MERCED IRRIGATION DISTRICT

WATER & POWER

November 4, 2016

Mr. Steven Carrigan, City Manager
City of Merced Manager's Office
678 West 18th Street
Merced, CA. 95340

Dear Mr. Carrigan,

The purpose of this letter is to confirm an equal contribution from the City of Merced (City) for groundwater modeling as an amendment to the ongoing existing effort approved under contract with RMC since January 2016.

As you are aware MID and City are undertaking tasks relating to groundwater management on multiple fronts. These activities are taking place under the MAGPI umbrella and shaping present and future discussions regarding best management, optimization of resources, sustainability and defending existing local water rights against a potential water grab by the State of California (State) and preparing data relating to development of a Ground Water Sustainability Plan (GSP) for the Merced Groundwater Basin. The State water grab is being proposed for implementation in the published draft Substitute Environmental Document (SED) establishing the first phase of a multiple phase approach to update the State's Bay-Delta Water Quality Plan.

As early as 2006 the locals acquired a grant for a groundwater-surface water interaction model for the Merced Groundwater Basin and surrounding areas. We have collaborated on splitting the local contribution in half. The grant work is at its completion and the model as it currently stands has encompassed the history of the groundwater basin and the current baseline. It includes estimated overdraft and migration of water to and from adjacent groundwater basins.

Currently and due to the urgency of the State's water grab, we are moving as fast as technically possible to make the case for the environmental impact on groundwater storage, quality, and their consequent impact on life and economics in the Merced area. In order to provide a scientific backup, we are establishing a baseline to be used in predicting the water quantity impact. This includes the completion of a mass balance analysis to be used in estimating the anticipated water quality degradation as a result of the water grab. This last activity is due to completion within ten days and we intend to use it in our comments on the draft SED. The total

cost for these immediate activities is $347,547 (see Attachment A), which puts the City's share at $173,773.50.

The overall activities are also integral activities of the future GSP. We expect the City and MID be partially reimbursed for these activities by other groundwater users, depending on the progress of the future collaborative GSP.

MID appreciates the positive relationship between our agencies and your support in protecting the sustainability of the Merced Groundwater Basin.

Sincerely,

For John Sweigard
General Manager

(209) 722-5761 744 West 20th Street P.O. Box 2288 Merced, California 95344-0288
Administration / FAX (209) 722-6421 • Finance / FAX (209) 722-1457 • Water Resources / FAX (209) 726-4176
Energy Resources / FAX (209) 726-7010 • Customer Service (209) 722-3041 / FAX (209) 722-1457

Attachment A

MERCED IRRIGATION DISTRICT

WATER & POWER

October 24, 2016

RMC Water and Environment
1545 River Park Drive, Suite 425
Sacramento, CA 95815

Attention: Dr. Ali Taghavi

Subject: Amendment 1 to the contract for Merced Water Resources Model

Dear Ali:

This letter serves as Amendment No. 1 to our Consultant Agreement, as amended, for the above-referenced project. The agreement is amended as described below. Please sign where indicated, return, and keep a copy for your records.

The Consultant Agreement for Services dated January 6, 2014 is hereby amended as follows:

1. Term of contract is extended through December 31, 2017.
2 Contract fee is amended by $347,547, from 895,000 to a total of $1,242,547, based on the following schedule:
   - Development of Merced Area Water Quality Model (Scope of work is in Attachment A of the original contract): $159,966.
   - Development of Baseline Condition and Subsidence Module (Exhibit A): $131,575.
   - Development of Merced Area Mass Balance Model (Exhibit b): $56,006.

This amendment is hereby agreed to between the parties. MID is executing this agreement on behalf of Merced Area Groundwater Pool Interests (MAGPI) for work approved on its meeting held on August 3, 2016.

Executed this 3rd day of November, 2016, at MERCED, California.

