HYDROFOCUS INC
Solutions for Land and Water Resources

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[redacted]

SUBJECT: Review of Los Osos Basin Update and Current Wastewater Project Description--Revised

After reviewing San Luis Obispo County's update on groundwater conditions in the Los Osos basin and the current description of the wastewater project, I would like to offer the following observations.

- **The seawater intrusion problem is extremely urgent.** Seawater intrusion moved over a half mile in four years and has reached the center of municipal pumping from the lower aquifer. As I stated in my previous review (February 4) seawater intrusion is very difficult to reverse and renders water unusable for drinking when it exceeds only 1.5% of the inflow to a well. The most recent intrusion data indicate seawater intrusion is accelerating and threatens to shut down (or is already shutting down) the community's largest production wells.

- **Two immediate actions are needed to protect the water supply and prevent further intrusion.** Both actions can be implemented quickly (1-2 years), and both actions are mutually compatible:

    - **Shift most of the municipal pumping up from the lower to the upper aquifer system, and/or shift some of the municipal pumping farther inland.** This requires drilling new wells and laying more pipeline.
        - This action may not be sufficient to provide long-term protection against seawater intrusion because the basin has never experienced that much upper-zone pumping, particularly in the absence of septic system recharge.

    - **Decrease average per-capita water residential use from 104 gallons per capita per day (gpcd) to 74 gpcd or lower.** This latter level is reasonable since it is the current average for the City of San Luis Obispo.
        - This action provides more reliable long-term protection against seawater intrusion because it addresses the fundamental problem which is an overall imbalance in the water budget (i.e., more water is consumed in the basin than is being replenished). This would reduce total water production in the basin by about 500 AFY, which provides a reasonable

margin of safety given the uncertainty in previous studies (simulated intrusion rates) and uncertainties in the effects of currently proposed projects (shifting large amounts of pumping from the lower to upper aquifer; the percolation capacity of the Broderson leach fields).

- **Seawater intrusion and nitrates must be managed with an integrated basin-wide plan—they are interconnected problems within a single hydrologic system.** Examples of the interconnectedness between issues include:

    - Sewering will greatly decrease recharge to the upper aquifer at the same time municipal pumping from the upper aquifer will be increasing to minimize seawater intrusion. These two major changes are a huge shift in the upper aquifer water balance and could cause seawater intrusion in that aquifer.
    - Indoor water conservation tends to increase the salinity of wastewater (same quantity of salts will be dissolved into a smaller volume of water). Conservation is urgently needed, but its effect on recycled water salinity needs to be considered when planning for irrigation reuse. The Fine Screening Analysis estimates domestic water use adds 200 mg/l of total dissolved solids (TDS) from salts to the wastewater stream.
    - A small amount of saltwater intrusion can also increase the salinity of the municipal water supply to the point that resulting reclaimed wastewater will be unacceptable for irrigation reuse. A small amount of intrusion could easily push the TDS concentration of the municipal supply to near the short-term drinking water MCL of 1,000 mg/L, if intrusion outpaces the upward shift in pumping. Adding 200 mg/L of TDS from normal urban use would result in a wastewater TDS approaching 1,200 mg/L. The reuse technical memorandum (Carollo Engineers 2008) indicated that this level of salts could decrease yields of lettuce and peppers to less than 90% of normal yields, although other crops would remain above 90%. Nevertheless, this constraint on crop selection could diminish the appeal of recycled water to local growers
    - Outdoor conservation measures, especially xeriscape, can also have a beneficial effect on the amount of nitrates and other contaminants entering the groundwater. As water tables drop, nitrates are treated to a greater extent in the vadose (dry) zone of the soil, and use of native plants with xeriscape requires fewer fertilizers reducing nitrates entering the soil.
    - Stormwater recharge, along with conservation, benefit the water balance equation. Stormwater recharge will also control flooding in problem locations, reduce pollution of surface water, and dilute contaminants in the groundwater by promoting more efficient percolation of clean stormwater (infiltrated before it picks up pollutants).

- **The conservation target of 160 AFY in the project description is too small. Greater conservation is feasible and needed.**

