Kennedy/Jenks Consultants

303 Second Street, Suite 300 South
San Francisco, California 94107
415-243-2150
FAX: 415-896-0999

Phase 1 Conjunctive Use and Enhanced Aquifer Recharge Project

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Prepared for

County of Santa Cruz
Environmental Health Services
701 Ocean Street
Room 312
Santa Cruz, CA 95060-4011

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Executive Summary

ES.1 - Introduction

The Phase 1 Conjunctive Use and Enhanced Aquifer Recharge Project (Conjunctive Use Project) is the initial phase of a long-term Feasibility Study process to evaluate methods to increase groundwater levels in the southern Santa Margarita Groundwater Basin (SMGB). The Conjunctive Use Project is one of fifteen projects funded by a Proposition 50 Integrated Regional Water Management (IRWM) Program Water Bond grant from the California State Water Resources Control Board to the Community Foundation of Santa Cruz County. The Conjunctive Use Project is Component #3 of the grant.

The work was performed under the direction of the Santa Cruz County Environmental Health Services (County). A Technical Advisory Committee composed of members from the County, Scotts Valley Water District (SVWD), San Lorenzo Valley Water District (SLVWD), Santa Cruz Water Department (SCWD) and the University of California at Santa Cruz participated in this project and reviewed the work.

ES.2 - Objective

The Conjunctive Use Project is an assessment of the actions that can be taken to increase groundwater levels in the SMGB that have declined by as much as 200 feet in the Scotts Valley area of the SMGB between 1985 and 2007. This effort is to evaluate a wide range of water source and aquifer recharge alternatives to increase groundwater levels. By increasing groundwater levels, the primary Project goals of the Conjunctive Use Project which include the following, can be achieved:

- Improve the reliability of drinking water supplies in the Scotts Valley area through coordinating the utilization of multiple water sources at times of water surplus and using this water to either directly or indirectly to recharge the aquifer.
- Improve the fishery conditions in the San Lorenzo River and its tributaries with the focus on improving summertime baseflows primarily in the tributary streams that are critical for fish rearing.

The objective of the Conjunctive Use Project is to identify three preferred alternatives consisting of a water source and recharge methodology that achieve the Project goals, best meet technical feasibility and cost criteria, and minimize long-term environmental impacts.

To quantitatively meet the project goals, the Conjunctive Use Project is defined as needing to provide at least 500 acre-feet per year (AFY) of groundwater recharge on average with a target goal of 1,000 AFY. Cumulative historical declines in aquifer storage are on the order of 15,000 acre-feet. If the Conjunctive Use Project is assumed to contribute half of the recharge to long-term aquifer storage and half to stream baseflow, a 500 to 1,000 AFY preferred alternative would contribute between 5,000 to 10,000 acre-feet to groundwater storage over 20 years and are estimated to increase baseflow between 0.35 to 0.7 cubic feet per second (cfs). This is considered to be an appropriate scale for a project to meet the stated goals on a regional scale.

ES.3 – Background

Several public and private water purveyors overlie the SMGB and operate within northern Santa Cruz County. The primary water purveyors relevant to the Conjunctive Use Project include:

- The SVWD provides water to a majority of the residents of Scotts Valley. Groundwater is the sole source of potable water supply. SVWD also has a recycled water program to replace groundwater primarily for landscape watering uses.
- The (SLVWD supplies water to the communities of Boulder Creek, Brookdale, Ben Lomond, Zayante, Felton, and portions of Scotts Valley. SLVWD uses a combination of surface water from San Lorenzo River tributaries and groundwater from the SMGB.
- The SCWD serves water to the City of Santa Cruz and outlying areas. The City of Santa Cruz operates a surface water diversion on the San Lorenzo River near Felton, and also operates the Loch Lomond Reservoir.

The SMGB consists of a sequence of sandstone, siltstone, and shale that is underlain by granite. In the SMGB, the sandstone units serve as the primary aquifers for water supply. The majority of groundwater production has been derived from the Santa Margarita, Lompico, and Butano Formations.

As a result of groundwater level declines between 1985 and 2007, groundwater storage in the SMGB was reduced by an estimated 5,000 acre-feet in the Santa Margarita and 10,000 acre-feet in the Lompico. The areas of greatest historical declines in groundwater levels provide the greatest aquifer storage potential that could be utilized by the Conjunctive Use Project.

The San Lorenzo River is the primary surface water feature, and most of the SMGB is situated within the San Lorenzo River Watershed. Surface water flows in the watershed vary with the season with highest flows in the rainy winter months and lowest flows occurring in late summer and early fall. The San Lorenzo River and its tributaries provide a source of surface water available for potential diversions especially during high wintertime flows.

Bean Creek is a tributary of the San Lorenzo River that flows to the north of Scotts Valley. Average annual total streamflow from 1989 to 2007 through the Bean Creek gage was 8,000 acre-feet. In the lower reaches of its watershed, groundwater discharges to Bean Creek. The cool groundwater discharges helps to support an important fishery habitat especially in the summer months.

The San Lorenzo River system historically supported the largest salmon and steelhead fishery south of San Francisco Bay; however, Coho salmon and steelhead are now listed as threatened or endangered species. Requirements for the fishery place limitations on the volume of water that can be diverted in the San Lorenzo River watershed. Significant study and resource agency negotiation are typically required to justify a diversion. The recently issued a draft Coho Recovery Plan (NOAA, 2010) proposes to limit further diversions, even during the wet season, in the San Lorenzo River watershed.

Stormwater that does not soak into the ground becomes surface runoff that either flows directly into surface waterways or is channeled into storm sewers before discharge to surface waters. Stormwater runoff in Scotts Valley has increased significantly as a result of urbanization, and this has resulted in a commensurate loss of natural groundwater recharge in the urbanized areas. Because of the complex geology of the SMGB, there are limited areas of potential recharge to the aquifer; therefore, the effects of urbanization have been locally significant.

There is evidence that urbanization has also resulted in higher peaks in stormwater runoff that has contributed to downstream flooding and downcutting, or hydromodification, of the stream channel. The City of Scotts Valley has a Stormwater Management Plan (SWMP) to comply with federal and state laws and regulations regarding stormwater management

ES.4 – Overview of Technical Work

For Phase 1 of the Conjunctive Use Project, the emphasis is on evaluating a wide range of water sources and aquifer recharge methods that best accomplish the goal of improving groundwater supplies and summertime stream baseflows in the southern SMGB. A screening process was developed to evaluate the wide range of potential project alternatives based on a technical evaluation of the data, The scope of work for the Phase 1 Conjunctive Use Project consists of two main parts that include:

- A series of technical evaluations that were conducted to provide key technical information for the screening analysis, and are documented in a series of eight technical memoranda that are attached as appendices to this Technical Report.
- A screening analysis based of a large number of potential conjunctive use alternatives that was developed and applied to identify three Preferred Alternatives that achieve the Project goals, best meet technical feasibility and cost criteria, and minimize long-term environmental impacts. This screening analysis is documented in the Technical Report.

Below is a brief summary of the technical work that was conducted for Phase 1 of the Conjunctive Use Project.

Technical Evaluations

The eight technical memoranda provide a summary of the technical information needed for understanding the key issues related to developing a Conjunctive Use Project in the SMGB, support the screening analysis, and document this information for future phases of the Conjunctive Use Project. The technical evaluations are grouped into four categories that include:

- Hydrogeology
- Hydrology and Fishery
- Engineering
- Regional Water Demand

The hydrogeologic evaluation provides a summary of the geologic and groundwater framework of the study area based on previous studies with a focus on describing the areas of significant historical groundwater level declines. Analysis was performed to evaluate the aquifer recharge potential of the study area and to evaluate the potential effectiveness of the various conjunctive use activities using the current regional groundwater model.

The surface water hydrology provides a physical description of the watershed and a summary of existing water rights. Analysis was performed to evaluate the quantities of surface water and stormwater potentially available for a Conjunctive Use Project. The fishery evaluation provides an overview of the fishery of the San Lorenzo River and its tributaries with an emphasis on the Coho salmon and steelhead trout.

The engineering evaluation provides a summary of the engineering requirements and a preliminary cost comparison of key components of a potential Conjunctive Use Project. The evaluation also documented existing infrastructure available to the Conjunctive Use Project. The analysis was used to support the engineering criteria for the screening analysis.

The regional demand analysis provides a summary of water resources from each major water purveyor in the region including current and projected water needs based on a review of existing plans and reports. The analysis was used to identify underutilized resources potentially available to the Conjunctive Use Project.

Conjunctive Use Alternatives Screening Analysis

The screening analysis provides a relative comparison of a large number of potential conjunctive use alternatives to identify three Preferred Alternatives that achieve the Project goals, best meet technical feasibility and cost criteria, and minimize long-term environmental impacts. The primary function of the screening analysis is to reduce the number of potential alternatives to a small number so that future work can focus on the technical and non-technical issues needed for implementation.

The screening analysis is applied to the water source and aquifer recharge components separately. The highest ranking water source and aquifer recharge components are then grouped together and evaluated as projects. The preferred alternatives group together closely related projects and evaluates their feasibility these based on engineering, cost and implementability criteria. Based on this screening analysis, three preferred Conjunctive Use Project alternatives are identified.

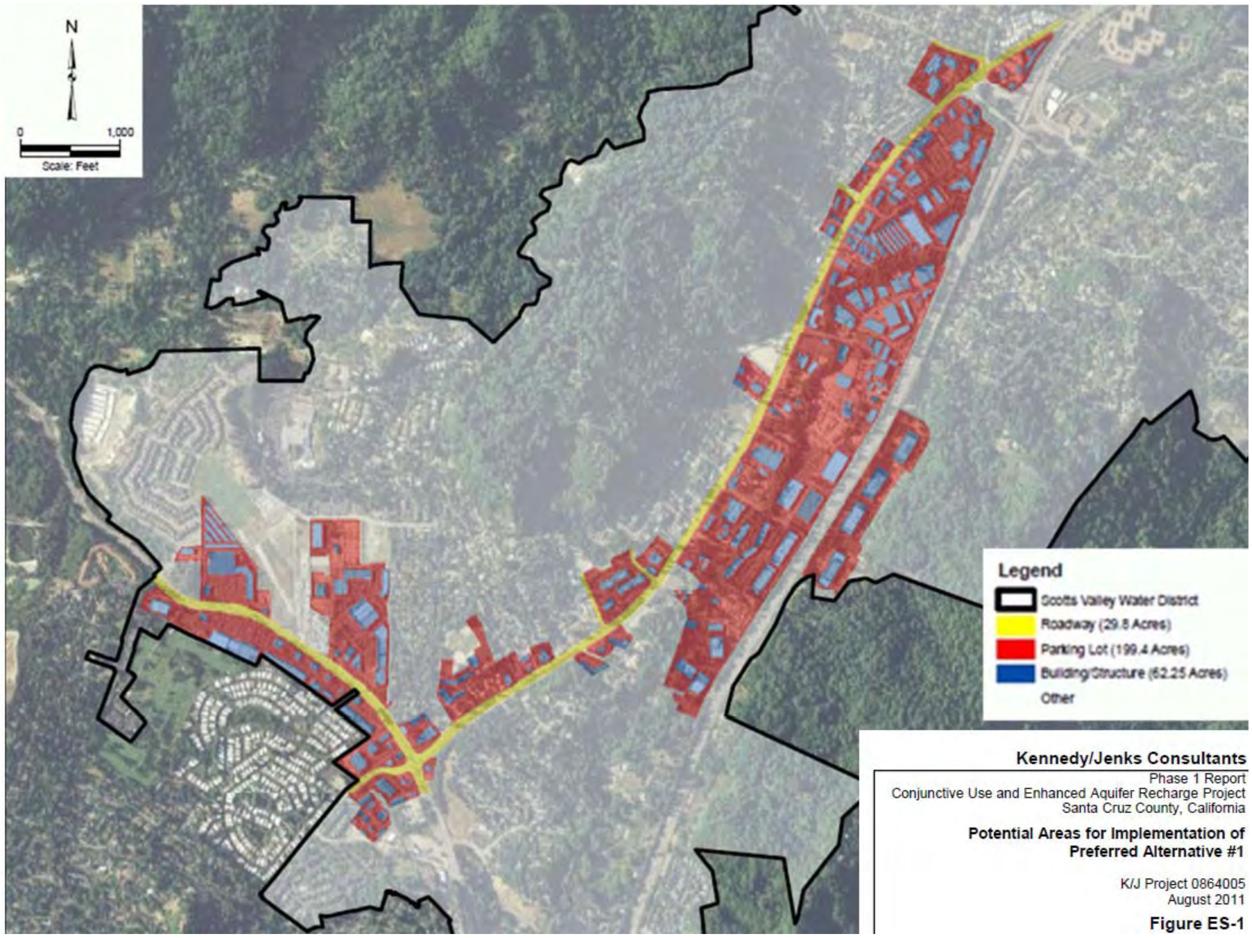
The screening analysis primarily focused on technical issues; however, it is understood that technical issues are not the only factor that can influence the viability of a potential Conjunctive Use Project. Other projects, especially those that are considered during the final step of the alternatives analysis, should still be considered as potentially viable in helping resolve water issues on a more local basis.

ES.5 – Preferred Alternatives

For each of the preferred alternatives, a conceptual-level engineering analysis, preliminary order-of-magnitude cost estimates, and a conceptual implementation plan was developed. The conceptual implementation plan identifies the major steps necessary for future implementation of each preferred alternative. Below is a brief summary of the three preferred alternatives which are described in greater detail in Sections 10, 11 and 12.

Preferred Alternative #1 - Enhanced Stormwater Recharge in Scotts Valley Using Low Impact Development

Alternative #1 uses stormwater from roofs, parking lots and streets along Mount Hermon Road and Scotts Valley Drive for groundwater recharge using low impact development facilities such as infiltration basins, pervious pavement, vegetated swales, and landscape islands as shown on Figure ES-1. This alternative would utilize stormwater that is currently routed away from the



SMGB by storm drains for groundwater recharge to help restore natural groundwater recharge lost to the effects of urbanization. Implementing this alternative on the scale necessary to achieve the project goals will require retrofitting the existing commercial and business property with low impact development facilities to accommodate recharge of stormwater.

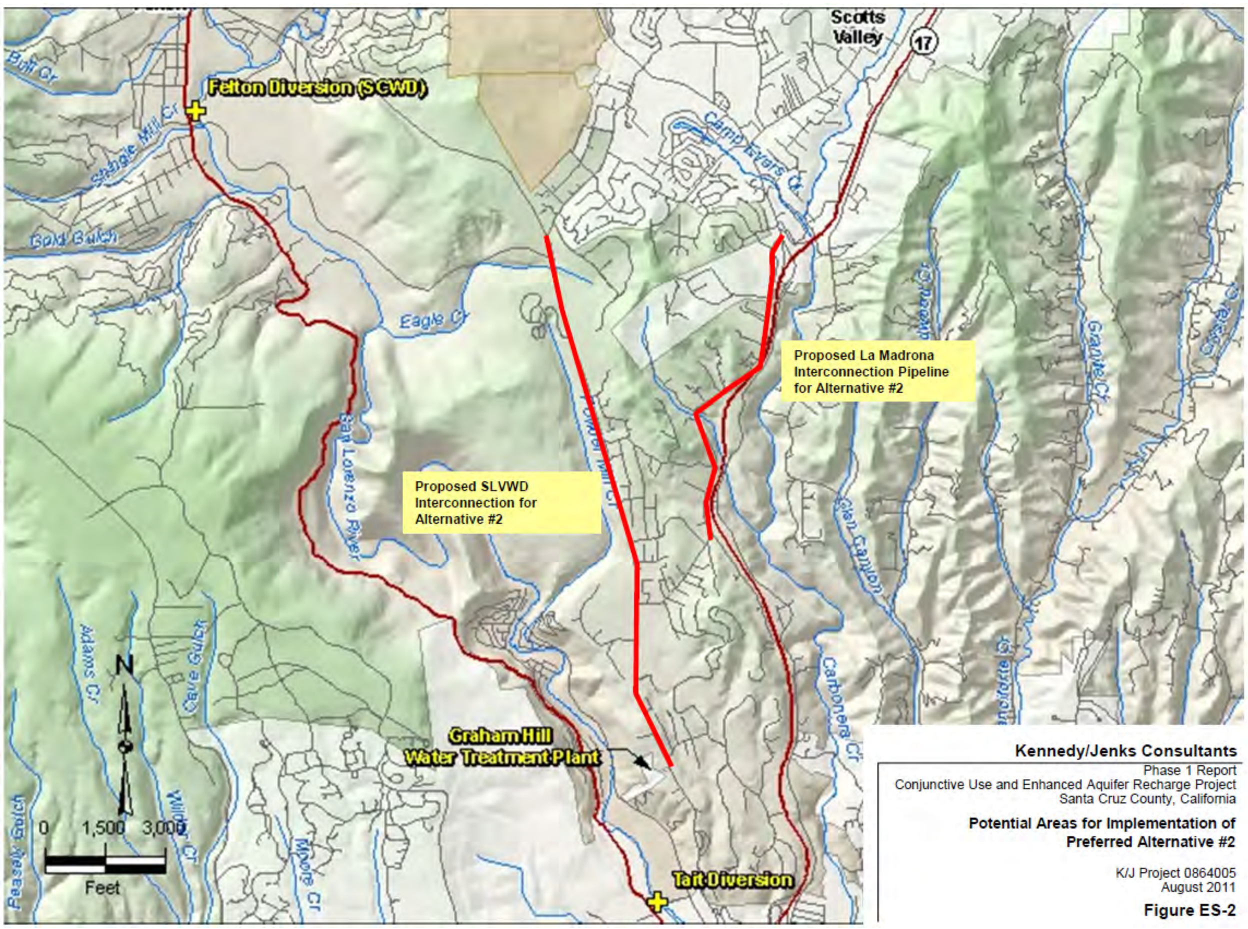
The main advantage of this alternative is that it is relatively straightforward in concept and would produce benefits to both groundwater storage and summertime baseflows (especially in Bean Creek) as well as potential water quality benefits in the surface waters. Stormwater sources have the advantage of being derived directly from rainfall and not having water rights and fisheries issues associated with them. Enhanced stormwater recharge is generally encouraged by the California Department of Water Resources and the State Water Resources Control Board and there are potential funding sources that could help with implementation of this alternative.

This alternative will require negotiating with private land owners to get permission to access property to implement this alternative, and is considered a limitation to the alternative. Water quality is another concern as stormwater can pick up contaminants from contact with streets, parking lots and structures. The potential impacts of contaminant plumes in the Camp Evers area will have to be included in future evaluations to fully implement this alternative because of the potential to remobilize these plumes.

Preferred Alternative #2 - Inter-District Exchange for In-Lieu Recharge

Alternative #2 utilizes the existing water sources used by the participating water districts. Since these include a combination of surface water and groundwater resources, this alternative proposes that the water districts set up agreements to sell, trade or share these water resources to take advantage of natural cycles. The general concept is to use more surface water during high flow seasons and/or years instead (or in-lieu) of groundwater pumping.

More specifically, this Alternative #2 proposes to utilize excess capacity at the SCWD's Graham Hill Water Treatment Plant (WTP) during the winter months when water demand is relatively low and water availability is high as shown on Figure ES-2. Treated potable water from the Graham Hill WTP would be conveyed to the SVWD and SLVWD for use instead of groundwater pumping. The SLVWD's Felton WTP is another potential source of water; however it may not have additional treatment capacity that is available at the Graham Hill WTP. Over time, the reduced pumping in the SMGB will allow groundwater levels to rise. During low surface flow periods, reliance would be shifted back to groundwater or other sources.



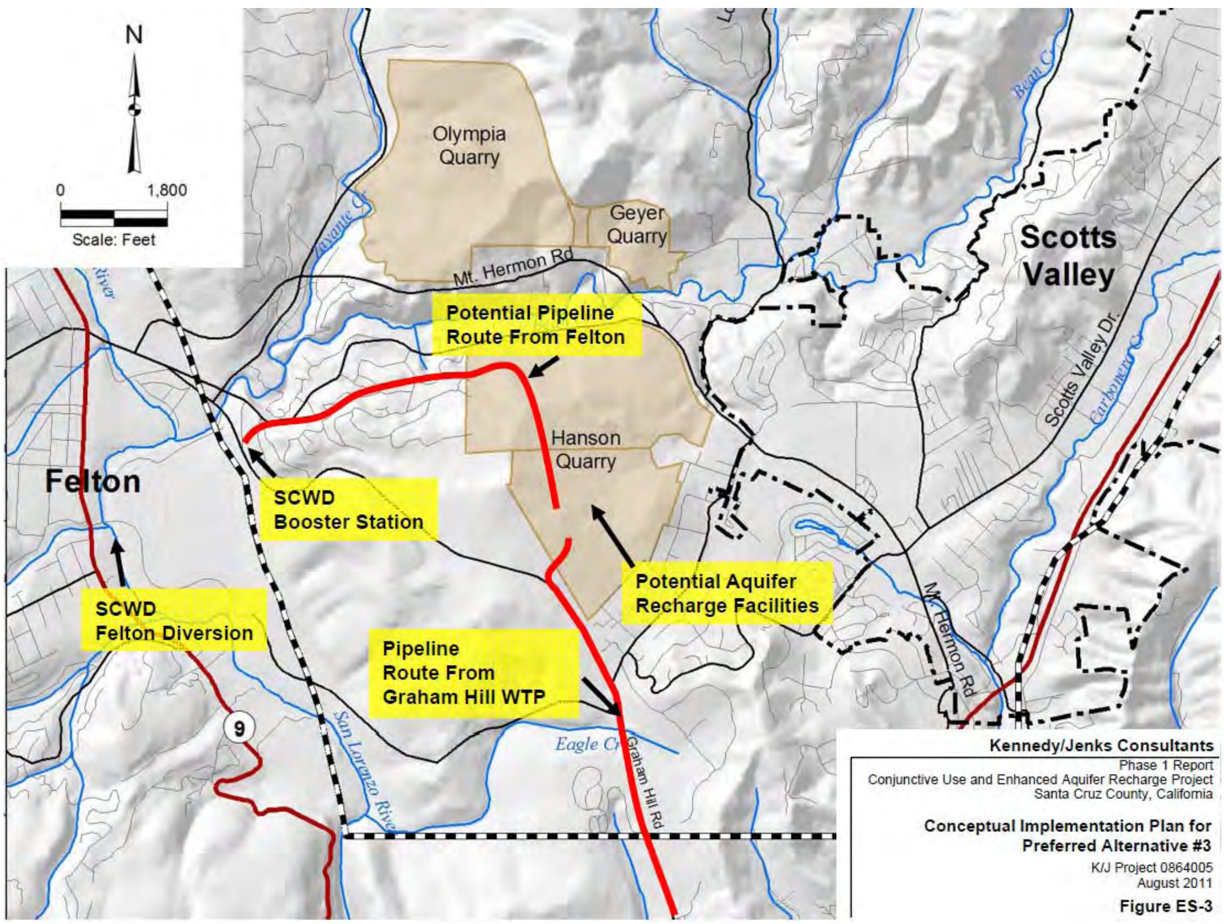
The advantage of this alternative is that it makes use of existing water supplies and infrastructure. This will help to reduce overall project costs and minimize environmental impacts. In-lieu recharge is generally highly efficient in increasing groundwater storage.

Increasing groundwater levels in the SMGB as a result of this project would also help to increase summertime baseflows in streams such as Bean Creek.

The main limitations include the cost of constructing pipelines to interconnect the different water districts, engineering issues of making these systems compatible, and water rights issues. Another potential limitation is that agreements will need to be negotiated between the districts to define the volume, timing and payment for these exchanges. However, individual districts have already initiated discussions and planning-level work to explore this concept in greater detail.

Preferred Alternative #3 - Surface Water from Felton Diversion for Aquifer Recharge in Hanson Quarry Area

Alternative #3 would divert water from the existing Felton Diversion on the San Lorenzo River and convey this water to aquifer recharge facilities located in the Hanson Quarry area west of Scotts Valley as shown on Figure ES-3. The concept is to utilize surface water during the high flow periods for aquifer recharge to increase groundwater levels in the SMGB. Aquifer recharge would be done by either percolation ponds, injection wells or a combination of both. Further evaluation including identification of a final site would be required to determine options that are more viable. The Hanson Quarry is identified here because it represents a large area of potentially available land that could accommodate a large recharge facility; however, other locations in this general area could be considered as well if necessary.



Advantages are that this alternative can potentially add significant volumes of groundwater to the basin to help increase groundwater levels and help to increase summertime baseflows. Another advantage of these projects is that they can be engineered to be able to recharge large volumes of groundwater. This alternative also makes use the existing infrastructure at the Felton Diversion which helps to lower the overall project costs.

The main limitation of this alternative is with respect to water rights, environmental and fishery concerns with the San Lorenzo River diversion. Because of the geologic complexity of the basin, there are limited areas for potential sites; however, this varies with recharge method. For example, injection wells are more flexible with respect to location than percolation ponds. The size and complexity of the engineering and operation of these facilities also increase capital and operational costs. A large aquifer recharge facility would require a significant amount of land that has to be located at a site with the appropriate geology.

Section 1: Introduction

The Phase 1 Conjunctive Use and Enhanced Aquifer Recharge Project (Conjunctive Use Project) is considered the initial phase of a long-term Feasibility Study to evaluate potential Conjunctive Use Projects in the southern Santa Margarita Groundwater Basin (SMGB). The Conjunctive Use Project is one of fifteen projects funded by a Proposition 50 Water Bond grant from the California State Water Resources Control Board to the Community Foundation of Santa Cruz County. The Conjunctive Use Project is Component #3 of the grant. The work was performed under the direction of the Santa Cruz County Environmental Health Services (County).

1.1 Conjunctive Use Project Goals

Historically, groundwater levels have been significantly higher in the Scotts Valley area of the SMGB than current conditions. Some areas have experienced over 200 feet of groundwater level declines between 1985 and 2007. The Conjunctive Use Project seeks to evaluate potential water sources and aquifer recharge methods that will increase groundwater levels in the southern SMGB on a regional scale. By increasing groundwater levels, the primary goals of the Conjunctive Use Project include the following:

- Improving the reliability of drinking water supplies in the Scotts Valley area through coordinating the utilization of multiple water sources to take advantage of times of water surplus and minimize long-term environmental impacts.
- Improving the fishery conditions in the San Lorenzo River and its tributaries with the focus on improving summertime baseflows primarily in the tributary streams that are critical for fish rearing.

The objective of the Conjunctive Use Project is to assess the a wide range of potential water sources and aquifer recharge methodologies and identify three preferred project alternatives that will best meet the project goals, engineering feasibility criteria and implementability measures. Subsequent phases will perform additional evaluation of the recommended three preferred alternatives including site-specific hydrogeological studies, comprehensive engineering analyses and performing pilot projects.

1.2 General Approach

The study area for the Conjunctive Use Project is located in the SMGB. The SMGB is a significant groundwater basin that covers over 30 square miles in the Santa Cruz Mountains. The SMGB forms a roughly triangular area that extends from Scotts Valley in the east, to Boulder Creek in the northwest, to Felton in the southwest (Figure 1-1). The San Lorenzo River is the primary surface water feature and most of the SMGB is in the San Lorenzo River Watershed.

The study area for the Conjunctive Use Project is primarily focused on the southern portion of the SMGB south of Bean Creek (Figure 1-2). The project area includes portions of both the Scotts Valley Water District (SVWD) and the San Lorenzo Valley Water District (SLVWD) that have experienced significant declines in groundwater levels over the past 25 years in response to increased pumping. To meet the project goals, the Conjunctive Use Project is defined as needing to provide between 5,000 to 10,000 acre-feet to groundwater storage over 20 years and provide a long-term increase summertime baseflow in the San Lorenzo River tributaries (primarily Bean Creek) between 0.35 to 0.7 cubic feet per second (cfs).

The Conjunctive Use Project investigated the opportunities to use water exchanges, winter streamflow diversion, and stormwater runoff to increase groundwater levels in the SMGB. The Conjunctive Use Project is intended to address the following issues:

- Evaluate the hydrogeological conditions in the southern SMGB to identify areas with available aquifer storage and conditions suitable for groundwater recharge.
- Determine the maximum average annual surface water rights availability and to whom and when they are available within the study area.
- Determine the maximum surface water that can be safely diverted on an average annual basis to support a conjunctive use project in the study area and at what times of the year the water is available, based on flow, water quality, other water rights, and instream flow needs. Assess differences in water availability during wet years and dry years.
- Compile and analyze potentially available water resources (i.e. surface water, groundwater, recycled water, desalinated seawater, and storm water runoff) for each of the major water purveyors within the study area, when and where these resources are available, and the purveyors' current and projected needs.
- Identify existing infrastructure that can be used to support a conjunctive use project(s). Because of the closing of the local sand quarries, these quarries were evaluated as part of a regional conjunctive use project.
- Screen a large number of potential water sources and aquifer recharge methods to identify three preferred alternatives.
- Identify additional infrastructure and water rights that would be needed to support a conjunctive use project(s).

This approach considers a wide range of issues related to potential Conjunctive Use Alternatives. The focus of the Conjunctive Use Project is on evaluation of potential regional solutions by screening a variety of potential conjunctive use alternatives. The project will evaluate a variety of approaches to off-stream diversion of water to optimize utilization of flows to off-stream groundwater recharge facilities , in a manner that satisfies aquatic habitat preservation requirements while fulfilling operational objectives.

To maximize the amount of work that can be accomplished, County and stakeholder agencies provided in-kind services including management and technical support including ongoing hydrogeologic work of the SMGB. Furthermore, a regional SMGB groundwater model developed under a past state grant project was used to support Phase 1.

Below is a description of the scope of work that was developed and applied to evaluate a large number of potential conjunctive use projects to identify three Preferred Alternatives for the Conjunctive Use Project.

1.3 Scope of Work

The Conjunctive Use Project evaluates a wide range of potential components that could be implemented to accomplish the goal of improving groundwater supplies and summertime stream baseflows in the southern SMGB. Based on this analysis, three preferred alternatives are identified that best meet a series of technical criteria. A conceptual engineering plan is presented for these three preferred alternatives. Future phases of the Feasibility Study will continue in the development of the engineering design that will lead to the planned implementation of one or more of these preferred alternatives. Tasks such as determining aquifer storage capacities; providing detailed, site-specific hydrogeological and hydrological studies; comprehensive engineering analyses and constructing pilot projects will be performed in these later phases.

1.3.1 Task 1: Hydrogeologic/Conjunctive Use Evaluation

The goal of Task 1 is to characterize the hydrogeologic framework of the study area to address the following topics:

- Identify the areas where significant historical groundwater level declines have occurred,
- Define the recharge potential across the study area,
- Evaluate the potential effectiveness of the various conjunctive use alternatives in terms of the changes in long-term groundwater levels and stream baseflows, and
- Prioritize the various groundwater recharge options in terms of effectiveness.

The results of Task 1 are summarized in three technical memoranda found in the appendices that are used to support the screening analysis in Task 5 to identify the preferred alternatives. The Task 1 technical memoranda include the following:

- **Technical Memorandum 1A (TM-1A) Hydrogeology Evaluation** – Describes the hydrogeological framework of the southern SMGB by providing a summary of the geology, aquifer characteristics, groundwater flow, historical changes in groundwater levels, groundwater-surface water interactions and water quality issues based on existing reports and data.
- **Technical Memorandum 1B (TM-1B) - Evaluation of Recharge Potential** - Provides a summary of the factors that control the application of a groundwater recharge projects including the soil conditions, aquifer characteristics and operational issues to provide a general evaluation of the aquifer recharge potential and storage capacity of the southern SMGB.
- **Technical Memorandum 1C (TM-1C) Groundwater Modeling Evaluation of Potential Conjunctive Use Projects** - Uses the existing SMGB groundwater model to provide a quantitative analysis of the effectiveness of various potential aquifer recharge projects on long-term groundwater levels, aquifer storage and stream baseflow (with a focus on summertime baseflow).

1.3.2 Task 2: Surface Water Availability Assessment

The goal of Task 2 is to characterize the hydrogeologic framework of the study area to address the following topics:

- Evaluate the quantities of surface water and stormwater that may be available for a conjunctive use project.
- Summarize existing water rights and entitlements to water supplies in the project area.

- Provide a summary of the local issues regarding San Lorenzo Valley watershed fishery with emphasis on the Coho salmon and steelhead trout.

The assessment includes determining the quantity of water available for recharge, identifying potential diversion locations, and evaluating the water quality characteristics of available flows to determine suitability and pre-treatment requirements for recharge. These are used in the screening process in Task 5. The results of Task 2 are summarized in three technical memoranda found in the appendices that include the following:

- **Technical Memorandum 2A (TM-2A) Water Rights Evaluation** – Provide a summary of the existing or potentially available water rights on the San Lorenzo River and key tributaries.
- **Technical Memorandum 2B (TM-2B) Streamflow Availability and Stormwater Assessment** – Assess the local surface water sources to quantify the volumes of streamflows on the San Lorenzo River and key tributaries during different climatic conditions, stream baseflow with emphasis on summertime baseflows, and stormwater characteristics including changes due to urbanization.
- **Technical Memorandum 2C (TM-2C) Fisheries Study** – Provide a summary of the local issues regarding San Lorenzo Valley watershed fishery with emphasis on the Coho salmon and steelhead trout. .Assess previous recommendations for bypass requirements to sustain instream flows supporting winter habitat needs.

1.3.3 Task 3: Engineered Facilities Evaluation

The goal of Task 3 is to develop preliminary engineering evaluations necessary for the Conjunctive Use Project. This includes the preparation of an inventory of existing and potential future infrastructure that could potentially be incorporated into a conjunctive use project.

The results of Task 3 are documented in **Technical Memorandum 3 (TM-3) - Engineered Facilities Evaluation** found in the appendices. TM-3 provides a comparison of the engineering requirements and costs for the potential conjunctive use alternatives. The comparisons are used in the screening process in Task 5. The work for Task 3 includes:

- Provide an inventory of existing facilities that could be used for conjunctive use.
- Provide a conceptual listing of the water supply facilities relevant to conjunctive use, and the understanding of characteristics and parameters associated with evaluating those facilities.

1.3.4 Task 4: Regional Water Demand Projection

The goal of Task 4 is to compile and analyze water resources potentially available from each major water purveyor in the region, when and where these resources are available, and the purveyors' current and projected water needs. This is a regional evaluation looking for potential partners outside the specific project area.

The results of Task 4 are documented in **Technical Memorandum 4 (TM-4) – Regional Water Demand** found in the appendices. TM-4 provides a summary of the available water supplies, especially those supplies that provide opportunities for in-lieu water exchanges for use in the alternative screening process in Task 5. The work for Task 4 includes:

- Inventory current and future water supply and demand based on existing reports to summarize the regional water supplies.
- Identify other potential water supplies including non-traditional water sources for potential use in the Conjunctive Use Project.
- Identify potential water supply issues including water quantity, quality, and availability issues, and regulatory requirements for the use of various sources of water for recharge to a drinking water aquifer.

1.3.5 Task 5: Feasibility Analysis of Potential Conjunctive Use Projects

Task 5 uses the analysis from Tasks 1 through 4 to identify and screen potential conjunctive use alternatives. A systematic screening process was developed using a set of performance criteria to provide a consistent basis of comparison of the various conjunctive use alternatives consisting of water sources and recharge applications. Based on this process, the various alternatives were screened and ranked. The alternatives were also evaluated with respect to critical issues or "fatal flaws" that will render an alternative infeasible. From this analysis, a set of preferred alternatives were identified for addressing groundwater issues in the project area. The overall project goal was to identify three preferred Conjunctive Use Alternatives. A systematic screening process is used to prioritize and rank the potential alternatives using the following approach:

- Develop Potential Conjunctive Use Projects - Generate a list of potential conjunctive use projects based on the analysis conducted in Tasks 1 through 4.
- Establish Alternatives Screening Criteria - Develop the screening criteria to help prioritize the list of potential conjunctive use projects that have the highest potential for success in addressing the goals of the Conjunctive Use Project in the project area.
- Potential Conjunctive Use Alternative Screening – Apply screening criteria to the list of potential conjunctive use projects and alternatives in a systematic manner to provide a consistent comparison. The screening was conducted primarily on a technical evaluation of effectiveness and preliminary order-of-magnitude cost estimates.
- Conceptual Implementation of Preferred Alternatives - For three (3) of the three preferred Conjunctive Use Alternatives, preliminary conceptual implementation plans were prepared that identify the major steps necessary to implement these alternatives. These conceptual plans will be further developed in future phases of this project.

1.3.6 Task 6: Phase 1 Report Preparation

Task 6 includes the final documentation of the Conjunctive Use Project. The final document presents the technical analysis used to identify the preferred alternatives. This is important for appropriate review by interested stakeholders and for obtaining funding for future phases of work.

1.3.7 Task 7: Public/Stakeholder Outreach and Participation

Task 7 includes communication between the project team and the County staff. Stakeholder outreach that consisted of a Technical Advisory Committee that reviewed the status of the project and provide input as the work was being performed. Public Outreach consists of providing updates to the Santa Margarita Groundwater Basin Advisory Committee and providing the County with graphics and project summaries.

1.3.8 Task 8: Project Management and Quality Assurance/Control

Task 8 addresses the project management including proper documentation of time and expenses for receiving the grant funding and providing Quality Assurance and Quality Control.

1.4 Report Structure

The Technical Report is focused on documenting the development, application and results of the screening methodology used to identify the three preferred Conjunctive Use Alternatives under Task 5 of the Scope of Work. The general report structure is as follows:

- Sections 1 through 4 of the Report provide background information for the Conjunctive Use Project.
- Sections 5 through 9 describe the steps used in performing the Alternatives Screening Analysis for Task 5.
- Sections 10 through 12 provide a project description and conceptual implementation plan for the three preferred alternatives.

Much of the technical information used for this analysis is documented in the technical memoranda found in the appendices, and are referenced throughout the text. The technical memoranda attached to this Report include the following:

- Technical Memorandum 1A (TM-1A) - Hydrogeology Evaluation
- Technical Memorandum 1B (TM-1B) - Evaluation of Recharge Potential
- Technical Memorandum 1C (TM-1C) - Groundwater Modeling Evaluation of Potential Conjunctive Use Projects
- Technical Memorandum 2A (TM-2A) - Water Rights Evaluation
- Technical Memorandum 2B (TM-2B) - Streamflow and Stormwater Assessment
- Technical Memorandum 2C (TM-2C) – Fisheries Study
- Technical Memorandum 3 (TM-3) - Engineered Facilities Evaluation
- Technical Memorandum 4 (TM-4) - Regional Water Demand

1.5 Acknowledgments

The Conjunctive Use Project was overseen by the Santa Cruz County Environmental Health Services who provided overall project management and contract coordination for the state grant.

A Technical Advisory Committee (TAC) of experts and stakeholders was formed to review the work as it progressed. The consultant team would like to acknowledge the input and support of the TAC which included the following:

- John Ricker, Santa Cruz County Environmental Health Services
- Mike Cloud, Santa Cruz County Environmental Health Services
- Chris Coburn, Santa Cruz County Environmental Health Services
- Charlie McNiesh, Scotts Valley Water District
- Bill O'Brien, Scotts Valley Water District
- Bill Kocher, Santa Cruz Water Department
- Jim Mueller, San Lorenzo Valley Water District
- Andy Fisher, University of California, Santa Cruz

Kennedy/Jenks was the prime consultant and performed a majority of the technical work for this project. Kennedy/Jenks would like to acknowledge the technical support provided by the following subconsultants for their roles with the project.

- Balance Hydrologics – Prepared TM-2B - Streamflow and Stormwater Assessment. Balance Hydrologics conducted multiple tasks in Task 2, and participated in TAC meetings, and provided as-needed support for Tasks 1, 5, 7 and 8
- D.W. Alley & Associates – Prepared TM-2C – Fisheries Study and participated in TAC meetings.
- Montclair Environmental – Provided as-needed support for Tasks 1 and 4, participated in TAC meetings, and made contributions to TM-1A - Hydrogeology Evaluation and TM-4 - Regional Water Demand.

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Section 2: Water Usage Summary

This section provides a summary of the water purveyors and a summary of present and projected future water usage. The planning and ultimate implementation of a Conjunctive Use Project is dependent upon an understanding of who the water purveyors are, what their water demand is, and what percentage of their water demand is met by local groundwater. This section summarizes the more detailed discussions provided in TM-2A and TM-4.

2.1 Water Purveyors

Several public and private water purveyors operate within northern Santa Cruz County. Figure 2-1 shows the jurisdictional boundaries of the water districts and those private water purveyors identified in this document. These water purveyors include:

- The SVWD provides water to a majority of the residents of Scotts Valley. Groundwater is the sole source of potable water supply. SVWD serves primarily residential customers with some commercial development.
- The SLVWD supplies water to the communities of Boulder Creek, Brookdale, Ben Lomond, Zayante, Mañana Woods and Felton. SLVWD also serves water to part of the southwestern portion of the City of Scotts Valley and adjacent areas to the west. The type of water (surface water or groundwater) served varies by community and its location relative to the San Lorenzo River.
- The SCWD serves water to the City of Santa Cruz and outlying areas. The SCWD operates a surface water diversion on the San Lorenzo River near Felton, and also operates the Loch Lomond Reservoir on Newell Creek in the Santa Margarita Groundwater Basin. SCWD also has wells located adjacent to the San Lorenzo River which are used seasonally.
- Lompico County Water Department supplies fresh water primarily from Lompico Creek to the Lompico Community, but also has groundwater wells that can supplement surface water supplies when necessary.
- The Mt. Hermon Association is a year-round conference center and camp that serves more than 60,000 guests each year with groundwater.
- Soquel Creek Water District (SqCWD) serves groundwater to four service areas primarily in the cities of Capitola, Aptos, La Selva Beach, Opal Cliffs, Rio Del Mar, Seascape, and Soquel.
- Domestic production outside the service area of these water purveyors is primarily by private wells or small community water systems.

A brief overview of the water supply of these purveyors is provided below. Additional information on these water districts is provided in TM-2A and TM-4.

2.1.1 Scotts Valley Water District

SVWD covers an area of about 5.5 square miles (Figure 2-1) and provides water to a majority of the residents in and around the City of Scotts Valley. Groundwater is the sole source of potable water supply for SVWD who has been actively managing the groundwater basin since the early 1980's in an effort to increase water supply reliability and to protect local water supply sources. SVWD serves primarily residential customers with some commercial development.

Groundwater production currently provides 100 percent of the SVWD's potable water supply. Annual groundwater production by SVWD in 2008 was 1,664 acre-feet. SVWD's monthly water production is typically between 100 and 150 acre-feet per month during the wetter months of November through April and between 175 and 250 acre-feet per month during the drier months of May through October when water demand is higher primarily for outdoor uses.

In 1994, SVWD formally adopted its Groundwater Management Plan (Todd Engineers, 1994), and has been managing groundwater resources through a comprehensive monitoring program of groundwater conditions in the Scotts Valley area for over 20 years. Results, analysis and interpretation of the monitoring program are reported each year in the Annual Groundwater Management Report. The annual report that was issued in May 2009 (Kennedy/Jenks, 2010) is a key source of information for this report.

Since 2004, SVWD has actively worked to control growth of water supply demand primarily through implementing the Water Conservation and the Recycled Water Programs. The observed decline in groundwater production is considered to primarily represent the effects of these programs. In the past five years groundwater production has steadily declined by about 75 acre-feet per year (AFY), even though the number of service connections has continued to grow (Kennedy/Jenks, 2009a).

SVWD's Recycled Water Program augments the water supply and offsets groundwater pumping for non-potable uses, especially for landscape irrigation. The source of recycled water is the tertiary wastewater treatment plant operated by the City of Scotts Valley in conjunction with the SVWD.

2.1.2 San Lorenzo Valley Water District

Established in 1941, SLVWD supplies water to the southwestern portion of the City of Scotts Valley and the communities of Boulder Creek, Brookdale, Ben Lomond, Zayante, Mañana Woods and Felton (Figure 2-1). In 2007, the Mañana Woods Mutual Water Company formally joined SLVWD, and SLVWD took over the operation of the two Mañana Woods production wells. The Mañana Woods Mutual Water Company was previously a private water supplier that delivered water to its residences near Scotts Valley. In 2008, SLVWD took over as water supplier for the City of Felton.

SLVWD relies entirely on local groundwater supplies and surface water from five tributaries to the San Lorenzo River, all with pre-1914 water rights. SLVWD does not import water from state or federal agencies (SLVWD, 2009; Johnson, 2009).

SLVWD's surface water supply flows primarily from creeks on the western side of the watershed. Together, these creeks provide approximately half of the total SLVWD water supply (SLVWD, 2009). SLVWD currently operates four standalone water systems with separate water supplies: The Northern System, the Southern System, the Mañana Woods System and the Felton System. Together, these water systems serve approximately 7,400 connections for 22,500 people (Johnson, 2009, SLVWD, 2009). The Southern System and the Mañana Woods System each serve a portion of the Scotts Valley area and rely solely on groundwater.

2.1.3 City of Santa Cruz

SCWD serves a wide area in northern Santa Cruz County (Figure 2-1). In addition to the limits of the City of Santa Cruz, the SCWD service area includes unincorporated areas to the north and east of city limits and a small portion of the City of Capitola. An estimated population of 90,000 is served by the SCWD. The governing body for the Water Department is the Santa Cruz City Council, which is advised by a seven member Water Commission.

Surface water is the primary source of water and is supplemented by groundwater when the SCWD's surface water becomes inadequate to meet the peak demand. The SCWD's water supply relies entirely on rainfall, surface runoff, and groundwater infiltration occurring within watersheds located in Santa Cruz County. The SCWD does not purchase water from state or federal agencies and does not import water from outside the Santa Cruz area.

On average, about 75 percent of the SCWD's annual water supply needs are met by surface water diversions from the San Lorenzo River and the North Coast streams. Withdrawals from the Loch Lomond Reservoir, approximately 20 percent of the SCWD average annual supply, are made mainly in the summer and fall months when flows drop off and additional supply is needed to meet higher daily demands. During the winter, this water is utilized when the North Coast and San Lorenzo River sources become untreatable due to excessive turbidity from storm runoff

Groundwater constitutes about 4 to 5 percent of the entire SCWD water supply on an annual basis; however, groundwater is a crucial component of the water system for meeting peak season demands and during periods of drought when surface water supplies are low. The three currently active SCWD production wells are normally operated 150 to 200 days of the year during the dry season at a combined rated of about 1.0 MGD. Details on the SCWD's historical groundwater pumping can be found in the 2005 UWMP (SCWD, 2006). Groundwater production from the SCWD wells falls outside of the SMGB.

The SCWD follows a variety of policies, procedures, and legal restrictions in operating the water supply system. In general, the system is managed to take advantage of the better quality and least expensive sources as a first priority, and to retain the maximum amount of water possible in Loch Lomond Reservoir to safeguard against future droughts. In addition to considerations for cost, water quality, and storage, legal constraints on the diversion of surface waters contained in the City's water rights govern the operation of the water system (SCWD, 2006). Furthermore, the draft anadromous fish Habitat Conservation Plan (HCP) prepared by SCWD (2010) in compliance with the Endangered Species Act and National Oceanographic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) draft Coho Recovery Plan (CRP) for Central California including the San Lorenzo River will likely influence instream flow requirements in the future (NOAA, 2010).

2.1.4 Other Water Purveyors

Other water districts and organizations have water rights to the surface streams in the Watershed. Descriptions of those listed by the SWRCB that are in the vicinity of the Conjunctive Use Project are provided below.

2.1.4.1 Lompico County Water District

The Lompico County Water District (LCWD) is a small county water district located north of Scotts Valley and east of Boulder Creek (Figure 2-1). LCWD was issued a permit in 1966 to serve drinking water to the Lompico area which consists of mostly single-family homes with an estimated population of 1,500 people and about 500 service connections. The surface water sources are Lompico and Mills Creeks with a small diversion dam on Lompico Creek (SLVWD, 2009). Lompico Creek is a tributary to Zayante Creek. LCWD has an appropriative right of 26.9 AFY with a requirement for a minimum release of 0.10 cfs at all times. The District also operates groundwater wells that can be used to supplement surface water supplies.

