COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

John Hickenlooper, Governor

Robert Randall, DNR Executive Director

Lauren Ris, CWCB Acting Director

TO: Colorado Water Conservation Board Members

FROM: Andy Moore, Water Resources Engineer
Interstate, Federal, & Water Information Section

DATE: May 17-18, 2017 Board Meeting

AGENDA ITEM: 29. Underground Storage Pilot Projects – Grant Applications
b. Lost Creek Alluvial Aquifer Storage Pilot Project

Background

In Section 8 of the 2016 Projects Bill (SB16-174), Senator Sonnenberg placed a $200,000 appropriation for CWCB to conduct underground storage pilot projects "to further evaluate the suitability of various aquifers to store water, availability of water to be stored, and a conceptual framework to initiate an underground storage project."

The City of Aurora (Aurora) has applied for $100,000 from this appropriation for a pilot project in the Lost Creek Designated Basin alluvial aquifer (Lost Creek), located northeast of Denver and southeast of Greeley. The total project cost is estimated to be $205,000; matching funds of $105,000 will be provided.

The purpose of this pilot project is to identify a suitable location to construct and operate a recharge facility in Lost Creek. Site-specific data will be collected that builds on previous studies; this will include a surface geophysical survey, exploratory borehole drilling, and surface infiltrometer testing. Data analysis and reporting will be performed, along with recommendations for a next phase of the project.

Although Aurora is the applicant, this is a collaborative effort including the City of Castle Rock and the Lost Creek Designated Ground Water Management District. Leonard Rice Engineers will conduct field investigations and provide consulting services for the pilot project.

Note that Lost Creek was highly ranked for aquifer storage potential in the SB06-193 Underground Water Storage Study completed by CWCB in March 2007.

A detailed scope of work and estimated costs are attached.

Staff recommendation

CWCB Staff recommends that the Board approve this $100,000 grant to Aurora.

To:	Aurora Water, Town of Castle Rock, and Lost Creek Ground Water Management District
From:	Leonard Rice Engineers, Inc.
Date:	April 28, 2017
Project:	Lost Creek Underground Storage Pilot (LCUSP) Project
Subject:	Proposed Scope of Study

Purpose and Need

Water storage has been identified as a critical need for the State of Colorado (State) to overcome the projected gap between future water supplies and demand. The 2016 State Water Plan identified 400,000 acre feet of water storage needs by 2050. The South Platte Basin has the majority of Colorado's water demand with most of the population and a significant portion of its agriculture. Identifying storage opportunities in the South Platte Basin is a crucial component of closing the State's future water supply gap. The South Platte Basin Implementation Plan (SPBIP, http://southplattebasin.com) calls for storage projects, including underground water storage or aquifer storage and recovery (ASR):

> *The Metro and South Platte Basin Roundtables strongly advocate for the development of additional surface and groundwater storage, further research of aquifer storage and recovery (ASR), and investigation into additional off-channel storage and reservoir sites in the basin. Additionally, they encourage the consideration of alternatives to "State Water Projects" such as regional collaboration on and financing of water projects.*

Many types of projects will be needed to solve Colorado's future water storage challenges. Underground water storage has several advantages over surface storage:

- Decreased permitting costs and schedule repercussions;
- Fewer environmental impacts;
- Decreased land use impacts;
- Reduction in evaporative losses; and,
- Potentially lower capital investment requirement.

Underground water storage in the South Platte Basin can have Statewide benefits. It will reduce the pressure to consider new trans-mountain diversions from the Western slope, and will put water supplies closer to the demand centers. South Platte water storage will also help to meet compact requirements.

Following on the prior statewide and basin scale planning efforts, the 2016 Colorado Legislature appropriated State funding for underground storage pilot projects in the Colorado Water Conservation Board (CWCB) Projects Bill (SB16-174, https://leg.colorado.gov/sites/default/files/documents/2016a/bills/2016A_174_signed.pdf). The legislative language specific to underground water storage is quoted below.

SECTION 8. Underground storage pilot project - appropriation. (1) For the 2016-17 state fiscal year, $200,000 is appropriated to the department of natural resources for use by the Colorado Water Conservation Board. This appropriation is from the Colorado Water Conservation Board construction fund created in section 37-60-121, C.R.S. To implement this section, the Colorado water conservation board may use this appropriation to conduct an underground storage pilot project to further evaluate the suitability of various aquifers to store water, availability of water to be stored, and a conceptual framework to initiate an underground storage project.

