MOTT MACDONALD

SECWCD - Fryingpan-Arkansas Storage Recovery Study

Phase 1 Final Report

September 2020

Mott MacDonald
165 South Union Boulevard
Suite 200
Lakewood
CO 80228
United States of America

T +1 (303) 831 4700
mottmac.com

SECWCD - Fryingpan-Arkansas Storage Recovery Study

Phase 1 Final Report

September 2020

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
01	9-22-2020	JD	JC	WJP	Fry-Ark Final Report

Document reference: 507402411 | TR-10-01

Information class: Standard

Contents

ATTACHMENTS

Tables

Figures

1 Introduction

The following report is prepared for the Southeastern Colorado Water Conservancy District (District) by Mott MacDonald for the purpose of providing a summary of the main project tasks, deliverables, conclusions and next steps for the Fryingpan-Arkansas Storage Recovery Study (Project).

Sections 2 through 6 of this report provide a synopsis and results of the five main project tasks, which include:

- Task 3 - Reference Document Review and Data Gaps Analysis;
- Task 4 – Site Visit and Field Investigation;
- Task 5 – Project Baseline;
- Task 7 – Environmental Assessment;
- Task 8 – Engineering Assessment.

Task 1 for this project included Project Management and lasted the duration of the project. Task 2, 6, and 9 were formally scheduled project initiation, planning, and progress meetings.

The execution of Tasks 3, 4, 5, 7, and 8 included the development of several project deliverables produced by the Mott MacDonald team and reviewed by the District. Project deliverables include the production of several technical memorandums and reports developed and submitted to the District in a sequential manner. Project deliverables include the following:

- Technical Memorandum 3-01 – Document Review and Data Gaps Analysis;
- Technical Memorandum 4-01 – Field Investigation Report;
- Technical Memorandum 5-01 – Basis of Assessment;
- Technical Report 7-01 – Environmental Assessment;
- Technical Report 8-01 – Engineering Assessment;
- The Fryingpan-Arkansas Storage Recovery Alternatives Register (SRAR).

The technical memorandums developed for Tasks 3, 4, and 5 summarize the input criteria and project baseline data for the Task 7 – Environmental Assessment and Task 8 – Engineering Assessment reports. The purpose of these reports is to assess pre-screened, selected alternatives/methodologies for storage recovery and/or reservoir expansion within the Pueblo Reservoir project area limits. The Task 7 and 8 reports include likely regulatory frameworks, potential environmental and natural resource impacts, implementation considerations, costs, and schedules of the selected alternatives/methodologies.

The deliverables summarized above are appended to this report in Attachments 1. through 6.

Recommended Next Steps, developed by Mott MacDonald in coordination with the District, are summarized in Section 7 herein and include costs and associated schedules for the next phase (Phase II) of the Fryingpan-Arkansas Storage Recovery Study. Recommended Next Steps for Phase II of the Project is organized within Section 7 as follows:

1. Appoint a Storage Recovery Strategy Committee (SRSC)
2. Define the Study Area
3. Conduct a pre-screening assessment of alternative/methodologies for storage recovery or sustainability within the Upper Arkansas River Basin

4. Conduct a detailed alternatives analysis of pre-screened alternatives
5. Develop a scope of work for data collection programs and develop an implementation strategy prior to advancing the project to a feasibility level.
6. Collect the necessary data, identify preferred alternatives in conjunction with the stakeholders and scope a full environmental and engineering feasibility study, including costing and scheduling.

Phase II will include the assessment of alternatives/methodologies for reducing the combined annual sediment load (wash, suspended, and bed load) deposited within Pueblo Reservoir via the Upper Arkansas River Basin.

The development of each alternative will consider multiple factors including, but not limited to environmental, social, and economic impacts, ease of implementation, performance, and cost. Near-term solutions that can be implemented within the existing infrastructure and/or areas that would likely not interfere directly with Reclamation's Fryingpan-Arkansas Project will be emphasized. For example, off-project reservoirs for increased storage capacity do not need to be Federally owned. However, a partnership arrangement with one or more adjacent Upper Arkansas River water agencies might be needed for financial and/or other purposes.

2 Document Review and Data Gaps Analysis

The Mott MacDonald Team prepared **Attachment 1 – TM-03-01 Reference Document Review and Data Gaps** for the District in order to summarize the results of Task 3 – Reference Document Review and Data Gaps analysis for the Fryingpan-Arkansas Storage Recovery Study. This document developed by the Mott MacDonald team provides an explicit summary of the documentation and data used to complete Task 5 – Project Baseline, Task 7 – Environmental Assessment, and Task 8 – Engineering Assessment.

2.1 Purpose and Results

The purpose of the document review and data gaps analysis was to provide a summary of the documentation to be used to complete the study work as described in Tasks 5 through 10. The Mott MacDonald team compiled and reviewed reference documentation provided by the District, obtained online within the public domain, and/or retrieved from internal company archives (included in **Attachment 1**). Following this review a data gaps analysis was conducted in order to identify additional information that would be required for the environmental and engineering assessment works.

A summary of the reference documentation, including document/data content summaries is provided in **Attachment 1**. To facilitate the execution of project study tasks 5 through 10 the reference documentation and data was categorized based upon the Task 5 – Project Baseline categories. Following this, the documents were catalogued in accordance to their relevance to the Task 7 – Environmental Assessment and/or Task 8 – Engineering Assessment.

A data gaps analysis was then conducted by the Mott MacDonald Team to identify critical data gaps, which are defined as missing information and/or data within the reviewed reference documentation or data that may aid in the completion of Task 7 – Environmental Assessment and/or Task 8 – Engineering Assessment. The results of developing this deliverable were:

- Two critical data gaps were identified:
    - Pueblo Reservoir in-situ sediment characterization data
    - Bathymetric and topographic survey data within the Pueblo Reservoir and upstream project area.

2.2 Conclusions

Conclusions developed by the Mott MacDonald team were:

- Reference documentation and data provided to and/or recovered by the Study Team was satisfactory for the purposes of the study.
    - Assumptions regarding in-situ sediment characteristics and gradations can be made during the engineering assessment.
    - Bathymetric and topographic data from the public domain can be used during the engineering assessment.
    - Bathymetric and topographic and sediment sampling data collection efforts should be conducted in future phases of the work.
- The Mott MacDonald team should continue with the tasked study work unless directed otherwise by the District

3 Site Visit & Field Investigation

A site visit and field investigation was conducted by the Mott Macdonald team with the objective of characterizing sediment being transported by the Arkansas River and selected tributaries to the Pueblo Reservoir. The site visits and sampling occurred between June 3 and June 9, 2020 and the complete Field Investigation Report has been attached to this document (**Attachment 2 – TM-04-01 – Field Investigation Report**). The field investigation included:

- Complete preliminary observations of reaches of the Arkansas River and selected tributaries with respect to stream channel stability and their geomorphic character
- Sediment sampling at selected locations and submittal of the samples to the contracted laboratory for size gradation analysis

Sediment samples were obtained at ten (10) specific locations which were identified to characterize the sediment delivered to the reservoir and the Arkansas River. The sampling locations can be seen in **Figure 3.1** and the full list of the sites can be found in **Attachment 2**.

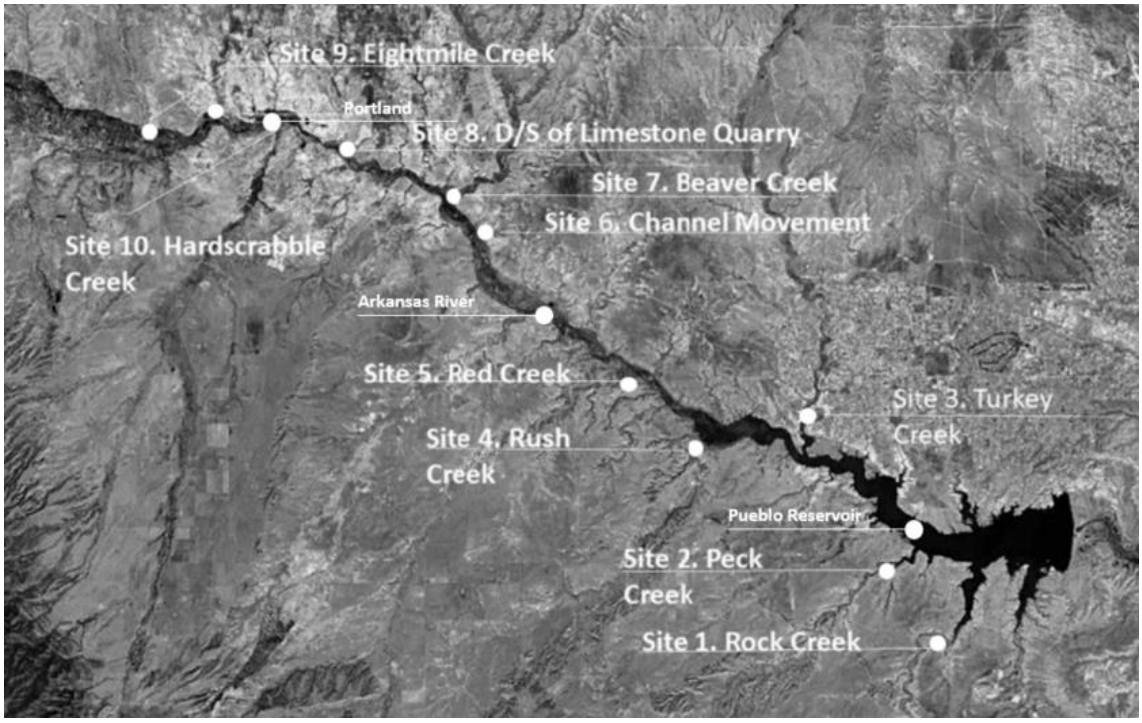


Figure 3.1: Sediment Sampling Locations

Sediment sampling sites 1 through 5 were located on federally owned lands and thus did not require consent to access. Sites 6 through 10 required coordination with three landowners, all of whom provided both access and a representative to accompany the sampling team.

Samples were taken to characterize the nature of material actively being transported by the stream. Consequently, samples were taken from depositional features at the point where a stream terminated at Pueblo Reservoir or the Arkansas River. Field personnel obtained samples at each site using a hand shovel; no mechanized equipment was used. Site samples

were composited in a five-gallon bucket and a one-gallon subsample was submitted to the laboratory for gradation analysis.

Laboratory testing was completed by Terracon Consultants, Inc. and provided to the Mott MacDonald team on June 24, 2020. The results of the sieve gradation test results are presented in **Table 3.1**. Across the ten (10) sites tested, the grain size character of the samples varied greatly. This can be attributed to several factors, including local geology and soils type, land use of the tributary, hydrologic conditions, etc. Two of the tributaries displayed distinctively finer texture: Rush Creek and Turkey Creek. At the time of the sampling, the numerous beaver ponds observed on Rush Creek are likely trapping coarser grained sediments transported by the stream. During high flow events, beaver ponds tend to fail, at which point the trapped sediment becomes available for mobilization and downstream movement to the Arkansas River. The approach to Pueblo Reservoir is a low gradient reach where most of the coarser sands are likely deposited upstream of the sample location. A third sample (Site 6: channel movement) consisted of a depositional environment where vegetation has reestablished itself following significant channel erosion. The remaining sites were generally well-sorted fine to coarse grained sands larger than the 200-sieve size. Based upon this data, the portion of the samples which would be considered wash load ranges from approximately 1 percent (Site 7: Beaver Creek) to 30 percent (Site 1: Rock Creek).

Table 3.1: Grain Size Distribution at Ten (10) Sites Tested

Site	Sieve Size [% Finer Than]					
	2″	¾″	No. 4	No. 10	No. 40	No. 200
Site 1	100	89	42	36	33	30
Site 2	100	85	46	28	15	8
Site 3	100	100	99	98	87	76
Site 4	100	100	100	100	96	83
Site 5	100	100	86	70	20	9
Site 6	100	100	100	100	99	71
Site 7	100	100	79	60	28	1
Site 8	100	100	77	63	27	3
Site 9	100	100	100	99	98	15
Site 10	100	100	100	100	98	9

The complete grain size analysis for all sites sampled is provided within **Attachment 2**.

4 Project Baseline

Following the site visit and field investigation the Mott MacDonald team developed **Attachment 3 – TM-05-01 Fryingpan-Arkansas Storage Recovery Project - Basis of Assessment Technical Memorandum** to facilitate the execution of the subsequent project study tasks. This document was the product of the project baseline effort, which finalized the data available for the Fry-Ark Storage Recovery Study and formed it into a cohesive structure that could then be used to develop the Task 7 – Environmental Assessment and Task 8 – Engineering Assessment Reports. The document provides the key input criteria, such as storage capacity loss and sediment yield/distribution, to be used within the two assessment tasks. Ten (10) baseline categories were identified as pertinent to the project and include:

1. Project Limits and Key Baseline Data;
2. Pueblo Reservoir operations and capacities;
3. Sediment/material distribution;
4. Sediment Yield;
5. Water Quality;
6. Geomorphology and Forest Fire Impacts;
7. Biology: Endangered species and critical habitat;
8. Historical and current land use;
9. Pueblo Reservoir storage rights and water use;
10. Regulatory Entities Summary

The key findings of this assessment are summarized below, however, additional information can be found in **Attachment 3 – TM-5-01 Fryingpan-Arkansas Storage Recovery Project - Basis of Assessment Technical Memorandum**.

4.1 Project Limits and Key Baseline Data

The overall project limits of the study may vary depending upon the project baseline category considered. For the purposes of Task 7 and Task 8, the storage recovery project area limits extend from Pueblo Dam (downstream limit) to the upper Arkansas River delta within Pueblo Reservoir (upstream limit), approximately 11.4 miles upstream of the dam face at a water surface elevation of 4,900 feet (USBR 2015). The elevation of the uncontrolled spillway at Pueblo Dam is elevation 4,898.70 feet. Project limits information and key baseline data that were used for the assessment works can be found in **Attachment 3**. See **Figure 4.1** below for the full extents of the project study area. Investigations outside of these project limits, including tributaries upstream of those shown in **Figure 4.1** are recommended in future phases of this study as described in Section 7.

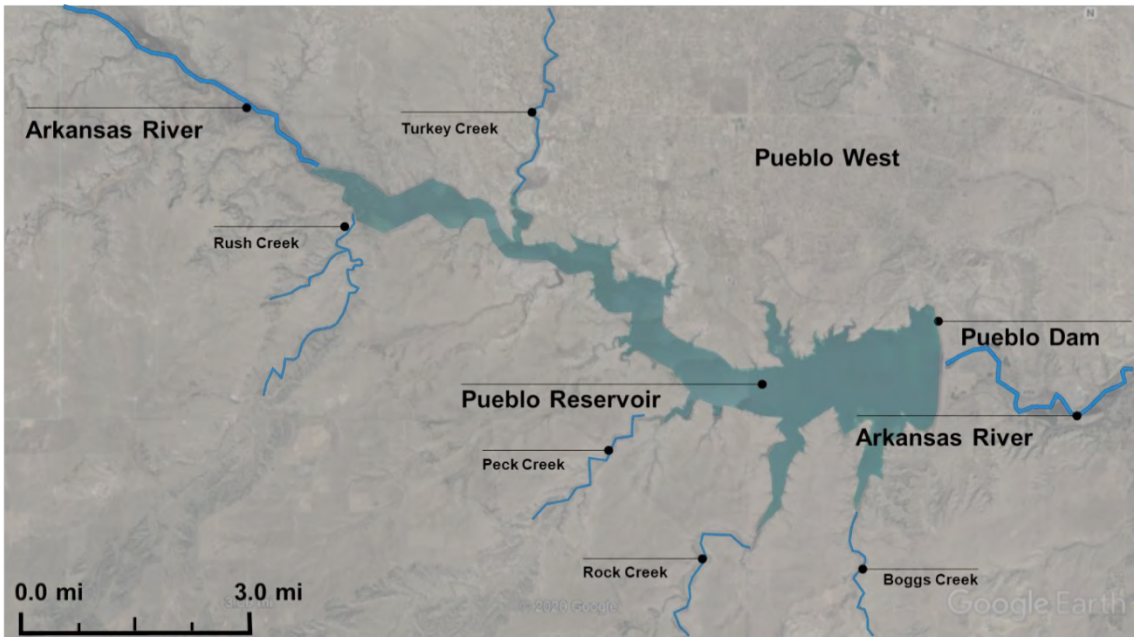


Figure 4.1: Pueblo Reservoir Storage Recovery Study Area

Pueblo Reservoir operations were used for a variety of purposes to facilitate the assessment work. Several of these assessment activities can be found in **Attachment 3**. Previously recorded minimum and maximum forebay elevations, as well as inflow estimates to Pueblo Reservoir were provided by the USBR and documented as part of the 2012 sedimentation study (USBR 2012). This information was tabulated by the USBR (USBR 2015) and is shown in **Figure 4.2** below.

45. RANGE IN RESERVOIR OPERATION [10]

YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF	YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF
1974	4,792.6	4,776.6	448,200	1975	4,800.4	4,790.5	567,900
1976	4,821.8	4,800.1	414,900	1977	4,830.2	4,799.6	234,000
1978	4,802.2	4,779.7	401,500	1979	4,822.1	4,797.0	581,400
1980	4,835.6	4,799.5	779,300	1981	4,879.6	4,820.0	327,400
1982	4,837.3	4,798.6	618,600	1983	4,879.6	4,820.0	944,100
1984	4,884.3	4,868.0	1,007,400	1985	4,886.9	4,875.0	978,000
1986	4,883.8	4,875.8	767,400	1987	4,881.9	4,872.6	792,400
1988	4,881.1	4,851.2	454,200	1989	4,873.7	4,838.6	467,600
1990	4,851.5	4,828.2	427,200	1991	4,854.5	4,824.5	506,400
1992	4,856.5	4,823.3	522,300	1993	4,864.0	4,834.3	666,900
1994	4,868.4	4,834.4	600,900	1995	4,881.5	4,834.2	1,258,000
1996	4,888.4	4,866.4	640,900	1997	4,885.6	4,865.5	781,600
1998	4,880.7	4,852.1	580,600	1999	4,881.6	4,851.4	759,900
2000	4,885.3	4,856.0	509,300	2001	4,873.4	4,834.1	461,200
2002	4,851.7	4,826.3	202,300	2003	4,840.7	4,820.6	334,500
2004	4,841.6	4,819.9	361,100	2005	4,851.2	4,831.7	411,100
2006	4,855.7	4,831.8	485,000	2007	4,866.6	4,840.7	635,100
2008	4,880.3	4,853.0	734,200	2009	4,879.7	4,860.2	605,100
2010	4,882.6	4,863.5	525,800	2011	4,882.6	4,857.8	622,400
2012	4,879.0	4,857.2	176,700				

Figure 4.2: Reservoir Operations Table 1974-2012 (USBR 2015)

4.2 Sediment/Material Distribution with Pueblo Reservoir

Following Pueblo Dam closure in January of 1974, two survey (bathymetric and topographic) programs have been conducted by the USBR within Pueblo Reservoir for the purposes of estimating reservoir capacity losses due to long-term sediment and debris accumulation (USBR 1994) (USBR 2015). Following the last bathymetric survey program conducted within Pueblo Reservoir in May of 2012 by the USBR, it was calculated that more than 7% of the total storage capacity below the top of the Joint Use allocation (el. 4,893.8), had been lost to fluvial sedimentation and debris accumulation within the reservoir (USBR 2015). It is certain that this percentage loss of storage capacity within Pueblo Reservoir has increased since 2012 but has yet to be confirmed with subsequent survey programs and new capacity estimates. Based on the information in (Southeastern Colorado Water Conservancy District 2019), the in-situ volume of sediment deposition within the Pueblo Reservoir project area limits was assumed to be 20,000 acre-feet for the Fry-Ark Storage Recovery Study.

Sediment/material distribution within Pueblo Reservoir is considered as part of the Task 8 – Engineering Assessment work for a variety of purposes. For example, the construction engineering assessment will consider if land-based equipment is appropriate for sediment removal works (excavation in the dry) within the upper reaches of Pueblo Reservoir. This equipment assessment was based upon, among other factors, in-situ sediment volumes, estimated production rates and the operational parameters of Pueblo Reservoir. Both sediment survey program reports (1993 and 2012) were reviewed for this purpose. Sediment accumulation along the reservoir thalweg was found to be mostly uniform in thickness. Of the estimated 20,000 acre-feet of storage capacity lost, approximately 36% of the accumulated materials within Pueblo Reservoir are located within elevation range 4,900 to 4,850 feet, 34% within elevation range 4,850 to 4,800 feet, and 30% within elevation range 4,800 to 4,740. The highest percentage of total sediment accumulation within the reservoir study limits (12.6%) is located within elevation range 4,900 to 4,870 feet (Pueblo Reservoir delta). Sediment distribution within the reservoir can be found in **Figure 4.3** below.

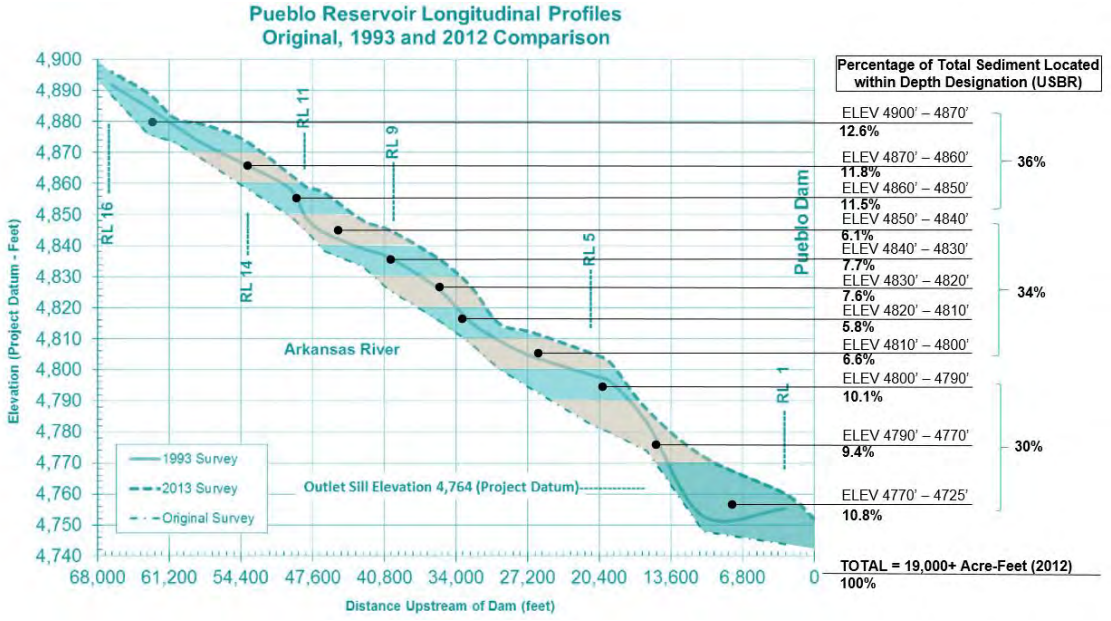


Figure 4.3: Sediment Distribution with the Pueblo Reservoir Study Area Limits (Modified from USBR, 2015)

4.3 Sediment Yield within the Upper Arkansas River Basin

Evaluation of sediment yield within the study area limits was characterized and described using existing data from the 1993 and 2012 sediment survey studies conducted by the USBR and tabulated within **Table 4.1** below.

Table 4.1: Estimated Sediment Yield for Pueblo Reservoir Since Dam Closure (USBR, 2015)

Period (Month-Year to Month-Year)	Period (Years)	Pueblo Reservoir Drainage Area (square miles)	Estimated Sediment Yield per Annum (Acre-Feet per square mile)	Approximate Annual Capacity Loss (Acre-Feet)	Approximate Sediment Volume Deposited per Annum (cubic yards)
January-1974 to May 1993	19.3	4,669	0.087	410	660,000
May 1993 to May 2012	19.0	4,669	0.125	583	940,000
January 1974 to May 2012	38.3	4,669	0.106	496	800,000

For the purposes of this study, a range of sediment yield values were used during the Task 8 – Engineering assessment to develop mitigative alternatives/methodologies for reducing sedimentation within Pueblo Reservoir.

4.4 Geomorphology and Forest Fire Impacts

A Geomorphologic Assessment of the Upper Arkansas River Basin was developed by the Mott MacDonald Team to support the Task 8 – Engineering Assessment and future studies associated with developing alternatives/methodologies focused on reducing the impacts of future sediment and debris accumulation within Pueblo Reservoir.

Following the evaluation, preliminary conclusions related to geomorphic processes and forest fires impacts were developed by the Mott MacDonald Team and include the following:

- The Arkansas River downstream of Portland displays the tendencies of naturally meandering alluvial river system. The channel appears to migrate slowly in some places and in other locations, sudden and significant changes occur. With these changes, sediment will be delivered to the system which may ultimately be deposited within Pueblo Reservoir.
- Tributaries to the Arkansas River and to Pueblo Reservoir appear to contribute significant quantities of sediment. Observations made during field assessment coupled with evaluation of aerial photography indicated the presences of significant quantities of sediment stored in the form of deltaic deposits at confluences and point and alternate bars in the tributary channels. When flow conditions permit, this material is likely transported to the reservoir.
- Forest fires have likely had a significant impact on several of the tributary watersheds, specifically, Peck Creek, Rush Creek, Red Creek, and Hardscrabble Creek. Erosion and sedimentation increase with higher flows, reduction in vegetative cover, and exposed soils.

In addition to the information detailed within the preceding sections, several additional categories were considered within the project baseline's Basis of Assessment. Information regarding; storage rights and water use data, water quality, biology (endangered and threatened species and critical habitat), historical and current land use, and key regulatory entities, can be found in **Attachment 3**. Further investigations of geomorphological changes and forest fire impacts is recommended for inclusion in future phases of this study as described in **Section 7.**

5 Environmental Assessment

The Environmental Assessment report is provided as **Attachment 4 – TR-07-01 Fryingpan-Arkansas Storage Recovery Project – Environmental Assessment Report**. The report was produced at a concept screening-level by the Mott MacDonald Team, including Carnavale Environmental Consulting, LLC and Ecological Resource Consultants, Inc., on behalf of the District to assess and review the environmental and natural resources that may be affected by the proposed storage recovery or reservoir expansion alternatives. Likely regulatory frameworks and permits, timelines, and associated costs are summarized within the report and the associated attachments.

5.1 Fryingpan-Arkansas Storage Recovery Project Environmental Assessment Report Summary

The Environmental Assessment report provides an evaluation of permitting requirements associated with the current proposed alternatives for the Pueblo Reservoir storage recovery project. These alternatives include the following: 1) large-scale sediment removal/diversion project (e.g., dredging) and 2) raising the elevation of Pueblo Dam 5 to 10 feet (e.g., reservoir expansion). The report includes a summary of environmental and natural resources that may be affected by the proposed storage recovery alternatives. Additional studies, permits, and environmental review documents that will likely be required prior to implementation of either alternative are summarized herein. This report is not meant to replace or augment additional local, state, and federal documentation and/or permitting required to implement these alternatives. Rather, this report is meant to be a pre-project screening document that can be used by the District to assess overall environmental permitting requirements and costs.

This report describes the affected environment under each alternative and focuses on the following resources that may require permitting and additional environmental review: wetlands, water quality, vegetation resources, wildlife resources, fisheries, aquatic nuisance species, and soils.

5.2 Conclusions and Results

The Environmental Assessment report provides a summary of permits, environmental review documents, and regulatory approvals that will likely be required for a storage recovery and/or reservoir expansion (dam raise) project within Pueblo Reservoir.

The following table summarizes the environmental permits, costs, and timeframe associated with each alternative.

Table 5.1 Summary of Permits and Costs Associated with Each Alternative

Alternative	Agencies Involved	Permits/Documents Required	Anticipated Environmental Costs	Permitting Timeframe
Sediment Removal	• Reclamation • USACE • USEPA • USFWS • CPD • CDPHE • SHPO	NEPA Review (EA or EIS) 404 Permit	Up to $10 Million Preliminary scoping: ~$200k	3 to 5 years to complete
Dam Raise	• Reclamation • USACE • USEPA • USFWS • CPD • SHPO • CDPHE	NEPA Review (EIS) 404 Permit Additional agency coordination/consultation	$10-30 Million	10-15 years to complete

6 Engineering Assessment

The Engineering Assessment report is provided as **Attachment 05 – TR-08-1 Fryingpan-Arkansas Storage Recovery Project – Engineering Assessment Report**. The report was produced at a concept screening-level by Mott MacDonald on behalf of the District to assess and review potentially feasible alternatives for storage recovery and reservoir expansion within Pueblo Reservoir from a cost and schedule-perspective.

6.1 Fryingpan-Arkansas Storage Recovery Project Engineering Assessment Report Summary

This Engineering Assessment includes the following subsections:

6.1.1 Introduction

Section 1 of the Engineering Assessment report provides an overview of document purpose, goals and objectives, and content. The purpose of this document is to assess the implementation, costs, and schedules of potentially feasible storage recovery and/or reservoir expansion alternatives/methodologies developed and/or previously developed by other consultants. Mott MacDonald acknowledges that the screening-level concept costs and schedules developed as part of this assessment might be used by the District to help develop future capital expenditure planning.

6.1.2 Pre-Screening Analysis and Alternatives Development

Mott MacDonald conducted a pre-screening analysis of storage recovery and/or previously developed reservoir expansion alternatives/methodologies based upon a review of historical data and reference documentation. To facilitate the pre-screening process, **Attachment 6 –The Fryingpan-Arkansas Storage Recovery Alternatives Register (SRAR)** was developed by the Mott MacDonald team for the purposes of comparing and assessing potential alternatives for storage recovery and/or reservoir expansion within Pueblo Reservoir. The alternatives/methodologies considered are categorized within the SRAR as follows:

- Reservoir Storage Recovery
- Reservoir Sustainability
- Reservoir Enlargement
- Reservoir Reoperation

Detailed descriptions of the alternatives/methodologies considered as part of the pre-screening analysis are provided herein. It is recommended that reservoir sustainability methods be considered during future studies. As documented within previous deliverables of this study (Tasks 3 and 5 Technical Memorandums), significant data gaps preclude the assessment of potentially viable alternatives; specifically, reservoir sustainability alternatives/methodologies. Eliminated and/or postponed alternatives are identified in Section 2.5.1 of the Engineering Assessment report.

As a result of the pre-screening analysis and the development of **Attachment 6 – The Fry-Ark Project SRAR,** six (6) alternatives, including a No Action alternative, were selected for the detailed alternatives assessment. Selected alternatives/methodologies include:

- Alternative 1: No Action.
- Alternative 2: Complete Storage Recovery via Dredging and Excavation of Pueblo Reservoir (Active Conservation and Inactive Pools only)
- Alternative 3: Partial Storage Recovery via Dredging and Excavation to facilitate the venting of turbid density currents through the North Outlet in Pueblo Dam.
- Alternative 4: Dam Raise increase storage capacity by approximately 25,000 acre-feet.
- Alternative 5: Dam Raise to increase storage capacity by approximately 60,000 acre-feet.
- Alternative 6: Dam Raise to increase storage capacity by approximately 75,000 acre-feet.

6.1.3 Alternatives Assessment

Cost estimating frameworks and guidelines developed by the United States Environmental Protection Agency (USEPA), the United States Army Corps of Engineers (USACE), and the United States Society on Dams (USSD) were used as a basis for developing the concept/screening-level order of magnitude cost estimates and schedules developed as part of this study. These are referenced within Section 3 - Alternatives Assessment, of the Engineering Assessment report (USEPA, 2000, USSD, 2012).

Cost and production estimating data and information specific to the alternatives assessed as part of this study are documented within **Attachment 2 of the Engineering Assessment – Basis of Cost and Production Estimates**. Included within this document are the assumptions, limitations, and sources of cost and production data and information.

6.1.3.1 Alternatives 2 and 3 Assessment Results:

Capital and Operations and Maintenance (O&M) costs and schedules were developed at a concept screening-level (+100%/-30%, USEPA, 2000) for Alternatives 2 and 3. Cost estimates are provided in 2020 dollars ($USD) for both alternatives. The following results are documented within Section 3 of the Engineering Assessment report:

- Total capital and O&M costs for Alternative 2 are estimated to be approximately $830 million dollars ($USD). The estimated schedule for Alternative 2, not including permitting, is approximately 15 years.
- Total capital and O&M costs for Alternative 3 are estimated to be approximately $98 million dollars ($USD). The estimated schedule for Alternative 3, not including permitting, is approximately 2 years.
- A present value analysis should be conducted during future studies to assess costs based upon the estimated permitting and construction schedules included within the Environmental Assessment and herein.

6.1.3.2 Alternatives 4 through 6 Assessment Results:

Alternatives 4 through 6 were originally developed by GEI Consulting Engineers, Inc. in December of 1998. Capital cost estimates developed in 1998 were updated by Mott MacDonald to 2020 dollars ($USD) via cost indexing analysis based upon Engineering News Record (ENR) cost indexing data. Estimated O&M costs and construction schedules were not assessed as part of this study. The following results are documented within Section 3 of the Engineering Assessment report:

- Total capital costs for Alternatives 4 through 6 are estimated to range between approximately $58 and $135 million dollars ($USD).

- A present value analysis should be conducted during future studies to assess costs based upon the estimated permitting and construction schedules included herein.

6.2 Conclusions

This Engineering Assessment Report provides guidance to the District on feasible alternatives and order of magnitude costs for future storage recovery planning efforts. The considerations and future studies detailed in this document can be used to guide further storage recovery analyses and studies rather than select a single preferred alternative. Measures and alternatives reviewed as part of the pre-screening assessment, particularly the reservoir sustainability measures not investigated as part of this study, can be combined with the proposed alternatives to increase the lifespan of the project and reduce future maintenance costs. Comprehensive data collection, analysis, and numerical modeling programs should be implemented in future studies if sustainability measures are to be further investigated . Although not included in the Engineering Assessment Report, additional considerations for new, District-owned storage alternatives should also be developed and assessed as part of future studies.

7 Next Steps and Future Considerations

7.1 Introduction

Next Steps necessary to develop and assess viable alternatives to increase off-project storage capacity (meaning off-Fryingpan-Arkansas Project) and reduce annual storage capacity loss within Pueblo Reservoir are identified in Sections 7.2 - 7.2.5, below. These Next Steps, developed by the District & Mott MacDonald team, are organized for the purpose of providing a framework for future studies and assessments. The recommended future studies and assessments are focused on decreasing sediment load conveyed through the Upper Arkansas River Basin into Pueblo Reservoir.

Sediment load (bed, suspended, and wash) and debris (large woody debris) conveyed through the Arkansas River is transported and deposited within Pueblo Reservoir via fluvial processes following seasonal melt off periods (spring freshet), storm events, and seasonal rains. Additionally, forest fires contribute to a flux of sediment and debris conveyed through the drainage basin into reservoir. In combination, the sediment and debris conveyed through the Upper Arkansas River Basin via the Arkansas River and its tributaries has steadily reduced storage capacity within Pueblo Reservoir by an average of about 600 acre-feet per year. The development of solutions to minimize future storage capacity loss is instrumental for prolonging reservoir life, enabling the District to continue to meet the demands of its customers.

Recommended Next Steps are organized within the following sub sections as follows:

- Appoint a Storage Recovery Strategy Committee
- Define the Study Area
- Conduct a pre-screening assessment of alternative/methodologies for storage recovery or sustainability within the Upper Arkansas River Basin
- Conduct a detailed alternatives analysis of pre-screened alternatives
- Develop a scope of work for data collection programs and develop an implementation strategy prior to advancing the project to a feasibility level.
- Collect the necessary data, identify preferred alternatives in conjunction with stakeholders, and scope a full environmental and engineering feasibility study, including costing and scheduling.

The scope of these next steps does not include any study of alternatives for removing existing sediment from Pueblo Reservoir, which is addressed in the present document.

Steps 1, 2, and 3 can all be accomplished during a single year with consultant costs of $200,000 to $300,000.

Steps 4 and 5 can both be accomplished in a single year at a consultant cost of between $200,000 and $300,000. Step 6 can be accomplished in a year and a half at a cost of approximately $250,000 for data collection in the field and consultant cost of between $200,000 and $300,000.

When Step 6 is complete, the District will be in a position to decide whether to perform a full feasibility study that results in the project concept definition, cost, scope, schedule, and permits needed to solve the long term storage loss problems associated with the Fryingpan-Arkansas Project. Such a full feasibility study will take two to three years to perform and cost between $5,000,000 and $10,000,000. At that point, the District will be equipped to make a final go/no-go decision on implementing the long-term solution, which could cost on the order of $150,000,000.

7.2 Study Approach

7.2.1 Appoint a Storage Recovery Strategy Committee

The **Storage Recovery Strategy Committee** (SRSC) will be appointed by the District Board of Directors and consist of select District Board Members and Staff, with support from the District's Consultant team. The charge to SRSC will be to develop and execute, through staff and consultants, a program of projects on a timeline that will result in the recovery of District storage lost to sediment and the mitigation of future storage loss to sediment. The SRSC will gather additional input and a broad historical perspective from its members diverse experiences and key roles in the community. The SRSC will also act as the lead contact with other agencies.

7.2.2 Define Study Area

A study area will be defined based upon a review of historical reference documentation and data pertinent to the Upper Arkansas River Basin. The purpose of expanding the study area is to identify the potentially critical catchment areas within the basin. These are catchments that may significantly affect sediment load conveyed via the Arkansas River into Pueblo Reservoir.

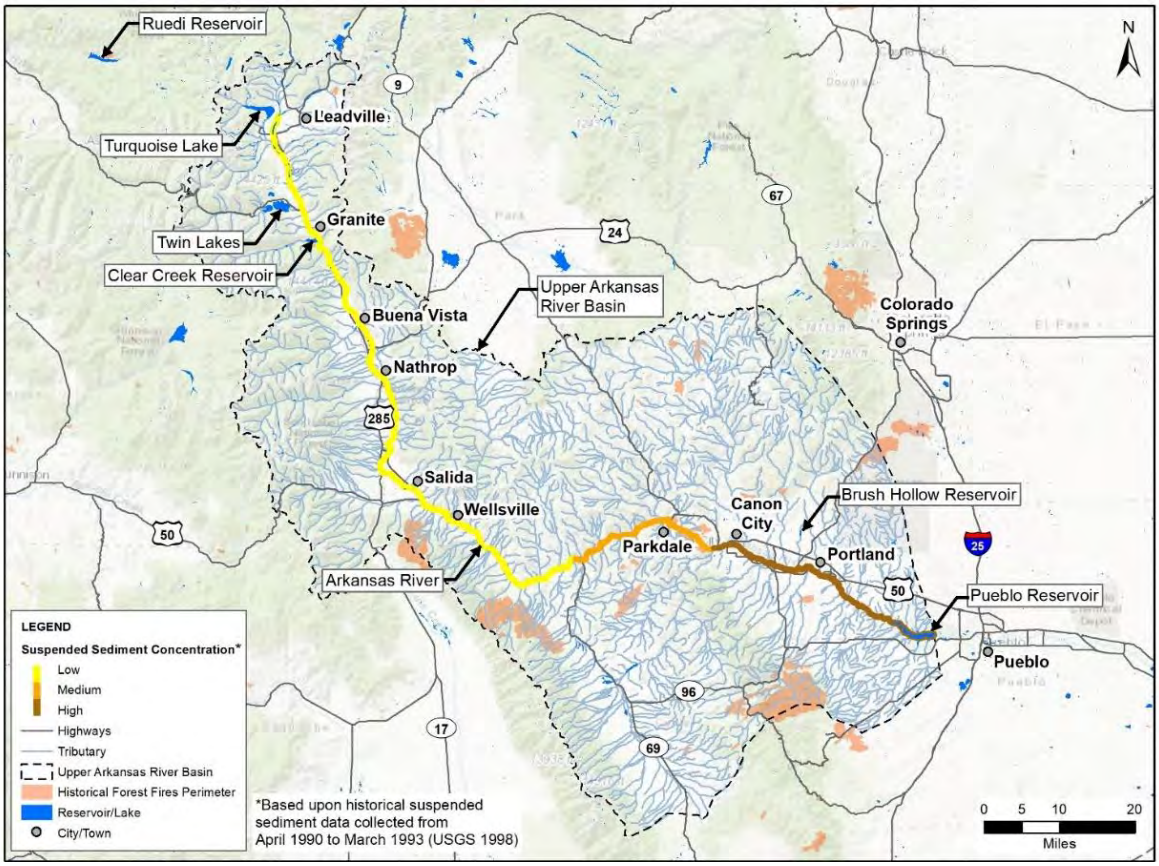


Figure 7.1: Expanded Study Area Including Upper Arkansas River Basin and Associated Tributaries

Figure 7.1 shows the extent of the Upper Arkansas River Basin which drains to Pueblo Reservoir, including an expansive area over 4,600 square miles with numerous unregulated tributaries that contribute to the sediment load entering Pueblo Reservoir. The graphic shows all known tributaries as light blue lines, as well as the suspended sediment concentration along the Arkansas River as a gradient from yellow (low concentration of sediment) to brown (high concentration of sediment). Also included in **Figure 7.1** are the known boundaries of historical wildfires, shown as orange areas, and upstream lakes and reservoirs shown as dark blue areas. The transmountain diversion contributes almost no sediment to the upper Arkansas and Pueblo Reservoir.

7.2.3 Pre-Screening Assessment

The SRSC, assisted by the consultant to the District, will gather input from external stakeholder during the development and review of potential storage capacity and sediment management alternatives. Similar to the present concept-level planning study, a pre-screening assessment will be conducted by the District's consultant to evaluate potential near and long-term alternatives that could be implemented to reduce annual storage capacity losses within Pueblo Reservoir. These potential alternatives are listed within the Storage Recovery Alternatives Register (SRAR) and are also identified within the Section 2 of the Fryingpan Arkansas Storage Recovery Engineering Assessment (**Attachment**) as postponed and/or delayed storage recovery alternatives or sustainability methods. The alternatives include, but are not limited to, the assessment of the following potential storage recovery and/or sustainability alternatives within the Upper Arkansas River Basin:

- Off-project reservoir storage capacity and/or Pueblo or other reservoir expansion for District use
- Reservoir sustainability methods (check dams, debris basins, sediment diversion structures, upriver/tributary channel protection, and/or other methods)
- Beneficial Sediment Reuse.

The development of each alternative will consider multiple factors including, but not limited to environmental, social, and economic impacts, ease of implementation, performance, and cost. Near-term solutions that can be implemented within the existing infrastructure and/or areas that would likely not interfere directly with Reclamation's Fryingpan-Arkansas Project will be emphasized. For example, off-project reservoirs for increased storage capacity do not need to be Federally owned. However, a partnership arrangement with one or more adjacent Upper Arkansas River water agencies might be needed for financial and/or other purposes.

In collaboration with the SRSC, the consultant team will conduct a reference document and data review pertinent to the Upper Arkansas River Basin. The results of this review will lead to the identification of data gaps, which will be addressed following the development of selected viable alternatives as part of the alternatives/methodologies assessment. Refer to Section 1.6 herein for potential data collection programs and future studies that may be required prior to initiating a detailed analysis of selected alternatives at a feasibility study level.

Following the pre-screening of concept level alternatives/methodologies within the Upper Arkansas River Basin, an alternatives evaluation program will be conducted to provide a preliminary assessment of the viability of each alternative, and develop recommendations for future data collection. Following the alternatives evaluation a data collection and future studies program will be prepared by the District's consultant for review by the STF and approval by the SRSC.

7.2.4 Alternatives Evaluation

The Upper Arkansas River Basin consists of approximately 4,669 square miles. A multitude of unregulated tributaries flow into the Arkansas River upstream of the Pueblo Reservoir. These tributaries convey sediment into the Arkansas River which ultimately deposits into Pueblo Reservoir, reducing storage capacity over time. Sustainability methods such as check dams, debris basins, or sediment

diversion structures can be implemented to slow or divert the sediment volume entering Pueblo Reservoir.

In order to identify the tributaries that convey the largest sediment load into the Arkansas River, a pre-screening level data collection program is recommended. The pre-screening data collection program will be a desktop effort focused on data for each tributary including but not limited catchment size, land use, historical forest fires, and available sediment data. Using this data, a risk matrix will be developed to identify problem tributaries that contribute the most sediment to Pueblo Reservoir. Such tributaries will become targets for further study and eventually for sustainability measures. Problem tributaries will be assessed for the necessity of further data collection programs and future studies as described in the following Section.

Off-project reservoir storage capacity expansion alternatives will also be evaluated. This process will identify existing reservoirs suitable for expansion in order to mitigate and/or reduce the sediment load entering Pueblo Reservoir. This alternative would assess the viability of selected reservoirs identified during the pre-screening analysis and lay the groundwork for future coordination and studies with the reservoir owners. The construction of one or more new, potentially off-stream, reservoirs to replace lost storage will be considered.

Costs, permitting difficulty, schedule, and viability of the alternatives will be assessed. Capital and operations and maintenance (O&M) costs and schedules will be evaluated at a concept screening level (AACE Class 5, +100% to -30%) for each alternative. Similarly, permitting frameworks and environmental impacts will be evaluated from a cost and schedule perspective. This analysis will be used to identify viable alternatives for further assessment.

7.2.5 Data Collection Programs and Future Studies

The alternatives evaluation will be used to guide future data collection efforts and further studies to finalize viable near- and long-term alternatives for storage recovery, new off-project storage, and/or sustainability through sediment control within the Upper Arkansas River Basin. The data collection programs for each alternative are expected to include the following:

- Geotechnical investigations (including gradation analysis and sediment/debris distribution)
- Sediment chemistry
- Geomorphology and Sedimentation analysis
- Sediment yield measurements (bed load and suspended load) of selected tributaries
- New bathymetric and topographic surveys.

Further studies should be designed and conducted once the data collection program is complete. Further studies could include numerical modeling to gain a better understanding of sediment flows into and through Pueblo Reservoir, pilot programs of preferred alternative on selected tributaries to assess their effectiveness, and more detailed analyses of the most promising alternatives.

ATTACHMENTS

Attachment 1

TM-03-01
Reference Document Review and Data Gaps

mottmac.com

MOTT MACDONALD

Technical Memorandum

Project:	SECWCD Fryingpan-Arkansas Storage Recovery Study		
Our reference:	TM 3-01	**Your reference:**	TM 3-01
Prepared by:	John Dawson	**Date:**	May 22, 2020
Approved by:	David Jurich	**Checked by:**	Warren J. Paul
Subject:	DRAFT Synopsis of Existing Reference Documentation and Data Gaps		

1 Executive Summary

The Mott MacDonald Team (Study Team) has prepared this technical memorandum for the Southeastern Colorado Water Conservancy District (District) in order to summarize the results of Task 3 – Reference Document Review and Data Gaps analysis for the Fryingpan-Arkansas Storage Recovery Study. The purpose of this synopsis and data gaps analysis is to provides an explicit summary of the documentation that will be used to complete the study work as described in Tasks 5 through 10.

This technical memorandum and the associated attachments provide an overview of the available reference documentation provided to the Study Team by the District, obtained by the Study Team online within the public domain, and/or retrieved from internal company archives. Based upon the Study Team's review of the available reference documentation, a data gaps analysis was conducted for the purposes of identifying additional reference documents, information, and/or data that may be needed to facilitate the completion of the Task 5 – Project Baseline, Task 7 – Environmental Assessment, and/or Task 8 – Engineering Assessment.

Project baseline categories applied during the review of the contents of the project-specific reference documentation and data are indicated within Section 3 of this technical memorandum. Furthermore, the documents and data are catalogued by relevance to either the Task 7 - Environmental Assessment or Task 8 - Engineering Assessment works.

