Appendix B1

Groundwater Management, Monitoring, and Mitigation Plan

Groundwater Management, Monitoring, and Mitigation Plan

For

The Cadiz Groundwater Conservation, Recovery and Storage Project

November 29, 2011

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EXECUTIVE SUMMARY

The fundamental purpose of the Cadiz Valley Groundwater Conservation, Recovery and Storage Project (Project) is to conserve and recover substantial quantities of groundwater that in absence of the Project would otherwise evaporate. This Groundwater Management, Monitoring and Mitigation Plan (Management Plan) sets forth the plan of action to optimally manage groundwater resources, monitor and mitigate physical effects of the Project, and ensures that Project operations will be conducted without significant adverse impacts to critical resources. It is prepared to comply with the County of San Bernardino's Desert Groundwater Ordinance either as a permitted or exempted Project. The Project is a 50-year groundwater recovery, conservation and conjunctive use storage project located within the collective Fenner, Orange Blossom Wash, Bristol and Cadiz Watersheds in the Eastern Mojave Desert. It will provide reliable water supply to the Santa Margarita Water District (SMWD) and other participating water agencies. The first phase of the Project will provide for the extraction of groundwater in amounts not to exceed an annual average of 50,000 acre-feet per year (afy) from a wellfield in the area within and south/southwest of the Fenner Gap. The second phase of the Project will use available aquifer capacity to operate a one million acre-feet groundwater storage bank to facilitate the storage and recovery of imported water over the Project’s 50-year term. The full term of the Project’s operation, including the first and second phases, shall be limited to 50-years.

In order to assess impacts that might occur post-project operations, modeling of impact assessments associated with groundwater extraction cover at least 100 years: 50 years of Project operations and 50 years after completion of Project operations. During the first phase, the average extraction of 50,000 afy will capture annual native recharge plus groundwater in storage that is migrating toward the Bristol and Cadiz Dry Lakes. Additional extractions above annual native recharge are planned for the purpose of strategically lowering groundwater levels in the vicinity of the Project wellfield in a managed manner to realize two essential Project benefits that are not available under existing conditions. First, the lowering of groundwater levels will cause existing groundwater gradients to reverse so that the Project will retrieve substantial quantities of potable groundwater located to the south and east of the wellfield that would otherwise flow into the saline groundwater underlying the dry lakes and ultimately be lost to evaporation. Lowered groundwater levels at the end of pumping will further slow the loss of groundwater to evaporation at the dry lakes until these lowered groundwater levels recover as a result of natural recharge and restore the hydraulic gradient such that losses to evaporation return to pre-project levels. The cumulative reduction in evaporative losses of groundwater from the dry-lakes over 100 years could be as much as 2,210,000 acre-feet for the higher recharge rate. Second, the managed lowering of groundwater levels will also establish dewatered space within the aquifer to facilitate the storage and recovery of imported water during the second phase of the Project.

The Management Plan is designed to avoid significant adverse impacts to the critical resources within the region, including the following:

- Groundwater aquifers tapped by the Project, including chronic decline in groundwater levels, potential impacts to groundwater quality, land subsidence, and existing groundwater uses;
- Local springs within the Fenner Watershed;
- Brine resources of Bristol and Cadiz Dry Lakes
- Air quality in the Mojave Desert region; and
- Adjacent areas, including the Colorado River and its tributary sources of water.

By definition, the Project intends to implement a managed drawdown in water levels to achieve specific conservation objectives. This Management Plan is designed to prevent adverse Project impacts traditionally associated with groundwater pumping by collecting data and determining if observed changes in groundwater levels, groundwater quality, and land subsidence are consistent with projected changes from groundwater modeling as described in this Management Plan and references cited herein. If there are deviations from the groundwater modeling projections, those deviations will prompt further investigation and assessment under this Management Plan, and if necessary, implementation of corrective measures so as to avoid potential adverse impacts to critical resources. As discussed in this Management Plan, significant technical research has been undertaken to determine the likely impacts of the Project, if any, to these critical resources. The Project approval is limited to a defined period of operations (50 years). The existing research demonstrates that it is unlikely the Project will cause any significant adverse impacts to the identified critical resources, including area springs, vegetation, regional air quality, and the Colorado River and its tributary sources of water. Existing research and groundwater modeling also demonstrates that the drawdown of groundwater caused by the Project will not cause any long-term material impacts to the aquifer system or surface uses within the Project area.

The Management Plan nonetheless incorporates a comprehensive network of monitoring features and data collection facilities combined with procedures for comprehensive scientific review of all actions and decisions to avoid potential significant adverse impacts by the Project to the critical resources. The monitoring features and data collection facilities include:

- Local springs;
- Observation wells at various locations, several of which will be clustered wells with depth-discrete screened intervals;
- Project production wells;
- Land survey benchmarks;
- Downhole flowmeter surveys;
- Gamma-ray and dual induction electric logs;
- Nephelometers for dust monitoring; and
- Weather stations.

The Management Plan establishes a process for scientific review of the observations and data obtained from monitoring features and facilities, and sets forth action criteria, and if appropriate, corrective measures to be taken if an action criterion is exceeded. The Management Plan has taken a conservative approach in its action criteria and potential corrective measures for the following potential Project impacts so that even where technical memoranda indicate that no impacts are expected to occur, some action still may be contemplated:

- Local springs;
- Third-party wells;
- Land subsidence;
- Induced flow of lower-quality water from Bristol and Cadiz Dry Lakes;

- Brine resources underlying Bristol and Cadiz Dry Lakes;
- Air quality; and
- Adjacent groundwater basins, including the Colorado River and its tributary sources of water.

This Management Plan requires FVMWC to operate the Project while using Cadiz land and resources in compliance with the plan's provisions. These provisions incorporate those required by the California Environmental Quality Act (CEQA) as mitigation for potential project impacts and also include additional project design features to monitor and verify project operations and predicted effects and confirm protection of critical resources. These additional project design features are not required under CEQA but, for the avoidance of doubt, they have been included to provide a comprehensive monitoring program for the groundwater basin and all critical resources within the watershed. In particular, some of the additional project design measures have been included in the plan for select resource areas even though the technical information (as reflected in the EIR analysis) indicates that the Project would have no adverse effect on these resources. These resource areas include springs, air quality/dust, and groundwater resources within adjacent basins. Although the Project would not result in adverse effects on these specific resources, verification monitoring will be conducted on these resource areas under this Plan.

A Technical Review Panel (TRP) is created to review data, technical analyses compiled by the Fenner Valley Mutual Water Company (FVMWC) as well as FVMWC's assessment of technical data and responsive actions, proposed refinements to the Management Plan, and corrective measures regarding compliance with the provisions of the Management Plan. The TRP will be constituted by technical appointees of the County of San Bernardino, the FVMWC and/or its joint powers agency affiliate, and a third technical appointee chosen and appointed by the technical appointees of the County and the FVMWC. Determinations and recommendations from the TRP are to be provided to SMWD for final decision as the Project's Lead Agency with responsibility for mitigation of Project impacts pursuant to the Project's Environmental Impact Report and Public Resources Code section 21081.6.

The Management Plan requires that all technical data be made available to the public in the form of annual reports approved and maintained by SMWD, and also calls for periodic water resources model refinements and incremental five-year projections of the physical impacts of Project operations to be set forth in periodic reports, together with any recommendations for Project improvements.

CHAPTER 1
INTRODUCTION AND BACKGROUND

1.1 The Cadiz Valley Water Conservation, Recovery, and Storage Project

This Groundwater Management, Monitoring and Mitigation Plan (Management Plan) is an integral part of the Cadiz Groundwater Conservation, Recovery and Storage Project (Project). The Project is a water conservation supply and conjunctive use storage project that would make optimal use of the groundwater resources within the collective Fenner, Orange Blossom Wash, Bristol and Cadiz Watersheds in the Eastern Mojave Desert, without displacing other beneficial uses (See Figure 1-1). The Project will develop a new water supply from the surplus waters of the Watersheds and enable the use of groundwater storage for banking with participating water agencies as described herein.

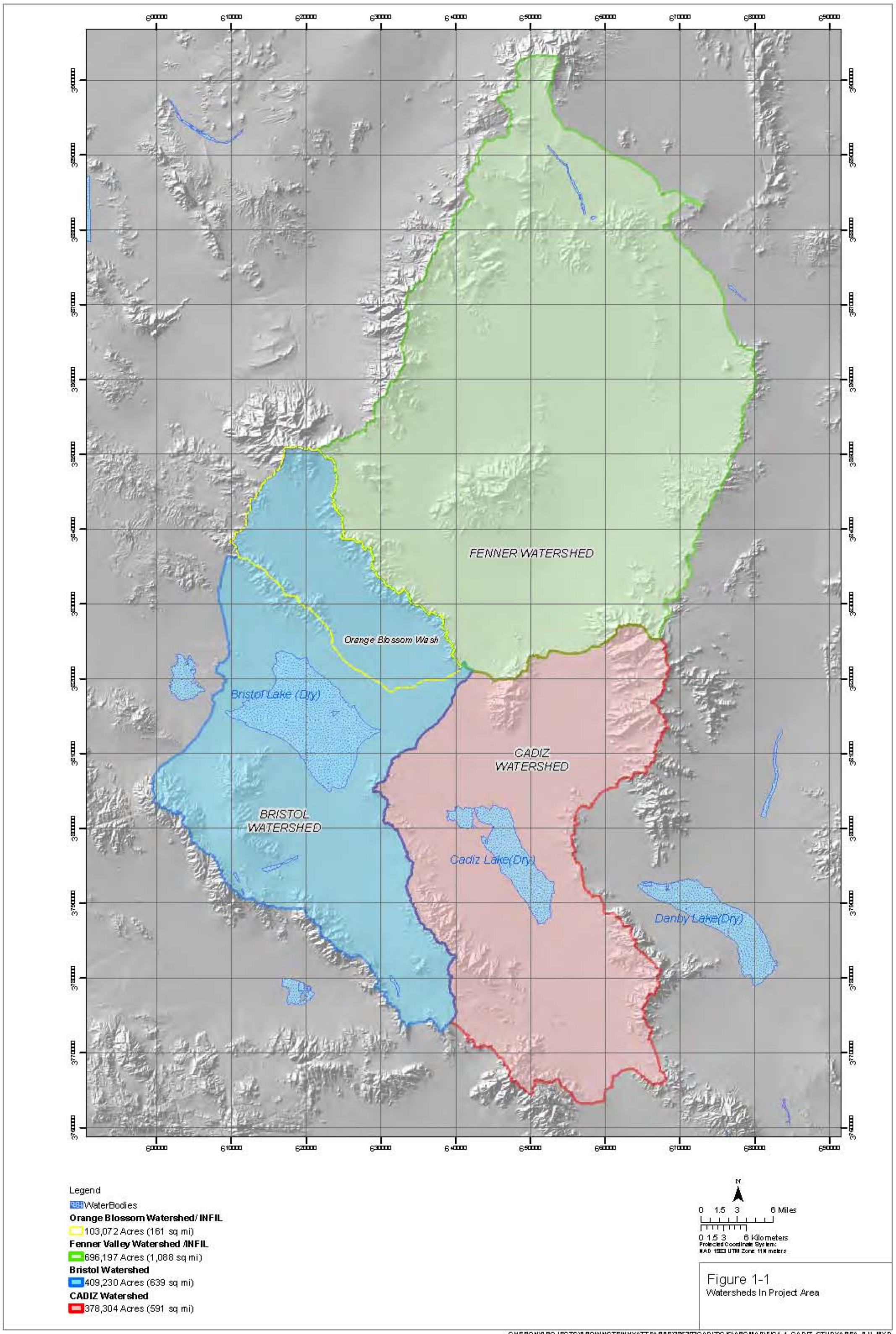


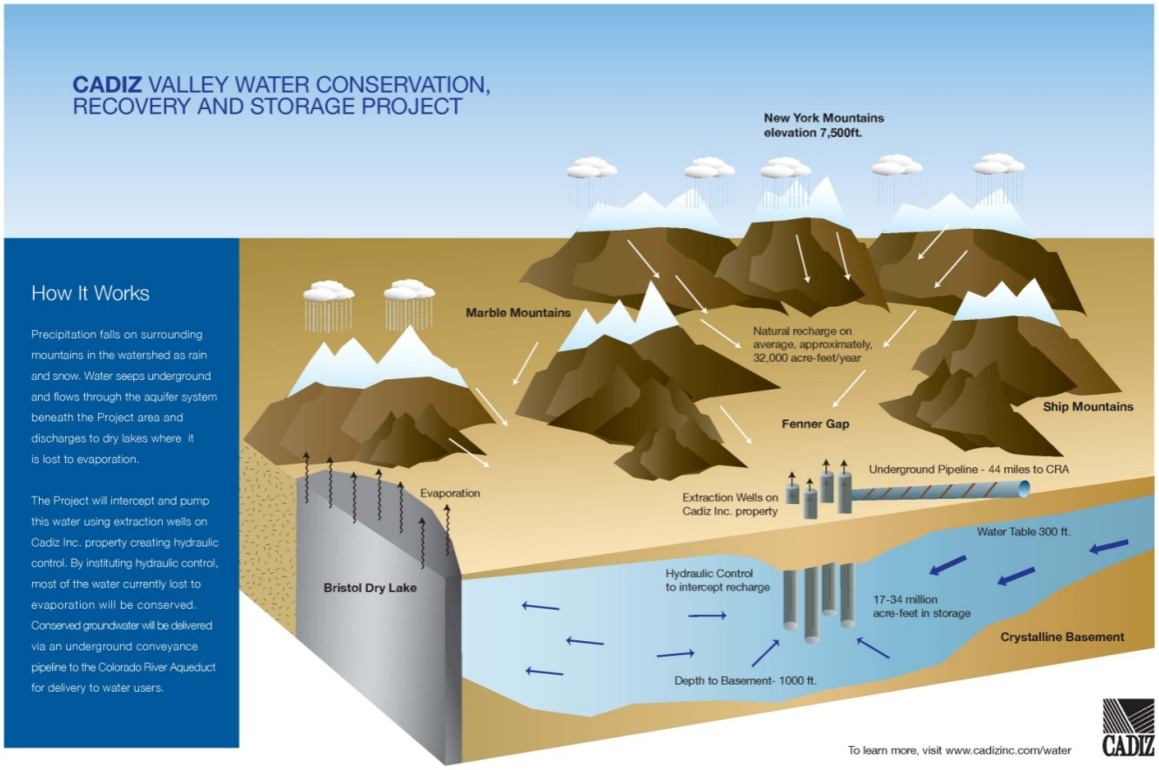
Figure 1-1
Watersheds In Project Area

The first phase of the Project, which is referred to herein as the “Conservation Component,” would extract and convey an average of approximately 50,000 acre-feet per year (afy) from a wellfield in the area within and south/southwest of Fenner Gap via pipeline to the Colorado River Aqueduct (CRA). The 50,000 afy of extraction will make use of the long-term average annual natural recharge from the Fenner and Orange Blossom Wash Watersheds. Groundwater extraction will strategically lower groundwater levels within the immediate vicinity of the Project wellfield to intercept natural recharge and retrieve groundwater already held in storage beneath and downgradient of the wellfield before it can evaporate from the dry lakes as discussed below.

The second phase of the Project, the Storage Project, would involve managing the groundwater basin conjunctively, by importing water during times of surplus, storing it in the basin, and recovering the stored water to meet drought, emergency, or other demands. The dewatered storage created by extracting more than the annual natural recharge in Phase I will create supplemental storage space within the aquifer system, which can support a conjunctive use project to store surplus imported surface water when available to be recovered when needed. Imported water for storage would be conveyed to the Fenner Gap area by pipeline from the CRA, and potentially an interconnection of the California Aqueduct to the Project through a converted natural gas pipeline. The water would be recharged into the groundwater basin via spreading basins constructed within or just north of the Fenner Gap.

Under the Storage Component of the Project, up to 1 million acre-feet of dewatered capacity would be managed and made available for groundwater banking.

A conceptual model of the Project is shown in Figure 1-2.



Proposed monitoring in this Management Plan only addresses Phase I of the Cadiz Groundwater Conservation, Recovery and Storage Project. The potential storage and recovery of up to a million acre-feet of imported water was previously analyzed in 2000-2002 by the United States Bureau of Land Management in connection with its grant of a right-of-way for a project then proposed by the Metropolitan Water District of Southern California. This Management Plan will be updated and revised prior to implementation of Phase II in order to integrate additional monitoring and mitigation requirements that may result from additional CEQA analysis and review associated with the proposed conjunctive use operations taking into account variables such as the identify of the project participants, the source of supply, volumes and timing.

1.2 Overview of the Management Plan

This Management Plan governs water use, storage and extraction for the Project, and ensures that Project operations and future irrigation under the Cadiz Valley agricultural development will be conducted without significant adverse impacts to critical resources. Agricultural irrigation will also remain subject to the Cadiz Valley Agricultural Development Ground Water Monitoring Plan required by the County of San Bernardino until the agricultural operations are phased out, when this Project produces 50,000 afy. Regardless, the total quantity of groundwater extracted will not exceed 50,000 afy annual average over the 50-year operational term. This Management

Plan is designed to prevent adverse Project impacts by collecting data and determining if observed changes in groundwater levels, groundwater quality, and land subsidence are consistent with projected changes from groundwater modeling as described in this Management Plan and references cited herein. If there are deviations from the groundwater modeling projections, those deviations will prompt further investigation and assessment under this Management Plan, and if necessary, implementation of corrective measures, so as to avoid potential adverse impacts to critical resources. Critical resources identified in this Management Plan are as follows:

- The basin aquifers tapped by the Project, including chronic decline of groundwater levels, potential impacts to groundwater quality, land subsidence, and existing groundwater uses;
- Springs within the Fenner Watershed, including springs of the Mojave National Preserve and BLM-managed lands;
- Brine resources of Bristol and Cadiz Dry Lakes
- Air quality in the Mojave Desert region;
- Project area vegetation; and
- Adjacent groundwater basins, including the Colorado River and its tributary sources of water.[1]

This Management Plan establishes a comprehensive network of monitoring and data collection facilities combined with procedures for comprehensive scientific review of all actions and decisions. The groundwater modeling analysis completed for impacts assessments provide the baseline for future observations and actions. For example, if changes in groundwater levels, groundwater quality, and land subsidence exceed that projected by the model, then these observations will trigger a reassessment of those impacts, including recalibration of the groundwater models and updated projections of potential impacts. For several critical resources, including local springs, air quality, and

[1] As explained in Chapter 2 of this Management Plan, technical analysis to date concludes that there is no hydrogeologic connection between groundwater that would be extracted by the Project, and groundwater supplies to the northeast within watersheds that are tributary to the Colorado River. Nonetheless, to confirm that no such hydraulic connection exists, this Management Plan proposes the monitoring of groundwater levels in the adjacent Piute Watershed, which is tributary to the Colorado River. This confirmation will demonstrate that the Project will not pose adverse impacts to the Colorado River, and will enable Colorado River water users to qualify for Intentionally Created Surplus (discussed below) in relation to their Project participation,

the groundwater resources of neighboring basins, the Management Plan provides for monitoring of such critical resources even though technical research and available scientific data demonstrate that the Project will not impact these critical resources. The monitoring is done as a cautionary measure for the avoidance of any doubt as to the potential to cause environmental harm and to comport with the recommendations of the Groundwater Stewardship Committee, a multi-disciplinary panel of earth science and water professionals assembled to provide advice and comment on the Project. (See Appendix A - Groundwater Stewardship Committee, Current Summary of Findings and Recommendations Cadiz Groundwater Conservation, Recovery and Storage Project.)

This Management Plan also mandates specific action criteria (trigger levels) for impacts to critical resources, and specified responses if an action criterion is reached. It establishes a defined process for scientific review of groundwater management, climate information, a decision-making process to protect critical resources, and allows for refinements to this Management Plan. Management Plan reports will be of public record.

This Management Plan has been prepared by Cadiz and FVMWC to comply with the County of San Bernardino's Guidelines for Preparation of a Groundwater Monitoring Plan and Desert Groundwater Ordinance, which provides that a groundwater extraction project may be exempted from the Ordinance if the project will be managed consistent with a County-approved management, monitoring and mitigation plan. FVMWC will operate the Project in compliance with the provisions of this Management Plan and by definition it will avoid chronic overdraft. The Project's fundamental objective is conserving groundwater already in storage that would otherwise evaporate in the absence of the Project. The Project is intended to pump groundwater in excess of the recharge rate so as to enable the retrieval of more than 2 million af of groundwater and the beneficial use of 2.5 million af of groundwater over a defined 50-year period. A TRP will be established to review data, technical analyses, and FVMWC's assessment, proposed refinements to this Management Plan, and corrective measures regarding compliance with the provisions of this Management Plan. The TRP will be comprised of technical appointees of the County of San Bernardino, the FVMWC and/or its joint powers agency affiliate, and an at large representative selected by the representative from the County and FVMWC. The composition, duties and responsibilities of the TRP, and its decision-making process are described in Chapter 8.

The term "feature" refers to any fixed object, either natural or man-made, from which data will be collected. Man-made features include wells from which water level measurements and water quality samples could be retrieved, weather stations, bench marks, etc. A detailed list of monitoring features is given in Chapter 5 of this plan. As new data become available during Project operations, these monitoring features, monitored parameters, and monitoring frequency may be refined to protect critical resources in and adjacent to the Project area. Refinements to monitoring features will be made in accordance with the decision-making process described in Chapters 6 and 8.

The Project will be comprised of three time periods: a pre-operational period, an operational period of 50 years, and a post-operational monitoring period that will span a minimum of 10 years, subject to review and a potential extension by the TRP and SMWD. The pre-operational phase will commence upon start of construction. The pre-operational phase will last a minimum of 12 months. Cadiz will use its best efforts to complete and deliver all needed permits for monitoring facilities, as soon as practicable within the pre-operational phase. Cadiz will construct all facilities that are agreed to in this Management Plan and for which permits have been received. Construction of these facilities will be completed within one year of receipt of permits.

The Project may be extended pursuant to the exercise of discretion of the Project participants for an additional forty-year period. In the event the project participants elect to extend the Project for an additional term, new agreements and a new management plan will be required for such an extension. In addition, new environmental review would be required prior to the Project being extended. Moreover, an extension of the Project would not entitle any participant to a specific quantity of water. No quantity of recoverable groundwater for an extension is estimated at this time. A new management plan would be required for an extension.

1.3 The Project Area

The Project area is located in the eastern Mojave Desert of San Bernardino County, California approximately 200 miles east of Los Angeles, 60 miles southwest of Needles, and 40 miles northeast of Twentynine Palms. The Project wellfield is located within and south/southwest of the Fenner Gap which is centered between the Marble and Ship Mountains east of Cadiz.

The Project area can be divided into four areas for discussion purposes. The first and largest area is the area encompassed by the totality of Bristol, Cadiz and Fenner Watersheds as shown in Figure 1-3, which is referred to herein as the "larger watershed area." Orange Blossom Wash is within the Bristol Watershed. The second area is the region beyond the larger watershed area, which includes adjacent areas that are tributary to the Colorado River, such as the Piute Watershed. This second area is referred to herein as "adjacent regions." All precipitation within the larger watershed area that infiltrates to the groundwater table or runs off as surface flow, ultimately discharges to the Bristol or Cadiz Dry Lakes. Groundwater flow from the Fenner Watershed converges on and discharges through the Fenner Gap and ultimately makes its way to the Bristol and Cadiz Dry Lakes. Similarly, groundwater flow in the Orange Blossom Wash area moves downgradient to Bristol dry lake. The proposed Project wellfield would be located downgradient of the Fenner Gap, within the third area, the freshwater zone between Fenner Gap and Bristol dry lake as mapped by Shafer (1964), which is referred herein as the northern Bristol/Cadiz sub-basin (Figure 1-3). The fourth area is the area of the proposed wellfield, which is referred to herein as the wellfield area (Figure 1-3).

The total area of the Bristol (which includes Orange Blossom Wash), Cadiz and Fenner watersheds is approximately 2,320 square miles. The Bristol Watershed is approximately 640 square miles, the Cadiz Watershed is 590 square miles, and the Fenner Watershed is approximately 1,090 square miles.

These watersheds are considered to be a single closed drainage system because all surface and groundwater drains to central lowland areas of the Bristol and Cadiz Dry Lakes. The Bristol, Cadiz, and Fenner watersheds are separated from the surrounding watersheds within the adjacent regions by topographic divides (generally mountain ranges).

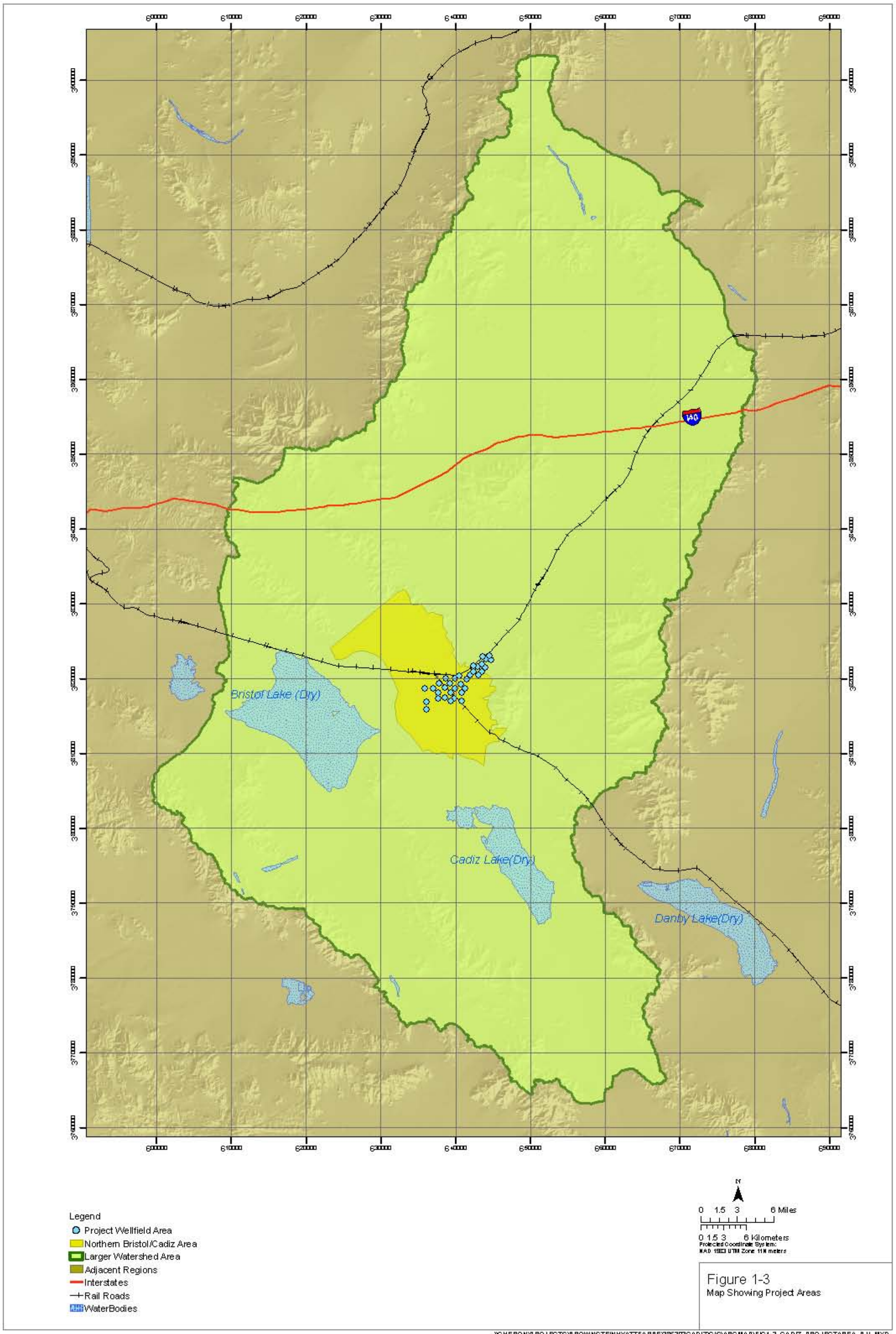


Figure 1-3
Map Showing Project Areas

A map of key current and future Project facilities is shown in Figure 1-4.

