

**DRAFT – FOR DISCUSSION PURPOSES ONLY**  
**SUBJECT TO REVIEW BY TECHNICAL ADVISORY COMMITTEE**

2 November 2011

**MEMORANDUM**

To: Nigel Quinn, Ph.D., P.E., D.WRE, CV-SALTS Technical Advisory Committee Chair

From: Michael Steiger, P.E., Andy Safford, P.E., Erler & Kalinowski, Inc.

Subject: An Approach to Developing Central Valley Salt and Nutrient Management Plan

At the Technical Advisory Committee (“TAC”) meeting on 29 September 2011, Erler & Kalinowski, Inc. (“EKI”), as CV-SALTS’ Technical Project Manager, presented an approach for developing a salt and nutrient management plan (“SNMP”) for the Central Valley region regulated by the Central Valley Regional Water Quality Control Board (“CVRWQCB”), i.e., Region 5. The TAC requested that EKI document the approach. This memorandum summarizes the overall approach to developing a Central Valley SNMP and describes the initial tasks to be accomplished by CV-SALTS. The purpose of this memorandum is to obtain input from the TAC on the approach and initial tasks.

**BACKGROUND**

In collaboration with CVRWQCB, CV-SALTS is considering Basin Plan amendments that address the beneficial use designations of Central Valley surface water and groundwater, including narrative and numerical water quality objectives (“WQOs”) to protect beneficial uses.<sup>1</sup> Certain water bodies may be determined to have only limited beneficial uses, such as water bodies that are extremely impaired; are ephemeral, intermittent, or have low flows; or that consist of canals, channels, ditches, and drains carrying treated wastewater or agricultural drainage water.<sup>2</sup>

The Basin Plan amendments will include authorization of a Central Valley SNMP that will be prepared by CV-SALTS. Elements of this plan will provide the framework, including a plan of implementation, for ensuring existing or revised beneficial uses and associated WQOs for surface and groundwater are maintained or restored. The SNMP is intended to address the fact that the salinity of Central Valley surface water and groundwater supplies is steadily increasing as more salt is imported into the valley

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<sup>1</sup> CVRWQCB has two Basin Plans for Region 5. One plan covers the Sacramento River Basin and the San Joaquin River Basin. The other plan pertains to the Tulare Lake Basin.

<sup>2</sup> Risk Sciences. 6 May 2011. *Test Consensus Summary for MUN*. Revised draft. pp. 1-3.

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than is exported.<sup>3,4</sup> Achieving a sustainable salt balance is the recognized solution to this salinity issue and will enable achievement of WQOs.<sup>5,6,7</sup>

The immense scale of the Central Valley requires involvement by local governments, agencies, and other third parties to effectively manage salt and nitrate sources.<sup>8</sup> CV-SALTS acts as the umbrella organization coordinating the planning efforts of these stakeholders.<sup>9</sup> This strategy of involving local governments, agencies, and other third parties that have the best understanding of their salt and nitrate challenges is consistent with the approach recommended by the Department of Water Resources (“DWR”) for addressing California’s water issues.<sup>10</sup> The Central Valley SNMP will emphasize a regional distributed salinity management strategy with local control of regional SNMPS.

**SUMMARY OF APPROACH TO DEVELOPING CENTRAL VALLEY SNMP**

At a minimum, the Central Valley SNMP must satisfy the requirements in the State Water Resources Control Board (“SWRCB”) Recycled Water Policy. According to this policy, every region in California is encouraged to develop a salt and nutrient management plan by 2014 that is sustainable on a long-term basis.<sup>11</sup>

The Central Valley SNMP will be a comprehensive plan that considers all of Region 5. The Central Valley SNMP needs to be sufficiently detailed to assess if sustainable salt and nitrate balances exist, evaluate potential regional management practices, and assess whether local management practices must be augmented by regional management practices to achieve sustainable salt and nitrate balances to meet

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<sup>3</sup>DWR. December 2009. Volume 1 – Resource Management Strategies. *California Water Plan, Update 2009, Integrated Water Management*. Bulletin 160-09. pp. 18-5 and 18-6.

<sup>4</sup> CVRWQCB. May 2006. *Salinity in the Central Valley, An Overview*. p. 1.

<sup>5</sup> CV-SALTS. 21 February 2011. *CV-SALTS Basin Plan Needs & Issues*. Version 6. pp. 2-3.

<sup>6</sup> Integrated Planning and Management, Inc. June 2008. op. cit. p. 11.

<sup>7</sup> CVRWQCB, 2006. op. cit. p. 3.

