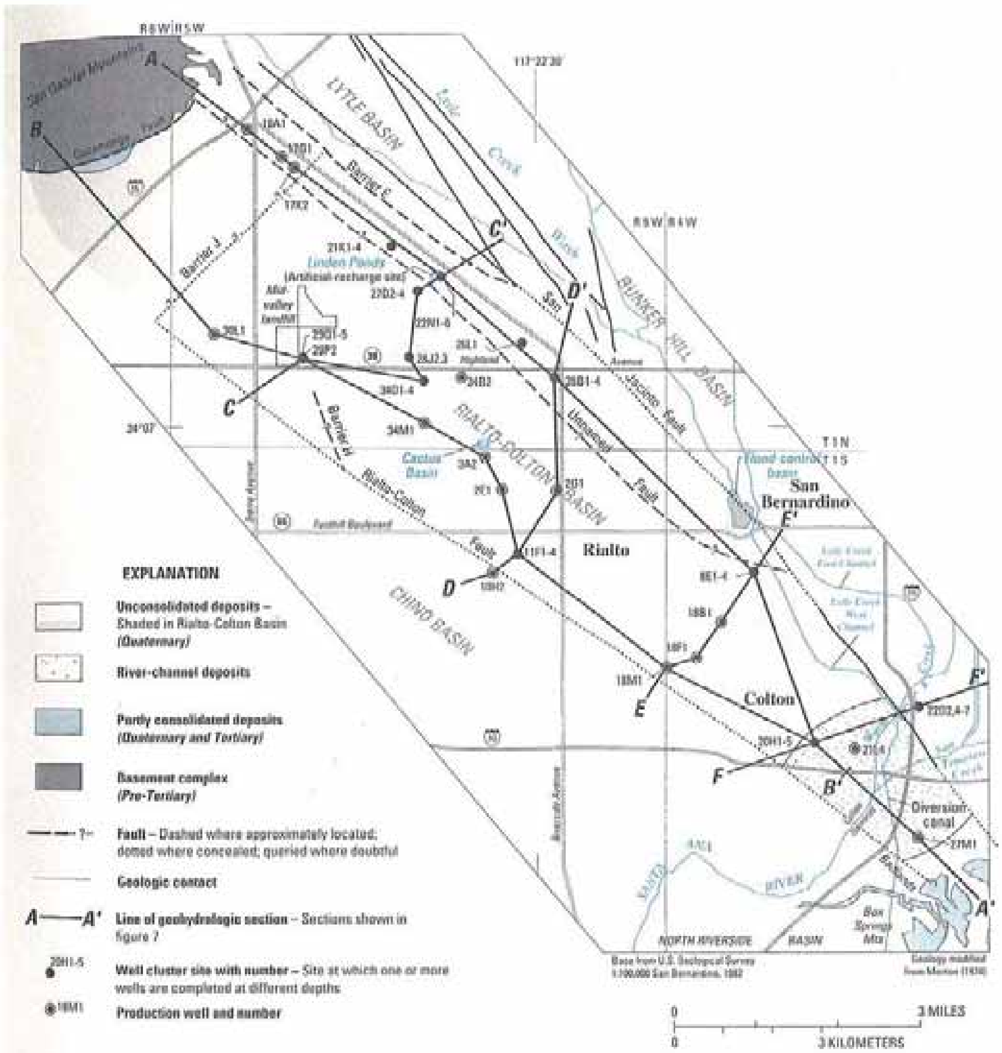
Groundwater within the subbasin is primarily unconfined to semi-confined (Wildermuth 2000). Specific yield ranges from about 6 percent northwest of Rialto to about 16 percent near Colton (DWR 1934).

The San Jacinto fault, its extension Barrier E, an unnamed fault that parallels the San Jacinto fault, and the Rialto-Colton fault are northwest-trending partial barriers to groundwater movement in this subbasin (DWR 1934, DWR 1970, Wildermuth 2000). Groundwater may flow relatively unrestricted in the shallow parts of the flow system; however, the faults generally become more restrictive at depth. The San Jacinto fault displaces water levels about 50 feet in older deposits, but is not a barrier in the youngest materials, particularly beneath the SAR (DWR 1970). Groundwater flows across the fault from the Bunker Hill subbasin in the vicinity of Warm Creek and the SAR, within the river deposits and upper water-bearing unit. Barrier E (Dutcher and Garrett 1963) forms the northeastern boundary of the basin. Groundwater flows across the section of Barrier E from the Lytle Creek subbasin between Barrier J and the San Gabriel Mountains (Woolfenden 2001). At depth, the fault displaces groundwater elevations by about 25 to 50 feet (Wildermuth 2000). The Rialto-Colton fault is a barrier to groundwater flow along much of its length, especially in its northern reaches where groundwater elevations can reach about 400 feet higher within the Rialto-Colton subbasin than in the Chino subbasin to the west (Wildermuth 2000). Groundwater flows across the fault in the river deposits and in the upper and middle water-bearing units in the southeastern part of the basin (Woolfenden 2001). Barrier J (Dutcher and Garrett 1963) is a northeast-trending, southward step in groundwater elevation of about 100 feet in the northern part of the subbasin that may be a barrier to groundwater movement southward (Dutcher and Garrett 1963, Wildermuth 2000) or may be a groundwater cascade (DWR 1970).

The principal recharge areas are Lytle Creek , Reche Canyon in the southeastern part, and the SAR in the south-central part. Lesser amounts of recharge are provided by percolation of precipitation to the valley floor, underflow, and irrigation and septic returns (DWR 1970, Wildermuth 2000). Underflow occurs from fractured basement rock (DWR 1970, Wildermuth 2000) and through the San Jacinto fault in younger SAR deposits at the south end of the subbasin (Dutcher and Garrett 1958) and in the northern reaches of the San Jacinto fault system (Wildermuth 2000).

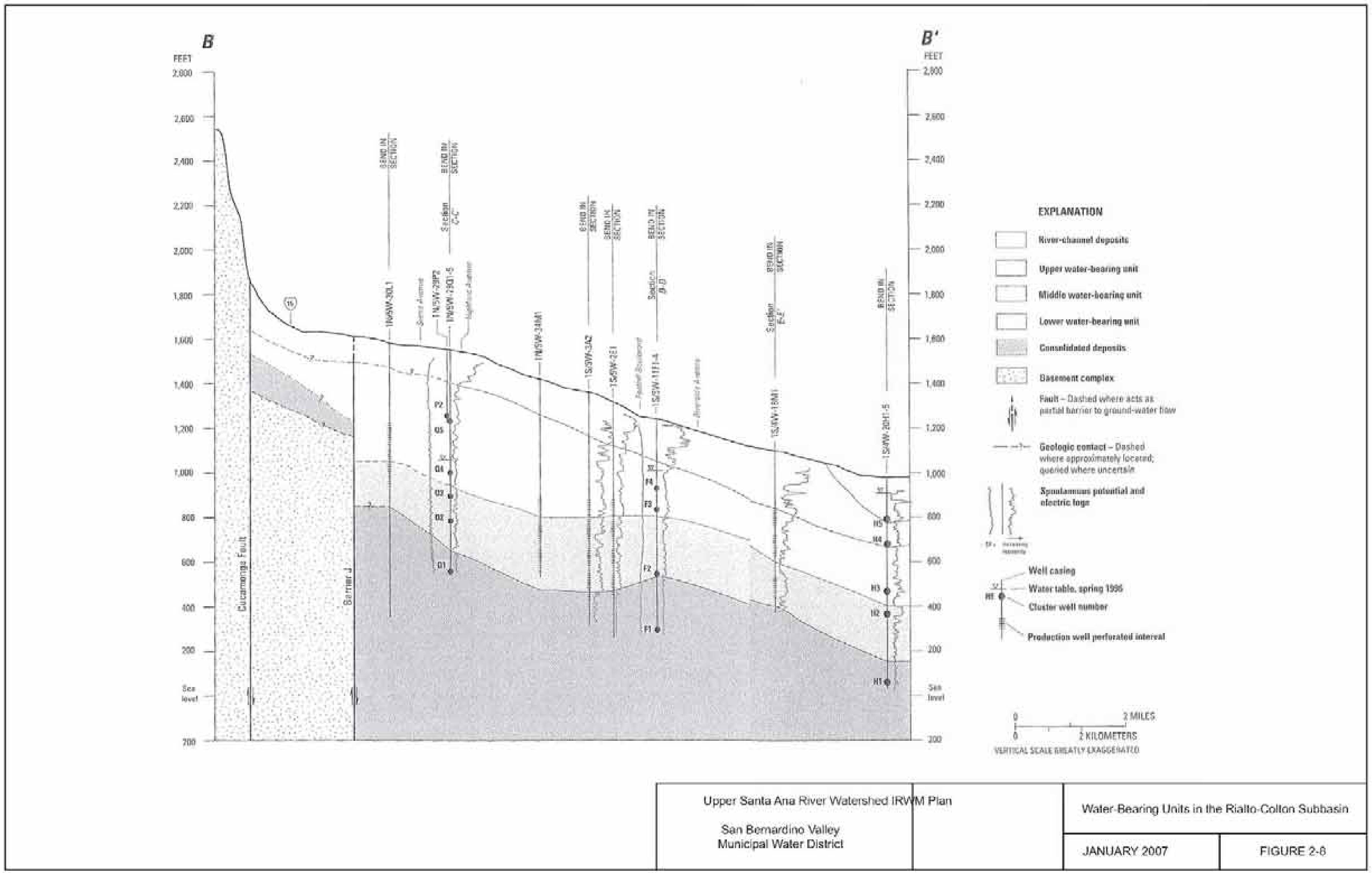
Groundwater recharge has been augmented through the use of two spreading basins, the Linden Ponds and the Cactus Basin. Figure 2-9 shows the locations of the basins. Groundwater modeling simulations showed that artificial recharge at the Cactus Basin may be more effective than recharge at Linden Ponds (no longer available as a spreading ground) at raising water levels in a greater part of the basin and that the imported water can be captured by production wells (Woolfenden 2001).

Figure 2-7
Rialto-Colton Subbasin and Faults



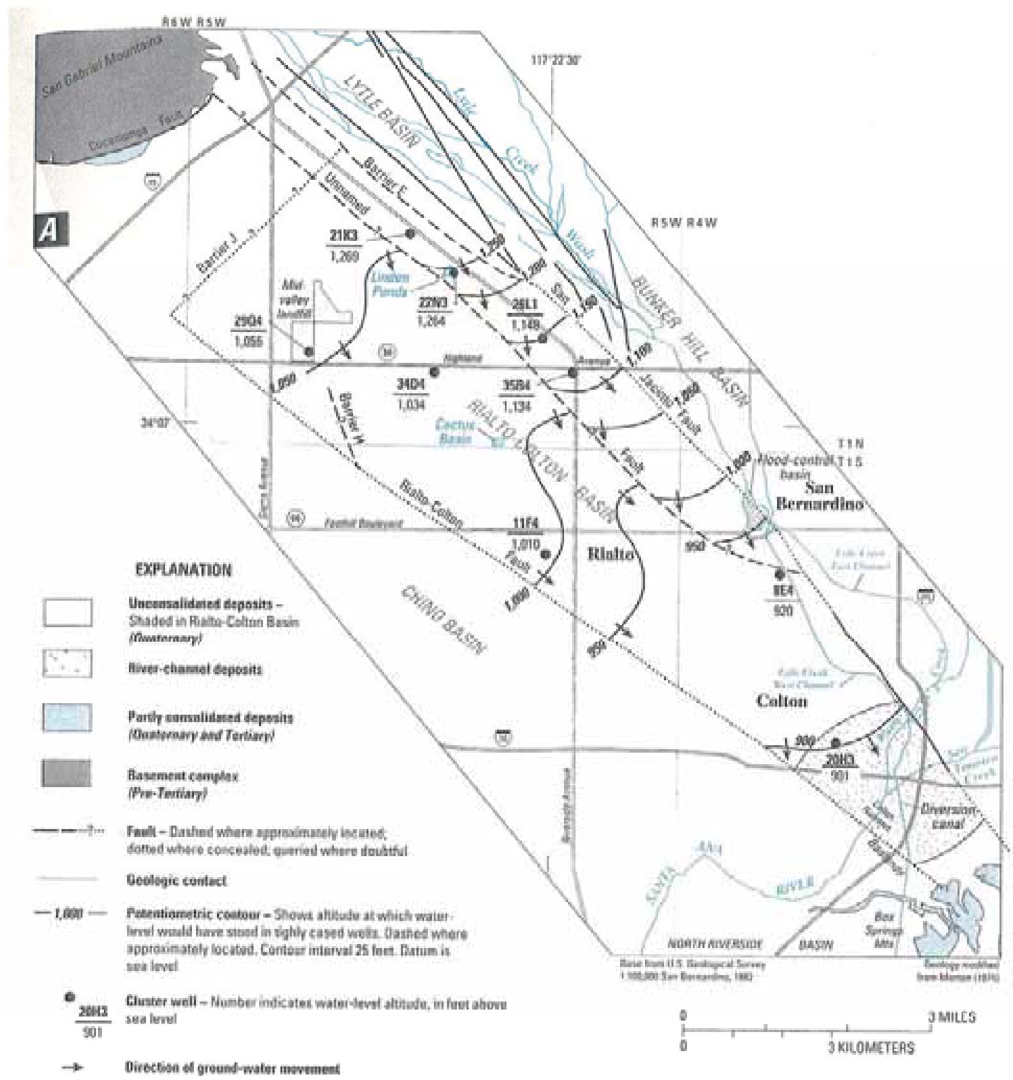
Upper Santa Ana River Watershed IRWM Plan San Bernardino Valley Municipal Water District	Rialto-Colton Subbasin and Faults	
	JANUARY 2007	FIGURE 2-7

Figure 2-8
Water-Bearing Units in the Rialto-Colton Subbasin



Source: USGS, 2002

Figure 2-9
Spreading Basins in the Rialto-Colton Subbasins



Upper Santa Ana River Watershed IRWM Plan San Bernardino Valley Municipal Water District	Spreading Basins in the Rialto-Colton Subbasin	
	JANUARY 2007	FIGURE 2-9

Source: USGS, 2002

Cajon Subbasin (DWR 8-02.05)

The Cajon subbasin underlies Cajon Valley and Lone Pine Canyon, mostly in Cajon Pass, which is the boundary between the San Gabriel and San Bernardino Mountains. This subbasin is bounded by the Upper Mojave River Valley Groundwater Basin on the north along a surface drainage divide and the Bunker Hill subbasin of the Upper Santa Ana Valley Groundwater Basin on the south. The subbasin is bounded by impermeable rocks of the San Gabriel Mountains on the west and the San Bernardino Mountains on the east. Cajon and Lone Pine Creeks drain the valley southward as tributaries to the SAR. Annual precipitation throughout the subbasin ranges from 23 inches to 33 inches. The San Andreas fault zone crosses the southern part of the subbasin and cuts up Lone Pine Canyon. Springs are found along the trace of the fault zone indicating it is a barrier to groundwater. Lost Lake is a spring-fed sag pond formed in older alluvium where there is a step in the fault trace.

The chief water-bearing material in the Cajon subbasin is alluvium. Holocene-age alluvium consists of relatively unweathered sand, silt, and gravel deposited in active creek beds (DWR 1970). Older Pleistocene-age alluvium is found as alluvial fan deposits derived from the bordering mountains. Recharge is derived from percolation of precipitation, return irrigation water, and streamflow.

Riverside-Arlington Subbasin (DWR 8-02.03)

The Riverside-Arlington subbasin underlies part of the SAR Valley in northwest Riverside County and southwest San Bernardino County. This subbasin is bounded by impermeable rocks of Box Springs Mountains on the southeast, Arlington Mountain on the south, La Sierra Heights and Mount Rubidoux on the northwest, and the Jurupa Mountains on the north. The northeast boundary is formed by the Rialto-Colton fault, and a portion of the northern boundary is a groundwater divide beneath the community of Bloomington. The SAR flows over the northern portion of the subbasin. Annual average precipitation ranges from about 10 to 14 inches.

Groundwater in the subbasin is found chiefly in alluvial deposits. Quaternary-age alluvial deposits in the subbasin consist of sand, gravel, silt, and clay deposited by the SAR and its tributaries. Near the City of Riverside, the upper 50 feet of deposits are principally clay; however, deposits near the neighborhood of Arlington have considerable sand and little clay. At the northern end of the subbasin, coarser gravels with cobbles four to six inches in diameter are common. Based on data from wells, a minimum specific yield of 15 percent was assigned to unweathered gravels at the extreme northern end of the subbasin. The specific yield increases sharply to 18 percent near the SAR, then increases gradually to a maximum of 20 percent near the neighborhood of Arlington (DPW 1934).

The Rialto-Colton fault to the northeast separates the Riverside-Arlington subbasin from the Rialto-Colton subbasin. The fault is a barrier to groundwater flow along its length, especially in its northern reaches (Wildermuth 2000). A groundwater divide in the alluvium separates the Riverside portion from the Arlington portion of the subbasin (DPW 1934). The Riverside-Arlington subbasin is replenished by infiltration from SAR flow, underflow past the Rialto-Colton fault, intermittent underflow from the Chino subbasin, return irrigation flow, and deep percolation of precipitation (DPW 1934, Wildermuth 2000).

San Timoteo Subbasin (DWR 8-02.08)

The San Timoteo subbasin underlies Cherry Valley and the City of Beaumont in southwestern San Bernardino and northwestern Riverside Counties. The subbasin is bounded to the north and northeast by the Banning fault and impermeable rocks of the San Bernardino Mountains, Crafton Hills, and Yucaipa Hills; on the south by the San Jacinto fault; on the west by the San Jacinto Mountains; and on the east by a topographic drainage divide with the Colorado River hydrologic region. The surface is drained by Little San Gorgonio Creek and San Timoteo Canyon to the SAR. Average annual precipitation ranges from 12 to 14 inches in the western part to 16 to 18 inches in the eastern part of the subbasin.

Holocene-age alluvium, which consists of unconsolidated clay, silt, sand, and gravel, is the principal water-bearing unit in this subbasin. The alluvium, which is probably thickest near the City of Beaumont (DPW 1934), thins toward the southwest and is not present in the central part of the subbasin.

The Pliocene-Pleistocene-age San Timoteo Formation consists of alluvial deposits that have been folded and eroded. These deposits are widely distributed and principally composed of gravel, silt, and clay, with comparatively small amounts of calcite-cemented conglomerate. The clasts are chiefly granitic, with lesser amounts of volcanic and metamorphic pebbles and cobbles (DPW 1934). The total thickness of the San Timoteo Formation is estimated to be between 1,500 and 2,000 feet, but logs of deep wells near the central part of the subbasin indicate water-bearing gravels to depths of only 700 to 1,000 feet (DPW 1934).

The Banning and Cherry Valley faults and two unnamed faults in the northeast part of the subbasin offset impermeable basement rocks, stepping down to the south (DWR 1965a, 1967b). Water levels change across the Banning fault, dropping 100 to 200 feet to the south (DWR 1967b, Dutcher and Fenzel 1972). In the western part of the subbasin, water levels drop to the south about 75 feet across the Loma Linda fault and about 50 feet across the San Timoteo barrier (Dutcher and Fenzel 1972). In the northeastern part of the subbasin, water levels drop to the south across two unnamed faults (DWR 1965a, 1967b). Each of these faults appears to disrupt groundwater movement in the subbasin.

Groundwater is replenished by subsurface inflow and percolation of precipitation, runoff, and imported water. Runoff and imported water are delivered to streambeds and spreading grounds for percolation (DWR 1967a, 1970). Groundwater is found in alluvium in the San Timoteo Formation. Estimated specific yields in the subbasin range from 3 percent for fine materials to 35 percent for coarser materials (DWR 1970), with an average of about 11 percent (DWR 1967b).

Yucaipa Subbasin (DWR 8-02.07)

The Yucaipa subbasin underlies the southeast part of San Bernardino Valley. It is bounded on the northeast by the San Andreas fault, on the northwest by the Crafton fault, on the west by the Redlands fault and the Crafton Hills, on the south by the Banning fault, and on the east by the Yucaipa Hills. The average annual precipitation ranges from 12 to 28 inches. This part of the San Bernardino Valley is drained by Oak Glen, Wilson, and Yucaipa Creeks south and west into San Timoteo Wash, a tributary to the SAR.

Groundwater is found chiefly in alluvium, with lesser quantities in the San Timoteo Formation and fractured bedrock beneath the alluvium (Moreland 1970). Specific yield is estimated to vary from less than 4 percent northeast of Yucaipa, to a maximum of about 10 percent in the southeastern part of the subbasin (DPW 1934). Alternatively, specific yield is estimated to range from about 6 to 22 percent (DWR 1967a), with the average for the subbasin being about 10 percent (DWR 1979).

Alluvial deposits in the subbasin are divided into older and younger units. The Holocene-age younger alluvium consists of unconsolidated boulders, gravel, sand, silt, and clay (Moreland 1970). This unit forms a thin veneer and is mostly above the water table (Moreland 1970). The middle to late Pleistocene age older alluvium consists of boulders, gravel, sand, silt, and clay (Moreland, 1970), and holds the primary source of groundwater in the subbasin. Clays present in this section are due to weathering and soil formation during accumulation of the deposits (DPW 1934).

The Pliocene-Pleistocene age San Timoteo Formation consists of alluvial deposits that have been folded and eroded. These deposits are widely distributed and principally composed of gravel, silt, and clay, with comparatively small amounts of calcite-cemented conglomerate. The clasts are chiefly granitic, with lesser amounts of volcanic and metamorphic pebbles and cobbles (DPW 1934). The total thickness of the San Timoteo Formation is estimated to be between 1,500 and 2,000 feet, but logs of deep wells near the central part of the subbasin indicate water-bearing gravels to depths of only 700 to 1,000 feet (DPW 1934).

Dominant recharge to the subbasin is from percolation of precipitation and infiltration within the channels of overlying streams, particularly Yucaipa and Oak Glen Creeks; underflow from the fractures within the surrounding bedrock beneath the subbasin; and artificial recharge at spreading grounds. Four artificial recharge facilities with a total capacity of about 56,500 acre-feet per year were noted in 1967 (DWR 1967b). By increasing the spreading acreage along Oak Glen Creek by 25 to 50 acres, the capability exists to spread 7,000 to 14,000 acre-feet of surface water annually to recharge the Yucaipa subbasin (Yucaipa Valley Water District (YVWD) 2000a).

2.8.1.2 Lytle Creek Subbasin

Lytle Creek subbasin is adjoined on the west by the Rialto-Colton subbasin along the Lytle Creek fault, and on the east and southeast by the Bunker Hill subbasin along the Loma Linda fault and Barrier G. The northwestern border of the subbasin is delineated by the San Gabriel Mountains, and runoff from the mountains flows south/southeast through Lytle and Cajon Creeks into the basin.

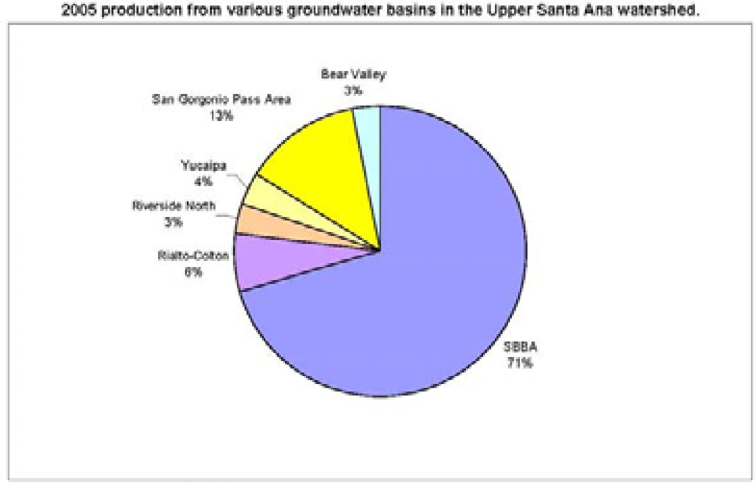
The Lytle Creek tributary to the Santa Ana River contributes significantly to groundwater recharge.

Lytle Creek subbasin is not mapped in DWR Bulletin 118-2003; however, the subbasin is an integral part of the Upper Santa Ana Valley Groundwater Basin and a major recharge area for both the Bunker Hill and Rialto-Colton subbasins. Historically, local agencies have recognized Lytle Creek subbasin as a distinct groundwater subbasin. It is important to note that the water rights in Lytle Creek are set forth in long-standing court judgments governing the rights of the parties in that basin. For purposes of this report, the Bunker Hill and Lytle Creek subbasins are generally considered as one groundwater basin—the SBBA. However, the three separate water-bearing zones and intervening confining zones of the Bunker Hill subbasin are not observed in the Lytle subbasin. Sediments within the Lytle subbasin are, for the most part, highly permeable, and the aquifer has a high specific yield. High permeability and specific yield tend to result in an aquifer that responds rapidly to changes in inflow (precipitation and streamflow) and outflow (groundwater pumping, streamflow, and subsurface outflow).

Numerous groundwater barriers are present within Lytle Creek subbasin, resulting in six compartments within the subbasin. Barriers A through D divide the northwestern portion of the subbasin into five sub-areas and the southeastern portion of the subbasin comprises the sixth sub-area. Barrier F divides the northwestern sub-areas from the southeastern sub-area. Studies have shown that the groundwater barriers are less permeable with depth (Dutcher and Garrett 1963). When groundwater levels are high during wet years, more leakage occurs across the barriers than when groundwater levels are lower (i.e., during dry years). The amount of pumping in each sub-area, in large part, controls the movement of groundwater across the barrier within the older alluvium but not the younger alluvium (Dutcher and Garrett 1963).

2.8.1.3 San Bernardino Basin Area

2005 production from various groundwater basins in the Upper Santa Ana watershed.



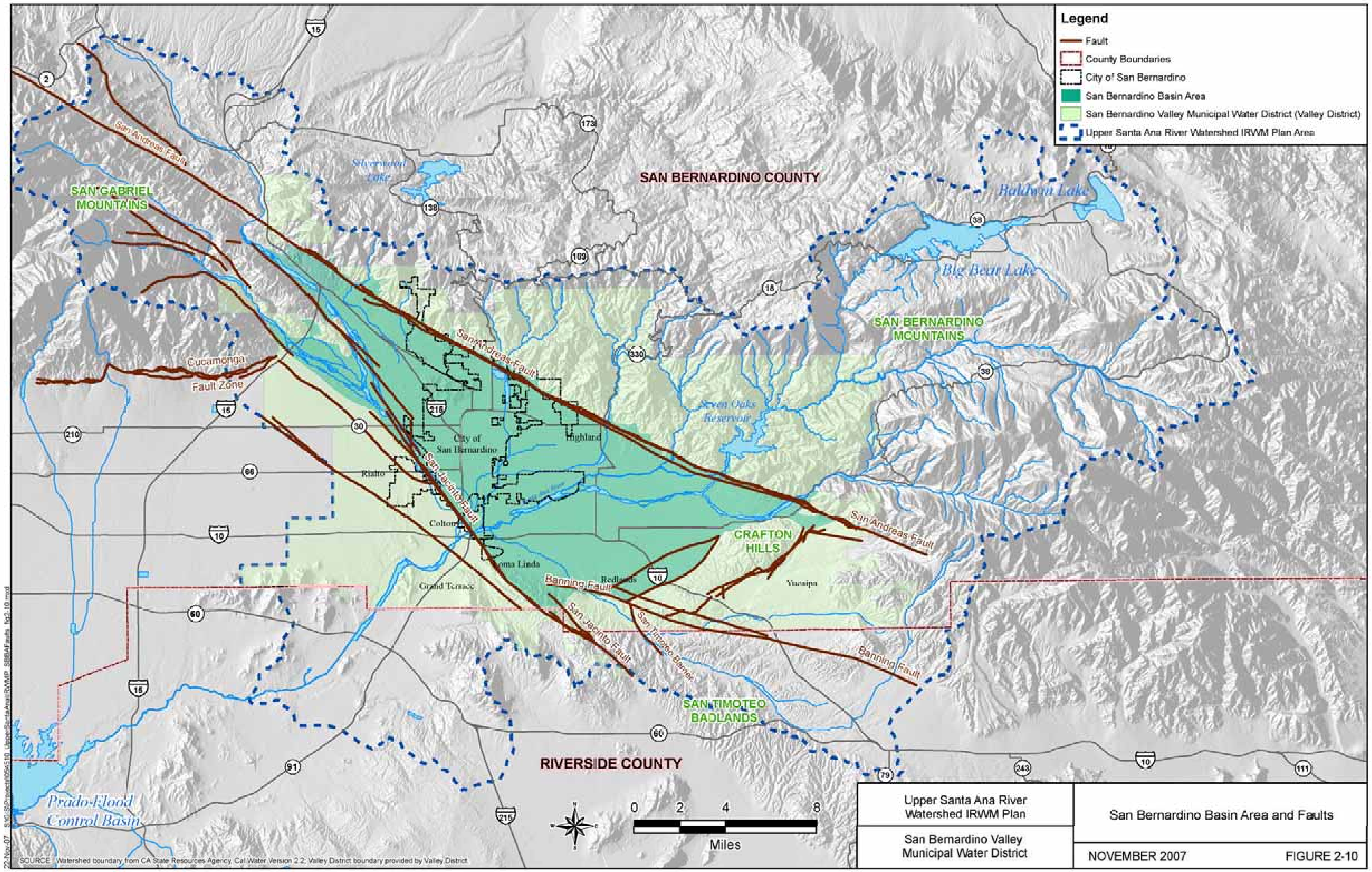
SBBA is a major source of groundwater for the region.

The 1969, Western-San Bernardino Judgment defines an area known as the SBBA. This area is defined as the "…area above Bunker Hill Dike [San Jacinto fault], but excluding certain mountainous regions and the Yucaipa, San Timoteo, Oak Glen and Beaumont Basins" (Figure 2-10). The SBBA is the focus of this IRWM Plan and plays a central role in the water supply for communities within the Region. The SBBA traditionally refers to two groundwater subbasins—Bunker Hill and Lytle Creek. The Western-San Bernardino Watermaster provides a careful accounting of the SBBA on an annual basis. If pumping in the area exceeds the safe yield of the basin, then water must be imported to offset the amount exceeding the safe yield. If pumping in the area is below the safe yield, then the basin accrues "credits" in a like amount.

The SBBA has a surface area of approximately 140.6 square miles and lies between the San Andreas and San Jacinto faults. The basin is bordered on the northwest by the San Gabriel Mountains and Cucamonga fault zone; on the northeast by the San Bernardino Mountains and San Andreas fault zone; on the east by the Banning fault and Crafton Hills; and on the south by a low, east-facing escarpment of the San Jacinto fault and the San Timoteo Badlands. Alluvial fans extend from the base of the mountains and hills that surround the valley and coalesce to form a broad, sloping alluvial plain in the central part of the valley. The Pressure Zone, which is within the SBBA, is described in more detail in this chapter because of high groundwater levels that historically have been of concern in the Region.

Per the provisions of the Western-San Bernardino Judgment, Valley District and Western are responsible for managing the SBBA. The judgment does not allow extractions to exceed the long-term natural safe yield without replacing the incremental amount over the safe yield with water from an outside source.

Figure 2-10
San Bernardino Basin Area



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Geologic Structure of SBBA

Although mountain belts tend to be associated with the uplift of rock material to several miles in height, they are bordered by regions of subsidence called foreland sedimentary basins. These basins are wedge shaped in the cross-section, with a depth that gradually increases away from the mountain front. The SBBA is a foreland basin and receives sediment eroded from the San Bernardino Mountains. The foreland basin refers to the area of intake or recharge where most recharge occurs by direct percolation of SAR water. The SBBA foreland basin is characterized by highly permeable sands and gravel with few clay and silt deposits.

The San Andreas fault zone impedes movement of groundwater, producing springs and a groundwater-level change that marks the fault trace along the northern boundary of the subbasin. The San Jacinto fault forms a strong barrier to the lateral southwest flow of groundwater. The water table rises on the upstream side of the San Jacinto fault nearly to the surface below the course of the SAR. The combination of alluvial material with a high water table in a seismically active area creates a hazard for liquefaction. The Redlands and Banning faults also impede groundwater movement along the borders of the subbasin (DWR 1986).

Geologic Units of SBBA

The water-bearing material in the subbasin consists of unconsolidated alluvial deposits and consolidated sediments. Most municipal and agricultural supply wells obtain water from the unconsolidated alluvial deposits. Figure 2-11 shows the relationship of the sediments in the basin (USGS 2006).

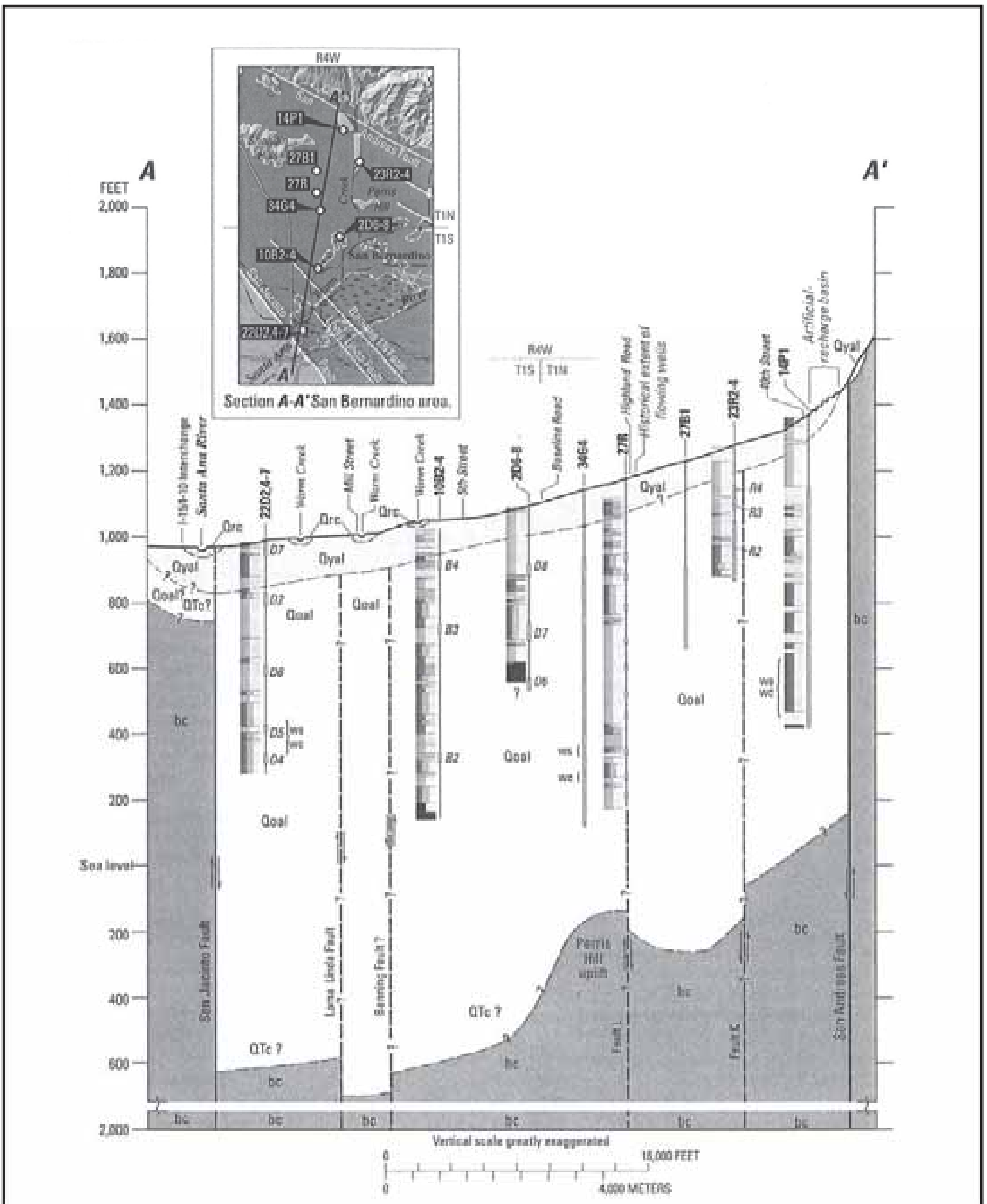
The unconsolidated alluvial deposits consist of sand, gravel, and boulders interspersed with deposits of silt and clay. The deposits are divided into older (Pleistocene) and younger (Holocene) alluvium and Holocene river-channel deposits. Near the mountain front, the unconsolidated deposits tend to be coarse-grained and poorly sorted, becoming finer-grained and better sorted downstream. The older alluvium consists of continental, fluvial deposits, ranging in thickness from some tens of feet to more than 800 feet. The younger alluvium is about 100 feet thick, composed mainly of floodplain deposits. The relatively recent river channel deposits are less than 100 feet thick but are among the most permeable sediments in the SBBA and contribute to large seepage losses from streams (Danskin et. al. n.d.). Wells yield up to 5,000 gallons per minute (gpm) and average about 1,245 gpm. Specific yield of these deposits ranges from 7 to 21 percent and averages 13 percent (WE 2000).

Within the unconsolidated alluvial deposits are three (upper, middle, and lower) fine-grained sequences that are separated by coarse-grained sediment. Both the upper and middle fine-grained layers are present in the central portion of the valley and cover about 25 square miles. The upper fine-grained deposits (clay and silt) are part of the younger alluvium and are exposed on ground surface near the San Jacinto fault but, to the north, are covered by coarser-grained sediments. The clay layer may be locally eroded and replaced with coarse sand and gravel. Boreholes drilled in the vicinity of the SAR and the San Jacinto fault indicate a predominance of coarse sand and gravel, not fine-grained silt and clay. The middle fine-grained sequence is part of the older alluvium and is present at a depth of about 350 feet below ground surface (bgs). The sequence is as much as 300 feet thick and consists of interbedded silt, clay, and sand and thins towards the margins of the basin. Although previously conceived as a moderately clay unit, geophysical logs show this fine-grained sequence to consist of relatively continuous zones of silt and sand (Danskin 2006). Little is known about the lower fine-grained interval because most production wells do not penetrate to that depth.

The consolidated sedimentary rocks crop out mainly in the southern part of the San Bernardino area between the San Jacinto fault and Crafton Hills and underlie unconsolidated deposits throughout most of the valley. In the badlands, these sedimentary rocks are referred to as the San Timoteo Formation and are composed of partly lithified, non-marine alluvial and lacustrine sediments ranging in age from late Tertiary to early Quaternary. Well yields are moderate from the more permeable layers and are generally less than 500 gpm (Dutcher and Garrett 1963). Both the unconsolidated and consolidated sediments rest on and abut basement complex, which, for the purposes of this report, are considered to be essentially non-water bearing.

Faults in the area have both vertically and horizontally offset these geologic units.

Figure 2-11
Representative Geologic Sections – SBBA



Upper Santa Ana River Watershed IRWM Plan San Bernardino Valley Municipal Water District	Representative Geologic Sections – SBBA	
	JANUARY 2007	FIGURE 2-11

Source: USGS, 2002, Water Resources Investigative Report 02-4243

RECENT

Qrc **River-channel deposits**
Unconsolidated coarse gravel, sand, and silt in major river channels, generally becoming finer grained at greater distance from the San Bernardino and San Gabriel Mountains. Highly permeable, but largely unsaturated except near the San Jacinto Fault. Large quantities of water seep into these deposits from streams during runoff.

LOCAL UNCONFORMITY

Qyal **Younger alluvium**
Unconsolidated coarse gravel, sand, and clay, forming of a fine-grained and coarse-grained member, which in places are indistinguishable. Largely unsaturated near the mountains. Where present, the fine-grained member, which is 60 to 90 feet thick and composed mostly of silt and clay, overlies and confines the coarse-grained member. The coarse-grained member is composed mostly of gravel and sand, is highly permeable, and yields water copiously to wells.

LOCAL UNCONFORMITY

PLEISTOCENE

Qoal **Older alluvium**
Unconsolidated coarse gravel, sand, silt, and clay of continental, largely fluvial origin. In places, deeply weathered with red and yellow soil zones; often contains easily broken pebbles of dioritic and granitic gneiss; marker beds include a white clay and white sand at about 800 feet below land surface. Locally unconformably overlies crystalline bedrock; fractured by numerous faults and in places slightly folded. Contains thick, fine-grained silt and clay beds which confine underlying permeable members; some lower members are partly cemented. More permeable members yield water copiously to wells.

LOCAL UNCONFORMITY

QUATERNARY

PLIOCENE

QTs **Quaternary and Tertiary sedimentary rocks**
Upper members are poorly consolidated to compacted gravel, sand, silt, and clay, locally containing a mammalian fauna and broken by numerous faults. Lower members are predominately brown to blue-green calcareous, indurated clays with locally discontinuous lenses of sand. Tertiary rocks, also non-marine, include compacted, cemented calcareous units, in places laminated with beds of conglomerate. Upper members yield water in moderate quantities to wells that penetrate permeable members; lower members are essentially non-water-bearing.

TERTIARY

UNCONFORMITY

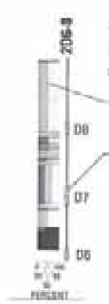
bc **Basement complex**
Consolidated metamorphic and igneous rocks. Essentially non-water-bearing, though small quantities of water, including geothermal fluids, flow in fractures.

PRE-TERTIARY

Fault—Dashed where inferred; queried where uncertain. Arrows indicate relative movement

Contact between stratigraphic units—Dashed where approximately located, queried where uncertain

Well design and lithologic units



Well and abbreviated state well number—Multiple numbers (D6-8) represent piezometers at selected depths

Lithologic log

Perforated casing

Lithologic log composition—Queried where uncertain

- Gravel
- Sand
- Clay or silt
- Hard rock or hard drilling

ws White sand

wc White clay

Upper Santa Ana River Watershed IRWM Plan San Bernardino Valley Municipal Water District	Representative Geologic Sections – SBBA Explanation for Figure 2-11	
	JANUARY 2007	FIGURE 2-11

Aquifer Systems of SBBA

Dutcher and Garrett (1963) divided the SBBA alluvial sediments into the upper, middle, and lower water-bearing members that are separated by the upper, middle, and lower confining members (fine-grained sequences). Figure 2-12 shows a profile of the water-bearing and confining members (Danksin et. al., 2006). The aquifer system of the SBBA is generally unconfined, however, with water moving vertically between the multiple water-bearing layers. The confining members are more accurately described as very leaky aquitards[1] of finer-grained sediments.

The upper confining member is a near-surface deposit with low hydraulic conductivity. The upper confining member extends over a relatively large area from the San Jacinto fault to Highland Road, but only produces confining conditions in a relatively small area referred to as the "Pressure Zone" (see Figure 2-13). As shown in Figure 2-12, the upper confining member is effectively at land surface between the San Jacinto fault and Banning fault and would prevent recharge from precipitation from reaching the upper water-bearing member. In the area between Warm Creek and the SAR, the upper confining member acts to restrict vertical flow causing semi-confined conditions within the upper water-bearing member. North of the Banning fault to about Highland Road, the upper confining member is covered with coarse sediments. Perched water may occur in these areas and springs or seeps may occur where the contact is exposed at ground surface. In the vicinity of the SAR and San Jacinto fault, the upper confining member appears to have been eroded and replaced with coarse sand and gravel. In these areas, the coarse-grained sediments are essentially part of the upper water-bearing member and allow recharge or discharge of water from the upper water-bearing member.

The upper water-bearing member is not usually filled with groundwater. Near the foothills, as shown in Figure 2-12, the member is essentially dry as the groundwater levels are below the base of the unit. Localized areas of perched groundwater may be present as recharge percolates through the sediments. Within the central portions of the valley, the member becomes fully saturated as water moves from the upper portions of the valley to lower elevations. The upper water-bearing aquifer is likely full along the course of the SAR.

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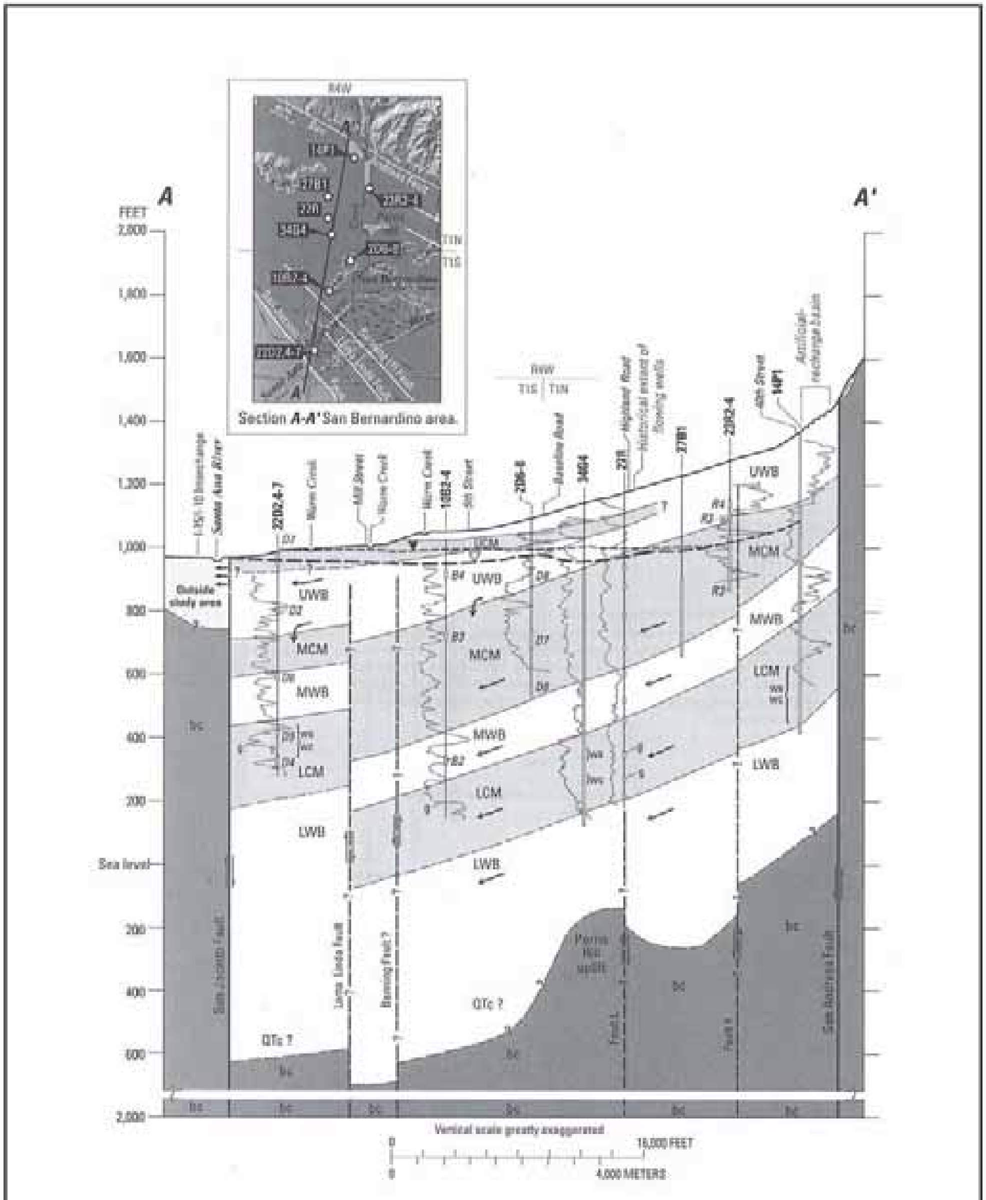
[1] An aquitard is a low-permeability sedimentary unit that can store groundwater and also transmit it slowly from one aquifer to another (Fetter 1988). An aquitard is generally considered to be a barrier or partial barrier to movement of groundwater because water tends to move substantially slower through aquitards than aquifers.

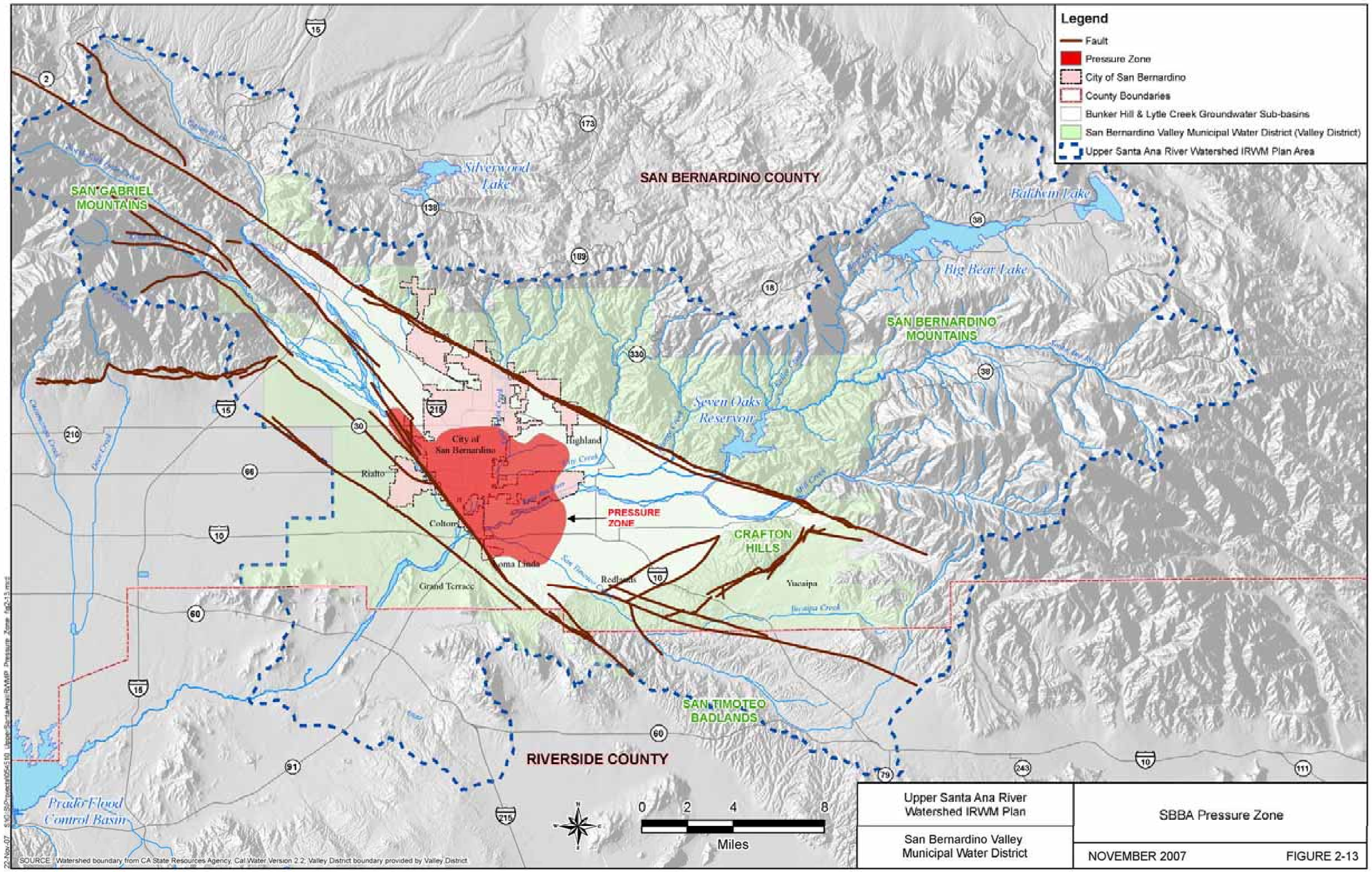
Figure 2-12
Water-Bearing and Confining Members – SBBA



Upper Santa Ana River Watershed IRWM Plan San Bernardino Valley Municipal Water District	Water-Bearing and Confining Members – SBBA	
	JANUARY 2007	FIGURE 2-12

Source: USGS, 2002, Water Resources Investigative Report 02-4243

Figure 2-13
SBBA Pressure Zone



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The upper and middle water-bearing members provide most of the water to municipal and agricultural wells. Flow meter testing in three production wells shows that most of the water is extracted from the shallow, younger deposits (Izbicki et. al., 1998). In the central part of the SBBA, these water-bearing members are separated by as much as 300 feet of interbedded silt, clay, and sand (the middle confining member). This middle confining member produces confined conditions over the central part of the basin (referred to locally as the “confined area”), but thins and becomes less effective toward the margins of the basin (Dutcher and Garrett 1963). As shown in Figure 2-12, USGS shows that the middle confining bed extends to the northern edge of the basin. Other sections prepared for the basin show that the middle confining member pinches out before reaching the edge of the basin (Numeric Solutions 2006). Although the middle confining member is not as permeable as the adjacent water-bearing zones, this unit consists primarily of continuous sand and silt (not silt and clay as is found in most aquitards), and there is water production from this zone in many wells (Danskin et al. 2006). It appears that groundwater recharge to the middle water-bearing aquifer is from vertical leakance through the middle confining member and near the fringes of the valley where the upper and middle aquifers may merge.

The lower confining and lower water-bearing members are not typically penetrated by most production wells and play a smaller role in the valley-fill aquifer, mainly due to deeper depth and generally lower permeability. The lower water-bearing member may be consolidated older alluvium or part of the consolidated sediments (Danskin, et. al. 2006).

The areal pattern of groundwater flow is from areas of recharge along the base of the mountains to areas of discharge where the SAR crosses the San Jacinto fault and has remained relatively unchanged over the period of record. Groundwater elevation contours shown in Figure 2-14 illustrate this flow regime in the Bunker Hill subbasin. However, vertical groundwater movement has changed through time due to groundwater extraction and artificial recharge. Groundwater pumping has occurred from increasingly deeper depths, altering the natural vertical movement of groundwater by progressively draining deeper zones of groundwater (Danskin et. al. n.d.).

Recharge to the Bunker Hill subbasin historically has resulted from infiltration of runoff from the San Gabriel and San Bernardino Mountains in areas where the upper confining member is absent or from the forebay. The SAR, Mill Creek, and Lytle Creek contribute more than 60 percent of the total recharge to the groundwater system (USGS 1989). Lesser contributors include Cajon Creek, San Timoteo Creek, and most of the creeks flowing southward out of the San Bernardino Mountains. The subbasin is also replenished by deep percolation of

Figure 2-14
SBBA Groundwater Contours

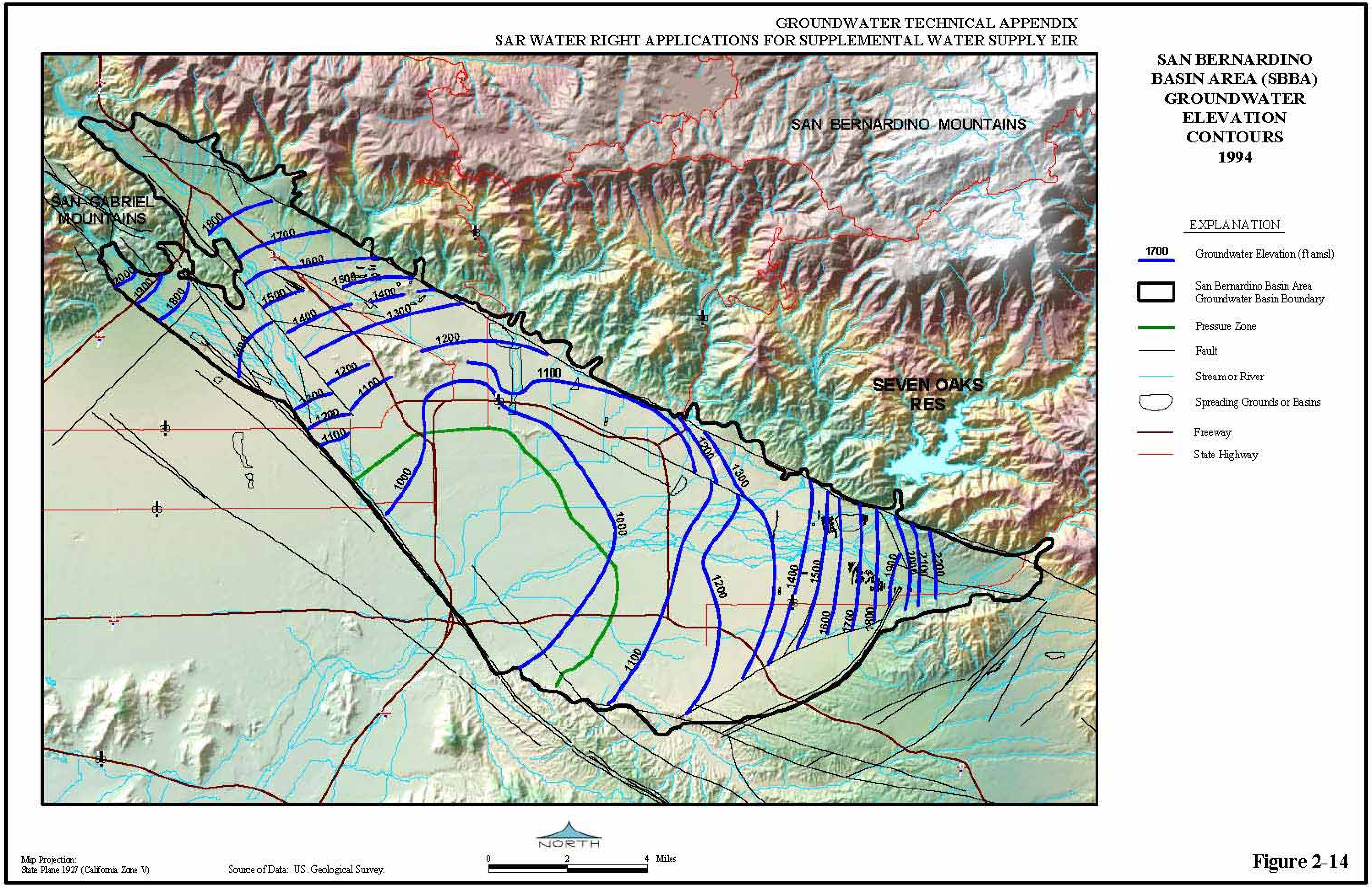


Figure 2-14

Percolation from streams, such as Devil Canyon Creek above, is the major source of recharge in the SBBA.

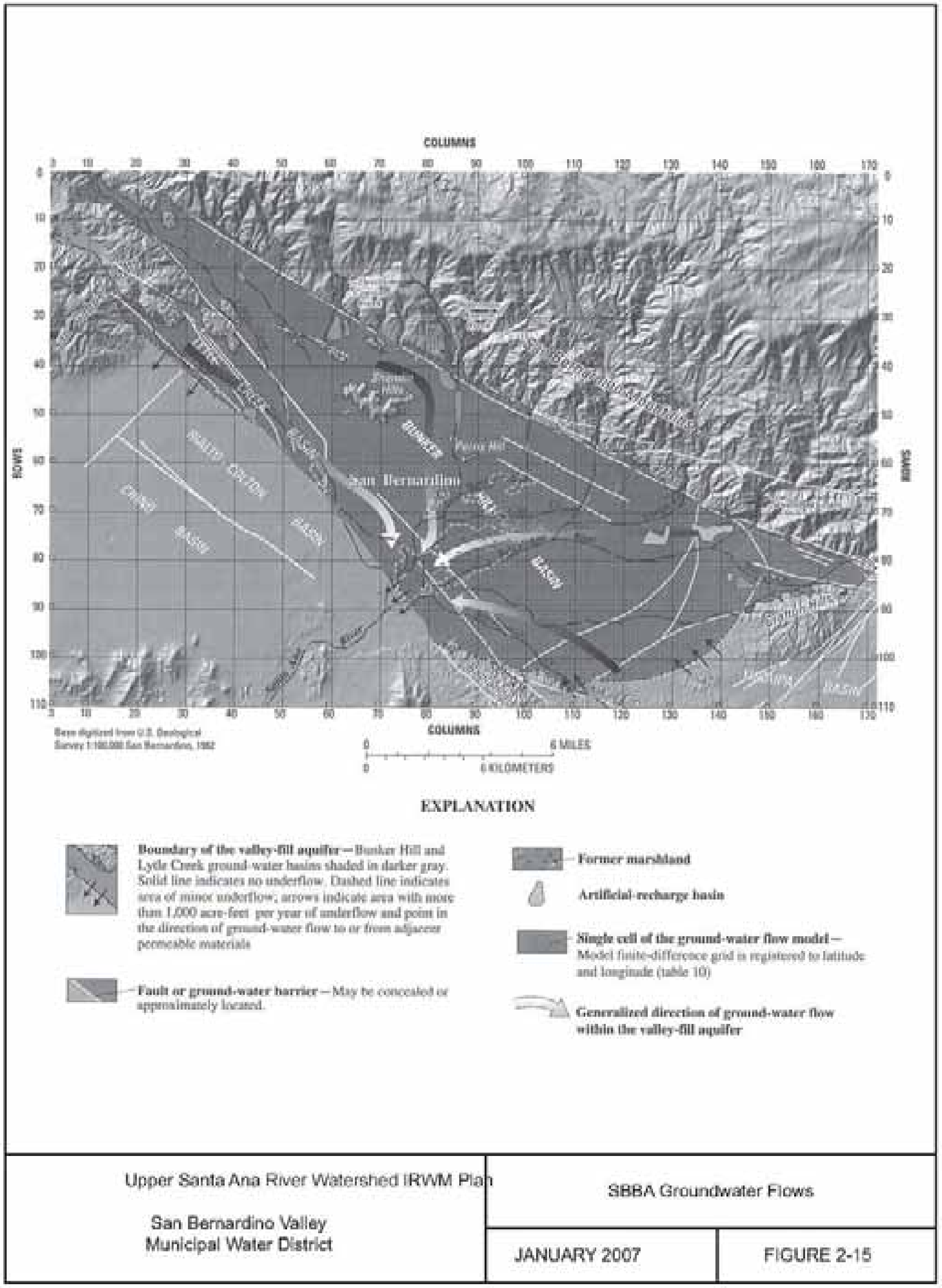
water from precipitation and resulting runoff, percolation from delivered water, and water spread in streambeds and spreading grounds.