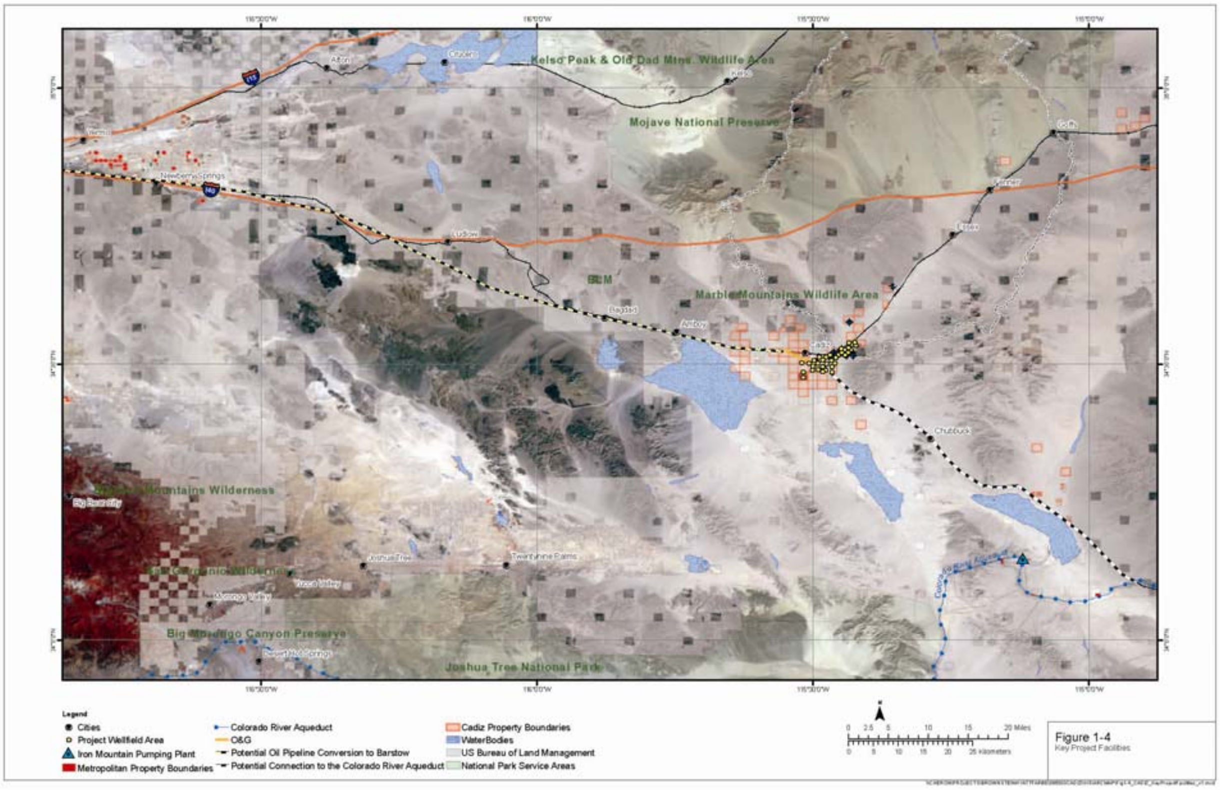


Figure 1-4
Key Project Facilities

1.4 The Parties

The Project and the Groundwater Management Plan are the joint efforts of Cadiz Inc., the SMWD, and in coordination with the County of San Bernardino Guidelines for Preparation of a Groundwater Monitoring Plan.

1.4.1 *Cadiz, Inc.*

Founded in 1983, Cadiz Inc. (Cadiz) is a renewable resources company based in Los Angeles. Using integrated satellite imagery and geological, geophysical, and geochemical survey methods, the company has identified and acquired 34,000 acres of land in Cadiz Valley situated over a large, naturally recharging basin. Cadiz's goal is for this basin to provide a high-quality, reliable water supply to southern Californians, as well as much-needed underground storage for surplus water, all without causing material adverse impacts to the local environment.

1.4.2 *Santa Margarita Water District*

SMWD was initially formed in 1964 by ranchers seeking a reliable water supply for their cattle, and it has grown into the second largest retail water agency in Orange

County. It supplies clean, affordable, reliable water and wastewater services to over 155,000 residents and businesses in Mission Viejo, Rancho Santa Margarita and the unincorporated areas of Coto de Caza, Las Flores, Ladera Ranch and Talega. When implemented, the Project will diversify SMWD's water portfolio and help drought-proof the District to ensure its water demands are met regardless of the State's supply. The District is the Lead Agency for the Project's California Environmental Quality Act (CEQA, Cal. Pub. Res. Code §§ 21000 *et seq*.) review process, and is responsible for evaluating the Project's alternatives, environmental impacts, and potential mitigation measures. This Groundwater Management Plan shall serve as an exhibit to, and be incorporated within, the Environmental Impact Report certified by SMWD for purposes of its compliance with CEQA in conjunction with its approval of the Project.

1.4.3 *County of San Bernardino*

The County of San Bernardino (County) exercises its management authority over County groundwater resources through the Desert Groundwater Management Ordinance (Ordinance). The proposed Project lies within the unincorporated desert area of eastern San Bernardino County, where water groundwater production is regulated under the County's Desert Groundwater Management Ordinance (Ordinance). (San Bernardino Code §§ 33.06551 *et seq*.). The Ordinance does not apply to the operation of groundwater wells where the operator has developed a groundwater management, monitoring and mitigation plan approved by the County and the County and the operator have executed a memorandum of understanding (MOU) that complies with the provisions of the Ordinance. (San Bernardino Code §33.06552(b)(1).) This Groundwater Management Plan shall serve as an exhibit to, and be incorporated within, a MOU amongst the County, FVMWC, SMWD and Cadiz to establish the exemption of the Project from the Ordinance pursuant to section 33.06552(b)(1) of the Ordinance, and to otherwise ensure that the Project is optimally operated to realize the Project's objectives of making the fullest beneficial use of the area's groundwater resources while avoiding significant adverse impacts to the environment. Because the County's execution of such an MOU to qualify the Project for exclusion from the Ordinance is a discretionary action by the County, it is anticipated that Santa Bernardino County's decision is discretionary and subject to CEQA with the County acting as a responsible agency.

1.4.4 *Fenner Valley Mutual Water Company*

FVMWC is a California mutual water company formed in accordance with California Water Code Section 2700 et seq. for the purpose of owning and operating a water company for the delivery of water to its shareholders at cost. Outstanding shares are available for issuance to all project participants, and it has the power to contract with public agencies for the purposes of forming a joint powers agency. FVMWC will operate the Water Project. It may elect to contract with an affiliated joint powers agency (See California Government Code Section 6525.) Pursuant to this Management Plan, FVMWC shall assess technical data and responsive actions, proposed refinements to the Management Plan, and corrective measures regarding compliance with the provisions of the Management Plan, and prepare and submit various annual and periodic technical reports, all in consultation with the TRP and subject to the oversight and final decision of SMWD, as specified further in Chapters 6, 7, 8 and 9.

1.4.5 *Other Anticipated Project Participants*

In addition to the three Project parties listed above, other water service providers and additional users are expected to participate in the Project. These participants include:

- Three Valleys Municipal Water District, which serves 133 square miles in Los Angeles County, California, and includes Azusa, City of Industry, Covina, Claremont, Diamond Bar, Glendora, Hacienda Heights, La Puente, La Verne, Pomona, Rowland Heights, San Dimas, Walnut, and West Covina.

- Golden State Water Company, which provides service to three water service regions across 10 California counties. Region I consists of 7 customer service areas in northern and central California, and Ventura County; Region II consists of 4 customer service areas located in Los Angeles and Orange County; and Region III consists of 10 customer service areas in eastern Los Angeles County and in Orange, San Bernardino, and Imperial counties.

- Suburban Water Systems Service Area, which serves an area covering approximately 42 square miles, including all or portions of Glendora, Covina, West Covina, La Puente, Hacienda Heights, City of Industry, Whittier, La Mirada, La Habra, Buena Park and unincorporated portions of California's Los Angeles and Orange counties.

- Jurupa Community Services District (JCSD), which provides potable water, sewer and street lights to over 101,000 people located throughout 48 square miles in the Jurupa area of Riverside County. JCSD serves unincorporated areas of Riverside County as well as the communities of Jurupa Valley and Eastvale.

- California Water Service Company (Cal Water) distributes and sells water to 1.7 million Californians through 435,000 connections. Its 24 separate water systems serve 63 communities from Chico in Southern California to the Palos Verdes Peninsula in Southern California.

- Arizona California Railroad (ARCZ) owns and operates a railway line in a right-of-way that runs between the Cadiz Property and the Colorado River. Its parent company is RailAmerica.

1.5 Project Description

The Project will include two phases:

1.5.1 *Phase I*

Phase I will provide for extraction and delivery to the CRA of up to an annual average of 50,000 afy for delivery to Project participants in compliance with this Management Plan, to avoid adverse impacts to critical resources. Extraction in any given year may range from 25,000 to 75,000 afy, but over the 50-year operating period of the Project, shall not exceed more than an annual average of 50,000 afy, inclusive of agricultural production by Cadiz. Project participants will also be authorized to carryover their annual allocations by storing their water in the basin for later extraction and delivery during drought or emergency conditions within the 50-year operation period.

The Project involves construction and operation of the facilities shown on Figures 1-3 and 1-4 and as described below:

- A wellfield of up to approximately 34 extraction wells and appurtenant facilities;

- An approximately 43-mile long conveyance pipeline and appurtenant facilities from CRA to the wellfield, including power, generally parallel to the conveyance;

- Instrumentation and control systems to monitor all Project operations; and

- Observation wells, cluster wells, land survey benchmarks, extensometers, weather stations and other appurtenant facilities necessary for this Management Plan.

The conveyance and power distribution facilities, observation wells, land survey benchmarks, and other monitoring features, along with all Project facilities, will be located on land owned or easements obtained by Cadiz.

1.5.2 *Phase II*

Phase II will provide conjunctive-use storage, up to a total storage at any given time of one million acre-feet, in compliance with an updated version of the Management Plan and without significantly adversely impacting critical resources. Conceptually, imported water to be stored will be conveyed from either the CRA to spreading basins in the Project area during periods of surplus supply, or from the California Aqueduct via potential conversion of an existing pipeline previously used for oil and recently made ready for the delivery of natural gas. A maximum of 75,000 to 105,000 afy of water will be stored in the basin annually. This stored water will subsequently be extracted by the Project wellfield and conveyed back to the CRA and/or through a converted natural gas pipeline for conveyance of water to and from the Barstow area as needed. A maximum of 75,000 to 105,000 afy of water will be extracted annually and conveyed through the 43-mile pipeline to the CRA and/or through the converted natural gas pipeline to the State Water Project facilities in San Bernardino County. Phase I and Phase II operations will be coordinated and in lieu storage may be used for Phase II. Phase II will require additional CEQA review and updates to this Management Plan prior to implementation.

1.6 Project Objectives

The Project objectives are as follows:

- Maximize beneficial use of groundwater in the Bristol, Cadiz, and Fenner Valleys by conserving and using water that would otherwise be lost to brine and evaporation;

- Improve water supply reliability for Southern California water providers by developing a long term source of water that is not significantly affected by drought;

- Reduce dependence on imported water by utilizing a source of water that is not dependent upon surface water resources from the Colorado River or the Sacramento-San Joaquin Delta;

- Enhance dry-year water supply reliability within SMWD and other Southern California water provider Project Participants;

- Enhance water supply opportunities and delivery flexibility for SMWD and other participating water providers through the provision of carry-over storage and, for Phase II, imported water storage;
- Support operational water needs of the ARZC in the Project area;
- Create additional water storage capacity in Southern California to enhance water supply reliability;
- Locate and design the Project in a manner that minimizes significant environmental effects and provides for long-term sustainable operations.

1.7 Existing Groundwater Management

Cadiz owns 35,000 acres of largely contiguous land in the Cadiz and Fenner Valleys of eastern San Bernardino County, where they have farmed successfully for more than 15 years, as shown in Figure 1-3. Approximately 1,600 acres of this land has been developed for citrus and stone fruit orchards, vineyards, and specialty row crops.

In 1993, San Bernardino County certified a Final Environmental Impact Report (FEIR), and granted various land use approvals for expansion of agricultural operations up to 9,600 acres on this property. As a component of this approval, the County identified specific groundwater monitoring activities to be undertaken by Cadiz. To comply with these monitoring requirements, the Cadiz Valley Agricultural Development Ground Water Monitoring Plan (GWMP) was developed in cooperation with San Bernardino County to monitor all potential environmental impacts that could result from the agricultural irrigation. This Management Plan governs water use, storage, and extraction for the agricultural operations, and ensures that Project operations and future irrigation under the Cadiz Valley agricultural development will be conducted without adverse impacts to critical resources. Agricultural irrigation will also remain subject to the GWMP required by the County, but will be phased out as the Project comes on line and produces an annual average of 50,000 afy. Regardless of any phasing, the average annual extraction over the 50 years of Project operations will be no greater than 50,000 afy from all Cadiz pumping.

1.8 Purpose and Scope of Management Plan

The purpose of this Management Plan is to facilitate the optimal management of groundwater and ensure protection of the critical resources in or near the larger watershed area and adjacent regions, and to serve as a supporting document to be incorporated within (a) the Environmental Impact Report certified by SMWD for purposes of its compliance with CEQA in conjunction with its approval of the Project, and (b) a MOU between the County, FVMWC, SMWD and Cadiz to establish the exemption of the Project from the County's Desert Groundwater Management Ordinance. For purposes of this Management Plan, Project operations would be evaluated to also include the agricultural operations as outlined in the GWMP.

This Management Plan includes the following:

1) Description of the Project location and objectives;

2) Description of physical characteristics of the groundwater basin;

3) Identification of the critical resources and assessment of potential impacts in and surrounding the Project area due to Project groundwater extraction;

4) Description of the modeling tools that will be used to refine the monitoring network, and, will be used, in the future, to refine impact assessments and action criteria;

5) Description of the monitoring network and identification of the locations of the features of the monitoring network;

6) Description of the monitoring, testing, and reporting procedures that will be used to collect and analyze data;

7) Description of the action criteria established to avoid potential significant adverse impacts;

8) Description of the decision-making process to be used once the action criteria are met or when SMWD considers refinements to this Management Plan;

9) Description of corrective measures that may be implemented to minimize potential significant adverse impacts;

10) Description of objectives and requirements for a Closure Plan; and

11) Description of the TRP and its responsibilities and procedures.

CHAPTER 2
DESCRIPTION AND CHARACTERISTICS OF GROUNDWATER BASINS AND PRESENT USES

2.1 Geologic Setting

As shown above in Figure 1-3, the study area includes the Fenner, Bristol, and Cadiz watersheds. These watersheds are located in the Eastern Mojave Desert, which is a part of the Basin and Range Province of the western United States. The Basin and Range Province is characterized by a series of northwest/southeast trending mountain and valleys formed largely by faulting. One of the prominent features of the area is the Bristol Trough, a major structural depression caused by faulting. The Bristol Trough encompasses the Bristol and Cadiz watersheds that together form a relatively low land area that extends from just south of Ludlow, California on the northwest to a topographic and surface drainage divide between the Coxcomb and Iron mountains on the southwest. The Bristol and Cadiz Valleys are bounded on the southwest by the Bullion, Sheep Hole, Calumet, and Coxcomb mountains and on the northeast by the Bristol, Marble, Ship, Old Woman, and Iron mountains. The Cadiz and Bristol Dry Lakes are separated by a low topographic and surface drainage divide. The Fenner Watershed is located north of the Bristol Trough. This watershed encompasses approximately 1,100 square miles (mi2). It is bounded by the Granite, Providence, and New York mountains on the west and north and the Piute, Ship, and Marble mountains on the east and south. Fenner Gap occurs between the Marble and Ship mountains, where the surface drainage exits Fenner Watershed and enters the Bristol and Cadiz watersheds. The Clipper Mountains rise from the southern portion of the watershed, just northwest of Fenner Gap. (CH2M Hill, July 2010.)

The Orange Blossom Wash Watershed is a subarea of the Bristol Watershed, which is located in the western portion of the Project area between the Marble and Bristol mountains. The Orange Blossom Wash Watershed is bounded on the west by the Granite Mountains, and drains to the southeast into the Bristol Dry Lake. The Bristol and Cadiz Watersheds are located in the southern portion of the Project area. The proposed Project wellfield is located in the northern Bristol and Cadiz valleys, within and south/southwest of the Fenner Gap.

The total area of the Bristol, Cadiz and Fenner watersheds is approximately 2,330 square miles and consists of the Fenner Watershed (1,100 square miles), Bristol Watershed (640 square miles), and Cadiz Watershed (590 square miles). The surface water drainage and groundwater flow from all four of the watersheds in this Project area drain into the Bristol and Cadiz Dry Lakes, where it joins the brine water underlying the dry lakes and evaporates. (*Id.*)

The alluvial sediments of the Fenner Valley are underlain by carbonate, granitic and metamorphic rocks, forming a rock-bounded basin overlain with sands and gravels hundreds of feet thick. Groundwater ranges from approximately 270 to 400 feet bgs in the northeastern portion of the Project area to 140 feet bgs in the southwest, becoming shallower with increasing proximity to the dry lakes. Groundwater in storage has been estimated at between 17 to 34 million acre feet. Of this amount 4 to 10 million acre-feet is thought to exist in the fresh water zone south of the Fenner Gap. (CH2M HILL, July 2010)

2.2 Surface Water Resources

Native springs and localized wet areas associated with these springs are present in the mountain ranges in the Project vicinity, as shown in Figure 2-15 of CH2M Hill's July 2010 Report. The closest native springs to the Project site are located to the north, in the Granite, Clipper, and Old Woman Mountains. The nearest spring is Bonanza Spring (Spring 007N015E22DS01S), which is located in the Clipper Mountains, approximately 11 miles north of the center of Fenner Gap. These springs are located in hard rock (volcanic, granitic and metamorphic rocks) formations substantially higher in elevation than the carbonate and alluvial aquifers of the groundwater basin, such that they are not in hydraulic communication with the proposed wellfield and spreading basin areas. Therefore, pumping in the carbonate aquifer and alluvial aquifer in the Project well field should not affect groundwater levels in the hard rock formations that supply water to the vicinity springs. Nonetheless, this Management Plan provides for monitoring of the springs to confirm that Project operations have no impact on the spring flow from these springs consistent with recommendations of the Groundwater Stewardship Committee.

The Bristol and Cadiz dry lake playas are the lowest points in the Project area and are separated by a low topographic and surface drainage divide. Since the four Watersheds are part of a closed drainage system, the only natural outlet for surface water and groundwater is through evaporation at the dry lake surfaces.

2.3 Natural Recharge

The natural recharge in the Project area watersheds has been the subject of several studies since 1970. (See Appendix D to Geoscience, September 1, 2011.) The most recent study, based on data obtained from field investigations in the Fenner Gap, use of

INFIL3.0 watershed soil-moisture budget model released in 2008, and three-dimensional groundwater flow model simulations for the Fenner Gap, estimated the long-term average annual natural recharge of 32,000 afy. (CH2M Hill, July 2010). Notwithstanding the results of the most recent study, for purpose of evaluating potential impacts attributable to the Phase I (Conservation Component) of the Project, a modeling effort was undertaken using a range of recharge rate assumptions: 32,000 afy; 16,000 afy; and 5,000 afy. See discussion in Chapter 4.

The primary sources of replenishment to the groundwater system within the larger watershed area include direct infiltration of precipitation (both rainfall and snowfall) in fractured bedrock exposed in mountainous terrain and infiltration of ephemeral stream flow in sand-bottomed washes, particularly in the higher elevations of the watershed. The source of much of the groundwater recharge within the larger watershed area occurs in the higher elevations, including Bristol Mountains, Granite Mountains, Providence Mountains, Marble Mountains, New York Mountains, Piute Mountains, Old Woman Mountains, Ship Mountains, Clipper Mountains, Wood Mountains, and Hackberry Mountains (CH2M Hill, July 2010).

Most of the precipitation in the Eastern Mojave Desert accumulates during the winter months from November through March. Early summer and late fall are typically periods of little rainfall. The amount of precipitation in the Bristol, Cadiz, and Fenner Watersheds vary with differences in altitude. Average annual precipitation ranges from approximately 3 inches on the Cadiz and Bristol Dry Lakes (elevations of 545 to 595 ft amsl) to over 12 inches in the Providence and New York mountains (elevations over 7,000 ft amsl). However, most of the larger watershed area receives, on the average, 4 to 6 inches of rain annually. (Geoscience, September 2011). A conceptualized model of groundwater recharge in the area is shown in Figure 2-1.

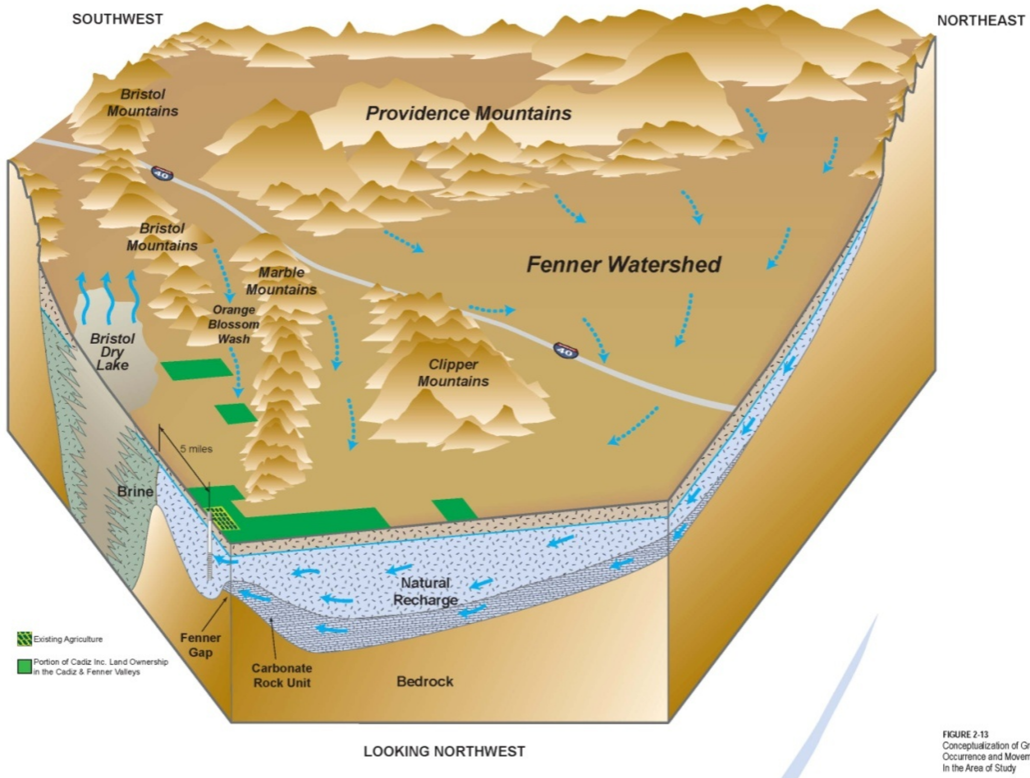


FIGURE 2-13
Conceptualization of Groundwater Occurrence and Movement In the Area of Study

2.4 Hydrogeology

Based on available geologic and geophysical data, the principal geologic deposits in the Project area that can store and transmit groundwater (i.e., aquifers) can be divided into three units: an upper alluvial aquifer, a lower alluvial aquifer, and a bedrock aquifer consisting of Tertiary fanglomerate, Paleozoic carbonates and fractured and faulted granitic rock. In general, these three units are in hydraulic continuity with each other and the separation is primarily due to stratigraphic differences. (Geoscience, September 2011).

The alluvial aquifer system consists mainly of Quaternary alluvial sediments which consist of stream-deposited sand and gravel with lesser amounts of silt. The thickness of the alluvial aquifer varies between 200 and 800 feet. To the west of Fenner Gap, the upper aquifer is separated from the lower aquifer system by discontinuous layers of silt and clay. The average thickness of the upper aquifer in Fenner Gap is approximately 500 feet. The upper aquifer is very permeable in places and can yield 3,000 gallons per minute (gpm) or more to wells with less than 20 feet of drawdown. (Geoscience, September 2011).

The lower alluvial aquifer consists of older sediments, including interbedded sand, gravel, silt, and clay. The maximum thickness of the lower aquifer is unknown but may reach over 6,000 feet in the vicinity of Bristol dry lake. Where these materials extend below the water table, they yield water freely to wells but are generally less permeable than the upper aquifer sediments. The Cadiz agricultural wells are screened primarily in the lower alluvial aquifer and typically yield 1,000 to 2,000 gpm. (Geoscience, September 2011).

Based on findings from recent drilling in the Fenner Gap area, Tertiary fanglomerate, fractured and faulted granitic rock, and Paleozoic carbonates, located beneath the lower alluvial aquifer, contain groundwater and are considered a third aquifer unit. Groundwater movement and storage within the carbonate bedrock aquifer primarily occurs within secondary porosity features (i.e., fracture zones associated with faulting and cracks and cavities developed within the rocks over time). (Geoscience, September 2011).

2.5 Groundwater Storage

The volume of groundwater in storage was estimated to be about 17 million to 34 million acre-feet in the alluvium of the Fenner Valley, Orange Blossom Wash, and northern Bristol/Cadiz area, where the conservation and storage Project will be sited. Four to ten million acre-feet of groundwater lie to the west and southwest of the proposed wellfield location. (Geoscience Tech Memo September 20, 2011.) Estimates of groundwater in storage in various zones within the general Project area are listed in Table 2-1, which also includes estimates of the following variables: volume of aquifer, determined as the volume between the groundwater table and the base of the alluvium (saturated thickness), percent of aquifer saturated thickness that is expected to be an aquifer (to exclude clay and silt intervals that do not yield water readily), and estimated specific yield. Low and high ranges are provided for each of these variables based on previous estimates. (CH2M Hill, July 2010.)

Table 2.1

Cadiz Study Area Groundwater Storage Calculations

Low Estimate					High Estimate				
Zones	Saturated Thickness Volume (ac-ft)	% of Saturated Thickness which is Aquifer	Specific Yield	Groundwater in Storage (ac-ft)	Zones	Saturated Thickness Volume (ac-ft)	% of Saturated Thickness which is Aquifer	Specific Yield	Groundwater in Storage (ac-ft)
Zone 1	11,251,515	75%	0.15	1,265,795	Zone 1	11,251,515	85%	0.20	1,912,758
Zone 2a	63,758,585	50%	0.10	3,187,929	Zone 2a	63,758,585	60%	0.15	5,738,273
Zone 2	93,083,800	50%	0.10	4,654,190	Zone 2	93,083,800	60%	0.15	8,377,542
Zone 3	13,052,800	20%	0.10	261,056	Zone 3	13,052,800	40%	0.15	783,168
Zone 4	489,237	50%	0.10	24,462	Zone 4	489,237	75%	0.15	55,039
Zone 5	88,466,500	50%	0.10	4,423,325	Zone 5	88,466,500	75%	0.15	9,952,481
Fenner	93,676,400	50%	0.05	2,341,910	Fenner	93,676,400	60%	0.10	5,620,584
Goffs	32,917,900	50%	0.05	822,948	Goffs	32,917,000	60%	0.10	1,975,074
				16,981,615					**34,414,919**

This storage estimate does not include water contained within the carbonate and fractured portion of the bedrock beneath the alluvial units. Recent drilling has revealed that these units also store groundwater. As such, the estimated volume of groundwater in storage is a conservative underestimate; the actual volume of groundwater in storage is larger by some unknown amount. (Geoscience, September 2011). Figure 2-2 shows the storage zones used in the calculations of groundwater in storage.

