GEOSCIENCE

February 13, 2019 **DRAFT**

Mr. Mark Norton, PE, LEED AP, ENV SP
Water Resources & Planning Manager
Santa Ana Watershed Project Authority
11615 Sterling Ave.
Riverside, CA 92503

Re: Fourth Request for Budget Amendment for Consulting Services for Santa Ana River Waste Load Allocation Model Update

Dear Mark:

GEOSCIENCE Support Services, Inc. (GEOSCIENCE) submitted a first budget amendment on February 8, 2018 (draft dated January 5, 2018) to address out of scope work requested in comments received on the Santa Ana River Waste Load Allocation Model (WLAM) draft Technical Memorandums (TMs) No. 1 and 2. This first budget amendment also included a budget reduction arising from the Basin Management Program (BMP) Task Force's decision to forego Task 4 (Develop WLAM for Managed Recharge in Percolation Basins). The budget for Task 9 was also affected by this decision since it included a Draft TM No. 4 summarizing the results of Task 4.

GEOSCIENCE submitted a draft second budget amendment on July 26, 2018 in response to a request from the Regional Water Quality Control Board (Regional Board) to include an evaluation of the impacts of surface spreading at Corona Ponds and Redlands Basin on receiving groundwater and surface water. This work was originally covered under Tasks 4 and 9, but was cancelled during the October Task Force meeting. The remaining funds for this work were then used to cover a portion of the out of scope work proposed in the February budget amendment. The draft second budget amendment proposed reinstating a portion of Task 4 and the draft TM No. 4 under Task 9. However, in response to concerns raised by the City of Corona during the August 14, 2018 meeting, the Task Force requested that an amendment to reinstate work related to the Corona Ponds and Redlands Basin be postponed until Corona and the Regional Board reached a consensus on how to proceed. Per the Regional Board, additional modeling conducted by the City of Corona provided sufficient information regarding the impact of waste water spreading. Therefore, the finalized second budget amendment only included additional expenses for extra meetings as a result of unforeseen project delay.

Per your request at the October 30, 2018 BMP Task Force meeting, GEOSCIENCE submitted a third budget amendment to account for requested additional modeling work with revised scenario assumptions and further analyses.

During the course of completing the work requested from the third budget amendment, the question of whether or not to account for stormwater diversions and spreading in off-channel recharge basins came up again. In response to Risk Science's letter presenting a rationale for restoring some elements of Task 4 in the WLAM scope of work (dated January 24, 2019; included here as Attachment A), GEOSCIENCE has been asked to prepare this fourth budget amendment. Two options were recommended by Risk Sciences to address the absence of accounting for recharge of higher quality stormwater in the previous and current WLAM versions:

Option 1. Since the WLAM already accounts for any known flows diverted out of the stream channel and the associated TIN/TDS concentrations, these diversions should be summarized in tables that are attached as appendices to Geosciences Final Report. The report should also state explicitly that these diversions are not included in the calculation of the volume-weighted average TIN and TDS concentrations in recharges to each GMZ [groundwater management zone]. This is a lower cost option that assures stakeholders throughout the region continue to work from the same set of facts but also depends on others to perform that additional work in order to know the true net impact of our activities on groundwater quality.

Option 2. Where stream flows are diverted to percolation ponds that recharge the same underlying groundwater basin, the WLAM should be adjusted to recognize such recharges as a separate nodal inputs. The volume-weighted average TIN and TDS concentrations of recharge to each GMZ should be calculated with and without accounting for the off-channel recharges. This is a higher cost option that better assures that the WLAM provides the most accurate and complete answers possible to the most critical water quality questions. The additional analysis is inevitable because it is essential; therefore, it may be less expensive (in the long run) to integrate this work with the WLAM already under development.

The additional scope of work and associated level of effort to address each option is discussed in the following sections.

1.0 PROPOSED ADDITIONAL SCOPE OF WORK

Task 4 – Develop WLAM for Managed Recharge in Percolation Basins

Additional work under this task will address Risk Science's 24-Jan-19 letter and the two recommendation options provided therein (see Attachment A).

Task 4e.1 – Option 1: Summarize Stormwater Diversion and Spreading

Under Option 1, the volumes of diverted stormwater for spreading in recharge basins, along with the associated TDS and TIN concentrations, will be summarized in the final study report as a series of tables. The beneficial impact of this spreading can then be incorporated in and evaluated by future basin studies. Text will also be added to the final WLAM study report explicitly stating that recharge from stormwater diversion and spreading is not considered by the WLAM.

Task 4e.2 – Option 2: Create Nodal Inputs in the WLAM for Stormwater Diversion and Recharge

Option 2 will require additional work to incorporate separate nodes in the WLAM associated with each stormwater diversion and recharge location. The WLAM will then be run to calculate the volume-weighted average groundwater recharge and TDS/TIN concentrations with and without the off-channel recharge of stormwater. The results of each run will be summarized in the final study report. Text will also be included evaluating the impact of stormwater recharge and identifying other factors which could affect recharging water quality not considered by the WLAM (i.e., the recharge of imported and/or recycled water in off-channel spreading basins).

Task 10 – Monthly Project Meetings

In the previous budget amendment request (dated November 12, 2018), additional scope of work and budget was included for monthly project meetings through February, 2018, due to unforeseen project delay. Since that amendment, GEOSCIENCE attended an unforeseen meeting with Inland Empire Utilities Agency (IEUA), Chino Basin Watermaster (CBWM), and Wildermuth Environmental, Inc. (WEI) to address concerns and provide additional information about modeling approaches used in the WLAM. Preparation for and attendance at this meeting (held on January 21, 2019) is also included in this budget amendment.

Given the additional out of scope of work detailed above, it is anticipated that preparation for, and attendance at, additional meetings will be required – depending on which option the Task Force decides to pursue. For Option 1 (Summarize Stormwater Diversion and Spreading), it is anticipated that two (2) additional meetings will be needed (i.e., March and April Task Force Meetings). Option 2 (Create Nodal

Inputs in the WLAM for Stormwater Diversion and Recharge) is anticipated to need three (3) additional meetings (i.e., March, April, and May Task Force Meetings).

