FEASIBILITY STUDY
FOR THE
REHABILITATION OF
ADOBE CREEK DAM

Prepared for

The Fort Lyon Canal Company

and

The Colorado Water Conservation Board

August 1, 2017

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FEASIBILITY STUDY APPROVAL
Pursuant to Colorado Revised Statutes 37-60-121 &122, and in accordance with policies adopted by the Board, the CWCB staff has determined this Feasibility Study meets all applicable requirements for approval.

Signed 9/8/17 Date

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Water Project Loan Program

Application Type

☐ Prequalification *(Attach 3 years of financial statements)* ☑ Loan Approval *(Attach Loan Feasibility Study)*

Agency/Company Information

Company / Borrower Name: Fort Lyon Canal Company

Authorized Agent &Title: Jerred Hoffman – Superintendent

Address: 750 Bent Ave. Las Animas, CO 81054

Phone: (719)456-0720 | Email: info@flcc.net

Organization Type: ☑ Ditch Co, ☐ District, ☐ Municipality ☐ other: _____ | Incorporated? ☑ YES ☐ NO

County: Bent | Number of Shares/Taps: 93,989.41 shares

Water District: 17 | Avg. Water Diverted/Yr 221,000 acre-feet

Number of Shareholders/Customers Served: ~275 | Current Assessment per Share $ 29.00 (Ditch Co)

Federal ID Number: 84-0579583 | Average monthly water bill $ _____ (Municipality)

Contact Information

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Project Information

Project Name: Adobe Creek Dam Rehabilitation

Brief Description of Project: (Attach separate sheets if needed)

The project involves replacement of the existing 112-year-old outlet works conduit and constructing seepage control systems in the existing dam. The project is required because of concerns with the condition of the outlet works and uncontrolled seepage from the dam that has resulted in a reservoir restriction from the Colorado Dam Safety Branch.

The costs opinions below are ballpark costs that assumes that the FLCC pursues increasing storage capacity as part of the Project. Total grants of $1,100,00 are also assumed.

General Location: (Attach Map of Area)

Construction cost includes contingency & construction engineering. Other costs including permitting, legal & administrative costs.

Estimated Engineering Costs: $1,693,000	Estimated Construction Costs: $6,400,000
Other Costs (Describe Above): $1,107,000	Estimated Total Project Costs: $9,200,000
Requested Loan Amount: $8,100,000	Requested Loan Term (10, 20, or 30 years): 40 Years

Project Start Date(s) Design: August 2017 Construction: September 2018

Signature

Phil Hopkins 09-7-2017
Signature / Title President Date

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EXECUTIVE SUMMARY

This feasibility report was prepared by W. W. Wheeler and Associates, Inc. (Wheeler) for the Fort Lyon Canal Company (FLCC) and the Colorado Water Conservation Board (CWCB). This report documents the feasibility and financing of rehabilitation of the FLCC's Adobe Creek Dam. Adobe Creek Dam is a 32-foot-high, high hazard embankment dam that impounds approximately 77,400 acre-feet of active storage and 4,292 acre feet of dead storage. The water stored in Adobe Creek Reservoir (also known as Blue Lake) is used to irrigate approximately 93,000 acres of land in Bent, Otero, and Prowers County. Adobe Creek Dam is located approximately 12 miles northwest of the City of Las Animas, in Bent County Colorado.

The FLCC has an immediate need for the rehabilitation of Adobe Creek Dam, which is a vital component of their water supply system. A storage restriction Order was issued by the Colorado Division of Water Resources on May 5, 2017 due to adverse seepage conditions in the dam's foundation and deteriorated conditions in the 112-year-old, vitrified clay outlet works. The first phase of the project include would be constructed starting in September 2018 and includes the design and construction of a new outlet works and seepage control systems in Adobe Creek Dam to regain the approximately 32,560 acre-feet of storage that was lost due to the storage restriction Order. A second phase of the project could be implemented currently or a few years after the first phase and this phase would involve raising the normal high water line in the reservoir by two to five feet, which could increase storage by approximately 11,150 to 18,700 acre-feet.

An island in the reservoir provides wildlife and waterfowl habitat for many species. The reservoir also provides significant recreation opportunities for the Adobe Creek State Wildlife Area, administered by Colorado Parks and Wildlife and the reservoir is an important component of the Arkansas River Winter Water Storage Program. If the FLCC raises the dam as part of the second phase of the project, there is the potential to restore the full decreed capacity of the reservoir and provide additional storage for other Arkansas Basin water users. Enlarging the reservoir could provide up to approximately 28,700 acre-feet of additional water in the Arkansas Basin for less than $400 per acre-foot.

Table ES1 – Summary of Phase 1 and 2 Project Financing

	Phase 1 Rehabilitation	**Phase 2 Enlargement**	**Total Project**
Design	$650,000	$75,000	$725,000
Construction	$8,550,000	10,325,000	$18,875,000
Total	**$9,200,000**	**$10,325,000**	**$19,960,000**
WSRA Grants	$1,100,000	$0	$1,100,000
Colorado Water Plan Grant	$0	$1,500,000	$1,500,000
CWCB Loan	$8,550,000	$10,325,000	$19,600,000

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PROJECT TEAM

Directors of the Fort Lyon Canal Company

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Rex Davis, Vice President

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ACKNOWLEDGEMENTS

Acknowledgments of those who assisted in the preparation of the report:

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Anna Mauss, P.E. and Jack Goble P.E.
Colorado Water Conservation Board

Jerred Hoffman and Amy Van Horn
The Fort Lyon Canal Company

1.0 INTRODUCTION AND BACKGROUND

1.1 PURPOSE

The Fort Lyon Canal Company (FLCC) has an urgent and immediate need to rehabilitate Adobe Creek Dam. Adobe Creek Dam was originally constructed in 1910 and raised 5 feet in 1970. Adobe Creek Dam is a 32-foot-high, high hazard embankment dam that impounds approximately 77,400 acre-feet of active storage and 4,292 acre-feet of dead storage. The dam is located approximately 12 miles north and 2 miles west of the City of Las Animas, Colorado as shown on Figure No. 1. The dam impounds Adobe Creek Reservoir, also known as Blue Lake, the largest storage component of the FLCC system. The water stored behind the dam is vital to supplementing irrigation supply in later summer when Arkansas River flows diminish.

Temporary repairs were made to the dam in March of 2016 after piping conditions were observed along the outlet works conduit during a routine dam inspection (Wheeler, 2016). Dam safety evaluations of Adobe Creek Dam, completed in January of 2017, concluded that there are higher than acceptable seepage exit gradients in a continuous sand layer identified in the foundation of the dam. In addition, it was determined that the 112-year-old, vitrified clay outlet works in the dam is severely deteriorated and has exceeded its design life (Wheeler, 2017). In a letter dated May 5, 2017, the Colorado State Engineer ordered the reservoir restricted to 7 feet below the spillway crest “due to the adverse seepage conditions through the dam’s foundation and along the outlet conduits and the deteriorated condition of the dam’s outlet works.” This equates to a loss of almost 33,000 acre-feet of reservoir storage volume.

Maintaining water storage in Adobe Creek Reservoir (Blue Lake) is important to the State of Colorado because it is truly a multi-purpose storage reservoir. The reservoir provides over 77,400 acre-feet of critical drought protection for agriculture in southeast Colorado, which is important to nearly 1,000 people in Bent, Otero, and Prowers Counties. A failure of the Adobe Creek Dam would affect the entire State of Colorado due to potential crop loss within the FLCC service area.

Water storage in the reservoir also has an important non-consumptive use that enhances 5,174 acres of wildlife and waterfowl habitat in the Adobe Creek Reservoir State Wildlife

Area, which is one of the most popular recreation areas in southeast Colorado. When there is water in the reservoir it provides excellent opportunities for hunting, fishing, camping, hiking, and boating within this State Wildlife Area. The reservoir also has the potential to provide habitat for the Interior Least Tern, which is a federally listed endangered species and the federally threatened Piping Plover.

This project is consistent with the Arkansas Basin Implementation Plan as follows:

- From the Arkansas Basin Implementation Plan's (ArkBIP) Master Needs List: Replace aging infrastructure.

- From the ArkBIP Master Needs List: Maintenance of dams in the state are in need of repair.

- ArkBIP Policy Statement: "The preservation of irrigated agriculture in the Arkansas Basin shall be given a high priority in the state water plan. It is too important to tourism, the preservation of food production, recreation, the environment and the health and well-being of our citizens as well as the economy of the State of Colorado."

- The reservoir storage restrictions already in place or the potential for dam failure could significantly affect the agricultural economy of the Arkansas River Basin and the State of Colorado making this project critical and time-sensitive. The loss of water storage could also potentially affect wildlife and waterfowl habitat and recreation use in the Adobe Creek State Wildlife Area and surrounding wildlife areas.

The potential for enlarging the reservoir in conjunction with the outlet works replacement and seepage control measures Would preserve the FLCC decreed storage capacity and potentially provide additional storage for other water users in the Arkansas River Basin. Enlargement through raising of the existing dam embankment follows the Colorado Water Plan initiative to increase storage at existing reservoirs.

1.2 STUDY AREA DESCRIPTION

As shown on Figure No. 1, the Fort Lyon Storage Canal, which is independent of the main canal, is diverted from the Arkansas River in Section 20, of Township 22 South, Range 57 West of the 6th P.M. approximately 3.1 miles northeast of the Town of Manzanola. Water flows in a northeasterly direction for about 47 miles through the Fort Lyon Storage Canal to Horse Creek Reservoir (also known as Timber Lake) and Adobe Creek Reservoir. The Adobe Creek Dam is located in Section 7, of Township 21 South, Range 52 West of the 6th P.M. and approximately 12 miles northwest of the City of Las Animas in Bent County.

The Fort Lyon Canal is the one of largest irrigation systems in the State of Colorado. The canal is 113 miles long from its diversion from the Arkansas River northwest of La Junta, to its termination in the Wheatridge lateral east of the City of Lamar. Water conveyed through the Fort Lyon Canal is also supplied to the Amity Mutual Irrigation Company through the Kicking Bird Canal to the Great Plains Reservoirs, which diverts water from the Fort Lyon Canal approximately 11.5 miles northeast of the City of Las Animas.

The Fort Lyon Canal System includes three off-channel water storage reservoirs: Horse Creek, Adobe Creek, and Thurston. The first two are supplied by the Storage Canal and contain the vast majority of the storage space. Winter storage of water in these two reservoirs provides supplemental supply to the Fort Lyon Canal direct flow diversions in periods of low flows in the Arkansas River. These are typically months when irrigation water is needed most.

Historically, the Fort Lyon Canal water was used for irrigation of alfalfa, pasture grass, corn, wheat, and sorghum in the vicinity of the canal in Otero, Bent and Prowers Counties. The water user's service area is located south of the canal and north of the Arkansas River. The general service area is shown on Figure No. 2. The acreage served by the Fort Lyon Canal water is approximately 93,000 acres. Based on historic cultivation trends within in the Fort Lyon Canal area (NASS, 2016) and current crop yields and prices in Colorado (NASS, 2016), the annual production value of all crops grown within the FLCC service area is estimated at approximately $36 million.

Based on U.S. Census Data, Otero, Bent, and Prowers Counties are among the least populated of Colorado Counties and the median household income is substantially below

average for the State. As shown in Table No. 1, the populations of these counties range from about 5,600 to 18,000 people. Median annual incomes range from approximately $34,000 to $37,000 and the percentage of the population that is considered to be in poverty ranges from about 19 to 25 percent. In addition, each of these counties has decreased in population since 2010.

TABLE 1
SUMMARY OF 2014 U.S. CENSUS DATA

	Otero County	Bent County	Prowers County
2014 Population	18,488	5,630	12,034
Population Change (April 2010 to July 2014)	-1.8%	-13.4%	-4.1%
Land Area (square miles)	1,262	1,513	1,638
Population Per Square Mile	14.9	4.3	7.7
Median Household Income	$33,848	$37,340	$34,391
Persons in Poverty	25.2%	19.1%	23.3%

1.3 PREVIOUS STUDIES

The FLCC has had a long history of performing maintenance to address issues associated with seepage in the dam and the deterioration of the outlet works. Toe drains were installed in the dam to address seepage in 1984, 1996, 2008, and 2011, but these temporary drainage repairs are not considered to be effective nor consistent with modern dam safety practice. The Colorado Dam Safety Branch has also been concerned with the deteriorating conditions of the 112-year old, vitrified clay, outlet works conduits in the dam for many years. The FLCC sealed more than 50 leaking joints in the conduits in 1984 and had to seal another 27 leaking joints in 2011.

Wheeler performed an inspection of the interior of the four outlet conduits of the Adobe Creek Dam on November 9, 2016. The Wheeler inspection of the outlet works determined that the conduits have exceeded their design life, are in poor condition, and most of the

previous joint repairs have failed. Wheeler contracted with Kumar and Associates, Inc. (Kumar), to perform subsurface investigations and seepage analysis of the dam near the outlet works. The investigations identified a consistent pervious sand layer in the foundation of the dam at the level of the outlet works. The resulting seepage analyses indicated seepage exit gradients from the dam near the outlet works are higher than State of Colorado allowances, which could lead to piping failure. As a result of this evaluation, Wheeler recommended replacement or lining of the outlet conduit and installation of a more effective seepage control system in the dam. The FLCC Board of Directors determined that complete replacement of the outlet conduit would be the most prudent decision. Wheeler's repair letter report and evaluation letter report are provided in Appendix F (Wheeler, 2017).

A follow-up inspection of the outlet works conduits by Wheeler and Colorado Dam Safety Engineers on March 31, 2017 also documented sandy material in the bottom of the left outlet conduit, likely caused by seepage inflow through cracks in the conduit. As a result of this inspection and Wheeler's 2017 evaluations, the State Engineer issued a storage restriction order on May 5, 2017. The Order restricted the level of water stored by the dam to 7 feet below the spillway crest, or normal high water line, resulting in a loss of approximately 32,560 acre feet of water storage.

2.0 PROJECT SPONSOR

2.1 CORPORATE STRUCTURE

The FLCC is a Colorado mutual ditch company and a non-profit Corporation organized under the laws of the State of Colorado. The FLCC was incorporated in 1897, as a success-in-interest to the La Junta and Lamar Canal Company. Construction of the canal began in the 1860's by a predecessor of the La Junta and Lamar Canal Company and the senior water rights were appropriated in the 1880s & 1890s. Refer to Appendix A which contains the Articles of Incorporation and By-laws of the FLCC.

2.2 BOARD OF DIRECTORS

There are five directors of the FLCC. All directors serve for three year terms, not to exceed nine successive years, and are elected at the annual stockholders meeting. The officers are elected by the Board of Directors. The FLCC's bookkeeping and administrative services are performed by in-house staff, and engineering and legal services are performed by independent consultants and the Company attorney on an as-needed basis. The FLCC has 15 employees who perform the routine administration, operation, and maintenance of the Fort Lyon Canal system.

The Board of Directors has certain duties and responsibilities, which include the power to incur indebtedness, to enforce the payment of all assessments, and to pay bills. The full power and duties of the board are enumerated in Articles II and III of the Bylaws of the FLCC, attached in Appendix A.

2.3 CURRENT SHAREHOLDERS

The FLCC has approximately 275 shareholders holding 93,989.41 shares of stock. There are approximately 93,000 acres irrigated by the FLCC stockholders. All of the shareholders use their water for agricultural purposes. A list of the current FLCC shareholders has been provided to the CWCB under separate cover.

2.4 HISTORY OF ORGANIZATION

The original work on what is now the Fort Lyon Canal was started in 1860, and the canal is now one of the largest irrigation systems in the State of Colorado (Dodson, 1997). The FLCC's senior water rights were appropriated in the 1880s & 1890s. The Fort Lyon Canal Company was created and incorporated in 1897 after legal reorganization gave control of the canal to local farmers using the water. Since then the FLCC has operated as a non-profit mutual ditch company, maintaining the canal and providing water to irrigate approximately 93,000 acres of land in the Arkansas River Basin. Historically, the Fort Lyon Canal has provided water used to irrigate alfalfa, pasture grass, corn, wheat, sorghum and other crops.

2.5 FINANCIAL STATUS

A summary of the FLCC's financial reports for fiscal years 2014, 2015, and 2016 is provided in Table No. 2. The complete financial reports are included in Appendix C. The FLCC has typically operated in a cash neutral mode over the years, balancing income with expenses. In any year, however, income may not necessarily match expenses. FLCC maintains an operating reserve to fund capital projects and meet unanticipated expense. Excess annual operating revenues are temporarily held in reserves until the next year when they are used to reduce anticipated expenditures, and thereby, reduce operating assessments required. In years where annual operating expenses exceed revenues, operating reserves are used until the next year's operating assessments are increased to fund the prior year's shortfall.

TABLE 2
SUMMARY OF FLCC FINANCIAL REPORTS

	2014	2015	2016[1]
Total Assets	$5,613,914	$5,889,866	$8,303,181
Liabilities	$423,661	$457,325	$2,042,163
Capital Stock	$469,947	$469,947	$469,947
Total Operating Revenue	$1,627,210	$2,328,059	$3,293,054
Total Operating Expenses	$1,537,124	$2,085,771	$2,464,577
Net Income	$90,086	$242,288	$828,477

[1]The increase in Total Assets and Liabilities in 2016 was due to the Horse Creek Flume

2.6 REVENUE SOURCES

The FLCC derives most of its revenue from shareholder assessments. Additional revenue comes from a carriage contract with the Amity Mutual Irrigation Company to transport water through the canal to the Great Plains Reservoirs. Other minor revenue sources include interest on savings accounts and other miscellaneous sources.

2.7 PHYSICAL ASSETS

The FLCC owns a diversion dam on the Arkansas River near the City of La Junta, Colorado for the113 miles of irrigation canal and appurtenant structures. In addition, the FLCC owns a diversion dam on the Arkansas River near the Town of Manzanola, Colorado for the 47 miles of conveyance canal to the off channel storage reservoirs. Additionally, the FLCC owns Horse Creek Dam, Adobe Creek Dam, and Thurston Dam.

3.0 WATER RIGHTS

3.1 WATER RIGHTS

The Fort Lyon Storage Canal, which conveys water from the Arkansas River to Horse Creek and Adobe Creek Reservoirs, has a decreed diversion rate of 2,306 cfs. Horse Creek Reservoir, also known as Timber Lake, has a total decreed capacity of 28,000 acre feet. Fort Lyon Canal Company has decreed water rights from Horse Creek via a feeder canal into the reservoir. Adobe Creek Reservoir, also known as Blue Lake, has a total decreed capacity of 87,000 acre feet. The decreed water rights are shown in Table 3 below.

TABLE 3
STORAGE WATER RIGHTS FOR ADOBE CREEK[1] AND HORSE CREEK[2] RESERVOIRS

Reservoir	Amount (ac-ft)	Adjudication Date	Appropriation Date	Priority No.	Source
Horse Creek	11,400	8-Nov-1928	15-Aug-1900	10	Horse Cr & Ark Riv
Adobe Creek	61,575	8-Nov-1928	25-Jan-1906	27.5	Horse Cr & Ark Riv
Horse Creek	15,487	8-Nov-1928	25-Jan-1906	27.5	Horse Cr & Ark Riv
Horse Creek	1,113	8-Nov-1928	12-Jun-1908	37	Horse Cr & Ark Riv
Adobe Creek	25,425	8-Nov-1928	29-Dec-1908	41	Horse Cr & Ark Riv

Canal	Rate (cfs)	Adjudication Date	Appropriation Date	Priority No.	Source
Horse Cr Feeder	2,000	8-Nov-1928	15-Aug-1900	10	Horse Creek
Storage Canal	840	8-Nov-1928	25-Jan-1906	27.5	Arkansas River
Adobe Cr Feeder	8,631	8-Nov-1928	25-Jan-1906	27.5	Adobe Creek
Horse Cr Feeder	5,000	8-Nov-1928	20-Dec-1907	30.5	Horse Creek
Storage Canal	1,466	8-Nov-1928	1-Mar-1910	50	Arkansas River

[1]Also known as Blue Lake
[2]Also known as Timber Lake

TABLE 4
DIRECT FLOW WATER RIGHTS FOR FORT LYON CANAL

Structure	Amount (cfs)	Use	Adjudication Date	Appropriation Date	Source
Fort Lyon Canal	164.64	Irrigation	8-Apr-1905	15-Apr-1884	Arkansas River
Fort Lyon Canal	597.16	Irrigation	8-Apr-1905	1-Mar-1887	Arkansas River
Fort Lyon Canal	171.20	Irrigation	8-Apr-1905	31-Aug-1893	Arkansas River
Thurston Pipeline[1]	25.00	Irrigation	20-Nov-1972	15-Jul-1969	Springs, seepage, waste water, rainfall
Thurston Reservoir[2]	1,515 ac-feet	Irrigation	8-Apr-1905	8/12/1889	Arkansas River

[1]Pumped from Thurston Reservoir to Fort Lyon Canal.
[2]Transferred from Prince Reservoir and subordinate to a priority date of May 1, 1931 (Case No. W-27).

3.2 WATER DIVERSIONS

The FLCC stored water release records from Adobe Creek Reservoir are provided in Table No. 4 for the years 1997 through 2016. Annual releases have ranged from zero to nearly 67,000 acre-feet in the past 20 years. On average, about 28,000 acre-feet of water is released from the reservoir to the Fort Lyon Canal to FLCC stockholders in Otero, Bent, and Prowers Counties.

TABLE 5
ADOBE CREEK DAM RELEASE RECORDS
MONTHLY RELEASES (in acre feet)

Water Year	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
1997	-	-	-	-	2,709	3,757	102	870	16,373	220	6,655	700	31,386
1998					1,264	5,117	5,747	2,828	9,706	8,072	7,402	2,778	45,396
1999	-	-	-	-	2,751	7,041	-	-	1,006	105	-	-	10,903
2000	-	-	-	-	-	-	-	6,021	10,619	7,489	6,806	1,857	32,792
2001	-	-	-	-	-	1,650	3,336	5,365	18,054	12,783	12,386	1,907	55,481
2002	-	-	-	-	-	7,869	9,576	4,360	1,895	-	-	-	23,700
2003	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-	-	-
2005	-	-	-	-	-	-	-	-	-	-	-	-	-
2006	-	-	-	-	-	12,313	7,157	880	1,017	1,435	1,115	549	24,466
2007	-	-	-	-	-	-	-	-	12,729	14,914	15,967	8,981	52,591
2008	-	-	-	-	-	12,369	17,315	685	4,236	7,090	3,505	1,321	46,978
2009	-	-	-	-	1,209	4,795	6,705	694	7,751	7,809	6,564	1,635	37,162
2010	-	-	-	-	-	-	-	770	15,257	9,246	9,810	1,375	36,458
2011	-	-	-	-	-	3,970	8,206	984	1,585	6,935	1,312	-	22,992
2012	-	-	-	-	-	3,729	10,494	8,260	553	445	-	-	23,481
2013	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	2,860	-	1,334	4,056	2,124	533	10,907
2015	-	-	-	-	-	-	-	2,240	9,335	5,521	13,008	7,456	37,560
2016	-	7,295[A]	2,327 [A]	1,640 [A]	7,977 [A]	2,354 [A]	1,460	1,949	11,764	16,350	7,313	6,173	66,602

[A]The winter diversions in 2016 are Winter Storage Water for the Amity Mutual Ditch Company diverted through the storage canal, regulated and released from Adobe Creek Reservoir, for delivery through the Fort Lyon Canal and Kicking Bird Canal to the Great Plains Reservoirs.

4.0 PROJECT DESCRIPTION AND ALTERNATIVES ANALYSIS

4.1 ALTERNATIVES EVALUATION APPROACH

Based on the 2017 evaluation by Wheeler and the May 5, 2017 storage restriction letter from the Colorado Division of Water Resources, the objective of this project is to replace the outlet works and seepage control systems in the Adobe Creek Dam. A potential second project phase involves increasing reservoir storage in the reservoir. The Fort Lyon Canal is currently operating under the restriction of its largest water storage facility and is planning on rehabilitation of the outlet works and seepage control gates as soon as possible. The Fort Lyon Canal Company has set a construction startup date after August of 2018. The construction should be substantially completed prior to spring runoff flow rates in May of 2019. As a result, key alternative evaluation criteria for this project are as follows:

- Total project cost of the alternative;
- Constructability within the 8 month winter drawdown period; and
- Cost per acre foot of increased storage.

Six alternatives were considered to meet the project objective. The alternatives are listed below.

1) Alternative No. A – Replacement of Outlet Works in Existing Alignment
2) Alternative No. A1 – Alternative A with 2 foot Embankment Raise
3) Alternative No. A2 – Alternative A with 5 foot Embankment Raise
4) Alternative No. B – Replacement of Outlet Works in New Alignment
5) Alternative No. B1 – Alternative B with 2 foot Embankment Raise
6) Alternative No. B2 – Alternative B with 5 foot Embankment Raise

Section 4.2 provides a short description of each alternative, followed by a brief description and comparison of the alternatives. Alternative Nos. A and B are shown on Figure Nos. 3 and 4. The additional scope of work for a 2 foot raise, Alternatives No. A1 and B1, are shown on Figure 5. Similarly, additional scope for a 5 foot raise, Alternatives No. A2 and B2, are shown on Figure 6. The details of the total project cost budget opinion for each alternative is documented in Appendix D.

The rehabilitation of the outlet works by slip-lining the existing outlet was considered as concept in the previous study completed in January 2017. The FLCC Board of Directors determined that it would be more cost effective to completely replace the outlet works. The use of a soil-bentonite cutoff wall for seepage control and a full reservoir height cofferdam during construction were also considered as a part of the 2016 evaluations. These concepts were considered to be cost prohibitive and not explored further as viable alternatives for this report.

4.2 ANALYSIS OF ALTERNATIVES

Alternative No. A – Replacement of Outlet Works in Existing Alignment

This alternative consists of removing the four existing 120-foot-long, 3-foot-diameter vitrified clay pipe outlet conduits and replacing them with a ten-foot-wide by six-foot-tall cast-in-place reinforced concrete outlet works conduit, the replacement of the existing system of toe drains with a sand filter chimney drain in the main dam section, and a shallow buried toe drain in the left and right wing dikes. This alternative also includes construction of a new cast–in-place reinforced concrete gate tower, and outlet works terminal basin. An access bridge is also included for access to the new intake tower at high water surface levels. The new gate tower includes a set of three 60-inch-square guard gates and a set of four control gates. The control gates would include two 60-inch-square and two 36-inch-square cast iron sluice gates. Riprap slope protection would be placed on the new upstream slope of the constructed embankment. Base course would also be installed on the dam crest in the replaced section. A profile of Alternative No. A is provided on Figure No. 3.

Wheeler's opinion of the total project budget required to implement Alternative No. A is approximately $9,200,000. This alternative could be completed in the eight month construction season. One of the expected advantages to this alternative is that it replaces the outlet works in-kind in the shortest section through the dam which reduces length of the outlet works and embankment earthwork quantities. A disadvantage to this alternative includes a larger cofferdam required for temporary reservoir control during construction.

Alternative No. A1 – Alternative A with 2 foot Reservoir Enlargement

This alternative consists of the same replacement of the outlet works and the seepage control systems as in Alternative No. A, but also includes a two foot vertical enlargement of the reservoir. The additional components of this alternative include two feet of additional embankment fill on the crest and placement of additional soil on the downstream slope of the dam, modifications to the spillways, and raising the island in the reservoir to maintain wildlife and waterfowl habitat. Spillway modifications include topsoil removal and excavation for the existing 1,100 feet of spillway as well as an additional 300 feet of new length on the left and right abutments, removal of the existing 355 feet of spillway concrete and replacement with a new reinforced concrete sill wall. Two 500-foot-long training berms, one for each spillway, have also been included to protect the embankment from erosion during a flood event. Riprap slope protection is planned for the protection of the added upstream slope of the main dam embankment. The construction of earthen to baffle wave action and protect the new upstream slope of the wing dikes. Base course would also be installed along the entire dam crest. A profile of Alternative No. A1 is provided on Figure No. 5.

Wheeler's opinion of the total project budget required to implement Alternative No. A1 is $15,200,000. This alternative could be completed in the eight month construction season concurrent with Alternative A or at a later date. An expected advantage to this alternative is that it combines straightforward rehabilitation of the outlet works and seepage control systems with an increase of about 11,150 acre feet of storage for a cost of about $541 per acre foot. Some disadvantages to this alternative include those stated in Alternative No. A as well as the necessity to update the flood hydrology and reconstruct the existing spillways. This alternative also requires providing flood easement to adjacent land owners and to raise the island to maintain wildlife and waterfowl habitat.

Alternative No. A2 – Alternative A with 5 foot Reservoir Enlargement

This alternative consists of the same components as in Alternative No. A1, but expands the reservoir enlargement to five vertical feet. A profile of Alternative No. A2 is provided on Figure No. 6.

Wheeler's opinion of the total project budget required to implement Alternative No. A2 is $19,600,000. This alternative could also be constructed currently with Alternative A in the eight-month construction season or at later date. An expected advantage to this alternative

is that it combines straightforward rehabilitation of the outlet works and seepage control systems with an increase of about 28,700 acre feet of storage, at a cost of $363 per acre foot. The disadvantages of this alternative are the same as A1.

Alternative No. B – Replacement of Outlet Works in New Alignment

This alternative consists of the same replacement components of the outlet works and the seepage control systems as in Alternative No. A, but with the new outlet works constructed in a new alignment. By constructing the new outlet in a different alignment, the existing outlet works can be utilized during construction until the new outlet works are complete. This alternative would minimize the size of the cofferdam during construction. A profile of Alternative No. B1 is provided on Figure No. 4.

