LEGISLATIVE SUMMARY SHEET
Tracking No. 0183-19

DATE: June 28, 2019

TITLE OF RESOLUTION: PROPOSED STANDING COMMITTEE RESOLUTION; AN ACTION RELATING TO RESOURCES AND DEVELOPMENT COMMITTEE; APPROVING A TEMPORARY CONSTRUCTION EASEMENT FOR THE TERM OF ONE YEAR TO THE NAVAJO NATION WATER RESOURCES DEPARTMENT FOR THE PURPOSE OF REPLACING THE YELLOWMAN SIPHON LOCATED WITHIN THE NENAHNEZAD CHAPTER VICINITY (SAN JUAN COUNTY, NEW MEXICO)

PURPOSE: Approving a temporary construction easement to the Navajo Nation Department of Water Resources, for the replacement of the Yellowman Siphon located within the Nenahnezad Chapter (San Juan County, New Mexico).

This written summary does not address recommended amendments as may be provided by the standing committees. The Office of Legislative Counsel requests each Council Delegate to review each proposed resolution in detail.

PROPOSED STANDING COMMITTEE RESOLUTION

24th NAVAJO NATION COUNCIL -- Fourth Year, 2019

INTRODUCED BY

(Prime Sponsor)

TRACKING NO. 0183-19

AN ACTION

RELATING TO RESOURCES AND DEVELOPMENT COMMITTEE; APPROVING A TEMPORARY CONSTRUCTION EASEMENT FOR THE TERM OF ONE YEAR TO THE NAVAJO NATION WATER RESOURCES DEPARTMENT FOR THE PURPOSE OF REPLACING THE YELLOWMAN SIPHON LOCATED WITHIN THE NENAHNEZAD CHAPTER VICINITY (SAN JUAN COUNTY, NEW MEXICO)

Section One. Authority

A. Pursuant to 2 N.N.C. §500, the Resources and Development Committee is established as a standing committee of the Navajo Nation Council.

B. Pursuant to 2 N.N.C. §501 B 2(a), the Resources and Development Committee grants final approval for all, non-mineral leases, permits, licenses, rights of ways, and surface easements on Navajo Nation lands and unrestricted (fee) land.

Section Two. Findings

A. The Navajo Nation Department of Water Resources has requested a temporary construction easement to enable the replacement of the Yellowman Siphon within the Fruitland-Cambridge Irrigation Project. See **Exhibit C**.

B. The proposed Yellowman Siphon Temporary Construction Easement Survey is attached as **Exhibit B**.

C. The Finding of No Significant Impact (FONSI) and other Environmental and archaeological studies have been completed and are attached hereto as **Exhibit D**.

D. The Nenahnezad Chapter supports replacement of Yellowman siphon pipe. See **Exhibit E**.

E. The request for a temporary construction easement has been reviewed by the appropriate Departments and Divisions and found legally sufficient by the Department of Justice. See **Exhibit F**.

F. The Terms and Conditions for the Yellowman Siphon is found at **Exhibit A**.

Section Three. Approval

A. The Resources and Development Committee of the Navajo Nation hereby approves the request for a temporary construction easement to the Navajo Nation Department of Water Resources, for the replacement of the Yellowman Siphon, subject but not limited to the Terms and Conditions attached hereto and incorporated herein as found at **Exhibit A**.

B. The Resources and Development Committee of the Navajo Nation hereby approves a waiver of the requirement for a bond, insurance or alternative form of security on the part of the Grantee, based on the determination that the project benefits the Navajo Nation and such a waiver is in the best interest of the Navajo Nation, pursuant to Title 25 CFR § 169.103 (f) (2).

C. The Resources and Development Committee hereby approves waiving valuation and waiving compensation for the temporary construction easement because it has determined that accepting the agreed-upon compensation and waiving valuation is in its best interest of the Navajo Nation, pursuant to Title 25 CFR § 169.110.

D. The Resources and Development Committee of the Navajo Nation Council hereby authorizes the President of the Navajo Nation to execute any and all documents necessary to affect the intent and purpose of this resolution.

EXHIBIT

A

EXHIBIT D

NAVAJO NATION TEMPORARY CONSTRUCTION EASEMENT TERMS AND CONDITIONS

Navajo Nation Water Resources Department **(GRANTEE)**

1. The term of the temporary construction easement (TCE) shall be for one (1) years, beginning on the date the TCE is granted by the Secretary of Interior.

2. Consideration for the TCE is assessed at $ 138,449.42 and shall be paid in full to the Controller of the Navajo Nation, in lawful money of the United States, and a copy of the receipt for such payment provided to the Navajo Nation Minerals Department, or its successor, within ____ days of approval of and consent to the grant of the TCE by the Navajo Nation.

   Consideration for the grant of the TCE is hereby waived.
   [ ] NO [ ] YES

   If consideration has been waived, then the Navajo Nation contributes the amount listed above to the project because the project serves a public purpose and will benefit Navajo residents.

3. The Grantee may develop, use and occupy the TCE for the purpose(s) of replacing 36" steel siphon. The Grantee may not develop, use or occupy the TCE for any other purpose, nor allow others to use or occupy the TCE for any other purpose, without the prior written approval of the Navajo Nation and the Secretary of the Interior. The approval of the Navajo Nation may be granted, granted upon conditions or withheld in the sole discretion of the Navajo Nation. The Grantee may not develop, use or occupy the TCE for any unlawful purpose.

4. In all activities conducted by the Grantee within the Navajo Nation, the Grantee shall abide by all laws and regulations of the Navajo Nation and of the United States, now in force and effect or as hereafter may come into force and effect, including but not limited to the following:

   a. Title 25, Code of Federal Regulations, Part 169;

   b. All applicable federal and Navajo Nation antiquities laws and regulations, with the following additional condition: In the event of a discovery all operations in the immediate vicinity of the discovery must cease and the Navajo Nation Historic Preservation Department must be notified immediately. As used herein, "discovery" means any previously unidentified or incorrectly identified cultural resources, including but not limited to archaeological deposits, human remains, or location reportedly associated with Native American religious/traditional beliefs or practices;

   c. The Navajo Preference in Employment Act, 15 N.N.C. §§ 601 et seq., and the Navajo Nation Business Opportunity Act, 5 N.N.C. §§ 201 et seq.; and

   d. The Navajo Nation Water Code, 22 N.N.C. § 1101 et seq.. Grantee shall apply for and submit all applicable permits and information to the Navajo Nation Water Resources Department, or its successor.

5. The Grantee shall ensure that the air quality of the Navajo Nation is not jeopardized due to violation of applicable laws and regulations by its operations pursuant to the TCE.

6. The Grantee shall clear and keep clear the lands within the TCE to the extent compatible with the purpose of the TCE, and shall dispose of all vegetation and other materials cut, uprooted or otherwise accumulated during any surface disturbance activities.

7. The Grantee shall reclaim all surface lands disturbed related to the TCE, as outlined in a restoration and revegetation plan, which shall be approved by the Navajo Nation Environmental Protection Agency (NNEPA) prior to any surface disturbance. The Grantee shall comply with all provisions of such restoration and revegetation plan and shall notify the Director of the NNEPA immediately upon completion of the surface disturbance activities so that a site inspection can be made.

8. The Grantee shall at all times during the term of the TCE and at the Grantee's sole cost and expense, maintain the land subject to the TCE and all improvements located thereon and make all necessary and reasonable repairs.

9. The Grantee shall obtain prior written permission to cross existing TCEs, if any, from the appropriate parties.

10. The Grantee shall be responsible for and promptly pay all damages when they are sustained.

11. The Grantee shall indemnify and hold harmless the Navajo Nation and the Secretary of the Interior and their respective authorized agents, employees, landusers and occupants, against any liability for loss of life, personal injury and property damages arising from the development, use or occupancy or use of TCE by the Grantee.

12. The Grantee shall not assign, convey, transfer or sublet, in any manner whatsoever, the TCE or any interest therein, or in or to any of the improvements on the land subject to TCE, without the prior written consent of the Navajo Nation and the Secretary of the Interior. Any such attempted assignment, conveyance or transfer without such prior written consent shall be void and of no effect. The consent of the Navajo Nation may be granted, granted upon conditions or withheld in the sole discretion of the Navajo Nation.

13. The Navajo Nation may terminate the TCE for violation of any of the terms and conditions stated herein. In addition, the TCE shall be terminable in whole or part by the Navajo Nation for any of the following causes:

    a. Failure to comply with any term or condition of the grant or of applicable laws or regulations;

    b. A non-use of the TCE for the purpose for which it is granted for a consecutive two year period; and

    c. The use of the land subject to the TCE for any purpose inconsistent with the purpose for which the TCE is granted.

    d. An abandonment of the TCE.

14. At the termination of this TCE, the Grantee shall peaceably and without legal process deliver up the possession of the premises, in good condition, usual wear and tear excepted. Upon the written request of the Navajo Nation, the Grantee shall provide the Navajo Nation, at the Grantee's sole cost and expense, with an environmental audit assessment of the premises at least sixty (60) days prior to delivery of said premises.

15. Holding over by the Grantee after the termination of the TCE shall not constitute a renewal or extension thereof or give the Grantee any rights hereunder or in or to the land subject to the TCE or to any improvements located thereon.

16. The Navajo Nation and the Secretary of the Interior shall have the right, at any reasonable time during the term of the TCE, to enter upon the premises, or any part thereof, to inspect the same and any improvements located thereon.

17. By acceptance of the grant of TCE, the Grantee consents to the full territorial legislative, executive and judicial jurisdiction of the Navajo Nation, including but not limited to the jurisdiction of the Navajo Nation, including but not limited to the jurisdiction to levy fines and to enter judgments for compensatory and punitive damages and injunctive relief, in connection with all activities conducted by the Grantee within the Navajo Nation or which have a proximate (legal) effect on persons or property within the Navajo Nation.

18. By acceptance of the grant of TCE, the Grantee covenants and agrees never to contest or challenge the legislative, executive or judicial jurisdiction of the Navajo Nation on the basis that such jurisdiction is inconsistent with the status of the Navajo Nation as an Indian nation, or that the Navajo Nation government is not a government of general jurisdiction, or that the Navajo Nation government does not possess full police power (i.e., the power to legislate and regulate for the general health and welfare) over all lands, persons and activities within its territorial boundaries, or on any other basis not generally applicable to a similar challenge to the jurisdiction of a state government. Nothing contained in this provision shall be construed to negate or impair federal responsibilities with respect to the land subject to the TCE or to the Navajo Nation.

19. Any action or proceeding brought by the Grantee against the Navajo Nation in connection with or arising out of the terms and conditions of the TCE shall be brought only in the Courts of the Navajo Nation, and no such action or proceeding shall be brought by the Grantee against the Navajo Nation in any court of any state.

20. Nothing contained herein shall be interpreted as constituting a waiver, express or implied, of the sovereign immunity of the Navajo Nation.

21. Except as prohibited by applicable federal law, the law of the Navajo Nation shall govern the construction, performance and enforcement of the terms and conditions contained herein.

22. The terms and conditions contained herein shall extend to and be binding upon the successors, heirs, assigns, executors, administrators, employees and agents, including all contractors and subcontractors, of the Grantee, and the term "Grantee," whenever used herein, shall be deemed to include all such successors, heirs, assigns, executors, administrators, employees and agents.

23. There is expressly reserved to the Navajo Nation full territorial legislative, executive and judicial jurisdiction over the TCE and all lands burdened by the TCE, including without limitation over all persons, including the public, and all activities conducted or otherwise occurring within the TCE; and the TCE and all lands burdened by the TCE shall be and forever remain Navajo Indian Country for purposes of Navajo Nation jurisdiction.

24. **The Navajo Nation reserves the right to grant temporary construction easement within the temporary construction easement referenced herein for utilities, provided that such temporary construction easement do not interfere with the Grantee's use of the temporary construction easement.**

EXHIBIT B

FRUITLAND DITCH - YELLOWMAN SIPHON
T.C.E. SURVEY NAVAJO NATION LANDS

LOCATED IN PORTIONS OF SECTION 7, SECTION 8 AND SECTION 9 OF TOWNSHIP 29 NORTH, RANGE 15 WEST, NEW MEXICO PRINCIPAL MERIDIAN, SAN JUAN COUNTY, NEW MEXICO

Basis of Bearing

AS MEASURED BY GPS BETWEEN THE SOUTHWEST CORNER AND THE SOUTHEAST CORNER OF SECTION 8, T-29-N, R-15-W, N.M.P.M. LINE BEARS S 89°38'11" E A DISTANCE OF 5,243.16 FEET

NOTES

1- Date of Survey July 17-July 23, 2015

2- Reference BLM dependent resurvey, approved April 20, 2000.

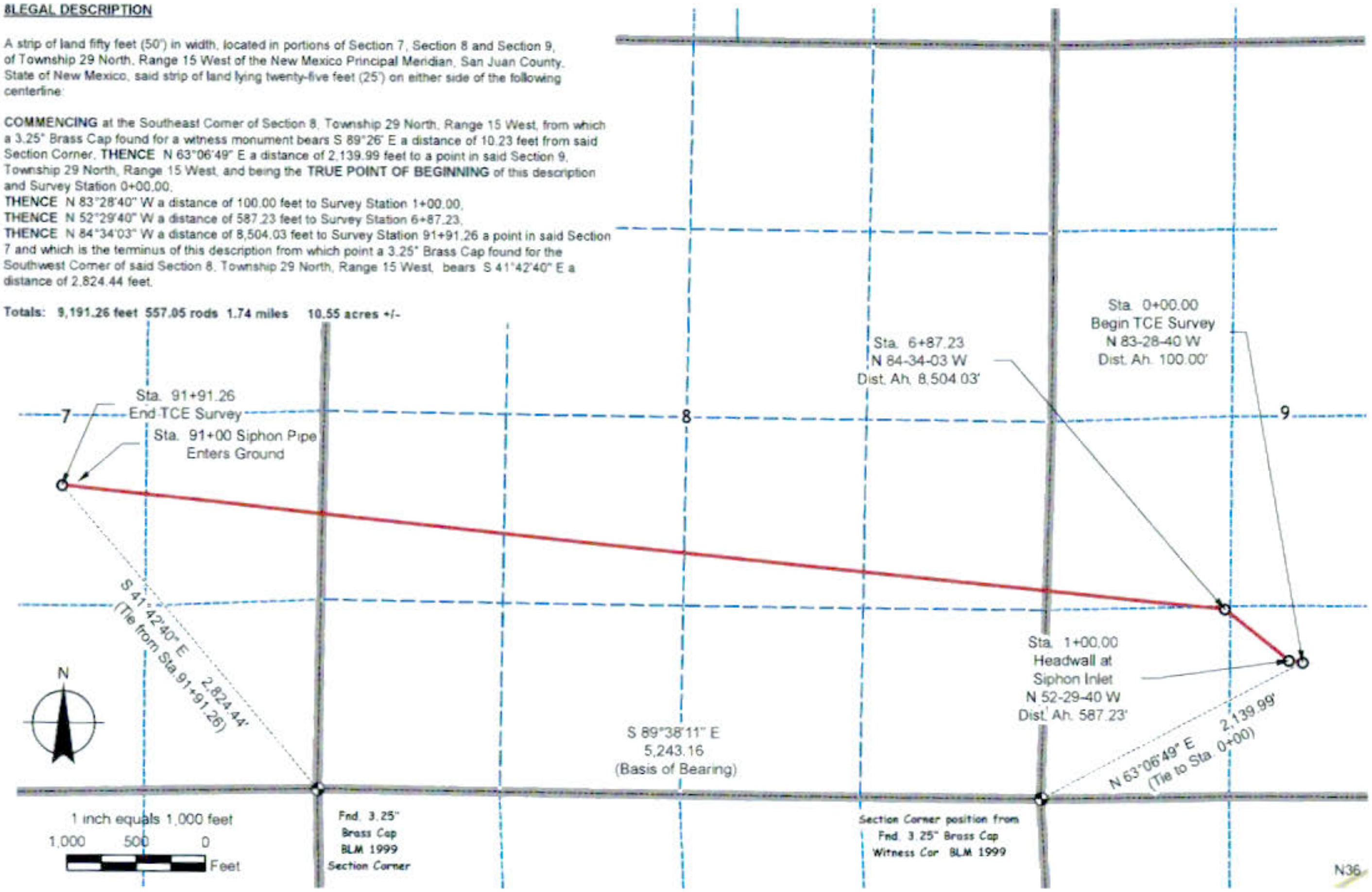
3- The locations of underground utilities depicted are approximate, actual locations of underground utilities must be field verified prior to construction

8LEGAL DESCRIPTION

A strip of land fifty feet (50') in width, located in portions of Section 7, Section 8 and Section 9, of Township 29 North, Range 15 West of the New Mexico Principal Meridian, San Juan County, State of New Mexico, said strip of land lying twenty-five feet (25') on either side of the following centerline:

COMMENCING at the Southeast Corner of Section 8, Township 29 North, Range 15 West, from which a 3.25" Brass Cap found for a witness monument bears S 89°26' E a distance of 10.23 feet from said Section Corner, **THENCE** N 63°06'49" E a distance of 2,139.99 feet to a point in said Section 9, Township 29 North, Range 15 West, and being the **TRUE POINT OF BEGINNING** of this description and Survey Station 0+00.00,
THENCE N 83°28'40" W a distance of 100.00 feet to Survey Station 1+00.00,
THENCE N 52°29'40" W a distance of 587.23 feet to Survey Station 6+87.23,
THENCE N 84°34'03" W a distance of 8,504.03 feet to Survey Station 91+91.26 a point in said Section 7 and which is the terminus of this description from which point a 3.25" Brass Cap found for the Southwest Corner of said Section 8, Township 29 North, Range 15 West, bears S 41°42'40" E a distance of 2,824.44 feet.

Totals: 9,191.26 feet 557.05 rods 1.74 miles 10.55 acres +/-



CERTIFICATION

I, DAVID A. JOHNSON, A REGISTERED PROFESSIONAL SURVEYOR UNDER THE LAWS OF THE STATE OF NEW MEXICO, CERTIFY THAT THIS SURVEY PLAT WAS PREPARED FROM AN ACTUAL GROUND SURVEY PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION, THAT I AM RESPONSIBLE FOR THIS SURVEY, THAT THIS SURVEY IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF AND THAT THIS PLAT AND THE FIELD SURVEY UPON WHICH IT IS BASED CONFORM TO THE "MINIMUM STANDARDS FOR LAND SURVEYING IN NEW MEXICO"

DAVID A. JOHNSON PROFESSIONAL SURVEYOR NEW MEXICO 14827 REGISTERED

2015-08-2

DAVID A. JOHNSON
NEW MEXICO LICENSE NO. 14827

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JMAS
JOHNSON MAPPING AND SURVEYING, LLC
PO BOX 2174
FARMINGTON, NM 87499-2174
505-360-8029
alex@johnsonmapping.biz

THE NAVAJO NATION
DEPARTMENT OF WATER RESOURCES
P.O. Box 678, Fort Defiance, Arizona 86504 / (928) 729-4003 / Fax (928) 729-4029

Russell Begaye
President

Jonathan Nez
Vice President

EXHIBIT
C

August 06, 2018

Ms. Elerina Yazzie – Program Manager
General Land Development Department
Division of Natural Resources
PO Box 69
St. Michaels, Arizona 86511

RE: Request for Temporary Construction Easement – Yellowman Siphon

Dear Ms. Yazzie:

San Juan River Navajo Irrigation Project respectfully submits a letter of application for the Temporary Construction Easement for Yellowman Siphon on Tribal Trust Land in San Juan County, New Mexico. The Navajo Nation Department of Water Resources plans to replace the Yellowman Siphon Pipe and install new trash screen on the inlet of the siphon in the Nenahnezad Chapter area.

Location:
Portions of Section 7, Section 8 and Section 9 of Township 29 North, Range 15 West, New Mexico Principal Meridian, San Juan County, New Mexico.
(Legal Description enclosed)

Should you have any questions or require further information, please contact me at (505) 368-1016 (office), (928) 349-2957 (cell) or by email at james_chery@outlook.com. Thank you.

Sincerely,

Cherylena James
Senior Engineering Technician
San Juan River Navajo Irrigation Project

KB-Walkoma, LLC
707 N. Dustin Avenue
Farmington, NM 87401
Technical services to rural communities for developing their agriculture and natural resources in Farmington, NM, USA and Chisinau, Moldova

For client:

NNDWR-TCOB
PO Box 57
Shiprock, NM 87420

CO 12418 90% DRAFT SPECIFICATIONS:

Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Contract Specifications

Submitted:

June 18, 2018

Contents

PART 1 – GENERAL

1.01 DEFINITIONS

A. ***General***. This section provides definitions to better understand this document.

B. ***Owner***. The Navajo Nation Department of Water Resources.

C. ***Contractor***. The general contractor awarded the Yellowman Siphon RFP (RFP#) and contracted by the Navajo Nation (COXXXXXXXX).

