CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MEETING OF JUNE 19-20, 2013
LEE VINING

ITEM: **19**

SUBJECT: **RESOLUTION REQUESTING THE STATE WATER RESOURCES CONTROL BOARD GRANT FUNDING FOR THE SQUAW VALLEY PUBLIC SERVICE DISTRICT'S SQUAW CREEK / AQUIFER INTERACTION STUDY PHASE II, OLYMPIC VALLEY, PLACER COUNTY**

CHRONOLOGY: April 13, 2006 – Resolution No. R6T-2006-0017 approved a program (TMDL) to control sediment in Squaw Creek. The TMDL study identified low creek flow, in addition to sediment, as a cause of aquatic life impairment in Squaw Creek. Creek flow was identified to be affected by groundwater pumping in the Olympic Valley aquifer.

January 14, 2009 – Resolution R6T-2009-0008 approved granting the Squaw Valley Public Service District (District) $46,216 from the Red Dog Diesel Spill Mitigation Fund to develop a groundwater monitoring plan and groundwater management database for Squaw Valley. The monitoring plan and database comprise Phase I of the Squaw Creek/Aquifer Interaction Study.

February 12, 2013 – The District requested $257,815 from the State Water Resources Control Board's (State Water Board's) Cleanup and Abatement Account to complete Phase II of the Squaw Creek/Aquifer Interaction Study (Enclosure 1).

ISSUE: Should the Lahontan Water Board adopt a resolution requesting the State Water Board provide funding to the District from the Cleanup and Abatement Account for Phase II of the Squaw Creek/Aquifer Interaction Study?

If funding the project is acceptable to the Water Board, what amount of funding should be requested from the Cleanup and Abatement Account for the project?

DISCUSSION: The State Water Board's Administrative Procedures Manual (APM) identifies uses of the Cleanup and Abatement Account, including the following:

- *Cleanup and/or abatement of water bodies that will help to implement a Total Maximum Daily Load (TMDL)*, and
- *Completion of a study/plan and/or monitoring addressing significant Statewide water quality problems.*

Stream flow has been identified in the Squaw Creek Sediment TMDL as a factor in aquatic habitat health in Squaw Creek, and groundwater pumping has been identified as a factor in reducing Squaw Creek flow. Though not directly related to cleanup or abatement of sediment affecting Squaw Creek, abatement of groundwater pumping's effect on Squaw Creek will positively affect aquatic life in the creek and may reduce the adverse effects of excessive sediment in the creek, thereby assisting implementation of the TMDL.

The State Water Board, in its approval of the Squaw Creek TMDL, directed the Lahontan Water Board to "… *support the efforts of entities pumping groundwater as well as other stakeholders in Squaw Valley to*: *(1) minimize effects on the creek, (2) develop a groundwater management plan that recognizes potential effects of pumping on the creek and seeks to minimize or eliminate adverse effects on Squaw Creek, and (3) conduct a study of potential interaction between groundwater pumping and flows in Squaw Creek.*"

In accordance with the District's *Olympic Valley Groundwater Management Plan*, the District developed a coordinated monitoring plan and groundwater management database to collect and store data and information on well pumping rates, groundwater elevations at pumping wells and at a network of monitoring wells, and on creek flows that may be used to evaluate pumping's effects on the aquifer and the creek. That program (Phase I) has been implemented. Analysis of those data and information (Phase II) is needed to develop and implement strategies to reduce groundwater pumping's adverse effect on creek flow. Both Phases I and II of the Squaw Creek/Aquifer Interaction Study support the Lahontan Water Board's efforts to comply with the direction of the State Water Board.

Squaw Valley Real Estate, LLC, the development arm of Squaw Valley ski area's new owner, KSL Capital Partners, is proposing significant development at the base of the ski area. That development will need water for its condominiums, hotel rooms, indoor water park, and other planned facilities. The District will prepare a Water Supply Assessment (WSA) to evaluate the ability of the District to meet the water supply demand of the proposed development. Placer County, as the permitting authority for the proposed development, will be drafting an Environmental Impact Report (EIR) that will include assessment of impacts from additional groundwater pumping, including potential impacts to Squaw Creek's flow. Completion of parts of Phase II of the Squaw Creek/Aquifer Interaction Study will inform both the WSA and the EIR.

The District's proposal for Phase II includes a scope of work and costs for conducting the study. Study task Nos. 1.1, 1.2, 2.1, 2.2, and 2.3 are needed for the WSA and EIR (in addition to the Phase II Study); those tasks cost a total of $88,320 (not including costs of the District in administration of the contract and related expenses). Though those enumerated tasks would be needed to complete the study regardless of whether the WSA and EIR for Squaw Valley Real Estate's project were needed, an argument can be made that Squaw Valley Real Estate should fund those tasks that support evaluation of its development project.