2.0 PROPOSED BUDGET AMENDMENT

The estimated cost of the additional work associated with Task 4 and the extra meetings in response to an extended project schedule is detailed in Table 1 and summarized below.

Proposed Budget for Additional Scope of Work

TASK		Total Additional Hours	Total Additional Cost
4e.1	Option 1: Summarize Stormwater Diversion and Spreading	27	$3,530
4e.2	Option 2: Create Nodal Inputs in the WLAM for Stormwater Diversion and Recharge	88	$11,280
10.0	Option 1: Prepare For and Participate in up-to 2 Half-Day Monthly Meetings and 21-Jan-19 Meeting with IEUA, CBWM, and WEI	52	$9,150
10.0	Option 2: Prepare For and Participate in up-to 3 Half-Day Monthly Meetings and 21-Jan-19 Meeting with IEUA, CBWM, and WEI	67	$12,020
	TOTAL (Option 1)	**79**	**$12,680**
	TOTAL (Option 2)	**155**	**$23,300**

Budget Amendment Summary

TASK		Original Approved Budget (6-Jan-17)	1st Budget Amendment Request (8-Feb -18)	2nd Budget Amendment Request (15-Aug-18)	3rd Budget Amendment Request (12-Nov-18)	4th Budget Amendment Request (12-Feb-19)	Total Project Budget
1.0	Update the Data Used in the Waste Load Allocation Model (WLAM)	$25,665	$4,600	-	-	-	$30,265
2.0	Update and Recalibrate the WLAM	$59,255	$30,255	-	-	-	$89,510
3.0	Evaluate Waste Load Allocation Scenarios for Major Stream Segments	$33,150	-	-	$23,970	-	$57,120
4.0	Develop WLAM for Managed Recharge in Percolation Basins	$16,070	$(12,374)	-	-	Option 1: $3,530 Option 2: $11,280	Option 1: $7,226 Option 2: $14,976
5.0	Estimate Off-Channel Recharge From Natural Precipitation	$6,385	-	-	-	-	$6,385
6.0	Run the WLAM in Retrospective Mode, Using Historical Discharge Data, to Estimate the Quantity and Quality of Recharge that Actually Occurred	$8,290	-	-	-	-	$8,290
7.0	Compile the WLAM into a Run-Time Software Simulation Package	$17,340	-	-	-	-	$17,340
9.0	Draft Task Reports, Draft and Final Report	$45,005	TM 2: $7,245 TM 4: $(5,760) Total:$1,485	-	-	-	$46,490
10.0	Monthly Project Meetings	$35,640	-	$11,480	$5,740	Option 1: $9,150 Option 2: $12,020	Option 1: $62,010 Option 2: $64,880
11.0	Pilot Evaluation of the Doppler Data Compared to Precipitation Gauge Data	$3,000	-	-	-	-	$3,000
	TOTAL	**$249,800**	**$23,966**	**$11,480**	**$29,710**	Option 1: $12,680 Option 2: $23,300	Option 1: $327,636 Option 2: $338,256

Our existing contract amount, which includes the November 12, 2018 budget amendment, is $314,956. The requested cost for this contract amendment is **$12,680** for Option 1 (Summarize Stormwater Diversion and Spreading) and **$23,300** for Option 2 (Create Nodal Inputs in the WLAM for Stormwater Diversion and Recharge), which would increase the total contract amount to **$327,636** for Option 1 and **$338,256** for Option 2. This includes the cost of the additional work for summarizing stormwater diversion and spreading ($3,530) or accounting for stormwater recharge in the WLAM ($11,280), as well as two additional meetings associated with Option 1 ($9,150) or 3 additional meetings associated with

Option 2 ($12,020) as a result of project delay. The remaining tasks are still in place and do not require additional budget or changes in budget.

3.0 REVISED PROJECT SCHEDULE

A revised project schedule in response to delay associated with the requested stormwater recharge analyses is presented on Table 2. As shown, we anticipate finishing the Draft Study Report mid- to late-March 2019, and the Final Study Report mid- to late-April 2019 for Option 1. Option 2 will delay the project an additional month, meaning the Final Study Report is anticipated to be completed mid- to late-May 2019.

We appreciate the opportunity to provide our services on this important project. If you have any questions, please call us at (909) 451-6650.

Sincerely,

Johnson Yeh

Dennis E. Williams, Ph.D., PG, CHG
President

Johnson Yeh, Ph.D., PG, CHG
Principal/Groundwater Modeler

encl.

TABLES

GEOSCIENCE

Santa Ana Watershed Project Authority
Fourth Request for Budget Amendment for Consulting Services for Santa Ana River Waste Load Allocation Model Update

