

# **Monitoring Program for the Northern Cities Management Area**

**Prepared for**

**The Northern Cities**

**By**

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# Monitoring Program for the Northern Cities Management Area

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This report was prepared by the staff of Todd Engineers under the supervision of professionals whose signatures appear hereon. The findings or professional opinions were prepared in accordance with generally accepted professional engineering and geologic practice.



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## 1. Introduction

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### 1.1. Background

This Monitoring Program is a joint effort of the Northern Cities, namely the City of Arroyo Grande, City of Grover Beach, City of Pismo Beach and the Oceano Community Services District (CSD). The Northern Cities and Northern Landowners have actively and cooperatively managed surface water and groundwater resources for more than 30 years. This is recognized in the 2002 Settlement Agreement between the Northern Cities, Northern Landowners, and Other Parties and in the 2005 Settlement Stipulation for the Santa Maria groundwater basin adjudication, which was adopted by the Court in its Judgment After Trial, entered January 25, 2008 (herein “Judgment”).

The Monitoring Program is a key component of the Judgment and forms the basis of the Annual Reports for the Northern Cities Management Area. As shown in Figure 1, the Northern Cities Management Area (NCMA) represents the northernmost portion of the Santa Maria Groundwater Basin. Adjoining the NCMA to the southeast is the Nipomo Mesa Management Area, while the Santa Maria Valley Management Area encompasses the remainder of the groundwater basin.

This Monitoring Program includes a discussion of the various elements to be monitored within the NCMA. As described in this document, the Monitoring Program will obtain pertinent information on an annual basis through data requests to agencies, field work, and online research. Data from these sources will be compiled into a comprehensive database, the Northern Cities Management Area Database (NCMA DB). The results of the monitoring program and NCMA DB will be used to prepare an Annual Report as described in Sections IV D of the Settlement Stipulation.

### 1.2. Judgment

On January 25, 2008, the Judgment after Trial was handed down from the Superior Court of California, County of Santa Clara. The Judgment approves the June 30, 2005 Stipulation agreed upon by numerous parties, including the Northern Cities, and orders the stipulating parties to comply with each and every term of the Stipulation. The 2002 Settlement Agreement is affirmed as part of the Judgment and its terms incorporated into the Stipulation, except for the provisions regarding continuing jurisdiction, groundwater monitoring, reporting, and the Technical Oversight Committee that are superseded by the respective provisions of the Stipulation.

As specified in the Judgment, groundwater monitoring in the Northern Cities Management Area will be conducted by the Northern Cities. The Judgment requires all Management Areas (including the NCMA) to prepare a Monitoring and Reporting Program within 180 days from the Judgment, in other words by July 23, 2008, and present it to the Court for approval.

### **1.3. Objectives of Monitoring Program**

The Monitoring Program, in accordance with requirements of the Judgment, is designed to collect and analyze data pertinent to water supply and demand. For example, the Monitoring Program must document:

- Land and water uses in the basin,
- Sources of supply to meet those uses,
- Groundwater conditions (including water levels and water quality).

### **1.4. Reporting Requirements**

The results of the NCMA Monitoring Program will be documented and discussed in Annual Reports which are due to the court 120 days after the end of each calendar year. An outline for the first Annual Report, which will be submitted by April 30, 2009, is included in Section 5 of this document.

## 2. Elements of the NCMA Monitoring Program

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This section of the NCMA Monitoring Program identifies required data and presents specific steps for data collection and analysis.

### 2.1. Hydrologic Conditions

Hydrologic and climatological data for the NCMA will be used in the calculation of water demand, in assessments of recharge to groundwater, and for comparison to water use.

#### 2.1.1. Precipitation.

Historical rainfall data have been compiled on a monthly basis for the NOAA Pismo Beach station for 1949 to 2005. Precipitation data from 2005 to present are available from a County-operated rain gage in Oceano. Data from the Oceano gage will be requested from the County, compiled on a monthly basis, and incorporated into the annual report. Additional precipitation data from other local rain gages will be collected for comparison with the Oceano data on an as-needed basis. In the event that data from the Oceano station become unavailable, another suitable station will be used.