A data gaps analysis was performed. The identified critical data gap is pertinent to subsequent tasked works, specifically, Task 5 – Project Baseline and Task 8 – Engineering Assessment. The critical data gap includes retrieving any information associated with sediment characterization within Pueblo Reservoir (reservoir bottom) and historical reservoir operations and statistics.

A complete summary of the reviewed documentation pertinent to the Fryingpan-Arkansas Storage Recovery Study is included in Attachment A – Reference Document Review and Data Gaps Summary (Attachment A). This document is considered a living document and may be updated throughout the execution of project work.

2 Introduction

This technical memorandum provides a synopsis of the information that will be used as a basis for the study, and a data gaps analysis based on available information and project needs at this phase of work. The synopsis is intended to be provide a summary of project-specific reference documentation that will be used to facilitate the development of subsequent task deliverables. Additionally, a data gaps analysis has been performed to highlight the need for additional information that may be required for the environmental and engineering assessment works.

All project reference documentation and data has been stored on Mott MacDonald's project SharePoint site accordance with the Document Management Plan included as part of the SECWCD Fryingpan-Arkansas Storage Recovery Study Project Management Plan (PMP) submitted to the District by Mott MacDonald in draft form on May 1, 2020.

3 Synopsis of Reference Documentation and Data

A summary of the reference documentation and data specifics, including authors, dates of publications, electronic file names, project baseline categories (measles chart), and document/data content summaries is provided in Attachment A. The Mott MacDonald Team requests that the District review Attachment A and confirm that the catalogued references are satisfactory for the purposes of this study. Any additional information provided by the District in the future to the Study Team, or found by the Study Team within the public domain, will be reviewed for relevancy to the project and incorporated as reference documentation for the study if appropriate

To facilitate the execution of subsequent project study tasks, the reference documentation and data listed in Attachment A has been categorized by content based upon the Task 5 – Project Baseline categories indicated within the study SOW. Project baseline categories include, but are not limited to, the following:

- Project Limits information;
- Pueblo Reservoir operations and capacities;
- Sediment/material distribution;
- Sediment Yield;
- Water Quality;
- Geomorphology and Forest Fire Impacts;
- Biology: Endangered species and critical habitat;
- Historical and current land use;
- Pueblo Reservoir storage rights;
- Hydrology and Hydraulics within the project limits;
- Pueblo Reservoir storage rights;
- Pueblo Reservoir water use;
- Regulatory Entities;

Furthermore, the reference documentation and data listed in Attachment A is catalogued in accordance to its relevance to the Task 7 – Environmental Assessment and/or Task 8 - Engineering Assessment works. For example, reference documents and data that are catalogued as related to the environmental assessment works are further organized by the appropriate project baseline categories based upon the document or data contents.

Attachment A will serve as the main document for cataloguing project-specific reference documentation and data. At the completion of this study the references indicated within Attachment A will be formally documented within references section of the final Fryingpan-Arkansas Storage Recovery Study Report.

4 Data Gaps Analysis

A gaps analysis was conducted by the Mott MacDonald Team to assess the critical information that is necessary to facilitate the efficient execution of the study works. Critical data gaps are defined as missing information within the reviewed reference documentation or data that may serve as the basis for or be supplemental to the development storage recovery methodologies or alternatives for the environmental and engineering assessment tasks. The critical data gaps identified are tabulated below in Table 1.

Table 1. Data Gaps Analysis Summary:

Item No.	Critical Data Gap	Affiliated Study Tasks	Purpose and Additional Notes
1	Pueblo Reservoir in-situ sediment and debris loading characterization data. For example, sediment cores, borings, grab samples, sediment gradation analysis, etc.	Task 5 – Project Baseline Task 8 - Engineering Assessment	Sediment characterization data will facilitate the development of dredger production estimating, sediment bypass structures analysis, cost estimating, schedule estimating, beneficial sediment reuse, etc.
2.	Historical Pueblo Reservoir operating levels (daily WSE, if available) and reservoir operations rules.	Task 5 – Project Baseline Task 8 - Engineering Assessment	Determination of potential construction windows for sediment removal alternatives and methodology development.
3.	Bathymetric and Topographic Survey Data	Task 5 – Project Baseline Task 8 – Engineering Assessment	Request is pending with the District. Mott MacDonald to sign confidentiality agreements and forward back to the District.

No other critical data gaps have been identified at this time. If needed, additional requests from the Study Team will be developed and documented via email to the District in accordance with Project Communication Plan included within the PMP.

5 Conclusions

The Mott MacDonald Team acknowledges that the reference documentation and data provided to and/or recovered by the Study Team is satisfactory for the purposes of this study. Based upon the identified Data Gaps documented within Section 4 of this memorandum, it is likely that assumptions regarding the in-situ sediment characteristics and gradation of the material currently stored within Pueblo Reservoir may have to be made during the engineering assessment phase (Task 8) of this study.

The Study Team's intent is to continue with the tasked study work unless the District has reservations or has any additional reference documentation or data for review and consideration for inclusion.

Next steps include completing Task 5 – Project Baseline. The key deliverables for Task 5 includes developing the Basis of Assessment (BOA) and submitting Draft 1.0 of the Storage Recovery Alternatives Register.

This document is considered a living document and may be updated throughout the execution of project work.

Reference Document Review and Data Gaps Analysis Summary Table

SECWCD - FRYINGPAN-ARKANSAS STORAGE RECOVERY STUDY
ENGINEERING ASSESSMENT DOCUMENTATION

MOTT MACDONALD

		Submittal 1	Submittal 2	Submittal 3
Draft/Version:	1.0	1.0		
Revision Date:	5/22/2020	5/22/2020		

Document Name	Electronic Document Name	Owner	Author(s)	Project Baseline Categories: Project limits overview	Pueblo Reservoir Operations	Sediment/material distribution and sediment characteristics/toxicology within Pueblo Reservoir	Reservoir bathymetry and regional topography	Regulatory entities	Geomorphology related to past, present, and potential future sedimentation in Pueblo Reservoir and the Arkansas River	Field investigation results	Historical and current land use (e.g. mining, agricultural, parks/recreation)	Critical stakeholders	Pueblo Reservoir storage rights	Hydrology and Hydraulics within the project limits	Other	Document Synopsis/Additional Notes
Pueblo Dam: Study to Raise the Operating Pool for Southeastern Colorado Water and Storage Needs Assessment Enterprise (1999)	Study To Raise The Operating Pool	USBR	John Trojanowski		x									x	x	Study regarding increasing capacity via spillway crest height, and embankment dam raising. Includes cost estimates for the proposed modifications.
SECWCD/Arkansas Basin Future Water and Storage Needs Assessment (1998)	SECWCD Future Water and Storage Needs	SECWCD	GEI Consultants, Inc.		x							x	x	x	x	Contains water supply, use, and rights data for surrounding municipalities in SECWCD. Includes population growth projections.
Storage needs in the Arkansas River Basin (2019)	Storage Needs in the Arkansas River Basin	SECWCD	SECWCD		x								x		x	Storage needs through an assessment of reservoir operations & loss of storage (observed & projected) from 1974-2074. Includes: recovery of storage alternatives with cost estimates associated (dredging included), changing storage patterns, and population growth rate & water use.
Arkansas River Line Diagram Wall Map (2013)	Ark River Line Diagram Map	SECWCD	Applegate Group, Inc.		x									x	x	Comprehensive map of water supply and tributaries in the Fry-Ark Basin.
Pueblo Reservoir 1993 Sedimentation Survey (1994)	Pueblo Reservoir 1993 Sedimentation Survey	USBR	Ronald L. Ferrari	x	x		x		x	x					x	Comprehensive field data study of past (1993) storage-elevation relationship. Includes: data for future surveys, and area-capacity curves regarding sedimentation.
Pueblo Reservoir 2012 Bathymetric Survey (2015)	Pueblo Reservoir 2012 Bathymetric Survey	USBR	Kent Collins, Ronald L. Ferrari	x	x		x		x	x					x	Comprehensive field data survey of past (2012) reservoir topography and storage-elevation relationship. Includes: previous surveys, reservoir operations, area-capacity tables/plots/curves, sediment data summary, and aerial photography.
2012 Multibeam and Single-beam bathymetric survey data (2012)	Pueblo Reservoir 2012 Bathymetric Survey	USBR	Kent Collins, Ronald L. Ferrari			x	x									Pending signed confidentiality agreements and distribution by the USBR.

Notes:

1 **Current Data Gaps: Cost estimates for dredging (1 reference), Sediment distribution/characteristics.**

Reference Document Review and Data Gaps Analysis Summary Table

SECWCD - FRYINGPAN-ARKANSAS STORAGE RECOVERY STUDY
ENVIRONMENTAL ASSESSMENT DOCUMENTATION

MOTT MACDONALD

	Submittal 1	Submittal 2	Submittal 3
Draft/Version:	1.0	1.0	
Revision Date:	5/22/2020	5/22/2020	

Document Name	Electronic Document Name	Owner	Author(s)	Project Baseline Categories: Project limits overview	Pueblo Reservoir Operations	Sediment/material distribution and sediment characteristics/toxicology within Pueblo Reservoir	Reservoir bathymetry and regional topography	Water quality	Forest fires	Regulatory entities	Field investigation results	Biology: Endangered species and critical habitat	Historical and current land use (e.g. mining, agricultural, parks/recreation)	Critical stakeholders	Pueblo Reservoir storage rights	Hydrology and Hydraulics within the project limits	Other	Document Synopsis/Additional Notes
Environmental Assessment: Finding of No Significant Impact (2018)	Excess Capacity Storage Environmental Assessment	USBR												x	x		x	Environmental assessment of temporary excess capacity storage contracting program. Includes project/contract alternatives & summary of potential environmental impacts.
Physical, Chemical, and Biological Characteristics of Pueblo Reservoir, Colorado (1994)	Water Quality 1985-89	USBR	Michael E. Lewis, Patrick Edelmann	x	x			x			x					x	x	Comprehensive water quality study of past conditions (1985-89). Includes description of Pueblo Reservoir & operations.
Water-Quality Data for the Arkansas River Basin, Southeastern Colorado (1996)	Water Quality 1990-93	USBR	Russell G. Dash, Roderick F. Ortiz	x				x			x		x			x	x	Comprehensive water quality study of past conditions (1990-93). Includes: description of study area, and census population data.
Final Environmental Assessment: Pueblo Hydropower Project (2016)	Hydropower Environmental Assessment	USBR		x	x			x		x		x	x	x		x	x	Environmental assessment regarding consequences of hydropower plant operations on: energy/socioeconomic conditions, water quality, fisheries, wildlife/vegetation, endangered species, historic properties, and recreation.
National Wetland Inventory Map	Online database. Click for link.	USFWS	N/A									x	x				x	Online mapping tool that provides information of America's wetland resources. Includes areas of interest such as: wetlands, riparian zones, FWS managed lands, historic wetland data. Data downloads are available.
Compass Colorado's On-line Cultural Resource Database	Online database. Click for link.																	N/A
Species Activity Map (2019)	Online database. Click for link.	CPW	N/A									x					x	GIS layer presenting information on wildlife distributions in Colorado.
Web Soil Survey	Online database. Click for link.	USDA	N/A										x				x	Online mapping tool that provides soil data and information in the upland areas surrounding Pueblo Reservoir.
Colorado Fishing Atlas	Online database. Click for link.	CPW	N/A									x				x	x	Online mapping tool detailing fish species in the area. Also includes stream gage data, topographic maps and aerial photography. Printable report of all associated species available.
National Flood Hazard Layer	Online database. Click for link.	FEMA	N/A													x	x	GIS layer that contains current effective flood hazard data.
Colorado Wetland Inventory	Online database. Click for link.	CNHP	N/A									x	x				x	Online mapping tool that provides the location and classification of wetlands and riparian areas in Colorado.
Colorado Natural Heritage Program Spatial Layers (2019)	Online database. Click for link.	CNHP	N/A									x	x					Various GIS data layers depicting elements by 7.5 Minute USGS Quadrangle, Potential Conservation Areas, Networks of Conservation Areas and Terrestrial Ecological System Patches
Pueblo Reservoir Fish Survey and Management Data (2019)	Click for link.	CPW											x				x	Survey outlining fishery data and forecasting. Includes: recreation amenities, fishing opportunities, and fish stocking data.
2020 Drinking Water Quality Report (2019)	Click for link.	PBWW						x									x	High-level report regarding drinking water from Pueblo Reservoir. Includes source water and detected contaminants data.

Notes:

Reference Document Review and Data Gaps Analysis Summary Table

SECWCD - FRYINGPAN-ARKANSAS STORAGE RECOVERY STUDY
ENVIRONMENTAL ASSESSMENT DOCUMENTATION

MOTT MACDONALD

	Submittal 1	Submittal 2	Submittal 3
Draft/Version:	1.0	1.0	
Revision Date:	5/22/2020	5/22/2020	

Document Name	Electronic Document Name	Owner	Author(s)	Project Baseline Categories: Project limits overview	Pueblo Reservoir Operations	Sediment/material distribution and sediment characteristics/toxicology within Pueblo Reservoir	Reservoir bathymetry and regional topography	Water quality	Forest fires	Regulatory entities	Field investigation results	Biology: Endangered species and critical habitat	Historical and current land use (e.g. mining, agricultural, parks/recreation)	Critical stakeholders	Pueblo Reservoir storage rights	Hydrology and Hydraulics within the project limits	Other	Document Synopsis/Additional Notes
Water Resources Investigations Report (1989)	Click for link.	USGS	Patrick Edelmann	x	x		x	x		x			x			x	x	Comprehensive assessment of water quality within Pueblo reservoir (1985). Also includes: description of drainage basin and reservoir, streamflow & rainfall data, reservoir operations and capacity, and retention times.
Water Quality Portal Data Sites	Online database. Click for link.	USGS	N/A					x								x	x	A data source for the Arkansas River above, below and within Pueblo Reservoir (2017-2019).
Arkansas River Water-Quality Data (1980-1990)	Click for link.	USGS	William Banks					x		x							x	Water quality reports listed and linked from the 1980's to the late 1990's. Input from: Conservancy Districts, local Water Utility companies and State agencies have identified the need for a common data repository of existing basin data from Federal, State, academia, and local sources.
Water Quality Control Commission Regulations	Click for link.	CDPHE	N/A					x									x	Regulations promulgated by the CDPHE present the surface water standards for the entire Arkansas River drainage including Pueblo Reservoir. The regulations (31-32) list use impaired segments and specify the constituents that are exceeded resulting in the impairment listing.
401 Water Quality Certification	Click for link.	CDPHE	N/A					x									x	Water quality certifications under Section 401 of the federal Clean Water Act for projects or actions applicable to the provisions of the Colorado 401 Certification Regulation (No. 82: 5 CCR 1002-82).
Water-Quality Assessment of the Arkansas River Basin, Southeastern Colorado (1998)	Click for link.	USGS	Roderick F. Ortiz, Michael E. Lewis, Mary Jo Radell	x		x	x	x		x			x			x	x	Dated (1990-93) but good water quality information on the Arkansas and Pueblo Reservoir. Includes description of study area, and streamflow data.
Current and Future Challenges to Upper Arkansas Basin Water Supplies (2019)	Click for link.	UAWCD	Ralph Scanga					x	x						x		x	General information on programs/issues in the Upper Arkansas River Basin. Contaminants are noted. Describes the system by which water is and has been allocated in Colorado since statehood
Colorado's Water Plan (2019)	Click for link.	CWCB	N/A										x			x	x	The plan addresses future needs, water supply strategies including storage needs, water conservation and environmental issues. Water storage needs and strategies for meeting needs in the Arkansas Basin are discussed.
Arkansas Basin Roundtable	Click for link.	ABR	N/A					x			x			x			x	The Arkansas Basin Roundtable meets periodically to discuss water supply, water quality, recreation and wildlife issues in the basin and coordinates with others to address water supply shortages and strategies for addressing shortages.
National Interagency Fire Center	Online database. Click for link.	NIFC	N/A						x								x	Online mapping tool for: Active and upcoming wildland incident response, prescribed fires, fuels treatment planning and data collection, fire planning and data sharing for wildfire response.

Notes:

Attachment 2

TM-04-01
Field Investigation Report

Fryingpan – Arkansas Storage Recovery Study

Geomorphic Assessment

Field Investigation Report

1. Purpose

The purpose of the field investigation was to evaluate the nature and sources of sediment contributed to Pueblo Reservoir. Specific tasks included in the field investigation included:

a. Complete preliminary observations of limited reaches of the Arkansas River and selected tributaries with respect to stream channel stability and their geomorphic character.
b. Obtain sediment samples at selected locations and submittal of the samples to the contracted laboratory for size gradation analyses.

2. Project Limits

Typical sources of sediment in surface water systems include sediment produced by channel degradation and erosion, land use and management, wildfires, etc. It is recognized that the sediment contributed within the entire Arkansas River watershed, which covers over 4,000 square miles, can ultimately find its way to Pueblo Reservoir. However, it is recognized that the area contributing directly to the reservoir and within a limited extent upstream likely pose the greatest sources as well as the most likely solutions to sediment control.

Consequently, the 8th order HUC 11020002 Upper Arkansas basin defined the area considered for this effort. The subbasin extends generally from Canon City to Pueblo and encompasses approximately 2,306 square miles (Figure 1).

3. Sediment Sampling Locations

Sediment samples were obtained at ten (10) specific locations which were identified to characterize the sediment delivered to the reservoir and the Arkansas River. The sites are listed below and displayed in Figure 2.

- Site 1. Rock Creek Delta (tributary sediment)
- Site 2. Peck Creek Delta (tributary sediment)
- Site 3. Turkey Creek Delta (tributary sediment)
- Site 4. Rush Creek Delta (tributary sediment)
- Site 5. Red Creek Confluence (tributary sediment)
- Site 6. Channel Movement (Arkansas River mainstem sediment)
- Site 7. Beaver Creek Confluence (tributary sediment)
- Site 8. D/S of Limestone Quarry (tributary sediment)
- Site 9. Eightmile Creek Confluence (tributary sediment)
- Site 10. Hardscrabble Creek Confluence (tributary sediment)

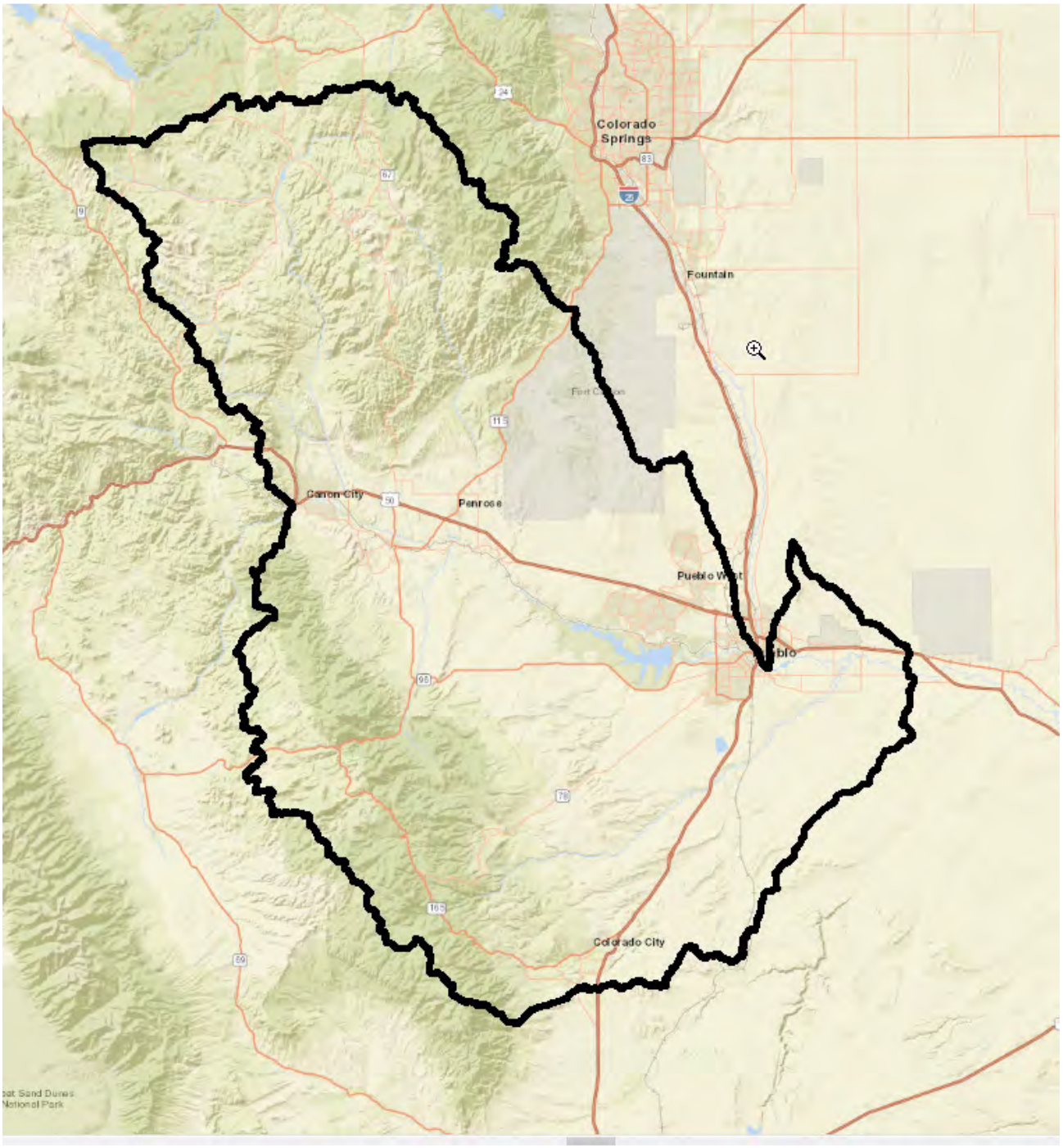


Figure 1. Geomorphic investigation study limit.

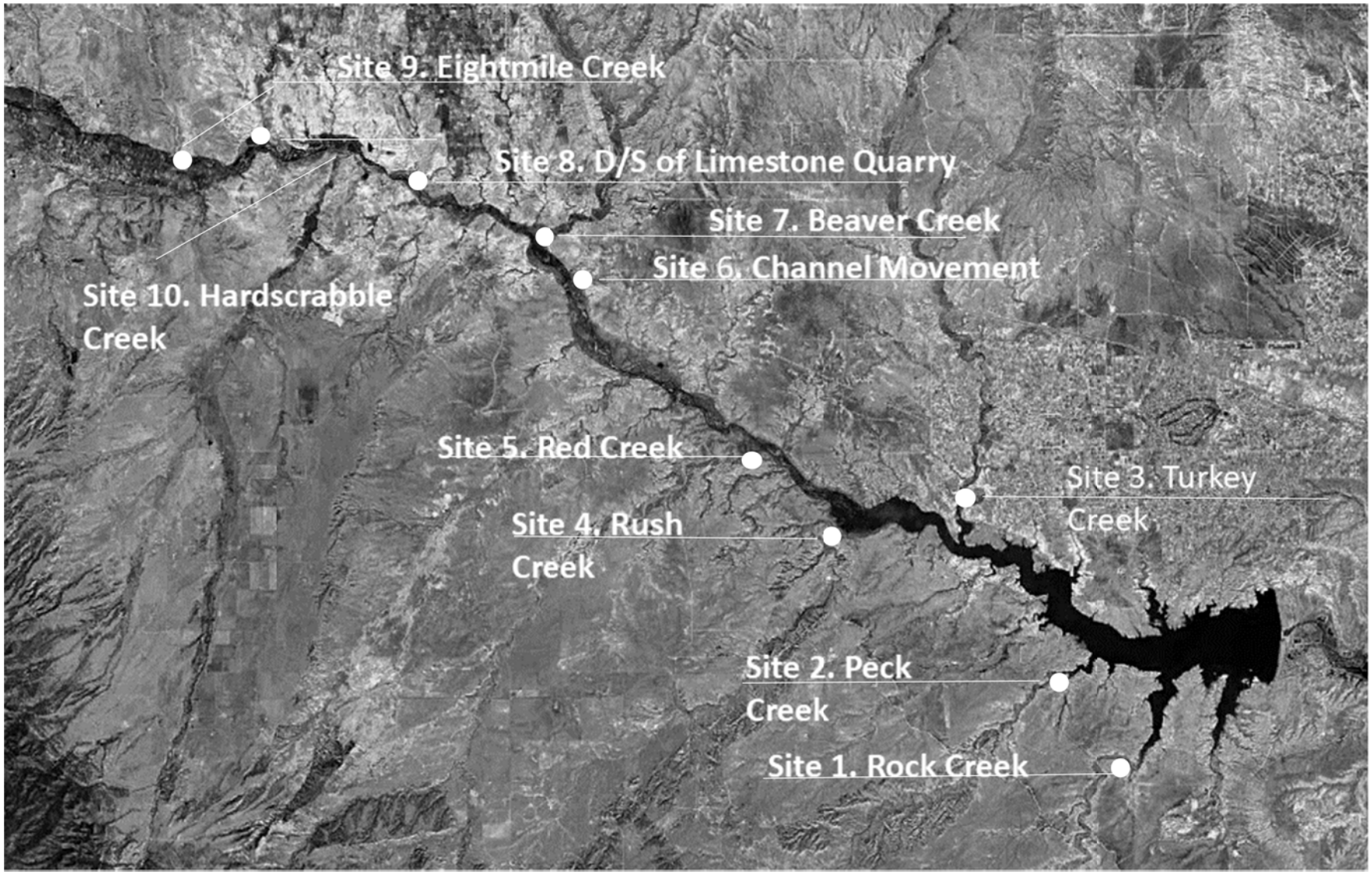


Figure 2. Sediment sampling locations

4. Property Ownership

Surface ownership was determined by reviewing data available online through the Fremont County and Pueblo County Assessors Offices websites. Table 1 tabulates the ownership information obtained.

Consent was not requested for access to Sites 1 through 5 as these were all on federally owned lands within the Pueblo Reservoir State Park.

The five remaining sites (Sites 6 through 10) required coordination with three landowners. Each owner granted consent to access the property and each provided a representative who accompanied the field team to the site while they collected samples and made observations of channel conditions.

5. Field Protocol

All sites, with the exception of Site 9: Eightmile Creek, were sampled during the initial field trip which was conducted between June 3 and June 5, 2020. Site 9 landowners requested they accompany the field crew but were not available during the initial field trip. Consequently, crews completed a second field trip on June 9 when the landowners were available and completed the sampling effort.

Samples were taken to characterize the nature of material actively being transported by the stream. Consequently, samples were taken from depositional features at the point where a stream terminated at Pueblo Reservoir or the Arkansas River. At the two sites located on the Arkansas River itself, samples were taken from exposed point bars.

Samples were obtained at each site location using hand shovel; no mechanized equipment was used. The upper 1 to 2 inches of surface material was removed prior to sampling; this effort provided a “clean” sample of material by eliminating surface material which may have been altered by wind, debris, etc.

Field personnel obtained samples at each site using a hand shovel; no mechanized equipment was used. Two to three samples were placed in separate 1-gallon Ziploc bags and labeled with the site location. Site samples were later composited in a five-gallon bucket and a one-gallon subsample was submitted to the laboratory for gradation analysis.

Photos of each sample site are included as Appendix A.

Results of the laboratory analysis are included as Appendix B.

Site Number	Site Name	Surface Owner	Mailing Address				Site Address		
			Street	City	State	Zip	Street	City	State
1	Rock Creek Delta	United States Bureau of Reclamation	Federal Government / Addresses not listed in assessors office databases						
2	Peck Creek Delta	United States Bureau of Reclamation							
3	Turkey Creek Delta	United States Bureau of Reclamation							
4	Rush Creek Delta	United States Bureau of Reclamation							
5	Red Creek Confluence	United States Bureau of Reclamation							
6	Channel Movement	Mary Wallace	307 W. 19th St	Pueblo	CO	81003-2607	2100 COUNTY ROAD 120	ND	ND
7	Beaver Creek Confluence	Mary Wallace	307 W. 19th St	Pueblo	CO	81003-2607	2100 COUNTY ROAD 120	ND	ND
8	D/S Limestone Quarry	Holcim	6211 ann arbor	Dundee	MI	48131-9527	State Highway 120	Florence	CO
9	Eightmile Creek Confluence	MacKenzie Ranch LLLP 1/2 interest	1340 College Ave	Canon City	CO	81212-3541	ND	ND	ND
		Emmerson Ann M Trust 1/2 interest	No address listed for Emmerson				ND	ND	BD
10	Hardscrabble Creek Confluence	Holcim	6211 ann arbor	Dundee	MI	48131-9527	State Highway 120	Florence	

Note: Data were obtained from the following sources unless noted otherwise:

Pueblo County Assessor Webpage: https://county.pueblo.org/assessor/assessor-home

ND = value not provided by Pueblo or Fremont county databases

Table 1. Sample site surface ownership

APPENDIX A

Sample Site Photos

Site 1. Rock Creek Delta (tributary sediment)

Site 2. Peck Creek Delta (tributary sediment)

Site 3. Turkey Creek Delta (tributary sediment)

Site 4. Rush Creek Delta (tributary sediment)

Site 5. Red Creek Confluence (tributary sediment)

Site 6. Channel Movement (Arkansas River mainstem sediment)

Site 7. Beaver Creek Confluence (tributary sediment)

Site 8. D/S of Limestone Quarry (tributary sediment)

Site 9. Eightmile Creek Confluence (tributary sediment)

Site 10. Hardscrabble Creek Confluence (tributary sediment)

APPENDIX B
LABORATORY ANALYSES

June 24, 2020

Mott MacDonald, LLC
12647 Alcosta Blvd., Suite 275
San Ramon, California 94583

Attn: Mr. Chris Metzger – Sr. Vice President
P: (408) 876-6039

Re: Laboratory Test Results Letter
Fryingpan-Arkansas Project Storage Recovery Study – Phase 1
600 Pueblo Reservoir Road
Pueblo, Colorado
Terracon Project No. 25205088

Mr. Metzger:

Terracon has completed the laboratory testing for this project in general accordance with the Subcontractor Agreement dated April 28, 2020 provided by Mott MacDonald, LLC for the above referenced project.

Sieve gradation testing to sieve size 200 was performed on samples delivered to our office by Anderson Consulting Engineers and arrived at our office labeled as Sites 1 through 10. The results of sieve gradation testing performed on the samples received for this project are presented in the following table and are attached:

Sample Location	Depth	Percent Finer by Weight					
		Sieve Size					
		2 inch	3/4 inch	No. 4	No. 10	No. 40	No. 200
Site 1	Surface	100	89	42	36	33	30
Site 2	Surface	100	85	46	28	15	8
Site 3	Surface	100	100	99	98	87	76
Site 4	Surface	100	100	100	100	96	83
Site 5	Surface	100	100	86	70	20	9
Site 6	Surface	100	100	100	100	99	71
Site 7	Surface	100	100	79	60	28	1
Site 8	Surface	100	100	77	63	27	3
Site 9	Surface	100	100	100	99	98	15
Site 10	Surface	100	100	100	100	98	9

We appreciate being of service to you in the geotechnical engineering phase of this project. If you have any questions concerning this letter, please do not hesitate to contact us.

Sincerely,
TERRACON CONSULTANTS, INC.

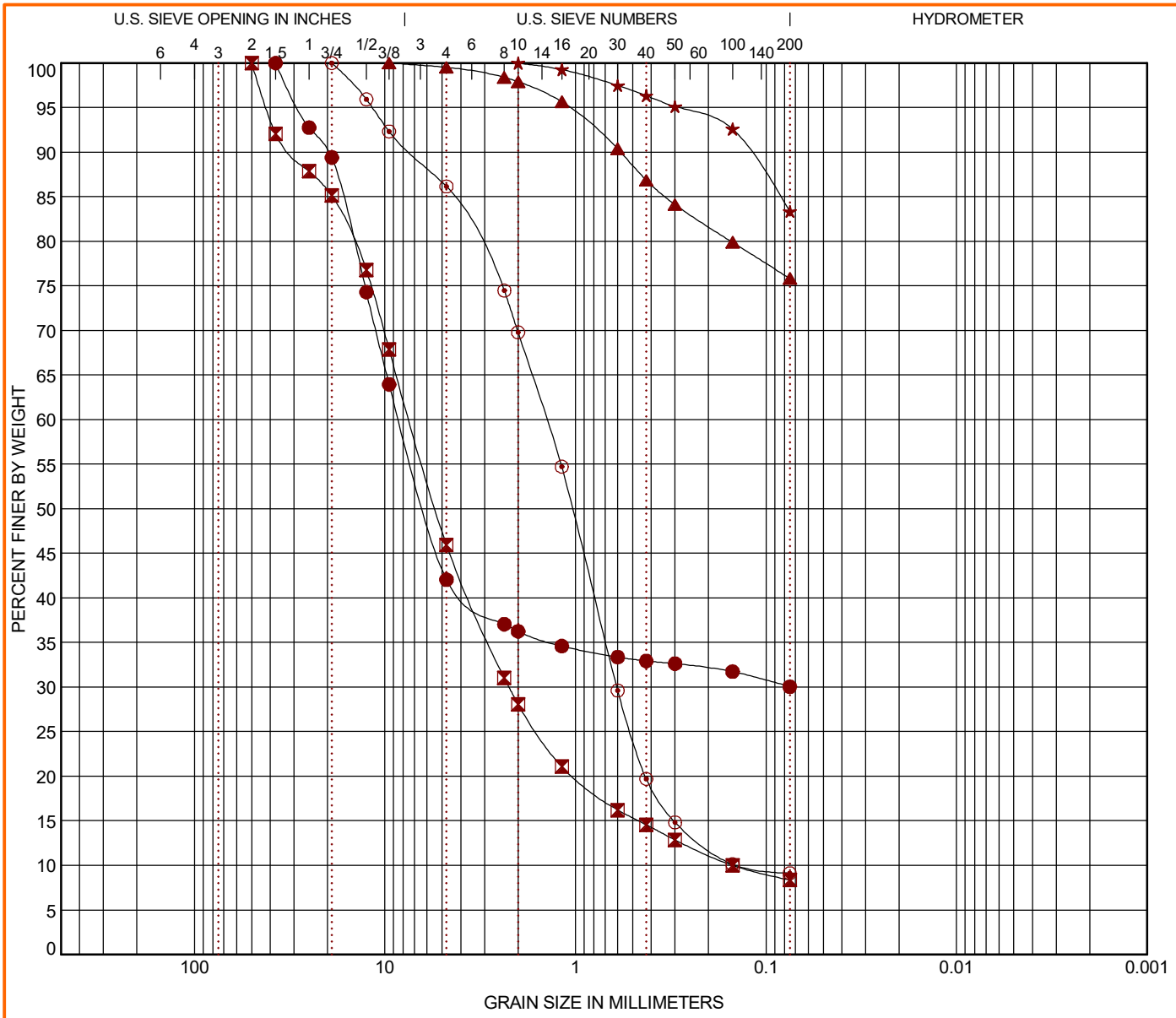
Nicholas M. Novotny, P.G., C.E.G.
Senior Staff Geologist

Scott B. Myers, P.E.
Regional Senior Consultant

Attachment: Grain Size Analysis Results

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● Site 1	Surface							
⊠ Site 2	Surface						4.48	49.48
▲ Site 3	Surface							
★ Site 4	Surface							
⊙ Site 5	Surface						1.88	10.32

Boring ID	Depth	D_{90}	D_{50}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
● Site 1		19.938	6.109			58.0	12.0		30.0	
⊠ Site 2		30.711	5.401	2.229	0.15	54.1	37.6		8.3	
▲ Site 3		0.578				0.5	23.7		75.8	
★ Site 4		0.123				0.0	16.6		83.4	
⊙ Site 5		7.315	1.039	0.606	0.138	13.8	77.0		9.1	

PROJECT: Fryingpan-Arkansas Project Storage Recovery Study - Phase I

PROJECT NUMBER: 25205088

SITE: 600 Pueblo Reservoir Road
Pueblo, Colorado

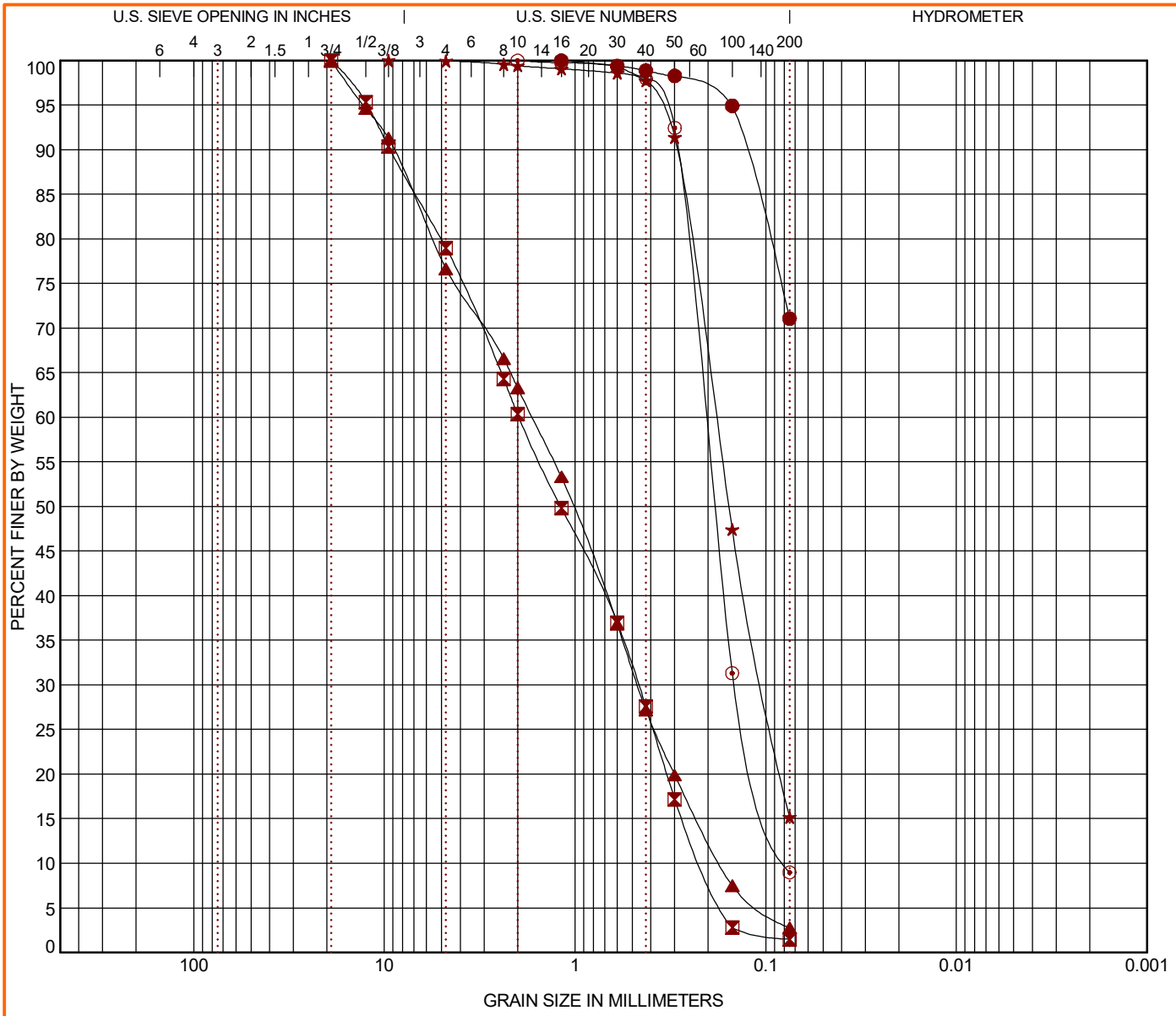
Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

CLIENT: Mott MacDonald, LLC

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE USCS-2_SCOUR 25205088 FRYINGPAN-ARKANSA.GPJ TERRACON_DATATEMPLATE.GDT 6/19/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
Site 6	Surface							
Site 7	Surface	POORLY GRADED SAND with GRAVEL (SP)					0.52	9.26
Site 8	Surface	POORLY GRADED SAND with GRAVEL (SP)					0.76	9.73
Site 9	Surface							
Site 10	Surface						1.29	2.68

Boring ID	Depth	D_{90}	D_{50}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
Site 6		0.13				0.0	28.9		71.1	
Site 7		9.307	1.189	0.464	0.212	21.0	77.5		1.5	
Site 8		8.941	1.029	0.47	0.173	23.3	73.9		2.8	
Site 9		0.293	0.156	0.103		0.1	84.8		15.1	
Site 10		0.292	0.185	0.144	0.077	0.0	91.0		9.0	

PROJECT: Fryingpan-Arkansas Project Storage Recovery Study - Phase I

PROJECT NUMBER: 25205088

SITE: 600 Pueblo Reservoir Road
Pueblo, Colorado

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

CLIENT: Mott MacDonald, LLC

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE USCS-2_SCOUR 25205088 FRYINGPAN-ARKANSA.GPJ TERRACON_DATATEMPLATE.GDT 6/19/20

Attachment 3

TM-05-01
Fryingpan-Arkansas Storage Recovery
Basis of Assessment Technical Memorandum

MOTT MACDONALD

Technical Memorandum

Project:	SECWCD Fry-Ark Storage Recovery Study		
Our reference:	TM-05	**Your reference:**	TM-05
Prepared by:	John Dawson	**Date:**	June 19, 2020
Approved by:	Warren J. Paul	**Checked by:**	John Chesterton
Subject:	DRAFT Basis of Assessment		

1 Introduction

The Mott MacDonald team (Team) has prepared this Basis of Assessment Technical Memorandum (TM) for the Southeastern Colorado Water Conservancy District (District) in order to summarize the results of Task 5 - Project Baseline for the Fryingpan-Arkansas (Fry-Ark) Project Storage Recovery Study. The TM also incorporates results of Task 3 – Document Review and Data Gaps Analysis, and Task 4 – Project Site Visit and Field Investigation. Pursuant to Task 4, a field investigation report, providing an overview of the investigation works and sediment sampling data, will be provided at a later date.

The purpose of this TM is to document the baseline information that will be used to develop the Task 7 – Environmental Assessment and Task 8 – Engineering Assessment reports, as well as the draft and final Fry-Ark Storage Recovery Study Report.

2 Project Baseline Categories

Project baseline categories pertinent to the Fry-Ark Storage Recovery Study are summarized within the subsequent sub-sections of this Basis of Assessment and generally include the following:

1. Project Limits and Key Baseline Data;
2. Pueblo Reservoir operations and capacities;
3. Sediment/material distribution;
4. Sediment Yield;
5. Water Quality;
6. Geomorphology and Forest Fire Impacts;
7. Biology: Endangered species and critical habitat;
8. Historical and current land use;
9. Pueblo Reservoir storage rights and water use;
10. Regulatory Entities Summary

3 Basis of Assessment

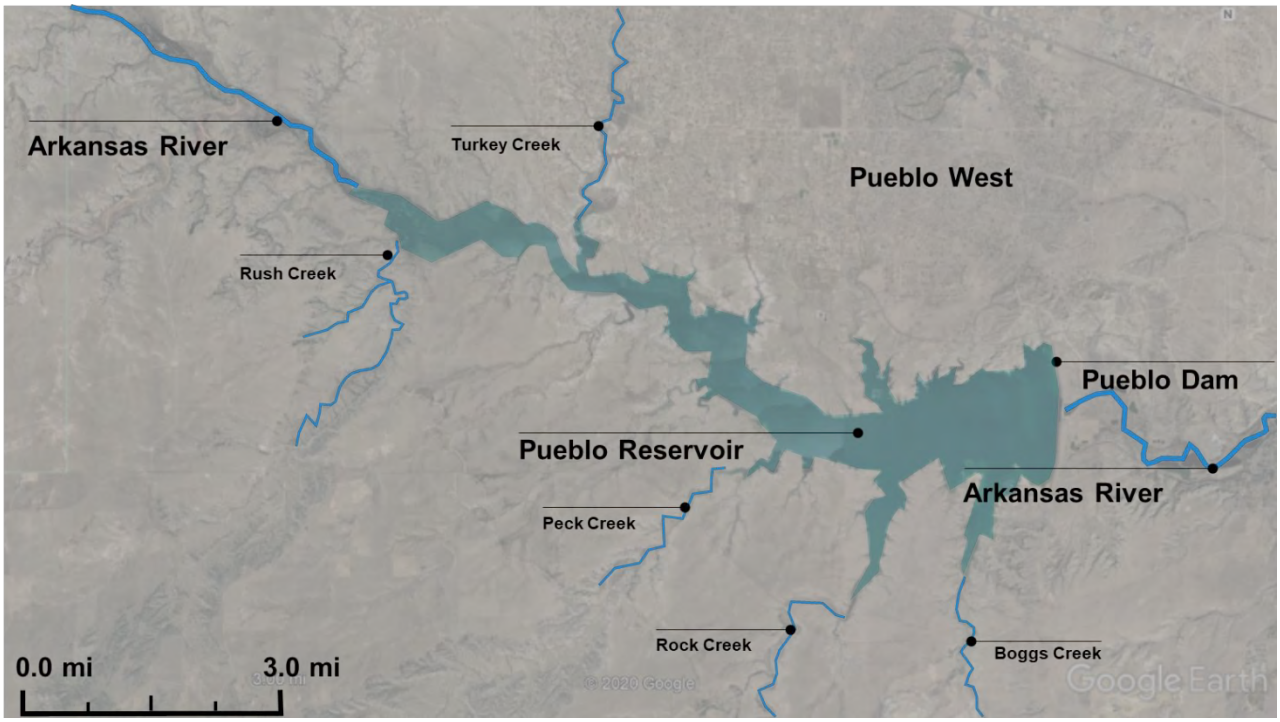
To facilitate the execution of the subsequent project study tasks, the following subsections document the Basis of Assessment categorized per the project baseline categories listed in Section 2. This information serves as the basis for the Task 7 – Environmental Assessment and Task 8 – Engineering Assessment work.

3.1 Project Limits and Key Baseline Data

While the Fryingpan-Arkansas (Fry-Ark) Storage Recovery Study limits are well defined within the limits of Pueblo Reservoir, the overall project limits may vary depending upon the project baseline category considered. For the purposes of Task 7 and Task 8, the storage recovery project area limits extend from Pueblo Dam (downstream limit) to the upper Arkansas River delta within Pueblo Reservoir (upstream limit), approximately 11.4 miles upstream of the dam face at an assumed water surface elevation of 4,900 feet (USBR 2015). The elevation of the uncontrolled spillway at Pueblo Dam is elevation 4,898.70 feet.

The approximate project limits of the Fry-Ark Storage Recovery Study are shown schematically in **Figure 3.1** below. The figure identifies Pueblo Reservoir, Pueblo Dam, the Arkansas River (main tributary and outlet) on the upstream and downstream end of Pueblo Reservoir, in addition to the five main tributary creeks that flow into the reservoir. Pueblo Reservoir tributaries are shown in blue in the figure, the reservoir itself (study area) is depicted as a turquoise color. The focus of the storage recovery assessment works will be within the reservoir study area indicated within the figure unless otherwise indicated herein and/or within subsequent project documents.

Figure 3.1: Pueblo Reservoir Storage Recovery Study Area



Project limits information and key baseline data that will be used for the assessment works are summarized within **Table 3.1**. The table includes key baseline data specific to Pueblo Reservoir, Pueblo Dam and the outlet structures located within the concrete buttress and/or earthen embankment dam sections. Project parameters, dimensions, and references are indicated within **Table 3.1** to ensure that the Mott MacDonald Team members are using the most up-to-date information that is available.

