Attachment to Exhibit A

Reclaimed Water System Hydraulic Model Development and Masterplan Update

Scope of Services

Background and Objectives

In the summer of 2017, the City of Franklin (COF) Reclaimed Water System experienced flow and pressure drops and delivery issues in multiple service areas, particularly along the southern service areas in and around the Berry's Farm subdivision. The City's Water Management Department solicited CDM Smith to develop a Reclaimed Water System model to evaluate the overall system; and specifically, evaluate the issues being experienced in the southern service areas in order to propose short-term alternatives that could address the operations (such as valve operations, system interconnections and potential storage options) over the remainder of the summer.

As a result of the discussions related to the reclaimed system service and a follow-up to the initial analysis, the City desired to update the existing reclaimed water system masterplan and progress the model to develop short-term and long-term recommendations for both operations and capital investment for the entire system. The updates would consider a broad-range of options to address future reclaimed water system demands city-wide; as well as, options for reclaimed water utilization to comply with increasingly stringent nutrient reduction requirements for the existing and future wastewater effluent discharge.

The following sections summarize the proposed tasks to provide the City with short-term solutions for system pressure issues and long-range planning for future reclaimed water demands.

Project Scope of Work

Task 1 – Model Development

Task 1.1 City Staff Coordination and System Information Gathering

CDM Smith will obtain the following information and determine the adequacy of the information to assist in the development of the reclaimed water system analytical model. The information assembled shall include, but is not limited to, the following:

- City's GIS geodatabase of the existing reclaimed water system infrastructure,
- Historical and current customer demands (billing data),
- Reclaimed pump station pump curves and control settings,
- SCADA Data, including average and peak day demands (as available), and
- As-built drawings (pipe size, material, etc.)

To date, CDM Smith and the City have coordinated on the available data for the system; as well as collected additional field data to assist in the initial development and calibration of the model. The information collected and utilized to date include the following items. Additional data collection to be completed is described in additional tasks herein.

- GIS database of existing reclaimed water network
- Pumps curves for reclaimed water pump station
- Actual usage (meter data) versus contract usage for customers
- System data collected on existing system pressures and flows at various locations within the system (see below)

System Data:

Location	Data Type	Dates
Franklin WRF at Reclaimed Pumps	Pressure	5/23/2017 - 5/26/2017 6/2/2017 - 6/6/2017 6/12/2017 - 6/13/2017 6/28/2017 - 7/3/2017 11/9/2017 – 11/10/2017
Franklin WRF at Reclaimed Pumps	Flow	6/2/2017 - 6/6/2017 6/28/2017 - 7/3/2017 11/9/207 – 11/10/2017
Redwing Farms	Pressure	5/23/2017 – 5/26/2017 6/6/2017 – 6/13/2017 11/9/207 – 11/10/2017
Berry Farms Air Release	Pressure	6/6/2017 – 6/13/2017
Berry Farms Hydrant	Pressure	5/23/2017 – 5/26/2017 6/6/2017 – 6/13/2017 6/28/2017 – 7/3/2017 11/9/207 – 11/10/2017
Berry Farms Reclaim Meter	Pressure	6/28/2017 – 7/3/2017
Berry Farms Domestic Hydrant	Pressure	6/28/2017 – 7/3/2017
Downs Blvd.	Pressure	6/28/2017 – 7/3/2017
Legends Golf Club	Pressure	11/9/207 – 11/10/2017
Westhaven LS	Pressure	11/9/207 – 11/10/2017

Task 1.2 Develop Reclaimed System Hydraulic Model

After performing a review of the available data, CDM Smith will develop a WaterGEMS hydraulic model of the City's existing Reclaimed Water System. The City's GIS database will be used to construct the base model and incorporate all existing system infrastructure. Customer demands from City records will

be distributed to the appropriate nodes within the model and system wide diurnal demand curves will be developed.