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Table 1

ADDITIONAL COST ESTIMATE FOR CONSULTING SERVICES

Santa Ana River Waste Load Allocation Model Update

Task		Description	ADDITIONAL COST - THIRD BUDGET AMENDMENT										Original Budget (6-Jan-17)	First Amended Budget (8-Feb-18)	Second Amended Budget (15-Aug-18)	Third Amended Budget (12-Nov-18)	Fourth Amended Budget (12-Feb-19)
			Principal Hydrologist	Senior Geohydrologist	Project Geohydrologist	Staff Geohydrologist	Graphics	Clerical	Total Hours	Labor Cost	Reimbursable Expenses [1]	Additional Cost					
		Hourly Rate:	$285	$200	$165	$125	$110	$95									
1.0	**Update the Data Used in the Waste Load Allocation Model (WLAM)**																
	1a	Update Relevant Land Use Maps for the Region							0	$ -		$ -	$ 4,520	$ 4,520	$ 4,520	$ 4,520	$ 4,520
	1b	Update the Stormwater Management Facility Maps							0	$ -		$ -	$ 4,520	$ 4,520	$ 4,520	$ 4,520	$ 4,520
	1c	Update the Historical Precipitation Data for the Region							0	$ -		$ -	$ 2,530	$ 2,530	$ 2,530	$ 2,530	$ 2,530
	1d	Review and Confirm the Operating Assumptions for Seven Oaks Dam and Prado Dam							0	$ -		$ -	$ 2,020	$ 2,020	$ 2,020	$ 2,020	$ 2,020
	1e	Update and Consolidate the Flow Data Used in the WLAM							0	$ -		$ -	$ 3,530	$ 3,530	$ 3,530	$ 3,530	$ 3,530
	1f	Update and Consolidate the Water Quality Data Used in the WLAM							0	$ -		$ -	$ 3,530	$ 3,530	$ 3,530	$ 3,530	$ 3,530
	1g	Perform a Systematic QA/QC Review of All Data							0	$ -		$ -	$ 5,015	$ 5,015	$ 5,015	$ 5,015	$ 5,015
	1h	Update and Consilidate Flow Data from Additional Discharge Sources Identified in the WLAM							0	$ -		$ -	$ -	$ 2,400	$ 2,400	$ 2,400	$ 2,400
	1i	Create Plots and Database Files of Model Input Data (to be included as appendices)							0	$ -		$ -	$ -	$ 2,200	$ 2,200	$ 2,200	$ 2,200
		Task 1.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 25,665**	**$ 30,265**	**$ 30,265**	**$ 30,265**	**$ 30,265**
2.0	**Update and Recalibrate the WLAM**																
	2a	Update the Estimate of Surface Water Runoff to Major Stream Segments							0	$ -		$ -	$ 24,800	$ 24,800	$ 24,800	$ 24,800	$ 24,800
	2b	Update the Estimate of Stream Flow in Major Stream Segments							0	$ -		$ -	$ 10,685	$ 10,685	$ 10,685	$ 10,685	$ 10,685
	2c	Update the Estimated Concentration of TDS in Major Stream Segments							0	$ -		$ -	$ 10,685	$ 10,685	$ 10,685	$ 10,685	$ 10,685
	2d	Update the Estimated Concentration of TIN in Major Stream Segments							0	$ -		$ -	$ 5,885	$ 5,885	$ 5,885	$ 5,885	$ 5,885
	2e	Estimate the Volume of Stream Flow Recharging from Each Major Stream Segment to the Underlying Groundwater Management Zone							0	$ -		$ -	$ 2,400	$ 2,400	$ 2,400	$ 2,400	$ 2,400
	2f	Estimate the Average Daily Concentration and Mass of TDS Recharging from Each Major Stream Segment to the Underlying Groundwater Management Zone							0	$ -		$ -	$ 2,400	$ 2,400	$ 2,400	$ 2,400	$ 2,400
	2g	Estimate the Average Daily Concentration and Mass of TIN Recharging from Each Major Stream Segment to the Underlying Groundwater Management Zone							0	$ -		$ -	$ 2,400	$ 2,400	$ 2,400	$ 2,400	$ 2,400
	2h	Create an Impoundment for the Prado Wetlands to Account for Evapotranspiration and Changes in Water Quality							0	$ -		$ -	$ -	$ 6,485	$ 6,485	$ 6,485	$ 6,485
	2i	Re-Estimate Stream Flow in Major Stream Segments after Incorporating Additional Discharge Data							0	$ -		$ -	$ -	$ 3,400	$ 3,400	$ 3,400	$ 3,400
	2j	Re-Estimate Concentration of TDS in Major Stream Segments after Incorporating Additional Discharge Data and Effects of the Prado Wetlands							0	$ -		$ -	$ -	$ 3,400	$ 3,400	$ 3,400	$ 3,400
	2k	Re-Estimate Concentration of TIN in Major Stream Segments after Incorporating Additional Discharge Data and Effects of the Prado Wetlands							0	$ -		$ -	$ -	$ 3,400	$ 3,400	$ 3,400	$ 3,400
	2l	Tabulate the Differences between WLAM Versions							0	$ -		$ -	$ -	$ 7,370	$ 7,370	$ 7,370	$ 7,370
	2m	Tabulate the Average Mass Balance (by Source) for Flow, TDS, and TIN in Each Major Stream Segment							0	$ -		$ -	$ -	$ 3,800	$ 3,800	$ 3,800	$ 3,800
	2n	Conduct Formal Outlier Analyses for Areas of High Model Over/Underestimation (i.e., greater than two orders of magnitude)							0	$ -		$ -	$ -	$ 2,400	$ 2,400	$ 2,400	$ 2,400
		Task 2.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 59,255**	**$ 89,510**	**$ 89,510**	**$ 89,510**	**$ 89,510**
3.0	**Evaluate Waste Load Allocation Scenarios for Major Stream Segments**																
	3a	Specify the Range of Probable Discharge Conditions							0	$ -		$ -	$ 6,720	$ 6,720	$ 6,720	$ 6,720	$ 6,720
	3b	Use WLAM to Analyze Six Scenarios							0	$ -		$ -	$ 15,040	$ 15,040	$ 15,040	$ 15,040	$ 15,040
	3c	Report Results of the WLAM Scenario Analyses							0	$ -		$ -	$ 11,390	$ 11,390	$ 11,390	$ 11,390	$ 11,390
	3d	Revise Assumptions for the Six WLAM Scenarios and Rerun							0	$ -		$ -	$ -	$ -	$ -	$ 7,780	$ 7,780
	3e	Conduct Additional Analyses on the Results from the Six WLAM Scenarios							0	$ -		$ -	$ -	$ -	$ -	$ 5,060	$ 5,060
	3f	Conduct Sensitivity Runs or Mass Balance Analyses to Understand Key Issues							0	$ -		$ -	$ -	$ -	$ -	$ 11,130	$ 11,130
		Task 3.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 33,150**	**$ 33,150**	**$ 33,150**	**$ 57,120**	**$ 57,120**
4.0	**Develop WLAM for Managed Recharge in Percolation Basins**																
	4a	Identify the Percolation Ponds and Recharge Basins to be Evaluated							0	$ -		$ -	$ 3,720	$ 3,720	$ 3,720	$ 3,720	$ 3,720
	4b	Characterize the Volume and Quality of Water Recharged to Groundwater							0	$ -		$ -	$ 6,720	$ 6,720	$ 6,720	$ 6,720	$ 6,720
	4c	Summarize the Results of Task 4b by Groundwater Management Zone							0	$ -		$ -	$ 2,815	$ 2,815	$ 2,815	$ 2,815	$ 2,815
	4d	Integrate Results from Task 4c with the Results from Task 3c							0	$ -		$ -	$ 2,815	$ 2,815	$ 2,815	$ 2,815	$ 2,815
		Remove Costs for Task 4 (minus $3,696.25 for work already completed)							0	$ -		$ -	$ -	$ (12,374)	$ (12,374)	$ (12,374)	$ (12,374)
	4e.1	Option 1: Summarize Stormwater Diversion and Spreading		1	2	24			27	$ 3,530		$ 3,530	$ -	$ -	$ -	$ -	$ 3,530
	4e.2	Option 2: Create Nodal Inputs in the WLAM for Stormwater Diversion and Recharge		2	4	80	2		88	$ 11,280		$ 11,280	$ -	$ -	$ -	$ -	$ 11,280
		Task 4.0 Subtotal Hours and Costs (Option 1)	**0**	**1**	**2**	**24**	**0**	**0**	**27**	**$ 3,530**	**$ -**	**$ 3,530**	**$ 16,070**	**$ 3,696**	**$ 3,696**	**$ 3,696**	**$ 7,226**
		Task 4.0 Subtotal Hours and Costs (Option 2)	**0**	**2**	**4**	**80**	**2**	**0**	**88**	**$ 11,280**	**$ -**	**$ 11,280**	**$ 16,070**	**$ 3,696**	**$ 3,696**	**$ 3,696**	**$ 14,976**
5.0	**Estimate Off-Channel Recharge from Natural Precipitation**																
		Estimate the Volume and Quality of Natural Rainfall that Percolates to The Underlying Groundwater Basin							0	$ -		$ -	$ 6,385	$ 6,385	$ 6,385	$ 6,385	$ 6,385
		Task 5.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 6,385**	**$ 6,385**	**$ 6,385**	**$ 6,385**	**$ 6,385**