<sup>8</sup> Integrated Planning and Management, Inc. June 2008. *Salinity Management Strategy Report*. Prepared for Central Valley Regional Water Quality Control Board. p. 23.

<sup>9</sup> CV-SALTS. 12 November 2010. *3a-3b Committee Recommended Questions and Statements*. Version 3. pp. 1-3.

<sup>10</sup> DWR. December 2009. Volume 1 – The Strategic Plan. *California Water Plan, Update 2009, Integrated Water Management*. Bulletin 160-09. p. v. The California Water Plan is the State’s strategic plan for managing and developing water resources statewide.

<sup>11</sup> SWRCB. 3 February 2009. *Recycled Water Policy*. Resolution No. 2009-0011. p. 1.

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existing or revised WQOs in the Central Valley. The initial SNMP will include an analysis of possible regional management practices for managing salts and nutrients,<sup>12</sup> but is not expected to include an analysis of specific local management practices.

CVRWQCB recognizes the Central Valley SNMP may take many years to complete.<sup>13</sup> Further investigation and assessment will likely be required to refine the SNMP and identify specific local management practices for achieving sustainable salt and nitrate balances throughout all areas of the Central Valley.

Figure 1 depicts the preliminary schedule for developing the Central Valley SNMP that incorporates strategies and concepts adopted by CV-SALTS, and applicable regulatory agency guidance. The tasks and schedule will be refined as work progresses on the Central Valley SNMP and Basin Plan amendments.

**INITIAL TASKS OF APPROACH TO BE COMPLETED BY CV-SALTS**

The remainder of this memorandum is limited to descriptions of Tasks 1 through 5 on Figure 1. Subsequent tasks on Figure 1 will be developed based upon input received on Tasks 1 through 5.

**Task 1: Identify Boundaries of SNMP Regions**

CV-SALTS will work with stakeholders to identify boundaries of areas or regions (“SNMP Regions”).<sup>14,15</sup> CV-SALTS and stakeholders will consider DWR hydrologic (i.e., watershed), and groundwater basin and

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<sup>12</sup> CVRWQCB believes a drain or brine line is “the only feasible, long-range solution for achieving a salt balance in the Central Valley” and is the “best technical solution to the water quality problems of the San Joaquin River and Tulare Lake Basin.” CVRWQCB, September 2009. *Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin*. 4<sup>th</sup> ed. p. IV-15.00. Other regional management practices may include construction of desalters, establishment of salt sinks, construction of agricultural drainage collection and treatment systems, development of industries built around salt conversion, controlled degradation, and land retirement.

<sup>13</sup> CVRWQCB. June 2011. *Future Actions List and Workplan for the August 2010 Groundwater Quality Protection Strategy for the Central Valley Region, a Roadmap*. p. 5.

<sup>14</sup> The guidelines for salinity and nutrient management in the San Diego region illustrate the importance of identifying SNMP Region boundaries. According to these guidelines, the initial step in preparing a management plan is to define the exact areal extent of the study area, such that “The implementing agency or agencies should select a study area that is appropriate for achieving their desired salinity/nutrient management goals.” See page 5-5 of *Proposed Guidelines, Salinity/Nutrient Management Planning in the San Diego Region (9)*, dated 1 September 2010, prepared by Michael R. Welch, Ph.D., P.E. on behalf of the Southern California Salinity Coalition and San Diego County Water Authority.

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sub-basin boundaries that overlap with governmental, Irrigated Lands Regulatory Program (“ILRP”) coalition, and Integrated Regional Water Management (“IRWM”) region boundaries. Physical, governmental, ILRP coalition, and IRWM region boundaries throughout the Central Valley will be incorporated into CV-SALTS’ GIS database.

**Task 2: Coordinate and Involve Stakeholders**

CV-SALTS will organize and involve stakeholders that may prepare and implement regional SNMPs. Possible stakeholders include ILRP coalitions and Regional Water Management Groups (“RWMGs”) that are in charge of IRWM programs. CV-SALTS will continue outreach activities to stakeholders within candidate SNMP Regions and potentially establish agreements with stakeholders to facilitate implementation of locally controlled salt and nutrient management practices. Keeping stakeholders engaged in the process will encourage their proactive input on the Central Valley SNMP and proposed Basin Plan amendments.

