Feasibility of Piping
the
Orchard Ranch Ditch

Sponsored by the
Orchard Ranch Ditch Company
in conjunction with
The Colorado Water Conservation Board
and
The United States Bureau of Reclamation

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

1/13/16
Date

November 2015

Table of Contents and list of Appendices

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Paul Kehmeier
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BACKGROUND

Purpose

The proposed project will pipe an earthen canal and several laterals in conjunction with the U.S. Bureau of Reclamation Salinity Control program. Approximately 90% of the cost of will be provided by the U.S. Bureau of Reclamation. The Orchard Ranch Ditch Company is requesting a $150,000 loan from the CWCB to complete the funding package needed to carry out the project. This project is considered to be rehabilitation of existing facilities. The piping project will accomplish two main goals:

1) Decrease the amount of salt entering into the Colorado River by an estimated 1004 tons each year over the 50 year lifespan of the project.

2) Modernize the irrigation delivery system for the shareholders of the Orchard Ranch Ditch. The modernization will result in an increased opportunity for shareholders to implement water saving irrigation practices such as sprinkling. The project will also increase the amount of water available for irrigation because of a decrease in canal transit loss.

The project is needed to keep local agriculture viable as the farmers face pressures from increased housing development near to the ditch and increased demand for water from other users of water from Colorado River.

Study Area Description

The study area is located in Delta County near the town of Eckert. The largest nearby town is Delta which is located about 10 miles south of Eckert. The topography of the area is dominated my mesas and valleys. The piping project is on the Surface Creek mesa, a relatively flat mesa which has been farmed for well over 100 years. Currently about 350 acres served by the ditch are being farmed. In the past over 400 acres have been farmed and some of that land is expected to resume irrigation when new ownership takes place. The main crops are hay, pasture, and fruit. Typical alfalfa yields are 4 tons per acre per year. Typical apple yields are 600 bushels per acre. Cattle are the main livestock grazed on the pastures.

The main stream in the study area is Surface Creek which originates about 20 miles to the north on the Grand Mesa. The Gunnison River is located about 8 miles to the south of the study area. The Gunnison River drains the entire region.

The study area is historically an agricultural area with small towns serving the agriculture industry. Coal mining has taken place nearby, but is no longer active. Other important employers are education, health care, and government. No major industry is located in the study area. In the last 40 years, the mild climate and beauty of the area has made the area a popular location to retire. Some of the agricultural lands have been converted to residential developments which are populated mainly by older citizens. The population of the entire Delta County is currently about 30,000 people.

Appendix A contains maps showing the study area and proposed project.

Previous Studies

The NRCS conducted reconnaissance level studies in 1989-92 to modernize the Orchard Ranch Ditch 1989-92. Both underground piping and concrete lined ditch were considered. During that period one cost estimate for piping only the main canal was $281,000. For various funding reasons both on the part of the NRCS and the ditch company the project was not implemented.

In the U.S. Bureau of Reclamation's 2012 funding cycle the Orchard Ranch Ditch applied for funds to pipe the ditch and several laterals. The application was not funded because the project cost of $1,479,000 was not competitive with other applicants for the U.S. Bureau of Reclamation funds.

PROJECT SPONSOR

The sponsor of this project is the Orchard Ranch Ditch Company. The Company's ditch was dug in the late 1800's by a group of early settlers cooperating to get water to their new farms. The ditch has been in continuous operation since that time. The Orchard Ranch Ditch Company is a mutual ditch company incorporated in the State of Colorado on August 8, 1915. A copy of company's Articles of Incorporation and By-laws are found in Appendix B.

There are 17280 shares of stock in the Orchard Ranch Ditch Company. There are 34 shareholders, three of which are homeowners' associations. Natural stream flow water from the company's decrees is divided proportional to the number of shares owned by each shareholder.

Revenue for company comes almost entirely from assessments on shares of stock. A very small portion of the revenue comes from administrative fees charged to the shareholders.

The Orchard Ranch Ditch owns a concrete diversion in Surface Creek. It also owns, a concrete spillway, concrete headgate structure, and 2 Parshall flumes set in concrete. In the canal itself the ditch company owns 9 concrete division boxes for sending water into the laterals. The easement for the ditch is prescriptive. The ditch company does not own any rights of way.

WATER RIGHTS

Water Availability

The Orchard Ranch Ditch owns 3 decrees for natural stream flow water in Surface Creek. They are listed below:

Court Action 0038	adjudication of 06/17/1889, absolute, Decree #4	5.70 cfs
Court Action 0457	adjudication of 09/28/1907, absolute, Decree # 27	6.45 cfs
Court Action 4808	adjudication of 01/31/1964, absolute, Decree #K46	10.00 cfs

The number 4 decree typically runs April 1 – July 10

The number 27 decree typically runs May 1 – June 10
The number K46 decree typically runs May 10 – May 20, but in years of below normal snowpack on the Grand Mesa it may not run at all.

Many of the shareholders own storage water rights in private reservoirs on the Grand Mesa. The ditch delivers water from these reservoirs to the owners of the storage water in addition to their proportional rights to the natural stream flow decrees.

The annual amount of water the Orchard Ranch Ditch carries varies substantially depending on the snowpack on the Grand Mesa. A typical year is 2500-3000 acre feet of water with perhaps three quarters of that being natural stream flow water and one quarter being storage water.

Water Supply Demands

The availability and demand for water in the project area can be characterized as, "almost adequate if you do a good job irrigating." This is typical of the dry mesas of Delta County. A certain amount of the service area of the Orchard Ranch Ditch will probably be converted from agriculture to housing and small acreage farming over the 50 year lifespan of this project. However as the house owners and small acreages become owners of ditch company shares they typically use the water as fully as the farmer previously did. Currently about ¼ of the farmland is in conservation easement, so at a minimum this much acreage is expected to continue in production agriculture.

The project will provide a small increase in water availability – probably no more than 5% - from stopping the seepage out of the bottom of the earthen canal. However the project will go a long ways towards providing water security for the ditch's service area in a situation of increasing population in the service area and increasing demand for Colorado River water.

PROJECT DESCRIPTION

Analysis of Alternatives

The purpose of the project is to rehabilitate and improve existing facilities. Three alternatives were considered:
1) The no action alternative
2) Piping the ditch and portions of 4 laterals with Polyvinyl chloride plastic (PVC) pipe
3) Piping the ditch and portions of 4 laterals with High density polyethylene (HDPE) pipe

The alternatives were compared to each other using the evaluation factors suggested in the CWCB Water Project Loan Program Guidelines. In some cases the evaluation factors were applied in a non quantitative manner. However this technique was sufficient to highlight differences and choose a preferred alternative. Appendix C shows the analysis of alternatives.

The evaluation methodology used in choosing a preferred alternative consisted of reviewing the evaluation table in Appendix C while guided by the following goals:

1) The preferred alternative should **modernize** water delivery and provide the opportunity to shareholders to implement more efficient irrigation practices.
2) The preferred alternative should provide long term **security** of water availability to shareholders in the face of increased density of local population and increased demand on Colorado River water
3) The preferred alternative should choose a practice that has long term **reliability.** A lifespan of 50 years was considered.
4) The preferred alternative should have the **Shareholders**' portion of the **cost** not be excessive
5) The preferred alternative should be able to retain a construction grant from the U.S. Bureau of Reclamation. The grant focuses on **decreasing the salt load** in the Colorado River

Alternative 1 was ruled out because it did not achieve the ditch company's goal of modernizing the water delivery system. The alternative was also ruled out because it does not achieve the goals of decreasing salt in the Colorado River nor of improving the long term ability of the ditch company to deliver water to shareholders.

Alternative 2 was ruled out because our engineering company advised that HDPE would be a better material for our project.

Alternative 3 was chosen because it was only slightly more expensive that Alternative 2. This made the shareholders portion of the cost acceptable. In addition alternative 3 did the best job of achieving the other 4 goals.

Selected Alternative

Narrative Description

The project will replace approximately 8260 feet of earthen main canal and 2560 feet of earthen laterals with underground pipe. In some sections multiple pipes lying side by side will be used instead of a single pipe. This multiple pipe feature will better manage water distribution to shareholders. In all, approximately 16,660 feet of pipe will be laid. A new headgate and screening structure will be constructed at the inlet of the piping system. The existing diversion in the creek and spillway are functioning well, so no new diversion or spillway are planned.

The project will be operated much the same as at present. Namely the water will be divided among the shareholders in proportion to the number of shares they own. The ditch company will continue to employ a ditch rider to do this task.

Map

Map 3 in Appendix A shows existing and proposed components for the entire project.

Conceptual Plan/Cross-Section

A diagram of typical trench excavation, pipe bedding and back fill is found in Appendix D. A detailed survey has been done of the project. It is not yet available for

inclusion in this feasibility study. It will show profile and hydraulic gradeline.

Conceptual Design Features

The U.S. Bureau of Reclamation grant which the ditch company received for this project states that at a minimum all projects must meet NRCS construction standards. A sample standards sheet is found in Appendix E

Field Investigations

This project is to rehabilitate an existing facility. It is anticipated that minimal field investigations will be needed.

Right-of-Way/Land

A tabulation of land ownership and easement requirements is found in Appendix F.

Cost estimate

A detailed cost estimate for the project is found in Appendix G

Implementation Schedule

The project implementation schedule is found in Appendix H

Impacts

The terms of the ditch company's grant from the U.S. Bureau of Reclamation include requirements for compliance with NEPA, cultural resource regulations, and paleontological protection regulations. An environmental analysis will be conducted. A cultural study will be conducted to determine historical and paleontological impacts. A wildlife habit replacement plan will be implemented during the same time the piping project is being implemented.

The U.S. Bureau of Reclamation will be the lead Federal agency for NEPA compliance and will be responsible for evaluating technical information and ensuring that natural, and cultural, and socioeconomic concerns are appropriately addressed.

Impacts on local and/or regional plans for water resource development, land use, recreation, and economic development will likely be minimal since this project rehabilitates facilities that are already existing and in use. The ability to manage water quality will be greatly upgraded. The project will cause an estimated decrease of 1004 tons of salt entering the Colorado River every year for the next 50 years.

Two of the three decrees for natural stream flow water are pre 1922 decrees. The proposed project should help insure the continued use of those decrees and thus safeguard water rights for the state of Colorado.

Funds to study and mitigate impacts of the project are included in the detailed cost estimate shown in Appendix G.

Institutional Feasibility

The U.S. Bureau of Reclamation will oversee obtaining compliance with Federal and State agencies. Local permits for such things as road crossings will be obtained by the ditch company.

FINANCIAL FEASIBILITY ANALYSIS

Loan Amount

The project is expected to cost $1,430,720. The Orchard Ranch Ditch Company is requesting a loan of $150,000 from the CWCB with a 30 year term and a hybrid agricultural - municipal interest rate of 1.95%

Financing Sources

Grant currently being processed by U.S. Bureau of Reclamation	$1,280,720
Loan from CWCB	$ 150,000

Revenue and Expenditure Projections

The Orchard Ranch Ditch schedule of revenue and expenditures for the 30 year life of the loan is found in Appendix I. The schedule is built on the assumption that when the piping project is completed operation, maintenance, and replacement costs will be approximately 50% higher than they are a present.

Loan Repayment Sources

The funds for loan payment will come from shareholder assessments. Current assessments are $.40 per share plus $75 per shareholder. Increase in assessments for servicing the CWCB loan is expected to be approximately $0.39 per share for 30 years.

Financial Impacts

Currently the Orchard Ranch Company has no debt. The total assessment for operations, maintenance, replacement and debt repayment is expected to be about $1.15 per share before inflation during the 30 year life of the CWCB loan. It is unknown if any financial savings will result from this project.

TABOR

The Orchard Ranch Ditch is a private mutual ditch corporation. It has tax exempt status with the Internal Revenue Service. The Orchard Ranch Ditch Company is not subject to the provisions of TABOR

Collateral

The Orchard Ranch Ditch Company will provide the following collateral:
1) A pledge of assessment revenues backed by a rate covenant that guarantees the assessment rates will be adequate to cover all of debt obligations
2) A pledge of the company's water distribution facilities

Sponsor Creditworthiness

The 2015 assessment is $.40 per share and the administration fee is $75.00 per shareholder.

Copies of the three most recent annual financial statements are found in Appendix I.

CONCLUSIONS AND RECOMMENDATION

The Orchard Ranch Ditch piping project is a rehabilitation project that is technically feasible. Approximately 90% of the funding for the project is being provided by the U.S. Bureau of Reclamation. The funding from the U.S. Bureau of Reclamation makes the project financially feasible for the ditch company.

The project will help protect natural stream flow decrees that predate the 1922 Colorado River Compact.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

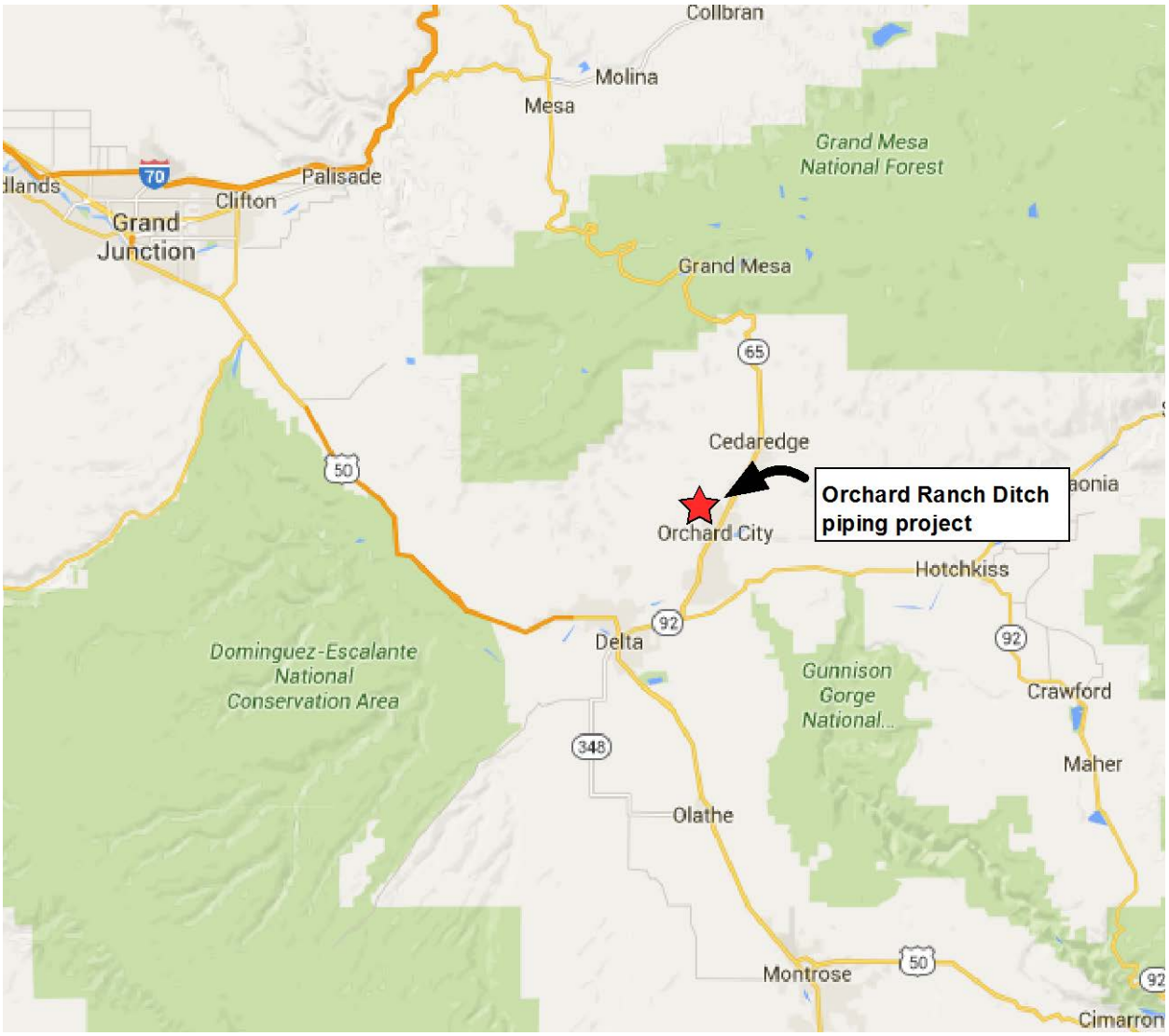
Water Project Loan Program

Application Type	
☐ Prequalification *(Attach 3 years of financial statements)* ☒ Loan Approval *(Attach Loan Feasibility Study)*	
Agency/Company Information	
Company / Borrower Name: Orchard Ranch Ditch Company	
Authorized Agent &Title: Paul Kehmeier, Vice president and manager of piping project	
Address: 20490 North Road, Eckert CO 81418	
Phone: (970) 835-3004, 779-0723	Email: Paul-Kehmeier@msn.com
Organization Type: ☒ Ditch Co, ☐ District, ☐ Municipality ☐ other:_____	Incorporated? ☒ YES ☐ NO
County: Delta	Number of Shares/Taps: 17280 shares
Water District: 40	Avg. Water Diverted/Yr__3000___ acre-feet
Number of Shareholders/Customers Served:	Curr Assess per Share $0.40 (+ $75 per shareholder)
34	Average monthly water bill $ _____ (Municipality)
Contact Information	
Project Representative: Paul Kehmeier	
Phone:970-835-3004, 779-0723 cel	Email: Paul-Kehmeier@msn.com
Engineer: J-U-B Engineers Inc., Tracy Allen	
Phone:801-547-0393, 726-5818 cel	Email: tla@jub.com
Attorney: none at this time	
Phone: ( )	Email:
Project Information	
Project Name: Orchard Ranch Ditch Pipe Project	
Brief Description of Project: (Attach separate sheets if needed)	
-- Please refer to page 2 of this application --	
General Location: (Attach Map of Area) -- Please refer to the map on page 3 of this application --	
Estimated Engineering Costs: $143,670	Estimated Construction Costs: $1,197,243
Other Costs (Describe Above): $89,807 (see pg 2)	Estimated Total Project Costs: $1,430,720
Requested Loan Amount: $150,000 (*Limit 90% of Total Project Costs*)	Project Start Date(s) Design: Jan., 2016 Construction: Sept 2016
Signature	
Paul Kehmeier ___Vice_President_____11/25/15 Signature / Title Date	Return to: Finance Section Attn: Anna Mauss 1313 Sherman St #718 Denver, CO 80203 Ph. 303/866.3449 e-mail: anna.mauss@state.co.us