D. ***Engineer of Record.*** KB-Walkoma, LLC of Farmington, NM under CO12418. Principal engineer is Michael Isaacson who is certifying this design using engineering license NM 274592-2202.

E. ***BIA.*** Bureau of Indian Affairs. BIA has contracted the Navajo Nation Department of Water Resources using a PL93 638 Subpart J contract.

F. ***Contract.*** The agreement (MOA) between the Navajo Nation Department of Water Resources and the San Juan River Dineh Water Users, Inc.

G. ***Pipe Supplier.*** The Navajo Nation Department of Water Resources has purchased the steel pipe for this project from ______________________________ (PO#XXXXXXXXXX)

H. ***Other.***

ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
GFCI	Ground Fault Circuit Interrupter
HDB	Hydrostatic Design Basis
HDPE	High Density Polyethylene
NEPA	National Environmental Policy Act
NEMA	National Electrical Manufacturers Association
NOI	Notice of Intent
NTUA	Navajo Tribal Utility Authority
PE	Polyethylene
PPI	Plastic Pipe Institute
PSI	Pressure per Square Inch
PVC	Polyvinyl Chloride
SDR	Standard Dimension Ratio

1.02 WORK INCLUDED

A. ***Project***. This scope of work covers all material not furnished by the Owner and workmanship required to replace 2,450 ft of Yellowman Siphon, replace the inlet structure, replace two road crossings, repair one road crossing, tie-in to the existing outlet, and to install a new trash screen in front of the new siphon inlet.

B. ***General***. The Yellowman Siphon is a 36-inch above-ground steel pipe siphon that is part of Fruitland Canal. Most of the steel siphon has been previously replaced by others. Only 2,450 ft remain to be replaced. The siphon is located on the south side of the San Juan River, approximately one mile southwest of the town of Fruitland, New Mexico. The siphon is located in Nenahnezad Chapter, Navajo Nation.

C. ***Scope***. Work covered includes all material not furnished by the Owner, demolition, disposal, earthwork, excavation, dewatering (if required), handling, installation, mechanical work, electrical work, concrete work, welding, backfill, and final grading to complete the work as shown in the drawings and described in these specifications. All material, unless specified, are furnished by the Contractor.

D. ***Material Furnished by the Owner***. The Owner has purchased steel material listed in Appendix A of these Specifications.

E. ***Material To Be Furnished by this Contract***. The Contractor shall furnish all other material not listed in Appendix A.

1.03 GENERAL

A. ***Materials***. All materials, unless otherwise noted, shall be of new, first-quality manufacture, free from defects and suitable for the intended use. Where manufacturer's names are used in the Specifications it is for the purpose of establishing the standard for quality and general configuration. Products of other manufacturer's will be considered, provided they meet the same standards and the manufacturer's name and product specifications are submitted to the Engineer for approval.

B. ***Environmental***. The Owner has secured National Environmental Policy Act (NEPA) compliance for this project and exemptions from the Clean Water Act Section 401 (from Navajo EPA) and 404 permits (from USCAE). The Contractor shall comply with all the contract specifications to ensure compliance with the NEPA and the Clean Water Act Exemptions.

C. ***Notice of Intent Section 402. Clean Water Act.*** The Contractor shall be responsible for submitting a Notice of Intent (NOI) with the United States Environmental Protection Agency and be responsible for preparing and implementing a Storm Water Pollution Prevention Plan.

D. ***NM One Call***. The Contractor shall be responsible for complying with New Mexico one-call requirements prior to completing any excavation work.

E. ***Permits***. The Contractor shall provide all other permits, fees, materials, labor, and equipment necessary to complete the work.

F. ***Workmanship***. All workmanship shall be of the highest quality.

G. ***Statutes***. All work shall be performed in strict accordance with these Specifications, and the applicable national, state and tribal law, codes and regulations. In addition, manufacturer's instructions for all materials shall be strictly followed. In the event of disagreement between national and tribal codes and these Specifications, the codes shall prevail. Such situations shall be discussed with the Engineer prior to proceeding with the work in question.

H. ***Change Orders***. In the event of conflicts between the design and field conditions, the Engineer shall be consulted. No changes in the design or construction method shall occur without the review and approval of the Engineer, the Owner, and the BIA. If changes in the design are deemed necessary by the Contractor, details of the proposed changes shall be submitted to the Engineer for review as soon as practical to allow time for review before installation.

I. ***Materials Furnished by the Owner***. Materials furnished by the Owner shall be transferred to the Contractor after receipt of the material by the Owner or Engineer and the Contractor. The Owner or Engineer and the Contractor shall inspect the steel pipe upon delivery to the job site by the Pipe Supplier. Once a pipe is determined to be satisfactory, the Owner or Engineer and the Contractor shall sign the delivery receipt acknowledging receipt of the pipe. This receipt shall delegate the Contractor to unload, handle, install, coat, and test the steel pipe. Pipe that are found to be unsatisfactory shall be returned to the Pipe Supplier or repaired by the Pipe Supplier at the Pipe Supplier's expense.

J. ***Material Handling***. Proper handling and storage of all materials and equipment prior to installation shall be the responsibility of the Contractor. Materials damaged in the course of installation shall be repaired or replaced at the approval of the Engineer at the Contractor's expense. The Contractor shall be liable for damage during handling or installation of all materials, whether provided as a part of this Contract or provided by others.

K. ***Costs***. The cost of all materials furnished by the Contractor and the cost of all work performed by the Contractor necessary to complete the project as described by the drawings and these specifications shall be included in the prices listed in the Bid Schedule.

1.04 WARRANTY

A. ***Contractor warranty***. Contractor shall warrant the work to be free from defects for a period of one year after completion of the project. Warranty shall cover all work performed by the Contractor and all materials provided by the Contractor.

B. ***Manufacturer warranties***. All manufacturer warranties for materials furnished by this scope of work shall be transferred to:

Navajo Nation Department of Water Resources
Technical Construction and Operations Branch
P.O. Box 678
Fort Defiance, AZ 86504

C. ***Pipe Supplier Warranty.*** The Contractor is not liable to fulfill pipe supplier warranty on steel pipe received from the Pipe Supplier. The Contractor shall warrant all workmanship required to unload, handle, install, and test the steel pipe.

D. ***Costs***. All costs associated with warranting the scope of work as described in the drawings and specifications shall be included in the bid schedule for each item applicable to the warranty.

PART 2 – SITE CONDITIONS, PREPARATION & RESTORATION

2.01 GENERAL

A. ***General***. Construction activity shall be kept to the right-of-way at all times. Activity outside the construction boundary shall be by permission from the owner only. Keep project area neat and orderly at all times, free of rubbish and excess construction materials.

B. ***Prevent contamination***. Do not dump waste oil, fuel, rubbish or other similar contaminants on the ground or in any streambed. The Contractor shall avoid contamination of the aquifer, soil, or streams with any contaminant and shall be liable for containment and cleanup of any such contamination at his own expense.

2.02 ENVIRONMENTAL QUALITY PROTECTION

A. ***Landscape Preservation***. The Contractor shall be responsible for restoring any land disturbed by construction activities. This includes preserving the natural landscape by keeping construction impacts to a minimum, limiting all activity within the designated construction boundaries, cleaning the construction area during construction and after completion of the project, re-grading disturbed lands so natural contours are restored, and providing proper drainage to prevent erosion during and after construction. The remediation plan must be submitted and approved by the Engineer.

B. ***Vegetation Preservation***. The Contractor shall preserve and protect existing vegetation which is not required to be removed by construction activity

C. ***Water Quality Management***. The Contractor shall be responsible for any sediment and erosion control, wastewater control, and storm water management for all land within the construction boundary and any drainage to and from the construction boundary during the duration of the project. All Federal, State, and Tribal requirements for maintaining water quality during construction activity shall be met. The Contractor shall prepare and submit a storm water pollution prevention plan and a Notice of Intent as required by the Clean Water Act section 402 permit fourteen (14) days prior to construction. The contractor shall submit a weekly inspection sheet of any measures implemented by the storm water pollution prevention plan.

D. ***Air Quality Management***. The Contractor shall comply with any applicable Federal, State, or Tribal regulations governing air quality for construction activity for the duration of the project. This includes all equipment emissions and dust abatement.

E. ***Cultural Preservation***. The Contractor shall protect any sites identified by the Navajo Nation as having any historical, religious, scientific, pre-historical, or archaeological significance warranting preservation. No such areas are currently known to be within the construction boundaries. Should the Contractor discover any additional historical, religious, scientific, pre-historical, or archaeological findings, all work involving that site shall cease until clearance is obtained. Expenses incurred by the delay shall be negotiated between the Owner and the Contractor. Any excess disturbances by the Contractor or any individual associated with the Contractor as judged by the Navajo Nation shall be subject to the full extent of the law.

F. ***Submittals***. The Contractor shall submit to the Owner a copy of any required permit to complete the scope of work fifteen (15) days prior to any construction activity.

G. ***Payment***. All material and labor costs associated with preserving environmental quality shall be included in the bid schedule for the applicable items. The costs for preparing, submitting, and complying with a storm water pollution prevention plan shall be included in Bid Item 2.

2.03 PUBLIC ROADS

A. ***General.*** The work is parallel to a rural road serving several homes and linking Nenahnezad Chapter with areas to the west. The Contractor shall maintain reasonable daily access for the public to access the home sites. The Contractor shall accept full responsibility for the safety of the traveling public during the duration of the project.

B. ***Traffic Control Plan.*** The Contractor shall prepare and submit a traffic control plan for approval at least fifteen (15) days prior to any construction. The traffic control plan must be implemented and maintained for the duration of the project. The traffic control plan shall meet the requirements of the "Manual on Uniform Traffic Control Devises" (MUTCD), latest edition and the configuration shown on the Drawings.

C. ***Restoration of Roads.*** Any and all damages to public roads and road appurtenances shall be repaired and/or replaced to the satisfaction of the Engineer.

D. ***Restoration of Lands.*** The Contractor shall restore the lands within the roadway right-of-way to its natural conditions including grading, drainage, re-seeding and mulching.

E. ***Payment.*** All material and labor costs associated with preparing and implementing a traffic control plan for the duration of the project shall be included in Bid Item 2.

2.04 SAFETY

A. ***General***. The Contractor shall fully comply with all Federal, State and Tribal safety regulations.

B. ***Safety Program***. The Contractor shall establish and maintain a safety program during the duration of the project. The Contractor shall submit the safety program to the Owner for approval fifteen (15) days prior to any construction activity. Minutes of weekly safety meetings shall be submitted to the Owner for the duration of the project.

C. ***Public Safety***. The work area will be difficult to prohibit public access from the entire length of the project during the duration of the project. The Contractor shall schedule work activities so that they are performed in smaller areas where public access might be controlled and monitored. Signage warning the public of the works shall be maintained for the duration of the project.

D. ***Payment***. The costs for establishing and maintaining a safety program shall be included in Bid Item 3.

2.05 STAGING AND EQUIPMENT SERVICE AREA

A. ***General.*** The Owner has designated two equipment staging and service areas for the Contractor. One is near the inlet while the other is near the outlet. Each staging and service area may be used for parking of equipment and storage of materials prior to installation. The Contractor shall be responsible for security at the staging area. Servicing of equipment and vehicles will be allowed only at the designated service area, except in cases where the repair must be performed on site before the equipment can be moved.

B. ***Fuel and Lubrication***. Care shall be taken to avoid fuel and oil spills. All waste material, packaging and unused material shall be removed from the site upon completion of the Contract.

C. ***Maintenance.*** The staging area shall be free of debris and re-graded to its original surface contour upon completion of the Contract.

D. ***Costs.*** Costs associated with establishing and maintaining a staging area for the duration of the project shall be included in Bid Item 4.

2.06 UTILITIES

A. ***General***. Existing utilities may be located at the site. The Contractor shall identify all utilities, mark them during the duration of the project, and protect them from all construction activity. Any damage to existing utilities by the Contractor or their sub-contractors shall be repaired as directed by the utility owner at the Contractor's expense.

B. ***NM One Call***. The Contractor or any sub-contractor shall submit a confirmation number to the Owner at least two days prior to any excavation at the site. The Contractor shall maintain the confirmation number for the duration of the excavation.

C. ***NTUA Electric***. Navajo Tribal Utility Authority (NTUA) has power service poles near the project site. The Owner is hiring NTUA to provide electrical service to the inlet of Yellowman Siphon which will be used to power the trash screen. The Contractor shall be responsible for all electrical work necessary to tie-in to NTUA electrical service. Any work associated with the utility must be coordinated with NTUA.

D. ***NTUA Water Pipeline.*** NTUA has a water line parallel and south of Yellowman Siphon. The Contractor shall not park heavy equipment on the centerline of this pipeline.

E. ***Navajo Municipal Pipeline.*** Navajo Municipal Pipeline both crosses and runs parallel to Yellowman Siphon. The Contractor shall not park heavy equipment on the centerline of this pipeline.

F. ***Electricity***. The Contractor is responsible for all required electrical requirements necessary to complete construction of the project.

G. ***Water***. The Contractor is responsible for all required water requirements necessary to complete the project.

H. ***Payment***. The costs for working with utilities shall be included in the applicable bid item.

PART 3- STEEL PIPE FURNISHED BY THE OWNER

3.01 GENERAL

A. ***General***. This section provides information for the steel pipe furnished by the Owner. These specifications cover pipe to be supplied by the Pipe Supplier. Shop drawings and lay schedule prepared by the Pipe Supplier will be shared with the Contractor once they have been finalized.

3.02 STEEL PIPE

A. ***General.*** Thirty-six (36) inch outside diameter steel pipe shall be designed, reviewed, furnished, fabricated, coated, loaded, and shipped in accordance with this paragraph. Drawing profiles and notes indicate required pipe joints. Stationing and Lengths are calculated using horizontal distances.

Where shown on the drawings, the pipe shall be supplied with:

1. Bell and spigot lap joints ready for field welding.
2. Expansion Joints
3. The pipe ends assembled with the necessary components for expansion joints.
4. Butt straps for butt strap closure joints
5. Where bevel joints are required, the Supplier shall trim the end for the proper joint angle.
6. Thrust ring at inlet structure.
7. Fittings for air and drain valves.
8. Manholes including accessories such as nuts, bolts, and gaskets.
9. Special miter bends at stations 598+68 and 604+15.05.
10. Anchor stop at Type 1 tie-down anchors (will be field welded to pipe)
11. Tie down straps at Type 2 tie down anchors (will be field welded to pipe)
12. Exterior and interior coatings
13. Additional paint as specified.

The pipe to be supplied has been summarized in Appendix A. This list shows pipe lengths and fittings. Expansion joints shall be included with the pipe length shown on the summary table.

B. ***Steel Material.*** Steel materials specifications as follows:

1. Steel Plate. ASTM A 283, grade C or D; ASTM A 36
2. Steel Sheet. ASTM A570, grade 40, 45, or 50
3. Wall – 0.25"
4. Electric fusion (arc-) welded spiral-seam steel pipe. ASTM 139, grade B, C, D, or E.

C. ***Coal Tar Epoxy Lining.*** Coal tar epoxy lining shall conform to AWWA C 210. The minimum lining thickness shall be 16 mils.

D. ***Exterior Coating.*** Polyurethane conforming with ASTM D15. The minimum thickness is 36 mils.

E. ***Fabrication.*** Steel pipe 36 inches in outside diameter shall be fabricated in accordance with AWWA C 200. The pipe shall have bell and spigot lap joint ends prepared for field welding. Expansion joints shall be installed on the pipe ready for field assembly. The minimum steel wall thickness of the pipe shall be 0.25 inches. No minus tolerances will be permitted on wall thickness. Mitered pipe bends shall be fabricated in accordance with AWWA C 208.

F. ***Hydrostatic Test.*** All steel pipe shall be given a shop hydrostatic test which stresses the steel to 23,000 pounds per square inch. Any section with formed or welded-on ends shall be tested after the ends have been formed or welded on. All defects shall be repaired and the section retested before coatings are applied.

G. ***Transport and Handling.*** During loading, transportation, unloading, storage, and laying, every precaution shall be taken to prevent damage to the steel pipe, pipe fittings, and coatings. Trucks, trailers, or railway cars used for transporting coated pipe shall be provided with padded bolsters curved to fit the outside of the pipe, and heavy padding shall be used under ties. Open ends of shop-applied, coal tar epoxy-lined pipe shall be tightly closed with a plastic wrap for protection of the coal-tar epoxy lining during shipment. The plastic wrap shall consist of at least two thicknesses of 6-mil sheet polyethylene plastic and shall remain on the pipe until the time of installation. The pipe shall not be dropped or subjected to any unnecessary jars, impacts, or other treatment that might damage the pipe or the coatings. Any damage to the coatings shall be repaired as directed if, in the opinion of the Owner, a satisfactory repair can be made; otherwise, the damaged section shall be returned and replaced at the expense of the Supplier. An inspection of all pipe and fittings and materials will be required at the time of initial delivery at the delivery site. Any defects will be noted at the time of inspection and indicated on the delivery manifest for action by the Supplier.

3.03 STEEL PIPE FITTINGS

A. ***General.*** Tees for manholes, thrust rings, miter bends, fittings for air and drain valves, and expansion joints shall be furnished and installed by the Contractor as shown on the drawings and in accordance with this paragraph. Butt straps shall also be supplied as part of the Bid schedule. Welding shall conform with the applicable requirements of AWWA C 200.

B. ***Steel Material.*** Steel material specifications as follows:

1. Structural Steel – ASTM A36
2. ASTM A283, Grade C or D
3. Standard and schedule steel pipe – ASTM, Grade A or B, Type E or S, black for pipe 4-inches in diameter and larger and galvanized for pipe less than 4-inches in diameter.
4. Screwed fittings. ANSI B16.11 or ASTM A105
5. Welded fittings – ANSI B16.9
6. Flanges – AWWA C207, Class D, 150#
7. Flange Gaskets – AWWA C207, full face or ring type

C. Hydrostatic Test. Fittings fabricated from steel plate shall be tested under hydrostatic pressure sufficient to stress the steel to 23,000 pounds per square inch. The pressure shall be held long enough to allow a thorough inspection of all welded joints, and any leaks shall be repaired by re-welding and the fittings shall then be retested. Fittings fabricated from tested steel pipe do not require hydrostatic testing; however, the girth butt welds shall be complete penetration welds and shall be given a dye penetrant test in accordance with ASTM E 165. Defects in welds as disclosed by the dye penetrant test or hydrostatic test shall be chipped, flame gouged, or ground to sound metal, and the resulting cavities shall be re-welded and retested. The pipe Supplier shall furnish all equipment, supplies, and labor required for making the dye penetrant test and hydrostatic test.

D. ***Manhole***. Manhole joints shall include a 24-inch diameter tee with reinforcement plate that protrudes upward 6-inches from the inside diameter of the pipe. A 24-inch Class D flange shall be welded on top of the manhole. A blind flange with lift rings shall be fabricated as shown on the drawings. Gaskets, bolts, washers, and nuts shall be provided to connect the blind flange to the pipe flange.

E. ***Drain.*** A 6-inch tee shall be configured downward as shown on the drawings. A reinforcement plate shall be welded around the 6-inch tee. A 6-inch 90-degree elbow and 6-inch steel pipe terminating in a 6-inch Class D flange shall be welded to the 6-inch tee as shown on the drawings.

F. ***Air Vent***. Air vent shall consist of a 4-inch #3000 (FPT) threadlet coupler welded onto the top of the pipe at the location shown on the Drawings.

G. ***Anchor Ties***. Anchor ties shall be furnished for field welding onto the pipe. An anchor tie shall consist of a ¼-inch wall 9-inch wide strap that fits the outside diameter of the 36-inch steel pipe. Each end of the tie is welded to a gusset as shown in the drawings.

H. ***Butt straps***. A 6-inch butt strap (either 1 piece or 2 piece) shall be furnished where two plain ends are to be specified at a joint without having an expansions coupler. The steel pipe shall have ¼-inch wall and beveled ready for field welding.

I. ***End Flanges.*** A 36-inch Class D flange shall be welded to the end of plain end on pipes designated to have a flange.

J. ***Expansion Joint.*** The expansion joints shall be Type 1, single-end, Series 401 expansion joint manufactured by Baker Coupling Company Inc., 2929 So. Santa Fe Ave., Los Angeles CA 90058 or equivalent; having the following salient characteristics:
   1. Expansion joint allows up to 10 inches of longitudinal pipe movement.
   2. Joint consists of a slip pipe that telescopes within a body to compensate for changes in the length of the pipeline due to expansion and contraction.
   3. The body has a packing chamber that contains resilient packing to form a seal between the body and slip pipe.
   4. Packing gland is adjustable to maintain the proper compaction of the packing so the joint functions properly while maintaining a seal.

