Section K.
Data Management

Section K. Data Management

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Section K. Data Management

Data Management plays a significant role in the implementation the IRWM Plan. Data management includes all activities, by hand or through use of technology, which measure and result in factual information for use in furthering the knowledge and ability to describe the San Luis Obispo region (see **Section C – Region Description**), to capture changes in the region over time and to monitor Plan performance. As an activity of the IRWM Plan implementation, the RWMG understands the importance of data management when used for assessing progress in water resources management and reporting progress of management activities to the region's stakeholders.

Data management is a regional effort amongst stakeholders to actively engage in understanding their interests by measuring and reporting factual information and developing defensible estimates. The task of managing data is at the center of every community, interest group, and agency that has an interest in the understanding of water resources, has a commitment, or regulatory requirement to report on the change in water resources. In either case, the standards of data management do not differ and the quality of data management is continuously reviewed in light of new technology.

K.1 INTRODUCTION

This section of the IRWM Plan is developed to address the Data Management Standards of the California Department of Water Resources' Guidelines for the Integrated Regional Water Management (IRWM) Propositions 84 and 1E, dated November 2012 (2012 CDWR IRWM Guidelines), described as follows:

> *The IRWM Plan must describe the process of data collection, storage, and dissemination to IRWM participants, stakeholders, the public, and the State. Data in this standard may include, but is not limited to technical information such as designs, feasibility studies, reports, and information gathered for a specific project in any phase of development including the planning, design, construction, operation, and monitoring of a project.*

In addition, the guidelines provide an overview of the minimum requirements of the IRWM Plan Data Management section:

- A brief overview of the data needs within the IRWM region
- A description of typical data collection techniques

- A description of how stakeholders contribute data to a DMS
- The entity responsible for maintaining data in the DMS
- A description of the validation or quality assurance/quality control measures that will be implemented by the RWMG for data generated and submitted for inclusion into the DMS
- An explanation of how data collected for IRWM project implementation will be transferred or shared between members of the RWMG and other interested parties throughout the IRWM region, including local, State, and federal agencies
- An explanation of how the DMS supports the RWMG's efforts to share collected data
- An outline of how the data saved in the DMS will be distributed and remain compatible with State databases including California Environmental Data Exchange Network (CEDEN), Water Data Library (WDL), California Statewide Groundwater Elevation Monitoring (CASGEM), California Environmental Information Catalog (CEIC), and the California Environmental Resources Evaluation System (CERES)

K.1.1 Background

The term "Database Management" implies a myriad of activities including, but not limited to, database programming, creating and maintaining data driven websites, creating stakeholder driven monitoring programs, processing large queries and data reports, developing graphical user interfaces for interpretation and management of data, uploading to state and federal database systems and running the data through algorithms for QA/QC. The topic of data management and Data Management Systems (DMS) has been extensively studied and implemented in many IRWM regions throughout California.

Given the enormity of the amount of information and the fact that much of it has been captured in detail in other reports, this section only summarizes data needed for the IRWM Plan. In December 2008, the District completed a comprehensive *Data Enhancement Plan*[1] (DEP), setting the stage for the regional data monitoring programs looking ahead. Acting as a clearinghouse for data storage and dissemination, the District seeks to create a flexible system to provide data for planning, design, and operational purposes. Given the regional nature and complexity of these data, the DEP incorporates improvements over time as new technologies are implemented and new resources become available to better collect, evaluate, and manage the data in perpetuity.

To provide additional detail, **Appendix K-1 – Data Management Summary Report by Wallace Group** includes a Data Summary Memorandum prepared by Wallace Group and others, describing the data needs and on-going efforts taking place in the greater San Luis Obispo region.

[1] Go to <http://www.slocountywater.org/site/Frequent%20Downloads/Integrated%20Regional%20Water%20Management%20Plan/Data%20Enhancement/>.

In addition to the Data Summary Memorandum, the County's DEP and Master Water Report (MWR) are used as supporting documents to the summarized format of this section.

The following chapters are included in this section:

- K.1 Introduction – summarizes the contents of Section K
- K.2 Overview of the Data Needs within the IRWM Region – provides a comprehensive listing of the water resource and related data needed to accurately characterize the region and report on changes over time
- K.3 Description of Data Needs – provides a brief description of the state database platforms, locations of various data collection efforts, and data collection issues facing the region.
- K.4 Current Data Programs and Collection Techniques – includes an inventory of on-going data collection efforts and what monitoring techniques are used in harvesting data, and identifies the entities responsible for maintaining data in the IRWM Plan region and applicable State databases to be distributed to.
- K.5. Quality Assurance/Quality Control Measures – describes implementation of steps set by the RWMG for ensuring the highest quality of data generated and submitted for inclusion into the regions Data Management System (DMS) and repository
- K.6 Regional Water Management-DMS Overview – brief overview of the existing DMS used for IRWM region description
- K.7 Anticipated Features of a Data Management System – brief overview of the potential transition of the existing DMS to a GIS-based DMS used for monitoring data throughout the IRWM Region
- K.8 Other Potential Future GIS/DMS Needs and Development – highlights future regulatory monitoring and reporting programs and the need for a robust DMS

The organization of **Section K** is written to identify the anticipated features of the data management system(s), what and how data are being collected, processes of data management taking place after measurement, and an example of the recommended DMS. Please refer to appendices and reference documents for more in-depth detailed information.

K.1.2 Plan Performance Monitoring Data Needs

It should be noted that data is also collected to monitor plan performance at both the programmatic and project level as described in **Section J – Plan Performance and Monitoring**. Monitoring and reporting activities related to measuring the success of the IRWM program in meeting the IRWM Plan's Goals and Objectives using both programmatic monitoring and reporting methods, and project level data measuring physical and qualitative benefits collected from project proponents/sponsors are described in detail in that section.

The data collected is shared per the Communications Plan with the RWMG, local, state and federal agencies and other stakeholders by distributing the 5 year report and/or updated project list and maintaining an online database of reports and/or lists.

K.2 Overview of the Data Needs within the IRWM Region

The data needed for the Region relates to updating the region description and monitoring IRWM Plan Performance at the IRWM program level and project level as described in Section J. The next section describes the data needs for the region description and describes the data collected for those monitoring efforts, the source and/or stakeholder that will supply it, how it is collected, and it's applicability for upload to a State database. The section after that includes the monitoring methods identified in Tables J-6 to J-10 in **Section J – Plan Performance and Monitoring** and describes the data collected for those monitoring efforts, the source and/or stakeholder that will supply it, how it is collected, and it's applicability for upload to a State database. The section after that describes how project and program information will be managed.

K.3 Description of Data Needs

This section describes the data needs for the region, the source and/or stakeholder that will supply it, how it is collected, and it's applicability for upload to a state or federal database system. Popular statewide databases currently include, but are not limited to, the following:

- **Californial Environmental Data Exchange Network (CEDEN)** - Facilitates the integration and sharing of water and environmental data with the purpose of making this data accessible to the public in a simple and standardized manner. The data comes from many diverse monitoring and data management efforts which include participants from federal, state, county and private organizations. <http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010/ir2010_factsheet.pdf>
- **GeoTracker -** A data management system for managing sites that impact groundwater, especially those that require groundwater cleanup as well as permitted facilities such as operating USTs and land disposal sites.< http://www.waterboards.ca.gov/publications_forms/publications/factsheets/docs/geotrkgama_fs.pdf>
- **Water Data Library (WDL)** - WDL contains hydrologic data (groundwater level data and some groundwater quality data) for over 35,000 wells California. The data is collected by DWR Region Offices and dozens of local and federal cooperators. < http://www.water.ca.gov/waterdatalibrary/>

- **California Statewide Groundwater Elevation Monitoring (CASGEM)** - In 2009, the Legislature passed SBX7 6, which establishes, for the first time in California, collaboration between local monitoring parties and DWR to collect groundwater elevations statewide and that this information be made available to the public. < http://www.water.ca.gov/groundwater/casgem/>
- **California Environmental Resources (CERES)** - CERES is an information system developed by the California Natural Resources Agency to facilitate access to a variety of electronic data describing California's rich and diverse environments. The goal of CERES is to improve environmental analysis and planning by integrating natural and cultural resource information from multiple contributors and by making it available and useful to a wide variety of users.< http://ceres.ca.gov/>
- **California Environmental Information Catalog (CEIC)** - CEIC is an online directory for reporting and discovery of information resources for California. Participants include cities, counties, utilities, state and federal agencies, private businesses and academic institutions that have spatial and other types of data resources. The Catalog has been developed through a collaborative effort with the California Geographic Information Association, California Environmental Resources Evaluation System, and the Federal Geographic Data Committee <http://ceic.resources.ca.gov/aboutCEIC.html>

The need for numerical data collection varies with each of the three Sub-Regions. Monitoring stakeholders can be categorized based on their area of interest or expertise. A helpful glimpse of the interest categories and issues facing the IRWM region is provided in **Table K-1**. The table briefly describes programs unique to each Sub-Region, and those crossing over multiple Sub-Regions. The different data types are bolded to highlight the context of the specific monitoring programs in the region and where data collection is taking place.

Figure K-1, **Figure K-2,** and **Figure K-3** identify the approximate geographic distribution of the various data collection efforts taking place by the participating monitoring stakeholders. In some cases, limited resources and long-term commitments required to collect data limit the data being harvested, and results in concentrated "areas of concern." Uniformity and changes in topography generally govern the number of monitoring locations for data such as precipitation, temperature and stream flows. Other specific points of monitoring include the coastal beaches, estuaries, and groundwater wells. **Section K.4** provides a brief summary of the various programs. For additional detail, please refer to the 2012 MWR, Chapter 3, Section 3.2.

K.4 CURRENT DATA PROGRAMS AND COLLECTION TECHNIQUES

Table K-2 lists all of the region's data collection activities including a short definition of the data and how the resulting data are generally used. Techniques used in the data collection effort

vary a great deal based on the agency taking the measurement and the age of the monitoring device or station. Over time, technology has had a big role in the quantity and quality of data for all locations. A brief description of the various programs and methods used follows.

