GEOSCIENCE

December 17, 2014

Ms. Courtney Howard
Project Manager-Engineer
San Luis Obispo County Flood Control and Water Conservation District
1087 Santa Rosa Street
San Luis Obispo, CA 93408

Subject: **Budget Amendment Request for Professional Services to Refine the Updated Paso Robles Groundwater Basin Model and Perform Additional Predictive Analyses.**

Dear Courtney:

GEOSCIENCE Support Services, Inc. (GEOSCIENCE) has prepared this budget amendment request for additional work required to refine the updated Paso Robles Groundwater Basin Model (Basin Model) and perform additional predictive analyses. The proposed refinements were developed by personnel from GEOSCIENCE, Todd Groundwater, and Fugro Consultants during a technical meeting held on 30-Oct-14. The purpose of the meeting was to discuss issues identified by Fugro during their peer review of the Paso Robles Groundwater Basin Model Update report issued by GEOSCIENCE and Todd Groundwater on 19-Sep-14. This meeting also provided the opportunity to work together in order to determine the technical feasibility of the proposed model refinements.

The following proposed work is intended to address Fugro's peer review comments, and will provide additional enhancements to the updated Paso Robles Basin Model to improve its accuracy and functionality. The scope also includes performing nine (9) additional predictive analyses using the refined Basin Model to update the baseline with growth condition and to evaluate potential benefits from groundwater management alternatives.

As discussed previously, Fugro identified some technical issues during their peer review of the updated Paso Robles Basin Model. The five main issues are:

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1. The amount of rainfall and streamflow that recharges the bedrock and enters the groundwater basin as subsurface inflow from the surrounding watershed is over-estimated based on the expected permeability of the bedrock geologic formations which characterize the area of the watershed outside of the groundwater basin. Although the overall contribution from the surrounding watershed to groundwater basin recharge may be reasonable, the contribution via streambed percolation within the groundwater basin is likely greater than simulated and subsurface inflow is less than simulated.
2. The amount of recharge from deep percolation of direct precipitation (not including stream recharge) within the groundwater basin is lower than expected.
3. The horizontal and vertical hydraulic conductivity values adjusted during recalibration of the Basin Model are generally lower than expected for sediments in the groundwater basin interior and too high at the margins.
4. Paso Robles Basin Watershed Model calibration scatter plots indicate the model tends to over-estimate streamflow less than 100 cubic feet per second (cfs) and under-estimate flows which exceed 100 cfs. This condition suggests that the overall groundwater basin recharge estimate may be reasonable but that the temporal and areal distribution of that recharge is somewhat different than was simulated.
5. Review of gross applied water for irrigation vs. consumptive use indicates a significant component of applied water is in excess of crop demands. The fate of this excess irrigation water should be determined – if most of it goes to return flows then essentially there is no precipitation recharge being simulated in the groundwater basin.

The technical approach to address each of the five main issues and to enhance the updated Basin Model includes the following proposed tasks:

- Tasks D.5 and D.6 address issue #1
- Task D.7 addresses issue #2 and #5
- Task D.8 addresses issue #3
- Task E.2 addresses issue #4

The scope of work to refine the updated Basin Model and to perform the additional predictive analyses includes:

Task D.5 Reevaluate Fate of Water from the Watershed Entering the Groundwater Basin

GEOSCIENCE will extract annual volumes of streamflow infiltration which occurs within the Paso Robles Watershed but outside of the groundwater basin, deep percolation of areal precipitation which occurs outside of the groundwater basin, and surface water flow into the groundwater basin. The extracted data will be plotted as time-series graphs and compared to annual precipitation curves to determine how the watershed hydrology is represented on an annual basis. A collaborative effort will be used to reevaluate the water entering the groundwater basin as subsurface inflow calculated by the Watershed Model and re-apportion an agreed-upon percentage as water entering the groundwater basin as streamflow.

