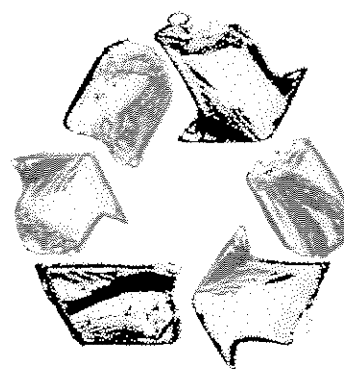


Cherokee Metropolitan District
Total Dissolved Solids Research for Reuse
under the WaterSMART:
Water Reclamation Research
Title XVI Water Reclamation and Reuse
Program for Fiscal Year 2016
Funding Opportunity: R16-FOA-DO-011

Submitted by:
Cherokee Metropolitan District

Prepared for:
US Department of the Interior, Bureau of Reclamation
Policy and Administration
Denver, Colorado





Project Applicant:
Sean Chambers
General Manager
Cherokee Metropolitan District
6250 Palmer Park Blvd.
Colorado Springs, CO 80915
schambers@cherokeemetro.org
719-597-5080



Study Manager:
Wilbur Koger, P.E.
Division Manager, Colorado
Forsgren Associates Inc.
56 Inverness Drive East, Suite 112
Englewood, CO 80112
wkoger@forsgren.com
720-214-5884

FORSGREN
Associates Inc.



TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 TECHNICAL STUDY DESCRIPTION.....	2
2.0 EVALUATION CRITERIA	4
2.1 Evaluation Criterion 1: Statement of Problems and Needs (10 Points)	4
2.2 Evaluation Criterion 2: Water Reclamation and Reuse Opportunities (15 Points).....	7
2.3 Evaluation Criterion 3: Description of Potential Alternatives (15 Points).....	10
2.4 Evaluation Criterion 4: Stretching Water Supplies (15 Points)	13
2.5 Evaluation Criterion 5: Environment and Water Quality (15 Points).....	14
2.6 Evaluation Criterion 6: Legal and Institutional Requirements (10 Points).....	15
2.7 Evaluation Criterion 7: Renewable Energy and Energy Efficiency (10 Points).....	17
2.8 Evaluation Criterion 8: Watershed Perspective (10 Points).....	18
3.0 REQUIRED PERMITS AND APPROVALS	19
4.0 OFFICIAL RESOLUTION	20
5.0 FUNDING PLAN AND LETTERS OF COMMITMENT	21
6.0 PROJECT BUDGET PROPOSAL	22
7.0 PROJECT BUDGET NARRATIVE	23
7.1 Salaries and Wages.....	23
7.2 Fringe Benefits	23
7.3 Travel	23
7.4 Equipment	23
7.5 Materials and Supplies	23
7.6 Contractual	23
7.7 Reporting.....	24
7.8 Other.....	24
7.9 Indirect Costs.....	24
7.10 Total Cost	24
8.0 PROJECT BUDGET FORM	24

APPENDIX

Project Budget Forms: SF-424, SF-424A and SF-424B

Letters of Support

Resolution



EXECUTIVE SUMMARY

Date: April 2016

Applicant: Cherokee Metropolitan District (CMD)

City, County, State: Colorado Springs, El Paso County, Colorado

Purpose: CMD respectfully requests federal grant assistance to perform a detailed evaluation of treatment technologies and establish preliminary design criteria for a facility (or facilities) needed to effectively reduce total dissolved solids (TDS) from treated wastewater effluent. That effluent is recharged to a designated groundwater basin, and subsequently used for both agricultural irrigation and for use in CMD's potable system. The effluent, however, exceeds a very restrictive discharge permit requirement for TDS. CMD needs to develop a cost-effective means of TDS reduction to continue water reclamation/reuse in the basin while complying with State requirements, and minimizes water lost to brine disposal. The more efficient the TDS removal process(es), as established by the research proposed with this grant request, the more efficiently water supplies can be used in this water-short region.

Schedule: The anticipated duration of this Research Study is 24 months. If funding can be secured by September 2016, the work would be completed by August 2018.

Background: CMD is a quasi-municipal governmental entity located just outside the city limits of Colorado Springs. Established in 1957, CMD serves approximately 23,000 customers. CMD's main service area, known as Cimarron Hills, encompasses approximately 6,300 acres north of the Colorado Springs Airport and Peterson Air Force Base (AFB). The area is a working-class neighborhood that serves as home to many military personnel and civilian support staff assigned to nearby Schriever and Peterson AFBs, and Fort Carson. The Median Household Income (MHI) for Cimarron Hills from 2008-2012 was \$51,888; 89 percent of Colorado's MHI over the same period (U.S. Census data).

CMD completed construction of a new 4.8-million gallon per day (MGD) regional wastewater reclamation facility (WRF) in 2010. Treated water from the WRF is conveyed approximately four miles to a complex of rapid infiltration basins (RIBs) for recharge of the Upper Black Squirrel Creek (UBSC) aquifer. Water from the UBSC aquifer makes up approximately 85 percent of CMD's existing water supply. The new WRF was developed to allow CMD to establish a sustainable water supply by recharging the alluvial aquifer using reclaimed water in the vicinity of one of CMD's primary well fields.

A permit authorizing recharge of the aquifer through the RIBs was approved in May 2010.

Due to a regulatory oversight, the TDS discharge limit was not imposed until shortly before startup of the new WRF. The newly constructed WRF treatment processes had not been designed to remove TDS. CMD received a Compliance Order on Consent (COC No. MC-140514-1) from the Colorado Department of Public Health and Environment (CDPHE) on June 23, 2014. As set forth in the COC, CMD is required to meet several milestones toward coming into compliance with the TDS permit limits.

The challenge of cost-effective TDS compliance without a significant amount of water lost to the water stream remains. CMD completed a preliminary evaluation of adding microfiltration (MF) and reverse osmosis (RO) treatment to treat a portion of the WRF flow. Although construction of an MF/RO facility would provide CMD with a reliable means of compliance, TDS removal facilities have several disadvantages, such as water waste. Further evaluation is needed.



Under terms of the COC, the District submitted to CDPHE a feasibility study generally comparing several alternatives (*Water Reclamation Facility Total Dissolved Solids Compliance Feasibility Study, Forsgren Associates and Hatch Mott MacDonald, Rev. April 17, 2015* [Feasibility Study]). Those alternatives include:

1. **Water Supply Management** - manage operation of available, or potential new, water sources to reduce TDS delivered to customers, and thus reduce TDS to the WRF.
2. **Wastewater Source Control - reduce customer TDS contributions through customer education, water softener moratoriums, and best management practices for industrial customers.**
3. **Increased Irrigation Reuse** – reduce the volume of reclaimed water delivered to the RIBs, reducing TDS loading to the alluvial aquifer.
4. **Regulatory Options** – investigate changes to Regulation 42, *Site-Specific Water Quality Classifications and Standards for Ground Water*, which may allow CMD to more cost-effectively manage TDS while still protecting potable and agricultural uses of the alluvial groundwater.
5. **Wastewater Treatment** - add new treatment to remove TDS from a side-stream flow of WRF effluent, to comply with the permitted TDS limit.
6. **Water Treatment** - construct new treatment for some or all of the UBSC wells to reduce TDS supplied to potable water customers, and thus reduce TDS to the WRF to comply with the permitted limit.

Some of these measures have been successfully applied including management and mixing of appropriate wells, education, and water softener moratoriums. These alternatives can provide some TDS reduction. However, additional treatment, combined with possible regulatory changes, will be needed for the District to continue full reuse operations. As identified in CMD's Feasibility Study (also required by the COC), the District is now collecting much more relevant data, and with greater accuracy, while pursuing regulatory changes. It is also committed to a parallel track of planning for TDS removal treatment.

1.0 TECHNICAL STUDY DESCRIPTION

Cherokee Metro District must establish a cost-effective and energy efficient TDS reduction method to continue water reclamation and reuse in the Upper Black Squirrel Creek (UBSC) Basin. Research is needed on the TDS removal processes to continue reuse and allow for the most efficient management of water supplies in the water-short region. The wastewater effluent is recharged into the UBSC, a designated groundwater basin, and then used for both agricultural irrigation and in CMD's potable system. The effluent exceeds a very stringent discharge permit requirement for TDS. Reuse of the water will lessen the demand from one of CMD's other sources of supply; the nonrenewable bedrock aquifers of the Denver Basin and potential future draws from the Arkansas River which is many miles away. Reclamation/reuse has proven to be a very important component of CMD's water supply. This Research Study is targeted at continuing such use.