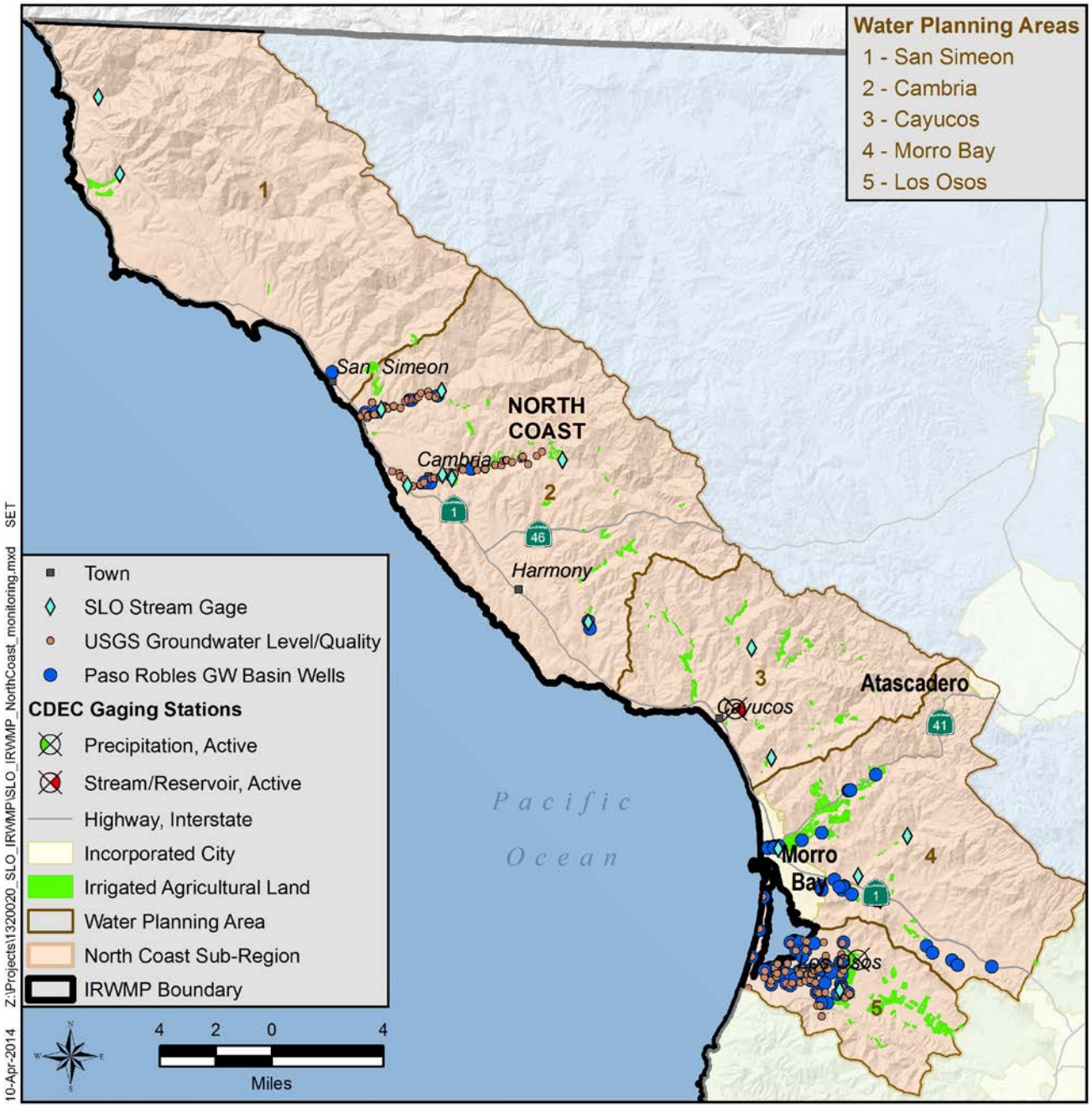


Figure K-1. North Coast Sub-Region Data Monitoring and Collection Programs

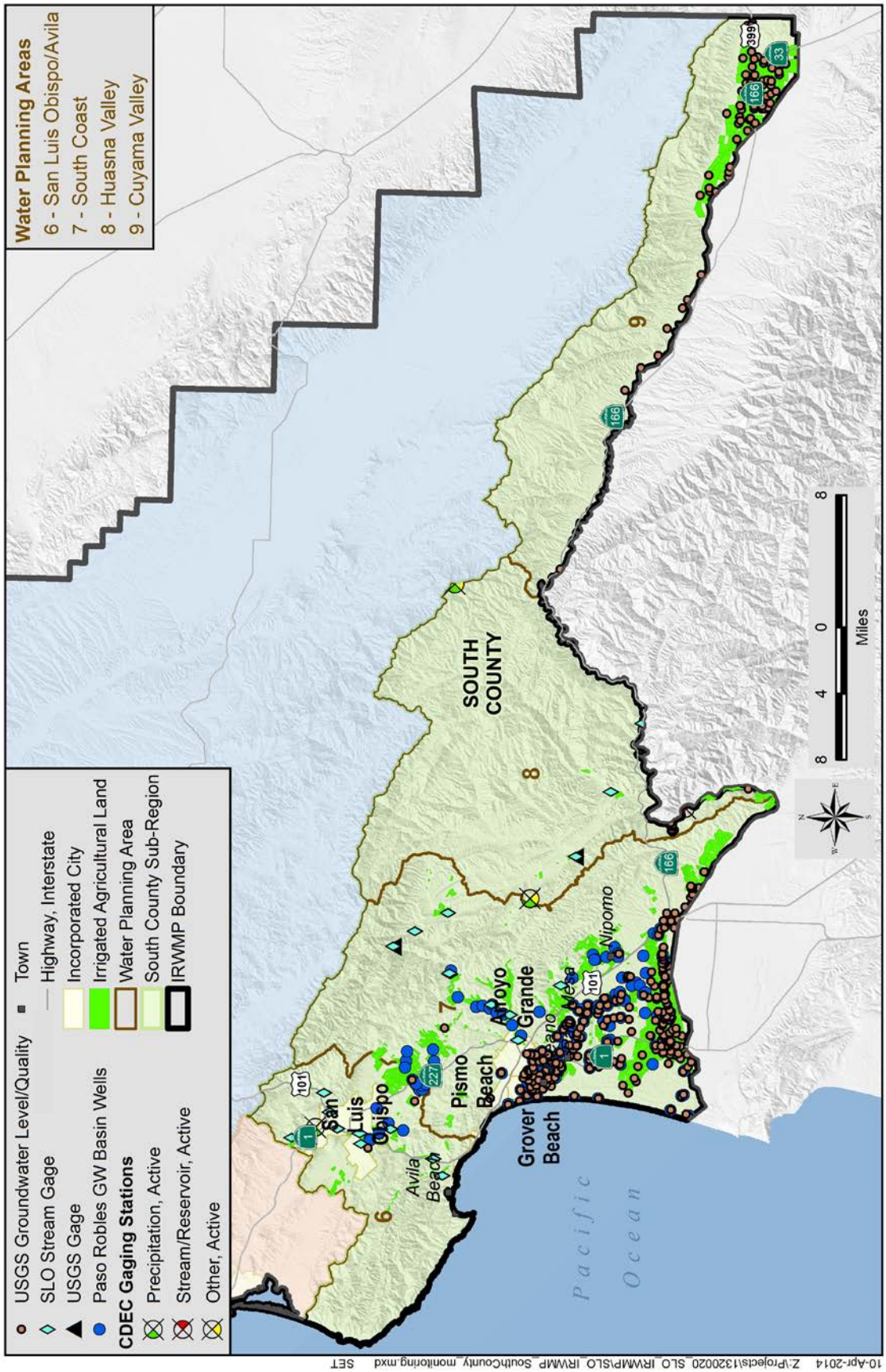


Figure K-2. South County Sub-Region Data Monitoring and Collection Programs

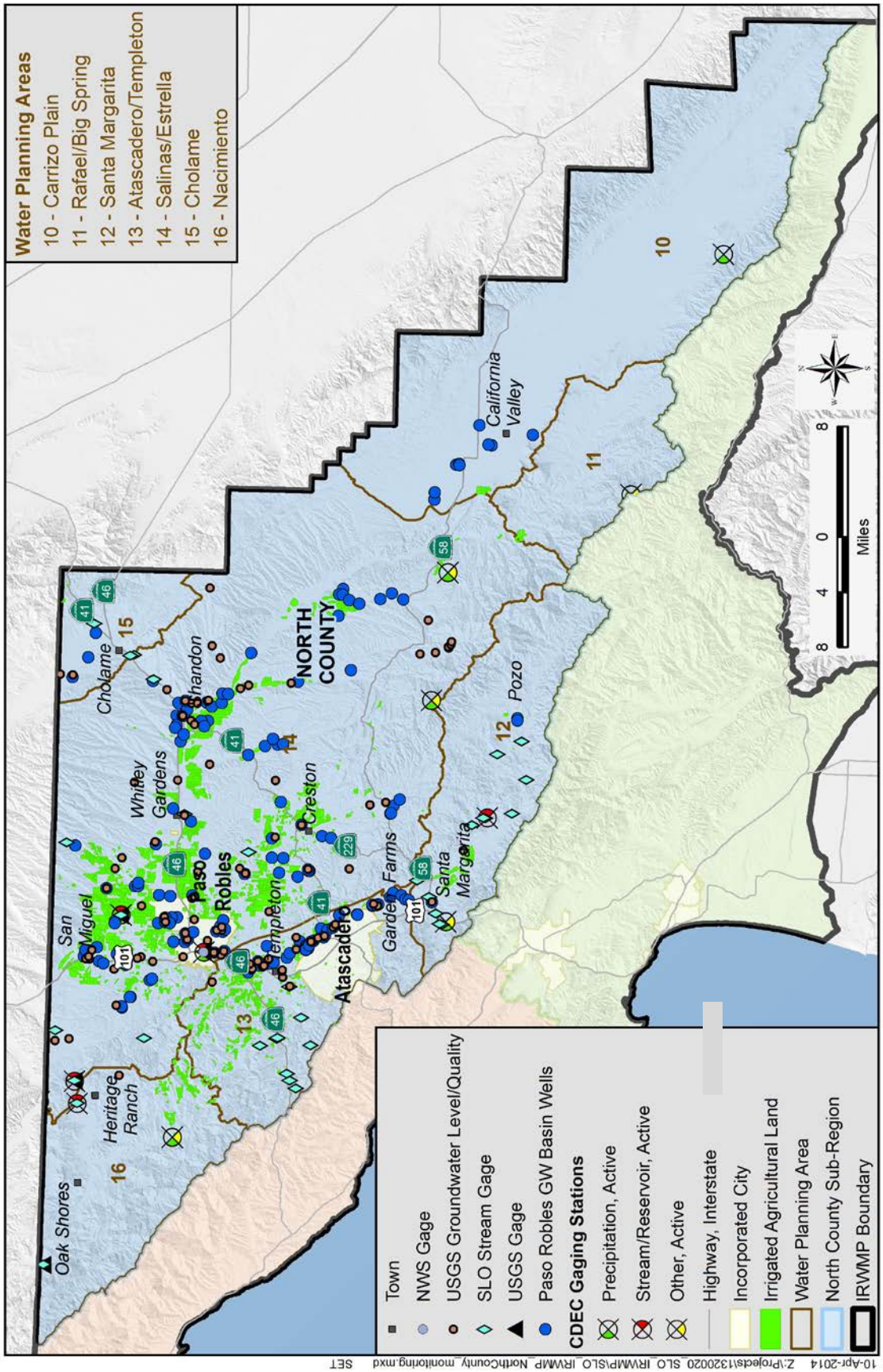


Figure K-3. North County Sub-Region Data Monitoring and Collection Programs

Table K-1. Sub-Region Areas of Concern Requiring Data Collection

Regional Interest Classifications	Primary Definitions as Related to the IRWM Plan and Region	North Coast	South County	North County
Hydrogeology	The study of groundwater and geologic characterization of substrata composing the geologic makeup of water bearing formations and areas of recharge and extractions	Six small coastal alluvial aquifers (Pico Creek Valley, San Carpoforo Valley, Arroyo De La Cruz Valley San Simeon, Santa Rosa, and Villa Valley Groundwater Basins) are the primary source of drinking and irrigation water to the North Coast region requiring a constant groundwater monitoring of groundwater elevations, salinity concentrations and storage, all used as measures of sustainability.	Nine coastal alluvial aquifers (San Luis Obispo Valley, San Luis Valley, Edna Valley, Santa Maria Valley, Pismo Creek Valley, Arroyo Grande Valley, Nipomo Valley, Huasna Valley, Cuyama Valley Groundwater Basins) are the primary source of drinking and irrigation water to the South County region requiring a constant measurement of change due to groundwater management activities, groundwater elevations, salinity concentrations, sea water intrusion and storage availability to measure sustainability.	Nine alluvial aquifers (Carrizo Plain, Rafael Valley, Big Spring Area, Santa Margarita Valley, Rinconada Valley, Pozo Valley, Atascadero, Paso Robles and Cholame Valley Groundwater Basins) are the primary source of drinking and irrigation water to the North County region requiring a constant measurement of change due groundwater management activities, groundwater elevations, salinity concentrations and storage availability as a measure of sustainability.
Oceanology/Marine Biology	The study of marine science, beaches, and the coastal oceanic influences	The Pacific Ocean strongly influences the coastal communities of the North Coast and South County. Tidal patterns, sea level rise, sea water temperature, marine habitats and sea water intrusion (above and below ground) require measurements over long periods of time. Monitoring the safety of public beaches is done through forecasting and buoy measurement data. The predominance of public beaches exist in the South County Sub-Region. Sand movement is a concern to shipping channels along the coast.		While the North County is not contiguous to the Pacific Ocean, however, it is influenced by weather pattern, influencing the amount of precipitation as discussed in climatology.
Climatology	The study of weather and climate change	Weather patterns across the North Coast and South County carry a significant amount of rainfall and are influenced heavily by the ocean and the terrain of the coastal mountain range. Measurement of precipitation and stream flow data are important to flood forecasting, and a long-term understanding of climate change. The average rainfall for the North Coast is		Weather patterns crossing the North County are predominantly influenced by the ocean and being landward of the coastal mountain range. Measurement of climate data, including precipitation and temperature, are important to flood forecasting and a long-term understanding of climate change.