Task D.6 Replace Combined Recharge and Streamflow Packages with Streamflow Routing (SFR) Package

GEOSCIENCE will replace the combined MODFLOW recharge and streamflow packages used to simulate streamflow recharge and discharge for the Basin Model update with the MODFLOW Streamflow Routing (SFR) package. Use of the SFR package will provide a more accurate simulation of the stream-aquifer interaction. Combined with the surface water outflows calculated by the Watershed Model, this refinement will improve the simulated groundwater recharge and groundwater basin outflows.

Task D.7 Reevaluate Deep Percolation of Direct Precipitation in the Paso Robles Groundwater Basin

GEOSCIENCE will reevaluate the water balance component for deep percolation from direct precipitation occurring in the groundwater basin. The data will be evaluated for the period December through March on an annual basis as the first of two steps to estimate the contribution of precipitation recharge versus the contribution from irrigation return flows (which are assumed to occur annually from April to November). The second step will evaluate the difference between irrigation demand (consumptive use) and gross applied water in order to identify other pathways (besides return flows) for water that is in excess of irrigation demand. This evaluation will provide further understanding of how much precipitation falling directly on the groundwater basin recharges the deep aquifers, the amount of irrigation return flows, the amount of excess applied irrigation water that follows other pathways, and could potentially help refine assumptions used for predictive simulations based on forecasted climatic conditions.

Task D.8 Establish Minimum Hydraulic Conductivity Values for Basin Model Recalibration

GEOSCIENCE and Fugro will work together to establish horizontal and vertical conductivity values which are representative of sediments present in the groundwater basin. The values will be representative of

those established by the Phase I Paso Robles Groundwater Basin Study and will be used by GEOSCIENCE during recalibration of the refined Basin Model. The use of hydraulic conductivity values that have been established through evaluation of aquifer pumping test data will make the Basin Model more defendable.

Task E.2 Recalibrate Refined Paso Robles Groundwater Basin Model

GEOSCIENCE will use the results from Tasks D.5 through D.8 to refine the Basin Model. The refined Basin Model will then be recalibrated until model-simulated streamflow (semi-annual stress periods) and groundwater levels (monthly stress periods) matches the observed data to within the acceptable industry standard.

Task F.5 Perform Additional Predictive Analyses with the Refined Basin Model

Two model scenarios (Run 1 – Baseline with No Growth and Run 2 – Baseline with Growth) have been completed under the existing contract. GEOSCIENCE will use the refined Basin Model to perform Run 2 (Baseline with Growth) and eight (8) additional model runs or "predictive analyses." Work performed under this task will develop the data files required for model input which are specific to each analysis, run the Basin Model, analyze, present and document the results. All analyses will be simulated for a period of 29 years (Water Years 2012-2040) with a monthly stress period, which is consistent with the Groundwater Sustainability Act timing requirement for high priority basins to achieve sustainability.

The analyses will include the following:

<u>Baseline</u>

- Updated Baseline with Growth Run

<u>Specific Action Analyses</u>

- Analysis 1 – Demand Reduction Scenario
- Analysis 2 – Salinas River Recharge
- Analysis 3 – Offset Basin Pumping with Recycled Water

<u>Basin Management Objectives Analyses</u>

- Analysis 4 – Offset Water Demand in Estrella Sub-Area
- Analysis 5 – Additional Releases to Huer Huero Creek
- Analysis 6 – Additional Releases to Estrella Creek
- Analysis 7 – Offset Pumping in Creston Sub-Area with Supplemental Water
- Analysis 8 – Offset Pumping in Shandon Sub-Area with Supplemental Water

The following work will be completed for each analysis:

1. Compile and format for input into the refined Basin Model data and/or assumptions developed for the model run (e.g., projected supplemental water supplies).
2. Run the refined Basin Model.
3. Check the water balance to ensure the groundwater management alternative scenario is represented appropriately.
4. Prepare water use and water demand differences tables (i.e., difference from the updated Baseline with Growth run) to check model input and for predictive model simulation documentation.
5. Prepare groundwater level difference map (i.e., difference from the updated Baseline with Growth run) to identify the affected area(s) within the groundwater basin.
6. Prepare groundwater level hydrographs at selected locations within the groundwater basin to identify the magnitude of the difference in groundwater levels (i.e., difference from the updated Baseline with Growth run) at pre-determined key points of interest.