Percolation from streams (such as the SAR, Lytle Creek, Cajon Creek, Devil Canyon Creek, East Twin Creek, Warm Creek, City Creek, Plunge Creek, and Mill Creek) is the major source of recharge in the SBBA. Recharge occurs both in the stream channels and in nearby artificial recharge basins. As a result of the highly permeable river channel deposits and the artificial recharge operations, nearly all of the flow in the smaller streams (Devil Canyon, Waterman, East Twin, Plunge, and San Timoteo Creeks) is recharged to the upper and middle aquifers close to the mountain front.

During floods, the major streams (SAR, Mill Creek, and Lytle Creek) transmit large volumes of water over a short period, resulting in some surface water exiting the basin without contributing to groundwater recharge. Recharge to the SBBA also results from underflow (subsurface inflow), direct infiltration of precipitation, return flow, infiltration from underground sanitary sewer lines and storm drains, and artificial recharge of imported water. Subsurface inflow to the SBBA occurs across the Crafton fault and through the poorly transmissive materials comprising the Badlands, across a small section of unconsolidated deposits north of the Crafton Hills, and through materials beneath the Cajon Creek and Lytle Creek channels. Figure 2-15 shows the areas of underflow into the basin. Total underflow for 1945 to 1998 averaged about 5,000 acre-feet per year (Danskin et. al. 2006). Annual values have declined from a maximum of about 7,000 acre-feet in 1945 to about 4,000 acre-feet in 1998, predominately as a result of declining water levels in the Yucaipa subbasin. With the exception of unusually wet years, recharge from direct precipitation on the valley floor is minimal. An additional source of recharge is that derived from return flow of water pumped from and used locally within the SBBA. Hardt and Hutchinson (1980) estimated return flow to be 30 percent of total extractions, except for wells that export groundwater directly out of the San Bernardino area.

Subsurface outflow from the basin occurs only in the upper 100 feet of the younger alluvium through a breach in the San Jacinto fault, carved by the SAR (Danskin, et. al. 2006). Outflow also occurs through Barrier E at two locations, near the SAR and near Barrier J where Lytle Creek emerges from the San Gabriel Mountains. Subsurface outflow near the Barrier J fault is into the Rialto-Colton subbasin. Figure 2-15 shows the location of the subsurface outflow from the basin.

Figure 2-15
SBBA Groundwater Flows



Source: USGS, 2002, Water Resources Investigative Report 02-4243

2.8.1.4 Bear Valley Groundwater Basin 8-9

This groundwater basin underlies Bear Valley and is bound by crystalline rocks of the San Bernardino Mountains in southern San Bernardino County. Big Bear Lake, which lies in the western portion of the valley, receives runoff from Grout Creek to the northwest, Van Dusen Canyon to the northeast, Sawmill Canyon and Sand Canyon to the southeast, Knickerbocker and Metcalf Creek to the south, and North Creek to the southwest. Baldwin Lake, which is typically dry, lies in the northeast portion of the valley and receives occasional runoff from Van Dusen Canyon to the northwest and Shay Creek to the south (GEOSCIENCE 2001). Average annual precipitation to the valley ranges from 23 to 29 inches.

Groundwater in the Bear Valley Groundwater Basin is found primarily in the unconsolidated alluvial deposits. The water-bearing deposits in the valley have been separated into upper, middle, and lower aquifers (GEOSCIENCE 1999). The upper and middle aquifers are the primary water producers. In addition, wells completed in underlying bedrock produce as much as 300 gpm (GEOSCIENCE 1999).

A groundwater divide exists between Big Bear Lake and Baldwin Lake in the vicinity of the Big Bear Airport (GEOSCIENCE 1999). Faults are mapped cutting Pleistocene alluvium but it is not known if these are barriers to groundwater movement.

Recharge of this basin is likely from percolation of precipitation and runoff and underflow from fractured crystalline rocks.

2.8.1.5 Big Meadows Valley Groundwater Basin 8-7

This basin underlies a mountain valley in the upper reach of the SAR. The basin is bounded on the west by Seven Oaks Valley Groundwater Basin along the Slide Peak fault (Rogers 1967) and elsewhere by impermeable crystalline rocks of the San Bernardino Mountains. The valley is drained by the SAR and receives an average annual precipitation ranging from 24 to 36 inches. Groundwater in the basin is found in alluvium that typically consists of clay, silt, sand, and gravel. Alluvial material appears to reach about 400 feet in thickness in some parts of the basin. The Slide Peak, Santa Ana, and San Gorgonio faults are mapped as cutting through basin materials (Rogers 1967); however, it is not known whether these faults impede groundwater movement.

2.8.1.6 Seven Oaks Valley Groundwater Basin 8-08

This basin underlies a mountain valley in the upper reach of the SAR. The basin is bounded on the east by Big Meadows Valley Groundwater Basin along the Slide Peak fault (Rogers 1967) and elsewhere by impermeable crystalline rocks of the San Bernardino Mountains. The valley is drained by the SAR and receives an average annual precipitation ranging from 24 to 36 inches. Groundwater in the basin is found in alluvium that typically consists of clay, silt, sand, and gravel that reaches at least 50 feet thick. The Slide Peak and Santa Ana faults are mapped as cutting through basin materials (Rogers 1967); however, it is not known whether these faults impede groundwater movement.

Recharge is probably derived principally from percolation of precipitation and streamflow in the SAR.

2.9 Groundwater Management in the Region

Conjunctive use of surface water and groundwater is a long-standing practice in the Region. Part of the potable water used in the Region is imported from sources in the Sierra and Northern California through the SWP. Several reservoirs are operated primarily for the purposes of storing surface water for domestic and irrigation use, but groundwater basins are also recharged from the outflow of some reservoirs. The concept is to maintain streamflow over a longer period of time than would occur without regulated flow and thus provide for increased recharge of groundwater basins. Most of the larger basins in this Region are managed with many conjunctive use projects being developed to optimize and manage water supply. Numerous groundwater spreading grounds have been developed to recharge the groundwater basins when adequate surface water supply is available. Management of the water level in the SBBA, in general, and the Pressure Zone, in particular, is a focus of the groundwater management of this IRWM Plan. Management of the SBBA is discussed in more detail in Chapter 4.

Numerous groundwater spreading grounds have been developed to recharge the groundwater basins.

2.9.1 Recharge Area Programs

The SBVWCD and its predecessors have conducted groundwater recharge activities since 1912 in the Bunker Hill groundwater subbasin. Artificial recharge of imported water to the SBBA began in 1972. Because of the extremely permeable sand and gravel deposits, maximum instantaneous recharge rates are high. Based on a recharge efficiency rate of 95 percent, the total quantity of artificial recharge in the basin averaged about 7,400 acre-feet per year from 1972 to 1992. Because of the size of several of the recharge basins and exceptionally permeable material, a larger quantity of water could be imported and recharged along the base of the San Bernardino Mountains, if necessary (i.e., recharge basin capacity and infiltration rates are not currently limiting the amount of imported water recharged). Any additional recharge and extraction should be carefully planned and implemented to avoid liquefaction and unacceptable decreases in groundwater levels in the basins.

Numerous existing groundwater recharge facilities (spreading grounds or spreading basins) are located in the SBBA, Rialto-Colton, and Yucaipa subbasins. The locations of these facilities are shown in Figure 2-16, and selected characteristics are summarized in Table 2-11. Existing turnouts serve each recharge facility, with the exception of the Cactus Spreading and Flood Control Basins, which would be served by the Cactus Basins Pipeline proposed by Valley District. A description of each spreading ground follows.

Figure 2-16
Location of Spreading Grounds in the Region

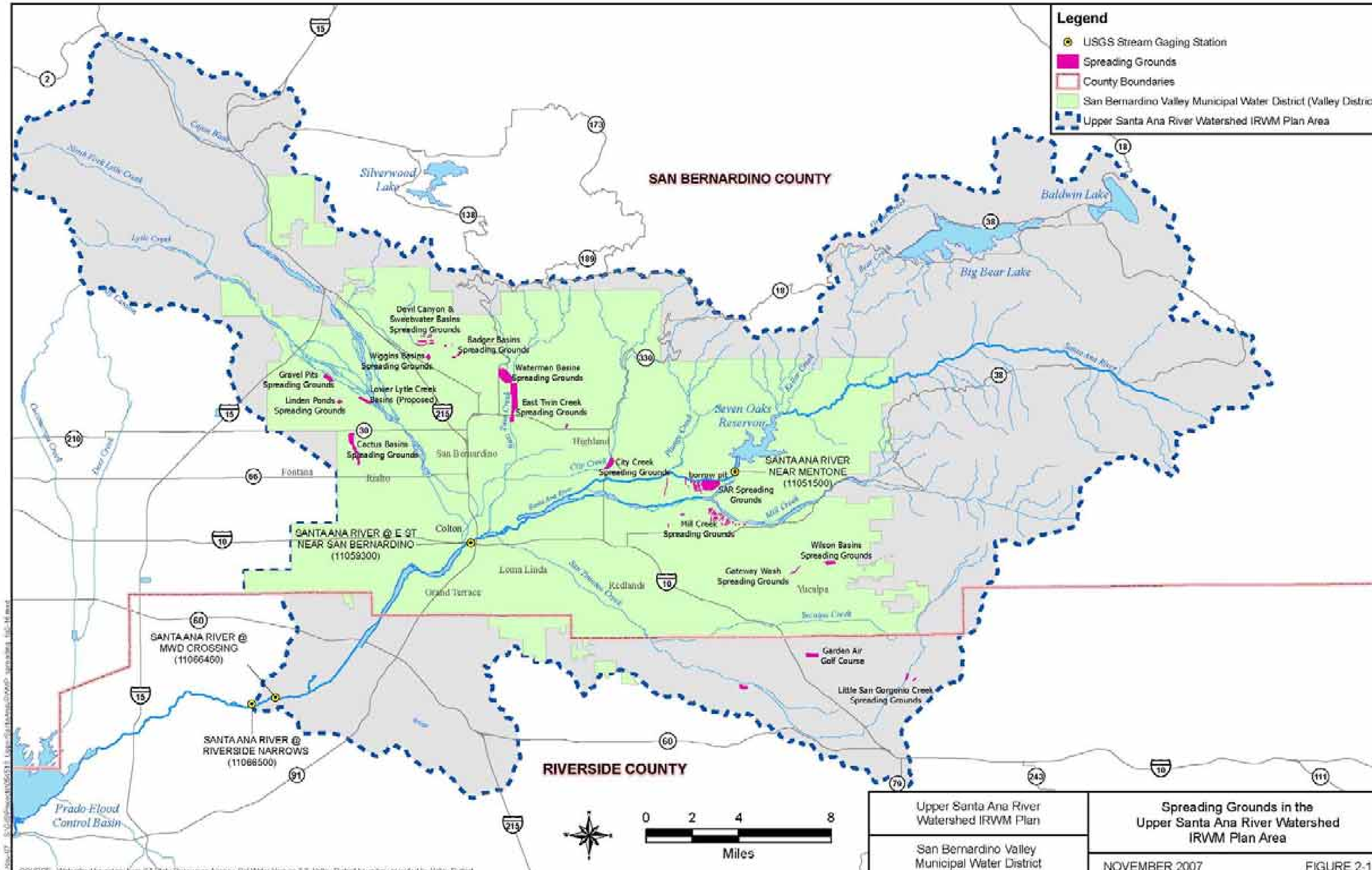


Table 2-11
Recharge Facilities

Facility Name	Owner or Operator	Conveyance Used to Serve Facility	Recharge Facility Characteristics[a]			
		Turnout Name & Capacity (cfs)	Active Recharge Facility Area[b] (acres)	Percolation Rate[c] (feet/day)	Monthly Capacity (acre-feet)	Groundwater Basin (and Subbasin) Recharged[d]
SAR Spreading Grounds	SBVWCD	Foothill Pipeline Santa Ana Low Flow (288) Santa Ana Intake (200 Max)	64[d]	3	12,000	SBBA (Bunker Hill)
Devil Canyon and Sweetwater Basins	SBCFCD[f]	Foothill Pipeline Sweetwater (37)	30	1.5	1,350	SBBA (Bunker Hill)
Lytle Basins	Lytle Creek Water Conservation Association	Fontana Power Plant Constructed drainage channel	Variable	1.5	Variable	SBBA (Lytle Creek)
City Creek Spreading Grounds	SBCFCD	Foothill Pipeline City Creek (60)	75	1.5	3,375	SBBA (Bunker Hill)
Patton Basins	SBCFCD	Foothill Pipeline Patton (12)	3	0.3	27	SBBA (Bunker Hill)
Waterman Basins	SBCFCD	Foothill Pipeline Waterman (135)	120	0.5	1800	SBBA (Bunker Hill)
East Twin Creek Spreading Grounds	SBCFCD	Foothill Pipeline Waterman (135)	32	1.5	1440	SBBA (Bunker Hill)
Badger Basins	SBCFCD	Foothill Pipeline Sweetwater (22)	15	0.5	225	SBBA (Bunker Hill)
Mill Creek	SBVWCD	Greenspot Pipeline Mill Creek Spreading (50) Mill Creek Intake (110)	66	3	6,000	SBBA (Bunker Hill)
Cactus Spreading and Flood Control Basins	SBCFCD	San Gabriel Valley MWD Lytle Pipeline Lower Lytle Creek (55)	46	1.5	2,070	Rialto-Colton
Wilson Basins	SBCFCD	East Branch Exten. Wilson Basins (30)	12	1	360	Yucaipa subbasin
Garden Air Creek	Valley District	East Branch Exten. Garden Air Creek (16)0	n/a	n/a	n/a	San Timoteo subbasin

[a] Values are from tabulation on map contained in Water Right Application by Valley District and Western to appropriate water from the SAR or by engineering evaluation of spreading grounds.

[b] Recharge facility area is the geographical extent of each basin that can be inundated for recharge.

[c] Estimated percolation rate. This is the estimated rate at which water can percolate into the ground through the basin, expressed in feet per day. The values used have generally been computed from the annual recharge capacity. These rates are typically about one-half of the percolation rates presented by the USGS (1972). The use of the small percolation rates is reasonable in that it would involve longer-term percolation rates that are typically smaller than short-term rates.

[d] Note that there may be flow out of the subbasin or basin identified. For example, a report by Geoscience Support Services, Inc. (1992) estimated that only 36 percent of the water recharged in the upper Lytle Creek area remains in the Lytle Creek subbasin, while most of it flows to the Rialto-Colton subbasin.

[d]Recharge facility area based upon 4/11/03, SBVWCD Report: “SBVWCD Basin Storage Capacity for SAR and MC.” Or by estimating using GIS.

2.9.1.1 SAR Spreading Grounds

The SAR spreading grounds, located downstream of Seven Oaks Dam on the alluvial fan of the SAR, are operated by the SBVWCD. The SAR spreading grounds include a borrow pit that was a source of materials used in the construction of Seven Oaks Dam.

The percolation rate for the SAR spreading grounds is approximately 3 feet per day, which results in a recharge rate (based on 64 acres) of about 6,000 acre-feet per month, or about 97 cubic feet per second (cfs). Absorptive capacity is estimated by multiplying the active area of the recharge facility by the estimated percolation rate. Water delivered to the SAR spreading grounds recharges the Bunker Hill subbasin of the SBBA (Table 2-11).

2.9.1.2 Devil Canyon and Sweetwater Basins

The Devil Canyon and Sweetwater Basins, located northwest of the California State University, San Bernardino campus, are operated by the SBCFCD and have an active spreading area of 30 acres. The estimated long-term percolation rate for the site is about 1.5 feet per day, which results in a recharge rate of about 1,350 acre-feet per month, or about 23 cfs. The Devil Canyon and Sweetwater Basins recharge the Bunker Hill subbasin of the SBBA (Table 2-11).

2.9.1.3 Lytle Creek Subbasin

Gravel Pits and spreading grounds have been used for recharge of the subbasin for over 80 years. Significant groundwater recharge occurs in the gravel pits adjacent to Lytle Creek. However, evaluating recharge potential can be more complicated for recharge in a gravel pit than in a spreading facility dedicated to recharge.

2.9.1.4 The City Creek Spreading Grounds

The spreading grounds located along City Creek, between State Highway 30 and Boulder Avenue, are operated by SBCFCD. These spreading grounds have an active spreading area of about 75 acres and an estimated percolation rate of about 1.5 feet per day, which results in a recharge rate of about 3,375 acre-feet per month, or about 57 cfs. The City Creek spreading grounds recharge the Bunker Hill subbasin of the SBBA.

2.9.1.5 Patton Basins

The Patton Basins are located along Sand Creek, north of East Highland and west of the Patton State Hospital. The Patton Basins have an active spreading area of about 3 acres and an estimated percolation rate of about 0.3 foot per day. This equates to a recharge rate of about 27 acre-feet per month, or about 1 cfs. Recharge at this site contributes to the Bunker Hill subbasin of the SBBA.

2.9.1.6 Waterman Basins

The Waterman Basins are located northeast of Wildwood Park and north of 40th Street in the City of San Bernardino. These basins are operated by SBCFCD, have an active spreading area of about 120 acres, and have an estimated percolation rate of about 0.5 foot per day. This percolation rate equates to a recharge rate of about 810 acre-feet per month, or about 14 cfs. However, the absorptive capacity used in the Allocation Model is 30 cfs, based on historic use. The Waterman Basins recharge the Bunker Hill subbasin of the SBBA (Table 2-11).

2.9.1.7 East Twin Creek Spreading Grounds

The East Twin Creek spreading grounds are located south of 40th Street, immediately south of the Waterman Basins, and are operated by SBCFCD. These spreading grounds have an area of about 32 acres and an estimated percolation rate of about 1.5 feet per day, which results in a recharge rate of about 225 acre-feet per month, or about 4 cfs. However, the absorptive capacity used in the Allocation Model is 24 cfs, based on historic use. The East Twin Creek spreading grounds recharge the Bunker Hill subbasin of the SBBA (Table 2-11).

2.9.1.8 Badger Basins

The Badger Basins, located in the Sycamore Flood Control Basin immediately east of the California State University, San Bernardino campus, are operated by the SBCFCD and have an active spreading area of about 15 acres. The estimated percolation rate for this site is 0.5 foot per day, which results in a recharge rate of about 225 acre-feet per month, or about 4 cfs. The Badger Basins recharge the Bunker Hill subbasin of the SBBA (Table 2-11).

2.9.1.9 Mill Creek Spreading Grounds

The Mill Creek spreading grounds are located south of the main channel of Mill Creek, about one mile upstream of the confluence with the SAR, and are operated by the SBVWCD. The Mill Creek spreading grounds have an active spreading area of about 66 acres and an estimated percolation rate of about 3 feet per day. This equates to a recharge rate of about 6,000 acre-feet per month. Recharge at this site contributes to the Bunker Hill subbasin of the SBBA (Table 2-11).

2.9.1.10 Cactus Spreading and Flood Control Basin

The Cactus recharge basins are located within the central portion of the Rialto-Colton subbasin. The basins are operated by the SBCFCD. Artificial recharge operations have an active spreading area of about 46 acres. The estimated percolation rate for this site is 1.5 feet per day.

2.9.1.11 Wilson Basins

The Wilson Basins are located northeast of the intersection of Oak Glen Road and Bryant Street, just north of the City of Yucaipa, and are operated by SBCFCD. The Wilson Basins have an active spreading area of about 12 acres and an estimated percolation rate of about 1 foot per day, which results in a recharge rate of about 360 acre-feet per month, or about 6 cfs. The Wilson Basins recharge the Yucaipa Basin.

2.9.1.12 Garden Air Creek

Garden Air Creek is a tributary of San Timoteo Canyon Creek. There are no plans for a formal spreading facility at this location and recharge will be accomplished by percolation from existing natural channels, up to a rate of 16 cfs. Although the turnout is outside Valley District and inside the boundary of SGPWA, the recharge area is in the San Timoteo Canyon region, and thus inside the Valley District service area boundary. This delivery will recharge the San Timoteo Basin.

2.9.1.13 Linden Ponds

Though no longer in existence the Linden Ponds were located between the San Jacinto fault and an unnamed fault in the northeastern portion of the Rialto-Colton subbasin. The basins were operated by the SBCFCD. Imported water was recharged between 1982 and 1994. Artificial recharge operations had an active spreading area of about 46 acres. The estimated percolation rate for this site was 1.5 feet per day.

2.9.2 SAR Natural Recharge

Most groundwater recharge occurs in the natural channels of the Upper SAR. However, evaluating the actual recharge potential for a natural channel is more complicated. The recharge rate depends on the wetted area, which varies substantially in a natural channel depending on flow conditions. The area of the "active" channel of the SAR (defined by the area on aerial photographs with limited vegetation) has been estimated to be about 79 acres, while the area from the mouth of the canyon to Sterling Avenue (i.e., to about the San Bernardino International Airport or former Norton Air Force Base), including overflow lands, is about 2,110 acres (Danskin et al. n.d.).

Danskin et al. estimated the potential percolation rate to be about four feet per day. Consistent with the percolation rates for spreading grounds included in the applications, a percolation rate of two feet per day is used here as the long-term percolation rate that might be achieved in the channel. Using the two-feet–per-day rate, the recharge rate may be about 4,740 acre-feet per month (or about 80 cfs) for the active channel from the mouth of the canyon to Sterling Avenue, and about 126,600 acre-feet per month (or about 2,128 cfs) if the overflow lands are included. Percolation in the river could recharge the Bunker Hill subbasin of the SBBA and the Rialto-Colton subbasin. In a similar analysis, USACE (1997) estimated that recharge in the active channel to Sterling Avenue would be approximately one cfs per wetted acre, which approximates to 79 cfs.

The maximum recharge area (including overflow lands) for SAR reaches from Sterling Avenue to Lower Warm Creek and from Lower Warm Creek to the San Bernardino/Riverside County line (Danskin et al. n.d.). No recharge rate is provided, however, because those reaches overlie an area where the upward flow of groundwater into the stream channel is greater than the downward recharge of streamflows. It was estimated that there was a net recharge of approximately 95 cfs from Sterling Avenue to Prado Dam (USACE 1997).

2.9.3 Groundwater Discharge from SBBA

Groundwater discharge from the SBBA occurs from (1) rising water, (2) subsurface outflow, and (3) groundwater extractions. Rising water primarily occurs in the lower reaches of Warm Creek, when groundwater rises above the level of the ground surface or channel bottom and contributes to surface flows. The quantity of groundwater discharge into the creek for the period 1945 to 1992 was determined to be highly variable, with a maximum discharge exceeding 40,000 acre-feet per year and a minimum discharge of zero for 16 consecutive years, from 1963 to 1978 (Danskin et al. n.d.).

Subsurface outflow occurs across the San Jacinto fault and Barrier E at two locations, in the vicinity of the SAR at the Colton Narrows and where Lytle Creek emerges from the San Gabriel Mountains north of Barrier J. In the vicinity of the SAR at the Colton Narrows, subsurface outflow occurs in the younger alluvium. For the period 1936 to 1949, subsurface outflow in this area was estimated to range from 14,300 to 23,700 acre-feet per year (Dutcher and Garrett 1963). Subsurface outflow north of Barrier J was estimated to be approximately 4,000 acre-feet per year (Dutcher and Garrett 1963) and between 2,700 and 4,200 acre-feet per year during water years 1935 to 1960 (DWR 1970b).

While streamflow and subsurface outflow contribute to basin discharge, groundwater extraction is the primary discharge of groundwater from storage. Extracted water is used for agricultural, municipal, and industrial purposes. Most pumping is located near major streams, including the SAR, Lytle Creek, Warm Creek, and East Twin Creek. This areal distribution of pumpage reflects the exceptionally permeable deposits that underlie the stream channels and the abundant nearby recharge (Danskin et al. n.d.). As the area has become urbanized, the quantity of agricultural pumpage has declined considerably, presently accounting for less than 20 percent of the gross pumpage (Danskin et al. n.d.). However, overall pumpage has increased in the basin due to increased pumping for municipal and industrial purposes. Prior to 1940, gross pumpage in the basin was less than 110,000 acre-feet per year, while current pumping has reached as high as about 200,000 acre-feet per year (Western-San Bernardino Watermaster 2002).

2.9.4 Groundwater Storage

Estimates of the change in groundwater volume, or storage, in the SBBA are made annually by both Valley District and the SBVWCD from which a cumulative change in basin storage is calculated. The approach employed by Valley District calculates the change in storage for nine sub-areas: Cajon, Devil Canyon, Lytle Creek,, Pressure Zone, City Creek, Redlands, Mill Creek, Reservoir, and Divide. Calculating the change in storage for the SBBA is accomplished by summing the individual values for each of the sub-areas (Table 2-12).

Table 2-12
Summary of Groundwater Storage Capacities and Basin Surface Area

Basin	Storage Capacity (af)	Surface Area (acres)
SBBA	5,976,000	90,000
Rialto–Colton	2,517,000	30,100
Yucaipa	783,000 – 1,230,000	25,300
San Timoteo	2,010,000	73,100
Source: DWR, 2003b.		

The first change in storage calculation was completed for the years 1934 to 1960 by DWR (DWR 1970b). The values were calculated using the Specific Yield Method and a mathematical model developed by TRW, Inc. (TRW 1967). In 1980, Valley District updated the change in storage calculation to include the years 1961 to 1980. In the early 1990s, Valley District created a new change in storage model using software developed by Environmental Systems Research Institute (ESRI). In years of low precipitation, infiltration (direct from precipitation and surface streams) decreases while groundwater extractions increase, thereby causing the cumulative storage to decrease. The cumulative change in storage is cyclical based upon weather conditions. For example, 1934 through 1949 and 1979 through 1987 were wet periods, which produced increases in storage, while 1950 through 1978 was a dry period, resulting in decreased storage.

In general, the far eastern and northwestern portions of the Bunker Hill subbasin show the largest decreases, while the rest of the subbasin shows mostly stable or increasing groundwater elevations.

Groundwater in the Bunker Hill subbasin generally flows in a southwesterly direction from the San Bernardino Mountains to the Colton Narrows. The San Jacinto fault generally runs perpendicular to the groundwater flow and acts as a partial barrier resulting in water level differences across the fault. This phenomenon also contributes to the high groundwater located within the City of San Bernardino, commonly referred to as the Pressure Zone. Figure 2-13 depicts depth to groundwater contours throughout the SBBA, Rialto-Colton subbasin, and Yucaipa subbasin, including those reflecting shallow groundwater conditions in the Pressure Zone. In the past, water levels in the Pressure Zone were raised high enough to cause artesian conditions.[1]

For the basin as a whole, there can be wide fluctuations in the average depth to groundwater from year to year, with annual changes as high as almost 40 feet. However, for the most part, annual changes register less than 20 feet (+ or -), with only six years exceeding this range. There are, however, noticeable variations in behavior across subbasins.

The Lytle Creek subbasin (Figure 2-6) contains Lytle Creek, with extensive headwaters in the adjacent mountain areas and a river channel comprised of deep, porous alluvial deposits. Due to the presence of Lytle Creek and its relatively small size, this subbasin exhibits far greater and more extreme changes than any other subbasin of the SBBA. In 40 of 68 years, the annual average change in depth to groundwater exceeds 20 feet, with 8 years showing changes greater than 50 feet, and 3 years showing changes greater than 100 feet.

The Bunker Hill and Lytle Creek subbasins are generally considered as one groundwater basin, the SBBA. However, the three separate water-bearing zones and intervening confining zones of the Bunker Hill subbasin are not observed in the Lytle Creek subbasin. Sediments within the Lytle Creek Basin are, for the most part, highly permeable and the aquifer has a high specific yield. High permeability and specific yield tend to result in an aquifer that responds rapidly to changes in inflow (precipitation and streamflow) and outflow (groundwater pumping, streamflow, and subsurface outflow). Water levels in the Lytle Creek subbasin have fluctuated in excess of 200 feet over relatively short periods (less than 5 years) and in select wells (e.g., FWC's Well F34A). From 1934 to 2002, depth to groundwater as measured in various wells in the basin has ranged from approximately 8 feet in the south-central portion of the basin to over 500 feet in the north-central portion of the basin (SBVMWD 2003).

Lytle Creek subbasin is adjoined on the west by the Rialto-Colton subbasin, along the Lytle Creek fault, and on the east and southeast by the Bunker Hill subbasin, along the Loma Linda fault and Barrier G. The northwestern border of the subbasin is delineated by the San Gabriel Mountains, and runoff from the mountains flows into the Rialto-Colton subbasin. Numerous faults that act as barriers to groundwater flow create six compartments within the basin. Barriers A through D divide the northwestern portion of the basin into five sub-areas and the southeastern portion of the basin comprises the sixth sub-area. Barrier F divides the northwestern sub-areas from the southeastern sub-area. Studies have shown that the groundwater barriers are less permeable with depth (Dutcher and Garrett 1963). When groundwater levels are high during wet years, more leakage occurs across the barriers than when groundwater levels are lower (i.e., during dry years). The amount of pumping in each sub-area, in large part, controls the movement of groundwater across the barriers (Dutcher and Garrett 1963).

2.9.5 Groundwater Quality

Groundwater quality varies among the subbasins of the Upper SAR due to geology and faulting patterns and recharge points, and from anthropogenic sources of contamination.

Perchlorate treatment facilities, similar to the West Valley Water District plant above, treat groundwater for use in the Region.

2.9.5.1 San Bernardino Basin Area

Groundwater in the SBBA is generally a calcium-bicarbonate type, containing equal amounts (on an equivalent basis) of sodium and calcium in water near the land surface and an increasing predominance of sodium in water from deeper parts of the valley-fill aquifer. A TDS range of 150 to 550 mg/L, with an average of 324 mg/L, is found in public supply wells (DWR 2003). Electrical conductivity (EC) is a measure of total dissolved ionic constituents. EC has been measured within a range of 95 to 2,920 microMhos (µMhos) with an average of 523 µMhos.

The inorganic composition of the groundwater may be affected by geothermal water emanating from faults and fractures in the bedrock surface underlying the aquifer. For example, concentrations of fluoride that exceed the public drinking

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[1] Conditions where groundwater levels rise above the land surface in confined aquifers.

water standard have limited the use of groundwater extracted near some faults and from deeper parts of the aquifer.

In some public supply well locations in the SBBA, some inorganics (primary and secondary), radiological constituents, nitrates, pesticides, Volatile Organic Compounds (VOCs), Synthetic Organic Compounds (SOCs), and Perchlorate were found above the maximum contaminant level (MCL) (Table 2-13).

Table 2-13
Prevalence of Contaminants in SBBA Wells

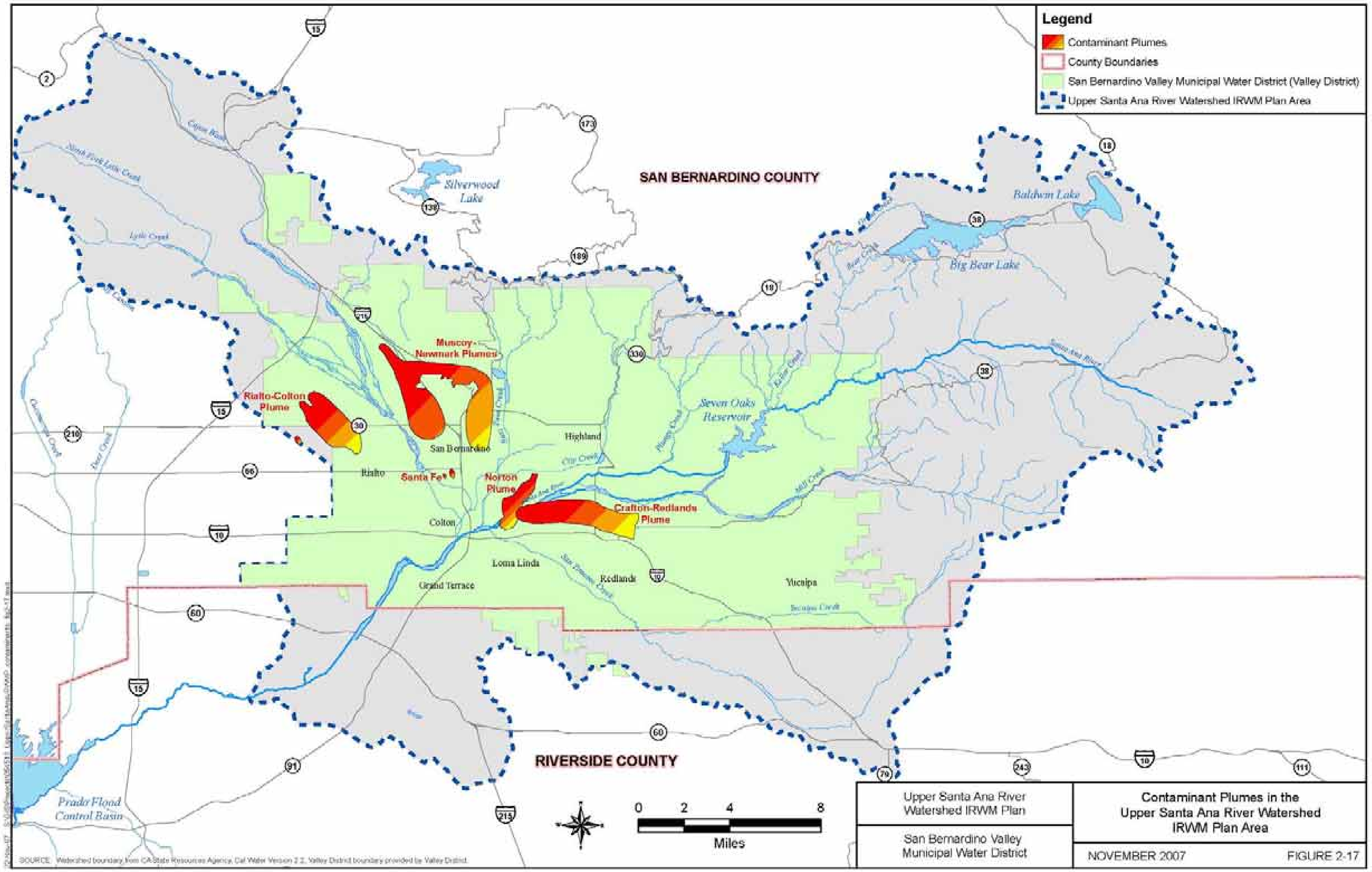
Constituent	No. Wells Sampled	No. of Wells with a Concentration Above MCL
Inorganics (primary)	212	13
Radiological	207	34
Nitrates	214	34
Pesticides	211	20
VOCs and SOCs	211	32
Inorganics (secondary)	212	25
Perchlorate	369	156 (1)

Source: DWR 2003. and Geoscience
1. No MCL has been established for Perchlorate. But “action level” is 4ug/l.

The SBBA is affected by five major groundwater contaminant plumes (Figure 2-17). Plumes in the basin include (1) the Crafton-Redlands plume, with TCE and lower levels of perchloroethylene (PCE) and debromochloropropane (DBCP); (2) the Norton Air Force Base TCE and PCE plume, stretching 2.5 miles from its source and contaminating 100,000 acre-feet of groundwater; (3 and 4) the Muscoy and Newmark plumes near the Shandon Hills, which are Superfund sites with TCE and PCE; and (5) the Santa Fe plume with PCE, TCE, and 1,2 dichloroethylene (1,2-DCE) contamination.

Within the City of San Bernardino, the Newmark plume and the Muscoy plume consist primarily of PCE. The plumes have impacted San Bernardino water supply wells. Under the federal Superfund Program, the U. S. Environmental Protection Agency (EPA) has implemented cleanup of these plumes, including use of groundwater extraction and treatment using granulated activated carbon. The treated water is then used to supplement the City of San Bernardino’s potable water supply. It appears that cleanup efforts will be adequate to protect 32 down-gradient water supply wells (Santa Ana River Watershed Project Authority (SAWPA) 2002). However, groundwater model simulations suggest that containment of the plume will need additional extraction wells that will result in pumping of at least 14,000 acre-feet per year (Danskin, et al 2006).

Figure 2-17
Contaminant Plumes in SBBA



The Norton Air Force Base plume, located just to the southwest of the former installation in the City of San Bernardino, is a major contaminant plume, consisting primarily of TCE and PCE. The plume has impaired 10 wells owned by the City of Riverside and the City of San Bernardino. Cleanup efforts by the Air Force, consisting of soil removal, soil gas extraction, and groundwater treatment, have significantly reduced this plume. The treatment plants now operate in a standby mode (SAWPA 2002).

Two commingled plumes, comprising the Crafton-Redlands plume, have impacted water supply wells for the cities of Riverside, Redlands, and Loma Linda, including Loma Linda University wells. One plume contains TCE and the other perchlorate; both are in the upper 300 to 400 feet of groundwater. TCE has been measured in water supply wells at over 100 parts per billion (ppb), over 20 times the MCL of 5 ppb. Currently, however, water supply well concentrations are around 7 ppb. Perchlorate is present in water supply wells at concentrations up to 77 ppb.

As required by the SARWQCB, the Lockheed Martin Corporation (Lockheed) has prepared contingency plans to address impacts of the plume on water supply wells. These include blending, treatment, and/or providing alternative water supply sources. The plumes are currently being captured by the City of Riverside’s Gage Well Field. Lockheed has installed granular activated carbon treatment units at some of the gage wells to remove TCE and has installed ion exchange units on some of these wells for the removal of perchlorate (SAWPA 2002).

The Santa Fe groundwater plume consists primarily of 1,2-DCE, TCE, and PCE; this plume is currently being monitored (ERM 2001).

Separately from the foregoing remediation efforts, FWC currently operates and maintains a groundwater remediation project at its Plant F10 pursuant to a long-term agreement with San Bernardino County, the owner and operator of the Mid Valley Sanitary Landfill and corresponding Clean-Up and Abatement Order issued to San Bernardino County by the RWQCB. The 5,000 gpm treatment plant utilizes liquid phase granular activated carbon to treat for volatile organic compounds including, but not limited to, PCE, TCE, 1,1-DCE, and cis-1,2-DCE. The plant treats and removes those contaminants from groundwater extracted from both the Rialto-Colton and No-Mans Land subbasins.

2.9.5.2 Rialto-Colton Groundwater Subbasin

In public supply well samples in the Rialto-Colton subbasin, the average TDS is 264 mg/L, with a range of 163 to 634 mg/L (DWR 2003). Other source samples show an average TDS of 230 mg/L and a range of 201 to 291 mg/L. This is a lower TDS range than the groundwater in the Bunker Hill subbasin, where TDS levels from 1995 through 1997 ranged as high as 1,000 mg/L along the SAR. The San Jacinto fault markedly affects the groundwater chemistry in the basin. The TDS in groundwater downstream from the San Jacinto fault is greater than that in the surface water found in the Bunker Hill outflow area.

Of 38 public supply wells sampled, two were over the MCL for nitrates, and in three wells, secondary inorganics, VOCs, and SOCs exceeded the MCL (Table 2-14). Most reported NO_3 concentrations are less than 22.5 mg/L, with a few samples ranging from 45 to 90 mg/L. Most of the wells sampled did not contain constituents over the MCL concentration.

More than 143 water source wells in Riverside and San Bernardino Counties alone now exceed 4 ppb of perchlorate contamination (California Department of Health Services 2003a). In the Valley District service area, the City of Rialto, the City of Colton, West Valley, and FWC have shut down or restricted the use of 20 wells due to perchlorate contamination in the Rialto-Colton subbasin, where concentrations reach above 4 ppb (SARWQCB 2003b).

Table 2-14
Prevalence of Contaminants in Rialto–Colton Subbasin Wells

Constituent	No. Wells Sampled	No. Wells with a Concentration Above an MCL
Inorganics (primary)	38	0
Radiological	40	0
Nitrates	38	2
Pesticides	40	0
VOCs and SOCs	40	3
Inorganics (secondary)	38	3
Perchlorate	38	7 (1)

Source: DWR 2003 and Geoscience.
1 No MCL has been established for Perchlorate. But “action level” is 4 ug/L

2.9.5.3 Riverside-Arlington Groundwater Subbasin

The Riverside subbasin contains groundwater that is predominantly calcium or sodium bicarbonate. Of the water sampled from 46 wells, TDS ranged from 210 to 889 mg/L, with an average of 463 mg/L (see Table 2-15) (DWR 2003). From other sources, TDS has been found to range from 320 to 756 mg/L. This is a higher TDS range than in the Rialto–Colton and Bunker Hill subbasins.

In some of the sampled public supply wells, MCLs were exceeded for inorganics (primary and secondary), radiological constituents, nitrates, pesticides, VOCs, and SOCs. Nitrate (as NO_3) concentrations of greater than 20 mg/L were detected as early as the 1940s, probably due to historical land use, including citrus production. NO_3 was the constituent found most frequently in the sampled wells, followed by pesticides. Only a few wells were found to have concentrations of primary and secondary inorganics.

Table 2-15
Prevalence of Contaminants in Riverside Subbasin Wells

Constituent	No. Wells Sampled	No. Wells with a Concentration Above an MCL
Inorganics (primary)	48	2
Radiological	48	11
Nitrates	51	21
Pesticides	50	19
VOCs and SOCs	50	8
Inorganics (secondary)	38	3
Source: DWR 2003		

2.9.5.4 Yucaipa Groundwater Subbasin

Most of the recent groundwater samples from the Yucaipa subbasin indicate a calcium bicarbonate-type groundwater, generally meeting drinking water standards, with little variation across the basin. Groundwater has higher mineral concentrations, but otherwise is similar to the surface water in the area. The average TDS from public supply wells is 322 mg/L, with a range of 200 to 630 mg/L. This is similar to average TDS values of 343 mg/L and 334 mg/L estimated from other sources (DWR 2003). The TDS estimates in the Yucaipa subbasin are lower than the Riverside subbasin and slightly higher than the Rialto-Colton and Bunker Hill subbasins.

Table 2-16 contains data from wells sampled for various pollutants (DWR 2003). Some samples contained concentrations above the MCL. This was true for one sample with primary inorganics, VOCs, and SOCs; four samples with pesticides and secondary inorganics; and 12 samples with nitrates. As in the Riverside subbasin, nitrates were found more than any other constituent in the sample well set.

Table 2-16
Prevalence of Contaminants in Yucaipa Subbasin Wells

Constituent	No. Wells Sampled	No. Wells with a Concentration Above an MCL
Inorganics (primary)	43	1
Radiological	44	1
Nitrates	46	12
Pesticides	43	4
VOCs and SOCs	44	1
Inorganics (secondary)	43	4
Source: DWR 2003.		

2.9.5.5 San Timoteo Groundwater Subbasin

The mineral character of groundwater beneath San Timoteo Canyon is sodium bicarbonate; calcium bicarbonate in the alluvium of Little San Gorgonio Creek; calcium bicarbonate in younger alluvium near Beaumont; and sodium bicarbonate in older deposits. Water samples from 24 public supply wells have an average TDS content of approximately 253 mg/L, with a range of 170 to 340 mg/L. The TDS range is lower than in the Riverside, Bunker Hill, and Yucaipa subbasins and comparable to the Rialto–Colton subbasin. Out of 27 sampled wells, one well contained secondary inorganics above the MCL (Table 2-17). Otherwise, no contaminants were found (DWR 2003).

Table 2-17
Prevalence of Contaminants in San Timoteo Subbasin Wells

Constituent	No. Wells Sampled	No. Wells with a Concentration Above an MCL
Inorganics (primary)	27	0
Radiological	26	0
Nitrates	28	0
Pesticides	27	0
VOCs and SOCs	27	0
Inorganics (secondary)	27	1
Source: DWR 2003.		

2.9.5.6 Cajon Subbasin

The mineral character of groundwater within the Cajon subbasin has an average TDS content of about 130 mg/L, with a range of 99 to 155 mg/L. The TDS range is lower than in the Riverside, Bunker Hill, and Yucaipa subbasins, and comparable to the Rialto–Colton subbasin. Only two public supply wells have been sampled. No exceedance of MCL in drinking water has been reported.

2.10 Ecological and Environmental Resources

2.10.1 San Bernardino National Forest Land and Resource Management Plan

The U.S. Forest Service (USFS) has jurisdiction over land uses in the San Bernardino National Forest. The *San Bernardino National Forest Land and Resource Management Plan of 1988* (USDA Forest Service 1988) directs the management of the forest. Its goal is to provide a management program that reflects a mix of activities that allows both the use and protection of forest resources; fulfills legislative requirements; and addresses local, regional, and national issues.

The San Bernardino National Forest is divided into 15 management areas based on (1) combinations of watersheds that have similar characteristics, (2) wilderness areas, and (3) potential wilderness areas. The Seven Oaks Dam and adjacent areas are located in the Central Section of the San Gorgonio District of the Santa Ana Management Area. Much of the area in this district is classified as the Santa Ana Recreation Area, a designation designed to provide continued protection of the recreation values for which it was established.

The management for this area emphasizes (1) fire management, (2) recreation (dispersed recreation opportunities in the lower SAR area), and (3) other integrated activities (including wildlife management and non-motorized recreation).

2.10.2 U.S. Bureau of Land Management (BLM) Area of Critical Environmental Concern

The BLM designated an Area of Critical Environmental Concern (ACEC) in the SAR in 1994. The purpose of the ACEC designation is to protect and enhance the habitat of federally listed species occurring in the area while providing for the administration of valid existing rights (BLM 1996). The species of concern in the SAR area include the SAR wooly-star, the Slender-Horned spineflower, and the San Bernardino kangaroo rat. The BLM manages over 1,100 acres that are part of the ACEC. Although the establishment of the ACEC is important in regard to conservation of sensitive habitats and species in this area, the administration of valid existing rights supersedes BLMs conservation abilities in this area. Existing rights include a withdrawal of federal lands in this area for water conservation through an act of Congress, February 20, 1909 (Pub. L. 248). The entire ACEC is included in this withdrawn land and may be available for water conservation measures such as the construction of percolation basins, subject to compliance with the act.

The San Bernardino Kangaroo rat is a species of concern in the SAR area. (Photo, courtesy of NPS).

2.10.3 U.S. Army Corps of Engineers Wooly-Star Preserve Area

To protect significant populations of the SAR wooly-star (a federally protected plant species), lands within the corridor of the SAR and portions of the alluvial fan terraces were set aside as a conservation area. The Wooly-Star Preserve Area (WSPA) is a 764-acre area located west of the Greenspot Bridge that crosses the SAR. The WSPA was established by mitigation in the 1990s by the USACE and local sponsors to address impacts related to the construction of Seven Oaks Dam.

2.10.4 Western Riverside County Multi-Species Habitat Conservation Plan

The Multi-Species Habitat Conservation Plan (MSHCP) is a comprehensive, multi-jurisdictional plan that focuses on the conservation of species and their habitats in western Riverside County. The plan area includes all unincorporated land in Riverside County west of the crest of the San Jacinto Mountains to the Orange County line, as well as the jurisdictional areas of a number of cities. The MSHCP established a conservation area of more than 500,000 acres and focuses on the conservation of 146 species.

2.10.5 SAR Corridor

The SAR corridor is defined as the area located within the incised channel of the river. Persistent aquatic and riparian habitats are present immediately downstream of the Seven Oaks Dam plunge pool; in oxbows; in fault zones; in areas with manmade or natural water sources, such as a tributary confluence or a storm drain outfall; in areas with perched water tables; and downstream of river mile (RM) 54.5, where groundwater emerges and flows on the surface of the riverbed (USACE 2000). Much of the habitat within the project area provides optimal foraging opportunities and several areas provide adequate breeding areas for raptors. Trees found in the riparian woodlands provide perches for foraging over the scrub and grassland.

Except during the winter months of December through March, surface flows in the SAR between Seven Oaks Dam and the San Bernardino International Airport are generally absent, and the riverbed is a braided, dry channel. Riparian habitat from Cuttle Weir to the airport is uncommon and limited to a few patches.

Downstream from the airport, surface flows are more prevalent and large areas of contiguous, well-developed riparian habitat as well as giant reed (*Arundo donax*) infestations along the banks of the SAR are common. Just downstream of the region are Prado Flood Control Basin and Prado Dam. Approximately 2,150 acres of land upstream of Prado Dam are owned by Orange County Water District (OCWD), the local sponsor for Prado Dam. Within this area are approximately 465 acres of constructed wetlands as well as large areas of mature riparian habitat, naturally occurring wetlands, and deepwater habitats.

The vegetation communities discussed above provide wildlife habitat throughout most of the SAR corridor. In general, wildlife within the area is extremely diverse and abundant due to the amount of natural open space and diversity of habitat types from the active river channels to the uppermost flood terraces. While a few wildlife species depend entirely on a single habitat type, the mosaic of all the vegetative communities within the study area and adjoining areas constitutes a functional ecosystem for a variety of wildlife species.

The SAR contains a variety of riverine conditions and habitat types that support a number of fish species throughout nearly the entire river when winter and spring flows are present. Portions of the SAR, such as the segment that traverses the alluvial fan, are dry during most of the year and, consequently, offer only temporary habitat for fish.

The scrub, woodland, and riparian habitats in the SAR corridor provide foraging and cover habitat for song birds including year-round residents, seasonal residents, and migrating individuals. The overall condition of these communities in the corridor is good and mostly undisturbed. In addition, portions of the SAR and its tributaries provide a perennial water source for birds.

The SAR wash is a state-designated Significant Natural Area. Approximately 27 sensitive plant and animal species are known to occur in the wash. About 760 acres of BLM land within the Upper SAR wash area downstream from the Greenspot Bridge have been designated by BLM as an ACEC because of the presence of the federally listed species, SAR wooly-star, and the San Bernardino kangaroo rat (U.S. Fish and Wildlife Service (USFWS) 1988).

Wildlife corridors link areas of suitable habitat that are separated by unsuitable habitat such as rugged terrain, development, or changes in vegetation. Riverbeds often provide a favorable passageway for wildlife movement to otherwise disconnected areas. Historically, the SAR bed was likely to have supported substantial regional wildlife movement. In addition, the SAR floodplain may have acted as a hub for wildlife movement with many major tributaries converging in a relatively short section of the river. In recent years, however, loss of habitat due to development on the floodplain and surrounding lowlands, as well as construction of Seven Oaks Dam, are likely to have greatly reduced the amount of regional movement through the corridor.

3 Water Budget for Integrated Regional Water Management Plan Region

The water budget for the Integrated Regional Water Management Plan (IRWM Plan) Area (Region) compares the supply and demand for the Region. The water supply and water demand data that comprise the water budget are used in the development of integrated water management strategies that will be used to manage both supplies and demands into the future.

The data presented in this report are based upon water demand figures provided by each water agency in the Region. Actual demand figures for each agency may be different based upon the water agency's water right(s) recognized by the State of California (State)**.**

3.1 Review of Previously Published Water Budgets

The San Bernardino Valley Municipal Water District (Valley District) compiled a water budget for its 352-square-mile service area in its Regional Water Facilities Master Plan (1995). The original Valley District water budget, with some modifications, was used by the Santa Ana Watershed Project Authority (SAWPA) as the basis for water budget tables in the SAWPA Integrated Water Resources Plan (2002). In 2004, Valley District and Western Municipal Water District (Western) updated the water budget by incorporating projections from the 2000 Urban Water Management Plans (UWMPs) in the Valley District/Western Santa Ana River (SAR) Water Right Application Draft Environmental Impact Report (DEIR) (2004).

3.2 Data Sources

The IRWM Plan water budget relies primarily on the 2005 update of the UWMPs within the Region. Table 3-1 provides a list of the water agencies within the Region and the UWMPs that were used in this analysis. Not all water agencies have completed the update of their UWMPs, and not all agencies are required to publish a UWMP (agencies that provide water to less than 3,000 connections and less than 3,000 acre-feet per year are not required to publish a UWMP). For these agencies, the necessary data for the water budget were obtained from the Western-San Bernardino Watermaster Report (see Chapter 2). For the purpose of preparing the water demands and supplies, the Region's water agencies were divided into four groups: (1) Non-Plaintiffs (water agencies in San Bernardino County of the Western Judgment (Western Municipal Water District of Riverside County v. East San Bernardino County Water District, Case No. 78426),

(2) Plaintiffs of the Western Judgment (water agencies in Riverside County), (3) water agencies outside the Western Judgment and located in the San Gorgonio Pass Water Agency (SGPWA) service area, and (4) water agencies outside the Western Judgment and located in the San Bernardino Mountains area.

Table 3-1
Data Utilized in the Water Budget

Water Agency	2005 UWMP	Other Documents
Non-Plaintiffs of the Western Judgment		
Colton, City of		Watermaster, SCAG
East Valley Water District	X	
Fontana Water Company	X	2005 Master Plan, Pers. Comm.
Loma Linda, City of		2002 UWMP
Marigold Mutual WC		Rialto, WVWD 2005 UWMP
Muscoy Mutual WC		2005 Community Plan
Redlands, City of - Water Utility	X	
Rialto, City of	X	Updated in 2006
San Bernardino MWD	X	
Terrace Water Co.		Watermaster
West Valley Water District	X	Personal Communication
Yucaipa Valley Water District[1]	X	
Other/Private[2]		Watermaster
Plaintiffs of the Western Judgment		
Meeks and Daley WC		Watermaster
Riverside-Highland WC	X	Watermaster
Riverside Public Utilities	X	Watermaster
San Gorgonio Pass Area		
Beaumont Cherry Valley WD	X	2006 LAFCO Report
Banning, City of[3]	X	2006 LAFCO Report
Cabazon Water District[3]		2006 LAFCO Report
South Mesa Water Company	X	2006 LAFCO Report
Yucaipa Valley Water District[1]	X	2006 LAFCO Report
San Bernardino Mountains Area		
Big Bear City CSD		2000 UWMP
City of Big Bear Lake DPW	X	
Big Bear Municipal WD		Personal Communication

[1]Yucaipa Valley Water District overlies the SGPWA and the Valley District. Yucaipa Valley WD includes Western Heights WC and Oak Valley.
[2]Includes Devore WC, Crafton WC, Inland Valley Development Company, Mount Vernon WC, Pioneer Mutual WC, Pharaoh-Powell Mutual WC, Redlands WC, Tennessee WC, California Portland Cement Company, Corridor Land Company, El Rivino Country Club, and Elsinore Valley MWD.
[3]Agencies outside of the Santa Ana River Watershed but inside the SGPWA service area.

3.2.1 Applied Water Demands

The applied water demands developed for the water budget are based on the demand projections provided by each individual agency. If demand projections were unavailable for an agency, a per-capita applied water demand was calculated using Southern California Association of Governments (SCAG) data along with the water demands published by Western-San Bernardino Watermaster. Projections for the water users that do not belong to a city or water agency are based on historical demand trends using historical data compiled by the Watermaster. The applied water demands from 2005 to 2030 are summarized in Table 3-2.

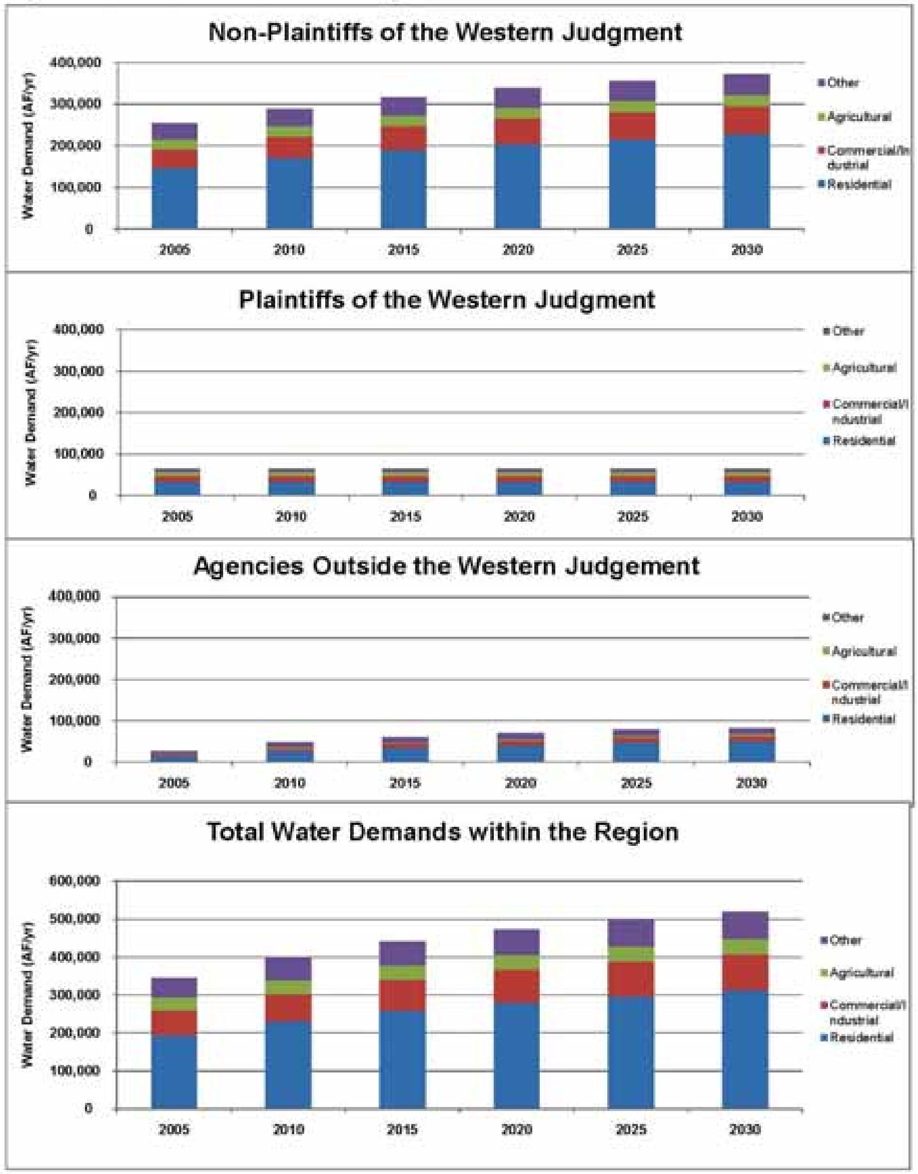
The Urban Water Management Planning Act requires that water demands be broken down into water use categories. The categories selected for this Region are Residential, Commercial/Industrial, Agricultural, and Other. The Other category includes uses such as unaccounted-for system losses, water sales to other agencies, and water used in construction. Figure 3-1 displays the total water demands in the region and breaks them down by water use. The projected total demand in the Region is expected to increase by about 50 percent from 349,200 acre-feet in 2005 to 519,700 acre-feet in 2030 (See Table 3-2).

Table 3-2
Future Applied Water Demands in the Region (Acre-Feet per Year)

Water Agency	2005	2010	2015	2020	2025	2030
Non-Plaintiffs of the Western Judgment						
Colton, City of	11,900	13,500	14,800	16,100	17,300	17,300
East Valley Water District	27,000	30,400	34,200	35,900	35,900	35,900
Fontana Water Company[1]	31,300	37,200	39,600	39,600	39,600	39,600
Loma Linda, City of	7,600	8,800	9,400	9,900	10,200	10,600
Marygold Mutual WC	0	0	1,500	1,500	1,500	1,500
Muscoy Mutual WC	2,100	2,100	2,100	2,100	2,100	2,100
Redlands, City of - Water Utility	45,500	50,600	55,000	59,500	61,500	65,300
Rialto, City of	14,300	13,300	13,900	13,900	13,900	13,900
San Bernardino MWD	47,500	54,800	61,900	67,700	73,500	73,500
Terrace Water Co.	900	900	900	900	900	900
West Valley Water District	25,300	30,000	33,700	39,000	45,000	56,400
Yucaipa Valley Water District[2]	13,900	13,200	15,600	17,300	19,400	20,000
Other/Private[3]	28,600	28,300	28,000	27,700	27,400	27,100
Subtotal	**255,900**	**283,100**	**310,600**	**331,100**	**348,200**	**364,100**
Plaintiffs of the Western Judgment[4]						
Meeks and Daley WC	7,800	7,800	7,800	7,800	7,800	7,800
Riverside-Highland WC	4,300	4,300	4,300	4,300	4,300	4,300
Riverside Public Utilities	52,200	52,200	52,200	52,200	52,200	52,200
Regents of California	500	500	500	500	500	500
Subtotal	**64,800**	**64,800**	**64,800**	**64,800**	**64,800**	**64,800**
San Gorgonio Pass Area						
Beaumont Cherry Valley WD	8,800	22,300	27,900	29,300	30,000	30,500
Banning, City of	9,500	12,500	15,500	18,500	21,600	24,600
Cabazon Water District	1,000	4,000	8,000	12,000	16,000	16,000
South Mesa Water Company	2,500	2,700	3,200	3,600	3,700	4,300
Yucaipa Valley Water District[2]	1,800	5,400	6,100	7,100	7,300	8,600
Subtotal	**23,600**	**46,900**	**60,700**	**70,500**	**78,600**	**84,000**
San Bernardino Mountains Area						
Big Bear City CSD	1,300	1,400	1,500	1,600	1,600	1,600
City of Big Bear Lake DPW	2,600	2,900	3,200	3,500	3,900	4,200
Big Bear Municipal Water District	1,000	1,000	1,000	1,000	1,000	1,000
Subtotal	**4,900**	**5,300**	**5,700**	**6,100**	**6,500**	**6,800**
TOTAL	**349,200**	**400,100**	**441,800**	**472,500**	**498,100**	**519,700**

[1]The demands shown for Fontana Water Company are their projected supplies from the Region, not FWC total demand. Portions of the supplies will be delivered outside the Region.
[2]Includes Western Heights WC and Oak Valley and overlies both SGPWA and Valley District.
[3]Includes Bear Valley Mutual WC, Devore WC, Crafton WC, Inland Valley Development Company, Mount Vernon WC, Pioneer Mutual WC, Pharaoh-Powell Mutual WC, Redlands WC, Tennessee WC, California Portland Cement Company, Corridor Land Company, El Rivino Country Club, Elsinore Valley MWD, San Gabriel Valley Water Company, and Reche Canyon Mutual WC.
[4]The demands for the Plaintiffs are their adjusted rights to the SBBA, not the total demand of the Plaintiff water agencies

Figure 3.1. Water Demands within the Region



3.2.1.1 Increase in Water Demand in Dry Years

During drought periods, water demands increase due to the increased irrigation demands for agriculture and landscaping. The demands outlined in Table 3-2 and Figure 3-1 are the average water demands projected by the water agencies. For the purposes of the modeling of the San Bernardino Basin Area (SBBA) analysis, water demands were assumed to increase in “critically dry” years by four percent (California Department of Water Resources (DWR) Bulletin

160-93). Critically dry years were defined to be the driest 20 percent of years using the SAR annual flows near Mentone from 1962 to 2000.