Task 1.3 Inspect Effluent Pump Station for Reclamation

To ensure a thorough understanding of the condition and current operations of the system pump station, CDM Smith staff will visit and inspect the effluent pump station (water reclamation pump station) at the Water Reclamation Facility (WRF) to catalog the nameplate, information for each operable pump and verify the normal operating point(s) for the pump systems by recording flow and pressures for the station. If power meters are available, CDM Smith will calculate wire-to-water efficiencies and identify any inefficiencies of the pump(s).

Task 1.4 Pump Curves and Pump Controls Incorporated into the Model

CDM Smith will incorporate all the pump curves into the model, adding curves as needed and setting up controls to start and stop pumps during extended period simulations. If available, the City will provide test curves for any pumps that have been tested within the past 10 years, certified performance curves, or manufacturer's design curves for each pump. The City will provide on/off settings for automatically controlled pumps, and CDM Smith will interview operators to obtain information for simulating manually controlled pumps. CDM Smith will assimilate this information and the results of the water reclaimed pump station inspection(s) to ensure each pump station is accurately represented in the model. We will identify pumps that operated during spot-checks at points that do not fall on the provided curves in the model and recommend formal pump tests where discrepancies cannot be resolved. If SCADA data is available, we will also compare to field measurements for an additional accuracy check and utilize the SCADA data for the calibration efforts.

Task 1.5 System Field Testing

CDM Smith will conduct a multitude of field tests to best calibrate the system model to the conditions observed in the field. The testing will include a mix of system analysis including monitoring at individual customer meters, flow and pressure measurements within the system, hydrant testing (limited due to minimal hydrants and blow-offs on the system) and c-factor testing.

Initially, CDM Smith will coordinate the installation of recorders at approximately 10 of the City's largest customers to watch real-time usage within the system. A Meter Master 100EL, or similar type monitor, will be installed on the existing reclaimed water meters for an extended, continuous period, estimated from May 2018 to August 2018 to capture the extents of the high demand period. Monitors will record water usage in small increments (one to five-minute periods) for the entire period to ensure that the usage patterns are captures. The exact number of monitors will be adjusted as necessary to obtain the information required for successful calibration. Due to the unknown cost of the monitor rentals and data collection, an allowance for the equipment and/or subcontractor to perform the work has been included for $20,000. The actual contract value of the monitoring program will be provided to the COF for approval prior to commencing the work.

In addition to the monitoring at the meters, CDM Smith will work with the COF to field measure flows and pressures within selected pipes similar to the data collected and shared above from the summer of 2017. These tests will typically be completed during high demand days during summer months to accentuate head losses along trunk mains during periods of minimal flushing. We will utilize system pressure loggers and associated flow data from the system to convert measured pressures to feet of water and add gauge elevations in order to plot hydraulic grade lines (HGLs) against distance. These plots will demonstrate the accumulation of head losses and illustrate bottlenecks or other potential hydraulic restrictions within the pipe network. The hydraulic gradient tests also provide accurate bench mark information for model calibration. We anticipate utilizing up to 8 pressure loggers within the reclaimed system assuming the locations can be accessed and available for the connection of the loggers. These field activities will be coordinated with the City of Franklin to identify the most appropriate, and available, locations.

In addition to the field tests identified above, CDM Smith may also utilize c-factor testing and hydrant testing as appropriate to collect additional calibration data. The c-factor testing is not anticipated to be as valuable as the testing above due to the relative newness of the piping network. CDM Smith will work with the City staff to identify up to five areas within the system with the oldest infrastructure to verify pipe c-factor. The purpose of these tests is to provide a characterization of the C-factor for the various grouping of pipes throughout the reclaimed water system. The chosen locations, including the primary piping leaving the WRF pump station, will assist with determining the conveyance capacity of the piping network; as well as assisting with any piping affected by tuberculation or deposits. The preliminary C-factors in the model will be adjusted based on the test results. We assume that the COF Water Management Department will provide staff to accompany CDM Smith during the tests and perform operation of hydrants/valves as required.

