Nipomo Mesa Management Area

6th Annual Report

Calendar Year 2013

Prepared by

NMMA Technical Group

Submitted April 2014

This page intentionally left blank.

Table of Contents

List of Figures

List of Tables

Acronyms

AF	-	acre-feet
AF/yr	-	acre-feet per year
ALERT	-	Automated Local Evaluation in Real Time
C.E.G.	-	Certified Engineering Geologist
C.H.G.	-	Certified Hydrogeologist
CCAMP	-	Central Coast Ambient Monitoring Program
CDF	-	California Department of Forestry (now Cal Fire)
CIMIS	-	California Irrigation Management Information System
CPUC	-	California Public Utilities Commission
CU	-	consumptive use
D	-	Day
DPH	-	California Department of Public Health
DWR	-	California Department of Water Resources
ES	-	Executive Summary
Ft	-	Feet
ft^2	-	square feet
ft msl	-	feet above mean sea level
Gpd	-	gallons per day
GSWC	-	Golden State Water Company
K	-	hydraulic conductivity
MCL	-	Maximum Contaminant Level
mg/L	-	milligrams per Liter
MOU	-	memorandum of understanding
Msl	-	mean sea level
NCSD	-	Nipomo Community Services District
NMMA	-	Nipomo Mesa Management Area
NSWP	-	Nipomo Supplemental Water Project
TG	-	Nipomo Mesa Management Area Technical Group
P.E.	-	Professional Engineer
P.G.	-	Professional Geologist
PG&E	-	Pacific Gas & Electric
RF	-	return flow
RP	-	reference point
RWC	-	Rural Water Company
SCWC	-	Southern California Water Company (now Golden State Water Company)
SLO	-	San Luis Obispo
SLO DPW	-	San Luis Obispo County Department of Public Works
SWP	-	State Water Project
TDS	-	Total Dissolved Solids
U.S.	-	United States
WWTF	-	wastewater treatment facility
WY	-	Water Year
Yr	-	year

Abbreviations

Blacklake WWTF	-	Blacklake Reclamation Facility
Cypress Ridge WWTF	-	Rural Water Company's Cypress Ridge Wastewater Facility
Judgment	-	Judgment After Trial dated January 25, 2008
Phase III	-	Santa Maria Groundwater Litigation Phase III
Program	-	Nipomo Mesa Management Area Monitoring Program
Santa Maria Groundwater Litigation	-	*Santa Maria Valley Water Conservation District vs. City of Santa Maria, et al.* Case No. 770214
Southland WWTF	-	Southland Wastewater Treatment Facility
Stipulation	-	Stipulated Judgment dated June 30, 2005
Temp	-	Temperature
Woodlands	-	Woodlands Mutual Water Company
Woodlands WWTF	-	Woodlands Mutual Water Company Wastewater Reclamation Facility

Executive Summary

This 6th Annual Report, covering calendar year 2013 for the Nipomo Mesa Management Area (NMMA), is prepared in accordance with the Stipulation and Judgment for the Santa Maria Groundwater Litigation (Lead Case No. 1-97-CV-770214). The Annual Report provides an assessment of hydrologic conditions for the NMMA based on an analysis of the data accruing each calendar year. Each Annual Report is submitted to the court annually in accordance with the Stipulation in the year following that which is assessed in the report. This Executive Summary contains three sections: ES-1 Background; ES-2 Findings; and ES-3 Recommendations.

ES-1 Background

The Court established three management areas overlying the Santa Maria Groundwater Basin. The NMMA lies between the Northern Cities Management Area to the north and the Santa Maria Valley Management Area to the south. The NMMA Technical Group (TG) is one of three management areas committees formed to administer the relevant provisions of the Stipulation. The TG is the committee for the NMMA. Phillips 66, Golden State Water Company, Nipomo Community Services District, and Woodlands Mutual Water Company are responsible for appointing the members of the committee, and along with an agricultural overlying landowner, who is also a Stipulating Party, are responsible for the preparation of this Annual Report. The goal of each management area is to promote monitoring and management practices so that present and future water demands are satisfied without causing long-term damage to the underlying groundwater resource.

The TG, charged with developing the technical bases for sustainable management of the surface and groundwater supplies, prepared this 6th Annual Report – Calendar Year 2013. The TG collected and compiled data and reports from numerous sources including the NMMA Monitoring Parties, the Counties of San Luis Obispo and Santa Barbara, the California Departments of Forestry, Water Resources, and Public Health, the State Water Resources Control Board, the U. S. Geological Survey, and the Engineers for the Northern Cities and Santa Maria Valley Management Areas. The TG previously developed, updates, and maintains an electronic database to aid in the evaluation of the long-term sustainability of the NMMA portion of the Santa Maria Groundwater Basin. The TG reviewed these data and reports and concluded that the development of additional data and evaluations will be on-going to aid the understanding of the hydrogeologic conditions of the NMMA and to make comprehensive recommendations for the long-term management of the NMMA.

The TG evaluated the available compiled data to reach the findings presented in the following section of this Executive Summary. The TG recognizes that the data used in the evaluations are not equally reliable but represent what is currently available. In some cases, additional analysis will be required for an adequate characterization of the physical setting within NMMA to develop an appropriately detailed model of the stratigraphy, defining the location and thickness of production aquifers and confining layers. Refinements in the understanding of the physical setting will improve upon estimates of groundwater in storage available for pumping to meet water demands. Such work is an important goal for the TG and mirrors the TG's desire to characterize groundwater storage in the NMMA. The TG has developed specific recommendations to address these issues for the next Annual Report.

ES-2 Findings

Presented in this section of the Executive Summary are brief descriptions of the findings by the TG for calendar Year 2013. Presented in the body of this report are the details and bases for these findings.

1. Potentially Severe Water Shortage Conditions continue to exist in the NMMA, as indicated by the Key Wells Index. More importantly, the Key Wells Index nearly reached the Severe Water Shortage Conditions criterion (see Section 7.2 Water Shortage Conditions). Coastal water quality continues to be better than thresholds for Water Shortage Conditions (i.e., chloride concentrations are less than threshold concentrations).

2. Spring groundwater elevations underlying the NMMA, indicated by the Key Wells Index of eight (8) wells, declined sharply from 2012 levels continuing a general decline from calendar year 1999 (see Section 7.1.1 Groundwater Conditions).

3. There are a number of direct measurements that indicate that demand exceeds the ability of the supply to replace the water pumped from the aquifers (see Section 7.1.2 Hydrologic Inventory).

4. The Nipomo Supplemental Water Project is under construction. Phase 1(650 AFY) is scheduled to be complete by summer 2015. Construction of Phase 2 (increases capacity to 1,600 AFY) and Phase 3 (increases capacity to 3,000 AFY) will be scheduled as soon as funding is available (see Section 1.1.7 Supplemental Water).

5. Total rainfall for Water Year 2013 (October 1, 2012 through September 30, 2013) is approximately 45 percent of the long-term average (see Section 3.1.3 Rainfall).

6. The period of analysis (1975-2013) used by the TG is roughly 9 percent “wetter” on average than the long-term record (1920-2013) indicating there is a slight bias toward overstating the amount of local water supply resulting from percolation of rainfall (see Section 7.3.1 Climatological Trends).

7. The total estimated 2013 calendar year groundwater production is 16,350 acre-feet (AF). The breakdown by user and type of use is shown in the following table (see Section 3.1.9 Groundwater Production).

Agriculture	6,830 AF
Urban/Industrial	9,520 AF
Total Production	**16,350 AF**

8. The total Waste Water Treatment Facility effluent discharged in the NMMA was 786 AF for Calendar Year 2013 (see Section 3.1.10 Wastewater Discharge and Reuse).

9. Contour maps prepared using Spring and Fall 2013 groundwater elevation data suggest regional groundwater flow is generally from east to west (toward the ocean). This regional flow direction is interrupted locally however, by the expanded pumping depression in the central NMMA. The contour maps also show a landward gradient from the coast, an indication that groundwater flow is from the ocean area toward inland areas (see Section 6.1.3 Groundwater Contours and Pumping Depressions).

10. The acreage for land use classification of Urban is 10,460 acres; of Agriculture is 2,970 acres; and, of Native is 7,702 acres (see Section 3.1.8 Land Use).

11. There is no evidence of any water quality contamination, including seawater intrusion that would significantly restrict current use of groundwater to meet the current water demands. However, there are known local water quality impairments, particularly with respect to nitrate, including in portions of the shallow aquifer. In 2013, monitoring wells in areas of known contamination reflected water quality concentrations greater than the drinking water MCL for nitrate and other contaminants (see Section 6.2.2 Results of Inland Water Quality Monitoring).

12. There continues to be a lack of understanding of the contribution of Los Berros and Nipomo Creeks to the NMMA water supplies, though a new gauge on Los Berros Creek will be installed by the County of San Luis Obispo (see Section 3.1.5 Streamflow).

13. There is a lack of understanding about confined and unconfined aquifer conditions in the NMMA, except near the coast and locally adjacent areas where the deep aquifers are known to be confined, despite plans to further develop the shallow unconfined aquifer (see Sections 2.3.1 Geology and 2.3.2 Groundwater Flow Regime).

14. There is a lack of understanding of the flow path of rainfall, applied water, and treated wastewater to specific aquifers underlying the NMMA (see Section 3.1.10 Wastewater Discharge and Reuse).

ES-3 Recommendations

A list of recommendations were developed and published in each of the previous NMMA Annual Reports. The TG will address past and newly developed recommendations along with the implementation schedule based on future budgets, feasibility, and priority. The recommendations are subdivided into three categories: (1) Draft capital and operation expenditure plan, (2) Achievements from earlier NMMA Annual Report recommendations accomplished in 2013; and (3) Technical Recommendations – to address the needs of the TG for data collection and compilation.

1.1. *ES-3.1Funding Recommendations*

The TG acknowledges that the work items and budget presented below represent a consensus view that additional technical work is necessary beyond that covered under the current $75,000 annual budget limit. Completing this broader scope of work will require a formal adjustment to the NMMA TG budget limit.

NMMA 5-Year Cost Analysis

Task Description	Total Cost	Targeted Completion Year	Projected 5-year Cash Flow				
			2014	2015	2016	2017	2018
Yearly Tasks							
Annual Report preparation			$50,000	$50,000	$50,000	$50,000	$50,000
Grant funding efforts			$10,000	$10,000	$10,000	$10,000	$10,000
Confining layer definition			$10,000	$10,000	$10,000	$10,000	$10,000
Well head surveying			$3,000	$3,000	$3,000	$3,000	$3,000
Analytical testing			$5,000	$5,000	$5,000	$5,000	$5,000
Long Term Studies							
Groundwater model (NMMA share)	$250,000	2018	$33,300	$33,300	$33,300	$75,000	$75,000
Capital Projects							
Oso Flaco monitoring well	$130,000	2018	$43,300	$43,300	$43,300	- -	- -
Automatic monitoring equipment	$25,000	2018	- -	- -	- -	$12,500	$12,500
Total Projected Annual Cost			$154,600	$154,600	$154,600	$165,500	$165,500

1.2. *ES-3.2Achievements from Previous NMMA Annual Report Recommendations*

The TG worked diligently to address several of the recommendations outlined in the previous Annual Reports. Accomplishments and/or progress made during 2013 include:

- Development of refined cross sections through key areas of the basin,
- Update of Land Use classification,
- Update of Crop Coefficients defining water use by specific crop type.

ES-3.3 Technical Recommendations

The following technical recommendations are not organized in their order of priority because the monitoring parties, considering their own particular funding constraints and authorities, will determine the implementation strategies and priorities. However, the TG has suggested a priority for some of the technical recommendations.

- **Supplemental Water Supplies –** Additional water supplies that would allow for reduced pumping within the NMMA are the most effective method of reducing the stress on the aquifers and allow for groundwater elevations to recover, and provide means for long-term basin management. The NSWP (see Section 1.1.7-Supplemental Water) is the fastest and most viable alternative water supply in the next ten years. Given the Potentially Severe Water Shortage Conditions within the NMMA and the other risk factors discussed in this Report, the TG recommends that this project be fully implemented as soon as possible.

- **Subsurface Flow Estimates – C**ontinue to develop and evaluate geologic cross-sections along NMMA boundaries and make estimates of subsurface flow.

- **Installation of Groundwater Monitoring Equipment –** The pumping of nearby wells and the length of time a well is not pumped (rested) may have an impact on the static water level measured in a well. For the Key Wells, the installation of transducers and data loggers will largely solve this problem. Installation of transducers is also recommended for purveyors' wells that pump most of the time.

- **Changes to Monitoring Points or Methods –** The coastal monitoring wells are of great importance in the Monitoring Program. The inability to locate the monitoring well cluster under the sand dunes proximally north of Oso Flaco Lake renders the southwestern coastal portion of the NMMA without adequate coastal monitoring. During 2009 and 2010, the NMMA TG reviewed options for replacing this lost groundwater monitoring site. The TG was given written support of the concept from the State Parks Department to allow replacement of the well, and the TG has also had discussions with San Luis Obispo County, which may be able to provide some financial assistance for the project. The NMMA TG has incorporated replacement of this monitoring well in its long-term capital project planning and will investigate possible State or Federal grants for financial assistance with the construction of this multi-completion monitoring well.

- **Well Management Plan –** It is recommended that for calendar year 2014, purveyors compile and present to the TG a Well Management Plan status update.

- **County of San Luis Obispo Monitoring Locations –** Review proposed County of San Luis Obispo monitoring well and stream gauge locations.

- **Well Reference Point Elevations –** It is recommended that all the wells used for monitoring have an accurate RP elevation. This could be accomplished by surveying a few wells every year or by working with the other Management Areas and the two counties in the Santa Maria Groundwater Basin to obtain LIDAR data for the region; the accuracy of the LIDAR method allows one-foot contours to be constructed and/or spot elevations to be determined to similar accuracy.

- **Groundwater Production –** Estimates of total groundwater production are based on a combination of measurements provided freely from some of the parties, and estimates based on land use. The TG recommends developing a method to collect groundwater production data from all stipulating parties. The TG recommends continued updating the land use classification on an interval commensurate with significant changes in land use patterns and as is practical, with the intention that the interval is more frequent than DWR's 10-year cycle of land use classification.

- **Increased Collaboration with Agricultural Producers –** To better estimate agricultural groundwater production where data is incomplete, it is recommended that the TG work with a subset of farmers to measure groundwater production. This measured groundwater production can then be used to calibrate models and verify estimates of agricultural groundwater production where data are not available.

- **Hydrogeologic Characteristics of NMMA –** Further defining the continuity of confining conditions within the NMMA remains a topic of investigation by the TG. The locations of confined and unconfined conditions is important – they control to a significant degree both the NMMA groundwater budget as to the quantity of recharge from overlying sources and any calculation of changes in groundwater storage. Further review of well screen intervals, lithology, groundwater level, and other relevant information to segregate wells into the different aquifers groups (e.g., shallow versus deep aquifers) for preparation of groundwater elevation contour maps for different aquifers. In addition, the NMMA will be requesting geologic information obtained during the PG&E long-term seismic studies program.

- **Modifications of Water Shortage Conditions Criteria –** The Water Shortage Conditions and Response Plan was submitted to the Court in 2008. The TG will review the plan on a regular basis.

- **Groundwater Modeling –** The TG continues to recommend the advancement of a groundwater model as presented in the NMMA 5-year Cost Analysis. This may include collaboration with the Northern Cities Management Area, the Santa Maria Valley Management Area or both.

1. Introduction

The rights to extract water from the Santa Maria Groundwater Basin have been in litigation since the late 1990s. By stipulation and Court action three separate management areas were established, the Northern Cities Management Area, the Nipomo Mesa Management Area (NMMA) and the Santa Maria Valley Management Area. Each management area was directed to form a group of technical experts to continue to study and evaluate the characteristics and conditions of each management area and present their findings to the Court in the form of an Annual Report.

This 6th Annual Report - Calendar Year 2013 is a joint effort of the NMMA Technical Group (TG). The requirement contained in the Judgment for the production of an Annual Report is as follows:

> Within one hundred and twenty days after each Year, the Management *Area Engineers will file an* Annual Report with the Court. The Annual *R*eport will summarize the results of the Monitoring Program, changes in groundwater supplies, and any threats to Groundwater supplies. The Annual Report shall also include a tabulation of Management Area water use, including Imported Water availability and use, Return Flow entitlement and use, other Developed Water availability and use, and Groundwater use. Any Stipulating Party may object to the Monitoring Program, the reported results, or the Annual Report by motion.

This Annual Report is organized into ten sections that present: the general background of the litigation and some of the requirements imposed by the Court, a description of the Basin, Data Collection, Water Supply and Demand, Hydrologic Inventory, Groundwater Conditions, Analysis of Groundwater Conditions, Other Considerations, Recommendations; and References.

Five appendices are also included in the Annual Report: Appendix A – NMMA Monitoring Program, Appendix B – NMMA Water Shortage Conditions and Response Plan, Appendix C – Well Management Plan, Appendix D – Data Acquisition Protocols for Groundwater Level Measurements for the NMMA, and Appendix E – Additional Data. Five annual reports have previously been prepared, spanning calendar years 2008 to 2012 (NMMA, 2009, 2010, 2011, 2012, and 2013).

1.1. *Background*

Presented in this subsection is the history of the litigation process and general discussions of activities that have been undertaken to date or are underway to manage the water resources of the NMMA.

1.1.1. History of the Litigation Process

The Santa Maria Groundwater Basin has been the subject of ongoing litigation since July 1997. Collectively called the Santa Maria Groundwater Litigation (*Santa Maria Valley Water Conservation District vs. City of Santa Maria, et al.* Case No. 770214), over 1,000 parties were involved with competing claims to pump groundwater from within the boundary of the Santa Maria Groundwater Basin (Figure 1-1).

The Santa Maria Valley Water Conservation District was originally concerned that banking of State Water Project (SWP) water in the groundwater basin by the City of Santa Maria would give the City priority rights to the groundwater. The lawsuit was broadened to address groundwater management of the entire Santa Maria Groundwater Basin.

On June 30, 2005, the Stipulating Parties entered a Stipulated Judgment ("Stipulation") in the case that was approved by the Court on August 3, 2005. The Stipulation divides the Santa Maria Groundwater Basin into three separate management sub-areas (the Northern Cities Management Area, the Nipomo Mesa Management Area (NMMA), and the Santa Maria Valley Management Area). The Stipulation contains specific provisions with regard to rights to use groundwater, development of groundwater monitoring programs, and development of plans and programs to respond to Potentially Severe and Severe Water Shortage Conditions.

The TG was formed pursuant to a requirement contained in the Stipulation. Sections IV D (All Management Areas) and Section VI (C) (Nipomo Mesa Management Area) contained in the Stipulation were independently adopted by the Court in the Judgment After Trial (herein "Judgment"). The Judgment is dated January 25, 2008, and was entered and served on all parties on February 7, 2008.

It is noted that pursuant to paragraph 5 of the Judgment, the TG retains the right to seek a Court Order requiring non-stipulating parties to monitor their well production, maintain records thereof, and make the data available to the Court or the Court's designee. The compilation and evaluation of existing data, and the aggregation of additional data, are ongoing processes. Given its limited budget and resources, the TG has focused its efforts on the evaluation of readily accessible data. The TG does intend to slowly integrate into its assessment new data that may be collected from stipulating parties and other sources that were not previously compiled as part of the existing database.

1.1.2. Description of the Nipomo Mesa Management Area Technical Group

The TG is composed of representatives of the Nipomo Community Services District (NCSD), Golden State Water Company (GSWC) (formerly named Southern California Water Company), Phillips 66 (formerly named ConocoPhillips), Woodlands Mutual Water Company (Woodlands), and an agricultural user that is also a Stipulating Party. In addition, Rural Water Company (RWC) is responsible for funding a portion of the TG's efforts, but does not appoint a representative to the TG. Conversely, the agricultural user representative is not responsible for funding a portion of the TG's efforts. The TG is responsible for preparing the Monitoring Program, conducting the Monitoring Program, and preparing the Annual Reports. The TG attempts to obtain unanimous approval on all material issues by way of a single vote per Monitoring Party. If the TG is unable to obtain unanimous approval, the matter may be taken to the court for resolution.

The TG may hire individuals or consulting firms to assist in the preparation of the Monitoring Program and Annual Reports (the Judgment describes these individuals or consulting firms as the "Management Area Engineer"). The representatives to the TG, as a group, function as the Management Area Engineer (Table 1-1) and attend meetings where data collection and preparation of the Annual Report are the primary focus. The TG Monitoring Parties have the sole discretion to select, retain, and replace the Management Area Engineer.

Table 1-1. NMMA Technical Group

Monitoring Parties	Management Area Engineer Representatives
Agricultural Users	Jacqueline Frederick, J.D.
Phillips 66	Steve Bachman, Ph.D., P.G.
	Norm Brown, Ph.D., P.G.
Golden State Water Company	Robert Collar, P.G., C.H.G.
	Toby Moore, Ph.D., P.G., C.H.G.
	Ken Petersen, P.E.
Nipomo Community Services District	Brad Newton, Ph.D., P.G.
Woodlands	Tim Cleath, P.G., C.H.G., C.E.G.
	Rob Miller, P.E.
Note: Each Monitoring Party has a single vote in order to unanimously approve final work product.	

1.1.3. Coordination with Northern Cities and Santa Maria Valley Management Areas

The NMMA is bounded on the north by the Northern Cities Management Area and on the south by the Santa Maria Valley Management Area (Figure 1-1). Subsurface Flows are monitored in all three Management Areas by comparing groundwater elevation data on each side of the management area boundary to determine the gradient and direction of flow. Groundwater elevation data is collected within the boundaries and shared with the others to allow estimates of the quantity and direction of flow. The TG has incorporated this concept in its monitoring program submitted to the court and described in the next section. It is understood that the neighboring subareas will do the same.

One of the sources of uncertainty is the subsurface quantity of groundwater that crosses the NMMA boundaries. The TG recognizes that collaborative technical efforts with the Northern Cities Management Area and Santa Maria Valley Management Area technical groups will be important to the appropriate management of the basin. Examples of current collaborative efforts include:

- Sharing of technical data throughout the year, and during the preparation of Annual Reports,
- Opportunities for review and comment on technical work products,
- Sharing of protocols and standards for data collection and analysis, and
- Consideration of jointly-pursued projects and grant opportunities.

As the conditions of the existing basin underlying the NMMA are described in subsequent sections, periodic reference will be made to the Annual Reports produced by the two neighboring technical groups. The aerial extent of groundwater contours has also been limited to the immediate vicinity of the NMMA.

1.1.4. Development of Monitoring Program

In 2008, the TG developed and the Court approved the NMMA Monitoring Program ("Monitoring Program"), attached as Appendix A, to ensure systematic monitoring of important information in the basin. This Monitoring Program includes information such as groundwater elevations, groundwater quality, and pumping amounts. The Monitoring Program also identifies a number of wells in the NMMA to be monitored (Figure 1-3) and discusses the methods of analysis of the data.

A large areal extent within the NMMA receives water service from the major water purveyors (Figure 1-2). The majority of the lands within the NMMA obtain water by means other than from a purveyor. A fraction of these property owners are Stipulating Parties. All of the larger purveyors are also Stipulating Parties. All Stipulating Parties are obligated to make available relevant information regarding groundwater elevations and water quality data necessary to implement the NMMA Monitoring Program.

1.1.5. Development of Water Shortage Conditions and Response Plan

Pursuant to the Stipulation, the TG developed a Water Shortage Conditions and Response Plan that is included as part of the Monitoring Program. The Water Shortage Conditions are characterized by two different criteria – those for Potentially Severe Water Shortage Conditions and those for Severe Water Shortage Conditions. The Response Plan for these conditions includes voluntary and mandatory actions by the parties to the Stipulation. The Court approved the Water Shortage Conditions and Response Plan on April 22, 2009, and the document is attached as Appendix B to this report.

1.1.6. Well Management Plan

The Stipulation requires the preparation of a Well Management Plan (WMP) when Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions exist prior to the completion of a Supplemental Water project. The WMP provides for steps to be taken by the NCSD, GSWC, Woodlands and RWC under these water shortage conditions. The WMP has no applicability to either Phillips 66 or Overlying Owners as defined in the Stipulation. The WMP was adopted by the TG in January 2010 and is attached as Appendix C to this report.

There are currently no facilities to transfer water between RWC and the other purveyors. Beginning in 2010, NCSD and RWC began discussing the planning and design related to establishing facilities to convey water.

1.1.7. Supplemental Water

To bring Supplemental Water to the NMMA, pursuant to the Stipulation:

> "The NCSD agrees to purchase and transmit to the NMMA a minimum of 2,500 acre-feet of Nipomo Supplemental Water each Year. However, the NMMA Technical Group may require NCSD in any given Year to purchase and transmit to the NMMA an amount in excess of 2,500 acre-feet and up to the maximum amount of Nipomo Supplemental Water which the NCSD is entitled to receive under the MOU if the Technical Group concludes that such an amount is necessary to protect or sustain Groundwater supplies in the NMMA. The NMMA Technical Group also may periodically reduce the required amount of Nipomo Supplemental Water used in the NMMA so long as it finds that groundwater supplies in the NMMA are not endangered in any way or to any degree whatsoever by such a reduction."

> "Once the Nipomo Supplemental Water is capable of being delivered, those certain Stipulating Parties listed below shall purchase the following portions of the Nipomo Supplemental Water Yearly:
>
> NCSD - 66.68%
> Woodlands - 16.66%
> SCWC (i.e. GSWC) - 8.33%
> RWC - 8.33%"

The final Judgment entered on January 24, 2008, states: "The court approves the Stipulation, orders the Stipulating Parties only to comply with each and every term thereof, and incorporates the same herein as though set forth in full." Thus, the terms of the Stipulation as herein stated must be complied with in accordance with the order of the Court.

The NCSD is constructing a project (i.e. the NSWP) to bring Supplemental Water to the above referenced Stipulating Parties within the NMMA. The NSWP involves the construction of approximately five miles of new water main to transport up to 3,000 AF of water from the City of Santa Maria. Phase 1 is under construction and expected to be complete by summer 2015. In the first year of Phase 1 operation, NCSD expects to deliver ~650 AF of water from the City. Construction of Phase 2 (increases capacity to 1,600 AFY) and Phase 3 (increases capacity to 3000 AFY) will be scheduled as soon as funding is available. Phase 1 includes installation of 24-inch inner diameter pipe from the point of connection with the City of Santa Maria to the pump station located on the Nipomo Mesa. This pipe is capable of delivering 6,200 AFY. The pipe from the pump station to the purveyor distribution systems is capable of delivering 3,000 AFY. There are no current plans to increase the project size beyond 3,000 AFY. The License Agreement the County of Santa Barbara issued to facilitate the pipeline crossing the County's flood control levee constrains the project to a maximum delivery of 3,000 AFY.

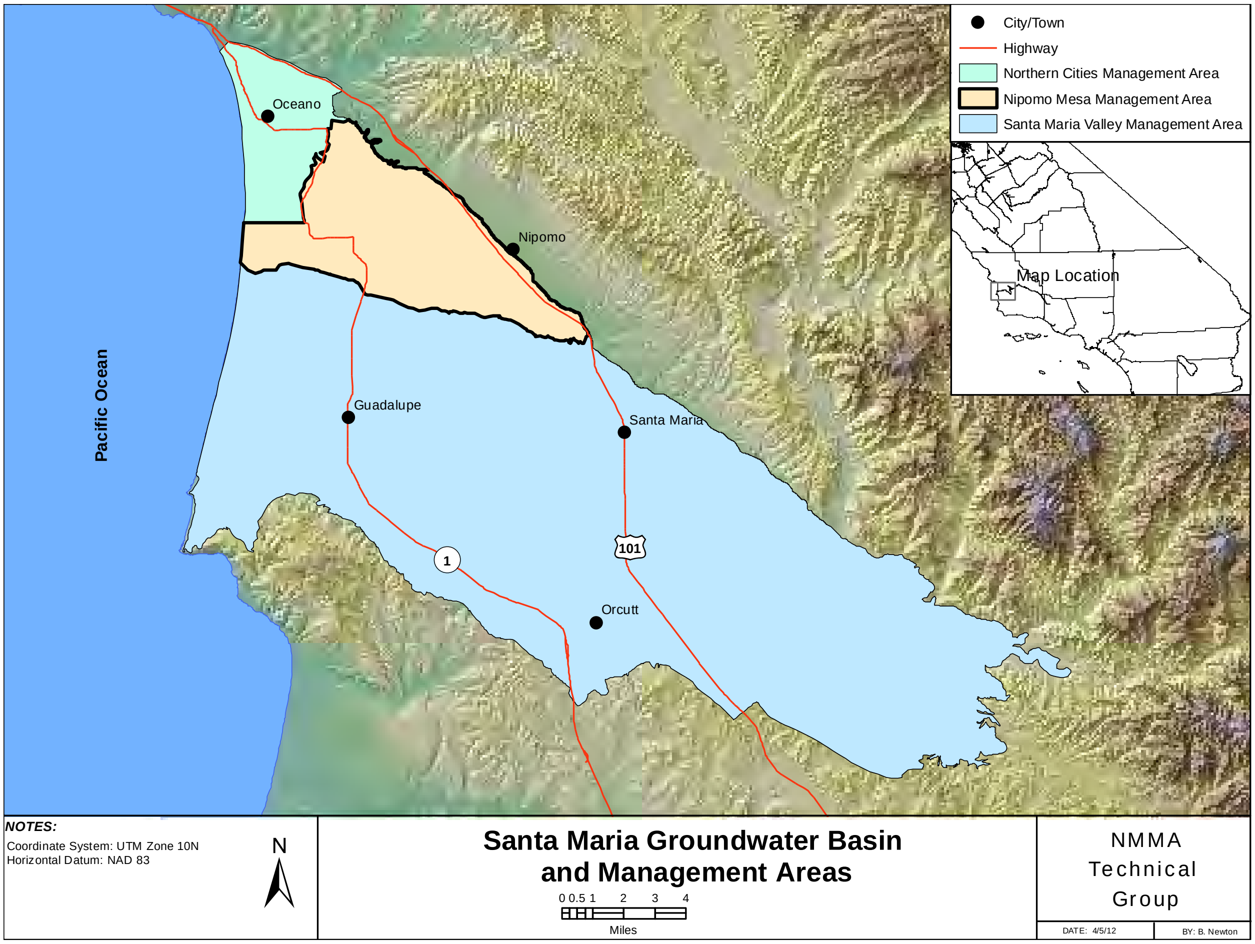


Figure 1-1. Santa Maria Groundwater Basin and Management Areas

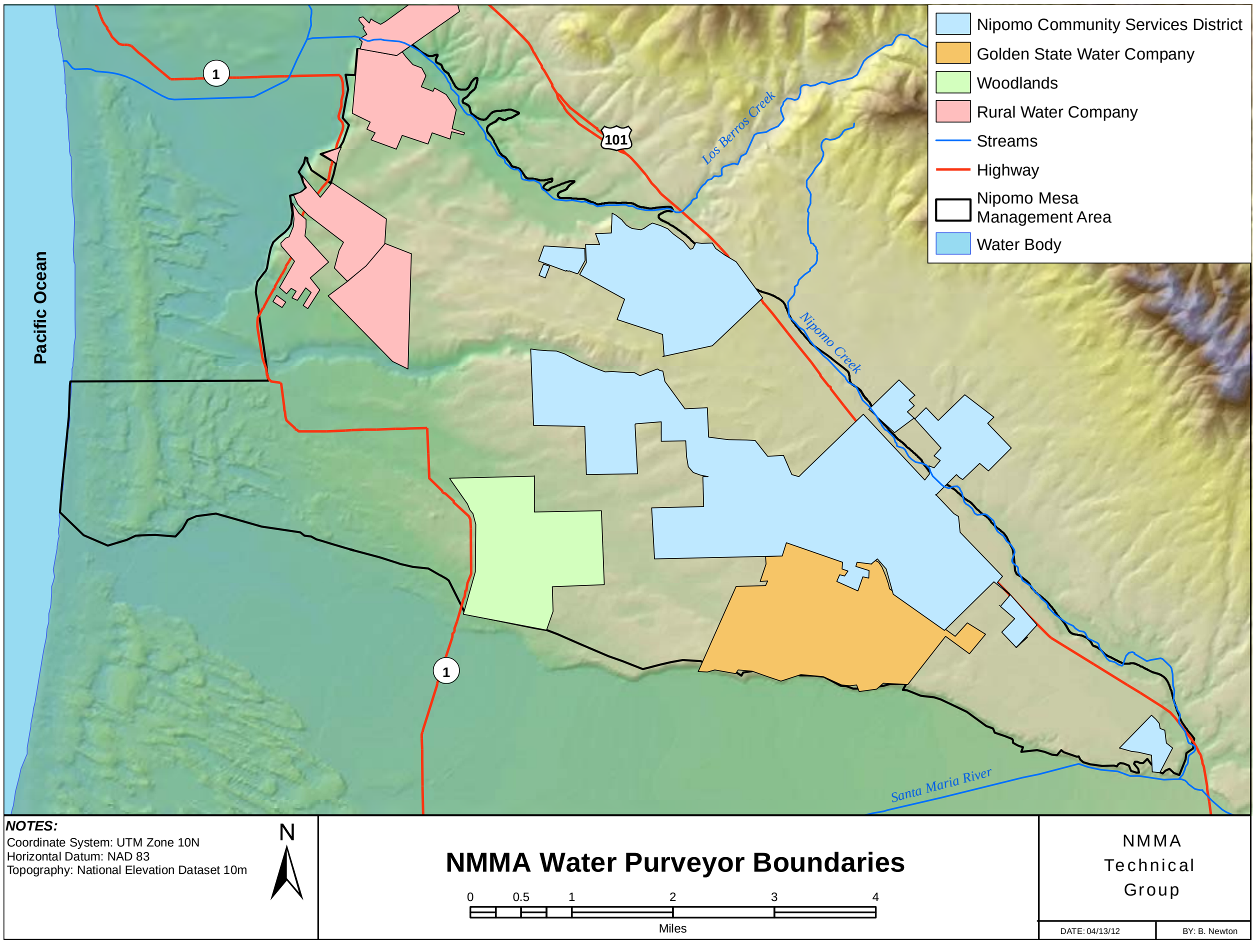


Figure 1-2. NMMA Water Purveyor Boundaries

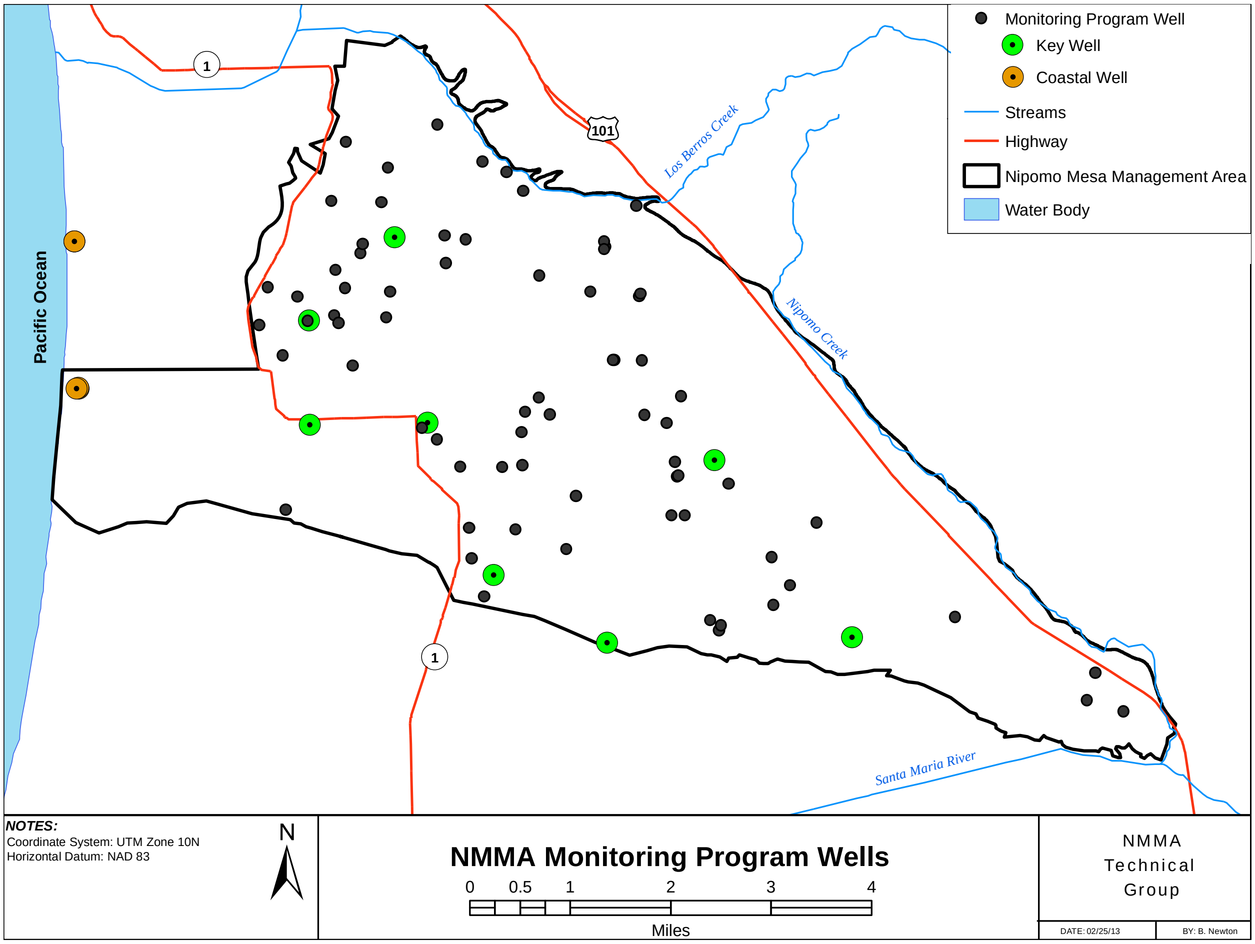


Figure 1-3. NMMA Monitoring Program Wells

2. Basin Description

The Santa Maria Groundwater Basin, covering a surface area of approximately 256 square miles, is bounded on the north by the San Luis and Santa Lucia mountain ranges, on the south by the Casmalia-Solomon Hills, on the east by the San Rafael Mountains, and on the west by the Pacific Ocean. The basin receives water from rainfall directly and runoff from several major watersheds drained by the Cuyama River, Sisquoc River, Arroyo Grande Creek, and Pismo Creek, as well as many minor tributary watersheds. Sediment eroded from these nearby mountains and deposited in the Santa Maria Valley formed beds of unconsolidated alluvium, averaging 1,000 feet in depth, with maximum depths up to 2,800 feet and comprise the principal production aquifers from which water is produced to supply the regional demand. Three management areas were defined to recognize that the development and use of groundwater, State Water Project water, surface water storage, and treatment and distribution facilities have historically been financed and managed separately, yet they are all underlain by or contribute to the supplies within the same groundwater basin.

2.1. *Physical Setting*

The NMMA has physical characteristics which are distinct from the other two management areas. It is largely a mesa area that is north of the Santa Maria River, west of the San Luis Range and south of the Arroyo Grande Creek, with a lower lying coastal environment to the west. The mesa was formed when the Santa Maria River and Arroyo Grande Creek eroded the surrounding area. The current coastal environment developed subsequently, is composed of beach dunes and lakes, and is currently a recreational area with sensitive species habitat. Locally, hummocky topography on the mesa area reflects the older dune deposits. Black Lake Canyon is an erosional feature north-central in the NMMA and where the dune deposit thickness is exposed.

2.1.1. Area

The NMMA covers approximately 33 square miles or 21,100 acres, which accounts for approximately 13 percent of the overall Santa Maria Groundwater Basin (164,000 acres). Approximately 13,000 acres on the NMMA, or 60 percent, is developed land requiring water pumped from the underground aquifers to sustain the agricultural and urban development.