3.2.1.2 Reduced Demand Due to Conservation

Conservation reduces water demand in ways that are not easily measured. Demand is reduced through changed consumer behaviors and more water-efficient fixtures like ultra-low-flow toilets and showerheads. These savings happen gradually over time as non-conserving fixtures are replaced with newer water-efficient models. The agencies within the Region implement a prescribed set of urban water conservation best management practices (BMPs) according to the Urban Water Planning Act. The current water demands reflect the effect of water conservation projects that are implemented by the purveyors. However, in general, demand projections of the UWMPs do not include estimates of conservation due to the implementation of future water conservation programs.

3.2.2 Water Supplies

The following sections provide a description of each water supply within the Region, the projected demands on each supply, and an estimate of the available water supply based on data presented in UWMPs and the Western-San Bernardino Watermaster report. The majority of the groundwater basins in the Region are adjudicated. The projected demands on each water supply were based on the UWMPs. The projected water supplies of water purveyors were scaled to meet the projected demand. This was necessary to make a realistic projection of demand on shared water supplies within the Region.

3.2.2.1 San Bernardino Basin Area

The San Bernardino Basin Area (SBBA) was adjudicated by the Western Judgment in 1969. The judgment established the natural safe yield of the SBBA to be a total of 232,100 acre-feet per year for surface water diversions and groundwater extractions. Surface water is diverted from Mill Creek, Lytle Creek, and the SAR. The average surface water diversions in the SBBA for direct use from 1968 to 2000 were 39,000 acre-feet per year. It was determined in the Western Judgment that the Plaintiffs have a 64,862 acre-feet per year share of the safe yield, which equates to 27.95 percent of the safe yield. The Plaintiffs include the City of Riverside (the successor to the Riverside Water Company and the Gage Canal Company), Riverside Highland Water Company, Meeks & Daley Water Company, and the Regents of the University of California (Regents).

The Non-Plaintiffs' (agencies within San Bernardino County) rights are 167,238 acre-feet which equates to 72.05 percent of the safe yield. If the Non-Plaintiff extractions exceed the safe yield of the SBBA, Valley District is obligated to import and recharge a like amount of water into the SBBA. The Western-San Bernardino Watermaster produces an annual report calculating the total extractions and comparing it to the safe yield. If the total extractions are less than the safe yield, it results in a "credit." If the total extractions are more than the safe yield, it results in a replenishment obligation. Table 3-3 and Figure 3-2 outline the projected increase in demands for the local surface water and groundwater in the SBBA and provide an estimate of how much replenishment will be needed in the future. According to the 2006 Annual Western-San Bernardino Watermaster Report, Valley District has 256,000 acre-feet of credit accumulated in the SBBA.

The SBBA is forecasted to supply over 60 percent of the future water demand within the Region. Computer models were used to help determine whether the available surface water (local surface water and imported water) and groundwater supplies would meet ultimate demands (2030). Based on the modeling results (described in Chapter 4.3), if the State Water Project (SWP) is as reliable as DWR estimated in 2005 (77%) and the Valley District's water rights application on the SAR is approved, the SBBA storage can be maintained to meet the 2030 demands.

Table 3-3
Projected SBBA Local Surface Water Diversions and Groundwater Extractions
(Acre-Feet per Year)

Water Agency	2005[1]	2010	2015	2020	2025	2030
Non-Plaintiffs						
Colton, City of	5,600	*7,000*	*7,700*	*8,300*	*9,000*	*9,000*
East Valley Water District	26,100	21,400	25,200	27,000	27,000	27,000
Fontana Water Company	17,300	*18,000*	*18,000*	*18,000*	*18,000*	*18,000*
Loma Linda, City of	6,600	8,800	9,400	9,900	10,200	10,600
Marygold Mutual WC	*0*	*0*	*1,500*	*1,500*	*1,500*	*1,500*
Muscoy Mutual WC	2,100	2,100	2,100	2,100	2,100	2,100
Redlands, City of - Water Utility	*37,500*	*39,100*	*42,000*	*45,000*	*47,000*	*50,300*
Rialto, City of	*11,400*	*9,300*	*9,900*	*9,900*	*9,900*	*9,900*
San Bernardino MWD	49,900	53,900	61,000	66,900	72,700	72,700
Terrace Water Co.	*800*	*900*	*900*	*900*	*900*	*900*
West Valley Water District	*10,900*	*12,800*	*14,800*	*17,600*	*21,100*	*30,700*
Other/Private[2,3]	*22,200*	*20,200*	*19,900*	*19,600*	*19,300*	*19,000*
Subtotal	**190,400**	**193,500**	**212,400**	**226,700**	**238,700**	**251,700**
Plaintiffs (Based on Adjusted Rights[5])						
Meeks & Daley WC	7,800	7,800	7,800	7,800	7,800	7,800
Riverside-Highland WC	4,300	4,300	4,300	4,300	4,300	4,300
Riverside Public Utilities	52,200	52,200	52,200	52,200	52,200	52,200
Regents of California	500	500	500	500	500	500
Subtotal	**64,800**	**64,800**	**64,800**	**64,800**	**64,800**	**64,800**
Total Groundwater and Surface Water Demand	**255,200**	**258,300**	**277,200**	**291,500**	**303,500**	**316,500**
Safe Yield	**232,100**	**232,100**	**232,100**	**232,100**	**232,100**	**232,100**
Extractions above Safe Yield	**23,200**	**26,300**	**45,200**	**59,500**	**71,500**	**84,500**
Return flow from Extractions above the Safe Yield[6]	**8,400**	**9,500**	**16,300**	**21,400**	**25,700**	**30,400**
Replenishment Obligation[7]	**14,800**	**16,800**	**28,900**	**38,100**	**45,800**	**54,100**

Italic = Estimated value. Projected demands in the SBBA were not specified in UWMPs.

[1]The extractions for 2005 are based on the Western-San Bernardino Watermaster 2006 Annual Report.
[2]Includes Devore WC, Crafton WC, Inland Valley Development Company, Mount Vernon WC, Pioneer Mutual WC, Pharaoh-Powell Mutual WC, Redlands WC, and Tennessee WC.
[3]In 2005 Other/Private includes a portion a Bear Valley Mutual Water Company (BVMWC) demands. BVMWC stock is owned by the City of Redlands and East Valley WD. After 2005 it was assumed that BVMWC are included in the City of Redlands and East Valley WD projections, as they purchase rest of the shares.
[4]Adjusted rights are based on the natural safe yield of the SBBA and were effective in 1972. Prior to 1972, extractions were limited to the “base rights,” which were the average extractions during the base period from 1959 to 1963.
[5]The Western Watermaster assumes a 36 percent return flow from extractions above the safe yield.
[6]The Replenishment Obligation is the Extractions above the Safe Yield minus the Return Flow from the extractions. above the Safe Yield.

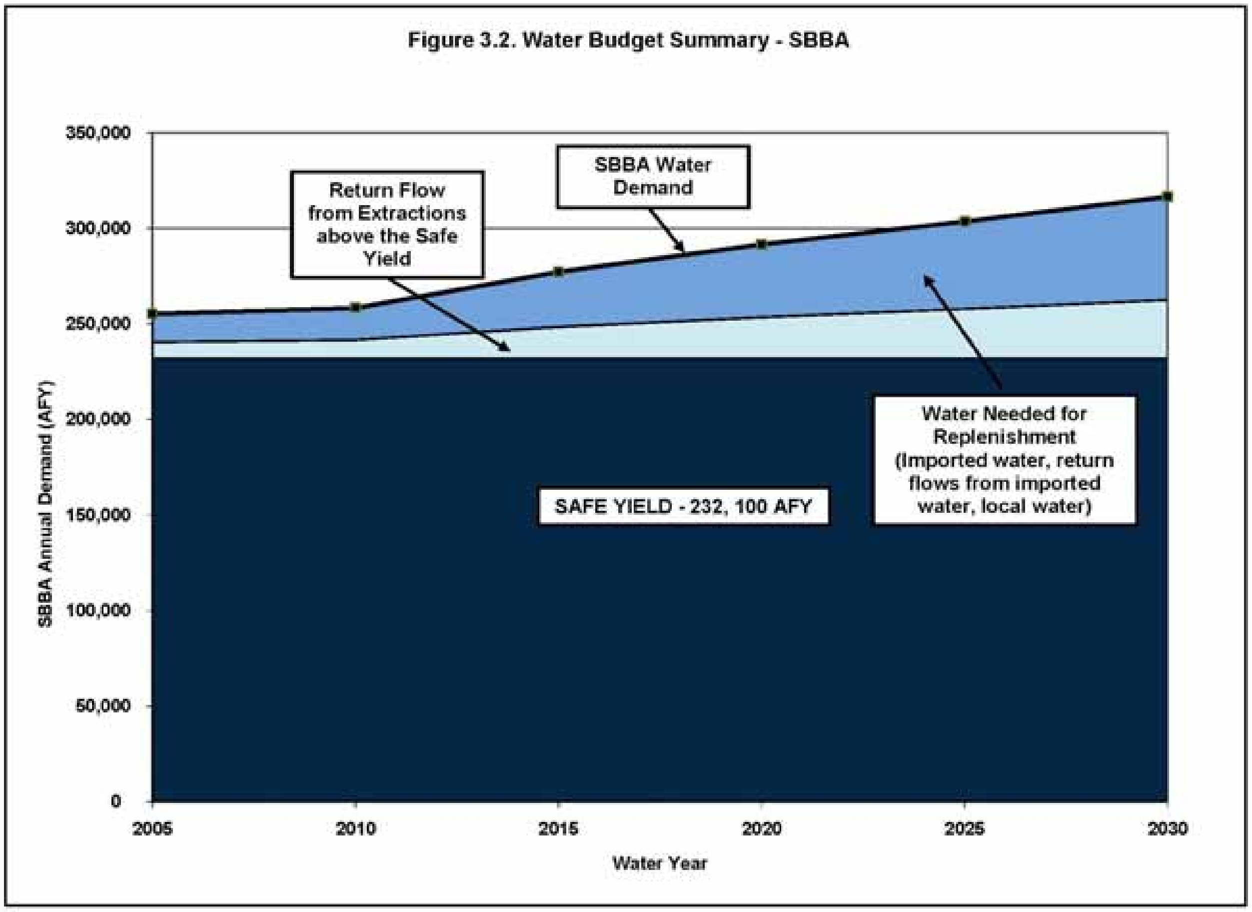


Figure 3.2. Water Budget Summary - SBBA
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
SBBA Annual Demand (AFY)
2005
2010
2015
2020
2025
2030
Water Year
Return Flow from Extractions above the Safe Yield
SBBA Water Demand
Water Needed for Replenishment (Imported water, return flows from imported water, local water)
SAFE YIELD - 232, 100 AFY

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3.2.2.2 Colton Basin Area

The groundwater extractions in the Colton Basin Area are governed by the Rialto Basin Decree and the Western Judgment. The Western Judgment uses the terminology "Colton Basin Area"; however, this basin is also known as the Rialto-Colton Basin. Fontana Water Company (FWC), City of Rialto, City of Colton, and West Valley Water District are subject to the Rialto Basin Decree, entered on December 22, 1961, by the Superior Court for the County of San Bernardino. Entitlement extractions for any given water year (October 1 to September 30) are affected by groundwater elevations between March and May for three specific "index" wells (Duncan Well, Willow Street Well, and Boyd Well). Under specified conditions, groundwater extractions may be limited during certain months.

The Western Judgment requires Valley District to maintain the average lowest static water levels in three index wells in the Colton Basin Area and Riverside North Basins above 822.04 feet mean sea level (msl). If the water levels fall below 822.04 feet msl, Valley District is obligated to recharge the basin with imported water or reduce extractions. Extractions for use in Riverside County are limited to 3,381 acre-feet per year.

The safe yield for the Colton Basin Area was not defined by the Western Judgment or the Rialto Basin decree. Extractions during the five-year base period of the Western Judgment, 1959 to 1963, were, on average, 11,731 acre-feet per year. Extractions have averaged 17,300 acre-feet per year from 1996 to 2005. Since 1971, when the Watermaster reports began, the water levels in the three index wells have never fallen below 822.04 feet. In 2006, the average lowest static level was 878.74 feet msl for the three index wells. Projected extractions in the Colton Basin Area are found in Table 3.4.

Since the safe yield has not been determined for the Colton Basin Area, the average extraction from 1996-2005 of 17,300 acre-feet per year was used as the available supply from the Colton Basin Area in the water budget summary.

Table 3-4
Projected Extractions in the Colton Basin Area (Acre-Feet per Year)

Water Agencies	2005[1]	2010	2015	2020	2025	2030
Colton, City of	4,100	4,100	4,500	4,900	5,300	5,300
Rialto, City of	1,600	2,000	2,000	2,000	2,000	2,000
West Valley Water District	2,200	3,500	4,500	5,900	8,200	10,000
Fontana Water Company	7,300	8,000	8,000	8,000	8,000	8,000
Other/Private[2]	2,100	2,100	2,100	2,100	2,100	2,100
Total	17,300	17,600	19,000	20,800	23,500	25,300
Historical Average (1996-2005)	17,300	17,300	17,300	17,300	17,300	17,300

[1]The extractions for 2005 are based on the 2006 Western-San Bernardino Watermaster Annual Report.
[2]Includes San Gabriel Valley WC and Reche Canyon Mutual WC.

3.2.2.3 Riverside North Basin

Groundwater extractions in the Riverside North Groundwater Basin (the portion of the Riverside Basin in San Bernardino County) are governed by the Western Judgment. Extractions for use in San Bernardino County are unlimited, provided that water levels at three index wells in the Rialto-Colton and Riverside North Basins stay above 822.04 feet msl. (Extractions from the Riverside North Basin for use in Riverside County are limited to 21,085 acre-feet per year.)

Total extractions during the five-year base period of the Western Judgment, 1959 to 1963, were, on average, 33,729 acre-feet per year. Historically, average static low measurements have never been below 822.04 feet and in 2006 were 878.74 feet msl. Because the safe yield of the Riverside North Basin has not been determined, the average historical extraction from 1996 to 2005 of 30,100 acre-feet per year was used as the available supply of the Riverside North Basin. Because the agencies in Riverside County are limited to 21,085 acre-feet per year, the available supply used in the water budget summary is the amount for the Non-Plaintiffs of 9,000 acre-feet per year. Table 3-5 lists the projected demands on the Riverside North Basin. If this increased production causes the water levels to drop, water agencies would have to either restrict use or Valley District would need to recharge the basin with imported water.

Table 3-5
Projected Extractions in the Riverside North Basin (Acre-Feet per Year)

Water Agencies	**2005[1]**	**2010**	**2015**	**2020**	**2025**	**2030**
Colton, City of	2,100	2,400	2,700	2,900	3,100	3,100
Rialto, City of	-0	1,000	1,000	1,000	1,000	1,000
West Valley Water District	1,300	2,900	3,700	4,800	5,000	5,000
Agencies in Riverside County[2]	11,200	21,100	21,100	21,100	21,100	21,100
SBMWD – RIX Overextraction[3]	5,000	6,000	6,000	6,000	6,000	6,000
Other/Private[4]	5,000	6,000	6,000	6,000	6,000	6,000
TOTAL	**29,100**	**38,400**	**39,500**	**40,800**	**41,200**	**41,200**
Historical Average (1996-2005)	30,100	30,100	30,100	30,100	30,100	30,100

[1]The extractions in 2005 are based on the 2006 Western-San Bernardino Watermaster Report
[2]Agencies in Riverside County have the adjusted right of 21,085 AF in the Riverside North basin.
[3]The Rapid Infiltration and Extraction (RIX) facility overlies the Riverside North Basin. In order to ensure that the secondary effluent applied to ground does not percolate to the groundwater and it is fully recovered, it is necessary that extractions exceed the amount of water applied. At present, this water is discharged from the RIX outfall into the SAR. In the long-term, the over-extractions rates will be approximately 10 percent more than that recharged (Watermaster 2003 pg. 14).
[4]Includes California Portland Cement Company, Corridor Land Company, El Rivino Country Club, and Elsinore Valley MWD.

3.2.2.4 Yucaipa Groundwater Basin

Yucaipa Valley Water District (YVWD) estimates the safe yield of the Yucaipa Groundwater Basin to be 10,000 acre-feet per year (YVWD 2005 pgs. 2-6). YVWD accounts for the majority of the demand on the Yucaipa Groundwater Basin. The City of Redlands Municipal Utilities Department and South Mesa Water Company also extract water from the Yucaipa groundwater basin to a lesser extent. YVWD demands are projected to increase from 15,700 acre-feet in 2005 to 28,600 acre-feet by 2030. In order to meet demands above the groundwater safe yield, YVWD plans to recycle water and import surface water from Mill Creek, SAR, and the SWP through transfer and exchange agreements with the City of Redlands and Valley District. YVWD's new water treatment plant became operational in 2007. There is potential to increase spreading of water in the Wilson Creek spreading grounds and also to utilize the Oak Glen Creek stream channel for additional recharge. By maximizing the existing spreading grounds and expanding spreading acreage along Oak Glen Creek (25 to 50 acres), the capability exists to spread from 7,000 to 14,000 acre-feet of surface water annually into the Yucaipa Basin.

Table 3-6
Projected Extractions in the Yucaipa Basin (Acre-Feet per Year)

Water Agencies	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Redlands, City of – Municipal Utilities Department	1,000	1,000	1,000	1,000	1,000	1,000
South Mesa Water Company	2,500	2,700	2,000	2,300	1800	1,800
YVWD	12,600	7,800	7,800	7,800	7,800	7,800
TOTAL	**16,100**	**11,500**	**10,800**	**11,100**	**10,600**	**10,600**
Safe Yield	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**

3.2.2.5 Other Groundwater and Surface Water Supplies

3.2.2.5.1 San Gorgonio Pass Area Groundwater Basins

The supplies available in the SGPWA are based on the "2006 Report on the Water Supply Conditions in the San Gorgonio Pass Region" submitted to LAFCO by SGPWA and the San Timoteo Watershed Management Authority (STWMA). This report concluded that the retail agencies in the region will be able to supply the projected demands to 2030 as long as the agencies aggressively develop local supplies and recycled water, complete the East Branch extension, and secure additional supplies outside the SGPWA service area.

The available groundwater supplies in the San Gorgonio Pass region are found in Table 3-7. The available supplies were based on Table 7 of the 2006 LAFCO report.

Table 3-7
Projected Extractions of Other Groundwater and Surface Water Supplies (Acre-Feet per Year)

Water Agencies	2005	2010	2015	2020	2025	2030
San Gorgonio Pass Area Groundwater Supplies[1]						
Edgar Canyon Basin	1,800	1,800	1,800	1,800	1,800	1,800
Beaumont Basin	24,700	24,700	8,700	8,700	8,700	8,700
Banning Storage Unit	2,500	2,700	3,000	3,200	3,500	3,700
Banning Canyon	5,000	5,000	5,000	5,000	5,000	5,000
Cabazon Storage Unit	1,000	6,000	6,000	6,000	6,000	6,000
Local Enhancements	700	8,100	10,100	11,500	12,900	13,600
Supplies	**35,700**	**48,300**	**34,600**	**36,200**	**37,900**	**38,800**
Big Bear Valley Groundwater						
City of Big Bear Lake D.W.P	2,500	2,800	2,200	2,500	2,800	3,100
Big Bear City C.S.D	1,300	1,400	1,500	1,600	1,600	1,600
BBV Groundwater Subtotal	**3,800**	**4,200**	**3,700**	**4,100**	**4,400**	**4,700**
Big Bear Lake						
Big Bear Municipal W.D.[2]	1,000	1,000	1,000	1,000	1,000	1,000
No Man's Land Groundwater						
Fontana Water Company	3,700	3,600	3,600	3,600	3,600	3,600
Rialto, City of	1,200	1,000	1,000	1,000	1,000	1,000
TOTAL PROJECTED SUPPLIES	**44,400**	**57,100**	**42,900**	**44,900**	**46,900**	**48,100**

[1]The SGPA groundwater available supplies are based on Wildermuth Demand and Supply data LAFCO 2006, Table 7.

[2]Surface water from Big Bear Lake used for snow making

3.2.2.5.2 Big Bear Valley Groundwater

Big Bear Community Services District (BBCSD) supplies all its water from groundwater in Big Bear Valley. The City of Big Bear Lake Department of Water and Power (BBLDWP) also produces groundwater in Big Bear Valley. The projected extractions from Big Bear Valley groundwater are found in Table 3-7. The reduction in demand in 2015 is due to the planned additional recycled water supply becoming available after 2010.

Water from Big Bear Lake is used for snowmaking at local ski resorts. Most of the melted snow from the resorts flows back into the lake.

3.2.2.5.3 Big Bear Lake

Big Bear Municipal Water District has a contract with Bear Mountain/Snow Summit to sell water from Big Bear Lake for snowmaking. The contract allows the sale of up to 1,300 acre-feet per year and no more than 11,000 acre-feet for any 10-year period. Currently, the sales of water for snowmaking have not exceeded 1,000 acre-feet per year. The projected extractions from Big Bear Lake are found in Table 3-7.

3.2.2.5.4 No Man's Land

FWC and City of Rialto extract water from a small unadjudicated groundwater basin between the Chino Basin and the Colton Basin Area known as "No Man's Land." FWC plans to extract 3,600 acre-feet per year from the basin. The City of Rialto plans also extract water from No Man's Land. Projected extractions from "No Man's Land" are found in Table 3-7.

3.2.2.6 State Water Project Water

SWP water is delivered from Northern California to Valley District. Valley District has the fifth largest SWP contract, with a maximum Table A amount of 102,600 acre-feet per year through 2035. To help assess the reliability of SWP supplies, DWR published the 2005 State Water Project Delivery Reliability Report. In this report, various hydrologic studies were conducted on the expected deliveries (expressed as percentage of entitlement) that would be available during different hydrologic years from 1922 to 1994. DWR ran two modeling studies, Study 4 and Study 5. Study 4 estimated the SWP deliveries based on 2005 demand levels with a repeat of the hydrology from 1922 to 1994. Study 4 estimated that, on average, 68 percent of the Table A SWP amounts would be delivered based on 2005 demand levels. Study 5 estimated SWP deliveries based on 2025 demand (which was assumed to be the full Table A amount). Study 5 estimated that, on average, 77 percent of the Table A SWP amounts would be delivered based on 2025 demand levels. The existing facilities and environmental constraints are the same between the two studies; the difference in reliability is the result of not limiting the deliveries to the 2005 demand levels for Study 5. (Example: in a repeat of the hydrology in 1956, Study 4 estimates the 2005 demand to be 3,639 thousand acre-feet (TAF).

Therefore, the deliveries are limited to 3,639 TAF. In 1956, with Study 5, the deliveries are not limited by the demands and the full amount of 4,133 TAF could be delivered). For this analysis, the reliability of the SWP is based on Study 5, which reflects the projected availability of SWP water not limited by 2005 demand levels. Therefore, Valley District's Table A amount of 102,600 acre-feet is estimated to be 77 percent reliable, or, on average, Valley District could receive 79,000 acre-feet per year of the Table A amount.

The water agencies in the Valley District service area forecast approximately 34,200 acre-feet per year for SWP deliveries in 2030, outlined in Table 3-8, based upon UWMP projections. Valley District is estimated to need approximately 54,100 acre-feet per year to meet the replenishment obligations in the SBBA with the projected demands in 2030 (Table 3-3). Replenishment may also be required for the Colton Basin Area and the Riverside North groundwater basins depending on the future water levels. Valley District would have 44,800 acre-feet per year of available SWP water to use for replenishment from its Table A amount after the SWP deliveries in 2030. The shortfall in 2030 may be met by the Valley District's water rights application on the SAR.

The other state water contractor in the Region is SGPWA. SGPWA has a contracted Table A amount of 17,300 acre-feet per year but is currently limited to importing 8,650 acre-feet per year until the next phase of the East Branch Extension is completed. Beaumont-Cherry Valley Water District and the City of Banning plan to purchase additional water from SGPWA and are investigating acquiring SWP water from other contractors' Table A amounts through SGPWA. The need for SWP water in the San Gorgonio Pass to meet the projected demands is higher than the current SGPWA Table A amount. Table 3-8 summarizes the forecasted demand for direct deliveries of SWP water and Table 3-9 is the available SWP supplies to the Region based on state water contractors' Table A amounts. Crestline-Lake Arrowhead Water Agency (CLAWA) is outside of the Region but provides 66 acre-feet per year water to the City of Big Bear Lake Department of Water and Power.

Table 3-8
Projected Deliveries of State Water Project (Acre-Feet per Year)

Water Agencies	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
SBVMWD						
East Valley WD	800	9,000	9,000	9,000	9,000	9,000
Fontana Water Company	3,000	5,000	5,000	5,000	5,000	5,000
Redlands, City of, Water Utility	0	3,000	4,000	5,000	5,000	5,000
San Bernardino MWD	2,000	2,000	2,000	2,000	2,000	2,000
West Valley Water District	1,300	7,000	7,000	7,000	7,000	7,000
Yucaipa Valley Water District	0	2,900	4,000	4,500	6,100	6,200
Subtotal	**7,100**	**28,900**	**31,000**	**32,500**	**34,100**	**34,200**
SGPWA (Portions of the SGPWA deliveries will be delivered for recharge)						
Banning, City of	0	4,000	8,800	9,300	9,300	9,300
Beaumont-Cherry Valley	0	6,000	6,800	6,800	6,900	6,900
Cabazon Water District	0	0	2,000	6,000	10,000	10,000
South Mesa Water Company	0	0	1,100	1,100	1,700	2,200
Yucaipa Valley Water District	500	2,300	3,600	4,700	4,800	6,100
Subtotal	**500**	**12,300**	**22,300**	**27,900**	**32,700**	**34,500**
CLAWA						
City of Big Bear Lake DWP	100	100	100	100	100	100
Subtotal	**100**	**100**	**100**	**100**	**100**	**100**
Total Deliveries	**7,700**	**41,300**	**53,400**	**60,500**	**66,900**	**68,800**

Table 3-9
Available State Water Supplies Based on Table A Amounts (AFY)

Water Agencies	**Table A Amount**	**Average Reliability (77%)**	**Multi-Year Drought Reliability (39%)**	**Single-Year Drought Reliability (21%)**
Valley District	102,400	79,000	40,000	21,500
SGPWA[1]	17,300	13,300	6,700	3,600
CLAWA to BBLDWP[2]	100	100	100	100
Total	**119,800**	**92,400**	**46,800**	**25,200**

[1]SGPWA plants to acquire an additional 21,000 AF of Table A amount for City of Banning and BCVWD.
[2]Crestline-Lake Arrowhead Water Agency supplies 66 acre-feet per year to BBLDWP.

3.2.2.7 Recycled Water

The projected use of recycled water is summarized by water agency in Table 3-10. Recycled water use is forecasted to increase from 9,200 acre-feet per year in 2005 to 35,700 acre-feet per year in 2030. The Orange County Judgment

(Orange County Water District v. City of Chino, et al., Case No. 117628) stipulated that Valley District shall be responsible for the delivery of an average annual supply of 15,250 acre-feet of "base flow" at the Riverside Narrows. Valley District has an agreement with the City of San Bernardino that at least 16,000 acre-feet of treated wastewater effluent will continue to discharge from its sewage treatment plant into the Santa Ana River to meet Valley District's obligation under the Orange County Judgment.

The City of Rialto delivers 85 acre feet per year of recycle water to the California Department of Transportation (Caltrans) (not shown on the table) and may increase to 2,260 acre feet in the future.

Table 3-10
Projected Use of Recycled Water (Acre-Feet per Year)

Water Agencies	2005	2010	2015	2020	2025	2030
Banning, City of	0	1,500	1,800	2,200	2,500	2,800
Beaumont Cherry Valley WD	0	5,800	7,000	7,100	7,200	7,200
City of Big Bear Lake DWP	0	0	1,000	1,000	1,000	1,000
Fontana Water Company	0	2,600	5,000	5,000	5,000	5,000
Redlands, City of – Water Utility[6]	7,000	7,500	8,000	8,500	8,500	9,000
San Bernardino MWD	0	800	800	800	800	800
South Mesa Water Company	0	0	100	100	200	200
Yucaipa Valley WD	1,300	2,500	3,800	5,000	5,500	6,000
West Valley Water District	900	3,700	3,700	3,700	3,700	3,700
Total	**9,200**	**24,400**	**31,200**	**33,400**	**34,400**	**35,700**

[1]The recycled water by the City of Redlands would otherwise percolate into the SBBA. In the water budget summary this was not counted as a new supply. The recycled water that would otherwise discharge into surface streams and flow out of the Region was counted as new supply.

3.2.3 Water Budget Summary

The current balance between supply and applied demand for the Region is presented as the summary of the water budget in Table 3-11 to 3-15 and Figure 3-3. Based on this analysis, the water supplies within the Valley District and San Bernardino Mountains area are adequate to meet the demands through 2025. This is assuming the SWP reliability published in the 2005 State Water Project Delivery Reliability Report and the Valley District/Western Municipal Water District water rights applications for the SAR are approved. Additional water from the water rights applications is denoted as Seven Oaks Supply in Table 3-11. The amount available from the water rights application may be higher or lower and depends on the conditions placed on the applications by the State Water Resources Control Board. Additional conservation of 8,400 acre-feet will be needed to ensure supply reliability for 2030.

Table 3-11
Water Budget Summary for Valley District and San Bernardino Mountains (Acre-Feet per Year) for an Average Year

	2005	2010	2015	2020	2025	2030
SBBA Surface Water	39,000	39,000	39,000	39,000	39,000	39,000
Big Bear Surface Water	1,000	1,000	1,000	1,000	1,000	1,000
Seven Oaks Supply	0	0	10,800	10,800	10,800	10,800
Surface Water	**40,000**	**40,000**	**50,800**	**50,800**	**50,800**	**50,800**
SBBA Groundwater	193,100	193,100	193,100	193,100	193,100	193,100
SBBA Return Flows from Extractions above safe yield[2]	8,400	9,500	16,300	21,400	25,700	27,000
SBBA return flow from SWP deliveries[3]	1,000	5,000	5,400	5,800	5,800	5,800
Rialto-Colton Groundwater	17,300	17,300	17,300	17,300	17,300	17,300
Riverside North Groundwater	9,000	9,000	9,000	9,000	9,000	9,000
Yucaipa Groundwater	10,000	10,000	10,000	10,000	10,000	10,000
Other Groundwater	8,700	8,800	8,300	8,700	9,000	9,300
Groundwater	**247,500**	**252,700**	**259,400**	**265,300**	**269,900**	**271,500**
Imported Water[4]	**34,600**	**48,400**	**52,800**	**65,400**	**77,300**	**79,100**
Recycled Water[5]	**3,500**	**12,100**	**18,100**	**20,500**	**21,500**	**22,500**
Additional Conservation[6]	**0**	**0**	**0**	**0**	**0**	**8,400**
Total Supplies	**325,600**	**353,200**	**381,100**	**402,000**	**419,500**	**435,700**
Total Demands	**-325,600**	**-353,200**	**-381,100**	**-402,000**	**-419,500**	**-435,700**
Shortfall	**0**	**0**	**0**	**0**	**0**	**0**

[1]Water rights applications are pending. The supplies of the project depend on conditions placed on the applications by the State Water Resources Control Board. The 15,000 acre-feet are estimated based on the agreements in the Seven Oaks Accord and the Conservation District Settlement and are only preliminary estimates until the applications are approved. The Water Rights EIR estimates the average annual diversions could range from 10,000 to 27,000 acre-feet per year. The Plaintiffs portion is 27.95% and the Non-Plaintiffs portion is 72.05% or 10,800 acre-feet per year.
[2]The watermaster estimates 36% return flows from extractions above the safe yield of the SBBA. This is estimated in Table 3-3.
[3]The Watermaster estimates a 36% return from the direct deliveries of SWP in the SBBA. Only the direct deliveries to East Valley Water District and the City of Redlands were used in the calculations, as the other agencies that project to receive SWP water do not overly the SBBA.
[4]The amount of SWP water used in the given year is the minimum between (a) the difference between the applied demand and the surface water, groundwater, recycled water, and future Seven Oaks Supply and (b) the available Table water found in Table 3-10.
[5]The recycled water supply does not include recycled water from the City of Redlands, because it would otherwise percolate into the basin. The recycled water included would otherwise be discharged into surface streams and out of the Region, and therefore can be counted as new supply.
[6]Additional conservation was limited to five percent of the total demand.

Table 3-12
Water Budget Summary for San Gorgonio Pass Water Agency Area

	2005	2010	2015	2020	2025	2030
Groundwater	22,700	25,500	24,500	24,700	25,000	25,200
Imported Water	200	6,000	13,300	13,300	13,300	13,300
Recycled Water	0	7,300	8,900	9,400	9,900	10,200
Local Enhancement Projects	700	8,100	10,100	11,500	12,900	13,600
Additional Conservation[1]	0	0	3,000	3,500	3,900	4,200
Total Supplies	**23,600**	**46,900**	**59,800**	**62,400**	**65,000**	**66,500**
Total Demands	**-23,600**	**-46,900**	**-60,700**	**-70,500**	**-78,600**	**-84,000**
Shortfall	**0**	**0**	**-900**	**-8,100**	**-13,600**	**-17,500**

[1]Additional conservation was limited to five percent of the total demand.

Table 3-13
Region-Wide Water Budget Summary for Average Year (Acre-Feet per Year)

	2005	2010	2015	2020	2025	2030
Surface Water	40,000	40,000	50,800	50,800	50,800	50,800
Groundwater	270,900	286,300	294,000	301,500	307,800	313,700
Imported Water	34,800	54,400	66,100	78,700	90,600	92,400
Recycled Water	3,500	19,400	27,000	29,900	31,400	32,700
Additional Conservation	0	0	3,000	3,500	3,900	12,600
Total Supplies	**349,200**	**400,100**	**440,900**	**464,400**	**484,500**	**502,200**
Total Demands	**-349,200**	**-400,100**	**-441,800**	**-472,500**	**-498,100**	**-519,700**
Shortfall	**0**	**0**	**-900**	**-8,100**	**-13,600**	**-17,500**

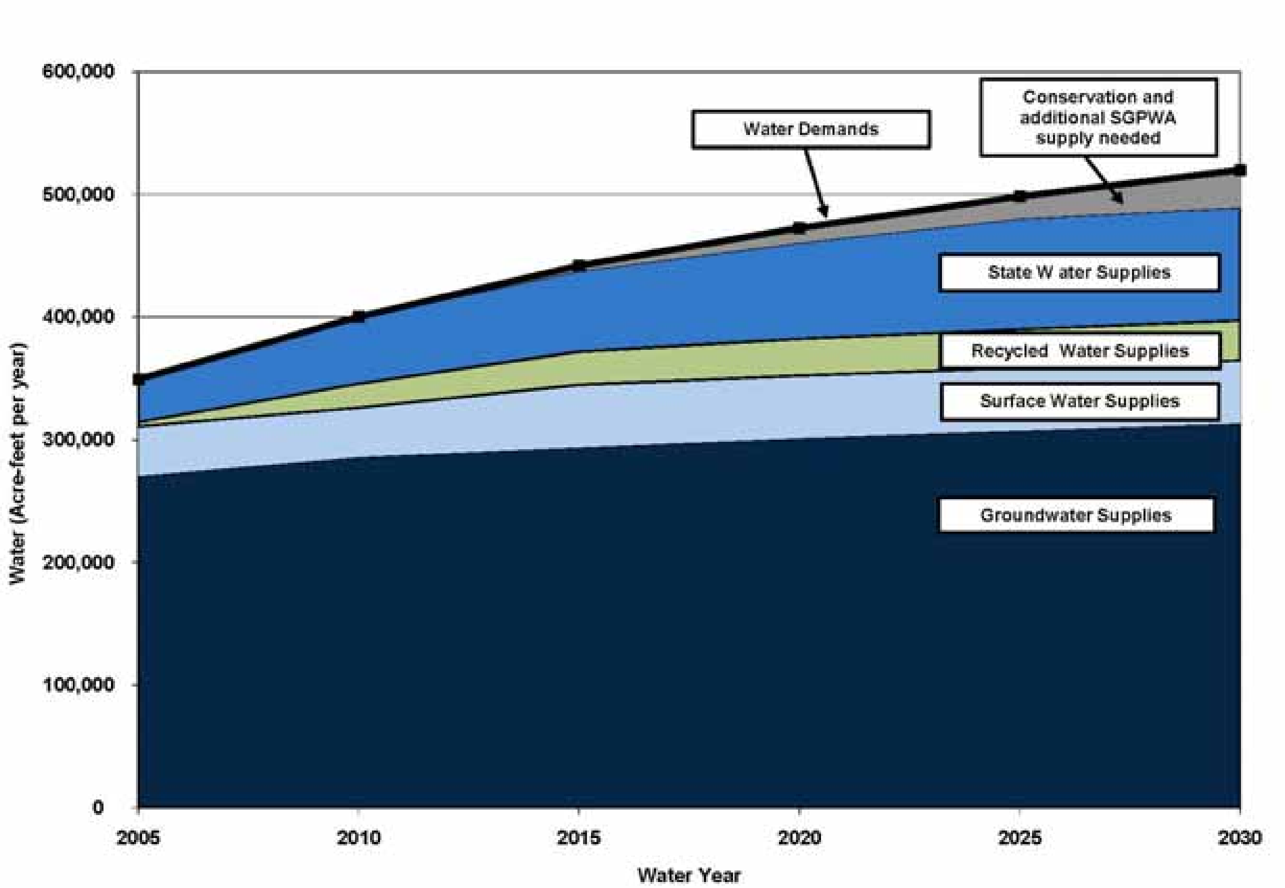
Table 3-14
Region-Wide Water Budget Summary for Multi-Year Drought (Acre-Feet per Year)

	2005	2010	2015	2020	2025	2030
Surface Water	30,000	30,000	30,000	30,000	30,000	30,000
Groundwater	289,700	304,000	335,100	362,400	371,000	372,200
Imported Water	26,000	46,700	46,700	46,700	46,700	46,700
Recycled Water	3,500	19,400	27,000	29,900	31,400	32,700
Additional Conservation	0	0	3,000	3,500	3,900	12,600
Total Supplies	**349,200**	**400,100**	**438,800**	**469,000**	**479,100**	**481,600**
Total Demands	**-349,200**	**-400,100**	**-441,800**	**-472,500**	**-498,100**	**-519,700**
Shortfall	**0**	**0**	**-3,000**	**-3,500**	**-19,000**	**-38,100**

Table 3-15
Region-Wide Water Budget Summary for a Single-Dry Year (Acre-Feet per Year)

	2005	2010	2015	2020	2025	2030
Surface Water	20,000	20,000	20,000	20,000	20,000	20,000
Groundwater	300,600	335,600	366,700	378,000	380,000	381,200
Imported Water	25,100	25,100	25,100	25,100	25,100	25,100
Recycled Water	3,500	19,400	27,000	29,900	31,400	32,700
Additional Conservation	0	0	3,000	3,500	3,900	12,600
Total Supplies	**349,200**	**400,100**	**438,800**	**453,000**	**456,500**	**459,000**
Total Demands	**-349,200**	**-400,100**	**-441,800**	**-472,500**	**-498,100**	**-519,700**
Shortfall	**0**	**0**	**-3,000**	**-19,500**	**-41,600**	**-60,700**

Figure 3.3. IRGMP Region - Water Budget Summary

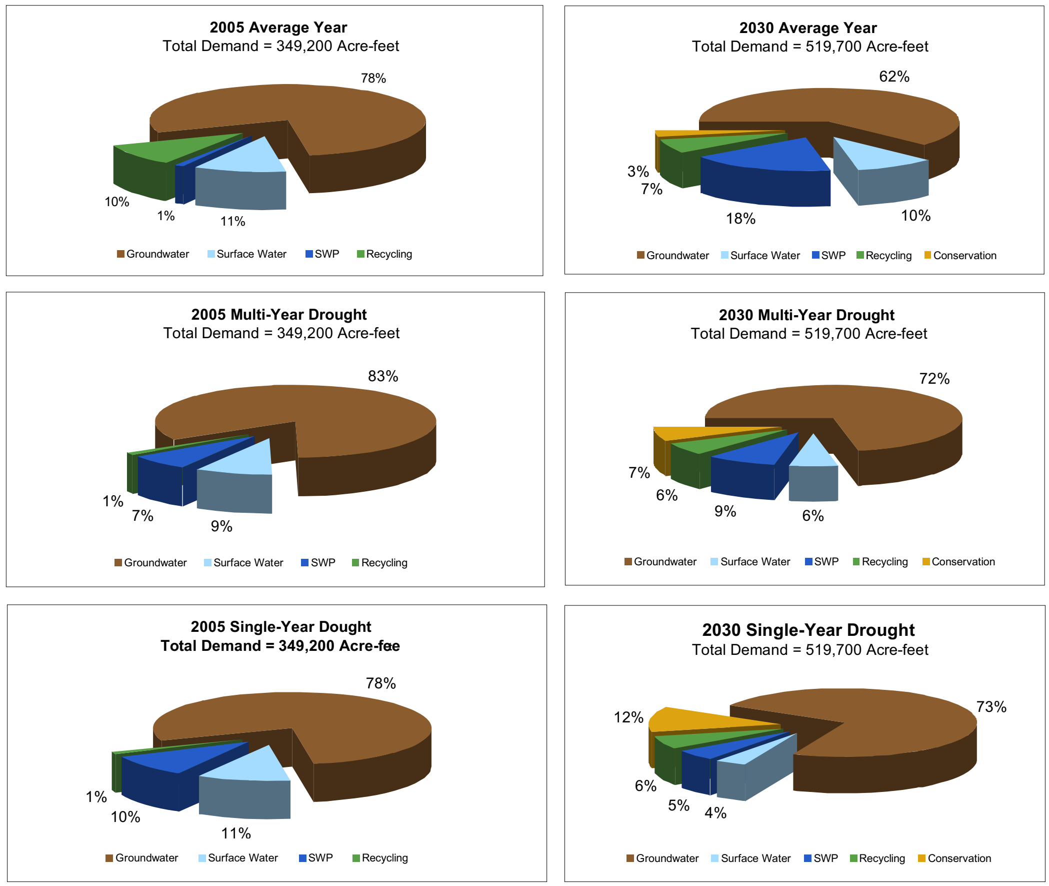


Most of the shortage after 2015 shown in the overall water budget in Table 3-13 is within the SGPWA. In Table 3-13, the supply and demands for the SGPWA area are broken out separately. SGPWA is attempting to purchase supplemental water to meet their projected shortage in supply. By 2030, it is estimated that demands may outpace the current supplies by about 21,700 acre-feet per year.

During multi-year and single-year droughts, the Region is more reliant upon the groundwater. Based on groundwater modeling of the SBBA (described in Chapter 4), during a dry period, agencies typically increase their groundwater extractions to overcome any deficiency in local surface water and imported water supplies. Computer modeling suggests that groundwater extractions in the SBBA can increase by 40 percent (190,000 to 280,000 acre-feet) to meet the demands in drought years if imported water is captured and stored when it is available in "wet years."

Figure 3-4 below shows the percentage of supply used to meet the demand in an average year, single-year drought, and multiple-year drought for the entire region. The breakdown of the amount of supplies by category is found in Tables 3-13 to 3-15.

Figure 3-4
Water Supply Summary



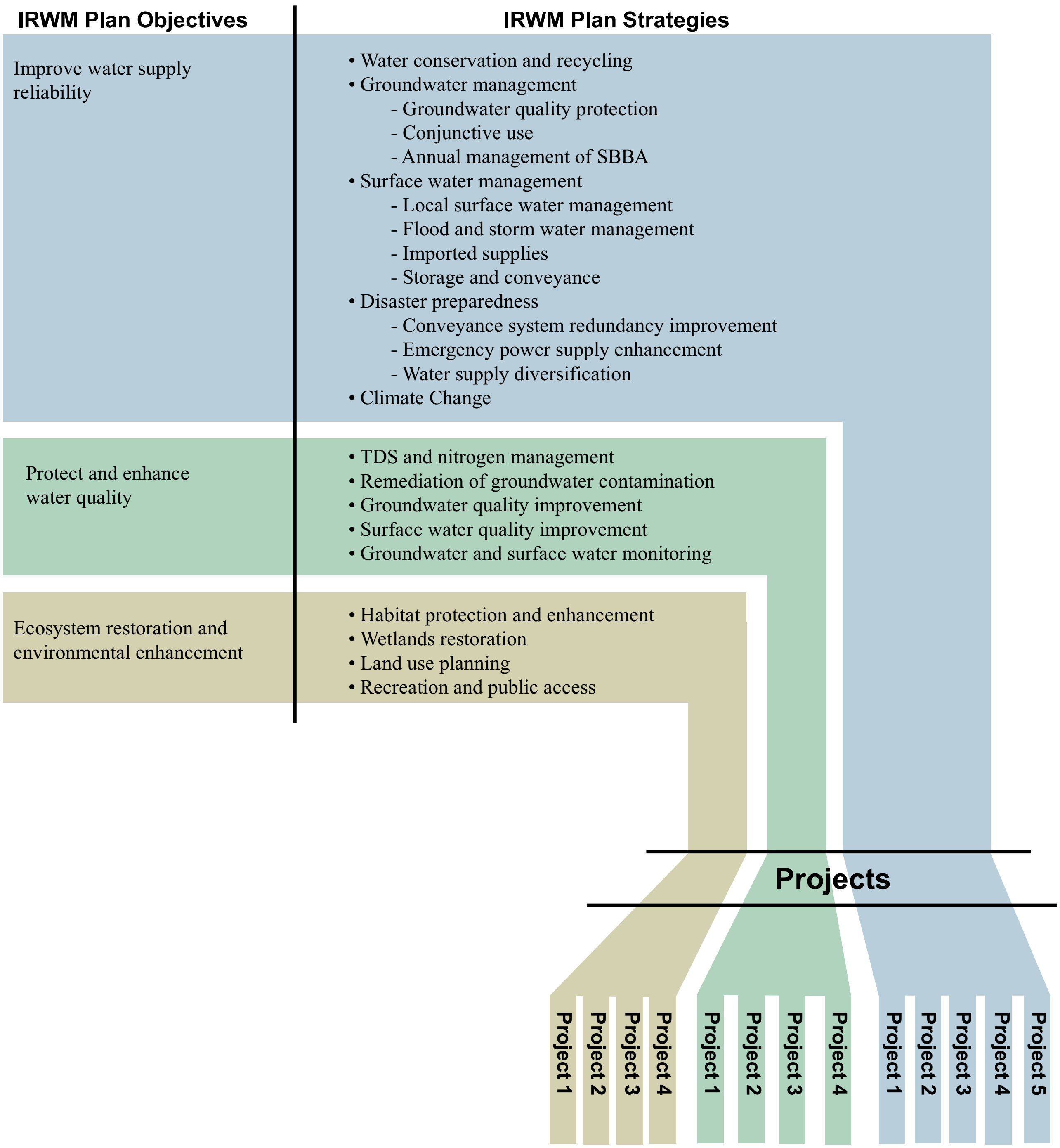
4 Develop Integrated Regional Water Management Plan

4.1 Introduction

This chapter provides the planning framework for water management activities in the Upper Santa Ana River (SAR) watershed region. The Integrated Regional Water Management Plan (IRWM Plan) is a roadmap for the management of water resources to ensure long-term, reliable water supply availability for the region. The first step in developing this roadmap is the formulation of water management objectives. The water management objectives are the overarching statements that define water management goals for the region. The objectives define the desired outcome from implementation of the plan. Specific objectives for management of water resources have been developed and will be discussed in this chapter.

Upon formulation of the objectives, specific water management strategies are examined and evaluated in support of the objectives. Water management strategies are the action plans and the ways of achieving the stated objectives. Evaluation of various water management strategies results in formulation of related feasible projects that would be implemented in the region to achieve the region's water management objectives. Figure 4-1 illustrates the process. This figure also summarizes water management objectives and strategies considered in this IRWM Plan. For the IRWM Plan, water management strategies and specific projects will be further optimized to eliminate undesired effects from implementing the projects on water resources of the region. It should be mentioned that some of the water management strategies listed by the California Department of Water Resources (DWR) under IRWM Plan Guidelines are considered as not being applicable in the region and have not been discussed in the plan. This includes the sea water desalting strategy. The following sections describe this planning process in more detail.

Figure 4-1
Objectives and Strategies



4.2 Water Management Objectives, Strategies, and Projects (California Water Code §§ 79562.5 and 79564)

The water management objectives are broad statements that drive the water management planning in the region. As stated earlier, water management in the study area is currently governed by a complex set of constraints, court decisions, judgments, and agreements. However, the IRWM Plan process facilitated a cooperative environment in which the existing institutional constraints do not limit the water managers from implementing decisions that optimize the use of available resources. In other words, the water management objectives for the study area must be consistent with the objectives stated in these historic documents, while meeting the vision of the water leaders in the region for managing their water resources. Other considerations in formulating the water management objectives for the region include California Water Code, Section 7956.2.5(b), which requires an Integrated Water Management Plan to address the objectives and conflicts of the region covered by the plan.

Groundwater is a major source of water supply for the Upper Santa Ana Region.

Because groundwater is a major source of water supply and plays a significant role in meeting water needs of the region, groundwater management has been blended into the IRWM Plan to ensure a balanced approach to management of the water resources of the region, while seeking solutions that benefit all stakeholders. Consistent with the Groundwater Management Planning Act, Basin Management Objectives (BMOs) have been formulated for the groundwater basins and for the San Bernardino Basin Area (SBBA).

The consulting team and the Technical Advisory Group (TAG) have reviewed various court judgments and water management agreements currently in place within the region to formulate objectives that are consistent with the existing water management framework. The TAG evaluated a broad range of objectives over several bi-weekly meetings to ensure consistency with the existing objectives of the agencies that have a vested interest in the water resources of the Upper Santa Ana River watershed. The comprehensive list of objectives was categorized into the broader set of objectives that are intended to be as follows:

- Consistent with the governing laws, judgments, and agreements that govern the water management in the region. These laws, agreements, and judgments were discussed in Chapter 2.

- In harmony with the vision of water leaders for management of the region's water resources.
- Consistent with local agencies' water management objectives.
- Fulfilling the planning standards of the California Water Code.

Two sets of objectives have been identified and discussed by the TAG and other water leaders in the region. These objectives are as follows:

- A set of broad water management objectives to guide a wide range of water management activities of the region. Formulation of these objectives is also required by the Integrated Regional Water Management Planning Act.

  1. **Water Supply Reliability Improvement.** Because surface water management and groundwater resources management of the region are critical and inseparable components of water supply reliability**, surface water management and groundwater management** are considered a subset of the broader water supply reliability objective,
  2. **Water Quality Protection.**
  3. **Ecosystem Restoration and Environmental Improvement.**

- A set of **BMOs** for management of the groundwater basins and, particularly, for the SBBA. Establishment of the BMOs for groundwater basins is one of the requirements of the Groundwater Management Planning Act. These BMOs include **reducing the risk of liquefaction** in the pressure Zone and **avoiding impacts to and from the contaminant plumes**.

The objectives, water management strategies, and associated programs and projects to achieve the above objectives are described in detail in this chapter. It should be noted that most of the strategies and projects discussed below serve more than one objective and provide multiple benefits. For the purpose of organizing these strategies, however, they are categorized under one specific objective.

4.2.1 Improve Water Supply Reliability

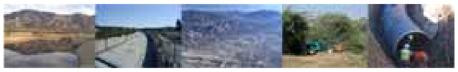
Improving water supply reliability is the primary objective of the IRWM Plan. This objective is formulated to ensure that a reliable water supply is available for the region through 2030. As mentioned earlier, an important subset of this objective is surface water and groundwater management. Given the variability of the State Water Project (SWP) supplies, another of the region's water supply reliability goals is to optimize the use of SWP supplies to be able to reduce its reliance on the SWP during drought periods. Various water management strategies and projects are identified and evaluated to achieve water supply reliability objectives.

To evaluate the performance of the water management strategies (as they are implemented) in achieving the water supply reliability goal of the region, the TAG considered the "performance criteria" for water supply reliability as established in the Urban Water Management Plan (UWMP) Act. These criteria include evaluation of the following:

- Reliable water supply for a minimum of a 25-year period,
- Meeting average year water demands through 2030,
- Meeting single-year drought water demands,
- Meeting multi-year drought water demands,
- Preparing a water shortage (up to 50 percent loss) contingency plan, and
- Preparing for catastrophic interruption in water supplies.

The Upper SAR watershed has adequate water resources to accommodate most hydrologic events and water agencies have substantially invested in facilities and institutions to protect those resources. Local agencies have been planning and implementing facilities needed to improve water supply reliability by improving management of water resources of the region as demonstrated by the ongoing implementation of the San Bernardino Valley Municipal Water District (Valley District) Regional Water Facilities Master Plan and Santa Ana Watershed Project Authority's (SAWPA's) IRWM Plan for the watershed. That said, those resources are subject to a number of challenges, including drought, contamination, climate change, and aging infrastructure. Furthermore, substantial residential and commercial growth in the region is increasing the demands placed on available water, requiring careful planning and management of the region's water resources.

The following sections will describe water management strategies for meeting the region's water supply reliability objective.



4.2.1.1 Water Conservation Strategies and Projects

Over the past 30 years, water conservation and water demand management has grown to be a significant sector of California's water supply picture. Indeed, new technology and application of other proven technologies have "produced" substantial real water savings for both the agricultural and urban sectors. In many communities in Southern California, per capita water use has decreased, allowing the same water supply to serve more people and industries.

Today, many water conservation measures are cost-effective for agencies, especially those that depend on imported water supplies. Furthermore, when one considers energy usage and the current incentives to save energy through water-energy conservation partnerships, even more water saving efforts become cost-effective.

4.2.1.1.1 Irrecoverable vs. Recoverable Water Savings

Depending upon the water conservation measure and its relative location, a water conservation measure can actually reduce real water use. Real water is saved when discharges are reduced to a salt sink or ocean, or actual water consumption is reduced (i.e., through reduction of evapotranspiration) by managing landscape irrigation or changing irrigated lawn with more water-saving plants. In this case, the real water savings would be made through reduction of an irrecoverable loss (evapotranspiration).

On the other hand, in a system where excess water and treated wastewater are discharged to a river and potentially used again by downstream municipal, agricultural, or industrial users, there may not be significant system-wide water savings from water conservation. In such situations, the overall water demand may not be significantly reduced. Replacing older or less efficient toilets with more efficient ones and reducing the effluent discharge to the river where it would have been reused is a good example. Saving recoverable water, however, has a number of benefits. Improving water supply reliability for local purveyors, implementing the conservation project, saving energy on transportation, reducing the cost of water treatment, and improving water quality are all substantial benefits of water conservation in a recoverable system.

4.2.1.1.2 Best Management Practices

In 1991, nearly 100 urban water agencies and environmental groups signed a Memorandum of Understanding (MOU), pledging to develop and implement a series of Best Management Practices (BMPs) for water conservation. The California Urban Water Conservation Council (CUWCC) was thus created to increase efficient water use statewide through partnerships among urban water agencies, public interest organizations, and private industry. There are now 384 members and signers to the MOU (www.cuwcc.com). CUWCC members voluntarily pledge to implement a series of BMPs within a reasonable time frame and coverage. Members must periodically report the status of their BMP work to the CUWCC for verification. Only those BMPs that are cost-effective for the water retailer or wholesaler need to be implemented. Members have tools to estimate and show that a measure would not be as cost-effective and can receive a pass on that particular BMP. Thus, successful implementation of all BMPs and credit for actively participating in the CUWCC process need not be a "complete" implementation of all BMPs.

The table in Figure 4-2 shows the 14 BMPs that the CUWCC currently endorses. The CUWCC is constantly reviewing new technologies and strategies to improve water conservation. New BMPs are added for new water saving methods and existing BMP requirements are adjusted for effectiveness. This active BMP review and adoption process has kept this list the state-of-the-art in proven water saving measures.

The CUWCC maintains a self-reporting database on the status of BMP implementation by water agency member. This information includes recorded use and results of each BMP, the money invested in each BMP, and the estimated or calculated water savings for each of those measures by water purveyor. This information is then summarized and aggregated to present a total water conservation picture for the collective membership on an annual basis. The CUWCC database can be accessed at http://bmp.cuwcc.org.

Not all BMPs are such that their benefits are quantifiable or measurable. For example, BMP #12 requires the water agency to designate a staff member to manage the agency's water conservation programs (water conservation coordinator). BMPs #1, #2, #5, #6, #9, #9A, and #14 are generally considered to have measurable benefits. (BMP #9A is the installation of ultra-low-flush toilets within the Commercial, Industrial, and Institutional sectors).

Figure 4-3, data compiled by CUWCC, estimates the statewide current net annual water savings from those BMPs that can be quantified. These values have also accounted for plumbing code changes. Since the MOU only requires participation when water conservation measures are cost-effective, the resultant water savings shown in Figure 4-3 represents substantial savings that is within the economic reach.

Figure 4-2
Best Management Practices

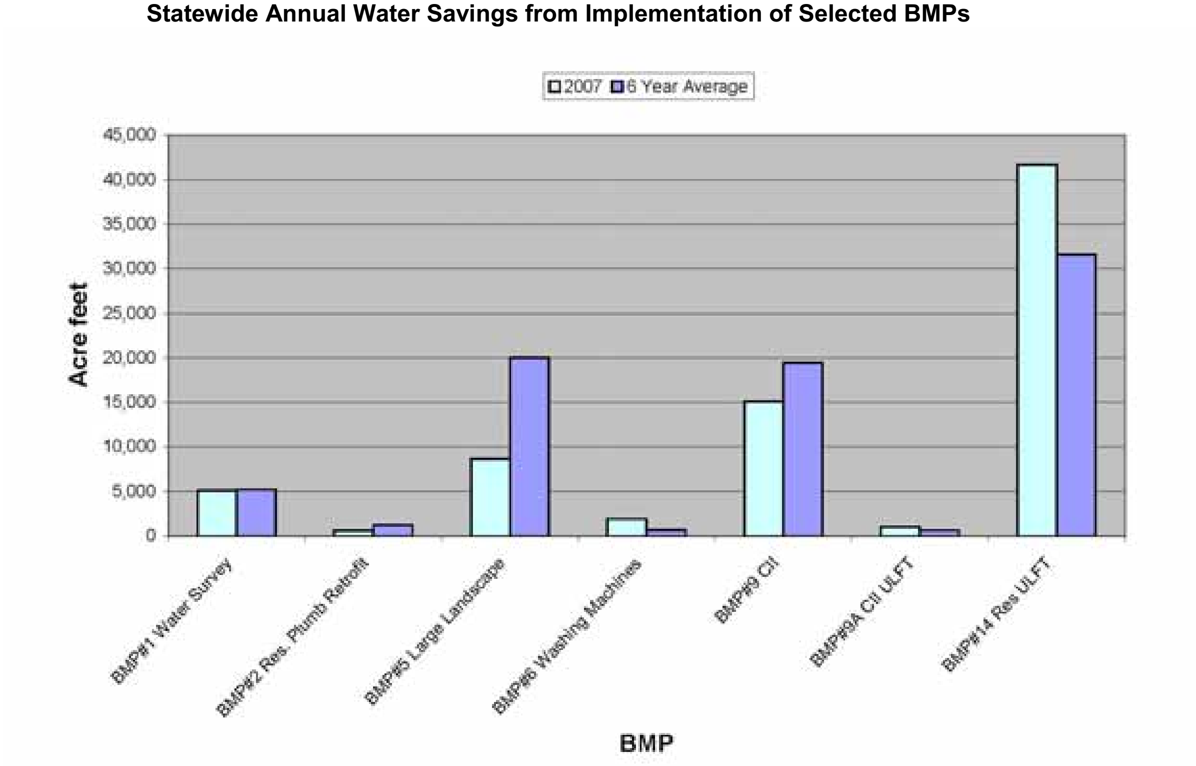
California Urban Water Conservation Council
Annual Report Year 2005

Table 1: Council MOU Urban Water Conservation Best Management Practices

#	BMP	Requirements
1	Water Survey Programs for Single and Multi Family Residential Customers	Survey 15% of residential singe-family and 15% of multi-family customers within 10 years.
2	Residential Plumbing Retrofit	Retrofit 50% of residential housing constructed prior to 1992 with low-flow showerheads, toilet displacement devices, toilet flappers and aerators; or achieve 75% saturation of the water agency service area and be able to prove it statistically.
3	System Water Audits, Leak Detection and Repair	Audit the water utility distribution system regularly and repair any identified leaks; check yearly to see that water loss is less than 10%.
4	Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections	Install meters in 100% of existing unmetered accounts within 10 years; bill by volume of water use; assess feasibility of installing dedicated landscape meters.
5	Large Landscape Conservation Programs and Incentives	Prepare water budgets for 90% of commercial and industrial accounts with dedicated landscape meters; provide irrigation surveys to 15% of mixed-metered customers.
6	High-Efficiency Washing Machine Rebate Programs	Provide cost-effective customer incentives, such as rebates, to encourage purchase of machines that use 40% less water per load. Number of clothes washers required is based on the total dwelling units x .048; up to a third fewer machines required if all of them are super high-efficiency (6.0 or less water factor).
7	Public Information Programs	Water utilities to provide active public information programs to promote and educate customers about water conservation.
8	School Education Programs	Provide active school education programs to educate students about water conservation and efficient water uses.
9	Conservation Programs for Commercial, Industrial, and Institutional Accounts	Provide a water survey of 10% of these customers within 10 years and identify retrofitting options; OR reduce water use by an amount equal to 10% of the baseline use within 10 years.
10	Wholesale Agency Assistance Programs	Provide financial incentives to water agencies and cities to encourage implementation of water conservation programs
11	Conservation Pricing	Eliminate non-conserving pricing policies and adopt pricing structure such as uniform rates or inclining block rates, incentives to customers to reduce average or peak use, and surcharges to encourage conservation.
12	Conservation Coordinator	Designate a water agency staff member to have the responsibility to manage the water conservation programs.
13	Water Waste Prohibition	Adopt water waste ordinances to prohibit gutter flooding, single-pass cooling systems, non-recirculating systems in all new car wash and commercial laundry systems, and non-recycling decorative water fountains.
14	Residential Ultra-Low-Flush Toilet Replacement Programs	Replace older toilets for residential customers at a rate equal to that of an ordinance requiring retrofit upon resale.