CLIENT
Merced Irrigation District

By: _____

Title: GENERAL MANAGER

Dated: Nov. 3, 2016

RMC WATER AND ENVIRONMENT,
a California corporation,

By: _____

Title: _____

Dated: _____

Attachment A

Merced Area Water Resources Model (MWRM)

Development of Baseline Model

Scope of Work

August 29, 2016

Background

The Merced Area Water Resources Model (MWRM) has been developed as a fully integrated analytical computer program to assist in meeting the following goals for the stakeholders in the Merced groundwater basin:

1- Optimize water supply conditions within the Basin
2- Manage Basin operations in a balanced and sustainable manner
3- Assist the Groundwater Sustainability Agency(ies) in the Basin to manage the Basin in a sustainable manner
4- Assess water quality in the Basin to assist the water purveyors in meeting safe drinking water standards for the municipal and urban water users

The Model has been developed in an open and transparent environment in the context of the Merced Area Groundwater Pool Interest (MAGPI) participants, with financial and technical resources provided by the City and County of Merced and Merced Irrigation District as the lead agencies overseeing the development of the model. The DWR has also partially funded the development of the Model. A Technical Work Group consisting of representatives of the DWR, USGS, and the UC Merced have been involved in the review of the model development process, conceptual model preparation, model and data analysis and assumptions, model calibration, and interpretation of model results. Model calibration was completed in February 2016, and during the Month of March 2016, the model calibration approach and results have been presented to the Technical Work Group, City and County of Merced staff and management, Merced Irrigation District staff and management, as well as the MAGPI Board. The model calibration status has been considered to be at a very good state by both the technical reviewers as well as the management from respective agencies. As a result of meeting with the management of respective agencies, and in order to ensure that the Model is fully prepared to assist the agencies and the County in addressing the requirements of the Sustainable Groundwater Management Act (SGMA), additional model features and scenarios were identified for further development.

The following scope of work presents additional Tasks to be considered for development of additional features and application and use of the model in meeting the Basin management goals.

Task 1- Extend Model Hydrologic Period to Include Recent Drought

The purpose of this Task is to extend the model hydrologic period to 2015. The historical hydrologic period used in development of the model is through water year 2012. Recognizing that the state has been suffering from an extreme drought during water years 2013-2015, and that future planning will need to address water supply conditions during similar extreme droughts, the model hydrologic period needs to be extended to 2015 to reflect the land use and water supply conditions during the drought. This Task includes the following activities:

1.1 Data collection efforts will consist of the coordination with local agencies and DWR staff to ensure the availability of all datasets in the extension of the MercedWRM simulation to 2015.

1.2 Precipitation data will be updated from PRISM datasets, which is available from DWR's CalSIMETAW model.

1.3 Stream inflow data will be collected from USGS/CDEC gauging stations and will be analyzed for any missing data or inconsistencies for model input. If gauged records are unavailable, data will be estimated using trend analysis and/or similar year method.

1.4 Land use and cropping patterns will be updated using the USDA CropScape datasets from USDA website.

1.5 MID surface water deliveries, at the element level will be integrated into the model; assumed to be provided by MID in similar format as provided for the calibration period.

1.6 MID canal recharge will be estimated by diversion, spill, and delivery data as supplied by MID.

1.7 MID groundwater production will be updated from MID pumping records, as provided by MID.

1.8 Urban groundwater production will be developed by population and water consumption data as supplied by participating MAGPI member agencies.

1.9 General Head boundary condition dataset will be updated by groundwater elevation contours as available from the Department of Water Resources.

1.10 Other surface water deliveries will be updated from data available from Stevinson Water District, Turlock Irrigation District and Chowchilla Water district.

1.11 This subtask involves compilation of all model input data sets, debugging the datasets and ensuring seamless model input data, post-processing and analysis of simulation results will be performed in order to ensure quality of model input data sets and results.

1.12 One project meeting will be held with staff representing MAGPI to review model updates upon completion.

Task 2 – Integration of the IWFM Subsidence Package into the MercedWRM

This purpose of this Task is to develop the simulation of regional subsidence within the MercedWRM. The completion of this task will require collection and analysis of data relating to local and regional subsidence and recalibration of the MercedWRM. This Task includes the following activities:

2.1 Collect available data on local subsidence

2.2 Perform hydrogeological analysis and develop subsidence parameters

2.3 Perform analysis of observed historical subsidence trends.

2.4 Calibrate the MercedWRM simulated subsidence to observed records

2.5 One project meeting will be held with staff representing MAGPI to review the development of the subsidence package upon completion.

Task 3- Develop Existing Conditions Baseline Model (s)

This purpose of this Task is to collect, analyze, and prepare input data sets for the model to develop a baseline scenario representing the existing conditions in the Basin. Existing conditions assume that the current level of land and water use development would stay in place during a hydrologic period similar to the period 1970-2015.

