



COLORADO WATER CONSERVATION BOARD



WATER SUPPLY RESERVE ACCOUNT 2007-2008 GRANT APPLICATION FORM

South Metro Water Supply Authority Aquifer Recharge Pilot Study

Name of Water Activity/Project

River Basin Location

\$550,000.00

Amount of Funds Requested

☐

Basin Account

☒

Statewide Account

☒

Yes

☐

No

Please Check Applicable Box

Approval Letter Signed By
Roundtable Chair and
Description of Results of
Evaluation and Approval
Process

*** For the Basin Account, the Application Deadline is 60 Days Prior to the Bimonthly CWCB meeting. The CWCB meetings are posted at www.cwcb.state.co.us and are generally the third week of the month.**

*** For the Statewide Account, the Application Deadline is 60 Days Prior to the March and September CWCB Board Meetings.**

* In completing the application you may attach additional sheets if the form does not provide adequate space. If additional sheets are attached please be sure to reference the section number of the application that you are addressing (i.e., A.1. etc.).

Instructions: This application form must be submitted in electronic format (Microsoft Word or Original PDF are preferred). The application can be emailed or a disc can be mailed to the address at the end of the application form. The Water Supply Reserve Account Criteria and Guidelines can be found at <http://cwcb.state.co.us/IWMD/>. The criteria and guidelines should be reviewed and followed when completing this application. You may attach additional sheets as necessary to fully answer any question, or to provide additional information that you feel would be helpful in evaluating this application. Include with your application a cover letter summarizing your request for a grant. If you have difficulty with any part of the application, contact Todd Doherty of the Intrastate Water Management and Development (Colorado Water Conservation Board) for assistance, at (303) 866-3441 ext.3210 or email Todd at todd.doherty@state.co.us.

Generally, the applicant is also the prospective owner and sponsor of the proposed water activity. If this is not the case, contact the Todd Doherty before completing this application.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

Part A. - Description of the Applicant (Project Sponsor or Owner);

1.	Applicant Name(s):	Rod Kuharich Executive Director	
	Mailing address:	South Metro Water Supply Authority 8400 East Prentice Avenue, Suite 1500 Greenwood Village, CO 80111	
	Taxpayer ID#:	611497221	Email address: rodkuharich@southmetrowater.org
	Phone Numbers: Business:	(303) 409-7747	
	Home:	(303) 409-7747	
	Fax:	(303) 409-7748	

2. Person to contact regarding this application if different from above:

Name:

Position/Title

3. Provide a brief description of your organization below: see “Description of Applicant” in Part 2 of Criteria and Guidance for required information.

South Metro Water Supply Authority (SMWSA) is the south Metro region's leader in water development and distribution. Formed in August 2004, SMWSA is an experienced and knowledgeable regional water entity that plans, develops, and sources renewable water for Douglas and Arapahoe Counties in Colorado. The organization is comprised of 13 individual water providers working collaboratively to foster long-term reliable water supplies through water acquisition and infrastructure.

More information can be found at <http://www.southmetrowater.org/>.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

4. If the Contracting Entity is different then the Applicant (Project Sponsor or Owner) please describe the Contracting Entity here.

Part B. - Description of the Water Activity – Please Refer to Criteria and Guidance Document for Eligibly Requirements

1. Name of water activity/project:

South Metro Water Supply Authority Aquifer Recharge Pilot Study

What is the purpose of this grant application?

☐

Environmental compliance and feasibility study

☐

Technical Assistance regarding permitting, feasibility studies, and environmental compliance

☒

Studies or analysis of structural, nonstructural, consumptive, nonconsumptive water needs, projects

Study or Analysis of:

☒

Structural project or activity

☐

Nonstructural project or activity

☒

Consumptive project or activity

☐

Nonconsumptive project or activity

☐

Structural and/ or nonstructural water project or activity

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

2. Describe how the water activity meets these **Threshold Criteria**.

1. The water activity meets the eligibility requirements outlined in Part 2 of the Criteria and Guidelines.

This water activity meets the eligibility requirement by providing further information about aquifer recharge potential in the largest "gap" area in the State of Colorado, and will further the dialogue regarding water management in this critical area of the state.

2. The water activity is consistent with Section 37-75-102 Colorado Revised Statutes. The requirements/language from the statute is provided in Part 3 of the Criteria and Guidelines.

The water needs assessment will not restrict the ability of the holder of a water right to use or to dispose of that water right in any manner permitted by Colorado law and is consistent with CRS 37-75-102.

3. The water activity underwent an evaluation and approval process and was approved by the Basin Roundtable (BRT) and the application includes a description of the results of the BRT's evaluation and approval of the activity. At a minimum, the description must include the level of agreement reached by the roundtable, including any minority opinion(s) if there was not general agreement for the activity. The description must also include reasons why general agreement was not reached (if it was not), including who opposed the activity and why they opposed it. Note- If this information is included in the letter from the roundtable chair simply reference that letter.