Table 3.1: Pueblo Reservoir – Key Baseline Data

Description	Parameter	Dimension
Pueblo Reservoir	Original Total Storage Capacity[1]	358,121 ac-ft
	1993 Total Storage Capacity	349,940 ac-ft
	2012 Total Storage Capacity	338,374 ac-ft
	Reservoir Length[2]	11.4 miles
	Reservoir Width[3]	0.8 miles
	Combined Inflow[4]	589,890 ac-ft
	Drainage Area	4,669 square miles
Pueblo Dam	Dam Crest Elevation	4,925.0 feet
	Maximum Structural Height of Dam	250 feet
	Hydraulic Height of Dam	191 feet
	Dam Length	10,200 feet
	Uncontrolled Spillway Crest Elevation	4,898.7 feet
Outlet 1 – Bessemer Ditch	Design Capacity	393 cfs
Outlet 2 – River Outlet	Design Capacity	1,120 cfs
	Intake Invert Elevation[5]	4,764.0 feet
Outlet 3 – Spillway Outlets	Design Capacity	8,190 cfs (max discharge)
Outlet 4 – Fish Hatchery Outlet	Design Capacity	30 cfs (max discharge)
Outlet 5 – South Outlet	Design Capacity	345 cfs (max discharge)
Notes and References.		
1. Values for Pueblo Reservoir storage capacity taken at spillway crest elevation 4,898.7. The original capacity was recomputed using the segmented least squares fit option of the Bureau of Reclamation program ACAP.		
2. Approximate length of reservoir at elevation 4,900.0 (USBR, 2015)		
3. Average width determined by dividing the surface area by the reservoir length at elevation 4,900.0.		
4. Calculated mean annual inflow to Pueblo Reservoir for water years 1974 through 2012.		
5. The inlet sill to the lowest outlet, top of dead storage elevation 4,764 feet.		

3.2 Pueblo Reservoir Operations and Capacities

As the terminal storage facility for the Fryingpan-Arkansas Project, Pueblo Reservoir operations and capacities are allocated such that the facility continues to provide irrigation and municipal water, flood control storage, wildlife and recreation benefits, and electrical power generation. Pueblo Reservoir operations and storage capacities are summarized in the following subsections for the purposes of documenting the general reservoir operations information (forebay elevations) and historical storage allocation capacities as they relate to storage recovery within the project area limits.

3.2.1 Pueblo Reservoir Operations

Forebay water surface elevation data at Pueblo Dam, provided online by the USBR, will be assessed during Task 8 - Engineering Assessment. Reservoir operations information will be used for a variety of purposes to facilitate the assessment work. To provide additional context, several assessment activities are listed below:

- Develop potential in-water work windows;
- Assess potential construction equipment access (land-based and in-water equipment);
- Assess potential alternatives/methodologies for storage recovery (sediment removal and reservoir expansion);
- Develop assumptions regarding Pueblo Reservoir users and seasonal impacts;
- Develop recommendations for reservoir operation modifications; and
- Other applications.

Previously recorded minimum and maximum forebay elevations, as well as inflow estimates to Pueblo Reservoir were provided by the USBR and documented as part of the 2012 sedimentation study (USBR 2012). This information was tabulated by the USBR (USBR 2015) and is shown in **Figure 3.2** below.

Figure 3.2: Reservoir Operations Table 1974-2012 (USBR 2015)

45. RANGE IN RESERVOIR OPERATION [10]

YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF	YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF
1974	4,792.6	4,776.6	448,200	1975	4,800.4	4,790.5	567,900
1976	4,821.8	4,800.1	414,900	1977	4,830.2	4,799.6	234,000
1978	4,802.2	4,779.7	401,500	1979	4,822.1	4,797.0	581,400
1980	4,835.6	4,799.5	779,300	1981	4,879.6	4,820.0	327,400
1982	4,837.3	4,798.6	618,600	1983	4,879.6	4,820.0	944,100
1984	4,884.3	4,868.0	1,007,400	1985	4,886.9	4,875.0	978,000
1986	4,883.8	4,875.8	767,400	1987	4,881.9	4,872.6	792,400
1988	4,881.1	4,851.2	454,200	1989	4,873.7	4,838.6	467,600
1990	4,851.5	4,828.2	427,200	1991	4,854.5	4,824.5	506,400
1992	4,856.5	4,823.3	522,300	1993	4,864.0	4,834.3	666,900
1994	4,868.4	4,834.4	600,900	1995	4,881.5	4,834.2	1,258,000
1996	4,888.4	4,866.4	640,900	1997	4,885.6	4,865.5	781,600
1998	4,880.7	4,852.1	580,600	1999	4,881.6	4,851.4	759,900
2000	4,885.3	4,856.0	509,300	2001	4,873.4	4,834.1	461,200
2002	4,851.7	4,826.3	202,300	2003	4,840.7	4,820.6	334,500
2004	4,841.6	4,819.9	361,100	2005	4,851.2	4,831.7	411,100
2006	4,855.7	4,831.8	485,000	2007	4,866.6	4,840.7	635,100
2008	4,880.3	4,853.0	734,200	2009	4,879.7	4,860.2	605,100
2010	4,882.6	4,863.5	525,800	2011	4,882.6	4,857.8	622,400
2012	4,879.0	4,857.2	176,700				

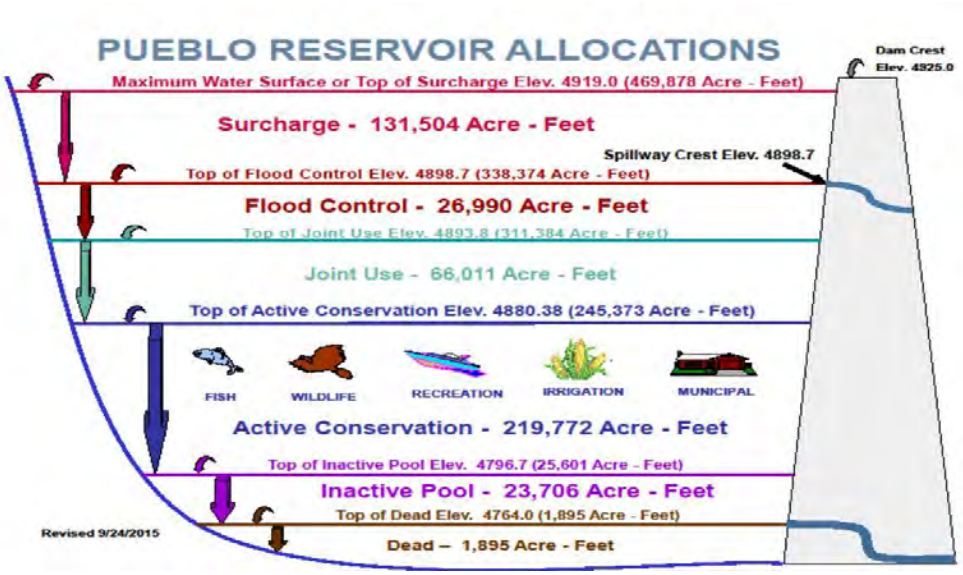
The maximum forebay elevation within Pueblo Reservoir was recorded in 1996 (El. 4,888.4 feet, approximately 10 feet below the top of the Flood Control Storage elevation). The minimum forebay elevation within the Pueblo Reservoir was recorded in 1974 (El. 4,776.6 feet) shortly after dam commissioning and prior to the initiation of normal operations within the Reservoir which began in August of 1975. Since 1983, recorded minimum reservoir elevations have not been lower than el. 4,819.9 feet, which occurred in 2004. Updated forebay water surface elevation statistics will be developed and documented as part of Task 8 - Engineering Assessment.

3.2.2 Pueblo Reservoir Capacities

Following Pueblo Dam closure in January of 1974, two survey (bathymetric and topographic) programs have been conducted by the USBR within Pueblo Reservoir for the purposes of estimating reservoir capacity losses due to long-term sediment and debris accumulation (USBR 1994) (USBR 2015). The first survey program was completed in May of 1993 (approximately 19.3 years post dam closure), the second survey program was completed in May of 2012 (approximately 38.3 years post dam closure). Since the completion of the 2012 survey program, updates to programs, survey means and methods, and calculations conducted by the USBR have been modified slightly within updated capacity estimates for storage allocation elevations within the reservoir. However, cumulative storage capacity estimates have not changed since the 2012. Approximately 20,000 acre-feet storage capacity has been lost within Pueblo Reservoir due to long-term sediment and debris accumulation.

Figure 3.3, developed by the USBR in September of 2015, shows the most recent storage allocation capacity information for Pueblo Reservoir and will serve as the main reference for storage capacity/allocation within Pueblo Reservoir for the Fry-Ark Storage Recovery Study.

Figure 3.3: 2015 Pueblo Reservoir Allocations (USBR 2015)



Furthermore, a summary overview of storage allocations, including top elevation and capacities are summarized within **Table 3.2** below. Subsequent to dam closure in 1974, sedimentation studies conducted in 1993 and 2012 provide updated allocation storage capacities. Additionally, allocation capacity estimates (referenced to **Figure 3.3** above) are documented within the table as they are slightly different from the storage allocation capacities documented in 2012.

Table 3.2: Storage Allocation Summary and Capacity Loss Estimates (USBR 2015)

Storage Allocation	Top of Pool Elevation (Feet)	Original Capacity (Acre-Feet)	1993 Capacity (Acre-Feet)	2012 Capacity (Acre-Feet)	2015 Capacity (Acre-Feet)	Capacity Loss – 1974 to 2015 (Acre-Feet)
Surcharge	4,919.0	131,504	131,504	131,504	131,504	0
Flood Control	4,898.7	26,992	27,044	26,990	26,990	2
Joint Use	4,893.8	66,266	65,716	65,522	66,011	255
Active Conservation	4,880.5	234,210	229,059	220,261	219,772	14,438
Inactive Pool	4,796.7	26,895	25,792	23,706	23,706	3,189
Dead	4,764.0	3,758	2,329	1,895	1,895	1,863
					Total	**19,747**[1]

Notes: 1. Calculated below the top of Flood Control pool, el. 4,898.7 feet. Note, cumulatively the total capacity loss for 2012 and 2015 are the same. This would suggest that capacity calculations for each allocation were updated by the USBR between 2012 and 2015 in lieu of having new elevation survey data in 2015.

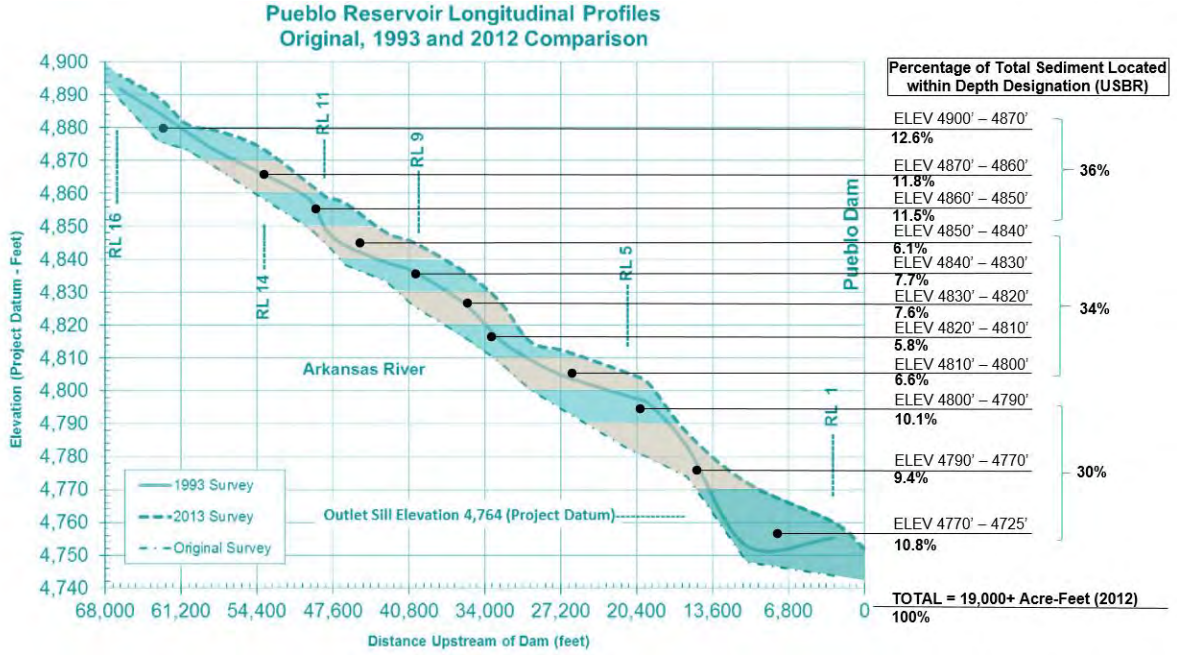
Following the last bathymetric survey program conducted within Pueblo Reservoir in May of 2012 by the USBR, it was calculated that more than 7% of the total storage capacity below the top of the Joint Use allocation (el. 4,893.8), had been lost to fluvial sedimentation and debris accumulation within the reservoir (USBR 2015). It is certain that this percentage loss of storage capacity within Pueblo Reservoir has increased since 2012 but has yet to be confirmed with subsequent survey programs and new capacity estimates. Based on the information in the 2012 bathymetric survey (USBR 2015), the in-situ volume of sediment deposition within the Pueblo Reservoir project area limits will be assumed to be 20,000 acre-feet for the Fry-Ark Storage Recovery Study.

3.3 Sediment/Material Distribution and Characterization within Pueblo Reservoir

3.3.1 Sediment/Material Distribution within Pueblo Reservoir

Estimates of accumulated sediments and debris deposited within Pueblo Reservoir since dam closure is documented within the 1993 and 2012 sediment survey program reports (USBR 1994) (USBR 2015). To illustrate the sediment accumulation within the reservoir study area limits, the USBR plotted the thalweg (lowest elevation within the Arkansas River plotted over multiple cross-sections/range lines) from Pueblo Dam (downstream limit) to approximately 12 miles up the Arkansas River. The longitudinal profile of sediment accumulation within Pueblo Reservoir is shown in **Figure 3.4** below.

Figure 3.4: Sediment Distribution with the Pueblo Reservoir study area limits (USBR 2015)



From right to left, the horizontal axis indicates the distance from Pueblo Dam measured in feet. The left vertical axis represents the elevation (project datum, in feet). Plotted within the figure are three lines. The bottom line (dashed) indicates the estimated thalweg elevations of Pueblo Reservoir and the Arkansas River at dam closure (Original Survey) plotted as a function of distance from Pueblo Dam. The middle line (solid) indicates the thalweg elevations following the 1993 sedimentation survey works. The top line (dashed) indicates the thalweg elevations following the 2012 bathymetric survey program.

Colors depicted within the figure are provided to separate the different elevations ranges depicted within the figure. Storage capacity loss percentages are shown on the right vertical axis and are relative to the total capacity loss measured in 2012 below the top of the joint use pool elevation.

Based upon **Figure 3.4**, sediment accumulation within the reservoir is mostly uniform in thickness. Of the 20,000 acre-feet of storage capacity lost, approximately 36% of the accumulated materials within Pueblo Reservoir are located within elevation range 4,900 to 4,850 feet, 34% within elevation range 4,850 to 4,800 feet, and 30% within elevation range 4,800 to 4,740. The highest percentage of total sediment accumulation within the reservoir study limits (12.6%) is located within elevation range 4,900 to 4,870 feet.

Sediment/material distribution within Pueblo Reservoir will be considered as part of the Task 8 – Engineering Assessment work for a variety of purposes. For example, the construction engineering assessment will consider if land-based equipment is appropriate for sediment removal works (excavation in the dry) within the upper reaches of Pueblo Reservoir based upon, among other factors, in-situ sediment volumes, estimated production rates and the operational parameters of Pueblo Reservoir discussed in Section 3.2.1.

3.3.2 Sediment Characterization within Pueblo Reservoir

Following the Task 3 – Reference Documentation and Data Gaps Analysis work, sediment grain size analysis and characterization data within Pueblo Reservoir was identified as a critical data gap by the Mott MacDonald Team. To facilitate the collection of this information, and upon receiving District approval and private property permissions, the Mott MacDonald team conducted a field investigation to obtain sediment samples at ten (10) specific locations which were identified in an effort to characterize the sediment delivered to the reservoir via the Arkansas River and its local tributaries. Sediments collected by the Mott MacDonald Team during the field investigation works were collected at land access points without the use of watercraft. The sediment characterization sites are listed below in Table 3.3 and shown in **Figure 3.5** below.

Table 3.3: June 2020 Arkansas River and Pueblo Reservoir sediment sampling site locations.

Site No.	Site Name	Source Type
Site 1	Rock Creek Delta	Tributary sediment, Pueblo Reservoir
Site 2	Peck Creek Delta	Tributary sediment, Pueblo Reservoir
Site 3	Turkey Creek Delta	Tributary sediment, Pueblo Reservoir
Site 4	Rush Creek Delta	Tributary sediment, Pueblo Reservoir
Site 5	Red Creek Confluence	Tributary sediment, Arkansas River Sediment
Site 6	Arkansas Mainstem	Arkansas River Sediment
Site 7	Beaver Creek Confluence	Tributary sediment, Arkansas River Sediment
Site 8	Downstream of Limestone Quarry	Arkansas River Sediment
Site 9	Eightmile Creek Confluence	Tributary sediment, Arkansas River Sediment
Site 10	Hardscrabble Creek Confluence	Tributary sediment, Arkansas River Sediment

Figure 3.5: June 2020 Arkansas River and Pueblo Reservoir sediment sampling site locations

Sediment samples collected during the field investigation works have been delivered to a qualified laboratory for analyses. Particle size gradation will be determined for each sample to a minimum sieve size of 200 (0.074 mm).

Finally, during the field sediment sampling effort, observations were documented pertinent to stream channel conditions, sediment deposition patterns (i.e. Point bars, alternate bars, deltaic formations, etc.), bank erosion, channel degradation, profile, and other items of interest.

Additional reference documentation and data requests have been sent to USBR and the Albuquerque District of the U.S. Army Corp of Engineers (USACE) by the to obtain raw files from the 2012 single and multi-beam bathymetric surveys, as well as sediment investigation reports conducted within John Martin Reservoir, which is located downstream of Pueblo Reservoir. An updated draft of this memorandum will be delivered to the District in final form once the field investigation results and the additional federal agency data is received.

3.4 Sediment Yield

Evaluation of sediment yield within the study area limits is characterized and described using existing data from the 1993 and 2012 sediment survey studies conducted by the USBR and tabulated within Table 3.4 below.

Table 3.4: Estimated Sediment Yield for Pueblo Reservoir since Dam Closure (USBR 2015)

Period (Month-Year to Month-Year)	Period (Years)	Pueblo Reservoir Drainage Area (square miles)	Estimated Sediment Yield per Annum (Acre-Feet per square mile)	Approximate Annual Capacity Loss (Acre-Feet)	Approximate Sediment Volume Deposited per Annum (cubic yards)[1]
January-1974 to May 1993	19.3	4,669	0.087	410	660,000
May 1993 to May 2012	19.0	4,669	0.125	583	940,000
January 1974 to May 2012	38.3	4,669	0.106	496	800,000

References and Notes: 1. 1-Acre-foot is approximately 1,613 cubic yards.

For the purposes of this study, a range of sediment yield values will be used during the Task 8 – Engineering assessment to develop mitigative alternatives/methodologies for reducing sedimentation within Pueblo Reservoir. This information may also be used to develop ranges in approximate storage capacity loss in the years following the 2012 sedimentation study works by the USBR.

3.5 Water Quality

3.5.1 Ambient Water Quality

Water quality in Pueblo Reservoir is generally good. Pueblo Reservoir is the main raw water supply for the City of Pueblo. The Pueblo Board of Water Works operates an intake from Pueblo Reservoir. The Pueblo Board of Water Works reported no violations of drinking water standards in 2016 (Pueblo Board of Water Works 2017).

Pueblo Reservoir also stores and supplies water for Colorado Springs Utilities' (CSU) Southern Delivery System. CSU maintains a diversion directly from Pueblo Dam.

Pueblo West also diverts water directly from Pueblo Reservoir for treatment in their Water Treatment Plant.

The following potential contamination sources were reported by the Colorado Department of Public Health and Environment (CDPHE) in 2004 (Pueblo Board of Water Works 2004):

- Aboveground, underground, and leaking storage tank sites (3)
- Solid waste sites (3)
- Existing abandoned mine sites (44)
- Other facilities (3)

A report prepared by the U.S. Geological Survey (Radell, Ortiz and Lewis 1998) noted that the median pH at Portland was 8.4 and dissolved oxygen at all stations was above 6.0 mg/L. Dissolved solids and major ions in Pueblo Reservoir were all below limits set for protection of aquatic fauna.

3.5.2 State Water Quality Regulations

The following CDPHE water quality regulations constitute a possibly incomplete list of State of Colorado Water Quality Regulations relevant to the Fry-Ark Storage Recovery Study (CDPHE 2018):

Regulation 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31), section 31.11.(1) states:

> *"(1) Except where authorized by permits, BMPs, 401 certifications, or plans of operation approved by the Division or other applicable agencies, state surface waters shall be free from substances attributable to human-caused point source or nonpoint source discharge in amounts, concentrations or combinations which:*
>
> *(a) for all surface waters except wetlands;*
>
> *(i) can settle to form bottom deposits detrimental to the beneficial uses. Depositions are stream bottom buildup of materials which include but are not limited to anaerobic sludges, mine slurry or tailings, silt, or mud; or*
>
> *(ii) form floating debris, scum, or other surface materials sufficient to harm existing beneficial uses; or*
>
> *(iii) produce color, odor, or other conditions in such a degree as to create a nuisance or harm existing beneficial uses or impart any undesirable taste to significant edible aquatic species or to the water; or*
>
> *(iv) are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life; or*
>
> *(v) produce a predominance of undesirable aquatic life; or*
>
> *(vi) cause a film on the surface or produce a deposit on shorelines…"*

The regulation further states: "Suspended solid levels will be controlled by Effluent Limitation Regulations, Basic Standards and Best Management Practices (BMPs)"

Regulation 32: Classifications and Numeric Standards for Arkansas River Basin (5 CCR 1002-32) (CDPHE 2019).

The following standards (among others) apply to the proposed project:

> *(1) Temperature: All waters of the Arkansas River Basin are subject to the following standard for temperature.*
>
> *(Discharges regulated by permits, which are within the permit limitations, shall not be subject to enforcement proceedings under this standard). Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to the resident aquatic life. This standard shall not be interpreted or applied in a manner inconsistent with section 25-8-104, C.R.S.*

Both Regulation 31 and Regulation 32 contain antidegradation standards that will be applied to this project. Variances can be granted for temporary impacts but given the duration and magnitude of any reservoir dredging operation, a variance is not a certain outcome. For projects involving the scope, complexity and unique nature of Fryingpan-Arkansas Storage Recovery, considerable analysis and modeling will be required by the CDPHE. Recent 401 Certification evaluations have required extensive studies, water quality, and flow modeling and analyses to determine impacts and develop mitigation plans.

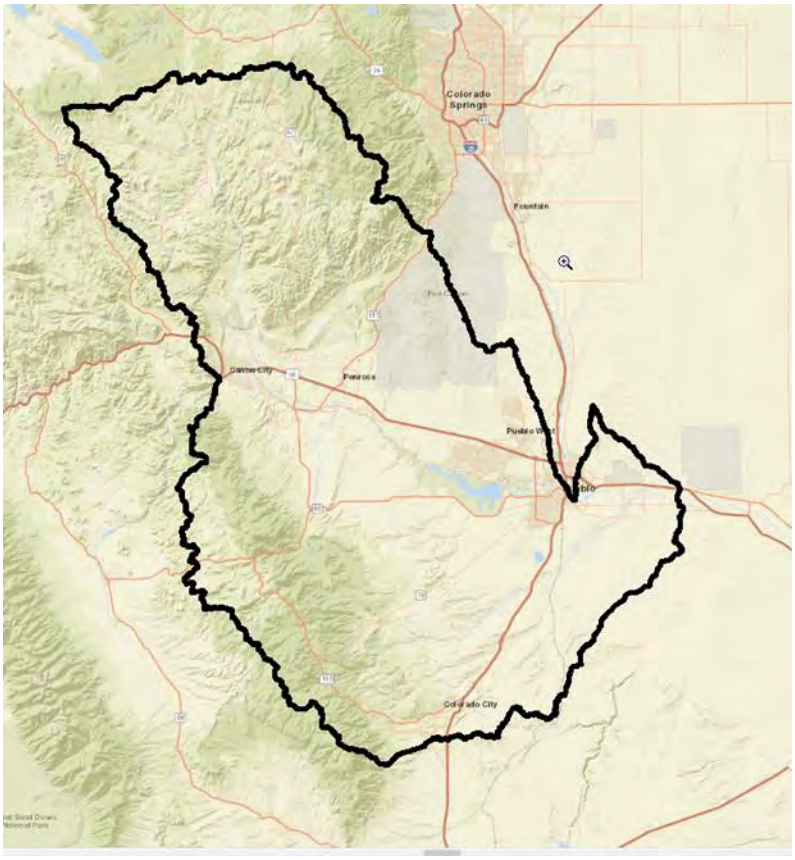
It is also worth noting that CDPHE will likely require that water that will be discharged from decanting basins to receiving waters receive treatment to reduce turbidity, mitigate temperature, adjust pH, and to adjust the dissolved oxygen. Monitoring of the discharged water will be required.

3.6 Geomorphology and Forest Fire Impacts

The objective of the geomorphic investigation is to evaluate the nature and sources of sediment contributed to Pueblo Reservoir. Typical sources of sediment in surface water systems include sediment produced by channel degradation and erosion, land use and management, wildfires, etc. The sediment contributed within the entire Arkansas River watershed above Pueblo Reservoir, which covers approximately 4,669 square miles, can ultimately find its way to Pueblo Reservoir. However, the area contributing directly to the reservoir and a limited reach of the river extending upstream likely is the major source of Pueblo Reservoir sediment and likely offers the best opportunities for sediment control.

Consequently, the 8th order HUC 11020002 Upper Arkansas Basin has been adapted as the area considered for this study. The sub-basin extends generally from Canon City to Pueblo and encompasses approximately 2,306 square miles (**Figure 3.6**).

Figure 3.6: Geomorphic investigation study limit



The geomorphic evaluation will consider the following watershed attributes:

- Arkansas River geomorphology and geomorphic changes with time,
- Sediment delivery from tributaries directly contributing to the reservoir,
- Sediment delivery from tributaries contributing to the Arkansas River upstream of the reservoir,
- Areas significantly affected by wildfires (both recent and historic), and other noted land use changes.

Geomorphic characterization of the Arkansas River and significant tributaries will be completed using current and historic aerial photography within GoogleEarth where photographs dating from 1984 to 2016 are available. By comparing current channel alignment to historic alignment visible in the historic photos, significant changes will be noted and trends in channel migration documented. Man-made channel modifications will also be documented. Finally, areas of active bank erosion will be documented by exploiting the available high-quality photographs taken in 2016. We will confirm this evaluation against observations made during the Task 4 field sediment sampling effort.

Forest fire impacts will be evaluated using spatial data obtained from the USGS. Data attributes include fire centroid location, date of the fire, and area burned. This data will be evaluated to determine the areas of the watershed affected and the corresponding tributaries to the Arkansas River and to Pueblo Reservoir. Analysis will include evaluation of cumulative area burned through time.

Other land use changes in the watershed will be evaluated with respect to the impact on channel morphology and sediment delivery.

3.7 Biology: Endangered Species and Critical Habitat

The Mott MacDonald Team will produce a summary of endangered species and critical habitat associated with Pueblo Reservoir based on a variety of studies, environmental planning documents, and on-line resources. Baseline information and data fall into two categories:

1. National Environmental Policy Act (NEPA) planning documents and
2. Online resources and databases.

These documents and on-line resources will form the basis of information used to support the completion of Task 7 – Environmental Assessment.

The two primary NEPA documents that will be used for the endangered species and critical habitat assessment are the Excess Capacity Storage Environmental Assessment (EA) and the Hydropower EA.

The Excess Capacity Storage EA was prepared by the USBR in 2018 to evaluate resource impacts associated with the continuation of the Fryingpan – Arkansas Project's Temporary Excess Capacity Contracting Program (Temporary Program) with the Donala Water and Sanitation District and the Bureau of Land Management (USBR 2018).

The final EA evaluates the No-Action and Proposed Action alternatives. For the Temporary Program, the EA focuses on broad scale of resource impacts associated with the Action Alternative and its broad level of proposed contract actions. Chapter 3 of the EA provides a summary of the affected environment and of the environmental consequences associated with the project. The EA provides information about the following resources associated with the project: hydrology, groundwater, water rights, water quality, aquatic life, recreation, historic properties, endangered species, critical habitat, socioeconomics, environmental justice, Native American Trust assets, and climate change.

The Hydropower EA, prepared by Reclamation in 2016, was written to identify and evaluate the potential effects on the human and natural environment associated with the issuance of the Lease of Power Privilege (LOPP) for the construction and operation of the Pueblo Hydropower Project. Like the 2018 Excess Capacity EA, the 2016 Hydropower EA provides significant information about natural resources associated with Pueblo Reservoir. Importantly, the Hydropower EA provides information regarding fisheries in the Arkansas River, wildlife, and wetland and riparian resources. Both the Excess Capacity EA and Hydropower EA will be key sources of information for the environmental assessment portion of this project.

The primary on-line resources that will be used to support the Task 7 - Environmental Assessment are:

- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Map
- Colorado Parks and Wildlife (CPW) Species Activity Map (SAM)
- Natural Resources Conservation Service (NRCS) Web Soil Survey
- CPW Colorado Fishing Atlas
- Federal Emergency Management Agency (FEMA) National Flood Hazard Layer
- Colorado Natural Heritage Program (CNHP) Wetland Inventory and Vegetation Layers
- CPW Fish Survey and Management Data

3.8 Historical and Current Land Use

The Mott MacDonald Team will evaluate existing and historic land use using raster-based GIS land use data mapping in conjunction with historic aerial photos within the GIS environment. Special attention will be given to Pueblo West and other land development activities, quarry operations, wildfires, and agricultural uses, Visible changes in land use will be described.

3.9 Pueblo Reservoir Storage Rights and Water Use

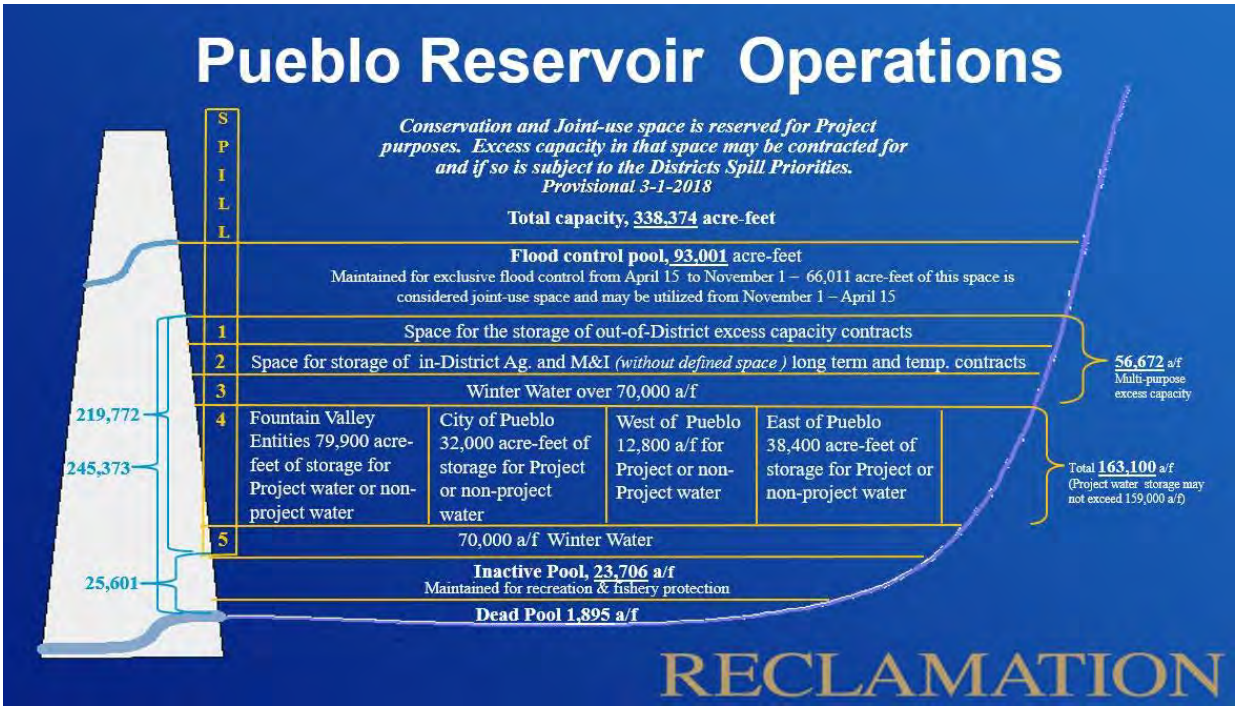
Storage rights and water use information will be used by the Mott MacDonald Team in parallel with the operational analysis summarized within Section 3.2.1 herein to evaluate potential impacts associated with future storage recovery projects within the reservoir. Storage rights and water use data will be reviewed to assess how the various storage accounts in the reservoir are typically distributed, and how a storage recovery project would have to be executed to mitigate potential impacts to end-users.

Primary documents used to perform an analysis of water rights and storage for the reservoir will include the following:

- Current and Future Challenges to Upper Arkansas Basin Water Supplies (Scanga 2019)
- Colorado's Water Plan (Colorado Water Conservation Board 2019)
- Available documents from the Arkansas Basin Roundtable.

Figure 3.7 below provides a schematic diagram of current Pueblo Reservoir storage rights, water use and associated allocations (USBR 2018) that will be used during the assessment.

Figure 3.7: Pueblo Reservoir Storage Rights and Water Use by allocation.



3.10 Regulatory Entities Summary

3.10.1 Federal Regulatory Agencies

3.10.1.1 U.S. Bureau of Reclamation NEPA/Dam Operations/ Fryingpan-Arkansas Project Operations

The U.S. Bureau of Reclamation built and manages the Fryingpan-Arkansas Project of which Pueblo Reservoir is both the terminal reservoir and major storage component. As such, USBR will certainly be the lead federal agency for any environmental review conducted under the National Environmental Policy Act (NEPA). As noted in section 3.9, there are numerous storage and carriage contracts that Reclamation manages, all of which must be considered in a NEPA evaluation. In addition, the U.S. Army Corps of Engineers (USACE) controls dam operations when storage enters the flood control pool of the reservoir.

The USBR-NEPA Handbook has been developed in response to the Council on Environmental Quality's (CEQ) and the U.S. Department of the Interior's (Interior) implementing regulations for NEPA. The USBR-NEPA Handbook published in February 2012 describes the process and procedures Reclamation uses to conduct NEPA evaluations when it is the lead federal agency. The USBR-NEPA Handbook implements the CEQ and Interior legislative mandates and specifically addresses the provisions of NEPA as a supplement to its existing authority and as a mandate to consider its policies and missions in the light of national environmental objectives.

The CEQ and Interior implementing regulations provide oversight and broad general direction to the USBR's conduct of NEPA. The NEPA Review for any alternative considered for any proposed SECWCD Fryingpan-Arkansas Storage Recovery Project would involve several other Federal cooperating agencies: 1) The USACE, 2) the U.S. Environmental Protection Agency (EPA), 3) the U.S. Fish and Wildlife Service (FWS) and the Federal Energy Regulatory Agency (FERC).

There is no specified time frame for USBR review and approval.

3.10.1.2 U.S. Army Corps of Engineers (USACE) 404 Permit Program and Reservoir Flood Control Operations

The Federal Clean Water Act requires the USACE issue permits for the discharge of dredged or fill materials into waters of the United States (WOTUS). 33 U.S. Code § 1344 authorizes the issuance of permits for dredged or fill material into WOTUS. Discharges must comply with the EPA's 404(b)(1) guidelines and a MOA between the U.S. EPA and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines. Additional (and numerous) regulations, guidance documents, and court rulings also apply.

Any modifications to Pueblo Dam that require placement of fill in the reservoir or the Arkansas River will require an Individual 404 Permit, a NEPA review (likely a USBR led Environmental Impact Statement) and appropriate mitigation. There is an exemption for materials dredged from the WOTUS and removed to be disposed of at an upland site. The "Incidental Fallback Rule" also called the "Tulloch Exemption" allows for the dredging and removal of dredged materials.

The USACE will be a cooperating agency because of their involvement in the operation of the flood control pool of Pueblo Reservoir. There is no specified time frame for USACE review and approval.

3.10.1.3 U.S. Environmental Protection Agency (EPA) Oversight of NEPA and 404 Permit Programs

Federal law provides the EPA with oversite of the NEPA process to ensure agencies comply with the letter and spirit of the law. As such, EPA plays a pivotal and active role in the NEPA process ensuring that project purpose and need is documented and supported and that an adequate range of alternatives is considered and evaluated. EPA also has oversight of the protection of water quality and works with the Colorado Department of Public Health and Environment to assure that projects will not result in adverse impacts to water quality.

Federal law has provided the EPA with oversite of the 404 Permit program. As previously mentioned, EPA has promulgated the 404(b)(1) guidelines and is signatory to a MOA with the USACE concerning the determination of mitigation under the Clean Water Act Section 404(b)(1) Guidelines.

Because of these legislative mandates, EPA is a significant partner in the environmental review and 404 Perm processes.

3.10.1.4 U.S. Fish and Wildlife Service (FWS) – Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires that federal agencies consult with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and State wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the Section 404 compliance process, NEPA, or other federal permit, license, or review requirements.

3.10.2 State of Colorado Regulatory Agencies

3.10.2.1 Colorado Department of Public Health an Environment (CDPHE)

There are several regulations promulgated by CDPHE that regulate discharges to surface water and protect water quality.

Regulation 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) and Regulation 32: Classifications and Numeric Standards for Arkansas River Basin (5 CCR 1002-32). Were discussed in Section 3.5. Together, these two CDPHE regulations present the surface water standards for the entire Arkansas River drainage including Pueblo Reservoir. The regulations list use impaired segments and specify the exceeded constituents that result in each impairment listing.

Regulation 82: 401 Water Quality Certification presents the requirements for water quality certification of federal water development projects. The process is often as much art as science. Regulation 31 and Regulation 32 compliance is required in order to protect water quality. The process requires extensive public review and comment. 401 Certification is a lengthy and costly process. The analysis required is determined on a case-by-case basis. The exact requirements cannot be determined until a meeting is held with CDPHE staff and an application is presented to the agency. There is no specified time frame for CDPHE review and approval.

Last but equally important, Regulation 61 - Colorado Discharge Permit System (5 CCR 1002-61). This regulation has been promulgated to implement the Colorado Water Quality Control Act

Regulation 61 conforms with the provisions of the Federal Clean Water Act (CWA) and the regulations that implement the CWA. The regulations apply to all operations discharging to waters of the State from a point source. Any activities that may affect water quality and exceed the water quality standards

described in Regulation 31 and 32 require a discharge permit or variance from the CDPHE. The discharge permit system regulates all manner of discharges and other activities that may impact water quality. Turbidity, temperature, nutrients, and other parameters are strictly regulated.

3.10.2.2 Colorado Department of Parks and Wildlife (CDPW)

As previously mentioned, The Fish and Wildlife Coordination Act requires that federal agencies consult with State wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water in order to minimize the adverse impacts of such actions on fish and wildlife resources, and habitat. This consultation is generally incorporated into the process of complying with Section 404, NEPA or other federal permit, license, or review requirements. The FWS (and by proxy the lead Federal agency) usually gives great deference to the states in this regard.

CDPW operates Pueblo State Park with boat ramps, camping facilities, picnic grounds, a comfort station, and other amenities. Where past projects have impacted similar facilities, mitigation and compensation for lost opportunities have been required.

4 Next Steps

The purpose of this TM is to document the baseline information that will be used to develop the Task 7 – Environmental Assessment and Task 8 – Engineering Assessment reports, as well as the draft and final Fry-Ark Storage Recovery Study Report. Upon District review and acceptance of this TM, next steps include proceeding into the Task 7 and Task 8 assessment works.

5 References

CDPHE. 2018. *5 CCR 1002-31 REGULATION NO. 31 - THE BASIC STANDARDS AND METHODOLOGIES FOR SURFACE WATER.* Accessed June 2020. https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=8637&fileName=5%20CCR%201002-11.

CDPHE. 2019. *5 CCR 1002-32 REGULATION NO. 32 - CLASSIFICATIONS AND NUMERIC STANDARDS FOR ARKANSAS RIVER BASIN.* Accessed June 2020. https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=8114&fileName=5%20CCR%201002-32.

Colorado Water Conservation Board . 2019. "Colorado Water Plan."

Pueblo Board of Water Works. 2017. "Pueblo Water 2017 Water Quality Report for Calendar Year 2016." Pueblo.

Pueblo Board of Water Works. 2004. *Source Water Assessment Report, Surface Water Sources and Ground Water Sources Under the Direct Influence of Surface Water.* Pueblo, Colorado: Public Water System ID: CO0151500.

Radell, Mary J, Roderick F Ortiz, and Michael E Lewis. 1998. *Water-Quality Assessment of the Arkansas River Basin, Southeastern Colorado, 1990-93.* Water-Resources Investigations Report 97-4111, USGS.

Scanga, R. 2019. *Current and future challenges to Upper Arkansas Basin Water supplies.* Upper Arkansas Water Conservancy District. https://arkvalleyvoice.com/current-and-future-challenges-to-upper-arkansas-basin-water-supplies/.

Southeastern Colorado Water Conservancy District. 2019. "Storage needs in the Arkansas River Basin. Storage Programs Review."

USBR. 2016. *Final Environmental Assessment: Pueblo Hydropower Project, Project 2015-001.* Eastern Colorado Area Office Great Plains Region.

USBR. 2018. *Final Programmatic Environmental Assessment for Pueblo Reservoir: Temporary Excess Capacity Storage Contracting Program, and Site Specific Environmental Assessment for Donala Water and Sanitation District.* 40-Year Excess Capacity Storage and Conveyance Contract, and Bureau of Land Management 40-Year Excess Capacity Storage Contract. Exhibit B—Environmental Commitments, FONSI No. 2018-02.

USBR. 1994. "Pueblo Reservoir 1993 Sedimentation Survey. Sedimentation Section Surface Water Branch Division of Earth Sciences." Denver, Colorado.

USBR. 2015. *Pueblo Reservoir 2012 Bathymetric Survey. Technical Report No. SRH-2014-15.* Denver, Colorado: Sedimentation and River Hydraulics Group of the Technical Service Center.

USBR. 2012. *Reservoir Survey Reports and Data Sets, Sedimentation and River Hydraulics Group, Technical Service Center.* Denver, Colorado. Accessed 2020. https://www.usbr.gov/tsc/techreferences/reservoir.html.

Attachment 4

TR-07-01
Fryingpan-Arkansas Storage Recovery Project
Environmental Assessment Report

MOTT MACDONALD

ERC

Carnevale Environmental Consulting, LLC

Fry-Ark Storage Recovery Study

Draft Environmental Assessment

August 2020

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
01	8-3-2020	JD	JC	WJP	Draft Environmental Assessment

Document reference: 507102411 | TR-07-01 |

Information class: Standard

Contents

Tables

Figures

Appendices

Figures - Appendices

Executive Summary

This Environmental Assessment report provides an evaluation of permitting requirements associated with the current proposed alternatives for the Pueblo Reservoir storage recovery project. These alternatives include the following: 1) large-scale sediment removal/diversion project (e.g., dredging) and 2) raising the elevation of Pueblo Dam 5 to 10 feet (e.g., reservoir expansion). The report includes a summary of environmental and natural resources that may be affected by the proposed storage recovery alternatives. Additional studies, permits, and environmental review documents that will likely be required prior to implementation of either alternative are summarized herein. This report is not meant to replace or augment additional local, state, and federal documentation and/or permitting required to implement these alternatives. Rather, this report is meant to be a pre-project screening document that can be used by the Southeastern Colorado Water Conservancy District (SECWCD) to assess overall environmental permitting requirements and costs.

This report describes the affected environment and focuses on the following resources that may require permitting and additional environmental review under each alternative: wetlands (Section 2), water quality (Section 3), vegetation resources (Section 4), wildlife resources (Section 5), fisheries (Section 6), aquatic nuisance species (Section 7), and soils (Section 8). Section 9 (Conclusion) provides a summary of likely permits and associated costs/timeframes for each alternative. Appendix A to this report provides a detailed breakdown of permits and costs that may be required.

1 Introduction

1.1 Fryingpan-Arkansas Project

Pueblo Reservoir is part of the Fryingpan-Arkansas (Fry-Ark) Project, which is a transmountain water diversion and delivery project that diverts approximately 56,000 acre-feet (ac-ft) annually from the Fryingpan River and other tributaries of the Roaring Fork River on the west side of the Continental Divide for use in the Arkansas River Basin on the east slope of the Rocky Mountains in Colorado. Along with Pueblo Reservoir, the other storage facilities on the east slope include Turquoise Reservoir and Twin Lakes Reservoir. The U.S. Bureau of Reclamation (Reclamation) owns and operates the Fry-Ark Project facilities. The Colorado Division of Parks and Wildlife (CPW) manages wildlife, recreation, and land-based resources at Pueblo Reservoir under agreements between the State of Colorado and Reclamation. Additional information about trans-basin water diversions associated with the Fry-Ark Project, including descriptions of tunnels, pipelines, facilities, and hydrology, is in Reclamation's *Arkansas Valley Conduit and Master Contract Final Environmental Impact Statement* (Reclamation 2013).

1.2 Storage Needs Assessment

In 1997-1998 the Southeastern Colorado Water Conservancy District (SECWC) commissioned a Water Storage and Needs Assessment (GEI 1998) for the Arkansas River Basin. As part of this assessment, water storage recovery was identified as a key priority for the long-term integrated storage plan for the basin. The Preferred Storage Options Plan (PSOP) was finalized in September 2001 (SECWCD 2019). In 2012 Reclamation, using bathymetric survey data, reported that Pueblo Reservoir has lost approximately 20,000 ac-ft of storage space due to sedimentation since opening the reservoir in 1974 (SECWCD 2019). Excess sedimentation within Pueblo Reservoir has reduced the conservation pool as well as the inactive pool that protects fisheries and recreation. The flood control pool must remain at 93,000 ac-ft to maintain protection from modeled flooding (SECWCD 2019). In 1974, the storage capacity of Pueblo Reservoir was 357,816 ac-ft; whereas, in 2012 the capacity has been reduced to 338,374 ac-ft. It is suspected that recent large wildfires in the upper Arkansas River Basin have accelerated sedimentation within Pueblo Reservoir (SECWCD 2019).