Table K-1. Sub-Region Areas of Concern Requiring Data Collection, Continued

Regional Interest Classifications	Primary Definitions as Related to the IRWM Plan and Region	North Coast	South County
Hydrology	The study of surface water resources and flood plain analysis	Stream and river flows in the North Coast and South County are influenced by precipitation, groundwater elevations, topography and man-made structures and reservoir storage and release operations. Real-time stream flow data provides forecasting and determinations of flood protection (i.e. 100-year flood events). Measurements also take place at river outflow points to the ocean and at release points from man-made reservoirs. Groundwater basin watersheds listed under hydrogeology are monitored.	The Salinas Valley is the largest watershed in the North County Sub-Region requiring real-time stream flow monitoring of flow data throughout its course north into Monterey County and then to the Pacific Ocean. Lake Nacimiento provides fresh water supplies for treated drinking water to North County communities requiring monitoring of lake storage and discharge.
Biology	The study of plant and animal life-cycles as they relate to the quantity and quality of fresh and saline water	Sampling of biological indicators through marine observations and estuary and wetland monitoring is used to protect the sensitive flora and fauna of the region. Minimum in-stream flows are monitored to ensure protection of fisheries along the coastal and inland watersheds. Point and non-point source discharge of pollutants is a primary regulatory concern, and the Coastal Ambient Monitoring Program was created for the purpose of monitoring water quality constituents for the protection of biologically sensitive areas.	
Geography	The study of land use and man's influence on nature	Land use, whether it is agriculture, urban or rural, affects change to both water quality and quantity (or demand). Land use monitoring allows for the study and correlation of human activities and the changes found in the region's water resources through other monitoring programs.	

Table K-2. General Data Collection Efforts and Techniques

Data Need	Data Collection Descriptions
Agricultural Water Demands	Calculating agricultural irrigation demands uses data from measuring crop types (pesticide permits, aerial imagery, growers and drive-by), crop acreage (aerial imagery and parcel maps), and from using weather station data including temperatures, evapotranspiration and precipitation. Water use by well or surface water diversion is difficult to obtain. All water demand data are used to monitor available agricultural water supplies and sustainability of those supplies over time and through drought periods. See **Appendix J – Agricultural Water Demand Analysis** for additional information on agricultural areas and crop locations.
Beach Water Quality	Monitoring (water sampling) of beaches assists in the management of coastal recreation to regulate designated swimming, bathing, surfing, or similar activities. Events affecting the frequency of beach monitoring include pollution from wastewater treatment discharges, point and non-point source discharges including from inland streams and rivers, and marine spills from ocean shipping activities.
Estuaries and Wetlands	Estuaries and wetlands require constant monitoring of man's influence on the long-term health of these sensitive ecosystems. Conductivity (measurement of salinity using probe), temperature (thermometer), dissolved oxygen (oxygen sensor), oxygen saturation, fluorescence, turbidity, nitrate, current/current profile, and depth of water (sonar) are some of the indicator measurements needed to monitor the overall health of estuaries and wetlands.
Geologic Characterization	Geologic characterization is the pursuit of descriptive information on the earth's soils and rock formations. Withing the context of water resources, data are useful in understanding the movement of groundwater, the quality of groundwater and ground elasticity (subsidence). Driller logs are the best means of capturing subsurface lithologic information (driller's interpretation notes) regarding soil types encountered as the well is drilled. Municipal well drillers will also run a geophysical profile (probe) to determine variations in groundwater conductivity, clay content, and porosity and/or saturation. Both lithology and geophysical data are used to determine where to screen a well for both extractions and monitoring.
Groundwater Elevations	Groundwater elevation data (sounding probes and various data loggers) are used to evaluate the total amount and change in groundwater storage in the local and regional groundwater basins. Data are best taken semi-annual to understand the differences between spring and fall as the irrigation season occurs each year. Minimal influence from high production wells, uniform geographic distribution and density of monitoring wells are required to provide the highest degree of certainty in regional groundwater trends.
Groundwater Management Efforts	As Groundwater Management Plans are approved with implementation of adopted Basin Management Objectives (BMOs), monitoring programs (i.e., groundwater elevation and water quality) are used to measure and report positive (or negative) change resulting from BMO activities. Annual reporting through State-of-the-Basin reports, provides dissemination of the changes to basin users.
Groundwater Quality	Groundwater quality monitoring detects changes in the quality of water and ensures early alert if contamination (natural or manmade) is moving towards drinking water supply wells. At a minimum, public groundwater wells are tested for water quality on a regular basis as required by the Department of Public Health. Private wells are often tested by the owner using a grab sample kit from a local lab for analysis. Use of fertilizers and septic systems are a concern in the rural and ag areas.
Land Use and Population Changes	Land use constantly changes over time based on public and private actions to further the interests of the land owner and community. Tracking changes (GIS and aerial imagery) requires high resolution parcel and imagery files to capture changes (including conversion of lands from native to ag, ag to urban, and ag fallowing) as they occur over time. Population changes are measured every ten years with the U.S. Census information. Intervening years are often calculated based on population projections from local and State agencies.

Table K-2. General Data Collection Efforts and Techniques, Continued

Data Need	Data Collection Descriptions
Marine Observations	Marine observations (bouys) of the Pacific Ocean are monitored for purposes of tracking and forecasting the ocean's changes. Forecasters need frequent, high-quality marine observations to examine conditions for forecast preparation and to verify their forecasts after they are produced. Other users rely on marine observation data for the protection of marine life and coastal ecosystems, and monitoring Sea Level Rise as a part of climate change forecasting.
Point and Non-Point Pollution Discharge	Monitoring pollutant concentrations in rivers and streams provides an assessment of the overall health of the watershed. Monitoring of point sources using sampling equipment and measuring discharge flows over time can alert regulatory agencies of non-compliance with NPDES permitting statutes. Non-point source is difficult to monitor but can be correlated with various human activities (e.g., automobile use, gas stations, air pollution, etc.).
Precipitation and Climate	Data from rainfall gauges serves to provide real-time information to flood forecasters and engineers during storm events. The amount of runoff into streams and rivers is calculated using models to warn of possible flood danger. Most locations of climatological monitoring include water-related monitoring activities (i.e., precipitation, humidity, solar radiation and temperature).
Reservoir Storage and Release Flows	Reservoir operations affect flood safety, water supplies and environmental demands. Real-time data of both storage (as a function of level) and release flows are needed to forecast the change required to accommodate storm events over the year. Storage in the reservoir can also affect the attraction for recreation and, as a result, the local economy.
Rural Water Demands	Rural water demands represent a sector of water use comprised of small private water systems or individual wells. A calculated determination of the rural demands is based on the mix of agriculture, livestock, and urban (house and driveways) uses taking place on the small acreage property. Water use by well or surface water diversion is difficult to obtain from private owners. All calculated water demand data are used to monitor available water supplies and sustainability of those supplies over time and through drought periods.
Sea Water Intrusion	Sea water intrusion data is needed for coastal communities reliant on groundwater supplies for their source of drinking water. Salinity monitoring using sentry wells alerts the regions to possible intrusion and to implement preventative measures to halt further intrusion.
Stream Flow	Stream flow measurements (depth of water) are used to calculate the flow of water passing by a specific point along the stream or river channel. Measurements provide an understanding of the watershed's response to various storm events. Real-time data are used to forecast possible flooding and improve public safety.
Drinking Water Quality and Ambient Monitoring Program	Ambient monitoring refers to any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in those characteristics. Water quality measurements in surface waters assess environmental and human health risks over time. Water quality measurements in drinking water supplies ensure the protection to human health by meeting primary and secondary water quality standards.
Urban Water Demands	Urban water demands are a significant water use sector is growing regions. Monitoring urban growth (planned and existing) through actual water production records (metered water treatment plant discharges or well use), or through changes in land use, provides for the required determination (under SB 610 and SB 221) of long-term sustainability of supplies. Data are also used extensively in the reporting and completion of an Urban Water Management Plan required for larger water systems every five years. See **Section D – Water Supply, Demand, and Water Budget** for more information regarding urban water agency demands and projections.

K.4.1 Existing San Luis Obispo Data Management System and Communication with State and Federal Database Systems

Data is currently being collected and managed as part of county-wide programs cited in the tables above and described more fully in the sections below. The datasets are currently being managed through the San Luis Obispo County Water Resources Division of Public Works website http://www.slocountywater.org/site/ where the public can access map-based real-time data and learn about what data is being collected, how it is reported, and how to request and download the data for use in reporting, etc.

Technology has led to a great deal of efficiencies in data management over the past decade, with the region moving towards improved data transfers between local, state, and federal database systems. The District currently participates in state data management programs (e.g., CASGEM groundwater elevations, GeoTracker local remedial clean-up sites, etc.) and has dedicated staff to support the role as data administrator, ensuring quality control of the data and abiding by confidentiality agreements with various data sources. The website and direct communication with state and federal agencies will continue to take place as the county migrates to a GIS web-enabled data management system (SLO-DMS), as described in **Section K.8.4 – Proposed Implementation of the SLO-DMS;** a planned two-year process to facilitate data upload and download available to regional stakeholders, the public, and state and federal agencies.

K.4.2 Groundwater Elevations

Groundwater levels have been measured by the District in selected wells on a semi-annual basis to provide data for planning and engineering purposes. The monitored wells are located within groundwater basins and sub-basins of the Central Coast Hydrologic Region described in Department of Water Resources Bulletin 118. Program wells are selected based on aquifer definition and uniform aerial distribution.

Well Sounding Probe

The District maintains a database with hundreds of wells. Readings started in the early 1950s. Water level readings are taken in April and October. The groundwater elevation data obtained from this monitoring program collected over time provide a general indication of groundwater basin conditions. This information is used in determining groundwater availability and basin yield estimates, and for hydrogeologic and geotechnical impacts and assessment studies on potential projects.

K.4.2.1 Techniques for Measurement

The method of measurement varies based on who is performing the measurement. Steel tape is the most common method of manually measuring the depth to groundwater below a surveyed reference point where the ground elevation is known. The tape line is chalked and then lowered down the casing to several feet below the last known measurement in the same season. The water wets the chalk and a distance is noted and a calculation made to establish the depth to water. More recent methods include electronic sounding devices where a probe is connected to a measurement tape and sounds off when water is found. Problems can occur when there is insufficient space to lower the device or, in the case of older wells, if oil is being used to lubricate the pump, creating a column of oil standing on top of the water surface.

Downhole surveys of some of the existing wells currently being monitored could be conducted to obtain additional construction details and determine which aquifers are being monitored (or where the wells are screened). These downhole surveys would improve the understanding of the groundwater elevation measurements and groundwater movement in the area of the well.

Dedicated Multi-Completion Monitoring

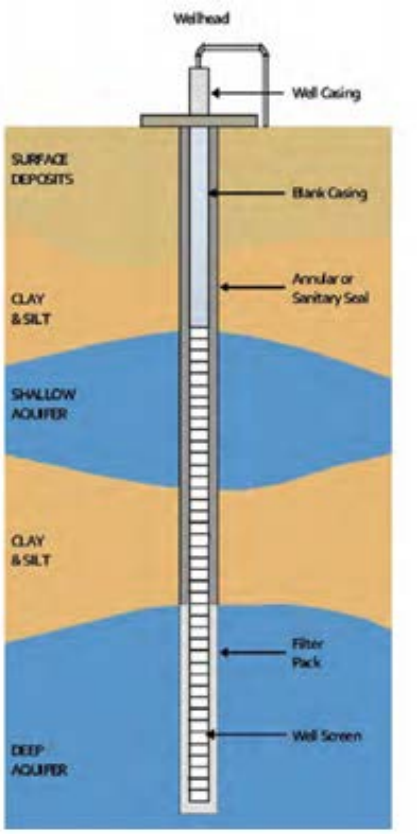
K.4.2.2 Participants

The majority of well owners participate on a voluntary basis and the wells are typically production wells, which create certain challenges with maintaining an accurate, long-term record, making information available to the general public and understanding the condition of every groundwater basin in the County.

The District is initiating the development of a more formal groundwater monitoring program using dedicated monitoring wells for approval by the Board of Supervisors and with elements that can be adopted by ordinance. The program will, at a minimum, monitor well construction, and address groundwater level and water usage data collection. Efforts to develop the program will include town hall meetings to ensure stakeholder involvement. Issues to be addressed during the development of the program would include, but not be limited to, the following:

- Gaps in the existing monitoring network
- Construction methods and impacts and benefits to property owners
- Voluntary versus non- voluntary participation
- Distinguishing how different users (urban, agricultural, rural) would be involved/affected/not affected

- Identify methods in land use planning to preserve monitoring wells rather than abandon wells with urban development



Typical Well Construction

- Methods to educate and provide public outreach on the need to preserve and contribute to the well monitoring program
- Gain understanding what other amendments to County Code related to groundwater data collection are being developed
- Define legal authorities of the County/District

The USGS also contributes to the groundwater measurement program as part of their nation-wide monitoring program. Their groundwater database contains records from about 850,000 wells that have been compiled during the course of groundwater hydrology studies over the past 100 years.

