Soquel Creek Water District

Central Water District

Groundwater Management Plan -2007
Soquel-Aptos Area

SANTA CRUZ COUNTY, CALIFORNIA

April 2007

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Santa Cruz County, California

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Abbreviations, Symbols, and Acronyms

AA to F	stratigraphic units of Purisima Formation
AB	Assembly Bill
AB3030	Assembly Bill 3030 (Section 10750, et seq. of the California Water Code)
AF	Acre-feet
afy	Acre-feet per year
ARR	Annual Review and Report
ARS	Aromas Red Sands Aquifer
ASR	Aquifer Storage and Retrieval
BMO	Basin Management Objective
cfs	Cubic feet per second
RWQCB	Regional Water Quality Control Board
CWC	California Water Code
CWD	Central Water District
DHS	California Department of Health Services
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection Program
GIS	Geographical Information System
GMP	Groundwater Management Plan
gpm	Gallons per minute
IGSM	Integrated Ground and Surface Water Model
IRP	Integrated Resources Plan
IRWMP	Integrated Regional Water Management Plan (Northern Santa Cruz County)
in/yr	inches per year
JPA	Joint Powers Authority
MCL	Maximum Contaminant Level
µg/L	micrograms per liter; parts per billion
mg/L	Milligrams per liter; parts per million
mgd	Million gallons per day
msl	Mean sea level
N/A	Not applicable
ND	Non-Detected
NAWQA	National Water Quality Assessment
NGS	National Geodetic Survey
PVWMA	Pajaro Valley Water Management Agency
PCAs	Potential Contaminating Activities
PL	Public Law
RWQCB	Regional Water Quality Control Board
Qa	geologic map symbol for the Aromas Red Sands
$Q_{UA, - LA}$	geologic map symbol for the Aromas Red Sands, upper and lower units
SAGMA	Soquel-Aptos Groundwater Management Alliance
SB	Senate Bill
SC	Santa Cruz
SC-#	prefix to SqCWD monitoring well number

SOI	Sphere of Influence
SqCWD	Soquel Creek Water District
SRP	Satellite reclamation plant
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TDS	Total dissolved solids
TM2	Technical Memorandum 2
Tp	geologic map symbol for Purisima Formation
Tm	possible interval of Purisima Formation below unit AA
Tu	geologic symbol for undifferentiated Tertiary unit older than Purisima Formation
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
WDO	Water Demand Offset
WL	Water Level
WY	Water Year

Conversion Factors

1 acre-foot = 325,850 gallons
1 gpm = 1.61 ac-ft/yr
1 unit =100 cubic feet = 748 gallons

Section 1
Introduction and Purpose

1.1 Introduction

The *Groundwater Management Act*, California Water Code (CWC) §10753 et. seq., was originally enacted as Assembly Bill (AB) 3030 in 1992, and encouraged local public agencies to adopt formal plans to manage groundwater resources within their jurisdictions. In accordance with the Groundwater Management Act, the *AB3030 Ground-Water Management Plan Soquel-Aptos Area* (Luhdorff & Scalmanini, April 1996) was produced under the joint authority of the Soquel Creek Water District and Central Water District. This plan served as the initial framework for management of groundwater resources within the Soquel-Aptos Area Basin.

In September 2002, *Senate Bill (SB) 1938* was signed into law amending sections of the CWC related to groundwater management. The bill requires any public agency seeking State funds administered through DWR for the construction of groundwater production or groundwater quality projects to prepare and implement a groundwater management plan with certain specified components. Additionally, SB1938 sets forth specific requirements for groundwater management plans. New requirements include establishing basin management objectives, preparing a plan to involve other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management.

This current Groundwater Management Plan (GMP) replaces and supersedes the *AB3030 Ground-Water Management Plan Soquel-Aptos Area (1996).* This update GMP incorporates data collected since 1996 and reflects analyses performed subsequent to the 1996 Plan. Additionally, it now brings the GMP into compliance with the requirements of SB1938.

The lead agency for this plan is the Soquel-Aptos Area Groundwater Management Committee, formed under a Joint Powers Agreement between Soquel Creek Water District (SqCWD) and Central Water District (CWD). The plan has been prepared with assistance from a Technical Advisory Committee and consulting hydrologists, HydroMetrics, LLC.

This report consists of the following sections:

Section 1 Introduction and Purpose – This section contains general information about SqCWD and CWD and the purpose of the GMP for the Soquel-Aptos area.

Section 2 Groundwater Management Plan Process – This section describes the steps and procedures that were conducted to draft, review, and finalize this Groundwater Management Plan. Records of public participation, input from the technical advisory committee, and the timeline of all events relating to the GMP process are included in this section.

Section 3 Existing Groundwater Conditions – This section addresses the current hydrogeologic conditions and issues related to the GMP area. It includes discussions of the Management Area basin boundaries, local hydrogeology and groundwater levels, existing water supplies and groundwater extractions, and groundwater quality.

Section 4 Basin Management Goals and Objectives – This section presents SqCWD's and CWD's strategy for managing the Basin with specific goals and objectives. The goals are broad principles, and the Basin Management Objectives (BMOs) are quantifiable or verifiable attributes that support and corroborate achievements of the Basin goals.

Section 5 Basin Management Elements – This section details the specific projects, programs, and policies that will be implemented to manage the Soquel-Aptos Area Basin. It describes new elements and formalizes existing programs and policies.

Section 6 Implementation Plan – This section outlines a schedule to assist with the implementation and assessment of this GMP.

Several appendices are included in this GMP, containing documents related to this GMP Update. Attached at the end of the Appendices are the written public comments to the Draft GMP Update with SqCWD and CWD responses.

1.2 Purpose

This Soquel-Aptos Area Groundwater Management Plan satisfies multiple objectives, including:

- Building on the existing groundwater management plan.
- Formalizing historically successful management activities that have been implemented in the Soquel-Aptos Area Basin.
- Developing a framework for implementing future groundwater management activities.
- Updating our understanding of the Soquel-Aptos Area Basin hydrogeology and water balance, based on studies that have been conducted over the last 10 years.
- Identifying a specific set of programs, projects and policies for near-term and long-term implementation to achieve management goals and objectives.
- Laying the groundwork for extending the geographic coverage of the plan to natural basin boundaries, and including neighboring municipal agencies such as the City of Santa Cruz, the County of Santa Cruz, and the Pajaro Valley Water Management Agency.

An additional purpose of this GMP is to bring the existing GMP into conformance with the changes to CWC § 10753 *et seq*. imposed by SB1938. To that end, this GMP addresses the following:

- Seven mandatory components included in CWC §10753.7 *et seq*. These seven components are required for agencies to be eligible for funds administered by DWR for constructing groundwater projects.
- Seven recommended components as described in DWR Bulletin 118 (2003).
- Twelve voluntary components included in CWC §10753.8. These components describe 12 specific technical issues that could be addressed in GMPs to manage the basin optimally and protect against adverse conditions.

All seven mandatory components are addressed directly in this GMP. The seven recommended components and twelve voluntary components are also addressed in this update. These various components are addressed throughout this GMP and Table 1-1 lists the section(s) within the report where each is addressed.

Table 1-1
Location of Soquel-Aptos Area Groundwater Management Plan Components

Description		Section
California Water Code §10750 et seq. Mandatory Components (7 components)		
1	Documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan" (CWC, § 10753.4 (b)).	Section 2.1, Appendix A
2	Basin management objectives (BMOs) for the groundwater basin that is subject to the plan (CWC, § 10753.7 (a)(1)).	Section 4
3	Components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping (CWC, § 10753.7 (a)(1)).	Section 5, Elements 1,2,3
4	A plan to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin"	Section 5, Elements 4, 8, 9
5	Adoption of monitoring protocols capable of tracking changes in conditions for the purpose of meeting BMOs.	Section 4
6	A map showing the area of the groundwater basin as defined by DWR Bulletin 118, the area of the local agency subject to the plan, and other local agencies that overlie the basin	Section 3
7	For agencies not overlying groundwater basins, plans shall be prepared using geologic and hydrologic principles.	Not applicable
Department of Water Resources (DWR) Suggested Components (7 components)		
1	Manage with guidance of an advisory committee	Section 2
2	Describe area to be managed under the GMP	Section 3
3	Create a link between BMOs and the goals and actions of the GMP	Section 4 and Section 5
4	Describe the GMP monitoring programs	Section 5, Elements 1,2,3
5	Describe integrated water management planning efforts	Section 5, Elements 4, 8, 9
6	Report on implementation of GMP	Section 6
7	Evaluate GMP periodically	Section 6

Table 1-1 (continued)

California Water Code §10750 et seq. Voluntary Components (*12 components*)		
1	Control of Saline Water intrusion	Section 4, BMO 2.2 Section 5, Elements 1,4,5,8
2	Identification and management of wellhead protection areas and recharge areas	Section 4, BMO 2.1 Section 5, Elements 6,7,12
3	Regulation of the migration of contaminated groundwater.	Section 4, BMO 2.3. Section 5, Element 11
4	Administration of well abandonment and well destruction program.	Section 4, BMO 2.3. Section 5, Element 11
5	Mitigation of conditions of overdraft	Section 4, BMO 1.2. Section 5, Elements 5, 8, 10, 13
6	Replenishment of groundwater extracted by producers.	Section 4, BMO 1.2. Section 5, Element 5
7	Monitoring of groundwater levels and storage	Section 5, Element 1
8	Facilitating conjunctive use operations	Section 4, BMO 1.2. Section 5, Element 5
9	Identification of well construction policies	Section 5, Element 11
10	Construction and operation by local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects	Section 5, Elements 6, 7, 10, 11, 12
11	Development of relationships with state and federal regulatory agencies	Section 5, Element 4
12	Review of land use plans and coordination with land use planning agencies to assess activities that create reasonable risk of groundwater contamination.	Section 4, BMO 3.1, Section 5, Elements 4, 12

The Soquel-Aptos Area Groundwater Management Plan was developed by incorporating the efforts and ideas of many groups and individuals. The process was guided by a Groundwater Management Committee, and included input from a Technical Advisory Committee, consultants, and members of the public. The process was designed to achieve broad consensus, and meet both the requirements and the intent of CWC §10753 *et seq*. Each of the key contributors, along with a description of the GMP process, is included below.

2.1 Groundwater Management Committee

The Groundwater Management Committee led the effort to update and replace the Soquel-Aptos Area GMP under the Joint Powers Agreement between Soquel Creek Water District and Central Water District (Appendix A). The Groundwater Management Committee included representatives from both the SqCWD and CWD Boards of Directors. Additionally, one representative from a local mutual water company and/or a private well owner was invited to serve on the Groundwater Management Committee to ensure the concerns of the community were reflected in the GMP. Members of the Groundwater Management Committee included:

Mr. Bruce Daniels/Chair	SqCWD
Dr. Bruce Jaffe	SqCWD
Mr. Ken Mabie	CWD
Ms. Carol Monkerud	CWD
Ms. Jean Thomas	CWD (alternate)
Mr. Bill Wigginton	Seascape Greens Homeowners Association
Mr. Michael Mills	Pure Source Water Inc. (alternate)

The Committee was supported by Derrik Williams (HydroMetrics LLC), Melanie Schumacher, P.E. (Soquel Creek Water District), Laura Brown (Soquel Creek Water District General Manager), and Clarke Wales (Central Water District General Manager).

The process and schedule for developing and adopting the GMP was as follows:

GMP Committee Meetings:

- January 24, 2006 — Review JPA and select HydroMetrics LLC as consulting hydrologist for GMP
- February 13, 2006 — Select 5th committee member, elect chair, approve timeline, appoint SAGMA and invite PVWMA to serve as the TAC, approve Scope of Work
- May 9, 2006 — Review of GMP Goals, Basin Management Objectives and Plan Elements
- August 8, 2006 — Review of Sections 3 and 5
- September 26, 2006 — Review of Sections 1, 2, and 6
- October 26, 2006 — Develop GMP Implementation Provisions

- November 28, 2006 — Review Final Administrative Draft and Schedule Public Hearing
- February 13, 2007 — Review Final Draft GMP and Recommend Approval by SqCWD and CWD Board of Directors

SqCWD and CWD Boards of Directors Meetings:

- March 20, 2007 — Noticed Public Hearing and First Reading of Ordinances Adopting GMP
- April 17, 2007 — Second Reading of Ordinances Adopting the GMP
- May 17, 2007 — Ordinances Become Effective

2.2 Public Involvement

This GMP was completed as an open process with public participation, consistent with California Water Code §10753 *et seq*. For this GMP the following steps were taken to provide opportunity for public input:

***Initial Notice of Intent*:** In accordance with CWC §10753.2, a Notice of Intent to adopt a resolution to prepare a GMP was published in the Santa Cruz Sentinel newspaper on December 4, 2005 and again on December 11, 2005. Each respective Board of Directors for Soquel Creek Water District and Central Water District adopted the Resolution of Intent at their separate publicly held Board Meetings on December 20, 2005. The Resolution of Intent to prepare a GMP was published in the SC Sentinel on January 1, 2005 and again on January 8, 2006.

Both the Notice of Intent and the Resolution of Intent are included in Appendix A.

Public Outreach and Notifications: During the development of the GMP, the public was provided information on the GMP progress through the following:

- Direct Mail List – A list of individuals and organizations that have shown interest in the GMP Update was maintained, and meeting agendas and minutes were sent to these individuals and organizations. (Appendix A).

- Web Page – A section of the Soquel Creek Water District's website was dedicated to disseminate GMP Update Information to those who have access to a computer and use the internet. (http://www.soquelcreekwater.org/GWMgmt_Plan.htm)

- Press Releases – Notification of GMP Meetings and request for Public Comments were provided to the local newspaper, the Santa Cruz Sentinel. These press releases described the manner in which interested parties may participate in developing the groundwater management plan (see Appendix A).

- Newsletters – Notification of the GMP was included in the March/April 2006 "What's On Tap" Newsletter, an in-house publication that is sent out to Soquel Creek Water District Customers with their bi-monthly bill.

Public Meetings during the GMP Update: All GMP Committee meetings are public under the Brown Act because the JPA was formed by two local Water Districts. Meetings which involved review of draft sections from the GMP had a public comment period.

Public Comment Period for the 2007 Groundwater Management Plan: Notices were published on Sunday, February 18 and 25 in the Santa Cruz Sentinel and e-mail notices were sent to the list of potential stakeholders to inform the public of the proposed adoption of the 2007 GMP. Written copies of the Plan were made available at SqCWD and CWD Main offices, four local libraries, and on SqCWD's website.

***Public Hearing*:** A Public Hearing was held on March 20, 2007 at a joint meeting of the SqCWD and CWD Boards of Directors.

Public comments and responses are included in Appendix A-6.

2.3 Formation of an Advisory Committee

At the February 13, 2006 GMP Committee meeting, a technical advisory committee (TAC) was appointed to assist with developing this Groundwater Management Plan. The TAC consisted of representatives from the Soquel Creek Water District, Central Water District, County of Santa Cruz, City of Santa Cruz, and the Pajaro Valley Water Management Agency (PVWMA).

The TAC met on the following schedule during the GMP Development:

- April 7, 2006 and April 19, 2006 — Discussion of the GMP Goals, Basin Management Objectives, and Plan Elements
- July 19, 2006 — Review of Elements (Programs, Projects, and Policies)
- August 30, 2006 — Review of Section 3 and Section 5

Once the GMP is adopted, the Technical Advisory Committee shall serve as the Implementation Team to coordinate agency efforts and recommend an annual work plan for groundwater management activities and establish action items to achieve the basin management objectives. This Groundwater Management Work Plan shall be presented to the GMP Committee and respective funding agencies for approval.

2.4 Developing Relationships with State and Federal Agencies

As interested stakeholders, it was critical to develop and maintain good working relationships with local, state, and federal regulatory agencies during the development of the GMP Update. The Department of Water Resources (DWR), Regional Water Quality Control Board, and USGS were all included on the direct-mail list for the public involvement process. Staff from SqCWD and CWD conducted an all-day meeting with Brian E. Smith, Chief of the Resources Assessment Branch, DWR (San Joaquin District) on June 13, 2006 to brief DWR on the condition of the Soquel-Aptos Area Basin, impress upon them the urgency of the overdraft situation in the basin, and discuss and agree upon the groundwater management strategies being implemented as part of this GMP.

2.5 Consistency with other Local Programs and Policies

The writers of the GMP checked with other agencies and confirmed that this Plan, to the best of our knowledge, is consistent with other local programs and policies. These include, but are not limited to, the following:

- County of Santa Cruz General Plan/Local Coastal Program, 1994
- City of Capitola General Plan, 1989 with 2004 Housing Element Update
- Pajaro Valley Water Management Agency's 2002 Revised Basin Management Plan
- City of Santa Cruz Integrated Water Plan, 2003
- City of Santa Cruz Urban Water Management Plan Update 2006
- Northern Santa Cruz County Integrated Water Resources Management Plan, 2006
- An Evaluation of Water Resources Monitoring and Management Efforts in Santa Cruz County prepared by County of Santa Cruz Administrative Office, Planning Department and Environmental Health Services, April 1998
- Chapter 7.70 of the Santa Cruz County Code Relating to Water Wells
- Soquel Creek Watershed Assessment and Enhancement Plan prepared by the Santa Cruz County Resource Conservation District, 2003
- Aptos Creek Watershed Assessment and Enhancement Plan prepared by the Coastal Watershed Council, 2003

Soquel Creek Water District and Central Water District rely on groundwater as their sole source of supply. Both Districts extract water from two primary geologic formations: the Purisima Formation and the Aromas Red Sands. This Section describes the existing groundwater conditions in both the Purisima Formation and Aromas Red Sands, and discusses current groundwater management strategies.

3.1 Physical Setting

3.1.1 Service Areas and Topography

The SqCWD serves a population of approximately 49,000 through approximately 14,900 connections in four service areas within mid-Santa Cruz County. The SqCWD encompasses seven miles of shoreline along Monterey Bay, and extends from one to three miles inland into the foothills of the Santa Cruz Mountains (**Figure 3-1**). Part of the SqCWD, the Glenwood area, is not served water by the District and is not considered part of the service area. Ninety percent of the SqCWD's customers are residential and the remaining 10 percent are primarily commercial and institutional. SqCWD also provides customers with dedicated fire services. There are no agricultural connections to the system. The elevation of the service area ranges from sea level to almost 700 feet above sea level. The City of Capitola is the only incorporated area within the SqCWD. Unincorporated communities include Aptos, La Selva Beach, Rio Del Mar, Seascape, Seacliff Beach, and Soquel.

CWD, with an estimated population of approximately 2,700, has approximately 790 customers served through approximately 850 service connections. Situated in the foothills of the Santa Cruz Mountains east of Aptos, it covers a service area of roughly five square miles (**Figure 3-1**). CWD service connections include residential, fire, commercial, and agricultural. The elevation of the service area ranges from 150 feet to over 1100 feet above sea level. CWD serves unincorporated County areas in and around Aptos.

3.1.2 Climate and Rainfall

The Soquel-Aptos area is located on the Monterey Bay, 30 miles north of Monterey and 80 miles south of San Francisco. The Soquel-Aptos area enjoys a mild climate with temperatures in January and July averaging 50 and 63 degrees, respectively. Summers are mild and dry, and winters are cool, with an average precipitation rate of approximately 30 inches per year.

Precipitation in the Soquel-Aptos area ranges between 25 and 45 inches per year (Geomatrix, 1999). **Figure 3-2** displays the average annual rainfall (in inches) constructed from 120 precipitation gauges, adjusted to reflect long-term averages (Geomatrix, 1999). Johnson et. al (2004) states that approximately 15 percent of the rain that falls in the Soquel-Aptos watershed infiltrates the ground and becomes groundwater. The rest flows overland into streams or storm drains, is absorbed by plants, or evaporates. Given the nature of groundwater recharge in the

Soquel-Aptos area, cycles of droughts and above-normal precipitation do not appear to have had a short-term effect on deep, municipal groundwater wells.

3.2 Basin Boundaries and AB3030 Study Area

Several different boundaries have been used to define the Soquel-Aptos area in terms of its geographical, jurisdictional, and hydrologic extents. There is no clear definition of the Soquel-Aptos area; the designation is often used to refer to the water bearing central coast portion of Santa Cruz County. Below are the various boundaries that have been used to describe this groundwater region.

3.2.1 DWR, Bulletin 118 Basin Definitions

As stated in the *AB3030 Ground-water Management Plan Soquel-Aptos Area* (Luhdorff and Scalmanini, 1996), the Department of Water Resources (DWR) does not define a Soquel-Aptos Groundwater Basin in Bulletin 118. Instead, this area comprises four DWR designated basins including:

- DWR Basin 3-1: Soquel Valley
- DWR Basin 3-21: Santa Cruz Purisima Formation Highlands
- DWR Basin 3-26: West Santa Cruz Terrace
- DWR Basin 3-2: Pajaro Valley

Figure 3-3 shows the four DWR Basin boundaries, along with the outlines of the SqCWD and CWD service areas.

