9 ATTACHMENT 6 - BUDGETS

For the "AttachmentName" in the naming convention of BMS, use "Budget" for this For the "AttachmentName" in the naming convention of BMS, use "BUDGET" for this attachment.

The budget must be consistent with and support the work plan and schedule. The budget attachment should consist of a budget table (Table 3) and explanatory text. In the table, for each work plan task, a budget line item estimate should be presented, as well as a breakdown of the applicant's funding match and requested grant funds. Explanatory text should allow the reviewer to understand how the budget estimate was developed (basis of estimate). This may include supporting information for the budget such as labor categories, hourly rates, labor time estimates, and subcontractor quotes. Subcontractor quotes should also include information supporting the quotes, such as hourly rates and the number of hours required to perform each included task. Submittal of lump sum task estimates may be appropriate; however, applicants must substantiate the reasonableness and logic for using a lump sum basis of estimate. The sources for other funding to complete the proposal must be identified, though a funding match is not required. Applicants are encouraged to limit direct project administrative expenses to less than 5% of the total proposal costs.

Supporting documentation for the costs included in the Plum Basin Project budget can be found in **Appendix B of the PIXID Groundwater Banking Support Project Appendices** of the application.

9.1.1 **Direct Project Administration**

9.1.1.1.1 Task 1 - Administration

Proposal administration costs from Pixley ID to DWR were included in this cost category. The person identified to do this reporting will be Mr. Eric Limas, Pixley ID's Business Manager. However Mr. Limas will use the District's grant and engineering consultant for much of the effort. Grant funds were requested for these costs. Office supplies were not included. Grant funds were not requested for these costs.

9.1.1.1.2 Task 2 - Labor Compliance Program

Pixley ID does not currently have a formal labor compliance plan for contracted services. The costs in this task area associated with the development of a labor compliance plan for the District by a consultant. The costs were developed from similar efforts by neighboring districts that were awarded IRWM Implementation grants through Proposition 84.

Table 9-1: PIXID Groundwater Banking Support Project Summary Budget Table

2012 PIXID Groundwater Banking Investigation Table 3 - Budget				
Tasks	**Budget Category**	**Non-State Share* (Funding Match)**	**Requested Grant Funding**	**Total**
1	Administration	$8,000		$8,000
2	Labor Compliance Program	$1,000		$1,000
3	Reporting	$3,500		$3,500
4	Agreement with Landowners for Use of 20 Ag/Monitor Wells	$2,000		$2,000
5	Preliminary Biological Assessment	$1,500		$1,500
6	Dedicated Monitor Wells			$0
6 .1	Design Memorandum		$1,000	$1,000
6 .2	Construction Drawings		$8,000	$8,000
6 .3	Project Specifications		$5,000	$5,000
6 .4	Solicitation and Competative Bide Documents		$5,000	$5,000
6 .5	Contract Documents		$2,500	$2,500
7	Environmental Documentation			$0
7 .1	Environmental Checklist and Biological Assessment	$1,500		$1,500
7 .2	Development of CEQA Documentation	$500		$500
7 .3	Final CEQA Documentation	$100		$100
8	Permitting			$0
8 .1	Private Property Access and GW Data Use	$500		$500
8 .2	Well Driller's Permit	$150		$150
8 .3	Well Completion Report	$150		$150
9	Developing a Numeric Groundwater Model			$0
9 .1	Scoping Meeting with Project Team		$9,000	$9,000
9 .2	Compile Gathered Data		$32,000	$32,000
9 .3	Model Development and Calibration			$0
9 .3 .1	Hydrogeological Conceptual Model		$8,000	$8,000
9 .3 .2	Numerical Model Setup and Transient Calibration		$14,000	$14,000
9 .3 .3	Sensitivity and Uncertainty Analysis		$20,000	$20,000
9 .3 .4	Numerical Model Verification and Validation		$20,000	$20,000
9 .3 .5	Predictive Simulations		$12,000	$12,000
9 .4	Model Documentation		$35,000	$35,000
10	GPS Survey of Additional Ag/Monitor Wells			$0
10 .1	Selection of Preferred Locations	$0	$1,000	$1,000
10 .2	Selection of alternative ag/monitor wells if necessary	$1,000		$1,000
10 .3	GPS Survey of authorized ag/monitor wells		$5,000	$5,000
10 .4	Update of previous documentation of Monitoring Network wells		$2,000	$2,000

11	Construction Contracting and Deliverables			$0
11 .1	Publish Notice to Bidders		$7,500	$7,500
11 .2	Pre-Bid Meeting and Addendum No. 1	$1,000		$1,000
11 .3	Bid Opening and Bid Evaluation	$1,000		$1,000
11 .4	Bid Award	$1,000		$1,000
12	Construction			$0
12 .1	Mobilization and Site Preparation			$0
12 .1 .1	Mobilization		$8,000	$8,000
12 .1 .2	Worker Protection		$500	$500
12 .1 .3	Miscellaneous Facilities and Operations		$2,000	$2,000
12 .2	Project Construction			$0
12 .2 .1	Construction Staking	$180	$420	$600
12 .2 .2	Miscellaneous Engineering Services	$1,500		$1,500
12 .2 .3	Monitor Well Construction		$44,980	$44,980
12 .2 .4	E-logs, Geologic and Geophysical Logging		$3,600	$3,600
12 .2 .5	Construction Inspection	$7,500		$7,500
12 .2 .6	As-Built Drawings		$1,500	$1,500
12 .3	Demobilization		$2,000	$2,000
13	Environmental Compliance/Mitigation/Enhancement	$250		$250
14	Construction Administration	$1,500		$1,500
	Grand Total	$33,830 12%	$250,000 88%	$283,830

9.1.1.2Task 3 – Reporting

Proposal reporting costs from Pixley ID to DWR were included in this cost category. The person identified to do this reporting will be Mr. Eric Limas, Pixley ID's Business Manager. However Mr. Limas will use the District's grant and engineering consultant for much of the effort. Grant funds were requested for these costs. Office supplies were not included. Grant funds were not requested for these costs.

9.1.2 <u>Task 4 - Agreement with Landowners for Use of 20 Ag/Monitor Wells</u>

Pixley ID will work with landowners in the area of the potential groundwater banking project to add an additional 20 existing irrigation wells to the District's groundwater monitoring network. This task accounts for the District's effort through staff time and consultant services to identify the wells to be initially investigated and the iterative process to investigate each site, determine if the landowner is willing and to secure an agreement from the landowner to allow the District to use that well as a monitoring location and publish the data to the public. The budget included in this task reflects the anticipated involvement by the District's engineering consultant and the District's staff time was not accounted for.

9.1.3 **Row (c) Planning/Design/Engineering/Environmental Documentation**

9.1.3.1Task 5 – Preliminary Biological Assessment

The two dedicated monitor well sites will be preliminarily reviewed by District staff and their environmental consultant to determine if it appears likely that the initial sites selected for the construction of the dedicated monitor wells is concerning. Prior to visiting the sites the District's environmental consultant will research nearby sightings recorded in the California Natural Diversity Database for reference. The costs included in this task are the estimated consultant costs associated with the effort. The District staff time was not accounted for.