Wheeler's opinion of the total project budget required to implement Alternative No. B is $12,300,000. This alternative could be completed in the eight-month construction season. An expected advantage to this alternative is that it significantly reduces the size of the cofferdam and increases the functionality of the reservoir during construction over Alternative A. The disadvantages of this alternative are the additional cost associated with the extra conduit length required, the additional excavation to remove the existing outlet and the new outlet in separate alignments, and the additional cost to excavate a hydraulic transition from the new outlet works to the existing outlet works approach channel.

Alternative No. B1 – Alternative B with 2 foot Reservoir Enlargement

This alternative consists of the same replacement of the outlet works and the seepage control systems as in Alternative No. B, but also includes a two foot vertical enlargement of the reservoir. The additional components of this alternative include two feet of additional embankment fill on the crest and placement of soil on the downstream slope of the dam, modifications to the spillways, and raising the island to maintain wildlife and waterfowl habitat. Spillway modifications include topsoil removal and excavation for the existing 1,100 feet of spillway as well as an additional 300 feet of new length on the left and right abutments, removal of the existing 355 feet of spillway concrete and replacement with a new reinforced concrete sill wall. Two 500-foot-long training berms, one for each spillway, have also been included to protect the embankment from erosion during a flood event. Riprap slope protection is planned for the protection of the added upstream slope of the main dam embankment. The construction of earthen berms planned to baffle wave action and protect

the new upstream slope of the wing dikes. Base course would also be installed along the entire dam crest. A profile of Alternative No. B1 is provided on Figure No. 5.

Wheeler's opinion of the total project budget required to implement Alternative No. B1 is $18,700,000. This alternative could be completed in the eight-month construction season. An expected advantage to this alternative is that it combines straightforward rehabilitation of the outlet works and seepage control systems with an increase of about 11,150 acre feet of storage, at a cost of about $542 per acre foot. Some disadvantages to this alternative include those stated in Alternative No. B as well as the necessity to update the flood hydrology and reconstruct the existing spillways. This alternative also requires providing flood easement to adjacent land owners, and to raise the island to maintain wildlife and waterfowl habitat.

Alternative No. B2 – Alternative B with 5 foot Reservoir Enlargement

This alternative consists of the same components as in Alternative No. B1, but expanded to a five foot vertical enlargement of the reservoir. A profile of Alternative No. B2 is provided on Figure No. 6.

Wheeler's opinion of the total project budget required to implement Alternative No. B2 is $23,100,000. This alternative could be completed in the eight-month construction season. An expected advantage to this alternative is that it combines straightforward rehabilitation of the outlet works and seepage control systems with an increase of about 28,700 acre feet of storage, at a cost of about $363 per acre foot. The disadvantages of this alternative are the same as B1.

4.3 ALTERNATIVE COMPARISON

A comparison of some of the key decision criteria associated with the primary alternatives developed for this feasibility study is provided in Table No. 5 below.

TABLE 6
ALTERNATIVE COMPARISON SUMMARY

Alternatives	Descriptions	Opinion of Probable Cost	Storage Volume Increase (acre feet)	Cost Per Acre foot of added storage
Alternative No. A	Rehabilitation	$9,171,000	0	0
Alternative No. A1	Alt A with 2 foot Raise	$15,204,000	11,150	$541
Alternative No. A2	Alt A with 5 foot Raise	$19,579,000	28,700	$363
Alternative No. B	Rehabilitation, new outlet alignment	$12,666,000	0	0
Alternative No. B1	Alt B with 2 foot Raise	$18,711,000	11,150	$542
Alternative No. B2	Alt B with 5 foo. Raise	$23,086,000	28,700	$363

4.4 SELECTED ALTERNATIVE

During a meeting of the FLCC Board of Directors on July 10, 2017, the FLCC Board of Directors selected Alternative No. A as the best approach for Phase 1 of the project to replace the outlet works and improve seepage control in the dam. This first phase must be completed by the spring of 2019 to regain the reservoir storage lost due to the current reservoir restriction Order.

A second phase of the project would involve raising the normal high water line in the reservoir by two to five feet. The second phase would occur if a Colorado Water Plan Grant for reservoir enlargement is approved by the CWCB and the FLCC provides a suitable partner to share in the cost of the reservoir enlargement work. The design for both phases of the work would occur in the last quarter of 2017 so that the design of both phases could be approved by the Colorado Dam Safety Branch. Construction of Phase 2 could occur concurrently with Phase 1 or within a few years of the Phase 1 construction pending completing of project financing, flood easement acquisition, and permitting.

4.5 IMPLEMENTATION SCHEDULE

The key project milestones are summarized in Table No. 6 below.

TABLE 7
PROJECT SCHEDULE

Task	Completion Date
Initiate Final Design	August 9, 2017
Complete Field Investigations	September 30, 2017
Final Design Submitted For Colorado Dam Safety Branch Approval	December 15, 2017
State Approval of the Design	May 15, 2018
Construction Contractor Selected	August 1, 2018
Begin Construction	September 3, 2018
Construction Complete	May 1, 2019

5.0 SOCIAL, ECONOMIC, AND PHYSICAL IMPACTS

The replacement of the Adobe Creek Dam outlet works and seepage control systems are not expected to have any significant adverse social, economic, or physical impacts. Without rehabilitation of the dam, long-term loss of the 32,580 acre feet of storage due to the Colorado Division of Water Resources storage restriction could have significant economic impacts to FLCC Stockholders in Bent, Otero, and Prowers Counties and to the economy of the Arkansas River Valley.

If the reservoir is enlarged two vertical feet, it would impact approximately 300 acres of land owned by adjacent property owners. If the reservoir is enlarged five vertical feet, it would impact approximately 500 acres of land owned by adjacent property owners. The impacts to adjacent property owners is shown on Figure No. 7. Reservoir enlargement would increase the reservoir shoreline which can benefit waterfowl, fisheries, and recreational opportunities in the Blue Lake State Wildlife Area. The FLCC would compensate adjacent landowners with flood easement for impacts to their grasslands. Reservoir enlargement would also include raising the island in the reservoir. Raising the island and increasing the shoreline would increase habitat for wildlife and waterfowl including the Least Interior Tern and the Piping Plover.

During construction, there may be some minor benefits to the local economy associated with the construction work from September of 2018 through March of 2019, but no significant impacts to local housing or infrastructure is anticipated during the anticipated eight month construction season. During rehabilitation the of the outlet works, the work will require a large excavation that would close County Road UU for a several month period.
Borrow sources for embankment fill would be required for both rehabilitation and reservoir enlargement. All construction disturbed areas would be reseeded and reclaimed.

6.0 INSTITUTIONAL FEASIBILITY

6.1 PERMITTING

The key permit required for most water resources projects is a 404 permit for impacts to wetlands or waters of the United States that is issued by the U.S. Army Corps of Engineers. Other potential project construction permits are listed below. No significant wetland impacts are anticipated with this project and a Nationwide Maintenance Permit is expected to complete the outlet works replacement and seepage repairs. If reservoir enlargement is pursued, an Individual 404 permit may be required, but an overall enhancement of the existing environment is expected with reservoir enlargement.

1. **Bent and Kiowa County Permits:** FLCC will be required to comply with all applicable County permitting requirements, including HB1041 permits, in Bent and Kiowa Counties.

2. **Fugitive Particulate Air Pollution Emission Notice/Control Plan Permit with the Colorado Department of Health and Environment:** The construction contractor will be required to obtain this permit, which is a routine permit required for most construction projects.

3. **Stormwater Discharges Associated with Construction Activity Permit with the Colorado Department of Health and Environment:** The construction contractor will be required to obtain this permit, which is a routine permit required for most construction projects.

The construction work required to replace the outlet works and seepage control systems for this project will occur on lands owned by the FLCC or within FLCC easements for operation and maintenance. As a result, no additional construction easements or land acquisition is needed to complete this construction work. Enlargement of the reservoir will require acquisition of flood easements for the land owners adjacent to the reservoir. The FLCC has the authority to raise assessments for special projects like this and has held a special Shareholders meeting in May of 2017, in which the Shareholders voted to allow the FLCC to take on debt financing to rehabilitate the Adobe Creek Dam.

7.0 FINANCIAL FEASIBILITY ANALYSIS

7.1 LOAN AMOUNT AND FINANCING SOURCES

As documented in Appendix D, opinion of total cost for the first phase of the preferred alternative, replacing the dam outlet works and seepage control systems is $9,200,000. The Arkansas Water Roundtable has approved a $100,000 Water Supply Reserve Account (WSRA) grant from the Arkansas Basin Account and an application for a WSRA $1,000,000 grant from the Statewide Account has been forwarded to the CWCB for approval during their September, 2017 meeting. The second phase of the project could cost up to $10,400,000 for the five-foot reservoir enlargement for a total cost of about $19,600. As shown in the financing projections in Appendix E, the loan amounts would range from about $8,000,000 to $17,000,000 depending on if enlargement is constructed or not. Assuming a 40-year interest rate of about 2.05 percent annual loan payments could range from about $300,650 per year for Phase 1 of the project and up to $632,400 per year if the five-foot enlargement is implemented. As shown in the tables in Appendix E, the annual loan payment could be paid by increasing the current cost per share by 1.5 percent per year or by making a special assessment for the project.

On July 10, 2017, the FLCC Board of Directors adopted a resolution concerning a secured loan with the CWCB. The complete Loan Resolution is included in the Appendix G.

7.2 FINANCIAL PROJECTIONS

A financial plan has been prepared to show the projected revenues and expenses of the FLCC and demonstrate the ability of the FLCC to fund this emergency repair project and to repay the loan sought from the CWCB. The financial plan is included in Appendix E.

7.3 COLLATERAL

The FLCC intends to pledge assessment revenues as collateral to assure repayment of the CWCB loan.

7.4 CREDITWORTHINESS

The FLCC is considered to be in a strong financial condition and has been pre-approved for a loan of up to $10,000,000 by the Colorado Water Conservation Board.

8.0 CONCLUSIONS AND RECOMMENDATION

Replacement of the 112-year-old Adobe Creek Dam outlet works and seepage control system is considered to be vital to the continued operation of the Fort Lyon Canal system. 32,580 acre feet of water storage space has already been lost due to restrictions. Without rehabilitation of the dam components, more than 93,000 acres of irrigated farm land in Otero, Bent, and Prowers Counties are at risk, which could be devastating to the local economy and the entire State of Colorado.

As documented in Section 7, a grant loan mix from the CWCB would help finance this project and the FLCC has the financial ability to repay the loan amounts for Phase 1 and Phase 2 of the project. The FLCC would only implement Phase 2 of the project with the aid of a Colorado Water Plan Grant and the assistance of another water user financial partner.

The final design for this project will be initiated in August of 2017 and it is planned for construction between September 2018 and May 2019.

9.0 REFERENCES

1 Colorado Water Conservation Board (CWCB, 2006) *Water Project Loan Guidelines*, January, 2006.

2 O. Ray Dodson (Dodson, 1997) *The Fort Lyon Canal, The First 100 Years, 1897 to 1997*, written by O. Ray Dodson, Ph.D., 1997.

3 National Agricultural Statistics Service (NASS, 2016) Irrigated Acreage and Crops Under the Fort Lyon Canal, 2016.

4 National Agricultural Statistics Service (NASS, 2017) Colorado 2016 State Agriculture Overview, 2017.

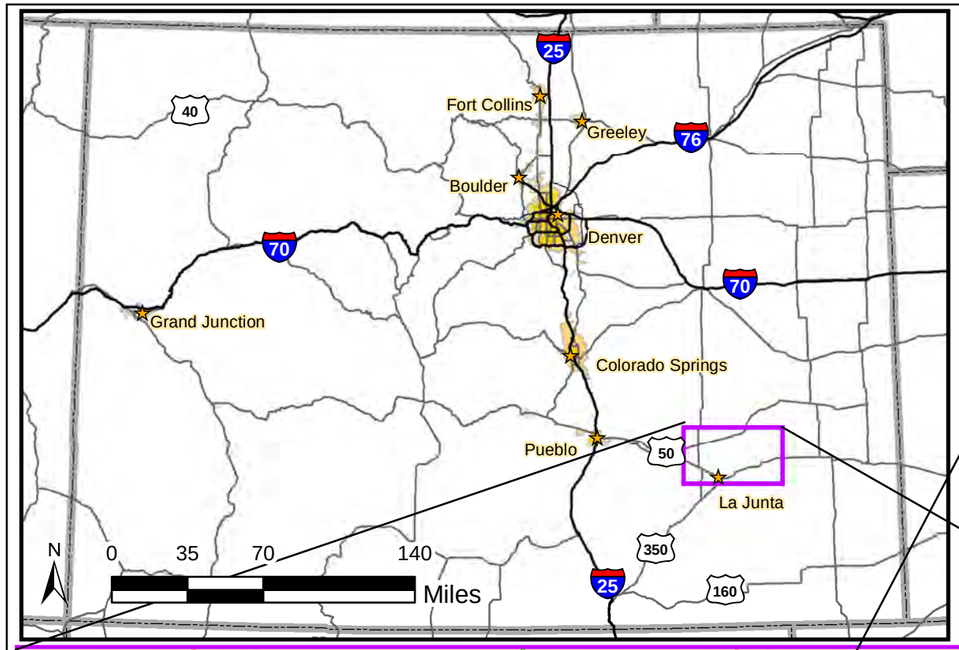
5 United States Census Bureau (U.S. Census, 2014) *2014 National Population Projections*, 2014.

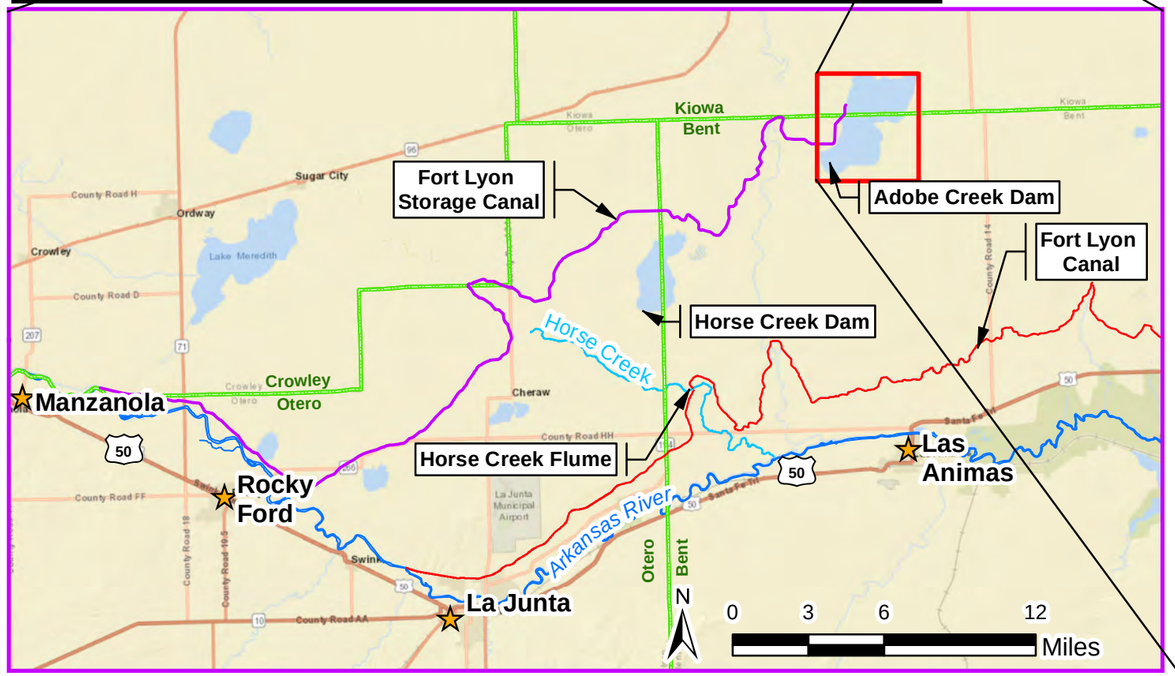
6 W. W. Wheeler & Associates, Inc. (Wheeler, 2016) *Adobe Creek Dam March 2016 Uncontrolled Seepage Repair Letter Report*, April, 7, 2016.

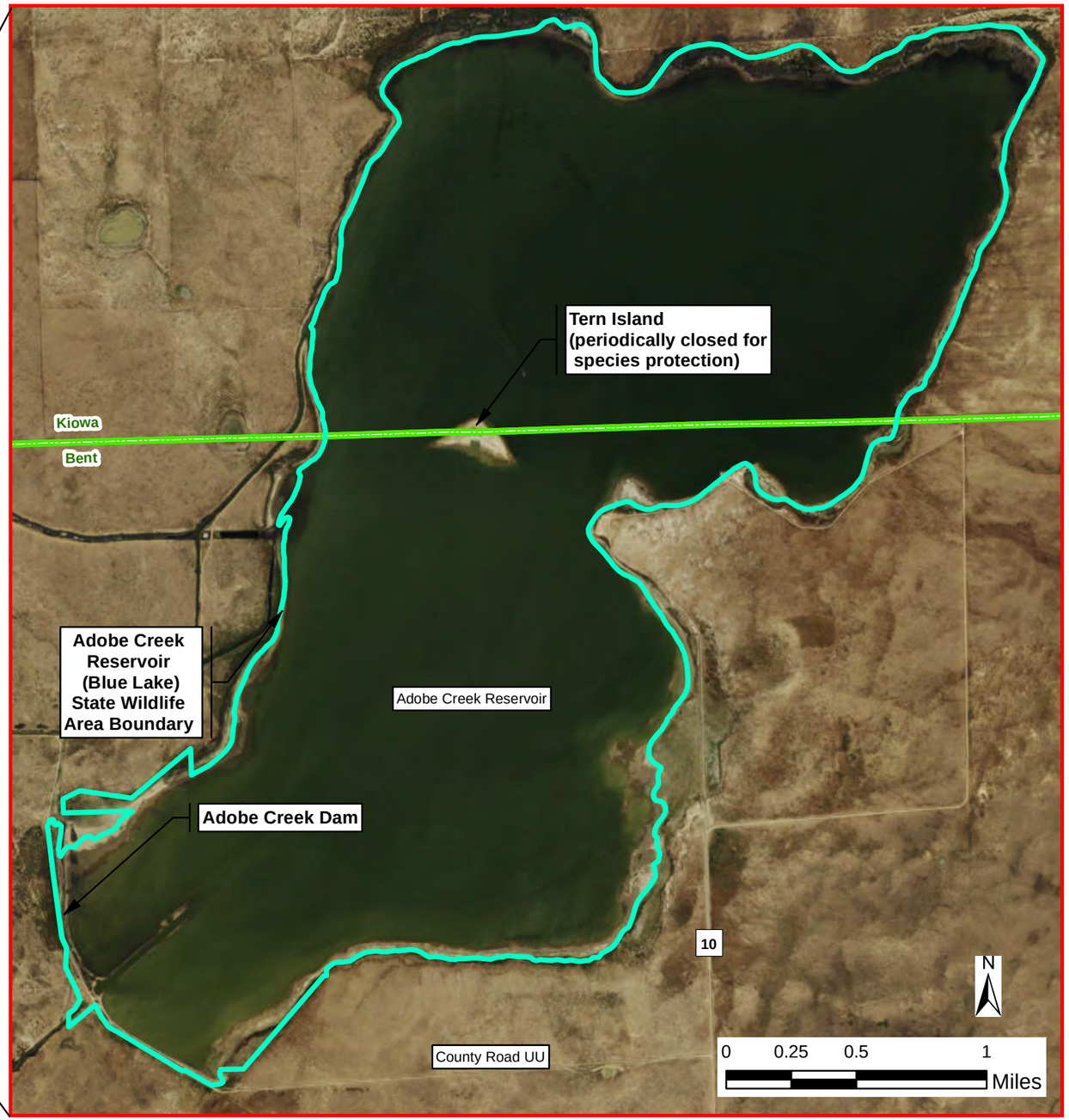
7 W. W. Wheeler & Associates, Inc. (Wheeler, 2017) *Adobe Creek Dam Outlet Conduit and Seepage Evaluation Letter Report*, January, 27, 2017.

10.0 LIMITATIONS

This feasibility study report was prepared based on our best knowledge and judgment and, in part, from information provided by others. This study was conducted in accordance with generally accepted engineering practices in the State of Colorado. The execution of the work documented in this report will be performed by others and this work and other factors that can affect the final product, budget, and schedule are outside of the control of W. W. Wheeler & Associates, Inc. As a result, there is no expressed or implied warranty or guarantee of the work described in this study. W. W. Wheeler & Associates, Inc. is also not responsible for the liability associated with the interpretation of the information presented in this report by others.







Legend

- City
- Counties
- Fort Lyon Canal
- State Wildlife Boundary
- Arkansas River
- Horse Creek
- Fort Lyon Storage Canal

JULY 2017

W. W. WHEELER & ASSOCIATES, INC.
Water Resources Engineers

Fort Lyon Canal Company
Adobe Creek Dam
Location and Vicinity Map

Job Number:1830.04 | Figure 1

R:\1800\1830\1830.02\Adobe Creek Dam\GIS\MXD\Location_Map_Adobe_Creek_Dam.mxd

R:\1800\1830.01\Analysis\GIS\MXD\Aerial_Scale_360000_11x17_FtLyonIrrigatedLand.mxd

Kiowa County

Bent County

Prowers County

Crowley County

Otero County

Horse Creek Flume

Fort Lyon Canal Headgate

John Martin Reservoir

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend

- ★ Fort Lyon Canal Headgate
- HorseCreek
- Counties
- Land Irrigated by Fort Lyon Canal

0 5 10 20 Miles

N

JULY 2015

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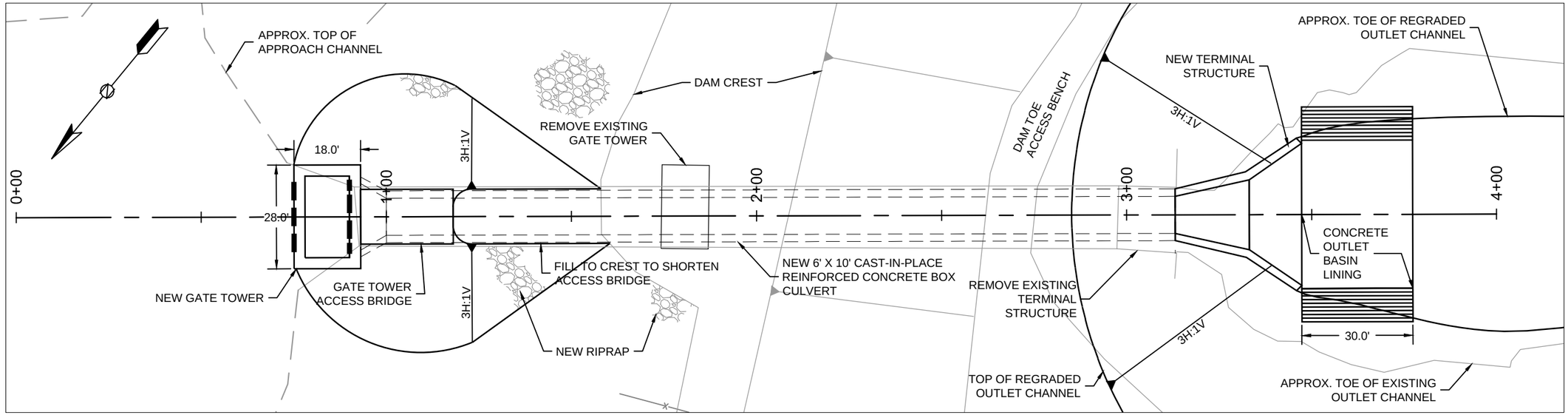
Water Resources Engineers

Fort Lyon Canal Company Feasibility Report
Horse Creek Flume Rehabilitation
Irrigated Land

Job Number:1830.01

Figure 2

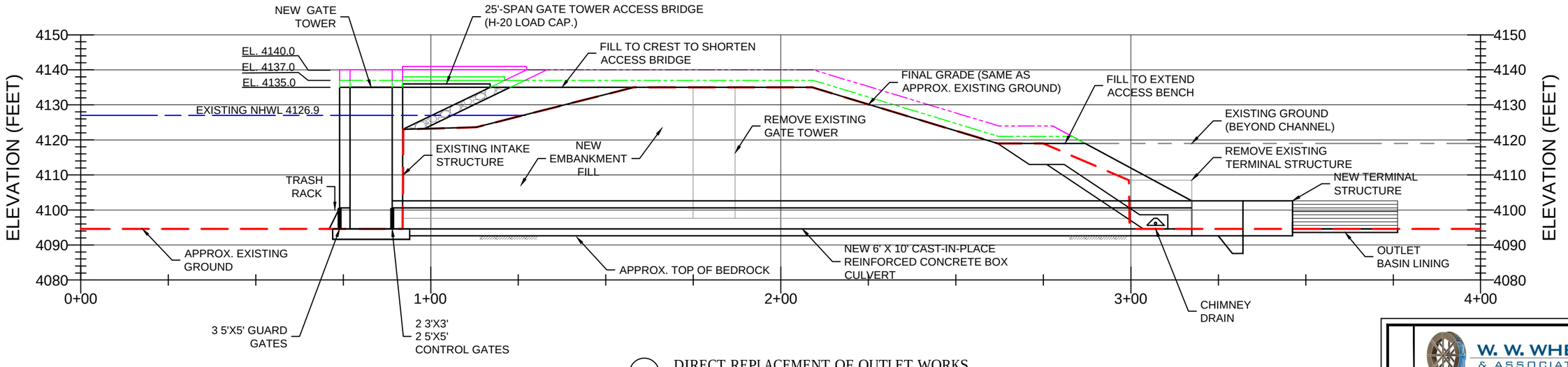


1 DIRECT REPLACEMENT OF OUTLET WORKS
PLAN VIEW

0 10 30 60
Scale in Feet

ANTICIPATED SEQUENCE OF CONSTRUCTION:

1. CONSTRUCT EMBANKMENT COFFERDAM IN OUTLET WORKS APPROACH CHANNEL.
2. EXCAVATE TO AND REMOVE EXISTING OUTLET WORKS.
3. CONSTRUCT NEW OUTLET WORKS.
4. BACKFILL WITH NEW EMBANKMENT FILL AND FILTER MATERIAL.
5. INSTALL OUTLET TOWER NEW ACCESS BRIDGE.
6. EXCAVATE TO AND REMOVE EXISTING TOE DRAINS.
7. INSTALL NEW CHIMNEY DRAIN IN MAIN DAM SECTION (400' EITHER SIDE OF OUTLET WORKS).
8. INSTALL NEW TOE DRAIN ALONG TOE OF DAM WING DIKES.



