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General Manager
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2122 9th Street, Suite 102
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SUBJECT: Response to Sierra Club/Los Osos Sustainability Group comments on the Basin Plan for the Los Osos Groundwater Basin.

Dear Ms. Kivley:

As requested, Cleath-Harris Geologists (CHG) has prepared this response to the June 11, 2015 comments letter (Letter) from the Sierra Club and Los Osos Sustainability Group to the Interlocutory Stipulated Judgment (ISJ) parties regarding the Los Osos Groundwater Basin Plan (Plan). This response to comments focuses primarily on technical issues that pertain to basin hydrology, and is organized based on the main headings contained in the Letter.

Comments of the Sierra Club and Los Osos Sustainability Group on development of the Basin Plan for the Los Osos Groundwater Basin.

The first two pages of the Letter are an introduction and overview of the comments. Specific issues are presented in sections that follow.

Basin conditions - why a strong Basin management plan is urgently needed.

This section includes a summary of the current status of seawater intrusion that supports the urgent need for a strong Plan, followed by a detailed discussion of water conservation in the Plan. Regulatory requirements related to water conservation, including the Governor Brown's Executive Order B-29-15 and the Coastal Development Permit for the Los Osos Wastewater Project (LOWWP) are discussed. The last paragraph on Page 5 questions the implementation order of Basin Infrastructure Programs and their cost-benefits.

The issues raised by the Letter regarding the Urban Water Use Efficiency Program and applicable regulations are not directly related to basin hydrology or CHG involvement in Plan development, and response is deferred to other Plan contributors. Rationale regarding the implementation order of the Basin Infrastructure Programs and cost-benefits are also deferred to other Plan contributors.

The Plan does not address major adverse impacts on the Basin.

The Letter contains several issues related to Basin hydrology, including drought impacts, climate change impacts, LOWWP impacts, and pumping redistribution impacts. Each of these are addressed separately below.

Drought Impacts

Issue #1: The Basin Plan estimates the sustainable yield under "current conditions" (without any of the proposed Basin Plan mitigation programs) is 2,450 acre-feet per year (AFY). Current production is about 2,500 AFY. With the drought, a reasonable estimate of sustainable yield is half the Basin Plan estimate of 2,450 AFY, or 1,225 AFY. The drought will clearly have a very serious adverse impact on the Basin, but the Basin Plan does not address it.

CHG Response: The sustainable yield of a basin is the quantity of water that can be withdrawn every year, including drought years, without causing an undesirable result. During drought, the seawater intrusion front moves inland. During wet periods, when there is more recharge, the seawater intrusion front is pushed back toward the coast. If temporary drought period movement of the seawater front creates an undesirable result (i.e. unacceptable chloride concentrations at a production well), then the sustainable yield value would need to be reduced accordingly.

The Basin Model (Model) scenarios proceed to a steady-state condition using average climatic conditions and do not simulate temporary drought impacts on the position of the seawater intrusion front. Maximum drought conditions were, however, effectively simulated in steady-state during the climate change scenarios. The Plan addresses drought, together with other issues of uncertainty, in Section 6.4 (The Challenge of Uncertainty).

Climate Change Impacts

Issue #2: Climate change...would reduce the "sustainable yield" of the basin under current conditions to 1,800 AFY from the current Basin Plan estimate of 2,450 AFY, or about 25%. It [The USEPA climate change evaluation] also found that the yield increase predicted with all Basin Plan programs in place (3,400 AFY) would drop to 2,325 AFY, or about 32%, negating all the predicted increase. The evaluation concluded that Morro Bay Estuary ecosystems, including Los Osos Creek, could be adversely impacted by LOWWP and Basin Plan programs...The study states "Climate change and precipitation trends and patterns must be considered when planning for the future". The Basin Plan does not discuss this evaluation. It recommends a 20% margin of safety to account for "climate variability" but the 20% is not nearly enough, as explained below (see Page 13).

[Page 13] The USEPA climate change evaluation provides a good place to start. The evaluation estimates "sustainable yields" at 1,800 AFY without Basin Plan programs in place and 2,325 AFY with all programs in place. However, the evaluation uses the current Basin Plan definition of "sustainable yield," which allows seawater intrusion to advance. The Basin Plan recommends subtracting 20% to reverse seawater intrusion. Therefore, we recommend a targeted Basin Yield of

under 2,000 AFY for the current population with Infrastructure Programs A, C, and D in place. This provides a reasonably cautious target given present conditions that can be changed in the future based on conclusive evidence (i.e. well monitoring over time).