The Orchard Ranch Ditch is located on the south side of Grand Mesa about 10 miles north of Delta Colorado. The ditch has natural stream flow decrees for 22.17 cfs from Surface Creek, a tributary of the Gunnison River. The ditch also delivers water which comes from privately owned reservoirs on Grand Mesa. The Orchard Ranch Ditch has been in continuous operation for approximately 120 years. The ditch currently serves about 400 acres of farmland and 3 subdivisions. The proposed project will pipe the 1.6 mile long main earthen canal and portions of 4 laterals. The project will be done in conjunction with the U.S. Bureau of Reclamation Salinity Control program. Approximately 90% of the cost of the project will be provided by the U.S. Bureau of Reclamation. Of the 30 or more ditches in the Surface Creek area, the Gunnison Roundtable has listed the Orchard Ranch Ditch as number 3 in priority for piping.

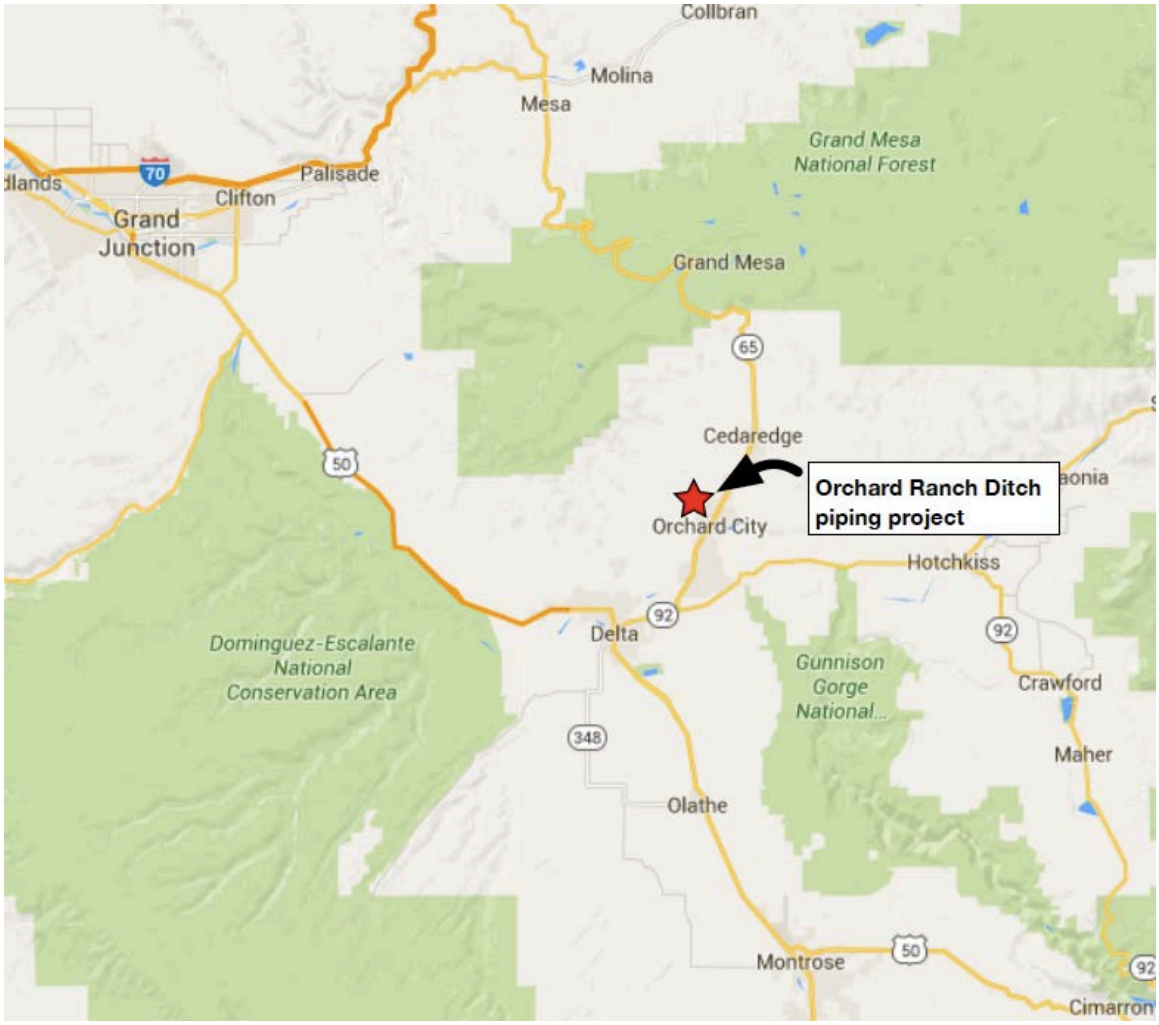
Description of Other Costs	
NEPA and Cultural compliance	$23,945
Implementation of habitat mitigation	$59,862
Required audits	$ 6,000
TOTAL	$89,807

General location of the proposed project



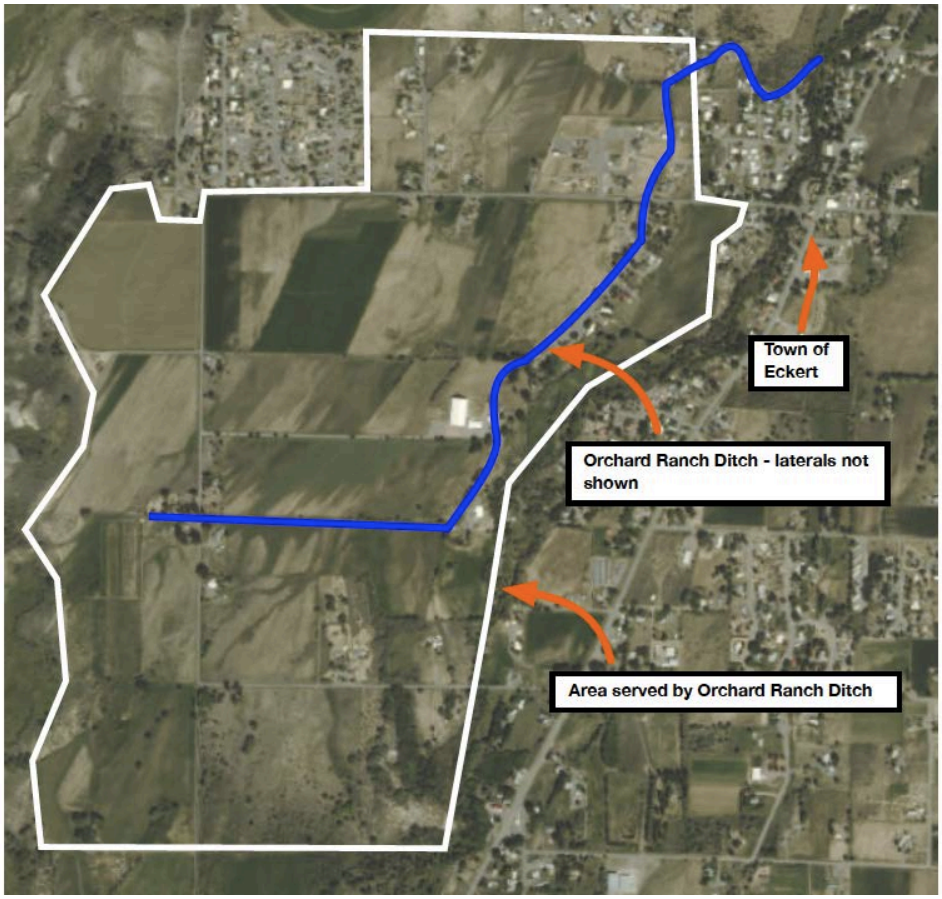
Appendix A – Maps

Map 1 – General area of project



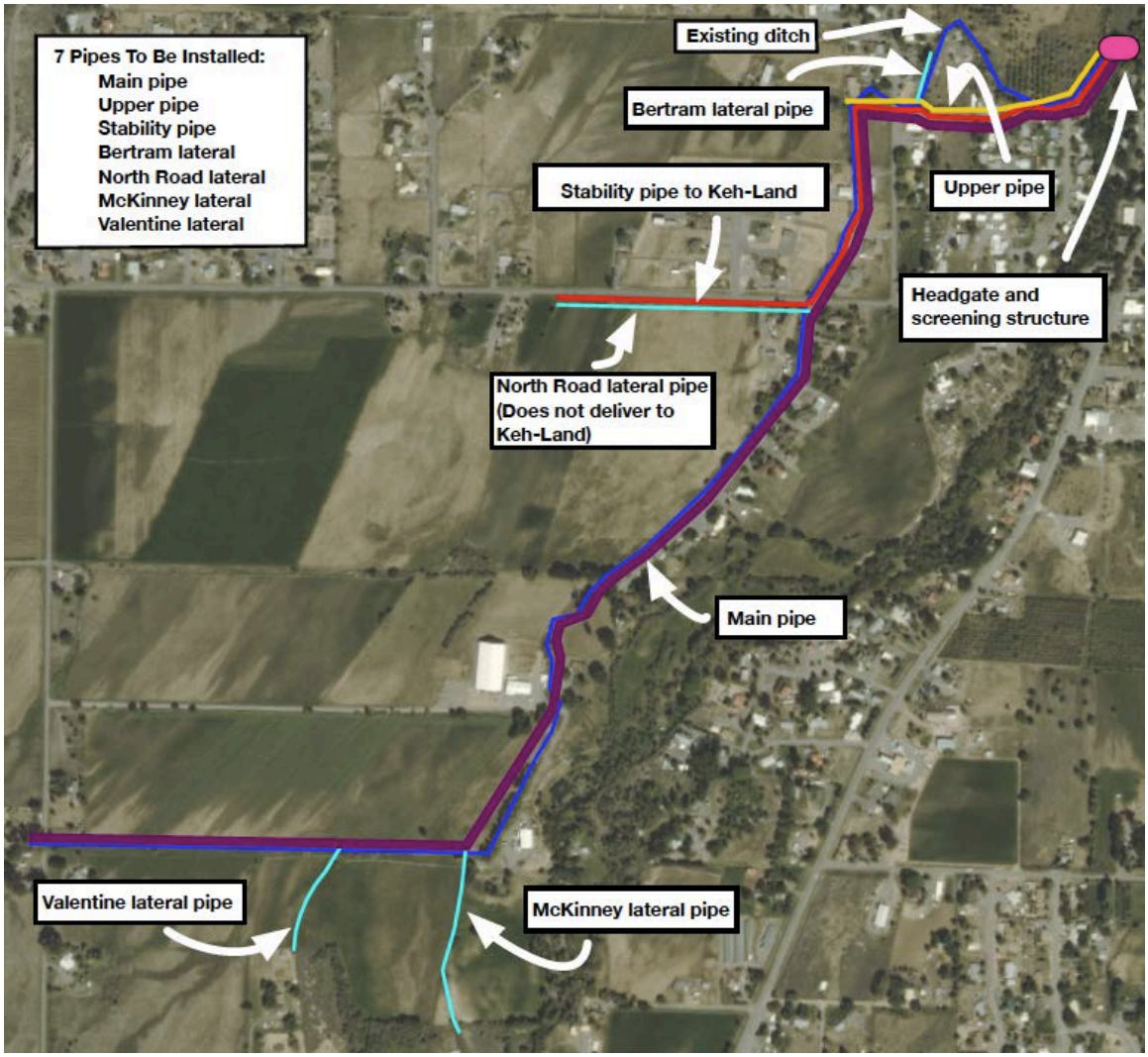
Appendix A – Maps

Map 2 – Land irrigated by the Orchard Ranch Ditch



Appendix A – Maps

Map 3 – Proposed Orchard Ranch Ditch Piping Project



BYLAWS
OF
THE ORCHARD RANCH DITCH Company

ARTICLE I.
Name

The corporate name shall be as stated in the certificate of incorporation, "The Orchard Ranch Ditch Company."

ARTICLE II.
Object

The object is to carry, control and deliver water for irrigation and domestic purposes to the stockholders only, as their interests may appear; to construct dams, headgates, necessary weirs, or ditches for the purpose of handling such water; to construct and maintain the ditch known as The Orchard Ranch Ditch as described in Articles of Incorporation.

ARTICLE III.
Stock Certificates, Fees and Assessments

Section 1: Certificates of stock shall be issued under the seal of the Company and be signed by the President and Secretary,
PROVIDED, no certificate of stock shall be transferred unless all assessments charged against the owner, or owners of such stock upon the books of this Company shall have been fully paid either in money, labor, or both as hereinafter provided.

Section 2: Transfers of stock shall be made on the books of the Company only upon the return and cancellation of the certificate thereof.
PROVIDED, that when stock is held in pledge or as collateral for loans, transfers may be noted subject to such loans without the production and cancellation of the original certificate.
PROVIDED, that in case of loss of certificate of shares, a new certificate may be issued upon security being first given by bonds, conditional against damage or loss by reason of the issuing of such certificate and the amount of which shall be set at the reasonable discretion of the Board of Directors.

Section 3: A fee, the amount of which having been duly authorized by a majority of the stockholders, may be assessed against any new stockholder to cover the paperwork costs of executing a stock transfer. (3-15-79 $10.00)

Section 4: The stockholders of the Company may at any annual meeting or at any special meeting for the purpose, make assessments on all of the stock of said Company for the purpose of maintenance, upkeep and repairs, or said stockholders may authorize the Directors to make such assessments by placing a maximum limit upon the amount to be levied for any one share.

Section 5: Assessments may be fully or partially satisfied by labor and materials for ditch improvements provided by a stockholder or his representatives. Any and all ditch work and credits against assessments thereto must be witnessed approved and documented by the Orchard Ranch Ditch Board of Directors duly appointed Ditch Supervisor. The Ditch Supervisor will then report his documentation of ditch work accomplished, by any shareholder and/or their representatives, in writing to the Secretary-Treasurer, and only those credits will be allowed against assessments. Any alleged ditch work and claimed credits not duly documented by the Ditch Supervisor will not be allowed.