CV-SALTS will continue to integrate other key programs already underway to control Central Valley salt and nitrate loads.<sup>16</sup> These programs include, among others, the San Joaquin River Restoration Program, U.S. Department of Interior, Bureau of Reclamation’s (“Reclamation’s”) Salinity Management Plan, CVRWQCB’s ILRP and concentrated animal feeding operations (“CAFO”) programs, and implementation of best management practices (“BMPs”) in conjunction with National Pollutant Discharge Elimination System (“NPDES”) permits and Waste Discharge Requirements (“WDRs”) issued to publicly owned treatment works (“POTWs”), wineries, and food processors. Integration of these programs will minimize duplicative efforts and enable a holistic approach to addressing salt and nitrate loads.<sup>17</sup>

**Task 3: Gather Existing Information and Data and Create an Inventory**

In 2006, CV-SALTS began to identify available data that could inform salt and nutrient management practices. In 2008, CV-SALTS supervised a pilot study of three areas in the Central Valley to assess the availability and usability of data for estimating salt and nitrate loads.<sup>18</sup> The work by CV-SALTS is helpful

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<sup>15</sup> CV-SALTS. 28 July 2011. *A Framework for Salt/Nitrate Source Identification Studies*. p. 1. The framework document uses the phrase “Study Area” instead of SNMP Region. The framework document does not define Study Areas beyond thinking of them as small enough to be effectively modeled to enable salt and nutrient management.

<sup>16</sup> CV-SALTS. 2009. *Salinity Programs Coordination Matrix*. Draft Version 11.

<sup>17</sup> CVRWQCB recognizes other federal, state, and local agencies have interests in protecting surface water and groundwater and these interests need to be coordinated to avoid duplicating efforts (CVRWQCB. 2010. pp. 8-9).

<sup>18</sup> Larry Walker Associates. February 2010. *Salt and Nitrate Sources Pilot Implementation Study Report*.

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in identifying the specific information and data needed to characterize a given SNMP Region. The next step is for CV-SALTS to gather and organize the information and data that will be relied upon to characterize all of the SNMP Regions comprising the Central Valley. Such information and data will be obtained from various reports and datasets, and will be gathered by CV-SALTS in a form consistent with CV-SALTS' GIS database.<sup>19</sup>

CV-SALTS' GIS database will include data files, shapefiles, and metadata, i.e., descriptions of external databases that are too large to add to the GIS database itself. Examples of metadata include the following:

- U.S. Environmental Protection Agency (“U.S. EPA”) STOrage and RETrieval databases
- U.S. Geological Survey (“USGS”) National Water Information System database
- DWR Water Data Library and California Statewide Groundwater Elevation Monitoring Program
- SWRCB GeoTracker, Groundwater Ambient Monitoring and Assessment Program, and Surface Water Ambient Monitoring Program<sup>20</sup>

Additionally, copies of documents used to substantiate land use, surface water and groundwater flow rates; representative total dissolved solids (“TDS”) concentrations, electrical conductivity (“EC”) measurements, and nitrate concentrations; and relevant fate and transport mechanisms such as nitrogen conversion, atmospheric deposition, biomass creation, and mineral dissolution will be maintained by CV-SALTS. Organizing key documents will facilitate preparation of the administrative record required for formal adoption of the Central Valley SNMP and Basin Plan amendments.

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<sup>19</sup> Recent submittals to the CV SALTS Knowledge Gained Subcommittee have advocated expanded use and reliance on GIS to create the data inventory. See Larry Walker Associates, et al, 18 October 2011, *A Recommended Approach to Salt and Nutrient Management Plan Development in the Central Valley*, and PlanTierra, 17 October 2011, *Conceptual Modeling of Salt and Nutrient Loads*. GIS is undoubtedly a valuable tool in organizing, evaluating, and providing visual representations of data, but the value derived from adding information to the GIS database must be balanced against the effort required to do so and should be limited to information and data that are needed to complete the Central Valley SNMP and Basin Plan amendments.

<sup>20</sup> Additional metadata may become available as SWRCB creates a geodatabase of USGS National Hydrography Dataset map layers updated with associated attribute tables of Basin Plan elements. See California State University, Northridge and California State University, Chico, 2011, *State of California - Basin Plan Geospatial Data Management and Implementation Project*. PowerPoint presentation by Shawna Dark, Danielle Bram, and Jason Schwenkler.

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**Task 4: Assess Data**

CV-SALTS will check information and data for accuracy following procedures similar to those employed in the salt and nutrient pilot study for CV-SALTS in 2010.<sup>21</sup> Values for a given parameter compiled from different studies or reports will be checked against each other. Consistency in the reported values provides an indication of the value's accuracy, particularly if it has been independently derived in more than one study. References will be provided for all values based on information or data in published studies or reports. Incomplete or conflicting data will be described. Assumed values will be clearly identified as such if no available data exist or the data are in conflict.