Completion of Phase II of the Squaw Creek/Aquifer Interaction Study will provide a tool to the District and others in the future to assess groundwater pumping scenarios and aquifer management strategies that will have the least impact on Squaw Creek flows. Funding the project through the Cleanup and Abatement Account is consistent with the identified uses of the Account. The Lahontan Water Board may consider recommending the State Water Board provide funding (1) for the entire requested amount of $257,815, (2) for those tasks not needed for the WSA and EIR, which total $169,495 ($257,815 - $88,320), or (3) may consider not supporting the request to complete Phase II of the Squaw Creek/Aquifer Interaction Study using Cleanup and Abatement Account funds.

RECOMMENDA-TION: Staff is not providing a recommendation at this time.

ENCLOSURE	DESCRIPTION	BATES NUMBER
1	Squaw Valley Public Services District funding request	**19-7**
2	Proposed Board Resolution	**19-25**

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ENCLOSURE 1

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SQUAW VALLEY
PUBLIC SERVICE DISTRICT

February 12, 2013

Ms. Patty Kouyoumdjian, Executive Officer
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Dear Ms. Kouyoumdjian:

The Squaw Valley Public Service District respectfully requests funds from the Cleanup and Abatement Account in the amount of $257,815 to complete Phase II of the Squaw Creek / Aquifer Interaction Study.

The District completed Phase I of the study in March 2011 with funds granted from the Department of Water Resources' Local Groundwater Assistance Program (Prop. 84) for $221,000.

The goals, objectives, and scope of work for Phase II of the Creek / Aquifer Interaction Study are included in the attached proposal from HydroMetrics WRI. The proposal also includes the requested cost and schedule information. Of the many benefits this study brings, the District looks forward to practical guidelines for groundwater pumping that achieves our goal of supplying potable to our customers while minimizing impacts to the creek.

The District has prepared and submitted several grant applications at an estimated cost of $37,000 from our own capital reserves in pursuit of funding to complete this project. We have had no success to date.

The urgency of the project has been amplified by the proposed Village at Squaw Valley Project, which requires an EIR to comply with CEQA. Analyses of data collected in Phase I of the study are essential to satisfactorily complete the EIR but also to better understand the hydrologic relationship between pumping activities in the aquifer and stream flows in Squaw Creek.

Squaw Valley Real Estate (SVRE), the owner of the Village at Squaw Valley Project, has agreed to fund all of the District's internal expenses necessary to support the consultant and project and to administer the contract, on a time and materials basis.

Wide support for the completion of Phase II of the Creek / Aquifer Interaction Study is well documented. The District completed the Olympic Valley Groundwater Management Plan (GMP) in May 2007 with guidance and support from a stakeholders group that included Lahontan staff. The underpinning of many of the goals and objectives identified in the GMP is the completion of the Creek / Aquifer Interaction Study, whose results either satisfy or support implementation of many of the GMP's recommendations.

The Olympic Valley GMP Advisory Group recommended to the GMP Implementation Group that they, "*Support efforts to secure grant funding for Phase 2 of the Creek/Aquifer Interaction Study*" on July 31, 2012.

In 2007, the State Water Resources Control Board passed Resolution No. 2007-0008, which resolved to direct:

> *the Lahontan Water Board to continue to support the efforts of entities pumping groundwater as well as other stakeholders in Squaw Valley to: (1) minimize effects on the creek, (2) develop a groundwater management plan that recognizes potential effects of pumping on the creek and seeks to minimize or eliminate adverse effects on Squaw Creek, and (3) conduct a study of potential interaction between groundwater pumping and flows in Squaw Creek. The State Water Board further directs the Lahontan Water Board to report on the progress of these efforts at a future State Water Board meeting in March 2008.*

Thank you in advance for considering our request. If you have any questions or require any additional information, please call or email. We are also available to meet with you to discuss this further, at your desire.