Bulletin 118 (DWR, 1975) defined a basin called the Santa Cruz Purisima Formation Highlands which included the area overlying the aquifers from north and east of Santa Cruz to a boundary with the Pajaro Valley as well as a separate basin named Soquel Valley. The 1980 update of Bulletin 118 (DWR, 1980) identified the Santa Cruz-Pajaro Basin, which included both the Santa Cruz Purisima Formation Highlands and Soquel Valley, and was classified as subject to critical conditions of overdraft. This finding, according to Bulletin 118-80, was "at the request of the City of Santa Cruz and a Supervisor of Santa Cruz County".

DWR revised Bulletin 118-80 again in 1992 and better defined the boundaries for Soquel Valley, Santa Cruz Purisima Formation Highlands and the Pajaro Valley Basins. It also cited that the Soquel-Aptos area was not subject to critical conditions of overdraft. This finding was primarily based on the Groundwater Management Program and Monitoring that was implemented by SqCWD in 1981.

Bulletin 118 was most recently updated in 2003 and includes a written report and supplemental material consisting of individual hydrogeologic descriptions, maps, and GIS compatible data files of each delineated groundwater basin in California. Bulletin 118 (2003), however, still does not clearly and accurately describe the hydrogeologic conditions of the Soquel-Aptos area.

3.2.2 Jurisdictional Boundaries - Cities, Special Districts, and County

In the Soquel-Aptos area, there are four (4) municipal purveyors that pump groundwater within their jurisdictional boundaries: City of Santa Cruz, Soquel Creek Water District, Central Water District, and City of Watsonville. Pajaro Valley Water Management Agency (PVWMA) also operates within the area as a state-chartered water management agency and is an agricultural purveyor. PVWMA has developed and oversees a Basin Management Plan for its jurisdiction. SqCWD, CWD, and PVWMA all rely exclusively on groundwater to meet their needs, while the Cities of Santa Cruz and Watsonville use a combination of groundwater and surface water supplies to meet demand. The County of Santa Cruz does not provide water service to its residents; however the County Environmental Health Services oversees groundwater related issues including well policies for construction, abandonment, and destruction; groundwater recharge; well location mapping; and wellhead protection. Locations of these agencies' service boundaries are shown in **Figure 3-4**.

3.2.3 Hydrogeologic System Boundary

A conceptual model of the Soquel-Aptos Area Groundwater Basin was presented in the *Groundwater Assessment of Alternative Conjunctive Use Scenarios - Technical Memorandum 2: Hydrogeologic Conceptual Model* report (Johnson et al., 2004). The basin boundaries described in the 2004 report encompass the aquifer zones that contribute to SqCWD's existing groundwater supply, and extend outward to suitable hydrogeologic boundaries. The study area covered a 66-square-mile area, from Branciforte Creek on the east; through the developed areas of eastern Santa Cruz, Live Oak, Soquel, Capitola, and Aptos; inland towards the Zayante Fault; and, southeast through Rio Del Mar and La Selva Beach, and the western margin of Pajaro Valley. This basin definition does not constitute a single, well defined hydrogeologic basin. Instead, this boundary, shown in **Figure 3-5** was defined to isolate the Soquel-Aptos groundwater system by minimizing the potential for cross-boundary subsurface flows.

Most of the basin's groundwater recharge and discharge occur within these boundaries. This basin definition is referred to in this document as the Soquel-Aptos Hydrogeologic System Boundary (Johnson et al.).

3.2.4 Regional Water Quality Control Board (RWQCB) Basin Plan Boundary Proposal

In 2006, the Central Coast Regional Water Quality Control Board requested public input on the DWR Bulletin 118 boundary descriptions in preparation for updating and amending the Central Coast Basin Plan. In response to this request, the County of Santa Cruz Environmental Health Services worked with the SqCWD, City of Santa Cruz, CWD, and Scotts Valley Water District to develop basin descriptions based on geologic features. The County proposed adopting a Central Santa Cruz County Purisima Basin, as shown on **Figure 3-6**. The main features defining the boundaries of this Basin include the following:

Western Boundary - The western boundary generally follows Branciforte Creek. Branciforte Creek dissects the Purisima Formation such that the Purisima Formation constitutes a single continuous unit east of the creek, but only occurs as dissected and discontinuous islands west of Branciforte Creek.

Northern Boundary - The northern boundary can be taken as either the trace of the Zayante Fault, or as the contact between the Purisima Formation and the shales, sandstones, and conglomerates north of the Purisima Formation. The latter would include an area referred to as the Glenwood Syncline.

Eastern Boundary - The eastern boundary is defined by the contact between the Purisima Formation and the contiguous Aromas Red Sands.

Southern Boundary - The southern boundary is defined by the coastline.

3.2.5 Soquel-Aptos Area Groundwater Basin Management Area Boundary (1996)

The Soquel-Aptos Boundary in the *AB3030 Ground-water Management Plan, Soquel-Aptos Area* (Luhdorff and Scalmanini, 1996), was practically defined to coincide with the area monitored and managed by the Soquel Creek Water District and Central Water District. The basin boundaries extended from the westerly outcrop of the Purisima Formation in the vicinity of Branciforte Creek to the eastern limits of the Soquel Creek and Central Water Districts' service areas, and from the Zayante Fault to Monterey Bay (**Figure 3-7**). Although it made reference to the eastern limits of CWD, approximately one-quarter of the CWD service area was not included in the 1996 AB3030 Plan.

3.2.6 Soquel-Aptos Area Groundwater Basin Management Area Boundary (2007)

For the 2007 Groundwater Management Plan, the boundary has been slightly altered from the 1996 boundary discussed above, to include the hydrologic system defined by Johnson et al. (2004) and encompass all of the CWD Service Area. **Figure 3-7** shows the previous and updated Soquel-Aptos Management Area Boundaries. The updated Management Area Boundary includes areas that will be directly managed as part of this GMP, as well as areas of concern that border the SqCWD and CWD service areas. The Soquel-Aptos Groundwater Management Area is defined as:

Northern Boundary[1]: Following the Zayante Fault, and including the Glenwood Syncline. While some groundwater in the Glenwood Syncline may flow southeast to the Corralitos Creek area, Johnson et al (2004) notes that there is little gradient driving groundwater in this direction. It is reasonable to assume that some groundwater in the Glenwood Syncline migrates across the Zayante fault where units of the Purisima Formation abut.

Southern Boundary[2]: Encompassing the Purisima Formation's seafloor exposure that occurs within two miles south of Pleasure Point.

The Management Area Boundary also extends outward into the Pacific Ocean to encompass the hydrostratigraphic units that outcrop offshore with potential water storage capabilities.

Western Boundary[3]: Following the hydrogeologic boundary of Branciforte Creek, from its headwaters downstream to the San Lorenzo River, and then along the river to its mouth at the ocean.

Eastern Boundary: Starting at the eastern edge of the Northern Boundary (as described above) and encompassing the entire service area of CWD and Service Area IV (Canon Del Sol) of SqCWD.

SqCWD and CWD currently only have jurisdictional authority within their service areas and not within the entire Soquel-Aptos groundwater management area. However, as the lead agencies

[1] Northern Boundary edge coincides with the northern boundary as set forth in the TM2: Hydrogeologic Conceptual Model (Johnson et al., 2004)

[2] Southern Boundary edge coincides with the southern boundary as set forth in the TM2: Hydrogeologic Conceptual Model (Johnson et al., 2004)

[3] Western Boundary edge coincides with western boundary as set forth in the TM2: Hydrogeologic Conceptual Model (Johnson et al., 2004)

that oversee and manage the basin management objectives, a larger boundary was defined to encompass the hydrogeologic conditions of the Soquel-Aptos area.

3.3 Local Geology and Hydrogeology

3.3.1 Geologic Units

SqCWD and CWD wells extract groundwater from two geologic formations: the consolidated Purisima Formation and the unconsolidated Aromas Red Sands. The Pliocene to late Miocene age Purisima Formation is a sequence of grey, sometimes described as blue, moderately consolidated, silty to clean, fine to medium sandstones containing siltstone and claystone interbeds. It underlies the entire Soquel-Aptos area; however it is blanketed by the Aromas Red Sands in the eastern third of the Soquel-Aptos area, and by relatively shallow alluvial and terrace deposits elsewhere. The Pleistocene age Aromas Red Sands are a sequence of brown to red, poorly consolidated, fine to coarse-grained sandstones containing lenses of siltstone and claystone. A composite lithologic column, showing the general lithology and relative thickness of each of the hydrostratigraphic units is shown on **Figure 3-8**.

Purisima Formation (Tp)

The Purisima Formation has an uneroded total thickness of roughly 2,000 ft. Hickey (1968) subdivided the Purisima Formation into three hydrostratigraphic units in the Soquel-Aptos area, designated from oldest to youngest as A, B, and C. In 1983, SqCWD drilled eight exploratory test holes which resulted in an updated stratigraphic model. Based on an interpretation of the associated geophysical logs, Luhdorff and Scalmanini Consulting Engineers (LSCE, 1984) correlated at least a dozen distinctive marker beds within nearly 1,200 ft. of strata. Bounded between six of these markers, LSCE designated five units labeled A through E from oldest to youngest. Additionally, LSCE designated the zones below and above this package as unit AA and unit F, respectively.

Although the marker beds identified by LSCE are convenient for interpolating between boreholes, they do not necessarily define hydrostratigraphic boundaries. Johnson et al. (2004) developed the current hydrostratigraphic model by first accepting the general layered aspect of the Purisima Formation suggested by the marker beds, then splitting and combining the AA through F units into hydrostratigraphic units that define regional aquifers and aquitards. The hydrostratigraphic units are generally named according to the LSCE-defined units that constitute them, although the lowest units are named with more standard geologic nomenclature. The hydrostratigraphic units are defined from oldest to youngest as follows:

Aquifer Tu (0 to 300 feet thick). The Tu aquifer comprises the lower part of the undefined Tertiary age sediments below the base of the Purisima Formation. This aquifer has only been observed in occasional deep wells, and is limited in extent. It is identified by a significantly high resistivity signature. Some investigators have proposed that the Tu aquifer may represent remnants of the Santa Margarita Formation or Lompico sandstone. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 1 and 20 feet per day.

Aquitard Tm (0 to 200 feet thick). This is a poorly defined fine-grained unit below the AA unit of the Purisima Formation. It is unclear whether this hydrostratigraphic unit is part of the Purisima Formation or an older unit such as the Santa Cruz Mudstone or Monterey Formation. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 0.005 and 1 foot per day.

Aquifer AA (150 to 300 feet thick). This unit comprises a sequence of interbedded, moderately coarse- and fine-grained zones underlying the well defined A unit. A fine-grained zone 20 to 70 feet thick divides the AA unit from the overlying A unit. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 1 and 10 feet per day.

Aquifer A (~250 feet thick). This distinct aquifer is the most consistently coarse-grained aquifer within the Purisima Formation. It is sometimes divided into an upper and lower zone, with the lower zone being more coarse-grained. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 7 and 65 feet per day.

Aquitard B (~150 feet thick). This aquitard consists of the lower portion of the LSCE unit B. This portion of unit B is consistently fine-grained, with the lower 25 to 45 feet being the most highly correlated feature across the Soquel-Aptos Area Basin. A coarse-grained bed is often encountered in the middle of this otherwise fine-grained unit. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 0.005 and 1 foot per day.

Aquifer BC (~200 feet thick). The LSCE unit C is grouped with the upper portion of the LSCE unit B to form Aquifer BC. This is a moderately coarse-grained unit with a distinct 15 to 20 foot thick coarse-grained unit at the top of the unit. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 1 and 3 feet per day.

Aquitard D (~80 feet thick). The lower 60 to 80 ft of LSCE unit D is predominantly fine-grained, with one or two minor coarse-grained intervals. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 0.005 and 1 foot per day.

Aquifer DEF (~330 feet thick). This moderately coarse aquifer includes intermittent fine-grained zones. The top of this aquifer seems poorly defined; Johnson et al. (2004) does not identify a distinct marker or aquitard separating this aquifer from the overlying Aquifer F. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 2 and 6 feet per day.

Aquifer F (500+ feet thick). This unit consists of alternating moderately coarse- and fine-grained zones. Johnson et al. (2004) identifies this aquifer as the upper portion of the Purisima F unit that is often screened in conjunction with the lower Aromas Red Sands. Johnson et al. (2004) estimates that the hydraulic conductivity of this hydrostratigraphic unit ranges between 2 and 6 feet per day.

Aromas Red Sands (Qa)

The poorly consolidated Aromas Red Sands consist of interbedded fluvial, marine, and eolian sandstones with lenses of siltstone and claystone. As a result of this complex depositional history, the Formation contains significant heterogeneities. The Aromas Red Sands overlie the Purisima Formation in the hills and coastal terraces east and southeast of Aptos. LSCE (1987) subdivided the Aromas Red Sands into an upper and a lower unit within Pajaro Valley. A large portion of the upper zone may be unsaturated, especially where the water table is drawn down to near sea level. Johnson et al. (2004) estimates that the hydraulic conductivity of the Lower Aromas Red Sands ranges between 6 and 50 feet per day, and the hydraulic conductivity of the Upper Aromas Red Sands ranges between 3 and 40 feet per day.

3.3.2 Geologic Structure

Both the Purisima Formation and Aromas Red Sands are relatively undeformed in the Soquel-Aptos area. Locally the Purisima Formation dips to the southeast at approximately 4 degrees. This dip results in remnants of the lower-most strata occurring only along ridge tops west of the study area. The Purisima Formation also occurs within a tightly folded syncline north of the Zayante Fault along the upper portions of the Soquel and Aptos Creek watersheds. The Aromas Red Sands are assumed to be flat lying, although no extensive structures have been identified that could be used to determine strike and dip.

Figure 3-9 shows the estimated outcrop pattern of the hydrostratigraphic units. The outcrops of the Purisima Formation hydrostratigraphic units are based on Johnson et al. (2004). Coastal terrace deposits mapped by Brabb et. al (1997) are additionally shown on **Figure 3-9**. The hydrostratigraphic units do not outcrop in these areas, but are covered by the coastal terrace deposits. The boundary between the Purisima Formation and the Aromas Red Sands is based on the eastern boundary of the Central Santa Cruz County Purisima Basin, as proposed by the County of Santa Cruz (**Figure 3-6**). The Undifferentiated Purisima/Glenwood Syncline area is based on the Geologic Map of Santa Cruz County by Brabb, et. al,. (1997).

Figure 3-9

Figure 3-9 additionally shows the location of cross-section A-A', and locates the wells that form the basis of the cross section. Cross Section A-A' is shown on **Figure 3-10**. This cross section shows the general southeastern dip of the Purisima hydrostratigraphic units. The hydrostratigraphic unit contacts shown on **Figure 3-10** are based on contacts identified in Johnson et. al. (2004), and modified by Cloud (personal communication).

3.3.3 Offshore Geology

Both the Purisima Formation and Aromas Red Sands extend offshore beneath Monterey Bay. The offshore geology and structure is assumed to be similar to the onshore geology and structure. The lower Purisima units (A and AA units) are assumed to be exposed in the northeastern portions of Monterey Bay, and buried deeply beneath Monterey Bay to the southeast.(**Figure 3-11).**

Sediment mapping of the Monterey Bay seafloor with acoustic imagery has identified Purisima Formation along much of the seafloor (Eittreim et al., 2000, 2002). Additionally, a band of unconsolidated deposits extending offshore from the mouth of Soquel Creek appears to be an infilled paleochannel cut into the Purisima Formation (**Figure 3-12**). The Aromas Red Sands are difficult to distinguish acoustically and may be exposed more extensively offshore in areas interpreted as "mud and fine sand".

3.3.4 Faults

The Zayante Fault (**Figure 3-5**) likely affects groundwater flow where it extends through the basin southeast of Soquel Creek, although the degree of impact is unquantified. The San Gregorio Fault lies at least 20 miles offshore in Monterey Bay. No other named fault traverses the basin.

3.4 Groundwater Conditions

3.4.1 Water Levels and Flow Directions

Purisima Formation

Water levels in the Purisima Formation are characterized by a broad and persistent pumping trough surrounding the production wells. Piezometric maps for the A unit of the Purisima Formation during Spring and Fall 2005 are shown on **Figure 3-13** and **Figure 3-14**. Water level contours are based on data from Purisima A-zone monitoring wells, Purisima A-zone production wells, City of Santa Cruz wells, and water level data for upland areas from Bloyd (1981). These two figures demonstrate that a drawdown trough persists in the A unit of the Purisima Formation throughout the year. The drawdown trough is centered in the middle of the SqCWD service area, and is anchored by drawdown at the Main Street and Rosedale wells in the west, and the Estates well to the east.

The arrows on **Figure 3-13** and **Figure 3-14** show the inferred groundwater flow directions. Groundwater generally flows from the northern hills towards the pumping depressions. Groundwater in the western portion of the basin displays an aspect of west to east flow, consistent with previous interpretations including the groundwater mapping of Bloyd (1981), the City of Santa Cruz DWSAP (Johnson, 2003), and consistent with the relatively high rates of recharge in nearby aquifer outcrop areas. The natural west to east aspect of groundwater flow is sometimes modified by seasonal or regular pumping depressions. This is apparent in Figures 3-13 and 3-14. Groundwater flow directions south of the Garnet Well are to the southeast in the spring when water levels are relatively high (Figure 3-13), but these flow directions are more directly east in the fall when pumping depressions are greater (Figure 3-14). The contours shown on **Figure 3-13** and **Figure 3-14** additionally suggest that a portion of the groundwater pumped by the SqCWD wells is derived from beneath Monterey Bay.

Piezometric maps for the BC aquifer of the Purisima Formation during Spring and Fall 2005 are shown on **Figure 3-15** and **Figure 3-16**. Water level contours were based on data from Purisima B-zone and Purisima C-zone monitoring wells, Purisima BC aquifer production wells, and upland water level data from Bloyd (1981). Similar to the Purisima A-unit, a drawdown trough persists in the BC aquifer throughout the year. The drawdown trough is anchored by drawdown at the Madeline, Ledyard, and T. Hopkins wells. The drawdown trough in the BC aquifer is deeper than the drawdown trough in the A-unit, reflecting the lower hydraulic conductivity of the BC aquifer.

The arrows on **Figure 3-15** and **Figure 3-16** show the inferred groundwater flow directions. Groundwater generally flows from the northern hills towards the pumping depressions. The contours in the figures additionally suggest that a portion of the groundwater pumped by the SqCWD wells is derived from beneath Monterey Bay.

Figure 3-17 and **Figure 3-18** show hydrographs from the SC-9 and SC-14 monitoring well clusters, respectively. These hydrographs are representative of historical conditions in the Purisima formation. These hydrographs show relatively large variations in water levels in the deeper aquifer zones, suggesting that water levels are highly influenced by pumping and less so by annual recharge. This is consistent with earlier findings that the recharge to the deep aquifers approaches some steady state value, independent of annual fluctuations. The hydrographs also show large vertical gradients between different hydrostratigraphic units. The hydrographs both show that the Purisima B and C sub-units are responding as a single sub-unit, and that pumping has produced a significant drawdown cone in the BC aquifer.

Aromas Red Sands

Water levels in the lower Aromas and Purisima F aquifers are characterized by a moderate seaward gradient in upland areas that transitions to a relatively flat surface throughout the coastal plain. Water table maps for these aquifers during Spring and Fall 2005 are shown on **Figure 3-19** and **Figure 3-20** and are based on the average of water levels for lower Aromas and Purisima F aquifers and upland water level data from Bloyd (1981). The flat coastal water-level surface was slightly above sea level in April 2005 but included a depression slightly below sea level near monitoring well SC-A1 in October 2005. The arrows in the figures show the inferred groundwater flow directions. Groundwater generally flows from the hills towards the Pacific Ocean but appears to be almost entirely captured by municipal, private, and agricultural wells in the coastal plain area.

A water table map for the lower Aromas and Purisima F aquifers during April 2002 are shown on **Figure 3-21**. This map shows that the historical groundwater flow was parallel to the coast in the La Selva Beach area. These contours are largely influenced by low water levels measured in monitoring well SC-A4. It is unclear if this historical flow parallel to the coast results from regional or local flow patterns. The 1996 Soquel-Aptos Area AB3030 plan includes a water table map for 1991 (Figure 6 in Luhdorff and Scalmanini, 1996) that suggests regional flow southward toward Pajaro Valley. These contours were based on water levels in SC-A4 and Pajaro Valley wells PV-1 and PV-8. However, water level data from two Pajaro Valley wells that are closer to La Selva Beach (wells 12S/01E-03F01 and 12/01E-03K01) do not support a broad regional southward flow from La Selva Beach to Pajaro Valley (PVWMA, State of the Basin Report, July 2001). The water table map shown in **Figure 3-21** only shows a local southward gradient, with no implication as to whether this is part of a larger, regional gradient.

Figure 3-22 and **Figure 3-23** show hydrographs from the SC-A2 and SC-A4 monitoring well clusters, respectively. These hydrographs are representative of historical conditions in the Aromas Red Sands. These hydrographs show that water levels have been fairly constant over time in the Aromas Red Sands. Unlike the Purisima formation, water levels do not appear to significantly respond to changes in the SqCWD's pumping rates in the Aromas Red Sands. Water levels in the Aromas Red Sands are also consistently low, near sea level. The hydrograph for SC-A4 shows the exception to the constant water levels in the Aromas Red Sands. Water levels rose significantly in the SC-A4 wells in 2002.

