# California's Groundwater Update 2013

## A Compilation of Enhanced Content for California Water Plan Update 2013

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State of California
Natural Resources Agency
Department of Water Resources

FINDINGS, DATA GAPS, AND RECOMMENDATIONS

# Statewide Findings, Data Gaps, and Recommendations

The primary goal of *California's Groundwater Update 2013: A Compilation of Enhanced Content for California Water Plan Update 2013* (California's Groundwater Update 2013) is to provide foundational information to improve the statewide and regional understanding of groundwater conditions and management programs. The set of data, information, and analyses developed by the California Department of Water Resources (DWR) will help set the stage for future Bulletin 118 and California Water Plan updates, and help local and regional agencies plan for sustainable groundwater management by providing an on-going reporting of essential groundwater data, information, and analyses. A second goal is to identify data gaps and groundwater management challenges that are meant to serve as a guidepost for prioritizing future groundwater data collection and funding opportunities. The final goal is to develop a set of recommendations to improve groundwater management in California.

Findings, data gaps, and recommendations were developed for the state as a whole and for each of the 10 hydrologic regions. Statewide findings, data gaps, and recommendations presented herein serve as a summary of those commonly identified at the regional level.

## Statewide Groundwater Findings

The following provides a summary of the statewide findings based on data and analysis conducted for California's Groundwater Update 2013. The bulleted items listed are summaries of the more comprehensive information presented in Chapter 2, "Statewide Groundwater Update." In some cases, the compiled information expands upon the data and recommendations that were included in California Water Plan Update 2009; however, much of the groundwater information, including well infrastructure discussions, water supply analysis, change in groundwater storage estimates, and groundwater management plan reviews, are new to this update of the California Water Plan. The groundwater-specific data presented in this document will be used as the foundation for the next update to Bulletin 118, as well as for the California Water Plan, with the goal of generating information that can be used to make informed decisions for sustainably managing California's groundwater resources.

### Statewide Groundwater Supply and Development

- California contains 515 alluvial groundwater basins and subbasins underlying approximately 61,900 square miles (Figure 2-3), as recognized in DWR Bulletin 118-2003.
- The total number of wells completed in California between 1977 and 2010 is approximately 432,469 and ranges from a high of 108,346 wells for the Sacramento River Hydrologic Region to a low of 4,069 wells for the North Lahontan Hydrologic Region (Figure 2-4 and Table 2-1).
- Based on the June 2014 California Statewide Groundwater Elevation Monitoring (CASGEM) basin prioritization for California's 515 groundwater basins, 43 basins are identified as high priority, 84 basins as medium priority, 27 basins as low priority, and the remaining 361 basins as very low priority.
- The 127 basins designated as high or medium priority account for 96 percent of the average

annual statewide groundwater use and 88 percent of the 2010 population overlying the groundwater basin area (Figure 2-7 and Table 2-2).

## Statewide Groundwater Use and Aquifer Conditions

- The 2005-2010 average annual total water supply for California is estimated at 43 million acre-feet (maf). Statewide water demands are met through a combination of State Water Project and Central Valley Project surface water deliveries, local surface water diversions, reservoir storage, groundwater, and reused/recycled water supplies (Figure 2-8).
- Groundwater contributes an estimated 16.5 maf (38 percent) to California's 2005-2010 average annual total water supply (Figure 2-8 and Table 2-3).
- Groundwater supplies in California, based on average annual estimates for 2005-2010, contribute 39 percent of the supply to meet the state's total agricultural water uses, 41 percent of the supply to meet the total urban water uses, and approximately 18 percent of the supply to meet the total managed wetlands uses (Table 2-3).
- Of the 2005-2010 average annual groundwater extraction in California, approximately 76 percent of the supply met agricultural uses, 22 percent met urban uses, and 2 percent met managed wetlands uses (Table 2-4).
- Between 2002 and 2010, annual groundwater extraction throughout California ranged between a low of 12.0 maf (in 2005) and a high of 20.1 maf (in 2009) and contributed between 30 percent and 46 percent toward California's annual water supply (Figure 2-9).
- Of the groundwater pumped on an annual basis from 2002 to 2010, between 69 percent and 80 percent of the groundwater was used to meet agricultural uses, while 19 percent to 29 percent of the total groundwater extraction was used to meet urban uses (Figure 2-10).
- Depth-to-groundwater contours were developed for the unconfined aquifer system in the Central Valley. In the Sacramento Valley, the spring 2010 groundwater depths range from less than 10 feet below ground surface (bgs) to approximately 50 feet bgs, with local areas showing maximum depths of as much as 160 feet bgs. In the San Joaquin Valley, depths to groundwater were more variable, with groundwater levels at their shallowest adjacent to the San Joaquin River and its tributaries (20 to 60 feet bgs) and at their deepest in areas with high groundwater dependency (up to 600 feet bgs) (Figure 2-13).
- A geographic information systems (GIS) tool was developed by DWR to estimate the change in groundwater in storage throughout California's Central Valley by using groundwater elevation data collected from monitoring wells. Between spring 2005 and spring 2010, the water table in the Central Valley lowered an average of 9.0 feet, which represents a total decline of groundwater in storage between 5.4 maf and 13.1 maf (Figures 2-16 and 2-17, and Table 2-6).