9.1.3.2Task 6 – Design of Dedicated Monitor Wells

The following efforts are described in the work plan and included in the project budget as Planning/Design/Engineering/Environmental Documentation efforts. These efforts were developed in coordination with Pixley ID's engineering and planning consultant as efforts necessary to prepare for a contractor to construct the two dedicated monitoring wells.

- Task 5 – Preliminary Biological Assessment
- Task 6 – Design of Dedicated Monitor Wells
    - Task 6.1 – Design Memorandum
    - Task 6.2 – Construction Drawings
    - Task 6.3 – Project Specifications
    - Task 6.4 – Solicitation and Competitive Bid Documents
    - Task 6.5 – Contract Documents
- Task 7 – Environmental Documentation
    - Task 7.1 – Environmental Checklist and Biological Assessment
    - Task 7.2 – Development of CEQA Documentation
    - Task 7.3 – Final CEQA Documentation
- Task 8 – Permitting
    - Task 8.1 – Private Property Access and GW Data Use
    - Task 8.2 – Well Driller's Permit
    - Task 8.3 – Well Completion Report

- Task 10 – GPS Survey of Additional Ag/Monitor Wells
  - Task 10.1 – Selection of Preferred Locations
  - Task 10.2 – Selection of alternative ag/monitor wells if necessary
  - Task 10.3 – GPS Survey of authorized ag/monitor wells
  - Task 10.4 – Update of previous documentation of Monitoring Network wells

The costs included in the project budget for these efforts were developed from the man-hour estimates developed by Pixley ID's engineer consultant. These man-hour estimates outlined the work items involved in the efforts, estimated the required costs per task, quantified the number hours for each person on the project team and the cost per hour for their involvement in the effort, estimated the approximate schedule for the major tasks involved in the effort, and described the potentially related efforts to the study that were not included in the submitted proposal. The average hourly rate shown in individual lines of the project budget are developed from the more specific man-hour estimates for the portions of the work. The total cost for the effort was divided through by the total number of hours shown to be necessary to develop an average cost per hour for the project team involved. This average cost per hour was then applied to the total number of hours required for the effort to account for the cost associated with the effort in the overall project budget.

Task 9 contains the effort to develop a numeric groundwater model to evaluate the benefits and impacts of the proposed groundwater banking project in Pixley ID. This effort was preliminarily scoped by the District's engineering consultant, but then the scope was further developed by a very experience groundwater modeling consultant. This consultant has years of experience evaluating groundwater banking projects in the southern San Joaquin Valley and developing numeric groundwater models.

- Task 9 – Developing a Numeric Groundwater Model
  - Task 9.1 – Scoping Meeting with Project Team
  - Task 9.2 – Compile Gathered Data
  - Task 9.3 – Model Development and Calibration
    - Task 9.3.1 – Hydrogeological Conceptual Model
    - Task 9.3.2 – Numerical Model Setup and Transient Calibration
    - Task 9.3.3 – Sensitivity and Uncertainty Analysis
    - Task 9.3.4 – Numerical Model Verification and Validation
    - Task 9.3.5 – Predictive Simulations
  - Task 9.4 – Model Documentation

Again, the costs included in this portion of the project budget were developed from the man-hour estimates developed by Pixley ID's groundwater modeling consultant.

9.1.4 **Construction/Implementation**

9.1.4.1Task 11 – Construction Contracting and Deliverables

The effort included in the project budget for the selection of the successful low-bidding contractor and the bid award by Pixley ID were developed from the efforts recently necessary to accomplish other similar efforts for construction projects by Pixley ID. These previous efforts were evaluated for the time required and how applicable they were to the proposed project. Then reasonable adjustments were made for particular aspects of the project that differed or needed to be accounted for. This was the basis for a man-hour estimate for the effort to review submitted bids, select the successful low-bidding contract and award the contract from Pixley ID.

- Task 11 – Construction Contracting and Deliverables
  - Task 11.1 – Publish Notice to Bidders
  - Task 11.2 – Pre-Bid Meeting and Addendum No. 1
  - Task 11.3 – Bid Opening and Bid Evaluation
  - Task 11.4 – Bid Award

This estimate quantified the anticipated costs per task for constructing two new monitoring wells, quantified the number hours for each person on the project team and the cost per hour for their involvement in the effort, estimated the approximate schedule for the major tasks involved in the effort, and described the potentially related efforts to the study that were not included in the submitted proposal. The average hourly rate shown in the project budget is developed from the more specific man-hour estimate for the generation of effort that was generated by Pixley ID's consultant. The total cost for the effort was divided through by the total number of hours shown to be necessary to develop an average cost per hour for the project team involved. This average cost per hour was then applied to the total number of hours required for the effort to account for the cost associated with the effort in the overall project budget.

9.1.4.2Task 12 – Construction Costs

The construction costs estimated for the two new dedicated monitor wells were developed from a quote received from a well drilling contractor who has worked with the District's engineering consultant in the past (see **Appendix 6 – C)**. The unit prices for portions for consultant services relating to the constructed effort were compiled by Pixley ID's consulting engineer from project bid summaries from within the last 24-months associated with similar construction project within the local area that the consultant was involved with. This process was followed for the following construction efforts broken out in the project budget:

- Task 12 - Construction
    - Subtask 12.1 - Mobilization and Site Preparation
        - Subtask 12.1.1 – Mobilization
        - Subtask 12.1.2 – Worker Protection
        - Subtask 12.1.3 – Miscellaneous Facilities and Operations
    - Subtask 12.2 – Project Construction;
        - Subtask 12.2.1 – Construction Staking
        - Subtask 12.2.2 – Miscellaneous Engineering Services
        - Subtask 12.2.3 – Monitor Well Construction
        - Subtask 12.2.4 – E-logs, Geologic and Geophysical Logging
        - Subtask 12.2.5 – Construction Inspection
        - Subtask 12.2.6 – As-Built Drawings
    - Subtask 12.3 –Demobilization

9.1.5 **Task 13 – Environmental Compliance/Mitigation/ Enhancement**

The environmental compliance effort accounted for in the project budget involves a biological site survey prior to construction beginning for the two new monitoring projects that are a part of the Project. This site survey will be accomplished by a qualified environmental consultant. Results from the site survey will be documented and recorded for Pixley ID. Pixley ID will be made immediately aware of any issues identified.

9.1.6 **Task 14 – Construction Administration**

As the project's design has not yet been completed, the hours for construction inspection and administration were estimated by a consultant to Pixley ID based on similar local efforts accomplished in the recent years. This estimate outlined the work items involved in the construction management for different portions of the construction for the two new monitoring wells. The proposal estimated the required costs per task, quantified the number hours for each person on the project team and the cost per hour for their involvement in the effort, estimated the approximate schedule for the major tasks involved in the effort, and described the potentially related efforts to the study that were not included in the submitted proposal.

The average hourly rate shown in the project budget is developed from the more specific man-hour estimate for the generation of new easements in support of project right-of-way acquisition that was generated by the City of Visalia's consultant. The total cost for the effort was divided through by the total number of hours shown to be necessary to develop an average cost per hour for the project team involved. This average cost per hour was then applied to the total number of hours required for the effort to account for the cost associated with the effort in the overall project budget.