Recharge began in the basin when the RIBs and WRF were constructed in 2010. Given the TDS in Cherokee Metropolitan District's current water supplies, and TDS increases in wastewater through normal use, a TDS removal facility will be necessary to achieve compliance with the required TDS limit of 400 mg/L. There are several treatment processes that may be used to remove TDS from the water, including reverse osmosis (RO), electrodialysis (ED) or



electrodialysis reversal (EDR), and de-ionization. The two principal treatment processes that are typically considered for TDS removal are RO and EDR.

Reverse Osmosis: RO is a membrane treatment process that uses membranes with very small pores to remove dissolved constituents, including monovalent salts, from water. Pressure is applied across the membrane to overcome osmotic pressure, resulting in a permeate stream with very low concentrations of dissolved solids, and a concentrate or brine stream that contains the rejected dissolved constituents.

For wastewater applications, which have a higher potential for fouling the membranes, more robust pretreatment is needed. One common pretreatment step is the use of microfiltration (MF). The MF/RO process is highly effective and is the most commonly used process for TDS removal. It has been demonstrated for salt removal at a number of wastewater treatment facilities.

Electrodialysis and Electrodialysis Reversal: Similar to RO, ED and EDR are membrane treatment processes that use membranes with very small pores to remove dissolved solids from water. However, they are unlike RO where pressure is applied to drive water across the membrane, removing most of the dissolved solids on the feed side of the membrane. ED and EDR use electrodes to develop an electrical potential to attract anions and cations across anion and cation transfer membranes to remove the dissolved solids from the water. EDR is based on the same concept as ED, but the polarity of the electrodes is reversed to help reduce membrane fouling.

Some of the typical advantages for the new ED or EDR system for wastewater treatment processes are that it does not require pretreatment as robust as required by RO systems, thereby reducing capital and O&M costs as well as operational complexity. However, salt rejection of the process is lower than RO, requiring a higher percentage of the water be treated to meet the same TDS goal.

As presented in the Feasibility Study, there are a number of considerations that will impact the final treatment technology, capacity, and location. Further research is needed for the preliminary treatment plant design.

Brine Disposal

All TDS removal processes produce a waste stream that must be disposed. For inland locations such as Colorado, it is critical to identify a feasible brine disposal option to ensure that the implementation of a TDS removal process is practicable. The Feasibility Study identified the following general options that will be considered further in the Research Study:

- A. Deep Injection Wells**– Deep injection wells are dedicated wells that can be used to dispose of waste streams such as RO concentrate. Deep injection wells are used extensively for disposal of oil and gas field waste streams, and have been used in Colorado for disposal of RO concentrate streams. Two examples of this are the East Cherry Creek Valley RO Water Treatment Plant (WTP) located in Brighton Colorado, and the City of Sterling’s RO WTP.
- B. Evaporation Ponds** – Evaporation ponds are a low technology method of achieving zero liquid discharge. Evaporation ponds are sized to take advantage of natural evaporation to dispose of brine streams. Depending on the required size of any TDS removal facilities, evaporation ponds may be a feasible alternative.
- C. Mechanical Zero Liquid Discharge (ZLD)** –ZLD systems rely on combinations of treatment processes that accomplish higher product stream recovery rates above what the



“primary” treatment process will produce by itself, and/or processes for evaporating the final reduced brine stream.

Research will include:

TDS Removal. Research final treatment technology, capacity, and location.

- a. Reverse Osmosis
- b. Microfiltration/Reverse Osmosis Combination
- c. Electrodialysis
- d. Electrodialysis Reversal

Brine Disposal

- a. Deep Injection Wells
- b. Evaporation Ponds
- c. Mechanical Zero Liquid Discharge (ZLD)

2.0 EVALUATION CRITERIA

2.1 Evaluation Criterion 1: Statement of Problems and Needs (10 Points)

Points will be awarded based on the presence of watershed-based water resource management problems and needs for which water reclamation and reuse may provide a solution.

(1) If the proposed research study aims to address the needs of a specific applicant or locale, describe in detail the water resource management problems and needs in the local area and explain how water reclamation and reuse may address those problems and needs.

The proposed Cherokee Metro District research will include a detailed evaluation of treatment technologies, and establish preliminary design criteria for a facility (or facilities) needed to effectively reduce total dissolved solids (TDS) from treated wastewater effluent. CMD must develop an efficient and cost-effective means of TDS reduction in order to continue water reclamation and reuse in the UBSC. CMD’s regional wastewater reclamation facility is, by far, the largest effluent recharge facility in the State, with 1.6 MGD entering the UBSC Basin.

The effluent is recharged to a designated groundwater basin, and must meet a very restrictive discharge permit requirement for TDS. Subsequently, it is used for both agricultural irrigation and as a supply to CMD’s potable system. Due to extensive development in the Basin since the mid-1950s, pumping of groundwater from storage in the UBSC aquifer has resulted in declines of the water table up to 42 ft at some locations. (Upper Black Squirrel Creek Basin Aquifer Recharge and Storage Evaluation, Colorado Geologic Survey, Ralf Topper, December, 2008). Water has also been over appropriated in the UBSC Basin with water rights exceeding water supply.

CMD’s WRF uses biological treatment with sequencing batch reactors (SBRs) to provide carbon oxidation, nitrification, denitrification and ultraviolet light (UV) disinfection. The existing WRF treatment processes were not intended to remove TDS, and the TDS concentration of the treated water is expected to generally be the same as the TDS concentration of the influent wastewater. Treated water is conveyed by gravity to the CMD’s RIBs, where it percolates back into the UBSC aquifer. In 2014, some of the reclaimed water was also provided to an agricultural irrigation customer. CMD will consider expanding such use, but that option is not available during winter months.

CMD completed a preliminary evaluation of adding microfiltration (MF) and reverse osmosis (RO) treatment to treat a portion of the WRF flow for TDS removal. Construction of an MF/RO

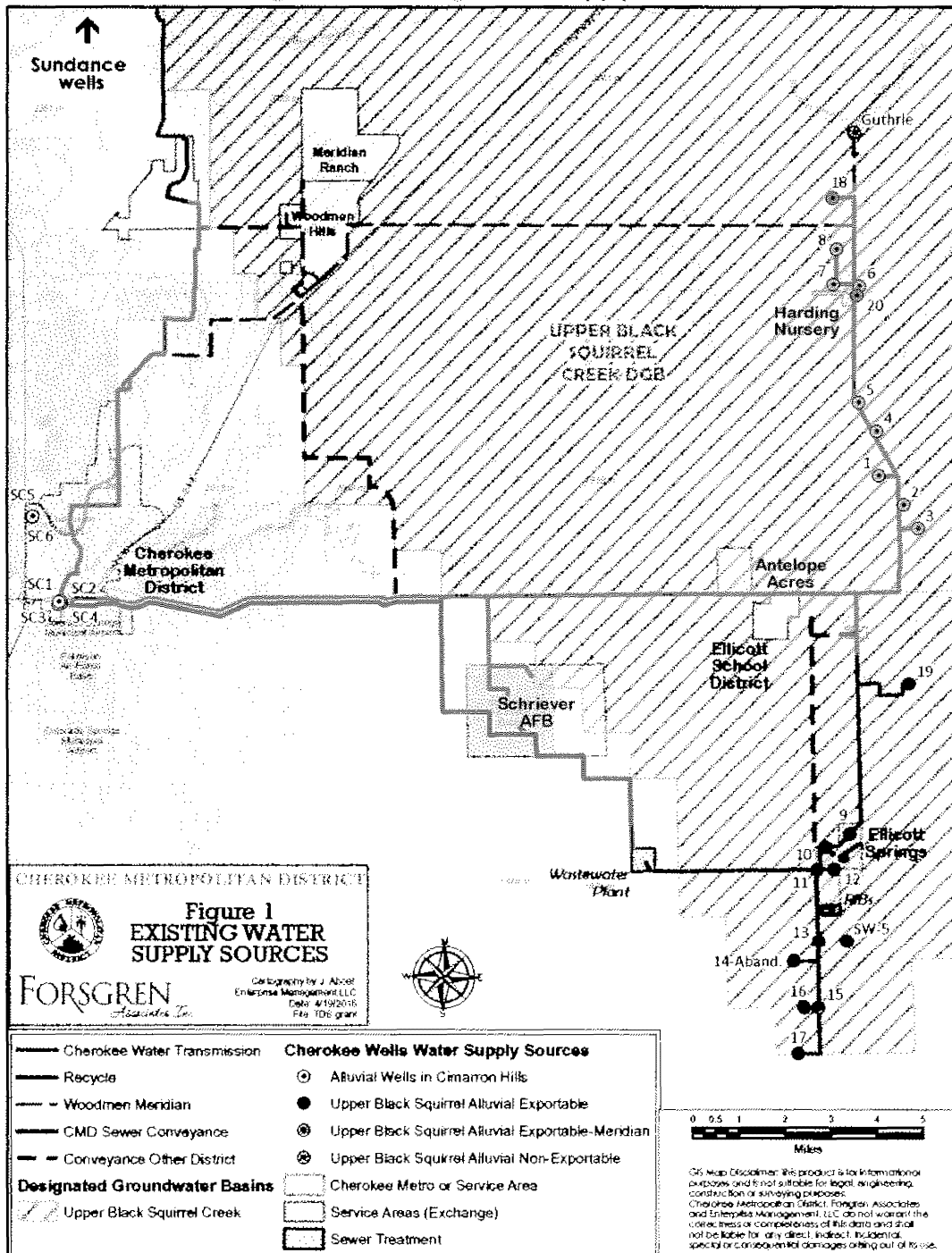


facility would provide CMD with a reliable means of compliance, although TDS removal facilities have the complexity of waste brine. Therefore, further evaluation and pilot testing is needed.