2.1.2. General Land Use

Land uses include agricultural, urban (residential/commercial), and native or undeveloped areas. There are also three golf courses and one oil-processing facility. The crop types grown in the order of largest acreage were strawberries and cane berries, nursery, rotational vegetables (broccoli, lettuce, etc.) avocado and lemon, pasture, and deciduous and grapes, based on a survey in year 2013.

2.2. *Climate*

A Mediterranean-like climate persists throughout the area with cool moist winters and warm dry summers. During the summer months, the warm air inland rises and draws in the relatively cooler marine layer near the coastline keeping summer cooler and providing moisture for plant growth, while in the winter months the relatively warmer ocean temperature keeps the winter warmer. The average annual maximum temperature is 69 degrees Fahrenheit, and the average annual minimum temperature is 46 degrees Fahrenheit. Precipitation normally occurs as rainfall between November and April when cyclonic storms originating in the Pacific Ocean move onto the continent. The long-term (1959 to 2013) average annual rainfall reported at CDF Nipomo Rain Gauge #151.1 is 15.77 inches and is representative of the larger area of the NMMA. Rainfall variability exists across the NMMA and rainfall increases in the foothills and mountains due to the orographic (elevation) effect. The average annual evapotranspiration from standard turf (a well-watered actively growing closely clipped grass that is completely shading the soil) is 52 inches, and is referred to as the reference evapotranspiration (Table 2-1).

Table 2-1. Climate in the Nipomo Mesa Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temp (Fahrenheit)[1]	63.3	64.3	64.8	66.9	68.3	70.6	72.8	73.2	74.4	73.5	69.2	64.3	68.8
Average Min Temp (Fahrenheit)[1]	39.0	40.9	42.0	43.5	46.8	50.1	53.1	53.6	52.2	48.1	42.6	38.7	45.9
Average Rainfall (inches)[2]	3.24	3.27	2.74	1.12	0.24	0.05	0.02	0.04	0.19	0.72	1.57	2.51	15.71
Monthly Average Reference Evapotranspiration (inches)[3]	2.21	2.50	3.80	5.08	5.70	6.19	6.43	6.09	4.87	4.09	2.89	2.28	52.13
Monthly Average Reference Evapotranspiration (inches)[4]	2.18	2.41	3.56	4.55	5.10	4.46	4.98	4.54	3.77	3.38	2.41	1.94	43.29

Notes:
1. Data from Santa Maria Airport - Nearest long-term temperature record to the NMMA in the Western Regional Climate Center is from the Santa Maria Airport, station #47946. The average is from 1948 through 2013. Source: http://www.wrcc.dri.edu/climsum.html2.
2. Data from CDF Nipomo Rain Gauge 151.1 (1959 to 2013).
3. Data from California Irrigation Management Information System (CIMIS) - Records at Nipomo (202) are less than 8 years; therefore, CIMIS reports the regional average for Central Coast Valleys for Station #202. Source: http://www.cimis.water.ca.gov/cimis/data.jsp
4. Data from California Irrigation Management Information System (CIMIS), calculated from monthly evapotranspiration (ET_o) for the period of record at Station 202 Nipomo (June 2006 to December 2013). Source: http://www.cimis.water.ca.gov/cimis/data.jsp

2.3. *Hydrogeology*

Groundwater management is founded upon an understanding of the geology and the groundwater flow regime specific to the NMMA.

2.3.1. Geology

The NMMA overlies part of the northwest portion of and is contiguous with the Santa Maria Groundwater Basin (Figure 1-1). The unconsolidated sedimentary deposits comprising the main aquifers of the groundwater basin underlying the NMMA include the Pliocene age Careaga Formation and the Plio-Pleistocene age Paso Robles Formation. These basin sedimentary formations are overlain by Quaternary age dune sands on the Mesa (Figure 2-1), and by the Quaternary age alluvium in Los Berros Valley and in Nipomo Valley (on the eastern perimeter of the NMMA) which, where saturated, are also aquifers. These sedimentary beds have been deposited within the Santa Maria Valley synclinal basin. The pre-Quaternary age sedimentary beds have been displaced by faults within and on the perimeter of the basin. The extent of the geologic formations and the faulting within the NMMA area are shown on the following geologic map. Further information on these geologic formations and the geologic structure is available in the 2nd Annual Report – Calendar Year 2009 (NMMA, 2010).

The deep aquifers within the Paso Robles and Careaga Formations underlying the Nipomo Mesa comprise the main source of water for municipal and agricultural wells. The shallow aquifers in the Los Berros Valley alluvium and Nipomo Mesa dune sands are tapped by lower capacity domestic and agricultural wells. These deep and shallow aquifers are in places separated vertically by relatively low hydraulic conductivity layers (i.e. aquitards), which act locally as confining layers within the NMMA. Notably, a shallow aquifer well, which encountered the base of the shallow aquifer at an elevation of about 130 feet below mean sea level, was completed by Woodlands in 2013. The static groundwater level was measured at an elevation of about 85 feet above mean sea level and the well will be used to supply water for irrigation.

A cross section generally following the northwestern boundary of the NMMA from Los Berros Creek and Nipomo Hill in the north to Black Lake Canyon and State Route 1 (Figure 2-1) has been prepared based on well logs and geologic maps as a foundation for evaluating groundwater flow in this area. The cross section (Figure 2-2) was developed primarily using 19 wells distributed from north to south along, and located within roughly one half mile east (primarily) and west of, the approximately 4-mile-long cross section. The wells and associated lithology are not included on the cross section because they are considered confidential according to the California Water Code. It should be noted that this cross section represents a little more than about 10 percent of the roughly 30-mile-long boundary of the NMMA.

The cross section generally shows the land surface, relatively permeable aquifers tapped by many wells in the area, underlying relatively impermeable bedrock, and the Oceano fault. Aquifers include the Younger Alluvium, Dune Sand deposits, Paso Robles Formation (clay and gravel beds), and underlying marine sands of the Careaga Formation. The base of the Dune Sand slopes to the southwest from where it laps onto the Nipomo Hill bedrock at an elevation of more than 100 feet above sea level to an elevation of about 100 feet below sea level at the southern end of the cross section. The Paso Robles and Careaga Formation beds also slope to the southwest from Nipomo Hill toward Black Lake Canyon, where the base of these formations drops to an elevation of at least about 400 feet below sea level (Figure 2-2).

The relatively impermeable bedrock, which is tapped by very few wells, is comprised of the Cretaceous and Jurassic age Franciscan Complex rock and older sedimentary beds (early Pliocene age Sisquoc Formation). Franciscan Complex bedrock is exposed at the base of Nipomo Hill at Los Berros Road and remains at relatively shallow depths, within a few hundred feet of the land surface, toward the south to Woodland Hills Road (Figure 2-2). As the sedimentary beds thicken toward the coast, older low permeability sedimentary beds underlie the water-bearing formations. These older sedimentary beds, though not as impermeable as the Franciscan Complex rock, are less permeable and contain poorer quality groundwater than the overlying Paso Robles and Careaga Formations.

The Oceano fault (U.S. Geological Survey and California Geological Survey, 2006) trends northwest-southeast as it crosses the NMMA boundary near Woodland Hills Road and Kip Lane. Separation of the Paso Robles and Careaga Formations is evident, whereas separation of the Dune Sands is not known. Movement on the fault has down-dropped aquifers to the southwest and the fault may be an impediment to groundwater flow within the Paso Robles and Careaga Formations.

A geologic cross section was prepared to advance understanding of groundwater flow at the Santa Maria Valley Management Area/Nipomo Mesa Management Area (SMVMA/NMMA) boundary (Figure 2-3). The cross section generally follows the southern boundary of the NMMA and is based on available subsurface information from exploratory oil well logs, water well logs, published geology and hydrogeologic reports, and geophysical surveys. The aquifers depicted extend both to the south and north of the SMVMA/NMMA boundary and groundwater flow can be expected to occur across this boundary. Groundwater flow may be impeded by geologic features including near-vertical boundaries such as faults and near-horizontal aquitards that are illustrated on this cross section. Understanding groundwater flow across this boundary will require additional information that is being developed by the NMMA technical group.

2.3.2. Groundwater Flow Regime

Groundwater flows within the NMMA from recharge sources toward areas of groundwater discharge. Groundwater flow is controlled by:

- hydraulic head (e.g., recharge and pumping),
- impediments to flow (e.g., faults),
- preferential flow paths (e.g., buried gravel channel deposits), and
- geology (e.g., geologic facies contacts or leakage through fine grained beds).

Groundwater elevation hydrographs show measured groundwater elevations over time within the specific aquifers tapped by a well and are site-specific for specific times. Groundwater elevation measurements within an aquifer are mapped and interpreted to develop groundwater contours (see Section 6.1.3 Groundwater Contours and Pumping Depressions). Groundwater contour maps provide an interpreted understanding of the hydraulic head conditions within specific aquifer zones.

The following paragraphs present our current understanding of the groundwater flow regime. This understanding includes groundwater flow along the boundaries of the NMMA and groundwater flow within the NMMA.

Groundwater flow at the NMMA Boundary

The NMMA area encompasses only part of the Santa Maria Groundwater Basin. Groundwater flow between adjacent portions of the basin can be expected to occur, but less subsurface flow is likely to occur along bedrock basin edges than between areas where there is continuity of the aquifers.

The eastern boundary of the NMMA is approximately coincident with Nipomo Creek in Nipomo Valley. Groundwater recharge from the creek may occur through the shallow creek deposits but minimal subsurface inflow into the NMMA area occurs from the bedrock underlying the creek alluvium.

The northern boundary of the NMMA is coincident with the creek alluvium – Paso Robles Formation boundary within Los Berros Creek Valley. It is underlain by alluvium that receives recharge from Los Berros Creek which may be a significant source of groundwater recharge. Formations north of the Los Berros Valley include sedimentary deposits and underlying Franciscan Complex, where groundwater flow from these formations to the NMMA is likely negligible.

The northwest boundary of the NMMA is at the base of the Mesa along the Cienega Valley of Arroyo Grande Creek. Groundwater flow across this boundary can occur, and may be impeded by the Oceano fault and the bedrock outcrop at Nipomo Hill. A cross section along the north edge of the Mesa was developed to aid in characterization of the subsurface geology (Figure 2-2). Hydrogeologic parameters have subsequently been used, along with groundwater level contour maps, to evaluate the amount of groundwater flow that occurs across this interface between the NMMA and the Northern Cities Management Area (see Section 5.2 Subsurface Flow).

The southern boundary of the NMMA is at the base of the Mesa along the Santa Maria River Valley. Groundwater flow across this boundary can occur and may be impeded by the Oceano fault. A cross section along this boundary is being developed to aid in characterization of the subsurface geology. Hydrogeologic parameters can then be used, along with groundwater level contour maps, to estimate the amount of flow that occurs at this interface between the NMMA and the Santa Maria Valley Management Area.

The western boundary of the NMMA is a combination of the east-west R3 administrative line (San Luis Obispo County land use zoning) from the Cienega Valley to the coast and south along the coastline. Groundwater flow has historically occurred from land to the ocean across this boundary. This boundary is particularly important because a reversal of flow across this boundary may result in seawater intrusion.

Along the coastal portion of the NMMA, there is a potential for seawater intrusion to occur. The risk of seawater intrusion to NMMA water supply is a function of the groundwater elevation, the depth of the aquifers, the structural geology and stratigraphy, and the location of a seawater-fresh groundwater interface. It is not known if the principal aquifers are exposed on the seafloor along the coastal portion of the NMMA. The nearest known aquifer exposure on the seafloor occurs to the north of the NMMA area. A further risk of seawater intrusion to NMMA water supply could exist along vertical migration pathways in a near coastal zone or lateral intrusion from the adjacent management areas. Seawater intrusion is minimized where offshore gradients exist, and could occur most rapidly if the onshore aquifers are pumped in excess of fresh water replenishment.

Groundwater flow within the NMMA

Groundwater flow within the NMMA is influenced by geologic features, and recharge and discharge points. Aquitards within the Nipomo Mesa restrict vertical groundwater flow particularly between the shallow and deep aquifers. Recharge sources include major point sources (Los Berros Creek, stormwater runoff basins and wastewater percolation ponds) and distributed recharge sources (septic systems, percolation of rainfall and irrigation return flows). Discharge locations include pumping wells, areas of surface outflow, and phreatophyte consumption.

Groundwater flow from the Los Berros Creek alluvium toward the Mesa can occur where the alluvium overlies or is in contact with the shallow and deep aquifers along the southern edge of the Los Berros Valley. A cross section along this alignment is being developed to aid in characterization of the subsurface geology. Hydrogeologic parameters can then be used, along with groundwater levels, to estimate the amount of flow that occurs at Los Berros Valley alluvium and Mesa basin sediments interface.

Faults have been identified by the California Department of Water Resources (2002) and by previous geological studies (Figure 2-1). These studies identify multiple faults that cross the NMMA. These faults have been interpreted to vertically displace the pre-Holocene geologic units. The overlying dune sands do not appear to be displaced along these faults. The faults could impede flow within basin sedimentary beds. Current seismic studies are being performed for Pacific Gas and Electric Company as mandated by the Nuclear Regulatory Commission for permitting operation of the Diablo Nuclear Power Plant. Additionally, SLO County Public Works is characterizing the groundwater basins under the NMMA and NCMA to support their Salt and Nutrient Management Plan process. These studies can be expected to provide additional information that can be used to improve the definition of faulting and its impact on groundwater flow in the NMMA.

Aquitards that influence vertical migration of groundwater between aquifers have varying thicknesses and hydraulic conductivities (Figure 2-4). A significant aquitard exists in some areas near the base of the dune sand deposits that confines groundwater in underlying aquifers. Locally groundwater may be perched above the aquitard. Some leakage is likely to occur where the aquitard hydraulic conductivity increases and thickness decreases. The extent and thickness of the aquitards have been defined in some places based on well logs and correlations or inferred based on groundwater levels.

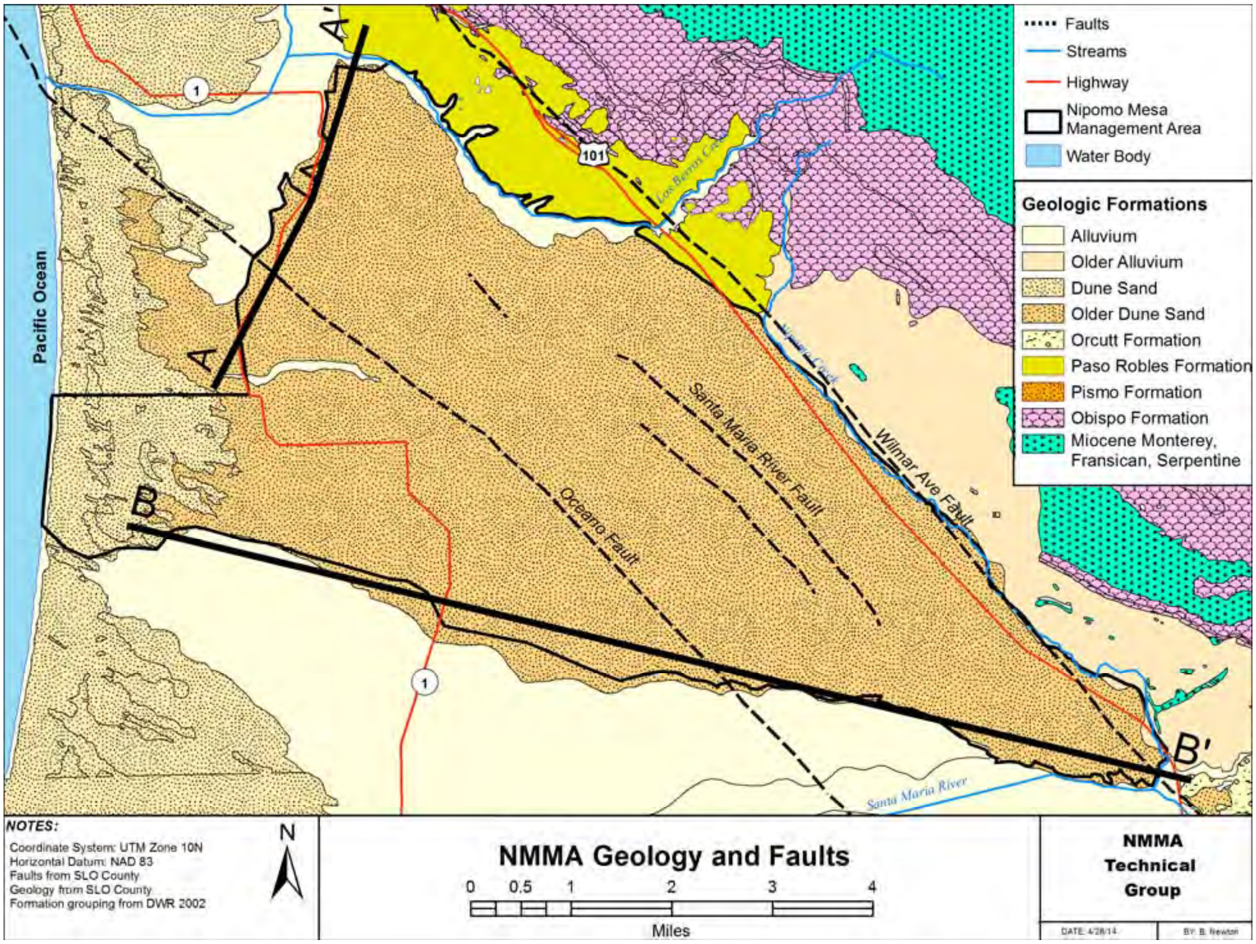


Figure 2-1. NMMA Geology with Faults and Cross Sections

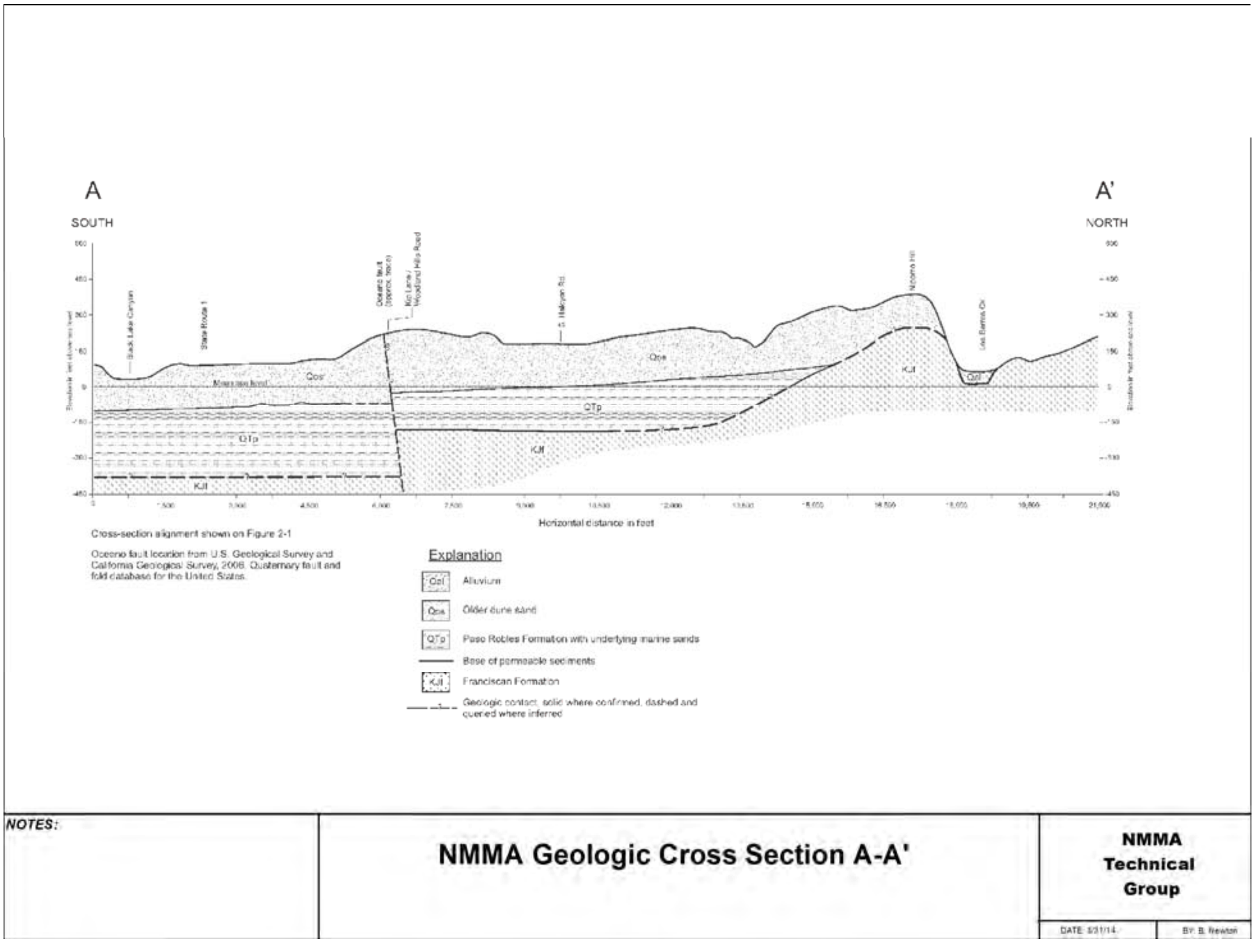


Figure 2-2. NMMA Geologic Cross Section A-A'

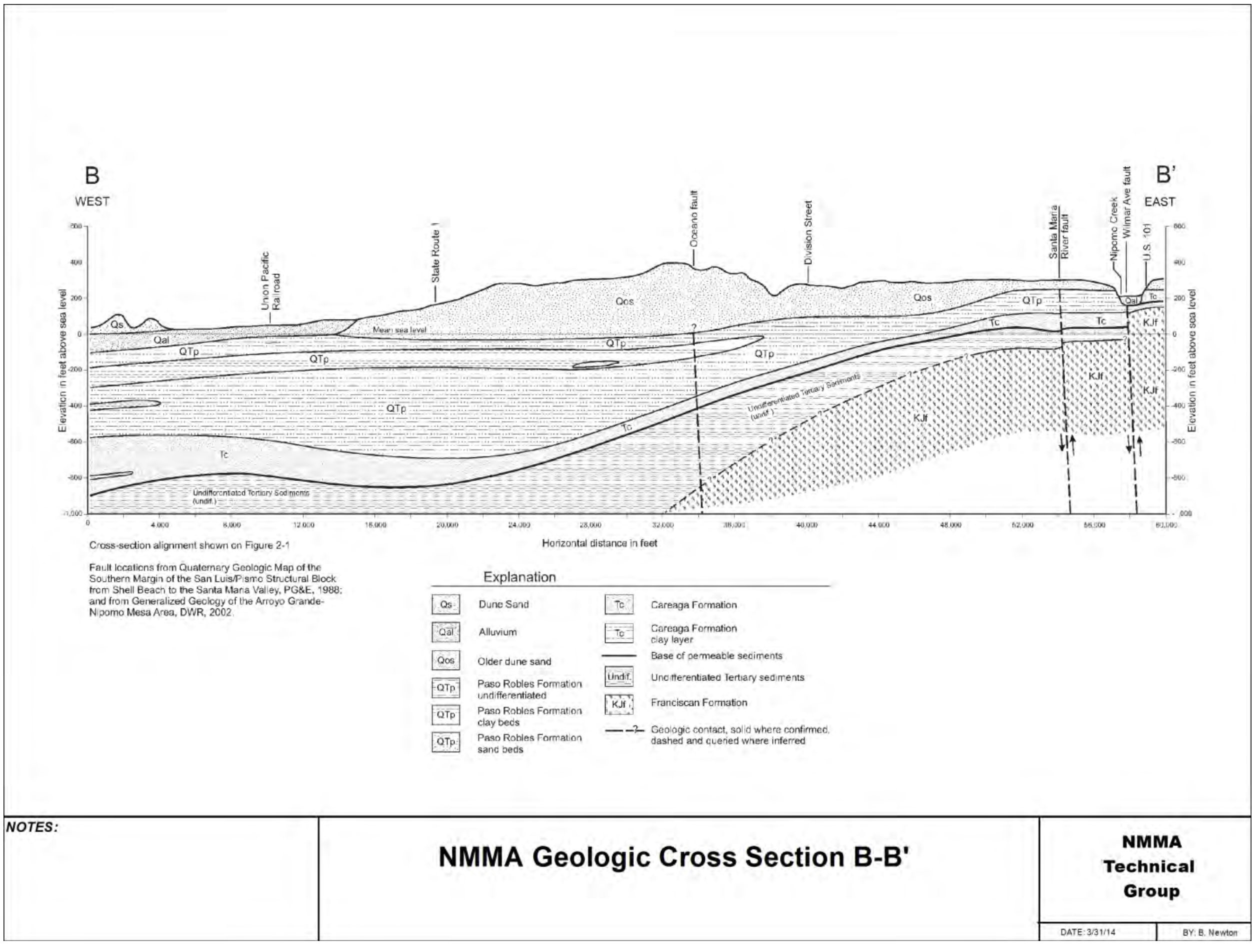


Figure 2-3. NMMA Geologic Cross Section B-B'

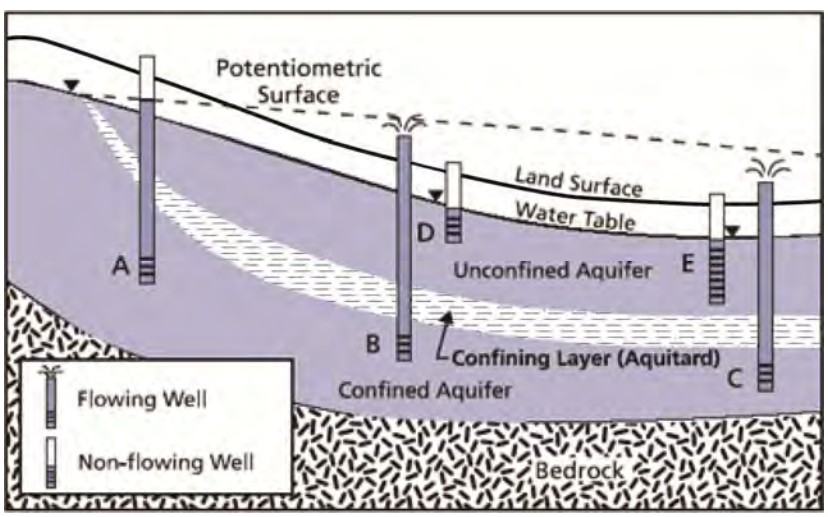


Figure 2-4. Schematic of Confining Layer and Confined Aquifer (Bachman et al., 2005)

3. Data Collection

The TG is monitoring and analyzing water conditions in the NMMA in accordance with the requirements of the Stipulation and Judgment. The Stipulating Parties are required to provide monitoring and other production data at no charge, to the extent that such data are readily available. The TG has developed protocols concerning measuring devices in order to obtain consistency with the Monitoring Programs of other Management Areas. Discussions of these subjects are presented in the following sub sections of this 6th Annual Report – Calendar Year 2013.

3.1. *Data Collected*

The data presented in this section of the Annual Report were measured during the calendar Year 2013 and are the subject of this Annual Report. Groundwater elevations, water quality, rainfall, surface water, land use, groundwater production and wastewater discharge data were compiled and are presented in the following sections.

3.1.1. Groundwater Elevations in Wells

Groundwater elevation is determined by measuring the depth to water in a well from a reference point at the top of the well casing. The reference point and depth to water data are collected from each agency and input into a TG database that includes groundwater elevation determinations. The date, depth to water, measuring agency, pumping condition, and additional comments are recorded. When the database is updated with new data, an entry is posted in the database log describing the changes that have been made to the database. The groundwater elevation measurements are subjected to Quality Assurance Quality Control procedures adopted by the TG in part by reviewing historical hydrographs to determine if the measurements are within the historical range for the given well.

The accuracy of the groundwater elevations depends on measurement protocols, the reference point and local drawdown effects at that well. The TG surveyed the elevation for all the reference points at each Key Well in February of 2009. Additional elevation surveys for all monitoring program wells are scheduled for the continued improvement of groundwater elevations accuracy. Furthermore, protocol standards were developed by the TG regarding the length of time for well shut down before a groundwater elevation measurement is taken, and a notation of whether nearby wells are known to be concurrently pumping.

Depth-to-water measurements were collected in the April and October of 2013 by the County of San Luis Obispo. In addition, NCSD, Phillips 66, Woodlands, GSWC, Cypress Ridge Golf Course, RWC (October only), and the U.S. Geological Survey collected depth-to-water measurements in calendar Year 2013 (Figure 3-1, Figure 3-2).

3.1.2. Water Quality in Wells

Water quality of the NMMA and adjacent areas is summarized from a wide range of data sources, including:

- California Department of Public Health water quality records of water supply system groundwater sources,
- Regional Water Quality Control Board waste discharge reports, site assessments, remediation project reports and related materials,

- State Water Resources Control Board site assessments, remediation project reports and related materials (GeoTracker database),
- California Department of Toxic Substances Control site assessments and related materials,
- U.S. Geological Survey ambient groundwater monitoring program (GAMA) data and reports, and
- Other NMMA groundwater production monitoring data.

Data reported in this Annual Report are derived from samples obtained using standard professional sampling protocols and analyzed at certified laboratories. The TG maintains these data in a digital database. In the NMMA, historical data from approximately 200 wells can be used to map groundwater quality conditions in both the shallow and deep aquifers. In some cases, water quality records consist of only one or two sampling events from a well, and with only a few water quality parameters, such as total dissolved solids or chloride. In other cases, such as wells within potable water systems, regular groundwater quality testing for a wide range of constituents is conducted.

Groundwater quality in wells near the ocean is of considerable importance because this is the most likely area where intrusion of seawater would first be detected. The southern coastal nested monitoring wells are monitored under agreement with San Luis Obispo County and are scheduled to provide quarterly water quality sampling of general mineral and physical water quality constituents subject to access constraints for the protection of endangered species (Figure 1-3). In addition to monitoring this coastal site for water quality, the TG has assessed the cost of updating coastal monitoring near the former nested well site 13K2-K6 adjacent to Oso Flaco Lake and recommends replacement.

Shallow groundwater in some places has high concentrations of total dissolved solids, chloride, and nitrate. Similarly, some wells completed in the principal aquifers are known to produce water with elevated nitrate, manganese, and iron concentrations. No other water quality constituents are known to restrict local use of groundwater supplies for domestic or irrigation purposes.

In 2013, a few wells producing groundwater from the principal production aquifer had water quality data; such monitoring is not conducted every year for all wells. In addition, there was water quality monitoring of shallow wells, generally for environmental monitoring and compliance (Figure 3-3).

3.1.3. Rainfall

There are six active rainfall gauges available to estimate the NMMA rainfall (Figure 3-4). Three gauges are part of the ALERT Storm Watch System, Nipomo East (728), Nipomo South (730), and Oceano (795). One gauge is a California Irrigation Management Information System (CIMIS station), CIMIS (202). The other two gauges are active volunteer gauges and include Mehlschau (38), and Nipomo CDF (151.1). The data are collected by the County of San Luis Obispo Department of Public Works (SLO DPW) and CIMIS. The TG obtains these data by filing a data request with County Public Works at the beginning of the calendar year for the rainfall data from the preceding year. SLO DPW staff collects volunteer gauge data once each year in the month of July for the previous year, July through June. Rainfall data are often compiled on a water year basis. A water year typically begins October 1st and ends September 30th of the following year, and the year referenced is that of September (i.e., WY2003 is defined as October 1, 2002, through September 30, 2003). For the volunteer gauges, data collected from July 2012 to December 2012 is unavailable until July 2013, when County staff collects and compiles the rainfall data.

The WY 2013 rainfall totals are approximately 45 percent of the long-term average (Table 3-1). Reference evapotranspiration for WY 2013 is 43.3 inches; as compared to 44.2 inches in WY 2012 (see Section 2.2).

Table 3-1. Rainfall Gauges and 2013 Rainfall Totals

Name	Period of Record	Period of Record Mean	Water Year 2013[1]	Calendar Year 2013	Percent of Normal[2]
Nipomo East (728)	2005-2013	15.82	5.91	3.07	38%
Nipomo South (730)	2005-2013	14.71	6.57	2.80	42%
Oceano (795)	2005-2013	12.98	6.54	2.60	42%
CIMIS Nipomo (202)	2006-2013	11.95	NA	NA	NA
Nipomo CDF (151.1)	1958-2013	15.71	8.07*	2.63*	51%
Mehlschau (38)	1920-2013	16.69	8.37*	2.49*	53%

Notes:
NA - Data reported is indicative of irrigation overspray with daily reported amounts ranging from 0.01 to 0.03 from spring into summer.
1. Water Year is defined as Oct. 1 of previous year through Sept. 30 of the current year.
2. Percent of Normal, calculated using the period of record annual mean for gauge #151.1.
* Voluntary gauge data collection occurs in July of each year, and rainfall is assumed to be zero for the remainder of the WY (July, August, and September) or CY (July through December).

3.1.4. Rainfall Variability

Quantifying the temporal and spatial variability is critical where rainfall is a large portion of the water supply. Spatial variability in the volume of rainfall across the NMMA is apparent when comparing the WY2013 rainfall totals from these gauges. The WY2013 total rainfall ranged from 5.91 inches (Nipomo East #728) to 8.37 inches (Mehlschau #38).

Climatic trends and interannual variability also impact the water supply to the NMMA. The cumulative departure from the mean was prepared for two rain gauge stations Mehlschau #38 and Nipomo CDF #151.1 over the period from WY 1975 to WY 2013 (Figure 3-5). Periods of wetter than average and drier than average conditions are coincident at both gauges. The most pronounced dry period occurred from 1983 to 1994, followed by a wetter than average period from 1994 to 1998. From 1998 to present, there have been several years of alternating wet and dry conditions. WY 2013 has been the driest year since WY 2007, with the last two years both well below normal.

3.1.5. Streamflow

Currently, there are some records of streamflow within the NMMA. On Los Berros Creek, the Los Berros #757 streamflow sensor is located 0.8 miles downstream from Adobe Creek and 3.7 miles north of Nipomo on Los Berros Road, and the Valley Road #731 streamflow sensor is located on at the Valley Road bridge over Los Berros Creek (Figure 3-6). The data at the Los Berros gauge are compiled by San Luis County Department of Public Works. Nipomo Creek streamflow is not currently gauged. A new gauge on Los Berros Creek is in the process of being installed by the County of San Luis Obispo at the Quailwood Lane bridge, downstream of State Route 101.

3.1.6. Surface Water Usage

There are no known diversions of surface water within the NMMA.

3.1.7. Surface Water Quality

Surface water quality samples were taken in Nipomo Creek in 2001 and 2002 and in Los Berros Creek in 2002 and 2003 for the Central Coast Ambient Monitoring Program (www.ccamp.org). Nipomo Creek was listed as an impaired water body because of fecal coliform counts in exceedance of the basin plan standard.

Surface water sampling programs associated with a County-led integrated regional water management program (IRWMP) together with a Regional Board program for agricultural discharges to surface water are in development. These are expected to provide more comprehensive surface water quality data within the NMMA during 2014 and after.

3.1.8. Land Use

Land use data historically have been collected for the NMMA by the DWR at approximately ten year intervals from 1959 to 1996. DWR periodically performs land use surveys of the Southern Central Coast area (which includes the NMMA). Ideally, DWR will update the land use for the South Central Coast area (which includes the NMMA) in the near future. The status of the DWR land use program for the Southern District can be accessed at http://www.dpla.water.ca.gov/sd/land_use/landuse_surveys.html.

The 2007 NMMA land use was classified by applying the DWR methodology to a June 2007 one-foot resolution aerial photograph. Land use was classified into four main categories based on the methodology used by DWR in 1996; agriculture, urban, golf course and native vegetation (undeveloped lands). Agricultural lands for 2009 were further subdivided using the San Luis Obispo County Agriculture Commissioner survey of the 2009 crop types and acreage for San Luis Obispo County. The major crops grown on in the NMMA are strawberries, vegetable rotational, avocados, and nursery plants.

Urban lands were classified following the DWR methodology with additional sub categories based on San Luis Obispo County land use categories from land use zoning maps. The categories for urban include (1) Commercial-Industrial; (2) Commercial-office, (3) Residential Multi-family; (4) Residential-Single Family; (5) Residential-Suburban; (6) Residential-Rural; (7) Recreational grass; (8) Vacant. Golf courses were classified separately from Agricultural or Urban Lands.

Native vegetation lands were classified following the 1996 DWR methodology. In the DWR methodology, all undeveloped land was classified as native vegetation and includes groves of non-native eucalyptus and fields of non-native grasses. The lands classified as native vegetation were further broken down into two categories: grasses; and trees and shrubs; to better estimate deep percolation of rainfall required for the hydrologic inventory (see Section 5 Hydrologic Inventory).

The land use acreage was surveyed and updated in 2013 by performing aerial imagery analysis, observations made by NMMA TG engineer representatives, and assessing San Luis Obispo County pesticide purchase records. The update indicates that an increase in agriculture usage has occurred from 2009 to 2013. The largest increase occurred in areas of the NMMA planted with strawberries and cane berries. The second largest increase in agriculture usage occurred in areas planted with vegetable rotational. In addition to agriculture, golf course acreage increased (Table 3-2).

The land use acreage for Urban is 10,460 acres; for Agriculture is 2,970 acres; and for Native is 7,717 acres. Sub- categorical land use acreage is also defined and will subsequently be utilized to compute the groundwater productions and consumptive use of water for each subcategory (Table 3-2).

Table 3-2. Land Use Summary

Land Use Category	Year of Data	Acreage
Urban		
Commercial – Industrial	2007	472
Commercial – Office	2007	118
Golf Course	2013	599
Residential Multi-family	2007	24
Residential Single Family	2007	821
Residential Suburban	2007	3,597
Residential Rural	2012	4,829
Recreational grass	2013	210
Urban Total	**2013**	**10,460**
Agriculture		
Grape and Deciduous	2013	19
Pasture	2013	65
Vegetable rotational	2013	356
Avocado and Lemons	2013	328
Berries	2013	1,453
Nursery	2013	360
Non-irrigated farmland	2013	389
Agriculture Total	**2013**	**2,970**
Non Irrigated		
Native Vegetation	2013	6943
Urban Vacant	2007	765
Water Surface	2007	9
Native Total	**2013**	**7,717**
Total Land Use		**21,147**

3.1.9. Groundwater Production (Reported and Estimated)

The groundwater production data presented in this section of the Annual Report were collected for calendar Year 2013. Where groundwater production records were unavailable, the groundwater production was estimated for calendar Year 2013 (Figure 3-7).

Reported Groundwater Production

Individual landowners, public water purveyors, and industry all rely on groundwater pumping from the aquifers underlying the NMMA. Data were requested by the TG from the public water purveyors and individual pumpers and incorporated in this calendar Year 2013 Annual Report. Stipulating Parties to the Judgment are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available.

Stipulating parties provided production records that report a total of 6,726 acre feet (AF) of groundwater produced in calendar Year 2013 (Table 3-3), an increase of 431 AF from last year. NCSD

(+174 AF), Woodlands (+159 AF), GSWC (+66 AF) and RWC (+32 AF) increased production in Calendar Year 2013 compared to Calendar Year 2012, while Phillips 66 remained unchanged.

Table 3-3. Calendar Year 2013 Reported Groundwater Production

Stipulating Parties	Production (AF/yr)
NCSD	2,646
GSWC	1,169
Woodlands	1,016
Phillips 66	1,100
RWC	795
Total	**6,726**

Estimated Production

The Calendar Year 2013 estimated groundwater production for irrigating agricultural crops in the NMMA is 6,831 AF computed on a daily time-step by multiplying the crop area and the crop specific water demand met by either soil moisture, rainfall, or groundwater production, thus developing the unit production for Calendar Year 2013 (Table 3-4). The crop specific water demand was re-evaluated in conjunction with the 2013 Land Use update (see Section 3.1.8 Land Use). The change in crop coefficients used for this estimate is presented in an appendix to this Annual Report (see Appendix E). The increase in groundwater production for agriculture is partly due to an increase in irrigated acreage in the NMMA, partly due to the dry winter during WY 2013, and largely due to the updated crop coefficients. Groundwater production for the berry crops amounted to 60 percent of the total annual agricultural groundwater production (Table 3-4).

