CV-SALTS Technical Advisory Committee Meeting

When: Thursday, November 10th, 2011 from 1:30 PM to 4:30 PM

Location: SacRegional, 10060 Goethe Road, Sacramento

Conference #: (218) 339-4600 Participant Code: 927571#

GoToMeeting Link: link Meeting ID: 842-614-834

https://www2.gotomeeting.com/join/842614834

Agenda

1. Welcome and Introductions

2. Update from Knowledge Gained Subcommittee – Tom Grovhoug
   a. Highlights of October 19th call (**See below for a link to more Knowledge Gained documents.)
   b. Consider approval of framework document, evaluation form, and checklist

3. Approach to Developing Central Valley SNMP– Michael Steiger
   a. Solicit input and discuss draft memorandum
   b. Consider approval of approach

4. Discuss boundaries of potential Central Valley SNMP Regions – Michael Steiger
   a. Present and discuss potential boundary types using GIS-based system
   b. Discuss pros and cons of different boundaries
   c. Solicit input on process to involve stakeholders on boundaries

5. Next Meeting/Call December _____ at _____

**A package of additional documents from the 10/19 Knowledge Gained call has been posted at the following link: http://cvsalinity.org/index.php/documents/doc_download/778-knowledge-gained-supporting-docs-for-111011

A Framework for Salt/Nitrate Source Identification Studies

Prepared by: CV-SALTS Knowledge Gained Subcommittee for CV-SALTS Technical Advisory Committee [should contributors be named in a footnote?]

November 4, 2011

1. Introduction

At the April 22, 2011 Executive Committee Meeting, the Knowledge Gained Subcommittee presented a technical memorandum, dated April 15, 2011, to the Executive Committee outlining a framework for preparing salt/nitrate source identification studies. The Executive Committee approved the basic elements provided in the memorandum and directed the Knowledge Gained Subcommittee to complete a more detailed framework document. This document provides the more detailed framework for preparing regional-scale salt/nitrate source identification studies in the Central Valley, as requested by the Executive Committee. These studies would be completed as an element of salt and nutrient management plan development in the Central Valley. An overarching conceptual framework for preparation of salt and nitrate management plans in the Central Valley will be developed in the future by the CV-SALTS Technical Advisory Committee.

Our recommendation is that salt/nitrate source identification studies be conducted in a phased manner that utilizes best available information and tools to promote cost-effective and timely evaluations, and to provide an opportunity for on-going stakeholder input to that process. We have developed a suggested approach for preparing "Initial Studies" consisting primarily of initial data gathering and simplified conceptual modeling to establish preliminary water budgets and salt/nitrate balances for each identified Study Area.[1]

[1] We use the term "Study Area" throughout the document to define planning areas within the Central Valley. At this point we have not attempted to define Study Areas beyond thinking of them as small enough to be effectively managed and modeled. The framework described herein is intended to guide regional-scale salt/nitrate source identification studies and is not necessarily applicable to source identification studies that would be accomplished on a facility- or municipal-scale basis, although much of this framework is scalable for those applications. [Note: To complete the Initial Studies described in this memo, a delineation of Study areas must be completed]

The Knowledge Gained Subcommittee recommends that the Initial Studies include basic information about known sources of salt and nitrate, land uses, areas of contamination and impairment, recycled water and groundwater recharge projects, regulatory constraints, and past or ongoing local planning programs and monitoring pertaining to the management of salt and nitrate within the Study Area. [2] Such basic information will be useful to Stakeholders for characterizing and categorizing identified Study Areas and evaluating the need and scope for subsequent "Follow-up Studies"[3] needed to support the development of Salt and Nitrate Management Plans .

2. Technical Study Goals

The goals, or general statements of intent, of the salt/nitrate source identification studies[4] , as an element of the overall Salt and Nutrient Management Plans, are to provide data and information that can contribute to:

- Characterization and categorization of identified Study Areas throughout the Central Valley;
- An understanding of the linkages between Study Areas;
- Prioritization of potential salt/nitrate management practices;
- Support for Salt and Nitrate Management Plans required by the Recycled Water Policy;
- Support for appropriate changes to beneficial use and water quality objective changes; and
- Support for proposed Basin Plan amendments.

3. Technical Study Objectives

Technical objectives define the strategies or steps to attain the identified goals. To provide flexibility to the parties performing the studies, these objectives are general in nature. Steps for performing studies that comply with these objectives are described in later sections of this document.

The key technical objectives for an Initial Study are:

[2] Such information does not include detailed evaluations of the current management and policy issues in Study Areas. However, we recognize the value and need for such evaluations and recommend that they be completed simultaneously with, but separate from, the Initial Studies. Ultimately, salt/nitrate source identification studies must consider these topics/issues to be relevant.

[3] At this point, a detailed approach for preparing subsequent "Follow-up Studies" has not been developed because the specific scopes of such additional studies will depend on the Initial Study results and region-specific management and policy issues for the Study Area.

[4] The term "salt/nitrate source identification studies" is a general term, and refers to both the Initial Studies and Follow-up Studies.

1. Develop a conceptual model for the Study Area including identification of sources, sinks, and transformation processes necessary for the development of water budgets and salt/nitrate mass balances;
2. Characterize the current understanding of the movement of water and salt/nitrate into and out of neighboring Study Areas;
3. Develop preliminary water budgets and salt/nitrate mass balances using available information;
4. Identify potential management strategies;
5. Make a preliminary estimate of the rate of salt/nitrate accumulation or reduction in surface water and groundwater within a Study Area;
6. Analyze historical and projected salt /nitrate loading rates and concentrations for surface water and groundwater within the Study Area in cases where these loads can be quantified; and
7. Identify and evaluate data gaps, data sensitivity, default assumptions, and data limitations for the Study Area.