**Task 5: Develop Conceptual Model and Estimate Salt and Nitrate Loads**

CV-SALTS will develop a conceptual model to serve as the baseline from which salt and nitrate loads are estimated. The conceptual model will (1) describe known and potential salt and nitrate sources and sinks, (2) identify surface water and groundwater bodies, and (3) provide an understanding of the movement of water, salt, and nitrate within each SNMP Region and between neighboring SNMP Regions. The conceptual model will be established as part of Initial Studies performed by CV-SALTS for each SNMP Region. The Initial Studies will consist of data gathering and use of simplified methods to estimate preliminary salt and nitrate loads.<sup>22</sup>

Follow-up Studies may be necessary for a SNMP Region based upon stakeholder review of Initial Study results and region-specific management and policy issues. Follow-up Studies, if needed, will be prepared by stakeholders implementing salt and nutrient management practices in the SNMP Region.

Salt and nitrate loads will be estimated by CV-SALTS for potentially significant sources in each SNMP Region. Potentially significant salt and nitrate sources identified in studies completed to date include source water, mineral dissolution, irrigated agriculture, CAFOs, POTWs, wineries, and food processors

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<sup>21</sup> Larry Walker Associates. 2010. pp. 2-7 to 2-8.

<sup>22</sup> The Initial Studies are described in more detail in the framework document prepared by the CV-SALTS Knowledge Gained Subcommittee, as approved by the Executive Committee at its 9 August 2011 meeting. The Knowledge Gained Subcommittee is making final revisions to the framework document based upon its review of the document.

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that discharge wastewater under NPDES permits or WDRs.<sup>23,24,25,26</sup> Water balances, and representative TDS and nitrate concentrations for each significant source must be obtained to estimate salt and nitrate loads. Useful studies on water balances and salt and nitrate loads in the Central Valley have been or are being performed by CV-SALTS, CVRWQCB, USGS, Reclamation, CUWA and Central Valley Drinking Water Policy Work Group, and the Nitrate Interagency Task Force.<sup>27,28,29,30,31,32,33</sup>

For some sources, salt and nitrate loads being discharged to particular water bodies can be estimated by multiplying the flow volume of each discharge by its TDS and nitrate concentrations.<sup>34</sup> Other types of loads (e.g., fertilizer and soil amendments) can be calculated on the basis of land use data (e.g., crop types) and reported literature values.

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<sup>23</sup> Reclamation. July 2010. *Technical Memorandum, Salt and Nitrate Source and Process Information, Westside Salt Assessment, California*. pp. 2-15 to 2-24.

<sup>24</sup> EKI. June 2010. *A Mass Balance Approach to Evaluate Salinity Sources in the Turlock Sub basin, California*. p. 56.

<sup>25</sup> Larry Walker Associates. 2010. op. cit. p. 2-2.

<sup>26</sup> CVRWQCB. 2006. op. cit. p. 18.

<sup>27</sup> Larry Walker Associates. 2010. op. cit.

<sup>28</sup> CVRWQCB. July 2004. *Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River, Draft Final Staff Report, Appendix 1: Technical TMDL Report*.

<sup>29</sup> USGS. 2011. *Trends in Nutrient Concentrations, Loads, and Yields in Streams in the Sacramento, San Joaquin, and Santa Ana Basins, California, 1975–2004*. Scientific Investigations Report 2010-5228.

<sup>30</sup> As part of its Salinity Management Plan, Reclamation is completing a water balance and estimating salt and nitrate loads for the Westside Salt Assessment SNMP Region, which Reclamation defines as encompassing lands that receive water from the Central Valley Project (“CVP”) and potentially discharge all or a portion of CVP water to the lower San Joaquin River. See Reclamation, March 2010, *Draft Technical Memorandum, Water Budget Methodology, Westside Salt Assessment, California*, and Reclamation, July 2010, *Technical Memorandum, Salt and Nitrate Source and Process Information, Westside Salt Assessment, California*.

<sup>31</sup> Systech. 2011a. op. cit.

<sup>32</sup> Systech. 25 April 2011b. *Task 3, Technical Memorandum, Analytical Modeling of the Sacramento River*.

<sup>33</sup> Water Code Section 83002.5 requires SWRCB to develop pilot projects in the Tulare Lake Basin and the Salinas Valley to study nitrate contamination, and to identify remedial solutions and funding options to recover costs associated with cleanup or treatment of nitrate-impacted groundwater.

<sup>34</sup> Salt concentrations in water are most often quantified by measuring TDS or EC. TDS concentrations can be converted to EC values for comparison to WQOs. However, TDS concentrations, as opposed to EC values, must be used to estimate salt loads.