1.3 Alternatives Under Consideration

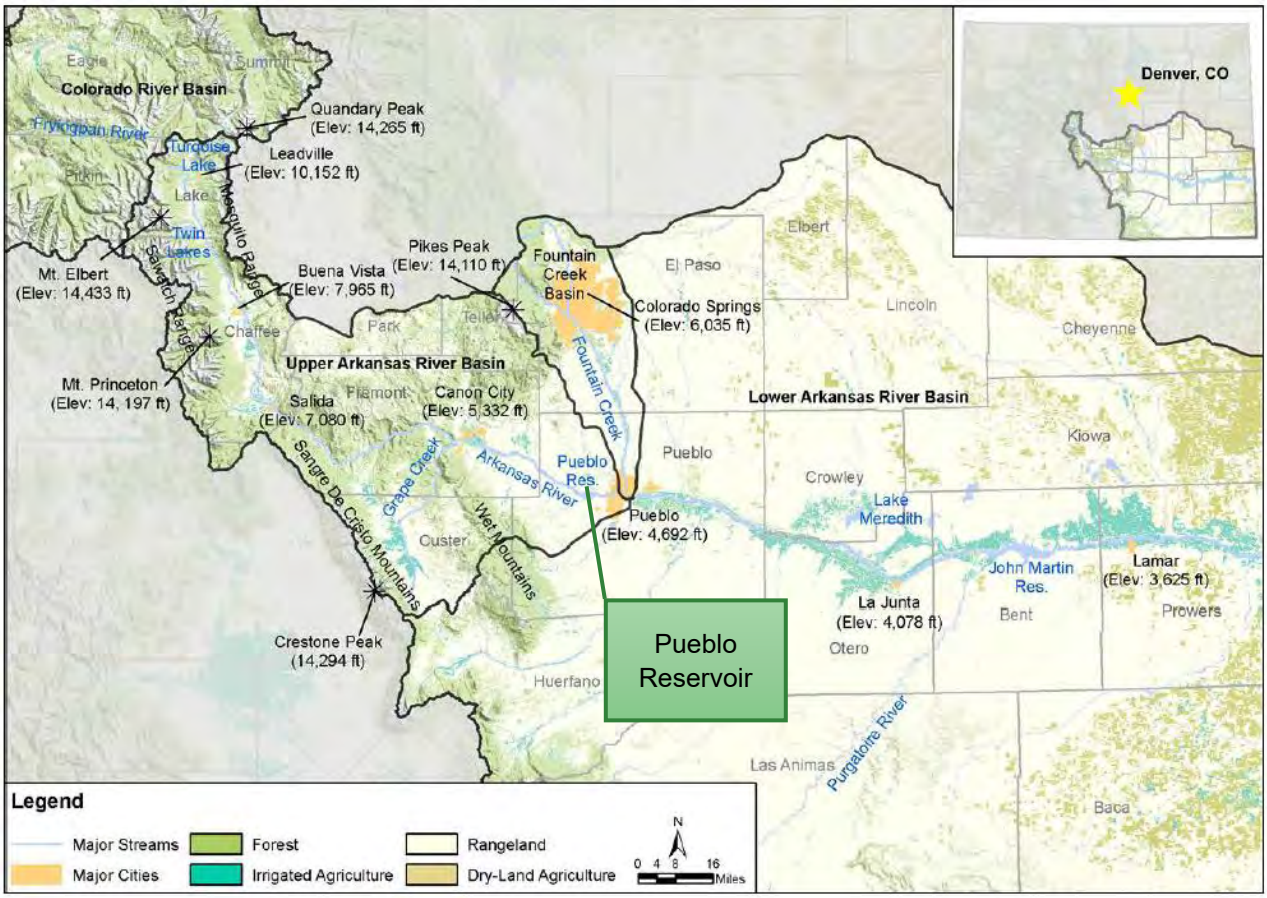
As outlined in the PSOP, there are currently two primary alternatives under consideration by the SECWCD for storage recovery for Pueblo Reservoir. These include the following: 1) large-scale dredging sediment removal/diversion project; and 2) raising the elevation of Pueblo Dam 5 to 10 feet (e.g., reservoir expansion). Therefore, the subject of this Environmental Assessment report (report) includes an evaluation of costs and permitting requirements associated with both alternatives (e.g., sediment removal and dam raise). The purpose of this report is to provide the SECWCD with a summary of environmental and natural resources that may require federal, state, and local permits (as well as associated high-level costs for these permits) for recovering/enhancing storage capacity under each alternative for Pueblo Reservoir. Internal scoping associated with this report considered issues previously identified as part of Task 3 (Document Review and Data Gap Analysis) and Task 5 (Basis of Assessment). This report describes the potentially affected environment and focuses on the following resources that may require permitting under each alternative:

- Wetlands

- Water quality
- Vegetation resources
- Wildlife resources
- Fisheries
- Aquatic nuisance species
- Soils

This report provides a summary of permits, environmental review documents, and regulatory approvals associated with the resources listed above that will be likely required for dredging, sediment removal, and/or dam modifications for Pueblo Reservoir. The location of the project, as well as a map of the Arkansas River Basin, is shown in **Figure 1**. **Appendix A (Tables 1 and 2)** to this report provide a comprehensive summary of likely environmental regulatory requirements (i.e., permits and approvals) for each storage enhancement alternative (e.g., sediment removal and dam raise).

Figure 1. Pueblo Reservoir and the Arkansas River Basin (Source: Reclamation 2013).



2 Wetlands and Clean Water Act Section 404 Permitting

2.1 Clean Water Act

Pueblo Reservoir and the Arkansas River are waters of the United States (WOTUS) and regulated by the Clean Water Act (CWA). Due to climate variability and Fry-Ark Project operations which keeps storage at higher mountain reservoirs to reduce excess evaporation, Pueblo Reservoir incurs long cycles between reservoir fills. Higher storage occurs during and immediately after wet years; however, Fry-Ark project yields are not enough to completely fill the reservoir each year (Reclamation 2018). Additionally, wetland areas adjacent to WOTUS that fluctuate as a result of seasonal changes and climate fluctuations within and between years may also be subject to CWA permitting requirements. Riparian areas surrounding Pueblo Reservoir are dominated by cottonwood (*Populus* spp.), willow (*Salix* spp.), sagebrush (*Artemisia tridentata*), western wheatgrass (*Pascopyrum smithii*), sand dropseed (*Sporobolus crytandrus*), and little bluestem (*Schizachyrium scoparium*) (Reclamation 2018). Dominant invasive species include tamarisk (e.g., salt cedar) and Russian olive (*Elaeagnus angustifolia*). These riparian areas may be impacted by either sediment removal/diversion (i.e., land disturbance in adjacent wetlands) or inundated by raising Pueblo Dam.

2.2 USACE Section 404 Dredge and Fill Permits

The U.S. Army Corps of Engineers (USACE) administers the Section 404 Dredge and Fill Permit program authorized by the CWA. The CWA requires the USACE to issue permits for the discharge of dredged or fill materials into WOTUS. 33 U.S. Code § 1344 authorizes the issuance of permits for dredged or fill material into WOTUS. Discharges must comply with the U.S. EPA's (EPA) 404(b)(1) guidelines and a Memorandum of Agreement (MOA) between the EPA and the USACE Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines. Additional (and numerous) regulations, guidance documents, and court rulings also apply.

Any modifications to Pueblo Dam that require placement of fill in the reservoir or the Arkansas River may require an Individual 404 Permit, a National Environmental Policy Act (NEPA) review (likely an Environmental Impact Statement led by Reclamation), and appropriate mitigation. In addition, extensive input from other Federal and State agencies can be expected.

2.3 Reservoir Sediment Management

Reclamation (Timothy Randell, et.al., 2019) led a team of 25 experts from government agencies, academia, and private contractors/consultants that produced a white paper entitled *Reservoir Sediment Management: Building a Legacy of Sustainable Water Storage Reservoirs*. The white paper addressed environmental permitting for sediment removal projects in reservoirs and concluded:

"For projects in water bodies such as reservoirs, lakes, rivers, streams, wetlands, or the ocean, much of the regulatory framework centers on application of the Clean Water Act (CWA), as implemented by the U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency at the federal level, and state water quality or public health agencies at a more local level. CWA requirements intersect with sediment management by requiring protections for water quality during and following sediment management operations and requiring analysis of the

potential impacts from the final disposition of the sediment within river courses or water bodies. A suite of other federal and state regulations may apply to sediment management operations in reservoirs, including…the Endangered Species Act, the National Historic Preservation Act, and similar state regulations pertaining to protection of wildlife, sensitive habitat, recreation, and public access. Compliance with these regulations is typically linked to project review and analysis under NEPA and state environmental procedures and usually involves coordination among multiple agencies. The federal and state environmental review processes typically include opportunities for public review and comment."

2.4 Incidental Fallback Rule

However, there is an exemption for materials dredged from a WOTUS and removed to disposal at an upland site. The "Incidental Fallback Rule" also called the "Tulloch Exemption" allows for the dredging and removal of dredged materials. Thus, if only a dredging operation is undertaken to remove sediments from a reservoir, no NEPA review is required. A synopsis of the "Incidental Fallback Rule" is provided in **Appendix B** to this report.

2.5 Notifications

If a 404 Permit is needed for the storage recovery project, other Federal, State, and local agencies should be advised of the pending action and consulted regarding impacts and mitigation measures. In addition, all landowners adjacent to the project should be notified and provided with an opportunity to comment. Additionally, the USACE may contact the following agencies as part of the permitting process: 1) Reclamation, 2) EPA, 3) U.S. Fish and Wildlife Service (USFWS), 4) Colorado Department of Public Health and Environment (CDPHE), 5) Colorado Department of Parks and Wildlife (CPW), and 6) Colorado State Historic Preservation Office (SHPO). Local governments such as Pueblo County, the City of Pueblo, and Pueblo West Metro District should be notified of the pending action. Water rights holders and water utilities who divert from the reservoir or the Arkansas river immediately downstream from the dam should be requested to comment on the proposed project.

2.6 Lead Agency

The regulations of the USACE, Reclamation, and EPA are intertwined in the 404 Permit and National Environmental Policy Act (NEPA) processes. Reclamation constructed and operates Pueblo Reservoir. Therefore, if an environmental review (i.e., Environmental Assessment (EA) or an Environmental Impact Statement (EIS)) is required under the provisions of the NEPA, Reclamation will be the Lead Federal Agency.

2.7 Probable Permitting Requirements and Process

Table 1 and **Table 2** in **Appendix A** present probable CWA permitting requirements associated with the two potential project approaches (e.g., sediment removal and dam raise). The alternative addressed in **Table 1** (**Appendix A**) involve dredging sediments from the bottom of Pueblo Reservoir and placing the dredged materials on upland sites in confined disposal facilities (CDFs) that avoid depositing the dredged materials into WOTUS. This alternative would likely have the least involvement of the USACE and the EPA. The provisions of the "Incidental Fallback Rule" may eliminate the need for a 404 Permit minimizing the involvement of EPA in the entire regulatory process. Downstream disposal into the channel of the Arkansas River below Pueblo Dam is a potential alternative that could be explored with Reclamation, USACE, and the CDPHE to determine permitting requirements. Because this potential sediment disposal action will deposit fill into a WOTUS, the USACE will need to issue a permit for this activity.

The permitting process for the dam enlargement option addressed in **Table 2** (**Appendix A**) may be more complex, time consuming, and expensive. Under this scenario, an EIS led by Reclamation may be required. The USACE may need to complete a detailed "Purpose and Need" evaluation and "Alternatives" analysis to comply with the regulatory provisions of the 404 Permit program.

The USACE has a very rigid process for evaluating projects such as a potential enlargement of Pueblo Reservoir. There are two documents that detail the USACE approach to conducting their evaluation. These documents include:

- U.S. EPA. Robert H. Wayland, III and Michael L. Davis, *Memorandum: Appropriate Level of Analysis Required for Evaluating Compliance with the CWA Section 404(b)(1) Guidelines Alternatives Requirements*. Available online.
- USACE. *Guidelines for Preparation of Analysis of Section 404 Permit Applications Pursuant to the Section 404(B)(1) Guidelines of The Clean Water Act (40 CFR, Section 230*). Available online.

To determine the level of effort and cost of permitting more accurately for either storage recovery scenario, consultation with the staff of regulatory agencies is highly recommended. All sediment removal or storage recovery projects have unique conditions that must be identified and evaluated.

3 Water Quality

The Arkansas River above Pueblo is not included on Colorado's 303D list of impaired waters. However, the Colorado-Arkansas Headwaters and Upper Arkansas watersheds include impaired tributaries listed on the 303D list due to historic mining (**Figure 1**). Primary constituents of concern include lead, cadmium, zinc, copper, aluminum, pH, and dissolved oxygen. Pueblo Reservoir stratifies during the summer months which may cause suspended sediments containing nutrients and other materials (i.e., heavy metals) to dissolve. Additionally, stratification reduces mixing and may lead to low dissolved oxygen levels near the bottom of the reservoir causing heavy metal and nutrient dissolution.

3.1 Ambient Water Quality

Water quality in Pueblo Reservoir is adequate to provide full body contact recreation, support a cool water fishery, and serve as a raw water supply for several municipalities. The Pueblo Board of Water Works operates an intake from Pueblo Reservoir. The Pueblo Board of Water Works in a 2017 publication entitled: ***"Pueblo Water 2017 Water Quality Report for Calendar Year 2016"*** reported no violations of drinking water standards. Pueblo Reservoir is also the storage water supply for the Colorado Springs Utilities' (CSU) Southern Delivery System. The CSU maintains a diversion directly from Pueblo Dam. Pueblo West also diverts water directly from Pueblo Reservoir Water for treatment in their Water Treatment Plant.

The following potential contamination sources are summarized for Pueblo Reservoir in Colorado Department of Public Health and Environment's (CDPHE) Source Water Assessment Report, Surface Water Sources and Ground Water Sources Under the Direct Influence of Surface Water. Pueblo Board of Water Works, Public Water System ID: CO0151500, Pueblo, CO, Pueblo County. 11/8/2004:

- Aboveground, underground, and leaking storage tank sites (3)
- Solid waste sites (3)
- Existing abandoned mine sites (44)
- Other facilities (3)

A report prepared by the USGS in 1998 based upon water quality data collected between 1990 and 1993 noted that the median pH at Portland, CO upstream from Pueblo Reservoir was 8.4 and dissolved oxygen at all stations was above 6.0 mg/L (USGS, 1998). Dissolved solids and major ions in Pueblo Reservoir were all below limits set for protection of aquatic fauna.

3.2 Water Quality Regulations

The CDPHE has promulgated drainage specific standards (Regulation 32: Classifications and Numeric Standards for Arkansas River Basin (5 CCR 1002-32)) for the Arkansas River. These standards expand upon the basic water quality standards presented in Regulation 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

The following standards presented in CDPHE Regulation 32 (among others) apply to Pueblo Reservoir:

> (1) Temperature:
> All waters of the Arkansas River Basin are subject to the following standard for temperature (Discharges regulated by permits, which are within the permit limitations,

shall not be subject to enforcement proceedings under this standard): Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to the resident aquatic life. This standard shall not be interpreted or applied in a manner inconsistent with section 25-8-104 (Interpretation and construction of water quality provisions) of the Colorado Water Quality Control Act.

Regulation 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31), section 31.11.(1) states:

> *"(1) Except where authorized by permits, BMPs, 401 certifications, or plans of operation approved by the Division or other applicable agencies, state surface waters shall be free from substances attributable to human-caused point source or nonpoint source discharge in amounts, concentrations or combinations which:*
>
> *(a) for all surface waters except wetlands;*
>
> *(i) can settle to form bottom deposits detrimental to the beneficial uses. Depositions are stream bottom buildup of materials which include but are not limited to anaerobic sludges, mine slurry or tailings, silt, or mud; or*
>
> *(ii) form floating debris, scum, or other surface materials sufficient to harm existing beneficial uses; or*
>
> *(iii) produce color, odor, or other conditions in such a degree as to create a nuisance or harm existing beneficial uses or impart any undesirable taste to significant edible aquatic species or to the water; or*
>
> *(iv) are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life; or (v) produce a predominance of undesirable aquatic life; or*
>
> *(vi) cause a film on the surface or produce a deposit on shorelines…"*

The regulation further states: *"Suspended solid levels will be controlled by Effluent Limitation Regulations, Basic Standards and Best Management Practices (BMPs)"*

For both Regulation 31 and regulation 32 there are antidegradation standards that will be applied to this project. Variances can be granted for temporary impacts but given the duration and magnitude of any reservoir storage recovery operation, a variance is not a certain outcome. For projects involving the scope, complexity and unique nature of the Pueblo Reservoir storage recovery project, considerable analysis and modeling may be required by the CDPHE. Recent 401 Certification evaluations have required extensive studies, water quality and flow modeling and analyses to determine impacts and develop mitigation plans.

At a minimum, CDPHE may require that waters discharged from any decanting basins to receiving waters be treated to reduce turbidity, mitigate temperature, adjust pH, and adjust the DO. Monitoring of the discharge(s) will also be required during the period of operation. The volume of the receiving water (Pueblo Reservoir) may be large enough to mitigate the effects of any discharges associated with a sediment dredging program. However, additional water quality modeling mat be required and the suction dredging when the lake is stratified may further impact water quality in the hypolimnion.

4 Vegetation

Vegetation within and immediately surrounding Pueblo Reservoir consists of open water marsh habitat, wetland and riparian vegetation in the low topographic areas near the shoreline and banks of the Pueblo Reservoir, and upland vegetation abutting the outer edges of the wetlands through the exterior of the survey area. Certain land-based activities associated with the storage enhancement alternatives (i.e., placement/widening of access roads, dam construction, placement of Confined Disposal Facilities or CDFs, etc.) may impact vegetation resources surrounding Pueblo Reservoir. Since the lands surrounding Pueblo Reservoir are administered by the U.S. Bureau of Land Management (BLM) in addition to other state and privately held entities, the BLM, CPW, and Pueblo County may require certain impacts to be evaluated under NEPA or other local and state permits (See **Appendix A** for additional information).

Land neighboring the reservoir to the south and west is primarily undeveloped, and to the north and east includes commercial and residential development. The dam and reservoir operation building are present in the eastern portion of the reservoir. Several perennial streams drain into Pueblo Reservoir including Boggs Creek, Rock Creek, Peck Creek, Turkey Creek, Rush Creek, as well as numerous unnamed drainages. Two marinas are located in the reservoir; one in the southeast corner near the confluence of Boggs Creek, and one along the northern shore near North Marina Road. A Union Pacific railway line running northwest to southeast bisects portions of the northern portion of the reservoir area.

Four primary land use class/vegetation communities exist within the vicinity of the survey area including Tamarisk species Ruderal Riparian Shrubland, Cottonwood/Western Wheatgrass – Switchgrass Floodplain Woodland, Blue Grama – Buffalograss Shortgrass Prairie, and Wyoming Big Sagebrush / Western Wheatgrass Shrub Grassland (Comer et al. 2003) (refer to **Vegetation Map** in **Appendix C**). In general, the vegetation communities surrounding Pueblo Reservoir are somewhat based on natural vegetation associations in the region (NatureServe 2020); however, have been disturbed by historic and current land use practices thus represent somewhat degraded forms of these communities. A summary of the vegetative community types is provided below.

4.1 Tamarisk species Ruderal Riparian Shrubland

The Tamarisk species Ruderal Riparian Shrubland community is composed of thickets on banks of streams across the western U.S. and northern Mexico. Stands are dominated by introduced species of *Tamarix*, including *Tamarix ramosissima, Tamarix chinensis, Tamarix gallica*, and *Tamarix parviflora*. Introduced from the Mediterranean, this genus has become naturalized in various sites, including salt flats and other saline habitats, springs, and especially along streams and regulated rivers, where it replaces the native vegetation, such as shrublands dominated by species of *Salix* or *Prosopis* or woodlands of *Populus* spp. An herbaceous layer may be present, depending on the age and density of the shrub layer, which may consist of aggressive exotic species (NatureServe 2020). Other native shrubs may include species of *Salix* (especially *Salix exigua*) and *Prosopis*, as well as *Rhus trilobata* and *Sarcobatus vermiculatus* but with low cover (if shrub species are codominant, then the stand is classified as a natural shrubland). Scattered native trees such as *Acer negundo, Salix amygdaloides, Populus* spp., or another introduced tree, *Elaeagnus angustifolia*, may also be present. Depending on stand age and density of the shrub layer, an herbaceous layer may be present. Associated native species include *Distichlis spicata* and *Sporobolus airoides*, and introduced species include *Agrostis gigantea, Agrostis stolonifera*, and *Poa pratensis*. Introduced

herbaceous species such as *Polypogon monspeliensis, Conyza canadensis, Lepidium latifolium*, and many others have been reported from shrublands in this association.

4.2 Cottonwood/Western Wheatgrass – Switchgrass Floodplain Woodland

The Cottonwood/Western Wheatgrass – Switchgrass Floodplain Woodland community has been identified in the panhandle of northern Texas. The woodland occurs on mesic sites near rivers and large streams. Soils are sandy and formed from alluvium. The canopy is moderate and formed almost exclusively of *Populus deltoides*. Shrub cover is sparse. Perennial grasses dominate the understory forming a moderate to dense herbaceous stratum. *Pascopyrum smithii* and *Panicum virgatum* are the dominants, usually with lesser amounts of *Elymus canadensis* (NatureServe 2020). community is an open woodland with tree canopy cover averaging 25-35%. *Populus deltoides* is the major tree species. Few shrubs are present in general, but scattered *Rhus trilobata, Baccharis salicina, Amorpha fruticosa, Prunus gracilis*, and shrubby *Celtis laevigata* occur. Shrub cover is usually less than 10%. The understory vegetation is mainly perennial grasses with cool-season grasses dominating. The major species of grass is *Pascopyrum smithii*. Lesser amounts of *Elymus canadensis* also occurs. The predominant warm-season grass is *Panicum virgatum*. This understory is often shaded most of the day. Grasses make up the majority of the understory with forbs usually being 10 to 15%. Most frequently found forb species include *Ambrosia psilostachya, Gaura suffulta, Gaura coccinea, Heterotheca subaxillaris, Symphyotrichum ericoides (Aster ericoides)*, and *Glycyrrhiza lepidota*.

4.3 Blue Grama – Buffalograss Shortgrass Prairie

The Blue Grama – Buffalograss Shortgrass Prairie community is common across much of the central and southern Great Plains of the United States. Stands occur on flat to rolling uplands. The surface soil may be sandy loam, loam, silt loam, or loamy clay. The subsoil is often finer than the surface soil. This community is characterized by a moderate to dense sod of short grasses with scattered mid grasses and forbs. The dominant species are *Bouteloua gracilis* and *Bouteloua dactyloides* (NatureServe 2020). The foliage of these species is 7-19 cm tall, while the flowering stalks of *Bouteloua gracilis* may reach 45 cm. The midgrasses are usually stunted by the arid conditions and often do not exceed 0.7 m. Other short graminoids found in this community are *Bouteloua hirsuta, Carex duriuscula, Carex inops ssp. heliophila*, and *Carex filifolia* (in Nebraska). Several mid grasses occur regularly, such as *Aristida purpurea, Bouteloua curtipendula, Pascopyrum smithii, Schizachyrium scoparium, Elymus elymoides, Sporobolus cryptandrus, Hesperostipa comata*, and *Vulpia octoflora*. Forbs, such as *Astragalus* spp., *Gaura coccinea, Machaeranthera pinnatifida var. pinnatifida, Opuntia polyacantha, Plantago patagonica, Psoralidium tenuiflorum, Ratibida columnifera*, and *Sphaeralcea coccinea*, are common throughout this community. Shrubs are very rare except in the southern part of this community's range where scattered individuals may occur.

4.4 Wyoming Big Sagebrush/Western Wheatgrass Shrub Grassland

Wyoming Big Sagebrush/Western Wheatgrass Shrub Grassland community is found throughout the northern Great Plains and adjacent basins, Black Hills, and Rocky Mountains of the United States. Stands occur on gently rolling uplands or upper parts of stream terraces and drainageways. Drier examples may be found on more exposed slope positions. Soils are moderately deep clay, clay loam, silt loam and loam. Soil moisture conditions are relatively mesic. Soil pH ranges from 5.8 to 7.8. The vegetation contains an open short-shrub layer, approximately 0.5 m tall, dominated by microphyllous-leaved shrubs, and a dense herbaceous layer dominated by medium-tall graminoids. Shrub cover averages between 15 and 30% but

may range as high as 55%. *Artemisia tridentata ssp. wyomingensis* dominates the shrub layer. Other shrubs may be present, including *Symphoricarpos oreophilus, Ericameria nauseosa, Amelanchier utahensis*, or *Purshia tridentata* (NatureServe 2020). The dense herbaceous layer has a canopy cover ranging between 10% in heavily grazed sites to over 75% in protected, mesic sites. *Pascopyrum smithii* is the leading dominant. Important associates include *Koeleria macrantha, Poa secunda*, and *Nassella viridula (Stipa viridula)*. In drier or more heavily grazed phases, *Bouteloua gracilis, Hesperostipa comata (Stipa comata)*, and *Carex filifolia* may be more common, along with the succulent *Opuntia polyacantha*. Forbs contribute low cover, often less than 10%, and are typically of low constancy. More constant species (>50%) include *Artemisia frigida, Sphaeralcea coccinea*, and *Vicia americana*. Grassy leaf litter usually covers over 75% of the ground; stones and bare soil comprise the remainder.

As aforementioned, if construction and land-clearing activities associated with the two water storage enhancement alternatives for Pueblo Reservoir will impact vegetation resources, additional assessment and/or mitigation may be required by the agencies responsible for managing Pueblo Reservoir and surrounding lands (e.g., Reclamation, BLM, or CPW). Additional information about potential permits and environmental review documents that may be required to further assess impacts to vegetation resources are provided in **Appendix A**.

5 Wildlife

The following section provides information about wildlife species that occur in the vicinity of Pueblo Reservoir as well as a discussion of applicable laws and regulations used to protect these species. Pueblo Reservoir and surrounding lands provide important habitat for a variety of big game and non-game species that are statutorily protected by either state or federal laws and regulations. Assessment of impacts to habitat, populations, or individual wildlife species (either direct or indirect) may by required by state and federal agencies for the two water storage enhancement alternatives. Additional information about potential permits and environmental review documents (i.e., NEPA) are provided below and within **Tables 1** and **2** of **Appendix A**.

5.1 Overall Habitat

The project area provides summer range for mule deer. In addition, Pueblo Reservoir provides habitat for white pelican. There are no prairie dog towns in the vicinity. The Arkansas River downstream of Pueblo Dam offers foraging habitat for osprey and winter range for bald eagle (Reclamation 2018). Waterfowl also occasional use low velocity sections of the Arkansas River. Other wildlife potentially within the analysis area include songbirds, raptors, reptiles, and large and small mammals such as coyote, bobcat, pronghorn, and white-tailed deer (Reclamation 2018).

5.2 Migratory Birds

Migratory birds are likely to exist in the vicinity of Pueblo Reservoir. Migratory birds are protected under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 730-712). The MBTA makes it illegal for anyone to take, possess, import, export, transport, sell, purchase barter, or offer for sale, purchase, or barter any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations. In Colorado, all birds except for the European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*) and rock pigeon (*Columba livia*) are protected under the MBTA. A total of 523 migratory bird species are known to occur in the Mountain-Prairie Region (USFWS Region 6, Montana, Wyoming, Utah, North Dakota, South Dakota, Nebraska, Kansas and Colorado); 320 of the 523 migratory bird species are known to breed in USFWS Region 6.

The vegetation communities surrounding Pueblo Reservoir provide at the very least, potential nesting and foraging habitat for migratory birds. Migratory birds are protected under the MBTA and killing or possession of these birds (or their parts and nests) is prohibited under the MBTA. The migratory birds observed likely utilize the survey area primarily for foraging and limited seasonal nesting.

- Based upon a literature review and evaluation of wildlife habitat associated with Pueblo Reservoir, ERC has determined that migratory birds utilize area. These birds, their eggs, and active nests are protected under the MBTA and to take or possession of these resources is prohibited. Active nests must become inactive prior to destruction of the nest without a USFWS permit.
- Generally, the active nesting season for most migratory birds in this region of Colorado occurs between April 1 and August 31. According to the USFWS Region 6 Migratory Bird Conservation Actions for Projects to Reduce the Risk of Take during the Nesting Season, an active nest survey should be performed “no more than 7-10 days prior to when work actually begins on the project site” during migratory bird nesting season to determine the presence

and activity status of nests protected by the MBTA (CPW 2008. If work for the project must begin prior to the nest becoming inactive within the recommended buffer, further agency coordination would be required. prior to vegetation removal or surface land disturbance, an on-site nest survey for potential MBTA species should be performed during the nesting season to ensure that active nests are not disturbed.

- Active raptor nest sites are regulated by the USFWS under the MBTA with local review from the CPW. The CPW has established recommended buffer zones and seasonal activity restrictions for a variety of Colorado raptors (CPW 2008). CPW recommends no surface occupancy within ¼ mile of active nest sites and recommends seasonal restrictions to human encroachments within ½ mile from October 15 through July 31. The CPW Species Activity Maps (SAM) were searched to determine any known nest sites in and around Pueblo Reservoir. Refer to the **Colorado Parks and Wildlife Species Activity Map** provided in **Appendix D**. The CPW SAM mapped 12 active, 2 unknown, and 2 inactive osprey (*Pandion haliaetus*) nests within the buffer zones along the western portion Pueblo Reservoir and east of the dam. One inactive bald eagle (*Haliaeetus leucocephalus*) is located near where the Arkansas River drains into Pueblo Reservoir on the CPW SAM mapping (**Appendix D**). The CPW SAM mapping also depicts a historic great blue heron (*Ardea herodias*) nest area in the western portion of Pueblo Reservoir (CPW 2020b). In accordance with CPW guidelines, no new disturbance should occur within ½ to ¼ -mile of an active raptor nest (if present), depending on the species, between February 15 and June 15 or until the young have fledged. Once a nest becomes inactive surface occupancy may resume within the buffer and vegetation occupied by the inactive nest may be removed for species other than bald and golden eagles. Eagle nests are protected by the Bald and Golden Eagle Act and destruction of these nest require a permit whether they are occupied or not. Prior to vegetation removal and surface disturbance, an on-site nest survey for potential raptor species should be performed during the nesting season to ensure that active nests are not disturbed.
- Great blue herons return to the same nest site for consecutive breeding seasons. CPW recommends a 500-meter buffer for active heron nests and a seasonal restriction to human encroachment from March 1 to July 1 (CPW 2020a). Impacts related to human activity and development can disrupt heron nesting and cause nest abandonment and mortality. Buffer zones are not required for historic nesting areas, nests that have been destroyed or which no courtship, breeding, or brooding activity has been observed at any time during the past 5 years. Great blue heron nest surveys are recommended prior to any land disturbance.

5.3 Species Protected Under the Endangered Species Act of 1973

The Endangered Species Act (ESA) of 1973 was enacted by the U.S. to conserve endangered and threatened species and the ecosystems that they depend on. Under the ESA, species may be listed as either “endangered” or “threatened”; both designations are protected by law. The ESA is administered by the USFWS. The USFWS has developed project specific species lists, available online by request, identifying threatened, endangered, and proposed species, designated critical habitat, and candidate species protected under the ESA that may occur within the boundary of a proposed project and/or may be affected by a proposed project (06E24000-2020-SLI-1355) (USFWS 2020). The USFWS species list for Pueblo County identifies 3 potential threatened or endangered species that may occur within the vicinity of Pueblo Reservoir. However, these species are not known to exist at the reservoir and/or have specific habitat requirements (i.e., occur within higher elevations) that are not present near the reservoir. These 3 species are listed below:

Common Name	Scientific Name	Status*	Determination
Canada lynx	*Lynx canadensis*	FT	NOT LIKELY TO EFFECT

Common Name	Scientific Name	Status*	Determination
Greenback cutthroat trout	*Oncorhynchus clarki stomias*	FT	NOT LIKELY TO EFFECT
Mexican spotted owl	*Strix occientalis lucida*	FT	NOT LIKELY TO EFFECT

*Status key:

FT – Federally listed as threatened

Canada lynx inhabit high-elevation (above 8,000 feet) spruce-fir forests in Colorado (Koehler 1990). Greenback cutthroat trout are found in steep gradient mountain streams that run cold and clear above 5,905 feet elevation (USDA 2009). Mexican spotted owls typically nest in caves or ledges on steep-walled pinyon-juniper box canyons in Colorado, between 5,820- and 9,100-feet elevation (Despain et al., 2000). These species and/or critical habitat are not present near Pueblo Reservoir. Therefore, the project will not likely adversely affect the species, its habitats, or proposed or designated critical habitat.

5.4 State Threatened and Endangered Species

Species identified as state threatened or endangered are protected by the CPW under Colorado Statute Title 33. State regulations prohibit "*any person to take, possess, transport, export, process, sell or offer for sale, or ship and for any common or contract carrier to knowingly transport or receive for shipment*" any species or subspecies listed as state endangered or threatened. The CPW also has identified State Species of Special Concern, which are species or subspecies of native wildlife that are currently vulnerable in their Colorado range and have the potential to become threatened or endangered. Species of Special Concern are not protected under State regulations but the 'take' of individuals and disturbance of their habitat is strongly discouraged.

All state listed species were screened as potential inhabitants of Pueblo Reservoir and vicinity based on general habitat requirements and CPW Species Profiles (CPW 2020c). The 3 federally listed threatened and endangered species described above are also listed by the CPW as threatened or endangered, respectively, therefore were not duplicated below.

The following listed threatened and endangered species are identified to occur within the state (CPW 2020c). However, these species are not known to exist within the specific vicinity of Pueblo Reservoir and/or have specific habitat requirements (i.e., elevation range) that are not common in the vicinity of Pueblo Reservoir (CPW 2020c and USFWS 2020).

Scientific Name	Common Name	Status*
Athene cunicularia	Burrowing owl	ST
Bufo boreas	Boreal toad	SE
Empidonax traillii extimus	Southwestern willow flycatcher	SE
Tympanuchus pallidicinctus	Lesser prairie-chicken	ST
Tympanuchus phasianellus jamesii	Plains sharp-tailed grouse	SE
Gila elegans	Bonytail	SE
Xyrauchen texanus	Razorback sucker	SE
Gila cypha	Humpback chub	ST
Ptychocheilus lucius	Colorado pikeminnow	ST
Oncorhynchus clarki stomias	Greenback cutthroat trout	ST
Catostomus plebeius	Rio Grande sucker	SE
Couesius plumbeus	Lake chub	SE
Phoxinus eos	Northern redbelly dace	SE

Scientific Name	Common Name	Status*
Hybognathus hankinsoni	Brassy minnow	ST
Luxilus cornutus	Common shiner	ST
Canis lupus	Gray wolf	SE
Ursus arctos	Grizzly bear	SE
Lynx canadensis	Canada lynx	SE
Gulo	Wolverine	SE
Vulpes macrotis	Kit fox	SE
Lontra canadensis	River otter	ST

*Status key:

ST – State listed as threatened

SE – State listed as endangered

- Pueblo Reservoir and vicinity does not contain the specific habitat characteristics necessary to support the species listed above. These species and/or critical habitat are not present within Pueblo Reservoir and vicinity. Therefore, the project will have no effect on the species, their habitats, or proposed or designated critical habitat.

5.4.1 Species Potentially within Range

The following state listed threatened and endangered species are identified to occur or historically occur within Pueblo County. The survey area is located within the potential known range for these species. Further analysis was conducted to determine if the species or habitat has the potential to exist considering site-specific conditions and characteristics or Pueblo Reservoir and vicinity. A brief explanation is provided as to life cycle, habitat requirements and potential occurrence of these species.

Common Name	Scientific Name	Status*
Black-footed ferret	*Mustela nigripes*	SE
Burrowing owl	*Athene cunicularia*	ST
Arkansas darter	*Etheostoma cragini*	SE
Southern redbelly dace	*Phoxinus erythrogaster*	ST

*Status key:

ST – State listed as threatened

SE – State listed as endangered

5.4.2 Black-Footed Ferret (*Mustela nigripes*)

The black-footed ferret (BFF) *(Mustela nigripes)* is a medium-sized mustelid (a member of the weasel family) and listed as a state-endangered species in Colorado. The BFF is the only ferret species native to the Americas. Its historical range spanned much of western North America's intermountain and prairie grasslands, extending from Canada to Mexico. Historically, BFF habitat coincided with habitats of black-tailed prairie dog *(C. ludovicianus)*, Gunnison's prairie dog *(C. gunnisoni)*, and white-tailed prairie dog *(C. leucurus)*. Prairie dogs make up more than 90% of the BFF's diet. BFF's are limited to open habitat, the same habitat used by prairie dogs: grasslands, steppe, and shrub steppe. It depends largely on prairie dogs: ferrets prey on prairie dogs and utilize their burrows for shelter and denning (Hillman and Clark, 1980). It has been estimated that about 40-60 hectares of prairie dog colony are needed to support one ferret

(Belant and Biggins 2008). BFF's once numbered in the tens of thousands, but due to a combination of human-induced threats they were believed to be extinct twice in the 20th century. As of 2015, BFFs have been reintroduced in the wild at 24 sites across 8 states, Canada, and Mexico.

- Pueblo Reservoir is located within the overall range of the black-tailed prairie dog; however, the reservoir occurs within the block clearance zone for black-footed ferret surveys (USFWS 2009). Therefore, any future land use changes within the survey area should have no effect on the continued existence or potential habitat of this species.

5.4.3 Burrowing Owl (Athene cunicularia)

The burrowing owl (Owl) is listed as a state-threatened species in Colorado. The Owl is small (length of 24 centimeters), long-legged, boldly spotted, and barred with brown and white. The Owl is a breeding species across the plains of eastern Colorado however rarely winters in the state. Nesting habitat is abandoned burrows, especially prairie dog colonies, located in grasslands, mountain parks, well-drained steppes, deserts, prairies and agricultural lands from late March through October. The Owl can usually be observed on low perches such as fence posts, dirt mounds or the ground. Clutch size of this Owl averages six to seven and incubation lasts up to 30 days. The owlets usually run and forage at 4 weeks and fly at 6 weeks. Primary threats to existence of this species are habitat loss due to intensive agriculture, habitat degradation and fragmentation due to control of burrowing mammals and predation by cats and dogs.

- Pueblo Reservoir is located within the overall range of the burrowing owl. Much of the land surrounding Pueblo Reservoir is comprised of short grass prairie allowing for potential use of the area by this species and its primary prey item, prairie dog species. Any future land use changes within the survey area should be evaluated for the presence of this species.

5.4.4 Arkansas Darter (*Etheostoma cragini*)

The Arkansas darter is listed as a state-endangered species in Colorado. Arkansas darters are 2 ½ to 3-inch-long fish in the perch family. Generally spotted brown on the dorsal and lateral sides, during mating season (April-May) the bellies of breeding males change color from white to bright orange. Arkansas darters prefer spring-fed streams, stream channels, and pools, sometime found near shorelines, often beneath undercut banks. The diet of the Arkansas darter consists of snails, insects, crustaceans, macroinvertebrates, and fish eggs. Arkansas darters are known to occur in the Upper Arkansas portion of the Arkansas River Basin (CPW 2016). Their preferred habitat conditions include first and second order streams with high exposure to sunlight and a width of 5 to 60 feet. The preferred water depth for this species is between 4 and 20 inches.

- The survey area is located within the HUC 8 watershed in the overall range of the Arkansas darter. This species is known to inhabit the Upper Arkansas River section of the Arkansas River Basin. This species potentially uses Pueblo Reservoir for passage to its preferred stream habitats but due to the size and depth is unlikely to utilize reservoirs extensively for feeding or mating activities. This species prefers habitat such as spring-fed streams channels and pool with a much shorter water depth than the waters in the survey area. Any future changes to Pueblo Reservoir within the survey area that allow for fish passage should not adversely affect the continued existence or potential habitat of this species.

5.4.5 Southern redbelly dace (Phoxinus erythrogaster)

Southern redbelly dace is listed as a state threatened species in Colorado. The southern redbelly dace is a fish that averages 2 ½ inches long. This dace species has horizontal black stripes and a silvery area above the black stripe. Males have red or yellow stripes below the main black stripe that are especially evident during breeding season. All fins on this species are yellow, with the dorsal and caudal fins having a red base at their proximal connection (Stasiak 2007). Southern redbelly dace diet consists a variety items, including algae, diatoms, and invertebrates. Southern redbelly dace have a strong habitat preference for sluggish, spring-fed headwaters and upland creeks with vegetation and woody debris. This species prefers waters that are generally clear with substrates of sand or gravel. In Colorado, populations occur in the headwaters of the Arkansas River near Pueblo and Canon. Southern redbelly dace have been transplanted from a known population near Fort Carson population into three waters in the Pueblo State Wildlife Area and Lathrop Park State Recreation Area in 1997 and 1998. This species preferred habitat is characterized as “small creeks and spring branches having a permanent flow of clear, cool water and silt-free gravelly bottoms. In larger creeks and rivers, it occurs only as strays or as highly localized populations in spring pools away from the main channel.” This species is frequently found in small pools 1 to 3 feet deep and is often associated with aquatic vegetation (Mettee et al., 1996) and schools of the southern redbelly dace are often found under bank overhangs among tree roots, especially in clear pools with a muck bottom (Smith 1979).

- Pueblo Reservoir is located within the Arkansas River basin which is within the overall range of the Southern redbelly dace. This species is known to inhabit the Upper Arkansas River section of the Arkansas River Basin. This species potentially uses Pueblo Reservoir for passage to its preferred stream habitats but due to the size and depth is unlikely to utilize reservoirs extensively for feeding or mating activities. This species prefers habitat such as small creeks and streams with gravelly bottoms and clear running water unlike the waters found within the survey area. Any future changes to Pueblo Reservoir within the survey area that allow for fish passage should not adversely affect the continued existence or potential habitat of this species.

6 Fisheries

Pueblo Reservoir and surrounding lands support recreation and include sailing, motor-boating, waterskiing, river tubing, swimming, fishing, and camping. Pueblo reservoir offers 4000 acres for fishing. The Arkansas River is home to both cold and warm water species. In years past (2015-2019), CPW has stocked the river with brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), cutbow trout (*Oncorhynchus clarkii x mykiss*), snake river cutthroat(*Oncorhynchus clarkii*) and saugeye (*Stizostedion vitreum*) (CPW 2019a). The Arkansas River also includes black bullhead (*Ameiurus melas*), fathead minnow (*Pimephales promelas*), red shiner (*Cyprinella lutrensis*), plains minnow (*Hybognathus placitus*), and speckled chub (*Macrhybopsis aestivalis*) (Reclamation 2018).

Water elevation fluctuation allows Pueblo Reservoir to contain both cold and warm water species. CPW has stocked Pueblo Reservoir with blue catfish (*Ictalurus furcatus*), channel catfish (*Ictalurus punctatus*), cutbow, largemouth bass (*Micropterus salmoides*), rainbow trout, walleye (*Sander vitreus*), wiper (*Morone saxatilis x chrysops*), and black crappie (*Pomoxis nigromaculatus*). Pueblo Reservoir also contains populations of white crappie (*Pomoxis annularis*), blue gill (*Lepomis macrochirus*), flathead catfish (*Pylodictis olivaris*), and yellow perch (*Perca flavescens*) (CPW 2019b). Studies in 2019 have shown that walleye make up most of the fish population at Pueblo reservoir with 51% and Wiper at 13% (Reclamation).

CPW fish survey and management data for 2019 are provided in **Appendix E** to this report. The CPW should be consulted prior to implementation of storage enhancement construction projects to determine potential impacts resulting from changes in water flows, water temperature, turbidity, water quality, etc. that may negatively affect fish populations within Pueblo Reservoir and points along the Arkansas upstream or downstream of Pueblo Dam.

7 Aquatic Nuisance Species

The State of Colorado State Aquatic Nuisance Species Act (ANS) was signed into law in May of 2008. The Act defines ANS as exotic or nonnative aquatic wildlife or any plant species that have been determined to pose a significant threat to the aquatic resources or water infrastructure of the state. It makes it illegal to possess, import, export, ship, transport, release, plant, place, or cause an ANS to be released. The Act allocated funding to ANS programs in both the former Colorado Department of Wildlife and Colorado Department of Parks. It provides authority for qualified peace officers to inspect, and if necessary, decontaminate or quarantine watercraft for ANS. It also provides authority for CPW trained authorized agents to inspect and decontaminate watercraft for ANS (CPW 2014).

ANS species within Colorado include zebra and quagga mussels (CPW 2020d). Zebra mussels (*Dreissena polymorpha*) are a small shellfish named for the stripped pattern on its shell. The mussel is typically found attached to objects, surfaces, or other mussels. Females generally reproduce eggs in autumn with fertilization taking place in the spring. Zebra mussels attach to any stable substrate in the water including rock and artificial surfaces.

Quagga mussel is a small shellfish with stripes similar to the zebra mussel. The quagga mussel is noticeably rounder with asymmetrical valves vs. the zebra mussel. If water temperatures are right, quagga mussels can reproduce year-round. Quagga mussels, similar to zebra mussels, are typically found attached to hard objects.

In Colorado, there are no waters positive for zebra or quagga mussels. However, in the past, these mussels have been found in Pueblo Reservoir, Grandby Reservoir, Grand Lake, Shadow Mountain Reservoir, Willow Creek Reservoir, Tarryall Reservoir, Jumbo Reservoir, and Blue Mesa Reservoir. These waters have been delisted following 5 years of no detections.

However, the CPW should be consulted prior to implementation of storage enhancement construction projects to determine if those activities may affect ANS within Pueblo Reservoir. Changes in water level, nutrient levels, water quality, and temperature may affect the likelihood that exotic or nonnative aquatic wildlife or any plant species could become problematic in the future.

8 Soils

Certain land-based activities associated with the storage enhancement alternatives (i.e., placement/widening of access roads, dam construction, placement of Confined Disposal Facilities or CDFs, etc.) may impact soil resources. Since much of the lands surrounding Pueblo Reservoir are administered by the U.S. Bureau of Land Management (BLM), the BLM may require certain impacts to soil resources be evaluated under NEPA (See **Appendix A** for additional information).

The U.S. Department of Agriculture National Resource Conservation Service (NRCS) Web Soil Survey map depicts 16 soil map unit types in the lands surrounding Pueblo Reservoir. A map showing soil mapping units surround the reservoir is provided in **Appendix F**.

The soils surrounding Pueblo Reservoir have a range of textures from silty loam to gravelly sandy loam. Only one mapped soil unit, Water, in the survey area is rated as a hydric soil. Two mapped soil units, Glenberg-Haversid complex, 0 to 2 percent slopes and Haversid silt loam, 0 to 2 percent slopes, have Farmland Classifications of “Prime farmland if protected from flooding or not frequently flooded during the growing season,” and Kim fine sandy loam is the only soil unit to receive a classification of “Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60.” Refer to **Table 1** below for descriptions of mapped soil units.