Sincerely,

Mike Geary, PE
General Manager

Attachments: HydroMetrics WRI Scope of Work, December 17, 2012

cc: Lauri Kemper, PE; Assistant Executive Officer, CRWQCB – Lahontan Region
Chuck Curtis, PE; Supervising Water Resources Control Engineer, CRWQCB – Lahontan Region

519 17th Street, Suite 500
Oakland, CA 94612

Mr. Mike Geary
Squaw Valley Public Service District
PO Box 2026
Olympic Valley, CA 96146-2026

December 17, 2012

Subject: Scope and cost for finalizing the Squaw Valley creek/aquifer interaction study

Mike,

In a recent telephone conversation with you, staff from Todd Engineers, and Squaw Valley Development Inc., we were requested to provide a scope and cost for finalizing the Squaw Valley creek/aquifer interaction study. As a reminder, we are also submitting a grant application to the State of California to complete this work. The State funding mechanism, however, can take quite a bit of time. If the work is funded by the State of California it may not be complete in time to provide useful information to your client.

This scope in this letter is based on a scope and cost we are submitting to the State of California for potential grant funding. We have added some activities that are necessary to complete the Water Supply Assessment (WSA) and Environmental Impact Report (EIR) for the proposed Squaw Valley Development Inc. project. We are prepared to start immediately on this scope of work. We will start each task only after being specifically authorized to do so by SVPSD. Authorization to proceed with work on each task is required from the SVPSD in advance, and in writing.

PROJECT PURPOSE, GOALS, AND OBJECTIVES

The primary purpose of this project is to analyze existing data and incorporate these analyses into the existing groundwater flow model so that the model will accurately

estimate impacts from t Squaw Valley Development Inc.'s proposed project. Incorporating recently collected data into the model is important to meet the requirements of the WSA and EIR. Data that will be analyzed and incorporated into the model include data already collected in the Olympic Valley Creek/Aquifer Interaction Project Phase I; and data collected during the ongoing Test Well Program

The project's goals are:

1. Improve and quantify our understanding of creek/aquifer interaction;
2. Diminish groundwater pumping impacts on Squaw Creek and the associated Truckee River; and
3. Increase groundwater storage in Olympic Valley.

Specific objectives of the project include:

1. Quantify the impact of pumping wells on Squaw Creek;
2. Quantify the amount of groundwater being drained by the trapezoidal channel in Squaw Creek;
3. Quantify climate change impacts on Squaw Creek;
4. Improve the existing groundwater model to more confidently evaluate groundwater and stream impacts from pumping;
5. Provide a management tool that can be used for Squaw Creek restoration being undertaken by Friends of Squaw Creek and Truckee River Watershed Counsel; and
6. Develop data that can be shared with other Stakeholders.

DESCRIPTION OF WORK

The proposed scope of work is divided into five tasks:

1. Assess and evaluate Phase I data;
2. Integrate the Creek/Aquifer Interaction Results into the Olympic Valley Groundwater Flow Model;
3. Developing groundwater pumping guidelines
4. Reporting, and
5. Administration

A detailed description of the work items to be performed for each task is presented below:

TASK 1: ASSESS AND EVALUATE PHASE I DATA

TASK 1.1: QUANTIFY CREEK/AQUIFER INTERACTION USING DEPTH SPECIFIC TEMPERATURE DATA

As a first step towards reducing pumping impacts on Squaw Creek, we will quantify seasonal and long-term creek/aquifer interactions using heat (temperature) as a tracer to track the movement of water between Squaw Creek and the underlying groundwater system. The method is based on quantifying changes in phase and amplitude of temperature variations between pairs of subsurface sensors set below the streambed. The figure below illustrates the temperature sensors at different depths and the resultant temperature data plotted from data stored on the loggers.

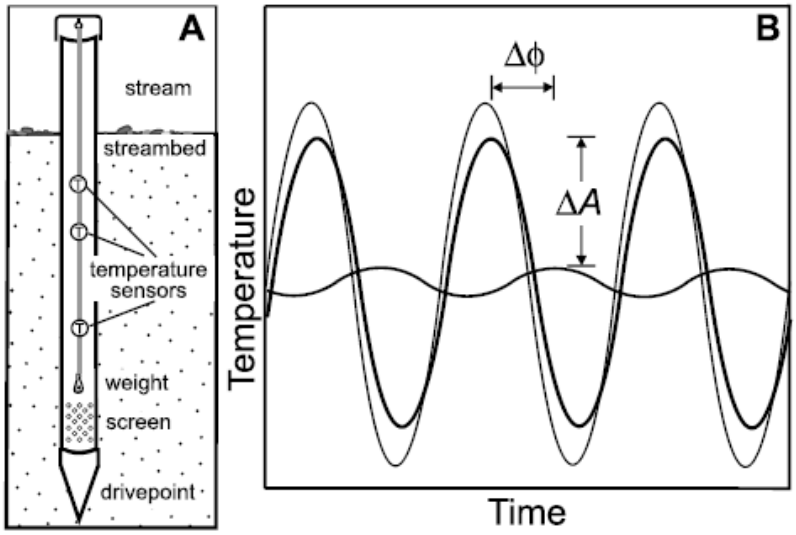

Figure 1. Diagrams illustrating acquisition of streambed temperature records and basis for new analytical method. (a) Streambed piezometer with temperature sensors at various depths. (b) Temperature versus time records showing reduction in amplitude (ΔA) and shift in phase ($\Delta\phi$) with greater depth.