The South Metro Water Supply Authority is presenting its application to the Metro Basin Roundtable on December 10, 2008. The meeting notes from the meeting should reflect the discussions.

4. The water activity meets the provisions of Section 37-75-104(2), Colorado Revised Statutes. The requirements/language from the statute is provided in Part 3 of the Criteria and Guidelines.

This projects meets the provisions of CRS 37-75-104(2)(c) by providing more information regarding a 'gap' area identified as part of the Statewide Water Supply Initiative. This information generated in the study can be added to existing consumptive use needs assessment information.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

3. For Applications that include a request for funds from the Statewide Account, describe how the water activity meets the **Evaluation Criteria**. See Part 3 of Criteria and Guidelines.

The following Evaluation Criteria are met by this grant application:

(a) This project addresses multiple needs and issues including (1) helping meet identified gaps in water supply by getting the south Metro region closer to large-scale implementation of conjunctive use; (2) helping reduce consumptive losses from evaporation by storing water underground; (3) reducing demands for transbasin renewable supplies by recharging water during off-peak times and relying on it during high demand periods.

(b) Thirteen entities are represented by the South Metropolitan Water Supply Authority. These entities comprise the majority of water demands and areas of water supply gap in the south Metro Denver area identified in the SWSI report. This project relies on cooperation amongst these entities including water used for recharge, use of conveyance structures, and use of wells. This project will help reduce the key intrabasin water supply gap identified in the Metro Denver region and will benefit multiple users.

(c) The south Metro region is in great need for additional aquifer recharge projects. Outside of CWSD (Highlands Ranch) there has been little formal recharge activity in the Front Range, in part due to the uncertainties of how well the local aquifers will accept recharged water, what chemical reactions may occur, and the relatively high cost to evaluate these planning-level issues. Funding this project will provide the needed information at several locations within the south Metro region in which the aquifer conditions differ considerably from those at CWSD, and for which the recharge water will be more typical of the water available for future recharge projects.

(f) The applicant and its engineers and consultants have considerable expertise in conducting ASR studies and include the individuals responsible for almost all of the existing ASR projects in the Front Range.

(g) The applicant anticipates providing matching funds in the form of in-kind contributions of labor, materials and water.

(i) The SWSI report identified the south Metro region as having one of the largest unmet water supply needs in the State. This project will help fulfill those needs providing the south Metro entities with the pilot scale field data and information on infrastructure and well retrofit requirements, water treatment needs, likely O&M activities and costs, so they can incorporate ASR activities into their water supply planning.

(j) The south Metro region was identified in the SWSI study as having a water supply gap of 40,000 acre-feet/year by 2030. Implementing this project will accomplish a necessary step in allowing the south Metro entities to implement large-scale ASR in the region. The SMWSA's Water Master Plan developed in 2007 identified the need for additional surface water and/or aquifer storage projects. This study will help the SMWSA determine whether aquifer storage is a feasible option.

(k) Aquifer storage promotes water conservation and efficiency by eliminating evaporative losses that occur in surface reservoir storage. This project will provide the SMWSA entities the information they need to implement aquifer storage projects and thereby improve the efficiency of their water storage.

(r) This study will help replenish and sustain the bedrock aquifer supplies in the south Metro region. Increased supplies will counter adverse publicity about water availability this region has experienced in recent years and thereby provide a large public relations benefit by reducing the public's concerns about moving to and living in this area. Increasing local supplies for the south Metro region by recharging water during low-use times of the year will also benefit the State by reducing demands for additional transbasin diversions and water storage structures, reduce demands for surface water during peak-use months, and help maintain flow in the South Platte River for the benefit of the environment.

(t) Having supplies that are more secure, as would occur with increase aquifer recharge, will help maintain the property values, business vitality, and tax base in this economically important area.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

4. Please provide an overview of the water project or activity to be funded including – type of activity, statement of what the activity is intended to accomplish, the need for the activity, the problems and opportunities to be addressed, expectations of the participants, why the activity is important, the service area or geographic location, and any relevant issues etc. Please include any relevant TABOR issues that may affect the Contracting Entity. Please refer to Part 2 of Criteria and Guidance document for additional detail on information to include.

The purpose for the South Metro Water Supply Authority Aquifer Recharge Pilot Study is to evaluate the feasibility of implementing ASR in additional areas within the SMWSA region other than within the CWSD, and using different water sources that are lower in quality but more likely to be available in the future for ASR programs. Testing is proposed for several locations so the effects on ASR operations of different aquifer settings and source waters can be characterized. Pilot-scale testing is needed because the aquifers vary significantly in their hydraulic characteristics to accept recharge water and to react chemically with injected water. These questions and the costs for conducting pilot-scale field studies have inhibited water entities in the region from embarking on this important activity.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

5. Please summarize the proposed scope of work. Please refer to Part 2 of the Criteria and Guidance document for detailed requirements. On the following page there is an example format for the Scope of Work. You can use the example format or your own format, provided that comparable information is included.