Source: California Urban Water Conservation Council

Figure 4-3
Statewide Annual Water Savings from Implementation of Selected BMPs



Source: California Urban Water Conservation Council

4.2.1.1.3 Urban Water Management Plans

In 1983, the California legislature enacted the Urban Water Management Planning Act (Water Code Sections 10610-10658). It states that every retail water supplier providing 3,000 acre-feet of water annually or supplying water to 3,000 customers or more must file a UWMP with DWR. The requirement is designed to ensure thoughtful planning for future water reliability. Water purveyors must submit an updated plan and have that plan deemed complete by DWR every five years. The statute requires quite a detailed assessment, including an analysis of Demand Management Measures (DMMs). DMMs are the **same actions** as BMPs under the CUWCC MOU. UWMP reporting under the Act is actually simplified for CUWCC members reporting their progress in implementation of BMPs.

4.2.1.1.4 Potential Water Conservation Strategies for Upper Santa Ana River

Table 4-1 summarizes the general implementation of DMMs for the water purveyors in the Upper SAR watershed, and thus, which water conservation measures are, at least at some level, being used within each agency. The data for this table have been compiled from agency UWMPs. The table does not show the magnitude of the investment or the level of effort involved in the measure.

Table 4-1
Upper Santa Ana River Water Agencies Implementation of BMPs

Water Agency	2005 UWMP	Demand Management Measure Implementation													
		Residential Water Surveys	Residential Plumbing Retrofits	System Water Audits Leak Detection and Repair [2]	Metering [2]	Large Landscape Conservation Program	High Efficiency Washing Machine Rebate Program	Public Information Program	School Education Program	Conservation Program [3]	Wholesale Agency Program	Conservation Pricing	Water Conservation Coordinator	Water Waste Prohibition	Residential Ultra-low flush Toilet Replacement
East Valley Water District	X	N	N	Y	Y	N	N	Y	Y	Y	N	N	N	Y	N
Fontana Water Company	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Loma Linda, City of	2002 UWMP	N	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	N
Redlands, City of - Water Utility	X	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
Rialto, City of	X	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y
San Bernardino MWD	X	Y	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N
West Valley Water District	X	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Yucaipa Valley Water District	X	N	N	Y	Y	N	N	Y	N	N	N	Y	Y	Y	N
Riverside Public Utilities	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Beaumont Cherry Valley W.D.	X	N	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	N	N
Big Bear City C.S.D.	2000 UWMP	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
City of Big Bear Lake D.P.W.	X	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y
Crestline-Lake Arrowhead W.A.	X	N	N	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	N
Rubidoux C.S.D.	X	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y

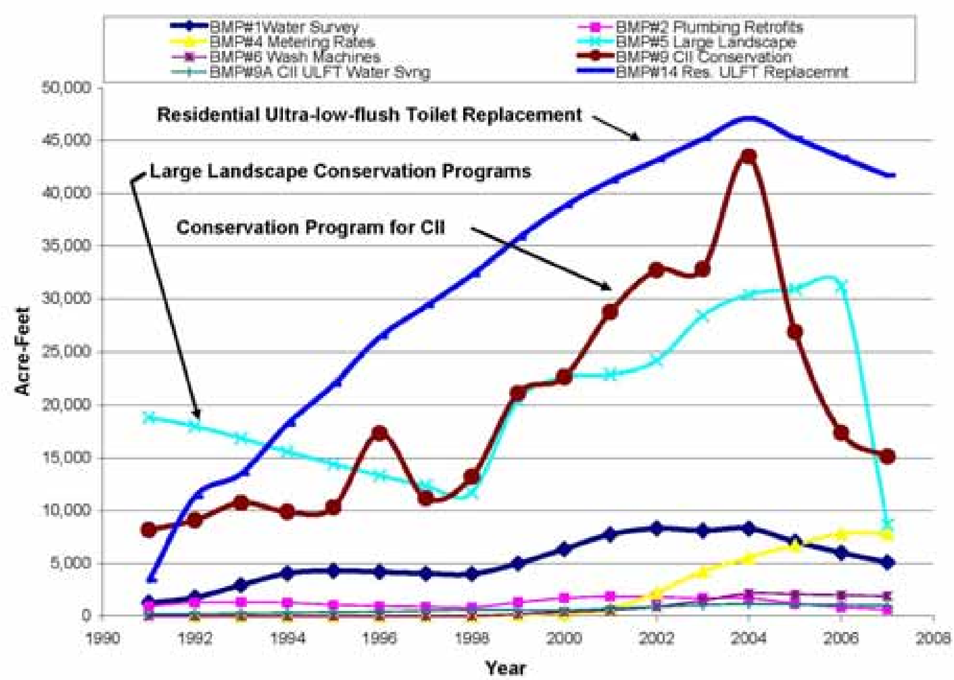
Each agency is implementing some of the measures, but some agencies are implementing most of the measures. There is potential to further enhance water savings efforts within the Upper SAR watershed communities and improve water supply reliability within the region.

Two factors are important in evaluating the feasibility of water use efficiency measures: the quantity of the potential water savings and the cost-effectiveness of the water saving measures. Both factors must be considered to determine when a particular BMP is cost-effective for implementation.

Figure 4-4 shows the annual water savings for quantifiable or measurable BMPs from 1991 through 2007 using the CUWCC data.

While the magnitude of the water savings would clearly be a function of the effort or investment in the particular BMP, the graph indicates three or four BMPs have produced some significant water over the past several years: BMP #14 – Residential Ultra-Low-Flush Toilet Replacement, BMP #9 – Conservation Programs for Commercial Industrial and Institutional Accounts, BMP #5 – Large Landscape Conservation Programs, and BMP #1 – Water Survey Programs. For areas with less aggressive water conservation efforts, further review may suggest that investment in these BMPs could have potential for significant conservation.

Figure 4-4
Annual Estimated Water Savings from BMPs

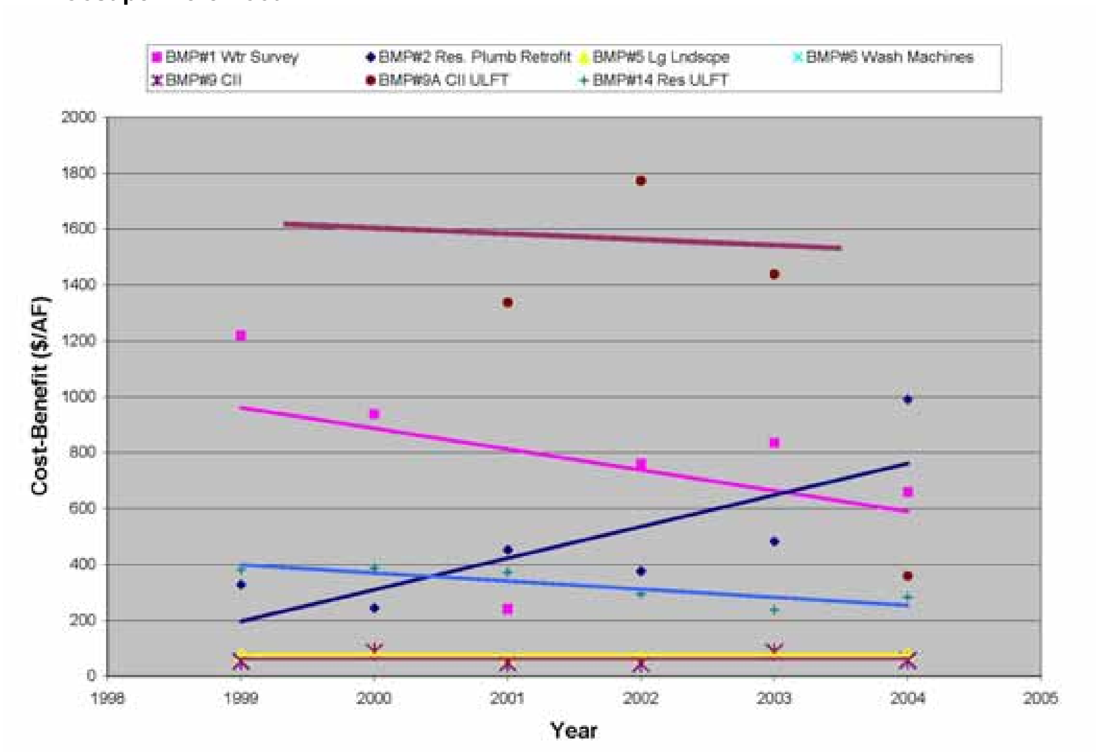


Source: California Urban Water Conservation Council

One should note that BMP #14, Ultra-Low-Flush Toilet Replacement, may be even more efficient by the recent trend during the past few years in using High-Efficiency Toilets (HETs), those that require 1.3 gallons per flush instead of 1.6 gallons. This change in technology would make the general process of toilet and/or water fixture replacement more efficient but not necessarily alter the methodology of the BMP.

To examine which water conservation measures would be most cost-effective to implement, one can compare the CUWCC data summaries on total expenditures for a particular BMP with the total estimated water savings from that BMP. Figure 4-5 shows the ratio of total dollar investment (cost) over the total annual estimated water savings for the measurable BMPs for the period 1999 through 2004.

Figure 4-5
BMP Cost per Acre-Foot



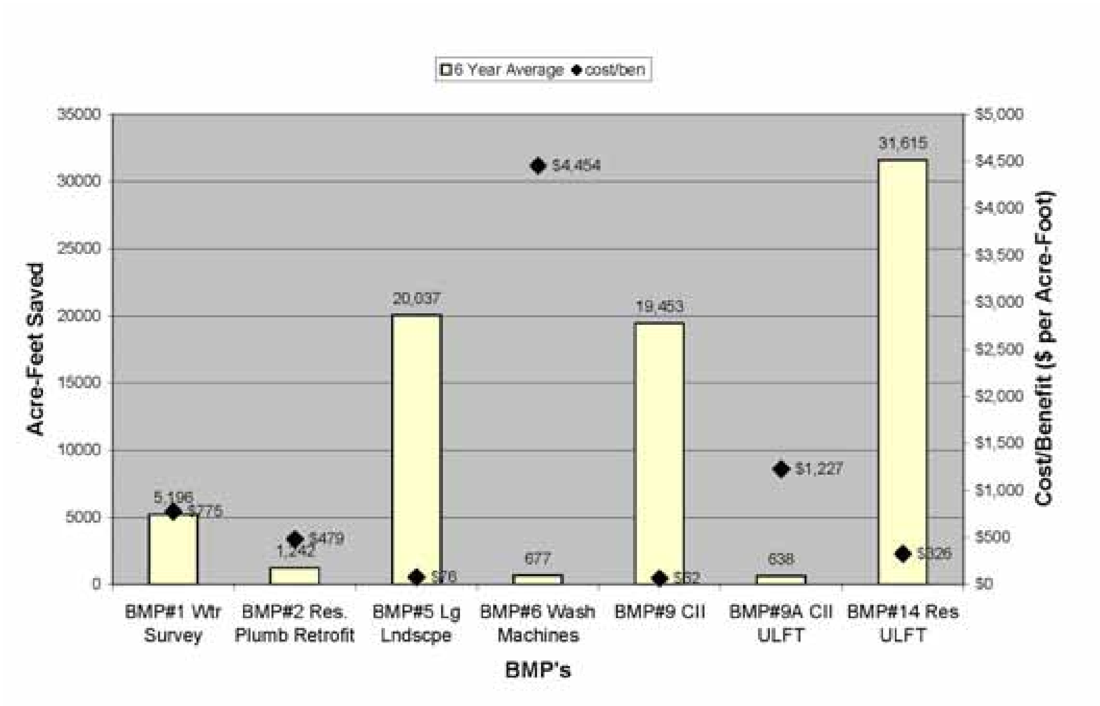
Source: California Urban Water Conservation Council

The lower lines on the graph suggest the more cost-effective water saving measures. The higher points on the graph show measures that are comparably more expensive to implement. BMPs #5 – Large Landscape Conservation Programs, #9 – Conservation Programs for Commercial, Industrial, and Institutional Accounts, #14 – Residential Ultra-Low-Flush Toilet Replacement

Program, and #2 – Residential Plumbing Retrofit, appear to be the most cost-effective measures based on the aggregated CUWCC data.

Figure 4-6 combines both quantity and cost-effectiveness (the information from Figures 4-4 and 4-5) on one graph. Clearly, the past investments in BMPs #5, #9, and #14 seem to carry the best rewards both in quantity of water and cost.

Figure 4-6
BMP Benefit and Cost/Benefit



Source: California Urban Water Conservation Council

4.2.1.1.5 Examples of Successful Water Conservation Programs

Evidence about which program would be beneficial is often best characterized by the case study experiences of other water purveyors. Water conservation programs for The Metropolitan Water District of Southern California (Metropolitan) have been reviewed to examine its current water conservation program activities.

Metropolitan Water District of Southern California – Metropolitan is a water wholesaler for a majority of the Southern California area. Metropolitan submits an annual report of its activities, including water conservation programs and accomplishments, to the State Legislature. From its February 2007 report, Metropolitan offers the following current water conservation programs:

- **High-Efficiency Toilets** – Metropolitan offers a $165 incentive for HETs, which use even less water than Ultra-Low-Flow Toilets (ULFTs). It has provided incentives for about 14,000 HETs to date. (Related to BMP #14.)

- **High-Efficiency Clothes Washers** – Metropolitan retrofitted more than 175,000 residential clothes washers since the incentive program began in 1995. As a direct result of grant funding and an increased incentive, high-efficiency clothes washers are currently being installed at a rate of about 30,000 retrofits per year. (BMP #6.)

- **"Smart" Irrigation Controller Rebate** – This year Metropolitan also had a concerted effort to reach residential customers with water-saving technology tips. "Smart" irrigation controllers, many of which use a combination of weather and historical data to automatically adjust irrigation schedules, have been a particular focus. Nearly 5,000 residential controllers have been retrofitted since the inception of the program. (This irrigation efficiency measure relates to BMP #5.)

- **Synthetic Turf Program** – Metropolitan continues to seek turf alternatives to conventional warm season grasses through a pilot program for large landscape areas. (This also relates to BMP # 5.)

- **Commercial/Industrial/Institutional Program** – To address this niche of water saving opportunities, Metropolitan developed its current CII program, which includes two components (BMP #9):

    - **Rebates** -- fixed rebates for common fixture retrofits or installations.

    - **Process Improvements** – customized financial incentives for water-use process improvements on a pay-for-performance basis, which is typically applied to manufacturing and industrial applications.

- **California Friendly Landscape Program** encourages native and drought-resistant plants within landscapes to reduce water consumption. (BMP #5.)

4.2.1.1.6 Conclusions and Recommendations

The following conclusions and recommendations have been formulated based on the water conservation data gathered by CUWCC and other agencies' experiences.

Water Conservation projects have significant water and energy saving benefits, both in recoverable and non-recoverable water systems.

BMPs #5, #9, and #14 appear to be the most attractive to water agencies because of potential significant water saving measures and high benefit-cost ratio. Current programs of other water agencies generally support activities in BMPs #5, #9, and #14.

Other BMPs with non-measurable water savings should be considered on a case-by-case basis if they could support other tangible benefits, including a balanced water conservation approach.

Water purveyors in the Upper SAR Region should consider developing a program for evaluation and implementation of feasible water conservation strategies. Initial program steps should focus on large-scale implementation of BMPs #5, #9, and #14.

Water purveyors in Upper Santa Ana should consider obtaining a water use efficiency grant for a feasibility study of regional water conservation programs.

These conservation strategies are essential for better stewardship of our resources and would improve water supply reliability, reduce energy use and cost, and provide a means for dealing with potential climate changes.

4.2.1.1.7 Planned Water Conservation Projects in Upper Santa Ana Region

As discussed above the following BMPs may have the greatest conservation potential in the region:

- BMP #5 - Large Landscape Conservation Programs
- BMP #9 - Conservation programs for Commercial, Industrial, and Institutional
- BMP #14 - Residential Ultra-Low Flush Toilet replacement

The degree of effectiveness of the conservation programs varies by communities. It is therefore recommended that the following conservation projects be undertaken in the region to better scope the scale and size of potential conservation projects:

- **Regional Water Conservation Feasibility Study** to document the feasibility of implementation of various BMPs in the region and to develop conservation programs for implementation. It is suggested that Valley District take a lead role on this project.

- **Water Conservation Demonstration Garden** to educate and encourage citizens in low water use California Friendly landscape. This is a cooperative program between Valley District and the Water Resources Institute - California State University, San Bernardino (WRI-CSUSB).

- **Smart Irrigation Controller Program** currently being developed by Valley District.

- **Model institutional water conservation makeover** to demonstrate water conservation in various institutions in the region. This is a cooperative program between Valley District and the WRI-CSUSB.

4.2.1.2 Water Recycling Strategies and Projects

Water recycling projects improve water supply reliability and can contribute to improvement of water quality of the streams. To the extent that treated wastewater from the water treatment facilities in the Upper SAR watershed is currently released to the SAR and used by downstream water users, water recycling may not add to the overall water supplies of the SAR watershed. Tangible local water supply reliability and water quality benefits could be realized, however, through implementation of water recycling strategies. These benefits include the following:

- Recycled water is available throughout the year and is independent of hydrologic cycles. Improved water supply reliability will be achieved at the local level by the agency that is implementing the project by substituting potable water used for non-potable purposes with recycled water.

- Water recycling reduces the release of treated wastewater (and generally warmer water) to the streams and therefore reduces the nutrient load of the receiving water. This contributes to improvement of water quality and water temperature in the stream.

- Depending on the purveyor's source water, water recycling may reduce energy use for conveyance (i.e., conveyance of SWP or Colorado River water) and water treatment. This may also reduce the water delivery system's cost to the customers.

Costs associated with water recycling include additional treatment and separate conveyance and distribution systems. Water purveyors generally conduct a feasibility study to evaluate the costs and benefits of water recycling projects prior to commitment of funding and design of the facilities for water recycling projects.

A number of water purveyors in the Upper SAR watershed are planning to expand or construct new water recycling facilities. Summaries of the planning efforts for water recycling programs are presented below.

4.2.1.2.1 Beaumont-Cherry Valley Water District

The City of Beaumont treats all its wastewater to meet Title 22 regulations for recycled use. As of 2005, about two million gallons per day (mgd) (all flows) were discharged to Cooper Creek, which is a tributary to San Timoteo Creek. In partnership with the Beaumont-Cherry Valley Water District (BCVWD), Beaumont is upgrading its wastewater treatment plant (WWTP) capacity to four mgd and installing a recycled water pumping station and recycled water pipelines. Also as of 2005, about 18 to 20 miles of recycled water pipeline were “in the ground.” These lines serve irrigation systems in parks and common areas in Pardee Sundance, Three Rings Ranch, Oak Valley Greens, Pardee Tournament Hills, and elsewhere. Pipelines also extend to the Oak Valley and the two PGA West golf courses. The district is in a unique position, as there is more demand for recycled water than available supply.

BCVWD intends to serve recycled water, to the extent possible, for non-potable uses and as permitted by law. This would make potable water, now used for irrigation, available for new development. As new development occurs, the new projects would include appropriate piping systems to permit the use of recycled water for irrigation of street medians, greenbelts, schools, parks, and common areas. In the future, the recycled water system could be expanded to irrigate cherry and other fruit orchards. This concept then envisions limiting the use of quality potable water to potable water purposes to the extent practical. Surplus recycled water will be available during certain times of the year when normal irrigation demands are reduced. During these times, the surplus will be piped to spreading basins for surface spreading of recycled water for groundwater recharge.

4.2.1.2.2 City of Big Bear Lake Department of Water and Power and Big Bear Community Services District

Currently, neither City of Big Bear Lake Department of Water and Power (BBLDWP) nor Big Bear Community Services District (BBCSD) use recycled water within their service areas; however, this is slated to change. In 2004 and 2005, the Big Bear Area Regional Wastewater Agency (BBARWA), working along with BBLDWP and BBCSD, cooperated in the preparation of a Draft Recycled Water Master Plan for the Big Bear Valley. The Master Plan, whose implementation will result in benefits to all three agencies, includes reduction of the valley’s dependence on limited groundwater supplies, extension of available water resources, and provision of valuable economic and environmental benefits to the valley’s communities.

The objective of the Recycled Water Master Plan is to investigate the feasibility of using recycled water throughout Big Bear Valley. It provides a comprehensive planning document that outlines a phased road map for incremental implementation of facilities to achieve the listed benefits. The recycled water supply implementation is divided into four improvement phases at the WWTP, each phase in 500 acre-foot increments. The plan has identified numerous opportunities for recycled water use, with emphasis placed on groundwater recharge. It is anticipated that this plan will be implemented such that completion of the first phase and deliveries of recycled water will occur in 2011.

4.2.1.2.3 Fontana Water Company

Currently, Fontana Water Company (FWC) is working cooperatively with the City of Fontana for FWC to design and construct the first phase of a recycled water program. Once recycled water becomes available and the necessary infrastructure is constructed, FWC will be the purveyor of recycled water to those customers within its service area who can make use of such water. In the first phase of the recycled water program, FWC will provide approximately 1,700 acre-feet of recycled water to schools, parks, commercial customers, and Community Facilities Districts' landscape irrigation locations in the southern portion of the City of Fontana within FWC's service area. Ultimate build-out in FWC's service area will enable FWC to provide approximately 5,000 acre-feet of recycled water. FWC supports the use of recycled water where its use is appropriate and where recycled water is available.

Recycled water will be supplied by the Inland Empire Utilities Agency's (IEUA) RP-4 regional WWTP. This plant produces disinfected and filtered tertiary-treated recycled water suitable for outdoor irrigation, industrial uses, and groundwater recharge. RP-4 has a current capacity of 7 mgd and is being expanded to 14 mgd (scheduled for completion in mid-2007). Not all of the plant's production will be available for purchase by FWC because other users are also served by the WWTP.

4.2.1.2.4 City of Redlands Municipal Utilities Department

Beginning in 2005, most effluent from the City of Redland's WWTP has met Title 22 standards for recycled water. In 2005, approximately 60 percent of the recycled water was used for industrial purposes, with the remainder used for groundwater recharge. The City of Redlands requires some new commercial development to provide dual plumbing for irrigation systems and to accommodate the use of recycled water as it becomes available. Through the use of financial incentives, the city expects industrial recycled water use to reach 6000 acre-feet per year by 2010.

4.2.1.2.5 City of Rialto and West Valley Water District

The City of Rialto is investigating the expansion of its existing tertiary treatment plant and reclaimed water system as a way to supplement the city's water supply. The existing tertiary treatment plant wastewater flows are approximately 7.5 mgd (9,000 acre-feet per year). The city currently discharges the majority of its flows to the SAR, but is under no obligation to continue this practice.

The City of Rialto has constructed a hydropneumatic booster station and approximately 7,000 feet of 10-inch-diameter transmission water line to provide the California Department of Transportation (Caltrans) with recycled water for 42,000 feet of landscape irrigation for Interstate-10. Caltrans has been using 1.0

mgd of recycled water during the summer months and 0.5 mgd during the winter for an annual total of 850 acre-feet. Currently, there are no other users of the recycled water.

Rialto recently prepared a Wastewater Master Plan that investigated recycled water systems as a way to supplement the city's water supply and reduce the need to purchase water. The plan analyzed the feasibility of converting a currently unused water main that extends several miles up Riverside Avenue and identified potential landscape irrigation customers (San Bernardino Park, Convalescent Hospital, the Senior Center, a baseball field, and a recreation center). A Proposition 50 grant funded the construction of recycled water lines that tie into the unused water main. The city is also investigating the use of package plants in the north end of the city and has identified potential users of recycled water that could result in approximately 2,250 acre-feet of annual demand.

All of the wastewater collection and treatment within the West Valley Water District (West Valley) is handled by the City of Rialto. West Valley utilizes non-potable raw SWP water and decanted backwash water from the Oliver P. Roemer Water Filtration Facility to supply the El Rancho Verde Golf Course. Records show that the golf course consumed 1,357 acre-feet in 2003. West Valley identified other additional potential users of recycled water that could result in approximately 3,700 acre-feet of annual demand. Most of these new users are currently supplied with potable water.

4.2.1.2.6 City of Riverside

The City of Riverside Public Works Department operates and maintains the Riverside Regional Water Quality Control Plant (RRWQCP). The daily average wastewater inflow to the RRWQCP is 33 mgd. The plant capacity is 40 mgd, with the ultimate planned capacity of 60 mgd. The service area of the RRWQCP extends beyond the Riverside Public Utilities (RPU) service area to include the areas served by Jurupa, Rubidoux, and Edgemont Community Services District. Tertiary-treated effluent (recycled water) is discharged into the SAR and the Hidden Valley Wetlands (the wetlands provide additional nitrogen removal.) RRWQCP is required to discharge 15,250 acre-feet per year, adjusted for quality, to meet downstream obligations to Orange County Water District (OCWD). Some recycled water is used for landscape irrigation and commercial purposes.

RPU petitioned the State Water Resources Control Board (SWRCB) for a wastewater change to reduce permitted discharge to the SAR by 11,000 acre-feet per year in connection with the citywide recycled water program. The envisaged recycled water program includes landscape irrigation, agriculture irrigation, and other commercial and industrial purposes. Under its proposed Recycled Agricultural Water Program, RPU would design and construct a distribution system to serve existing agricultural operations, wholesale users, and other agencies.

4.2.1.2.7 San Bernardino Municipal Water Department

The San Bernardino Municipal Water Department (SBMWD) operates the San Bernardino Water Reclamation Plant serving the cities of San Bernardino, Highland, and Loma Linda, property that was formerly Norton Air Force Base, East Valley, Patton State Hospital, and portions of the unincorporated areas of San Bernardino County. All the wastewater at the San Bernardino Water Reclamation Plant is treated to the secondary level. The secondary-treated effluent is sent to the Rapid Infiltration Extraction (RIX) Facility and treated to tertiary levels, then released into the SAR. In mid-2006, the San Bernardino Water Reclamation Plant re-activated its tertiary treatment facility and diverts approximately 0.75 mgd or 840 acre-feet per year of water from the influent stream to RIX for treatment to Title 22 standards for landscaping applications at the City of San Bernardino Municipal Golf Course and Caltrans located adjacent to Interstate 215. SBMWD estimates that in the future the reclamation plant's service area will be able to potentially recycle an additional 2.25 mgd or 2,519 acre-feet per year of water for use within its service area (SBMWD 2005). Valley District and SBMWD are initiating a master plan study to evaluate the treatment of more secondary effluent at the existing water reclamation plant, reducing flows to the RIX. For additional planned recycling by San Bernardino, see the RIX Facility section below.

4.2.1.2.8 Yucaipa Valley Water District

Yucaipa Valley Water District (YVWD) treats recycled water meeting Title 22 requirements through its Henry N. Wochholz Wastewater Treatment Facility. The facility has a rated capacity of 4.5 mgd and is undergoing an expansion and upgrade to a capacity of 6.7 mgd. Currently, treated effluent is conveyed through a land outfall and discharged to San Timoteo Creek. Three customers along the existing land outfall are receiving recycled water for irrigation purposes. Dual plumbing is being installed in new developments. Delivery amounts are expected to grow to about 6,700 acre-feet by 2020 or about 24 percent of total agency water demands. Ultimately, YVWD expects to deliver about 8,000 acre-feet per year of recycled water (YVWD 2005).

In addition, a new water reclamation plant (WRP) is planned to serve the Oak Valley development. This WRP will provide both wastewater treatment and a source of recycled water for the Oak Valley area. The Yucaipa Wastewater Master Plan identifies the capacity of the new WRP at 4 mgd required to serve the needs of Oak Valley and other areas of the district from where wastewater could flow by gravity to the new WRP. Based on the projected capacities contained in the Yucaipa Wastewater Master Plan for both treatment plants, there are approximately 11 mgd of wastewater available for recycling (YVWD 2005).

4.2.1.2.9 Rapid-Infiltration Extraction Facility

The RIX facility treats secondary-treated wastewater from the Colton and San Bernardino plants. The RIX facility treats the wastewater to tertiary levels for release into the SAR. The RIX facility was designed as a 40-mgd plant, but as of 2005, operates at 27 mgd. The RIX facility releases 16,000 acre-feet per year in agreement with Valley District to meet the downstream obligations to Orange County. In 2003, SBMWD released a Programmatic Environmental Impact Report evaluating the sale of up to 18,000 acre-feet per year of excess effluent to potential buyers downstream. SBMWD has previously determined that the use of recycled water from the RIX facility to offset water demands within its service area is not feasible at this time. The RIX facility is located at an elevation and distance from SBMWD's service area that makes it economically impractical to utilize recycled water (SBMWD 2005). This could change if the water is not sent to the RIX facility.

Table 4-2 summarizes the proposed water recycling projects of the region.

Table 4-2
Upper Santa Ana River Water Agencies Recycling Water Programs

Water Agency	Recycling Plant	Recycled Water Production Capacity	Description
Beaumont Cherry Valley WD	City of Beaumont WWTP	2 MGD	Current expansion will upgrade production to 4 mgd.
City of Big Bear Lake DWP & Big Bear City CSD	Big Bear Area Regional Wastewater Agency Plant	1.63 MGD	Future construction plans aim to produce 500AFY by 2011, and 1000AFY by 2015.
Fontana Water Company	IEUA Regional treatment Plant 4	7 MGD	FWC needs additional infrastructure to deliver recycled water in its service area.
City of Redlands Municipal Utilities Department	City of Redlands WWTP	6 MGD	Recycled water used for basin recharge and industrial purposes.
Rialto, City of & West Valley WD	City of Rialto Water Treatment Plant	12.0 MGD	Recycled water used for landscape irrigation on the I-10. City plans to expand use of recycled water.
Riverside Public Utilities	Riverside Regional Water Quality Control Plant	40 MGD	Applied for a change in permit to recycle up to 41,400 ac-ft/yr.
San Bernardino MWD	San Bernardino Water Reclamation Plant	0.75 MGD	Construction of a tertiary plant at the existing San Bernardino Water Reclamation Plant to recycle water for landscape irrigation.
Yucaipa Valley Water District	Henry N. Wochholz WWTP	6.7 MGD	New plant at Oak Valley will increase total recycled water availability to 12,000 ac-ft/yr.
San Bernardino MWD, City of Colton, City of Loma Linda, County of San Bernardino, and East Valley Water District	Rapid Infiltration and Extraction	40 MGD	All the water from the RIX is currently released into the Santa Ana River. The City of San Bernardino is exploring selling part of its portion of the recycled water.

4.2.1.3 Groundwater Management Strategies and Projects

Improving groundwater management will significantly contribute to the sustainability of water resources in the region. The IRWM Plan is intended to provide strategies to improve management of the groundwater resources of the Upper SAR watershed. Management of groundwater resources includes conjunctive use of surface water and groundwater resources as well as management of groundwater levels and water quality. Three BMOs have been considered for management of groundwater basins as described below.

Maximize Conjunctive Use and Increase Ability to Collect and Recharge Storm and Flood Water

Integration of flood and stormwater management strategies with recharge and conjunctive use opportunities contributes to water supply reliability in the region. The San Bernardino Valley area has been significantly urbanized over the past several decades and the area continues to grow with numerous in-fill development projects. As the amount of impervious surface increases with urbanization, the runoff, and, therefore, storm and flood flows are also increasing. Without adequate flood control systems to capture and contain these surface waters for recharge, the opportunities for water supply, water quality, and environmental improvement are greatly lessened or lost. Therefore, formulating strategies to capture storm runoff and use it for recharge of the groundwater basins will provide both flood management and water supply benefits to the region.

Some of the water-related judgments and agreements in the region, including the Western Judgment (Western Municipal Water District of Riverside County v. East San Bernardino County Water District, Case No. 78426), Orange County Judgment (April 17, 1969 Orange County Superior Court Judgment), and the Rialto Decree focus on ensuring the reliability of the water supply by controlling and carefully monitoring annual groundwater extractions. If a certain “threshold” is exceeded, some of these judgments and agreements require that the groundwater basin(s) be recharged from an “outside” source such as the SWP. A key to increasing future water supply reliability will be to increase conjunctive management of the surface water and groundwater resources of the region.

Reduce the Risk of Liquefaction

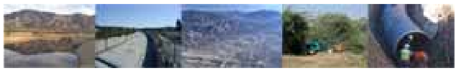
The most significant considerations in groundwater management in the SBBA are reducing the risk of liquefaction in the Pressure Zone due to high groundwater levels and avoiding impacts to and from the various groundwater contaminant plumes. Those two considerations are recognized as BMOs for the basin. All management strategies must satisfy these two constraints.

A significant portion of the SBBA—generally, the downtown and southern portions of the City of San Bernardino—is an area of historically high groundwater. This high groundwater combined with the thick layer of sand in the aquifer may create a risk of liquefaction in an earthquake. Liquefaction occurs only during an earthquake in areas of water-saturated, sandy soil. Given the large extent of sandy soils under the City of San Bernardino, the most practical way to reduce this risk is to reduce groundwater levels through basin management. Many of the facilities in the San Bernardino Valley Municipal Water District's (Valley District) Master Plan (CDM 1995) and some of the Santa Ana watershed Project Authority (SAWPA) proposed facilities are intended to assist in managing groundwater levels in this liquefaction-susceptible area. Due to the public safety threats associated with liquefaction, reducing the risk of liquefaction has been recognized within the BMOs for the SBBA. The objective of managing groundwater levels to reduce the risk of liquefaction is consistent with the Groundwater Management Planning Act and the California Water Code requirement that BMOs should be developed to manage water levels in the basin.

The Cuttle Weir is a concrete and rock diversion structure owned by the San Bernardino Valley Water Conservation District and is used to divert water from the Santa Ana River to the Conservation District's Santa Ana River Spreading Grounds for artificial recharge of the SBBA. The Seven Oaks Dam can be seen in the background. The good quality Santa Ana River water is used to recharge SBBA, hence improving water supply reliability and improving SBBA groundwater quality.

To meet this objective, strategies were identified and evaluated during the planning process. Most of these strategies serve multiple objectives and contribute to groundwater management, water quality objectives, and water supply reliability for the region. The region generally relies on local surface water, groundwater, recycled water, and the SWP for its water supplies.

Groundwater basins, in general, and the SBBA, in particular, are the primary sources of water supply for most of the water purveyors in the region. It is noteworthy to mention that the local agencies in the region have limited surface storage facilities for carryover storage and they rely on groundwater storage for seasonal as well as year-to-year water storage and regulation. Therefore, management of surface water, groundwater, groundwater quality improvement, and imported water are intrinsically interrelated and interconnected. It was recognized early in the planning process that water supply reliability, groundwater management, and the water quality objectives



of the plan can be met by performing a comprehensive evaluation and developing conjunctive water management.

Protect Groundwater Quality

The goal of this BMO is to protect the quality of the region's groundwater resources. Groundwater management is currently influenced by the presence of contamination plumes. Most of these plumes resulted from historic military and industrial operations in the region. The following plumes have been identified:

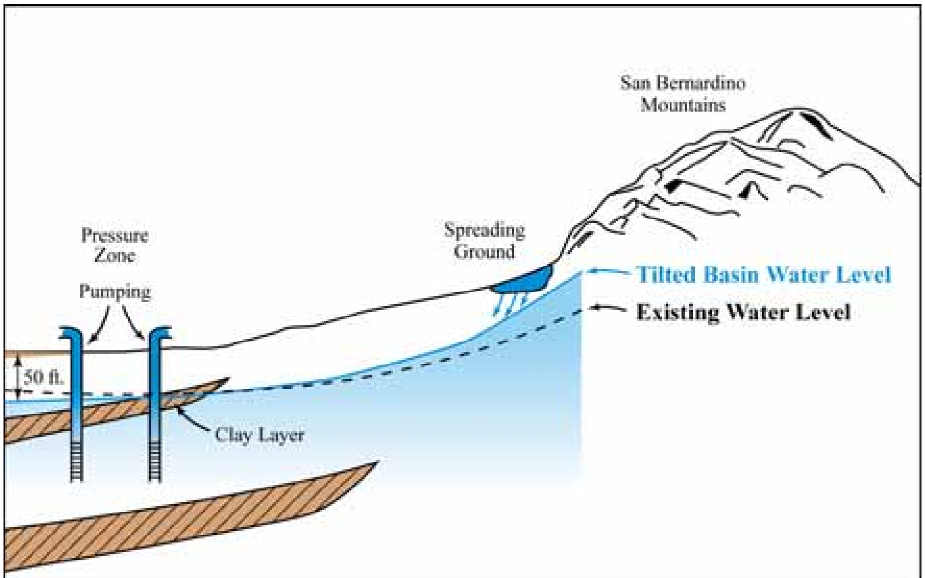
1. Newmark-Muscoy Superfund (trichloroethylene [TCE])
2. Redlands-Crafton (TCE, Perchlorate)
3. Santa Fe Plume (TCE)
4. Former Norton Air Force Base (TCE)
5. Rialto-Colton Subbasin (PCE, TCE, 1,1-DCE, cis-1,2-DCE, perchlorate)
6. No-Mans Land (PCE)

Management strategies are developed to not only avoid any adverse impacts that would cause these plumes to spread further but also to develop projects that will accelerate the cleanup of these plumes. These strategies are evaluated using computer models. Avoiding any impacts to and from the plumes, and their removal when possible, is considered a BMO for the region. This BMO is also consistent with the Groundwater Management Planning Act requiring BMOs to be formulated to address groundwater quality issues of the basin.

4.2.1.3.1 Groundwater Management Strategies

The region currently relies primarily on groundwater to meet its water needs and will continue to do so in the future. The SBBA is by far the largest source of groundwater for the region. When the basin is too full, high groundwater conditions occur in the Pressure Zone. The high groundwater levels are a concern because they increase the risk of liquefaction. High groundwater conditions also limit opportunities for recharge and/or groundwater banking in the basin. A "tilted basin" concept (see Figure 4-7) was suggested by some of the water leaders in the region as a way to maximize groundwater banking and manage the water levels in the SBBA.

Figure 4-7
Tilted Basin



Tilted Basin Concept

Management of groundwater levels under the tilted basin concept consists of recharging the basin at the "rim spreading grounds" and shifting the pumping, to the degree possible, to the Pressure Zone. The rim spreading grounds are located at the base of the San Bernardino Mountains and have high permeability soil. The "travel time" for the water to move from the rim recharge basins to the Pressure Zone is long enough to allow for seasonal regulations as well as conjunctive management of the basin. Under the tilted basin concept, groundwater levels could be generally higher in areas outside the Pressure Zone, while the water levels may be lower within the Pressure Zone. Considerable technical activities were undertaken during the planning process to:

- Develop analytic tools for basin management such as groundwater and surface water models. These models are discussed in Appendix C.
- Assess "baseline" conditions.
- Develop operational strategies for management of the groundwater basins, including groundwater levels and quality considerations.
- Develop groundwater production and artificial recharge strategies.
- Develop a process for management of the SBBA. This process is discussed in detail in this chapter.

- Develop a groundwater monitoring plan for collection, storage, and use of groundwater level and quality data, as well as assessment of the groundwater management strategies and their impacts on groundwater levels.

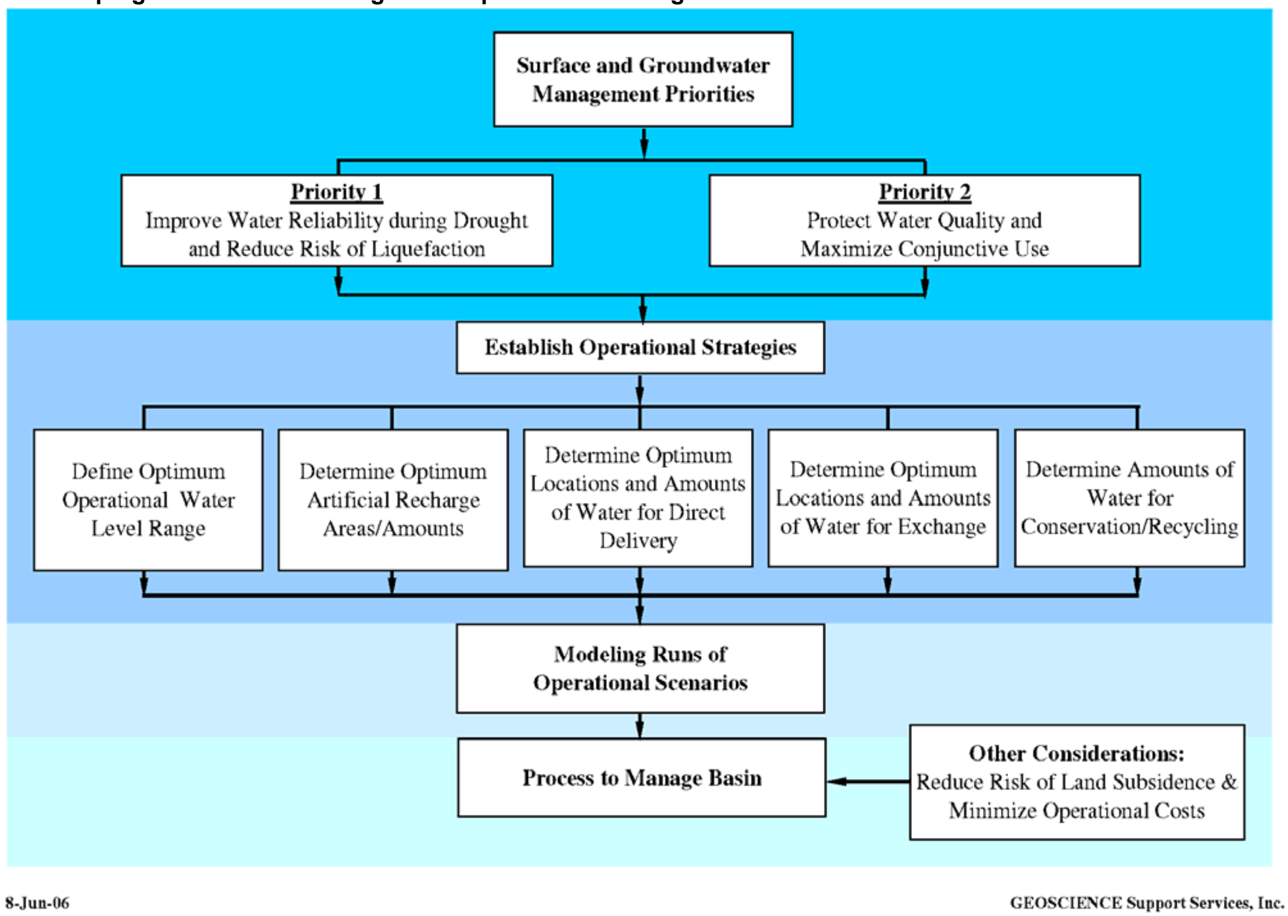
As stated earlier, management of the groundwater levels to reduce the risk of liquefaction and protect groundwater quality are key BMOs. Figure 4-8 shows operation strategies for managing groundwater resources of the SBBA. As shown, operational strategies are established during the planning process to ensure established BMOs (listed as Priority 1 and Priority 2) are met and that planned projects and programs are consistent with the goals of the BMOs and will contribute to attainment of the objectives. Considerable resources were used to develop tools for understanding and management of this basin. A groundwater model has been developed and further refined to simulate the behavior of the aquifers under different operational scenarios. A detailed discussion of groundwater modeling efforts is presented in Appendix C.

The key model outputs include groundwater levels and resulting groundwater directions. The model is used to design appropriate levels of groundwater conjunctive management strategies while meeting stated BMOs. The model runs were to identify the range ("book-ends") and provide information such as the following:

- Suitable places for managed groundwater recharge;
- Amount of water to be recharged in each managed recharge area;
- Key groundwater monitoring locations;
- Groundwater pumping, including location and number of the production wells; and
- Programs and projects to facilitate pumping, treatment, and the use of contaminated groundwater.

Development of the water management strategies and associated projects to meet the BMOs requires a clear understanding of the SBBA hydrogeology and groundwater flows and directions under various operational scenarios. Groundwater modeling studies are performed and water level contours are prepared for operation of the basin assuming a range of conjunctive use operations. Operations of existing and future recharge facilities and production wells can be further refined through these modeling studies. Using modeling study results, additional facilities are formulated to implement the conjunctive use strategies.

Figure 4-8
Developing Groundwater Management Operational Strategies



Two specific BMOs mentioned earlier must be met as the IRWM Plan is being implemented. These BMOs are specifically designed for management of the water level and water quality in the Bunker Hill and Lytle Creek Basins.

To achieve the objective of reducing the risk of liquefaction, the groundwater level(s) in the Pressure Zone would be reasonably managed to maintain at least 50 feet below ground surface (bgs). This objective will be implemented through optimization of groundwater recharge and groundwater production activities and monitoring of key "index wells" throughout the year. Implementation strategies may include increasing production in the Pressure Zone and reducing recharge in the areas that may contribute to the speedy rise of the water level in the Pressure Zone.

4.2.1.3.2 Groundwater Quality Protection Strategies

A key water quality objective in the Bunker Hill Basin is minimizing adverse impacts from and to groundwater contaminant plumes. The IRWM Plan recommends specific strategies that would facilitate and expedite clean up while meeting the above water quality objective. These strategies consist of (1) formulating and implementing a program to increase groundwater pumping and cleanup in the plume areas, and (2) designing conjunctive use strategies that ensure avoidance of impacts to and from the contaminant plumes.

Bunker Hill Basin Regional Water Supply Program

In the mid-1990s, Valley District completed a Regional Water Facilities Master Plan for its service area that identified a regional transmission system to deliver high groundwater from the Bunker Hill Basin Pressure Zone to the surrounding communities. Since then, Valley District has constructed some of these facilities. Facilities within the City of San Bernardino have been incorporated into the SBMWD's Lower Zone distribution system. The SBMWD may then operate Valley District's facilities as a part of the city's Lower Zone.

The proposed Bunker Hill Regional Water Supply Program consists of design and construction of facilities for regional production, treatment, and distribution of treated water in the basin. Groundwater from the Newmark plume would be conveyed to treatment facilities and distributed to interested agencies within and outside the Valley District's service area. This program will provide water supply reliability by accelerating the cleanup of groundwater plumes, and improve the management of the groundwater levels in the Pressure Zone.

Facilities needed to implement this program include:

- Groundwater production wells and collection system;
- Regional wellhead treatment facilities; and
- Potable water storage, transmission, and pumping facilities.

Additional detailed discussion of this program and associated facilities can be found in Appendix E.

4.2.1.3.3 Conjunctive Use Strategies

As mentioned previously, the design of conjunctive use programs should ensure avoidance of impacts to and from the contaminant plumes and minimize the increased risk of liquefaction. With this criterion and the "tilted basin" concept in mind, four conjunctive use scenarios have been evaluated for this plan. The first scenario is the base level conjunctive use. The baseline level conjunctive use is intended to demonstrate how conjunctive management of the region's surface and groundwater resources (groundwater, local, and imported surface water supplies) will help the region meet its water demand through 2030. The next three scenarios are designed to examine the response of the basin when an additional 40 thousand acre-feet (TAF), 90 TAF, and 140 TAF conjunctive use programs are implemented. The intent of these studies is to characterize the book-ends for water banking in the SBBA under the "tilted basin" concept. The model runs were prepared with consideration of the following:

- Hydrologic base period is from 1962 through 2000.
- Basin storage must be maintained to comply with existing adjudications, i.e., no long-term storage depletion—basin storage at the end of the modeling run period would be "equivalent" to the storage at the start of the modeling period.
- Water levels within the Pressure Zone would be within acceptable ranges.
- Water levels outside the Pressure Zone may be higher.
- Avoiding impacts to and from known groundwater contaminant plumes.

Conjunctive use operation of the SBBA should also comply with numerous other agreements and MOUs. Compliance with these documents will be verified during real-time operation of the SBBA and are discussed in more detail in Section 4.2.1.3.5.

Modeling studies were conducted for the four scenarios and are described below. A summary of the assumptions of the four modeling studies is presented in Figure 4-9.

The groundwater model developed as part of this planning effort does not include the terms and conditions set forth in the Seven Oaks Accord and the Riverside Agreement. The modeling runs developed for the IRWM Plan provide valuable information, however, on how to manage the groundwater basins within the framework of all existing legal constraints. Future proposed conjunctive use projects will be analyzed using a groundwater model to ensure their compliance with the terms and conditions of the various legal agreements in the basin.

Baseline Scenario – The baseline scenario assumes compliance with the existing adjudication constraints and includes the diversion rights of Senior Water Right Claimants, Valley District's Replenishment Obligations, and SBVWCD. Future water demand within

Figure 4-9
Groundwater Modeling Assumptions

Scenario	Hydrologic Base Period	Model Assumptions							
		Groundwater Pumping[1]	Valley District's Replenishment Obligation[2]	SBVWCD Diversion[3]	Diversion by Senior Water Rights Claimants[4]	SAR Water Right Applications[5]	Maximum Additional Yield		
							40,000 acre-ft/yr	90,000 acre-ft/yr	140,000 acre-ft/yr
Baseline 1	1962-2000 (wet, avg, dry)	x	x	x	x	x			
A		x	x	x	x	x	x		
B		x	x	x	x	x		x	
C		x	x	x	x	x			x

1 Based on 2005 Urban Water Management Plans pumping data

2 Replenishment obligation is based on Western Judgment and is safe yield minus annual production

3 SBVWCD diversions are based on Valley District/SBVWCD settlement agreement

4 Limited to 88 cfs, see Seven Oaks Accord

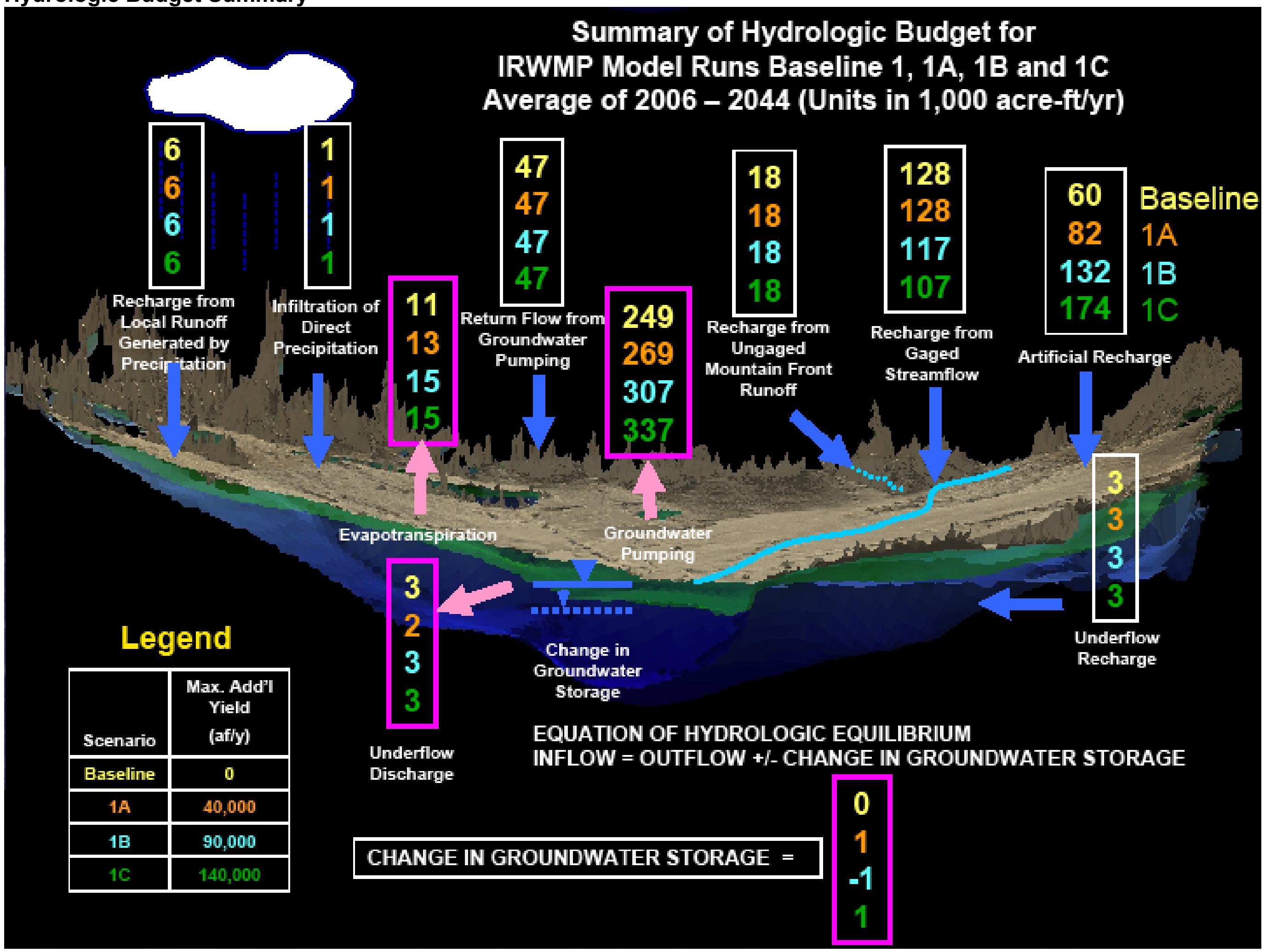
5 Assumes SAR water rights applications are approved by SWRCB

the region is estimated using data presented in UWMPs prepared by the water purveyors as presented in Chapter 3. To meet the water demand, it is assumed that Valley District will use newly conserved SAR water, as is defined in water right applications, and its SWP Table A allotment, as available, for recharge and direct delivery to the treatment plants.

The modeling studies have been conducted to document the performance of the basin when local surface water and SWP supplies are used to replenish the basin by Valley District as required by the adjudication. Modeling studies are designed to cover a 39-year period (1962-2000), which includes the wet years such as 1969 and 1980 and the driest period of 1987 through 1992. This modeling scenario is intended to show how the base conjunctive use project can be used to meet future water needs of the region. This scenario was used in preparation of the water budget (Chapter 3).

The results of the base scenario suggest that the region can meet its water needs through 2030, while achieving the BMOs. The results also indicate that the available surface water for recharge and the SWP supplies, assuming a 77 percent allocation, are adequate to offset the pumping demand on SBBA, and that at the end of the 39-year modeling run the basin storage is the same as the beginning of the period (see Figures 4-9 and 4-10) The IRWM Plan consulting team has evaluated any potential impact of conjunctive use operation upstream of the SBBA (U.S. Forest Service (USFS) land) to ensure the operation will not impact the groundwater level and associated ecosystem of the USFS land. Facilities needed to implement the base conjunctive use scenario include those that are necessary to bring SAR water to the treatment facilities and spreading grounds and are discussed in the Local Surface Water Management section.

Figure 4-10
Hydrologic Budget Summary



Scenario A – This scenario is intended to show the performance of a project with potential 40 TAF additional conjunctive use per year. The level of conjunctive use presented with this scenario is intended to evaluate the feasibility of a 40 TAF conjunctive use project. The other modeling run assumptions used for this scenario were similar to the base scenario.

The modeling studies indicate that this level of conjunctive use operation is feasible and the stated BMOs are also met. The facilities needed to implement this level of conjunctive use include:

- A well field consisting of 20 production wells and connecting pipeline,
- Treatment facilities,
- Pipeline to connect the well field to the treatment and distribution facilities, and
- Improvement in existing groundwater managed recharge basins.

Scenario B – This scenario is for an additional 50 TAF per year conjunctive use opportunity (for a total of 90 TAF per year over the Base Scenario). Additional facilities needed to implement this level of conjunctive use include:

- A well field consisting of 30 additional production wells (50 total),
- Treatment facilities for production wells pumping from the plumes, and
- Conveyance facilities.

Scenario C – This scenario is for an additional 50 TAF per year of conjunctive management over Scenario B for the total conjunctive use of 140 TAF per year. Additional facilities needed to implement this incremental level of conjunctive use include:

- A well field consisting of 30 additional production wells (80 total),
- Treatment facilities for production wells pumping from the plumes,
- Conveyance facilities, and
- Additional spreading grounds.

4.2.1.3.4 Yield of Conjunctive Use Strategies

The yield of conjunctive use strategies listed above is calculated using the groundwater model based on water demands for the basin. Model runs A, B, and

C represent the conjunctive use scenarios discussed in the previous section. Table 4-3 below shows the yield of three conjunctive use scenarios for a single drought year and a three-year drought period (1990 year type is used for Upper SAR watershed as the driest single year and 1988 to 1990 is used as the three-year drought period).

Table 4-3
Summary of Potential Additional Yield for the SBBA

Terms	Period	Baseline Run [acre-ft]	Run A [acre-ft]	Run B [acre-ft]	Run C [acre-ft]
Groundwater Pumping	2032	271,987	301,987	381,987	421,987
	2033	277,330	307,330	367,330	387,330
	2034	289,105	329,105	409,105	449,105
	Total	838,422	938,422	1,158,422	1,258,422
Conjunctive use Additional Yield	Single Year Drought 2034 (1990)	N/A	40,000	120,000	160,000
	3-Year Drought 2032-2034 (1088-1990)	N/A	100,000	320,000	420,000

Single-year drought 2034 (hydrologic year 1990)
Three-year drought 2032-2034 (hydrologic years 1988-1990)

As shown in the above table, for the single drought year, the additional yield for the conjunctive use would be 40,000 acre-feet, 120,000 acre-feet, and 160,000 acre-feet for Model Runs A, B, and C, respectively. The yield during a three-year drought would be 100,000 acre-feet (or 33 TAF per year), 320,000 acre-feet (or 106 TAF per year), and 420,000 acre-feet (or 140 TAF per year) for Model Runs A, B, and C, respectively.

Specific facilities needed to implement the conjunctive use program discussed above are summarized in Table 4-4.

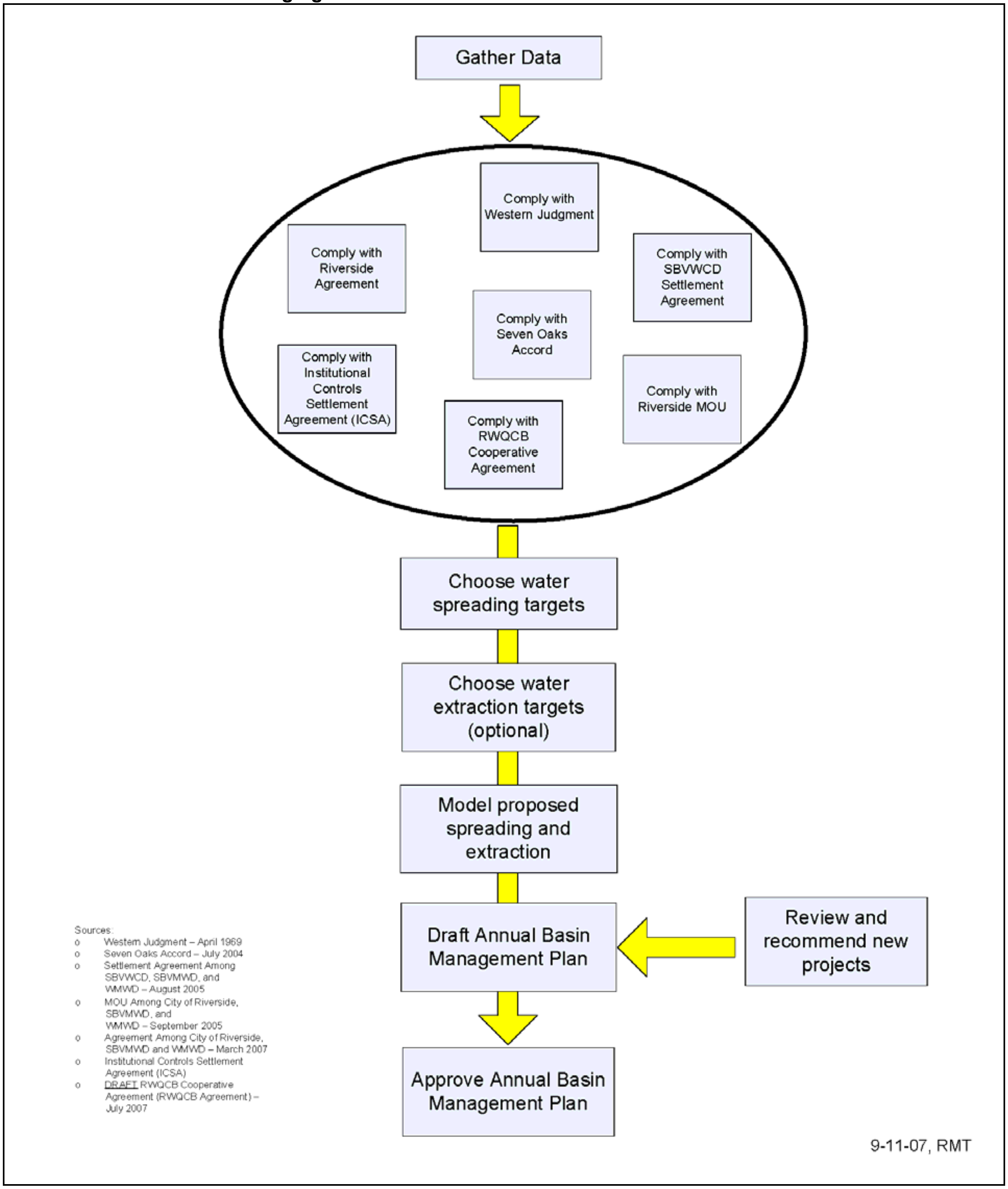
Table 4-4
Facilities Needed to Implement Various Conjunctive Use Program Scenarios

Conjunctive Use Scenario	Facilities Needed
Baseline	Facilities to divert SAR water per water rights application
1A	20 new extraction wells and conveyance facilities
1B	30 additional extraction wells (in addition to 1A) and conveyance facilities
1C	30 additional extraction wells (in addition to 1B) and conveyance facilities

4.2.1.3.5 Process for Managing the SBBA

Implementation of the conjunctive use operation in the SBBA must meet the requirements of various judgments, agreements, and MOUs developed and agreed upon by water entities in the region. To effectively manage the SBBA in real time, the TAG drafted a basin management process for a coordinated and comprehensive management plan of the SBBA. This process will be submitted to the Board of Directors of Valley District and Western Municipal Water District (Western) for review and approval. The process is outlined in Figure 4-11.