(2) The money appropriated in subsection (1) of this section remains available for the designated purposes until the project is completed.

Described herein is a proposed project to identify a suitable location for an underground water storage pilot site. This document is intended to accompany a grant application to the CWCB for a Construction Fund Non-Reimbursable Project Investment grant.

Previous Studies

The State has funded several previous studies that evaluated the feasibility of underground water storage at the State and basin scale (**Table 1**).

Table 1 - Previous Underground Water Storage Publications

Title	Publisher	Author	Year
Artificial Recharge of Ground Water in Colorado - A Statewide Assessment	Colorado Geological Survey	Ralf Topper, Peter E. Barkmann, David A. Bird, and Matthew A. Sares	2004
SB06-193 Underground Water Storage Study	CWCB	CDM	2007
Lost Creek Basin Aquifer Recharge and Storage Study	Lost Creek Ground Water Management District and Colorado Geological Survey	Nicholas Watterson and Ralf Topper	2011

These studies ultimately identified several favorable locations for underground water storage, including within the Lost Creek Basin. The proposed study will focus on identifying a specific location for an underground water storage pilot site.

This study also intends to support science based decision making and policy development that will establish potential recharge projects that are helpful and not injurious to existing water resources and land use. The Lost Creek Ground Water Management District is tasked with long term management of the aquifer and this project will reinforce that goal.

Technical Approach

Our approach has been developed to evaluate local hydrogeologic conditions and refine the location of a pilot site location by collecting site specific data that builds on the regional analyses performed during previous studies. The methods will be consistent with previous work and will provide the local information required to select a specific pilot site. We will specifically refine a location identified in the *Lost Creek Basin Aquifer Recharge and Storage Study* (Waterson and Topper, 2011). The study's area of interest is in the center of the Lost Creek Basin, south of 144th Ave (Study Site, **Figure 1**).

Task 1 - Existing Data Compilation and Review

The first project task will be to collect relevant information for the Study Site regarding the hydrogeologic, water supply/rights, infrastructure and land use characteristics of the Lost Creek Basin. While much of this data will come from previous studies, we will also investigate the availability of additional data from public sources such as the Colorado Division of Water Resources, Colorado Decision Support System, Colorado Geological Survey and the US Geological Survey.

Task 2 - Land Use, Ownership, and Infrastructure Evaluation

We will use the existing data to select one or more candidate locations within the Study Site for pilot consideration. We will work with the Lost Creek Ground Water Management District to identify land owners with land suitable for a pilot test facility who would likely allow field investigation and longer term test facilities. Parcel suitability considerations will include land characteristics and the availability of infrastructure required for a pilot facility (power, source water, etc.).

Task 3 - Hydrogeologic Field Investigation

We will design and implement a field investigation program to collect hydrogeologic information at the candidate location(s) identified in the previous task. The investigation will focus on aquifer characteristics specific to the recharge, control, and recovery of water stored in the subsurface.

Surface Geophysical Survey

We will procure and manage a geophysical surveying subcontractor to perform a surface geophysical survey to characterize the aquifer configuration and properties at the candidate location(s). We will consider several geophysical methods, including controlled source audio-frequency magnetotellurics (CSAMT). The geophysical data will provide hydrogeologic data across the candidate location(s).

Exploratory Borehole Drilling

If the budget is sufficient for additional investigation, the surface geophysical results will be used to select exploratory borehole drilling locations. We will procure and manage a subcontractor that will provide borehole drilling and depth-specific percolation testing. We will provide borehole construction oversight, lithologic material descriptions during drilling, and oversight of drill stem percolation testing. Borehole Lithologic logging results will be used to calibrate and/or validate the surface geophysical data.

Surface Infiltrometer Testing

Single-ring infiltrometer tests will be conducted in vicinity of areas that appear favorable for recharge. The purpose of these tests is to estimate infiltration rates of surface/near-surface soils.