2.1.4.2 Mount Hermon Association

The Mount Hermon Association (MHA) is located near Bean Creek upstream from the confluence with the San Lorenzo River (Figure 2-1). MHA has three appropriative water rights for a total of about 216 AFY (see TM-2A) including Acadia and Redwood Springs plus another at an unspecified location. The MHA water supply is provided by three groundwater wells located on the property.

2.1.4.3 Soquel Creek Water District

SqCWD serves approximately 50,000 customers through nearly 15,000 connections in four service areas primarily in the cities of Capitola, Aptos, La Selva Beach, Opal Cliffs, Rio Del Mar, Seascape, and Soquel. For the most part, the SqCWD is located outside of the study area and did not participate in this study. The SqCWD does not produce water from the Basin, but the SqCWD includes a detached portion of the Soquel Creek watershed just northeast of Scotts Valley (Figure 2-1). This area was once the proposed site of Glenwood Reservoir on Soquel Creek, but the reservoir was never constructed.

2.2 Regional Groundwater Usage in the Study Area

Groundwater production in the Scotts Valley area consists of pumping by the SVWD, other water purveyors and private wells. Figure 2-2 provides a summary of annual groundwater production by user type in the southern SMGB. The user types include:

- SVWD Wells – groundwater production by SVWD.
- Other Municipal Wells –primarily includes SLVWD and the Mount Hermon Association.
- Industrial Wells – includes private wells for commercial and industrial usage.
- Environmental Remediation Wells – includes groundwater pumped for the environmental compliance sites (see TM-1A).
- Private Wells – includes wells serving one to 4 households

Groundwater usage is reported here to represent a water year (WY) that runs from October through September of the following year. The purpose of the water year is to better represent the typical groundwater cycle in the SMGB. The typical California climate pattern consists of a rainy season from November through April and a dry summer from May through September. Groundwater levels are typically highest in late spring and lowest in late summer and early fall.

Total groundwater pumping in the Scotts Valley and Pasatiempo GW Subareas was estimated to be 2,350 acre-feet in WY2009. Historically, groundwater production increased from about 1,400 acre-feet in WY1976 to about 3,600 acre-feet in WY2001 (Figure 2-2). Groundwater production has steadily declined by an average of 155 AFY since WY2001. Production in WY2009 was about 330 acre-feet less than in WY2008. SVWD continues to be the largest groundwater user in the area, using approximately 1,500 acre-feet in WY2009, which represents approximately two-thirds of total local production.

The SLVWD supplies water to areas west of Scotts Valley. Groundwater production by SLVWD in the Pasatiempo GW Subarea was about 370 acre-feet in WY2009. Annual groundwater production by SLVWD has been relatively constant with production rates fluctuating between 330 to 450 AFY from WY1995 to the present (Figure 2-2). SLVWD pumping in the Scotts Valley and Pasatiempo GW Subarea is from the production wells Pasatiempo #6 and #7. SLVWD also now operates the Mañana Woods #2 well which produced 43 acre-feet in WY2009.

Pumping by the Mount Hermon Association is from Mount Hermon #2 and Mount Hermon #3 wells. Pumping increased from 126 acre-feet in WY1992 to 232 acre-feet in WY2008, but was down to 185 acre-feet in WY2009.

Historically, industrial usage consisted primarily of groundwater pumping by the Hanson Quarry, which was a significant groundwater user until the quarry was closed in 2004. Groundwater was used for gravel mining operations, gravel washing and dust control. The decline in total local groundwater production in WY2002 and WY2003 was due to the decline in groundwater usage by the quarry (Figure 2-2).

Environmental remediation activities, primarily for the Watkins-Johnson Superfund Site and the Camp Evers MTBE plume remediation, have accounted for significant groundwater production locally (Figure 2-2). However, groundwater production for environmental remediation has steadily declined from 464 acre-feet in WY1986 to an estimated 28 acre-feet in WY2009.

Estimates of groundwater production from private wells are based on available information of the type of usage. Private groundwater production has decreased over the years as properties connect to public water supplies. The private well production prior to 1998 is based on the Todd Engineers (1998) report. Private production has been assumed to be stable at 220 acre-feet in recent years.

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Section 3: Physical Setting

This section provides a summary of the physical aspects of the study area (Figure 1-2). An understanding of the physical environment is important to the future planning and ultimate implementation of a Conjunctive Use Project. This section provides a summary and more detailed discussions are provided in TM-1A and TM-2B.

3.1 Topography

The project study area is situated on the southwestern slope of the central Santa Cruz Mountains in Santa Cruz County (Clark et al, 1989, Brabb, et al, 1997). The Santa Cruz Mountains comprise a portion of the California Coast Ranges physiographic province (Clark 1966). The relief in the Scotts Valley area is moderately rugged, with elevations ranging from less than 300 feet above mean sea level using the North American Vertical Datum (NAVD 1988) along the San Lorenzo River to over 1,800 feet on Ben Lomond Mountain. Within Scotts Valley, which is situated along the Carbonera Creek, ground surface elevations range from 550 feet along Carbonera Creek to over 800 feet on the ridges north of the city, and over 1,000 feet on the ridges east of the city (Clark et al, 1989, Brabb, et al, 1997).

The general topography of the area consists of north-south trending, elongated steep-sided ridges alternating with V-shaped valleys (Figure 1-1). One of the largest of these valleys is Scotts Valley. Scotts Valley is contiguous with Camp Evers, a broad bench on the south side of Scotts Valley that straddles the divide between the Carbonera and Bean Creek watersheds.

3.2 Climate

Scotts Valley has warm summers and mild winters. In inland areas that have a sunny exposure, the mean maximum daily temperature is often more than 80 degrees. The elevated inland areas are approximately 3 to 5 degrees cooler per 1,000-foot rise in elevation (USDA 1980).

Precipitation varies across Santa Cruz County primarily due to the orographic effects of topography. Precipitation is heaviest in the mountains, such as Ben Lomond Mountain, where seasonal precipitation totals average 60 inches whereas mean annual precipitation along the coast is approximately 30 inches. In the driest years, which occur every 20 years on average, the Santa Cruz Mountains receive only 30 to 35 inches of precipitation. In the wettest years, precipitation totals more than 90 inches in parts of the Santa Cruz Mountains (USDA 1980).

The Study Area is primarily at lower elevations, and the rainfall is slightly lower than in the mountainous areas. Annual precipitation in Scotts Valley averages about 42 inches per year based on historical measurements (Kennedy/Jenks, 2009a). The median rainfall is 40.5 inches per year, indicating a slight shift in the average rainfall due to a few extremely wet years. During this period, the highest annual rainfall in Scotts Valley was 86.25 inches in WY1983, and the lowest annual rainfall was 19.89 inches in WY1976.

The climate pattern in the Scotts Valley area is Mediterranean with distinct rainy and dry seasons. During the typical rainy season from November through March, the long-term average precipitation is over 35 inches representing about 84 percent of the average annual rainfall. During the typical dry season from June through September, the long-term average precipitation is less than one inch representing about 2 percent of the average annual rainfall. During the shoulder months that represent the transition from the rainy to the dry season, (typically October, April and May), the long-term average precipitation is less than 6 inches representing about 14 percent of the average annual rainfall.

Since most of the groundwater recharge in the Santa Margarita Groundwater Basin is ultimately derived from precipitation, above-average rainfall years tend to produce increased groundwater recharge, sustaining long-term groundwater levels, whereas below-average rainfall years produced decreased groundwater recharge. Stream flows are fed by runoff from both the mountainous and lower elevation areas; therefore, the variation in rainfall due to the orographic effects is important for understanding streamflows in the San Lorenzo River and its tributaries. Additional information on climate is presented in TM-1A and TM-2B.

3.3 Land Use

Within the City of Scotts Valley, much of the land has been developed for residential, commercial, and industrial uses. Much of the land along Scotts Valley Drive and Mt. Hermon Road, which form the primary corridors through the city, has been developed and covered with asphalt parking areas, roads, and buildings. A study based on satellite image analysis approximated that more than 60 percent of the City of Scotts Valley is covered with impervious areas as shown on Figure 10-2. Residential development has occurred over much of the City of Scotts Valley and several parts of the surrounding area. Undeveloped parts of the Scotts Valley area are typically covered by redwood or pine forests.

A large sand quarry in the south Scotts Valley area was operated by Hansen Aggregates as shown on Figure 1-2. Operations at the quarry have been concluded and no further mining activity is anticipated at the site. The site is currently undergoing closure procedures. Similarly, nearby Olympia Quarry is also closed. Smaller, older closed quarries are also located throughout the area.

3.4 Geology

Scotts Valley is located on the southwestern slope of the Santa Cruz Mountains in western Santa Cruz County. The regional geology is based on previous studies by the United States Geological Survey (USGS) in reports by Clark (1966, 1981) Clark et al (1989), Brabb et al (1997), Akers and Jackson (1977) and McLaughlin et al (2001). Other relevant reports on the subsurface geology include ETIC (2005, 2006), Kennedy/Jenks (2008, 2009a, 2010), Johnson (2002, 2009) and R.L. Stollar & Associates (1988). A more detailed discussion of groundwater in the SMGB is provided in TM-1A. A brief overview is provided below.

3.4.1 Santa Margarita Groundwater Basin

The SMGB comprises a portion of the California Coast Ranges, and is a geologically complex area that was formed by the same tectonic forces that created the Santa Cruz Mountains. The SMGB lies with a major tectonic block defined by the San Andreas Fault to the northeast and the San Gregorio Fault to the southwest. The geology of this tectonic block is characterized by Cenozoic clastic sedimentary and volcanic rocks with a composite thickness of over 30,000 feet that rest upon the crystalline basement rocks (Clark, 1966, 1981, Brabb et al, 1997, and McLaughlin et al 2001).

3.4.2 Geologic Units

The SMGB consists of a sequence of sandstone, siltstone, and shale that is underlain by granite. This sequence of sedimentary rocks is divided into several geologic formations that are defined on the basis of the type of rock and their relative geologic age based on studies by the USGS (Clark, 1966, 1981, Brabb et al, 1997, and McLaughlin et al, 2001). The stratigraphic column for the study area consists of a crystalline basement rock overlain by a Tertiary-aged sedimentary sequence (Figure 3-1). As shown on Figure 3-1 the geologic formations in the area from youngest to oldest include:

- **Alluvial Deposits** (alluvium) – thin, surface deposits consisting of unconsolidated sands and silts found in the Scotts Valley area associated with existing and prehistoric streams.
- **Purisima Formation** (Purisima) – Siltstone and sandstone that forms the tops of some of the hills in the Scotts Valley area. It is a key aquifer in the Soquel area.
- **Santa Cruz Mudstone** – Dense shale that is found near the ground surface underlying much of the northern areas of Scotts Valley.
- **Santa Margarita Sandstone** (Santa Margarita) – Thick sandstone that forms the light-colored bluffs around Scotts Valley. The local sand quarries mined this unit for its high quality sand.
- **Monterey Formation** (Monterey) – Thick shale with a few sandstone layers. It separates the Santa Margarita and Lompico, but is missing underneath parts of Scotts Valley.
- **Lompico Sandstone** (Lompico) – A thick sandstone that looks similar to the Santa Margarita; however, this unit is primarily found in the subsurface with limited surface outcrops primarily along the basin margin both to the north and south of Scotts Valley.
- **Butano Formation** (Butano) – A thick sequence of sandstone and shale. It is found at depths greater than 1,000 feet below Scotts Valley, but it is found at the surface to the north.
- **Locatelli Formation** (Locatelli) – Primarily a shale sequence. It also contains a basal sandstone layer that supports some domestic water wells.
- **Crystalline Basement Rock** (crystalline basement) – composed primarily granite and quartz diorite, the crystalline basement forms the base of the SMGB.

The geologic map (Figure 3-2), from Brabb et al (1997), shows surface outcrop distribution of these units in the Scotts Valley area. Areas outside of the SMGB have a different sequence of sedimentary units that are not present within the SMGB.

3.4.3 Geologic Structure

The SMGB is a roughly triangular area that is bounded by the two regional faults, the Ben Lomond Fault to the west and the Zayante Fault to the north (Figure 1-1). To the southeast, the basin is bounded by the granitic crystalline rock which rises steeply in this area. As mapped by the USGS (Brabb et al, 1997), the Ben Lomond Fault trends north-northwest and forms the western boundary of the basin (Figure 3-2). Ben Lomond Mountain, which is primarily composed of crystalline basement rock, is located west of the fault. The Zayante Fault forms the northern basin boundary. The area north of the Zayante Fault is composed of a sequence of Tertiary-aged sedimentary formations that are not present south of the Zayante Fault in the SMGB (Figure 3-2). There is a significant displacement along both of these faults, and there is not considered to be appreciable groundwater flow across either the Ben Lomond or Zayante Faults.

Regional folding has produced a major syncline, or trough, termed the Scotts Valley Syncline, which crosses through the North Scotts Valley area. The axis of the syncline has a northwest-southeast trend (Clark 1981; Brabb et al., 1997). The syncline is expressed at the surface by geologically younger geologic units outcropping in the center of the syncline, with progressively older units outcropping on the flanks of the syncline. The Scotts Valley Syncline was formed as a result of uplift along the Zayante Fault and therefore essentially parallels the fault. The Scotts Valley Syncline is the primary geologic structure that forms the SMGB.

The deepest part of the Basin is located in northern Scotts Valley where the sedimentary rocks that form the basin aquifers are over 1,500 feet thick. The depth to the crystalline basement varies from near the surface along Carbonera Creek to over 2,000 feet in the area of SVWD Wells #3B and #7A. These two wells are located in the axis of the Scotts Valley Syncline which is the deepest part of the SMGB.

3.5 Groundwater

Historically, the majority of groundwater production has been derived from the Santa Margarita, Lompico, and Butano. A more detailed discussion of groundwater in the SMGB is provided in TM-1A. A brief overview is provided below.

3.5.1 Aquifers

In the SMGB, the geologic formations that contain significant sandstone layers are the primary aquifers for water supply. The primary aquifers in the Basin include the following:

- Santa Margarita,
- Lompico , and
- Butano.

The Santa Margarita and Lompico have long been recognized as primary aquifers. The Santa Margarita has a long groundwater production history, with several production wells completed within this unit (Muir, 1981). Similarly, the Lompico is currently the primary groundwater-producing formation. The Butano had been mapped in surface outcrop by Clark (1966, 1981). However, it was not recognized as the deep aquifer underlying the northern Scotts Valley until more recently (ETIC, 2006). Minor local production is derived from the sandstone interbeds and the fractured siltstones in the Monterey; however, the Monterey has limited water supply potential that is typically used for private domestic wells rather than for municipal supply.

3.5.2 Santa Margarita

The Santa Margarita generally consists of massive, fine-to-medium-grained sandstone that forms a distinctive formation of white sand that can be observed in cliffs around Scotts Valley. The Santa Margarita has widespread surface exposures in southern Scotts Valley and north of Bean Creek. The Santa Margarita thins from over 400 feet thick in the western part of the basin to being absent at SVWD #7A on the eastern edge. The Santa Margarita unconformably overlies the Monterey, and has completely eroded away the Monterey in the southeast and southern portions of the basin.

Groundwater flow within the Santa Margarita is considered to be compartmentalized with flow generally towards the formation down-dip direction. Groundwater flow north of Scotts Valley is generally directed towards Bean Creek. In areas south and west of Scotts Valley, groundwater flow is more localized towards nearby springs (Figure 3-3). In the areas west of Scotts Valley, groundwater flow is generally directed towards large springs. In an area along Mt Hermon Road, groundwater levels in the Santa Margarita form a broad depression that extends to near Scotts Valley Drive with groundwater elevations below 350 feet (NAVD 1988). The cause of this depression is considered to be a combination of pumping, reduced groundwater recharge due to urbanization and changes in water usage (ETIC 2005, 2006; Johnson 2002, 2009; Kennedy/Jenks, 2008, 2009, 2010).

The groundwater gradient is generally on the order of 0.02 to 0.03 feet/feet (ft/ft). These gradients can steepen in the vicinity of large wells. Pumping rates for production wells in the Santa Margarita typically range between 100 and 200 gallons per minute (gpm). Higher pumping rates may have been achievable historically when groundwater levels were higher.

3.5.3 Lompico

The Lompico is typically 200 to 350 feet thick (Clark, 1981, Brabb et al, 1997). Groundwater level declines in the Lompico have been more widespread than in the Santa Margarita. Groundwater flow in the Lompico is primarily from north to south. Figure 3-4 presents a groundwater elevation map of the Lompico for September 2009 based on the groundwater levels collected by SVWD, SLVWD and others (Kennedy/Jenks 2010). As noted above, wells are generally limited to the southern margin of the basin. The general pattern shown on Figure 3-4 is a broad area of depressed groundwater levels forming a trough along the southern margin of the basin. The individual pumping wells are shown as isolated areas of increased drawdown. To the north, the higher groundwater elevations are interpreted to represent groundwater flow from the center of the basin towards the pumping centers in the south.

The groundwater gradient is also generally on the order of 0.02 to 0.03 ft/ft. Discharge is primarily to the large groundwater pumping wells operated by SVWD and SLVWD. These gradients can steepen in the vicinity of large wells. Pumping rates for large production wells in the Lompico typically range between 200 and 400 gpm.

In parts of the Scotts Valley area, especially within a strip along the southern and eastern portions of the basin, the Monterey was eroded away prior to deposition of the Santa Margarita, so that the Santa Margarita lies directly upon the Lompico. In these areas, there is no known barrier to percolation of groundwater from the Santa Margarita to the Lompico, so surface recharge would have the potential to reach the Lompico. Declining groundwater levels in the Lompico has impacted groundwater levels in the Santa Margarita in this area causing portions of the Santa Margarita to become unsaturated (Figure 3-3).

3.5.4 Butano

The Butano is a thick sandstone unit that consists largely of sandstone and interbeds of mudstone, shale, and siltstone. Specifically, the Butano consists of three members that include the lower sandstone member, the middle siltstone member, and the upper sandstone member (Clark, 1981). The Butano forms a wedge along the northern portion of the SMGB and has been mapped in surface outcrop along the northern SMGB margin. The Butano has a total stratigraphic thickness of up to 5,000 feet; however, due to structural deformation and erosional history the thicknesses found in the Scotts Valley area is several hundred to a thousand feet thick (Clark, 1966, 1981; Brabb et al, 1997; and McLaughlin et al, 2001).

Groundwater recharge is most likely from infiltration of precipitation and from the streams that flow over the Butano Formation in these exposure areas north of Scotts Valley. Correspondingly, the Butano Formation appears to have few natural discharge points.

Annual groundwater production from the Butano is estimated to range from 500 to 1,000 acre-feet per year. Groundwater level declines in the Butano are not as well understood as those in the Lompico and the Santa Margarita due to a lack of monitoring wells completed entirely within the Butano. Static groundwater levels fluctuate about 100 feet seasonally due to pumping, but overall groundwater levels have maintained a relatively stable trend. This suggests that the Butano is actively recharged, allowing groundwater levels to recover each year in spite of the high volume of groundwater produced by these wells.

The lack of surface exposure and overlying fine-grained layers precludes any surface recharge methods for the Butano. The Butano is absent over much of the Study Area, and is only present at depths over 1,000 feet in the northern portions of Scotts Valley causing increased injection well installation costs. Because of these limitations, the Butano is not considered to be a viable candidate for groundwater recharge by the Conjunctive Use Project.

Section 4: Overview of Water Issues

The objective of the Conjunctive Use Project is to assess the most appropriate approaches for coordinating water projects and increasing groundwater storage to provide reliable drinking water to the lower San Lorenzo River Watershed, mitigate declines in groundwater levels, and increase summertime stream baseflow to improve fish habitats. A summary of the water-related issues pertinent to the Conjunctive Use Project are summarized below. Additional information regarding these issues is available in the attached technical memoranda. This section provides a summary and more detailed discussions provided in TM-1A, TM-1B, TM-1C, TM-2A, TM-2B, TM-2C and TM-3. Specific references to these technical memoranda included with the discussion below.

4.1 Groundwater

Groundwater storage is a measure of the volume of groundwater present in the aquifer. The change in groundwater storage measures the increase or decrease in the volume of groundwater in the aquifer resulting from changes in groundwater levels. Previous losses of groundwater from aquifer storage provide the potential for future groundwater storage through the Conjunctive Use Project.

The primary aquifers to be discussed in context of the Conjunctive Use Project include the Santa Margarita and the Lompico. Below is a brief overview of the historic changes in groundwater that could be utilized by the Conjunctive Use Project in these aquifers. Additional information on the hydrogeology is provided in TM1A.

4.1.1 Santa Margarita

Historically, groundwater levels have been significantly higher in the Scotts Valley area than the current conditions; however, these declines are localized. Some areas have experienced over 200 feet of groundwater level declines whereas other nearby areas have experienced relatively little change in groundwater levels during the same period. The volume of groundwater in the Santa Margarita has declined by as much as 5,000 acre-feet from 1985 through 2007 (Johnson 2002; ETIC 2005, 2006; Kennedy/Jenks 2008, 2009a, 2010). The areas with lower groundwater levels provide the potential capacity for a groundwater recharge project.

For the Conjunctive Use Project, the key aspect is the distribution and magnitude of the historical groundwater declines. These depleted areas represent aquifer storage potential. The distribution of the historical drawdown can be evaluated using a groundwater model that was constructed for the SMGB (ETIC, 2006). This model is currently being updated by SVWD as part of their annual groundwater management program and reported in their annual reports (Kennedy/Jenks, 2008, 2009a, 2010). Figure 4-1 shows groundwater model results of the distribution of groundwater level declines for the Santa Margarita in the Scotts Valley area.

4.1.2 Lompico

Groundwater levels have declined by 100 to 250 feet over broad areas underlying Scotts Valley. The volume of groundwater in the Lompico is estimated to have declined up to 10,000 acre-feet from 1985 through 2007 (Johnson 2002, ETIC 2005, 2006; Kennedy/Jenks, 2008, 2009a, 2010). The areas with lower groundwater levels provide the potential capacity for a groundwater recharge project.

Figure 4-2 shows the groundwater model interpreting the distribution of groundwater level declines for the Lompico as more uniform in the Scotts Valley area than what was seen in the Santa Margarita. The largest declines are focused on the areas in eastern margin of the SMGB in the Scotts Valley area with declines over 200 feet near the principal water supply wells. Declines in the groundwater levels decrease to the north and west but are still in excess of 100 feet in many areas. This demonstrates that the Lompico acts more as a regional aquifer and is not impacted by localized conditions as is the Santa Margarita.

With respect to the potential for aquifer recharge for the Conjunctive Use Project, the regional groundwater level declines in the Lompico provide a higher potential for aquifer storage capacity. The areas of greatest historical declines in groundwater levels provide the greatest aquifer storage potential that could be utilized by the Conjunctive Use Project. In addition, those areas where Santa Margarita directly overlies the Lompico provide potential storage capacity in both the Santa Margarita and Lompico.

4.1.3 Change in Groundwater Storage

Changes in groundwater storage can be analyzed by either of two methods: 1) a model-based calculation; or, 2) an empirical method. The regional groundwater model (ETIC, 2006) has been used to evaluate the change in groundwater storage (Kennedy/Jenks 2008, 2009a, 2010). Over the past 25 years, the annual change in groundwater storage has varied from an increase of over 600 AFY to decreases of nearly 1,900 AFY (Figure 4-3).

Previous losses of groundwater storage create the potential for future groundwater storage through the Conjunctive Use Project. Based on the regional groundwater model, the volume of lost groundwater storage over the past 25 years is estimated to be approximately 12,000 acre-feet (Kennedy/Jenks 2008, 2009a, 2010). Estimates of groundwater storage loss by Johnson (2009) suggest a cumulative loss of approximately 5,000 acre-feet in the Santa Margarita of and an additional loss of 10,000 acre-feet in the Lompico. The key observations most pertinent to the Conjunctive Use Project include the following:

- Cumulative declines in groundwater storage range from 12,000 to 15,000 acre-feet in the Scotts Valley area.
- Most of the storage decline has occurred in the Lompico rather than the Santa Margarita.

Based on this assessment, there is a substantial volume of potential aquifer storage, which suggests that enhanced aquifer recharge in the Scotts Valley area should be viable. Additional information on the change of groundwater storage is provided in TM1A and TM-1C.

4.2 Surface Water

The San Lorenzo River and its tributaries provide a potential source of surface water available for potential diversions. Below is a summary of the surface water streams in the San Lorenzo River Watershed pertinent to the Conjunctive Use Project and a summary of some of the issues that surround the use of water from these streams. Additional information is available in TM-2A, TM-2B and TM-2C.

4.2.1 San Lorenzo River

The San Lorenzo Watershed covers 138 square miles in the Santa Cruz Mountains along the Central California Coast in northern Santa Cruz County. The San Lorenzo River empties into the Pacific Ocean in the City of Santa Cruz. Small, steep tributaries feed the river from the west at Ben Lomond Mountain, while wider, more gently sloping tributaries feed the river from the east and northeast (Santa Cruz County, 2001, SLVWD, 2009).

The San Lorenzo River historically supported the largest salmon and steelhead fishery south of San Francisco Bay; the fourth largest steelhead fishery in the state. Coho salmon and steelhead are now listed as threatened or endangered species (Santa Cruz County, 2001, SLVWD, 2009).

The USGS Gage No. 11160500 on the San Lorenzo River at Big Trees (Big Trees Gage) is the primary stream gage in the San Lorenzo Valley, with a long period of record (from October 1936 to present). The contributing area above the gage is 106 square miles. The Big Trees gaging station is approximately 2,000 feet downstream from the mouth of Zayante Creek. The gage responds to flow from the Zayante and Bean Creek systems, which constitute 18 percent of the contributing watershed to the gage. It is also affected by the operations of Loch Lomond Reservoir on Newell Creek, including seasonal diversions from San Lorenzo River, which supplies water to the reservoir from the inflatable diversion dam at the Felton Diversion, as well as the inflation and deflation of this dam.

The volume of potentially available surface water is linked to rainfall patterns and is thus subject to climatic variability. Average rainfall over the San Lorenzo Watershed varies from 28 inches per year at the coast to more than 60 inches per year on Ben Lomond Mountain. Annual rainfall totals for Zayante Creek, Bean Creek, and Carbonera Creek watersheds average about 45, 42, and 34 inches per year, respectively, and vary considerably from year to year.

Average annual streamflow total through the Big Trees Gage was 96,100 AFY, with a statistical recurrence interval of 2.6 years. In addition, flows in excess of 10,000 AFY occur with a statistical recurrence interval of slightly over 1 year. Of the 74-year period of record reviewed, it is estimated that about one-third of all days in the five months with higher surface water flows (typically mid-November to mid-April) have daily mean discharge (flow) greater than 200 cfs. An analysis of Big Trees Gage data for daily mean discharge greater than 25 cfs indicate that 63 percent of all days of record have flows greater than 25 cfs. Initial studies on anadromous fish in the San Lorenzo River were performed in 1976 by the SWRCB and revised in the late 1980s as part the water rights process, and established a bypass flow requirement of up to 25 cfs (see TM- 2A for details).

4.2.2 Bean Creek

Bean Creek parallels Zayante Creek to the south and east, flowing into Zayante Creek approximately 3,000 feet upstream of the San Lorenzo River confluence. The USGS streamflow gage No. 11160430 on Bean Creek is located approximately 1.2 miles upstream of the confluence of Bean and Zayante Creeks, 100 feet upstream of Mount Hermon Road. The period of record for the gage is from January 1989 through water year 2007, when the gage was discontinued. The drainage area above the gage is 8.81 square miles, which is 90 percent of the total watershed (above its Zayante Creek confluence). All major tributaries to Bean Creek are upstream of the gage and captured in the gaging record.

Average annual total streamflow from 1989 to 2007 through the Bean Creek gage was 8,000 acre-feet which occurred on a 2.6 year seasonal recurrence and represents 8.3 percent of the annual average streamflow at the San Lorenzo at Big Trees station (see TM-2B, Figure 13). The highest stream flows are typically measured in February. The most rapid decline in stream flow typically occurs from March through May. Upper Bean Creek and its tributaries are typically losing streams that recharge the groundwater. By contrast, in much of the lower watershed where Bean Creek and its larger tributaries have eroded down to the Santa Margarita, streamflow is enhanced by leakage from the Santa Margarita.

The Bean Creek watershed contains large areas where the Santa Margarita is exposed at the ground surface where higher initial infiltration rates of precipitation are anticipated before runoff occurs. This tends to result in a delayed and extended response to high precipitation events.

In order to estimate anadromous fish bypass flow needs, the present practice by the resource agencies and the SWRCB Division of Water Rights is to evaluate the level of flow impairment associated with a proposed diversion. This evaluation is performed by calculating the Cumulative Flow Impairment Index (CFII) for the proposed diversion using a methodology developed for use on the Russian River and applying the methodology to other waterways.

As part of the CFII analysis for Bean Creek described in TM-2B, an instantaneous diversion rate up to 5 cfs was used that resulted in an average annual yield for the diversion of 520 acre-feet. Figure 4-4 (from TM-2B) plots the annual flow in Bean Creek for each water year and the volume of water that would have been diverted with a 5 cfs maximum diversion rate between October 1st and March 31st while maintaining a minimum bypass flow of 10 cfs.

Based on the water years of record, the average CFII for Bean Creek is calculated to be 0.085, using the assumptions described above. This CFII value is within the acceptable ranges that are thought to not cause significant cumulative impacts to anadromous fish through flow impairment. If the CFII values are between 0.05 and 0.1, threshold parameters must be demonstrated to occur during a 2-year annual streamflow recurrence interval. These threshold parameters, by definition, cannot reduce February stormflows by greater than 5 percent, and must allow winter storm events to pass through the diversion with exceedance flows greater than 20 percent of average winter flow.

4.2.3 Zayante Creek

The Zayante Creek USGS Gage No. 1160300 was operated during water years 1958 to 1992 to collect background data for a proposed surface-water impoundment in the upper Zayante Watershed. It was located 3.5 miles upstream from the confluence of Zayante Creek with San Lorenzo River at the bridge near the Zayante Store. The gage monitored a drainage area of 11.1 square miles, which covers about 60 percent of the total Zayante Creek Watershed. The Zayante gage measured flow above the confluence with Lompico Creek, which has a drainage area of 3.4 square mile and supplies a substantial portion of the streamflow in Zayante Creek (RAMLIT, 2002). Average annual streamflow for the period of record is 8,000 acre-feet, which represents 8.3 percent of the annual average streamflow at the San Lorenzo at Big Trees station and occurs on approximately a 2.6 year seasonal recurrence (see TM-2B, Figure 17).

As part of the CFII analysis for Zayante Creek, an instantaneous diversion rate of 5.5 cfs was used and the average annual yield over the period of record of the diversion is estimated to be 500 AFY which is consistent with the quantity necessary to overcome annual overdraft. The average annual yield is shown on Figure 4-5 (from TM-2B, Figure 25) which plots the annual flow in Zayante Creek per water year and the volume of water that would have been diverted with a 5.5 cfs diversion rate between October 1st and May 31st and a minimum bypass flow of 10 cfs.

The average CFII of 0.067 at the Zayante Creek gaging site and the ranges of yearly CII are mostly within the acceptable ranges that are thought to not cause significant cumulative impacts to anadromous fish through flow impairment. However, the ranges of yearly CII in some years are above the threshold indicating likely significant cumulative impacts. A lower diversion rate, such as that necessary to meet estimated winter usage without replenishing storage, would likely result in a range of yearly CFII that are expected not to cause significant cumulative impacts through flow impairment. All points of diversion downstream of the gage will need to be evaluated for flow impairment as detailed in the 2000 with 2002 errata NOAA/California Department of Fish and Game (CDFG) memorandum (DFG/NOA Fisheries, 2002) during the next stage of feasibility analysis. The 2002 memorandum is described in greater detail in TM-2C.

4.2.4 Carbonera Creek

Carbonera Creek is south of Bean Creek and is a tributary to Branciforte Creek, which flows into the San Lorenzo River well downstream of the USGS Big Trees gage. Branciforte Creek merges with the San Lorenzo in the City of Santa Cruz about 6,000 feet upstream of the river's mouth. Carbonera Creek USGS Gage No. 11161300 is located 4.1 miles upstream of its confluence with Branciforte Creek and 1.1 miles upstream of Glen Canyon Road. The drainage area to the gage is 3.60 square miles, which is 50 percent of the total watershed above the confluence with Branciforte Creek. The period of record is from February 1985 through water year 2007, when the gage was discontinued.

The gage was located in a losing reach of Carbonera Creek where the stream transitions from flowing over Santa Cruz Mudstone to Santa Margarita and alluvial stream terrace deposits. Average annual streamflow totals measured by the gage were 4,000 acre-feet which is approximately a 2.6 year seasonal recurrence.

As part of the CFII analysis for Carbonera Creek, an instantaneous diversion rate up to 10 cfs was assumed to result in an average annual yield over the period of record of the diversion of 480 AFY. The average annual yield is shown Figure 4-6 (from TM-2B) which plots the annual flow in Carbonera Creek per water year and the volume of water that would have been diverted with a 10 cfs diversion rate between October 1st and March 31st and a minimum bypass flow of 10 cfs.

The average CFII for Carbonera Creek is 0.16 and the ranges of CFII exceed the threshold indicating likely significant cumulative impacts to anadromous fish through flow impairment. Because the CFII values are above 0.1, flow impacts of the proposed diversion will be initially deemed to be severe and any diversions must be considered infeasible. However, during the past decade there have been changes in the hydrology from increased urbanization of the Carbonera Creek watershed.

4.2.5 Estimated Baseflow

Based on the available stream gage data, dry season estimates of baseflow for the San Lorenzo River and its tributaries are made to provide a framework for evaluating the potential benefits of the proposed projects.

San Lorenzo River at Big Trees - As would be expected even in the dry season of dry years, the San Lorenzo River has some level of baseflow from its main channel and tributaries. The minimum daily discharge for the period of record was a flow of 5.6 cfs which occurred on July 27 and 28, 1977, one of the most intense droughts in recent time. More typical values of dry season average daily baseflow are in the 20 to 30 cfs range.

Bean Creek at Zayante Road - summer baseflows in Bean Creek are supported by ground water seeping into the channel from the Santa Margarita and Purisima pinching out against the Monterey Shale. Baseflow is maintained throughout all of the years of record, but is clearly lowest during below average to critically dry rainfall years. The minimum daily flow was 0.94 cfs.

Zayante Creek downstream from the Zayante gage - The channel flows through the sandy soils of the southeastern block, underlain by the hard shales and mudstones of the Monterey. Summer baseflows near the confluence with Bean Creek are fed by ground water by the same mechanism that supplies baseflow to Bean Creek.

Carbonera Creek - The gage was located in a losing reach of Carbonera Creek where the stream transitions from flowing over Santa Cruz Mudstone to Santa Margarita and alluvial stream terrace deposits. The gage did not measure flows from Camp Evers Creek or the unnamed creek that joins Carbonera Creek below Camp Evers which are both characterized as perennial. There is no flow for many days in each year because the flows are either lost before they can be recorded and/or do not occur because of declining groundwater levels.

4.2.6 Water Rights

As discussed in TM-2A, the San Lorenzo River and its tributaries are identified as being fully appropriated during the period from June 1 through October 31 which indicates that with the exception of new riparian water rights diverters, no other diversions can be made during this period. More recently, the fisheries/natural resources agencies have proposed fully appropriating the San Lorenzo River and its tributaries year round, including the highly productive wet season. To date, this proposal has not been resolved.

The SCWD and SLVWD both have water rights from the San Lorenzo River and Newell Creek, some of which are in the process of being modified so that the water can be put to full beneficial use. The SCWD's Water Rights Conformance Proposal seeks to add the right of direct diversion to the City's Newell Creek and San Lorenzo River at Felton water rights, rectifying an oversight in the original water right filings (EDAW, 2005). In addition, SWRCB holds an inactive right for 17,000 acre-feet of storage held for use by Northern Santa Cruz County on Zayante Creek. Three potential options are summarized below for utilizing existing or applying for new appropriative water rights:

1. File for change in place of use and purpose use of either the SCWD's or SLVWD's current water rights to a different point of delivery. The SCWD's Water Rights Conformance Proposal is an example of this option.
2. File for New Appropriative Right- filing for a new right such as on Bean Creek is an example of this option.
3. Partial assignment of the existing Zayante Creek Right held by the SWRCB - filing for the inactive right for 17,000 acre-feet held for Northern Santa Cruz County is an example of this option.

Any water rights process will require significant additional study and will be a lengthy process.

4.3 Stormwater

Stormwater is water that originates during precipitation events. Stormwater that does not soak into the ground becomes surface runoff, which either flows directly into surface waterways or is channeled into storm sewers, which eventually discharge to surface waters. Stormwater is of concern for two main issues related to the volume and timing of runoff water and to potential for contamination. Stormwater can also be a potential water resource that can potentially make urban environments more self sustaining in terms of water with proper stormwater management.

4.3.1 Urban Stormwater Runoff

For the Conjunctive Use Project, stormwater is considered the runoff from the urbanized areas around Scotts Valley whereas the runoff from the surrounding rural and undeveloped lands is considered as part of the surface water flow system of the San Lorenzo River and its tributaries.

Stormwater runoff in Scotts Valley has increased significantly as a result of increased urbanization and resulted in a commensurate loss of groundwater recharge. The impervious area in Scotts Valley is approximately 300 acres with a conservative estimate to account for landscape and unpaved areas of 250 acres. In urbanized areas, the increase in impervious surfaces from parking lots, roads, buildings, and compacted soil limit the ability for rain to infiltrate into the ground. Therefore, urbanized areas generate more runoff than the same areas in undeveloped condition. The reduced percentage of rainfall infiltrating into the soil results in less groundwater recharge. This has potential impacts to both the replenishment of groundwater supplies and the sustainability of stream baseflow in dry weather.

The runoff from the impervious surfaces occurs faster than on undeveloped land which leads to higher peak flows with higher flow velocities. Storm sewers collect runoff from these impervious surfaces and convey it to waterways. Therefore, even small storm events result in increased waterway flows. The runoff conditions generated from urbanized areas can lead to erosion of streams and rivers (hydromodification) as well as increase the potential for downstream flooding due to the higher peak flows reaching the streams in a shorter timeframe.

There is evidence that increased stormwater runoff resulting from urbanization has affected the local streams. Carbonera Creek shows signs of having been impacted by increasing peak stormwater flows from Scotts Valley. Stormwater runoff reaches the creek faster and has a higher and longer duration peak flow that is a result of urbanization. The increased stormwater flows have resulted in increased downcutting and erosion in the creek bed (i.e. hydromodification) and has also contributed to flooding issues further downstream. This issue is discussed in more detail in TM-2B.

Pollutants can enter the stormwater as the runoff flows over areas altered by development where it can pick up contaminants such as oil and grease, pesticides, heavy metals, and nutrients (e.g., nitrogen and phosphorus). Stormwater runs off and ultimately makes its way to the local streams. While there is some attenuation of these pollutants before entering the receiving waters, the quantity of human activity results in large enough quantities of pollutants to impair these receiving waters.

Several techniques are available to reduce stormwater flows, help to restore the natural recharge of groundwater and provide biofiltration to store and treat runoff and release it at a controlled rate to reduce impact on streams. The most popular incorporate land-based solutions to handle stormwater runoff through the use of retention ponds, bioswales, infiltration trenches, sustainable pavements, and others noted above. Solutions require a balance of the desired results of controlling runoff and reducing pollution with the associated capital cost.

4.3.2 City of Scotts Valley Stormwater Management Plan

The City of Scotts Valley has a Stormwater Management Plan (SWMP) to comply with federal and state laws and regulations regarding stormwater management (Scotts Valley, 2008). The SWMP is a planning document to help implement Best Management Practices (BMPs) that reduce pollutants in storm water runoff to the technology-based standard of Maximum Extent Practicable (MEP) to protect water quality. During the term of the SWMP, the City will review existing ordinances and general plans and develop legal authority for implementing the SWMP. In particular, legal authority for the following will be established:

- Effectively prohibiting non-storm water discharges to storm drains and implementing appropriate enforcement procedures and actions
- Requiring that persons engaged in activities that are potential sources of pollutants implement BMPs to reduce pollutant discharges to the MEP
- Requiring erosion and sediment controls, as well as sanctions or other effective mechanisms, to ensure compliance from construction site activities that result in a land disturbance of greater than or equal to one acre
- Addressing post-construction runoff from new development and redevelopment projects that disturb greater than or equal to one acre; including projects less than one acre that are part of a larger common plan of development or sale.

Some of the key aspects of the SWMP relative to the Conjunctive Use Project are summarized below.

4.3.2.1 Post Construction Runoff Control

Post-construction storm water management in areas undergoing new development or redevelopment is necessary because runoff from these areas has been shown to significantly affect receiving water bodies. Many studies indicate that prior planning and design for the minimization of pollutants in post-construction storm water discharges is the most cost effective approach to storm water quality management.

The requirements for new development and redevelopment are included in the City's Storm Water Ordinance to ensure storm water quality. These requirements are applied to new development and redevelopment proposals as they are being processed through the Planning Division. Project improvement plans will be evaluated to determine their consistency with conditions of approval intended to address post-construction storm water run-off. Inspections conducted on each site by City staff or their representatives will determine if the conditions of approval have been met. Each new project is required to include a specified amount of landscaping, measured as a minimum percentage of the property's size. This assists in reducing erosion and siltation.

The City supports the incorporation of Low Impact Development (LID) strategies into all new development and redevelopment projects as appropriate. This provides for the development and adoption of LID design guidelines within the permit period. Once adopted, the LID design guidelines will serve as a reference guide to designers and engineers in the early phases of project development. The City also provides a Planned Development (PD) zoning designation that can be applied to properties allowing clustered development and development transfers. This encourages the retention of natural features such as drainages, buffering development from drainages and riparian vegetation.

4.3.2.2 Total Maximum Daily Loads (TMDL's) to Carbonera and Camp Evers Creeks

The Federal Clean Water Act requires the development of Total Maximum Daily Loads (TMDL's) and implementation plans to bring impaired water bodies back into compliance with water quality objectives. A Sediment TMDL and a Pathogen TMDL have been developed for Carbonera Creek and/or Camp Evers Creek in the City of Scotts Valley.

Carbonera Creek, as a tributary to San Lorenzo River, was identified as impaired by sediment on the 1998 Clean Water Act list of impaired water bodies. The TMDL for sediments in Carbonera Creek became effective on December 18, 2003. During TMDL development, Central Coast RWQCB staff developed seven trackable implementation actions to be undertaken by the City of Scotts Valley. In January 2007, the RWQCB requested the City of Scotts Valley to submit the first triennial report for those actions. The water board staff concluded that the City made, "significant progress towards implementing the actions and continued their commitment to sediment control".

The RWQCB adopted the TMDL for pathogens in Carbonera Creek and Camp Evers Creek on March 21, 2008 (Scotts Valley, 2008). The TMDL includes a source analysis indicating the opinion that the relative order of controllable sources, in descending order, are storm drain discharges, pet waste, homeless encampments, septic systems, domesticated animals, City sanitary sewer collection system leaks, including private laterals. Through the SWMP, the City of Scotts Valley continues to implement measures that target the City's contribution to sediment loading in Carbonera Creek and fecal indicator bacteria in Carbonera Creek and Camp Evers Creek.

4.3.2.3 Hydromodification Plan (HMP)

In response to the February 15, 2008, letter from the Central Coast RWQCB regarding hydromodification control requirements, the County of Santa Cruz, City of Santa Cruz, City of Watsonville and City of Scotts Valley established a strategy to develop alternative hydromodification criteria (Scotts Valley, 2008). The goal of the criteria is to determine an economically viable and practicable hydromodification management strategy that will provide protection of water resources to the maximum extent practicable.

The City of Scotts Valley, in conjunction with Santa Cruz County and the municipalities within the County, has established a strategy to develop hydromodification standards for new and redevelopment projects. The primary goal of the HMP is to determine an economically viable and effective set of Scotts Valley specific hydromodification control standards that will provide protection of water resources (e.g. water quality, beneficial uses, biological and physical integrity of watersheds and aquatic habitats) to the maximum extent practical.

4.4 Groundwater-Surface Water Interactions

Groundwater-surface water interactions play an important role in aquifer recharge. Understanding these interactions is necessary to determine the degree to which the Conjunctive Use Project can meets its primary goals of 1) increasing the volume of groundwater in aquifer storage and 2) increasing the volume of summertime stream baseflow. Below is a brief summary on groundwater-surface water interactions based on earlier reports (Johnson 2002, 2009, ETIC 2005, 2006) and is described in more detail in TM-1A and TM-2B.

4.4.1 Groundwater Interaction with Streams

Groundwater–surface water interactions with streams, such as Carbonera and Bean Creeks, are important hydraulic features that influence groundwater levels and flow. Depending on several factors, the groundwater–surface water interaction may result in one of the following:

- a stream may recharge the groundwater ("losing reach"),
- the groundwater may discharge to the stream ("gaining reach"),
- stream locations that can vary seasonally between gaining reaches during the spring and losing reaches during the fall, or
- streams flowing over low permeability materials that restrict flow so that little interaction occurs.

Understanding the groundwater-surface water interactions is necessary to demonstrate the degree to which the Conjunctive Use Project can meets its primary goals of increasing the volume of groundwater in aquifer storage and while also increasing the summertime baseflow in streams. Some of the key aspects for understanding the groundwater-surface water interactions in the SMGB include:

- The primary gaining reach in the Scotts Valley area is the Lower Bean Creek. This reach is a key discharge area for Santa Margarita groundwater. Lower Bean Creek flows are sustained by groundwater, especially in the summertime.
- Upper Bean Creek and its tributaries, and Carbonera Creek are typically losing streams throughout the year.
- Much of the groundwater discharge from the Santa Margarita is directed towards springs and/or discharge to Bean Creek. This characteristic limits its potential for aquifer storage but increases its benefit for increasing summertime baseflow.
- There is little to no groundwater-surface water interactions with the Lompico in the Scotts Valley area. This characteristic increases its potential for aquifer storage but limits its benefit for increasing summertime baseflow.

Historically, some of the groundwater-surface water interactions were likely different in the Scotts Valley area when groundwater levels in the SMGB were higher. Due to the compartmentalization of the Santa Margarita, stretches of Bean Creek that flow over areas where groundwater conditions have remained stable have varied little from historical conditions. Reduced groundwater discharge to Bean Creek occurs along those stretches where the declines in groundwater levels have occurred.

Carbonera Creek is underlain along its route in Scotts Valley by the Santa Margarita and Lompico. Also, the Springs Lakes area has been described historically as a cranberry bog that likely represented shallow groundwater levels. During these high groundwater conditions, these areas were likely variable gaining and losing reaches depending on climatic conditions. Lower groundwater levels have also contributed to hydromodification along Carbonera Creek where the creek bed has been eroded deeper into the alluvium (ETIC 2005, 2006). The implications of this downcutting are discussed in more detail in TM-2B.

4.4.2 Effects of Urbanization on Groundwater Recharge

The loss of groundwater recharge is integrally linked to the increased stormwater runoff from increased urbanization. The relatively high rainfall volumes in the Santa Cruz Mountains produce a high volume of runoff. A portion of this runoff contributes to groundwater recharge, particularly in the areas where Santa Margarita is exposed at the ground surface. However, the increased impervious areas in Scotts Valley overlie some of the most productive Santa Margarita recharge areas, resulting in a significant loss of groundwater recharge. Therefore, the declining water levels in the Scotts Valley area can be attributed in part to urbanization as well as the increased pumping.