CHG response: The sustainable yields reported in the Letter for climate change conditions represent the worst-case results out of all the climate outcomes evaluated. The greatest adverse impact to sustainable yield associated with climate change was due to decreased precipitation, compared to warming and sea level rise. Precipitation is also the least consistent component of climate change prediction when comparing the various global circulation models. Precipitation projections used for the USEPA evaluation were from the French CNRM model, which provided the lowest overall precipitation projections (i.e. worst-case). Some climate models show increases in future Central Coast precipitation. The maximum climate change impacts also occur at mid-century, and decrease between mid-and late-century, based on global circulation model outcomes.

The reduction in sustainable yield due to sea level rise and warming, which are consistently predicted by the global circulation models, would be 225 AFY with all adaptive management programs in place (from 3,400 AFY to 3,175 AFY). By comparison, when worst-case precipitation declines are factored into climate change, the reduction in sustainable yield reaches 1,075 AFY with adaptive management programs in place (from 3,400 AY to 2,325 AFY). This maximum reduction in yield can be mitigated under the Plan by increasing the buffer between basin production and sustainable yield.

The adaptive management programs for the USEPA climate change evaluation included all Plan programs except Program G (Agricultural Water Reinvestment), Infrastructure Program D (Creek Valley Expansion Wells), or Program S (Supplemental Water). In Plan terminology, the adaptive management programs for the USEPA evaluation would be U+ABC, with a sustainable yield of 3,350 AFY in Plan Table 43. The buildout population water demand for the basin is 2,880 AFY (without Program G), resulting in a buffer between basin production and sustainable yield of 470 AFY, which is not sufficient to offset the 1,075 AFY reduction in yield due to maximum climate change impacts. Under these conditions, the ISJ Parties could implement both Infrastructure Program D and the Agricultural Water Reinvestment Program G in order to maximize the buffer between sustainable and actual production in the Basin (Plan, page 293).

With the added adaptive management programs, equivalent to UG+ABCD in Plan Table 46, the Basin Yield increases to 3,500 AFY and the Basin production decreases to 2,380 AFY, resulting in a 1,120 AFY buffer between the two. This would be sufficient to offset the 1,075 AFY reduction in yield due to maximum climate change impacts at buildout.

LOWWP Impacts

Issue #3. The California Coastal Commission found substantial uncertainties in the ability of Broderson leach field and other LOWWP mitigations to avoid/minimize seawater intrusion and other impacts, so it added Special Condition 5 the requires conservation, recycled water reuse, monitoring, and adaptive programs to "maximize" the sustainability of the Basin and related

resources (see Exhibit 11). Hydrologist and water resources expert Eugene Yates (hereinafter,"Yates") one of the foremost authorities on the Los Osos Groundwater Basin and one of the creators of the Basin model, states that elimination of septic system return flows in conjunction with planned increases in pumping from the Upper Aquifer could cause seawater intrusion in that aquifer. He also states that the Project could adversely impact sensitive habitat by reducing groundwater flows (see Exhibit 1, Pages 4 & 5, and Exhibit 2, Pages 1 & 2). The Monterey Bay Watershed Institute also found that the LOWWP could adversely impact seawater intrusion in the Lower and Upper Aquifers and harm habitat (see Exhibit 3). These experts recommend maximizing conservation, recycled water use, and low impact development (LID) recharge measures, and implementing adaptive programs that put specific measures in place to address potential impacts. It is important to note that the Yates and the Monterey Bay's Institute's reviews were done in 2010, so did not factor in the added impacts of the present drought. The Basin Plan does not mention or address LOWWP impacts, e.g., it does not provide specific contingency measures, not does it maximize the conservation and recycled water reuse programs as recommended by experts and required by the LOWWP CDP.

CHG response: Potential LOWWP impacts to water resources were addressed during the environmental review and permitting process for that project. The Plan assumes the LOWWP is constructed and operated according to its permit requirements, which define conditions for wastewater reuse and disposal when evaluating specific Basin Program combinations. The Plan and the LOWWP need to work in concert, and Special Condition 5 is included in the Plan.