Table 1. Mapped Soil Unit Descriptions

Soil Map Unit Name	Soil Texture	Landform	Hydric Soil Rating	Farmland Classification
Arvada-Keyner complex, 0 to 4 percent slopes	Sandy loam to clay loam	Terrace	No	Not prime farmland
Bankard sand, 0 to 2 percent slopes, frequently flooded	Sand to sandy loam	Flood plain steps, flood plains	No	Not prime farmland
Cascajo very gravelly sandy loam, 2 to 20 percent slopes	Very gravelly sandy loam to very gravelly sand	Terraces	No	Not prime farmland
Orthents (Dam)	N/A	N/A	N/A	N/A
Glenberg-Haversid complex, 0 to 2 percent slopes, occasionally flooded	Very fine sandy loam to coarse sand	Flood plain steps, flood plains	No	Prime farmland if protected from flooding or not frequently flooded during the growing season
Haversid silt loam, 0 to 2 percent slopes, frequently flooded	Silt loam to stratified fine sandy loam	Flood plains	No	Prime farmland if protected from flooding or not frequently flooded during the growing season
Keyner loamy sand, wet, 0 to 3 percent slopes, occasionally flooded	loamy fine sand to clay loam	Flood plains	No	Not prime farmland
Kim fine sandy loam	Silt loam to fine sandy loam	Fans, stream terraces	No	Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Limon silty clay loam, 0 to 2 percent slopes	Silty clay to silty clay loam	Fans, terraces	No	Not prime farmland

Soil Map Unit Name	Soil Texture	Landform	Hydric Soil Rating	Farmland Classification
Manvel silt loam, 2 to 6 percent slopes, dry	Silt loam	Interfluves, fans	No	Not prime farmland
Midway-Shale outcrop complex, 1 to 9 percent slopes	Silty clay	Plains	No	Not prime farmland
Oterodry sandy loam, dry, 1 to 4 percent slopes	Sandy loam to fine sandy loam	Paleoterraces, hillslopes	No	Not prime farmland
Penrose-Minnequa complex, 1 to 15 percent slopes, dry	Channery loam	Hogbacks, scarps, hills	No	Not prime farmland
Penrose-Midway-Rock outcrop complex, 10 to 45 percent slopes	Channery loam to loam	Cuestas, mesas	No	Not prime farmland
Travessilla-Rock outcrop complex, 25 to 65 percent slopes	Sandy loam	Scarps	No	Not prime farmland
Water	N/A	Marshes	Yes	N/A

9 Conclusion

This report provides a summary of permits, environmental review documents, and regulatory approvals that will likely be required for the sediment removal and dam raise alternatives for the Pueblo Reservoir storage enhancement project. The following resources were evaluated in this document: wetlands (Section 2), water quality (Section 3), vegetation resources (Section 4), wildlife resources (Section 5), fisheries (Section 6), aquatic nuisance species (Section 7), and soils (Section 8). Any modifications to Pueblo Dam that require placement of fill in the reservoir or the Arkansas River or affect the environmental resources described herein may require an Individual 404 Permit, a NEPA review, consultation and coordination with numerous State and Federal agencies, and appropriate mitigation. The regulations of the USACE, Reclamation and EPA are intertwined in the 404 Permit and National Environmental Policy Act (NEPA) processes. Reclamation constructed and operates Pueblo Reservoir. Therefore, if an environmental review (i.e., Environmental Assessment (EA) or an Environmental Impact Statement (EIS)) is required under the provisions of the NEPA, Reclamation will most likely be the Lead Federal Agency. If a 404 Permit is needed for the storage recovery project, other Federal, State, and local agencies should be advised of the pending action and consulted regarding impacts and mitigation measures. In addition, all landowners adjacent to the project should be notified and provided opportunity to comment. Additionally, the USACE may contact the following agencies as part of the permitting process: 1) Reclamation, 2) EPA, 3) U.S. Fish and Wildlife Service (USFWS), 4) Colorado Department of Public Health and Environment (CDPHE), 5) Colorado Department of Parks and Wildlife (CPW), and 6) Colorado State Historic Preservation Office (SHPO). Local governments such as Pueblo County, the City of Pueblo, Pueblo West Metro District should be notified of the pending action. Water rights holders and water utilities who divert from the reservoir or the Arkansas River immediately downstream from the dam should be requested to comment on the proposed project.

The following table summarizes the permits, costs, and timeframe associated with each alternative. This information is also provided in more detail in Appendix A, Tables 1 and 2.

Table 1. Summary of Permits and Costs Associated with Each Alternative

Alternative	Agencies Involved	Permits/Documents Required	Anticipated Costs	Permitting Timeframe
Sediment Removal	• Reclamation • USACE • USEPA • USFWS • CPD • CDPHE • SHPO	NEPA Review (EA or EIS) 404 Permit	Up to $10 Million Preliminary scoping: ~$200k	3 to 5 years to complete
Dam Raise	• Reclamation • USACE • USEPA • USFWS • CPD • SHPO • CDPHE	NEPA Review (EIS) 404 Permit Additional agency coordination/consultation	$10-30 Million	10-15 years to complete

10 References

Andrews, J.M., and R. Righter. 1992. Colorado Birds: a reference to their distribution and habitat Denver Museum of Natural History, Denver.

Armstrong, D.M., et al. Edited by M.E. Bakeman. May 1997. *Report on Habitat Findings of the Preble's Meadow Jumping Mouse*. Presented to the US Fish and Wildlife Service and the Colorado Division of Wildlife.

Belant, J., Gober, P. & Biggins, D. 2008. *Mustela nigripes*. The IUCN Red List of Threatened Species 2008: e.T14020A4382826. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T14020A4382826.en.

Colorado Parks and Wildlife (CPW). Colorado Parks and Wildlife. 1992. Wildlife in Danger: The status of Colorado's Threatened or Endangered Fish, Amphibians, Birds and Mammals.

CPW. 2008 Recommended Buffer Zones and Seasonal Restrictions for Raptors. Available online at: https://cpw.state.co.us/Documents/WildlifeSpecies/LivingWithWildlife/RaptorBufferGuidelines2008.pdf

CPW. Colorado Parks and Wildlife. 2014. *State Aquatic Nuisance Species (ANS) Program Summary for Colorado Legislators per SB 08-226.* Available online at: https://www.colorado.gov/pacific/sites/default/files/Aquatic%20Nuisance%20Species%20Program%20LegislativeReport-January2014-FINAL.pdf

CPW. 2016. Colorado Parks and Wildlife. Arkansas Darter: Assessing Habitat Quality for Priority Species in Colorado Wetlands. Available online at: https://cnhp.colostate.edu/download/documents/cwic_docs/CPWSpeciesProfiles/CPWProfiles_ArkansasDarter.pdf

CPW. Colorado Parks and Wildlife. 2019a. *Arkansas River at Pueblo Fish Survey and Management Data.* Available online at: https://cpw.state.co.us/thingstodo/Fishery%20Survey%20Summaries/ArkansasRiverPueblo.pdf
CPW. Colorado Parks and Wildlife. 2019b. *Pueblo Reservoir Fish Survey and Management Data.* Available online at: https://cpw.state.co.us/thingstodo/Fishery%20Survey%20Summaries/PuebloReservoir.pdf

CPW. 2020a. Colorado Parks and Wildlife GIS Species Activity Mapping Definitions Publicly Available Data. Available at https://cpw.state.co.us/learn/Maps/CPW-Public-GIS-Species-Activities-Definitions.pdf

CPW. 2020b. Species Activity Mapping (SAM), Geographic Information Systems (GIS) Data. Updated December. Available online at: http://www.arcgis.com/home/item.html?id=190573c5aba643a0bc058e6f7f0510b7

CPW. 2020c. Threatened and Endangered List. Available at http://cpw.state.co.us/learn/Pages/SOC-ThreatenedEndangeredList.aspx

CPW. 2020d. Colorado Parks and Wildlife. *Invasive Concerns: Zebra and Quagga mussels.* Available online at: https://cpw.state.co.us/aboutus/Pages/ISP-Zebra-Quagga.aspx

Despain, Don G.; Beier, Paul; Tate, Cathy; Durtsche, Bruce M.; Stephens, Tom. 2000. Modeling biotic habitat high risk areas. Journal of Sustainable Forestry. 11(1/2): 89-117. [37579]

GEI Consultants, Inc. 1998. Water and Storage Needs Assessment. Report for the SECWCD/Assessment Enterprise. December 10, 1998.

Kingery, Hugh. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership 1998.

Koehler, Gary M.; Brittell, J. David. 1990. Managing spruce-fir habitat for lynx and snowshoe hares. Journal of Forestry. 88(10): 10-14. [13599]

Mettee, M.F., P.E. O'Neil, and J.M. Pierson. 1996. Fishes of Alabama and the Mobil Basin. Geological Survey of Alabama Monograph 15. State of Alabama, Tuscaloosa, AL.

NatureServe 2020. NatureServe Explorer Central Database. Ecological Association Comprehensive Report. Available online at: http://explorer.natureserve.org. October.

Smith, P.W. 1979. The fishes of Illinois. Illinois Natural History Survey, University of Illinois Press. Urbana, IL.

Stasiak Richard H. 2007. US Forest Service. "Southern Redbelly Dace (Phoxinus erythrogaster): a technical conservation assessment", p. 11, USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/southernredbellydace.pdf

Southeastern Colorado Water Conservancy District (SECWCD). 2019. Storage Programs Review. October 3, 2019.

U.S. Department of Agriculture (USDA). 2009. Greenback Cutthroat Trout (Oncorhynchus clarkii stomias): A Technical Conservation Assessment. Rocky Mountain Research Station. Missoula, Montana. February 6.

United States Bureau of Reclamation (Reclamation). 2013. Arkansas Valley Conduit (AVC) and Master Contract Final EIS. Eastern Colorado Area Office, Great Plains Region.

Reclamation. 2015. Draft Environmental Assessment, Project 2015-001, Pueblo Hydropower Project, Eastern Colorado Area Office, Great Plains Region.

Reclamation. 2018. Final Programmatic Environmental Assessment for Pueblo Reservoir Temporary Excess Capacity Storage Contracting Program. Fryingpan-Arkansas Project, Eastern Colorado Area Office, Great Plains Region.

U.S. Geological Survey (USGS). 1998. Roderick F. Ortiz, Michael E. Lewis, and Mary Jo Radell. Water-Quality Assessment of the Arkansas River Basin, Southeastern Colorado, 1990-93. Water-Resources Investigations Report 97-4111)

U.S. Fish and Wildlife Service (USFWS). 2009. USFWS Block-cleared Areas for Black-Footed Ferret Surveys in Colorado. September. Available online at: http://www.fws.gov/mountain-prairie/species/mammals/blackfootedferret/BlockClearanceMap2009SeptemberColoradoState.pdf

USFWS. 2020. Official Species List. List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project. Consultation Tracking Number 06E24000-2020-SLI-1355. June 19.

Appendices

A. Regulatory Permits Tables 1 and 2

APPENDIX A

TABLE 1. LIKELY REGULATORY REQUIREMENTS (PERMITS AND APPROVALS) FOR DREDGING

FEDERAL REGULATORY REQUIREMENTS			
Regulatory Agency	**Role**	**Estimated Permitting Schedule and Permitting Considerations**	**Estimated Cost to Fulfill Requirements**
U.S. Bureau of Reclamation (Reclamation)	National Environmental Policy Act (NEPA) – Likely Lead Federal Agency. An Environmental Assessment (EA) will likely be required. It is also possible that Reclamation will require an Environmental Impact Statement (EIS). Pueblo Reservoir Dam Operations and Management Fryingpan-Arkansas Project Operations and Management	The U.S. Bureau of Reclamation (Reclamation) built and manages the Fryingpan-Arkansas Project, of which Pueblo Reservoir is a major component. As such, it is a near certainty that the Reclamation will be the lead federal agency for any environmental review conducted under the National Environmental Policy Act (NEPA). There are numerous storage and carriage contracts and environmental issues that must be considered in a NEPA evaluation. In addition, the U.S. Army Corps of Engineers (USACE) influences dam operations when storage enters the flood control pool of the reservoir. NEPA analyses for the dredging option with some discharge of dredged materials into the Bessemer Irrigating Ditch Company canal will likely require preparation of an Environmental Assessment (EA) and perhaps an Environmental Impact Statement (EIS). In this role, the Reclamation will conduct the public interest review process and coordinate the input of several Federal and State regulatory agencies. There is no specified time frame for Reclamation review and approval. Because of the complexity, scope, unique approach, and potential environmental impacts of the proposed storage recovery project at Pueblo Reservoir, a five to seven-year NEPA schedule may be required. The permitting schedule will be better defined after preliminary meetings are conducted between the Southeastern Colorado Water Conservancy District (SECWCD) and the Reclamation. Reclamation is an experienced in the preparation of NEPA documents, Reclamation has recently been the Lead Federal Agency in the preparation of two (2) major NEPA documents requiring (EISs). The Windy Gap Firming Project is expanding Windy Gap Project Storage by constructing a new 90,000 AF reservoir on the East Slope west of Loveland and by constructing mitigation on the West slope. Preliminary studies, the EIS process, and other state and federal approvals required nearly 20 years to complete. Construction is scheduled to begin in 2020 with completion in 2024. Dredging to recover storage in Pueblo Reservoir is not nearly as complex or controversial as creating new storage for Windy Gap. Planning commenced in the 1990s for the Colorado Springs Utilities, Southern Delivery System Project. Environmental reviews and permits to build the project were undertaken from 2001-2010. This project	The SECWCD should plan on a budget of approximately $10 Million for the overall permitting effort of this option. However, this estimate will be refined after preliminary meetings are conducted with the SECWCD and Reclamation and after agency and public scoping is conducted early in the project planning process. SECWCD could conduct thorough Purpose and Need Analysis that includes project economics, a comprehensive alternatives analysis, and measures to avoid and mitigate impacts. This will act to set the agenda and the tone for the formal NEPA compliance review, whether this review is an EIS or an EA. The cost of the Purpose and Need Analysis will be approximately $200,000.00.

U.S. Bureau of Reclamation (Reclamation) – continued		required right-of-way disturbance to install a pipeline from Pueblo Reservoir to Colorado Springs during Phase 1. New terminal reservoir storage is planned for a future Phase 2. The Pueblo Reservoir dredging project is expected to be considerably less controversial. The U.S. Bureau of Reclamation (Reclamation) National Environmental Policy Act (NEPA) Handbook has been developed in response to the Council on Environmental Quality's (CEQ) and the U.S. Department of the Interior's (Interior) implementing regulations on NEPA. The Reclamation NEPA Handbook published in February 2012 describes the process and procedures that the Reclamation uses to conduct NEPA evaluations where Reclamation is the lead federal agency. The Reclamation NEPA Handbook implements the Council on Environmental Quality (CEQ) and U.S. Department of Interior legislative mandates and specifically addresses the provisions of NEPA as a supplement to its existing authority and as a mandate to consider its policies and missions in the light of its national environmental objectives. The CEQ and Interior implementing regulations provide oversight and broad general direction to the Reclamation's conduct of NEPA). The NEPA Review for any alternative considered for the proposed SECWCD Fryingpan-Arkansas Storage Recovery Project will involve several other Federal cooperating agencies: 1) The USACE, 2) the U.S. Environmental Protection Agency (EPA) and, 3) the U.S. Fish and Wildlife Service (FWS). Extensive Colorado State agency involvement will also occur: 1) the Colorado Department of Parks and Wildlife (CDPW), 2) the Colorado Department of Public Health and Environment (CDPHE), and 3) the Colorado State Historic Preservation Office (SHPO).	
U.S. Army Corps of Engineers (USACE)	Federal Clean Water Act Section 404 Permitting Flood pool operations of Pueblo Reservoir	The Federal Clean Water Act requires the USACE issue permits for the discharge of dredged or fill materials into waters of the United States (WOTUS). 33 U.S. Code § 1344 authorizes the issuance of permits for dredged or fill material into WOTUS. Discharges must comply with the EPA's 404(b)(1) guidelines and a MOA between the U.S. EPA and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines. Additional (and numerous) regulations, guidance documents and court rulings also apply. Any modifications to Pueblo Dam that requiring placement of fill in the reservoir or the Arkansas River will likely require an Individual 404 Permit, a NEPA review (the Reclamation led NEPA process) and appropriate mitigation. If the USACE determines that a 404 Permit is needed, a near certainty, the agency is constrained to select the Least Environmentally Damaging Practicable Alternative (LEDPA). The LEDPA is described in 40 C.F.R. Section 230.10(a). The basis for the LEDPA determination, states that except as provided in CWA section 404(b)(2),22 a permit	Preliminary meetings with the Reclamation and the USACE are strongly advised to determine the regulatory authority of the USACE regarding the "incidental fallback' rule and the role of the USACE in the NEPA and 404 Permit process. The cost of the 404 Permit analyses and coordination with the USACE is included in the NEPA budget presented for the Reclamation.

U.S. Army Corps of Engineers (USACE) - continued		will not be issued "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. The LEDPA analysis is often the biggest stumbling block in the 404 Permit process, since it involves extensive alternatives analyses. There is an exemption for materials dredged from WOTUS and removed to disposed at an upland site. The "Incidental Fallback Rule" also called the "Tulloch Exemption" allows for the dredging and removal of dredged materials. It is our opinion that USACE will be able to justify the need for a 404 permit under Section 10 of the Rivers and Harbor act despite the incidental Fallback Rule. While SECWCD should pursue an exemption if this alternative is selected, it should be prepared for the likelihood that a 404 Permit will be required. The USACE will likely be a cooperating agency because they guide the flood control operation of Pueblo Reservoir when the pool elevation exceeds 4393.8 feet. There is no specified time frame for USACE review and approval.	
Federal Energy Regulatory Commission (FERC)	No Jurisdiction	Southeastern Colorado Water Conservancy District (SECWCD), Board of Water Works of Pueblo (PBWW), and Colorado Springs Utilities (CSU) have been granted a Lease of Power Privilege (LOPP) by Reclamation to operate a 7MW hydropower facility. FERC has no jurisdiction in the licensing of this power plant.	
U.S. Environmental Protection Agency (EPA)	Oversight of the NEPA and 404 Permit processes	Federal law has provided the EPA with oversite of the NEPA process to ensure agencies comply with the letter and spirit of the law. As such, EPA plays a pivotal and active role in the NEPA process from the beginning to the end ensuring that project purpose and need is documented and supported and that an adequate range of alternatives is considered and evaluated. EPA also has oversight of protection of water quality and works with the Colorado Department of Public Health and Environment to ensure that projects do not result in adverse impacts to water quality. Federal law has also provided the EPA with oversite of the 404 Permit program. EPA has promulgated the 404(b)(1) guidelines that provide direction to the USACE for their administration of the 404 Permit program. The EPA is also signatory to a MOA with the USACE concerning the determination of mitigation under the Clean Water Act Section 404(b)(1) Guidelines. The Mitigation MOA requires that 1) impacts to aquatic resources be avoided by selecting alternatives or configuring projects that have no impact on aquatic resources, 2) if the project cannot avoid impacts to aquatic resources, measures should be considered to minimize the impacts and 3) impacts to aquatic	The cost of the coordination with the EPA is included in the NEPA budget presented for Reclamation. However, the EPA often requests additional analyses after reviewing draft sections of a NEPA document or draft 404 Permits. If the Lead Federal Agency deems that EPA's requests are reasonable and that the additional analyses will strengthen the NEPA document or the 404 Permit, the applicant will be directed to conduct additional studies.

U.S. Environmental Protection Agency (EPA) continued		resources must be mitigated only if avoidance is not feasible. Projects that have been designed to minimize impacts must also be mitigated. Because of these legislative mandates, EPA is a significant partner in the environmental review and 404 Permit processes and usually requests additional analyses after reviewing draft sections of a NEPA document or draft 404 Permits.	
U.S. Fish and Wildlife Service (USFWS)	Fish and Wildlife Coordination Act (FWCA) Endangered Species Act (ESA) Migratory Bird Treaty Act (MBTA)	The FWCA requires that federal agencies consult with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and State wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license, and/or review requirements. Migratory birds likely exist within the survey area. The vegetation communities in the survey area provide, at the very least, potential nesting and foraging habitat for migratory birds. Migratory birds are protected under the Migratory Bird Treaty Act (MBTA). Killing or possession of these birds (or their parts and nests) is prohibited under the MBTA. The Endangered Species Act (ESA) of 1973 was enacted by the United States to conserve endangered and threatened species and the ecosystems that they depend on. Under the ESA, species can be listed as either endangered or threatened. Both designations are protected by law. The ESA is administered by the USFWS.	The cost of the coordination with the FWS is included in the NEPA budget presented for Reclamation.
Colorado Department of Parks and Wildlife (CDPW)	Management of Lake Pueblo State Park State agency responsible for Fish and Wildlife Coordination Act implementation with the FWS and Lead Federal Agency	The Fish and Wildlife Coordination Act requires that federal agencies consult with State wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license, or review requirements. The FWS (and by proxy the lead Federal agency) usually gives great deference to the states in this regard. CDPW and operates Pueblo State Park with boat ramps, camping facilities, picnic grounds, comfort stations and other amenities. When past projects have impacted similar facilities, mitigation and compensation for lost opportunities have been required.	Preliminary meetings with SECWCD, the CDPW staff and Reclamation are strongly advised to determine the extent of their concerns and suggestions to minimize and mitigate impacts.

Colorado Department of Public Health and Environment (CDPHE)	Protection of Water Quality	There are several regulations promulgated by CDPHE that regulate discharges to surface water and protect water quality. Regulation 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) and Regulation 32: Classifications and Numeric Standards for Arkansas River Basin (5 CCR 1002-32). Together, these two regulations promulgated by the CDPHE present the surface water standards for the entire Arkansas River drainage including Pueblo Reservoir. The regulations list use impaired segments and specify the constituents that are exceeded resulting in the impairment listing. Regulation 82: 401 Water Quality Certification: This regulation presents the requirements for water quality certification of federal water development projects. The process is often as much art as science and the compliance with Regulation 31 and Regulation 32 are the standards that generally must be met to protect water quality. The process requires extensive public review and comment. 401 Certification is a lengthy and costly process. The analyses required are determined on a case-by-case basis. The exact requirements cannot be determined until a meeting is held with CDPHE staff and an application is presented to the agency. There is no specified time frame for CDPHE review and approval. Last but equally important, Regulation 61 - Colorado Discharge Permit System (5 CCR 1002-61). This regulation has been promulgated to implement the Colorado Water Quality Control Act as amended. Regulation 61 conforms with the provisions of that act and the Federal Clean Water Act (CWA) and regulations promulgated under the CWA. The regulations apply to all operations discharging to waters of the State from a point source. Any activities that may affect water quality and exceed the water quality standards described in Regulation 31 and 32 will require a discharge permit or variance from the CDPHE. The discharge permit system regulates all manner of discharges and activities that may impact water quality. Allowances for turbidity, temperature, nutrients, and other parameters may be granted if the applicant can show that the discharges will not impair designated uses. An option that may be feasible would be to dredge the reservoir and discharge the sediments into the Arkansas River via a pipeline below the city of Pueblo. This option may be acceptable to CDPHE if an environmental benefit could be shown (i.e., stream habitat restoration). The channel of the Arkansas River Downstream from the City of Pueblo has deepened and narrowed due to the storage of sediment in Pueblo Reservoir.	Preliminary meetings with the SECWCD, the CDPHE staff and Reclamation (and perhaps the USACE) are strongly advised to determine the extent of water quality analyses and modeling that may be required. SECWCD is advised to contact Denver Water to determine the water quality permitting requirements that CDPHE applied to the Strontia Springs dredging project.

Colorado Department of Public Health and Environment (CDPHE) – continued		A major dredging project has been conducted at Strontia Springs Reservoir, a Denver Water facility, after forest fires and torrential rains resulted in a great deal of ash and sediment (160,000 cubic yards) being deposited into the reservoir. This significantly affected the storage volume of this small (7,863 acre-feet) municipal reservoir and affected the quality of water delivered to the Foothills and Marston Water Treatment Plants. Eighty (80) percent of Denver's drinking water passes through Strontia Springs Reservoir — one of the smallest in Denver Water's system. Specific permitting information for this project is not readily available, but SECWCD might be able to obtain such information by contacting Denver Water or CDPHE staff. Given the unique nature of the proposed storage recovery project, CDPHE staff will provide guidance for sampling and monitoring protocols and to determine the modeling that may be needed to secure a 401 Certification and discharge permits. These protocols are determined on a case-by-case basis and a meeting with the CDPHE to determine their specific requirements will be needed.	
	Colorado Noise Statute – Section 25-12-103	(1) Every activity to which this article is applicable shall be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness. Sound levels of noise radiating from a property line at a distance of twenty-five feet or more therefrom in excess of the db(A) established for the following time periods and zones shall constitute prima facie evidence that such noise is a public nuisance: 7:00 a.m. to next 7:00 p.m. / 7:00 p.m. to next 7:00 a.m. Residential: 55 db(A) / 50 db(A) Commercial: 60 db(A) / 55 db(A) Light industrial: 70 db(A) / 65 db(A) Industrial: 80 db(A) / 75 db(A) (2) In the hours between 7:00 a.m. and the next 7:00 p.m., the noise levels permitted in subsection (1) of this section may be increased by ten db(A) for a period of not to exceed fifteen minutes in any one-hour period.	
	Air Pollutants Emissions Notice (APEN)	Any business in Colorado that emits air pollution may be required to report its emissions and/or apply for a permit. Submitting an Air Pollutant Emissions Notice (APEN) is required to report your emissions, apply for a permit, or modify a permit.	
Colorado State Historic Preservation Officer	Section 106 of the National Historic Preservation Act & State Register Act Review and Compliance	When a federal agency funds, licenses, or permits an activity that may affect cultural resources, the agency must consult with the State Historic Preservation Officer. This is known as Section 106 review or consultation.	Unknown. The lands where the dredged materials will be processed or deposited will need to be surveyed and assessed for the presence of cultural resources. If significant cultural resources are found, mitigation could be required, or in some cases, the proposed disposal site could be precluded from use.

TABLE 2. LIKELY REGULATORY REQUIREMENTS FOR ENLARGING PUEBLO RESERVOIR DAM

FEDERAL REGULATORY REQUIREMENTS			
Regulatory Agency	**Role**	**Estimated Permitting Schedule and Permitting Considerations**	**Estimated Cost to Fulfill Requirements**
U.S. Bureau of Reclamation (Reclamation)	National Environmental Policy Act (NEPA) – Likely Lead Federal Agency. Pueblo Reservoir Dam Operations and Management Fryingpan-Arkansas Project Operations and Management	NEPA analyses for the dam raise option will undoubtedly require preparation of an Environmental Impact Statement (EIS). In this role, the Reclamation will conduct the public interest review process and coordinate the input of several Federal and State regulatory agencies. The U.S. Bureau of Reclamation (Reclamation) built and manages the Fryingpan-Arkansas Project and Pueblo reservoir is a major component. As such, it is a near certainty that Reclamation will be the lead federal agency for any environmental review conducted under the National Environmental Policy Act (NEPA). There are numerous storage and carriage contract that the Reclamation manages and must be considered in a NEPA evaluation. In addition, the U.S. Army Corps of Engineers (USACE) influences dam operations when storage enters the flood control pool of the reservoir. Because of the complexity, scope, and potential environmental impacts to Pueblo Reservoir and the Arkansas River due to the proposed storage recovery project at Pueblo Reservoir, a ten year NEPA schedule is projected. An EIS, not an EA, will certainly be required. As previously noted under the dredging scenario, there is no specified time frame for Reclamation review and approval. The permitting schedule will be better defined after preliminary meetings are conducted between the Southeastern Colorado Water Conservancy District (SECWCD) and Reclamation. Pueblo Dam was constructed over a five (5) year period from 1970 – 1975. An enlargement of the dam will take even more time to construct, with significant impacts to recreation, the ecosystems upstream of the current reservoir and downstream of the dam, and to wildlife to be mitigated. Similar reservoir enlargement projects such as Halligan Reservoir, Gross Reservoir, Seaman Reservoir, and Chatfield Reservoir have all taken more than 15 years to study and permit. As noted in Table 1, the Reclamation National Environmental Policy Act (NEPA) Handbook has been developed in response to the Council on Environmental Quality's (CEQ) and the U.S. Department of the Interior's (Interior) implementing regulations on NEPA. The Reclamation NEPA Handbook published in February 2012 describes	The SECWCD should plan on a budget of $10 Million – $30 Million for the overall permitting effort including legal, in-house staff, consultants, and owners' representatives, third party NEPA consultant and others. This estimate will be refined after preliminary meetings between SECWCD and Reclamation and after agency and public scoping is conducted early in the NEPA Process.

U.S. Bureau of Reclamation (Reclamation) – continued		the process and procedures that the Reclamation uses to conduct NEPA evaluations where Reclamation is the lead federal agency. The Reclamation NEPA Handbook implements the Council on Environmental Quality (CEQ) and U.S. Department of Interior legislative mandates and specifically addresses the provisions of NEPA as a supplement to its existing authority and as a mandate to consider its policies and missions in the light of its national environmental objectives. The CEQ and Interior implementing regulations provide oversight and broad general direction to the Reclamation's conduct of NEPA). The NEPA Review for the dam raise option will be extensive with preparation of a detailed purpose and need and extensive alternatives analysis evaluating other storage options, the dredging alternative(s), no action alternative, and conservation options among others. As noted in Table 1, several other Federal cooperating agencies and affected State of Colorado agencies would be very involved in the NEPA and permitting process.	
Federal Energy Regulatory Commission (FERC)	No Jurisdiction	Southeastern Colorado Water Conservancy District (SECWCD), Board of Water Works of Pueblo (PBWW), and Colorado Springs Utilities (CSU) have been granted a Lease of Power Privilege (LOPP) by Reclamation to operate a 7MW hydropower facility. FERC has no jurisdiction in the licensing of this power plant.	
U.S. Army Corps of Engineers (USACE)	Federal Clean Water Act Section 404 Permitting Flood pool operations of Pueblo Reservoir	The Federal Clean Water Act requires the USACE issue permits for the discharge of dredged or fill materials into waters of the United States (WOTUS). 33 U.S. Code § 1344 authorizes the issuance of permits for dredged or fill material into WOTUS. Discharges must comply with the EPA's 404(b)(1) guidelines and a MOA between the U.S. EPA and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines. Additional (and numerous) regulations, guidance documents and court rulings also apply. Any modifications to Pueblo Dam that requiring placement of fill in the reservoir or the Arkansas River will likely require an Individual 404 Permit, a NEPA review (likely a Reclamation lead Environmental Impact Statement) and appropriate mitigation. Because additional fill will be placed in the channel of the Arkansas River and the existing Pueblo Reservoir is a Water of the United States, , the USACE will play a significant role in the NEPA process if the option to enlarge the reservoir is pursued.	Preliminary meetings with the Reclamation and the USACE are strongly advised to determine the regulatory authority of the USACE regarding the "incidental fallback' rule and the role of the USACE in the NEPA and 404 Permit process. The cost of the 404 Permit analyses and coordination with the USACE is included in the NEPA budget presented for the Reclamation.

U.S. Army Corps of Engineers (USACE) - continued		The USACE will certainly determine that a 404 Permit is needed to raise Pueblo Dam. USACE is constrained to select the Least Environmentally Damaging Practicable Alternative (LEDPA). The LEDPA is described in 40 C.F.R. Section 230.10(a). The basis for the LEDPA determination, states that except as provided in CWA section 404(b)(2),22 a permit will not be issued "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences". The LEDPA analysis is often the biggest stumbling block in the 404 Permit process since it involves extensive alternatives analyses. There is no specified time frame for USACE review and approval.	
U.S. Environmental Protection Agency (EPA)	Oversight of the NEPA and 404 Permit processes	Federal law has provided the EPA with oversite of the NEPA process to ensure agencies comply with the letter and spirit of the law. As such, EPA plays a pivotal and active role in the NEPA process from the beginning to the end ensuring that project purpose and need is documented and supported and that an adequate range of alternatives is considered and evaluated. EPA also has oversight of protection of water quality and works with the Colorado Department of Public Health and Environment to ensure that projects do not result in adverse impacts to water quality. Federal law has also provided the EPA with oversite of the 404 Permit program. EPA has promulgated the 404(b)(1) guidelines that provide direction to the USACE for their administration of the 404 Permit program. The EPA is also signatory to a MOA with the USACE concerning the determination of mitigation under the Clean Water Act Section 404(b)(1) Guidelines. The Mitigation MOA requires that 1) impacts to aquatic resources be avoided by selecting alternatives or configuring projects that have no impact on aquatic resources, 2) if the project cannot avoid impacts to aquatic resources, measures should be considered to minimize the impacts and 3) impacts to aquatic resources must be mitigated only if avoidance is not feasible. Projects that have been designed to minimize impacts must also be mitigated. Because of these legislative mandates, EPA is a significant partner in the environmental review and 404 Permit processes and usually requests additional analyses after reviewing draft sections of a NEPA document or draft 404 Permits.	The cost of the coordination with the EPA is included in the NEPA budget presented for the Reclamation. However, EPA generally requests additional analyses after reviewing draft sections of a NEPA document or draft 404 Permits. If the Lead Federal Agency deems that EPA's requests are reasonable and that the additional analyses will strengthen the NEPA document or the 404 Permit, the applicant will be directed to conduct additional studies.
U.S. Fish and Wildlife Service (FWS)	Fish and Wildlife Coordination Act (FWCA) Endangered Species Act (ESA)	The FWCA requires that federal agencies consult with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and State wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process	The cost of the coordination with the FWS is included in the NEPA budget presented for Reclamation.

U.S. Fish and Wildlife Service (FWS) - continued	Migratory Bird Treaty Act (MBTA)	of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license, and/or review requirements. Migratory birds likely exist within the survey area. The vegetation communities in the survey area provide at the very least, potential nesting and foraging habitat for migratory birds. Migratory birds are protected under the MBTA. Killing or possession of these birds (or their parts and nests) is prohibited under the MBTA. The Endangered Species Act (ESA) of 1973 was enacted by the United States to conserve endangered and threatened species and the ecosystems that they depend on. Under the ESA, species can be listed as either endangered or threatened. Both designations are protected by law. The ESA is administered by the USFWS. Because of potential impacts to fisheries and wildlife habitat in Pueblo Reservoir and downstream in the Arkansas River, the Fish and Wildlife Coordination Act Report will likely be extensive. Detailed mitigation of fish and wildlife resources will be likely be recommended.	
Colorado Department of Parks and Wildlife (CDPW)	Management of Lake Pueblo State Park State agency responsible for Fish and Wildlife Coordination Act implementation with the FWS and Lead Federal Agency	Because the reservoir enlargement alternative will result in significant impacts to recreation, fish and wildlife resources and habitats, the CDPW will have a large role in the NEPA and permitting process. Extensive coordination between Reclamation, other federal and state agencies, and the SECWCD will be required. The Fish and Wildlife Coordination Act requires that federal agencies consult with State wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA, or other federal permit, license, or review requirements. The FWS (and by proxy the lead Federal agency) usually gives great deference to the states in this regard. CDPW and operates Pueblo State Park with boat ramps, camping facilities, picnic grounds, comfort stations and other amenities. Where past projects have impacted similar facilities, mitigation and compensation for lost opportunities have been required.	Preliminary meetings with SECWCD, the CDPW staff and Reclamation are strongly advised to determine the extent of their concerns and suggestions to minimize and mitigate impacts.
Colorado Department of Public Health and Environment (CDPHE)	Protection of Water Quality	There are several regulations promulgated by CDPHE that regulate discharges to surface water and protect water quality. Regulation 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) and Regulation 32: Classifications and Numeric Standards for Arkansas River Basin (5 CCR 1002-32). Together, these two regulations promulgated by the CDPHE present the surface water standards for the entire Arkansas River drainage including Pueblo Reservoir. The regulations list use impaired	Preliminary meetings with the SECWCD, the CDPHE staff and Reclamation (and perhaps the USACE) are strongly advised to determine the extent of water quality analyses and modeling that may be required.

Colorado Department of Public Health and Environment (CDPHE) - continued		segments and specify the constituents that are exceeded resulting in the impairment listing. Regulation 82: 401 Water Quality Certification: This regulation presents the requirements for water quality certification of federal water development projects. The process is often as much art as science and the compliance with Regulation 31 and Regulation 32 are the standards that generally must be met to protect water quality. The process requires extensive public review and comment. 401 Certification is usually a lengthy and costly process and the analysis required is determined on a case-by-case basis. The exact requirements cannot be determined until a meeting is held with CDPHE staff and an application is presented to the agency. There is no specified time frame for CDPHE review and approval. Last but equally important, Regulation 61 - Colorado Discharge Permit System (5 CCR 1002-61). This regulation has been promulgated to implement the Colorado Water Quality Control Act as amended. Regulation 61 conforms with the provisions of that act and the Federal Clean Water Act (CWA) and regulations promulgated under the CWA. The regulations apply to all operations discharging to waters of the State from a point source. Any activities that may affect water quality and exceed the water quality standards described in Regulation 31 and 32 will require a discharge permit or variance from the CDPHE. The discharge permit system regulates all manner of discharges and activities that may impact water quality. Allowances for turbidity, temperature, nutrients, and other parameters may be granted if the applicant can show that the discharges will not impair designated uses. Given the unique nature of the proposed storage recovery project, it is unlikely that CDPHE staff has developed sampling and monitoring protocols and determined the modeling that may be needed to secure a 404 Certification and discharge permits.	
	Colorado Noise Statute – Section 25-12-103	Every activity to which this article is applicable shall be conducted in a manner so that any noise produced is not objectionable due to intermittence, beat frequency, or shrillness as established in Section 25-12-103	
	Air Pollutants Emissions Notice (APEN)	Any business in Colorado that emits air pollution may be required to report its emissions and/or apply for a permit. Submitting an Air Pollutant Emissions Notice (APEN) is required to report your emissions, apply for a permit, or modify a permit.	

Colorado State Historic Preservation Officer	Section 106 & State Register Act Review and Compliance	When a federal agency funds, licenses or permits an activity that may affect cultural resources, the agency must consult with the State Historic Preservation Officer. This is known as Section 106 review or consultation.	Unknown. The alternatives that would be considered may have cultural resources that would need to be evaluated for the presence of cultural resources. Field surveys can be time consuming and expensive.

B. Incidental Fallback Rule

Federal Register

Monday
May 10, 1999

Part II

Department of Defense

Department of the Army, Corps of Engineers

Environmental Protection Agency

33 CFR Part 323

40 CFR Part 232

Revisions to the Clean Water Act Regulatory Definition of ''Discharge of Dredged Material''; Final Rule

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

33 CFR Part 323

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 232

[FRL–6338–9]

Revisions to the Clean Water Act Regulatory Definition of ''Discharge of Dredged Material''

AGENCIES: U.S. Army Corps of Engineers, Department of the Army, DOD; and Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: The U.S. Army Corps of Engineers (Corps) and the Environmental Protection Agency (EPA) are promulgating a final rule amending a Clean Water Act (CWA) section 404 regulation that defines the term ''discharge of dredged material.'' This action conforms that definition to the results of a lawsuit holding that by asserting jurisdiction over any redeposit of dredged material, including incidental fallback, the Agencies had exceeded our statutory authority under the CWA. Today's action is intended to comply with the injunction issued by the district court in that case. Today's rule responds to the court decision by deleting language from the regulation that was held to exceed our CWA statutory authority and by adding clarifying language.

EFFECTIVE DATE: May 10, 1999.

FOR FURTHER INFORMATION CONTACT: For information on the final rule, contact Mr. John Lishman of EPA at (202) 260–9180 or Mr. Mike Smith or Mr. Sam Collinson of the Corps at (202) 761–0199. For questions on project-specific activities, contact your local Corps District office. Addresses and telephone numbers for Corps District offices can be obtained from the Corps Regulatory Homepage at http://www.usace.army.mil/inet/functions/cw/cecwo/reg/district.htm. If you do not have access to the Internet, telephone numbers for Corps District offices can be obtained by calling the National Wetlands hotline at 800–832–7828.

SUPPLEMENTARY INFORMATION:

I. Background

A. Potentially Affected Entities

Persons or entities engaged in discharging dredged material to waters of the US could be affected by today's rule. Today's rule addresses the regulatory definition of ''discharge of dredged material,'' a term which is important in determining what types of activities do or do not require a CWA section 404 permit. As described further below, today's action does not increase regulatory burdens, but rather conforms the language in our section 404 regulations to the outcome of a lawsuit challenging the regulatory definition. Examples of entities that might potentially be affected include:

Category	Examples of potentially affected entities
State/Tribal governments or instrumentalities	State/tribal agencies or instrumentalities that discharge dredged material to waters of the U.S.
Local governments or instrumentalities	Local governments or instrumentalities that discharge dredged material to waters of the U.S.
Industrial, commercial, or agricultural entities	Industrial, commercial, or agricultural entities that discharge dredged material to waters of the U.S.
Land developers and landowners	Land developers and landowners that discharge dredged material to waters of the U.S.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities that are likely to carry out activities affected by this action. This table lists the types of entities that the Agencies are now aware of that carry out activities potentially affected by this action. Other types of entities not listed in the table could also perform activities that are affected. To determine whether your organization or its activities are affected by this action, you should carefully examine the preamble discussion in section II of today's final rule. If you still have questions regarding the applicability of this action to a particular activity, consult the Corps District offices as listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

B. Tulloch Rule and Related Litigation

Section 404 of the Act authorizes the Corps (or a State with an authorized permitting program) to issue permits for the discharge of dredged or fill material into waters of the United States. On August 25, 1993 (58 FR 45008), we issued a regulation (the ''Tulloch rule'') defining the term ''discharge of dredged material'' as:

> Any addition of dredged material into, including any redeposit within, the waters of the United States. The term includes, but is not limited to the following: * * * any addition, including any redeposit, of dredged material, including excavated material, into waters of the United States which is incidental to any activity, including mechanized landclearing, ditching, channelization, or other excavation.

33 CFR 323.2(d)(1); 40 CFR 232.2.

The American Mining Congress and several other trade associations challenged this regulation. On January 23, 1997, the U.S. District Court for the District of Columbia ruled that the regulation exceeded our authority under the CWA because it impermissibly regulated ''incidental fallback'' of dredged material.[1] The court concluded that incidental fallback is not subject to the CWA as an ''addition'' of pollutants, and declared the rule ''invalid and set aside.'' The Court also enjoined us from applying or enforcing the regulation. The government appealed the court's ruling and, on June 19, 1998, the U.S. Court of Appeals for the District of Columbia Circuit affirmed the district court's decision.[2] *American Mining Congress* v. *United States Army Corps of Engineers*, 951 F.Supp. 267 (D.D.C. 1997); *aff'd sub nom, National Mining Association* v. *United States Army Corps of Engineers*, 145 F.3d 1339 (D.C. Cir. 1998) (''*NMA*'').

II. Today's Rule

Today's rule modifies our definition of ''discharge of dredged material'' in order to respond to the Court of Appeals' holding in *NMA*, and is intended to comply with the district court's injunction. The D.C. Circuit

[1] Incidental fallback results in the return of dredged material virtually to the spot from which it came. *See*, *NMA*, 145 F.3d at 1403.

[2] The *NMA* decision did not address the definition of ''discharge of fill material'' (33 CFR 323.2(f); 40 CFR 232.2), and thus did not affect the regulation of discharges of fill material, nor are the Agencies altering that definition in today's rulemaking.

found that the Tulloch rule changed the prior regulatory regime by regulating incidental fallback for the first time. 145 F.3d at 1402. The court found that the rule accomplished this result by defining ''discharge'' to include ''any redeposit'' of dredged material. *See,* 145 F.3d at 1403 (''It is undisputed that by requiring a permit for '*any* redeposit' the Tulloch rule covers incidental fallback'') (emphasis in original) (citation omitted). The court concluded that incidental fallback is not an ''addition'' of a pollutant, and that, therefore, our assertion of authority to regulate *any* redeposit of dredged material exceeded our statutory authority. 145 F.3d at 1405 (''We hold only that by asserting jurisdiction over '*any* redeposit,' including incidental fallback, the Tulloch rule outruns the Corps's statutory authority'') (emphasis in original). To conform our regulation to this holding we have made two modifications to the rule. First, today's rule deletes use of the word ''any'' as a modifier of the term ''redeposit.'' Second, today's rule expressly excludes ''incidental fallback'' from the definition of ''discharge of dredged material.''

Today's rule does not alter the well-settled doctrine, recognized in *NMA,* that some redeposits of dredged material in waters of the United States constitute a discharge of dredged material and therefore require a section 404 permit. *See* 145 F.3d at 1405 (''But we do not hold that the Corps may not legally regulate some forms of redeposit under its section 404 permitting authority.''); 145 F.3d at 1405, n.6 (recognizing that ''a redeposit could be an addition to [a] new location and thus a discharge'').

Deciding when a particular redeposit is subject to CWA jurisdiction will require a case-by-case evaluation, based on the particular facts of each case. Judicial decisions have established, and the D.C. Circuit recognized in *NMA,* that redeposits associated with the following are subject to CWA jurisdiction: mechanized landclearing, redeposits at various distances from the point of removal (e.g., sidecasting), and removal of dirt and gravel from a streambed and its subsequent redeposit in the waterway after segregation of minerals. 145 F.3d at 1407. *See also, Avoyelles Sportsmen's League* v. *Marsh,* 715 F.2d 897 (5th Cir. 1983) (mechanized landclearing requires section 404 permit); *United States* v. *M.C.C. of Florida,* 772 F.2d 1501 (11th Cir. 1985), *vacated on other grounds,* 481 U.S. 1034 (1987), *readopted in relevant part on remand,* 848 F.2d 1133 (11th Cir. 1988) (redeposit of river bottom sediments on adjacent sea grass beds is an ''addition''); *Rybachek* v. *EPA,* 904 F.2d 1276 (9th Cir. 1990) (resuspension of materials by placer miners as part of gold extraction operations is an ''addition of a pollutant'' under the CWA subject to EPA's regulatory authority); *NMA,* 951 F.Supp. at 270 (''Sidecasting, which involves placing removed soil alongside a ditch, and sloppy disposal practices involving significant discharges into waters, have always been subject to section 404'').

Determining whether a particular redeposit constitutes incidental fallback and, under the court's decision is not subject to section 404, will also require evaluation on a case-by-case basis. The *NMA* decision indicates incidental fallback ''* * * returns dredged material virtually to the spot from which it came.'' 145 F.3d at 1403. It also describes incidental fallback as occurring ''when redeposit takes place in substantially the same spot as the initial removal.'' 145 F.3d at 1401. Similarly, the district court described incidental fallback as ''the incidental soil movement from excavation, such as the soil that is disturbed when dirt is shoveled, or the back-spill that comes off a bucket and falls back into the same place from which it was removed.'' 951 F.Supp. at 270.

The court in *NMA* recognized that the CWA ''sets out no bright line between incidental fallback on the one hand and regulable redeposits on the other'' and that ''a reasoned attempt to draw such a line would merit considerable deference.'' 145 F.3d at 1405. We have not attempted to draw such a line here. Nor have we evaluated (as we did when promulgating the Tulloch rule) the complex legal, factual and policy questions associated with interpreting the reach of the CWA. Rather, we have promulgated today's rule to comply with the injunction issued in *NMA,* and as described below, will expeditiously undertake notice and comment rulemaking that will make a reasoned attempt to more clearly delineate the scope of CWA jurisdiction over redeposits of dredged material in waters of the U.S. In the interim, we will determine on a case-by-case basis whether a particular redeposit of dredged material in waters of the United States requires a section 404 permit, consistent with our CWA authorities and governing case law. Entities that are engaging, or intend to engage, in activities in waters of the U.S. that may result in a ''discharge of dredged material'' as that term is defined in today's final rule are hereby given notice that the agencies intend to regulate those activities that we find, based on the particular circumstances, would result in an addition of pollutants to waters of the U.S.

III. Future Notice and Comment Rulemaking

As explained in the preamble language accompanying the issuance of theTulloch rule (57 FR 26894 (June 16, 1992); 58 FR 45008 (August 25, 1993)), some small volume discharges associated with mechanized landclearing, ditching, channelization, or other excavation activities were not consistently subject to environmental review under the pre-Tulloch regulations even though waters of the U.S., including wetlands, were destroyed or degraded. By using specialized dredging and disposal techniques some developers sought to use a loophole in those regulations to convert wetlands without the need to obtain a CWA section 404 permit. The section 404 environmental review process is not aimed at preventing development, but instead is designed to avoid unacceptable adverse environmental impacts, and to the extent adverse impacts cannot be avoided, assure they are appropriately minimized or mitigated.

The Agencies are particularly concerned that, without further action to clarify the definition of ''discharge of dredged material,'' large-scale destruction of wetlands could occur, resulting in increased flooding or runoff and harm to neighboring property, pollution of streams and rivers, and loss of valuable habitat. Moreover, available information indicates that such losses are already occurring. Accordingly, the Agencies will expeditiously undertake additional notice and comment rulemaking in furtherance of the CWA's objective to ''restore and maintain the chemical, physical, and biological integrity of the Nation's waters.'' Additionally, the *NMA* court recognized that the CWA ''sets out no bright line between incidental fallback on the one hand and regulable redeposits on the other'' and that ''a reasoned attempt to draw such a line would merit considerable deference.'' (145 F.3d at 1405). Further rulemaking thus is appropriate not only to ensure that the Nation's wetlands and other waters of the U.S. will continue to receive the protection required by section 404 of the CWA, but also to enhance clarity, certainty, and consistency in determining what activities are subject to section 404 in light of the *NMA* decision.