The benefits of each predictive analysis will be measured in terms of increases in groundwater levels or increases in groundwater storage compared to the projected baseline condition. The Basin Management Objective ranges identified in Section 4.4 of the 2011 Basin Management Plan will also be used for the purposes of level stabilization targets.

The following sections describe each analysis to be done using the model.

Baseline

Subtask F.5.1 Updated Baseline with Growth Analysis

In order to assess the benefit of the additional analysis to the groundwater basin, the Baseline with Growth scenario will be rerun using the refined Basin Model.

Specific Action Analyses

Subtask F.5.2 Analysis 1 – Demand Reduction Scenario

This analysis scenario will evaluate the benefit of a 10% reduction in water demand on the groundwater basin applied to the projected annual 1% increase in demand. It is assumed that an iterative process will be required in order to determine whether maximum benefit is achieved by reducing water demand uniformly across the groundwater basin or only in certain area(s) of the groundwater basin (i.e., Estrella, Creston and Shandon Sub-Areas).

Subtask F.5.3 Analysis 2 – Salinas River Recharge

This analysis scenario will evaluate the benefit of discharging varying amounts of reserve Nacimiento Water Project water into the Salinas River using the existing recharge facilities located within the groundwater basin. It is assumed that an iterative process may be required in order to determine the optimal discharge amounts for each existing facility.

Subtask F.5.4 Analysis 3 – Offset Basin Pumping with Recycled Water

This analysis scenario will evaluate the benefit of, and potential impacts downstream of the current wastewater treatment plant discharge site(s), of implementing the recycled water scenario to be identified by Supply Options Study Technical Memorandum #4 for analysis in the rough screening phase of the project. This scenario will likely include distributing the recycled water (approximately 2,500 acre-ft/yr) to an area located outside the service area of the wastewater facility owner(s) in order to benefit the groundwater basin. It is assumed this analysis may include evaluating multiple discharge areas and varying amounts of recycled water.

Basin Management Objective Analyses

Subtask F.5.5 Analysis 4 – Offset Water Demand in Estrella Sub-Area

This analysis scenario will determine the amount of water demand required to be offset in order to stabilize groundwater levels in the Estrella Sub-Area by simulating the use conservation, direct use of supplemental water, or a combination of both.

Subtask F.5.6 Analysis 5 – Additional Releases to Huero Huer Creek

This analysis scenario will determine the amount of water needed to be released into the Huer Huero Creek in order to stabilize groundwater levels in the Creston and Estrella Sub-Areas. It is assumed that an iterative process may be required in order to determine the optimal discharge point(s) and volumes.

Subtask F.5.7 Analysis 6 – Additional Releases to Estrella Creek

This analysis scenario will determine the amount of water needed to be released into the Estrella Creek in order to stabilize groundwater levels in the applicable areas of the groundwater basin. It is assumed that an iterative process may be required in order to determine the optimal discharge point(s) and volumes.

Subtask F.5.8 Analysis 7 – Offset Pumping in the Creston Sub-Area with Supplemental Water

This analysis scenario will determine the amount of supplemental water required to offset groundwater pumping and stabilize groundwater levels in the Creston Sub-Area by simulating the use conservation, direct use of supplemental water, or a combination of both.

Subtask F.5.9 Analysis 8 – Offset Pumping in the Shandon Sub-Area with Supplemental Water

This analysis scenario will determine the amount of supplemental water required to offset groundwater pumping and stabilize groundwater levels in the Shandon Sub-Area by simulating the use conservation, direct use of supplemental water or a combination of both.