The buffer between basin production and sustainable yield provides the margin of safety recommended by Yates in 2010. Yates also conducted a peer review of the Plan which included a workshop with Cleath-Harris Geologists (Todd Groundwater, Final Peer Review of Plan for the Los Osos Groundwater Basin, September 14, 2014). Five of the six principal recommendations from the 2014 peer review were incorporated into the Updated Basin Plan. The Plan peer review was also performed during the present drought. An excerpt of the Yates 2014 peer review (Page 4) is as follows:

> "The Basin Yield Metric proved to be an important factor in the performance of the management strategies. For example, operating the basin at 100 percent of potential yield (Basin Yield Metric = 100) resulted in saltwater intrusion into the deepest parts of the basin (Zone E) as far inland as downtown Los Osos, whereas operating at a Basin Yield Metric of 80 avoided intrusion. Simulation results for the latter case showed the seawater intrusion front (250 mg/L isochlor) only moving inland as far as the western part of Morro Bay. Simulated water levels in Zone E also exceeded the Water Level Metric Target of 8 feet above sea level by several feet, thereby protecting the basin against seawater intrusion to a greater depth than suggested by the Water Level Metric Target."

The 2010 Monterey Bay Watershed Institute study included a Contingency Plan Outline (Figure 22, Page 57). The Plan contains most of the specific components of this plan, such as the Monitoring Well Network, Groundwater Sampling Program and Data Analysis, Hydrologic Balance Evaluation, and Performance Criteria and Benchmarks. The study identifies four Priority Zones for which contingency plans are recommended. Two of the Priority Zones (Zone 2 and Zone 3) relate to

seawater intrusion and are addressed by the Plan. The contingency measure for mitigating seawater intrusion (while preserving a sustainable water supply), include redistribution of pumping through the purveyor water system interties and implementing both Infrastructure Program D and the Agricultural Water Reinvestment Program G together in order to maximize the buffer between sustainable and actual production in the Basin.

The other two Priority Zones in the 2010 Monterey Bay Watershed Institute study are Priority Zone 1 covering Broderson Leachfield Disposal Capacity and Priority Zone 4 covering Environmental Conditions - Willow Creek, Los Osos Creek, and Morro Bay National Estuary. These Priority Zones are mainly covered by the LOWWP. As previously mentioned, the Plan assumes the LOWWP is constructed and operated according to its permit requirements. The Plan does provides surface water information with the hydrologic budgets. Agricultural water reinvestment (Program G) may also be considered a contingency measure to increase surface flows in Los Osos Creek.

Pumping Redistribution Impacts

Issue #4. The impacts from the redistribution of pumping (Basin Plan Infrastructure Programs A through D), in combination with LOWWP impacts, were not analyzed in the LOWWP EIR. However, Yates indicates additional pumping from the Upper Aquifer in conjunction with removal of septic system flows can cause seawater intrusion in the Upper Aquifer. He also states that the redistribution of pumping will not increase yield and may not protect against seawater intrusion (see Exhibit 6, e..g., page 4). Further, the Monterey Watershed Institute cites potential impacts to the Upper Aquifer and habitat due to interruptions in groundwater flows, which will be exacerbated by added pumping in the Upper Aquifer and inland. Stetson Engineers, the firm hired by the Parties to perform a peer review of the Basin model and proposed changes in pumping, warned that redistribution should be "gradual...with contingency plans in place" to address signs of harm to Basin resources (see Exhibit 3, e.g. Page 65 and Basin Plan, Page 80).

CHG response: Concerns from Yates that the redistribution of pumping will not increase yield and can cause seawater intrusion in the Upper Aquifer were resolved during a workshop with CHG in 2014. The hydrologic budget for recommended Plan program combinations was discussed and has been included in the Plan. An excerpt of the Yates 2014 peer review (Page 4) is as follows:

> "Additional water balance information not included in the draft Plan but communicated by CHG revealed that the export of wastewater from the western and central areas was fully balanced by recycled water returned to those areas, increases in simulated groundwater inflow and decreases in simulated groundwater outflow. For example, the three municipal expansion wells included in Infrastructure Program C increased the simulated net groundwater flow from the eastern area to the central area by 300 AFY."