K. ***Closure or Makeup or Sections.*** (butt strap joint) or makeup sections shall be used where necessary as determined by the Supplier, subject to the approval of the Owner.

3.04 INTERIOR LINING

A. ***General.*** Coal tar epoxy lining shall conform to AWWA C 210. The minimum lining thickness shall be 16 mils.

B. ***Coal Tar Epoxy.*** The coal tar epoxy shall have the following salient characteristics:

1. Self-priming, two-component, coal-tar-epoxy coating.
2. Mixed usable pot life at 75° F and 50 percent relative humidity (RH): 2 hours, maximum.
3. Cathodic disbondment, has passed a recognized standard test.
4. Volume solids: 68 percent, minimum.
5. VOC (as supplied): 2.5 pounds per gallon (298.8 grams per liter), maximum.
6. Mixing ratio: Manufacturer's recommendation by volume.
7. Application Method: Brush, roller, conventional, or airless spray.
8. Minimum curing temperature: 50° F.
9. Time before immersion after the final coat has been applied at 70° F: 7 days, minimum.

C. ***Approved Brands.*** The following brands meet minimum requirements. Other linings will be considered if they meet the minimum requirements.

1. Amercoat 78 and 78HB as manufactured by Ameron
2. Bitumastic 300-M as manufactured by KOP-COAT
3. C-200, SSPC No. 16 as manufactured by Sherwin-Williams
4. Tnemec 46H-413 as manufactured by Tnemec Company, Inc.
5. Tarset Standard Black as manufactured by Porter International

D. ***Application.*** All interior surfaces shall be lined. Coal tar epoxy shall be applied so as to permit welding without damage to the coal tar epoxy. All fittings other than chrome or stainless steel (expansion joints) shall be lined. Following the initial solvent cleaning, the surfaces shall be blast-cleaned to base metal, using dry, hard, sharp, blasting media, to produce a near-white, abrasive blasted surface free of all foreign substances to achieve the specified or recommended surface profile. The surface shall be cleaned to equal or exceed NACE No. 2 or SSPC-SP10. The lining shall be applied in two (2) coats to produce a minimum thickness of 16mils.

E. ***Miscellaneous***. Coal tar epoxy shall be applied so as to permit field welding without damaging the coal tar epoxy. Additional coal tar epoxy shall be supplied to line all field weld joints.

3.05 EXTERIOR COATING

A. ***General.*** For the exterior coating, polyurethane ASTM D16 shall be applied to all exterior surfaces of the pipe with the exception of all welded joints. The Contractor shall be supplied sufficient coating material to field coat welded joints.

B. ***Materials.*** CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW as manufactured by Madison Chemical Industries, Inc. or approved equal.

C. ***Cured Coating Properties:***

1. Conversion to Solids by Volume: 99% ±1%
2. Temperature Resistance: -20°F to 150°F
3. Minimum Adhesion: 2000 psi steel
4. Cure Time: 45 minutes recoat at 70°F, and full cure within 7 days at 70° F.
5. Maximum Specific Gravities: Polysisocyanate resin, 1.20. Polyol resin, 1.15.
6. Hardness: 70±
7. Minimum Tensile Strength: 2000 psi

D. ***Surface Preparation.*** Remove deposits of oil, grease, or other organic contaminates before blast cleaning by using solvent wash as specified in SSPC-SP10. Clean and dry surfaces making them completely dry, free of moisture, dust, grit, oil, grease, or any other deleterious substances prior to application of coating. Proceed only if the substrate temperature is greater than 5°F above the dew point temperature.

E. ***Thickness.*** Minimum DFT of 35 mils (0.035 inch)

F. ***Application.*** Conform to coating manufacturer's recommendation. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

G. ***Inspection.*** All surfaces shall be inspected using a Holiday Inspection per AWWA 5.3.3.1.

H. ***Repair.*** Apply repair/touchup materials in conformance with manufacturer's recommendations. Cover at least one inch of roughened area surrounding damage.

3.06 SHIPPING

A. ***General.*** The Supplier shall deliver the steel pipe and fittings to the Owner as described. Access to the project site is via paved highway until 0.3 miles of the pipeline route. The last 0.3 miles consists of a graded gravel road.

B. ***Safety***. The Supplier shall follow all Federal, state, tribal, and local safety codes.

E. ***Transport and Handling.*** During loading, transportation, unloading, storage, and laying, every precaution shall be taken to prevent damage to the steel pipe, pipe fittings, and coatings. Trucks, trailers, or railway cars used for transporting coated pipe shall be provided with padded bolsters curved to fit the outside of the pipe, and heavy padding shall be used under ties. Open ends of shop-applied, coal tar epoxy-lined pipe shall be tightly closed with a plastic wrap for protection of the coal-tar epoxy lining during shipment. The plastic wrap shall consist of at least two thicknesses of 6-mil sheet polyethylene plastic and shall remain on the pipe until the time of installation. The pipe shall not be dropped or subjected to any unnecessary jars, impacts, or other treatment that might damage the pipe or the coatings. Any damage to the coatings shall be repaired as directed if, in the opinion of the Owner, a satisfactory repair can be made; otherwise, the damaged section shall be returned and replaced at the expense of the Supplier. An inspection of all pipe and fittings and materials will be required at the time of initial delivery at the delivery site. Any defects will be noted at the time of inspection and indicated on the delivery manifest for action by the Supplier.

F. ***Delivery Notice***. The Supplier shall give the Owner two (2) day notice prior to delivering a load of pipe so the Owner can arrange for off-loading the truck. Any shipping costs for trucks waiting to be unloaded because of failing to notify the Owner shall be the responsibility of the Supplier.

PART 4 – MATERIALS

4.01 GENERAL

B. ***General***. All materials, unless otherwise noted, shall be of new, first-quality manufacture, free from defects and suited for the intended use. Where manufacturer's names are used in the Specifications it is for the purpose of establishing the standard for quality and general configuration. Products of other manufacturers will be considered, provided they meet the same standards and the manufacturer's name and product specifications are submitted to the Engineer for approval.

C. ***Submittals***. All materials that are furnished by the Contractor for this project shall be submitted to the Owner for approval fifteen (15) days prior to ordering them.

D. ***Handling***. Materials damaged in the course of transportation or installation shall be repaired or replaced at the option of the Engineer.

E. ***Warranties***. All material manufacture warranties shall be transferred to the Owner at the completion of the project.

F. ***Storage and security***. The Contractor is responsible for storing all material including the security of all material for the duration of the project. Any damage or loss shall be repaired or replaced by the Contractor at the Contractor's expense. This is to include any salvage material in the Contractor's care between the time of demolition and transport to the Owner.

G. ***Payment***. All costs associated with furnishing, handling, storing, and the security of all material furnished by this contract are to be included in the applicable cost in the bid schedule.

4.02 Concrete

A. ***Cement***. The cement to be used shall conform to the "Standard Specification for Portland Cement" designation C.150 of the American Society for Testing Materials (ASTM). The recommended cement is Type II Normal Portland Cement. Any request to deviate from this will be subject to approval by the Engineer. No rapid hardening (Type III) cement types will be allowed.

B. ***Water***. Water to be used for concrete mixing shall be potable water.

C. ***Aggregate***. Aggregate proposed for concrete shall be subject to inspection and approval by the Engineer. The dust content, measured as the percentage of material passing a 75μm sieve shall not exceed 5% in the case of fine aggregate and 1.5% in the case of coarse aggregate. The fineness modulus shall fall in the range of 1.6 to 3.5 (inclusive). The chloride content of the aggregates shall not exceed 0.03% by mass and the aggregate shall be free of organic materials.

D. ***Admixtures***. The use of accelerating admixtures will not be allowed. The use of water reducing admixtures is encouraged in order to lower the water/cement ratio.

E. ***Mixture Design***. The mix shall be designed to conform to the following parameters:

1. 28-day minimum compressive strength f'c = 4000 psi
2. Maximum water/cement ration = 0.45 (by weight)
3. Total entrained air = 5% (-1% to +1%)
4. Maximum size of aggregate = 3/4-inch
5. Minimum slump = 2-inch and maximum slump = 4-inch

F. ***Mixing***, Transporting and Placing. All work shall be conducted in accordance with ACI 212.2, "Guide for Use of Admixtures in Concrete," ACI 211.1. "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete," ACI 304. "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."

G. ***Curing***. Minimum times for stripping formwork shall be 48 hours. No concrete shall be backfilled until after a 48-hour curing period. Should cement other than Type I be used, formwork/backfilling times shall be subject to review by the Engineer.

H. ***Reinforcement***. Reinforcement shall conform to ASTM 615 or ASTM 616 or A617. The minimum characteristic yield strength f_y=60 ksi unless noted otherwise. All reinforcement bars shall be #4 deformed placed on 12-inch centers each way unless noted otherwise. Footings shall have two rows of #4 rebar. Dowel pins 12-inch on center extending at least 12 inches into the vertical walls shall be placed in all footings or slabs used as footings and tied to the reinforcement steel of the walls. Where required, transition bars between walls and the footings shall be bent to conform to the shape of the structure. All reinforcement plans shall be submitted to the Engineer for approval 15 days prior to forming any structures. Ties for reinforcement shall be black annealed wire not less than 1/16-inch in diameter.

I. ***Cover***. The minimum cover to any reinforcing bar shall be two inches for 6-inch thick slabs and walls and three inches for 8-inch or greater slabs and walls.

J. ***Embedded Items***. All items to be embedded in the concrete shall be securely fastened to the reinforcement in the correct positions. No concrete shall be placed before the Engineer has inspected the reinforcement, built-in items and formwork and certified them as ready for concrete placement. Such inspection and certification shall in no way relieve the Contractor of any liabilities due to errors and/or omissions of any part of the construction.

K. ***Tolerances***.

1. Compressive Strengths. No more than 5% of the random samples collected shall yield strengths less than the specified strength and no individual test shall yield a strength more than 10% below the specified strength.
2. Dimensional Tolerances. Variation in cross sectional sizes, positions of built-in items, plan dimensions, levels and any linear structural dimensions shall be -1/4 inches to +1/2 inches.

L. ***Quality Control***. All concrete and reinforced concrete work will be subject to inspection and testing according to the provisions of the applicable ASTM standards as listed under Section 1, Volume 01.04, "Steel-Structural, Reinforcing, Pressure Vessel, Railway" and Section 4, Volumes 04.01 "Cement; Lime; Gypsum" and 04.02, "Concrete and Aggregates," without compromising the requirements of other standards and specifications as mentioned elsewhere within this document.

1. The frequency of casting test cylinders for concrete compressive strength tests will be determined by the Engineer. Generally, one set of three will be taken per pour over 5 cubic yards and a minimum of one set per 30 cubic yards placed.

2. No backfill on top of reinforced concrete shall commence before the concrete has reach a minimum of 70% of its design compressive strength.

3. Inspection by the Engineer will be required before re-commencing work after completion of each of the following concreting stages:

   a) Placing rebar and built-in items

   b) Erecting formwork

   c) Placing concrete

   d) Stripping formwork

   e) Backfilling against the structure

M. ***Payment***. All costs associated with furnishing concrete included in the applicable bid item.

4.03 Trash Screen

A. ***Traveling Screen***. International Water Screens, Traveling Screen, 5'0" wide by 22'0" long or approved equivalent. Screen has a frame made of 12" channel iron, with 6" box channel, and 2 1/2" angle iron as cross member supports. All wear surfaces are 2 1/2" angle iron covered with U. H. M. W. (ultra-high-molecular-weight polyethylene). The frame will be coated with coal tar epoxy.

B. ***Screening Media***. The screening media will be 24-20-14, 24 openings per foot vertical 20 openings per foot horizontal, made out of 14 gauge stainless steel 304 wire. The screening media rides on 5/16" rods on 6" centers which are driven by a C2060 chain. All chains, rods and belting are stainless steel 304.

C. ***Bearings***. Underwater non-lubricated sleeve and bushing Stellite brand bearings.

D. ***Spray Wash***. Pump and 40-mesh filter for spray bar water. Centrifugal pump with a capacity of 45 gallons per minute @ 60 psi.

E. ***Control Panel***. Control panel to power the screen and the pump. Panel equipped with an adjustable timer which can be set to have the machine come on after a pre-set amount of time, and to shut off after a pre-set time.

F. ***Power***. 480 V three phase motor.

G. ***Payment***. All costs associated with furnishing the trash screen included in Bid Item ADD-1.

4.04 Electrical

A. ***General***. A permanent power supply is required to operate the automated trash screen and the spray bar that cleans the screen with jets of water.

B. ***Power Service***. 480-volt three phase power service to the site and an electric meter shall be provided by NTUA through a service contract with the Owner.

C. ***Distribution***. A distribution panel with a main breaker, a circuit breaker to power the trash screen, a circuit breaker to power a 120 volt outlet, and a GFCI receptacle for miscellaneous use, are required.

D. ***Electrical Work***. System is to be designed and built by the contractor. All work is to be completed by a licensed electrician. Supply cables, fittings, grounding and distribution equipment are installed and connected in accordance with current regulations and standards. The work site is left free of installation waste and excess materials in accordance with industry practice.

E. ***Wire.*** Wire shall be rated for outdoor/hazardous service and sized by a licensed electrician to meet demand requirements.

F. ***Disconnect Boxes.*** The disconnect boxes shall be 30 amp 600 volt heavy duty fused disconnects enclosed within a vertically hinged NEMA 3R enclosure. Three 600 V fuses appropriately sized by a licensed electrician that fit the disconnect block shall be provided with each box. One 1-1/4 inch steel hub suitable for installing onto the disconnect box shall be provided with each box.

G. ***Junction Box.*** The junction box shall be a NEMA 3R powder coated carbon steel enclosure rated for 30 amps and 600 Volts. The junction box shall be a screw cover wall mounted enclosure. Each junction box shall come with four ¼-inch spring nuts and four ¼-inch bolts to mount the box to 1-5/8-inch by 7/8-inch 12 gauge galvanized Uni-Strut Channel.

H. ***Conduit.*** Conduit shall be rigid Schedule 80 PVC grey conduit.

I. ***Ground Rods.*** Ground rods shall be ½-inch diameter 8 ft long copper-bonded, pointed ground rods. Each ground rod shall be provided with a ground clamp connector for securing the ground wire.

J. ***Payment.*** All costs associated with furnishing the power supply from the NTUA service pole shall be included in Bid Item ADD-2.

4.05 Security Fencing

A. ***General***. A commercial grade chain link fence should be installed for security and safety purposes.

B. ***Height***. The height of the chain link fence shall be 6 ft tall. Three strands of barbed wire are installed above the chain link fence as shown on the drawings.

C. ***Specifications***. The fence specifications include:

1. Fence posts. 2, 3, and 4-inch Schedule 40 galvanized steel pipe in accordance with ASTM F1083
2. Fence fabric. 72-inch, 9 gauge, 2-inch opening galvanized steel fabric.
3. Barbed wire. 2 point (5-inch spacing), 12.5 gage, galvanized or aluminized, class 3 barbed wire.
4. Brace Bands. 11 gage galvanized steel bands.
5. Tension Bands. 11 gage galvanized tension bands
6. Rails. 1-5/8-inch galvanized steel tubing

D. ***Fittings.*** The fittings shall meet the requirements for ASTM F626.

E. ***Gates***. The slide gates shall meet the requirements of ASTM F1184.

F. ***Payment***. All costs associated with furnishing the power supply included in Bid Item 14.

4.06 Valves and Gates

A. ***Drain Gate Valves***. Gate valve shall have a ductile iron body per AWWA C515 with 150 flanges. The valve shall be rated for 250 lbs. The valve shall have a stainless steel non-rising stem operated by a handwheel. The valve is put together with stainless cap screws that are wax encapsulated and stainless trim. The ductile iron body shall have a fusion bonded epoxy coating.

B. ***Air Vent/Vacuum Relief Valve.*** Air/vacuum relief valves shall be a 4 inch diameter, designed to discharge air until the line is filled and open as pressure drops below atmospheric pressure. They shall also be capable of releasing air under pressure through a 3/32" float-activated orifice. The valves shall be 4-inch Waterman CR101 or approved equal, with working pressure capability of 80 psi or greater. The valve shall have fpt pipe threads to connect to a 4-inch galvanized steel mpt nipple.

C. ***Canal Gate***. The canal gate shall be an 24-inch epoxy coated grey iron gate with an all-bolted steel frame with ¼-inch minimum thickness. The stem shall be leaded steel which resists corrosion. The stem is operated at the structural frame top by a heavy cast-bronze lift nut and a cast iron wheel. The gate is seated by adjustable cast iron wedge block held securely in place by two machine bolts. The cast iron seats are machined or grounded. The canal gate stem shall be eight feet (102-inches) in length with an appropriate frame to support the stem of that length. The gate is to be mounted flat back onto a concrete wall

D. ***Payment.*** Payment for supplying valves shall be included in the applicable bid item.

4.07 Other Pipe and Fittings.

A. ***General.*** Other pipe material include HDPE pipe and corrugated steel culverts for road crossings. Fittings include HDPE and steel flanges for transitioning between steel pipe and HDPE pipe.

B. ***HDPE Pipe***. Black PE materials used for the manufacture of polyethylene pipe, tube and fittings shall be PE 3408 high density polyethylene meeting ASTM D3350 cell classification 445574C (formerly PE 2406 meeting 345464C per ASTM D3350-02) and shall be listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4 with a standard grade HDB rating of 1600 psi at 73°F. The material shall be listed and approved for potable water in accordance with NSF/ANSI 61. The HDPE pipe shall have a SDR or DR 26 or greater.

C. ***HDPE Fittings.*** Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full service pressure rating of the mating pipe. Fabricated fittings shall be tested in accordance with AWWA C906.

D. ***Steel Culvert***. Steel Culvert shall be galvanized 12 gauge corrugated metal pipe with ½-inch deep corrugations. The culvert shall comply with AASHTO M36 and AASHTO M218. Steel culvert shall be supplied with appropriate bands for joining two sticks.

E. ***Payment.*** Payment for supplying other pipe material shall be included in the applicable bid item.

Part 5 – Workmanship

5.01 Demolition

A. ***General.*** Approximately 2,450 ft of siphon requires demolition as shown on the drawings. In addition, the concrete inlet shall be removed. Care shall be taken to not damage the existing pipe and existing concrete saddle supports. Any damage to existing pipe or structures shall be repaired by the Contractor at the Contractor's Expense.

B. ***Steel Pipe.*** Approximately 2,450 feet of 36-inch steel pipe shall be removed, cut into transportable pieces, and taken to a steel recycler. The steel pipe being removed has a 0.5-inch thick concrete lining. The concrete lining may be broken on site and disposed of at either the San Juan County Landfill or at a concrete recycler. Approximate weight of the existing pipe is 135 lb/ft.

C. ***Concrete.*** All concrete debris that is removed shall be taken either to the San Juan County Landfill or to a concrete recycler.

D. ***Concrete Saddles.*** The Contractor shall remove concrete saddles as identified on the drawings. The concrete saddle structure shall be removed prior to new pipe installation. The concrete saddle structure shall be excavated as required to remove all of the concrete. All concrete debris that is removed shall be taken either to the San Juan County Landfill or to a concrete recycler.

E. ***Vegetation Removal.*** All vegetation shall be removed from the existing siphon. Vegetation shall be hauled away and disposed of properly in a legal land fill.

F. ***Excavation***. All earth excavated to remove any concrete structure shall be backfilled with native fill and compacted to 95 percent of standard proctor.

G. ***Payment***. Payment for cleaning, demolishing, and disposing of the steel siphon per these Specifications and Drawings shall be included in the Bid Item 5. Payment for the removal of concrete saddle structures shall be included in Bid Item 15. Payment for the removal of the concrete inlet structure shall be included in Bid Item 7.

5.02 Earthwork.

A. ***General***. The Contractor shall be responsible for obtaining a One Call confirmation number from NM One Call prior to any excavation.

B. ***Safety***. All appropriate and applicable safety precautions and regulations shall be followed during excavation, including trench shoring or sloped trench walls for protection of workers where required. Open trenches shall be clearly marked with appropriate barricades when close to public access. All national, state and tribal safety regulations shall be followed.

C. ***Survey***. Two elevation benchmarks are provided on each end of the project. All other survey requirements are furnished by the Contractor. Coordinate System is NM State Plane West Zone, NAD83 (2011) in US Survey Feet. The elevation datum are NAVD88 as predicted by GEOID12A. The benchmarks are as follows:

lame	Description	Northing	Easting	Elevation
)1		2,087,886.05	2,549,696.93	5,245.03
)2		2,090,655.20	2,537,012.81	5,221.09
	TOP 3IN Yellow Post	2,089,224.33	2,541,527.52	5,071.75
	SW Cor Barricade	2,087,891.84	2,550,373.51	5,177.31

D. ***Grade***. Grade shall be controlled such that when the pipe is installed the invert elevation shall not deviate from that shown on Drawings by more than 0.1 ft.