APPENDIX 6-A: ESTIMATE OF CONSULTANT HOURS IN TOTAL PROJECT COST

PIXLEY IRRIGATION DISTRICT
2012 Groundwater Banking Support Project

		District Engineering & Surveying Labor Costs																							Totals	
	STAFF HOURS	Principal Engineer V	Senior Engineer IV	Associate Engineer III	Associate Engineer II	EIT Engineer I	Senior Technician I	GIS Specialist III	Senior Planner I	Licensed Survey III	Administrative Asssistant II	2 Man GPS Crew	AMEC - Principal Engineer	AMEC - Senior Engineer II	AMEC - Project Engineer I	AMEC - GIS Technician	AMEC - Project Assitant	AMEC - Technical Editor	Materials	Wages	Benefits	Overhead Costs	Profit	Subtotal Labor Costs	Total Engineering Hours	Total Cost
	Rate / Hour	$170	$135	$105	$100	$85	$100	$105	$120	$120	$60	$185	$225	$195	$135	$148	$75	$85		35%	30%	25%	10%			
Task 1	**Project Administration**	2	24	20	4	12					15									$2,800	$2,400	$2,000	$800	**$8,000**	**77**	**$8,000**
																									Task 1 Total =	**$8,000**
Task 2	**Labor Compliance Program**	2	4								2									$350	$300	$250	$100	**$1,000**	**8**	**$1,000**
																									Task 2 Total =	**$1,000**
Task 3	**Reporting**	1	12	8		6					6									$1,225	$1,050	$875	$350	**$3,500**	**33**	**$3,500**
																									Task 3 Total =	**$3,500**
Task 4	**Agreement w/ Landowners for Use of 20 Ag/Monitor Wells**		8	1			4	4												$702	$602	$501	$201	**$2,005**	**17**	**$2,005**
																									Task 4 Total =	**$2,005**
Task 5	**Preliminary Biological Assessment**		4	4				4			2									$525	$450	$375	$150	**$1,500**	**14**	**$1,500**
																									Task 5 Total =	**$1,500**
Task 6	**Dedicated Monitor Wells**																									
Task 6.1	Design memorandum	2	4			2														$368	$315	$263	$105	**$1,050**	**8**	**$1,050**
Task 6.2	Construction Drawings		8	2		32	40													$2,804	$2,403	$2,003	$801	**$8,010**	**82**	**$8,010**
Task 6.3	Project Specifications	2	8	8		30					2									$1,726	$1,479	$1,233	$493	**$4,930**	**50**	**$4,930**
Task 6.4	Solicitation and Competative Bid Documents	2	12	8		20					8									$1,743	$1,494	$1,245	$498	**$4,980**	**50**	**$4,980**
Task 6.5	Contract Documents	2	10	8																$886	$759	$633	$253	**$2,530**	**20**	**$2,530**
																									Task 6 Total =	**$21,500**
Task 7	**Environmental Documentation**																									
Task 7.1	Environmental Checklist and Biological Assessment		4						8											$525	$450	$375	$150	**$1,500**	**12**	**$1,500**
Task 7.2	Development of CEQA Documentation		1						2		1									$152	$131	$109	$44	**$435**	**4**	**$435**
Task 7.3	Final CEQA Documentation		1																$0	$47	$41	$34	$14	**$135**	**1**	**$135**
																									Task 7 Total =	**$2,070**
Task 8	**Permitting**																									
Task 8.1	Private Property Access and GW Data Use		2			2					1									$175	$150	$125	$50	**$500**	**5**	**$500**
Task 8.2	Well Driller's Permit																		$150	$0	$0	$0	$0	**$0**	**0**	**$150**
Task 8.3	Well Completion Report																		$150	$0	$0	$0	$0	**$0**	**0**	**$150**
																									Task 8 Total =	**$800**
Task 9	**Developing a Numeric Groundwater Model**																									
Task 9.1	Scoping Meeting with Project Team	2	10	8				8					12	12			8			$3,154	$2,703	$2,253	$901	**$9,010**	**60**	**$9,010**
Task 9.2	Compile Gathered Data		12	12		40		20			7		24	40	40	30				$11,144	$9,552	$7,960	$3,184	**$31,840**	**225**	**$31,840**
Task 9.3	Model Development and Calibration																									
Task 9.3.1	Hydrogeological Conceptual Model												24	8	8					$2,814	$2,412	$2,010	$804	**$8,040**	**40**	**$8,040**
Task 9.3.2	Numerical Model Setup and Transient Calibration												13	32	36					$4,909	$4,208	$3,506	$1,403	**$14,025**	**81**	**$14,025**
Task 9.3.3	Sensitivity and Uncertainty Analysis												30	40	40					$6,983	$5,985	$4,988	$1,995	**$19,950**	**110**	**$19,950**
Task 9.3.4	Numerical Model Verification and Validation												30	40	40					$6,983	$5,985	$4,988	$1,995	**$19,950**	**110**	**$19,950**
Task 9.3.5	Predictive Simulations												12	16	24	20				$4,207	$3,606	$3,005	$1,202	**$12,020**	**72**	**$12,020**
Task 9.4	Model Documentation												40	42	50	50		45		$12,308	$10,550	$8,791	$3,517	**$35,165**	**227**	**$35,165**