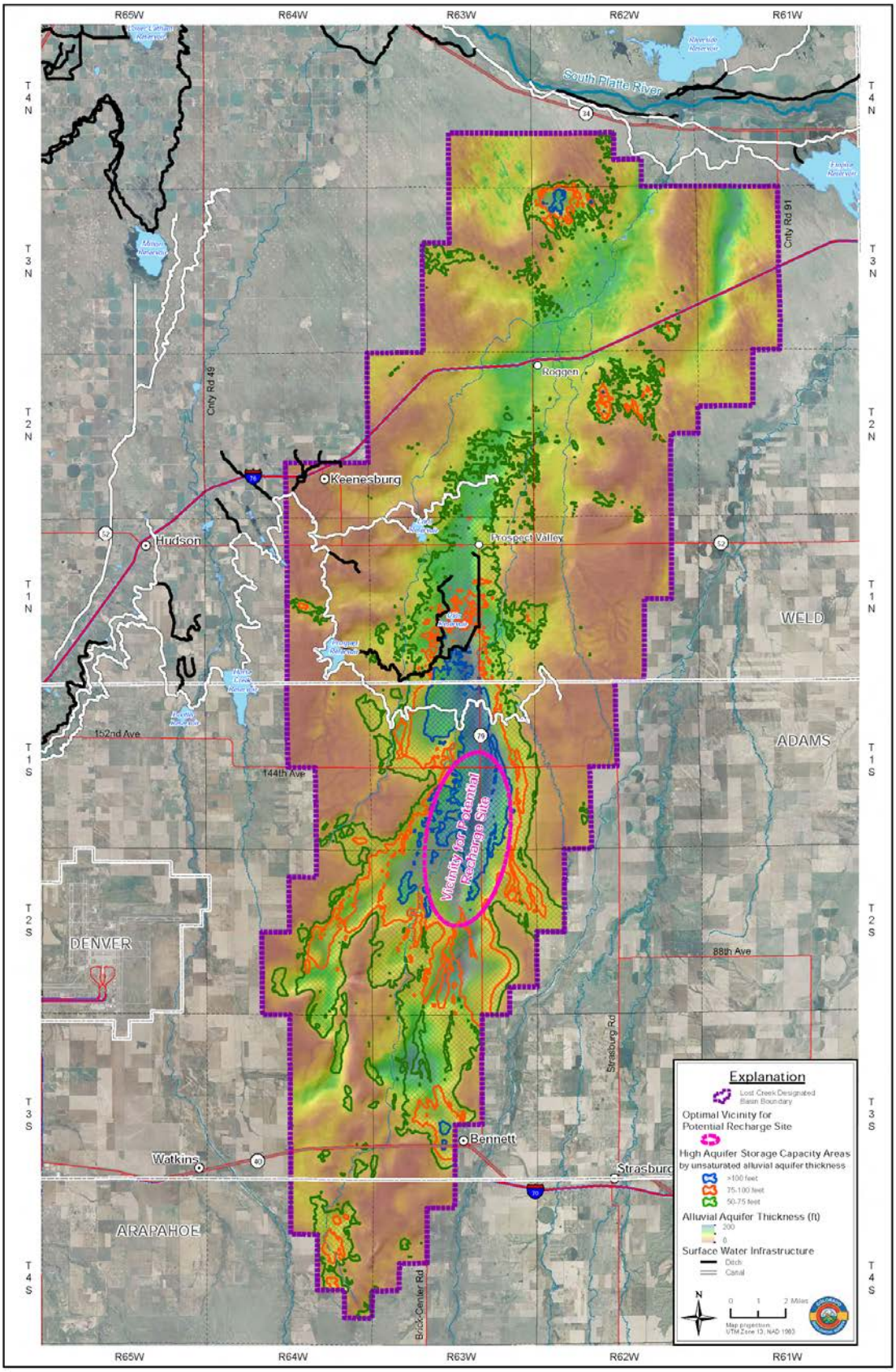

Figure 1 - Lost Creek Potential Recharge Site (adapted from Colorado Geological Survey, 2011)

Task 4 - Data Analysis and Reporting

We will use the data collected in the previous tasks to characterize the potential for an underground water storage pilot facility at the candidate location(s). Our characterization will include considerations of land use, aquifer properties, and potential for water recharge, storage, and recovery.

