Salinas River Groundwater Basin Investigation, Salinas Valley, California.

Amended Scope and Fee Schedule for Agreement #16WSCA600466210

By

Wesley Henson, U.S. Geological Survey, and

Howard Franklin, Monterey County Water Resources Agency

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Problem and Study Area

The Salinas River Groundwater Basin is the largest coastal groundwater basin in Central California. It lies within the southern Coast Ranges between the San Joaquin Valley and the Pacific Ocean, and is drained by the Salinas River. The valley extends approximately 150 miles from the La Panza Range north-northwest to its mouth at Monterey Bay, draining approximately 5,000 square miles in Monterey and San Luis Obispo Counties. The valley is bounded on the west by the Santa Lucia Range and Sierra de Salinas and on the east by the Gabilan and Diablo Ranges. The Monterey Bay acts as the northwestern boundary of the Basin (Baillie and others, 2015b) (fig. 1A). The basin is part of the Monterey County Water Resources Agency (MCWRA) Benefit Zone 2C (Zone 2C), and consists of 7 subareas named as follows: Above Dam, Below Dam, Upper Valley, Arroyo Seco, Forebay, East Side, and Pressure. The analyses detailed in this report cover the four primary water-producing subareas: Pressure, East Side, Forebay (including the Arroyo Seco), and Upper Valley Subareas (fig. 1A). These four subareas include most of the land area and account for nearly all of the reported groundwater usage within Zone 2C (Baillie and others, 2015b). In addition to these four subareas, an additional assessment will be made for the "Below Dam" subarea and nearby Hames Valley area which are directly below the San Antonio Dam/Reservoir and have been regions of recent agricultural developments. A recent summary of the state of the basin was completed by Brown and Caldwell hydrologists for Monterey County in preparation for developing a new integrated hydrologic model (Baillie and others, 2015b). The region covered by part of the five-layer Seaside Basin model (Hydrometrics, 2009) of the Seaside subbasin, is an additional subarea that will be evaluated and simulated separately because it was adjudicated separately (fig. 1B).

This project is the result of the lawsuit by several parties concerning the over-exploitation of water resources in the Salinas Valley and the resulting settlement agreement, Salinas Valley Water Coalition et al v. County of Monterey: Monterey County (MC, 2010). The settlement requires that Monterey County, among

other things, evaluate total water demand for existing and future uses, seawater intrusion and groundwater levels, and on an annual basis for the study period, groundwater-level elevations and the extent of the seawater intrusion boundary. The evaluation is to be completed between October 31, 2017 and March 31, 2018, and the period of study is to extend to 2030.

Currently, surface water and groundwater are conjunctively used for irrigation and public water supply in the Salinas Valley. Groundwater withdrawals, mainly for the irrigation of agricultural crops, have resulted in water-level declines throughout the Basin. In the Pressure Subarea, water-level declines have led to seawater intrusion of as much as 11,000 to 18,000 acre-feet per year (ac-ft/yr) since the 1930s (Baillie and others, 2015b). An evaluation of conjunctive use and groundwater overdraft in the Salinas groundwater basin by Montgomery Watson for MCWRA (Baillie and others, 2015b; MW, 1998) indicated that during the period from 1959 to 2013, Zone 2C was out of groundwater balance with a loss of fresh-water storage of 17,000 to 24,000 ac-ft/yr, which includes storage loss due to seawater intrusion (Baillie and others, 2015). A Salinas Valley water budget for 2013 indicated a total pumpage of 509,000 acre-ft, as reported to MCWRA, (Table 1) with an estimated cumulative storage depletion of 559,000 ac-ft from 1944 to 2013 (Baillie and others, 2015b) (fig 2).

With the implementation of the Salinas Valley Water Project (SVWP) in 2010, there was an expectation among residents and water managers that the advancement of the seawater intrusion would slow, or even halt, and the balance of the basin would improve. Under current drought conditions many are concerned about the effectiveness of the SVWP and whether the groundwater basin will continue to be overdrafted. In addition, there is concern that the groundwater-level declines have or will result in potential impediment to surface-water transmission via the Salinas River to the Salinas River Diversion Facility (SRDF) because of increased infiltration induced from pumping of high-capacity wells adjacent to the Salinas River.