This task will result in the development of two baseline conditions:
Baseline A: Assumes that the reservoir operation and Main Canal deliveries are under historical regulatory settings as of 2015.
Baseline B: This Baseline is similar to Baseline A; however, the operations of the Exchequer Dam and Main Canal deliveries will be based on the recently adopted FERC rules, as part of the FEIS for the Merced River.
This Task includes the following activities:

- 3.1 No effort will be needed for data collection, as most of data will be based on recent historical conditions.
- 3.2 Precipitation data will utilize 1970-2015 historical records
- 3.3 Stream flow data will be based on historical operations or supplied by MercedSIM model.
- 3.4 Land use and cropping patterns will be prepared for the current conditions within the basin, the primary source of data will be the USDA CropScape dataset.
- 3.5 MID deliveries will be based upon the monthly average of the respective water year type or supplied by MercedSIM model.
- 3.6 MID canal recharge will be based upon the monthly average of the respective water year type.
- 3.7 MID groundwater production will be based upon the monthly average of the respective water year type.
- 3.8 Urban groundwater production will be developed by existing population and water consumption data as supplied by participating MAGPI member agencies.
- 3.9 General Head boundary conditions will be based on C2VSim Existing Condition Baseline.
- 3.10 Other surface water deliveries will be developed based on monthly average of the respective water year type.
- 3.11 Model input data compilation, debugging of input datasets, post-processing and analysis of simulation results will be performed in order to ensure model quality.
- 3.12 A Technical Memorandum will be prepared documenting the development process of the existing condition baseline.
- 3.13 One project meeting will be held with MAGPI staff review model updates upon completion.

Task 4- Update Report

The purpose of this Task is to document the work completed under this Scope of Work. This Task assumes that the documentation for work under this scope of work will be in the form of an update to the model development report that is currently being completed under the original scope of work for Model development.
The final Model, corresponding database, and results will be available to the County and City or Merced, and Merced Irrigation District. It is assumed that by the time this Scope of Work is completed, the three entities (City and County of Merced and MID) will have developed a Model ownership, maintenance, operation, and governance protocol which will govern the use and application of the model by all entities in the Basin.
It is further assumed that the report will be produced in final form, as such, there is no time allowed to address comments for the updated report.

Task 5- Project Management and Coordination

This task includes activities required to manage the project, including preparation of invoices and monitoring the budget and schedule, as well as coordination with the MID project manager, and preparing and attending coordination meetings and or Board meetings. In specific, the Consultant will prepare and attend the following meetings, and make presentations as necessary:

- Up to three (3) meetings with agency staff
- Up to two (2) meetings with the Technical Work Group
- Up to three (3) MAGI Board meetings
- Up to three (3) meetings including County Board of Supervisors, City Council, and MID Board of Directors, or other management staff as deemed necessary by the project manager.

Deliverables

The deliverables for this phase of project will be as follows:

1- Updated historical model data sets
2- Model data sets for the Baseline Conditions
3- Updated model report
4- Presentation slides and material for the meetings and workshops

Budget: The budget for this scope of work is not to exceed $131,575. A detail table of cost by labor hours

Schedule: This work to be completed within six (6) months of the notice to proceed.