Locally, only a few wells are measured by the USGS, all of which are located on the southern county border in the vicinity of Santa Maria and Cuyama. Information from these wells is served via the internet through NWISWeb, the National Water Information System Web Interface. NWISWeb provides all USGS groundwater data that are approved for public release. More information can be found at: <http://waterdata.usgs.gov>.

K.4.3 Geologic Data

Well Driller Logs are on file for locations throughout the county, and legislators are currently working on legislation to clarify the availability of proprietary well log information to the public. The County's Environmental Health Department is responsible for issuance of well driller's permits and the collection of well log information as a part of its oversight process on adequate spacing between wells and known sources of potential contamination (e.g., septic systems, leaking underground storage tanks, etc.). Some well logs are also on file at both the County Public Works Department and the State Department of Water Resources.

K.4.3.1 Techniques for Measurement

Because of the age of some wells and past practices in the completeness of well logs, well construction data may not be available for all wells in the region and especially those currently

included in the groundwater elevation monitoring network. For wells without construction records, video logs could be performed during pump maintenance. Recent technology developments allow down-hole investigation of wells without having to remove their pumps and can provide a video survey to determine their screen intervals; estimate the amount of flow contributed by the aquifer (allowing the aquifer characteristics to be estimated); and collect water quality samples by aquifer. These video surveys do have limitations due to the pump column being in the well during the survey. The well owner could notify the District and the well logging service to coordinate these efforts with their pump maintenance.

K.4.4 Stream Flow

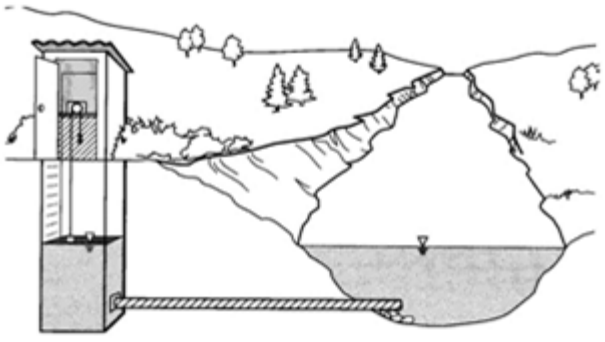
Water levels are typically collected in streams as part of a stream flow monitoring program. In addition, water levels are also collected in streams to support flood protection activities and in reservoirs to assist with daily operations.

The major streams and rivers in the region include:

- Arroyo De La Cruz Creek
- Arroyo Grande Creek*
- Cayucos Creek
- Chorro Creek*
- Estrella River*
- Los Osos Creek*
- Morro Creek*
- Old Creek
- Pismo Creek
- Salinas River*
- San Capoforo Creek
- San Luis Obispo Creek*
- San Simeon Creek*
- Santa Rosa Creek*
- Toro Creek
- Villa Creek

** - has a current gauge station*

K.4.4.1 Techniques for Measurement



Example of Real Time Stream Gage

In order to measure stream flow at the outlet of each Hydrologic Catalog Unit within the region, stream gauges are placed at the outlet of the streams and rivers. The Salinas River, Santa Maria River, and Estrella River watersheds all have real-time USGS stream gauges that measure streamflow from their respective accounting units. Measurements are often made by depth of flow using a staff gauge and knowing the relationship of depth of water to

flow in the channel (stage-discharge relationship). Technological advances have provided many other methods, but are typically not as simple to maintain and make measurements over time. Data loggers can be used with transducers to maintain a constant stream of data during storm events when flood forecasting is taking place.

K.4.4.2 Participants

There are two agencies that collect stream flow information in the region: the District and the United States Geological Survey. Stream flow data is also collected on occasion through the Central Coast Ambient Monitoring Program (CCAMP), but only when water quality samples are collected. The CCAMP does not use permanent stream flow gauges.

For more information of the District's Stream Gauges, go to:
<http://www.slocountywater.org/site/Water%20Resources/Data/maps/stream-flow.htm.>

The U.S. Geological Survey's National Streamflow Information Program (NSIP) operates and maintains approximately 7,500 stream gauges which provide long-term, accurate, and unbiased information on streamflow to meet the needs of many diverse users. The mission of NSIP is to provide the streamflow information and understanding required to meet local, State, regional, and national needs.

When adding new sites to the District's stream network, using past, inactive gauges, which may have a period of record that will complement any new data collected, are considered first. The District's real-time monitoring network will be the primary user of the data. Once each major stream in the region has a stream gauge, the District will look to include some of the smaller tributaries and creeks in the region. County basins that would significantly benefit from enhanced stream flow monitoring conducted for land use and water resources planning include the Paso Robles Basin, San Simeon Basin, Santa Rosa Basin, Los Osos Basin, San Luis Obispo/Edna Valley Basin, Arroyo Grande Basin, Nipomo Mesa Basin, and the Santa Maria Basin. When enhancing the monitoring in these regions, placing gauges on major creeks near the confluence with significant tributaries, on some smaller streams and tributaries, and at major cities along the major creeks should be considered.

An enhanced county-wide flood warning system could be used to some extent in participating communities of the region. With adequate warning, property owners may have time to install flood gates or move valuable objects to higher ground. Unfortunately, times of concentration (i.e., time when rainfall travels overland to creeks and then routed to downstream rivers) of creeks and rivers in the county are relatively short – only a few hours or less. A flood warning system only allows time for the most basic preparations. The following communities with historic flooding can benefit from a flood warning system:

- Cambria and other North Coast Communities
- San Luis Obispo to Avila Beach
- Five Cities/Arroyo Grande Watershed
- Los Osos
- Shandon
- Nipomo (old town)

K.4.5 Precipitation and Climate

Manual Rain Gauge

There are a number of recording rain gauges in operation in the County. These gauges provide a record of accumulated precipitation versus time. The District Recording Rain Gauge network consists of 13 recording gauges located throughout the region. The distribution and density of recording rain gauges in the region is fairly limited, and noticeably lacking in the northern and eastern part of the region.

K.4.5.1 Techniques for Measurement

Real-Time Tipping Bucket Rain Gauge

Records of rainfall are usually in the form of daily entries of the precipitation occurring during the preceding 24-hour periods. Simple rainfall gauges are inexpensive and require little to no cost to maintain. Daily records are typically manually taken and are generally summarized in monthly totals. For more reliable and timely rainfall data, recording rain gauges are being used to provide accurate time-series precipitation data. A rainfall monitoring network strives for uniformity across the region with higher density monitoring in regions of changing topography. To partially achieve this uniformity, additional recording gauges would be beneficial in the extreme northwest corner of the County, the Hearst Castle area, the Cayucos area and the Templeton area.

Weather stations are used by some participants for recording rainfall and other climatological data. More of the stations are becoming automated to provide streaming real-time telemetry data. Methods of measurement of rainfall are the same except with sensors to electronically record the measurement at given time intervals, and a method to empty the gauge every 24-hour period. The change from manual to automated weather stations has been identified as

leading to erroneous estimates of climate trends because of sampling methods and the higher degree of interpretation obtained from manual observations.

K.4.5.2 Participants

Precipitation data from approximately 50 stations throughout San Luis Obispo County are collected by the County Public Works Department. Volunteer rain gauges are generally operated at-will, by regional residents, business owners, or local agencies. The volunteers independently collect precipitation data and provide it to the District or other agency on an annual basis. There are a significant amount of volunteer rain gauges in the region, particularly in urban and suburban areas. As with the District recording rain program, the east portion of the region is particularly under represented.

ALERT is an acronym for Automated Local Evaluation in Real Time, which is a method of using remote sensors in the field to transmit environmental data to a central computer in real time. This standard was developed in the 1970s by the National Weather Service and has been used by the National Weather Service, U.S. Army Corps of Engineers, Bureau of Reclamation, as well as numerous State and local agencies, and international organizations.

In 1982, through a joint research and development effort between UC Davis and CDWR a computerized weather station system was established as a more cost effective method for estimating crop water use. This program was given the name "California Irrigation Management Information System" or CIMIS. In 1985, the administration and implementation of the program, and its further development, were turned over to CDWR.

The CIMIS is a program of the Office of Water Use Efficiency, California Department of Water Resources (CDWR) that manages a network of over 120 automated weather stations in the State of California. CIMIS was developed to assist irrigators in managing their water resources efficiently. Efficient use of water resources benefits Californians by saving water, energy, and money.

CIMIS Station

The CIMIS stations gather climatic data (precipitation, temperature, humidity, solar radiation, etc.), which is used to calculate the evapotranspiration (ET). ET is the loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues). It is an indicator of how much irrigation water is needed (or used) for healthy growth and productivity.

CIMIS stations are maintained by local agencies that use standard equipment and maintenance procedures. The data seems to be reliable, particularly for hourly rainfall information during storms. To help estimate agricultural water use in each climatic region and to supplement evaporation data collected at reservoirs and by weather stations, it is recommended that two additional evaporation pans (or weather stations) are established around Cambria (or further north) and east of Paso Robles.

Other smaller contributions made in the measurement of precipitation and climate data include the following:

- National Weather Service Cooperative Observer Program (COOP)
- Citizen Weather Observer Program (CWOP)
- Remote Automated Weather Stations (RAWS)
- Automated Surface Observing System (ASOS) Stations

Each provides a small number of gauge data that is used in region but is, in general, not considered as reliable as the larger programs.

Release Weir

K.4.6 Reservoir Storage and Release Flows

Daily surface water levels are measured for most major reservoirs in the region as part of daily reservoir operations. The County maintains reservoir operational records for two reservoirs – Lopez and Salinas. Other agencies collect and maintain reservoir operation data for the other major reservoirs.

Data for each reservoir is available from the agency that operates the reservoir. As part of regular reservoir operations, daily lake elevation values are recorded at the following reservoirs:

- Chorro
- Lopez (includes Terminal Reservoir)
- Nacimiento
- Salinas
- Whale Rock
- Twitchell

K.4.6.1 Techniques for Measurement

Reservoir storage is typically developed as a function of depth at the dam or discharge point. Sediment transport into a reservoir can change the available storage over time requiring

calibration of the function. Releases are measured through weir flow depth or flow meters in discharge pipelines. Data for both storage and release flow is automated at set time intervals and reported at daily intervals.

K.4.6.2 Participants

Water supply reservoir operators typically work with downstream water users in providing sufficient water supplies for urban, agriculture, and rural supplies throughout the year taking into account the need for environmental flows (i.e., minimum in-stream flow requirements). Flood control (or multi-purpose reservoirs) have the same requirements but require a rule curve to ensure sufficient storage exists at the peak of the flood season. The balance of benefits between water supply, environmental, flood, and recreation is constantly being monitored using storage and release data to assist in making operational decisions and in forecasting the next year's performance criteria.

K.4.7 Drinking Water Quality and Ambient Monitoring Program

Numerous federal, State, and local agencies and organizations conduct water quality monitoring in the region, with some programs having several decades of drinking and surface water monitoring data. Non-profit organizations and other smaller agencies are also monitoring water quality in the county and especially in the Central Coast region (including Monterey and Santa Barbara counties). These groups have relatively well-developed programs with monitoring efforts as described below.

K.4.7.1 Techniques for Measurement

Operators of public water systems (defined as any system that serves drinking water to at least 24 persons for at least 60 days out of the year, or who serves domestic water to 15 or more service connections) conduct routine monitoring to ensure that the water they produce complies with Safe Drinking Water Act standards. State certified laboratory testing of water samples results in reports submitted to the State of California Department of Public Health (CDPH) based on their monitoring schedule for the various constituents.[2]

Water Quality at Tap

Monitoring broadly encompasses several categories of

[2] < http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Monitoringschedule/CountyDataFiles-PDF%20Monitoring%20Page/SanLuisObispoCountyDistrict70.pdf>

constituents: microorganisms, disinfectants, disinfection byproducts, inorganic chemicals, organic chemicals, and radionuclides. Sampling is conducted at treatment plants, within distribution systems, and at the tap, and monitoring results are evaluated to ensure that applicable drinking water quality standards are met. For regulated constituents, results are compared to Primary and Secondary MCLs, and unregulated contaminants are evaluated against CDPH Detection Limits for Purposes of Reporting (e.g., color, corrosivity, and odor).

Small water systems are also required to conduct routine monitoring and report to the Environmental Health Services Division of the San Luis Obispo County Public Health Department.

K.4.7.2 Participants

Beyond the local water treatment The Surface Water Ambient Monitoring Program (SWAMP) is the primary program intended to integrate existing water quality monitoring activities of the State Water Resources Control Board and the Regional Water Quality Control Boards, and to coordinate with other monitoring programs.