The scope of work should outline by task how the water activity will be accomplished. It is important that the scope of work detail the specific steps, activities/procedures that will be followed to accomplish the water activity and the specific products/deliverables that will be accomplished. The scope of work should include but not be limited to: task description, key personnel, budget, schedule and deliverables and the final report/project documentation upon completion of the water activity.

See attached Scope of Work and Budget.

The budget estimates will be revised based on the results of the SMWSA Regional Aquifer Supply Assessment, being conducted in early 2009. The Regional Aquifer Supply Assessment will identify areas within the south Metro region in which artificial recharge will be most beneficial to the aquifer systems and users in terms of sustaining supplies and helping address identified gaps. The revised budget estimates will be incorporated into the final budget.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

Suggested Format for Scope of Work

The scope of work will form the basis for the contract between the Applicant and the State of Colorado. In short, the Applicant is agreeing to undertake the work for the compensation outlined in the scope of work and budget, and in return, the State of Colorado is receiving the deliverables/products specified. Summarized below is a suggested format for the Scope of Work.

I. Task 1

- Description of task:
- Method or procedure that will be used or followed to accomplish the task and identify who will undertake the task:
- Description of the major deliverables/products that will be produced upon successful completion of the task:

Task 2 (Repeat the above format for each task)

II. Personnel

Provide a list of key water activity/project participants and their qualifications to accomplish the water activity/project. If specific individuals or firms have not yet been identified indicate the types of expertise that will be sought (i.e. professional engineering firm, registered land surveyor, aquatic biologist etc.).

III. Budget

A detailed budget by task, which includes the level of effort (hours) and rates. Any unit costs or other direct costs must be specified (i.e. mileage, number of miles, dollars per mile). For an example budget format – See Attachment 1 at the end of this application.

If applicable, the budget should also detail the source and amount of matching funds and/or in-kind contributions, if any. If applicable, the budget should also include any other outstanding or previously applied for funding that also supports the water activity:

IV. Schedule

A detailed project schedule including key milestones and the dates these are expected to be completed.

NOTE: Costs incurred prior to execution of a contract or purchase order are not subject to reimbursement.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

6. Water Availability and Sustainability – this information is needed to assess the viability and effectiveness of the water project or activity. Please provide a description of each water supply source to be utilized for, or the water body to be affected by, the water activity. For water supply sources being utilized, describe its location, yield, extent of development, and water right status. For water bodies being affected, describe its location, extent of development, and the expected effect of the water activity on the water body, in either case, the analysis should take into consideration a reasonable range of hydrologic variation.

The south Metro area relies on non-tributary groundwater supplies located beneath their boundaries. The dramatic increase in groundwater withdrawals over the past two decades have led to water level declines of 20 to 30 feet per year over large portions of the south Metro area. Knowing this, the SMWSA would like to undertake pilot-scale artificial recharge testing in several locations by retrofitting wells to be suitable for aquifer storage and recovery (ASR). These tests will help provide a detailed understanding of the local effects of recharge and will be an important contribution toward implementing ASR on a larger scale in this critical 'gap' area, thereby prolonging the life of the aquifers and increasing their sustainability.

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

7. Please provide a brief narrative of any related or relevant previous studies.

In 2004, the Colorado Geological Survey completed a study called "Artificial Recharge of Ground Water in Colorado – A Statewide Assessment". The goal of this project was to assess the best aquifers in Colorado for their artificial recharge potential of ground water based primarily on their hydrogeological suitability. This study provides summaries of basic terminology of the artificial recharge system, objectives of artificial recharge applications, artificial recharge technologies, and an inventory of artificial recharge projects within Colorado.

<<http://geosurvey.state.co.us/portals/0/ARExecSum%20for%20web.pdf>>

In March 2007 the CWCB completed a more detailed study of potential locations for underground water storage in the South Platte and Arkansas River Basins, conducted under Senate Bill 06-193 (SB06-193). This study developed a set of evaluation criteria and performed detailed analysis of 44 subareas within these basins, including the Denver Basin bedrock aquifers that underlie the south Metro region. Results showed that several areas within the Denver Basin bedrock aquifers scored very well in terms of hydrogeologic, environmental and implementation considerations. The pilot ASR testing locations are included in these high-scoring areas.

In addition, SMWSA completed the South Metro Regional Water Master Plan in 2007. This report identified buildout water demands, renewable water supply goals and potential sources of renewable supplies. One of the key findings was the need for additional surface and/or underground storage of renewable supplies. This project will help determine the feasibility of ASR as a water storage and recovery option.

Water Supply Reserve Account – Grant Application Form

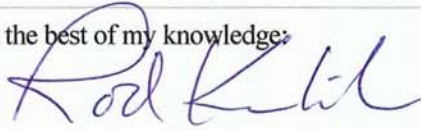
Form Revised May 2007

8. Additional Information – If you feel you would like to add any additional pertinent information please feel free to do so here.

This analysis will assist the South Metro Water Supply Authority in demonstrating that ASR is a viable tool to increase water supply availability and reduce the continued reliance on the non-renewable groundwater supplies in the south Metro Denver area. It will also further efforts by the Authority to implement a more coordinated regional management of this precious resource.