To evaluate the loss of groundwater recharge as a result of urbanization in the groundwater model, the land use factors were changed back to those for undeveloped lands prior to development (ETIC, 2006). The groundwater recharge in Scotts Valley was recalculated and compared to the urbanized recharge volume. The amount of lost groundwater recharge is directly proportional to annual precipitation. Therefore, there is more lost recharge in an above-average precipitation years. Conversely, less groundwater recharge is lost in below-average precipitation years. The results of this analysis indicate that the volume of lost groundwater recharge due to urbanization is on the order of 500 to 1,000 AFY. Over the past 25 years, the volume of lost groundwater recharge is estimated to be approximately 15,000 acre-feet (Kennedy/Jenks 2008, 2010). This loss of groundwater recharge contributes to both the historic declines in groundwater levels observed in the SMGB and to reduced stream baseflows in the San Lorenzo River Watershed. This issue is discussed in more detail in TM-1A.

4.4.3 Springs

Springs represent another form of groundwater-surface water interaction. The Scotts Valley area contains numerous natural springs and seeps throughout the groundwater basin. Springs represent a location where groundwater discharges to the surface. Springs form at hydraulic low points, typically the base of the Santa Margarita overlying a lower permeability geologic unit such as the Monterey, Locatelli, or crystalline bedrock. Therefore, spring discharge will tend to remain relatively stable until the groundwater source feeding the spring is depleted.

The Redwood Springs, Ferndell Spring, and Eagle Creek represent large springs that have a history of flow measurements. For Redwood Springs and Ferndell Spring, located on the grounds of Mt. Hermon Conference Center, flows range from 0.33 to 0.17 cfs, respectively during the spring, and from 0.24 to 0.13 cfs during the fall. Eagle Creek is comprised of multiple springs and seeps in a small watershed that drains into the San Lorenzo River. Flow ranges from 0.66 cfs during the spring to 0.35 cfs during the fall. Several more springs exist that have not been measured, such as those along Camp Evers Creek and Dufour Springs; therefore, substantially more discharge by springs occurs than is documented.

Springs also occur at the contact of the Santa Cruz Mudstone and the Purisima. These units are typically found capping topographic highs in the Scotts Valley area. These springs drain precipitation recharge captured by the Purisima. The Purisima is generally unsaturated in the Scotts Valley area so these are small springs that flow during the rainy season that are termed wet-weather springs. Because of this relationship, these springs are unrelated to the primary groundwater aquifers in the Santa Margarita, Lompico and Butano.

4.5 Fishery

As discussed earlier, the San Lorenzo River system historically supported the largest salmon and steelhead fishery south of San Francisco Bay and the fourth largest steelhead fishery in the state. Coho salmon and steelhead are now listed as threatened or endangered species which can limit the potential to divert water without significant study and resource agency negotiation. As a result of the presence of threatened or endangered species, SCWD has prepared a draft Habitat Conservation Plan (SCWD, 2010) for steelhead in support of their Incidental Take Permit under the Endangered Species Act for their routine operations and maintenance activities. In addition, the NOAA Fisheries recently issued a draft Coho Recovery Plan (NOAA, 2010) that proposes to limit any further diversions, even during the wet season, on the San Lorenzo River.

TM-2C discusses the broad fisheries issues and evaluation methods that can be used to assess the surface water flow requirements to protect the fisheries of the San Lorenzo River and its tributaries. TM-2C reported that new diversions are limited to the period from December 15 to March 31 under 2002 NOAA Fisheries and Department of Fish and Game draft guidelines. The purpose of the draft guidelines is to preserve the natural hydrograph, allow flushing flows for recruitment of spawning gravels and flushing fine sediments, as well as preventing riparian encroachment to protect salmonid passage flows and spawning habitat during the period of potential diversion.

Impacts of diverting after March 31 may include reduced adult passage flows, reduced smolt passage flows, reduced spawning flows, reduced egg incubation flows and reduced rearing flows for juvenile steelhead/ Coho feeding and growth. The impacts would be reduced if diversion occurs in the larger mainstem rather than in a tributary such as Zayante. Instream Flow Incremental Methodology (IFIM) studies would address minimum bypass flows for these life history phases. TM-2C also describes some of the fisheries benefits of increased streamflow in the dry season as the density of juvenile fish was well correlated to the average streamflow.

Section 5: Conjunctive Use Screening Analysis Approach

The Conjunctive Use Project investigated a large number of potential conjunctive use opportunities in the Scotts Valley area. A systematic screening analysis was developed and applied to help sort through the large number of potential projects. Section 5 provides an overview of the general approach and methodology used for this screening analysis.

5.1 Objective

The objective of the Conjunctive Use Project is to identify three preferred alternatives that best meet the goals and satisfy other criteria with respect to technical feasibility and costs. As stated in Section 1, the goals of the Conjunctive Use Project include the following:

- Improve the reliability of drinking water supplies in the Scotts Valley area through coordinating the utilization of multiple water sources to take advantage of times of water surplus and minimize long-term environmental impacts.
- Improve the fishery conditions in the San Lorenzo River and its tributaries with the focus on improving summertime baseflows primarily in the tributary streams that are critical for fish rearing.
- Identify potential projects that will increase groundwater levels in the southern SMGB as the key mechanism to achieve the first two goals on a regional scale.

The three selected preferred alternatives are considered to represent the options with the highest likelihood of success in meeting these goals. However, other projects, especially those that are considered during the final step of the alternatives analysis, should still be considered as viable and relevant to solving future water issues in the region. Therefore, projects and alternatives not included in the three preferred alternatives may be considered for future implementation based on their own merit either in outside of the Conjunctive Use Project or in combination with the preferred alternatives.

To meet these goals, the Conjunctive Use Project is defined as needing to provide at least 500 AFY of groundwater recharge on average with a target goal of 1,000 AFY. Historical declines in aquifer storage are on the order of 15,000 acre-feet. The rationale for the Conjunctive Use Project is that increasing groundwater levels in the southern SMGB to meeting the goals stated above. If the Conjunctive Use Project is assumed to contribute half of the recharge to long-term aquifer storage and half to stream baseflow, a 500 to 1,000 AFY preferred alternative would contribute between 5,000 to 10,000 acre-feet to groundwater storage over 20 years and increase baseflow between 0.35 to 0.7 cfs. This is considered to be an appropriate size for a project to meet the stated goals on a regional scale. Smaller projects could be combined with others to develop a viable regional alternative. Larger projects are preferable if other technical issues and costs are acceptable. Additional information on the historical changes in groundwater levels and streamflow is provided in Section 4 and supported by TM-1A, TM-1C and TM-2B.

5.2 Methodology for Screening Analysis

There are a large number of potential projects that could be used to meet these goals. To sort through the long list of potential projects, a systematic screening process was developed, based on a set of performance criteria, to provide a consistent basis of comparison of the various conjunctive use projects. Using this process, the large number of projects were evaluated and ranked. Based on this analysis, the preferred project alternatives were identified that best meet the project goals. For this analysis, the following definitions were used:

- **Component** – A component is a single water source, a water application method, or conveyance mechanism between the source and application area.
- **Project** – A project is a single combination of components consisting of one water source, water application method, and a conveyance component.
- **Alternative** – An alternative is defined as one or more closely-related projects that can be grouped together for future planning.

The reason for defining projects and alternatives separately is that for the Alternatives Screening Analysis, the process starts with evaluating individual project components. This is considered as part of the systematic process to look at each project component individually and evaluate it based on its own merits.

The screening analysis provides an initial technical evaluation of each component and project with its respect to its effectiveness in meeting the Conjunctive Use Project goals. For each step of the process, screening criteria were developed to provide a consistent framework for comparing the wide ranging list of potential conjunctive use components and alternatives. The development of the screening criteria was based on professional judgment supported by the technical analysis provided by the Technical Memoranda conducted in Tasks 1 through 4 for this project and included with this Report.

The Alternatives Screening Analysis applies screening criteria to the list of potential projects to evaluate their feasibility in a systematic manner. This systematic methodology was developed to evaluate each potential project with respect to critical issues and is outlined in the flow chart in Figure 5-1. Below is an outline of the methodology developed and applied to evaluate a wide range of potential conjunctive use projects to identify three preferred Conjunctive Use Project Alternatives. The methodology includes the following steps:

1. **Evaluate Potential Water Sources** – Screening criteria for water sources emphasize physical, CEQA and regulatory issues, and engineering aspects.
2. **Evaluate Potential Recharge Application** - Screening criteria for application locations emphasize relative groundwater storage and summertime stream baseflow benefits, CEQA and regulatory issues, and engineering aspects.
3. **Develop Long-List of Conjunctive Use Projects** – Combine the top-ten water sources and the top-ten recharge application locations into a list of 100 potential projects.
4. **Evaluate Project Long- List Criteria** - Screening criteria emphasize engineering feasibility and water sustainability aspects to identify the top 25 potential projects from the 100 potential projects.
5. **Evaluate Project Short-List Criteria** - Screening criteria emphasize relative capital and O&M costs, funding potential, and system reliability to identify a short list of approximately ten potential projects from the top 25 potential projects.
6. **Identify Conjunctive Use Alternatives** – Group together closely-related projects into viable larger-scale conjunctive use alternatives and rank them based on the maximum screening level score for each.

7. **Define the Three Preferred Conjunctive Use Alternatives** – Based on the Alternatives Screening Analysis, define the three preferred alternatives and present a preliminary conceptual implementation plan.

To apply the methodology, the development and application of screening criteria were used to prioritize the list of project components to define a list of potential projects. These projects were further analyzed and grouped into alternatives to identify the three preferred alternatives. These preferred alternatives will be those that have the highest potential for success in addressing the groundwater issues in the project area.

The screening criteria were developed based on the technical issues of performance and viability for each of the steps listed above (see Figure 5-1). The interim results of the Alternatives Screening Analysis were presented to the TAC for discussion at the May 25, 2010, TAC meeting and the TAC input was integrated into the final analysis results.

A system to assign points was developed to apply the Alternative Screening Analysis. Each screening criteria was scored between one (1) and five (5) with one (1) being the least favorable and five (5) being the most favorable with respect to the criteria. This score was based on a quantitative measure where practical. However, in most cases the score was based on a subjective analysis based on an overall assessment of the criteria with emphasis on maintaining relative scoring consistency.

Each screening criteria were assigned a weighting factor based on the relative importance of the criteria. Some screening criteria were weighted lower because of the subjectivity of the analysis at this point in the overall analysis. Much of the technical basis for the screening criteria to identify and screen potential conjunctive use alternatives was developed for Tasks 1 through 4 and is presented in the eight Technical Memoranda (see Section 1 for listing) attached to this report. A discussion of the criteria is presented in the following sections for each of these steps. As discussed in Section 6.2, examples of source screening criteria include water quantity and reliability, degree of water rights or permitting required, infrastructure required, and implementability and public acceptance. As discussed in Section 7.2, examples of recharge application screening criteria include potential groundwater and baseflow benefit, regulatory issues, infrastructure required, implementability, and public acceptance.

The weighted score was calculated by multiplying the score for the screening criteria by the weighting factor for the criterion. The scores for each criterion were added together for the final score. If a criterion was determined to have a “fatal flaw” such that it was considered infeasible, a score of zero (0) was assigned and the average score of zero (0) was assigned. The project components or projects being evaluated were ordered from highest (most favorable) to lowest (least favorable).

Based on the screening analysis, three preferred alternatives were identified based on this analysis. For each of the preferred alternatives, a conceptual-level engineering analysis, preliminary order-of-magnitude cost estimates, and a conceptual implementation plan was developed. The conceptual implementation plan was developed by the consultant team based on the analysis conducted in Tasks 1 through 4 and identifies the major steps necessary for future implementation for each preferred alternative. It is anticipated that these conceptual plans will be further developed in Phase 2 of the Conjunctive Use Project which is anticipated to being in 2011.

5.3 Application of the Screening Analysis

This screening analysis primarily focuses on technical issues; however, it is understood that technical issues are not the only factor that can influence the viability of a potential conjunctive use project. Discussions with the County and the TAC included identification of potentially sensitive local non-technical issues. The primary function of this study was to reduce the number of potential alternatives to a small number so that future work can focus on the technical and non-technical issues that will need further analysis.

The approach was to consider a wide range of aspects and issues related to these projects. However, a number of issues are still evolving in the region. Evolving issues such as the Habitat Conservation Plan and draft Coho Recovery Plan, future trends in water usage and supplies, and changes in the regulatory framework may change the outcome of this analysis. The results of the Alternatives Screening Analysis are considered to be appropriate and reliable for the time the work was conducted.

The following sections provide a more detailed discussion of each step in the application of the screening analysis. An outline for the discussion of the screening analysis application is discussed in this Report is as follows:

- Identify Potential Water Sources (described in Section 6 in greater detail)
- Identify Potential Application of Water (described in Section 7 in greater detail)
- Develop Screening Criteria (described in Section 8 in greater detail)
- Perform Alternatives Screening Analysis (described in Section 8 and 9 in greater detail)
- Identify Three (3) Preferred Alternatives (described in Section 9 in greater detail)
- Conceptual Implementation Plan for each preferred alternative (described in Section 10, 11 and 12 in more detail).

Section 6: Water Source Screening

A step-by-step process was applied in evaluating water sources during the Alternatives Screening Analysis. Potential water sources were evaluated independently to identify these water sources on their own merits separate from other project components. Drawing on information developed under the Technical Memoranda (primarily TM-1A, TM-2A, TM-2B, TM-2C, TM-3 and TM-4), estimates of available quantity, potential for permitting, and other information necessary to evaluate the water sources using the screening criteria were estimated. This section provides a discussion of this process summarizes the available information.

6.1 Identification of Potential Water Sources

An extensive list of individual water sources was grouped into broad categories that represent the key potential water sources that include

- Surface water including the San Lorenzo River and its tributaries
- Stormwater runoff
- Recycled water from the Scotts Valley Wastewater Treatment Plant
- Inter-district exchange of water from existing water sources.

These sources are described in more detail below.

6.1.1 Surface Water Sources

The surface water sources evaluated for the Conjunctive Use Project is limited to the San Lorenzo River and its tributaries. The surface water sources considered for the screening analysis includes the following streams:

- San Lorenzo River
- Bean Creek
- Carbonera Creek
- Zayante Creek

The locations of these streams are shown on Figure 6-1. As described in more detail in TM-2A and TM-2B, there is a range of supply sources of varying quantities and qualities that can be used conjunctively within the SMGB. Table 6-1 provides an overview of the surface water characteristics of these streams.

Three different potential options to obtain water from these surface water sources were included in the screening analysis. TM-3 provides more detailed information on the engineering requirements for surface water diversions structure requirements. The three options include the following:

- Surface Diversion – Typically consists of a diversion structure utilizing a concrete or inflatable dam. Water is diverted or pumped from the upstream-side of the diversion.

This is an efficient method of water diversion, but it does interfere with streamflow, sediment transport and fish migration.

- Subsurface Diversion - Use a shallow horizontal collector well that is completed underneath the stream. This approach does not directly interfere with streamflow, but does take advantage of the natural filtering capability of the alluvium to remove sediment. Potential issues include a reduction in streamflow during the diversion operation.
- Nearby Wellfield – Use one or more vertical wells installed in the shallow aquifer in the vicinity of the creek to capture groundwater that would otherwise discharge to the creek. This approach also does not directly interfere with streamflow, and minimizes water quality issues from sediment. Potential issues include reduction of streamflow during operation.

It should be noted that water rights along the San Lorenzo River and its tributaries are considered fully appropriated from June 1 through October 31. Therefore, surface water diversions will only be considered if they occur from November to May when there is sufficient surface water flow... It is anticipated that the period of operation will be restricted based on minimum flow rates, fishery issues, water rights, and other issues.

6.1.2 Stormwater Sources

As discussed in Section 4, TM-1A and TM-2B, urbanization in Scotts Valley has resulted in increased quantities of stormwater runoff and reduced quantities of groundwater recharge. Capture and recharge of stormwater in Scotts Valley could have multiple benefits including increased aquifer storage, increased summer base flows to Bean and Carbonera Creeks, and reduced erosion and downcutting of Carbonera Creek, and potentially reduced downstream flooding. Potential source areas for stormwater runoff include the following:

- Urban Runoff – Capture stormwater runoff from urbanized areas including streets, parking lots, roofs, and storm drain systems.
- Ephemeral streams - Capture stormwater runoff from ephemeral streams in the study area.
- Hillside runoff – Captures stormwater runoff typically as sheet flow from nearby hillslopes.

Most of the urban stormwater in the SMGB is generated within Scotts Valley along Scotts Valley Drive and Mount Hermon Road and conveyed in an existing storm drain system. Much of it is discharged to Carbonera Creek while a small portion flows northwest toward Bean Creek. An initial estimate of impervious area within Scotts Valley is approximately 291 acres. The imperious areas consist of:

- Streets and parking lots covering approximately 229 acres
- Roofs of large buildings and structures covering approximately 62 acres

Impervious area also includes landscape and unpaved areas. An estimate of 15 percent of the 291 acres may be landscaped and/or unpaved areas for a net impervious area of about 250 acres. With an average annual rainfall in Scotts Valley of 42 inches, the total stormwater volume that could be potentially captured from impervious surfaces could be over 1,000 AFY of which the runoff available for recharge would be in the 300 to 500 AFY range.

Utilizing these water sources would require an engineered structure to capture, divert and convey the stormwater to a water application area or possibly a temporary storage area. The critical issues related to stormwater sources are water quality issues. Also capturing stormwater can be problematic because of its more widespread geographic distribution and that it is episodic in nature; meaning it comes in large volumes in short durations. This can complicate the capture and storing of stormwater, depending on the type of recharge application that is used.

6.1.3 Recycled Water Sources

For use in the Conjunctive Use Project, recycled water must be Title 22 tertiary-treated, unrestricted use recycled water. Recycled water meeting these specifications is already being used in the Scotts Valley area for irrigation during the summer period. It is estimated that at build-out at the Scotts Valley Wastewater Treatment Plant, there may be a wastewater influent of 0.877 million gallons per day (MGD) or almost, 1,000 AFY that could be fully used for irrigation during the dry season (Kennedy/Jenks, 2009b). Excess recycled water is available in the wet season (estimated at up to 400 AFY based on 5 month availability) when irrigation demands are low and could potentially be used for recharge. However, there is currently more dry-season recycled water demand identified than supply, and California Department of Public Health (DPH) draft groundwater regulations issued in 2008 (DPH, 2008) indicate that permitting a wintertime groundwater recharge facility using recycled water will require additional dilution water and may have significant challenges. Additional discussion regarding recycled water can be found in TM-3 and TM-4.

6.1.4 In-lieu Exchange Sources

One approach to conjunctive use is to coordinate existing supplies of groundwater and surface water. The concept of an in-lieu exchange is to obtain other potable water through an exchange with another existing water supply, and in doing so, significantly reduce the amount of groundwater that is pumped from the SMGB. In-lieu groundwater recharge is defined as replacing the groundwater supply with water from another source such as surface water or recycled water. During the in-lieu supply periods, groundwater levels are allowed to increase because a major outflow, groundwater pumping for water supply, is significantly reduced allowing groundwater levels to naturally recover.

This type of exchange requires that there be sufficient water treatment capacity and water rights to allow for the exchange. Infrastructure needs consist primarily of adding pipelines and pumping facilities to interconnect the purveyors that are exchanging water. Agreements are required to set up a process for exchanging or selling water between the districts. Additional discussion of existing water supplies and infrastructure can be found in TM-3 and TM-4.

Both the SCWD and SLVWD use surface water as part of their water supplies and have already invested in infrastructure that could be used. The SCWD facilities that are potentially relevant to the Conjunctive Use Project are the Felton and Tait Street Diversions, located on the San Lorenzo River, and Loch Lomond Reservoir on Newell Creek.

- The Felton Diversion is located just downstream of the confluence of Zayante Creek and the San Lorenzo River. Water rights limitations at Felton include a 20 cfs/12.9 MGD year-round rate limit as well as instream flow requirements ranging from 10 cfs/8.4 MGD to 25 cfs/16.2 MGD depending on the time of year. Water from the Felton Diversion is generally pumped north to Loch Lomond Reservoir via the Newell Creek Pipeline but also can physically be pumped directly south to the Graham Hill Water Treatment Plant (WTP) which is currently not within the existing water right as written. The pipeline from Felton Diversion to Graham Hill WTP is the lower segment of the same pipeline used to convey water from Loch Lomond to Graham Hill WTP.

- The SCWD Tait Street Diversion is located just north of Highway 1 on the San Lorenzo River. The Tait Street Diversion has a total diversion right of 12.2 cfs/79 MGD, and water is pumped north to the Graham Hill WTP.
- The Loch Lomond Reservoir on Newell Creek has 8,900 acre-feet of storage and an estimated annual yield of 3,230 AFY. Of the 3,230 AFY, 742 AFY is allocated for instream releases resulting in a net annual yield of 2,500 AFY. The SCWD is entitled to 2,187 acre-feet of the annual yield while the SLVWD is entitled to 313 acre-feet of the annual yield although SLVWD currently has no means to access this entitlement. The SCWD is currently applying to modify their water rights to maximize water storage such that up to 5,600 AFY from Newell Creek be allowed to flow to storage in Loch Lomond Reservoir and allow up to 3,000 AFY of the SCWD's Felton water right to flow to storage.
- SLVWD uses surface water diversions from seven tributary streams to the San Lorenzo River that supply approximately 900 AFY on average.
- SLVWD's recent acquisition of the Felton water system included additional water rights and facilities from the Fall Creek and the existing Felton Water Treatment Plant. It should be noted that SLVWD's northern and southern service areas are served by separate sources of water supply, and SLVWD does not currently have the infrastructure in place to exchange water between the northern and southern services areas.

In the wintertime, there may be excess surface water in the SCWD or SLVWD northern service area that could be used for in-lieu recharge by SVWD or SLVWD in the Scotts Valley area. New intertie facilities would be required to allow for the exchange of water between the different water districts.

6.2 Water Sources Screening Criteria

Table 6-2 provides a description of screening criterion used to evaluate potential water sources, the basis for developing a screening score, and the criterion weighting factor. Criteria used for evaluating water sources emphasize water quantity, water rights, CEQA and regulatory issues, and engineering aspects. Much of the technical basis for the screening criteria to identify and screen potential conjunctive use alternatives was developed for Tasks 1 through 4 and is presented in the Technical Memoranda attached to this report. The screening criteria consist of the following:

- Water Quantity and Reliability – Assess the ability of the water source to meet the project goals of 500 to 1,000 AFY on a consistent basis.
- Water Rights – Assesses the availability and likelihood of obtaining new or modifying existing water rights for a Conjunctive Use Project.

- CEQA and Regulatory Issues – Assesses a broad range of potential environmental issues related to use of the water source.
- Engineering Facilities Requirements – Provides a conceptual assessment of the anticipated engineering infrastructure required to utilize the water source for the Conjunctive Use Project.
- Implementability – Assesses a broad range of potential issues in utilizing the water source. This is a subjective evaluation based on the current understanding of the water source.
- Public Acceptance – Provides a subjective assessment of the public acceptance of a new water source based on current issues, visibility of the project, and potential impacts from using the new water source.

Each screening criteria were assigned a score between one (1) and five (5) points, with one (1) being the least favorable and five (5) being the most favorable, based on how well a project met the each criteria. An emphasis was placed on maintaining scoring consistency. Each was assigned a weighting factor based on the perceived relative importance of each screening criteria. A score was calculated by multiplying the screening criteria score by the assigned criteria weighting factor. The scores for each criterion were added together for the final score. If a criterion was determined to have a "fatal flaw" such that it was considered infeasible, a score of zero (0) was assigned and the average score was assigned zero (0) as well. The project components or projects being evaluated are ordered from highest to lowest.

6.3 Water Sources Screening Evaluation

The screening-level analysis focused on a technical evaluation of the identified water sources in meeting the project goals. The Alternative Screening Analysis of the water sources is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. The results of the water sources screening evaluation are shown on Table 6-3. Below is a discussion of the screening analysis for water sources with references to the appropriate Technical Memorandum for additional information.

6.3.1 Water Quantity and Reliability

Based on the analysis in TM-2B, the largest potential source of water for a Conjunctive Use Project is a surface diversion on the San Lorenzo River. Bean and Zayante Creeks are also considered to have potentially available flows that could be utilized for the Conjunctive Use Project whereas Carbonera Creek is not considered to have sufficient flows.

Subsurface diversion methods for Zayante and Carbonera Creeks are considered infeasible based on the geology and are therefore considered to have fatal flaws. Similarly, a nearby wellfield to capture groundwater discharging to the San Lorenzo River is also considered as infeasible. Additional information is provided in TM-2B.

Stormwater is available as a water resource but, it has issues related to its episodic nature. Stormwater availability is often large in volume over a short time interval, which makes stormwater less desirable than other surface water sources. Additional information is provided in TM-3 and TM-4.

Recycled water is generally available during the winter months. However, recycled water reliability for summertime irrigation is directly related to influent wastewater flows and, to a lesser degree, engineering and treatment issues at the wastewater treatment plant. Recycled water demand for irrigation in excess of supply during the summer months has been identified by SVWD's Recycled Water Facilities Planning Report (Kennedy/Jenks, 2009b). Additional information is provided in TM-3 and TM-4.

Treatment plants for inter-district supplies are considered to have sufficient hydraulic and treatment capacity in the wintertime. Reliability of inter-district supplies can be affected by climatic factors including droughts. Wintertime flows may be impacted by water quality issues at the water source, thereby reducing the availability of potable water for exchange. Additional information is provided in TM-4.

6.3.2 Water Rights

Water rights are an important factor for both surface water diversion and inter-district water exchange. TM-2A provides for more detailed information regarding water rights in the San Lorenzo River Watershed. From the June 1 to October 31, the San Lorenzo River and its tributaries are considered to be fully appropriated from a water rights perspective. However, the period from November 1 to May 31 typically has high winter flows that may be available for diversion. Obtaining rights to these wintertime flows will require consultation and negotiation with the State and Federal fishery agencies. An additional complicating factor in acquiring water rights is that the draft Coho Recovery Plan (NOAA, 2010) is recommending that the fully appropriated status be applied on a year-round basis.

From a water rights and hydrologic perspective, Bean, Zayante and Carbonera Creek appear to have unappropriated water rights. In addition, Zayante Creek has a filing of 17,000 acre-feet on behalf of North Santa Cruz County which could also be accessed.

Use of existing water supplies for inter-district exchange of San Lorenzo River water held by SCWD or SLVWD will require modification of existing water rights. This is considered to be complex issue that may take considerable time and effort to resolve.

Stormwater and recycled water are not considered to have water rights issues. However, utilizing stormwater from storm drains, ephemeral streams or hillside runoff may be challenged with respect to water rights.

6.3.3 CEQA and Regulatory Issues

The use of surface water sources is anticipated to generate the most CEQA and regulatory issues. Surface water is likely to be high in suspended sediments, especially during large storm events. Most Carbonera Creek flow is derived from urban stormwater runoff as evidenced in the high wintertime peak flows and low dry season base flows (seeTM-2B).

As described earlier, provisions in the draft Coho Recovery Plan (NOAA, 2010) and draft Habitat Conservation Plan (SCWD, 2010) will require reevaluation of surface water availability on a broader basis outside of strictly water rights and hydrologic availability.

Stormwater use limitations are primarily related to water quality. Urban stormwater runoff includes anthropogenic contaminants as well as high sediment loads. It is now well understood that urban runoff is a significant source of pollution resulting in impacts to water resources. The urban activities of most concern include corporation/maintenance yards, street maintenance, industrial/commercial activities, construction activities, and residential activities. Vector control resulting from standing water is also a potential concern when managing urban stormwater runoff.

Draft groundwater recharge reuse regulations, (DPH, 2008), allow for recharge of aquifers with recycled water; however, there are considerable constraints. These regulations require 1) large volumes of dilution water prior to recharge, 2) a minimum retention time in the aquifer of 6 months before entering a drinking water well, which must be documented by a tracer study, 3) total organic carbon limitations, and 4) extensive monitoring of both wastewater treatment and groundwater during operation. These extensive regulatory requirements are the basis for a low screening score for the use of recycled water.

The use of inter-district water exchange is not considered to have DPH constraints since the water is already used for drinking water supplies. However, CEQA analysis may determine that there could be potential environmental impacts from inter-district water exchange. Because of the uncertainty of this issue, the inter-district water exchanges were given slightly lower screening scores.

6.3.4 Engineered Facilities Requirements

Detailed discussion of the engineered facilities requirements is provided in TM-3 with supporting information in TM-1B and TM-4.

The surface water sources are considered to have the highest engineering facilities requirements. These sources will need construction of large facilities to divert water using surface diversion, subsurface diversions or nearby wellfields. Based on this general assessment, the surface water sources are scored lower than other sources. The engineered facilities ratings for the surface water sources listed in Table 6-3 assume that a new diversion and related infrastructure are required.

Stormwater sources are more variable in engineering facilities requirements. The retrofitting of stormwater catchment and recharge structures among the existing urban development along Mount Hermon Road and Scotts Valley Drive may be disruptive. However, the engineering requirements may be minimized by using low impact development methods discussed in TM-3. Using stormwater in conjunction with other aquifer recharge facilities may require more extensive engineering requirements.

Use of recycled water may require additional treatment at the wastewater treatment plant. Also, regulations require dilution water; therefore, another water source is required. Recycled water cannot be used by itself for groundwater recharge. Other regulatory requirements for an extensive monitoring system also increase the engineering facilities requirements.

Inter-district exchange of water supplies is considered to have sufficient available infrastructure capacity and the potential to use of existing infrastructure. The primary engineering requirements are construction of pipelines to inter-connect the distribution systems of the various water districts. This may require additional infrastructure such as pumping facilities to accommodate elevation changes and system pressures. The engineered facilities ratings for the inter-district exchange sources listed in Table 6-3 assumes that an existing diversion and related infrastructure are required, and this is the primary differentiation between these and the surface water sources listed above. These are discussed in more detail in TM-3.

6.3.5 Public Acceptance Issues

Public acceptance issues for water sources were assessed on a more general basis because these types of issues can be difficult to anticipate. The goal of this screening criterion was to incorporate any known issues that may affect the implementation of water sources based on current understanding of local issues.

Public acceptance was assumed to be based primarily on perceived water quality issues and the visibility of the water source facility. For example, recycled water was considered as potentially generating significant public acceptance issues whereas inter-district exchange of existing drinking water supplies would generate fewer issues based on perceived water quality. Similarly, a large, permanent surface water diversion structure would be visible to the public as affecting streamflow and fish passage; therefore, it would be anticipated to generate more public acceptance issues. In contrast, injection wells would be much less visible to the public and, therefore, are anticipated to generate fewer public acceptance issues based on visibility.

In summary, utilizing stormwater was considered to have some level of public acceptance whereas use of recycled water was anticipated to generate public resistance. Otherwise, public acceptance was left generally the same for the other water source options.

6.4 Water Source Screening Results

The screening of the water sources was applied systematically to each of the identified water sources using the criteria discussed above. The results of the water sources screening evaluation are presented on Table 6-4. Based on the results of this analysis, the top ten water sources were identified as the following:

1) Stormwater from the large building roofs (score of 8.3)
2) Stormwater from streets and parking lots (score of 7.5)
3) Inter-district water exchange between SCWD, SLVWD, and SVWD (score of 7.3)
4) San Lorenzo River utilizing the existing Felton Diversion (score of 7.0)
5) Surface diversion on Zayante Creek (score of 6.7)
6) Stormwater utilizing existing storm drains (score of 6.5)
7) Inter-district water exchange between SLVWD and SVWD (score of 6.5)
8) Nearby wellfield for Bean Creek (score of 6.3)
9) Surface diversion on Bean Creek (score of 5.8)
10) Surface diversion on San Lorenzo River (score of 5.7)

The top ten potential water sources were further used in the analysis of potential conjunctive use projects (Section 8) and identifying the top three preferred Conjunctive Use Alternatives (Section 9).

Section 7: Recharge Application Screening

The step-by-step process was also applied in evaluating the Recharge Application portion of the Screening Analysis. Potential applications of aquifer recharge were evaluated independently and ranked based on their own merits separate for other project components. Technical information supporting the development of the screening criteria and application of the screening method are supported by the analysis in the attached Technical Memoranda including TM-1B, TM-1C, TM-2B, and TM-3. This section provides a discussion of this process.

7.1 Identification of Potential Recharge Applications

Various aquifer recharge methods were evaluated for use in conjunctive use projects. Based on this evaluation, a map was produced that defines the areas where active groundwater recharge by either surface infiltration or injection wells would help mitigate groundwater supply issues in the project area (Figure 7-1). Additional information on the requirements of these different aquifer recharge methodologies is discussed in more detail in TM-1B, TM-1C, and TM-3. A brief overview of the potential options for active groundwater recharge considered is as follows:

- Percolation Ponds – Large, shallow ponds situated above the groundwater level and enclosed by dikes or levees. Ponds are filled intermittently, followed by periods of drying and recharge water is delivered to the groundwater by using the saturated and unsaturated zones.
- Leach Fields – A system of perforated pipes installed in a series of shallow trenches backfilled with highly permeable material to disperse the discharge flow. Discharge flow percolates through the unsaturated soils to reach groundwater.
- Injection Wells – A series of wells drilled into a suitably transmissive zone in the underlying groundwater flow system. Discharge water is pumped under low pressures into these wells and allowed to flow into the aquifer, bypassing the unsaturated zone.
- Low Impact Development – A series of distributed treatment/recharge measures that include constructed wetlands, infiltration basins, vegetated swales and buffer strips that allow percolation of stormwater runoff. These measures can be oversized to capture flow over that required for water quality treatment. Local piped stormwater may be able to be directed to these treatment/recharge facilities as well.
- In-Lieu Recharge – In-lieu recharge is accomplished by reducing pumping in existing groundwater wells and replacing its contribution to the water supply by water from another source.

The location of the aquifer recharge project is important because of the complex geology of the SMGB. For the Alternatives Screening Analysis, five areas were evaluated for active groundwater recharge as shown on Figure 7-1. These areas include the following:

- The South Hanson Quarry targets the area west of the City of Scotts Valley where the Santa Margarita and Lompico are in direct contact. The site is associated with the Hanson Quarry because it represents a large area of potentially available land. However, the analysis also applies to the adjacent areas where the Santa Margarita and

Lompico are in contact. Recharge in these areas is expected to restore groundwater in both the Santa Margarita and Lompico aquifers.

- The North Hanson Quarry targets the area west of the City of Scotts Valley downgradient of the area where the Santa Margarita directly overlies the Monterey. The site is associated with the North Hanson Quarry because it represents a large area of potentially available land. However, the analysis applies to the adjacent areas as well. Recharge in these areas is expected to restore groundwater in Santa Margarita aquifer only.
- The Camp Evers area targets the area where the Santa Margarita has experienced the largest groundwater level declines. This area is generally along Mount Hermon Road in the western portion of the City of Scotts Valley. Recharge in this area is expected to restore groundwater in Santa Margarita aquifer only.
- The south Scotts Valley area targets the location where the Santa Margarita and Lompico are in direct contact and the Monterey is absent. This area is generally along Scotts Valley Drive in the southern portion of the City of Scotts Valley. Recharge in this area is expected to restore groundwater in both the Santa Margarita and Lompico aquifers.
- The North Scotts Valley area targets the area where the Santa Margarita is underlain by the Monterey along Scotts Valley Drive in the northern portion of the City of Scotts Valley.

Additional analysis evaluating the potential for recharge applications for these different areas is provided in TM-1A, TM-1B, and TM-1C. TM-1A provides a summary of the general hydrogeology and how the geologic structure and groundwater flow characteristics play a role in groundwater recharge. TM-1B provides an assessment of the recharge potential for the different methods based on geologic and engineering analysis. TM-1C provides the results of using the SMGB groundwater model to evaluate the potential benefits of long-term groundwater storage in the SMGB and on summertime baseflows in the streams in the study area.

7.2 Recharge Application Screening Criteria

Table 7-1 provides a description of each screening criterion, the basis for the developing a screening score, and the criterion weighting factor. The screening criteria used for evaluating recharge applications emphasize the potential benefits to groundwater storage, summertime stream baseflows, CEQA and regulatory issues, and engineering aspects. Much of the technical basis for the screening criteria to identify and screen potential conjunctive use alternatives was developed for Tasks 1 through 4 and is presented in the Technical Memoranda attached to this report primarily TM-1B, TM-1C, TM-2B, and TM-3. The screening criteria consist of the following:

- Potential Groundwater Benefit – Assess potential for increasing the volume of groundwater in aquifer storage through groundwater recharge. Results are summarized in Table 7-2, and are based on primarily on the groundwater model results from TM-1C.
- Potential Baseflow Benefit – Assesses the potential for increasing summertime baseflows in key streams in the area, primarily Bean Creek, through groundwater recharge. Results are summarized in Table 7-2, and are based on primarily on the groundwater model results from TM-1C.

- CEQA and Regulatory Issues – Assesses a broad range of potential environmental and water quality issues related to use of the recharge application.
- Engineering Facilities Requirements – Provides a conceptual assessment of the anticipated engineering infrastructure required to implement the recharge application. Supporting information provided in TM-3.
- Implementability – Assesses a broad range of issues in implementing the recharge application. This is a subjective evaluation based on current understanding of the type of recharge application under consideration. Supporting information provided in TM-1B and TM-3.
- Public Acceptance – Provides a subjective assessment of public acceptance issues associated with potential water sources based on current issues, visibility of the project, and potential disruption from utilizing the water source.

Each screening criteria were assigned a score between one (1) and five (5) with one (1) being the least favorable and five (5) being the most favorable, based on how well a project met the each criterion. An emphasis was placed on maintaining scoring consistency. Each was assigned a weighting factor based on the perceived relative importance of the screening criteria. A score was calculated by multiplying the screening criteria score by the assigned criteria weighting factor. The scores for each criterion were added together for the final score. If a criterion was determined to have a "fatal flaw" such that it was considered infeasible, a score of zero (0) was assigned and the average score was assigned zero (0) as well. The project components or projects being evaluated were ordered from highest to lowest.

The screening-level analysis focused on a technical evaluation of the identified recharge applications in meeting the Project goals. The Alternative Screening Analysis of the recharge applications is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. The results of the recharge application screening evaluation are shown on Table 7-3. Below is a discussion of the screening analysis for the recharge applications with references to the appropriate Technical Memorandum for additional information.

7.3 Analysis for Evaluating Project Benefits

A portion of the screening-level analysis focused on the potential benefits related to long-term increases in groundwater in aquifer storage and increases in the summertime discharge of groundwater to streams, also known as baseflow. The benefits analysis primarily used the SMGB groundwater model developed under a prior state grant (ETIC, 2006). The model covers the entire SMGB; therefore, it provides a regional analytical tool. The application of the SMGB model for the Conjunctive Use Project is documented in TM-1C. Below is a summary of TM-1C and discussion on the application of the model results to the screening criteria.

7.3.1 Implementability

In the Alternatives Screening Analysis, implementability issues were assessed to account for the project complexity and the anticipated amount of time that may be required to implement the project. Preferences were given to simpler projects that can be implemented more easily and in a shorter amount of time, whereas lower ratings were given to projects that are more complex and/or may require a long time before implementation. This is a more subjective assessment based on the judgment of the consultant team and the TAC members. In general, a summary of the issues considered for the Alternatives Screening Analysis include the following:

- Inter-district exchanges are considered as having fewer implementability issues because of existing infrastructure and the water supply is already used for drinking water. These are discussed in more detail in TM-3.
- Stormwater is also considered to having relatively fewer implementability issues. Stormwater projects can be implemented in a phased approach, which would help to lower costs. These are discussed in more detail in TM-3.
- Surface water sources are considered to be problematic to implement due to water rights and fishery issues. These are discussed in more detail in TM-2A, TM-2B, TM-2C, and TM-3.
- Recycled water is not implementable because of the regulatory issues at this time. These are discussed in more detail in TM-3.

The implementability ratings for the inter-district exchange sources listed in Table 6-3 assumes that an existing diversion and related infrastructure are required, whereas those listed under surface water sources assumes that a new diversion and related infrastructure are required. This is the primary differentiation between inter-district and the surface water sources listed in Table 6-3.

7.3.2 Groundwater Modeling Overview

The SMGB groundwater model was used to evaluate the 16 potential groundwater recharge project scenarios were created to cover different enhanced groundwater recharge configurations, locations, and timings. Full documentation of the model scenarios is provided in TM-1C. These model scenarios are considered as a screening-level analysis to help support the development of the screening criteria for Task 5. These are general scenarios that were developed and run prior to the initiation of Task 5; therefore, the model scenarios are not exact combinations used for Task 5.

The model scenarios used future conditions that repeated the natural hydrologic conditions from 1985 through 2005. The locations for recharge were chosen based on their expected ability to transmit water into the deep aquifer fairly quickly. Specifically, areas where the Santa Margarita directly overlies the Lompico were targeted. In these areas, the Monterey, which has relatively low permeability, is not present thus allowing direct communication between the Santa Margarita and Lompico.

For most of the model scenarios, the total aquifer recharge is assumed to be 1,000 afy. However, the in-lieu recharge scenarios were limited by the available reduction in groundwater pumping available for the chosen time interval. The goal of this analysis was to determine how the changes to the water budget created by the directed recharge varied with the recharge magnitude and location. The scenarios were set up as follows.

- **Base Case:** This scenario is essentially identical to the final model from ETIC (2006). No directed recharge is applied to the model. The results of this scenario were used as a comparative tool, to quantify the changes effected by the directed recharge systems.

- **Large-Scale Surface Recharge:** Four scenarios were created to simulate recharge applied in large percolation ponds. Recharge was applied to Model Layer 1 (the Santa Margarita) only.
- **Injection Wells:** Four scenarios were created to simulate injection wells completed within the Lompico (Model Layer 3).
- **Low Impact Development:** Two scenarios were created to simulate surface recharge in a more dispersed system to simulate the use of low-impact development on existing urbanized areas to capture and recharge stormwater to groundwater. This setup was intended to mimic numerous small recharge points, such as in a stormwater recharge system. Recharge was applied to Model Layer 1 only.
- **In-Lieu Recharge:** Three scenarios were created to simulate in-lieu recharge, which is accomplished by reducing pumping in existing groundwater wells rather than actively adding water to the basin. These scenarios assume that the water supply needs are met by utilizing another water source that is outside of the basin. In these scenarios, pumping in wells is decreased in specific areas, or from specific layers.
- **Bean Creek Wellfield:** Two scenarios were constructed to simulate the effect of pumping from the aquifer to capture wintertime groundwater discharges to Bean Creek when streamflows are high. The objective is to evaluate how much of an impact this type of pumping has on the aquifer and streams.

The aquifer recharge from the simulated Conjunctive Use Projects assumed that the recharge period would occur during the cool, wet months of the year, starting in mid-November and ending in mid-May. The SMGB model is subdivided into three-month-long stress periods that represent seasonal variations. For Surface Recharge, Lompico Injection, and Low Impact Development scenarios, the project groundwater recharge was varied seasonally, with 25% of water recharged during the first quarter of the water year (October through December), 50% in the second quarter, 25% in the third quarter, and 0% in the fourth quarter. This distribution represents the proposed seasonal operation of a conjunctive use project to take advantage of the distribution of precipitation in the region, where winters are wet and summers dry.

7.3.3 Groundwater Modeling Results Relevant to Screening Criteria

The goal of the modeling is to determine the ability of the recharge system simulated in each scenario to achieve the project goals of increasing groundwater levels in the SMGB and helping to sustain dry season baseflows in the San Lorenzo River Watershed.

The potential groundwater benefits were determined by using the SMGB groundwater model to evaluate various recharge scenarios. The model scenario results are summarized in Table 7-2 and discussed in greater detail in TM-1C. The goal of screening criteria was to determine the ability of the recharge system simulated in each scenario to achieve the project goal of increasing groundwater levels in the SMGB.

With respect to aquifer storage, the Injection Well and In-Lieu Scenarios showed the highest efficiency as defined by the percentage of enhanced recharge still present in the aquifer at the end of the simulation period. This is because the groundwater recharge is directed into the deeper Lompico and Butano.

- Due to the complex geology of the SMGB, the Lompico and Butano occur at greater depths in the SMGB and have fewer outlets to surface water discharge than does the Santa Margarita.
- The Lompico and Butano have experienced significant declines in groundwater levels historically, so they potentially have aquifer storage capacity available.

The Large-Scale Surface Recharge and Low Impact Development scenarios show lower aquifer storage efficiencies.

- The Santa Margarita has numerous springs and experiences direct groundwater-surface water interactions with several creeks in the area, primarily Bean Creek. Therefore, groundwater recharge added to the Santa Margarita will ultimately be discharged to streams or springs.
- Groundwater recharge from the surface primarily affects the Santa Margarita; however, the Santa Margarita areas with historic groundwater declines are more limited to areas around Scotts Valley. In areas where the Santa Margarita has not experienced historic drawdowns, it is assumed that there is not sufficient capacity for additional aquifer recharge.

With respect to summertime baseflow, the Large-Scale Surface Recharge, Low Impact Development, and Injection Well scenarios show increases.

- The Large-Scale Surface Recharge and Low Impact Development scenarios also have a high percentage of their stream discharge occurring during the winter and spring during higher flow conditions (TM-1C) and a lower percentage during the summer months which are more critical to the fishery.
- The Injection Well Scenarios are able to sustain more summertime baseflow because they result in higher groundwater levels which ultimately help sustain summertime baseflow. Injection wells directly emplace the recharge into the groundwater which results in higher groundwater levels. For stream discharge, the distribution of stream discharge is more uniform resulting in higher stream discharges during the critical summer month.
- Enhanced recharge under In-Lieu Recharge Scenarios is limited to the amount of groundwater pumping during the potential wintertime recharge period because water demand, and therefore groundwater pumping, is less during the winter. For example, groundwater pumping for SVWD typically averages about 100 acre-feet per month during the winter. Therefore, groundwater level increases are smaller than for injection wells, which results in less increase in summertime baseflows. Also, the more heavily used aquifers (e.g. Lompico and Butano) have limited direct contact with local streams.

The scenario results indicate that the aquifer storage potential, especially for injection wells and in-lieu recharge, is greatest at the Scotts Valley Drive, North Hanson Quarry and Mount Hermon Road areas. The South Hanson Quarry site has slightly less potential for aquifer storage than do the others; however, the model may need further refinement to better simulate interactions between in the Santa Margarita and Lompico in this area.

For summertime baseflow, the model results were similar for all the sites, especially for surface recharge projects, with the largest increase in baseflow resulting from recharge at the Mount Hermon Road site, and the smallest from recharge at the South Hanson Quarry site; however, the large increase in spring discharge from the South Hanson Quarry would result in higher summertime baseflows in Camp Evers and Carbonera Creeks.

These model results indicate that the Bean Creek Wellfield is a potential Conjunctive Use alternative. Even though pumping is from the vicinity of Bean Creek, the wellfield takes advantage of the natural conditions that cause this area to be a major discharge area from the Santa Margarita.

- The model results suggest that there are minimal impacts on aquifer storage. There are impacts to summertime baseflow at Bean Creek.
- However, for the scenario where the Bean Creek Wellfield pumping is compensated by reduced pumping in the Lompico, there is a minor long-term benefit to summertime baseflow.

These model scenarios conducted for TM-1C are considered appropriate for this screening-level analysis. It should be noted that the results could vary if additional model simulations were run to optimize these systems. In addition, further site-specific investigations may find conditions that may affect the actual performance relative to the SMGB model, which is constructed on a regional scale.

7.3.4 Application of Model Results

The SMGB model has been calibrated to historical conditions and is, therefore, considered capable of forecasting future case scenarios. The numerical model provides a quantitative tool to provide a relative comparison of the amount of water entering and exiting the basin to determine the potential change in aquifer storage and groundwater levels. However, in evaluating the model results, it is recommended for the evaluation to focus more on the relative differences and overall trends between the scenario and the baseline scenarios.