APPENDIX 6-A: ESTIMATE OF CONSULTANT HOURS IN TOTAL PROJECT COST

PIXLEY IRRIGATION DISTRICT
2012 Groundwater Banking Support Project

		District Engineering & Surveying Labor Costs																							Totals	
	STAFF HOURS	Principal Engineer V	Senior Engineer IV	Associate Engineer III	Associate Engineer II	EIT Engineer I	Senior Technician I	GIS Specialist III	Senior Planner I	Licensed Survey III	Administrative Assistant III	2 Man GPS Crew	AMEC - Principal Engineer	AMEC - Senior Engineer II	AMEC - Project Engineer I	AMEC - GIS Technician	AMEC - Project Assitant	AMEC - Technical Editor	Materials	Wages	Benefits	Overhead Costs	Profit	**Subtotal Labor Costs**	Total Engineering Hours	Total Cost
	Rate / Hour	$170	$135	$105	$100	$85	$100	$105	$120	$120	$60	$185	$225	$195	$135	$148	$75	$85		35%	30%	25%	10%			
																									Task 9 Total =	**$150,000**
Task 10	**GPS Survey of Additional Ag/Monitor Wells**																									
Task 10.1	Selection of Preferred Locations		2					8												$389	$333	$278	$111	**$1,110**	**10**	**$1,110**
Task 10.2	Selection of alternative ag/monitor wells if necessary		2					6												$315	$270	$225	$90	**$900**	**8**	**$900**
Task 10.3	GPS Survey of authorized ag/monitor wells		1					10				20							$145	$1,710	$1,466	$1,221	$489	**$4,885**	**31**	**$5,030**
Task 10.4	Update of previous documentation of Monitoring Network wells		2			5		12												$684	$587	$489	$196	**$1,955**	**19**	**$1,955**
																									Task 10 Total =	**$8,995**
Task 11	**Construction Contracting and Deliverables**																									
Task 11.1	Publish Notice to Bidders		12	24		24		8			8									$2,625	$2,250	$1,875	$750	**$7,500**	**76**	**$7,500**
Task 11.2	Pre-Bid meeting and Addendum No. 1		6								2									$326	$279	$233	$93	**$930**	**8**	**$930**
Task 11.3	Bid Opening and Bid Evaluation		6			2														$343	$294	$245	$98	**$980**	**8**	**$980**
Task 11.4	Bid Award		2			8					2									$375	$321	$268	$107	**$1,070**	**12**	**$1,070**
																									Task 11 Total =	**$10,480**
Task 12	**Construction**																									
Task 12.1	Mobilization and Site Preparation																									
Task 12.1.1	Mobilization																		$8,000	$0	$0	$0	$0	**$0**	**0**	**$8,000**
Task 12.1.2	Worker Protection																		$500	$0	$0	$0	$0	**$0**	**0**	**$500**
Task 12.1.3	Miscellaneous Facilities and Operations																		$2,000	$0	$0	$0	$0	**$0**	**0**	**$2,000**
Task 12.2	Project Construction																									
Task 12.2.1	Construction Staking									5										$210	$180	$150	$60	**$600**	**5**	**$600**
Task 12.2.2	Miscellaneous Engineering Services		6			8														$522	$447	$373	$149	**$1,490**	**14**	**$1,490**
Task 12.2.3	Monitor Well Construction																		$44,980	$0	$0	$0	$0	**$0**	**0**	**$44,980**
Task 12.2.4	E-logs, Geologic and Geophysical Logging																		$3,600	$0	$0	$0	$0	**$0**	**0**	**$3,600**
Task 12.2.5	Construction Inspection		25	20		24														$2,630	$2,255	$1,879	$752	**$7,515**	**69**	**$7,515**
Task 12.2.6	As-Built Drawings						15													$525	$450	$375	$150	**$1,500**	**15**	**$1,500**
Task 12.3	Demobilization																		$2,000	$0	$0	$0	$0	**$0**	**0**	**$2,000**
																									Task 12 Total =	**$72,185**
Task 13	**Environmental Compliance/Mitigation/Enhancement**		1	2																$121	$104	$86	$35	**$345**	**3**	**$345**
																									Task 13 Total =	**$345**
Task 14	**Construction Administration**		4			8					4									$511	$438	$365	$146	**$1,460**	**16**	**$1,460**
																									Task 14 Total =	**$1,460**
	Total Hours:	15	193	125	4	223	59	80	10	5	60	20	185	230	238	100	8	45								
	Total Cost:	$2,550	$26,055	$13,125	$400	$18,955	$5,900	$8,400	$1,200	$600	$3,600	$3,700	$41,625	$44,850	$32,130	$14,800	$600	$3,825	$61,525	$77,810	$66,695	$55,579	$22,232	$222,315	**1,600**	**$283,840**

$283,840

PROPOSAL FOR GROUNDWATER MODELING IN SUPPORT OF WATER BANKING ALTERNATIVES

Pixley Irrigation District & Delano-Earlimart Irrigation District
Tulare County, California

Submitted to:
Provost & Pritchard Consulting Group, Visalia, CA

Submitted by:
AMEC Environment & Infrastructure, Inc., Fresno, CA

July 13, 2013

Proposal 2012-025

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FIGURES

PROPOSAL FOR GROUNDWATER MODELING IN SUPPORT OF GROUNDWATER BANKING ALTERNATIVES

Delanio-Earlimart Irrigation District and Pixley Irrigation District
Tulare County, California

1.0 INTRODUCTION

This proposed modeling effort is designed to simulate groundwater flow beneath and in the vicinity of a proposed groundwater banking facility located along Deer Creek in southern Tulare County (Figure 1). The proposed water banking facility would be jointly operated by the Delano-Earlimart Irrigation District (DEID) and Pixley Irrigation District (PIXID). The proposed extraction facilities would recover up to 30,000 acre feet (af) of groundwater per year.

The objectives of the proposed modeling effort are to:

- prepare a groundwater numerical flow model of the proposed DEID-PIXID groundwater banking facility and vicinity;
- calibrate the groundwater flow model to historical groundwater elevation data for the period 1996 through 2009;
- validate model calibration using a sub-set of the historical groundwater elevation data; and
- estimate the potential impacts of groundwater banking and recovery operations on groundwater resources beneath and in the vicinity of the banking facilities assuming three proposed operational scenarios, including:
    - ❖ recharge and recovery of 10,000 af/y,
    - ❖ recharge and recovery of 20,000 af/y, and
    - ❖ recharge and recovery of 30,000 af/y.

    - ❖ Additional or alternative operational scenarios may be run based on initial predictive simulation results

2.0 PROJECT TEAM AND EXPERIENCE

The proposed AMEC Environment & Infrastructure, Inc. (AMEC) project team members for this project have extensive experience in hydrogeologic investigations and preparing numerical groundwater models throughout the Central Valley. The project team members and their experience are described in the following subsection.

2.1 PROJECT TEAM AND QUALIFICATIONS

The key proposed project team personnel consists of David Bean, PG, CHg; Philip Ross, PG; Gary Kramer, PG; and Diana Babshoff. The project team roles are as follows:

David Bean, PG, CHg, will be the Principal in Charge and lead modeler for the project. He will assure that the necessary AMEC resources are provided to complete this project in a timely and cost effective manner. Mr. Bean has 28 years of experience evaluating groundwater resources on a local, regional, and basin scale throughout California and North America. He has utilized field data to develop conceptual hydrogeologic models, prepared detailed water budgets, and estimated yields of wells and aquifers. Many of the studies used analytical and numerical 3-dimensional groundwater flow and contaminant transport models (GWFLOW, MODFLOW, MT3DMS, etc.) to evaluate the fate and transport of chemicals in groundwater. He has also used particle tracking models (MODPATH, Path3D) to optimize the zone-of-capture of remediation wells and evaluate the influence of extraction wells, municipal well fields, and agricultural supply wells on the migration of contaminants in groundwater. Mr. Bean has experience in aquifer testing and data analysis, database design and management, statistical data analysis, report preparation, and regulatory agency interaction.

Philip Ross, PG, will be the Technical Reviewer for the project. He will assure that the project is conducted in a technically sound and defensible manner. Mr. Ross has served in senior technical and management capacities on a multitude of groundwater and surface water projects. His 37 years of professional experience provide substantial expertise in surface and groundwater hydrology, water resources evaluation and development, groundwater modeling, hydrogeochemical evaluation, waste discharge permitting, and groundwater monitoring system design and installation. His duties have included project management, client consultation, regulatory agency interaction, report preparation, supervision of drilling, well installation, groundwater sampling, aquifer testing, surface water measurement and sampling, and data interpretation.