Task G.5 Amend Updated Paso Robles Groundwater Basin Model Report

Subtask G.5.1 Prepare Administrative Draft Technical Memorandum

The GEOSCIENCE/Todd Groundwater Team will prepare a draft technical memorandum (TM) to summarize the components of the refinement efforts made to the Basin Model and results of the additional predictive analyses and submit to the San Luis Obispo Public Works Department. The aspects of each model refinement included in this scope of work will be summarized. The draft TM will also include water use and water demand difference tables, groundwater level difference maps, and hydrographs at selected locations for each predictive analysis scenario.

The GEOSCIENCE/Todd Groundwater Team will review and respond to one round of comments on the Administrative Draft TM.

Subtask G.5.2 Prepare Public Draft Technical Memorandum No. 1

The GEOSCIENCE/Todd Groundwater Team will prepare a Public Draft TM No. 1 based on the results of Subtask G.5.1, and submit to the San Luis Obispo Public Works Department for review and comment by the Paso Basin Advisory Committee.

The GEOSCIENCE/Todd Groundwater Team will review and respond to one round of comments on the Public Draft TM No. 1.

Subtask G.5.3 Prepare Public Draft Technical Memorandum No. 2

The GEOSCIENCE/Todd Groundwater Team will prepare a Public Draft TM No. 2 based on the results of Subtask G.5.2, and submit to the San Luis Obispo Public Works Department for review and comment by the public.

The GEOSCIENCE/Todd Groundwater Team will review and respond to one round of comments on the Public Draft TM No. 2.

Subtask G.5.4 Prepare Final Technical Memorandum

The draft TM will be finalized based on the results of Subtask G.5.3. The final TM will be submitted as an addendum to the Paso Robles Groundwater Basin Model Update report. For budgeting purposes, it is assumed that two (2) hard copies and one (1) electronic (i.e., PDF) copy of the final TM will be submitted.

Task H.9 Prepare for and Attend Webinar for Task D.5

At least one (1) webinar (using GoToMeeting) will be held to present the results to Fugro, Inc. and Todd Groundwater. The goal of the meeting will be to work together and determine how much streamflow infiltration and/or deep percolation of direct precipitation occurring outside of the groundwater basin should be re-apportioned as streamflow entering the groundwater basin.

Task H.10 Prepare for and Attend Webinar for Task D.7

A minimum of two (2) webinars (using GoToMeeting) will be held to present preliminary results to Fugro, Inc. and Todd Groundwater, and to work together to determine whether additional deep percolation from direct precipitation should be added to the interior of the groundwater basin.

Task H.11 Prepare for and Attend Webinar for Task D.8

At least one (1) webinar (using GoToMeeting) will be held between GEOSCIENCE and Fugro to establish the minimum hydraulic conductivity values.

Task H.12 Prepare for and Attend Webinar for Task E.2

At least one (1) webinar (using GoToMeeting) will be held between GEOSCIENCE, County Public Works Department, Fugro and Todd Groundwater to present the preliminary results of the recalibration.

Task H.13 Prepare for and Attend Conference Calls

Key personnel from GEOSCIENCE and Todd Groundwater will prepare for and attend conference calls during the review and comment period following submittal of the administrative and public draft technical memorandums. For budgeting purposes, it is assumed that four (4) conference calls will take place.

Task H.14 Prepare for and Attend Public Meeting

Key personnel from GEOSCIENCE and Todd Groundwater will prepare for and attend one (1) Public Meeting to present the results of the Basin Model refinements and predictive analyses to the Paso Basin Advisory Committee. For budgeting purposes, it is assumed that the meeting will take place in Templeton, CA.

Task H.15 Prepare for and Attend County Board of Supervisors Meeting

Key personnel from GEOSCIENCE and Todd Groundwater will prepare for and attend two (2) County Board of Supervisors meetings. For budgeting purposes, it is assumed that the meetings will take place in San Luis Obispo, CA.

Our total cost for this additional scope of work is $155,949. A detailed cost proposal is provided in the attached Table 1. Should you have any questions, please do not hesitate to call me at (909) 451-6650.

Sincerely,

Joseph D. Kingsbury, PG
Senior Geohydrologist
Encl.