2 DIRECT REPLACEMENT OF OUTLET WORKS
SECTION VIEW

0 10 30 60
Scale in Feet

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Water Resources Engineers

June 2017

Adobe Creek Dam Rehabilitation
Feasibility Design Alternative A
Outlet Works Direct Replacement

Job Number 1830.04

Figure 3

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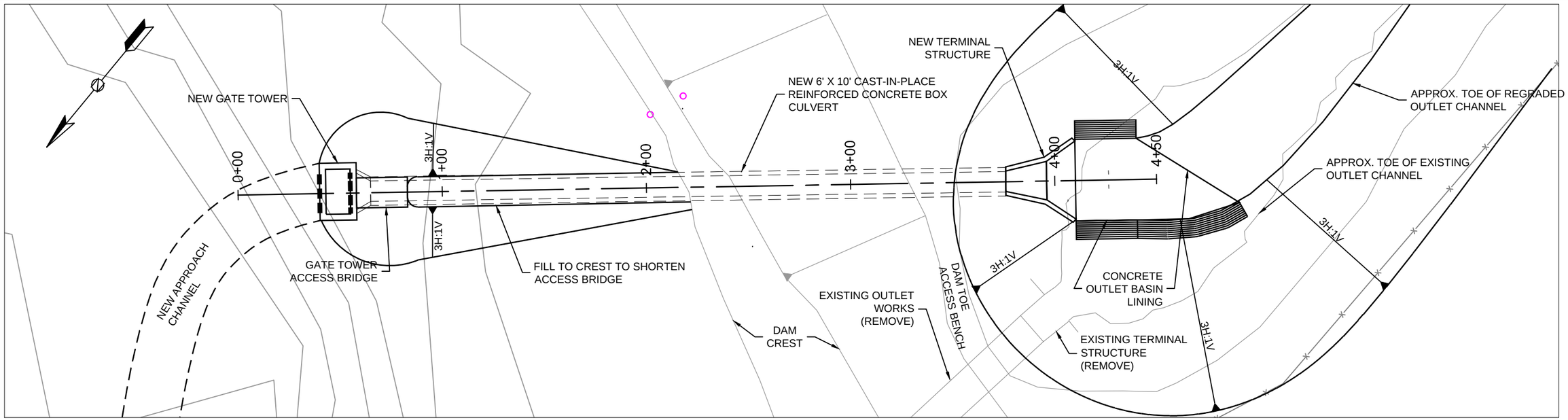
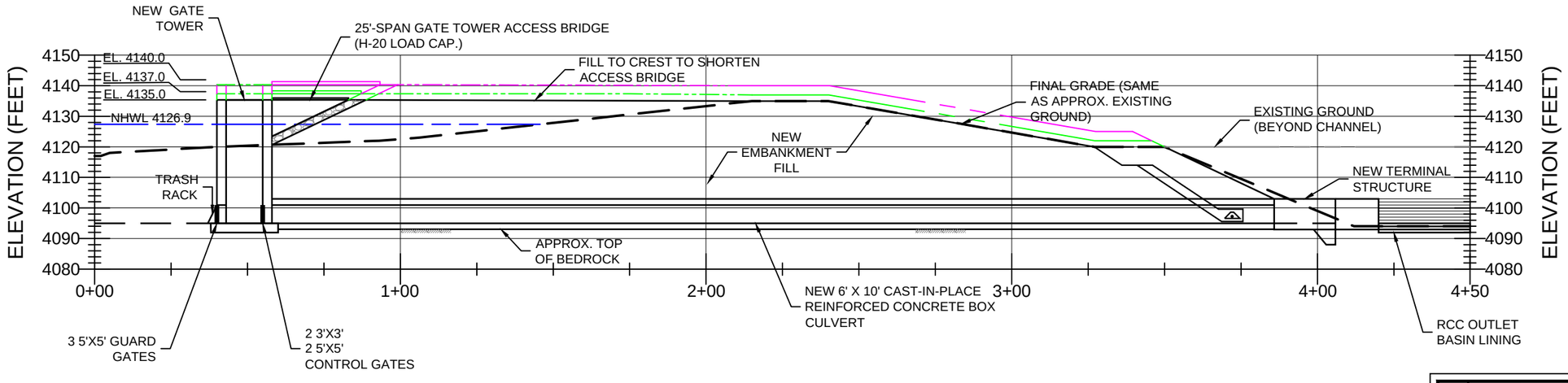


1 NEW ALIGNMENT OUTLET WORKS REPLACEMENT

PLAN VIEW

0 20 50 100

Scale in Feet



2 NEW ALIGNMENT REPLACEMENT OF OUTLET WORKS

SECTION VIEW

0 20 40 80

Scale in Feet

ANTICIPATED SEQUENCE OF CONSTRUCTION:

1. CONSTRUCT COFFERDAM UPSTREAM OF NEW OUTLET WORKS.
2. EXCAVATE DAM EMBANKMENT IN NEW OUTLET WORKS ALIGNMENT.
3. CONSTRUCT NEW OUTLET WORKS.
4. BACKFILL NEW OUTLET WORKS WITH NEW EMBANKMENT FILL AND FILTER MATERIAL.
5. EXCAVATE NEW OUTLET WORKS APPROACH CHANNEL TO CONNECT WITH EXISTING OUTLET WORKS CHANNEL.
6. CONSTRUCT LOW LEVEL COFFER DAM UPSTREAM OF EXISTING OUTLET WORKS.
7. EXCAVATE TO AND REMOVE EXISTING OUTLET WORKS.
8. BACKFILL EXISTING OUTLET WORKS WITH NEW EMBANKMENT FILL AND FILTER MATERIAL.
9. INSTALL OUTLET TOWER NEW ACCESS BRIDGE.
10. EXCAVATE TO AND REMOVE EXISTING TOE DRAINS.
11. INSTALL NEW CHIMNEY DRAIN IN MAIN DAM SECTION (400' EITHER SIDE OF OUTLET WORKS).
12. INSTALL NEW TOE DRAIN ALONG TOE OF DAM WING DIKES.

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Water Resources Engineers

June 2017

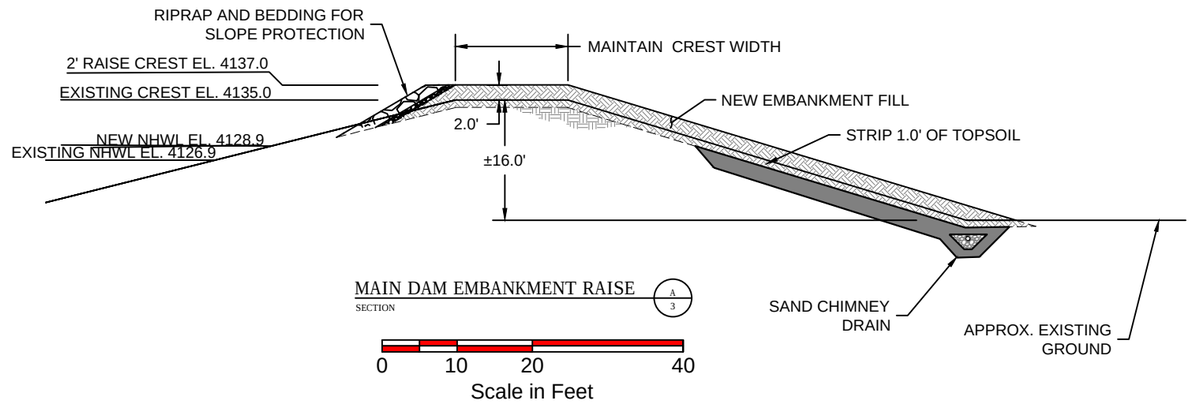
Adobe Creek Dam Rehabilitation
Feasibility Design Alternative B
New Alignment Outlet Replacement

Job Number 1830.04

Figure 4

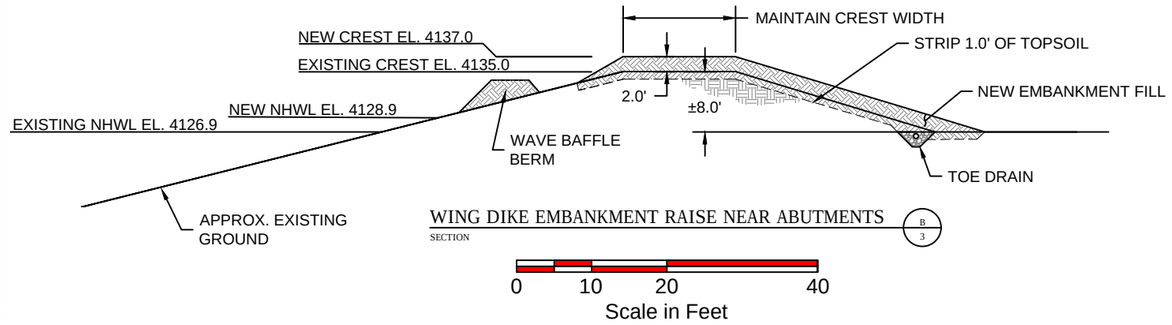
1 DAM RAISE
PLAN VIEW

0 500 1000 2000
Scale in Feet



MAIN DAM EMBANKMENT RAISE
SECTION A 3

0 10 20 40
Scale in Feet



WING DIKE EMBANKMENT RAISE NEAR ABUTMENTS
SECTION B 3

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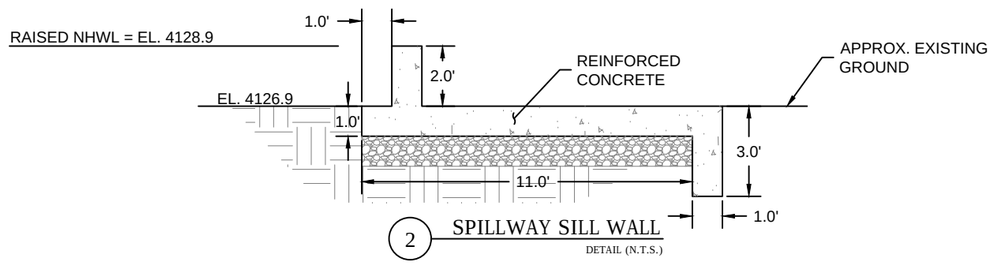
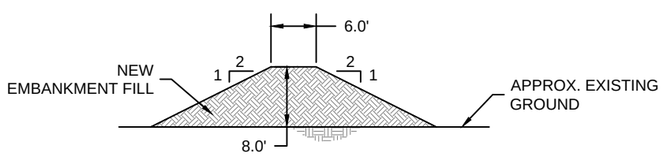
Scale in Feet



2 SPILLWAY SILL WALL
DETAIL (N.T.S.)



3 SPILLWAY TRAINING BERM
DETAIL (N.T.S.)

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June 2017

Adobe Creek Dam Rehabilitation
Feasibility Design Alternatives
Two Foot Crest Raise

Job Number 1830.04

Figure 5

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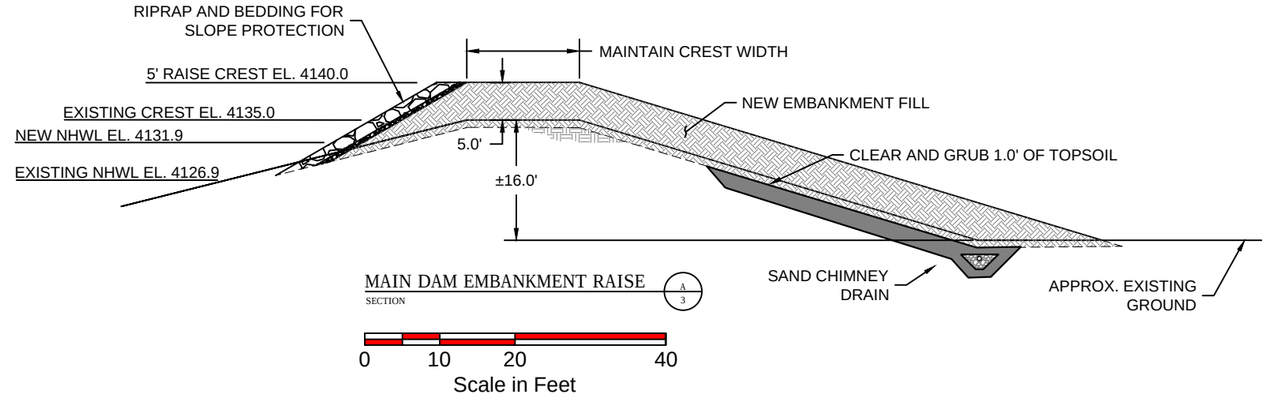
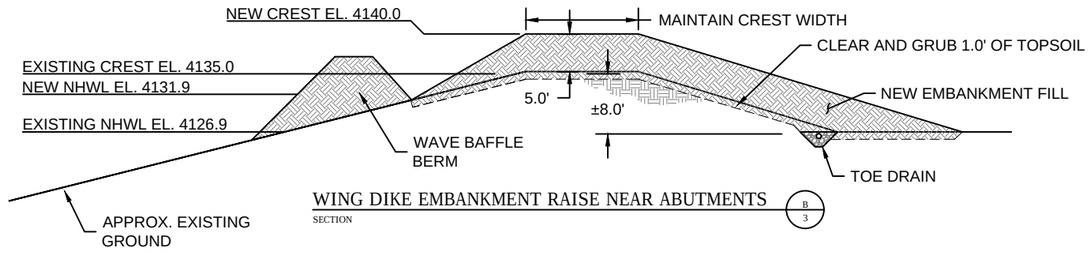
1 DAM RAISE
PLAN VIEW

0 500 1000 2000
Scale in Feet



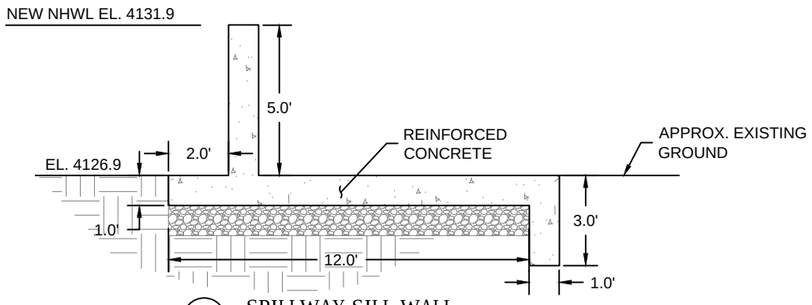
MAIN DAM EMBANKMENT RAISE (A 3)
SECTION

0 10 20 40
Scale in Feet

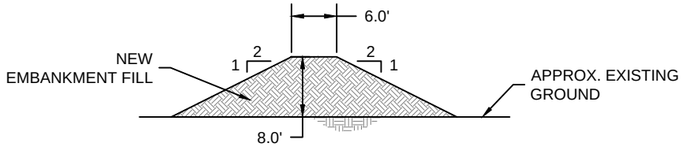


WING DIKE EMBANKMENT RAISE NEAR ABUTMENTS (B 3)
SECTION

0 10 20 40
Scale in Feet



2 SPILLWAY SILL WALL
DETAIL (N.T.S.)



3 SPILLWAY TRAINING BERM
DETAIL (N.T.S.)

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Water Resources Engineers

June 2017

Adobe Creek Dam Rehabilitation
Feasibility Design Alternatives
Five Foot Crest Raise

Job Number 1830.04

Figure 6

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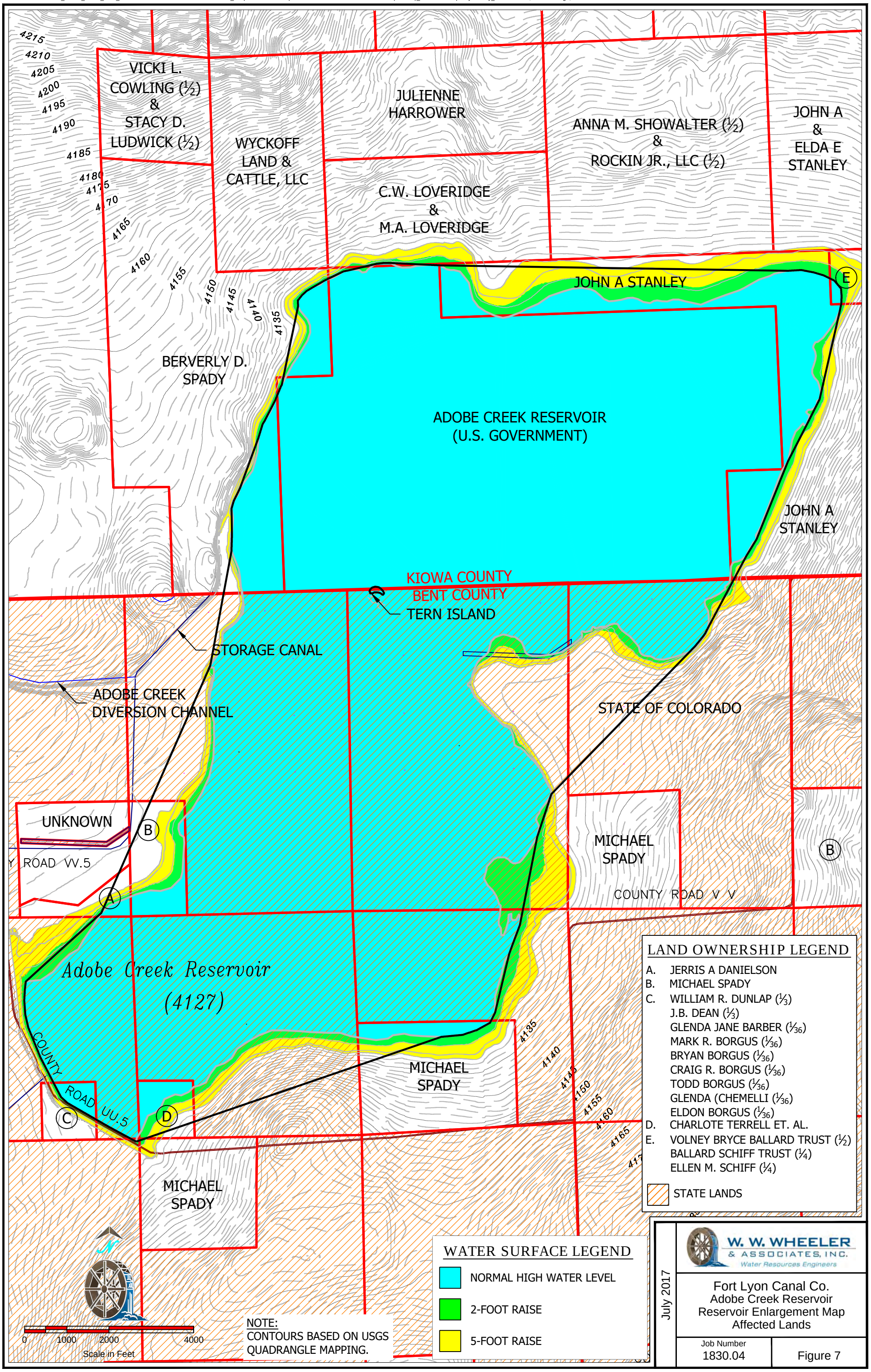

July 2017

W. W. WHEELER & ASSOCIATES, INC.
Water Resources Engineers

Fort Lyon Canal Co.
Adobe Creek Reservoir
Reservoir Enlargement Map
Affected Lands

Job Number 1830.04

Figure 7

Appendix A

Articles of Incorporation and Bylaws

Articles of Incorporation of the Fort Lyon Canal Company

This is to certify that we, Benjamin E. Brown, Daniel E. Cooper, William C. Burke, Frank Kreybill and John B. O'Neil, all citizens of Colorado, have associated ourselves together to become a body corporate under and by virtue of the laws of the State of Colorado, and we do hereby make, sign and acknowledge this certificate of incorporation, and declare as follows:

First.

The corporate name of said Corporation shall be The Fort Lyon Canal Company.

Second.

Said Company is incorporated for the following purposes:

1. To receive, own, hold, control, manage and operate that certain canal system known as the La Junta and Lamar Canal, including the King and Prince Reservoirs connected therewith, in accordance with the terms of the several contracts and deeds conveying rights to water from said canal system, heretofore executed by The Arkansas River, Land, Reservoir and Canal Company and The La Junta and Lamar Canal Company, in and by which it was provided that when said above named companies should have sold and in force a number of water rights equal to the estimated capacity of said canal to furnish water, and two-thirds of such rights should have been fully paid for, the title to said canal should pass to the owners of said water rights; which said provisions the District Court of Prowers County in a certain decree entered on the first day of June, A.D. 1896, in an action therein pending, in which John Hess suing upon behalf of himself and all other owners of rights to water

from said canal, were plaintiffs; and The La Junta and Lamar Canal Company, was defendant, adjudged and decreed had fully complied with, and by which the title to said canal system has become vested in said several water right owners. The said canal system being more particularly described as follows:

The headgate is located in the Northeast quarter of Section Thirty-two (32), Township twenty-three (23), of Range fifty-five (55) West of the Sixth Principal Meridian, or more particularly described, that the center of the headgate is at a point whence corner to Sections twenty-eight (28), twenty-nine (29), thirty-two (32) and thirty-three (33) of above Township and Range bears north 85 degrees, 7 minutes east, 25.43 chains distant, and in Otero County, State of Colorado, on the North Bank of the Arkansas River, a natural stream of said State of Colorado, from which natural stream said canal draws its supply of water; running thence in a general northeasterly direction through Townships 23 South of Range 55 West, and 23 South of Range 54 West, in Otero County, Colorado, and on in a general northeasterly direction through Townships 23 South of Range 53 West, and 22 South of Range 53 West, and 22 South of Range 52 West and 22 South of Range 51 West, and 22 South of Range 50 West, and 22 South of Range 49 West, and 22 South of Range 50 West, and 22 South of Range 49 West, and 21 South of Range 49 West, and 22 South of Range 48 West, and 21 South of Range 48 West, in Bent County, Colorado, to Big Sandy Creek; and also the reservoirs known as the King and Prince Reservoirs that are connected with the aforesaid canal system, in accordance with the plats and field notes of said canal and reservoirs, duly filed in the office of the State Engineer of the State of Colorado, in the City of Denver, at 1:30 P.M., August 12, A.D. 1889, which more specifically describes the location of said canal and above mentioned reservoirs.

2. To carry out, keep and perform all terms, obligations, contracts and undertakings set forth, established and authorized in and by the several decrees, orders and judgments heretofore rendered in respect to said premises by the said District Court of the County of Prowers, in the proceedings hereinbefore referred to.

3. To possess, exercise, manage and control all the rights, privileges, franchises and appropriations heretofore belonging to or exercised by The Arkansas River, Land, Reservoir and Canal Company, and The La Junta and Lamar Canal Company, and to acquire all lands, rights of way, ditches, laterals and reservoirs necessary to the use and operation of said canal system, and of the rights, privileges, franchises and appropriations connected therewith, and to contract with any other canal, reservoir, storage or water company for the storage and carriage of water, or for right of way therefor, and to acquire by gift, grant, devise or otherwise all real and personal property usual and necessary in the conduct of the business for which said Company is incorporated and to do any and all things necessary and usual in the division and use of water for irrigation, domestic or other purposes.

Third.

The capital stock of said Company shall be Five Hundred and Twenty-Five Thousand Dollars, divided into one hundred and five thousand shares, of the par value of Five Dollars each, which shares shall be issued to the several owners of rights to water from said canal system, in the proportion that the number of rights of each owner shall bear to the whole number of rights sold and upon the filing of this certificate with the Secretary of State of the State of Colorado, each water right owner shall be deemed a Stockholder to the extent hereinbefore set forth and entitled to exercise all the rights and privileges incident thereto.

Fourth.

Said Company shall exist for the term of twenty (20) years from and after the date of filing the Articles of Incorporation with the Secretary of the State of Colorado. (Amended 12/31/1935)

Fifth.

The affairs of this Company shall be managed by a Board of Directors, consisting of five (5) members and Benjamin B. Brown, of Pueblo County; Daniel E. Cooper, of Prowers County; William C. Burke, of Bent County; Frank Kreybill, of Bent County; and John B. O'Neil, of Otero County, Colorado; are hereby designated to act as such Board of Directors for the first year of the existence of said Company, and until their successors are elected or appointed and qualified, and the members of said Board shall thereafter be selected in accordance with the orders, judgments and decrees of said District Court of Prowers County, heretofore entered and hereinbefore referred to, and in accordance with the Bylaws of said Company.

Sixth.

The principal office of said Company shall be kept in the Town of Las Animas, County of Bent, and State of Colorado.

Seventh.

The principal business of said Company shall be carried on in the Counties of Otero, Bent, Prowers and Kiowa of the State of Colorado.

Eighth.

The Directors shall have power to make such prudential Bylaws as they may deem proper for the management of said Company. (Amended 12/7/1998)

IN TESTIMONY HEREBY, we have hereunto set our hand and seals in quadruplicate this eighth day of July, A.D. 1897.

Benjamin B. Brown (SEAL.)

Daniel E. Cooper (SEAL.)
William C. Burke (SEAL.)
Frank Kreybill (SEAL.)
John B. O'Neil (SEAL.)

Certificate of Amendment to Certificate of Incorporation of the Fort Lyon Canal Company

KNOW ALL MEN BY THESE PRESENTS that we, M.M. Simpson, President, and Jessie Simmons, Secretary of The Fort Lyon Canal Company, a corporation duly organized and existing under and by virtue of the laws of the State of Colorado, do hereby make this certificate in accordance with the laws of the State of Colorado, and state as follows, to-wit: First: That at a general meeting of the Stockholders of The Fort Lyon Canal Company, to-wit: the annual meeting thereof, duly and regularly called as provided by the Bylaws of said Corporation, and in accordance with the statutes of the State of Colorado, and held at Las Animas, Colorado on the 9th day of December, A.D. 1935, the following resolution was presented and regularly adopted by an affirmative vote of not less than two-thirds of the outstanding capital stock of said Corporation, entitled to vote, in accordance with the statutes of the State of Colorado so made and provided, amending Article Fourth of the Articles of Incorporation, to read as follows, to-wit:

"WHEREAS, Article Fourth of the Articles of Incorporation of The Fort Lyon Canal Company as amended, now provides that the corporate life of the said Company shall exist only until the year 1937, and the said Corporation has recently incurred obligations which may not entirely be matured until December 1, 1948; and

"WHEREAS, the principal business of the said Corporation is the distribution of water, the use of which has been decreed perpetually to The Fort Lyon Canal Company.

"NOW, THEREFORE, BE IT RESOLVED that the Fourth Article of the Articles of Incorporation of The Fort Lyon Canal Company be amended by striking the whole of said paragraph, and submitting in lieu thereof the following, to-wit:

"'FOURTH: Said Company shall have perpetual existence'

"BE IT FURTHER RESOLVED, that the Officers of the said Company be and they are hereby directed to file a certified copy of said amendment together with a copy of this resolution and the pertinent minutes of this meeting, with the Secretary of State of Colorado, and with the County Clerk and Recorder of the counties, to-wit: Otero, Bent, Prowers, Kiowa and Crowley, State of Colorado." Second: That the President and Secretary of the Corporation were at said Stockholders meeting duly authorized and directed to make and file such certificate as provided by law, setting forth such amendment or amendments, to the Certificate of Incorporation as adopted by the Stockholders of said Corporation.

IN WITNESS WHEREOF, we, the President and Secretary of the said Corporation have hereunto set our hands this 31st day of December, A.D. 1935, and have caused the seal of the said Corporation to be affixed hereunto.

M.M. Simpson
President

Attest:
Jessie Simmons
Secretary

Election to Accept the Colorado Nonprofit Corporation Act

Pursuant to the provisions of the Colorado Nonprofit Corporation Act, the undersigned Corporation elects to adopt the provisions of the Colorado Nonprofit Corporation Act and does hereby state that:

1. The Name of the Corporation is The Fort Lyon Canal Company.
2. All required reports have been or will be filled, and all fees, taxes and penalties due to the State of Colorado accruing under any act to which the Corporation has been subject have been paid.
3. On the 13th day of September, 1972, the Directors of the Corporation, a quorum being present, voted to accept the Colorado Nonprofit Corporation Act (the acceptance is authorized, by at least 2/3 of the votes of the members, OR 2/3 of the votes of the Stockholders, OR by a majority vote of the Directors, which were present at such meeting).
4. The Corporation followed the requirements of the law under which it was organized.
5. The address of the registered office in Colorado is Las Animas, Colorado 81054 and the name of its registered agent at such address is Alferd Putnam (Bent County).
6. Following is the name and address of the Officers and Directors.

Name	Title	Address
Arthur F. Esgar	President	Wiley, Colo.
George Reyher	Vice-President	McClave, Colo.
Alvin Spady	Treasurer	Las Animas, Colo.
D.C. Moore	Director	La Junta, Colo.
Seth Coen	Director	Lamar, Colo.
William E. Deal	Secretary	Las Animas, Colo.

7. The attached copy of incorporation is true and correct. Not Applicable.

8. Issued shares of stock are authorized.

NUMBER OF SHARES AUTHORIZED 105,000

NUMBER OF SHARES ISSUED AND OUTSTANDING 93,989.4166

9. All issued and outstanding shares of stock have been delivered to the Corporation to be canceled. Not applicable. Corporation organized for the acquisition and distribution of water to Stockholders.

10. The authority of the Corporation to issue shares of stock shall hereby be terminated. Not applicable. See 9.

Arthur F. Esgar
President

William E. Deal
Secretary

Bylaws
Fort Lyon Canal Company

Article I
Meetings

Section 1: Office

The Company shall maintain a principal office in Las Animas, Colorado where the annual meeting shall be held.

Section 2: Annual Meeting

The annual meeting of the Shareholders for the election of Directors and the transaction of other business as may properly come before it shall be held at the principal office of the Company or some other suitable building in Las Animas, Colorado on the second or third Monday as determined by the Directors in December of each year.

Section 3: Notice of Meeting

Notice of each meeting signed by the President or Secretary or both of them shall be sent by mail to all Stockholders of record to the last known post office address of such Stockholders as shown by the Company's records at least thirty (30) days prior to the day of said meeting and by publication in a newspaper of general circulation in the towns of La Junta, Las Animas, and Lamar, Colorado once a week for at least four weeks previous to the time designated for such meeting.

Section 4: Special Meetings

Special meetings of Shareholders may be called at any time

upon not less than 15 days notice by mail and publication as provided above by a majority of the Directors, and must be called by the President upon written request of 20% of the Stockholders of record and state the purpose or purposes for which it is called. No business other than that specified in the notice of meeting shall be transacted in such special meeting.

Section 5: Waiver of Notice of Meeting

Notice of Stockholders meeting, regular or special, may be waived by a signed waiver or by attendance at the meeting.

Section 6: Quorum

The presence, in person or by proxy, of the holders of the majority of the outstanding shares entitled to vote thereat shall be necessary to constitute a quorum for the transaction of business at all meetings of the Shareholders. If, however, such quorum shall not be present or represented at any meeting of the Stockholders, the Shareholders entitled to vote thereat, present in person or by proxy, shall have the power to adjourn the meeting to a future date in which the quorum shall be present or represented. At such adjourned meeting any business may be transacted which might have been transacted at the meeting as originally called.

Section 7: Voting

A Shareholder entitled to vote at a regular or special meeting may vote at such meeting in person or by proxy. Every Shareholder shall be entitled to one vote for each share standing in his name in the stock register of the Company.

Section 8: Proxies

Every proxy must be dated and signed by the Shareholder or

by his attorney-in-fact. No proxy shall be valid after the expiration of eleven months from the date of its execution. Every proxy shall be revocable at the pleasure of the Shareholder executing it upon written notice of such Shareholder to the Secretary of the Company.

Section 9: Definition of Shareholder

A Shareholder is the equity owner of the shares as reflected by the records of the stock register of the Company. A person or Corporation having a security interest in stock shall have no right to vote said stock at a Stockholders meeting of the Company except on proxy from the equity owner or mortgagor. Provided, however, that if an owner of stock appearing as record owner in the records of the Company is under contract to transfer such stock upon payment or other specific performance by a buyer, the record owner shall retain the right to vote said stock at Stockholders meeting of the Company, and such an equity owner, as distinguished from the Shareholder owning stock subject to a lien, shall have no right to vote said stock except by proxy executed by the record owner.

