

## Attachment B

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# Technical and Regulatory Supporting Documentation (Summaries with Report Links)

## B.1 Regulatory Evaluations

### B.1.1 Salinity Effects on MUN-related Uses of Water

CV-SALTS completed research to define what constitutes reasonable protection of existing and probable future MUN uses (CDM Smith 2016d). This research focused on the preparation of a summary of the current state of knowledge regarding the effects of elevated salinity concentrations on drinking water supply, including human health concerns, and other domestic uses of water, including impacts of salinity on residential, commercial and industrial water-using devices. In addition, the research effort reviewed water quality objectives established in other California regions, federal recommendations developed by the U.S. Environmental Protection Agency (US EPA), MUN-related water quality standards adopted by other states, and guidelines established by selected international entities. The resulting White Paper provides a summary of the key findings along with supporting data and references. Findings were used to support development of a Central Valley SNMP and ensure that MUN-related uses of water are appropriately protected.

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/water-quality-objective-reviews/3618-cvsalts-final-mun-tech-memo-120116/file.html>

### B.1.2 Salinity-related Effects on Agricultural Irrigation Uses

CV-SALTS completed research to define what constitutes reasonable protection of existing and probable future use of water for agricultural irrigation (CDM Smith 2016c). This research focused on the preparation of a summary of the current state of knowledge regarding the effects of elevated salinity concentrations on crop yields, wetland plants and vegetation commonly used for landscaping. In addition, the research effort reviewed water quality objectives established in other California regions, federal recommendations developed by the US EPA, water quality standards adopted by other states to protect water used for irrigation, and guidelines established by selected international entities. The resulting White Paper provides a summary of the key findings along with supporting data and references. Findings were used to support development of a Central Valley SNMP and ensure that AGR irrigation-related uses of water are appropriately protected.

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/water-quality-objective-reviews/3619-cvsalts-final-agr-tech-memo-vers3-120116/file.html>

### B.1.3 Stock Watering Protection

CV-SALTS implemented this study to identify water quality criteria that may be used to establish salinity and nitrate-related water quality objectives to protect stock watering supplies in the Central Valley (Kennedy/Jenks 2013). This study relied on the findings from research on the following information sources: (a) water quality objectives established in other regions of California or in other selected states; (b) review of US EPA recommendations; (c) university extension publications and specialists; (d) published peer-reviewed literature; and (e) selected international agencies. The final report provides recommendations for protection of stock watering sources which was used to support development of the Central Valley SNMP.

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/water-quality-objective-reviews/2376-stock-drinking-water-final-report052013/file.html>

### **B.1.4 Aquatic Life Study**

CV-SALTS implemented a study to identify potential water quality criteria that could be used to establish salinity-related water quality objectives to protect aquatic life in Central Valley surface waters (Buchwalter 2014). This study researched the following information sources to fulfill the project purpose: (a) recent literature reviews conducted by selected states to establish water quality criteria for salinity-related constituents; (b) peer-reviewed published literature; (c) data and methodologies developed by federal agencies, including US EPA and Department of Interior; (d) recommendations developed by selected international agencies; and (e) any information developed by other California agencies. The final report provided technical recommendations for adoption of salinity-related water quality objectives to protect aquatic life.

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/water-quality-objective-reviews/2645-final-aquatic-life-study-report010614/file.html>

## **B.2 Technical Supporting Documentation**

### **B.2.1 Initial Conceptual Model Analyses**

The Initial Conceptual Model (ICM) was developed to provide a conceptual level (or 30,000-foot level) analysis of water balance and associated salt and nutrient (nitrate) conditions in the Central Valley (Larry Walker Associates et al. 2013). This effort relied on the establishment of Initial Analysis Zones (IAZs) to complete water quantity and quality analyses within smaller areas within the Central Valley and detailed analyses in two selected subareas of the Central Valley. The ICM work provided an initial assessment of salt/nitrate conditions in the Central Valley, including identification of hotspots and long term trends for salt and nitrate concentrations. SNMP Section 3 provides an overview of the findings from the ICM analyses. The following subsections below provide supplemental information to SNMP Section 3. The links to documents provided in these subsections provide an executive level summary of information developed on various topics.