The above statements are true to the best of my knowledge:

Signature of Applicant:



Print Applicant's Name: Rod Kuharich

Project Title: South Metro Water Supply Authority Regional Aquifer Supply Assessment

Return this application to:

Mr. Todd Doherty
Intrastate Water Management and Development Section
COLORADO WATER CONSERVATION BOARD
1580 Logan Street, Suite 600
Denver, CO 80203

To submit applications by Email, send to: todd.doherty@state.co.us

Reference Information

The following information is available via the internet. The reference information provides additional detail and background information regarding these criteria and guidelines and water policy issues affecting our state.

Sample Contract and Purchase Order – <http://cwcb.state.co.us/IWMD/RelatedInformation/ToolsResources/>

Colorado Water Conservation Board Policies

Loan and Grant policies and information are available at – <http://cwcb.state.co.us/Finance/>

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

Water Supply Reserve Account Criteria and Guidelines –

<http://cwcb.state.co.us/IWMD/RelatedInformation/ToolsResources/>

Interbasin Compact Committee and Basin Roundtables

Interbasin Compact Committee By-laws and Charter (under Helpful Links section) –

<http://ibcc.state.co.us/Basins/IBCC/>

Legislation

House Bill 05-1177 - Also known as the Water for the 21st Century Act –

<http://cwcbweblink.state.co.us/DocView.aspx?id=105662&searchhandle=28318>

House Bill 06-1400 – Adopted the Interbasin Compact Committee Charter –

<http://cwcbweblink.state.co.us/DocView.aspx?id=21291&searchhandle=12911>

Senate Bill 06-179 – Created the Water Supply Reserve Account –

<http://cwcbweblink.state.co.us/DocView.aspx?id=21379&searchhandle=12911>

Statewide Water Supply Initiative

General Information – <http://cwcb.state.co.us/IWMD/>

Phase 1 Report – <http://cwcb.state.co.us/IWMD/SWSITechnicalResources/SWSIPhaseIReport/>

Water Supply Reserve Account – Grant Application Form

Form Revised May 2007

Attachment 1

Sample Budget Table: Please note that this budget table is an example and will need to be adapted to fit each individual application. In the tables below please list the personnel by specialty/ expertise i.e. project manager, project engineer, etc. Also, tasks should correspond to the scope of work of your project and the number of tasks listed will vary accordingly.

Total Costs				
	Labor	Other Direct Costs	Matching Funds (If Applicable)	Total Project Costs
Task 1 - (Specify name of task)				
Task 2 -				
In-Kind Contributions				
Total Costs:				

1) Identify specific source and amount by task.

Example Titles

Example Project Personnel:	Project Manager	Project Engineer	Geologist	Scientist	Graphics/ Designer	Clerical		Total Costs
Hourly Rate:								
Task 1 -								
Task 2 -								
Total Hours:								
Cost:								

Other Direct Costs

Item:	Copies	Materials	Equipment/ Supplies	Mileage		Total
Units:	No.			Miles		
Unit Cost:						
Task 1 -						
Task 2 -						
Total Units:						
Total Cost:						

In-Kind Contributions (If Applicable)

Project Personnel:				Total
Hourly Rate:				
Task 1 -				
Task 2 -				
Total Hours:				
Total Cost:				

Scope of Work

South Metro Water Supply Authority

Aquifer Recharge Pilot Study

This Scope of Work is divided into four sections as suggested in the Grant Application Instructions. Section 1 provides a description of each major task associated with the project along with a functional description of who will be completing the work and a description of the deliverables associated with the task. Section 2 lists the key personnel proposed for the project along with a brief description of their relevant project experience. Section 3 presents a detailed breakdown of the costs to complete the study and Section 4 presents the proposed Project Schedule.

Section 1 Task Summary

Introduction and Background

In 2004, the Colorado Water Conservation Board (CWCB) completed the Statewide Water Supply Initiative (SWSI). That study included estimates of unmet water demands in the South Platte Basin will be over 40,000 acre-feet in the south Metro Denver area. This 40,000 AFY gap was based on assumption that existing levels of groundwater pumping could continue indefinitely. The southern Metro area relies almost entirely on non-renewable groundwater supplies from the Denver Basin bedrock aquifers. These groundwater supplies do not have a natural source of recharge so are considered non-renewable. Legally, water from these bedrock aquifers is defined as non-tributary.

There has been a dramatic increase in groundwater withdrawals over the past two decades within the south Metro area, which has led to water level declines of 20 to 30 feet per year over large portions of the area. As a result, one of the key findings from SWSI is that continued reliance on nonrenewable, non-tributary groundwater supplies brings serious concerns over the reliability and sustainability of this supply along the Front Range area.