Follow-up Studies will likely be needed for a Study Area based upon stakeholder review of Initial Study results and the region-specific management and policy issues for the Study Area[5]. Technical objectives for the Follow-up Studies may include:

1. Delineate the lateral and vertical extents of regions within a Study Area where beneficial uses are being or have been impaired by salt/nitrate accumulation, or are vulnerable to such impairment;
2. Determine current and legacy salt/nitrate sources that may have contributed to beneficial use impairment and refine the estimates of the salt/nitrate load contribution of each source;
3. Assess the fate and transport of salt and nitrate in surface and ground waters, including surface water mixing, denitrification and preferential migration pathways (e.g., presence or absence of low permeability strata, proximity of irrigation or potable supply wells);
4. Ensure compliance with the salt and nutrient management plan requirements of the Recycled Water Policy; and
5. Characterize temporal variations in salt/nitrate loads that may influence implementation of management practices, e.g. the Real Time Management Program of discharges to the San Joaquin River.

4. Technical Study Approach

Studies should be conducted in a phased approach to promote cost-effective evaluations and provide an opportunity for stakeholder input at intermediate points in the technical study process.

[5] The study area for any Follow-up Study should be the same as the study area for the Initial Study.

Initial Studies should be completed for all Study Areas. They should consist of the initial data gathering and simplified conceptual modeling to determine preliminary water budgets and salt/nitrate balances. The Initial Studies should also include the collection of additional information about known contamination and impairments, recycled water and groundwater recharge projects, regulatory constraints, and local planning, monitoring and management programs pertaining to salt and nitrate within the Study Area.

INITIAL STUDIES

Step 1: Study Area Delineation and Characteristics - The first step in an Initial Study is a clear delineation of the Study Area and a description of Study Area characteristics. All studies should pertain to a clearly defined Study Area, with horizontal and vertical boundaries that are consistently used as the frame of reference for all subsequent evaluations. Considerations in establishing boundaries should include natural hydrological boundaries (watersheds and groundwater basins), water supply and wastewater infrastructure, boundaries for application of existing salt/nitrate water quality objectives or TMDL wasteload/load allocations, land use characteristics, data availability and coverage in compatible GIS format, availability and extent of existing surface and groundwater modeling tools, and boundaries of existing planning entities such as counties, water districts, agricultural coalitions, and Integrated Regional Water Management (IRMW) planning areas. An advantage to selecting Study Areas based on natural hydrological boundaries may be a reduction in the cost and amount of time it takes to develop water budgets and salt/nitrate mass balances. On the other hand, use of political boundaries may better define a sustainable management area that engages appropriate stakeholders and capitalizes on existing planning efforts and tools. Study area characteristics that should be described include land use, surface and ground water quality, climate, physiography, geology, hydrology, and hydrogeology. GIS should be used to delineate Study Areas and Study Area features to promote consistency between Study Areas and to incorporate geo-spatial information into the conceptual model.

Step 2: Screening Existing Analytical Tools – The second step is the screening of publicly available analytical tools and surface and groundwater simulation models that cover the region of interest. Making use of existing models, in particular those that are calibrated and well-documented, can save considerable time and lend credibility to the water and salinity budget analysis. It also allows comparisons to previous studies which helps to validate the analysis, especially if the previous studies were well accepted. Linkage or integration of surface, groundwater and water quality models is desirable if this linkage allows more thorough tracking of basin hydrology and if the models are capable of exchanging component hydrology and water quality information in a prescribed manner. Care should be taken to understand the conceptual basis of these models to avoid attempting to link models that are fundamentally incompatible. For example the WARMF model has a very limited groundwater depiction – the groundwater layer is typically two meters deep and does not recognize constructs such as tile drainage or deep percolation. Hence it cannot explicitly simulate subsurface tile drainage and the salt loads that are contained in the drainage - a significant component of salt loads to the River from west-side San Joaquin Basin irrigation and water districts.[Delete?] The different evapotranspiration

tomg 11/4/11 2:16 PM
Formatted: Font:14 pt

computation algorithms utilized in the WARMF model and in groundwater models such as IWFM and MODFLOW and the difficulty in determining a groundwater model component analogous to the WARMF deep recharge present challenges in linking the models together. Where these sorts of data exchange problems arise – it should be incumbent on the modeling team to document these problems and the remedies adopted. The difficulties of linking models within a modeling framework are usually underestimated.

Water and salt balances can be readily constructed from calibrated groundwater simulation models. Models such as MODFLOW and IWFM have built-in water budget subroutines – known as ZONEBUDGET in the case of the finite difference MODFLOW model and Z-Budget in the case of the finite element IWFM model. These water budget outputs have been further manipulated into customized spreadsheets for model applications such as WESTSIM into terms that stakeholders may be more familiar with and therefore able to provide critical feedback. For example expressing recharge, evapotranspiration and seepage for a pre-defined three dimensional "zone" in units of acre-ft/acre (depth of water) makes sense to an irrigator who tends to think in these terms. [Delete?] [Concern exists that root-zone salt and water balances are not addressed in sufficient detail or with sufficient accuracy by many groundwater models. This is very important for properly accounting for the amount of salt going to deeper groundwater and how much goes out laterally to surface water.]