## Statewide Groundwater Monitoring Efforts

- A total of 10,834 wells are actively monitored for groundwater level information in California as of July 2012 (Figure 2-11 and Figure 2-12).
- There are an estimated 2,584 community water systems (CWSs) in California with an estimated 8,396 active CWS wells; 1,659 of the active CWS wells (20 percent), used by 680 CWSs, are contaminated by a principal chemical contaminant that exceeds a maximum contaminant level (MCL).
- The most prevalent groundwater contaminants affecting California's community drinking water wells are arsenic, nitrate, gross alpha activity, and perchlorate (Figure 2-18 and Table 2-7).

- Groundwater basin overdraft resulting from unsustainable groundwater pumping is the major cause of land subsidence in California. Land subsidence has been documented in the San Joaquin Valley (which includes both the San Joaquin River and Tulare Lake hydrologic regions), the Santa Clara Valley, Antelope Valley, and in some coastal and southern basins in California (Appendix F).

### Statewide Groundwater Management and Conjunctive Water Management

- There are 119 groundwater management plans (GWMPs) in California that collectively cover approximately 20 percent of the state and 42 percent of the Bulletin 118-2003 alluvial basin area (Figure 2-19).
- DWR's assessment of statewide GWMPs determined that 82 GWMPs have been developed or updated to include the 2002 legislative requirements of Senate Bill (SB) 1938, and are considered "active" for the purposes of the GWMP assessment.
- Only 35 of the 82 active GWMPs, or 17 percent of California's alluvial basin area, address all of the required components identified in California Water Code Section 10753.7 (Figure 2-19, Figure 2-21, and Table 2-9).
- There are 24 groundwater adjudications in California as of 2013 (Figure 2-22 and Table 2-15).
- A statewide survey conducted by DWR and the Association of California Water Agencies (ACWA) determined that there were 89 agencies or programs operating a conjunctive management or groundwater recharge project in California. The effort to fully characterize California's conjunctive management programs was limited because numerous agencies were reluctant to make details about their groundwater recharge operations publicly available (Figure 2-24 and Appendix D).

## Statewide Data Gaps

Gaps in statewide groundwater information are organized according to the following three themes:

- Data collection and analysis.
- Basin assessments.
- Sustainable management.

Data gaps are meant to serve as a guidepost to focus and prioritize future monitoring, data collection, and financing efforts. Addressing these data gaps at both the local level and State agency level will help ensure that groundwater resources throughout California are better characterized and sustainably managed.

### Data Collection and Analysis

Although the general characterization of alluvial aquifers in California is satisfactory from a regional standpoint, locally there is a need to further improve the characterization of many of the state's aquifers. More complete hydrogeological data is necessary to better understand basin-wide and region-wide groundwater levels, groundwater quality, groundwater use, the interaction between surface water and groundwater, and to develop meaningful water budgets at a the groundwater basin scale.