Source: Hatch, *et al.* (2006)

Our approach to analyzing the temperature data is based on well documented methods developed by the U.S. Geological Survey and researchers at U.C. Santa Cruz. The following published scientific papers document the development and application of our methodology:

- Constantz, J., Su, G.W., and Hatch, C., 2006, Heat as a ground water tracer at the Russian River RBF facility, Sonoma County, California, in Hubbs, S.A., ed., Riverbank Filtration Hydrology: Dordrecht, Springer, p. 243-259.
- Hatch, C.E., Fisher, A.T., Revenaugh, J. S., Constantz, J., and Ruehl, C, 2006, Quantifying surface water - groundwater interactions using time series analysis of streambed thermal records: Methods development : Water Resources Research, v. 42, W10410, doi: 10.1029/2005WR004787.
- Sun, M., and Fisher, A., 1992, WSTP/Origin, Graphical Software for Windows-based processing of temperature data from the Water-sampling Temperature Probe.
- USGS Fact Sheet 2004-3010, February 2004. Using temperature to study stream-ground water exchanges.

Andy Fisher at UC Santa Cruz, is one of the developers of this technique, and has successfully applied it in a number of studies. We will draw on his expertise to assist us with analyzing the depth-specific temperature data collected in Squaw Creek.

The available data for this subtask are eight months of 15-minute interval temperature measurements from six probes that were installed in Squaw Creek. In addition to the depth-specific temperature loggers, stilling wells and groundwater piezometers were installed next to the temperature probes. These were equipped with pressure transducers that recorded water levels. From these data, it is possible to identify accurately when the creek was flowing and what the vertical hydraulic gradients were at any point in time. These data will be used in conjunction with the temperature data, and other nearby well groundwater level, to develop a conceptual understanding of when the monitored reach of Squaw Creek is gaining water from the aquifer and when it is losing water to the aquifer.

It is envisioned that the order of work for this task will be as follows:

1. Initial meeting with Dr. Andy Fisher to establish working protocol.
2. Manually filter already compiled temperature data according to defined protocols and water level data.
3. Apply frequency bandpass filter to extract daily temperature signal, and resample.
4. Run data through creek/aquifer interaction software developed by Dr. Fisher and other to calculate time series of amplitude ratio and phase shift.
5. Iterate for seepage rates from amplitude ratio and phase shift.
6. Determine final daily seepage rates between Squaw Creek and the underlying aquifers.

Results from this task will quantify the long-term interaction between Squaw Creek and the adjoining aquifer. These results will show when the stream is gaining water from the aquifer, and when it is losing water to the aquifer. These results will inform future groundwater management decisions, as well as provide important input to the groundwater model.

TASK 1.2: ESTABLISH PUMPING IMPACTS ON SQUAW CREEK BY ANALYZING AQUIFER TEST DATA

Pumping impacts on Squaw Creek can be directly measured by analyzing results from two similar aquifer tests. Two controlled aquifer tests were conducted on Squaw Valley Public Service District Well 2 in 2009 and 2010. The first test in June 2009 was designed to collect data while Squaw Creek was flowing. A second, similar test took place in September 2010 after Squaw Creek had dried up and before winter rain started. Data collected during the tests include SCADA groundwater level and pumping data from the pumping well; groundwater level data for one nearby municipal well, five nearby monitoring wells and four streambed piezometers.

By conducting two similar aquifer tests under different hydrologic conditions, it is possible to compare the drawdown characteristics of the two tests to determine whether there are differences in the response curve. It is expected this comparative analysis will indicate whether and when Squaw Creek is a source of water to the well when it pumps. We will first analyze the two aquifer tests using standard hydrogeologic techniques such as Theis analyses, Cooper-Jacob analyses, and Hantush leaky-aquifer analyses. These analyses will be used to estimate the aquifer's hydraulic properties such as transmissivity, storage, and leakance from the aquifer tests. The transmissivity and storage properties estimated from the test when Squaw Creek is not flowing constrain the hydraulic properties of the test when Squaw Creek is flowing. This allows us to compare the two tests and establish exactly how much of the pumping was directly extracted from Squaw Creek.