IV. Related Statutes and Executive Orders

A. Findings Under 5 U.S.C. 553

Under the Administrative Procedure Act (APA), 5 U.S.C. 553, agencies are required to publish a notice of proposed rulemaking and provide an opportunity for the public to comment on any substantive rulemaking action. Notice and comment is not required, however,

> when the agency for good cause finds (and incorporates the finding and a brief statement of reasons therefore in the rules issued) that notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest.

5 U.S.C. 553(b)(3)(B).

Today's rule merely conforms the language in our section 404 regulations to the current status of those regulations after the *NMA* case. The district court judgment, as affirmed by the D.C. Circuit, invalidated application of our regulation to incidental fallback and enjoined us from applying or enforcing the rule. By expressly excluding incidental fallback from the definition of ''discharge of dredged material,'' today's revisions conform the regulations to reflect the legal status quo in light of the *NMA* decision. Therefore, we find that solicitation of public comment is unnecessary.

Under 5 U.S.C. 553(d)(1) and (3), rules must be published at least 30 days prior to their effective date, except where the rule ''grants or recognizes an exemption or relieves a restriction,'' or where justified by the agency for ''good cause.'' Today's rule, in accordance with the *NMA* decision, removes the requirement for a section 404 permit for incidental fallback in waters of the U.S. Accordingly, today's rule is effective immediately.

B. Paperwork Reduction Act

The Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.*, is intended to minimize the reporting and record-keeping burden on the regulated community, as well as to minimize the cost of Federal information collection and dissemination. In general, the Act requires that information requests and record-keeping requirements affecting ten or more non-Federal respondents be approved by the Office of Management and Budget (OMB). The current OMB approval number for information requirements related to the CWA section 404 program is 0710–0003 (expires June 30, 2000). Today's rule merely conforms the definition of ''discharge of dredged material'' to reflect the ruling in the *NMA* case. It does not establish or modify any information reporting, or record-keeping requirements, and therefore is not subject to the requirements of the Paperwork Reduction Act.

C. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (''NTTAA''), Public Law 104–113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards. Today's rule does not involve technical standards. Therefore, EPA did not consider the use of any voluntary consensus standards.

D. Other Statutes and Executive Orders

Today's rule does not establish any new requirements, mandates or procedures. As explained above, today's rule merely conforms the regulations' definition of ''discharge of dredged material'' to reflect the judicial decision in the *NMA* case. Because today's rule is a ''housekeeping'' measure undertaken to conform the regulatory language to that judicial determination, it does not result in any additional or new regulatory requirements. In fact, the judicial determination which it reflects has the practical effect of removing incidental fallback from coverage under the regulations. Accordingly, it has been determined that this rule is not a ''significant regulatory action'' under Executive Order 12866, and is therefore not subject to review by the Office of Management and Budget. In addition, this action does not impose any enforceable duty, contain any unfunded mandate, or impose any significant or unique impact on small governments as described in the Unfunded Mandates Reform Act of 1995 (Public Law 104–4). This rule also does not require prior consultation with State, local, and tribal government officials as specified by Executive Order 12875 (58 FR 58093, October 28, 1993) or Executive Order 13084 (63 FR 27655 (May 10, 1998), or involve special consideration of environmental justice related issues as required by Executive Order 12898 (59 FR 7629, February 16, 1994). Because this action is not subject to notice-and-comment requirements under the APA or any other statute, and because it does not impose any requirements on small entities, it is not subject to the regulatory flexibility provisions of the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*). This rule is not subject to E.O. 13045 (62 FR 19885, April 23, 1997) because it is not economically significant as defined under E.O. 12866. Further, EPA interprets E.O. 13045 as applying only to those regulatory actions that are based on health or safety risks such that the analysis required under section 5–501 of the Order has the potential to influence the regulation. This rule is not subject to E.O. 13045 because it does not establish an environmental standard intended to mitigate health or safety risks.

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. Section 808 allows the issuing agency to make a good cause finding that notice and public procedure is impracticable, unnecessary or contrary to the public interest. This determination must be supported by a brief statement. 5 U.S.C. 808(2). As stated previously, we have made such a good cause finding, including the reasons therefore, and established an effective date of May 10, 1999. We will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. This action is not a ''major rule'' as defined by 5 U.S.C. 804(2).

List of Subjects

33 CFR Part 323

Navigation, Water Pollution Control, Waterways

40 CFR Part 232

Environmental protection, Wetlands, Water Pollution Control.

Dated: April 27, 1999.

Carol D. Browner,

Administrator, Environmental Protection Agency.

Dated: April 30, 1999.

Joseph W. Westphal,

Assistant Secretary of the Army (Civil Works), Department of the Army.

In consideration of the foregoing, 33 CFR Part 323 and 40 CFR Part 232 are amended as set forth below:

33 CFR CHAPTER II—CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY

PART 323—[AMENDED]

1. The authority citation for Part 323 continues to read as follows:

Authority: 33 U.S.C. 1344.

2. Amend section 323.2(d) as follows:

a. In the first sentence of paragraph (d)(1), remove the words ''any redeposit of dredged material'' and add, in their place, the words ''redeposit of dredged material other than incidental fallback''.

b. In paragraph (d)(1)(iii), remove the words ''any redeposit,'' and add, in their place, the words ''redeposit other than incidental fallback,''.

c. In paragraph (d)(2), add at the end thereof a new paragraph (d)(2)(iii) to read as follows:

§ 232.2 Definitions.

* * * * *

(d) * * *

(2) * * *

(iii) Incidental fallback.

* * * * *

40 CFR CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

PART 232—[AMENDED]

3. The authority citation for Part 232 continues to read as follows:

Authority: 33 U.S.C. 1344.

4. In § 232.2 the definition of ''discharge of dredged material'' is amended as follows:

a. In the first sentence of paragraph (1), remove the words ''any redeposit of dredged material'' and add, in their place, the words ''redeposit of dredged material other than incidental fallback''.

b. In paragraph (1)(iii), remove the words ''any redeposit,'' and add, in their place, the words ''redeposit other than incidental fallback,''.

c. In paragraph (2), add at the end thereof a new paragraph (2)(iii) to read as follows:

§ 232.2 Definitions.

* * * * *

Discharge of dredged material * * *

(2) * * *

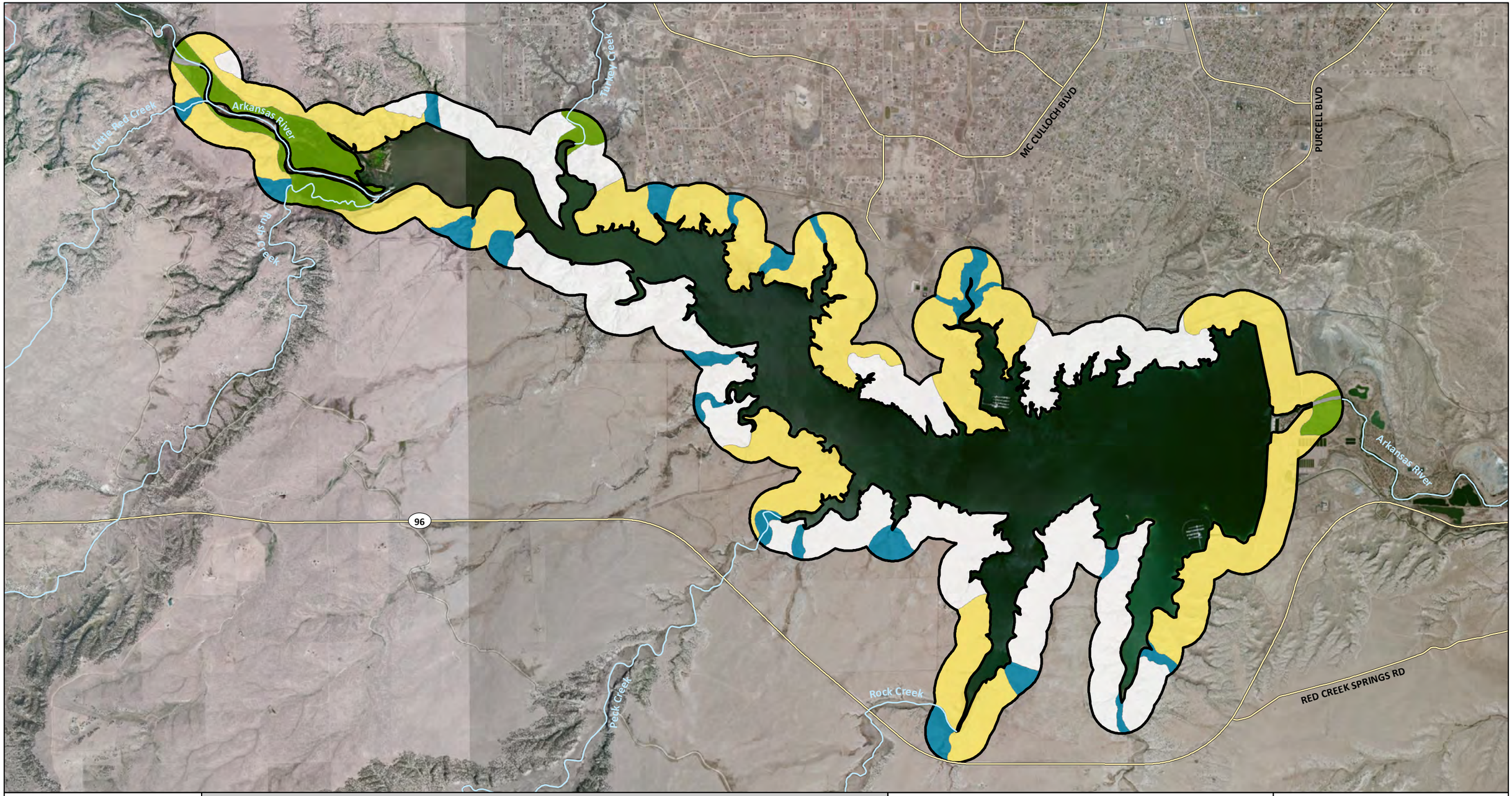
(iii) Incidental fallback.

* * * * *

[FR Doc. 99–11680 Filed 5–5–99; 3:41 pm]

BILLING CODE 6560–50–P

C. Vegetation Map



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

Survey Area

Vegetation Community

- Blue Grama/Buffalograss Shortgrass Prairie
- Cottonwood/Western Wheatgrass-Switchgrass Floodplain Woodland
- Tamarisk Species Ruderal Riparian Shrubland
- Wyoming Big Sagebrush/Western Wheatgrass Shrub Grassland
- River

OVERVIEW
VEGETATION COMMUNITIES MAP

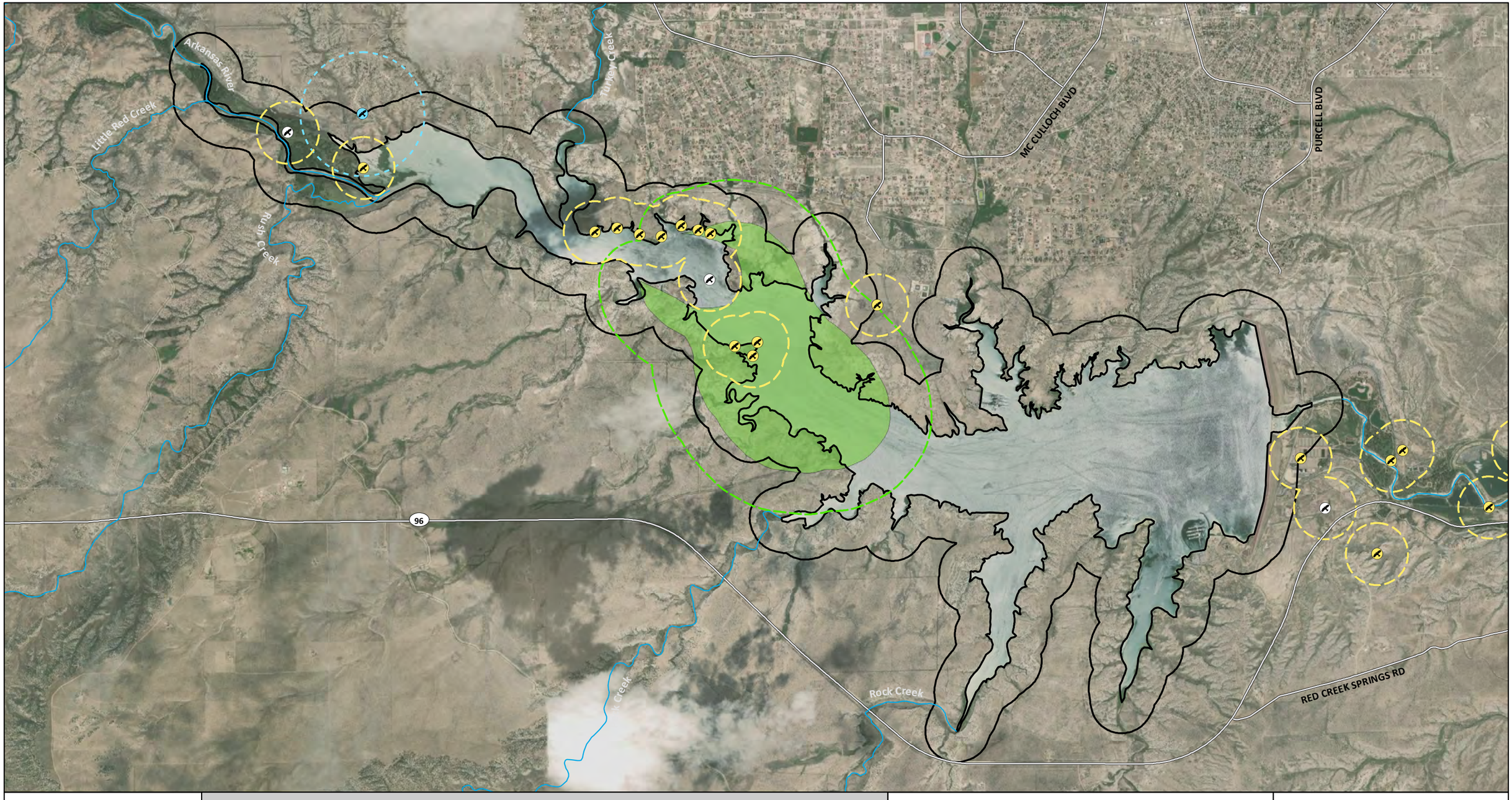
FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT
PUEBLO COUNTY, COLORADO

N

1 inch = 4,000 feet

0 2,000 4,000 8,000 Feet

D. CPW SAM Mapping



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

- Survey Area
- Osprey Nest Buffer - 1/4 mile
- Bald Eagle Nest Buffer - 1/2 mile
- Great Blue Heron Historic Nesting Buffer - 1/3 mile

CPW Species Nests (Status)

- Osprey Nest - Active
- Osprey Nest - Unknown
- Bald Eagle Nest - Unknown
- Great Blue Heron - Historic Nesting Area

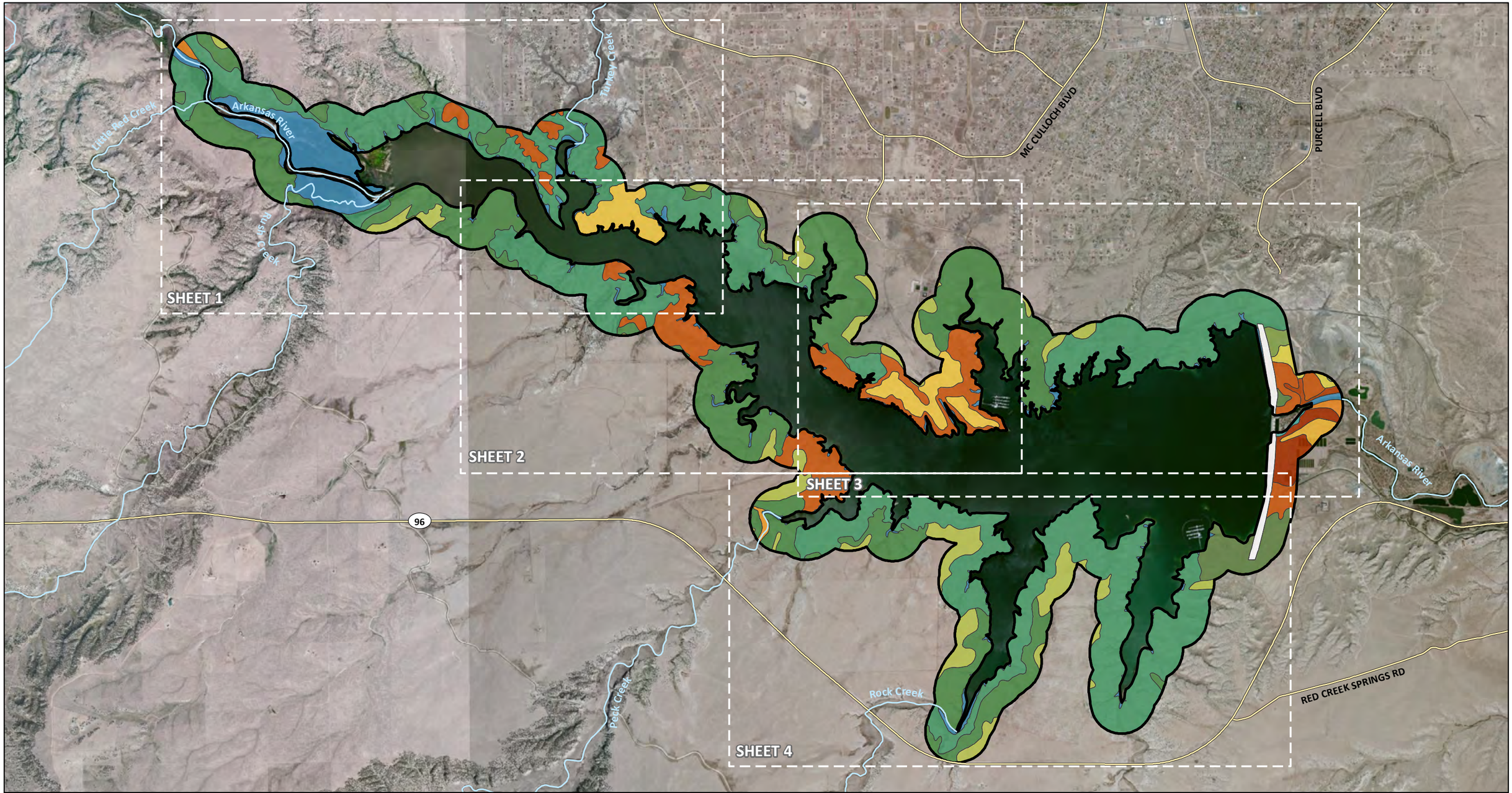
COLORADO PARKS AND WILDLIFE SPECIES ACTIVITY MAP

FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT PUEBLO COUNTY, COLORADO

1 inch = 4,000 feet

0 2,000 4,000 8,000 Feet

E. Soil Maps



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

- Survey Area

- AR - Arvada-Keyner complex
- Bk - Bankard sand
- CaE - Cascajo very gravelly sandy loam
- Gh - Glenberg-Haversid complex
- Ha - Haversid silt loam
- Ke - Keyner loamy sand
- Km - Kim fine sandy loam
- LnA - Limon silty clay loam
- MaB - Manvel silt loam
- MsD - Midway-Shale outcrop complex
- OdA - Oterodry sandy loam
- PM - Penrose-Minnequa complex
- PrF - Penrose-Midway-Rock outcrop complex
- TsF - Travessilla-Rock outcrop complex
- W - Water
- Dam

OVERVIEW SOIL TYPE MAP

FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT PUEBLO COUNTY, COLORADO

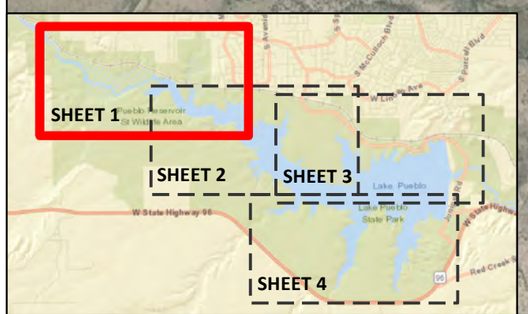
N

1 inch = 4,000 feet

Feet
0 2,000 4,000 8,000

MCCULLOCH BLV

Gh
MaB
PM
W
PrF
PM
PM
PM
PM
W
PrF
W
CaE
W
W
PM
CaE
CaE
PrF
CaE
W
CaE
MaB
PM
PrF
PM
W
Km
W
PrF
MaB
PM
CaE
PrF
W
CaE



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

- Survey Area
- CaE - Cascajo very gravelly sandy loam
- Gh - Glenberg-Haversid complex
- Km - Kim fine sandy loam
- MaB - Manvel silt loam
- PM - Penrose-Minnequa complex
- PrF - Penrose-Midway-Rock outcrop complex
- W - Water

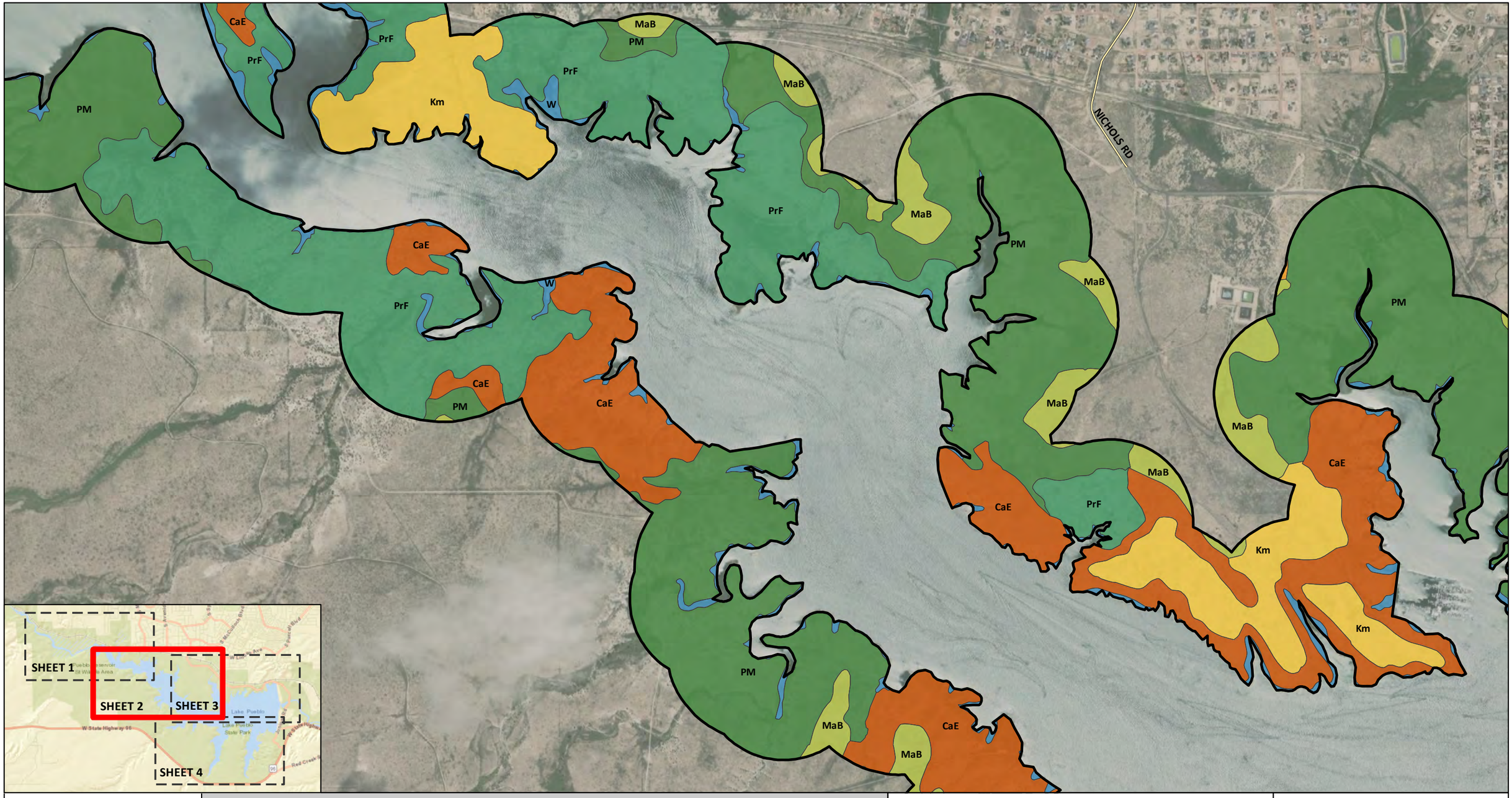
SHEET 1
SOIL TYPE MAP

FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT
PUEBLO COUNTY, COLORADO

N

1 inch = 1,500 feet

0 750 1,500 3,000 Feet



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

- Survey Area
- CaE - Cascajo very gravelly sandy loam
- Ha - Haversid silt loam
- Km - Kim fine sandy loam
- MaB - Manvel silt loam
- PM - Penrose-Minnequa complex
- PrF - Penrose-Midway-Rock outcrop complex
- W - Water

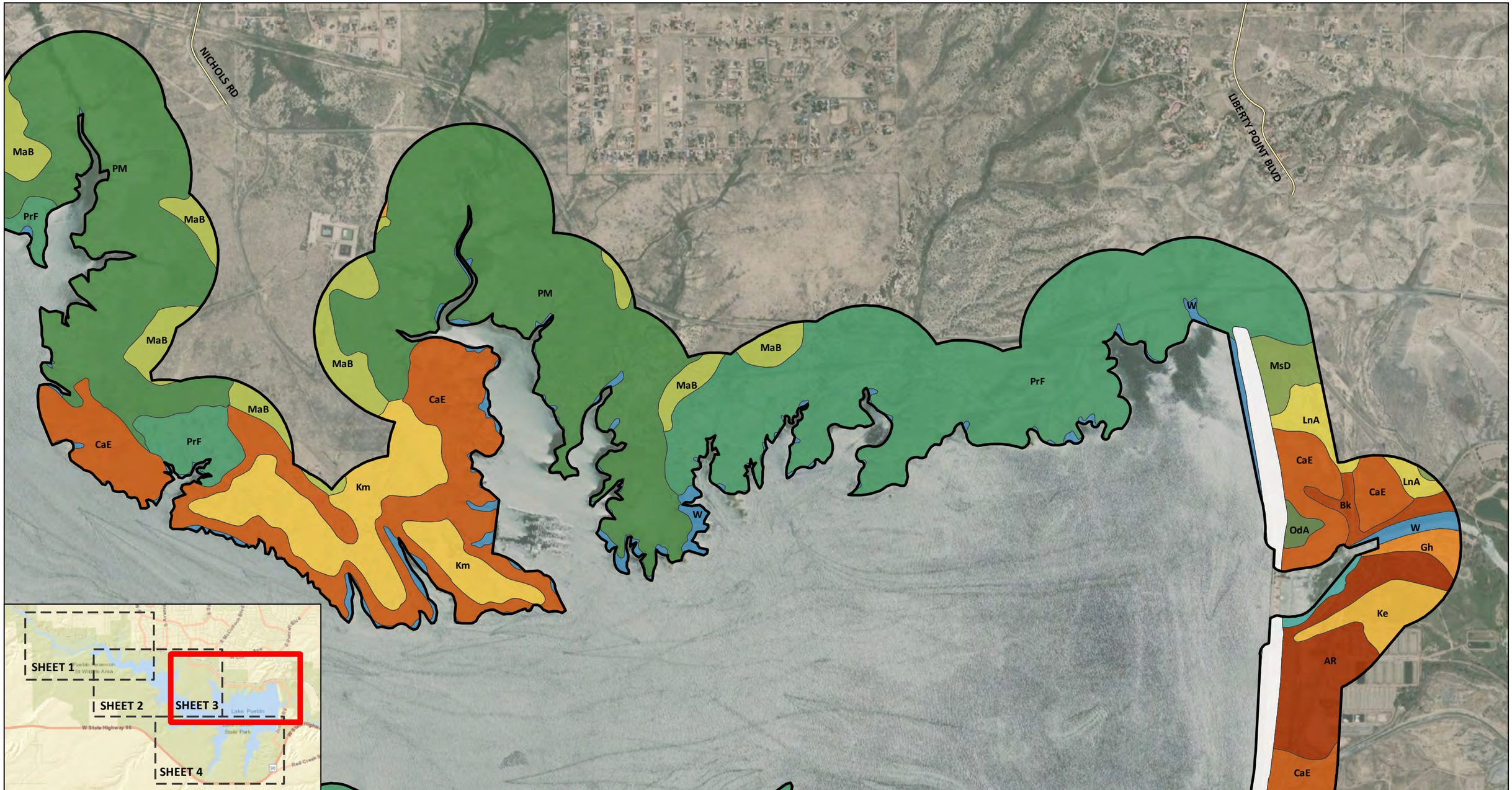
SHEET 2
SOIL TYPE MAP

FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT
PUEBLO COUNTY, COLORADO

N

1 inch = 1,500 feet

0 750 1,500 3,000 Feet



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

- Survey Area

- AR - Arvada-Keyner complex
- Bk - Bankard sand
- CaE - Cascajo very gravelly sandy loam
- Gh - Glenberg-Haversid complex
- Ha - Haversid silt loam
- Ke - Keyner loamy sand
- Km - Kim fine sandy loam
- LnA - Limon silty clay loam
- MaB - Manvel silt loam
- MsD - Midway-Shale outcrop complex
- OdA - Oterodry sandy loam
- PM - Penrose-Minnequa complex
- PrF - Penrose-Midway-Rock outcrop complex
- TsF - Travessilla-Rock outcrop complex
- W - Water
- Dam

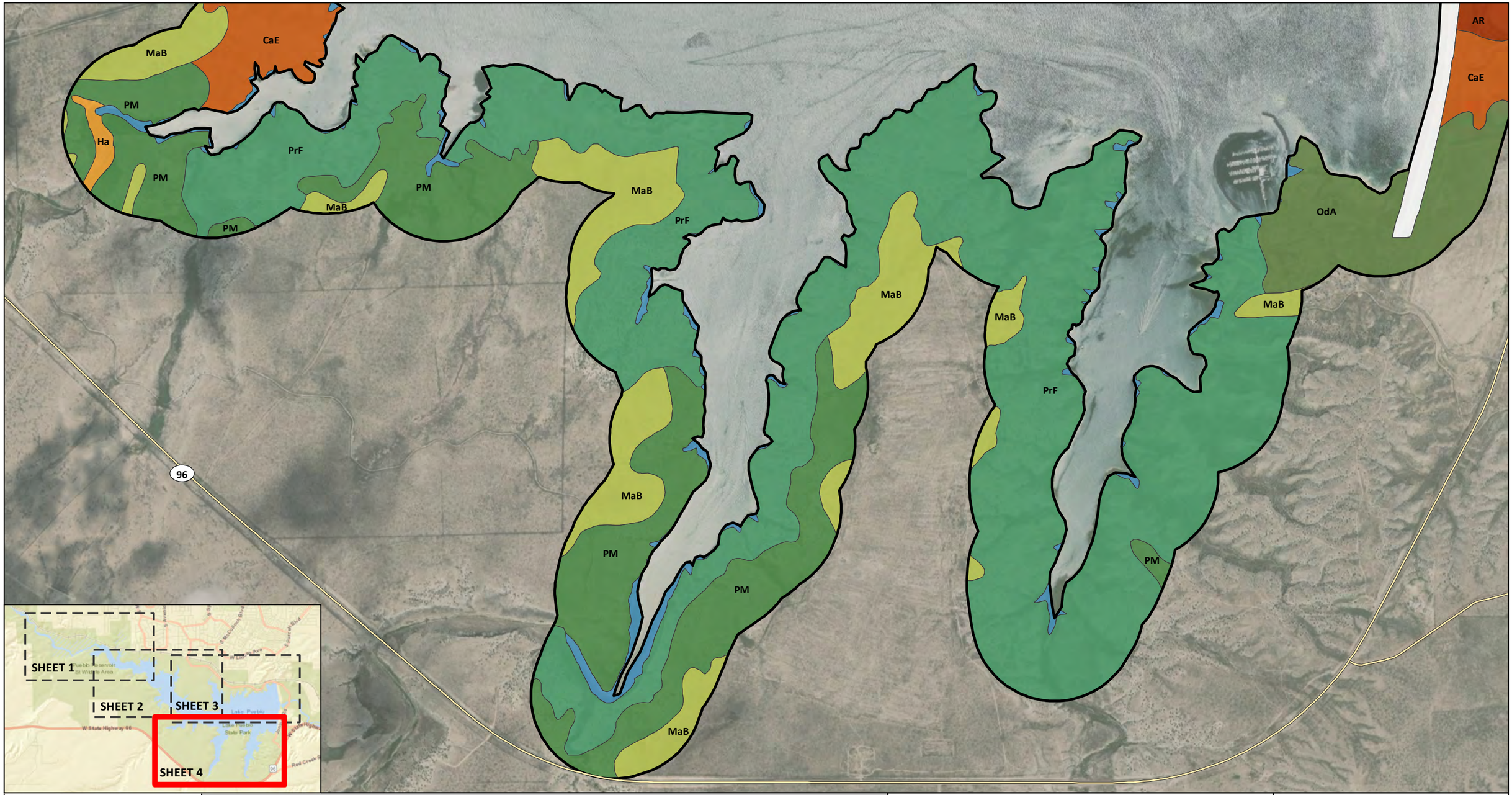
SHEET 3
SOIL TYPE MAP

FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT
PUEBLO COUNTY, COLORADO

N

1 inch = 1,500 feet

0 750 1,500 3,000 Feet



Prepared By:

ERC

2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820

ERC #1280-2001

MAP LEGEND

- Survey Area
- AR - Arvada-Keyner complex
- CaE - Cascajo very gravelly sandy loam
- Ha - Haversid silt loam
- MaB - Manvel silt loam
- OdA - Oterodry sandy loam
- PM - Penrose-Minnequa complex
- PrF - Penrose-Midway-Rock outcrop complex
- W - Water
- Dam

SHEET 4
SOIL TYPE MAP

FRYING PAN-ARKANSAS STORAGE RECOVERY PROJECT
PUEBLO COUNTY, COLORADO

1 inch = 1,500 feet

0 750 1,500 3,000 Feet

F. CPW Fisheries Data

Pueblo Reservoir

FISH SURVEY AND MANAGEMENT DATA

Carrie Tucker - Aquatic Biologist (Pueblo)
carrie.tucker@state.co.us / 719-561-5312

General Information: Pueblo Reservoir, approximately 4000 acres in size, offers good fishing for walleye, wiper, catfish, bass, and crappie. Additional species include bluegill, yellow perch, and rainbow trout. The reservoir has a State Park on the east end and a State Wildlife Area on the west end. For park hours, fees, and other information: http://cpw.state.co.us/placestogo/parks/LakePueblo/
Location: Pueblo County. The south entrance is located 5 miles west of Pueblo off of HWY 96 (Thatcher Blvd). The north entrance is south of HWY 50, and can be located by taking McCulloch Blvd. south from HWY 50 in Pueblo West, and turning south on Nichols Road.
Recreational Management: Colorado Parks and Wildlife (wildlife, 719-561-5300; Lake Pueblo State Park (719-561-9320) *click here to buy a fishing license*
Fishery Management: Warm and Cold water species. **Annual Survey Data:** (see page 2)

Amenities

- Boat Ramps (2)
- Picnic Areas
- Camping
- Restrooms
- Marinas (2)
- Hiking trails

Regulations

https://cpw.state.co.us/aboutus/Pages/RegulationsBrochures.aspx

- Daily bag for walleye is 5 fish over 18" in length with no more than 1 fish > 21"
- Minimum size for largemouth, smallmouth, and spotted bass is 15" in length
- Daily bag for wiper is 5 fish with no more than 1 fish > 21"
- Daily bag/possession for crappie is 10, minimum size of 10"
- Possessing filleted or cleaned fish in a boat on the lake is prohibited
- *See the regulations brochure for bag and possession limits of all other fish species*
- Fishing prohibited from dam & within 100 ft. of dam or walleye spawning nets Mar. 1 – Apr. 15, or until walleye spawning operations are complete

Previous Stocking

2019
Black Crappie (1.5")
Blue Catfish (3.5")
Bluegill (1.5")
Channel Catfish (3")
Cutbow (10")
Flathead Catfish (0.5")
Largemouth Bass (0.3")
Rainbow Trout (10")
Wiper (0.3")
Walleye (0.20")

2018
Black Crappie (1.5")
Blue Catfish (4")
Channel Catfish (3")
Cutbow (10")
Flathead Catfish (0.5")
Largemouth Bass (0.2")
Rainbow Trout (10")
Walleye (0.2")
Wiper (0.2")

2017
Black Crappie (1.5")
Cutbow (10")
Flathead Catfish (0.5")
Largemouth Bass (1")
Rainbow Trout (10")
Walleye (0.2")
Wiper (0.2")

Sportfishing Notes

Walleye

- Big walleye are present in good numbers because the regulations protect larger fish. This regulation gives anglers an opportunity to catch a trophy fish and allows for an egg take operation that supplies other Colorado waters with millions of young walleye.

Wiper

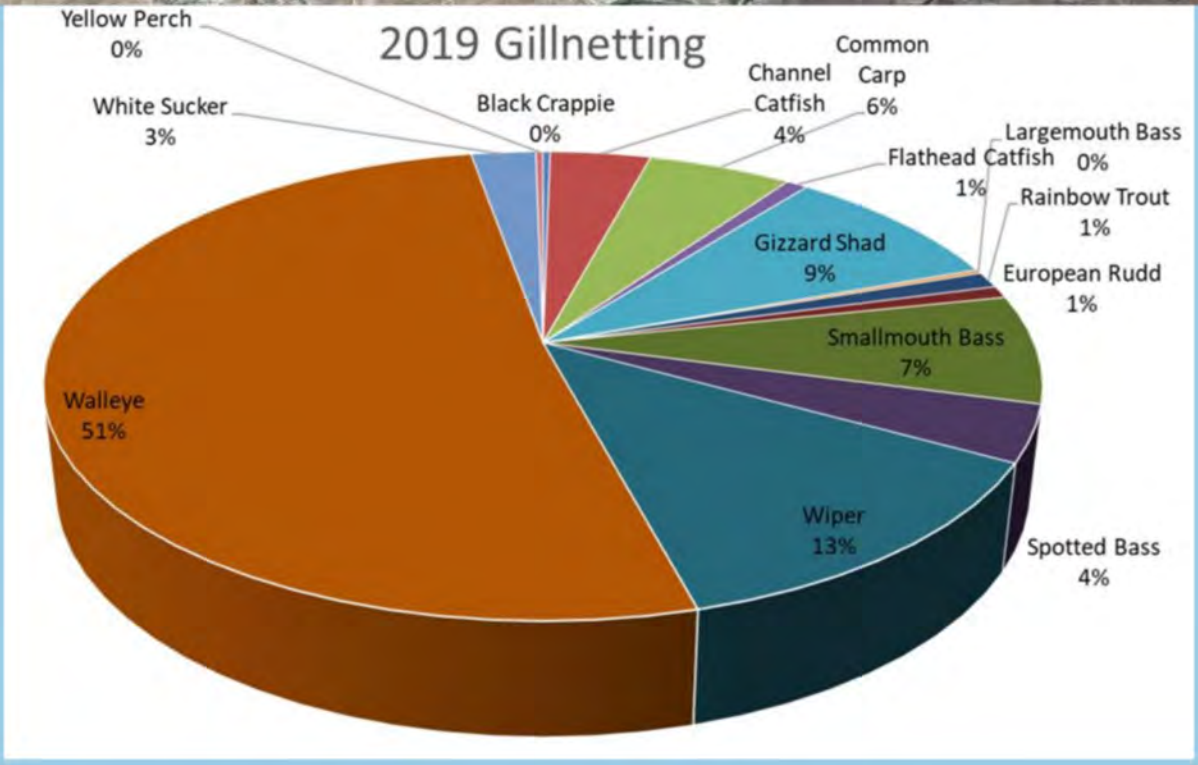
- Wiper provide a fishery for quality fish and allow anglers to take fish home for the table. Wiper fishing can be spotty and requires adaptability by anglers to catch these fish.

Bass

- Pueblo contains three species of bass: largemouth, smallmouth, and spotted. Many techniques are used to catch these fish and all can be caught virtually year round. A minimum size regulation allows some harvest while also protecting young fish and some spawning adults.

PUEBLO RESERVOIR

Fish sampling data



PUEBLO RESERVOIR

FISH SAMPLING DATA AND 2020 FORECAST

2019 FALL SAMPLING (GILLNETTING, CONTINUED)

Species	# Caught	CPUE Fish/Net	Length Average (in)	Length Range	Weight Average (lbs)	Weight Range	PSD	Relative Weight
Black Crappie (BCR)	1	0.13	11.5	(11.5-11.5)	1.05	(1.05-1.05)	100	112.4
Channel Catfish (CCF)	14	1.75	23.5	(17.7-33.9)	6.73	(2.11-35.72)	100	108.0
Common Carp (CPP)	20	2.50	22.2	(16.9-24.5)	5.37	(2.38-6.66)	100	96.8
Flathead Catfish (FLC)	3	0.38	19.1	(17.4-21.2)	2.98	(2.24-4.22)	33.33	97.1
Gizzard Shad (GSD)	32	4.00	15.5	(14.2-16.9)	1.57	(1.13-2.20)	100	100.8
Largemouth Bass (LMB)	1	0.13	11.5	(11.5-11.5)	0.87	(0.87-0.87)	0	112.0
Rainbow Trout (RBT)	4	0.50	16.8	(15.4-18.2)	1.72	(1.40-2.05)	75	83.7
European Rudd (RUD)	3	0.38	13.2	(10.5-14.7)	1.46	(0.57-2.02)	-	112.9
Smallmouth Bass (SMB)	27	3.38	11.6	(3.4-15.6)	0.81	(0.19-1.72)	76	83.7
Spotted Bass (SPB)	14	1.75	13.4	(11.5-22.3)	1.11	(0.73-2.05)	100	89.3
Wiper (SXW)	46	5.75	16.7	(5.5-21.3)	2.73	(0.07-4.83)	100	93.0
Walleye (WAL)	185	23.13	15.2	(6.0-21.8)	1.20	(0.09-3.38)	69.89	87.9
White Sucker (WHS)	9	1.13	17.3	(12.4-19.1)	2.54	(0.78-3.06)	100	108.1
Yellow Perch (YPE)	1	0.13	6.5	(6.5-6.5)	0.10	(0.10-0.10)	0	73.6
TOTALS	360	45						

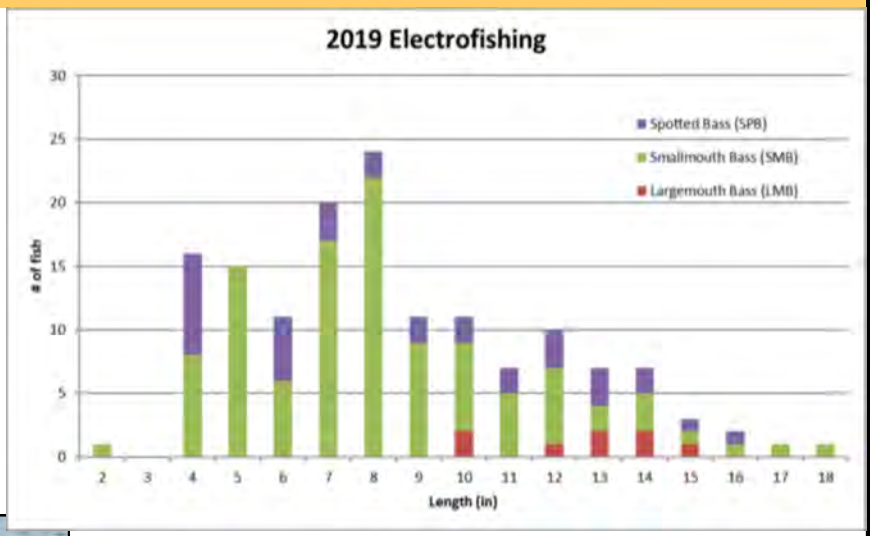
PUEBLO RESERVOIR

FISH SAMPLING DATA AND 2020 FORECAST

BLACK BASSES

Pueblo has three species of black bass (largemouth, smallmouth, and spotted). Numbers of bass in Pueblo Reservoir are high. Most fish are smaller than 15" in length, but some over 15" can be caught.

Bass were sampled through the use of night electrofishing in summer 2019. The majority of the catch was bass, with smallmouth bass being most predominant (see figure to right). The largemouth bass sampled were larger, between 10 and 15" in length. The largest size-group was 13-14 inches. The bass were in good condition (see figure at right).

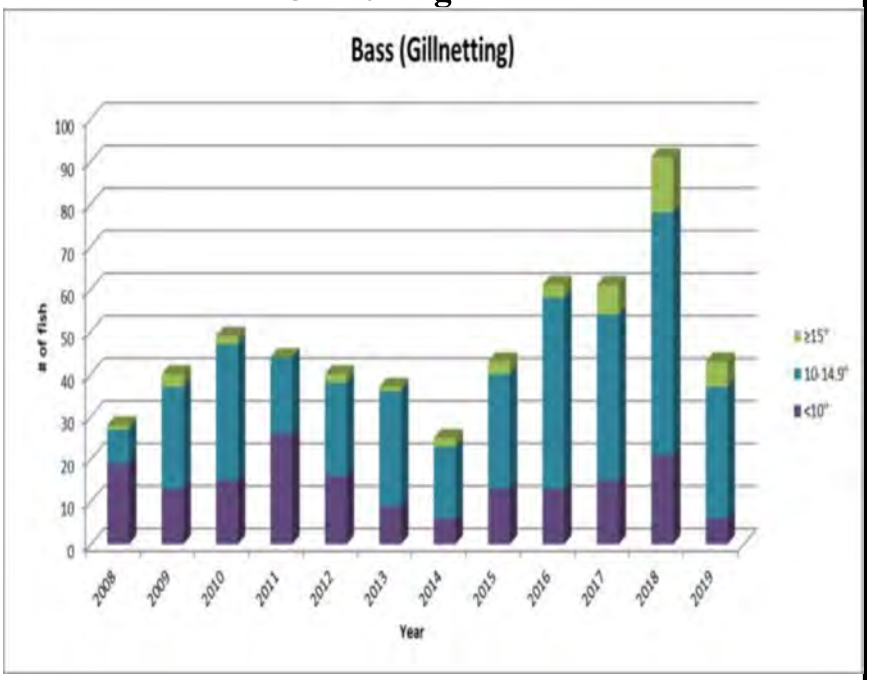


The length frequency of black bass collected via night electrofishing at Pueblo Reservoir in 2019.

Gillnetting

Six bass larger than 15" were sampled in 2019 gillnetting. Gillnetting is not the most productive way to catch bass, but many are sampled. However, trend data indicate that the majority of the bass population is between 10 and 15" in length, similar to the size structure seen during electrofishing. Age, growth, reproduction, and fishing pressure on bass will be assessed in the future.

Anglers should see good catches of bass in 2020, as there were a good number of 10-15" fish in fall 2019. Fishing is particularly good in the spring during spawning. Bass fishing has been exceptional at Pueblo, and should continue to be a premier location to fish for bass in 2020, with many tournaments occurring on the lake throughout the year.



The number of black bass (largemouth, smallmouth, and spotted) collected in gillnets at Pueblo Reservoir from 2008 to 2019.