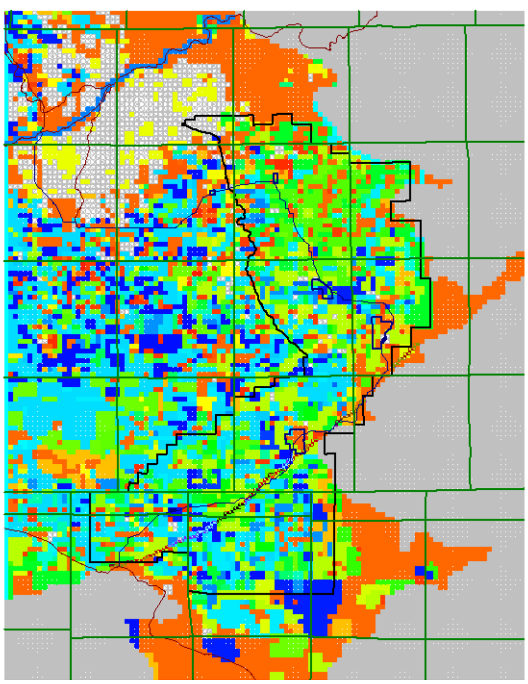
Gary Kramer, PG, will be the assistant modeler for the project. Mr. Kramer has more than 20 years of experience in engineering projects that involve soil and groundwater assessment and remediation and the characterization and development of groundwater resources. He has conducted investigation and remediation projects in California, Nevada, and Utah. He has coordinated investigative site activities that involved drilling soil borings; monitoring well installation, development, and sampling; statistical analysis; and geophysical investigations. Mr. Kramer is experienced in soil logging, hydrogeology, evaluation of groundwater geochemistry, and statistical analysis of groundwater data.

Diana Babshoff will provide geographic information systems (GIS) and database services for the project. Ms. Babshoff's experience includes creating maps, figures, and visualizations for geotechnical and environmental projects. She has successfully applied her GIS knowledge to the production of deliverables for projects including environmental sampling and water resources using ESRI's ArcView GIS. Her GIS experience includes: data acquisition, georeferencing of maps and images, projections, data queries, and data posting. She most recently has added computer aided drafting (CAD) to her work experience, applying CAD knowledge to the production of environmental engineering drawings. Her database skills include: data entry, query development, data import/export, data formatting and data quality assurance/quality control using Microsoft Access. She has 7 years of experience in data compilation and management, project administration, and reporting for projects involving surface water, groundwater, and geotechnical data.

Additional administrative personnel will be utilized as necessary.

2.2 Relevant Experience

The AMEC team members have worked together on several projects relevant to the proposed modeling effort for DEID-PIXID. All of these projects involved developing and calibrating numerical groundwater flow models at a local, regional, or basin scale, and several involved evaluating the groundwater banking operations throughout the Central Valley. A brief description of these projects is provided in the following paragraphs.

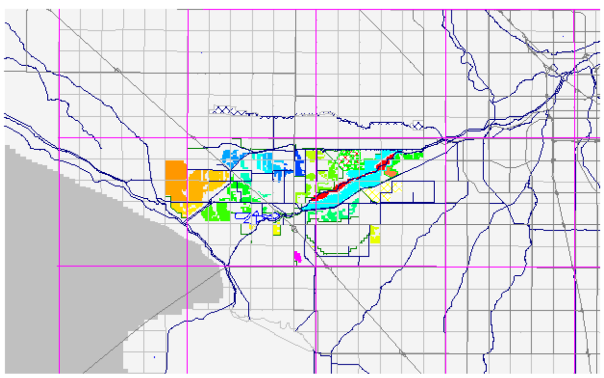


Distribution of Agricultural Demand 1992

Arvin-Edison WSD Model

Arvin-Edison Water Storage District
Arvin, California

The Arvin-Edison Water Storage District (AEWSD) retained AMEC to prepare a water budget and calibrate a MODFLOW2000 numerical groundwater flow model of the AEWSD and surrounding area in Kern County, California. The AEWSD model covers an area of approximately 945 square miles in the southern San Joaquin Valley in California. The model encompasses the AEWSD (~206 square miles) and portions of the adjacent Kern Delta WD, Wheeler- Ridge-Maricopa WSD, and the City of Bakersfield. The San Joaquin Valley is a large structural trough filled with several thousand feet of alluvium derived primarily from the Sierra Nevada to the east and Tehachapi Mountains to the south. The basin dips steeply to the north and west away from the mountain fronts and towards the Buena Vista Lake bed. Structural controls include the Edison Fault in the north and the White Wolf Fault in the south. The model simulates the period from 1992 through 2008 using 68 quarterly stress periods. Inflow to the model was primarily via mountain front recharge, recharge from the Kern River and streams, leakage from surface water irrigation canals, artificial recharge, over application of irrigation water, and precipitation. Outflow was primarily via 72 recovery wells and 475 agricultural supply wells. Inflows and outflows were balanced in an Excel spread sheet on a quarterly basis and the resulting recharge or discharge arrays were imported into the MODFLOW2000 data set. The model was calibrated to approximately 5,200 water level observations in 246 monitoring and water supply wells within the basin. The model is being utilized to evaluate the potential impact(s) of different recharge and recovery scenarios on groundwater levels beneath the AEWSD and to assist the AEWSD in optimizing future agricultural demand, water supply, and water banking operations.



Surface Water Conveyances and Recharge Basins

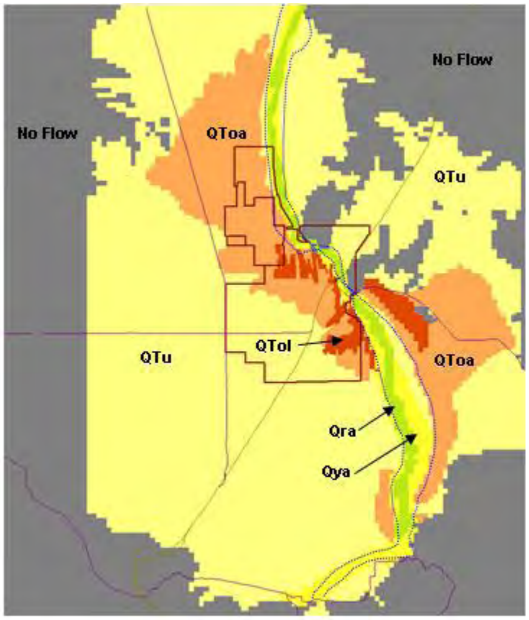
Kern River Alluvial Fan Model

Kern Water Bank Authority
Bakersfield, California

KWBA has retained AMEC to develop a regional scale groundwater flow model to evaluate artificial recharge and recovery pumping operations on the Kern River Alluvial Fan. The model utilizes MODFLOW2000 and MODPATH to evaluate the impacts of the infiltration of over 900,000 acre-ft of applied water on groundwater levels beneath 75 recharge basins spread over a 13 square mile area. The model is an update of a 1995 modeling effort by the DWR. The model domain has been expanded to encompass nearby and adjacent recharge operations by others and the model grid was refined from 1-mile spacing to 2.5 acre spacing in the water bank area. Over 260 geophysical logs were utilized to develop a 3-dimensional model of hydraulic conductivity distribution in the upper 1,000 feet of the alluvial aquifer. The model simulates the period from October 1988 through December 2011 using 217 semi-annual and quarterly stress periods. Inflow to the model was primarily via intentional recharge in over 70 basins and regional precipitation. Outflow was primarily via 678 recovery wells and water supply wells. The model was calibrated to over 21,000 water level observations in 165 monitoring and water supply wells within the model domain. In addition, the model was verified against a target data set not used in the calibration process which consists of 5,700 observations of heads in 56 groundwater supply wells randomly distributed through the model domain. The model has been used to evaluate the benefits of the water banking projects on the Kern River Alluvial Fan.