Figure 4-11
Overview of Process for Managing the San Bernardino Basin Area



Governance

The Western Judgment identifies regional representative agencies to be responsible, on behalf of the numerous parties bound thereby, for implementing the replenishment obligations and other requirements of the judgment. The representative entities for the Western Judgment are Valley District and Western. Valley District is solely responsible for providing replenishment of the SBBA if extractions exceed the safe yield of the basin. The court-appointed Watermaster includes representatives from Valley District and Western. The proposed basin management process could be under the authority of the Valley District and Western Boards of Directors with inputs from other significant producers. (See Figure 4-12.)

Basin Technical Advisory Committee

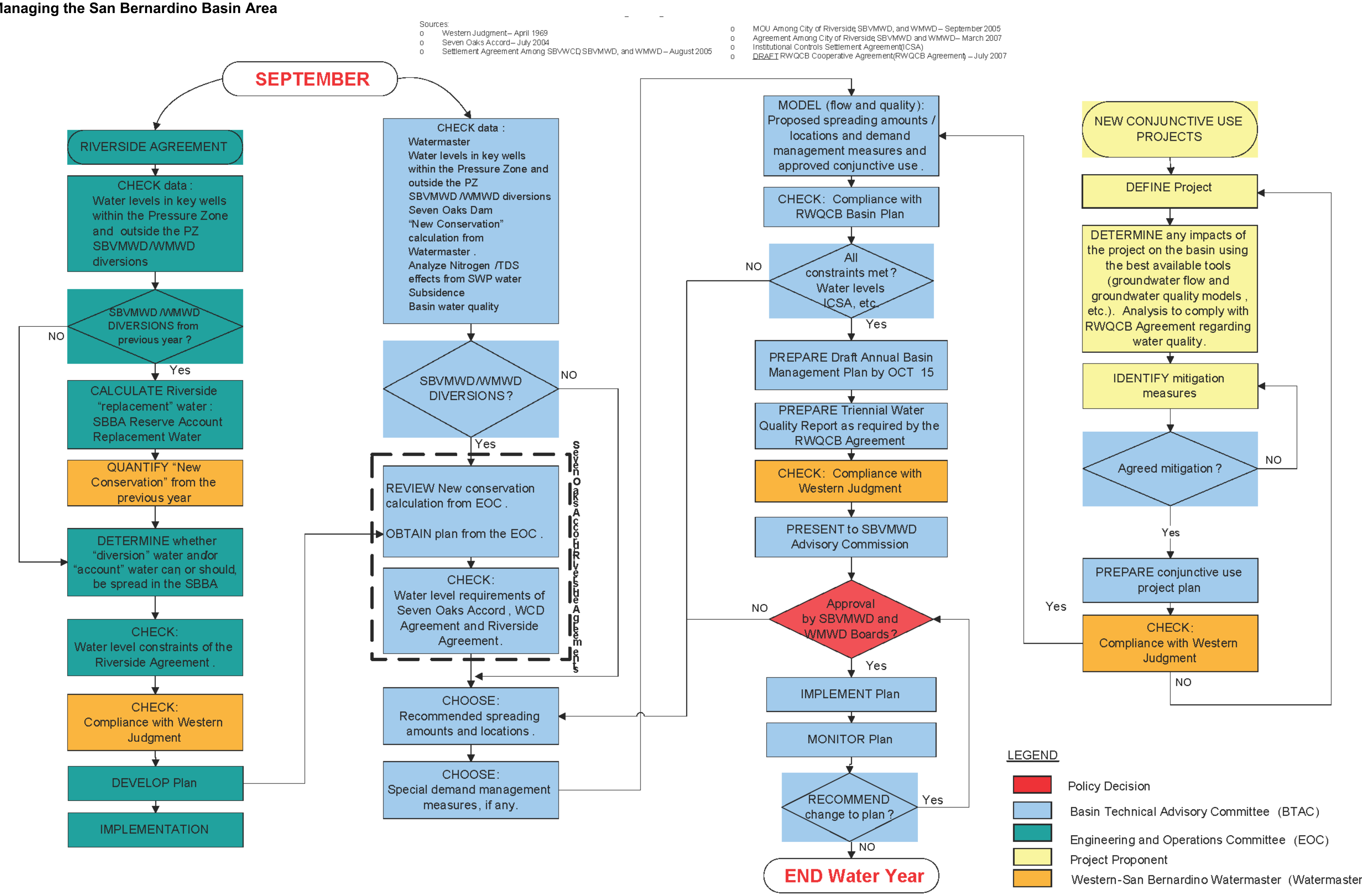
The annual basin management plan for any given year will be formulated by a Basin Technical Advisory Committee (BTAC) and forwarded onto the Valley District and Western Boards of Directors for review and approval. The BTAC will be comprised of staff representatives from plaintiffs and non-plaintiffs of the Western Judgment, as listed below:

BTAC Membership

- i) Western
- ii) City of Riverside
- iii) Valley District
- iv) Bear Valley Mutual Water Company (Bear Valley Mutual)
- v) East Valley Water District (East Valley)
- vi) City of Loma Linda
- vii) City of Redlands
- viii) San Bernardino Municipal Water Department
- ix) SBVWCD
- x) West Valley Water District (West Valley)

The BTAC will meet as needed to effectively operate the SBBA on a real-time basis and to address technical issues related to basin management. The BTAC members will cooperatively work together and will strive to make decisions by consensus.

Figure 4-12
Process for Managing the San Bernardino Basin Area



Overall Basin Management Strategy

The BMOs formulated for the SBBA are the driving force in developing strategies for the basin management plan. The BMOs are as follows:

- Improve water supply reliability during droughts,
- Protect water quality,
- Reduce risk of liquefaction, and
- Avoid impact from and to the contaminant plumes.

To ensure adequate reliable water supply for the communities in the Upper SAR watershed during a prolonged drought, the overall basin management strategy will be to operate the basin under the "Tilted Basin Concept" such that the basin would begin a drought period in "as full as possible" condition. Keeping the basin relatively full and operating a conjunctive management program according to the "Tilted Basin Concept" also provides the added flexibility to reduce imports from the SWP when water quality is less desirable. This overarching management strategy will be followed by the BTAC as they draft the basin management plan. Some of the specific management strategies that could contribute to improving water supply reliability during a drought are as follows:

- Retailers could take direct deliveries of SWP water when available instead of producing water from their wells. This reduces the amount of water withdrawn from the groundwater basin, which is equivalent to recharging the basin. This strategy will require participation by the water agencies and may require the construction of new water treatment plants or upgrades to existing plants.

- Recharge as much SWP water as possible when available. This will likely result in spreading water in wet years, which has not occurred as much in the past. It may also require upgrading the existing spreading grounds.

- Prepare, to the extent possible, for the high groundwater condition that may be created by maintaining a "full basin" when a wet year arrives.

  - Implement an agreement(s) with groundwater producers within the Pressure Zone to maximize production from the Pressure Zone as much as practicable during unacceptably high groundwater level conditions.

- Construct additional facilities to pump and convey large quantities of water from the Pressure Zone for use outside the Pressure Zone.

The San Bernardino Basin Area Management Plan will be developed in consideration of this overall management strategy and the BMOs.

Basin Management Requirements

The annual basin management plan for the SBBA will meet the requirements identified in the following legal documents:

1. Western Judgment – April 1969
2. Seven Oaks Accord – July 2004
3. Settlement Agreement between SBVWCD, Valley District, and Western – August 2005
4. MOU between City of Riverside, Valley District, and Western – September 2005
5. Agreement between City of Riverside, Valley District, and Western – March 2007
6. Institutional Controls and Settlement Agreement (ICSA) Agreement and its subsequent amendments

A summary of the pertinent basin management information from each of these documents is provided below.

1) Western Judgment

a) **Natural Safe Yield** - established at 232,100 acre-feet per year. The Plaintiffs' (Western entities) rights are capped at 27.95 percent of the natural safe yield, or 64,862 acre-feet, notwithstanding any Additional Extraction Agreements or "new conservation," as defined in the judgment. The Non-Plaintiffs' (Valley District entities) rights are unlimited provided that an equal amount of basin replenishment occurs to offset any amount that the Non-Plaintiff production exceeds—72.05 percent of the natural safe yield, or 167,238 acre-feet. An annual report, entitled *Annual Report of the Western-San Bernardino Watermaster*, provides an "accounting" of basin extractions.

b) **Replenishment** – Valley District is responsible for replenishing the SBBA for that amount of Non-Plaintiff extractions exceeding 167,238 acre-feet. The replenishment obligation may be met by any of the following means:

   i) Return flow from excess extractions;

ii) Replenishment provided in excess of that required;

iii) Amounts extracted without replenishment obligations (i.e., Additional Production Agreement);

iv) That amount of water extracted below the natural safe yield; and

v) Return flow from imported water.

c) **New Conservation** is defined in the 1969 Judgment as "any increase in replenishment from natural precipitation which results from operation of works and facilities not now in existence." The judgment contemplated that the parties would develop facilities that would result in the capture of more natural runoff. Construction of the Seven Oaks Dam within the SAR has provided such an opportunity, and Valley District and Western are seeking to obtain a water right from the SWRCB and to construct the facilities necessary to capture SAR water that was not historically captured. The parties under the Western Judgment will have their adjusted extraction rights increased to include a proportionate share of any New Conservation, provided that each Plaintiff party pays its proportionate share of the costs to develop said New Conservation.

2) Seven Oaks Accord

a) **Groundwater Spreading/Management Program** (GMP) – Requires Valley District and Western to develop and manage a groundwater spreading program in cooperation with other parties, "That is intended to maintain groundwater levels at the specified wells at relatively constant levels, in spite of the inevitable fluctuations due to hydrologic variation." Specific requirements of the Seven Oaks Accord are as follows:

i) GMP shall identify target water-level ranges in the specified "index wells" subject to the requirement that such spreading will not worsen high groundwater levels in the Pressure Zone.

ii) Thresholds of significance in terms of SAR water diverted by Valley District and Western and spreading by all parties should be observed (see sidebar). See Appendix I of the Accord.

iii) The determination as to whether a certain groundwater management action will "worsen" high groundwater levels in the Pressure Zone is made through the use of the integrated surface and groundwater models.

iv) GMP must be "adopted" within five years of the date the SWRCB grants a permit to Valley District/Western. To date, Valley District and Western have not received the permit.

v) Redlands, East Valley, and Bear Valley Mutual agree to limit spreading to conform to the annual GMP.

3) San Bernardino Valley Water Conservation District Settlement Agreement

a) Annual Groundwater Management Plan – Valley District and Western will consult with SBVWCD in the development of the GMP.

b) An interim GMP could be developed prior to the completion of the model being developed for the San Bernardino Basin Area.

c) GMP objectives to be achieved simultaneously include:

i) Maximize the quantity of water spread in the SAR spreading grounds.

ii) Establish and maintain a shallowest target of 50 feet depth to water within the Pressure Zone.

iii) Maintain groundwater levels in the Forebay Area within 10 feet of the levels that would have occurred in the absence of SAR diversions by Valley District and Western. Quantifying the difference between diversions and no diversions will be accomplished using the groundwater flow model developed for the SBBA.

iv) Otherwise avoid significant impacts on the environment.

d) Set as a goal to coordinate the San Bernardino Consent Decree management plan with the GMP.

e) No spreading will take place without authorization by the GMP.

4) Riverside MOU

a) Basin Management Account – Established with funds and future revenues from the SBVWCD "to fund recharge efforts in the basin."

b) Valley District and Western are required to exercise SBVWCD water rights in a manner that:

Thresholds of Significance and Mitigation Measures to be Included in Applicants' EIR

1. Threshold of Significance: Reduction in Groundwater Levels at Index Wells Outside the Pressure Zone

A reduction in groundwater levels outside the Pressure Zone is significant if the analysis in this EIR, using the integrated surface water and groundwater model developed by the project proponents, predicts that the project would reduce static groundwater levels at one or more index wells, on average, by more than 10 feet during a repetition of the 39-year base period hydrology, as compared to static water levels in the absence of the project.

2. Threshold of Significance: Increase in Groundwater Levels at Index Wells Within the Pressure Zone

An increase in groundwater levels in the Pressure Zone is significant if the analysis in this EIR, using the integrated surface water and groundwater model developed by the project proponents, predicts that the project would increase static groundwater levels at one or more index wells in the Pressure Zone, on average, by more than 10 feet during a repetition of the 39-year base period hydrology, as compared to static water levels in the absence of the project.

3. Mitigation Measure: Targeted Spreading to Maintain Groundwater Levels

To avoid a significant effect on groundwater levels at one or more index wells located outside the Pressure Zone, the project proponents shall spread sufficient water to maintain static groundwater levels at the affected index wells to reduce this project impact to a less-than-significant level.

4. Mitigation Measure: Limitation on Spreading to Prevent High Groundwater Levels

To avoid a significant effect on groundwater levels in the Pressure Zone, the project proponents shall curtail their spreading or direct other parties engaged in the spreading of water to replenish the San Bernardino Basin to curtail their spreading to reduce this project impact to a less-than-significant level.

i) Maintains groundwater levels for the benefit of the production wells in the geographic area historically served by the SBVWCD at relatively constant levels.

ii) Maximizes the use of native water supplies to replenish the SBBA without causing high groundwater problems in the artesian zone and without causing the migration of contaminant plumes that would result in significant degradation of the water quality in any domestic well.

c) Valley District will spread sufficient water to ensure that groundwater supplies necessary to support the safe yield of the SBBA are maintained pursuant to the Western Judgment.

5) Riverside Agreement

a) This agreement establishes the Seven Oaks Dam Water Diversions Engineering and Operations Committee (EOC) to develop and implement procedures to:

i) Maintain the groundwater levels in the Index Wells at relatively constant levels, in spite of fluctuations due to hydrologic variation.

ii) Minimize such fluctuations (reduce highs and lows).

iii) Provide water “accounts” to Riverside to offset the loss of recharge to the SBBA and/or Riverside North due to Western/Valley District SAR water diversions.

(1) “Reserve Account” is initially established as 38 percent of the total volume of water diverted from the SAR by Valley District and Western pursuant to the SWRCB water right permit. To be recharged in the SBBA either directly or through an exchange.

(2) “Replacement water” varies from 0 to 6 percent of the flow at the E Street Bridge. Water to be recharged into the Riverside North basin.

iv) Develop recommendations to the Western Judgment Watermaster regarding the classification of diverted SAR water as either New Conservation or existing safe yield of the SBBA.

b) EOC will meet no later than six months after the SWRCB grants permits to Valley District and Western to develop the initial procedures. Ongoing, the EOC will meet no later than October 1 of each year. The EOC shall meet on a regular basis to effectively operate, on a real-time basis, a program to achieve the objectives listed above. EOC decisions will be implemented once approved by the EOC and will be provided to the BTAC for inclusion in the Annual San Bernardino Basin Area Management Plan. The tasks of the EOC could be covered at the BTAC meetings, realizing that most of the members of the BTAC have no standing in this agreement and the decisions of the EOC are not subject to review by BTAC or any of the BTAC members.

c) Water levels at the index wells outside the Pressure Zone must be maintained at no lower than 10 feet, on average, during a repeat of the 39-year base period. Valley District will commence spreading to maintain these levels.

d) If the 12-month rolling averages of the Backyard Well ports D4, D5, and D6 are 50 feet bgs or greater, Valley District and Western will recharge water from the Reserve Account.

6) Consent Decree, City of San Bernardino March 23, 2005

a) The City of San Bernardino Municipal Water Department (SBMWD) is a party to a consent decree lodged with the United States District Court, Central District of California, Western Division (Court), on August 18, 2004. The Consent Decree obligates the SBMWD to operate and maintain a system of wells and treatment plants known as the Newmark Groundwater Contamination Superfund Site (Newmark Site). The Newmark Site specifically treats groundwater contaminated with TCE and perchloroethylene (PCE).

b) The SBMWD is required by the terms of the Consent Decree, entered on March 23, 2005, to enact institutional controls and implement an ordinance providing for the protection and management of the Interim Remedy set forth in the Record of Decisions and Explanation of Significant Differences prepared by the Environmental Protection Agency (EPA).

7) City of San Bernardino Ordinance No. MC-1221 and Institutional Controls Settlement Agreement (ICSA)

a) Ordinance No. MC-1221 – This ordinance establishes the management zone boundaries within the City of San Bernardino for water spreading and water extraction activities.

i) The Consent Decree requires that the City of San Bernardino adopt and enforce an ordinance to ensure that activities occurring in the management zone, including, but not limited to, development, digging, drilling, boring or reconstruction of wells, extraction of groundwater from wells, and spreading of recharge water, do not interfere or cause pass-through of contaminants from the Newmark and Muscoy Operable Units. The ordinance was approved on March 20, 2006, by the Mayor and City Council.

ii) The Interim Remedy requires the extraction of contaminated groundwater from the Bunker Hill Groundwater Basin and within the

Newmark and Muscoy Operable Units, and treatment of the groundwater to meet all State of California (State) and federal permits and requirements for drinking water.

iii) Unless a permit issued by the SBMWD pursuant to the provisions outlined in the ordinance is first obtained, it shall be unlawful for any person, as principal, agent, or employee to spread (artificial recharge) or extract (well pumping) within the Management Zones as defined in the ordinance.

b) Institutional Controls Settlement Agreement (ICSA)

i) An agreement (ICSA) has been executed to develop and adopt a successor agreement, titled Institutional Controls Groundwater Management Program (ICGMP), between the following parties:

(1) City of San Bernardino Municipal Water Department

(2) San Bernardino Valley Municipal Water District

(3) Western Municipal Water District

(4) City of Riverside

(5) West Valley Water District

(6) East Valley Water District

(7) City of Colton

(8) Riverside Highland Water Company

ii) The parties identified above will not be subject to the provisions of City of San Bernardino Ordinance No. MC-1221 as long as each is a party to the ICSA and, subsequently, the ICGMP Agreement.

Development of Annual San Bernardino Basin Area Management Plan

Considering the provisions of the above judgments and agreements, the following process is suggested for the preparation of an Annual SBBA Management Plan. This process is intended to be flexible and changed as needed. The main purpose in suggesting a process is to ensure that the SBBA Management Plan is in compliance with the provisions of the applicable judgment and agreements and to provide a cooperative forum among the water agencies to engage in developing solutions.

As part of the first annual SBBA Management Plan, BTAC will work toward defining the term “conjunctive use” and draft a conjunctive use policy that may be used for the basin. The policy will define issues such as (1) imported water, (2) imported water delivery, (3) the groundwater recharge system, (4) usable groundwater storage capacity, (5) “water loss factor,” (6) expiration date for the imported water, (7) groundwater recovery rights, (8) groundwater extraction capacity, and (9) recovered water delivery.

A. **Prepare** Annual SBBA Management Plan. The plan will be prepared considering the following:

   a. **Review** the Watermaster data:

      i. Recharge

      ii. Extractions

      iii. Credits

The BTAC may have to rely on preliminary production information compiled by the Watermaster because the Watermaster reports typically lag the calendar year.

   b. **Analyze** nitrogen and TDS effects from imported water. Prepare conjunctive use operation criteria to ensure the use of SWP water for recharge will not cause water quality degradation in Bunker Hill Basin.

   c. **Quantify** "new conservation."

      i. Develop recommendations to the Western Judgment Watermaster regarding the classification of diverted SAR water as either New Conservation or existing safe yield of the SBBA.

   d. **Check** Valley District/Western/Riverside SAR diversions from the previous year.

   e. **Check** Seven Oaks Dam operations data.

      i. Debris pool.

      ii. Current elevation.

   f. **Check** water levels.

      i. Check water levels in the Pressure Zone (establish and maintain 50 feet to water level in the Pressure Zone).

      ii. Check water levels outside the Pressure Zone. Ensure water levels at the index wells outside the Pressure Zone are maintained at no lower than 10 feet, on average, during a repeat of the 39-year base period.

   g. **Review** the amount of "replacement" water agreed to by the EOC to be "deposited" into the Riverside "accounts" based upon the Valley District/Western/Riverside diversions from the previous year.

i. SBBA Reserve Account: 38 percent of the total volume of water diverted from the SAR by Valley District and Western pursuant to a SWRCB permit or license. To be recharged in the SBBA either directly or through an exchange.

ii. Replacement water volume calculation: Replacement water is the lost recharge opportunities in Riverside North Basin due to diversion of New Conservation water from SAR. This replacement water is estimated to vary, depending on SAR hydrology, from 0 to 6 percent of the flow at the E Street Bridge. Replacement water to be recharged into the Riverside North Basin.

h. **Determine** whether water will be spread from the SBBA Reserve Account in the coming year.

i. Calculate the 12-month rolling averages of the Backyard Well ports D4, D5, and D6. If it is 50 feet bgs or deeper, Valley District/Western will recharge water from the Riverside Reserve Account in the coming year.

i. **Review** constraints of various agreements on Valley District/Western/Riverside diversions. If SAR diversions were made in the previous year, check the following:

i. Maintain groundwater levels in the forebay area (use wells from Seven Oaks Accord and Riverside Agreement, "Index Wells") within 10 feet of the levels that would have occurred in the absence of SAR diversions by Valley District/Western**.**

ii. Maintain groundwater levels in the Seven Oaks Accord, Valley District, and Riverside Agreement wells at relatively constant levels, in spite of the inevitable fluctuations due to hydrologic variation.

1. Identify target water level ranges for the Seven Oaks Accord index wells subject to the requirement that such spreading will not worsen high groundwater levels in the Pressure Zone.

2. Review Seven Oaks Accord thresholds of significance.

3. Maintain water levels in the Riverside Agreement wells outside the Pressure Zone at no lower than 10 feet, on average, during a repeat of the 39-year base period.

4. Minimize fluctuations (highs and lows).

j. **Review** spreading amounts and locations chosen by the EOC and choose other spreading amounts and locations based upon the following:
    - i. Maximize the quantity of water spread in the SAR spreading grounds.
    - ii. Water spread for conjunctive use projects, if any.
        1. Water banking.
        2. Exchange.
        3. Establish “accounts” in the basin.
            - a. Expiration?
            - b. Define assumed losses due to evaporation and evapotranspiration.
    - iii. Riverside Reserve Account (see 2 and 3 above).

k. **Choose** special demand management measures (if any).
    - i. Extra pumping to dewater a particular area.
    - ii. Extra pumping to dewater due to a wet year.
    - iii. Suggest conservation measures.

l. **Check compliance with the Regional Water Quality Control Board (RWQCB) Agreement**

B. **Model:** The groundwater models for the SBBA can be used to model the proposed SBBA Management Plan developed above to ensure that all of the constraints are met.

a. Maintain 50 feet to water level in the Pressure Zone.

b. Check target water level ranges in the Seven Oaks Accord index wells.

c. Check water level requirements from Riverside Agreement.

d. Check water level requirements from SBVWCD Agreement.

e. Determine any impacts on the environment.

f. Prepare groundwater flow map to determine any impacts on the Consent Decree.

g. Determine any impacts on any other contamination cleanup projects.

h. Determine if there are any subsidence impacts.

i. Adjust SBBA Management Plan, as necessary, in an attempt to remove any impacts and re-run model. Continue this trial-and-error process until all of the constraints are met.

C. **Prepare** triennial water quality report.

D. **Adopt** Annual SBBA Management Plan. The Annual SBBA Management Plan must be adopted by the Board of Directors of the Valley District and Western.

E. **Monitor** plan throughout the year. The operation of the SBBA will be monitored and groundwater level and quality data will be collected and reviewed throughout the year to ensure basin behavior is consistent with the SBBA Management Plan desired outcome(s). If unexpected impact is observed, the conjunctive use operation will be modified to ensure the impact is mitigated.

F. **Review** implementation of the Annual SBBA Management Plan at the end of the year. Compare the anticipated water levels with actual field observations. This would provide valuable information for developing an adaptive management plan for development of the basin management plan for the following year.

G. **Adapt** the process, as necessary, to maintain its effectiveness.

Suggested Calendar for Preparation and Implementation of the Annual Basin Management Plan (water year)

MONTH	**ACTION ITEM(S)**
OCT	1) Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells. **2) <u>BTAC MEETING</u>** o Develop recommendation regarding the classification of diverted SAR water as either New Conservation or existing safe yield of the SBBA. o Review Watermaster data. o Check water levels in the Pressure Zone. o Calculate Riverside Reserve Account. o Determine whether water will be spread from Reserve Account in the coming year. o Check groundwater levels in the Forebay Area. o Check water levels in the Seven Oaks Accord wells. o Check water levels in the Riverside Agreement wells. o Review Valley District Change in Storage Calculation. o Review SBVWCD Change in Storage Calculation. o Review hydrologic index (SBVWCD Engineering Investigation). o Choose spreading amounts and locations. o Choose demand management measures. o Model spreading amounts for the year.
NOV	1) Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells. **2) <u>BTAC MEETING</u>** o Finalize/Implement Groundwater Management Plan. o Present to Valley District and Western Boards of Directors.
DEC	Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells.
JAN	Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells.
FEB	Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells.
MAR	1) Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells. **2) <u>BTAC MEETING</u>** o Review water levels and plan. o Review Valley District Change in Storage Calculation.
APRIL-SEPT.	Collect water levels from the Forebay Area, the Seven Oaks Accord wells, and the Riverside Agreement wells.

4.2.1.3.6 The Potential Impact of the Agreement on Cooperating Agencies' Ability to Beneficially Use SWP Water for Groundwater Recharge

Background

The Santa Ana Regional Water Quality Control Board (SARWQCB) is charged by statute with adopting water quality objectives as may be required to protect the beneficial uses of water within the region. In particular, the long-term conjunctive use of groundwater requires that the quality of water in groundwater basins be managed to meet the water quality objectives for nitrogen and total dissolved solids (TDS) [collectively, the "Salinity Objectives" adopted by the SARWQCB in the 1995 Water Quality Control Plan for the Santa Ana River Basin as amended in 2004 by R8 2004-0001 (Basin Plan)].

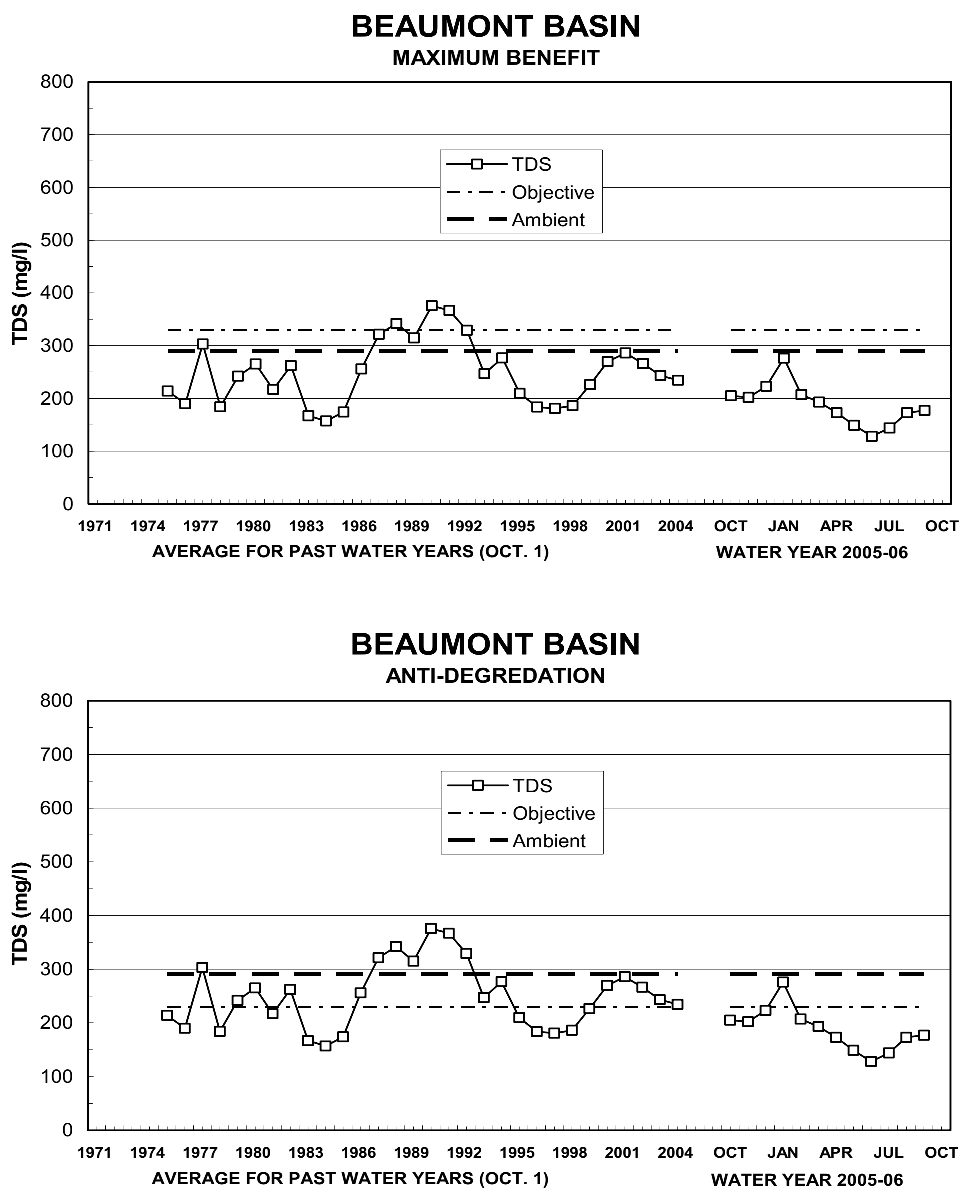
In June 2007, water entities in the Upper SAR watershed (cooperating agencies) and the SARWQCB entered into the Cooperative Agreement to "Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basins." This Agreement is intended to allow the water entities to monitor and improve water quality within the Santa Ana region in a manner that is consistent with both adopted water quality objectives and the needs of the inhabitants of the region for a reliable supply of water. Specifically, the Agreement addresses the use of imported water for groundwater recharge and compliance with Basin Plan Salinity Objectives for individual groundwater management zones.

Implementation of the Agreement could prevent the groundwater recharge of SWP water in some groundwater basins when TDS of imported water is too high. The purpose of this section is to evaluate the potential impact of this draft Agreement on cooperating agencies' ability to beneficially use SWP water for groundwater recharge. The analysis below qualitatively estimates potential impacts. Actual conjunctive use operations and potential impact of the Agreement will be based on annual monitoring and preparation of the Triennial Water Quality Report as required by the Agreement.

Potential Impact

To estimate the potential impact of the Agreement on use of SWP for recharge, TDS and nitrate of SWP water is compared with the TDS and nitrate of the groundwater management zones. Figures 4-13 through 4-16 compare Basin Plan Salinity Objectives to SWP annual TDS levels. For this analysis, it is assumed that SWP water can be utilized for recharging groundwater basins when the level of TDS or nitrate nitrogen of SWP water is equal to or less than the ambient level of a specific groundwater management zone. In other words, this analysis enables us to understand when and to what extent SWP water can be used for groundwater recharge without treatment in any of the six groundwater management zones with the limited available data.

Figure 4-13

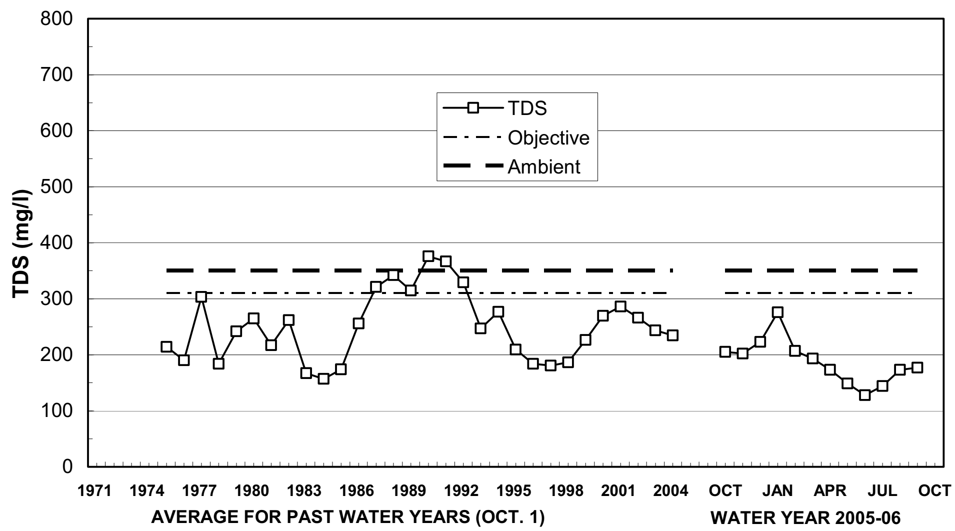


HISTORICAL TDS FOR EAST BRANCH AT SILVERWOOD LAKE AND BASIN OBJECTIVES

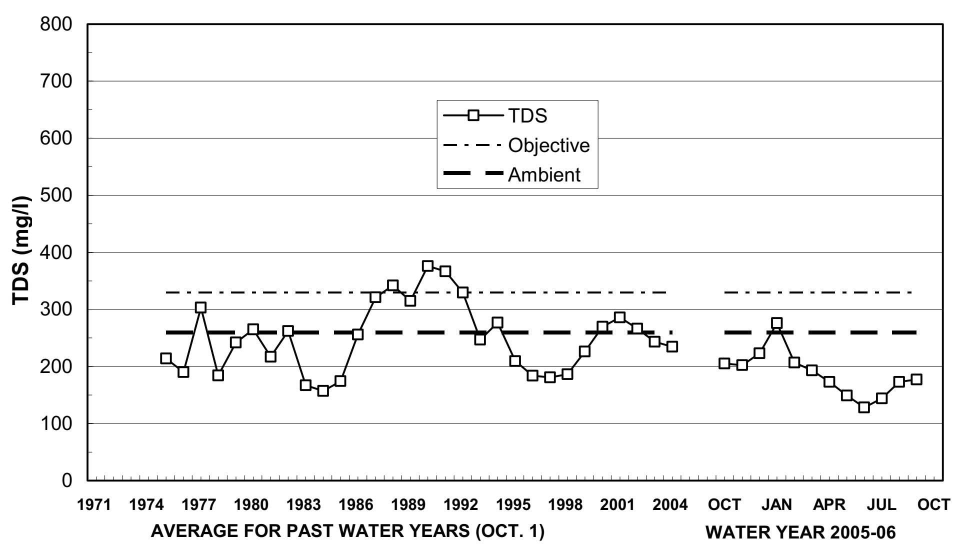
GEI / B-E AUGUST 2007

Figure 4-14

BUNKER HILL BASIN - A



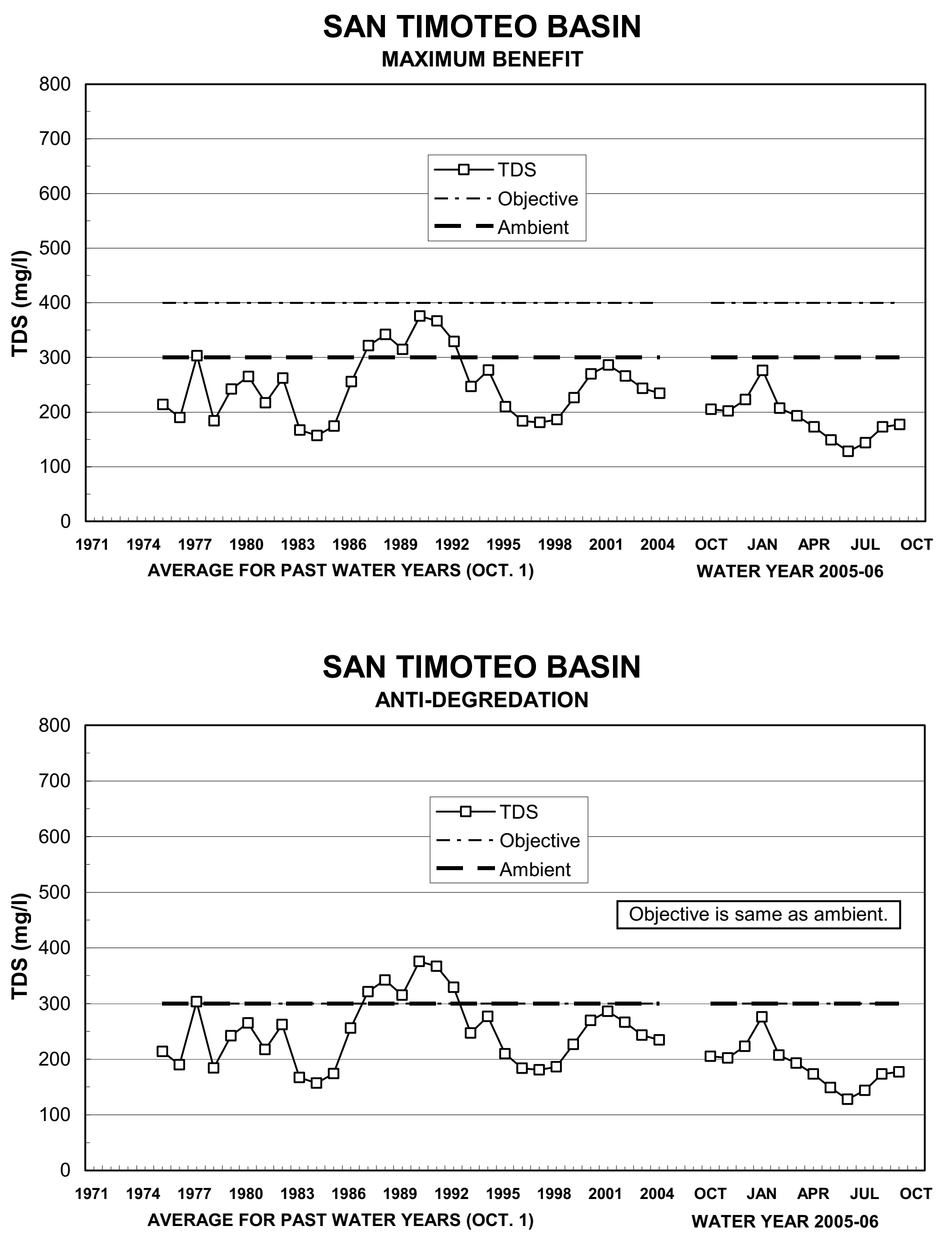
BUNKER HILL BASIN - B



HISTORICAL TDS FOR EAST BRANCH AT SILVERWOOD LAKE AND BASIN OBJECTIVES

GEI / B-E AUGUST 2007

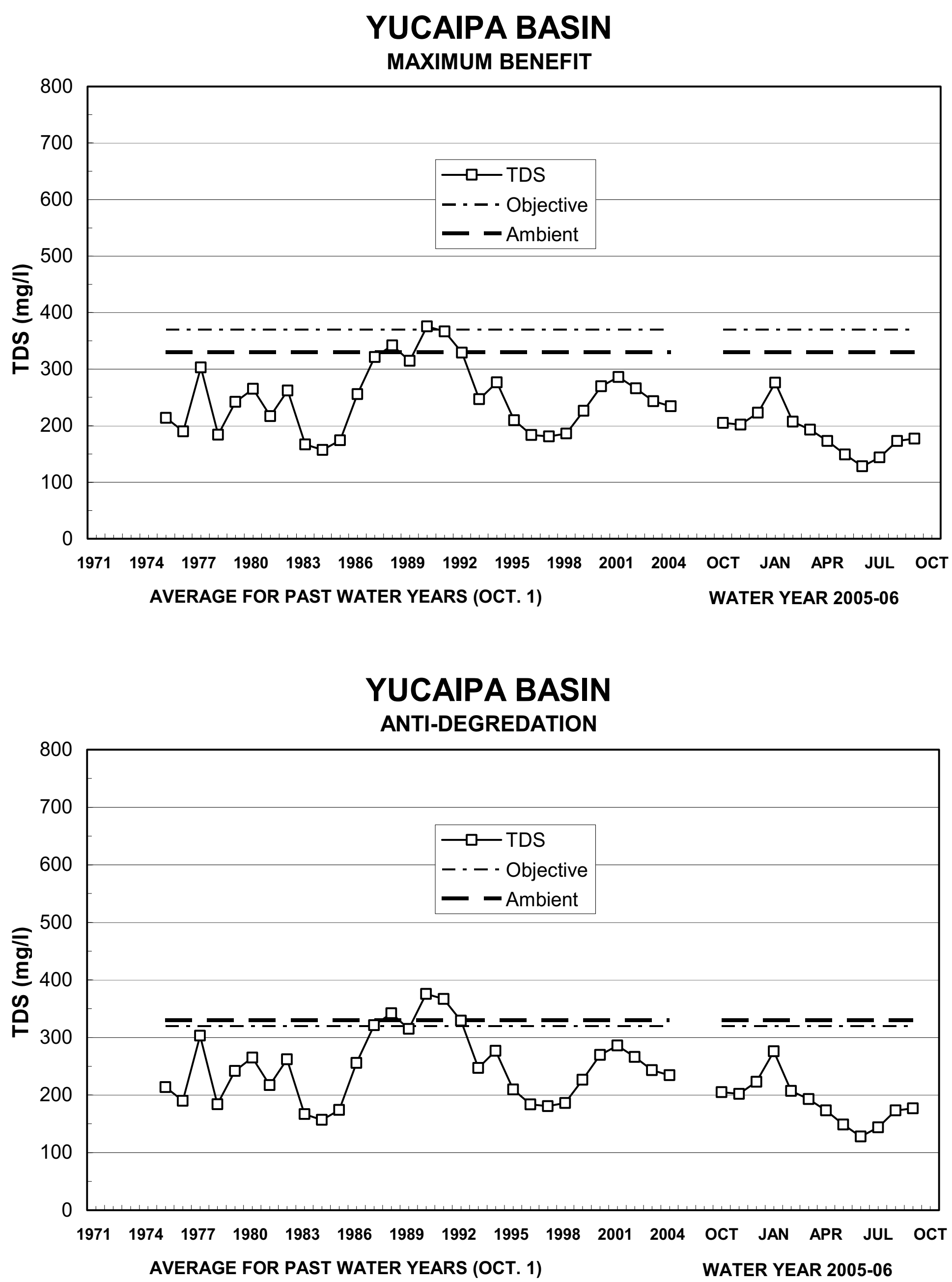
Figure 4-15



HISTORICAL TDS FOR EAST BRANCH AT SILVERWOOD LAKE AND BASIN OBJECTIVES

GEI / B-E AUGUST 2007

Figure 4-16



HISTORICAL TDS FOR EAST BRANCH AT SILVERWOOD LAKE AND BASIN OBJECTIVES

GEI / B-E — AUGUST 2007

The Basin Plan delineates six groundwater management zones in the San Bernardino Valley and Yucaipa/Beaumont Plains: Bunker Hill – A, Bunker Hill – B, Lytle, San Timoteo, Yucaipa, and Beaumont. For each groundwater management zone, TDS and nitrogen nitrate Water Quality Objectives, ambient water quality, and estimated assimilative capacities are defined. [Basin Plan (Tables 5-3 and 5-4)].

Untreated SWP East Branch water quality data (TDS and nitrogen nitrate) are available from 1975 through 2005. The data are collected by Metropolitan at the Devil Canyon Afterbay Turnout. Ambient TDS and nitrogen nitrate data are available for the six groundwater management zones.

A review of historic yearly and monthly SWP water quality information indicates that the level of nitrogen-nitrate found in SWP water does not limit or otherwise control the ability to use SWP water to recharge any of the six groundwater management zones since the highest recorded nitrogen level found in SWP water is less than the lowest ambient level found in all six groundwater management zones. The Beaumont Groundwater Management Zone has the *lowest* measured ambient nitrogen nitrate level at 2.6 mg/L. This is substantially higher than the highest recorded nitrogen nitrate level of 0.7mg/L measured in SWP water.

Although nitrogen nitrate is not expected to impact the ability to use SWP water, the level of TDS in SWP water could limit the use of the water for groundwater recharge.

Figures 4-13 through 4-16 compare yearly SWP water TDS levels (for the period 1975 through October 2006) with 2004 ambient basin conditions. The analysis of yearly data reveals that during some dry-year and multiple dry-year periods, all basins, to varying degrees, would exceed the TDS limits set by the RWQCB. Likewise, the analysis of monthly data reveals that all basins, to varying degrees, could exceed the TDS limits during summer and fall months. The two basins that could exceed the limits the most are the Bunker Hill Basin – B and Lytle Basin. Bunker Hill Basin - A would exceed the TDS limits only in limited conditions such as a period similar to 1990 to 1992.

4.2.1.3.7 Findings and Recommendations

Findings

Review of Figures 4-13 through 4-16 indicates the following:

- The basins exceed the TDS limits during dry, or drought, periods. During the 1975 to 2004 period, SWP water TDS exceeded the ambient TDS in 1977 and during the 1987 to 1992 drought period or about 23 percent of the study period. These are the dry years when SWP deliveries typically are substantially cut. Computer modeling indicates that the SWP can deliver only four percent of its Table A amount in a drought year such as 1977. In a drought period such as 1987 to 1992, the SWP reliability is about 46 percent. Assuming that the limited amount of SWP water available during drought periods could be used by direct delivery, there may be little impact to groundwater recharge operations.

- During the late summer and fall months of some years, TDS of the SWP water may exceed the TDS limits.

Recommendations

1. Since, historically, the TDS of SWP water rarely exceeds the TDS limits, the region may want to consider suggesting that the RWQCB allow the region to maintain a "salt account" for the basins. When the TDS of SWP water is lower than the limit, a credit would be given. When the TDS of SWP water is higher than the limit, a debit would be taken. As long as the balance of the account is greater than, or equal to, zero, no mitigation would be required. If the account were to fall below zero, the region would have to implement some sort of mitigation measures to get the account back to a positive balance.

2. The SWP contractors in the region could attempt to use the SWP water for recharge in the winter, spring, and early summer months when the TDS is its lowest and try to maximize direct deliveries in late summer and fall when TDS is the highest.

The above recommendation strategies will considerably limit the impacts of implementation of the cooperative agreement on conjunctive use and groundwater recharge in the region. The above strategies will be implemented and their effectiveness will be examined periodically. There may be times in the future that SWP supplies must be used for groundwater recharge with the likelihood of significant degradation from TDS, and there may also be impacts to wastewater treatment plants. In such cases, other strategies such as desalting plants should be evaluated.

4.2.1.3.8 Facilities Needed for Dewatering the Pressure Zone

This evaluation was conducted to determine if additional pumping and conveyance facilities are needed to dewater the SBBA Pressure Zone in extreme wet years to avoid risk of liquefaction in the area. Liquefaction typically occurs in recent (Holocene to late Pleistocene) deposits of silt, sand, and gravel. Most liquefaction occurs where the depth to groundwater is less than 50 feet; this depth is traditionally considered adequate for most investigations of liquefaction potential (Martin and Lew 1999). For purposes of this investigation, areas with depth to groundwater of less than 50 feet in the Pressure Zone were evaluated. Groundwater model runs were conducted for this evaluation.

Areas where depth to groundwater was less than or equal to 50 feet below the land surface were delineated using the groundwater model results from Baseline Run 1. Annual potential liquefaction area as a percentage of the Pressure Zone area ranges from zero in a dry year (hydrologic year 1992) to 6.0 percent in a wet year (hydrologic year 1986), with an annual average of 2.3 percent. The area with potential for liquefaction in a wet year such as 1986 (year with the greatest potential liquefaction area) was mapped. This area is located in the eastern portion of the Pressure Zone near the Santa Ana River and City Creek areas, and is away from the City of San Bernardino. Therefore, potential liquefaction, even in the extreme wet years, is considered minimal.

During the model simulation period from 2006 through 2044, groundwater pumping from the Pressure Zone area was assumed to be 117,434 acre-feet in year 2010 to 149,717 acre-feet in 2044, with an annual average of 133,959 acre-feet per year. The greatest historical pumping from the Pressure Zone was 141,892 acre-feet in year 2000. A review of existing operational production wells and apparatus in the Pressure Zone indicates that the sum of the instantaneous pumping rate in the Pressure Zone is 180,526 gallons per minute (gpm). Assuming these wells can pump 70 percent of their instantaneous pumping rates, they would yield 184,000 acre-feet per year. This amount is significantly higher than the historic pumping and the pumping assumed for Baseline Run 1. Therefore, it can be concluded that there are enough existing wells and apparatus in the Pressure Zone to control the water levels given the conditions assumed for Baseline Run 1.

4.2.1.4 Surface Water Management Strategies and Projects

Improving surface water management will significantly contribute to the sustainability of water resources in the region. Management of surface water resources includes strategies such as use of SAR conservation water, use of water from the local streams, and flood and stormwater management. Integration of flood and stormwater management strategies with recharge and conjunctive use opportunities contributes to surface water and groundwater management as well as water supply reliability in the region as discussed below.

4.2.1.4.1 Local Surface Water Management

This strategy outlines the use of local surface water from the SAR and tributaries such as Mill Creek. Completion of the Seven Oaks Dam on the SAR provided the opportunity for Valley District and Western to jointly file two applications with the SWRCB to appropriate water from the SAR. The applications seek the right to divert up to 200,000 acre-feet per year of local water to help improve the water supply reliability of the region. In support of water right applications and associated facilities, Valley District and Western have prepared and completed an environmental documentation for the project. Seven Oaks Dam is a flood control structure with limited carryover storage. Because the SAR hydrology is highly variable, the available water will vary in any year from zero to 200,000 acre-feet. Therefore, efficient use of SAR water will require conjunctive management and groundwater banking in the region. Other possible uses of the SAR water include direct delivery and exchange with outside agencies. The use of seasonal storage at the Seven Oaks Dam will not affect flood protection provided by the facilities to downstream communities.

Valley District, Western, and City of Riverside financed the costs of feasibility studies, design, and construction of improvements to the Seven Oaks Dam to allow conservation storage. Implementation of conservation storage projects, which include modification of the intake structure and relocation of the access road, would require compliance with the National Environmental Policy Act in order to evaluate any potential impact of proposed conservation pool on the USFS lands.

To implement this strategy, existing facilities would be used, to the extent possible, to divert and convey newly appropriated water from the SAR. However, additional facilities are needed to connect existing facilities to diversion facilities and recharge areas so that supplemental water supplies can efficiently be used in the region. New project-related facilities will be constructed in four construction areas, as described below.

The SAR. Water diverted from the SAR should be conveyed to areas of use. Additional facilities will be needed to connect diversion points to the existing facilities. Most of the water diverted from the SAR would be conveyed through the proposed Plunge Pool Pipeline, Low Flow Connector Pipeline, or the Morton Canyon Connector II Pipeline. The Plunge Pool Pipeline will connect the SAR to Valley District's Foothill Pipeline and then to the Metropolitan's Inland Feeder Pipeline in the next phases of the project.

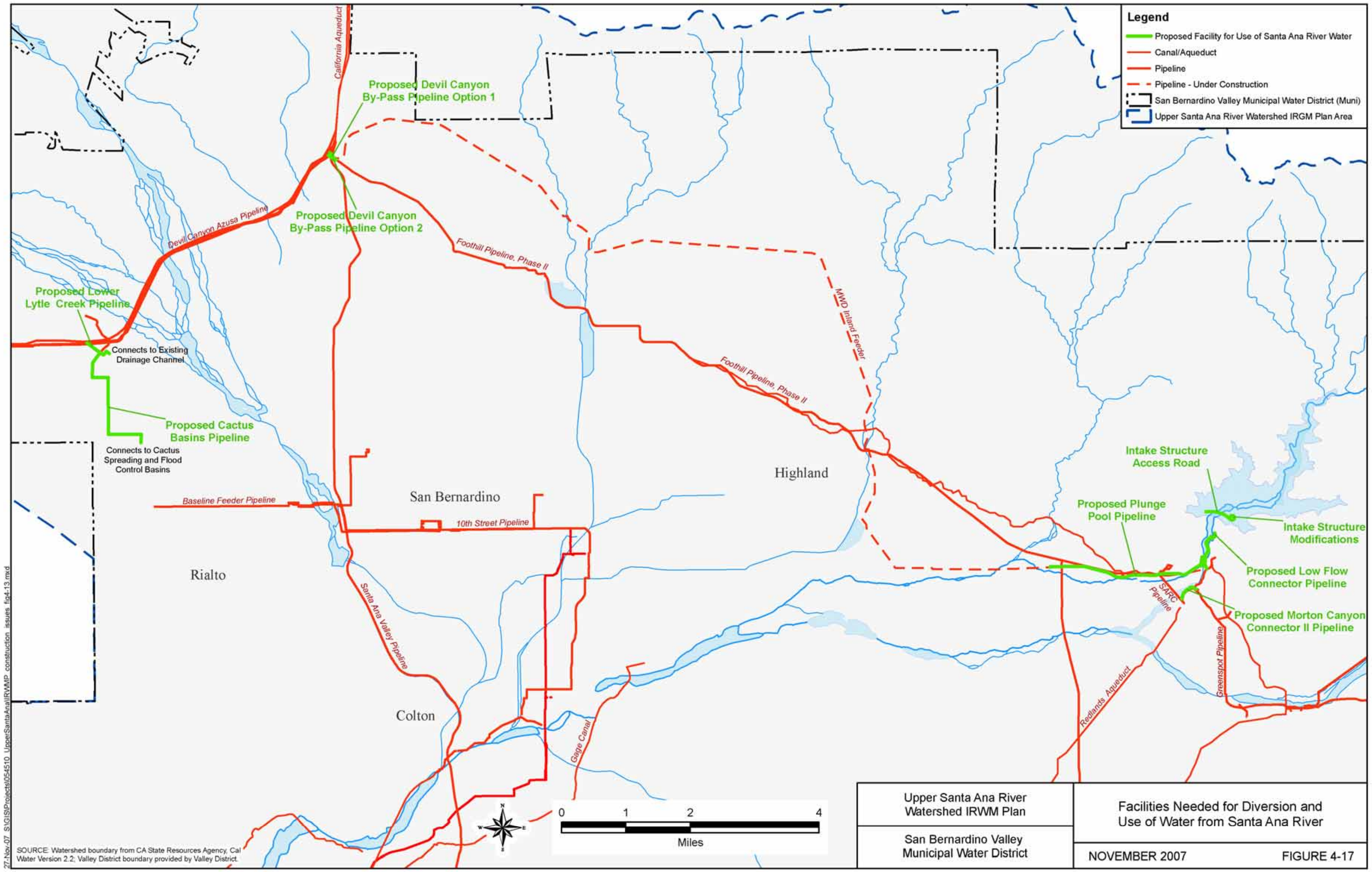
The Devil Canyon. The SAR water conveyed by Valley District's Foothill Pipeline will enter the Devil Canyon Bypass Pipeline. This pipeline will connect to both the Lytle Pipeline and the California Aqueduct.

The Lytle Creek. The SAR water conveyed through the Lytle Pipeline will reach Lytle Creek basins. The water could also be conveyed to West Valley and FWC water treatment facilities, as well as to the Cactus Spreading and Flood Control Basins through the Cactus Basin Pipeline.

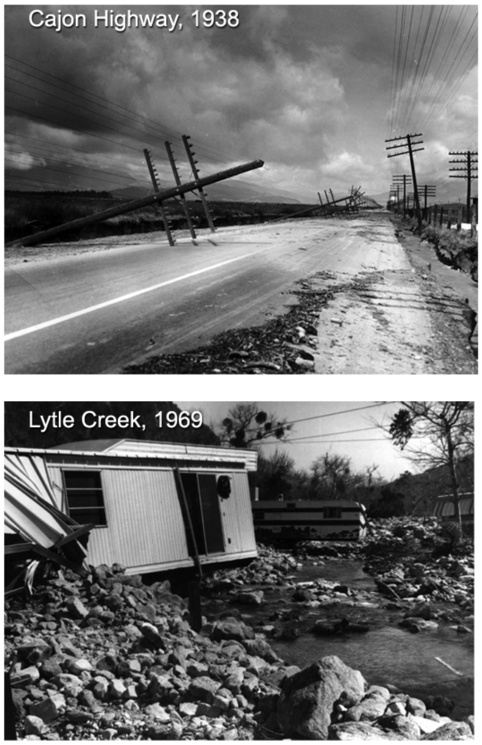
The Seven Oaks Dam and Reservoir. The specific facilities in this area include modification of the intake structure of the Seven Oaks Dam and relocation of the access road serving the intake structure. Modification of the intake structure is needed to allow for proper regulation of the flood flows. A Technical Feasibility Study for these facilities is underway. It appears that the above modifications can marginally increase the yield of the SAR. The feasibility study is intended to show the benefit-cost ratio of these facilities.

The facilities listed above will make possible conveyance of water from the Seven Oaks Dam to groundwater spreading grounds and the water treatment facilities in the region. Figure 4-17 shows the location of the construction areas and the proposed facilities for the use of native water in the region. Detailed descriptions of the facilities can be found in Appendix E.

Figure 4-17
Proposed Facilities for the Use of Santa Ana River Water



4.2.1.4.2 Flood and Stormwater Management Strategies



It is critical to explore strategies to improve flood protection and manage stormwater. (Photos courtesy of the San Bernardino County Museum.)

Historically, the SAR Wash was a natural floodplain and alluvial fan that provided a place to convey frequent devastating flood waters and to deposit sediment. The alluvial deposit provided excellent conditions for establishing settling basins for percolating surface water to the groundwater basin, providing a significant source of water supply for the Upper SAR watershed. Substantial new commercial and residential development has occurred in the region and significant additional development is forecasted for the Upper SAR watershed. In anticipation of this development and the potential loss of open space and increase in impervious surfaces such as roads and buildings that accompany such development, it is critical to explore strategies to improve flood protection and manage stormwater. Flood and stormwater management strategies are designed to:

- Reduce peak flood flow in the streams,
- Improve groundwater recharge within the channel,
- Provide additional recharge through improvement of the detention basins, and
- Increase channel capacities of stormwater management facilities to safely convey stormwater.

The stormwater strategies can reduce flood damage, increase groundwater recharge and water supply, and improve water quality of the streams by reducing discharge of debris, sediment, and urban pollutants to the streams. The San Bernardino County Flood Control District (SBCFCD) operates and maintains a system of channels and detention basins to manage stormwater throughout the region. SBCFCD's objective is to provide 100-year flood protection for the communities in the region. Significant improvements to the regional facilities are needed to ensure the flood control system can provide 100-year protection today and in the future as additional development occurs in the area.

Two types of strategies have been formulated to address the flood and stormwater management issues of the Upper SAR watershed.

Strategies to Reduce Flood Flows in the SAR and Tributaries

Construction of the Seven Oaks Dam contributes significantly to management and control of flood flows in the SAR. Additional facilities are planned for diversion and conveyance of the flows to spreading grounds. Construction of these facilities and improvement of the spreading grounds to accept additional flood flows are considered the next step for reducing flood flows downstream. The facilities required to implement this strategy are described in Section 4.2.1.5.1.

Strategies for Management of Stormwater

Stormwater management strategies consist of programs to improve and expand the detention basins and improve the flood control channels.

SBCFCD plans and designs the improvements needed for flood detention facilities. These improvements include excavation and removal of the sediment from the existing basins, expansion of the existing basins, and design and construction of new retention basins. The objective is to increase the holding capacity of the basins in order to increase recharge and reduce peak flood flows downstream. Projects to achieve this objective include Randall Basin Project; Cactus Basins 3, 4, and 5; and Cable Creek Debris Basin.

SBCFCD plans to improve flood control channels to increase channel capacity, increase opportunities for recharge, and maintain the integrity of the system. These improvements include channel enlargement, channel works, and channel lining. Projects formulated under this strategy include Sand/Warm Confluence and Upper Warm Channel. Other channel improvement projects are planned in the Upper SAR watershed area, but they do not have the multiple benefits expected from the Sand/Warm Confluence and Upper Warm Creek project since they would be concrete-lined conveyance systems.

SBCFCD is also developing plans to certify and potentially improve flood control levees in order to maintain the integrity of the system. These improvements include hard lining, rebuilding, lengthening, and repairing levee facilities. Projects are currently being formulated in conjunction with the Federal Emergency Management Agency (FEMA) certification effort.

A detailed description of the stormwater management projects is presented in Appendix E.

4.2.1.5 Imported Supplies

State Water Project water is treated and distributed to some urban areas in the Upper Santa Ana Region.

Imported supplies to the region include the SWP supply. Imported water is delivered directly or through Metropolitan. Western receives SWP supplies through Metropolitan. San Gorgonio Pass Water Agency (SGPWA) has a “Table A” allotment of 17,300 acre-feet, and Valley District has a SWP “Table A” allotment of 102,600 acre-feet per year. Reliability of the SWP supplies varies considerably from about 5 percent to 100 percent depending on the water-year type. To evaluate the SWP water supply reliability, the SWP Delivery Reliability Report (Public Review Draft, November 15, 2005) was reviewed. The report presents the results of five operational studies that simulate the SWP operations under 2003 and 2025 water demand scenarios. For the purpose of this water supply reliability discussion, the updated study with 2025 level of demand is used (Study 5). These studies were conducted specifically to document the SWP delivery reliability. SWP water supply available to Valley District for direct delivery and recharge for each year was calculated based on reliability values presented in Study 5. On average, SWP water supply reliability is presented as 77 percent of the Table A allotment to as low as 4 percent. However, SWP delivery may vary from full Table A allotment. For example, the Valley District Table A delivery capability may vary from 102,600 acre-feet in wet years to 5,100 acre-feet in dry years, such as 1997.

As mentioned earlier, to improve water supply reliability, Valley District is planning for conjunctive management of groundwater as well as banking of SWP supplies when available. Strategies for the use of Valley District’s SWP supplies include direct delivery of SWP water to water treatment facilities and use of water for groundwater recharge.