Finally, CDM Smith will perform hydrant testing within the system where possible. The lack of hydrants and blow-off locations within the system will limit the opportunities for the two-hydrant testing, but testing will be coordinated with the City staff. The field pressure data for static and flowing conditions will be collected utilizing the two hydrant testing protocols. Data for two flow tests and a static pressure reading near the highest system elevation will be collected. Flow tests will be conducted using a procedure similar to hydrant flow tests on the potable water system, with reclaimed water blowoff valves opened to induce a large demand on the system instead of opening a flow hydrant. Although the blowoff flow rate may not be able to be measured directly due to the configuration, we will be able to estimate the blowoff flow rate using SCADA data from the high service pumps at the WRFs. The system demands, operating conditions, and blowoff flow rates observed during the field tests will be simulated in the hydraulic model, and the modeled and field pressures will be compared and calibrated against at each location. Due to the lack of current knowledge in regards to the potential locations where testing could be completed, this proposal includes up to 10 flow (hydrant/blowoff) tests and will be adjusted based on actual coordination on potential locations with the City staff.

Task 1.6 Calibrate Model using Field Tests

The accuracy of a computer model is highly dependent on its degree of calibration. To determine if a computer model is calibrated, actual field conditions are simulated using the model. System operating

parameters (e.g. system pressures, flow, etc.) generated by the model are compared with the parameters measured in the field activities outlined above in task 1.5.

CDM Smith will calibrate the developed model by running steady-state simulations to mirror the existing operations observed during the field tests discussed above. The calibration will compare the predicted flows and pressures with measurements from the hydrant flow tests and hydraulic gradient tests. The model will be adjusted until its predictions agree reasonably, as agreed upon by CDM Smith and the COF, with the observed measurements. Major discrepancies will be investigated and resolved prior to finalizing the calibration.

Task 1.7 Prepare a Model Calibration Report

CDM Smith will prepare a briefing report that describes the sources of information used for background model data and documents the final calibration results. The report will include charts and tables comparing model predictions with flow and pressure measurements, including SCADA data sets (as available).

Task 1.8 Train City Staff

CDM Smith will conduct three 8-hour days of training for all appropriate City staff at the Water Management offices focusing on:

- Basic overview of model components, including general background and operations of WaterGEMS Software
- Updating the model using GIS data or drawings of new developments/subdivisions
- Creating scenarios to model multiple operations situations

In addition to the time for the actual training, this task includes all the time and effort to prepare the documents, presentation and materials for the training.

Task 2 – City-Wide Reclaimed Water System Analysis

Task 2.1 Kickoff and Additional Meetings to Develop System Goals and Demand Scenarios/Alternatives Approach

CDM Smith will facilitate a kickoff meeting and up to four follow-up meetings to determine the COF Water Reclamation System usage goals; for example, whom and where the City wants to serve (residential vs commercial) as major customers and how the City wants to expand and operate the system into the short-term and long-term future. The meetings will be utilized to develop demand and alternative scenarios based on the meeting discussions that will be utilized in the model and are intended to meet the following criteria:

- The adequacy of the system under its current demands, including identifying systems weakness. This will be a scenario consisting of two sub-sets: one with actual current metered use showing

deficiencies, if any, and a second showing contractual committed usages showing deficiencies, if any**.**

- The adequacy of the system where capacity has been granted, but is not currently in service. This will be a scenario that will consist of the two subsets. (actual use = existing metered use + granted contractual with peaking factor)
- The adequacy of the system to incorporate the City's future needs based on projected growth. This scenario will consist of the ability to add projected growth nodes and areas with appropriate peaking factors to the scenarios above.

Task 2.2 Hydraulic Model Update with Developed Scenarios/Alternatives

CDM Smith will utilize the hydraulic model developed in Task 1 to model the scenarios discussed above and any additional needs developed as part of Task 2.1 discussions. These scenarios will be incorporated into the model to allow for future usage of the scenarios by the COF.

Task 2.3 Develop Peaking Factors

Peaking factors will be assigned to represent daily and seasonal variation in water usage based on current usage patterns observed in the reclaimed system, specific usage information obtained from customer billing database, reclaimed profiles from customer types in other similar communities, and typical peaking factors from accepted manuals of practice. In addition, we will utilize the field testing and monitoring of individual meters in Task 1 to verify these peaking factors.