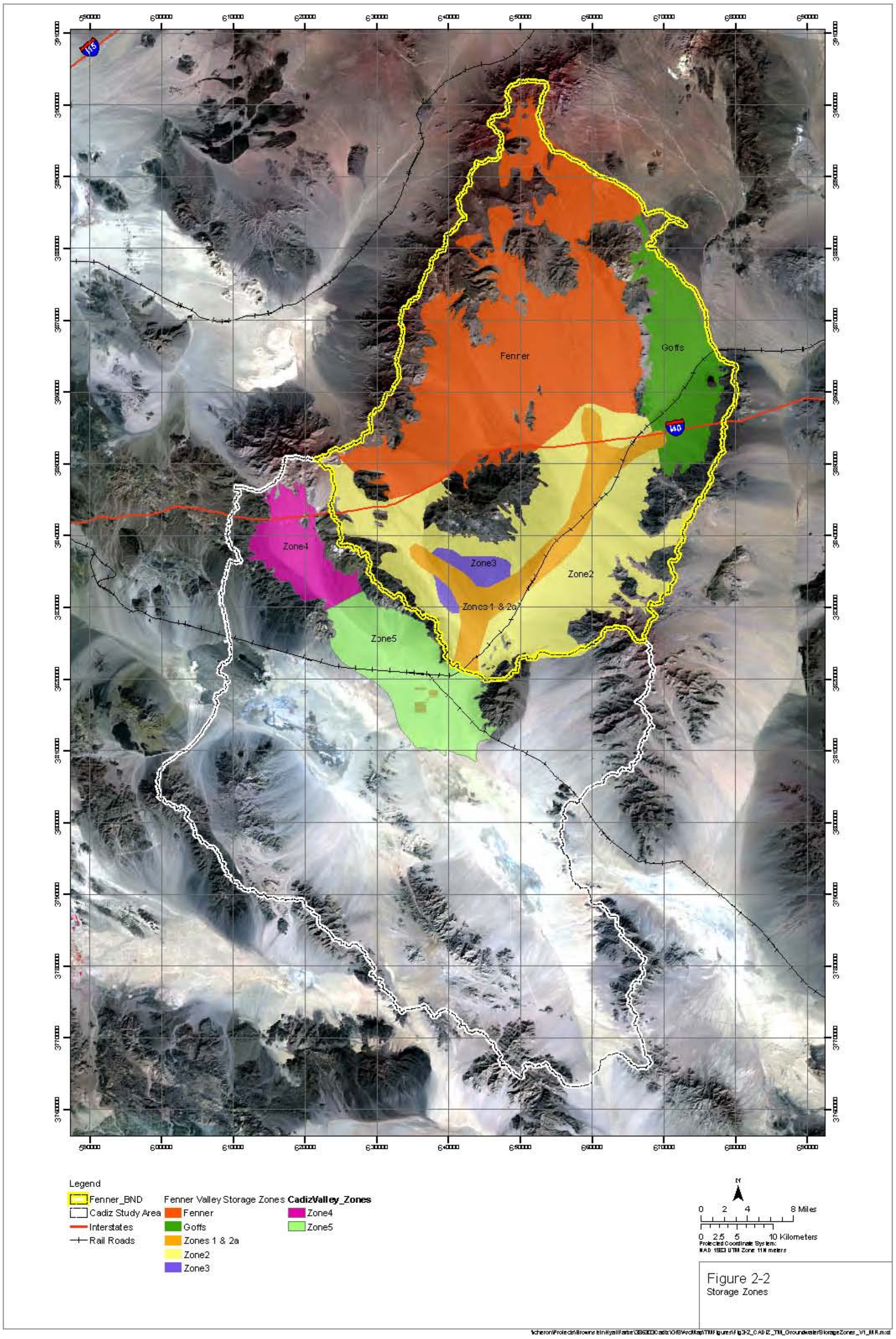


Figure 2-2
Storage Zones

2.6 Groundwater Quality

With the exception of the areas underlying and immediately adjacent to the Bristol and Cadiz Dry Lakes, the quality of the groundwater in the northern Bristol/Cadiz and Fenner Gap area is relatively good, with total dissolved solids (TDS) concentrations typically in the range of 300 to 400 milligrams per liter (mg/L). Table 2-2 summarizes water quality data collected from an existing well on the Cadiz agricultural operations property, south/southwest of the Fenner Gap. The State of California guideline for drinking water is a maximum TDS of 1,000 mg/L. However, all groundwater having a TDS below 3,000 mg/L is considered by the State to be a potential domestic or municipal source of water supply.

TABLE 2-2: GROUNDWATER CHEMISTRY AT CADIZ ALLUVIAL AQUIFER

	CA MCL	CA SMCL	CADIZ GROUNDWATER
TDS		500-1000 mg/L	260 mg/L
Arsenic	10 µg/L		3.1 µg/L
Chloride		250-500 mg/L	34 mg/L
Total Chromium	50 µg/L		16 µg/L
Fluoride	2.0 mg/L		1.6 mg/L
Manganese		50 µg/L	Not Detected (< 20 µg/L)
Nitrate as NO3	45 mg/L		12 mg/L
Sulfate		250-500 mg/L	11 mg/L

CA MCL: California primary maximum contaminant levels for drinking water (chemicals affecting health and safety)

CA SMCL: California secondary maximum contaminant level for drinking water (chemicals affecting taste and odor)

mg/L = milligrams per liter

μg/L = micrograms per liter

Not Detected = not detected at or above the reportable detection limit

Source: 22 CCR §§ 64431, 64449

Table 2-3 shows water quality data obtained from recent hydrogeologic investigations in the Fenner Gap area. Overall, groundwater quality in the alluvial and carbonate aquifers are of very high quality, with low total dissolved solids. Chromium, and in particular hexavalent chromium, is a constituent of potential concern given the recently adopted California Public Health Goal for hexavalent chromium of 0.02 ug/l. Groundwater containing hexavalent chromium could require treatment depending on the water quality standard developed by the State. Groundwater in the deeper section of the bedrock shows elevated concentrations of iron and manganese; however, the relative contribution of groundwater from these deeper bedrock units is expected to be small, such that the quality of groundwater in productions is expected to be representative of the water quality of the alluvial and carbonate aquifers.

Table 2.3

Summary of Water Quality Results

Parameter	Regulatory Action Levels				Analytical Results[1]			
	CA Primary MCL	USEPA Primary MCL	CA Secondary MCL	USEPA Secondary MCL	TW-1 Carbonate 11/10/2009	TW-1 Alluvium 12/04/2009	TW-2 Alluvium 11/24/2009	DT-1 Bedrock 02/24/2011
Anions **:**								
Chloride (mg/L)			250 to 500	250	38	34	35	110
Fluoride (mg/L)	2	4		2	1.5	1.6	1.6	3.6
Nitrate as NO_3 (mg/L)	45				13	12	12	ND < 1.0
Sulfate (mg/L)			250 to 500	250	32	11	30	110
Total Anions (me/L)					4.23	3.46	4.09	-
Alkalinity **:**								
Total Alkalinity (mg/L)					110	100	110	130
Bicarbonate Alkalinity (mg/L)					130	130	130	160
Carbonate Alkalinity (mg/L)					ND < 3.0	ND < 3.0	ND < 3.0	ND < 3.0
Hydroxide Alkalinity (mg/L)					ND < 3.0	ND < 3.0	ND < 3.0	ND < 3.0
Cations **:**								
Calcium (µg/L)					24	27	26	13
Magnesium (µg/L)					5.7	5.2	5.7	5.0
Potassium (µg/L)					5.0	4.9	5.2	4.9
Sodium (µg/L)					60	48	53	170
Total Hardness (mg/L)					84	89	88	54
Total Cations (me/L)					4.4	4	4.2	-
General Parameters **:**								
pH				6.5 to 8.5	8.0	8.0	7.9	8.6
Langlier Index at 25 C					0.01	-0.01	-0.11	-
Total Dissolved Solids (mg/L)			500 to 1,000	500	220	260	300	530
Metals and Metalloids **:**								
Arsenic (µg/L)	10	10			7.5	3.1	6.5	11
Total Chromium (µg/L)	50	100			14	16	18	2.9
Hexavalent Chromium (µg/L)	[2]				16	14	14	-
Iron (µg/L)			300	300	ND < 100	ND < 100	ND < 100	11,000
Manganese (µg/L)			50	50	ND < 20	ND < 20	ND < 20	210

Notes:
(1) TW-1 and TW-2 samples were collected at the end of constant rate pumping tests.
DT-1 sample airlifted through the drill string after achieving total depth (1,500 feet).
(2) Hexavalent chromium is currently regulated under the MCL for total chromium.
CA = California
USEPA = United States Environmental Protection Agency
MCL = maximum contaminant level

At the Bristol and Cadiz Dry Lakes, surface water and shallow groundwater evaporation has concentrated dissolved salts resulting in TDS concentrations as high as 298,000 mg/L. (Shafer, R. A., *Report on Investigations of Conditions which Determine the Potentials for Development in the Desert Valleys of Eastern San Bernardino County, California* (1964); Engineering Department Southern California Edison Company, Unpublished Report at 172, pp 12 plates; *cited in* Metropolitan and Cadiz Inc., *Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Cadiz Groundwater Storage and Dry-Year Supply Program (Cadiz Project)*, pages 5-72, 5-80, and 5-81 (September 2001)). The location of the interface between the low-TDS "fresh" groundwater (i.e., TDS concentrations less than 1,000 mg/L) and high-TDS "saline" groundwater underlying the dry lakes has been mapped on the basis of data from observation wells in the area, and is shown in Figure 2-3.

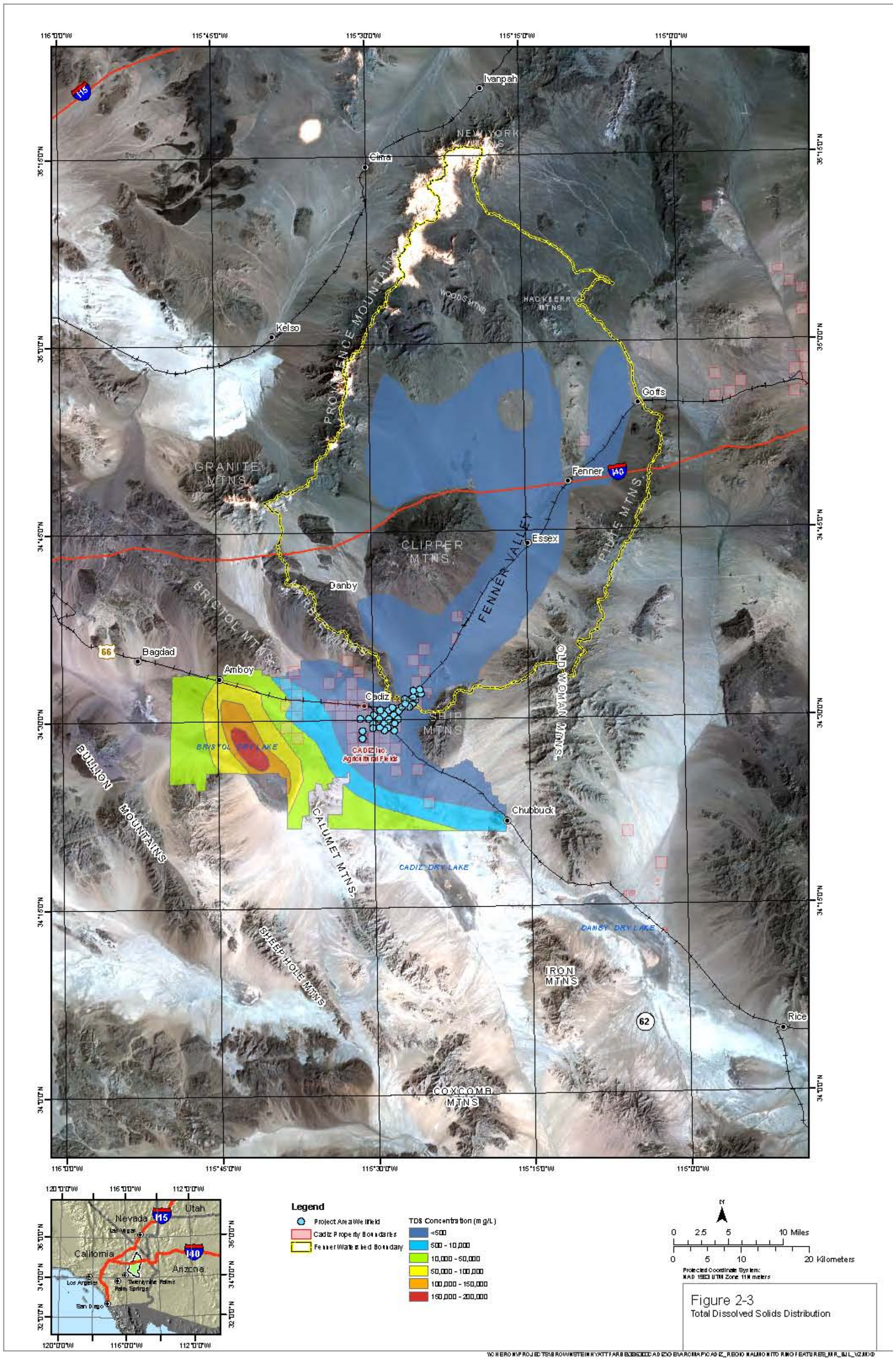


Figure 2-3
Total Dissolved Solids Distribution

2.7 Present Groundwater Production and Uses

Land use in the area consists primarily of desert conservation open space and agriculture, with limited chloride mining of the brine from the dry lakes and other mining, military uses, recreation, railroad, and electrical, gas, and oil utility corridors. Cadiz used, on average, 5,000 to 6,000 afy of groundwater between 1994 and 2007 for its agricultural operations. This annual usage was reduced beginning in 2007 in connection with the removal of approximately 500 acres of vineyard that had reached the end of its commercial life. Based on the current crop mix (lemons on 370 acres and grapes on 160 acres and seasonal row crops), the agricultural operations are using approximately 1800-1900 acre-feet of water per year. Another 1,070 acres are fallow and currently not irrigated.

There are also two existing salt mining operations at the Bristol and Cadiz Dry Lakes. These operations involve evaporation of the hyper-saline groundwater from the dry lakes to obtain remaining salts. One operation uses approximately 500 afy of the hyper-saline groundwater based upon recorded water extractions pursuant to California Water Code Section 4999 et seq., while it is estimated that the other operation, being approximately one-half of the size, uses approximately 250 afy for a total of 750 afy.

CHAPTER 3
PROJECT OPERATION, GROUNDWATER CONSERVATION, AND CONSISTENCY WITH APPLICABLE LEGAL AUTHORITY

The Project is designed to operate consistent with California's constitutional requirement that all waters of the state not be wasted, but rather put to fullest beneficial use. In relevant part, article X, section 2 of the California Constitution declares:

> "[B]ecause of the conditions prevailing in this State the general welfare requires that the *water resources of the State be put to beneficial use to the fullest extent of which they are capable*, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. . ." (California Constitution Article X, Section 2 [emphasis added].)

For decades, California has emphasized the importance of using its groundwater supplies responsibly and to manage surface and groundwater supplies conjunctively. According to the California Supreme Court, each groundwater basin has a safe or perennial yield which is "the maximum quantity of water which can be withdrawn annually from a ground water supply under a given set of conditions without causing an undesirable result." (*City of Los Angeles v. City of San Fernando* (1975) 14 Cal.3d 199, 278).

By applying modern groundwater management strategies, groundwater levels can be adjusted to achieve conservation objectives, to enhance the a basin's recoverable yield, promote conservation, and conjunctively manage surface water and groundwater. As articulated by the California Supreme Court, "if a ground basin's lack of storage space will cause a limitation of extractions to safe yield to result in a probable waste of water, the amount of water which if withdrawn would create the storage space necessary to avoid the waste and not adversely affect the basin's safe yield is a temporary surplus available for appropriation to beneficial use." (*City of Los Angeles v. City of San Fernando* (1975) 14 Cal.3d 199, 280).

Consistent with the groundwater management principles articulated by the California Supreme Court, a temporary surplus exists in the northern Bristol/Cadiz sub-basin. The Project's withdrawal of groundwater is intended to exceed the natural recharge for the intentional and strategic purpose of lowering the water table in the well-field to change the hydraulic gradient. The specific effects of the Project in terms of changes in aquifer water levels and associated impacts are discussed in detail in Chapter 4 below.

By strategically lowering water levels in the northern Bristol/Cadiz sub-basin, the Project will not only intercept natural recharge flowing through the Fenner Gap and from Orange Blossom Wash, but reverse existing groundwater gradients and retrieve water stored in alluvial aquifers to the immediate southwest and southeast of the Fenner Gap back to the Project wellfield. (Geoscience, September, 20 2011.) Existing groundwater gradients cause water within these alluvial aquifers to flow towards the Bristol and Cadiz Dry Lakes, where it blends with brine beneath the dry lakes and ultimately evaporates (and therefore is wasted). Thus, the Project's goal of lowering the water table will facilitate the recovery and conservation of this water before it is lost to the dry lakes where it evaporates.

This premise was studied and reported on in a technical memorandum issued by Project consultant Geoscience Support Service Inc. (Geoscience), titled Supplemental Assessment of Pumping Required for the Cadiz Groundwater Conservation, Storage and Recovery Project, dated September 20, 2011. Geoscience used a variable density groundwater flow and transport model that it developed for the Project (see discussion of groundwater flow models in Chapter 4) to evaluate the savings of fresh groundwater as a result of the Project that would otherwise be loss to evaporation in the dry lakes absent the Project. It determined that assuming 32,000 and 16,000 afy natural recharge scenarios (see discussion of recharge assumptions in Chapter 4), an average pumping of 50,000 afy, would create a net savings of 1,990,000 and 674,000 acre-feet, respectively over a 100-year period. (Geoscience, September 20, 2011). The volumes of groundwater impacted by the migration of saline water from the dry lakes into presently fresh water supplies to northeast towards the Project wellfield were 173,000 and 215,000 acre-feet for the 32,000 and 16,000 natural recharge scenarios, respectively. However, even considering these volumes, Geosciences modeling concluded there would still be a significant net savings of fresh groundwater by implementing the Project versus not implementing it. (*Id.*) The only modeled scenario in which the production of an average pumping of 50,000 afy would create a net loss of freshwater (i.e., the volume of groundwater impacted by the migration of saline water exceeds savings of water from evaporation) is where recharge is assumed to only be 5,000 afy. A summary of the results of Geoscience's modeling of net water savings as a result of the Project's proposed production quantities is set forth in Table 3-1. It should be noted that Geoscience found that savings from evaporation would be even higher if Project groundwater production were accelerated into the first half of the Project operation period pumping at the higher rates early (i.e., 75,000 afy were produced in the first 25 years of the alternative pumping schedule). (*Id.*) In all cases, the recovered groundwater would be beneficially used by Project Participants.

Table 3-1: Summary of Net Savings from Proposed Project Production (Average 50,000 afy/50 Years)

Natural Recharge	Time	Cumulative Reduction of Evaporative Losses [acre-ft]	Cumulative Depletion of Storage [acre-ft]	Cumulative Net Water Saving from Project [acre-ft]
32,000 acre-ft/yr	At the End of 100 Years	2,210,000	220,000	1,990,000
16,000 acre-ft/yr	At the End of 100 Years	1,544,000	870,000	674,000
5,000 acre-ft/yr	At the End of 100 Years	470,000	1,870,000	-1,400,000

By lowering groundwater levels in the alluvial aquifers, the Project will also create space in the sub-basin to store imported water as part of the conjunctive use planned for the second phase of the Project. In sum, the Project will capture natural recharge, optimize conservation by retrieving groundwater presently in storage before it can evaporate, allow for the carry-over of native water in storage and set the stage of a new conjunctive use storage opportunity that does not presently exist. As explained below in Chapter 4, this Management Plan provides for comprehensive monitoring of potential Project impacts to critical resources, together with a series of action criteria and potential corrective measures, to ensure that the Project does not cause material adverse environmental impacts. For these reasons, the Project is entirely consistent with the state policy of fullest beneficial use of water resources for municipal uses as set forth in Article X, Section 2 of the California Constitution and the other legal principles discussed above.

CHAPTER 4
ASSESSMENTS OF POTENTIAL ADVERSE IMPACTS TO CRITICAL RESOURCES IN OR ADJACENT TO THE PROJECT AREA

As discussed above, the objectives of this Management Plan are to ensure that the groundwater supplies within the Project area are put to beneficial use to the fullest extent possible, and the present waste of groundwater to salinity and evaporation is significantly reduced, all while avoiding any material adverse impact to critical resources. This Management Plan addresses the following critical resources:

- The basin aquifers tapped by the Project, including avoiding the chronic decline of groundwater levels, potential impacts to groundwater quality, land subsidence, and existing groundwater uses;
- Brine resources of Bristol and Cadiz Dry Lakes;
- Springs within the Fenner Watershed including springs of the Mojave National Preserve and BLM-managed lands;
- Air quality in the Mojave Desert region;
- Project area vegetation; and
- Adjacent groundwater basins, including the Colorado River and its tributary sources of water.

This Chapter 4 takes a conservative approach in its technical analysis of the potential adverse impacts to these critical resources as a result of the Project operations.

4.1 Potential Project Impacts to Basin Aquifers

For the purposes of this Management Plan, the basin aquifers include aquifers of the Fenner, Bristol, and Cadiz watersheds as described in Chapter subsection 2.4. However, emphasis is placed on the aquifers in the vicinity of the northern Bristol/Cadiz area. Emphasis is placed on Fenner and the northern Bristol/Cadiz sub-basin areas, which encompasses the proposed extraction wellfield and potential artificial recharge facilities proposed for implementation in Phase II in and around the Fenner Gap area and existing Cadiz agricultural wellfield. Potential Project impacts to the Fenner and northern Bristol/Cadiz project sub-basin include:

- Potential for chronic decline of groundwater levels
- Potential for impacts to wells owned by neighboring landowners (including wells operated in the larger watershed area) due to Project operations;
- Potential for land subsidence and loss of groundwater storage capacity due to groundwater withdrawal; and
- Potential for induced flow of lower quality water from Bristol and Cadiz Dry Lakes; and

Water resources models were developed and applied to assess these potential impacts. The specific models and their application are described below in Sections 4.1.1 and 4.1.2.

4.1.1 *Water Resources Modeling*

Water resources models developed during the pre-operational phase of the Project have been, and are planned to be, used to simulate the impacts of planned Project operations. These models include the INFIL3.0 soil-moisture budget model, MODFLOW-2000/MT3D groundwater flow and solute transport model, and SEAWAT-2000 model (note that selection of models may change based on either updates to these models or availability of comparable models). The results of simulations using these models have been used to assess potential impacts during Project operations. Results of these simulations are used to identify monitoring features and conditions to be monitored and locations and frequency of monitoring during Project operations in order to verify these model projections. During Project operations, the results of monitoring will be used to evaluate whether any action criteria are triggered. Evaluation of monitoring results could result in refinements to action criteria as well as identifying areas where collection of additional data may be needed to improve the monitoring network. Any refinements to models that monitoring data indicate may be needed will be made in accordance with the decision-making process described in Chapters 6 and 8.

4.1.1.1 INFIL3.0

INFIL3.0 is a grid-based, distributed–parameter, deterministic water-balance watershed model, released for public use by the USGS in 2008, which is used to estimate the areal and temporal net infiltration of precipitation below the root zone (USGS, 2008). This model was used to estimate potential recoverable water for the Project. The model is based on earlier versions of INFIL code that were developed by the USGS in cooperation with the Department of Energy to estimate net infiltration and groundwater recharge at the Yucca Mountain high-level nuclear-waste repository site in Nevada. Net infiltration is the downward movement of water that escapes below the root zone, and is no longer affected by evapotranspiration and is capable of percolating to and recharging groundwater. Net infiltration may originate as three sources: rainfall, snow melt, and surface water run-on (runoff and streamflow). Application of INFIL3.0 to the Fenner and Orange Blossom Wash watersheds produced long-term average annual natural recharge estimates of approximately 32,000 afy.

If necessary, this model will be updated and refined during Project operations based on data obtained from the monitoring features.

4.1.1.2 MODFLOW-2000/MT3D - Groundwater Flow And Transport Model

Geoscience Support Services, Inc. (Geoscience) developed a numerical groundwater flow and solute transport model of a large portion of the larger watershed area, based on MODFLOW2000 and MT3D. This model provides the basis for developing the density-dependent model described in the next section. If necessary, this model along with other models, will be updated and refined during Project operations based on monitoring data, and the monitoring network and action criteria refined during the Project if needed.

The numerical groundwater flow and solute transport model was developed based on a conceptual model developed during the pre-operations stage incorporating the area of interest, aquifer systems and boundary conditions. This conceptual model of hydrogeology and groundwater flow conditions in the larger watershed area will be further refined based upon a thorough analysis of the available hydrogeologic data for the modeled area as additional information is collected from installation of the monitoring wells and extraction wells, and as monitoring data are compiled during the operations stage. The groundwater flow model will integrate quantities and distribution of recharge and discharge estimated from updates to INFIL3.0 and Project extractions.

4.1.1.3 Density-Dependent Groundwater Flow And Transport Model, Including Subsidence

A density-dependent flow and transport model based on SEAWAT-2000 was also developed by Geoscience. This model simulates the transport of solute mass through numerical solution of a mass balance equation involving fluid density, and was specifically designed to estimate the likely effects of Project operations on the projected saline/freshwater interface (northerly of the margins of the dry lakes). The single solute species, total dissolved solids (TDS) is transported conservatively (i.e., there is no absorption or any other losses of TDS) in the model. Sources and boundary conditions of solutes are specified as sources of salts, such as the dry lakes.

The model domain extends over the same area as the flow and solute transport model domain. The height, and horizontal and vertical grid spacing was selected based on available data and the intended use of the model. These models include hydraulic conductivity, specific storage, effective porosity, and dispersion coefficients for each model element. Specified flux and chloride mass fraction was provided by the regional groundwater flow and solute transport model described previously.

In addition, in order to simulate subsidence potential, the density-dependent flow and transport model was augmented by incorporating the Subsidence and Aquifer-System Compaction (SUB) Package (Hoffmann, et. al, 2003). The SUB package is used in conjunction with SEAWAT-2000 to simulate the elastic (recoverable) compaction and expansion and inelastic (permanent) compaction of compressible fine-grained beds (interbeds) within the aquifers. The deformation of interbeds is caused by changes in effective stress as a result of groundwater level changes. If the stress is less than the preconsolidation stress of the sediments, the deformation is elastic (i.e., recoverable). If the stress is greater than the preconsolidation stress, the deformation is inelastic (i.e., permanent).

If necessary, this model will be updated and refined during Project operations based on data obtained from the monitoring features.

4.1.2 *Application of Water Resources Models*

To obtain a comprehensive understanding of the likely effects of the Project's proposed groundwater extraction and storage activities, Cadiz Inc. retained the firm Geoscience to assess the Project's potential impacts associated with environmental concerns, including lowering of groundwater levels, movement of the saline water/freshwater interface and potential land subsidence.