Pumping redistribution inland and to the Upper Aquifer has been, and will be, gradual. The Plan also allows phasing to better achieve Plan Objectives. Contingency planning with respect to redistribution of pumping is provided through the purveyors water system interties (part of Infrastructure Program A).

The Plan fails to fulfill the purpose of the Interlocutory Stipulated Judgment.

Issue #5. As a result of its deficiencies, the Basin Plan does not fulfill the stated purpose of the Interlocutory Stipulated Judgment "to establish a process for developing and implementing a BMP (Basin Management Plan) that will serve as a physical solution for the management of the Basin water resources...." It does not include as a main component: "A strategy for maximizing the reasonable and beneficial use of the Basin water resources while ensuring: the long-term integrity and viability of the Basin as a potable water supply for the Parties collectively and each Party individually, including water quantity and water quality: and the sustainability of environmentally sensitive areas within or influenced by the Basin hydrology" (Page 5). The Basin Plan also does not fulfill another stated purpose: to provide a "safe yield" (see ISJ, Component A).

CHG response: The alleged deficiencies relating to Basin hydrology are resolvable under the current Plan, indicating the Plan fulfills its main purpose. Response to some of the issues presented in the Letter are deferred to other Plan contributors.

The Plan fails to consider and incorporate the recommendations of experts.

Issue #6. The Basin Plan ignores several expert reviews of the Basin and related recommendations.

CHG Response: The Letter refers to reviews and recommendations from Eugene Yates (currently with Todd Groundwater), the Monterey Bay Watershed Institute, and Peter Pyle of Stetson Engineers. The disposition of recommendations for the Plan is determined by the ISJ Parties. CHG has been involved with the peer review process, however, and the Plan does not appear to ignore, or fail to consider the recommendations of experts, as detailed below.

Eugene Yates, Todd Groundwater

Yates was invited by the ISJ Parties to conduct a peer review of the Draft Basin Plan. Concerns expressed in 2010 were repeated after reviewing the Draft Basin Plan. In response, the ISJ Parties organized a workshop meeting at CHG's office to review the Model and Plan in-depth. An excerpt of the Yates 2014 peer review (Page 1) is as follows:

> "The draft version of this review raised numerous questions related to potential weaknesses or inadequacies of the Plan. At a subsequent meeting with Spencer Harris of Cleath Harris Geologists (CHG), substantial amounts of additional information were provided that largely allayed the initial concerns. To assist others who might have similar questions about the Plan, the initial concern for some topics is retained under the subheading "Initial Review Concern". That is followed by a section titled "Resolution of Concern" that describes how the concern was addressed by additional data and explanation provided by CHG. "

The Yates 2014 peer review reconciled long-held concerns about seawater intrusion and basin yield with the information provided by CHG. Five of the six principal recommendations from the peer review were incorporated into the Updated Basin Plan. One recommendation related to increasing

the target for the Water Level Metric was not incorporated for technical reasons related to the Key wells.

Monterey Bay Watershed Institute

The Monterey Bay Watershed Institute study was produced in 2010, three years before the Plan. Some of the recommendations are directed toward the LOWWP, but other recommendations in the study are either part of the Plan or are considered in the Plan. These latter recommendations include the following (sections numbers from study):

- *4.2. Pursue a Balanced Hydrological Budget, Monitor to Improve Basin Understanding, and Update Models*. The Plan includes balanced hydrologic budgets for recommended Plan project combinations and a comprehensive monitoring program. Updating the Model to transient conditions (also recommended by the Stetson peer review) was considered by the ISJ. Given the magnitude of the changes in basin dynamics that will occur with implementation of the LOWWP, the most effective calibration period for a transient Model will include the transition from current conditions to LOWWP conditions. Peter Pyle of Stetson confirmed that the current steady-state Model is reasonable and adequate for planning. Therefore, the ISJ Parties decided to delay further consideration of a transient Model until calibration data for LOWWP conditions are available.
- *4.3 Rain water Harvesting from Roof Top Collection.* Rainwater harvesting is considered in the Plan (page 247).
- *4.5 Rain and Drought*. A climate change readiness analysis was performed by the ISJ Parties that considered worst-case precipitation declines based on global circulation models (discussed previously).
- *4.8 Contingency Plan.* The Plan contains most of the specific components of this plan (discussed previously).