3.4.2 Current Groundwater Extraction

Groundwater is extracted from the Soquel-Aptos area by SqCWD, CWD, the City of Santa Cruz, small or private water systems, and residential and agricultural water users. **Figure 3-24** shows annual pumping from SqCWD, CWD, and the City of Santa Cruz between 1986 and 2005. **Figure 3-24** shows that extractions by water purveyors have fluctuated between an estimated 5,700 afy (1986) and 6,900 afy (1988). Extraction from the Purisima Formation ranged from 3,500 afy (2005) to 4,700 afy (1988); production from Aromas Red Sands ranged from 1,900 afy (1991) to 2,700 afy (2002). No trend is apparent on the SqCWD and CWD graphs; fluctuations are apparently due to climatic variation and SqCWD's conservation efforts since 2000. City of Santa Cruz pumping relates directly to drought conditions, which limit surface water supplies.

See Appendix B for tabular information of SqCWD and CWD Production and Monitoring Wells.

Private well users (residential, commercial, institutional, and agricultural) and small water systems pump groundwater in addition to the totals shown on **Figure 3-24**. Johnson et al. (2004, Table 5-7) estimated that these groundwater users pumped approximately 3,200 acre feet annually based on water use factor assumptions derived from land use. Of the 3,200 acre feet, private well users annually extract an estimated 2,200 acre-feet from the Purisima Formation. The remaining 1,000 acre-feet is extracted from the Aromas Red Sands portion of the Soquel-Aptos area.

3.4.2.1 SqCWD Extraction

SqCWD customers consumed an average of about 5,400 acre-feet of water per year (afy) from 2000-2005. Groundwater is extracted from 15 currently active production wells that tap into the deep, confined aquifers of the Purisima Formation as well as the semi-confined and unconfined units of the shallower Aromas Red Sands. SqCWD's delivery system is divided into four service areas, with limited capabilities for transferring water from one service area to another. The Service Areas are numbered as I through IV, from west to east (**Figure 3-25)**.

The majority of SqCWD groundwater is produced from wells within Service Areas I and II. The average pumping over the last five years is distributed as shown on **Table 3-1**.

Table 3-1
SqCWD Extraction Percentages based on Service Area (2000-2005)

Area	Source (Aquifer)	Production Total (%)
Service Area I	Deeper Purisima Formation aquifers A and AA	44%
Service Area II	Purisima Formation aquifers A, BC, DEF	18%
Service Areas III & IV	Purisima F and Aromas Red Sands aquifer	38%

Groundwater production for SqCWD varies during the year as a function of seasonal demand, with peak demands occurring in July and August. Demand in winter (January/February) is approximately half of the summer demand.

3.4.2.2 CWD Extraction

CWD customers consumed an average of about 570 acre-feet of water per year (afy) from 2000-2005. The CWD relies solely on 6 production wells to serve its customers, all within the Aptos area (**Figure 3-25**). The six production wells are grouped into two well fields: the Cox well field and the Rob Roy well field. The Cox wells extract water from the Purisima Aquifer and the Rob Roy wells extract water from the Aromas Red Sands. The average pumping in 2005 was distributed as:

Table 3-2
CWD Extraction Percentages Based on Service Area (2000 - 2005)

Area	Source (Aquifer)	Production Total (%)
Cox Road Well Field	Purisima Formation	7%
Rob Roy Well Field	Aromas Red Sands Aquifer[1]	93%

[1] Buried contact between the Aromas Red Sands and the Purisima Formation is undefined in the vicinity of the Rob Roy Wells. The lower portions of these wells could also draw from the Purisima F aquifer unit.

Historically, the Cox Road Well Field produced more water than the Rob Roy Well Field. Between 1973 and 1974, the Cox Road Well Field accounted for 89% of the CWD production. CWD production has shifted to the Aromas Red Sands Aquifer (Rob Roy Wells) due to the high levels of iron and manganese in the Purisima Formation.

CWD demands will likely remain relatively constant in the near future. *The North Santa Cruz County Water Master Plan Study, Final Report* (EIP/HEA et al., June 1985), estimated that based upon Santa Cruz County General Plan densities, CWD could expect 918 customers by the year 2000 and 944 customers at build out. Currently, CWD has approximately 850 services, which includes 51 fire and 12 irrigation services. This same report noted that CWD is one of the only two water districts in Northern Santa Cruz County capable of meeting demands for water at build out with the current facilities in place. A 1994 CWD Buildout Study (conducted as a pilot study by Santa Cruz County), which reviewed vacant and developable lots using computer generated models, indicated that previous projections overstated the number of future connections because a majority of the area within CWD lies within the designated Primary Recharge Area of Santa Cruz County where parcel sizes are limited to a 10-acre minimum.

3.4.2.3 City of Santa Cruz Extraction

The City of Santa Cruz extracts groundwater to supplement surface water they provide to their customers in the Live Oak area. Groundwater is extracted from the Purisima Formation in the Pleasure Point area from production wells known as the Live Oak or Beltz Wellfield. Groundwater production for the City of Santa Cruz is seasonal, usually beginning in the Spring to meet peak summer demands. Groundwater typically comprises 5 to 7% of the City's water supply and can be a higher percentage of its supply when surface water sources are significantly diminished.

City of Santa Cruz customers consumed an average of 430 afy (140 MGY) of groundwater from 2000-2005; however, the *Preliminary Hydrogeological Study for the City of Santa Cruz Integrated Water Plan Environmental Impact Report Supplemental Study* (Hopkins, 2004) states:

> "Historically, the City has used the groundwater during a period of 150 to 200 days out of the year at a combined operational rate of about 1 mgd on average but at 2 mgd during the extended drought in 1987 and 1988 … As indicated in the IWP, the future operation of the Live Oak well field will be conducted on this same basis…The annual demand during dry years may be as high as 400 million gallons per year (1,228 afy)."

3.4.2.4 Current Private and Agricultural Extraction

It is estimated that there are several thousand private wells in the Soquel-Aptos area that extract groundwater for domestic and agricultural uses; however, accurate records do not exist since most of these private wells are unmetered. Several studies over the years have estimated extraction quantities by these private pumpers. The most recent study (Wolcott, 1999) applied water use factors based on land use to develop estimates of 2,250 afy in the Purisima Formation. Private pumping in the Aromas Red Sands was most recently estimated to be 900 afy (Johnson et al, 2004). These pumping estimates do not include any estimates for consumptive use, or return flow from septic systems and irrigation.

Also, of recent concern, are three private irrigation wells along the coast near Seascape where a saltwater wedge appears to be advancing onshore. SqCWD continues to monitor this area and has shifted its own pumping plan to decrease withdrawals in this localized area.

Within the CWD area, there are large portions around Pleasant Valley that are privately irrigated to support apple and grape crops. This agricultural usage has not been quantified; however, it should be noted that CWD serves approximately 12 agricultural customers in the Pleasant Valley area, and these agricultural water demands are metered. These 12 customers used approximately 32.6 afy (10.62 MG) in fiscal year 2004/2005.

3.4.3 Groundwater Yield and Sustainability

Groundwater levels that are consistently at or below sea level are observed in both Purisima and Aromas aquifers. These low water levels, combined with rising chloride levels in portions of the coastal Aromas area, suggest that sustainable levels of pumping may have been exceeded in the Soquel-Aptos Area Basin. This overdraft increases the Basin's vulnerability to seawater intrusion. Recent studies of groundwater conditions in the SqCWD's service area indicate that, even with conservation savings, a supplemental source of supply is needed to prevent overdraft and salt water intrusion. (Integrated Resources Plan, 2006).

The recent Hydrogeologic Conceptual Model (Johnson et al, 2004) estimated total pumping in the Soquel-Aptos area to be approximately 10,300 afy. This pumping rate reflects total pumping, and does not account for return flow/recharge from septic systems and irrigation. This regional pumping rate is not sustainable, as discussed above. In order to help protect against seawater intrusion, SqCWD has set a goal of limiting its total annual groundwater yield to no more than 4,800 afy within the context of an overall regional solution to address overdraft of the Soquel-Aptos Area Basin. Under this plan, SqCWD's annual groundwater yield would be apportioned as no more than 3,000 afy from the Purisima Formation and no more than 1,800 afy from the Aromas Red Sands Aquifer. This target pumping rate represents a significant reduction from SqCWD's maximum pumping of 5,884 afy (Johnson et. al, 2004, Table 4-1a)
CWD pumping accounts for approximately six percent of the total groundwater production in the Soquel-Aptos area. Johnson et al. (2004, Table 5-2) estimates that 38% of CWD's production from the Aromas Red Sands returns to the groundwater through recharge.

3.5 Natural Groundwater Quality

Groundwater in the Soquel-Aptos Area Basin can be divided into two water quality types: a calcium bicarbonate type and a calcium-magnesium bicarbonate type (Kennedy Jenks, 2000). Groundwater in the Purisima A subunit is of a calcium bicarbonate type. Groundwater in the upper Purisima subunits is generally classified as a calcium-magnesium bicarbonate type. Groundwater from the Aromas Red Sands is also consistently a calcium-magnesium bicarbonate type (Luhdorff & Scalmanini, 1996).

SqCWD and CWD routinely test their untreated groundwater to determine the water quality of the basin. Water quality parameters analyzed by SqCWD and CWD include general minerals, general physical parameters, and organic/inorganic compounds. Analyses for these are conducted in accordance with the requirements of the California Code of Regulations, Title 22. Water quality results are compared against primary and secondary drinking water standards, established by the US Environmental Protection Agency (USEPA), and water quality standards established by the California Department of Health Services.

Water from the Soquel-Aptos Area Basin does not regularly exceed any primary drinking water standard. A few naturally occurring constituents exceed secondary drinking water standards, and other naturally occurring constituents are closely monitored even though they remain below established drinking water standards. These constituents include Iron, Manganese, Chlorides, Total Dissolved Solids (TDS), Arsenic and Chromium VI.

3.5.1 Iron and Manganese

Water extracted from the Purisima Formation has levels of iron and manganese above the secondary standards of 0.30 and 0.050 mg/L respectively. Both iron and manganese occur naturally in the Purisima Formation as a result of the dissolution of metals within the aquifer. Neither constituent poses a health concern, but can result in undesirable aesthetics, causing discoloration of the water.

Groundwater pumped by SqCWD from the Purisima Formation is treated to reduce iron and manganese levels prior to distribution. Iron and Manganese treatment plants serve the following SqCWD Wells: Garnet Well, Main Street Well, Monterey Well, Rosedale Well, Maplethorpe Well, Tannery II Well, Estates Dr. Well, T Hopkins Well, Aptos Creek Well, and Aptos Jr. High Well.

Water produced from the CWD Cox Road Well Field (Wells #2, 3 and 5) exceeds the secondary MCLs for iron and manganese. Due to poorer groundwater quality and the lack of a treatment facility, CWD has reduced its pumping at the Cox Road Well Field. Water that is pumped from Wells #2, 3, and 5 is blended with water from the Rob Roy Wells (Wells #4, 10, and 12), reducing the levels of iron and manganese.

3.5.2 Chlorides and Total Dissolved Solids (TDS)

TDS concentrations measured in production wells in the Purisima Formation have historically ranged between 270 and 710 mg/L. TDS concentrations measured in production wells in the Aromas Red Sands have historically ranged between 95 and 470 mg/L. Chloride concentrations measured in production wells in the Purisima Formation have ranged between 13 and 110 mg/L. Chloride concentrations measured in production wells in the Aromas Red Sands have historically ranged between 8 and 40 mg/L.

Increasing TDS and chloride are indicators of potential seawater intrusion. The mechanisms of seawater intrusion, and the threat posed by seawater intrusion, are discussed further in Section 3.6. The observed TDS and chloride levels do not suggest any seawater intrusion impacting the production wells.

The coastal monitoring wells (**Figure 3-25**) described in Section 3.8 are regularly sampled for TDS and chloride. Coastal monitoring wells in the Purisima Formation currently do not show any indication of seawater intrusion. A number of the coastal monitoring wells in the Aromas Red Sands indicate ongoing seawater intrusion. **Figure 3-26** and **Figure 3-27** show measured TDS and chloride concentrations in monitoring wells SC-A2B and SC-A3B. Concentrations of both TDS and chlorides in well SC-A2B show a steady increase, indicating ongoing seawater intrusion. Concentrations of both TDS and chlorides in well SC-A3B show a significant rise in the mid-1990s, indicative of seawater intrusion.

3.5.3 Arsenic

Low levels of arsenic have been regularly detected at two of SqCWD's water supply wells that produce water from the Purisima Formation. These two wells, T-Hopkins and Aptos Creek, have average total arsenic concentrations of approximately 3 ppb and 4 ppb, respectively. The two wells are operated in tandem and share a single treatment facility at T-Hopkins. The average arsenic concentration in both of these wells remains below the federal drinking water standard for arsenic, which was lowered to 10 ppb in January 2006.

In 2003, the SqCWD conducted a special investigation of the low levels of arsenic detected at the T-Hopkins and Aptos Creek wells (LCSE, 2003). The investigation concluded that the arsenic detections in SqCWD wells are most likely associated with the natural occurrence of arsenic resulting from the depositional and geochemical conditions in the Soquel-Aptos coastal environment. Desorption or dissolution of arsenic oxyanions from iron oxide appears to be the most common cause of arsenic in groundwater.

Although there is no existing regulatory requirement to do so, SqCWD has modified the T-Hopkins treatment plant to remove arsenic using ferric chloride as a coagulant combined with the existing anthracite filtration. This facility also treats the raw water from the Aptos Creek Well.

3.5.4 Chromium VI

Chromium is a naturally occurring metallic element that can be found in water, soil, and rocks. SqCWD detected Total Chromium at concentrations between 6.3 and 37 ppb in their Aromas Red Sands production wells in 1998 and 2000. These levels were below the State MCL of 50 ppb. Subsequent testing showed that the total chromium that was identified was essentially 100% Chromium VI (hexavalent chromium). Inhalation of Chromium VI is known to cause cancer in humans, and is likely to be more toxic when inhaled than when ingested. At present, there has been no Public Health Goal (PHG) established for Chromium VI.

Although the levels of Chromium VI in SqCWD wells are below action levels, SqCWD has voluntarily opted to reduce the levels of Chromium VI in delivered water through blending. Wells with the highest Chromium VI levels are concentrated in Service Area IV. SqCWD is currently importing water from Service Area III to blend with water in Service Area IV to reduce the Chromium VI levels. This blending reduces the concentrations of Chromium VI in water served to Service Area IV by an average reduction of between 10 and 15 ppb.

SqCWD continues to monitor the efforts by DHS related to health effect studies and has requested to be included in any research projects conducted by the AWWA Research Foundation associated with Chromium VI treatment.

3.5.5 Nitrates

Nitrate (NO3) is a naturally occurring compound that is formed in the soil when nitrogen and oxygen combine. Common sources of nitrogen in the soil are fertilizers, livestock waste, and septic systems. High levels of nitrate can cause health problems for infants which results in a dangerous condition called methaemoglobinaemia, also known as "blue baby syndrome". The State MCL is 45 mg/L and nitrate levels of ND (non-detected) to 38 mg/L were detected during testing by SqCWD in 2005. These levels, detected in the La Selva Beach area of the Aromas Red Sands, are below the State MCL and have not impacted the domestic water supplies.

Nitrate Levels for CWD ranged from ND to 27 mg/L in 2005, most likely due to runoff and leaching from fertilizer use, leaching from septic tanks and sewage, and erosion of natural deposits. The majority of CWD customers are on septic systems because of the rural, low residential density and CWD will be assessing nitrate levels as part of its DWSAP Update in 2006-2007.

3.6 Seawater Intrusion

Groundwater elevations in the Soquel-Aptos area have been near or below sea level since groundwater monitoring was initiated in 1983. These low groundwater elevations provide the opportunity for seawater intrusion into the Purisima Formation and Aromas Red Sands. Johnson et. al (2004) summarized the seawater intrusion threats to both the Purisima Formation and Aromas Reds Sands as follows.

3.6.1 Seawater Intrusion in the Purisima Formation

Seawater intrusion is currently not detected in production wells in the Purisima Formation but elevated chloride concentrations have been detected in the City of Santa Cruz monitoring wells at Moran Lake and Soquel Point as well as SqCWD's monitoring well SC-8F. Also, historically, seawater intrusion has been detected in shallow monitoring wells in the Seacliff area (Purisima unit E), shallow monitoring wells in the Pleasure Point area (Purisima unit A), and deeper monitoring wells near the mouth of Aptos Creek (Purisima unit B). Combining this historical seawater intrusion with the low groundwater elevations existing in the Purisima Formation suggests that future seawater intrusion is likely.

Analyses of historical seawater intrusion, combined with geologic interpretations, suggest the following likely locations for seawater intrusion:

- Pleasure Point. The highly productive A-unit of the Purisima Formation outcrops offshore of Pleasure Point (**Figure 3-11**). This outcrop provides a potential pathway for seawater to enter the A aquifer, which would threaten all of the City of Santa Cruz's existing wells as well as a coastal production well operated by SqCWD.

- Soquel Creek and Aptos Creek Paleochannels. The paleochannels of Aptos Creek and Soquel Creek have been mapped offshore of the Soquel-Aptos Area Basin by Eittreim et al. (2000, 2002). These paleochannels potentially cut into the aquitards that protect the lower aquifers, providing a shortcut for seawater to seep into the Purisima aquifers. (**Figure 3-12**)

3.6.2 Seawater Intrusion in the Aromas Red Sands

Seawater intrusion is currently not detected in production wells in the Aromas Red Sands; however, water quality data from coastal monitoring wells suggest ongoing seawater intrusion in the vicinity of Seascape (**Figure 3-26** and **Figure 3-27**). This intrusion results from regional pumping rates that are not sustainable. Johnson et al. (2004) estimated that in light of total current extractions by all production wells in this area, pumping reductions by SqCWD of at least 100 afy from the Seascape well, and additional pumping reductions of at least 100 afy from the combined Bonita and San Andreas wells are necessary to help prevent the saltwater wedge's landward advancement. Within the context of an overall regional solution to address overdraft in the Aromas Red Sands, SqCWD's goal is to reduce production from this aquifer by an estimated 400 afy to meet its sustainable yield goal of no more than 1,800 afy.

Seawater intrusion has continued despite recent pumping reductions in the Aromas Red Sands initiated by SqCWD and validates the theory presented by Johnson et al. (2004) that intrusion appears to result from general overuse of the Aromas Red Sands, rather than pumping by any one entity.

3.7 Manmade (Anthropogenic) Contamination

MTBE and PCE are manmade contaminants that have been identified within the Soquel-Aptos groundwater management area which could jeopardize the groundwater supply. Methyl Tertiary butyl ether (MTBE) is a gasoline additive that has been used since the late 1970s to help reduce automobile emissions. It is highly water-soluble and has contaminated approximately 20% of the nation's urban wells.

MTBE cleanup efforts were performed in 2001 within SqCWD's service area. SqCWD retained a consultant to oversee the remediation and establish a work plan to provide protection to the nearby wells in Service Area I. Contamination is still being monitored.

Water resources agencies within the Soquel-Aptos area each have Drinking Water Source Assessment and Protection (DWSAP) reports which identify potential sites for manmade contamination. The City of Santa Cruz has already identified a large TPH (total petroleum hydrocarbons) plume in the Live Oak area and recently PCE (Perchloroethylene) has been detected in monitoring wells with levels near 3000 ppb. PCE is a chemical associated with dry cleaners which can persist for decades, and the RWQCB has yet to identify a source for this plume.

3.8 Historical and Ongoing Basin Management Activities

SqCWD, CWD, and other governmental agencies have actively studied, monitored, and managed the Soquel-Aptos Area Groundwater Basin for over 40 years, beginning with the initial USGS investigation (Hickey, 1968). Management activities have included regular groundwater level and quality monitoring from production wells and dedicated monitoring wells, developing water conservation programs, practicing pumping management and redistribution, developing groundwater management plans, and developing conjunctive use plans.

3.8.1 Groundwater Monitoring

Both groundwater levels and groundwater quality are monitored with a network of dedicated monitoring wells operated by SqCWD, CWD, and the City of Santa Cruz. The monitoring well network focuses on the coast, but also includes inland wells. **Figure 3-25** illustrates the groundwater monitoring network with respect to the locations of the municipal production wells for the above mentioned agencies.

Other monitoring activities conducted in the Soquel-Aptos area by SqCWD include monitoring baseflow conditions using stream gauges along Soquel Creek, establishing rainfall-runoff relationships via rain gauges in the area, and estimating stream-aquifer interaction based on the shallow well monitoring along Soquel Creek. More detailed descriptions of these activities are included in Section 5 of this Plan.

3.8.2 Water Conservation Efforts

Both SqCWD and CWD have implemented water conservation measures to reduce demand. In 1997, a water conservation program analysis was developed as part of the SqCWD's long-term supply planning and Integrated Resources Plan (IRP) and was updated in 2006 (ESA, 2006). Projected water savings range from 300 afy (6% of demand) in 2005 to 910 afy (16% of demand) in 2030 if conservation measures and programs are in place. Since 1997, SqCWD has adopted numerous conservation programs including a tiered rate structure, rebates on water efficient appliances, indoor and outdoor water use surveys, extensive public outreach and school education, and the water demand offset program.