Results from this task will quantify the direct relationship between pumping an individual well and flows in Squaw Creek. These results will inform future groundwater management decisions, as well as provide important input to the groundwater model.

TASK 1.3: INTEGRATE RESULTS FROM TASKS 1.1 AND 1.2 WITH LLNL CLIMATE CHANGE AND TRACER STUDY

Jean Moran was a principal investigator during the Olympic Valley groundwater study carried out and funded by Lawrence Livermore National Laboratory (LLNL) in 2008 and 2009. Dr. Moran will be brought in as a collaborator in the proposed project to integrate and interpret data generated in 2008 and 2009 by LLNL during experiments designed to delineate groundwater inflow to Squaw Creek. These data were not included in the LLNL Water Resources Research publication which focused on groundwater residence time and recharge area determination in Squaw Valley (Singleton and Moran, 2010).

For this project, Dr. Moran will compile and evaluate temperature data collected during the Distributed Temperature Sensor experiment in the middle reach of Squaw Creek, which took place in July 2009, along with geochemical data such as dissolved Radon, major ions, and carbon isotopes collected during Squaw Creek sampling in June and July of 2009 (approximately 100 sample results). These tracers can be interpreted to identify locations of groundwater inflow and potentially to quantify groundwater inflow to Squaw Creek during the time period over which the sampling took place. Dr. Moran will supervise a graduate student who will be engaged in an effort to model Radon gas loss at the stream water-air interface during transport downstream from groundwater input locations.

In addition, Dr. Moran will work with staff from our consultant, HydroMetrics Water Resources Inc., to integrate all data generated during the surface water and groundwater LLNL studies with data collected by Hydrometrics and SVPSD. Interpretation of results will center on seasonal creek/aquifer interaction, groundwater recharge, and the effects of climate change (higher snowline, more precipitation as rain) on runoff, groundwater recharge, and the water budget for the basin.

TASK 2: INTEGRATE THE CREEK/AQUIFER INTERACTION RESULTS AND THE TEST WELL PROGRAM RESULTS INTO THE OLYMPIC VALLEY GROUNDWATER FLOW MODEL

Integrating the results of the seasonal temperature data, new geologic data, aquifer test data, and LLNL study data into the Olympic Valley groundwater flow model will allow the model to accurately predict seasonal interactions between shallow aquifers and Squaw Creek, as well as the impact of pumping on Squaw Creek flows. This will then allow us to use the model to analyze impacts from Squaw Valley Development Inc.'s

proposed project, as well as establish groundwater management guidelines that minimize pumping impacts on Squaw Creek and maximize groundwater storage.

The Olympic Valley groundwater flow model was developed 13 years ago, using the USGS's MODFLOW code. This model will be updated to the end of 2011 using data already stored in the Olympic Valley groundwater database. The conceptual understanding of the basin will be updated based on the results of the temperature data, results of the Test Well Program, results of the aquifer test analysis, and findings of the LLNL climate change study discussed in Task 1.3. This will require that some of the input terms, such as boundary conditions, horizontal flow barriers, and spatial distribution of recharge be changed. Aquifer parameters may also be revised based on properties estimated from the aquifer tests (Task 1.2).

The model will be re-calibrated according to industry standard methods, such as those discussed in Applied Groundwater Modeling (Anderson and Woessner, 1992), Groundwater Flow Modeling Guideline (Murray Darling Basin Commission, 2000), and Effective Groundwater Model Calibration (Hill and Tiedeman, 2007). Hydrographs showing both modeled and measured groundwater levels for key wells will be used to demonstrate the effectiveness of the model for simulating historical conditions in the Olympic Valley.

Up to 5 model scenarios will be run with the updated groundwater model to answer a combination of the following questions:

1. During times when the creek flows, how much water is drawn from the creek into the aquifer when all municipal wells are pumping?
2. How much water is flowing from the aquifer into the creek and what impact does that have on groundwater storage?
3. What are the recommended pumping scenarios to reduce pumping impacts on the stream and to maximize the use of aquifer storage?
4. What climatic conditions will result in critical conditions when flow in Squaw Creek is minimal but still sustains biota?
5. What is the maximum sustainable groundwater yield, without significantly impacting Squaw Creek?
6. What modifications to Squaw Creek can be made to increase groundwater storage?