Step 3: Preliminary Water Budgets - The third step in an Initial Study is the development of preliminary water budgets.[6] A water budget is the characterization and accounting of inputs (water sources), outputs (water sinks), and changes in water volume (e.g., groundwater elevation changes) for a defined Study Area. Examples of water sources and sinks are provided in the attached Salt/Nitrate Balance Study Evaluation Checklist (Table 1). The study also may need to identify constraints to the water budget as applicable[7] (e.g. permit terms, environmental regulations, risk management). *The development of accurate water budgets is the foundation of the salt/nitrate mass balances.*

Step 4: Preliminary Loads and Mass Balances - The fourth step in an Initial Study is the development of preliminary salt/nitrate loads and mass balances using available information. All salt/nitrate sources, sinks, concentrators and transformation processes are identified with appropriate quantitative, location, and associated land use data. Examples of salt/nitrate sources, sinks, and concentrators are provided in the attached Salt/Nitrate Balance Study Evaluation Checklist (Table 1). This information is used in conjunction with the water budgets to estimate salt/nitrate loads and to complete accompanying mass balances. Salt/nitrate loads being discharged to a particular water body are estimated by multiplying

[6] More than one water budget may need to be developed to capture variability in water volumes and management strategies attributable to different hydrologic conditions (e.g., wet, above normal, below normal, dry, and critical water year classifications, dry vs. rainy seasons). For surface water evaluations, a minimum of a monthly temporal scale for water budgets and salt/nitrate mass balances should be used. For groundwater evaluations, an annual, or if justified, longer temporal scale for water budgets and salt/nitrate balances should be used.

[7] It is critical to identify the water that may be consumed in the Study Area and that which passes through or remains in place.

Tom Grovhoug 11/3/11 9:05 AM
Deleted: differs from that used in most regional

Tom Grovhoug 11/3/11 9:06 AM
Deleted: – making it impossible to directly substitute the estimates made with one model for the other.

tomg 11/4/11 2:18 PM
Deleted:

tomg 11/4/11 2:15 PM
Formatted: Highlight

tomg 11/4/11 2:16 PM
Formatted: Font:14 pt, Highlight

the flow volume of each discharge by its total dissolved solids (TDS) (or other measurement of salt concentration) and nitrate concentrations. For groundwater it will be necessary to define an appropriate unit of the aquifer system for purposes of analyzing assimilative capacity and to establish that there is an equivalent analysis of the groundwater data that is representative of that unit (e.g., it should not be assumed that the entire volume of groundwater in a basin/sub-basin is instantaneously and uniformly mixed).

As with the water budgets, the data and assumptions relied upon to conduct the salt/nitrate mass balances must be clearly identified.

Step 5: Budget and Mass Balance Graphics - The fifth step in an Initial Study is to synthesize and create visualizations of water budget and salt/nitrate mass balance information. Data visualization should be done in consideration of salt/nitrate issues and regulatory endpoints so that stakeholders can determine if the studies are sufficient to accomplish the goals of the study (i.e., the goals established in Section 2 of this document) and facilitate development of regional Salt and Nutrient Management Plans that act together to protect or restore surface water and groundwater beneficial uses ultimately adopted in the Basin Plan.

The Knowledge Gained Subcommittee recommends that water budget and mass balance results be presented in a consistent manner and that uniform data visualization templates be developed by CV SALTS such that results of studies from different Study Areas can be compared and integrated.

Examples of recommended data visualization tools are water budget diagrams, mass balance diagrams, bar charts, pie charts, histograms and time series graphs. For consistency, we recommend that such data visualizations use the following units:

- Loading rates: tons/day, tons/month, or tons/yr (depending on temporal scale of interest)
- Concentrations: mg/L
- Flowrates: acre-ft/day, acre-ft/month, or acre-ft/yr (depending on temporal scale of interest)

The salt/nitrate source identification studies should contribute to the "common language" between regional Salt and Nitrate Management Plans, so as to enable regional management practices to be coordinated and not acting at cross-purposes to one another.

Step 6: Data Gaps and Limitations – The sixth step in an Initial Study is the Identification and evaluation of data gaps, data sensitivity, default assumptions, and data limitations for the Study Area.

FOLLOW-UP STUDIES

The nature and complexity of the necessary Follow-up Studies will vary depending on the situation. Additional investigations or computer modeling will likely be needed to refine water budgets, more accurately characterize temporal salt/nitrate concentration trends, evaluate salt/nitrate fate and

transport, and help prioritize management practices needed to meet (or attempt to meet) regulatory requirements (e.g., attainment of water quality objectives in local and downstream water bodies).

Follow-up Studies may include the following:

- Surface and groundwater modeling[8] to develop more refined water budgets, salt/nitrate mass balances, and for other complex analytical needs;
- Evaluation of surface water bodies carrying the largest loads and regions within groundwater basins with the highest salt/nitrate concentrations;
- Evaluation of drivers of surface water and groundwater supply management and of land cover decisions in the Study Area;
- Evaluation of land cover at current development level and at estimated build out (or through end of existing general plan coverage);
- Evaluation of current best management practices in the region; and
- Evaluation of current monitoring gaps and funding/schedule to fill.

DATA COMPLETENESS AND ACCURACY

All data relied upon to conduct the studies should be clearly documented.

The reliability of the water budgets and salt/nitrate mass balances largely depends upon data completeness and accuracy. Data completeness and accuracy varies broadly throughout the Central Valley. Incomplete or conflicting data should be described, and actions needed to address such problems (e.g., using other assumptions supported by references needed to develop salt/nitrate loads and mass balances) should be documented.

Only data that has undergone quality assurance/quality control review should be used to conduct salt/nitrate source identification studies. Other data, considered but not used, should be clearly documented as being of lower quality. Sensitivity analyses should be conducted to determine whether data variability affects water budgets and salt/nitrate mass balances.

Assumptions will need to be made in cases where no data exist. All assumptions should be clearly identified and, whenever, possible, supported by references. **The Knowledge Gained Subcommittee recommends that CV SALTS develop a set of suggested default assumptions for use when data are not available. Sensitivity analyses can be used to determine whether default assumptions are appropriate, or whether additional data collection or studies are needed.**

[8] It is critical that the strengths and weaknesses of the existing models be evaluated, particularly with respect to the work completed prior to the groundwater model development to physically characterize the coupling of stormwater and groundwater systems. To the extent that complex surface water and ground water flow dynamics are recognized for a subbasin or planning and analysis unit with identified salt and nitrate issues, a flow model would allow for greater spatial and temporal differentiation, which is critical for salt and nitrate management.