E. ***Dewatering***. Dewatering is not anticipated to be part of this project. If dewatering is necessary in order to keep the bottom of the trench free of water, a pump shall be used to pump water out of the trench and disposed into existing drains. In areas requiring dewatering, the contractor shall over-excavate the trench by 6-inches to allow for the placement of clean, washed gravel.

F. ***Compaction.*** All compaction shall be compacted as specified using the following moisture-density curves:

Stations	Curve	Type	x. Dry Unit Weight (lb/ft^3)	Optimum Water Content
29 to 601+35	Inlet	Brown Sandy Silt	107.8	14.4
601+35 to 609+68	East	Brown Silty Sand	115.4	11.4
675+16 to 688+28	West	Brown Clay	115.2	13.1

G. ***Payment***. All costs associated with earthworks per the Specifications and the Drawings shall be included in the applicable bid item. No dewatering is anticipated for this project. If groundwater is encountered, costs associated with any dewatering requirements will be as negotiated between the Contractor and the Owner.

5.03 Steel Pipe Installation

A. ***General.*** The new 36-inch outside diameter steel pipe (wall = 0.25 inches) shall be installed between approximate stations as shown on the drawings. The pipe shall be assembled and welded in place as shown on the drawings.

B. ***Unloading.*** The Contractor shall unload the pipe delivered by the Pipe Supplier and string the pipe along the pipe route for installation. The Owner will work with the Contractor on pipe delivery providing two (2) day notice.

C. ***Handling***. Pipes shall be stored with plastic coverings over each end and with temporary support that maintains the roundness of the pipe. Pipes shall only be lifted with non-metal slings that protect the exterior coating of the steel pipe. Interior supports shall not be removed until the pipe has been installed.

D. ***Assembly***. The steel pipe sections shall be assembled in accordance to the profile drawings. The pipe shall be placed accurately to lines and grades as shown on the drawings or as established by the Engineer. Permissible departure and return to established alignment and grade of 1/16-inch per foot of pipe, but not to exceed 1-inch departure. The pipe shall be placed in an uphill direction with spigots inserted into bells. That is when viewing in profile, pipe will have the spigot at the downhill end and the bell at the uphill end. Subsequent sections will place a spigot into the bell. After inserting the spigot into the bell, the pipe shall be adjusted for bends and lines and grade. After adjusting, the pipe shall be welded and the weld checked for completeness. Closing or makeup sections may be used where necessary as determined by the Engineer.

E. ***Pipe roundness***. The circularity of each pipe section shall be maintained. The differences between the maximum and minimum diameters, at any point along the pipe, shall not exceed 1 percent of the nominal pipe diameter.

F. ***Support***. The contractor shall ensure proper support from either concrete saddle supports or temporary cribbing prior to pipe placement. Newly poured concrete saddles structure shall have 48 days cure prior to placing a steel pipe onto the structure.

G. ***Welding***. Welding shall conform to American Welding Society requirements AWS D10.12M/D10.12:2000, Guide for Welding Mild Steel Pipe.

H. ***Weld Inspection.*** The Owner or designated representative shall examine each weld first by visual and then followed by Magnetic Particle testing. The inspection shall be completed per AWS B1.10M:2009, Guide for the Nondestructive Examination of Welds. The Contractor shall allow access to the Owner to complete weld inspections. Any findings observed during the inspection shall be corrected by the Contractor at the Contractor's expense.

I. ***Interior Lining.*** All weld joints shall be lined on the interior per Section 3 of these Specifications. Manholes regularly placed in the steel pipe shall allow the Contractor to access the interior of the pipe.

J. ***Exterior Coating***. All weld joints shall be coated per Section 3 of these Specifications.

K. ***Payment.*** All costs associated with installing the steel pipe per these Specifications and Designs shall be included in Bid Item 6.

5.04 Concrete Saddle Support

A. ***General.*** The drawings specify concrete saddle support as follows:

1. Remove Supports - Remove existing concrete saddle supports which are so identified. Excavate below existing saddle supports and construct new concrete saddle supports as shown on the Drawings. Weld flange to pipe for Type 1 or strap to pipe for Type 2 anchors.
2. Replace anchors. – Over excavate below anchors and construct new concrete supports as shown on the Drawings. Weld flange to pipe for Type 1 or strap to pipe for Type 2 anchors.
3. Existing supports - Place pipe on supports and install joints as shown on the drawings. Lap joints shall be welded together. Welded butt straps shall be used for closure sections. Expansions joints shall be installed at locations shown.

B. ***New Concrete Saddle Supports.*** The concrete saddle supports shall be constructed as shown on the Drawings. The foundations shall be excavated as shown on the Drawings. The trench invert shall be free of organic material and debris. Any over excavation shall be backfilled and compacted to 95 percent of a standard proctor. Once completed, the structure shall be compacted to 95 percent of standard proctor using native spoils.

C. ***Welded seams.*** Where welded seams come into contact with the saddle surface, the seam shall be ground to the surface of the pipe. One-half inch sponge rubber filler can be inserted between the pipe and the saddle as an alternative to grinding.

D. ***Filler.*** The Contractor shall place a sponge rubber filler between the steel pipe and the concrete saddle structure. Sponge rubber shall conform to ASTM D 1752, Type I, sponge rubber: Provided, That the load required to compress the test specimen to 50 percent of its thickness before test shall be not less than 50 pounds per square inch nor greater than 150 pounds per square inch. Sponge rubber shall be stored in as cool a place as practicable, preferably at 70 °F or less and in no case shall the rubber be stored in the open, exposed to the direct rays of the sun.

E. ***Payment.*** All costs associated with installing the concrete saddle supports per these Specifications and Designs shall be included in Bid Item 15.

5.05 Concrete Inlet Structure.

A. ***General***. A new siphon inlet transition structure shall be constructed that will be the connection between the termination of the steel pipe and the beginning of the existing concrete canal.

B. ***Remove Existing Inlet Structure***. The existing concrete inlet structure shall be removed per the drawings and these specifications. The trench invert shall be free of organic material and debris. Any over excavation shall be backfilled and compacted to 95 percent of a standard proctor.

C. ***Construct Inlet Transition Structure***. After the existing inlet has been removed, to create the new transition structure, concrete formwork with steel reinforcement shall be constructed on properly compacted ground. The steel pipe shall be placed in its final position with the end properly inside the concrete formwork. Fill shall be compacted around the bottom and sides of the steel pipe outside of the transition structure to secure it in its permanent location. Concrete should then be poured in the formwork that creates the outlet structure and the connection to the steel pipe.

D. ***Elevations***. The elevations of the steel pipe, concrete structure floor, emergency spillway, and top shall be within 0.1 ft of the elevations shown on the Drawing.

E. ***Canal Gate***. The canal gate for the sluice way shall be installed per manufacturer recommendations and as shown on the drawings.

F. ***Backfill***. The canal structure shall be backfilled with native material compacting to a 95 percent of a standard proctor.

G. ***Payment***. All costs associated with the inlet transition structure per the Specifications and Drawings shall be included in Bid Item 7.

5.06 Trash Screen

A. ***General***. An electrically powered automated trash screen for removing debris that could enter or clog the siphon shall be installed in front of the inlet. The trash screen shall be able to fit within the current configuration of the concrete inlet. The trash screen shall be configured to not interfere with the current sluice gate and so that floating debris does not go around the trash screen and enter into the siphon.

B. ***Operations.*** The trash screen shall discharge debris on the ground above and away from the inlet in a manner that allows for mechanical removal of accumulated debris.

C. ***Safety***. A shield shall be placed over the trash screen moving parts accessible by land to protect the public and personnel from mechanical operations. The shield shall be removable to allow for maintenance of the screen.

D. ***Canal Shield***. A steel shield shall be configured between the trash screen and the concrete lining to block debris from entering into the siphon inlet. Dimensions are field fitted so that the largest open space is less than three inches. The steel screen shall be configured so that the shield directs debris onto the screen. The shield shall be fabricated from 3/16-inch steel sheet.

E. ***Safety rope***. A safety rope upstream of the trash screen with floating buoys shall be installed to prevent persons who have fallen into the canal from floating onto the screen.

F. ***Safety ladder***. A ladder shall be installed upstream of the trash screen in conjunction of the safety rope to allow a person to climb out of the canal without venturing onto the trash screen.

G. ***Payment***. The cost for the trash shall be included in Bid Item ADD-1.

5.07 Electrical

A. ***General***. The Contractor shall install the electrical wiring and controls necessary to power the trash screen. The Owner shall provide the electrical service pole near the inlet. All electrical shall be installed under the direction of a licensed electrician. All electrical work shall comply with applicable codes. All work shall not be hazardous or dangerous to any personnel working on the site or to the public accessing the site in the future.

B. ***Handling***. Proper loading, handling, and transportation are important to the integrity of all electrical material. The material shall be handled at all times so as to avoid any damage. Damage to any material from any cause during the loading, handling, and transportation shall be replaced or repaired.

C. ***Storage***. All electrical components shall be stored in a manner to prevent contaminants from entering. The best method for accomplishing this is to keep electrical parts in packaging until installation. If the packaging has been breached or does not exist, the part should be protected by repackaging as required.

D. ***Underground Wire***. Trench depths for direct burial underground wire shall have a minimum depth of 24-inches. Wire installation shall follow trenching as soon as possible to ensure the placement of the wire on the bottom of the trench. Any damage to the insulation of the wire during installation shall be repaired or replaced. Backfill of the trench shall follow installation as close as possible. Where splices are required, the splice shall be completed by a licensed electrician. Splice kits used shall be 3M low voltage kits suitable for direct burial or equivalent. The splice area shall only be backfilled after inspection and the location documented.

E. ***Outdoor Steel Framing***. All framing shall be fabricated from galvanized 12 gauge uni-strut channel or equivalent. Vertical posts shall be 1-5/8" x 1-5/8" channel and cross bracing shall be 1-5/8" x 7/8" channel. Vertical posts shall be inserted 18-inches into the ground and anchored with concrete post mix. Boxes and components shall be secured to the channel by spring nuts. Boxes shall be mounted so the bottom of the disconnect box is 44-inches above the ground.

F. ***Cleaning***. All electrical parts shall be clean, free of dust and debris prior to installation.

G. ***Switches, Outlets, and Miscellaneous Part Installation***. All switches, outlets, control boxes, and other access boxes shall be installed at a height or location that allows for easy access.

H. ***Unused Openings***. All unused openings in any electrical part shall be safely covered to prevent contamination.

I. ***Inspection***. All electrical work requires inspection by a licensed electrician prior to covering.

J. ***Testing***. All electrical work shall be tested for proper function prior to commissioning the facility.

K. ***Payment***. The cost for the electrical and the electrical components shall be included in Bid Item ADD-2.

5.08 Security Fence

A. ***General.*** For security and safety purposes, a commercial grade fence should be installed around the inlet structure and trash screen. Security fence shall be installed, in accordance with the ASTM F567 standards. The fence shall be placed so that it allows room for equipment to turn around in the trash screen yard. One access gate is configured centered on the canal road.

B. ***Payment***. The cost for the fence and the fencing components shall be included in Bid Item 14.

5.09 Manholes

A. ***General.*** The Contractor shall install the steel tee fitting with manhole as shown on the Drawings. The Contractor shall supply all material for installing the manhole. The manholes are for entering in the pipe to place the interior lining. The interior of the pipe with access through the manhole is considered a confined space. The Contractor shall comply with confined space entry regulations.

B. ***Blind Flange.*** Once all interior pipe work has been completed and approved, the Contractor shall install the blind flange for the manhole following manufacturer directions.

C. ***Payment.*** All costs for installing the manhole shall be included in the Bid Item 10.

5.10 Air Vents

A. ***General.*** The Contractor shall install the air vents as shown on the drawings. The Contractor shall supply all required material to install the air vent.

B. ***Air Vent Shields.*** The Contractor shall furnish and fabricate the air vent shields as shown on the drawing. Shields shall be welded to the steel nipple as shown.

C. ***Payment.*** All costs for installing the air vent shall be included in the Bid Item 8.

5.11 Drain Assembly

A. ***General.*** The Contractor shall install the drain assemblies as shown on the drawings. The Contractor shall supply all required material to install the drain assembly.

B. ***Discharge Pipe.*** The Contractor shall direct the drain discharge piping so it is facing away from any road or other infrastructure.

C. ***Payment.*** All costs for installing the drain assembly shall be included in the Bid Item 11.

5.12 Thrust Anchor

A. ***General.*** The Contractor shall install the thrust anchor at the miter elbow as shown on the Drawings. The Contractor shall supply all required material to install the thrust anchor.

B. ***Excavation.*** The existing concrete structure shall be removed per the drawings and these specifications. The trench invert shall be free of organic material and debris. Any over excavation shall be backfilled and compacted to 95 percent of a standard proctor.

C. ***Installation***. The concrete structure shall not be poured until the steel pipe has been placed and secured to both upstream and downstream expansion joints. The steel pipe shall be cast into the concrete as shown on the drawings. The structure shall be backfilled with native fill and compacted to 95 percent of standard proctor.

D. ***Payment.*** All costs for installing the Thrust Anchor shall be included in the Bid Item 9.

5.13 Road Crossing

A. ***General.*** The Contractor shall install the road crossings as shown on the drawings. The Contractor shall ensure the safety of the public during the construction of the road crossing. The work area should be blocked off with barriers and signage during the construction period to prevent drivers from driving into the work area. The Contractor is responsible for providing detour routes to maintain the public's access to existing homes and farms.

B. ***Culvert Placement.*** The Contractor shall place the 48-inch steel culvert to the elevations shown on the Drawings. Culverts shall be joined following manufacturer directions.

C. ***Backfill***. The Contractor shall backfill the culverts with native fill compacting the material to 95 percent of a standard proctor. The grade for approaching the road crossing shall not exceed a slope of five (5) percent.

D. ***Armoring.*** The Contractor shall armor the road surface with a 6-inch layer of road base meeting NMDOT Section 304. The armoring shall be placed for the crossing, the two approaches, plus 50 ft on each side of the approach.

E. ***HDPE Pipe Installation.*** During installation, pipe shall be handled carefully to avoid any damage. Any debris in the pipe shall be removed prior to installation. Joints between plain end pipes and fittings shall be made by butt fusion. The butt fusion procedures used shall be procedures that are recommended by the pipe and fitting Manufacturer. Pipe ends should be squarely cut to 90°± 5°. Do not use bar chain lubrication if cutting pipe with a chainsaw. The joining of the pipe shall be accomplished according to the manufacturer's specifications. Assemble the joints in as straight an alignment as possible. The manufacturer's recommended maximum joint deflection shall not be exceeded at any time. ASTM standards say that fusion is generally not recommended below -4°F without special provisions. Follow all guidelines set forth in ASTM F2620.

F. ***Grade***. The approaches for the crossing shall not exceed five percent.

G. ***Payment.*** All costs for installing the Road Crossing shall be included in the Bid Item 12.

5.14 Outlet Structure

A. ***General.*** The Contractor shall tie-in to the existing outlet as shown on the Drawings.

B. ***Excavation.*** The Contractor shall carefully expose the outlet structure where the new steel pipe will tie-in to the existing structure. Any damage to the existing structure shall be repaired by the Contractor at the Contractor's expense.

C. ***Removal***. Once the structure has been exposed, the Contractor and the Owner shall mark the existing concrete pipe joint where the new steel pipe will join the existing concrete pipe. The Contractor shall carefully remove all concrete pipe upstream of this joint and dispose of the concrete to a landfill or a concrete recycler.

D. ***Installation***. The Contractor shall install the steel pipe so the end of the steel pipe butts up to the end of the concrete pipe joint as shown on the drawings. A concrete structure shall be poured joining the two pipes. The structure shall be backfilled compacting to 95 percent of a standard proctor.

E. ***Payment.*** All costs for installing the outlet structure shall be included in Bid Item 13.

Bid Schedule

Bid Item	Description	Quantity	Cost	Extension
1	Mobilization & Demobilization	Lump Sum		
2	Environmental Quality Protection per Sections 2.02 and 2.03 of these Specifications	Lump Sum		
3	Safety program, weekly safety meetings, and submittals per Section 2.04 of these Specifications	Lump Sum		
4	Establish and Maintain a staging area per Section 2.05 of these Specifications	Lump Sum		
5	Demolish and salvage steel pipe per the Drawings and these Specifications	2,450 ft		
6	Unloading, handle, install, weld, coat, and test steel pipe per the Drawings and these Specifications. Included are installation of Type 2 Anchors (supplied by the Pipe Supplier) and installation of the Expansion Joints (supplied by the Pipe Supplier)	2,450 ft		
7	Demolish and dispose existing concrete inlet and furnish and install a new concrete inlet per the Drawings and these Specifications	1 each		
8	Furnish and install air vents per the Drawings and these Specifications	4 each		
9	Furnish and install the thrust anchor at Station 604+15 per the Drawings and these Specifications	1 each		
10	Furnish and Install the Manhole blind flanges per the Drawings and these Specifications	6 each		
11	Furnish and Install the drain blow-off at Station 680+16 per the Drawings and these Specifications	1 each		
12	Furnish and Install the road crossing at Station 680+94 per the Drawings and these Specifications	1 each		
13	Furnish and Install the outlet per the Drawings and these Specifications	1 each		

Bid Item	Description	Quantity	Cost	Extension
14	Furnish and Install the Security Fence per the Drawings and these Specifications	160 ft		
15	Demolish and dispose of existing concrete structures (if required) and furnish and install new concrete structures per the Drawings and these Specifications (Designated as "replace" or "new" in Drawings)	33 each		
			Total	
			Navajo Nation Tax (6%)	
			Grand Total	
ADD-1	Furnish and Install the Trash Screen per the Drawings and these Specifications	1 each		
ADD-2	Furnish and Install Electrical Service per the Drawings and these Specifications	1 each		

Appendix A – Steel Pipe Furnished by Owner

Item	Length	Upstream End	Downstream End	Specials
1. Pipe Segment 0	42 ft	Plain	Plain	
2. Pipe Segment 1	13.2 ft	Plain	Plain	Pre-fabricated bend, Air Vent
3. Pipe Segment 2	26.2 ft	Plain	Plain	
4. Pipe Segment 3	38 ft	Bell	Plain	Pre-fabricated bend
5. Pipe Segment 4	14 ft	Bell	Expansion	Bevel
6. Pipe Segment 5	38 ft	Expansion	Plain	
7. Pipe Segment 6	45 ft	Plain	Plain	
8. Pipe Segment 7	15 ft	Bell	Plain	Bevel
9. Pipe Segment 8	45 ft	Bell	Plain	
10. Pipe Segment 9	45 ft	Bell	Plain	
11. Pipe Segment 10	45 ft	Bell	Plain	
12. Pipe Segment 11	45 ft	Bell	Plain	Manhole
13. Pipe Segment 12	45 ft	Bell	Plain	Air Vent
14. Pipe Segment 13	45 ft	Bell	Plain	Bevel
15. Pipe Segment 14	45 ft	Plain	Plain	
16. Pipe Segment 15	45 ft	Bell	Plain	
17. Pipe Segment 16	17 ft	Bell	Expansion	
18. Pipe Segment 17	18 ft	Expansion	Plain	

19. Pipe Segment 18	19 ft	Plain	Plain	Pre-Fabricated Bend
20. Pipe Segment 19	45 ft	Plain	Plain	
21. Pipe Segment 20	45 ft	Bell	Plain	
22. Pipe Segment 21	45 ft	Bell	Plain	Manhole
23. Pipe Segment 22	45 ft	Bell	Expansion	
24. Pipe Segment 23	11 ft	Expansion	Plain	
25. Pipe Segment 24	45 ft	Bell	Plain	Type 2 Anchor
26. Pipe Segment 25	45 ft	Bell	Plain	
27. Pipe Segment 26	45 ft	Bell	Plain	
28. Pipe Segment 27	45 ft	Bell	Plain	
29. Pipe Segment 28	45 ft	Bell	Plain	
30. Pipe Segment 29	30 ft	Bell	Plain	
31. Pipe Segment 30	16 ft	Bell	Expansion	Manhole
32. Pipe Segment 31	1.4 ft	Expansion	Plain	
33. Pipe Segment 32	45 ft	Bell	Plain	
34. Pipe Segment 33	45 ft	Bell	Plain	
137. Pipe Segment 137	42 ft	Bell	Plain	
138. Pipe Segment 138	42 ft	Bell	Plain	
139. Pipe Segment 139	45 ft	Bell	Plain	Type 2 Anchor
140. Pipe Segment 140	45 ft	Bell	Plain	
141. Pipe Segment 141	45 ft	Bell	Plain	
142. Pipe Segment 142	42 ft	Bell	Plain	

143. Pipe Segment 143	42 ft	Bell	Plain	
144. Pipe Segment 144	42 ft	Bell	Plain	
145. Pipe Segment 145	29.5 ft	Bell	Expansion	
146. Pipe Segment 146	10.5 ft	Expansion	Plain	
147. Pipe Segment 147	42 ft	Bell	Plain	
148. Pipe Segment 148	42 ft	Bell	Plain	
149. Pipe Segment 149	45 ft	Bell	Bell	Manhole, Drain
150. Pipe Segment 150	42 ft	Plain	Flange	Downstream Flange
151. Pipe Segment 151	4 ft	Flange	Bell	
152. Pipe Segment 152	45 ft	Plain	Bell	
153. Pipe Segment 153	35 ft	Plain	Bell	Air Vent
154. Pipe Segment 154	42 ft	Plain	Bell	
155. Pipe Segment 155	42 ft	Plain	Bell	
156. Pipe Segment 156	42 ft	Plain	Bell	
157. Pipe Segment 157	45 ft	Plain	Bell	
158. Pipe Segment 158	15 ft	Plain	Expansion	
159. Pipe Segment 159	37 ft	Expansion	Bell	Manhole
160. Pipe Segment 160	42 ft	Plain	Bell	
161. Pipe Segment 161	45 ft	Plain	Bell	
162. Pipe Segment 162	45 ft	Plain	Bell	
163. Pipe Segment 163	45 ft	Plain	Bell	Type 2 Anchor
164. Pipe Segment 164	42 ft	Plain	Bell	

165. Pipe Segment 165	42 ft	Plain	Bell	
166. Pipe Segment 166	19.7 ft	Plain	Expansion	
167. Pipe Segment 167	42 ft	Expansion	Bell	Manhole
168. Pipe Segment 168	42 ft	Plain	Plain	Type 2
169. Pipe Segment 169	40.3 ft	Plain	Bell	Air Vent

KB-Walkoma, LLC
707 N. Dustin Avenue
Farmington, NM 87401

Technical services to rural communities for developing their agriculture and natural resources in Farmington, NM, USA and Chisinau, Moldova

For client:

NNDWR-TCOB
PO Box 57
Shiprock, NM 87420

CO 12418 90% DRAFT SPECIFICATIONS:
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Steel Pipe Specifications

Submitted:

June 15, 2018

Contents

PART 1 – GENERAL

1.01 WORK INCLUDED

A. ***Project Description***. This scope of work covers the 36-inch steel pipe required to replace 2,450 ft of Yellowman Siphon.