Water providers in the south Metro area have joined together as the South Metro Water Supply Authority (SMWSA) to coordinate on a variety of activities leading to more sustainable water supplies. In 2004 a study was completed on the effects of future pumping of the Denver Basin bedrock aquifers by south Metro water providers through 2050. This study concluded that substantial investment in new wells will be required just to meet current demands. Alternative sources of supply, including conservation, reuse and conjunctive use (combined surface and groundwater) were recommended as methods to extend the life of the bedrock aquifer supplies. A 2007 study conducted for the CWCB under Senate Bill 06-193 evaluated potential locations for underground water storage. This study identified several areas within the Denver Basin bedrock aquifers that would be good locations, and included most of the region underlying the SMWSA.

The SMWSA completed the South Metro Regional Water Master Plan in 2007. This report identified build out water demands, renewable water supply goals and potential sources of renewable supplies. In addition, this study also developed proposed regional infrastructure that will allow delivery of new renewable sources to be stored in surface and groundwater reservoirs. The current study would help the SMWSA evaluate whether aquifers are a viable storage option. The SMWSA members also understand the need to implement strategies to preserve the bedrock aquifers and in September 2007 began discussions on more coordinated management. Current plans include formal arrangements to share equipment, personnel and infrastructure in times of supply emergency, and developing a common resource pool for contracting drilling services.

Through the detailed groundwater studies conducted by CWCB under the South Platte Decision Support System project the SMWSA is also aware, that the bedrock aquifers vary significantly in their yield and impacts within the south Metro area. The SMWSA applied for and received a grant under the auspices of HB-1177 and the Metro Basin Roundtable to conduct a study of existing pumping and aquifer in the region to enable the Authority to more accurately evaluate the likely impacts of continued reliance on the non-renewable groundwater supplies in the south Metro Denver area and to explore more coordinated regional management of this precious resource. One of its member organizations, the Centennial Water and Sanitation District (CWSD) has had implemented a successful full-scale aquifer storage and recovery (ASR) program for over a decade on over half of their wells, and others would also like to implement ASR projects. The SMWSA entities understand that a coordinated ASR program is as important as coordinated aquifer pumping. Due to delays in funding the Regional Aquifer Supply Assessment study is expected to begin in early 2009 and be completed by summer 2009. To expedite the process the current Aquifer Recharge Pilot Study should begin in summer 2009.

As part of the current study a series of location-specific activities must be undertaken at a potential well site to determine whether ASR is appropriate. These activities include:

- identifying potential wells in which to conduct ASR and evaluating site access;
- determining the piping and other infrastructure needed to implement ASR;
- evaluating geochemical compatibility of the source water and the receiving aquifer to identify pretreatment requirements;
- conducting injection and recovery field tests on the pilot ASR well to quantify recharge rates, aquifer water level rise, and changes in water chemistry.

While each of these activities are needed to identify the feasibility of implementing an ASR project at a particular location, the results can be used to streamline and expedite the addition of future ASR wells recharging a similar quality of water to the same aquifer.

The CWSD ASR program has been successful and no adverse impacts to the aquifers or well yields have been reported. The water supply used for the CWSD project has generally been of high quality with relatively low total dissolved solids (TDS) and nutrient content. The source water for future projects envisioned for the SMWSA is unknown and may consist of water obtained from a supply such as potable reuse or water diverted from sources downstream of urban or agricultural areas. The potential for adverse geochemical reactions or microbial growth to occur in the well or adjacent formation can have a significant impact on the success of an ASR project. These potential impacts include but are not limited to:

- mineral precipitation (scaling) on well screens;
- mineral precipitation and/or swelling of clays in the aquifer formation due to incompatibility of native and injected waters;
- dissolution of minerals in the aquifer materials resulting in water quality degradation during storage;
- microbial growth fouling the injection well or adjacent aquifer materials, and/or resulting in undesirable taste and odor in the recovered water.

Given this background, it is appropriate and opportune for a pilot-scale ASR testing program to be undertaken to evaluate the feasibility of implementing ASR in additional areas within the SMWSA region other than within the CWSD, and using water sources that are lower in quality but more likely to be available in the future for ASR programs. Testing is proposed for several locations so the effects on ASR operations of different aquifer settings and source waters can be characterized.

Study Objectives

The objectives of the study are to:

1. Identify a source of renewable water to be used in a full-scale ASR program.
2. Identify two wells within areas identified in the SMWSA Regional Aquifer Supply Assessment study that might be suitable for retrofitting as ASR wells. Undertake the necessary evaluations, including engineering conceptual-level design for retrofit, and geochemical analyses on candidate ASR wells to identify their infrastructure and pre-treatment requirements.
3. Undertake the design and construction needed to retrofit the candidate wells for ASR pilot testing and associated pretreatment.
4. Conduct pilot-scale ASR testing and evaluate the feasibility of implementing long-term ASR operations with two wells.

5. Provide recommendations for full-scale implementation of ASR in the south Metro area, including water pre-treatment needs, well preparation and retrofitting, and O&M.

Tasks

This study is divided into three tasks, addressing each of the objectives. The following is a list and description of tasks to be completed under this work plan.