Information related to groundwater extraction, groundwater use, managed and natural recharge, and basin-wide water budgets throughout California is limited. Much of the related information presented in

this report has been estimated primarily through water supply balance and land use information derived from DWR's land use surveys. Little or no information is known about California's fractured bedrock aquifers and how they interact with regional alluvial aquifer systems.

Some local water agencies in California are collecting appropriate groundwater data, conducting necessary analyses, and are sustainably managing their basins using the authorities they have under the law. However, locally collected and analyzed data, which could be used by regional water management groups and State agencies to better characterize the groundwater basins, are generally not readily available.

## Basin Assessments

Region-wide depth-to-groundwater information and annual estimates of change in groundwater in storage are not well understood for most of the groundwater basins in California.

Cleanup of shallow groundwater contamination is a high priority in California. Additional data collection and information dissemination is necessary to better educate the public and correlate existing or potential drinking water supplies with degraded groundwater quality.

There is no comprehensive or regionally-coordinated land-subsidence monitoring program in California. The land subsidence information presented in California's Groundwater Update 2013 is an overview of local and regional investigations that include various monitoring efforts, primarily in the Central Valley.

Eighty-nine groundwater recharge or conjunctive use projects have been identified throughout California; however, projects that may be in the planning or feasibility stage were not included in the inventory. The survey conducted as part of *California Water Plan Update 2013* was unsuccessful in collecting comprehensive information about many programs because numerous agencies were reluctant to make details about their groundwater recharge operations publically available; therefore, a general understanding of the effectiveness of California's groundwater recharge and conjunctive management programs could not be determined. In addition, it was unknown at the time of data collection for this report whether local agencies have complied with the groundwater recharge mapping requirements of Assembly Bill (AB) 359, which became effective January 1, 2013.

## Sustainable Management

A total of 119 GWMPs were identified throughout California; these plans collectively cover approximately 42 percent of the groundwater basins identified in Bulletin 118-2003. The 35 GWMPs that were determined to meet all of the California Water Code requirements cover 17 percent of the state's groundwater basin area. A key gap to implementing sustainable groundwater management practices at the local level is the limited authority of some agencies to assess management fees, restrict groundwater extraction, regulate land use in groundwater-short areas, and more broadly protect groundwater recharge areas. As discussed in this report, the Sustainable Groundwater Management Act, enacted in 2014, can help fill some of these gaps. Many of the statewide groundwater recommendations listed in the following section have been incorporated into the Sustainable Groundwater Management Act. The latest information and announcements on implementation of the Sustainable Groundwater Management Act are available online at DWR's sustainable groundwater management Web site: (http://www.water.ca.gov/groundwater/sgm/index.cfm)

## Statewide Groundwater Recommendations

The following recommendations identify key actions that are needed to better characterize, evaluate, and sustainably manage California's groundwater resources. These recommendations are consistent with those included in *California Water Plan Update 2013*, Volume 1, Chapter 8, "Roadmap for Action" and Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage." Recommendations for each of California's 10 hydrologic regions are provided in Chapters 3 through 12 of California's Groundwater Update 2013.

1. DWR and the State Water Resources Control Board (SWRCB) should implement a program to promote public education about groundwater through educational materials and workshops.
   A. Education programs can help explain the following groundwater topics:
      i. Reasons for changes in availability of groundwater.
      ii. Interconnection of surface water and groundwater.
      iii. Benefits of recharging groundwater with surface water and recycled water.
      iv. Importance of protecting groundwater quality and recharge areas.
      v. Reasons for developing a water budget.
      vi. Seasonal versus long-term changes in groundwater levels.
      vii. Potential impacts of climate change on groundwater resources.

2. Improve collaboration, coordination, and alignment among State, federal, tribal, local, and regional agencies and organizations to help implement sustainable groundwater management by ensuring that data and tools are evaluated and shared, programs are coordinated, and duplication is minimized.
   A. Provide State incentives to local water management agencies to coordinate with tribes and other agencies for taking actions to ensure the long-term sustainability of groundwater supply and suitable water quality.
   B. Improve coordination among State, federal, tribal, and local agencies to:
      i. Prevent conflicting rules or guidelines.
      ii. Provide timely regulatory approval.
   C. Form an interagency task force to expedite an environmental permitting process for the development, implementation, and operation of conjunctive management, managed aquifer recharge, groundwater cleanup, and water banking facilities when facility operations increase ecosystem services and include predefined benefits/mitigation for wildlife and wildlife habitat.
   D. Establish a process, led by the SWRCB, to simplify the water rights permitting process for water transfers designated for conjunctive management in which the recharged water is part of a groundwater management plan and is a beneficial use.