B. ***Background***. The Yellowman Siphon is a 36-inch above-ground steel pipe siphon that is part of Fruitland Canal. The siphon is located on the south side of the San Juan River, approximately one mile southwest of the town of Fruitland, New Mexico. The siphon is located in Nenahnezad Chapter, Navajo Nation or Fruitland, NM 87416.

C. ***Scope of Work***. Work covered includes all designs, submittals, material, fabrication, coating, loading, and shipping to furnish the 36-inch steel pipe.

1.02 GENERAL

A. ***Materials***. All materials, unless otherwise noted, shall be of new, first-quality manufacture, free from defects and suitable for the intended use.

B. ***Workmanship***. All workmanship shall be of the highest quality.

C. ***Design***. The Supplier is responsible for completing the shop drawings necessary to manufacture the steel pipe and the lay schedule necessary to guide installation of the steel pipe.

D. ***Drawings***. Design drawings for replacing 2,450 ft of Yellowman Siphon are included in this bid package for information and so the Supplier can complete their design of the steel pipe. Drawing stations and lengths are horizontal lengths and require slope adjustment prior to finalizing the lay schedule. The 2,450 ft of pipe is a <u>horizontal length</u> and may require additional footage to account for elevation differences. The Supplier shall account for these differences in the lay schedule.

E. ***Submittals***. Submittals are required for:

- Shop drawings of pipe and fittings
- Pipe lay schedule

The review period for approving a design submittal shall be 15 calendar days. The review period shall include an initial submittal and review and any modifications required to achieve approval. The Owner shall respond to each submittal within 10 calendar days of receiving a submittal. No fabrication of pipe shall begin until the Owner has approved the submittal in writing.

F. ***Material Handling***. Proper handling, storage, and shipping of all materials prior to being received by the Owner shall be the responsibility of the Supplier.

G. ***Shipping***. The steel pipe shall be shipped to the project site located at the following coordinates:

> N 36°44′ 17″; E 108° 25′ 38″ which is 0.3 miles west of the intersection of N367 and N365; Nenahnezad Chapter, Navajo Nation, New Mexico, USA

Unloading will be completed by a Contractor contracted by the Owner after the load has been inspected and signed off for by the Owner's representative. The chain of custody from Supplier to the Owner occurs when the shipping documents are signed by an authorized representative of the Owner.

H. ***Tax***. A six (6) percent Navajo Nation Sales Tax shall be applied to the final sales cost. Information for reporting and paying the tax may be obtained from the:

Office of the Navajo Tax Commission
PO Box 1903
Window Rock, AZ 86515
PH (928) 871-6681
www. Tax.navajo-nsn.gov

The Nation is exempt all state taxes if final sale is to be delivered to the Navajo Nation.

I. ***Costs***. The cost of all materials, design, workmanship, shipping, and tax as described by the drawings and these specifications shall be included in the prices listed in the Bid Schedule.

1.03 WARRANTY

A. ***Manufacturer warranties***. All warranties for materials (ie. coating, etc.) furnished by this scope of work shall be transferred to:

Navajo Nation Department of Water Resources
Technical Construction and Operations Branch
P.O. Box 678
Fort Defiance, AZ 86504

The Supplier shall warrant all material, shop welds, and shop coating for a minimum of one year after the steel pipe was received by the Owner.

B. ***Costs***. All costs associated with warranting the steel pipe as described in the drawings and specifications shall be included in the bid schedule for each item applicable to the warranty.

PART 2 – MATERIALS

2.01 GENERAL

A. ***General***. All materials, unless otherwise noted, shall be of new, first-quality manufacture, free from defects and suited for the intended use.

2.02 STEEL PIPE

A. ***General.*** Thirty-six (36) inch outside diameter steel pipe shall be designed, reviewed, furnished, fabricated, coated, loaded, and shipped in accordance with this paragraph. Drawing profiles and notes indicate required pipe joints. Stationing and Lengths are calculated using horizontal distances.

Where shown on the drawings, the pipe shall be supplied with:

1. Bell and spigot lap joints ready for field welding.
2. Expansion Joints
3. The pipe ends assembled with the necessary components for expansion joints.
4. Butt straps for butt strap closure joints
5. Where bevel joints are required, the Supplier shall trim the end for the proper joint angle.
6. Thrust ring at inlet structure.
7. Fittings for air and drain valves.
8. Manholes including accessories such as nuts, bolts, and gaskets.
9. Special miter bends at stations 598+68 and 604+15.05.
10. Anchor stop at Type 1 tie-down anchors (will be field welded to pipe)
11. Tie down straps at Type 2 tie down anchors (will be field welded to pipe)
12. Exterior and interior coatings
13. Additional paint as specified.

The pipe to be supplied has been summarized on the Bid Schedule. This list shows pipe lengths and fittings. Expansion joints shall be included with the pipe length shown on the summary table.

B. ***Steel Material.*** Steel materials specifications as follows:

1. Steel Plate. ASTM A 283, grade C or D; ASTM A 36
2. Steel Sheet. ASTM A570, grade 40, 45, or 50
3. Wall – 0.25"
4. Electric fusion (arc-) welded spiral-seam steel pipe. ASTM 139, grade B, C, D, or E.

C. ***Coal Tar Epoxy Lining.*** Coal tar epoxy lining shall conform to AWWA C 210. The minimum lining thickness shall be 16 mils.

D. ***Exterior Coating.*** Polyurethane conforming with ASTM D15. The minimum thickness is 36 mils.

E. ***Fabrication.*** Steel pipe 36 inches in outside diameter shall be fabricated in accordance with AWWA C 200. The pipe shall have bell and spigot lap joint ends prepared for field welding. Expansion joints shall be installed on the pipe ready for field assembly. The minimum steel wall thickness of the pipe shall be 0.25 inches. No minus tolerances will be permitted on wall thickness. Mitered pipe bends shall be fabricated in accordance with AWWA C 208.

F. ***Hydrostatic Test.*** All steel pipe shall be given a shop hydrostatic test which stresses the steel to 23,000 pounds per square inch. Any section with formed or welded-on ends shall be tested after the ends have been formed or welded on. All defects shall be repaired and the section retested before coatings are applied.

G. ***Transport and Handling.*** During loading, transportation, unloading, storage, and laying, every precaution shall be taken to prevent damage to the steel pipe, pipe fittings, and coatings. Trucks, trailers, or railway cars used for transporting coated pipe shall be provided with padded bolsters curved to fit the outside of the pipe, and heavy padding shall be used under ties. Open ends of shop-applied, coal tar epoxy-lined pipe shall be tightly closed with a plastic wrap for protection of the coal-tar epoxy lining during shipment. The plastic wrap shall consist of at least two thicknesses of 6-mil sheet polyethylene plastic and shall remain on the pipe until the time of installation. The pipe shall not be dropped or subjected to any unnecessary jars, impacts, or other treatment that might damage the pipe or the coatings. Any damage to the coatings shall be repaired as directed if, in the opinion of the Owner, a satisfactory repair can be made; otherwise, the damaged section shall be returned and replaced at the expense of the Supplier. An inspection of all pipe and fittings and materials will be required at the time of initial delivery at the delivery site. Any defects will be noted at the time of inspection and indicated on the delivery manifest for action by the Supplier.

2.03 STEEL PIPE FITTINGS

A. ***General.*** Tees for manholes, thrust rings, miter bends, fittings for air and drain valves, and expansion joints shall be furnished and installed by the Contractor as shown on the drawings and in accordance with this paragraph. Butt straps shall also be supplied as part of the Bid schedule. Welding shall conform with the applicable requirements of AWWA C 200.

B. ***Steel Material.*** Steel material specifications as follows:

1. Structural Steel – ASTM A36
2. ASTM A283, Grade C or D
3. Standard and schedule steel pipe – ASTM, Grade A or B, Type E or S, black for pipe 4-inches in diameter and larger and galvanized for pipe less than 4-inches in diameter.
4. Screwed fittings. ANSI B16.11 or ASTM A105
5. Welded fittings – ANSI B16.9
6. Flanges – AWWA C207, Class D, 150#
7. Flange Gaskets – AWWA C207, full face or ring type

C. ***Hydrostatic Test.*** Fittings fabricated from steel plate shall be tested under hydrostatic pressure sufficient to stress the steel to 23,000 pounds per square inch. The pressure shall be held long enough to allow a thorough inspection of all welded joints, and any leaks shall be repaired by re-welding and the fittings shall then be retested. Fittings fabricated from tested steel pipe do not require hydrostatic testing; however, the girth butt welds shall be complete penetration welds and shall be given a dye penetrant test in accordance with ASTM E 165. Defects in welds as disclosed by the dye penetrant test or hydrostatic test shall be chipped, flame gouged, or ground to sound metal, and the resulting cavities shall be re-welded and retested. The pipe Supplier shall furnish all equipment, supplies, and labor required for making the dye penetrant test and hydrostatic test.

D. ***Manhole***. Manhole joints shall include a 24-inch diameter tee with reinforcement plate that protrudes upward 6-inches from the inside diameter of the pipe. A 24-inch Class D flange shall be welded on top of the manhole. A blind flange with lift rings shall be fabricated as shown on the drawings. Gaskets, bolts, washers, and nuts shall be provided to connect the blind flange to the pipe flange.

E. ***Drain.*** A 6-inch tee shall be configured downward as shown on the drawings. A reinforcement plate shall be welded around the 6-inch tee. A 6-inch 90-degree elbow and 6-inch steel pipe terminating in a 6-inch Class D flange shall be welded to the 6-inch tee as shown on the drawings.

F. ***Air Vent***. Air vent shall consist of a 4-inch #3000 (FPT) threadlet coupler welded onto the top of the pipe at the location shown on the Drawings.

G. ***Anchor Ties***. Anchor ties shall be furnished for field welding onto the pipe. An anchor tie shall consist of a ¼-inch wall 9-inch wide strap that fits the outside diameter of the 36-inch steel pipe. Each end of the tie is welded to a gusset as shown in the drawings.

H. ***Butt straps***. A 6-inch butt strap (either 1 piece or 2 piece) shall be furnished where two plain ends are to be specified at a joint without having an expansions coupler. The steel pipe shall have ¼-inch wall and beveled ready for field welding.

I. ***End Flanges.*** A 36-inch Class D flange shall be welded to the end of plain end on pipes designated to have a flange.

J. ***Expansion Joint.*** The expansion joints shall be Type 1, single-end, Series 401 expansion joint manufactured by Baker Coupling Company Inc., 2929 So. Santa Fe Ave., Los Angeles CA 90058 or equivalent; having the following salient characteristics:

1. Expansion joint allows up to 10 inches of longitudinal pipe movement.
2. Joint consists of a slip pipe that telescopes within a body to compensate for changes in the length of the pipeline due to expansion and contraction.
3. The body has a packing chamber that contains resilient packing to form a seal between the body and slip pipe.
4. Packing gland is adjustable to maintain the proper compaction of the packing so the joint functions properly while maintaining a seal.

K. ***Closure or Makeup or Sections.*** (butt strap joint) or makeup sections shall be used where necessary as determined by the Supplier, subject to the approval of the Owner.

2.04 INTERIOR LINING

A. ***General.*** Coal tar epoxy lining shall conform to AWWA C 210. The minimum lining thickness shall be 16 mils.

B. ***Coal Tar Epoxy.*** The coal tar epoxy shall have the following salient characteristics:

1. Self-priming, two-component, coal-tar-epoxy coating.
2. Mixed usable pot life at 75° F and 50 percent relative humidity (RH): 2 hours, maximum.
3. Cathodic disbondment, has passed a recognized standard test.
4. Volume solids: 68 percent, minimum.
5. VOC (as supplied): 2.5 pounds per gallon (298.8 grams per liter), maximum.
6. Mixing ratio: Manufacturer's recommendation by volume.
7. Application Method: Brush, roller, conventional, or airless spray.
8. Minimum curing temperature: 50° F.
9. Time before immersion after the final coat has been applied at 70° F: 7 days, minimum.

C. ***Approved Brands.*** The following brands meet minimum requirements. Other linings will be considered if they meet the minimum requirements.

1. Amercoat 78 and 78HB as manufactured by Ameron
2. Bitumastic 300-M as manufactured by KOP-COAT
3. C-200, SSPC No. 16 as manufactured by Sherwin-Williams
4. Tnemec 46H-413 as manufactured by Tnemec Company, Inc.
5. Tarset Standard Black as manufactured by Porter International

D. ***Application.*** All interior surfaces shall be lined. Coal tar epoxy shall be applied so as to permit welding without damage to the coal tar epoxy. All fittings other than chrome or stainless steel (expansion joints) shall be lined. Following the initial solvent cleaning, the surfaces shall be blast-cleaned to base metal, using dry, hard, sharp, blasting media, to produce a near-white, abrasive blasted surface free of all foreign substances to achieve the specified or recommended surface profile. The surface shall be cleaned to equal or exceed NACE No. 2 or SSPC-SP10. The lining shall be applied in two (2) coats to produce a minimum thickness of 16mils.

E. ***Miscellaneous***. Coal tar epoxy shall be applied so as to permit field welding without damaging the coal tar epoxy. Additional coal tar epoxy shall be supplied to line all field weld joints.

2.05 EXTERIOR COATING

A. ***General***. For the exterior coating, polyurethane ASTM D16 shall be applied to all exterior surfaces of the pipe with the exception of all welded joints. The Contractor shall be supplied sufficient coating material to field coat welded joints.

B. ***Materials.*** CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW as manufactured by Madison Chemical Industries, Inc. or approved equal.

C. ***Cured Coating Properties:***

1. Conversion to Solids by Volume: 99% ±1%
2. Temperature Resistance: -20°F to 150°F
3. Minimum Adhesion: 2000 psi steel
4. Cure Time: 45 minutes recoat at 70°F, and full cure within 7 days at 70° F.
5. Maximum Specific Gravities: Polysisocyanate resin, 1.20. Polyol resin, 1.15.
6. Hardness: 70±
7. Minimum Tensile Strength: 2000 psi

D. ***Surface Preparation.*** Remove deposits of oil, grease, or other organic contaminates before blast cleaning by using solvent wash as specified in SSPC-SP10. Clean and dry surfaces making them completely dry, free of moisture, dust, grit, oil, grease, or any other deleterious substances prior to application of coating. Proceed only if the substrate temperature is greater than 5°F above the dew point temperature.

E. ***Thickness.*** Minimum DFT of 35 mils (0.035 inch)

F. ***Application.*** Conform to coating manufacturer's recommendation. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

G. ***Inspection.*** All surfaces shall be inspected using a Holiday Inspection per AWWA 5.3.3.1.

H. ***Repair.*** Apply repair/touchup materials in conformance with manufacturer's recommendations. Cover at least one inch of roughened area surrounding damage.

2.06 SHIPPING

A. ***General.*** The Supplier shall deliver the steel pipe and fittings to the Owner as described. Access to the project site is via paved highway until 0.3 miles of the pipeline route. The last 0.3 miles consists of a graded gravel road.

B. ***Safety***. The Supplier shall follow all Federal, state, tribal, and local safety codes.

C. ***Transport and Handling.*** During loading, transportation, unloading, storage, and laying, every precaution shall be taken to prevent damage to the steel pipe, pipe fittings, and coatings. Trucks, trailers, or railway cars used for transporting coated pipe shall be provided with padded bolsters curved to fit the outside of the pipe, and heavy padding shall be used under ties. Open ends of shop-applied, coal tar epoxy-lined pipe shall be tightly closed with a plastic wrap for protection of the coal-tar epoxy lining during shipment. The plastic wrap shall consist of at least two thicknesses of 6-mil sheet polyethylene plastic and shall remain on the pipe until the time of installation. The pipe shall not be dropped or subjected to any unnecessary jars, impacts, or other treatment that might damage the pipe or the coatings. Any damage to the coatings shall be repaired as directed if, in the opinion of the Owner, a satisfactory repair can be made; otherwise, the damaged section shall be returned and replaced at the expense of the Supplier. An inspection of all pipe and fittings and materials will be required at the time of initial delivery at the delivery site. Any defects will be noted at the time of inspection and indicated on the delivery manifest for action by the Supplier.

D. ***Delivery Notice***. The Supplier shall give the Owner two (2) day notice prior to delivering a load of pipe so the Owner can arrange for off-loading the truck. Any shipping costs for trucks waiting to be unloaded because of failing to notify the Owner shall be the responsibility of the Supplier.