TASK 3: DEVELOP GROUNDWATER PUMPING GUIDELINES FOR OLYMPIC VALLEY

Based on the findings from Task 2, a guideline document will be prepared that outlines different pumping options for different hydrologic conditions in Squaw Creek. The guidelines will be developed with the goal of sustainably using groundwater for water supply purposes, while maximizing aquifer storage and minimizing creek impacts.
The guideline document will include creek mitigation measures that could be implemented to counter pumping impacts. Based on the results of modeling impacts to the trapezoidal channel (Task 2), SVPSD will work cooperatively with the property owner to identify potential mitigation measures that could be considered. Mitigation measures will only be included in the guideline document if they improve annual pumping capacity and in-stream flows.

TASK 4: REPORTING

TASK 4.1: TECHNICAL MEMORANDUM ON SEASONAL STREAM/AQUIFER INTERACTIONS

The data, methodology, and analyses from Task 1.1 will be summarized in a technical memorandum at the conclusion of that task. This memorandum will serve as the task deliverable and to evaluate progress and performance.

TASK 4.2: TECHNICAL MEMORANDUM ON PUMPING IMPACTS ON SQUAW CREEK

The data, methodology, and analyses from Task 1.2 will be summarized in a technical memorandum at the conclusion of that task. This memorandum will serve as the task deliverable and to evaluate progress and performance.

TASK 4.3: TECHNICAL MEMORANDUM ON LLNL TEMPERATURE ISOTOPE TRACERS AS THEY RELATE TO CREEK/AQUIFER INTERACTIONS

The data, methodology, and analyses from Task 1.3 will be summarized in a technical memorandum at the conclusion of that task. This memorandum will serve as the task deliverable and to evaluate progress and performance.

TASK 4.4: TECHNICAL MEMORANDUM ON THE GROUNDWATER MODEL UPDATE AND SCENARIO RESULTS

The model update from Task 2 will be extensively documented in this technical memorandum. All changes to the model will be documented and supported by data from Tasks 1 and 2. The model calibration results will be presented in graphical form to show how the modeled groundwater levels and creek flows match measured data. A description of the five model scenarios will be provided, along with the results of each of the simulations.

TASK 4.5: FINAL REPORT

All three technical memoranda from Tasks 4.1 through 4.4 will be included as appendices to the project's final report. Additionally, the groundwater pumping guidelines from Task 3 will be included in the final repot as a separate appendix. The final report will describe all analyses, results and recommendations. A draft will be distributed to the Board of Directors, and interested parties. After a reasonable review period, comments provided will be addressed and incorporated into the final report.

TASK 5: ADMINISTRATION

TASK 5.1: PROJECT MANAGEMENT

Project management for the project will include, preparing and submitting monthly invoices, budget and schedule tracking, and day-to-day communication with contractors and partners, as necessary. Most of these management tasks will continue throughout the duration of the project.

TASK 5.2: CONTRACT ADMINISTRATION

This subtask ensures close coordination with contractors and partner agencies that receive funding from this grant. Work will involve preparing agreements with all contractors, including HydroMetrics WRI, Dr. Andy Fisher of UC Santa Cruz, and Dr. Jean Moran of Lawrence Livermore Laboratory (LLNL) / California State University East Bay (CSUEB). The task will additionally involve reviewing and approving subcontractor invoices, as they are submitted. Review of subcontractor change orders is also included under this task.

TASK 5.3: MEETINGS

Regular interaction with the Squaw Valley Development staff, District's staff, Board of Directors, GWMP Advisory Group, and Todd Engineers staff is needed to ensure the project remains on budget and schedule. This task includes preparation for and attendance at four meetings and/or presentations to keep interested parties apprised of the project's progress.

COST AND SCHEDULE

The proposed costs are included in the attached table. These costs are based on the estimates included in our grant application.

A proposed schedule is included following the cost table. The schedule assumes that Task 1 analyses begin on December 17, 2012. The schedule shows the timeline for completing all tasks, although all tasks are not necessary for the WSA and EIR. The schedule identifies the tasks that are on the critical path for completing the WSA and EIR. The schedules for only those tasks on the critical path are relevant for the Squaw Valley Development Inc. project.

If you have any questions, do not hesitate to contact me. We look forward to hearing from you soon regarding this proposal.

Sincerely,

Derrik Williams

Derrik Williams
President, HydroMetrics Water Resources Inc.

REFERENCES

Anderson, M.P., and W.W. Woessner. 1992. *Applied groundwater modeling, simulation of flow and advective transport,* Academic Press, Inc., San Diego, California, 381 p.

Hill, M.C., and C.R. Tiedeman. 2007. *Effective groundwater model calibration; with analysis of data, sensitivities, predictions and uncertainty*. John Wiley & Sons, Inc., Hoboken, NJ, 455 p.