Section 6: Should any stockholder or stockholders permit any assessment or assessments to become delinquent, the Directors of said Company may declare a forfeiture of said shares for said delinquent assessment or assessments, and may order a sale thereof and fix a time and place of sale, in which event the Secretary of the Company shall give notice to such delinquent stockholder or stockholders and shall also publish a notice thereof, as required by the statutes of the State of Colorado, and at such sale the Secretary or President of said Company shall offer said shares or as many thereof as are necessary for sale to pay such delinquent assessments and shall sell only a sufficient number of said shares to pay said assessments, and shall sell to the highest and best bidder and in case no one shall offer a sufficient amount on the shares of any one stockholder to pay his or her assessments on said shares, then said shares shall be bid in by the Company for the amount of such assessments and in such event said shares shall become the property of said Company, to be disposed of thereafter by said Company in such manner as the Directors may see fit.

ARTICLE IV.
Meetings

Section 1: Annual meetings of the stockholders, for the election of Directors, and for other business shall be held at Eckert, in the County of Delta and State of Colorado on the 15th day of March in each year.
PROVIDED, that when said day in any year shall fall on Sunday, or a legal holiday, then the next succeeding day shall be the day of meeting. At such meeting the President of the Board of Directors, if present, shall act as Chairman, and in his absence, the Vice-President, or a stockholder elected by a majority of those present shall so act.

Section 2: Public notice of the time and place of the annual meeting and all general or special meetings of the stockholders shall be published not less than ten (10) days previous thereto in a newspaper published in, or nearest to the place in which the principal office of said Company shall be kept, and by delivering, personally or depositing in the Post Office at least thirty days before such meeting a notice properly addressed to each stockholder signed by the Secretary or President, stating the time, place, and object of said meeting, and no business shall be transacted at any special meeting except such as shall be mentioned in said notice.
PROVIDED, however, that if any stockholder shall fail to furnish the Secretary with his correct Post Office address, he shall not be entitled to such separate notice.

Section 3: Only those persons who are actual stockholders shall be eligible to hold any elective office, to vote or make motions, except that the spouse of a stockholder may be substituted in all matters for the stockholder by filing with the Secretary a Power of Attorney, duly attested by said stockholder, conveying such authority to such spouse.

Section 4: At all meetings of stockholders a majority of all stock must be represented in person or by proxy. If the majority of the stock issued shall not be represented on the day herein fixed for the annual meeting, such meeting may be adjourned by the stockholders present, for a period not exceeding sixty days at any one adjournment, and the stockholders shall be notified of the time to which said meeting is adjourned if such period be for less than one year.

Section 5: Special meetings of the stockholders may be called by the Directors upon resolutions passed by a majority of the Board at any meeting, and shall be called

whenever requested to do so in writing by persons owning one-third of the stock issued and outstanding, which request shall state the object of the meeting.

Section 6: At the election of Directors, when it is found that a majority of the stock is represented, the stockholders shall proceed to nominate the number of Directors to be elected. The election shall be by ballot on which each person voting shall write the names of as many persons as are to be elected from the nominees. Each stockholder shall have the right to vote in person or by written proxy the number of shares owned by him or her, and in balloting for Directors he or she shall vote said number of shares for as many Directors as are to be elected. The persons having the highest number of votes in consecutive order shall be declared elected the Board of Directors for that year. The cumulative system of voting shall not be permitted.

ARTICLE V.
Board of Directors

Section 1: The Directors, three in number, shall be elected annually.

Section 2: Within five (5) days after their election, the Directors shall elect from their number, a President, a Vice-President, and a Secretary - Treasurer who shall be one and the same person. These shall serve for one year and until their successors are elected.

Section 3: The Board of Directors shall fix the sum to be paid to employees of the said Company, and shall have power to require, of any officer, agent, clerk, ditch superintendent, or other officer or employee, bonds with sufficient sureties for the proper discharge of their duties and shall have full control of all the Company's business.

Section 4: Vacancies occurring in the Board of Directors shall be filled by a vote of the majority of the remaining members of the Board. Meetings of the Board of Directors may be held at any time when it is deemed necessary, and a notice of one day to the members of the Board of Directors shall be given of all special meetings.

Section 5: The President shall be the chief executive officer of the Company; he shall sign all official documents of the Company, preside at all meetings of the Board and Company, and under the direction of the Board have general supervision and

superintendency of the business of the Company.

Section 6: In the absence of the President, the Vice-President shall preside over meetings and perform the duties of the President.

Section 7: The Secretary shall keep a correct record of the proceedings of the Board of Directors and of the Company; shall keep the stock certificate books and Seal of the Company and shall attest, by his signature and the Seal of the Company, all official documents and all certificates of stock issued; shall keep a complete set of books, showing the accounts, property and transactions of the Company; shall collect all assessments and money due the Company and pay the same to the Treasurer, and shall make a report of the business transacted by them annually, or oftener if required by the Board of Directors; and shall keep a true and correct record of the stock of said Company as required by law and these bylaws.

Section 8: The Treasurer shall be custodian of the funds and shall pay them out on order of the Board of Directors, signed by the President and Secretary, and shall make an annual report at or prior to, the annual meeting of the stockholders.

ARTICLE VI.
Water Distribution

Section 1: The Water Commissioner, or his duly constituted deputy, shall be authority as to the ownership of any and all water flowing in The Orchard Ranch Ditch, and his notice placed upon the headgate shall be authority and shall be assumed to be correct, and all water shall be distributed accordingly.

Section 2 : The ditch Company shall maintain said ditch in good repair and order, ready to receive water by April 15 of each year, so far as can be accomplished by reasonable care and diligence. The Company shall construct and maintain diversion structures in the ditch for proper delivery of water to persons owning and having rights to water therein, at points mutually convenient to the Company and the claimant.

Section 3: It shall be the duty of the Board of Directors to appoint a Ditch Supervisor, whose duty it shall be to measure the water from the said ditch through

the outlets, to those entitled thereto according to his pro rata share, and to perform such other duties as may be designated by this Company through its proper officers.

Section 4: The Parshall System of measurement of water is hereby adopted for measurement of water diverted into the ditch from the Creek or other source of supply. The structure which is used in the main ditch to divert water to lateral ditches shall be designed insofar as possible to divide the flow approximately pro rata between the main ditch and the lateral ditch automatically as the flow in the main ditch might increase or decrease. It shall also be designed and constructed so that the entire flow of the ditch may be diverted to the lateral, or so that the flow to the lateral may be shut off entirely. At each diversion and within a reasonable distance from the intake, a measuring device approved by the Board of Directors, shall be installed in the lateral ditch by, and at the expense of, the owner of the lateral. It shall be the responsibility of the owner of the lateral ditch to maintain the accuracy of the measuring device and such owner may be required by the Board of Directors to make adjustments or repairs to the measuring device before water is diverted to said lateral.

Section 5: No new takeouts, other than those already constructed as of March 20, 1979, will be authorized in the Orchard Ranch Ditch. No pumps will be permitted to pump water from the Orchard Ranch Ditch.

Section 6: When all the water in the main ditch is owned by, or is properly for the use of, one owner, or one group of owners, using one outlet or lateral ditch from the main ditch, nothing herein shall prevent a temporary head-gate being placed in the dividing box in the main ditch by the proper officer, to prevent water from flowing through to any party not legally and properly entitled thereto.

Section 7: Any party desiring to transfer any water owned by him to some other owner in this ditch for temporary use may do so, but a notice in writing, signed by the owner of the water so transferred, must be given to the superintendent of the ditch and a copy must be posted by the superintendent upon the division box at the point of temporary diversion; and the superintendent must adjust all division boxes of parties affected by such temporary transfer.

Section 8: When deemed advisable for the protection of the owners in this ditch, the Company, by its duly delegated officers, may place locks and fastenings upon any or all lateral ditches.

ARTICLE VII.
Amendment of Bylaws

The bylaws of this Company may be amended at any meeting of the stockholders of this Company, by a vote of two-thirds of all the stock outstanding in favor thereof, provided due notice shall have been given in the call for such proposed amendment, setting forth the particular clause to be amended, the proposed amendment, the time and the place when such proposed amendment shall be acted upon.

Article VIII.
Severability

If any part of these bylaws shall be found in violation of statutes of the State of Colorado, or otherwise invalid, such violation shall not affect, nor cause to be null and void, any of the valid parts of these bylaws.

Article IX.
Non-Profit Status

The Company shall at all times be operated as a non-profit organization and all assessments and other income of the Company shall be used for repair and maintenance and operational purposes. No part of the income of the Company shall be distributed to stockholders as dividends. Upon dissolution of the Company, any assets remaining after payment of final indebtedness shall be distributed to another qualifying non-profit organization and shall not inure to the benefit of any stockholders.

APPROVED: _____
_____ (Directors)
_____

Approved by the stockholders this _____ day of _____, 1991.

Articles of Incorporation

OFFICE
Chas. L. Keller
COUNTY ASSESSOR
DELTA COLO

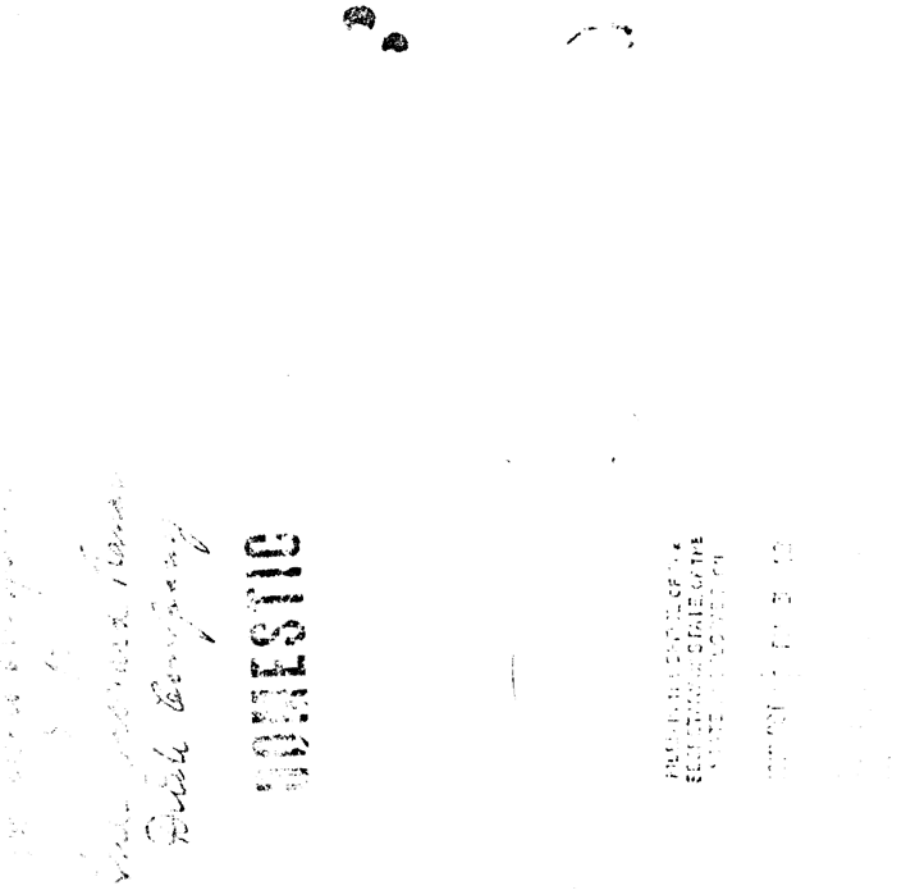
RECE

S.S.

...e certify that the "Orchard Ranch Ditch ...
...ainst which taxes are assessed, ...
...f belief, said Company does not operate for ...
...th, this 16th. day of October, A.D. 1915,

Chas L Keller
Assessor, Delta Co. ...

Articles of Incorporation



Articles of Incorporation

ARTICLES OF INCORPORATION

KNOW ALL MEN BY THESE PRESENTS, That we, [illegible] Templeton, J. A. Bumgardner and C. L. Simpson have associated ourselves together under the name and style of the Orchard Ranch Ditch Company for the purpose of becoming a body corporate and politic, under and by virtue of the laws of the State of Colorado and in accordance with the provisions of the laws of said State, we do hereby make, execute and acknowledge and duplicate this certificate in writing of our intentions so and state:

FIRST. The corporate name of said company shall be Orchard Ranch Ditch Company.

SECOND. The object for which said corporation is formed is for the purpose of acquiring, maintaining and operating ditches, canals, pipe lines, reservoirs, the [illegible] and water rights, decrees and priorities and [illegible] the same for the irrigation of lands owned by said company or the individual members thereof as hereinafter set forth and to do all things that can be lawfully done by and by virtue of the laws of the State of Colorado to carry such object.

THIRD. The amount of capital stock of said company shall be Seventeen Thousand, two hundred and eighty (17,280) dollars.

FOURTH. The term of existence of said corporation shall be twenty years.

FIFTH. The number of shares of which said capital stock shall consist shall be Seventeen Thousand, two hundred and eighty(17,280) of the par value of One (1.00) Dollar each, and such stock shall be non-assessable except for purposes of maintaining, operating and protecting the [illegible]

-2-

s, reservoirs, water rights and other property company.

SIXTH. The number of directors of the company shall be three, and cumulative voting shall not be permitted.

SEVENTH. The names of the directors who shall manage the affairs of the said company for the first year of its existence are L. K. Ferguson, J. A. Dunsicker and

EIGHTH. The name of the town or place and county in which the principal offices of the company shall be, is Eckert, Delta County, Colorado, in which the principal business of the company shall be carried on.

NINTH. The stream, channel or source from which the water is to be taken by said company is Surface Creek and its tributaries, situated in the said County, in District #40 of said State.

TENTH. That the immediate and principal business of this company is to acquire the Orchard Ranch Ditch, headgates, laterals, water rights, decrees and priorities. The said ditch diverts water from the left bank of Surface Creek at a point whence the 1/16 corner on the east side of the SE 1/4 of Sec. 12, T. 14S., R. 95 W., bears S. ...°-35' ... feet distant-

From said diversion point, the course of said ditch is described by the following traverse (Reference made to the ... plat) ---

STA.	0-S.57°- 0'W.,--136 ft.-	(Sta. 0-D diversion point)	
"	1-S.55°-10'W.,	75 "	headgate and spillway
"	2-S.67°-20'W.,	39 "	
"	3-S.35°-45'W.,	440 "	
"	4-S.71°-00'W.,	148 "	
"	5-S.67°-00'W.,	216	
"	6-N.29°-20'W.,	350	

Articles of Incorporation

[illegible] 87 ft.

[illegible] 79 "

9-N.81°-00'... 98 " to qtr. post on N. line sec. 12-

10-N.42°-00'W.. 118 "

11-S.46°-45'... 118 "

12-S. 4°-[illegible]... 200 " to Shippeney's [illegible]

" 13-S. 1°-30'E.. 2441 "

14-S.17°45'.. 187 "

" 15-S.39°40'W.. 90 " to south line sec. [illegible] of s. side qtr of [illegible]

" 16-S. 4°10'W.. 300 "

" 17-S.33°-40'W.. 440 "

" 18-S.39°-10'... 810 " point 90ft.e. of sec. 15 and 14.

" 19-S.45°-30'W.. 460 " "

" 20-S. 4°-45'W.. 515 "

" 21-S.39°-35'W.. 375 "

" [illegible]-S.11°-30'W., 200 " to e. [illegible] w. 1/4 sec. [illegible] 14-14-95 et a point 1/4oin. bet. secs. [illegible] 14S., R.9E W.-

of 1/4

[illegible] west, on south side said 1/4 sec. line [illegible]

N. [illegible] ft.; thence along N. side 1/4 sec. line [illegible]

[illegible] ft.; thence along N. side 1/4 sec. [illegible]

[illegible] 39°-48' W. along a natural draw 395 ft.

ELEVENTH. The use to which the water [illegible] be applied by said company is the irrigation of [illegible] stockholders of the company and for domestic use of stockholders.