(2) Identify the water supply imbalance that the research study will address for the area of responsibility of the applicant. Additional consideration will be given to proposals that explain how water supply imbalances in the area may be impacted by climate change, and/or if the research study will attempt to address projected climate change impacts in the area.

This Research Study aims to address the immediate needs of CMD and its wastewater connectors (Schriever AFB, Meridian Service Metro District) to comply with TDS discharge requirements. See Figure 1 of existing water supply sources.

Figure 1 - Existing Water Supply Sources





In a broader context, it is of interest to the Pikes Peak Regional Water Authority (PPRWA), a group of El Paso County water providers with shared interests in water supply issues. Many of those member entities have growing demands, and/or are heavily dependent on nonrenewable Denver Basin groundwater that is being depleted over time. In fact, this region makes up the largest municipal and industrial (M&I) “gap” in the Arkansas River Basin projected through 2050 (Statewide Water Supply Initiative 2010, CDM). As the PPRWA providers need additional supplies, they have considered developing water from the Arkansas River and recently evaluated infrastructure. This infrastructure may be similar to the Southern Delivery System that Colorado Springs Utilities is completing to move water from Pueblo Reservoir on the Arkansas River, approximately 50 miles south of the city.

Renewable water from the Arkansas River depends on flow conditions that are vulnerable to climate change. Higher average temperatures are expected to result in greater evaporation, and earlier, more intense spring runoff is expected in the future. Preserving the ability to recharge groundwater with treated effluent (a consistent, year-round flow not dependent on weather conditions), protecting it from evaporation, and reusing it as part of a water supply portfolio helps harden CMD’s long-term water supplies against the effects of climate change.

(3) If the proposed research study aims to address broader needs of the industry in terms of technology or practices, describe these needs as they occur on a watershed, regional, and/or national scale.

The “gap” between Colorado’s water supply and water demand is projected to grow as Colorado’s population grows. Colorado’s population is estimated to double by 2050, thus the water demand is expected to dramatically increase. The Statewide Water Supply Initiative (SWSI) was completed in 2004 and updated in 2016. According to the 2011 update, a gap between supply and demand in Arkansas Basin Urban Counties will occur around 2035-2040. This “gap” is an estimated 41,000 to 61,000 acre-feet per year of water that will be needed to meet municipal, industrial, and agricultural water demand.

The issues facing CMD are also being faced by communities across the region. CMD will evaluate options and identify cost effective, energy efficient technologies and practices that will optimize its water resources through reuse of its treated effluent. There are relatively new technologies that will be investigated in the Research Study and this information will benefit others in the region, state, and nation. While there are RO facilities in Colorado, there are still relatively few municipal facilities. Additionally, since there are no known municipal ED or EDR facilities in Colorado, this Research Study offers an opportunity to provide a case study of one of these technologies in the State and provide another option for municipalities facing the same challenges. ZLD is a newer technology and Mechanical ZLD systems have received quite a bit of attention in recent years.

As other municipalities are faced with the same challenges as CMD, this Research Study will provide a better understanding of these technologies and how they can be implemented and optimized for municipal operations.



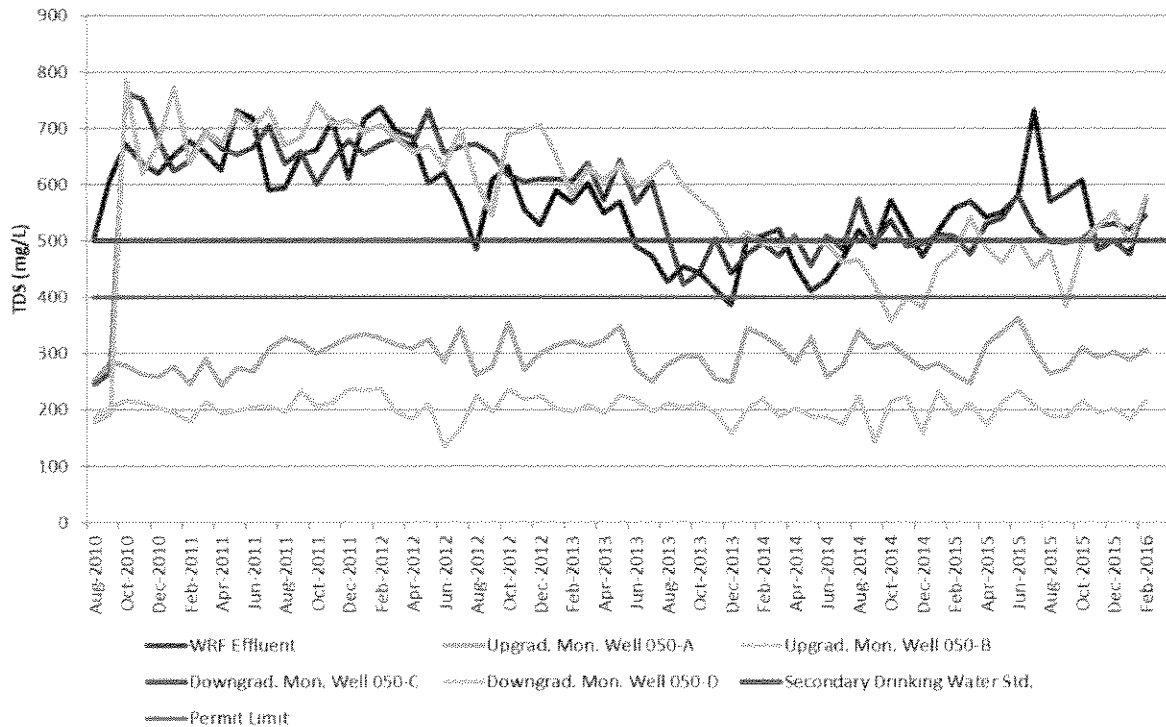
2.2 Evaluation Criterion 2: Water Reclamation and Reuse Opportunities (15 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will explore opportunities for water reclamation and reuse within and outside the research study area.

(1) Describe the source(s) of water that will be investigated for potential reclamation, including impaired surface or ground waters.

The TDS of the reclaimed water used to recharge the UBSC aquifer is primarily made up of inorganic constituents such as sodium, calcium, silica, potassium, magnesium, bicarbonate, sulfate, and chloride. The source of the majority of the TDS in the reclaimed water is CMD's water supply, followed by TDS increases from use of the water prior to discharge to the wastewater collection system. Figure 2 presents the historic TDS data in the WRF effluent and at monitoring wells both up- and down-gradient of the RIBs. The Figure also indicates the permit limit of 400 mg/L and the EPA's secondary (aesthetic) drinking water standard of 500 mg/L.