Recent studies of the Salinas River Groundwater Basin (Baillie and others, 2015b) have documented the geohydrologic conditions of the area when groundwater development was substantially developed. The goal of this project is to characterize the major aquifers and simulate groundwater flow and storage in all of the major aquifers above the Monterey Formation, as well as the movement and use of water across the landscape of the valley floor and surface-water flow in all drainages surrounding the major aquifers (fig. 3). Because the Salinas Valley is a conjunctive use system, it will be important to define the water-bearing and water-quality properties of the deeper aquifers and their relation to surface-water in the groundwater basin. To plan for future use, it will be important to define the quantity and quality of the groundwater supply and establish tools to allow users to efficiently and optimally utilize the available groundwater resources without incurring unacceptable, deleterious effects, and to evaluate the effects of potential changes in climate and land use on these resources.

Objectives

The objectives of this study are to: (1) refine the geohydrologic framework of the Salinas Valley, (2) develop integrated hydrologic models, (3) quantify the historical hydrologic budget of the valley and evaluate total water demand for existing and support consultants in the use of the integrated hydrologic model for evaluation of future water and land uses, (3) develop hydrologic modeling tools (models and related preparation and analysis tools) to help evaluate and manage the water resources, (4) provide support and guidance in the development and use of integrated model to develop the required deliverables of the settlement agreement Salinas Valley Water Coalition et al v. County of Monterey: Monterey County (MC, 2010), and (5) guide and assist consultants with incorporating climate model results into the integrated hydrologic model and evaluate the potential effects of climate change for selected scenarios. The study will develop a greater understanding of the geohydrology of the Salinas Valley and evaluate the potential hydrologic effects of future water-resource and land-use development as well as changes in natural land cover in the valley, and can aide in the potential development of a new resource management plan. These modeling tools will specifically be used to evaluate, on an annual basis during the study period (2014 – 2018), groundwater-level elevations and the quantify seawater intrusion. This amended scope and fee schedule provides funding for deliverables defined in the first agreement that were not funded and defines modifications to the scope and deliverables since the development of the original joint funded agreement (#16WSCA600466210), hereafter called the original agreement which was funded for federal fiscal year (FFY) 2016 through 2017.

Approach

The proposed study will include six main tasks:

1. Geohydrologic model development,
2. Surface-water hydrologic models development,
3. Development of an integrated groundwater/surface-water hydrologic model,
4. Provide annual refinements to the Historical 1967-2014 integrated hydrologic model for the period 2014-2018.
5. Provide guidance for a consultant to perform analysis of water availability and future land use, and
6. Report/information preparation. The previously compiled geologic information and databases will be used to develop the geohydrologic framework of the Salinas Valley. This framework will include the creation of a texture model and related layering and structural barriers to groundwater flow. Climate, land-use, geologic, hydrologic, and water-quality data previously compiled and assembled into databases and a Geographic Information System (GIS) will be used with current monitoring networks to

develop GIS coverages, models, and comparison information needed to calibrate hydrologic models, update the hydrologic models, generate illustrations of model output and report results.

Geohydrologic and hydrologic models will be developed as part of this study to more accurately assess and simulate the storage and flow of water in Salinas Valley. The culmination of the data and models will be the development of the Salinas Valley Integrated Hydrologic Model (SVIHM) using MODFLOW-OWHM (MF-OWHM version 2) (Hanson and others, 2014, Boyce and others, 2017, in prep.). The SVIHM will be used to analyze changes in the use and movement of water throughout the landscape, surface-water networks and aquifers, as well as changes in groundwater storage and related seawater intrusion in different hydrologic regions of Salinas Valley caused by current and projected water use and potential climate change.

Deliverables

The project will deliver the following specific items, not yet provided or funded under the agreement # 16WSCA600466210, hereafter called the original agreement. Item 1 (a, b, c) as called out here are model refinements for the 1967-2014 historical model developed in the original agreement and updates and support and guidance for consultant work necessary to meet the terms of the settlement agreement. Updated model results are considered "provisional" products until the completion of the project. Item 1 also includes the development of a new land-use and water demand tool/methodology not included within the original agreement. Items 2, 3 and 4; future model update training and model transfer (beyond 5-year investigation), the Scientific Investigations Reports and Fact Sheets, and model archive and data releases were included in the original agreement and are funded in this amendment.