#### 2.1.2. Evapotranspiration.

The California Irrigation Management Information System (CIMIS) maintains a weather station in Nipomo that records additional climatological data including temperature, wind speed, humidity, and evapotranspiration (ET). These data will be downloaded from the CIMIS website and added to the monitoring program database. The CIMIS Nipomo station has been in operation from 1996 to the present. CIMIS operates two other stations near the City of San Luis Obispo (stations 52 and 160). These stations have period of records from 1986 and 2000, respectively. Data from these stations may be used to confirm and/or supplement the data from the Nipomo station.

#### 2.1.3. Surface Water.

Surface water discharge data support the calculation of stream percolation to groundwater. The gage on Arroyo Grande Creek near Arroyo Grande (see Figure 2), originally installed and operated by the United States Geological Survey (USGS), has the most consistent stage-discharge curve for conversion of stage height to stream discharge. The County has five stream gages on Arroyo Grande Creek and one on Los Berros Creek, as shown on Figure 2. Surface water stage data are primarily available from San Luis Obispo County's monitoring network of electronic stream gages. These data will be requested from the County annually. A rating curve, to calculate flow rates, is available for the former USGS gage on Arroyo Grande Creek. Other rating curves may become available for the other surface water sites within the next few years. At that time, the additional data from these stations may be used to assess stream infiltration. Until

supplemental rating curve data become available, additional stream synoptic surveys should be considered to better understand stream infiltration.

#### **2.1.4. Other Recharge.**

Other sources of recharge into the groundwater basin will also be monitored. Other sources may include storm water recharge ponds operated by the cities. Updated information about these storm water systems should be added to the NCMA DB. This could include actual measurements of inflow and outflow from ponds. If such specific data are not available, then useful information would include location and capacity of ponds, location and extent of relevant urban watersheds, and information on rainfall/runoff relationships. Storm water quality data also would be useful.

In addition, data and information about other types of recharge that may be added in the future should also be collected and added to the NCMA DB.

## **2.2. Water Demand**

A key component of the monitoring program is the documentation of water demand. In the NCMA, water demand falls into two major categories: urban demand and agricultural demand. These will be evaluated using available land use data, urban water management plans, and population data.

#### **2.2.1. Land use.**

Land use information for the NCMA is basic to the quantification of water demand inside and outside of the incorporated areas. DWR land use surveys are generally scheduled for completion every ten years; the last one for the NCMA was completed in 1995. The most recent land use survey was completed by the San Luis Obispo Agricultural Commission in 2007 as part of the County's Master Plan Update. The County plans to update the land use map as part of each Master Plan Update. While the schedule for future updates is not set, it is expected to be about every ten years. When available, new land use maps will be requested from DWR and the County.

In addition, planning maps and up-to-date land use information are also available from the four municipalities. This information can aid in identifying areas of cropland conversion to urban uses and in determining the density of urban populations.

Land use will be used primarily to estimate agricultural water demand in the NCMA. Land use maps provide information such as acreage and type of crops in the area. Agriculture water use statistics, published by DWR for Detailed Analysis Units (DAU), will be combined with information from the land use maps to estimate total demand. These statistics (available for 1998-2001 and found at <http://www.landwateruse.water.ca.gov>) include applied water use, consumptive use, and crop ET coefficients. More recent data will be downloaded from the website when



available. The DWR Agricultural Water Use Specialist for the Southern District and the County Agricultural Commissioner's Office will be contacted as needed to provide information on specific cropping and irrigation patterns (e.g., double-cropping and use of drip irrigation) that affect water demand.

A summary of the type of agricultural land in the area and a table of the DWR water use statistics for the Arroyo Grande DAU will be included in the NCMA DB.