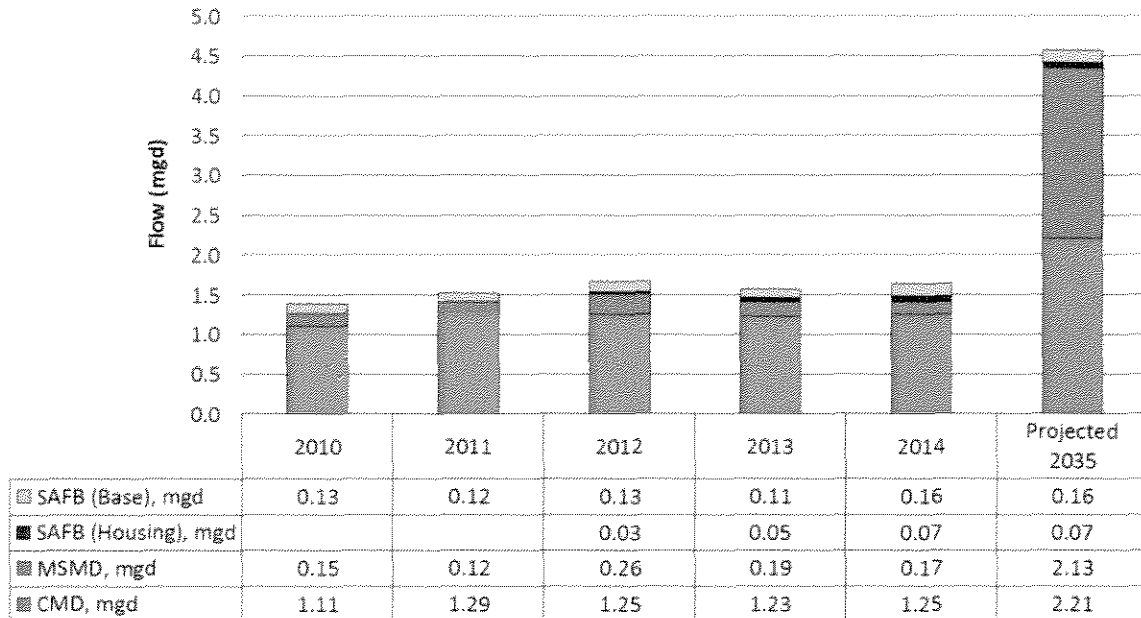
Figure 2: Reclaimed Water Historical TDS August 2010 - Feb 2016



The Research Study will focus on TDS removal for continued reclamation of municipal wastewater. The WRF was constructed with the capacity to serve projected wastewater flows through 2035, from the sources identified in Figure 3. Currently, wastewater from the CMD's main service area makes up a majority of the total flow to the WRF. In the future, Meridian Service Metropolitan District's (MSMD) wastewater contribution will increase until it nearly equals CMD's wastewater contribution.



Figure 3: Water Reclamation Facility
 Historical and 2035 Projected Influent Wastewater Flows
 Note: SAFB-Housing flows were not independently measured in 2010 & 2011)



As flows from CMD and its connectors grow, there will be an accompanying increase in water demands. Reuse and production from its UBSC wells will continue to be a key component of CMD’s water supply portfolio, provided that the reuse supply remains viable through additional treatment to remove TDS.

As for MSMD, much of their supply is drawn from deep bedrock aquifers of the Denver Basin, a nonrenewable source of supply. That water is, however, fully reusable, and MSMD’s ability to produce water from the UBSC is essential to their supply planning as well. Other water suppliers in the Falcon area, like MSMD, are very reliant on Denver Basin supplies. CMD and MSMD will be able to fully use their reuse supplies but, even if they had excess, those other water providers would have interests in purchasing the water as the Falcon area continues to grow. CMD is already able to deliver water to the Falcon area via a system of existing tanks and pipelines.

As previously noted, there is also a demand for direct reuse of WRF effluent for crop irrigation, and CMD had one such connector in 2014-15. The Research Study will consider how this demand may be integrated with plans to recharge and reuse the effluent to help meet municipal water demands.

(2) Describe how the research study will help to eliminate obstacles for using reclaimed water as a supply within and/or outside the area of responsibility of the applicant.

To reduce the need for additional supplies from far away and at great cost, the region’s water providers need to use current supplies as efficiently as possible, and maximize reuse. CMD takes both seriously, maintaining one of the lowest average water demands in Colorado, and reclaiming all of their effluent for recharge to the UBSC Basin. The District updated its Water Conservation Plan on file with the State, considering ways to reduce demand even further.



To continue with reuse, however, CMD must effectively control TDS for compliance with a discharge limit of 400 mg/L. Most of CMD's current water supplies have a TDS of 200-300 mg/L and, with an expected increase of 200-250 mg/L in the wastewater due to municipal use, compliance cannot be achieved through water supply management alone.

Most of CMD's current municipal supply comes from the UBSC aquifer, but the District recently developed two of its Sundance wells, pumping from nonrenewable Denver Basin aquifers. Table 1 presents a summary of CMD's current water sources. Planned production values indicate what the source can actually produce at this time, rather than the decreed amount available. Values presented in the table represent an annual water right.

CMD exchanges production from its non-exportable wells (Nos. 1 – 8) for water from an exportable water well owned by two districts within the UBSC Basin. As shown, reuse water blended with native groundwater downgradient of the RIBs (Wells 13-17) comprises 30 percent of the District's current supply. The volume of reuse water used from those wells would increase as the WRF capacity grows, provided the TDS issue can be resolved.

Table 1
Summary of CMD's Current Water Supplies

Water Supply Source	Decree (AF/YR)	Planned Production (AF/YR)	Percent of Supply	Notes
UBSC Wells Non-Exportable	5,260	2,897	46%	Wells Nos. 1-8 can only be used to supply water within the UBSC Basin
UBSC Wells Exportable (uninfluenced)	1,556	1,556	24%	Wells 9-12, and 19 are not influenced by the RIBs
UBSC Wells Exportable (influenced)	2,167	2,167	30%	Wells 13-17 & *SW5 potentially influenced by the RIBs
Sundance Black Forest Wells	742	247**		Wells SD-AR-1, SD-DN-(1-3) Sundance planned production is unknown at one well
Total	9725	6867	100%	

*SW5 or Sweetwater 5 is a future well that has not been developed yet. The planned production is based on the decreed volume.

CMD and its connectors have already established the need for reclamation and reuse as previously described. The WRF has been operating to recharge the UBSC aquifer with treated effluent for almost five years, and reuse of that water is also well established. During that time, CMD has worked diligently to resolve obstacles to reuse, improving water quality through TIN reduction in production wells downgradient of the RIBs. Now, meeting the very stringent discharge limit for TDS presents the most significant obstacle to continuing and growing regional reclamation/reuse.



(3) Describe how the research study will expand a water market and promote implementation of new uses or expand existing uses for reclaimed water (e.g., environmental restoration, fish and wildlife, groundwater recharge, municipal, domestic, industrial, agricultural, power generation, and recreation).

The Research Study, and the outcome, will allow CMD and its connectors to make best use of their water resources for continued economic development. As they grow, more water will be available for reuse, primarily for return to the potable system for municipal use. This study will focus on expanding groundwater recharge objectives through the uses of innovative technology to improve water quality for municipal, domestic, industrial, agricultural, and recreational uses. (CMD initiated a new park fund in 2014, and is now developing parks in select locations to offer more recreational opportunities to its residents/customers. Those improvements will include new irrigated areas served from CMD's potable system.)

(4) Describe how the research study will help establish or expand a water market to use reclaimed water outside your specific locale, including providing regional or West-wide benefits.

CMD's WRF is the State's largest facility recharging treated effluent to groundwater. Noncompliance with the TDS discharge standard jeopardizes the facility's continued operation and its ability to support a growing service area. The Research Study will establish a direction for CMD to return the facility to satisfactory operation and could provide a model for other water providers throughout El Paso County and the State of Colorado to optimize their water resources through reuse.

2.3 Evaluation Criterion 3: Description of Potential Alternatives (15 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will evaluate water supply alternatives or technology implementation options that support water reclamation and reuse of nontraditional water supplies.

(1) Describe objectives of the proposed research study and how the proposed research is innovative in advancing water reclamation knowledge and/or practices relative to existing knowledge and/or standard practices. References and literature citations should be provided, as applicable

The Research Study alternatives, consisting of forms of treatment and brine disposal, will be directed toward meeting a TDS discharge limit of 400 mg/L in accordance with CDPHE regulations. Such treatment would promote continued reliance on reclamation and reuse as an essential part of CMD's water supply portfolio.

The importance of reuse is addressed, and other supply alternatives were briefly evaluated in a separate study (*Cherokee Metro District Water Supply Master Plan, Forsgren Associates, 2016*). Further, CMD also considered water supply delivery on a large regional scale through participation in the *PPRWA Regional Water Infrastructure Study, Forsgren Associates, 2015*.

Listed below are just a few references that were reviewed during the Feasibility Study.