For a complete set of documents, the reader should consult the ICM work products which are available here: <http://www.cvsalinity.org/index.php/committees/technical-advisory/conceptual-model-developments/102-initial-conceptual-model-icm.html>

#### **B.2.1.1 Characterization of the Hydrologic Regions**

This section provides a general characterization of the groundwater basins and surface waters within the Central Valley Regional Water Board's jurisdictional boundary. It supplements the information contained in SNMP Section 3. The characterization of groundwater quality utilizes the delineation of the upper portion of the aquifer in the Central Valley Floor that represents a 20-year vertical travel distance, as well as the lower portion of the aquifer systems where most groundwater supply is obtained.

**Information Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3643-b-2-1-1-characterization-of-hydrologic-regions-120116-text/file.html>

### **B.2.1.2 Basin Water Balance**

This section broadly describes the water budget components at the Central Valley and regional hydrologic unit scales, along with summaries of water budget components at the IAZ scale. The movement of water and the components of the water balance dictate the conveyance of salt and nitrate, and therefore are important for an SNMP. When discussing management practices, the movement of water in the context of different water balance components becomes critical for sustaining good quality groundwater sources and/or improving impaired groundwater. Water balance components such as groundwater recharge, surface water/groundwater interaction (stream leakage), horizontal movement from one area to another, vertical movement downward toward deeper aquifer units, groundwater pumping, and groundwater storage all play roles in the movement and management of salt and nitrate into and out of areas of interest. This section bases the water balance information on the ICM work (Larry Walker Associates et al. 2013), which divided the Central Valley Floor into 22 water balance subregions (or IAZs). These areas are based on hydrologic boundaries, and for the purposes of this section, they are grouped and summarized geographically into the Northern Central Valley, Middle Central Valley, and Southern Central Valley.

***Information Links:*** Section may be found at:

<http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3642-b-2-1-2-basin-water-balance-120116-text/file.html>

The section is supported by the following appendix which provides additional detail on the water balance information for each of the 22 water balance subregions:

<http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3641-b-2-1-2-basin-water-balance-120116-appendix-1/file.html>

### **B.2.1.3 Basin Salt & Nitrate Mass Balance**

As part of the evaluation of Central Valley water quality, nitrate and salt loading estimates and fate and transport analyses were completed. Development of this information considered a number of components that affect the salt/nitrate balance in any given area. This section broadly describes the mass balance components at the Central Valley and regional hydrologic unit scales, along with summaries of mass balance components at the IAZ scale. Mass balance components such as groundwater recharge, surface water/groundwater interaction (stream leakage), horizontal movement from one area to another, vertical movement downward toward deeper aquifer units, and groundwater pumping all play roles in the movement and management of salt and nitrate into and out of areas of interest. Understanding the movement of salt and nitrate is critical, as these assessments provide the basis from which to determine the overall increasing/decreasing trends of total mass in groundwater. When discussing management practices, the movement of mass in the context of individual balance components becomes critical for sustaining good quality groundwater sources and/or improving impaired groundwater.

***Information Links:*** Section may be found at:

<http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3639-b-2-1-3-basin-salt-nitrate-mass-balance-120116-text/file.html>

The section is supported by the following appendix which provides additional detail on the mass balance information for each of the 22 IAZ subregions:

<http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3638-b-2-1-3-basin-salt-nitrate-mass-balance-120116-appendix/file.html>

#### **B.2.1.4 Basin Evaluation of Trends and Projected Water Quality**

In this section, ambient shallow nitrate and TDS concentrations and qualitative trends for each of the 22 IAZs are provided at the aggregate scale. In addition to the aggregate scale analysis of the IAZs, an in-depth analysis was completed for the Alta Irrigation District (AID) model area, including ambient groundwater quality and projected water quality. The AID model area encompasses all of IAZ 17, and small portions of IAZs 15, 16, and 18. The analyses for the AID model area serve as an archetype analysis to provide guidance on the methods that can be employed in any groundwater basin. See Section B.2.1.5 for detailed discussion and examples of methodologies for ambient groundwater quality, trend analyses, and projected groundwater quality.