Section 10: Record Date

The last business day not less than ten (10) days preceding a Shareholders meeting shall be the record date for the determination of Shareholders entitled to vote at such meeting as reflected by the stock register of the Company or by stock assignments delivered to the office of the Secretary of the Company.

Article II
Directors

Section 1: Management of Company

The property, business, and affairs of the Company shall be managed and controlled by its Board of Directors pursuant to these Bylaws and to operating Rules and Regulations adopted by said Board of Directors with respect to the operation of the physical facilities of the Company and its standard Rules and Regulations for the conduct of the business affairs of the Company; such Rules and Regulations shall be reduced to writing, printed and made available alike to the Directors, employees and Shareholders of the Company; provided, however, that, except for the purchase of water or water rights, or a disaster emergency, the authority of the Board of Directors to contract indebtedness in excess of anticipated available funds for the fiscal year is limited to $50,000.00; any indebtedness in excess of this amount shall be submitted to and approved by the Shareholders.

Section 2: Board of Directors and Classification

(a) Director Qualifications: The Board of Directors shall consist of five members. No person shall be qualified to serve as a member of the Board of Directors unless said member is a Stockholder of record or the purchaser under a contract to purchase land to which Fort Lyon stock is appurtenant and holds a proxy from the record owner of such appurtenant stock. Such qualifications must exist with reference to land and water in the Director District the member is elected to represent and the member shall also be a resident of said Director District .

(b) Director Districts: One such Director shall be elected to

represent Stockholders having water rights located for delivery in each of the following five districts:

District:	Headgate Nos.:
La Junta	No. 3 through and including No. 77 (Gholson Lane)
Las Animas	No. 78 through and including No. 138 (Bifurcation Gate)
McClave	No. 138+ through and including No. 181 (Arbor Lateral)
Wiley	No. 182 through and including No. 237 (Marburg Lateral)
Lamar	No. 238 through and including No. 259 (Wheatridge Lateral)

Section 3: Resignation

Any Director may resign his office at any time; such resignation shall be made in writing and may take effect immediately without acceptance.

Section 4: Removal of Directors

Any Director may be removed either with or without cause at any time, by vote of the Shareholders holding a majority of the shares then issued and outstanding and entitled to vote for the election of the Directors sought to be removed at any special

meeting called for that purpose or at an annual meeting. A Director may be removed for cause by a vote of a majority of the entire Board.

Section 5: Bond

The Board of Directors shall require of the Secretary and the Treasurer to furnish bonds in the penal sum of not less than $100,000.00 with corporate surety, the premium of which shall be paid by the Company.

Section 6: Money Management

The Board of Directors shall develop Rules and Regulations for the management of the Corporation's money which shall include:

(a) A system of purchase orders and the Company shall not be obligated for the payment of any purchases except those authorized.

(b) The issuance of numbered receipts for all monies received and the prompt deposit of such monies.

(c) Disbursement only upon the vouchers approved by the Board of Directors, vouchers to be numbered in such a manner as to permit accurate reconciliation of checks and vouchers.

(d) Monthly cash flow reports, reconciliations of receipts and deposits and reconciliations of vouchers approved and checks issued.

(e) Annual audits by a certified public accountant.

The Rules and Regulations shall be reduced to writing, printed and made available for the guidance and reference of employees and Shareholders.

Section 7: Meetings

The Board of Directors shall meet for the appointment of Officers and for the transaction of any other business as soon as practicable after the adjournment of the annual meeting of the Shareholders. Thereafter, they shall hold regular meetings not less frequently than once a month and special meetings upon 10 hours telephoned notice called by the President or by any three Directors at any place within or without the State of Colorado as required by the business and the best interest of the Company.

Section 8: Notice of Meeting

No notice need be given of any regular meeting of the Board of Directors. Notice of special meetings may be given by telephone not less than 10 hours prior to the date for which such special meeting is called, specifying the time and place and the business to be transacted thereat. Any defects in notice may be cured by waiver or by attendance and participation; and at such meeting any business may be transacted which might have been transacted if the meeting had been duly called.

Section 9: Quorum

At any meeting of the Board of Directors, the presence of the majority of the Board shall be necessary to constitute a quorum for the transaction of business. However, should a quorum not be present the lesser number may adjourn the meeting to some future time, not more than seven days later.

Section 10: Voting

At all meetings of the Board of Directors, each Director shall have one vote irrespective of the number of shares that he may hold individually or in the area which he may represent.

Section 11: Vacancies

Any vacancy occurring in the Board of Directors by death, resignation, or otherwise, shall be filled promptly by a majority vote of the remaining Directors at a regular or special meeting called for that purpose within thirty (30) days after the occurrence of the vacancy. The Director thus chosen shall hold office for a term ending at the next annual meeting of the Shareholders and until the election and qualification of his or her successor. If the original term of the preceding Director is unexpired, a successor Director shall be elected to hold office for the remainder of such original term so that the staggered terms of Directors shall be continued.

Section 12: Term of Office

The Directors of the Company shall be classified in respect of the time for which they shall each hold office, by dividing them into three classes, the first class consisting of one Director from the Lamar district, who shall be elected for a term to expire at the third annual meeting of the Stockholders after said member's election, the second class consisting of two Directors, one from the La Junta district and one from the McClave district, who shall be elected for a term to expire at the second annual meeting of the Stockholders after their election, and the third class consisting of two Directors, one from the Las Animas district and one from the Wiley district, who shall be elected for a term to expire at the first annual meeting of the Stockholders after their election.

At the annual meeting of the Stockholders to be held in December, 2000 in Las Animas, Colorado, five Directors who shall be eligible to serve the entire term of office shall be elected as above set forth. All of the Stockholders shall be entitled to

vote for all of the Directors nominated for the office of Director. At each subsequent annual election, the successors to the Directors of the class whose term shall expire in that year shall be elected to hold office for a term to expire at the third annual meeting of the Stockholders after their election.

No Stockholder shall be qualified to serve continuously as Director for a period of longer than nine years and shall be disqualified to serve again for the ensuing three years. Prior years of continuous service beginning December 13, 1993 for any current Director shall be included in this term limitation.

Section 13: Indemnification

The Company shall indemnify a Director, Officer, employee, fiduciary or agent of the Company against liability or expenses of a proceeding to the extent legally permitted as set forth in the section governing indemnification, Article 129 of the Colorado Revised Nonprofit Corporation Act, as amended.

Article III
Officers

Section 1: Officers and Qualifications

The Officers of the Corporation shall be a President, a Vice President, a Secretary, Treasurer and a Superintendent of Operations and such other Officers as the Board of Directors may determine. Any two offices except the office of President or Treasurer may be held by the same person. All Officers except Superintendent and Secretary shall be Shareholders of the Company as hereinabove defined.

Section 2: Election

All Officers of the Corporation shall be elected annually by the Board of Directors at the meeting held immediately after the annual meeting of Shareholders.

Section 3: Term of Office

All Officers shall hold office until their successors have been duly elected and qualified or until a removal as hereinafter provided.

Section 4: Removal of Officers

Any Officer may be removed either with or without cause by the vote of the majority of the Board of Directors.

Section 5: Duty of Officers

The duties and powers of the Officers of the Corporation shall be as follows and as may hereafter be set by resolution of the Board of Directors:

President:

(a) He shall preside at all the meetings of the Board of Directors. He shall also preside at all meetings of the Shareholders.

(b) He shall present at each annual meeting of the Shareholders and the Directors a report of the conditions of the business of the Corporation.

(c) He shall cause to be called regular and special meetings of the Shareholders and Directors in accordance with the requirements of the statute and of these Bylaws.

(d) He shall co-sign and execute all contracts in the name of the Corporation, and all notes and security instruments in connection with borrowing money.

(e) He shall sign all certificates representing shares.

(f) He shall cause all books, reports, statements and certificates to be properly kept and filed as required by the law and these Bylaws.

(g) He shall enforce these Bylaws and perform all the duties incident to his office which are required by law.

Vice President:

(a) During the absence or incapacity of the President, the Vice President shall perform the duties of President and, when so acting, he shall have all the powers and be subject to all the responsibilities of the office of President and shall perform such duties and functions as the Board may prescribe.

Secretary:

(a) He shall attend all meetings of the Board of Directors and of the Shareholders and keep minutes of such meetings in the appropriate books.

(b) He shall attend to the giving of notice of all meetings of the Shareholders of the Corporation.

(c) He shall be the custodian of the records and the seal of the Corporation and shall affix the seal to the certificate representing shares and other corporate papers when required.

(d) He shall keep at the principal office of the Corporation a book or record containing the names, alphabetically arranged, of all persons who are Shareholders of the Corporation, showing their places of residence, the number of shares held by them respectively, the dates they respectively became the owners of record thereof and the gates through which irrigating water to which they are entitled as a result of their stock ownership is delivered. He shall keep such book or record and the minutes of the proceeding of its Shareholders and Board of Directors open daily during the usual business hours, for inspection by any Shareholder, and such Shareholder's attorney-in-fact or attorney.

(e) He shall sign all certificates representing shares and affix the corporate seal thereto.

(f) He shall attend to all correspondence and present to the Board of Directors at its meeting all official communications received by him.

(g) He shall perform all the duties incident to the office of the Secretary of the Corporation in accordance with the office rules and procedures adopted by the Board of Directors.

Treasurer:

(a) The Treasurer shall have the care and custody of and be responsible for all funds and securities of the Corporation, and shall deposit such funds and securities in the name of the Corporation in such banks or safe deposit box companies as the Board of Directors may designate.

(b) Prior to each regular meeting of the Stockholders, the Treasurer shall reconcile receipts, deposits, vouchers and checks and present his reconciliation together with a statement of the condition of the Company to each regular meeting of the Board of Directors.

(c) The Treasurer and the Secretary shall sign checks for payment of all vouchers approved by the Board of Directors, except that in the absence of either the Secretary or Treasurer, the President shall sign in the place and stead of the Secretary or Treasurer. Checks for payment of the payroll and payroll related items may be issued by a Director and the office manager; provided, there is no increase in wages or salaries.

(d) He shall make a full financial report at the annual meeting of the Shareholders.

(e) He shall further perform all the duties incident to the office of the Treasurer of the Company.

Section 6: Maintenance of Inventory

The Board of Directors shall cause to be developed and maintained a property list or inventory of all the real and personal property of the Company together with an appraisal of its condition and current market value.

Section 7: Annual Report

The Officers of the Company under the supervision of the Board of Directors shall prepare an annual report detailing the Company's operation up to and including October 31 preceding the annual meeting of Shareholders; said report shall include a summary of operation and report on the state of maintenance of the Company's physical facilities, a Treasurer's report of the financial conditions of the Company and the report of the audit by the CPA and a proposed budget for the next succeeding year. Copies of the annual report and proposed budget shall be mailed to all Shareholders prior to the annual meeting of Shareholders, proposed long range plans together with proposed funding, a summary of the physical assets of the Company and its condition.

Article IV
Shares

Section 1: Certificates

The shares of the Corporation shall be represented by certificates prepared by the Board of Directors and signed by the President or the Vice President and by the Secretary or an assistant Secretary, or the Treasurer or an assistant Treasurer, and sealed with the seal of the Corporation or a facsimile. The certificates shall be numbered consecutively; they shall be bound in a book and shall be issued in consecutive order therefrom, and in the

margin thereof shall be entered the name of the person to whom the shares represented by each such certificate are issued, the number of such shares and the date of issue. Each certificate shall state the registered holder's name, the number of shares represented thereby and the date of issue, deemed personal property and the shares of the Corporation shall be freely transferable upon assignment by the owner as reflected by the records of the Corporation and the Corporation itself.

Section 2: Limitations of Relocation of Water Rights Within System

Relocation of water rights up or down the canal may be made, subject to approval by the Board of Directors, which approval may include terms and conditions to prevent injury.

Section 3: Transfer of Shares

Subject to the limitations of these Bylaws, the shares of the Corporation shall be assigned and transferable only on the books and records of the Corporation by the registered owner, or by his duly authorized attorney, upon surrender of the certificate duly and properly endorsed with proper evidence of authority to transfer. Such evidence of assignment or transfer may be in a form other than by endorsement of the certificate, but must be in a form and on such conditions as required by the Board of Directors and the Company attorney. The Corporation shall issue a new certificate for the shares surrendered to the person or persons entitled thereto subject to the provision of Article VII for the enforcement of the payment of assessments.

Section 4: Returned Certificates

All certificates for shares changed or returned to the Company for transfer shall be marked by the Secretary "canceled", with the

date of cancellation, and the transaction shall be immediately recorded in the certificate book opposite the memorandum of their issue. The returned certificate may be attached to the certificate book.

Section 5: Lost Certificates

(a) Replacement certificates may be issued for lost certificates upon satisfactory proof that the outstanding certificate is lost or destroyed and upon filing with the Board of Directors an indemnity bond in an amount to be fixed by the Directors, endorsed by a commercial surety company authorized to do business in the State of Colorado, or in the alternative:

(b) Any owner of capital stock of the Fort Lyon Canal Company entitling the owner to the use of water subject to the payment of assessments whose certificate has been lost, mislaid or destroyed may have a duplicate certificate issued without the filing of an indemnification bond if such Stockholder or his or its legal representative, successors or assigns files with the Company a demand for re-issue supported by an affidavit stating that diligent search has been made for the certificate and that it is lost, mislaid or destroyed; that possession of said stock has not been delivered to any other person in connection with its sale or transfer or pledge and requesting issuance of a duplicate certificate and if the applicant is not the owner as reflected by the records of the Corporation, establishes and documents his or its chain of title from the owner of record to the applicant to the satisfaction of the Board of the Corporation and thereafter pays all assessments levied by the Fort Lyon Canal Company upon such stock for a period of three years.

Upon the expiration of three years after filing such request and affidavit in compliance with the other provisions of the

foregoing paragraph, if the Board is satisfied that the applicant is the legal owner of said stock, the Board of the Corporation shall cause to be published a notice, at the expense of the person making such application, which notice shall be published at least once a week for five successive weeks, the fifth publication being on the 28th day after the first publication in a newspaper of general circulation in Bent County, Colorado, where the principal office of the Corporation is located, setting forth such demand in full, that demand has been filed with the Corporation for issuance of a duplicate certificate; that said Corporation will issue, on or after a date therein stated, following the last publication of said notice by at least thirty days, a duplicate certificate to the registered owner, his or its personal representative, successors or assigns, unless a contrary claim is filed with said Corporation prior to the dates stated in the notice.

If no claim of interest of ownership other than that made by the applicant for duplicate certificate with the Secretary of the Corporation is made prior to the date stated in the notice, the Corporation will issue, on or after said date a duplicate certificate to said applicant. All rights under the original certificate shall immediately cease and terminate.

Section 6: Expense

The Company shall not incur any expense as the result of the transfer of shares of the capital stock of the Fort Lyon Canal Company.

Article V
Water

Section 1: Basis for Water Pro-Ration and Delivery

Each holder of capital stock shall be entitled to receive from the Company's canal water for domestic purposes and for irrigation of lands lying under the line of said canal owned or controlled by said Shareholder in the following amount, to-wit:

For each share of capital stock one-hundredth (1/100) of one cubic feet of water per second of time; that is to say, for each one hundred (100) shares of stock, one (1) cubic foot of water per second of time, provided, that no right to the use of water shall accrue to the holder of any stock in less than eighteen (18) share lots, unless the lands owned or controlled by the Shareholder which can be irrigated from the Company's canal shall have an area of less than ten (10) acres, in which case the Board of Directors may grant the right to appropriate water in the quantity and for the area they may see fit and proper. And provided further that no transfer of water from one tract of land to another tract of land shall be made or permitted except by and upon order and approval of the Board of Directors.

No change shall be made in standard of measurement of the amount of water per share unless at a regular annual meeting upon motion duly made to that effect and approved by a vote of two-thirds (2/3) of all capital stock of the Company.

The Board of Directors shall approve the transfer of water to a tract of land which has not been historically irrigated only if the owner agrees to continue to comply with all of the Articles of Incorporation, Bylaws, Rules and Regulations of the Company now in effect, or as may hereafter be amended, and the owner obtain a final decree from a water court approving such transfer and containing in such decree a provision incorporating this bylaw.

Each Stockholder desiring to change the type of use, place of use, time of use, point or means of diversion, storage or other change of said Stockholder's water shall make written request therefore to the Board of Directors. If in the opinion of the Board

of Directors, such change may be made without injury to the canal, the Company, and other Stockholders, such request shall be granted, with such terms and conditions as may be necessary to prevent injury. However, all other Stockholders who are entitled to delivery of water at either the place from or to which delivery is changed shall be notified in writing of such request and shall have the right to participate in any meetings scheduled by the Board of Directors to consider such request. It is the current policy of the Board of Directors not to approve any transfer into or out of a shared headgate without the written consent of the other Stockholders using the headgate. In the event that the Board of Directors, in making any such determination as provided herein, shall require legal and/or engineering services, such expense shall be paid by the Stockholder making such request and the Board of Directors may require that all or part of the estimated cost thereof be paid to the Company prior to engaging such services by the Board of Directors. In such event the Board of Directors may, without penalty or liability, defer any such determination until such condition has been met. The determination by the Board of Directors shall be final, and shall not be subject to revision unless it is proven in a court of law having jurisdiction over water matters that such determination was arbitrary or capricious.

Article VI
Operations

Section 1:

The Board of Directors shall develop Rules and Regulations for the care, maintenance and operation of the Company's physical facilities which shall be reduced to writing and printed and made available for the reference of the employees and Shareholders.

Section 2: Water Delivery

Available water shall be delivered to Stockholders through their respective headgates pro-rata for periods of two days for the equivalent of 150% head except that if water is available, the Company may as a matter of operating economy deliver 200% head and provided further that fractional heads of less than 75% shall not be counted. The Company shall repair and replace any existing headgates and measuring devices: except that in the event of any modification of either the headgate or measuring device at the Stockholder's request, then the Stockholder shall reimburse the Company for the cost of materials therefor. All headgates and measuring devices shall be installed by the Company, in close proximity to the point of delivery. The Company's responsibility ends with the departure of the water from the measuring device. Fractional heads of less than 100% shall be avoided as far as feasible.

Section 3: Repair of Construction of Distribution Facilities

Upon notice to the superintendent, Shareholders involved in repair or construction of distribution facilities at the time they are entitled to receive water on rotation shall be allowed to pass one run with the privilege of a "make-up" run at a later feasible date.

Section 4: Distribution of Water

The Company shall not be considered as guaranteeing to the holders of stock the use at all times of the full amount of water specified in their stock holdings, but each Stockholder shall be entitled to a proportionate share of the water flowing in the ditch, which share shall be the proportion such stock bears to the entire outstanding stock of the Company, and not exceeding the amount mentioned in the stock certificates. And, in order that the water

may be equitably distributed among the Stockholders, the Directors and the persons entrusted by them with the management of the ditch, are empowered to rotate water among consumers, or to divide the ditch into districts for the distribution of water or to adopt such other methods as in their judgment may, from time to time, become necessary to secure to all Stockholders their proportionate share of water.

Section 5: Failure of Equitable Distribution of Water

And if, in the distribution of water, any Stockholder may, at any time, fail to receive his or her proportionate share, the Company shall not be liable to such Stockholder in damages, if such failure was caused by an error in judgment on the part of those charged with the distribution of water, or by reason of circumstances beyond the control of such persons, but shall only be liable in case such failure to distribute water equally was the result of some willful discrimination against such Stockholder on the part of the Directors or of those charged by the Directors with the distribution of water.

Section 6: Numbering of Headgates

Each headgate from which water is delivered to landowners receiving water from the main canal of the Fort Lyon Canal Company shall be numbered and the said numbers shall be recorded by the Superintendent or Secretary in the office of the said Company in Las Animas, Colorado.

Article VII
Assessment on Stock

The Company shall have power to make an assessment on the

capital stock thereof, to be levied pro-rata on the shares of stock, payable in money for the purpose of keeping the property of the Company in good repair and for the payment of any indebtedness or interest thereon. No such assessment shall be made unless the question of making the assessment shall be first submitted to the Stockholders of the Corporation at an annual meeting or at a special meeting called for that purpose and a majority of the stock issued and outstanding, represented either by the owner in person or by proxy, voting thereon shall vote in favor of making such assessments; and if said Stockholders shall fail to hold any such meeting or fail to make or authorize any assessment by the 1st of March in any year, the Directors shall have the power to make such assessment at any regular meeting or special meeting called therefor for that year. The assessment resolution shall fix the date of payment of regular or special assessments which shall become delinquent in thirty (30) days after the date fixed for payment and draw interest at a rate as fixed by the Board of Directors from time to time; but which interest shall never be more than 2% greater than the rate charged by First National Bank, Las Animas, Colorado.

No Stockholder who shall fail to pay any regular or special assessment when due and shall remain delinquent for a period of thirty (30) days after the date fixed for final payment shall be entitled to receive any water for domestic or irrigation purposes.

The Corporation shall have a perpetual lien upon such shares of stock and water rights represented by the same for any and all such assessments until the same are fully paid. After termination for delivery of water the Corporation may proceed further to collect delinquent assessments by one of the two following methods:

(a) By suit for a money judgment for the amount of delinquent assessments plus interest from the due date;

(b) By declaring a forfeiture of the stock and sale.

No forfeiture shall be declared until demand of not less the thirty (30) days for the amount due be made upon the owner of record or his personal representative by certified mail addressed to said person at the address as shown by the Company's records. At the option of the Board of Directors service of Notice of Forfeiture may be made by personal service of the notice on the Shareholder.

If payment not be made on or before the day specified, the President or Secretary shall then give notice by advertisement in a weekly newspaper published in each of the counties of Otero, Bent and Prowers for not less than two weeks, and then the share of such delinquent Stockholder shall be sold for cash to the highest and best bidder, at the office of the Company at Las Animas. For the purpose aforesaid, the President or Secretary shall offer said stock for sale and sell the same for the highest cash price obtainable, not less the amount of said assessment with the cost of the sale. The proceeds of the sale, over and above the amount due on said shares including cost of sale, shall be paid to the delinquent Stockholder. The Stockholder shall have sixty (60) days from date of sale in which to redeem by payment of the sale price plus interest at the legal rate. If redemption not be made in that time the certificate or certificates of such delinquent Stockholder shall be canceled on the books of the Company, and a new certificate for said shares shall be issued to the purchaser.

Article VIII
Amendments

Section 1: Manner of Amending

The Bylaws may be altered or amended by a majority vote of

all capital stock of the Company at a special meeting of the Shareholders called for that purpose, or at the annual meeting of the Shareholders provided that notice of the proposed amendment shall be included in the notice for the annual meeting.

Rules and Regulations for Water Use in The Fort Lyon Canal Company

I. Authority

The following Rules and Regulations have been prepared by the Board of Directors from the Fort Lyon Canal Company Bylaws and Resolutions passed by the Stockholders at their annual meetings and govern the distribution of water throughout the Fort Lyon Canal Company system.

II. General Descriptions Service Area

The Fort Lyon Canal Company has decreed water rights on the Arkansas River over 100 years old. These water rights permit the Company to divert water from the Arkansas River into a main canal northwest of La Junta, which said canal runs eastward along the north side of the Arkansas River, past La Junta, Las Animas, McClave, Wiley, May Valley, for some 100 miles, terminating northeast of Lamar. The irrigation water is taken from the river at a headgate north of La Junta and measured through a measuring flume, and distributed by ditchriders, who are employees of the Company, throughout its entire length, beginning on the west at the **La Junta Division** down through Gate 21D; then to the **Horse Creek Division** down to Gate 77; then on through the **Las Animas Division** down through Gate 149; then on through the **Limestone**

Division through Gate 202D; and then to the **Lamar Division** from Gate 203 through Gate 259, including the Wheatridge Lateral.

During the winter and during flood conditions, the Company stores water in various reservoirs. This water is used to supplement the natural river flow, during the irrigation season. These reservoirs are: Adobe Creek Reservoir, also known as Blue Lake; Horse Creek Reservoir, also known as Timberlake; Thurston Reservoir, Queen Reservoir and John Martin Reservoir.

III. Stockholder Shares

Water is diverted from the main canal to a Stockholder, or a water user, based upon the number of shares that the Stockholder owns.

Each holder of capital stock shall be entitled to receive from the Company's canal, water for the irrigation of lands lying under the said canal, owned or controlled by said Shareholder, in the following amount: for each share of capital stock, .01 of a cubic foot of water per second of time; that is to say, for each 100 shares of stock, 1 cubic foot of water per second of time, provided that no right to the use of water shall accrue to the holder of any stock in less than 18 share lots; unless the lands owned or controlled by the Shareholder which can be irrigated from the Company's canal shall have an area of less than 10 acres, in which case the Board of Directors may grant the right to appropriate in the quantity and for the area as they may see fit and proper.

The Board of Directors of the Company is charged with the administration of Bylaws relating to water distribution and the Superintendent and the ditchriders administratively carry out these instructions.

a. Stock Certificates, Diversions, and Records

The Stockholder's interest in water is evidenced by a stock certificate which has been approved by the Board of Directors of the Company, showing the number of shares owned by the Stockholder, which relate to diversions at a certain gate. Throughout the diversions of water through the system, each ditchrider maintains records of the date the water was turned on, the readings on the staff gauge in the Parshall Measuring Flume, and the date and time the water was turned off. These records are compiled bimonthly and are on file in the main Fort Lyon Canal Company office.

The amount of water allocated to a specific gate based upon a Stockholder's number of shares is normally a fixed figure, and cannot be transferred or re-allocated anywhere in the system without submitting a request to the Superintendent for a relocation certificate, and for approval by the Board of Directors, which will make such transfer final.

It is the policy of the Board not to approve any transfer into or out of a shared headgate, without the written consent of the other Stockholders using the headgate. It is the responsibility of the Stockholder requesting the transfer to obtain and present such written consent on a form provided by the Board, when requesting such a transfer.

If a Stockholder opens the Stockholder's gate without permission, or out of turn, the Stockholder shall be subject to having said gate locked down by the ditchrider and shall forfeit the next run of water, in accordance with the Company Bylaws.

b. Sale of Land and/or Water

If a Shareholder desires to transfer any of the Stockholder's shares, the Stockholder must deliver the Stockholder's certificate

to the Company's office together with an assignment of the shares. A charge is made for such transfer, and approval of the Board of Directors is required before the transfer becomes final.

IV. Water Management

The Fort Lyon Canal Company Superintendent supervises and allocates the water for the Company. The Superintendent will decide when the water will be allocated to a specific ditchrider, who physically distributes the water, and who will normally have the names and telephone numbers of each person getting water out of each gate, will make a reasonable effort to contact the water user advising the Stockholder that the Stockholder will get water on a certain day, at a certain time. A normal "run" is 150% of certificate amount, for a 48 hour period, after which the water is normally rotated down the ditch to the east to the next user. This process goes on throughout the entire length of the main canal from North La Junta to Lamar. Normally, after the Lamar Division diversions are in progress, we start again on the west edge of the La Junta Division and repeat the process. Normally, Run #1, for any fiscal year, begins on March 15 of the year, or immediately thereafter, and runs are then numbered sequentially until the end of the fiscal year, which would be November 15. A run of water requires approximately 10,000 acre feet of water, depending on weather conditions and the condition of the canal.

Since the advent of the Winter Storage Program, the irrigation season has run from March15 to November15 with exact dates set by Board action. During the winter, water is stored in reservoirs for future use.

a. Accounting for Water

Normally, a Stockholder is considered to have received the

Stockholder's "run" of water, when water has been available to the Stockholder at the Stockholder's headgate for 48 hours. However, when the Stockholder is unable to obtain the Stockholder's full allotment due to conditions beyond the Stockholder's control, such as reduced flow in the canal, the ditchrider may extend the Stockholder's running time to allow the Stockholder's full allotment to be released. No running time shall be charged, when delivery rate is less than 75% of allotment. The extra time is computed for reduced flow as follows:

150%	no extra at 48 hours
125%	10 minutes per hour (8 hours over on 48 hours)
100%	20 minutes per hour (16 hours over on 48 hours)
75%	30 minutes per hour (48 hours over on 48 hours)

b. Broken or Partial Runs

Fluctuating water levels or other operational problems may cause broken or partial runs. Normally, an extra two hours shall be added to running time, when an interruption of delivery occurs.

c. No Guarantee

The Company shall not be considered as guaranteeing to the holder of stock, the use at all times of the full amount of water specified in their stock holdings, but each Stockholder shall be entitled to a proportionate share of the water flowing in the ditch, which share shall be the proportion such stock bears to the entire outstanding stock of the Company and not exceeding the amount mentioned in the stock certificate. Also in order that water my be equitably distributed among Stockholders, the Directors and the staff are empowered to rotate water among the Stockholders based on their best judgment from time to time, as it may become necessary to secure all Stockholders their share of water.

d. Assessments

Notice of delinquent water assessments will be mailed by the Company to all Stockholders of record who are delinquent on January 1 of each year requiring payments in full within 30 days. On failure to pay, the matter will be referred to the Company's attorney for further action as provided by the Bylaws. Said notice shall be mailed with the first installment assessment notice for the following year.