Task 1 Determine Source Water for ASR Program

Several potential sources of water exist for use in pilot-scale ASR testing. The SMWSA Master Plan identified sources of renewable supplies and one of these would likely be available in off-peak times during the non-growing season. The potential sources include Denver Water, under their pilot agreement with SMWSA; East Cherry Creek Valley through their western pipeline; and CWSD. Once well locations for the ASR pilot testing have been identified these and potentially other entities will be contacted to discuss procurement of water to be used in the pilot testing.

Task 2 Evaluate Candidate ASR Wells

Results from the SMWSA Regional Aquifer Supply study, to be completed by summer 2009, will be used to identify areas from which candidate wells will be evaluated. Criteria for selection of candidate wells within target areas will include but is not limited to:

- the aquifer in which the well is completed and well construction details;
- condition of the well, pump and piping;
- ease of retrofitting for ASR operations;
- source(s) of water to be used in the pilot testing;
- proximity of pipelines from which source water can be delivered;
- proximity of power supplies;
- potential benefit to the aquifer in terms of water level recovery;
- geochemical modeling to identify potential reactions between source water and formation water and the associated source water pre-treatment requirements;
- site ownership, access, security, and cooperation of the well owner;
- regulatory and pilot testing permit requirements.

These and possibly other criteria will be used to evaluate and screen candidate wells so that two wells will be selected for ASR pilot testing. The results of this task will be documented in a technical memorandum that will include discussion of the site

selection criteria and screening, results of geochemical modeling, and identification of the target wells that will undergo pilot testing.

Task 3 Design and Construction

This task includes the preparation of engineering criteria, drawings, and specifications needed to implement the ASR Pilot testing program. Specific elements will include:

- design documents and technical specifications for temporary piping connections and pumping facilities from recharge water source to pilot treatment unit and from pilot treatment unit to pilot recharge well site , including process schematics and unit treatment process sizing for up to a 0.5 million gallon per day (mgd) flow rate (350 gpm);
- evaluate the need for water pretreatment to meet recharge injection well regulatory requirements and to maximize geochemical compatibility with native groundwater;
- develop conceptual layouts, including a piping and pumping schematic, considering relative locations and infrastructure of pilot water source and pilot recharge well;
- prepare initial and final design documents for ASR injection/pumping, conveyance, and treatment units;
- identify field parameters to be monitored and frequency of monitoring in injection water and in recovered water throughout the operational testing period;
- obtain permits necessary for construction of the source water piping and pumping;
- procure construction subcontractors for the source water conveyance to the injection well, pumping and pre-treatment infrastructure and provide engineering guidance and inspection during construction.

ASR pilot water source will be temporary (used only for duration of pilot test), and therefore will be treated using a temporary (e.g., trailer-based) treatment/water quality adjustment unit to meet recharge standards.

The results of this task will include engineering designs and specifications appropriate for the infrastructure and water quality treatment requirements for each pilot test well, subcontractor bid packages and contracts, and permits.

Task 4 Pilot ASR Testing and Evaluation

The pilot testing will be conducted at two locations using wells completed in up to three different aquifers, and the results from the pilot tests will be evaluated under this task. Previous experience in the region has shown the benefit of conducting multiple cycles of injection and recovery. The pilot tests for this study are anticipated to undergo three 3 cycles of injection and withdrawal, with the duration of the injection cycles to be approximately one, two and four weeks. The recharged water will stay in the aquifer for up to twice the duration as the recharge cycle and then will be fully extracted prior to the next injection cycle. Aquifer hydraulics testing will be also be conducted during each injection/recovery cycle by analyzing pumping rates and water levels. Water quality sampling will be conducted each at beginning, middle and end of each cycle for a full suite of drinking water parameters and for other constituents that will provide insight on chemical and biological reactions that may be occurring in the subsurface.

The water quality and hydraulic test data and trends will be evaluated for each pilot test well relative to pre-ASR test conditions and trends prior to its conversion to an ASR well and pilot operations. The analyses will be documented in a technical memorandum that:

- describes the pilot testing observed conditions and trends,
- identifies locations with the south Metro area in which ASR operations will be beneficial,
- estimates operational rates, storage and recovery volumes available and ASR costs for each area tested,
- evaluates infrastructure, treatment and O&M requirements for successful ASR in the pilot test areas,
- discusses opportunities and challenges for full scale implementation of ASR in the south Metro area.

Deliverables

Technical memoranda will be prepared for each task as described above. The memoranda will provide documentation for the plans, specifications and operations needed to implement ASR projects elsewhere in the Denver Basin bedrock aquifers, thus serving as valuable guidance. The evaluation report will describe the pilot testing and results, providing much needed information to the State and others interested in pursuing ASR activities.

Section 2 Key Personnel

Relevant project experience for the key personnel proposed for the SMWSA Regional Water Supply Assessment are presented in this section.

Michael Smith, P.G. – Project Director

Mr. Smith has more than 35 years of experience directing and conducting investigations for water resources, mining, waste disposal, and remediation projects. His project experience has focused on the application of quantitative techniques to solve water resources and environmental problems. This work has included quantification of aquifer characteristics, assessment of recharge and basin safe yield, quantification of stream – aquifer interactions, assessments of well and well field performance, and development of both local- and regional-scale groundwater models.