PUEBLO RESERVOIR

FISH SAMPLING DATA AND 2020 FORECAST

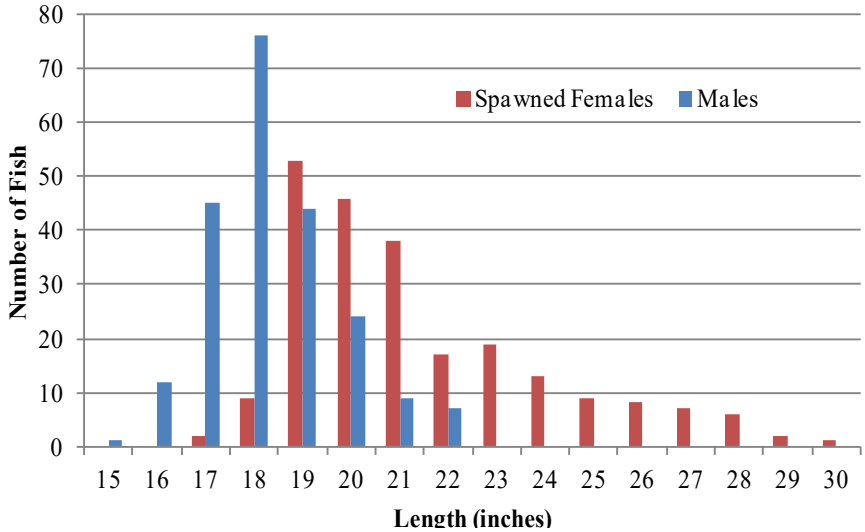
WALLEYE

The total number of walleyes caught in gillnets in 2019 was again consistent with recent years, particularly the 11-17" length group (see figure below). Yet another large cohort of mid-range fish should lead to a better than average group of legal-sized fish in the near future. The 18" and over size group was larger than recent years. Gillnet samples do not do a good job of assessing the status of larger walleye in the reservoir. These larger fish are present in the reservoir in good numbers, but are difficult to catch, especially when gizzard shad are numerous. Average catches of walleye in Pueblo Reservoir yields around 3 to 7 legal fish per 100 fish caught. 2019 was a good year for legal walleye, and 2020 should be very similar with the high water levels expected through June.

The total number of walleye collected in gillnets at Pueblo Reservoir from 2008 to 2019.

The walleye population in Pueblo Reservoir supports a spawning operation where biologists and hatcheries produce walleyes and saugeyes to stock in lakes and reservoirs throughout Colorado. These fish are also used to trade with other states so we can obtain fish we do not typically produce, like wiper.

The highest catch rates for walleye will usually occur from mid-May to the end of June. At this time the fish will be located on the flats and points in shallow water and will be feeding heavily as they recover from spawning efforts. Anglers looking for larger fish should use larger baits and move away from the large schools of small fish. Catch rates will be significantly lower, but quality of fish will be significantly higher.



The number and sex of fish caught and spawned at Pueblo Reservoir walleye spawn, 2011.

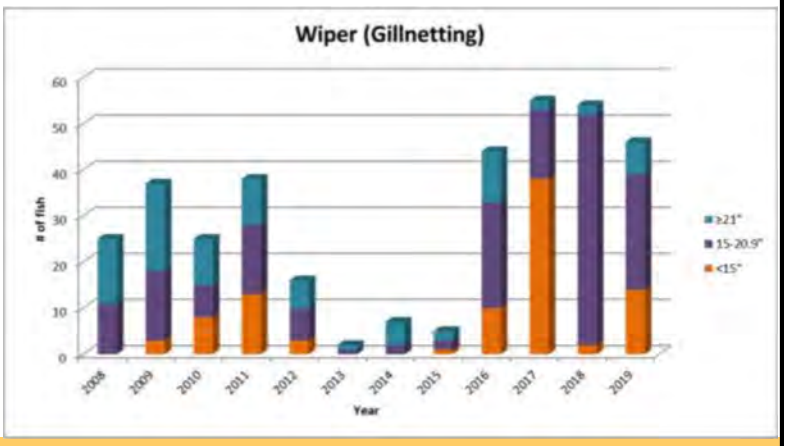
PUEBLO RESERVOIR

FISH SAMPLING DATA AND 2020 FORECAST

WIPER

Wiper have been stocked consistently in Pueblo Reservoir since the 80's. Weather conditions for stocking since 2016 have been better than in 2013 (see photo at left). During gillnetting, wiper caught in gillnets averaged 16.7 inches in length. The number of wipers has started to rebound over recent years, indicating that the population is growing and recovering (see figure below). Forty-six wiper were caught during sampling in 2019. There was a shift in the size of wipers caught in 2019; there were more wiper captured larger than 21" than the last two years combined.

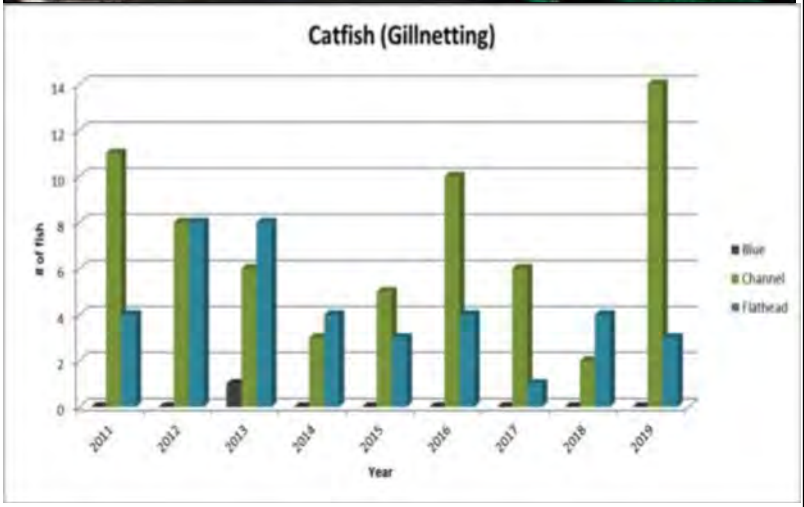
Fishing for wipers requires a lot of effort and patience as these fish are very particular about when and what they eat. Techniques to catch wipers change with the season and availability and size of forage in the reservoir. Anglers must pay attention to the changes and adapt their techniques. Best times to catch wipers include April and May and August through October.



CATFISH

Pueblo has three species of catfish (channel, flathead, and blue). Numbers of catfish in Pueblo Reservoir have been fairly consistent in recent years and appear to be made up of fairly large fish. A good number of catfish over 18" can be caught.

Blue catfish, primarily discontinued from the stocking schedule due to poor survival, were stocked in 2013, 2015, 2018, and 2019. Blue catfish are rare, but the possibility of catching one is possible. The new state record was caught in 2019 and measured 38 5/8" and 29 lbs! Channel catfish are more abundant than flathead catfish, but the number of flatheads has increased in recent years.



The new state record for flathead catfish was caught in Pueblo Reservoir in 2017! It weighed 30 lbs and 38.63 inches. In 2019, catch rates for catfish will likely be decent, especially if you target them. The quality of fish could be very high.

PUEBLO RESERVOIR

2020 FORECAST AND MASTER ANGLER AWARDS

OTHER SPECIES

Pueblo Reservoir also contains fishable populations of black and white crappie, bluegill, yellow perch and rainbow trout. Both of the species of crappie can be caught year round in the reservoir at very good sizes. With the extremely high water levels in recent years, all of the trees and brush (especially on the west end) have been flooded for extended periods. This bodes very well for young fish survival, and should amount to another phenomenal year of fishing on the reservoir in 2020. A number of "catchable" (10") trout are stocked in the North and South marina coves during the early spring. Anglers fishing January through March can catch some spawning rainbows that run from 16 to 24 inches in length. Boat anglers can also pick up these better trout by trolling from April through June.

MASTER ANGLER AWARDS

The Master Angler Recognition Program is designed to recognize anglers for success in their sport, as well as to promote the conservation of fishery resources and quality fishing by encouraging the careful release of trophy-size popular sport species. The program offers Master Angler award certificates in two general categories: fish caught and released, and fish caught and kept. Awards are based on fish length rather than weight. See http://cpw.state.co.us/learn/Pages/MasterAngler.aspx for more information.

2019 Pueblo Reservoir Master Anglers

2019 Master Angler Awards

Name	Species	Length	Location	Month	Year	Status
Jerry Wyatt	walleye	26"	Pueblo Reservoir	April	2019	Kept
Anthony Gooch	crappie	14"	Pueblo Reservoir	May	2019	Released
David Vogt	smallmouth bass	18"	Pueblo Reservoir	May	2019	Released
Tony Steven Huskey	channel catfish	33 1/2"	Pueblo Reservoir	May	2019	Kept
Don Haggart	walleye	28 3/4"	Pueblo Reservoir	June	2019	Kept
Joseph Hill	largemouth bass	19"	Pueblo Reservoir	June	2019	Released
Melissa Didonato	crappie	14 1/2"	Pueblo Reservoir	June	2019	Released
Pete Vigil	smallmouth bass	18 1/2"	Pueblo Reservoir	July	2019	Released

mottmac.com

Attachment 5

TR-08-1
Fryingpan-Arkansas Storage Recovery Project
Engineering Assessment Report

MOTT MACDONALD

SECWCD - Fryingpan-Arkansas Storage Recovery Study

Draft Engineering Assessment

August 2020

Mott MacDonald
143 Union Blvd
Suite 1000
Lakewood
CO 80228
United States of America

T +1 (303) 831 4700
mottmac.com

SECWCD - Fryingpan-Arkansas Storage Recovery Study

Draft Engineering Assessment

August 2020

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
01	8-3-2020	JD	JC	WJP	Draft Engineering Assessment

Document reference: 507102411 | TR-08-01 |

Information class: Standard

Contents

Tables

Figures

Attachments

Executive summary

Storage capacity loss within reservoirs is both a nationwide and worldwide issue. As reservoir life decreases due to storage capacity loss, federal agencies, public and private operators, and owners are faced with the challenge of meeting current and future water distribution rights, while mitigating the environmental, social, and economic impacts associated with the implementation of storage recovery alternatives.

The following Engineering Assessment has been developed at a concept screening-level by Mott MacDonald on behalf of the Southeastern Colorado Water Conservancy District (District) to assess and review potentially feasible alternatives for storage recovery and reservoir expansion as part of the Fryingpan-Arkansas Storage Recovery Study.

This Engineering Assessment includes the following subsections:

Introduction

Section 1 provides an overview of document purpose, goals and objectives, and content. The purpose of this document is to assess the implementation, costs, and schedules of potentially feasible storage recovery and/or reservoir expansion alternatives/methodologies developed and/or previously developed by other consultants. Mott MacDonald acknowledges that the screening-level concept costs and schedules developed as part of this assessment might be used by the District for future capital expenditure planning.

Pre-Screening Analysis and Alternatives Development

Mott MacDonald conducted a pre-screening analysis of storage recovery and/or previously developed reservoir expansion alternatives/methodologies based upon a review of historical data and reference documentation. To facilitate the pre-screening process, **Attachment A –The Fryingpan-Arkansas Storage Recovery Alternatives Register (SRAR)** was developed by the Mott MacDonald team for the purposes of comparing and assessing potential alternatives for storage recovery and/or reservoir expansion within Pueblo Reservoir. The alternatives / methodologies considered are categorized within the SRAR and herein as follows:

- Reservoir Storage Recovery;
- Reservoir Sustainability;
- Reservoir Enlargement; and
- Reservoir Reoperation.

Detailed descriptions of the alternatives/methodologies considered as part of the pre-screening analysis are provided. It is recommended that reservoir sustainability methods be considered during future studies. As documented within previous deliverables of this study (Tasks 3 and 5 Technical Memorandums), significant data gaps preclude the assessment of potentially viable alternatives; specifically, reservoir sustainability alternatives/methodologies. Eliminated and/or postponed alternatives are identified in Section 2.5.1 of this report.

As a result of the pre-screening analysis and the development of **Attachment A – Fryingpan-Arkansas SRAR**, six (6) alternatives, including a No Action alternative, were selected for the detailed alternatives assessment. Selected alternatives/methodologies include:

- Alternative 1: No Action.

- Alternative 2: Complete Storage Recovery via Dredging and Excavation of Pueblo Reservoir (Active Conservation and Inactive Pools only)
- Alternative 3: Partial Storage Recovery via Dredging and Excavation to facilitate the venting of turbid density currents through the North Outlet in Pueblo Dam.
- Alternative 4: Dam Raise to achieve an increase of approximately 25,000 acre-feet of storage capacity.
- Alternative 5: Dam Raise to achieve an increase of approximately 60,000 acre-feet of storage capacity.
- Alternative 6: Dam Raise to achieve an increase of approximately 75,000 acre-feet of storage capacity.

Alternatives Assessment

Cost estimating frameworks and guidelines developed by the United States Environmental Protection Agency (USEPA), the United States Army Corps of Engineers (USACE), and the United States Society on Dams (USSD) are used as a basis for developing the concept/screening-level order of magnitude cost estimates and schedules developed as part of this study. These are referenced within Section 3 - Alternatives Assessment, of this report (USEPA, 2000, USSD, 2012).

Cost and production estimating data and information specific to the alternatives assessed as part of this study are documented within **Attachment B – Basis of Cost and Production Estimates**. Included within this document are the assumptions, limitations, and sources of cost and production data and information.

Alternatives 2 and 3 Assessment Results:

Capital and Operations and Maintenance (O&M) costs and schedules are developed at a concept screening-level (+100%/-30%, USEPA, 2000) for Alternatives 2 and 3 and included within Section 3 herein. Cost estimates are provided in 2020 dollars ($USD) for both alternatives. The following results are documented within Section 3 of this report:

- Total capital and O&M costs for Alternative 2 are estimated to be approximately $830 million dollars ($USD). The estimated schedule for Alternative 2, not including permitting, is approximately 15 years.
- Total capital and O&M costs for Alternative 3 are estimated to be approximately $98 million dollars ($USD). The estimated schedule for Alternative 3, not including permitting, is approximately 2 years.
- A present value analysis should be conducted during future studies to assess costs based upon the estimated permitting and construction schedules included within the Environmental Assessment and herein.

Alternatives 4 through 6 Assessment Results:

Alternatives 4 through 6 were originally developed by GEI Consulting Engineers, Inc. in December of 1998. Capital cost estimates developed in 1998 are updated by Mott MacDonald to 2020 dollars ($USD) via cost indexing analysis based upon Engineering News Record (ENR) cost indexing data. Estimated O&M costs and construction schedules were not assessed as part of this study. The following results are documented within Section 3 of this report:

- Total capital costs for Alternatives 4 through 6 are estimated to range between approximately $58 and $135 million dollars ($USD).

- A present value analysis should be conducted during future studies to assess costs based upon the estimated permitting and construction schedules included herein.

Discussion and Next Steps

Section 4 provides discussion and potential next steps for the District's consideration during future phases of work. Future data collection programs, studies, stakeholder and community outreach, and regulatory agency correspondence are required to successfully permit storage recovery and/or reservoir expansion projects while also limiting the inherent social, environmental and economic impacts associated with their implementation.

This assessment was completed by Mott MacDonald for the purposes of providing the District with a concept screening-level order-of-magnitude estimated cost range for potentially feasible storage recovery and/or reservoir expansion alternatives. Significant data gaps preclude the assessment of viable reservoir sustainability solutions that may reduce the impacts of sediment yield within the Upper Arkansas River Basin.

The initiation of future studies and data collection programs will be critical to understanding the Upper Arkansas River System's role and impact on Pueblo Reservoir. Future data collection programs and studies may include, but are not limited to, the following:

- Updated bathymetric and topographic surveying programs;
- Geotechnical Investigations (Sediment sampling, gradation analysis, and chemical contaminant analysis) within Pueblo Reservoir and the Upper Arkansas River Basin;
- Market research on the viability of the beneficial reuse of Pueblo Reservoir sediments;
- Geomorphologic analysis to assess sediment loading and distribution within the Upper Arkansas River Basin.
- Numerical and physical modeling to assess the effectiveness of developed alternatives;
- Regulatory outreach and correspondence to confirm the requirements and permitting frameworks associated with developed alternatives;
- Land-use and land acquisition studies and outreach to determine the viability of confined disposal facility development; and
- Pueblo Dam operations planning and modifications that could be implemented to facilitate natural run of the river processes through Pueblo Reservoir.

It is recommended that future studies focus on the collection of data and development of studies within the Upper Arkansas River Basin and within Pueblo Reservoir for the purposes of assessing the least-cost alternatives and/or methodologies for storage recovery that will ultimately maintain or increase the reservoir life of Pueblo Reservoir.

This Engineering Assessment was conducted to provide guidance on feasible alternatives and order of magnitude costs for future storage recovery planning efforts. The considerations and future studies detailed in this document can be used to guide further storage recovery analyses and studies rather than select a single preferred alternative. Measures and alternatives reviewed as part of the pre-screening assessment, particularly the reservoir sustainability measures not investigated as part of this study, can be combined with the proposed alternatives to increase the lifespan of the project and reduce future maintenance costs. Comprehensive data collection, analysis, and numerical modeling programs should be implemented in future studies if sustainability measures are to be investigated further. Although not included in this Engineering Assessment, additional considerations for new, district-owned storage alternatives should also be developed and assessed as part of future studies.

1 Introduction

This engineering assessment has been developed by Mott MacDonald for the Fryingpan-Arkansas Storage Recovery Study on behalf of the Southeastern Colorado Water Conservancy District (District). This report provides a pre-screening assessment, order-of-magnitude costs (capital and/or O&M), and schedules (permitting and construction) for potentially feasible storage recovery and reservoir expansion alternatives. The purpose of this document is to provide supplemental information for the District's development of future capital expenditure planning documentation.

1.1 Document Purpose

The following Engineering Assessment has been developed for the purpose of providing the District with concept screening-level (+100/-30%) estimated costs and schedules for pre-screened storage recovery and reservoir expansion alternatives/methodologies for the District's future capital expenditure planning purposes.

1.2 Document Objectives

The objective of this document is to identify and pre-screen potential storage recovery and reservoir expansion alternatives for the purpose of selecting and assessing, from a cost and/or schedule perspective, feasible storage recovery methods for Pueblo Reservoir. Concept screening-level cost estimates and schedules are provided for the selected storage recovery alternatives. Updated capital cost estimates for previously developed reservoir expansion alternatives are also provided for comparison.

1.3 Document Summary

Pre-screened, concept screen-level storage recovery alternatives/methodologies for Pueblo Reservoir are documented within **Attachment A – Fryingpan-Arkansas Project Storage Recovery Alternatives Register (SRAR)** and summarized herein. High-level overviews of reservoir storage recovery, reservoir sustainability, reservoir expansion, and reservoir reoperation are provided for informational purposes. Documented alternatives/methodologies within Attachment A are either selected and assessed as part of Section 3, or postponed and/or eliminated for the reasons documented within Section 2 of this report.

Results of the pre-screening assessment, selection of identified alternatives, and detailed summaries of selected storage recovery alternatives are included within Section 2 of this report. Cost and schedule assessments for the selected alternatives as well as updated cost estimates for the previously developed reservoir expansion alternatives are summarized within Section 3 of this report. Cost estimates and schedules are developed at a concept screening-level (+100/-30%) and provided to the District. **Attachment B – Basis of Cost and Production Estimates** provides an overview of estimated capital and O&M costs associated with the developed of storage recovery alternatives/methodologies.

Section 4 of this report provides an overview discussion of the results of this assessment as well as future data collection and study topics for the District's consideration.

2 Pre-Screening Analysis and Alternatives Development

A multitude of reservoir sediment management alternatives/methodologies are well documented and have been implemented discretely and in combination with other methods based upon project and site-specific factors associated with, but not limited to, sediment yield, sediment deposition processes, and the distribution of sediments within reservoirs. Reference is made to these management methods within previously published technical literature produced by the World Bank (2016), the National Reservoir Sedimentation and Sustainability Team (2019) and other reference texts.

Storage recovery within Pueblo Reservoir is inherently a complex process due to a variety of considerations associated with potentially significant social, environmental and economic factors related to the implementation of potential storage recovery and/or reservoir expansion alternatives.

Attachment A – Fryingpan-Arkansas Storage Recovery Alternatives Register (SRAR) appended to this engineering assessment report provides an overview of the pre-screening alternatives/methodologies process the Mott MacDonald team conducted for the purposes of developing and selecting potential alternatives and combinations thereof. Within the SRAR, alternatives/methodologies are placed into the following general categories:

- Reservoir Storage Recovery;
- Reservoir Sustainability;
- Reservoir Enlargement; and
- Reservoir Reoperation.

An explanation of the application and potential limitations of the sediment management methods, preliminary results of the pre-screening assessment conducted by the Mott MacDonald Team in the SRAR, and selected alternatives/methodologies for storage recovery assessed from a cost and schedule perspective are documented within the following subsections.

2.1 Sediment Management Methods Overview

An overview of the sediment management methods evaluated as part of the pre-screening assessment for storage recovery within Pueblo Reservoir are described below.

2.1.1 Reservoir Storage Recovery Methods

For the purposes of this study, storage recovery is considered synonymous with the removal and/or redistribution of sediment deposits within the Active Conservation and Inactive pool storage allocations of Pueblo Reservoir. The removal and/or redistribution alternatives/methodologies considered during the pre-screening assessment include:

- **Dredging.** Dredging includes both the mechanical and hydraulic removal of in-situ sediments from below the water surface within the project study area limits. Placement of dredged materials would be facilitated through the use of slurry pipelines to an upland location within Confined Disposal Facilities (CDFs) and/or discharged directly

downstream of Pueblo Dam within the Arkansas River and/or through the Bessemer Ditch Outlet within Pueblo Dam.

- **Dry Excavation.** Dry excavation includes the mechanical removal of in-situ sediments from areas that are not inundated with water (permanent or temporary) within project study area limits. Placement of excavated materials would likely be facilitated via trucks, rail, conveyor, ropeway or other means of transportation to an upland CDF or offsite disposal and/or processing location.
- **Flushing.** Flushing includes a partial or complete drawdown of Pueblo Reservoir for the purposes of mobilizing/scouring in-situ sediments via increased current velocities and passing the mobilized sediment slurry through the outlets within Pueblo Dam to the Arkansas River below the dam.

2.1.2 Sustainability Methods

Sustainability methods include a broad range of sediment management methods that may be implemented to pass, redirect, and/or capture incoming sediment prior to entering and depositing within a reservoir via wash load, suspended sediment load, and bedload transport. Sustainability methods are therefore a means of reducing the mean annual capacity loss of a reservoir. Sustainable sediment management alternatives/methodologies considered during the pre-screening assessment include the following:

- **Sluicing.** Sluicing usually includes a short duration, coordinated drawdown of reservoirs during large flood events and/or seasonal high flow (freshet) periods with the objective of passing sediment-laden water through a reservoir to reduce sediment deposition.
- **Turbid Density Current Venting/Siphoning.** Turbid Density Currents within reservoirs exist when sediment laden water enters a reservoir during flood events and/or seasonal high flow (freshet) periods. The sediment laden water is denser than the clear water within the reservoir which results in the turbid density currents submerging to the reservoir bottom after flowing over the reservoir delta and riding the natural gradient for an unknown length of the reservoir, sometimes reaching as far as the dam face. If a low-level outlet is not available, the turbid density currents settle out and consolidate into a muddy lake bottom. Venting of turbid density currents includes the discharge of the dense sediment laden water through a low-level outlet in the dam. Similarly, siphoning (hydrosuction dredging) turbid density currents includes siphoning the dense sediment laden water through an outlet in the dam and/or the main spillway (Annandale, 2016).
- **Sediment Bypass Structures.** Sediment bypass structures include constructed tunnels and/or channels built for the purposes of redirecting upriver flows during flood events and/or seasonal high flow (freshet) periods. Both suspended and bed load may be conveyed via tunnel and/or channel to a discharge point below the dam or to a sacrificial off stream reservoir constructed for the purpose of sediment capture.
- **Check Dams.** Check dams (silt traps, debris basins, etc.) are generalized for the purposes of this study as upriver structures constructed for the purposes of capturing main channel and/or tributary flows. Check Dams provide a means of capturing significant amounts of suspended and bed load materials prior to it reaching main river channels/reservoirs. Continuous maintenance is inherent to the construction of check dams for successful long-term sediment management, but they can be strategically located to provide an efficient means of access to deposited sediments prior to it settling out within reservoirs.

- **Upriver and Tributary Channel Stabilization.** Upriver channel stabilization includes stabilizing the banks of the Arkansas River and tributary channels above Pueblo reservoir for the purposes of reducing sediment yield through the mitigating the impacts associated with channel erosion. Stabilization alternatives include the installation of riprap, concrete mats, vegetation, and other alternatives.

2.2 Reservoir Enlargement

For the purposes of this study, reservoir enlargement exclusively refers to raising the crest elevation of Pueblo Dam as an adaptive management strategy, in lieu of, or in combination with storage recovery methods and/or sustainability methods. Previous studies (GEI, 1998 and USBR, 1999) assessed a total of six (6) dam raise alternatives, including three (3) ungated spillway raise alternatives and (3) gated spillway alternatives. These alternatives included raising Pueblo Dam to achieve approximately 25,000, 60,000 and 75,000 acre-feet in additional storage capacity within the reservoir. Construction cost assessment results pertinent to the reservoir enlargement alternatives are updated to year 2020 dollars ($USD) through the application of Engineering News Record (ENR) cost indexing and are tabulated in Section 4 of this engineering assessment report. Order-of-magnitude costs associated with permitting a dam raise alternative within Pueblo Reservoir are documented within the Fry-Ark Environmental Assessment Report prepared by the Mott MacDonald team.

2.3 Reservoir Storage Reallocation

Reservoir Storage Reallocation within Pueblo Reservoir is an adaptive management strategy that would likely include the reallocation and raising of the active conservation pool elevation into the flood control storage allocation. For a variety of reasons, including, but not limited to, political reasons, the need to develop an accurate real-time weather prediction model for flood control, the location of Pueblo Reservoir within the greater Upper Arkansas River Basin, and other reasons, the reoperation of Pueblo Reservoir was omitted as an adaptive strategy for storage recovery during the pre-screening process and is not considered any further as part of this assessment.

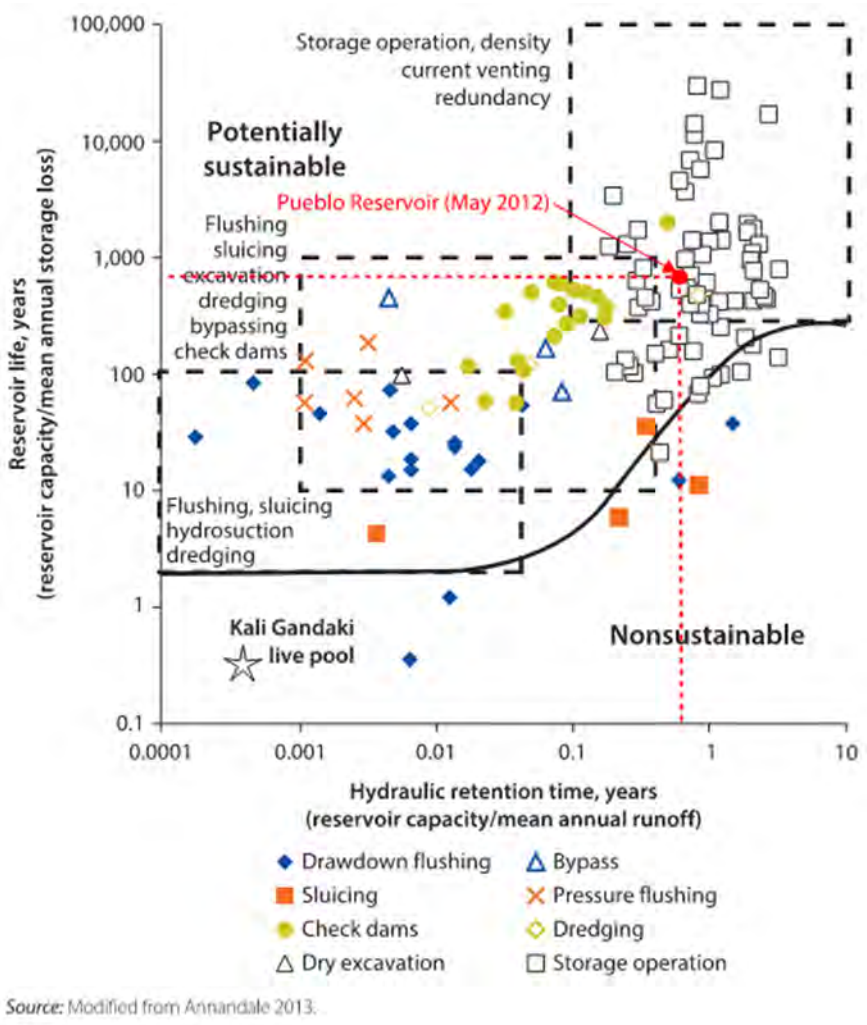
2.4 Basis of Pre-Screening Assessment

Mott MacDonald conducted a pre-screening of the sediment management methods described within Section 3.1 of this assessment. Alternatives/methodologies were initially assessed based upon a review of Figure 2.1 below (World Bank, 2016). The figure plots reservoir life (years), expressed as a ratio of reservoir capacity over mean annual storage volume loss versus hydraulic retention time (years), expressed as a ratio of reservoir capacity over mean annual runoff. Limitations for use of this figure are clearly described within the referenced text, and explicitly state that the figure should be used as a general guideline, not a design tool, for the types of sediment management methods that may be applicable to a reservoir given current capacity.

The x- and y-axis are plotted on a logarithmic scale, and scatter points depicted on the plot represent sediment management methods that have been implemented within reservoirs at unknown locations. Within the plot, *Potentially Sustainable* and *Non-sustainable* regions are indicated above and beneath an S-Curve (solid line). The sediment management methods shown on the plot (shown as symbols) are defined in the legend accompanying the plot, and include (refer Section 3.1 for general descriptions):

- Drawdown flushing;
- Sluicing;

- Check dams;
- Dry excavation;
- Bypass;
- Pressure flushing (localized flushing at low-level outlet);
- Dredging; and
- Storage operation.



Source: Modified from Annandale 2013.

Figure 2.1: Applicability of Sediment Management Methods (World Bank, 2016)

For informational planning purposes, qualitative trends associated with **Figure 2.1** are summarized below:

- Increasing storage capacity and/or expanding a reservoir will increase the reservoir life (move up along the y-axis) and hydraulic retention time of a reservoir (move right along the x-axis), assuming mean annual storage loss and mean annual runoff remain constant.
- As reservoir capacity decreases, reservoir life will decrease over time (move down along the y-axis), assuming a constant or increased mean annual storage loss.

- As reservoir capacity decreases, hydraulic retention time will decrease over time (move left along the x-axis), assuming a constant or increased mean annual runoff within the reservoir drainage area.
- As reservoir capacity decreases, reservoir life may either remain approximately the same or decrease at a reduced rate compared to the constant mean annual storage loss scenario (remain the same or move down the y-axis), assuming measures are implemented to reduce mean annual storage loss (example. through the implementation of sustainability measures),
- As reservoir capacity decreases, hydraulic retention time could remain approximately the same or decrease at a reduced rate compared to the constant mean annual runoff scenario (remain the same or move left along the x-axis), assuming a decreased rate of mean annual runoff within the drainage area (example, drought).

Based upon the results of the 2012 Bathymetric Survey Technical Report developed by the United States Bureau of Reclamation (Reclamation, 2015), reservoir life (years) and hydraulic retention time (years) are calculated for Pueblo Reservoir using the input parameters summarized in **Table 2.1** below.

Table 2.1: Pueblo Reservoir life (years) and Hydraulic retention time (years) calculation table

Input Parameter	Value (acre-feet)[1]
Reservoir Capacity	338,374 acre-feet (Below top of Flood Control Pool, el. 4,898.7'')
Annual Storage Loss	496 to 583 acre-feet/year[2]
Mean Annual Runoff	589,890 acre-feet (1974 to May 2012)
Calculated Output	**Calculated Value (years)**
Reservoir Life	**580-682 years**
Hydraulic Retention Time	**0.57 years**

Notes: 1. Based upon values provided within the Pueblo Reservoir 2012 Bathymetric Survey Technical Report (Reclamation, 2015).
2. Average annual storage capacity loss for periods from 1974 to 2012 and from 1993 to 2012 (Reclamation, 2015).

As indicated within **Figure 2.1**, as of May 2012 Pueblo Reservoir falls within the *Potentially sustainable* area of the plot above the S-Curve, in a region where suggested sediment management methods include "storage operation (reallocation of storage and operational improvements), density current venting redundancy".

Based upon these preliminary results, and considering the proximity of Pueblo Reservoir on the plot to the dashed box applicable to flushing, sluicing, excavation, dredging, bypassing and check dams, the Mott MacDonald team decided to carry all alternatives forward into the detailed pre-screening assessment for cursory evaluation and an assessment of applicability.

The results of the pre-screening assessment are documented within **Attachment A – Fryingpan-Arkansas Study SRAR** and summarized within the next section.

2.5 Results of Pre-Screening Assessment

A detailed pre-screening assessment of potential storage recovery, sustainability, and/or reservoir expansion alternatives/methodologies was conducted by the Mott MacDonald team following the initial pre-screening work documented within Section 2.4 above. As part of the detailed pre-screening assessment, a comprehensive list of provided for District review within

Attachment A – Fryingpan-Arkansas SRAR. Selected alternatives are described in detail within Section 3.6 herein.

Additionally, justification for postponing or eliminating potential storage recovery and sustainability methods for the purposes of this assessment is included within Section 3.5.1 below.

2.5.1 Postponed or Eliminated Storage Recovery and Sustainability Methods

A summary of alternatives/methodologies included within **Attachment A – Fryingpan-Arkansas SRAR** that have been postponed and/or eliminated and the reasons for precluding them from further assessment as part of this study are briefly tabulated below within **Table 2.2**. Several of the identified alternatives may be viable but may either require additional data collection and/or future studies in order to assess the feasibility of implementation and the associated costs.

Table 2.2: Postponed Storage Recovery and Sustainability Methods following Pre-Screening Assessment

Category	Alternative/Methodology	Reason(s) for Postponement
Storage Recovery	Reservoir Flushing	• This alternative requires a complete drawdown of Pueblo Reservoir, disrupting normal operations. • Significant impacts to downstream habitat and critical biology due to water quality problems such as increases of turbidity. • May require future studies to determine the feasibility of this alternative/methodology.
Reservoir Sustainability	Sluicing	• This alternative requires a complete/partial drawdown of Pueblo Reservoir, disrupting normal operations. • Significant impacts to downstream habitat and critical biology due to water quality degradation. • May require future studies to determine the feasibility of this alternative/methodology.
	Settling basin/reservoir, Sediment bypass structures, Check dams, etc.	• A comprehensive data collection program and future studies are needed to assess these alternatives/methodologies.
	Upriver and Tributary Channel Stabilization	• A comprehensive data collection program and future studies are needed to assess these alternatives/methodologies. • The scale of stabilization works cannot be determined. The Arkansas River upstream of Pueblo Reservoir has 70+ unregulated tributaries located along its length between Clear Creek Reservoir and Pueblo Reservoir.
New Storage	Off-project storage reservoir	• Assessment of new District storage. This alternative was eliminated from the scope of this study.

Reservoir sustainability measures documented within **Table 2.3** should be revisited during future studies related to assessing sediment yield and/or mean annual storage capacity loss reduction methods.

2.6 Selected Alternatives/Methodologies for Storage Recovery and Reservoir Expansion

Following the detailed pre-screening assessment of storage recovery alternative/methodologies, documented within **Attachment A – Fryingpan-Arkansas SRAR**, the following six (6) alternatives/methodologies were selected for assessment.

Selected Storage Recovery and/or Sustainability Management Alternatives/Methodologies:

- **Alternative 1.** No Action
- **Alternative 2.** Complete Storage Recovery within Pueblo Reservoir (Active Conservation and Inactive Storage Allocation Pools) via Dredging and Excavation.
- **Alternative 3.** Partial Storage Recovery of Pueblo Reservoir via Dredging and Applied Sustainability Management via Turbid Density Current Venting through Pueblo Dam.

Previously Selected Dam Raise Alternatives (GEI, 1998):

- **Alternative 4.** Dam raise with gated spillway to add approximately 25,000 acre-feet of additional storage capacity.
- **Alternative 5.** Dam raise with gated spillway to add approximately 60,000 acre-feet of additional storage capacity.
- **Alternative 6.** Dam raise with gated spillway to add approximately 75,000 acre-feet of additional storage capacity.

Detailed descriptions, assumptions, limitations, and risks are documented for each of the selected storage recovery alternatives/methodologies in the subsections below. Brief descriptions of the reservoir expansion alternatives (dam raise alternatives) developed by GEI in 1998 are provided in Section 2.6.

2.6.1 Alternative 1. No Action Alternative

Alternative 1 is a no action alternative. Annual sediment yield and/or reservoir capacity loss increase on an annual basis commensurate to or higher than previously estimated by studies conducted in 1993 and 2012 by Reclamation (490 to 580 acre-feet/year). Reservoir life is approximated within a range of 580 to 682 years as of May 2012. See Section 3.4 for further information.

2.6.2 Alternative 2. Alternative/Methodology Description, Assumptions and Limitations Summary

2.6.2.1 Description

Alternative 2 consists of the complete storage recovery of the Active Conservation and Inactive storage allocation pools within Pueblo Reservoir (nearly 28.5 million cubic yards of in-situ sediment and debris as of May 2012). Sediment and debris removal will occur through the use of a variety of dredging (mechanical and hydraulic) and exaction equipment. A percentage of the dredged materials removed on an annual basis will be placed in upland Confined Disposal Facilities (CDFs) and the remaining volume will be directly discharged downstream into the Arkansas River and/or through a pre-existing outlet or the main spillway of Pueblo Dam. It is estimated that construction of this alternative would take approximately 15 years (See Attachment B – Cost Estimate Basis for additional assumptions, limitations, and background on assumed capital and O&M costs).

2.6.2.2 Assumptions

The following assumptions and limitations apply to Alternative 2:

- **Volumes.** Dredging and excavation volumes (in-situ) are estimated based on values presented within the 2012 bathymetric survey work provided by Reclamation for the Active Conservation and Inactive storage pools (Reclamation, 2015).
- **In-water work window.** The in-water work window is assumed to be from November 1 to March 31 of the following year.
- **Confined Disposal Facility Placement.** It is assumed that approximately 60 acres of land is required for every 1 million cubic yards of dredged material placed within CDFs. This assumes a terminal placement height of approximately 10 feet above existing elevations within the CDF. Additionally, CDF placement assumes passive dewatering of the dredged slurry/placed materials following excavation.
- **In-Situ Sediment Gradation.** For the purposes of this study, in-situ sediment to be removed via hydraulic and/or mechanical dredging equipment is assumed to be fine to medium sands and silt.
- **Chemical Contaminants within sediments.** It is assumed for this study that in-situ sediments are not contaminated, and that additional treatment of effluent at discharge end points is not required.
- **Direct Discharge into Arkansas River.** Historical mean annual storage capacity loss within Pueblo Reservoir ranges from approximately 410 to 583 acre-feet per year (660,000 to 940,000 cubic yards of sediment and debris accumulation) depending on the period time considered (Reclamation, 2015). Therefore, it is assumed that the quantity of dredged material that will be permitted to be hydraulically discharged directly downstream of Pueblo Reservoir into the Arkansas River is commensurate with the mean annual storage capacity loss. The basis of this assumption is rooted in the fact that without the reservoir in place, a volume of sediment equivalent to the annual sediment yield or mean annual storage capacity loss would be transported through to the Arkansas River downstream, thus mimicking natural run of the river processes. For the purposes of this study, a conservative estimate of current (year 2020) mean annual storage loss is 620 acre-feet per year (~1 million cubic yards of sediment deposition per year).
- **Turbid Density Current Venting.** The application of turbid density current venting through Pueblo Reservoir and eventually through Pueblo Dam requires that an extensive study program be completed to verify the concept described herein. The study program would include, but not be limited to, geotechnical investigations, numerical modeling (sediment and fluvial processes), bathymetric surveys, and analysis of suspended, wash, and bed load transport.

Equipment Allocation within the Reservoir

A preliminary analysis of dredge equipment allocation within the reservoir was conducted to refine the feasibility assessment and cost estimate for Alternative 2. Dredge equipment types considered for this analysis include mechanical excavation, hydraulic cutterhead dredging, and cable rig dredging. This analysis was used to refine the dredging/excavation volumes and applicable depths for each type of equipment. This analysis was also used to refine the cost estimate and as a high-level planning tool to assess the spatial allocation of the different types of dredging equipment.

First, an elevation surface was developed using available bathymetric and topographic data. Data used to develop the bathymetric and topographic surface includes contour data from the National Map (USGS, 2020), thalweg location data from the National Hydraulic Dataset

(accessed with the USGS National Map) (USGS, 2020), and 2012 thalweg elevations. Note that this elevation surface is meant for qualitative pre-screening analysis purposes only. A comprehensive survey program and refined analysis is recommended for future studies.

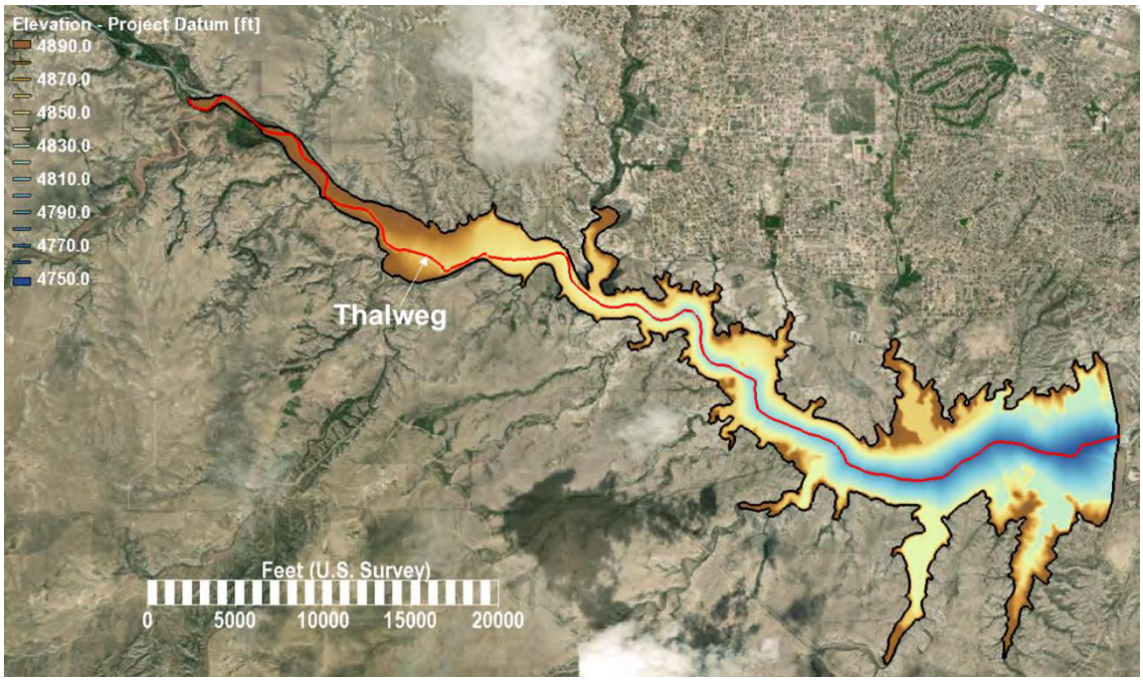


Figure 2.2: Plan-view of interpolated bathymetry elevations within Pueblo Reservoir (USGS, 2020) (Reclamation, 2015)

It was assumed that mechanical excavation, hydraulic cutterhead dredging, and mechanical (cable rig) dredging will be used to remove sediments at different depth ranges within reservoir. Equipment assumptions detailed in **Error! Reference source not found.** were used to d elineate applicable equipment types for different reaches of Pueblo Reservoir. A key assumption in this analysis is that the contractor will stage work around Ordinary Low Water (OLW) during the work window, +4867 as detailed in the Basis of Assessment technical memorandum developed as part of Task 5, allowing the contractor to excavate more material in the dry, and to reach greater depths with the hydraulic cutterhead. Based on these assumptions shown in **Table 2.3** applicable elevation ranges for each type of equipment were developed. These elevation ranges, along with the bathymetric surface developed as described earlier in this section, were used to develop a spatial plot of equipment applicability within the Pueblo Reservoir (See **Figure 2.3** below).

Table 2.3: Assumptions made for different equipment types and assumed applicable elevation ranges

Equipment Type	Applicable Elevations of Reservoir [ft Project Datum]	Assumptions
Mechanical Excavation (Dry)	+4867 to +4880.5	Assumed that contractor will stage work so all areas above OLW (+4867) will be mechanically excavated in the dry. No excavation/removal of sediment above top of active pool layer (+4880.5)
Hydraulic Dredging (Cutterhead)	+4802 to +4867	Assumed cutterhead working range of 65 feet below the still water surface elevation.

Equipment Type	Applicable Elevations of Reservoir [ft Project Datum]	Assumptions
		Assumed contractor will stage work so that greater depths of the reservoir are reached at OLW (4867)
Mechanical Dredging (Cable Rig)	+4764 to +4802	A cable rig will be used to reach sediments below the working depth of hydraulic cutterhead. No material will be excavated below top of dead storage (+4764)

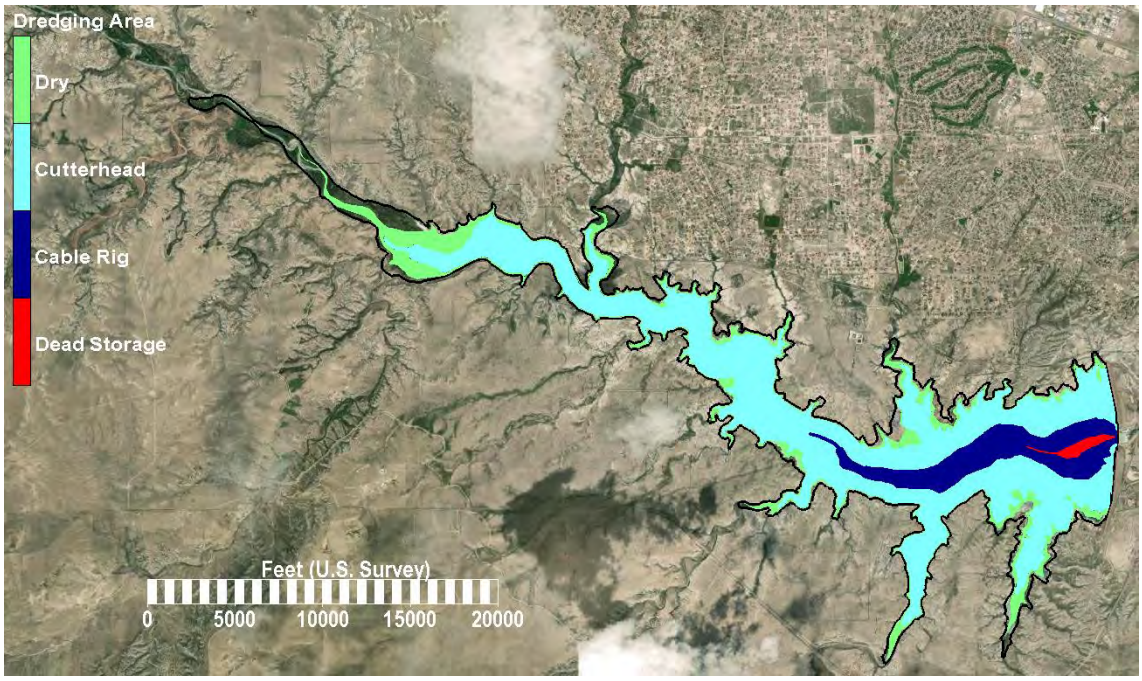


Figure 2.3: Plan-view of conceptual dredging areas within Pueblo Reservoir

Volumetric Summaries

Since dam closure in 1974 to the time of the last bathymetric survey conducted within Pueblo Reservoir in May of 2012, approximately 17,630 acre-feet of storage capacity has been lost within the previously indicated storage allocation pools (Active Conservation and Inactive Storage Allocation Pools) due to sediment and debris accumulation within the reservoir. This amounts to nearly 28.5 million cubic yards of sediment and debris accumulation over this time period. Using the assumed elevation ranges for the different equipment types (See **Table 2.4**), estimated volumes were developed for each sediment removal method. The results of this analysis are shown below in **Table 2.4**.