V. Exceptions and General Information

a. Loss of Entitlement

If during the course of a regular run of water, the Stockholder fails to take the Stockholder's water at the scheduled time, normally the Stockholder will lose the right to that water.

b. Deferment of Regular Diversion

If, in advance of notification of a regular run of water, the Stockholder advises the ditchrider and Superintendent that the Stockholder would like to defer or delay that particular run due to extenuating circumstances, such as: building of a lined canal; installation of a pipeline; or some similar type of situation, this on the decision of the Superintendent may be permitted. Normally, if the Stockholder passes a run for any reason, the Stockholder may request that the Stockholder receive water on the next following run to partly compensate for the previous lost water, in accordance with the Bylaws. Make-up water is limited to one run, subject to approval by the Superintendent.

c. Major Construction

In cases where major construction is involved, it is requested

that the Stockholder, through the Superintendent, make arrangements to meet with the Board of Directors at one of the Board's regular meetings, to formally request that the Stockholder will obtain the Stockholder's full run, on a deferred basis.

d. Assessments

The Company derives its operational revenue from assessments which are normally set each year at the meeting of the Stockholders at so much per share. Usually these assessments are due in three installments. If the last installment is not paid by a specific time, the Stockholder's gate will be locked, and the Stockholder will not be entitled to receive any water until the assessment, plus interest is paid.

e. Measuring Devices

Each Stockholder will have Parshall Measuring Flume for measuring the water out of the Stockholder's headgate. The water user is responsible for the ditch downstream from the measuring flume. That part of the ditch from the gate outlet to the measuring flume will be maintained by the Company at the Company's expense.

f. Company Replacement Responsibility

The Company, as a part of regular maintenance, shall replace all steel paddles, bolts, and other material for proper operation of the headgate. The Company is also responsible for keeping the rating flume in good repair.

Company responsibility for water ends when the water passes the rating flume. It is the Stockholder's responsibility for disposing of waste water so as to avoid damage to the Company facilities, county roads, and adjacent farms.

g. New Gate Installation

In case of new gate installation, such as a transfer or relocation

of shares of stock, the Stockholder must specifically notify the Superintendent, in writing, what the Stockholder proposes to do. Upon receipt of the request, the Superintendent will contact the Stockholder, obtaining a relocation certificate, if required, and present a Company cost estimate for the new construction to the Stockholder. After review of the cost estimate, the Stockholder may thereby sign the "Responsibility for Payment Form" which authorizes the Superintendent to complete the work and installation, after which the Stockholder will be billed by the Company for the cost thereof. These costs are due and payable immediately and if delinquent, will be charged interest at prevailing rates, and if not paid by the last date of assessments due, these costs, and interest, will be added to the assessments.

h. Pump Installations

Stockholders will be permitted to install and use pumps for laterals below weir boxes.

i. Waste of Water

Any waste of water by any Stockholder shall be sufficient cause for closing said Stockholder's headgates. Before any action is taken to close the headgate, notice of such intended action must be given by the Superintendent to the person in charge of using the water. If the Superintendent determines that the water user is wasting water, the Superintendent shall so inform said person, and close the user's headgates.

j. Locking of Headgates

Normally, headgates shall be locked by the ditchrider, when the gate is not scheduled to receive water. Gates will be unlocked just prior to the scheduled turn-on time. Stockholders are free to

open their gates at the time specified by the ditchrider. At the end of a scheduled run, the ditchrider shall close and lock all gates.

k. Unchargeable Water

Under certain conditions, such as floods, dike failures, or similar emergencies, Stockholders may be asked to open their headgates to protect the system against damage. Water released on this basis normally shall be "free", that is not charged against the Stockholder's normal allotment or "run". Obviously, there is no guarantee that such events will be distributed evenly over the system.

l. Excess Water

Under rare circumstances, such as an unseasonably wet spring, the Company's direct flow and storage priorities may yield more water than is being demanded, so that all Stockholders desiring water are receiving their full allotment. Under such circumstances, the Superintendent may, using the Superintendent's best judgment, permit releases to headgates above and beyond their normal allotment, provided beneficial use will be made of the water.

m. Variations in Rotation Sequence

As mentioned in **Section IV. Water Management**, a "run" normally progresses eastward, sequentially along the ditch. This procedure is desirable in that it is fair, easily understandable, and helps Stockholders anticipate and plan their irrigation work with greater confidence. However, a variety of circumstances may make departure from this procedure necessary, prudent, or otherwise desirable operationally from time to time.

For example, restricted carrying capacity at certain points in the system may prevent delivery to all points east of the restriction

simultaneously, regardless of available water. Delivery out of sequence may be unavoidable under these circumstances.

Similarly, under high flow conditions, large sections of the canal may be running simultaneously. Prudence dictates that some gates be left off, at intervals along the canal, to permit action to be taken should unexpected surges or restrictions occur.

Stockholders have objected strongly, from time to time, against inconveniences, night turn-ons, runs of irregular length, and broken runs. Obviously, to take such concerns into consideration, management must have more freedom of choice than a rigid rotation discipline permits. For all of these reasons, the Superintendent is expected to exercise mature judgment and adhere to the highest standards of fairness in the distribution of water. In return, the Superintendent should receive understanding and fair treatment from the Stockholders.

n. Complaints

Stockholder complaints should be first addressed at the ditchrider's level. Problems which cannot be resolved at that level should be brought to the attention of the Superintendent. If satisfactory resolution is not possible at that level, final authority in matters of water delivery rests with the Board of Directors. Individual Directors, acting alone, have no authority to intervene in water delivery matters.

o. Penalty for Failure to Submit Required Annual Report Forms for the U. S. Bureau of Reclamation

The headgate of a Stockholder who fails to submit all required annual report forms required by the U. S. Bureau of Reclamation by February 15, of the ensuing year shall be shut down, time being of the essence. The lock down will be lifted upon payment of the

sum of $100.00 per day from February 15, to the date of payment.

p. Installing Flow Meters

Requests by Stockholders to install a flow meter will be considered, subject to the following:

1. Such requests will be considered on a case by case basis by the Board.
2. The flow meter will be installed by the vendor, manufacturer or licensed engineer.
3. The flow meter will be checked by a licensed engineer at the Stockholder's expense upon the request by the Company, but no less than once each year, and a written report of this inspection will be sent to the Company.
4. The Stockholder will keep the flow meter in good repair and condition at all times at the Stockholder's sole expense.
5. The Company shall have no liability or expense for the installation, construction, repair, replacement or maintenance of the flow meter and all other labor and materials required for such diversion.

q. Conflict

In the event of any conflict of these Rules and Regulations with the Bylaws and Articles of Incorporation of the Company, the Bylaws and Articles shall control.

Appendix B

List of Shareholders

(Provided Under Separate Cover)

Appendix C

Financial Reports for 2014, 2015, and 2016

Appendix D

Opinions of Alternative Project Costs

ADOBE CREEK DAM
DAM MODIFICIATION FEASIBILITY ALTERNATIVES
FORT LYON CANAL COMPANY

Item No.	Description	Unit	Unit Price	ALTERNATIVE A OUTLET REPLACEMENT WITH COFFERDAM Quantity	ALTERNATIVE A Contingency Markup Total	ALTERNATIVE A1 ALTERNATIVE A WITH 2' RESERVOIR ENLARGEMENT Quantity	ALTERNATIVE A1 Contingency Markup Total	ALTERNATIVE A2 ALTERNATIVE A WITH 5' RESERVOIR ENLARGEMENT Quantity	ALTERNATIVE A2 Contingency Markup Total	ALTERNATIVE B OUTLET REPLACEMENT IN NEW ALIGNMENT TO USE EXISTING OUTLET DURING CONSTRUCTION Quantity	ALTERNATIVE B Contingency Markup Total	ALTERNATIVE B1 ALTERNATIVE B WITH 2' RESERVOIR ENLARGEMENT Quantity	ALTERNATIVE B1 Contingency Markup Total	ALTERNATIVE B2 ALTERNATIVE B WITH 5' RESERVOIR ENLARGEMENT Quantity	ALTERNATIVE B2 Contingency Markup Total
General Work															
1a	Storm Water Management - Erosion and Sediment Control	LS		1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000
1b.	Cofferdam Construction and Removal	LS		1	$303,000	1	$303,000	1	$303,000	1	$51,000	1	$51,000	1	$51,000
1c.	Temporary Reservoir Control	LS		1	$50,000	1	$50,000	1	$50,000	1	$0	1	$0	1	$0
1d.	Dewatering	LS		1	$75,000	1	$75,000	1	$75,000	1	$75,000	1	$75,000	1	$75,000
1e.	Site Reclamation	LS		1	$22,000	1	$22,000	1	$22,000	1	$22,000	1	$22,000	1	$22,000
1f.	Instrumentation	LS		1	$55,000	1	$83,000	1	$83,000	1	$55,000	1	$83,000	1	$83,000
1g.	Inlet Diversion Improvements	LS		1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000	1	$20,000
	Subtotal				**$545,000**		**$573,000**		**$573,000**		**$243,000**		**$271,000**		**$271,000**
Earthwork															
2a.	Excavation	CY	$8.00	53,300	$469,000	140,900	$1,240,000	272,600	$2,399,000	152,300	$1,340,000	239,900	$2,111,000	371,600	$3,270,000
2b.	Demolition	LS		1	$50,000	1	$50,000	1	$50,000	1	$50,000	1	$50,000	1	$50,000
2c.	Embankment Fill	CY	$13.00	54,000	$702,000	126,100	$1,639,300	257,700	$3,350,100	154,000	$2,002,000	226,100	$2,939,300	357,700	$4,650,100
2d.	Furnish and Place Type A Filter Sand	CY	$80.00	3,400	$299,000	3,400	$299,000	3,400	$299,000	3,400	$299,000	3,400	$299,000	3,400	$299,000
2e.	Furnishing and Installing Toe Drain Gravel and Pipe	LF	$85.00	6,600	$561,000	7,100	$664,000	7,100	$664,000	6,600	$561,000	7,100	$664,000	7,100	$664,000
2f.	Slope Protection	LS	$185,000.00	1	$185,000	1	$248,000	1	$340,000	1	$185,000	1	$248,000	1	$340,000
2g.	Aggregate Base Course	CY	$80.00	215	$26,000	2,070	$165,600	2,070	$165,600	215	$17,200	2,070	$165,600	2,070	$165,600
	Subtotal				**$2,292,000**		**$4,305,900**		**$7,267,700**		**$4,454,200**		**$6,476,900**		**$9,438,700**
Outlet Works Construction															
3a.	Furnish and Install New Intake Tower and Access Bridge	LS		1	$710,000	1	$746,000	1	$799,000	1	$710,000	1	$746,000	1	$799,000
3b.	Furnish and Install New Outlet Conduit	LF	$3,800.00	225	$898,000	225	$898,000	225	$898,000	330	$1,317,000	330	$1,317,000	330	$1,317,000
3c.	Furnish and Install New Intake Tower Slide Gates and Operators	LS		1	$233,000	1	$233,000	1	$233,000	1	$233,000	1	$233,000	1	$233,000
3d.	Furnish and Install Outlet Filter Diaphragm	CY	$80.00	1,000	$88,000	1,000	$88,000	1,000	$88,000	2,000	$176,000	2,000	$176,000	2,000	$176,000
3e.	Furnish and Install New Type II Outlet Basin Soil Cement Lining	LS		1	$486,000	1	$486,000	1	$486,000	1	$608,000	1	$608,000	1	$608,000
3f.	Furnish and Install Intake Trashrack	LS		1	$53,000	1	$53,000	1	$53,000	1	$53,000	1	$53,000	1	$53,000
	Subtotal				**$2,468,000**		**$2,504,000**		**$2,557,000**		**$3,097,000**		**$3,133,000**		**$3,186,000**
Spillway Improvements															
4a.	Spillway Berm Fill	CY	$13.00	0	$0	6,600	$85,800	6,600	$85,800	0	$0	6,600	$85,800	6,600	$85,800
4b.	Spillway Concrete	CY	$700.00	0	$0	900	$662,000	1,000	$735,000	0	$0	900	$662,000	1,000	$735,000
	Subtotal				**$0**		**$747,800**		**$820,800**		**$0**		**$747,800**		**$820,800**
Alternative Total Construction Costs					$5,305,000		$8,130,700		$11,218,500		$7,794,200		$10,628,700		$13,716,500
5	Mobilization (10% of DCS)	10	%		$530,500		$813,070		$1,121,850		$779,420		$1,062,870		$1,371,650
6	Unscheduled Items (10% of DCS)	10	%		$530,500		$813,070		$1,121,850		$779,420		$1,062,870		$1,371,650
DIRECT CONSTRUCTION COSTS					**$6,366,000**		**$9,756,840**		**$13,462,200**		**$9,353,040**		**$12,754,440**		**$16,459,800**
INDIRECT COSTS															
7	Construction Contingency (15% of DCS and Mobilization)	15	%		$954,900		$1,463,526		$2,019,330		$1,402,956		$1,913,166		$2,468,970
8	Surveying	1	LS		$120,000		$140,000		$140,000		$120,000		$140,000		$140,000
9	Final Design Subsurface Exploration	1	LS		$55,000		$55,000		$55,000		$55,000		$55,000		$55,000
10	Final Design Materials Lab Testing	1	LS		$18,000		$18,000		$18,000		$18,000		$18,000		$18,000
11	Land Acquisition	1	LS		$0		$1,970,000		$2,010,000		$0		$1,970,000		$2,010,000
12	Final Design Engineering	8	%		$650,000.00		$725,000.00		$725,000.00		$650,000.00		$725,000.00		$725,000.00
13	Permitting and Administrative Costs (2% of DCS)	2	%		$127,320.00		$195,136.80		$269,244.00		$187,060.80		$255,088.80		$329,196.00
14	Construction Administration and Engineering		%		$850,000.00		$850,000.00		$850,000.00		$850,000.00		$850,000.00		$850,000.00
15	State Engineer Design Review Fee (0.6% of project cost, Max $30,000)				$30,000		$30,000		$30,000		$30,000		$30,000		$30,000
TOTAL INDIRECT COSTS					**$2,805,220**		**$5,446,663**		**$6,116,574**		**$3,313,017**		**$5,956,255**		**$6,626,166**
TOTAL ALTERNATIVE COSTS (DCS +IC)					**$9,171,220**		**$15,203,503**		**$19,578,774**		**$12,666,057**		**$18,710,695**		**$23,085,966**

Appendix E

Financial Plan

Fort Lyon Canal Company: Adobe Creek Dam Rehabilitation
Financial Repayment Schedule

Financing — Cost Opinion of Chosen Alternative A: $9,172,000

Source	Project Total	Loan Share	Principal	Interest	Years	Annual Payment
CWCB Loan	$9,252,720	88.1%	$8,152,720	2.05%	40	$300,648

Project Cost Sharing

Source	Amount	% Total
FLCC Match	$0	0.0%
Basin Grant	$100,000	1.1%
Statewide Grant	$1,000,000	10.9%
Remaining Project Cost	$8,072,000	88.0%
1% CWCB Service Fee	$80,720	
Total CWCB Loan	$8,152,720	

Miscellaneous Information

Annual Inflation Rate for Op Assess, Other Inc and Exps:	1.50%
Annual Interest Income Rate for Reserve Fund:	2.00%
Number of Stock Shares Outstanding:	93,989.41

	ANNUAL INCOME									ANNUAL EXPENDITURES						RESERVES AND CASH	
Year	Annual Oper Assessment Per Share	Number of Shares	Annual Oper Assessment Revenue	Special Assessment Per Share	Special Assessment Revenue	Other Income	Interest On Reserve Fund	Total Annual Assessment Per Share	Total Income	Normal O & M Expense	Extra-ordinary O & M Expense	Dam Rehabilitation Annual Pmt CWCB Loan	0.00% Payment Match	Reserve Fund Expense (1)	Total Expenditures	Reserve Fund Balance (2)	Cash Balance
2017						$267,423				$2,464,577						$0	$1,344,015
2018	$29.00	93,989.41	$2,725,693	$0.00	$0	$271,434	$601	$29.00	$2,997,729	$2,501,546	$0	$300,648	$0	$30,065	$2,832,259	$30,065	$1,509,485
2019	$29.44	93,989.41	$2,766,578	$0.00	$0	$275,506	$1,203	$29.44	$3,043,287	$2,539,069	$0	$300,648		$30,065	$2,869,782	$60,130	$1,682,989
2020	$29.88	93,989.41	$2,808,077	$0.00	$0	$279,638	$1,804	$29.88	$3,089,519	$2,577,155	$0	$300,648		$30,065	$2,907,868	$90,195	$1,864,641
2021	$30.32	93,989.41	$2,850,198	$0.00	$0	$283,833	$2,405	$30.32	$3,136,436	$2,615,812	$0	$300,648		$30,065	$2,946,525	$120,259	$2,054,552
2022	$30.78	93,989.41	$2,892,951	$0.00	$0	$288,091	$3,006	$30.78	$3,184,048	$2,655,049	$0	$300,648		$30,065	$2,985,763	$150,324	$2,252,837
2023	$31.24	93,989.41	$2,936,345	$0.00	$0	$292,412	$3,608	$31.24	$3,232,365	$2,694,875	$0	$300,648		$30,065	$3,025,588	$180,389	$2,459,614
2024	$31.71	93,989.41	$2,980,391	$0.00	$0	$296,798	$4,209	$31.71	$3,281,398	$2,735,298	$0	$300,648		$30,065	$3,066,011	$210,454	$2,675,000
2025	$32.19	93,989.41	$3,025,096	$0.00	$0	$301,250	$4,810	$32.19	$3,331,157	$2,776,328	$0	$300,648		$30,065	$3,107,041	$240,519	$2,899,116
2026	$32.67	93,989.41	$3,070,473	$0.00	$0	$305,769	$5,412	$32.67	$3,381,653	$2,817,973	$0	$300,648		$30,065	$3,148,686	$270,584	$3,132,084
2027	$33.16	93,989.41	$3,116,530	$0.00	$0	$310,355	$6,013	$33.16	$3,432,898	$2,860,242	$0	$300,648		$30,065	$3,190,955	$300,648	$3,374,026
2028	$33.66	93,989.41	$3,163,278	$0.00	$0	$315,011	$6,013	$33.66	$3,484,301	$2,903,146	$0	$300,648		$0	$3,203,794	$300,648	$3,654,534
2029	$34.16	93,989.41	$3,210,727	$0.00	$0	$319,736	$6,013	$34.16	$3,536,476	$2,946,693	$0	$300,648		$0	$3,247,341	$300,648	$3,943,668
2030	$34.67	93,989.41	$3,258,888	$0.00	$0	$324,532	$6,013	$34.67	$3,589,433	$2,990,893	$0	$300,648		$0	$3,291,542	$300,648	$4,241,559
2031	$35.19	93,989.41	$3,307,771	$0.00	$0	$329,400	$6,013	$35.19	$3,643,184	$3,035,757	$0	$300,648		$0	$3,336,405	$300,648	$4,548,338
2032	$35.72	93,989.41	$3,357,388	$0.00	$0	$334,341	$6,013	$35.72	$3,697,742	$3,081,293	$0	$300,648		$0	$3,381,942	$300,648	$4,864,138
2033	$36.26	93,989.41	$3,407,749	$0.00	$0	$339,356	$6,013	$36.26	$3,753,118	$3,127,513	$0	$300,648		$0	$3,428,161	$300,648	$5,189,095
2034	$36.80	93,989.41	$3,458,865	$0.00	$0	$344,446	$6,013	$36.80	$3,809,324	$3,174,425	$0	$300,648		$0	$3,475,074	$300,648	$5,523,345
2035	$37.35	93,989.41	$3,510,748	$0.00	$0	$349,613	$6,013	$37.35	$3,866,374	$3,222,042	$0	$300,648		$0	$3,522,690	$300,648	$5,867,029
2036	$37.91	93,989.41	$3,563,409	$0.00	$0	$354,857	$6,013	$37.91	$3,924,279	$3,270,372	$0	$300,648		$0	$3,571,021	$300,648	$6,220,287
2037	$38.48	93,989.41	$3,616,860	$0.00	$0	$360,180	$6,013	$38.48	$3,983,053	$3,319,428	$0	$300,648		$0	$3,620,076	$300,648	$6,583,264
2038	$39.06	93,989.41	$3,671,113	$0.00	$0	$365,583	$6,013	$39.06	$4,042,709	$3,369,219	$0	$300,648		$0	$3,669,868	$300,648	$6,956,106
2039	$39.64	93,989.41	$3,726,180	$0.00	$0	$371,066	$6,013	$39.64	$4,103,259	$3,419,758	$0	$300,648		$0	$3,720,406	$300,648	$7,338,959
2040	$40.24	93,989.41	$3,782,073	$0.00	$0	$376,632	$6,013	$40.24	$4,164,718	$3,471,054	$0	$300,648		$0	$3,771,702	$300,648	$7,731,974
2041	$40.84	93,989.41	$3,838,804	$0.00	$0	$382,282	$6,013	$40.84	$4,227,098	$3,523,120	$0	$300,648		$0	$3,823,768	$300,648	$8,135,305
2042	$41.46	93,989.41	$3,896,386	$0.00	$0	$388,016	$6,013	$41.46	$4,290,415	$3,575,967	$0	$300,648		$0	$3,876,615	$300,648	$8,549,105
2043	$42.08	93,989.41	$3,954,831	$0.00	$0	$393,836	$6,013	$42.08	$4,354,681	$3,629,606	$0	$300,648		$0	$3,930,254	$300,648	$8,973,531
2044	$42.71	93,989.41	$4,014,154	$0.00	$0	$399,744	$6,013	$42.71	$4,419,911	$3,684,050	$0	$300,648		$0	$3,984,698	$300,648	$9,408,744
2045	$43.35	93,989.41	$4,074,366	$0.00	$0	$405,740	$6,013	$43.35	$4,486,119	$3,739,311	$0	$300,648		$0	$4,039,959	$300,648	$9,854,904
2046	$44.00	93,989.41	$4,135,482	$0.00	$0	$411,826	$6,013	$44.00	$4,553,321	$3,795,401	$0	$300,648		$0	$4,096,049	$300,648	$10,312,176
2047	$44.66	93,989.41	$4,197,514	$0.00	$0	$418,004	$6,013	$44.66	$4,621,531	$3,852,332	$0	$300,648		$0	$4,152,980	$300,648	$10,780,726
2048	$45.33	93,989.41	$4,260,477	$0.00	$0	$424,274	$6,013	$45.33	$4,690,763	$3,910,117	$0	$300,648		$0	$4,210,765	$300,648	$11,260,725
2049	$46.01	93,989.41	$4,324,384	$0.00	$0	$430,638	$6,013	$46.01	$4,761,035	$3,968,768	$0	$300,648		$0	$4,269,417	$300,648	$11,752,342
2050	$46.70	93,989.41	$4,389,250	$0.00	$0	$437,097	$6,013	$46.70	$4,832,360	$4,028,300	$0	$300,648		$0	$4,328,948	$300,648	$12,255,754
2051	$47.40	93,989.41	$4,455,088	$0.00	$0	$443,654	$6,013	$47.40	$4,904,755	$4,088,724	$0	$300,648		$0	$4,389,373	$300,648	$12,771,137
2052	$48.11	93,989.41	$4,521,915	$0.00	$0	$450,309	$6,013	$48.11	$4,978,236	$4,150,055	$0	$300,648		$0	$4,450,704	$300,648	$13,298,669
2053	$48.83	93,989.41	$4,589,743	$0.00	$0	$457,063	$6,013	$48.83	$5,052,820	$4,212,306	$0	$300,648		$0	$4,512,954	$300,648	$13,838,534
2054	$49.57	93,989.41	$4,658,589	$0.00	$0	$463,919	$6,013	$49.57	$5,128,522	$4,275,491	$0	$300,648		$0	$4,576,139	$300,648	$14,390,917
2055	$50.31	93,989.41	$4,728,468	$0.00	$0	$470,878	$6,013	$50.31	$5,205,359	$4,339,623	$0	$300,648		$0	$4,640,271	$300,648	$14,956,005
2056	$51.06	93,989.41	$4,799,395	$0.00	$0	$477,941	$6,013	$51.06	$5,283,349	$4,404,717	$0	$300,648		$0	$4,705,366	$300,648	$15,533,989
2057	$51.83	93,989.41	$4,871,386	$0.00	$0	$485,110	$6,013	$51.83	$5,362,509	$4,470,788	$0	$300,648		$0	$4,771,436	$300,648	$16,125,062
2058	$52.61	93,989.41	$4,944,457	$0.00	$0	$492,387	$6,013	$52.61	$5,442,857	$4,537,850	$0	$300,648		$0	$4,838,498	$300,648	$16,729,421
Total			$152,862,070		$0	##########	$219,473		$168,304,100	$140,291,464	$0	$12,326,582	$0	$300,648	$152,918,694		

Notes: (1) Includes 10% of annual loan payment for 10 years to build reserve fund.
(2) Total accumulated is one annual loan payment.

Fort Lyon Canal Company: Adobe Creek Dam Rehabilitation
Financial Repayment Schedule

Financing		Cost Opinion of Chosen Alternative A1:	$15,204,000			
Source	Project Total	Loan Share	Principal	Interest	Years	Annual Payment
CWCB Loan	$15,330,040	83.0%	$12,730,040	2.05%	40	$469,446

Project Cost Sharing		
Source	Amount	% Total
FLCC Match	$0	0.0%
WSRF Basin Grant	$100,000	0.7%
WSRF Statewide Grant	$1,000,000	6.6%
CWP Grant	$1,500,000	9.9%
Remaining Project Cost	$12,604,000	82.9%
1% CWCB Service Fee	$126,040	
Total CWCB Loan	$12,730,040	

Miscellaneous Information	
Annual Inflation Rate for Op Assess, Other Inc and Exps:	1.50%
Annual Interest Income Rate for Reserve Fund:	2.00%
Number of Stock Shares Outstanding:	93,989.41