### **2.2.2. Urban Water Management Plans.**

Urban water demand will be compiled directly from Urban Water Management Plans (UWMPs) which are prepared every five years; the next UWMPs are due in 2010. This information can be updated using water service connection numbers from Pismo Beach, Arroyo Grande, and Grover Beach. Oceano CSD is not required to prepare a UWMP because of its limited number of connections. Oceano's demand will be calculated from census data, number of water service connections, and appropriate multipliers for household use.

### **2.2.3. Population.**

To confirm the data presented in the UWMPs and to calculate water demand for Oceano CSD, population data will be obtained from census data which are available online by census tract at <http://www.census.gov/main/www/access.html>. Population estimates will be used to confirm the municipal water demand totals and estimate domestic use outside the urban areas. New census data will be reviewed when available. The next US Census will take place in 2010.

## **2.3. Water Supply**

The NCMA has three major sources of water supply: Lopez Reservoir, State Water Project, and groundwater.

### **2.3.1. Lopez Reservoir.**

All four municipalities in the NCMA receive water from Lopez Reservoir. Data on the volume of Lopez deliveries will be compiled for each municipality and entered into the NCMA DB. Expected deliveries for future years will also be examined.

### **2.3.2. State Water Project.**

The City of Pismo Beach and Oceano CSD receive water from the California State Water Project (SWP). Data on the volume of water delivered to these municipalities will be compiled in the NCMA DB. Estimates of SWP availability in terms of annual allocations for long-term contractors will be obtained from the Department of Water Resources website on SWP analysis and water deliveries (<http://www.swpao.water.ca.gov/deliveries/>).

### **2.3.3. Groundwater.**

#### **2.3.3.1. Pumping**

Location and volume of pumping data are recorded by the Northern Cities. Additional pumping from non-urban domestic and agricultural uses will be based on the estimated water demand. These data will be collected or calculated annually and compiled in the NCMA DB.

#### **2.3.3.2. Water Levels**

Groundwater elevation data will be used to monitor annual effects of groundwater use, groundwater recharge, and changes in groundwater storage. There are approximately 145 wells within the NCMA that the County has monitored at some time in the past. The County currently monitors 38 of these wells on a semi-annual basis, including five “sentry wells” located along the coast. The County monitors more than 70 additional wells in the southern San Luis Obispo County area. These wells are shown on Figure 3. Wells logs are available for 23 of these wells, 15 located within the NCMA. Information regarding water level monitoring protocols are provided in Section 4 of this report. Water level data will be requested on an annual basis and the NCMA DB will be updated. Wells may be added or subtracted from the monitoring program, and the compilation and analysis of water level data may be modified as needed.

A subset of twenty wells within the NCMA was created to focus the analysis of annual water level changes. These key wells will be used to create hydrographs and contour maps showing long-term water level trends and regional groundwater conditions. Wells were selected for this detailed analysis based on the following criteria:

- Part of the County’s current monitoring program,
- Detailed location information available,
- Geographically distributed,
- Well depth known and/or well log available,
- Long and relatively complete record.

The wells selected are shown in Table 1 below and on Figure 3 in yellow. For the annual report, the hydrographs will be updated with new data, and water level data from the fall monitoring event will be mapped and contoured. The fall water levels are selected for mapping to promote consistency from year to year, as spring levels fluctuate in response to precipitation. Additional data from wells both inside and outside the NCMA may be used in the construction of the contour map. When possible, the same wells will be used to construct each contour map. The wells

selected as a subset for further analysis may be modified in the future to more accurately monitor the overall conditions of the groundwater basin.