The groundwater model is planned to be updated in the near future and these areas will be evaluated more closely at that time to determine if the model parameters in these areas need to be adjusted. For this report, the model results are shown as they were produced by the current version of the SMGB Model based on the ETIC (2006) report.

7.4 Recharge Applications Screening Evaluation

The screening-level analysis focused on a technical evaluation of the identified recharge applications in meeting the Project goals. The Alternative Screening Analysis of the recharge applications is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. The results of the recharge application screening evaluation are shown on Table 7-3. Below is a discussion of the screening analysis for the recharge applications with references to the appropriate Technical Memorandum for additional information.

7.4.1 Potential Groundwater Benefit

One of the primary goals of the Conjunctive Use Project is to increase groundwater levels that will have the benefit is improving water supply reliability by increasing the volume of groundwater in aquifer storage. Due to the complex geology in the SMGB, aquifer recharge added to the SMGB may not stay in aquifer storage for the long-term but may be lost to outflows including streams, springs, evapotranspiration and groundwater pumping. Outflows to streams may have benefits that will be addressed in the following section.

For the screening criteria, applications that show the ability to retain a higher percentage of groundwater recharge in aquifer storage are considered desirable. Table 7-2 provides a summary of the percentage change in aquifer recharge relative to the total groundwater recharge.

Another consideration is the potential capacity of groundwater recharge for a particular application. This is especially true for in-lieu recharge which is limited by the volume of groundwater pumping available to be replaced. For applications that divert from other sources, such as surface water, that have a higher potential availability, then the potential exists for potentially a higher total volume of aquifer recharge. Table 7-2 shows the total volumes of aquifer recharge in addition to the percentages.

With respect to groundwater storage, the Injection Wells and In-Lieu Recharge scenarios showed the highest storage efficiency (Table 7-2) and are scored the highest. This retention occurs because the aquifer recharge is directed into the deeper Lompico and Butano that have experienced significant declines in groundwater levels historically, so they potentially have aquifer storage capacity available. The results for all of the injection well scenarios (Table 7-2 and TM-1C) are similar enough that the four areas that were considered to have relatively equal viability.

The Percolation Ponds, Leach Fields and/or Low Impact Development scenarios generally show lower groundwater storage efficiencies. From Table 7-2, the percentage of aquifer recharge going to groundwater storage ranges from 5 to 25 percent. The Mount Hermon Road area had higher groundwater recharge potential due to historic groundwater level declines being more localized in the Santa Margarita.

The cause of the low recharge potential for these applications is primarily related to the complex geology. Over much of these areas, especially for the Low Impact Development scenarios, the aquifer recharge occurs where the Santa Margarita is underlain by the Monterey. The Santa Margarita has numerous springs and experiences direct groundwater-surface water interactions with several creeks in the area, primarily Bean Creek. Therefore, most of the water added to the Santa Margarita tends to ultimately be discharged to streams or springs which helps with baseflow, but is less efficient for groundwater storage. The exception to this may be where the facilities, especially Low Impact Development can be strategically located to maximize enhanced recharge to the deeper aquifers.

7.4.2 Potential Baseflow Benefit

The beneficial effect of increased groundwater levels in the SMGB on summertime baseflows on the nearby streams was also evaluated using the SMGB model based on the model scenarios. The results documented in TM-1C are summarized in Table 7-2. With respect to summertime baseflow, the Percolation Ponds, Leach Fields, Low Impact Development, and Injection Wells scenarios all show similar increases. Specific results from TM-1C include:

- The Percolation Ponds, Leach Fields, and Low Impact Development scenarios show increased summertime baseflow; however, a higher percentage of the stream discharge for these applications tends to also occur during the winter and spring during higher flow conditions.

- The Injection Well Scenarios are able to sustain more summertime baseflow because they result in higher groundwater levels which ultimately help sustain summertime baseflow.
- Enhanced recharge under In-Lieu Recharge scenarios is limited by the amount of wet season pumping. Therefore, groundwater level increases are smaller than for injection wells, which results in less increase in summertime baseflows.

For summertime baseflow, the model results from Table 7-2 and documented in TM-1C were similar for all the sites, with the largest increase in baseflow resulting from recharge at the Mount Hermon Road site, and the smallest from recharge at the South Hanson Quarry site.

As noted above, the model results could vary if additional model simulations were run to optimize these systems. In addition, further site-specific investigations may find conditions that may affect the actual performance relative to the SMGB model, which is constructed on a regional scale. Therefore, the results for all of the injection well scenarios are considered close enough that the four sites are essentially of equal viability.

7.4.3 CEQA and Regulatory Issues

The implementation of recharge applications is anticipated to generate multiple CEQA and regulatory issues. The CEQA process would likely require a full Environmental Impact Report (EIR) that would require considerable time and expense to complete.

Water quality issues are a primary regulatory concern because of the presence of existing groundwater contamination in the Camp Evers and South Scotts Valley area from regulated environmental remediation sites. Rising groundwater levels due to aquifer recharge may cause remobilization of plumes. This could impact the long-term usage of the aquifer for water supply. Recharge impacts on existing plumes will require significant additional evaluation.

The use of recharge applications that allow water to percolate through the unsaturated or vadose zone may provide for potential water quality benefit due to natural processes that allow for degradation in the soil. Therefore, percolation ponds, leachfields and low impact development may require less regulatory oversight. However, site specific data collection and analysis using actual recharge water are necessary to verify that these potential water quality benefits. Use of injection wells to directly recharge water into the groundwater aquifer will require additional groundwater permits including an Underground Injection Control (UIC) permit from the USEPA.

7.4.4 Engineered Facilities Requirements

A brief overview of the engineering facilities issues considered during the Alternatives Screening Analysis is provided below. Detailed discussion of the engineered facilities requirements is provided in TM-3 with supporting information in TM-1B and TM-4.

Percolation ponds are shallow basins enclosed by dikes or levees. The pond bottom is situated above the water table. The discharge flow percolates through the unsaturated soils in the pond to reach groundwater. Thus, the ponds have no direct connection to underlying groundwater. The actual discharge capacity will depend on the site-specific soil and aquifer characteristics. A percolation facility to accommodate 1 mgd may range from 15 to 150 acres depending on the underlying soil conditions. Discussion of the engineering requirements and sizing of the facilities is discussed in TM-1B and TM-3.

A leach field utilizes a system of perforated pipes installed in a series of shallow trenches backfilled with highly permeable material to disperse the discharge flow. The pipes and trenches are situated above the water table and recharge water is pumped into the trenches through perforated pipes/slotted well screens. A leach field uses the same principle as a percolation pond, namely percolation of discharge water through the unsaturated zone. The discharge flow percolates through the unsaturated soils to reach groundwater; thus, the trenches have no direct connection to underlying groundwater. Actual recharge capacity would depend upon the site-specific soil and aquifer characteristics. This issue is discussed in more detail in TM-1B and TM-3.

The injection well option consists of a series of wells drilled into transmissive zones of the aquifer. Water is pumped under low pressures into these wells and allowed to flow into the aquifer. The wells discharge water directly to the saturated zone and bypass the unsaturated zone; therefore, the injection well option would produce the water-quality benefits from flow through the aquifer, but not the benefits from flow through the unsaturated soils (Kennedy/Jenks, 2008). This issue is discussed in more detail in TM-1B and TM-3.

Low-impact development (LID) is primarily designed to be operated passively and is typically sized for treatment of small (approximately 2-year return interval) frequent storms. If the facilities are sized to capture larger storm events than are typically used for treatment, recharge quantities can be increased. Using this method, stormwater can be recharged directly into the groundwater at multiple, disperse locations using relatively small infiltration facilities when compared to percolation ponds. Therefore, these types of facilities have the potential for significantly lower operational costs compared to other methods. However, retrofitting LID in previously developed areas may make the overall costs more comparable with other methods. More site specific data is necessary to provide an improved cost analysis. Additional information about low impact development is provided in TM-3.

Diversion of stormwater from existing storm drain facilities to be used for groundwater recharge may require infrastructure, especially for water quality treatment. In addition, pipelines, or open channels, flow equalization and/or wet well structures may also be needed, especially if the stormwater requires pumping. Depending on the type, location, and flow to be diverted, settling and/or other treatment may be required prior to recharge. This issue is discussed in more detail in TM-3.

In-lieu recharge is anticipated to make considerable use of existing infrastructure; however, several engineered facilities will be required. Treated water could be transferred from an adjacent district, such as the SCWD's Graham Hill Water Treatment Plant. This would require connection to the adjacent district's closest pipeline via a tee and valves. Integration of the different water systems may require a meter station, consisting of a flow meter, bypass line, and valves, and a pressure reducing valve depending upon the pressures in the sending and receiving systems. A pipeline and possibly pump station, between the adjacent water supplier and the receiving agency's distribution system and/or the recharge area may be necessary. This issue is discussed in more detail in TM-1C, TM-3 and TM-4.

7.4.5 Implementability

The Implementability criteria accounts for the complexity of the recharge application and the anticipated amount of time that may be required until implementation. Preferences were assigned to simpler applications that can be implemented more easily and in a shorter amount of time, whereas lower ratings were assigned to applications that were more complex and/or that may require more time to implement. This is a more subjective assessment based on the judgment of the consultant team and the TAC members. In general, a summary of the issues considered for the Alternatives Screening Analysis include the following:

- Inter-district water exchanges are considered as having fewer implementability issues because existing infrastructure can be used and the water supply is already potable (see TM-3 and TM-4).
- Injection wells may have operations and maintenance issues related to the potential for growth of iron bacteria and other clogging issues (see TM-1B and TM-3).
- Injection wells in the North Scotts Valley and North Hanson Quarry areas may be considerably deeper and therefore likely more expensive and difficult to install and maintain (see TM-1A and TM-1B).
- The application of surface recharge in the North Scotts Valley area is considered infeasible due to the presence of the Santa Cruz Mudstone near the surface (see TM-1A and TM-1B).
- Implementation of aquifer recharge in the Camp Evers and South Scotts Valley areas would be complicated by existing groundwater contamination in these areas (see TM-1A).
- From a technical standpoint, low impact development is considered to be implementable in the Scotts Valley area. Implementation issues are more likely related to coordinating with private land owners and the City of Scotts Valley (see TM-1B and TM-3).
- Construction of large percolation ponds in the Camp Evers and South Scotts Valley areas is unlikely due to lack of available land and potential incompatibility with nearby land uses (see TM-1B and TM-3).

7.4.6 Public Acceptance Issues

Public acceptance issues for recharge applications were assessed on a more general basis because these types of issues can be difficult to anticipate. The goal of this screening criterion was to incorporate any known issues that may affect the implementation of the recharge application based on current understanding of local issues.

In summary, public acceptance was primarily based on anticipated visibility of the water application. Recharge facilities that would be less visible to the public were rated higher. For example, construction of a percolation pond facility within Scotts Valley close to existing businesses and residences would be anticipated to generate public acceptance issues. On the other hand, in-lieu recharge would require less visible structures so it is anticipated to generate fewer public acceptance issues.

7.5 Recharge Application Screening Results

The screening of the recharge applications was applied systematically to each of the identified recharge applications using the criteria discussed above. The results of the recharge applications screening evaluation are presented on Table 7-4. Based on the results of this analysis, the top ten recharge applications were identified as the following:

- Stormwater Low Impact Development in South Scotts Valley (score of 8.7)

- Stormwater Low Impact Development in Camp Evers area (score of 8.7)
- Injection Wells in South Hanson Quarry (score of 7.5)
- Injection Wells in North Hanson Quarry (score of 7.2)
- In-Lieu Recharge between SCWD, SLVWD and SVWD (score of 7.0)
- Percolation Ponds in South Hanson Quarry (score of 6.8)
- Injection Wells in South Scotts Valley (score of 6.8)
- Injection Wells in Camp Evers area (score of 6.8)
- Percolation Ponds in South Scotts Valley (score of 6.5)
- In-Lieu Recharge between SCWD and SVWD (score of 6.3)

The top ten recharge applications were used in the analysis to develop a list of potential conjunctive use projects (Section 8) from which three preferred Conjunctive Use Alternatives were identified (Section 9).

Section 8: Potential Project Screening

The step-by-step process of the Alternatives Screening Analysis was continued to define potential conjunctive use projects based on the results of the screening analysis of potential water sources and recharge applications. The potential conjunctive use projects were evaluated using a separate set of screening criteria that emphasize engineering feasibility and water sustainability parameters. Each project was independently evaluated based its own merits separate for other projects. This section provides a discussion of this process.

8.1 Define Project Long-List

The development of potential conjunctive use projects was done by combining the results of the screening analysis for the primary project components of identifying potential water sources (see Section 6.4) and recharge applications (see Section 7.4). The top ten list for each project component has been combined to develop a long-list of 100 potential conjunctive use projects, as provided on Table 8-1.

8.2 Project Screening Criteria

Table 8-2 summarizes the screening criteria used to evaluate potential conjunctive use projects, including a description of each screening criterion, the basis for the developing a screening score, and the criterion weighting factor. The screening criteria used for evaluating projects emphasize engineering feasibility and water sustainability aspects. Much of the technical basis for the screening criteria to identify and screen potential conjunctive use projects was developed for Tasks 1 through 4 and is presented in the Technical Memoranda attached to this report. The screening criteria consist of the following:

- Component Compatibility – Assesses whether the potential water source and recharge application could be combined into a practical project.
- Constructability – Assesses issues that could arise for the construction of the potential project including the likelihood of finding a suitable construction site, compatibility with nearby land use, and an initial assessment of the complexity of constructing the project.
- Conveyance – Assesses issues related to moving water from the water source to the recharge application including conceptual-level costs, right-of-way issues, site conditions, and environmental issues during construction.
- Project Engineering – Assesses issues related to engineering design including a general assessment of complexity of project design, use of existing infrastructure, and need for detailed site-specific data are considered.
- Long-Term Sustainability – Assesses the projects long-term ability to meet the Conjunctive Use Project goals based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions.
- Water Source Rating – Incorporates scores from the water source screening analysis into the project score so that the previous analysis can influence the project screening.

- Recharge Application Rating – Incorporates scores from the recharge application screening analysis into the project score so that the previous analysis can influence the project screening.

Component compatibility assessed whether the matching of a potential water source and recharge application could be combined into a practical project. If a project was considered as incompatible, it was removed from the screening process at this point.

The remaining screening criteria were scored similarly as the project components with a assigned score ranging between one (1) and five (5) with one (1) being the least favorable and five (5) being the most favorable with respect to the criteria, based on how well a project met the each criteria. An emphasis was placed on maintaining relative scoring consistency. Each criterion was assigned a weighting factor based on the perceived relative importance of the screening criteria. A score was calculated by multiplying the screening criteria score by the assigned criteria weighting factor. The project components or projects being evaluated were ordered from highest to lowest.

8.3 Project Screening Evaluation

This is considered a screening-level analysis that focused primarily on an initial technical evaluation of the effectiveness potential projects defined by a single pair of water source and recharge application in meeting the Conjunctive Use Project goals. The Alternative Screening Analysis of the recharge applications is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. The results of the project screening evaluation are shown on Table 8-1. Below is a discussion of the screening analysis for the project screening evaluation with references to the appropriate Technical Memorandum for additional information.

8.3.1 Component Compatibility

Component Compatibility evaluated whether the two project components could be practically combined into a single project. The screening score was assigned either one (1) or zero (0). Component pairs that were deemed incompatible to be evaluated as a single viable project were assigned a zero (0) and not evaluated using the other screening criteria.

Stormwater sources were considered as incompatible with in-lieu recharge as stormwater is not considered as a viable source of a drinking water supply. Therefore, the fundamental concept for in-lieu recharge could not be met with a stormwater source. This included stormwater runoff from roofs, parking lots, streets, and from storm drains.

The use of treated potable water from an inter-district water exchange was considered as incompatible for low impact development. Low impact development is essentially designed to capture stormwater runoff from parking lots and streets. It is considered an inappropriate and impractical use of treated portable water with low impact development.

Similarly, diversions from surface water sources including Bean Creek, Zayante Creek and the San Lorenzo River were considered as incompatible for low impact development. It is considered inappropriate and impractical to divert surface water for use with low impact development.

Intercepting water from a storm drain was also considered as incompatible for low impact development. Storm drains concentrate the water into a single drain. It is considered an inappropriate and impractical use to redistribute the storm drain flow back to the low impact development areas.

The use of the SLVWD's Loch Lomond Reservoir water right was considered as incompatible for use with SVWD only. The use of the SLVWD's Loch Lomond water right was considered as requiring participation from SLVWD.

Other combinations of the selected water sources and recharge applications were considered a potentially viable and were included in the screening process. Of the 100 potential projects, 74 were evaluated using the screening analysis and 26 were removed from further consideration using the component capability criteria.

8.3.2 Constructability

Constructability accounts for issues that may affect the ability to construct the project. Different types of sites may have very different issues. Detailed discussion of the engineered facilities requirements is provided in TM-3 with supporting information in TM-1B and TM-4. Engineering facilities issues include:

- Site access and logistics – The ability for workers, machinery and materials to reach and maneuver within the site,
- Logistics – Having sufficient space for operation of machinery and storing materials, presence of necessary utilities, and special safety or environmental conditions
- Site suitability – Covers a wide range of potential issues that include the required size of the site, site conditions, pre-existing conditions such as geotechnical issues.

A brief overview of the engineering facilities issues considered during the Alternatives Screening Analysis is provided below.

- Low impact development was scored higher because it is considered more flexible allowing better ability to construct. Low impact development can also be retrofitted into existing urbanized areas.
- Inter-district water exchange was scored higher because of the potential for use of existing infrastructure. Conveyance is the primary component and it addressed with separately in this analysis (see Section 8.3.3).
- Construction of large-scale recharge facilities including percolation ponds and injection wells was scored lower because these types of projects require more extensive construction activities including acquisition of sufficient land area for the facility and for construction activities.
- Construction of surface water diversion facilities was scored lower because these types of projects require more complex construction practices for working in a sensitive water habitat.

8.3.3 Conveyance

Conveyance can be a limiting factor for many water projects because of the cost of a long pipeline, resolving right-of-way issues to define a pipeline route, and special environmental conditions during construction. Other complications in conveyance include steep topography in the study area. Pumping water uphill takes additional infrastructure and energy which affect the overall project cost. The variable geology may influence the construction of a pipeline as different types of materials, steep slopes, and unstable soil conditions may also lead to additional construction costs and may require special equipment.

The primary factors that were considered in scoring a project on conveyance include the following:

- Distance between the water source and recharge application areas – The greater the distance the higher the overall costs and the greater the likelihood of encountering complicating conditions.
- Existing land use – If the conveyance was required to pass through a developed area such as the City of Scotts Valley, it was considered that these areas would have the potential for issues from pre-existing utilities and infrastructure that would significantly complicate the construction of a pipeline.
- Environmental – If the conveyance was required to cross large creeks or pass through protected areas, these were considered as areas that would have a higher potential for issues that would significantly complicate the construction of a pipeline.
- Topography - If the conveyance would encounter steep topography, this was considered as a potential issue that would significantly complicate the construction of a pipeline.

Each project was scored by applying these factors. A brief summary of how these were factors were applied is provided below:

- Low impact development was given a high score because it requires minimal conveyance.
- Inter-district water exchange was given relatively a low score because the pipeline component is the primary capital expense. However, these were given a higher score for aquifer recharge at the Hanson Quarry because of the shorter distance and the potential for use of existing infrastructure.
- Stormwater sources from roofs, streets, and parking lots were given a low score because as they are being dispersed sources significant conveyance would be required to collect the stormwater and then convey it to the recharge applications. Stormwater from storm drains was given a higher score since the existing storm drain provides a conveyance for collecting the stormwater.
- Surface water sources to either of the Hanson Quarry sites were given a higher score because of the shorter distance and because the quarry site is undeveloped which would lower the potential for construction complications.
- Surface water sources to sites within Scotts Valley were given a lower score because of the longer distance and because the urbanized areas present a higher potential for construction complications.

8.3.4 Project Engineering

Project Engineering accounts for the requirements for the design of the project. Projects utilizing existing infrastructure are considered preferable. Projects requiring primarily standard engineering components are considered to be of relatively low risk. Projects requiring complex design and installation of non-standard engineering components and/or the design that are dependent on detailed site-specific data are considered to have higher risk of unanticipated complications and were rated lower. Detailed discussion of the engineered facilities requirements is provided in TM-3 with supporting information in TM-1B and TM-4.

Each project was scored by applying these factors. A brief summary of how these were factors were applied is provided below:

- Low impact development was scored higher because it is considered to require less complex project design.
- Inter-district water exchange was scored higher because the potential for use of existing infrastructure. Conveyance is the primary complex component and it is addressed in Section 8.3.3. Supporting infrastructure including pump stations and water treatment may be necessary.
- Construction of large-scale recharge facilities including percolation ponds and injection wells was scored lower because these types of projects require detailed site-specific data and have complex design components.
- Construction of surface water diversion facilities was scored lower because these types of projects require detailed site-specific data and have complex design components.

8.3.5 Long-Term Sustainability

Long-Term Sustainability provides a general assessment of the projects ability to meet the Conjunctive Use Project objectives based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions. Projects are rated higher for proven technologies with strong conceptual understanding for success. Projects are rated lower for less proven technology, or uncertainty in site conditions. Additional discussion of the long-term sustainability is provided in TM-1B, TM-1C, TM-3, and TM-4.

8.3.6 Water Source Rating

Scores from the water source screening analysis (Section 6.4) were incorporated into the project score to allow the results of the previous analysis to be a factor in the project screening. These were weighted lower than the other factors since all of the projects included one of the top ten water sources.

8.3.7 Recharge Application Rating

Scores from the water application screening analysis (Section 7.4) were incorporated into the project score to allow the results of the previous analysis to be a factor in the project screening. These were weighted lower than the other factors since all of the projects included one of the top ten recharge applications.

8.4 Screening Results

The results of the Alternatives Screening Analysis including the selected short-list of 25 projects are provided on Table 8-3. The discussion below provides a general evaluation of the screening results with respect to both water sources and recharge applications.

8.4.1 Water Source

Potential sources of water for the Conjunctive Use Project consist of several groups including stormwater, surface water diversions, in-lieu exchanges with existing water supplies outside of the area, and wellfield sources (however these can be considered as modified surface water diversions). Below is a discussion of each of these groups.

Stormwater sources account for six of the 25 short-listed projects. These include two projects defined as using stormwater runoff from the roofs of large buildings, two projects using stormwater runoff from parking lots and streets, and two projects using stormwater intercepted from storm drains. Stormwater sources have the advantage of being derived directly from rainfall and not having water rights issues associated with them. The main limitations are water quality concerns as stormwater can pick up contaminants from contact with streets, parking lots and structures.

New surface water sources account for fourteen of the 25 short-listed projects. These include three projects on the San Lorenzo River, three projects on Zayante Creek, five projects on Bean Creek, and one project on Loch Lomond Reservoir. Surface water sources have the advantage of having the potential to directly intercept high volume flows during the rainy season when excess surface water is hydrologically available. The main limitations are environmental concerns (e.g. fishery), water quality from potentially high sediment load during high flows, and complexity of project implementation.

- Nine projects include new surface water diversion structure on the waterway including the San Lorenzo River, Zayante Creek, and Bean Creek.
- Two projects consist of a groundwater wellfield to capture water that would discharge to Bean Creek.
- One project includes infrastructure to take advantage of existing water rights to Loch Lomond Reservoir by SLVWD.

Utilizing existing sources account for three of the 25 short-listed projects. These consist of five projects that use the existing Felton Diversion owned by the SCWD on the San Lorenzo River, and inter-district water exchanges that utilize the SCWD Graham Hill WTP. As an alternative, the SLVWD's Felton WTP is a second potential source; however, it is much smaller than Graham Hill WTP and may not have excess winter-time treatment capacity. The advantage of these projects is the use of existing water supplies and infrastructure. The main limitations are issues with conveyance requiring potentially long pipelines to interconnect the different water districts, engineering issues of making these systems compatible and non-technical issues requiring agreements on the amounts, timing and payments of these water exchanges.

Wellfield sources account for two of the 25 short-listed projects. This consists of two projects for a shallow groundwater wellfield along Bean Creek in an area of consistent groundwater discharge to the creek. This is considered a surface water project in respect of its goal is to intercept groundwater discharging to the creek, but it is a groundwater project in that the water produced would be groundwater with respect to water quality regulations. The main advantage of this project is that is a relatively straightforward engineering project. The main limitations are environmental concerns regarding impacts to Bean Creek and the fishery.

8.4.2 Recharge Application

Potential recharge applications for the Conjunctive Use Project consist of several groups including low impact development, active groundwater recharge involving percolation ponds, injection wells or leach fields, and in-lieu recharge replacing existing groundwater supplies. Below is a discussion of each of these groups.

Low impact development applications account for four of the 25 short-listed projects. These include the retrofitting of small recharge facilities to existing developed areas including large shopping centers and office complexes along Mount Hermon Road and Scotts Valley Drive in Scotts Valley. The main advantage of these projects is that they are relatively straightforward to implement. The main limitations are working with private land owners to get permission, identifying funding for the projects and the possibility of impacting contaminant plumes in the vicinity.

Aquifer recharge applications account for fourteen of the 25 short-listed projects. Of these, 5 projects use percolations ponds and 9 projects use injection wells. The primary advantage of these projects is that they are engineered to be able to recharge large volumes of groundwater and that these structures can be owned an operated by a single entity which provides for operational efficiency. The main limitations are the size and complexity of the engineering and operation of these facilities.

In-lieu recharge applications account for seven of the 25 short-list projects. These include projects for inter-district water exchanges between the SCWD, SVWD, and SLVWD. The main advantages of these projects are that they use mostly existing infrastructure and water supplies, and are highly efficient in increasing groundwater storage. The main limitations are negotiating agreements for the exchanges with the participating districts and the potential for constructing long pipelines.

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Section 9: Conjunctive Use Alternatives Ranking

The step-by-step process of ranking the projects for the Alternatives Screening Analysis has two parts. Section 8 covered the screening from a long-list of 100 to a short-list of 25 projects. This section covers a second ranking of the short-listed projects using a separate set of screening criteria that emphasize project costs and system reliability factors to arrive at the three preferred alternatives. Each project was independently evaluated based its own merits separate for other projects. This section provides a discussion of this process.

9.1 Define Project Short-List

The short-list of 25 conjunctive use projects was identified in Section 8 and provided on Table 8-3. The project alternatives were ranked according to the maximum screening level score for a single project. Using this methodology assures that the highest rated projects are selected for the preferred alternatives, and that a highly ranked project does not get diluted by being mixed with lower ranking projects in the alternative grouping process. The assumption is that a poorly ranked project included in an alternative would not have to be implemented; therefore, the ranking should be guided by the highest ranking project.

9.2 Project Screening Criteria

The screening criteria used to evaluate potential conjunctive use short-list of projects is summarized on Table 9-1, including a description of each screening criterion, the basis for developing a screening score, and the criterion weighting factor. The screening criteria used for evaluating the short-list of projects emphasize costs and system reliability factors. A summary of screening criteria applied for the short-list of projects includes the following:

- Relative Design and Build Cost – Provides conceptual evaluation of potential project costs based on analogy with similar projects. These are considered relative, preliminary order-of-magnitude costs that could vary significantly based on actual site conditions and project requirements.
- Relative Long-Term Operations and Maintenance (O&M) Costs – Provides a conceptual evaluation of potential O&M costs based on similar projects. These are considered generalized estimates that could vary significantly based on actual site conditions and project requirements.
- Outside Funding Potential – Provides an initial assessment of the potential for obtaining outside funding to construct the project based on knowledge of what types of projects are currently being funded by the State and Federal agencies.
- Stakeholder Acceptance – Provides a criterion to account for the level of support by the local stakeholders to implement the project based on local knowledge and input from the TAC.
- Relative Cost of Water – Provides a conceptual evaluation of the relative cost of water based on an assessment of the relative design and build cost and long-term O&M costs versus the potential groundwater and baseflow benefits.

- System Reliability – Provides a general assessment of the project's long-term reliability to have a long project life based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions.

This is considered a screening-level analysis to provide an initial technical evaluation of the ability of the implementability of the project. The Alternative Screening Analysis is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC.

9.3 Alternative Screening Evaluation

This is considered a screening-level analysis that focused primarily on an initial technical evaluation of the effectiveness of the identified project screening in meeting the Conjunctive Use Project goals. The Alternative Screening Analysis of the project screening is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. Below is a discussion of the screening analysis for the project screening with references to the appropriate Technical Memorandum for additional information.

9.3.1 Relative Design and Build Cost

Relative design and build cost provides a general conceptual evaluation of potential capital costs of implementing the project based on similar projects. These are considered preliminary order-of-magnitude costs because actual costs may vary significantly based on actual site conditions and project requirements. For this evaluation, lower cost projects were considered preferable and given higher scores. Below is an overview of the general guidelines used for the screening process. Additional information on relative design and build costs is presented in TM-3.

- Constructing large surface water diversions or large aquifer recharge facilities were considered as having higher relative capital costs.
    - Installation of wells varied based on the relative depth and complexity of the wells.
    - Construction of percolation ponds varied based on the relative size and location of the facilities.
- Use of existing infrastructure was seen as having advantages of lower relative capital costs.
    - Use of the existing Felton Diversion on the San Lorenzo River as a water source was considered to provide a significant capital cost savings relative to constructing a new surface water diversion structure.
- Inter-district exchange of existing water supplies for use as in-lieu recharge was considered to have lower relative costs because of the ability to use existing infrastructure.
- Low impact development was considered to have lower relative capital costs.

9.3.2 Relative Long-Term Operations and Maintenance Costs

Relative long-term O&M costs provide a general conceptual evaluation of potential future O&M costs based on analogy with similar projects. These are considered preliminary order-of-magnitude costs because actual costs may vary significantly based on actual site conditions and project requirements. For this evaluation, lower O&M costs were considered preferable and given higher scores. Below is an overview of the general guidelines used for the screening process. Additional information on O&M costs is presented in TM-3 and further discussion of O&M issues is also included in TM-1B.

- Larger facilities handling higher volumes of untreated water were considered as having higher relative O&M costs.
    - Surface water diversions were considered to require frequent O&M due to the need to manage water quality, flow equalization, and other issues related to operating on a river or stream.
    - Large aquifer recharge facilities were considered to require frequent O&M due to the need to manage water quality, clogging, and other related issues.
    - Use of the existing Felton Diversion on the San Lorenzo River as a water source was considered to provide lower O&M costs because existing O&M procedures should be adequate so that little additional O&M is required.
    - Injection wells were considered to have higher O&M costs due to replacement of pumps and filters. The potential for clogging, especially in the Lompico (see TM-1A) may also increase O&M costs.
- Inter-district exchange of existing water supplies for use as in-lieu recharge was considered to have lower relative O&M costs because the use of existing infrastructure would require less additional O&M costs.
- Low impact development was considered to have lower O&M costs because these types of facilities only require infrequent maintenance.

9.3.3 Outside Funding Potential

Outside funding potential provides a general assessment of the potential for obtaining outside funding to construct the project. This assessment is based on knowledge of what types of projects are currently being funded by the State and Federal agencies. It is assumed that projects that provide multiple benefits including water supply reliability, fisheries, stormwater management, flooding and other environmental aspects have a higher potential for future funding. Projects that are more “green” and use less energy and make better use of water resources are also considered as having a higher potential for future funding.

- Recharge of stormwater is an approach receiving increased attention at the State levels and was considered as having a higher likelihood of receiving outside funding.
- Inter-district water exchange to better utilize of existing water supplies was considered as having a lower likelihood of receiving outside funding.
- Large aquifer recharge projects were considered as having a moderate likelihood of receiving outside funding.

- Projects requiring new surface water diversions in the river or stream were considered as having a lower likelihood of receiving outside funding.

9.3.4 Stakeholder Acceptance

Stakeholder acceptance provides a criterion to account for the level of support by the local stakeholders to implement the project. Projects with stronger local support have a higher likelihood to be implemented and were given a higher score. This is a subjective assessment based on local knowledge and input from the TAC. Rankings for stakeholder acceptance were based on the following assumptions:

- Low impact development was considered as having relatively strong stakeholder support.
- Inter-district exchange was considered as having relatively strong stakeholder support as there are already discussions underway on these issues.
- Large aquifer recharge projects were considered as having moderate likelihood of stakeholder support.
- Projects requiring new surface water diversions in the river or stream were considered as having relative weak stakeholder support.

9.3.5 Relative Cost of Water

The conceptual evaluation of the relative cost of water provided by the project is a critical element of project implementability. The preliminary cost estimates that are applicable at this conceptual stage were considered as too uncertain and considered to have a wide range to calculate a specific unit cost of water. Therefore, for this analysis the relative design and build and long-term O&M costs were assessed compared to the potential groundwater and baseflow benefits. This provides a relative assessment of the overall value of a project and provides some balance to the analysis due to the overall wide range of uncertainty regarding project costs. Higher scores were given for projects with high benefits but low costs, and lower scores were given for projects with low benefits and high costs.

- Low impact development was considered as having a low relative cost of water because of the lower capital and O&M costs.
- Inter-district water exchange was considered as having a low relative cost of water because of the use of existing infrastructure.
- Large aquifer recharge projects were considered as having a higher relative cost of water because of the higher capital and O&M costs.
- Projects requiring new surface water diversions were considered as having a higher relative cost of water because of the higher capital and O&M costs.

9.3.6 System Reliability

System reliability provides a general assessment of the project's long-term reliability to have a long project life based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions. Projects were rated higher for proven technologies under similar project conditions, and rated lower for less proven technology, or uncertainty in project conditions. Rankings for system reliability were based on the following assumptions:

- Low impact development was considered having higher system reliability because it is a more passive stormwater recovery system.
- Projects that use existing infrastructure were considered as having higher system reliability because existing infrastructure is already operational and the issues associated with it are already known.
- Projects that require new surface water diversions were considered as having moderate system reliability. Although these are well established technologies with a good track record of success, they are susceptible to interruption due to stream flows, water rights, fishery and other environmental issues.
    - A new surface water diversion on the San Lorenzo River was considered of low reliability whereas use of the existing Felton Diversion was considered having moderate reliability because the issues of stream flows, water rights, fishery and other environmental issues are known.
- Percolation ponds were considered as having higher system reliability because these are well established technologies with a good track record of success.
- Injection wells were considered as having moderate system reliability because of potential operational issues related to clogging and equipment maintenance.
- Inter-district water exchange was considered as having moderate system reliability because it can be affected by water supply, operational, and non-technical issues.

9.3.7 Alternative Ranking

This is considered a screening-level analysis that focused primarily on an initial technical evaluation of the effectiveness of the identified project screening in meeting the Conjunctive Use Project goals. The Alternative Screening Analysis of the project screening is based on the technical information presented in the attached Technical Memoranda, a conceptual-level engineering analysis, and local knowledge by the consultant team and the TAC. Below is a discussion of the screening analysis for the project screening with references to the appropriate Technical Memorandum for additional information.

The results of the Alternatives Screening Analysis including the selected short-list of 25 projects are provided on Table 9-3. The discussion below provides a general evaluation of the screening results for the top ten alternatives with respect to both water sources and recharge applications.

9.4 Conjunctive Use Alternatives

The objective of the Conjunctive Use Project is to identify three preferred alternatives that can be evaluated by future phases of the feasibility study. The analysis described previously in this report has focused on looking a relatively small components and projects. However, to define the preferred alternatives, it was planned that projects with similar characteristics would be grouped together. The list of 25 projects were grouped into 10 alternatives to allow the future phases of the feasibility study to evaluate a broader range of related project features, and not cause unwarranted limitations on future evaluations.

To determine the final scoring for the preferred alternative, the rankings from the previous analyses were averaged arithmetically with no additional weighting. Since the different steps in the screening analysis had a different emphasis, the averaging of the rankings allowed each of these analyses to be weighted equally in the final analysis. The results are shown on Table 9-3. The previous analyses include the following:

- Scores from the water source screening analysis (Section 6.4)
- Scores from the water application screening analysis (Section 7.4)
- Scores from the project screening analysis (Section 8.4)
- Scores from the alternative screening analysis (Section 9.3)

The 25 projects were grouped into ten Conjunctive Use Alternatives in the order that they were ranked as shown on Table 9-3. The projects were grouped together that had similar characteristics so that future evaluations could consider a wider range of projects. Below is a summary of the ten Conjunctive Use Alternatives.

9.4.1 Alternative #1 - Enhanced Stormwater Recharge in Scotts Valley Using Low Impact Development

Alternative #1 includes four projects that use stormwater from roofs, parking lots and streets along Mount Hermon Road and Scotts Valley Drive for groundwater recharge using low impact development facilities such as infiltration basins, pervious pavement, vegetated swales, and landscape islands. . These projects are closely linked by source of water and recharge application. This alternative would utilize stormwater that is currently routed away from the SMGB by storm drains for groundwater recharge to help restore natural groundwater recharge lost to the effects of urbanization. Implementing this alternative on the scale necessary to achieve the project goals would require retrofitting the existing commercial and business property with low impact development facilities to accommodate recharge of stormwater.

This alternative is relatively straightforward in concept and would produce benefits to both groundwater storage and summertime baseflows, especially in Bean Creek, as discussed in TM-1C. Stormwater sources have the advantage of being derived directly from rainfall and not having water rights and fisheries issues associated with them. Enhanced stormwater recharge is generally encouraged by the Department of Water Resources and State Water Resources Control Board and there are potential funding sources that could help with implementation of this alternative.

This alternative will require negotiating with private land owners to get permission to access property to implement this alternative, and this is considered a limitation to the alternative. Water quality is another concern as stormwater can pick up contaminants from contact with streets, parking lots and structures. Water quality concerns can be addressed by implementation of treatment, such as bioswales, prior to recharge. The presence of contaminant plumes in the Camp Evers area is another issue as groundwater recharge has the potential to remobilize the existing plumes. The potential impacts of contaminant plumes in the Camp Evers area will have to be included in future evaluations to fully implement this alternative because of the potential to remobilize these plumes.

9.4.2 Alternative #2 - Inter-District Exchange for In-Lieu Recharge

Alternative #2 includes two projects that utilize existing water sources for in-lieu recharge. Alternative #2 utilizes uses the existing water sources used by the participating water districts. Since these include a combination of surface water and groundwater resources, this alternative proposes that the water districts set up agreements to sell, trade or share these water resources to take advantage of natural cycles. The general concept is to use more surface water during years of high flows instead (or in-lieu) of groundwater pumping.

The water source for Alternative #2 is to utilize excess capacity at the SCWD's Graham Hill WTP during the winter months when water demand is relatively low and water availability is high. Treated potable water from the Graham Hill WTP would be conveyed to the SVWD and SLVWD for use instead of groundwater pumping. The SLVWD's Felton WTP is another potential source of water; however it may not have additional treatment capacity that is available at the Graham Hill WTP.

The advantage of this alternative is that it makes use of existing water supplies and infrastructure to help reduce overall project costs and minimize environmental impacts. In-lieu recharge is generally highly efficient in increasing groundwater storage (see TM-1C). Increasing groundwater levels in the SMGB as a result of this project would also help to increase summertime baseflows in streams such as Bean Creek. Additional information is discussed in TM-1C.

Limitations include the cost of constructinon and water rights issues. The cost of construction includes building long pipelines to interconnect the different water districts and resolving engineering issues of making these systems compatible. This alternative requires inter-district exchanges between several water districts; therefore, a potential limitation is that agreements will need to be negotiated between the districts to define the volume, timing and payment for these exchanges. However, individual districts have already initiated discussions and planning-level work to explore this concept in greater detail.

9.4.3 Alternative #3 - Surface Water from Felton Diversion for Aquifer Recharge in Hanson Quarry Area

Alternative #3 includes three projects that divert water from the existing Felton Diversion on the San Lorenzo River and convey this water to aquifer recharge facilities located in the Hanson Quarry area west of Scotts Valley. The concept is to utilize surface water during the high flow periods for aquifer recharge to increase groundwater levels in the SMGB.

Aquifer recharge would be done by either percolation ponds, injection wells or a combination of both. Injection wells are generally highly efficient in increasing groundwater storage whereas percolation ponds appear to be less efficient; however, this is highly dependent upon site-specific conditions. Both of these methods help increase groundwater levels in the basin which would also help increase summertime baseflows in the area streams. Further evaluation including identification of a final site would be required to determine options that are more viable.

The Hanson Quarry is identified here because it represents a large area of potentially available land that could accommodate a large recharge facility. However, the alternative could be located in areas adjacent to the quarry if necessary. Aquifer recharge would be done by either percolation ponds, injection wells or a combination of both. Further evaluation including identification of a final site would be required to determine options that are more viable.

Advantages are that this alternative can potentially add significant volumes of groundwater to the basin to help increase groundwater levels and help to increase summertime baseflows as discussed in TM-1C. Another advantage of these projects is that they can be engineered to be able to recharge large volumes of groundwater. This alternative also makes use the existing infrastructure at the Felton Diversion which helps to lower the overall project costs.

The main limitation of this alternative is with respect to water rights and environmental and fishery concerns with the San Lorenzo River diversion (see TM-2C). Because of the geologic complexity of the basin, there are limited areas for potential sites; however, this varies with recharge method. The size and complexity of the engineering and operation of these facilities also increase capital and operational costs. For example, injection wells are more flexible with respect to location than percolation ponds. A large aquifer recharge facility would require a significant amount of land that has to be located overlying the appropriate geology.

9.4.4 Alternative #4 - Surface Water from Felton Diversion for In-Lieu Recharge

Alternative #4 includes two projects that utilize water from the existing Felton Diversion on the San Lorenzo River for in-lieu recharge. Water from the Felton Diversion would then be piped directly to the SVWD and/or SLVWD where the water would be treated and used in the local water distribution system. This alternative would require pipelines to connect Felton Diversion to the local water systems, and could require construction of a new water treatment plant or use of the SLVWD's existing Felton WTP.

The advantage of this alternative is that it makes use of existing water supplies and infrastructure. In-lieu recharge is generally highly efficient in increasing groundwater storage. Increasing groundwater levels in the basin as a result of this project would also increase summertime baseflows in the area streams as discussed in TM-1C.

The main limitation of this alternative is with respect to water rights and environmental concerns with the San Lorenzo River diversion, primarily with the fishery (see TM-2C). Other limitations are potentially high cost of treatment, conveyance to connect the local water districts, system engineering compatibility, and non-technical issues requiring agreements on the amounts, timing and payments of these water exchanges.

9.4.5 Alternative #5 - Bean Creek Wellfield for In-Lieu Recharge

Alternative #5 consists of a shallow groundwater wellfield along Bean Creek in an area of consistent groundwater discharge to the creek. Pumping is from the vicinity of Bean Creek takes advantage of the natural conditions that cause this area to be a major discharge area from the Santa Margarita.

This wellfield would be used in-lieu of pumping the existing wells from the Lompico or Butano allowing the water in deeper aquifers to remain in storage. This is considered a surface water project with respect to its goal to intercept groundwater before it is discharged to the creek, but it is a groundwater project in that the water produced would be groundwater with respect to water quality regulations. Pumping from the Bean Creek wellfield would have the same restrictions as surface water diversions with pumping limited to the period of November to May when there is sufficient surface water flow in Bean Creek.

The main advantage of Alternative #5 is that it is a relatively straightforward engineering project, and the water may require less water treatment. In-lieu recharge is generally highly efficient in increasing groundwater storage. For this alternative, the potential increases to groundwater storage and the impacts to the summertime baseflow are relatively small if pumping is restricted to the wet season (see TM-1C). This potentially makes this alternative to be relatively neutral with respect with respect to benefits in meeting the Conjunctive Use Project goals.

The model results (see Table 7-2, also documented in TM-1C) indicate that shifting groundwater pumping from the Lompico to the Bean Creek Wellfield would help to increase groundwater in aquifer storage in the Lompico, but have minimal impact on groundwater storage in the Santa Margarita. Alternative #5 does not provide a long-term improvement or benefit to summertime baseflow. However, the model scenarios show that potential impacts to summertime baseflow at Bean Creek are minimal if pumping is restricted to the November to May time period.

The main limitation of this alternative is with respect to water rights and environmental concerns with the San Lorenzo River and its tributaries (e.g. Bean Creek) primarily with the fishery (see TM-2C). The total volume of water potentially produced by this alternative may be limited; therefore, it may potentially be smaller than the Conjunctive Use Project goals. Additional work would be needed to evaluate how much water could be produced using this alternative.

This alternative is strongly supported by the Scotts Valley Water District which is planning on further evaluation and potentially implementing this alternative. This strong stakeholder support is a strong consideration for this project. Although Alternative #5 is not one of the preferred alternatives for a regional conjunctive use project, it is recommended that the SVWD continue evaluating this alternative independently as a local water district project.

9.4.6 Alternative #6 - Storm Drain Capture for Aquifer Recharge in South Scotts Valley Area

Alternative #6 includes two projects to intercept stormwater from the existing Scotts Valley storm drains and to convey this water to aquifer recharge facilities located in the Hanson Quarry area west of Scotts Valley. The Hanson Quarry is identified here because it represents a large area of potentially available land that could accommodate a large recharge facility. However, the alternative could be located in areas adjacent to the quarry if necessary. One potential location to be explored in the next phase of study would be the golf course which would require less pumping than Hanson Quarry. Aquifer recharge would be done by either percolation ponds, injection wells or a combination of both. Further evaluation including identification of a final site would be required to determine options that are more viable.

Stormwater sources have the advantage of being derived directly from rainfall and not having water rights issues associated with them. The advantage of percolation ponds and/or injection wells is that they can be engineered to handle large volumes of groundwater recharge and that these structures can be owned an operated by a single entity which provides for operational efficiency.

The main limitations of this alternative are water quality concerns as stormwater can pick up contaminants from contact with streets, parking lots and structures. Therefore, some level of water treatment would likely be required prior to recharge. Also, stormwater occurs episodically whereas groundwater recharge needs to occur more continuously. Therefore, a system for storage of stormwater would likely be necessary to meet the conjunctive use goals. The size and complexity of the engineering and operation of these facilities increases capital and O&M costs. A large aquifer recharge facility would require a significant amount of land that has to be located overlying the appropriate geology. Because of the geologic complexity of the basin, this limits the potential locations. Injection wells are more flexible with respect to location than percolation ponds.

9.4.7 Alternative #7 - Zayante Creek for Aquifer Recharge in Hanson Quarry Area

Alternative #7 calls for construction of a new surface water diversion structure on Zayante Creek. The water would then be conveyed to aquifer recharge facilities located in the Hanson Quarry area west of Scotts Valley. The Hanson Quarry is identified here because it represents a large area of potentially available land that could accommodate a large recharge facility. However, the alternative could be located in areas adjacent to the quarry if necessary. Aquifer recharge would be done by either percolation ponds, injection wells or a combination of the two. Further evaluation including identification of a final site will be required to determine which of these options is more viable.

The primary advantage of this alternative is that existing water rights have been reserved for North Santa Cruz County on Zayante Creek that may be utilized for this project. Zayante Creek is located relatively close to the Hanson Quarry site which would reduce costs of conveyance. Surface water sources have the advantage of having the potential to directly intercept high volumes flows during the rainy season when excess surface water is available.

The main limitations of this alternative are environmental concerns (e.g. fishery), water quality from potentially high sediment load during high flows, and the complexity of project implementation as an additional diversion structure and some level of water treatment would be necessary. Also, flows on a smaller creek, like Zayante Creek, occur more episodically whereas groundwater recharge needs to occur more continuously. Therefore, a system for storage of water from the stream to dampen hydrologic peaks and provide a constant flow to recharge facilities would likely be necessary to meet the conjunctive use goals. The size and complexity of the engineering and operation these facilities increases capital and O&M costs. A large aquifer recharge facility would require a significant amount of land that has to be located overlying the appropriate geology. Because of the geologic complexity of the basin, this limits the potential locations. Injection wells are more flexible with respect to location than percolation ponds.