CWD has implemented water conservation strategies through metering and tiered pricing. All connections in the CWD service area are metered, and CWD has adopted a policy to provide only one standard service connection and meter per parcel. Additional housing units and large multi-family housing are limited to usage as determined by meter flow capacity.

More detailed descriptions of the above mentioned water conservation efforts are included in Section 5 of this Plan.

3.8.3 Wellfield Expansion and Pumping Management

The existing SqCWD and City of Santa Cruz well fields are heavily concentrated along the coast, and have limited flexibility to distribute pumping (**Figure 3-25**). SqCWD has historically modified its pumping distribution based on suggestions from consultants (Luhdorff & Scalmanini, 1995) in order to minimize unwanted pumping impacts. The limited system flexibility, however, constrains SqCWD's ability to redistribute pumping. SqCWD is currently working on a Well Master Plan to expand its existing wellfield and move pumping inland away from the critical coastal areas as well as reduce pumping depressions at specific locations. The City of Santa Cruz is also considering options for redistributing its groundwater production more inland and.

The CWD's well fields are relatively inland compared to the SqCWD and City of Santa Cruz Wellfields (**Figure 3-25**). As with the SqCWD well field, the CWD well fields have limited flexibility, but the threat of seawater intrusion from pumping these wells is minimal. Therefore pumping management is less critical for the CWD well fields.

3.8.4 Interagency Coordination of Groundwater Management

In 2005, the Soquel-Aptos Groundwater Management Alliance (SAGMA) was formed by SqCWD, the City of Santa Cruz, County of Santa Cruz, and CWD to coordinate and support groundwater management efforts undertaken by all four agencies. (See Appendix B). Under the SAGMA cooperative agreement, the agencies meet on a regular, ongoing basis to cooperatively improve the overall health and management of the over-drafted Soquel-Aptos groundwater area.

In June 2006, the General Managers from CWD and SqCWD and the Principal from HydroMetrics LLC met with Brian Smith, Section Chief from Department of Water Resources, San Joaquin Regional Office, for an all day informational meeting/tour to give an overview of the Soquel-Aptos area and to illustrate the concerns regarding protecting this coastal basin.

3.8.5 Development and Implementation of a Groundwater Management Plan and Integrated Resources Plan.

In 1996, SqCWD and CWD jointly adopted the *AB3030 Ground-water Management Plan, Soquel-Aptos Area* (Luhdorff and Scalmanini, 1996). The GMP was produced under the authority of Assembly Bill 3030, and the subsequent incorporation of the provisions of AB3030 into the California Water Code. The general purpose of the GMP was to implement a more regional groundwater management program by coordinating management activities between districts, and to formalize and expand existing groundwater management activities.

In 2006, SqCWD adopted the *SqCWD Integrated Resources Plan* (ESA, January 2006). This plan details the water supply problems in the Soquel-Aptos area, identifies potential supplemental water supplies, and develops the basis of a conjunctive use program.

3.8.6 Conjunctive Use Supply Planning

SqCWD began preparation of its Integrated Resources Plan (IRP) in 1997 with the formation of a Public Advisory Committee (PAC). Through the PAC process and subsequent expanded evaluation, SqCWD identified and investigated a number of conjunctive use options including ocean and brackish water desalination, on-stream reservoir and off-stream diversion on Soquel Creek, recycled water for non-potable and potable indirect reuse, surface supply from the City of Santa Cruz, and imported supply. Most options were found to be fatally flawed. The three options that emerged as the most viable conjunctive use alternatives are described in the final *Integrated Resources Plan* (ESA, 2006). They are:

- a joint desalination project with the City of Santa Cruz
- a water import/groundwater banking project with Pajaro Valley Water Management Agency (PVWMA) and the City of Watsonville,
- a diversion project along Soquel Creek

The import/banking project with PVWMA and the off-stream diversion project are considered less feasible than the regional desalination project. In July 2005, PVWMA decided to re-evaluate the import pipeline option, thereby postponing that project for several years. The diversion project was determined not to be a viable option due to complexities regarding permitting, a high degree of uncertainty regarding yield due to potential variability of the required fish bypass as the result of changing channel conditions, suitable land acquisition, stream flow volatility, and groundwater injection issues.

The proposed regional desalination project consists of a 2.5 million gallon per day (mgd) ocean water desalination plant located in the City of Santa Cruz. SqCWD would operate the desalination plant to alleviate pumping demands in the Soquel-Aptos area during normal and wet years as well as off-peak periods in drought years. In dry years, SqCWD would rely on existing groundwater supplies, and the City of Santa Cruz would operate the desalination plant to supplement their surface water supplies.

Element 5: Develop a Supplemental Source of Supply discusses the above mentioned conjunctive-use options in more detail.

3.8.7 Integrated Regional Water Management Plan (IRWMP)

Collaborative efforts between Northern Santa Cruz County water resources agencies resulted in the development of an *Integrated Regional Water Management Plan* (IRWMP) and Proposition 50, Chapter 8 first round grant application (Kestrel Consulting, 2005 and 2006) to help address serious challenges regarding water supply, water quality, and environmental protection. Partner agencies in the preliminary IRWMP are the County of Santa Cruz, Santa Cruz County Resource Conservation District, Soquel Creek Water District, Scotts Valley Water District, Santa Cruz County Sanitation District, and Davenport Sanitation District. Other agencies participated in preparing the IRWMP, including Central Water District, the City of Santa Cruz, City of Watsonville, Community Foundation of Santa Cruz County, and Watsonville Wetlands Watch.

The IRWMP is a vehicle to strengthen efforts for truly integrated water management within the region covered by the Plan. Through the IRWMP preparation process, 17 high priority projects were identified for potential funding assistance in the 2006 IRWMP grant program. While the Northern Santa Cruz County application was not selected for funding in the first round, five projects that would directly benefit the Soquel-Aptos Area Basin may be included in future IRWMP grant applications. They are as follows:

1. Abandoned Well Destruction Program
2. Enhance and Protect Primary Groundwater Recharge Zones
3. Engineering for Regional Ocean Desalination Project
4. Polo Grounds Well, Treatment Plant, Pipelines and Water Conservation Project
5. Groundwater Monitoring Wells in the Aromas and Purisima Formations

3.9 Key Basin Management Issues

Key basin management issues include the obstacles to groundwater development, and the impacts from current groundwater use that must be addressed in the Goals, Objectives, and Elements of this Groundwater Management Plan. Key basin management issues in the Soquel-Aptos area include the following:

- Avoiding overdraft
- Identifying and preventing seawater intrusion
- Avoiding stream baseflow depletion
- Preserving groundwater quality
- Planning for and meeting future increases in demand
- Ensuring continued water supply reliability
- Avoiding land subsidence

For purposes of this Groundwater Management Plan, basin management goals are statements of broad principles that express a desired result. Basin management objectives are specific, verifiable, or quantifiable accomplishments or results that support the basin management goals.

4.1 Basin Management Goals

Groundwater management goals express the desired state of the groundwater basin in qualitative terms. These groundwater management goals provide the foundation for the more specific basin management objectives discussed in Section 4.2. This GMP identifies three groundwater management goals:

GOAL 1: ENSURE WATER SUPPLY RELIABILITY FOR CURRENT AND FUTURE BENEFICIAL USES

The primary function of both the SqCWD and CWD is to provide adequate quantities of water for residential, commercial, institutional, agricultural, and fire suppression uses within their respective service areas. Ensuring that adequate water supplies are available to meet these various demands must therefore be one of the primary goals of this groundwater management strategy. Aspects of guaranteeing water supply reliability include optimizing the use of existing resources, reducing demand for groundwater, and maintaining or enhancing groundwater recharge and storage.

GOAL 2: MAINTAIN WATER QUALITY TO MEET CURRENT AND FUTURE BENEFICIAL USES

The Water Quality Control Plan (Basin Plan) developed by the Central Coast RWQCB (1994) establishes water quality objectives for groundwater throughout the Central Coastal Basin based on the beneficial uses of the groundwater. These uses, in turn, establish water quality standards as well as the level of treatment necessary to maintain the regulated standards. For the primarily residential, commercial and institutional beneficial uses supplied by SqCWD and CWD, water quality objectives of taste, odor, bacteria, and CCR Title 22 chemicals and radionuclides are applicable. Irrigation also requires water of suitable quality with respect to constituents such as salinity, sodium and boron.

From a financial perspective, maintaining high quality groundwater in the Basin is more cost-effective than treating groundwater after it has been extracted from the Basin. Implementing policies and procedures to effectively manage groundwater quality in the Basin will prevent expensive future treatment costs.

GOAL 3: PREVENT ADVERSE ENVIRONMENTAL IMPACTS

Human use of groundwater can unfortunately cause adverse impacts on riparian and aquatic ecosystems. These can include: changes in water quantity, such as depletion of stream baseflow; degradation of quality, such as discharge of pollutants or increased temperature into surface waterways; and land subsidence. A goal of this GMP is to manage groundwater such that adverse impacts on the environment do not occur.

4.2 Basin Management Objectives (BMOs)

Basin Management Objectives (BMOs) are specific criteria defining the desired state of the basin. They provide a mechanism for determining whether groundwater management goals are being achieved. They are verifiable and are ideally quantifiable. BMOs adopted for this GMP are listed below, organized by groundwater management goal. **Table 4-1** summarizes the relationship between the basin management goals and the basin management objectives in this GMP.

GOAL 1: Ensure Water Supply Reliability

BMO 1-1: Pump Within the Sustainable Yield

Verifiable actions and targets

- Reduce pumping to the estimated sustainable yield
- Update sustainable yield estimates as data become available
- Increase conservation efforts to reduce demand
- Promote recharge efforts
- Reduce demand by limiting new service connections, if necessary

BMO Description

Sustainable yield is defined as the maximum quantity of water that can be withdrawn annually from a groundwater basin without causing undesirable impacts. Undesirable impacts might include insufficient drought reserves, reduced well pumping capacities, reduced streamflows, or seawater intrusion. Based on the current understanding of the Soquel-Aptos Area Basin, the total sustainable yield is assumed to be no more than 6,200 afy in the Purisima Formation and no more than 3,200 afy in the Aromas Red Sands (Johnson et al, 2004, pg 8-8). Within the context of an overall regional solution to address overdraft of the Soquel-Aptos basin, SqCWD has set a goal to reduce its pumping to no more than 4,800 afy: no more than 3,000 afy from the Purisima Formation and no more than 1,800 afy from the Aromas Red Sands. SqCWD has been pumping in excess of these target objectives over a number of years, contributing to the basinwide pumping impact that has created a state of overdraft. CWD's annual pumping of 143 afy in the Purisima Formation and 479 afy in the Aromas Red Sands currently meets their target objectives for pumping within the localized sustainable yield. Assuming the total cumulative withdrawal from the basin does not exceed current estimates, SqCWD's plans to lower its annual groundwater production to no more than 4,800 afy are expected to essentially bring the basin into balance.

BMO Contribution to Reliability of Long Term Beneficial Uses

This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by preventing depletion of the groundwater resource that could lead to seawater intrusion, and increased pumping costs.

Elements Associated with BMO

Management actions that will help achieve this BMO include:

- Element 1: Groundwater Monitoring
- Element 2: Surface Water Monitoring
- Element 4: Interagency Coordination
- Element 5: Develop a Supplemental Water Supply

- Element 8: Manage Pumping
- Element 9: Identify and Manage Cumulative Impacts
- Element 10: Water Conservation and Re-use
- Element 13: Public Education
- Element 14: Improve Groundwater Basin Management Tools

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

BMO 1-2: Develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demand

Verifiable actions and targets

- Obtain supplemental water supply for SqCWD
- Build infrastructure to distribute supplemental source of supply for current and future projections.

BMO Description

A supplemental water supply is needed to prevent overdraft and meet BMO 1-1. Pursuit of a supplemental water supply has been a primary focus of SqCWD since the mid 1990s. The SqCWD intends to develop a supplemental water supply capable of reducing annual groundwater withdrawals to approximately 500 acre-feet less than its targeted sustainable yield (4,300 afy), in order to facilitate the recovery of groundwater levels. The needed supplemental supply is calculated from the future demand less the anticipated groundwater supply. *SqCWD's Integrated Resources Plan* (ESA, 2006, Table 23) projects demands and the anticipated groundwater supplies from the combined Purisima Formation and the Aromas Red Sands for years 2010-2050, as shown in the following table.

Table 4-2
Anticipated Future Pumping by SqCWD in the Soquel-Aptos area

Year	SqCWD Average Demand[1] (afy)	SqCWD Groundwater Supply[2] (afy)	SqCWD Supplemental Supply Needed (afy)
2002-2005 (average)	5,400	5,400	Not Available
2010	5,210	5,210	Not Available
2015	5,320	4,300	1,020
2020	5,430	4,300	1,130
2025	5,535	4,400	1,135
2030	5,640	4,500	1,140
2035	5,750	4,575	1,175
2040	5,860	4,650	1,210
2045	5,970	4,725	1,245
2050[3]	6,080	4,800[4]	1,280

1 Demand after implementing conservation measures

2 Once a supplemental supply project is on-line (estimated 2012), groundwater supply is shown less than sustainable yield through 2045 to allow water level recovery and groundwater storage via in-lieu recharge

3 Buildout for SqCWD is estimated to occur in 2050

4 SqCWD's goal is to reduce its pumping to no more than 4,800 afy in the context of an overall regional solution to address overdraft in the Soquel-Aptos basin.

CWD anticipates low to moderate growth through 2020 and, with increased conservation efforts and potential restrictions on irrigation services, the average demand will be no greater than 650 afy. Thus, CWD's projected demands do not warrant a supplemental supply project for their future needs.

SqCWD's preferred project to provide this supplemental supply is partnering with the City of Santa Cruz to develop a regional seawater desalination facility. In non-drought years and off-peak periods in drought years, all or a portion of the desalination supply would be available for SqCWD to meet this objective. Additional supplemental supply options could also be explored to enhance SqCWD's ability to meet this objective. These additional supply options include:

- Site-specific recycled water supplies for irrigation
- Soquel Creek diversion project
- Local-only desalination

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by replacing a portion of the current groundwater withdrawals with imported water. This will in turn prevent long-term depletion of the groundwater resource.

Elements Associated with BMO
Management actions that will help achieve this BMO include:

- Element 4: Interagency Coordination
- Element 5: Develop a Supplemental Water Supply
- Element 10: Water Conservation and Reuse
- Element 13: Public Education

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

BMO 1-3: Manage groundwater storage for future beneficial uses and drought reserve

Verifiable actions and targets
- Raise groundwater levels by storing additional water underground through in-lieu recharge
- Reduce pumping to below the sustainable yield
- Investigate groundwater recharge potential for future beneficial uses.

BMO Description
Water supply reliability and flexibility can be improved by storing water for future use. In-lieu or active recharge of groundwater aquifers may provide adequate storage for this purpose. This stored supply can help meet demand during droughts or water supply emergencies. Achieving this objective is likely to depend on first achieving BMO 1-1 and BMO 1-2 since storing surplus water will not be possible without first eliminating overdraft conditions and developing alternative supplies. The most likely means of storing water is through in-lieu recharge: using alternative supplies during normal and wet periods, thereby allowing natural recharge to remain stored in local aquifers. The quantifiable objective is to store a volume of water that can be accessed during a drought, when the supplemental supply developed under BMO 1-2 is unavailable.

The most likely area for storing water in the Soquel-Aptos area is in the offshore extensions of the deeper Purisima aquifers. Williams (2004) showed that the relatively large quantity of water in the offshore aquifers has been the source of a portion of the water pumped by the SqCWD. Fresh water removed from the offshore aquifers has been replaced by seawater. Sufficient

amounts of in lieu recharge could slowly replace the fresh water in the offshore aquifers, pushing the seawater farther away from the coastline.

The groundwater storage potential in the Aromas Red Sands portion of the Soquel-Aptos area is currently unknown. Although the recharge potential of the Aromas Red Sands is significant – substantial areas are designated primary recharge zones – the volume of aquifer available for storage is uncertain. Water levels in the Aromas aquifers beneath CWD are already relatively high, however there may be opportunities for additional groundwater mounding in some inland areas. Offshore groundwater storage in the Aromas aquifers is assumed to be limited because the aquifers are semi-confined to unconfined, and likely discharge fresh water to the ocean relatively close to the shore. Very few studies have been conducted which evaluate potential storage possibilities within the Aromas Red Sands; additional studies may highlight further storage opportunities.

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by preventing long-term depletion of the resource. The long term beneficial use of groundwater is also enhanced if more groundwater is available during drought periods, because alternative supplies are less likely to be available during these periods.

Elements Associated with BMO
Management actions that will help achieve this BMO include:

- Element 1: Groundwater Monitoring
- Element 4: Interagency Coordination
- Element 5: Develop a Supplemental Water Supply
- Element 6: Protect Existing Recharge Zones
- Element 7: Enhance Recharge
- Element 8: Manage Pumping
- Element 9: Identify and Manage Cumulative Impacts

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

GOAL 2: Maintain Adequate Water Quality

BMO 2-1: Meet existing water quality standards for beneficial uses, such as drinking water standards.

Verifiable actions and targets
- Compare regular groundwater monitoring results to water quality targets

BMO Description

The intent of this BMO is to ensure that local groundwater quality meets the numerical water quality objectives of the Central Coast basin plan and all other regulatory requirements. These water quality objectives include criteria for taste, odor, bacteria, and chemical concentrations that meet drinking water standards. The CCR Title 22 drinking water standards (MCLs) that make up this BMO are listed on the CA Dept. of Health Service's Website (http://www.dhs.ca.gov). The groundwater produced by SqCWD and CWD currently meets all water quality objectives with the exception of iron and manganese. Additionally, water produced by CWD does not always meet the water quality objective for color. Iron and manganese levels are naturally high in the Purisima Formation water so SqCWD treats that water for iron and manganese and the CWD blends water from the Purisima Formation with lower iron and manganese water from the Aromas Red Sands Aquifer. The secondary drinking water standards (SMCLs) for iron, manganese, and color are 0.30 mg/L, 0.050 mg/L, and 15 color units, respectively.

The water quality objective for the Purisima Formation is to maintain all water quality parameters at or below drinking water standards except for iron and manganese. Water produced from the Aromas Red Sands aquifer currently meets all drinking water standards and the objective for this aquifer is to maintain this status.

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater because a deterioration of groundwater quality could result in a portion of the water supply becoming unusable.

Elements Associated with BMO
Management actions that will help achieve this BMO include:

- Element 1: Groundwater Monitoring
- Element 12: Well Head Protection Measures

These actions in the form of projects, programs, and policies are the elements discussed in detail in Section 5.

BMO 2-2: Maintain groundwater levels to prevent seawater intrusion

Verifiable actions and targets
- Establish target water levels adequate to prevent seawater intrusion
- Monitor groundwater levels and compare with the target levels
- Monitor groundwater quality for TDS and Chlorides

BMO Description
A consequence of overdraft in this coastal basin is the risk of seawater intrusion, which can rapidly cause water supply wells to become unusable due to high salinity. Seawater intrusion can be prevented if groundwater levels are high enough to prevent seawater from flowing towards pumping wells. Groundwater level monitoring results, along with historical evidence of seawater intrusion in the basin, indicate that groundwater levels are not consistently high enough to maintain an adequate seaward gradient.

The quantifiable objective of this GMP is to raise groundwater levels sufficiently to prevent seawater intrusion. Groundwater levels protective of seawater intrusion will depend on local geologic and hydrogeologic conditions. Groundwater levels near sea level may not be sufficient to prevent the advancement of the saltwater wedge because saltwater is denser than fresh water. The water levels that will make up this quantifiable objective will be higher than seawater levels. An analysis will be performed to establish these objective water levels based on density differences and the geology of the aquifers.

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by ensuring that local groundwater aquifers remain a fresh water resource that is suitable for the beneficial uses, most prominently domestic use.

Elements Associated with BMO
Management actions that will help achieve this BMO include:

- Element 1: Groundwater Monitoring
- Element 4: Interagency Coordination
- Element 8: Manage Pumping
- Element 9: Identify and Manage Cumulative Impacts
- Element 14: Improve Groundwater Basin Management Tools, specifically establishing target groundwater levels for preventing seawater intrusion

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

BMO 2-3 Prevent and monitor contaminant pathways

Verifiable actions and targets
- Support and help implement the County well abandonment ordinance
- Continue to update the Drinking Water Source Assessment Program (DWSAP) Reports to reflect current status/activities.

BMO Description

There are potential sources of groundwater contamination overlying many parts of the basin. One strategy for decreasing the risk of contamination is eliminating natural and artificial pathways for downward movement of contaminants. One such pathway is well casings and gravel packs that function as conduits for rapid movement of shallow groundwater to deeper aquifers used for water supply. It is the objective of this GMP to eliminate contaminant pathways that may harm the water quality of the groundwater resource.

Santa Cruz County has a well abandonment ordinance included in Section 7.70.100 of the County's code. This ordinance includes requirements for maintenance of inactive wells, destruction of abandoned wells by methods described in Bulletins 74-81 and 74-90 with County specific amendments, and the requirement that defective wells be destroyed. Additionally, SqCWD has adopted a policy requiring that any existing wells serving a property must be destroyed according to state and local regulations as a condition of service.