**Table 1. List of Selected Wells in the NCMA**

<b>Well</b>	<b>Screened Interval Elevation (feet Mean Sea Level)</b>	<b>Water Elevation Data Available</b>	<b>Water Quality Data Available</b>
11N/35W-05N02	258'-278'	X	
12N/35W-29N01	80-98'	X	
12N/35W-29R03	385-305'	X	
12N/35W-30K03	40-58', 85-87', 94-100	X	
32S/13E-28K02	59-101'	X	
32S/13E-31H08	90-140'	X	X
32S/13E-31H09	380-520'	X	X
32S/13E-32D03	114'-128'	X	X
32S/13E-32D11	305'-459', 545'-597'	X	X
32S/13E-33A05	18-40'	X	
32S/13E-33K03	64-82'	X	
32S/13E-30N01	15-40'	X	
32S/13E-30N02		X	
32S/13E-30N03	60-135'	X	
<b>Sentry Wells</b>			
12N/36W-36L01	227-237'	X	X
12N/36W-36L02	535-545'	X	X
12N/36W-12C01	280-290'	X	X
12N/36W-12C02	450-460'	X	X
12N/36W-12C03	720-730'	X	X
32S/12E-24B01	48-65'	X	X
32S/12E-24B02	120-145'	X	X
32S/12E-24B03	270-435'	X	X
32S/13E-30F01	15-30'	X	X
32S/13E-30F02	40-55'	X	X
32S/13E-30F03	305-372'	X	X

**2.3.3.3. Water Quality**

Water quality is a key element of documenting available water supply. Contaminants from anthropogenic sources or seawater intrusion can potentially impact the basin, reducing the available water supply.

Currently the sole source of consolidated water quality information for the area is the California Department of Public Health (DPH formally DHS). The Northern Cities and other community systems in the NCMA submit water quality data to the DPH annually. These data are then uploaded to a state-wide water quality database. Data

from DPH will be requested annually and used to update the NCMA DB. Locations of these wells are not released by DPH, but some well locations are available from the individual water systems. A list of water systems from the DPH water quality database is listed below.

**Table 2. List of Drinking Water Systems in the NCMA**

Drinking Water System	Number of Monitoring Locations
ARROYO GRANDE, WATER DEPARTMENT	12
DOUBLE J MOBILE ESTATES	2
GRANDE MOBILE MANOR	2
GROVER BEACH WATER DEPARTMENT	7
HALCYON WATER SYSTEM	3
KEN MAR GARDENS MHP	2
LA MESA WATER COMPANY	1
LAGUNA NEGRA MWC	3
MESA DUNES MOBILE HOME ESTATES	5
OCEANO COMM SERVICES DIST.	14
PACIFIC DUNES RANCH	2
PISMO BEACH WATER DEPARTMENT	14
RIM ROCK WATER COMPANY	2

Data from DPH Water Quality database.

Groundwater quality monitoring is conducted at 73 locations within the NCMA and vicinity. No map of these locations is provided because of restrictions placed on the distribution of these data in accordance with the DPH, which provides monitoring results for 69 locations. The remaining four groundwater quality sampling locations are the Sentry Wells. These wells will be sampled regularly, in conjunction with depth to water measurement collection. Current plans are underway for cooperative water quality monitoring at the Sentry Wells between the Northern Cities, the Nipomo Mesa Management Area, and San Luis Obispo County. The Sentry Wells, shown on Figure 3, will be sampled quarterly for a range of constituents to detect the first signs of seawater intrusion. These constituents include the major cations and anions, plus selected constituents such as total nitrogen, bromide, and iodide. The analytes, frequency and number of Sentry Wells monitored may be adjusted as needed.

The methodology of using water quality data to assess seawater intrusion analysis is discussed in the next section. Water quality monitoring protocols are found in Section 4.

#### **2.3.3.4. Seawater Intrusion**

The NCMA is underlain by a coastal aquifer system that extends offshore. The aquifers include an interface between freshwater and seawater. While the location of the freshwater-seawater interface(s) is not known, there is currently an estimated net outflow of freshwater from the basin to the ocean and no known seawater intrusion into the water supply aquifers. However, given the potential for intrusion, coastal groundwater levels and quality will be carefully monitored.