Peter Pyle, Stetson Engineers

The 2010 peer review by Stetson Engineers was prior to the Plan and is mainly focused on the Model. The Stetson peer review concluded that the Model scenario regarding redistribution of pumping in the Basin with an increase in pumping in the Eastern Area is reasonable and could be initiated, assuming the change is gradual, with continued water level and water quality monitoring and analysis. The Model could be updated as effects of that strategy become more fully understood. Stetson recommended phased redistribution of pumping with contingency plans in place to make adjustments as needed and as ongoing monitoring data indicate.

The recommendation for gradual pumping redistribution, with monitoring, and contingency plans are in place. Pumping redistribution inland and to the Upper Aquifer has been, and will be, gradual. The Plan also allows phasing to better achieve Plan Objectives. Basin groundwater monitoring is on-going. Contingency planning with respect to redistribution of pumping is provided through the purveyors water system interties (part of Infrastructure Program A). Contingency planning with respect to Model uncertainty is provided by the Basin Yield Metric uncertainty buffer. As

previously discussed, the recommendation to upgrade the Model to transient capability was delayed by the ISJ Parties until a suitable transient calibration data set is available that incorporates LOWWP conditions.

The Plan fails to apply modeling assumptions and decision making tools that prioritize preserving the Basin.

Issues related to the modeling assumptions/safe yield estimates and with Metric/Success Criteria are presented in this section of the Letter.

Modeling Assumptions and Safe Yield Estimates

Issue #7a. The Basin Plan bases some of its most important findings and recommendations on modeling. However, Basin modeling does not include climate change factors and reduced rainfall predictions.

CHG Response: Climate change factors, including worst case precipitation declines, were simulated using the Model and are incorporated into the Challenge of Uncertainty section in the Plan (Section 6.4).

Issue #7b. Neither does Basin Plan Modeling factor potential impacts on Basin yield from the LOWWP and Basin Plan infrastructure programs (pumping redistribution). Yates points out that the combined impacts could cause seawater intrusion in the Upper Aquifer, reducing Basin yield and flows to habitat along estuary, potentially requiring more production from the Basin to replace groundwater flows. Yates also states that pumping redistribution will not increase yields, and in fact the Basin Plan may be overstating yield by 40%. The Basin Plan asserts that the overstating of estimates may not be known until harm is impossible to reverse (see Page 137).

CHG Response: The Model specifically simulates the effects on Basin yield from the LOWWP and Plan infrastructure programs (pumping redistribution). As previously described, concerns regarding the effects of redistribution of pumping on Basin yield were resolved during the 2014 peer review workshop. Pumping redistribution can increase Basin inflow and decrease Basin outflow, thereby increasing Basin yield.

The uncertainty of rainfall-runoff coefficients and depth of the rooting zone in soil moisture budget methods is attributed by Yates (2010) to result in a potential +/- 40% variation in estimated recharge and corresponding yield, based on two referenced studies. The rainfall-runoff coefficients and depths of the rooting zone developed for the Model were actually derived by Yates from other California coastal basins "where more rigorous calibration was possible" (Yates and Williams, Simulated Effects of a Proposed Sewer Project on Nitrate Concentrations in the Los Osos Valley Groundwater Basin, 2003).

The greater portion of the Basin, and most of the high-density development areas, are underlain by highly permeable sands. There are many recharge basins, closed depressions, and historically flooded low-lying areas where precipitation that does not evapotranspire or deep percolate in-situ can runoff into. According to Yates (2003), "This effectively concentrates the runoff in a small area, where it overwhelms soil moisture capacity, allowing a large percentage of the runoff to percolate past the root zone and become groundwater recharge." Given that conditions in the Los Osos Basin are highly favorable to deep percolation of precipitation and runoff, it seems unlikely that uncertainty in the soil moisture budget parameters would lead to the maximum possible overestimate of recharge. It seems more likely that the Basin recharge estimate could be too low, all other things being equal.

Metrics/Success Criteria

Issue #8. The Yield Metric relies on Basin Plan modeling and does not provide a reasonably cautious tool for decision making. The other metrics rely on actual physical evidence and provide much more reliable results. However, they do not asses the programs' effects on Zone E, the large, deep aquifer which is a vital part of the Basin's structure that is more seriously impacted by seawater intrusion than Zone D.