    - The conservation element focuses only on residential indoor water use within the prohibition zone. This scope is unnecessarily narrow. Expanding to a larger footprint (the Urban Reserve Line) and to all types of water use (residential outdoor and commercial) greatly increases the conservation potential, as the following bullets demonstrate.
    - Current per-capita water use within the Urban Reserve Line is about 104 gpcd (1,722 AFY residential water use/14,800 residents, per LOSG data sheets).
    - Residential water use in San Luis Obispo is 74 gpcd. If Los Osos decreases its water use to the same level, the annual savings would be 497 AFY. This exceeds the proposed percolation rate at the Broderson leach fields, and it does not include potential reductions in commercial and institutional use.
    - The recent County update on the project commits to a target of 50 gpcd for residential indoor use within the prohibition zone (12, 450 population). This goal is less effective than meeting the San Luis Obispo target. If indoor residential use in this zone is 66 gpcd (per the Fine Screening Analysis), then a decrease to 50 gpcd would save only 223 AFY. If the 74 gpcd target were used in the prohibition zone, 418 gpcd would be saved. The target for overall use (74 gpcd) is preferable (especially if used within the URL) to the target for indoor use (50 gpcd) because it encompasses a broader range of conservation opportunities.
    - Conservation has many co–benefits, such as reduced energy consumption for pumping and heating water for domestic and commercial uses. Conservation is doubly important in conjunction with the wastewater project, because it decreases the amount of water that is exported from the western half of the basin in the first place, thereby decreasing the volume of recycled water that needs to be piped back to the west side. This decreases energy and operating costs for water treatment, wastewater treatment, and conveyance in both directions.
    - Conservation measures that decrease indoor water use or reuse water on-site have the dual benefit of decreasing municipal pumping and decreasing wastewater generation. These measures include low-flow plumbing fixtures and graywater systems. The previous, onerous regulations governing residential graywater systems were largely eliminated in the 2010 update to the California Plumbing Code. Graywater systems are now much more feasible from a permitting and cost standpoint.
    - Other conservation and water management measures have no effect on wastewater generation but are needed to bring the water budget in the Western Compartment back into balance. Some of these are mentioned in the Basin Update and previous project design studies but are not included in the current project description. Measures in this category include agricultural exchange

(using irrigation wells in the Los Osos Creek area for municipal supply in exchange for recycled water delivered for crop irrigation), stormwater management to increase percolation of runoff, and rainwater harvesting. These should all be included as part of a comprehensive program to address wastewater management and seawater intrusion.

- **Previous studies should be updated to reflect the current project description and current status of seawater intrusion.**
  The current project description reportedly does not include sprayfields. The recently documented arrival of seawater intrusion at the center of pumping in the lower aquifer will undoubtedly alter pumping patterns. Some of the cost and feasibility analyses in previous studies (for example, the Fine Screening Analysis and reuse technical memorandum) should be updated to reflect current conditions and opportunities.
  - The arrival of seawater intrusion at the center of pumping in the lower aquifer will force purveyors to shift a large percentage of municipal pumping from the lower aquifer to the upper aquifer. This would move the seawater intrusion problem from the lower aquifer to the upper aquifer. It also means that the "mitigation factors" used to evaluate the effect of wastewater alternatives on lower aquifer intrusion are not as relevant. The water balance and intrusion risk in the upper aquifer will be as important as in the lower aquifer, if not more so. For example, the effectiveness of percolation from the Broderson leach fields for mitigating upper aquifer intrusion is greater than for the lower aquifer, but new problems arise because the localized nature of Broderson recharge and increased upper aquifer pumping could result in seawater intrusion. As I mentioned in the previous review, Broderson recharge will not supply water to bay fringe marshes in the Baywood Park area.
  - The Fine Screening Analysis, the reuse technical memorandum (Carollo Engineers, 2008) and the Basin Update all assumed that water conservation would decrease water use and wastewater generation by only 160 AFY. The current project description assumes a 16 gpcd decrease in indoor water use (from 66 to 50 gpcd), which would decrease wastewater generation by 223 AFY for the initial population in the sewer service area (12,450 people) and by 330 AFY at buildout (18,428 people).
  - The previous studies rejected water conservation, urban reuse, graywater systems, low impact development (LID) and stormwater percolation as elements of the project because they would require purveyor participation. I disagree. All of those measures can be implemented by dealing directly with homeowners and public works agencies, bypassing the purveyors.
  - The current project description includes urban reuse, in spite of the previous conclusion that they would be infeasible because they require purveyor participation.

- The current, rapid advance of the intrusion front could change purveyor willingness to participate in conservation measures and alternative supply options such as agricultural exchange.
- Collectively, these several changes in basic project parameters (increased conservation, shifting pumping from the lower to upper aquifer, elimination of sprayfields) warrant an updated evaluation of project design and operation with an eye toward minimizing overall costs and impacts.