5. Suggested Initial Study Outline

A suggested general outline for the Initial Study report, along with a brief description of each report section, is provided below. In addition, the attached checklist titled "Data and Information Needs for the Identification and Quantification of Salt/Nitrate Sources" provides more detail and should be reviewed and used in conjunction with the outline below. The recommended outline for each Initial Study report includes:

- Description of the Study Area and Physical Description of Regions: This section should include an overview of the study goals and objectives, the constituents addressed in the study, and any stakeholders participating in study. In addition, both written and graphical descriptions should be provided of regional, watershed, and groundwater basin boundaries; areal extent of the region; climate, water sources, hydrology, geology, hydrogeology, and land use of the region.

- Data: This section should identify data sources, discuss data quality, limitations and sensitivity, and describe any assumptions used and the basis for those assumptions.

- Water Budgets: This section should include one or more preliminary water budgets that characterize the water dynamics and use of the region, at spatial and temporal scales that are appropriate for salt/nitrate management. This section should include a conceptual model of the budgets; discuss factors influencing the budgets; identify and quantify the significant surface and groundwater sources entering and pathways leaving the region; and should develop and discuss the water balances. All assumptions upon which the water budgets were based should be clearly identified, and the bases for the assumptions should be explained and, where possible, supported by references.

- Salt/Nitrate Loads and Mass Balances: This section should include preliminary salt/nitrate loads and mass balances that correspond to each water budget developed. This section should identify all significant salt/nitrate sources and sinks; quantify salt/nitrate loads associated with each source and sink; prioritize sources to surface water and groundwater, and estimate the rate of salt/nitrate accumulation or loss and project groundwater TDS/nitrate concentrations into the future. Representative TDS/nitrate concentrations used to calculate salt/nitrate loads should be identified. All assumptions upon which the mass balances were based should be clearly identified, and the bases for the assumptions should be explained and, where possible, supported by references. Data gaps and recommended areas of further study, if needed, should be discussed.

- Additional Basic information: For each Study Area, additional basic information should be collected that will be needed for the overall CV-SALTS effort. This additional information should include a

summary of:

- Known contamination/impairment in the Study Area – this information could be obtained from individuals, organizations, or agencies familiar with water quality issues in the Study Area (e.g. County Environmental Health Departments, Integrated Regional Water Management Groups, water purveyors. water users)
- Recycled water and groundwater recharge projects in effect or planned in the Study Area
- Water quality objectives, beneficial uses, local planning objectives, and existing management programs and strategies pertaining to salt and nitrate loads and concentrations within the Study Area, and
- Surface water and groundwater monitoring programs collecting flow, groundwater level, and salt and nitrate-related water quality data.

Data & Information Needs for the Identification and Quantification of Salt/Nitrate Sources

NOTE: The yellow highlighted rows indicate that there are comments that should be referred to.

Study Aspects	Comments
1 Description of the Study and Physical Description of Study Area	It may be more appropriate to gather and summarize this information as a part of the Initial Basin Characterization for each defined Study Area (prior to the Source Identification work).
Identifies Stakeholders Participating in the Study	
Identifies Goals and Objectives of the Study	
Physical Description of Study Area	
Describes physical boundaries of the Study Area	
Describes the rationale for the physical boundaries	
Applies physical boundaries to water, salt, and nitrate balances	
Provides the areal extent (acreage) of the Study Area	
Identifies watershed boundaries within and near the Study Area	
Identifies groundwater subbasin boundaries within and near the Study Area	
Identifies hydrologic areas (surface and groundwater) tributary to and from the Study Area	
Describes Study Area geology	
Describes Study Area hydrogeology	
Describes current Study Area land use	
Describes the Study Area climate	
Identifies Study Area water sources	
Are GIS shapefiles and data sources available for the following:	
Physical boundaries of Study Area	
Boundaries of watershed(s)	
Boundaries of groundwater subbasin(s)	
Surface water bodies	
Land use	
2 Data	It may be more appropriate to gather and summarize this information as a part of the Initial Basin Characterization for each defined Study Area (prior to the Source Identification work).
Presents and references all flow data used for the study	
Presents and references all salt data used for the study	
Presents and references all nitrate data used for the study	
Evaluates and discusses data sensitivity	
Identifies and quantifies data limitations, including accessibility and availability in useful format	
3 Water Budget(s)	
Provides a conceptual model of the water budget(s)	This would likely be developed as a part of the Iniital Basin Characterization for each defined Study Area.
Identifies and describes the water uses associated with various land uses	
Defines and discusses an appropriate physical scale based on available data	This would likely be developed as a part of the Iniital Basin Characterization for each defined Study Area.
Defines and discusses an appropriate temporal scale based on available data	
Develops water budget(s) for dry, wet, and average conditions	
Identifies and discusses the applicability of the following factors in the water budget:	Duplicate with row 37 - keep one or the other
assumed water usage used for different land use categories	
hydrology	
residence time factors	

Data & Information Needs for the Identification and Quantification of Salt/Nitrate Sources

NOTE: The yellow highlighted rows indicate that there are comments that should be referred to.