TWELFTH. The board of directors [illegible] shall have power to make such prudential by-laws as deem proper for the management of the affairs of [illegible] in accordance with the statute in such case made [illegible]

IN WITNESS WHEREOF, We have hereunto set [illegible] and seals, this 16th day of August A.D. 1916

[illegible] 1915

Articles of incorporation

...PUBLIC) ss
...of Delta)

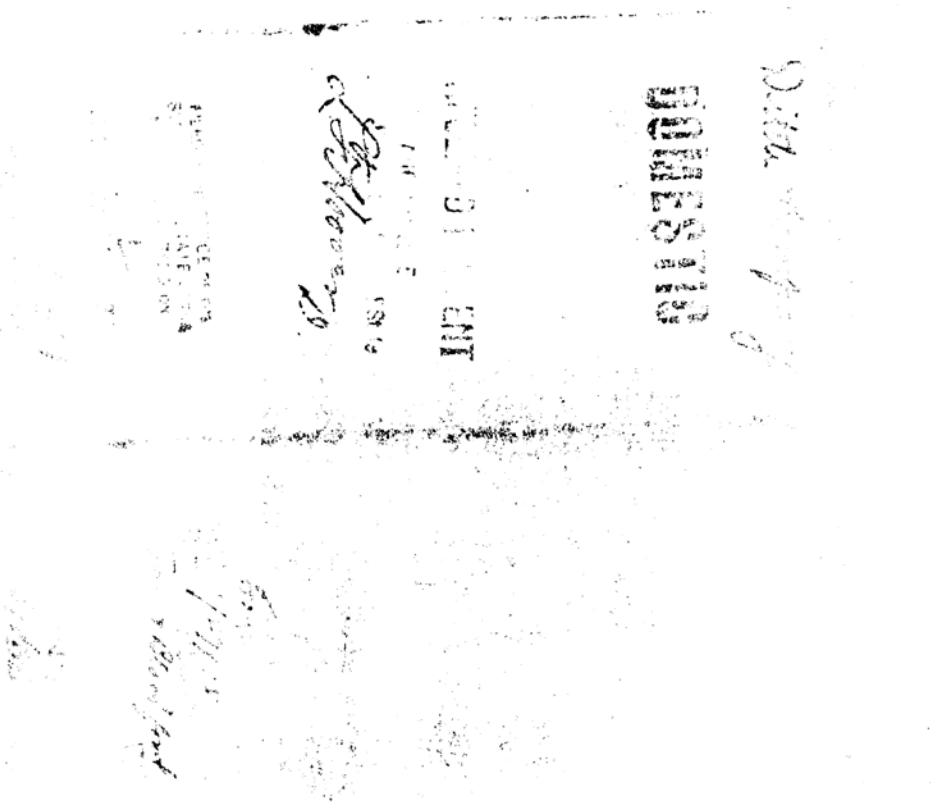
I, [illegible], a Notary Public, in and for said County, in the State of Colorado, do hereby certify that A. A. Ferguson, W. A. Hungsicker and [illegible], who are personally known to me to be the same persons whose names are subscribed to the annexed and foregoing certificate of incorporation, appeared this day before me, in person, and acknowledged that they signed, sealed and delivered the said instrument of writing as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and seal, this 16th day of August A. D. 1915.

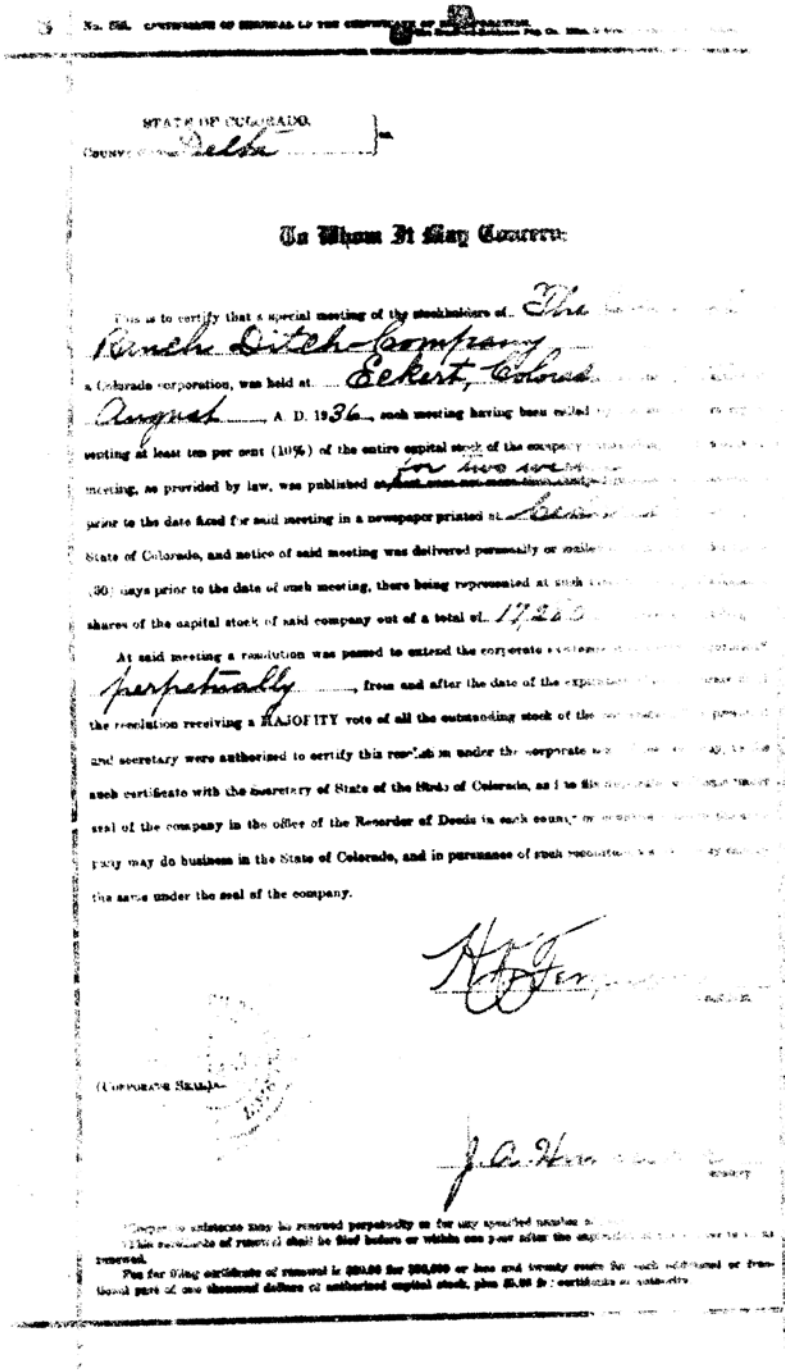
My commission expires Feb. 28 1917

[illegible]
Notary Public.

Articles of incorporation



Articles of incorporation



STATE OF COLORADO
County of Delta

To Whom It May Concern:

This is to certify that a special meeting of the stockholders of The Orchard Ranch Ditch Company, a Colorado corporation, was held at Hotchkiss, Colorado, August, A. D. 1936, such meeting having been called [illegible] meeting at least ten per cent (10%) of the entire capital stock of the company [illegible] meeting, as provided by law, was published for two weeks [illegible] prior to the date fixed for said meeting in a newspaper printed at [illegible] State of Colorado, and notice of said meeting was delivered personally or mailed [illegible] (30) days prior to the date of such meeting, there being represented at such [illegible] shares of the capital stock of said company out of a total of 1720 [illegible]

At said meeting a resolution was passed to extend the corporate existence [illegible] perpetually, from and after the date of the expiration [illegible] the resolution receiving a MAJORITY vote of all the outstanding stock of the [illegible] and secretary were authorized to certify this resolution under the corporate [illegible] such certificate with the Secretary of State of the State of Colorado, as [illegible] seal of the company in the office of the Recorder of Deeds in each county [illegible] may do business in the State of Colorado, and in pursuance of such resolution [illegible] the same under the seal of the company.

H. D. Fer, President

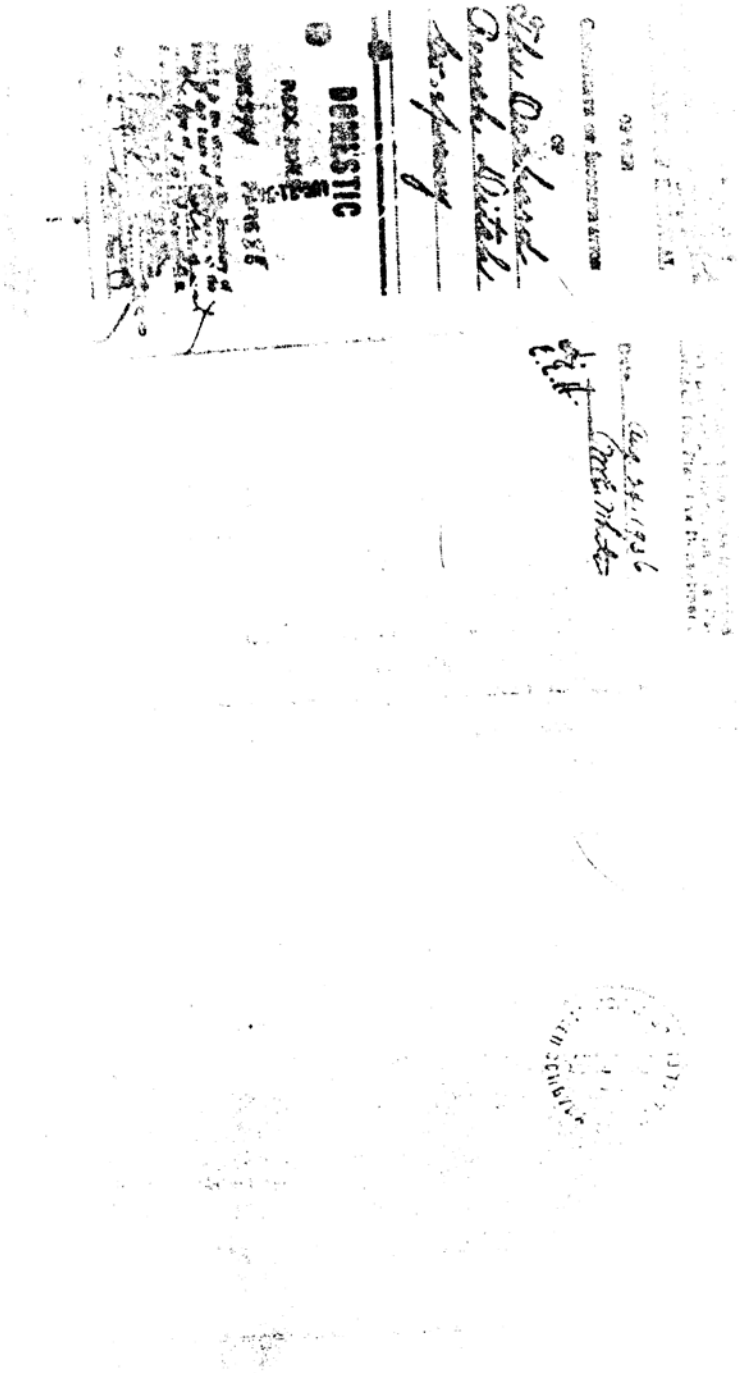
(Corporate Seal)

J. A. Hen, Secretary

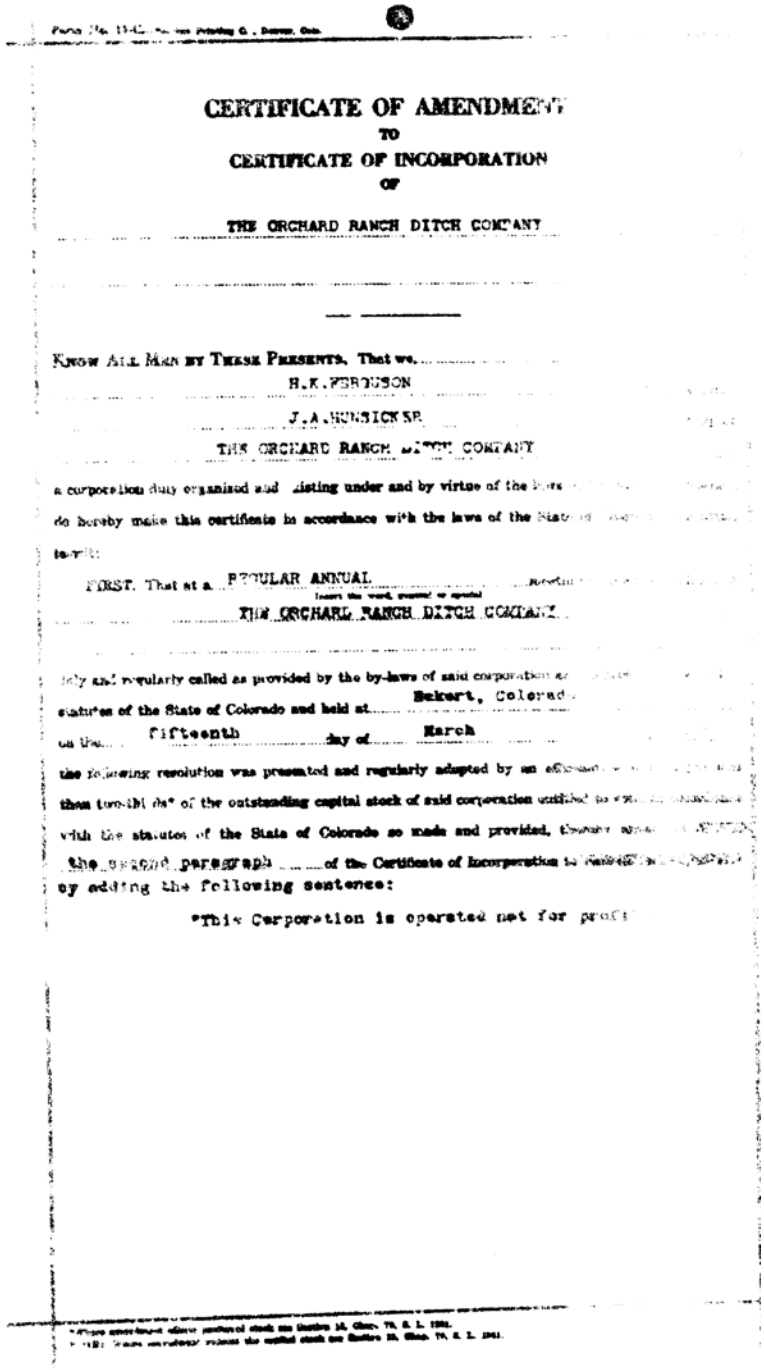
Charter existence may be renewed perpetually or for any specified number [illegible] This certificate of renewal shall be filed before or within one year after the expiration [illegible] renewed.

Fee for filing certificate of renewal is $50.00 for $50,000 or less and twenty cents for each additional or fraction thereof per one thousand dollars of authorized capital stock, plus $5.00 for certificate and seal.