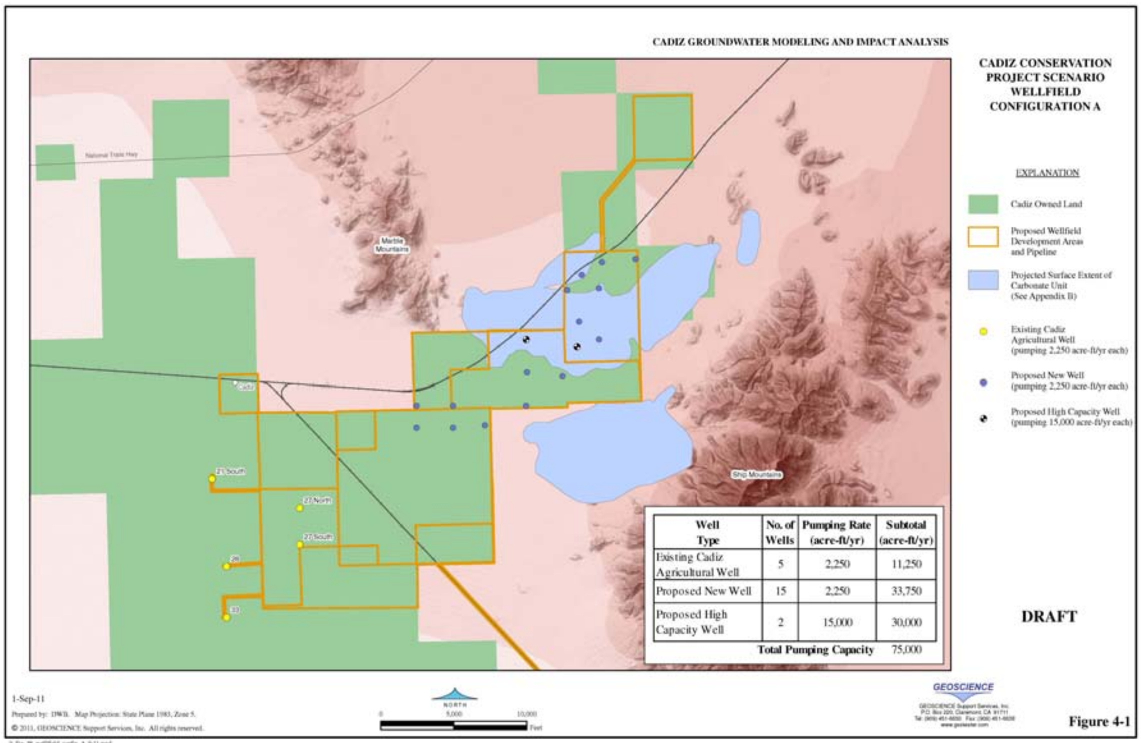
Building on prior technical investigations of area groundwater resources, geologic mapping, and recent exploratory drilling and testing, Geoscience developed a three-dimensional density-dependent groundwater flow and solute transport model of a larger portion of the larger watershed area to simulate the operation of the proposed wellfield and its effects on groundwater levels, groundwater in storage, the freshwater/saltwater interface near the dry lakes, and potential land subsidence. The results of Geoscience's investigation and modeling are set forth in its report titled Cadiz Groundwater Modeling and Impact Analysis, dated September, 1, 2011.

Geosciences's groundwater model consists of a six-layer density-dependent flow and solute transport model constructed to simulate the groundwater conditions that underlie Fenner Valley, Fenner Gap, and a portion of the Bristol and Cadiz Dry Lakes. Recent geologic mapping, interpretive geologic cross-sections, and lithologic logs from exploratory borings and water wells, along with geologic and hydrologic data available in the literature, are used to develop the six model layers. The model layers consist of the following:

- Layer 1 - Upper Alluvium
- Layer 2 - Alluvium beneath the Upper Alluvium to a depth of approximately 1,200 ft
- Layer 3 - Alluvium beneath a depth of 1,200 ft
- Layer 4 - Fanglomerate, carbonate, lower Paleozoic sequence and weathered granitic rocks
- Layer 5 - Carbonate, lower Paleozoic sequence and weathered granitic rocks
- Layer 6 - A Detachment Fault Zone (approximately 200 ft thick) in the Fenner Gap area, and weathered granitic rocks.

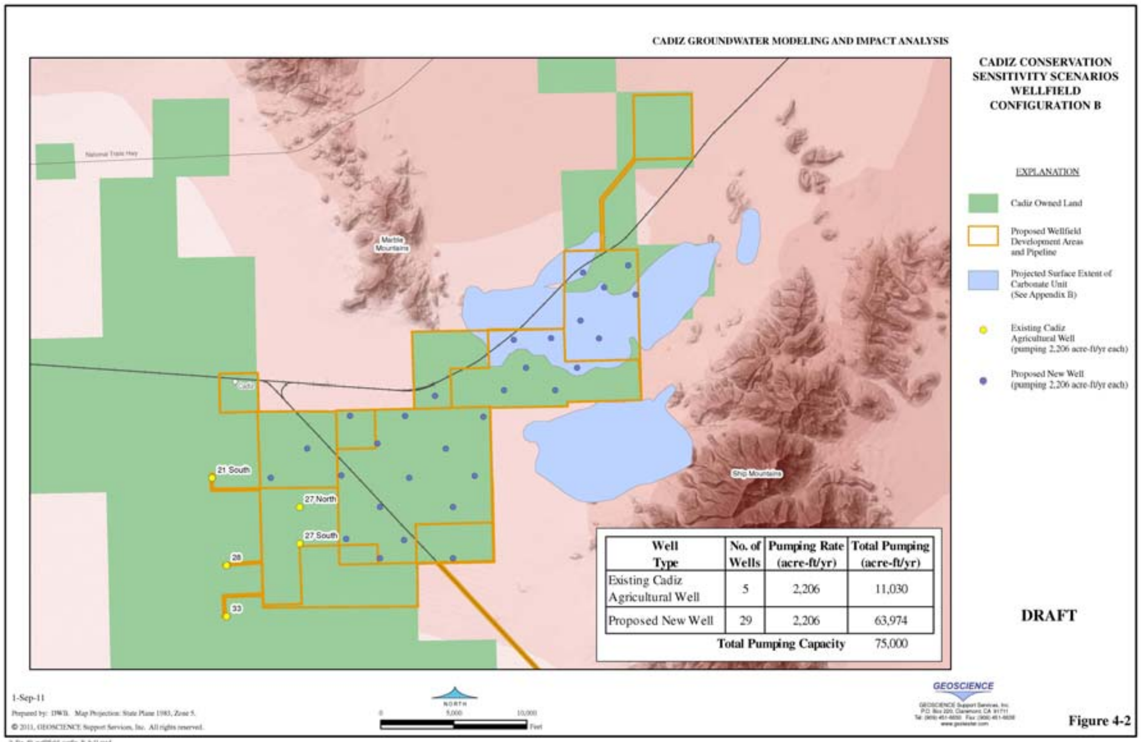
(Geoscience, September 1, 2011).

Geoscience simulated two wellfield configurations as shown in Figures 4-1 and 4-2. The first simulation (Configuration A) modeled a wellfield configuration of two large-capacity wells in the carbonate units encountered in the Fenner Gap area, which results in a more tightly clustered wellfield in the Fenner Gap area. The second simulation (Configuration B) assumed a more dispersed wellfield with pumping more evenly distributed among the wells.



Well Type	No. of Wells	Pumping Rate (acre-ft/yr)	Subtotal (acre-ft/yr)
Existing Cadiz Agricultural Well	5	2,250	11,250
Proposed New Well	15	2,250	33,750
Proposed High Capacity Well	2	15,000	30,000
		Total Pumping Capacity	75,000

Figure 4-1



The groundwater model developed by Geoscience assumed horizontal groundwater flow through each model layer, with vertical leakage providing hydraulic connection between the layers. The model accounted for both natural and artificial recharge, as well as discharge via evaporation at the dry lakes and agricultural pumping. Geoscience applied the industry standard "history matching" technique to both steady state and transient calibration. For each calibration run, the relative error was 0.15% for the steady state model and 1.7% for the transient model, both well below the recommended relative error of 10%.

Geoscience simulated three recharge scenarios, including 5,000 afy, 16,000 afy, and 32,000 afy to assess effects on groundwater levels, the movement of the freshwater/saltwater interface near the dry lakes, and land subsidence. The 32,000 afy recharge scenario is based on INFIL3.0 modeling of the soil-moisture water budget for the Fenner and Orange Blossom Wash watershed areas. Geoscience simulated this large range in long-term average annual recharge by reducing the projected recharge by 50 percent (16,000 afy) and then to an amount that is generally equivalent to Cadiz historical agricultural pumping (5,000 afy) in order to increase the conservatism of the analysis (identify potential worst-case impacts).

After the model was calibrated, Geoscience simulated 100-year predictive runs for each of the three ranges of recharge scenarios, including 32,000 afy, 16,000 afy, and 5,000 afy.

The Project Scenario assumed 32,000 afy of natural recharge, and a Project wellfield clustered around Fenner Gap (Configuration A). The 32,000 afy recharge scenario was based on INFIL3.0 modeling of the soil-moisture water budget for the Fenner and Orange Blossom Wash watershed. The two Sensitivity Scenarios, which assumed less natural recharge and a Project wellfield spread out from Fenner Gap (Configuration B), allowed Geoscience to evaluate the potential range of worst-case impacts on groundwater levels, migration of the saline/freshwater interface, and subsidence. The model scenarios and assumptions used in each are summarized in Table 4-1.

TABLE 4-1: GEOSCIENCE GROUNDWATER MODEL ASSUMPTIONS

Model Scenario	Model Assumptions			
	Natural Recharge (afy)	Wellfield Configuration	Groundwater Pumping Years 1 to 50 (afy)	Groundwater Pumping Years 50 to 100 (afy)
Project Scenario	32,000	Configuration A	50,000	0
Sensitivity Scenario 1	16,000	Configuration B	50,000	0
Sensitivity Scenario 2	5,000	Configuration B	50,000	0

4.1.2.2 Project Impact Findings from Groundwater Flow Model

Based on the results of its groundwater model, Geoscience made the determinations about the impact of the Project discussed in this section below. As the Project is implemented, data will be obtained from drilling and testing of Project production and monitoring wells and monitoring data will be obtained as a part of the monitoring plan described in Chapter 5. The monitoring plan will serve to verify the model projections. As data are obtained, these water resources models will be periodically updated to continuously assess the validity of the model projections and if necessary, to revise the monitoring program, action triggers, and mitigation responses as described in Chapter 6.

4.1.2.3 Groundwater Elevations

Table 4-2 below shows the change in groundwater elevations at the end of year 50 under each model-calculated scenario. The lowest groundwater levels (i.e., greatest impact) would occur at the center of the Project wellfield. The pumping would create a cone of depression and groundwater would flow toward the proposed wellfield from Fenner, Bristol and Cadiz valleys. At the end of 100 years, groundwater levels in the wellfield approach pre-Project levels for the Project scenario (full recovery in Year 117) (Geoscience, September 1, 2011). For the two scenarios simulating lower recharge values, recovery to pre-Project levels is estimated to occur approximately 100 to almost 400 years after pumping stops. The groundwater flow model simulations show that there is no chronic decline of groundwater levels: groundwater levels are drawn down to effect capture of water that would otherwise evaporate to the dry lakes, then groundwater levels recover upon cessation of pumping.

TABLE 4-2: GROUNDWATER DRAWDOWN IMPACTS

Model Scenario	End of 50 Years (End of Project Pumping)		End of 100 Years (End of Model Simulation or 50 Years After Pumping Stops)	
	Drawdown at Wellfield (feet)	**Drawdown at Bristol Dry Lake (feet)**	**Drawdown at Wellfield (feet)**	**Drawdown at Bristol Dry Lake (feet)**
Project Scenario	70 – 80	10 – 30	0 – 10	10 – 20
Sensitivity Scenario 1	120 – 130	10 – 60	10 – 20	30 – 40
Sensitivity Scenario 2	260 – 270	0 – 80	50 – 60	10 – 70

Figures 4-3 through 4-8 show groundwater-level drawdown for those various recharge scenarios simulated, both at the end of 50 years of pumping and then for 50 years since cessation of pumping (for a total of simulated period of 100 years). Groundwater level drawdown decreases northward into Fenner Valley, such that drawdown effects near Danby decrease to about 15 feet and at Interstate 40 (and certainly at Goffs) are negligible. The following observations are made from these simulations:

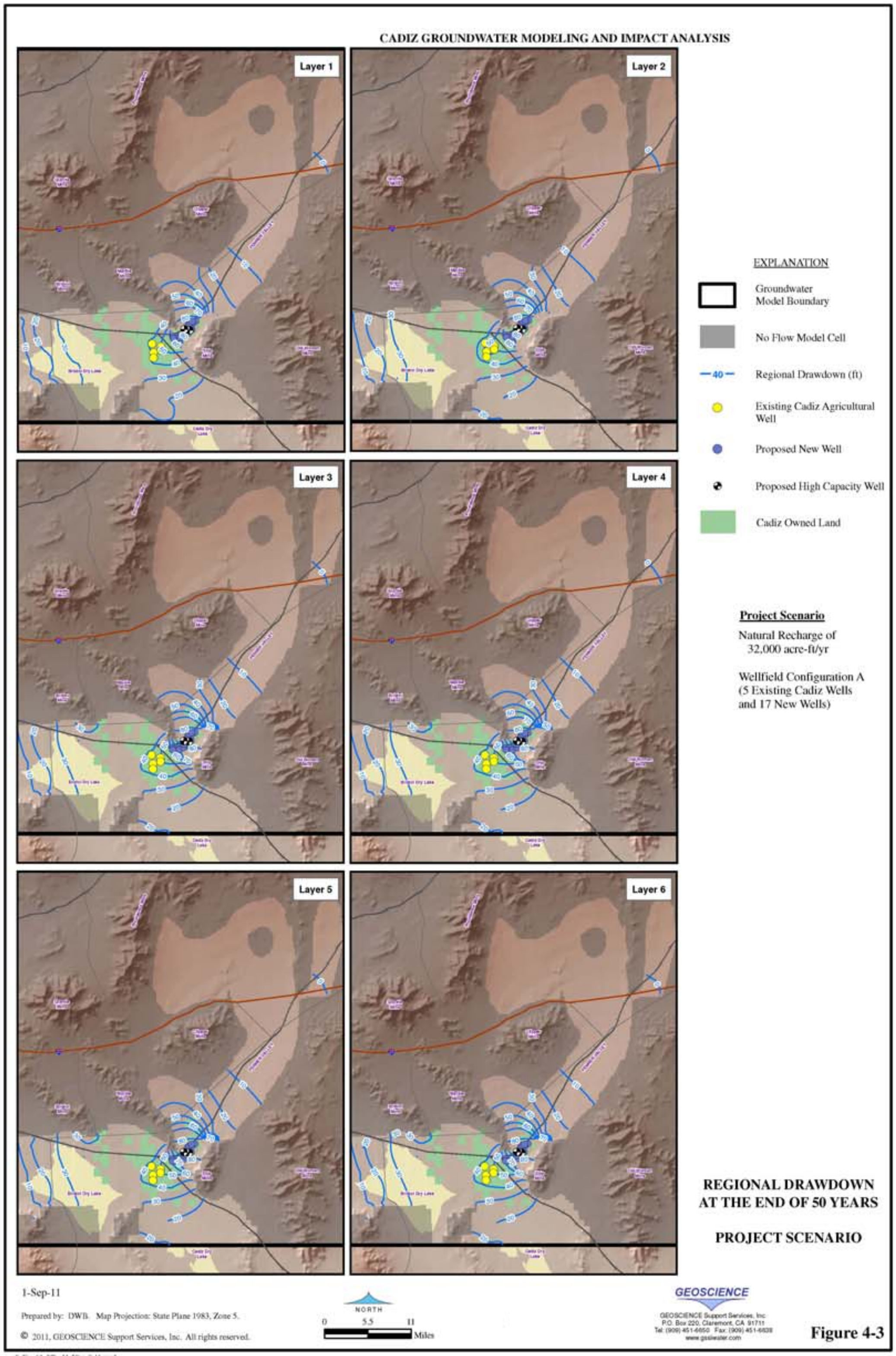

CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Proposed High Capacity Well
Cadiz Owned Land
Project Scenario
Natural Recharge of 32,000 acre-ft/yr
Wellfield Configuration A (5 Existing Cadiz Wells and 17 New Wells)
REGIONAL DRAWDOWN AT THE END OF 50 YEARS
PROJECT SCENARIO
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
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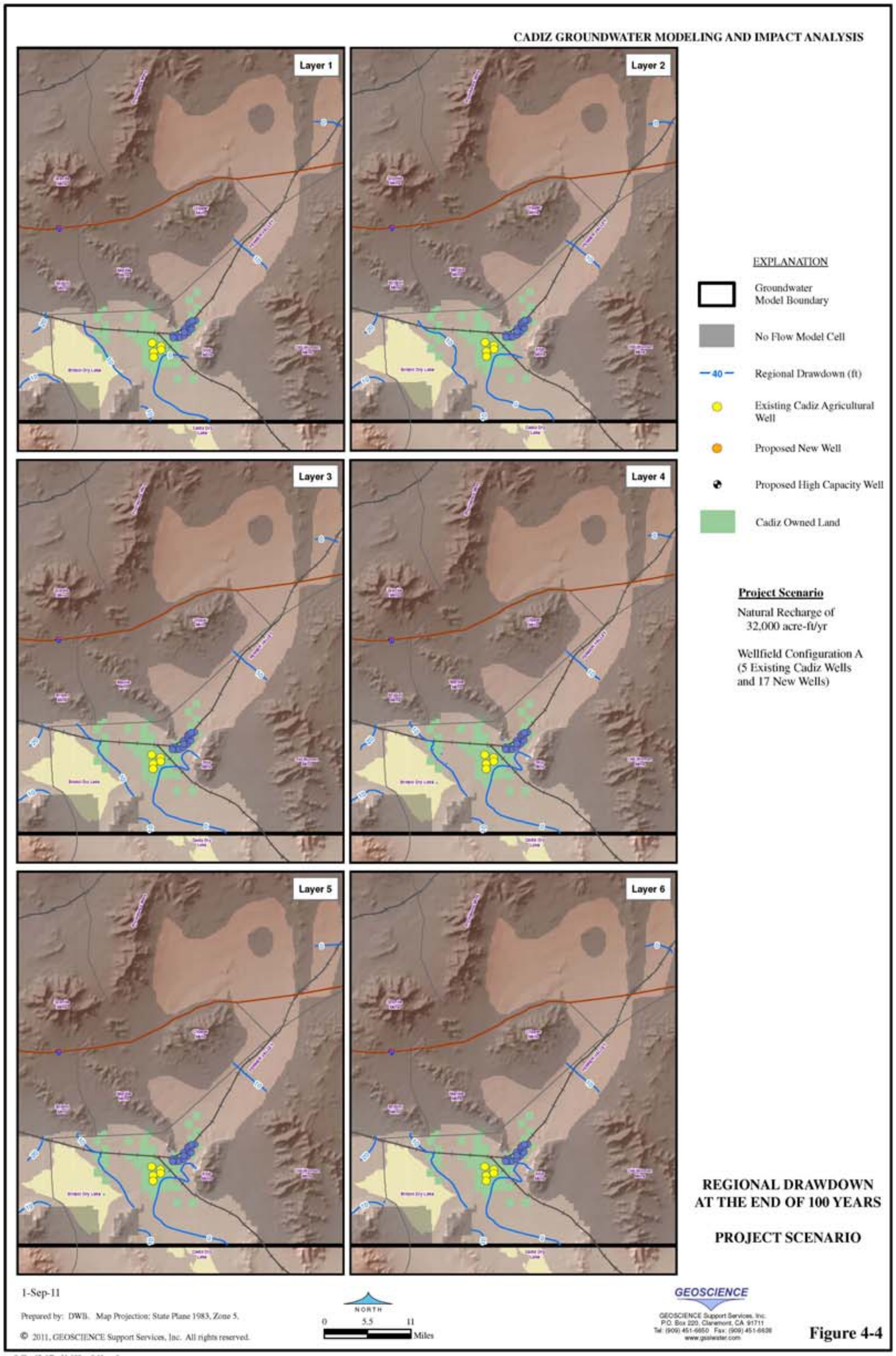
Figure 4-3


CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
40
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Proposed High Capacity Well
Cadiz Owned Land
Project Scenario
Natural Recharge of 32,000 acre-ft/yr
Wellfield Configuration A (5 Existing Cadiz Wells and 17 New Wells)
REGIONAL DRAWDOWN AT THE END OF 100 YEARS
PROJECT SCENARIO
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
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GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com
Figure 4-4
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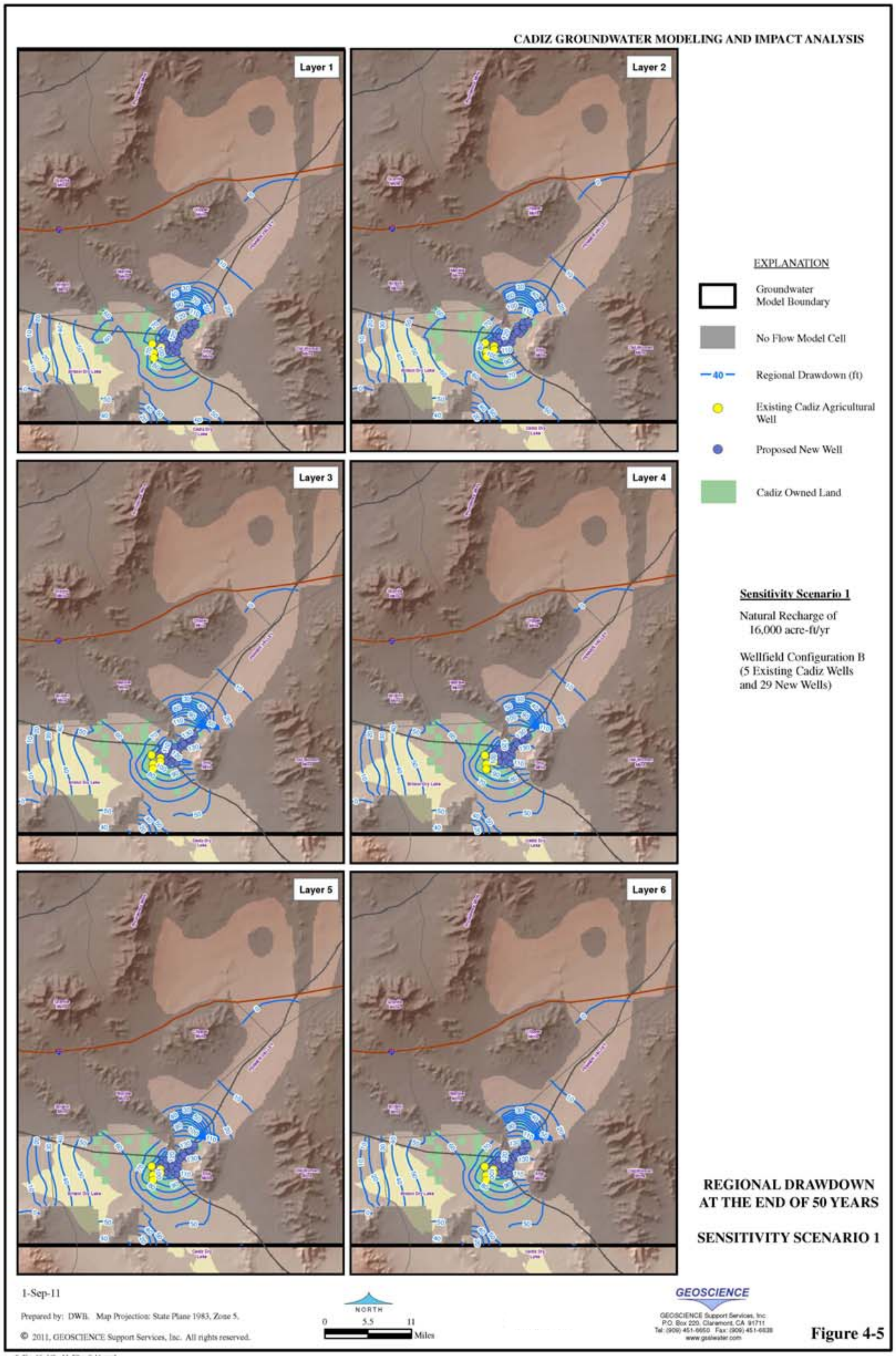
CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Cadiz Owned Land
Sensitivity Scenario 1
Natural Recharge of 16,000 acre-ft/yr
Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)
REGIONAL DRAWDOWN AT THE END OF 50 YEARS
SENSITIVITY SCENARIO 1
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
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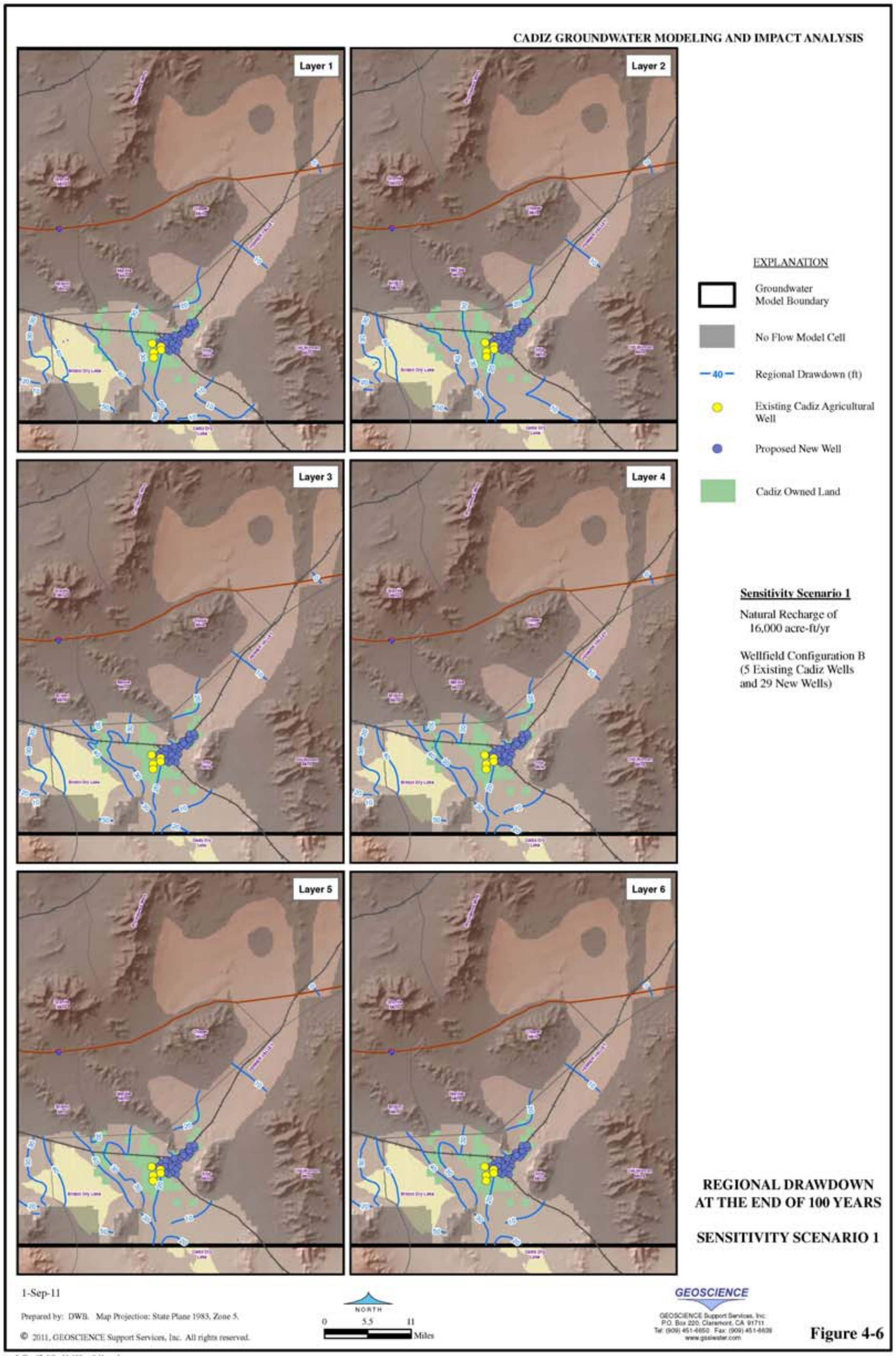
Figure 4-5


CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
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Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
40 Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Cadiz Owned Land
Sensitivity Scenario 1
Natural Recharge of 16,000 acre-ft/yr
Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)
REGIONAL DRAWDOWN AT THE END OF 100 YEARS
SENSITIVITY SCENARIO 1
1-Sep-11
Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.
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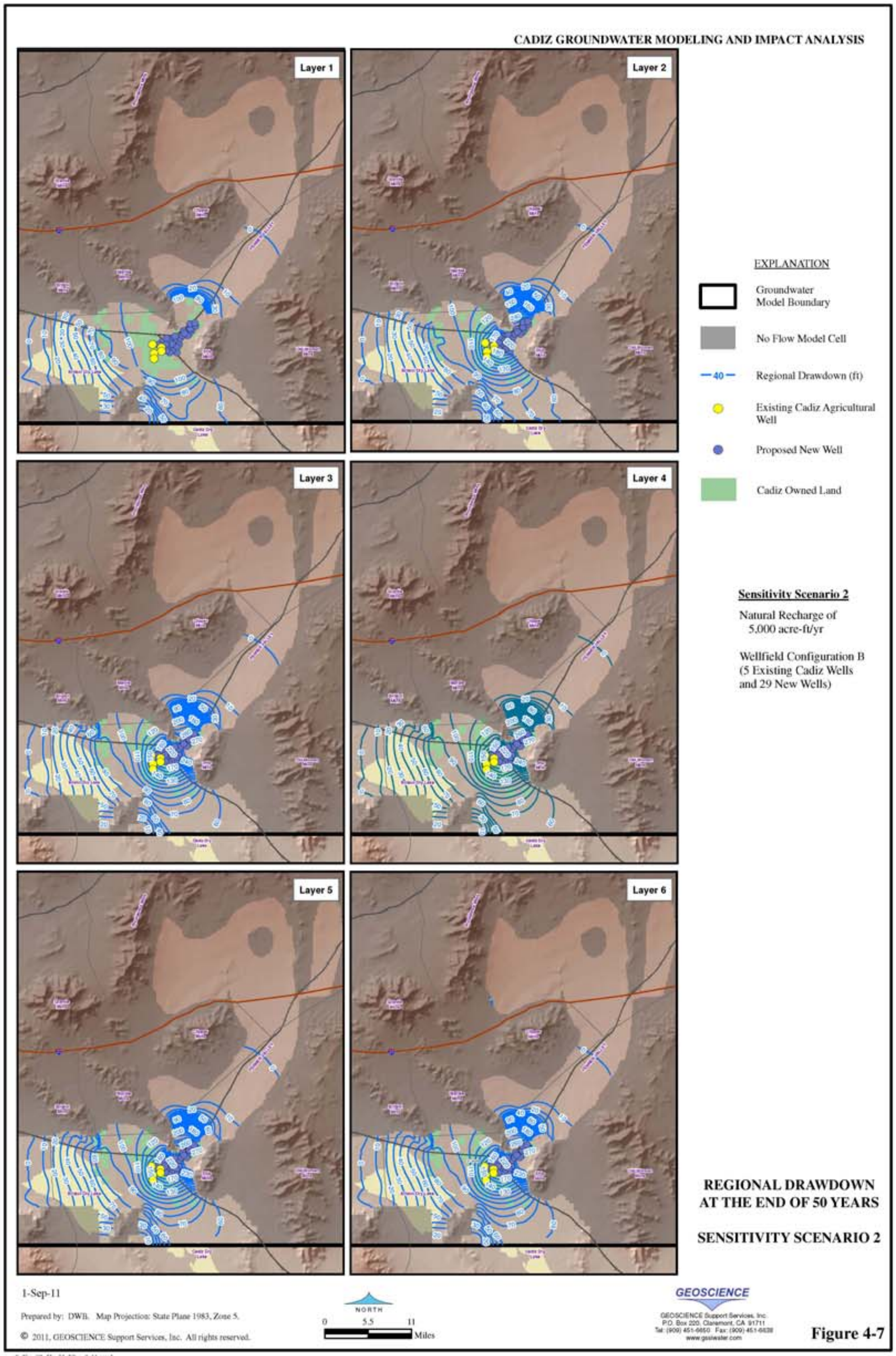
Figure 4-6



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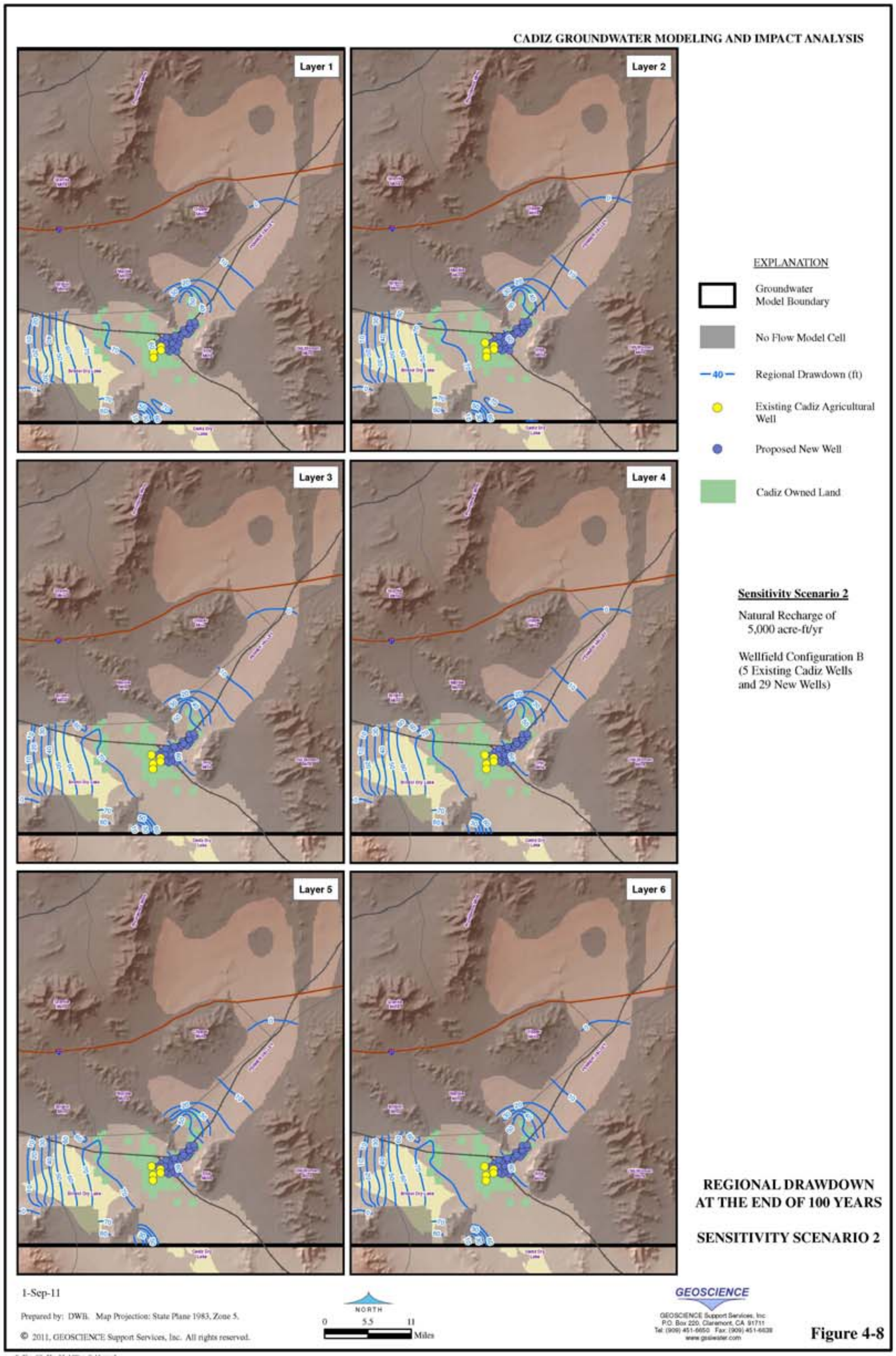
CADIZ GROUNDWATER MODELING AND IMPACT ANALYSIS
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6
EXPLANATION
Groundwater Model Boundary
No Flow Model Cell
40
Regional Drawdown (ft)
Existing Cadiz Agricultural Well
Proposed New Well
Cadiz Owned Land
Sensitivity Scenario 2
Natural Recharge of 5,000 acre-ft/yr
Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)
REGIONAL DRAWDOWN AT THE END OF 100 YEARS
SENSITIVITY SCENARIO 2
1-Sep-11
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Figure 4-8

4.1.2.4 Depth to Groundwater

Table 4-3 shows the predicted depth to groundwater during the 100 year model simulation period at selected locations including the center of the Project wellfield, the existing Cadiz Inc. wells, the edge of the Bristol Dry Lake, the center of Bristol Dry Lake, and the edge of Cadiz Dry Lake. (Geoscience, September 1, 2011). There is no chronic decline in groundwater levels attributable to the Project: groundwater levels decline for a specific purpose during pumping in order to capture groundwater that is flowing to the dry lakes. The Project operations are for a limited term (50 years) in which the Project objectives can be achieved. Thereafter, groundwater levels will recover upon cessation of pumping.

TABLE 4-3: GROUNDWATER MODEL DEPTH IMPACTS

Location	Time	Depth to Groundwater (feet)			
		Existing	Project Scenario	Sensitivity Scenario 1	Sensitivity Scenario 2
Center of Wellfield	End of 50 Years	354	435	486	627
	End of 100 Years		351	371	412
Existing Cadiz Inc. Wells	End of 50 Years	156	197	241	315
	End of 100 Years		154	181	219
Edge of Bristol Dry Lake	End of 50 Years	33	68	95	118
	End of 100 Years		42	74	108
Center of Bristol Dry Lake	End of 50 Years	18	50	63	54
	End of 100 Years		33	62	79
Edge of Cadiz Dry Lake	End of 50 Years	7	21	59	72
	End of 100 Years		10	17	68

4.1.2.5 Saline/Freshwater Interface

Geoscience used the SEAWAT-2000 variable density groundwater flow and solute transport model to predict the movement of the saline/freshwater interface as a result of Project pumping. The location of the current saline/freshwater interface is defined by the location of the 1,000 mg/L total dissolved solids (TDS) concentration contour, which is based on groundwater quality data from historical data from wells in the area.

Results of the modeling indicate that the saline/freshwater interface in the Bristol Dry Lake area would move up to 10,400 feet northeast during years 1-50 under the Project Scenario, up to 9,700 feet under Sensitivity Scenario 1, and up to 6,300 feet under Sensitivity Scenario 2. During years 50-100, after Project pumping has ceased, the saline/freshwater interface would continue to move northeast, reaching a total distance of 11,500 feet, 11,100 feet, and 9,200 feet under the Project Scenario, Sensitivity Scenario 1, and Sensitivity Scenario 2, respectively. Table 4-4 summarizes the maximum migration distance of the saline/freshwater boundary. (Geoscience, September 1, 2011). This extent of subsurface migration of saline/freshwater interface is not considered to be a significant adverse environmental impact because there are no known or projected beneficial users of fresh (<1,000 mg/l) groundwater in the affected area, nor is there any vegetation that uses the groundwater table in the affected area (see discussion below).

TABLE 4-4: SALINE/FRESHWATER BOUNDARY MIGRATION

Model Scenario	Maximum Migration of Saline/Freshwater Boundary at Year 50	Maximum Migration of Saline/Freshwater Boundary at Year 100
Project Scenario	10,400 ft Northeast	11,500 ft Northeast
Sensitivity Scenario 1	9,700 ft Northeast	11,100 ft Northeast
Sensitivity Scenario 2	6,300 ft Northeast	9,200 ft Northeast

4.1.2.6 Groundwater in Storage

Based on its groundwater model, Geoscience determined that the cumulative annual change in groundwater storage would reach a maximum of -1,090,000 acre-feet (a negative sign represents a decline in groundwater storage) in year 50 under the Project Scenario conditions. This change in storage reflects ongoing evaporation from the dry lakes of approximately 244,000 af and about 33,000 af of water contributed from interbed storage ("squeezing" of water out of fine-grained units, which results in the compaction as discussed below), so an additional net loss of about 211,000 af during the initial 50 years, in addition to pumping beyond the natural recharge rate. Groundwater modeling shows that additional evaporative losses could be reduced by implementing higher pumping rates to more quickly change the hydraulic gradients (such as pumping 75,000 afy for 25 years and then 25,000 afy for 25 years (Geoscience, September 20, 2011)). This temporary decline in storage is approximately 3% to 6% of the total groundwater in storage, which is estimated to be 17 to 34 million acre-feet. The groundwater in storage would begin to recover after the Project pumping stops in year 50, and the cumulative annual change in groundwater storage would be approximately -220,000 acre-feet in year 100 under the Project Scenario. Evaporative losses to the dry lakes accelerates through time as groundwater levels recover between years 50 and 100. Based on the rate of recovery projected for years 51 to 100, the groundwater in storage would fully recover in year 117 (i.e., 67 years after Project pumping stopped). The contribution of water from interbed storage increases and the losses due to evaporation from the dry lakes decreases in the sensitivity scenarios. Table 4-5 summarizes the cumulative annual changes in groundwater storage as calculated from Geoscience's model simulations of the three scenarios. (Geoscience, September 1, 2011). This operation precludes the chronic decline of groundwater levels, as it establishes drawdown in groundwater levels for the purposes of capturing water that would otherwise discharge to the dry lakes and evaporate, then allows for recovery of groundwater levels subsequent to establishing this condition of capture.

TABLE 4-5: REDUCTION IN ALLUVIAL GROUNDWATER IN STORAGE

Model Scenario	Cumulative Annual Changes in Groundwater Storage at Year 50		Cumulative Annual Changes in Groundwater Storage at Year 100		Time to Full Recovery after Pumping Ceases in Year 50
	Volume (acre-feet)	% of Total Groundwater Storage	Volume (acre-feet)	% of Total Groundwater Storage	
Project Scenario	-1,090,000	3% - 6%	-220,000	1%	67 (year 117)
Sensitivity Scenario 1	-1,680,000	5% - 10%	-870,000	3% - 5%	103 (year 153)
Sensitivity Scenario 2	-2,160,000	6% - 13%	-1,870,000	6% - 11%	390 (year 440)

4.1.2.7 Potential Land Subsidence

Because the Project involves a temporary strategic lowering of groundwater levels as discussed above in Chapter 3, potential land subsidence is a concern that must be evaluated and monitored. In general, the potential for land subsidence corresponds to the magnitude of groundwater level decline and the thickness of the fine-grained layers in the aquifer. Based on the results of the Geoscience groundwater model, any predicted subsidence would occur gradually and be dispersed laterally over a large area from the Fenner Gap to the Bristol and Cadiz Dry Lakes. Table 4-6 summarizes the model-predicted land subsidence over time at selected locations including the center of the wellfield, existing Cadiz Inc. wells, the edge of Bristol Dry Lake, the center of Bristol Dry Lake, and the edge of Cadiz Dry Lake. (Geoscience, September 1, 2011.) This degree of potential land subsidence would not significantly impact the alluvial aquifer's storage capacity because consolidation of the aquifer will occur in clay and silt intervals, which do not contribute to the useable storage capacity. Potential subsidence in the range projected is also unlikely to harm any surface structures (for example, subsidence is not expected to exceed thresholds established for railroad tracks by the Federal

Railroad Administration Track Safety Standards Compliance Manual, April 1, 2007). Subsidence at, or below, the range projected in Table 4-6 is therefore not determined to be a significant environmental impact. This Management Plan nonetheless provides at Chapter 6 for monitoring and action criteria triggers, and potential corrective actions that may be taken in response to the triggering of those action criteria.

TABLE 4-6: MAXIMUM POTENTIAL LAND SUBSIDENCE

Location	Time	Maximum Potential Land Subsidence (feet)		
		Project Scenario	Sensitivity Scenario 1	Sensitivity Scenario 1
Center of Wellfield	End of 50 Years	0.2	0.4	0.7
	End of 100 Years	0.2	0.4	0.7
Existing Cadiz Wells	End of 50 Years	0.6	1.0	1.5
	End of 100 Years	0.6	1.0	1.5
Edge of Bristol Dry Lake	End of 50 Years	0.5	1.0	1.4
	End of 100 Years	0.5	1.0	1.7
Center of Bristol Dry Lake	End of 50 Years	0.9	1.7	1.2
	End of 100 Years	0.9	2.1	2.7
Edge of Cadiz Dry Lake	End of 50 Years	0.1	0.4	0.5
	End of 100 Years	0.1	0.4	0.6

4.2 Potential Impacts to Springs Within the Fenner Watershed

A potential adverse environmental impact that, depending on physical conditions, can result from lowering of regional groundwater levels is the cessation or reduction of flow from area springs. Native springs are present in the vicinity of the Project within the Fenner Watershed, as shown in Figure 4-9 (CH2M Hill, August 2011.) These springs support habitat of the desert environment, and some are located within the Mojave National Preserve and BLM-managed lands. Those springs closest to the proposed Cadiz extraction wellfield are located in the adjacent mountains and include: Bonanza Spring, Hummingbird Spring, and Chuckwalla Spring in the Clipper Mountains to the north; Willow Spring, Honeymoon Spring, Barrel Spring and Fenner Spring in the Old Woman and Piute Mountains on the east; and Van Winkle Spring, Dripping Spring, Unnamed-17BS1, Unnamed-17GS1, Granite Cove Spring, Cove Spring, BLM-1 and BLM-2 springs at the Southern End of the Providence Mountains. (*Id.*) The Bonanza Spring in the Clipper Mountains, which is the closest spring to the proposed extraction wellfield, is over 11 miles from the center of the Fenner Gap. (*Id.*) All Fenner Watershed springs, including Bonanza Spring, are located in hard rock formations substantially higher in elevation than the alluvial aquifer. (*Id.*)

CH2M HILL was retained to evaluate the potential that the lowering of groundwater levels, as proposed by the Project, could impact the flow from Fenner Watershed springs. The results of CH2M HILL's analysis are set forth in a report titled "Assessment of Effects of the Cadiz Groundwater Conservation Recovery and Storage Project Operations on Springs," dated August 3, 2011. CH2M HILL reviewed the groundwater flow modeling results reported by Geoscience (Geoscience, September 1, 2011.) and developed two conceptual models of the Bonanza Spring, which was chosen as an appropriate indicator spring of all springs in the Fenner Watershed because it is the closest spring to the Project's proposed wellfield, and thus would be the most likely to experience any effect from the Project of any of the Fenner Watershed springs.

In the first conceptual model (Concept-1), there is no physical connection of the springs to a regional groundwater table. This model is based on the absence of any information demonstrating a physical connection of the springs to a regional groundwater table, the elevation differences between the groundwater in the alluvial aquifer and elevation of the springs, and the distance between the saturated alluvial aquifer and springs. Under this concept, the spring is fed by upstream fracture flows that are not hydraulically connected to the regional water table, and thus flow rates at the spring are independent of groundwater levels in the alluvium, and no impacts would occur to the spring as a result of Project operations.

Although there is no information that demonstrates a direct hydraulic connection between the springs and a regional groundwater table, the second conceptual model (Concept-2) assumed that such a connection exists. A simple numerical groundwater flow model was developed around this concept to evaluate potential impacts under Concept-2, where hydraulic continuity is assumed, in which the regional water table forms the source of water to the springs. The model was a simple representation of a generic mountain system with similar characteristics to the Clipper Mountains, intended to evaluate the general response of a water table in fractured bedrock of mountains under various assumptions that are specific to the Bonanza Spring hydrogeologic conditions. The results of the Concept-2 model suggest that a ten foot decline in groundwater levels at the Project wellfield (an assumption derived from simulations by Geoscience discussed above) could result in about six to seven feet of drawdown at the springs after hundreds of years and assuming that the decline in the adjacent alluvial aquifer was maintained at ten feet of drawdown. For example, CH2M HILL explains that after about 100 years, the drawdown would only be about 25 percent of the potential maximum drawdown in the alluvial aquifer. In addition, it is possible that, depending on how muted the water table response is to annual changes in precipitation, natural fluctuations of groundwater levels at the spring due to climate variability could be of a similar order of magnitude to potential Project-induced drawdown at the springs. CH2M HILL determined that such an impact would not be material.

CH2M HILL further determined that potential impacts to other springs in the southern part of Fenner Watershed are expected to be de minimus and even more remote than hypothetical potential impacts on the Bonanza Spring because those springs are at higher elevations and greater distances from the adjacent alluvial aquifer compared to Bonanza Spring. Consequently, CH2M HILL determined that any Project effect on other springs in the Fenner watershed would be at most inconsequential.

In sum, because of the distance, change in elevation, and assumed lack of hydraulic connection between the fractured bedrock groundwater feeding the Fenner Watershed springs and the alluvial groundwater developed by the Project, there is no anticipated impact of the Project on Fenner Watershed springs, and even assuming hydraulic connection (as CH2M HILL modeled in Concept-2), any impact would not be material. Nonetheless, consistent with the recommendations of the Groundwater Stewardship Committee and as discussed in Chapters 5 and 6, this Management Plan provides for visual, non-invasive monitoring of spring flows from Bonanza Spring, Whiskey Spring, and Vontrigger Spring to confirm the modeling results.

4.3 Potential Impacts to Brine Resources Brine Resources at Bristol and Cadiz Dry Lakes

The brine groundwater at the Bristol and Cadiz Dry Lakes support two existing salt mining operations. These operations involve evaporation of the hyper-saline groundwater from the dry lakes to obtain remaining salts. Potential Project impacts to brine resources on Bristol and Cadiz Dry Lakes are limited to potential lowering of the groundwater or brine water levels within wells used by the salt mining operations

The density-dependent groundwater flow and transport modeling by Geoscience shows that groundwater levels beneath Bristol dry lake potentially will be lowered by 10 to 30 feet under the Project Scenario and as much as 80 feet under Sensitivity Scenario 2. These depths are well within the feasibility to continue to extract brine resources from the dry lakes. FVMWC will work with the mining operators on the dry lakes to discuss potential impacts (economic in additional to physical) and potential mitigation measures as appropriate.

4.4 Potential Impacts to Air Quality

The Project is in the Mojave Desert Air Basin (MDAB). The MDAB is an assemblage of mountain ranges interspersed with long broad valleys that often contain dry lakes. Many of the lower mountains which dot the vast terrain rise from 1,000 to 4,000 feet above the valley floor. Prevailing winds in the MDAB are out of the west and southwest. These prevailing winds are due to the proximity of the MDAB to coastal and central regions and the blocking nature of the Sierra Nevada Mountains to the north; air masses pushed onshore in Southern California by differential heating are channeled through the MDAB. The MDAB is separated from the Southern California coastal and Central California valley regions by mountains where highest elevation reaches approximately 10,000 feet, and whose passes form the main channels for these air masses.

The Mojave Desert is bordered on the southwest by the San Bernardino Mountains, which are separated from the San Gabriel Mountains by the Cajon Pass (4,200 feet). A lesser channel, the Morongo Valley, lies between the San Bernardino Mountains and the Little San Bernardino Mountains.

One potential adverse environmental impact that, depending on physical conditions, can result from dewatering of aquifers in the vicinity of dry lakes is the potential to materially increase fugitive dust from the playa surface, thereby increasing the severity of area dust storms. Examples of this problem have been documented in the Mojave

Desert at the Owens and Franklin Playas. To evaluate the potential for increased fugitive dust resulting from the Project, the consulting firm HydroBio was retained to evaluate whether the Project's intended groundwater production would have an adverse effect on the generation of dust from the surface playas of the Bristol and Cadiz Dry Lakes. The results of HydroBio's investigation are set forth in a report titled Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino County, California, dated August 30, 2011.

HydroBio's investigation characterized the soil chemistry and structure on the Bristol and Cadiz Playas and the immediate margins to evaluate the relationship between groundwater and surface soils. (HydroBio, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino, California, August 30, 2011.) HydroBio's study found that the soil and water chemistry of both Cadiz and Bristol Playas have very low quantities of the sodium salts of carbonate, bicarbonate and sulfate that are known to cause severe fugitive dust storms from Owens and Franklin Playas. (*Id.*) The study explains that Bristol Playa does produce fugitive dust from erosion by sand grains driven by high wind across the playa surface. In this process, the quantity of sand available on the playa margin is responsible for the magnitude of the dust release. The available sand appears to have diminished over time and this is hypothesized to be due to the action of a mix of weedy species that have grown increasingly dominant over the past 50 years. The severity of Bristol Playa fugitive dust is believed to be diminishing with time. (*Id.*) Importantly, the HydroBio study concluded that changes in groundwater level, which may result from the Project's groundwater production, will likely have no impact upon the amount dust production from the playas or severity of area dust storms. (*Id.*)

With respect to the Cadiz Playa, the study concluded that the Cadiz Playa appears to be the sink for the sand blown from the region of the Bristol Playa directly upwind to the northwest. (*Id.*) This sand tends to be stabilized by the growth of Russian thistle (tumbleweed). While the Cadiz Playa has the same soil and water chemistry as the Bristol Playa, the copious sand dunes around the shore, particularly in the north to northeast regions result in large amounts of available sand to erode the playa surface, thereby adding dust to area dust storms. (*Id.*) However, the HydroBio study concluded that the potential lowering of groundwater levels within the Cadiz Dry Lake will not affect the amount of dust or severity of dust storms emanating from the Playa. (*Id.*)

The HydroBio study explains that the reason that the potential lowering of water levels in the Bristol and Cadiz Playas will not affect fugitive dust concentrations and occurrence is that the chemistry of the soil comprising the playas is not of the type that causes an increase in fugitive dust as a result of lowered groundwater levels.

Specifically, the study explains that the chemistry of the Bristol and Cadiz Playas is low in carbonate, bicarbonate and sulfate ions that are implicated in other playas that produce major dust storms (such as Owens and Franklin Playas). Instead, the Bristol and Cadiz Playas playa contains chemistry that has been noted to induce surface stability (Ca, Na and Cl). Cadiz Playa appears to have the same chemistry. For these reasons, it is not anticipated that the Project will have any material effect on the concentration of dust emanating from the Bristol and Cadiz Playas nor the severity of area dust storms. Nonetheless, consistent with the recommendations of the Groundwater Stewardship Committee and as discussed in Chapters 5 and 6 and the avoidance of doubt, this Management Plan provides for the installation and monitoring of two nephelometers to confirm these technical conclusions.

4.5 Potential Impacts to Project Area Vegetation

Another potential adverse environmental impact that, depending on physical conditions, can result from lowering of groundwater levels is the lowering of groundwater tables that are accessed by area vegetation, thereby causing the stress or death of that vegetation. Vegetation in environments like that found in the Project area, provides important stabilization of soils against the action of wind erosion. The consulting firm HydroBio was retained to evaluate whether the Project's intended groundwater production would have an adverse effect on the occurrence and health of area vegetation. The results of HydroBio's investigation are set forth in a report titled, Vegetation, Groundwater Levels and Potential Impacts from Groundwater Pumping Near Bristol and Cadiz Playas, San Bernardino, California, dated September 1, 2011. The HydroBio study concludes that there is no connection of vegetation with groundwater in the Project area, and hence, no vegetation will be affected by changes in water table elevation. (HydroBio, September 1, 2011.)