Table 3-4. Calendar Year 2013 Estimated Groundwater Production for Agriculture

Crop Type	2013 Area (Acres)	2013 Unit Production (AF/acre)	2013 Production (AF/yr)
Grape and Deciduous	19	1.3	25
Pasture	65	3.3	214
Vegetable rotational	356	2.2	799
Avocado and Lemon	328	2.6	860
Berries	1,453	2.8	4,086
Nursery	360	2.3	847
Un-irrigated Ag Land	389	0.0	0
Total	**2,970**		**6,831**

Groundwater production for urban use was estimated for rural landowners not served by a purveyor. The estimated production for the rural landowners is 2,792 AF for Calendar Year 2013 (Table 3-5). About 60 percent of the estimated production for other land uses types was used for golf course irrigation (Table 3-5).

Table 3-5. Calendar Year 2013 Estimated Groundwater Production for Other Land Use

Land Use Type	Water Use Area (acres)	Unit Production (AF/acre)	Production (AF/yr)
Golf Course[2]	471	3.6	1,703
451RS Zoned Parcels[1]	172	2.6	452
616 RR Zoned Parcels[1]	243	2.6	637
Total	**886**		**2,792**

Note:
1. Unit production values from NCSD 2007, Water and Sewer Master Plan Update
2. Woodlands Golf Course groundwater production is included in Table 3-3 and therefore not included here.

Combining the estimates of groundwater production for Stipulating Parties (Table 3-3), for Agriculture (Table 3-4), and for Rural Landowners (Table 3-5) results in an estimated total groundwater production of 16,349 AF for Calendar Year 2013 (Table 3-6).

Table 3-6. Calendar Year 2013 Measured and Estimated Groundwater Production (AF/yr)

Measured	
NCSD	2,646
GSWC	1,169
Woodlands	1,016
Phillips 66	1,100
RWC	795
Subtotal	**6,726**
Estimated	
Other Land Uses	2,792
Agriculture	6,831
Total NMMA Production	**16,349**

3.1.10. Wastewater Discharge and Reuse

Five wastewater treatment facilities (WWTF) discharge treated effluent within the NMMA: the Southland Wastewater Works (Southland WWTF), the Blacklake Reclamation Facility (Blacklake WWTF), RWC's Cypress Ridge Wastewater Facility (Cypress Ridge WWTF), the Woodlands Mutual Water Company Wastewater Reclamation Facility (Woodlands WWTF) (Figure 3-8). The GSWC iron and manganese removal treatment facilities at La Serena and Osage groundwater production wells discharge filter backwash to percolation ponds. The total waste water discharge in the NMMA was 786 AF for Calendar Year 2013 (Table 3-7).

Table 3-7. 2013 Wastewater Volumes

WWTF	Influent (AF/yr)	Effluent (AF/yr)	Re-use
Southland	724	634 (1)	Infiltration
Blacklake	58	48 (1)	Irrigation
Cypress Ridge	46.3	40	Irrigation
Woodlands	Not Reported	55	Irrigation
La Serena	Not Applicable	8.4 (2)	Infiltration
Osage	Not Applicable	2 (2)	Infiltration
Total		**786**	

Notes:

1. Effluent was estimated as the sum of Influent - Evaporation from Aeration Ponds - 10% of Influent to account for biosolid removal. For the Nipomo Mesa calendar Year 2013, the annual evapotranspiration measured at CIMIS 232 gage is 46.4 inches and the rainfall measured at CIMIS 232 gage is 6.6 inches (CIMIS, 2012). This results in a net evaporation from a pond of 39.8 inches per year.
2. GSWC's La Serena and Osage iron and manganese removal treatment facilities treat water from GSWC's La Serena and Osage wells. Filter backwash water is discharged to percolation ponds, where water infiltrates into the basin.

3.2. *Database Management*

The database of monitoring data is an entirely digital database and is maintained in Microsoft Excel as a confidential document. The database is broken into five datasets: Groundwater elevation, groundwater production, wastewater treatment, stream flow, groundwater quality, climate, and land use.

NCSD's technical representative is currently designated as the database steward and is responsible for maintaining and updating the digital files and for distributing any updated files to other members of the TG. A "change log" is maintained for each database. The date and nature of the change, along with any special features, considerations or implications for linked or related data are recorded in the change log. The Stipulation and Judgment require that absent a Court order or written consent, the confidentiality of well data from individual owners and operators is to be preserved.

3.3. *Data and Estimation Uncertainties*

Uncertainties exist in data, and therefore uncertainties exist in derivatives of data including interpretations and estimations made from direct measurements. Uncertainties arise from errors in measurements, missing measurements, and inaccurate methodologies and generalizing assumptions. For example, rainfall is measured at a few locations across the NMMA. However, it is well known that the spatial and temporal variability in rainfall deposition in a storm is much greater than that which the density of rainfall gauges can represent. Ground surface elevation across the NMMA is known to be in error at places and may be reported incorrectly by amounts as large as 20 feet. This affects the accuracy of groundwater elevations and contours. There exists missing data from both groundwater elevations and rainfall records. Estimations are made to fill in these data gaps with the understanding that the accuracy of these estimates is reduced. Derivatives from these data therefore contain inaccuracies. Additionally, precision issues arise when interpretations are made from data, in that individuals make decisions during the process of interpreting data that are subjective and therefore not documentable. For example, aerial image classification is a subjective process as is the preparation of groundwater elevation contours. Estimations are made for parameters, such as crop coefficients, that are not measurable or very difficult to measure. The methodologies used to make estimates represent a simplified numerical representation of the environment and are based on assumptions defining these simplifications. Quantifying the uncertainty in data or data derivatives is a rigorous and ongoing process.

The measured groundwater production values are reliable and are considered precise to the tens place for NCSD, GSWC, and Woodlands, RWC and the hundreds place for Phillips 66. The estimated production values are less reliable and precise for the rural residence groundwater production. The unit production factors used to estimate the rural residence groundwater production were developed for the NCSD Water and Sewer Master Plan. For the estimated agricultural production, there is no measured data available in the NMMA to verify the precision or reliability of the agricultural production.

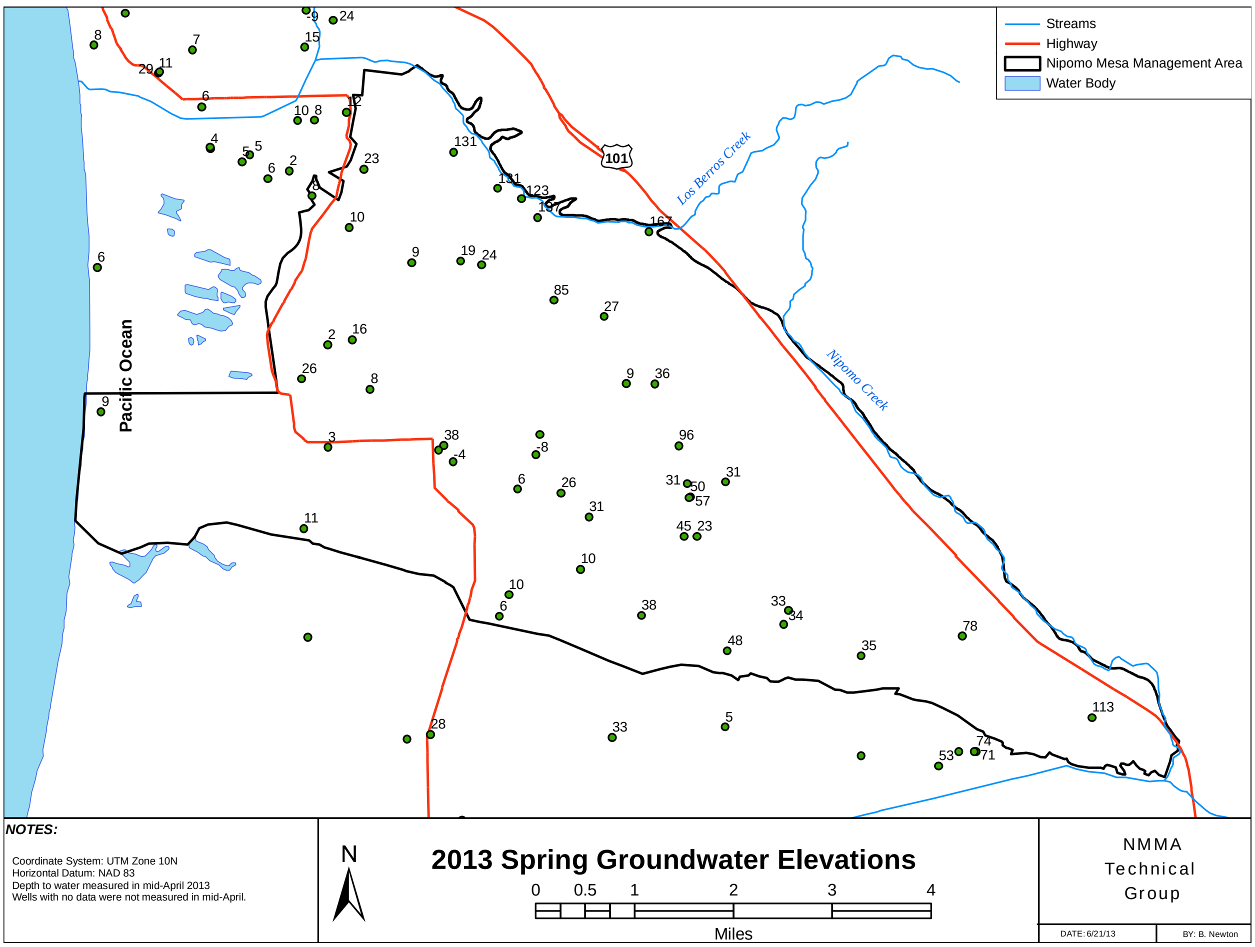


Figure 3-1. 2013 Spring Groundwater Elevations

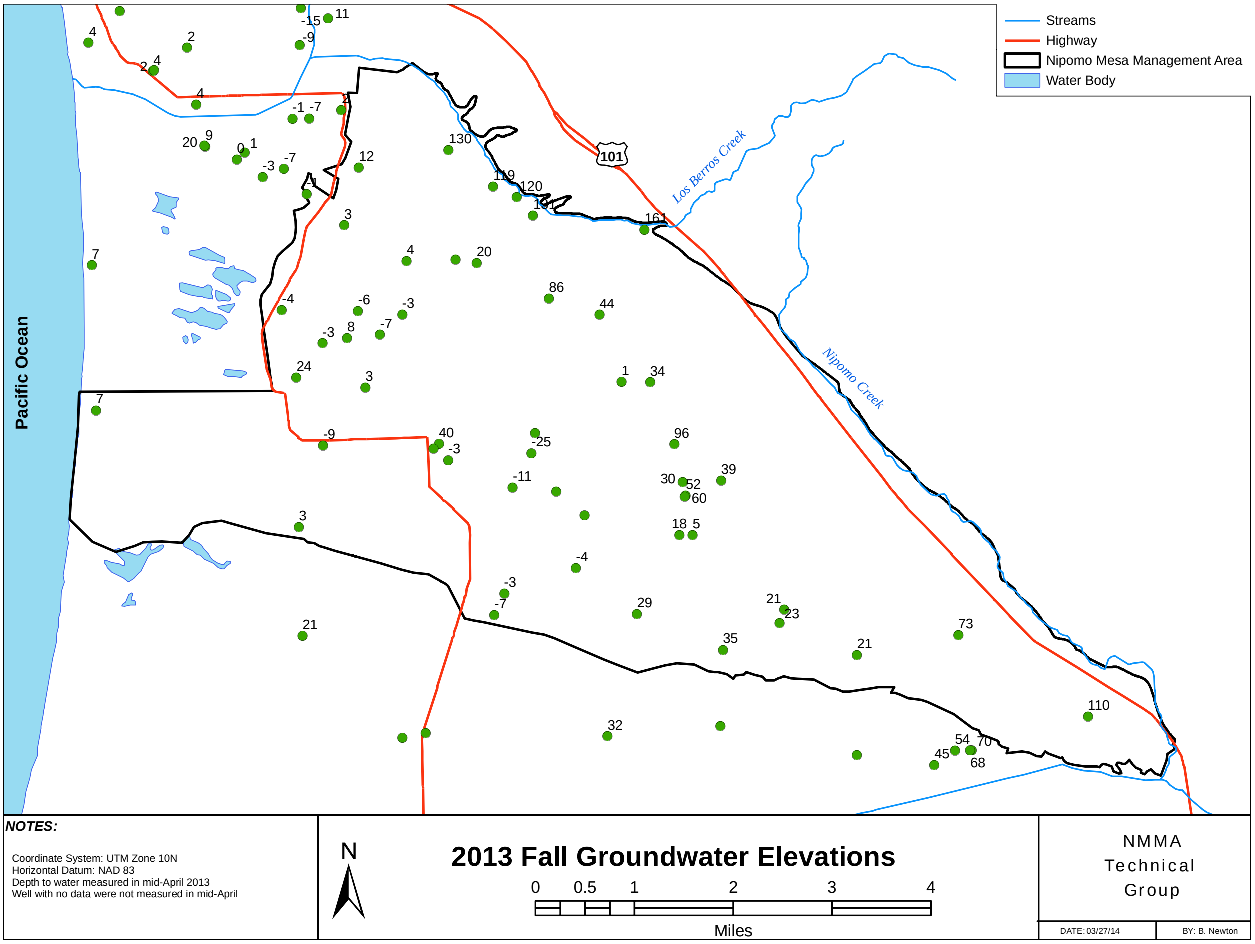


Figure 3-2. 2013 Fall Groundwater Elevations

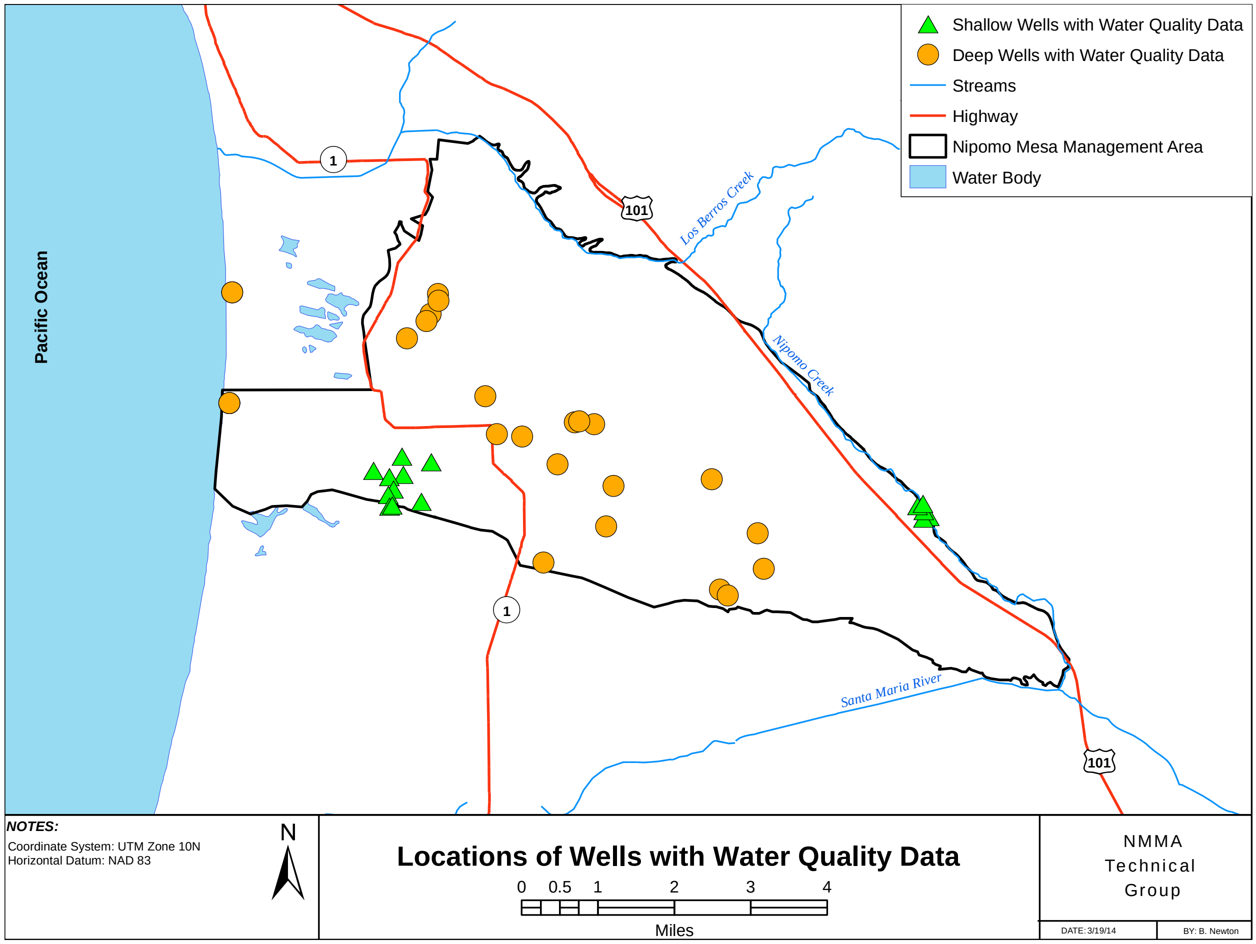


Figure 3-3. Locations of wells with water quality data.

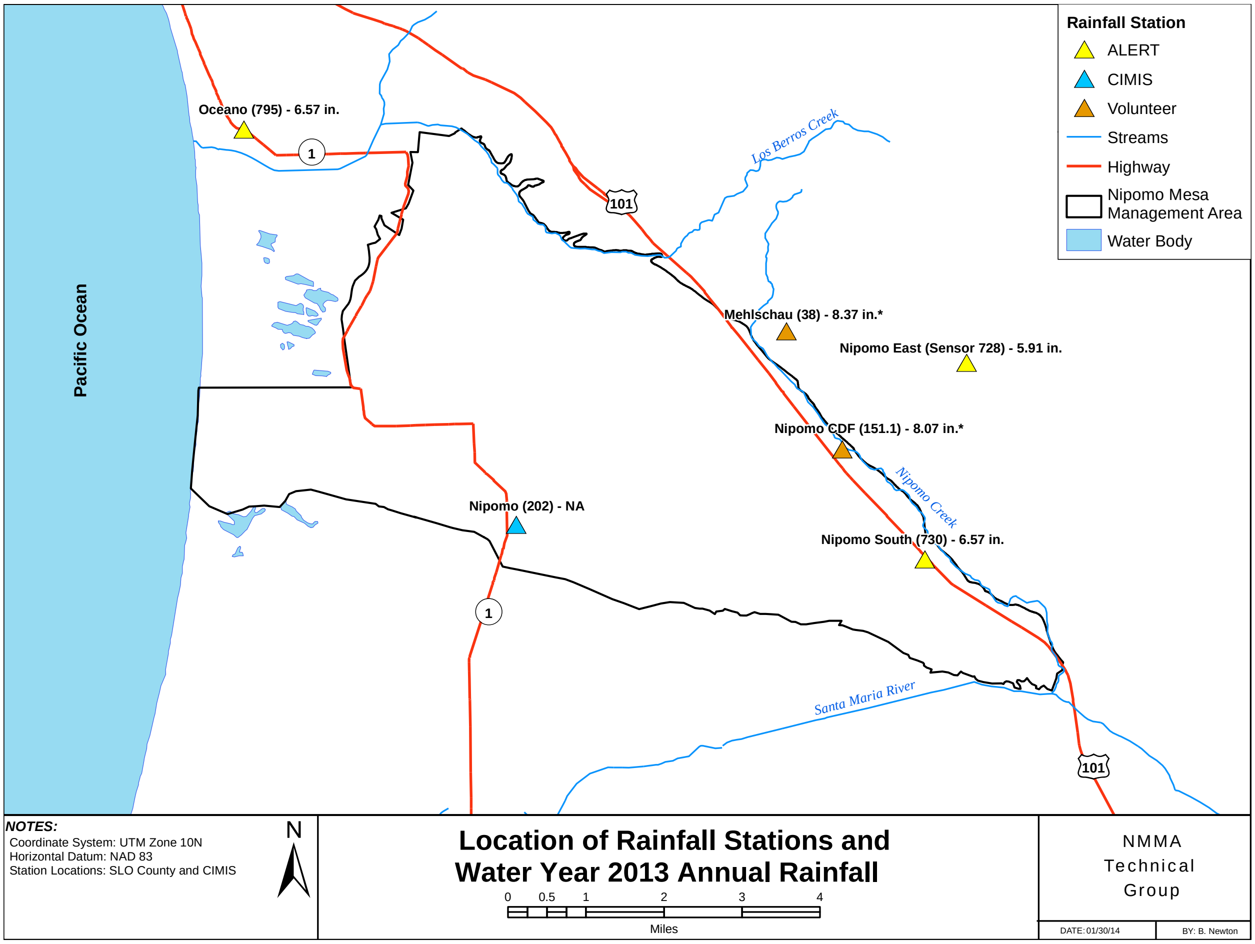
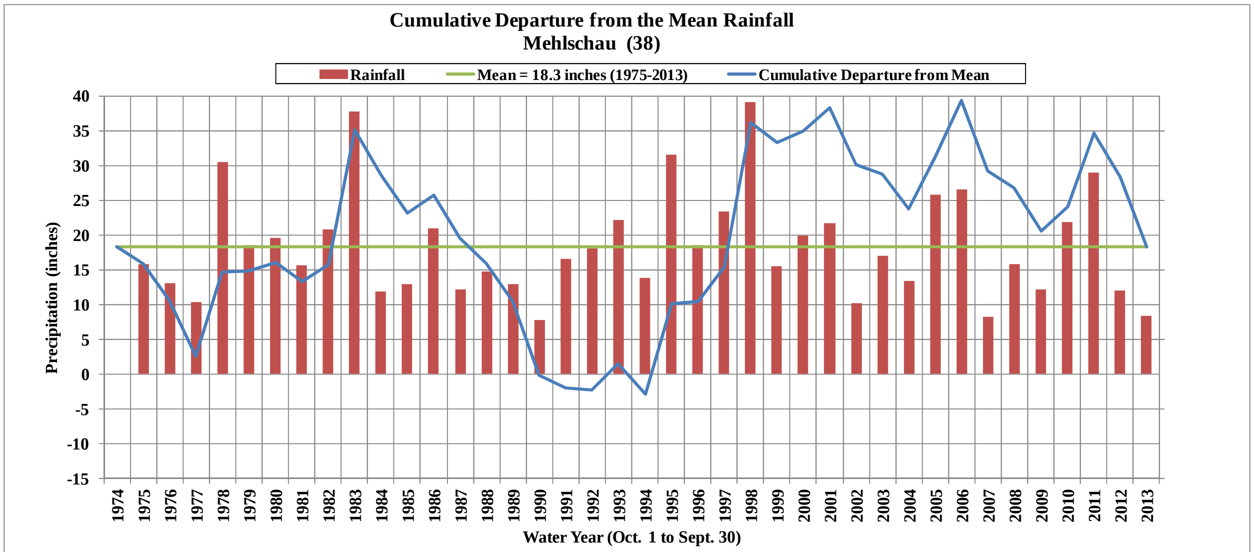


Figure 3-4. Rainfall Station Location and Water Year 2013 Annual Rainfall



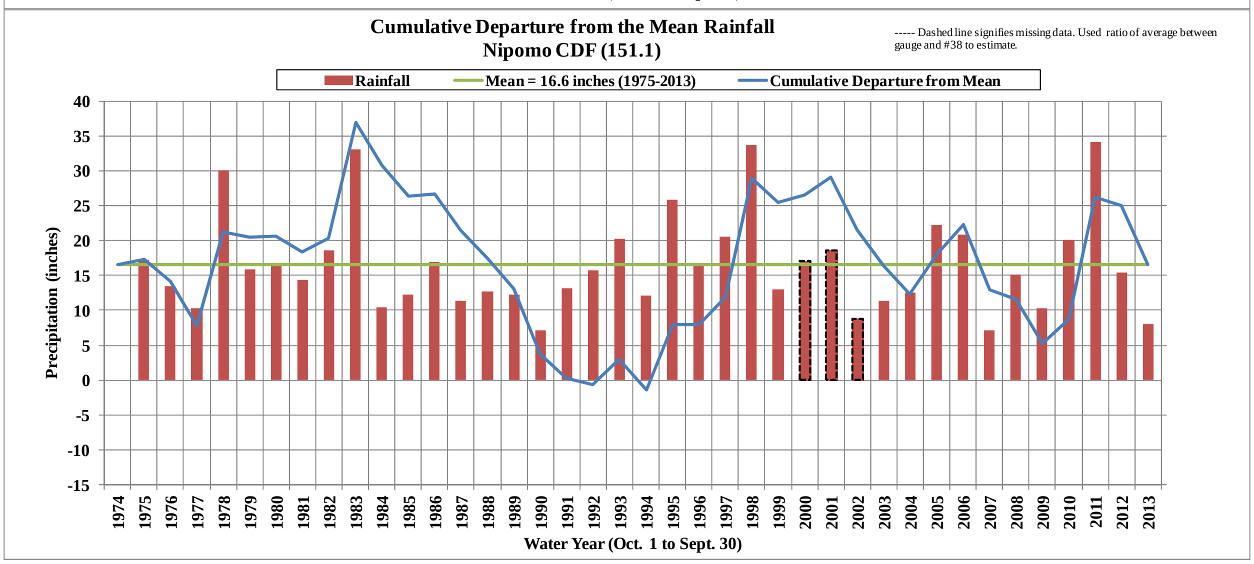


Figure 3-5. Cumulative Departure from the Mean for the following rain gauges: Mehlschau (38) and Nipomo CDF (151.1)

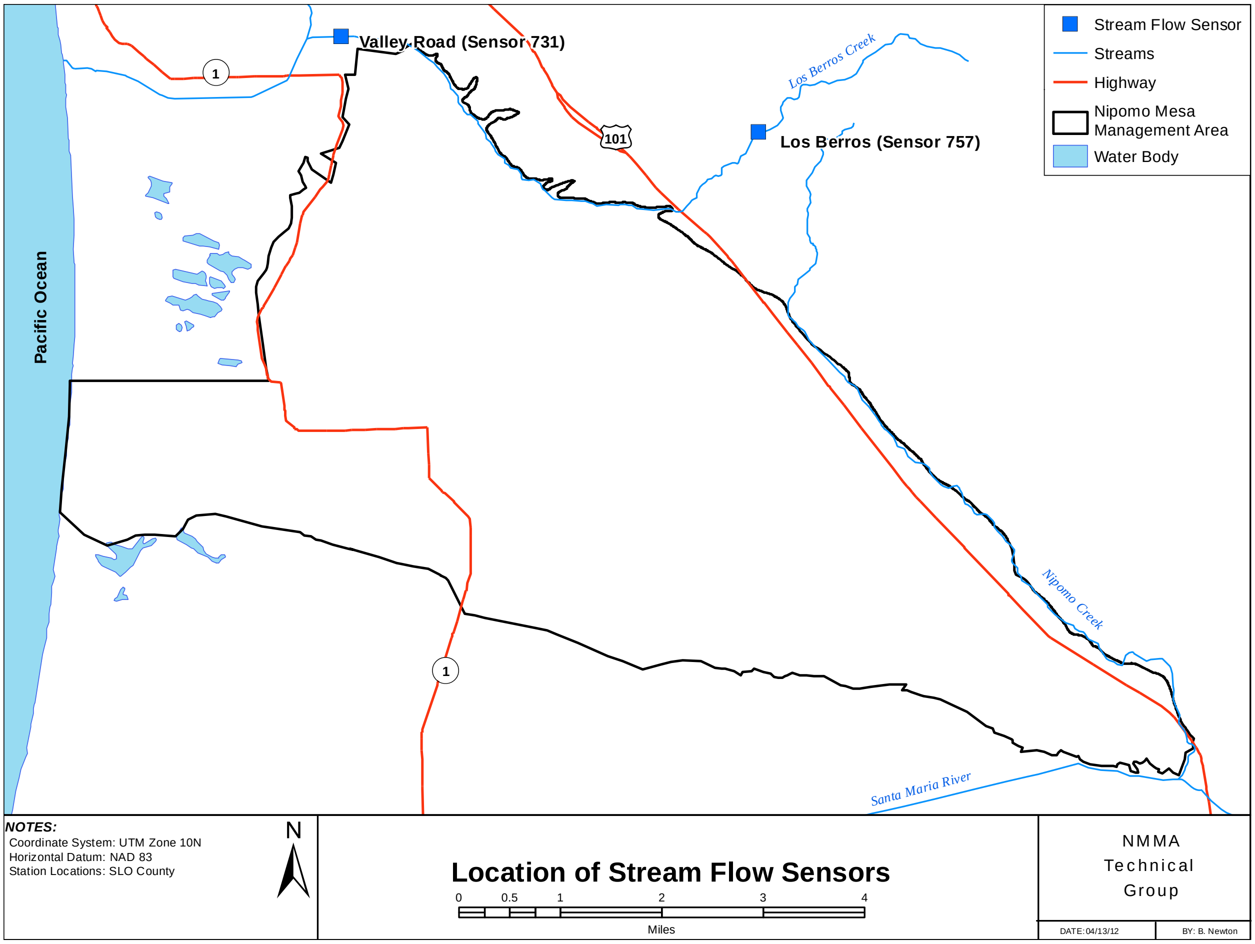


Figure 3-6. Location of Stream Flow Sensors

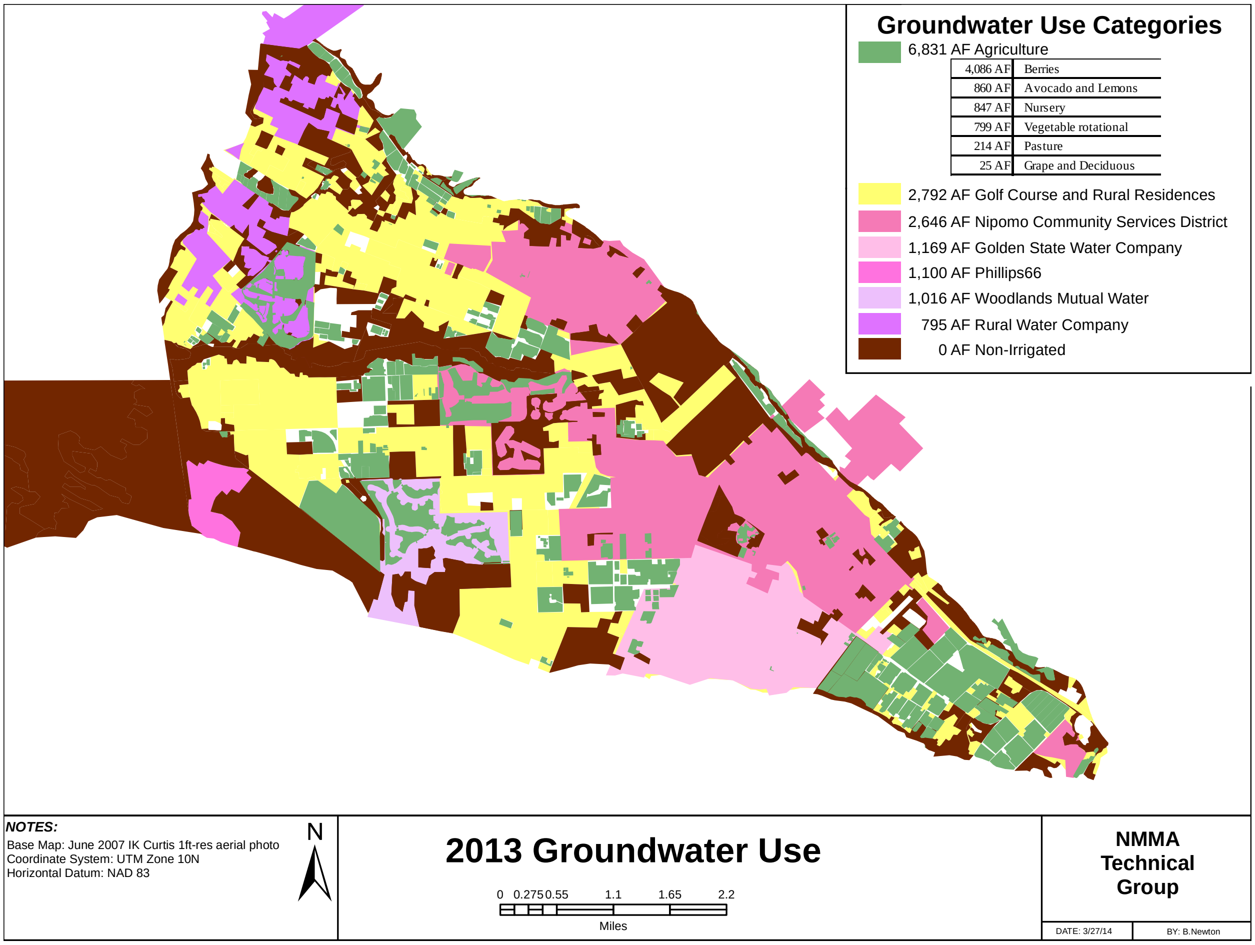


Figure 3-7. 2013 Groundwater Use

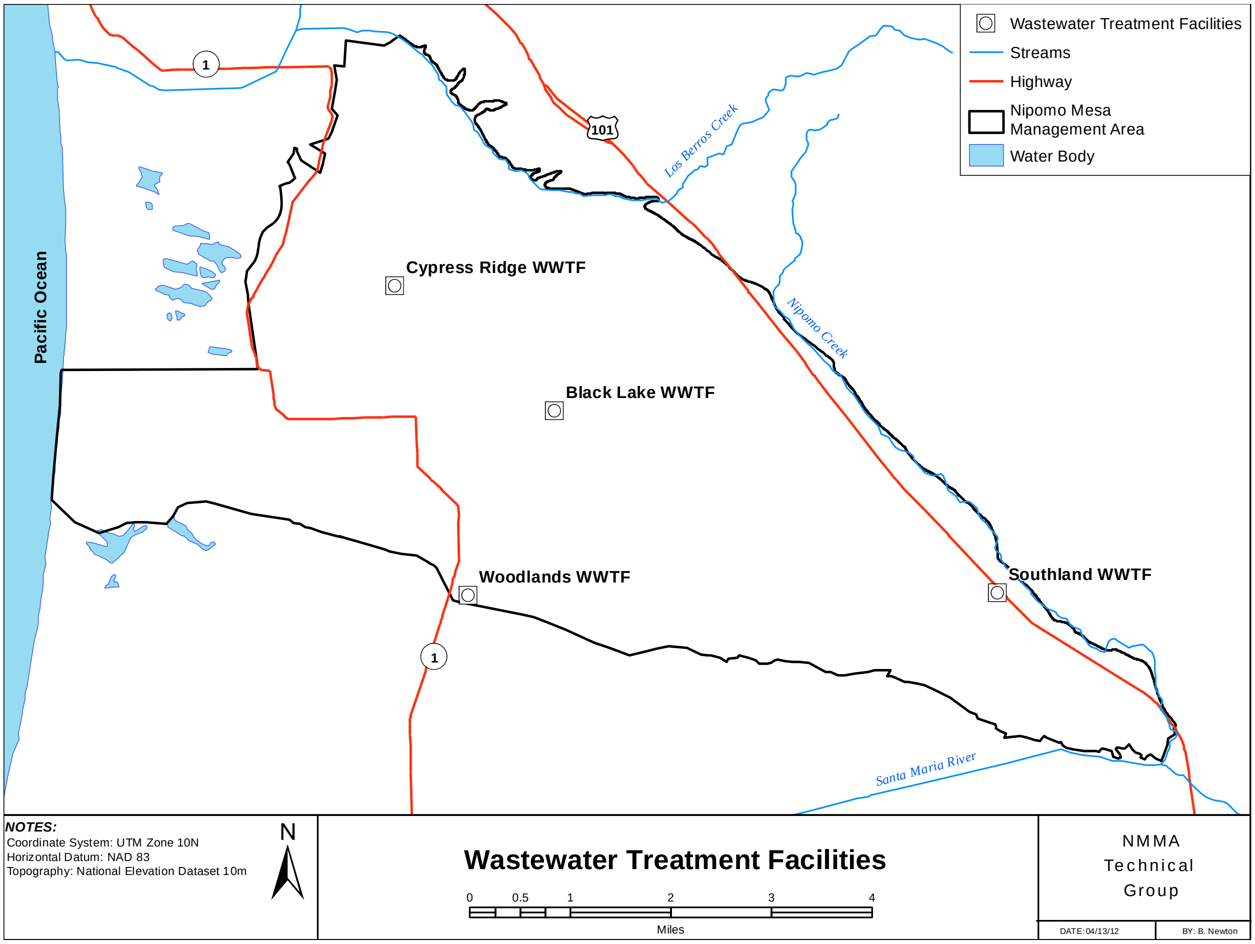


Figure 3-8. Wastewater Treatment Facilities

4. Water Supply & Demand

Presented in this section are discussions of the various components of current and projected estimates of water supplies and demands for the NMMA.

4.1. *Water Supply*

The water supplies supporting the activities within the NMMA are met primarily from groundwater production with a minor amount of recycled water. No surface water diversions exist, nor is there currently any imported water. Supplemental Water, as defined by the Stipulation, is being developed and delivery is expected in late 2015. A brief description of the groundwater production, recycled water, Supplemental Water, and surface water diversion is presented in the following sections.

4.1.1. Groundwater Production

Groundwater pumping has not been differentiated between various strata, shallow or deep aquifers. The specifics of shallow and deep aquifer production are better known by the TG for purveyor wells which, at least through 2013, produce primarily from the deep aquifers, but this information is not available for many more private wells in the NMMA.

Shallow Aquifers

Domestic production by rural landowners was estimated to be about 1,089 AF/yr (see Table 3-5). The majority of this production may be from the shallow aquifers. A portion of the estimated 6,831 AF agricultural pumping may also be from the shallow aquifers. It is worth noting that a pumping test was performed at a rate of 140 gallons per minute at the Woodlands' shallow aquifer well in 2013, but less than one acre-foot of water was produced from this well (i.e. during development and testing after construction of the well). However, it is anticipated that the well will be used to supply water for landscape irrigation beginning in 2014 (see Section 2.3.1 Geology).

Deep Aquifers

All production from wells used for public drinking water and industrial water is likely pumped from the deep Aquifers (primarily the Paso Robles Formation). This pumping is estimated to be about 8,429 AF (see Table 3-3 and Table 3-5). In addition, a portion of the estimated 6,831 AF/yr of agricultural pumping may also be from the deep aquifers.

4.1.2. Recycled Water

Wastewater effluent from the golf course developments at Blacklake Village, Cypress Ridge, and Woodlands is recycled and utilized for golf course irrigation. The amount of recycled water used in calendar Year 2013 for irrigation at Blacklake Village, Cypress Ridge and Woodlands are 48 AF, 40 AF, and 55 AF, respectively (see Section 3.1.10 Wastewater Discharge and Reuse).

4.1.3. Supplemental Water

There was no Supplemental Water delivered to the NMMA in calendar Year 2013.

4.1.4. Surface Water Diversions

There are no known surface water diversions within the NMMA.

4.1.5. Future Water Supply

The Stipulation (VI.E.5.) states all new urban uses shall provide a source of supplemental water to offset the water demand associated with the development. Currently, the only source of supplemental water dedicated to new urban uses is the 500 AF of capacity NCSD added to the NSWP. Woodlands level of participation in the NSWP is considered their projected build out demand. It is expected that new urban demand will be met by delivery of supplemental water, and possibly better utilization of recycled water or other sources.

NCSD has committed to holding approval of new (since date of Final Judgment) water connections to the 500 AF of capacity unless and until the District defines and acquires additional sources of supplemental water.