Hydrometrics Water Resources Inc. 2007. Olympic Valley Groundwater Management Plan. Prepared for Squaw Valley Service District. May. http://www.svpsd.org/pdffiles/GMP%20Files/OV_GMP_Final_rev1_06-01-07.pdf

Murray-Darling Basin Commission. 2000. Groundwater Flow Modeling Guideline, Aquaterra Consulting PTY LTD, Project No. 125, 72 p.

Singleton, M.J. and Moran, J.E. (2010) Dissolved noble gas and isotopic tracers reveal vulnerability of groundwater in a small, high elevation catchment to predicted climate changes. Water Resources Research doi: 10.1029/2009WR008718.

Tasks	HydroMetrics WRI Labor Costs	Sub-contractor	Other Direct Costs[1]	TOTALS
	($)	($)	($)	($)
Task 1. Assessment and Evaluation of Phase I Data				
1.1 Quantify Stream/Aquifer Interaction using Depth Specific Temperature Data	$ 11,460	$ 4,440	$ -	$ 15,900
1.2 Establish Pumping Impacts on Squaw Creek by Analyzing Aquifer Test Data	$ 17,700	$ -	$ -	$ 17,700
1.3 Integrate Results from Tasks 1.1 and 1.2 with LLNL Climate Change and Tracer Study	$ 8,640	$ 35,000	$ -	$ 43,640
Subtotal Task 1	***$ 37,800***	***$ 39,440***	***$ -***	***$ 77,240***
Task 2. Integrate the Creek/Aquifer Interaction Results into the Olympic Valley Groundwater Flow Model				
2.1. Update Conceptual Model	$ 9,060	$ -	$ -	$ 9,060
2.2 Update Input Data	$ 12,120	$ -	$ -	$ 12,120
2.3 Run Model and Calibrate	$ 33,540	$ -	$ -	$ 33,540
2.4 Design and Run Up to Five Model Scenarios	$ 21,060	$ -	$ -	$ 21,060
Subtotal Task 2	***$ 75,780***	***$ -***	***$ -***	***$ 75,780***
Task 3: Develop Groundwater Pumping Guidelines for Olympic Valley	***$ 15,720***	***$ -***	***$ -***	***$ 15,720***
Task 4: Reporting				
4.1 Technical Memorandum on Seasonal Creek/Aquifer Interactions (Deliverable for Task 1.1)	$ 14,580	$ -	$ -	$ 14,580
4.2 Technical Memorandum on Pumping Impacts on Squaw Creek (Deliverable for Task 1.2)	$ 9,720	$ -	$ -	$ 9,720
4.3 Technical Memorandum on LLNL Temperature Isotope Tracers as they Relate to Creek/Aquifer Interactions (Deliverable for Task	$ -	$ 11,718	$ -	$ 11,718
4.4 Technical Memorandum on the Groundwater Model Update and Scenario Results (Deliverable for Task 2)	$ 16,860	$ -	$ -	$ 16,860
4.6 Final Report	$ 10,590	$ -	$ 385	$ 10,975
Subtotal Task 4	***$ 51,750***	***$ 11,718***	***$ 385***	***$ 63,853***
Task 5. Administration				
5.1 Project Management	$ 8,640	$ -	$ -	$ 8,640
5.2 Contract Administration	$ 1,560	$ -	$ -	$ 1,560
5.3 Meetings (Four)	$ 13,320	$ -	$ 1,702	$ 15,022
Subtotal Task 5	***$ 23,520***	***$ -***	***$ 1,702***	***$ 25,222***
PROJECT TOTAL	***204,570***	***51,158***	***2,087***	***257,815***

Tasks	Week	12/17/2012	12/24/2012	12/31/2012	1/7/2013	1/14/2013	1/21/2013	1/28/2013	2/4/2013	2/11/2013	2/18/2013	2/25/2013	3/4/2013	3/11/2013	3/18/2013	3/25/2013	4/1/2013	4/8/2013	Critical Path Task
Task 1. Assessment and Evaluation of Phase I Data																			
1.1 Quantify Stream/Aquifer Interaction using Depth Specific Temperature Data																			✓
1.2 Establish Pumping Impacts on Squaw Creek by Analyzing Aquifer Test Data																			✓
1.3 Integrate Results from Tasks 1.1 and 1.2 with LLNL Climate Change and Tracer Study																			
Task 2. Integrate the Creek/Aquifer Interaction Results into the Olympic Valley Groundwater Flow Model																			
2.1. Update Conceptual Model																			✓
2.2 Update Input Data																			✓
2.3 Run Model and Calibrate																			✓
2.4 Design and Run Up to Five Model Scenarios																			
Task 3: Develop Groundwater Pumping Guidelines for Olympic Valley																			
Task 4: Reporting																			
4.1 Technical Memorandum on Seasonal Creek/Aquifer Interactions (Deliverable for Task 1.1)																			
4.2 Technical Memorandum on Pumping Impacts on Squaw Creek (Deliverable for Task 1.2)																			
4.3 Technical Memorandum on LLNL Temperature Isotope Tracers as they Relate to Creek/Aquifer Interactions (Deliverable for Task 1.3)																			
4.4 Technical Memorandum on the Groundwater Model Update and Scenario Results (Deliverable for Task 2)																			
4.6 Final Report																			
Task 5. Administration																			
5.1 Project Management																			
5.2 Contract Administration																			
5.3 Meetings (Four)																			