Reference	Use
GMS Antidegradation Analysis. (2004).	MF/RO and evaporation pond costs
Burbano, A., Brandhuber, P. (2012). <i>Demonstration of Membrane Zero Liquid</i>	Comparison of concentrate disposal options



Reference	Use
<i>Discharge for Drinking Water Systems.</i> Water Environment Research Foundation.	
Trussel, R.S., Williams, G.J. (2012). <i>Reclaimed Water Desalination Technologies. A Full-Scale Performance and Cost Comparison Between Electrodialysis Reversal and Microfiltration/Reverse Osmosis.</i> WaterReuse Research Foundation.	Comparison of EDR and MF/RO technologies for reclaimed water desalination
Poulson, T.K. (2010). <i>Central Arizona Salinity Study. Strategic Alternative for Brine Management in the Valley of the Sun.</i>	Comparison of brine disposal alternatives
Adham, S., Gillogly, T., Hansen, E. Lehman, G., Rosenblum, E. (2009). <i>Comparison of Advanced Treatment Methods for Partial Desalting of Tertiary Effluents.</i> U.S. Department of the Interior, Bureau of Reclamation.	Comparison of MF/RO and EDR, capital and O&M costs

(2) *If applicable, describe alternative water reclamation measures or technologies that will be investigated as part of the research study.*

The Research Study will consist of evaluating RO, ED, and EDR for TDS removal. Brine disposal options to be evaluated will include deep-well injection, evaporation ponds, and ZLD.

The research will include the following tasks:

1. Collect and evaluate additional data.
2. Provide a comparative evaluation of treatment alternatives, including conceptual facility sizing and present worth cost opinions, and long-term operation and maintenance.
3. Evaluate treatment capacity needs, and treatment processes to be pilot-tested. Conduct bench-scale and pilot studies.
 - a. Determine membrane flux and other design parameters.
 - b. Determine potential for fouling and effective cleaning agents.
 - c. Establish full energy consumption based on the pilot.
4. Perform Brine Disposal Feasibility Study
 - a. Determine percent rejection
 - b. Define Brine concentration
 - c. Resolve related disposal cost
 - d. Evaluate options: deep-well injection, evaporation ponds, and ZLD
5. Coordinate with CDPHE and Bureau of Reclamation throughout.

If data collected suggest that alternative technologies, such as lime softening, may cost-effectively reduce TDS, then these technologies will be further investigated as well.

The Research Study will consist of a detailed evaluation of alternatives for adding TDS removal treatment to allow continued operation of CMD's regional WRF for recharge to the UBSC aquifer. That reuse water then blends with native groundwater to supply some of CMD's highest



production wells, comprising a large share of CMD's water supply, with future growth to also serve MSMD's demands.

The treatment alternatives must be evaluated for current conditions and with respect to likely changes in water quality through buildout of the WRF as CMD develops new supplies in the years ahead. A portion of treated wastewater effluent will require TDS removal treatment, then be blended back such that the flow recharged to the RIBs meets the TDS discharge limit.

Even as there is consideration to limit the brine stream, resulting in a greater share of water for recharge to the aquifer, disposal of the brine stream is another essential part of the Research Study evaluation. The compliance feasibility study points to deep-well injection as the more likely option, but that also faces challenges, and other options will need to be considered.

With preliminary consideration of deep-well injection in the area of the WRF, it is believed that the brine would need to be injected to a depth of 8,000-10,000 feet to reach an aquifer having a TDS level exceeding 10,000 mg/L. It is not clear whether such a well could operate by gravity or require high-capacity pumping. The area geology and characteristics will need to be reviewed in detail to determine the feasibility of deep-well injection. Each well would cost millions of dollars, and a second well may be needed to assure reliable operation.

(3) Describe any collaborators involved with the research and their respective roles.

The Research Study will be performed at CMD's direction and in collaboration with the following staff: Sean Chambers, General Manager; Brian Beaudette, CMD Compliance and Asset Management; Zack Temple, District Engineer; Mike Poeckes, WRF Operator in Charge; and Art Sintas, Superintendent.

The Research Study will be accomplished by the engineering team that prepared the Feasibility Study, in collaboration with an expert technical advisor: Dr. Tzahi Cath, Professor at the Colorado School of Mines. He has extensive experience in membrane processes for water and wastewater treatment and for desalination. His expertise and research projects focus on membrane contactor processes (osmotically driven and thermally driven membrane processes) and on pressure driven membrane processes (RO, NF, UF) for seawater and brackish water desalination, for treatment of oil and gas exploration and production wastewater, for potable reuse, and for energy, nutrients, and mineral recovery. He is deeply involved in research associated with onsite treatment and reuse of wastewater using conventional and hybrid membrane bioreactors.

(4) Please describe the credentials, experience, and past performance of the research team. Alternatively, describe the process and criteria that will be used to select an appropriate, experienced research team.

The research team was identified through a request for proposals and competitive selection process in 2014, based on qualifications in accordance with CMD policies and State statutes. The team prepared the related Feasibility Study and Implementation Plan in response to the COC. The team includes the following key members:

Will Koger will be the research team Project Manager. He has successfully managed planning and design, and performed construction oversight of a wide variety of water, wastewater, and reuse projects in Colorado for over 25 years, both in the private sector and as the head engineer for two Front Range water/wastewater service providers. He served as the program manager on two projects valued at over \$60 M to develop indirect potable reuse; a large



expansion of a water reuse facility and a new RO water treatment plant. Mr. Koger also managed an evaluation of CMD's RIB Facility and Water Supply Master Plan.

Bill Veydovec will be the Assistant Project Manager. Bill is a civil engineer with experience in all phases of water, wastewater, and reuse projects, including conceptual development, planning, permitting, design, construction administration, startup, and operations. During his career, Mr. Veydovec has developed expertise in wastewater treatment facility planning, treatment process evaluation, and biological/chemical phosphorus removal.

Steve Farabaugh will be the Lead Research Engineer. Steve has extensive experience in drinking water research, piloting, design, and project management for water and wastewater projects. Steve's experience includes water treatment technologies and processes such as reverse osmosis, ultrafiltration, granular activated carbon, ultraviolet disinfection, ozone, limestone contactors, chlorination, conventional treatment, membrane concentrate treatment and sequencing batch reactors. His research background includes conducting bench-scale and pilot studies for various technologies. Recently, he was the lead design and process engineer for a reverse osmosis project that included a reverse osmosis pilot study.

Jason Broome will be the Lead Analysis and Report Engineer. Jason has 20 years of experience in project management of water and wastewater systems, including master planning, regional feasibility studies, preliminary engineering, detailed design, construction services, and startup and operation. Jason has been involved in over 30 water and wastewater treatment plant projects, ranging from simple lagoon systems to complex membrane filtration systems. His pertinent experience in wastewater treatment and reuse includes a Category A, 5-MGD biological nutrient removal system where 100% of the reclaimed water is used at golf courses and parks (Mesquite, NV), a Class B 2.5-MGD activated sludge system where 100% of the reclaimed water is used for irrigation of crops (Rupert, ID), and a Class A 5-MGD biological nutrient removal system for partial reuse (Burley, ID).

2.4 Evaluation Criterion 4: Stretching Water Supplies (15 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will address activities that will help to secure and stretch water supplies.

(1) At your specific locale and/or on a regional or West-wide scale, if applicable, describe how the research study could promote the establishment or expansion of a market for water reclamation and reuse that will reduce, postpone, or eliminate the development of new or expanded water supplies.

In 2006, supplies were determined to be inadequate for commitment by the State Engineer's Office, curtailing additional development. The current recharge is part of a strategy that assures a more reliable supply, thus reducing the need for purchase of additional raw water supplies. This reuse also allows for more efficient use of existing supplies and reduces the draw on the native supplies of the UBSC Basin.

An essential part of evaluating treatment technologies is to consider their recovery rates; that is, the percentage of finished water produced compared to treatment process influent. A typical recovery rate for RO treatment, for example, is 75-80 percent. That rate results in a significant brine stream that is then lost for water supply purposes, however. Higher recovery rates can be achieved with successive passes, but at higher operating costs. The economics and energy usage of higher recoveries will need to be evaluated carefully, given that this is a water-short region with significant increases in water supply costs expected. In the Feasibility Study, lost water



values for brine disposal is approximately 420 acre-feet per year for a TDS removal to meet 400 mg/L.

CMD has relied on reclamation and reuse as an essential part of its water supply planning and, as noted in Table 1, production wells in the path of recharge from the RIBs comprised 30 percent of the District's supply last year. A TDS treatment facility will increase the costs of continued reclamation and reuse for CMD but high costs are also associated with new supply development. It is anticipated that reuse, even at greater cost with TDS removal, will continue to be an essential part of CMD's water supply portfolio. The alternatives are to import renewable water from many miles away at a cost exceeding \$30,000 per acre-feet per year, or expand use of nonrenewable Denver Basin groundwater—a supply expected to diminish over time.

(2) Describe how the research study could or will streamline the implementation of a project that will reduce or eliminate the use of existing diversions from natural watercourses or withdrawals from aquifers and improve available supplies during droughts.