Although these policies help identify and properly destroy some wells, older wells likely exist that continue to be a potential contaminant pathway. While there is no current program to actively seek out inactive, abandoned, and defective wells in this GMP area, Santa Cruz County Environmental Health Services has recently been working to create a County Well Database using GIS technology to map well locations based on DWR Driller Logs and is seeking potential funding to assist property owners with destruction costs of abandoned wells via Proposition 50 water bond funds. The County also received an EPA grant to inventory potential shallow injection wells, including abandoned wells. This work is scheduled to be completed by Summer 2007.

Streambeds represent another potential contamination source. Runoff from streets, parking lots, or municipal areas may enter the stream and seep into aquifers. Chemical spills or other discharges into the streams may similarly impact groundwater quality. The SqCWD ongoing stream monitoring program can be used to identify stream discharge areas, and these areas could be monitored for water quality constituents.

A further strategy for minimizing contamination is to inventory potential sources of contamination in the basin, particularly ones in close proximity to wells or areas of rapid recharge. This activity is typically conducted under the California Department of Health Services' Drinking Water Source Area Protection (DWSAP) program and can be characterized more generically as wellhead protection measures.

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by helping prevent contamination of the groundwater supply. Meeting this BMO will help SqCWD and CWD accomplish BMO 2-1, and achieve the overall goal of maintaining water quality for beneficial uses.

Elements Associated with BMO
Management actions that will help achieve this BMO include:

- Element 2: Surface Water Monitoring
- Element 11: Policies and Ordinances for Well Construction, Abandonment, and Destruction
- Element 12: Well Head Protection Measures

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

GOAL 3: Prevent Environmental Impacts

BMO 3-1: Maintain or Enhance the Quantity and Quality of Groundwater Recharge by participating in land use planning processes.

Verifiable actions and target
- Support Santa Cruz County efforts to protect and enhance groundwater recharge zones

BMO Description
Activities that affect the quality of recharge, such as land-use decisions, can affect the groundwater resource. It is the objective of the GMP to address issues related to the management of groundwater recharge and prevent activities or types of development in recharge areas that might increase the risk of reducing or contaminating recharge zones.

Previous investigations have reached different conclusions regarding the location of groundwater recharge to the Purisima Formation. Santa Cruz County has mapped groundwater recharge areas based on an assumption that most recharge occurs where streams cross the outcrop areas of individual Purisima aquifers (See Figure 5-3). Johnson and others (2004) noted that streams in the area are almost all gaining streams and that groundwater hydrographs suggest a diffuse movement of water from shallow and upland areas to deeper zones in the coastal plain that are tapped by water supply wells. Additional analysis is needed to determine the relative importance of these two recharge mechanisms and the appropriate geographic extent of recharge quality protection measures.

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater because the quantity and quality of groundwater available over the long term depends on the quantity and quality of groundwater recharge.

Elements Associated with BMO
Management actions that will achieve this BMO include:

- Element 4: Interagency Coordination
- Element 6: Protect Existing Recharge Zones
- Element 7: Enhance Recharge

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

BMO 3-2: Avoid alteration of stream flows that would adversely impact the survival of populations of aquatic and riparian organisms

Verifiable actions and targets
- Monitor and analyze shallow groundwater levels near streams
- Monitor and analyze streamflow

BMO Description
Groundwater extraction can deplete baseflow in streams by intercepting groundwater that would otherwise seep into the stream (in gaining stream reaches) or by increasing the rate at which water seeps out of streams (in losing stream reaches). Baseflow depletion decreases the total amount of aquatic habitat, interferes with migration of anadromous fish, and tends to increase water temperature. It is the objective of the GMP to prevent groundwater extraction from altering streamflows in a manner that would have a significant adverse biological effect. A required streamflow of 3 cfs has been established for flow entering the Lagoon of Soquel Creek in the Soquel Creek Adjudication (Decree No. 57081, Superior Court of the State of CA for the County of Santa Cruz, 1977). In lieu of such an objective for other locations, this BMO is to maintain baseflow depletion levels below current detection levels.

Pumping aquifers adjacent to Soquel Creek and other streams may induce downward leakage from the streams. No previous investigation, however, has established a discernable pumping-related depletion in Soquel Creek. Johnson et al. (2004) concluded that historical baseflow depletion at the Main Street gage on Soquel Creek has been less than 0.5 cfs. This fits the conceptual model for the stream-aquifer system where the hydraulic connection between Soquel Creek and deep aquifers in the Purisima Formation is weak and slow, and the impact from historical pumping has been smaller than effects of other factors such as precipitation.

Currently, available data appear insufficient to determine whether this BMO is being achieved because of the large number of factors affecting stream baseflow. Only one streamflow gage is presently operating in a reach likely to be impacted by pumping, and some streams, such as Rodeo Creek and Arana Gulch, are not gauged at all. The SqCWD has installed a number of shallow groundwater wells adjacent and in Soquel Creek to help estimate the groundwater/surface water interaction. These shallow wells have not discerned any pumping related streamflow depletions to date. Long-term monitoring of streamflow, shallow and deep groundwater levels at multiple locations along Soquel Creek, Aptos Creek and other major streams could be necessary to reliably detect pumping-induced changes in baseflow.

Part of this BMO is to monitor and collect background information about streamflow that will protect against a significant adverse biological effect. In the interim, this BMO is to maintain baseflow depletion levels below current detection thresholds.

BMO Contribution to Reliability of Long Term Beneficial Uses
This BMO achieves Goal 3 by directly addressing the most likely mechanism for adverse environmental impacts related to groundwater use.

Elements Associated with BMO
Management actions that will achieve this BMO include:

- Element 2: Surface Water Monitoring (Streamflow and Shallow Groundwater Levels Near Streams)
- Element 4: Interagency Coordination
- Element 8: Manage Pumping
- Element 9: Identify and Manage Cumulative Impacts
- Element 14: Improve Groundwater Basin Management Tools

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

BMO 3-3: Protect the structure and hydraulic characteristics of the groundwater basin by avoiding withdrawals that cause subsidence

Verifiable actions and target
- Monitor changes in ground surface elevation

BMO Description
Declining groundwater levels can result in compaction of clay layers in the aquifer system due to the decrease in interstitial pore water pressure. The resulting lowering of the land surface, known as subsidence, can change gradients in streams and pipes, and cause flooding and structural damage to roads, bridges, and buildings. It is the objective of the GMP to prevent subsidence caused by groundwater extraction.

Subsidence has not historically been detected in the basin. There is currently no program to monitor for subsidence since it is unlikely due to the fact that the ocean boundary prevents groundwater levels from dropping too low. If subsidence is detected, it may be necessary to decrease groundwater withdrawals so that water levels remain above the level at which subsidence is initiated.

BMO Contribution to Reliability of Long Term Beneficial Uses
Meeting this BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater because, like seawater intrusion, subsidence could potentially constrain the sustainable groundwater yield.

Elements Associated with BMO
Management actions that will achieve this BMO include:

- Element 3: Subsidence Monitoring
- Element 8: Manage Pumping

These actions in the form of projects, programs, and policies are discussed in detail in Section 5.

Element 1: Groundwater Monitoring

Brief Description:	Groundwater monitoring assists with managing pumping, provides early detection of seawater intrusion, corroborates groundwater storage efforts, and assists with estimating stream-aquifer interactions. SqCWD and CWD maintain groundwater monitoring programs with dedicated monitoring wells that are frequently tested and evaluated. These programs will be continued and expanded, and data coordination among all local agencies in the Soquel-Aptos Area Basin will be enhanced.
Required:	Yes (CWC, § 10753.7 (a) (1 and 4)) Mandatory Component # 3 (Refer to Table 1-1)
Type:	Program and Project
Status:	On-Going

Detailed Description:

Groundwater monitoring assists with managing pumping, provides early detection of seawater intrusion, corroborates groundwater storage efforts, and assists with estimating stream-aquifer interactions. Groundwater Monitoring is used to track changes and establish trends for the purpose of meeting the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield.
- BMO 1.3 - Store water for future beneficial uses and drought reserve.
- BMO 2.1 - Maintain existing water quality standards for beneficial uses, such as drinking water standards.
- BMO 2.2 - Maintain groundwater levels to prevent seawater intrusion.

As part of this Groundwater Management Plan, the following action items have been identified for the groundwater monitoring element:

1. **Continue and Expand Existing Regional Groundwater Monitoring Programs.**

   Both the SqCWD and CWD maintain regional groundwater monitoring programs. These programs are specifically designed to identify trends and changes in groundwater elevation and quality, and support the BMOs in this Groundwater Management Plan. The regional monitoring programs rely on an extensive network of dedicated monitoring

wells and production wells, as shown on **Figure 3-25**. Sampling frequency is shown on **Table 5-1**.

As data deficiencies are identified, the monitoring programs will be updated and expanded. This may entail analyzing for additional parameters or expanding the monitoring network. The SqCWD is currently expanding the monitoring well network, having identified four locations for new monitoring well clusters (**Figure 3-25**).

2. **Continue shallow Groundwater Monitoring Program.**
   SqCWD monitors water levels in shallow wells along Soquel Creek for the purpose of evaluating stream-aquifer interactions. This activity is described in detail in Element 2: Surface Water Monitoring

3. **Share and consolidate monitoring data among all agencies overlying the Soquel-Aptos Area Basin.**
   In addition to SqCWD and CWD, the Pajaro Valley Water Management Agency and City of Santa Cruz maintain groundwater monitoring programs in the Soquel-Aptos Area Basin. A complete understanding of groundwater conditions in the Basin relies on sharing data among all four agencies. Currently, data is shared in an ad-hoc manner. We will develop a formalized data sharing program that includes:

   - Data sharing schedule
   - Groundwater monitoring parameters to be shared
   - Minimum data accuracy requirements
   - Standardized software and data formats

4. **Analyze data and assess the adequacy of the monitoring well network annually.**
   Groundwater data are analyzed annually in support of a number of the elements in this Groundwater Management Plan. As part of the analysis, a determination of the adequacy of the existing monitoring programs will be developed. Recommendations for modifying or expanding the groundwater monitoring program will be included in the annual analysis.

5. **Coordinate with other groundwater resource agencies to develop uniform data collection procedures and data sharing protocols.**
   Standardizing groundwater monitoring protocols among all agencies in the Soquel-Aptos Area Basin could lead to a more consistent and easily analyzed data set. We will work to develop standard monitoring protocols that each local agency can adopt. These protocols will set minimum standards, but will be designed to not impose an unreasonable financial burden on any agency. Additionally, the County of Santa Cruz has an ongoing collaboration with local water resources agencies to create a GIS Well Layer which will include geographic location, driller's logs, and any supplemental data that exists for

municipal and private wells within the Santa Cruz County boundaries. This project is currently in its infancy stage, and SqCWD and CWD will continue to support these efforts.

6. **Develop an outreach program to obtain groundwater level data from private pumpers within the Soquel-Aptos area.**
   Prior to construction of the existing dedicated monitoring well network, nine (9) private well owners volunteered for water quality and levels to be periodically sampled. These private wells were not monitored after the construction of SqCWD's monitoring wells; however, the program could be resurrected or revisited, creating a new outreach program to private well owners. Sampling private wells, in conjunction with the existing monitoring well programs in place, will increase our knowledge of water quality and levels throughout the Soquel-Aptos area.

Element 2: Surface Water Monitoring

Brief Description: Surface flow and surface water quality can directly affect groundwater levels or quality. In addition, streamflows can be influenced by groundwater extractions, potentially impacting riparian and aquatic habitats. Surface water monitoring helps evaluate background conditions, the relationship between groundwater recharge and stream discharge, and the potential impacts of groundwater pumping on streamflow. SqCWD currently maintains two (2) stream gauges and two (2) rain gauges along Soquel Creek, participates in the USGS Stream Gauge Program, and collects data for its Shallow Well Monitoring Network. CWD does not presently perform any surface water monitoring.

Required: Yes (CWC §10753.7 (a) (1 and 4))
Mandatory Component # 3 (Refer to Table 1-1)

Type: Program and Project

Status: On-Going

Detailed Description:

Surface flow and surface water quality can directly affect groundwater levels or quality. In addition, streamflows can be influenced by groundwater extractions, potentially impacting riparian and aquatic habitats. Surface water monitoring helps evaluate background conditions, the relationship between groundwater recharge and stream discharge and the potential impacts of groundwater pumping on streamflow. Streamflow monitoring addresses the following Basin Management Objectives:

- BMO 1.1 - Pump within the sustainable yield.
- BMO 2.3 - Prevent and monitor contaminant pathways.
- BMO 3.2 - Avoid alteration of stream flows that would adversely impact the survival of populations of aquatic and riparian organisms.

As part of the Groundwater Management Plan, the following action items have been identified for surface water monitoring:

1. **Monitor Stream Gauges on Soquel Creek to identify and track changes in baseflow conditions.**

   Changes in baseflows may alter groundwater recharge and the sustainable yield and may impact riparian and aquatic habitats. Modifications to baseflows are often recognizable only by analyzing long-term data. Regular analysis of the stream data in coordination with other data described below, will allow SqCWD to modify pumping distributions if it appears as though pumping is impacting streamflows.

   SqCWD is already collecting stream data, and will continue to do so as part of this element. In the summer of 1983, SqCWD funded the installation of two stream gauges within the Soquel Creek watershed. **Figure 5-1** shows the locations of the stream gauges monitored by SqCWD and USGS within the Soquel-Aptos area. Data loggers record streamflow and temperature every 15 minutes, and the data are downloaded and converted to daily values once a month.

   Streamflow data are based on a stage-discharge rating at the gauges. The stage-discharge ratings for the gauges will be reevaluated if data indicate the stage-discharge relationship may have changed or events such as scouring or sediment deposition occur.

   In addition to the stream and rain gauges referenced above, SqCWD also financially contributes to a stream gauge under the USGS Cooperative Water Resources Program. Since 1994, SqCWD contributes one-fourth of the cost to operate and maintain the Soquel Creek Stream Gauging Station at Bridge Street. The location of the USGS stream gauge is also shown on **Figure 5-1**. Date from this USGS gauging station will be included in the analysis of streamflows described below.

2. **Monitor rainfall in the Soquel-Aptos Area Basin to establish rainfall-runoff relationship.**

   Rainfall data will be collected to establish and confirm rainfall-runoff relationships. SqCWD already collects rainfall data, and will continue to do so as part of this element. In the summer of 1983, SqCWD installed two recording rain gauges within the Soquel Creek Watershed. **Figure 5-1** shows the locations of the rain gauges monitored by SqCWD within the Soquel-Aptos Area Basin. Data loggers record rainfall every 15-minutes, and the data are downloaded and converted to daily average values once a month.

3. **Monitor selected shallow wells adjacent to creeks to identify and quantify stream aquifer interactions. Coordinate a meeting with SqCWD and the County of Santa Cruz to discuss future analysis of the shallow well monitoring data from 2003 – 2006.**

   Shallow groundwater levels are currently collected by the SqCWD to establish the interaction between shallow groundwater and Soquel Creek. Aspects of this interaction include the relationship between groundwater recharge and surface discharge and evaluating the potential for the stream to be a contaminant pathway. In 2001, SqCWD and the County of Santa Cruz collaborated in a Shallow Well Monitoring Program which included installing shallow piezometers adjacent to Soquel Creek to determine the impact of groundwater pumping on summer flows (baseflow). Four monitoring sites exist along the eastern side of Soquel Creek: (1) Nob Hill Shopping Center in Capitola, (2) SqCWD production well site on Main Street north of Soquel Drive, (3) private property of Mr. and Mrs. Balogh above the Soquel Nursery, and (4) the private property of Mr. and Mrs. Simons below Tiedemann Nursery. **Figure 5-1** shows the locations of these shallow monitoring wells.

   SqCWD has continuously collected data for these shallow wells, however, no analysis of the data has been performed since the Status Report and Initial Findings was presented in 2003.

4. **Analyze stream gauge data, rainfall data, and shallow monitoring data annually.** Data collected from the three monitoring programs identified above will be analyzed and reported annually. At a minimum, the annual analyses will include the following:

   - Identification of baseflow trends.
   - Identification of stream quality trends.
   - Identification of shallow groundwater level trends.
   - Identification of changes in the apparent stream-aquifer interaction.

5. **Support stream monitoring and management activities along Aptos Creek and Valencia Creek.**
   Soquel Creek is currently the only monitored stream in the Soquel-Aptos area. The Central Coast Regional Water Quality Control Board (RWQCB) has completed the Total Maximum Daily Load (TMDL) Preliminary Project Report for Sediment in Aptos Creek and Valencia Creek and is in the process of developing an Implementation Strategy. The TMDL relied on Swanson Hydrology and Geomorphology prior work completed for the Aptos Creek Watershed Assessment. This work indicated that bank erosion in Valencia Creek is vastly accelerated, and that the Creek is not able to recover. It is generally acknowledged by the area's water resource agencies that improving conditions in the Valencia Creek sub-watershed, especially in the upper reaches, would benefit

groundwater recharge and fisheries habitat. CWD and SqCWD will participate in interagency meetings regarding implementation of TMDL projects and programs in the Aptos Creek Watershed and support activities that correlate to groundwater recharge.

Element 3: Subsidence Monitoring

Brief Description:	Land subsidence is the gradual or sudden lowering of the land surface that can result from groundwater extraction. There are no current programs at either SqCWD or CWD to monitor land surface subsidence in the basin. SqCWD and CWD will undertake a program to develop a subsidence monitoring network.
Required:	Yes (CWC, § 10753.7 (a) (1 and 4)) Mandatory Component # 3 (Refer to Table 1-1)
Type:	Program and Project
Status:	Future

Detailed Description:

Land subsidence is the gradual or sudden lowering of the land surface resulting from groundwater extraction. There is no known anecdotal evidence of subsidence in the Soquel-Aptos Area Basin. According to the County of Santa Cruz, there have been no formal studies on subsidence in this region. However, ongoing extraction in the basin could cause future subsidence and a monitoring program should be implemented to meet the following Basin Management Objective:

- BMO 3.2 - Protect the structure and hydraulic characteristics of the groundwater basin by avoiding withdrawals that cause subsidence.

As part of this Groundwater Management Plan, the following action item has been identified for monitoring subsidence in the Soquel-Aptos Area Basin:

1. **Develop and implement a GPS based subsidence monitoring program.**

   SqCWD and CWD will develop a subsidence monitoring program. The program will consist of a set of benchmarked stations where land surface elevation is periodically measured, most likely by means of Global Positioning System (GPS) surveys. Using sophisticated satellite transponders in accordance with guidelines created by the National Oceanographic and Atmospheric Administration's National Geodetic Survey, ground elevation can be measured to within a few centimeters. GPS technology eliminates the need for stable ground-based reference stations, which may only be possible to establish some distance from the areas of interest.

The Soquel-Aptos Area subsidence monitoring will be coordinated with the California DWR's existing subsidence program. SqCWD and CWD will seek DWR's advice in designing, installing, and maintaining the monitoring network.

2. Analyze data and assess the frequency of the subsidence monitoring.

Elevations will initially be monitored every two (2) years. If no significant subsidence is observed after the first two years, monitoring will be conducted every five (5) years unless water levels at nearby wells fall below their historic minimum levels, at which point measurement frequency would be increased to once per year. Results of the subsidence monitoring will be included in the groundwater reports for SqCWD and CWD for that year.

3. Review other means of subsidence measuring and monitoring.

A relatively new technique, Permanent Scatters SAR Interferometry (PS-InSAR), has proven to be a powerful tool to explore subsidence with high accuracy (range of 0.5 mm/yr). Using the PS-InSAR technique, a large set of SAR images (generally more than 20) are used and stable pixels such as bridges or metallic objects on buildings are selected to determine small changes in elevation. PS-InSAR data have been used successfully by the U.S. Geological Survey in other basins to estimate subsidence. SqCWD and CWD will look into the possibility of using PS-InSAR as satellite data for measuring subsidence instead of a GPS based system.

Element 4: Interagency Coordination

Brief Description: Groundwater is the sole source of supply for the SqCWD, CWD and numerous mutual water companies and private well owners in the Soquel-Aptos area. Although a small percentage of its total supply, groundwater is also a crucial source of supply for the City of Santa Cruz, particularly during droughts. It is imperative that water agencies coordinate to manage the local groundwater resources. Interagency coordination involves fostering good working relationships with local, regional, state and federal agencies.

Required: No

Type: Program and Project

Status: On-Going

Detailed Description:

The Soquel-Aptos Area basin provides the sole source of water to customers of SqCWD, CWD, and numerous mutual water companies and private well owners. The City of Santa Cruz also relies on groundwater from wells located in the Soquel-Aptos Area Basin as a crucial water supply, particularly during droughts. Comprehensive projects, programs and policies developed to manage our groundwater are dependent on interagency coordination.

Coordinating interagency efforts supports the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield.
- BMO 1.2 - Develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demands.
- BMO 1.3 - Store water for future beneficial uses and drought reserve.
- BMO 2.2 - Maintain groundwater levels to prevent seawater intrusion.
- BMO 3.1 - Maintain or enhance the quantity and quality of groundwater recharge by participating in land use planning processes.
- BMO 3.2 - Avoid alteration of stream flows that would adversely impact the survival of populations of aquatic and riparian organisms.