ADDITIONAL COST ESTIMATE FOR CONSULTING SERVICES

Santa Ana River Waste Load Allocation Model Update

Task	Description	ADDITIONAL COST - THIRD BUDGET AMENDMENT										Original Budget (6-Jan-17)	First Amended Budget (8-Feb-18)	Second Amended Budget (15-Aug-18)	Third Amended Budget (12-Nov-18)	Fourth Amended Budget (12-Feb-19)
		Principal Hydrologist	Senior Geohydrologist	Project Geohydrologist	Staff Geohydrologist	Graphics	Clerical	Total Hours	Labor Cost	Reimbursable Expenses [1]	Additional Cost					
	Hourly Rate:	$285	$200	$165	$125	$110	$95									
6.0	**Run the WLAM in Retrospective Mode, Using Historical Discharge Data, to Estimate the Quantity and Quality of Recharge that Actually Occurred**															
	Run the Most Current Version of the WLAM Produced in the RFP Task 2 After It Has Been Finalized (Calibrated and Validated) to Estimate the Actual Volume and Quality of Water Recharged to the Six GMZ's Named in Task 5 for the 12-Year Period Commencing in January of 2005 and Ending in December of 2016							0	$ -		$ -	$ 6,385	$ 6,385	$ 6,385	$ 6,385	$ 6,385
	Prepare a Summary Comparing the Estimated Actual Values to the WLAM Projects for the Same GMZs.							0	$ -		$ -	$ 1,905	$ 1,905	$ 1,905	$ 1,905	$ 1,905
	Task 6.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 8,290**	**$ 8,290**	**$ 8,290**	**$ 8,290**	**$ 8,290**
7.0	**Compile the WLAM into a Run-Time Software Simulation Package**															
	Develop a Simple Windows-Based Graphical User Interface for the WLAM	The proposed WinHSPF computer code is a Windows-Based Graphic User Interface						0	$ -		$ -	$ -	$ -	$ -	$ -	$ -
	Prepare a Standardized Input File Specifying the Key Input Variables for Each Wastewater Discharge							0	$ -		$ -	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600
	Prepare a User Manual* and Training for up to 15 Staff Members on How to Analyze Scenarios, Run and Retrieve Results From the WLAM.							0	$ -		$ -	$ 6,480	$ 6,480	$ 6,480	$ 6,480	$ 6,480
	Prepare and Submit Model Documentation Suitable for Peer Review							0	$ -		$ -	$ 4,260	$ 4,260	$ 4,260	$ 4,260	$ 4,260
	Task 7.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 17,340**	**$ 17,340**	**$ 17,340**	**$ 17,340**	**$ 17,340**
9.0	**Draft Task Reports, Draft and Final Report**															
	Prepare Draft Task Report for Task 1 Documenting the Results of Task 1							0	$ -		$ -	$ 4,380	$ 4,380	$ 4,380	$ 4,380	$ 4,380
	Prepare Draft Task Report for Task 2 Documenting the Results of Task 2							0	$ -		$ -	$ 9,680	$ 9,680	$ 9,680	$ 9,680	$ 9,680
	Prepare Second Draft Task Report for Task 2 Documenting the Results of Task 2							0	$ -		$ -	$ -	$ 7,245	$ 7,245	$ 7,245	$ 7,245
	Prepare Draft Task Report for Task 3 Documenting the Results of Task 3							0	$ -		$ -	$ 5,760	$ 5,760	$ 5,760	$ 5,760	$ 5,760
	Prepare Draft Task Report for Task 4 Documenting the Results of Task 4							0	$ -		$ -	$ 5,760	$ 5,760	$ 5,760	$ 5,760	$ 5,760
	Remove Costs for Draft Task Report for Task 4 Documenting the Results of Task 4							-	$ -		$ -	$ -	$ (5,760)	$ (5,760)	$ (5,760)	$ (5,760)
