August 18, 2014
SBX2 1 Agricultural Expert Panel

Suggestion for a new Section to be added to the Final Report

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Rationale for a Paradigm Shift

This section does not address the specific questions posed by the State Board. Rather, it summarizes several key facts and observations to describe the Panel's overarching thinking on the subject matter which directly leads to a rationale for a new approach to address the nitrate/salt issue. This new approach is intended to replace the current regulatory approach. A beginning framework for this approach is developed herein and is hoped to provide the impetus for constructive future action.

1. Regional Boards are charged to protect the beneficial uses of the waters of the state of California, including groundwater.
2. Harter et al. (2012) indicate that circa 96% of the total nitrate loading to groundwater within their study area (i.e., Tulare Lake Basin and Salinas Valley) emanate from cropland. While the exactness of this figure maybe debatable, the Panel does not disagree with their finding of agriculture being the principle source of nitrate loading to groundwater. This finding is consistent with many recent research efforts in the U.S., Canada, the European Union and other areas of intensive agriculture.
3. Agricultural nitrate loading to groundwater, including the associated loading of general minerals (collectively referred to as salts in this report), is a serious issue that needs to be addressed to ensure long-term sustainability of agriculture itself, many other sectors of California's economy, and environmental health.
4. Harter et al. (2012) state that, "Within the framework of Porter-Cologne, unless groundwater were to be de-designated as a drinking water source, reduction of nitrate loading to groundwater is required to improve long-term water quality." The Panel agrees and adds that source load reduction will need to play a critical part in the effort to protect beneficial groundwater uses in the long term. However, it is also cautioned to have realistic expectations on groundwater quality improvements. While source load reductions will eventually lead to groundwater quality improvements (other variables held constant and given a sufficiently large outflow from the groundwater basin) at monitoring points in aquifers at depth where thorough mixing has occurred, groundwater quality improvements should not be expected to be the norm in first encountered groundwater (e.g., near the groundwater table) (see below Item 7).
5. The regulation of agriculture via the ILRP and other agricultural orders (e.g., the Dairy General Order) far exceeds in complexity and difficulty other regulatory programs that have been implemented by Regional Boards. This is discussed by comparing the traditional use of regulatory groundwater monitoring activities (below Item 6) to challenges that are being encountered in the context of agricultural non-point source loading of nitrate and salt to groundwater (below Items 7-9).

6. Monitoring of first encountered groundwater has traditionally been the Regional Boards' most important tool to determine compliance or noncompliance with Waste Discharge Requirements (WDRs). In the context of traditionally regulated units (e.g., underground storage tanks, refineries, dry cleaners, and landfills) that can be summarized as point-source dischargers of constituents of concern that are not commonly found in natural groundwater systems (e.g., petroleum products, volatile or aromatic organics, pesticides, and other chemicals), or not in as high of concentrations (e.g., heavy metals), groundwater monitoring for regulatory compliance has proven effective. The reason for this effectiveness is illustrated with this example: If a groundwater sample retrieved from a monitoring well downgradient of a service station in an urban/industrial setting shows any detection of benzene (no matter what the concentration and regardless of how small it might be), and the upgradient well has no such detections, it is determined that the unit is leaking. The mass rate of the UST's subsurface emissions is not subject to debate in this case. Therefore, the Regional Board's decision would be straight forward and would entail a requirement for corrective action including the removal of the source of discharge (i.e., the leaking tank). Importantly, even if no particular remedial action were required, concentrations of the constituent of concern would be expected to eventually decline due to natural attenuation processes.
7. In the context of cropland nitrate and salt loading to groundwater, groundwater monitoring of first encountered groundwater does not provide the same utility as in the example in above Item 6. This is illustrated with an excerpt from "Concentration Versus Mass Flow, A supporting document for the UC Center for Water Resources, Nitrate Groundwater Pollution Hazard Index[1]:

> The possibility of having high chemical mass transport with a low concentration can best be described by considering salts dissolved in the water. As water is lost from the soil through evapotranspiration (ET), the salts are left behind and become concentrated. Assuming no precipitation or dissolution of salts in the soil, the concentration of salts in the water leaving the root zone (Cd) is related to the concentration of the salts in the irrigation water (Ci) by the following equation:
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> $$Cd = Ci/LF;$$
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> where LF is the leaching factor and is defined as:
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> $$LF = (AW–ET)/AW,$$
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> where AW is the applied water that infiltrates the soil. The amount of deep percolation carrying chemicals to the ground water is equal to AW–ET. Thus, the concentration of chemical in the water leaving the root zone is inversely proportional to the amount of deep percolation.
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> A conclusion that is well supported by research findings and scientific principles is that the concentration is not a valid indicator of good versus bad agricultural management practices.