The following action items have been identified as interagency coordination within the Soquel-Aptos Area Basin:

1. **Develop and secure a supplemental source of supply with the City of Santa Cruz.**

   SqCWD is currently partnering with the City of Santa Cruz to design, build, and operate a regional desalination plant. The plant will provide potable water to SqCWD during non-drought years and off-peak periods during droughts, allow for groundwater levels to recover, prevent the negative effects of salt water intrusion, and allow for groundwater storage via in-lieu recharge. The City of Santa Cruz will use desalinated water during high demand times in drought years, and SqCWD will rely on groundwater production only. This activity is described in detail in Element 5: Develop a Supplemental Source of Supply.

2. **Continue to cooperatively manage groundwater under the provisions of the Soquel Aptos Groundwater Management Alliance (SAGMA)**

   In 2005, SqCWD, CWD, City of Santa Cruz and County of Santa Cruz created the Soquel Aptos Groundwater Management Alliance (SAGMA) and entered into a cooperative agreement to responsibly manage the groundwater in the Soquel-Aptos area (Appendix B). Staff from each agency meets at least semi-annually to discuss operational plans for production wells, the County well mapping project, and the need to update the Soquel-Aptos Area GMP to reflect current groundwater conditions and management objectives. Most recently, SAGMA members served as part of the Technical Advisory Committee (TAC) to update the Soquel-Aptos area (AB3030) groundwater plan.

   SAGMA will continue to meet at least semi-annually to help create and oversee the projects, programs, and policies established to effectively manage the basin which includes the monitoring protocols as outlined in Section 5 of this GMP.

3. **Expand the Soquel-Aptos Groundwater Management Authority to include other water resource agencies that have jurisdiction within the Soquel-Aptos area.**

   The Soquel-Aptos Groundwater Management authority was established through a Joint Exercise of Powers Agreement between CWD and SqCWD (JPA). Under this Agreement, a groundwater management plan committee was established comprised of two representatives from SqCWD, two representatives from CWD and one representative served by a private well. The public agency members of the JPA represent the area subject to the provisions of this GMP.

   The Soquel-Aptos management area defined in this plan is based on watershed and jurisdictional boundaries as well as common water management issues (Figure 3-7). The Soquel-Aptos management area encompasses portions of other water resource agencies' jurisdictions. For example, the City of Santa Cruz operates the Live Oak Well Field

system (AKA Beltz Wells) within the Soquel-Aptos management area and maintains a monitoring well network along the coastline near Pleasure Point and the Live Oak area. The County of Santa Cruz is the regulatory agency that issues permits for both private and public wells, and oversees policies on private well construction, well destruction, groundwater recharge, and land use planning in the Soquel-Aptos management area.

Both the City of Santa Cruz and the County of Santa Cruz currently conduct their own groundwater management activities within the Soquel-Aptos area and participate in the SAGMA. Consideration will be given to expanding the Soquel-Aptos Groundwater Management Authority to include those portions of the designated management area that are outside CWD and SqCWD's jurisdictions in order to uniformly address basin challenges and strengthen ongoing integrated, regional groundwater management efforts.

4. Continue to support the USGS GAMA project and work cooperatively with USGS, State, and regional agencies to improve statewide monitoring.

The Groundwater Ambient Monitoring and Assessment Program (GAMA) is an ongoing comprehensive assessment of California's groundwater, intended to characterize constituents in the State's groundwater, and identify trends in groundwater quality. In 2005, private and public wells within the Soquel-Aptos area were tested by USGS Staff. The GAMA program intends to sample a subset of these wells every three years to establish groundwater quality trends. Establishing these trends provides important information on the Soquel-Aptos management area, and data from the GAMA project will be regularly incorporated into analyses of the basin status.

5. Continue to support the USGS Soquel Creek Stream Gauging Station

Under the USGS Cooperative Water Resources Program, SqCWD has contributed one-fourth of the cost to operate and maintain the Soquel Creek Stream Gauging Station at Bridge Street in Soquel since September 1994. The County of Santa Cruz also pays one-fourth of the cost.

The data is published annually, along with other stream gauge information throughout California, in the USGS Report titled "Water Resources Data- California". This report includes records on surface water data including (1) discharge records for streamflow-gauging stations and crest-stage partial-record streamflow stations, (2) stage and contents records for lakes and reservoirs, (3) water quality records for streamflow-gauging stations and partial-record stations, and (4) precipitation records for stations.

6. Continue to participate and support the Northern Santa Cruz County Integrated Regional Water Management Plan (IRWMP.)

The Preliminary Integrated Regional Water Management Plan (Kestrel Consulting, 2005) for Northern Santa Cruz County (IRWMP) has been prepared to coordinate water resources management efforts and to be eligible for grants for project implementation under Proposition 50, Chapter 8. The IRWMP addresses projects pertaining to water supply, water quality, and environmental protection. SqCWD and CWD both assisted in the development of the IRWMP. Seventeen high priority projects were identified in the Preliminary Integrated Regional Water Management Plan. Although funding was not received in the first round, these projects will be reconsidered for inclusion in future funding applications.

Five of these projects would benefit the Soquel-Aptos area basin:

1. Abandoned Well Destruction Program
2. Enhance and Protect Primary Groundwater Recharge Areas
3. Engineering for Regional Ocean Desalination Project
4. Polo Grounds Well, Treatment Plant, Pipelines, and Water Conservation Project
5. Groundwater Monitoring Wells in the Aromas and Purisima Formations

7. Support implementation of PVMWA's Basin Management Plan and PVWMA/City of Watsonville efforts to develop the Watsonville Area Water Recycling Project.

The Watsonville Area Water Recycling Project (Recycling Project) is a PVWMA project being built in partnership with the City of Watsonville. This is one of two major projects scheduled to be constructed by 2007 that, when completed, is projected to provide 4,000 afy of recycled water for coastal agriculture. The second major project, the Coastal Distribution System, is a series of pipelines that will deliver the recycled water, along with all future sources of new water, to farmlands in the areas intruded by saltwater.

8. Support PVMWA efforts to develop a numerical model of the Pajaro Valley groundwater basin.

SqCWD is currently providing data and technical assistance to the PVWMA's Groundwater Basin model and has authorized HydroMetrics LLC to serve as its representative on the groundwater model TAC. See 'Element #14, Improve Groundwater Basin Management Tools' for more information.

9. Support the Central Coast Regional Water Quality Control Board's (RWQCB) Implementation Strategy for the Aptos Watershed Sediment Total Maximum Daily Load (TMDL) Report.

Five local agencies including Soquel Creek Water District, Central Water District, County of Santa Cruz, Coastal Watershed Council and Santa Cruz County Resource Conservation District are working with the RWQCB and State Fish and Game to identify projects, programs and funding to reach mutual goals for water quality, water quantity, and fisheries habitat in the Aptos Watershed.

Element 5: Develop a Supplemental Source of Supply

Brief Description:	Hydrogeologic studies indicate that pumping from the Soquel-Aptos area basin currently exceeds the sustainable yield. SqCWD is actively pursuing the projects and programs outlined in the 2006 SqCWD Integrated Resources Plan, which includes a regional desalination plant with the City of Santa Cruz.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program and Project
Status:	Under Development

Detailed Description:

To ensure water supply reliability for current and future beneficial uses, SqCWD recently completed an *Integrated Resources Plan (IRP)* (ESA, 2006) which updates the components of the 1997 Draft IRP and incorporates new findings and recent project developments. A key component of the preferred alternative in the IRP is implementing conjunctive use with a supplemental water supply. Developing a supplemental water supply addresses the following BMOs:

- BMO 1.2 - Develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demands.
- BMO 1.3 - Store water for future beneficial uses and drought reserve.

As part of this Groundwater Management Plan, the following action items have been identified for developing a supplemental source of supply:

1. **Develop and secure a supplemental water supply suitable for implementing a conjunctive use program.**

   The supplemental water source must be adequate to develop a conjunctive use program of sufficient size that can serve two purposes:

   - Meet any supply shortfalls through the anticipated SqCWD buildout in 2050.
   - Increase groundwater levels through in-lieu recharge, correcting the existing overdraft problem.

Currently identified potential supplemental water supplies include the following:

Regional desalination plant - SqCWD is currently partnering with the City of Santa Cruz to design, build, and operate a regional desalination plant. This plant will provide potable water to SqCWD during non-drought years, offsetting a portion of the water pumped from the Soquel-Aptos Area Basin. The current conceptual plan is to provide SqCWD up to 2,000 afy on average of desalinated water. Several design and operational studies have already been completed for this project and include:

- City of Santa Cruz/Soquel Creek Water District Alternative Water Supply Study: Evaluation of Regional Water Supply Alternatives (Carollo Engineers in Association with Black and Veatch Engineers and Hopkins Groundwater Consultants, 2002)
- City of Santa Cruz Integrated Water Plan - Draft Final Report (Gary Fiske & Associates, 2003)
- City of Santa Cruz Draft Integrated Water Plan Program Environmental Impact Report (IWP PEIR), (EDAW, 2005)
- Soquel Creek Water District Integrated Resources Plan, (ESA, 2006)

Local Recycled Water Projects - There is currently no large-scale recycled water use in the SqCWD and CWD service areas, primarily because of the distance to the Santa Cruz Wastewater Treatment Plant. A sufficiently large market for recycled water has not been identified that would justify designing and building a new distribution system from the Santa Cruz Wastewater facility. However, new technologies may allow local recycled water projects to be implemented on a project-by-project basis. Satellite reclamation plants (SRP) reduce potable water demand by using water treated from a nearby sewer main for large-scale irrigation. SqCWD completed a preliminary feasibility study of potential SRP's within its service area. The most viable location for a SRP is Seascape Golf Course, which is currently irrigated by a private well. SqCWD recently submitted an application for State grant funds to conduct a planning study for a SRP.

SRPs are not an option for CWD because it is not serviced by municipal wastewater collection. However, other technologies are possible for local recycled water projects in CWD. A new housing development within CWD's service area (Parkhurst Terrace Apartments, formerly known as Golden Torch RV Park) will incorporate an advanced wastewater treatment facility using a multiple deep-pit leach system that will recharge treated water into the basin. The level of treatment will also allow for the water to be recycled for irrigating the apartment complex.

Local-Only Desalination Project - At this time, SqCWD is only considering the regional desalination project as the primary supplemental source of supply. However, if that project ultimately does not proceed, SqCWD may re-evaluate a local-only desalination

project. In 2000, SqCWD conducted a study to evaluate whether seawater from shallow beach wells could be used as feedwater for a desalination project that could produce up to 2 MGD. The report concluded that a local desalination project of this size was not feasible for a number of reasons including insufficient sand cover, erosion, and permitting issues (Feeney, 2000). Advancements in technology or other considerations could make local desalination a feasible supply alternative for SqCWD in the future.

Other water supply sources that may be difficult to implement, but should be considered for future sources include:

Soquel Creek Diversion – The SqCWD has longstanding water rights on Upper Soquel Creek that could possibly be transferred to a downstream site for diversion during peak flow periods (primarily winter months.) This project could yield an annualized estimate of 14 cubic feet per second (cfs), assuming a minimum bypass flow of 37 cfs is required to provide fish passage for Central California coast steelhead, a federally listed threatened species. The diverted water would be pumped into a settling pond, treated, and conveyed into the SqCWD's distribution system. During periods when diverted flows exceed current demand, the water would be injected into the aquifer for artificial recharge of the groundwater basin. This project would be complicated due to permitting, suitable land acquisition, stream flow volatility, and a high degree of uncertainty regarding potential yield because of possible variability of the required fish bypass due to changing channel conditions.

Import Water from PVWMA and Watsonville –PVWMA is planning to construct an import pipeline connecting to inland water sources within the next two to five years. SqCWD may potentially be able to augment the amount of imported water through separate purchase and transfer agreements. This water would be stored in the Pajaro Valley Groundwater Basin in exchange for the SqCWD receiving a percentage of that amount from the City of Watsonville through a distribution system intertie. This supplemental supply option currently has a number of legal and institutional challenges.

2. Explore and pursue funding opportunities for supplemental supply projects.

The financial aspects of potential supplemental supply projects to be implemented will be determined based on the agencies involved and potential state and federal grants available. For example, state grant funds were received to cover one-half the cost for the regional desalination plant pilot study and an application has been submitted for additional state grant funds to assist with engineering costs for this project.

Element 6: Protect Existing Recharge Zones

Brief Description:	Protecting groundwater recharge is critical for maintaining the quantity and quality of groundwater for future beneficial use. Whether the threat of contamination is natural or manmade, protective efforts for existing and potential recharge areas are valuable elements of a conjunctive management and groundwater storage strategy. Currently, Santa Cruz County is the lead agency in protecting groundwater recharge zones within the Soquel-Aptos area and SqCWD and CWD continue to monitor and encourage projects, programs, and policies related to groundwater recharge.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Policies
Status:	On-Going

Detailed Description:

Recharge zones are regions that provide the primary means of replenishing groundwater stored in aquifers. Protecting groundwater recharge is critical for maintaining quantity and quality of groundwater for future beneficial use. Recharge zone protection comprises two general activities: 1) Preventing primary recharge areas from being covered by urban infrastructure that could reduce the amount of recharge; and 2) Preventing contaminating activities that would either require expensive treatment, or pollute the aquifer to a point that groundwater becomes unusable.

By protecting the recharge zones in the Soquel-Aptos area, natural recharge can take place and provide higher groundwater levels, prevent coastal movement of the seawater-freshwater interface, and store water for future use. Coordination among regional and local agencies is required to ensure a cohesive recharge zone protection strategy. Protecting existing recharge zones supports the following Basin Management Objectives:

- BMO 1.3 - Store water for future beneficial uses and drought reserve.
- BMO 3.1 - Maintain or enhance the quantity and quality of groundwater recharge by participating in land use planning processes.

The following action items have been identified to assist in protecting groundwater recharge areas within the Soquel-Aptos Area Basin:

1. **Support existing Santa Cruz County efforts to update Groundwater Recharge Maps that identify primary groundwater recharge zones.**

   Primary groundwater recharge zones were defined in the late 1970s as those areas "important for capturing water" (Burns, 2005). Because 85-90% of the potable water used in the County comes from groundwater, a number of land use regulations and policies call for protecting the primary recharge zones. Groundwater Recharge Maps were originally created in the 1980's as a series of Resource and Constraint Maps within the General Plan. The County of Santa Cruz revised these maps in 2005, reflecting more accurate data. These maps have been converted into new County GIS layers illustrating primary groundwater recharge zones (**Figure 5-2).**

2. **Support PVWMA's efforts to optimize recharge recovery, and develop an ASR (Aquifer Storage and Retrieval) Project in the Aromas Red Sands.**

   PVWMA currently diverts storm flows from Harkins Slough to a percolation pond west of San Andreas Road south of La Selva Beach. The water percolates into the dune sands and is withdrawn from a series of shallow recovery wells. PVWMA believes that a significant portion of this recharge water has percolated below their recovery wells, into the underlying Aromas Red Sands. The PVWMA is considering drilling a deeper well to recover the water that has percolated into the Aromas. This deeper well project is only in the feasibility stage, and no formal project has been developed. Further investigation and planning of a potential deep well, or an ASR well, would require studies to assess the volume that the Aromas Red Sands could potentially store.

3. **Support future efforts to characterize recharge areas within the Soquel-Aptos area.** When water recharges an aquifer, it carries with it the chemical signature of the atmosphere from which it was derived. The atmospheric concentration of tritium ($_3$H), the radioactive isotope of hydrogen, changes over time and scientists are able to analyze this constituent for age dating groundwater. During the summer of 2005, private and public wells within the Soquel-Aptos Area Basin were tested by USGS Staff. Age dating was performed on some wells. A report of the data for the GAMA Project in the Soquel-Aptos area has not yet been released.

4. Coordinate and expand efforts between groundwater management agencies and the County of Santa Cruz to establish regulations for land use within Primary Recharge Areas.

Land use planning and zoning plays a major role in recharge zone protection. The current County land division and density requirements in Primary Groundwater Recharge zones require a minimum parcel size of 10 acres.

Involving SqCWD and CWD in the review of County guidelines and policies for recharge protection would ensure that groundwater management is an integral part of land use planning. A formal system for allowing the relevant water agencies to review development proposals that could have a significant impact on primary recharge zones will be pursued.

Element 7: Enhance Groundwater Recharge

Brief Description:	Aquifer depletion is a growing concern and recharge enhancement is necessary for sustaining groundwater supplies. Although Santa Cruz County is the primary agency for projects related to enhancing groundwater recharge, SqCWD and CWD continue to support their efforts and assist in developing projects that could replenish the Soquel-Aptos area groundwater basin.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Projects and Policies
Status:	To be determined

Detailed Description:

Aquifer depletion is a growing concern and recharge enhancement is necessary for sustaining groundwater supplies. While protecting recharge zones primarily focuses on protecting designated areas already identified as primary recharge areas, enhancing recharge entails developing projects and policies that will assist in replenishing the aquifer.

Enhancing groundwater recharge supports the following Basin Management Objectives:

- BMO 1.3 - Store water for future beneficial uses and drought reserve.
- BMO 3.1 - Maintain or enhance the quantity and quality of groundwater recharge by participating in land use planning processes.

The following action items have been identified to assist in enhancing groundwater recharge within the Soquel-Aptos Area Basin:

1. **Enhance groundwater recharge with stormwater runoff.**

   The SqCWD and CWD are working with Santa Cruz County, neighboring water agencies, and regional resource agencies to identify opportunities to enhance groundwater recharge as a byproduct of implementing erosion control and reducing stormwater runoff. Currently, the SqCWD is monitoring implementation of the "Blue Trail Gully Project", which involves sediment reduction and enhanced groundwater

recharge. This project will provide an estimated seven (7) acre-feet/ year of recharge to the deep layers (A Unit) of the Purisima Formation (**Figure 5-3**).

2. **Develop and implement standards that require discretionary projects in primary recharge zones to maintain or increase a site's pre-development absorption of runoff.**

   SqCWD and CWD will support County efforts to develop a program that will include standards regulating impervious surfaces according to project type, land use, soils and area characteristics, and provide for water impoundments, protecting and planting vegetation, and installing cisterns, dry wells, bioswales and other measures to increase runoff retention and groundwater recharge.

   Working with other agencies, SqCWD & CWD will conduct site surveys to assess the feasibility of reducing impervious surfaces and investigate design features that will enhance groundwater recharge at future Water District construction projects within primary recharge zones.

   Additionally, County policies, programs and regulations will be reviewed and updated to enhance requirements and incentives for protecting and restoring recharge during new development and remodel projects.

3. **Support County of Santa Cruz efforts to prioritize potential sites for drainage facilities, and implement construction.**

   The County of Santa Cruz Public Works Department conducted an analysis of drainage facilities located in primary groundwater recharge areas in the Fall of 2005 with assistance from a Prop 13 Coastal Non-point Source Pollution Control grant. This analysis provided a prioritized list of sites and drainage facilities with good potential for enhancing groundwater recharge. Construction of groundwater recharge projects will be implemented if funding is granted. Projects include daylighting culverts, creating grassy swales, building retention and detention ponds, and associated land acquisition either through easement or fee title.

4. **Participate in public outreach and awareness for groundwater recharge.**

   SqCWD and CWD will participate in educational programs to inform customers, businesses, residents, and other groundwater users of the best management practices and techniques for increasing groundwater recharge. More information on current outreach programs is included in Element 13: Public Education.

5. Investigate the water storage potential of the Aromas Red Sands.

Few studies have been conducted which evaluate the groundwater storage potential in the Aromas Red Sands. It's assumed that along the coast, fresh water discharges close to shore since the Aromas Red Sands aquifers are semi-confined to unconfined. Thus near-coastal storage would be limited.

In spite of the apparent limited long-term storage volume in the Aromas Red Sands, enhanced recharge of the Aromas aquifer presents a number of project opportunities because the aquifer is unconfined. Possible projects in the primary recharge area of Pleasant Valley/Freedom Blvd. will be explored with the County of Santa Cruz, Central Water District, the Central Coast Regional Water Quality Control Board and various other environmental protection agencies. Enhanced groundwater recharge in the Soquel-Aptos area was identified as a priority project in the IRWMP (Kestrel Consulting, 2005) for which grant funds are now being sought.

Element 8: Manage Pumping

Brief Description:	Managing pumping entails both the areal and vertical distribution of pumping. Pumping must be managed to influence pumping depressions, provide adequate flow throughout the distribution system, avoid overdraft conditions, and prevent seawater intrusion.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program (Operation Management Plan) Policy (Private Well Incentive Policy) Project (Well Master Plan)
Status:	Active and on-going

Detailed Description:

Managing pumping entails both the areal and vertical distribution of pumping. Historic pumping practices in the Purisima Formation have demonstrated the effectiveness of redistributing pumping on groundwater levels. However, those pumping practices have also identified the lower yield of shallower Purisima subunits, both in terms of individual well yield and lower aquifer transmissivity. The present pumping distribution has created localized water-level depressions. SqCWD is seeking to shift pumping away from the coast, to spread out groundwater pumping in order to achieve more uniform drawdown and to minimize local pumping depressions, especially in critical groundwater areas.