	Prepare Draft Task Report for Task 5 Documenting the Results of Task 5							0	$ -		$ -	$ 3,440	$ 3,440	$ 3,440	$ 3,440	$ 3,440
	Prepare Draft Task Report for Task 6 Documenting the Results of Task 6							0	$ -		$ -	$ 3,440	$ 3,440	$ 3,440	$ 3,440	$ 3,440
	Prepare a Draft Study Report, Reflecting a Compilation of the Draft Reports and Addressing All Comments Received from SAWPA and Members of the Task Force on the Previous Drafts							0	$ -		$ -	$ 8,720	$ 8,720	$ 8,720	$ 8,720	$ 8,720
	Prepare a Final Study Report in Electronic Format for Distribution to SAWPA							0	$ -		$ -	$ 3,825	$ 3,825	$ 3,825	$ 3,825	$ 3,825
	Task 9.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 45,005**	**$ 46,490**	**$ 46,490**	**$ 46,490**	**$ 46,490**
10.0	**Monthly Project Meetings**															
	Prepare For and Participate in up-to-18 Half-Day Monthly Meetings Where GSSI will Describe Project Status and/or Present Draft and Final Results to the BMPTF and/or Regional or State Water Boards							0	$ -		$ -	$ 35,640	$ 35,640	$ 35,640	$ 35,640	$ 35,640
	Prepare For and Participate in up-to-4 Half-Day Monthly Meetings Where GSSI will Describe Project Status and/or Present Draft and Final Results to the BMPTF and/or Regional or State Water Boards							0	$ -		$ -	$ -	$ -	$ 11,480	$ 11,480	$ 11,480
	Prepare For and Participate in up-to-2 Half-Day Monthly Meetings Where GSSI will Describe Project Status and/or Present Draft and Final Results to the BMPTF and/or Regional or State Water Boards							0	$ -		$ -	$ -	$ -	$ -	$ 5,740	$ 5,740
	Option 1: Prepare For and Participate in up-to-2 Half-Day Monthly Meetings and 21-Jan-19 Meeting with IEUA, CBWM, and WEI	4	18	18	8	4		52	$ 9,150		$ 9,150	$ -	$ -	$ -	$ -	$ 9,150
	Option 2: Prepare For and Participate in up-to-3 Half-Day Monthly Meetings and 21-Jan-19 Meeting with IEUA, CBWM, and WEI	6	24	24	8	5		67	$ 12,020		$ 12,020	$ -	$ -	$ -	$ -	$ 12,020
	Task 10.0 Subtotal Hours and Costs (Option 1)	**4**	**18**	**18**	**8**	**4**	**0**	**52**	**$ 9,150**	**$ -**	**$ 9,150**	**$ 35,640**	**$ 35,640**	**$ 47,120**	**$ 52,860**	**$ 62,010**
	Task 10.0 Subtotal Hours and Costs (Option 2)	**6**	**24**	**24**	**8**	**5**	**0**	**67**	**$ 12,020**	**$ -**	**$ 12,020**	**$ 35,640**	**$ 35,640**	**$ 47,120**	**$ 52,860**	**$ 64,880**
11.0	**Pilot Evaluation of the Doppler Data Compared to Precipitation Gauge Data**															$ -
	Pilot Evaluation of the Doppler Data Compared to Precipitation Gauge Data							0	$ -		$ -	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
	Task 11.0 Subtotal Hours and Costs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**$ -**	**$ -**	**$ -**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**
	TOTAL HOURS AND COST with OPTION 1 (Task 4e.1):	**4**	**19**	**20**	**32**	**4**	**0**	**79**	**$ 12,680**	**$ -**	**$ 12,680**	**$ 249,800**	**$ 273,766**	**$ 285,246**	**$ 314,956**	**$ 327,636**
	TOTAL HOURS AND COST with OPTION 2 (Task 4e.2):	**6**	**26**	**28**	**88**	**7**	**0**	**155**	**$ 23,300**	**$ -**	**$ 23,300**	**$ 249,800**	**$ 273,766**	**$ 285,246**	**$ 314,956**	**$ 338,256**

Note

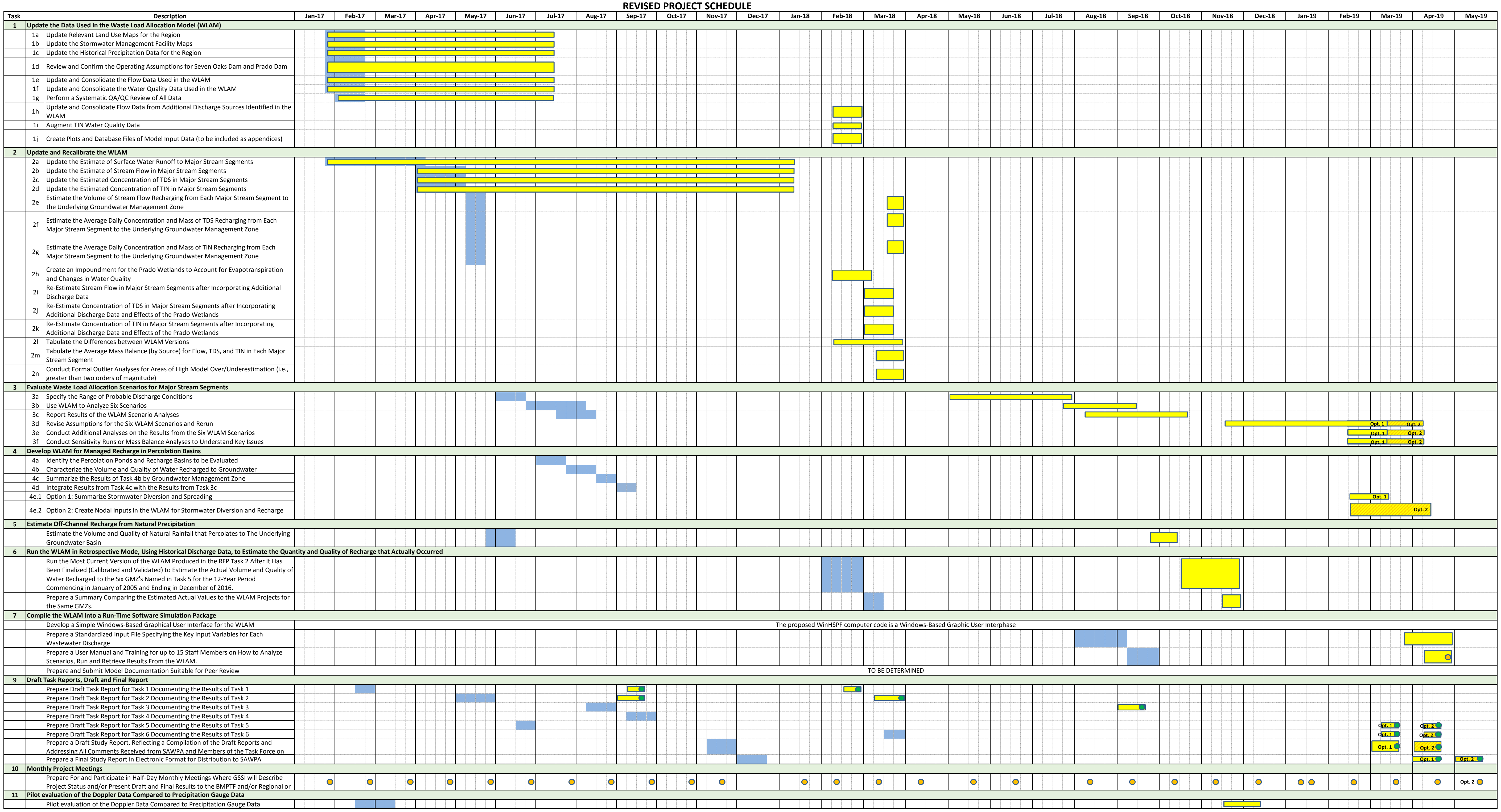
[1] Reimbursable expenses include report reproduction.