Fee Estimate

Merced Area Groundwater Pool Interests
MercedWRM Baseline

Tasks	Labor						Total
	Taghavi	Cayar	Amador	Jiang/Miller	Ayala	Total Hours	Total Fee
	PIC	PE	PE	PE	Admn.		
	$267	$209	$161	$151	$101		
Task 1: Extend Model Hydrologic Period to Include Recent Drought							
1.1 Data Collection			16	8		24	$3,784
1.2 Precipitation			2	8		10	$1,530
1.3 Stream Flow				4		4	$604
1.4 CropScape Land Use			2	8		10	$1,530
1.5 Surface Water Deliveries			2	4		6	$926
1.6 MID Canal Recharge			1	8		9	$1,369
1.7 MID Groundwater Production				8		8	$1,208
1.8 Urban Groundwater Production				4		4	$604
1.9 Boundary Condition General Head				8		8	$1,208
1.10 Other Surface Water Deliveries				4		4	$604
1.11 Compile Model and Quality Control	4	2	16	16		38	$6,478
1.12 Project Meeting (1)	4		8			12	$2,356
Subtotal Task 1:	8	2	47	80	0	137	$22,201
Task 2: Integration of the IWFM Subsidence Package							
2.1 Collect Data on Local Subsidence			4	16		20	$3,060
2.2 Develop initial Subsidence Parameters			4	16		20	$3,060
2.3 Preform Analysis of Historical Subsidence			4	24		28	$4,268
2.4 Calibrate MercedWRM Subsidence Package	4	4	40	80		128	$20,424
2.5 Project Coordination and Meeting (1)	4		8			12	$2,356
Subtotal Task 2	8	4	60	136	0	208	$33,168
Task 3: Develop Existing Conditions Baseline Model (s)							
3.1 Data Collection						0	$0
3.2 Precipitation						0	$0
3.3 Stream Flow	1		2	8		11	$1,797
3.4 CropScape Land Use			2	12		14	$2,134
3.5 MID Deliveries	1		4	24		29	$4,535
3.6 MID Canal Recharge				8		8	$1,208
3.7 MID Groundwater Production				4		4	$604
3.8 Urban Groundwater Production				8		8	$1,208
3.9 Boundary Condition General Head				8		8	$1,208
3.10 Other Surface Water Deliveries				4		4	$604
3.11 Compile Model and Quality Control	4	2	12	16		34	$5,834
3.12 Technical Memorandum	4		8	16		28	$4,772
3.13 Project Coordination and Meeting (1)	4		8			12	$2,356
Subtotal Task 3:	14	2	36	108	0	160	$26,260
Task 4: Update Report							
4.1 Update Model Report	16	4	40	16	8	84	$14,772
Subtotal Task 4	16	4	40	16	8	84	$14,772
Task 5: Project Management and Coordination							
5.1 Three (3) meetings with Agency Staff	12		24			36	$7,068
5.2 Two (2) Meetings with Technical Work Group	8		16			24	$4,712
5.3 Three (3) meetings with MAGPI Board	18		24			42	$8,670
5.4 Three (3) Meetings with Agency Boards	16		24			40	$8,136
5.5 Project Management	12		16		8	36	$6,588
Subtotal Task 6	66	0	104	0	8	178	$35,174
TOTAL	112	12	287	340	16	767	$131,575

1. The individual hourly rates include salary, overhead and profit.
2. Subconsultants will be billed at actual cost plus 10%.
3. Other direct costs (ODCs) such as reproduction, delivery, mileage (rates will be those allowed by current IRS guidelines), and travel expenses, will be billed at
4. RMC reserves the right to adjust its hourly rate structure and ODC markup at the beginning of the calendar year for all ongoing contracts.

Attachment B

Merced Area Water Resources Model (MWRM)

Development of the Merced Mass Balance Model (MercedMBM**)**

Scope of Work

August 29, 2016

The following scope of work presents the tasks to be considered for development of the Merced Mass Balance Model (MercedMBM), an Excel based, mass transport simulation. Water quality modeling is intended to evaluate and simulate trends in Total Dissolved Solids (TDS) and will be calculated utilizing the following methodology:

Surface Loading:

$$X_t = X_{t-1} + \sum_{j=1}^{m} Q_j^t \, C_j^{t-1}$$

Aquifer Loading:

$$M_t = M_{t-1} + \sum_{i=1}^{n} Q_i^t \, C_i^{t-1}$$

$$C_t = M_t S_t$$

Where: $\mathbf{X_t}$ is the mass of the constituent in the root zone available for deep percolation.

$\mathbf{M_t}$ is the mass of the constituent in the subregional aquifer at timestep t.

m is the total number of budgetary flow components (j) experienced by the root zone (groundwater pumping, applied surface water, precipitation, and misc surface loading).

n is the total number of budgetary flow components (i) experienced by the groundwater system (deep percolation, stream recharge, canal recharge, subsurface boundary flows, groundwater pumping).

$\mathbf{Q_t}$ is the flow into, out of, or between adjacent subregions at timestep t.

$\mathbf{C_t}$ is the concentration of the constituent at timestep t.

$\mathbf{S_t}$ is the end-of-month storage in the groundwater system at timestep t.

In order to develop a mass balance water quality model for the Merced Region the following steps will be taken:

Task 1.1 Compile and analyze water quality data, determine assumptions.