Effectively managing pumping within the Soquel-Aptos Area Basin addresses the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield.
- BMO 1.3 - Store water for future beneficial uses and drought reserve.
- BMO 2.2 - Maintain groundwater levels to prevent seawater intrusion.
- BMO 3.2 - Avoid alteration of stream flows that would adversely impact the survival of populations of aquatic and riparian organisms.

As part of this Groundwater Management Plan, the following action items have been identified for managing pumpage within the Soquel-Aptos area:

1. **Locate, design, and install additional and replacement production wells to improve**

pumping distribution, disperse the basin's overall drawdown and improve operational flexibility.

In 2004, SqCWD completed an evaluation of production capacity throughout its system as the first step towards determining the need and optimal location for replacement wells. It was noted that the SqCWD has very little flexibility in the existing pumping and distribution system. To increase the District's flexibility and reliability, a number of potential well sites were identified and analyzed. As a result of this analysis, SqCWD has identified the following sites, shown on **Figure 5-4**, as the preferred sites for new or replacement wells:

- O'Neill Ranch (estimated capacity 500-1000 gpm)
- Cunnison Lane (estimated capacity unknown)
- Austrian Way Tank Site (estimated capacity unknown)
- Granite Way (estimated capacity of 350 gpm)
- Polo Grounds Well (estimated capacity of 500-750 gpm)

In March 2006, SqCWD approved the development of a Well Master Plan Environmental Impact Report (EIR) that analyzes the preferred sites listed above. The EIR is currently being developed.

2. **Continue to encourage private well users located within critical groundwater areas of the Soquel-Aptos basin to discontinue pumping and connect to the local municipal water supply systems.**

On February 15, 2005, SqCWD adopted the Private Well Incentive Policy (Appendix C) to encourage private wells located in critical groundwater areas to properly abandon their wells and connect to the District's distribution system. The policy establishes guidelines for determining possible incentives (i.e. reduced connection fees) that may be offered for abandoning private wells.

The major benefits of the Private Well Incentive Policy are the ability to manage and redistribute pumping to control seawater intrusion; and the opportunity for SqCWD to quantify previously unmetered water use. This Policy also has the potential to reduce the number of shallow, private wells along Soquel Creek that might be reducing baseflow in the Creek.

3. Cooperatively work with City of Santa Cruz to develop a coordinated pumping plan for the City's Live Oak wells and SqCWD's Purisima wells.

Both SqCWD and the City of Santa Cruz operate municipal production wells in the western portion of the Soquel-Aptos Area Basin. The City relies on its Live Oak Wells for supplying summer peaking capacity and emergency supply. A Well Operational Management Plan between the City and SqCWD would allow the two agencies to coordinate their groundwater extractions. The goal of this coordination is to allow extractions from the Purisima Formation to continue at existing rates, with minimal or no decreases in the quality of groundwater. Jointly agreed upon verifiable targets should be set to prevent seawater from moving onshore through the Purisima Formation near Pleasure Point.

4. Analyze groundwater level/quality data and groundwater pumping data at least annually, and recommend changes to the groundwater pumping distribution as necessary.

Data collected from the groundwater and surface water programs (Elements 1 and 2) will be analyzed and reported annually. At a minimum, the annual analyses will include the following:

- Identify groundwater level trends and contours
- Identify seawater intrusion and landward movement of the seawater/freshwater interface
- Identify changes in groundwater storage
- Identify changes in the apparent stream-aquifer interaction.

These analyses will form the bases for annual modifications to the groundwater pumping distribution. Evidence of seawater intrusion, baseflow depletion, anthropogenic contamination, or excessive drawdown may all be cause for modifying the groundwater pumping distribution.

Figure 5-4
SqCWD Preferred Sites for New or Replacement Production Wells

Element 9: Identify and Manage Cumulative Impacts

Brief Description:	Identifying and managing cumulative impacts recognizes that parties other than SqCWD and CWD affect the groundwater conditions in the Soquel-Aptos area. Cumulative impacts can increase pumping depressions, lead to overdraft conditions, and lead to seawater intrusion.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program (Operation Management Plan) Project (Well Master Plan)
Status:	Active and on-going

Detailed Description:

Identifying and managing cumulative impacts addresses the impacts on groundwater supplies and groundwater conditions resulting from all parties in the Soquel-Aptos area, including parties other than SqCWD and CWD. Effectively identifying and managing cumulative impacts within the Soquel-Aptos area addresses the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield.
- BMO 1.2 - Develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demands. (This element helps reduce future demands).
- BMO 1-3 - Store water for future beneficial uses and drought reserve.
- BMO 2.2 - Maintain groundwater levels to prevent seawater intrusion.
- BMO 3.2 - Avoid alteration of stream flows that would adversely impact the survival of populations of aquatic and riparian organisms.

As part of this Groundwater Management Plan, the following action items have been identified for identifying and managing cumulative impacts within the Soquel-Aptos Area Basin:

1. **Encourage sustainable pumping from non-agency groundwater users.**

   Groundwater extraction by mutual water companies and private wells is estimated to be approximately 2,200 afy in the Purisima Formation and 900 afy in the Aromas Red Sands (Johnson et. al, 2004, Table 5-2). Any increase in pumping by these non-agency groundwater users would make it difficult for SqCWD and CWD to meet BMO 1.1 of

this GMP. SqCWD and CWD will consider methods for identifying increases in non-agency groundwater use and for encouraging these users to reduce pumping to sustainable quantities.

2. Identify and manage well interference and manage groundwater storage for beneficial uses and drought reserve.

SqCWD, CWD, and the City of Santa Cruz all operate municipal production wells within the Soquel-Aptos Area Basin. Interference between wells in a groundwater basin is common; however, excessive interference can result in significant impacts. In particular, excessive drawdown from nearby cones of depression could result in declining production levels. Localized cones of depression around municipal wells should be managed to avoid any material injury to other pumpers. Within this context, material injury is would be as described in *California Groundwater Management* (Bachman et al, 2005): "… material injury … turns on the existence of an appreciable diminution in the quantity or quality of water…"

The Well Operational Plan between the City and SqCWD proposed in Element 8 will include estimates and measurements of cones of depression around municipal wells. If it is determined that a cone of depression has lowered water levels in a neighboring well to the point where there is an appreciable diminution in the quantity or quality of water pumped by that well, the two agencies will discuss remedies to the problem, including adjusting pumping locations and rates.

Similarly, both SqCWD and CWD will estimate the extent of the cones of depression around their municipal wells that are in proximity to the boundary of the Purisima Formation and the Aromas Red Sands. If it is determined that a cone of depression has lowered water levels in a neighboring well to the point where there is an appreciable diminution in the quantity or quality of water pumped by that well, the two agencies will promptly discuss remedies to the problem, including adjusting pumping locations and pumping rates.

Municipal pumpers operating production wells within the Soquel-Aptos basin will attempt to manage pumping to preserve water storage for beneficial uses and drought reserve.

3. Install new wells in locations that reduce cumulative impacts.

New wells should be sited within the Soquel-Aptos Area Basin with an eye to reducing cumulative impacts from pumping. SqCWD is currently developing an EIR for their Well Master Plan that addresses these cumulative impacts. The Well Master Plan identifies five future municipal well sites for SqCWD. The purposes for siting and

installing these new wells, as identified in the Well Master Plan, include broadly distributing well locations to minimize drawdown cones, limiting pumping of individual wells, and moving pumping away from the coast to mitigate seawater intrusion. By broadly distributing wells across the Soquel-Aptos area, concentrated pumping in vulnerable locations is prevented, and interference between wells is thereby minimized. Additionally, shifting pumping among several production wells, minimizing run-times, and allowing wells to recover will result in reducing cones of depression. Adopting the Well Master Plan, therefore, will substantially reduce cumulative impacts from pumping in the basin.

CWD does not have any current plans to install additional wells.

4. Continue to improve and quantify projected future demands from all groundwater users.

This action item addresses BMOs 1.2 and 1.3 by quantifying future beneficial uses of the water supply. *SqCWD's Integrated Resources Plan* (ESA, 2006) projects both anticipated demands and groundwater supplies from the combined Purisima and Aromas Red Sands for years 2010-2050. These projections directly affect the amount of supplemental supply required to ensure water supply reliability. The demand projection will be updated when new data become available. In addition, improved methods for projecting future demands will be developed under this element.

Element 10: Water Conservation

Brief Description:	Water conservation reduces demand on the Soquel-Aptos Area Groundwater Basin, allowing more efficient use of the limited groundwater resource. SqCWD has an extensive conservation program that includes a Water Demand Offset Program, rebates for low-flow plumbing fixtures, and residential and commercial water use surveys, and leak detection audits of the distribution system.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program
Status:	Active and on-going

Detailed Description:

Water conservation reduces demand on the Soquel-Aptos Area Groundwater Basin, allowing more efficient use of the limited groundwater resource. Implementing water conservation measures will support the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield
- BMO 1.2 - Develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demands.

As part of this Groundwater Management Plan, the following action items have been identified for reducing demand through water conservation:

1. **Continue and update the existing water conservation programs for SqCWD.**

   Water conservation comprises a number of ongoing SqCWD programs that reduce demand on the Soquel-Aptos Area Groundwater Basin. SqCWD has implemented an active water conservation program since 1997 that is projected to achieve a 16% reduction in demand by 2030 relative to projected demand without conservation. This element will continue the existing conservation program. Aspects of the existing conservation program include the following:

   Residential Water Survey Program - SqCWD offers indoor and outdoor water use surveys to existing single-family and multi-family residential customers with a history of high water use. As part of the survey, SqCWD staff installs conservation devices such as

low-flow showerheads and faucet aerators, and offer customers customized landscape irrigation schedules.

Residential Plumbing Retrofit - SqCWD distributes showerheads, faucet aerators, low-flow hose nozzles, and toilet tank leak detection tablets to customers in its service area. These devices are currently distributed at the headquarters office, at community events, by the customer service field crew, and by water use surveyors.

System Water Audits, Leak Detection, and Repair - SqCWD maintains data on detected leaks within the distribution system and regularly repairs leaks. A map is maintained showing all leaks in the system, and areas prone to leaking are given high priority for main replacement.

Metering and Commodity Rates - SqCWD requires meters on all service connections and in 2003 adopted a policy requiring separate meters for each unit of multi-unit developments. This is an effective conservation measure that directly associates cost with the amount of water used. It also provides the means for the SqCWD to identify and monitor high use customers.

Large Landscape Conservation Programs - This measure targets irrigators of landscapes larger than three acres, such as greenbelts, common areas, multifamily housing landscapes, schools, business parks, cemeteries, parks, golf courses and publicly owned landscapes on or adjacent to roadways. Participants are informed of their current irrigation efficiency and water budget. To facilitate conservation, participants are also offered low-cost hardware improvements, baseline irrigation schedules, weather-based irrigation controllers, and water savings information.

High-Efficiency Clothes Washing Machine Rebate Program - The SqCWD offers a $100 credit to residential and commercial customers in the SqCWD's service area who purchase and install highly water-efficient washing machines.

Public Information and School Education - Public Information is a key component to the Conservation Program. Disseminating information to the public has been successful due to the numerous outreach programs conducted by SqCWD. These include, but aren't limited to, producing a bi-monthly newsletter, 'What's on Tap' that's mailed to customers with their bill, maintaining a website (www.soquelcreekwater.org), participating in the County's 10-agency water conservation committee, hosting a Water Conservation Booth at Cabrillo College Farmer's Market and the annual Aptos/Capitola Chamber of Commerce Business Showcase, conducting demonstration garden and educational workshops on water wise plants and synthetic turf, maintaining a lending library of video and books for customers, and continuing to provide press releases and articles to local newspapers on water related issues.

SqCWD had a water-wise school education program from 1980 to 1992. In 2000, the SqCWD re-established and expanded its school education program. The current program includes: presenting and instructing at local schools with activities and lessons related to water resources and conservation, hosting WET Curriculum Workshops for teachers, co-creating a Local Water Resources Activity Book for Santa Cruz County Schools, holding an annual "School Poster Contest" on water awareness, participating in the "World of Water" booth at the Santa Cruz County Fair, and funding school assemblies that are related to water conservation.

Commercial, Industrial, and Institutional Water Conservation- The commercial, industrial and institutional (CII) sector have been sent letters or contacted by telephone and offered a free interior and/or exterior survey and incentives sufficient to achieve customer implementation of survey findings. This survey will be repeated every five years to maintain or improve the conservation level. The SqCWD also partners with the County of Santa Cruz's Green Business Program to provide "one-stop shopping" and added value. In 2004, SqCWD partnered with a local nonprofit to provide pre-rinse spray nozzles to over 95 percent of the restaurants in the SqCWD service area.

Conservation Pricing - This type of rate structure provides an incentive for high-use customers to evaluate their usage and reduce their bill by using less water. Effective January 2006, the single-family residential quantity rates for a two-month billing period were as follows:

5/8 Domestic Meters	\$2.97 per 100 cubic feet (0-30 units[4)] \$6.00 per 100 cubic feet (31units and above)
¾" and 1" Domestic Meters	\$2.97 per 100 cubic feet (0-49 units) \$6.00 per 100 cubic feet (50 units and above)

Water Demand Offset Program - The SqCWD's Water Demand Offset (WDO) Program requires each new commercial or residential development to offset 120% of its projected water use. The offset requirements are met by retrofitting high water use devices in existing development with lower water use devices (e.g., toilets, etc.).

Water Efficiency Requirements – All new development must meet water efficiency requirements for both indoor water use and landscaping. The water efficiency resolution sets limits on the amount of allowable lawn and high water use plants, restricts the types of irrigation systems that can be installed, and sets requirements for the efficiency of plumbing fixtures in any new development.

[4] 1 unit = 100 cubic feet = 748 gallons

Retrofit on Resale - This program tracks and enforces compliance with the City of Capitola and County of Santa Cruz ordinances that require installation of water efficient devices when properties are sold. This includes installing 1.6 gallon per flush toilets, low-flow showerheads and faucet aerators, and repairing leaking toilets.

Weather-Based Irrigation Controller Program - In 2003, SqCWD installed and tested weather-based irrigation control devices at 10 sites. In 2005, the U.S. Bureau of Reclamation awarded SqCWD a grant to install 325 weather-based devices. Approximately one-third to one-half of the 325 controllers are designated for dedicated irrigation meter sites, for an estimated water savings of at least 26 afy. This program is to be implemented over a two-year period from 2005 into 2007.

Zero-Water Urinals - The SqCWD offers a rebate to customers who replace existing urinals with waterless urinals. The rebate is $75 per urinal.

Synthetic Turf Rebate - The SqCWD offers a rebate to customers who replace existing lawn with synthetic turf. The rebate is $1 per square foot with a maximum of $300.

2. Continue and update the existing water conservation programs for CWD.

Water conservation programs for CWD are aimed to reduce demand on the Soquel-Aptos Area Groundwater Basin. They include:

Metering - CWD requires meters on all services. CWD has adopted a policy to provide only one standard service connection and meter per parcel. Additional housing units and large multi-family housing are limited to usage as determined by meter flow capacity.

Conservation Pricing- A Conservation-based tiered rate structure is in place for all of CWD's customers to provide cost savings for those who use less water. Water rates[5] were recently revised in 2005 as:

[5] CWD Rates were rounded to the unit price per 100 cubic feet.

Primary Area	$1.32 per 100 cubic feet (0-30 units) $1.69 per 100 cubic feet (31-50 units) $1.94 per 100 cubic feet (above 50 units)
Above Primary Area (Day Service Zone)	$1.59 per 100 cubic feet (0-30 units) $1.98 per 100 cubic feet (31-50 units) $2.27 per 100 cubic feet (above 50 units)
Above Primary Area (Redwood Heights and Maintenance Dist. Service Zone)	$1.46 per 100 cubic feet (0-30 units) $1.84 per 100 cubic feet (31-50 units) $2.12 per 100 cubic feet (above 50 units)
Commercial and Agricultural	$1.32 per 100 cubic feet (0 -10 units) $1.69 per 100 cubic feet (11-16 units) $1.94 per 100 cubic feet (above 16 units)
2-inch Meter	$1.32 per 100 cubic feet (0-10 units) $1.69 per 100 cubic feet (11-16 units) $1.94 per 100 cubic feet (above 16 units)

3. Annually report estimated savings from the ongoing water conservation program.

The effectiveness of the water conservation programs will be analyzed and reported annually. Actual water use will be compared with anticipated water use without conservation. The effectiveness of rebate and incentive programs will be analyzed, and modified as needed.

Element 11: Support the Development and Update of Policies and Ordinances for Well Construction, Abandonment, and Destruction

Brief Description:	Continue to support and help implement revisions to the County of Santa Cruz Well Ordinance, support County's well destruction program, and continue to apply SqCWD's well destruction policy.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Policies
Status:	Recently revised by the County of Santa Cruz and on-going

Detailed Description:

Improperly constructed or abandoned wells can be a significant pathway for the migration of groundwater contamination. Properly constructing wells and properly destroying abandoned wells will address the following Basin Management Objective:

- BMO 2.3 – Prevent contaminant pathways

As part of this Groundwater Management Plan, the following action items have been identified for supporting and updating well construction and abandonment policies within the Soquel-Aptos area:

1. **Support existing well construction and well destruction standards, including the recent revisions to the County of Santa Cruz Well Ordinance.**

   The recent revisions address location and construction of new wells, potential contamination hazards in the vicinity of new wells, and new sealing requirements to prevent contaminant migration. These revisions have not yet been formally adopted or implemented.

Two sets of well construction and abandonment standards regulate wells in the Soquel-Aptos Area Groundwater Basin: California DWR well standards and the County of Santa Cruz (County) well construction and abandonment policies. California Water Code Section 231 requires DWR to develop well standards to protect groundwater quality. These DWR well standards have been documented in Bulletin 74-81 (DWR, 1981) and its updated supplement Bulletin 74-90 (DWR, 1991).

As with most cities and counties, the County has adopted ordinances and policies to establish standards for safe and adequate water supplies to ensure groundwater quality. In Chapter 7.70 "Water Wells" of the County Code specifically addresses well requirements within SqCWD Service area. The County is presently updating its requirements.

The State and County regulations for new wells establish setback requirements from property lines, sewers, septic tanks and sewage leach fields and other sources of contamination. They mandate a minimum borehole diameter and depth and type of surface seal to prevent contaminants from migrating downward from the ground surface to the well screen.

The County regulates the maintenance of inactive wells and the destruction of abandoned wells. Abandoned wells are wells that have not been used for one year, unless the well owner can demonstrate that it is an inactive well that will be used again for water supply and the well does not provide a contaminant pathway through defects or between multiple aquifers. Maintenance requirements of inactive wells include a watertight cover and clear marking. Destruction under permit is by methods in Bulletin 74-81 with several County modifications that address temporary cover, sealing methods and sealing materials

SqCWD and CWD will work closely with the County to adopt and implement the revisions to the water well ordinance. Should additional modifications to the well construction and abandonment ordinances be required in the future, SqCWD and CWD will provide technical support and political support to implement needed changes.

2. Support County of Santa Cruz's well destruction program.

Identifying and properly destroying existing abandoned wells will prevent these wells from acting as conduits for contamination. The County is developing a well destruction program that includes the following components:

- Create GIS database of wells. Well locations will be mapped based on DWR drillers' logs.

- Seek funding for costs of destroying wells. The County has applied for Proposition 50 water bond funding to assist property owners with the costs of properly destroying abandoned wells.
- SqCWD and CWD will provide data to the County for the GIS database and technical and political support for seeking funding for destruction costs.

3. Continue to implement SqCWD well destruction policy.

SqCWD has a policy that under most circumstances requires property owners to properly destroy abandoned private wells before connecting to the SqCWD system. SqCWD will continue to enforce this policy.

4. Request Santa Cruz County Environmental Health Services to establish a voluntary monitoring program of private wells, particularly in inland areas of the Soquel-Aptos groundwater management area.

By including private wells, the existing groundwater monitoring program could be greatly expanded. SqCWD and CWD will work with the County of Santa Cruz on developing this program to identify locations where monitoring is needed and solicit voluntary participation from owners with wells that are suitable for monitoring.

Element 12: Wellhead Protection Measures

Brief Description:	Wellhead protection measures protect groundwater quality, allowing it to be used for potable or other beneficial uses. Wellhead protection measures include assisting with and endorsing the County's updated provisions for wellhead protection in the well and hazardous materials ordinance, continuing to implement the State drinking water source protection program, and supporting groundwater remediation activities.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program and Project
Status:	Active and On-Going

Detailed Description:

Wellhead protection measures protect the quality of the groundwater resource, allowing it to be used for potable or other beneficial uses. Wellhead protection measures support the following Basin Management Objectives:

- BMO 2.1 - Maintain existing water quality standards for beneficial uses, such as drinking water standards.
- BMO 2.3 - Prevent contaminant pathways.

As part of this Groundwater Management Plan, the following action items have been identified for supporting and implementing wellhead protection measures.

1. **Periodically update and review the SqCWD and CWD Drinking Water Source Assessment and Protection (DWSAP) analysis and submittals.**

   The California Department of Health Services requires large water system operators to complete DWSAP analyses for each well or surface water intake in their system (Section 11672.60 of the California Health and Safety Code), SqCWD and CWD have produced DWSAP reports that include:

   - A delineation of the groundwater protection zone around each drinking water source through which contaminants might move and reach that drinking water supply (well)

- An inventory of possible contaminating activities (PCAs) that might lead to the release of microbiological or chemical contaminants within the delineated area.
- A vulnerability analysis of the PCAs to which the drinking water source is most vulnerable.