	ANNUAL INCOME									ANNUAL EXPENDITURES						RESERVES AND CASH	
Year	Annual Oper Assessment Per Share	Number of Shares	Annual Oper Assessment Revenue	Special Assessment Per Share	Special Assessment Revenue	Other Income	Interest On Reserve Fund	Total Annual Assessment Per Share	Total Income	Normal O & M Expense	Extra-ordinary O & M Expense	Dam Rehabilitation Annual Pmt CWCB Loan	0.00% Payment Match	Reserve Fund Expense (1)	Total Expenditures	Reserve Fund Balance (2)	Cash Balance
2017						$267,423				$2,464,577						$0	$1,344,015
2018	$29.00	93,989.41	$2,725,693	$0.00	$0	$271,434	$939	$29.00	$2,998,066	$2,501,546	$0	$469,446	$0	$46,945	$3,017,937	$46,945	$1,324,144
2019	$29.44	93,989.41	$2,766,578	$0.00	$0	$275,506	$1,878	$29.44	$3,043,962	$2,539,069	$0	$469,446		$46,945	$3,055,460	$93,889	$1,312,646
2020	$29.88	93,989.41	$2,808,077	$0.00	$0	$279,638	$2,817	$29.88	$3,090,532	$2,577,155	$0	$469,446		$46,945	$3,093,546	$140,834	$1,309,633
2021	$30.32	93,989.41	$2,850,198	$0.00	$0	$283,833	$3,756	$30.32	$3,137,787	$2,615,812	$0	$469,446		$46,945	$3,132,203	$187,779	$1,315,216
2022	$30.78	93,989.41	$2,892,951	$0.00	$0	$288,091	$4,694	$30.78	$3,185,736	$2,655,049	$0	$469,446		$46,945	$3,171,440	$234,723	$1,329,512
2023	$31.24	93,989.41	$2,936,345	$0.00	$0	$292,412	$5,633	$31.24	$3,234,391	$2,694,875	$0	$469,446		$46,945	$3,211,266	$281,668	$1,352,636
2024	$31.71	93,989.41	$2,980,391	$0.00	$0	$296,798	$6,572	$31.71	$3,283,761	$2,735,298	$0	$469,446		$46,945	$3,251,689	$328,613	$1,384,707
2025	$32.19	93,989.41	$3,025,096	$0.00	$0	$301,250	$7,511	$32.19	$3,333,858	$2,776,328	$0	$469,446		$46,945	$3,292,719	$375,557	$1,425,846
2026	$32.67	93,989.41	$3,070,473	$0.00	$0	$305,769	$8,450	$32.67	$3,384,692	$2,817,973	$0	$469,446		$46,945	$3,334,364	$422,502	$1,476,174
2027	$33.16	93,989.41	$3,116,530	$0.00	$0	$310,355	$9,389	$33.16	$3,436,274	$2,860,242	$0	$469,446		$46,945	$3,376,633	$469,446	$1,535,815
2028	$33.66	93,989.41	$3,163,278	$0.00	$0	$315,011	$9,389	$33.66	$3,487,677	$2,903,146	$0	$469,446		$0	$3,372,592	$469,446	$1,650,900
2029	$34.16	93,989.41	$3,210,727	$0.00	$0	$319,736	$9,389	$34.16	$3,539,852	$2,946,693	$0	$469,446		$0	$3,416,139	$469,446	$1,774,612
2030	$34.67	93,989.41	$3,258,888	$0.00	$0	$324,532	$9,389	$34.67	$3,592,809	$2,990,893	$0	$469,446		$0	$3,460,340	$469,446	$1,907,081
2031	$35.19	93,989.41	$3,307,771	$0.00	$0	$329,400	$9,389	$35.19	$3,646,560	$3,035,757	$0	$469,446		$0	$3,505,203	$469,446	$2,048,438
2032	$35.72	93,989.41	$3,357,388	$0.00	$0	$334,341	$9,389	$35.72	$3,701,118	$3,081,293	$0	$469,446		$0	$3,550,740	$469,446	$2,198,816
2033	$36.26	93,989.41	$3,407,749	$0.00	$0	$339,356	$9,389	$36.26	$3,756,494	$3,127,513	$0	$469,446		$0	$3,596,959	$469,446	$2,358,350
2034	$36.80	93,989.41	$3,458,865	$0.00	$0	$344,446	$9,389	$36.80	$3,812,700	$3,174,425	$0	$469,446		$0	$3,643,872	$469,446	$2,527,179
2035	$37.35	93,989.41	$3,510,748	$0.00	$0	$349,613	$9,389	$37.35	$3,869,750	$3,222,042	$0	$469,446		$0	$3,691,488	$469,446	$2,705,440
2036	$37.91	93,989.41	$3,563,409	$0.00	$0	$354,857	$9,389	$37.91	$3,927,655	$3,270,372	$0	$469,446		$0	$3,739,819	$469,446	$2,893,277
2037	$38.48	93,989.41	$3,616,860	$0.00	$0	$360,180	$9,389	$38.48	$3,986,429	$3,319,428	$0	$469,446		$0	$3,788,874	$469,446	$3,090,832
2038	$39.06	93,989.41	$3,671,113	$0.00	$0	$365,583	$9,389	$39.06	$4,046,085	$3,369,219	$0	$469,446		$0	$3,838,666	$469,446	$3,298,251
2039	$39.64	93,989.41	$3,726,180	$0.00	$0	$371,066	$9,389	$39.64	$4,106,635	$3,419,758	$0	$469,446		$0	$3,889,204	$469,446	$3,515,682
2040	$40.24	93,989.41	$3,782,073	$0.00	$0	$376,632	$9,389	$40.24	$4,168,094	$3,471,054	$0	$469,446		$0	$3,940,500	$469,446	$3,743,275
2041	$40.84	93,989.41	$3,838,804	$0.00	$0	$382,282	$9,389	$40.84	$4,230,474	$3,523,120	$0	$469,446		$0	$3,992,566	$469,446	$3,981,184
2042	$41.46	93,989.41	$3,896,386	$0.00	$0	$388,016	$9,389	$41.46	$4,293,791	$3,575,967	$0	$469,446		$0	$4,045,413	$469,446	$4,229,561
2043	$42.08	93,989.41	$3,954,831	$0.00	$0	$393,836	$9,389	$42.08	$4,358,057	$3,629,606	$0	$469,446		$0	$4,099,052	$469,446	$4,488,566
2044	$42.71	93,989.41	$4,014,154	$0.00	$0	$399,744	$9,389	$42.71	$4,423,287	$3,684,050	$0	$469,446		$0	$4,153,497	$469,446	$4,758,356
2045	$43.35	93,989.41	$4,074,366	$0.00	$0	$405,740	$9,389	$43.35	$4,489,495	$3,739,311	$0	$469,446		$0	$4,208,757	$469,446	$5,039,094
2046	$44.00	93,989.41	$4,135,482	$0.00	$0	$411,826	$9,389	$44.00	$4,556,697	$3,795,401	$0	$469,446		$0	$4,264,847	$469,446	$5,330,944
2047	$44.66	93,989.41	$4,197,514	$0.00	$0	$418,004	$9,389	$44.66	$4,624,906	$3,852,332	$0	$469,446		$0	$4,321,778	$469,446	$5,634,072
2048	$45.33	93,989.41	$4,260,477	$0.00	$0	$424,274	$9,389	$45.33	$4,694,139	$3,910,117	$0	$469,446		$0	$4,379,563	$469,446	$5,948,648
2049	$46.01	93,989.41	$4,324,384	$0.00	$0	$430,638	$9,389	$46.01	$4,764,410	$3,968,768	$0	$469,446		$0	$4,438,215	$469,446	$6,274,844
2050	$46.70	93,989.41	$4,389,250	$0.00	$0	$437,097	$9,389	$46.70	$4,835,736	$4,028,300	$0	$469,446		$0	$4,497,746	$469,446	$6,612,834
2051	$47.40	93,989.41	$4,455,088	$0.00	$0	$443,654	$9,389	$47.40	$4,908,131	$4,088,724	$0	$469,446		$0	$4,558,171	$469,446	$6,962,794
2052	$48.11	93,989.41	$4,521,915	$0.00	$0	$450,309	$9,389	$48.11	$4,981,612	$4,150,055	$0	$469,446		$0	$4,619,502	$469,446	$7,324,905
2053	$48.83	93,989.41	$4,589,743	$0.00	$0	$457,063	$9,389	$48.83	$5,056,195	$4,212,306	$0	$469,446		$0	$4,681,752	$469,446	$7,699,348
2054	$49.57	93,989.41	$4,658,589	$0.00	$0	$463,919	$9,389	$49.57	$5,131,898	$4,275,491	$0	$469,446		$0	$4,744,937	$469,446	$8,086,308
2055	$50.31	93,989.41	$4,728,468	$0.00	$0	$470,878	$9,389	$50.31	$5,208,735	$4,339,623	$0	$469,446		$0	$4,809,069	$469,446	$8,485,974
2056	$51.06	93,989.41	$4,799,395	$0.00	$0	$477,941	$9,389	$51.06	$5,286,725	$4,404,717	$0	$469,446		$0	$4,874,164	$469,446	$8,898,536
2057	$51.83	93,989.41	$4,871,386	$0.00	$0	$485,110	$9,389	$51.83	$5,365,885	$4,470,788	$0	$469,446		$0	$4,940,234	$469,446	$9,324,187
2058	$52.61	93,989.41	$4,944,457	$0.00	$0	$492,387	$9,389	$52.61	$5,446,233	$4,537,850	$0	$469,446		$0	$5,007,296	$469,446	$9,763,123
Total			$152,862,070		$0	##########	$342,696		$168,427,323	$140,291,464	$0	$19,247,304	$0	$469,446	$160,008,214		

Notes: (1) Includes 10% of annual loan payment for 10 years to build reserve fund.
(2) Total accumulated is one annual loan payment.

Fort Lyon Canal Company: Adobe Creek Dam Rehabilitation
Financial Repayment Schedule

Financing		Cost Opinion of Chosen Alternative A2:	$19,579,000			
Source	Project Total	Loan Share	Principal	Interest	Years	Annual Payment
CWCB Loan	$19,748,790	86.8%	$17,148,790	2.05%	40	$632,397

Project Cost Sharing		
Source	Amount	% Total
FLCC Match	$0	0.0%
WSRF Basin Grant	$100,000	0.5%
WSRF Statewide Grant	$1,000,000	5.1%
CWP Grant	$1,500,000	
Remaining Project Cost	$16,979,000	86.7%
1% CWCB Service Fee	$169,790	
Total CWCB Loan	$17,148,790	

Miscellaneous Information	
Annual Inflation Rate for Op Assess, Other Inc and Exps:	1.50%
Annual Interest Income Rate for Reserve Fund:	2.00%
Number of Stock Shares Outstanding:	93,989.41

	ANNUAL INCOME									ANNUAL EXPENDITURES						RESERVES AND CASH	
Year	Annual Oper Assessment Per Share	Number of Shares	Annual Oper Assessment Revenue	Special Assessment Per Share	Special Assessment Revenue	Other Income	Interest On Reserve Fund	Total Annual Assessment Per Share	Total Income	Normal O & M Expense	Extra-ordinary O & M Expense	Dam Rehabilitation Annual Pmt CWCB Loan	0.00% Payment Match	Reserve Fund Expense (1)	Total Expenditures	Reserve Fund Balance (2)	Cash Balance
2017						$267,423				$2,464,577						$0	$1,344,015
2018	$29.00	93,989.41	$2,725,693	$0.00	$0	$271,434	$1,265	$29.00	$2,998,392	$2,501,546	$0	$632,397	$0	$63,240	$3,197,182	$63,240	$1,145,225
2019	$29.44	93,989.41	$2,766,578	$0.00	$0	$275,506	$2,530	$29.44	$3,044,614	$2,539,069	$0	$632,397		$63,240	$3,234,705	$126,479	$955,133
2020	$29.88	93,989.41	$2,808,077	$0.00	$0	$279,638	$3,794	$29.88	$3,091,510	$2,577,155	$0	$632,397		$63,240	$3,272,792	$189,719	$773,851
2021	$30.32	93,989.41	$2,850,198	$0.00	$0	$283,833	$5,059	$30.32	$3,139,090	$2,615,812	$0	$632,397		$63,240	$3,311,449	$252,959	$601,493
2022	$30.78	93,989.41	$2,892,951	$0.00	$0	$288,091	$6,324	$30.78	$3,187,366	$2,655,049	$0	$632,397		$63,240	$3,350,686	$316,198	$438,172
2023	$31.24	93,989.41	$2,936,345	$0.00	$0	$292,412	$7,589	$31.24	$3,236,346	$2,694,875	$0	$632,397		$63,240	$3,390,512	$379,438	$284,007
2024	$31.71	93,989.41	$2,980,391	$0.00	$0	$296,798	$8,854	$31.71	$3,286,042	$2,735,298	$0	$632,397		$63,240	$3,430,935	$442,678	$139,114
2025	$32.19	93,989.41	$3,025,096	$0.00	$0	$301,250	$10,118	$32.19	$3,336,465	$2,776,328	$0	$632,397		$63,240	$3,471,964	$505,918	$3,614
2026	$32.67	93,989.41	$3,070,473	$0.00	$0	$305,769	$11,383	$32.67	$3,387,625	$2,817,973	$0	$632,397		$63,240	$3,513,609	$569,157	($122,370)
2027	$33.16	93,989.41	$3,116,530	$0.00	$0	$310,355	$12,648	$33.16	$3,439,533	$2,860,242	$0	$632,397		$63,240	$3,555,879	$632,397	($238,716)
2028	$33.66	93,989.41	$3,163,278	$0.00	$0	$315,011	$12,648	$33.66	$3,490,936	$2,903,146	$0	$632,397		$0	$3,535,543	$632,397	($283,322)
2029	$34.16	93,989.41	$3,210,727	$0.00	$0	$319,736	$12,648	$34.16	$3,543,111	$2,946,693	$0	$632,397		$0	$3,579,090	$632,397	($319,302)
2030	$34.67	93,989.41	$3,258,888	$0.00	$0	$324,532	$12,648	$34.67	$3,596,068	$2,990,893	$0	$632,397		$0	$3,623,290	$632,397	($346,524)
2031	$35.19	93,989.41	$3,307,771	$0.00	$0	$329,400	$12,648	$35.19	$3,649,819	$3,035,757	$0	$632,397		$0	$3,668,154	$632,397	($364,859)
2032	$35.72	93,989.41	$3,357,388	$0.00	$0	$334,341	$12,648	$35.72	$3,704,377	$3,081,293	$0	$632,397		$0	$3,713,690	$632,397	($374,173)
2033	$36.26	93,989.41	$3,407,749	$0.00	$0	$339,356	$12,648	$36.26	$3,759,753	$3,127,513	$0	$632,397		$0	$3,759,910	$632,397	($374,330)
2034	$36.80	93,989.41	$3,458,865	$0.00	$0	$344,446	$12,648	$36.80	$3,815,959	$3,174,425	$0	$632,397		$0	$3,806,822	$632,397	($365,193)
2035	$37.35	93,989.41	$3,510,748	$0.00	$0	$349,613	$12,648	$37.35	$3,873,009	$3,222,042	$0	$632,397		$0	$3,854,439	$632,397	($346,623)
2036	$37.91	93,989.41	$3,563,409	$0.00	$0	$354,857	$12,648	$37.91	$3,930,914	$3,270,372	$0	$632,397		$0	$3,902,769	$632,397	($318,478)
2037	$38.48	93,989.41	$3,616,860	$0.00	$0	$360,180	$12,648	$38.48	$3,989,688	$3,319,428	$0	$632,397		$0	$3,951,825	$632,397	($280,614)
2038	$39.06	93,989.41	$3,671,113	$0.00	$0	$365,583	$12,648	$39.06	$4,049,344	$3,369,219	$0	$632,397		$0	$4,001,616	$632,397	($232,887)
2039	$39.64	93,989.41	$3,726,180	$0.00	$0	$371,066	$12,648	$39.64	$4,109,894	$3,419,758	$0	$632,397		$0	$4,052,155	$632,397	($175,147)
2040	$40.24	93,989.41	$3,782,073	$0.00	$0	$376,632	$12,648	$40.24	$4,171,353	$3,471,054	$0	$632,397		$0	$4,103,451	$632,397	($107,245)
2041	$40.84	93,989.41	$3,838,804	$0.00	$0	$382,282	$12,648	$40.84	$4,233,733	$3,523,120	$0	$632,397		$0	$4,155,517	$632,397	($29,028)
2042	$41.46	93,989.41	$3,896,386	$0.00	$0	$388,016	$12,648	$41.46	$4,297,050	$3,575,967	$0	$632,397		$0	$4,208,363	$632,397	$59,658
2043	$42.08	93,989.41	$3,954,831	$0.00	$0	$393,836	$12,648	$42.08	$4,361,316	$3,629,606	$0	$632,397		$0	$4,262,003	$632,397	$158,971
2044	$42.71	93,989.41	$4,014,154	$0.00	$0	$399,744	$12,648	$42.71	$4,426,546	$3,684,050	$0	$632,397		$0	$4,316,447	$632,397	$269,069
2045	$43.35	93,989.41	$4,074,366	$0.00	$0	$405,740	$12,648	$43.35	$4,492,754	$3,739,311	$0	$632,397		$0	$4,371,708	$632,397	$390,116
2046	$44.00	93,989.41	$4,135,482	$0.00	$0	$411,826	$12,648	$44.00	$4,559,956	$3,795,401	$0	$632,397		$0	$4,427,797	$632,397	$522,274
2047	$44.66	93,989.41	$4,197,514	$0.00	$0	$418,004	$12,648	$44.66	$4,628,165	$3,852,332	$0	$632,397		$0	$4,484,729	$632,397	$665,711
2048	$45.33	93,989.41	$4,260,477	$0.00	$0	$424,274	$12,648	$45.33	$4,697,398	$3,910,117	$0	$632,397		$0	$4,542,513	$632,397	$820,596
2049	$46.01	93,989.41	$4,324,384	$0.00	$0	$430,638	$12,648	$46.01	$4,767,669	$3,968,768	$0	$632,397		$0	$4,601,165	$632,397	$987,100
2050	$46.70	93,989.41	$4,389,250	$0.00	$0	$437,097	$12,648	$46.70	$4,838,995	$4,028,300	$0	$632,397		$0	$4,660,697	$632,397	$1,165,398
2051	$47.40	93,989.41	$4,455,088	$0.00	$0	$443,654	$12,648	$47.40	$4,911,390	$4,088,724	$0	$632,397		$0	$4,721,121	$632,397	$1,355,667
2052	$48.11	93,989.41	$4,521,915	$0.00	$0	$450,309	$12,648	$48.11	$4,984,871	$4,150,055	$0	$632,397		$0	$4,782,452	$632,397	$1,558,086
2053	$48.83	93,989.41	$4,589,743	$0.00	$0	$457,063	$12,648	$48.83	$5,059,454	$4,212,306	$0	$632,397		$0	$4,844,703	$632,397	$1,772,838
2054	$49.57	93,989.41	$4,658,589	$0.00	$0	$463,919	$12,648	$49.57	$5,135,157	$4,275,491	$0	$632,397		$0	$4,907,888	$632,397	$2,000,107
2055	$50.31	93,989.41	$4,728,468	$0.00	$0	$470,878	$12,648	$50.31	$5,211,994	$4,339,623	$0	$632,397		$0	$4,972,020	$632,397	$2,240,081
2056	$51.06	93,989.41	$4,799,395	$0.00	$0	$477,941	$12,648	$51.06	$5,289,984	$4,404,717	$0	$632,397		$0	$5,037,114	$632,397	$2,492,951
2057	$51.83	93,989.41	$4,871,386	$0.00	$0	$485,110	$12,648	$51.83	$5,369,144	$4,470,788	$0	$632,397		$0	$5,103,185	$632,397	$2,758,911
2058	$52.61	93,989.41	$4,944,457	$0.00	$0	$492,387	$12,648	$52.61	$5,449,492	$4,537,850	$0	$632,397		$0	$5,170,247	$632,397	$3,038,156
Total			$152,862,070		$0	##########	$461,650		$168,546,277	$140,291,464	$0	$25,928,275	$0	$632,397	$166,852,136		

Notes: (1) Includes 10% of annual loan payment for 10 years to build reserve fund.
(2) Total accumulated is one annual loan payment.

Appendix F

Condition Assessment Report

W. W. WHEELER
& ASSOCIATES, INC.
Water Resources Engineers
WWW.WWWHEELER.COM

April 7, 2016

Mark Perry, P.E., Dam Safety Engineer
Colorado Division of Water Resources, Division 2
210 East Abriendo Avenue
Pueblo, CO 81004

Subject: **Adobe Creek Dam, March 2016 Uncontrolled Seepage Repair, Water Division 2, Water District 17, Dam ID 170101, Wheeler Project No. 1830.02**

Dear Mark,

This letter report summarizes the temporary repair of uncontrolled seepage along the left side of the outlet works conduit at Adobe Creek Dam. The repairs were considered to be consistent with Rule 12.3 of the State of Colorado Rules and Regulations for Dam Safety and Dam Construction.

INCIDENT BACKGROUND INFORMATION

Adobe Creek Dam is an off-channel water storage facility for the Fort Lyon Canal Company (FLCC) located approximately 11 miles due north of Las Animas, Colorado. It is classified as a high hazard, embankment dam with a height of about 32 feet and normal storage of approximately 77,300 acre-feet.

Uncontrolled seepage was observed along the left side of the outlet works at about 2:00 P.M. on March 22, 2016 during the annual dam inspection conducted by Mark Perry, Division 2 Dam Safety Engineer. Steve Jamieson and Trevor Mugele from W. W. Wheeler and Associates, Inc. (Wheeler) and Jerred Hoffman, Superintendent of the FLCC, also participated in the inspection.

The location of the seepage and subsequent repair photos are provided in Attachment A. A Record "As-built" Sketch of the repair is provided in Attachment B. The uncontrolled seepage was observed to be exiting near the bottom of the left downstream outlet works end wall. The main seepage exit point was approximately one foot wide and two feet tall and was located immediately right of the 2008, six-inch-diameter steel toe drain outfall pipe. A second seepage exit point was observed to be about six inches in diameter and was located immediately below and left of the 2008 left toe drain pipe. The combined flow from both seepage exit points was estimated to be about 5 to 10 gallons per minute and appeared to be clear. Initial probing indicated that the seepage exit opening was least six feet deep.

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303-761-4130 | fax 303-761-2802

During the inspection, it was noted that the two larger 1996 and 1984 left toe drains were discharging at flows similar to previous readings, but the 2008 toe drain outfall was not flowing. The reservoir gage height was measured at 30.1 feet and the outlet gates were leaking at an estimated rate of about two cubic feet per second (cfs). It is also important to note that Adobe Creek Reservoir was near full from winter storage diversions for the first time in several years.

In an attempt to observe potential changes in seepage flow and start a potentially necessary reservoir drawdown, the center two outlet gates were opened approximately halfway to begin discharging about 300 cfs from the reservoir prior to leaving the site. The inspection party reconvened at the FLCC office to discuss emergency repairs and agreed to initiate the Emergency Action Plan (EAP) at Level 1, a non-emergency unusual event.

VIDEO INSPECTION

On Wednesday, March 23, 2016, the FLCC performed a video inspection of the interior of the left abutment seepage drain pipes and the interior of the uncontrolled seepage exit point. Jerred Hoffman and Mark Perry were on-site for the video inspection. Wheeler was given the recorded video at a later date. A brief summary of the observations from review of each video is provided below.

Uncontrolled Seepage Path:

The inspection camera was able to travel approximately 12 feet upstream of the exit point. The water flowing in the seepage path appeared clear.

Left Abutment Seepage Drain No. 1 (1984, Far Left):

This 8-inch-diameter perforated PVC pipe conveys the highest seepage flow; therefore, for parts of the video the camera lens is at the water surface and the image is obscured. Once the lens drops below the surface, there is some gravel and finer sediment observe in the bottom third of the pipe. The inspection proceeded approximately 112 feet into the pipe, this is not the apparent end of the pipe and it is unclear from the video why the inspection did not progress further. According to the Record Drawing, the pipe extends 25 feet towards the embankment before turning 90 degrees to parallel with the dam toe for an additional 162 feet. The seepage slots appear to be unclogged.

Left Abutment Seepage Drain No. 2 (1996, Far Right):

The inspection video showed a relatively clean 8-inch-diameter, PVC pipe with only a small amount of sediment near the invert of the pipe. Unfortunately, the camera lens was obstructed upon contact with sediment about halfway through the inspection. This obstruction did not clear until the camera reached the end of the pipe, which showed a perforated end cap. The perforations appeared to be unclogged. The

inspection proceeded approximately 42 feet to the end of this pipe, which is longer than indicated on the 1996 as-built sketches. The slots in the drain pipe appeared to be unclogged.

Left Abutment Seepage Drain No. 3 (2008, Middle):

The video inspection proceeded 22 feet up the 6-inch-diameter steel pipe to an unseen obstruction, presumably the cap on the end of the pipe. There is apparent build-up of material from the slots in the pipe indicating that they have been slowly clogging over time. No water was flowing in the pipe at the time of the inspection.

Pertinent screenshots from the video inspection are included with captions in Attachment C.

SEEPAGE REPAIRS

The seepage repairs, documented in Attachment B, were completed by the FLCC on March 25 under the direction of Trevor Mugele, P.E. of Wheeler. Wheeler provided a preliminary repair plan to Mark Perry prior to the work. The design intent was to provide a temporary filter repair to minimize uncontrolled seepage and to provide temporary erosion protection over the new filter. The uncontrolled seepage was repaired by careful excavation at the toe of the dam immediately left of the concrete outlet works wall. The excavated soils were replaced with a filter of gravel, ASTM C-33 concrete sand and a new 6-inch-diameter slotted Contech A-2000 pipe. A Construction Observation Report and the gradations of the gravel and ASTM C33 concrete sand are provided in Attachment D. The new 12.5-foot length of slotted A-2000 pipe was installed with the capped upstream end approximately 8 feet upstream of the downstream face of the left, concrete outlet works wing wall. The ASTM C-33 concrete sand was encased with fiber reinforced concrete to protect it from surface erosion and eddy currents from outlet works discharges. The new filter was backfilled with native clay fill as shown on the repair drawing in Attachment B.

After the seepage repair was made, the flow from the new discharge pipe has been consistently measured on a daily basis at about 0.5 gpm and the flow is reported to be clear. As a result, the Level 1 EAP operations were terminated by Mark Perry on March 31, 2016 after discussions with Steve Jamieson.

CONCLUSIONS AND RECOMMENDATIONS

It is Wheeler's opinion that the temporary repairs completed by the FLCC on March 25, 2016 are functioning as intended. It is also our opinion that continued safe water storage behind Adobe Creek Dam can continue this year provided that diligent observations and monitoring of the seepage repair area by the FLCC continues. Wheeler recommends the following near-term monitoring schedule for this dam:

1. Continued daily visual observation of the seepage repair area and measurements of toe drain pipe discharges through at least the end of April.

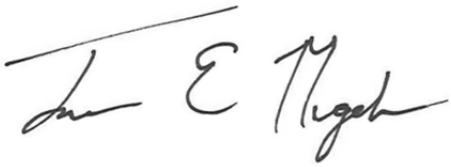
2. If the daily observations and discharge pipe readings indicate adequate performance of the dam through April, the visual observations, measurements of toe drain pipe discharge, and piezometer readings can be reduced to a once per week schedule; while the reservoir is above 75 percent of the normal storage, which would be above gage height 28.3.

3. If the reservoir water storage is reduced to below 50 percent of the normal storage, gage height 23.8, and there is continued good performance of the dam, visual observations, toe drain pipe discharge, and piezometer readings can be reduced to once every two weeks.

It is apparent that the seepage issues at Adobe Creek Dam have occurred for many years and will likely continue to be an issue in the future. We recommend that the FLCC Board of Directors consider additional subsurface investigations and engineering evaluations in the near future to gain a better understanding of the cause of the uncontrolled seepage at this dam. After completion of these investigations, repair designs and budgets should be developed, if needed, to develop a more permanent solution that would maintain the long-term reliability of water storage behind Adobe Creek Dam.

Sincerely,

W. W. Wheeler & Associates, Inc.



Stephen L. Jamieson, P.E.
Principal

Trevor E. Mugele, P.E.
Project Engineer

Cc: Jerred Hoffman, Superintendent, Fort Lyon Canal Company

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Attachment A

Adobe Creek Dam Seepage Repair

Photo Log

Attachment A
Adobe Creek Dam Seepage Repair
Photo Log

Photo 1: View of left abutment seepage drains and uncontrolled seepage path exit point left of the outlet works. March 22, 2016.

Photo 2: View of Trevor Mugele observing the uncontrolled seepage path exit point left of the outlet works. March 22, 2016.

Attachment A
Adobe Creek Dam Seepage Repair
Photo Log

Photo 3: View looking up the uncontrolled seepage path left of the outlet works. March 22, 2016.

Photo 4: View of the outlet works and seepage drain pipes looking upstream. The center two outlet pipes were discharging approximately 300 cfs when the photo was taken. March 22, 2016.

Photo 5: Commencement of initial excavation and riprap removal from slope above seepage drains left of the outlet works. March 25, 2016.

Photo 6: The excavation has reached the uncontrolled seepage path in this view. March 25, 2016.

Photo 7: View of excavation during initial placement of gravel along upstream excavation slope. March 25, 2016.

Photo 8: View of the bottom of new 6-inch-diameter slotted PVC drain pipe (Contech A2000). March 25, 2016.

Photo 9: View of the new 6-inch-diameter slotted drain pipe bedded in the ASTM C-33 concrete sand. March 25, 2016.

Photo 10: View of the new drain excavation with ASTM C33 concrete sand cover over the new slotted pipe and gravel upstream. Note the seepage water ponded behind a temporary sand dam. March 25, 2016.

Photo 11: Initial placement of concrete cap over ASTM C-33 concrete sand on the slope downstream of the outlet works concrete wing wall. March 25, 2016.

Photo 12: View of completed concrete placement over ASTM C-33 concrete sand. FLCC is performing finishing work of concrete. Note the seepage water ponded behind the concrete. March 25, 2016.

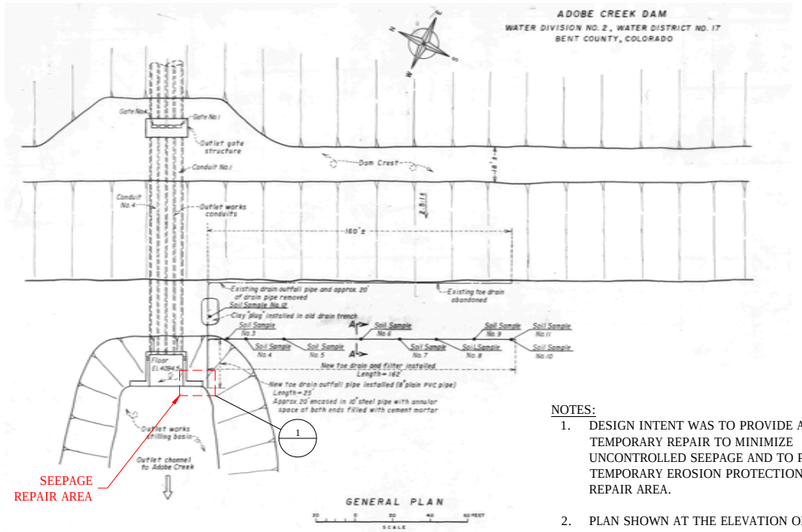
Photo 13: View of left abutment seepage drain pipes after concrete cap placement on new drain. The blue pipe on the far right pipe in the picture is a temporary sleeve to prevent water flow on uncured concrete. March 25, 2016.

Photo 14: View of the repair area after completion of work. Note the additional riprap placed below the toe drains. Further riprap to be placed above the drain pipes at a later date. March 25, 2016.

Attachment B

Adobe Creek Dam Seepage Repair

Record “As-built” Sketch

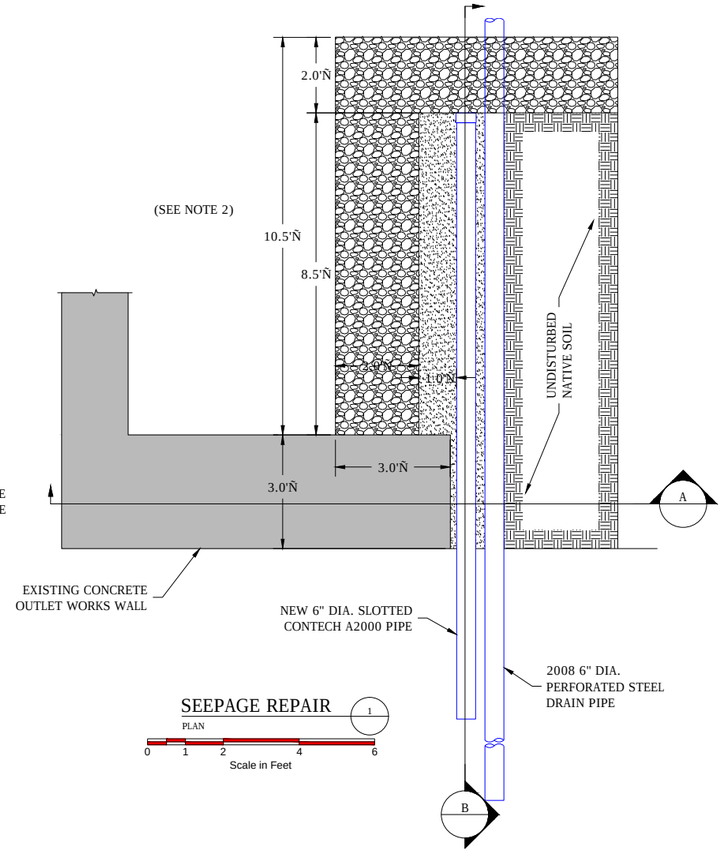


BASEMAP FROM 1984 DRAWING C-1270A

1 OUTLET WORKS
GENERAL PLAN

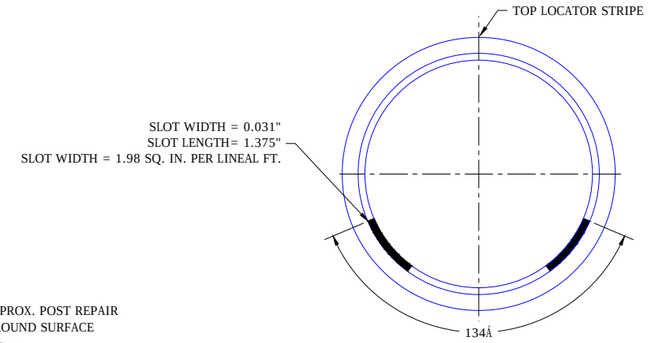
NOTES:

1. DESIGN INTENT WAS TO PROVIDE A TEMPORARY REPAIR TO MINIMIZE UNCONTROLLED SEEPAGE AND TO PROVIDE TEMPORARY EROSION PROTECTION OF THE REPAIR AREA.
2. PLAN SHOWN AT THE ELEVATION OF THE DRAIN PIPE SPRING LINE. CONCRETE ENCASEMENT AND NATIVE CLAY FILL ARE NOT SHOWN FOR CLARITY. THE 1984 & 1996 DRAIN PIPES ALSO NOT SHOWN FOR CLARITY.