**Information Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3637-b-2-1-4-basin-trends-projected-water-quality-120116-text/file.html>

#### **B.2.1.5. Water Quality Analysis Methods**

The methodologies outlined in this section provide the foundation for estimating groundwater quality in terms of salt and nutrient concentrations. Estimating past, current, and future levels of salt and nutrients in groundwater are key components for supporting implementation of the SNMP, and provide a critical framework from which future planning and management of groundwater systems can be based upon.

**Information Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3636-b-2-1-5-wq-analysis-methods-120116-text/file.html>

This section is supplemented by an appendix that provides detailed analyses for use of the described methodologies at four different scales. From smallest to largest:

- A wastewater treatment plant (WWTP);
- A 4-mile vicinity around a WWTP;
- The AID boundary; and
- The AID model boundary.

**Information Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3635-b-2-1-5-wq-analysis-methods-120116-appendix/file.html>

#### **B.2.1.6 Management Zone Delineation Methods**

The Recycled Water Policy promotes the management of salt and nitrate at the appropriate scale through the adoption of local salt and nitrate implementation plans that are tailored to the local water quality concerns. The Central Valley SNMP recommends the adoption of the Groundwater Management Zone Policy which encourages dischargers to work collectively to manage nitrate in

areas referred to as management zones (see SNMP Attachment A-1). This section identifies factors that dischargers may want to consider when delineating a management zone boundary.

**Information Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/3634-b-2-1-6-mz-delineation-methods-120116-text/file.html>

## **B.2.2 Final Groundwater Analyses**

CV-SALTS implemented a project to update the groundwater quality analysis originally conducted as part of the ICM project (see Section B.2.1 above) (Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates 2016a). The project deliverables included: (a) high resolution ambient groundwater quality maps (nitrate and TDS) for the Central Valley for three defined groundwater zones: Upper zone, lower zone, and production zone; and (b) high resolution assimilative capacity maps (nitrate and TDS) for the Central Valley (upper, lower, and production zones). Analyses were completed at both groundwater basin/subbasin (consistent with DWR Bulletin 118, DWR 2003) and IAZ scales. SNMP Section 3 provides an overview of the findings from the deliverables of this project.

Access to all project deliverables is available here:

<http://www.cvsalinity.org/index.php/committees/technical-advisory/conceptual-model-developments/171-updated-groundwater-quality-analysis-for-central-valley.html>

## **B.2.3 Salt and Nitrate Management Studies**

### **B.2.3.1 Nitrate Implementation Measures Study (NIMS)**

CV-SALTS completed a study to evaluate nitrate contamination in the groundwater basins of the Central Valley and develop appropriate implementation measures to mitigate this contamination using a phased approach that includes providing safe drinking water, reducing or eliminating impacts to drinking water sources and implementing managed restoration activities where needed to restore beneficial uses in groundwater (CDM Smith 2016a). SNMP Section 4.2.5.1 provides a summary of findings from this study. These findings supported development of the SNMP's Nitrate Permitting Strategy (Attachment A-2) and the nitrate management strategy in SNMP Section 4.3.2.

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/implementation-planning/3275-20160331-nims-report-rev1/file.html>

### **B.2.3.2 Strategic Salt Accumulation Land and Transportation Study (SSALTS)**

CV-SALTS implemented a study to identify the range of viable Central Valley alternatives for salt disposal (taking into account regulatory, institutional, economic, and technological issues) to provide input for consideration during development of the SNMP for the Central Valley. Potential alternatives for salt disposal range from expanded use of existing salt disposal areas, establishment of new salt disposal areas within the Central Valley, export or transport of salt out of the Central Valley, or some combination of the above. The findings from this study provided input to policymakers regarding development of a Salinity Management Strategy (see SNMP Attachment A-3) for inclusion in the SNMP. Three study phases occurred: (a) Phase 1 focused on an evaluation of current salt disposal practices at selected study areas in the Central Valley (CDM Smith 2013); (b) Phase 2 concentrated on the development of potential future salt

disposal/treatment alternatives for the Central Valley (CDM Smith 2014); and (c) Phase 3 evaluated the potential salt disposal/treatment alternatives identified in Phase 2, identified interim salt management measures and provided support to the Salinity Management Strategy (CDM Smith 2016b). SNMP Section 4.2.5.2 provides a summary of findings from this study.