Articles of incorporation



Articles of incorporation



CERTIFICATE OF AMENDMENT
TO
CERTIFICATE OF INCORPORATION
OF
THE ORCHARD RANCH DITCH COMPANY

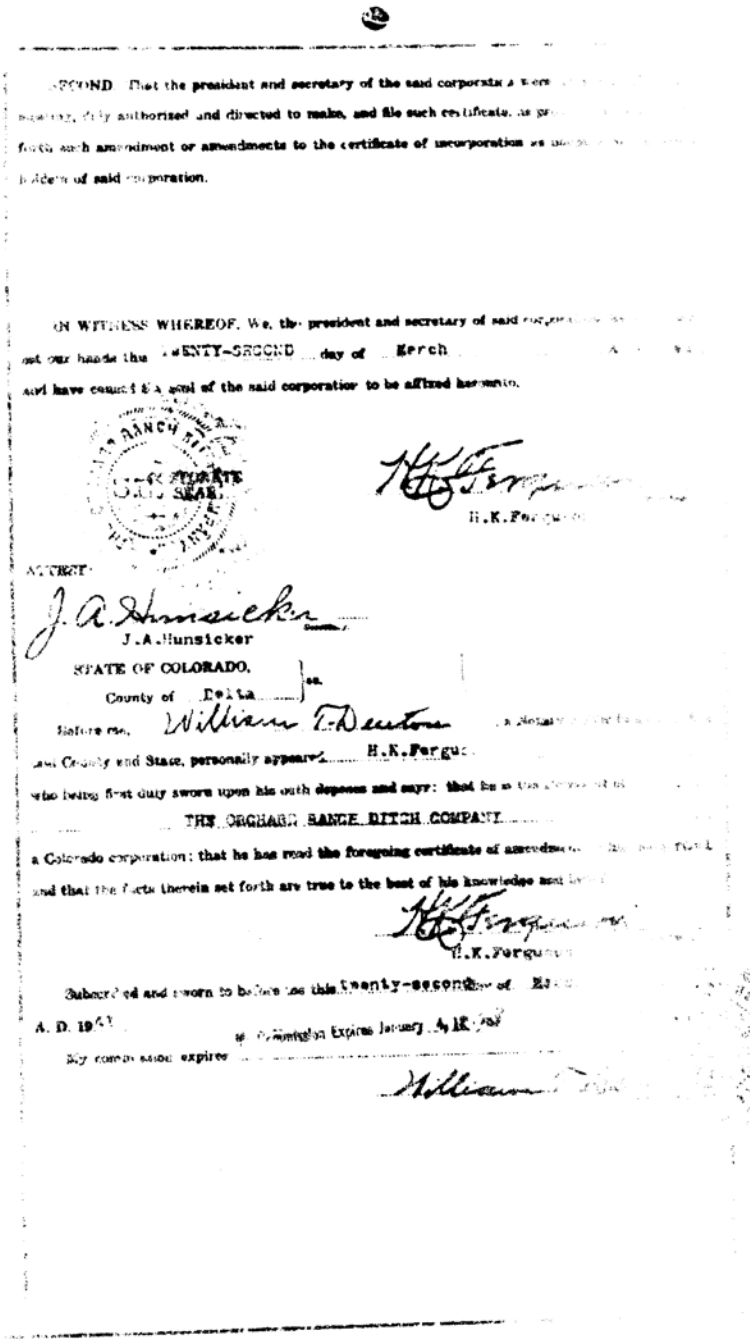
KNOW ALL MEN BY THESE PRESENTS, That we,
H.K.FERGUSON
J.A.HUNSICKER
THE ORCHARD RANCH DITCH COMPANY
a corporation duly organized and existing under and by virtue of the laws
do hereby make this certificate in accordance with the laws of the State
to-wit:

FIRST. That at a REGULAR ANNUAL
(insert the word, annual or special)
THE ORCHARD RANCH DITCH COMPANY
duly and regularly called as provided by the by-laws of said corporation at
statutes of the State of Colorado and held at Eckert, Colorado
on the fifteenth day of March
the following resolution was presented and regularly adopted by an affirmative
three-fourths (¾) of the outstanding capital stock of said corporation entitled to vote
with the statutes of the State of Colorado so made and provided, the
the second paragraph of the Certificate of Incorporation
by adding the following sentence:

"This Corporation is operated not for profit

* Where amendment affects preferred stock see Section 38, Chap. 79, S. L. 1931.
** Where amendment reduces the capital stock see Section 39, Chap. 79, S. L. 1931.

Articles of incorporation



SECOND That the president and secretary of the said corporation were ... authorized and directed to make, and file such certificate, as ... forth such amendment or amendments to the certificate of incorporation as ... holders of said corporation.

IN WITNESS WHEREOF, We, the president and secretary of said ... set our hands this TWENTY-SECOND day of March ... and have caused the seal of the said corporation to be affixed hereunto.

H.K.Ferg...

ATTEST:

J.A.Hunsicker
J.A.Hunsicker

STATE OF COLORADO,
County of Delta } ss.

Before me, William T.Denton ... and County and State, personally appeared H.K.Fergu... who being first duly sworn upon his oath deposes and says: that he is the ... THE ORCHARD RANCH DITCH COMPANY ... a Colorado corporation; that he has read the foregoing certificate of amendm... and that the facts therein set forth are true to the best of his knowledge and ...

H.K.Ferguson

Subscribed and sworn to before me this twenty-second day of M... A. D. 19[illegible] ... Commission Expires January 4, 19[illegible]

My commission expires ...

William ...

Articles of incorporation

106097

CERTIFICATE OF AMENDMENT
TO
Certificate of Incorporation
OF
THE ORCHARD RANCH DITCH CO.
Eckert, Colorado

RECORDED
BOOK 446 PAGE 263

DOMESTIC

FILED in the office of the Secretary of State, of the State of Colorado on the ... day of April A.D. 1941, at 1:32 o'clock P.M.
WALTER P. MORRISON
Secretary of State
Filing Clerk
Old Age Pension Fund

This document has been [illegible] and properly filed in the offices of The Flat Tax Department

Dated April 7, 1941

Appendix B – Orchard Ranch Ditch business documents

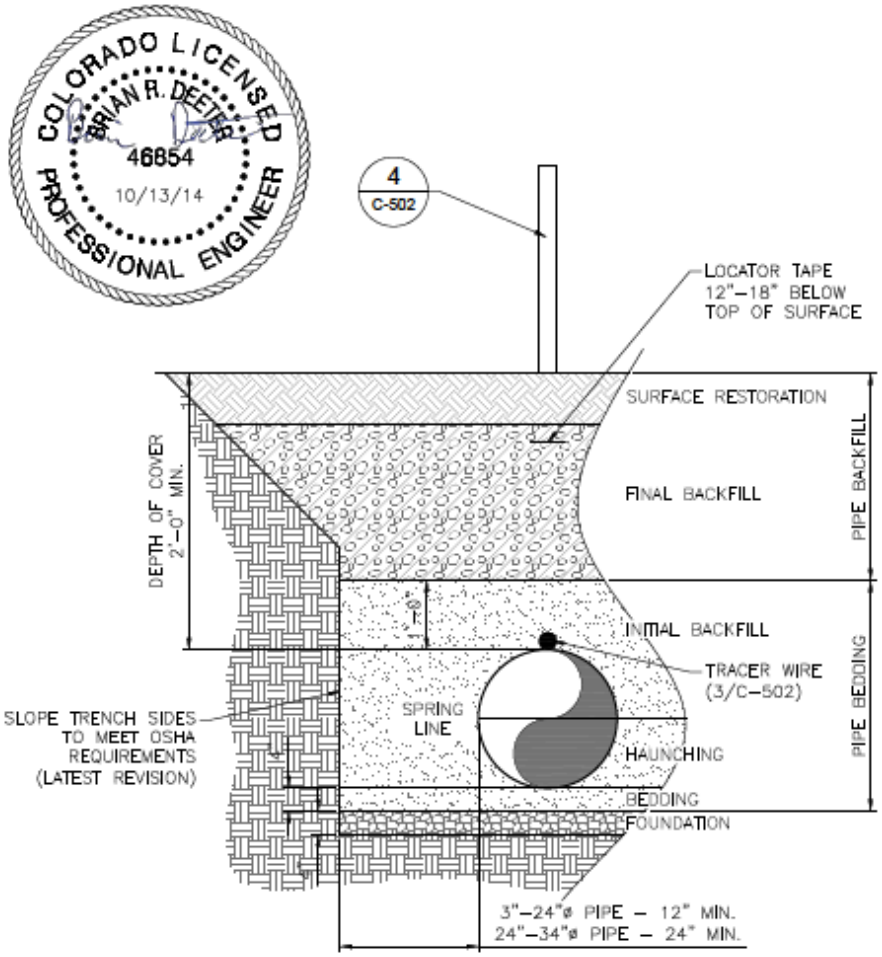
Appendix C - Analysis of alternatives

Analysis of Alernatives for the Orchard Ranch Ditch Improvement Project

	Evaluation Factors					
Alternative	**Change in water yield**	**Cost to shareholders**	**Impacts to man-made environment**	**Impacts to natural environment**	**Economic feasibility**	**Institutional requirements**
No action	0%	No change in cost in the short term. Assessments for maintenance of open canal may increase over time.	none	none	High in short term, in longterm may become costly to maintain open canal	none
Pipe ditch and portions of 4 laterals with PVC	5% increase	Total project cost is about 2.2% less with PVC compared to HDPE	Approximately 5 acres disturbed during construction. Few man made structures impacted. Disturbed fences will be rebuilt. Bridges across canal become unnecessary.	Approximatley 5 acres disturbed during construction. Disturbed lands will be reclaimed. Loss of wildlife habitat will be mitigated off site.	High due to Bureau of Reclamation cost share funds already allocated	Approximately 5 new easements and 3 adjustments of existing easements. 3 road crossing permits
Pipe ditch and portions of 4 laterals with HDPE	5% increase	Total project cost is about 2.2% less with PVC compared to HDPE	Approximately 5 acres disturbed during construction. Few man made structures impacted. Disturbed fences will be rebuilt. Bridges across canal become unnecessary.	Approximatley 5 acres disturbed during construction. Disturbed lands will be reclaimed. Loss of wildlife habitat will be mitigated off site.	High due to Bureau of Reclamation cost share funds already allocated	Approximately 5 new easements and 3 adjustments of existing easements. 3 road crossing permits

Appendix D – Conceptual plan and cross section

Trench evacuation and backfill



TRENCH BACKFILL NOTES:

1. SURFACE RESTORATION:
   A. REFER TO SURFACE RESTORATION IN TYPICAL SECTIONS 2, 3, 4, 5, AND 6 ON SHEET C–501.
2. FINAL BACKFILL:
   A. 85% TYPICAL
   B. 95% COMPACTION IN ROAD RIGHT–OF–WAY AND DRIVE WAYS.
   C. USE ASTM D 1557 MODIFIED PROCTOR FOR COUNTY ROADWAYS.
   D. USE ASTM D 695 STANDARD PROCTOR FOR ALL OTHER AREAS.
   E. SUBSOIL TYPE S1, ONSITE BACKFILL TYPE A2, IMPORTED GRANULAR FILL TYPE A1.
   F. INSTALL MAGNETIC LOCATOR TAPE 12"–18" BELOW FINISHED SURFACE. CENTER TAPE IN TRENCH.
3. BEDDING:
   A. ONSITE BEDDING TYPE A4, IMPORTED BEDDING TYPE A3. LIMIT PARTICLE SIZE TO 1".
   B. INITIAL BACKFILL:
      B.1. 90% COMPACTION
      B.2. FILL VOIDS BETWEEN PIPE AND TRENCH SIDES.
      B.3. USE HAND HELD OR WALK BEHIND COMPACTION EQUIPMENT TO PROTECT PIPE.
      B.4. LIFT THICKNESS: MAX. 8" UNCOMPACTED.
   C. HAUNCHING:
      C.1. 90% COMPACTION
      C.2. SHOVEL–SLICE AND MANUAL TAMP EMBEDMENT MATERIAL TO ASSURE ALL VOIDS BETWEEN THE PIPE AND THE TRENCH BOTTOM AND SIDES ARE FILLED.
      C.3. COMPACT MATERIAL TO PROVIDE COMPLETE CONTACT WITH PIPE BOTTOM.
   D. BEDDING:
      D.1. LEVEL EMBEDMENT MATERIAL TO PROVIDE CONTINUOUS FIRM SUPPORT ALONG FULL LENGTH OF PIPE. HIGH SPOTS SHOULD BE SHAVED OFF AND LOW SPOTS FILLED WITH WELL TAMPED SOIL. EXCAVATE A BELL HOLE, IF NECESSARY, TO ASSURE NO UNDUE WEIGHT IS PLACED ON BELL AND THAT THE PIPE BARREL IS SUPPORTED.
4. FOUNDATION:
   A. IMPORTED FOUNDATION TYPE A5.
   B. USE FOUNDATION MATERIAL AS REQUIRED TO PROVIDE STRUCTURAL SUPPORT FOR PIPE.

Appendix D – Conceptual plan and cross section

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION PIPELINE

(Ft.)

CODE 430

DEFINITION

A pipeline and appurtenances installed to convey water for storage or application, as part of an irrigation water system.

PURPOSE

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Conveyance of water from a source of supply to an irrigation system or storage reservoir.
- Reduce energy use.
- Develop renewable energy systems (i.e., in-pipe hydropower).

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to water conveyance and distribution pipelines installed above or below ground.

This standard does not apply to multiple outlet irrigation system components (e.g., surface gated pipes, sprinkler lines, or micro irrigation tubing).

CRITERIA

General Criteria Applicable to All Purposes

The water supply, quality, and rate of irrigation delivery for the area served by the pipeline shall be sufficient to make irrigation practical and feasible, for the crops to be grown and the irrigation water application methods to be used.

Pipelines shall be placed only in soils and environmental conditions suitable for the material type being selected.

Pipelines shall be designed to meet all service requirements such that internal pressure, including hydraulic transients or static pressure at any point is less than the pressure rating of the pipe.

Capacity. Capacity shall be sufficient to convey the design delivery flow rate for the planned conservation practices.

Design capacity of the pipeline conveyance or distribution system for irrigation systems shall be sufficient to meet the requirements for efficient application based on one of the following:

- Adequate to meet the moisture demands of all crops to be irrigated in the design area.
- Sufficient to meet the requirements of selected irrigation events during critical crop growth periods when less than full irrigation is planned.
- For special-purpose irrigation systems, sufficient to apply a specified amount of water to the design area in a specified operating period.

In computing the above capacity requirements, allowance must be made for reasonable water losses during application or use.

Friction and Other Losses. For design purposes, head loss for hydraulic grade line computations shall be computed using one of the following equations: Manning's, Hazen-Williams, or Darcy-Weisbach.

Except where joints, connections, or condition of the pipe indicate that a more conservative value is required, the following equations and roughness coefficient are recommended:

Material	Equation	Recommended Roughness Coefficient	Source
PVC	Hazen Williams "C"	150	1
	Manning's "n"	.009 (clean water)	
Aluminum	Manning's "n"	0.010	2

Concrete	Manning's "n"	0.011 Gasket 0.012 Mortar 0.014 Cast in Place	3
Polyethylene	Hazen Williams "C"	150 Smooth wall	4
	Manning's "n"	0.009 0.012 Bell Ends	4
Corrugated/Profile Wall Plastic Pipe	Manning's "n"	See manufacturer's association recommended values;	
Steel, Smooth	Manning's "n"	0.010 Lined 0.012 Unlined	5
Steel, Corrugated	Manning's "n"	Varies w/diameter and/or shape of corrugation. See reference 6 or 7	

Reference Sources:

1. Unibell. 2001. Handbook of PVC Pipe Design and Construction, 4th Ed.. Unibell PVC Pipe Assn. Dallas, TX.
2. SCS. 1972. Practice Standard 430-A Underground Irrigation Tubing.
3. ACPA. 2000. Concrete Pipe Design Manual. American Concrete Pipe Association. Irving, TX.
4. PPI. Handbook of Polyethylene Pipe. Plastic Pipe Institute. **www.plasticpipe.org**
5. SCS. 1972. Practice Standard 430-F Irrigation Pipe, Steel. (AWWA M-11 recommends n = 0.011)
6. Brater, et.al.. 1996. Handbook of Hydraulics, 7th Ed. McGraw-Hill. New York, NY.
7. AISI. 1999. Handbook of Steel Drainage & Highway Construction Products, 4th ed. American Iron and Steel Institute. Washington, D.C.

Equation selection shall be based on the given flow conditions and the pipe materials used. Other head losses (also called minor losses) from change in velocity and direction of flow due to inlet type, valves, bends, enlargements or contractions can be significant and shall be evaluated as appropriate. For closed, pressurized systems, the hydraulic grade line for all pipelines shall be maintained above the top of the pipeline at all locations for all flows unless specifically designed for negative internal pressures.

Flexible Conduit Design. Flexible conduits such as plastic pipe, steel pipe, aluminum pipe, corrugated metal pipe, or ductile iron pipe, shall be designed using NRCS National Engineering Handbook (NEH) Part 636, Chapter 52, Structural Design of Flexible Conduits, and the following criteria:

Smooth Wall Plastic Pipe. When operating at design capacity, the full-pipe flow velocity should not exceed 5 feet per second in pipelines with valves or some other flow control appurtenances placed within the pipeline or at the downstream end. As a safety factor against surge, the working pressure at all locations and under all anticipated flow conditions should not exceed 72 percent of the pressure rating of the pipe. If either of these limits is exceeded, special design consideration must be given to the flow conditions, and measures must be taken to adequately protect the pipeline against transient pressures. In all cases, the effects of surge pressures should be considered in the design of the pipeline. Design considerations for PVC pipe are contained in the Handbook of PVC Pipe, and considerations for polyethylene (PE) and high density polyethylene (HDPE) pipe are outlined in the Handbook of PE Pipe.