PART 3 – BID

Pricing shall include all materials, design, workmanship, shipping, and warranty. Complete a cost proposal showing the cost for each pipe segment. Include a six (6) percent Navajo Nation Sales Tax on the total costs. Show any additional terms on the cost proposal. Return the cost proposal by _______________________ to:

Mr. Francis Johnson, PE
Navajo Nation Department of Water Resources
PO Box 57
Shiprock, NM 87420
Ph: (505) 368-1018

For any technical questions regarding the material, please refer to:

Michael Isaacson, PE
KB-Walkoma, LLC
707 N Dustin Ave
Farmington, NM 87401
Cell (505) 320-9916
m.isaacson@kb-w.com

BID SCHEDULE

Item	Length	Upstream End	Downstream End	Specials	Cost
0. Pipe Segment 0	42 ft	Plain	Plain		
1. Pipe Segment 1	13.2 ft	Plain	Plain	Pre-fabricated bend, Air Vent	
2. Pipe Segment 2	26.2 ft	Plain	Plain		
3. Pipe Segment 3	38 ft	Bell	Plain	Pre-fabricated bend	
4. Pipe Segment 4	14 ft	Bell	Expansion	Bevel	
5. Pipe Segment 5	38 ft	Expansion	Plain		
6. Pipe Segment 6	45 ft	Plain	Plain		
7. Pipe Segment 7	15 ft	Bell	Plain	Bevel	
8. Pipe Segment 8	45 ft	Bell	Plain		
9. Pipe Segment 9	45 ft	Bell	Plain		
10. Pipe Segment 10	45 ft	Bell	Plain		
11. Pipe Segment 11	45 ft	Bell	Plain	Manhole	
12. Pipe Segment 12	45 ft	Bell	Plain	Air Vent	
13. Pipe Segment 13	45 ft	Bell	Plain	Bevel	
14. Pipe Segment 14	45 ft	Plain	Plain		
15. Pipe Segment 15	45 ft	Bell	Plain		
16. Pipe Segment 16	17 ft	Bell	Expansion		
17. Pipe Segment 17	18 ft	Expansion	Plain		

Item	Length	Upstream End	Downstream End	Specials	Cost
18. Pipe Segment 18	19 ft	Plain	Plain	Pre-Fabricated Bend	
19. Pipe Segment 19	45 ft	Plain	Plain		
20. Pipe Segment 20	45 ft	Bell	Plain		
21. Pipe Segment 21	45 ft	Bell	Plain	Manhole	
22. Pipe Segment 22	45 ft	Bell	Expansion		
23. Pipe Segment 23	11 ft	Expansion	Plain		
24. Pipe Segment 24	45 ft	Bell	Plain	Type 2 Anchor	
25. Pipe Segment 25	45 ft	Bell	Plain		
26. Pipe Segment 26	45 ft	Bell	Plain		
27. Pipe Segment 27	45 ft	Bell	Plain		
28. Pipe Segment 28	45 ft	Bell	Plain		
29. Pipe Segment 29	30 ft	Bell	Plain		
30. Pipe Segment 30	16 ft	Bell	Expansion	Manhole	
31. Pipe Segment 31	1.4 ft	Expansion	Plain		
32. Pipe Segment 32	45 ft	Bell	Plain		
33. Pipe Segment 33	45 ft	Bell	Plain		
137. Pipe Segment 137	42 ft	Bell	Plain		
138. Pipe Segment 138	42 ft	Bell	Plain		
139. Pipe Segment 139	45 ft	Bell	Plain	Type 2 Anchor	
140. Pipe Segment 140	45 ft	Bell	Plain		
141. Pipe Segment 141	45 ft	Bell	Plain		

Item	Length	Upstream End	Downstream End	Specials	Cost
142. Pipe Segment 142	42 ft	Bell	Plain		
143. Pipe Segment 143	42 ft	Bell	Plain		
144. Pipe Segment 144	42 ft	Bell	Plain		
145. Pipe Segment 145	29.5 ft	Bell	Expansion		
146. Pipe Segment 146	10.5 ft	Expansion	Plain		
147. Pipe Segment 147	42 ft	Bell	Plain		
148. Pipe Segment 148	42 ft	Bell	Plain		
149. Pipe Segment 149	45 ft	Bell	Bell	Manhole, Drain	
150. Pipe Segment 150	42 ft	Plain	Flange	Downstream Flange	
151. Pipe Segment 151	4 ft	Flange	Bell		
152. Pipe Segment 152	45 ft	Plain	Bell		
153. Pipe Segment 153	35 ft	Plain	Bell	Air Vent	
154. Pipe Segment 154	42 ft	Plain	Bell		
155. Pipe Segment 155	42 ft	Plain	Bell		
156. Pipe Segment 156	42 ft	Plain	Bell		
157. Pipe Segment 157	45 ft	Plain	Bell		
158. Pipe Segment 158	15 ft	Plain	Expansion		
159. Pipe Segment 159	37 ft	Expansion	Bell	Manhole	
160. Pipe Segment 160	42 ft	Plain	Bell		
161. Pipe Segment 161	45 ft	Plain	Bell		
162. Pipe Segment 162	45 ft	Plain	Bell		

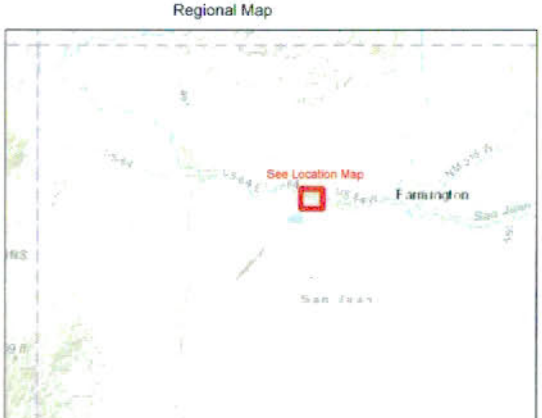
Item	Length	Upstream End	Downstream End	Specials	Cost
163. Pipe Segment 163	45 ft	Plain	Bell	Type 2 Anchor	
164. Pipe Segment 164	42 ft	Plain	Bell		
165. Pipe Segment 165	42 ft	Plain	Bell		
166. Pipe Segment 166	19.7 ft	Plain	Expansion		
167. Pipe Segment 167	42 ft	Expansion	Bell	Manhole	
168. Pipe Segment 168	42 ft	Plain	Plain	Type 2	
169. Pipe Segment 169	40.3 ft	Plain	Bell	Air Vent	
				Total	
				Navajo Nation Tax (6%)	
				Grand Total	

Yellowman Siphon

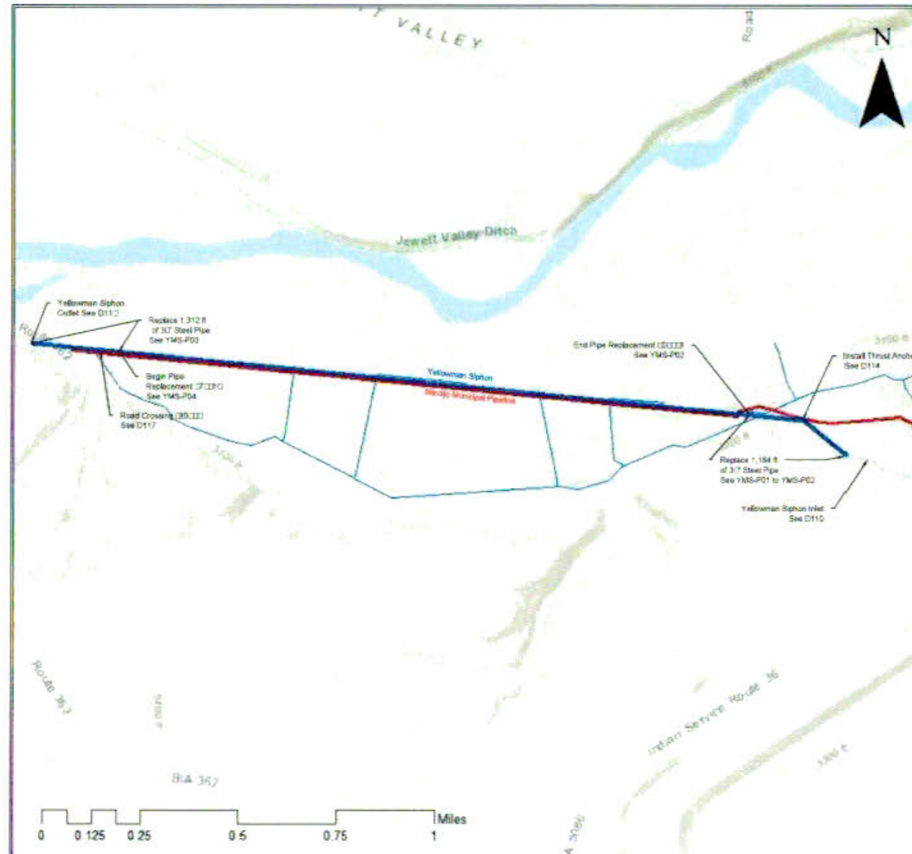
Project Location

Vicinity Map

Regional Map



Location Map



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#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	

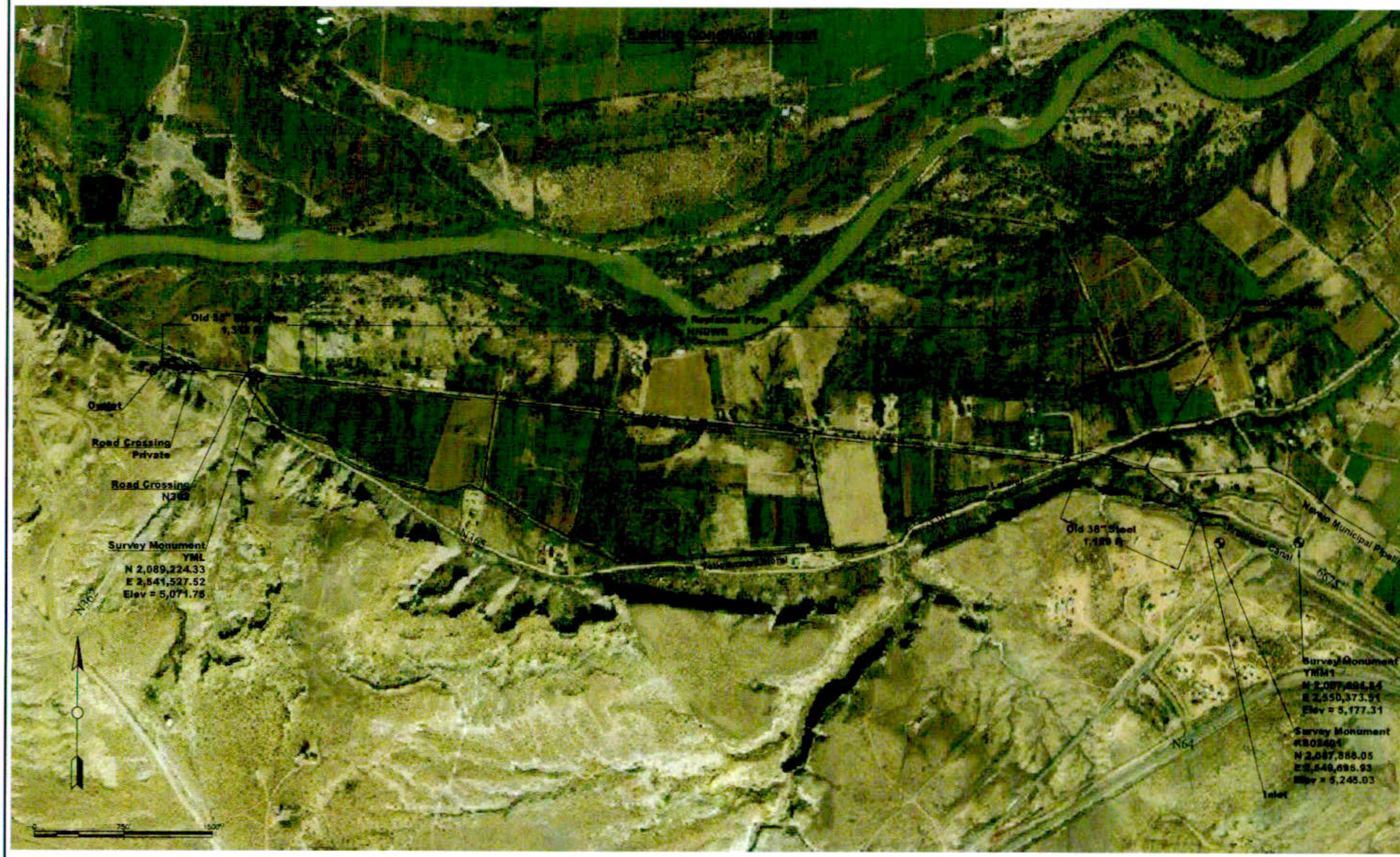
Coordinate System: State Plane - New Mexico West
Datum: NAD 83/ GEOID12A
Survey Data Source: KB-Walkoma, LLC & JMAS
File Name:

Technical Construction and Operations Branch
Ft. Defiance, AZ

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Project Location

CO12418
Date: 11/24/17
Sheet 0 of 17
DRAWING NO. YMS-L00
REV



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Navajo Nation
Dept. of Water Resources
Technical, Construction and Operations Branch

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Existing Conditions Layout

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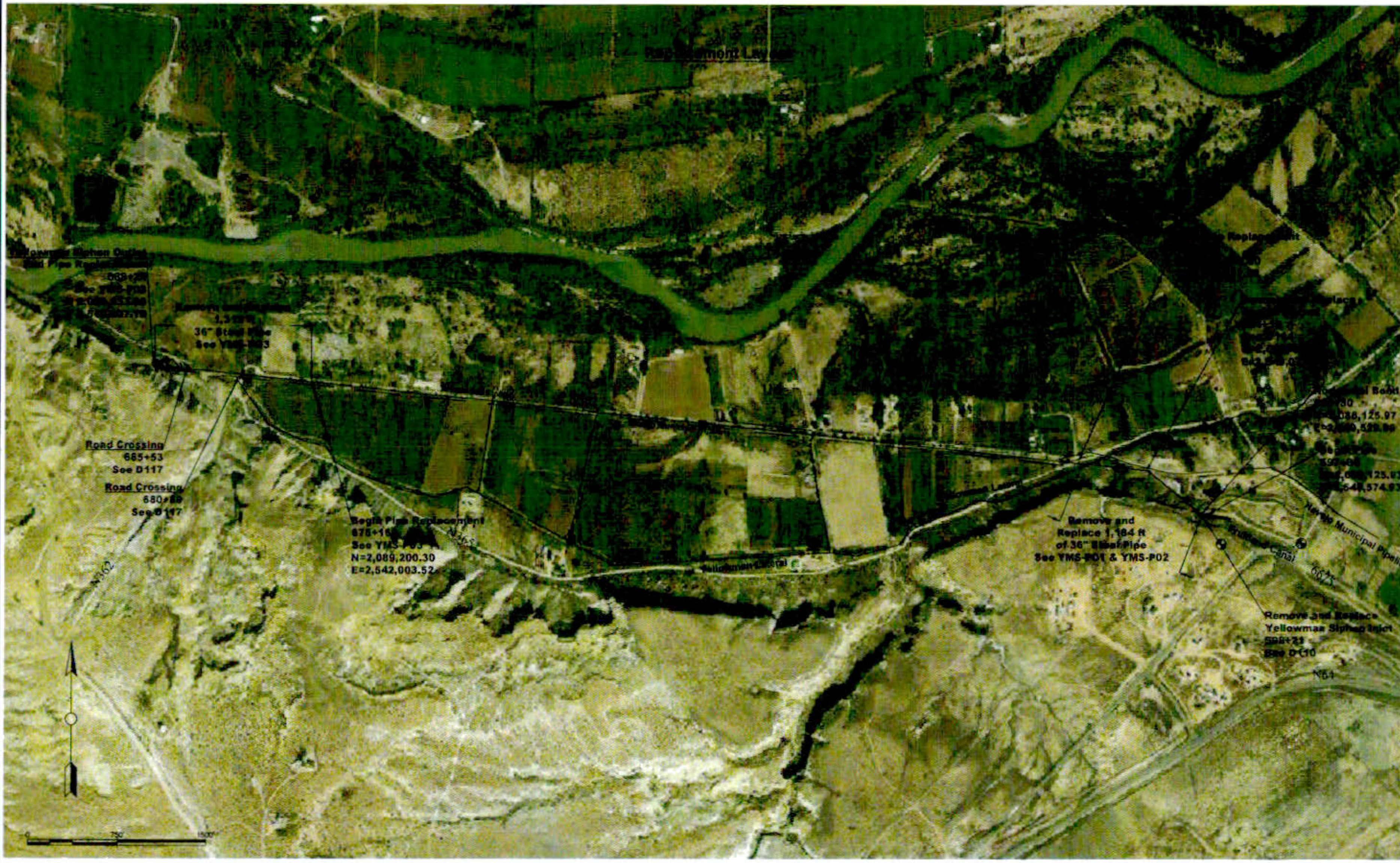

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Technical, Construction
and Operations Branch

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Replacement Layout

CO12418
Date: 11/24/17
Sheet 2 of
DRAWING NO. YMS-L01a
REV

General Notes

Demolition Notes

1. Only remove steel pipe as specified.
2. Steel pipe to be removed is 36-inch outside diameter, 0.25-inch wall with a 0.75-inch mortar lining. The weight of the pipe with mortar lining is estimated to be 154 lb/ft. The weight of the pipe without mortar lining is estimated to be 96 lb/ft.
3. Mortar lining may be broken on site before disposing of steel pipe. Mortar lining shall be properly disposed of to a legal landfill or a recycler.
4. Steel pipe shall be disposed of at salvage yard.
5. Valves shall be taken to Shiprock Irrigation yard in Shiprock, NM.
6. Concrete shall be either disposed of at landfill or recycled.
7. Vegetation on centerline shall be removed and disposed of prior to new pipe installation.

Installation Notes

1. Contact NM-One Call (Phone# 811) prior to any excavation.
2. Pipe is designated in callout from left to right by: horizontal station length, left end joint, right end joint. An example of a 45-foot (45') long pipe with a bell on the left end and a spigot on right end is 45', BE, PE.
3. The steel pipe shall be assembled with the bell end pointed uphill.
4. Field welding required for all joints with the exception of expansion joints.
5. Replacement siphon pipe has a maximum span between supports of 18 feet.
6. Plan and Profile Drawings identify concrete saddle structures requiring replacement. See D113 for details on replacing saddles.
7. Existing siphon was constructed using design elevations at pipe bottom. Replacement pipe is also based on elevations at pipe bottom, called out at vertical bends and concrete saddle supports.
8. For bends with an angle less than 1°, pull joint to make bend. For bends with an angle between 1° and 5°, use bevel pipe joint. For bends with an angle over 5°, pre-fabricated bend fitting required.
9. Replace earthwork about siphon pipe supports. The siphon pipe is not to be partially backfilled unless specified. Grade earthwork to prevent ponding along siphon.
10. Existing siphon has tie-down anchors at approximate 500 ft spacing. Expansion joints are placed midway between anchors. Pipe shall be furnished with expansion joint fittings installed on the ends.
11. Outlet for air valves and blowoff drains shall be placed at stations shown. Locations may be adjusted slightly to suit construction. See Drawing D111 for outlet details.
12. For details on Manhole. See D116.

Legend

STA = Station
ELEV = Elevation
VPI = Vertical Bend point of intersection
BE = Bell End
PE = Plain End - Spigot
LJ = Lap Joint, bell and spigot ends; field welded
EJ = Expansion joint
PB = Prefabricated Bend
MH = Manhole
FL = 150# Flange
AV = 4" FPT weldlet for air vent
——— = Yellowman Siphon
- - - - - - = Navajo Municipal Pipeline
——— = Yellowman Lateral Ditch
(2) = Steel Pipe Segment Identification Number

Concrete Saddle Structure Action:

Keep = Retain existing structure; Remove existing pipe and install new pipe
Replace = Remove existing structure and construct new structure in it's place
New = Construct new structure in new location
Abandon = Do nothing. Only remove structure if it obstructs the new pipe
Anchor = Construct Thrust Anchor Structure; See D114

Steel Pipe Specifications:

1. Outside Diameter = 36 inches.
2. Pipe Wall = 0.25 inches
3. Electric Fusion (arc) welded spiral-seam steel pipe per ASTM A 139, grade B, C, D, or E
4. Interior Lining is 16mil Coal Tar Epoxy
5. Exterior Coating is 25mil polyurethane with a thin topcoat of aliphatic polyurethane.
6. Bell and spigot lap joints ready for field welding.
7. Expansion Joints spacing = 10 inches.
8. Butt straps for butt strap closure joints.
9. Thrust Ring at inlet structure.
10. Special miter bends at stations 598+30, 598+68, and 604+15
11. Anchor stop for Type 1 tie-down anchors will be wrapped around pipe. See D113.
12. Tie-down straps at Type 2 tie-down anchors will be wrapped around pipe. See D113.
13. Pipe supplied with additional polyurethane kits and coal tar epoxy for field coating.