HydroBio began its investigation by locating the most likely vegetation in the area potentially affected by the planned groundwater pumping. This "most likely" cover was identified by its higher activity (denser growth, larger plants) than all other locations around the Bristol Playa. Observations of the Cadiz Playa indicated that this region could be eliminated from concern because the vegetation around the playa is generally no more verdant than the surrounding area, hence obviously receiving no promotion from groundwater. HydroBio observed that the lowermost edge of the higher shrub zone was the region with higher vegetation activity that appeared to have the highest potential for connection of vegetation to groundwater. (*Id.*)

The HydroBio study explains that there are three shrub species that grow around the Bristol Playa: creosote bush [Larrea tridentata], cattle saltbush [Atriplex polycarpa] and four wing saltbush [Atriplex canescens]. Of these, the only species that may act as a phreatophyte (a plant species that uses groundwater), is the four-wing saltbush, and that this species is specifically a facultative phreatophyte, meaning it can benefit from but does not require shallow groundwater. (*Id.*) To determine whether any of the area four-wing salt brush in the area are presently accessing groundwater, HydroBio reconstructed a curve for depth to water (DTW) versus elevation based on hydrographic data collected in the region of the Cadiz Ranch. A DTW point was added on the Bristol Playa that was reconstructed using photogrammetry. The study found that together, these points describe a highly linear relationship of DTW versus elevation above sea level (r2 = 99.9%). (*Id.*) Based on the robust and accurate relationship of the DTW curve, HydroBio estimated the DTW at the lowermost edge of the higher vegetation cover – the location most likely to have a vegetation/groundwater connection - was 65 feet. Root excavations of four-wing saltbush have been measured to reach a maximum of 25 feet on only rare occasions when soils and hydrology permit but typical root depths for the species average about 13 feet. Thus, based on measured and estimated DTW, the HydroBio study concluded that the shallowest water table position is 40 feet below the record rooting depth for the four-wing salt brush – the only species that could be potentially affected by groundwater decline. HydroBio therefore concluded that there is no connection of vegetation with groundwater in the region Project area. (*Id.*) HydroBio further hypothesized that the promotional effect of periodic surface flows from the upstream catchments is the reason for the apparent promotion of this vegetation. (*Id.*)

4.6 Potential Impacts to the Colorado River and its Tributary Sources of Water

It is assumed that the groundwater that would be extracted by the Project at the Fenner Gap is not tributary to the Colorado River because the aquifer systems within the Fenner, Bristol and Cadiz Watersheds are believed to be a closed basin, isolated from aquifer systems to the east that are tributary to the Colorado River by bedrock and groundwater divides. It is important to ensure that the Project groundwater is not tributary to the Colorado River for several reasons. First, the Colorado River is fully appropriated and rights to divert water therefrom are governed by a complex set of federal and state laws. Material extractions of tributary groundwater could reduce flows in the Colorado River, thus frustrating the administration of the Colorado River and affected environmental resources.

It is also important to confirm that the Project groundwater is not tributary to the Colorado River for purposes of satisfying the provisions of the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (Guidelines) administered by the U.S. Bureau of Reclamation

(Reclamation), for purposes of establishing Intentionally Created Surplus (ICS) credits under the Guidelines for potential Project participants that have contracts with the Reclamation for diversions from the Colorado River. Under the Groundwater Conservation and Recovery Component of the Project, groundwater that is non-tributary to the Colorado River would be introduced into the Colorado River Aqueduct as "new," non-tributary water. For potential participants who have contracts with Reclamation for Colorado River water, the receipt of Project water creates the opportunity to establish ICS Credits based on the use of non-tributary water supplies in lieu of Colorado River diversions pursuant to Reclamation contracts. This opportunity could allow a participant to further augment its water supplies and improve overall water supply reliability. To qualify for ICS credits under the Guidelines, the surplus water used in lieu of Colorado River diversions must be non-tributary to the Colorado River.

While the assumption that the Project groundwater is non-tributary to the Colorado River is supported by substantial physical evidence (e.g., bedrock and groundwater divides), two monitoring wells (one existing and another to be installed) on property owned by Cadiz within the adjacent Piute Watershed that is tributary to the Colorado River will be monitored for the purpose of further demonstrating no interconnection exists.

CHAPTER 5
MONITORING NETWORK

To ensure continued protection of the watershed and other resources, a comprehensive monitoring network has been developed to assess and continually evaluate the technical aspects of the Project, and any potential impacts to critical resources during the life of the Project, as designated in Chapter 4. The development of the monitoring network was based on the groundwater flow model that has been developed to better understand the hydrogeologic impacts of the Project's proposed groundwater production. The groundwater flow model will be continuously refined as additional monitoring data are obtained. (See discussion of groundwater flow model in Chapter 4).

This Management Plan will be implemented with a set of monitoring features and parameters as discussed in this Chapter. As new data becomes available, the monitoring features may be refined to ensure protection of critical resources in and adjacent to the Project wellfield area. If FVMWC proposes a refinement to monitoring features, it will submit a written proposal describing the refinement along with supporting data and materials to the TRP for review and recommendation to SMWD.

SMWD will make a final decision on FVMWC's proposal through the decision-making process described in Chapters 6 and 8.

A total of twelve different types of monitoring features have been identified for assessing potential impacts to critical resources during the term of the Project, as identified in Chapter 4. A summary of these twelve types of monitoring features, as well as monitoring frequencies and parameters to be monitored is provided in Tables 5-1 and 5-2. Generalized locations are shown in Figures 5-1 and 5-2.

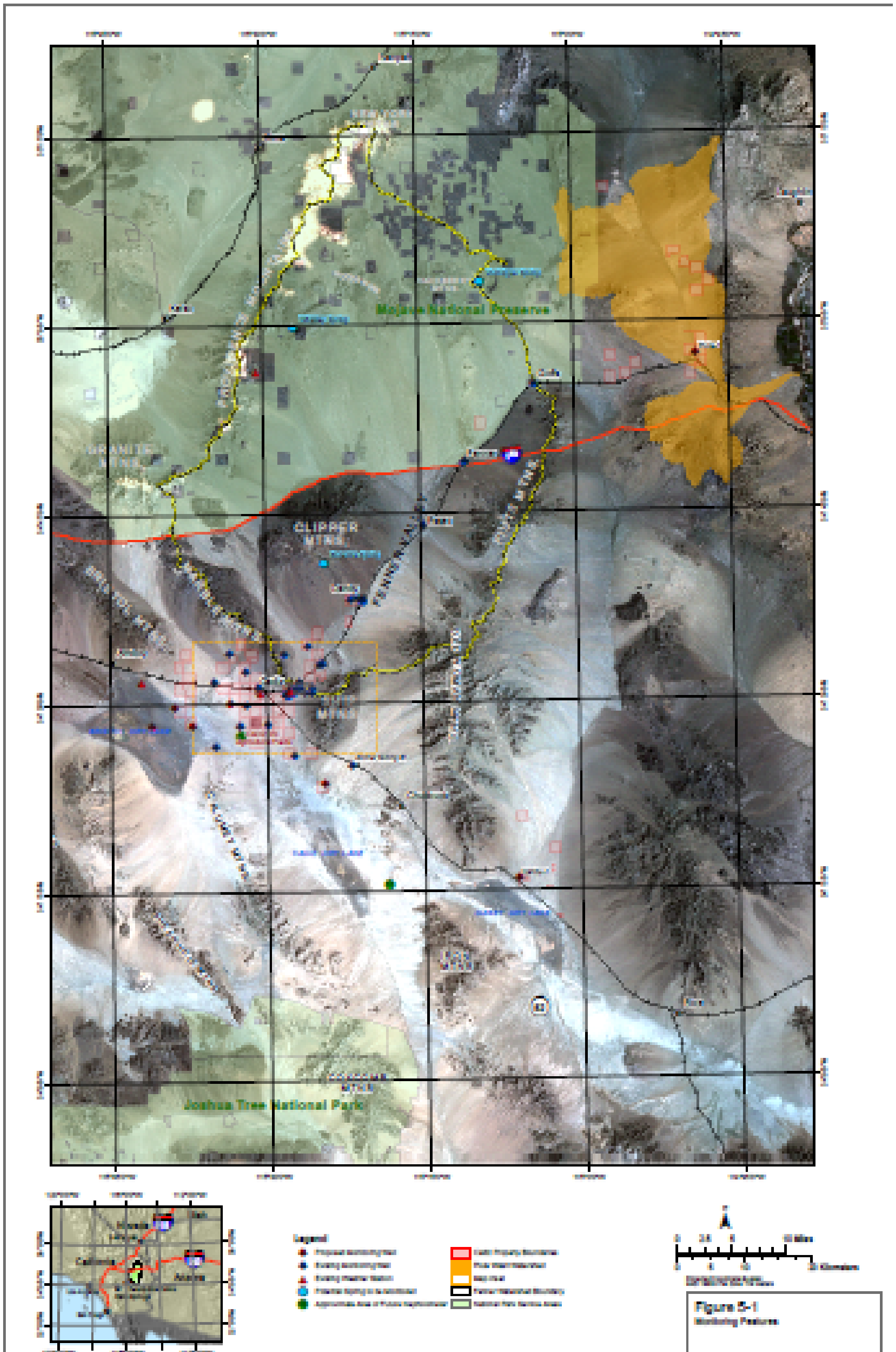
Mojave National Preserve
CLIPPER MTNS
Joshua Tree National Park
California
Arizona

Figure 5-1

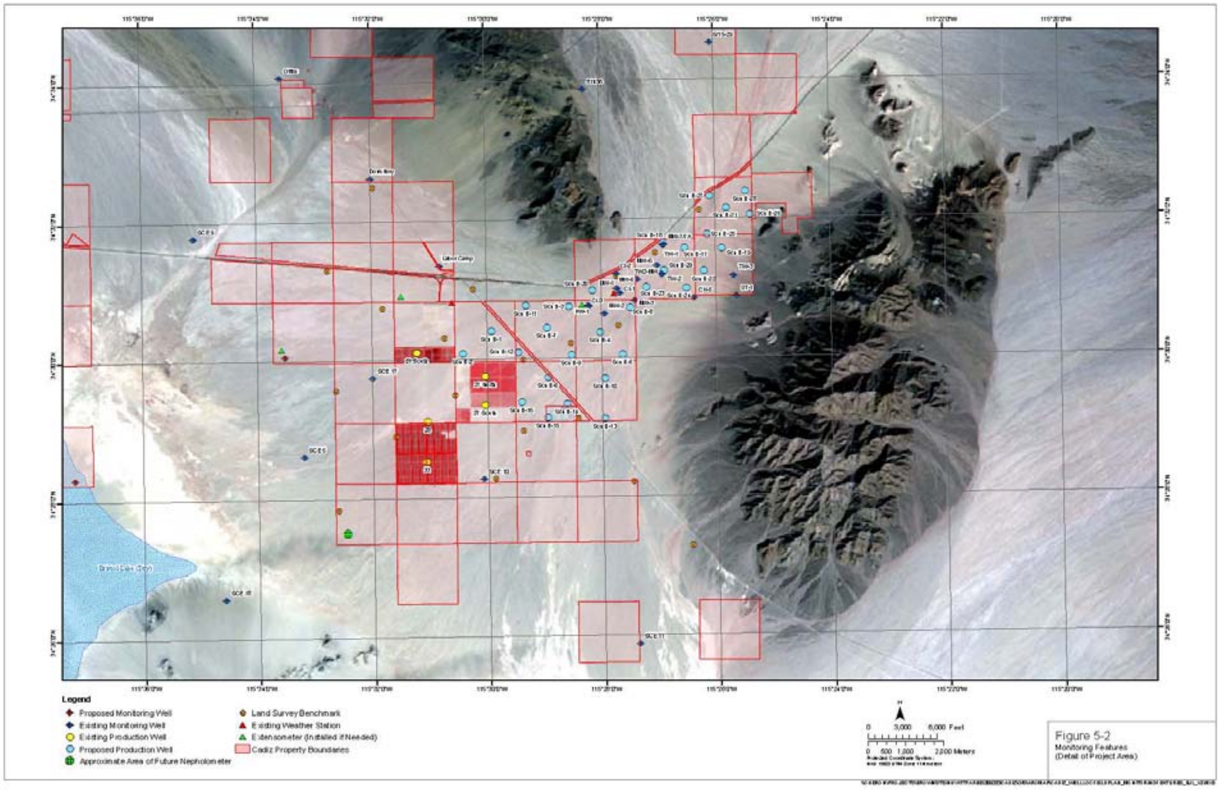

Figure 5-2
Monitoring Features
(Detail of Project Area)

Installation of certain monitoring features, where construction of facilities is required, will be subject to site-specific approval and permitting by applicable regulatory agencies. Cadiz will complete and deliver all needed permits for monitoring facilities as soon as practicable within the pre-operational phase. FVMWC will construct all facilities that are agreed to in this Management Plan and for which permits have been received. Construction of these facilities will be completed within one year of receipt of permits. If the implementation of monitoring features currently contained in this Management Plan is not approved, FVMWC will evaluate and implement alternate monitoring sites subject to approval by SMWD (with review and receipt of recommendations by the TRP), and the applicable regulatory agencies.

The following text describes in detail the various proposed monitoring features.

5.2 Springs (Feature 1)

An inventory of 28 known springs within the Fenner Watershed was completed by the USGS (USGS, 1984). Locations of these springs are shown on Figure 5-3. As discussed in detail in Chapter 4, the potential for Project impacts to these springs has been evaluated. It is not anticipated that the Project will have any impact on the springs. Nonetheless, this Management Plan provides for quarterly monitoring of the Bonanza Spring as an "indicator spring" because it is the spring that is in closest proximity to the

Project wellfield (approximately 11 miles from the center of Fenner Gap), and of all springs within the Fenner Watershed, this one would be the first one to be affected by the Project, if it were somehow possible to be in hydraulic connection with the alluvial aquifers, which appears unlikely. The Whisky and Vontrigger Springs, which are located beyond the Project's projected effects on groundwater levels in the alluvial aquifers of the Fenner Watershed, will also be monitored to compare variations in spring flow from those springs to variations in spring flow from the Bonanza Spring to assist in determining whether any material reduction of flow at the Bonanza Spring is attributable to the Project operation, or instead, is attributable to regional climate conditions.

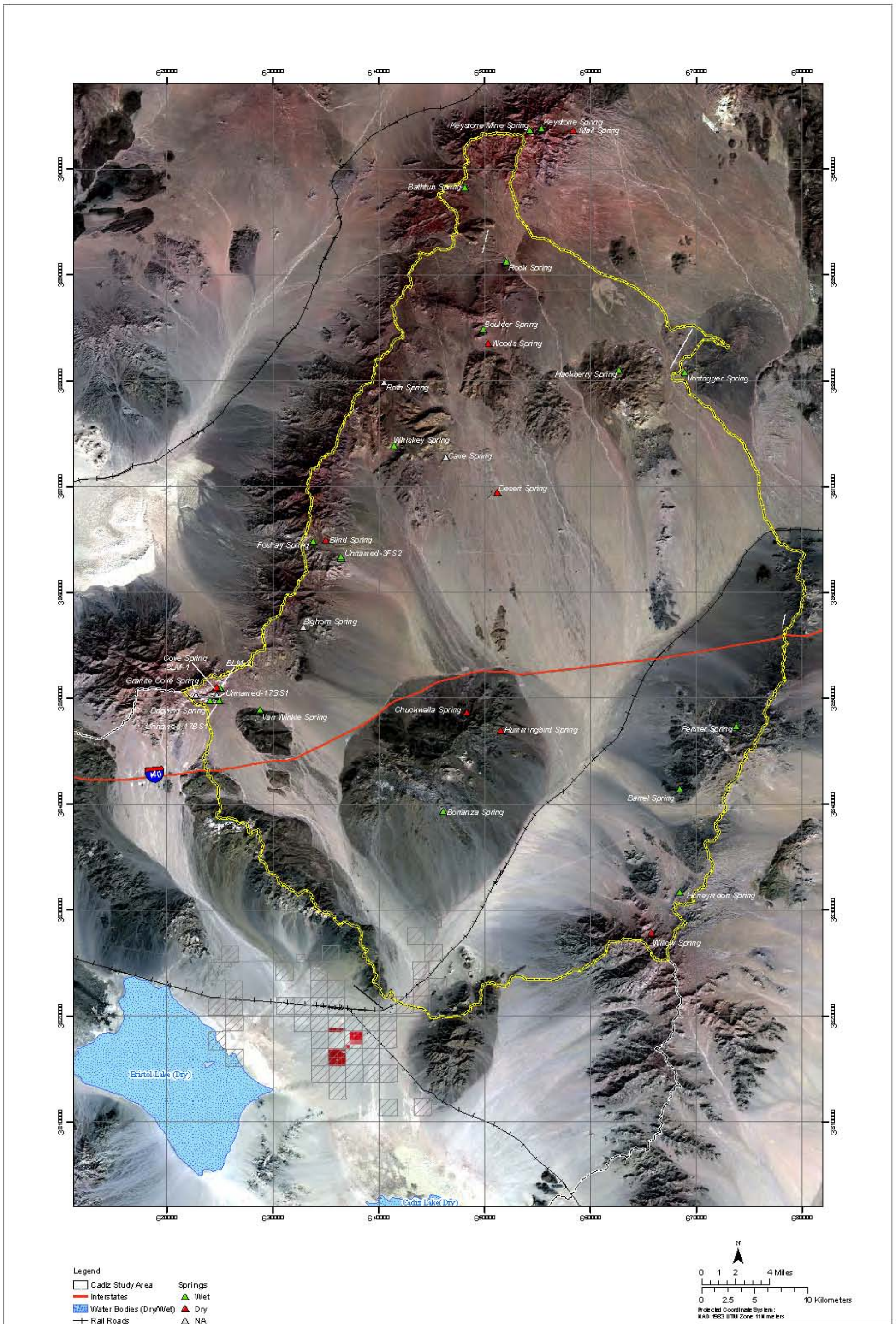

Figure 5-3
Location of Springs

The springs will be monitored by visual observations and flow measurements. Visual observations will include starting and ending points of observed ponded or flowing water, estimated depth of ponded water and flow rate of flowing water, conductivity, pH and temperature of water, any colorations of water, and general type and extent of vegetation.

5.3 Observation Wells (Features 2)

A total of 15 existing observation wells and 2 new observation wells will be used to monitor groundwater levels during the Project (see Tables 5-1 and 5-2). Locations of these wells are shown on Figures 5-1 and 5-2. Six of these wells were installed in the 1960's by Southern California Edison as part of a regional investigation (wells whose designation begins with "SCE"). Four of the observation wells (Labor Camp, Dormitory, 6/15-29, 6/15-1) are owned and monitored by Cadiz as part of their agricultural operation. Existing well CI-3 was installed in Fenner Gap during the pilot spreading basin test for the Project. Existing wells at Essex, Fenner, Goffs, and Archer Siding #1 are related to railroad operations or municipal supply. All of these existing wells will be utilized provided that appropriate permission and approval is obtained.

One new well, Piute-1, will be installed in the Piute Watershed, north of the Fenner Watershed, and is tributary to the Colorado River. This well will be installed on property owned by Cadiz and will be used as a "background" monitoring well to monitor undisturbed groundwater levels in an adjacent watershed, to provide information on groundwater level variations due to climatic variations only. In addition, this will serve to demonstrate that the Project will not impact groundwater that is tributary to the Colorado River.

Another new well, Danby-1, will be installed in the Danby Watershed to the east. Similar to Piute-1, this Danby-1 observation well will be used to demonstrate that impacts on groundwater levels do not extend beyond the Cadiz watershed on the west. This well will also provide information on regional groundwater level conditions and is expected to provide additional background monitoring and information groundwater level changes that may be due to climatic variations as well.

Groundwater levels will be measured in accordance with the monitoring procedure presented in Appendix B[2]. All water samples would be collected according to the protocol described in Appendix C. Field parameters such as groundwater temperature, pH, electrical conductivity, and total dissolved solids (TDS), will be collected at each well during well purging and prior to sampling. Samples from each well will be analyzed for the general mineral and physical parameters specified in Appendix D. In addition, all samples collected during the pre-operational phase will also be analyzed

[2] These procedures are being reviewed for consistency and will be made available on October 26.

for bromide, boron, iodide barium, arsenic, hexavalent chromium, total chromium, nitrate, and perchlorate. The sample analytical protocol is presented in Appendix D.

Groundwater monitoring frequency will be revisited as determined appropriate by the decision-making process should any of the action criteria be exceeded, as discussed in Chapter 6.

5.4 Proposed Observation Well Clusters (Feature 3)

Three well clusters will be established in the immediate vicinity of the Project wellfield (see Figure 5-2). These cluster wells will provide a basis to compare groundwater level and water quality changes in both the shallow and deep portions of the alluvial and bedrock aquifer systems. Two well clusters, using existing monitoring well MW-7, MW-7a, and TW-1, and TW-2 and TW-2MW will be established for monitoring in the immediate vicinity of the Project. The screened intervals are in the upper alluvial, carbonate aquifer, and bedrock. The third cluster well combination will be installed in the area between Bristol Dry Lake and the Project wellfield to monitor groundwater elevations and water quality. All new Project monitoring wells shall be designed, installed, and completed in manner consistent with all applicable state and local regulations, and industry standards. Monitoring will occur as presented in Tables 5.1 and 5.2.

5.5 Project Production Wells (Feature 4)

Data from the well field (new project wells and existing Cadiz agricultural wells) will be collected to provide information on the groundwater levels and discharge rates. Each well will be equipped with a flow meter to monitor well discharge and a sounding tube for obtaining groundwater level measurements. Production data from the project wells will be verified using totaled readings of flow at CRA.

5.5.1 *Existing Cadiz Agricultural Wells*

The Cadiz agricultural operation owns and operates seven agricultural wells used for irrigation, which are located west and southwest of Fenner Gap (see Figure 1-3). Five of the seven Cadiz irrigation wells could be incorporated into the Project wellfield (Wells 21S, 27N, 27S, 28 and 33).

5.5.2 *New Production Wells*

The Project wellfield would consist of approximately 29 additional production wells to be located as shown on Figure 5-2. Each new well would be completed to a depth of about 1,000 feet (see Figure 5-4). This well design may be modified based on observations in the field and expectations of drawdown that may be encountered during Project operations. The total capacity of the wellfield would allow for a pumping range of 25,000 afy to 75,000 afy. All new Project production wells shall be designed, installed, and completed in manner consistent with all applicable state and local regulations, and industry standards and be equipped with flow meters.

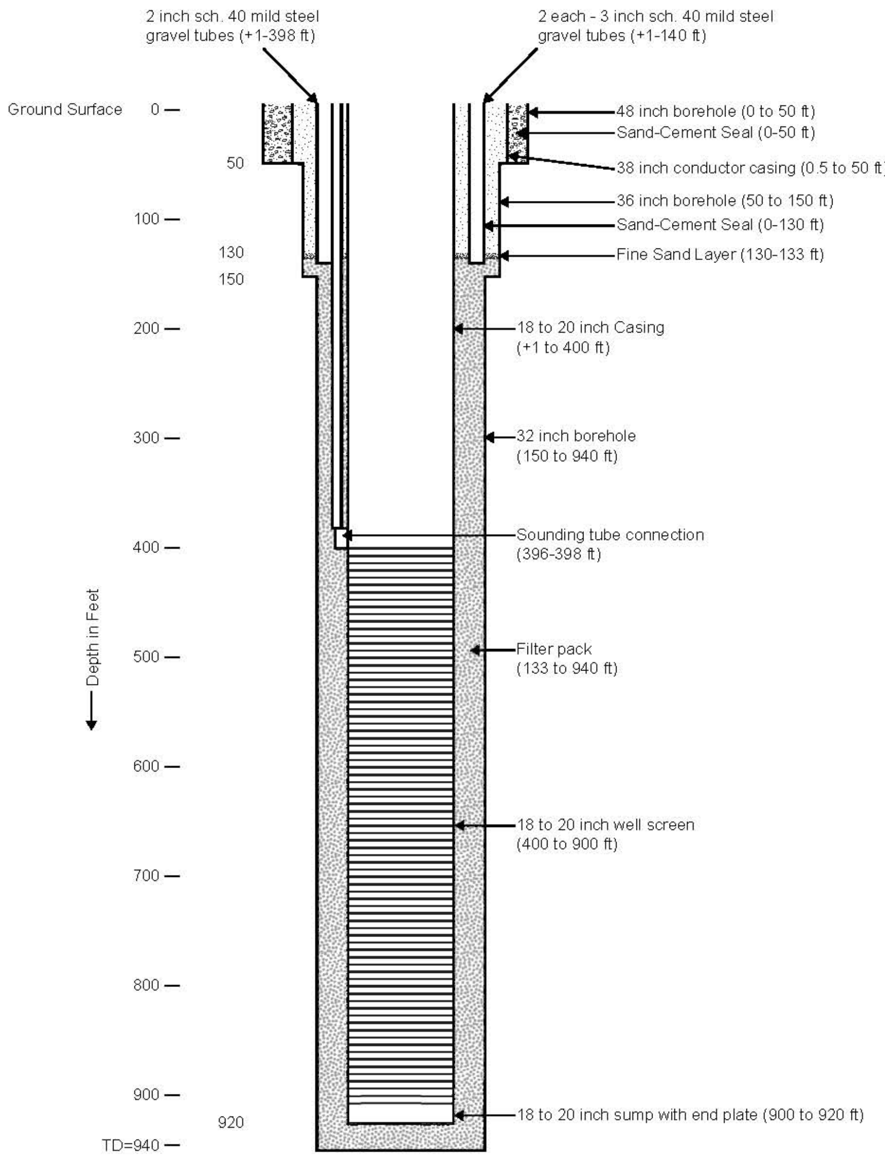

FIGURE 5-4
Conceptual Well Design Diagram

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5.6 Land Surface Monitoring (Feature 5)

A network of approximately 20 land survey benchmarks will be installed at the approximate locations shown on Figure 5-2 to monitor changes in land surface elevation should they occur. Horizontal and vertical accuracy will be established in accordance with a second order Class I survey standard (1:50,000). Each benchmark will be established and surveyed by a California licensed land surveyor. All locations will be dependent upon permitting from the appropriate agencies. Benchmark surveys will be conducted on an annual basis during the term of the Project (see Table 5-1).

Pre-operational baseline Interferometric Synthetic Aperture Radar ("InSAR")will be used to evaluate potential impacts in conjunction with the benchmarks. FVMWC will obtain surveyed baseline land surface elevations which then will be compared to each other along with any InSAR data collected during the course of the Project. The InSAR data would be used to monitor relative changes of land surface elevation that could be related to aquifer system deformation in the Project area. This pre-operational InSAR data (collected at two separate times during the year prior to the operational phase of the Project) will complement the land survey data to establish changes in land surface elevations. During the operational phase, annual benchmark surveys will be conducted and InSAR images will be obtained and evaluated every five years to evaluate potential impacts. During the post-operational phase, InSAR data and benchmark survey will be obtained every five years (Table 5-1). InSAR images will be obtained and evaluated more frequently, along with benchmark surveys if determined appropriate by the TRP and authorized by SMWD, should trends be observed which may lead to action criteria being exceeded as discussed in Chapter 6.

5.7 Extensometers (Feature 6)

To evaluate potential impacts during the operational phase, FVMWC will construct three extensometers in the area of the highest probability of subsidence (see Figure 5-2). The extensometers will be constructed to continuously measure non-recoverable compaction of fine-grained materials interbedded within the alluvial aquifer systems.

5.8 Flowmeter Surveys (Feature 7)

Downhole flowmeter surveys will be generated in five selected new extraction wells. This is expected to be a one-time activity. The flowmeter surveys will provide data regarding vertical variation in groundwater flow to the well screens. Depth-specific water quality samples will also be collected to assess vertical variation of groundwater quality in the Project wellfield area. Data will be used to help refine geohydrologic parameters regarding layer boundaries used in the groundwater models.