9.4.8 Alternative #8 - Loch Lomond for In-Lieu Recharge

Alternative #8 includes two projects that utilize existing water rights on Loch Lomond Reservoir by the SLVWD for use instead of groundwater thus providing in-lieu recharge. This alternative would require a new diversion on Loch Lomond or an agreement with the SCWD to convey the water from Loch Lomond for use as in-lieu recharge by the SLVWD and/or SVWD. This option would likely require new water treatment and delivery infrastructure, unless the water is treated at either the SCWD's Graham Hill WTP or the SLVWD's Felton WTP.

The primary advantage of this alternative is that it utilizes an existing water right from a source that already exists. In-lieu recharge is generally highly efficient in increasing groundwater storage.

The primary limitation of this alternative is that at a conceptual level this alternative has some appeal; however, there is still uncertainty on how this alternative could be implemented given additional engineered facilities that would likely be required. It would also require significant additional planning work to implement this alternative.

9.4.9 Alternative #9 - Bean Creek for Aquifer Recharge in Hanson Quarry Area

Alternative #9 is similar to Alternative #8 except for the water source. Alternative #9 calls for construction of a new surface water diversion structure on Bean Creek. The water would then be conveyed to aquifer recharge facilities located in the Hanson Quarry area west of Scotts Valley. The Hanson Quarry is identified here because it represents a large area of potentially available land that could accommodate a large recharge facility. However, the alternative could be located in areas adjacent to the quarry if necessary. Aquifer recharge would be done by either percolation ponds, injection wells or a combination of the two. Further evaluation to identify a final site will be required to determine which of these options is more viable.

Bean Creek is located relatively close to the Hanson Quarry site which would reduce costs for conveyance. Surface water sources have the advantage of having the potential to directly intercept high volumes flows during the rainy season when excess surface water is available. However, Alternative #9 does not provide a long-term improvement or benefit to summertime baseflow.

The main limitations are environmental concerns (e.g. fishery), water quality from potentially high sediment load during high flows, and complexity of project implementation. Therefore, some level of water treatment would be necessary. Also, flows on a smaller creek occur more episodically whereas groundwater recharge needs to occur more continuously. Therefore, a system for storage of water from the stream would likely be necessary to meet the conjunctive use goals. The size and complexity of the engineering and operation these facilities increases capital and O&M costs. A large aquifer recharge facility would require a significant amount of land that has to be located overlying the appropriate geology. Because of the geologic complexity of the basin, this limits the potential locations. Injection wells are more flexible with respect to location than are percolation ponds.

9.4.10 Alternative #10 - San Lorenzo River Water for Aquifer Recharge in Hanson Quarry Area

Alternative #10 is similar to Alternatives #8 and #9 except for the source. Alternative #10 calls for construction of a new surface water diversion structure on the San Lorenzo River. The water would then be conveyed to aquifer recharge facilities located in the Hanson Quarry area west of Scotts Valley. The Hanson Quarry is identified here because it represents a large area of potentially available land that could accommodate a large recharge facility. However, the alternative could be located in areas adjacent to the quarry if necessary. Aquifer recharge would be done by either percolation ponds, injection wells or a combination of the two. Further evaluation including identification of a final site will be required to determine which of these options is more viable.

Surface water sources have the advantage of having the potential to directly intercept high volumes flows during the rainy season when excess surface water is available. The San Lorenzo River has more consistent high level flows that would allow for a more continuous source of water than the smaller creeks.

The main limitations are environmental concerns (e.g. fishery), water quality from potentially high sediment load during high flows, and complexity of project implementation. Therefore, some level of water treatment would be necessary. The size and complexity of the engineering and operation these facilities increases capital and O&M costs especially on the San Lorenzo River. A large aquifer recharge facility would require a significant amount of land that has to be located overlying the appropriate geology. Because of the geologic complexity of the basin, this limits the potential locations. Injection wells are more flexible with respect to location than percolation ponds.

9.5 Selection of Preferred Alternatives

Based on the results the Alternatives Screening Analysis, the three preferred alternatives include the following:

- Preferred Alternative #1 - Enhanced Stormwater Recharge in Scotts Valley Using Low Impact Development
- Preferred Alternative #2 - Inter-District Exchange for In-Lieu Recharge
- Preferred Alternative #3 - Surface Water from Felton Diversion for Aquifer Recharge in Hanson Quarry Area

A more detailed project description and conceptual implementation plan for each of these preferred alternatives is provided in the following Sections 10, 11, and 12.

Section 10: Preferred Alternative #1 – Enhanced Stormwater Recharge through Low Impact Development in Scotts Valley

This section provides a more detailed project description and conceptual implementation plan for Preferred Alternative #1 - Enhanced Stormwater Recharge in Scotts Valley through Low Impact Development (LID).

10.1 Project Concept Summary

Alternative #1 includes four projects with water sources from stormwater from roofs, parking lots and streets for application in low impact development facilities along Mount Hermon Road and Scotts Valley Drive. This project type would be most hydrogeologically beneficial in the areas of Camp Evers and South Scotts Valley as shown on Figure 10-1. These projects are closely linked by source of water and recharge application. To implement this alternative on the scale necessary will require retrofitting the existing commercial and business property with low impact development facilities to accommodate recharge of stormwater.

The concept for this type of project is, through low impact design, to capture and treat stormwater runoff as close as possible to its source area and to allow the runoff to infiltrate into the underlying aquifer. This concept builds on the retrofit projects that have been conducted as Component 3 of the Integrated Regional Water Management Plan implementation projects.

Source water: Local stormwater from roofs and parking lots; at individual locations such as public buildings/parking lots; commercial buildings/parking lots; and, on a case by case basis, residential buildings/subdivisions.

Application Location: The project concept can be used on new developments (in accordance with the City of Scotts Valley policies and stormwater management plan) and to retrofit existing buildings and parking lots so that runoff is redirected to landscaped and other pervious areas. LID facilities are typically sized to treat a quantity of water that is typically described as the water quality treatment volume (approximately 2-year return interval or 0.2 inches of rainfall). By contrast, recharge facilities in these areas would be increased in size to infiltrate a substantial proportion of the 42 inches of average rainfall that occurs in Scotts Valley. The concept should be applied to areas that are hydrogeologically well-suited for infiltration and that have benefit in recharging aquifers with available storage.

10.2 Detailed Project Description

As discussed in TM-1A, urbanization in Scotts Valley has produced increased quantities of stormwater that are captured in pipelines and conveyed to a surface water, but has also resulted in reduced groundwater recharge. Capture and recharge of stormwater in Scotts Valley could have multiple benefits such as increased aquifer storage, increased summer baseflows to Bean and Carbonera Creeks, and reduced erosion and downcutting of Carbonera Creek, and potentially reducing downstream flooding.

Most of the stormwater in the SMGB is generated within the City of Scotts Valley along Scotts Valley Drive and Mount Hermon Road. The runoff is a result of rainfall intercepted by impervious surfaces. Much of the runoff is discharged to Carbonera Creek while a small portion flows northwest toward Bean Creek. An initial estimate of impervious area within Scotts Valley is approximately 291 acres (Figure 10-2). The imperious areas include the following:

- Streets and parking lots covering approximately 229 acres
- Roofs of large buildings and structures covering approximately 62 acres

However, the identified impervious area also includes some landscape and unpaved areas. An estimate of 15 percent of the 291 acres may be landscaped and/or unpaved areas for a net impervious area of about 250 acres. The average annual rainfall in Scotts Valley is 42 inches. If all of the stormwater could be captured from impervious surfaces it would represent a potential groundwater recharge volume of more than 1,000 AFY. However, since less than 100 percent of the average annual rainfall captured and recharged, a more likely volume of runoff that can be captured is in the 300 to 500 AFY range. A more detailed discussion of this analysis is provided in TM-3.

10.2.1 Infrastructure Requirements

The infrastructure needs for Preferred Alternative #1 include the following:

- Roof runoff – Modified planter boxes, customized infiltration trenches/galleries, and/or bioretention would be integrated into existing landscape. These types of infrastructure improvements can be adapted to existing development as well as integrated into new development.
- Parking lot/road runoff – Pervious pavement (asphalt, concrete, and pavers), vegetated swales/buffer strips, rain garden bioretention in landscape islands or adjacent to roadways, infiltration trenches/basins could be used, if sized appropriately, for both treatment and recharge. Parking lot retrofits may require regrading, replacement of paved surfaces, and integration of existing drainage features (e.g. catch basins and subsurface piping for overflow).

10.2.2 Other Requirements

Some of the other requirements for this type of project include coordination with both public entities (e.g. City of Scotts Valley Department of Public Works and Planning) as well as private landowners. Funding may be more readily available when compared to other types of projects because of the multiple benefits of this recharge method (described in greater detail in Section 10.3 below),

10.2.3 Estimated Costs

Estimated capital costs for LID infrastructure are summarized below. As described earlier in the introduction to Section 10.2, since the LID infrastructure will have to be oversized with respect to recharge capacity, these costs may represent the low end of the estimated construction costs. These costs were developed using the 2009 Best Management Practices (BMP) and LID Whole Life Cost Models estimating tool developed through a Water Environment Research Foundation (WERF) project (WERF, 2009). .

- Pervious Pavement – Asphalt - $1.50 per square foot ($ft^2$) for new construction based on $\$1/ft^2$ installed cost; and 25 percent design allowance and 20 percent contingency. Estimated yield for 3 feet of rainfall per year (yr) = 1.5 AFY.

- Pervious Pavement – Concrete - $\$9.75/ft^2$ for new construction based on $\$6.50/ft^2$ installed cost; and 25 percent design allowance and 20 percent contingency. Estimated yield for 3 feet of rainfall/yr = 1.5 AFY.

- Vegetated Swale - $\$0.40/ft^2$ of tributary drainage area for new construction based on construction cost of $\$0.32/ft^2$ tributary drainage area adjusted for small project plus 25 percent for engineering and planning; Approximately 870 ft^2 of swale (based on 4 percent of tributary area) for an estimated yield for 3 ft of rainfall/yr =0.06 AFY.

- Curb Contained Bioretention - $\$0.98/ft^2$ for 1,300 ft^2 of bioretention area as retrofit to serve 0.5 acres of impervious area at 80 percent impervious based on construction cost of $\$0.98/ft^2$ of tributary drainage area including 25 percent engineering/planning and retrofit adjustment; 1,300 ft^2 of bioretention area for an estimated yield = 0.09 AFY for 3 feet of rainfall/yr.

In addition, a pilot project at the Scotts Valley Library estimates from $40,000 to $50,000 for a 6,000 cubic foot recharge facility that is intend to capture and infiltrate all the water from a 2-year storm from the 1.62 Acre site. This is equal to about $8.33/cubic feet of recharge facility and is sized for about 1 cubic foot of recharge facility per 10 ft^2 of tributary area.

Estimated O&M costs for LID infrastructure are summarized below, developed using the WERF estimating tool:

- Pervious Asphalt and Concrete - Up to $2,700/yr which includes inspection, reporting, monthly litter/debris removal; and sweeping.

- Vegetated Swale - Up to $1,900/yr which includes inspection, reporting, monthly litter/debris removal; and sweeping.

- Curb Contained Bioretention - Up to $3,800/yr for 1,300 ft^2 of bioretention which includes inspection, reporting, and monthly vegetation management with litter/debris removal.

The estimated capital and O&M costs were developed using a more conservative approach (i.e. upper end of the range of costs) to reflect regional costs.

10.3 Potential Benefits of Implementation

The multiple benefits of LID recharge are summarized as follows:

- Increased Groundwater Storage: The implementation of the LID measures would be located in areas where the Santa Margarita, the shallowest aquifer unit, is located near the surface. So, the most immediate increase in groundwater storage would occur in that formation. Where the Santa Margarita directly overlies the Lompico, the deeper and more heavily pumped aquifer in the basin, it is anticipated that recharge to the Santa Margarita would drain into the underlying aquifer and thereby increase groundwater storage in the underlying Lompico.

- Sustaining Summer Baseflow: Over time, the increased groundwater storage created by the LID measures would result in an increase in natural outflows from the Santa Margarita to local streams. Based on the location and hydrogeological relationships, Bean Creek would be the primary beneficiary from the LID measures. The key benefit would be increased stream baseflow during the summer months that would provide habitat and food, and maintain temperatures in the range suitable for juvenile trout and salmon.

- Stormwater Management Plan: Retrofitting of existing developed urbanized lands in Scotts Valley would further contribute to the BMPs for the City of Scotts Valley Stormwater Management Plan including help achieve BMPs such as the Hydromodification Plan and helping meet TMDL's for sediment and pathogens in Carbonera and Camp Evers Creeks by reducing stormwater flow to the creeks and providing improved water quality benefits.
- Stormwater Quality: LID measures will improve the quality of stormwater runoff by trapping a significant portion of contaminants in the pore spaces of pervious pavement, in the grasses and soil in a vegetated swale or curb contained bioretention structures.
- Reduced Peak Storm Flows: By storing and recharging a portion of the stormwater in groundwater rather than discharging all of it into Carbonera or Bean Creeks, the volume and peak flow rates of stormwater would be significantly reduced; thereby, reducing erosion and the flood potential in the streams.
- Multi-Agency Benefits: The agencies that would benefit from the project include the City of Scotts Valley by reducing the volume and peak flow of stormwater runoff that results in hydromodification in Carbonera Creek and improving stormwater quality; SVWD and SLVWD by increasing the volume of groundwater in storage; SCWD by increasing baseflows that would provide more divertible water in the summertime; NOAA Fisheries/CDFG for improvements in the fishery conditions in the San Lorenzo River tributaries.

10.4 Issues and Challenges for Implementation

There are several challenges to implementing LID for recharge which include funding for planning and implementation of a program and development of a working relationship between key agencies since it is likely that these projects will be developed over several years. Also, many of these facilities need to be implemented on private property and obtaining approval from private property owners would present challenges. A summary of implementation issues and challenges is provided below:

- Retrofitting Existing Facilities: Much of the Scotts Valley area along Scotts Valley Drive and Mt Hermon Road has already been developed. The implementation of this alternative would require retrofitting existing development with LID type facilities for stormwater recharge and additional engineering analysis to define cost-effective methods for implementation.
- Water Quality: Even though LID is considered to generally have a water quality benefit, additional hydrogeological and engineering analysis would be necessary to demonstrate that the water quality of stormwater recharge to the aquifer will be of suitable quality. Additionally, due to the presence of contaminant plumes in the Camp Evers area, larger LID projects, such as those for parking lots, have the potential to remobilize the plumes. At this time it is unclear how widespread LID recharge would impact contaminant

plumes. Coordination with the Central Coast Regional Water Quality Control Board is anticipated.

- Interagency and Stakeholder Agreements: Development of working relationships between key agencies will be critical to successful implementation of these LID recharge approaches. For example, the City of Scotts Valley will likely approve and potentially implement these types of projects, utilize LID recharge as an element of stormwater management, and would therefore be a key stakeholder in the development of a LID recharge program. As beneficiaries and key stakeholders in the development and implementation of a LID recharge program, the SVWD, SLVWD, and SCWD could provide guidance, funding, and perhaps also implement projects within the City of Scott Valley. Santa Cruz County would also be a key stakeholder and has taken the lead in updating the Integrated Regional Water Management Plan (IRWMP) likely to be one of the funding sources for implementation. Although there are other entities such as the Regional Water Quality Control Board, CDFG, NOAA Fisheries, and non-governmental organizations, they are not likely to be actively involved in program development and implementation. Topics such as water rights and fishery requirements are not likely to present significant challenges for LID recharge.
- California Environmental Quality Act (CEQA) Review: The CEQA environmental document process would require consideration of a wide range of issues ranging from water usage, fisheries to construction issues.
- Funding: Funding would likely be available in current and upcoming water bonds through programs such as the IRWMP; private foundations such as the National Fish and Wildlife Foundation which administers a wide range of grants; loans from the State Water Resources Control Board wastewater State Revolving Fund; and potentially through surcharges and fees to develop local match and/or bond repayments funds.

10.5 Conceptual Implementation Plan

The followings are essential components of a LID recharge program

10.5.1 Summary of Activities

Feasibility Study –Consists of the development of more detailed GIS maps that include aerial photography, topography, existing stormwater systems, land ownership, and subsurface soils and geology to identify candidate areas for LID recharge projects; estimate likely yield benefits; utilize the IRWMP Component #3 LID pilot program work to estimate project implementation costs; and identify funding opportunities for future phases.

Program Development – Once potential project sites are identified in the Feasibility Study, the broader program development to implement the projects would need to be defined. This would likely consist of agency coordination, decision-making regarding agency responsibilities and governance, cost-sharing, as well as coordination of implementation. This activity could be concurrent with Feasibility Study.

LID Recharge Master Plan, Financing Plan, and CEQA Document – Further develop information from Feasibility Study into executable Master Plan which includes outreach to property owners, establishes project packages including which LID measures would be implemented at which location and initial sizing of LID measures, and planning-level capital cost estimates. This would describe a financing plan for each phase of construction and describe surcharges or fees that could be implemented for local match as well as identifying grant/bond/loan programs available to the program. This activity would coordinate construction phasing with funding availability and include discussion of coordination/responsibilities of property owners. This element would also include preparation of a project-specific CEQA document so that construction can commence after adoption.

LID Recharge Construction – For each planned phase, preparation of plans, and specifications and construction management for implementation of LID recharge project.

LID Recharge Monitoring – In order to document the impact of LID recharge on groundwater, water quality, and hydromodification, some type of monitoring would likely be required, especially if the program is state grant funded. Monitoring can be integrated into existing agency monitoring.

10.5.2 Estimated Funding Needs for Implementation

Estimated funding needs for implementation of these components are as follows:

- Feasibility Study - $100,000 - $250,000
- Program Development - $25,000 - $80,000, costs may vary depending on level of planning development planned
- LID Recharge Master Plan, Financing Plan, and CEQA document - $50,000 - $200,000
- LID Recharge Construction – variable, will result from LID Recharge Master Plan
- LID Recharge monitoring – variable, will result from LID Recharge Master Plan

10.5.3 Estimated Schedule for Implementation

Estimated schedule for implementation of these components is as follows:

- Feasibility Study – 6 to 12 months
- Program Development – 4 to 12 months
- LID Recharge Master Plan, Financing Plan, and CEQA document – 6 to18 months
- LID Recharge Construction – variable schedule, depending on LID Recharge Master Plan
- LID Recharge monitoring – variable schedule, depending on LID Recharge Master Plan

10.5.4 Complementary Activities

During the preparation of this analysis, it was identified that other alternatives could be integrated into a preferred alternative to enhance the improvements to the SMGB. Some of the other alternatives that could complement Alternative #1 and the benefits of integration are summarized below.

- Alternative #5 – Bean Creek Wellfield: The Bean Creek Wellfield represents an in-lieu recharge opportunity by reducing the SVWD wintertime pumping in the Lompico and Butano aquifers. Alternative #1 has a relatively low percentage of the recharge going to aquifer recharge with most of the recharge going to surface water baseflow, but not necessarily summertime baseflow. The wellfield provides a mechanism to capture a portion the increased wintertime baseflow resulting from Alternative #1. The water from the wellfield would be used in-lieu water supply by reducing pumping in the Lompico and Butano in the winter months and thereby increasing the aquifer storage. Limiting pumping to the winter months when there is sufficient flow in Bean Creek essentially eliminates impacts to the Bean Creek summertime baseflow. The size for Alternative #5 is limited by the lower water demand in the winter months. Therefore, Alternative #5 is a smaller project, but it can be used enhance the LID-related surface recharge with deeper in-lieu recharge thus increasing the overall benefit of Alternative #1. This alternative could be enhanced by locating the wells closer to the LID recharge areas.

- Alternative #6 – Storm Drain Capture for Recharge in South. This alternative to intercept runoff from existing infrastructure and convey it to the Hanson Quarry or other locations such as the golf course can be analyzed in conjunction with Alternative #1. It is possible that local recharge facilities can be expanded to increase recharge beyond that which can be captured from rooftops and parking lots.

10.6 IRWMP Linkage

It is likely that further funding will be solicited from the IRWMP Grant program. The following components from the checklist of IRWMP Program Preferences are applicable to Alternative #1.

- Include Regional Projects/Programs
- Integrate water management within hydrologic region
- Effectively resolve significant water-related conflicts within or between regions
- Effectively integrate water management with land use planning
- Drought Preparedness
- Use and Reuse Water more Efficiently
- Climate Change Response Actions
- Expand Environmental Stewardship
- Protect Surface Water and Groundwater Quality
- Ensure Equitable Distribution of Benefits

The following components from the checklist of IRWMP Program Preferences are not applicable to Alternative #1.

- Contribute to attainment or one or more objectives to Cal Fed
- Address critical water supply/quality needs of Disadvantaged Communities (DAC)
- For flood management - projects that provide multiple benefits
- Practice integrated flood management
- Improve tribal water and natural resources

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Section 11: Preferred Alternative #2 – Inter-District Exchange for In-Lieu Recharge

This section provides a more detailed project description and conceptual implementation plan for Preferred Alternative #2 – Inter-District Exchange for In-Lieu Recharge. The potential exchange from the SCWD Graham Hill WTP with SVWD and SLVWD is described in greater detail below.

11.1 Project Concept Summary

The Graham Hill WTP is located on Graham Hill Road in northern Santa Cruz (Figure 11-1). The SVWD and SLVWD Southern District provide water service in Scotts Valley area. An additional alternative of using water from the Graham Hill WTP for aquifer recharge at Hanson Quarry is described in Preferred Alternative #3 in Section 12.

The basic in-lieu recharge concept consists utilizing “surplus” winter surface water runoff treated at the SCWD Graham Hill WTP and providing the water to the adjoining groundwater purveyors in the Scotts Valley area (Figure 11-1). The adjoining purveyors would reduce their groundwater production by corresponding volumes during this winter supply period and gain in-lieu recharge of their aquifers. “Surplus” is defined here as the difference between the production capability of the GHWTP and the winter demand by the City of Santa Cruz water system. It is recognized that several improvements may be required to the intake infrastructure so that the Graham Hill WTP could receive sufficient water to meet its production capability.

To avoid impacts on salmonids, San Lorenzo River diversions at Tait Street, if used, would be limited to higher volume flows during the December though March time frame.

The delivery of treated water, when available, for use in-lieu of groundwater pumping by the SVWD and SLVWD (e.g. from GHWTP) and/or direct recharge of the SMGB (e.g. from Felton diversion), as discussed in Preferred Alternative #3, retains groundwater in storage for use during the dry season and droughts.

Source Water: Excess wintertime surface water from the San Lorenzo River would be treated at the SCWD’s Graham Hill WTP using existing or planned treatment capacity. This concept is being developed in parallel with a summer time recycled water exchange from the City of Scotts Valley/SVWD to the Pasatiempo Golf Course, one of SCWD’s larger customers that are looking for a reliable source of irrigation water.

Application Location: The treated surface water would be delivered through new and existing pipelines to Scotts Valley to be delivered by the SVWD and San SLVWD to their customers. Water could also be delivered to a recharge area such as Hanson Quarry or other areas within Scotts Valley as described in Preferred Alternative #3.

11.2 Detailed Project Description

The SCWD has several water sources that are treated at the Graham Hill WTP, which has a sustainable treatment capacity of about 16 MGD. The average daily water demand during the year is 11 MGD. In the summer time, the SCWD water demand can be as high as 15 MGD on a maximum day basis and 18 MGD on a peak hour basis. SCWD’s wintertime demands are typically in the 7 – 9 MGD range. Therefore, in the wintertime, the GHWTP has excess capacity on the order of 8 MGD. The primary water source for SCWD is the San Lorenzo River. Based on flow measurements from 1936 to 2008, on average there is adequate flow to meet the SCWD demand in six years out of seven.

During most years, surplus treated water from the Graham Hill WTP could be either sold or traded to the SVWD and SLVWD to help supplement their wintertime water demand. When the supplemental water is provided by the SCWD, groundwater pumping from the SMGB would be reduced by a corresponding volume. The water not pumped would be considered as in-lieu groundwater recharge that would allow groundwater levels in the basin to recover.

The primary components of this project are obtaining the surplus treated surface water, conveying the water to the South Scott Valley area, and possibly providing temporary storage for the water. A secondary project component is the delivery of secondary effluent to the Pasatiempo Golf Course, a SCWD water customer, from the Scotts Valley Wastewater Treatment Plant so that Pasatiempo Golf Course can be irrigated with recycled water in the summer time which reduces SCWD potable water demands. This secondary component is not developed any further in this report as it does not provide direct groundwater benefits. Below is a brief outline of the potential infrastructure requirements.

11.2.1 Infrastructure Requirements

New infrastructure requirements would primarily consist of conveyance to interconnect the SCWD, SVWD, and SLVWD water systems. It is anticipated that existing and planned upgrades to the water treatment and distribution systems would be sufficient. To use the Graham Hill WTP, the following infrastructure is required.

Water Transmission Pipeline - SVWD's initial study has identified two main alternative routes from the Graham Hill WTP to Scotts Valley. The first, shorter, route would connect from the SCWD's system at west of the Sims Road -La Madrona junction along La Madrona Road to a 12-inch SVWD transmission pipeline at Silverwood Drive for a distance of about 7,400 linear feet as shown on Figure 11-1. The second route would continue north along Graham Hill Road and connect through SLVWD's distribution system to SVWD's distribution system. The second route may be limited in transmission capacity because of smaller diameter pipelines within SLVWD's system. Both alignments would require a booster pump station to pump the water to the Scotts Valley area. Potential water quality issues related to disinfection residuals and/or disinfection by products would have to be evaluated and may require additional facilities.

Temporary Storage Facilities - Depending on the volume and timing of supplemental water supplied by the Graham Hill WTP, temporary storage, most likely in the form of large storage tanks, may be required. Existing water storage reservoirs can likely be utilized but would need to be evaluated.

11.2.2 Other Requirements

One of the major constraints to implementing this project concept is water rights. The project would require either an application for a new water right on the San Lorenzo River or one of its tributaries, or modification of an existing water right.

Any changes to water rights would be closely tied to SCWD's draft anadromous fish HCP (SCWD, 2010) in compliance with the Endangered Species Act and NOAA's NMFS draft CRP (NOAA 2010) for the San Lorenzo River that are both in process.

11.2.3 Estimated Costs

Capital costs are estimated at approximately $2 million for planning, design, and construction of pipeline and booster pump station for the 1.4 miles of new pipeline along La Madrona.

No cost has been estimated for additional water quality facilities such as disinfection addition that may be required. Water quality interactions will have to be studied as part of a feasibility study.

O&M costs are estimated at approximately $20,000/yr for power costs (for 120 days/yr) and maintenance.

11.3 Potential Benefits of Implementation

The following water supply benefits are expected to result from this project.

- Increased Groundwater Storage: Various estimates have been made on the level of overdraft in the Southern Santa Margarita basin. Most estimates suggest an average annual overdraft on the order of several hundred acre-feet per year over the past 25 to 30 years. Water demand by the SVWD and SLVWD has been steadily dropping since the early 2000s. From December 2008 through March 2009, the demand was approximately 500 acre-feet. Preliminary analysis of the current demand in the Scotts Valley area and potential surplus from the Graham Hill WTP suggests that in most years there is sufficient surplus to meet all or most SVWD and SLVWD demand during this winter period. The resultant decrease in demand on the groundwater basin should translate into an average next storage increase of a couple hundred acre-feet per year. Replacing all of SVWD's winter groundwater demand with surplus surface water may require modifications to the potable water distribution system. The technical feasibility of delivering this higher quantity of water would have to be evaluated with both SVWD and SLVWD.

- Increases to Summer Baseflow: Reduced groundwater pumping over time would help restore historical groundwater levels. A key benefit is that groundwater discharge to local streams increases as groundwater levels recover. In this case baseflow would be increased to the tributary streams in the San Lorenzo River Watershed, primarily Bean Creek. The increased summertime baseflow in the streams is critical in providing habitat, food, and maintaining temperatures in the range suitable for juvenile trout and salmon.

- Benefits to Multiple IRWM Participants: This project would benefit SCWD by reducing summer time potable water demand by replacing potable water with recycled water for a large irrigation customer. The SCWD would benefit from the long-term recovery of stream baseflow resulting from increased groundwater storage. Additionally, as the groundwater storage increases, SCWD should be able to purchase the banked groundwater during periods of drought. SVWD and SLVWD would benefit from this project by having an alternative winter supply that allows their groundwater storage to recover. Furthermore the construction of a pipeline would also allow SCWD, SVWD and SLVWD to improve their inter-connectivity in case of emergencies. Increased summer baseflow would greatly benefit local fisheries. The environmental benefits to the San Lorenzo River supports the efforts of many agencies and entities that strive to increase the ecological value of the river.

11.4 Issues and Challenges for Implementation

As discussed in TM-2A, TM-2B, and TM-2C, water rights and associated fisheries and ecological issues are likely the greatest challenges for proceeding with this project. However, by including this intertie project for discussion in an IRWM framework, it may be possible to improve understanding amongst concerned stakeholders and thereby reduce the conflicts so that a mutually beneficial project can be defined and supported.

- Interagency and Stakeholder Agreements: Development of working relationships between key agencies would be critical to successful implementation of in-lieu recharge. These would require agreements for SCWD to either sell or trade water to SVWD and SLVWD.
    - The SVWD has been studying the in-lieu potable water delivery concept in conjunction with a recycled water delivery from the Scotts Valley Wastewater Treatment Plant to the Pasatiempo Golf Course, which is in the feasibility planning stage. The delivery of treated surface water during the winter from the Graham Hill WTP to the Scotts Valley area could potentially be balanced, at least in part, by the delivery of recycled water to Pasatiempo Golf Course from Scotts Valley in the summer time which would reduce the summer time potable water demand from the SCWD.
- Water Rights: As discussed in TM-2A, one option is to file a new appropriative water right that is held on Zayante Creek by the SWRCB on behalf of North Santa Cruz County. This new water right would require a change in diversion location, possibly to the existing Felton Diversion. A second option would be a change in place of use from either the SCWD's current water rights to the Scotts Valley area. SLVWD has water rights that may require change in use but also have rights to the Loch Lomond Reservoir that could be treated at the SLVWD's Felton WTP and delivered to Felton. Existing water rights may preclude delivery of SLVWD's Loch Lomond water to Scotts Valley. The SCWD has initiated a water rights conformance process to allow for direct diversion for the SCWD's Loch Lomond Reservoir water right. Another water rights option to consider is whether SCWD and/or SLVWD could store excess wintertime surface water in the SMGB through direct recharge as will be discussed in Preferred Alternative # 3.
- Fishery Impacts: Any changes to water rights would be closely tied to the draft HCP (SCWD, 2010) and draft CRP (NOAA, 2010) for the San Lorenzo River. Since both of these plans are currently being developed, it is not clear what the requirements may be; however, these will clearly need significant consideration during planning and design of this project. The draft HCP is needed to support the SCWD's incidental take permit application for routine activities such as water diversion and sediment removal from impoundments, maintenance of pipeline right of way and flood control. The NOAA Fisheries draft CRP proposed to extend fully appropriated status year round to the San Lorenzo River which could significantly impact a water rights transfer process. The HCP, CRP, and the water rights conformance application are complex regulatory processes that would require negotiation between SCWD, NMFS, US Fish and Wildlife Service (USFWS), CDFG, SWRCB, and as well as other stakeholders in the watershed. This negotiation may be well suited to the IRWMP process currently underway in Santa Cruz County. It should be stressed that during the negotiations the baseflow cannot be restored in the San Lorenzo River Watershed without first restoring groundwater storage

in the overdrafted aquifers within the watershed. The specific studies and technical analysis necessary to better analyze fisheries impacts and benefits are described in TM-2C.

- Pipeline alignment: Developing a pipeline alignment to convey the water from Graham Hill WTP to SVWD and SLVWD would require 1 to 2 miles of pipeline. Obtaining a right of way would require negotiation with multiple agencies and property owners. Construction of a pipeline would likely interrupt traffic flow.
- CEQA Review: The CEQA environmental document process would require consideration of a wide range of issues ranging from water usage, fisheries, to construction issues. Entities such as the Regional Water Quality Control Board, CDFG, NOAA Fisheries, and non-governmental organizations are likely to be actively involved.

11.5 Conceptual Implementation Plan

11.5.1 Summary of Activities

The following Feasibility Study tasks and data needs should be implemented. There are several steps that can be taken to further this project as follows:

1. Develop Water Rights Strategy (within IRWM framework) – This would involve discussions between Santa Cruz County, SVWD, SLVWD, SCWD, and SWRCB, as well as the resources agencies such as NMFS, USFWS, and CDFG to discuss the impediments and resolution to exercising the following potential water rights options:
   a. SCWD water rights conformance (in process) with draft HCP and draft CRP
   b. SCWD water storage in the SMGB
   c. SCWD – transfer of place of use of existing water rights or exchange arrangement
   d. SLVWD – water storage in the SMGB or exchange within SLVWD's service area using existing SLVWD Loch Lomond Water Rights
   e. Santa Cruz County/SVWD/SLVWD – apply for water rights set aside on Zayante Creek for North Santa Cruz County
2. Field data collection on existing summer baseflow in San Lorenzo River and key tributaries (Bean Creek and Lower Zayante Creek)
3. Update the groundwater model with field data collection to develop estimate of range of summer base flows based on range of in-lieu recharge assumptions.
4. Evaluate fisheries impacts/benefits with new data.
5. Engineering Pre-Design for pipeline, pump station, and possible water quality improvements for a range of potential deliveries.
6. Engineering Design and Construction for pipelines, a pump station, and possible water quality improvements.
7. Develop and complete institutional arrangements for project implementation

11.5.2 Estimated Funding Needs for Implementation

The Feasibility Study tasks could be implemented as a facilitated process within the Santa Cruz County IRWM update or as an effort parallel to the IRWM update. It is expected to take several years (assumed two years) and require commitment of staff as well as consultant (legal, technical, etc.) resources to examine the technical issues associated with arriving at a mutually beneficial water rights solution. Items 2, 3, 4, 5, and 6 can be performed as stand-alone planning/technical study efforts.

11.5.3 Estimated Schedule for Implementation

- Items1, 2, 3, and 4 can be conducted in parallel. However Item 1 is likely to take much longer than Items 2, 3, and 4.
- It is recommended that Item 5 not be undertaken until there is a clear path to resolution on Item 1.

11.5.4 Complementary Activities

During the preparation of this analysis, it was identified that other alternatives could be integrated into a preferred alternative to enhance the improvements to the SMGB. Some of the other alternatives that could complement Alternative #2 and the benefits of integration are summarized below. It should be noted that in-lieu recharge is limited by the quantity of groundwater pumping that SVWD and SLVWD use during the wintertime.

- Alternative #4 – Surface Water from the Felton Diversion for In-lieu Recharge: This concept increases the potential for in-lieu recharge in the SMGB by implementing an additional project.

- Alternative #8 – Loch Lomond for In-lieu Recharge: Additional in-lieu recharge can be achieved by further decreasing pumping in the SMGB by SLVWD assuming that the surface water can be delivered to the portions of SLVWD that are currently using SMGB groundwater.

11.6 IRWMP Linkages

It is likely that further funding would be solicited from the IRWMP Grant program. The following components from the checklist of IRWMP Program Preferences are applicable to Preferred Alternative #2.

- Include Regional Projects/Programs
- Integrate Water Management Within Hydrologic Region
- Effectively Resolve Significant Water-related Conflicts Within or Between Regions
- Effectively Integrate Water Management with Land use Planning
- Drought Preparedness
- Use and Reuse Water more Efficiently
- Climate Change Response Actions
- Expand Environmental Stewardship
- Protect Surface Water and Groundwater Quality
- Ensure Equitable Distribution of Benefits

The following components from the checklist of IRWMP Program Preferences are not applicable to Preferred Alternative #2.

- Contribute to Attainment of One or More Objectives to Cal Fed
- Address Critical Water Supply/Quality Needs of DAC
- For Flood Management - Projects That Provide Multiple Benefits
- Practice Integrated Flood Management
- Improve Tribal Water and Natural Resources

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Section 12: Preferred Alternative #3 – Surface Water from Felton Diversion for Aquifer Recharge in Hanson Quarry Area

This section provides a more detailed project description and conceptual implementation plan for Preferred Alternative #3 that consists of aquifer recharge in the South Scotts Valley area utilizing the 270-acre Hanson Quarry site.

12.1 Project Concept Summary

The primary concept of this project is to recharge the overdrafted SMGB in the South Scotts Valley area with high wintertime flows from the San Lorenzo River watershed. Surface water would only be diverted during high winter flow periods (per recommendations of TM-2B) and at times that would have the least impact on fisheries (per TM-2C). Recharge water may be raw or treated and would be diverted from the existing Felton or Tait Street facilities owned and operated by the City SCWD (per TM-3). Depending on project design, additional water diversion rights may need to be applied for (per TM-2A).

The Hanson Quarry and South Scotts Valley area are located in a hydrologically favorable area for groundwater recharge (per TM-1B) in the eastern portion of the San Lorenzo River watershed. Beach Creek, a tributary to the San Lorenzo River, is located north from Hanson Quarry and northwest from Scotts Valley as shown on Figure 12-1. Diverted winter flow would be piped to the Hanson Quarry where it can be temporarily stored then distributed for recharge via surface recharge ponds, subsurface lateral spreading fields, or deep aquifer injection wells (per TM 3).

The benefits of this type of project include the restoration of groundwater levels in the SMGB, improvement of groundwater quality, and over time, an increase in local stream baseflow. The ecological benefit of higher groundwater discharge during the summer months is that it helps to maintain temperatures in the range suitable for juvenile trout and salmon and supports riparian vegetation.

While this project could be completed as a stand-alone water resource project, it would provide more benefits if it were to be implemented in conjunction with an in-lieu recharge project (Preferred Alternative #2) that utilizes much of the same water infrastructure.

12.2 Detailed Project Description

Analysis of the San Lorenzo River hydrograph suggests that in most years there is more than adequate flow to meet environmental needs as well as supply demands by local water purveyors. Preferred Alternative #3 proposes to divert a portion of the high wintertime flows from the San Lorenzo River and deliver this water to the Hanson Quarry. The water could be temporary stored in the large southern pond at the quarry and used to recharge the Santa Margarita Groundwater Basin in the South Scotts Valley area. The Hanson Quarry and the South Scotts Valley area, in addition to their close proximity to the existing water supply infrastructure, have the geological advantage of having more hydrologically direct access to both the Santa Margarita and Lompico. Additionally, the Hanson Quarry property is currently up for sale and therefore potentially available for this type of project.

There are two potential options to get water from existing water supply infrastructure to the Hanson Quarry site.

- Water from the SCWD Felton Diversion could be conveyed directly to the Hanson Quarry and treated onsite. Hanson Quarry has an existing pond in the southern portion of the quarry that is undergoing reclamation. The raw water would likely require sediment settling basins in the northern part of the quarry prior to temporary storage in the larger southern pond. The treated water then can be recharged directly through the base of the southern pond or piped to other recharge facilities in the South Scotts Valley area.
- Water could be treated elsewhere using an existing treatment facility and then conveyed to the Hanson Quarry. A potential treatment facility options may include either the SCWD Graham Hill WTP using existing treatment capacity or from SLVWD's Felton WTP, if capacity is available.

12.2.1 Infrastructure Requirements

The primary elements of this project are obtaining the water, treatment of the water prior to recharge, conveying the water between these components and, application method for aquifer recharge. Below is a brief outline of the potential infrastructure requirements.

a. <u>Surface Water Diversion Structure:</u> The surface water diversion from the San Lorenzo River could use the existing infrastructure at the SCWD Felton Diversion structure. The SCWD Tait Street diversion can pump raw water to Graham Hill WTP, and with modification, may be able to pump water from Tait Street to Hanson Quarry via the Graham Hill WTP and the Felton Booster Pump Station. These facilities would need to be evaluated for feasibility and whether any modifications would be required.

b. <u>Conveyance:</u> Water from the Felton and/or Tait Street diversions would require new infrastructure (pipelines and pump stations) to deliver the water to the Hanson Quarry. There are four potential options to deliver water from the diversions to the Hanson Quarry site.

   Pipeline Considerations

   i) Option 1 is to deliver raw water directly from the Felton Diversion to the Hanson Quarry Site. This option would require construction of a new pipeline from the Felton Diversion to the Hanson Quarry Site as shown on Figure 12-1.

      (1). An 8-inch diameter pipeline would convey about 600 gpm (1.3 cfs) which would result in about 300 AFY over a 4 month pumping period. Pumping of 600 gpm up to N. Hanson Quarry is estimated to require 80 horse power (hp) of pumping capacity.

   ii) Option 2 is to deliver raw water from the Felton and/or Tait Diversions to the SCWD Graham Hill WTP for treatment. The treated surface water would be delivered through new and existing pipelines from Graham Hill WTP to Hanson Quarry. This option could also be combined with Preferred Alternative #2.

      (1). Water delivery from Felton Diversion to Graham Hill WTP would use an existing 24-inch raw water pipeline that becomes a 20 inches raw water pipeline on

Graham Hill Road. The raw water pipeline goes north and south on Graham Hill Road towards the SCWD Felton Booster Pump Station (Figure 12-1)

(2). As discussed in Preferred Alternative #2, an intertie between the SCWD pipeline at Sims Road and the SVWD pipeline at Silverwood Road would require approximately 7200 feet of pipeline. Once this intertie is established, it would be possible to deliver treated water to the Hanson Quarry through a new treated water pipeline from the SVWD pipeline at Lockwood Lane and Mt. Hermon Road to the North Hanson Quarry as shown on Figure 12-1.

iii) Option 3 is to divert water from the Felton Diversion, treat it at an upgraded Felton WTP, and then pipe it to the Hanson Quarry using a pipeline similar in alignment to that shown on Figure 12-1.

(1). The Felton WTP would require an upgrade to handle the higher winter input.

(2). A single pipeline that could deliver either raw water or treated water would require operational guidelines if it is a multi-use pipeline.

iv) Option 4 is to divert water directly from the Tait Street facilities, treat the water at the Graham Hill WTP, then pump the water to the quarry.

(1). New water rights or modifications to existing water rights would be required to divert additional water from the Tait Street facilities.

(2). This option would require the raw water pipeline from Loch Lomond/Felton Diversion to Graham Hill WTP to be operated in reverse and to convey treated water. Operational guidelines for multi-use pipeline as well as evaluation of pumping capacity at Graham Hill WTP will also be required.

Pump Station Considerations

i) There are three pumps at the Felton Diversion pump station. In addition, there are six pumps at the SCWD Booster Pump Station that are configured to provide operational flexibility.

ii) It is possible that the SCWD Booster Pump Station could be reconfigured to be used to pump raw water to Hanson Quarry from the Felton Diversion. If this option is pursued further, additional analysis of the pumping at the Felton Diversion and at the SCWD booster pump station would be required.

c Hanson Quarry Current Site Operations: Since the sand mining operations ceased in 2004, the 270 acre site is undergoing reclamation. The reclamation primarily consists of grading of the quarry floor to reduce slope steepness, providing better planting surfaces and proper drainage control to reduce erosion, and widely distributing runoff amongst multiple ponds and drainage systems.

i. The Santa Cruz County Planning Department 2010 staff report to the Planning Commission (Santa Cruz County, 2010) indicates that the southern portion of the site includes a large retention pond with low water levels. The southern pond is managed to keep water levels below the steeper fill slopes (2:1 slopes) at about elevation of 556.8 feet on the southern margins of the pond. The staff report also notes that infiltration of water is minimal because of the silts and clay soils that are accumulating in the basin bottom.

ii. The 2010 staff report indicated that the BMP to maintain water levels in the southern pond as identified in the reclamation plan was modified to include a siphon system to remove water from the southern retention basin to Willow Pond to the north; a siphon would minimize long-term maintenance. Although there were no figures in the staff report to identify these ponds.

iii. The Conditions of Approval (Santa Cruz County, 2010) required that the quarry operator retain a local engineering contractor to monitor and maintain the site, in particular the ponds, during the wet season. The contractor's activities include monitoring water levels, pumping water when necessary, and grading to improve pond performance. The program will continue until 2030

d Aquifer Recharge Facility: Aquifer recharge could occur at the Hanson Quarry or in suitable areas in the SSV areas using one or more methods including surface recharge ponds, subsurface lateral spreading fields, or deep aquifer injection wells. Additional supporting infrastructure may also be necessary depending on the location and type of recharge. Subsurface lateral spreading fields and deep aquifer injection wells are likely best suited to the South Scotts Valley area.

i) Additional water treatment would be necessary for the option where water is delivered directly from the Felton Diversion. This is anticipated to require a siltation pond for the settlement of sediment. Use of water provided by one of the water treatment plants (Graham Hill WTP or Felton WTP) would likely require little to no additional water treatment since the water was already treated at the plant. Additional study is necessary to evaluate whether disinfection byproducts or other water quality interferences would be an issue.

ii) Depending on which aquifer recharge methodology is used, additional water treatment may be necessary. This would have to be determined based on additional engineering analysis.

(1). The use of surface recharge ponds or subsurface lateral spreading fields is anticipated to require less treatment because of the natural filtering from the percolation of the recharge water through the vadose zone will provide a water quality benefit.

(2). Use of injection wells would require a higher level of water quality treatment because the water would be placed directly into the aquifer. There are additional regulatory requirements for use of injection wells for aquifer recharge to maintain water quality.

iii) Installation of the aquifer recharge facility would depend on the final selection of method. Here is a brief summary of potential methods

(1). Surface recharge ponds consist of a series of four to six shallow ponds situated above the groundwater level and enclosed by dikes or levees.

(a) Ponds are filled intermittently, followed by periods of drying and recycled water is delivered to the groundwater by using the saturated and unsaturated zones. Rotating the ponds with regular resting periods is good practice to maintain long-term sustainable percolation rates.

Regular operation is for two ponds to receive discharge for 10 days, followed by a 20-day resting period.

(b) Recharge ponds are the most efficient method to operate and maintain. However, recharge ponds require substantial space that must be dedicated to the recharge operations. They also have a higher visual impact than the other methods.

(c) General size requirement for the recharge pond facility would likely be about 10 to 40 acres of area depending on the design capacity of the recharge ponds. Berms are constructed between ponds to provide separation and access for maintenance vehicles. Berm design assumptions include a height of 5.75 feet, a base width of 35 feet, a top width of 12 feet, and a side slope of 2:1.

(2). Subsurface lateral spreading fields utilize a system of perforated pipes installed in a series of shallow trenches backfilled with highly permeable material to disperse the discharge flow. The pipes and trenches are situated above the water table.

(a) Subsurface lateral spreading fields would minimize the visual impact. The facility could be interspersed among existing land use but the overlying land needs restrictions so that future land use would not interfere with operations. The ground surface can be left in its original state or landscaped.

(b) This concept could also be expanded to include vertical diffusion wells that would allow recharge through the lower permeability backfill material.

(3). The injection well option consists of a series of wells drilled into a suitably transmissive zone in the underlying groundwater flow system. Discharge water is pumped under low pressures into these wells and allowed to flow into the aquifer.

(a) The advantage of injection wells is that they would likely require the least land area and the facility could be interspersed among existing land use, and they would minimize the visual impact of recharge facilities. The ground surface between the wells can be left in its original state or landscaped.

(b) The number of injection wells would depend on the design capacity. To apply 1,000 acre-feet of water over a 6 month period is anticipated to require seven wells. As with recharge ponds, additional wells would be necessary to allow for some wells to rest while others are being used for recharge. Final number and design of the wells would be based on future engineering evaluation.

(4). Significant regrading may be required as part of the construction of the aquifer recharge facilities and supporting infrastructure.

(5). Limited water storage capacity is anticipated for the project, but this could be added based on future engineering evaluations. Storage may consist of additional ponds or tanks that could store water and help manage the aquifer recharge operations.