Drawing Index

Sheet No.	Title	Drawing	Rev
0	Project Location	YMS-L00	0
1	Existing Conditions Layout	YMS-L01	0
2	Replacement Layout	YMS-L01a	0
3	General Notes	YMS-L02	0
4	Inlet Layout	YMS-L110	0
5	Plan & Profile 598+29 to 604+00	YMS-P01	0
6	Plan & Profile 604+00 to 609+68	YMS-P02	0
7	Plan & Profile 675+16 to 688+28	YMS-P03	0
8	Concrete Saddle Supports for 675+16 to 688+28	YMS-P03a	0
9	Inlet Details	D110	0
10	Air Valve & Blow off Details	D111	0
11	Saddle Supports	D112	0
12	Tie-Down Anchor Supports	D113	0
13	Thrust Anchor	D114	0
14	Phase 3 Outlet Details	D115	0
15	Manhole Details	D116	0
16	Road Crossing 680+69	D117	0
17	Traffic Control Plan	YMS-L02t	0
18	Chain Link Fence & Gate	D118	0
19	Electric Details	D119	0

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Navajo Nation Dept. of Water Resources
Technical, Construction and Operations Branch

KB-Walkome, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
General Notes

CO12418
Date: 11/24/17
Sheet 3 of
DRAWING NO. YMS-L02
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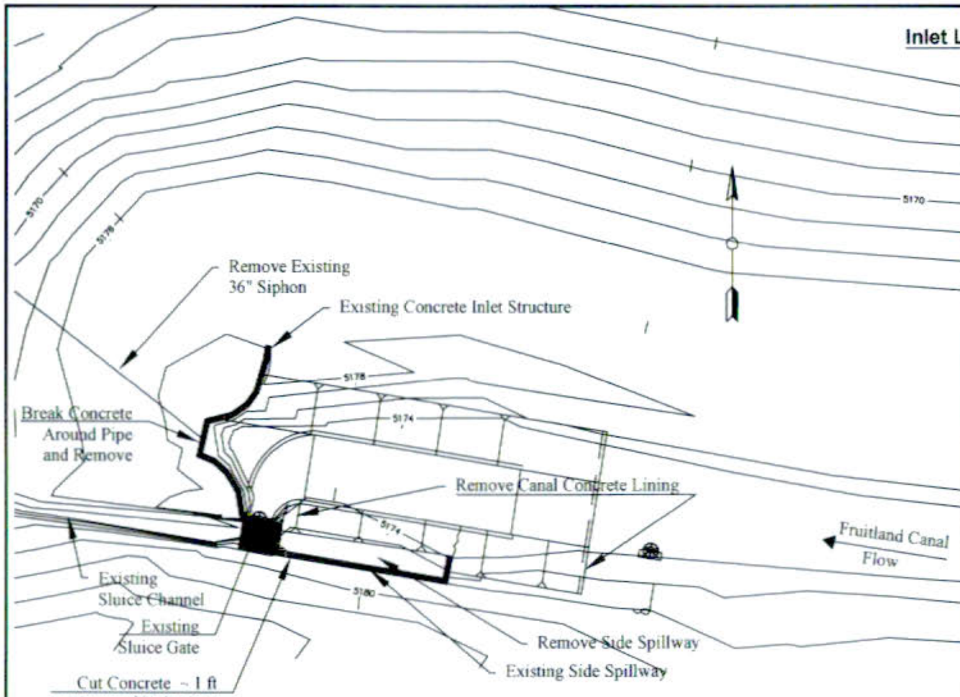
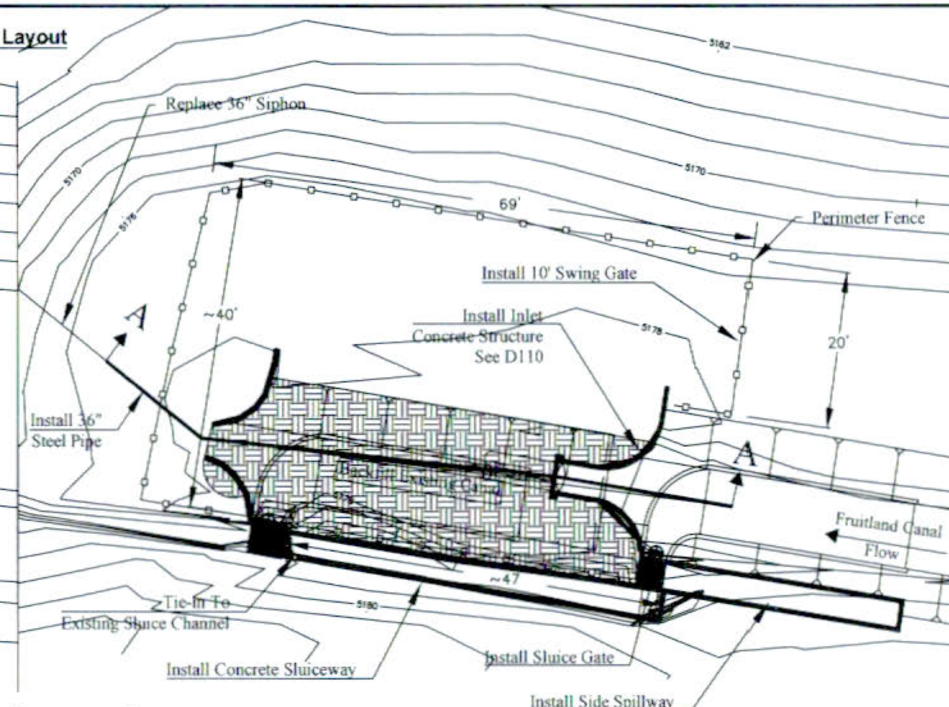
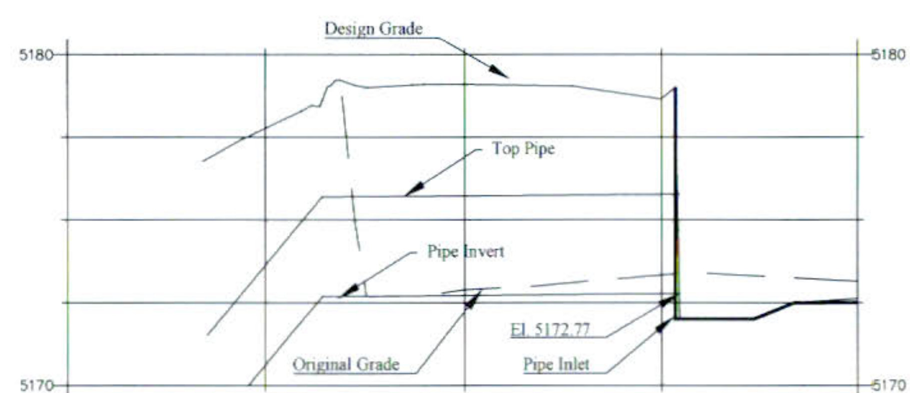
Inlet Layout



Inlet Existing Conditions and Demolition Requirements



New Inlet Layout



Section A-A

Notes:

1. See D110 for Inlet Structure Details
2. Existing Inlet Components to be removed as shown. Remaining inlet may be backfilled. Surface shall be clear of protruding debris
3. Concrete = 4,000 psi
4. #4 Rebars on 12" Centers
5. Drill and dowl-in to Existing Concrete 4-inches.
6. Backfill canal using imported, reasonably graded pit run from a commercial sand and gravel yard as shown.
7. Estimated fill requirement is 170 cubic yards
8. Compact all backfill to 95% of standard proctor.
9. Perimeter Fence shall be 12 gauge chain link w/ 3 strand barbed wire.
10. Trash screen not shown. See D118

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Navajo Nation Dept. of Water Resources Technical, Construction and Operations Branch

KB-Walkoma, LLC 707 N. Dustin Ave Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Inlet Layout

CO12418
Date: 11/24/17
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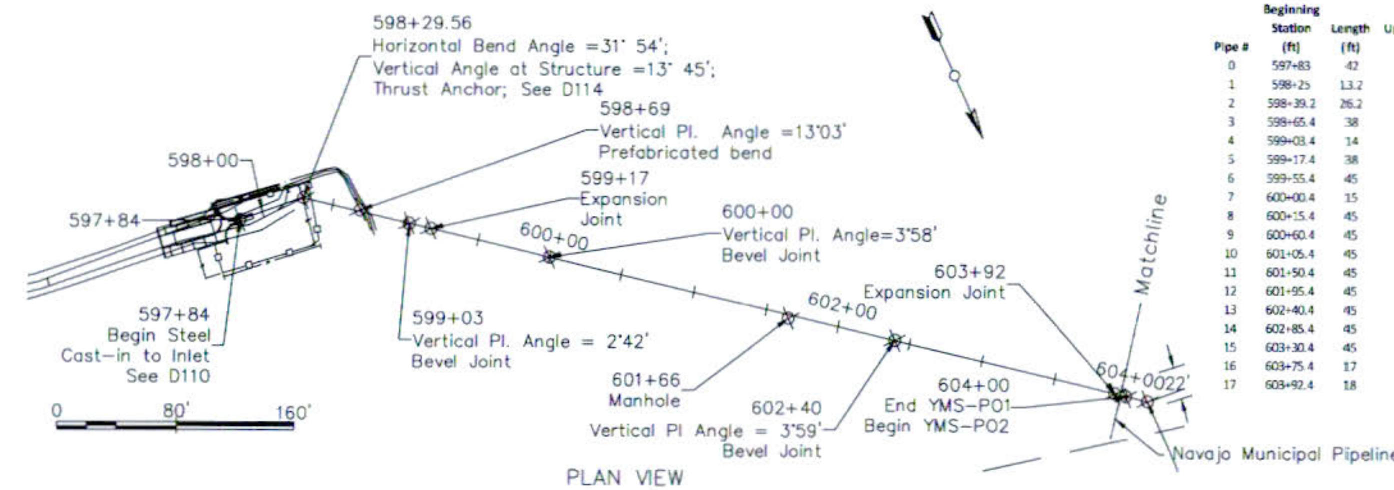
REV: ○

Plan & Profile 598+29 to 604+00

Pipe Concrete Saddle Support Structures

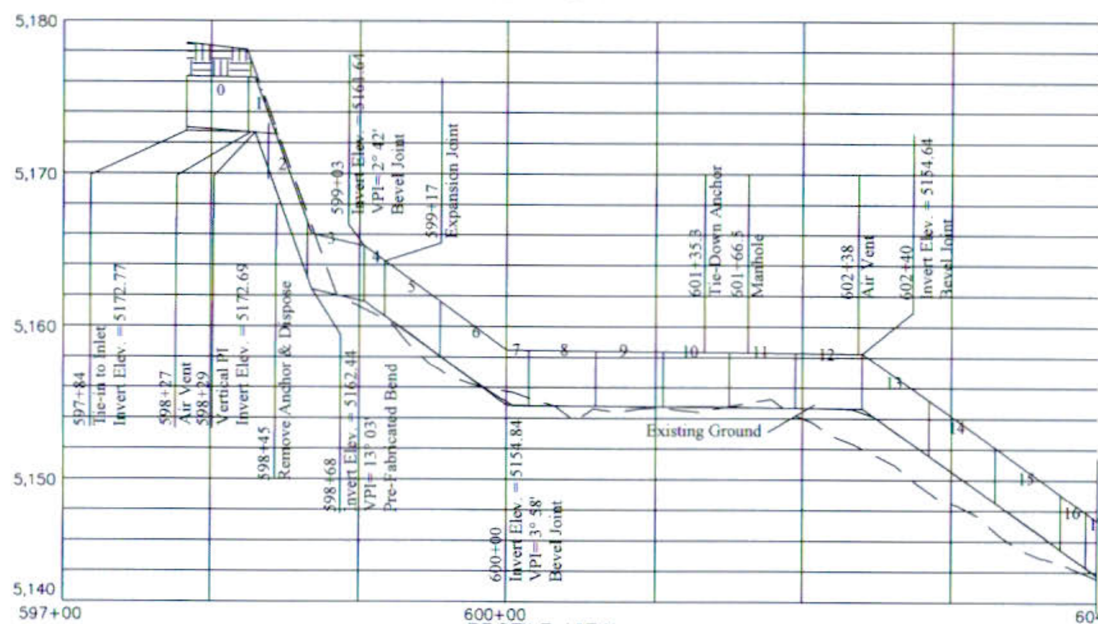
Saddle	Station	Action	Pipe Invert Elevation
Saddle 1	598+99	Abandon	n/a
Saddle 2	599+06	Keep	5,161.43
Saddle 3	599+20	Keep	5,160.45
Saddle 4	599+27	Abandon	n/a
Saddle 5	599+34	Keep	5,159.47
Saddle 6	599+40	Abandon	n/a
Saddle 7	599+47	Keep	5,158.56
Saddle 8	599+54	Abandon	n/a
Saddle 9	599+62	Keep	5,157.50
Saddle 10	599+69	Abandon	n/a
Saddle 11	599+77	Keep	5,156.45
Saddle 12	599+83	Abandon	n/a
Saddle 13	599+90	Keep	5,155.54
Saddle 14	599+97	Abandon	n/a
Saddle 15	600+04	Keep	5,154.84
Saddle 16	600+11	Abandon	n/a
Saddle 17	600+18	Keep	5,154.83
Saddle 18	600+25	Abandon	n/a
Saddle 19	600+32	Keep	5,154.81
Saddle 20	600+39	Abandon	n/a
Saddle 21	600+46	Keep	5,154.80
Saddle 22	600+52	Abandon	n/a
Saddle 23	600+58	Keep	5,154.79
Saddle 24	600+66	Abandon	n/a
Saddle 25	600+74	Keep	5,154.78
Saddle 26	600+81	Abandon	n/a
Saddle 27	600+88	Keep	5,154.77
Saddle 28	600+95	Abandon	n/a
Saddle 29	601+02	Keep	5,154.76
Saddle 30	601+11	Abandon	n/a
Saddle 31	601+15	Keep	5,154.74
Saddle 32	601+20	Abandon	n/a
Saddle 33	601+29	Keep	5,154.73
Saddle 34	601+37	Abandon	n/a
Saddle 34-a	601+46	New	5,154.72
Saddle 35	601+51	Abandon	n/a
Saddle 36	601+64	Replace	5,154.70
Saddle 37	601+78	Abandon	n/a
Saddle 37-a	601+82	New	5,154.69
Saddle 38	601+91	Abandon	n/a
Saddle 38-a	602+00	New	5,154.67
Saddle 39	602+06	Abandon	n/a
Saddle 39-a	602+18	New	5,154.66
Saddle 40	602+20	Abandon	n/a
Saddle 41	602+34	Keep	5,154.65
Saddle 42	602+48	Abandon	n/a
Saddle 42-a	602+51	New	5,153.89
Saddle 43	602+62	Replace	5,153.07
Saddle 44	602+76	Keep	5,152.19
Saddle 44-a	602+89	New	5,151.30
Saddle 45	602+90	Abandon	n/a
Saddle 46	603+04	Keep	5,150.28
Saddle 47	603+18	Abandon	n/a
Saddle 47-a	603+21	New	5,149.12
Saddle 48	603+32	Abandon	n/a
Saddle 48-a	603+39	New	5,147.89
Saddle 49	603+45	Abandon	n/a
Saddle 49-a	603+57	New	5,146.66
Saddle 50	603+60	Abandon	n/a
Saddle 51	603+74	Replace	5,145.43
Saddle 52	603+87	Abandon	n/a
Saddle 52-a	603+92	New	5,144.21



PLAN VIEW

Estimated Pipe Lay Schedule (Pipe Manufacturer will Finalize)

Pipe #	Beginning Station (ft)	Length (ft)	Upstream End	Special	Down Stream End
0	597+83	42	PE		PE
1	598+25	13.2	PE	AV, PB	PE
2	598+39.2	26.2	PE		PE
3	598+65.4	38	BE	PB	PE
4	599+03.4	14	BE	BEV	EJ
5	599+17.4	38	EJ		PE
6	599+55.4	45	PE		PE
7	600+00.4	15	BE	BEV	PE
8	600+15.4	45	BE		PE
9	600+60.4	45	BE		PE
10	601+05.4	45	BE		PE
11	601+50.4	45	BE	MH	PE
12	601+95.4	45	BE	AV	PE
13	602+40.4	45	BE	BEV	PE
14	602+85.4	45	PE		PE
15	603+30.4	45	BE		PE
16	603+75.4	17	BE		EJ
17	603+92.4	18	EJ		PE



PROFILE VIEW

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Coordinate System: State Plane - New Mexico West
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Navajo Nation
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Technical, Construction and Operations Branch

kbw
KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Plan & Profile 598+29 to 604+00

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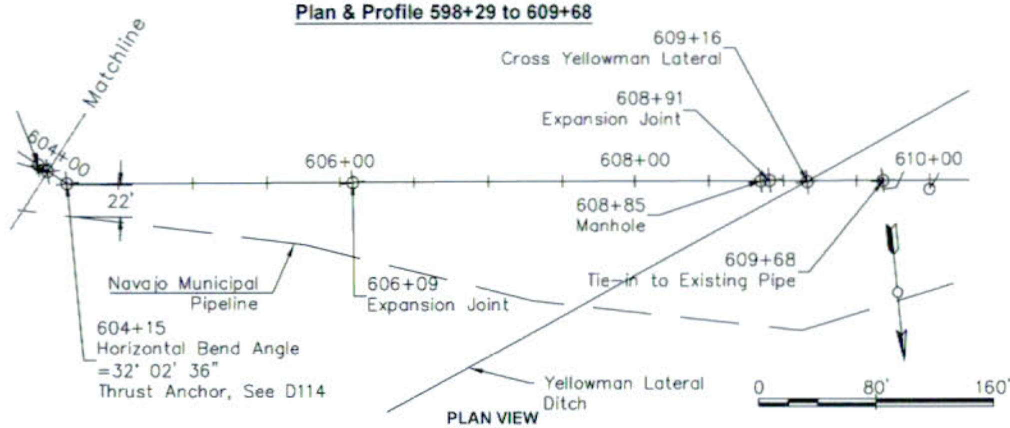
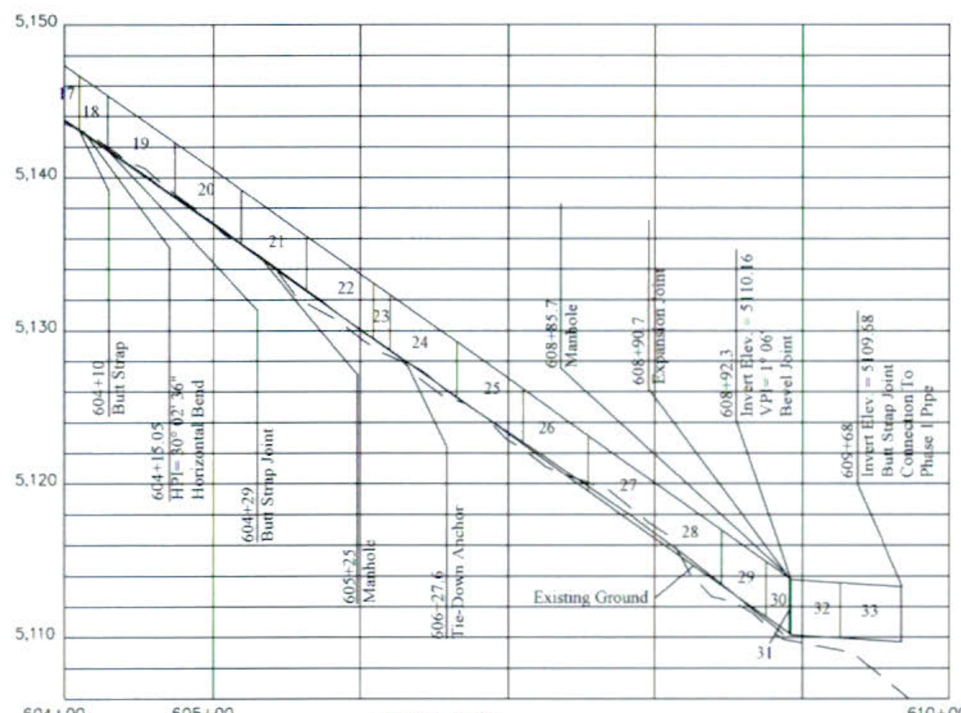
Plan & Profile 598+29 to 609+68



PLAN VIEW



PROFILE VIEW

Pipe Concrete Saddle Support Structures

Saddle	Station	Action	Pipe Invert Elevation
Saddle 53	604+01	Abandon	n/a
Anchor	604+11	Anchor	5,142.98
Saddle 54	604+28	Replace	5,141.75
Saddle 55	604+41	Abandon	n/a
Saddle 55-a	604+46	New	5,140.46
Saddle 56	604+54	Abandon	n/a
Saddle 56-a	604+64	New	5,139.23
Saddle 57	604+67	Abandon	n/a
Saddle 58	604+80	Abandon	n/a
Saddle 58-a	604+82	New	5,138.00
Saddle 59	604+93	Abandon	n/a
Saddle 59-a	605+00	New	5,136.77
Saddle 60	605+06	Abandon	n/a
Saddle 61	605+18	Replace	5,135.55
Saddle 62	605+32	Abandon	n/a
Saddle 62-a	605+36	New	5,134.32
Saddle 63	605+45	Abandon	n/a
Saddle 63-a	605+54	New	5,133.09
Saddle 64	605+58	Abandon	n/a
Saddle 65	605+72	Replace	5,131.86
Saddle 66	605+86	Abandon	n/a
Saddle 66-a	605+90	New	5,130.64
Saddle 67	606+00	Abandon	n/a
Saddle 67-a	606+10	New	5,129.41
Saddle 68	606+14	Replace	5,129.04
Saddle 69	606+29	Keep	5,128.11
Saddle 70	606+42	Abandon	n/a
Saddle 70-a	606+46	New	5,126.96
Saddle 71	606+56	Abandon	n/a
Saddle 71-a	606+64	New	5,125.73
Saddle 72	606+70	Abandon	n/a
Saddle 72-a	606+82	New	5,124.50
Saddle 73	606+84	Abandon	n/a
Saddle 74	606+98	Abandon	n/a
Saddle 74-a	607+00	New	5,123.27
Saddle 75	607+12	Abandon	n/a
Saddle 75-a	607+18	New	5,122.05
Saddle 76	607+26	Abandon	n/a
Saddle 76-a	607+36	New	5,120.82
Saddle 77	607+40	Abandon	n/a
Saddle 78	607+54	Abandon	n/a
Saddle 78-a	607+54	New	5,119.59
Saddle 79	607+68	Abandon	n/a
Saddle 79-a	607+72	New	5,118.36
Saddle 80	607+82	Abandon	n/a
Saddle 80-a	607+90	New	5,117.14
Saddle 81	607+96	Abandon	n/a
Saddle 81-a	608+08	New	5,115.91
Saddle 82	608+10	Abandon	n/a
Saddle 83	608+24	Abandon	n/a
Saddle 83-a	608+26	New	5,114.68
Saddle 84	608+38	Abandon	n/a
Saddle 84-a	608+44	New	5,113.45
Saddle 85	608+52	Abandon	n/a
Saddle 85-a	608+62	New	5,112.23
Saddle 86	608+66	Abandon	n/a
Saddle 86-a	608+76	New	5,111.27
Saddle 87	608+80	Abandon	n/a
Saddle 88	608+87	New	5,110.52
Saddle 88-a	609+05	New	5,110.08
Saddle 88-b	609+23	New	5,109.96
Saddle 88-c	609+41	New	5,109.85
Saddle 88-d	609+59	New	5,109.74