As CMD operates its regional WRF to recharge the UBSC aquifer, that reuse component “base-loads” their water supply, reducing the District's reliance on native UBSC groundwater. Reuse also defers the District's need to develop the additional Denver Basin water rights that it holds in the Black Forest area, allowing more of that diminishing supply to be reserved for emergency use. CMD's reuse component also reduces the amount of water that will need to be imported from far away as described in the *PPRWA Regional Water Infrastructure Study*. Denver Basin water would have to be developed more quickly, and costly Arkansas River water would have to be acquired sooner without efficient reuse.

(3) Describe how the research study could or will streamline the implementation of a project that will reduce the demand on existing Federal water supply facilities.

The likely import of water via the PPRWA regional system can be quantified for CMD as a share of the supply. CMD's share with reuse is 3250 acre-feet per year and without reuse as approximately 4875 acre-feet per year. CMD water reuse is assumed with the regional system. That system concept includes possible water storage in Pueblo Reservoir, a USBR facility. Continued reuse would reduce the volume of water that needs to be imported and consequently, the volume of storage that could be needed in Pueblo Reservoir.

2.5 Evaluation Criterion 5: Environment and Water Quality (15 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will address the potential or provide results that improve surface, ground water, or effluent discharge quality; restore or enhance habitat for nonlisted species; or provide water or critical habitat for federally listed threatened or endangered species.

(1) Describe the potential for the research study to identify methods or produce results that improve the quality of surface or groundwater, including description of any specific issues that will be investigated or information that will be developed as part of the research study.

The treatment processes that will be evaluated in the Research Study will serve to reduce TDS in water recharged to the UBSC aquifer, improving the quality of that groundwater downgradient of the RIBs, and continue to protect its use for domestic drinking water wells and crop irrigation. The improved effluent quality and water drawn from wells downgradient of the recharge basins will provide general benefit to a rural agricultural area with no critical habitat, and for return to CMD's service area for potable service.



Describe the potential for the research study to identify methods or produce results that improve flow conditions in a natural stream channel that benefit the environment, including a description of any specific issues that will be investigated or information that will be developed as part of the research study.

Continuing reclamation/reuse will reduce CMD's potential demands from surface water diversions from Fountain Creek or its tributaries and, ultimately, the Arkansas River. The efficient use of existing supplies helps defer the need to divert new surface water, and reduces the volume of those diversions. Because CMD's effluent recharges groundwater, it has no direct effect on surface streams.

(3) Describe the potential for the research study to identify methods or produce results that provide water or habitat for non-listed, sensitive, or federally-listed threatened or endangered species, including description of any specific issues that will be investigated or information that will be developed as part of the research study.

Water reuse allows for efficient use of existing water supplies in a region that is served, in part, by transmountain diversions. Reuse will reduce the need for those diversions and has the potential to limit future imports from the Colorado River Basin and associated fisheries. Species such as the whooping crane, piping plover, interior least tern, and pallid sturgeon are all benefitted by limiting diversions from the Colorado waterways.

2.6 Evaluation Criterion 6: Legal and Institutional Requirements (10 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will address legal or institutional requirements or barriers to implementing a project, including water rights issues and any unresolved issues associated with implementation of a water reclamation and reuse project.

One institutional challenge is balancing water rights with flows. CMD is in the process of evaluating their Replacement Plan application before the Ground Water Commission (Case No.08GW71) and determining how to proceed after a recent resolution by the Colorado Supreme Court's (Case No. 13SA330) regarding CMD's ability to claim replacement credits for return flows using Wells No. 14-17.

The Replacement Plan will affect CMD's ability to reuse return flows from the water rights. This will affect the provision of reclaimed water for agricultural irrigation past 2016, and for indirect use in CMD's potable system. Expanding the use of reclaimed water for agricultural use was identified in the Implementation Plan as one of the various option to reduce the TDS loading to the RIBs. CMD will continue to implement its reuse program based on the results of the pending Replacement Plan. CMD continues to provide reclaimed water for irrigation use to reduce TDS loading to the RIBs during irrigation months. Expansion of this use is currently in question due to the pending Replacement Plan.

Another challenge in this Research Study is knowing the historic level of TDS and how TDS will change over time.

Additionally, Upper Black Squirrel Creek Groundwater Management District is a challenging district and believes any change to the regulation is a degradation. Both CMD and UBSCGMD are looking to protect the water quality, however UBSCGMD desires to limit TDS loading at any cost.



(1) For planning related research, describe how the research study will to identify method or produce results that help to eliminate obstacles for using reclaimed water as a supply in the research study area.

No planning related research will be pursued within the Funding Group II.

(2) For field research studies focused on state of the art technology deployment describe the readiness to proceed in terms of.

a. The type and level of preliminary research investigations that have been completed.

The Feasibility Study looked at alternatives for TDS compliance. The team is ready to proceed with TDS removal technology and brine disposal research beginning this summer. As shown in Figure 4 below, per the COC, the District must have the treatment system operational by 2020.

Figure 4 - Summary of Implementation Plan Schedule

(Cherokee Metropolitan District Water Reclamation Facility Total Dissolved Solids Compliance Implementation Plan, April 17, 2015)

	Year 1 2015	Year 2 2016	Year 3 2017	Year 4 2018	Year 5 2019	Year 6 2020	Year 7 2021	Year 8 2022
Regulatory	1. Permit Renewal (Current Status: Draft Permit Pending)							
	2. Request Site-Specific TDS Standard in Reg. 42 (Current Status: Stakeholder Meetings)							
TDS Removal Facility & Brine Disposal	1. Manage water supply. Reduce use of higher TDS wells to the extent possible. 2. Develop Lower TDS water source (Black Forest Dawson Water). 3. Regenerative softener moratorium, industrial pretreatment limits, agricultural best management practices, reuse for agricultural irrigation. 4. Submit update report to CDPHE: Data evaluation, Drinking water vs. Wastewater TDS relationship, wastewater source TDS, etc. (March 31, 2016).							
	TDS Removal Facility							
	1. Data gathering/evaluation, Pilot test planning/CDPHE Coordination 2. Pilot Testing 3. Procure, Site App. Amendment, Design, CDPHE Design Approval 4. Bidding and Construction		Brine Disposal					
			1. Feasibility Study (Deep Injection Wells, Evaporation Ponds) 2. Prepare deep injection well permit application, EPA permit review/approval to construct 3. Construct, test, evaluate data 4. Design/Construct deep injection well pumping system					

b. The type and level of preliminary research plans or testing designs that have completed.

In the Compliance Feasibility Study, preliminary research was for RO and ED and EDR. No testing has been completed at this time.

c. Uncertainties that could affect the timing of research completion associated with environmental compliance, permitting, etc. as applicable to the research study?

CMD is pursuing a State Regulation #42 change for TDS with potential reclamation discharge limit of 500 or 600 mg/l. The current standard is very restrictive and CMD proposed a revised standard that is still protective of the uses. Regardless of the regulatory change the District will still need to do research and design for TDS removal. Some uncertainty are potential regulatory changes affecting the TDS limit.

d. How will the testing of new state of the art technology aid in produce results that help address institutional requirements to implement a project?



Compliance with the TDS standard is a condition for continued reuse and reclamation. Applying RO, ED, EDR to wastewater is “state of the art” because it would be a new practice in Colorado and these technologies are constantly improving in recovery abilities and energy efficiency. This treatment process could potentially set a precedent for groundwater storage and TDS removal.

2.7 Evaluation Criterion 7: Renewable Energy and Energy Efficiency (10 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will evaluate methods to incorporate the use of renewable energy or will otherwise address energy efficiency aspects of the water reclamation and reuse project being investigated.

(1) For research studies that include evaluation or incorporation of renewable energy, please describe the proposed or existing renewable energy system and the research objectives proposed to evaluate the integration of renewable energy into the research study area or project.

Membrane treatment processes such as RO can be very energy intensive, leading to high operating costs. Adding such treatment could drive the need for additional electrical service capacity, possibly including the need to construct a new electrical substation. CMD has met with Mountain View Electric Association (MVEA) for a conceptual discussion of the facilities that may be needed. CMD has a vested interest in minimizing its capital and operating costs to support TDS removal, and will work closely with MVEA to address energy efficiency and possible renewable energy strategies.

(2) For research studies focused on improving energy efficiency, describe the full scale plant energy requirements, if applicable, proposed efficiency improvements, and reduced carbon footprint. Provide calculations and describe assumptions and methodology.

Full scale plant energy requirements are projected in the range of 2 to 2.5 million Kwh per year. This is based on similar plants currently operating in Colorado. The energy values are for an alternative that proposes microfiltration, reverse osmosis, and deep well injection brine disposal. Energy requirements may vary if a different alternative is selected.