Access to the reports for each project phase is available here:

<http://www.cvsalinity.org/index.php/committees/technical-advisory/implementation-plannings/105-strategic-salt-accumulation-land-and-transport-study-ssalts.html>

### **B.2.3.3 Management Zone Archetype Analysis Report: Alta Irrigation District**

CV-SALTS completed the CV-SALTS Management Zone Archetype Analysis: Alta Irrigation District study to evaluate a number of issues that might affect the development and implementation of a groundwater management zone (Larry Walker Associates et al. 2016). The conceptual management zone for the study was the AID within the Kings groundwater subbasin. The study, which was developed and implemented in a collaborative setting with local stakeholders, including regulatory and partner agencies, served as an example and “proof of concept” to help test, on a spatially refined basis, the application of selected policies, data analysis methods, and salt and nitrate management approaches under consideration by CV-SALTS. SNMP Section 4.2.5.3 provides a summary of findings from this study; these findings provided support to the development of the Groundwater Management Zone Policy (see Attachment A-1) and SNMP management strategies for salt and nitrate (SNMP Sections 4.3.2 and 4.3.3, respectively).

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/conceptual-model-development/3335-aid-management-zone-report-final-may-2016-072916/file.html>

### **B.2.3.4 Aggressive Restoration Scenario Modeling**

The NIMS study summarized above identified a number of potential nitrate management controls (e.g., pump, treat, and serve, or pump, treat, and re-inject) that could be deployed in the Central Valley to improve water quality. The AID Management Zone Archetype Study, also summarized above, evaluated a number of management scenarios and the potential benefits to water quality within the AID area. To better understand the types of nitrate control measures that would be necessary to meet SNMP management goal #3 (Implement a Managed Aquifer Restoration Program), a modeling study was completed that linked management Scenario #3 from the AID Management Zone Archetype Study (with specified targets for irrigation efficiency, reduced nitrogen loading, and artificial recharge changes) with selected nitrate management controls identified by the NIMS and on-farm winter recharge (Luhdorff & Scalmanini Consulting Engineers and Larry Walker Associates 2016b). The study evaluated two selected areas within the AID boundary (Dinuba and Cutler/Orosi) with varying nitrate conditions. Well fields were designed for each of the study areas and then modeled to observe the degree to which nitrate decreases in ambient groundwater within 10 to 20 years (and as long as 100 years) using different simulations. These findings were then extrapolated to the AID and Central Valley floor scale. The findings from this study supported the development of the nitrate management strategy in the SNMP (Section 4.3.2), Nitrate Permitting Strategy (Attachment A-2) and supporting SNMP environmental and economic analyses (see SNMP Section 6 and Attachment C).

**Report Link:** <http://www.cvsalinity.org/index.php/docs/ceqa/ceqa-documents/3525-final-tm-aggressive-restoration-scenario-09292016/file.html>

#### **B.2.4 Surveillance and Monitoring Program Evaluation**

CV-SALTS developed an approach for the establishment of a Surveillance & Monitoring Program (SAMP) to support implementation of the SNMP and fulfill monitoring requirements for the Basin Plan amendments recommended for adoption (CDM Smith 2016e). This evaluation developed an approach for consideration during development of the Basin Plan amendments. This approach is intended to be coordinated with existing groundwater monitoring programs so that existing data collection activities can provide as much data as possible to support SNMP implementation. SNMP Section 5 provides more information regarding this program.

**Report Link:** <http://www.cvsalinity.org/index.php/docs/committee-document/technical-advisory-docs/implementation-planning/3644-final-revised-samp-122016/file.html>