Study Aspects	Comments
regulatory demands	
habitat considerations	
flood control	
water supply variability	
Identifes and discusses the applicability of the following elements in the water budget(s):	
imported surface water	
precipitation	
land application of wastewater	
wastewater discharges to surface water	
residential irrigation	
irrigation subsurface drainage	
agricultural runoff	
stormwater runoff	
groundwater extraction	
groundwater recharge	
groundwater seepage to surface water	
groundwater inflow from outside the Study Area	
groundwater outflow from the Study Area	
surface water inflow from outside the Study Area	
surface water outflow from the Study Area	
infiltration	
evaporation	
evapotranspitration	
Defines terminologies used in the water budget(s)	
Provides a written explanation of the water budget(s)	
Identifies data gaps in the water budget(s) and recommends areas for further study	This would likely be included as a part of Identification of Additional Data and/or Information Needs
Provides a graphical representation of the water budget(s)	
--Graphic identifies and quantifies all significant sources of inflow to the Study Area	
--Graphic identifies and quantifies all water leaving the study area	
4 Salt Balance(s)	
Provides a conceptual model of salt movement from sources to sinks in the Study Area	This would likely be developed as a part of the Iniital Basin Characterization for each defined Study Area.
Develops salt balance(s) for dry, wet, and average conditions	
Identifies and discusses the applicability of the following sources and sinks in the salt balance(s):	
imported surface water	
agricultural runoff	
irrigation subsurface drainage	
soil amendments	
fertilizer	

Data & Information Needs for the Identification and Quantification of Salt/Nitrate Sources

NOTE: The yellow highlighted rows indicate that there are comments that should be referred to.

Study Aspects	Comments
CAFOs (e.g., dairies)	
industries (e.g., food processors, wineries)	
food and other products exported from the Study Area	
land application of wastewater	
-- CAFOs	
-- municipalities	
-- food processors and other industries	
wastewater discharges to surface water	
-- municipalities	
-- food processors and other industries	
residential irrigation	
septic tank systems	
stormwater runoff	
water transfers	
groundwater extraction	
groundwater recharge	
groundwater seepage to surface water	
groundwater inflow from outside the Study Area	
groundwater outflow from the Study Area	
surface water inflow from outside the Study Area	
surface water outflow from the Study Area	
mineral dissolution	
atmospheric deposition and scour	
upwelling of saline groundwater	
Defines terminologies used in the salt balance(s)	
Identifies, quantifies, and prioritizes salt sources to groundwater largest to smallest	
Identifies, quantifies, and prioritizes salt sources to surface water largest to smallest	
Provides concentrations and flow rates for each source	
Provides loading rates for each source (determine units for reporting)	
lbs	The units for the loading rates can be calculated as needed.
tons	
per day	
per month	
per year	
per acre	
per Study Area	
Identifies and quantifies salt sinks	
Provides loading rates to each sink	
Provides a written explanation of the salt balance(s)	
Provides a graphical representation of the salt balance(s)	

Data & Information Needs for the Identification and Quantification of Salt/Nitrate Sources

NOTE: The yellow highlighted rows indicate that there are comments that should be referred to.

Study Aspects	Comments
--Graphic identifies and quantifies all significant salt sinks out of the Study Area	
Identifies data gaps in the salt balance and recommends areas for further study	This would likely be included as a part of Identification of Additional Data and/or Information Needs
Quantifies the rate of salt accumulation or reduction in the Study Area assuming current conditions	
Projects salinity concentrations into the future assuming current conditions	
5 Nitrate Balance(s)	
Provides a conceptual model of nitrate movement from sources to sinks in the Study Area	This would likely be developed as a part of the Iniital Basin Characterization for each defined Study Area.
Develops nitrate balance(s) for dry, wet, and average conditions	
Identifies and discusses the applicability of the following sources and sinks in the nitrate balance(s):	
imported surface water	
agricultural runoff	
irrigation subsurface drainage	
soil amendments	
fertilizer	
CAFOs (e.g., dairies)	
industries (e.g., food processors, wineries)	
food and other products exported from the Study Area	
land application of wastewater	
-- dairies and other CAFOs	
-- municipalities	
-- food processors and other industries	
wastewater discharges to surface water	
-- municipalities	
-- food processors and other industries	
residential irrigation	
septic tank systems	
stormwater runoff	
water transfers	
groundwater extraction	
groundwater recharge	
groundwater seepage to surface water	
groundwater inflow from outside the Study Area	
groundwater outflow from the Study Area	
surface water inflow from outside the Study Area	
surface water outflow from the Study Area	
atmospheric deposition and scour	
naturally occuring nitrate in groundwater	
plant uptake and nutrient cycle	
reaction decay	

Data & Information Needs for the Identification and Quantification of Salt/Nitrate Sources

NOTE: The yellow highlighted rows indicate that there are comments that should be referred to.

Study Aspects	Comments
gaseous loss, volatilization	
Defines terminologies used in the nitrate balance(s)	
Identifies transformation of nitrate precurors into nitrates by discharge type	
Identifies, quantifies, and prioritizes nitrate sources to groundwater largest to smallest	
Identifies, quantifies, and prioritizes nitrate sources to surface water largest to smallest	
Provides concentrations and flow rates for each source and pre-cursor	
Provides loading rates for each source and pre-cursor (determine units for reporting)	
lbs	The units for the loading rates can be calculated as needed.
tons	
per day	
per month	
per year	
per acre	
per Study Area	
Identifies and quantifies nitrate and precursor sinks	
Provides loading rates to each sink	
Includes nitrogen losses in analysis	
Provides a written explanation of the nitrate balance(s)	
Provides a graphical representation of the nitrate balance(s)	
--Graphic identifies and quantifies all significant nitrate sources into the Study Area	
--Graphic identifies and quantifies all significant nitrate sinks out of the Study Area	
Identifies data gaps in the nitrate balance and recommends areas for further study	This would likely be included as a part of Identification of Additional Data and/or Information Needs
Quantifies the rate of nitrate accumulation or reduction in the Study Area assuming current conditions	
Projects nitrate concentrations into the future assuming current conditions	