An evaluation will be conducted to determine the lifecycle cost and energy savings of utilizing the most state of the art and energy efficient equipment and components throughout the entire facility. Pump and membrane technologies have achieved major improvements in energy efficiency in recent years and the alternatives will be fully researched as part of this project.

Membrane system energy recovery technologies such as turbines, intermediate stage boosters and pressure exchangers will also be evaluated. These technologies are showing improved efficiency on waters with TDS concentrations equal to or less than brackish waters where a few years ago they would not have been effective on systems treating the water qualities seen for this project.

(3) Please quantify the energy savings that are expected to be identified in the research study through renewable energy or improved facility efficiencies. Include support for how energy savings were calculated.

Recent case studies at reverse osmosis plants treating similar water quality, show that energy saving of 5%-20% are possible with a combination of high efficiency membranes, pumps, and energy recovery devices. Based on the range of annual energy requirements identified above, power savings could range from 100,000 Kwh to 500,000 kWh per year.



2.8 Evaluation Criterion 8: Watershed Perspective (10 Points)

Points will be awarded based on the extent to which the proposal demonstrates that the research study will promote and apply a regional or watershed perspective to water resource management.

(1) Describe whether or the extent to which the research study is based off of recommendations from an existing plan that is sponsored or otherwise recommends research needs on a regional or national scale.

The research is based on the *CMD WRF Total Dissolved Solids Compliance Feasibility Study* and the conclusion is that there is further need to do TDS removal study. Also the *CWCB Underground Water Storage Study* has identified the UBSC Basin as a principal site for alluvial water storage and the *PPRWA Regional Water Infrastructure Study* evaluates water supply delivery on a large regional scale. The *CWCB Statewide Water Supply Initiative* report (November, 2004) identified municipal reuse as an important option for meeting future water needs.

(2) Explain any additional benefits of, or specific need for, the proposed research study within the sponsors watershed, regional area, and nationally.

CMD is a part of the Pikes Peak Regional Water Authority (PPRWA), a group of water providers with growing demands that significantly depend on nonrenewable Denver Basin groundwater. Any reuse will conserve more water for the UBSC Basin, for the other Denver Basin groundwater users and within the PPRWA group.

CMD's regional reclamation/reuse facility currently operates at approximately one-third of its capacity. This important facility was planned, designed, and constructed with capacity to provide for the region's growing wastewater flows and water demands for 20 more years. Adding TDS removal to allow continued operation is a key component of water resource management in the region.

The Colorado Water Conservation Board (CWCB) has identified the UBSC Basin as a premier site for alluvial water storage (SB06-193 *Underground Water Storage Study*, Colorado Water Conservation Board, March 1, 2007). Supporting CMD's success in using the UBSC Basin could set an important example for other municipal water providers in and around nearby Colorado Springs, Colorado's second largest metropolitan area. Indirect potable reuse is much more acceptable to the public than direct potable reuse, and the UBSC alluvium requires an environmental buffer. Below ground storage protects supplies from evaporation losses of three feet per year associated with surface reservoir storage. This Research Study and its outcome are important steps toward significant long-term sustainability for the region, where several municipal water providers depend heavily on nonrenewable Denver Basin groundwater, or must import water from many miles away.

Notably, there are implications on a grander scale. Colorado's Water Plan, completed in December 2015, projects a possible statewide water supply gap of over 500,000 acre-feet per year by 2050 as Colorado's population almost doubles. It also establishes a very aggressive goal to achieve 400,000 acre-feet per year in conservation and reuse efficiency by then.

(3) Describe how the research objectives will benefit other locations and the technical, economic, or institutional questions that will be answered by the research study.



Cherokee Metro District, Meridian Service Metro District, and Schriever AFB are all stakeholders that have a portion of their water treated by the Water Reclamation Facility. The Upper Black Squirrel Creek Ground Water Management District is the governing agency and a major stakeholder in the basin. Conserving and reusing water will help the Basin to keep their water.

As Colorado grows and more water, by necessity, is reclaimed and reused, the connection to water quality will grow in importance. The Research Study is an opportunity for a municipal water provider to address water quality and maintain reuse operations, despite growing levels of background TDS in its source water and having to meet a very stringent permit limit. What is learned from this process will be of value to others that will need to follow.

(4) Explain how the research study includes or promotes and encourages collaboration among parties. Identify if there is widespread support for the research study.

Treating water to remove as much TDS will benefit the basin, including the Water Districts and Schriever AFB. There is collaboration between Cherokee Metro District, Meridian Service Metro District, Woodmen Hills, and Falcon Highlands for the regulatory changes and to work together for the success of the TDS project. There are also letters of support (included in the Appendix) attached from Woodmen Hills Metropolitan District and the City of Fountain.

The Research study promotes collaboration and provides direction for other water providers in the PPRWA. They also have an interest in the results for future regional consideration.

3.0 REQUIRED PERMITS AND APPROVALS

The Research Study will address required permits and approvals needed to implement a solution including the following:

- The need for TDS removal treatment is driven by the COC, and the Research Study will be closely coordinated for CDPHE approval.
- Coordinate with Bureau
- Brine disposal by deep-well injection would require EPA permitting.
- Brine disposal by evaporation ponds may require a 1041 Permit from El Paso County.
- Facility construction will require building permits from the Pikes Peak Regional Building Department.

Environmental Compliance

1. Will the research study activities impact the surrounding environment (i.e., soil [dust], air, water [quality and quantity], animal habitat, etc.)?

The proposed study will research TDS removal technologies and brine disposal. Bench scale or pilot scale is proposed at the existing water reclamation facility, or similar location. No new earth disturbing activities that would affect species, habitat, water-ways, or archeology are proposed as a part of this research.

o Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the research study area.

No earth disturbing activities are planned for the research study.

o Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.



The future TDS removal facility will likely be attached or adjacent to the existing water reclamation facility.

2. *Are you aware of any species listed, or proposed to be listed as a Federal endangered or threatened species, or designated Critical Habitat in the research study area? If so, how would they be affected by activities associated with the proposed research study activities?*

We are not aware of any species listed, or proposed to be listed as a Federal endangered or threatened species, or designated Critical Habitat in the research study area

3. *Are there wetlands or other surface waters inside the research study boundaries that potentially fall under Federal Clean Water Act jurisdiction as "waters of the United States?" If so, please describe and estimate any impacts the research study activities may have.*

The research study will not have an impact on any "waters of the United States".

4. *Are there any known archeological sites in the research study activities area? If so, please describe and estimate any impacts the research study may have.*

The research study will not have an impact on any archeological sites. There are no known archeological sites on the District property.

5. *Will the proposed research study activities have a disproportionately high and adverse effect on low income or minority populations? If so, please describe and estimate any impacts the research study may have.*

The proposed research study activities will not have a disproportionately high and adverse effect on low income or minority population. The research study should help low and middle income residents of the District by offering efficient TDS removal technologies, which will keep their rates reasonable.

6. *Will the research study activities limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands? If so, please describe and estimate any impacts the research study activities may have.*

The proposed research is not on any Indian sacred sites or tribal land.

7. *Will the research study activities contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area? If so, please describe and estimate any impacts the research study activities may have.*

The research study activities will not contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area

4.0 OFFICIAL RESOLUTION

The official resolution was approved in the CMD's Board of Directors meeting for Board approval, Tuesday, April 12, 2016. The signed resolution is attached in the Appendix.



5.0 FUNDING PLAN AND LETTERS OF COMMITMENT

Funding Sources	Funding Amount
Non-Federal Entities	
1. Cherokee Metropolitan District*	\$450,000
Non-Federal Subtotal	\$450,000
Other Federal Entities	
1. None	\$0
Other Federal Subtotal	\$0
Requested Reclamation Funding	\$150,000
Total Study Funding	\$600,000

The funding plan must include all research study costs, as follows:

(1) How you will make your contribution to the cost share requirement, such as monetary and/or in-kind contributions and source funds contributed by the applicant (e.g., reserve account, tax revenue, and/or assessments).

CMD will fund its portion of the study cost from its wastewater enterprise fund which is derived from connection fees and service charges.

(2) Describe any in-kind costs incurred before the anticipated research study start date that you seek to include as research study costs. Include:

(3) What research study expenses have been incurred

(a) How they benefitted the research study, (b) The amount of the expense, (c) The date of cost incurrence

CMD contracted with Forsgren Associates and their subconsultants to complete the compliance feasibility study and implementation plan pursuant to the COC, and the related tasks of regulatory coordination and stakeholder/customer outreach, this research was conducted prior to July 2015. Research data collection efforts have increased significantly in the District since 2015 and to date, the District has incurred over \$46,000 in expenses since July 1, 2015. The data collection effort has been used to better designate the source and location of TDS. The work involved data collection review and analysis. It also set the direction to collect more and better data, and develop the Research Study contemplated for treatment and brine disposal alternatives as described in this application.