A key to improving long-term water supply reliability is for all SWP contractors in the region to fully utilize their SWP supplies when available and store or bank to build reserves for drought periods. Facilities required for the use of SWP water include additional conveyance to water treatment facilities in the region.

As a component of the water supply reliability study, Valley District is also conducting sensitivity analyses for SWP and local surface water supply reliability. The analyses include:

- SWP reliability of 60 percent and 50 percent of Table A allotment (instead of 77 percent).

- SAR flows of 90 percent of long-term average flows.

Modeling studies were conducted to document the potential impacts of reduced SWP and local supply reliability on groundwater levels. The purpose of the sensitivity analyses was to provide general information to water managers as to the potential impacts of hydrologic (climate change) and operational changes in water supply facilities on the region's water supply reliability.

Major regional conveyance facilities connect purveyors' water supply systems.

4.2.1.5.1 Conveyance, Storage, and Emergency Interties

Conveyance, storage, and interties are essential elements of water supply reliability. Conveyance strategies are needed to convey the water supply to the place of use. Storage feasibilities provide operational flexibility for daily and seasonal operation of the water system. Interties are essential to providing for system redundancy and emergency operations. The elements of conveyance, storage, and intertie strategies include the following:

- **Regional conveyance facilities** are major pipelines, pump stations and turnouts, and associated facilities critical to water supply reliability of water purveyors in the region. A number of additional conveyance facilities are planned for the region, including Central Feeder Pipeline Phase 2, City Creek Crossing, Riverside Corona Feeder, associated pumping stations, and Waterman Pump Station.

- **Interties** are planned to improve supply reliability through integration of water supply and distribution systems and to have conveyance redundancy for water supply during major catastrophic failure of a conveyance system. Planned interties include Raub Emergency Supply Intertie and Waterman-Gage Intertie.

Storage reservoirs regulate water production and distribution while providing emergency storage for the communities.

Storage facilities are planned for seasonal and operational storage and system flexibility and to provide water during emergencies and major disasters. Planned storage projects include:

- San Bernardino Reservoir
- Citrus Reservoir (Mentone Reservoir)
- Sunrise Ranch Emergency Reservoir
- Zanja Emergency Storage
- Redlands Reservoir

4.2.1.6 Performance Evaluation of Water Supply Reliability Strategies

This section evaluates the performance of the water supply reliability strategies (when implemented) in improving the region's water supply reliability. In evaluating performance of the water supply reliability strategies, criteria established for development of the UWMP have been considered. These criteria, listed below, are intended to be used to examine the performance of water supply reliability strategies and to ensure water supply needs of the region are met:.

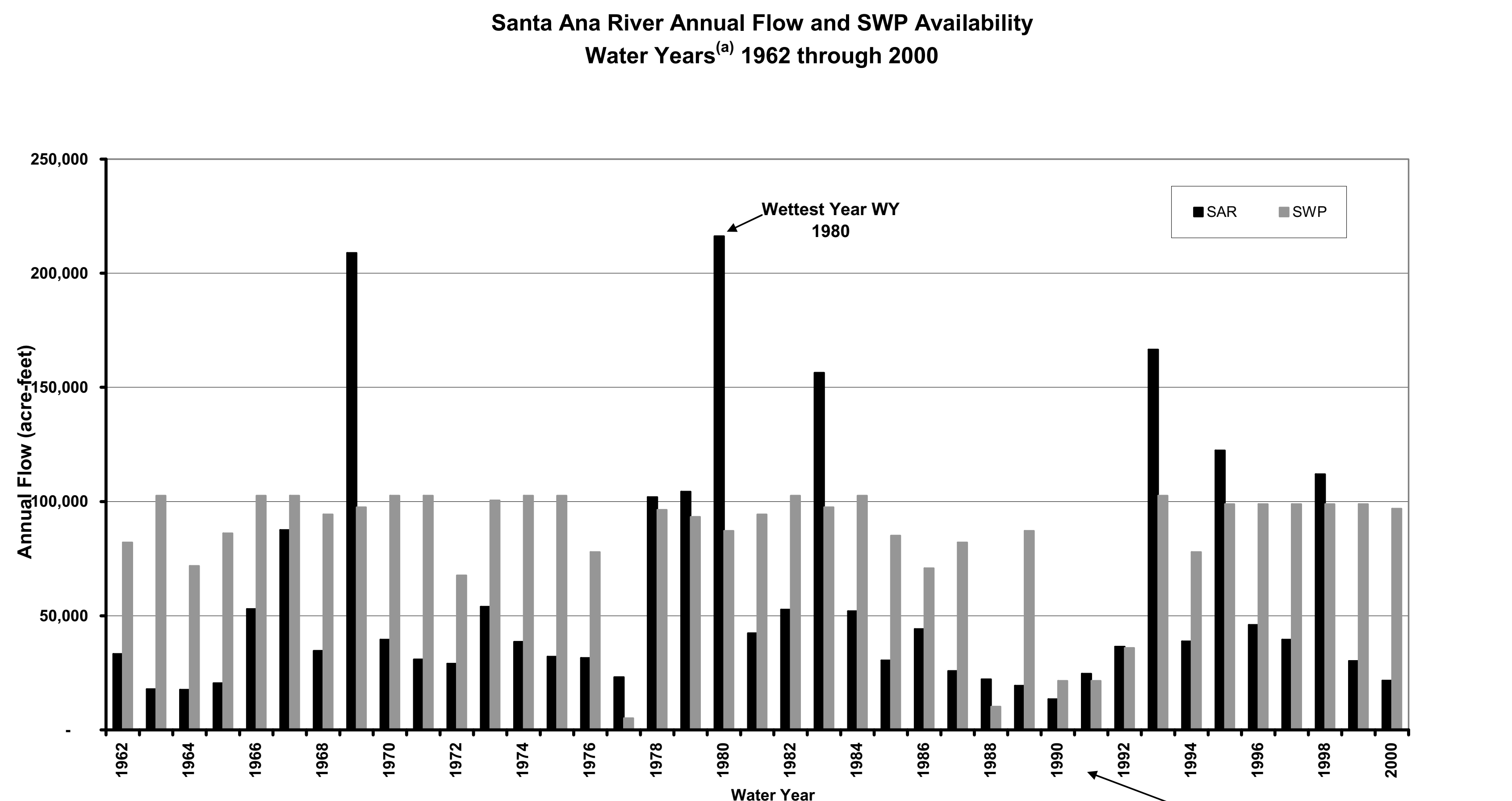
- Meeting average water year for the next 25 years,
- Meeting water needs during a single-year drought,
- Meeting water needs during a multi-year drought,
- Water shortage (up to 50 percent loss) contingency plan, and
- Catastrophic interruption in water supplies.

In addition to the above criteria, meeting peak demand water needs of the local purveyors within the Valley District service area may also be evaluated. Valley District initiated a study to review and evaluate how the above requirements can be met within the region. Below is a summary discussion to demonstrate how the region will meet its water needs as characterized above during the next 25 yearss.

As stated earlier, SAR flows are highly variable. Figure 4-18 shows the annual flows of the river from 1962 through 2000 and its range from over 200,000 acre-feet per year in 1980 to less than 15,000 acre-feet per year in 1992. The Seven Oaks Dam is operated as a flood control facility. Therefore, timely capture and use of SAR flows for recharge of the groundwater basin would provide significant water supply reliability benefits.

Chapter 3 presents the water budget for the region through 2030. The water budget assumed that SAR and SWP water will be used conjunctively with existing supplies used by the purveyors. Modeling studies were conducted for the water budget (base scenario) to examine how the water demand can be met using the SBBA as a reservoir to store, bank, and regulate the water resources of the region. The results of the modeling indicate the following:

Figure 4-18
Santa Ana River Annual Flow and SWP Availability



(a) - Water years start on October 1st and run through September 30th of the following year and are designated by the latter year
SAR - Santa Ana River flows are based on the Combined Gage at Mentone (11051501) (Prepared for Santa Ana River Water Rights Hearings)
SWP - SBVMWD SWP Reliability based on DWR 2005 SWP Reliability Report Study 5

Note: Graph prepared for Valley District/Western Water Rights Applications Hearings

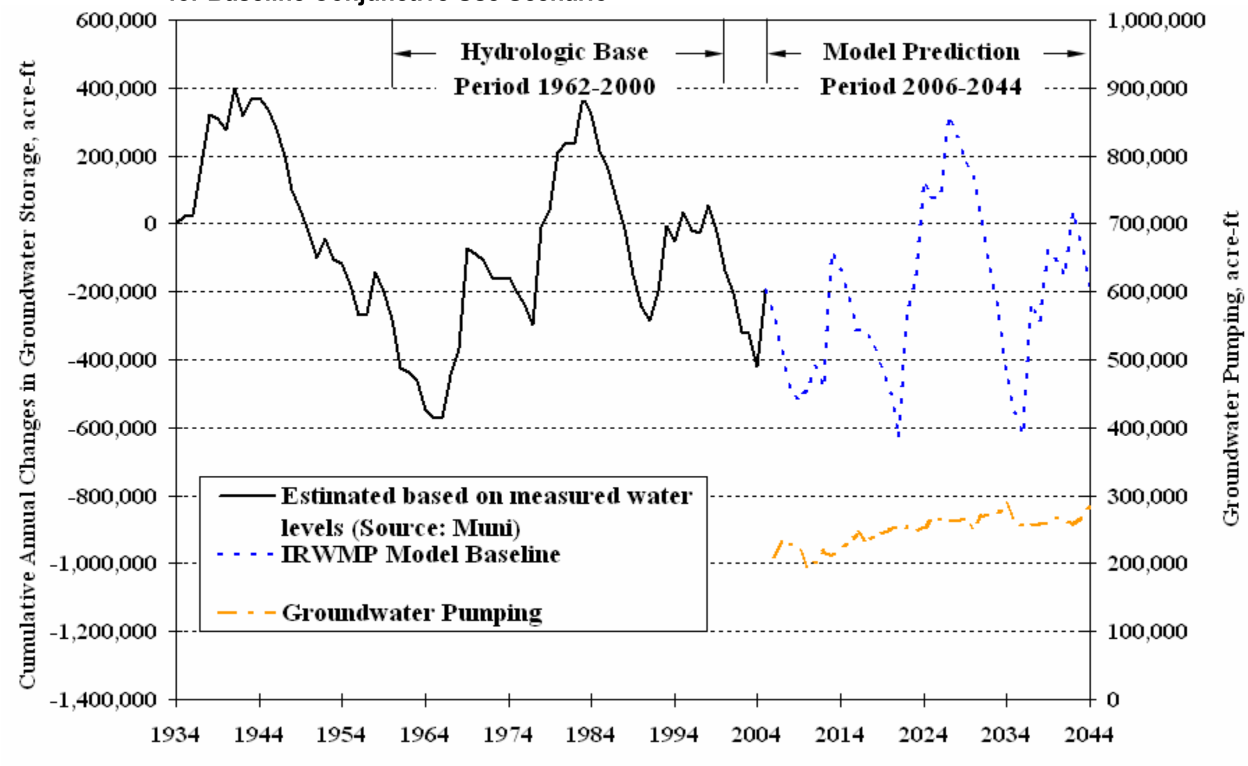
- **Average Year**: Modeling studies assumed that the SAR conservation water will be available to the region (Water Right Applications will be approved by the SWRCB), and SWP water supply reliability is as defined by DWR studies. Under the baseline conjunctive use operation scenario and water demand through 2030, the groundwater storage at the beginning and end of the 39-year study period was 200,000 acre-feet below the full basin (for this discussion, full basin is defined as storage at the 1993 level). This means on average the existing water supply is adequate to meet the demand in the region during the next 20 years, assuming published SWP reliability of 77 percent and that there will not be any long-term depletion of storage in the SBBA. This study was conducted for the Valley District service area and does not include the SGPWA service area, which will have a shortage in 2030.

- **Multi-Year Drought Period**: The modeling studies mimic the 1962 to 2000 period. The period of 1987 to 1992 is the driest recorded period for the SAR. During this period, maximum draw down of the SBBA occurred at approximately 600,000 acre-feet (see Figure 4-19). However, the storage in the basin recovered after the drought period (by 2000). The storage reduction during the multi-year drought period is approximately 10 percent of total groundwater storage.

- **Single-Year Drought**: The driest year of the period was 1992, which coincides with the last year of the multi-year drought period. The cumulative storage change in 1992 was about 600,000 acre-feet. Considering that SBBA storage is over 5 million acre-feet and the water levels recovered by the year 2000, the region can meet its water demand during the single-year drought as well as the multi-year drought period.

It should be mentioned that the modeling studies assumed that the newly conserved SAR water will be available for use and banking in the region (water rights applications are approved by the SWRCB). In order to take advantage of new SAR water, the facilities listed in Section 4.2.1.4.1 should be prioritized and implemented based on cost-effectiveness. This plan also assumes the current water quality problems at Seven Oaks Dam will be resolved by United States Army Corps of Engineers (USACE).

Figure 4-19
Cumulative Annual Changes in Groundwater Storage for Baseline Conjunctive Use Scenario



4.2.1.6.1 Water Shortage Contingency Plan

The water shortage contingency plan provides a framework for implementing specific measures to deal with water shortages during emergencies. A water shortage contingency plan has been drafted for the region and should be adopted and implemented during severe water shortages. The plan provides specific actions that should be taken to ensure critical water needs of the region are met during a period in which water supplies are cut by 50 percent. A copy of the plan is presented in Appendix F.

4.2.1.6.2 Meeting Daily Peak Demands of Water Purveyors

This section examines the Valley District's ability to deliver water to meet the purveyors' service area peak day demand on SWP supplies. The purpose of this evaluation is to determine the adequacy of the conveyance capacity of Valley District's facilities to make direct deliveries of SWP water during peak demand, today and in the future.

Valley District direct deliveries are to surface water treatment plants that were generally built to treat local surface water and for artificial recharge. The District deliveries are required when local surface water supplies are insufficient.

The peak day water demands for the following purveyors are examined by review of their UWMP:

- City of San Bernardino
- City of Redlands
- City of Rialto
- East Valley Water District
- West Valley Water District
- Yucaipa Valley Water District
- Fontana Water Company

Purveyors may have multiple sources of water to meet their peak demands. Groundwater supplies are generally used by the purveyors in the region to augment other sources of water. After discussion with agencies' staff and review of their UWMP data, Table 4-5 was prepared to show the future peak day demand on SWP supplies and the use of Valley District facilities.

In general, it is assumed for this analysis that there are no local surface water supplies available to meet peak demands. This is a conservative but reasonable assumption, since in some dry years local surface water may be severely limited on summer days; therefore, it is reasonable to examine peak day demands on the facilities when local surface water is not available. It is also assumed that SGPWA is obtaining its full Table A amount. Based on this cursory examination, all turnouts have adequate capacity for delivery of peak day demand on SWP water. The following Valley District's Pipelines, and pumping plants may be undersized for the future peak demands; however, the proposed East Branch Extension Phase II would alleviate all of these undersized facilities. It would provide parallel conveyance to the SARC Pipeline, Greenspot Pump Station, and Morton Canyon Connector I. It includes an annex to the Crafton Hills Pump Station that would contain three new 25 cfs pumps.

- If it is assumed that all Purveyors peak day demands coincide, the SARC Pipeline has a total future peak day demand of 144 cfs. Delivery to spreading grounds for the City of San Bernardino is 15 cfs, which can be interrupted and rescheduled for when peak day demands on the pipeline do not exceed its capacity. SARC has a capacity of 72 cfs

- The Greenspot Pump Station has a future peak day demand of 100 cfs under these assumptions. It has a current capacity of 80 cfs.
- The Morton Canyon Connector has a future peak day demand of 100 cfs under these assumptions. It has a current capacity of 70 cfs.
- The Greenspot Pipeline has a future peak day demand of 100 cfs under these assumptions. It has a current capacity of 70 cfs.
- The Crafton Hills Pump Station has a future peak day demand of 77 cfs. It has a current capacity of 135 cfs.

A more detailed discussion of meeting peak day water demands of the purveyors is presented in Appendix F.

Table 4-5
Future Peak Day SWP Demand for SBVMWD

		Peak Day SWP Demand(cubic-feet per second)												
		SWP East Branch Extension												
Delivery Point (Turnout)	**Turnout Capacity**	**Foothill Pipeline**	**SARC Pipeline**	**Greenspot Pump Station**	**Morton Canyon Connector**	**Greenspot Pipeline**	**Crafton Hills PS**	**Crafton Hills Reservoir**	**EBX Reach 1 Pipeline**	**EBX Reach 2 Pipeline**	**EBX Reach 3 Pipeline**	**Tate Pump Station**	**Yucaipa Pipeline**	**Devil Canyon - Azusa Pipeline**
City of San Bernardino (Sweetwater (16 in) and Waterman (30 in) Spreading Ground Turnouts)	35 cfs and 135 cfs, respectively	15.0												
East Valley WTP (Northfork Turnout (two 12in), City Creek (20in) Turnout (alternate))	16 cfs and 65 cfs, respectively	12.4	12.4											
Bear Valley - Northfork Irrigation (Northfork Turnout	16 cfs	4.0	4.0											
Mentone Reservoir (SARC – Bear Valley Sandbox Turnout)		6.0	6.0											
City of Redlands - Hinckley WTP (SARC – Bear Valley Sandbox (two parallel 30 in) Turnout)	40 cfs	21.7	21.7											
Bear Valley Highline (Bear Valley Highline Connector and/or Bear Valley Highline – Bouillioun Box Turnout)	20 cfs	4.0	4.0	4.0	4.0	4.0								
Greenspot Grove (Bear Valley #1 Turnout, _ cfs)	6 cfs	1.5	1.5	1.5	1.5	1.5								
Crafton Water Company (Crafton - Unger Turnout) (20 in)	25 cfs	6.0	6.0	6.0	6.0									
City of Redlands - Tate WTP (Tate Treatment Plant Turnout) (24 in) Tate Pump Station	32 cfs	27.9	27.9	27.9	27.9							27.9		
Yucaipa Regional Park (Yucaipa Regional Park Turnout) (8 in)	6 cfs	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5					
Yucaipa Non-potable system, untreated SWP (Yucaipa Valley Water District #1	60	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6				
Yucaipa WTP (Yucaipa Valley Water District #1 Turnout)		18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6				
San Gorgonio Pass Water Agency - Current		16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0			
San Gorgonio Pass Water Agency - Future		16.0					16.0	16.0	16.0	16.0	16.0			
West Valley Water District – Oliver P. Roemer WFF (Lytle Creek Turnout)	32 cfs													40.9
West Valley Water District - North Villages WFF (Glen Helen (30 in)	10 cfs													2.6
Fontana Water Company (Lytle Creek Turnout, 14 cfs)	14 cfs													18.7
Facility Peak Day Demand:		175.2	144.2	100.1	100.1	100.1	76.7	76.7	76.7	76.2		27.7	0.0	67.5
Facility Conveyance Capacity		288.0	72	70	70	80	135	104	104	104				110

4.2.1.7 Disaster Preparedness Strategies and Projects

This section addresses vulnerability of the region's water supply system to catastrophic events that may interrupt the water supply system in the Region. While not the only cause for catastrophic water supply interruption, the postulated Magnitude 8+ Earthquake certainly will be the predominant example in the region. Since a large magnitude earthquake is generally considered the most significant event for the region, this section concentrates on earthquake effects as the primary water supply interruption, knowing that other events would be treated similarly. Literature reviewed for this section include post-earthquake surveys of water system damage, earthquake planning reports included in purveyor's UWMPs, and available reports prepared by the State and federal agencies. Other catastrophic interruptions caused by regional power failure, terrorist attack, or other man-made or natural catastrophic event could cause similar conditions and issues to water supply systems in the region. For purposes of this report, a major earthquake is defined as an earthquake on the San Andreas Fault (SAF) on the order of 8.0.

The work conducted for this section is intended to be the fist step and is at the conceptual level. Additional detailed work should be conducted in the future to further evaluate options to effectively address water supply system vulnerabilities. Details on water supply system vulnerability can be found in Appendix F and is summarized below. Appendix F includes a discussion of the following:

- An earthquake literature search of major earthquake events and what has been learned from such events.
- Evaluation of catastrophic interruption of regional facilities.
- Vulnerabilities of the region's water supply system to SWP supply interruption.
- Vulnerably of local purveyors' systems to an earthquake.
- Summary of Findings and Recommendations including a Water Shortage Contingency Plan.
- Water Shortage contingency planning.

4.2.1.7.1 Findings and Recommendations

Findings

The region is located in a seismically active area of Southern California. Four major fault zones are found in the region, including the San Jacinto Fault, the

Chino-Corona segment of the Elsinore Fault, the Cucamonga Fault, and the SAF. Numerous other minor faults associated with these larger fault structures may also present substantial hazards.

In Southern California, the SAF runs along the southern base of the San Bernardino Mountains, crosses through Cajon Pass, and continues northwest along the northern base of the San Gabriel Mountains. Historical records indicate that massive earthquakes have occurred in the central section of the SAF in 1857 and in the northern section in 1906 (the San Francisco Earthquake). In 1857, an estimated magnitude 8+ earthquake occurred on the San Andreas Fault rupturing the ground for 200 to 275 miles, from near Cholame to Cajon Pass and possibly as far south as San Gorgonio Pass. The recurrence interval for a magnitude 8 earthquake along the total length of the fault is estimated to be between 50 and 200 years. It has been 147 years since the 1857 rupture. A study completed by Yuri Fialko (2005) suggests that the SAF in Southern California has been stressed to a level sufficient for an earthquake of magnitude 7.0 or greater.

These findings have been developed from a search of literature reporting the impacts of major earthquakes and limited work by water purveyors. More detailed, site-specific analyses are needed to better quantify and identify impacts from major earthquakes or other catastrophic outages.

- **Reliability of Groundwater Wells.** Review of post-earthquake lifeline performance reports reveals little discussion of groundwater well failure. However, loss of commercial power, damage to electrical equipment and aboveground appurtenances, or damage to the distribution system may effectively put the well out of service. Liquefaction, especially in areas where there is high groundwater levels between depths of 5 to 50 feet, may cause ground settlement and interfere with continued well operation.

  No discussion of the performance of well head treatment systems during earthquakes was found. This may be due to the limited amount of well head treatment in place during prior earthquakes. As well head treatment typically includes purchased equipment installed in a field location, there is significant opportunity for lapses in the seismic design.

  The groundwater basin and the groundwater production wells are a reliable part of the water supply system for the San Bernardino area.

- **Reliability of Pipelines**. Pipelines are generally the most fragile part of a water system. Generally, damage is a function of displacement rather than shaking. Empirical algorithms have been developed to predict seismic reliability of pipelines.

- **Reliability of Pump Stations**. Past earthquakes indicate that the structural and mechanical elements of a pump station are highly resistant to earthquake damage. The most likely failures are to the electrical equipment and loss of commercial power.

- **Reliability of Surface Water Treatment Facilities**. The major elements of a surface water treatment system are typically concrete structures that are very resistant to damage. However, these facilities include a large variety of mechanical equipment, much of it long and lightweight and subject to damage not only from the direct force of an earthquake, but also from the wave action created by the earthquake. Similar to a pump station, power supply and electrical equipment are fragile.

- **Reliability of the State Water Project**. While little specific information was found on anticipated damage to the SWP, the high susceptibility of the Santa Ana Valley Pipeline is recognized. Major vulnerability of the SWP includes the Sacramento-San Joaquin Delta and the California Aqueduct. The SWP does have a Business Resumption Plan and an Emergency Operations Plan.

- **Length of Outages.** Length of water service outages vary by earthquake and by purveyor. The Loma Prieta earthquake affected a large number of separate systems. The San Jose Water Company serves most of San Jose and all of Los Gatos. Los Gatos was hard hit and half of the water customers lost water service. In San Francisco, the worst hit area was the Marina District. Both fires and liquefaction affected the district. East Bay Municipal Water District serves 1.1 million customers and suffered $3.7 million in damage. Damage included a break in a 60-inch raw water line.

  After the Northridge earthquake, the Los Angeles Aqueducts Nos. 1 and 2 were in and out of service for temporary and permanent repairs over several months; these facilities were not critical at that time. Alternate supplies were available and drought conditions limited supply to these aqueducts.

  Valley District's Emergency Operations Plan includes estimates for repair of Valley District facilities. Electrical and pipe repairs are estimated to take 35 to 77 days. Pump repairs are estimated to take 168 to 273 days.

Table 4-6 shows how interruption in each of the Valley District facilities may impact water deliveries for the local purveyors. Interruption in

Table 4-6
Valley District Facilities Used to Deliver Water to Retail Agencies

Agency	Foothill Pipeline	SARC Pipeline	Morton Canyon Connector	Green-spot Pipeline	Green-spot Pump Station	Devil Canyon - Azusa	Tate Pump Station	Crafton Hills PS	Crafton Hills Reservoir	EBX[1] Reach 1 Pipeline	EBX Reach 2 Pipeline	Yucaipa Pipeline	Baseline Feeder
San Bernardino Municipal Water Department	✓	✓	✓	✓[2]	-	-	-	-	-	-	-	-	-
East Valley Water District	✓	✓	✓	✓[2]	-	-	-	-	-	-	-	-	-
City of Redlands – Hinckley	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-
City of Redlands – Tate	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
Bear Valley MWC - In lieu obligation and irrigation	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-
Yucaipa Valley Water District	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	-
Fontana Water Company	✓	✓	✓	✓[2]	-	✓	-	-	-	-	-	-	-
West Valley Water District	✓	✓	✓	✓[2]	-	✓	-	-	-	-	-	-	✓
City of Rialto	-	-	-	-	-	-	-	-	-	-	-	-	✓

Notes:
[1]EBX: East Branch Extension of the California Aqueduct
[2] Required only if Mill Creek water is being delivered in a westerly direction.
Valley District's conveyance system is used to implement the Santa Ana-Mill Creek Cooperative Water Project and effect deliveries of local surface water and exchanges of local surface water and State Project water.
The Devil Canyon - Azusa Pipeline is owned by San Gabriel Valley Municipal Water District. Valley District has conveyance capacity of the pipeline from Devil Canyon to the Lytle Creek area and uses this capacity to convey water to West Valley, Rialto, and Fontana. It could be used to convey local surface water if the SWP were to fail and if the legal issues were resolved.
The Baseline Feeder is used to convey groundwater to Rialto and West Valley. The groundwater is produced by the City of San Bernardino on behalf of Valley District and by Rialto for Rialto.
Valley District deliveries to San Bernardino Municipal Water Department are for recharge. Changes in recharge impact well hydrographs in six to seven months.

Foothill Pipeline, Santa Ana River Connector Pipeline, Morton Canyon Connector, and Greenspot Pipeline affect every purveyor that receives water from Valley District.

4.2.1.7.2 Recommendations for Disaster Preparedness

This section includes recommendations based on the literature review, review of the Valley District facilities, and discussions with District staff and purveyors. Some of the projects already included in the IRWM Plan that would enhance disaster preparedness have also been reviewed in this section.

General Recommendations

- Valley District should consider a Seismic Improvement Program/Water Infrastructure Reliability Project to review the adequacy of Valley District facilities to withstand an earthquake. East Bay Municipal Utilities District and Santa Clara Valley Water District (Santa Clara Valley Water District, 2005) are two agencies that have performed such studies. High priority facilities include Foothill Pipeline, Santa Ana River Connector, Morton Canyon Connector, and Greenspot Pipeline.

- Valley District should consider the opportunities that Big Bear Lake presents as an emergency source of water after an earthquake that interrupts SWP deliveries for many weeks.

- Valley District should consider using the existing MWD agreements to allow the use of Metropolitan Water District facilities to bypass failed Valley District facilities (and the reverse).

- Review the ability to provide drinking water immediately following an earthquake. Arrangements to provide bottled water may be appropriate.

- The USGS Multi-hazards Demonstration Project (MHDP) is leading an effort to create a scenario document for a future M7.8 southern San Andreas Fault earthquake. The document will describe in detail the effects of the earthquake. It will form the basis for a November 2008 statewide earthquake response exercise. This document should be reviewed when it is ready, as useful information for disaster preparedness planning will come out of this effort.

Proposed Projects to Provide Conveyance System Redundancies for the Regional Facilities

Implementation of the following projects (included in the IRWM Plan) may be of particular benefit during major disasters by providing redundancies for the conveyance system.

Project 12 - Central Feeder Pipeline

The Central Feeder System, including projects 12.1 through 12.7, provides the ability to convey Bunker Hill Basin groundwater to purveyors. This project is particularly important because it provides redundancy for the Foothill Pipeline.

Project 36 - West End Pump Station

By conveying Bunker Hill Basin groundwater to the west, provides redundancy to the Baseline Feeder West Extension and the Lytle Creek Pipeline.

Foundation for the Redlands Pump Station which will deliver water into the Central Feeder, Phase 1 Pipeline.

Project 37 - 9th Street Feeder

This project conveys Bunker Hill Basin groundwater as an alternative water supply to East Valley.

Project 39.1 - Mentone Pipeline

Mentone Pipeline may be constructed as the East Branch Extension Phase II to provide additional conveyance capacity to the east—YVWD and SGPWA.

Project 54 - Bunker Hill Regional Water Supply

This project improves the ability to produce groundwater and place that groundwater into regional transmission systems.

Project 57 - Bunker Hill Basin Water Supply Reliability Project

This project improves the ability to convey Bunker Hill Basin groundwater to the west and provides alternative conveyance to the Baseline Feeder and Lytle Creek Pipeline. This project also provides redundancy for Project 54.

Project 60 - Baseline Feeder West Extension

This project provides a method to deliver Bunker Hill Basin Groundwater west beyond West Valley's service area, providing an alternative supply to Fontana Water Company.

4.2.1.7.3 Alternative Local Supplies

This section is intended to initiate a discussion of options that would improve the water supply reliability in case of a catastrophic failure of portions of the Valley District water system.

Interties between Retail Agencies

Table 4-7 lists interconnections between purveyors. These interties could be used to balance supplies between purveyors during an emergency. An interconnection between the City of San Bernardino and East Valley is currently being used to facilitate blending. This use is anticipated to end in the near future. FWC has historically depended on supplies delivered through its interconnection with Cucamonga Valley to meet peak day demand.

Table 4-7
System Interties between Retail Agencies

Agencies	Direction	Capacity (MGD)	Remarks/data source
City of San Bernardino/East Valley	Either	4	Three interties. One currently used to facilitate blending.
City of San Bernardino/Riverside	To San Bernardino	2	(San Bernardino UWMP, Pg 2-10)
City of San Bernardino/West Valley	Either	3	(San Bernardino UWMP, Pg 2-10)
City of San Bernardino/Loma Linda	Either	5	(San Bernardino UWMP, Pg 2-10)
City of San Bernardino/Colton	To Colton	3	(San Bernardino UWMP, Pg 2-10)
City of San Bernardino/Rialto	Either	3.6	(San Bernardino UWMP, Pg 2-10)
City of San Bernardino/ Riverside Highland	To Riverside/ Highland	3	(San Bernardino UWMP, Pg 2-10)
Fontana/Cucamonga Valley	Either	3.6	Fontana UWMP (2500 gpm)
West Valley/Fontana	Either		West Valley UWMP.
West Valley/Rialto	Either		West Valley UWMP.
West Valley/Colton			West Valley UWMP.
Redlands/Loma Linda	To Loma Linda		Greg Gage
Rialto/Marygold	To Marygold		Rialto has historically conveyed 1,500 afy of groundwater to Marygold. The agreement under which this was accomplished is expiring.
Sources: San Bernardino Municipal Water Department 2005 UWMP; Jack Nelson, Yucaipa Valley; Ron Buchenwald, East Valley; Greg Gage, Valley District, West Valley 2005 UWMP. Based on the limited sources of data, this list may be incomplete.			

Big Bear Lake

Big Bear Lake has a capacity of over 70,000 acre-feet, most of which is owned by the Bear Valley Mutual Water Company. An agreement could be written that might make water from the lake available for municipal use in case of a catastrophe.

Increased Groundwater Production Capacity and Reliability

If the catastrophe is an earthquake, the most likely impact on groundwater production capacity will be damage to the electrical system of the well or to the electricity supplier's system.

Thus, providing emergency generators for "key" wells would help improve the area's ability to operate after a catastrophic failure.

4.2.1.7.4 Alternative Conveyance of Surface Water

Alternatives to Foothill Pipeline System

The following systems could provide some alternative conveyance of surface water should portions of the Foothill Pipeline System fail.

A segment of the 78-inch-diameter Central Feeder, Phase 1 pipeline is lowered into place.

- Metropolitan's Inland Feeder can convey water stored in Diamond Valley north to the SBVMWD service area. The conveyance capacity of the Inland Feeder operating from Diamond Valley Lake to the north is reported to be 250 cfs.
- Once completed, the tunnel portion of the Inland Feeder, with proper interties, will be able to convey SWP water from Devil Canyon Afterbay into the Foothill Pipeline.
- The Central Feeder, portions of which are under construction, would increase the ability to convey groundwater between agencies following a catastrophe. Connecting the Central Feeder to the Santa Ana Valley Pipeline and to the Crafton Hills Pump Station would provide redundancy for the Foothill Pipeline.
- The proposed East Branch Extension Phase II will convey SWP water from the eastern portion of the Foothill Pipeline to Crafton Hills Pump Station. This will provide increased capacity for the SARC Pipeline, Greenspot Pump Station, Morton Canyon Connector I, and Greenspot Pipeline.
- The proposed State Water Project Extension (previously called the Desert Aqueduct) contemplates extension of the State Water Project to Coachella Valley. Depending on the alignment chosen, this project could provide an alternative for conveying SWP water to portions of the Valley District service area or to San Gorgonio's service area.

Alternatives to the Lytle Pipeline

- Metropolitan's Foothill Feeder, the Rialto Pipeline segment, parallels the Devil Canyon-Azusa Pipeline east for approximately nine miles. With turnouts, it could provide alternative conveyance to West Valley's and FWC's surface water treatment plants.

- The Baseline Feeder conveys groundwater to West Valley and Rialto. This groundwater is an alternative to SWP water conveyed by the Lytle Pipeline.

Alternatives to Baseline Feeder System

- The Devil Canyon-Azusa Pipeline conveys SWP water to West Valley, FWC, and Rialto. This surface water is supplemental to groundwater conveyed by the Baseline Feeder.

4.2.1.7.5 Back-Up Power Supplies

Power Supplies for Pumping Plants and Groundwater Wells

A catastrophic earthquake may cause loss of electricity for an indeterminate amount of time. In order to ensure water supplies in the immediate aftermath and weeks following a major earthquake, it is critical to have back-up generators or internal combustion engines for key pumping stations and production wells throughout the region.

Similar evaluations should be conducted for other facilities such as water treatment plants and the key pumping plants, and back-up power generation should be put in place for use during emergencies.

4.2.1.7.6 Climate Change

Climate change may have considerable impact on the management of water supply and flood control systems in the State. Climate change impacts may include changes in the following:

- Temperature and its effect on timing of snow melt,
- Precipitation variation and intensity, and
- Snow pack and snow-covered areas in the watershed.

Climate change may have a considerable impact on management of water supply and flood control systems in the state.

In July 2006, DWR issued a Technical Memorandum Report entitled "Progress on Incorporating Climate

Change into Management of California's Water Resources." The study presented in the report focused on the four climate change scenarios selected by the Climate Action Team, which was appointed in response to the Governor's Executive Order SB3-05 on climate change. Four climate change simulations represent two greenhouse gas emission scenarios and two different models that were used to evaluate the climate effects. The two gas emission scenarios were developed by the Intergovernmental Panel on Climate Change representing low and high emission scenarios. Each scenario was then examined by two models, the Geophysical Fluid Dynamic Lab model (GFDL) and the Parallel Climate Model (PCM). The results of the study indicate the following:

- By 2050, the PCM model predicts a one-degree Celsius increase in temperature for both gas emission scenarios, while the GFDL model predicts a 2.25-degree increase for both scenarios. Increases up to 5 degrees Celsius occur by 2100 in the GFDL model.

- Climate model projections for changes in total annual precipitation in California through the end of this century are mixed. Models predicting the greatest amount of warming generally predicted moderate decreases in precipitation. Models projecting smaller increases in temperature tend to predict moderate increases in precipitation.

- Changes in runoff associated with climate change can be related to the changes in watershed response due to the modification of the seasonal snow pack. Increasing temperatures will likely push the snow level in watersheds to higher elevations, leaving more of the watershed available to contribute to direct winter runoff processes. In addition, higher elevation snow levels decrease the available watershed area for snow pack to develop.

- Increased temperatures are likely to lead to increased elevations for snow pack formation, which leads to a greater contributing area for winter storm runoff. In addition, warming temperatures may lead to early melting of snow pack. The combination of earlier melt time, greater variability, and greater potential for direct storm runoff may challenge the current flood and water supply system in California.

For Southern California, the GFDL model predicts a 10 percent decrease in precipitation after 2050 for both gas emission scenarios, while the PCM model predicts a 1 percent decrease in precipitation for both scenarios. By 2100, however, the PCM model predicts a 10 percent increase in precipitation for both scenarios. (See Table 4-8.)

Table 4-8
PCM Model of Precipitation

Southern CA	1961-1990 Average	2035-2064 Average	Difference
Historical	14.24	N/A	N/A
GFDL A2	17.92	17.70	-0.22
GFDL B1		16.15	-1.77
PCM A2	11.36	12.06	0.70
PCM B1		11.28	-0.08

Historically, average snowline elevations in California have ranged from about 4,500 feet in the north to above 6,000 feet in the southern Sierra mountains. DWR staff estimates that the average snow-covered area totals about 13,200 square miles in the water-supply-producing basins of the Central Valley and the Trinity River above Lewiston. This is about 8 percent of the State's total land surface. The northern Sierra and Trinity mountains account for about 7,000 square miles of the 13,200 square mile total. The west slope of the southern Sierra accounts for the remainder. Rising temperatures will cause reductions in the State's snow pack by raising snowline elevations and reducing the area where annual snow pack accumulates. A rudimentary analysis of the impact of rising temperatures on snow pack shows that a 3 degree Celsius rise will likely cause snowlines to rise about 1,500 feet, based on a moist lapse rate of 500 feet per 1 degree Celsius. This would cause a significant reduction in the amount of snow-covered area in the State and an estimated average annual loss of about 5 million acre-feet of effective water storage in snow pack. Climate model studies support projections for continued reductions in the State's snow pack as a result of warming. Simulations under various amounts of temperature rise indicate that California's snow pack is very vulnerable to warming.

Generally, there is great uncertainty in the magnitude, timing, and location of precipitation and runoff changes associated with climate change. However, it is generally understood that climate change would decrease snow runoff and therefore reduce the level of water supply reliability of the existing projects, including the SWP. It is also understood by the water managers that additional data sets, research, and studies will be needed to more accurately bracket the potential impacts of the climate change on the State water supply and flood control system.

There is also a great level of uncertainty in magnitude of reduction in water supply due to climate change for Southern California and for Upper Santa Ana, in particular. Considering uncertainty about the water supply impact of climate change in the Upper Santa Ana Region at this time, the TAG has acknowledged the need for additional studies. Because of the uncertainty about the magnitude of climate change impact on the water supply, it is premature to plan for expensive infrastructures in Upper Santa Ana to deal with associated impacts. Instead, the TAG has decided to first conduct a sensitivity analysis to determine what range of impact climate change may have on water supply availability and groundwater storage in the region and then plan for strategies to deal with the potential impacts. The sensitivities analysis is followed by formulation of appropriate strategies to deal with potential future water shortage associated with climate change.

The sensitivities analyses indicate that the impact of reduction of SWP reliability and the reduction of the long-term local surface supply by 10 percent will result in a reduction of about 20,000 acre-feet of water supplies in the region. Assuming reduction of SWP and local supplies will occur as stated above, the region will need about 20,000 acre-feet to offset the impact of climate change.

To deal with the changes in water supply associated with climate change, it is recommended that a series of additional aggressive water conservation and recycling programs be developed for the Upper Santa Ana Region. Because these conservation and recycling programs are in addition to 40 TAF conservations projects envisioned to be implemented to meet 2030 water needs, additional studies should be conducted to develop feasible projects. A detailed discussion of water conservation and water recycling strategies is presented under the water management strategy section of this plan.

4.2.2 Protect and Enhance Water Quality Objective

The goal of this objective is to protect the quality of the region's surface water and groundwater resources. To ensure reasonable protection, the water management strategies for the basin should be consistent with and contribute to the water quality objectives for the region, such as the Santa Ana Regional Water Quality Control Plan and the SAWPA IRWM Plan. The water quality objective is designed to address issues specific to the region.

Groundwater management is currently influenced by the presence of contamination plumes. Most of these plumes resulted from historic military and industrial operations in the region. The following plumes have been identified:

1. Newmark-Muscoy Superfund (trichloroethylene (TCE)
2. Redlands-Crafton (TCE, Perchlorate)
3. Santa Fe Plume (TCE)
4. Former Norton Air Force Base (TCE)
5. Rialto-Colton Subbasin (PCE, TCE, 1,1-DCE, cis-1,2-DCE, perchlorate)
6. No-Mans Land (PCE)

Management strategies will be developed to not only avoid any adverse impacts that would cause these plumes to spread further but also to develop projects that will accelerate the cleanup of these plumes. These strategies will be evaluated using computer models. Avoiding any impacts to and from the plumes, and their removal when possible, is considered a BMO for the region. This BMO is also consistent with the Groundwater Management Planning Act requiring BMOs to be formulated to address groundwater quality issues of the basins.

Federal and State law, the Orange County and Western Judgments, and sound water management practices require compliance with specific water quality standards. The Clean Water Act is the federal law requiring that water quality standards be established and, as appropriate, revised. The Porter-Cologne Act is the State law that established both the SWRCB and the present system of nine RWQCBs. This law directs that each Regional Board formulate a water quality control plan for its region that complies with the requirements of federal and State law and also regularly update these plans. The Upper SAR watershed is subject to the jurisdiction of the Basin Plan.

The Basin Plan establishes water quality standards for all the ground and surface waters in the watershed. It identifies a total of 19 beneficial uses of water in the

SAR Basin and the levels of water quality that must be met and maintained. Examples of these beneficial uses include Municipal and Domestic Supply, Groundwater Recharge, and Wildlife Habitat. The Basin Plan also includes narrative and specific numeric objectives for inland surface waters and groundwater and regulatory plans to achieve these objectives. Dissolved minerals, generally expressed as TDS; nitrogen levels, largely in the form of nitrate; and the presence of groundwater contamination, for example, PCE and TCE contaminants, are primary concerns.

With respect to surface water quality, the Federal Clean Water Act Section 303(d) requires that states identify waters that do not or are not expected to meet water quality standards (beneficial uses, water quality objectives, and the anti-degradation policy) with the implementation of Best Available Technology. Once a water body has been placed on the 303(d) list of impaired waters, states are required to develop a Total Maximum Daily Load (TMDL) to address each pollutant causing impairment.

A TMDL defines how much of a pollutant a water body can tolerate and still meet water quality standards. Each TMDL must account for all sources of the pollutant, including discharges from wastewater treatment facilities; runoff from homes, forested lands, agriculture, streets, or highways; contaminated soils/sediments and legacy contaminants such as dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs); on-site disposal systems (septic systems); and deposits from the air. Federal regulations require that the TMDL, at a minimum, account for contributions from point sources (permitted discharges) and nonpoint sources, including natural background.

In addition to accounting for past and current activities, TMDLs allocate allowable pollutant loads for each source, and identify management measures that, when implemented, will ensure that water quality standards are attained. The Basin Plan (described above) must include an implementation plan that describes how the water quality standards established in the Basin Plan will be met. TMDLs, with their associated implementation plans, are adopted into the Basin Plans through the Basin Planning process.

The ability to protect water quality has a direct bearing on the viability of many IRWM Plan objectives and strategies. This section describes strategies and projects for (1) TDS and Nitrogen Management, (2) Remediation of Groundwater Contamination, (3) Water Supply, (4) Surface Water Quality Improvement, and (5) Groundwater and Surface Water Quality Monitoring.

4.2.2.1 Total Dissolved Solids and Nitrogen Management Strategy

Groundwater quality in the Upper SAR watershed is generally good; however, long-term historic land-use practices, particularly agriculture, have resulted in an accumulation of salts that are now in the unsaturated soils overlying groundwater subbasins (now defined in the Basin Plan as groundwater management zones). These salts will, over time, degrade groundwater quality.

Watershed stakeholders have invested significant resources to better understand and resolve questions concerning the build-up of dissolved minerals in the watershed. These initiatives are in response to water quality monitoring and computer modeling of groundwater indicating that the levels of dissolved minerals, generally expressed as TDS, were exceeding water quality objectives or would do so in the future in some groundwater subbasins unless appropriate controls were implemented. Nitrogen levels, largely in the form of nitrate, were likewise projected to exceed objectives.

In 1996, a Nitrogen and Total Dissolved Solids (TIN/TDS) Task Force was formed in the watershed to conduct scientific investigations regarding the then existing TDS and nitrogen and water quality objectives of the 1995 Basin Plan. This Task Force, administered by SAWPA, was comprised of 22 water supply and wastewater agencies.

In 2003, a Final Technical Memorandum was completed that reported the results of this scientific investigation, *The TIN/TDS Study – Phase 2B of the Santa Ana Watershed Wasteload Allocation Investigation*. In 2004, as a result of this work, the Basin Plan was amended. As amended, the Basin Plan implements new water quality monitoring and reporting requirements. One such requirement is the preparation of an *Annual Report of Santa Ana River Water Quality.*

In June 2007, the third *Annual Report of Santa Ana River Water Quality* was prepared. The report provides water quality information that will be utilized to develop and implement a surface water monitoring program, which, in turn, will enable watershed stakeholders to determine compliance with the nitrogen and TDS objectives of the SAR, and, thereby, the effectiveness of wasteload allocations prescribed in the Basin Plan.

The Basin Plan establishes new TDS and nitrogen water quality objectives for both surface water and groundwater. It also establishes new surface water monitoring commitments associated with certain agencies' "maximum benefit" programs. This is a comprehensive monitoring program implemented by some Task Force members that includes an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4, and 5 of the SAR.

SAR Reach 5 is located in the Upper SAR watershed. The Basin Plan specifies water quality objectives for SAR Reach 5 for TDS, hardness, sodium, chloride, TIN, sulfate, and COD. Along SAR Reach 5, the OCWD monitors a single site, *SAR-WATERMAN-01*. In 2006, this site was monitored by OCWD only once in

August. Based upon analysis of the limited available data collected by OCWD, no constituents were shown to exceed Basin Plan objectives.

Non-tributary discharges to SAR Reach 5 include recycled water inflows from the City of San Bernardino Water Reclamation Facility and potential inflows from San Timoteo Creek produced at Yucaipa Valley Water District (YVWD) Wastewater Reclamation Facility and City of Beaumont's WWTP No. 1. As demonstrated in previous years' measurements of streamflow conducted by YVWD, during dry-weather conditions, the City of Beaumont's recycled water discharge completely infiltrates into the streambed in Cooper's Creek, a tributary of San Timoteo Creek. Prior to San Timoteo Creek's confluence with SAR, almost all of YVWD's recycled water discharge infiltrated the nearby streambed. The U.S. Geological Survey (USGS) maintains two gaging stations for this segment of the SAR—Station 11059300, located along the SAR at E Street near San Bernardino, and station 11057500, located along San Timoteo Creek near Loma Linda.

The water quality strategy for TDS and Nitrogen Management includes the following:

- Continue to work collaboratively with stakeholders throughout the entire Santa Ana watershed, including the RWQCB and the TDS/TIN Task Force to develop sound water management solutions that are responsive to site-specific hydrologic characteristics. Implement the signed agreement between the RWQCB and certain water agencies to "Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basins." The agreement does not restrict the beneficial uses of SWP water for groundwater recharge, with the acknowledgement that the RWQCB could consider regulatory actions to restrict the use of SWP water for groundwater recharge in the future.

- **YVWD Desalter and Brine Disposal Project** – The construction and operation of groundwater desalters to extract and treat poor quality groundwater has been and continues to be an essential component of salt management in the Upper SAR watershed. Such projects will be increasingly important in the watershed to protect local water supplies and provide supplemental, reliable sources of potable supplies.

  In the San Timoteo watershed areas, the YVWD anticipates that demineralization of groundwater or recycled water will be necessary in the future. YVWD is committed to constructing and operating desalting and brine disposal facilities according to terms and conditions described in the Basin Plan. The construction of these facilities will be in accordance with a plan and schedule submitted by YVWD and approved by the RWQCB. These facilities should be designed to stabilize or reverse the degradation trend evidenced by effluent and/or management zone quality.

- **City of Beaumont and the San Timoteo Watershed Management Authority (STWMA) Desalter and Brine Disposal Project –** The construction and operation of groundwater desalters to extract and treat poor-quality groundwater has been and continues to be an essential component of salt management in the Santa Ana watershed. Such projects will be increasingly important in the Upper SAR watershed to protect local water supplies and provide supplemental, reliable sources of potable supplies.

  The City of Beaumont and STWMA will construct and operate desalting facilities and brine disposal facilities according to terms and conditions described in the Basin Plan. The construction of these facilities will be in accordance with a plan and schedule submitted by the City of Beaumont and STWMA and approved by the RWQCB. These facilities shall be designed to stabilize or reverse the degradation trend evidenced by effluent and/or management zone quality.

- **Santa Ana Regional Interceptor (SARI) Improvement Project –** The SARI is primarily a utility for non-reclaimable wastewater. Its highest and best use is the removal of salts from the watershed to keep them from degrading water quality and thereby allowing better long-term and sustainable use of groundwater resources and expansion of the region's ability to reclaim water. The long-term goal of achieving salt balance within the region can be accomplished through the use of local desalters, selective use of imported water in combination with exporting salts from the watershed through the SARI pipeline.

  In the Upper SAR watershed, the SARI extends into the cities of Riverside and San Bernardino. The SARI faces challenges such as the deferral of system maintenance and high capital costs for on-going improvements, repairs, refurbishment, and capacity management. Projects will be developed to fully utilize the capacity of the SARI system and to ensure its viability as a means to remove salts from the watershed.

4.2.2.2 Remediation of Groundwater Contamination Strategy

Several contaminant plumes are present throughout the region. These plumes limit the use of groundwater in some areas as well as management of the groundwater basins. Clean-up activities are undertaken for some plumes as discussed below and specific strategies are being developed to expedite remediation in others. The SBBA is impacted by five major groundwater contamination plumes. Remediation of these plumes is underway. For example, remediation of the Newmark-Muscoy and former Norton Air Force Base Plumes is progressing under the EPA Superfund Program.

The proposed Bunker Hill Regional Water Supply Project is another measure to facilitate and expedite remediation of the Newmark Plume while accomplishing other important purposes—to provide a new source of water supply, improve water supply reliability during dry periods, develop a conjunctive use project that would optimize the capture and storage of imported water in strategic locations within the Bunker Hill Basin, facilitate in-lieu groundwater storage in adjacent groundwater basins, and improve regional water supply reliability during dry periods.

The project is the development of a well field to extract contaminated groundwater from the Newmark Plume and deliver it to a water treatment plant where it would be treated to remove PCE and TCE contaminants. After treatment, the water would be conveyed to Bunker Hill Basin groundwater purveyors for municipal and domestic use. The amount of water to be extracted and supplied ranges from 20,000 to 60,000 acre-feet per year. Annual production from the project could not exceed the quantities previously recharged under the program. In order to sustain these extraction rates, it is assumed that a similar amount of imported water, supplemented by stormwater, would be used to recharge the groundwater basin located upgradient of the proposed well field. This strategy was discussed in detail in Section 4.2.1.3.2 under Bunker Hill Basin Regional Water Supply Program.

FWC currently operates and maintains a groundwater remediation project at its Plant F10 pursuant to a long-term agreement with San Bernardino County, the owner and operator of the Mid Valley Sanitary Landfill, and a corresponding Clean-Up and Abatement order issued to San Bernardino County by the RWQCB. The 5,000 gpm treatment plant utilizes liquid phase granular activated carbon to treat for volatile organic compounds including but not limited to PCE, TCE, 1,1-DCE, and cis-1,2-DCE. The plant treats and removes those contaminants from groundwater extracted from both the Rialto-Colton and No-Mans Land subbasins.

Other projects to protect groundwater quality within the region include septic system conversion for the Highgrove Area and the Pellesier Ranch Barrier wells and water treatment plant.

4.2.2.3 Improving Groundwater Quality by Recharge of the Basins with Good Quality Water

The quality of water supply impacts the multiple beneficial uses of water. For example, the quality of water supply impacts the extent to which wastewater can be reused and recycled without resulting in adverse impacts on affected receiving waters as well as discrete industrial discharges, returns to groundwater from homes using septic tank systems, returns from irrigation of landscaping in sewered and unsewered areas, and returns to groundwater from commercial irrigated agriculture.

Imported SWP water is an important part of the region's water supply. The use of higher quality SWP water, with a long-term TDS average of less than 300 milligrams per liter (mg/L), together with the capture of flood/stormwater for groundwater recharge can also be an important part of the region's strategy to protect water quality.

The use of SWP water can allow for maximum reuse of water supplies without aggravating the watershed mineralization. It can also be utilized for direct and in-lieu recharge of groundwater basins to improve long-term and dry-year period water supply reliability. Under certain circumstances, such as the Bunkerhill Regional Water Supply Project (see "Remediation of Groundwater Contamination Strategy"), it can be utilized to facilitate and expedite groundwater remediation. Therefore, the use of high-quality SWP water in the Upper SAR watershed can provide multiple benefits that extend beyond direct water supply.

Likewise, the use of flood water/stormwater for groundwater recharge is an important part of an overall strategy to improve water quality. Most groundwater recharge occurs in the natural channels of the Upper SAR watershed. The San Bernardino County Flood Control District (SBCFCD), the SBVWCD, and other agencies in the region operate extensive recharge facilities that enhance the capture and recharge of high-quality stormwater.

Fully utilizing higher quality SWP water and flood water/stormwater for groundwater recharge will be accomplished through operation of existing facilities to maximize recharge during periods of optimal water quality (e.g., during wet periods) and through the planning, design, and construction of new groundwater recharge facilities and multi-purpose flood control district facilities such as soft-bottom flood control channels. This strategy will also require the planning and development of conveyance facilities and new institutional arrangements to share and coordinate use of facilities that are owned and operated by multiple agencies.

Facilities are planned by STWMA to recharge imported water and stormwater. Facilities are also planned as part of "maximum benefit" proposals by the YVWD, STWMA, and the City of Beaumont. Such proposals include efforts to import and recharge high quality SWP water when it is available. These activities increase both the quantity and quality of available groundwater resources.

4.2.2.3.1 Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin

The Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin was signed in 2007 by the Santa Ana Regional Water Quality Control Board (SARWQCB), and the City of Corona, City of Riverside, Eastern Metropolitan Water District, Elsinore Valley Metropolitan Water District, OCWD, Valley District, SGPWA, and Western (Recharge Parties).

The RWQCB is charged by statute with adopting water quality objectives as may be required to protect the beneficial uses of water within the region. In particular, the long-term conjunctive use of groundwater in the region requires that the quality of water in groundwater basins in the region be managed to meet the water quality objectives for nitrogen and TDS (collectively, the Salinity Objectives) adopted by the RWQCB in the 1995 Water Quality Control Plan for the Santa Ana River Basin, as amended in 2004 by R8 2004-0001 (Basin Plan).

The Salinity Objectives presently included in the Basin Plan are the result of a multi-year, multi-million dollar cooperative effort among many of the parties. The Salinity Objectives are a product of the best scientific and technical information available.

The parties that intentionally recharge imported water within the Santa Ana Region (the Recharging Parties) agree voluntarily to collect, compile, and analyze the TIN/TDS water quality data necessary to determine whether the intentional recharge of imported water in the region may have a significant adverse impact on compliance with the Salinity Objectives within the region. To that end, the Recharging Parties will collect, compile, and analyze such TIN/TDS water quality data and prepare, within 18 months from the effective date of the agreement and every three years thereafter, a report containing the following information:

a. A summary of the then-current ambient water quality in each groundwater management zone and a comparison of that ambient water quality with the Salinity Objectives. The Recharging Parties shall calculate ambient water quality for each groundwater management zone in a manner that allows for a technically valid comparison with the Salinity Objectives.

b. A summary of the amount and quality of imported water recharged in each groundwater management zone during the previous three-year period.

c. The initial report and each report prepared at six-year intervals thereafter will include a projection of ambient water quality in each groundwater management zone for the subsequent 20 years.

    (1) The projection of ambient water quality for each groundwater management zone will be based upon professionally accepted modeling techniques, will reasonably account for surface fluxed of salt input, will reflect the effects of all existing and reasonably foreseeable recharge projects for which there is a certified environmental document, and will compare baseline ambient water quality with the Salinity Objectives.

    (2) The projections for different groundwater management zones may be based on different modeling techniques.

    (3) Each report that includes a 20-year projection of ambient water quality will also present a comparison of then-current water quality in each groundwater management zone with the ambient water quality projection made six years earlier, together with an evaluation of the reason(s) for any differences.

The Recharging Parties agreed among themselves regarding the manner in which they will prepare the report and the manner in which they will share the cost of preparing the report. The Recharging Parties will circulate a draft version of each report to all other parties for review and written comments for at least a 45-day period prior to completing the final report and submission to the RWQCB.

Each Recharging Party also agreed that, when it serves as a lead agency under the California Environmental Quality Act (CEQA) for a proposed project involving the recharge of imported water within the region, the environmental document will include the water quality data compiled in the most recent triennial report to the RWQCB in the analysis of the potential impacts of the proposed project. The environmental document will also incorporate professionally acceptable modeling techniques.

This agreement provides a framework for groundwater recharge of imported water and will facilitate conjunctive management in the region while protecting water quality. A copy of the agreement is presented in Appendix A.

4.2.2.4 Surface Water Quality Improvement Strategy

The Basin Plan, pursuant to California state law (Porter-Cologne Water Quality Control Act, California Water Code Section 13000 et. seq.) and federal law (Clean Water Act 303(d)), must include an implementation plan that describes how the water quality standards established in the Basin Plan will be met. TMDLs, with their associated implementation plans, are adopted into the Basin Plans through the Basin Planning process. This strategy addresses TMDL implementation with respect to impaired (303(d)) bodies of water located in the Big Bear Lake watershed and consists of developing and implementing plans and projects to improve the water quality of impaired surface water bodies that do not or are not expected to meet water quality standards for beneficial uses pursuant to the 303(d) list of impaired waters.

The Big Bear area watershed is located in the San Bernardino Mountains. Major water bodies in this watershed include Big Bear Lake, Baldwin Lake, Stanfield Marsh, Shay Meadows, Rathbone (Rathbun) Creek, Summit Creek, and Grout Creek. Pursuant to the Clean Water Act Section 303(d), the following water bodies are impaired: Big Bear Lake, due to nutrients, copper, mercury, metals, and siltation; Grout Creek, for metals and nutrients; Summit Creek, due to nutrients; Knickerbocker Creek, for pathogens and metals; and Rathbone Creek, due to nutrients and siltation. The problem pollutants have been identified as coming from nonpoint sources. In conjunction with local stakeholders, the RWQCB has adopted TMDLs for these pollutants (Resolution R8-2006-0023).

A program has been formulated to identify a coordinated and comprehensive plan for management of the lake and surrounding watershed to protect the lake's beneficial uses. The Big Bear Municipal Water District (Big Bear Municipal) will serve as the sponsoring agency, with significant participation of Big Bear Lake watershed stakeholders. The plan will include data collection, modeling and analysis of data, and reporting. It will include a plan and schedule for short-term and long-term in-lake sediment nutrient reduction for Big Bear Lake. The plan will also include an evaluation of the applicability of various in-lake treatment technologies to support development of a long-term strategy for control of nutrients from the sediment, noxious and nuisance aquatic plants, and many other features.

Another water quality improvement project for Big Bear Lake is a phosphorous treatment plant. Based on existing data, phosphorus is the primary nutrient problem within Big Bear Lake. For example, past studies have shown that Big Bear Lake is eutrophic (meaning a body of water whose oxygen content is depleted by organic nutrients) and that the limiting nutrient is phosphorous. The phosphorous treatment project is intended to meet several water quality objectives identified in the Basin Plan, including those related to phosphorous, dissolved oxygen, and excess algae. The high nutrient levels are causing impairment to beneficial uses. Reducing phosphorous concentrations will restore aquatic habitat by reducing excess algae growth and inhibiting the spread of invasive plant species. In addition to improving water quality, this project will improve access and navigability for swimmers and boaters, particularly along the shallower shoreline of the lake.

The proposed project will expand successful pilot demonstrations supported by previous Proposition 13 grant funds. It will include the broad application of liquefied alum that will establish an ionic bond with dissolved phosphorous, forming an inert mineral salt that rapidly precipitates out of the water column. This project is co-sponsored by Big Bear Municipal, SBCFCD, and the City of Big Bear Lake as a joint effort to implement the water quality management strategies specified in the Basin Plan, the RWQCB's watershed Management Initiative, the Nutrient TMDL, BBMWD's Lake Management Plan, the County's Stormwater Management Plan, and the City's Stormwater Management Plan.

4.2.2.5 Groundwater and Surface Water Quality Monitoring Strategy

Groundwater and surface water quality monitoring and assessment information enables water resource managers to understand the effectiveness or needs for improvement of their water quality management practices. For example, water quality objectives for the SAR for TDS and nitrogen are set forth in the Basin Plan and water rights judgments. In order to ensure compliance, water quality is monitored on the SAR at a point just below Prado Dam. The USGS maintains a gaging station at this location to measure instantaneous flow and a water quality recorder provides continuous measurements of specific conductance. Surface water grab samples are taken by the RWQCB staff, the USGS, and others, and analyzed to determine compliance with water quality objectives. This information is used to assess the effectiveness of water management practices over time.

A comprehensive surface and groundwater monitoring and assessment program is currently underway in the region. Such a program provides information needed to evaluate the effectiveness of a water quality management practice and, as appropriate, modify management practices. Management of groundwater basins in general and the proposed process to manage the SBBA requires extensive monitoring to ensure the annual operation of the basin is in compliance with requirements of existing agreements and judgments and that operation of the basin will result in the expected outcome. A comprehensive groundwater monitoring plan has been prepared for this IRWM Plan and is presented in Appendix B.