3. DWR, SWRCB, and the Governor's Office of Planning and Research should develop a statewide groundwater management planning Web site or portal to promote easy access to groundwater information, such as well completion reports; well drilling, construction, and abandonment standards; groundwater supply and demand; groundwater level and quality; land subsidence; groundwater recharge and conjunctive management; and groundwater management plans and basin assessment studies.

4. DWR should improve essential data to enable sustainable groundwater management by expanding and funding the CASGEM Program with the purpose of maintaining baseline

groundwater level data, funding and providing technical assistance to better characterize groundwater basins and improve local groundwater management for long-term sustainability, and monitoring impacts of droughts on groundwater resources, including land subsidence.

5. Under the CASGEM Basin Prioritization, DWR should improve understanding of California's high- and medium-priority groundwater basins by conducting groundwater basin assessments in conjunction with the California Water Plan five-year production cycle, identifying basins in decline with recognition of both short- and long-term aquifer health, assessing impacts of climate change, identifying management practices for sustainable groundwater management that will prevent waste and unreasonable use of groundwater, and reporting key findings to the Legislature.
   A. Develop the initial and recurring schedule and scope for groundwater basin assessments that will allow data and information sharing under the California Water Plan five-year production cycle.
   B. Use CASGEM data and other data reports, groundwater basin studies, and best available science to compile and evaluate new and existing groundwater supply and demand information, groundwater level and quality data, groundwater recharge and conjunctive management activities, surface water/groundwater interaction, groundwater management planning, and land subsidence information. The State should not duplicate information already being reported by local agencies that may be actively managing CASGEM high-priority basins. The state should consult with agencies that have implemented successful conjunctive management programs for insights into specific problems or hurdles that, if removed, would increase the ability for multi-region cooperation to implement conjunctive management projects.
   C. Utilize local groundwater management agency information and data when available and develop detailed groundwater basin assessment reports by hydrologic region and groundwater basin with a special focus on high priority basins that currently are not actively managed. The assessment reports will:
      i. Characterize the groundwater basins.
      ii. Identify basins in decline.
      iii. Assess the sustainability of groundwater resources in terms of historical and existing trends.
      iv. Evaluate anticipated impacts of climate change on groundwater resources using future scenario projections.
      v. With a special focus on basins where water budgets and management practices have not been established, identify recommended incentives to establish basin-wide water budgets and adaptive management practices that will promote sustainable groundwater quantity, quality, and the maintenance of groundwater ecosystem services.
   D. Develop a summary report to California Legislature depicting the state of California's groundwater, which will highlight key findings and recommendations associated with the groundwater basin assessments.

6. DWR should establish statewide groundwater management advisory committees to assist with the development of a groundwater sustainability plan (GSP) evaluation and implementation process. The advisory committees can (1) provide valuable operational insight and help DWR prepare a best management practices (BMP) guidance document for sustainable groundwater management,

and (2) help guide and establish a process for evaluating the completeness of GSPs in California's high- and medium-priority groundwater basins.

A. With guidance from the groundwater management advisory committees, DWR should conduct the following activities:
   i. Conduct outreach to identify the needs and priorities of local and regional agencies.
   ii. Develop a GSP acceptance process.
   iii. Develop a groundwater management, planning, and program implementation guidance document that will provide a clear roadmap for GSP development and implementation based on BMPs.
   iv. Identify tools and data sharing needed to improve groundwater management.
   v. Develop a Web site for local agencies to upload, and interested stakeholders to download, GSPs.
B. With guidance from the groundwater management advisory committees and utilizing a public review process, DWR should develop improved standards and BMPs, which should include:
   i. GSP verification and implementation.
   ii. Goals, objectives, performance measures, and a clear description of additional management steps to be taken if performance measures are not met.
   iii. Water budgets to help understand the total inflow and outflow from the groundwater system.
   iv. The addition of ecosystem services into basin management objectives.
   v. Annual reporting of GSP implementation activities and performance.
   vi. Reporting of groundwater sustainability under current and future scenario projections.
   vii. Impact assessments (economic and environmental) under current and future scenario projections.
   viii. Online posting of GSPs and annual reports with water budgets.