San Luis Obispo County Ordinance §3090 (adopted May 2006) provides that Land Divisions authorized by the current South County Area Plan (Inland) pay a supplemental water charge Not-to-Exceed $13,200 for each dwelling unit equivalent. The Ordinance further provides that future General

Plan Amendments will not be approved unless supplemental water to offset the proposed development's estimated increase in non-agricultural demand has been specifically allocated for exclusive use of the development resulting from the General Plan Amendment and is available for delivery to the Nipomo Mesa Water Conservation Area. It should be noted that the County of San Luis Obispo has yet to formally define a supplemental water project or adopt a supplemental water in-lieu fee; and absent defining a project and adopting a fee based on the project, there is some uncertainty about the supplemental water in-lieu fee to be applied in accordance with County Ordinance §3090.

4.2. *Water Demand*

The water demands in the NMMA include urban (residential, commercial, industrial), golf course, and agricultural demands. The TG used a variety of methods to estimate the water demands of the respective categories (see Section 3.1.9 Groundwater Production).

4.2.1. Historical Demand

The historical data from 1975 to 2008 were compiled from available information. The TG has continued the historical data compilation with information from Annual Reports for 2008 to present. The historical demand estimated for urban (including golf course and industrial) and agricultural land uses has been steadily increasing since 1975, with urban accounting for the largest increase in total volume and percentage (Figure 4-1).

4.2.2. Current Demand

The estimated demand is 16,349 AF for Calendar Year 2013, based on annual groundwater production records provided by the water purveyors on the Nipomo Mesa, estimated groundwater production by land use area (see Section 3.1.8 Land Use), and recycled water use (see 3.1.10 Wastewater Discharge and Reuse). This amount of demand represents an increase from the previous year due to a dry winter and changes in estimated groundwater production for agriculture (see Section 3.1.9 Estimated Production). The TG has not differentiated the magnitude of each component of this increase; however the change in the crop coefficient is largely responsible for the increase in agricultural water demand.

4.2.3. Potential Future Production (Demand)

The projected future demand for NCSD is an increase from 2,293 AF/yr in calendar year 2010 to 3,400 AF/yr in 2030 (NCSD, UWMP 2010 – Table 21 and 23). The Phillips 66 refinery expects future production to be similar to recent years' production amounts of approximately 1,200 AF/yr. The projected water demand for Woodlands at build-out, according to the Woodlands Specific Plan Environmental Impact Report, is 1,600 AF/yr (SLO, 1998). The projected water demand for the GSWC at full build-out of the current service area is estimated to potentially increase to approximately 1,940 AF/yr in 2030 (GSWC, 2008). Currently, no estimate of potential future production for RWC or agriculture has been developed.

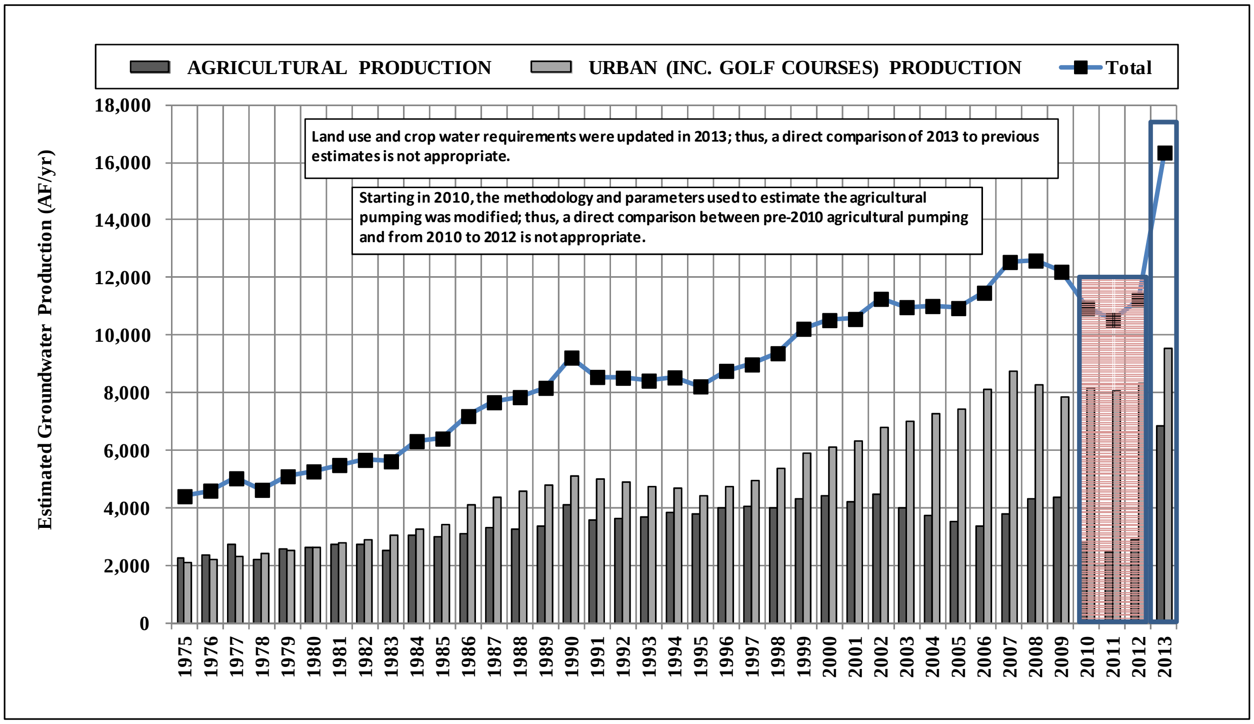


Figure 4-1. Historical NMMA Groundwater Production

5. Hydrologic Inventory

The hydrologic inventory accounts for the volumes of water that flow in to and out of the aquifers in the NMMA resulting in the change in storage. A conceptual schematic depicts the inflows and outflows to the aquifers underlying the NMMA (Figure 5-1). The hydrologic inventory can be formalized in the following equation:

Change in Storage (ΔS) = Inflow – Outflow.

In the following sections the components of the 2013 hydrologic inventory are presented and discussed. The principal sources of inflow are rainfall, streamflow, wastewater, groundwater (i.e. subsurface flow across the boundaries of the NMMA) inflow, and return flow. The principal outflows are groundwater production and groundwater outflow. Supplemental Water is also discussed as a potential future supplemental source of inflow.

5.1. *Rainfall and Percolation Past Root Zone*

Rainfall measurements made during Calendar Year 2013 range from 5.9 to 8.4 inches for WY 2013, and are approximately 45 percent of the average long-term annual rainfall (see Section 3.1.3 Rainfall). Rainfall on the NMMA infiltrates the soil surface and is either stored in the soil profile until it is evaporated or transpired by overlying vegetation, or percolates downward into shallow or deep aquifers. Rainfall on hardscape surfaces flows to local depressions where infiltration occurs. Locally rainfall may generate runoff from the NMMA to places adjacent to the NMMA boundary; however, the amount of runoff out of the NMMA is negligible. The TG has estimated the portion of rainfall that percolates past the root zone is 249 AF in WY 2013.

5.2. *Subsurface Flow*

The groundwater subsurface flow is the volume of water that flows into and out of the NMMA groundwater system. Typical methods used to estimate subsurface flow is Darcy's equation (using hydraulic conductivity, groundwater gradient, and aquifer thickness) or flow equations that are part of a regional groundwater model. In the NMMA, the three areas with the most potential for subsurface flow are at the northwestern boundary with the Northern Cities Management Area, the southern boundary with the Santa Maria Valley Management Area, and the seaward edge of the basin. Contours of groundwater elevations in this report (see Section 6.1.4 Groundwater Gradients) suggest that there is net inflow from the Santa Maria Valley Management Area, net outflow at the coast (required to prevent seawater intrusion), and subsurface flow into or out of the Northern Cities Management Area. The amount of inflow across the eastern boundary is not well understood.

The nature and extent of the confining layer(s) beneath the NMMA and the extent to which faults in the NMMA may act as impediments to subsurface flow are not well understood. The TG has not yet quantified the subsurface flows; however, the TG is currently evaluating detailed hydrogeologic cross-sections along portions of the NMMA boundary necessary to make estimates of subsurface flow (see Section 9 Recommendations).

5.3. *Streamflow and Surface Runoff*

Streamflow and surface runoff are the volumes of water that flow into and out of the NMMA through surface water channels or as overland flow. Streamflow includes water within the Los Berros Creek, Nipomo Creek, and Black Lake Creek (Figure 5-2). Surface runoff occurs during major rainfall events and could occur in locations where local conditions near the NMMA boundary are sufficient to promote overland flow out of the area, and where shallow subsurface flow contributes to streamflow that is conveyed out of the NMMA, or to coastal dune lakes where it evaporates. This may occur in the following areas (Figure 5-2):

- Los Berros Creek streamflow into and out of the NMMA,
- Nipomo Creek streamflow into and out of NMMA,
- Black Lake Canyon streamflow out of the NMMA,
- Surface runoff from steep bluffs adjacent to Arroyo Grande Valley, and
- Surface runoff from steep bluffs adjacent to Santa Maria River Valley.

The volume of streamflow which enters and leaves the NMMA is not well understood. The TG continues to analyze where it might be appropriate to install temporary or permanent stream gauging sites to determine the volume of water that percolates beneath streams in the NMMA. San Luis Obispo County is in the process of installing a stream gauge on Los Berros Creek that will be useful in this analysis (see Section 3.1.5 Streamflow).

5.4. *Groundwater Production*

The groundwater production component of the Hydrologic Inventory is calculated using metered production records where available and estimated from land use data where measurements are unavailable. The Calendar Year 2013 groundwater production is approximately 16,350 AF (see Table 3-6).

5.5. *Supplemental Water*

Supplemental Water is the volume of water produced outside the NMMA and delivered to the NMMA. There was no supplemental water delivered to the NMMA in Calendar Year 2013. Future deliveries of supplemental water will be measured and subsequent Annual Reports will present the volume and disposition of the supplemental water delivered to the NMMA.

5.6. *Wastewater*

Wastewater discharges include the volumes of wastewater effluent discharged by the five wastewater treatment facilities located within the NMMA, and individual septic tanks where centralized sewer service is not provided. Wastewater discharges are estimated for the Calendar Year 2013. The WWTFs include the Southland WWTF, the Blacklake WWTF, the Cypress Ridge WWTF, the Woodlands WWTF, and La Serena (GSWC). The Southland WWTF discharges treated wastewater into infiltration basins (see Section 3.1.10 Wastewater Discharge and Reuse). A portion of the water percolates and returns to the groundwater system and the remaining portion evaporates. The estimated percolation from Southland WWTF is 633 AF. The treated effluent from Blacklake WWTF (48 AF), Cypress Ridge WWTF (40 AF), and Woodlands WWTF (55 AF) is used to irrigate golf course landscaping, reducing the demand for groundwater production. La Serena discharged 8.4 AF and Osage discharged 2 AF. The total WWTF effluent in the NMMA was 634 AF (Table 3-7). The wastewater discharged in septic systems percolates downward and may recharge the shallow aquifers, the deep aquifers, or become shallow subsurface flow outside the NMMA. The estimated amount of return flow from indoor use by rural residences is 180 AF.

5.7. *Return Flow of Applied Water and Consumptive Use*

Return flow is defined as the amount of recharge to the aquifers resulting from applied water that percolates past the root zone to recharge the aquifer(s). This functional definition differs somewhat from that used in the Stipulation to apportion the right to use water that was imported to the basin. However, the physical process of recharge by return flow of applied water is the same regardless of where the water originated.

The TG currently assumes that with the exception of NCSD, Woodlands, GSWC, Phillips 66, and RWC, all other groundwater produced for outdoor use is attributable to sustaining plant life and replenishing soil profile storage, and that only rainfall generates percolation. Rural residences produce groundwater for indoor use in addition to outdoor use. The estimated amount of return flow from indoor use by rural residences is 180 AF. The estimated amount of return from urban outdoor water use is 44 percent of the water supplied by NCSD, Woodlands, GSWC, and RWC. The amount of return flow from outdoor water use is thus 44 percent of 5,626 AF (Table 3-3), or about 2,475 AF. There is no return flow occurs from Phillips 66’s groundwater production. The estimated total return flow, which includes 2,475 AF from urban outdoor use, 786 AF from infiltration at WWTPs, and 180 AF of recharge from septic systems (see Section 5.6 Wastewater), is 3,440 AF in Calendar Year 2013.

The estimated consumptive use of water in the NMMA, computed by subtracting the return flow from the groundwater production, is approximately 12,900 AF.

5.8. *Change in Groundwater Storage*

The change in groundwater storage from the hydrologic inventory reflects the difference between inflow and outflow for a period of time. Typically, this change in storage is compared to a change in storage computed from groundwater contours, cross-checking the results of each. Storage changes from groundwater contours are typically calculated by measuring change in groundwater elevation and multiplying that change by a storage factor. The TG's current understanding of confining conditions within the NMMA precludes calculating change in groundwater storage from groundwater contours at this time for the management area.

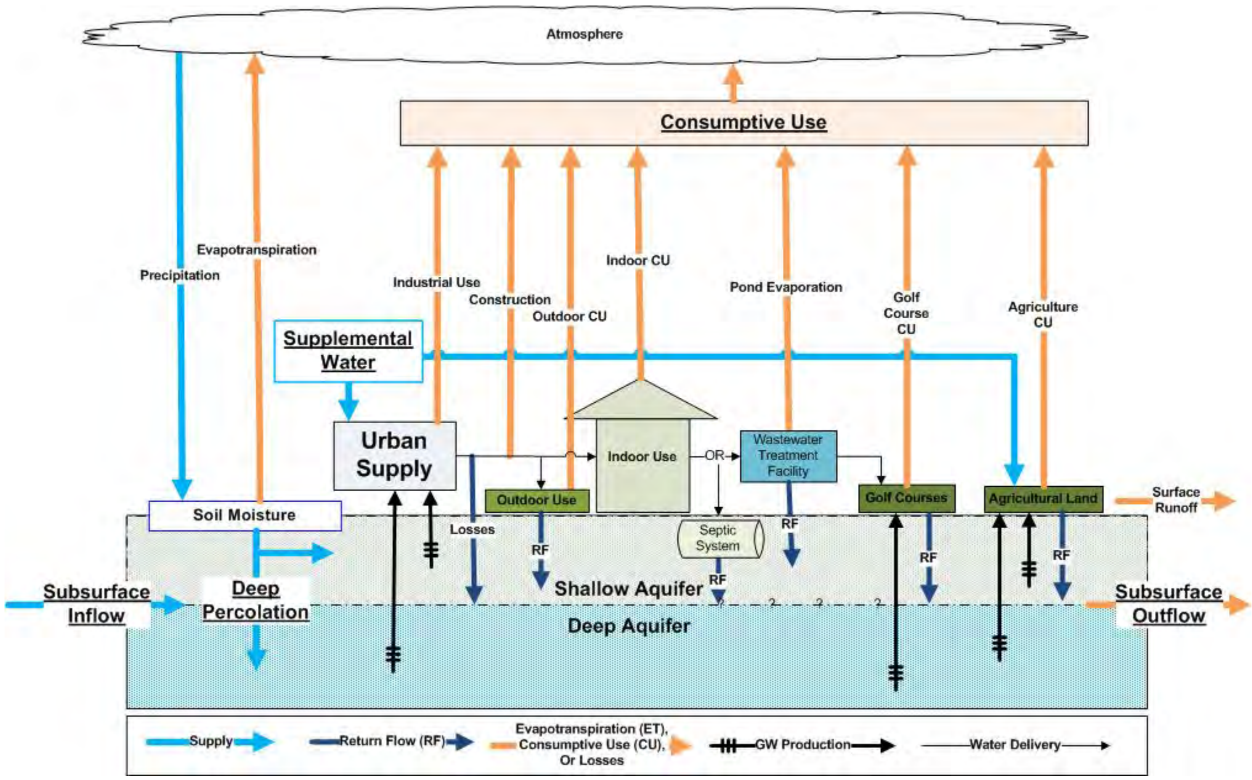


Figure 5-1. Schematic of the Hydrologic Inventory

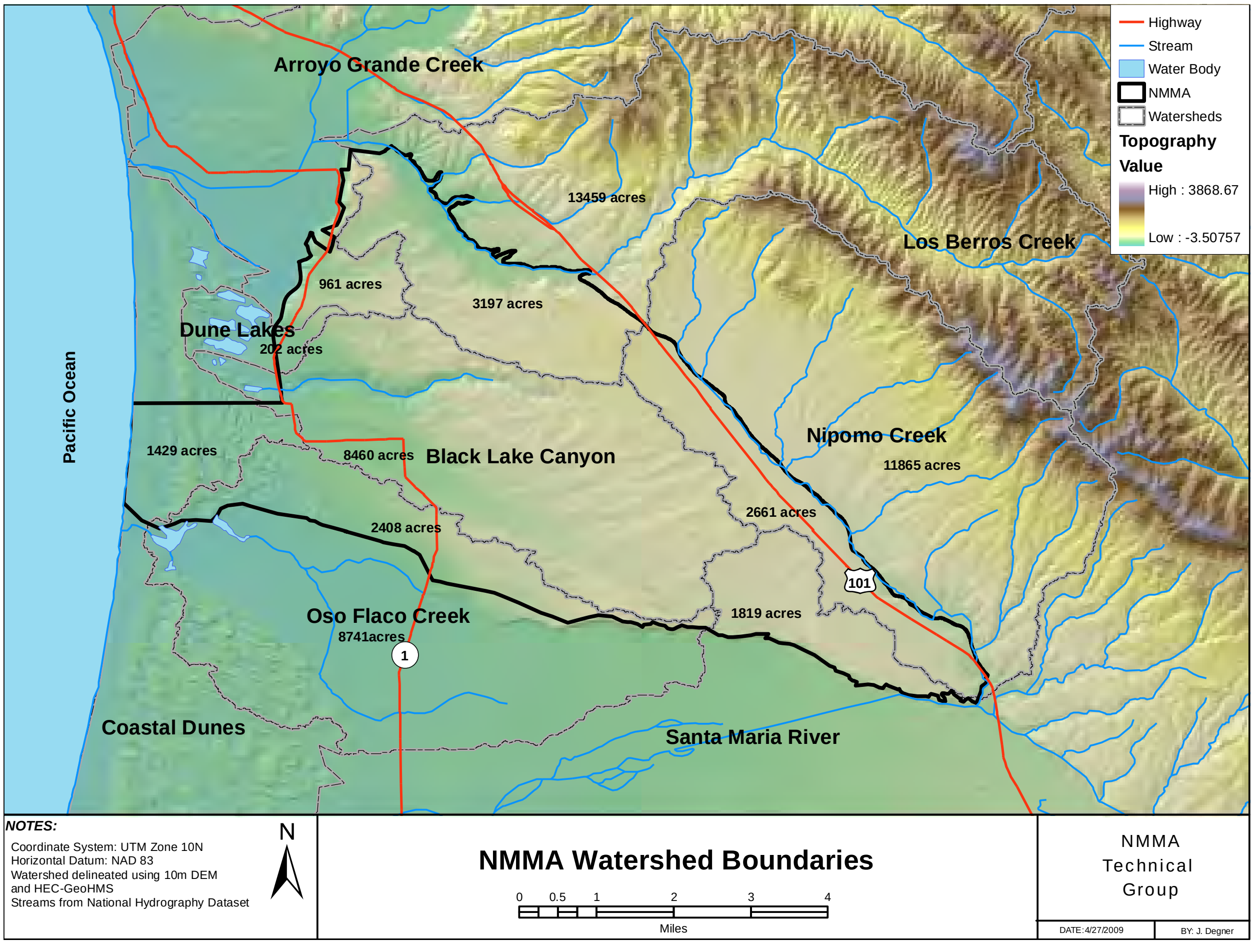


Figure 5-2. NMMA Watershed Boundaries

6. Groundwater Conditions

Groundwater conditions are principally characterized by measurements of groundwater elevations and groundwater quality, and interpretations such as groundwater elevation contours, groundwater gradients, and historical trends in elevations and water quality.

6.1. *Groundwater Elevations*

Groundwater elevations are analyzed using several methods. Hydrographs (graphs of groundwater elevation through time) for wells within and adjacent to the NMMA were updated through calendar Year 2013. Hydrographs were constructed for a number of wells, particularly all the Key Wells. The Key Wells generally represent overall groundwater elevations of the principal production aquifers in the inland areas. In coastal monitoring wells, groundwater elevations were graphed for each well completion within a nested site to compare to sea level. Finally, the aggregate of groundwater elevation measurements was used to construct groundwater contour maps for the Spring and Fall of 2013.

6.1.1. Results from Key Wells

Hydrographs were prepared for the Key Wells (Figure 6-1, Figure 6-2). Groundwater elevations in 2013 were above sea level in all Key Wells, although groundwater levels in several wells were at historically low elevations. Groundwater elevations in the South-East and North-West portions of the NMMA have generally declined since about 2000, even though the rate of decline has been negligible at times. And, following the last two dry years, groundwater elevations declined sharply in a few wells (e.g., well 11/35-22C2 and 11/35-13C1 [Figure 6-1]) and wells 11/35-5L1 and 11/35-8L1 [Figure 6-2]).

6.1.2. Results from Coastal Monitoring Wells

The elevation of groundwater in the coastal monitoring wells is very important because it is required to determine whether there is an onshore or offshore gradient to the ocean. In all coastal monitoring sites adjacent to the NMMA, groundwater elevations in Spring 2013 were higher than the criteria that defines the Potentially Severe Water Shortage Conditions (Figure 6-3). However, groundwater levels in all but one of the coastal wells reached historical low elevations during 2013.

6.1.3. Groundwater Contours and Pumping Depressions

Groundwater elevation data for the deep aquifers were plotted on separate maps for Spring and Fall of 2013 and contoured by hand. Groundwater elevation contours were constructed for both Spring and Fall of 2013 so that high and low groundwater conditions could be analyzed (Figure 6-5, Figure 6-6).

Spring 2013 groundwater contours are generally 5 to 10 feet or more lower across the NMMA than they were in 2012. At the coastline, contours were a few feet lower in Spring 2013. The contour defining the apparent high in groundwater elevations at the mouth of Black Lake Canyon dropped nearly 10 feet by Spring 2013.

Fall 2013 groundwater contours are a few feet to as much as 10 feet lower than in 2012. At the coastline, contours were a few feet lower in Fall 2013. The groundwater ridge defined by contours that extended northward from the mouth of Black Lake Canyon in Fall 2012 is largely absent in Fall 2013.

The groundwater contours along the eastern portion of the NMMA are sub-parallel to the eastern NMMA boundary indicating flow southwest into the NMMA. Besides the possibility of recharge from rainfall and seepage from adjacent older sediments along and to the east of the edge of the NMMA, Los Berros Creek flows across the shallow alluvium, which suggests local recharge may occur.

The pumping depression within the inland portion of the NMMA is present in both Spring and Fall 2013 groundwater elevation contours (Figure 6-5 and Figure 6-6). The area of the depression has increased and the surrounding groundwater elevations have declined, as compared to 2012.

6.1.4. Groundwater Gradients

Groundwater gradients, direction, and magnitude can be calculated directly from the groundwater elevation contour maps; however, numerical computations are not presented herein (Figure 6-5, Figure 6-6). The discussion of gradients is separated into coastal gradients that could affect potential seawater intrusion and gradients to/from adjacent management areas.

Coastal Gradients

Spring 2013 contours show a general flattening of groundwater gradients in the northwestern portion of the NMMA. There is only a small difference in groundwater elevation between the coastal plain of the NCMA, the coastal portion of the NMMA, and the pumping depression in the central portion of the NMMA. In Fall 2013 the divide between the pumping depression and the coastal wells is largely absent, creating a groundwater gradient that is landward from the coast.

The groundwater ridge that historically separated the coastal area from inland areas was a transient feature formed because of the inland pumping depression. Although groundwater elevations at the southern coastal monitoring well are above those defined for water shortage conditions, having such a landward gradient from coastal to inland increases the potential for sweater intrusion. This condition is not prudent for the long-term and will continue to be monitored carefully.

Gradients to/from Adjacent Management Areas

The groundwater elevation contours between the NMMA and the Northern Cities Management Area are at or below sea level, with a largely flat gradient separating the areas in Fall 2013. As discussed in previous Annual Reports, the groundwater divide between the two management areas might be in part related to recharge from Los Berros Creek – during dry years, this recharge is significantly reduced.

The northwest groundwater gradient along the southern boundary of the NMMA creates flow into the NMMA from the Santa Maria Valley Management Area (Figure 6-5, Figure 6-6). This northwest gradient is limited to the area between the river and the NMMA boundary. Thus, the groundwater elevation beneath the river represents a boundary, where groundwater flows toward the NMMA north of the river and into the main Santa Maria basin south of the river. This pattern of gradients suggests that the Santa Maria River is a source of supply to both management areas. If the deep aquifers are confined in the area between the river and the NMMA boundary, then recharge from the river to these aquifers must be largely occurring up-gradient in places where no confining conditions exist.

6.2. *Groundwater Quality*

Water quality is a concern for all groundwater producers, although the specific concerns vary by water use. Water quality is somewhat different in different portions of the NMMA because:

- the source of recharge varies for different portions of the aquifer system,
- groundwater can develop different mineral signatures from the rock it flows through, and
- percolation of surface water can mobilize constituents of concern and carry these into the aquifers.

Water quality conditions in the NMMA during calendar Year 2013 were relatively unchanged from 2012. The following sections describe coastal water quality and inland water quality conditions.

6.2.1. Results of Coastal Water Quality Monitoring

Quarterly coastal water quality monitoring within the NMMA boundary is currently limited to a single group of monitoring intervals at well 11N/36W-12C1, 2, 3, but the TG is also aware of published data for coastal water quality conditions in the NCMA. Limited historical water quality data are also available for other coastal monitoring wells to either side of the NMMA. Most chloride concentrations in the coastal wells are less than 100 mg/L, and do not show evidence of significant change over time (Figure 6-7). Coastal water quality monitoring at 11N/36W-12C1, 2 & 3 in 2013 also shows consistent results with respect to other common water quality characteristics such as TDS and electrical conductivity (specific conductance; Figure 6-8). Values for these constituents confirm relatively high dissolved ion content in groundwater, but at historically consistent values that are mostly within limits for existing uses.

6.2.2. Results of Inland Water Quality Monitoring

Water quality from inland wells is variable, both between wells (with similar groundwater elevations) and over time within a single well. Neither chloride nor total dissolved solids concentrations have experienced large temporal changes in samples from inland wells. There were limited data for the deep aquifer in 2013 because not all wells monitored for water quality in the NMMA are monitored or reported annually. Localized nitrate concentration measurements observed previously are likely to be a continued cause for concern, but water quality in the deep and shallow aquifers appears relatively unchanged in 2013.

Nitrate: Elevated nitrate concentrations in groundwater generally result from anthropogenic causes. Nitrate is principally a potable water concern (as compared to a concern for irrigation water), with a primary drinking water standard of 45 mg/L (nitrate as NO_3, which is used throughout this report).

In calendar Year 2013, reported nitrate concentration measurements within the principal aquifers were below the drinking water standard.

Chloride: A primary concern for both drinking water and irrigation use is high chloride concentrations. Depending upon the crop, chloride concentrations well below the drinking water standard of 500 mg/L can cause leaf burn, plant stunting, and plant death. Elevated chloride concentrations can occur in groundwater, especially in shallow or unconfined aquifers, from the recharge of return flows, tidal waters, and shallow lakes.

In calendar Year 2013, chloride concentrations were largely unchanged from the previous year, with measured concentrations between 37 and 66 mg/l or less in the deep aquifer. Shallow wells near industrial and wastewater facilities have the highest chloride concentrations, but the concentrations are below the water quality standards.

Total Dissolved Solids (TDS): In calendar Year 2013, TDS concentrations were similar to 2012 results. Based on limited sampling in calendar Year 2013, all deep aquifer production and monitoring wells contained TDS below 1,000 mg/l, measured over a wide range from 190 to 990 mg/l. Groundwater samples from several shallow wells contained total dissolved solids at or above the 1,000 mg/l California recommended secondary standard for TDS. The NMMA TG will continue to monitor the water quality of these wells.

Hydrocarbons. Four local sites of known or potential soil and shallow groundwater contamination are described by environment assessments or ongoing remediation and monitoring activity at sites within the NMMA. These sites are associated with an oil pipeline along Nipomo Creek and a gas station in the eastern portion of the NMMA. The sites are in various stages of assessment or corrective action and are regulated by the RWQCB or other state agencies. Four sites are currently undergoing study or remedial action in the NMMA (see Table 6-1).

Table 6-1. State Water Resources Control Board GeoTracker Active Sites

Site Name	Address	Status	Notes
Chevron Station 9-5867	460 West Tefft St	Open; Site Assessment	Leaking underground tank site. In 1998, a release of gasoline was discovered impacting soil. Closure Plan developed (for closure in 2014).
Nipomo Creek Pipeline, Line 300	671 Oakglen Ave	Open; Post-Cleanup Monitoring	Petroleum hydrocarbon impacted soil and shallow groundwater adjacent to petroleum pipeline at two sites approximately ½ mile apart. Post-cleanup monitoring continued in 2013.
Phillips 66, Line 300	Tefft St at Carillo St intersection	Open; Site Assessment	Petroleum hydrocarbon impacts to soil and shallow groundwater adjacent to two petroleum pipelines (Phillips 66 & Unocal). Monitoring continued and a conceptual work plan was developeded in 2013.
Phillips 66 Refinery, Santa Maria Facility	2555 Willow Rd	Open; Site Assessment	Case opened in 1999 to investigate potential soil and shallow groundwater impacts from a coke pile area. Soil and groundwater monitoring ongoing in 2013.
Source: http://geotracker.swrcb.ca.gov			

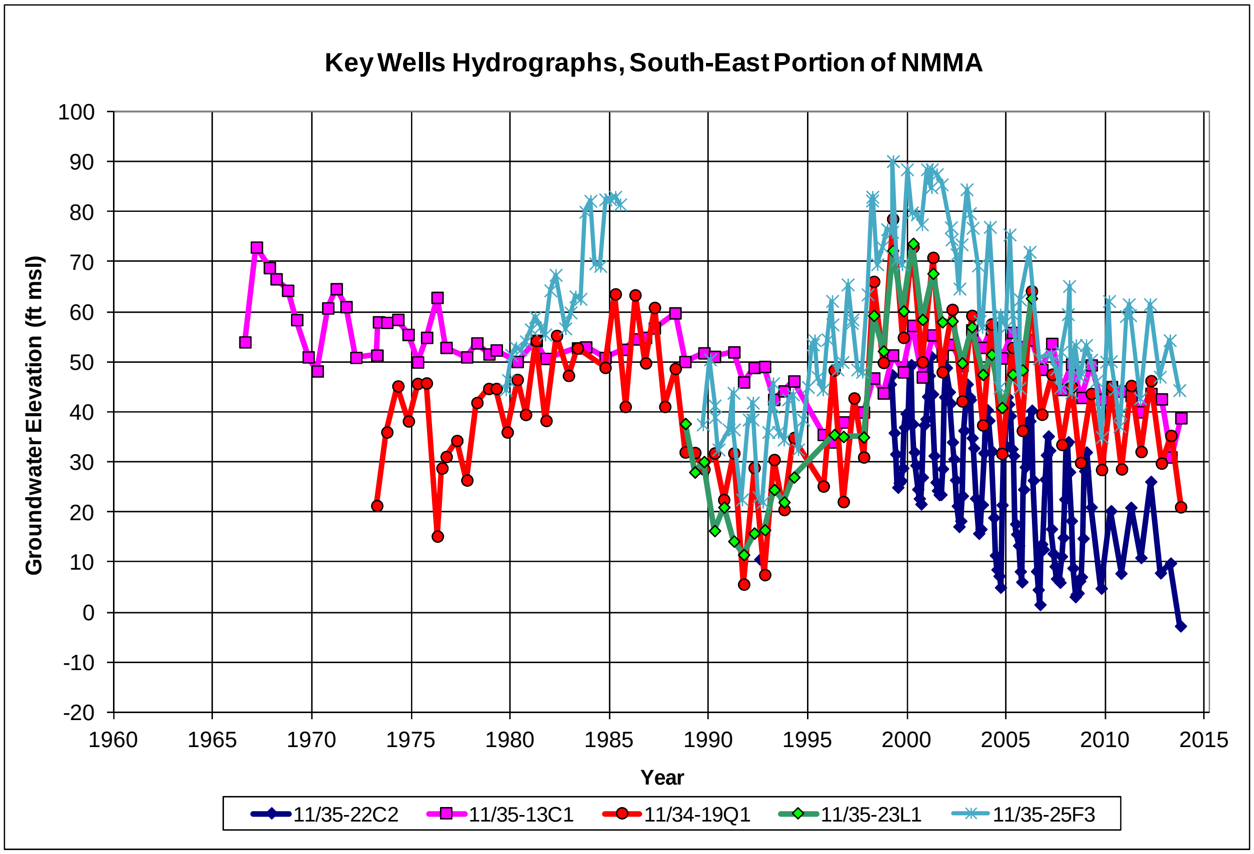


Figure 6-1. Key Wells Hydrographs, South-East Portion of NMMA. Note: Lines between data values are included to track the sequence of points and do not represent measurements**.**

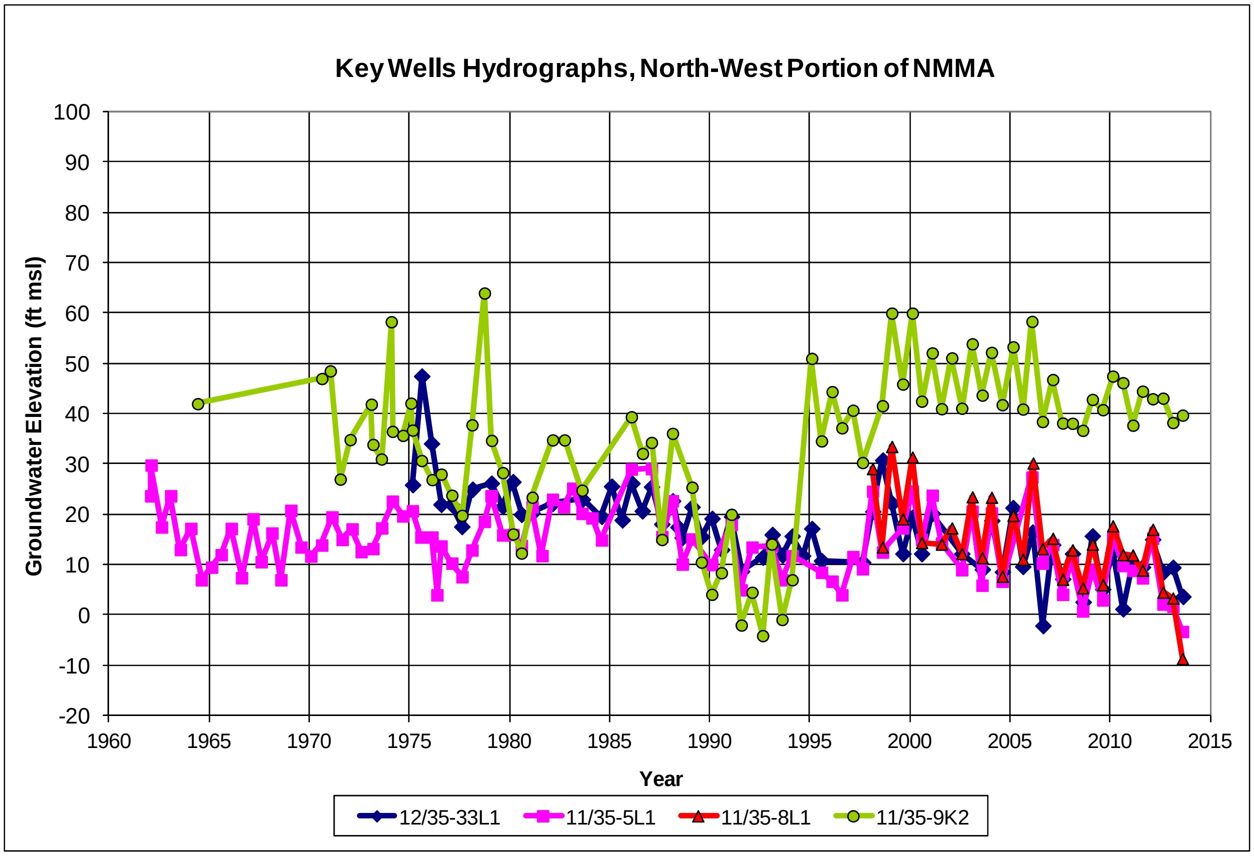


Figure 6-2. Key Wells Hydrographs, North-West Portion of NMMA

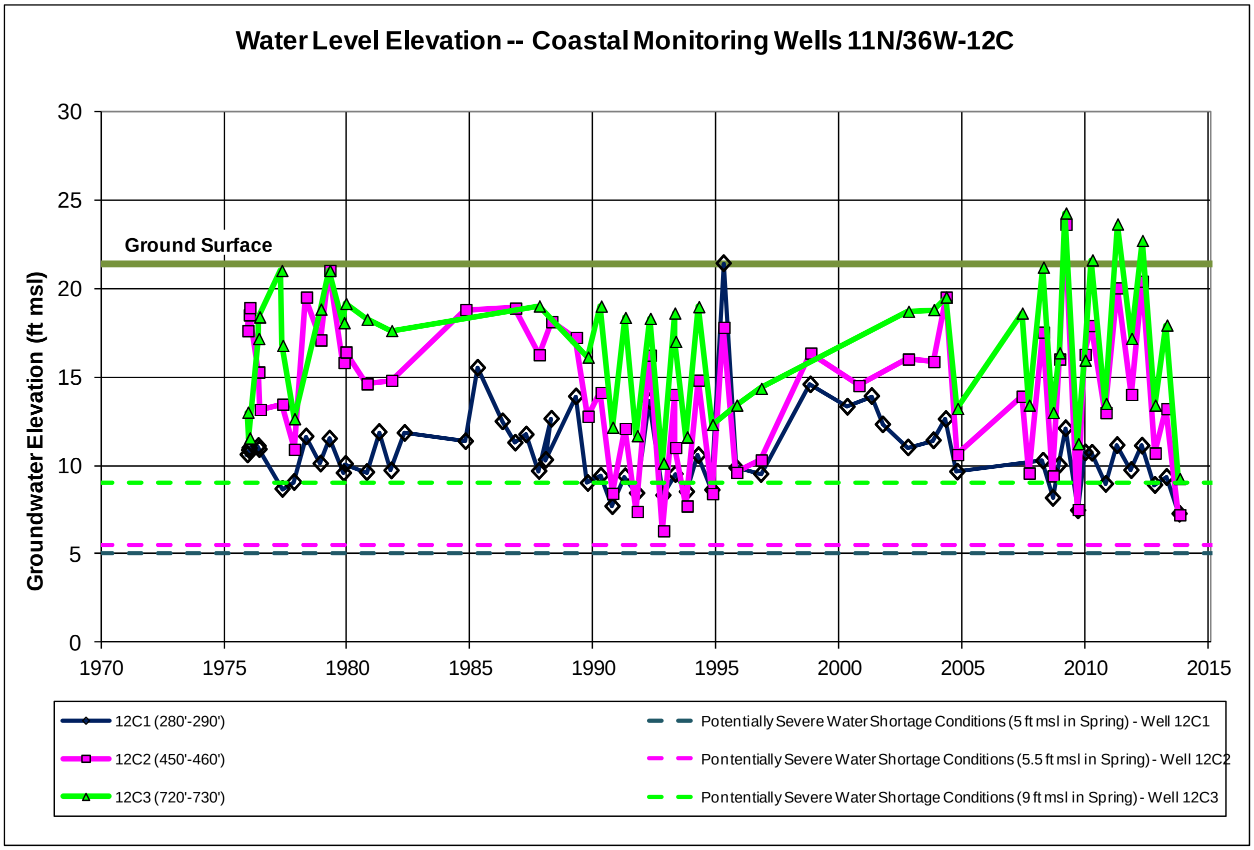


Figure 6-3. Hydrograph for Coastal Monitoring Well Clusters 11N/36W-12C. Note: Water levels measured under artesian flow prior to 2008 were observed without measuring the hydraulic head and recorded as a default value of 2 feet above the casing.