4.2.2.5.1 Surface Water Ambient Monitoring Program

In general, the RWQCB's surface water monitoring program is not strictly formalized. Other than monitoring at the location just below Prado Dam (described above), the sampling frequency, locations, constituents, and other details vary from year to year depending on identified problems and needs and on staff and funding availability. In addition to these efforts, a number of other agencies conduct surface water monitoring programs in the region, including water purveyors, wastewater dischargers, and flood control agencies.

The Surface Water Ambient Monitoring Program (SWAMP) is a relatively new statewide program (Water Code Section 13192). The purpose of SWAMP is to create an effective surface water quality ambient monitoring program for all of California's surface waters to ensure that water quality is comprehensively measured to protect beneficial uses and to evaluate protection and restoration efforts. The program also intends to capture monitoring information collected under other State and RWQCB programs, such as the State's TMDL, Nonpoint Source, and Watershed Project Support programs.

All State-funded projects that include a surface water monitoring component are required to develop and implement a SWAMP Quality Assurance Plan approved by the RWQCB as a condition of funding. This is a strategy to (1) implement this requirement, and (2) voluntarily adhere to and implement SWAMP Quality Assurance standards and protocols whenever possible for surface water quality monitoring in the Upper SAR watershed. Note that this does not include projects that include effluent or discharge monitoring, which is covered under National Pollutant Discharge Elimination System permits and Waste Discharge Requirements. The guidelines for preparation of such a plan, the Quality Assurance Project Plan, can be found at http://www.swrcb.ca.gov/swamp/qapp.html.

4.2.3 Ecosystem Restoration and Environmental Improvement Objective

Protecting and restoring, where possible, the ecological functions of the watershed is an objective for the region. This IRWM Plan provides a framework for the integration and coordination of ecosystem and environmental improvement strategies relating to flood management, recreation and public access, and land use planning. The purpose of this framework is to enable stakeholders to coordinate and advance strategies to improve the ecological health of the watershed and, in the process, improve public awareness, access, stewardship, and enjoyment of this region's most valued water resources.

This section begins with a definition and description of Ecosystem Restoration and Environment Improvement followed by three broad strategies to achieve this objective. The role of watershed stakeholders and the importance of collaboration to achieve this objective are also described. The section concludes with a more detailed explanation of the strategies and the projects to implement them.

Restoration means the reestablishment of structure and function of the Santa Ana watershed ecosystems. The restoration process is used to reestablish the general structure, function, dynamic, and self-sustaining behavior of the ecosystem. As this is accomplished, the natural biological attributes of the system return, such as native plants, fish, birds, and other wildlife, which enriches the quality of life for everyone.

It is not possible, nor would it be desirable, to restore the Upper SAR watershed ecosystem to a pre-disturbance condition. Human activity and use of the landscape has precluded many options and has altered natural ecosystem processes; for example, vegetation is changed and hardscape increased. A return to a more natural, self-sustaining system, however, can lower infrastructure costs, raise property values, and reconnect people with the natural wildland beauty of the Santa Ana watershed.

Many stakeholders, such as federal and state resource agencies; regional, county, and city governments; public and private non-governmental organizations; and the public, are actively engaged in Ecosystem Restoration and Environment Enhancement projects. Accordingly, the strategies described in the IRWM Plan are intended to serve as a framework for the integration and coordination of the projects to be performed by stakeholders. The foundation of this framework is collaboration. Through increasing collaboration, stakeholders are able to more effectively integrate and coordinate their resources to protect, restore, and enhance the environment; institute land use policies that protect the watershed values; and establish and maintain public access to open space, parks, trails, and other recreational amenities.

While the focus of these strategies is the Upper SAR watershed, it is recognized that all stakeholders within the watershed are linked to one another and to State and national resource management priorities. Accordingly, the Ecosystem Restoration and Environment Enhancement strategies described in this plan are intended to be consistent with broader watershed plans and strategies, such as the strategies described in the "Santa Ana Watershed Project Authority (SAWPA) Integrated Watershed Plan, 2005 Update," and the "2002 SAWPA Integrated Watershed Plan, Volume 2: Environmental and Wetlands Component."

The strategies for Ecosystem Restoration and Environment Improvement are (1) Habitat Protection, Restoration, and Enhancement; (2) Land Use Planning; and (3) Recreation and Public Access. Taken together, these strategies will enable stakeholders to advance the objective of ecosystem restoration and environment improvement. These strategies will also provide other benefits to the watershed, such as improved water quality, increased water supply, increased dry-year water supply reliability, increased groundwater storage, improved flood control and stormwater management, and greater public education and awareness that is critical for the long-term stewardship of the watershed.

4.2.3.1 Habitat Protection, Restoration, and Enhancement Strategy

The Upper SAR watershed is home to extraordinary natural resources. The headwaters of the watershed are located in the San Bernardino National Forest. The San Bernardino Valley is home to six unique habitat types, six state endangered species, 13 federally endangered or threatened species, and over 53 species of special concern. Riparian corridors thread through the watershed and provide important habitat.

The San Bernardino National Forest is home to extraordinary natural resources.

This strategy reflects the value of the watershed's natural resources. It addresses the economic benefits of natural systems; for example, the use of erosion control measures to reduce sediment loading and thereby improve water quality. It also strives to reduce conflict associated with human activity.

This strategy addresses policy, planning, projects, and project initiatives to protect, restore, and enhance Upper SAR watershed habitats. These initiatives are organized into three categories of projects: (1) Land Management and Habitat Conservation Planning Projects, (2) Habitat Improvement and Environmental Enhancement Projects, and (3) Non-Native Plant Removal Projects.

4.2.3.1.1 Land Management and Habitat Conservation Planning Projects

Land Management and Habitat Conservation Planning projects are policy and planning initiatives that recognize that wildlife habitat is often in direct competition with other land uses and strive to resolve these conflicts in a manner that protects and enhances the ecosystem value of the Upper SAR watershed as habitat for sensitive, threatened, and endangered species.

4.2.3.1.2 Habitat Improvement and Environmental Enhancement Projects

The second category of projects—Habitat Improvement and Environmental Enhancement Projects—are projects to improve habitat and enhance the environment. These are multi-faceted projects that range from property acquisition and construction of facilities, to oversight monitoring, maintenance of land and facilities, public education, and outreach. The benefits of these projects include ecosystem restoration, flood and stormwater management, water quality improvement, public access and recreation, and public outreach and education.

An example of an existing Habitat Improvement and Environmental Enhancement project is the Bear Creek Fishery Project. Located in the San Bernardino National Forest, this project was implemented to sustain the aquatic health of Bear Creek. Big Bear Municipal administers this program, which consists of monitoring and managing carefully controlled releases of water to the creek from Big Bear Lake. An example of a partially completed project is the 145-acre wildlife preserve, the Stanfield Marsh. This project, when completed, will restore and enhance habitat for aquatic species, wetland species, wildlife to include wintering and breeding waterfowl, wintering bald eagles, osprey, and summer residents, and potentially nesting pelicans. An example of a new project initiative is the Lytle Creek Watershed Assessment and Restoration Project. This is a proposed, multi-purpose program to advance ecosystem restoration and improve water quality and local water supply reliability. It also includes public outreach and education, addressing wildfire prevention, non-point pollution prevention, and public outreach targeted to Lytle Creek recreational users.

Upper Santa Ana River Wash Land Management and Habitat Conservation Plan (Project) – Historically, the Santa Ana River Wash was a natural floodplain and alluvial fan that provided a place to convey frequent devastating flood waters depositing sediment percolate surface water to the groundwater basin, providing a significant source of water supply for the Upper SAR watershed. It is also habitat for a variety of sensitive, threatened, and endangered species. Its ecosystem value has become more apparent due to several factors, including the decrease in this type of habitat throughout Southern California.

The proposed project is Land Management, Mining and Reclamation, Water Management and Conservation, and Habitat Conservation Plan for the Upper Santa Ana River Wash Area. The plan is being prepared under the guidance and direction of many stakeholders, with the SBVWCD serving as lead agency. The plan area encompasses approximately 4,500 acres and is generally bounded by the SAR on the south, Alabama Street on the west, Plunge Creek and Green Spot Road on the north, and Mill Creek on the east.

When completed, the plan would directly contribute to all three strategies for ecosystem restoration and environmental improvement presented in this IWRM Plan: (1) habitat protection, restoration, and enhancement; (2) land use planning; and (3) recreation and public access. Habitat preservation would be strategically located in large inter-connected areas with intact natural habitat. A trails system would be maintained, expanded, and improved. Water conservation (groundwater recharge) and flood control activities will continue in areas historically utilized for these activities. Through land use planning and land exchanges, it would confine and minimize mining activities to one area on land currently disturbed by mining or land adjacent to disturbed areas.

San Bernardino National Forest Watershed Management Planning – The upper reaches of the Santa Ana watershed are located in the San Bernardino National Forest. The San Bernardino National Forest is one of 18 national forests in California, collectively referred to as Region 5 of the United States Forest Service (USFS). In 1981, Region 5 entered into a Management Area Agreement with the SWRCB pursuant to Clean Water Act Section 208. This agreement designates Region 5 as the Water Quality Management Agency (WQMA) for the San Bernardino National Forest.

As the WQMA, Region 5 is responsible for the proper installation, operation, and maintenance of State- and EPA-approved BMPs in the San Bernardino National Forest. Region 5 is tasked with the responsibility of (1) correcting water quality problems in National Forests; (2) perpetually implementing BMPs; and (3) carrying out identified processes for improving or developing BMPs. In the Upper SAR watershed, the San Bernardino National Forest works conjunctively with the RWQCB on water quality issues such as TMDLs.

Currently, Region 5 is working with the State and RWQCBs to re-certify the Management Area Agreements pursuant to recent changes in State law, such as the new Nonpoint Source Implementation and Enforcement Policy. The process of revising the WQMP and Management Area Agreements will be a joint SWRCB and Region 5 effort. This will be a collaborative effort to develop a plan that identifies, prioritizes, and annually updates site-specific issues. In addition to re-certification of the Management Area Agreements, the San Bernardino National Forest (SBNF) will be implementing its 2006 Forest Plan. The Forest Plan describes the strategic direction at the broad program-level for managing the SBNF, including watershed management initiatives over the next 10 to 15 years.

Water Resources Institute Watershed Management Internship Program (Project) – Local governments in the Upper SAR watershed are facing major challenges with water quality, stormwater runoff, flood damage liability, and concerns about whether there will be enough water for new development. The long-term protection and management of the watershed will require the development and training of a new generation of water resources professionals.

The WRI- CSUSB is collaborating with the Natural Resource Conservation Service, SAWPA, local resource conservation districts, and other watershed groups to provide multi-disciplinary internships on watershed management projects related to increasing population, changing land use patterns, and expanding urbanization in the Santa Ana watershed. This program is funded by the United States Department of Agriculture. Under this program, up to 30 under-represented students will be selected for paid internships to conduct scientific research on real-world problems in the Santa Ana watershed. This program will also train students in the latest Internet-based information-sharing systems.

Lytle Creek Watershed Assessment and Restoration Project – Lytle Creek is an impaired stream on the 303(d) list with an existing pathogen impact. Because of increasing visitor traffic and recreational use, the condition of Lytle Creek will become worse if corrective actions are not taken.

The Lytle Creek Watershed Assessment and Restoration Project is a multi-faceted program to advance ecosystem restoration and improve water quality and local water supply reliability. Program elements include a water quality assessment and a biological assessment. The program includes bilingual (English and Spanish) public outreach and education and addressing wildfire prevention and non-point pollution prevention. Public outreach will be targeted to Lytle Creek recreational users. This program is sponsored by the WRI-CSUSB.

4.2.3.1.3 Non-Native (Arundo donax) Plant Removal Maintenance Project

The third and final project category under this strategy is Non-Native Plant Removal Projects. The removal of non-native plants is a specific type of habitat restoration—for example, Giant Reed or *Arundo donax* consumes large amounts of water and clogs up streams and waterways. Because *Arundo donax* spreads so rapidly, it pushes out native vegetation and the species that inhabit it. These Non-Native Plant Removal projects remove non-native plants and maintain such areas in order to restore native habitats and maintain the quality of restored habitat.

Non-native plants can drive out native vegetation and species.

A number of projects to remove non-native plants, especially *Arundo donax,* or giant reed, in order to restore and maintain native habitats have been implemented in the Upper SAR watershed. Some projects are located in environmentally sensitive areas; for example, along important biological corridors that are habitat for threatened and endangered species. Projects require continued vegetation management to maintain restored habitats and monitoring to prevent the establishment of invasive weed species. Many of these areas where removal has been successful, such as the least Bell's vireo, provide important habitat for federal- and State-listed species.

The Inland Empire Resource Conservation District (IERCD), together with Santa Ana Watershed Association (SAWA), removed approximately 2,800 acres of *Arundo donax* within the Upper SAR watershed. *Arundo donax* removal and maintenance is imperative with regards to water resources quantity and quality. An acre of *Arundo donax* is estimated to consume three times more water than an acre of native vegetation within the Santa Ana watershed. If the *Arundo donax* is not managed, it would result in reduced streamflow, reduced groundwater recharge, reduced availability of water for native species, and eventual replacement of native riparian vegetation with *Arundo donax*. Native species naturally hang over rivers and streams, creating shade and keeping water temperatures lower. Streams infested with *Arundo donax* have little shade, which raises water temperature and changes water chemistry. These changes, due to increased sunlight, promote algal growth and raise pH.

Past invasive species removal efforts have been very successful. Eradication contracts have included the initial physical removal of the non-native plants with hand tools or machinery followed by five years of monitoring and spraying with EPA-approved herbicide. IERCD wants to ensure these areas remain free of

Arundo donax in perpetuity and proposes to monitor and maintain these removal project areas to ensure re-infestation does not occur. *Arundo donax* removal maintenance will assist in accomplishing the following objectives: improve surface water and groundwater management, protect water quality, improve water supply reliability, and restore and sustain riparian ecosystems.

City of San Bernardino Warm Creek Restoration Project – The proposed project consists of restoration activities along Warm Creek in the City of San Bernardino. This area consists of approximately three acres of a highly degraded stream channel that runs through private property. Typically, Warm Creek has contained mostly 100 percent invasive non-native vegetation, including *Arundo donax*.

In the spring of 2006, the project sponsor, the IERCD, obtained landowner approval to remove invasive species, including *Arundo donax* and castor bean, and substantial work has been completed. To complete the restoration and rehabilitation of this urban stream, IERCD will continue to remove additional invasive species such as Mexican fan palm (*Washingtonia robusta)* and Date palm (*Phoenix canariensis*), and actively re-vegetate the riparian areas with native species like Mulefat (*Baccharis salicifoli)* and willow.

Restoring Warm Creek in the City of San Bernardino will allow for the return of native riparian habitat in this highly urban and economically disadvantaged area. In addition, this restoration will save water, increase streamflow, improve instream flow timing, and improve water quality. Restoring native riparian habitat to Warm Creek will also allow for native plant and animal species to occupy the area. The riparian zone may support threatened, endangered, or migratory birds, fish, or other aquatic species.

Stanfield Marsh Wetlands Habitat Restoration Project – Stanfield Marsh is habitat for numerous wet meadow species; the southern Bald Eagle and its roosting, perching, and foraging sites; thousands of wintering waterfowl; numerous breeding waterfowl and upland birds in summer; and a large population of white pelicans. It is also considered the most amenable valley in the Big Bear Lake watershed for ecological enhancement, sensitive land acquisition, education, recreation, and scenic beauty.

The habitat value of the marsh was reduced as the result of construction of Stanfield Cutoff, a causeway (land bridge) built during the 1920s that largely separated the marsh from Big Bear Lake. The history of this site, the presence of wetland species, and hydrologic conditions make this an exceptional site for wetland enhancement. Partial wetlands enhancement has been completed.

The proposed project, when completed, would maintain a more consistently wet marsh area and a permanent wet habitat. When needed, for example, during dry periods, up to several hundred gallons of water per minute would be pumped from Big Bear Lake to the marsh. Pumped water not consumptively used in the marsh would return to the lake through the culverts under Stanfield Cutoff, with lower nutrient concentration and higher dissolved oxygen concentration. In addition to improving habitat and restoring wetlands, this project would improve lake water quality by reducing nutrients and increasing dissolved oxygen. It would also provide numerous public education and public outreach benefits in conjunction with other programs administered by the project sponsor, Big Bear Municipal.

4.2.3.2 Land Use Planning Strategy

Land use in the Upper SAR watershed is regulated by county and city government General Plans and Zoning Ordinances. Within the San Bernardino National Forest, land use planning is guided by the Forest Service Land Management Plan.

The Upper SAR watershed is one of the fastest growing regions in the United States. Substantial new development is forecast for the Upper SAR watershed. Stakeholders are taking into consideration the impacts of growth, such as the potential loss of open space and increase in impervious surfaces such as roads and buildings, and are exploring strategies to efficiently manage land and water resources.

This strategy addresses water resource-efficient land use principles and stewardship actions that can be implemented by local governments and other watershed stakeholders to protect and restore, where possible, the ecological functions of the watershed as well as improve the reliability and quality of the region's water resources. An example is the Ahwahnee Water Principles for Resource Efficient Land Use (Principles) developed by the Local Government Commission to improve the stewardship of local water resources.

The Principles encourage the identification of natural resources in the watershed, such as wetlands, floodplains, recharge zones, open space, and native habitat, to preserve and protect as many valued assets as possible to augment flood protection, improve water quality, recharge groundwater, restore habitat, and sustain overall long-term water resources. For example, as development occurs, its impact to the watershed would be mitigated, in part, by incorporating water holding areas such as creek beds, recessed athletic fields, ponds, cisterns, and other features that allow for natural groundwater recharge, reduce stormwater runoff, and decrease local flooding.

The Principles seek to reduce water demand through water conservation measures and efficient land use practices. For example, all aspects of landscaping, from the selection of plants to soil preparation and the installation of irrigation systems, are addressed to reduce water demand, retain runoff, decrease flooding, and allow for groundwater recharge. Impervious surfaces such as driveways, streets, and parking lots are minimized so that land is available to absorb (recharge) stormwater and reduce polluted urban runoff. Dual plumbing that allows grey water from showers, sinks, and washers to be reused for landscape irrigation is included in the infrastructure for new development. The Principles advocate maximum use of recycled water for appropriate applications, including outdoor irrigation, toilet flushing, and commercial and industrial processes. Urban water conservation technologies such as low-flow toilets, efficient clothes washers, and more efficient water-using industrial equipment are encouraged to be incorporated in all new construction and retrofitted in remodeled buildings.

The Principles also encourage the preservation of water supplies and water quality by promoting growth in the form of compact, mixed-use, transit-oriented development.

4.2.3.2.1 Inland Empire Sustainable Watershed Program Project

The Inland Empire Sustainable Watershed Program is a multi-faceted program to inform and empower local communities to become effective watershed stewards to re-establish sustainable ecological function in the Upper SAR watershed. The program builds regional capacity for community-based watershed management by reaching out to residents, including children, municipalities, water districts, resource agencies, businesses, land developers, and other stakeholders that impact watershed function in their daily activities. California Resource Connection serves as the program manager. This is a CALFED watershed-funded program that began in December 2006 and will be completed in December 2008. The program activities summarized below will support IWRM Plan Ecosystem Restoration and Environment Improvement.

Upper Santa Ana River Watershed Management Opportunities Atlas and Green Map – This is a public outreach and education tool that attractively identifies watershed assets for community stakeholders to visualize open spaces serving areas for groundwater recharge, sensitive habitat needing to be protected, impaired waterways needing to be restored, that trails systems and parks can green the urban landscape, and water management facilities bringing water supplies to homes and businesses.

Model Ordinance Program – This program is assessing regulations in the municipal code and development codes in the Upper SAR watershed that prevent the implementation of the resource-efficient land use practices, such as the

Ahwahnee Water Principles for Resource Efficient Land Use, that were developed by the Local Government Commission with funding from the SWRCB. Model Ordinances will be drafted for local adoption in a form that cities or the county can use in a manner that best fits local conditions.

Green Development Initiative – This is an educational forum for developers, land use planners, architects/engineers, and nurseries in the Upper SAR watershed to promote "green" development practices during this period of rapid development.

Watershed U-Inland Empire – This is an educational program with forums on topics such as ecosystem function, urban greening and design, water-efficient landscaping, and local restoration projects to encourage the public to live and work with fewer impacts on the watershed and to get involved in local projects.

Think River! – This is a hands-on watershed education program for teachers and youth on water sustainability, water quality, geology, plants and wildlife, and other environmental science topics relevant to the Upper SAR watershed.

4.2.3.2.2 LIDS for KIDS (Low Impact Development for a Healthy Watershed) Project

Urban development in the Upper Santa Ana Region has increased impermeable surface acreage and, as a result, increased the amount of stormwater runoff. This stormwater runoff collects and carries pollutants that decrease the quality of water. The land use planning process can utilize the standards described in "Low Impact Development Design Strategies – An Integrated Design Approach" prepared by the Department of Environmental Resources, June 1999, and other sources to reduce the amount of permeable surface, reduce ecosystem impacts, and improve water quality.

The Lids for Kids project is a public demonstration and public outreach project that will assist with retrofitting existing structures and educating key stakeholders, such as land developers and homebuilders who design and build in the Upper SAR watershed. The project sponsor, IERCD, has been conducting public outreach within the Upper SAR watershed for many years. The objectives of this project are to improve stormwater management practices, encourage environmentally sensitive development practices, reduce construction and maintenance costs associated with the current stormwater control methods, encourage the public to utilize low-impact development methods, and increase "green zones" for wildlife and people of the region.

4.2.3.2.3 Low Impact Development Guidance and Training Project for Southern California

San Bernardino County's Low Impact Development (LID) Guidance and Training Project for Southern California is aimed at facilitating the incorporation of LID into National Pollutant Discharge Elimination System (NPDES) and TMDL programs at the local government level. LID employs construction, design, and landscape architecture features that reduce hydro-modification and, in turn, the water pollution caused by stormwater discharges. A Request for Qualifications (RFQ) was issued to compete for a multi-year project that will create a database of performance results for various BMPs by measuring and monitoring the effectiveness of these features at actual LID projects that have been constructed in Southern California.

The project is sponsored by the SBCFCD in cooperation with the Stormwater Monitoring Coalition made up of the three Southern California RWQCBs (Los Angeles, Santa Ana, San Diego), the SWRCB, the municipal permittees (the County of Ventura, Los Angeles, San Bernardino, Riverside, Orange, and San Diego), Heal the Bay, and the Southern California Coastal Water Research Project (SCCWRP).

The project will evaluate a LID pilot site with a combination of BMPs to identify the BMPs to integrate LID into existing design, construction, and maintenance programs. The project will develop a model program for localities in California that are interested in adopting LID strategies and techniques. It will produce a manual and provide training to local government and private planners to balance the needs of development while addressing the environmental concerns associated with urban runoff. Materials developed for the project will provide a foundation and benchmarks for local governments to incorporate LID techniques into their site design and construction and post-construction BMP design process.

4.2.3.2.4 Alluvial Fan Task Force

DWR is utilizing the knowledge and expertise of the WRI-CSUSB to coordinate the activities of an Alluvial Fan Task Force. Alluvial fans are prevalent throughout Southern California where alluvial fan flooding has occurred. The principle hazards associated with alluvial fan flooding at the base of mountain bases are high-velocity, debris-laden flows resulting from a series of storms, particularly following wildfires common in semi-arid regions. Alluvial fans are most prevalent in San Bernardino, Riverside, Los Angeles, Ventura, Santa Barbara, San Luis Obispo, Kern, Orange, Imperial, and San Diego Counties.

The task force will be comprised of stakeholders in areas affected by rapid growth on alluvial fans with broad representation from developers, elected officials, flood control districts, stormwater managers, water suppliers, water quality regulators, Native Americans, and the environmental community. The members of the Alluvial Fan Task Force are charged by the Legislature with reviewing the state of knowledge of alluvial fan flooding and developing a Model Ordinance that will reduce long-term flood damages on alluvial fans and provide land use guidelines for sustainable development on alluvial fans. The ordinance will be developed collaboratively by the members of the proposed task force, under the guidance of a professional facilitator, and is intended for voluntary adoption by local governments. The findings of the proposed Alluvial Fan Task Force will be reported to the Legislature.

Funding for the task force was provided by FEMA under the Pre-Mitigation Disaster Planning Grant Program with a 25 percent match from DWR Division of Flood Management.

4.2.3.2.5 WRI Watershed Management Internship Program

The WRI-CSUSB is collaborating with the Natural Resource Conservation Service (Redlands office), SAWPA, local resource conservation districts, and other watershed groups to provide multi-disciplinary internships on watershed management-related projects regarding increasing population, changing land use patterns, and expanding urbanization in the Santa Ana watershed.

Funded by the United States Department of Agriculture, the project will select up to 30 underrepresented students for paid internships to conduct scientific research in the Santa Ana watershed on real-world problems and trains students in the latest Internet-based information sharing systems.

4.2.3.4 Recreation and Public Access Strategy

This is a strategy to maintain and create new opportunities for the public to enjoy the area's waterways and other recreational amenities; enhance the watershed's natural features; and ensure access to the region's wetlands, lakes, and streams. In anticipation of further growth in the region, this strategy reflects the need for a balance between growth of urban areas and the environment to maintain a viable habitat for native plant and wildlife species, and to maintain a high quality of life for watershed residents and visitors. An effective means of establishing this balance is the development of open space corridors that allow for multiple species habitat, wetlands, storm flow capture and aquifer recharge, water quality improvements, and passive and active recreational facilities and open spaces.

When completed, the Santa Ana River Trail System will extend from Huntington Beach to the crest of the San Bernardino Mountains.

The development of the Santa Ana River Trail System (SART) trail tread and the integration of the trail tread with other (federal, state, regional, and local) planning initiatives is the backbone of this strategy. The SART is a 110-mile walking/biking/recreational trail system along the SAR. When completed, the trail will extend from the ocean in the City of Huntington Beach to the Crest of the San Bernardino Mountains. It will connect the many trails, recreation, and open space amenities into one cohesive park and trail system. At the trailhead in the San Bernardino Mountains it will connect to the USFS system of trails and to the Pacific Crest Trail.

Because SART involves many different governmental agencies and would cross many different landowners and water management facilities, it is critical that it be fully integrated with related plans. For example, SART is being planned in coordination with the Upper Santa Ana Wash Habitat Conservation Plan and the land use planning of the Cities of Highland and Redlands and the County of San Bernardino. Through this coordinated approach, the development of SART will advance multiple species habitat, wetlands, storm flow capture and groundwater recharge, water quality improvements, and passive and active recreational open spaces.

In the Upper SAR watershed, the SART will traverse a total of approximately 26 miles, the first eight miles of which are completed. This segment is located entirely in Riverside County beginning at Riverside Narrows and ending at the San Bernardino County line.

In San Bernardino County, the SART will traverse approximately 18 miles, primarily along the south levee of the river. A master plan for the SART was approved by the San Bernardino County Board of Supervisors in July 1990, and two initial phases of trail construction, a total of 6.7 miles, are completed. Planning, design, and permitting are currently underway for the final two phases of the SART, described below.

SART Phase III Project – SART Phase III is a 3.5-mile segment of the SART that will extend from Waterman Avenue in the City of San Bernardino to California Street in the City of Redlands. The trail tread width will be 18 feet, made up of 10 to 12 feet of asphalt and 6 to 8 feet of non-paved shoulder. The trail tread will be designed to Caltrans standards. The sponsor of this project is the County of San Bernardino Parks Department.

SART Phase IV Project – SART Phase IV is the final 7.8-mile segment of the SART system trail tread that will extend from California Street in the City of Redlands to Greenspot Road in the community of Mentone. The trail tread width will be 18 feet, made up of 10 to 12 feet of asphalt and 6 to 8 feet of non-paved shoulder. The trail tread will be designed to Caltrans standards. The sponsor of this project is the County of San Bernardino Parks Department.

5 Integrated Regional Water Management Plan Implementation

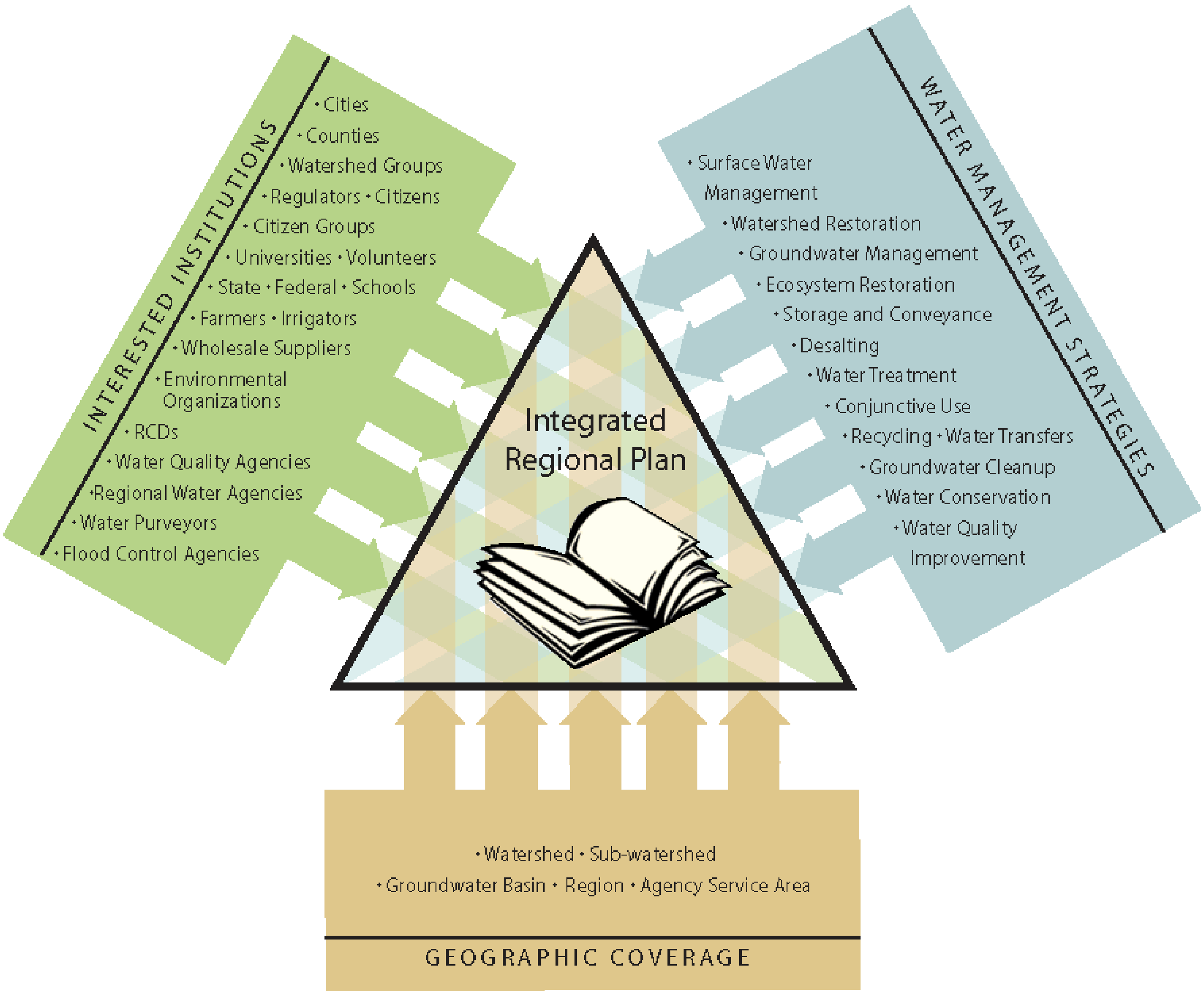
5.1 Integration of Water Management Strategies

Regional planning is a process in which regional agencies and stakeholders come together to develop a plan that serves the individual agencies involved as well as serving the region as a whole. Regional planning promotes sharing of resources and facilities and implementation of strategies that have benefits for multiple agencies.

Integrated planning encourages broad investigation of the interrelated strategies and implementation of projects that provide multiple benefits and serve a wide range of strategies. The investigation is designed to help develop water management strategies that contribute to achievement of multiple objectives. Integrated regional water management planning brings various water interests, stakeholders, and institutions together to plan for future management and use of resources in a large geographic area (Figure 5-1). With the above concept in mind, the Upper Santa Ana River Watershed Integrated Regional Water Management Plan (IRWM Plan) has been developed to prepare a road map for management of the water resources in the region. The Technical Advisory Group (TAG) recognized from the beginning that management of groundwater resources, surface supplies, stormwater, and imported water are inseparable and intrinsically interrelated. It is also recognized that water quality plays a critical role in management of groundwater basins and groundwater conjunctive use implementation.

During the planning process, interrelated water management strategies are identified and planned so that they work together in an integrated fashion. Some examples of such integrated planning are discussed below.

Figure 5-1
Integrated Regional Water Management Planning



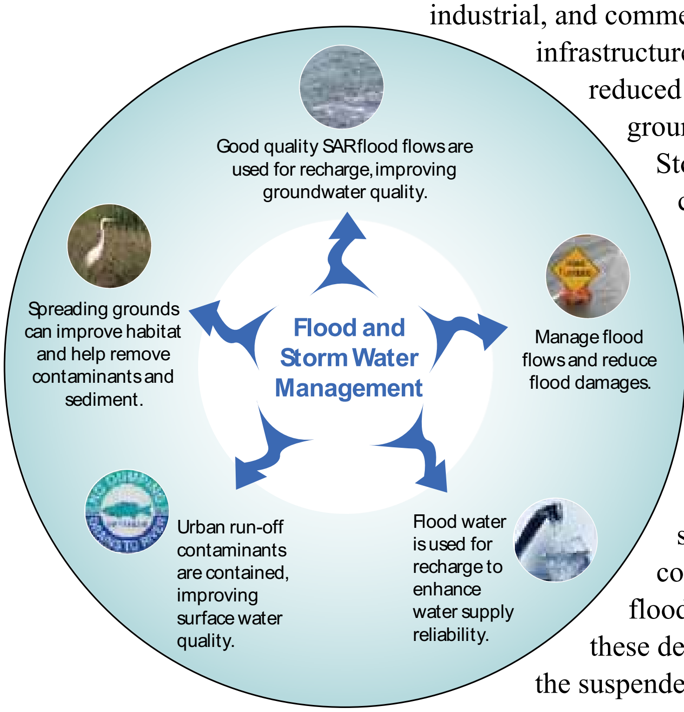
5.1.1 Integration of Surface Water and Groundwater Resources Strategies

Today, groundwater provides 79 percent of the water supply to the region and groundwater basins are used for water storage to regulate the highly variable local surface water and imported supplies. In order to continue to regulate the highly variable surface water in the region, surface water and groundwater resources must be integrated and optimized. When surface water is available it should be used for recharge as well as direct use. In addition, the region should work to limit the amount of high flows that go to the ocean in any given year.

These goals can be achieved through integration of surface water and groundwater.

5.1.2 Integration of Stormwater Management, Flood Management, Water Supply Reliability, and Surface and Groundwater Quality

The Upper Santa Ana River (SAR) Watershed is heavily developed. Housing, industrial, and commercial development, roads, and other urban infrastructure have replaced natural vegetation, which has reduced soil absorption capacity, reduced groundwater recharge, and increased urban runoff. Stormwater can cause flood damage and can carry sediment and urban pollutants into streams. Although stormwater can cause flooding, with proper management it could provide a source of water supply to this arid region. Improvement in the management of stormwater can help the region achieve multiple objectives while integrating a number of strategies in the Upper Santa Ana Region. Generally speaking, stormwater is captured and conveyed to detention basins to reduce peak flood flows and reduce flood damage. However, these detention basins can also be designed to settle the suspended sediment and pollutants out of the water, increase groundwater recharge, and possibly provide wildlife habitat. Use of stormwater for groundwater recharge and use of flood control detention basins for groundwater recharge during the non-flood seasons are strategies that have been used within the region and should be further enhanced to improve water supply reliability and groundwater quality in the Upper Santa Ana Region.



Integration of Water Management and Flood Management Strategies in the Upper Santa Ana River Watershed

5.1.3 Integration of Water Supply Reliability and Water Quality Strategies

Contamination plumes present a challenge and constraint for management and use of groundwater resources. An integrated approach has been taken to clean the plumes, which will eventually remove them as a constraint and improve water supply reliability for water users in the region. The Bunker Hill Basin Regional Water Supply Project is an example of a project that seeks to speed the cleanup of a contamination plume by pumping and treating water from the "heart" of the plume. This type of strategy can expedite the clean-up process and facilitate conjunctive use of the basins while providing reliable water supplies for the water purveyors.

5.1.4 Integration of Imported Water and Local Water Supplies Strategies

The region has a significant public investment in and is dependent upon imported water to meet the region's water needs into the future. However, the State Water Project (SWP) can be unreliable. To improve the reliability of SWP water supply, the region should take delivery of its entire Table A amount each year and store any "leftover" amount that is not used directly by the local water agencies. The water could be stored within local groundwater basins or in a "water bank." By storing as much SWP water as possible during "wet" years, the region will have that water available during drought periods.

5.2 Projects Identified for IRWM Plan Implementation

To implement the water management strategies identified in this plan, over 100 projects have been proposed. Project descriptions have been developed for these projects and are presented in Appendix E.

The focus of these projects is driven by the Water Management Objectives as well as Basin Management Objectives (BMOs) formulated during the planning process. These objectives include improving surface water and groundwater management, water supply reliability, water quality protection, ecosystem improvement, and environmental enhancement.

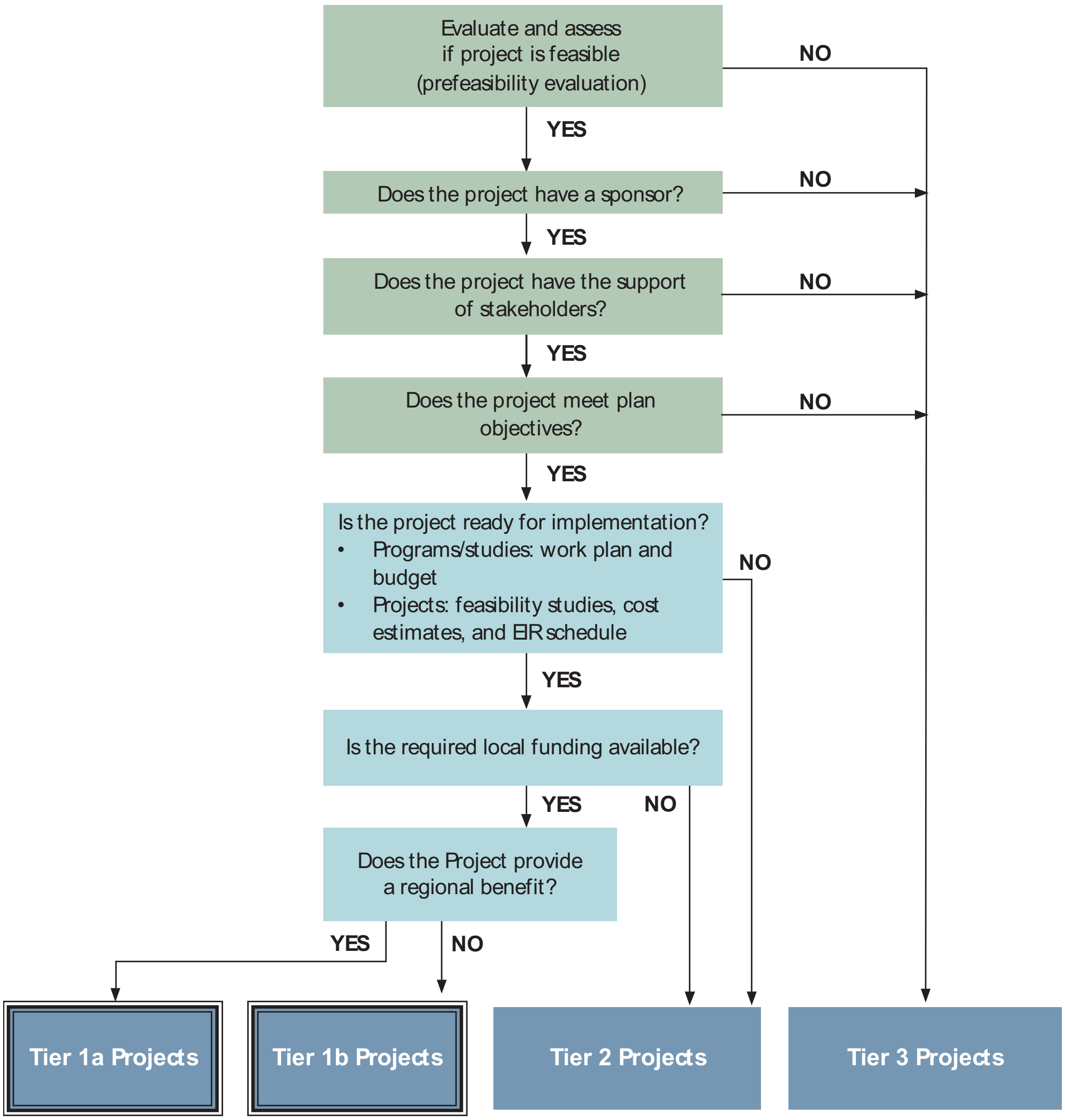
Some of the projects were taken from previous planning efforts such as the San Bernardino Valley Municipal Water District's (Valley District) Master Plan. The list also includes projects that will allow the region to capture and use SAR floodwater. The City of San Bernardino, the largest pumper in the Bunker Hill Basin and the key local agency with responsibility for mitigation of groundwater contamination, is the lead agency for the Bunker Hill Regional Water Supply Project, which involves several other agencies. Projects included in previous Santa Ana Watershed Project Authority (SAWPA) planning studies and Urban Water Management Plans (UWMPs) were also evaluated to identify specific projects that could achieve the objectives of the region and are incorporated into the plan.

In a series of TAG meetings starting in March 2006 and continuing through 2007, the TAG members reviewed the list of projects and provided additional input. Water agencies within the area that are not part of the TAG were also encouraged to participate in development of the list. Most of these projects are integrated and serve multiple strategies. Together, these projects help develop a regional system that would integrate the use of groundwater, SWP water of the State of California (State) contractors in the region, flood and stormwater, and local surface water to meet the Water Management Objectives.

5.2.1 Project Prioritization and Screening Process

The primary purpose of project prioritization and ranking is to provide a process for water leaders in the region to review the proposed projects and collectively decide the region's priorities for the construction of facilities. To facilitate this task, a prioritization and ranking process was developed and is presented in Figure 5-2. The project prioritization and ranking is a two-step process. The first step is to ensure that the project has a sponsor and meets the planning objectives and strategies. The projects that do not pass the first step will be ranked as Tier 3 projects until additional information is gathered that would suggest that it have a higher priority. The second step is to prioritize the projects that pass the first step. It is important to note that project ranking and prioritization is a

Figure 5-2
Planning Process for Project Screening and Ranking



"snapshot in time" and that projects will move from tier to tier as they meet the criteria requirements.

5.2.1.1 Definitions

5.1.2.1.1 Tier 1 Projects

Tier 1a and 1b projects are currently ready for construction per the following criteria:

- Projects have completed or will complete environmental documentation and feasibility studies and cost estimates by July 1, 2008, and will be ready for implementation by July 1, 2009 (design will be completed).
- Studies that are needed to improve water management in the region have developed a detailed scope of work and study cost estimate.
- Projects have necessary local funding for implementation.
- Projects serve the region and reduce regional water supply system vulnerability.

The only difference between Tier 1a and Tier 1b projects is that Tier 1a projects are regional (serve more than three communities).

5.1.2.1.2 Tier 2 Projects

Tier 2 projects include those projects that may not be ready for implementation or do not have local funding. Once a Tier 2 project meets all of the necessary criteria, it can become a Tier 1a or Tier 1b project.

5.1.2.1.3 Tier 3 Projects

Tier 3 projects are conceptual in nature as defined by the following:

- Technically, economically, or financially not feasible at this time (through a pre-feasibility evaluation of the project).
- Lack of local support/sponsor.
- Inconsistent with current water management goals and objectives of the region.
- Inconsistent with existing regulatory or institutional setting.

Once a Tier 3 project meets all of the necessary criteria, it will become a Tier 2 or Tier 1 project.

To prioritize and rank the project, a set of scoring criteria were developed and reviewed by the TAG. The criteria were then applied to all projects to prioritize implementation. A detailed description of the project ranking and scoring criteria is shown in Appendix E. A list of the projects and the results of the project prioritization and ranking is shown in Table 5-1. Table 5-2 shows how projects meet the region’s objectives and their relation to water management strategies.

Figure 5-3 shows the locations of the proposed projects.

Table 5-1
Upper Santa Ana IRWM Plan Project Ranking

STRATEGY / PROJECT NO	PROJECTS	Agency/ Project Sponsor	Project Effectiveness: Meets IRWMP Objectives: SGM	WSR	WQP	ESR	Supports Integration and Multiple Water Management Strategies	Provides Public Safety and Emergency Needs	Serves Disadvantaged Communities	Project commitment: Readiness for Implementation	Availability of Local Funds	Regional Benefit: Serves the Region	Reduce Water Supply Vulnerability	Overall Project Implementation Priority	Tier
Tier 1a - Regional Projects that are "Ready"															
54	Bunker Hill Regional Water Supply	City of SB	2	1	1	0	5	0	5	5	5	5	5	34	1a
90.3	City Creek Crossing	SBVMWD	0	2	0	0	5	0	5	5	5	5	5	32	1a
15	Seven Oaks Dam Borrow Pit Groundwater Recharge and Habitat	Conservation	2	1	0	1	5	0	2	5	5	5	5	31	1a
12	Central Feeder:	SBVMWD	1	2	0	0	5	0	2	5	5	5	5	30	1a
12.1	Central Feeder Pipeline	SBVMWD	See Project 12												
12.3	San Bernardino Pump Station #2	SBVMWD	See Project 12												
1.1	Enhance Spreading	SBVMWD	2	1	0	0	5	0	2	5	5	5	5	30	1a
4.0	Santa Ana River Construction Area - Plunge Pool Pipeline	SBVMWD	2	1	0	0	5	0	2	5	5	5	5	30	1a
80.2	Alabama Street Connector Pipeline	SBVMWD	1	2	0	0	5	0	2	3	5	5	5	28	1a
80.3	Alabama Street Wellfield	SBVMWD	1	2			5	0	2	3	5	5	5	28	1a
46	Pellesier Ranch Barrier Wells and Water Treatment Plant	RPU	1	2	0	0	5	3	0	3	3	5	5	27	1a
19	Riverside-Corona Feeder	WMWD	1	2	0	0	5	0	2	5	1	5	5	26	1a
12.7	Riverside Pump Station (Raub Emergenecy Supply Intertie)	RPU, SBVMWD, WMWD	1	2	0	0	3	3	0	3	3	5	5	25	1a
Tier 1b - Non-Regional Projects that are "Ready"															
9	Lytle Creek and Glen Helen Turnout	SBVMWD	1	2	0	0	5	0	0	5	3	3	2	21	1b
11	LIDS for Kids- Low Impact Development	IERCD	1	0	0	2	5	0	2	3	3	5	0	21	1b
18	San Timoteo Creek Aquatic Restoration	Redlands	1			2	5	0	2	3	3	5	0	21	1b
42	Oak Valley WRP	Yucaipa Valley WD	0	2	1	0	5	0	0	5	5	1	2	21	1b
48	Muscoy Spreading Basins	City of SB	1	2			5	0	5	3	5	0	0	21	1b
97	Erwin Lake/Sugarload Fire Flow & Water Transmission Improvement	BBLDWP	0	2	0	0	3	5	0	5	5	1	0	21	1b
99	Fontana Water Company Recycled Water Project	FWC	0	2	1	0	5	0		5	5	3	0	21	1b
110	San Timoteo Canyon State Park Acquisition and Restoration Project	WRI-CSUSB	0	0	1	2	5	0	2	5	3	3	0	21	1b
118	Lytle Creek Watershed Assessment and Restoration	R.L.C.	0	1	1	2	5	0	2	5	5	0	0	21	1b
127	Rialto Direct Connection to State Water Project	Rialto		2			5	0	5	3	3	1	2	21	1b
6	Inland Empire Sustainable Watershed Program	IERCD	1		1	2	3	0	2	5	3	5	0	22	1b
23	Installation of Groundwater Monitoring Wells in Santa Ana River	Conservation	2	0	0	0	5	0	2	5	3	5	0	22	1b
28	Tertiary Treatment Plant and Reclaimed Water Expansion Study	Rialto	0	2	1	0	5	0	5	3	3	3	0	22	1b
51	Groundwater Reclamation Interagency Project (GRIP)	City of Redlands	1	2	1	0	5	0	0	3	5	5	0	22	1b
53	Medical Center No. 2 Reservoir and Pump Station to Lower Zone	City of SB	0	2	0	0	3	3	5	5	3	1	0	22	1b
58	City of San Bernardino Water Recycling - RIX	City of SB	0	2	1	0	5	0	5	3	3	3	0	22	1b
98	Waterman-Gage Intertie	RPU	1	2	0	0	5	3	0	3	3	3	2	22	1b
113	Removal of Invasive Plant Maintenance	IERCD	1	1	0	2	3	0	0	5	5	5	0	22	1b
124	SAR Trail - Phase III	SBCPD	0	0	0	2	5	0	2	3	5	5	0	22	1b
125	SAR Trail - Phase IV	SBCPD	0	0	0	2	5	0	2	3	5	5	0	22	1b
128	Characterization Study of the Contaminant Plume in the Rialto-	Rialto		1	2		5	0	5	3	3	1	2	22	1b
129	Groundwater Production and Perchlorate Removal Treatment	Rialto		2	1		5	0	5	3	3	1	2	22	1b
131	Groundwater Remediation - Capture High-Concentration Perchlorate	Rialto		1	2		5	0	5	3	3	1	2	22	1b
132	Long-Term Remediation Plan for Rialto-Colton Basin	Rialto		1	2		5	0	5	3	3	1	2	22	1b
16	Recycled Water Program	BBARWWA	0	2	1	0	5	0	0	5	5	3	2	23	1b
22	City of Beaumont WWTP	City of Beaumont	0	2	1	0	5	0	0	5	5	3	2	23	1b
27	Rialto -Colton Basin Groundwater Recharge Study	WVWD, Rialto	2	1	0	0	5	0	5	5	5	0	0	23	1b
102	Big Bear Lake - Lake Management Plan	Multiple Agencies	0	0	2	1	5	0	0	5	5	5	0	23	1b
126	North Village Water Treatment Facility	WVWD	1	2	1		3	3	0	5	5	3	0	23	1b
130	Extension of the Baseline Feeder Agreement	Rialto		2			5	0	5	3	5	1	2	23	1b
13	Riverside North Recharge Basin	RPU	2	1	1	0	5	0	0	5	5	5	0	24	1b
25	North Lake Project	SBVMWD	0	2	0	1	3	5	2	3	3	5	0	24	1b
114	Warm Creek Restoration Project	IERCD	1	1	0	2	3	0	2	5	5	5	0	24	1b
31	Randall Basin	FCD	2	1	0	0	3	3	5	5	5	1	0	25	1b
33	Sand/Warm Confluence	FCD	2	1	0	0	5	3	5	5	3	1	0	25	1b
36	West End Pump Station	SBVMWD	1	2	0	0	5	0	2	5	5	5	0	25	1b
121	Alluvial Fan Development Guideline	WRI-CSUSB	2	1	1	1	5	0	2	5	3	5	0	25	1b
10	Wash Land Management Habitat Conservation Plan	Conservation	1	1	0	2	5	0	2	5	5	5	0	26	1b
120	Water Conservation Demonstration Garden	SBVMWD	1	2	0	1	5	0	2	5	5	5	0	26	1b
123	Regional W. C. Feasibility Study	SBVMWD	1	2	0	1	5	0	2	5	5	5	0	26	1b
8	Lytle Creek Construction Area	SBVMWD	2	1	0	0	5	0	2	5	5	5	2	27	1b
119	Model Institutional WC Makeover	SBVMWD, WRI-CSUSB	1	2	1	1	5	0	2	5	5	5	0	27	1b
29	Cactus Basins #4 and #5	FCD	2	1	1	1	5	3	5	5	5	1	0	29	1b
30	Cactus Basin #3	FCD	2	1	1	1	5	3	5	5	5	1	0	29	1b

Notes: Project readiness include completion of pre-feasibility study, environemental documenetation, project design, and expected implementation date

Tier:
1a - If Regional Benefit is 10 and Total Score is more than 20.
1b - If Total Score is more than 20
2 - If Regional Benefit is less than 10 and Total Score is less than 21
3 - If score for Project Commitment is 4 or less

Terms:
- SGM Surface Water and Groundwater Management
- WSR Water Supply Reliability
- WQP Water Quality Protection
- ESR Ecosystem Restoration

Agencies:
- BBARWWA Big Bear Area Regional Wastewater Agency
- BBLDWP Big Bear Lake Department of Water and Power
- IERCD Inland Empire Resource Conservancy District
- RPU City of Riverside Public Utility Department
- RLD Riverside Land Conservancy
- SBVMWD San Bernardino Valley Municipal Water District
- City of San Bernardino San Bernardino Municipal Water Department
- SBCPD San Bernardino County Parks Department
- WRI-CSUSB Water Resources Institute - California State University San Bernadino
- WVWD West Valley Water District
- Conservation San Bernardino Valley Water Conservation District
- WMWD Western Municipal Water District
- FWC Fontana Water Company

Scoring Criteria
1. Meets Objectives: Score 2 for one objective. Add 1 point for each additional objective met.
2. Supports Strategies: Score 1 for single strategy. Score 3 if integrated. Score 5 if integrated and supports multiple strategies.
3. Provides for Public Safety and Emergency Needs: Project is needed for either, score 3. Project is needed for both, score 5.
4. Serves Disadvantaged Communities: Provides regional benefit including disadvantaged communities, score 2. Provides specific benefit to disadvantaged communities and addresses environmental justice concerns, 5 points.
5. Ready for Implementation: Score 1 point for limited information. Score 3 points for a completed feasibility study or pre-design documents and a preliminary scope of work and budget estimate.
Score 5 points if environmental documentation and feasiblity study is complete and has a detailed scope of work and budget.
6. Available Local Funds: No funds, 0 point. 10%, 2 points. 50%, 3 points. 90% or more, 5 points.
7. Serves the Entire Region: Serves single agency, 1 point. Serves up to three agencies, 3 points. Serves multiple communities and agencies and is a regional project, 5 points.
8. Reduces Water Supply System Vulnerability: For single community, 2 points. For the region, 5 points.

Table 5-1
Upper Santa Ana IRWM Plan Project Ranking

STRATEGY / PROJECT NO	PROJECTS	Agency/ Project Sponsor	Project Effectiveness: Meets IRWMP Objectives: SGM	WSR	WQP	ESR	Supports Integration and Multiple Water Management Strategies	Provides Public Safety and Emergency Needs	Serves Disadvantaged Communities	Project commitment: Readiness for Implementation	Availability of Local Funds	Regional Benefit: Serves the Region	Reduce Water Supply Vulnerability	Overall Project Implementation Priority	Tier
Tier 2 - Projects Needing Additional Work															
45	**Septic System Conversion Highgrove Area - Phase II**	RPU	1	1	2	0	5	0	0	3	3	3	2	**20**	**2**
70.3	**Yucaipa Connector**	SBVMWD	1	2	0	0	3	3	0	3	3	5	0	**20**	**2**
43	**Riverside Regional Water Quality Control Plant**		0	2	1	0	5	0	0	3	3	3	2	**19**	**2**
20	**Regional Water Supply Renewal**	YVWD	0	1	2	0	5	0	0	3	3	3	0	**17**	**2**
26	**City of Redlands WWTP**	City of Redlands	0	2	1	0	5	0	0	3	3	1	2	**17**	**2**
24	**Security Fencing of Groundwater Recharge Facilities**	Conservation	2	1	0	0	5	0	2	3	3	0	0	**16**	**2**
57	**Bunker Hill Basin Water Supply Reliability**	WVWD	1	2	0	0	5	0	0	3	3	1	0	**15**	**2**
21	**Horace P. Hinckley WTP**	City of Redlands	0	2	1	0	3	0	0	3	3	1	0	**13**	**2**
Tier 3 - Projects Further Out on the "Planning Horizon," Need More Implementation Commitment															
39.1	**Mentone Pipeline**	SBVMWD	1	2	0	0	5	0	2	1	3	5	5	**24**	**3**
39.2	**Mentone Feeder**	SBVMWD	1	2	0	0	5	0	2	1	3	5	5	**24**	**3**
39.3	**Citrus Pump Station (Mentone Pump Station)**	SBVMWD	1	2	0	0	5	0	2	1	3	5	5	**24**	**3**
39.4	**Citrus Reservoir (Mentone Reservoir)**	SBVMWD	1	2	0	0	5	0	2	1	3	5	5	**24**	**3**
40.1	**DWR Pump Station Alternative 1**	SBVMWD	1	2	0	0	5	0	2	1	3	5	5	**24**	**3**
40.2	**DWR Pump Station Alternative 2 (only count cost of 40.1 as these are alternatives)**	SBVMWD	1	2	0	0	5	0	2	1	3	5	5	**24**	**3**
7	**Devil Canyon Construction Area**	SBVMWD	2	1	0	0	5	0	2	1	3	5	2	**21**	**3**
12.6	**Redlands Reservoir**	SBVMWD	0	2	0	0	5	0	2	1	3	5	2	**20**	**3**
35	**Existing Pilot Dewatering and Phased Dewatering Project**	SBVMWD	2	1	0	0	5	3	5	1	3	0	0	**20**	**3**
37	**9th Street Feeder**	SBVMWD	1	2	0	0	5	0	5	1	3	1	2	**20**	**3**
14	**Surface Water Treatment Plants**	SBVMWD	1	2	1	0	3	0	5	1	1	5	0	**19**	**3**
59	**Lytle Creek Reservoir**	City of SB	0	2	0	0	3	0	5	1	3	5	0	**19**	**3**
60.1	**Baseline Feeder West Extension**	SBVMWD	1	2	0	0	5	0	2	1	3	5	0	**19**	**3**
80.1	**Orange Street Connector Pipeline**	SBVMWD	1	2	0	0	5	0	2	1	3	5	0	**19**	**3**
12.4	**Redlands Pump Station**	SBVMWD	0	2	0	0	3	0	2	1	3	5	2	**18**	**3**
70.2	**Yucaipa Pump Station**	SBVMWD	1	2	0	0	3	3	0	1	3	5	0	**18**	**3**
1	**Seven Oaks Dam and Reservoir Construction Area**	SBVMWD	1	2	0	0	5	0	2	1	1	5	0	**17**	**3**
32	**Constructed Wetlands**	WRI-CSUSB	0	0	1	2	5	0	5	1	3	0	0	**17**	**3**
38.1	**South End Feeder**	SBVMWD	1	2	0	0	5	0	0	1	3	5	0	**17**	**3**
38.2	**South End Pump Station**	SBVMWD	1	2	0	0	5	0	0	1	3	5	0	**17**	**3**
60.2	**Baseline Feeder Pump Station (East and/or West Alternative)**	SBVMWD	0	2	0	0	3	0	5	1	3	3	0	**17**	**3**
34	**Cable Creek**	FCD	2	1	0	0	3	3	2	3	1	1	0	**16**	**3**
55	**Medical Center to Virginia Street Connector**	City of SB	0	2	0	0	3	0	5	1	3	1	0	**15**	**3**
100	**Foothill Pipeline Enlargement**	SBVMWD	0	2	0	0	3	0	2	1	3	1	3	**15**	**3**
61	**Waterman Pump Station to Lower Zone**	City of SB	0	2	0	0	3	0	5	1	3	0	0	**14**	**3**
12.2	**San Bernardino Pump Station #1**	SBVMWD	0	2	0	0	3	0	0	1	3	1	2	**12**	**3**
70.1	**Yucaipa Lakes Pipeline**	SBVMWD	0	2	0	0	3	0	0	1	3	1	0	**10**	**3**
4.1	**Morton Canyon Hydroelectric Gen. Plant**	SBVMWD	0	0	0	0	0	0	0	0	0	0	0	**0**	**3**
DWR Projects															
39.5	**East Branch Extension of the SWP, Phase 2**	DWR	1	2	0	0	5	0	2	3	3	5	5	**26**	**1a**
39.6	**DWR Pump Station Expansions**	DWR	0	2	0	0	5	0	2	3	3	5	5	**25**	**1a**
39.8	**Zanja Reservoir**	DWR	1	2	0	0	5	5	2	1	3	3	3	**25**	**3**
39.7	**Sunrise Ranch Reservoir**	DWR	1	2	0	0	5	5	2	1	3	5	0	**24**	**3**
Back Burner Projects															
	BCV Forest Land Reserved														
	Bogart Park Wetlands														
	City of Beaumont Desalter	City of Beaumont													
	Sari Improvement Project														
	Stanfield Marsh														
122	**Numeric Groundwater Model for Riverside/Arlington Groundwater Basins**	RPU, WMWD													

Notes: Project readiness include completion of pre-feasibility study, environemental documenetation, project design, and expected implementation date

Tier:
1a - If Regional Benefit is 10 and Total Score is more than 20.
1b - If Total Score is more than 20
2 - If Regional Benefit is less than 10 and Total Score is less than 21
3 - If score for Project Commitment is 4 or less

Terms:

SGM	Surface Water and Groundwater Management
WSR	Water Supply Reliability
WQP	Water Quality Protection
ESR	Ecosystem Restoration

Agencies:

BBARWWA	Big Bear Area Regional Wastewater Agency
BBLDWP	Big Bear Lake Department of Water and Power
IERCD	Inland Empire Resource Conservancy District
RPU	City of Riverside Public Utility Department
RLD	Riverside Land Conservancy
SBVMWD	San Bernardino Valley Municipal Water District
City of San Bernardino	San Bernardino Municipal Water Department
SBCPD	San Bernardino County Parks Department
WRI-CSUSB	Water Resources Institute - California State University San Bernardino
WVWD	West Valley Water District
Conservation	San Bernardino Valley Water Conservation District
WMWD	Western Municipal Water District
FWC	Fontana Water Company

Scoring Criteria

1. Meets Objectives: Score 2 for one objective. Add 1 point for each additional objective met.
2. Supports Strategies: Score 1 for single strategy. Score 3 if integrated. Score 5 if integrated and supports multiple strategies.
3. Provides for Public Safety and Emergency Needs: Project is needed for either, score 3. Project is needed for both, score 5.
4. Serves Disadvantaged Communities: Provides regional benefit including disadvantaged communities, score 2. Provides specific benefit to disadvantaged communities and addresses environmental justice concerns, 5 points.
5. Ready for Implementation: Score 1 point for limited information. Score 3 points for a completed feasibility study or pre-design documents and a preliminary scope of work and budget estimate. Score 5 points if environmental documentation and feasiblity study is complete and has a detailed scope of work and budget.
6. Available Local Funds: No funds, 0 point. 10%, 2 points. 50%, 3 points. 90% or more, 5 points.
7. Serves the Entire Region: Serves single agency, 1 point. Serves up to three agencies, 3 points. Serves multiple communities and agencies and is a regional project, 5 points.
8. Reduces Water Supply System Vulnerability: For single community, 2 points. For the region, 5 points.