Comparison of Central Valley Salt/Nitrate Balance Studies

	Study Aspects	Pilot Studies[1]	Turlock Study[2]
1	**Description of the Study and Physical Description of Study Area**		
	Identifies Stakeholders Participating in the Study	●	←○
	Identifies Goals and Objectives of the Study	●	●
	Physical Description of Study Area		
	Describes physical boundaries of the Study Area	●	●
	Describes the rationale for the physical boundaries	●	●
	Applies physical boundaries to water, salt, and nitrate balances	●	●
	Provides the areal extent (acreage) of the Study Area	●	●
	Identifies watershed boundaries within and near the Study Area	●	←○
	Identifies groundwater subbasin boundaries within and near the Study Area	●	●
	Identifies hydrologic areas (surface and groundwater) tributary to and from the Study Area	●	⊙
	Describes Study Area geology	●	●
	Describes Study Area hydrogeology	●	●
	Describes current Study Area land use	●	●
	Describes the Study Area climate	●	←○
	Identifies Study Area water sources	●	●
	Are GIS shapefiles and data sources available for the following:		
	Physical boundaries of Study Area	●	←○
	Boundaries of watershed(s)	●	←○
	Boundaries of groundwater subbasin(s)	●	←○
	Surface water bodies	●	←○
	Land use	●	←○
2	**Data**		
	Presents and references all flow data used for the study	●	●
	Presents and references all salt data used for the study	●	●
	Presents and references all nitrate data used for the study	●	←○
	Evaluates and discusses data sensitivity	●	⊙
	Identifies and quantifies data limitations, including accessibility and availability in useful format	●	⊙
3	**Water Budget(s)**		
	Provides a conceptual model of the water budget(s)	●	●
	Identifies and describes the water uses associated with various land uses	●	⊙
	Defines and discusses an appropriate physical scale based on available data	●	●
	Defines and discusses an appropriate temporal scale based on available data	●	←○
	Develops water budget(s) for dry, wet, and average conditions	●	←○
	Identifies and discusses the applicability of the following factors in the water budget:		
	assumed water usage used for different land use categories	●	●
	hydrology	●	←○
	residence time factors	⊙	←○
	regulatory demands	←○	←○
	habitat considerations	←○	←○
	flood control	←○	←○
	water supply variability	●	←○
	Identifes and discusses the applicability of the following elements in the water budget(s):		
	imported surface water	●	●
	precipitation	●	●
	land application of wastewater	●	●
	wastewater discharges to surface water	●	●
	residential irrigation	⊙	●
3	**Water Budget(s) (continued)**		
	irrigation subsurface drainage	●	●
	agricultural runoff	●	●
	stormwater runoff	●	●
	groundwater extraction	●	●
	groundwater recharge	●	●

Comparison of Central Valley Salt/Nitrate Balance Studies

Study Aspects				Pilot Studies[1]	Turlock Study[2]
			groundwater seepage to surface water	●	●
			groundwater inflow from outside the Study Area	○	●
			groundwater outflow from the Study Area	○	●
			surface water inflow from outside the Study Area	●	←○
			surface water outflow from the Study Area	●	←○
			infiltration	●	●
			evaporation	●	○
			evapotranspitration	●	●
		Defines terminologies used in the water budget(s)		○	●
		Provides a written explanation of the water budget(s)		●	●
		Identifies data gaps in the water budget(s) and recommends areas for further study		●	●
		Provides a graphical representation of the water budget(s)		●	●
		--Graphic identifies and quantifies all significant sources of inflow to the Study Area		←○	●
		--Graphic identifies and quantifies all water leaving the study area		←○	●
4	**Salt Balance(s)**				
		Provides a conceptual model of salt movement from sources to sinks in the Study Area		●	●
		Develops salt balance(s) for dry, wet, and average conditions		●	←○
		Identifies and discusses the applicability of the following sources and sinks in the salt balance(s):			
			imported surface water	●	●
			agricultural runoff	●	●
			irrigation subsurface drainage	●	●
			soil amendments	●	●
			fertilizer	●	←○
			CAFOs (e.g., dairies)	●	●
			industries (e.g., food processors, wineries)	●	●
			food and other products exported from the Study Area	●	●
			land application of wastewater		
			-- CAFOs	●	●
			-- municipalities	●	●
			-- food processors and other industries	●	●
			wastewater discharges to surface water		
			-- municipalities	●	●
			-- food processors and other industries	●	●
			residential irrigation	●	●
			septic tank systems	●	●
			stormwater runoff	●	●
			water transfers	●	←○
			groundwater extraction	●	●
			groundwater recharge	●	●
			groundwater seepage to surface water	●	●
			groundwater inflow from outside the Study Area	○	●
			groundwater outflow from the Study Area	○	●
			surface water inflow from outside the Study Area	●	●
4	**Salt Balance(s) (continued)**				
			surface water outflow from the Study Area	●	●
			mineral dissolution	●	●
			atmospheric deposition and scour	●	●
			upwelling of saline groundwater	←○	●
		Defines terminologies used in the salt balance(s)		●	●
		Identifies, quantifies, and prioritizes salt sources to groundwater largest to smallest		●	●
		Identifies, quantifies, and prioritizes salt sources to surface water largest to smallest		●	●
		Provides concentrations and flow rates for each source		●	○
		Provides loading rates for each source			
			lbs	●	←○
			tons	●	●