As part of the NCMA Monitoring Program, groundwater levels near the coast will be assessed and reported with a focus on the Sentry Wells. Each Sentry Well has multiple ports to monitor water levels at different elevations. Water levels in all ports will be examined relative to one another (to assess vertical differences) and to mean sea level.

Water quality monitoring of coastal wells will provide early warning of seawater intrusion. Depth-specific water quality monitoring of the Sentry Wells can help document any vertical variability of seawater intrusion. Evaluation of water quality data will include time plots of specific constituent concentrations (for example, chloride) that identify freshwater and seawater mixing. Other geochemical methods to identify seawater intrusion may be applied as warranted, including preparation of Piper, Schoeller and brine-differentiation plots.

### 3. Data Organization

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The data collected and measured as part of the monitoring program will be compiled into a comprehensive Northern Cities Management Area database (NCMA DB). The relational database is designed to be updated with new data annually and to generate tables and charts for inclusion in the Annual Report. The tables in the database begin with a prefix, indicating the general type of data found in the table. These prefixes are:

- HY – Hydrologic and climate data
- LU – Land use data
- POP – Population data
- SW – Surface water data
- WELL – Well data (location, construction, etc.)
- WL – Water level data
- WQ – Water quality data
- WS – Water supply data.

A list of proposed NCMA DB tables is found in Table 3. When applicable, each table contains a source field indicating where or from whom the data were collected. The database will be updated annually with data collected from all relevant sources. Tables and fields in the database may be added, subtracted, or modified as needed to better incorporate the data.

**Table 3. List of Tables in the NCMA DB.**

Table Name	Brief Description
HY_CIMIS_202	Hydrologic data (precip, ET, temperature) downloaded from the CIMIS Station #202 Nipomo
HY_Monthly_Precip_All	Monthly precip for the NOAA station at Pismo Beach (1949-2005) and SLO County precip data from Oceano (2005-current)
Hy_SW_Precip_SLO	SLO County data for precip stations and surface water locations
LU_Applied_Water	DWR Agricultural Water Use Statistics- Applied water by crop type in acre-feet per year per acre
LU_Consumed_Fraction	DWR Agricultural Water Use Statistics- Percent of irrigation water consumed by crop
LU_Crop_ET	DWR Agricultural Water Use Statistics- Crop ET coefficients
LU_DWR_Basin_Summary	Summary of agricultural areas in the basin, source: DWR
LU_DWR_DAU_Summary	Summary of agricultural areas in the DAU, source: DWR
LU_SIO_CO_Basin_Summary	Summary of agricultural areas in the basin, source: SLO County
LU_SLO_CO_DAU_Summary	Summary of agricultural areas in the DAU, source: SLO County
Pop_Population_City	Population data from City's UWMP
Pop_USCensus_2000	Population data from the 2000 Census
SW_SLO_Locations	Locations of County surface water stations
SW_Stormwater_Ponds	Information on the City's stormwater ponds
WELL_Comment_SIO_08	Comment codes for the County's water level data
WELL_LOCATIONS_All	Master well table. Contains locations, construction, notes, etc.
WL_DTW_All	Water level data from all sources, as depth to water in feet
WL_WSE_All	Water elevation data from all sources in feet below mean sea level
WQ_Data_All	All available water quality data
WQ_DHS_Locations	Locations with DHS water quality data
WQ_STORET	Storet chemical numbers
WS_Total	Municipal water supply by month

## 4. Protocols

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The collection of data will be conducted in accordance with the following protocols. These data will be collected annually in January and integrated into the project database and analyzed for the Annual Report to be submitted by April 30<sup>th</sup> of each year.

### 4.1. Climate and Hydrology Data

Climate and hydrology data will be collected from existing monitoring stations maintained by the County and by CIMIS.