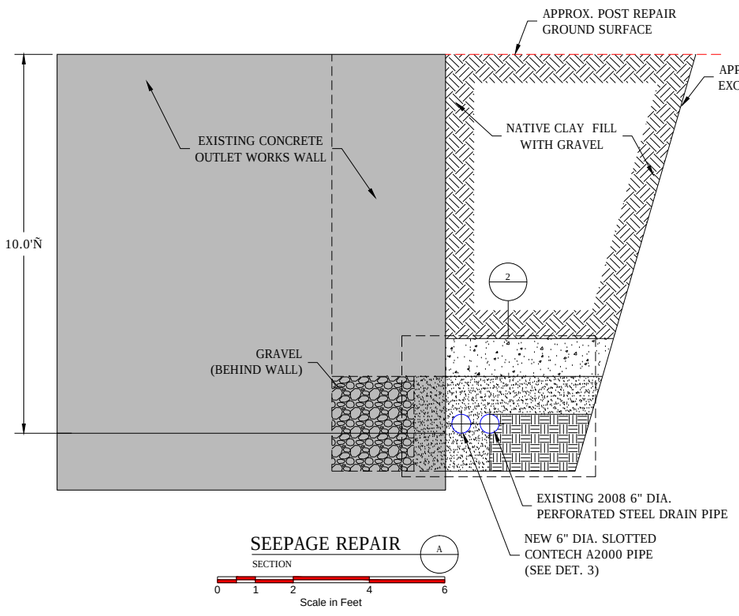


SEEPAGE REPAIR 1
PLAN
0 1 2 4 6
Scale in Feet

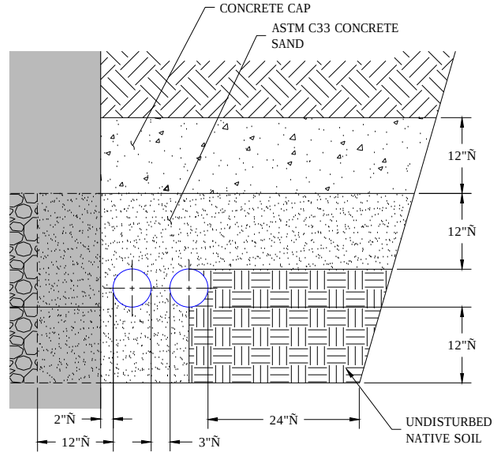
AS-BUILT PHOTO 3-25-16



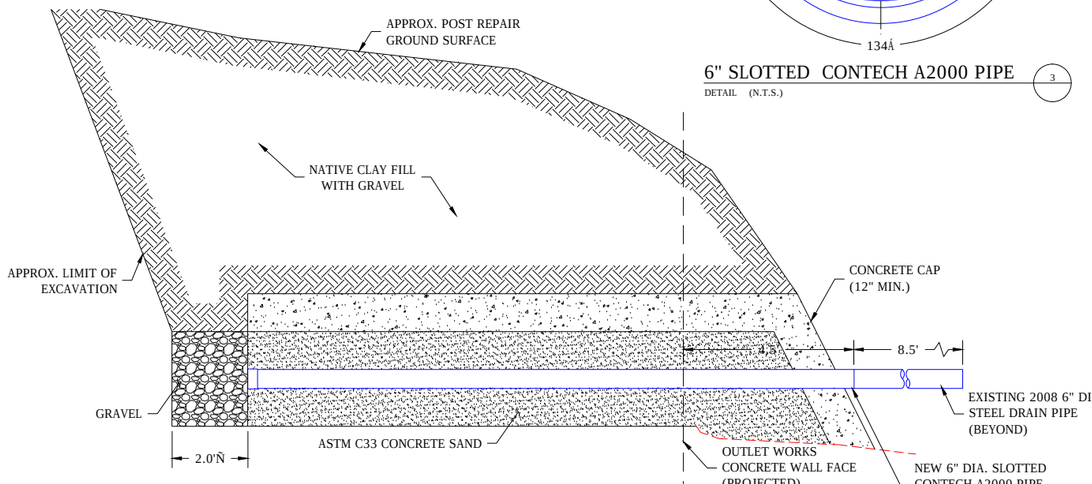
6" SLOTTED CONTECH A2000 PIPE 3
DETAIL (N.T.S.)



SEEPAGE REPAIR A
SECTION
0 1 2 4 6
Scale in Feet



SEEPAGE REPAIR 2
DETAIL
0 ½ 1 2 3
Scale in Feet



NEW SEEPAGE DRAIN B
SECTION
0 1 2 4 6
Scale in Feet

R:\1800\1830\1830.02\Adobe Creek Dam\DRAWINGS\Adobe Creek Dam Seepage Repair - AB 4-22-16 10:23am trevor XREFS:

Revisions	No.	Date	Made	Checked	Remarks
	1	4/8/2016	TEM	SLJ	RECORD AS BUILT SKETCH

Reference	Sheet No.	Drawing No.	Title

COLORADO LICENSED STEVEN L. JANSEN 25028 PROFESSIONAL ENGINEER 4/6/16

W. W. WHEELER & ASSOCIATES, INC
Water Resources Engineers
3700 S. Inca Street | Englewood, CO 80110-3405
303-761-4130 | fax 303-761-2802

ADOBE CREEK DAM

2016 RULE 12.3 SEEPAGE REPAIR

AS-BUILT SKETCH

Client	FORT LYON CANAL COMPANY		
Design	TEM	03/16	Wheeler No. 1830.02
Drawn	SAA	03/16	Sheet No. 1 OF 1
Check	SLJ	03/16	
Plot Date	04/22/2016	1	Drawing No. G1

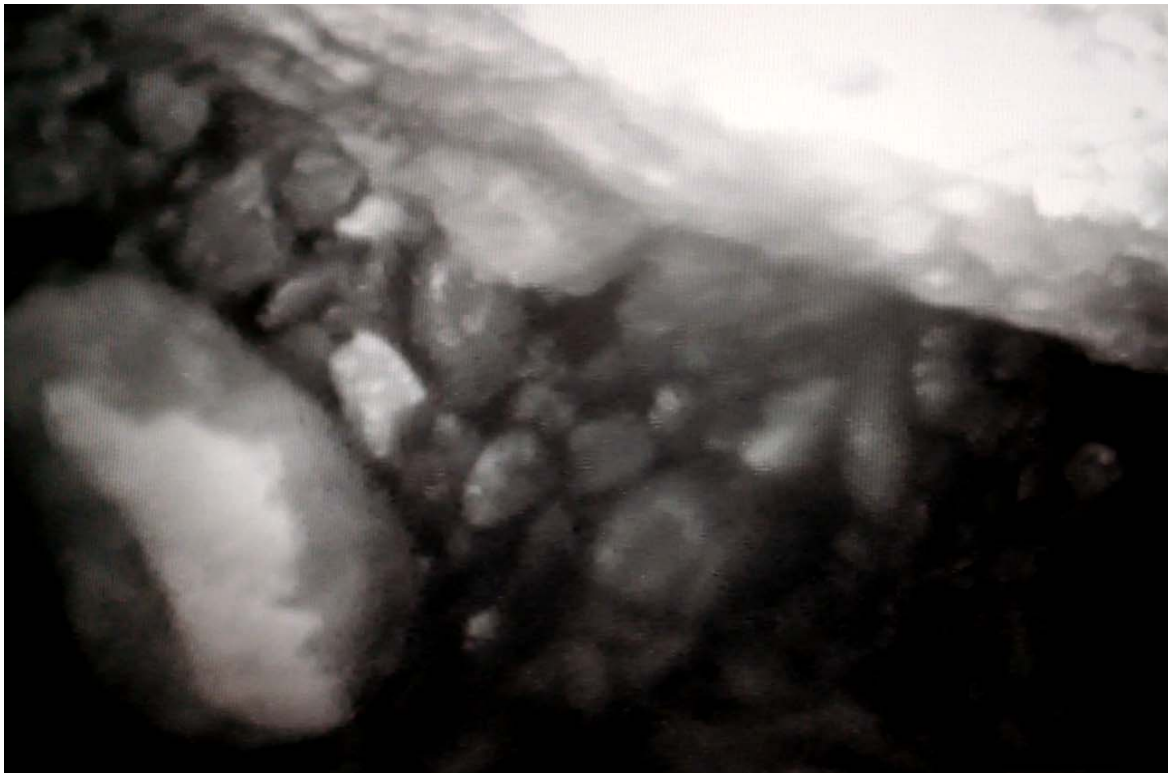
Attachment C

Adobe Creek Dam Left Seepage Drains

Video Inspection

Screen Images

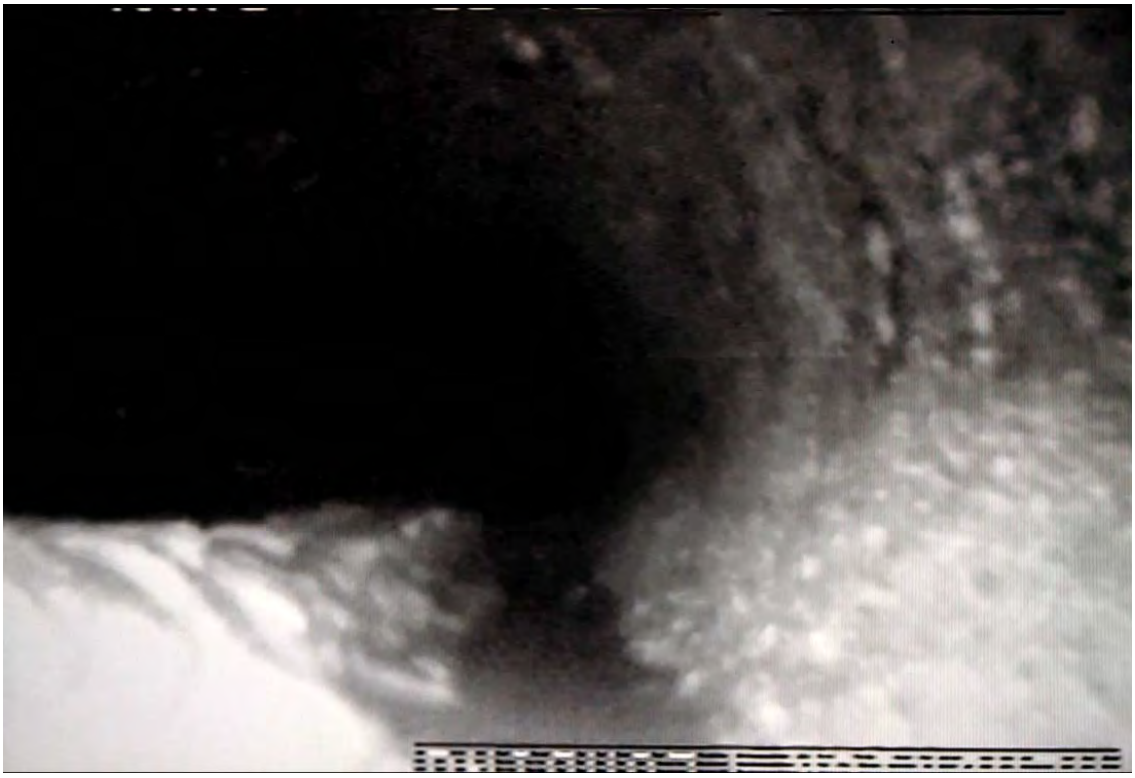
Attachment C
Adobe Creek Dam Left Seepage Drain
Video Inspection
March 23, 2015



Screenshot 1: Uncontrolled Seepage Exit: Clean gravel with uncontrolled seepage flow approximately one foot upstream of the exit point. March 23, 2016.

Screenshot 2: Uncontrolled Seepage Exit: View of interior of seepagechannel at approximately three feet upstream of the exit point. March 23, 2016.

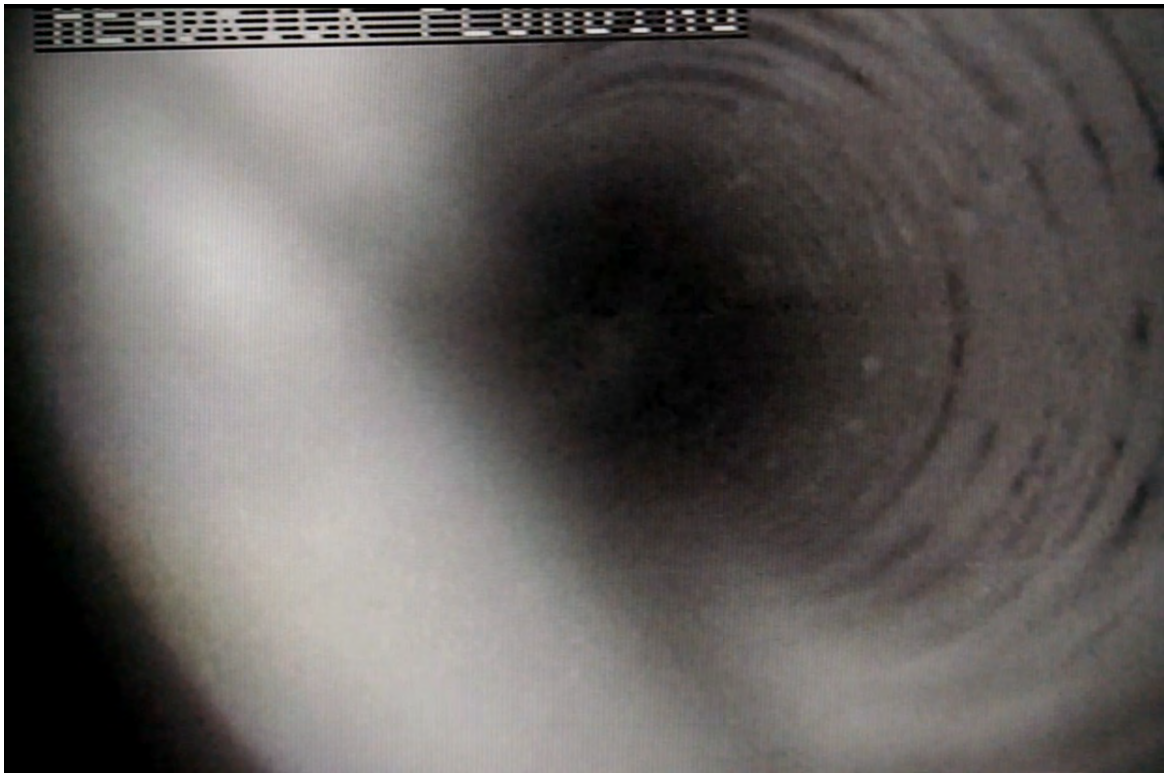
Attachment C
Adobe Creek Dam Left Seepage Drain
Video Inspection
March 23, 2015



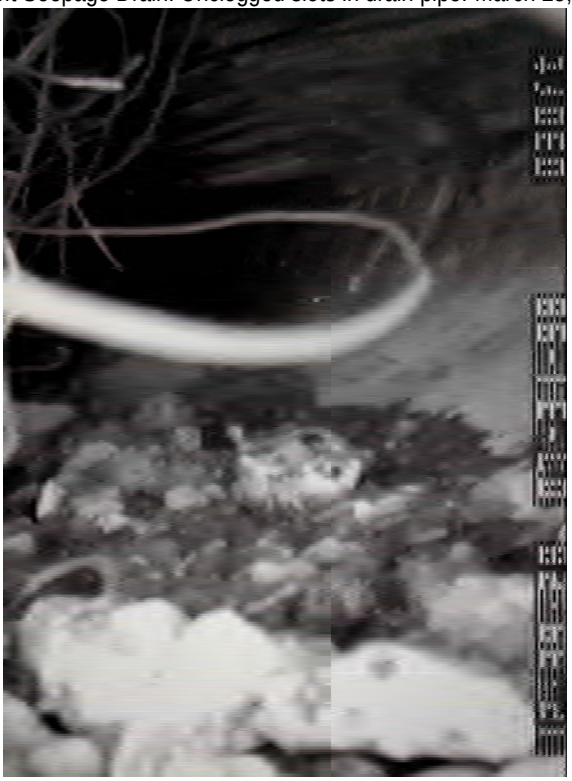
Screenshot 3: 2008 Left Seepage Drain: View of clogged slots on bottom half of pipe. March 23, 2016.

Screenshot 4: 1996 Left Seepage Drain: Unclogged perforations on upstream end cap of drain pipe. March 23, 2016.

Attachment C
Adobe Creek Dam Left Seepage Drain
Video Inspection
March 23, 2015



Screenshot 5: 1996 Left Seepage Drain: Unclogged slots in drain pipe. March 25, 2016.



Screenshot 6: 1984 Left Seepage Drain: Sediment on bottom of pipe and vegetation inside the pipe. March 23, 2016.

Attachment D

Adobe Creek Dam Seepage Repair
Construction Observation Report
Material Gradations

Adobe Creek Dam Seepage Repair
Daily Observation Report
Client: Fort Lyon Canal Company

Date: Friday, March 25, 2015

Report No.: 1 of 1

Weather: Partly Sunny, 5 to 10 mph wind
Temp: 45°F to 66°F
Reservoir Gage: 30.0 feet
Approximate outlet works discharge: 1-2 cfs (Gate Leakage)

Company	Management	Crew	Comments
Fort Lyon Canal Company (FLCC)	**Jerred Hoffman** Superintendent **Jeremy Pryor** Foreman	2 Operators and 2 Laborers	Emergency repairs by installation of new seepage drain.
W. W. Wheeler & Associates, Inc. (Wheeler)	**Trevor Mugele** Project Engineer		Construction observation.

Equipment	In Use	Comments
CAT 930 Loader	X	Brought sand and gravel to excavator from staging area.
CAT 324E Excavator	X	Riprap removal and placement, excavation, sand and gravel placement
CAT 420F Backhoe		Brought as backup to excavator.
Mikasa Rammer Jumping Jack Compactor	X	Used to compact sand, gravel, and native clay fill.

08:30 Trevor Mugele and Jerred Hoffman arrive on-site. Two laborers and two operators are already onsite.

08:40 A safety briefing is conducted by Trevor Mugele with Jerred Hoffman, Brad Owens, Dave Critchfield, Jeremy Prior, Lonnie Kaufman, and Tom Coribble in attendance.

09:00 FLCC begins excavation of riprap and soil above the drains on the left side of the outlet works.

10:00 Excavation is completed down to the top of the existing 1996 left toe seepage drain. The excavation extends about 6 feet upstream of the downstream face of the concrete wingwall.

10:15 Excavation reaches the uncontrolled seepage and the existing ¾-inch gravel pack surrounding the existing 6-inch-diameter, steel seepage drain pipe (2008). At this point

that pipe began to flow a trickle of turbid water. Excavation is also down to the apparent bottom of the old brick drain approximately 3 feet adjacent to the concrete outlet works wall.

10:35 Excavation between the existing drainage pipe and the outlet works wing wall reaches approximately 1 foot below the 2008 left toe seepage drain pipe.

10:45 Trevor Mugele has a phone call to Steve Jamieson to discuss only placing one of the two planned drainage pipes. The space between the 2008 drain pipe and the concrete wing wall is not wide enough to fit two pipes side-by-side. Steve agreed that one pipe is ok given the dimensions.

11:15 FLCC begins placement of first bucket load of gravel along the upstream end of the excavation to slow seepage from that face.

11:20 FLCC begins ASTM C-33 concrete sand placement. Seepage water temporarily flows over sand and washed some out before placement of more sand to temporarily dam up the seepage water.

11:25 FLCC begins placement of one 6-inch-diameter slotted PVC (Contech A-2000) drain pipe on 9 to 12 inches of ASTM C-33 concrete sand. The invert of the new pipe is approximately level with the invert of the 2008 left toe drain pipe.

11:30 FLCC places 9 to 12 inches of hand tamped ASTM C-33 concrete sand over the new drain pipe (4 excavator bucket loads).

11:45 FLCC places 2 more loads of gravel along the face of the excavation. FLCC continued placement of sand over pipe. Uncontrolled seepage in the excavation prohibited compaction of sand.

12:15 FLCC begins placement of 2 bucket loads of gravel in the downstream right corner of the excavation. Trevor Mugele directed FLCC to place a bucket load of sand to act as a temporary dam of seepage water to prevent further washouts.

FLCC bailed water out of excavation with buckets every few minutes (approx. 5 gpm) until concrete truck arrival.

12:30 FLCC crew breaks for lunch. One FLCC laborer remained in excavation to observe and continue to bail water.

Trevor Mugele checked the interior of the new pipe with a spotlight and was able to see to the end, no damage observed.

13:00 Trevor Mugele measured the flow from the left abutment seepage drains.
1996 (far right): 6 gpm
2008 (middle): trickle (clear)
1984 (far left): 21.5 gpm
Reservoir Stage: 30.0 feet

13:15 FLCC tried 2 passes with the jumping jack compactor over the ASTM C-33 concrete sand and gravel. The wet conditions prohibited good compaction. They then bailed more water out of the excavation and use the hand tamper for compaction.

Jerred Hoffman checks the interior of the new drainage pipe for damage, none found.

13:45 Concrete truck arrives on-site. FLCC bails water from excavation one last time and knocks down the temporary sand dam and hand tamps.

14:00 FLCC begins fiber mesh concrete placement on sloping ASTM C-33 concrete sand outside of the excavation from the end of the new seepage pipe up to the outlet works wingwall. The concrete slump was not measured but appeared to be about 2 inches.

14:15 FLCC placed the concrete level over the pipe in the excavation.

14:30 FLCC placed protective concrete to fill in erosion between the 2008 drain pipe and the far left drain pipe (1984).

14:45 End of the concrete placement. FLCC begins concrete finishing work on slope and embeds thin flat stone in the concrete to anchor additional riprap

15:05 FLCC begins backfill of native clay soil over the gravel and concrete. Trevor Mugele instructed them to go slowly to limit outflow of displaced seepage water in the excavation over the uncured concrete.

15:15 FLCC begins placement of Lift 2 of native clay fill in excavation. This lift was drier than that 1st. Compaction consisted of excavator bucket tamping followed by one pass with the jumping jack compactor. Approximate lift thickness 9 to 12 inches.

Due to the soft and wet subsoils Trevor Mugele thought it would be best not to compact with the jumping jack compactor until more soil was placed in the excavation. A phone conversation with Steve Jamieson confirmed this approach was acceptable.

15:30 FLCC begins placement of Lift 3 of native clay fill in excavation. Compaction consisted of tamping with the excavator bucket. Approximate lift thickness 6 to 9 inches.

15:40 FLCC begins placement of Lift 4 of native clay fill in excavation. Compaction consisted of excavator bucket tamping followed by 2 passes with the jumping jack compactor. Approximate lift thickness 6 to 12 inches.

16:10 FLCC begins placement of Lift 5 of native clay fill in excavation. Compaction consisted of excavator bucket tamping followed by 2 passes with the rammer. Approximate lift thickness 9 to 12 inches.

16:30 FLCC begins placement of Lift 6 of native clay fill in excavation. Compaction consisted of excavator bucket tamping followed by 3 passes with the rammer. Approximate lift thickness 6 to 9 inches.

16:55 FLCC begins placement of Lift 7 of native clay fill in excavation to top of outlet works wall. Compaction consisted of excavator bucket tamping followed by 3 passes with the rammer. Approximate lift thickness 9 to 12 inches.

17:20 FLCC begins riprap placement over the repaired area. FLCC begins with large riprap “step” placement above pipes for access.

FLCC placed 5 excavator bucket loads of riprap below and right of the left abutment seepage drains.

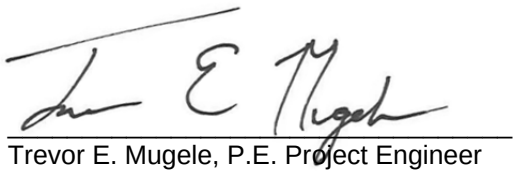
FLCC placed 4 excavator bucket loads of rirprap below and left of the left abutment seepage drains.

17:45 Trevor Mugele checked the flow rate of the new seepage drain pipe. The rate was measured at approximately 0.5 gpm and the flow was clear.

18:00 The remaining FLCC operators and laborers leave the site after a brief discussion of remaining riprap placement work on slope above drains next week.

18:05 Trevor Mugele and Jerred Hoffman call Steve Jamieson to discuss completion of the drain installation and backfill and to discuss the next steps for the EAP.

18:20 Trevor Mugele left site. Jerred Hoffman remains onsite to make calls to make EAP status calls.



Trevor E. Mugele, P.E. Project Engineer
W. W. Wheeler and Associates, Inc.

ALL RITE PAVING and REDI-MIX INC

Batch Start Date and Time		Batch End Date and Time	25-Mar-2016 12:44
Total Batch Number	754	Batch ID Number	6032
Mix Design Number	30	Batch Size (CY)	2
Mix Design Name	RES-MIX-5sk	Mix Design Type	3000PSI 45/55
Mix Design Usage	Residential Mix	Customer Name	FT LYON CANAL CO.
Truck Number	A206	Driver	Howard Meadows

Ingredient Name	Unit	Target	Actual	Moisture	Deviation Lb/gal/oz	Deviation %
3/4 Rock (57/67)	Lb	2904	2875	1	-29	-1.00
Washed Sand (C33)	Lb	3586	3586	2	0	0.0000
Fly Ash "F"	Lb	94	85		-9	-9.5745
Cement III	Lb	846	836		-10	-1.1820
Water	gal	36	40		4	11.1111
AEA	fl oz	4	4		0	0.0000
SPJ	fl oz	30	33		3	10.0000

Free Water in Sand and Rock (Lb)	100.4700	Total Water in Mix (gal)	52.0363
Water Cement Ratio	0.4715		

CESARE, INC.

SUMMARY OF LABORATORY TEST RESULTS

Fremont Paving & Redi-Mix, North River Pit
ASTM Size #57/#67 - Coarse Aggregate
Lab ID # 145110

Gradation (ASTM C136)

Sieve Size	Passing (%)	ASTM C33 Table 3 (%)	AASHTO M43 Table 1 (%)	CDOT Table 703-2 (%)
1.5" (37.5 mm)	100	100	100	100
1" (25 mm)	100	100	100	100
3/4" (19 mm)	91	90-100	90-100	90-100
1/2" (12.5 mm)	49	25-60	25-60	25-60
3/8" (9.5 mm)	26	20-55	20-55	20-55
#4 (4.75 mm)	5	0-10	0-10	0-10
#8 (2.36 mm)	3	0-5	0-5	0-5

Minus #200 Wash (ASTM C117)

Sieve Size	Passing (%)	ASTM C33 Table 4, Class 4S (%)	AASHTO M80 Table 2, Class A (%)	CDOT Section 703.02 (%)
#200 (75 µm)	1.4	≤ 1.5	≤ 1.5	AASHTO M80

Specific Gravity and Absorption (ASTM C127)

Bulk Specific Gravity (Oven Dry)	2.59
Bulk Specific Gravity (SSD)	2.62
Apparent Specific Gravity	2.68
Absorption (%)	1.4

Lightweight Particles (ASTM C123)

Lightweight Pieces at 2.4 Specific Gravity (%)*	Lightweight Pieces at 2.0 Specific Gravity (%)*	ASTM C33 Table 4, Class 4S at 2.4 Specific Gravity (%)	AASHTO M80 Table 2, Class A at 2.4 Specific Gravity (%)	ASTM C33 Table 4, Class 4S, Coal and Lignite (%)	AASHTO M80 Table 2, Class A, Coal and Lignite (%)
0.0	0.0	≤ 5.0	≤ 3.0	≤ 0.5	≤ 0.5

*Lightweight pieces test results provided by WesTest, LLC.