Task 1.2 Develop up to four (4) scenarios under SED conditions, as defined below:

a. SED flow standards (40% reduction in delivery at the Main Canal), with remaining flow left in the river, and increased groundwater pumping to meet agricultural water demand under the Baseline
b. SED flow standards (40% reduction in delivery at the Main Canal), with remaining flow left in the river, but groundwater pumping remaining the same as under the Baseline; which would result in water supply shortage to meet agricultural demand
c. SED flow standards (40% reduction in delivery at the Main Canal), with remaining flow left in the river, but groundwater pumping capped to the limits as set forth by SGMA to maintain sustainable groundwater basin
d. SED flow standards (40% reduction in delivery at the Main Canal), with remaining flow left in the river, but groundwater pumping capped to the limits as set forth by SGMA to maintain sustainable groundwater basin, and line MID canals, which would result in less seepage losses to the groundwater system, but more deliveries to the MID customers

Task 1.3 Develop a subregional flow regime under both the historical calibration version of the MercedWRM and the SED scenario.

Task 1.4 Develop a subregional mass balance loading model for the Merced Region within Microsoft Excel. Model assumptions and methodology are listed in the section below.

Task 1.5 Develop TM showcasing modeling process and results.

Task 1.6 Management of the project, including preparation of invoices, monitoring the budget and schedule, as well as coordination with the MID project manager.

Task 1.7 Up to Four (4) project meetings to coordinate the work with Merced ID, Merced County, and/or other entities as authorized by the project manager.

Assumptions for the development of the MercedMBM are listed below:

- The developed water quality model will be developed using complete-mixing formulation, will not simulate advective/dispersive methodology, and no degradation will take place for compounds being simulated.
- Budgetary flows will be determined by previous assumptions made from the Historical Calibration version of the MercedWRM.
- Aquifer flow and the concentration gradient in the vertical direction will not be modeled.
- Complete mixing within the aquifer will take place within each time step (1 year).
- Surface loading in the Region will be averaged into agricultural, urban, and native categories.
- The stream-groundwater interaction will be calculated on a net-subregional-annual basis.

Data required from Merced Irrigation District for the development of the MercedMBM are listed below:

- The initial concentration of TDS for all subregions.
- TDS concentrations of flows in all surface water bodies simulated within the model.
- TDS concentration of available surface water delivered (MID, TID, CWD, SWD).

- Regional average of agricultural, urban, and native non-point source loading per acre.
- Location, flow, and concentration of significant point-source loadings.
- SED Scenario –

Deliverables

The deliverables for this phase of project will be as follows:

- Merced Regional Water Quality Technical Memorandum
- Presentation slides and material for the meetings and workshops

Budget: The budget for this scope of work is not to exceed $56,006. A detail table of cost by labor hours

Schedule: This work to be completed within two (2) months of the notice to proceed.

Fee Estimate

Merced Area Groundwater Pool Interests
MercedWRM Salt Loading Model

Tasks	Labor						Total
	Taghavi	Blanke	Amador	Cochran	Hughart	Total Hours	Total Fee
	PIC	PE	PE	PE	Admn.		
	$267	$241	$161	$151	$101		
Task 2: Water Quality Model							
1.1 Data Compilation and Analysis			8	16		24	$3,704
1.2 Develop SED Scenario	8	12	72	16		108	$19,031
1.3 Develop (2) MercedWRM Subregional Flow Regimes	2		8	4		14	$2,426
1.4 Develop Loading Model	4		8	40		52	$8,396
1.5 Develop Documentation TM for the Model	2		16	24		42	$6,734
1.6 Project Management	4		4		1	9	$1,813
1.7 Project Meetings (Up to 4 meetings)	28	16	16			60	$13,902
Subtotal Task 1:	48	28	132	100	1	309	$56,006
TOTAL	48	28	132	100	1	309	$56,006

1. The individual hourly rates include salary, overhead and profit.
2. Subconsultants will be billed at actual cost plus 10%.
3. Other direct costs (ODCs) such as reproduction, delivery, mileage (rates will be those allowed by current IRS guidelines), and travel expenses, will be billed at
4. RMC reserves the right to adjust its hourly rate structure and ODC markup at the beginning of the calendar year for all ongoing contracts.