(1) **<u>Historical Model Updates, Results, and Guidance</u>** (with metadata):

(a) FFY2018

1. Continue building and refining methodology for land-use/water demand updates to historical model. This task was not identified and scoped in the original agreement.
2. Perform updates and refinement of the SVIHM for the hydrologic period 1967 through 2016. Develop Seawater Intrusion (SWI), Ground Water Level (GWL) contour's, water budgets, and selected calibration files for presentation to County Board of Supervisors: Spring 2018.

(b) FFY 2019

1. Complete building and refining methodology for land-use/water demand updates to historical model. This task was not identified and scoped in the original agreement.
2. Perform updates and refinement of the SVIHM for the hydrologic period 1967 through 2017. Develop SWI, GWL contours, water budgets, and selected calibration files for presentation to the County Board of Supervisors: Spring 2019.
3. Provide guidance to County's consultant in the development of a spatial distribution of land-use/water demands for build out years 2030 and 2045.
4. Provide support and guidance to County's modeling consultant in development of model input and performance of analysis necessary to meet terms of the settlement agreement.

(c) FFY 2020

1. Complete historical model updates and refinements, 1967 through 2018. Prepare SWI, GWL contour maps, and water budgets for presentation to County Board of Supervisors: Spring 2020.
2. Provide guidance to County's consultant in the development of a spatial distribution of land-use/water demands for build out years 2030 and 2045.
3. Provide support and guidance to County's modeling consultant in development of model input and performance of analysis necessary to meet terms of the settlement agreement.

(2) <u>Future Model Updates - Training and Model Transfer (Beyond 5-year Basin Investigation Study)</u>

The SVIHM is being developed in the structure of a "self-updating model." In FFY2018 and 2019 updates will be performed by USGS and MCWRA staff and the FY2020 updates will transition to MCWRA staff with USGS oversight. Model updates after FFY 2020 will be completed by MCWRA staff. The model updates serve two purposes (1) an updated model can be used to produce more current hydrologic and landscape budgets and related maps beyond the period of this project and (2) the updates are a mechanism for technology transfer to the MCWRA staff and their consultants so they can continue to develop the data streams needed to update the model input and observations that keep it current. The USGS staff will work with MCWRA staff to help build flow charts and procedures for maintaining the data streams for the self-updating temporal components of the hydrologic model inputs and observations. This is not an operations manual but a workflow record of how to maintain and build the input and observational data sets.

(3) <u>Reports</u>:

One USGS Scientific Investigations Report (SIR) will individually summarize the geohydrologic framework and the historical hydrologic results from the suite of hydrologic models.

A USGS Fact Sheet summarizing the geohydrologic framework, changes in land use and water availability and use, as well as hydrologic and landscape budgets that are derived from the more complete Hydrologic SIR reports.

(4) <u>Model Archive and Data Release</u>

Each of the hydrologic models developed as part of this project will be archived in the USGS Model Archive based on the current USGS standards for Fundamental Science Practices and Water Mission Area model archiving policies/guidelines. Metadata created as part of the model development process will be archived with the models. Even though USGS model archives are not publicly accessible, the archived models will be publically available (upon request) following USGS approved publication of the respective model reports.

Budget

The summary of funding in the original agreement and amendments from both entities is shown in Table 1, the budgets for the study tasks are shown in Table 2 by Federal fiscal year (FFY), and Table 3 provides the amended work plan. The land-use analysis and surface water operations module were not budgeted in the original agreement and were necessary for the model build completed in FY2017. The original budget assumed that land-use provided by the previous consultant was sufficient and that the surface water operations module could be used without modification. An updated detailed budget summary reflecting these changes and the remaining budget is provided in Table 2.