#### 4.1.1. Precipitation.

Precipitation data are collected by San Luis Obispo County; the locations of seven selected stations are shown on Figure 4. There are three different types of County monitored rain gages: tipping-bucket, rain gages with radio transmitters, and static rain gages. Static gages are read by volunteers and the hand written records are submitted to the County annually (EDAW 1998). Most precipitation data in the area are electronically collected using a tipping-bucket rain gauge connected to a datalogger with remote telemetry capability. The tipping-bucket gage is capable of measuring and recording rainfall in increments equivalent to at least one-hundredth of an inch (0.01). Each tip event is recorded with a date and time stamp to identify storm events and these data are summed for total monthly and annual precipitation.

Precipitation data for the NCMA area will be collected from the County-operated rain gage in Oceano, as shown on Figure 4. The Oceano rain gage is a tipping-bucket gage. Additional precipitation data from County-operated rain gages on Arroyo Grande Creek upstream of the NCMA, near Nipomo, as well as a CIMIS operated climate station in Nipomo and San Luis Obispo (Figure 4) will also be collected for comparison and data quality analysis as needed of the data from the Oceano gauge.

#### 4.1.2. Evapotranspiration.

California Irrigation Management Information System (CIMIS) operates climate stations with evapotranspiration (ET) information and other climate data across California. Many factors affect ET including weather parameters such as solar radiation, air temperature, relative humidity, and wind speed; soil factors such as soil texture, structure, density, and chemistry; and plant factors such as plant type, root depth and foliar density, height, and stage of growth. Although ET can be measured using such devices as lysimeters, estimating ET using analytical and empirical equations is a common practice because measurement methods are expensive and time consuming. Reference crop evapotranspiration is widely used as a reasonable estimate of the ET rate of a reference



crop, usually turf, expressed in inches. Reference crops are either grass (ETo) or alfalfa (ETr) whose biophysical characteristics have been studied extensively. At the Nipomo CIMIS weather station, the reference crop (with standard conditions for calculating ETo) is a well-watered, actively growing, closely-clipped grass that completely shades the soil. The input variables used in the CIMIS equation and the steps to calculate ETo are described on the CIMIS website at <http://www.cimis.water.ca.gov/cimis/infoEtoEquation.jsp>.

#### **4.1.3. Surface Water.**

Surface water discharge data are available primarily from the County's network of data-recording stream gages. The collection of stream discharge data is accomplished by measuring stream stage height and subsequently calculating discharge from a stage-discharge curve. Stage-discharge curves are created by manually collecting successive discharge and stage height measurements. For high flows, the County uses Hydrologic Engineering Centers River Analysis System (HEC- RAS) to develop rating curves from recorded flow depth. In addition to HEC-RAS, it is recommended that the Northern Cities work with the County to ensure that rating curves adhere to the USGS standards described in *Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter A8 – Discharge Measurements at Gaging Stations* (USGS, 1969). Stage height data at each gage site are collected using a transducer in a stilling well connected to a datalogger with remote telemetry capability. Electronic stage height records for this gage would be used to calculate discharge using the County maintained stage-discharge curve, when available.

Currently, no ongoing monitoring of surface water quality is performed in the area. However, any future monitoring should be consistent with the Surface Water Ambient Monitoring Program (SWAMP) guidelines to enable data integration with the larger state-wide databases. SWAMP monitoring protocols are available at [http://www.swrcb.ca.gov/water\\_issues/programs/swamp/qamp.shtml](http://www.swrcb.ca.gov/water_issues/programs/swamp/qamp.shtml). The key procedures and protocols for surface water quality sampling are available at this site in as appendices to the report on Quality Assurance and Quality Control, Appendix D – SWAMP Field Collection Standard Operating Procedures and Appendix E - SWAMP Field Data Measurement Standard Operating Procedures (SOP).

## **4.2. Groundwater Monitoring**

Groundwater monitoring will rely primarily on the long-established monitoring programs of the Northern Cities and County. The wells within the network and the monitoring protocols are described below.