- **Eliminating the Broderson recharge facility appears feasible and should be considered.**
  The current project description proposes to percolate 448 AFY at the Broderson leach fields to meet two objectives: preventing seawater intrusion and disposing of wastewater in winter. A decrease in municipal pumping of 448 AFY would be at least as effective for preventing intrusion and is achievable through water conservation, agricultural exchange and urban reuse (see above discussion). Winter wastewater handling could be achieved through additional seasonal storage. In the absence of sprayfields and the Broderson facility winter storage for 4 months of recycled water is needed in an average year, and 5 months in a wet year. Also, approximately 28 inches of additional reservoir depth is needed to store excess rainfall during an exceptionally wet winter. With an initial wastewater generation rate of 700 AFY and 83 AFY of inflow and infiltration during the wet season, then 5 months of seasonal storage would require reservoir capacity totaling 375 AF. The reuse technical memorandum indicated that reservoirs with a depth of 15 feet "should be possible in any location east of Los Osos Creek" (Carollo Engineers, 2008). On a gross area basis, this translated to 12 AF of storage per acre of reservoir. Because approximately 2 feet of reservoir depth must be reserved for storing rain that falls directly on the reservoir during an exceptionally wet year, recycled water storage would be approximately 10 AF per acre of reservoir. The Giacomazzi site has at least 12 acres available for a reservoir. The remaining 255 AF of storage (requiring about 26 acres) would need to be constructed off-site, possibly on property owned by the end users.

  The cost of the additional reservoir capacity would be substantially offset by eliminating the cost of the Broderson leach fields and possibly eliminating nitrate removal from the treatment process. Nitrate removal is necessary for recharge but not for irrigation. The storage facility (ies) would be on land not suitable for farming and without sensitive habitat, avoiding impacts to both. Since project construction will take several years, time is available to locate and plan these sites as reuse contracts are being developed.

  This alternative would recycle as much as 100% of the wastewater for irrigation (783 AFY, including winter inflow and infiltration). Current irrigation in the Los Osos Creek area is approximately 800 AFY (Cleath-Harris Geologists, Inc., 2008), and urban reuse

opportunities totaling 133 AFY have been identified (Carollo Engineers, 2008). Thus, sufficient demand already exists to absorb the annual recycled water supply.

- **Wellhead treatment to meet primary drinking water standards is inevitable.** Seawater intrusion is forcing municipal production into the upper aquifer, where nitrate concentrations exceed the maximum contaminant level for drinking water in some locations. Wellhead treatment to remove nitrates using exchange resins is an approved technology, and is less costly and energy intensive than using reverse osmosis to desalinate seawater. Well-head treatment has been approved by the CPUC for Golden State Water Company in Los Osos.

- **The discrepancy between measured and simulated rates of seawater intrusion is not surprising.** The measured rate of advance of the saltwater/freshwater interface has been much greater than the simulated rate. The discrepancy likely stems from aquifer heterogeneity (water moves through the aquifer along preferred flow paths within sand lenses) that is not represented at the scale of the model. Heterogeneity does not have much effect on simulated water levels and basin yield, but it has a large effect on simulating the advance of the saltwater front.

- **If onshore water levels are above sea level, there will probably be no intrusion.** The rapid rate of seawater intrusion is caused by unsustainably low onshore groundwater levels. Although the greater density of seawater can theoretically cause intrusion even while onshore water levels are above sea level, I am unaware of a single instance when this occurred. In every case, seawater intrusion has occurred when onshore water levels fell below sea level. Water levels in the pumping trough in the center of Los Osos have been 5-10 feet below sea level for years Seawater will tend to move into this trough until water levels are brought up, which is why pumping must be reduced drastically in the lower aquifers (by approximately 1000 AFY according to model simulations[Cleath-Harris Geologists, 2009]) as soon as possible. Reduced pumping from conservation provides a rapid and direct way to address this issue, with long-term benefits.

- **Use monitoring data to track the saltwater interface and the model to track the water balance.** Models have trouble simultaneously simulating both detailed constituent transport and volumetric water budget components due to numerical instability. A transient groundwater flow model with monthly or shorter time steps will provide reasonable estimates of the water balance, particularly recharge and discharge along Los Osos Creek. The flows from that model can be inserted into the steady-state SEAWAT model to estimate the long-term interface location. Margins of safety should be applied to all modeling results to account for the uncertainties in modeling (see my January 13 comment memorandum) and the difficulty of reversing seawater intrusion.

Given the rapid advance of the saltwater front, additional monitoring wells are probably warranted to monitor the status of intrusion and the effect of pumping reductions on the rate of intrusion.

- **In summary, the wastewater project must be designed to help solve the seawater intrusion problem as part of an integrated water management plan for the Los Osos basin.** Water conservation and wastewater recycling are the key links between the wastewater project and seawater intrusion, and the present level of commitment to those project components is inadequate. The project should include water conservation, wastewater recycling, agricultural exchange and stormwater management measures that were considered but prematurely dismissed in previous studies but that continue to be advocated by the Los Osos Sustainability Group. The reasons for dismissing them were based primarily on assumptions regarding institutional and public mindset rather than technical or financial infeasibility. Those assumptions are out of date, given the harsh reality of the intrusion situation and the opportunity to concurrently solve the intrusion and wastewater problems at minimum cost.

Please do not hesitate to contact me if you have any further questions.

Sincerely,

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