Santa Ana Watershed Project Authority

Fourth Request for Budget Amendment for Consulting Services for Santa Ana River Waste Load Allocation Model Update

DRAFT
Table 2

REVISED PROJECT SCHEDULE



Task		Description
1		**Update the Data Used in the Waste Load Allocation Model (WLAM)**
	1a	Update Relevant Land Use Maps for the Region
	1b	Update the Stormwater Management Facility Maps
	1c	Update the Historical Precipitation Data for the Region
	1d	Review and Confirm the Operating Assumptions for Seven Oaks Dam and Prado Dam
	1e	Update and Consolidate the Flow Data Used in the WLAM
	1f	Update and Consolidate the Water Quality Data Used in the WLAM
	1g	Perform a Systematic QA/QC Review of All Data
	1h	Update and Consolidate Flow Data from Additional Discharge Sources Identified in the WLAM
	1i	Augment TIN Water Quality Data
	1j	Create Plots and Database Files of Model Input Data (to be included as appendices)
2		**Update and Recalibrate the WLAM**
	2a	Update the Estimate of Surface Water Runoff to Major Stream Segments
	2b	Update the Estimate of Stream Flow in Major Stream Segments
	2c	Update the Estimated Concentration of TDS in Major Stream Segments
	2d	Update the Estimated Concentration of TIN in Major Stream Segments
	2e	Estimate the Volume of Stream Flow Recharging from Each Major Stream Segment to the Underlying Groundwater Management Zone
	2f	Estimate the Average Daily Concentration and Mass of TDS Recharging from Each Major Stream Segment to the Underlying Groundwater Management Zone
	2g	Estimate the Average Daily Concentration and Mass of TIN Recharging from Each Major Stream Segment to the Underlying Groundwater Management Zone
	2h	Create an Impoundment for the Prado Wetlands to Account for Evapotranspiration and Changes in Water Quality
	2i	Re-Estimate Stream Flow in Major Stream Segments after Incorporating Additional Discharge Data
	2j	Re-Estimate Concentration of TDS in Major Stream Segments after Incorporating Additional Discharge Data and Effects of the Prado Wetlands
	2k	Re-Estimate Concentration of TIN in Major Stream Segments after Incorporating Additional Discharge Data and Effects of the Prado Wetlands
	2l	Tabulate the Differences between WLAM Versions
	2m	Tabulate the Average Mass Balance (by Source) for Flow, TDS, and TIN in Each Major Stream Segment
	2n	Conduct Formal Outlier Analyses for Areas of High Model Over/Underestimation (i.e., greater than two orders of magnitude)
3		**Evaluate Waste Load Allocation Scenarios for Major Stream Segments**
	3a	Specify the Range of Probable Discharge Conditions
	3b	Use WLAM to Analyze Six Scenarios
	3c	Report Results of the WLAM Scenario Analyses
	3d	Revise Assumptions for the Six WLAM Scenarios and Rerun
	3e	Conduct Additional Analyses on the Results from the Six WLAM Scenarios
	3f	Conduct Sensitivity Runs or Mass Balance Analyses to Understand Key Issues
4		**Develop WLAM for Managed Recharge in Percolation Basins**
	4a	Identify the Percolation Ponds and Recharge Basins to be Evaluated
	4b	Characterize the Volume and Quality of Water Recharged to Groundwater
	4c	Summarize the Results of Task 4b by Groundwater Management Zone
	4d	Integrate Results from Task 4c with the Results from Task 3c
	4e.1	Option 1: Summarize Stormwater Diversion and Spreading
	4e.2	Option 2: Create Nodal Inputs in the WLAM for Stormwater Diversion and Recharge
5		**Estimate Off-Channel Recharge from Natural Precipitation**
		Estimate the Volume and Quality of Natural Rainfall that Percolates to The Underlying Groundwater Basin
6		**Run the WLAM in Retrospective Mode, Using Historical Discharge Data, to Estimate the Quantity and Quality of Recharge that Actually Occurred**
		Run the Most Current Version of the WLAM Produced in the RFP Task 2 After It Has Been Finalized (Calibrated and Validated) to Estimate the Actual Volume and Quality of Water Recharged to the Six GMZ's Named in Task 5 for the 12-Year Period Commencing in January of 2005 and Ending in December of 2016.
		Prepare a Summary Comparing the Estimated Actual Values to the WLAM Projects for the Same GMZs.
7		**Compile the WLAM into a Run-Time Software Simulation Package**
		Develop a Simple Windows-Based Graphical User Interface for the WLAM
		Prepare a Standardized Input File Specifying the Key Input Variables for Each Wastewater Discharge
		Prepare a User Manual and Training for up to 15 Staff Members on How to Analyze Scenarios, Run and Retrieve Results From the WLAM.
		Prepare and Submit Model Documentation Suitable for Peer Review
9		**Draft Task Reports, Draft and Final Report**
		Prepare Draft Task Report for Task 1 Documenting the Results of Task 1
		Prepare Draft Task Report for Task 2 Documenting the Results of Task 2
		Prepare Draft Task Report for Task 3 Documenting the Results of Task 3
		Prepare Draft Task Report for Task 4 Documenting the Results of Task 4
		Prepare Draft Task Report for Task 5 Documenting the Results of Task 5
		Prepare Draft Task Report for Task 6 Documenting the Results of Task 6
		Prepare a Draft Study Report, Reflecting a Compilation of the Draft Reports and Addressing All Comments Received from SAWPA and Members of the Task Force on
		Prepare a Final Study Report in Electronic Format for Distribution to SAWPA
10		**Monthly Project Meetings**
		Prepare For and Participate in Half-Day Monthly Meetings Where GSSI will Describe Project Status and/or Present Draft and Final Results to the BMPTF and/or Regional or
11		**Pilot evaluation of the Doppler Data Compared to Precipitation Gauge Data**
		Pilot evaluation of the Doppler Data Compared to Precipitation Gauge Data