Comparison of Central Valley Salt/Nitrate Balance Studies

Study Aspects				Pilot Studies[1]	Turlock Study[2]
			per day	●	←○
			per month	●	←○
			per year	⊙	●
			per acre	●	←○
			per Study Area	●	●
		Identifies and quantifies salt sinks		●	●
		Provides loading rates to each sink		●	●
		Provides a written explanation of the salt balance(s)		●	●
		Provides a graphical representation of the salt balance(s)		●	●
		--Graphic identifies and quantifies all significant salt sinks out of the Study Area		●	●
		Identifies data gaps in the salt balance and recommends areas for further study		●	⊙
		Quantifies the rate of salt accumulation or reduction in the Study Area assuming current conditions		●	●
		Projects salinity concentrations into the future assuming current conditions		●	●
5	**Nitrate Balance(s)**				
		Provides a conceptual model of nitrate movement from sources to sinks in the Study Area		●	←○
		Develops nitrate balance(s) for dry, wet, and average conditions		●	←○
		Identifies and discusses the applicability of the following sources and sinks in the nitrate balance(s):			
			imported surface water	●	←○
			agricultural runoff	●	←○
			irrigation subsurface drainage	●	←○
			soil amendments	●	←○
			fertilizer	●	←○
			CAFOs (e.g., dairies)	●	←○
			industries (e.g., food processors, wineries)	●	←○
			food and other products exported from the Study Area	●	←○
			land application of wastewater		
			-- dairies and other CAFOs	●	←○
			-- municipalities	●	←○
			-- food processors and other industries	●	←○
			wastewater discharges to surface water		
			-- municipalities	●	←○
			-- food processors and other industries	●	←○
			residential irrigation	●	←○
			septic tank systems	●	←○
			stormwater runoff	●	←○
			water transfers	●	←○
			groundwater extraction	●	←○
5	**Nitrate Balance(s) (continued)**				
			groundwater recharge	●	←○
			groundwater seepage to surface water	●	←○
			groundwater inflow from outside the Study Area	⊙	←○
			groundwater outflow from the Study Area	⊙	←○
			surface water inflow from outside the Study Area	●	←○
			surface water outflow from the Study Area	●	←○
			atmospheric deposition and scour	●	←○
			naturally occuring nitrate in groundwater	●	←○
			plant uptake and nutrient cycle	●	←○
			reaction decay	●	←○
			gaseous loss, volatilization	●	←○
		Defines terminologies used in the nitrate balance(s)		●	←○
		Identifies transformation of nitrate precurors into nitrates by discharge type		←○	←○
		Identifies, quantifies, and prioritizes nitrate sources to groundwater largest to smallest		●	←○
		Identifies, quantifies, and prioritizes nitrate sources to surface water largest to smallest		●	←○
		Provides concentrations and flow rates for each source and pre-cursor		●	←○
		Provides loading rates for each source and pre-cursor			

Comparison of Central Valley Salt/Nitrate Balance Studies

Study Aspects	Pilot Studies[1]	Turlock Study[2]
lbs	●	←○
tons	●	←○
per day	●	←○
per month	●	←○
per year	●	←○
per acre	●	←○
per Study Area	●	←○
Identifies and quantifies nitrate and precursor sinks	●	←○
Provides loading rates to each sink	●	←○
Includes nitrogen losses in analysis	●	←○
Provides a written explanation of the nitrate balance(s)	●	←○
Provides a graphical representation of the nitrate balance(s)	●	←○
--Graphic identifies and quantifies all significant nitrate sources into the Study Area	●	←○
--Graphic identifies and quantifies all significant nitrate sinks out of the Study Area	●	←○
Identifies data gaps in the nitrate balance and recommends areas for further study	●	←○
Quantifies the rate of nitrate accumulation or reduction in the Study Area assuming current conditions	●	←○
Projects nitrate concentrations into the future assuming current conditions	●	←○

LEGEND:

● Study adequately addresses issue

⊙ Study partially addesses issue

←○ Study does not address issue

1 *Salt and Nitrate Sources Pilot Implementation Study Report*, Larry Walker Associates, Luhdorff & Scalmanini Consulting Engineers, Systech Water Resources, Inc., Newfields Agriculture and Environmental Resources, LLC, , Department of Land, Air and Water Resources, UC Davis, February, 2010.

2 *A Mass Balance Approach to Evaluate Salinity Sources in the Turlock Sub-Basin, California*, Erler & Kalinowski, Inc., June 2010

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.[1] 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.[2]

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

[1] 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.

[2] Risk Sciences. 6 May 2011. *Test Consensus Summary for MUN*. Revised draft. pp. 1-3.

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

The immense scale of the Central Valley requires involvement by local governments, agencies, and other third parties to effectively manage salt and nitrate sources.[8] CV-SALTS acts as the umbrella organization coordinating the planning efforts of these stakeholders.[9] 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.[10] 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.[11]

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

---

[3] 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.

[4] CVRWQCB. May 2006. *Salinity in the Central Valley, An Overview.* p. 1.

[5] CV-SALTS. 21 February 2011. *CV-SALTS Basin Plan Needs & Issues*. Version 6. pp. 2-3.

[6] Integrated Planning and Management, Inc. June 2008. op. cit. p. 11.

[7] CVRWQCB, 2006. op. cit. p. 3.

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

[9] CV-SALTS. 12 November 2010. *3a-3b Committee Recommended Questions and Statements*. Version 3. pp. 1-3.

[10] 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.

[11] SWRCB. 3 February 2009. *Recycled Water Policy*. Resolution No. 2009-0011. p. 1.

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,[12] 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.[13] 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").[14,15] CV-SALTS and stakeholders will consider DWR hydrologic (i.e., watershed), and groundwater basin and

[12] 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*. 4th 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.

[13] 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.

[14] 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.

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.[16] 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.[17]

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.[18] The work by CV-SALTS is helpful

---

[15] 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.

[16] CV-SALTS. 2009. *Salinity Programs Coordination Matrix*. Draft Version 11.

[17] 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).

[18] Larry Walker Associates. February 2010. *Salt and Nitrate Sources Pilot Implementation Study Report*.