12.2.2 Other Requirements

One of the major constraints to implement this project concept is water rights. This would require either an application for a new water right on the San Lorenzo River or one of its tributaries, or modification of an existing water right.

Any changes to water rights would be closely tied to SCWD's draft anadromous fish HCP (SCWD, 2010) in compliance with the Endangered Species Act and NOAA's NMFS draft CRP (NOAA, 2010) for the San Lorenzo River that are both in process.

12.2.3 Estimated Costs

The estimated costs to implement this alternative are itemized as follows.

a. Capital Costs

- i) Raw Water Delivery
    - (1) One mile of 8-inch diameter pipeline is estimated to cost about $1.0 million for capital costs.
    - (2) One 80 hp new pump station is approximately $500,000 for capital costs. A new pump station may not be required if the existing SCWD Booster Pump Station can be reconfigured to pump to North Hanson Quarry.
- ii) Treated Water Delivery
    - (1) 0.5 miles of 8 inch diameter pipeline is estimated to cost about $500,000 for capital costs.
    - (2) One 30 hp pump station is approximately $380,000 for capital costs. A new pump station may not be required if there is sufficient system pressure in the existing SVWD distribution system.
- iii) Injection Wells
    - (1) An individual injection well is assumed to be approximately 700 feet deep with a 12-inch diameter casing that is screened across approximately 350 feet of the Lompico. Each well is estimated to cost about $350,000 assuming that a total of seven wells would be drilled. If fewer wells are drilled, the unit cost per well would likely increase.
    - (2) Injection facilities, if necessary, are expected to be low lift pump stations. This is because there is approximately 250 feet from ground surface to the existing water table and that the water table during recharge is assumed to be 50 feet from ground surface, aquifer recharge would occur through 200 feet of gravity head. A low lift pump station may be required to pump water to the top of the well casing around the quarry site and is estimated to cost approximately $100,000. If treated water delivery is at sufficient head, this low lift pump station may not be required.

b. O&M Costs

- i) Raw water pumping is estimated to cost approximately $37,000 per year for power costs for 120 days per year and maintenance.

ii) Treated water pumping is estimated to cost approximately $15,000 per year for power costs for 120 days per year and maintenance.

iii) Aquifer Injection Wells are not expected to incur any significant additional energy costs over the cost of water pumping accounted for above because recharge is assumed to occur through the head of the water column above the perforated zone.

12.3 Potential Benefits of Implementation

Depending on the method of aquifer recharge, water supply benefits are expected to be in the restoration of long-term storage in the Lompico and Butano and/or shorter term storage in the Santa Margarita which will have a more immediate impact on the Bean Creek baseflow. Additional groundwater modeling can improve the understanding of optimal locations depending on whether the focus of the project is on long-term or shorter term storage or both. The water supply benefits that are expected to result from this project are described in greater detail below.

- Increased Groundwater Storage: Aquifer recharge facilities in the area of the Hanson Quarry would be sited where the Santa Margarita directly overlies the Lompico. As discussed in TMs 1A and 1C, siting of facilities in these locations is preferred because direct recharge to the Santa Margarita would likely result in short travel times and discharge to Bean Creek even though there is a large volume of empty storage in the Santa Margarita. Storage of recharge water to the Lompico is preferred because there is deep groundwater storage capacity in the Lompico. The initial recharge from the Hanson Quarry operations would go to groundwater storage. The groundwater model scenarios documented in TM-1C indicate that injection wells are a more efficient method for increasing groundwater storage than recharge ponds or subsurface lateral spreading fields. However, additional field studies are necessary to verify this. Additional engineering evaluations may help improve the recharge to groundwater storage.
- Increases to Summer Baseflow: Baseflows in the watershed have diminished due to an over-reliance on groundwater resources. As groundwater levels drop, less groundwater is available to drain from the aquifers to the proximal streams. Over time, aquifer recharge operations would result in higher groundwater levels that would lead to increased natural outflows from the Santa Margarita. The key baseflow benefit would be increased groundwater discharge in the summer months that would increase summertime baseflow in the streams and also help maintain temperatures in the range suitable for juvenile trout and salmon.
- Benefits to Multiple IRWM Participants: The groundwater storage increases that result in increasing summer baseflow and the resulting fisheries and environmental benefits to the San Lorenzo River supports the efforts of many agencies and entities that strive to increase the ecological value of the San Lorenzo River. In addition, groundwater in storage also provides a water supply that could be accessed by the participating agencies during a drought and/or to manage the impacts of climate change on the surface water supply. The greatest problem facing water resource management in this region could be categorized as the lack of water storage. In the majority of years, there is more than enough rainfall in the San Lorenzo River Watershed to meet the needs of the environment and water users. However, the timing of water needs versus available supply makes sustainable management difficult without adequate storage capabilities.

This type of project would provide needed storage capability for both surface and groundwater users.

12.4 Issues and Challenges for Implementation

Water rights and associated fisheries and ecological issues are likely the greatest challenges for proceeding with this project. However, by including this intertie project for discussion in an IRWM framework, it may be possible to improve understanding amongst concerned stakeholders and thereby reduce the conflicts so that a mutually beneficial project can be defined and supported.

- Hanson Quarry Access: Another key issue is obtaining access to the Hanson Quarry site. Hanson Aggregates-Mid Pacific, a division of Lehigh Hanson, submitted an updated Basin Management Plan to the Santa Cruz County Planning Department in early 2010 to satisfy the requirements of the Conditions of Approval for closure of the quarry. The staff report (Santa Cruz County, 2010) indicates that County Mining Regulations require mined lands be reclaimed to a usable condition which is readily adaptable for alternative land uses. The Reclamation Plan indicates that the end use of the quarry site is open space. Changes to this end use would require an amendment to the Reclamation Plan, environmental review under the California Environmental Quality Act and the County's Environmental Review Guidelines.

- Interagency and Stakeholder Agreements: Development of working relationships between key agencies would be critical to successful implementation of an in-lieu recharge project. These would require agreements for SCWD to either sell or trade water to SVWD and SLVWD.

- Water Rights: One option is to file a new appropriative water right that is held on Zayante Creek by the SWRCB on behalf of North Santa Cruz County. This new water right would require a change in diversion location, possibly to the existing Felton Diversion. A second option would be a change in place of use from either the SLVWD or SCWD's current water rights to the Scotts Valley area. The SCWD has initiated a water rights conformance process to allow for direct diversion for the SCWD's Loch Lomond Reservoir water right. Another water rights option to consider is whether SCWD and/or SLVWD could store excess wintertime surface water in the SMGB through direct recharge.

- Fishery Impacts: Any changes to water rights would be closely tied to the draft HCP (SCWD, 2010) and draft CRP (NOAA, 2010) for the San Lorenzo River. Since both of these plans are currently being developed, it is not clear what the requirements may be; however, these will clearly need significant consideration during planning and design of this project. The draft HCP is needed to support the SCWD's incidental take permit application for routine activities such as water diversion and sediment removal from impoundments, maintenance of pipeline right of way and flood control. The NMFS draft CRP proposed to extend fully appropriated status year round to the San Lorenzo River which could significantly impact a water rights transfer process. The HCP, CRP, and the water rights conformance application are complex regulatory processes that will require negotiation between SCWD, NMFS, USFWS, CDFG, SWRCB, and other stakeholders in the watershed. This negotiation may be well suited to the IRWMP process currently underway in Santa Cruz County.

- Pipeline Alignment: Developing a pipeline alignment to convey the water from Graham Hill WTP to SVWD and SLVWD would require 1 to 2 miles of pipeline. Obtaining a right of way will require negotiation with multiple agencies and property owners. Construction of a pipeline would likely interrupt traffic flow.
- Environmental Impact Report (EIR): The EIR process would require consideration of a wide range of issues ranging from water usage, fisheries, to construction issues. Entities such as the Regional Water Quality Control Board, CDFG, NOAA Fisheries, and non-governmental organizations are likely to be actively involved.
- Endangered Species: Long-term improvements are constrained by the sensitive habitat, Santa Cruz Sandhills that is home for federally listed species. In addition, the stability of the fill slope in the quarry area may limit the fill level of quarry ponds. Based on the recent Santa Cruz County Planning Department staff report (Santa Cruz County, 2010), future use of the quarry for groundwater recharge would be constrained by the presence of endangered species, steep slopes and ongoing revegetation activities.

12.5 Conceptual Implementation Plan

12.5.1 Summary of Activities

In coordination with Project 2, the following Feasibility Study Tasks (e.g. data needs) should be implemented– There are several next steps that can be taken to further this project as follows:

1. Develop Water Rights strategy within IRWM framework – This would involve discussions between Santa Cruz County, SVWD, SLVWD, SCWD, and SWRCB, as well as the resources agencies such as NMFS, USFWS, and DFG to discuss the impediments and resolution to exercising the following potential water rights options:
    a. SCWD water rights conformance (in process) with draft HCP and draft CRP
    b. SCWD water storage in the SMGB
    c. SCWD – transfer of place of use of existing water rights or exchange arrangement
    d. SLVWD – water storage in the Santa Margarita GW Basin or exchange within SLVWD's service area
    e. Santa Cruz County/SVWD/SLVWD – apply for water rights set aside on Zayante Creek for N. Santa Cruz County
2. Field data collection on existing summer baseflow in San Lorenzo River and key tributaries (Bean Creek and Lower Zayante Creek)
3. Update the groundwater model with field data collection to develop estimate of range of summer base flows based on range of in-lieu recharge assumptions
4. Engineering Pre-Design for pipeline, pump station, and quarry improvements for a range of potential deliveries
5. Raw Water requires evaluation of SCWD pumping facilities and operations
6. Treated water requires evaluation of SVWD's storage and transmission/distribution facilities

a. Obtain and review Hanson Quarry Grading Plans to evaluate feasibility of surface recharge and/or identify location of aquifer injection facilities

b. Identify other potential aquifer injection facility locations

7. Engineering design and construction for pipelines, pump stations (if needed); wells, and/or grading/recharge pond plans.

8. Develop and complete institutional arrangements for project implementation

12.5.2 Estimated Funding Needs for Implementation

- The Feasibility Study tasks described above could be implemented as a facilitated process within the Santa Cruz County IRWM update or as an effort parallel to the IRWM update. It is expected to take several years (assumed 2 years) and require commitment of staff as well as consultant (legal, technical, etc.) resources to examine the technical issues associated with arriving at a mutually beneficial water rights solution.
- Items 2, 3, and 4 can be performed as stand-alone planning/technical study efforts.

12.5.3 Estimated Schedule for Implementation

- Items1, 2, and 3 can be conducted in parallel. However Item 1 is likely to take much longer than Items 2 and 3.
- It is recommended that Item 4 not be undertaken until there is a clear path to resolution on Item 1.

12.5.4 Complementary Activities

During the preparation of this analysis, it was identified that other alternatives could be integrated into a preferred alternative to enhance the improvements to the SMGB. Some of the other alternatives that could complement Alternative #3 and the benefits of integration are summarized below.

- Alternative #4 – Surface Water from the Felton Diversion for In-lieu Recharge: This concept increases the potential for in-lieu recharge in the SMGB by implementing an additional project. In-lieu recharge is limited by the quantity of groundwater pumping that SVWD and SLVWD use during the wintertime.

- Alternative #7 – Zayante Creek for Aquifer Recharge in Hanson Quarry: If recharge capacity is at Hanson Quarry exceeds the available supplies from Felton Diversion or SCWD, or if those supplies are not available, water from Zayante Creek could be diverted for recharge in Hanson Quarry.

- Alternative #9 – Bean Creek for Aquifer Recharge in Hanson Quarry: Similar to Alternative #7, if recharge capacity is at Hanson Quarry exceeds the available supplies from Felton Diversion or SCWD, or if those supplies are not available, water from Bean Creek could be diverted for recharge in Hanson Quarry.
- Alternative #10 – San Lorenzo River Water for Aquifer Recharge in Hanson Quarry: Similar to Alternative #7 and #9, if recharge capacity is at Hanson Quarry exceeds the

available supplies from Felton Diversion or SCWD, or if those supplies are not available, water from a new diversion on the San Lorenzo River could be diverted for recharge in Hanson Quarry.

12.6 IRWMP Linkage

It is likely that further funding will be solicited from the IRWMP Grant program. The following components from the checklist of IRWMP Program Preferences are applicable to Alternative #3.

- Include Regional Projects/Programs
- Integrate Water Management Within Hydrologic Region
- Effectively Resolve Significant Water-Related Conflicts Within Or Between Regions
- Effectively Integrate Water Management With Land Use Planning
- Drought Preparedness
- Use and Reuse Water more Efficiently
- Climate Change Response Actions
- Expand Environmental Stewardship
- Protect Surface Water and Groundwater Quality
- Ensure Equitable Distribution of Benefits

The following components from the checklist of IRWMP Program Preferences are not applicable to Alternative #3.

- Contribute To Attainment Or One Or More Objectives To Cal Fed
- Address Critical Water Supply/Quality Needs Of DAC
- For Flood Management - projects that provide multiple benefits
- Practice Integrated Flood Management
- Improve Tribal Water and Natural Resources

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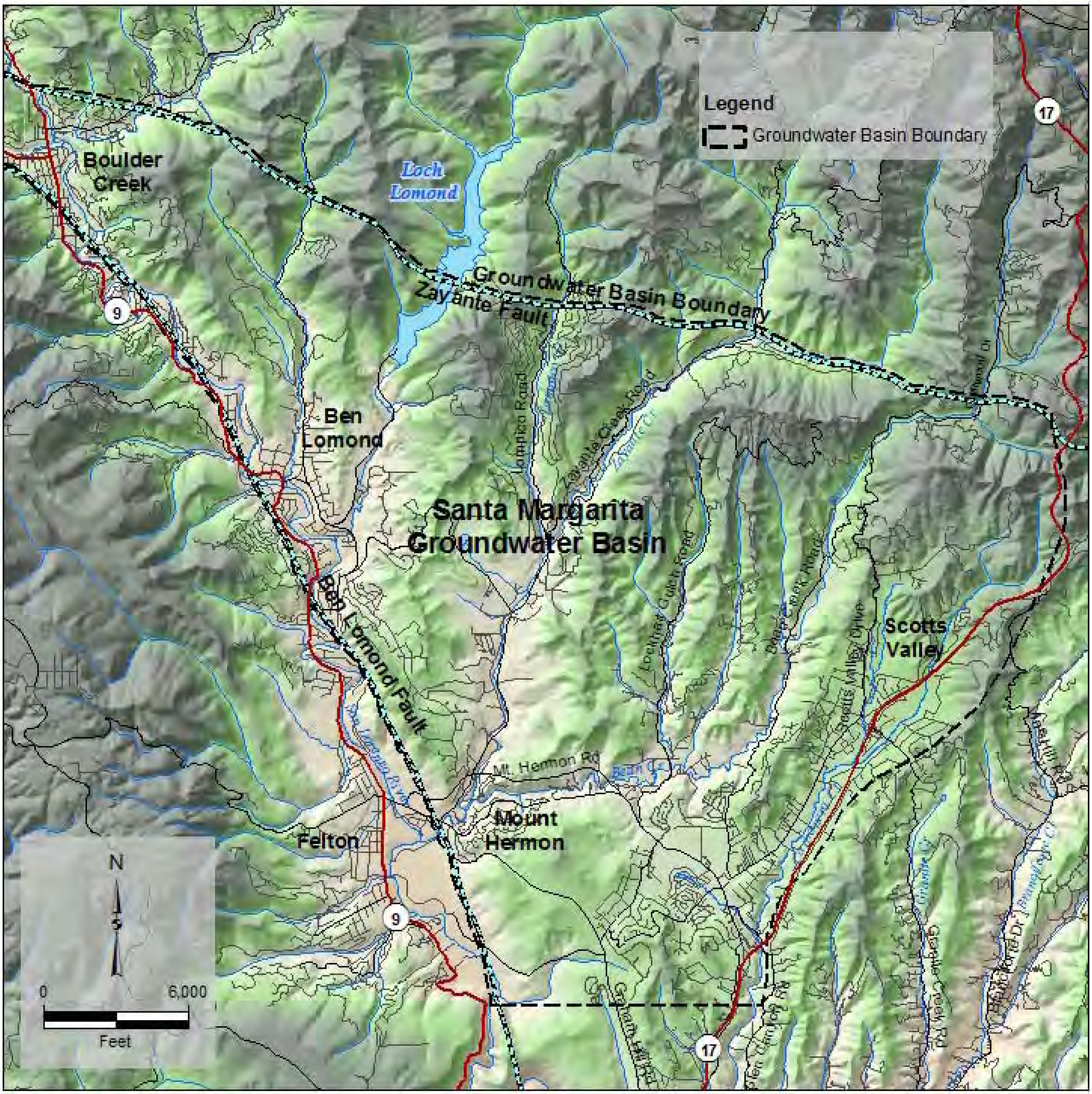
Figures



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Santa Cruz County, California

Santa Margarita Groundwater Basin

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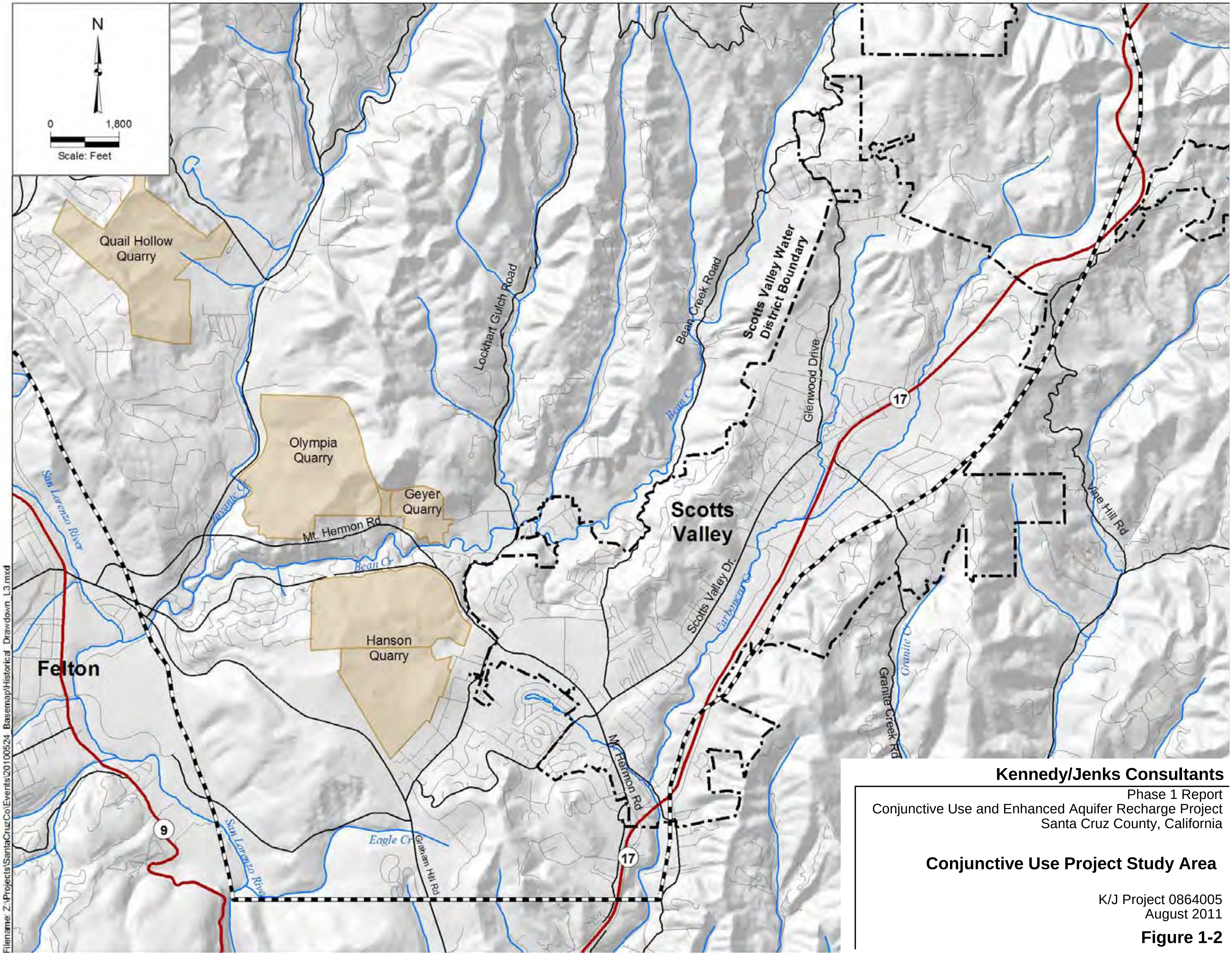
Figure 1-1



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Conjunctive Use Project Study Area

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Figure 1-2

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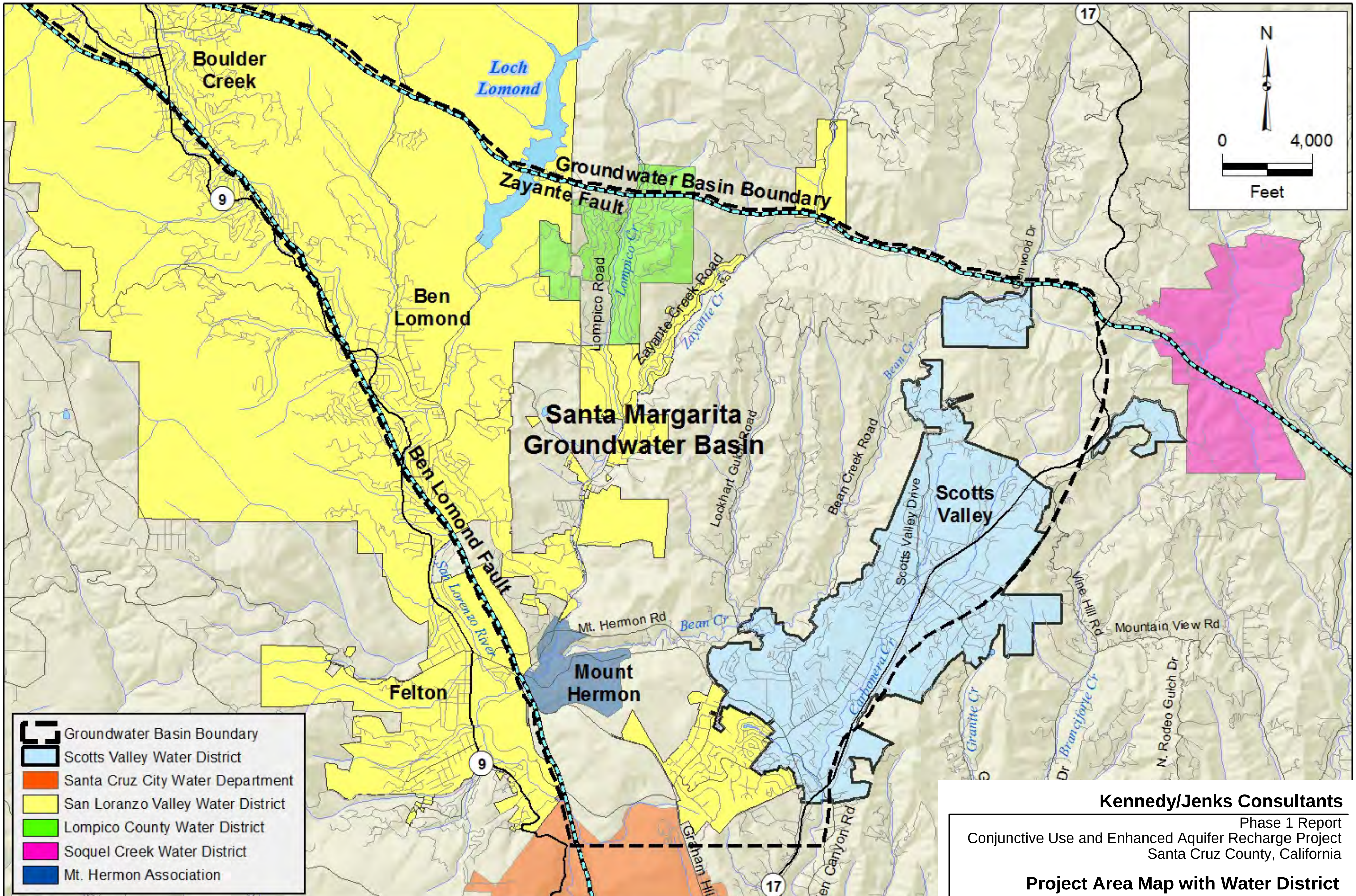

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Santa Cruz County, California

Project Area Map with Water District Boundaries

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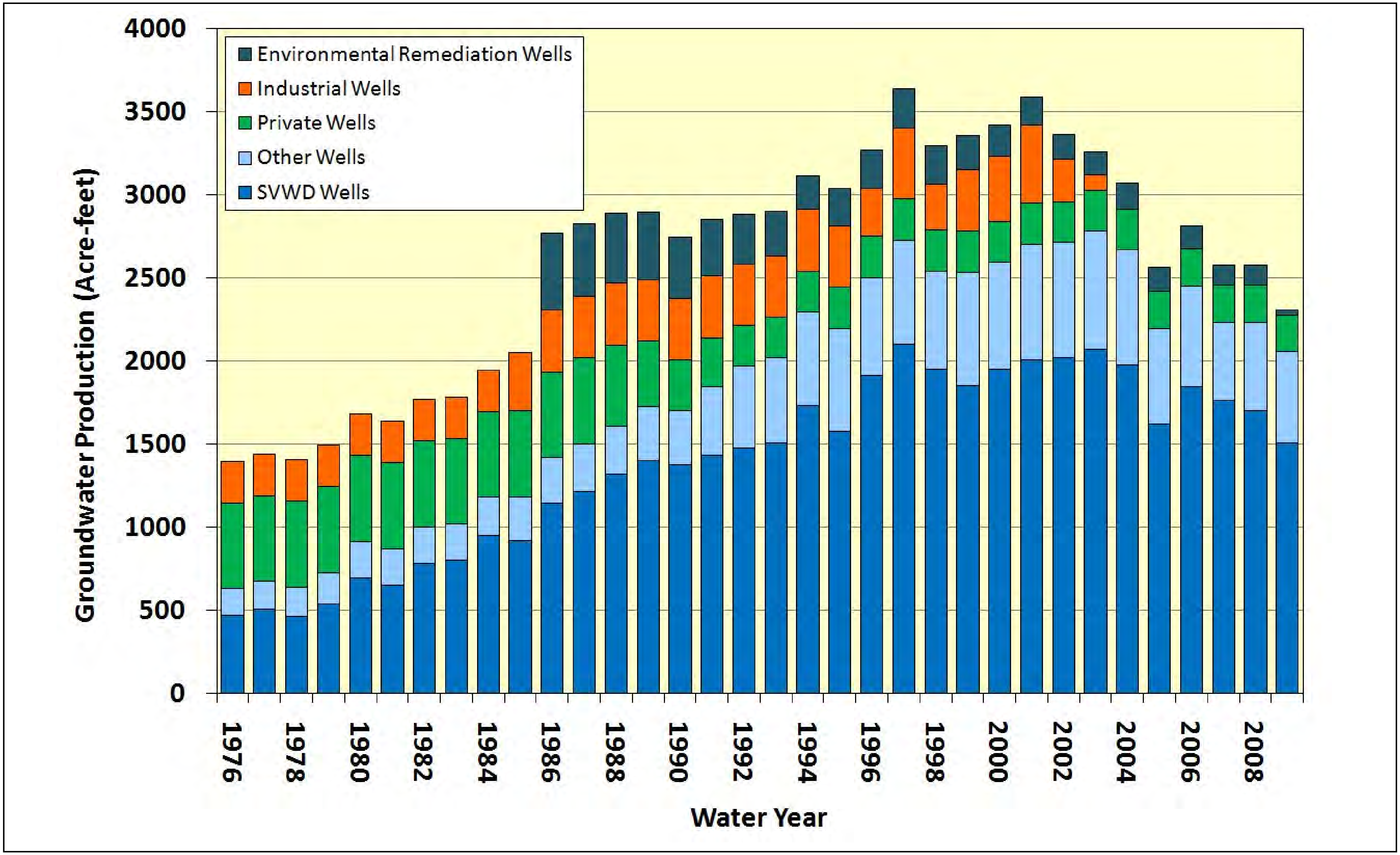
Figure 2-1



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Conjunctive Use and Enhanced Aquifer Recharge Project
Santa Cruz County, California

Annual Groundwater Production in the Scotts Valley Area by User Type

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Figure 2-2

ERA	PERIOD	SERIES	FORMATION	LITHOLOGY	THICKNESS (feet)	DESCRIPTION
CENOZOIC	QUARTERNARY	PLEISTOCENE-HOLOCENE	Terrace Alluvium		<50	Terrace deposits are weakly consolidated, poorly sorted sandy gravel to medium sands. Alluvium consists of unconsolidated, moderately sorted silt, sand and gravel along respective streams
CENOZOIC	QUARTERNARY / TERTIARY	PLEISTOCENE-HOLOCENE / PLIOCENE	Purisma Formation		500+	Very thick bedded yellowish-gray tuffaceous and diatomaceous siltstone with thick interbeds of bluish-gray semifriable andesitic sandstone
			Unconformity			
CENOZOIC	TERTIARY	MIOCENE	Santa Cruz Mudstone		0-200	Medium- to thick-bedded and faintly laminated pale yellowish-brown siliceous mudstone with scattered speroidal dolomite concretions; locally grades to sandy siltstone
CENOZOIC	TERTIARY	MIOCENE	Santa Margarita Sandstone		0-450	Very thick bedded and thickly crossbedded yellowish-gray to white friable arkosic sandstone
			Unconformity			
CENOZOIC	TERTIARY	MIOCENE	Monterey Formation		0-2,000	Medium- to thick-bedded and laminated olive-gray subsiliceous organic mudstone and sandy siltstone with few thick dolomite interbeds
CENOZOIC	TERTIARY	MIOCENE	Lompico Sandstone		200-300	Thick-bedded to massive yellowish-gray arkosic sandstone
			Unconformity			
CENOZOIC	TERTIARY	EOCENE	Butano Sandstone: Upper Sandstone Member		3,000	Thin- to very thick-bedded medium gray arkosic sandstone with thin interbeds of medium-gray siltstone
CENOZOIC	TERTIARY	EOCENE	Butano Sandstone: Middle Sandstone Mem.		250-750	Thin- to medium-bedded nodular olive-gray pyritic siltstone
CENOZOIC	TERTIARY	EOCENE	Butano Sandstone: Lower Sandstone Member		1,500	Very thick bedded to massive yellowish-gray arkosic sandstone with thick to very thick interbeds of sandy pebble conglomerate in lower part
			Unconformity			
			Not in contact within area			
CENOZOIC	TERTIARY	PALEOCENE	Locatelli Formation		800	Nodular olive-gray to pale-yellowish-brown micaceous siltstone; massive arkosic sandstone locally at base
			Non-conformable on crystalline complex of Ben Lomond Mountain			
MESOZOIC	CRETACEOUS		Crystalline Basement			Primary quartz diorite, light gray, medium gravel, plagioclase, and quartz with lesser amounts of feldspar, biotite, and hornblende

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Stratigraphic Column for the Santa Margarita Groundwater Basin

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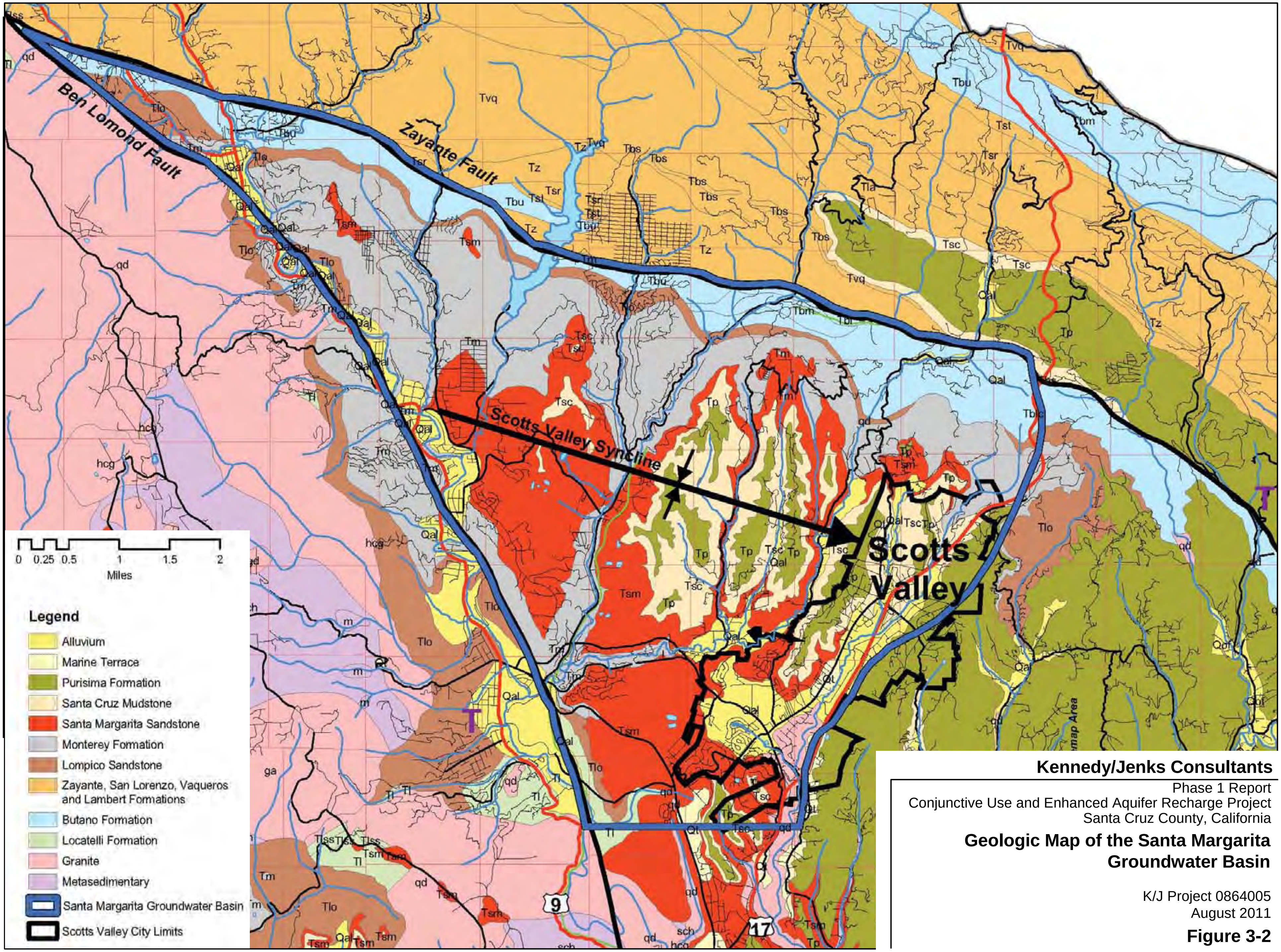
Figure 3-1



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Geologic Map of the Santa Margarita Groundwater Basin

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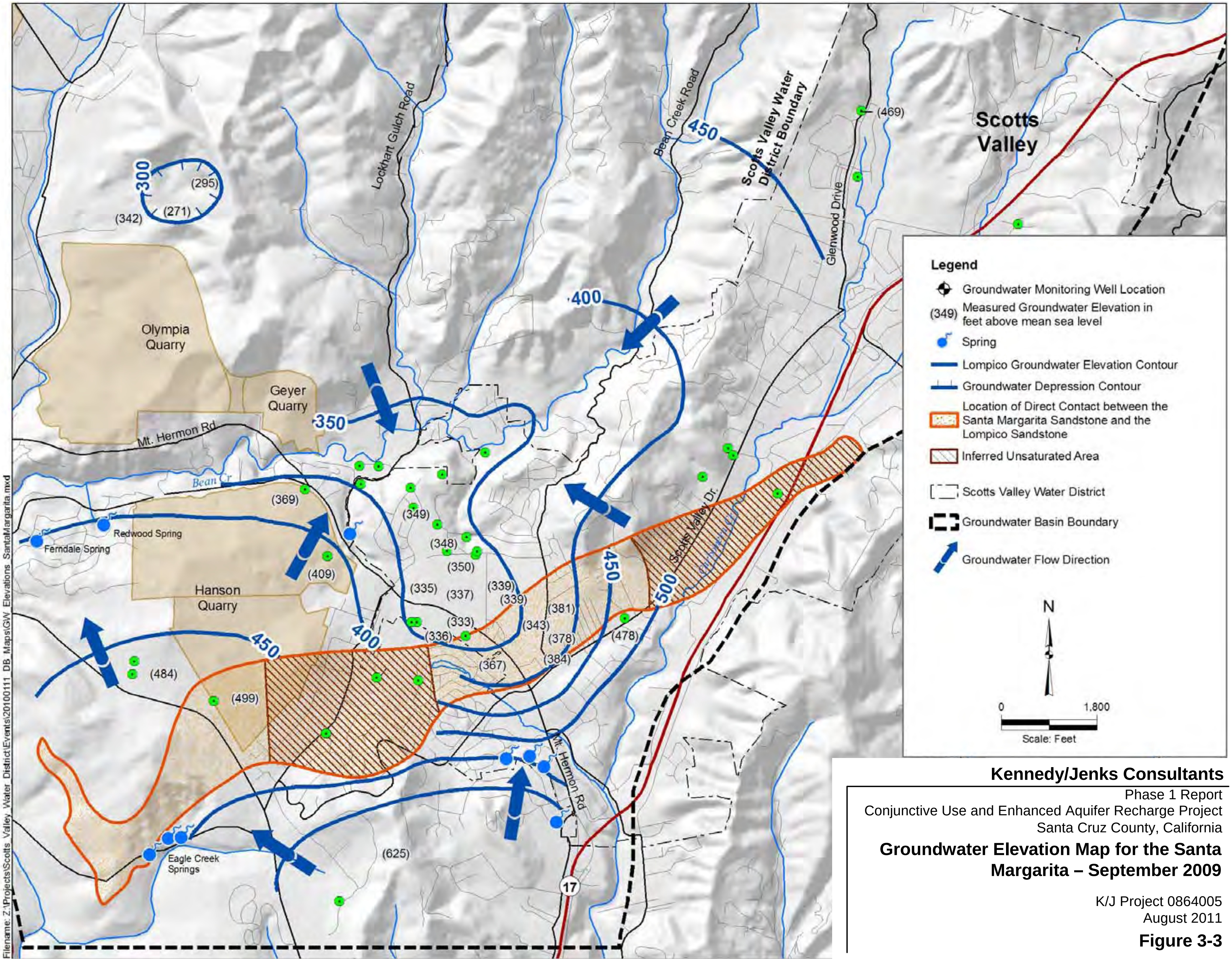
Figure 3-2



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Groundwater Elevation Map for the Santa Margarita – September 2009

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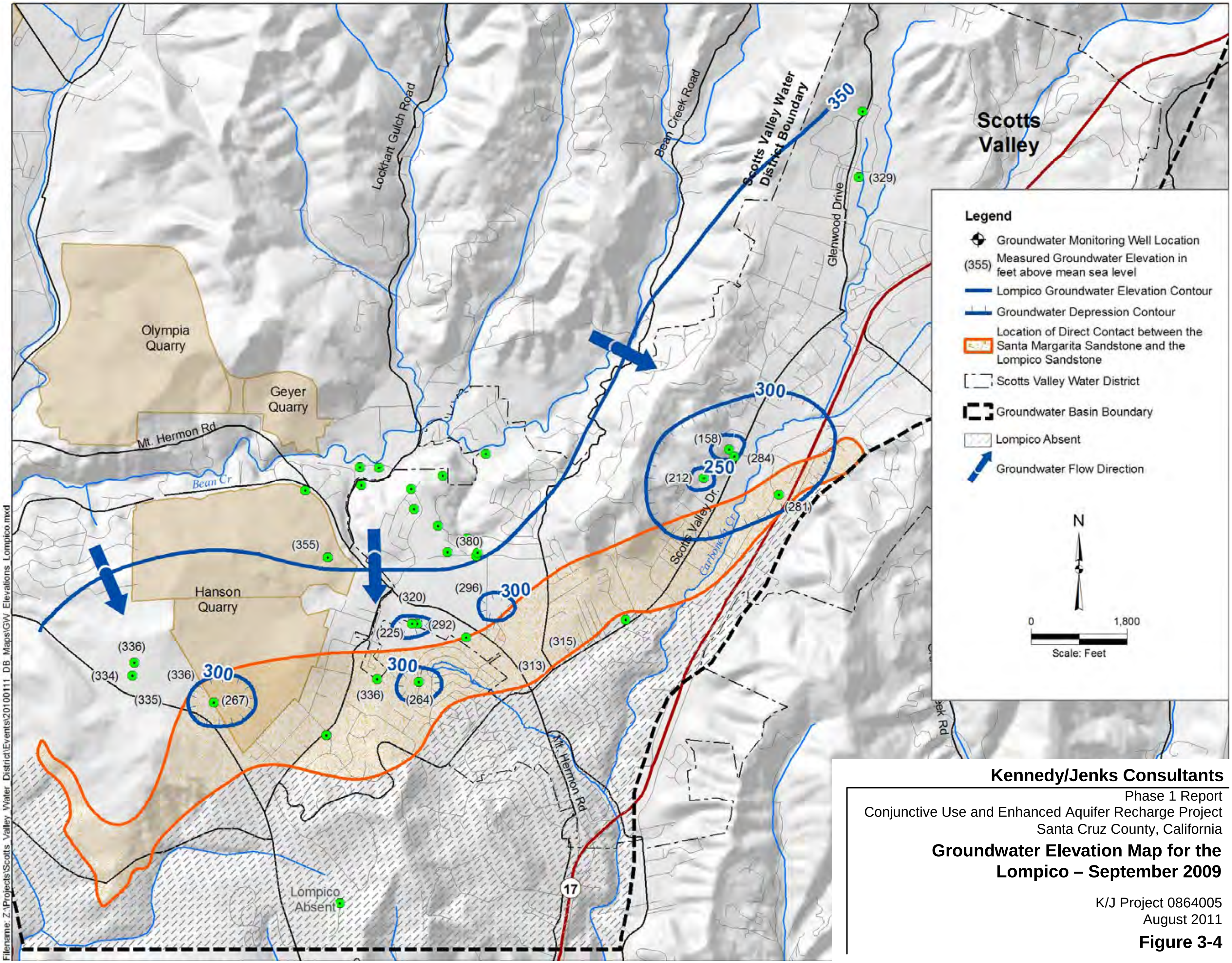
Figure 3-3



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Groundwater Elevation Map for the Lompico – September 2009

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Figure 3-4

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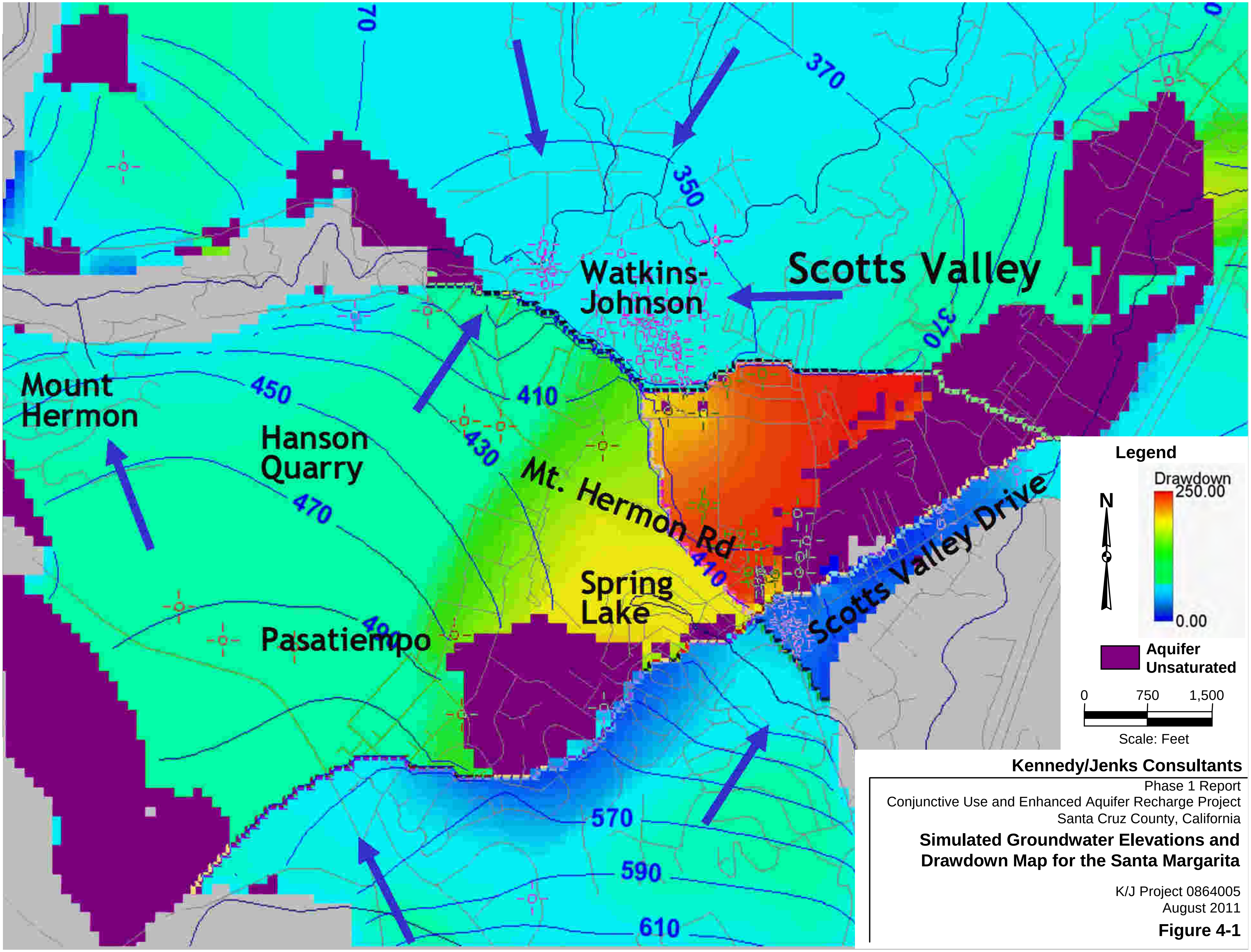

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Simulated Groundwater Elevations and Drawdown Map for the Santa Margarita