Task 2.4 Evaluation of Hydraulic Model Runs of Developed Scenarios/Alternatives and Developed Peaking Factors

CDM Smith will perform hydraulic model simulations to assess the capacity and ability of the existing water reclamation system's pumping, conveyance and storage to serve the developed scenarios. Water quality and operating conditions will be evaluated for seasonal conditions (winter average day, summer average day, summer maximum day). CDM Smith will review the City's Standard Operating Procedures with respect to best practices from other utilities resources and provide recommendations, as necessary, to improve system operations.

Task 2.5 Development of Water Reclamation System to Serve Water Reclamation Demand

After the water reclamation system scenarios/alternatives are established in the model, projections will be updated and potential system Improvement projects will be developed as part of both a short-term and long-term capital improvements program. CDM Smith will perform hydraulic modeling analysis to determine the infrastructure required to meet the projected demand scenarios established in 2.1. CDM Smith will utilize hydraulic model results to evaluate the least-cost combination of pumping, storage, and transmission improvements to meet the projected demands. In determining improvement recommendations, the following will be considered:

- Reclaimed water storage needs (at both the existing and future WRFs, as well as the reclaimed distribution system)
- Establishing pressure zones to correspond with the potable water system

- Operating protocols
- Water quality
- Balancing the mix of customer uses to reduce peak demand on the system
- Flexibility and redundancy to improve operation and maintenance
- System interconnections and looping
- Maintaining continual flow of water
- Need for system re-chlorination stations at pump/storage locations to maintain water quality
- End of pipe blow-off locations
- Remote flow control valves to manage system and customer delivery
- Additional treatment capacity
- Additional treatment needs

As part of the capital program development, up to three meetings will be held with the COF staff to develop and evaluate potential projects to meet the long-term needs of the system.

Task 2.6 Technical Memorandum of Model Results Tabulating System Improvements

Once conceptual facility improvements associated with each of the scenarios/alternatives are developed, CDM Smith will prepare a technical memorandum describing the analysis protocol, the model results and a list of potential conceptual infrastructure improvement projects. CDM Smith will conduct a meeting that will explain the protocol that developed the conceptual facility improvements. An update meeting will be held to give insight on the identified projects to the COF so decisions on the orderly improvement of the system can be achieved. Cost estimates will be prepared for the primary alternatives developed in conjunction with the COF. The cost evaluation will include both estimated capital costs and operation and maintenance costs for both the treatment facilities and the storage and distribution facilities. To compare among potential alternatives to supply customers, a unit cost per gallon of reclaimed water demand will be calculated.

Task 3 – Master Plan Update Report

Task 3.1 Master Plan Report Development

CDM Smith will prepare a draft report that summarizes the conceptual reclaimed water alternatives and identifies the highest potential primary alternatives based on the analysis conducted under Tasks 2.1 through 2.6. Within the report, CDM Smith will identify preliminary phasing of the recommended reclaimed water system alternatives with respect to current planned projects in the system, future development, and planned WRF expansions and future constructions. The plan will also include regulatory considerations, particularly as it relates to future discharges and potential WRF permitting limitations and capital project improvement costs. Upon review, CDM Smith will update the draft report based on all feedback from the COF and publish a final Reclaimed System Master Plan Report.

Compensation

CDM Smith proposes to complete the work under Tasks 1 through 3 above for a not-to-exceed budget of $195,500. The details of this cost estimate are shown on the table below and included in the task

breakdown. CDM Smith will bill the project on a monthly basis based on the attached task breakdown and billing rate table. For each monthly invoice, CDM Smith will submit a monthly progress report and update on project status and deliverables.