5.9 Proposed Observation Well Clusters At Bristol Dry Lake (Feature 8)

A total of three new observation well clusters will be installed and monitored in the vicinity of Bristol Dry Lake during the initial phases of the Project (see Table 5-1 and Figure 5-2). Two well clusters will be located along the eastern margin of Bristol Dry Lake to monitor the effects of Project operations on the movement of the fresh water/saline water interface (see Figure 5-2). One additional well cluster will be installed on the Bristol Dry Lake playa to monitor brine levels and chemistry at different depths beneath the dry lake surface. This well cluster will be positioned in relation to the well clusters at the margin of the dry lake so as to provide optimum data for the density-dependent transport model.

A typical observation well cluster completion is illustrated on Figure 5-5. Screened intervals for each of the wells within each cluster will be determined from logging of cuttings and geophysical logging of the deep borehole which will be drilled first. Each deep well will be completed with PVC or other suitable well casing and screen to allow for dual induction geophysical logging. Shallow wells will be completed with PVC or other suitable well casing and screen.

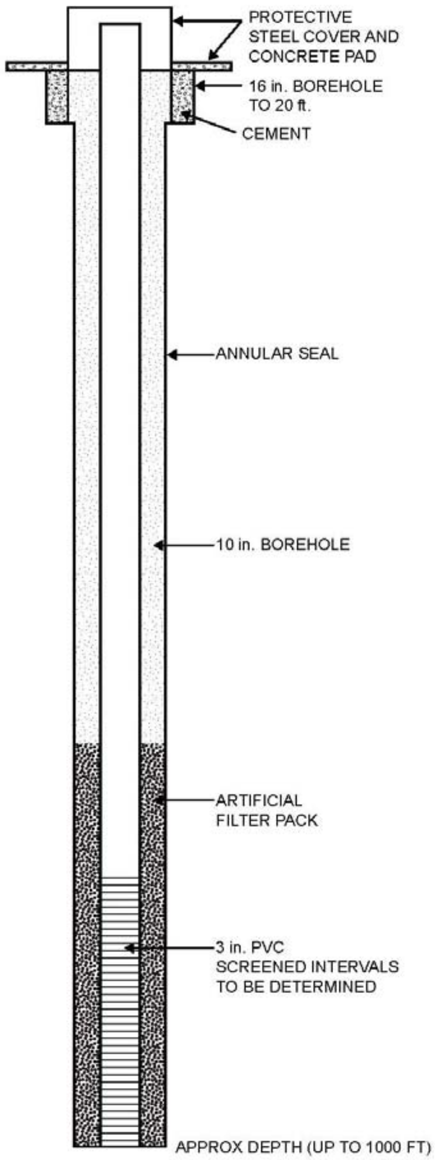

FIGURE 5-5
Typical Observation Well Cluster

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During the pre-operational phase, static groundwater levels will be monitored on a continuous basis from each well cluster using downhole pressure transducers. Project monitoring will begin immediately following well installation and development.

5.10 Proposed Observation Well Clusters At Cadiz Dry Lake (Feature 9)

One well cluster will be located along the northern margin of Cadiz Dry Lake to monitor the effects of Project operations on the movement of the fresh water/saline water interface in this area (see Figure 5-1). During the pre-operational phase, static groundwater levels will be monitored on a continuous basis from each well cluster using downhole transducers. Project monitoring will begin immediately following well installation and development and continue through the post-operational period.

5.11 Gamma-Ray/Dual Induction Downhole Geophysical Logs (Feature 10)

Gamma-ray and dual induction electric logs will be run for the deepest observation wells of each well cluster to be installed at the dry lakes (four total). These Downhole geophysical techniques allow for the measurement of groundwater electrical conductivity with depth and could be conducted in observation wells constructed of PVC casing and screen.

Gamma-ray/dual induction geophysical logs will be run as a one-time measurement to be conducted during observation well cluster installation during the pre-operational phase of the Project.

5.12 Weather Stations (Feature 11)

Data from four existing weather stations will be collected over the course of the Project (see Figures 5-1). Existing weather stations include the Mitchell Caverns weather station (located in the Providence Mountains), the Project weather station (located in Fenner Gap adjacent to the spreading basins), the Cadiz CIMIS station (operated by/for CDWR at the Cadiz Field Office), and the Amboy weather station (located near Bristol Dry Lake in the town of Amboy).

The Mitchell Caverns weather station would provide precipitation, temperature, and other climatic data for the mountain regions of the Fenner watershed. The Fenner Gap weather station would provide climatic data in the immediate vicinity of the Project area. The Amboy and Cadiz Field Office weather stations would provide climatic data representative of the lowest area of the regional watershed. Data obtained from the weather stations will incorporated into the water resource models described in Chapter 4, along with complementing data analysis of Feature 12.

5.13 Air Quality Monitoring (Feature 12)

5.13.1 *Monitoring at Bristol and Cadiz Dry Lakes*

The relationship between groundwater and the surface of Bristol and Cadiz Dry Lakes has been evaluated in a technical study conducted by HydroBio.[3] The technical study concludes that unlike some other playas in the arid Southwest such as Owens and Franklin Playas, the soil and water chemistry of both Cadiz and Bristol Dry Lakes have very low quantities of the sodium salts of carbonate, bicarbonate and sulfate that are known to generate excessive fugitive dust in high wind storms. Rather, the Bristol and Cadiz Dry Lakes are characterized by sodium and calcium chlorides that maintain rigid structure when desiccated, reducing the amount of loose dust on the ground surface that can be lofted by the wind. This surface crust is not aided or maintained by direct contact or indirect contact through capillary action with the groundwater.

Under current conditions, dust storms are not uncommon in the valley as sand particles saltate across the desert floor, dislodging other sand particles and lofting dust into the air.[4] Under current conditions, depth to groundwater in some areas beneath the dry lakes is over 60 feet below ground surface, and the surface soils in these areas exhibit the same crusty surface as areas with shallow groundwater. This crusty surface soil provides some resistance to wind erosion and limits dust emissions. It is not reliant on groundwater. Therefore, drawdown of the groundwater beneath the dry lakes will have no effect on surface soils and therefore no affect on dust emissions in the valley.

To verify the condition of the dry lakes consistent with recommendations of the Groundwater Stewardship Committee and to provide additional data on the environment of the area, FVMWC will install two nephelometers one downwind from Bristol Lake and one downwind of Cadiz Dry Lake to establish a set of baseline data of visibility in the valley. These nephelometers will be placed on privately-owned property, and outside the wind shadow of the agricultural properties.

In addition, FVMWC will conduct annual visual observations at four points on each of the dry lakes to record surface soil conditions. The visual observations will note soil texture and record susceptibility to wind erosion. Photographs of the soil will be taken. This data will record conditions over time on the two dry lakes surfaces at the same locations each time.

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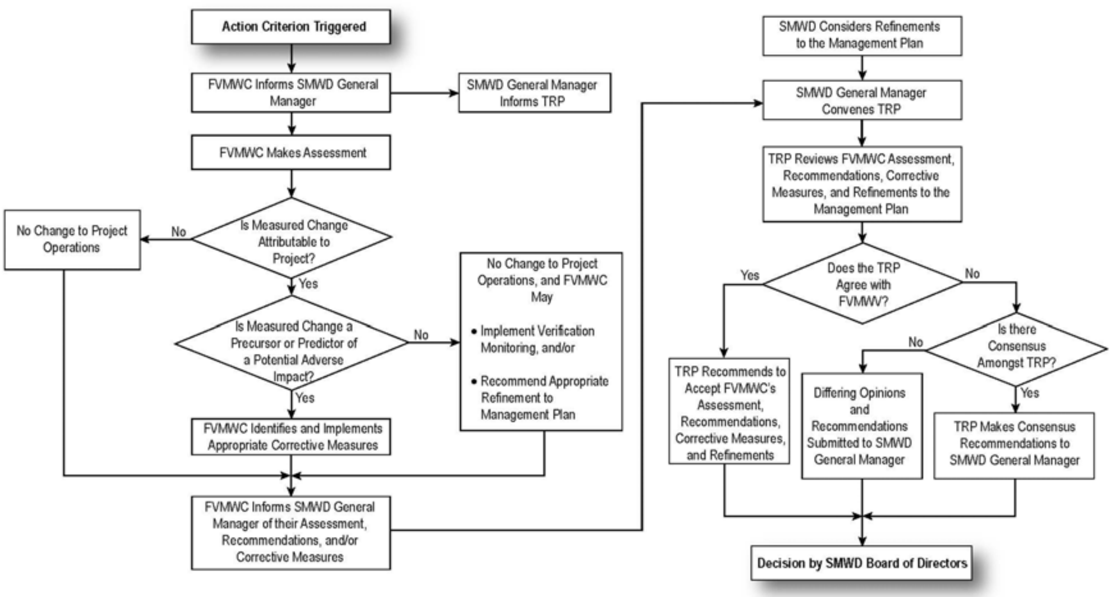
[3] HydroBio, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino, California, August 30, 2011, pg. i

[4] HydroBio, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas, San Bernardino, California, August 30, 2011, pg. 6

These nephelometers will provide data on a daily basis that records opacity of the air, measuring the effect of dust on visibility. Data will be collected in the pre-operational phase of the Project and in the early years of the Project, establishing a baseline before groundwater levels beneath the dry lakes are affected. Since wind velocity and dust storms are highly variable, the data will record trends over time. Data will also be collected during the operational and post-operational phase of the Project and compared to baseline data to evaluate whether Project operations have impacted air quality. A summary of these data and data analysis from the nephelometers will be submitted annually to the TRP. This analysis will inform the TRP on the environmental setting, augment the weather station data, and provide information for the long term management of the facilities in the valley.

CHAPTER 6
MONITORING AND MITIGATION OF PROJECT IMPACTS TO CRITICAL RESOURCES (ACTION CRITERIA, DECISION-MAKING PROCESS AND CORRECTIVE MEASURES)

This Management Plan identifies specific quantitative criteria (action criteria) that will "trigger" review to determine whether an observed change in conditions relating to critical resources is attributable to the Project operations, and if so, which specific corrective measures would be implemented to avoid adverse impact to critical resources. It is the intent of this Management Plan to identify deviations from baseline conditions, along with deviations from groundwater model projections, at monitoring features as early as possible in order to identify and prevent the occurrence of material adverse impacts to critical resources as a result of Project operations. A decision-making process has been developed, which outlines the process to be followed in the event deviations from model projections develop, or that an action criterion is triggered, or when refinements to the Management Plan are considered. Figure 6-1 shows the decision logic that will be used during the course of the Project. Finally, potential corrective measures to be implemented, if appropriate, are identified. Critical resources, action criteria, the decision-making process, and potential corrective measures are discussed in this Chapter 6 and summarized in Table 6-1.



FVMWC = Fenner Valley Mutual Water Company
SMWD = Santa Margarita Water District
TRP = Technical Review Panel

FIGURE 6-1
Decision-Making Process
Groundwater Management, Monitoring, and Mitigation Plan
Cadiz Conservation, Recovery, and Storage Project

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The initial action criteria and corrective measures presented in this Management Plan are considered conservative. FVMWC may propose refinements to the action criteria and monitoring network after additional data has been accumulated which indicates that the monitoring is unnecessary. However, any such refinement would occur in accordance with the terms of this Management Plan. If FVMWC proposes a refinement to action criteria or monitoring features, it will submit a written proposal describing the refinement along with supporting data and materials to the TRP. The TRP will then issue a recommendation concerning the proposed refinement to SMWD, which as lead agency for the Project under CEQA, will determine whether the refinement is warranted based on all available technical data and is otherwise consistent with all CEQA findings adopted by SMWD in conjunction with its approval of the Project EIR. SMWD will make a decision regarding the proposed refinement in accordance with the decision-making process presented here, in Figure 6-1 and further described in Chapter 8. Action criteria are intended to be used as predictors of potential material adverse impacts to critical resources, and exceeding these criteria does not necessarily constitute a material adverse impact to critical resources.

The decision-making process followed in this Management Plan, if an action criterion is triggered or when SMWD considers refinements to the Management Plan, is illustrated in Figure 6-1 and described in detail as follows. If an action criterion (defined in this Chapter 6) is triggered, FVMWC will promptly inform the General Manager of SMWD and the members of TRP that an action criterion has been triggered, and commence the decision-making process described herein.

FVMWC will assess whether the triggering of any action criteria is attributable to Project operations. If FVMWC determines that the change is not attributable to Project operations, it will make no change to Project operations and promptly submit the results of its assessment and determination to the TRP. Upon receipt of FVMWC's assessment and determination, where good cause exists, TRP may request additional data and analysis.

If FVMWC determines that the change is attributable to Project operations, it will assess whether the measured change is a precursor or predictor of a potential adverse impact and report its determination to TRP. If FVMWC determines that the measured change is not a precursor or predictor of a potential adverse impact, it would make no change to Project operations, but may implement verification monitoring and/or propose refinements to the Management Plan with notification to TRP. Such refinements may include modifications of the monitoring network (e.g. location, frequency, etc.) and the action criteria. FVMWC will promptly submit the results of any assessment, verification monitoring action taken, and/or proposed refinements to the Management Plan to the TRP.

If FVMWC determines that the measured change is a precursor or predictor of a potential adverse impact to a critical resource, it will identify and implement the appropriate corrective measures, and promptly inform the TRP of the result of its assessment and the corrective measures that it implemented.

After receiving the results of FVMWC's assessment and actions taken in response to any triggering of an action criterion, the TRP will convene within 30 days to determine whether it concurs with the assessment and the responsive actions taken by FVMWC (modifications of the monitoring network, corrective actions, etc.) Within 30 days of convening, the TRP will issue a written report to the General Manager of SMWD of its review of FVMWC's assessment and actions taken, including whether it concurs with the assessment and actions taken by FVMWC, and if it does not concur, the basis of its disagreement and any alternative recommended actions. The SMWD's Board of Directors will fully consider the findings and actions taken or recommended by FVMWC and the TRP, and as Lead Agency for the Project under CEQA, will issue a final determination in its sole discretion whether FVMWC's assessment of the triggering of the action criterion, and responsive actions taken, are appropriate based on all available technical data and are otherwise consistent with all CEQA findings adopted by SMWD in conjunction with its approval of the Project EIR. If SMWD determines that FVMWC's assessment and/or actions taken are not appropriate, it may order FVMWC to take alternative actions, but only so long as those actions are provided within the potential corrective actions set forth in this Chapter. SMWD will issue its determination in writing to FVMWC and to each member of the TRP within 30 days of receipt of the TRP's written assessment. FVMWC shall promptly comply with the determination and instructions set forth in SMWD's written correspondence concerning the matter.

Communications by and to FVMWC, the TRP, and SMWD, as provided in this Chapter, shall be made by and to, respectively, a point of contact for the FVMWC designated by the FVMWC Board of Directors ("FVMWC Representative"), a member of the TRP designated by the TRP as its point of contact ("TRP Contact Member"), and the SMWD General Manager.

6.2 Third-Party Wells

It is the intent of the Project to operate without adverse material impacts to wells owned by neighboring landowners in the vicinity of the Project area, nor those operated in conjunction with salt mining operations on the Bristol or Cadiz Dry Lakes. To avoid such potential impacts, the groundwater monitoring network will include monitoring wells located near neighboring landholdings and on and adjacent to the dry lakes. Groundwater levels will be monitored on a monthly to semi-annual basis (see Table 5-1) during the pre-operational and operational periods, then annually during the post-operational period. Water quality will be monitored on a quarterly to annual basis during the pre-operational period, annually thereafter during the operational period of the Project, and tri-annually during the post-operational period (see Table 5-1).

6.2.1 *Action Criteria*

The action criterion shall be drawdown at the Danby observation well (adjacent to Clipper Mountains) greater than projected by the pre-operational groundwater flow simulation models or the receipt of written complaints by well owners regarding decreased groundwater production yield, degraded water quality, or increased pumping costs submitted by neighboring landowners or the salt mining operators on the Bristol and Cadiz Dry Lakes.

6.2.2 *Decision-Making Process*

If drawdown at the Danby observation well is greater than projected by the pre-operational groundwater model simulation results or a written complaint is received, the decision-making process will be implemented as follows:

- FVMWC will determine if water level changes, decreased yields, increased pumping costs, and/or degraded water quality in neighboring landowner wells or the salt mining operations on the Bristol and Cadiz Dry Lakes are attributable to Project operations;
- If such water level changes, decreased yields, increased pumping costs and/or degraded water quality are determined to not be attributable to Project operations, then no action would be taken and FVMWC would discontinue its arrangement to provide water;
- If such water level changes, decreased yields, increased pumping costs and/or degraded water quality are determined to be attributable to Project operations, then further corrective measures would be implemented.

6.2.3 *Corrective Measures*

Upon receipt of the written complaint, and during the decision-making process, SMWD will arrange for an interim supply of water to the impacted party as necessary. Additional corrective measures that would be implemented at FVMWC's election may include one or more of the following actions:

- Deepen or otherwise improve the efficiency of the impacted well(s);
- Blend impacted well water with another local source;
- Construct replacement well(s);
- Pay the impacted well owner for any increased material pumping costs incurred by the well owner; or
- Modify Project operations until adverse impacts are no longer present at the impacted well(s). Modifications to Project operations would include one or more of the following:
  - Reduction in pumping from Project wells; or

- Revision of pumping locations within the Project wellfield; or
- Stoppage of groundwater extraction for a duration necessary to correct the predicted impact.

6.3 Land Subsidence

Twenty land survey benchmarks will be established and surveyed by a licensed land surveyor on an annual basis to identify and quantify potential subsidence within the Project area (see Figure 5-1 and 5-2). Three extensometers will be constructed in areas of projected subsidence (see Figure 5-2). The extensometers, which would be monitored continuously from installation through the post-operational period, would verify if the land surface changes (also potentially identified from land surveys and InSAR satellite data obtained and analyzed every five years through post-operational period) are due to (1) subsidence due to groundwater withdrawal; or (2) other mechanisms (e.g. regional tectonic movement).

6.3.1 *Action Criteria*

The decision-making process will be initiated if the action criteria are triggered. The action criteria are: 1) land subsidence and subsidence rate are greater than projected by the groundwater flow simulation model for an equivalent elapsed time; 2) a change in the ground surface elevation of more than 0.5 feet or of a magnitude which impacts existing infrastructure within the Project area; or 3) more than one inch vertically over 62 feet horizontally within the vicinity of railroad tracks.

6.3.2 *Decision-Making Process*

If the action criterion is triggered, the decision-making process will be implemented as follows:

- FVMWC will determine if the subsidence is attributable to Project operations.
- If land surface elevation changes equal to or in excess of the action criteria are determined to not be attributable to Project operations, then no action would be required, and FVMWC may propose refinement of the action criteria or monitoring network;
- If land surface elevation change equal to or in excess of the action criteria are determined to be attributable to Project operations, then an assessment

will be made to determine whether the subsidence constitutes a potential adverse impact to the aquifer or surface uses. Adverse impact includes the determination that there will be damage to surface structures as a result of differential settlement or fissuring, or general subsidence sufficient to alter natural drainage patterns or cause damage to structures, or a non-recoverable loss of aquifer storage capacity that affects the beneficial uses of the storage capacity of the aquifer system. A compaction of the silts, clays, or other fine materials will not result in loss of useable storage capacity. If no such adverse impacts are identified, potential actions may include:

- No action; or
- Refinement of the action criteria; or
- Verification monitoring, including a field reconnaissance to assess and detect any differential settlement; or
- Revision of the benchmark survey and/or InSAR monitoring frequency.

- If land surface elevation changes equal to or in excess of the action criterion are determined to be attributable to Project operations, and the changes constitute a potential adverse impact in the Project area, then corrective measures would be implemented.

6.3.3 *Corrective Measures*

Corrective measures that would be implemented may include one or more of the following actions:

- Modification of wellfield operations to arrest subsidence. Modifications to Project operations would include one or more of the following:
  - Reduction in pumping from Project wells; or
  - Revision of pumping locations within the Project wellfield; or
  - Stoppage of groundwater extraction for a duration necessary to correct the predicted impact; or

- Repair any structures damaged as a result of subsidence attributable to Project operations.

6.4 Induced Flow of Lower-Quality Water from Bristol and Cadiz Dry Lakes

A network of "cluster type" observation wells will be established between the Project wellfield and the margins of Bristol and Cadiz Dry Lakes (see Figures 5-1 and 5-2). Groundwater TDS concentrations in the well clusters will be monitored on a quarterly basis during the pre-operational period of the Project, semi-annually throughout the operational period, and annually during the post-operational period of the Project.

6.4.1 *Action Criteria*

The action criteria are, 1) monitored increases in TDS that are higher than projected by the groundwater flow simulation models or, 2) a change in TDS concentration in excess of 1,000 mg/l in monitoring wells sited along the saline/freshwater interface line projected by Geoscience as part of their impact assessments. If such a TDS change is measured, the decision-making process will be initiated.

6.4.2 *Decision-Making Process*

If the action criterion is triggered, the decision-making process will be implemented as follows:

- FVMWC will determine if the changes are attributable to Project operations;
- If groundwater TDS concentration changes equal to or in excess of the action criterion in the observation wells near the projected saline/freshwater interface (easterly of the margins of the dry lakes) are determined to not be attributable to Project operations, then no change in Project operations would be required and FVMWC may propose refinement of the action criteria;
- If groundwater TDS concentration changes equal to or in excess of the action criterion in the observation wells are determined to be attributable to Project operations, then an assessment will be made whether the TDS concentration changes constitute a potential adverse impact to beneficial use of the aquifer. If no such impacts are identified, potential actions may include:

    - No action; or
    - Refinement of the action criteria; or
    - Verification monitoring; or
    - Revision of the number of monitoring wells and/or monitoring frequency of the observation well clusters at the margins of the dry lakes.

- If groundwater TDS changes equal to or in excess of the action criteria in observation wells are determined to be attributable to the Project, and the changes constitute a potential adverse impact to beneficial use of the aquifer, then corrective measures will be implemented.

6.4.3 *Corrective Measures*

Corrective measures that would be implemented may include one or more of the following actions:

- Deepen or otherwise improve the efficiency of the impacted well(s); or
- Blend impacted well water with another local source; or
- Construct replacement well(s); or
- Pay the impacted well owner for any increased material pumping costs incurred by the well owner;
- Modify Project operations until adverse effects are no longer present at the affected well(s). Modification to Project operations would include one or more of the following:
    - Reduction in pumping from Project wells; or
    - Revision of pumping locations within the Project wellfield; or
    - Stoppage of groundwater extraction for a duration necessary to correct the predicted adverse affect on existing wells; or
- Modification of Project operations to reestablish the natural hydraulic gradient and background concentrations at the margins of Bristol and Cadiz Dry Lakes through one or more of the following:

- Reduction in pumping from Project wells
- Revision of pumping locations within the Project wellfield
- Stoppage of groundwater extraction for a duration necessary to correct the predicted impact

OR

- Installation of an injection or extraction well(s) in conjunction with appropriate injection of lower-TDS water or extraction of higher-TDS water to manage the migration of high-TDS water from the Dry Lakes.

6.5 Brine Resources Underlying Bristol and Cadiz Dry Lakes

A network of "cluster type" observation wells will be established between the Project wellfield and the margins of Bristol and Cadiz Dry Lakes (see Figures 5-1 and 5-2). Groundwater levels will be monitored on a continuous basis throughout the term of the Project.

6.5.1 *Action Criteria*

The decision-making process will be initiated if action criteria are triggered. The action criteria are, 1) changes in groundwater levels larger than projected by the groundwater model simulations or, 2) changes in groundwater or brine water levels of greater than 50 percent of the water column above the intake of any of the salt mining companies' wells in comparison to pre-operational static levels in cluster wells at the margins of the dry lakes. If such groundwater/brine water level change is measured, the decision-making process will be initiated.

6.5.2 *Decision-Making Process*

If the action criteria are triggered, the decision-making process will be implemented as follows:

- FVMWC will determine whether the change in groundwater/brine level change is attributable to Project operations;
- If groundwater/brine level changes equal to or in excess of the action criteria in the observation well clusters at the margins of the dry lakes are determined to not be attributable to Project operations, then no change to

Project operations would be required, and FVMWC may propose refinement of the action criteria;

- If groundwater/brine level changes equal to or in excess of the action criteria in the observation well clusters at the margins of the dry lakes are determined to be attributable to Project operations, then an assessment will be made to determine whether the groundwater/brine level changes constituted a potential adverse impact to brine operations on the dry lakes. Adverse impact includes changes to brine chemistry or yields from existing brine production wells or trenches attributable to Project operations. If no such impacts are identified, potential actions may include:
  - No action; or
  - Refinement of the action criteria; or
  - Verification monitoring; or
  - Revision of the monitoring frequency at the observation well clusters at the margins of the dry lakes.
- If groundwater/brine level changes equal to or in excess of the action criteria in observation well clusters at the margins of the dry lakes are determined to be attributable to Project operations, and the changes constitute a potential adverse impact to brine operations on the dry lakes, the corrective measures will be implemented;

6.5.3 *Corrective Measures*

Corrective measures that would be implemented may include one or more of the following actions:

- Modification of Project operations to reestablish the natural groundwater/brine levels at the margins of Bristol and Cadiz Dry Lakes. Modifications to Project operations would include one or more of the following:
  - Reduction in pumping from Project wells; or
  - Revision of pumping locations within the Project wellfield; or

  - Stoppage of groundwater extraction for a duration necessary to correct the predicted impact; or
  - Installation of an injection wells to mitigate the impact.
- Compensation to mining operators for the additional costs of pumping.

6.6 Adjacent Basins, Including The Colorado River and its Tributary Sources of Water

Adjacent basins will be monitored to provide verification that the project does not impact groundwater levels in these adjacent basins. Because the Bristol, Cadiz, and Fenner Watersheds are assumed to be closed watersheds, it is expected that the observation wells will demonstrate no Project impact. Baseline groundwater conditions observed in these adjacent basins will also provide information on climatic change effects on groundwater levels on a regional basis.

The Piute Watershed is tributary to the Colorado River. Groundwater flow from this watershed ultimately discharges to the Colorado River, so it is a part of the water resource of the Colorado River. As discussed above, it would be an adverse impact if this groundwater flow was impacted by Project Operations. The Piute-1 observation well will provide data on groundwater levels in this basin. In addition, the Piute-1 well is located approximately equi-distant from the next southerly well from the proposed Goffs observation well, so this well can be compared to these observations to assess groundwater level differences between these wells, if any.

The Danby basin is immediately to the east. A new observation well, Danby-1, will provide information on groundwater conditions in this adjacent basin.

6.6.1 *No Action Criteria; Verification Monitoring*

Because the Bristol, Cadiz, and Fenner Watersheds are assumed to be closed watersheds that are isolated from aquifer systems in neighboring basins by bedrock and groundwater divides, no action criteria are necessary to protect these critical resources. However, to accommodate requests of stakeholders in the Danby area, and to demonstrate the lack of any hydrogeologic connectivity between the alluvial groundwater developed by the Project and the Piute Basin, the monitoring wells in these adjacent basins, along with all the other Project observation wells, will be monitored to verify these factual conclusions.

6.7 Springs

As discussed at Section 4.2 of Chapter 4 above, because of the distance, change in elevation, and lack of hydraulic connection between the fractured bedrock groundwater feeding the Fenner Watershed springs and the alluvial groundwater developed by the Project, the Project is not anticipated to affect the spring flow within any of the on Fenner Watershed springs.

6.7.1 *No Action Criteria; Verification Monitoring*

Because the Project is not anticipated to have any effect on the spring flows in any of the Fenner Watershed springs, no action criteria are necessary to protect this critical resource. However, consistent with the recommendations of the Groundwater Stewardship Committee, and as a conservative monitoring protocol, visual observation and flow estimates shall be performed at the Bonanza Spring in the Clipper Mountains, the Whisky Springs in the Providence Mountains (near Colton Hills), and Vontrigger Spring in the Vontrigger Hills, east of the Hackberry Mountains, no less often than quarterly during the pre-operational and operational period of the Project and annually during the post-operational period. The Bonanza Spring will be monitored as an "indicator spring" because it is the spring that is in closest proximity to the Project wellfield (approximately 11 miles from the center of Fenner Gap). The Whisky and Vontrigger Springs will be monitored to compare variations in spring flow from those springs to variations in spring flow from the Bonanza Spring to verify that any material reductions of flow at the Bonanza Spring is not attributable to the Project operation, and is instead attributable to climate conditions.