Table 5-2
Upper Santa Ana IRWMP Prioritization and Cost

OBJECTIVES	STRATEGY / PROJECT NO	PROJECTS	Agency/ Project Sponsor	Project Ranking/ Tier	Objectives: SGM	WSR	WQP	ESR	Strategies	Funding Opportunities	Projected Costs
IMPROVE WATER SUPPLY RELIABILITY	**WATER TREATMENT AND RECYCLING**										
	14	**Surface Water Treatment Plants**	SBVMWD	3	✓	✔	✓		WS, SWQ	PROP 84	
	16	**Big Bear Area Regional Wastewater Agency Plant**	BBARWWA	2		✔	✓		WTR, SWQ, WS	SWRCB	$42,600,000
	21	**Horace P. Hinckley WTP**	City of Redlands	2		✔	✓		WTR, SWQ, WS	SWRCB, DPH	
	28	**Tertiary Treatment Plant and Reclaimed Water Expansion Study**	Rialto	1b		✔	✓		WTR, SWQ, WS	SWRCB	$165,000
	58	**City of San Bernardino Water Recycling - RIX**	City of SB	1b		✔	✓		WTR, SWQ, WS	SWRCB	$67,800,000
	22	**City of Beaumont WWTP**	City of Beaumont	1b		✔	✓		WTR, SWQ, WS	SWRCB, DPH	
	26	**City of Redlands WWTP**	City of Redlands	2		✔	✓		WTR, SWQ, WS	SWRCB, DPH	
	42	**Oak Valley WRP**	Yucaipa Valley WD	1b		✔	✓		WTR, SWQ, WS	SWRCB, DPH	
	43	**Riverside Regional Water Quality Control Plant**		2		✔	✓		WTR, SWQ, WS	SWRCB, DPH	
	126	**North Village Water Treatment Facility**	WVWD	1b		✔	✓		WTR, SWQ, WS	SWRCB	$14,540,000
	99	**Fontana Water Company Recycled Water Project**	FWC	1b		✔	✓		WTR, SWQ, WS	SWRCB	$7,547,352
	WATER CONSERVATION										
	123	**Regional W. C. Feasibility Study**	SBVMWD	1b	✓	✔		✓	WC, WS, EHE	PROP 84 CH 2, PROP 50	$250,000
	120	**Water Conservation Demonstration Garden**	SBVMWD	1b	✓	✔		✓	WC, WS, EHE	PROP 50, PROP 84	$120,000
	119	**Model Instutional WC Makeover**	SBVMWD, WRI-CSUSB	1b	✓	✔		✓	WC, WS, EHE	PROP 50, PROP 84	$350,000
	CONVEYANCE AND INTERTIE										
	9.1 & 9.2	**Lytle Creek and Glen Helen Turnout**	SBVMWD	1b	✓	✔			CI, WS	PROP 84 CH 2	$4,160,000
	12.1	**Central Feeder Pipeline**	SBVMWD	1a	✓	✔			CI, WS	PROP 84 CH 2	$117,000,000
	12.2	**San Bernardino Pump Station #1**	SBVMWD	3		✔			CI, WS	PROP 84 CH 2	$2,900,000
	12.3	**San Bernardino Pump Station #2**	SBVMWD	1b		✔			CI, WS	PROP 84 CH 2	$10,000,000
	12.4	**Redlands Pump Station**	SBVMWD	3		✔			CI, WS	PROP 84 CH 2	$55,000,000
	12.7	**Riverside Pump Station (Raub Emergenecy Supply Intertie)**	RPUD	1a	✓	✔			CI, WS	PROP 84 CH 2	$8,000,000
	19	**Riverside-Corona Feeder**	WMWD	1a	✓	✔			CI, WS	PROP 84 CH 2	$176,000,000
	36	**West End Pump Station**	SBVMWD	1b	✓	✔			CI, WS	PROP 84 CH 2	$10,000,000
	37	**9th Street Feeder**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$24,100,000
	38.1	**South End Feeder**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$11,500,000
	38.2	**South End Pump Station**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$1,090,000
	39.1	**Mentone Pipeline**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$11,700,000
	39.2	**Mentone Feeder**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$18,800,000
	39.3	**Citrus Pump Station (Mentone Pump Station)**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$13,800,000
	39.5	**EBX Phase 2 (Pipeline, PS & Reservoirs)**	DWR	1a	✓	✔			CI, WS	PROP 84 CH 2	$196,000,000
	39.6	**DWR Pump Station Expansions (Crafton Hills PS, Greenspot PS, Cherry Valley PS)**	DWR	1a		✔			CI, WS	PROP 84 CH 2	$5,000,000
	40.1	**DWR Pump Station Alternative 1**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$23,300,000
	40.2	**DWR Pump Station Alternative 2 (only count cost of 40.1 as these are alternatives)**	SBVMWD	same as above	Same as	above			CI, WS	PROP 84 CH 2	See 40.1
	55	**Medical Center to Virginia Street Connector**	City of SB	3		✔			CI, WS	PROP 84 CH 2	$3,475,000
	60.1	**Baseline Feeder West Extension**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$30,300,000
	60.2	**Baseline Feeder Pump Station (East and/or West Alternative)**	SBVMWD	3		✔			CI, WS	PROP 84 CH 2	$3,100,000
	61	**Waterman Pump Station to Lower Zone**	City of SB	3		✔			CI, WS	PROP 84 CH 2	$1,010,000
	70.1	**Yucaipa Lakes Pipeline Replacement**	SBVMWD	3		✔			CI, WS	PROP 84 CH 2	$760,000
	70.2	**Yucaipa Pump Station**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$12,900,000
	70.3	**Yucaipa Connector**	SBVMWD	2	✓	✔			CI, WS	PROP 84 CH 2	$4,500,000
	80.1	**Orange Street Connector Pipeline**	SBVMWD	3	✓	✔			CI, WS	PROP 84 CH 2	$4,900,000
	80.2	**Alabama Street Connector Pipeline**	SBVMWD	1a	✓	✔			CI, WS	PROP 84 CH 2	$8,800,000
	80.3	**Alabama Street Well Field**	SBVMWD	1a	✓	✔			CI, WS	PROP 84 CH 2	$4,500,000
	90.3	**City Creek Crossing**	SBVMWD	1a		✔			CI, WS	PROP 84 CH 2	$5,200,000
	97	**Erwin Lake Fire Flow**	BBLDWP	1b		✔			CI, WS	PROP 84 CH 2	$1,600,000
	98	**Waterman-Gage Intertie**	RPUD	1b	✓	✔			CI, WS	PROP 84 CH 2	$5,300,000
	100	**Foothill Pipeline Enlargement**	SBVMWD	1b		✔			CI, WS	PROP 84 CH 2	$25,000,000
	127	**Rialto Direct Connection to State Water Project**	Rialto	1b		✔			CI, WS	PROP 84 CH 2	$12,119,379
	130	**Extension of the Baseline Feeder Agreement**	Rialto	1b		✔			CI, WS	PROP 84 CH 2	
	STORAGE										
	12.5	**San Bernardino Reservoir**	SBVMWD	1b		✔			STO, WS	PROP 84 CH 2	$4,500,000
	12.6	**Redlands Reservoir**	SBVMWD	3		✔			STO, WS	PROP 84 CH 2	$5,700,000
	25	**North Lake Project**	SBVMWD	1b		✔		✓	STO, WS	PROP 84 CH 2	$133,000,000
	39.4	**Citrus Reservoir (Mentone Reservoir)**	SBVMWD	3	✓	✔			STO, WS	PROP 84 CH 2	$91,000,000
	39.7	**Sunrise Ranch Emergency Reservoir**	DWR	3	✓	✔			STO, WS	PROP 84 CH 2	$133,000,000
	39.8	**Zanja Emergency Storage**	DWR	3	✓	✔			STO, WS	PROP 84 CH 2	$130,000,000
	53	**Medical Center No. 2 Reservoir**	City of SB	1b		✔			STO, WS	PROP 84 CH 2	$18,100,000
	59	**Lytle Creek Reservoir**	City of SB	3		✔			STO, WS	PROP 84 CH 2	$16,100,000

✔ Denotes Primary Objective
✓ Denotes Secondary Objective

Strategies in **bold** are primary
Strategies not in bold are secondary

Notes: Project readiness include completion of pre-feasibility study, environemental documenetation, project design, and expected implementation date

Tier:
1a - If Regional Benefit is 10 and Total Score is more than 20.
1b - If Total Score is more than 20
2 - If Regional Benefit is less than 10 and Total Score is less than 21
3 - If score for Project Commitment is 4 or less

Terms:
SGM Surface Water and Groundwater Management
WSR Water Supply Reliability
WQP Water Quality Protection
ESR Ecosystem Restoration

Strategy Abbreviations

WTR Water Treatment and Recycling
WC Water Conservation
CI Conveyance and Intertie
STO Storage
GWM Groundwater Management
GQP Groundwater Quality Protection
CU Conjunctive Use
WS Water Supply
SWM Surface Water Management
FSW Flood and Storm Water Management
TNM TDS and Nitrogen Management
SWQ Surface Water Quality Improvement
EHE Ecosystem Protection and Habitat Enhancement
WR Wetlands Restoration
LU Land Use
RPA Recreation and Public Access
WR Water Recycling

Table 5-2
Upper Santa Ana IRWMP Prioritization and Cost

OBJECTIVES	STRATEGY / PROJECT NO	PROJECTS	Agency/ Project Sponsor	Project Ranking/ Tier	Objectives: SGM	WSR	WQP	ESR	Strategies	Funding Opportunities	Projected Costs
IMPROVE SURFACE WATER AND GROUNDWATER MANAGEMENT	**GROUNDWATER MANAGEMENT**										
	15	**Seven Oaks Dam Borrow Pit Groundwater Recharge and Habitat Restoration Project**	Conservation	1a	✔	✓		✓	**GWM, CU, EHE**	**PROP 84 CH 2, PROP 84 CH 5**	$9,700,000
	23	**Installation of Groundwater Monitoring Wells in Santa Ana River Forebay**	Conservation	1b	✔				**GWM**	**AB 303**	$640,000
	27	**Rialto -Colton Basin Groundwater Recharge Study**	WVWD	1b	✔	✓			**GWM, CU**	**PROP 84 CH 2 NON-IRWMP, AB303**	$280,000
	121	**Alluvial Fan Development Guideline**	WRI-CSUSB	1b					**GWM, LU, FSW**	**PROP 84 CH 3, 1E**	$630,000
	122	**Numeric Groundwater Model for Riverside/Arlington Groundwater Basins**	RPUD, WMWD		✔	✓			**GWM, CU**	**AB 303**	
	GROUNDWATER QUALITY PROTECTION										
	35	**Existing Pilot Dewatering and Phased Dewatering Project**	SBVMWD	3	✔	✓			**GWM, GQP, WS**	**PROP 84 CH 2**	Unknown
	45	**Septic System Conversion Higrove Area- Phase II**	RPUD	2	✓	✓	✔		**GQP, WS**	**PROP 84 CH 2, DPH**	$9,730,000
	46	**Pellesier Ranch Barrier Wells and Water Treatment Plant**	RPUD	1a	✓	✔			**GQP, WS, CI**	**PROP 84 CH 2, PROP 84 CH 2 NON-IRWMP, DPH**	$17,700,000
	51	**Groundwater Reclamation Interagency Project (GRIP)**	City of Redlands	1b	✓	✔	✓		**GQP, WS, WR**	**PROP 84 CH 2**	$9,100,000
	54	**Bunker Hill Regional Water Supply**	City of SB	1a	✔	✓	✓		**GQP, WS, GWM**	**PROP 84 CH 2, PROP 84 CH 2 NON-IRWMP, DPH**	$86,300,000
	57	**Bunker Hill Basin Water Supply Reliability**	WVWD	2	✓	✔			**GQP**	**PROP 84 CH 2**	$13,000,000
	128	**Characterization Study of the Contaminant Plume in the Rialto-Colton Basin**	Rialto	1b	✔	✓			**GQP, WS**	**AB 303**	$6,490,561
	129	**Groundwater Production and Perchlorate Removal Treatment**	Rialto	1b	✔	✓			**GQP, WS**	**PROP 84 CH 2, DPH**	$6,060,000
	131	**Groundwater Remediation - Capture High-Concentration Perchlorate Contamination in the Rialto-Colton Basin**	Rialto	1b	✔	✓			**GQP, WS**	**PROP 84 CH 2, DPH**	$14,500,000
	132	**Long-Term Remediation Plan for Rialto-Colton Basin**	Rialto	1b	✔	✓			**GQP, WS**	**PROP 84 CH 2, DPH**	$250,000
	CONJUNCTIVE USE										
	1	**Seven Oaks Dam and Reservoir Construction Area**	SBVMWD	3	✓	✔			**SWM, CU, WS**	**PROP 84 CH 2**	$29,000,000
	1.1	**Enhance Spreading**	SBVMWD	1a	✓	✔	✓		**SWM, CU, WS**	**PROP 84 CH 2**	$8,000,000
	4.0	**Santa Ana River Construction Area**	SBVMWD	1a	✔	✓			**SWM, CU, WS**	**PROP 84 CH 2**	$122,000,000
	4.1	**Morton Canyon Hydroelectric Gen. Plant**	SBVMWD	3					**CU**	**OTHER**	$38,000,000
	7	**Devil Canyon Construction Area**	SBVMWD	3	✔	✓			**SWM, CU, WS**	**PROP 84 CH 2**	$1,720,000
	8	**Lytle Creek Construction Area**	SBVMWD	1b	✔	✓			**SWM, CU, WS**	**PROP 84 CH 2**	$13,500,000
	13	**Riverside North Recharge Basin**	RPUD	1b	✔	✓	✓		**CU, SWM, WS**	**PROP 84 CH 2**	$13,400,000
	48	**Muscoy Spreading Basins**	SBVMWD	1b	✔	✓	✓		**CU, SWM**	**PROP 84 CH 2**	$5,227,200
	FLOOD AND STORM WATER MANAGEMENT										
	29	**Cactus Basins #4 and #5**	FCD	1b	✔	✓	✓	✓	**FSW, SWM, CU, SWQ**	**PROP 84 CH 3, PROP 84 CH 5, 1E**	$21,300,000
	30	**Cactus Basins #3**	FCD	1b	✔	✓	✓	✓	**FSW, SWM, CU, SWQ**	**PROP 84 CH 3, PROP 84 CH 5, 1E**	$21,300,000
	31	**Randall Basin**	FCD	1b	✔	✓			**FSW, SWM, CU, SWQ**	**PROP 84 CH 3, PROP 84 CH 5, 1E**	$1,460,000
	34	**Cable Creek Debris Basin**	FCD	3	✔	✓			**FSW, SWM, CU, SWQ**	**PROP 84 CH 3, PROP 84 CH 5, 1E**	$38,000,000
	33	**Sand/Warm Confluence**	FCD	1b	✔	✓			**FSW**	**PROP 84 CH 3, PROP 84 CH 5, 1E**	$2,600,000
PROTECT WATER QUALITY	**TDS AND NITROGEN MANAGEMENT**										
	20	**Desalter and Brine Disposal**	YVWD	2		✓	✔		**TNM, WS**	**PROP 84 CH 2, PROP 84 CH 2 NON-IRWMP**	$9,600,000
		City of Beaumont Desalter	City of B.	0					**TNM, WS**	**PROP 84 CH 2**	
		Sari Improvement Project		0					**TNM, WS**	**PROP 84 CH 2**	
	SURFACE WATER QUALITY IMPROVEMENT										
	24	**Security Fencing of Groundwater Recharge Facilities**	Conservation	2	✔	✓			**SWQ, GQP**	**PROP 84 CH 2, PROP 84 CH 2 NON-IRWMP**	$1,140,000
	102	**Big Bear Lake Management Plan**	Multiple Agencies	1b			✔	✓	**SWQ, WS, EHE**	**PROP 84 CH 2, PROP 84 CH 2 NON-IRWMP, PROP 84 CH 5**	$260,000
ECOSYSTEM RESTORATION AND ENVIRONMENTAL ENHANCEMENT	**ECOSYSTEM PROTECTION AND HABITAT ENHANCEMENT**										
	10	**Wash Habitat Conservation Plan**	Conservation	1b	✓	✓		✔	**EHE, CU**	**PROP 84 CH 5, PROP 84 CH 9, AB 303**	$300,000
	110	**Lytle Creek Watershed Assessment and Restoration**	WRI-CSUSB	1b		✓	✓	✔	**EHE**	**PROP 84 CH 5, PROP 84 CH 9**	$260,000
	118	**San Timoteo Canyon State Park Acquisition and Restoration**	R.L.C.	1b			✓	✔	**EHE**	**PROP 84 CH 5, PROP 84 CH 9**	$5,500,000
	113	**Removal of Invasive Plant**	IERCD	1b	✓	✓		✔	**EHE**	**PROP 84 CH 5, PROP 84 CH 9**	$300,000
	114	**Warm Creek Restoration Project**	IERCD	1b	✓	✓		✔	**EHE**	**PROP 84 CH 5, PROP 84 CH 9**	$63,000
	WETLANDS RESTORATION										
		Stanfield Marsh							**WR, EHE**		
		Bogart Park Wetlands							**WR, EHE**		
	LAND USE										
		BCV Forest Land Reserved							**LU, SWQ**		
	6	**I.E. Sustainable Watershed Project**	IERCD	1b	✓		✓	✔	**LU, SWQ**	**CALFED**	$115,000
	11	**LIDS for Kids- Low Impact Development**	IERCD	2	✓			✔	**EHE, SWQ**	**PROP 84 CH 5, PROP 84 CH 9**	$237,000
	RECREATION AND PUBLIC ACCESS										
	18	**San Timoteo Creek Aquatic Restoration**	Redlands	1b							$5,500,000
	32	**Constructed Wetlands**	WRI-CSUSB	1b			✓	✔	**RPA**	**PROP 84 CH 8, PROP 84 CH 9**	Unknown
	124	**SAR Trail - Phase III**	SBCPD	1b				✔	**RPA**	**PROP 84 CH 5**	
	125	**SAR Trail - Phase IV**	SBCPD	1b				✔	**RPA**	**PROP 84 CH 5**	
										Total:	$1,989,749,492

✔ Denotes Primary Objective
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Strategies in **bold** are
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Notes: Project readiness includes completion of pre-feasibility study, environmental documentation, project design, and expected implementation date

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WR Wetlands Restoration
LU Land Use
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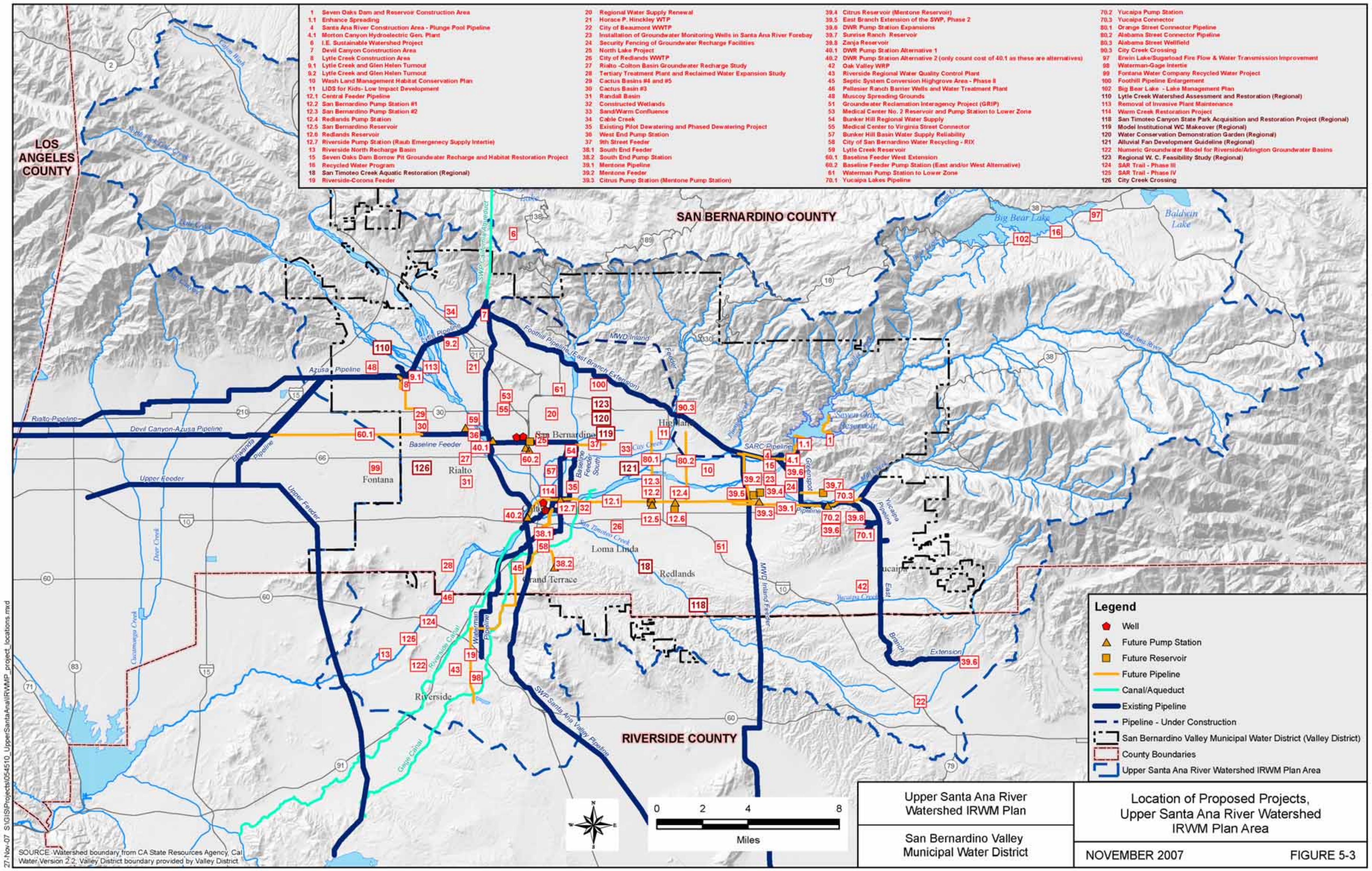
Figure 5-3
Project Locations



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5.2.2 Economic and Technical Feasibility of the Projects

As stated above, a pre-feasibility evaluation of the projects is conducted to assess technical and economical feasibility of the projects. Those projects that are deemed not feasible at this time (based on a pre-feasibility evaluation) are ranked as Tier 3 and considered not ready for implementation. These projects will be evaluated in the future as additional information is developed and becomes available.

The projects that pass the above test are ranked as Tier 1 or Tier 2. Tier 1 projects are considered to be ready for implementation. These projects must have or should have a completed feasibility study, pre-design documents, and environmental documents by mid-2008. Therefore, only those projects that are deemed economically and technically feasible will move forward for implementation. The project's sponsoring agency is responsible for meeting the stated schedule for conducting the feasibility evaluations.

5.3 Implementation Considerations

5.3.1 Institutional Structures Needed for Plan Implementation

The responsibility for implementation of the IRWM Plan will be shared among the individual entities that participated in the planning process and prepared this plan. The implementation responsibility is based upon the jurisdiction of each responsible entity. The following summarizes the proposed implementation approach for those projects, programs, and investigations that have been formulated to date, and identifies recommendations to assist in future program and project formulation and direction.

5.3.1.1 Management of San Bernardino Basin Area

The Basin Technical Advisory Committee (BTAC) will develop the annual operation plan for managing the San Bernardino Basin Area (SBBA). The annual basin management plan will then be forwarded on to the applicable elected officials for review and approval. The BTAC will be comprised of staff representatives from plaintiffs and non-plaintiffs of the Western Judgment (Western Municipal Water District of Riverside County v. East San Bernardino County Water District, Case No. 78426). A detailed discussion of the process for managing the SBBA and BTAC responsibility is presented in Chapter 4.

5.3.1.2 Management of the Groundwater Basins

Most of the groundwater basins in the Upper SAR Watershed are adjudicated by pumpers or adjudicated “in gross” and are overseen by “Watermasters” who keep an accounting of recharge and extractions.

5.3.2 Project Implementation

Implementation of the projects is the responsibility of the project sponsor(s). For projects funded through the grant programs, the TAG will work with regional agencies as well as SAWPA to coordinate, apply, receive, and distribute the grant funding for project implementation. Projects formulated for this plan must periodically be updated and reprioritized, and new projects may be introduced for screening and prioritization. These activities will also be the responsibility of the TAG, which will be coordinated by Valley District. Project implementation responsibilities include coordination with the appropriate local, State, and federal agencies to prepare and complete necessary environmental documents and to pursue opportunities to fund the projects that are under their jurisdiction, consistent with the IRWM Plan.

5.3.3 Periodic Review and Update of the IRWM Plan

In order to keep the IRWM Plan current, it should be refined as necessary. These refinements will be the result of knowledge gained through the use of the plan.

Valley District will assume responsibility for making updates to the plan on an interval agreed upon by the TAG. Reviews and updates will focus on analyzing new information developed since the adoption of the previous plan and the need for specific water management actions. The reviews would identify areas where the plan has been successfully implemented, as well as areas where deficiencies are apparent.

Valley District will continue to coordinate the regional planning activities of the TAG as needed, and coordinate with other IRWM Plan planning activities in the region and with State and federal agencies.

5.3.3.1 Monitoring and Data Management

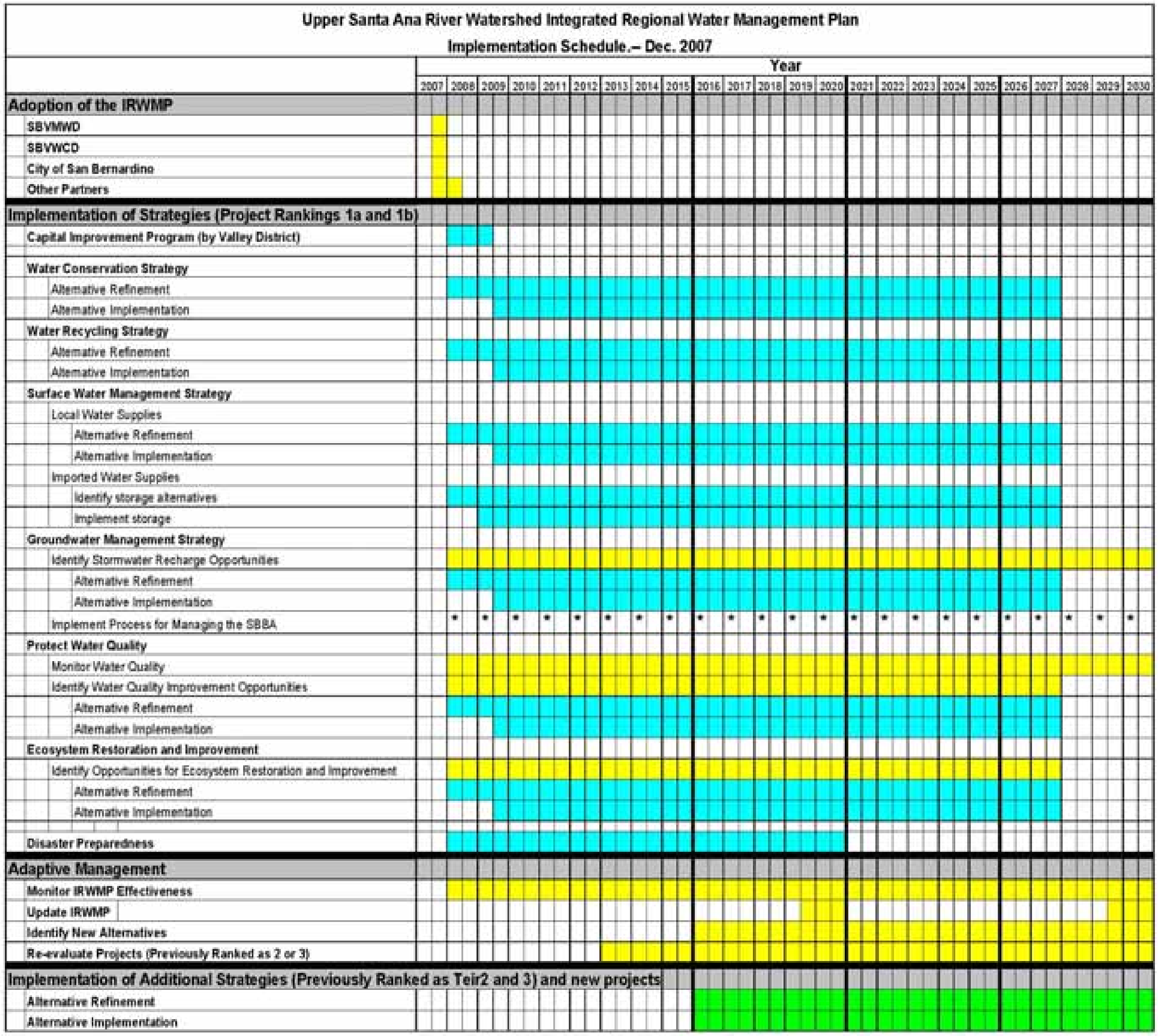
Implementation of monitoring programs and data management and coordination is the responsibility of the entities managing the basins, as summarized below.

- The BTAC will be responsible for monitoring, data management, and coordination for the SBBA, Rialto-Colton Basin, and North Riverside Basin as defined in the monitoring program developed for this plan.
- San Timoteo Watershed Management Authority is responsible for data collection, management, and coordination activities related to the San Timoteo Basin.
- Big Bear MWD is responsible for data collection, storage, and monitoring coordination activities associated with the Big Bear Lake Basin.

5.3.4 Implementation Schedule

The IRWM Plan will be implemented during the next 25 years. The first step in implementation is to prepare a capital improvement plan to identify funding sources for proposed projects. It is anticipated that feasible Tier 1a and 1b projects will be implemented during the next 20 years. Tier 2 and 3 projects will be periodically reviewed and as additional project information becomes available, will move up for implementation. Additional projects may be identified for implementation. Implementation schedules for individual projects will also be prepared along with feasibility studies. Figure 5-4 is a snap shot (as of December 2007) of the Plan implementation schedule. This schedule will be updated as additional information is developed and full feasibility of the projects is completed.

Figure 5-4
Implementation Schedule



Notes:

Alternative Refinement: Includes activities associated with project development, project feasibility, project design.

Alternative Implementation: Includes activities associated with: permitting and environmental review, plans and specifications, and project implementation.

* Annual SBBA Operation Plan

IRWMP activities and long-term monitoring.

Activities associated with Implementation of 1a and 1b ranked projects.

Activities associated with implementation of projects previously ranked as 2 or 3.

5.3.5 Regional and Statewide Priority and Issues of State Significance

Improving water supply reliability and reducing reliance on the SWP during droughts is considered an issue of Statewide significance. Environmental and fishery issues of the Sacramento-San Joaquin Delta (Delta), including endangered species, vulnerability of Delta levees, and Delta water quality issues, significantly reduce reliability of the SWP supplies. Recently, State water leaders and the Governor's Office have had renewed discussion of an "Isolated Facility" around the Delta as an alternative to the current "broken" operations in the Delta. The isolated facility has the potential to improve fishery issues, reduce the impact of water diversions on listed species, and improve drinking water quality (less total dissolved solids (TDS), trihelimethane, and bromide) for millions of Californians. This translates into increased reliability for the SWP supplies. The resolution of Delta conveyance issues, therefore, will benefit the region and its water supply, and will significantly contribute to water supply reliability and water quality improvement in the Upper Santa Ana Region.

It should also be noted that a major consideration and a regional priority for formulation of this IRWM Plan is to improve water supply reliability and optimize the use of imported water to reduce reliance on imported water during droughts. Implementation of water management strategies of this plan, therefore, will reduce stresses on SWP supplies, especially during drought periods, and will provide statewide water supply benefits.

5.4 Capital Improvement Funding

Implementation of the projects listed in Table 5-1 requires an estimated investment of over $2 billion. This level of funding is beyond the financial abilities of local agencies of the region at this time. Therefore, it is important for the water leaders to develop a capital improvement plan that identifies funding sources and further refines priorities for project implementation. In addition, the agencies should actively engage in obtaining grant funding to assist in project implementation.

Depending on the characteristics and scope of a particular project, some activities and projects currently identified in this IRWM Plan and future activities will likely be in some part contingent on securing funding from federal, State, and/or local sources. The following summarizes project funding approaches to date, as well as anticipated funding strategies.

5.4.1 Federal Funding

The federal grant funding sources are currently limited. The U.S. Bureau of Reclamation's (Reclamation) Challenge Grant Program provides funding for water management programs and projects in the western United States. This grant program might help fund the implementation of water conservation projects. Reclamation also provides funding for water recycling programs in Southern California. The Environmental Protection Agency (EPA) provides funding for environmental improvement projects. In addition, funding can be directed for implementation of projects under the IRWM Plan, through the Federal Energy and Water Development Appropriations legislation.

5.4.2 State Grant Funding

State funding may be a significant source of funding for implementation of the IRWM Plan. Current key State funding sources include the following:

- The Water Use Efficiency Program, which is currently administered by DWR and is funded through various bond initiatives, and provides grant funding for agricultural and urban water conservation programs.
- DWR's AB 303 Local Groundwater Assistance Program funds groundwater management, data collection, modeling, monitoring, and assessment programs. AB 303 is a potential source of funding for a range of groundwater management projects.
- The Integrated Regional Water Management Grant Program is well suited for funding of the projects developed for the IRWM Plan. Proposition 84 allocated $114 million for the Santa Ana Region integrated regional plans, which is a small fraction of the funding needed for the region's projects.

- The passage of Proposition 84 in the November 2006 election allocated $800 million for flood control projects in which $180 million is allocated for the subvention program to help local agencies outside the Central Valley to implement local flood control projects.
- Proposition 1E provides $300 million in funding for stormwater management and other projects outside of the Central Valley.
- Proposition 84 allocated $45 million in funding to expand and improve the Santa Ana River Parkway.

5.4.3 Local Agency Funding

Local entities for years have been implementing cost-effective projects and programs at the local level. In the past, local funding has been used in part or in total to fund local water projects. Today, however, a major constraint in implementing many of the projects in this IRWM Plan is the lack of financial capacity and funding availability at the local level. Some of the communities in the Upper Santa Ana Region are economically disadvantaged (i.e., their median income is less than 80 percent of the average) and they may not be able to finance costly projects. Bond laws (i.e., Chapter 8 of Proposition 50) generally require local agencies to share the cost of implementing their project unless the project is benefiting an economically disadvantaged community, in which case, the community could be qualified for exemption from local cost-sharing requirements.

5.5 Obstacles to Implementation

The most significant obstacle to implementation of the IRWM Plan is funding of capital improvement projects. Considering the limited financial capacity of the agencies in the Upper Santa Ana Region, it would be very difficult to fund projects with an estimated cost of $2 billion. Steps that can be taken to remedy funding obstacles include development of a capital improvement plan, implementation phasing, obtaining grant funding, and forging partnerships to fund major projects. No other insurmountable obstacles to implementation of the IRWM Plan have been identified. As described earlier, the agencies within the Plan Area have successfully worked together in the past on the development and implementation of projects and programs to improve the water resources management within the region. Working together, these agencies have developed a successful relationship, enabling them to accomplish things that satisfy the varied interests within the Upper SAR Watershed. Developing these initial relationships, trust, and accountability among the participating groups is one of the biggest challenges to any regional cooperation. The stakeholders and interested parties within the Upper Santa Ana Region can continue to successfully work together to implement future projects to improve the water resources management for the citizens of the region.

5.6 Impacts and Benefits of the Upper Santa Ana IRWM Plan

5.6.1 IRWM Plan Benefits

Probably the most significant benefit of the Upper Santa Ana River Watershed IRWM Plan is the planning process itself. The process has created a cooperative environment among all agencies in the region. They meet on a regular basis to discuss the water management issues and plan for meeting future water needs of the region. The agencies worked together to develop solution-oriented programs, they forged agreements, and they work together to provide the most basic and essential service to the communities—serving water. The planning process provided a framework for developing regional and integrated solutions.

Full implementation of the Upper Santa Ana River Watershed IRWM Plan will result in multiple benefits associated with meeting the objectives identified in Chapter 4 of this IRWM Plan. Key public and overall benefits from implementation of the plan elements include the following:

- Significant improvement in water supply reliability during drought periods while reducing reliance on imported water.
- Improved and coordinated management of the region's surface water and groundwater resources, including conjunctive management of groundwater and surface water resources and recharge of groundwater basins.
- Improved water quality through effective management of groundwater resources, expediting clean up process of contaminant plumes in the region, and improving stormwater management.
- Enhancement of water-dependent environmental assets.
- Improved water-related education, recreation, and public access opportunities in the region.
- Improved understanding of the region's water resources, including focused regional monitoring to ensure groundwater is used in a sustainable manner.
- Improved coordination of water management activities of the region through sharing of ideas and mutually beneficial management of project opportunities.
- Coordinated development of water management strategies and associated projects.

5.6.2 IRWM Plan Impacts

The potential negative impacts from implementing most of the projects in the Upper Santa Ana River Watershed IRWM Plan are anticipated to be primarily short-term facility construction impacts. It is proposed that conjunctive water management projects include a monitoring and assessment element to evaluate the impacts of project implementation. Monitoring and assessment elements will provide tools to evaluate and modify project operation to mitigate potential impacts. Further discussion of project monitoring and assessment is presented in Chapter 6.

5.6.2.1 Environmental Documentation and County Ordinance Compliance

Permitting and environmental documentation will be required for many of the new project facilities in accordance with federal, State, and local laws and ordinances. The project-specific environmental compliance will be performed by project sponsors on a case-by-case basis prior to project construction. Impacts and benefits of the proposed actions will be further assessed. All actions and investigations will be coordinated with local, State, and federal agencies to share information and ensure compliance with applicable laws and ordinances.

6 Data Management and Monitoring, Technical Analyses, and Plan Performance

This chapter summarizes the technical analyses, data management, and performance of the Integrated Regional Water Management Plan (IRWM Plan). The chapter is organized in two parts. Part I describes data management and monitoring as well as technical analyses conducted during plan preparation. Part II examines monitoring, data management, and plan performance during plan implementation. This chapter also describes how the performance data will be used to adapt the IRWM Plan and its management tools in response to plan implementation success and its performance.

6.1 Part I: Data Management and Technical Analyses for Plan Preparation

6.1.1 Use of Available Information to Develop the IRWM Plan

The Upper Santa Ana River (SAR) IRWM Plan documents the results of a comprehensive two-year effort of over 20 agencies with varying water management and flood control responsibilities in the region focused on developing a coordinated approach to water resources management. The IRWM Plan was prepared using information and guidance from the Technical Advisory Group (TAG) and the local agencies involved in water resources management and can, in turn, be used by these same agencies to guide and support their future water management efforts.

Prior to the preparation of the IRWM Plan, the water management agencies within the region often worked on an agency-by-agency basis to define their individual needs, and collectively to address water management issues that affect regional issues. During this time, extensive information and data were collected, compiled, and evaluated, including numerous agreements, memorandums of understanding (MOUs), and court judgments. This information served as the foundation for the development of this plan, as described below.

6.1.2 Existing Information and Reports

The IRWM Plan is a document that is intended to provide a common vision for water resources management within the Upper Santa Ana Watershed. A considerable amount of available information was used to develop this plan. Following is a general description of the existing reports that were extensively used in the IRWM Plan and their main contributions.

- Information in local water purveyors' 2005 **Urban Water Management Plans** was used in preparing the water budget for the region. Information analyzed included water demand projections through 2030, water supply reliability strategies in general, and water conservation and water recycling strategies in particular.

- **Master Plans** prepared by local water and flood control agencies were used to estimate water use, supplies, and existing and planned facilities, and for development of the conveyance and recharge strategies for the region.

- **County and City General Plans** were reviewed to ensure that land use assumptions and information used in the IRWM Plan are consistent with the Master Plans.

- **Court Judgments and Agreements** between or among water agencies were used as the basis of groundwater and surface water management activities and to develop surface water and groundwater management strategies that include developing a process to manage the San Bernardino Basin Area (SBBA) (Figure 4-12). These documents were reviewed to ensure the groundwater and surface water management strategies prepared for the Plan are consistent with these documents.

- **Environmental Impact Report for Santa Ana River Water Rights Applications for Supplemental Water Supply** information was used for water supply analyses, water supply reliability strategies, and background information about the region and its water resources.

- A number of other reports and data sources (Western Watermaster Reports, water level data, U.S. Geological Survey (USGS) models and reports, contaminant plume(s) data, and Conservation District Engineering Investigations) were used in a minor role to prepare this plan. A detailed list of reports used in the preparation of the IRWM Plan is included in Section 8, *References*.

6.1.3 Data Management and Monitoring

An extensive network of groundwater and surface water monitoring is in place in the region. Data from these monitoring sites were used extensively in the Operation Model, Allocation Model, Groundwater Model, and other studies conducted for the IRWM Plan. Surface water and groundwater data collected throughout the region by various agencies were used for preparation of the plan. The data are used in various models to evaluate water management strategies and potential benefits of the proposed projects. The majority of the data used in the preparation of the IRWM Plan are available to the public through the local agencies. The existing data and new data collected as a result of the preparation of the IRWM Plan are available to the TAG, stakeholders, interested parties, California Department of Water Resources (DWR), and other state agencies.

The Upper SAR Watershed IRWM Plan is nested within the larger Santa Ana Watershed Project Authority's (SAWPA) IRWM Plan, which serves as an umbrella plan. The information developed as part of the Upper SAR Watershed IRWM Plan is provided for inclusion in the umbrella watershed plan.

6.1.4 Technical Analyses to Develop the IRWM Plan and Projects

The initial efforts in preparing the IRWM Plan focused on identifying the key water resources goals and objectives of the Plan Area. Once the objectives were identified, a considerable amount of time, resources, and technical effort was allocated during a period of 18 months to evaluate surface water and groundwater resources of the region and define water management strategies that would meet plan objectives. A brief summary of the key technical analyses for the IRWM Plan is presented below.

- **Development and Use of Operations Model (OPMODEL).** OPMODEL was developed to estimate the quantity of unappropriated SAR water available for diversion by the San Bernardino Valley Municipal Water District (Valley District) and Western Municipal Water District (Western) after accounting for diversions by prior water rights holders and environmental flows. This model provides basic water supply data needed to evaluate the feasibility of conjunctive use strategies using local surface water supplies.

- An **"Allocation Model**" was developed and used to evaluate the use and allocation of local surface water and State Water Project (SWP) supplies throughout the service area, including direct deliveries to existing water treatment plants and spreading grounds.

- **Use of Groundwater Model.** A detailed and enhanced groundwater model was developed for the SBBA. Upon completion and calibration of the model, it was extensively used to evaluate potential conjunctive use projects and to define the locations and sizes of the recharge basins and the location and number of groundwater production wells needed for each conjunctive use scenario. The model is a tool that can be used for operation and management of the groundwater basin and for management of water levels and water quality in the SBBA.

- The surface and groundwater data collected in the SBBA were extensively used for development and calibration of the models and for the analysis of the conjunctive use scenarios.

- Preliminary engineering analyses were conducted for evaluation of diversion and conveyance facilities to convey water to the spreading basins.

- Water demand and supply analyses were conducted to understand water demands in the region and how future demands will be met.

- Detailed analyses of water demands and supplies included the ability of the purveyors to meet water demands during a single-year drought and a multiple-year drought scenario. In addition, water needs for the peak day demand of water purveyors within the Valley District service area were studied.

- A sensitivity analysis was conducted to determine the significant level of impact on meeting future water needs, assuming reduced local surface water and reduced reliability in SWP supplies. This analysis intended to capture uncertainties related to SWP future water supply reliability and/or uncertainties of local surface water supplies due to climate change.

- Conceptual engineering analyses were conducted to evaluate the impact of water supply interruption during major disasters and its impact on meeting customers' water needs as well as evaluation of the facilities needed to provide redundancies for infrastructures.

- Pre-feasibility evaluations were conducted of individual projects identified in response to water management strategies and to determine project benefits and associated costs.

The agencies began identifying individual projects that may contribute to meeting the planned water management strategies and objectives. Each project and program included in the Upper SAR IRWM Plan were identified by a local lead agency (project sponsor) that was primarily responsible for the project's description and technical evaluation, as well as the project's integration into the IRWM Plan. The project's sponsor will be responsible for any further project refinement, pursuit of funding, project implementation, and assessment of project performance.

The project description and available supporting information were used to evaluate and rank the individual projects and programs. There was a large range of available supporting information for the projects that tended to reflect the maturity of the planning process and previous efforts made to define project details and establish a project's readiness to proceed. Compared to other projects, the highest ranked projects (Tier 1a and 1b projects) typically had considerable supporting information such as feasibility studies, cost estimates, and preliminary design information. Completion of required additional studies and investigations needed for some of the other projects could improve ranking of such projects in the future.

6.2 Part II: Monitoring, Data Management, Plan Performance, and Adaptive Process during Plan Implementation

6.2.1 Data Collection and Monitoring

As stated earlier, an extensive network of data collection is already in place in the region. A monitoring plan was also developed for the region as a component of this IRWM Plan to formalize and standardize data collection procedures. The objectives of the monitoring plan are to:

- Provide a standard methodology for the collection, storage, and reporting of hydrologic data.
- Document the collection of data needed for management of the groundwater basin to meet the requirements of various judgments. In the SBBA and other adjudicated basins, the Watermaster is responsible for collection, review, and compilation of the data needed for management of the basin and for providing a level of coordination among many water users.
- Provide the data needed for developing the "Annual Operation Plan" for management of the SBBA.
- Provide standardized procedures to collect source water data that agencies use to meet requirements of the California Department of Public Health (CDPH) (formerly the California Department of Health Services) drinking water standards.

The monitoring plan is presented in Appendix B. Currently, the following hydrologic data are being collected in the region:

- **Groundwater data:** Groundwater monitoring is in place for measuring groundwater production, water quality, and water levels representative of the various subbasins. Groundwater level data were used to evaluate the groundwater level trends as well as to evaluate the groundwater flows and included the following:
    - USGS multi-level monitoring wells.
    - Target wells used in the groundwater model. A list of these wells, as well as a map showing the location of the targeted modeling wells, is presented in Appendix B.

- Groundwater monitoring wells identified in various agreements (e.g., Seven Oaks Accord, Riverside Agreement). Monitoring of these wells is required to ensure full compliance with the terms of the agreements. A list of these wells is presented in Appendix B.

- Environmental Protection Agency (EPA)/City of San Bernardino Newmark-Muscoy plume(s) monitoring wells.

- Local purveyors' water production data required by judgments and provided to the Watermaster. All purveyors of wells that pump groundwater are required to report the annual production of the wells to the Watermaster. Production data are then presented in an annual report prepared by the Watermaster.

- Water quality data collected by water purveyors for each well. These data are periodically monitored according to Title 22 and are required by the CDPH.

- **Stream gage data:** Stream gages in the region are operated by either the USGS or the San Bernardino County Flood Control District (SBCFCD).

- **Subsidence monitoring**: During the period from 1944 to 1969, at least one foot of subsidence occurred in the Pressure Zone immediately north of Loma Linda between the San Jacinto and Loma Linda faults. Currently, there is no subsidence monitoring station in place. No evidence of any significant subsidence is present in the subbasins at this time.

6.2.2 Data Gaps/Additional Monitoring Requirements

Although vast amounts of data are currently collected for management of the basin's water resources, there is always opportunity to collect additional data to fill necessary gaps. One such gap could be the lack of subsidence monitoring data in the region. The following additional data collection activities would be needed to fulfill the data gaps of the region:

- A network of benchmarks in the Pressure Zone area could be helpful in monitoring subsidence. Each benchmark should be established and surveyed by a California-licensed land surveyor. Locations of the benchmarks are dependent upon permitting from the appropriate agency. (This task should be coordinated with USGS to ensure there is not any duplication of efforts. USGS may collect some of these data.)

- If proven necessary, some extensometer wells could be installed on the basis of periodic land surveys within the Pressure Zone area where the highest probability of subsidence may occur. Extensometers could be installed to measure non-recoverable compaction of fine-grained materials interbedded within the aquifer systems.

6.2.3 Management of the Data

As part of the USGS program for disseminating water data, the USGS maintains a distributed network of computers for the acquisition, processing, review, and long-term storage of water data. This distributed network of computers is called the National Water Information System (NWIS). Many types of data are stored in the NWIS, including comprehensive information for site characteristics, well construction details, time-series data for gage stage, streamflow, groundwater level, precipitation, and physical and chemical properties of water. Data collected by the USGS in the region are available to stakeholders and the public through the NWISWeb (http://nwis.waterdata.usgs.gov/nwis).

Data collected as part of the IRWM Plan will be stored, organized, and secured in an electronic database. Valley District is developing a comprehensive database that will be utilized to house the data needed for management of surface and groundwater resources of the region.

The database created for storing all monitoring data will be maintained by Valley District. Valley District will provide a central storage location for data and documentation. Valley District will coordinate with all agencies collecting data to facilitate exchanges in a consistent manner.

Data collected in the region will be available to the stakeholders, DWR, and other local and state agencies. Data collected in support of state-funded water quality-related projects will be made available to the State Water Resources Control Board's (SWRCB) Surface Water Ambient Monitoring Program and Groundwater Ambient Monitoring and Assessment Program.

Monitoring data collected each year will be summarized in an Annual Monitoring Report. This report will incorporate the past year's data in tabular and electronic format.

6.2.4 Adaptive Management and Plan Performance for the Upper Santa Ana River Watershed IRWM Plan

The Upper SAR Watershed IRWM Plan presents the current state of water resources planning in the region, based upon available information, and recognizes that water management strategies will continue to evolve in response to changing conditions. In recognition of the fluid nature of water management in the region, the IRWM Plan incorporates an adaptive management approach that is intended to allow the IRWM Plan to stay current in light of changing conditions, such as local and regional water needs and changing regulatory requirements.

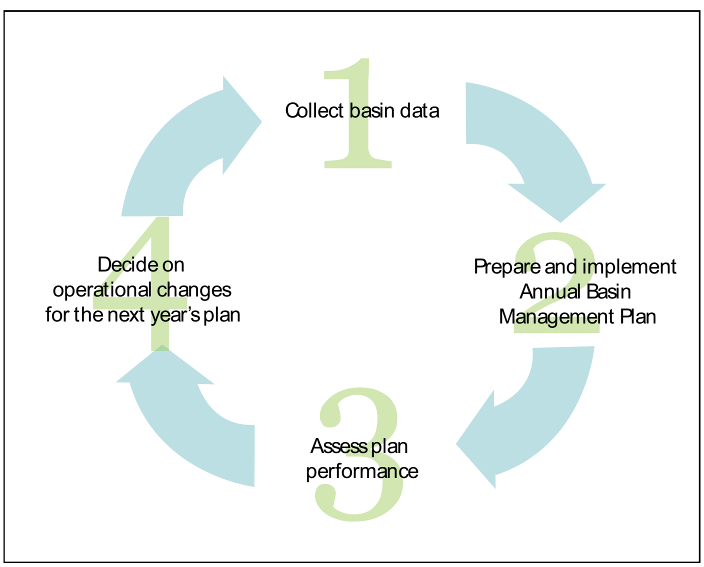
In that sense, the planning process is continually evolving in response to these changing conditions and the development of additional data that improve our understanding, which may redefine our objectives and priorities to respond to these changing conditions.

The adaptive management framework is based on an iterative process of:

- Collecting information and data regarding the conditions within the IRWM Plan Area,
- Evaluating the new data to determine plan/project performance, and
- Formulating a plan in response to these changing conditions.

For this IRWM Plan, adaptive management will primarily occur in the following areas:

Performance Evaluation and Adaptive Process
For Preparing the SBBA Annual Basin Management Plan



1. Preparation of the Annual Basin Management Plan for the SBBA. The process for updating the annual plan is discussed in detail in Chapter 4 and illustrated in Figure 4-12. This process is designed to manage the basin considering basin conditions especially in the preceding year. Performance is characterized by meeting specific water level and water quality objectives established for the basin. The data collected for specified key stations are reviewed. The groundwater levels and water quality data are compared with established performance criteria. Based on conditions of the groundwater basin, an annual basin management plan is prepared and adopted for implementation in the subsequent year. This process for management of the SBBA is continuous and adaptive.

2. Periodic review of the water management strategies and reprioritization of project implementation based on availability of funding, readiness of the projects to proceed, and changing conditions.

3. Continuous refinement of the IRWM Plan process in an adaptive management framework to proactively manage the available resources, including making a significant investment in the planning and implementation of new projects and programs. This includes preparation of periodic updates of the IRWM Plan as needed to respond to changing conditions and through a continued working relationship with the TAG and other means, and to inform project participants and stakeholders about changes to the IRWM Plan.

The performance evaluation activities will be conducted for the IRWM Plan in association with the implementation of projects identified in the Upper SAR Watershed IRWM Plan. Some form of performance evaluation criteria, such as a Project Assessment and Evaluation Plan (PAEP), could be developed for projects that include public funding prior to implementing the project. PAEP was developed by the SWRCB to measure the effectiveness of a project. The goals of a PAEP are as follows:

- To provide a framework for assessment and evaluation of project performance,
- To maximize the value of public expenditures to achieve results,
- To identify measures that can be used to monitor progress towards achieving project goals, and
- To provide information to help improve current and future projects.

The PAEP will be based on project-specific information, which may be included in the implementation of a funding contract agreement to:

- Describe project characteristics and the project sponsor,
- Demonstrate consistency with local planning documents such as the IRWM Plan,
- Identify project goals and link goals with desired outcome,
- Select performance indicators,
- Identify expected benefits and impacts,

- Determine outcome indicators (site-specific, regional, and system-wide),
- Identify/implement monitoring needed to evaluate a project's performance,
- Analyze and assess data,
- Evaluate overall success of the project, and
- Communicate the results to the TAG.

Table 6-1 presents an example of a project performance indicator that can be used for evaluation of overall success of the proposed projects for the Upper SAR Watershed IRWM Plan.

Table 6-1
Example of Project Performance Indicator to Assess Project Success

Projects/Programs	Project Goal	Desired Outcome	Outcome Indicators	Target
Project #1				
Project #2				

Implementation of projects that support one or more of the water management strategies identified in the Upper SAR Watershed IRWM Plan may have several monitoring efforts. These monitoring efforts will provide tools for evaluation of project performance. As mentioned earlier, the most significant performance evaluation will be the process for managing the SBBA. The annual operation of the SBBA must comply with a series of conditions set forth in judgments, agreements, and MOUs between signed parties for operation of the basin. The operation of the basin is examined every year to ensure the performance requirements are met or that specific adaptive management actions will be put into place as part of the annual plan for basin operation.

7 Abbreviations and Acronyms

ABBREVIATIONS AND ACRONYMS

Accord	Seven Oaks Accord
ACEC	Area of Critical Environmental Concern
Advisory Commission	San Bernardino Valley Municipal Water District Advisory Commission on Water Policy
AHHG	Area of Historic High Groundwater
Association	Upper Santa Ana Water Resources Association
Banning	City of Banning
Basin Plan	1995 Water Quality Control Plan for the Santa Ana River Basin as amended in 2004 by R8 2004-0001
BBARWA	Big Bear Area Regional Wastewater Agency
BBCSD	Big Bear Community Services District
BBLDWP	City of Big Bear Lake Department of Water and Power
BCVWD	Beaumont-Cherry Valley Water District
Bear Valley Mutual	Bear Valley Mutual Water Company
Beaumont	City of Beaumont
bgs	below ground surface
Big Bear Municipal	Big Bear Municipal Water District
BLM	Bureau of Land Management
BMO	Basin Management Objectives
BMP	Best Management Practice
BTAC	Basin Technical Advisory Committee
Caltrans	California Department of Transportation
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CLAWA	Crestline-Lake Arrowhead Water Agency
Colton Public Utilities	City of Colton Public Utilities Department

ABBREVIATIONS AND ACRONYMS

CRA	Colorado River Aqueduct
CSUSB	California State University at San Bernardino
CUWCC	California Urban Water Conservation Council
DBCP	debromochloropropane
DDT	dichlorodiphenyltrichloroethane
Declaration	Declaration of Fully Appropriated Streams
DEIR	Draft Environmental Impact Report
Delta	Sacramento-San Joaquin Delta
DMM	Demand Management Measures
DWP	Department of Water and Power
DWR	California Department of Water Resources
East Valley	East Valley Water District
EC	electrical conductivity
EOC	Engineering and Operations Community
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
Exchange Plan	Santa Ana River-Mill Creek Cooperative Water Project Agreement
FEMA	Federal Emergency Management Agency
FWC	Fontana Water Company
GFDL	Geophysical Dynamic Lab
GIS	Geographic Information System
GMP	Groundwater Management Program
gpm	gallons per minute
HET	High-Efficiency Toilet
ICGMP	Institutional Controls Groundwater-Management Program
ICSA	Institutional Controls and Settlement Agreement
IEUA	Inland Empire Utilities Agency
IRWM Plan	Integrated Regional Water Management Plan
IWP	Integrated Watershed Plan
LID	Low Impact Development
Lockheed	Lockheed Martin Corporation
Marygold	Marygold Mutual Water Company
MCL	maximum contaminant level

ABBREVIATIONS AND ACRONYMS

Metropolitan	Metropolitan Water District of Southern California
mg/L	milligrams per liter
mgd	million gallons per day
MOU	memorandum of understanding
MPD	Master Plan of Drainage
MSHCP	Multi-Species Habitat Conservation Plan
msl	mean sea level
Muscoy	Muscoy Mutual Water Company
Newmark Site	Newmark Groundwater contamination Superfund Site
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NWIS	National Water Information System
OCWD	Orange County Water District
OPMODEL	operations model
Orange County Judgment	April 17, 1969 Orange County Superior Court Judgment
PAEP	Project Assessment and Evaluation Plan
PCB	Polychlorinated Biphenyls
PCE	perchloroethylene
PCM	Parallel Climate Model
ppb	parts per billion
Reclamation	U.S. Bureau of Reclamation
Regents	Regents of the University of California
Region	Integrated Regional Water Management Plan Area
RFQ	Request for Qualifications
Rialto	City of Rialto
Riverside Highland	Riverside Highland Water Company
RIX	Rapid Infiltration Extraction
RM	river mile
RPU	City of Riverside Public Utilities Department
RRWQCP	Riverside Regional Water Quality Control Plant
RWQCB	Regional Water Quality Control Board
SAR	Santa Ana River

ABBREVIATIONS AND ACRONYMS

SARI	Santa Ana Regional Interceptor
SARRWQCB	Santa Ana River Regional Water Quality Control Board
SART	Santa Ana River Trail
SAWA	Santa Ana Watershed Association
SAWPA	Santa Ana Watershed Project Authority
SAWPA Plan	Santa Ana Watershed Project Authority Plan
SBBA	San Bernardino Basin Area
SBCFCD	San Bernardino County Flood Control District
SBMWD	San Bernardino Municipal Water Department
SBNF	San Bernardino National Forest
SBVWCD	San Bernardino Valley Water Conservation District
SCADA	Supervisory Control and Data Acquisition
SCAG	Southern California Association of Governments
SCCWRP	Southern California Coastal Water Resource Project
SGPWA	San Gorgonio Pass Water Agency
SOC	synthetic organic compound
State	State of California
STWMA	San Timoteo Watershed Management Authority
STWMP	San Timoteo Watershed Management Program
SWAMP	Surface Water Ambient Monitoring Program
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TAG	Technical Advisory Group
TCE	trichloroethylene
TDS	total dissolved solids
TMDL	total maximum daily load
UCR	University of California Riverside
ULFT	Ultra-Low-Flow Toilet
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

ABBREVIATIONS AND ACRONYMS

UWMP	Urban Water Management Plan
Valley District	San Bernardino Valley Municipal Water District
VOC	volatile organic compound
West Valley	West Valley Water District
Western	Western Municipal Water District
Western Judgment	Western Municipal Water District of Riverside County v. East San Bernardino County Water District, Case No. 78426
WQMA	Water Quality Management Agency
WQO	water quality objectives
WRI	Water Resources Institute
WRP	Water Reclamation Plant
WSPA	Wooly-Star Preserve Area
WWTP	waste water treatment plant
YVWD	Yucaipa Valley Water District

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Jack Nelson, Yucaipa Valley, August 2007
Matt Litchfield, August 2007

2005 Urban Water Management Plans:

East Valley Water District
Fontana Water Company
City of Redlands
West Valley Water District
Yucaipa Valley Water District

Thanks to the members of the Technical Advisory Group who actively participated in preparing the Plan.

Thanks also to the San Bernardino Valley Municipal Water District Advisory Commission on Water Policy for holding numerous public meetings and providing policy guidance for the development of this Plan.

This project has been funded by a grant from the California Department of Water Resources, Integrated Regional Water Management Plan Grant Program, and the entities participating in the Technical Advisory Group.

Prepared by GEI Consultants, Inc., in association with SAIC and GEOSCIENCE Support Services, Inc.