	Project Tasks	Hours	Totals
1	Task 1 – Model Development	600	$99,000
2	Task 2 - City-Wide Reclaimed Water System Analysis	535	$75,000
3	Task 3 - Master Plan Update Report	160	$21,500
	Total Tasks 1 - 3	1,295	$195,500

Labor Category	Billing Rate ($/hour)
Senior Technical Advisor	$ 225
Officer	$ 210
Project Manager	$ 195
Technical Specialist	$ 175
Senior Engineer	$ 155
Engineer II	$ 135
Engineer	$ 115
Senior Field Technician	$ 105
Junior Engineer	$ 100
GIS/Field Technician	$ 90
Clerical/Contract Administrator	$ 75

CDM Smith

Client: City of Franklin, TN

Project: Reclaimed Water Emergency Services and Master Plan Update **Date:** 12/18/17

Detail: Scope of Work Fee Estimate

		Senior Technical Advisor	Officer	Project Manager	Technical Specialist	Senior Engineer	Engineer II	Engineer	Senior Field Technician	Junior Engineer	GIS/Field Technician	Clerical/Contract Administrator					
Task Descriptions		$225	$210	$195	$175	$155	$135	$115	$105	$100	$90	$75		Labor	ODCs	OPs	Task Level
		Hrs	Hrs	Hrs	Hrs	Hrs	Hrs	Hrs		Hrs	Hrs	Hrs	Total Hr	Totals	Totals	Totals	Totals
Task 1 - Model Development																	
1.1	City Staff Coordination and System Information Gathering	2	2	4	4		32	20				2	66	$9,120	$250		$ 9,370
1.2	Develop Reclaimed System Hydraulic Model		2	2			52	16				2	74	$9,820			$ 9,820
1.3	Inspect Effluent Pump Station for Reclamation		2	2		4	4			8	4		24	$3,130	$150		$ 3,280
1.4	Pump Curves and Pump Controls Incorporated into the Model		2	2			12	8					24	$3,350			$ 3,350
1.5	System Field Tests	2	2	6	6		40	24	24		60	4	168	$19,470	$1,000	$20,000	$ 40,470
1.6	Calibrate Model using Field Tests		2	4			40	24					70	$9,360			$ 9,360
1.7	Prepare a Model Calibration Report	4	2	4			40	16		16		8	90	$11,540	$100		$ 11,640
1.8	Train City Staff	4	2	2	8		32	24			8	4	84	$11,210	$500		$ 11,710
	Task Totals	**12**	**16**	**26**	**18**	**4**	**252**	**132**	**24**	**24**	**72**	**20**	**600**	**$77,000**	**$2,000**	**$20,000**	**$ 99,000**
Task 2 - City-Wide Reclaimed Water System Analysis																	
2.1	Kickoff and Additional Meetings to Develop System Goals and Demand Scenarios/Alternatives Approach	6	5	7	8		16	12				3	57	$8,930	$200		$ 9,130
2.2	Hydraulic Model Update with Developed Scenarios/Alternatives			2	4		40	24		8			78	$10,050			$ 10,050
2.3	Develop Peaking Factors	2	2	2	2		16	4		4	4		36	$4,990			$ 4,990
2.4	Evaluation of Hydraulic Model Runs of Developed Scenarios/Alternatives and Developed Peaking Factors	8	4	8	16		50	40		16	4		146	$20,310			$ 20,310
2.5	Development of Water Reclamation System to Serve Water Reclamation Demand	8	4	4	10		56	16		4			102	$14,970			$ 14,970
2.6	Technical Memorandum of Model Results Tabulating System Improvements	2	2	4	12		40	40		16			116	$15,350	$200		$ 15,550
	Task Totals	**26**	**17**	**27**	**52**		**218**	**136**		**48**	**8**	**3**	**535**	**$74,600**	**$400**		**$ 75,000**
Task 3 - Master Plan Update Report																	
3.1	Master Plan Report Development	4	2	8	10		80	40			8	8	160	$21,350	$150		$ 21,500
	Task Totals	**4**	**2**	**8**	**10**		**80**	**40**			**8**	**8**	**160**	**$21,350**	**$150**		**$ 21,500**
	TOTAL	**42**	**35**	**61**	**80**	**4**	**550**	**308**		**72**	**88**	**31**	**1,295**	**$172,950**	**$2,550**	**$20,000**	**$195,500**