[Note: Recommendation 6 was originally developed in relation to GWMPs; however, because of the passage of the 2014 Sustainable Groundwater Management Act, the recommendation also includes mention of GSPs.]

7. State government and integrated regional water management (IRWM) groups should advance sustainable groundwater management by doing the following: identifying and including the goals and objectives of GWMPs and GSPs in IRWM plans; ensuring no transfer of impacts among regions; ensuring that regions accept responsibility for addressing risks resulting from climate change, population growth, and groundwater depletion; adopting stronger standards for local and regional groundwater management; and considering legislation to provide needed local and regional authority to effectively manage groundwater resources.
   A. Encourage IRWM plans to identify and include the goals and objectives of GWMPs and GSPs.
   B. The Legislature should consider enacting legislation to ensure that local and regional agencies have the incentives, tools, authority, and guidance to develop and enforce plans that protect groundwater elevations and quality, as well as surface water-groundwater interaction regime and groundwater ecosystem services.
   C. The Legislature should further strengthen and clarify legislation to define local and regional responsibilities and give local and regional agencies the authority necessary to manage groundwater sustainably and ensure no groundwater basin is in danger of being permanently

damaged by overdraft. The State should be provided authority to protect basins at risk of permanent damage (in the event that local authorized agencies have not made sufficient and timely progress to correct the problem) until such time that an adequate local program is in place.

[Note: Recommendation 7 was originally developed in relation to GWMPs; however, because of the passage of the 2014 Sustainable Groundwater Management Act, the recommendation also includes mention of GSPs.]

8. DWR and SWRCB should review analytical tools currently being used, and assist local agencies in developing improved tools, to assess conjunctive management and groundwater management strategies.
   A. The conjunctive management tool should help identify conjunctive management opportunities (projects) and evaluate implementation constraints associated with:
      i. Availability of aquifer space.
      ii. Availability of water for recharge.
      iii. Available means to convey water from source to destination.
      iv. Water quality issues.
      v. Environmental issues.
      vi. Jurisdictional issues.
      vii. Costs and benefits.
      viii. Potential interference between a proposed project and existing projects.
   B. The State should incentivize local and regional agencies to develop or adopt analytical tools to support integrated groundwater/surface water modeling and scenario analyses for assessing alternative groundwater management strategies as part of their IRWM planning activities.

9. Groundwater management authorities and sustainability agencies should increase local and regional groundwater recharge and storage to reduce groundwater depletion and enhance statewide water resource resiliency.
   A. The Legislature should consider revising the California Water Code to provide:
      i. Disincentives to actions which cause groundwater basin overdraft resulting from unsustainably operating or utilizing groundwater basins.
      ii. Incentives to actions that increase recharge.
   B. On an ongoing basis, State agencies should work with federal, tribal, local, and regional agencies on actions to increase local and regional groundwater recharge and storage, including:
      i. Cataloging best science and technologies applied to groundwater recharge and storage.
      ii. Improving interagency coordination and alignment.
      iii. Aligning land use planning with groundwater recharge area protection.
      iv. Completing rulemaking for groundwater recharge with recycled water.
      v. Identifying additional data and studies needed to evaluate opportunities for multi-benefit projects, such as capturing and recharging stormwater flows and other water not used by other users or the environment.
      vi. Identifying and evaluating local and regional opportunities to reduce runoff and increase recharge on residential, school, park, and other unpaved areas.

C. On an ongoing basis, State agencies should work with federal, tribal, local, and regional agencies to support a comprehensive approach to local and regional groundwater management by funding distributed groundwater recharge and storage projects identified in groundwater management plans and removing obstacles to implementation of such projects.

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