CWD is currently working with a consulting hydrologist to update their inventory of PCAs and update the DWSAP reports for their six wells. Septic tank systems within each protection zone will be quantified to estimate nitrogen loading and further analysis will evaluate whether this suitably accounts for observed groundwater nitrate concentrations. The DWSAP update will utilize the TurboSWAP program to generate the required forms and protection zone maps and other deliverables will include:

- Well Data Sheets
- Summary of the hydrogeologic conceptual model relevant to each wellfield
- Plots of groundwater production and quality
- Discussion of each well's vulnerability (including overdraft, saltwater intrusion, and land/resource management issues)
- Recommendations for addressing the identified protection issues.

DWSAPs for SqCWD will be updated as new wells are installed, as new PCAs are identified, as new analytical tools become available, or as required by statute.

2. Continue to assist with and endorse Santa Cruz County's expanded wellhead protection programs.

SqCWD and CWD endorsed the County's expanded wellhead protection program in June 2002 and continue to assist with the update. The program identified the following actions to be taken by the County to improve groundwater protection:

- Complete and update the mapping of existing information on wells, water sources, and hazardous material facilities and incorporate the information into the County's Geographic Information System (GIS). Review the mapped information to assist the Regional Water Quality Control Board (RWQCB) in prioritizing cleanup sites with the greatest potential to impact water supply wells. Provide for updating maps as additional information becomes available.
- Incorporate the designated water source protection zones from DWSAP into the County's GIS.
- Review and update mapping and protection policies for groundwater recharge areas and wellhead protection areas as part of the General Plan , including restricting potentially contaminating land uses in critical water resource areas.

- Consider developing overlay zoning or other measures to restrict the location of new gas stations and other hazardous material facilities that have the potential to contaminate groundwater within critical groundwater protection areas. Evaluate options to encourage phasing out of existing facilities in critical areas.

3. Support groundwater remediation activities.

The California Regional Water Quality Control Board and County of Santa Cruz Environmental Health Services oversee groundwater remediation in the Soquel-Aptos Area Basin. SqCWD and CWD will not implement an additional layer of regulation. Instead, the Districts will participate in information exchange to support the County and State agencies, and to use contamination information in managing local wellfield expansion and operation. For example, SqCWD and CWD will provide water level, production and hydrogeologic information to the County and State agencies to assist them in designing remediation activities, and SqCWD and CWD will periodically obtain updated information regarding the locations and status of local groundwater contamination sites to consider when planning new well sites or changes in the distribution of pumping among existing wells.

Element 13: Public Education

Brief Description:	By keeping customers informed and abreast of current and future management issues, the community can help protect and ensure the quality and quantity of groundwater in the Soquel-Aptos management area. A series of public education and outreach programs will be initiated and continued.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program and Project
Status:	Active and On-Going

Detailed Description:

Public Outreach and Education continues to be a priority for SqCWD and CWD. By keeping customers informed and abreast of current and future management issues, the community can help protect and ensure the quality and quantity of our groundwater. This element explains the current activities regarding public education.

Continuing and improving public education addresses the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield.
- BMO 1.2 - Develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demands.

As part of this Groundwater Management Plan, the following action items have been identified as Public Education for the Soquel-Aptos area:

1. **Maintain SqCWD's public information program.**
   SqCWD has developed a successful program to inform the public on issues related to the District's activities and plans. The Public Information program includes:
   - **Conservation Brochures -** The District provides an assortment of conservation brochures to customers free-of-charge.

- **Conservation Bill -** The District's bill format includes conservation information specific to each District customer. Information on the bill includes: four-year Usage History; Consumption History, detailing gallons consumed per billing period and per day; a Water Use Efficiency figure, which shows how much more or less a customer has used compared to the same period last year; and a Message Box for conservation and billing information.
- **Web Site - www.soquelcreekwater.org** - Customers can obtain information on the District, conservation programs and tips, download applications for rebate programs, read past issues of the District's newsletter, access District reports on integrated resources planning and groundwater management, and link to other sites pertaining to conserving water by accessing the District's web site.
- **New Customer Packets -** The District sends a packet to new homeowners that explains groundwater concerns and encourages water conservation. The packet contains information on District incentive programs and conservation.
- ***"What's on Tap"* District Newsletter -** A bi-monthly customer newsletter, which keeps District customers informed of current District activities including water supply and quality, conservation, and incentive programs is enclosed with the bills.
- **Video Lending Library -** The District has a video lending library with assorted titles dealing with landscaping, water use, and water history.
- **Participation in Community Events -** The District participates in community events including the Aptos/Capitola Business Showcase, the Aptos/La Selva Fire District Open House and local farmers markets.
- **Presentations to community groups -** Staff are available to make presentations to community or business groups by request. Topics of interest include conservation, water supply planning and water quality.
- **Advertising** - The District runs at least one conservation/information ad per month in the local newspapers and once per year teams with other agencies to educate the public about water resources and promote conservation.
- **Press Releases/Articles -** The District provides several articles and press releases per year to local media regarding conservation and groundwater management.
- **Demonstration Garden and Education Workshops -** The District has an onsite water-wise garden and conducts landscaping workshops to provide customers information about water-wise plants.

2. **Maintain SqCWD School Education Program.**
   SqCWD had a water-wise school education program from 1980 to 1992. In 2000, the SqCWD re-established and expanded its school education program. The current program includes:
   - **Project WET Teacher's Training:** In partnership with the City of Watsonville, SqCWD facilitates an annual Project WET (Water Education for Teachers) teacher training which includes hands-on demonstrations of the lessons and activities in the Project WET Curriculum and Activity Guide that promotes awareness, appreciation, knowledge, and stewardship of water resources.
   - **Classroom Presentations at local schools:** SqCWD staff provides standards based presentations and activities about water systems, resources and conservation. Some presentations are in partnership with an artist who is affiliated with the Cultural Council of Santa Cruz County.
   - **Co-developed the 'Local Water Resources Activity Book for Santa Cruz County Schools'**: SqCWD, in partnership with other local water agencies, developed and published a water and conservation reader for 5th and 6th grade students to learn about Santa Cruz County water resources. The reader is available to students throughout the County and is provided during class presentations in the SqCWD area.
   - **Funding school assemblies:** SqCWD sponsors creative performance groups that present water resources and conservation concepts through music, stories, juggling and tricks. The schools can choose one of two groups for a school wide assembly performance.
   - **Free Classroom Materials:** Readers, workbooks, coloring books, activity booklets and games related to water conservation, the water cycle, and groundwater are available to teachers and parents.
   - **Participating in the "World of Water" activity area at the Santa Cruz County Fair or Watershed Festival**: Each year, Soquel Creek Water District participates in a Water Awareness/Education Day at the Santa Cruz County Fair or the Watershed Festival in Capitola with other participating water and environmental agencies within Santa Cruz County. Both exhibits provide water education activities for young children.
   - **Holding an annual "School Poster Contest" on water awareness**: In recognition of May as Water Awareness Month, the District holds an annual "How I Conserve Water" poster contest for 4th and 5th grade students. Entrants are asked to create a colorful drawing and slogan that explains why water is so important and how we can conserve it. The SqCWD rewards the best posters and displays the art in the District's lobby and hallways.

3. **Maintain CWD Public Education Programs.**
   CWD's Public Information program includes:
   - **Conservation Messages –** Customers receive water conservation messages with their bills to promote using less water. Recently, CWD encouraged customers to use drought-tolerant plants.
   - **Participation in area-wide efforts –** CWD supports and participates in Water awareness activities such as the "World of Water" at the SC County Fair

4. **Support and participate in regional programs.**
   SqCWD and CWD will continue to support and participate in regional programs related to educating the public on groundwater management. There are ongoing cooperative efforts with other agencies, including but not limited to, the County of Santa Cruz, the City of Santa Cruz, the City of Capitola, City of Watsonville and PVWMA. SqCWD's public outreach projects during 2005-2006 include:

   - Capitola Water Festival
   - Local Water Resources Activity Book for SC County Schools
   - Project WET
   - Water Awareness Month Campaign
   - Presentations about conservation and the proposed desalination project to area realtors, the City of Capitola, the Capitola Academy, etc.

Element 14: Improve Groundwater Basin Management Tools

Brief Description:	Improving groundwater basin management tools includes developing or revising quantifiable Basin Management targets, and developing or enhancing methods to evaluate whether BMOs are being met. Targets that will be improved or developed include those related to sustainable yield, seawater intrusion, and streamflow.
Required:	No Voluntary Component (Refer to Table 1-1)
Type:	Program and Project
Status:	Active and On-Going

Detailed Description:

Improving groundwater basin management tools is necessary to ensure that the Basin Management Objectives have updated, relevant, and preferably quantifiable targets for groundwater management. Some BMOs have quantified targets that will be regularly updated and revised by this element. Targets for other BMOs will be developed under this element. This element will develop tools and methods for obtaining additional data and evaluating future management strategies.

Improving groundwater basin management instruments addresses the following Basin Management Objectives:

- BMO 1.1 - Pump within sustainable yield.
- BMO 2.2 - Maintain groundwater levels to prevent seawater intrusion.
- BMO 3.2 - Avoid alteration of stream flows that would adversely impact the survival of populations of aquatic and riparian organisms.

As part of this Groundwater Management Plan, the following action items have been identified for improving groundwater basin management instruments for the Soquel-Aptos Area Basin:

1. **Continue to improve and quantify sustainable yield estimates.**

   Johnson et al. (2004, pages 8-8 and 8-9) estimates the total annual sustainable yield by all pumpers within the Soquel Aptos area as 6,200 acre-feet in the Purisima Formation and 3,200 acre-feet in the Aromas Red Sands. These are based on estimates of groundwater recharge and consumptive use factors that should be periodically reevaluated. SqCWD and CWD will annually evaluate the data to revise the estimates of water budget which may lead to revising the estimated sustainable yield.

2. **Establish water levels that protect the groundwater basin against seawater intrusion.**

   Meeting BMO 2.2 requires raising coastal groundwater levels to identified target levels that will prevent seawater intrusion. These target levels have not been quantified. SqCWD will perform an analysis that quantifies these targets based on the geology of the aquifers and the differences in density between fresh groundwater and seawater.

3. **Assist state, federal, or local wildlife and fisheries agencies as they develop water flow or water quality requirements for riparian and aquatic organisms.**

   Meeting BMO 3.2 requires maintaining adequate streamflow for populations of riparian and aquatic organisms. Only the Soquel Creek Lagoon has identified a quantifiable objective of 3 cfs as protective flow (Soquel Creek Adjudication, Decree No. 57081, 1977); in all other areas, a quantifiable objective has not been determined. In lieu of such an objective, this standard for BMO 3.2 is to minimize impacts due to pumping. This action item will facilitate incorporating future streamflow objectives developed by wildlife and fisheries agencies into this GMP.

4. **Maintain and enhance data collection and management.**

   Effective data collection facilitates accurate data analyses. SqCWD is currently evaluating different data collection methods, such as using submersible pumps for groundwater sampling as opposed to the air lift mechanisms currently installed in monitoring wells. Installing groundwater probes in select locations such as the planned Dolphin and Sumner monitoring well is also planned. SqCWD and CWD will enhance data management by continuing to update the agencies' databases and Geographical Information Systems.

5. **Ensure data sharing among regional water agencies.**

   Data collected by members of SAGMA, including the County of Santa Cruz, the City of Santa Cruz, CWD and SqCWD as well as Pajaro Valley Water Management Agency should be available to all of these water agencies. Data collected by these agencies will be transferred to the other agencies semi-annually via the SAGMA meetings. Protocol for data formats and transmission methods will be developed as necessary.

6. **Explore methods to collect data from non-agency groundwater users.**

   SqCWD and CWD lack the authority to control groundwater pumping by others, but obtaining information about non-agency pumping and groundwater conditions would greatly assist in the management of the basin. The data that could be obtained from non-agency wells include pump rates, well characteristics, and groundwater levels.

7. **Prepare a subregional groundwater model for CWD's Rob Roy Well Field.**

   CWD has recently hired Nick Johnson, consulting hydrologist, to develop a subregional groundwater model encompassing CWD's Rob Roy Well Field and SqCWD's Aromas Wells. The model will incorporate the data, assumptions, and findings from Johnson et al. (2004) and will account for the area's geology, aquifer conditions, recharge, major pumping wells and ocean boundary using MODFLOW.

8. **Provide data and technical assistance to Pajaro Valley Water Management Agency (PVWMA) GW Basin Model.**

   PVWMA has hired the U.S. Geological Survey to develop a numerical model of its groundwater basin. A hydrogeological consultant for SqCWD serves as a member of the Technical Advisory Committee for the model development. Developing this model will provide SqCWD and CWD with insight to regional groundwater conditions that may affect groundwater management in the Soquel-Aptos Area basin.

9. **Explore opportunities to expand existing groundwater models to cover the Soquel-Aptos area.**

   The existing IGSM groundwater model developed by SqCWD for the Soquel-Aptos area is not currently used as a groundwater management instrument. SqCWD will continue to look for funding options for converting and using this groundwater model to be used for evaluating groundwater management options.

10. Explore methods to measure and locate the seawater/freshwater interface.

The SqCWD and CWD strive to improve our understanding of the location of the offshore seawater/freshwater interface with new technologies and methodologies as they become available. Identifying a more accurate location of the seawater/freshwater interface would allow for:

- Analyses of landward movement of seawater intrusion in response to pumping
- Analyses to quantify offshore storage in the Purisima Formation

New coastal monitoring wells will be designed to accommodate technologies that may help locate the seawater interface, such as electromagnetic logging tools.

Implementing the Soquel-Aptos GMP requires numerous actions including, but not limited to, the following:

- Establishing a Governance Structure to oversee implementation
- Establishing an Advisory Group to develop recommendations for the annual Groundwater Management Work Plans
- Determining and prioritizing action items to meet Basin Management Objectives
- Identifying Financing Mechanisms for groundwater management projects and programs
- Coordinating with other agencies
- Providing a process for Conflict Resolution
- Assuring future review and revisions of this GMP

This section presents the implementation plan for the Soquel-Aptos Area GMP by addressing each issue listed above. The purposes of this implementation plan are to continue existing groundwater management efforts and carry out the proposed activities outlined in Section 5.

6.1 Duties and Governance Structure of the Basin Implementation Group (BIG)

The existing Joint Exercise of Powers Agreement (JPA) between SqCWD and CWD specifically covered creating a groundwater management plan (1995) and updating the plan to meet current conditions and comply with the requirements of SB1938 (2005). No provisions in the JPA cover implementing the GMP. Thus, the JPA between SqCWD and CWD must be amended to provide provisions for the duties and governance structure of the Implementation Group and shall include a withdrawal provision for any of the parties. The Basin Implementation Group (BIG) shall be comprised of representatives as designated in the JPA. It will be the primary responsibility of the BIG to:

1) assure that the goals and objectives identified in this GMP are pursued in a reasonable and timely manner;
2) be accountable for the quality and accuracy of all reports associated with the groundwater management plan implementation;
3) modify the GMP as needed to address any new or escalated issues within the groundwater basin;
4) direct future updates to the GMP every five years or more frequently if needed to reflect changes in State law or in local conditions/programs.

The Implementation Group will meet at least annually at which time it will: 1) review the annual report on the status of the basin and review progress made to meet the GMP's goals and objectives; 2) discuss the work plan for the upcoming year as recommended by the Advisory Group; and 3) consider any proposed amendments to the GMP. It will be the responsibility of

SqCWD and CWD to conduct or complete work plan activities or projects within their respective jurisdictions.

Implementation of the GMP does not preclude any agency from pursuing programs and projects related to groundwater management either independently or in cooperation with other agencies that may or may not be a party to the Soquel-Aptos Area Groundwater Management Joint Powers Agreement.

6.2 Duties and Formation of a Basin Advisory Group (BAG)

The Basin Advisory Group (BAG) provides technical expertise necessary to guide and implement the groundwater management activities as well as provide interagency coordination. The Soquel Aptos Groundwater Management Alliance (SAGMA) with the addition of a representative from PVWMA, will serve as the Advisory Group for the GMP. This group will meet at least annually to: 1) discuss the status of the groundwater basin; 2) review progress on the management goals and objectives as outlined in this GMP; and 3) develop a recommended work plan for the following year. Any comments on the Annual Review and Report from the BAG will be forwarded to the Basin Implementation Group along with the Advisory Group's recommended work plan for the coming year.

6.3 Annual Review and Report, and Implementation

An Annual Review and Report (ARR) will be prepared by SqCWD's consulting hydrologist with assistance from SqCWD and CWD staff. The ARR will be prepared following each water year (October 1 – September 30) and will summarize groundwater conditions in the Soquel-Aptos area, document the status of groundwater management activities from the previous year, and recommend any amendments to the GMP. The ARR will include:

- Status of the Soquel-Aptos Basin
- Summary and analyses of monitoring efforts
- Summary and status of the elements that have been identified in Section 5.
- Review of the Annual Work Plan and BMOs, and assess whether management activities are proactively meeting those BMOs
- Contingency actions to undertake should any BMOs not be met
- Prioritization of projects and programs to achieve BMOs based on funding and other resources
- Recommendations for revisions to the BMOs or elements

The administrative draft ARR will first be presented to the BAG for review and comment. When the Draft ARR is provided to the BIG, it will also be made available for public review and

provided to the SqCWD and CWD Boards of Directors. Prior to acting on the ARR, the Basin Implementation Group will consider comments from the Advisory Group and the general public. The ARR will be added as an addendum to the GMP, and the GMP will be amended to reflect any changes to the basin management objectives or elements as directed by the BIG.

An implementation plan is shown on **Figure 6-1**. This figure includes all of the activities identified in Section 5. Each activity has been assigned a relative priority and an estimated time for implementation.

6.4 Financing Mechanisms

Each party to the Groundwater Management Plan JPA is financially responsible for funding groundwater management projects and programs within its respective jurisdiction unless otherwise determined by a vote of each Board. Preparation costs for the projects and programs that are basinwide in nature, e.g. the ARR, subsidence monitoring, and updates to the GMP, will be shared in accordance with provisions in the JPA.

The projects, programs and policies detailed in Section 5 may be financed through a variety of sources which include, but are not limited to:

1. Revenues from SqCWD and CWD (including connection and service fees, water sales, and bonds/loans, if applicable)
2. In-kind services or financial contributions from neighboring water agencies within the Soquel-Aptos area, e.g. staff support or funding partnerships for collaborative projects.
3. State or federal grant programs. Neither the SqCWD nor CWD have historically relied on grants for implementing groundwater management activities; however, large projects such as developing alternative sources of supply, groundwater recharge, and new production and monitoring wells are likely candidates for grant funding assistance.
4. Local, state, and federal partnerships. The current plan for developing a supplemental supply of water relies on a partnership between SqCWD and the City of Santa Cruz. Similar partnerships could be established for implementing regionally beneficial projects and programs. The existing Soquel-Aptos Groundwater Management Alliance (SAGMA) provides a natural vehicle for developing programs with regional partnerships.

6.5 Coordination with other Local Agencies

Coordination with other local agencies will continue to play a vital role in the success of the Soquel-Aptos area groundwater management strategy. Working together with the City of Santa Cruz, the County of Santa Cruz, and Pajaro Valley Water Management Agency to coordinate and cooperate on groundwater management activities and policies will enhance the effectiveness of the GMP. The adoption of this Soquel-Aptos Area Groundwater Management Plan under the Joint Powers Agreement and the structure to implement the GMP does not preclude either SqCWD or CWD from separately working with other agencies as appropriate for individual projects.

6.6 Conflict Resolution

Any conflicts regarding the implementation of the GMP will be resolved in the following manner:

1. Any party (public or private) that disagrees with any aspect of implementation of the GMP, hereinafter referred to as the Appellant, may request a hearing before the *Basin Implementation Group (BIG)* to voice their objections and propose a resolution that would satisfy their concerns. Such requests shall be made in writing and include the following: name, address and telephone number of the Appellant or authorized representative; a statement of the issues: any material the Appellant wishes to be considered before a decision is rendered; and a statement of the resolution that would satisfy the Appellant.
2. The *BIG* shall schedule a public hearing to consider the appeal. The procedure of the hearing shall be as follows:
    a. Staff report and recommendation.
    b. Appellant presentation including supporters of the appellant.
    c. Opposition presentation.
    d. Deliberation and decision by the *BIG* as determined by a majority vote. In deciding the matter, *BIG* members will consider what action would serve the best interest of the public and cite findings that support the decision.

6.7 Future Review and Revision of the Plan

The Soquel-Aptos Area Groundwater Management Plan documents an on-going and evolving groundwater management program. The GMP will be reviewed and updated based on new issues, changed conditions, and technological advancements that will occur over time.

A comprehensive review and update of the GMP will be scheduled every five years, unless the Implementation Committee decides otherwise. This action will ensure that the Plan is a current and viable tool to guide continuing management of groundwater resources within the Soquel-Aptos area.

Section 7
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