We will create composite logs that present the borehole lithology, percolation testing, and geophysical investigation results. These logs will be combined with the surface geophysical data to create a three dimensional hydrogeologic site conceptual model. We will use this model to provide preliminary design considerations for a pilot test facility.

We will prepare a report that describes the new and existing data collected. Field data collection methods and results will be included. We will summarize the data analysis results and provide our conclusions and recommendations for the siting and design of a pilot recharge facility.

Proposed Project Stakeholders

Several entities have expressed interest in this project. There are still project details being negotiated, and **Figure 2** represents a draft project governance structure.

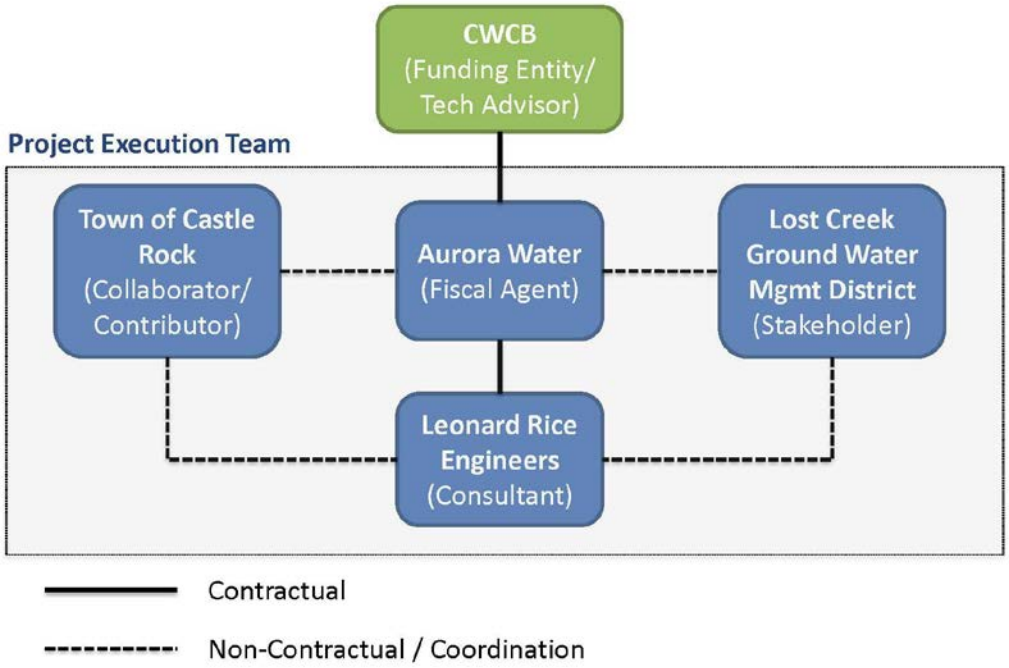

Figure 2 - Proposed Project Governance Structure

COST ESTIMATE - LOST CREEK UNDERGROUND STORAGE PILOT (LCUSP) PROJECT

Task #	Task / Activity	Task Total	Matching Funds	CWCB Grant
1	**Project and Subcontractor Management**			
	Meetings and Coordination Calls	$9,700		
	Subcontractor Procurement and Tech Specs	$9,000		
	Subcontractor Management	$5,450		
	Invoicing, Progress Reports, Schedule, etc.	$5,160		
	Subtotal	**$29,310**	**$17,155**	**$12,155**
2	**Field Data Collection**			
	Geophysical Survey	$55,220		
	Borehole Drilling and Percolation Tests	$62,280		
	Surface Infiltrometer Tests	$7,740		
	Subtotal	**$125,240**	**$62,620**	**$62,620**
3	**Data Analysis**			
	Analyze Geophysical Data	$9,660		
	Analyze Drilling and Perc Test Data	$12,960		
	Prepare Geodatabase Deliverable	$4,460		
	Subtotal	**$27,080**	**$13,540**	**$13,540**
4	**Summary Report and Phase 2 Scoping**			
	Draft and Final Summary Report	$15,810		
	Phase 2 Scoping and Cost Estimate	$7,560		
	Subtotal	**$23,370**	**$11,685**	**$11,685**
	Totals	**$205,000**	**$105,000**	**$100,000**