#### **4.1.4. Wells Used for Monitoring.**

The County's selection of monitoring locations has generally been based on the following criteria:

- Willingness of well owners to allow access to and use of private wells
- Access to wells
- Ability to physically collect measurements from the wells.

The location and elevation for each well within the monitoring network has been measured using handheld Global Positioning System (GPS) units. The GPS measured elevation is collected at a marked location on the well that will be used in the future for referencing depth to water measurements for calculation of groundwater elevation. Location and reference point elevation data are recorded in the project database with other pertinent well information (owner, common name, state well number, etc.). Well construction details are also collected and recorded in the project database when they are available. Well logs from thousands of wells in San Luis Obispo County are kept on file at both the County Engineering and Health Departments (EDAW 1998).

#### **4.1.5. Groundwater Elevations.**

San Luis Obispo County has been monitoring and compiling water level data across the County since the 1950's. The County maintains a database of over 625 wells (EDAW 1998). Groundwater elevations are monitored in all of the wells indicated above at least twice annually. Groundwater elevations are monitored in the County monitored wells semiannually in April and October. County personnel measure water levels in the active monitoring network to ensure consistency of the data (EDAW 1998). Depth to water measurements from each well are collected relative to the appropriate reference point using an electric water level indicator in general accordance with American Society for Testing and Materials (ASTM) Standard D4750-87 (ASTM, 2001). Care is taken to collect depth to groundwater measurements when pumps in the wells are not in operation. If a pump cannot be turned off, then collection of a depth to groundwater measurement is either postponed or the measurement is noted to have been taken while the pump was operating. Groundwater elevations are calculated by subtracting the depth to groundwater measurement from the reference point elevation.

In addition to the County's program, the Northern Cities will monitor groundwater elevations in the Sentry Wells in January and July.

#### **4.1.6. Water Quality.**

Groundwater quality is monitored in drinking water wells throughout the area. In addition, the Sentry Wells along the coast will be monitored quarterly. Groundwater quality sampling at drinking water wells is conducted to comply with Title 22 of the California Code of Regulations. These wells will be sampled in accordance with ASTM Standard D4448-01 (ASTM, 2007) and the samples will be analyzed by a State Certified

Laboratory for the major ions (calcium, bicarbonate, carbonate, chloride, magnesium, potassium, sodium, and sulfate) plus selected constituents for seawater intrusion such as bromide, iodide, and total nitrogen. When applicable, water quality data will be collected consistent with Groundwater Ambient Monitoring and Assessment (GAMA) programs. The GAMA policies and protocols are derived from U.S. Geological Survey Techniques of Water-Resources Investigations (USGS 1997 to present).

## 5. Annual Report

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The monitoring and reporting program will support preparation of an Annual Report that documents water demand, water supply, and the conditions of the groundwater basin. The Annual Report will be submitted to the court within 120 days after the end of each calendar year. The first Annual report will be submitted by April 30, 2009. A preliminary outline of the Annual Report is shown below.

### **Preliminary Annual Report Outline**

1. Introduction
2. Management Activities
3. Climatic Conditions
  - 3.1. Precipitation
  - 3.2. Evapotranspiration
4. Water Demand
  - 4.1. Land Use
  - 4.2. Population
  - 4.3. Water Use by City
    - 4.3.1. Urban Water Management Plans
  - 4.4. Changes in Current and Projected Water Demand
5. Water Supply
  - 5.1. Sources of Supply
    - 5.1.1. Lopez Reservoir
    - 5.1.2. State Water Project
    - 5.1.3. Developed Water
    - 5.1.4. Groundwater
  - 5.2. Groundwater Conditions
    - 5.2.1. Water Levels
      - 5.2.1.1. Hydrographs
      - 5.2.1.2. Change in Storage
    - 5.2.2. Water Quality
      - 5.2.2.1. Time Concentration Plots
      - 5.2.2.2. Trends
    - 5.2.3. Seawater Intrusion
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6. Comparison of Demand and Supply
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## 6. References

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# FIGURES