Corrugated or Profile Wall Plastic Pipe. When operating at design capacity, the full-pipe flow velocity should not exceed 5 feet per second in pipelines with valves or some other flow control appurtenance placed within the pipeline or at the downstream end. As a safety factor against surge, the working pressure at any point should not exceed 72 percent of the pressure rating of the pipe. If the pipe is not pressure rated, the maximum allowable pressure shall be 25 feet of head, or the maximum pressure as specified by the manufacturer for the pipe and connecting joints used.

Smooth Wall Steel Pipe. The specified maximum allowable pressure shall be determined using the hoop stress formula, limiting the allowable tensile stress to 50 percent of the yield-point stress for the material selected. The hoop stress formula and design stresses for commonly used steel and steel pipe are shown in the NEH Part 636, Chapter 52.

The minimum wall thickness for steel pipe shall be as follows:

Nominal Diameter (inches)	Wall Thickness
4-12	14 ga.
14-18	12 ga.
20-24	10 ga.
26-36	3/16 inch
38-48	1/4 inch

Corrugated Metal Pipe. Maximum allowable pressure for the pipe shall be:

- 20 feet of head for annular and helical pipe with sealed seams and watertight coupling bands.
- 30 feet of head for helical pipe with welded seams, annular ends, and watertight couplings.

Smooth Wall Aluminum Pipe. The maximum allowable pressure of the pipe shall be determined using the hoop stress formula limiting the allowed tensile stress to 7,500 psi. Refer to the procedures shown in NEH Part 636, Chapter 52.

Rigid Conduit Design. Rigid conduits such as concrete pipe or plastic mortar pipe shall be designed using the following criteria:

Non-reinforced Concrete Pipe with Mortar Joints. The maximum allowable pressure for pipe with mortar joints shall not exceed one-fourth of the certified hydrostatic test pressure as determined by the test procedure described in ASTM C118. Nor shall they exceed the following:

Diameter (inches)	Maximum Allowable Pressure (feet)
6 through 8	40
10 and greater	35

Non-reinforced Concrete Pipe with Rubber Gasket Joints. The maximum allowable pressure for non-reinforced concrete pipe with rubber gasket joints shall not exceed one-third the certified hydrostatic test pressure as determined by the test procedure described in ASTM C505. Nor shall they exceed the following:

Diameter (inches)	Maximum Allowable Pressure (feet)
6 through 12	50
15 through 18	40
21 and greater	30

Cast-in-Place Concrete Pipe. Maximum working pressure for cast-in-place concrete pipe shall be 15 feet above the centerline of pipe. Cast–in-place concrete pipe shall be used only in stable soils that are capable of being used as the outside form for approximately the bottom half of the conduit.

Reinforced Concrete Pipe with Gasket Joints. The maximum allowable pressure for reinforced concrete pipe with rubber gasket joints shall not exceed the rated hydrostatic pressure for the specified pipe according to appropriate ASTM or AWWA standards.

Reinforced Plastic Mortar Pipe. The pipeline shall be designed to meet all service requirements without a static or working pressure at any point greater than the maximum allowable working pressure of the pipe used. The static or working pressure of pipelines open to the atmosphere shall include free board. The minimum acceptable pipe pressure rating shall be 50 psi.

Support of Pipe. Irrigation pipelines both below and above ground shall be supported, where needed, to provide stability against external and internal forces. Pipe support shall be designed using NEH Part 636, Chapter 52.

Joints and Connections. All connections shall be designed and constructed to withstand the pipeline working pressure without leakage and leave the inside of the pipeline free of any obstruction that would reduce capacity.

Permissible joint deflection shall be obtained from the manufacturer for the joint type and pipe material used.

For sloping steel pipe, expansion joints shall be placed adjacent to and downhill from anchors or thrust blocks.

For welded pipe joints, expansion joints shall be installed, as needed, to limit pipeline stresses to the allowable values.

For suspended pipelines, joints shall be designed for pipe loading including the water in the pipe, wind, ice, and the effects of thermal expansion and contraction.

Joints and connections for metal pipes should be of similar materials whenever possible. If dissimilar materials are used, the joints or connections shall be protected against galvanic corrosion.

Depth of Cover. Buried pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic loads, farming operations, freezing temperatures, or soil cracking, as applicable.

Pipelines shall have sufficient strength to withstand all external loads on the pipe for the given installation conditions. Appropriate live loads shall be used for the anticipated traffic conditions. Refer to NEH Part 636, Chapter 52 for procedures to analyze external loads on buried pipe.

Shallow buried or above ground pipe installations require special consideration for protection from physical and environmental hazards. Refer to NEH Part 636, Chapter 52 for guidance when the depth of cover is less than the minimums specified below.

The minimum depth of cover for pipe susceptible to any of these hazards shall be:

Diameter (inches)	Depth of Cover (inches)
½ through 2½	18
3 through 5	24
6 or more	30
All sizes in soils subject to cracking	36

In areas where pipe is not be susceptible to freezing, vehicular, or cultivation hazards, and the soils do not crack appreciably when dry, the minimum depth of cover may be reduced to:

Diameter (inches)	Depth of Cover (inches)
½ through 1½	6
2 through 5	12
4 through 6	18
6 or more	24

At low places on the ground surface, extra fill may be placed over the pipeline to provide the minimum depth of cover. The top width of the fill shall be no less than 10 feet and the side slopes no steeper than 6:1.

Where it is not possible to achieve sufficient cover or sufficient strength, a carrier (encasement) pipe or other mechanical measures shall be used.

Pressure Reduction. Pressure reduction shall be incorporated in circumstances such as head gain exceeding pressure loss by a significant amount, excessive line pressures for the type of irrigation system supplied, or excessive static pressures.

Inlets. Inlets shall be of adequate size for the type of entrance condition to ensure design flow capacity without excessive head losses.

Provision shall be made to prevent the inflow of trash or other materials into the pipeline if these materials would be detrimental to the pipe capacity or performance of the irrigation application system.

For gravity flow inlets with square-edged or gated orifices, the nappe created by inflow at the orifice entrance shall be vented.

Water control structures, stands, Z-pipes and dog-legs are all acceptable inlet devices. Water control structures are commonly used for gravity flow pipelines, but do not account for removal of entrained air. Therefore, pipelines using these inlets must also meet the requirements listed under Vents.

Check Valves and Backflow Prevention. A check valve shall be installed between the pump discharge and the pipeline if detrimental backflow may occur. Check valves can cause extreme internal pressures, due to water hammer; if they close too fast as flow reversal occurs. “Non slam” type check valves or solenoid operated valves may be required.

Approved backflow prevention devices (chemigation valves) shall be used on all pipelines in which fertilizer, liquid manure, waste water, pesticides, acids, or other chemicals are added to the water supply and where back flow may contaminate the source water supply or groundwater.

Valves and Other Appurtenances. Pressure ratings of valves and other appurtenances shall equal or exceed the pipeline working pressure. When lever operated valves are used, an analysis shall be performed to evaluate potential surge/water hammer assuming an instantaneous valve closure.

Stands Open to the Atmosphere. Stands shall be used when water enters the pipeline to avoid entrapment of air; to prevent surge pressures and collapse because of vacuum failure; and to prevent pressure from exceeding the design working stress of the pipe. The stand shall be designed to:

- Allow a minimum of 1 foot of freeboard. The maximum height of the stand above the centerline of the mainline pipeline must not

exceed the maximum working head of the pipe.

- Have the top of each stand at least 4 feet above the ground surface except for surface gravity inlets or where visibility is not a factor. Gravity inlets and stands shall be equipped with trash racks and covers.
- Have a downward water velocity in stands not in excess of 2 feet per second. The inside diameter of the stand shall not be less than the inside diameter of the pipeline.

The cross sectional area of stands may be reduced above a point 1 foot above the top of the upper inlet, but the reduced cross section shall not be such that it would produce an average velocity of more than 10 feet per second if the entire flow were discharging through it.

If the water velocity of an inlet pipe exceeds three times the velocity of the outlet, the centerline of the inlet shall have a minimum vertical offset from the centerline of the outlet at least equal to the sum of the diameters of the inlet and outlet pipes.

Stands shall be constructed of steel pipe or other approved material and be supported on a base adequate to support the stand and prevent movement or undue stress on the pipeline.

Sand traps, when combined with a stand, shall have a minimum inside dimension of 30 inches and shall be constructed so the bottom is at least 24 inches below the invert of the outlet pipeline. The downward velocity of flow of the water in a sand trap shall not exceed 0.25 feet per second. Suitable provisions shall be made for cleaning sand traps.

The dimensions of gate stands shall be adequate to accommodate the gate or gates required, and shall be large enough to make the gates accessible for repair.

The size of float valve stands shall be adequate to provide accessibility for maintenance.

Stands must be constructed in a manner to insure vibration from the pump discharge pipe is not carried to the stand.

Pressure-relief valves can be used as an alternative to stands open to the atmosphere. A pressure-relief valve shall serve the pressure-relief function of the open stand or vent for which it is an alternative.

Stands Closed to the Atmosphere. If pressure-relief valves and air-and-vacuum valves are used instead of open stands, all requirements detailed in “Stands Open to the Atmosphere” shall apply except as modified below.

The inside diameter of the closed stand shall be equal to or greater than that of the pipeline for at least 1 foot above the top of the uppermost inlet or outlet pipe. To facilitate attaching the pressure-relief valve and the air-and-vacuum valve, the stand may be capped at this point, or if additional height is required, the stand may be extended to the desired elevation by using the same inside diameter or a reduced cross section. If a reduced section is used, the cross-sectional area shall be such that it would produce an average velocity of no more than 10 feet per second if the entire flow were discharged though it. If no vertical offset is required between the pump discharge pipe and the outlet pipeline and the discharge pipe is “dog-legged” below ground, the stand shall extend at least 1 foot above the highest part of the pump discharge pipe.

An acceptable alternative design for stands requiring no vertical inlet offset (when inlet velocity is less than three times that of the outletting pipeline) shall be:

- Construct the dog-leg section of the pump discharge pipe with the same nominal pipe diameter as that of the pipeline.
- Install the pressure-relief valve and the air-and-vacuum valve on top of the upper horizontal section of the dog-leg.

Pressure-relief and air-and-vacuum valves shall be installed on stands with the nominal size pipe required to fit the valves’ threaded inlets.

Surge Tanks and Air Chambers. If surge tanks and/or air chambers are required for control of hydraulic transients or water column separation, they shall have adequate size to ensure the water volume needs of the pipeline are met without the tank/chamber being emptied, and that the required flow into the pipeline for the calculated pressure drop is met.

Pressure Relief Valves. A pressure relief (PR) valve shall be installed between the pump discharge and the pipeline if excessive pressure can build up when all valves are closed. If needed to protect the pipeline against pressure reducing valve malfunction or failure, PR valves shall be installed downstream of pressure reducing valves. Pressure relief should be

provided upstream from valves and at the downstream end of pipeline sections as needed.

Manufacturers of PR valves marketed for use under this standard shall provide capacity tables that give the discharge capacities of the valves at the maximum permissible pressure and differential pressure settings. These tables shall be based on performance tests, and shall be the basis for acceptance of these valves and selection of the design pressure setting.

PR valves shall be set to open at a pressure as low as practical, but no greater than 5 psi above the pressure rating or maximum allowable pressure of the pipe. The valves shall have sufficient flow capacity to reduce the excessive pressures in the pipeline. In lieu, of a detailed surge/pressure analysis, the minimum size of PR valve shall be ¼ inch nominal valve size per inch of the nominal pipeline diameter.

The pressure at which the valves start to open shall be marked on each PR valve. Adjustable PR valves shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

Air Release Valves. Five types of air vents/valves commonly used on irrigation pipelines are continuous acting air release valves (CAV), vacuum-relief valves (VR), air release and vacuum relief valves (AVR), combination air valves (COMB), and open vents. Open vents are described in the “Vents” section of this standard.

If accumulation of air during operation may occur CAV shall be used to release air from the filled pipeline while under pressure. Normal orifice venting diameter is 1/16 to 3/8 inch.

VR valves shall be used for relief of vacuum pressures (i.e., negative pressures) due to sudden gate or valve closure, pump shutoff, or drainage of the pipeline.

AVR valves may be used for the same requirements described for VR valves. These valves shall also be used to release air from the pipeline on filling prior to the pipe being pressurized. They shall be used to alleviate flow restrictions, air locks, and water surging due to the presence of air within pipelines.

COMB valves have the combined function of all three valves (CAV, VR, and AVR) in one body. COMB valves may be used for any of the conditions in which a CAV, VR, or AVR is required.

If needed to provide positive means for air escape during filling and air entry while emptying, an AVR, VR, or COMB valve shall be installed at all summits, upstream and downstream of all in-line valves as needed, at the entrance, and at the downstream end(s) of the pipelines. Such valves are needed at these locations if the pipeline is closed to the atmosphere. However, they may not be needed if other features of the pipe system, such as permanently located sprinkler nozzles or other unclosed service outlets, adequately vent the particular location during filling and emptying operations. The use of these system features must be analyzed for air flow rate and the proper use of such features described in the Operation and Maintenance plan. High points in the pipeline require a CAV unless an outlet is located at that point.

In addition to the locations described above, an AVR or COMB valve shall be located at changes of grade in downward direction of flow in excess of 10 degrees, to ensure adequate air release during filling. On long pipelines, additional AVR or COMB valves may be required to adequately vent the pipe during filling.

For air release, the AVR or COMB valve shall be sized to exhaust air from the pipeline at the rate needed to prevent operational problems with the pipeline, while maintaining the proper operation of the valve. For design purposes, the exhaust pressure differential shall be limited to 2 psi. Long pipelines may require CAV (in addition to AVR) or COMB valves spaced in the range of 1,200 to 3,000 feet. Without some site specific analysis a spacing of ¼ mile is recommended.

For vacuum relief, the AVR, VR, or COMB valves shall be sized for air entry into the pipeline, ensuring the pipeline does not collapse due to vacuum created during drainage of the pipeline. For design purposes, the vacuum pressure differential shall be limited to the computed pipe collapse pressure or 5 psi, whichever is smaller.

If the required vacuum relief orifice diameter is significantly larger than the required air release orifice diameter, separate valves may be required to help eliminate excessive water hammer caused when the air is released too fast from the pipeline.

CAV or COMB valves shall be used as needed to permit air to escape while the line is at working pressure. Small orifices of these valve types shall be sized according to the design working

pressure and venting requirements recommended by the valve manufacturer.

The location of the CAV or COMB valves shall be sufficient distance downstream from the introduction of air into the system (under pressure conditions) to allow the air to be collected at the top of the pipe. Under some circumstances (e.g., pumped system with low pressure or velocity) consideration should be given to installing vent chambers for CAV or COMB valves. The vent chamber should be constructed according to the requirements under the second criterion in the "Vents" section of this standard.

Air vent size shall be based on pipeline size, pipe slope towards drains, and filling requirements. For pipeline size up to 3-inch diameter, 1/2-inch valves are generally adequate for filling operations, or preventing a vacuum from forming during emptying. For other pipe sizes, guidance for sizing air valves may be found in various valve manufacturers' literature (e.g., Val-Matic Valve Corp. or Crispin Valve) or in Appendix B of the AgPipe User Manual.

In lieu of a detailed design, for the corresponding pipe material below, the following size air valves shall be used:

- For Plastic ≤ 50 psi - 0.22 x pipe diameter
- For Plastic > 50 psi - 0.10 x pipe diameter
- For Metal - 0.125 x pipe diameter
- For Concrete - 0.125 x pipe diameter
- For Aluminum: ≤ 6" Dia. Pipe - 2-inch dia.
  8" to 10" - 3-inch dia.
  12" - 4-inch dia.

Manufacturers of air valves marketed for use under this standard shall provide dimensional data or a capacity table based on performance tests, which shall be the basis for selection and acceptance of these valves.