The proposed WinHSPF computer code is a Windows-Based Graphic User Interphase

TO BE DETERMINED

🟦 **Original GEOSCIENCE Working Period**
🟨 **Revised GEOSCIENCE Working Period (Option 1)**
▨ **Revised GEOSCIENCE Working Period (Option 2)**
● **Deliverable Date**
○ **Meeting / Workshop**
Note
* The dates of the Regional and State Water Board hearings have not yet been determined

ATTACHMENT A

Rationale for Restoring Some Elements of Task 4 in the WLAM Scope of Work

Risk Sciences – January 24, 2019

GEOSCIENCE

RISK SCIENCES

January 24, 2019

TO: Basin Monitoring Program Task Force

FROM: Tim Moore

RE: Rationale for restoring some elements of Task 4 in the WLAM scope of work

Background

The current Waste Load Allocation Model (WLAM), which was developed by WEI in the early 2000's and approved by the Regional Board in 2004, was designed to estimate the volume-weighted average concentrations of TIN and TDS in water that percolates from surface streams to the underlying groundwater basin. The existing WLAM was not designed to account for of any additional water that may be recharging to the same groundwater basins from areas other than directly beneath the streambeds. Consequently, the WLAM does not keep track of treated wastewater, imported water or captured stormwater that is recharged to the aquifers in off-channel percolation basins.[1] This includes stormwater runoff that may be diverted out of the stream channels and into recharge basins adjacent to the river.

In the fall of 2016, the Task Force formed a Scoping Committee to prepare an RFP to update the Santa Ana River Waste Load Allocation Model (WLAM). That RFP included Task #4 to "develop a new WLAM module that will consider other significant sources of recharge to groundwater management zones for the purpose of facilitating future permitting efforts by the Regional Board." Task 4b in the RFP Scope-of-Work states that these other sources of off-channel recharge include both stormwater and recycled water. The Task Force contracted with Geosciences, Inc. to update the WLAM (including Task #4) and work commenced in early 2017.

In the summer of 2017, Geosciences requested each agency to provide the detailed discharge and recharge data needed to update the WLAM. Several agencies questioned the need to expand the WLAM to include recharge activities that occurred off-channel. Following considerable discussion, the Task Force concluded that off-channel recharges could be addressed separately by individual agencies working with the Regional Board and need not be addressed in the WLAM. As a result, in October of 2017, the Task Force voted to delete Task #4 from Geosciences' scope-of-work and the resulting contract savings was reallocated to support other contract change orders.

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[1] The modeling and analyses performed by the Imported Water Recharge Workgroup, pursuant to their Cooperative Agreement with the Regional Board, attempts to account for some off-channel recharges.

Issue

In the years since the WLAM was originally developed, several agencies have significantly expanded their groundwater recharge facilities and their ability to capture and percolate stormwater runoff in these facilities. Some river flows that historically percolated through the natural streambeds are now being diverted to recharge basins adjacent to the channels. The WLAM must accurately account for such diversions as part of the model calibration process, but it does not explicitly track or report the fate of these diverted storm flows. Consequently, although the WLAM accounts for the reduction of flow and recharge within the stream channels below the diversion points, it does not know whether the diverted flow was recharged somewhere nearby or exported out of the basin altogether.

In general, the quality of stormwater is quite good with relatively low concentrations of TIN and TDS. If this stormwater is diverted out of the stream channel to a nearby percolation basin, and the WLAM acknowledges the former but ignores the latter, the net effect will make it appear that less high quality stormwater is being recharged to groundwater. Because it focuses exclusively on recharge occurring through the streambeds, the WLAM may also make it appear that the ratio of recycled water to stormwater percolating to a given aquifer is greater than it really is.

There are at least three groundwater management zones (GMZ) where there is significant diversion of instream flow to off-channel recharge basins (see table below). The WLAM's current inability to continue tracking such diversions may lead to inaccurate conclusions about the potential for water quality degradation and the rate at which such degradation might occur.

Groundwater MZ	Surface Streams[2]	Off-Channel Facilities
Bunker Hill-B	Santa Ana River-Reach 5	SBVWCD Recharge Basins
Chino-North	Chino Cr. & Cucamonga Cr.	IEUA Recharge Basins
Orange County	Santa Ana River-Reach 2	OCWD Recharge Basins

When the need for Task 4 was being reassessed in the fall of 2017, the discussion focused almost exclusively on whether the WLAM should keep track of wastewater and recycled water being discharged to ponds. There was very little, if any, attention given to the issue of stormwater harvesting and the effect such diversions might have on the accuracy and utility of the WLAM. Nevertheless, when Task 4 was cancelled in order to address the former issue, we inadvertently terminated the work intended to address the latter issue.