ENCLOSURE 2

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

RESOLUTION NO. R6T-2013- PROPOSED

REQUEST FROM THE SQUAW VALLEY PUBLIC SERVICE DISTRICT FOR FUNDS FROM THE CLEANUP AND ABATEMENT ACCOUNT TO COMPLETE PHASE II OF THE SQUAW CREEK/AQUIFER INTERACTION STUDY

_____Placer County_____

WHEREAS, the California Regional Water Quality Control Board, Lahontan Region (Water Board), finds:

1. The State Water Resources Control Board (State Water Board), in Resolution No. 2007-0008 approving the Squaw Creek Sediment Total Maximum Daily Load (TMDL), included the following direction to the Lahontan Water Board regarding aquifer/creek interactions in Squaw Valley:

   Directs the Water Board to continue to support the efforts of entities pumping groundwater as well as other stakeholders in Squaw Valley to: (1) minimize effects on the creek, (2) develop a groundwater management plan that recognizes potential effects of pumping on the creek and seeks to minimize or eliminate adverse effects on Squaw Creek, and (3) conduct a study of potential interaction between groundwater pumping and flows in Squaw Creek.

   The TMDL identified low creek flows, in addition to sediment, as a cause of aquatic life impairment in Squaw Creek. Creek flow was identified to be affected by groundwater pumping in the Olympic Valley aquifer.

2. The Water Board has supported efforts of the Squaw Valley Public Service District (District), the Squaw Valley Mutual Water Company, and other groundwater pumpers to minimize groundwater pumping's effects on Squaw Creek through (a) participation in development of the *Olympic Valley Groundwater Management Plan* (GMP), which the District adopted in May 2007 and (b) funding a groundwater monitoring plan and groundwater management database to assist basin-wide analysis and management of groundwater in compliance with the GMP's objective of minimizing pumping's effect on the creek. The Water Board provided a $46,216 grant from the Red Dog Diesel Spill Mitigation Fund through Resolution R6T-2009-0008 for that monitoring plan and database, which is Phase I of the Squaw Creek/Aquifer Interaction Study.

3. The District has requested funding in the amount of $257,815 to complete Phase II of the Squaw Creek/Aquifer Interaction Study (Enclosure 1). The Water Board's Red Dog Diesel Spill Mitigation Fund that was used to fund Phase I, has been fully expended and is not available to fund Phase II. The District had unsuccessfully sought grant funding for Phase II from the Department of Water Resources for the Study.

4. The funding request from the District has the support of the major landowners and groundwater pumpers in Squaw Valley, including Squaw Valley Mutual Water Company, Squaw Valley Ski Corporation, the Resort at Squaw Creek and Poulsen Commercial, as their representatives serve on the Olympic Valley GMP Advisory Group that recommended the District request these funds.

5. Use of the Cleanup and Abatement Account to fund Phase II of the Squaw Creek/Aquifer Interaction Study is consistent with uses of the Account identified in the State Water Board's Administrative Procedures Manual, including the following:

    - *Cleanup and/or abatement of water bodies that will help to implement a Total Maximum Daily Load (TMDL)*, and
    - *Completion of a study/plan and/or monitoring addressing significant Statewide water quality problems.*

6. A draft of this resolution has been widely circulated in the area for comment through mailings and posting on the Water Board's Internet web page.

7. The Water Board has considered all comments received.

THEREFORE, BE IT RESOLVED:

1. The Water Board requests the State Water Board provide a grant from the Cleanup and Abatement Account to the Squaw Valley Public Services District in the amount of $257,815 for use in completing Phase II of the Squaw Creek/Aquifer Interaction Study for Squaw Valley.

I, Patty Z. Kouyoumdjian, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Lahontan Region, on June 19, 2013.

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PATTY Z. KOUYOUMDJIAN
EXECUTIVE OFFICER