Vents. Venting must be designed into systems open to the atmosphere to provide for the removal and entry of air and protection from surge. The following criteria shall apply:

- Vents shall have a minimum freeboard of 1 foot above the hydraulic gradeline at design capacity. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum allowable working pressure of the pipe.
- A vent chamber shall be constructed to intercept and/or capture air within the pipeline. The chamber shall intercept the circumference arc of 75 degrees at the top of the pipe (i.e., a vent chamber diameter of 2/3 the diameter of the pipeline). The chamber shall extend vertically at least one pipeline diameter up from the centerline of the pipeline. Above this elevation, the vent chamber may be reduced to minimum diameter of 2 inches.
- When an AVR or COMB valve is used instead of a vent, the above requirements shall apply except that the reduced section shall be sized to meet the nominal pipe size required to fit the valve's threaded inlet. An acceptable alternative is to install the valve(s) in the side of a service outlet, provided that the service outlet riser is properly located and adequately sized. If both AVR and PR valves are required at the location, the 10 feet per second velocity criteria given under the "Stands Open to the Atmosphere" section of this standard, shall apply to the reduced section.
- Vent chambers shall be installed on all open vents and closed vents with air valves, when the normal operating pressure of the pipe is 10 psi or less.
- A vent shall be located at the downstream end of laterals, at summits in the line, and at points where the grade changes more than 10 degrees in a downward direction of flow.
- A study of irrigation pipeline venting observed that individual bubbles, in general, rise to the top of the pipe and are carried by flowing water until released by a vent. The distance for the bubbles to rise to the surface is a function of pipeline velocity and diameter. The following equation gives general guidance regarding the distance from a pipeline inlet to an air vent:

$$L = 1.76\ V\ D$$

Where: L = Distance from inlet to vent (ft)
V = Average velocity (ft/sec)
D = Inside diameter of pipe (ft)

Outlets. Appurtenances to deliver water from the pipe system to the field, ditch, reservoir, or surface pipe system, are known as outlets. Outlets shall have adequate capacity and pressure rating to deliver the required flow to:

- The hydraulic gradeline of a pipe or ditch,
- A point at least 6 inches above the field surface,
- The design surface elevation in a reservoir, or
- An individual sprinkler, lateral line, hydrant, or other device at the required operating pressure.

Outlets shall be designed to minimize erosion, physical damage, or deterioration due to exposure.

Filling. The pipe system shall have a means of controlling the filling of the pipeline to prevent entrapped air and excessive transient pressures.

Filling velocities greater than 1 foot per second in a closed-to-the-atmosphere pipe system (i.e., all outlets closed) requires special evaluation and provisions to remove entrapped air and prevent transient pressures.

If filling at a low flow rate is not possible, the system shall be open to the atmosphere (outlets open) prior to pressurizing. The valves to supplied irrigation system components (gated pipe, wheel line, pivot, etc.) should be opened to release entrapped air and minimize transient pressures in the system. The system shall be designed for air removal and excessive transient pressures that may develop at higher filling rates.

Flushing. If the sediment load in the water is significant, the pipeline shall have adequate velocity to ensure that sediment is moved through and flushed out of the pipeline.

If provisions are needed for flushing sediment or other foreign material, a suitable valve shall be installed at the downstream end(s) or low point(s) of the pipeline.

Draining. Provisions shall be made for the complete removal of water from the pipeline by gravity or other means when:

- Freezing temperatures are a hazard.
- Draining is required by the pipe manufacturer.
- Draining of the pipeline is otherwise specified.

The water drained from pipelines shall not cause water quality, soil erosion, or safety problems upon release.

Safe Discharge of Water. Provisions shall be made for water being discharged from valves, especially air valves and pressure relief valves. Such valves shall be located such that flows are directed away from system operators, livestock, electrical equipment, and other control valves or hook-ups.

Thrust Control. Abrupt changes in pipeline grade, horizontal alignment, tees, or reduction in pipe size, normally require an anchor or thrust blocks to absorb pipeline axial thrust. Thrust control is typically needed at the end of the pipeline, at in-line control valves, at reducers, and at wyes, tees, and elbows.

The pipe manufacturer's recommendations for thrust control shall be followed. In absence of manufacturer's data, thrust blocks shall be designed using NEH Part 636, Chapter 52.

Longitudinal Bending and Joint Deflection. For plastic pipe, the allowable longitudinal bending for the pipeline shall be based on material type and the pressure rating, and shall be in accordance with industry standards, or as described in NEH Part 636 Chapter 52.

Industry standards for PVC pipe generally recommend a maximum joint deflection of one degree for gasketed pipe joints only. For a 20 foot piece of pipe, this is a four inch offset per joint. The minimum radius of curvature for 20' joints is 1,146 feet. The following equation can be used to determine joint deflection angles or curve radii for various lengths of pipe.

$$\text{Joint Deflection Angle (degrees)} = \left(\frac{180}{\frac{R \times \pi}{L}} \right)$$

Where:

R = Curve Radius in ft.
π = 3.1416
L = Pipe Length in ft.

Thermal Effects. For plastic pipe, thermal effects must be properly factored into system design. Pressure ratings for pipes are normally based on a pipe temperature of 73.4ºF. When operating temperature is higher the effective pressure rating of the pipe shall be reduced accordingly.

Values and procedures for pressure rating reduction shall follow information described in the NEH Part 636, Chapter 52.

The pipe pressure rating shall be reduced where the pipe environment or fluid temperatures exceed 73.4° F using the factors in the following table, or factors obtained from the manufacturer.

Strength Reduction Factors for High Temperatures		
Temperature, ºF	Buried PVC Pipe	PE Pipe
≤ 73.4	1.0	1.0
80	0.88	0.92
90	0.75	0.81
100	0.62	0.72
110	0.50	0.63
120	0.40	0.60
130	0.30	0.55
140	0.22	0.50

Physical Protection. Steel pipe installed above ground shall be galvanized or shall be protected with a suitable protective paint coating, including a primer coat and a minimum of two final coats.

Plastic pipe installed above ground shall be resistant to ultraviolet light throughout the intended life of the pipe or measures taken to protect the pipe from damage due to ultraviolet light. PVC pipe and fittings installed above ground shall be protected from ultraviolet oxidation by painting with a heavy pigmented, exterior water-based latex paint.

All pipes shall be protected from hazards presented by traffic loads, farm operations, freezing temperatures, fire, thermal expansion and contraction. Reasonable measures shall be taken to protect the pipe from potential vandalism.

Corrosion Protection. All metal to metal fittings, such as risers, bends, tees, and reducers, should be of similar metals. If dissimilar metals are used, the fittings shall be protected against galvanic corrosion (e.g., separate dissimilar metals with rubber or plastic insulator).

Bolts used to join galvanized steel shall be galvanized; plastic coated, stainless steel, or otherwise protected to prevent galvanic corrosion. Bolts used to join aluminum, other than aluminum alloy bolts, must be plastic coated or otherwise protected to prevent galvanic corrosion.

Interior Linings. Interior protective lining shall be provided when the pH of the water falls outside the ranges shown in the following table.

Material	Water pH
Aluminized Steel	Less than 5 or greater than 9
Galvanized Steel	Less than 6 or greater than 10
Aluminum Alloy	Less than 4 or greater than 10

Unlined steel pipelines can experience corrosion from very pure water (e.g., snow melt). If the Langelier Saturation Index (LSI) is less than -1.0, interior corrosion protection shall be provided. LSI values less than 0 indicate corrosive conditions. An LSI number equal to zero indicates a balanced condition. Calcium Carbonate will tend to form with LSI numbers greater than 0.

To calculate the LSI, it is necessary to know the alkalinity (mg/l as CaCO3), the calcium hardness (mg/l Ca+2 as CaCO3), the total dissolved solids (mg/l TDS), the actual pH, and the temperature of the water (°C). These values are used in the following equations:

$LSI = pH - pH_s$

$pH_s = (9.3 + A + B) - (C + D)$

Where:

$A = (Log10\ [TDS] - 1) / 10$

$B = -13.12 \times Log10\ (°C + 273) + 34.55$

$C = Log10\ [Ca^{+2}\ as\ CaCO_3] - 0.4$

$D = Log10\ [alkalinity\ as\ CaCO_3]$

Interior pipe coatings can be selected from one of the following methods if the applied coating meets the requirements of the applicable reference specification:

Accepted Interior Coating	Reference Specification
Coal Tar Enamel Coating	AWWA C203
Cement Mortar Lining	AWWA C205
Liquid Epoxy	AWWA C210

Exterior Protective Coatings. All buried steel pipelines shall have a Class A or Class B Coating as follows: (1). A Class A coating shall be provided if the Resistivity Survey shows that either (a) 20 percent or more of the total surface area of the pipeline will be in soil having a resistivity of 1,500 ohm-cm or less or (b) 10 percent or more of the total surface area of the pipeline will be in soil having a resistivity of 750 ohm-cm or less; (2) A Class B coating shall be provided for pipe to be installed in uniform soils having a resistivity greater than 1,500 ohm-cm.

A Class A coating method shall be selected based on consideration of the on-site physical, chemical, and biological conditions that may contribute to exterior corrosion of the pipeline, using procedures described in one or more of the design references listed in the Reference Section of this standard.

A Class A Coating can be selected from one of the following methods if the applied coating meets the requirements of the applicable reference specification:

Accepted Type A Coating	Reference Specification
Coal Tar Enamel Coating (Including asbestos felt or inert outer wrap)	AWWA C203
Tape Coating System (80 mil min. thickness)	AWWA C214
Polyurethane Coating (25 mil min. thickness)	AWWA C222

A Class B Coating can be selected from one of the following methods if the applied coating meets the requirements of the applicable reference specification: (Note: Class A coatings are also acceptable for Class B)

Accepted Type B Coating	Reference Specification
Coal Tar Enamel Coating (Excluding asbestos felt or inert outer wrap)	AWWA C203
Epoxy Coating (16 mil min. thickness)	AWWA C210 or 213
Tape Coating System (50 mil min. thickness)	AWWA C214
Prefabricated Tape Coating, 20 mil min.	AWWA C209

Coatings on all fittings shall provide equal protection to the specified coating.

Supplementary cathodic protection shall be provided if the soil resistivity survey shows that any part of the pipeline will be in soil whose resistivity is less than 10,000 ohm-cm unless galvanized pipe is used. Pipe to soil potential shall be not less than 0.85 V negative, referred to as a copper/copper sulfate reference electrode, with the cathodic protection installed. The initial anode installation shall be sufficient to provide protection for a minimum of 15 years.

Galvanized steel pipe may be used when the soil resistivity is greater than 4000 ohm-cm.

Hot-dipped asphalt or polymeric-coated, galvanized steel pipe shall be provided if the soil resistivity along any part of the pipeline is between 3000 and 4000 ohm-cm. In addition to the above coatings, cathodic protection shall be provided for galvanized steel pipe if the soil resistivity is less than 3000 ohm-cm.

Aluminized steel pipe may be used when the soil resistivity is greater than 1500 ohm-cm and the soil pH is between 5 and 9.

Aluminum alloy pipe may be used when the soil resistivity is greater than 500 ohm-cm and the soil pH is between 4 and 10.

When cathodic protection is required, joints and connecting bands shall be electrically bridged to ensure continuous flow of current. A dielectric connection shall be placed between the pump and the pipeline and between pipes with different coatings.

The total current required, kind and number of anodes needed, and life expectancy for the cathodic protection shall be designed in accordance with NRCS Design Note 12, Control of Underground Corrosion.

Resistivity Measurement Requirements for Metal Pipe. If risk of corrosion is “high” based on the Cooperative Soil Survey’s Soil Features Report, soil-resistivity measurements shall be conducted to determine corrosion protection requirements. For this purpose, field resistivity measurements shall be made or samples for laboratory analysis shall be taken at least every 400 feet along the proposed pipeline and at points where a visible change in soil characteristics occurs. If adjacent readings differ markedly, additional measurements shall be taken to locate the point of change. Resistivity determinations shall be made at two or more

depths in the soil profile at each sampling station; with the lowest depth at the stratum in which the pipe will be laid. The lowest value of soil resistivity found at each sampling station shall be used as the design value for that station.

After the pipe trench is excavated, a detailed soil resistivity survey shall be made as a verification of the final required cathodic protection. At this time, resistivity measurements shall be made in each exposed soil horizon at intervals not exceeding 200 feet. The lowest value of soil resistivity found at each sampling station shall be used as the design value for that station. If design values for adjacent stations differ significantly, additional intermediate measurements shall be made.

Electric Fields. An electric field can develop where a metal pipeline is installed adjacent to an existing metal pipeline. This situation can adversely affect the new pipeline. The new pipeline shall be adequately protected from this condition.

Environmental Constraints for Aluminum Pipe. Water quality shall be considered for aluminum pipeline installations. A copper content in excess of 0.02 ppm produces nodular pitting and rapid deterioration of the pipe if water is allowed to become stagnant. When the copper content exceeds this limit, the pipeline shall be designed to allow draining after each use.

Protection from corrosion shall be provided for aluminum pipe installed in contact with concrete.

Environmental Constraints for Concrete Pipe. Concrete pipelines shall not be installed on sites where the sulfate-salt concentration in the soil or soil water exceeds 1.0 percent. On sites where the sulfate concentration is more than 0.1 percent but not more than 1.0 percent, concrete pipe may be used only if the pipe is made with Type V or Type II cement, with tricalcium aluminate content not exceeding 5.5 percent.

Additional Criteria Applicable to Reduce Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

Additional Criteria Applicable to Develop Renewable Energy Systems

Renewable energy systems shall meet applicable design criteria in NRCS and/or industry standards, and shall be in accordance with manufacturer's recommendations. Hydropower systems shall be designed, operated, and maintained in accordance with the Microhydropower Handbook, Sections 4 and 5, as appropriate.

CONSIDERATIONS

General. Limiting the working pressure of pipelines to 72% of the pressure rating of the pipe or limiting the velocity to 5 feet per second does not necessarily eliminate the need to evaluate the effects of surge pressure. The effects of surge pressure on the pipeline should be evaluated in all situations.

Careful consideration should be given to determining the "working pressure" of pipelines. For example, for pipelines with downstream controls or in-line valves, consider the working pressure to be the static head on the pipeline at that point, rather than the pressure in the pipe under flowing conditions. Consider, also, the possibility of in-line valves being installed in open-flow pipelines in the future. For gravity flow, static head could be defined as the pressure in the pipeline based on the distance between the static water level and the pipe centerline. For pumped systems, the static head could be determined by the distance between the centerline of the pipe and the hydraulic grade line created by the pump "shutoff head".

Pump shutoff head data can be obtained from the pump manufacturer. If this data is not available, the shutoff head for centrifugal pumps can be estimated by using the formula:

$$P_S = (d\ n\ /1840)^2$$

Where:

P_S = shutoff head in feet of water
d = pump impeller diameter in inches
n = speed of impeller, rpm

Hydraulic transients (surge pressures) due to valve closures can be minimized by closing the valve slowly. Consider the following:

- Avoid the use of quick closing, quarter-turn valves such as lever-operated butterfly valves, if possible.

- Specify slow closing valves, geared valve operators, “anti-slam” air valves, or other similar devices.

Safety. Pipelines may present a threat to the safety of people and property, during both installation and operation. Consider safety as follows:

- Address trench safety in design and during construction.
- Provide protection for people from inlets of pipelines and open stands.
- Provide protection for people from water blowing from pressure-relief, air-release, and other valves.
- Determine the existence or non-existence of underground utilities prior to construction.

Protection of Pipeline and Appurtenances. Consider protection of the pipeline and all appurtenances from potential damage:

- Locate the pipeline and above-ground appurtenances and control structures to minimize potential damage from equipment and tillage practices.

Protect all above-ground appurtenances and control structures from possible damage by livestock and wildlife.

Economic. Economics can be a major factor in pipeline design, as follows:

- Select pipe based on lifetime energy requirements, as well as initial costs of materials.
- Select pipe material based upon expected life of practice.
- Consider hydropower applications as alternatives to use of pressure reduction valves or reduced pipe diameter to induce friction loss.

Water Quality and Quantity. The effects of an irrigation pipeline on water quality and quantity should be considered when designing an irrigation pipeline. Consider the effects:

- On the water budget, especially on infiltration and evaporation,
- On downstream flows or aquifers that would affect other water uses or users,
- On potential use for irrigation management,
- Of installing a pipeline in vegetation that may have been located next to the original conveyance,
- Of installing the pipeline (replacing other types of conveyance) on channel erosion or the movement of sediment and soluble and sediment-attached substances carried by water,
- On the movement of dissolved substances into the soil and on percolation below the root zone or to ground water recharge,
- Of controlled water delivery on the temperatures of water resources that could cause undesirable effects on aquatic and wildlife communities,
- On wetlands or water-related wildlife habitats, and
- On the visual quality of water resources.

Environment. Base pipe material selection on exposure considerations (such as soil resistivity, pH, sunlight, and traffic). Soil texture, resistivity, pH, moisture content, redox potential and depth are important soil properties to be aware of for pipelines and in reducing soil limitations related to corrosivity, or packing of soil material. Refer to soil survey information of the area and on-site soil investigations should be considered during planning and design processes.