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[2] Includes flows diverted from unlined tributaries to these creeks.

Recommendation

Option 1: Since the WLAM already accounts for any known flows diverted out of the stream channel and the associated TIN/TDS concentrations, these diversions should be summarized in tables that are attached as appendices to Geosciences Final Report.[3] The report should also state explicitly that these diversions are not included in the calculation of the volume-weighted average TIN and TDS concentrations in recharges to each GMZ. This is a lower cost option that assures stakeholders throughout the region continue to work from the same set of facts but also depends on others to perform that additional work in order to know the true net impact of our activities on groundwater quality.

Option 2: Where stream flows are diverted to percolation ponds that recharge the same underlying groundwater basin, the WLAM should be adjusted to recognize such recharges as a separate nodal inputs. The volume-weighted average TIN and TDS concentrations of recharge to each GMZ should be calculated with and without accounting for the off-channel recharges. This is a higher cost option that better assures that the WLAM provides the most accurate and complete answers possible to the most critical water quality questions. The additional analysis is inevitable because it is essential; therefore, it may be less expensive (in the long run) to integrate this work with the WLAM already under development.

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[3] Geosciences prepared preliminary versions of such tables to illustrate the diversions which they estimate are currently taking place in the Chino-North GMZ and the Bunker Hill-B GMZ (copies attached to this memo).

Projected Annual Volume of Stormwater Recharge in Chino Basin with Existing Stormwater Recharge Capacity

Fiscal Year[1]	Volume of Stormwater Recharge under Scenario Conditions (acre-ft/yr)	Volume of Undiverted Flow under Scenario Conditions (acre-ft/yr)
1951	7,262	19,682
1952	24,189	86,665
1953	10,263	31,662
1954	12,457	52,925
1955	11,416	38,088
1956	11,848	49,494
1957	10,385	29,729
1958	20,110	80,270
1959	4,608	18,280
1960	6,746	35,399
1961	3,496	14,532
1962	8,418	50,782
1963	5,545	26,892
1964	6,526	34,562
1965	7,840	36,997
1966	11,134	56,120
1967	17,226	67,080
1968	10,908	30,906
1969	22,999	126,147
1970	8,540	25,418
1971	9,568	25,571
1972	5,563	25,490
1973	18,433	41,489
1974	10,709	16,600
1975	12,355	24,069
1976	6,433	20,662
1977	12,598	28,426
1978	25,738	114,366
1979	17,699	48,563
1980	21,213	111,784
1981	7,961	20,177
1982	15,554	47,797
1983	27,460	115,733
1984	12,581	26,961
1985	9,876	33,840
1986	13,986	50,686
1987	7,881	24,785
1988	11,717	14,469
1989	9,326	21,721
1990	6,847	25,993
1991	14,314	43,048
1992	14,314	55,171
1993	14,314	170,483
1994	14,314	29,266
1995	14,314	106,743
1996	14,314	43,853
1997	14,314	55,155
1998	14,314	76,343
1999	14,314	18,711
2000	14,314	26,354
2001	14,093	16,927
2002	14,093	6,931
2003	14,093	52,721
2004	14,093	22,488
2005	40,880	98,552
2006	30,499	27,375
2007	12,429	5,065
2008	24,605	34,928
2009	18,541	31,292
2010	33,264	56,840
2011	39,566	76,909
2012	22,409	20,156
2013	13,648	13,513
2014	11,445	10,035
2015	19,597	25,087
2016	22,325	22,184
Average	**14,760**	**43,893**

[1] Fiscal Year listed represents the year in which the fiscal year ends (e.g., FY 1950 = July 1940 - June 1950)

Annual Volume of Diverted and Undiverted Storm Water Released from Seven Oaks Dam with a Diversion Capacity of 500 cfs

Water Year[1]	Diverted Flow that Enters the Valley District Diversion Structure (acre-ft/yr)	Undiverted Flow that Passes the Valley District Diversion Structure (acre-ft/yr)
1950	6,098	0
1951	2,399	0
1952	54,135	28,973
1953	14,940	0
1954	31,358	0
1955	799	0
1956	238	0
1957	2,918	0
1958	59,463	8,926
1959	4,149	0
1960	14,951	0
1961	28,903	0
1962	7,833	0
1963	799	0
1964	238	0
1965	1,664	0
1966	30,122	0
1967	59,463	8,926
1968	5,234	0
1969	98,000	106,614
1970	28,903	0
1971	18,227	0
1972	10,782	0
1973	31,358	0
1974	5,698	0
1975	4,487	0
1976	5,970	319
1977	2,399	0
1978	43,000	28,432
1979	43,000	16,871
1980	43,000	136,260
1981	7,608	0
1982	15,069	0
1983	54,000	57,621
1984	14,951	0
1985	5,083	0
1986	12,227	0
1987	1,329	0
1988	1,409	0
1989	2,918	0
1990	239	0
1991	5,117	0
1992	8,300	0
1993	65,000	62,401
1994	6,098	0
1995	54,000	28,973
1996	10,564	0
1997	11,001	0
1998	65,000	7,948
1999	4,710	0
2000	4,149	0
2001	12,881	0
2002	9,971	0
2003	23,754	0
2004	14,893	0
2005	89,483	28,799
2006	54,485	1,190
2007	19,982	0
2008	31,698	0
2009	22,517	0
2010	43,868	862
2011	73,477	13,176
2012	28,117	0
2013	17,806	0
2014	13,474	0
2015	13,458	0
2016	13,667	0
Average	**22,281**	**8,004**
Maximum	**98,000**	**136,260**
Minimum	**238**	**0**

[1] Water Year listed represents the year in which the water year ends (e g WY 1950 = October 1940 - September 1950)