CHG Response: The Model is an appropriate methodology for developing the Basin Yield Metric. An excerpt from the Stetson Engineers peer review (Page 9) is as follows:

> "SEAWAT is an appropriate model code for the Los Osos basin for the evaluation of the average groundwater basin budget (including basin an subarea yields), the extent of seawater intrusion, and for use in evaluating the relative effects of development and changes in basin management or climate."

Groundwater monitoring data from Zone E are included in Basin metric calculations. Key wells for the Chloride Metric and Water Level Metric include five wells completed in Zone D, two wells completed in Zone E, and two wells completed in both Zone D and Zone E.

Issue #9. Metrics do not assess Zone C, the Upper Aquifer where the Basin Plan proposes to shift a lot more pumping. Zone C was reported to be only "relatively stable" in the 2005 Seawater Intrusion Assessment, subject to seawater intrusion during grouts. Another problem with the Water Level and Chloride Metric is that they rely on a relatively small number of wells, which may results in skewed results and high levels of seawater intrusion in some parts of the Basin). The Basin Plan also does not include a metric to measure Basin storage capacity, which the Basin Plan states is an important measure of Basin resilience (ability to weather droughts) (see Page 91).

CHG Response: Basin metrics are targets to help understand whether the Plan is meeting its primary goals of mitigating nitrate contamination in the upper aquifer and seawater intrusion in the lower aquifer. There is no seawater intrusion in the upper aquifer, so by definition there is no chloride metric for the upper aquifer. The basin monitoring program will screen the upper aquifer for potential new intrusion.

The Chloride Metric and Water Level Metric wells are selected based on location and period of record. These wells are in key locations where seawater intrusion has occurred or may be headed. Adding more wells to the metric dilutes the value of the selected key wells. The Basin monitoring program includes many more wells that will provide detailed information on changes to the groundwater system. If the monitoring program indicates the metric wells are not representative of the trends in seawater intrusion, the key wells may be added to or changed.

A Basin storage capacity metric would need to quantify the freshwater storage component. This would be complex and interpretive, due to the three-dimensional nature of the intrusion front. Water levels and chloride concentrations can be measured and compared directly.

The Plan fails to implement an effective adaptive management program and contingency measures.

Issue #10: The Basin Plan fails to identify and plan specific contingency measures to address impacts to the Basin that may occur despite mitigation programs. Instead, the Basin Plan includes what it calls an "Adaptive Management Plan' that is little more than a yearly review of monitoring data, which does not commit the Parties to take any action-nor does it ensure effective action is even feasible. According to the experts cited (Yates, Monterey Bay Watershed Institute), an effective adaptive/contingency program must include specific plans to address the most likely impacts, with measures in place to ensure effective responses within a timeframe that minimizes harm to the Basin (see Exhibit 1, Page 5 and Exhibit 3, Pages 56-66).

CHG Response: The Adaptive Management Plan provides the mechanism for suitable remedial action if negative trends or subsequent failure to meet the success criteria occur. As previously mentioned, the Plan contains most of components of the Contingency Plan outlined by the Monterey Bay Watershed Institute. The contingency measures for mitigating seawater intrusion Priority Zones (while preserving a sustainable water supply), include redistribution of pumping through the purveyor water system interties, and implementing both Infrastructure Program D and the Agricultural Water Reinvestment Program G together, in order to maximize the buffer between sustainable and actual production in the Basin. LOWWP conditions require action to address other Priority Zones identified by the Monterey Bay Watershed Institute.

The Plan fails to set time-specific objectives or use the authority needed to ensure effective program implementation as early as possible.

CHG defers the response on time-specific objectives or the use of authority to other Plan contributors.

Sierra Club/Los Osos Sustainability Group Recommendations

Recommended changes to the Plan are provided beginning on Page 11, and include four sections:

- *Improvements Critical to Basin Sustainability.*
- *Apply modeling assumptions and decision making tools that prioritize preserving the Basin and clarify the criteria for sustainable buildout.*
- *Develop specific contingency plans to avoid or minimize impacts that could occur despite maximized mitigation programs and revised yield targets.*
- *Requested modifications are consistent with state policy, the LOWWP CDP, Basin Plan, and ISJ.*

The recommendations are supported by the same, or similar, material previously discussed herein. Disposition of recommendations is deferred to the ISJ Parties.

Respectfully submitted,
CLEATH-HARRIS GEOLOGISTS

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