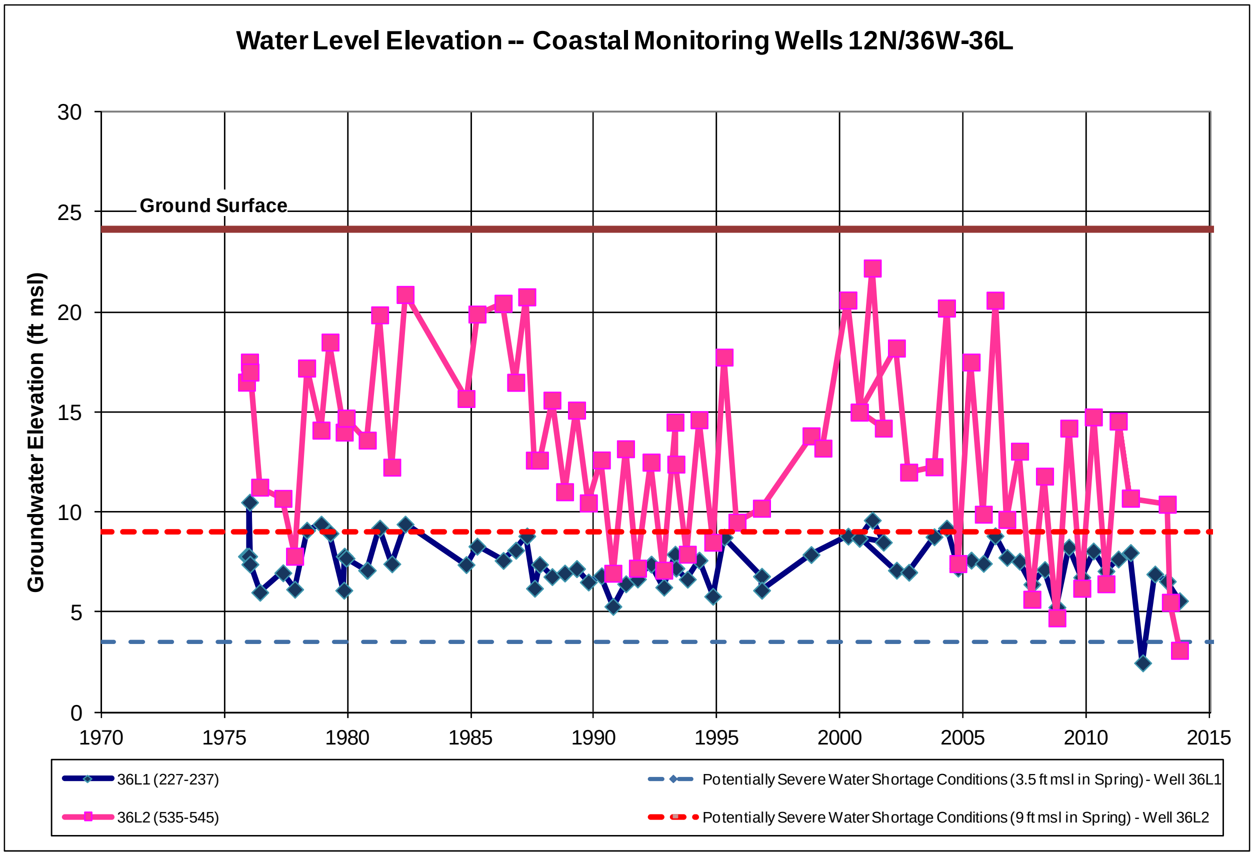


Figure 6-4. Hydrograph for Coastal Monitoring Well Clusters 12N/36W-36L

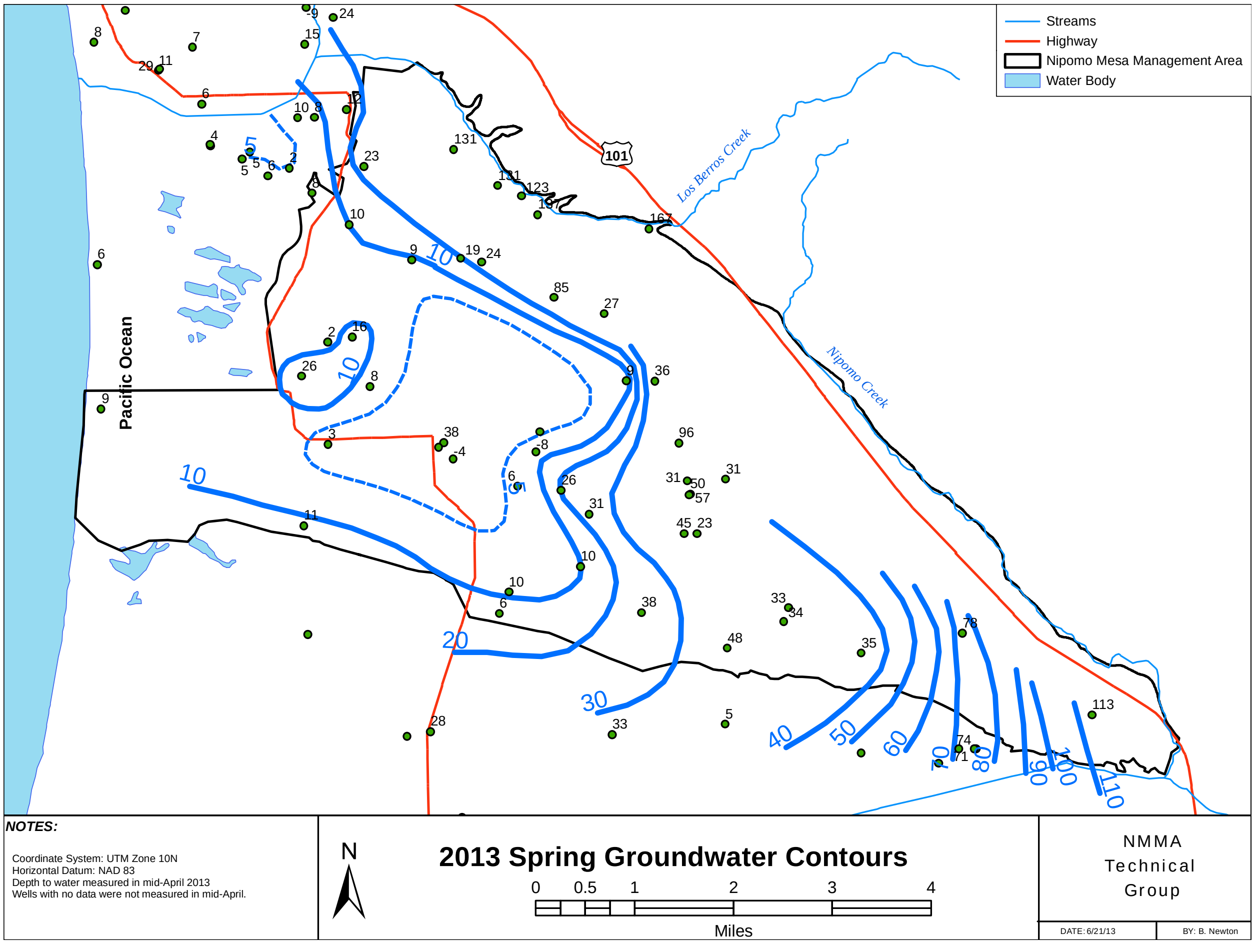


Figure 6-5. 2013 Spring Groundwater Contours

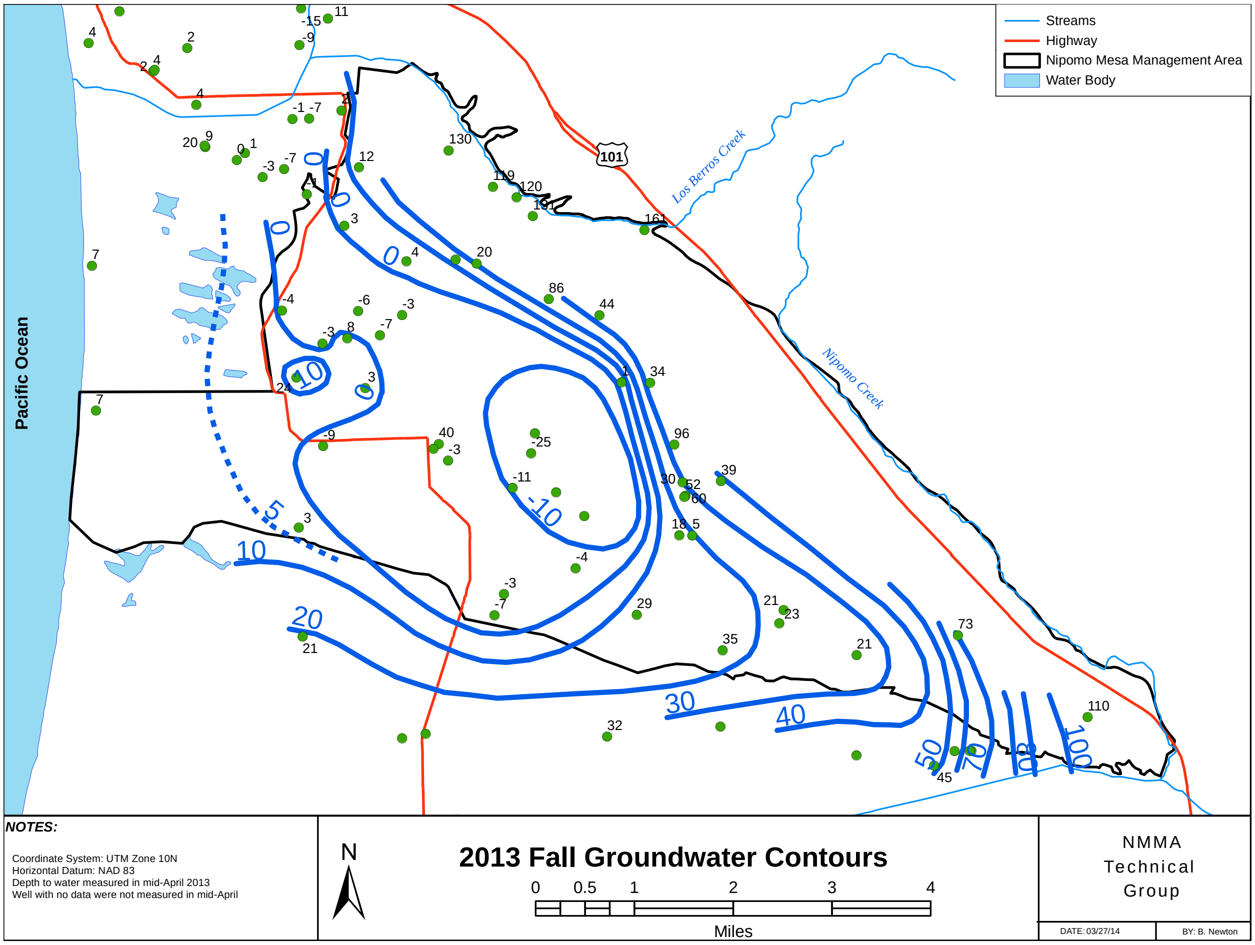


Figure 6-6. 2013 Fall Groundwater Contours

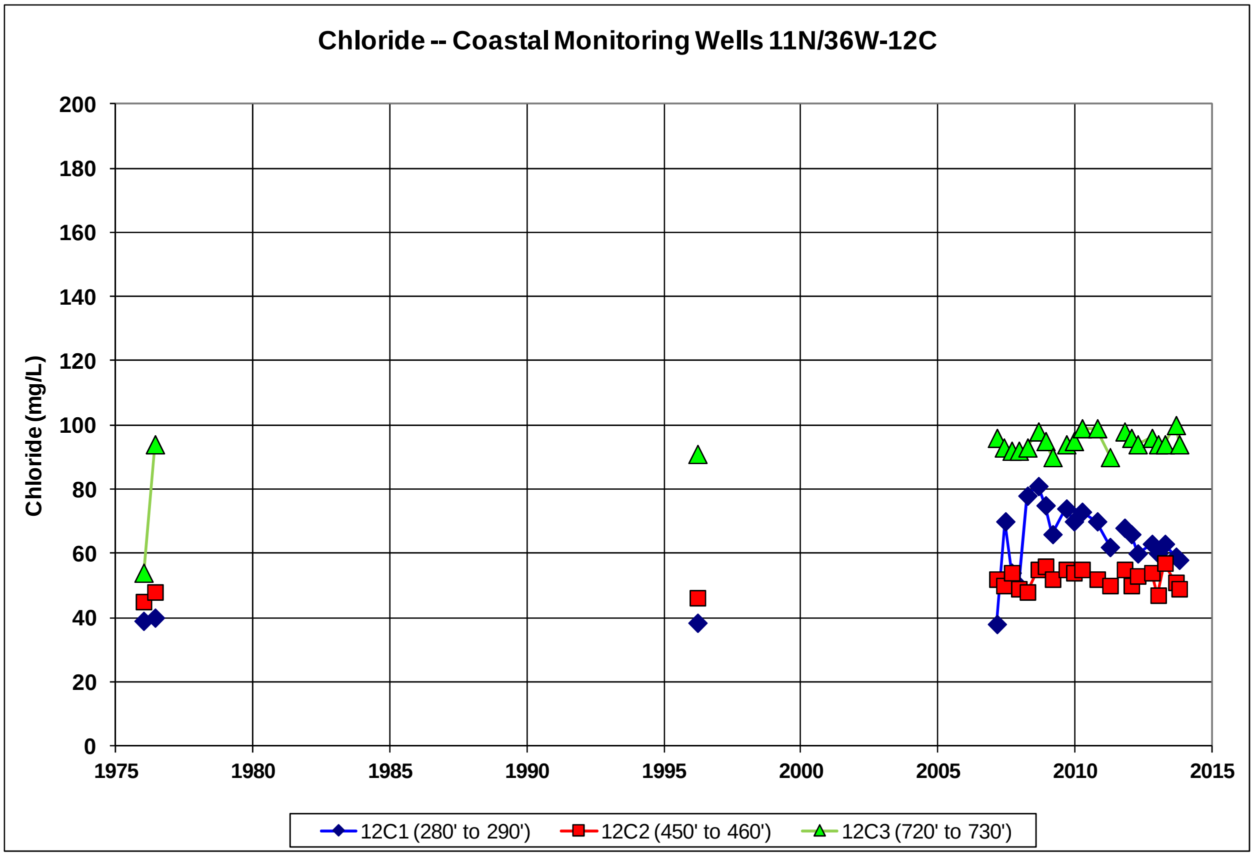


Figure 6-7. Chloride in Coastal Well 11N/36W-12C

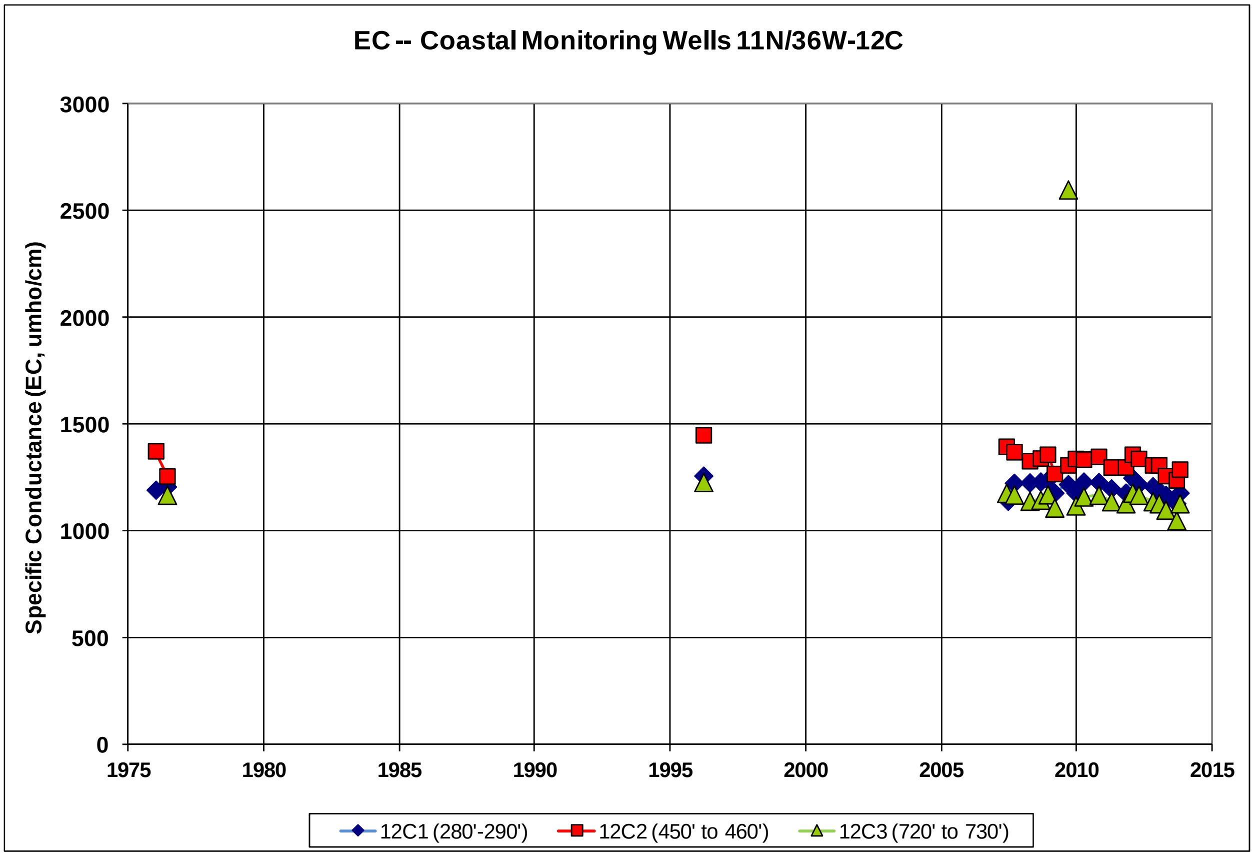


Figure 6-8. Electrical Conductivity in Coastal Well 11N/36W-12C

7. Analyses of Water Conditions

Current groundwater conditions, water shortage conditions, and long-term trends are presented in the following sections, with emphasis on the primary areas of concern.

7.1. *Current Conditions*

7.1.1. Groundwater Conditions

The primary areas of focus in evaluating the conditions of groundwater within the NMMA are: 1) groundwater elevations and water chemistry of coastal monitoring wells, 2) the coastal groundwater gradient, 3) the overall groundwater elevations within the NMMA, as measured by the Key Wells Index, and 4) the extent of the pumping depression.

Coastal Monitoring Wells – Groundwater elevations in the coastal well cluster within the NMMA have been declining since 2010 (Figure 6-3) whereas chloride concentrations have been relatively stable over the same period (Figure 6-7). Groundwater elevations in the coastal well cluster 12N/36W - 36L have declined the last decade (Figure 6-4).

Coastal Groundwater Gradient – Groundwater contours show an eastward component of flow toward the land beneath the coastal dunes (see Section 6.1.4 Groundwater Gradients). A landward gradient from the coastal monitoring wells to the inland groundwater depression has developed.

Key Wells Index – The Key Wells Index indicates trends in groundwater elevations within inland areas of the NMMA, and is intended to reflect whether there is a general balance between inflows and outflows in the NMMA. The 2013 Key Well Index declined sharply from 2012. Groundwater elevations in several of the wells that make up the Key Wells Index have generally declined since about 2000 (see Section 6.1.1 Results from Key Wells). The 2013 Key Wells Index value remains within the threshold criteria for Potentially Severe Water Shortage Conditions, although it has nearly reached the threshold criterion for Severe Water Shortage Conditions (Figure 7-1).

Pumping Depression – The groundwater depression within the inland portion of the NMMA was evident in both Spring and Fall 2013 groundwater elevation contours (Figure 6-5 and Figure 6-6). The groundwater depression widened to the west and lengthened to the north. The groundwater divide thus dissipated, resulting in a landward groundwater gradient from the coastal portion of the NMMA toward the inland. This reversal of groundwater gradients creates conditions favorable for seawater intrusion.

The other effect of the groundwater depression could be compaction and dewatering of fine-grained sediments within and adjacent to the aquifers of the NMMA, with subsequent land subsidence. There is currently no evidence of land subsidence within the NMMA, although small amounts of subsidence might go undetected. During dewatering and compaction, it is typically the finer grained sediments that are most impacted rather than the main water-producing horizons.

7.1.2. Hydrologic Inventory

The hydrologic inventory is currently incomplete due to ongoing efforts of the TG to develop an improved understanding of subsurface flow across the NMMA boundaries. Although the hydrologic inventory cannot be used directly to calculate the potential imbalance between inflow and outflow for calendar Year 2013, there are a number of observed conditions that indicate that outflow continues to exceed the ability of the inflow to replace groundwater pumped from the aquifers. These indicators include: 1) continued presence of the pumping depression in the NMMA, a portion of which is below sea level and continues to expand; 2) a reversal of offshore groundwater flow, resulting in a landward gradient from the coastal zone; and, 3) a dissipated groundwater divide between coastal and inland wells.

7.2. *Water Shortage Conditions*

The Stipulation requires the determination of the water shortage condition as part of the Annual Report. Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in groundwater levels (Potentially Severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (Severe). Potentially Severe Water Shortage Conditions exist in calendar Year 2013 based on the Key Wells Index.

Potentially Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Caution trigger point (Potentially Severe Water Shortage Conditions) *(a) Characteristics. The NMMA Technical Group shall develop criteria for declaring the existence of Potentially Severe Water Shortage Conditions. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation. Such criteria shall be designed to reflect that water levels beneath the NMMA as a whole are at a point at which voluntary conservation measures, augmentation of supply, or other steps may be desirable or necessary to avoid further declines in water levels.*

Severe Water Shortage Conditions

The Stipulation, page 25, defines Severe Water Conditions as follows:

Mandatory action trigger point (Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop the criteria for declaring that the lowest historic water levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation.

7.2.1. Coastal Criteria

Groundwater elevations and water quality at the coastal wells did not meet the criteria for Potentially Severe Water Shortage Conditions (Table 7-1).

Table 7-1. Criteria for Potentially Severe Water Shortage Conditions

Well	Perforations Elevations (ft msl)	Aquifer	Spring 2013 Elevations (ft msl)	Elevation Criteria (ft msl)	2013 Highest Chloride (mg/L)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	9.3	**5.0**	63	**250**
11N/36W-12C2	-431 to -441	Pismo	13.2	**5.5**	57	**250**
11N/36W-12C3	-701 to -711	Pismo	17.9	**9.0**	100	**250**
12N/36W-36L1	-200 to -210	Paso Robles	6.5	**3.5**	40	**250**
12N/36W-36L2	-508 to -518	Pismo	10.4	**9.0**	110	**250**

7.2.2. Inland Criteria

The inland criteria for water shortage conditions use the Key Wells Index as a basis. The Spring 2013 Key Wells Index was 17.9 ft msl, indicating Potentially Severe Water Shortage Conditions, and nearly Severe Water Shortage Conditions (Figure 7-1).

7.2.3. Status of Water Shortage Conditions

The Key Wells Index went below the elevation criterion for Potentially Severe Water Shortage Conditions with the Spring 2008 water level measurements, and has remained so through to Spring 2013. Exiting the Potentially Severe Water Shortage Conditions requires two consecutive years where the Key Wells Index is above the level of Potentially Severe Water Shortage Conditions.

The responses required by the Stipulation are set forth as follows:

VI(D)(1b) Responses [Potentially Severe]. *If the NMMA Technical Group determines that Potentially Severe Water Shortage Conditions have been reached, the Stipulating Parties shall coordinate their efforts to implement voluntary conservation measures, adopt programs to increase the supply of Nipomo Supplemental Water if available, use within the NMMA other sources of Developed Water or New Developed Water, or implement other measures to reduce Groundwater use.*

VI(A)(5). …In the event that Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions are triggered as referenced in Paragraph VI(D) before Nipomo Supplemental Water is used in the NMMA, NCSD, [GSWC], Woodlands and RWC agree to develop a well management plan that is acceptable to the NMMA Technical Group, and which may include such steps as imposing conservation measures, seeking sources of supplemental water to serve new customers, and declaring or obtaining approval to declare a moratorium on the granting of further intent to serve or will serve letters.

Nipomo Mesa groundwater management options to address water shortage conditions include responses required under the Stipulation as well as other possible groundwater management actions to address a range of resource concerns associated with the current Potentially Severe Water Shortage Condition. TG concerns directly relating to groundwater conditions include:

- Depressed groundwater elevations, both as measured by the Key Wells Index and in specific portions of the management area;
- An onshore gradient for a large area of the coastal and central portions of the NMMA.

Potential actions to address the above concerns include a range of projects and activities already in place, in progress, or contemplated for future consideration. Many of these possibilities have been reviewed previously in water supply evaluations (SAIC, 2006; Kennedy-Jenks, 2001; Bookman-Edmonston, 1994).

Existing actions in the NMMA reviewed by the TG include

- Adoption in calendar year 2010 of a purveyor Well Management Plan, which includes conservation, public outreach, and facilities upgrades to allow greater distribution of pumping stresses away from areas of concern (see Section 1.1.6 Well Management Plan)
- Continued progress in 2013 on a NSWP (see Section 1.1.7 Supplemental Water)

Potential actions to be reviewed by the TG include

- Increased development of reclaimed water for certain NMMA water supply needs in lieu of pumping from the deep aquifers.

Different management options have different potential capacity to reduce demand or increase supply, and each has its own technical considerations. By way of example and assuming regulatory agency approval and the establishment of an appropriate cost benefit that meets the requirements of Prop 218 or the PUC, wastewater effluent that is not already reclaimed may be discharged in locations where wastewater effluent would have a beneficial effect on the deep aquifers and in areas closer to the coast.

Areas of special concern with regard to Potentially Severe Water Shortage Conditions have special significance if they experience beneficial results from projects to manage groundwater demands and overall supply. For example, the coastal portion of the NMMA has a component of landward flow, and is potentially threatened by seawater intrusion in the deep aquifers. Actions that maintain a healthy ocean-ward component of flow protect the basin from potential seawater intrusion. Similarly, the pumping depression in the central portion of the NMMA has long-standing groundwater levels below sea level and is a pronounced feature of the main producing aquifers in the NMMA (see Figures 6-5 and 6-6). Allowing water levels to rebound in this area would also help to maintain protective groundwater gradients.

7.3. *Long-term Trends*

Long-term trends in climate, land use, and water use are presented in the following sections.

7.3.1. Climatological Trends

Climatological trends have been identified through the use of cumulative departure from mean analyses. A cumulative departure from the mean represents the accumulation, since the beginning of the period of record, of the differences (departures) in annual total rainfall volume from the mean value for the period of record. Each year's departure is added to or subtracted from the previous year' cumulative total, depending on whether that year's departure was above or below the mean annual rainfall depth. When the slope of the cumulative departure from the mean is negative (i.e. downward), the sequence of years is drier than the mean, and conversely when the slope of the cumulative departure from the mean is positive (i.e. upward), the sequence of years is wetter than the mean. The cumulative departures from the mean were computed for the rainfall station Mehlschau (38), the longest rainfall record for the NMMA (Figure 7-2).

Historical rainfall records for the Nipomo Mesa begin in 1920. There are three significant long-term dry periods in the record, from 1921 to 1934, from 1944 to 1951, and from 1984 to 1991. Long-term dry periods have occurred in the last 90 years that are longer in duration than the 1987 to 1992 drought (Figure 7-2). Between each large dry period, three wetting periods have occurred. These wetting periods are from 1935 to 1943, from 1977 to 1983, and from 1994 to 2001.

The period of analyses (1975-2012) used by the TG is roughly 9 percent "wetter" on average than the long-term record (1920-2012) indicating a slight bias toward overestimating the amount of local water supply resulting from percolation of rainfall. The Water Years 2007, 2008, and 2009 have had less than average rainfall. Water Year 2007 was approximately 45 percent to 50 percent of average rain fall, Water Year 2008 was approximately 94 percent to 97 percent of average rain fall, and Water Year 2009 was approximately 67 percent to 73 percent of average rain fall. For the past two years, (WY 2010 and WY2011), rainfall was approximately 130 percent and 180 percent of average conditions (Table 3-1).

7.3.2. Land Use Trends

The DWR periodically has performed land use surveys of the South Central Coast, which includes the NMMA, in 1958, 1969, 1977, 1985, and 1996. A land use survey for only the NMMA was performed in 2007 based on 2007 aerial photography (see Section 3.1.8 Land Use). The most recent survey occurred in 2013 by performing aerial imagery analysis, reviewing observations made by NMMA TG engineer representatives, and assessing San Luis Obispo County pesticide purchase reports. Based on these surveys, land use in the NMMA has changed dramatically over the past half-century (Table 7-2, Figure 7-3, and Figure 7-4). Urban development has replaced native vegetation at an increasing rate, especially over the past 10 years. Total agriculture acreage has remained relatively unchanged (see Section 3.1.8 Land Use).

Table 7-2. NMMA Land Use – 1959 to 2007 (acres)

	1959	1968	1977	1985	1996	2007	2013
Agricultural	1,600	2,000	2,000	2,200	2,000	2,600	2,970
Urban	300	700	2,200	3,300	5,800	10,200	10,460
Native	19,200	18,400	16,900	15,600	13,300	8,300	7,670
Total	21,100	21,100	21,100	21,100	21,100	21,100	21,100

7.3.3. Water Use and Trends in Basin Inflow and Outflow

DWR (2002) estimated the Dependable Yield (DWR, 2002; page ES21) for their study area to be between 4,800 and 6,000 AF/yr. Their study area is approximately equivalent to the NMMA.

The estimated groundwater production is 16,350 AF for calendar Year 2013, which is about nearly 4 (3.8) times the groundwater production in 1975 (Figure 4-1), confirming a trend of increased groundwater production over the last 40 years or so, although there was a downward trend observed in a few past years. The estimated consumptive use of water for urban, agricultural and golf course, and industrial use for calendar Year 2013 is 12,900 AF. Contours of groundwater elevations suggest that there is likely inflow from the Santa Maria Valley Management Area, a flat gradient between NCMA and NMMA, and likely landward flow from the coastal zone. The net subsurface flow to the NMMA is therefore likely to be positive, but insufficient to meet the consumptive use.

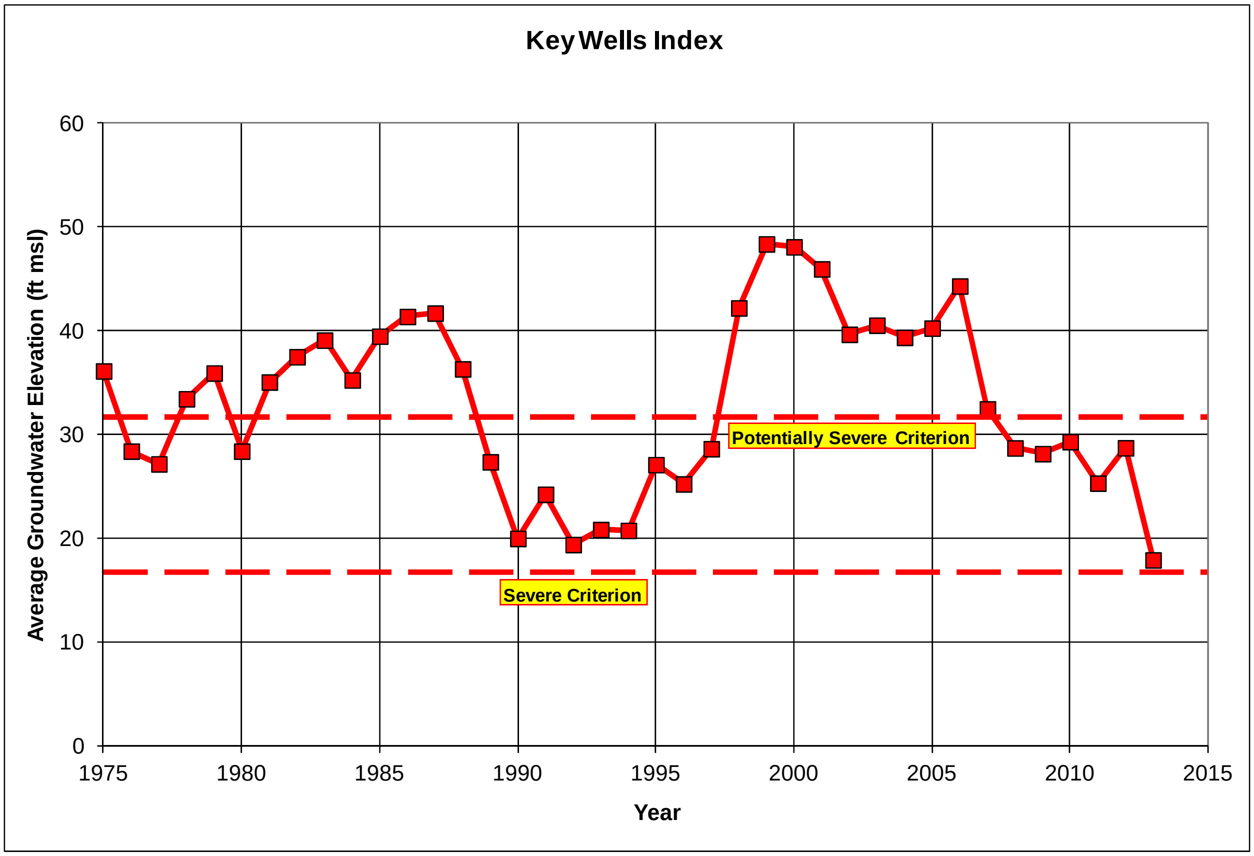


Figure 7-1**. Key Wells Index.** *The upper dashed line is the criterion for Potentially Severe Water Shortage Conditions and the lower dashed line is the criterion for Severe Water Shortage Conditions.*

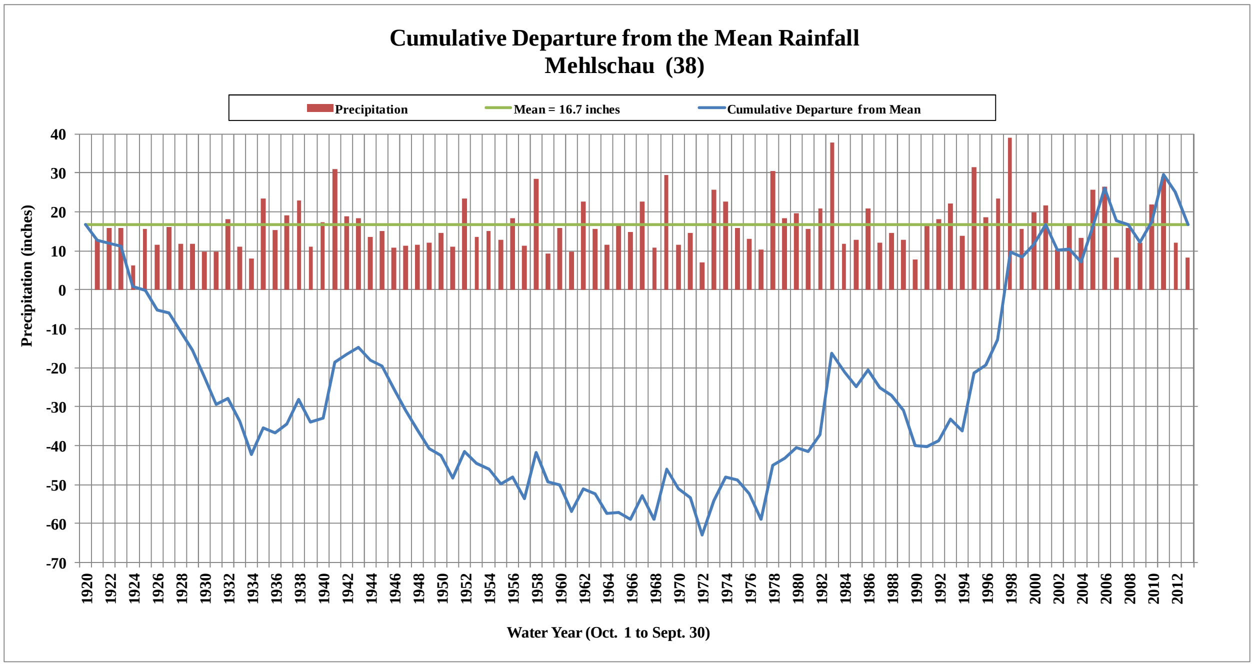


Figure 7-2. Rainfall: Cumulative Departure from the Mean – Rainfall Gauge Mehlschau (38)

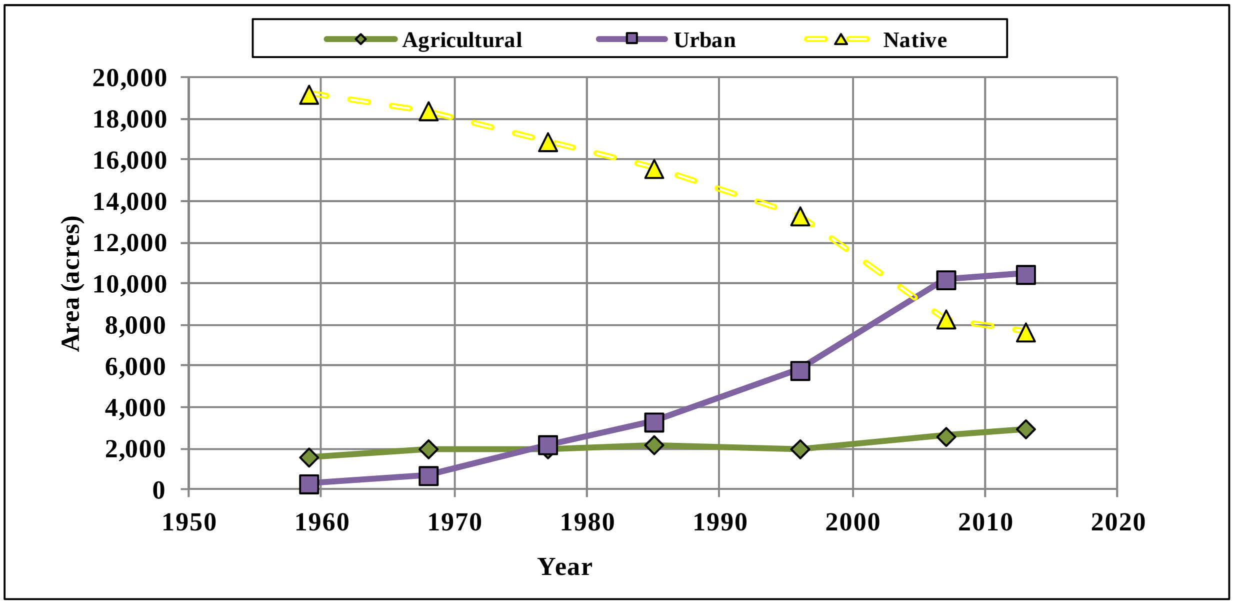


Figure 7-3. NMMA Land Use – 1959 to 2013

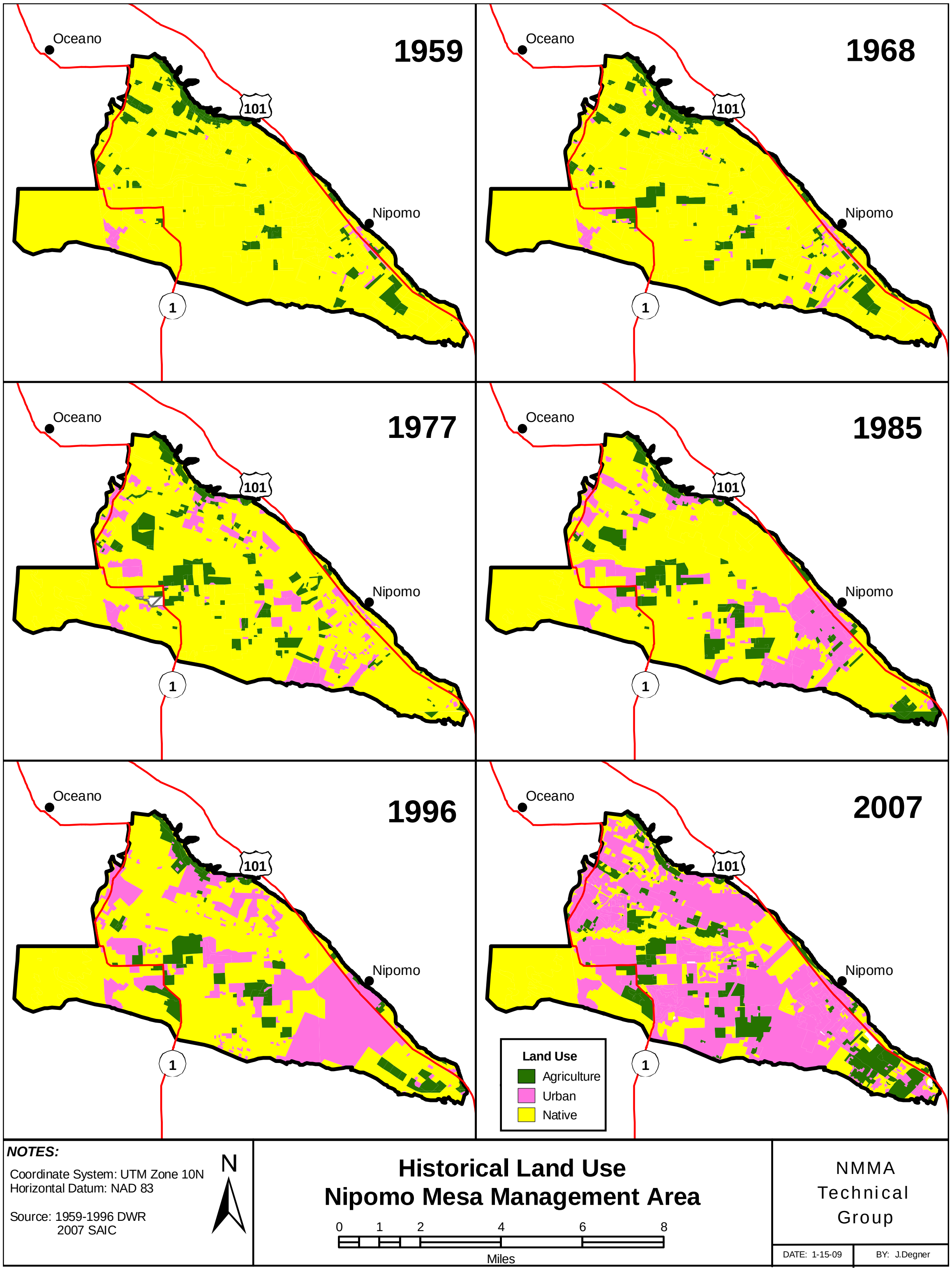


Figure 7-4. Historical Land Use in the NMMA (see Figure 3-7 for 2013 land use map)

8. Other Considerations

8.1. *Institutional or Regulatory Challenges to Water Supply*

Several types of entities and individual landowners extract water from aquifers underlying the NMMA to meet water demands and no single entity is responsible for the delivery and management of available water supplies. Each entity must act in accordance with the powers and authorities granted under California law.