Upper Mojave River Basin Model

Victor Valley Water District
Victorville, California



Surficial Geology and Mojave River

The Victor Valley Water District (VVWD) retained AMEC to prepare a water budget and calibrate a numerical groundwater flow model of the Upper Mojave River Basin, San Bernardino County, California. The Upper Mojave River Basin model covers an area of approximately 800 square miles and encompasses most of the Alto subarea and Alto Transition Zone groundwater subbasins within the Mojave River Basin. The model encompasses the Victor Valley Water District (~55 square miles) and portions of the adjacent Apple Valley Ranchos Water District, Baldy Mesa Water District, and the Cites of Adeanto and Hesperia. The Alto subarea and Alto Transition Zone form a large (~500,000 acres) basin filled with alluvium and debris flows derived from the San Gabriel and San Bernardino Mountains to the south, the Shadow Mountains to the west, and the Silver Mountains to the East. The basin dips steeply to the North and towards the Mojave River Channel with over 5,000 feet of relief from the San Bernardino Mountains to the outlet of the Mojave River at the northern edge of the model domain. The model simulates the period from 1980 through 2004 using 100 quarterly stress periods. Inflow to the model was primarily via mountain front recharge reaches, the Mojave River (intermittent stream), and deep percolation of irrigation water, septic systems, and waster water treatment plants. Outflow was primarily via 376 wells including 42 municipal water supply wells and stream discharge from to Mojave River. The model was calibrated to over 5,300 water level observations in 47 monitoring and water supply wells within the basin. The purpose of the model is to simulate groundwater flow in the vicinity of the VVWD under various production and recharge scenarios, to evaluate groundwater in storage, and to evaluate the impact of artificial recharge to local groundwater. Specifically, modeled scenarios included 3 percent (%) and 7% growth in groundwater demand (pumping) with and without artificial recharge. The model was used to estimate: (1) the “safe yield” of the aquifer system beneath the VVWD service area, (2) the time remaining to depletion of existing supply wells (with and without artificial recharge), (3) useful storage capacity available in the aquifer system, (4) flow into the VVWD service area from the south, (5) travel times for recharged surface water to reach the nearest pumping wells, and (6) groundwater mounding effects resulting from artificial recharge. As part of the study, the estimated percentage of VVWD delivered water that goes back into the ground as return flow was also calculated.

3.0 PROJECT UNDERSTANDING

The *Reconnaissance Study on Joint Groundwater Bank within Pixley Irrigation District* report (Reconnaissance Study, P&P, March, 2008) provided: 1) a comprehensive overview of existing in-lieu and direct recharge capabilities within Pixley Irrigation District (PIXID); 2) identified areas that could be used for potential direct recharge and in-lieu recharge; and 3) means to allow recovery of banked groundwater without adversely affecting PIXID water users. The Reconnaissance Study identified a potential groundwater bank location (Figure 1) and provided preliminary geologic assessments, engineering evaluations and cost analyses for three potential projects including the recharge and recovery of 10,000, 20,000, and 30,000 af/y.

The conceptual groundwater banking project (Project) includes in-lieu recharge, construction of new direct recharge ponds, recharge along Deer Creek, recharge from seepage losses along the existing canal system, construction of new recovery wells and construction of new conveyance facilities from the recovery wells to the existing distribution system for return to DEID for use or exchange.

The Reconnaissance Study noted that water management opportunities increase when entities share their resources and cooperate to achieve a goal greater than would be possible for the individuals. The benefits derived from these new opportunities cannot be obtained at the expense of others and the Project includes measures to preclude impacts to others in the area, with the guiding principal being that the groundwater bank and recovery wells not adversely impact local groundwater users. In order to protect local groundwater users, the Project has been structured to only recover water that has been recharged. In wet years, the newly proposed direct recharge facility will store banked volumes of water in the aquifer beneath the recharge facility.

This proposal describes a proposed numerical groundwater flow model for the Project area that will quantify groundwater inflows and outflows, consider seepage, precipitation and available surface water supplies, and also consider existing groundwater pumping in the area. This numerical groundwater flow model will be calibrated to historical groundwater elevation data in an effort to create a tool that accurately considers and anticipates responses to changes in available supplies and impacts to groundwater levels.

Once this modeling tool has been developed, then it can be utilized to evaluate potential impacts of the proposed Project so that Project partners and local growers have a reasonable idea of how Project operations may impact groundwater resources in the Project area. The groundwater model will assess groundwater flow directions and rates and provide estimates of the capture zone of the recovery wells. The changing shape of the groundwater table over time will be simulated as the recharge facilities are operated and recovery wells pumped. Hydrographs of simulated monitoring well locations will provide a history of water levels in the areas affected by the groundwater bank. The extent to which local farming operations benefit from a raised water table will be assessed. Such benefits would include lower pumping costs, increased well yields and improved water quality.

In years when banked water is requested for return, the recovery facilities would recover recharged water. The groundwater model will assist in drawing up restrictions on the amount that can be recovered in any one year and a schedule of recovery limits for successive dry years will protect local groundwater users from potential negative impacts from the Project. This modeling effort will also provide a basis for any environmental permitting or CEQA compliance that is undertaken prior to Project construction.

4.0 PROJECT APPROACH

AMEC proposes to prepare a 3-dimensional numerical groundwater flow model of the proposed DEID & PIXID groundwater bank and vicinity to simulate the response of groundwater to various operational alternatives. The following subsections describe the proposed modeling effort in general terms. Specific operational scenarios will be delineated as the model is developed.

4.1 PROPOSED MODEL CODES

In order to meet the model objectives discussed in Section 1.0, the groundwater flow model code must meet the following criteria:

- be able to simulate 3-dimensional groundwater flow and multi-species solute transport within the model domain,
- be well documented and verified against analytical solutions for specific flow scenarios,
- be accepted by regulatory agencies,
- be readily understandable and usable by others for simulation of future groundwater conditions, and
- have a readily available technical support structure.

The model codes MODFLOW-NWT (Niswonger et al., 2011) meets these criteria and are recommended to develop the site model.

MODFLOW-NWT is the latest version of MODFLOW2005, a modular, finite-difference computer code developed by the USGS to simulate three-dimensional groundwater flow (Harbaugh, 2005). The MODFLOW family of codes is well documented in technical literature and is the de facto standard for groundwater flow modeling worldwide. MODFLOW-NWT is a stand-alone version of MODFLOW-2005, including a new Upstream-Weighting Package that treats nonlinearities of a model cell drying and rewetting by use of a continuous function of groundwater head. This allows for the use of the Newton method for unconfined groundwater flow problems. The Newton method is a commonly used method in the earth sciences to solve nonlinear equations, such as for variably-saturated flow equations in an unconfined aquifer. MODFLOW-NWT solves the partial-differential equations that describe three-dimensional groundwater flow by approximating the solution through the finite-difference method, wherein the continuous groundwater flow system is replaced by a finite set of discrete points in time and space. This process leads to a system of linear algebraic equations, which are solved by the computer program to yield values of potentiometric head and groundwater flow velocity at specific locations and at specific points in time (Harbaugh, 2005).