Table 1. General funding summary

Agreement	Funding Source	FFY 2016	FFY 2017	FFY 2018	FFY 2019	FFY 2020	FFY 2021	Total Cost
Agreement # 16WSCA600466210	Monterey County	$597,400	$159,900					
Ammendment 1	USGS	$48,345	$15,263					
Ammendment 2	Monterey County			$232,659	$105,618	$109,725	$15,290	$1,205,302
	USGS			$23,266	$10,562	$10,973	$1,529	$109,937
	Total	**$645,745**	**$175,163**	**$255,924**	**$116,180**	**$120,698**	**$16,819**	**$1,330,529**

Table 2. Detailed cost For Monterey County of work-plan tasks

Study Components	Tasks		FFY 2016	FFY 2017	FFY 2018	FFY 2019	FFY 2020	FFY 2021	Total Cost
Model Development	Original Agreement	Geohydrologic Framework	$89,300						
	Original Agreement	Surface Water Models	$263,300						
	Original Agreement	SVIHM Model	$276,845	$148,204					
Total Cost Model Development			$629,445	$148,204					
Reporting	Original Agreement	Scientific and TAC reports	$16,300	$26,959					
Total Cost Reporting									
Model Products and Refinements	Task 1a	Geologic Framework Updates			$17,257				
	Task 1a	GIS Products			$5,072				
	Task 1a	Scientific Presentations and Travel			$14,248				
	Task 1a	Surface Water Model Updates-2015/2016			$28,521				
	Task 1a	SVIHM Updates-2015/2016			$39,031				
	Task 1b	GIS Products				$5,224			
	Task 1b	Scientific Presentations and Travel				$14,676			
	Task 1b	Surface Water Model Updates-2017				$29,377			
	Task 1b	SVIHM 2030 Analysis Guidance				$31,855			
	Task 1b	SVIHM Updates-2017				$35,048			
	Task 1c	GIS Products					$5,381		
	Task 1c	Scientific Presentations and Travel					$15,116		
	Task 1c	Surface Water Model Updates-2018					$30,258		
	Task 1c	SVIHM 2045 Analysis Guidance					$32,811		
	Task 1c	SVIHM Updates-2018					$20,461		
Total Cost Provisional Products					**$104,129**	**$116,180**	**$104,027**		
Reporting	Task 2	Annual Model Updates-Training and Model Transfer					$16,671	$16,819	
	Task 3a	SIR-SVIHM Geologic Framework and Historical Model			$120,687				
	Task 3b	Water Availability Fact Sheet			$15,554				
	Task 4	Model Archive and Data Release			$15,554				
Total Cost Reporting			$16,300	$26,959	$232,659	$105,618	$16,671	$16,819	$398,207
Total Cost MCWRA			$597,400	$159,900	$232,659	$105,618	$109,725	$15,290	$1,205,302
Total Cost USGS			$48,345	$15,263	$23,266	$10,562	$10,973	$1,529	$109,937
Total Cost			**$645,745**	**$175,163**	**$255,924**	**$116,180**	**$120,698**	**$16,819**	**$1,330,529**

Table 3. A generalized work plan for amended scope (by quarter, with I = Fall, II = Winter, III = Spring, and IV = Summer) is as follows: This proposed study will require parts of four Federal Fiscal Years (FY) to complete.

Year=>	2018	2018	2018	2018	2019	2019	2019	2019	2020	2020	2020	2020	2021
Quarter =>	1	2	3	4	1	2	3	4	1	2	3	4	1
Fiscal year =>	FFY 18	FFY 18	FFY 18	FFY 18	FFY 19	FFY 19	FFY 19	FFY 19	FFY 20	FFY 20	FFY 20	FFY 20	FFY 21
Project Task	I	II	III	IV	I	II	III	IV	I	II	III	IV	I
Task 1a-GIS Products													
Task 1a-Scientific Presentations and Travel													
Task 1a-Surface Water Model Updates-2015/2016													
Task 1a-SVIHM Updates-2015/2016													
Task 1b-GIS Products													
Task 1b-Scientific Presentations and Travel													
Task 1b-Surface Water Model Updates-2017													
Task 1b-SVIHM 2030 Analysis Guidance													
Task 1b-SVIHM Updates-2017													
Task 1c-GIS Products													
Task 1c-Scientific Presentations and Travel													
Task 1c-Surface Water Model Updates-2018													
Task 1c-SVIHM 2045 Analysis Guidance													
Task 1c-SVIHM Updates-2018													
Task 2-Annual Model Updates-Training and Model Transfer													
Task 3a-SIR-SVIHM Geologic Framework and Historical Model													
Task 3b-Water Availability Fact Sheet													
Task 4-Model Archive and Data Release													