8. Present crop fertilization guidelines were devised with the primary objective of increasing the yield and quality of crops without consideration of groundwater quality. The addition of a groundwater quality objective (whether absolute in nature or in terms of some desired reduction in groundwater concentrations) is counter to the former and creates an optimization problem between competing objectives. This is an exceedingly more difficult problem to

[1]http://ciwr.ucanr.edu/Tools/Nitrogen_Hazard_Index, accessed August 17, 2014).

solve than the traditional single-objective problem. Addressing this optimization problem will require entirely new thinking in the academic arena, on the farm, and in the regulatory community.

9. The success of a data collection effort, in terms of its effectiveness and its ability to achieve identified goals, begins in its planning stage. This should include the description of data needs, specific data quality objectives, and a delineation of sampling protocols/procedures that support data quality objectives. In addition, this plan should explain how data will be used, what questions are sought to be answered, and a demonstration of how the intended data collection effort will support the goals. Further, the quality of the collected data (i.e., data integrity) needs to be verifiable such that data can be flagged or dismissed if data objectives are not met. The important characteristics are not reflected in the agricultural orders with respect to nutrient mass accounting.
    a. The ability to conduct meaningful audits to verify data integrity is of particular importance to a regulatory data collection and reporting program because the data must ultimately support decision-making, including regulatory enforcement. Visual inspections that are currently part of the Regional Boards' enforcement tools can be effectively used to determine compliance with structural management practices (e.g., proper storage of dry manure and silage or positive drainage on corral surfaces) and identify some particular non-compliant conditions/actions (e.g., insufficient freeboard in a liquid manure storage basin or unauthorized discharges to surface waters of the state). However, as suggested by above Item 2, nutrient management (including irrigation management) on the cropland is the single most important management component that has the potential to drastically reduce nitrate and salt loading to groundwater; and, arguably the most basic quantity to document (i.e., nitrogen inputs to the cropland) is presently not verifiable.
10. In light of the observations made in above Items 7-9, the Panel recommends a paradigm shift away from the current regulatory approach. The paradigm shift is envisioned to be toward a well-planned and organized, comprehensive approach. This approach will need to include a robust research component complemented by extensive outreach, education, and a renewed look at professional training and certification programs. It is recognized that this would be a multi-million dollar effort spanning decades and including potentially significant regulatory restructuring. However, given the urgency of the nitrate/salinity matter and its tremendous complexity, it is difficult to imagine how this issue can be meaningfully addressed with a lesser effort.
11. While the Panel did not attempt to sketch out the exact scope of the above recommended approach, it is hoped that the formulation of its general concept provides a guide for future actions. Some additional thoughts are offered below.
    a. The optimization problem (see above Item 8) needs to be comprehensively addressed including economic analysis.
    b. An integral part of the research component will be crop-specific and field-scale nutrient mass balances with estimations of nutrients applied to cropland, nutrients removed with the harvest, losses from the investigated system, and changes in storage. Since growth-stage specific nutrient uptake is presently lacking for the majority of crops grown in California, this suggests a substantial demand for research.
    c. The extent of mass accounting (see Item 11b) to be required of individual farms needs to be rigorously assessed. This should consider an array of variables such as

objectives for accuracy and precision, sampling protocols that are demonstrated to support these objectives, economic viability, and practical limitations.

d. Data verifiability needs to be preserved. For example, mandatory tracking of fertilizer sales to specific farms would begin to support meaningful audits of fertilizer use.

e. Paperwork and human error during data input should be eliminated to the largest degree possible. This effort will likely require web-based software applications, a centralized database, and collaboration with analytical laboratories. It would be very advantageous if this kind of system were to be integrated with hands-on applications that farmers can use in the field to help them manage irrigation water and nutrients, and other software that is possibly already used to track harvest sales, moisture content, or milk production.