The powers and authorities for Woodlands and NCSD are set forth in the California Water Code. The CPUC regulates GSWC and RWC. This diversity of the public water purveyors' powers and the locations of their respective service areas (Figure 1-1) must be taken into account in attempting to develop consistent water management strategies that can be coupled with enforceable measures to ensure timely compliance with recommendations made by the TG, or mandatory Court orders. This is particularly true when there are legal requirements relating to the timing of instigating changes in water rates, implementation of mandatory water conservation practices or forcing a change in pumping patterns which may require one entity to deliver water to a location outside its service area.

A cooperative effort among the purveyors and other parties is the only expedient means to meet these institutional and regulatory challenges relating to the water supply and overall management of the NMMA. The purveyors developed a WMP in calendar year 2010 which outlines steps to take in "potentially severe water shortage conditions" as well as in "severe water shortage conditions"[1]. The WMP identifies a list of recommended water use restrictions to limit prohibited, nonessential and unauthorized water uses. For each condition, the WMP also identifies both voluntary and mandatory actions such as conservation goals, shifts in pumping patterns, and potential additional use and pumping restrictions.

9. Recommendations

A list of recommendations were developed and published in each of the previous NMMA Annual Reports. The TG will address past and newly developed recommendations along with the implementation schedule based on future budgets, feasibility, and priority. The recommendations are subdivided into three categories: (1) Draft capital and operation expenditure plan, (2) Achievements from earlier NMMA Annual Report recommendations accomplished in 2013; and (3) Technical Recommendations – to address the needs of the TG for data collection and compilation.

9.1. *Funding of Capital and Operating Expenditure Program*

The TG acknowledges that the work items and budget presented below represent a consensus view that additional technical work is necessary beyond that covered under the current $75,000 annual budget limit. Completing this broader scope of work will require a formal adjustment to the NMMA TG budget limit.

[1] See Appendix B- "NMMA Water Shortage Conditions and Response Plan" which defines these conditions.

Table 9-1. NMMA 5-Year Cost Analysis

Task Description	Total Cost	Targeted Completion Year	Projected 5-year Cash Flow				
			2014	2015	2016	2017	2018
Yearly Tasks							
Annual Report preparation			$50,000	$50,000	$50,000	$50,000	$50,000
Grant funding efforts			$10,000	$10,000	$10,000	$10,000	$10,000
Confining layer definition			$10,000	$10,000	$10,000	$10,000	$10,000
Well head surveying			$3,000	$3,000	$3,000	$3,000	$3,000
Analytical testing			$5,000	$5,000	$5,000	$5,000	$5,000
Long Term Studies							
Groundwater model (NMMA share)	$250,000	2018	$33,300	$33,300	$33,300	$75,000	$75,000
Capital Projects							
Oso Flaco monitoring well	$130,000	2018	$43,300	$43,300	$43,300	- -	- -
Automatic monitoring equipment	$25,000	2018	- -	- -	- -	$12,500	$12,500
Total Projected Annual Cost			$154,600	$154,600	$154,600	$165,500	$165,500

9.2. *Achievements from previous NMMA Annual Report Recommendations*

The TG worked diligently to address several of the recommendations outlined in the previous Annual Reports. Accomplishments and/or progress made during 2013 include:

- Development of refined cross sections through key areas of the basin,
- Update of Land Use classification,
- Update of Crop Coefficients defining water use by specific crop type.

9.3. *Technical Recommendations*

The following technical recommendations are not organized in their order of priority, because the monitoring parties, considering their own particular funding constraints and authorities, will determine the implementation strategies and priorities. However, the TG has suggested a priority for some of the technical recommendations.

- **Supplemental Water Supplies –** Additional water supplies that would allow for reduced pumping within the NMMA are the most effective method of reducing the stress on the aquifers and allow for groundwater elevations to recover, and provide means for long-term basin management. The NSWP (see Section 1.1.7-Supplemental Water) is the fastest and most viable alternative water supply in the next ten years. Given the Potentially Severe Water Shortage Conditions within the NMMA and the other risk factors discussed in this Report, the TG recommends that this project be fully implemented as soon as possible.

- **Subsurface Flow Estimates –** Continue to develop and evaluate geologic cross-sections along NMMA boundaries and make estimates of subsurface flow.

- **Installation of Groundwater Monitoring Equipment –** The pumping of nearby wells and the length of time a well is not pumped (rested) may have an impact on the static water level measured in a well. For the Key Wells, the installation of transducers and data loggers will largely solve this problem. Installation of transducers is also recommended for purveyors' wells that pump most of the time.

- **Changes to Monitoring Points or Methods –** The coastal monitoring wells are of great importance in the Monitoring Program. The inability to locate the monitoring well cluster under the sand dunes proximally north of Oso Flaco Lake renders the southwestern coastal portion of the NMMA without adequate coastal monitoring. During 2009 and 2010, the NMMA TG reviewed options for replacing this lost groundwater monitoring site. The TG was given written support of the concept from the State Parks Department to allow replacement of the well, and the TG has also had discussions with San Luis Obispo County, which may be able to provide some financial assistance for the project. The NMMA TG has incorporated replacement of this monitoring well in its long-term capital project planning and will investigate possible State or Federal grants for financial assistance with the construction of this multi-completion monitoring well.

- **Well Management Plan –** It is recommended that for calendar year 2014, purveyors compile and present to the TG a Well Management Plan status update.

- **County of San Luis Obispo Monitoring Locations –** Review proposed County of San Luis Obispo monitoring well and stream gauge locations.

- **Well Reference Point Elevations –** It is recommended that all the wells used for monitoring have an accurate RP elevation. This could be accomplished by surveying a few wells every year or by working with the other Management Areas and the two counties in the Santa Maria Groundwater Basin to obtain LIDAR data for the region; the accuracy of the LIDAR method allows one-foot contours to be constructed and/or spot elevations to be determined to similar accuracy.

- **Groundwater Production –** Estimates of total groundwater production are based on a combination of measurements provided freely from some of the parties, and estimates based on land use. The TG recommends developing a method to collect groundwater production data from all stipulating parties. The TG recommends continued updating the land use classification on an interval commensurate with significant changes in land use patterns and as is practical, with the intention that the interval is more frequent than DWR's 10-year cycle of land use classification.

- **Increased Collaboration with Agricultural Producers –** To better estimate agricultural groundwater production where data is incomplete, it is recommended that the TG work with a subset of farmers to measure groundwater production. This measured groundwater production can then be used to calibrate models, update crop coefficients and verify estimates of agricultural groundwater production where data are not available.

- **Hydrogeologic Characteristics of NMMA –** Further defining the continuity of confining conditions within the NMMA remains a topic of investigation by the TG. The locations of confined and unconfined conditions is important – they control to a significant degree both the NMMA groundwater budget as to the quantity of recharge from overlying sources and any calculation of changes in groundwater storage. Further review of well screen intervals, lithology, groundwater level, and other relevant information to segregate wells into the different aquifers groups (e.g., shallow versus deep aquifers) for preparation of groundwater elevation contour maps for different aquifers. In addition, the NMMA will be requesting information obtained during the PG&E long-term seismic studies program and SLO County Santa Maria Groundwater Basin Characterization Study.

- **Modifications of Water Shortage Conditions Criteria –** The Water Shortage Conditions and Response Plan was submitted to the Court in 2008. The TG will review the plan on a regular basis.

- **Groundwater Modeling –** The TG continues to recommend the advancement of a groundwater model as presented in the NMMA 5-year Cost Analysis. This may include collaboration with the Northern Cities Management Area, the Santa Maria Valley Management Area or both.

References

Bachman, S.B., Hauge, C., McGlothlin, R., Neese, K., Parker, T., Saracino, A., and Slater, S., 2005. California Groundwater Management, Second Edition: California Groundwater Resources Association, 242 p.

Bendixen, Warren and Hanson, Blaine. 2004. Drip irrigation evaluated in Santa Maria Valley Strawberries. California Agriculture Vol. 58, Number 1, pg. 48 -53.

Bookman-Edmonston, 1994. Evaluation of Alternative Supplemental Water Supplies. Report *prepared for* Nipomo Community Services District, 29 p.

California Department of Health Services, 2000. California Safe Drinking Water Act and related laws, 365 p.

California Department of Public Health [DPH], 2009. Water Quality Monitoring Data – electronic product, Drinking Water Program, Department of Public Health, 1616 Capitol Avenue, MS 7416, Sacramento, CA 95814.

California Department of Water Resources [DWR], 1970. Sea-water intrusion: Pismo-Guadalupe area: Bulletin 63-3, 76 p.

California Department of Water Resources [DWR], 1975. Vegetative Water Use in California, 1974. Bulletin 113-3. April 1975.

California Department of Water Resources [DWR], 2002. Water resources of the Arroyo Grande – Nipomo Mesa area: Southern District Report, 156 p.

Chipping, D.H., 1994. Black Lake Canyon geologic and hydrologic study, *prepared for* the Land Conservancy of San Luis Obispo County, 76 p.

Fugro West, Inc., 2007. Hydrogeologic characterization – Southland Wastewater Treatment Facility, Nipomo, California, July 2007.

Golden State Water Company [GSWC], 2008. Water Shortage Contingency Plan – Nipomo System, November 2008, internal report.

Kennedy Jenks, 2001. Evaluation of Water Supply Alternatives - Final Report. Report *prepared for* Nipomo Community Services District, 99 p.

Luhdorff & Scalmanini Consulting Engineers, 2000. Development of a numerical ground-water flow model and assessment of ground-water basin yield, Santa Maria Valley Ground-water Basin; *prepared for* Santa Maria Valley Water Conservation District, 65 p.

Miller, G.A., and Evenson, R.E., 1966. Utilization of ground water in the Santa Maria Valley area: U.S. Geological Survey Water-Supply Paper 1819-A, 24 p.

Morro Group, 1996. Final Environmental Impact Report, Cypress Ridge Tract Map and Development Plan, *prepared for* Office of Environmental Coordinator, San Luis Obispo County, August 1996.

Nipomo Community Services District [NCSD], 2006. 2005 Urban Water Management Plan Update. Adopted January 25, 2006. *Prepared by* SAIC.

Nipomo Community Services District [NCSD], 2011. 2010 Urban Water Management Plan. Adopted June 29, 2011. *Prepared by* WSC.

Nipomo Community Services District [NCSD], 2007. Water and Sewer Master Plan Update. December 2007. *Prepared by* Cannon Associates.

Nipomo Mesa Management Area [NMMA]. 2009. 1st Annual Report – Calendar Year 2008. NMMA TG.

Nipomo Mesa Management Area [NMMA]. 2010. 2nd Annual Report – Calendar Year 2009. NMMA TG.

Nipomo Mesa Management Area [NMMA]. 2011. 3rd Annual Report – Calendar Year 2010. NMMA TG.

Nipomo Mesa Management Area [NMMA]. 2012. 4th Annual Report – Calendar Year 2011. NMMA TG.

Nipomo Mesa Management Area [NMMA]. 2013. 5th Annual Report – Calendar Year 2012. NMMA TG.

Northern Cities Management Area [NCMA]. 2009. NCMA Annual Report 2008.

Northern Cities Management Area [NCMA]. 2010. NCMA Annual Report 2009.

Northern Cities Management Area [NCMA]. 2011. NCMA Annual Report 2010.

Northern Cities Management Area [NCMA]. 2012. NCMA Annual Report 2011.

Northern Cities Management Area [NCMA]. 2013. NCMA Annual Report 2012.

SAIC, 2006, Urban Water Management Plan Update. Report *prepared for* Nipomo Community Services District; 170 p.

San Luis Obispo County [SLO], 1998. Woodlands Specific Plan - Final Environmental Impact Report. *Prepared by* Environmental Science Associates.

San Luis Obispo County [SLO], 2001. Water Master Plan Update – Water Planning Area #6, Nipomo Mesa.

San Luis Obispo County Agriculture Commissioner [SLO Ag Commissioner]. 2009. Shapefile containing field boundaries of crops in San Luis County for 2008. Published January 2009. Accessed February 2009. http://lib.calpoly.edu/collections/gis/slodatafinder/

Santa Maria Valley Groundwater Litigation, 2003 [Phase III]. Water Resources Evaluation of the Nipomo Mesa Management Area. Toups Corporation, 1976. Santa Maria Valley water resources study: *prepared for* City of Santa Maria, 166 p.

Santa Maria Valley Management Area [SMVMA]. 2009. SMVMA Annual Report 2008.

Santa Maria Valley Management Area [SMVMA]. 2010. SMVMA Annual Report 2009.

Santa Maria Valley Management Area [SMVMA]. 2011. SMVMA Annual Report 2010.

Santa Maria Valley Management Area [SMVMA]. 2012. SMVMA Annual Report 2011.

Santa Maria Valley Management Area [SMVMA]. 2013. SMVMA Annual Report 2012.

U.S. Geological Survey and California Geological Survey, 2006, Quaternary fault and fold database for the United States, accessed December 28, 2011. http://earthquake.usgs.gov/regional/qfaults/

University of California, Agriculture and Natural Resources [UCANR], 2009. Avocado information website. Accessed March 2, 2009. http://www.ucavo.ucr.edu/AvocadoWebSite%20folder/AvocadoWebSite/Irrigation/CropCoefficients.html

Woodring, W.P and Bramlette, M.N. 1950. Geology and Paleontology of the Santa Maria District, California: U.S. Geological Survey, Professional Paper 222, 142 p.

Worts, G.F., Jr., 1951. Geology and ground-water resources of the Santa Maria Valley area, California: U.S. Geological Survey Water-Supply Paper 1000, 176 p.

Appendices

Appendix A: Monitoring Program

Nipomo Mesa Monitoring Program

Prepared by

Nipomo Mesa Management Area Technical Group

August 2008

Table of Contents

1 INTRODUCTION

1.1 Background

This Monitoring Program is a joint effort of the Nipomo Mesa Management Area ("NMMA") Technical Group ("Technical Group"). The Technical Group was formed pursuant to a requirement contained in the 2005 Stipulation ("Stipulation") for the Santa Maria Basin Adjudication. Sections IV D (All Management Areas) and Section VI (C) (Nipomo Mesa Management Area) contained in the Stipulation were independently adopted by the Court in the Judgment After Trial[1] (herein "Judgment"). The Monitoring Program is a key component of the portions of the Judgment that involve the NMMA and forms the basis for subsequent analyses of the basin to be included in Annual Reports for the NMMA.

This Monitoring Program includes a discussion of the various parameters to be monitored within the NMMA, and a discussion of data analysis methods and water shortage triggers. The Monitoring Program provides a permanent foundation for the type of information to be regularly monitored and collected. However, the Technical Group is expected periodically to evaluate and update the Monitoring Program to ensure it provides comprehensive information sufficient to assess the integrity of water resources within the NMMA. For example, the Technical Group may change or expand monitoring points or types of data to be collected and otherwise periodically amend the Monitoring Program. Material amendments will be submitted for court approval.

1.2 Judgment

As a component of the physical solution for the Santa Maria groundwater basin, the Judgment requires the development and implementation of comprehensive monitoring and reporting in each of three Management Areas in the basin – Northern Cities Management Area, Nipomo Mesa Management Area, and Santa Maria Valley Management Area (Figure 1). For each of these Management Areas the Judgment specifies:

"A Monitoring Program shall be established in each of the three Management Areas to collect and analyze data regarding water supply and demand conditions. Data collection and monitoring shall be sufficient to determine land and water uses in the Basin, sources of supply to meet those uses, groundwater conditions including groundwater levels and quality, the amount and dispositions of Developed Water supplies, and the amount and disposition of any sources of water supply in the Basin.

[1] The Judgment is dated January 25, 2008 and was entered and served on all parties on February 7, 2008. This Monitoring Program is to be submitted for court approval on or before August 6, 2008.

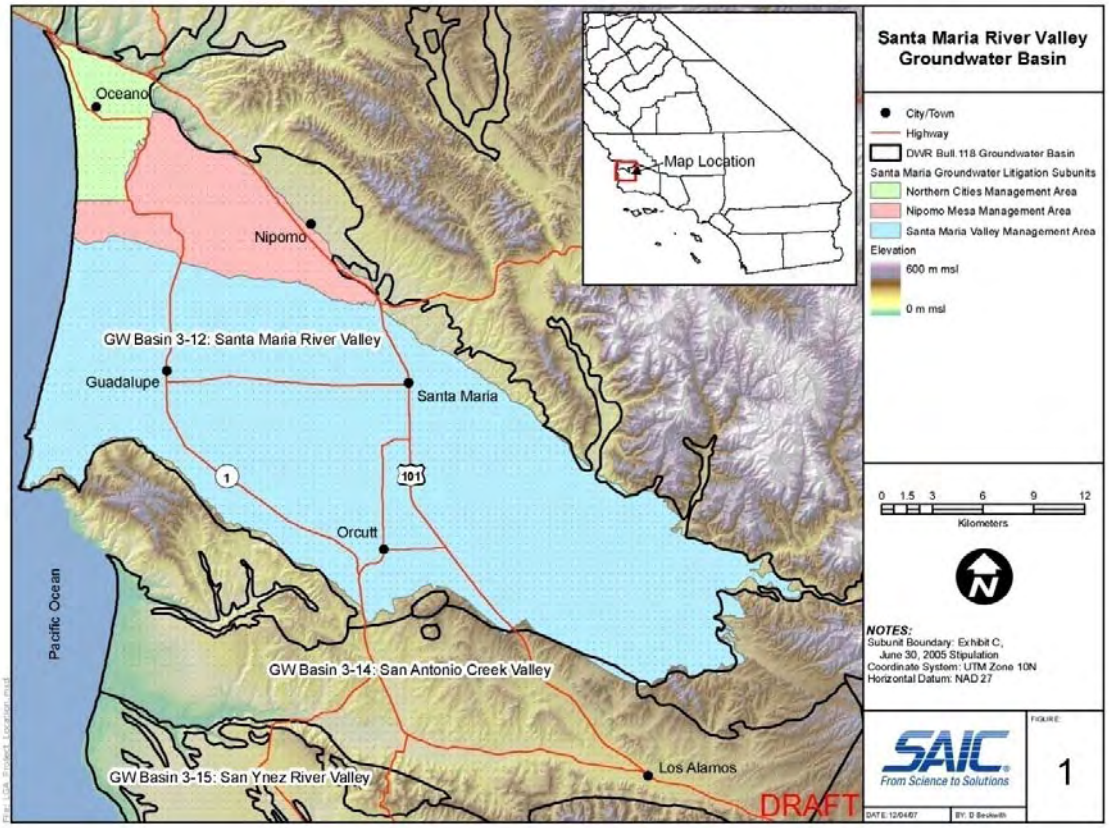


Figure 1. Santa Maria groundwater basin location map.

Within one hundred and eighty days after entry of judgment, representatives of the Monitoring Parties from each Management Area will present to the Court for its approval their proposed Monitoring Program."

The Judgment also requires the NMMA and the Santa Maria Valley management area technical committees to submit for court approval the criteria that trigger responses to "potentially severe and severe shortage conditions" that are specified in the Judgment.

An additional requirement of the Judgment is an Annual Report:

"Within one hundred and twenty days after each Year, the Management Area Engineers will file an Annual Report with the Court. The Annual Report will summarize the results of the Monitoring Program, changes in groundwater supplies, and any threats to Groundwater supplies. The Annual Report shall also include a tabulation of Management Area water use, including Imported Water availability and use, Return Flow entitlement and use, other Developed Water availability and use, and Groundwater use. Any Stipulating Party may object to the Monitoring Program, the reported results, or the Annual Report by motion."

Each Management Area Monitoring Plan will provide the basis for the preparation of the annual reports and the data to support the evaluations for the potentially severe and severe water shortage conditions relevant to the NMMA and the Santa Maria Valley management area.

1.3 Technical Group

The NMMA Technical Group is designated as the Monitoring Party for the NMMA.

Membership

The NMMA Technical Group is designated in the Judgment as including representatives appointed by Nipomo Community Services District, Southern California Water Company (now known as Golden State Water Company), ConocoPhillips, Woodlands Mutual Water Company, and an agricultural overlying owner who is also a Party to the Stipulation. The service areas of purveyors in the Technical Group are indicated in Figure 2.

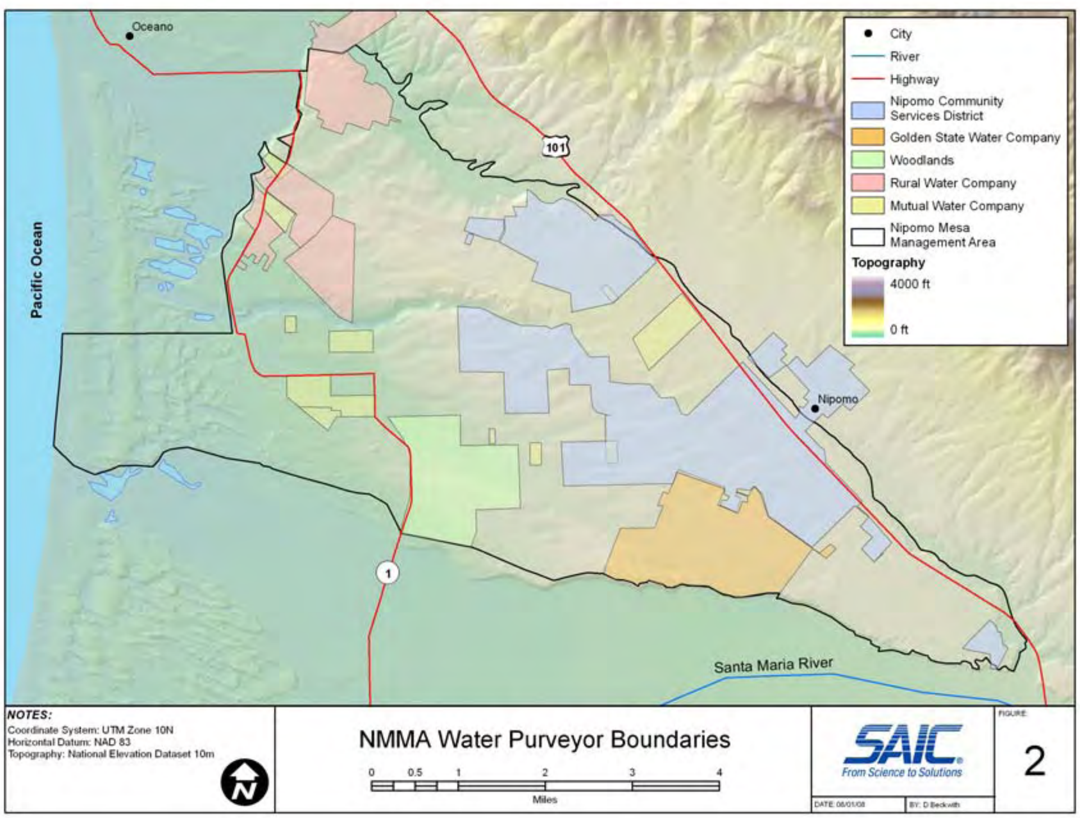


Figure 2. Water purveyors within the NMMA.

Role

The Technical Group is responsible for preparing the Monitoring Program, conducting the Monitoring Program, and preparing the Annual Reports. The Technical Group may hire individuals or consulting firms to assist in the preparation of the Monitoring Program and Annual Reports (the Judgment describes these individuals or consulting firms as the "Management Area Engineer"). The Technical Group has the sole discretion to select, retain, and replace the Management Area Engineer.

To assist the Technical Group in monitoring and analyzing water conditions in the NMMA, Stipulating Parties are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available. The Technical Group is required to adopt rules and regulations concerning measuring devices that are consistent with the Monitoring Programs of other Management Areas when feasible.

If the Technical Group is unable to agree on any aspect of the Monitoring Program, the matter may be taken to the Court for resolution.

Cost Sharing

The Technical Group functions are to be funded by contribution levels negotiated by Nipomo Community Services District, Golden State Water Company, Rural Water Company, ConocoPhillips, and Woodlands Mutual Water Company. In-lieu contributions through engineering services may be provided, subject to agreement by those parties. The budget of the Technical Group shall not exceed $75,000 per year without prior approval of the Court.

1.4 Objectives Of Monitoring Program

The objectives of the Monitoring Program are to establish appropriate data collection criteria and analytical techniques to be used within the NMMA so that groundwater conditions, changes in groundwater supplies, threats to groundwater supplies, water use, and sources of water can be documented and reported on an annual basis. In addition, data developed through the Monitoring Program will be relied upon to provide the criteria for potentially severe and severe water shortage conditions.

1.5 Reporting Requirements

The Monitoring Program shall be presented for Court approval consistent with the Judgment. The Annual Report shall be submitted to the Court by April 30 of each year (April 29 on leap years).

2 MONITORING PARAMETERS

To satisfy the objectives of the Monitoring Program (section 1.4), data need to be collected from a variety of sources. The data to be collected include:

- Groundwater elevations measured in wells
- Water quality measured in wells
- Precipitation
- Streamflow
- Surface water usage
- Surface water quality
- Land use to the extent differential uses impact the NMMA water budget
- Groundwater pumping (measured)
- Groundwater pumping (estimated)
- Wastewater discharge and reuse amounts and locations

2.1 Groundwater Elevations

The San Luis Obispo County Department of Public Works, the U.S. Geological Survey, the California Department of Water Resources, and some groundwater users within the NMMA periodically gather groundwater elevation data on a large number of wells within the NMMA. Various members of the NMMA Technical Group already maintain these data in digital databases.

Current monitoring of groundwater elevations is conducted primarily by the County of San Luis Obispo, and additionally by Nipomo Community Services District, ConocoPhillips, Woodlands, Golden State Water Company, and Rural Water Company. The Monitoring Program will include compilation of groundwater elevations for a large number (93 initially) of groundwater wells located throughout the NMMA. Typically, groundwater elevations are measured during the fall and spring of each year. The initial list of the wells to be included in the Monitoring Program are shown in the Appendix.

The extensive current monitoring of groundwater elevations within the NMMA is sufficient to provide initial information on groundwater trends. However, there are four additional issues that the Technical Group will consider for further monitoring or analysis over the first years of implementation of the Monitoring Program:

- Additional existing coastal nested monitoring wells will be considered for inclusion in the groundwater elevation monitoring program. These include the 13K2-K6 nested site near Oso Flaco Lake (currently not being monitored) and the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon (outside the NMMA, currently monitored for groundwater elevations by SLO County).

- The wells used in the Monitoring Program will be investigated as necessary to ensure that the aquifer penetrated by the wells is verified.

- Additional wells may be added as necessary to the Monitoring Program in a phased approach to fill in data gaps recognized during preparation of the Annual Reports.

- The Technical Group may recommend that additional dedicated monitoring well(s) need to be installed at critical locations where no other information is available.

2.2 Groundwater Quality

As an element of compliance with their drinking water reporting responsibilities, public water purveyors within the NMMA have historically gathered and reported groundwater quality data (filed with the California Department of Public Health). In addition, the U.S. Geological Survey, the California Department of Water Resources, and SLO County have also gathered some water quality data within the NMMA. Members of the NMMA Technical Group maintain these data in digital databases.

Of considerable importance is groundwater quality in wells near the ocean, the most likely site where any intrusion of seawater would first be detected. Because there was no current monitoring of groundwater quality in any of the coastal nested monitoring wells, the Monitoring Program will include the following:

- Coastal nested monitoring well site 11N/36W-12C (west of the ConocoPhillips refinery) is now monitored under agreement with SLO County and provides quarterly water quality sampling. Samples are collected for chloride, sulfate, and sodium lab analyses and pH, EC, and temperature are measured in the field.

Regular sampling and analyses of groundwater quality is an important component of the Monitoring Program, because of the potential threat of seawater intrusion at the coastline and potential water quality changes caused by pumping stress in other portions of the NMMA and the basin as a whole. Water quality does not change as rapidly as groundwater elevations, so quality monitoring does not have to be as frequent. With the addition of the coastal nested monitoring data, current water quality monitoring appears to be adequate. However, four aspects of the Monitoring Program will be further evaluated to ensure the ongoing adequacy of the Monitoring Program:

- The Technical Group will arrange to receive water quality monitoring results from purveyors within the NMMA, either directly from the purveyors or annually from the Department of Public Health.

- Coastal nested monitoring well site 12C will be evaluated to determine whether current quarterly sampling can be reduced in frequency (or field testing substituted for laboratory analysis), thus allowing funding for water quality monitoring of additional nested site 13K2-K6 near Oso Flaco Lake (not sampled for three decades) and the 36L1-L2 nested site in the coastal dunes west of Black Lake Canyon (last sampled 12 years ago).

- Each well used for monitoring of groundwater elevations will be tested once for general minerals (if such testing is not already conducted) as budgeting allows. This testing will help further define particular aquifer characteristics.

- A water quality monitoring contingency plan will be developed in the event that there are indications of seawater intrusion in coastal monitoring wells. This contingency plan will consider triggers for increased sampling, both in frequency and in added analytes (e.g., iodide, strontium, boron, oxygen/hydrogen isotopes).

2.3 Precipitation

There is a wide choice of existing precipitation stations that can be used to estimate rainfall within the NMMA. Two gauges are part of the ALERT Storm Watch System, Nipomo East (728) and Nipomo South (730). Other gauges include Simas (201.1), Black Lake (222), Runels Ranch (42.1), Oceano Wastewater Plant (194), Nipomo Mesa (152.1), Peny Ranch (175.1), Mehlschau (38), NCSD Shop (223), Nipomo CDF (151.1), and CIMIS Nipomo #202 Station. As part of the analysis for the Annual Reports, data from an appropriate subset of these gauges will be used to estimate precipitation each year.

2.4 Streamflow

Streamflow can be important both as an input and an output of the water balance for an area. Currently, streamflow within the NMMA is partially gauged. The Los Berros Creek gauge (Sensor 757) is located 0.8 miles downstream from Adobe Creek and 3.7 miles north of Nipomo on Los Berros Road. This station is located approximately where Los Berros Creek conveys water out of the NMMA.

Nipomo Creek is not currently being monitored and is observed to convey water out of the NMMA during some of the year. The Technical Group will consider whether monitoring of Nipomo Creek or any other surface water monitoring is necessary or appropriate.

2.5 Surface Water Quality and Usage

There has been limited surface water monitoring of the dune lake complex and in Black Lake Canyon by the San Luis Obispo Land Conservancy and others. The

Technical Group will evalute whether this monitoring is sufficient and will obtain this and any additional related data as necessary and appropriate.

It is not known whether there are surface water diversions within the NMMA. The Technical Group will investigate this issue and determine whether additional monitoring is necessary and appropriate.

2.6 Land and Water Uses Impacting NMMA Water Balance

Land uses within the NMMA include agricultural, residential/commercial, and undeveloped areas. Land use surveys can be useful both in developing an overall water balance assessment and as an aide to estimate water use when such use is not directly measured. The most common method of conducting a land use survey is to obtain current digital aerial photography, classify the land uses, and create GIS mapping of the various land use classifications. In some cases, field checking is also required to confirm information obtained from aerial photography.

Where necessary, water use may be established based on the various types of land use within the NMMA. Information may be obtained from both published data (including San Luis Obispo County WPA-6) and any information compiled from existing stations installed in and around the NMMA that monitor climate data (CIMIS). This is described in greater detail in Section 2.8.

2.7 Groundwater Pumping (Measured)

Individual landowners, public water purveyors, and industry all rely on groundwater pumping from the NMMA. To the extent users measure their volume of use, these data will be reported to the Technical Group on an annual basis. Stipulating Parties to the Judgment are required to provide monitoring and other production data at no charge, to the extent that such data have been generated and are readily available.

Pursuant to paragraph 5 of the Judgment, the Technical Group retains the right to seek a Court Order requiring non-stipulating parties to monitor their well production, maintain records thereof, and make the data available to the Court or the Court's designee.

2.8 Groundwater Pumping (Estimated)

Some groundwater users do not measure the volume of their groundwater production, and thus, this increment of groundwater pumping will have to be estimated each year. There are several methods of estimating groundwater pumping when totalizing meters are not installed. For cooperating pumpers, electrical records for pumping can be used, with the most accuracy obtained when the wells are tested regularly for pump efficiency.

Another method of estimating agricultural pumping is through self-reporting or surveys of crop type and irrigated acreage. For agriculture, water use can then be estimated using calculations that include crop water demand, effective precipitation, evapotranspiration, irrigation efficiency, and leaching requirements. An active California Irrigation Management Information System (CIMIS) station is located in the southern portion of the Woodlands within the NMMA and provides a useful reference for Nipomo Mesa evapotranspiration. A second active station is located adjacent to the Sisquoc River, above Tepusquet Creek.

For municipal or mixed rural lands, estimates will be based on acreage and development type. In some urban lands, a "unit water use" can be derived from average water consumption recorded from comparable or historical conditions.

To develop a complete picture of groundwater withdrawals for Nipomo Mesa, the Technical Group will develop methods for estimating unmetered groundwater pumping that will likely include some combination of those discussed above.

2.9 Wastewater Discharge and Reuse

Four wastewater treatment facilities discharge treated effluent within the NMMA and include the following: NCSD's Southland Wastewater Treatment Facility in the eastern portion of Nipomo Mesa, NCSD's wastewater treatment plant at Blacklake Village, Cypress Ridge's wastewater treatment facility, and the Woodland's wastewater treatment facilities. The Monitoring Program will include an annual compilation of wastewater treatment plant discharges, any reuse of the treated water (quantities and locations), and available water quality parameters.

3 DATA ANALYSIS & WATER SHORTAGE TRIGGERS

The primary purpose of the Monitoring Program is to detect changes in groundwater conditions that indicate current and future water supply problems within the NMMA. Although the determination of methods of data analysis and subsequent triggers that can indicate negative water supply conditions are not elements of the Monitoring Program, initial assessment of these issues are the responsibility of the Technical Group. A short discussion of potential methodologies follows.

3.1 Data Analysis

The focus of data analysis is to help detect and predict whether any conditions exist that could harm the aquifer, either by excessive drawdown or by degrading water quality. In evaluating the Monitoring Program data, the Technical Group will establish methodologies to use monitoring data to define the "health" of the basin. Among the methodologies that the Technical Group will evaluate in developing potentially severe and severe water shortage triggers are:

- **Coastal monitoring wells –** trends in water quality and groundwater elevations. Establish criteria to recognize both the potential for seawater intrusion and evidence of actual seawater intrusion.

- **Coastal groundwater gradient –** the direction and magnitude of groundwater flow either towards the ocean or in a landward direction. Establish criteria to recognize conditions that could cause seawater intrusion.

- **NMMA-wide groundwater elevation contouring –** establish groundwater flow directions, detect areas of increased drawdown, determine how pumping patterns are affecting the basin and the effects of any changes in the location of pumping that may serve to mitigate negative impacts.

- **Key wells –** indicator wells in key areas that track changes in groundwater elevations and water quality. Establish criteria to determine whether monitored changes could potentially be harmful to the aquifers.

- **Groundwater in storage –** calculation of changes of groundwater in storage and consideration of changes of groundwater storage over time can be used to analyze trends in the basin hydrologic balance.

3.2 Water Shortage Triggers

The Stipulation requires that water level and water quality criteria are to be established that will trigger responses to potential water shortages (the potentially severe and severe water shortage conditions). The Technical Group will rely on the Monitoring Program data and protocol in establishing the proposed criteria for these triggers. The triggers points will be presented for court approval, as required in the Stipulation, prior to or concurrent with the filing of the first Annual Report in 2009. Annual Reports will include an assessment of basin conditions relative to the proposed trigger points.

APPENDIX – MONITORING POINTS

The monitoring points shown on Figure A-1 and in Table A-1 are the 93 initial wells that the NMMA Technical Group determined would provide information to evaluate the health of the Nipomo Mesa portion of the Santa Maria basin. Many of the wells indicated are currently being monitored (see Table A-1), with the remainder planned to be monitored prior to preparation of the first Annual Report.

As discussed in the main text of this Monitoring Program, wells will be added and/or dropped in subsequent years as the basin is evaluated annually. The addition and/or subtraction of monitoring wells will be based on data gaps, areas of special concern that require more monitoring, and data redundancy. Information from some of the wells listed in Table A-1 that are monitored by the County of San Luis Obispo may not be available because of privacy concerns – this issue will be addressed prior to preparation of the first Annual Report.