(4) Provide the identity and amount of funding to be provided by funding partners, as well as the required letters of commitment.

There are not any non-federal funding partners. CMD will provide all of the non-Federal funding, and will confirm the District commitment through a resolution of its board of directors. The District is strongly motivated to seek Federal funding support for this Study, given that the MHI of their constituents is estimated at 89 percent of the state MHI.



(5) Describe any funding requested or received from other Federal partners. Note: other sources of Federal funding may not be counted towards your 75 percent cost share unless otherwise allowed by statute.

There are not any other Federal funding partners.

(6) Describe any pending funding requests that have not yet been approved, and explain how the research study will be affected if such funding is denied.

There are not any pending funding requests.

6.0 PROJECT BUDGET PROPOSAL

Budget Item Description	COMPUTATION		Quantity Type (hours/day)	Total Cost
	\$/Unit	Quantity		
Salaries and Wages				
General Manager	Combined:			
WRF Operator in Responsible Charge	\$45	500	Hours	\$22,500
Compliance/Asset Management Administrator				
District Engineer				
Fringe Benefits				
Full-Time Employees	\$15	500	Hours	\$7,500
Travel				
Mileage to Denver for meetings			Lump Sum	\$2,000
Equipment-N/A				
Supplies/Materials			Lump Sum	\$1,000
Contractual/Construction -NA				
Prior expenditure for Data Collection and Analysis, CMD (and Consultants)			Time and Expenses	\$46,000
Further Data Collection and Analysis, CMD (and Consultants)			Time and Expenses	\$26,000
Research of Treatment Technologies and Flow Projections			Time and Expenses	\$45,000



Budget Item Description	COMPUTATION		Quantity Type (hours/day)	Total Cost
	\$/Unit	Quantity		
Planning and Design of Pilot Test, CDPHE Coordination			Time and Expenses	\$45,000
Bench-scale and Pilot Testing			Time and Expenses	\$350,000
Brine Disposal Feasibility Study			Time and Expenses	\$50,000
Subtotal Research Study, Forsgren Associates, Inc. (and subconsultants)			Time and Expenses	\$595,000
Other-N/A				
Reporting			Time and Expenses	\$5,000
Total Direct Costs				\$600,000
Indirect Costs – N/A				
Total Research Study Costs				\$600,000

7.0 PROJECT BUDGET NARRATIVE

7.1 Salaries and Wages

Salaries and wages for CMD's four key staff managing the proposed Research Study are combined.

7.2 Fringe Benefits

Benefits are estimated at 33 percent of Salaries and Wages.

7.3 Travel

CMD will attend meetings at CDPHE's offices in Denver, and its Denver-based consultants throughout preparation of the Research Study. Mileage is determined at the rate set by the IRS, currently \$ 0.54 per mile.

7.4 Equipment

Not Applicable

7.5 Materials and Supplies

This item includes anticipated reproduction, postage, and delivery costs.

7.6 Contractual

CMD contracted part of the data collection, laboratory analysis, and data analysis efforts and also has completed some of the efforts in house and has spent over \$46,000 to date.



The District plans to contract the Research Study to Forsgren Associates, Inc. (and their subconsultants) on a time and expense basis estimated at another \$516,000.

7.7 Reporting

Reporting will be performed by CMD staff consisting of all reports and documentation required as a condition of grant acceptance.

7.8 Other

Not Applicable

7.9 Indirect Costs

Not Applicable

7.10 Total Cost

The anticipated cost of the Research Study, both Federal and non-Federal cost shares, is \$600,000.

8.0 PROJECT BUDGET FORM

The project budget forms SF-424, SF-424A and SF-424B are attached in the Appendix.



APPENDIX

WOODMEN HILLS

METROPOLITAN DISTRICT

Dear Evaluation Committee for the WaterSMART grant,

Woodmen Hills Metropolitan District (WHMD) is a stakeholder in the Upper Black Squirrel Creek Basin and supports the total dissolved solids reduction work that Cherokee Metropolitan District (CMD) plans to pursue and fund at their Water Reclamation Facility.

WHMD also supports CMD receiving the *WaterSMART: Water Reclamation Research under the Title XVI Water Reclamation and Reuse Program for Fiscal Year 2016* Grant. The grant funds will be used to research efficient total dissolved solids removal and brine disposal technologies so that more water can remain in the Upper Black Squirrel Creek Basin as practicable.

Please take this letter as a statement of our support. Thank you very much for your consideration.

Sincerely,



Gene Cozzolino

Director of Water and Wastewater



116 S. Main Street
Fountain, CO 80817
Phone: 719/322-2010
Fax: 719/322-2011

April 18, 2016

Evaluation Committee
U.S. Bureau of Reclamation

RE: WaterSMART: Water Reclamation Research
Title XVI Water Reclamation and Reuse Program for Fiscal Year 2016
Cherokee Metro District

Dear Sir or Madam:

Cherokee Metropolitan District is applying for a Field Research Grant for Funding Group 2 research under the *Water Reclamation Research under the Title XVI Water Reclamation and Reuse Program for Fiscal Year 2016*.

The City of Fountain Water Utility supports the Cherokee Metropolitan District's application for this Grant. The water from the City of Fountain's alluvial wells have relatively high Total Dissolved Solids content and this research will address TDS removal technologies and the potential treatment of the concentrated brine that results from this TDS removal process. This research will benefit the City of Fountain's customers as the Fountain Water Utility moves forward on addressing TDS from our source water.

Again, we thank you for your consideration of this Grant Application and request that your review positively recommends this funding for Cherokee Metropolitan District.

Truly,

Michael Fink, P.E.
Water Resources Engineer
Fountain, Colorado

cc: C. Mitchell

CHEROKEE METROPOLITAN DISTRICT

RESOLUTION 2016-12

**A RESOLUTION OF THE BOARD OF DIRECTORS OF THE
CHEROKEE METROPOLITAN DISTRICT APPROVING THE
"BUREAU OF RECLAMATION WATERSMART GRANT TITLE
XVI WATER RECLAMATION AND REUSE APPLICATION," AS
PREPARED BY FORSGREN ASSOCIATES, INC.**

WHEREAS, Forsgren Associates, Inc. has prepared and is submitting on behalf of the Cherokee Metropolitan District (the "District") a grant application to the Bureau of Reclamation (the "Bureau") for funds available through the "Funding Opportunity Announcement No. R16-FOA-DO-011; WaterSMART: Water Reclamation Research under the Title XVI Water Reclamation and Reuse Program;"

WHEREAS, the grant application follows the guidance set forth in "Funding Opportunity Announcement No. R16-FOA-DO-011 WaterSMART: Water Reclamation Research under the Title XVI Water Reclamation and Reuse Program for Fiscal Year 2016;"

WHEREAS, if the grant application is successful, the Bureau will provide funds up to \$150,000 under Funding Group II for research related to TDS Removal Technologies including a Pilot Study and Brine Disposal, with said research to be completed within twenty-four months of award;

WHEREAS, the grant requires that applicants be willing to cost share seventy-five percent (75%) of the total research study costs, which percentage of costs is estimated to be \$450,000 for such research;

WHEREAS, research study pre-award costs that have been incurred prior to the date of award but after July 1, 2015, may be submitted for consideration as an allowable portion of the District's cost share for the research study;

WHEREAS, if the application is successful, the District will work with the Bureau to meet established deadlines to complete the research study; and

WHEREAS, the District supports the grant application and in furtherance thereof, the District is willing to commit to said cost-sharing up

to \$450,000 if the grant application is successful, subject to limitations provided in Colorado law regarding multiple year fiscal obligations.

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE CHEROKEE METROPOLITAN DISTRICT AS FOLLOWS:

1. The Cherokee Metropolitan District ratifies the submittal of the grant application to the Bureau of Reclamation pursuant to the Funding Opportunity Announcement No. R16-FOA-DO-011; WaterSMART: Water Reclamation Research under the Title XVI Water Reclamation and Reuse Program.

2. If the grant application is successful, the Cherokee Metropolitan District commits to matching funds in an amount not to exceed \$450,000, subject to the limitation that any financial obligations of the District not performed during the current fiscal year are subject to annual appropriation, and thus any obligations of the District hereunder shall extend only to monies currently appropriated and shall not constitute a mandatory charge, requirement or liability beyond the current fiscal year.

DONE AND RESOLVED this 12th day of April, 2016.

CHEROKEE METROPOLITAN DISTRICT

BY:


President, Janet L. Cederberg

ATTEST:


Secretary, Melody Helton


Director