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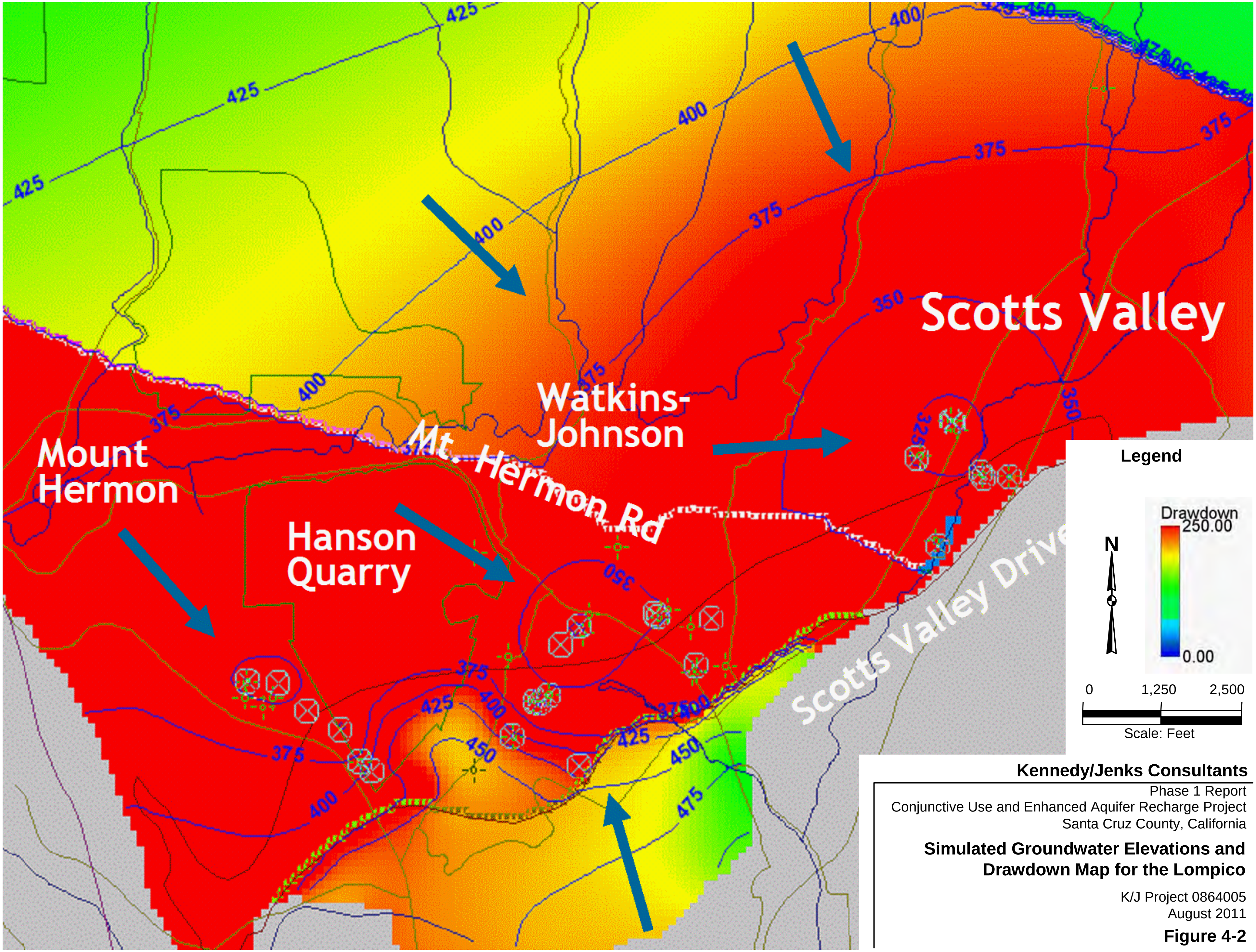
Figure 4-1



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Simulated Groundwater Elevations and Drawdown Map for the Lompico

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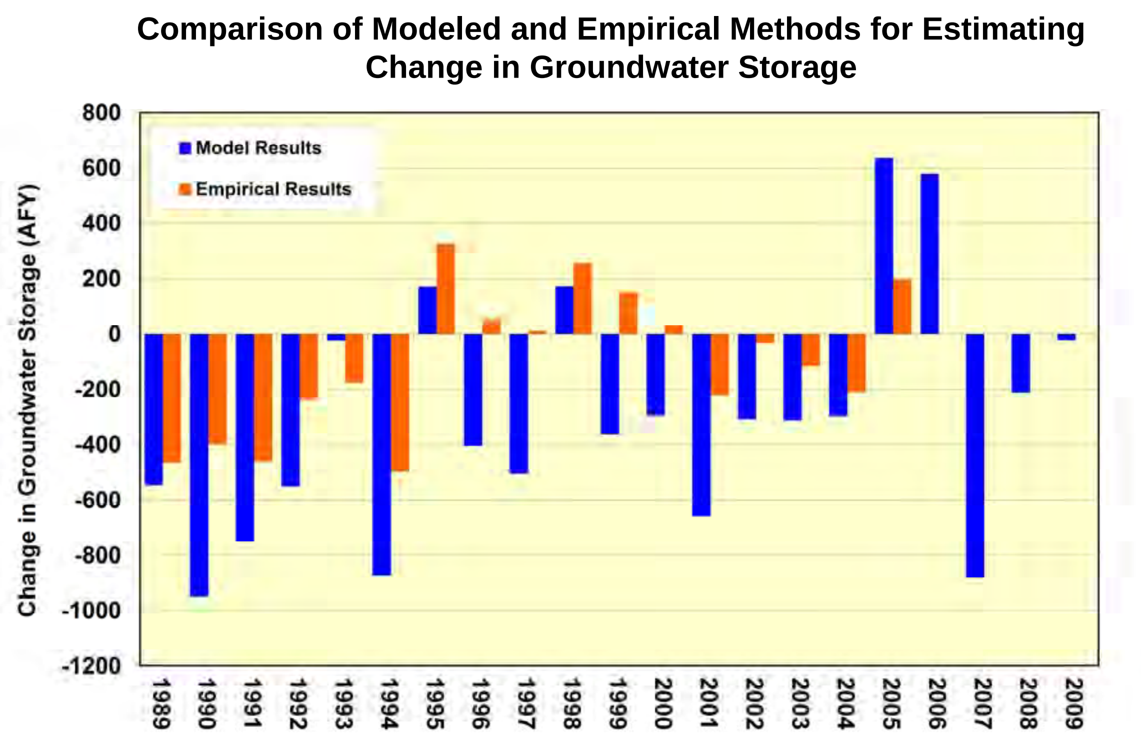
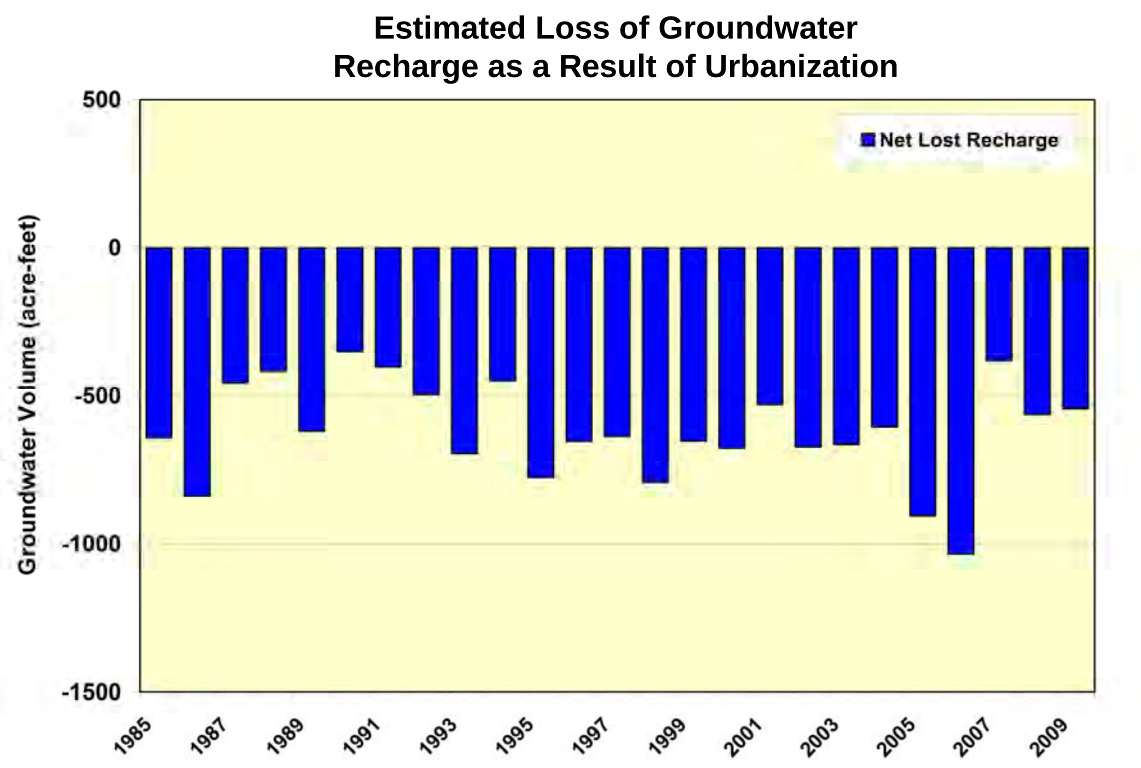
Figure 4-2





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Santa Cruz County, California

Change in Groundwater Storage and Loss of Groundwater Storage due to Urbanization

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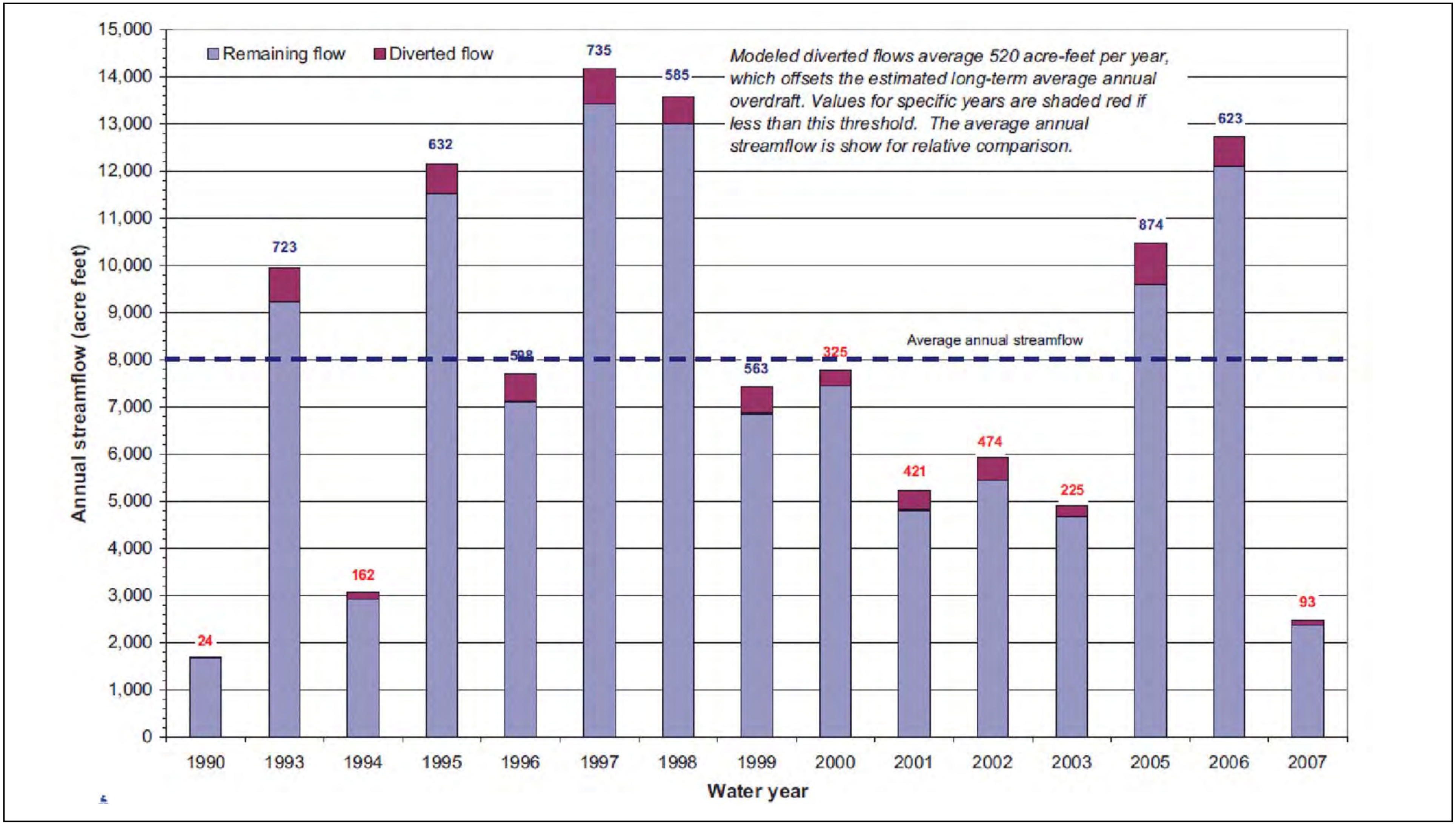
Figure 4-3



Assumptions: Bypass flow of 10 cfs, the maximum diversion rate of 5 cfs, and a diversion period from October 1 through March 31. (Figure 19, TM-2A, Balance Hydrologic)

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Santa Cruz County, California

Annual volume of water available by water year for diversion from Bean Creek

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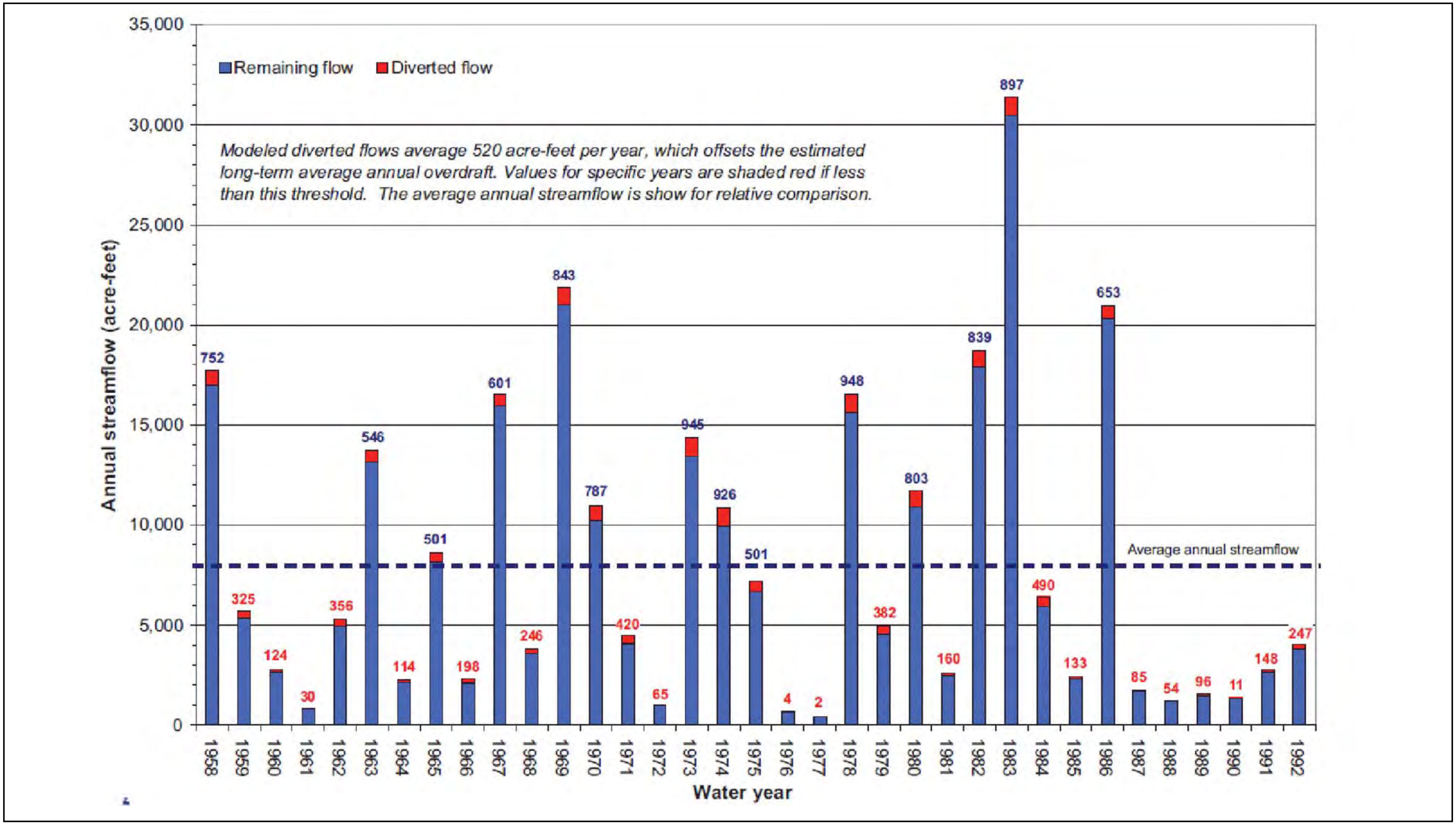
Figure 4-4



Assumptions: Bypass flow of 10 cfs, the maximum diversion rate of 10 cfs, and a diversion period from October 1 through March 31. (Figure 23, TM-2A, Balance Hydrologic)

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Annual volume of water available by water year for diversion from Zayante Creek

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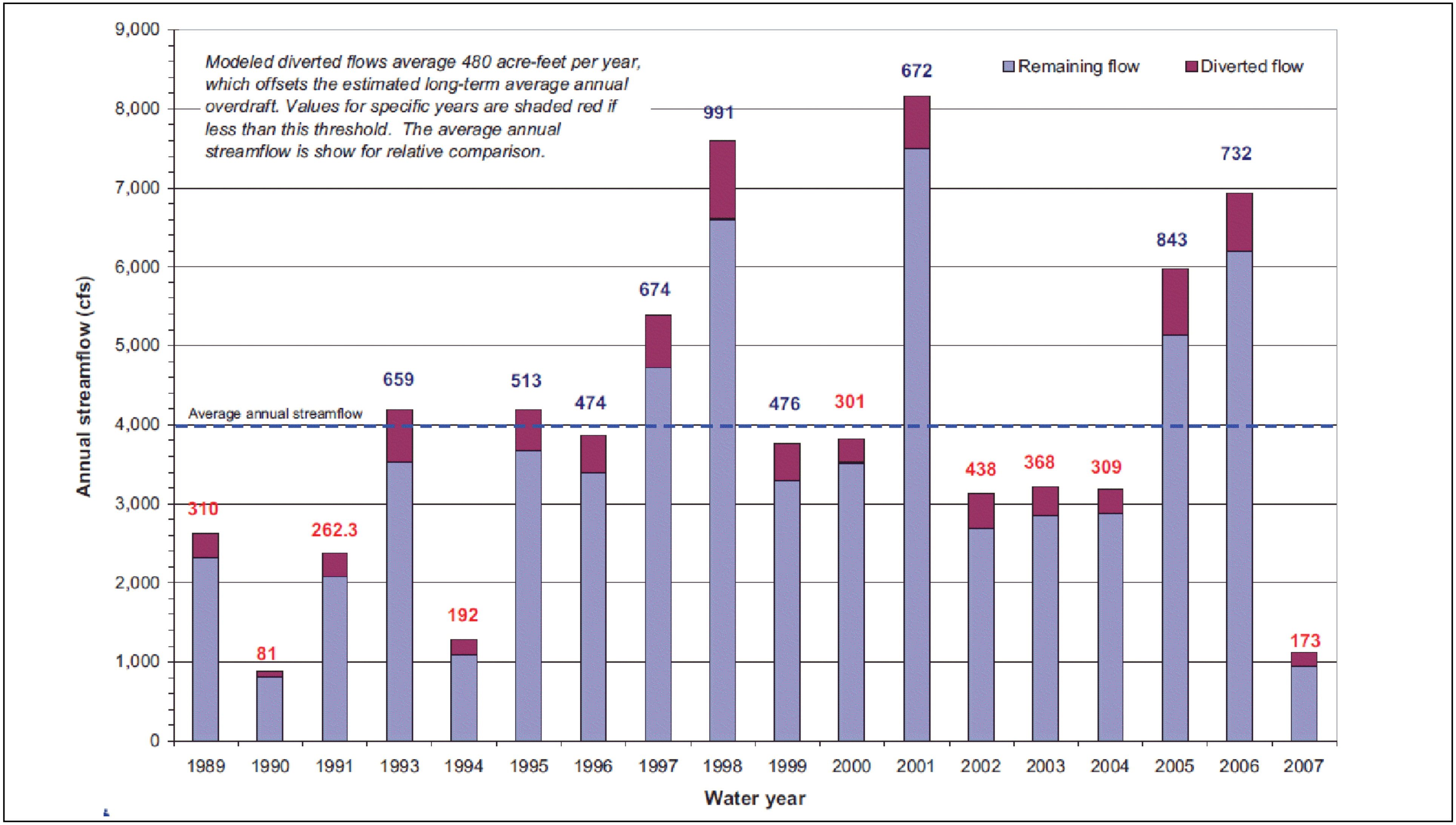
Figure 4-5



Assumptions: Bypass flow of 10 cfs, the maximum diversion rate of 5.5 cfs, and a diversion period from October 1 through March 31. (Figure 26, TM-2A, Balance Hydrologic)

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Annual volume of water available by water year for diversion from Carbonera Creek

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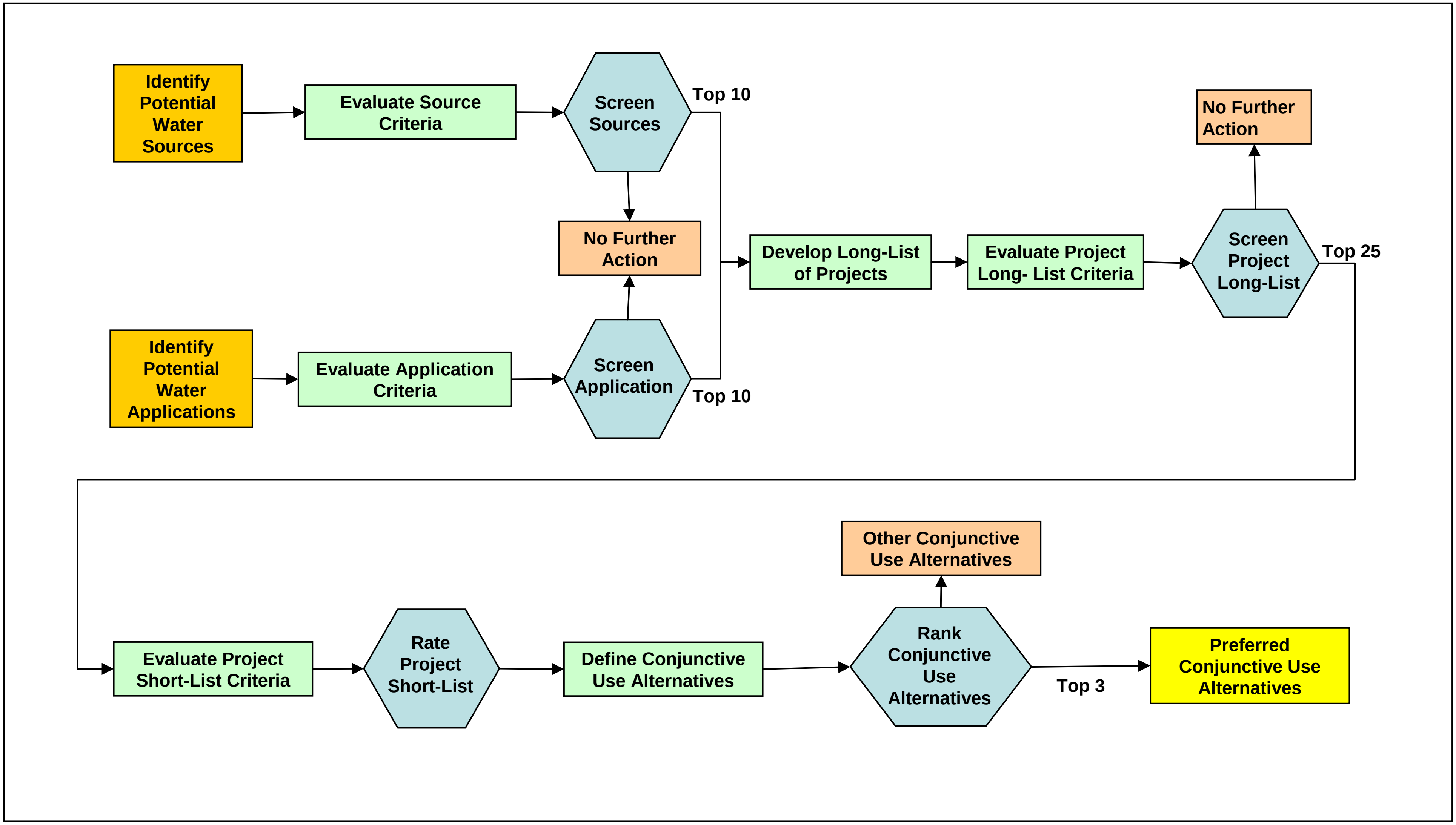
Figure 4-6



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Santa Cruz Conjunctive Use Project
Alternative Screening Methodology

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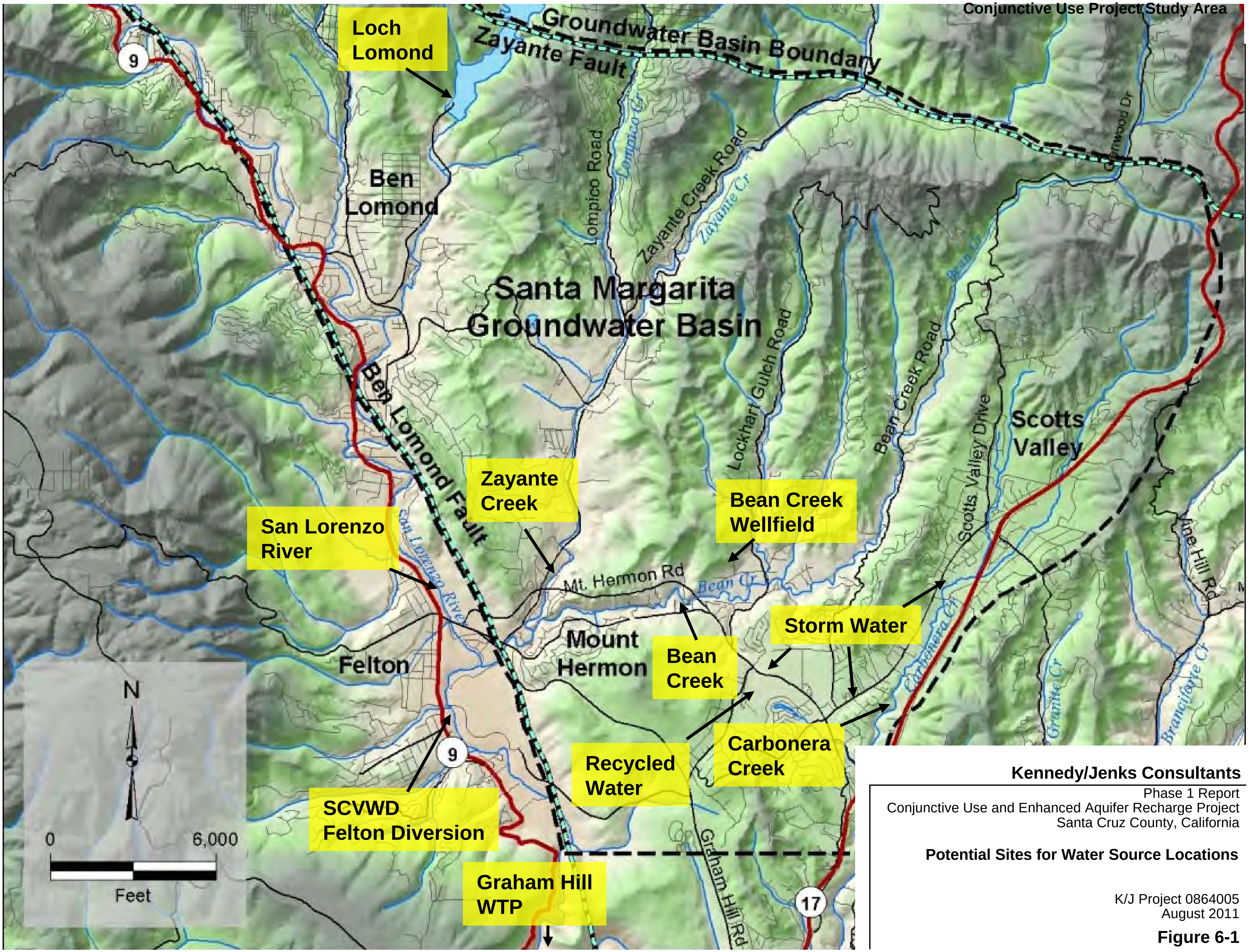
Figure 5-1



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Santa Cruz County, California

Potential Sites for Water Source Locations

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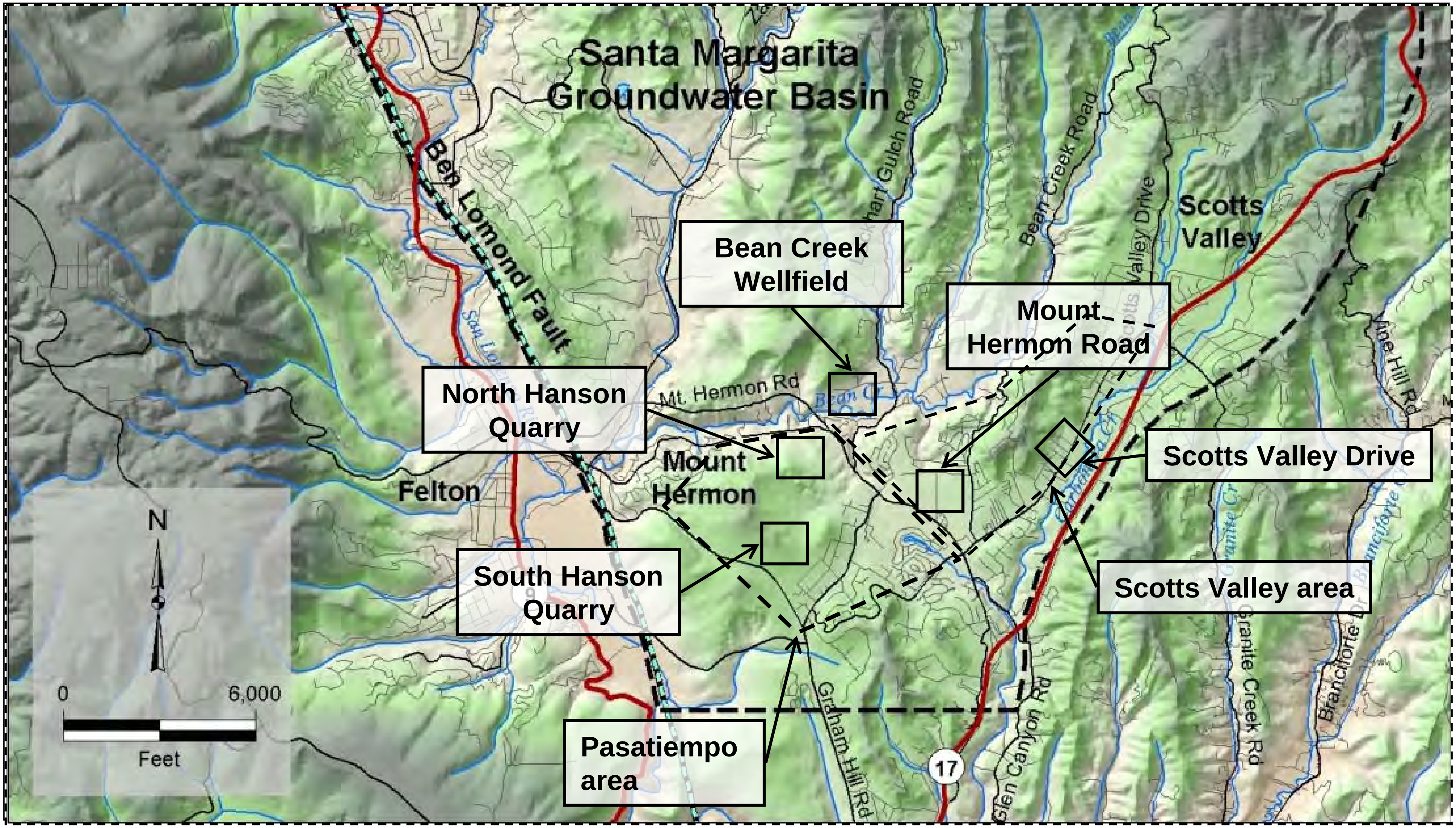
Figure 6-1



Note that boxes representing individual areas are not representative of the actual model area over which recharge occurs.

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Potential Sites for Recharge Application Locations

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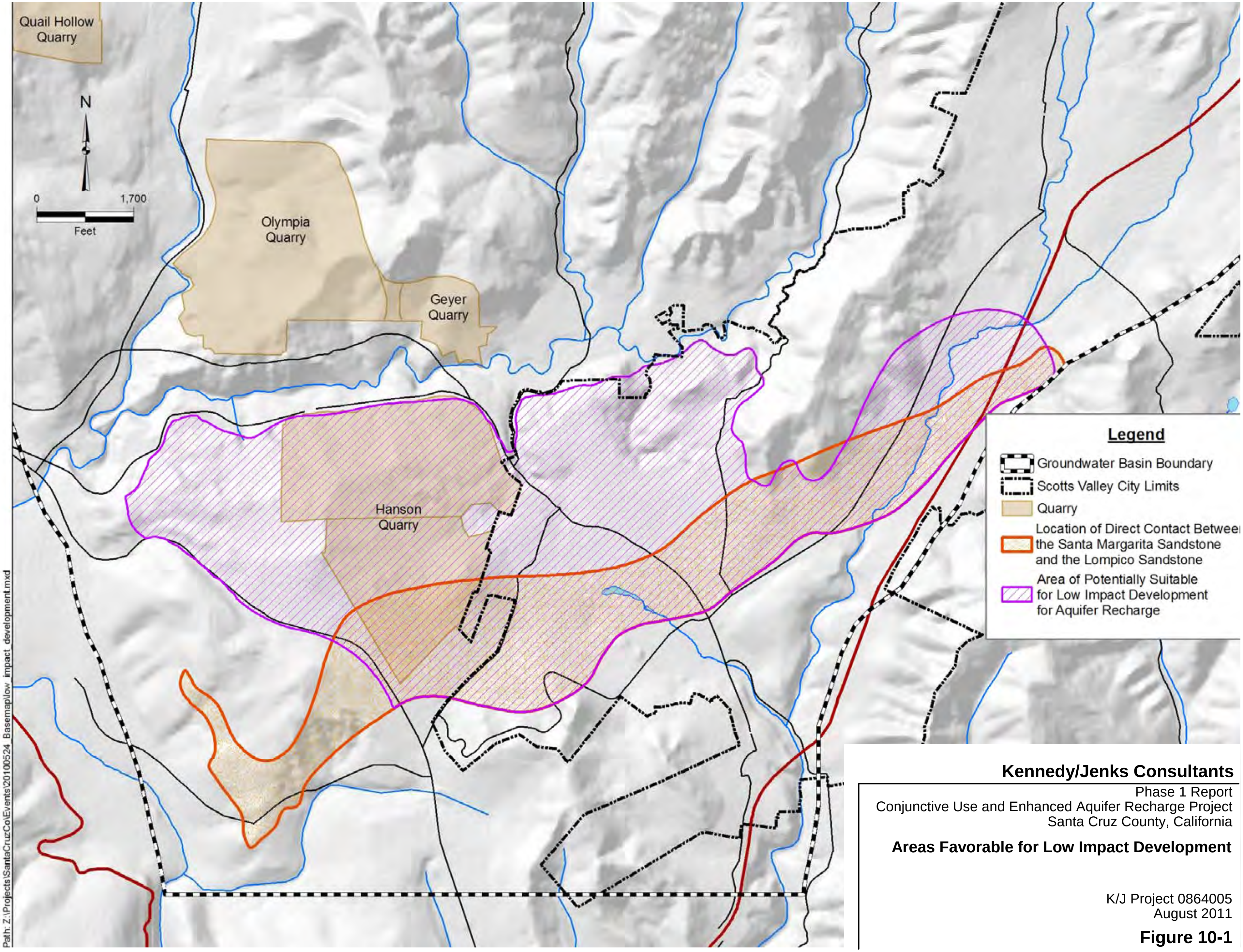
Figure 7-1



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Areas Favorable for Low Impact Development

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Figure 10-1

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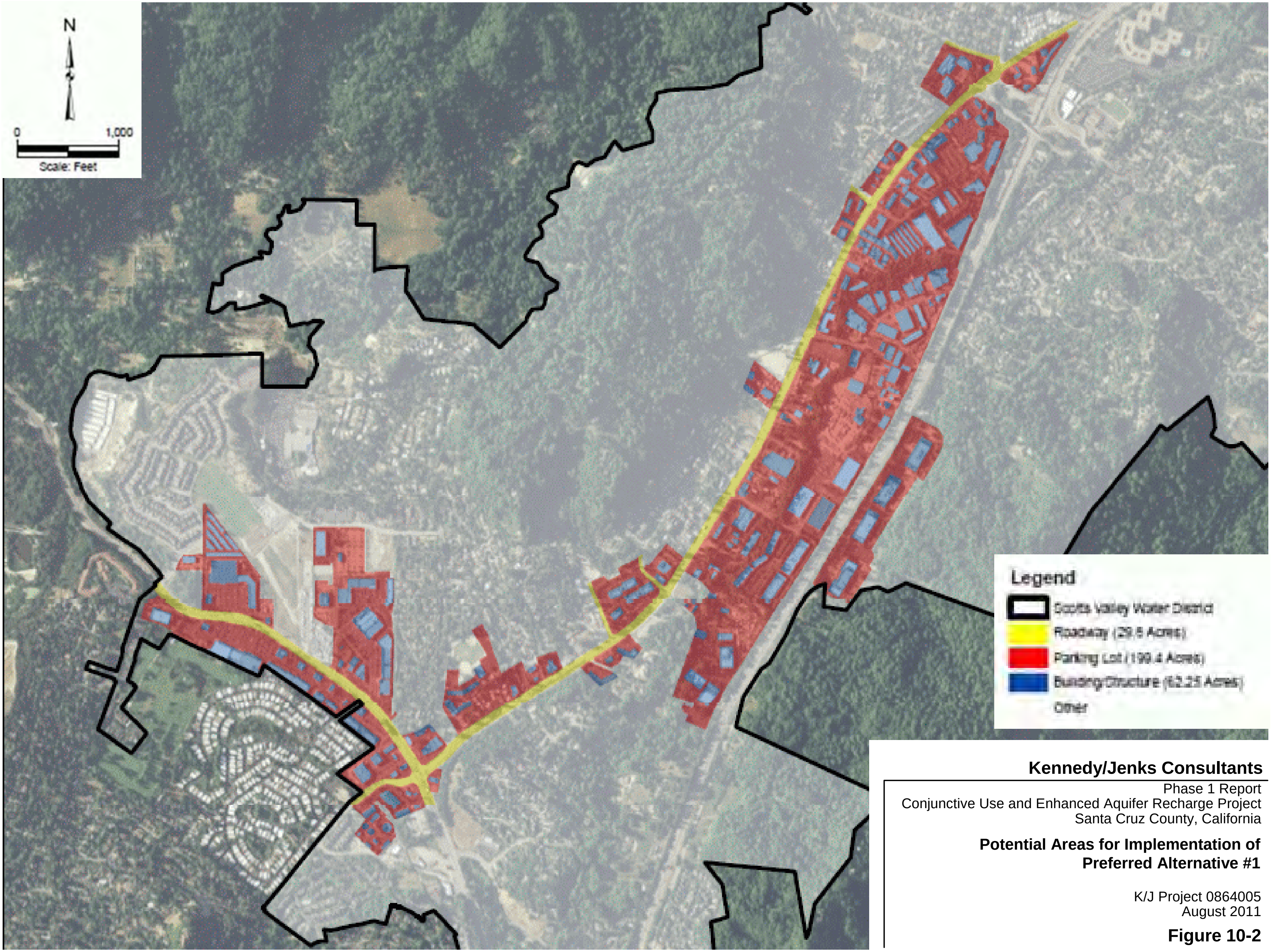

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Potential Areas for Implementation of Preferred Alternative #1

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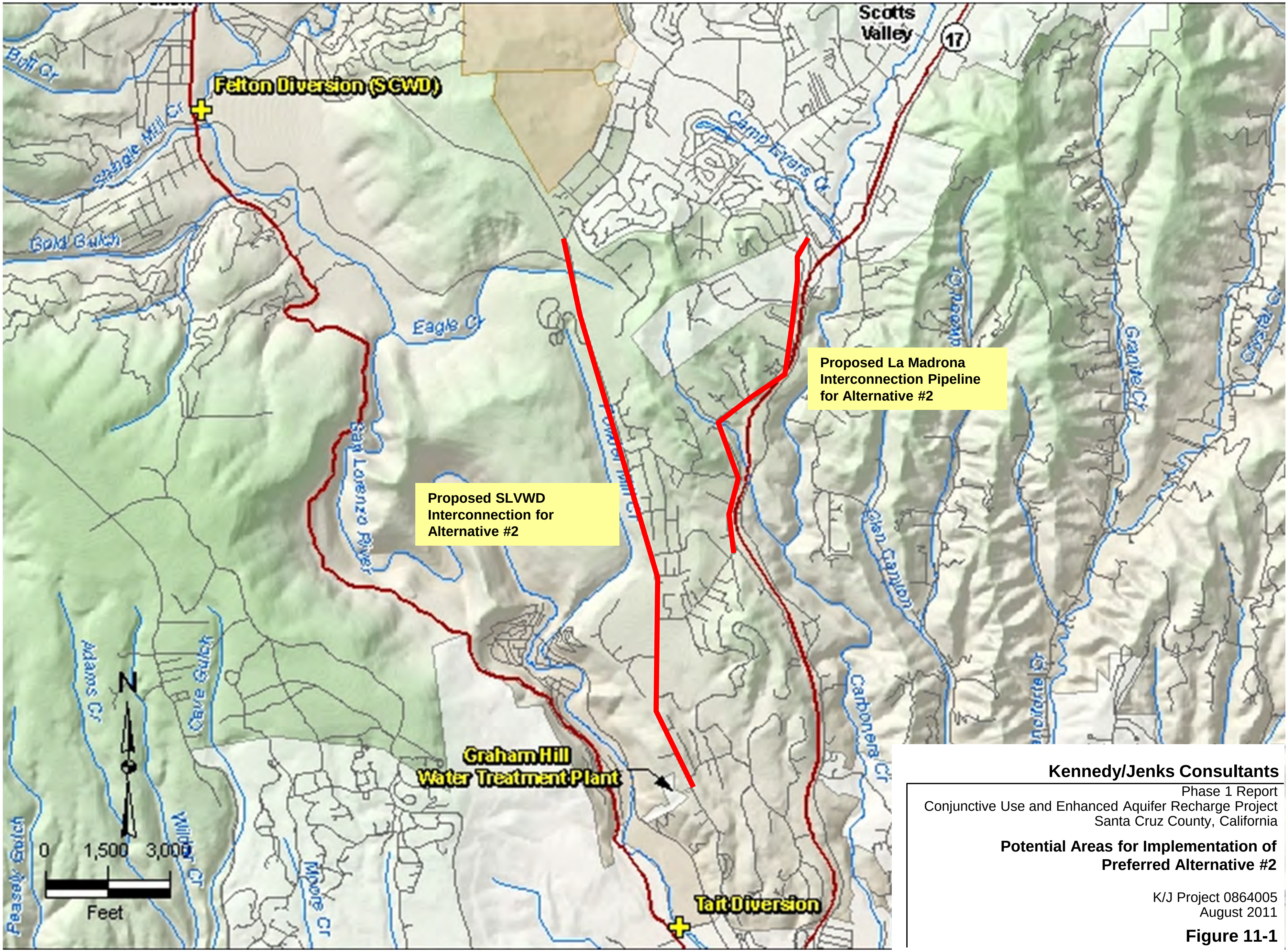
Figure 10-2



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Potential Areas for Implementation of Preferred Alternative #2

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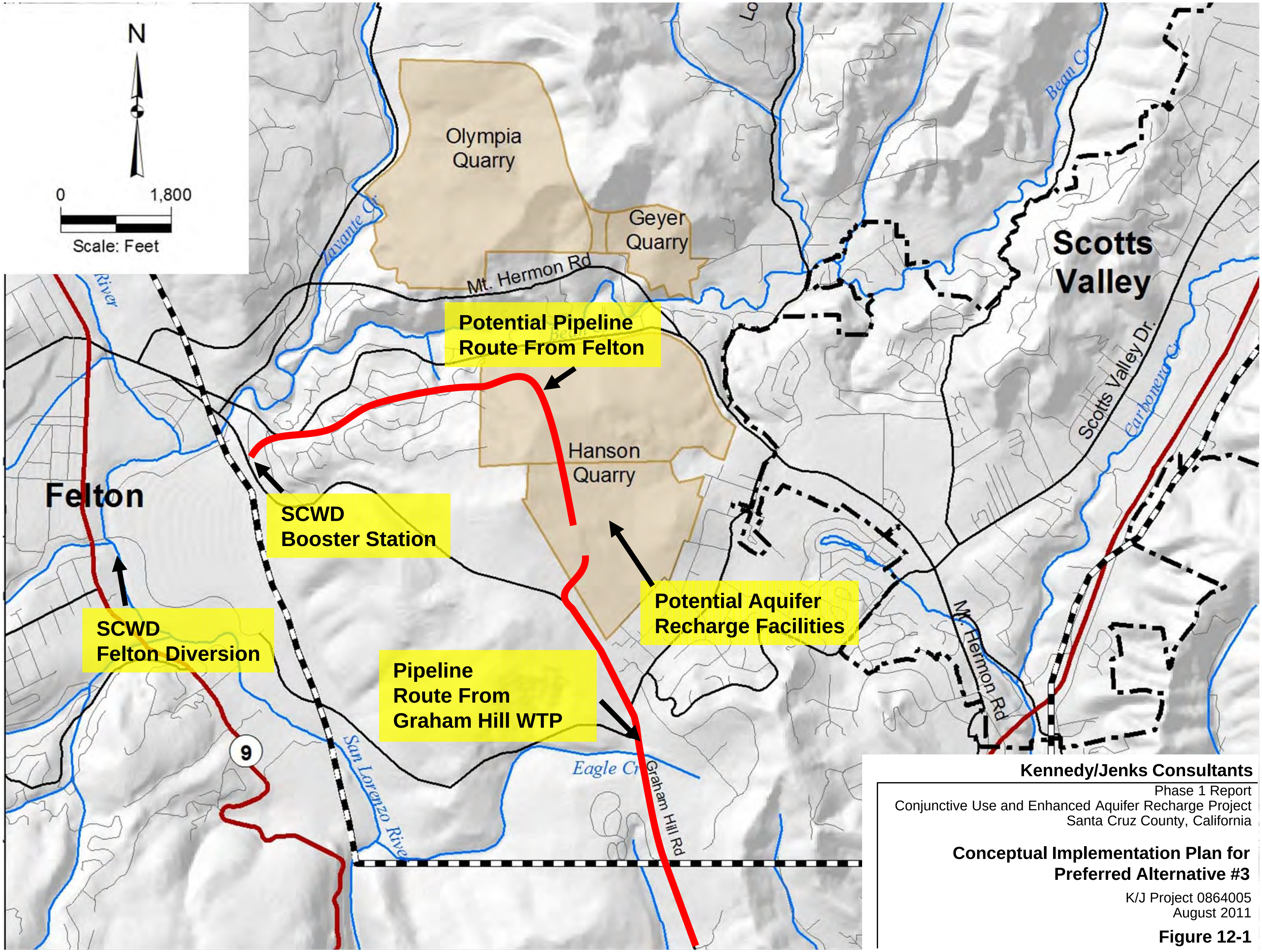
Figure 11-1



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Phase 1 Report
Conjunctive Use and Enhanced Aquifer Recharge Project
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Conceptual Implementation Plan for Preferred Alternative #3

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Figure 12-1

Tables

Table 6-1: Overview of Potential Source Waters

Source	Quantity		Quality	Notes
Surface Water	**Ave. Stream Flow[1] (AFY)**	**Ave. Yield[1] (AFY)**		
Bean Creek	8,000	520	Some sediments; may be controllable through erosion control	
Carbonera Creek	4,000	480	Suspended sediments from eroded creek bed and first flush urban runoff contaminants[2]	Highly urbanized watershed resulting in highly erosive peak flows.
Newell Creek	11,000 – 12,000 (est)[3]			Loch Lomond Reservoir not specifically evaluated
San Lorenzo River	96,100	1,643	Suspended sediments likely (70 – 1,700 tons/day during wet season)	Flow estimate from Big Trees Gauge, approximately 90 % of total watershed; cumulative flows including upstream tributaries (e.g. Newell Creek)
Zayante Creek	8,000	500	Suspended Sediments likely (8,000 tons of sediment/yr)	
Stormwater	300 – 500 AFY from urban runoff in Scotts Valley[4]		First flush urban runoff contaminants[2]	Not all available stormwater is likely to be captured and recharged.
Recycled Water for groundwater recharge	Up to 400 AFY based on 0.877 MGD of future wastewater flow for 5 month winter season		Treated to Title 22 Tertiary unrestricted use level; emerging contaminants such as personal care products	Demand for recycled water for dry season urban reuse exceeds supply regionally. Likely wintertime availability.
In-lieu Exchange	Likely to be accommodated within existing excess wet season surface water supplies		Treated potable water	Potential exchange partners include Santa Cruz Water Department, San Lorenzo Valley Water District, Scotts Valley Water District

Notes

[1] Average stream flow in acre-feet per year (AFY) is the average of the period of record available for the flow gage. The Average yield is a calculated value that accounts for a flow sufficient for environmental uses, then assumes an additional diversion for conjunctive use during the wet season. More detailed explanation is found in Technical Memorandum No. 2B for this Conjunctive Use Project (Balance Hydrologics, 2009).