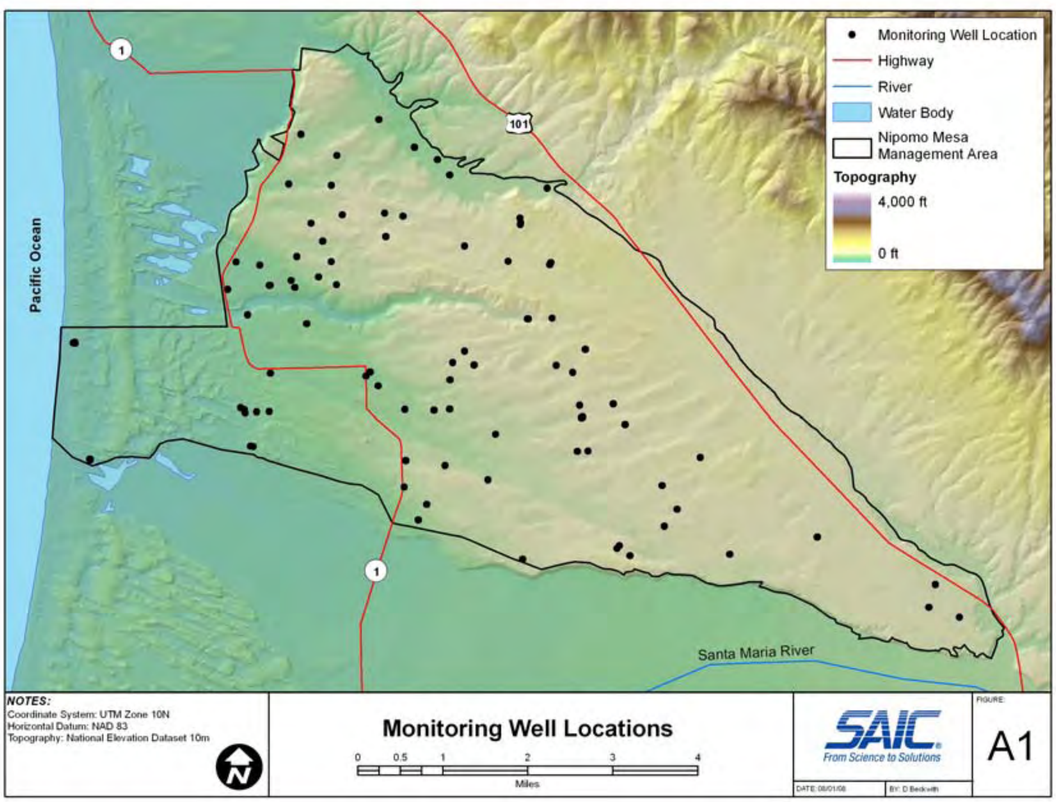


Figure A-1. Locations of monitoring points listed in Table A-1.

Appendix B: Water Shortage Conditions and Response Plan

Nipomo Mesa Management Area

Water Shortage Conditions and Response Plan

Nipomo Mesa Management Area
Technical Group

April 2009

The Santa Maria basin was divided into three management areas as a result of the adjudication of the Santa Maria groundwater basin. The June 30, 2005 Stipulation ("Stipulation"), the terms of which are incorporated into the Court's Judgment dated January 25, 2008 ("Judgment"), established the boundaries of the Nipomo Mesa Management Area ("NMMA"), and provided for a technical group (NMMA Technical Group) to oversee management of the NMMA. As part of the Stipulation, the Technical Group was tasked to develop a Monitoring Program that shall include the setting of well elevations and groundwater quality criteria that trigger the responses set forth in Paragraph VI(D) of the Stipulation.

The NMMA Technical Group prepared a Monitoring Program dated August 5, 2008 that was submitted to the Court in accordance with the Judgment. This Water Shortage Conditions and Response Plan is an addendum to the Monitoring Program and completes the Monitoring Program requirements as defined in the Stipulation.

This document is divided into three sections:

I. Water Shortage Conditions Nipomo Mesa Management Area,
II. Response Plan for Potentially Severe and Severe Water Shortage Conditions, and
III. Discussion of Criteria for Potentially Severe and Severe Water Shortage Conditions.

I. Water Shortage Conditions
Nipomo Mesa Management Area

Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in groundwater levels (Potentially Severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (Severe).

Groundwater levels beneath the NMMA as a whole impact the cost of pumping, the quality of groundwater pumped, and the overall flow of fresh water to the ocean that balances potential seawater intrusion. Lowering of groundwater levels below certain thresholds is to be curtailed by importing supplemental water, increasing conservation, and decreasing consumptive use of groundwater produced.

The NMMA Technical Group has developed criteria for declaring the existence of Potentially Severe and Severe Water Shortage Conditions. These criteria represent the conditions in both coastal and inland wells, and depend upon measurements of groundwater elevation and groundwater quality.

While this Response Plan relies on quantitative measurements of groundwater levels, the Technical Group acknowledges these measurements are subject to many variables so that any given measurement may only be accurate within a percentage range; no given measurement is exact or precise. For example, water level measurements obtained from groundwater production wells may be influenced by a range of factors, including but not limited to temperature, the method, protocol, and equipment used to obtain the measurement, the condition of the well, the time allowed for water levels in a previously producing well to equilibrate, and any nearby wells that remain pumping while the measurements are taken. As well, the historic data used as the basis to set action levels for Severe and Potentially Severe Water Shortage Conditions may be influenced by these and other factors. Finally, while there is sufficient historical data to reliably set Severe and Potentially Severe Water Shortage Conditions criteria, as more data is gathered pursuant to the NMMA Monitoring Plan, the Technical Group expects its understanding of NMMA characteristics will become increasingly more sophisticated and accurate. As a result of these considerations, the Technical Group acknowledges and expects that it will recommend modifications to the Severe and Potentially Severe Water Shortage Conditions criteria as more data are obtained on a consistent basis and as the Technical Group's understanding of the NMMA characteristics improves over time.

Seawater intrusion is a condition that could permanently impair the use of the principal producing aquifer to meet water demands of the NMMA. For coastal areas, the criteria described here are set either to indicate conditions that, if allowed to persist, may lead to seawater intrusion or increasing chloride concentrations, or that actual seawater intrusion has occurred.

Monitoring Wells

As with the NMMA Monitoring Plan, primary data for this Water Shortage Conditions and Response Plan is derived from a select group of wells located within the NMMA. Identification of these wells and the selection criteria are as follows.

Coastal sentinel wells, installed by the Department of Water Resources in the 1960s, are monitored to characterize any condition for the advancement of seawater into the freshwater aquifer. Specifically, the groundwater elevation and concentration of indicator constituents are evaluated to determine the threat or presence of seawater intrusion to the fresh water aquifer. These coastal monitoring wells are as follows:

Coastal Well	Perforation Elevation (ft msl)	Aquifer
11N/36W-12C1	-261 to -271	Paso Robles
11N/36W-12C2	-431 to -441	Pismo
11N/36W-12C3	-701 to -711	Pismo
12N/36W-36L1	-200 to -210	Paso Robles
12N/36W-36L2	-508 to -518	Pismo

For inland areas, criteria for water shortage conditions are based on annual Spring groundwater elevation measurements made in key wells located inland from the coast (the "Key Wells Index"). The inland Key Wells are as follows:

Key Wells
11N/34W-19
11N/35W-5
11N/35W-8
11N/35W-9
11N/35W-13
11N/35W-22
11N/35W-23
12N/35W-33

Potentially Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Caution trigger point (Potentially Severe Water Shortage Conditions)[1]

(a) Characteristics. The NMMA Technical Group shall develop criteria for declaring the existence of Potentially Severe Water Shortage Conditions. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation. Such criteria shall be designed to reflect that water levels beneath the NMMA as a whole are at a point at

[1] The multiple citations to and partial restatements of the Stipulation are intended to provide context to this Water Shortage Conditions and Response Plan. However, neither the restatement of a portion of the Stipulation herein, nor the omission of a portion of a quotation from the Stipulation, is intended to override or alter the mutual obligations and requirements set forth in the Stipulation.

which voluntary conservation measures, augmentation of supply, or other steps may be desirable or necessary to avoid further declines in water levels.

<u>Inland Areas</u>: The NMMA Technical Group set the criteria for a Potentially Severe Water Shortage Condition to the elevation of groundwater as determined by the Key Wells Index. If the Spring groundwater elevations indicate that the Key Wells Index is less than 15 feet above the Severe Water Shortage criterion (equal to **31.5 ft msl**[2]**)**, the Technical Group will notify the Monitoring Parties of the current data, and evaluate the probable causes of this low level as described below. If the Key Wells Index continues to be lower than **31.5 ft msl** in the following Spring, the Technical Group will report to the Court in the Annual Report that Potentially Severe Water Shortage Conditions are present and provide its recommendations regarding the appropriate response measures. During the period a Potentially Severe Water Shortage Condition persists, the NMMA Technical Group shall include in each Annual Report an assessment of the hydrologic conditions and any additional recommended response measures. A discussion of how the groundwater elevations criteria were determined is presented in discussion Section III. Potentially Severe Water Shortage Conditions will no longer be considered to exist when: 1) the Key Well Index is above the Potentially Severe criterion of 31.5 ft msl for two successive Spring measurements, or 2) the Key Well Index is 5 ft or higher above the Potentially Severe criterion (which calculates to 36.5 ft msl) in any Spring measurement. Alternatively, the NMMA Technical Group may determine that the Potentially Severe Water Shortage Condition no longer exists when the Key Well Index is above the Potentially Severe criterion of 31.5 ft msl and conditions warrant this conclusion.

The Key Well Index criteria for Potentially Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy of measured data and Key Well construction or condition.

<u>Coastal Areas</u>: The NMMA Technical Group set the coastal criteria for a Potentially Severe Water Shortage Condition using both groundwater surface elevation and groundwater quality measured in the coastal monitoring wells, as presented in the table below. The groundwater elevation criteria are discussed in Section III. The groundwater quality portion of the coastal criteria is set at **250 mg/L** chloride. There is no water quality criterion for the shallow alluvium. Potentially Severe Water Shortage Conditions are determined if <u>either</u> the Spring groundwater elevation drops below the criteria elevation, or chloride concentration exceeds the criteria concentration, in any of the coastal monitoring wells subject to the Response Plan data analysis and verification described below.

[2] The decimal point does not imply the accuracy of the historical low calculation.

The NMMA Technical Group will report to the Court in the Annual Report that Potentially Severe Water Shortage Conditions are present and provide its recommendations regarding the appropriate response measures. During the period a Potentially Severe Water Shortage Condition persists, the Technical Group shall include in each Annual Report an assessment of the hydrologic conditions and any additional recommended response measures.

When Spring groundwater elevations or groundwater quality subsequently improves so that the criteria threshold for two successive measurements are no longer exceeded, Potentially Severe Water Shortage Conditions will no longer be considered to exist. Alternatively, the Technical Group may determine that the Potentially Severe Water Shortage Condition no longer exists when the Spring groundwater elevation or groundwater quality criteria threshold are no longer exceeded in a single measurement and conditions warrant this conclusion.

The coastal threshold criteria for Potentially Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy and extent of the coastal data, including the potential for inclusion of additional coastal monitoring wells into the Monitoring Plan.

Criteria for Potentially Severe Water Shortage Conditions, Coastal Area

Well	Perforation Elevation (ft msl)	Aquifer	Elevation Criteria (ft msl)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	**5.0**	**250**
11N/36W-12C2	-431 to -441	Pismo	**5.5**	**250**
11N/36W-12C3	-701 to -711	Pismo	**9.0**	**250**
12N/36W-36L1	-200 to -210	Paso Robles	**3.5**	**250**
12N/36W-36L2	-508 to -518	Pismo	**9.0**	**250**

Severe Water Shortage Conditions

The Stipulation, page 25, defines Potentially Severe Water Conditions as follows:

Mandatory action trigger point (Severe Water Shortage Conditions)

(a) Characteristics. The NMMA Technical Group shall develop the criteria for declaring that the lowest historic water levels beneath the NMMA as a whole

have been reached or that conditions constituting seawater intrusion have been reached. These criteria shall be approved by the Court and entered as a modification to this Stipulation or the judgment to be entered based upon this Stipulation.

Inland Areas: A Severe Water Shortage Condition exists when the Key Wells Index is less than **16.5 feet msl**, using Spring groundwater elevation measurements. The Mandatory Response Plan will remain in effect until groundwater elevations as indicated by the Key Wells Index are 10 ft above the Severe criterion (which calculates to **26.5 feet msl**). Alternatively, the NMMA Technical Group may determine that the Severe Water Shortage Condition no longer exists when the Key Well Index is above the Severe criterion of 16.5 ft msl and conditions warrant this conclusion.

The criteria for Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy of measured data and Key Well construction or condition.

Coastal Areas: The NMMA Technical Group set the coastal criteria for Severe Water Shortage Condition to the occurrence of the chloride concentration in groundwater greater than the drinking water standard in any coastal monitoring well. Thus, the coastal criterion for a Severe Water Shortage Condition is the chloride concentration exceeding **500 mg/L** in any of the coastal monitoring wells. If the criterion is exceeded, an additional sample will be collected and analyzed from that well as soon as practicable to verify the result. The response triggered by the measurement will not be in effect until the laboratory analysis has been verified. If the chloride concentration subsequently improves above the criterion threshold for two successive Spring measurements, Severe Water Shortage Conditions will no longer be considered to exist. Alternatively, the Technical Group may determine that the Severe Water Shortage Condition no longer exists when groundwater quality criteria threshold are no longer exceeded in a single measurement and conditions warrant this conclusion.

The coastal threshold criteria for Severe Water Shortage Conditions may be modified in the future by the Technical Group as more data are developed on the accuracy and extent of the coastal data, including the potential for inclusion of additional coastal monitoring wells into the Monitoring Plan.

II. Response Plan for Potentially Severe and Severe Water Shortage Conditions
("Response Plan")

Introduction

This Response Plan is triggered by criteria designed to reflect either Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions. Nothing in this Response Plan is intended to, nor shall operate so as to reduce, limit or change the rights, duties, and responsibilities of the parties to this Response Plan as those rights, duties, and responsibilities are stated in the Stipulation and the Judgment.

1. Potentially Severe Water Shortage Conditions

The responses required by the Stipulation are set forth as follows:

VI(D)(1b) Responses [Potentially Severe]. *If the NMMA Technical Group determines that Potentially Severe Water Shortage Conditions have been reached, the Stipulating Parties shall coordinate their efforts to implement voluntary conservation measures, adopt programs to increase the supply of Nipomo Supplemental Water[3] if available, use within the NMMA other sources of Developed Water or New Developed Water, or implement other measures to reduce Groundwater use.[4]*

VI(A)(5). …In the event that Potentially Severe Water Shortage Conditions or Severe Water Shortage Conditions are triggered as referenced in Paragraph VI(D) before Nipomo Supplemental Water is used in the NMMA, NCSD, [GSWC[5]], Woodlands and RWC agree to develop a well management plan that is acceptable to the NMMA Technical Group, and which may include such steps as imposing conservation measures, seeking sources of supplemental water to serve new customers, and declaring or obtaining approval to declare a moratorium on the granting of further intent to serve or will serve letters.[6]

---

[3] A defined term in the parties' Stipulation. The following terms, when used in this Response Plan, are terms whose definitions are found in the Stipulation and that definition is specifically incorporated herein and adopted as the meaning of these terms: "Developed Water," "Groundwater," "Native Groundwater," "New Developed Water," "Nipomo Supplemental Water," "Nipomo Supplemental Water Project," "Stipulating Parties" and "Year."
[4] Ibid at p.25.
[5] Name changed from Southern California Water Company (SCWC) in 2005.
[6] Ibid at p.22.

The Response Plan shall be implemented when the Potentially Severe Water Shortage Conditions occur within the NMMA. The Response Plan is a combination of technical studies to better determine the nature of the threat, water supply and demand actions to mitigate overall conditions in the NMMA, and compliance with the Stipulation and the Judgment. The Response Plan includes, where applicable, the following:

1. Coastal Groundwater Elevation and/or Groundwater Quality Conditions:
   a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.
   b. Characterize the extent of either low groundwater elevation(s) or increased chloride concentration(s) near the coast, which might include adding and/or installing additional monitoring points.
   c. Identify, to the extent practical, factors that contributed to the low groundwater elevations in coastal monitoring wells.
   d. Investigate whether increased chloride concentration(s) indicate intrusion of seawater or other causes through chemistry/geochemistry studies.

2. Inland Groundwater Elevation Condition:
   a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.
   b. Characterize the extent of the area where groundwater elevation(s) have decreased sufficiently to lower the Key Wells Index.
   c. Identify factors that contributed to the low groundwater elevation(s) in coastal monitoring wells.

3. Implement sections VI(D)1(b) and VI(A)(5) of the Stipulation, as reproduced above.

4. When either the groundwater quality or groundwater elevation conditions are confirmed, the following provisions apply to the Response Plan for Potentially Severe Water Shortage Conditions:

   a. ConocoPhillips shall have the right to the reasonable and beneficial use of Groundwater on the property it owns as of the date of the Stipulation located in the NMMA without limitation.[7]

[7] Ibid at p. 23.

b. Overlying Owners that are Stipulating Parties that own land located in the NMMA as of the date of the Stipulation shall have the right to the reasonable and beneficial use of Groundwater on their property within the NMMA without limitation.[8]

c. Woodlands shall not be subject to restriction in its reasonable and beneficial use of Groundwater, provided it is concurrently using or has made arrangements for other NMMA parties to use within the NMMA, the Nipomo Supplemental Water allocated to Woodlands. Otherwise, Woodlands shall be subject to reductions equivalent to those imposed on NCSD, GSWC, and RWC.[9]

2. Severe Water Shortage Conditions

The responses required by the Stipulation are set forth following:

VI(D)(1b) Responses [Severe]. *As a first response, subparagraphs (i) through (iii) shall be imposed concurrently upon order of the Court. The Court may also order the Stipulating Parties to implement all or some portion of the additional responses provided in subparagraph (iv) below.*

(i) For Overlying Owners other than Woodlands Mutual Water Company and ConocoPhillips, a reduction in the use of Groundwater to no more than 110% of the highest pooled amount previously collectively used by those Stipulating Parties in a Year, prorated for any partial Year in which implementation shall occur, unless one or more of those Stipulating Parties agrees to forego production for consideration received. Such forbearance shall cause an equivalent reduction in the pooled allowance. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. The method of reducing pooled production to 110% is to be prescribed by the NMMA Technical Group and approved by the Court. The quantification of the pooled amount pursuant to this subsection shall be determined at the time the mandatory action trigger point (Severe Water Shortage Conditions) described in Paragraph VI(D)(2) is reached. The NMMA Technical Group shall determine a technically responsible and consistent method to determine the pooled amount and any individual's contribution to the pooled amount. If the NMMA Technical Group cannot agree upon a technically responsible and consistent method to determine the pooled amount, the matter may be determined by the Court pursuant to a noticed motion.

[8] Ibid.
[9] Ibid at p. 23.

(ii) ConocoPhillips shall reduce its Yearly Groundwater use to no more than 110% of the highest amount it previously used in a single Year, unless it agrees in writing to use less Groundwater for consideration received. The base Year from which the calculation of any reduction is to be made may include any prior single Year up to the Year in which the Nipomo Supplemental Water is transmitted. ConocoPhillips shall have discretion in determining how reduction of its Groundwater use is achieved.

(iii) NCSD, RWC, SCWC, and Woodlands (if applicable as provided in Paragraph VI(B)(3) above) shall implement those mandatory conservation measures prescribed by the NMMA Technical Group and approved by the Court.

(iv) If the Court finds that Management Area conditions have deteriorated since it first found Severe Water Shortage Conditions, the Court may impose further mandatory limitations on Groundwater use by NCSD, SCWC, RWC and the Woodlands. Mandatory measures designed to reduce water consumption, such as water reductions, water restrictions, and rate increases for the purveyors, shall be considered.

(v) During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of rights to pump Native Groundwater, voluntary fallowing, or the implementation of extraordinary conservation measures. Transfer of Native Groundwater must benefit the Management Area and be approved by the Court.[10]

The following Response Plan for Severe Water Shortage Conditions is premised on the assumption that the Nipomo Supplemental Water Project within the NMMA is fully implemented and yet Severe Water Shortage Conditions exist.

If either the coastal or inland criteria occur for Severe Water Shortage Conditions within the NMMA, a Response Plan shall be implemented. The Response Plan is a combination of technical studies to better determine the nature of the threat, water supply and demand actions to mitigate overall conditions in the NMMA that triggered a Response Plan, and compliance with the terms of the Stipulation and the Judgment. It includes, where applicable, the following NMMA Technical Group actions:

1. Groundwater Quality Condition:
   a. Verify data.

[10] Ibid at pp. 25-27.

b. Investigate whether increased chloride concentration(s) indicate intrusion of seawater or result from other causes through chemistry/geochemistry studies.

c. Characterize the extent of the increase in chloride concentration(s), which may include adding additional monitoring points and/or installing new monitoring points.

d. Given information from sections (a) and (b) above, identify the factors that may have caused the groundwater quality degradation.

2. Groundwater Elevation Condition:

a. Verify that the measurement is not an anomaly by retesting at the site(s) of exceedence as soon as practicable and again in the following month.

b. Characterize the extent of the area where groundwater elevation(s) have decreased sufficiently to lower the Key Wells Index.

c. Identify the factors that contributed to the low groundwater elevation(s) in key wells.

3. As a first response, the NMMA Technical Group shall request the Court to order concurrently sections VI(D)(1b)(i) through (iii) of the Stipulation, as reproduced above.

4. Prepare a semi-annual report on the trend in chloride concentration for the Court. If chloride concentration(s) continue to increase at the coastline, request the Court to implement section VI(D)(1b)(iv) of the Stipulation, as reproduced above.

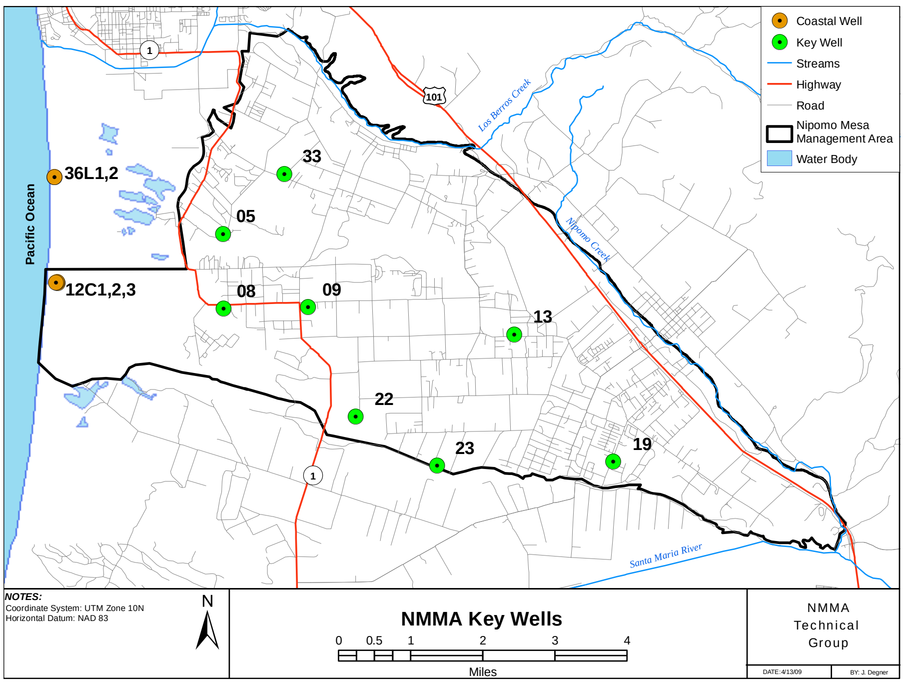
5. During Severe Water Shortage Conditions, the Stipulating Parties may make agreements for temporary transfer of groundwater pumping rights in accordance with section VI(D)(1b)(v) of the Stipulation, as reproduced above.

III. Discussion of Criteria for Potentially Severe and Severe Water Shortage Conditions

1. Water Shortage Conditions as a Whole

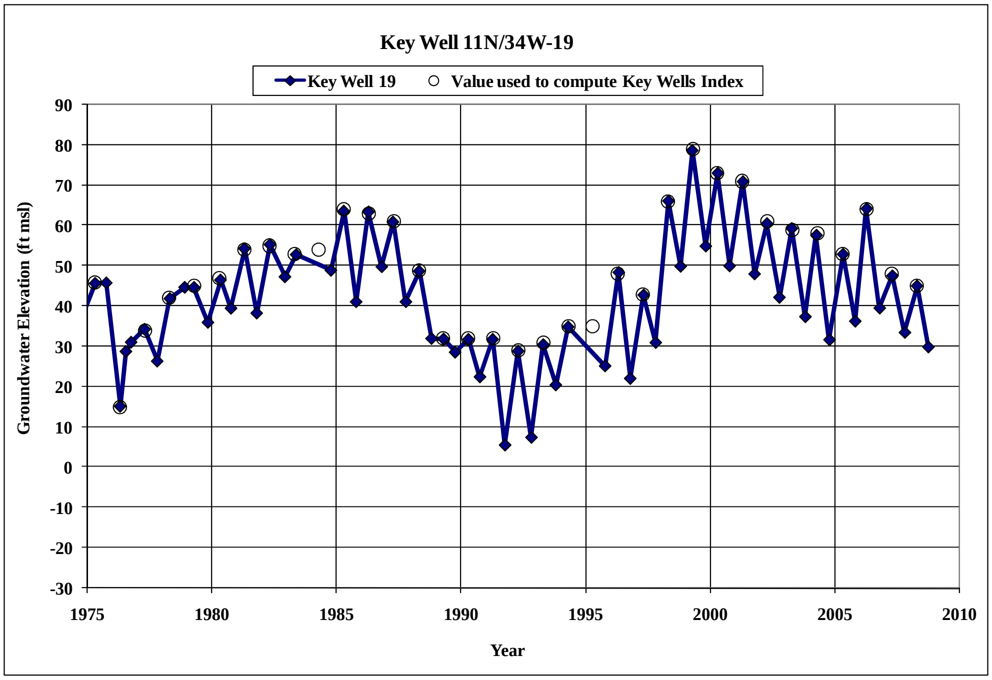
The Stipulation established that the Severe Water Shortage Conditions is characterized by the lowest historic groundwater levels beneath the NMMA as a whole. The NMMA Technical Group selected the data from eight inland key wells to represent the whole of the NMMA. These wells are listed in the following tabulation and are shown on the figure entitled “NMMA Key Wells”. The average Spring groundwater elevation of these key wells is used to calculate the Key Wells Index (“Index”).

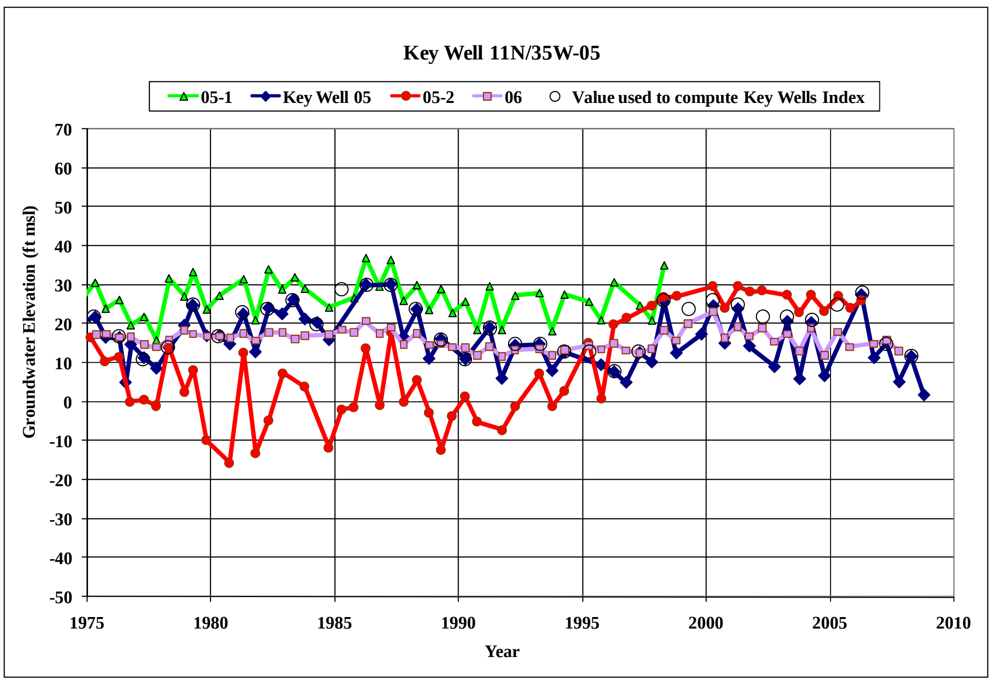
Key Wells For Inland Criterion
11N/34W-19
11N/35W-5
11N/35W-8
11N/35W-9
11N/35W-13
11N/35W-22
11N/35W-23
12N/35W-33

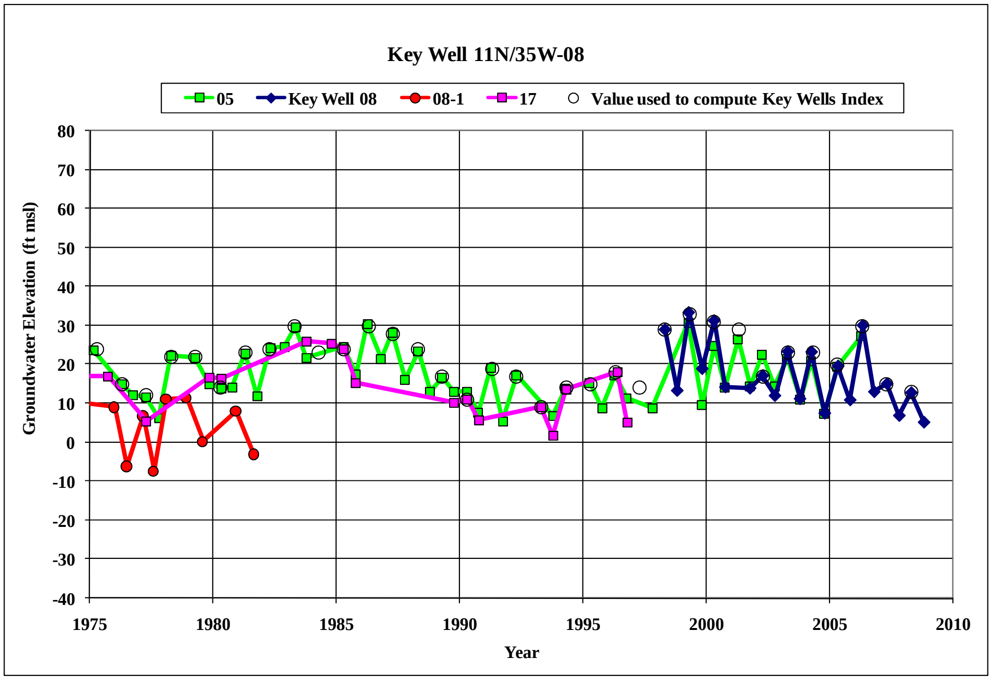


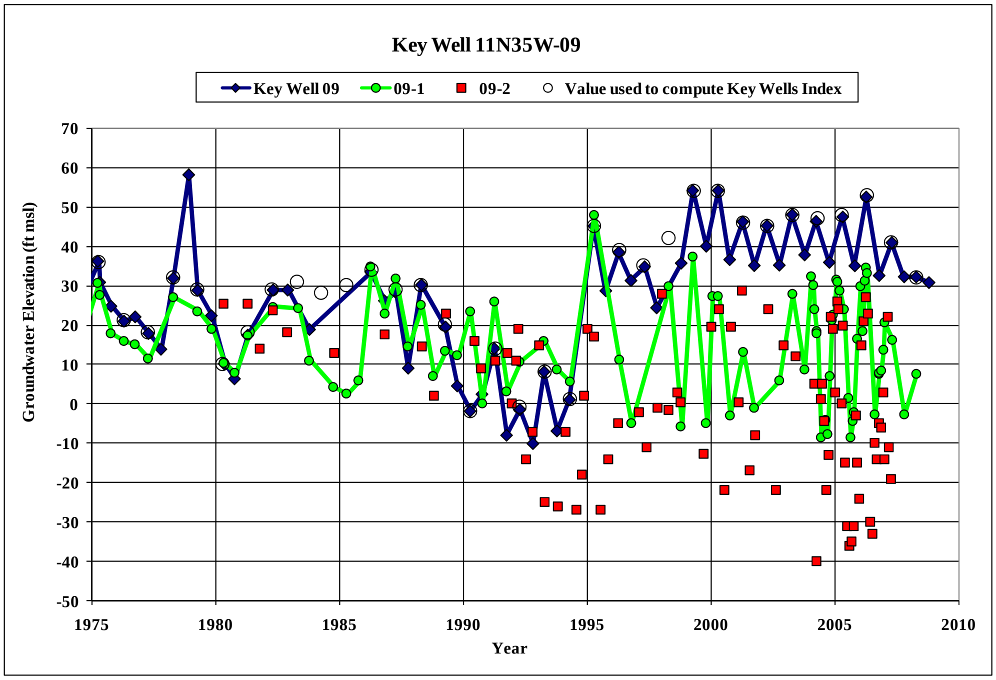
The Index was calculated annually using Spring groundwater elevation measurements from 1975 to 2008. The Key Wells were selected to represent various portions of the groundwater basin within the NMMA. The following charts display the hydrographs for each Key Well and surrounding wells. The open circles represent the actual Spring value for that year or a correlation of that value for each year that was used to compute the Index.

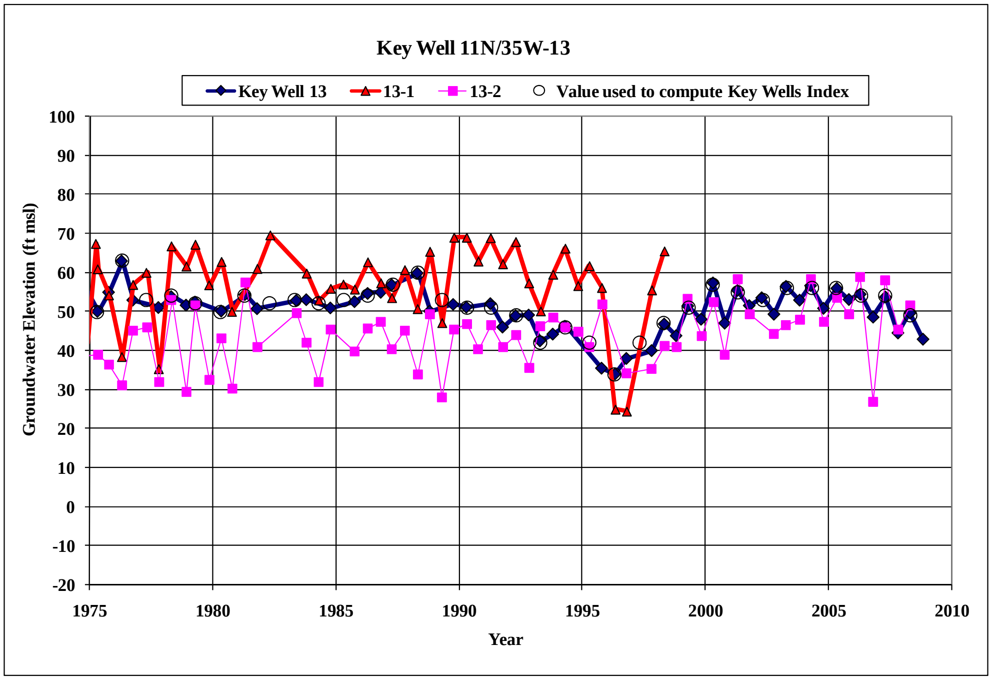
When there was no Spring groundwater elevation measurement for a particular year, the value was determined by either 1) interpolating between Spring measurements in adjacent years or 2) computing the Spring elevation by taking the Fall measurements in adjacent years and increasing the value by the typical increase in groundwater elevations between Spring and Fall measurements in that well. If there is a significant data gap in the record for a particular well (e.g., 22 well below), a nearby well was used to fill the gap.