Nicole Rowan, P.E. – Project Manager

Ms. Rowan has over 13 years of experience and is a senior project manager who focuses on water supply, watershed management and natural resources projects. She is the project manager for the Statewide Water Supply Initiative (SWSI) and for CDM's current contract with Colorado Department of Natural Resources (DNR) to provide technical support to the Interbasin Project Compact process. Ms. Rowan is managing the SMWSA Regional Aquifer Supply Assessment study.

Mark McCluskey, P.E. – Project Engineer

Mr. McCluskey has over 11 years of experience and is a project engineer who focuses on groundwater, water supply, and watershed management projects. He is the project manager for the groundwater component of the South Platte Decision Support System (SPDSS) and a project engineer with Colorado Department of Natural Resources (DNR) to provide technical support to the Interbasin Project Compact process. Mr. McCluskey has worked on several water supply and groundwater projects with South Metro entities such as the Town of Castle Rock, Castle Pines North and Castle Pines.

J. Gary Shaughnessy, P.G. – Project Hydrogeologist

Mr. Shaughnessy has more than 35 years of experience in performing geologic, geotechnical, hydrogeologic, and similar investigations to characterize soil and rock conditions for the purpose of placement, constructing and permitting utility installations, tunnels, landfills, mines, and industrial facilities and for the development, evaluation, protection, and restoration of groundwater and soil resources. Mr. Shaughnessy has also served as resident engineer/scientist on projects involving the construction of tunnels, pipelines and other components of water and wastewater facilities and environmental remediation systems. He is a registered professional geologist specializing in engineering geology.

Since joining CDM in 1979, Mr. Shaughnessy has participated in innumerable geologic, geotechnical, and hydrogeologic investigations and evaluations throughout the United States. Based on project-specific needs, Mr. Shaughnessy has served as project manager, principal investigator, task leader, staff scientist, on-site coordinator for these projects. He has also applied various investigative techniques including geologic mapping by onsite survey, remote imagery, exploratory drilling and

sampling of both soil and rock, installation of groundwater monitoring and production wells, water quality sample collection, aquifer performance testing, and surface and downhole geophysical methods. These investigations have encompassed all types of geologic settings and materials, including crystalline and sedimentary rocks, unconsolidated sediments; glaciated terrain; volcanic flows and pyroclastic units; fractured, faulted, and weathered bedrock materials; and manmade deposits. Mr. Shaughnessy is familiar with all aspects of these activities - from planning through implementation, execution and the reporting of results.

James Kriss – Project Engineer

Mr. Kriss has 15 years of experience in the civil engineering field and has provided design support and project management for projects including general civil design, hydraulic evaluations, water, wastewater, storm water, and construction management projects. Design experience includes raw and potable water pipelines, pump station design, layout, and configuration, and wastewater treatment plant improvements and modifications. Hydraulic design experience includes modeling of water supply distribution systems, treated water master planning, hydrology, and hydraulics. Construction management experience includes Resident Engineer and General Services support for multiple construction projects. Mr. Kriss served as project manager for design of the District's Northern Water Supply Project Water Transmission Pipeline, involving 31-miles of 48-inch steel pipeline. Mr. Kriss also served as project engineer for the final design of the Western Well Field Connection Project for the ECCV Water and Sanitation District, which involved construction of 42-inch through 4-inch transmission pipelines to connect the existing Western Well field to the Western Pump Station.

South Metro Water Supply Authority Staff and Engineering Support Team

The following South Metro Water Supply Authority staff and support team Engineers will be contributing to this project:

- Rod Kuharich
- Mark Palombo
- Curtis Wells
- Courtney Hemenway
- John Halapaska
- Bruce Lytle
- Scott Mefford
- Chris Sanchez

Section 3 Budget

A detailed breakdown of the estimated labor and other direct costs for the proposed project is presented on the following pages. The cost estimates may be revised based as additional information on well locations becomes available; any revisions will be incorporated into the final budget.

The costs associated with ASR pilot testing are developed with the following key assumptions. Other assumptions are listed in the attached budget page:

- two existing wells will be selected and retrofitted for ASR operations;
- potable water will be provided by the cooperating entities as part of in-kind cost sharing;
- technical analyses will be conducted concurrently and single technical memoranda will be produced for each task.