6.8 Air Quality

As described above, a network of observation wells will be established between the project wellfield and Bristol and Cadiz Dry Lakes (see Figures 5-1 and 5-2). Groundwater levels will be monitored in many wells on a continuous basis throughout the term of the project.

FVMWC will install two nephelometers downwind from Bristol and Cadiz Dry Lakes to establish a set of baseline data of visibility in the valley, along with providing air quality data throughout the duration of Project operations. In addition, FVMWC will conduct annual visual observations at four points on each of the dry lakes to record surface soil conditions. The visual observations will note soil texture and record susceptibility to wind erosion. Photographs of the soil will be taken. This data will record conditions over time at the same locations on each of these Dry Lake surfaces.

6.8.1 *Verification Monitoring*

Air quality in the Cadiz Valley and MDAB is a critical resource. Since the groundwater is not connected in any way to the erosion potential of the dry lake surface soils, the Critical Resource could not be adversely affected by the proposed Project. Lowering groundwater levels beneath the dry lakes will not increase dust generation from the dry lakes. Therefore, no action criteria are necessary to protect this critical resource. However, consistent with the recommendations of the Groundwater Stewardship Committee, for the avoidance of any doubt, and as a conservative monitoring protocol, nephelometers will be installed and monitored to verify that the Project does not increase dust generation from the dry lakes.

These nephelometers will provide data on a daily basis that records opacity of the air, measuring the effect of dust on visibility. Data will be collected in the early years of the Project, establishing a baseline before groundwater levels beneath the dry lake are affected and will continue during Project operations. Since wind velocity and dust storms are highly variable, the data will record trends over time. Data from the nephelometers will be analyzed by the FVMWC, with the results of the analysis submitted annually to the TRP. This data will inform the TRP on the environmental setting, augmenting the weather station data, and provide information for the long term management of the facilities in the valley. The TRP will provide recommendations over time regarding modifications to the verification data collection activities if needed.

6.8.2 *Action Criteria*

The following action criteria are provided at the request of the County of San Bernardino and out of an abundance of caution. The decision-making process will be initiated if the action criteria are triggered. The action criteria is: changes in air quality that exceed baseline conditions over a five-year moving average. If such air quality changes are measured, the decision-making process will be initiated.

6.8.3 *Decision-Making Process*

If the action criteria is triggered, the decision-making process will be implemented as follows:

- FVMWC will determine whether the change in air quality is attributable to Project operations;

- If air quality changes equal to or in excess of the action criteria in one or both nephelometers are determined to not be attributable to Project operations, then no change to Project operations would be required;
- If air quality changes equal to or in excess of the action criteria in the nephelometers are determined to be attributable to Project operations, the corrective measures will be implemented.

6.8.4 *Corrective Measures*

- Modification of Project operations to re-establish baseline level air quality levels. Modifications to Project operations would include one or more of the following:
  - Reduction in pumping from Project wells;
  - Revision of pumping locations within the Project wellfield;
  - Stoppage of groundwater extraction for a duration necessary to correct the predicted impact.

CHAPTER 7
CLOSURE PLAN AND POST-OPERATIONAL REPORTING

A Closure Plan will be developed as part of this Management Plan to ensure that no residual effects of Project operations will result in adverse impacts to critical resources (as defined in Chapter 4) in or adjacent to the Project wellfield area during the 50 years of Project operations or during the post-operational phase.

A Closure Plan will be prepared by FVMWC at the sooner of, 1) when static groundwater levels in the Project wellfield area have declined by an average of 200 feet from pre-operational levels, or 2) no later than at year 25 of Project operations. FVMWC will coordinate with the TRP, who will provide input and guidance throughout the development and refinement of a draft Closure Plan. The final Closure Plan will be approved by SMWD, as the lead agency for the Project, as it determines appropriate in its discretion after consideration of the draft plan developed by FVMWC in coordination with the TRP. The Closure Plan will monitor groundwater levels and groundwater quality for a minimum period of 10 years to protect critical resources and groundwater quality for beneficial uses as required by federal and state law, including the requirements of the California Regional Water Quality Control Board, Colorado River Basin Region. The Closure Plan shall also require that all Project wells that are abandoned be destroyed in manner consistent with all applicable state and local regulations, and industry standards. The provisions and mitigation obligations under this Management Plan will be in effect and run concurrently with the term of the Closure Plan. Once prepared, the Closure Plan will be reevaluated every five years in consultation with the TRP. Such reevaluation may include refinements to the Closure Plan. Any modification to closure plan must be approved by SMWD.

Under this Management Plan, FVMWC will review and analyze groundwater levels, water quality information, air quality and all other monitoring data; as well as prepare the annual reports for review by TRP and approval by SMWD. One purpose of the annual reports is to identify any actions that would be taken with the objective to ensure that any decline in pre-operational static groundwater levels would not exceed 100 feet at the 10 years after cessation of pumping from Project operations (Closure Groundwater Levels), or lead to projections of adverse impacts to critical resources during or after the post-operational phase.

As noted in Section 4.2 of the EIR, all pumping of groundwater in the Project area by the Cadiz Agricultural Development will be subject to the provisions of this Management Plan, with plans to phase out the agricultural operations once the Project is fully operational. With the combination of the Cadiz Agricultural Development and the Project, there may be declines in static groundwater levels at the termination of Project operations. Implementation of the Closure Plan is intended to ensure that the closure groundwater levels are not exceeded, and that the groundwater quality will be protected for beneficial uses as described in the policies of the Regional Water Quality Control Board, Colorado River Basin Region, including any applicable new or revised standards that may be adopted by the Regional Water Quality Control Board.

CHAPTER 8
TECHNICAL REVIEW PANEL

An integral part of this Management Plan involves regular and ongoing review of data collected during the term of the Project. The understanding and analysis of the data will require technical expertise. For this reason, a Technical Review Panel (TRP) will be organized for the purpose of monitoring and advising on technical aspects of the Project as set forth in this Chapter 8.

8.1 Members

The TRP shall consist of one technical representative appointed by the FVMWC one technical representative appointed by the County, and a third technical representative jointly selected by the technical representatives from FVMWC and the County.. All appointments shall be in the discretion of the County and FVMWC parties, but all three members of the TRP shall possess professional technical qualifications appropriate to the tasks of the TRP (e.g., state certifications in engineering, hydrology, or geology) and must have a minimum of ten years professional experience in working in the groundwater field. In the event the County and FVMWC representatives cannot agree on the designation of the third representative, they may petition San Bernardino Superior Court for the appointment of the third technical representative.

8.2 Responsibilities

As discussed above in Chapter 6, the TRP shall be responsible for reviewing and advising SMWD with respect to FVMWC's assessment of any triggering of action criterion concerning a potential impact to a critical resource, corrective measures adopted, and any proposed refinements to the Management Plan.

The TRP shall coordinate with FVMWC to review and monitor Project data and conditions in the northern Bristol/Cadiz sub-basin, as well as in the larger watershed area and adjacent region, including all information set forth for monitoring and reporting pursuant to Chapter 9 below, and shall issue recommendations to SMWD. The TRP shall also undertake or cause to be made studies which may assist in determining the migration of the saline/freshwater interface and the occurrence of land subsidence as appropriate. FVMWC shall have the primary responsibility for collecting, collating and verifying the data required under the monitoring program, and shall present the results thereof in annual filings with the TRP, and shall also make all raw data available to the TRP via an electronic network (e.g. web page within 90 days of its collection) or other appropriate means to enable regular updates on Project operation and management activities.

The TRP shall also approve annual reports developed by FVMWC as provided for in Chapter 9 below.

TRP's costs will be borne by the FVMWC, including those of the technical representatives, provided that annual costs do not exceed $50,000 per year, escalated by 2% per year.

8.3 TRP Convening, Determinations, and Reporting

As discussed above in Chapter 6, the TRP shall convene as necessary to review and advise SMWD with respect to FVMWC's assessment of any triggering of action criterion concerning a potential impact to a critical resource, corrective measures adopted, and any proposed refinements to the Management Plan. The TRP shall also convene at least once every year to discuss and take action with respect to its other responsibilities set forth in this Chapter 8. Convening of the TRP may occur by face-to-face meetings, telephone conferencing, or video conferencing.

The TRP shall designate one of its members as the Contact Member. The Contact Member shall take minutes of all convening meetings of the TRP, which shall be submitted to the General Manager of SMWD and the FVMWC Representative within 10 days of the TRP convening.

Determinations of the TRP shall require the affirmative agreement of at least two of the TRP Members, and the Contact Member shall notify the General Manager of SMWD and the FVMWC Representative in writing within 10 days of a determination of TRP being issued.

CHAPTER 9
MONITORING AND REPORTING

9.1 Project Data Monitoring

Monitoring is essential to making informed decisions regarding the prospective impacts of Project pumping. FVMWC will be responsible for preparation of the annual reports beginning one year after commencement of project construction, which will contain the following components:

- Summary of precipitation from climate stations;
- Baseline groundwater level and water quality conditions (as referenced in the EIR). Presentation of baseline conditions will include groundwater level elevation contours, water quality contours, and a figure showing the results of the initial land survey;
- Tables summarizing annual groundwater production for each project extraction well and cumulative extraction from the Project;
- Tables summarizing depth to static water level and groundwater elevation measurements for all observation wells;
- Report on Bonanza, Whiskey and Vontrigger Springs, including visual observations such as starting and ending points of observed ponded or flowing water, estimated depth of ponded water and flow rate of flowing

water, conductivity, pH and temperature of water, any colorations of water, and general type and extent of vegetation

- Hydrographs for all production and observation wells;
- Groundwater elevation contours;
- Tables summarizing water quality analyses for the observation wells;
- Results of land subsidence monitoring surveys and any changes relative to baseline;
- Summary tables of any data collected from wells owned by neighboring landowners in proximity to the project area (provided that permission was granted for such data collection);
- Summary of project developments, such as changes in storage or extraction operations or construction of new production wells;
- Discussion of project storage and extraction operations, and trends in groundwater levels and groundwater quality as compared to the baseline conditions;
- Updated groundwater flow, transport and density-dependent model results;
- Tables summarizing changes in frequency and severity of dust mobilization recorded on Bristol and Cadiz Dry Lakes and analysis correlating dust emissions with wind speed and direction, groundwater levels underlying the dry lakebeds and soil surface chemistry;
- Tables and figures (wind roses) summarizing wind data from regional meteorological towers addressing wind speed and direction, and stability frequency distributions. This data would be collected for five years. Data collection may be extended if required by the General Manager of the SMWD;
- Summary of FVMWC assessments, proposed refinements to the Management Plan, and corrective measures.

9.2 Project Reports

9.2.1 *Annual Reports*

Each year during the operational and post-operational periods of the Project, an annual report shall be prepared that shall include a summary of, and analysis of the implications of, all Project data listed for monitoring above.

9.2.2 *Five-Year Reports*

As discussed in Chapters 2 and 4 above, it is anticipated that as the Project proceeds, new data and analysis as well as any new Project operational considerations will be used to refine the calibration of the Project's various water resources models. It is also appropriate to periodically report on observed trends in observed data from the monitoring features and predictions of future trends. Thus, a "Five-Year Report" shall be prepared five years from commencement of construction, and on every five-year anniversary thereafter. The Five-Year Report shall report on the following matters in addition to the contents of previous annual reports:

- Changes to the number or locations of monitoring features;
- Changes in monitoring frequency;
- Changes in monitoring technology;
- Refinements of action criteria for critical resources;
- Refinements of models;
- Modifications of this Management Plan;
- Summary of total project storage and extraction operations;
- Documentation of any trends in groundwater levels evident from the monitoring data;
- Hydrogeologic analysis and interpretation of all project storage and extraction operations during the five-year period;
- Hydrogeologic analysis and interpretation of all water level elevation, water quality, and land survey data collected during the five-year period;

- Results of refined model output from the INFIL3.0 model, saturated groundwater flow and solute transport models, the density dependent groundwater flow model and the solute transport model;

- Detailed evaluation of impacts (if any) of project operations on surface or groundwater resources;

- Proposed refinements to the Management Plan to address any identified inadequacies; and

- Summary of project operations designed to prevent declines in static groundwater levels in excess of an average of 300 feet from pre-operational levels at the end of project operations or no more than an average of 100 feet after 10 years from cessation of pumping within the Project wellfield, or lead to projections of adverse impacts to critical resources during or after the post-operational phase.

- Documentation of any trends in water quality measurements evident from the monitoring data;

- Contours of the most recent static groundwater level elevations and groundwater level elevation changes over the previous five years;

- Documentation of any impacts to wells owned by neighboring landowners (provided that permission was granted to monitor such wells);

- Tables summarizing changes in frequency and magnitude (to the extent that can be determined from the data) of dust mobilization recorded on Bristol and Cadiz Dry Lakes, and analysis correlating wind-mobilized particulate matter with wind speed and direction, groundwater levels underlying the dry lakebeds, and soil moisture on the lakebed surfaces; and;

- Summary of regional wind data (in the first Five-Year Report, and subsequent reports as applicable) with conclusions for potential for project-mobilized lakebed dust to be transported throughout the Mojave Desert region; and;

- Recommendation for revisions to the Closure Plan.

All Five-Year Reports will include electronic data files and model input and output files. The annual reports will be available to agencies, organizations, interest groups, and the general public upon written notification to SMWD. All Five-Year Reports shall be distributed to the lead and cooperating agencies, San Bernardino County, and made available to the public electronically.

9.2.3 *Report Preparation and Approval Process*

The draft reports as provided for in this Chapter shall be prepared by FVMWC and submitted to the TRP on or before May 1 of each year for Annual Reports, and on or before December 31 for Five-Year Reports. The TRP shall then review the report and determine whether any recommended edits or additions are appropriate, which it shall provide to the General Manager of the SMWD within 45 days of receipt from FVMWC. SMWD shall then consider the report and any recommended edits or additions by TRP, and thereafter issue a final report, which shall be approved by SMWD's Board of Directors. SMWD shall thereafter make the report available in hard form at its offices and electronically on SMWD's website.

Table 5.1

Critical Resource Area	Feature No.	Monitoring Features[a]		No.	Pre-Operational Monitoring Frequency			Operational Monitoring Frequency[b]			Post-Operational Monitoring Frequency		
								Extraction					
					Water Level	**Water Quality**	**Other Monitoring**	**Water Level**	**Water Quality**	**Other Monitoring**	**Water Level**	**Water Quality**	**Other Monitoring**
Springs	**1**	**Springs, Monitoring**	Existing	3	-	-	Quarterly, Visual Observations and Flow at 3 Springs	-	-	Quarterly, Visual Observations and Flow at 3 Springs	-	-	Annual, Visual Observations and Flow 3 Springs
Aquifer System	**2**	**Observation Wells (16 total)**	Existing	13	Monthly	4 Quarterly, 8 Annually	-	Monthly for First 3 Months of Cycle, then Semi-Annually	Annually	-	Annually	Triannually	-
			Existing	2	Continuous	Annually	-	-	Annually	-	Annually	Triannually	-
			New	2	Monthly	Quarterly	-	Monthly for First 3 Months of Cycle, then Semi-Annually	Annually	-	Annually	Triannually	-

	3	**Project Area Well Clusters - Saturated Zone Only (1 x 3 well cluster + 2 x 2 well cluster = 3 total Clusters)**	Existing	7 wells	Continuous	Quarterly	-	Continuous	Semi-Annually	-	Continuous (Until No Longer Deemed Necessary)	Annually	-
	4	**Production Wells (34 total)**	Existing	5	Depth to Water Upon Completion	Sample after completion	-	Continuous	Composite Quarterly	Summarize Data Monthly	Annually	-	-
			New	29	Depth to Water Upon Completion	Sample after completion	-	Continuous	Composite Quarterly	Summarize Data Monthly	Annually	-	-
	5	**Land Surface Elevation Surveys (20 total)**	New Benchmark	20	-	-	Annually, reduce if warranted	-	-	Annually, reduce if warranted	-	-	Annually, reduce if warranted
			InSAR (New)	2/yr (If Warranted)	-	-	Once	-	-	Every 5 years	-	-	Twice at 5-year interval
	6	**Extensometer (3 total)**	New	3	-	-	Establish baseline	-	-	Records Daily	-	-	Summarize data annually
Aquifer System (con't)	**7**	**Flowmeter Surveys (5 total)**	New	5	-	One Time	One Time	-	-	-	-	-	-
Bristol and Cadiz Dry Lakes	**8**	**Bristol Dry Lake Well Clusters (2 per Cluster x 3 total Clusters)**	New	3 clusters 6 wells	Continuous	Quarterly	-	Continuous	Semi-Annually	-	Continuous (until no longer deemed necessary)	Annually as necessary	-

	9	**Cadiz Dry Lake Well Clusters (2 per Cluster x 1 total Clusters)**	New	1 cluster 2 wells	Continuous	Quarterly	-	Continuous	Semi-Annually	-	Continuous (until no longer deemed necessary)	Annually as necessary	-
	10	**Gamma / EM Logs (up to 6 total)**	New	6	-	-	One Time	-	-	-	-	-	-
Other (Regional)	**11**	**Weather Stations (4 total)**	Existing	3	-	-	Records Daily	-	-	Records Daily	-	-	-
			Cadiz Field Office	1	-	-	Records Hourly	-	-	Records Hourly	-	-	-
Air Quality	**12**	**Nephelometers**	New	2	-	-	Hourly	-	-	Hourly	-	-	-

NOTES:

a - See Table 5-2 for details of monitoring features.

b - Monitoring frequencies pertain to the initial monitoring period of each program operational phase. Monitoring frequency may be increased or decreased based on the initial monitoring results.

Table 5.2

Critical Resource Area	Feature No.	Feature Type	When Monitored	Name	State Well Number	Location Coordinates[a]	Monitoring Protocol Water Level	Water Quality	Other Monitoring
Springs in the Mojave National Preserve and BLM Wilderness Area	1	Springs, Monitoring	Pre-Operational Operational Post-Operational	Bonanza Spring	NA	34° 41' 08" N 115° 24' 20" W	-	-	See Section 5.1 and 6.1
		Springs, Monitoring	Pre-Operational Operational Post-Operational	Whiskey Spring	NA	34° 59' 52" N 115° 26' 59" W	-	-	See Section 5.1 and 6.1
		Springs, Monitoring	Pre-Operational Operational Post-Operational	Vontrigger Spring	NA	35° 03' 20" N 115° 08' 52" W	-	-	See Section 5.1 and 6.1
Aquifer System	2	Observation Well	Pre-Operational Operational Post-Operational	Dormitory	5N/14E-5F1	34° 32' 38" N 115° 31' 57" W	Transducer, See Sections 5.2 and 6.3	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	6/15-1	6N/15E-01H	34° 38' 23" N 115° 21' 22" W	Transducer, See Sections 5.2 and 6.4	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	6/15-29	6N/15E-29P1	34° 34' 20" N 115° 26' 04" W	Transducer, See Sections 5.2 and 6.4	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-11	4N/14E-13J1	34° 25' 51 N 115° 27' 25" W	Transducer, See Sections 5.2 and 6.5	See Appendices B, C & D	-

Aquifer System	2	Observation Well	Pre-Operational Operational Post-Operational	CI-3	5N/14E-24D2	34° 30' 40" N 115° 28' 01" W	Transducer, See Sections 5.2 and 6.6	See Appendices B, C & D	-
		Observation Well	Pre-OperationalOperationalPost-Operational	Archer Siding #1	4N/15E-24E1	34° 25' 11" N115° 21' 57" W	Manual,See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Essex	8N/17E-31	34° 43' 49" N 115° 14' 53" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Fenner	8N/17E-2	34° 48' 59" N 115° 10' 40" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Goffs	10N/18E-26	34° 54' 57" N 115° 03' 44" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	Labor Camp	5N14E-16H1	34° 31' 22" N 115° 30' 46" W	Transducer, See Sections 5.2 and 6.6	See Appendices B, C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-5	5N/14E-32N1	34° 28' 17" N 115° 32' 37" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-9	5N/13E-14B1	34° 31' 36" N 115° 35' 18" W	Manual, See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-10	5N/14E-34Q1	34° 28' 22" N 115° 29' 59" W	Manual, See Appendix B	See Appendices C & D	-

		Observation Well	Pre-OperationalOperationalPost-Operational	SCE-17	5N/14E-29B1	34° 29' 54" N115° 31' 58" W	Manual,See Appendix B	See Appendices C & D	-
		Observation Well	Pre-Operational Operational Post-Operational	SCE-18	5N/13E-11R1	34° 26' 37" N 115° 34' 59" W	Manual, See Appendix B	See Appendices C & D	-
	2	Observation Well	Pre-Operational Operational Post-Operational	Danby-1	TBD	34° 15' 58" N 115° 06' 05" W	Manual, See Appendix B	See Appendices C & D	
		Observation Well	Pre-Operational Operational Post-Operational	Piute-1	TBD	34° 57' 22" N 114° 48' 16" W	Manual, See Appendix B	See Appendices C & D	
Aquifer System		Project Area Well Cluster-Groundwater (3 well Cluster)	Pre-Operational Operational Post-Operational	MW-7a MW-7 TW-1	TBD	34° 31' 39" N 115° 26' 55" W	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Allunium/Carbonates/Bedrock
	3	Project Area Well Cluster-Groundwater (2 well Cluster)	Pre-Operational Operational Post-Operational	TW-2MW TW-2	TBD	34° 31' 13" N 115° 26' 57" W	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Allunium//Bedrock
		Project Area Well Cluster-Groundwater (2 well Cluster)	Pre-Operational Operational Post-Operational	New Cluster Well	TBD	34° 31' 13" N 115° 26' 57" W	Transducer, See Sections 5.3 and 6.4	See Appendices C & D	Monitor Allunium/Bedrock
	4		Operational	28	5N/14E-28Q1	34° 31' 05" N 115° 29' 59" W	-	-	See Sections 5.4
			Operational	27N	5N/14E-27B1	34° 29' 54" N115° 29' 59" W	-	-	See Sections 5.4

			Operational	27S	5N/14E-27Q1	34° 28' 14" N 115° 29' 59" W	-	-	See Sections 5.4
	4		Operational	21S	5N/14E-21P1	34° 30' 08" N 115° 31' 12" W	-	-	See Sections 5.4
			Operational	33	5N/14E-33K1	34° 28' 32" N 115° 31' 07" W	-	-	See Sections 5.4
		New Production Wells (29 total)	Operational	TBD (see Figure 5-2)	TBD	TBD	-	-	See Sections 5.4
Project Area Aquifer	5	Benchmark Stations (20 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5.5 and 6.3
		InSAR (2 per year)	Pre-Operational Operational Post-Operational	NA	NA	NA	-	-	See Sections 5.5 and 6.3
	6	Extensometer (3 total)	Pre-Operational Operational Post-Operational	TBD	NA	TBD	-	-	See Sections 5.5 and 6.3
	7	Flowmeter Surveys (5 total)	Pre-Operational	TBD	TBD	TBD	-	-	See Section 5.7
Bristol and Cadiz Dry Lakes	8	Bristol Dry Lake Well Cluster[b]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
		Bristol Dry Lake Well Cluster[b]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-

		Bristol Dry Lake Well Cluster[c]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
	9	Cadiz Dry Lake Well Cluster[d]	Pre-Operational Operational Post-Operational	TBD	TBD	TBD	Transducer, See Sections 5.8, 5.9, 6.4 and 6.5	See Appendices C & D	-
	10	Gamma/EM Logs (up to 6 total)	Pre-Operational	TBD	TBD	TBD	-	-	See Section 5.10
Other (Basin-wide)	11	Weather Station	Pre-Operational Operational Post-Operational	Amboy	NA	34° 31' 52" N 115° 41' 42" W	-	-	See Section 5.11
		Weather Station	Pre-Operational Operational Post-Operational	Mitchell Caverns	NA	34° 56' 06" N 115° 30' 58" W	-	-	See Section 5.11
		Weather Station	Pre-Operational Operational	Fenner Gap	NA	34° 30' 57" N 115° 27' 45" W	-	-	See Section 5.11
		Weather Station	Pre-Operational Operational Post-Operational	Cadiz Field Office (CIMIS Station)	NA	34° 30' 49" N 115° 30' 39" W	-	-	See Section 5.11
Air Quality	12	Nephelometers	Pre-Operational Operational Post-Operational	TBD	NA	TBD			See Section 5.12

NOTES:

a - Location coordinates to be verified in the field during initial Pre-Operational activity.

b - Two new well clusters to be installed at eastern margin of Bristol Dry Lake (see Figure 5-1).

c - One new well cluster to be installed on Bristol Dry Lake (see Figure 5-1).

d - One new well cluster to be installed north of Cadiz Dry Lake (see Figure 5-1).

Also see Table 5-1 for details of proposed monitoring features and frequencies.

Table 6.1

Cadiz Groundwater Conservation Recovery and Storage Project

Summary of Action Criteria, Impacts and Corrective Measures

Potential Impact	**Method of Measurement**	**Triggers (Action Criteria)**	**"Close Watch" Measures**	**Corrective Measures**
Third-Party Wells	Groundwater observation wells	Groundwater levels in observation wells are lower than projected by groundwater model or written complaints stating adverse impacts to yields and/or increased pumping costs and/or degraded water quality in wells owned by neighboring landowners	Investigation to determine if caused by project operations, and significance of impact Provision of supplemental water to impacted party	Deepen or improve efficiency of impacted wells Blend impacted well water with another local source Construct replacement wells Modify project operations
Land subsidence	Benchmark stations; InSAR; extensometers	Land surface elevations changes greater than projected by subsidence model. Land surface elevation changes of greater than 0.5 ft within the project area More than one inch vertically over 62 feet horizontally within the vicinity of railroad tracks	Determine if elevation changes were directly attributable to project operations Conduct ground surveys to look for evidence of differential compaction	Repair damaged structures Modification of project wellfield operations to arrest subsidence

Induced flow of lower-quality water from Bristol and Cadiz dry lakes	Groundwater observation wells and cluster wells at dry lakes	TDS concentration changes in excess of 1,000 mg/l in observation wells located near modeled simulated projection of boundary of freshwater/saline water interface	Determine if concentration changes are directly attributable to project operations Install additional observation wells to further assess saline water migration	Deepen or improve efficiency of impacted wells Blend impacted well water with another local source Construct replacement wells Compensation Modify project operations until adverse impacts are no longer present at the impacted well(s) Modification of project operations to re-establish the natural hydraulic gradient and background TDS concentrations near the margins of the dry lakes Installation of injection and/or extraction well(s) to manage TDS
Brine resources underlying Bristol and Cadiz dry lakes	Groundwater observation wells and cluster wells at dry lakes	Changes in brine water levels larger than projected by the groundwater model simulations, or changes in brine water levels of greater than 50 percent above water column of the brine company's pump intake in comparison to pre-operational static levels in cluster wells at the margins of the dry lakes	Determine if brine water level changes are directly attributable to project operations	Modification of Project operations to re-establish brine levels beneath the dry lakes Installation of injection and/or extraction well(s) Compensation
Adjacent groundwater basins	Groundwater observation wells	No action criteria necessary; verification monitoring only	None	None
Springs	Visual observation and manual flow measurements annually of bonanza, whiskey, and vontrigger springs and groundwater levels measurements in observation wells	No action criteria necessary; verification monitoring only	None	None

Air quality	Groundwater observation wells (cluster wells at dry lakes), open-air nephelometers	Changes in air quality that exceed baseline conditions over a five-year moving average	FVMWC to determine if change is air quality is attributable to Project operations	Modification of Project operations to re-establish baseline air quality levels