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.[19]

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[20]

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.

---

[19] 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.

[20] 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.

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.[21] 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.[22]

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

[21] Larry Walker Associates. 2010. pp. 2-7 to 2-8.

[22] 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.

that discharge wastewater under NPDES permits or WDRs.[23,24,25,26] 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.[27,28,29,30,31,32,33]

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.[34] 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.

---

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

[24] EKI. June 2010. *A Mass Balance Approach to Evaluate Salinity Sources in the Turlock Sub basin, California*. p. 56.

[25] Larry Walker Associates. 2010. op. cit. p. 2-2.

[26] CVRWQCB. 2006. op. cit. p. 18.

[27] Larry Walker Associates. 2010. op. cit.

[28] 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*.

[29] 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.

[30] 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*.

[31] Systech. 2011a. op. cit.

[32] Systech. 25 April 2011b. *Task 3, Technical Memorandum, Analytical Modeling of the Sacramento River*.

[33] 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.

[34] 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.

Although a variety of analysis methods could be used by CV-SALTS, the simplest method that meets project needs should be adopted.[35,36] 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.[37] For large areas, sub-regional plans can be the vehicles for providing the necessary management details.[38] 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.[39,40]

- *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

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

[36] U.S. EPA. March 2008. *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. p. 8-2.

[37] Ibid. p. 2-18.

[38] Ibid. p. 2-18.

[39] Systech Water Resources, Inc. ("Systech"). 25 April 2011a. *Task 2, Technical Memorandum, Analytical Modeling of the San Joaquin River*. p. 4-1.

[40] 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.

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.[41]

- *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."[42] 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.[43]

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.

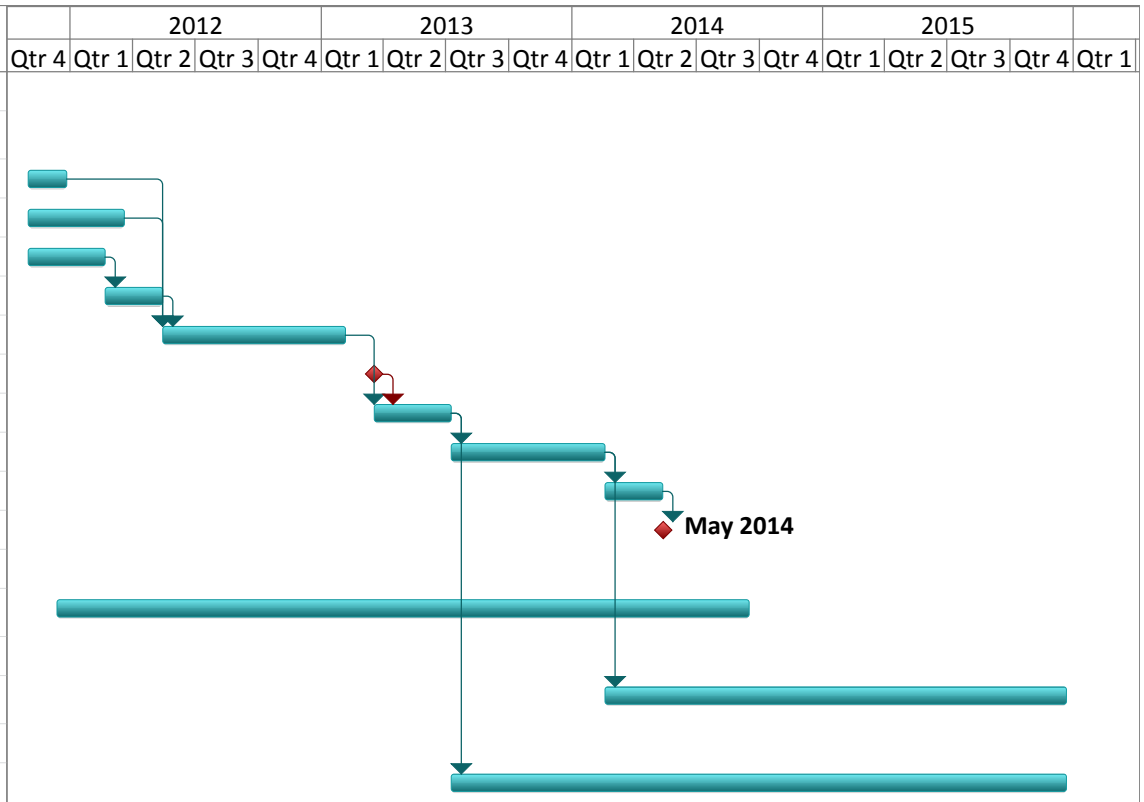
[41] U.S. EPA. 2008. op. cit. p. 8-3.

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

[43] Ibid. p. 5-28.

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

Task	2012				2013				2014				2015				
	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1
TECHNICAL TASKS TO COMPLETE CENTRAL VALLEY SNMP																	
Task 1: Identify Boundaries of SNMP Regions																	
Task 2: Coordinate and Involve Stakeholders																	
Task 3: Gather Existing Information and Data and Create an Inventory																	
Task 4: Assess Data																	
Task 5: Develop Conceptual Model and Estimate Salt and Nitrate Loads																	
Task 6: Confirm or Revise Beneficial Uses and WQOs																	
Task 7: Assess if Sustainable Salt and Nitrate Balances Exist																	
Task 8: Identify Potential Regional Management Practices																	
Task 9: Prepare Central Valley SNMP with Implementation Plan																	
Task 10: Finalize Central Valley SNMP																	
PUBLIC PARTICIPATION PROCESS AND CEQA																	
PREPARE BASIN PLAN AMENDMENTS																	
REGIONAL SALT AND NUTRIENT MANAGEMENT PLANS																	



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

Figure 1