The proposed model codes will be implemented on a Windows® based platform. To facilitate the preparation and evaluation of each model simulation, AMEC will utilize the graphics pre/post processor GWVistas™ Version 6.xx (GWV) by Environmental Simulations, Inc. (ESI). GWV is a Windows® program that utilizes a graphic user interface (GUI) to build and modify a database of model parameters. The model grid, hydraulic properties, and boundary conditions are input using the GUI and then GWV creates the necessary MODFLOW data input files. The input files generated by GWV are generic (standard) MODFLOW files compatible with USGS MODFLOW-88/96 and/or MODFLOW2000/2005. AMEC also utilized some in-house utilities and Microsoft EXCEL spreadsheets to generate standard MODFLOW data input files for selected simulations and for post-processing simulation results.

GWV comes supplied with MFNWTWin32, a Windows® based version of MODFLOW2005, compiled by ESI. MFNWTWin32 is a standard versions of MODFLOW2005 optimized to run under the Windows® environment. This version will be utilized for the modeling effort.

GWV will also be utilized to post-process the model simulations. GWV can display the simulated head and concentration results as plan views and cross sections. In plan view, the contour intervals and labels specified by the user and dry cells are denoted by a different color. In cross-section view, the water table surface is also plotted. Most outputs to the screen can be saved in a number of formats (DXF, WMF, PCX, SURFER, etc.) for utilization in other graphics programs.

4.2 PROPOSED MODEL DOMAIN

The lateral boundaries of the model domain must be placed far enough away from the area of interest so that the specified boundary conditions do not unduly influence the simulation results within the area of interest. In this case, the model boundaries should extend away from the recharge basins and recovery wells a distance to where there are little or no impacts from the Project operations. The model grid will be set up as a variable spacing network with two zones of grid spacing initially established. The inner grid area will consist of an approximately 7 by 7mile area centered on the proposed water bank lands (Figure 1). This area will be simulated using an approximately 330 by 330 foot grid spacing (about 2.5 acre spacing) to provide high resolution simulation and evaluation of potential impacts from water banking operations. The outer grid will extend an additional 3 miles around the perimeter of the inner grid and will be simulated using an approximately 1320 by 1320 foot grid spacing (about 40-acre spacing). The outer grid is designed to provide a buffer zone between the boundary conditions and the inner grid area of interest.

Based on a review of available site stratigraphy, six hydrogeologic units have been identified from the surface to a depth of approximately 1,600 feet. These consist of: younger alluvium surficial soils; an older alluvium upper water-bearing zone which generally overlies the Corcoran Clay; the Corcoran Clay (a laterally extensive confining clay); an older alluvium intermediate depth water-bearing zone generally located beneath the Corcoran Clay; the Schenley Sand, a major aquifer; and a lower water-bearing zone. The sediments dip to the west at 50 to 150 feet per mile, with the deeper sediments dipping at a greater angle than the shallower sediments. With the exception of the surface soils, the sedimentary zones important to the Project are shown on the conceptual block model. These hydrogeologic units will be simulated using no less than five model layers and as many as 11 model layers. The number of model layers will depend on the vertical resolution required to represent wells within the project area of interest.

The model grid will be aligned with the primary direction of groundwater flow and decrease from 1,320 by 1,320 feet around the edges of the model to 330 by 330 feet in the vicinity of the DEID-PIXED Water bank facilities as described above. The proposed model grid consists of 136 rows, 136 columns, and between 5 and 11 layers.

4.3 PROPOSED MODEL STRESS PERIODS

Review of the available data indicates that groundwater elevations have been measured in monitoring wells and production wells within the model domain on approximately a monthly basis since 1996. Based on these measurements, the proposed model will utilize 168 monthly stress periods to simulate the period from January 1996 through December 2009.

4.4 Proposed Aquifer Parameters

The hydrostratigraphic heterogeneity of the aquifer system will be simulated in the numerical model at a scale appropriate for the modeling objectives. AMEC proposes to initially populate the model with the aquifer parameters (horizontal hydraulic conductivity, vertical hydraulic conductivity, specific yield, specific storage, porosity) utilized by the USGS for the Central Valley Hydrologic model (USGS, PP 1766). Site-specific data collected various investigation (soil boring logs, geophysical logs, grain-size analysis, aquifer pumping tests, etc.) will be utilized to update the initial parameters estimates. The model parameters estimates will be further refined (within pre-set limits) during the model calibration process to achieve an acceptable level of fit to groundwater levels observed during the period January 1996 through December 2009. The aquifer parameters will only be modified as necessary to improve the calibration of the model to field observations. As such, the model will contain no more complexity than is justified by the available field data and the model objectives.

5.0 SCOPE OF WORK

The proposed scope of work is discussed in the following subsections.

5.1 Task 1 – Scoping Meeting with DEID-PIXID and Provost & Pritchard Team

AMEC will meet with representatives of DEID-PIXID and the Provost & Pritchard (P&P) teams to refine the scope of the modeling effort, determine what the data needs are, and establish a schedule of deliverables. We anticipate that the meeting can be conducted at the Pixley ID offices within 1 week of authorization to proceed.

5.2 Task 2 – Compile Available Data

AMEC will compile the available data for the study area into a database. The database will include: historical precipitation, groundwater elevations, pumping by well, surface water deliveries, cropping patterns, ETo, crop coefficients, etc. These data will be used to develop a water balance for the model domain on a monthly basis for use in the numerical model.

5.3 Task 3 – Model Development and Calibration

AMEC will develop and calibrate the proposed groundwater flow model in accordance with ASTM Standards and other modeling guidelines. Model development and calibration is a multi-step process as described in the following paragraphs.

5.3.1 Hydrogeologic Conceptual Model

AMEC will meet with DEID-PIXID and P&P to discuss the existing hydrogeologic conceptual model and to determine where refinements of the conceptual model may benefit the proposed groundwater flow model. The purpose of the hydrogeologic conceptual model will be to simplify field conditions and organize the associated field data so that the system can be analyzed more readily.

There are four steps in developing a hydrogeologic conceptual model: (1) define the model domain, (2) define the hydrostratigraphic units, (3) prepare a water budget, and (4) define the groundwater flow system. We assume that boring logs, geophysical logs, and well construction details (from both older and new wells) are available in some electronic format. The use of electronic data sets will simplify preparation of the hydrogeologic conceptual model and numerical model.

5.3.2 Numerical Model Setup and Transient Calibration

AMEC will prepare a numerical groundwater flow model of the proposed DEID-PIXID water banking facility and vicinity using MODFLOWNWT. AMEC will utilize GWVistas™, a pre- and post-processor for MODFLOW, to discretize the hydrogeologic conceptual model data and prepare input files for the numerical model.