Table 2.4: Estimated dredge volume for each type of equipment

Equipment Type	Applicable Elevations of Reservoir [ft, Project Datum]	Estimated Volume [cubic yards]	Percent of Total Volume [%]
Mechanical Excavation (Dry)	+4867 to +4880.5	3,800,000	13%
Hydraulic Dredging (Cutterhead)	+4802 to +4867	18,100,000	64%
Mechanical Dredging (Cable Rig)	+4764 to +4802	6,600,000	23%

2.6.3 Alternative 3. Alternative/Methodology Description, Assumptions, and Limitations Summary

2.6.3.1 Description

Alternative 3 includes the partial storage recovery of the Active Conservation and Inactive storage allocation pools within Pueblo Reservoir. Sediment and debris removal would occur through the use of dredging equipment (mechanical and hydraulic) to remove in-situ materials from an engineered channel that runs along the approximate orientation of the original thalweg of the Arkansas River within Pueblo Reservoir. Similar to Alternative 2, a percentage of the dredged materials removed from the channel would be placed in upland Confined Disposal Facilities (CDFs) and the remaining volume would be directly discharged downstream into the Arkansas River through pre-existing outlets or the main spillway of Pueblo Dam. It is estimated that construction of this alternative would take approximately 2 years (See Attachment B – Cost Estimate Basis for additional assumptions, limitations, and background on assumed capital and O&M costs).

Channel dimensions were developed based upon historical profile and cross-sectional data of the reservoir thalweg provided within previous Pueblo Reservoir sedimentation surveys (Reclamation, 1993 and 2015) and assumed in-situ material gradations. For the purposes of this study, Alternative 3 channel dimensions and approximate in-situ volumes are provided in **Table 2.5** below.

In addition to the partial storage recovery of Pueblo Reservoir achieved through the dredging work, the secondary purpose of this alternative is to convey the flow of turbid density currents entering Pueblo Reservoir into the dredged channel and eventually through Pueblo Dam (see Section 3.1 herein for a description of this sustainability method). Following dredging and material placement, the underwater channel would serve as a means of facilitating the transport of suspended sediment load through the reservoir during flood or high flow events and to eventually pass the turbid, sediment laden water through the North Outlet (assumed outlet sill elevation 4764 ft.) located within the concrete buttress section of Pueblo Dam.

Alternative 3 will restore a portion of the lost storage within Pueblo Reservoir, thus increasing the overall storage capacity, while also reducing mean storage capacity loss via the implementation of turbid density current venting through the low-level outlet at Pueblo Dam.

2.6.3.2 Assumptions and Limitations

The following assumptions and limitations are developed for Alternative 3.

- **Volumes.** Dredging and excavation volumes (in-situ) are estimated based on values presented within the 2012 bathymetric survey work provided by Reclamation for the Active Conservation and Inactive storage pools (Reclamation, 2015).
- **In-water work window.** The in-water work window is assumed to be from November 1 to March 31 of the following year.

- **Confined Disposal Facility (CDF) Placement.** It is assumed that approximately 60 acres of land is required for every 1 million cubic yards of dredged material placed within CDFs. This assumes a terminal placement height of approximately 10 feet above existing elevations within the CDF. Additionally, CDF placement assumes passive dewatering of the dredged slurry/placed materials following excavation.
- **In-Situ Sediment Gradation.** For the purposes of this study, the in-situ sediment to be removed via hydraulic and/or mechanical dredging equipment is assumed to be fine to medium sands and silt.
- **Chemical Contaminants within sediments.** It is assumed for this study that in-situ sediments are not contaminated, and that additional treatment of effluent at discharge end points is not required.
- **Direct Discharge into Arkansas River.** Historical mean annual storage capacity loss within Pueblo Reservoir ranges from approximately 410 to 583 acre-feet per year (660,000 to 940,000 cubic yards of sediment and debris accumulation) depending on the period time considered (Reclamation, 2015). Therefore, it is assumed that the quantity of dredged material that will be permitted to be hydraulically discharged directly downstream of Pueblo Reservoir into the Arkansas River is commensurate with the mean annual storage capacity loss. The basis of this assumption is rooted in the fact that without the reservoir in place, a volume of sediment equivalent to the annual sediment yield or mean annual storage capacity loss would be transported through to the Arkansas River downstream, thus mimicking natural run of the river processes. For the purposes of this study, a conservative estimate of current (year 2020) mean annual storage loss is 620 acre-feet per year (~1 million cubic yards of sediment deposition per year).
- **Turbid Density Current Venting.** The application of turbid density current venting through Pueblo Reservoir and eventually through Pueblo Dam requires that an extensive study program be completed to verify the concept described herein. The study program would include, but not be limited to, geotechnical investigations, numerical modeling (sediment and fluvial processes), bathymetric surveys, and analysis of suspended, wash, and bed load transport.

Equipment Allocation within the Reservoir

Equipment allocation within Pueblo Reservoir for Alternative 3 is similar to Alternative 2. Refer to Section 3.6.2.1.

Volumetric Summaries

Alternative 3 channel dimensions and approximate in-situ volumes are provided in **Table 2.5** below:

Table 2.5: Dredged Thalweg Channel Dimensions and Volumes for Alternative 3

Description	Unit	Dimension
Length of Dredged Channel	Miles	9 miles
Width of Dredged Channel (not including side slopes)	Feet	100 feet
Average Sediment Depth	Feet	15 feet
Side Slope	Slope (H:V)	5H:1V
Total Estimated Dredge Prism Volume	**Cubic Yards**	**4,620,000**

Dredging of the engineered thalweg channel to facilitate turbid density current flow through the reservoir to Pueblo Dam would require removing approximately 4.6 million cubic yards from

Pueblo Reservoir. This volume amounts to nearly twenty percent of the storage volume lost due to sediment deposition during the period between dam closure and May of 2012 within the storage allocations identified, or approximately 2,850 acre-feet of storage recovery.

Alternative 3 will likely require future, periodic dredging to maintain the engineered thalweg channel. Long-term maintenance dredging costs were not assessed as part of this study.

2.6.4 Alternatives 4 through 6. Alternative/Methodology Descriptions

2.6.4.1 Description

Alternatives 4, 5 and 6 include dam raise alternatives for Pueblo Dam. Screening-level concepts were developed by GEI Consultants, Inc. in 1998 and reviewed by Reclamation in 1999. Dam raise alternatives include a 25,000, 60,000, and 75,000 acre-feet options. Alternatives considered would require approximately 5 to 10 feet of additional elevation be added to earthen embankment and concrete buttress sections of the dam.

3 Alternatives Assessment

The following section provides an overview of the concept screening-level costs (capital and O&M) and schedules developed for the selected storage recovery alternatives and costs (capital only) for the previously selected reservoir expansion alternatives (dam raise) at Pueblo Dam. Cost and production basis information is included within **Attachment B – Basis of Cost and Production Estimates.**

3.1 Selected Alternatives Summary

Storage Recovery

- **Alternative 1 –** No Action
- **Alternative 2 –** Dredging for complete storage recovery of the Active Conservation and Inactive storage pools, approximately 17,630 acre-ft increase
- **Alternative 3 –** Dredging for partial storage recovery and sediment passthrough (turbid density current venting), approximately 2,850 acre-ft increase

Reservoir Expansion

- **Alternative 4 –** Dam Raise to achieve approximately 25,000 acre-ft increase
- **Alternative 5 –** Dam Raise to achieve approximately 65,000 acre-ft increase
- **Alternative 6 –** Dam Raise to achieve approximately 75,000 acre-ft increase

3.2 Cost Assessment

Screening-level cost estimates (-30/+100%) have been developed to aid the District in developing future expenditure planning documentation related to storage recovery within the Fry-Ark study limits. Screening-level cost estimates include both capital and operations and maintenance costs (O&M) for the alternatives listed within Section 3.1.

For this study, the basis of the screening-level cost estimates developed include cost estimating guidelines, cost curves, internal Mott MacDonald cost databases, and cost model data.

3.2.1 Basis of Cost and Production Estimates

For Alternatives 2 and 3, general assumptions, cost limitations, and cost and production basis information for Capital and O&M costs pertinent to development of storage capacity alternatives/methodologies are summarized within **Attachment B – Basis of Cost and Production Estimates.** The information included within Attachment B should be reviewed in parallel with this Report.

For Alternatives 4, 5 and 6, the Mott MacDonald converted capital costs from year 1999 dollars to 2020 dollars using the Engineering News Record (ENR) Cost Indexing database (ENR, 2020). Permitting costs associated with a dam raise alternative are documented within the Environmental Assessment accompanying this report.

Contingencies included within the original estimate amount to 40% (15% scope and 25% bid) of the capital construction costs (GEI, 1998). Pre-construction investigations, engineering design, program management, and construction management are estimated to be another 60% of capital construction costs.

3.3 Alternative Cost and Schedule Estimate Summary

Estimated concept screening-level costs (including capital and O&M in 2020 $USD) and schedules are provided below for Alternatives 1-6 in **Table 3.1** below. Schedules provided are for construction only. Permitting timelines are included as part of the Environmental Assessment which accompanies this report. Schedules associated with design and other non-construction activities for the alternatives listed are assumed to fall within the estimated permitting schedule timelines.

Table 3.1: Estimated Total Present Value and Construction Schedules for Alternatives 1 through 6

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Description	No Action	Complete storage recovery via dredging and excavation (17,630 acre-ft)[1]	Partial storage recovery via dredging and excavation with density current venting through Pueblo Dam (2,850 acre-ft)[2]	Dam raise to achieve 25,000 acre-feet increase in storage capacity	Dam raise to achieve 60,000 acre-feet increase in storage capacity	Dam raise to achieve 75,000 acre-feet increase in storage capacity
Duration of Construction (Years)	0	15	2	Not assessed.	Not assessed.	Not assessed.
Cost of Permitting and NEPA ($Mil USD)[3]	$0	$10	$10	$10 to $30	$10 to $30	$10 to $30
Capital Cost ($Mil USD)	$0	$808.1	$96.8	$55.1	$103.3	$127.0
Annual O&M ($Mil USD)	$0	$1.5	$0.8	Not assessed.	Not assessed.	Not assessed.
Total Present Value of Alternative ($Mil USD)[5]	**$0**	**$840.6**	**$108.4[4]**	**$85.1**	**$127.3**	**$157.0**

Notes:

1. **Estimated storage recovery based upon 2012 Pueblo Reservoir thalweg elevations (Reclamation, 2015).**
2. **See Table 2.5 for volumetric estimate basis.**
3. **See Environmental Assessment (TR-07-01).**
4. **The cost assessment for Alternative 3 does not include long term periodic dredging that might be required to maintain the engineered thalweg channel through Pueblo Reservoir to Pueblo Dam.**
5. **High end of Permitting and NEPA estimate used.**

3.4 Permitting Cost and Schedule Estimates

The Mott MacDonald team has developed and documented permitting costs and schedules within the Fryingpan-Arkansas Storage Recovery Study Environmental Assessment report. Two main alternatives are addressed: (1) Large-scale dredging project with upland CDF placement and/or direct discharge downstream. (similar to Alternatives 2 and 3); and (2) Reservoir expansion via Dam Raise (similar to Alternatives 4 through 6). Costs and schedules associated with the permitting of these alternatives should be considered in parallel with this engineering assessment report.

4 Discussion and Next-Steps

4.1 Discussion

The results of this engineering assessment report indicate, at a planning level, the potential cost implications associated with removing in-situ sediments from Pueblo Reservoir to recover a percentage of the storage lost since dam closure in 1974 based upon data collected in 2012. Alternatively, concept screening-levels cost associated with reservoir expansion (dam raise) alternatives provide a comparative cost basis for increasing storage within Pueblo Reservoir, without removing the sediment and debris accumulated since dam closure. Acknowledging that Storage capacity within the reservoir has continued to decrease since 2012, it is apparent that a no action alternative is a non-sustainable approach. Therefore, it is recommended that additional, refined studies and data collection programs proceed in order to refine the alternatives presented in this Engineering Assessment to determine the most cost-effective and prudent alternative(s) for ensuring that Pueblo Reservoir continues to provide the desired benefits for the District, Reclamation, and water users in the future.

4.2 Next Steps

Continuation and refinement of this study along with further data collection programs will improve the understanding the Upper Arkansas River System's role and impact on sedimentation in Pueblo Reservoir. Recommended future data collection programs and refinement studies include, but are not limited to, the following:

- Updated bathymetric and topographic surveying programs;
- Geotechnical Investigations (Sediment sampling, gradation analysis, and chemical contaminant analysis) within Pueblo Reservoir and the Upper Arkansas River Basin;
- Market research on the viability of the beneficial reuse of Pueblo Reservoir sediments;
- Geomorphologic analysis to assess sediment loading and distribution within the Upper Arkansas River Basin.
- Numerical and physical modeling to assess the effectiveness of developed alternatives;
- Regulatory outreach and correspondence to confirm the requirements and permitting frameworks associated with developed alternatives;
- Land-use and land acquisition studies and outreach to determine the viability of confined disposal facility development; and
- Pueblo Dam operations planning and modifications that could be implemented to facilitate natural run of the river processes through Pueblo Reservoir.

4.3 Closure

This Engineering Assessment was conducted to provide guidance on feasible alternatives and order of magnitude costs for future storage recovery planning efforts. The considerations and future studies detailed in this document can be used to guide further storage recovery analyses and studies rather than select a single preferred alternative. Measures and alternatives reviewed as part of the pre-screening assessment, particularly the reservoir sustainability measures not investigated as part of this study, can be combined with the proposed alternatives to increase the lifespan of the project and reduce future maintenance costs. Comprehensive data collection, analysis, and numerical modeling programs should be implemented in future studies if sustainability measures are to be investigated further. Although not included in this

Engineering Assessment, additional considerations for new, district-owned storage alternatives should also be developed and assessed as part of future studies.

5 References

Anchor QEA. 2020. *Development of Basic Cost Model for Removal of Sediment from Reservoirs.* Lakewood, Colorado.

Annandale, G., Morris, G., Karki, P. 2016. *Extending the Life of Reservoirs: Sustainable Management for Dams and Run-of-River Hydropower.* The World Bank. (World Bank).

GEI Consultants, Inc. 1998. *SECWCD/Arkansas Basin Water and Storage Needs Assessment*. Englewood, Colorado. In association with: Helton & Williamsen, P.C, David Bamberger & Associates.

National Reservoir Sedimentation and Sustainability Team. 2019. *Reservoir Sediment Management: Building a Legacy of Sustainable Water Storage Reservoirs* [White Paper].

Southeastern Colorado Water Conservancy District. 2019. *Storage needs in the Arkansas River Basin. Storage Programs Review.* Storage Programs Review.

USBR. 1994. *Pueblo Reservoir 1993 Sedimentation Survey*. Sedimentation Section Surface Water Branch Division of Earth Sciences. Denver, Colorado.

USBR. 1999. *Pueblo Dam: Study to Raise the Operating Pool for Southeastern Colorado Water and Storage Needs Assessment Enterprise*. Technical Service Center. Denver, Colorado.

USBR. 2015. *Pueblo Reservoir 2012 Bathymetric Survey*. Technical Report No. SRH-2014-15. Denver, Colorado: Sedimentation and River Hydraulics Group of the Technical Service Center.

USEPA. 2000. *Guide to Developing and Documenting Cost Estimates During the Feasibility Study.* Office of Emergency and Remedial Response. Washington, DC.

USGS. 2020. *The National Map*. https://viewer.nationalmap.gov/advanced-viewer/. Accessed 7/16/2020.

Attachments

Attachment A - The Fryingpan-Arkansas Storage Recovery Alternatives Register (SRAR)

Attachment B – Basis of Cost and Production Estimates

ATTACHMENT A

STORAGE RECOVERY ALTERNATIVES REGISTER (SRAR)

SECWCD - FRYINGPAN-ARKANSAS STORAGE RECOVERY STUDY

	Submittal 1	Submittal 2	Submittal 3	Submittal 4
Draft/Version:	2.0	0.0	1.0	2.0
Revision Date:	3-Aug-20	8-May-20	19-Jun-20	3-Aug-20

MOTT MACDONALD

Alternative/Methodology No.	Mott MacDonald Team Owner	Category (Storage Recovery/Reservoir Expansion)	District Acceptance		Alternative/Methodology Title	Description	Raised by	Estimated Total Installed Cost (TIC)[1] (Million $USD)	Estimated Schedule (Years)	Risks	Notes
			Draft Submitted Date	District Approval Date							
1	JD	No Action			**No Action Alternative**	No Action Alternative.	**Mott MacDonald**	0	N/A	N/A	N/A
2	JD	Storage Recovery			**Dredging to Recover Full Capacity Loss within Activie Conservation and Inactive Storage Allocation Pools (Selected Alt 2)**	Storage recovery alternaive Includes complete storage recovery via the removal of in-situ sediments within the Active Conservation and Inactive storage allocations within Pueblo Reservoir (approximately 17,800 acre-feet as of 2012). This option includes the removal of approximately 28.5M cubic yards of in-situ sediment. Removal of sediments within the reservoir would require the use of both hydraulic and mechanical dredging/excavating equipment. It is assumed that approximately 2/3 of the dredged material would be placed at upland CDF(s) and 1/3 discharged downstream of Pueblo Reservoir within the Arkansas River and/or Bessemer Ditch.	**Mott MacDonald**	$840.6	Design and Permitting: 3 to 5 years. Construction: 15 years	Availablity of CDFs, Pueblo Reservoir and downstream social and environmental impacts, contractor market, and sediment contamination.	Requires market research, additional data and studies for alternative to be assessed.
3	JD	Storage Recovery			**Dredging to Recover Partial Capacity Loss with Turbid Density Current Venting (Selected Alt 3)**	Storage recovery alternative includes partial storage recovery via the removal of in-situ sediments within the Active Conservation and Inactive storage allocations within Pueblo Reservoir. This alternative includes the removal of approximately 4.5M cubic yards. Removal of sediments within the reservoir would require the use of both hydraulic and mechanical dredging/excavating equipment. It is assumed that approximately 2/3 of the dredged material would be placed at upland CDF(s) and 1/3 discharged downstreamof Pueblo Reservoir within the Arkansas River and/or Bessemer Ditch.	**Mott MacDonald**	$108.4	Design and Permitting: 3 to 5 years. Construction: 15 years	Availablity of CDFs, Pueblo Reservoir and downstream social and environmental impacts, contractor market, and sediment contamination.	Requires market research, additional data and studies for alternative to be assessed.
4	JD	Storage Recovery			Flushing	Flushing includes a partial or complete drawdown of Pueblo Reservoir for the purposes of mobilizing/scouring in-situ sediments via increased current velocities and passing the mobilized sediment slurry through the outlets within Pueblo Dam to the Arkansas River below the dam.	**Mott MacDonald**	Not Assessed	Not Assessed	Operations, downstream social and environmental impacts.	Requires market research, additional data and studies for alternative to be assessed.
5	JD	Storage Recovery			Sluicing	Sluicing usually includes a short duration, coordinated drawdown of reservoirs during large flood events and/or seasonal high flow (freshet) periods with the objective of passing sediment-laden water through a reservoir to reduce sediment deposition.	**Mott MacDonald**	Not Assessed	-	Operations, downstream social and environmental impacts.	Requires market research, additional data and studies for alternative to be assessed.
6	JD	Storage Recovery (Material Management)			Direct Slurry Discharge Downstream of Pueblo Dam	The direct discharge of dredged materials downstream of Pueblo Dam includes the dredging and fluidization of in-situ dredged materials into a slurry (water with % solids) and transport downstream via hydraulic pipeline (HDPE or similar). The use of booster pumps and/or secondary pumps may be required for longer distances.	**Mott MacDonald**	Cost of direct slurry discharge is included with Alternatives 2 and 3.	See Alternative 2 and 3 above.	Reservoir operations, Reservoir and downstream social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
7	JD	Storage Recovery (Material Management)			Confined Disposal Facility (CDF) Placement	Placement of dredged materials within Confined Disposal Facilities (CDFs) includes either the hydraulic transport of dredged materials via hydraulic slurry pipeline (HDPE or similar) to the CDF and/or placement of excavated materails within the CDF via rehandling and transport (ex. truck, conveyor, material ropeway, etc.).	**Mott MacDonald**	Cost of placement within CDFs is included with Alternatives 2 and 3.	See Alternative 2 and 3 above.	Availablity of CDFs, Pueblo Reservoir and downstream social and environmental impacts, and sediment contamination.	Requires additional data and studies for alternative to be assessed in any more detail.
8	JD	Storage Recovery (Material Management)			Beneficial Resuse of Dredged Material	Beneficial reuse of dredged materials from Pueblo Reservoir refers to the transformation of dredged sediment material into a cost-essfective and useful product that can serve a positive environmental or human function (agricultural, resource of aggregates and other materials, landfill cover, and general fill). The beneficial use of dredged material has multiple inherent challenges (See risks).	**Mott MacDonald**	Not Assessed	Not Assessed	Transportaiton and handling costs to move the material, processing costs, competition against low cost alternatives, and the presence of contaiminants and need for treatment.	Requires market research, additional data and studies for alternative to be assessed.
9	JD	Storage Recovery (Material Management)			Material Ropeway or Conveyor	Transport of dredged materials via material ropeway or conveyor transport includes the rehandling of dredged materials onto a system to transport materails over a distance in lieu of using trucks or hydraulaulic transport. Material ropeways offer an advantage in rugged terrain due to limited impacts associated with construction and a potential reduction in transport costs in comparision to trucking.	**Mott MacDonald**	Not Assessed	Not Assessed	Additional infrastructure cost, CDF availability, transport distance, cocial and environmental impacts.	Requires additional data and studies for alternative to be assessed.
10	JD	Storage Recovery (Material Management)			Trucking	Trucking dredged or excavated materials includes transporting dredged material via dump truck via existing road infrastructure.	**Mott MacDonald**	Incorporated within Alternatives 2 and 3.	See Alternative 2 and 3 above.	Social and environmental impacts (emissions, traffic, etc.)	Requires additional data and studies for alternative to be assessed in any more detail.
11	JD	Storage Recovery (Material Management)			Rail	The transport of dredged material via rail includes using the Class 1 railway network located on the north side of Pueblo Reservoir to transport dredged materials to an offsite rehandling facilitiy via unit train. Additional rail infrastructure and rehandling areas would need to be considered for this transport option.	**Mott MacDonald**	Not Assessed	Not Assessed	Additional infrastructure cost, CDF availability, transport distance, cocial and environmental impacts.	Requires additional data and studies for alternative to be assessed.
12	JD	Reservoir Sustainability			Turbid Density Current Venting	Turbid Density Currents within reservoirs exist when sediment laden water enters a reservoir during flood events and/or seasonal high flow (freshet) periods. The sediment laden water is denser than the clear water within the reservoir which results in the turbid density currents submerging to the reservoir bottom after flowing over the reservoir delta and riding the natural gradient for an unknown length of the reservoir, sometimes reaching as far as the dam face. If a low-level outlet is not available, the turbid density currents settle out and consolidate into a muddy lake bottom. Venting of turbid density currents includes the discharge of the dense sediment laden water through a low-level outlet in the dam. Similarly, siphoning (hydrosuction dredging) turbid density currents includes siphoning the dense sediment laden water through an outlet in the dam and/or the main spillway (Annandale, 2016).	**Mott MacDonald**	Not assessed.	Not assessed.	Implementation, social and environmental impacts.	Requires additional data and studies for alternative to be assessed. In any more detail.
13	JD	Reservoir Sustainability			Sediment Bypass Structures and Off-Project Storage	Sediment bypass structures include constructed tunnels and/or channels built for the purposes of redirecting upriver flows during flood events and/or seasonal high flow (freshet) periods. Both suspended and bed load may be conveyed via tunnel and/or channel to a discharge point below the dam or to a sacrificial off stream reservoir constructed for the purpose of sediment capture.	**Mott MacDonald**	Not assessed.	Not assessed.	Implmentation, capital cost, O&M, social and environmental impacts.	Requires additional data and studies for alternative to be assessed.
14	JD	Reservoir Sustainability			Upriver Sediment Traps/Check Dams	Check dams (silt traps, debris basins, etc.) are generalized for the purposes of this study as upriver structures constructed for the purposes of capturing main channel and/or tributary flows. Check Dams provide a means of capturing significant amounts of suspended and bed load materials prior to reaching main river channels/reservoirs. Continuous maintenance is inherent to the construction of check dams for successful long-term sediment management, but they can be strategically located to provide an efficient means of access to deposited sediments prior to settling out within reservoirs.	**Mott MacDonald**	Not assessed.	Not assessed.	Implmentation, capital cost, O&M, social and environmental impacts.	Requires additional data and studies for alternative to be assessed.
15	JD	Reservoir Sustainability			Arkansas River and Tributary Channel Protection	Upriver channel stabilization includes stabilizing the banks of the Arkansas River and tributary channels above Pueblo reservoir for the purposes of reducing sediment yield through the mitigating the impacts associated with channel erosion. Stabilization alternatives include the installation of riprap, concrete mats, vegetation, and other alternatives.	**Mott MacDonald**	Not assessed.	Not assessed.	Implmentation, capital cost, O&M, social and environmental impacts.	Requires additional data and studies for alternative to be assessed.
16	JD	Reservoir Expansion			**U1 - Ungated Spillway (25,000 acre-feet) (Selected Alt 4)**	Ungated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacity by approximately 25,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$85.1	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
17	JD	Reservoir Expansion			**U2 - Ungated Spillway (60,000 acre-feet) (Selected Alt 5)**	Ungated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacity by approximately 60,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$127.3	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
18	JD	Reservoir Expansion			U3 - Ungated Spillway (75,000 acre-feet)	Ungated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacity by approximately 75,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam.	**GEI Consultants, Inc.**	$149.4	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
19	JD	Reservoir Expansion			G1 - Gated Spillway (25,000 acre-feet)	Gated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacaity by approximately 25,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$76.4	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
20	JD	Reservoir Expansion			G2 - Gated Spillway (60,000 acre-feet)	Gated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacaity by approximately 60,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$127.3	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
21	JD	Reservoir Expansion			**G3 - Gated Spillway (75,000 acre-feet) (Selected Alt 6)**	Gated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacaity by approximately 75,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$157.0	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
22	JD	Reservoir Operation			Pueblo Reservoir Operations Modifications.	Increase top of conservation pool into flood pool. Risks for many parties that are not understood. Requires future studies and an integrated model for weather forecasting to dump storage.	**Mott MacDonald**	Not Assessed	Not Assessed		Beyond the scope of this study.
-											

Notes: **1. Total Installed Cost (TIC) includes all project related District costs, permitting costs, design costs, land acquisition, construction costs, construction management costs, engineering services during construction, and start-up and commissioning.**

MOTT MACDONALD

Basis of Cost and Production Estimates

Project:	Fry-Ark Storage Recovery Study		
Our reference:	TM-02_507102411-Task 8	**Your reference:**	TM-02_507102411-Task 8
Prepared by:	John Dawson	**Date:**	8-3-2020
Approved by:	Warren J Paul	**Checked by:**	John Chesterton
Subject:	ATTACHMENT B - Basis of Cost and Production Estimates		

1 Introduction

The following basis of cost and production estimates is presented for informational purposes only. Cost data and production estimates were developed at the concept screening-level (Class 5) for comparison of the identified alternatives included within the Fryingpan-Arkansas Storage Recovery Engineering Assessment Report.

1.1 Uncertainty of Cost and Production Rates

Estimated costs are expected to be within -30% to +100% of the actual costs. Variables that introduce a degree of uncertainty into the estimate costs for the alternatives identified include, but are not limited to, the following:

- Uncertainty related to volume estimate. This arises due to the inherent need to project conditions within the study limits based upon a limited amount of data and information. Unidentified conditions could impact the volume of material to be removed. Actual volume may either increase or decrease.
- Uncertainty of in-situ sediment gradation. Full-scale sediment investigations conducted within Pueblo Reservoir are required to characterize in-situ sediments to be dredged. Sediment gradation and characterization are critical input parameters for hydraulic and mechanical dredging production estimates.
- Uncertainty of in-situ sediment contamination. The presence of chemical contamination within in-situ sediments would greatly increase the unit cost associated with sediment removal and sediment management. Cost increases would be accredited to the treatment of materials, environmental controls and protections, and restrictions on location and use of dredged material disposal sites.
- Uncertainty regarding project duration and schedule. A number of things could impact the project duration including general weather conditions, natural and man-made disasters, labor disputes, fish windows or other conditions.
- Uncertainty in the dredging productivity estimates based on site conditions. Dredging productivity estimates were developed based upon assumed site specific conditions, previously collected information from vendors, similar projects, and internal databases. If unforeseen conditions are encountered during dredging, productivity could change.
- Uncertainty in hydraulic and hydrologic processes. An assessment of the hydraulic and hydrologic processes that may affect the developed alternatives, beyond a cursory review of previously

developed documentation, is not included in the scope of this assessment. Future studies should include a detailed hydraulic and hydrologic engineering analysis to assess the selected alternatives which includes, but may not be limited to, empirical calculations, numerical modeling, and physical modeling.

1.2 Capital Costs

General Assumptions

- All costs provided are in $USD.
- Construction services are performed under a single and/or multi-year prime contract for all alternatives.
- The presence of and cost implications of potential chemical contaminants within the in-situ sediment to be removed as part of Alternatives 2 and 3 is not considered since this is outside the scope of this study. The in-situ material within the reservoir is assumed to be adequate for in-water and/or upland disposal.
- The annual in-water work window is assumed to be from November 1 through March 31 (150 calendar days).
- Material excavated in the dry is hauled to CDF or stockpile within 1 mile of the excavation location
- Mechanical dredge – cable crane and bucket will be utilized in locations where depths exceed approximately 65 feet.
- Mechanical dredge production rates are calculated assuming no reduction in production due to barge constraints
- Hydraulic dredge assumes working 24/7 straight for the season (except for 2 weeks) and has no production limitations due to CDF location.

Professional/Technical Services Costs:

- Ten percent for Program and Construction Management Costs
- Forty-five percent contingency (20% scope, 25% bid) added to all capital and O&M costs (USEPA, 2000).

Pre-Construction Activities

Design:

- Includes design analysis, design plans, technical specifications, and engineer's cost estimates.
- Ten percent of capital costs. [USEPA, 2000].

Regulatory Requirements, Legal, Community Outreach

- Includes permitting and establishing compliance with substantive requirements
- See Environmental Assessment for estimated costs associated with environmental permitting and regulatory compliance.

Pre-Design Site Investigations and Studies:

- Covers pre-design site investigations and studies including, but not limited to, geotechnical sampling and reporting, chemical analysis, geological analysis, geotechnical analysis, baseline studies, sub-bottom geophysics surveys, hydraulics and hydrology reports, geomorphology studies, bathymetric and topographic surveys, video survey for debris identification, habitat survey, cultural resource survey, and CDF site investigation studies.
- Ten percent of capital construction cost [Internal Database]

Construction Activities

Mobilization/Demobilization (Year 1):

- 10% of 1st Year Construction Activities [Internal Database]

Restart Cost (in lieu of 1st year Mobilization/Demobilization, 2nd Year to End of Project Schedule)

- Twenty-five percent of Year 1 Mobilization/Demobilization Cost [Internal Database]

Monitoring During Dredging

- Hydrographic Survey
  - Day rate of $8200, Vessel, Crew, Equipment [Internal Database]
- Water Quality Monitoring
  - Day rate of $8200, Vessel, Crew, Equipment [Internal Database]
- Biological Monitoring
  - Day rate of $8200, Vessel, Crew, Equipment [Internal Database]

Pier Dock/Structure for mooring support vessels, dredgers, laydown yard, etc.

- $160/SF [Internal Database]

Dredging – Hydraulic Cutterhead

- Equipment Type: Portable, Large-Scale 18-24" (Discharge) Diameter, 3000-7000 HP, Approximate Depth range 7 to 65 feet [Previous Vendor Outreach]
- Production: Maximum Dredging Production for 1-Large-Scale Dredge [assuming 65% effective working time] – 20,000 CY/Day, 7 days per week, 2 weeks of shut down for maintenance and repairs during work window (Nov 1st to March 31st), 136 total working days. [Previous Vendor Outreach, Internal Database].
- Assumed total production per work window: approximately 2.7M cubic yards.
- Cost for dredging and hydraulic placement of dredged material in upland CDF = $8 per cubic yard [Internal Database, Anchor QEA, 2020]
- Cost for direct discharge to Arkansas River and/or Bessemer Ditch (Downstream) = $4 per cubic yard. [Internal Database, Anchor QEA, 2020]

Dredging – Mechanical Clamshell (Cable Rig)

- Equipment Type: American 9310 or similar Crawler Crane with 6 cubic-yard bucket [Internal Database, Previous Vendor Outreach]
- Production: Maximum dredging production of one plant [assuming 65% effective working time] – 800 CY/Day (8-hour day), 5 days per week, 110 total working days.
- Assumed total production per work window: 90,000 cubic yards.
- Cost for Dredging ONLY = $15 per cubic yard [Internal Database, Previous Vendor Outreach, Anchor QEA, 2020].
- Cost for direct discharge to Arkansas River and/or Bessemer Ditch (Downstream) = $10 per cubic yard. [Internal Database, Previous Vendor Outreach, Anchor QEA, 2020]

Excavation – Hydraulic Excavator

- Equipment Type: Caterpillar 375 Excavator [Internal Database, Previous Vendor Outreach]

- Production: Maximum excavation production of one plant [assuming 65% effective working time] – 2,400 CY/Day (8-hour day), 5 days per week, 110 total working days. [Internal Database, Previous Vendor Outreach]
- Assumed total production per work window: 264,000 cubic yards.
- Cost for Excavation ONLY = $10 per cubic yard [Internal Database, Previous Vendor Outreach, Anchor QEA, 2020].
- Transport and Offloading = $15 per cubic yard [Internal Database, Previous Vendor Outreach, Anchor QEA, 2020].

Dredged Material Management

Preconstruction Activities

Design:

- Includes design analysis, design plans, technical specifications and engineer's cost estimates.
- Ten percent of capital costs. [USEPA, 2000].

Land Acquisition

- Acreage required to place 1M cubic yards 10 feet high equals 50-70 acres. CDF acreage required dredging season = 100 to 140 acres.
- Acreage Lease for Federal or State Land unknown. To be determined during future study works.
- Cost per Acre for CDFs (non-Federal or State Land) = $2,000 /acre [Internal Data Base]

Construction Activities

Mobilization/Demobilization (Year 1):

- 10% of 1st Year Construction Activities [Internal Database]

Stormwater Management at CDF

- LS cost of $100,000 [Internal Database]

Earthwork at CDF (Excavation and Fill)

- $50 per cubic yard [Internal Database]

Piping at CDF

- $30 per linear foot [Internal Database]

Loadout Facility

- Lump sum of 100,000 per CDF [Internal Database]

Site Decommission/Restoration

- $5,000 Acre [Internal Database]

1.3 Annual O&M Costs

Professional/Technical Services Costs:

- Ten percent for Program and Technical Support Costs
- Forty-five percent contingency (25% scope plus 20% bid) added to all capital and O&M costs (USEPA, 2000).

Annual Monitoring Activities (Outside of in-water construction window)

- Community Outreach – LS $100,000 [Internal Database]
- Bathymetric Survey - Day rate of $8200, Vessel, Crew Equipment [Internal Database]
- Sediment Sampling and Analysis – LS $150,000 [Internal Database]
- Biological Monitoring – LS $250,000 [Internal Database]
- Annual Monitoring Reports - $100,000 each [Internal Database]

Annual Maintenance Activities

Replacement HDPE Pipeline - $30 per linear foot, 15,000 feet replaced every 5 years [Internal Database]

mottmac.com

Attachment 6

The Fryingpan-Arkansas Storage Recovery Alternatives Register (SRAR)

ATTACHMENT A

STORAGE RECOVERY ALTERNATIVES REGISTER (SRAR)

SECWCD - FRYINGPAN-ARKANSAS STORAGE RECOVERY STUDY

	Submittal 1	Submittal 2	Submittal 3	Submittal 4
Draft/Version:	2.0	0.0	1.0	2.0
Revision Date:	3-Aug-20	8-May-20	19-Jun-20	3-Aug-20

MOTT MACDONALD

Alternative/Methodology No.	Mott MacDonald Team Owner	Category (Storage Recovery/Reservoir Expansion)	District Acceptance		Alternative/Methodology Title	Description	Raised by	Estimated Total Installed Cost (TIC)[1] (Million $USD)	Estimated Schedule (Years)	Risks	Notes
			Draft Submitted Date	District Approval Date							
1	JD	No Action			**No Action Alternative**	No Action Alternative.	**Mott MacDonald**	0	N/A	N/A	N/A
2	JD	Storage Recovery			**Dredging to Recover Full Capacity Loss within Activie Conservation and Inactive Storage Allocation Pools (Selected Alt 2)**	Storage recovery alternaive Includes complete storage recovery via the removal of in-situ sediments within the Active Conservation and Inactive storage allocations within Pueblo Reservoir (approximately 17,800 acre-feet as of 2012). This option includes the removal of approximately 28.5M cubic yards of in-situ sediment. Removal of sediments within the reservoir would require the use of both hydraulic and mechanical dredging/excavating equipment. It is assumed that approximately 2/3 of the dredged material would be placed at upland CDF(s) and 1/3 discharged downstream of Pueblo Reservoir within the Arkansas River and/or Bessemer Ditch.	**Mott MacDonald**	$840.6	Design and Permitting: 3 to 5 years. Construction: 15 years	Availablity of CDFs, Pueblo Reservoir and downstream social and environmental impacts, contractor market, and sediment contamination.	Requires market research, additional data and studies for alternative to be assessed.
3	JD	Storage Recovery			**Dredging to Recover Partial Capacity Loss with Turbid Density Current Venting (Selected Alt 3)**	Storage recovery alternative includes partial storage recovery via the removal of in-situ sediments within the Active Conservation and Inactive storage allocations within Pueblo Reservoir. This alternative includes the removal of approximately 4.5M cubic yards. Removal of sediments within the reservoir would require the use of both hydraulic and mechanical dredging/excavating equipment. It is assumed that approximately 2/3 of the dredged material would be placed at upland CDF(s) and 1/3 discharged downstreamof Pueblo Reservoir within the Arkansas River and/or Bessemer Ditch.	**Mott MacDonald**	$108.4	Design and Permitting: 3 to 5 years. Construction: 15 years	Availablity of CDFs, Pueblo Reservoir and downstream social and environmental impacts, contractor market, and sediment contamination.	Requires market research, additional data and studies for alternative to be assessed.
4	JD	Storage Recovery			Flushing	Flushing includes a partial or complete drawdown of Pueblo Reservoir for the purposes of mobilizing/scouring in-situ sediments via increased current velocities and passing the mobilized sediment slurry through the outlets within Pueblo Dam to the Arkansas River below the dam.	**Mott MacDonald**	Not Assessed	Not Assessed	Operations, downstream social and environmental impacts.	Requires market research, additional data and studies for alternative to be assessed.
5	JD	Storage Recovery			Sluicing	Sluicing usually includes a short duration, coordinated drawdown of reservoirs during large flood events and/or seasonal high flow (freshet) periods with the objective of passing sediment-laden water through a reservoir to reduce sediment deposition.	**Mott MacDonald**	Not Assessed	-	Operations, downstream social and environmental impacts.	Requires market research, additional data and studies for alternative to be assessed.
6	JD	Storage Recovery (Material Management)			Direct Slurry Discharge Downstream of Pueblo Dam	The direct discharge of dredged materials downstream of Pueblo Dam includes the dredging and fluidization of in-situ dredged materials into a slurry (water with % solids) and transport downstream via hydraulic pipeline (HDPE or similar). The use of booster pumps and/or secondary pumps may be required for longer distances.	**Mott MacDonald**	Cost of direct slurry discharge is included with Alternatives 2 and 3.	See Alternative 2 and 3 above.	Reservoir operations, Reservoir and downstream social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
7	JD	Storage Recovery (Material Management)			Confined Disposal Facility (CDF) Placement	Placement of dredged materials within Confined Disposal Facilities (CDFs) includes either the hydraulic transport of dredged materials via hydraulic slurry pipeline (HDPE or similar) to the CDF and/or placement of excavated materails within the CDF via rehandling and transport (ex. truck, conveyor, material ropeway, etc.).	**Mott MacDonald**	Cost of placement within CDFs is included with Alternatives 2 and 3.	See Alternative 2 and 3 above.	Availablity of CDFs, Pueblo Reservoir and downstream social and environmental impacts, and sediment contamination.	Requires additional data and studies for alternative to be assessed in any more detail.
8	JD	Storage Recovery (Material Management)			Beneficial Resuse of Dredged Material	Beneficial reuse of dredged materials from Pueblo Reservoir refers to the transformation of dredged sediment material into a cost-essfective and useful product that can serve a positive environmental or human function (agricultural, resource of aggregates and other materials, landfill cover, and general fill). The beneficial use of dredged material has multiple inherent challenges (See risks).	**Mott MacDonald**	Not Assessed	Not Assessed	Transportaiton and handling costs to move the material, processing costs, competition against low cost alternatives, and the presence of contaiminants and need for treatment.	Requires market research, additional data and studies for alternative to be assessed.
9	JD	Storage Recovery (Material Management)			Material Ropeway or Conveyor	Transport of dredged materials via material ropeway or conveyor transport includes the rehandling of dredged materials onto a system to transport materails over a distance in lieu of using trucks or hydraulaulic transport. Material ropeways offer an advantage in rugged terrain due to limited impacts associated with construction and a potential reduction in transport costs in comparision to trucking.	**Mott MacDonald**	Not Assessed	Not Assessed	Additional infrastructure cost, CDF availability, transport distance, cocial and environmental impacts.	Requires additional data and studies for alternative to be assessed.
10	JD	Storage Recovery (Material Management)			Trucking	Trucking dredged or excavated materials includes transporting dredged material via dump truck via existing road infrastructure.	**Mott MacDonald**	Incorporated within Alternatives 2 and 3.	See Alternative 2 and 3 above.	Social and environmental impacts (emissions, traffic, etc.)	Requires additional data and studies for alternative to be assessed in any more detail.
11	JD	Storage Recovery (Material Management)			Rail	The transport of dredged material via rail includes using the Class 1 railway network located on the north side of Pueblo Reservoir to transport dredged materials to an offsite rehandling facilitiy via unit train. Additional rail infrastructure and rehandling areas would need to be considered for this transport option.	**Mott MacDonald**	Not Assessed	Not Assessed	Additional infrastructure cost, CDF availability, transport distance, cocial and environmental impacts.	Requires additional data and studies for alternative to be assessed.
12	JD	Reservoir Sustainability			Turbid Density Current Venting	Turbid Density Currents within reservoirs exist when sediment laden water enters a reservoir during flood events and/or seasonal high flow (freshet) periods. The sediment laden water is denser than the clear water within the reservoir which results in the turbid density currents submerging to the reservoir bottom after flowing over the reservoir delta and riding the natural gradient for an unknown length of the reservoir, sometimes reaching as far as the dam face. If a low-level outlet is not available, the turbid density currents settle out and consolidate into a muddy lake bottom. Venting of turbid density currents includes the discharge of the dense sediment laden water through a low-level outlet in the dam. Similarly, siphoning (hydrosuction dredging) turbid density currents includes siphoning the dense sediment laden water through an outlet in the dam and/or the main spillway (Annandale, 2016).	**Mott MacDonald**	Not assessed.	Not assessed.	Implementation, social and environmental impacts.	Requires additional data and studies for alternative to be assessed. In any more detail.
13	JD	Reservoir Sustainability			Sediment Bypass Structures and Off-Project Storage	Sediment bypass structures include constructed tunnels and/or channels built for the purposes of redirecting upriver flows during flood events and/or seasonal high flow (freshet) periods. Both suspended and bed load may be conveyed via tunnel and/or channel to a discharge point below the dam or to a sacrificial off stream reservoir constructed for the purpose of sediment capture.	**Mott MacDonald**	Not assessed.	Not assessed.	Implmentation, capital cost, O&M, social and environmental impacts.	Requires additional data and studies for alternative to be assessed.
14	JD	Reservoir Sustainability			Upriver Sediment Traps/Check Dams	Check dams (silt traps, debris basins, etc.) are generalized for the purposes of this study as upriver structures constructed for the purposes of capturing main channel and/or tributary flows. Check Dams provide a means of capturing significant amounts of suspended and bed load materials prior to reaching main river channels/reservoirs. Continuous maintenance is inherent to the construction of check dams for successful long-term sediment management, but they can be strategically located to provide an efficient means of access to deposited sediments prior to settling out within reservoirs.	**Mott MacDonald**	Not assessed.	Not assessed.	Implmentation, capital cost, O&M, social and environmental impacts.	Requires additional data and studies for alternative to be assessed.
15	JD	Reservoir Sustainability			Arkansas River and Tributary Channel Protection	Upriver channel stabilization includes stabilizing the banks of the Arkansas River and tributary channels above Pueblo reservoir for the purposes of reducing sediment yield through the mitigating the impacts associated with channel erosion. Stabilization alternatives include the installation of riprap, concrete mats, vegetation, and other alternatives.	**Mott MacDonald**	Not assessed.	Not assessed.	Implmentation, capital cost, O&M, social and environmental impacts.	Requires additional data and studies for alternative to be assessed.
16	JD	Reservoir Expansion			**U1 - Ungated Spillway (25,000 acre-feet) (Selected Alt 4)**	Ungated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacity by approximately 25,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$85.1	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
17	JD	Reservoir Expansion			**U2 - Ungated Spillway (60,000 acre-feet) (Selected Alt 5)**	Ungated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacity by approximately 60,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$127.3	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
18	JD	Reservoir Expansion			U3 - Ungated Spillway (75,000 acre-feet)	Ungated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacity by approximately 75,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam.	**GEI Consultants, Inc.**	$149.4	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
19	JD	Reservoir Expansion			G1 - Gated Spillway (25,000 acre-feet)	Gated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacaity by approximately 25,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$76.4	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
20	JD	Reservoir Expansion			G2 - Gated Spillway (60,000 acre-feet)	Gated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacaity by approximately 60,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$127.3	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
21	JD	Reservoir Expansion			**G3 - Gated Spillway (75,000 acre-feet) (Selected Alt 6)**	Gated spillway option for raising the elevation of Pueblo Dam to increase the current storage capacaity by approximately 75,000 acre-feet. Construction includes: spillway crest, spillway foundation, drainage, stability berm extension, tendonds, and parapet wall modifications along the embankment and concrete buttress portions of the dam (GEI Consultants, Inc, 1998).	**GEI Consultants, Inc.**	$157.0	Design and Permitting: 10-15 years Construction: Not assessed.	Dam safety, existing infrastructure impacts, social and environmental impacts.	Requires additional data and studies for alternative to be assessed in any more detail.
22	JD	Reservoir Operation			Pueblo Reservoir Operations Modifications.	Increase top of conservation pool into flood pool. Risks for many parties that are not understood. Requires future studies and an integrated model for weather forecasting to dump storage.	**Mott MacDonald**	Not Assessed	Not Assessed		Beyond the scope of this study.
-											

Notes: **1. Total Installed Cost (TIC) includes all project related District costs, permitting costs, design costs, land acquisition, construction costs, construction management costs, engineering services during construction, and start-up and commissioning.**

Mott MacDonald
143 Union Blvd
Suite 1000
Lakewood
CO 80228
United States of America

T +1 (303) 831 4700
mottmac.com

SECWCD

Fry-Ark Storage Recovery Study

Draft Environmental Assessment

August 2020