[2] Urban runoff contaminants include nutrients from fertilizers, bacteria, zinc, copper, lead, and some oils and greases.

[3] Estimated based on rainfall-runoff relationship for Eastern Santa Cruz Mountains (Balance Hydrologics, 2009) and mean annual precipitation at Newell Creek of 45 – 46 inches.

[4] Based on estimated impervious area along Scotts Valley Drive and Mt Hermon Drive of approximately 300 Acres and average annual rainfall of 42 inches (3.5 ft).

Table 6-2 – Water Source Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Water Quantity and Reliability provides a conceptual assessment of the ability of the water source to meet the project objectives for the quantity of water available for a Conjunctive Use Project. The annual average includes years when water may not be available from a water source due to other requirements. In this manner, this conceptual assessment accounts for potential reliability of the water source. The higher the estimated annual average volume of available water, the higher the score.	1 – 0 to 250 acre-feet per year 2 – 250 to 500 acre-feet per year 3 – 500 to 750 acre-feet per year 4 – 750 to 1,000 acre-feet per year 5 – >1,000 acre-feet per year **Weight = 4** This is considered a key aspect so it is given a higher scoring weight.
Water Rights are complex legal issues that cannot be fully resolved in a conceptual assessment. This conceptual assessment provides a broad overview of the potential water rights issues that may be encountered in trying to access a water source for a new project. Water rights Additional water rights evaluations will be required based on the requirements of the potential future water source. Higher scores are given for existing water rights or water sources that do not require water rights. Lower scores are given where water rights are already allocated.	1 – No water rights available 2 – Low likelihood of obtaining available water right 3 – Potential water rights available but unlikely to obtain 4 – Potential water rights available 5 – Existing water rights held or water rights not an issue **Weight = 3**
CEQA & Regulatory Issues accounts for a wide range of potential issues that can arise in getting approval to move forward with a water project. CEQA issues are primarily focused on fishery issues, but account for other CEQA issues as well. Regulatory issues are primarily focused on water quality but account for other regulatory issues and permit requirements.	1 – Significant issues that may not be resolvable 2 – Difficult issues that may require long time and cost to resolve 3 – Multiple issues, significant effort required to resolve 4 – Limited issues anticipated that appear readily resolvable 5 – Few issues anticipated **Weight = 3**
Engineered Facilities Requirements accounts for a type, size and amount of infrastructure on a conceptual level. Projects utilizing existing infrastructure are considered preferable. Projects requiring primarily standard engineering components are considered to be of relatively low risk. Projects requiring all new engineering components and/or require significant land acquisition are considered to be a higher risk and are rated lower.	1 – Requires significant new infrastructure and land acquisition 2 – Requires new infrastructure and/or large land acquisition 3 – Uses mostly new infrastructure and/or large land acquisition 4 – Uses new and existing infrastructure with minor land acquisition 5 – Uses mostly existing infrastructure on available land **Weight = 2**

Table 6-2 – Water Source Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Implementability accounts for the project complexity and the anticipated amount of time that may be required until project implementation. Preference is given to simpler projects that can be implements more easily and in a shorter amount of time. Lower ratings are given to projects that are more complex and/or may require a long time before implementation.	1 – Highly complex project may require tens of years to implement 2 – Complex project may require over ten year to implement 3 – Moderately complex project may require years to implement 4 – Straightforward project that may require years to implement 5 – Straightforward project that can be readily implemented **Weight = 2**
Public Acceptance is a broad category to anticipate the potential level of public acceptance or criticism of a potential project. Based on a subjective assessment of the projects issues and knowledge of issues with similar projects in regional hydrological conditions, and general public opinion in Santa Cruz County.	1 – Controversial project with high public visibility 2 – Controversial project but with low public visibility 3 – Anticipate high public interest and concerns 4 – Anticipate high public interest and concerns for a limited number of issues 5 – Noncontroversial project with few concerns anticipated **Weight = 1**

Table 6-3 - Water Source Screening Criteria Results

Potential Source	Water Quantity and Reliability	Water Rights	CEQA & Regulatory Issues	Engineered Facilities Requirements	Implementability	Public Acceptance Issues	Total Score	Fatal Flaw	Average Score
Screening Weight	4	3	3	2	2	1			
Surface Water									
Bean Creek - Surface Diversion	3	2	2	2	2	3	35.0	No	**5.8**
Bean Creek - Subsurface Diversion	2	2	2	1	2	3	29.0	No	**4.8**
Bean Creek - Nearby Wellfield	1	4	3	2	3	3	38.0	No	**6.3**
Carbonera Creek - Surface Diversion	1	2	2	2	3	3	29.0	No	**4.8**
Carbonera Creek - Subsurface Diversion	0	2	2	1	0	3	17.0	Yes	**0.0**
Carbonera Creek - Nearby Wellfield	0	4	3	3	0	3	30.0	Yes	**0.0**
Zayante Creek - Surface Diversion	3	3	2	2	3	3	40.0	No	**6.7**
Zayante Creek - Subsurface Diversion	0	3	2	1	0	3	20.0	Yes	**0.0**
Zayante Creek - Nearby Wellfield	0	4	3	3	0	3	30.0	Yes	**0.0**
San Lorenzo River - Surface Diversion	4	2	1	1	1	2	31.0	No	**5.2**
San Lorenzo River - Subsurface Diversion	3	2	1	1	1	2	27.0	No	**4.5**
San Lorenzo River - Nearby Wellfield	0	3	2	2	1	2	23.0	Yes	**0.0**
Stormwater									
Stormwater - Intercept Storm Drains	2	3	3	2	3	3	39.0	No	**6.5**
Stormwater - drainage from quarry	1	3	2	2	2	3	30.0	No	**5.0**
Stormwater - Street and Parking Lots	2	5	2	3	3	4	45.0	No	**7.5**
Stormwater - Roofs	2	5	3	4	3	4	50.0	No	**8.3**
Stormwater - Ephemeral Stream Capture	1	2	2	2	1	3	25.0	No	**4.2**
Recycled Water									
Scotts Valley Recycled Water GW Recharge	2	4	1	2	1	1	30.0	No	**5.0**
Inter-District Water Exchange									
City of Santa Cruz Graham Hill WTP	4	3	3	3	3	3	49.0	No	**8.2**
City of Santa Cruz - Felton Diversion	3	3	3	2	3	2	42.0	No	**7.0**
SLVWD-SVWD Water Exchange	1	2	2	2	3	3	29.0	No	**4.8**
Loch Lomond + SLVWD-SVWD Exchange	2	4	2	2	3	3	39.0	No	**6.5**

Table 6-4 - Water Source Screening Ordered Results

Rank	Water Source	Source Score
1	Stormwater - Roofs	8.3
3	City of Santa Cruz Graham Hill WTP	8.2
2	Stormwater - Street and Parking Lots	7.5
4	City of Santa Cruz - Felton Diversion	7.0
5	Zayante Creek - Surface Diversion	6.7
6	Stormwater - Intercept Storm Drains	6.5
7	Loch Lomond + SLVWD-SVWD Exchange	6.5
8	Bean Creek - Nearby Wellfield	6.3
9	Bean Creek - Surface Diversion	5.8
10	San Lorenzo River - Surface Diversion	5.2
11	Scotts Valley Recycled Water GW Recharge	5.0
12	Stormwater - drainage from quarry	5.0
13	SLVWD-SVWD Water Exchange	4.8
14	Carbonera Creek - Surface Diversion	4.8
15	Bean Creek - Subsurface Diversion	4.8
16	San Lorenzo River - Subsurface Diversion	4.5
17	Stormwater - Ephemeral Stream Capture	4.2
18	San Lorenzo River - Nearby Wellfield	0.0
19	Carbonera Creek - Subsurface Diversion	0.0
20	Carbonera Creek - Nearby Wellfield	0.0
21	Zayante Creek - Subsurface Diversion	0.0
22	Zayante Creek - Nearby Wellfield	0.0

Table 7-1 – Recharge Application Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Potential Groundwater Benefit represents the estimated annual average volume of water that may be available from a particular source for use in a conjunctive use project. A primary objective of the Conjunctive Use Project is to restore groundwater levels in the Santa Margarita Basin for improved water supply sustainability and environmental conditions. Annual average volumes of additional groundwater storage are based on the Santa Margarita MODFLOW model.	1 – <100 acre-feet per year of additional groundwater storage 2 – 100 to 250 acre-feet per year of additional groundwater storage 3 – 250 to 400 acre-feet per year of additional groundwater storage 4 – 400 to 500 acre-feet per year of additional groundwater storage 5 – >500 acre-feet per year of additional groundwater storage **Weight = 4** This is considered a key aspect so it is given a higher scoring weight.
Potential Baseflow Benefit represents the estimated increase in summertime baseflow in the San Lorenzo River and its tributaries during the summer months of July, August and September. This is considered a critical period for fish habitat conditions. During these periods a higher percentage of streams are sustained by groundwater discharge. Increases in summertime baseflow are estimated based on the Santa Margarita MODFLOW model. These increases are a total net increase for all streams in the basin.	1 – < 0.25 cfs of additional summertime baseflow 2 – 0.25 to 1.00 cfs of additional summertime baseflow 3 – 1.00 to 1.75 cfs of additional summertime baseflow 4 – 1.75 to 2.50 cfs of additional summertime baseflow 5 – > 2.50 cfs of additional summertime baseflow **Weight = 3**
CEQA & Regulatory Issues accounts for a wide range of potential issues that can arise in getting approval to move forward with a water project. CEQA issues are primarily focused on fishery issues, but account for other CEQA issues as well. Regulatory issues are primarily focused on water quality but account for other regulatory issues and permit requirements.	1 – Significant issues that may not be resolvable 2 – Difficult issues that may require long time and cost to resolve 3 – Multiple issues, significant effort required to resolve 4 – Limited issues anticipated that appear readily resolvable 5 – Few issues anticipated **Weight = 3**
Engineered Facilities Requirements accounts for a type, size and amount of infrastructure on a conceptual level. Projects utilizing existing infrastructure are considered preferable. Projects requiring primarily standard engineering components are considered to be of relatively low risk. Projects requiring all new engineering components and/or require significant land acquisition are considered to be a higher risk and are rated lower.	1 – Requires significant new infrastructure and land acquisition 2 – Requires new infrastructure and/or large land acquisition 3 – Uses mostly new infrastructure and/or large land acquisition 4 – Uses new and existing infrastructure with minor land acquisition 5 – Uses mostly existing infrastructure on available land **Weight = 2**

Table 7-1 – Recharge Application Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Implementability accounts for the project complexity and the anticipated amount of time that may be required until project implementation. Preference is given to simpler projects that can be implements more easily and in a shorter amount of time. Lower ratings are given to projects that are more complex and/or may require a long time before implementation.	1 – Highly complex project may require tens of years to implement 2 – Complex project may require over ten year to implement 3 – Moderately complex project may require years to implement 4 – Straightforward project that may require years to implement 5 – Straightforward project that can be readily implemented **Weight = 2**
Public Acceptance is a broad category to anticipate the potential level of public acceptance or criticism of a potential project. Based on a subjective assessment of the projects issues and knowledge of issues with similar projects in regional hydrological conditions, and general public opinion in Santa Cruz County.	1 – Controversial project with high public visibility 2 – Controversial project but with low public visibility 3 – Anticipate high public interest and concerns 4 – Anticipate high public interest and concerns for a limited number of issues 5 – Noncontroversial project with few concerns anticipated **Weight = 1**

Table 7-2 - Summary of Groundwater Modeling Results for Change in Groundwater Storage and Summertime Baseflow

	Aquifer Recharge		Groundwater Storage		Summertime Baseflow		
Categories	**Annual Recharge Rate (AFY)**	**20-year Total Recharge**	**20-Year Change in Storage**[1]	**Percent Change Relative to Total Recharge**	**20-year Change in Summer Baseflow**[1,2]	**Percent Change Relative to Total Recharge**	**Change in Summertime Baseflow rate**
Units	Acre-feet per year	acre-feet	acre-feet	percent	acre-feet	percent	cubic feet per second
Surface Recharge Applications							
South Hanson Quarry area	1,000	20,000	2,545	13%	1,797	9%	0.53
North Hanson Quarry area	1,000	20,000	1,083	5%	1,765	9%	0.50
Mount Hermon Blvd area	1,000	20,000	6,157	31%	1,944	10%	0.65
Scotts Valley Drive area	*	*	*	*	*	*	*
Injection Well Applications							
South Hanson Quarry area	1,000	20,000	9,513	48%	1,052	5%	0.44
North Hanson Quarry area	1,000	20,000	11,542	58%	948	5%	0.42
Mount Hermon Blvd area	1,000	20,000	11,968	60%	1,135	6%	0.48
Scotts Valley Drive area	1,000	20,000	12,769	64%	920	5%	0.41
Low Impact Development Applications							
SLVWD area	990	19,800	3,422	17%	1,888	10%	0.55
Scotts Valley area	830	16,600	4,213	25%	1,766	11%	0.57
In-Lieu Recharge							
SLVWD - Lompico Wells	418	8,369	3,957	47%	360	4%	0.15
SVWD - Butano Wells	890	17,792	12,573	71%	646	4%	0.24
SVWD - Lompico & Santa Margarita Wells	539	10,786	6,918	64%	520	5%	0.23
Bean Creek Wellfield							
Increased in Total Pumping	-1,000	-20,000	-66	0%	-898	4%	-0.10
Replace pumping from SVWD Lompico Wells	0	0	1,275		-863		0.02

Notes:

[1] - 20-year change relative to the Baseline Scenario (see TM-1C)

[2] - Baseflow for San Lorenzo River Tributaries only (see TM-1C)

Table 7-3 - Recharge Application Screening Criteria Results

	Potential Groundwater Benefit	Potential Baseflow Benefit	CEQA & Regulatory Issues	Implementability	Engineered Facilities Requirements	Public Acceptance Issues	Total Score	Fatal Flaw	Average Score
Screening Weight	4	3	3	2	2	1			
South Hanson Quarry Area (SHQ)									
SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	2	3	3	3	3	3	41.0	No	**6.8**
SHQ - Aquifer Recharge - Injection Wells	5	2	2	3	2	3	45.0	No	**7.5**
SHQ - Aquifer Recharge - Leachfield/infiltration/gravity wells	2	3	2	2	3	3	36.0	No	**6.0**
SHQ - Aquifer Recharge - Small Scale Surface Infiltration	1	1	4	2	3	3	32.0	No	**5.3**
North Hanson Quarry Area (NHQ)									
NHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	3	3	3	3	3	37.0	No	**6.2**
NHQ - Aquifer Recharge - Injection Wells	5	2	2	3	1	3	43.0	No	**7.2**
NHQ - Aquifer Recharge - Leachfield/infiltration/gravity wells	1	3	2	2	3	3	32.0	No	**5.3**
NHQ - Aquifer Recharge - Small Scale Surface Infiltration	1	1	4	2	3	3	32.0	No	**5.3**
Camp Evers Area (CE)									
CE - Aquifer Recharge - Infiltration Basin/Percolation Ponds	3	2	3	2	1	1	34.0	No	**5.7**
CE - Aquifer Recharge - Injection Wells	5	2	1	3	2	2	41.0	No	**6.8**
CE - Aquifer Recharge - Leachfield/infiltration/gravity wells	3	2	2	2	2	2	34.0	No	**5.7**
CE - Aquifer Recharge - Low Impact Development	2	3	4	5	4	5	52.0	No	**8.7**
South Scotts Valley Area (SSV)									
SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	2	3	3	2	3	3	39.0	No	**6.5**
SSV - Aquifer Recharge - Injection Wells	5	2	1	3	2	2	41.0	No	**6.8**
SSV - Aquifer Recharge - Leachfield/infiltration/gravity wells	2	2	2	2	2	3	31.0	No	**5.2**
SSV - Aquifer Recharge - Low Impact Development	2	3	4	5	4	5	52.0	No	**8.7**
North Scotts Valley Area (NSV)									
NSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	0	3	3	1	0	1	21.0	Yes	**0.0**
NSV - Aquifer Recharge - Injection Wells	5	1	1	2	1	2	34.0	No	**5.7**
NSV - Aquifer Recharge - Leachfield/infiltration/gravity wells	0	3	2	1	0	2	19.0	Yes	**0.0**
NSV - Aquifer Recharge - Low Impact Development	0	4	4	3	0	4	34.0	Yes	**0.0**
In-Lieu Recharge									
In Lieu SVWD - 75% Dec-Mar water usage	2	1	3	4	3	4	38.0	No	**6.3**
In Lieu SLVWD - 75% Dec-Mar water usage	1	1	3	4	3	4	34.0	No	**5.7**
In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	3	1	3	4	3	4	42.0	No	**7.0**
In Lieu Local Water Source - Treat & Serve - 75% Dec-Mar	2	1	2	2	2	2	27.0	No	**4.5**

Table 7-4 - Recharge Application Screening Ordered Results

Rank	Water Source	Application Score
1	SSV - Aquifer Recharge - Low Impact Development	8.7
2	CE - Aquifer Recharge - Low Impact Development	8.7
3	SHQ - Aquifer Recharge - Injection Wells	7.5
4	NHQ - Aquifer Recharge - Injection Wells	7.2
5	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.0
6	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.8
7	SSV - Aquifer Recharge - Injection Wells	6.8
8	CE - Aquifer Recharge - Injection Wells	6.8
9	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.5
10	In Lieu SVWD - 75% Dec-Mar water usage	6.3
11	NHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.2
12	SHQ - Aquifer Recharge - Leachfield/infiltration/gravity wells	6.0
13	CE - Aquifer Recharge - Leachfield/infiltration/gravity wells	5.7
14	In Lieu SLVWD - 75% Dec-Mar water usage	5.7
15	CE - Aquifer Recharge - Infiltration Basin/Percolation Ponds	5.7
16	NSV - Aquifer Recharge - Injection Wells	5.7
17	NHQ - Aquifer Recharge - Leachfield/infiltration/gravity wells	5.3
18	SHQ - Aquifer Recharge - Small Scale Surface Infiltration	5.3
19	NHQ - Aquifer Recharge - Small Scale Surface Infiltration	5.3
20	SSV - Aquifer Recharge - Leachfield/infiltration/gravity wells	5.2
21	In Lieu Local Water Source - Treat & Serve - 75% Dec-Mar	4.5
22	NSV - Aquifer Recharge - Low Impact Development	0.0
23	NSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	0.0
24	NSV - Aquifer Recharge - Leachfield/infiltration/gravity wells	0.0

Table 8-1 - Project Screening Criteria Results

Rank	Source	Application	Option Compatibility	Construct-ability	Conveyence	Project Engineering	Long-Term Sustainability	Source Rating	Application Rating	Total Score	Incompat-ibility	Average Project Score
Screening Weight			**1**	**3**	**2**	**2**	**3**	**1**	**1**			
1	Stormwater - Roofs	SSV - Aquifer Recharge - Low Impact Development	1	5	5	4	3	8.3	8.7	59.0		9.8
2	Stormwater - Roofs	SSV - Aquifer Recharge - Injection Wells	1	1	1	2	1	8.3	6.8	27.2		4.5
3	Stormwater - Roofs	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	2	2	1	8.3	6.5	31.8		5.3
4	Stormwater - Roofs	SHQ - Aquifer Recharge - Injection Wells	1	1	1	2	1	8.3	7.5	27.8		4.6
5	Stormwater - Roofs	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	1	2	1	8.3	6.8	27.2		4.5
6	Stormwater - Roofs	NHQ - Aquifer Recharge - Injection Wells	1	1	1	2	1	8.3	7.2	27.5		4.6
7	Stormwater - Roofs	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	0	X	X	X	X	8.3	7.0	15.3	Yes	0.0
8	Stormwater - Roofs	In Lieu SVWD - 75% Dec-Mar water usage	0	X	X	X	X	8.3	6.3	14.7	Yes	0.0
9	Stormwater - Roofs	CE - Aquifer Recharge - Low Impact Development	1	5	5	4	3	8.3	8.7	59.0		9.8
10	Stormwater - Roofs	CE - Aquifer Recharge - Injection Wells	1	1	2	2	1	8.3	6.8	29.2		4.9
11	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Low Impact Development	1	3	5	3	4	7.5	8.7	53.2		8.9
12	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Injection Wells	1	1	1	2	1	7.5	6.8	26.3		4.4
13	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	2	2	1	7.5	6.5	31.0		5.2
14	Stormwater - Street and Parking Lots	SHQ - Aquifer Recharge - Injection Wells	1	1	1	2	1	7.5	7.5	27.0		4.5
15	Stormwater - Street and Parking Lots	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	1	2	1	7.5	6.8	26.3		4.4
16	Stormwater - Street and Parking Lots	NHQ - Aquifer Recharge - Injection Wells	1	1	1	2	1	7.5	8.7	28.2		4.7
17	Stormwater - Street and Parking Lots	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	0	X	X	X	X	7.5	7.0	14.5	Yes	0.0
18	Stormwater - Street and Parking Lots	In Lieu SVWD - 75% Dec-Mar water usage	0	X	X	X	X	7.5	6.3	13.8	Yes	0.0
19	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Low Impact Development	1	3	5	3	4	7.5	8.7	53.2		8.9
20	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Injection Wells	1	1	2	2	1	7.5	6.8	28.3		4.7

Table 8-1 - Project Screening Criteria Results

Rank	Source	Application	Option Compatibility	Construct-ability	Conveyence	Project Engineering	Long-Term Sustainability	Source Rating	Application Rating	Total Score	Incompat-ibility	Average Project Score
Screening Weight			**1**	**3**	**2**	**2**	**3**	**1**	**1**			
21	City of Santa Cruz Graham Hill WTP	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	8.2	8.7	16.8	Yes	0.0
22	City of Santa Cruz Graham Hill WTP	SSV - Aquifer Recharge - Injection Wells	1	1	1	1	1	8.2	6.8	25.0		4.2
23	City of Santa Cruz Graham Hill WTP	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	2	2	1	8.2	6.5	28.7		4.8
24	City of Santa Cruz Graham Hill WTP	SHQ - Aquifer Recharge - Injection Wells	1	1	2	2	1	8.2	7.5	29.7		4.9
25	City of Santa Cruz Graham Hill WTP	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	3	2	1	8.2	6.8	31.0		5.2
26	City of Santa Cruz Graham Hill WTP	NHQ - Aquifer Recharge - Injection Wells	1	1	2	2	1	8.2	7.2	29.3		4.9
27	City of Santa Cruz Graham Hill WTP	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	4	3	3	5	8.2	7.0	54.2		9.0
28	City of Santa Cruz Graham Hill WTP	In Lieu SVWD - 75% Dec-Mar water usage	1	4	3	3	4	8.2	6.3	50.5		8.4
29	City of Santa Cruz Graham Hill WTP	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	8.2	8.7	16.8	Yes	0.0
30	City of Santa Cruz Graham Hill WTP	CE - Aquifer Recharge - Injection Wells	1	1	1	1	1	8.2	6.8	25.0		4.2
31	City of Santa Cruz - Felton Diversion	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	7.0	8.7	15.7	Yes	0.0
32	City of Santa Cruz - Felton Diversion	SSV - Aquifer Recharge - Injection Wells	1	1	2	2	2	7.0	6.8	30.8		5.1
33	City of Santa Cruz - Felton Diversion	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	1	2	2	7.0	6.5	28.5		4.8
34	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Injection Wells	1	3	3	3	4	7.0	7.5	47.5		7.9
35	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	4	3	3	4	7.0	6.8	49.8		8.3
36	City of Santa Cruz - Felton Diversion	NHQ - Aquifer Recharge - Injection Wells	1	3	3	3	4	7.0	7.2	47.2		7.9
37	City of Santa Cruz - Felton Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	2	3	2	5	7.0	7.0	45.0		7.5
38	City of Santa Cruz - Felton Diversion	In Lieu SVWD - 75% Dec-Mar water usage	1	2	3	2	4	7.0	6.3	41.3		6.9
39	City of Santa Cruz - Felton Diversion	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	7.0	8.7	15.7	Yes	0.0
40	City of Santa Cruz - Felton Diversion	CE - Aquifer Recharge - Injection Wells	1	1	2	2	2	7.0	6.8	30.8		5.1

Table 8-1 - Project Screening Criteria Results

Rank	Source	Application	Option Compatibility	Construct-ability	Conveyence	Project Engineering	Long-Term Sustainability	Source Rating	Application Rating	Total Score	Incompat-ibility	Average Project Score
Screening Weight			1	3	2	2	3	1	1			
41	Zayante Creek - Surface Diversion	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.7	8.7	15.3	Yes	0.0
42	Zayante Creek - Surface Diversion	SSV - Aquifer Recharge - Injection Wells	1	3	1	3	3	6.7	6.8	39.5		6.6
43	Zayante Creek - Surface Diversion	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	1	2	2	6.7	6.5	31.2		5.2
44	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	1	4	3	3	4	6.7	7.5	50.2		8.4
45	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	4	3	3	4	6.7	6.8	49.5		8.3
46	Zayante Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	1	3	3	3	4	6.7	7.2	46.8		7.8
47	Zayante Creek - Surface Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	1	3	2	2	6.7	7.0	32.7		5.4
48	Zayante Creek - Surface Diversion	In Lieu SVWD - 75% Dec-Mar water usage	1	1	3	2	2	6.7	6.3	32.0		5.3
49	Zayante Creek - Surface Diversion	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.7	8.7	15.3	Yes	0.0
50	Zayante Creek - Surface Diversion	CE - Aquifer Recharge - Injection Wells	1	2	2	3	3	6.7	6.8	38.5		6.4
51	Loch Lomond + SLVWD-SVWD Exchange	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.5	8.7	15.2	Yes	0.0
52	Loch Lomond + SLVWD-SVWD Exchange	SSV - Aquifer Recharge - Injection Wells	1	1	1	1	1	6.5	6.8	23.3		3.9
53	Loch Lomond + SLVWD-SVWD Exchange	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	2	2	1	6.5	6.5	27.0		4.5
54	Loch Lomond + SLVWD-SVWD Exchange	SHQ - Aquifer Recharge - Injection Wells	1	1	2	2	1	6.5	7.5	28.0		4.7
55	Loch Lomond + SLVWD-SVWD Exchange	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	1	3	2	1	6.5	6.8	29.3		4.9
56	Loch Lomond + SLVWD-SVWD Exchange	NHQ - Aquifer Recharge - Injection Wells	1	1	2	2	1	6.5	7.2	27.7		4.6
57	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	2	2	2	5	6.5	7.0	42.5		7.1
58	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD - 75% Dec-Mar water usage	0	X	X	X	X	6.5	6.3	12.8	Yes	0.0
59	Loch Lomond + SLVWD-SVWD Exchange	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.5	8.7	15.2	Yes	0.0
60	Loch Lomond + SLVWD-SVWD Exchange	CE - Aquifer Recharge - Injection Wells	1	1	1	1	1	6.5	6.8	23.3		3.9

Table 8-1 - Project Screening Criteria Results

Rank	Source	Application	Option Compatibility	Construct-ability	Conveyence	Project Engineering	Long-Term Sustainability	Source Rating	Application Rating	Total Score	Incompat-ibility	Average Project Score
Screening Weight			**1**	**3**	**2**	**2**	**3**	**1**	**1**			
61	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.5	8.7	15.2	Yes	0.0
62	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Injection Wells	1	3	3	2	3	6.5	6.8	41.3		6.9
63	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	3	4	3	6.5	6.5	42.0		7.0
64	Stormwater - Intercept Storm Drains	SHQ - Aquifer Recharge - Injection Wells	1	2	2	2	2	6.5	7.5	34.0		5.7
65	Stormwater - Intercept Storm Drains	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	2	2	2	6.5	6.8	33.3		5.6
66	Stormwater - Intercept Storm Drains	NHQ - Aquifer Recharge - Injection Wells	1	2	2	2	2	6.5	7.2	33.7		5.6
67	Stormwater - Intercept Storm Drains	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	0	X	X	X	X	6.5	7.0	13.5	Yes	0.0
68	Stormwater - Intercept Storm Drains	In Lieu SVWD - 75% Dec-Mar water usage	0	X	X	X	X	6.5	6.3	12.8	Yes	0.0
69	Stormwater - Intercept Storm Drains	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.5	8.7	15.2	Yes	0.0
70	Stormwater - Intercept Storm Drains	CE - Aquifer Recharge - Injection Wells	1	2	3	2	3	6.5	6.8	38.3		6.4
71	Bean Creek - Nearby Wellfield	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.3	8.7	15.0	Yes	0.0
72	Bean Creek - Nearby Wellfield	SSV - Aquifer Recharge - Injection Wells	0	3	2	2	1	6.3	6.8	33.2	Yes	0.0
73	Bean Creek - Nearby Wellfield	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	0	3	2	2	1	6.3	6.5	32.8	Yes	0.0
74	Bean Creek - Nearby Wellfield	SHQ - Aquifer Recharge - Injection Wells	0	X	X	X	X	6.3	7.5	13.8	Yes	0.0
75	Bean Creek - Nearby Wellfield	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	3	3	2	1	6.3	6.8	35.2		5.9
76	Bean Creek - Nearby Wellfield	NHQ - Aquifer Recharge - Injection Wells	1	3	3	2	1	6.3	7.2	35.5		5.9
77	Bean Creek - Nearby Wellfield	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	4	4	2	2	6.3	7.0	43.3		7.2
78	Bean Creek - Nearby Wellfield	In Lieu SVWD - 75% Dec-Mar water usage	1	4	4	2	2	6.3	6.3	42.7		7.1
79	Bean Creek - Nearby Wellfield	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	6.3	8.7	15.0	Yes	0.0
80	Bean Creek - Nearby Wellfield	CE - Aquifer Recharge - Injection Wells	0	3	3	2	1	6.3	6.8	35.2	Yes	0.0

Table 8-1 - Project Screening Criteria Results

Rank	Source	Application	Option Compatibility	Construct-ability	Conveyence	Project Engineering	Long-Term Sustainability	Source Rating	Application Rating	Total Score	Incompat-ibility	Average Project Score
Screening Weight			**1**	**3**	**2**	**2**	**3**	**1**	**1**			
81	Bean Creek - Surface Diversion	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	5.8	8.7	14.5	Yes	0.0
82	Bean Creek - Surface Diversion	SSV - Aquifer Recharge - Injection Wells	1	3	1	3	3	5.8	6.8	38.7		6.4
83	Bean Creek - Surface Diversion	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	1	2	2	5.8	6.5	30.3		5.1
84	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	1	4	3	3	4	5.8	7.5	49.3		8.2
85	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	4	3	3	4	5.8	6.8	48.7		8.1
86	Bean Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	1	3	3	3	4	5.8	7.2	46.0		7.7
87	Bean Creek - Surface Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	1	3	2	2	5.8	7.0	31.8		5.3
88	Bean Creek - Surface Diversion	In Lieu SVWD - 75% Dec-Mar water usage	1	1	3	2	2	5.8	6.3	31.2		5.2
89	Bean Creek - Surface Diversion	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	5.8	8.7	14.5	Yes	0.0
90	Bean Creek - Surface Diversion	CE - Aquifer Recharge - Injection Wells	1	2	2	3	3	5.8	6.8	37.7		6.3
91	San Lorenzo River - Surface Diversion	SSV - Aquifer Recharge - Low Impact Development	0	X	X	X	X	5.2	8.7	13.8	Yes	0.0
92	San Lorenzo River - Surface Diversion	SSV - Aquifer Recharge - Injection Wells	1	3	1	3	3	5.2	6.8	38.0		6.3
93	San Lorenzo River - Surface Diversion	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	2	1	2	2	5.2	6.5	29.7		4.9
94	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	1	4	3	3	4	5.2	7.5	48.7		8.1
95	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	4	3	3	4	3	5.2	6.8	44.0		7.3
96	San Lorenzo River - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	3	3	3	4	3	5.2	7.2	44.3		7.4
97	San Lorenzo River - Surface Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	1	2	2	3	3	5.2	7.0	37.2		6.2
98	San Lorenzo River - Surface Diversion	In Lieu SVWD - 75% Dec-Mar water usage	1	2	2	3	2	5.2	6.3	33.5		5.6
99	San Lorenzo River - Surface Diversion	CE - Aquifer Recharge - Low Impact Development	0	X	X	X	X	5.2	8.7	13.8	Yes	0.0
100	San Lorenzo River - Surface Diversion	CE - Aquifer Recharge - Injection Wells	1	2	2	3	3	5.2	6.8	37.0		6.2

Table 8-2 - Project Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Constructability accounts for issues that may affect the ability of the project to be constructed. Different types of sites may have very different issues. These include: • Site access and logistics – the ability for workers, machinery and materials to reach and maneuver within the site, • Logistics – having sufficient space for operation of machinery and storing materials, presence of necessary utilities, and special safety or environmental conditions • Site suitability – covers a wide range of potential issues that include the required size of the site, site conditions, pre-existing conditions such as geotechnical issues.	1 – Problematic with complex logistical, access and site suitability issues anticipated 2 – Difficult logistical, access and site suitability issues anticipated 3 – Uncertain, logistical, access and site suitability issues may arise 4 – Standard logistical and site access issues anticipated 5 – Straightforward with few logistical, access and site suitability issues anticipated **Weight = 3** This is considered a key aspect so it is given a higher scoring weigh
Conveyance can be a limiting factor for many water projects because of the cost of a long pipeline, resolving right-of-way issues to define a pipeline route, and special safety or environmental conditions during construction. Viability and costs can also be impacted by topography and geology. Significant variations in topography may require booster stations. Poor geology conditions may require special equipment.	1 – Long pipeline with complex topography and right-of-way issues 2 – Long pipeline with standard topography and right-of-way issues 3 – Moderate pipeline with topography and right-of-way issues 4 – Moderate pipeline with few topography and right-of-way issues 5 – Short, direct pipeline with clear right-of-way **Weight = 2**
Project Engineering accounts for the requirements for the design of the project. Projects utilizing existing infrastructure are considered preferable. Projects requiring primarily standard engineering components are considered to be of relatively low risk. Projects requiring complex design and installation of nonstandard engineering components and/or the design is dependent on detailed site-specific data are considered of higher risk of unanticipated complications and are rated lower.	1 – Requires significant new infrastructure and land acquisition 2 – Requires new infrastructure and/or large land acquisition 3 – Uses mostly new infrastructure and/or large land acquisition 4 – Uses new and existing infrastructure with minor land acquisition 5 – Uses mostly existing infrastructure on available land **Weight = 2**

Table 8-2 - Project Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Long-Term Sustainability provides a general assessment of the projects ability to meet the Conjunctive Use Project objectives based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions. Projects are rated higher for proven technologies with strong conceptual understanding for success. Projects are rated lower for less proven technology, or uncertainty in site conditions.	1 – Problematic, low potential for resolving long-term water issues 2 – Low potential for resolving long-term water issues 3 – Reasonable potential to improve long-term water issues 4 – High potential to improve long-term water issues 5 – Clear potential to solve multiple long-term water issues **Weight = 3** This is considered a key aspect so it is given a higher scoring weight.
Water Source Rating scores from the water source screening analysis are incorporated into the project score. This allows for the results of the previous analysis to influence the project screening.	Uses Score from the Preliminary Screening Analysis for Water Source. **Weight = 1** These scores are considered to already be equivalently weighted; therefore, a low weighting factor is used.
Water Application Rating scores from the water application screening analysis are incorporated into the project score. This allows for the results of the previous analysis to influence the project screening.	Uses Score from the Preliminary Screening Analysis for Water Application. **Weight = 1** These scores are considered to already be equivalently weighted; therefore, a low weighting factor is used.

Table 8-3 - Project Screening Ordered Results

Rank	Source	Application	Project Score
1	Stormwater - Roofs	CE - Aquifer Recharge - Low Impact Development	9.83
2	Stormwater - Roofs	SSV - Aquifer Recharge - Low Impact Development	9.83
3	City of Santa Cruz Graham Hill WTP	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	9.03
4	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Low Impact Development	8.86
5	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Low Impact Development	8.86
6	City of Santa Cruz Graham Hill WTP	In Lieu SVWD - 75% Dec-Mar water usage	8.42
7	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	8.36
8	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	8.31
9	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	8.25
10	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	8.22
11	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	8.11
12	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	8.11
13	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Injection Wells	7.92
14	City of Santa Cruz - Felton Diversion	NHQ - Aquifer Recharge - Injection Wells	7.86
15	Zayante Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	7.81
16	Bean Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	7.67
17	City of Santa Cruz - Felton Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.50
18	San Lorenzo River - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	7.39
19	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	7.33
20	Bean Creek - Nearby Wellfield	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.22
21	Bean Creek - Nearby Wellfield	In Lieu SVWD - 75% Dec-Mar water usage	7.11
22	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.08
23	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	7.00
24	City of Santa Cruz - Felton Diversion	In Lieu SVWD - 75% Dec-Mar water usage	6.89
25	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Injection Wells	6.89

Table 9-1 - Preferred Alternative Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Relative Design and Build Cost provides only a general conceptual evaluation of potential project costs based on analogy with similar projects. These are considered rough order-of-magnitude costs that could vary significantly based on actual site conditions and project requirements. Lower cost projects are considered preferable and are given higher scores.	1 – Anticipated total project costs may exceed $50 million 2 – Anticipated total project costs between $25 to $50 million 3 – Anticipated total project costs between $10 to $25 million 4 – Anticipated total project costs between $5 to $50 million 5 – Anticipated total project costs less than $5 million **Weight = 2**
Relative Long-Term O&M Cost provides only a general conceptual evaluation of potential future operations and maintenance (OA&M) costs based on analogy with similar projects. These are considered very generalized estimates that could vary significantly based on actual site conditions and project requirements. Lower O&M costs are considered preferable and are given higher scores.	1 – Anticipated very high additional annual O&M costs 2 – Anticipated high additional annual O&M costs 3 – Anticipated moderate additional annual O&M costs 4 – Anticipated low additional annual O&M costs 5 – Anticipated minimal additional O&M costs **Weight = 2**
Outside Funding Potential provides general assessment of the potential for obtaining outside funding to construct the project. This assessment is based on knowledge of what types of projects are currently being funded by state and federal agencies. It is assumed that projects that provide multiple benefits including water supply reliability, fisheries, stormwater management, flooding and other environmental issues have a higher potential for future funding. Projects that are more "green" and use less energy and make better use of water resources are also considered as having a higher potential for future funding.	1 – Little to no potential for obtaining outside funds for project 2 – Minimal potential for obtaining outside funds for project 3 – Uncertain potential for obtaining outside funds for project 4 – Strong potential for future outside funds for project 5 – Current and future outside funds for project are available **Weight = 1**
Stakeholder Acceptance provides a criterion to account for the strength of support by the local stakeholders to implement the project. Projects with stronger local support have a higher likelihood to be implemented and are given a higher score. This is a subjective assessment based on local knowledge and input from the Technical Advisory Committee (TAC).	1 – Little to no regional support from TAC and local agencies 2 – Minimal regional support from TAC and local agencies 3 – Moderate regional support from TAC and local agencies 4 – Strong regional support from TAC and local agencies 5 – Regional support by TAC and local agencies is already underway **Weight = 4** This is considered a key aspect so it is given a higher scoring weight.

Table 9-1 - Preferred Alternative Screening Criteria Descriptions

Criteria Description	Ranking Criteria Definition
Relative Cost of Water provides a conceptual evaluation of the relative cost of water provided by the project. This provides a relative assessment of the Relative Design and Build and Long-Term O&M Costs versus the Potential Groundwater and Baseflow Benefits. This provides a relative assessment of the overall value of a project. This provides some balance to the analysis due to the overall wide range of uncertainty regarding project costs. Higher scores are given for projects with high benefits but low costs, and lower costs are given for projects with low benefits and high costs.	1 – Very high costs relative to unit volume of water benefit 2 – High costs relative to unit volume of water benefit 3 – Moderate costs relative to unit volume of water benefit 4 – Low costs relative to unit volume of water benefit 5 – Very low costs relative to unit volume of water benefit **Weight = 2**
System Reliability provides a general assessment of the projects long-term reliability to have a long project life based on current engineering knowledge of other similar projects and knowledge of the regional hydrological conditions. Projects are rated higher for proven technologies under similar project conditions. Projects are rated lower for less proven technology, or uncertain in project conditions.	1 – Problematic, highly susceptible to future changes 2 – Unstable, emerging issues may hinder project future use 3 – Reasonably stable, possibility of impacts from emerging issues 4 – Stable, few issues anticipated that could impact project's future 5 – Highly stable, good potential for long-term success **Weight = 1**
Project Rating scores from the project screening analysis are incorporated into the project score. This allows for the results of the previous analysis to influence the project screening.	Uses Score from the Preliminary Project Screening Analysis. **Weight = 1** These scores are considered to already be equivalently weighted; therefore, a low weighting factor is used.

Table 9-2 - Conjunctive Use Alternatives Screening Criteria Results

Rank	Source	Application	Design & Build Cost (Relative)	Long-term O&M Cost (Relative)	Funding Potential	Stakeholder Acceptance	Relative Water Cost	System Reliability	Total Score	Average Alternative Score
Screening Weight			**2**	**2**	**1**	**4**	**2**	**1**		
1	Stormwater - Roofs	CE - Aquifer Recharge - Low Impact Development	3	5	5	5	4	5	54.0	**9.0**
2	Stormwater - Roofs	SSV - Aquifer Recharge - Low Impact Development	3	5	5	5	4	5	54.0	**9.0**
3	City of Santa Cruz Graham Hill WTP	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	4	5	4	4	4	4	50.0	**8.3**
4	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Low Impact Development	4	4	4	4	3	4	46.0	**7.7**
5	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Low Impact Development	3	4	4	4	3	4	44.0	**7.3**
6	City of Santa Cruz Graham Hill WTP	In Lieu SVWD - 75% Dec-Mar water usage	4	5	4	4	4	4	50.0	**8.3**
7	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	2	2	2	2	2	2	24.0	**4.0**
8	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	3	3	3	3	3	4	37.0	**6.2**
9	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	2	2	2	2	2	2	24.0	**4.0**
10	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	2	2	2	2	2	2	24.0	**4.0**
11	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	1	2	1	1	1	1	14.0	**2.3**
12	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	2	2	2	2	2	2	24.0	**4.0**
13	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Injection Wells	4	4	3	3	3	3	40.0	**6.7**
14	City of Santa Cruz - Felton Diversion	NHQ - Aquifer Recharge - Injection Wells	4	4	3	3	3	2	39.0	**6.5**
15	Zayante Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	2	2	2	2	2	2	24.0	**4.0**
16	Bean Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	2	2	2	2	2	2	24.0	**4.0**
17	City of Santa Cruz - Felton Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	3	4	3	3	3	2	37.0	**6.2**

Table 9-2 - Conjunctive Use Alternatives Screening Criteria Results

Rank	Source	Application	Design & Build Cost (Relative)	Long-term O&M Cost (Relative)	Funding Potential	Stakeholder Acceptance	Relative Water Cost	System Reliability	Total Score	Average Alternative Score
Screening Weight			**2**	**2**	**1**	**4**	**2**	**1**		
18	San Lorenzo River - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	1	2	1	1	1	1	14.0	**2.3**
19	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	1	3	1	1	1	1	16.0	**2.7**
20	Bean Creek - Nearby Wellfield	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	5	5	4	2	3	3	41.0	**6.8**
21	Bean Creek - Nearby Wellfield	In Lieu SVWD - 75% Dec-Mar water usage	5	5	4	2	3	3	41.0	**6.8**
22	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	2	3	2	3	2	3	31.0	**5.2**
23	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	3	3	3	3	4	3	38.0	**6.3**
24	City of Santa Cruz - Felton Diversion	In Lieu SVWD - 75% Dec-Mar water usage	3	4	3	3	3	2	37.0	**6.2**
25	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Injection Wells	3	3	3	3	4	3	38.0	**6.3**

Table 9-3 - Conjunctive Use Alternatives Ordered Results

Alter-native	Source	Application	Source Rating	Application Rating	Project Rating	Alternative Rating	Preference Score
1	Stormwater - Roofs	CE - Aquifer Recharge - Low Impact Development	8.3	8.7	9.8	9.0	9.0
	Stormwater - Roofs	SSV - Aquifer Recharge - Low Impact Development	8.3	8.7	9.8	9.0	9.0
	Stormwater - Street and Parking Lots	CE - Aquifer Recharge - Low Impact Development	7.5	8.7	8.9	7.7	8.2
	Stormwater - Street and Parking Lots	SSV - Aquifer Recharge - Low Impact Development	7.5	8.7	8.9	7.3	8.1
2	City of Santa Cruz Graham Hill WTP	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	8.2	7.0	9.0	8.3	8.1
	City of Santa Cruz Graham Hill WTP	In Lieu SVWD - 75% Dec-Mar water usage	8.2	6.3	8.4	8.3	7.8
3	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Injection Wells	7.0	7.5	7.9	6.7	7.3
	City of Santa Cruz - Felton Diversion	NHQ - Aquifer Recharge - Injection Wells	7.0	7.2	7.9	6.5	7.1
	City of Santa Cruz - Felton Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	7.0	6.8	8.3	6.2	7.1
4	City of Santa Cruz - Felton Diversion	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	7.0	7.0	7.5	6.2	6.9
	City of Santa Cruz - Felton Diversion	In Lieu SVWD - 75% Dec-Mar water usage	7.0	6.3	6.9	6.2	6.6
5	Bean Creek - Nearby Wellfield	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	6.3	7.0	7.2	6.8	6.8
	Bean Creek - Nearby Wellfield	In Lieu SVWD - 75% Dec-Mar water usage	6.3	6.3	7.1	6.8	6.7
6	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.5	6.5	7.0	6.3	6.6
	Stormwater - Intercept Storm Drains	SSV - Aquifer Recharge - Injection Wells	6.5	6.8	6.9	6.3	6.6
7	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	6.7	7.5	8.4	4.0	6.6
	Zayante Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	6.7	6.8	8.3	4.0	6.4
	Zayante Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	6.7	7.2	7.8	4.0	6.4
8	Loch Lomond + SLVWD-SVWD Exchange	In Lieu SVWD + SLVWD - 75% Dec-Mar water usage	6.5	7.0	7.1	5.2	6.4
9	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	5.8	7.5	8.2	4.0	6.4
	Bean Creek - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	5.8	6.8	8.1	4.0	6.2
	Bean Creek - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	5.8	7.2	7.7	4.0	6.2
10	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Injection Wells	5.2	7.5	8.1	2.3	5.8
	San Lorenzo River - Surface Diversion	NHQ - Aquifer Recharge - Injection Wells	5.2	7.2	7.4	2.3	5.5
	San Lorenzo River - Surface Diversion	SHQ - Aquifer Recharge - Infiltration Basin/Percolation Ponds	5.2	6.8	7.3	2.7	5.5