Cost Estimates for SMWSA Aquifer Recharge Pilot Study

Staff Classification and Est. LOE

Task	Activity	Principal				Sr Eng/Geo.				Proj. Eng/Geo.				Staff Eng/Geo.				Clerical/Drafting				Total Hrs	Other Direct Costs	Task Cost
		\$		200		\$		195		\$		130		\$		100		\$		85				
		Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost							
Task 1	Identify Recharge Water Sources	8	\$ 1,600	16	\$ 3,120	40	\$ 5,200	40	\$ 4,000	8	\$ 680	112	\$ 14,700											
Task 2	Evaluate Candidate Wells	8	\$ 1,600	20	\$ 3,900	60	\$ 7,800	60	\$ 6,000	8	\$ 680	156	\$ 20,180											
Task 3	Permitting	8	\$ 1,600	24	\$ 4,680	40	\$ 5,200	40	\$ 4,000	20	\$ 1,700	132	\$ 17,480											
Task 3	Retrofit and Piping Design	4	\$ 800	20	\$ 3,900	50	\$ 6,500	50	\$ 4,000	40	\$ 3,400	164	\$ 19,900											
Task 3	Construction and Oversight	4	\$ 800	20	\$ 3,900	40	\$ 5,200	110	\$ 11,000	20	\$ 1,700	194	\$ 23,600											
Task 4	Field Testing and Post-Field Analysis	4	\$ 800	20	\$ 3,900	40	\$ 5,200	140	\$ 14,000	20	\$ 1,700	224	\$ 26,600											
Task 4	Reporting and Communications	20	\$ 4,000	30	\$ 5,850	100	\$ 13,000	120	\$ 12,000	40	\$ 3,400	310	\$ 38,540											
	Totals	56	\$ 11,200	150	\$ 29,250	370	\$ 48,100	560	\$ 56,000	156	\$ 13,260	1292	\$ 161,000											

Outside Professional Services (OPs), per well

Well Evaluation and Rehabilitation (video log, cleaning, test pumping)	per well	for 2 wells
Retrofit with ASR valve and specialized instrumentation	\$	56,000
Wellhead Modification and Injection Water Supply Piping	\$	30,000
Wellhead Water Quality Instrumentation	\$	55,000
Laboratory Analyses	\$	5,500
OP contingency	\$	33,000
Total OPs	\$	15,000
	\$	194,500
	\$	389,000

Total Engineering Labor

Outside Professional Services (OPs) for 2 wells	\$	161,000
Project Total	\$	389,000
	\$	550,000

Costing Assumptions

The evaluations will occur sequentially to allow for a rental ASR valve.

Source water for ASR testing will be potable water and will be available near well

Cost of injection water is not included and will be provided by the cooperating entity

Design injection rate is 350 gpm

Task 2 includes geochemical modeling and water compatibility evaluation, well video and an initial 24-hr drawdown/recovery test

Existing well pump can be used with minimal maintenance/modification; all pump costs will be born by the Cooperating entity

Thorough well evaluation and rehabilitation will be performed prior to pilot testing

Nearby production well can serve as a monitoring well for water levels, no monitoring well needed for water quality.

Source water will be conveyed to well using existing piping from well with tie-in to potable supply

Minimal wellhead infrastructure needed (flush valve, instrumentation, backflow preventer)

Connection of injection well to potable water line (providing injection water to well) and existing water line (from well) requires single excavation

Testing will consist of 3 cycles of injection, storage, and withdrawal, with increasing injection volumes and periods of storage between.

Water quality samples to be collected at beginning, middle and end of both injection and recovery cycles for up to 20 samples per well

No discharge permit needed for pumping to waste at beginning of each injection and recovery cycle

Laboratory cost assumes 20 sets of full drinking water parameters, offsite lab

In-Kind Cost Estimates for SMWSA Aquifer Recharge Pilot Study

South Metro Water Authority Members	In-House		Consultant		Total
	Rate	Hours	Rate	Hours	
South Metro Water Authority (Britta Strother)	\$65	35	\$160	8	\$3,600
Arapahoe County Water and Wastewater Authority	\$65	10	\$120	24	\$3,500
Castle Pines Metropolitan District	\$65	10	\$160	18	\$3,500
Castle Pines North Metropolitan District	\$65	10	\$160	18	\$3,500
Centennial Water & Sanitation District	\$65	20	\$160	70	\$12,500
Cottonwood Water and Sanitation District	\$65	10	\$160	18	\$3,500
East Cherry Creek Valley Water & Sanitation District	\$65	40	\$160	62	\$12,500
Inverness Water & Sanitation District	\$65	10	\$160	18	\$3,500
Meridian Metropolitan District	\$65	10	\$160	18	\$3,500
Parker Water & Sanitation District	\$65	40	\$160	62	\$12,500
Pinery Water & Wastewater District	\$65	10	\$160	18	\$3,500
Roxborough Park Metropolitan District	\$65	10	\$160	18	\$3,500
Stonegate Village Metropolitan District	\$65	10	\$140	20	\$3,500
Town of Castle Rock	\$65	40	\$150	65	\$12,400
			Total		\$85,000

This is the anticipated in-kind estimate for SMWSA member agencies for this project.

Section 4 Project Schedule

The proposed project schedule is presented on the following pages. The schedule is presented as yearly quarter from contract inception. It is anticipated that the project will be completed within approximately 2 years (8 quarters), depending on the availability of water for the pilot testing.

SMWSA Aquifer Recharge Pilot Study Schedule

Task	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Notice to Proceed								
1. Identify Sources								
2. Identify Wells								
3. Well Retrofitting								
4. Testing and Analyses								