The Langelier Saturation Index and related indices may be a factor in determining type of material to use for a pipeline.

Pipelines installed below the ground surface should have a soil plan describing soil reconstruction of disturbed soil during and after pipeline installation so original soil productivity is restored after pipeline installation. Appropriate vegetation should be established to stabilize disturbed areas that will not be cropped.

Follow State and Federal laws and regulations regarding cultural resources.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for irrigation pipelines that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include:

- A plan view of the layout of the pipeline.
- Profile of the irrigation pipeline.

- Pipe material and sizes.
- Pipe joint requirements.
- Locations and details for all appurtenances and control structures.
- Locations and specifications for all thrust blocks.
- Site specific construction specifications that describe in writing the installation of the irrigation pipeline. Include the specification for pressure testing of the irrigation pipeline.
- Depth of cover and backfill requirements.
- Disposal requirements for excess soil material.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) Plan shall be developed for each pipeline system installed. The plan should document needed actions to ensure that practices perform adequately throughout their expected life.

O&M requirements shall be included as an identifiable part of the design. Depending on the scope of the project, this may be accomplished by brief statements in the plans and specifications, the conservation plan narrative, or as a separate O&M Plan.

Other aspects of O&M, such as draining procedures for the pipeline and all valves and appurtenances, marking crossing locations, valve operation to prevent pipe or appurtenant damage, appurtenance or pipe maintenance, and recommended operating procedures, should be described as needed within the O&M Plan.

Monitoring of any cathodic protection systems shall be performed as specified in the O&M Plan.

A filling procedure shall be developed, which details allowable flow rates and appurtenance operation at the various phases of the filling process, required to assure safe filling of the pipeline. Flow measuring appurtenances such as flow meters or weirs, or other means (e.g., number of turns of a gate valve) should be used to determine the rate of flow into the pipeline system. This information shall be provided to the operator, and shall be incorporated into the Operation and Management Plan as appropriate.

REFERENCES

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Appendix F - Land ownership along Orchard Ranch Ditch (listed in order from start to end of pipe)			
Ownership at headgate, and the routes for the upper pipe, the main pipe, the Bertram lateral pipe, and a portion of the stability pipe			
Name of landowner	**Ditch company shareholder**	**New easement needed**	**Notes**
Moss, Tamara	no	perhaps	"Seth" Owner at headgate and screening structure. May need expanded easement to site the screening structure.
Young, Andrew	no	no	"Gene" North side of ditch
Vonfeld, Clement	no	no	South side of ditch
Hinchman, Forest	no	yes	"Mike" new easement is needed for cutoff
Town of Orchard City	no	yes	needed for cutoff
Phillips, Robert	no	yes	needed for cutoff, former shareholder
Kimberlin, James	no	yes	needed for cutoff
Morris, Steven	no	yes	needed for cutoff and part of Bertram lateral
Zeller, Robin	yes	yes	needed for cutoff
Berghauser, Trudy	yes	no	if we don't do the cutoff
Morris, Steven	no	no	if we don't do the cutoff. Same person as above
Penick, Dave	no	no	if we don't do the cutoff
Romero, Toby	yes	no	if we don't do the cutoff
Morris, Robert A.	yes	no	if we don't do the cutoff
KCO Corp	yes	no	
Hurford, Albert	yes	perhaps	We may want to straighten the ditch
Johnson, Robert	yes	perhaps	He wants us to straighten the ditch
Labrum, Jeffrey	yes	perhaps	We may want to straighten the ditch
Mansfield, Keven	yes	perhaps	We may want to straighten the ditch
Atwood, Charity	yes	perhaps	We may want to straighten the ditch
Isom, Michelle	yes	perhaps	We may want to straighten the ditch
?			It is unclear who owns the propety on the east side of the ditch in the Eckert Estates subdivision.

Stevens, Julia	yes	yes	
Deal, Lonnie	yes	no	
Pfeifer, Ruth	yes	no	Bob Morris's mother-in-law
Ownership for a portion of the Stability pipe and all the North Road lateral pipe			
Atwood, Charity	yes	no	
Isom, Michelle	yes	no	
Miller, Jess	yes	no	
Kehmeier, William	yes	no	
Ownership of the McKinney lateral pipe			
Stevens, Julia	yes	perhaps	We may want to straighten the ditch
Coates, William	yes	no	
Harmon, William	yes	no	Unclear if the ditch is on Coates or Harmon property
Ownership of the Valentine lateral pipe			
Stevens, Julia	yes	yes	We want to straighen the ditch
Overlease, Jessie	yes	no	
Blanchard, Earnest	yes	no	Unclear if the ditch is on Overlease or Blanchard

Appendix G – Cost estimate

DETAILED COST ESTIMATE
Orchard Ranch Ditch Piping Project

	Units	Number of Units	Cost	Number of Units * Cost	Salinity Program Funding	Other Funding	Basis of Cost Estimates
PROJECT DESIGN				$ 95,779.53	$ 95,779.53		8% of Construction
NEPA COMPLIANCE AND CULTURAL RESOURCES				$ 23,944.88	$ 23,944.88		2% of Construction
OWNER ADMINISTRATION				$ -	$ -		Basis = Eden Valley Irrigation & Drainage District - 2012 Lower West Side Piping Project (R09AP40880)
SUBTOTAL				**$ 119,724.41**	**$ 119,724.41**	**$ -**	
Mobilization	LS	1	$ 50,000.00	$ 50,000.00	$ 50,000.00		6% of Construction - Basis = Eden Valley Irrigation & Drainage District - 2012 Lower West Side Piping Project (R09AP40880)
Screening Structure	LS	1	$100,000.00	$ 100,000.00	$ 100,000.00		Average Bid - 2014 Forked Tongue Piping Project + Inflation 3% to 2017
24" HDPE DR 41 PIPE	LF	4220	$ 51.45	$ 217,138.69	$ 217,138.69		Average Bid - Sheep Creek South Valley Piping Project (R13AC40015) + Inflation 3% to 2017
18" HDPE DR 32.5 PIPE	LF	2100	$ 41.96	$ 88,105.92	$ 88,105.92		Average Bid - 2014 Roger's Mesa Water Distribution Association - Slack Piping Project (R13AC40003) + Inflation 3% to 2017
16" HDPE DR 32.5 PIPE	LF	5020	$ 40.11	$ 201,338.14	$ 201,338.14		Average Bid - 2014 Roger's Mesa Water Distribution Association - Patterson Piping Project (R13AC40003) + Inflation 3% to 2017
14" HDPE DR 32.5 PIPE	LF	1860	$ 32.99	$ 61,354.21	$ 61,354.21		Average Bid - 2014 Roger's Mesa Water Distribution Association - Patterson Piping Project (R13AC40003) + Inflation 3% to 2017
12" HDPE DR 32.5 PIPE	LF	1820	$ 28.34	$ 51,576.13	$ 51,576.13		Average Bid - 2014 Roger's Mesa Water Distribution Association - Slack Piping Project (R13AC40003) + Inflation 3% to 2017
6" HDPE DR 32.5 PIPE	LF	1350	$ 14.86	$ 20,061.00	$ 20,061.00		Average Bid - 2014 Roger's Mesa Water Distribution Association - Slack Piping Project (R13AC40003) + Inflation 3% to 2017
Fittings	LS	1	$ 60,000.00	$ 60,000.00	$ 60,000.00		10% of Pipe Costs
Meters	EA	11	$ 7,000.00	$ 77,000.00	$ 77,000.00		Average Bid - 2014 Forked Tongue Piping Project + Inflation 3% to 2017
Turnouts	EA	11	$ 12,000.00	$ 132,000.00	$ 132,000.00		Average Bid - 2014 Forked Tongue Piping Project + Inflation 3% to 2017
Easements	LS	1	$ 10,000.00	$ 10,000.00	$ 10,000.00		Average Bid - 2012 Sheep Creek Cedar Hollow Piping Project + Inflation 3% to 2017
Fill Ditch	LF	16370	$ 2.00	$ 32,740.00	$ 32,740.00		Average Bid - 2012 Sheep Creek Cedar Hollow Piping Project + Inflation 3% to 2017
Remove and Replace Fencing	LF	200	$ 7.00	$ 1,400.00	$ 1,400.00		Average Bid - 2012 Sheep Creek Cedar Hollow Piping Project + Inflation 3% to 2017
Imported Fill	CY	4900	$ 15.00	$ 73,500.00	$ 44,781.97	$ 28,718.03	Average Bid - 2014 Roger's Mesa Water Distribution Association - Patterson Piping Project (R13AC40003) + Inflation 3% to 2017
Reseeding	LF	13530	$ 1.00	$ 13,530.00		$ 13,530.00	Average Bid - 2012 Sheep Creek Cedar Hollow Piping Project + Inflation 3% to 2017
Road Crossings	LF	150	$ 50.00	$ 7,500.00	$ 7,500.00		Average Bid - 2012 Sheep Creek Cedar Hollow Piping Project + Inflation 3% to 2017
SUBTOTAL				**$ 1,197,244.09**	**$ 1,154,996.06**	**$ 42,248.03**	
CONSTRUCTION MANAGEMENT				$ 47,889.76		$ 47,889.76	4% of Construction
SUBTOTAL				**$ 47,889.76**	**$ -**	**$ 47,889.76**	
HABITAT REPLACEMENT				$ 59,862.20		$ 59,862.20	5% of Construction
A-133 AUDIT	EA	3	$ 2,000.00	$ 6,000.00	$ 6,000.00		Eden Valley Irrigation & Drainage District - (R09AP40880)
SUBTOTAL				**$ 65,862.20**	**$ 6,000.00**	**$ 59,862.20**	
TOTAL				**$ 1,430,720.47**	**$ 1,280,720.47**	**$ 150,000.00**	

Notes:

1) This cost estimate was submitted to the U.S. Bureau of Reclamation in the ditch company's successful grant application.

2) The "other funding" column currently shows where the $150,000 CWCB loan will be used, however in practice the loan may be used to pay a percentage (10.5%) of each line item.

3) The cost of financing is estimated to be $1,500 (1% of $150,000) loan. This cost is not included in the document above.

4) The line for 6" HDPE pipe is no longer current and should include an additional 290 feet. The affect of this addition on the overall budget is considered negligible.

Appendix G – Cost estimate

Appendix H – Orchard Ranch Ditch piping project Implementation Schedule

Orchard Ranch Ditch Piping Project

Construction & Funding Schedule

Milestone	Required Funding	2016 Q1	2016 Q2	2016 Q3	2016 Q4	2017 Q1	2017 Q2
FY 2016 Salinity Program Funding	$ 155,412.07						
FY 2016 Colorado Water Conservation Board Funding	$ 18,202.11						
Cooperatvie Agreement Signed							
Engineering Design							
NEPA/Cultural Resource Processes/Habitat Replacement							
50% Design Review w/USBR							
NEPA Report submitted to USBR							
Cultural Resource Report to USBR							
90% Design Review w/USBR							
Cultural Resources Report to SHPO							
Environmental Clearances							
Habitat Replacement Plan Adopted							
Design Complete/Advertise Project							
Bidding & Selection of Contractor							
Habitat Replacement Plan Implemention							
FY 2017 Funding	$ 1,125,308.40						
FY 2017 Colorado Water Conservation Board Funding	$ 131,797.89						
Construction							
Substantial Completion of Construction							
Habitat Replacement Plan Implemented							

Appendix I - Financal statements --30 year schedule of revenue and expenses

Assumptions	
Total Project Cost	$1,430,720
O&M	0.50%
Insurance	0.10%
Replacements	0.10%
Administration	0.20%
Total	0.90%
Revenue from M&I	0%
Numer of Shares in Co.	17,280
Inflation	2.0%
Interest on Reserves	0.0%

Financing

Source	Share	Principal	Interest	Years	Payment
CWCB Loan	11%	$157,379	2.0%	30	$6,979
U.S.B.R. gra	89%	$1,273,341	N.A.	N.A	$0

ORCHARD RANCH DITCH COMPANY

SCHEDULE OF REVENUE and EXPENDITURES

		Annual Revenue				Annual Expenditures									
Year of Operation		Irrigation Assessment	M&I water Sales	Total Revenue	Assessment Per Share	Operation, Maintenance, Replacement	Emergency Operating Reserve Fund Annual	Emergency Operating Reserve Fund Accum.	Loan and Bond Reserve Funds Annual	Loan and Bond Reserve Funds Accum.	Payments on CWCB Loan	Payments on Bonds	Interest on Reserve Funds	Total Expenditures
2017	1	$20,553	$0	$20,553	$1.19	$12,876	$0	$0	$698	$698	$6,979	$0	$0	$20,553
2018		20,811	0	20,811	$1.20	13,134	0	0	$698	1,396	6,979	0	$0	20,811
2019		21,073	0	21,073	$1.22	13,397	0	0	$698	2,094	6,979	0	$0	21,073
2020		21,341	0	21,341	$1.24	13,665	0	0	$698	2,792	6,979	0	$0	21,341
2021	5	21,615	0	21,615	$1.25	13,938	0	0	$698	3,489	6,979	0	$0	21,615
2022		21,893	0	21,893	$1.27	14,217	0	0	$698	4,187	6,979	0	$0	21,893
2023		22,178	0	22,178	$1.28	14,501	0	0	$698	4,885	6,979	0	$0	22,178
2024		22,468	0	22,468	$1.30	14,791	0	0	$698	5,583	6,979	0	$0	22,468
2025		22,763	0	22,763	$1.32	15,087	0	0	$698	6,281	6,979	0	$0	22,763
2026	10	23,065	0	23,065	$1.33	15,389	0	0	$698	6,979	6,979	0	$0	23,065
2027		22,675	0	22,675	$1.31	15,696		0		6,979	6,979	0	$0	22,675
2028		22,989	0	22,989	$1.33	16,010		0		6,979	6,979	0	$0	22,989
2029		23,309	0	23,309	$1.35	16,330		0		6,979	6,979	0	$0	23,309
2030		23,636	0	23,636	$1.37	16,657		0		6,979	6,979	0	$0	23,636
2031	15	23,969	0	23,969	$1.39	16,990		0		6,979	6,979	0	$0	23,969
2032		24,309	0	24,309	$1.41	17,330		0		6,979	6,979	0	$0	24,309
2033		24,655	0	24,655	$1.43	17,677		0		6,979	6,979	0	$0	24,655
2034		25,009	0	25,009	$1.45	18,030		0		6,979	6,979	0	$0	25,009
2035		25,370	0	25,370	$1.47	18,391		0		6,979	6,979	0	$0	25,370
2036	20	25,737	0	25,737	$1.49	18,759		0		6,979	6,979	0	$0	25,737
2037		26,113	0	26,113	$1.51	19,134		0		6,979	6,979	0	$0	26,113
2038		26,495	0	26,495	$1.53	19,516		0		6,979	6,979	0	$0	26,495
2039		26,886	0	26,886	$1.56	19,907		0		6,979	6,979	0	$0	26,886
2040		27,284	0	27,284	$1.58	20,305		0		6,979	6,979	0	$0	27,284
2041	25	27,690	0	27,690	$1.60	20,711		0		6,979	6,979	0	$0	27,690
2042		28,104	0	28,104	$1.63	21,125		0		6,979	6,979	0	$0	28,104
2043		28,526	0	28,526	$1.65	21,548		0		6,979	6,979	0	$0	28,526
2044		28,957	0	28,957	$1.68	21,979		0		6,979	6,979	0	$0	28,957
2045		29,397	0	29,397	$1.70	22,418		0		6,979	6,979	0	$0	29,397
2046	30	29,845	0	29,845	$1.73	22,867		0		6,979	6,979	0	$0	29,845
Totals		$738,715	$0	$738,715		$522,374	$0		$6,979		$209,363	$0	$0	$738,715

Nov 28, 2015

Colorado Water Conservation Board
Finance Section Attn: Anna Mauss
1313 Sherman St. #718
Denver, CO 80203

Dear Ms. Mauss,

Please find herein a loan application and feasibility study for the Orchard Ranch Ditch Company.

Signed,

Paul Kohmeier

Vice-President
Orchard Ranch Ditch Co. board of directors

Orchard Ranch Ditch Company
Piping Project Office
20490 North Road
Eckert CO 81418