SWAMP is a statewide monitoring effort designed to assess the conditions of waters throughout the State of California, including California's Coastal waters. The program is administered by the State Water Resources Control Board. Responsibility for implementation of monitoring activities resides with the nine Regional Water Quality Control Boards that have jurisdiction over their specific geographical areas of the State. Monitoring is conducted in SWAMP through the Department of Fish and Game and U.S. Geological Survey master contracts and local Regional Boards monitoring contracts.

Ambient monitoring refers to any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in those characteristics. For the purposes of SWAMP, ambient monitoring refers to these activities as they relate to the characteristics of water quality.

Unfortunately, only a small portion of SWAMP can be implemented in the IRWM Region at its current funding level. As a result, SWAMP resources are focused where monitoring information is most needed to support their own regional program priorities, such as maintaining high quality waters in Lake Tahoe, or supporting the restoration of priority watersheds throughout California.

SWAMP is also intended to capture monitoring information collected under other State and Regional Board Programs such as the State's TMDL (Total Maximum Daily Load), Nonpoint

Source, and Watershed Project Support programs. Data from sites that are a part of the SWAMP can be obtained online at:

<http://www.waterboards.ca.gov/water_issues/programs/swamp/regionalreports.shtml#rb3>

K.4.8 Point and Non-Point Pollution Discharge

Point Source Discharge Pipeline

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

EPA conducts inspections of facilities subject to the regulations to determine compliance. EPA inspections involve:

- Reviewing discharge monitoring reports
- Interviewing facility personnel knowledgeable of the facility
- Inspecting the processes that generate and treat wastewater
- Sampling wastewater discharges to navigable waterways and other points in the generation or treatment process
- Reviewing how samples are collected and analyzed by the laboratory

Monitoring of the effects of non-point discharges becomes difficult due to the ambiguous nature of the source (e.g., automobile use, gas stations, air pollution, etc.) of offending pollutants. The goal in monitoring any water source over time is tracking changes in constituents of concern and correlating these changes with combined benefits of education and outreach on ways to reduce pollutants (e.g., use of fertilizers, pesticides, washing cars, etc.).

K.4.8.1 Techniques for Measurement

Monitoring protocols for point and non-point source discharges are similar to the *Drinking Water Quality and Ambient Monitoring Program* approach to regulated monitoring and reporting. Individual permitting of point source discharges sets the frequency of sampling and the monitored constituents of concern as described below. Non-point source monitoring activities typically share with other program monitoring and data.

Key permit conditions applicable to all NPDES permits or WDRs include those for monitoring. These conditions apply to both storm water and non-storm water discharges. Although the

State, local authority, or EPA's general permits can impose additional requirements, the permit holder must typically monitor discharges within the following parameters:

- Flow
- Pollutants listed in the terms of the permit conditions
- Pollutants that could have a significant impact on the quality of the receiving streams
- Pollutants specified as subject to monitoring by EPA regulations
- Other pollutants for which the EPA requests monitoring in writing

Each of these monitoring parameters must be measured at the frequency specified in the NPDES permit, WDR, or at intervals sufficiently frequent to yield data that would characterize the nature of the discharge.

K.4.8.2 Participants

The Regional Board regulates point source discharge of wastewater to land and surface waters of the region so that the highest quality and beneficial uses of these waters are protected and enhanced. Regulation is by issuance of either Waste Discharge Requirements (WDRs) or National Pollutant Discharge Elimination System (NPDES) permits. Both WDRs and NPDES permits contain monitoring requirements to verify compliance with applicable conditions. These requirements vary according to those specific conditions.

All persons or agencies discharging (or proposing to discharge) pollutants from a point source into any waters of the State are required to apply for and have a permit under the NPDES program and/or WDRs (issued by the Regional Board) to discharge. Typically publicly owned treatment works are regulated through NPDES permits and/or WDRs to monitor water quality for all points of water discharge. Examples of cities and agencies that are currently operating wastewater collection, treatment, and disposal systems under a NPDES permit include:

- City of Paso Robles
- City of Atascadero
- Atascadero State Hospital
- Templeton CSD
- San Miguel CSD
- South San Luis Obispo County Sanitation District
- City of Pismo Beach

Automated Monitoring in Estuary

K.4.9 Estuaries and Wetlands

Current monitoring in estuaries and wetlands is summarized below. Note that there is significant estuarine monitoring that

is conducted by other federal agencies, State and local agencies, and the academic community that may not be discussed here.

K.4.9.1 Techniques for Measurement

Environmental monitoring requires sampling techniques in conductivity (and salinity), temperature, dissolved oxygen, oxygen saturation, fluorescence (a proxy for chlorophyll-a), turbidity, nitrate, current/current profile, and depth of water. Standard practices are used in both manual and automated sampling equipment. More information on the sites maintained by SLOSEA can be found here: <http://www.slosea.org>

K.4.9.2 Participants

The San Luis Obispo Science and Ecosystem Alliance (SLOSEA) monitors water quality in the Morro Bay Estuary at the following sites and hopes to map spatial and temporal changes in the physical and chemical characteristics of water quality in the Morro Bay ecosystem.

The US EPA's National Coastal Assessment surveys the condition of the Nation's coastal resources by creating an integrated, comprehensive monitoring program among the coastal states.

To answer broad-scale questions on environmental conditions, the Environmental Monitoring and Assessment Program (EMAP) and its partners have collected estuarine and coastal data from thousands of stations along the coasts of the continental United States. EMAP's National Coastal Assessment comprises all the estuarine and coastal sampling done by EMAP beginning in 1990. This includes the sampling done in the biogeographic provinces as well as data from the Regional EMAP (REMAP) studies done by EPA Regional Offices. Locally there are five stations in the region several of which are off-shore, coastal sampling sites. This data can be retrieved and stations mapped online at: <http://oaspub.epa.gov/coastal/coast.search>

K.4.10 Coastal Beaches

Beach Notification

The Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000 requires that coastal and Great Lakes states and territories report to United States Environmental Protection Agency (US EPA) on beach monitoring and notification data for their coast recreation waters. The BEACH Act defines coastal recreation waters as the Great Lakes and coastal waters (including coastal estuaries) that states, territories, and authorized tribes officially recognize or designate for swimming, bathing, surfing, or similar activities in the water.

The BEACH Program focuses on the following five areas to meet the goals of improving public health and environmental protection for beach goers and providing the public with information about the quality of their beach water:

- Strengthening beach standards and testing
- Providing faster laboratory test methods
- Predicting pollution
- Investing in health and methods research
- Informing the public

K.4.10.1 Techniques for Measurement

Monitoring includes ocean water samples collected from the County's most visited beaches on a weekly basis. Shoreline samples are analyzed for bacterial indicators.

Locally, the County's Environmental Health Services Division conducts the public health beach monitoring and regulatory program. In 2010, nineteen (19) locations were analyzed for three indicator bacteria: enterococcus, total coliform, and fecal coliform. Beaches monitored included:

- Pismo State Beach, Oceano
- Pismo Beach
- Shell Beach
- Avila Beach
- Olde Port Beach
- Hazard Canyon
- Morro Bay City Beach
- Cayucos Beach
- Pico Avenue, San Simeon

K.4.10.2 Participants

The County's Environmental Health Services Division monitors beach water quality for recreational use through a California State grant between April 1 and October 31 of each year.

K.4.11 Marine Observations

National Weather Service (NWS) forecasters need frequent, high-quality marine observations to examine conditions for forecast preparation and to verify their forecasts after they are produced. Other users rely on the observations and forecasts for commercial and recreational activities.

K.4.11.1 Techniques for Measurement

National Data Buoy Center (NDBC) provides hourly observations from a network of about 90 buoys and 60 Coastal Marine Automated Network (C-MAN) stations to help meet these needs. All stations measure wind speed, direction, and gust; barometric pressure; and air temperature. In addition, all buoy stations, and some C-MAN stations, measure sea surface temperature and wave height and period. Conductivity and water current are also measured at selected stations.

K.4.11.2 Participants

The National Oceanic and Atmospheric Administration (NOAA) National Data Buoy Center (NDBC), a part of the National Weather Service, designs, develops, operates, and maintains a network of data collecting buoys and coastal stations.

The major marine observing systems that form the US national marine observations backbone are:

- NOAA's National Weather Service's NDBC Ocean Observing System (NWS NOOS)
- NOAA's National Ocean Service's (NOS) National Water Level Observation Network (NWLON) and their Physical Oceanographic Real-Time System (PORTS)
- NOAA's Tropical Moored Buoy (TMB) projects
- NOAA's OAR drifting buoy programs

There are only a few stations in the region. More information on stations that are a part of the National Data Buoy Center can be found at: <http://www.ndbc.noaa.gov>

K.4.12 Groundwater Quality

USGS Groundwater Quality Sampling

Groundwater is often sampled to determine the chemistry of the groundwater for purposes of utilizing the water for human consumption. Public water supply systems are subject to regulation by the California Department of Public Health, which specifies minimum guidelines for sampling frequency and sampling procedures that must be followed by any water system operator. Additional sampling of groundwater takes place as part of groundwater management reporting and Basin Management Objective implementation (see *Groundwater Management Efforts* data need). Basin management activities often focus on areas of natural or manmade contamination and methods to reduce the threat of the contamination from migrating into drinking or irrigation supply wells.

K.4.12.1 Techniques for Measurement

Analytical parameters vary, but can include physical measures (e.g., pH and temperature) nutrients, major inorganics (e.g., chloride, potassium, and sulfate), and minor inorganics (e.g., boron and manganese).

K.4.12.2 Participants

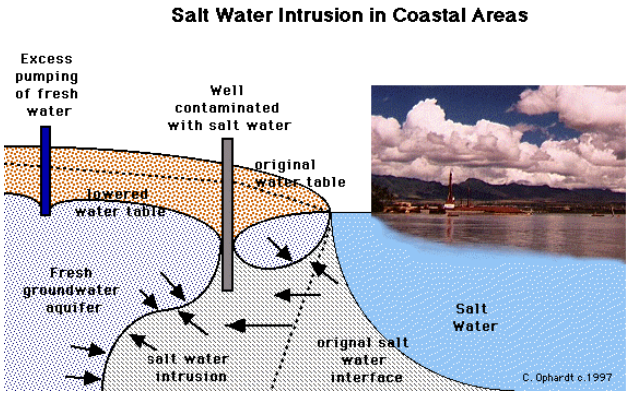
The USGS has conducted water quality sampling at more than 150 sites in the County since the 1920s. The USGS also conducts research and special studies to further the development of scientific knowledge and its application to real world management problems.

The Regional Board regulates discharges of wastewater to groundwater (e.g., direct injection or recharge ponds using recycled water) so that the highest quality and beneficial uses of these waters are protected and enhanced. Regulation is by issuance of either Waste Discharge Requirements (WDR) or a NPDES permit. WDRs contain monitoring requirements to verify compliance with applicable conditions. These requirements vary according to those specific conditions.

WDR permit requirements often include groundwater monitoring. For example, the Regional Board has established monitoring programs for recycled water and wastewater operations that discharge to groundwater. Dischargers must periodically collect and analyze groundwater quality samples from wells representative of the receiving groundwater. For a list of adopted orders, permits, resolutions, and settlements issued by the Central Coast Regional Water Quality Control Board, go to:

<http://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/>

K.4.13 Sea Water Intrusion



Management areas and communities along the coast monitor for seawater intrusion. For example, the Northern Cities Management Area (NCMA) conducts quarterly monitoring of four coastal "sentry wells" along with an Oceano observation well. Each well location includes a "cluster" of individual well completions at various depths. Quarterly monitoring includes level measurement, as well as sampling and analysis for water quality. The monitoring results are presented in the NCMA Annual Report, which is filed with

the Court. The coastal sentry wells monitored by the NCMA were renovated in 2010 to raise the surface completions above grade and secure them within locking enclosures. In early 2011, the NCMA agencies installed combination pressure transducers and conductivity probes in four of the sentry wells: 32S/12E-24B1; 32S/12E-24B2; 32S/13E-30F03; and 32S/13E-30N02. These probes allow the NCMA agencies to observe short duration variations in groundwater levels and quality to better characterize short- and long-term trends as they relate to variables such as tidal variation, precipitation patterns, and urban pumping.