As described in Section 4.2, we anticipate that the model domain will be larger than the water banking facility in order to push the numerical model boundaries sufficiently away from the area of interest. We anticipate using a relatively fine grid area of about 2.5-acres in the vicinity of the water bank recharge basins, expanding the grid size outward towards the model boundaries. We anticipate using five to eleven model layers to represent the sub surface stratigraphy. Vertical discretization into model layers will be dependent on the quality of the available data and the level of vertical resolution required by the project. The model will also incorporate significant hydrogeologic features which may fall within the model domain such as water delivery canals, streams, etc.

The numerical groundwater flow model will be calibrated in transient mode to historical groundwater levels, recharge, and pumping beneath the proposed water bank and vicinity. We anticipate calibrating the groundwater flow model over a 13-year period from 1996 through 2009 using monthly stress periods. The accuracy of the transient calibration will be dependent on the number and length of model stress periods, the accuracy of the discharge to land and pumping data, and the availability sufficient observation data. The calibration process will involve iterative modification of aquifer parameters and boundary conditions (within reasonable limits) in order to minimize the residual (difference) between observed and simulated heads at selected observation points. The model aquifer parameters may be further refined utilizing an automated parameter estimate program (PEST) to further reduce the model residuals.

5.3.3 Sensitivity and Uncertainty Analysis

Following calibration of the groundwater flow model, AMEC will conduct a sensitivity and uncertainty analysis. The purpose of this analysis is to quantify the reliability of the calibrated model in light of uncertainty in the estimates of aquifer parameters, discharge to land, pumping stresses, and boundary conditions used in the model. The analysis will help identify existing "data gaps" and suggest areas where additional information may be useful in improving model accuracy. The sensitivity and uncertainly analysis involves running the calibrated model numerous times, varying single aquifer hydraulic parameters over the likely range of values for each parameter. Model parameters that can be changed over a large range that do not significantly change the model calibration results are insensitive parameters. Model parameters that can be changed over a small range that significantly change the model calibration results are sensitive parameters. Sensitive model parameters that are poorly constrained by field data may require additional investigation.

5.3.4 Numerical Model Verification and Validation

Model verification and validation (V&V) are the primary processes for quantifying and building credibility in numerical models. Verification is the process of determining that a model implementation accurately represents the developer's conceptual description of the model and its solution. Validation is the process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model. Both verification and validation are processes that accumulate evidence of a model's correctness or accuracy for a specific scenario; thus, V&V cannot prove that a model is correct and accurate for all possible scenarios, but, rather, it can provide evidence that the model is sufficiently accurate for its intended use.

Prior to model calibration, approximately 20 to 25 percent of the groundwater elevation data available for calibration will be reserved for model V&V (i.e. the model will be calibrated using only 75 to 80 percent of the available data). After model calibration has been completed, the model will be verified and validated by comparing the reserved V&V data set to the calibrated model simulation results. If the model is well calibrated, the residual between the reserved V&V data set observations and the simulated heads will be approximately the same as for the calibration observation data set, thus validating the model calibration.

5.3.5 Predictive Simulations

Following model calibration, AMEC will conduct up to three predictive simulations to evaluate the potential impact(s) of proposed water banking operations on groundwater levels beneath and in the vicinity of the DEID-PIXID facilities. These predictive simulations will include: (1) 10,000 af/y recharge and recovery, (2) 20,000 af/y recharge and recovery, and 3) 30,000 af/y recharge and recovery. Additional or alternative operations scenarios may be developed in consultation with DEID-PIXID and P&P.

Each predictive simulation will be run by adding the proposed recharge and recovery to the calibrated model and re-running the simulation. The difference between the predictive simulation heads and the calibrated model heads will be a measure of the impacts of the proposed recharge and recovery on the aquifer system. The impacts will be visualized using simulated hydrogaphs at selected observation wells and map views of the differences in groundwater elevations.

5.4 MODEL DOCUMENTATION

AMEC will maintain a journal of the model setup and simulation runs during this task in accordance with ASTM International (ASTM) standards. The journal will document the purpose of each simulation, the results of the simulation, and recommended modifications for the subsequent simulation. The purpose of the journal is to facilitate reconstruction of each simulation (should that become necessary), reduce calibration time, and facilitate report preparation.

Subsequently, following completion of the modeling, a model report will be prepared in accordance with ASTM standards and other guidance. Descriptions of the model and the modeling results will be presented in a report submitted to DEID-PIXID and P&P. The model report will include a summary of the conceptual hydrogeologic model, the calibrated groundwater flow model parameters, the groundwater flow model sensitivity and uncertainty analysis, the groundwater flow model validation analysis, and a summary of predictive simulation results.

6.0 SCHEDULE

AMEC can begin as soon as we receive a signed authorization to proceed (ATP). The schedule will depend in large part on the amount of information available and what form the information is in (e.g., paper or electronic). We have the qualified personnel available to move expeditiously on this project. We would suggest a timeline that includes the following:

1. Kickoff Meeting, 1 week after ATP – Attended by key personnel from DEID-PIXID and P&P, and AMEC to determine scope of the modeling effort and what data are available and in what formats.

2. Exchange of Data, during 2 weeks following Kickoff Meeting – DEID-PIXID, P&P and AMEC exchange data and review how much time/effort will be required to upload data and to locate additional outside data (USGS, DWR, TID, etc.).

3. Conceptual Model Review Meeting, approximately 3 months from ATP – A review meeting is suggested to present the findings of the water balance and conceptual hydrogeologic model. We would also present the framework and timeline for the numerical model at this time. Generally, we would expect a numerical model could be done in about 3 months, assuming that the necessary data are readily available.

4. Presentation of Numerical Model Calibration Results, approximately 6 months from ATP – It is anticipated that the results of the numerical model calibration and sensitivity analysis can be presented in a meeting (or via Live Meeting) approximately 3 months following the conceptual model review meeting. If the results are acceptable, AMEC will conduct up to three predictive simulations, which will take approximately 1 month to complete.

5. Presentation of Numerical Model Predictive Simulations, approximately 7 months from ATP – It is anticipated that the predictive simulations results can be presented in a meeting (or via Live Meeting) approximately 1 month following the model calibration review meeting. If the results are acceptable, AMEC will begin drafting model documentation, which will take approximately 2 months to complete.

6. Draft Numerical Model Results Report, approximately 9 months after ATP – A draft model report conforming to ASTM standards and other guidance will be submitted to DEID-PIXID and P&P for review. The draft model report will describe the conceptual hydrogeologic model, model calibration to groundwater flow, sensitivity analysis, and predictive simulation results.

7. Submit Final Numerical Model Results Report – It is anticipated that approximately 2 weeks after receiving comments from DEID-PIXID and P&P (about 10 months after ATP), the final numerical model results report can be submitted to the DEID-PIXID and P&P.

7.0 COST ESTIMATE

AMEC will provide the proposed scope of work to the DEID-PIXID and P&P on a time-and-materials basis in accordance with the 2012 Schedule of Charges (Appendix A), with labor rates discounted 10 percent. Final costs will be dependent upon the agreed scope of work and the amount and format of available data. Based on the level of effort of work proposed and our understanding of DEID-PIXID and P&P needs at this time, we estimate that the project will cost approximately $100,000. These estimates will be refined after the scope of work is finalized and the data availability is better understood.

8.0 REFERENCES

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