Clay Lumps and Friable Particles (ASTM C142)

Sieve Size	Grading of Original Sample (%)	Mass of Test Fraction Before Test (g)	Mass of Test Fraction After Test (g)	Passing After Test (%)	Clay Lumps and Friable Particles (%)
1.5" (37.5 mm to 3/4" (19 mm)	8.5	1532.9	1530.0	0.1	0.1
3/4" (19 mm) to 3/8" (9.5 mm)	65.7	2006.0	1981.3	1.2	0.8
3/8" (9.5 mm) to #4 (4.75 mm)	20.5	1000.6	999.1	0.1	0.1
				Total Weighted Loss	1.0
				ASTM C33 Table 4, Class 4S	≤ 3.0
				AASHTO M80 Table 2, Class A	≤ 2.0

CESARE, INC.

SUMMARY OF LABORATORY TEST RESULTS

Fremont Paving & Redi-Mix, North River Pit
Washed Concrete Sand - Fine Aggregate
Lab ID # 145112

Gradation (ASTM C136)

Sieve Size	Passing (%)	ASTM C33 Table 1 (%)	AASHTO M6 Table 1 (%)	CDOT Table 703-2 (%)
3/8" (9.5 mm)	100	100	100	100
#4 (4.75 mm)	100	95-100	95-100	95-100
#8 (2.36 mm)	82	80-100	80-100	80-100
#16 (1.18 mm)	60	50-85	50-85	50-85
#30 (600 µm)	38	25-60	25-60	25-60
#50 (300 µm)	13	5-30	10-30	10-30
#100 (150 µm)	4	0-10	2-10	2-10
#200 (75 µm)	2.6	0-3	--	--
		ASTM C33 Sec. 6.2	AASHTO M6 Sec. 5.3	CDOT Sec. 703.01
Fineness Modulus	3.0	2.3-3.1	2.3-3.1	2.5-3.5

Minus #200 Wash (ASTM C117)

Sieve Size	Passing (%)	ASTM C33 Table 1 (%)	AASHTO M6 Table 2, Class A (%)	CDOT Section 703.01 (%)
#200 (75 µm)	2.6	≤ 3.0	≤ 2.0	≤ 3.0

Specific Gravity and Absorption (ASTM C128)

Bulk Specific Gravity (Oven Dry)	2.58
Bulk Specific Gravity (SSD)	2.60
Apparent Specific Gravity	2.65
Absorption (%)	1.0

Lightweight Particles (ASTM C123)

Lightweight Pieces at 2.0 Specific Gravity (%)*	ASTM C33, Table 2, Coal and Lignite, Concrete Surface Appearance Important (%)	AASHTO M6 Table 2, Class A (%)	ASTM C33 Table 2, All Other Concrete (%)	AASHTO M6 Table 2, Class B, (%)
0.0	≤ 0.5	≤ 0.25	≤ 1.0	≤ 1.0

*Lightweight pieces test results provided by WesTest, LLC.

W. W. WHEELER
& ASSOCIATES, INC.
Water Resources Engineers
WWW.WWWHEELER.COM

January 27, 2017

Jerred Hoffman, Superintendent
Fort Lyon Canal Company
750 Bent Avenue,
Las Animas, CO 81054

Subject: **Adobe Creek Dam Outlet Conduit and Seepage Evaluation, Water Division 2, Water District 17, Dam ID 170101, Wheeler Project No. 1830.04**

Dear Jerred,

This letter report summarizes our outlet conduit and seepage evaluations for Adobe Creek Dam. This report was prepared by W. W. Wheeler & Associates, Inc. (Wheeler) for the Fort Lyon Canal Company (FLCC). The subsurface investigations and seepage analyses were performed by Kumar and Associates, Inc. (Kumar) as a subconsultant to Wheeler. This report satisfies the reporting requirements of the Colorado Water Conservation Board (CWCB) Water Supply Reserve Account (WSRA) basin and statewide grant for the work (CWCB, 2016).

PROJECT BACKGROUND

Adobe Creek Dam is located in Bent County approximately 11 miles north of Las Animas, Colorado. The dam was originally constructed in 1904 by the FLCC as an off channel storage facility for Arkansas River water for agricultural use. In 1969, the dam was repaired and raised to provide further storage. It is classified as a high hazard, embankment dam with a height of about 32 feet and a crest length of 7,375 feet. The reservoir has a total storage capacity of nearly 77,400 acre-feet. During a March 2016 inspection by the Colorado State Engineer's Office (SEO), Division 2 Dam Safety Engineer (SEO,2016), uncontrolled seepage and the initial stages of a potential piping failure were observed in the downstream dam toe immediately left of the outlet works. Temporary repairs were made to the dam in March of 2016 with the goal of keeping the dam operational, without storage restrictions through the 2016 water year (Wheeler, 2016).

Recent review of the dam history by the SEO and Wheeler indicates a history of seepage issues at the dam when the reservoir is sustained at a high level. Since 2002, the reservoir has not stored water at near full levels for more than a year. With more water in the Arkansas River in 2015 and 2016, the reservoir has been filled at high levels for over a year and the previously documented seepage issues have resurfaced. It is apparent that uncontrolled seepage issues and have occurred at the dam for many years and will likely

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303-761-4130 | FAX 303-761-2802

continue to be an issue in the future. The FLCC has made several temporary seepage repairs in 1984, 1996, 2008, and 2016, but these temporary drainage repairs are not considered to be effective nor consistent with modern dam safety practice. The Colorado Dam Safety Branch is also concerned about the condition of the 112-year-old, vitrified clay, outlet works conduits in the dam. The FLCC sealed more than 50 leaking joints in the conduits in 1984 and had to seal another 27 leaking joints in 2011. Sealing these joints are also considered temporary repairs.

In order to avoid future reservoir restrictions and maintain safe water storage in Adobe Creek Reservoir, the SEO strongly recommended that the FLCC undertake an outlet works rehabilitation project immediately (SEO, 2016). Wheeler was retained by the FLCC to perform the following evaluations as the initial stage of a dam rehabilitation project under the WSRA grant (CWCB, 2016):

1) Complete subsurface investigations in the dam including installation of additional piezometers;
2) Complete an outlet conduit inspection;
3) Perform dam seepage analyses;
4) Develop dam and outlet conduit rehabilitation or replacement alternatives;
5) Prepare cost opinions for the dam rehabilitation alternatives,
6) Preparation of a repair and rehabilitation feasibility assessment report.

GEOTECHNICAL SUMMARY

Wheeler contracted with Kumar to perform the subsurface investigations and seepage analysis. The results of Kumar's evaluations are provided in a separated report provided in Attachment A (Kumar, 2016). The key results of Kumar's evaluations are summarized below.

Subsurface Investigations

Kumar drilled six exploratory borings in the dam from November 14 to 16, 2016. Three borings were completed along the downstream edge of the dam crest and three were completed along the downstream toe of the dam embankment. All six boreholes were converted into piezometers. There were three functional piezometers located within or near the dam prior to this study. These piezometers are what remain of four piezometers installed, from six boreholes, in June 1984 (Kumar, 2016). The boring logs and piezometer data for the new holes were used to complement data from the existing piezometers and supplement past boring log data. With data from the new piezometers, three cross sections of the phreatic surface through the dam near the outlet works were developed.

The subsurface conditions observed from the new boring logs are consistent with the previous boring logs. In general, the dam is constructed of lean clay with sand that varies in depths from about 28 to 32 feet at the dam crest. A consistent 6.5-foot to 9.5-foot-thick,

layer of medium dense to dense, well-graded sand with silt, generally underlies the lean clay in the foundation of the dam. The sand layer is underlain by a hard to very hard claystone bedrock that is generally located at a depth of about 45 feet below the dam crest. The existing outlet works conduit appears to have been founded on the claystone bedrock. The sand layer also appears to be in direct contact with the outlet works conduits.

Seepage Analysis

Preliminary two-dimensional seepage analyses were performed to evaluate existing seepage conditions through the dam embankment and foundation in the vicinity of the outlet works. Potential dam rehabilitation measures were also modeled to evaluate the effects on reduced seepage flow and exit gradients where uncontrolled seepage exits into the excavated outlet works channel downstream of the dam.

The clay embankment material, native clay foundation material, and claystone bedrock have relatively low hydraulic conductivities when compared to the alluvial sand, therefore the preliminary results of the model indicate that the sand layer controls seepage flow and gradients in the foundation of the dam. The modeled uncontrolled exit of seepage through the foundation sand layer is consistent with field observations of seepage flows exiting the side slopes of the outlet works channel.

The preliminary seepage analysis indicates that seepage exit gradients from the dam near the outlet works are higher than the SEO allowances, which could lead to a piping failure of the dam. Piping failure occurs when the internal or exit seepage gradients are sufficiently high enough that the velocities of the uncontrolled seepage cause movement or erosion of embankment material. This process can occur at the seepage exit on the dam's downstream face or internally along an outlet works conduit. The erosion can work backwards upstream through the dam creating a continually larger opening or "pipe" that can lead to failure of the dam. The uncontrolled seepage face observed in March of 2016 was an example of the early stages of the initiation of piping.

Kumar evaluated three alternatives for rehabilitation of the embankment to reduce the seepage gradients included a soil-bentonite wall, jet-grout columns and a chimney drain. The preliminary seepage analysis results suggest that the construction of a chimney drain system would provide the most effective seepage mitigation for the uncontrolled foundation seepage in the sand layer. The jet-grout columns were the least effective of the alternatives considered. Additional information on the subsurface investigations and preliminary seepage analyses is provided in Attachment A.

OUTLET INSPECTION & ANALYSIS SUMMARY

Outlet Inspection

An inspection of the interior of the four 36-inch-diameter, vitrified clay pipe (VCP) outlet works conduits, downstream of the control gates, was performed by Wheeler on November 9, 2016. This inspection was performed to assess the overall condition of the conduits and the condition of past repairs. In summary, the inspection provided visual confirmation that the conduits have exceeded their design life and are in poor condition. Significant horizontal and vertical displacement and deterioration of the pipe was observed. Significant longitudinal and circumferential cracks were observed throughout the conduits. Large gaps were also observed at pipe joints.

Previous repairs to mitigate leakage at cracks and pipe joints are no longer considered to be effective. Significant leakage was observed entering the conduits through joints and cracks, which could initiate piping in the dam foundation or embankment. Significant leakage of water at the control gates was also observed. In addition to the outlet conduit interior inspection, it was also observed that the concrete on the outlet works intake structure and the terminal structure had significant deterioration and are in need of repair. A summary of the internal inspection findings, including representative photos are provided in Attachment B.

Drawdown Capacity Analysis

Alternatives for design or rehabilitation of dam outlet works requires an evaluation of the hydraulic capacity of the conduits to make normal and emergency releases. The head, or height of water above the outlet works conduits, is dependent on reservoir storage level or stage. The rate that reservoir head drops during a release through the outlet works is dependent on the stage-storage relationship for the reservoir behind the dam and the size and corresponding capacity of the outlet conduits. The most recent topographic survey of the reservoir was performed by Nixon and Associates, Inc. in 2011 (Nixon, 2011). The survey provided an area-capacity curve used in the stage storage relationship calculations for drawdown capacity. The spillway crest is at Elevation 4126.9 feet, 32.3 feet above the outlet works intake at Elevation 4094.6 feet. The storage capacity of the reservoir at the spillway crest, or the normal high water level, is 77,339 acre-feet.

Existing Outlet Works Capacity

The existing outlet works consists of four conduits with approximately 200 feet of 36-inch-diameter VCP pipe. Wheeler performed hydraulic calculations to develop the outlet works rating curve for the existing outlet works conduits using Bernoulli's equation applied between the reservoir surface and the downstream end of the outlet conduits. The combined drawdown capacity of the four existing outlet works conduits was calculated as 535 cubic feet per second (CFS) with the reservoir level at the spillway crest.

Liner Capacity

A common method to rehabilitate existing outlet conduits for dams is to slip-line a smaller liner pipe inside the existing conduit. This is commonly done with a high density polyethylene (HDPE) liner pipe. The smaller outlet works conduit lining will decrease the discharge capacity from that of the existing outlet works. The minimum observed inside diameter of the existing VCP conduit during the inspection was 33 inches. As discussed on the next page, a nominal outside diameter of 28 inches for the liner pipe was used for capacity calculations after allowing for annular grout space between the liner pipe and the VCP and factoring in loading calculations. The DR 11 HDPE liner pipe was assumed to have an approximate inside diameter of 22.8 inches, and the Manning's "n" value is estimated to be 0.009. Hydraulic calculations were performed to develop the outlet works rating curve for the lined outlet conduit using Bernoulli's equation. The resulting combined outlet works capacity of the four lined outlet conduits with a reservoir water surface at the spillway crest is approximately 213 CFS.

Reservoir Drawdown Capacity

Rule 5.9.6.2.1 of the State of Colorado Rules and Regulations for Dam Safety and Dam Construction (SEO, 2007) states: "The outlets for High Hazard dams shall be capable of releasing the top five feet of the reservoir capacity in five days." This rule is intended to provide adequate outlet works capacity to quickly lower the reservoir water surface during an emergency at the dam. This rule is required to be addressed by the SEO for new dam construction or outlet works replacement and repair work. Calculations were performed to determine that the maximum flow rate of 2,360 CFS is required to drawdown the reservoir five feet from the spillway crest in five days.

Using the Army Corps of Engineers HEC-1 computer program, the current outlet conduits were estimated to have the capability to drawdown the top five feet of the reservoir in 24 days. The capability of the lined outlets were estimated to have the capability to drawdown the reservoir five feet in 59 days. Neither the existing conduits nor the lined conduits have the capacity to meet the SEO reservoir drawdown rule.

CONCEPTUAL REHABILITATION ATERNATIVES

Wheeler developed conceptual level dam rehabilitation alternatives that address outlet works rehabilitation and seepage control in Adobe Creek Dam. Using the data gathered from the geotechnical investigations and analysis and the outlet inspection two outlet works rehabilitation and two dam seepage control concepts were developed. There was limited existing survey data in the area of the outlet works, so field observations and aerial photos were used in developing the design concepts.

Outlet Works Rehabilitation

The two options considered for rehabilitation of the outlet works were to line the existing conduits with a smaller diameter HDPE pipe or completely replace the existing conduits with new, larger concrete box culvert conduit.

Colorado Dam Safety Rule 5.9.6.2.3 states: "Outlet conduits for all dams, except for dams with un-gated outlets, shall have a guard gate installed at the upstream end of the conduit." The existing outlet does not have guard gates; therefore, both the liner and replacement options include the provision to construct a new concrete gate tower. FLCC could apply for a waiver for this rule, but it may be unlikely to achieve approval from the SEO. The necessity for access to the new structure at all reservoir water levels required additional fill and a short access bridge from the dam crest to the new gate tower in our conceptual design. The new gate tower conceptual design also includes a steel trash rack.

HDPE Outlet Liner

Our outlet conduit liner concept assumed that a 28-inch-diameter, DR 11 HDPE pipe would be used to line the existing outlet works conduits. The annular space between the new liner and the existing outlet conduit would be grouted. The conceptual design of the new outlet works gate tower for a liner includes eight new 36-inch-square sluice gates. Four of the gates would be guard gates mounted on the upstream wall of the new gate tower and four of the gates would be control gates mounted on the downstream wall of the structure. All gates were assumed to be provided with a mobile electric or hydraulic actuator. The existing control gate tower was assumed to be abandoned by backfilling with lean concrete and left in place. Refer to Figure 1 of Attachment C for plan and profile views of the conceptual design components for the HDPE liner outlet works rehabilitation alternative.

Complete Outlet Works Replacement

A 12-foot-wide by 10-foot-tall concrete box culvert was selected for the replacement outlet works conduit using the calculations performed in the capacity analysis. The conceptual design of the new outlet works gate tower for a replacement conduit includes eight new three-foot-wide by 10-foot-tall square sluice gates. Four of the gates would be guard gates mounted on the upstream wall of the new gate tower and four of the gates would be control gates mounted on the downstream wall of the structure. All gates were assumed to be provided with a mobile electric or hydraulic actuator. The existing control gate tower would be demolished as a part of the excavation in the dam for the outlet works conduit replacement. The replacement of the conduits necessitates demolition of the existing terminal structure and replacement with a new reinforced concrete terminal structure. Refer to Figure 2 of Attachment C for plan and profile views of the conceptual design components for the complete replacement outlet works rehabilitation alternative.

For either option it is recommended that work be performed to regrade and reinforce the outlet channel downstream of the terminal structure to prevent erosion at the dam toe during

controlled water releases from the dam. Wheeler proposes to lay back the outlet channel side slopes to three horizontal to one vertical and to line the side slopes and channel bottom with soil cement for a distance of about 30 feet downstream of the outlet works terminal structure.

The increased discharge capacity resulting from the outlet works replacement conduit alternative is larger than the capacity of the Fort Lyon Canal downstream of the dam. As a result, the replacement alternative includes provisions for armoring about 1,000 feet of the canal dike crest and downstream slope with roller compacted concrete to act as an overflow spillway in the canal bank. This work would occur in the approximate location of the existing filled in spillway.

Temporary Reservoir Control

Temporary reservoir control during construction would be required with either outlet works rehabilitation concept to control inflows and provide temporary reservoir releases. Two concepts were considered: a large cofferdam built to the elevation of the dam crest, and a small cofferdam built to the elevation of the top of the sides of the approach channel. Both concepts would include temporary pumping facilities to provide limited bypass flows during construction. The large cofferdam would allow for reservoir storage levels up to the normal high water line during construction. The smaller cofferdam would allow storage up to about five feet below the top of the approach channel during construction. The cofferdams were assumed to be earthfill construction with a ten-foot-wide crest and three horizontal to one vertical side slopes. Refer to Figure 3 of Attachment C for plan and profile views of the conceptual design alternatives for temporary reservoir control.

Seepage Control Systems

Two of the three seepage control rehabilitation alternatives considered in the geotechnical report were incorporated into the conceptual design: a soil-bentonite cutoff wall and a chimney drain system. The jet-grout columns were not evaluated because this approach would be more expensive and less effective than the other alternatives.

Soil Bentonite Cutoff Wall

The soil bentonite cutoff wall concept is expected to significantly reduce the seepage through the embankment. The cutoff wall would extend through the entire sand layer into bedrock. The conceptual design for this seepage control mechanism includes a three foot wide by approximately 40 foot deep excavation of the embankment material from the crest with replacement by backfill of a soil-bentonite mixture. The cutoff wall is designed to extend along the crest approximately 400 feet in either direction from the outlet works. A shallow bury toe drain is also included in this design to replace the existing seepage drains and catch any seepage not blocked by the cutoff wall.

Chimney Drain

The chimney drain design concept would replace the existing toe drains with a two filter material collection system. The chimney drain design includes a fine sand filter material which extends vertically through most of the embankment toe down through the sand layer to bedrock, and a coarse drain gravel material that surrounds and collects flows from the filter into a drain pipe. The coarse drain gravel and the drain pipe would be located within the fine filter sand material just above bedrock. The chimney drain is designed to extend along the dam toe approximately 400 feet in either direction from the outlet works and is intended to collect and control seepage through the natural sand layer in the dam's foundation.

A shallow bury toe drain to collect seepage in the lower embankment sections located from 400 feet to the left and right of the outlet works to the dam abutments is also included as a part of both seepage control concepts. Past SEO inspection reports from the late 1990s, when the reservoir level was high for a long period, contain sketches of seepage observed at the dam toe for several hundred feet on either side of the outlet works conduits. Kumar observed an interface between native clay and embankment fill in the new boring logs. The interface may be the cause of seepage surfacing at the dam toe in these areas. A shallow bury toe drain would be designed to collect and control seepage in these areas when the reservoir is full for extended periods of time.

Refer to Figure 4 of Attachment C for plan and profile views of the conceptual design alternatives for seepage control rehabilitation alternatives.

ALTERNATIVES COMPARISON

Wheeler developed an itemized cost opinion for the conceptual dam rehabilitation and seepage control system alternatives designs. The cost opinions were generated utilizing the Wheeler database of similar dam construction bid items and the R.S. Means Heavy Civil Estimating Guide. The costs are considered Class 4 cost opinions under the Association for the Advancement of Cost Engineering (AACE) Accuracy Matrix (USSD, 2012). AACE Estimate Class 4 identifies projects as up to 15% of complete definition with an expected accuracy that could be vary the estimated costs by -30% or +50%.

The cost opinion for a large cofferdam and temporary bypass pumps and pumping for temporary reservoir control was estimated to be approximately $2,300,000, while the cost opinion for a small cofferdam and temporary bypass facilities was estimated to be $600,000. The cost for both included limited capacity pumping of water from the reservoir for a short period of time, which are well below the flow rate and volumes of normal reservoir releases. Wheeler considered the cost to construct the large cofferdam to be cost prohibitive for the FLCC. Therefore, a side-by-side cost comparison of the two outlet rehabilitations options using the small cofferdam temporary reservoir concept is provided in Table No. 1 below.

The chimney drain, with a cost opinion of $274,000, is included in both options below as it provides the better alternative for uncontrolled seepage mitigation and is also more cost effective than the soil-bentonite cutoff wall, with a cost opinion of $348,000.

Table No. 1: Rehabilitation Alternatives Cost Comparison

Outlet Works Conduit Lining		**Outlet Works Conduit Replacement**	
Small Cofferdam	$615,000	Small Cofferdam	$615,000
Line Outlet Works	$1,599,000	Replace Outlet Works	$3,448,000
Chimney Drain	$274,000	Chimney Drain	$274,000
Miscellaneous Work	$540,000	Miscellaneous Work	$540,000
Construction Subtotal	**$3,634,000**	**Construction Subtotal**	**$5,852,000**
Indirect Costs	$1,251,000	Indirect Costs	$1,972,000
Total Costs	**$4,885,000**	**Total Costs**	**$7,824,000**

The second row of the table, the rehabilitation method of the outlet works, is the key difference between the two alternatives. The total cost of the outlet lining alternative with seepage control, small cofferdam temporary reservoir control, miscellaneous work, and indirect costs is estimated to be about $4.9 million dollars. The total cost of the outlet replacement alternative with seepage control, small cofferdam temporary reservoir control, miscellaneous work, and indirect costs is estimated to be approximately $7.8 million dollars.

Miscellaneous work includes outlet channel reinforcement, which was recommended in the geotechnical report, as well as the inclusion of a shallow bury toe drain along a 6,300 foot length of the dam toe outside of the chimney drain. Along with other conceptual design components, the miscellaneous work will require further discussion with the FLCC and the Colorado Dam Safety Branch. There are some indirect costs associated with final design and construction that have been included in this cost opinion that may also vary with further refinement.

Refer to Attachment D for the detailed cost estimate for all of the components and the two primary alternatives considered.

REFERENCES

1. Colorado Office of the State Engineer (SEO, 2007) *Rules and Regulations for Dam Safety and Dam Construction*, January 1, 2007.
2. Colorado Office of the State Engineer (SEO, 2014) *Project Review Guide, June 27, 2014.*
3. Colorado Office of the State Engineer (SEO, 2016) *Engineer's Inspection Report for Adobe Creek Dam,* inspection date March 22, 2016.
4. Colorado Water Conservation Board (CWCB, 2016) *WSRA Grant for Evaluation of Seepage and Outlet Conduit Issues at Adobe Creek* Dam, 2016
5. Nixon and Associates, P.A. (Nixon, 2011) *Adobe Creek Reservoir Survey*, September 2005, Revised June 2011
6. Kumar & Associates, Inc. (Kumar, 2016) *Geotechnical Engineering Study, Adobe Creek Dam Seepage Evaluation*, December 21, 2016.
7. United States Society on Dams (USSD, 2012) *Guidelines for Construction Cost Estimating for Dam Engineers and Owners*, May 2012.
8. W.W. Wheeler & Associates, Inc. (Wheeler, 2016) *March 2016 Uncontrolled Seepage Repair*, April 7, 2016.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the presented findings, Wheeler offers the following conclusions and recommendations:

1. The subsurface investigations and seepage analysis identified an alluvial sand layer near the foundation bedrock for the dam that is considered to be the controlling factor in the historic seepage issues near the outlet works at the toe of the dam. Preliminary analyses for existing seepage have calculated higher than acceptable exit gradients in this sand layer.

2. A chimney drain system was preliminarily identified as the best alternative considered, in terms of both effectiveness and cost, for rehabilitation of the seepage control at Adobe Creek Dam.

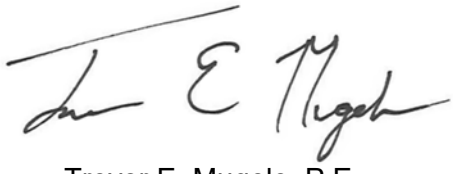
3. The outlet works conduit interior inspection identified significant deficiencies in the existing conduits that confirms the SEO opinion that the outlet works at Adobe Creek Dam has exceeded its design life and requires rehabilitation.

4. Two alternative concepts were considered for outlet works conduit rehabilitation: line the existing outlet works conduits with HDPE pipe, thereby reducing outlet works capacity; or replace the existing outlet works with a concrete box culvert designed to meet SEO capacity requirements.

5. Cost opinions were generated for both outlet works rehabilitation concept alternatives. Wheeler's opinion of total project costs for the outlet works lining and replacement alternatives was approximately $4.9 million and $7.8 million, respectively. These cost opinions were developed in 2016 and the costs will increase in future years.

Sincerely,

W. W. Wheeler & Associates, Inc.



Stephen L. Jamieson, P.E.
Principal

Trevor E. Mugele, P.E.
Project Engineer

Cc: Mark Perry, Dam Safety Engineer, Colorado Division of Water Resources, Division 2

Appendix G

Loan Resolution

Special Stockholders Meeting – May 23, 2017

A Special Meeting of the Stockholders of the Fort Lyon Canal was held on May 23, 2017 at the Pioneer Historical Society Museum to authorize the Board of Directors to contract indebtedness in excess of $50,000.00 above the anticipated available funds for the fiscal year for the repair of Adobe Creek Dam.

President Hemphill called the meeting to order and stated to those in attendance that only the subject posted in the Special Meeting Notice will be discussed today.

Director Mauch read the Notice of the Special Stockholder Meeting as placed in area newspapers.

Joe Kasza moved to nominate Amy Van Horn as secretary for the Special Stockholders Meeting. Bill Grasmick seconded and the motion carried by voice vote.

President Hemphill called upon Steve Jamieson with W. W. Wheeler & Associates. Mr. Jamieson reviewed a Power Point presentation pointing out the issues with the outlet works of Adobe Creek Dam. In March 2017 an inspection was performed on the outlet works by the Dam Safety Engineer and representatives from W. W. Wheeler. A reservoir restriction was then discussed with the Board of Directors.

In May 2017 a letter was received from Colorado Division of Water Resources ordering a restricted reservoir level of 25.3 feet. This storage restriction will result in a loss of storage volume of approximately 32,860 acre feet.

Discussion was held regarding the possibility of enlargement of the dam.

A prequalification application has been presented to the Colorado Water Conservation Board requesting a low interest loan for this project. There is the potential of obtaining 1.1 million in grant funds for this project.

A Feasibility Report will be prepared and presented to the CWCB. Approval of the loan and grants is expected in September 2017.

Construction on the project would be expected to be complete in 2019.

Mr. Jamieson answered questions from those in attendance.

Jack Goble with Lower Arkansas River Water Conservancy District discussed the grant funds that will be available for this project.

Tom Williamsen reported on possible alternate storage options while Adobe Creek Dam is under restriction.

- Winter water storage season – Use Horse Creek Reservoir and Adobe Creek Reservoir up to the restricted level. During construction it is expected that Fort Lyon will not be able to use Adobe. Winter water can also be stored in Lake Meredith, Pueblo Reservoir and John Martin Reservoir.
- Irrigation season – When the Storage Canal comes into priority and rehabilitation is underway:
    - Use Horse Creek reservoir to store up to its capacity, approximately 28,000 acre feet.

- Lake Meredith – unlikely because when the Storage Canal is in priority Colorado Canal is already in priority for 756 cfs so there would be no diversion capacity. The same reasoning for Holbrook/Dye Reservoirs.
- Pueblo Reservoir – must obtain excess capacity contract from USBR. The current charge is $40.04 per acre foot (USBR) plus $1.75 per acre foot (SECWCD). Expect 1.79% increase in 2018. Charge is for space of payment would be required whether or not water is stored. For 10,000 acre feet the annual charge works out to $418,000.00. Spill category 2 – spills after the out of district user contracts spill (mostly Aurora) and before winter water. We would need a substitute water supply plan approved by the State Engineer.
- John Martin Reservoir – Fort Lyon has an Article 3 account in JMR for up to 20,000 acre feet under the 1980 Resolution for an Operating Plan for John Martin Reservoir. Charge is 35% of the stored water. We cannot store water that otherwise would accrue to Conservation Storage. Use of the account in any other manner would require ARCA approval which is unlikely.

- Colorado Springs, Aurora and CAA may have an interest in Arkansas basin storage if the dam is enlarged.

The Credentials committee reported that there are 65,595.08 shares represented. A quorum is present. President Hemphill called for a motion to accept the Credentials report as read. Kim Siefkas made such motion, seconded by Fred Heckman. Motion carried by voice vote.

Wesley Eck made a motion, seconded by Fred Heckman, to move ahead with the project on Adobe Creek Dam. The motion carried by voice vote.

There was discussion as to whether the motion included the possible enlargement of Adobe Creek Dam. Wesley Eck and Fred Heckman rescinded their motion. A motion was then made by Lance Jagers, seconded by Burt Heckman to move ahead with the project, including as much enlargement to the dam as possible. The motion carried by voice vote.

There being no further discussion the meeting adjourned at 2:45 p.m.

Approved by the Board subject to motion and approval at the 2017 annual meeting.

Minutes approved 6/14/17

Dale L Mauch

Dale Mauch, Secretary

Phil Hemphill

Phil Hemphill, President