K.4.14 Groundwater Management Efforts

Various groundwater management efforts in the County also include groundwater elevation and quality sampling. These include efforts where:

1. Basins under adjudication are required to monitor and report annually and/or develop Groundwater Management Plans
2. A Groundwater Management Plan is voluntarily being developed
3. An entity is implementing a project with monitoring requirements
4. Individual entities or groups are developing Salt and Nutrient Management Plans in accordance with the State Water Board's Basin Plan
5. Seawater intrusion is of concern to agencies that rely on coastal groundwater basins for their water supply

6. Individual property owners check the quality of their drinking and/or irrigation water supply

The availability of the information varies with each effort, making it challenging to fully understand the condition of all groundwater basins. Sharing of this data with governmental agencies or regional groups conducting groundwater basin studies and, when appropriate, the public at-large is encouraged and promoted.

K.4.15 Land Use and Population Changes

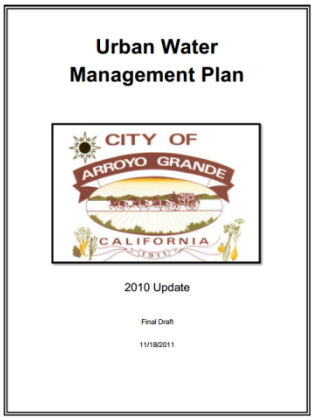
Land use monitoring refers to the deliberate action of collecting data on land use over time as part of an overall effort to understand the region and what changes might be affecting managed water resources. Local jurisdiction Planning departments, the State Department of Finance, and the San Luis Obispo Council of Governments all harvest and create land use and population data for use in making land use policy decisions.

Population data generally comes from U.S. Census data, using historical data to understand past trends in population providing insight into extrapolating population growth (or decline) in the future. Population data in WSMPs and UWMPs has become important in the calculation of

water use per capita (or person). Water conservation goals are State mandated (SBX7-7) using the per capita water use methodology.

K.4.16 Urban Water Demands

Urban land uses refer to the unincorporated communities and incorporated cities in the County, and include residential, commercial, industrial, parks, institutions, and golf courses.



Primary sources of water demand data for urban centers came from water system master plans (WSMP) and urban water management plans (UWMP) prepared by water purveyors, incorporated cities, and unincorporated communities. Additionally, the County's Annual Resource Summary Report 2008 (ARS) provides projected water demand and population data for these areas.

Since existing water demands and future water demand projections are based on information from WSMPs and UWMPs, land use information is not used to calculate water demand. Urban areas (or small water suppliers) where neither document is available are contacted and demand estimates are made through direct communication.

K.4.17 Data Enhancement Plan (DEP)

The DEP was a regional water monitoring program designed to provide data for planning, design, and operational purposes, yet it was also designed to be flexible and to change over time. This is not necessarily contradictory. Rather, it implies that regional water monitoring program data will be frequently interpreted to identify monitoring sites that might be dropped from the network or sampled less frequently, as well as identifying spatial gaps or the need for more frequent data collection. The design also recognizes that there will continue to be improvements in instrumentation that will allow for more in-situ monitoring and the collection of more data by remote sensing. New technologies will be incorporated into the regional water monitoring program when they are ready for operational deployment.

K.5 Quality Assurance/Quality Control Measures

Quality Assurance/Quality Control Measures (QA/QC) in completing tasks related to data management follow the trail of data as it is collected in the field, uploaded to electronic data files, and stored for historical long-term access and interpretation (See **Figure K-4)**.

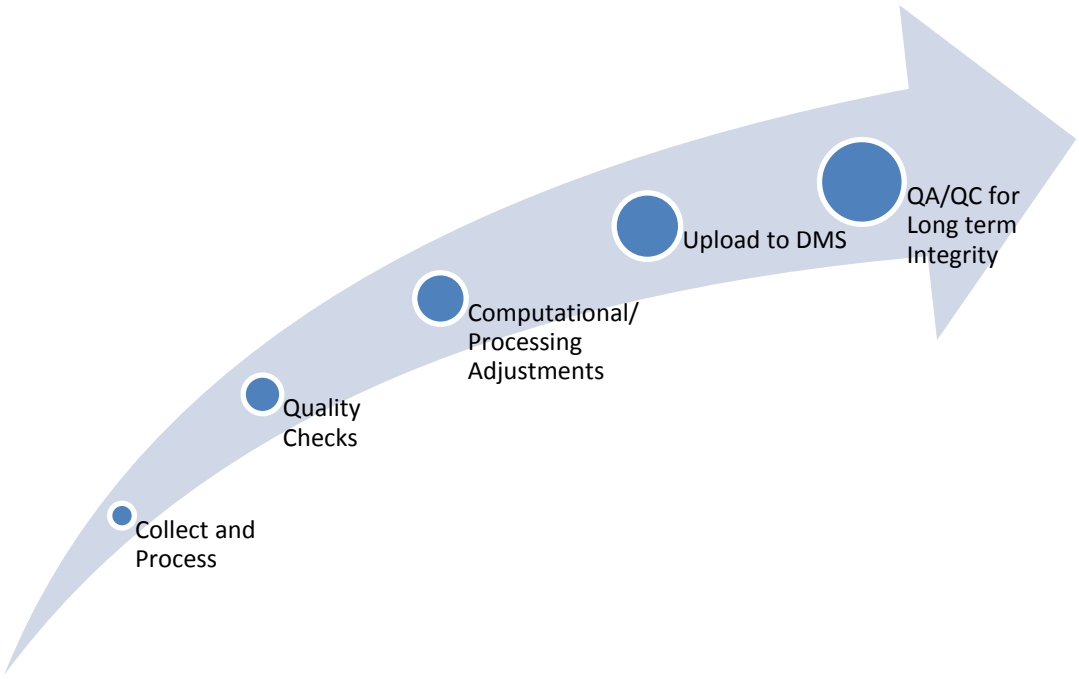


Figure K-4. Data Collection Process Leading to QA/QC Storage

K.5.1 Assessment of Existing DMS

The QA/QC measures implemented at the step where regional data is deposited for long-term storage and accessibility ensures the integrity of the data over time. So often, data becomes contaminated due improper data management practices or inexperience of DMS operators. To improve the existing DMS practices and operations, the District requested a review of the existing data collection program by the consulting firm URS in June 2009, *Technical Memorandum Water Resources Data Management System Update Recommendations (TM).* This review of the San Luis Obispo Water Resources Data Management System (SLO-DMS) describes the pros and cons of the SLO-DMS and a recommended set of steps to improve the SLO-DMS for purposes of maintaining the long-term integrity of stored data.

Specific points concerning the SLO-DMS are identified as follows:

1. The system is the result of 100+ years of data collection, with most of the hand written data converted over to electronic files
2. The long history of the SLO-DMS has created an organic construction of the system with much of the data structure not integrated into larger, more secure and more manageable sizes
3. The data in the SLO-DMS is highly fragmented making it difficult for staff to know where the data is located and how to manage the data

4. The data is stored as a series of electronic files with differing formats and a multitude of processing methods, leading to gross inconsistencies in similar data categories
5. The fragmentation of the data leads to extended time and effort to manage the data, support data requests and ensure long-term data integrity

In addressing these points, the District identified several primary objectives for URS to consider in the recommended solutions. These were to:

- Streamline the data entry and retrieval system
- Better manage existing data
- Standardize data collection and processing procedures
- Assess the range and completeness of existing datasets
- Report water resources information in a timely and appropriate manner

To accomplish these tasks, the District identified the following elements that should be addressed in the proposed recommendations to improve the SLO-DMS:

- Means to consolidate historic and current water resources data
- Methods to streamline data entry, retrieval, and reporting
- Methods or a framework to certify water resources data (QA/QC checks)
- Flexibility of proposed data management system to accommodate future data formats and types
- Future integration with GIS-based applications

K.6 Regional Water Management–DMS Overview

This section provides a brief overview of the RWM-DMS and built-in tools used to complete updates to the IRWM Plan. The database is currently populated with all relevant data needed to fully describe the IRWM Region within the context of the IRWM planning guidelines. The inherit nature of drilling down to information starting from the IRWM Region, Sub-Region, Water Planning Area, and Watershed is conducive to database design of providing data at the highest resolution and rolling up the data into summary reports unless the detail is needed.

The RWM-DMS is designed around the sections of the IRWM Region Description and Water Supply, Demand, and Water Budget, allowing for updates of the section with each update of the IRWM Plan or other regional water studies (e.g., Master Water Report). As a reporting tool, the interface accepts and outputs data in various formats to adhere to consistent reporting of data over time. The current level of populated data is considered to be sufficient to move forward assuming maintenance of descriptive data and updates in time sensitive numerical values as the two primary responsibilities.

The interface shown in **Figure K-6** is structured to allow for drilling down into each of the geographic and political entities. The tabs along the top are structured from left to right to allow the user to follow the hierarchy of choices shown in **Figure K-5**.

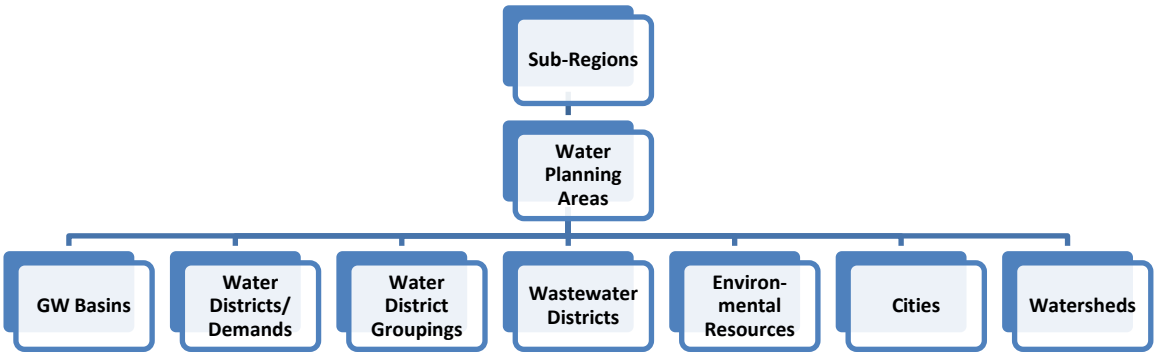


Figure K-5. Regional Water Management – DMS Hierarchy

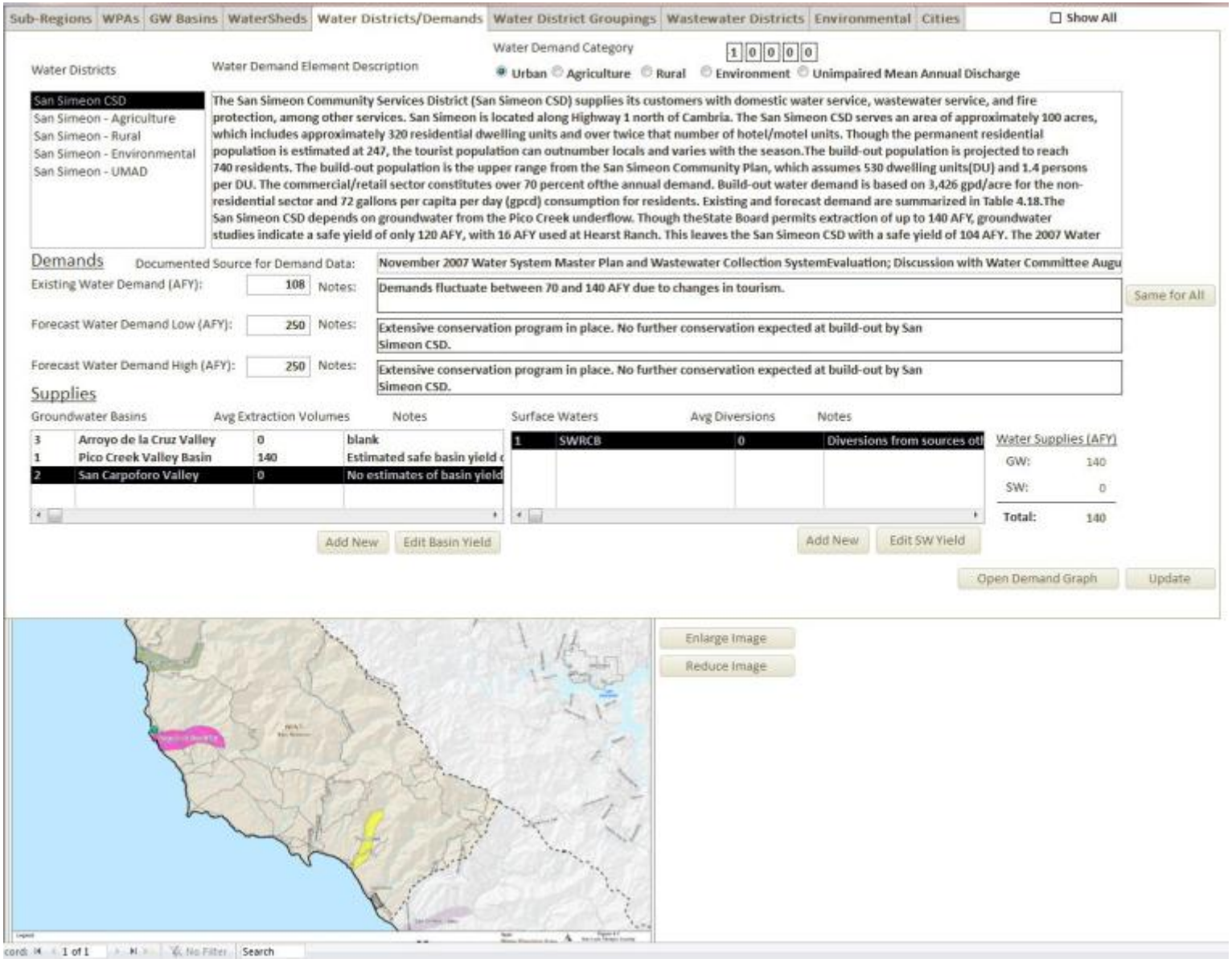


Figure K-6. Regional Water Management - DMS

Various approaches to maintaining[3] the data include the District updating the data directly or passing the database off to representative stakeholders for each Sub-Region and request that all data be updated annually or biennially. Portability and ease-of-use of the database is essential to both methods. The updated database can be emailed to the District and can easily be aggregated for all three Sub-Regions for purposes of reporting. The tabular reports in **Section D – Water Supply, Demand, and Water Budget** are generated through this tool, with one example report illustrated in **Figure K-7**.