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Although a variety of analysis methods could be used by CV-SALTS, the simplest method that meets project needs should be adopted.<sup>35,36</sup> The below factors were considered in selecting the method for estimating salt and nitrate loads:

- *Scale of Area:* The level of detail required for estimating salt and nitrate loads varies in proportion to the scale of the area under consideration. For instance, small urban watersheds or groundwater basins will be generally analyzed with a greater level of detail than watersheds or groundwater basins with large areas of a similar rural character.<sup>37</sup> For large areas, sub-regional plans can be the vehicles for providing the necessary management details.<sup>38</sup> The analysis method must be sufficiently detailed to provide an accurate first cut of the sizes, intensities, natures, and locations of sources to evaluate regional management practices.
- *Availability of Data.* The analysis method should rely upon readily available data to avoid new or challenging data collection activities. Detailed computer models require more extensive data to calibrate and validate the models than simpler approaches. Currently available data may not be sufficient to calibrate and validate more detailed computer models. The Watershed Analysis Risk Management Framework (“WARMF”) modeling performed for California Urban Water Agencies (“CUWA”) and the Central Valley Drinking Water Policy Work Group serves as an example. Errors were noted in comparison of available data with WARMF simulated nutrient concentrations in the San Joaquin River. The technical report and supporting documentation attributed these errors in part to data that lacked sufficient spatial resolution.<sup>39,40</sup>
- *Scientifically Defensible and Transparent Method.* One consideration in selecting an analysis method is the ease by which stakeholders understand the procedures followed and results obtained. The data and procedures used to estimate salt and nitrate loads need to be clear and scientifically defensible to foster consensus among stakeholders that the loads are reasonable

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<sup>35</sup> SWRCB. June 2005. *A Process for Addressing Impaired Waters in California*. State of California, SB 469 TMDL Guidance. p. 3-4.

<sup>36</sup> U.S. EPA. March 2008. *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. p. 8-2.

<sup>37</sup> Ibid. p. 2-18.

<sup>38</sup> Ibid. p. 2-18.

<sup>39</sup> Systech Water Resources, Inc. (“Systech”). 25 April 2011a. *Task 2, Technical Memorandum, Analytical Modeling of the San Joaquin River*. p. 4-1.

<sup>40</sup> NewFields Agricultural & Environmental Resources. 21 March 2011. *Technical Documentation and Limitations for Development of WARMF Model Input Parameters*. Technical memorandum to Central Valley Drinking Water Policy Working Group. p. 7.



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and consistent procedures have been followed to estimate loads for all SNMP Regions. Simplified methods, when sufficient to address project needs, are easier to interpret and more likely to be accepted by stakeholders than more complex methods.<sup>41</sup>

- *Common Use of Method.* The analysis method should be commonly used and, thus, familiar to others. For example, GIS has been employed as part of implementing the Drinking Water Policy for the Central Valley. Salt and nitrogen in the Santa Ana region are being managed primarily on the basis of “real-time data obtained through a rigorous monitoring program, rather than on model projections.”<sup>42</sup> In lieu of detailed modeling, stakeholders in the Santa Ana region are relying on groundwater monitoring in combination with a “projection tool” developed using a surface water flow/quality model and a groundwater continuous-flow stirred-tank reactor model.<sup>43</sup>

Given the above factors, salt and nitrate loads to surface water and groundwater will be estimated in the Initial Studies by CV-SALTS using GIS and spreadsheet computations. This method is easy to apply and explain, and is adequate for most SNMP Regions to assess whether sustainable salt and nitrate balances exist in those regions. The method also is sufficient to evaluate potential regional management practices, and assess whether local management practices must be augmented by regional practices.

It is recognized the proposed method has limitations. For instance, salt and nitrate loads estimated by the method will not account for temporal or spatial variations caused by changes in such parameters as soil types, applied water, precipitation, land use, or fate and transport processes, including de-nitrification and mineral dissolution. Follow-up Studies may be performed to characterize the temporal and spatial variations of salt and nitrate loads for particular SNMP Regions and to evaluate specific local management practices.

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<sup>41</sup> U.S. EPA. 2008. op. cit. p. 8-3.

<sup>42</sup> Santa Ana Regional Water Quality Control Board. Revised February 2008. *Water Quality Control Plan, Santa Ana River Basin (8)*. p. 5-43.

<sup>43</sup> Ibid. p. 5-28.

# PRELIMINARY SCHEDULE FOR COMPLETING TECHNICAL TASKS OF CENTRAL VALLEY SALT AND NUTRIENT MANAGEMENT PLAN