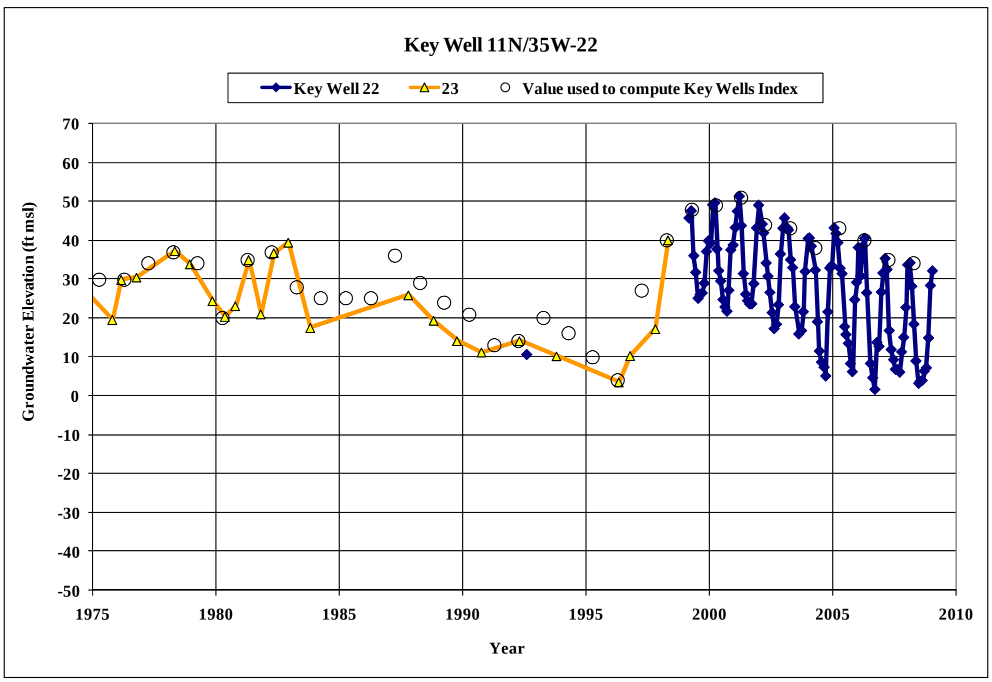


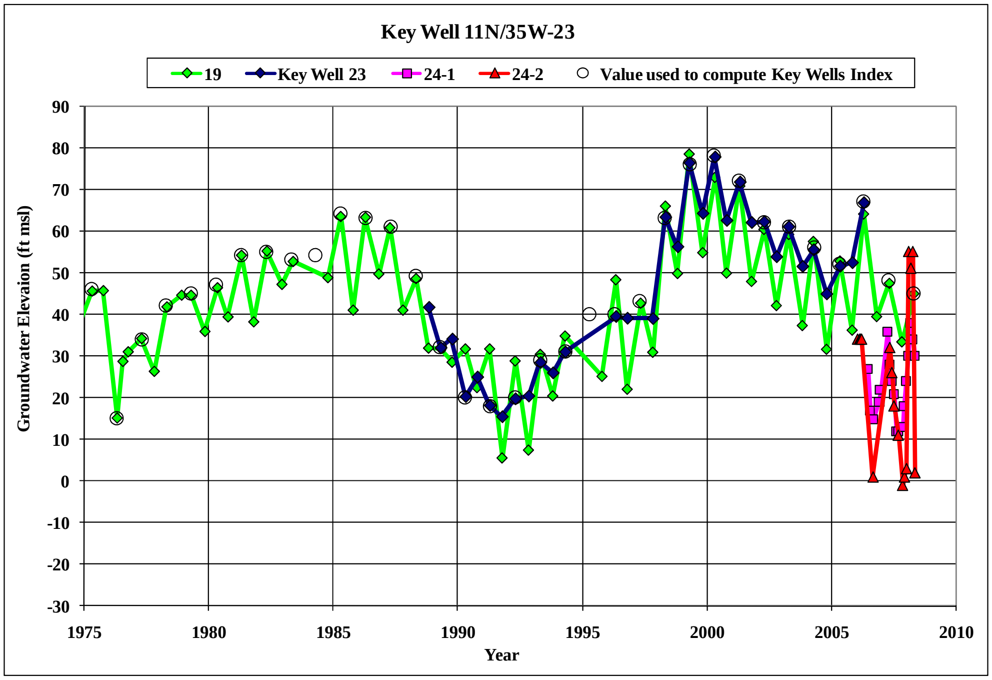


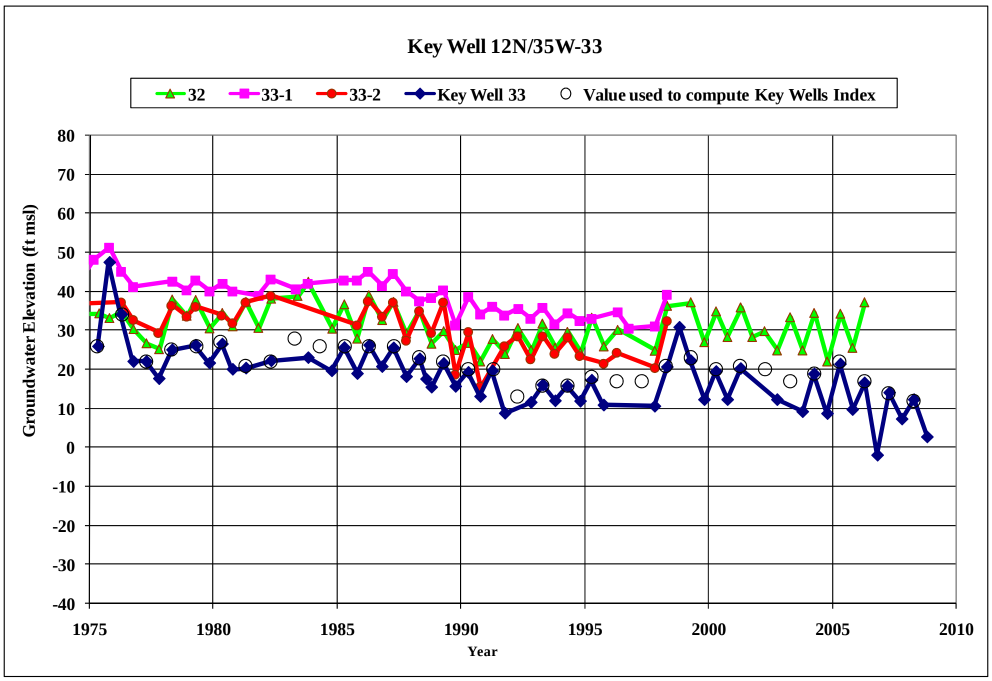

Key Well 11N/35W-08
05
Key Well 08
08-1
17
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
1975
1980
1985
1990
1995
2000
2005
2010
Year


Key Well 11N35W-09
Key Well 09
09-1
09-2
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1975
1980
1985
1990
1995
2000
2005
2010
Year


Key Well 11N/35W-13
Key Well 13
13-1
13-2
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
1975
1980
1985
1990
1995
2000
2005
2010
Year


Key Well 11N/35W-22
Key Well 22
23
Value used to compute Key Wells Index
Groundwater Elevation (ft msl)
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
1975
1980
1985
1990
1995
2000
2005
2010
Year





In selecting the eight key wells, the following criteria were applied so that the wells generally represent the NMMA as a whole:

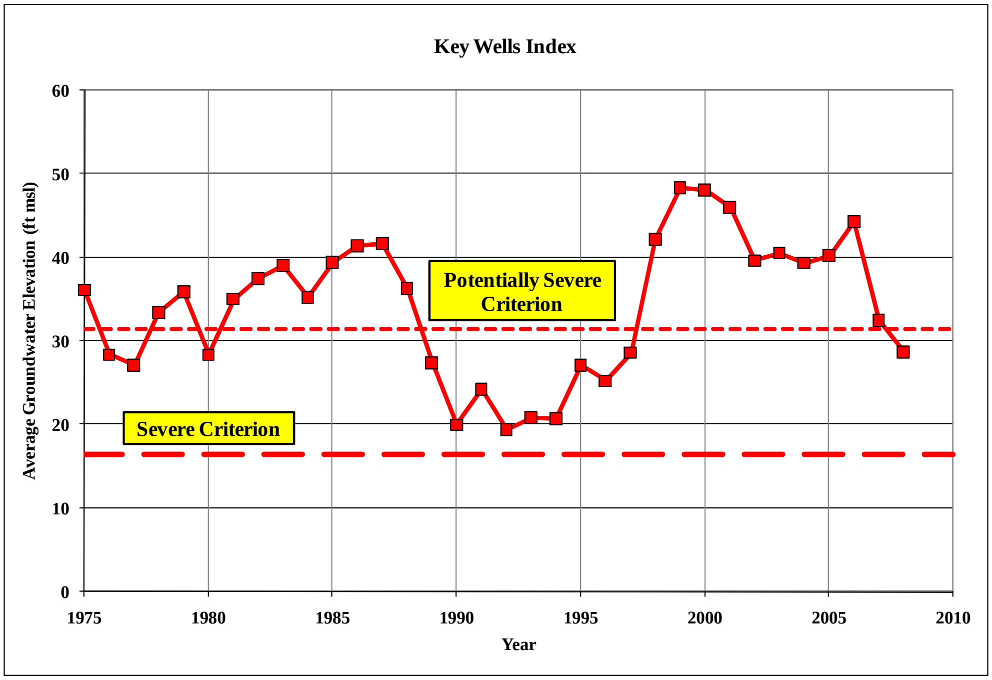
(1) The wells are geographically distributed.

(2) No single well overly influences the Index.

The first criterion was met in the selection of the wells. To meet the second criterion, groundwater elevations from each well were normalized so that any well where elevations were on the average higher or lower than the other wells did not overly influence the overall Index. This normalization was accomplished by dividing each Spring groundwater elevation measurement by the sum of all the Spring groundwater elevation data for that well.

The Index was defined for each year as the average of the normalized Spring groundwater data from each well. The lowest value of the Index could be considered the “historical low” within the NMMA. The sensitivity of that “historical low” was tested by examining the effect of eliminating a well from the Key Wells Index. Eight separate calculations of the Index from 1975 to 2008 were made by excluding the data from one of the eight wells, and computing the average value for each year from the remaining wells’ normalized Spring groundwater data.

The criterion for a Potentially Severe Water Shortage Conditions should provide for enough time before the Severe criterion occurs to allow pumpers time to implement voluntary measures to mitigate a falling Key Wells Index. Based on the assumption that two years is adequate for this early warning, then the historical Index can be used to determine the potential rate of fall of the Index. The maximum drop in the historical Index over a two-year period was about 15 feet, during the last two years of the 1986-1991 drought. Thus, the criterion for Potentially Severe Water Shortage Conditions is set at 15 feet above the Severe Water Shortage Condition criterion, which calculates to **31.5 ft msl**. The Key Wells Index for all eight wells, which will be computed each year in the future, will be compared to the Potentially Severe and Severe criteria discussed above. The Index through 2008 is shown below.



Key Wells Index for the period 1975 to 2008. Upper dashed line is criterion for Potentially Severe Water Shortage Conditions and lower dashed line is criterion for Severe Conditions.

The Index generally tracks wet and dry climatic cycles, indicating the importance of natural recharge in the NMMA. Significant deviations from this climatic tracking could occur if supplemental water deliveries reduced pumping, if overlying land use changed the return flows to the aquifer, or if there was a large change in groundwater extractions in addition to those resulting from the introduction of the Supplemental Water.

A. Seawater Intrusion Criteria for Potentially Severe Water Shortage Conditions

The criteria for potentially severe conditions in coastal areas are either gradient conditions that could pull seawater into the principal aquifer, or threshold chloride concentrations detected in coastal monitoring wells. Whereas chloride is the principal indicator for the groundwater quality portion of this criteria, other groundwater quality constituents may be considered for future refinement of this criteria.

To avoid seawater contamination, groundwater elevations in the coastal monitoring wells must be sufficiently high to balance higher-density seawater (about 2.5 of extra head is required for every 100 ft of ocean depth of an offshore outcrop of the aquifer). Thus, if an aquifer is penetrated at 100 ft below sea level in a coastal well, it is assumed that groundwater elevations in that aquifer must be at least 2.5 ft above sea level to counteract the higher density of seawater. Although offshore outcrop areas are not currently defined, it is assumed that some hydraulic connection between the onshore aquifers and seawater at the sea floor is possible or even probable.

Historical groundwater elevation data from these coastal wells indicate that groundwater elevations have not always been higher than the theoretical elevations of fresh water to balance sea water, described in the preceding paragraph. It is not known to what extent (if any) that seawater has advanced toward the land during the periodic depression of groundwater elevation, nor has any groundwater quality data supported the indication that seawater has contaminated the fresh water aquifer at the coastal monitoring well locations. Thus, coastal groundwater elevation criteria must take into account the periodic depression of groundwater elevations. To accommodate these fluctuations and until further understanding is developed, the coastal criteria are presented in the table below, based on the lower of 1) historical low groundwater elevations in the coastal monitoring wells or 2) a calculation of 2.5 ft of elevation for every 100 ft of aquifer depth in the well. If the historical low elevation is used, the value is reduced by one foot and rounded to the nearest half-foot. Similarly, if a calculated value is the lower option, it is rounded to the nearest half-foot. The results of these criteria are indicated in the following table.

Criteria for Potentially Severe Water Shortage Conditions

Well	Perforations Elevation (ft msl)	Aquifer	Historic Low (ft msl)	2.5' per 100' Depth (ft msl)	Elevation Criteria (ft msl)	Highest Chloride (mg/L)	Chloride Concentration Criteria (mg/L)
11N/36W-12C1	-261 to -271	Paso Robles	5.8	6.5	**5.0**	81	**250**
11N/36W-12C2	-431 to -441	Pismo	6.3	10.8	**5.5**	55	**250**
11N/36W-12C3	-701 to -711	Pismo	10.1	17.5	**9.0**	98	**250**
12N/36W-36L1	-200 to -210	Paso Robles	4.3	5.7	**3.5**	38	**250**
12N/36W-36L2	-508 to -518	Pismo	10.1	13.4	**9.0**	127	**250**

The groundwater quality portion of the criteria is set at 250 mg/L chloride. There is no groundwater quality criterion for the shallow alluvium. Although there is no assumption that seawater intrusion has occurred at this concentration, the cause of the rise in chloride concentration must be investigated and appropriate mitigation measures taken. Thus, Potentially Severe Water Shortage Conditions are established if either the groundwater elevation or groundwater quality criteria are met.

B. Seawater Intrusion Criteria for Severe Water Shortage Conditions

One criterion for Severe Water Shortage Conditions is the occurrence of conditions that result in chloride concentration(s) in groundwater greater than the drinking water standard in any of the coastal monitoring wells.

A principal threat for such occurrence is from seawater intrusion. The first evidence of seawater intrusion can occur very quickly or may involve a slower and more subtle change. Because the rate of change for chloride concentrations during seawater intrusion is difficult to predict for the NMMA, the criterion is set to the Maximum Contaminant Level for chloride in drinking water.

The Nipomo Mesa Technical Group set the coastal criterion for Severe Water Shortage Conditions at a chloride concentration at or above **500 mg/L** in any of the coastal monitoring wells. If the criterion is exceeded, an additional sample will be collected and analyzed from that well as soon as practically possible to verify the result. The Severe Water Shortage Condition will not be in effect until the laboratory analysis has been verified.

Appendix C: Well Management Plan

NMMA PURVEYOR

NMMA WELL MANAGEMENT PLAN[1]

Adopted January 21, 2010

Stage 1: Potentially Severe Water Shortage Conditions

- Potentially Severe Water Shortage Conditions Triggered[2];
- Voluntary measures urged by Water Purveyors (NCSD, GSWC, Woodlands, and RWC). See list of "Recommended Water Use Restrictions;"
- Voluntary evaluation of sources of new supplemental water;
- Voluntary purveyor conservation goal of 15% (Baseline to be suggested by the NMMA TG);
- Voluntary/Recommended public information program;
- Voluntary evaluation and implementation of shifting pumping to reduce GW depressions and/or protect the seaward gradient. This includes the analysis and establishment of a potential network of purveyor system interties to facilitate the exchange of water;

---

[1] This Well Management Plan is required by the terms of the Stipulation (page 22). The Well Management Plan provides for steps to be taken by the NCSD, GSWC, Woodlands and RWC under a factual scenario where Nipomo Supplemental Water (a defined term in the Stipulation) has not been "used" in the NMMA (page 22). The Well Management Plan, therefore, has no applicability to either ConocoPhillips or Overlying Owners as defined in the Stipulation (page 22).

[2] Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in the groundwater levels (potentially severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (severe). See current version of Water Shortage Conditions and Response Plan – appendix to Annual Report.

Adopted January 20, 2010

Stage 2: Severe Water Shortage Conditions

- Severe Water Shortage Conditions Triggered and Nipomo Supplemental Water has been used in the NMMA (see footnote 1)[3];

- Overlying landowners other than Woodlands and ConocoPhillips shall reduce groundwater use to no more than 110% of the highest pooled base year prior to the transmittal of Nipomo supplemental water. The NMMA TG will determine a technically responsible and consistent method to determine the pooled amount and an individual's contribution (To be determined when trigger occurs). The method of reducing pooled production to 110% is to be prescribed by the TG and approved by the court. Landowners may consider using less water for consideration received;

- ConocoPhillips shall reduce its yearly groundwater use to no more than 110% of the highest amount it used in a single year prior to the transmittal of Nipomo supplemental water. ConocoPhillips may consider using less water for consideration received and has discretion to determine how its groundwater reduction is achieved;

- Water Purveyors (NCSD, GSWC, Woodlands, and RWC) shall implement mandatory conservation measures. Where possible, institute mandatory restrictions with penalties;

- The mandatory conservation goals will be determined by the NMMA TG when the Severe water shortage trigger is reached. Annually, should conditions worsen; the NMMA TG will re-evaluate the mandatory conservation goal;

- Measures may include water reductions, additional water restrictions, and rate increases. GSWC and RWC shall aggressively file and implement[4] a schedule 14.1 mandatory rationing plan with the CPUC consistent with the mandatory goals;

- Penalties, rates, and methods of allocation under the rationing program shall be at the discretion of each entity and its regulating body;

---

[3] [see comment at footnote #1] Water shortage conditions are characterized by criteria designed to reflect that groundwater levels beneath the NMMA as a whole are at a point at which a response would be triggered to avoid further declines in the groundwater levels (potentially severe), and to declare that the lowest historic groundwater levels beneath the NMMA as a whole have been reached or that conditions constituting seawater intrusion have been reached (severe). See current version of Water Shortage Conditions and Response Plan (appendix to Annual Report).

[4] CPUC has the authority to set rates and allow mandatory conservation actions. As CPUC regulated entities, GSWC and RWC cannot implement such programs without CPUC approval.

- Aggressive voluntary public information program which includes discussions with high use water users such as school districts, parks, and golf courses to seek voluntary reductions in potable water irrigation;

List of Recommended Water Use Restrictions

The following provisions are examples of what may be considered prohibited, nonessential, and/or unauthorized water use:

1) Prohibit nonessential and unauthorized water use, including but not limited to:
   a) Use of potable water for more than minimal landscaping, as defined in the landscaping regulated of the jurisdiction or as described in Article 10.8 of the California Government Code in connection with new construction;
   b) Use through any meter when the company has notified the customer in writing to repair a broken or defective plumbing, sprinkler, watering or irrigation system and the customer has failed to effect such repairs within five business days;
   c) Use of potable water which results in flooding or runoff in gutters or streets;
   d) Individual private washing of cars with a hose except with the use of a positive action shut-off nozzle. Use of potable water for washing commercial aircraft, cars, buses, boats, trailers, or other commercial vehicles at any time, except at commercial or fleet vehicle or boat washing facilities operated at a fixed location where equipment using water is properly maintained to avoid wasteful use;
   e) Use of potable water washing buildings, structures, , driveways, patios, parking lots, tennis courts, or other hard-surfaced areas, except in the cases where health and safety are at risk;
   f) Use of potable water to irrigate turf, lawns, gardens, or ornamental landscaping by means other than drip irrigation, or hand watering without quick acting positive action shut-off nozzles, on a specific schedule, for example: 1) before 9:00 a.m. and after 5:00 p.m.; 2) every other day; or 3) selected days of the week;
   g) Use of potable water for watering streets with trucks, except for initial wash-down for construction purposes (if street sweeping is not feasible), or to protect the health and safety of the public;
   h) Use of potable water for construction purposes, such as consolidation of backfill, dust control, or other uses unless no other source of water or other method can be used.

i) Use of potable water for construction purposes unless no other source of water or other method can be used;

j) Use of potable water for street cleaning;

k) Operation of commercial car washes without recycling at least 50% of the potable water used per cycle;

l) Use of potable water for watering outside plants, lawn, landscape and turf areas during the hours of 9:00 am to 5:00 pm;

m) Use of potable water for decorative fountains or the filling or topping off of decorative lakes or ponds. Exceptions are made for those decorative fountains, lakes, or ponds which utilize recycled water;

n) Use of potable water for the filling or refilling of swimming pools.

o) Service of water by any restaurant except upon the request of a patron; and

p) Use of potable water to flush hydrants, except where required for public health or safety.

Appendix D: Data Acquisition Protocol for Groundwater Level Measurement for the Nipomo Mesa Management Area

Data Acquisition Protocol for Groundwater Level Measurement for the Nipomo Mesa Management Area

Introduction

The purpose of this memorandum is to establish a protocol for measuring and recording groundwater levels for Nipomo Mesa Management Area (NMMA) wells, and to describe various methods used for collecting meaningful groundwater data. Static groundwater levels obtained for the NMMA monitoring program are determined by measuring the distance to water in a non-pumping well from a measuring point that has been referenced to sea level. Subtracting the distance to water from the elevation of the measuring point determines groundwater surface elevations above or below sea level. This is represented by the following equation:

$$E_{GW} = E_{MP} - D$$

Where:

E_{GW} = Elevation of groundwater above mean sea level (feet)
E_{MP} = Elevation above sea level at measuring point (feet)
D = Depth to water (feet)

Groundwater elevation data can be used to construct groundwater contour maps, determine groundwater flow direction and hydraulic gradients, show locations of groundwater recharge, determine amount of water in storage, show changes in groundwater storage over time, and identify other aquifer characteristics. Miss-representation of aquifer conditions result from errors introduced during water level measurements, from a changed measuring point, during data recording, from equipment problems, or from using inappropriate measuring equipment or techniques for a particular well.

In an effort to minimize such errors and to standardize the collection of groundwater data, the U.S. Geological Survey (U.S.G.S.) has conducted extensive investigations into methods for measuring groundwater levels. In conjunction with several other federal agencies, the U.S.G.S. published the "National Handbook of Recommended Methods for Water-Data Acquisition" (1977); "Introduction to Field Methods for Hydrologic and Environmental Studies, (2001); and several Stand-alone Procedure Documents (GWPD, 1997). Excerpts from these publications relating to water-level measurements are attached. The following protocol for obtaining and reporting accurate data, including a discussion of potential errors associated with several measurement techniques, are based on these U.S.G.S. documents.

Well Information

To give the most meaningful value to the data obtained in the NMMA monitoring program, each well file should include as much information as is available. Table 1 below lists important well information to be maintained in a well file or in a field notebook. Additional information that should be available to the person collecting water-level data should include a description of access to the property and the well, the presence and depth of cascading water, or downhole obstructions that could interfere with a sounding cable. San Luis Obispo County Department of Public Works maintains well cards on the wells in the County monitoring network.

Table 1
Well File Information

Well Completion Report	Hydrologic Information	Additional Information to be Recorded
Well name	Map showing basin boundaries and wells	Township, Range, and ¼ ¼ Section
Well Owner	Name of groundwater basin	Latitude and Longitude (Decimal degrees)
Drilling Company	Description of aquifer	Assessor's Parcel Number
Location map or sketch	Confined, unconfined, or mixed aquifers	Description of well head and sounding access
Total depth	Pumping test data	Measuring point & reference point elevations
Perforation interval	Hydrographs	Well use and pumping schedule if known
Casing diameter	Water quality data	Date monitoring began
Date of well completion		Land use

Types of Wells

The monitoring program is likely to include several types of wells with various means of access and pumping schedules. It is important to understand the characteristics of each well type and its downhole conditions to best determine monitoring schedules and appropriate measuring technique. Below is a brief summary of well types and their pumping characteristics. A more detailed description of these well types is included in the attached "National Handbook of Recommended Methods for Water-Data Acquisition".

<u>Existing Wells</u>
These include abandoned wells, irrigation wells, public supply wells, and domestic wells. Existing wells provide convenient and inexpensive measuring sites; however, they should be carefully evaluated to show that they can provide accurate data under static conditions with reliable access.

Abandoned wells are often in poor condition and may have partially collapsed casing or accumulated sediments. Damaged casing may also result in cascading water. An undamaged well with the pump removed, however, can provide easy access and reliable water-level data.

Irrigation wells are generally pumped on a regular schedule, allowing static water-level measurements to be taken during known non-pumping periods. Seasonal changes in the pumping schedules should also be noted when planning monitoring events.

Public supply wells may be part of a monitoring program if sufficient information regarding their operations is available. Hydrographs showing periods or pumping and recovery should be obtained to determine the best time to measure static water levels.

Domestic wells are generally pumped frequently and for short durations, making it difficult to monitor during static conditions. Determining when the lowest domestic water use occurs during the day can facilitate monitoring schedules.

Observation Wells

These wells are designed for specific sites and depths in known hydrogeologic conditions to supply desired information. Typically, there is no permanent pump, making measurements relatively easy.

Piezometers

A piezometer is a small diameter observation well designed to measure the hydraulic head within a small zone. It should have a very short screen and filter pack interval so it can represent the hydraulic head at a single point within the aquifer.

Access to Supply Wells

Access into a well to obtain a water level measurement depends on pump types and wellhead construction. For turbine-pump wells, there is typically an opening between the pump column and the casing either through a port or between the base plate and the casing. The filter-pack fill tube should not be confused with a casing vent or sounding access pipe. In some wells, there is no access for a downhole measuring tape; however, the well may be equipped with an air-line measuring system.

Access to submersible wells is generally through a small diameter plug located in the plate on top of the casing. In wells where there is no sounding tube, caution should be used during water level measurements to minimize the chance of the sounding tape becoming entangled with the power cable. Additional information and wellhead diagrams regarding supply well access is found in the attached "National Handbook of Recommended Methods for Water-Data Acquisition".

Measuring Points and Reference Points

Measuring point (MP) elevations are the basis for determining groundwater elevations relative to sea level. The MP is generally that point on the well head that is the most convenient place to measure the water level in a well. In selecting an MP, an additional consideration is the ease of surveying either by Global Positioning System (GPS) or by leveling.

The MP must be clearly defined, well marked, and easily located. If permissible, the point should be labeled with the letters MP and an arrow. A description, sketch, and photograph of the point should be included in the well file.

The Reference Point (RP) is a surveyed point established near the wellhead on a permanent object. It serves as a benchmark by which the MP can be checked or re-surveyed if the MP is changed. The RP should be marked, sketched, photographed, and described in the well file.

All MPs and RPs for the NMMA monitored wells should be surveyed using the same horizontal and vertical datum by a California licensed surveyor to the nearest tenth of one foot vertically, and the nearest one foot horizontally. The surveyor's report should be maintained in the project file.

In addition to the MP and RP survey, the elevation of the ground surface adjacent to the well should also be surveyed and recorded in the well file. Because the ground surface adjacent to a well is rarely uniform, the average surface level should be estimated. This average ground surface elevation is referred to in the U.S.G.S. Procedural Document (GWPD-1, 1997) as the Land Surface Datum (LSD).

Water-Level Data Collection

Prior to beginning the field work, the field technician should review each well file to determine which well owners require notification of the upcoming site visit, or which well pumps need to be turned off to allow for water level recovery. Because groundwater elevations are used to construct groundwater contour maps and to determine flow direction, all water level measurements should be collected within a 24-hour period or within as short a period as possible. Weather and groundwater conditions are least likely to change significantly during a short period for data collection. For an individual well, the same measuring method and the same sounder should be used during each sampling event where practical.

Prior to taking a measurement, the length of time since a pump has been operating should be determined. If possible, a domestic well should be allowed to recover at least one half hour prior to measuring, whereas an irrigation or public well should recover a minimum of eight hours prior to measuring. If the well is capped but not vented, remove the cap and wait several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

When there is doubt about whether water levels in a well are continuing to recover, repeated measurements should be made. Or, if an electric sounder is being used, it is possible to hold the sounder level at one point just above the known water level and wait for a signal that would indicate rising water. For each well, the general schedule of pump operation should be determined and noted.

When lowering a graduated steel tape (chalked tape) or electric tape in a well without a sounding tube in an equipped well, the tape should be played out slowly by hand to minimize the chance of the tape end becoming caught in a downhole obstruction. The tape should be held in such a way that any change in tension will be felt. When withdrawing a sounding tape, it should also be brought up slowly so that if an obstruction is encountered, tension can be relaxed so that the tape can be lowered again before attempting to withdraw it around the obstruction.

All water level measurements should be made to an accuracy of 0.1 feet. The field technician should make at least two measurements. If measurements of static levels do not agree within 0.1 feet , the technician should continue measurements until the reason for the disparity is determined, or the measurements are within 0.1 feet.

Where groundwater levels are found to be above ground surface, a sensitive pressure gage can be used to determine the height above the measuring point or a sealed well could have a manometer tube that would show the height above ground surface. A manometer tube may not be high enough to measure the water level if the groundwater is under more than 5 feet of pressure.

Record Keeping in the Field

The information recorded in the field is often the only remaining evidence of the conditions at the time of the monitoring event. It is important that the field book be protected carefully and that it contains the name of the field technician and appropriate contact information. Because the field book contains original tables of multiple monitoring events, copies of the tables should be made following each monitoring event. The data can be further protected by entering the data electronically as soon as practicable.

All field notes must be recorded during the time the work is being done in the field. Accurate documentation of field conditions cannot be made after the field technician has returned to the office. Because much of the data will be reviewed by office staff, and because more than one field technician may participate in the monitoring program, it is essential that notes be intelligible to anyone without requiring a verbal explanation. As a means to support field information, sketches or digital photos attached to field notes should be encouraged.

All field notes should be made with a sharp pencil with lead appropriate for the conditions. Erasures should not be made when recording data. A single line should be drawn through an error without obscuring its legibility, and the correct value or information should be written adjacent to it or in a new row below it.

During each monitoring event it is important to record any conditions at a well site and its vicinity that may affect groundwater levels, or the field technician's ability to obtain groundwater levels. Table 2 lists important information to record, however, additional information should be included when appropriate. Table 3, The Water Level Measurement Form, is a suggested format for recording field data.

Table 2
Information Recorded at Each Well Site

Well name	Property access conditions	Downhole obstructions
Name and organization of field technician	Changes in land use	Presence of oil in well
Date & time (time in 24-hour notation)	Changes in MP	Cascading water
Measurement method used	Nearby wells in use	Equipment problems
Sounder used	Weather conditions	Physical changes in wellhead
Most recent sounder calibration	Recent rainfall events	Comments

Measurement Techniques

Four standard methods of obtaining water levels are discussed below. The chosen method depends on site and downhole conditions, and the equipment limitations. In all monitoring situations, the procedures and equipment used should be documented in the field notes and in final reporting. Additional detail on manual methods of water level measurement is included in the attached U.S.G.S. Stand-Alone Procedure Documents and the "National Handbook of Recommended Methods for Water-Data Acquisition". The attached "Introduction to Field Methods for Hydrologic and Environmental Studies" includes a discussion of pressure transducers.

<u>Graduated Steel Tape</u>

This method uses a graduated steel tape with a brass or stainless steel weight attached to its end. The tape is graduated in feet. The approximate depth to water should be known prior to measurement.

- Chalk the lower few feet of the tape by applying blue carpenter's chalk.
- Lower the tape to just below the estimated depth to water so that a few feet of the chalked portion of the tape is submerged. Be careful not to lower the tape beyond its chalked length.
- Hold the tape at the MP and record the tape position (this is the "hold" position and should be at an even foot);
- Withdraw the tape rapidly to the surface;
- Record the length of the wetted chalk mark;
- Subtract the wetted chalk number from the "hold" position number and record this number in the "Depth to Water below MP" column;
- Perform a check by repeating the measurement using a different MP hold value;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by pouring a small amount of chlorine bleach on a clean cloth and wiping down the portion of the tape that was submerged below the water surface.

The graduated steel tape is generally considered to be the most accurate method for measuring static water levels. Measuring water levels in wells with cascading water or with condensing water on the well casing causes potential errors, or can be impossible. The tape should be calibrated against another steel tape that is maintained in the office and is used only for calibration.

<u>Electric Tape</u>

An electric tape operates on the principle that an electric circuit is completed when two electrodes are submerged in water. Most electric tapes are mounted on a hand-cranked reel equipped with batteries and an ammeter, buzzer or light to indicate when the circuit is closed. Tapes are graduated in either one-foot intervals or in hundredths of feet depending on the manufacturer. Like graduated steel tapes, electric tapes are attached with brass or stainless steel weights.

- Check the circuitry of the tape before lowering the probe into the well by dipping the probe into water and observe if the ammeter needle or buzzer/light signals that the circuit is closed;
- Lower the probe slowly and carefully into the well until the signal indicates that the water surface has been reached;

- Place a finger or thumb on the tape at the MP when the water surface is reached;
- If the tape is graduated in one-foot intervals, partially withdraw the tape and measure the distance from the MP mark to the nearest one-foot mark to obtain the depth to water below the MP. If the tape is graduated in hundredths of a foot, simply record the depth at the MP mark as the depth to water below the MP;
- Make all readings using the same needle deflection point on the ammeter scale (if equipped) so that water levels will be consistent between measurements;
- Make check measurements until agreement shows the results to be reliable;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by pouring a small amount of chlorine bleach on a clean cloth and wiping down the submerged portion of the tape;
- Periodically check the tape for breaks in the insulation. Breaks can allow water to enter into the insulation creating electrical shorts that could result in false depth readings.

The electric tape may give slightly less accurate results than the graduated steel tape. Errors can result from signal "noise" in cascading water, breaks in the tape insulation, or tape stretch. Electric tape products graduated in hundredths of a foot generally give more accurate results than electric tapes graduated in one-foot intervals. This accuracy difference is due to less stretch and ease of measurement in the tapes graduated in hundredths of a foot. All electric tapes should be calibrated periodically against a steel tape that is maintained in the office and used only for calibration.

Air Line

The air line method is usually used only in wells equipped with pumps. This method typically uses a 1/8 or 1/4-inch diameter, seamless copper tubing, brass tubing, or galvanized pipe with a suitable pipe tee for connecting an altitude or pressure gage. Plastic tubing may also be used, but is considered less desirable. An air line must extend far enough below the water level that the lower end remains submerged during pumping of the well. The air line is connected to an altitude gage that reads directly in feet of water, or to a pressure gage that reads pressure in pounds per square inch (psi). The gage reading indicates the length of the submerged air line.

The formula for determining the depth to water below the MP is: $\mathbf{d = k - h}$ where d = depth to water; k = constant; and h = height of the water displaced from the air line. In wells where a pressure gage is used, h is equal to 2.31 ft/psi multiplied by the gage reading. The constant value for k is approximately equivalent to the length of the air line.

- Calibrate the air line by measuring an initial depth to water (d) below the MP with a graduated steel tape. Use a tire pump, air tank, or air compressor to pump compressed air into the air line until all the water is expelled from the line. When all the water is displaced from the line, record the stabilized gage reading (h). Add d to h to determine the constant value for k.
- To measure subsequent depths to water with the air line, expel all the water from the air line, subtract the gage reading (h) from the constant k, and record the result as depth to water (d) below the MP.

The air line method is not as accurate as a graduated steel tape or electric tape. Measurements with an altitude gage are typically accurate to approximately 0.1 foot, and measurements using a pressure gage are accurate to the nearest one foot at best. Errors can occur with leaky air lines, or when tubing becomes clogged with mineral deposits or bacterial growth.

Submersible Pressure Transducers

Electrical pressure transducers make it possible to collect frequent and long-term water-level or pressure data from wells. These pressure-sensing devices, installed at a fixed depth in a well, sense the change in pressure against a membrane. The pressure changes occur in response to changes in the height of the water column in the well above the transducer. To compensate for atmospheric changes, transducers may have vented cables or they can be used in conjunction with a barometric transducer that is installed in the same well or a nearby observation well above the water level.

Transducers are selected on the basis of expected water-level fluctuation. The smallest range in water levels provides the greatest measurement resolution. Accuracy is generally 0.01 to 0.1 percent of the full scale range.

Retrieving data in the field is typically accomplished by downloading data through a USB connection to a portable "lap-top" computer. A site visit to retrieve data should involve several steps designed to safeguard the data and the continued useful operation of the transducer:

- Inspect the wellhead and check that the transducer cable has not moved or slipped;
- Ensure that the instrument is operating properly;
- Measure and record the depth to water with a graduated steel or electric tape;
- Document the site visit, including all measurements and any problems;
- Retrieve the data and document the process;
- Review the retrieved data by viewing the file or plotting the original data;
- Recheck the operation of the transducer prior to disconnecting from the computer.

A field notebook with a checklist of steps and measurements should be used to record all field observations and the current data from the transducer. It provides an historical record of field activities. In the office, maintain a binder with field information similar to that recorded on the field notebook so that a general historical record is available there and can be referred to before and after a field trip.

Summary and Recommendations

Static groundwater levels obtained for the NMMA monitoring program are determined by measuring the distance to water from wellhead MPs that have been surveyed using an accepted sea level-based datum. Subtracting the distance to water from the elevation of an MP determines groundwater surface elevations above or below sea level. The following items should be considered important to creating and maintaining a successful monitoring program:

- All wells should be surveyed by a licensed surveyor;

- Three survey points should be set for each well: the MP on the wellhead, the RP on a nearby permanent object, and the adjacent ground surface;
- The points should be surveyed to the nearest tenth of one foot vertically, and the nearest one foot horizontally;
- A one-inch diameter water-level sounding tube should be installed in each NMMA monitoring program well;
- Static water levels should always be measured to the nearest 0.01 feet from the same measuring point, using the same measuring techniques for each well;
- Measurement techniques using graduated steel tapes, electric tapes graduated in hundredths of feet, or pressure transducers should be considered appropriate for the monitoring program;
- Because of its lower accuracy and higher potential for errors than other methods, the air-line method should not be used in the program;
- Thorough and accurate field documentation and complete project files are essential to a successful monitoring program.

Appendix E: Additional Data and Maps

To estimate the annual amount of pumped groundwater used for crop irrigation in the NMMA, land use data are used together with crop water use estimates and local climate data. A spreadsheet model with a daily time step keeps track of various parameters, including evapotranspiration, precipitation, soil moisture, crop water requirements, and related information, to estimate how much irrigation water is required for a crop and, during wet periods, how much precipitation is recharged to the aquifer.

The model estimates a crop's water requirement, otherwise known as the evapotranspirative requirement (ET_C), based on the local weather and a crop coefficient (K_C), and keeps track of soil moisture. The crop coefficient is an estimated value that accommodates seasonal conditions such as growth stage and canopy cover. Reference evapotranspiration (ET_O) values used in the model are obtained from a California Irrigation Management Information System (CIMIS) station in Nipomo, which provides daily meteorological data.

Crop Water Requirement:

$ET_C = K_C * ET_O$ where

ET_C = crop evapotranspirative requirement
K_C = crop coefficient
ET_O = reference evapotranspiration (data from Nipomo CIMIS station)

The model then keeps track of the amount of water on a daily time-step that is needed to grow the crop, and whether that water first comes from precipitation (P) and then from soil water. When the total amount of soil water is reduced to half or less of the soil's water-holding capacity (calculated together with the crop's rooting depth), it is assumed that application of water via irrigation (AW_T) will occur to replenish the soil water.

Crop Evapotranspiration of Applied Water:

$AW_T = ET_C – P$ where

AW_T = total applied crop water
P = precipitation

The NMMA TG modified the methodology used to estimate the annual amount of pumped groundwater used for crop irrigation and parameter values used in the model calculation in 2010. The crop coefficients, K_C, and land use areas were subsequently updated in 2013 compared to those used in 2012 (this Annual Report; see Tables 1 and 2 below).

Table 1: Crop Coefficients (K_c) assigned to Land Use categories for 2012.

Crop Coefficient (Kc)										
	Native		Agriculture						Golf Course	
Month	Grasses	Trees and Shrubs	Deciduous	Pasture	Vegetable Rotational	Avocado and Lemon	Strawberries	Nursery	Un-irrigated Ag Land	Golf Course	Urban
1	0.42	0.89	1.33	1.33	1.33	0.40	0.18	0.50	1.33	0.60	0.42
2	0.42	1.33	0.31	0.31	1.00	0.50	0.36	0.50	0.31	0.60	0.42
3	0.42	1.26	0.58	1.00	1.00	0.55	0.56	0.50	0.13	0.60	0.42
4	0.42	1.49	0.72	1.00	1.00	0.55	0.65	0.50	0.08	0.60	0.42
5	0.42	1.47	0.83	1.00	0.51	0.60	0.68	0.50	0.03	0.60	0.42
6	0.00	1.67	0.90	1.00	0.01	0.65	0.69	0.50	0.01	0.60	0.42
7	0.00	1.64	0.96	1.00	0.49	0.65	0.35	0.50	0.00	0.60	0.42
8	0.00	1.38	0.96	1.00	1.00	0.65	0.05	0.50	0.05	0.60	0.42
9	0.42	1.63	0.92	1.00	1.00	0.60	0.13	0.50	0.13	0.60	0.42
10	0.42	1.28	0.81	1.00	1.00	0.55	0.12	0.50	0.12	0.60	0.42
11	0.42	0.95	0.54	0.54	0.54	0.55	0.54	0.50	0.54	0.60	0.42
12	0.42	0.87	1.20	1.20	1.20	0.50	1.20	0.50	1.20	0.60	0.42

Table 2: Crop Coefficients (K_c) assigned to Land Use categories for 2013.

Crop Coefficient (Kc)										
	Native		Agriculture						Golf Course	
Month	Grasses	Trees and Shrubs	Grape	Pasture	Vegetable Rotational	Avocado and Lemon	Strawberries and cane berries	Nursery	Un-irrigated Ag Land	Golf Course	Urban
1	0.42	0.89	0.00	0.54	0.65	0.54	0.78	0.65	1.33	1.00	0.42
2	0.42	1.33	0.00	0.54	0.65	0.31	0.78	0.65	0.31	1.00	0.42
3	0.42	1.26	0.00	1.00	0.65	0.58	0.78	0.65	0.13	1.00	0.42
4	0.42	1.49	1.00	1.00	0.65	0.72	0.78	0.65	0.08	1.00	0.42
5	0.42	1.47	1.00	1.00	0.65	0.83	0.78	0.65	0.03	1.00	0.42
6	0.00	1.67	1.00	1.00	0.65	0.90	0.78	0.65	0.01	1.00	0.42
7	0.00	1.64	0.00	1.00	0.65	0.96	0.78	0.65	0.00	1.00	0.42
8	0.00	1.38	0.00	1.00	0.65	0.96	0.78	0.65	0.05	1.00	0.42
9	0.42	1.63	0.00	1.00	0.65	0.92	0.78	0.65	0.13	1.00	0.42
10	0.42	1.28	0.00	1.00	0.65	0.81	1.00	0.65	0.12	1.00	0.42
11	0.42	0.95	0.00	0.54	0.65	0.54	0.78	0.65	0.54	1.00	0.42
12	0.42	0.87	0.00	0.54	0.65	0.54	0.78	0.65	1.20	1.00	0.42

The golf course, nursery, and pasture K_C values (Table 2) were calculated from measured irrigation in portions of the NMMA. Strawberry and cane berry, vegetable rotational, and citrus and avocado K_C values were derived from known water demands for these crops in nearby coastal regions.