WPA No. 9 - Cuyama Valley

	Water Districts/Use Sectors/Environmental/Unimpaired Summary	Cuyama Valley - Agriculture		Cuyama Valley - Rural		Environmental & UMAD		Total	
Urban/Ag/ Rural		Demand (AFY)	*Notes*	Demand (AFY)	*Notes*	Demand (AFY)	*Notes*	Demand (AFY)	*Notes*
Water Demands	**Existing Demands**	30,714		10				30,724	
	Forecasted Demands (2035)	**28,823**		**180**		**0**		**29,003**	
Water Supply Source	**Groundwater**	**GW Supply (AFY)**		**GW Supply (AFY)**		**GW Supply (AFY)**		**GW Supply (AFY)**	
	Cuyama Valley	9,800	***1***	61	***1***			9,861	
	Other GW Supply Sources	19,023		119				19,142	
	Total GW	**28,823**		**180**		**0**		**29,003**	
	Surface Water	**SW Supply (AFY)**		**SW Supply (AFY)**		**SW Supply (AFY)**		**SW Supply (AFY)**	
	SWRCB - WPA 9	0						0	
	Total SW	**0**		**0**		**0**		**0**	
	Total Supplies	**28,823**		**180**		**0**		**29,003**	
	Balance (Supplies - Demand)	**0**		**0**		**0**		**0**	
Environmental Water						0	***2***		
Unimpaired Mean Annual Inflow						0	***3***		

Notes:

1 There is no separate yield estimate for the San Luis Obispo County portion of the basin.

2 Not Available

3 The eastern portion of the County (i.e., WPAs 9, 10, 11, 14, and 15) was ultimately excluded from the environmental water demand analysis due to the lack of data and regional physiographic differences.

Figure K-7. Illustration of Tabular Data Generated by the Regional Water Management - DMS

K.7 ANTICIPATED FEATURES OF A DATA MANAGEMENT SYSTEM

As part of the Updated 2013 IRWM Plan development, the need for a Regional Water Management DMS (RWM-DMS) in storing qualitative information regarding the IRWM region and projects became imperative. With regional descriptive information updated in the recent 2012 MWR, the intent of the content provided in the Updated Plan resulted in the refinement

[3] GEI Consultants, the developer, will not be maintaining the RWM-DMS beyond completion of IRWM Plan Update.

and merging of the MWR and IRWM Plan region descriptions. The RWM-DMS is also a tool to be used in the future to recreate the storyline with each subsequent update of the IRWM Plan.

Through the RWM-DMS, the advantages of having both a qualitative DMS and a quantitative San Luis Obispo DMS (SLO-DMS) outweighed the economies of a single DMS with the ability to do both jobs. The differences in the desired structural features and timeframe for implementation made it advantageous to push forward with the two system concept. The long list of structural features required of a DMS with today's technology has been trimmed down to the following list and short descriptions.

Database Platform

There are many choices of database platforms and tools to work with large data sets. The right database is often based on preference and level of support over time. The measure of a system's robustness is often made based on the database platform used. The platforms can be simple, such as using MS Excel, or very complex, such as Oracle. In between, there are many other platforms with various strengths and weaknesses. **Table K-3** provides a summary of the well-known database platforms in use for the type of data under consideration. The shaded attributes signify the strengths in areas indicated.

Table K-3. Strengths and Weaknesses of Common Database Platforms

Database Platform	Notes	Attributes								
		Portability and Cost	Minimum IT Support	Minimum Training	Provider Support	Scalable Over Time	Ease of Programming and Querying data	Reporting Tools	Web-Enabled	Compatibility with State Platforms
MS Excel	While convenient and requires little training, Excel has poor scalability making it difficult to expand with the data.	■	■	■	■					
MS Access	Portable with good support and average training, scalability is average.	■	■	■	■	■	■	■		
MS SQL Server Light	Portable and scalable, however not supported or popular for large secure datasets.	■	■			■	■			
MS SQL Server	Well supported and popular, but requires training and IT resources.				■	■		■	■	■
Oracle	Very robust, web-enabled, but requires high level of training, mandatory IT resources, and long-term support.					■			■	■

Upload/Download Methods

The upload/download method describes how the stakeholder will communicate with the system. Ease and speed of uploading or downloading data creates improved participation in

the data management program and minimizes criticism leading to continuously changing systems or platforms.

Change/Edit Log

Secure data systems often require the need to track changes made by the various users as a means of understanding the frequency of use or misuse of the system, the quality of data, and debugging interface and attending to user support issues.

Data Privacy

Secure data systems also feature privacy provisions to limit the access and visibility to some or all data to other users. A privacy management feature is used to profile the users and their level of access to the data.

Data Accessibility

Accessibility of the data is a measure of acceptance by the public audience for which the data is intended. Accessing data over the internet is a standard feature of any data management program built today. The deciding factor is whether the data is live or fixed (snapshot). Some users want to see up-to-the-minute monitoring data as it becomes available, making the need for data accessibility high relative to simply providing a spreadsheet or pdf file of a report.

Reports

Reporting comes standard with most platforms and third party software is often available to further improve reporting capabilities. As a critical interface piece with the intended users (i.e., State and federal regulatory agencies), a comprehensive well thought out set of standardized reports are often a measure of the data system's level of compliance.

System Backups

Automated system recovery and back-up features are necessary to ensure the data is not lost with a manmade or natural disaster affecting the integrity of the database or the servers upon which the database is stored. This requires IT resources in providing the needed hardware and software to have full system recovery activities taking place in the background on a continuous basis.

K.7.1 Preferred Features in Selected DMS

Each of the structural features described above have been screened for the preferred option while moving forward with having two systems, the RWM-DMS and SLO-DMS. The two unique

feature profiles recognize that advances and changes in technology will occur over time; especially since the timeframe for full implementation of both systems is not set.

RWM-DMS System Features

The RWM-DMS will initially serve as the dataset to updating and describing the region for purposes of tracking and reporting changes. Ultimately, the RWM-DMS will be used for monitoring IRWM and project implementation and reporting at the Water Planning Area and Sub-Region level. The current dataset properties include:

- Water districts
- Cities/communities
- Watershed descriptions
- Water supplies
- Groundwater basins
- Water demands
- Environmental resources
- Project tracking and ranking
- IRWM implementation monitoring

Foreseen use of the RWM-DMS is limited to water resources planners and IRWM implementation functions. As described in **Table K-4**, the system can be smaller in scale and more reliant on built-in data management and reporting tools. The qualitative nature of the RWM-DMS makes the need for GIS compatibility unnecessary, with large text and image files likely being the bulk of stored data along with numerical data for characterizing the region. The ability to store and view images and a user-friendly graphical interface are to be developed over time as needed to improve usability and to reduce needed training.

Table K-4. RWM-DMS Structural Profile

Structural Feature	Selection Criteria
Database Platform	MS Access selected for its portability, level of MS support and backward compatibility.
Upload/Download Methods	Data entry to be done through a VBA interface, use of a spreadsheet for large table-level changes, and use of copy and paste from Word to database.
Change/Edit Log	No log is needed.
Data Privacy	Database not to be publically available and no confidential data is anticipated.
Data Accessibility	Data accessible to IRWM development and implementation staff through direct access to the database.
Reports	Reporting for purposes of updating the IRWM Plan and creating project reports through MS Access tools
System Backups	System back-ups anticipated through current IT protocols of managing network drives.

SLO-DMS System Features

Foreseen use of the SLO-DMS is to provide the maximum amount of numerical information and interpretation staying within privacy and confidentiality constraints of the stakeholders. A GIS

interface is recommended as the primary method of accessing data along with MS Excel and text file upload and download features. Full security and back up features are a requirement along with IT resources in the day-to-day and long-term use of the system. Consideration is continuously given to advances in hardware and software and specialized training in their use.

K.7.2 Stakeholder Support and Ease of Use

The DMS needs of the region will eventually transition to a GIS web-enabled tool for secure use in collecting, sharing and storing all numerical data from monitoring sources in the SLO region. The intent would be for a map-based visualization tool to show many regional attributes at one time, include monitoring locations, images, information about the monitoring location and measuring device, monitoring data, contouring for groundwater elevation and water quality, stream flow hydrographs and historical flooding problem areas, and areas of groundwater contamination or salinity intrusion.

This future DMS effort would allow for multiple layers of stakeholder-provided information to be incorporated into shared database layers where data can be aligned with demographic information, city/county/district boundaries, and topographic and geologic features. The database would also store georeferenced reports, images, texts, plans, and other documents that can be easily retrieved. The DMS could be developed to allow secure access by stakeholders and the public through the web.

This transition is dependent upon the availability of funding and resources to develop such a tool. If accepted by the RWMG, the existing SLO-DMS would need to be populated with historic data, monitoring site locations and supporting information. The SLO-DMS would also require data maintenance and website hosting for stakeholder and public access, and uploads to state and federal databases (See **Section K.3 Description of Data Needs**).

K.8 Other Potential Future GIS/DMS Needs and Initial DMS Development

K.8.1 MS4[4] Permit/Order and TMDL DMS Needs

[4] A MS4 is a conveyance or system of conveyances that is: 1) owned by a State, city, town, village, or other public entity that discharges to waters of the United States; 2) designed or used to collect or convey storm water (including storm drains, pipes, ditches, etc.); 3) not a combined sewer; and 4) not part of a Publicly Owned Treatment Works or sewage treatment plant.

The MS4 and TMDL permits will require an individual permittee to develop an Integrated Monitoring Program (IMP) or to participate with other permittees in a Coordinated Integrated Monitoring Program (CIMP). Either approach will have extensive data collection, management and reporting. MS4 Permit/Order notes the benefits of the CIMP approach, noting that "the CIMP provides Permittees opportunities to increase the cost efficiency and effectiveness of the monitoring program" and that "the greatest efficiency may be achieved when a CIMP is designed and implemented on a watershed basis".

The IRWM region could reduce the overall monitoring and data management program costs to individual members through the CIMP to achieve economies of scale and management efficiencies. A CIMP will require a shared approach to sampling, laboratory analysis, data management and compliance reporting. The SLO-DMS could be expanded to include functionalities needed to support the CIMP, including:

- Allowing users to submit laboratory testing and monitoring results to a central data base that supports:
  - Quality control and assurance measures
  - Management of water quality time series data
  - Preparation of required compliance reports
- Submitting of the required data to the State (SWAMP/RWQCB)
- Tracking of projects that implement best management practices
- Management of reports and special studies to share and distribute results

K.8.1.1 Quality Control and Assurance Measures

MS4 permittees are required to develop a Monitoring and Reporting Plan (MRP) and Quality Assurance Project Plan (QAPP) for Regional Water Board Executive Officer approval. The IRWM Region could jointly develop the monitoring plan, establish locations and develop both the MRP and QAPP for the IRWM Region. The QAPP will include protocols for sample collection, standard analytical procedures, and laboratory certification. All samples will be collected in accordance with applicable Surface Water Ambient Monitoring Program (SWAMP) protocols.

K.8.1.2 Management of Water Quality Time Series Data

Large amounts of monitoring data will be generated by an IMP or CIMP and a DMS would need to effectively manage the sampling, QA/QC, monitoring, and reporting program. A GIS element to the DMS and the monitoring and reporting plan would help document the results and explain the problem and solutions to the public. The IRWM Region will need to make decisions regarding how to develop and apply a GIS/DMS to meet the requirements.

K.8.1.3 Preparation Compliance Report

The MS4 Permit/Order spells out the reporting requirements, including how the TMDL reporting could be integrated. The IRWM Region will need to develop a system to support reporting to the RWQCB.

K.8.1.4 Submitting of the Required Data to the State

Any tools developed to support the IRWM Region monitoring should include a functional requirement to support submittal to the State's regional data center as well as the required reports to the RWQCB.

K.8.2 Project Submittal System

For IRWM Plan updates and future rounds of grant funding, the IRWM Region could develop additional functionality in the web enabled SLO-DMS tool to:

- Allow project sponsors to submit and update their project information online
- Promote transparency and let other IRWM Region stakeholders view the project information and seek opportunities of integration or teaming
- Provide a map of proposed projects, also documenting the status of the project
- Allow for upload of supporting projects documentation
- Manage the IRWMP and project performance monitoring during implementation

K.8.3 Public Comments on Acceptance of a Single GIS/DMS

With the above concept of a single all-encompassing data management platform, public acceptance is a necessary requirement. Using the IRWM Plan public workshops as an audience for feedback on the current data management systems and the proposal of a single DMS, several comprehensive responses provided valuable feedback for consideration in moving forward. The questions posed to the audience in the form of a handout to be filled out by interested stakeholder, are as follows:

Question 1 – DATA NEEDS:

Regardless of data currently being monitored and managed, please list all of the data management and monitoring needs you see in your Sub-Region.

The purpose of this question is to find out from local residents and interest groups:

1. Where problems may exist and where monitoring activities are warranted for measuring change over time
2. How a given monitoring program is described, and, if implemented to its full extent, can improve the understanding and knowledge of the water-related resource

Question 2 – EXISTING MONITORING AND DATA MANAGEMENT PROGRAMS:

In the table below, please list existing monitoring and data management programs you are familiar with. Also provide what the collected data is used for/its purpose. Please identify the location of each program on the attached maps of your Sub-Region, and fill in as much of the table as you can.

The purpose of this question is to:

1. Correctly identify existing monitoring programs
2. Create a list of who is using data collected and why
3. Provide a list of who is currently managing the data
4. List the current funding sources for on-going monitoring programs (if known)

Question 3 – POTENTIAL WAYS TO MANAGE DATA:

How would you like to see your Sub-Region's data being managed?

The purpose of this question is to understand the preferences between having data management under a single IRWM Region entity/single data management system, for instance, or having data management under the entity actually doing the monitoring.

Question 4 – ACCESS TO DATA:

Why should managed data be, or not be, available via the internet, assuming security protocols are in place to limit access to confidential or proprietary data? What limitations do you see relative to online data management systems?

The purpose of this question is to find out the general acceptance of being able to download data from the internet, regardless of who is managing the data.

Question 5 – PRIORITY DATA AND REPORTING:

What types of data would be important to you if a reporting program was implemented for each Sub- Region. Please include elements of Climate Change or elements of the IRWM Plan Performance and Monitoring (i.e. ways that the region will monitor the IRWM Plan's implementation and achievement of benefits over time).

The purpose of this question is to gauge the IRWM Plan's reporting mechanisms based on the needs of the stakeholders over and above the minimum required by the State water code.

The cumulative response to these questions is included as **Appendix K-2 – Stakeholder Feedback on Regional DMS** of the IRWM Plan. Monitoring of groundwater and streamflow are identified as the highest priority activities for regional data collection and management. Also, in the case where there is an adjudicated groundwater basin, such as the Santa Maria Groundwater Basin, it is important to note that the monitoring of groundwater elevations is a Court requirement along with annual reporting. Permission by the Court to include the data in a public database (with QA/QC and security measures for confidential data), would be required, but is not seen as a fatal flaw in the proposed single DMS concept.

K.8.4 Proposed Implementation of the San Luis Obispo County Data Management System (SLO-DMS)

From the previous section, the purpose and needs of the initial SLO-DMS have been defined through regional stakeholder discussions, and has taken shape as a GIS web-enabled tool for secure use in collecting, sharing and storing all numerical data from all monitoring sources in the SLO region. The initial need is for a map-based visualization tool to show many regional attributes at one time, include monitoring locations, images, information about the monitoring location and measuring devices, monitoring data, contouring and bubble-plots for groundwater elevation and water quality measurements, stream flow hydrographs and historical flooding problem areas, and areas of groundwater contamination or salinity intrusion.

The initial SLO-DMS allows for multiple layers (See **Figure K-8** for example screenshot) of public domain and stakeholder provided information to be incorporated into shared database layers where data can be aligned with demographic information, city/county/district boundaries, and topographic and geologic features. The database can also store geo-referenced reports, images, texts, plans, and other documents that can be easily retrieved. The SLO-DMS is designed on a platform built for secure access by stakeholders and the public through the web.

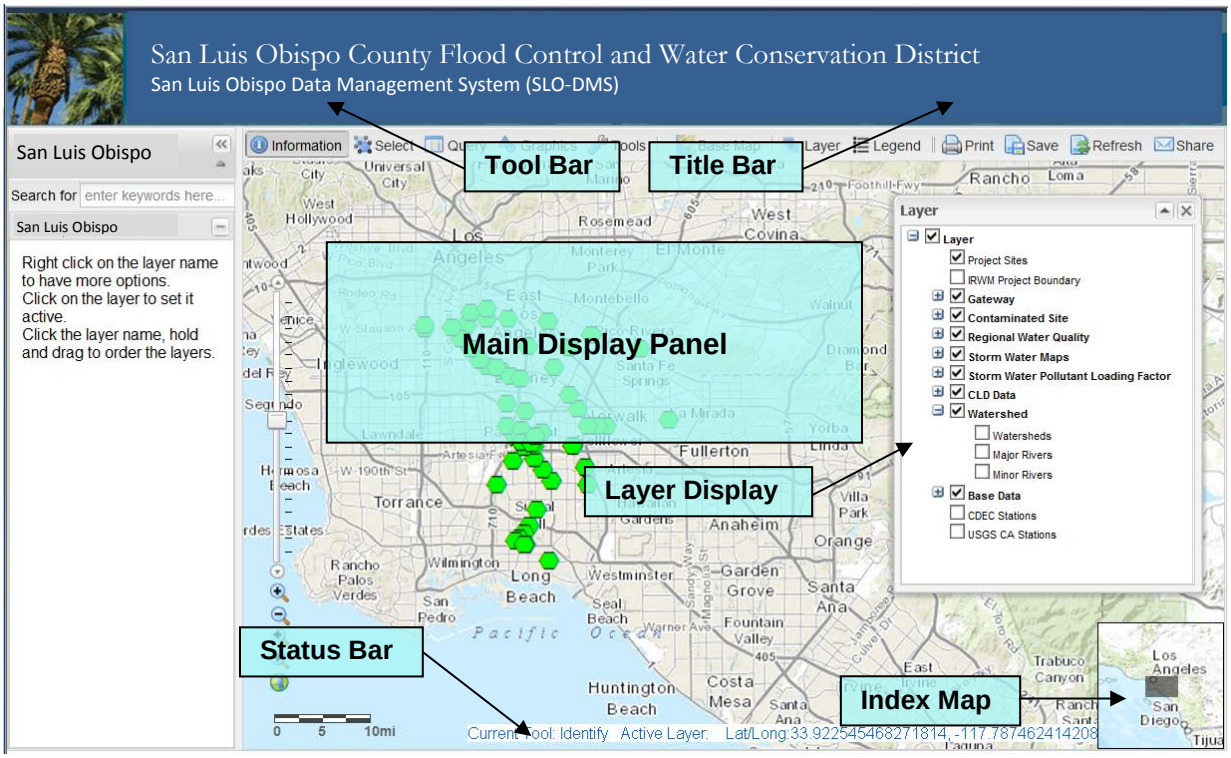


Figure K-8. SLO-DMS Interface and Map Layers (Example)

Accepted by the District for use as the region's DMS for monitoring data, the District will work to begin populating the SLO-DMS with historic data and monitoring site locations and any supporting information. The District will maintain the data and hosting of the website for stakeholder and public access; restricting confidential data based on permissions and agreements set for each type of user. Implementation is proposed to take approximately two-years with the estimated work plan shown in **Figure K-9** to bring the SLO-DMS online to internal stakeholders beginning in September 2015, scheduled uploading to state and federal databases in February 2016, and first available to the public by June 2016.

K.8.5 Formatting Data and Interacting with State and Federal Database Platforms

The initial SLO-DMS is built on a platform, and by a program developer,[5] which is familiar with state and federal database platforms described in **Section K.3**. The SLO-DMS platform and programing provides for interrogation by state database systems to download stored water quality data, or to allow the District DMS administrator to upload similar datasets (e.g., CASGEM data) deemed to be publically available. Based on **Figure K-9**, first uploading of data can possibly begin in February 2016.

[5] Dr. Donghai Wang, author, works closely with state agencies in relational database design and integration.

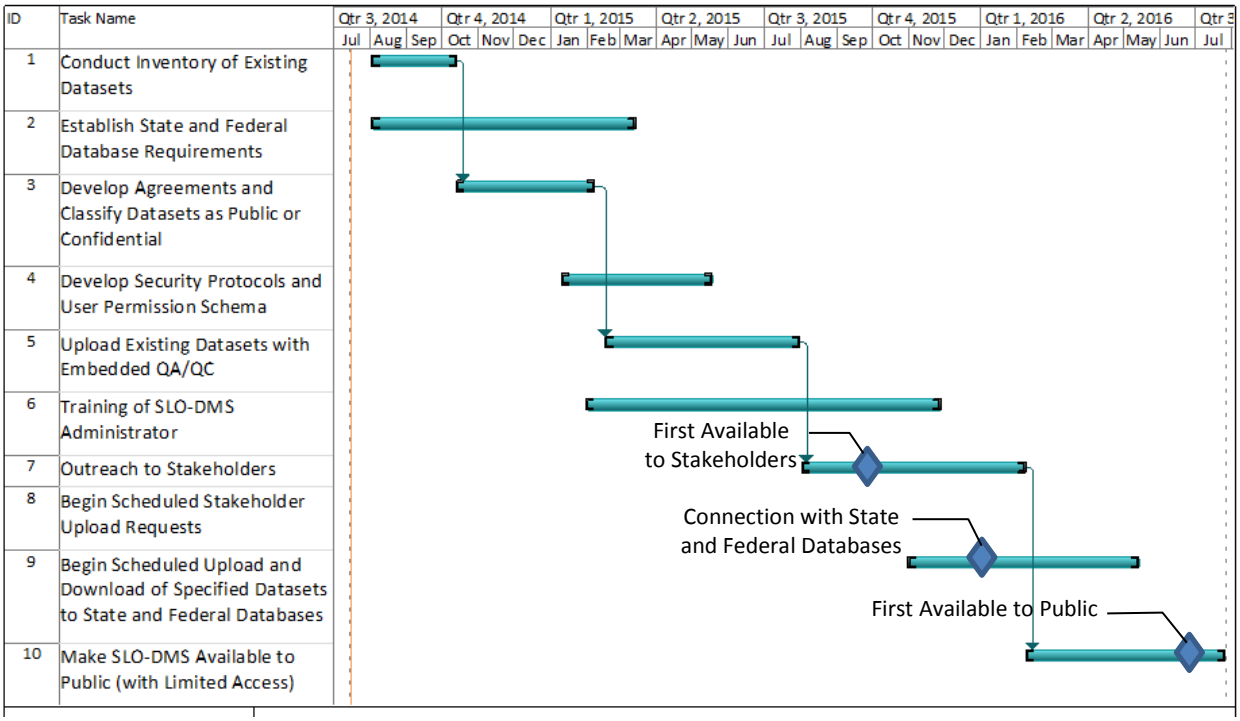


Figure K-9. Proposed Work Plan to Implement Initial SLO-DMS

San Luis Obispo Integrated Regional Water Management Plan