Estimated Pipe Lay Schedule
(Pipe Manufacturer will Finalize)

Pipe #	Beginning Station (ft)	Length (ft)	Upstream End	Special	Down Stream End
18	604+10.4	19	PE	PB	PE
19	604+29.4	45	PE		PE
20	604+74.4	45	BE		PE
21	605+19.4	45	BE	MH	PE
22	605+64.4	45	BE		EJ
23	606+09.4	11	EJ		PE
24	606+20.4	45	BE	Type 2	PE
25	606+65.4	45	BE		PE
26	607+10.4	45	BE		PE
27	607+55.4	45	BE		PE
28	608+00.4	45	BE		PE
29	608+45.4	30	BE		PE
30	608+75.4	16	BE	MH	EJ
31	608+91.4	1.4	EJ		PE
32	608+92.8	34	BE		PE
33	609+26.8	42	BE		PE

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707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Plan & Profile 598+29 to 609+68

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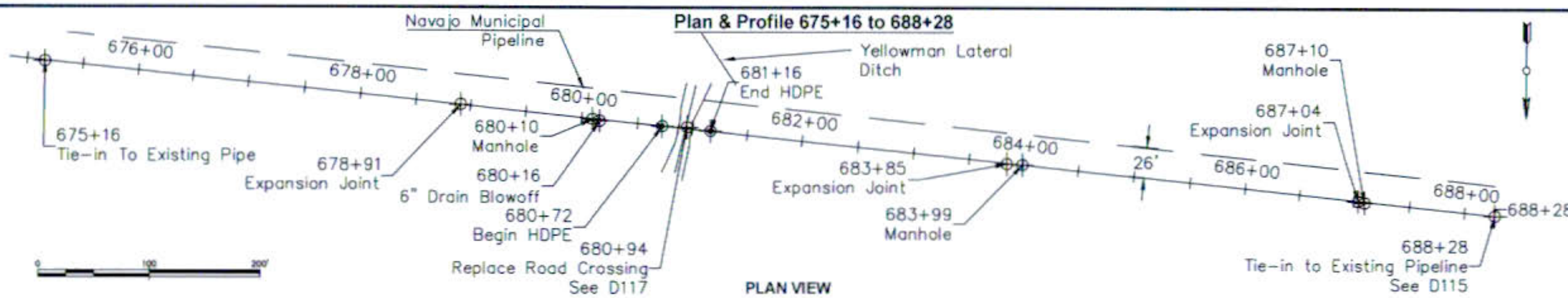
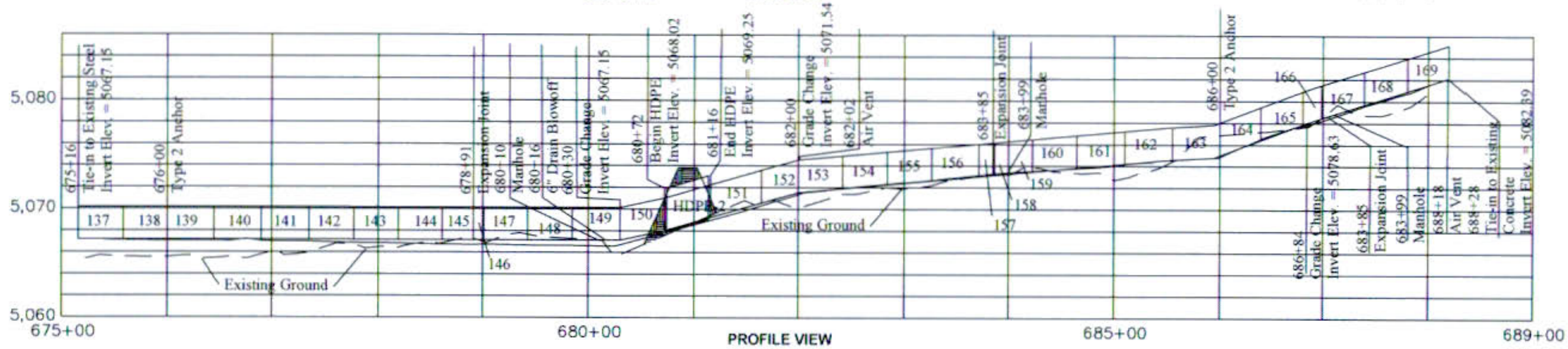
Plan & Profile 675+16 to 688+28



PLAN VIEW



PROFILE VIEW

Estimated Pipe Lay Schedule
(Pipe Manufacturer will Finalize)

Pipe #	Beginning Station (ft)	Length (ft)	Upstream End	Special	Down Stream End
137	675+16	42	BE		PE
138	675+58	42	BE		PE
139	676+00	45	BE	Type 2	PE
140	676+45	45	BE		PE
141	676+90	45	BE		PE
142	677+35	42	BE		PE
143	677+77	42	BE		PE
144	678+19	42	BE		PE
145	678+61	29.5	BE		EJ
146	678+90.5	10.5	EJ		PE
147	679+01	42	BE		PE
148	679+43	42	BE		PE
149	679+85	45	PE	MH, DR	BE
150	680+30	42	PE		FL
HDPE-2	680+72	44	FL		FL
151	681+16	4	FL		BE
152	681+20	45	PE		BE

Pipe #	Beginning Station (ft)	Length (ft)	Upstrea m End	Special	Down Stream End
153	681+65	35	PE	AV	BE
154	682+00	42	PE		BE
155	682+42	42	PE		BE
156	682+84	42	PE		BE
157	683+26	45	PE		BE
158	683+71	15	PE		EJ
159	683+86	37	EJ	MH	BE
160	684+23	42	PE		BE
161	684+65	45	PE		BE
162	685+10	45	PE		BE
163	685+55	45	PE	Type 2	BE
164	686+00	42	PE		BE
165	686+42	42	PE		BE
166	686+84	19.7	PE		EJ
167	687+03	42	EJ	MH	BE
168	687+47.7	42	PE	Type 2	PE
169	687+87.7	40.3	PE	AV	BE

Notes: See YMS-PO4 for Data Regarding Pipeline Concrete Saddle Supports

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Navajo Nation Dept. of Water Resources Technical, Construction and Operations Branch

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Plan & Profile 675+16 to 688+28

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Concrete Saddle Supports for 675+16 to 688+28

Anchor (W-#)	Station	Action	Pipe Invert Elev.
1	675+22.7	Keep	5067.15
2	675+29.3	Abandon	n/a
3	675+35.9	Keep	5067.15
4	675+42.0	Abandon	n/a
5	675+50.0	Keep	5067.15
6	675+57	Abandon	n/a
7	675+64.0	Keep	5067.15
8	675+71	Abandon	n/a
9	675+78.4	Keep	5067.15
10	678+85	Abandon	n/a
11	675+92.0	Keep	5067.15
12	675+99	Abandon	n/a
13	676+06	Keep	5067.15
14	676+13	Abandon	n/a
15	676+20.4	Keep	5067.15
16	676+27	Abandon	n/a
17	676+34.3	Keep	5067.15
18	676+41	Abandon	n/a
19	676+48	Replace	5067.15
20	676+54	Abandon	n/a
21	676+60.2	Keep	5067.15
22	678+68	Abandon	n/a
23	676+76.0	Keep	5067.15
24	676+82	Abandon	n/a
25	676+90.0	Keep	5067.15
26	676+97	Abandon	n/a
27	677+04.6	Keep	5067.15
28	677+11	Abandon	n/a
29	677+19	Replace	5067.15
30	677+32.8	Keep	5067.15
31	677+39	Abandon	n/a
32	677+46	Keep	5067.15
33	677+51	Abandon	n/a
34	677+55	Abandon	na
35	677+60.0	Keep	5067.15
36	677+67	Abandon	n/a
37	677+74.3	Keep	5067.15
38	677+81	Abandon	n/a

Anchor (W-#)	Station	Action	Pipe Invert Elev.
39	677+88.5	Keep	5067.15
40	677+96	Abandon	n/a
41	678+03.0	Keep	5067.15
42	678+10	Abandon	n/a
43	678+17.8	Keep	5067.15
44	678+24	Abandon	n/a
45	678+30.0	Keep	5067.15
46	678+37	Abandon	n/a
47	678+44.4	Keep	5067.15
48	678+51	Abandon	n/a
49	678+58.0	Keep	5067.15
50	678+65	Abandon	n/a
51	678+72.5	Keep	5067.15
52	678+79	Abandon	n/a
53	678+86.2	Keep	5067.15
54	678+95	Abandon	n/a
55	679+03.6	Keep	5067.15
56	679+12	Abandon	n/a
57	679+22	Replace	5067.15
58	679+35	Abandon	n/a
58-a	679+39	New	5067.15
59	679+51	Abandon	n/a
59-a	679+57	New	5067.15
60	679+64	Abandon	n/a
60-a	679+75	New	5067.15
61	679+78	Abandon	n/a
62	679+91	Replace	5067.15
63	680+06	Replace	5067.15
64	680+13.1	Keep	5067.15
65	680+19	Abandon	n/a
65-a	680+31	New	5067.17
66	680+45	Replace	n/a
67	680+55	Abandon	n/a
68	680+62	Keep	5067.81
	Road		
69	681+30	New	5069.63
71	681=36	Abandon	n/a
72	681+48	Replace	5070.12

Anchor (W-#)	Station	Action	Pipe Invert Elev.
73	681+64.0	Keep	5070.56
74	681+78	New	5070.94
75	681+92.0	Keep	5071.32
76	682+06	Abandon	n/a
76-a	682+10	New	5071.63
77	682+16	Abandon	n/a
78	682+22	Abandon	n/a
79	682+27.0	Keep	5071.77
80	682+34	Abandon	n/a
81	682+41.3	Keep	5071.89
82	682+48	Abandon	n/a
83	682+54.9	Keep	5072.01
84	682+62	Abandon	n/a
85	682+69.5	Keep	5072.14
86	682+76	Abandon	n/a
87	682+82.9	Keep	5072.25
88	682+90	Abandon	n/a
89	682+97.1	Keep	5072.37
90	682+03	Abandon	n/a
91	683+10.9	Keep	5072.49
92	683+18	Abandon	n/a
93	683+25.6	Keep	5072.62
94	683+32	Abandon	n/a
95	683+39.2	Keep	5072.73
96	683+46	Abandon	n/a
96	683+53	Replace	5072.85
97	683+60	Abandon	n/a
98	683+67.5	Keep	5072.98
99	683+74	Abandon	n/a
99-a	683+84	new	5073.12
100	683+88	Abandon	n/a
101	684+02	Replace	5073.27
102	684+09	Abandon	n/a
102-A	684+20	New	5073.43
103	684+30	Abandon	n/a
104	684+44	Abandon	
104-a	684+38	New	5073.58
104-b	684+56	New	5073.73

Anchor (W-#)	Station	Action	Pipe Invert Elev.
105	684+58	Abandon	n/a
106	684+71	Abandon	n/a
106-a	684+74	New	5073.89
107	684+86	Abandon	n/a
107-a	684+92	New	5074.04
108	685+00	Abandon	n/a
108-a	685+10	New	5074.20
109	685+14	Abandon	n/a
110	685+28	Replace	5074.35
111	685+34.8	Keep	5074.41
112	685+37	Abandon	n/a
113	685+41.8	Keep	5074.47
	Road		
117-a	686+00	New	5075.04
117-b	686+18	New	5075.81
118	686+30	Abandon	n/a
118-a	686+36	New	5076.58
119	686+43	Abandon	n/a
120	686+54	Replace	5077.35
121	686+72	Replace	5078.12
122	686+86	Abandon	n/a
122-a	686+90	New	5079.07
123	687+00	Abandon	n/a
123-a	687+08	New	5080.40
124	687+14	Abandon	n/a
125	687+26	Replace	5081.74
125-a	687+36	New	5082.47
126	687-40	Abandon	n/a
	687+46	New	5083.21
127	687+56	Abandon	n/a
	687+62	New	5084.40
128	687+84	Abandon	n/a
	687+80	New	5085.73
129	687+84	Abandon	n/a
130	687+98	Replace	5087.06
131	688+13.2	Keep	5082.00

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KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Concrete Saddle Supports for 675+16 to 688+28

CO12416
Date 11/24/17
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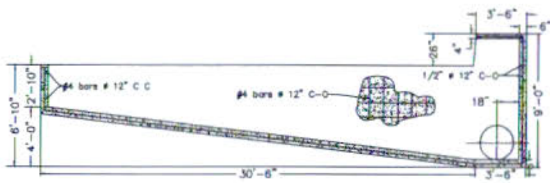
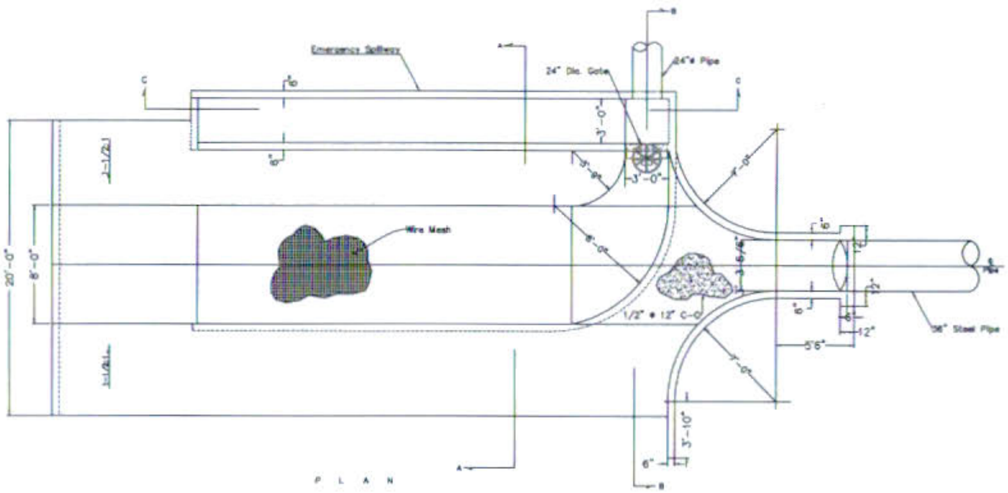
Inlet Details

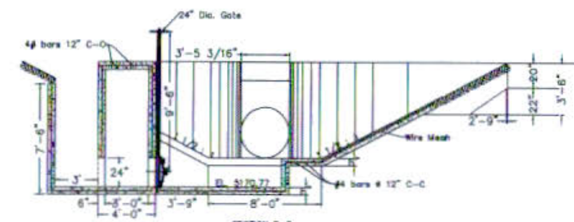


SECTION C-C

Notes:
1. 4000 psi concrete
2. #12 bars on 12" centers unless noted
3. Backfill and compact to 95% standard procture in 12" widths



P L A N



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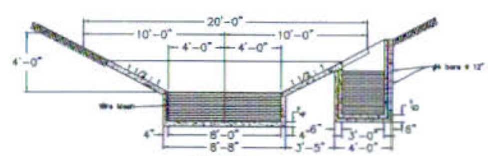
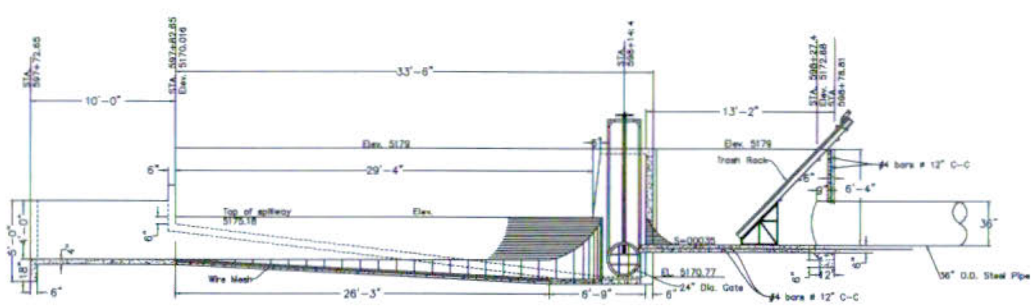


SECTION A-A



SECTION THRU CENTERLINE

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Yellowman Siphon
Inlet Details

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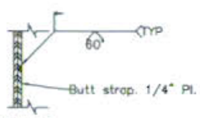
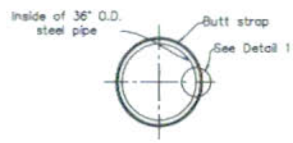
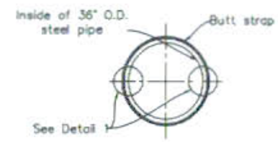
Air Valve & Blow off Details



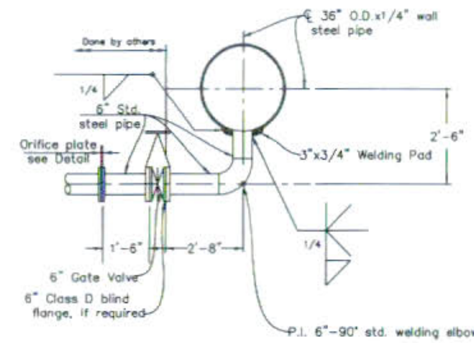
DETAIL 1



ONE – PIECE BUTT STRAP CONNECTION

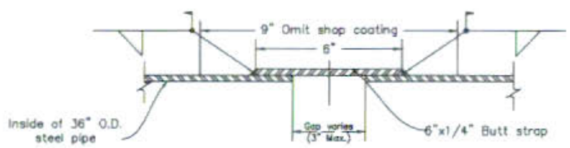


TWO – PIECE BUTT STRAP CONNECTION



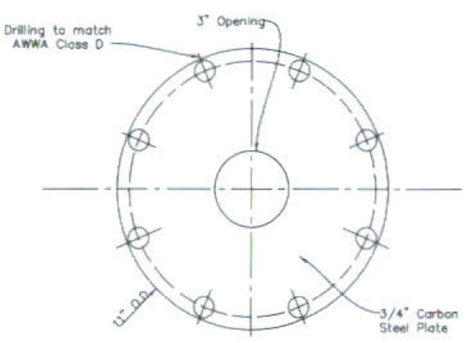
Note: Direction of turnout is shown in profile drawing.

6–INCH DRAIN

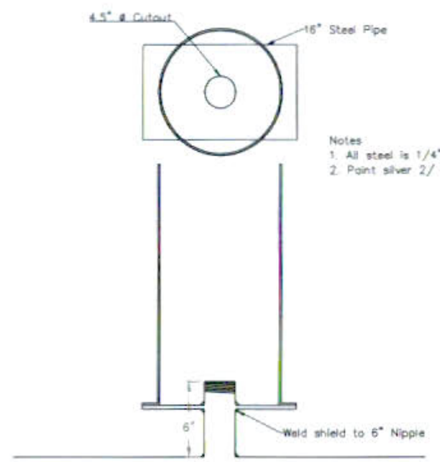


Note: Apply field coating after completion of field welding.

BUTT STRAP CONNECTION

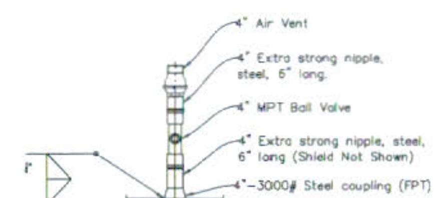


ORIFICE PLATE
FOR 6–INCH DRAIN



Notes
1. All steel is 1/4"plate.
2. Paint silver 2/ 2 part epoxy paint.

AIR VENT SHIELD DETAIL



AIR VENT DETAIL

Version/Revisions	Date	Design	Draw	Check	Approved
	11/24/17	MI	HD	GJ	

Coordinate System: State Plane - New Mexico West
Datum: NAD 83/ GEOID12A
Survey Data Source: KB-Walkoma, LLC & JMAS
File Name:

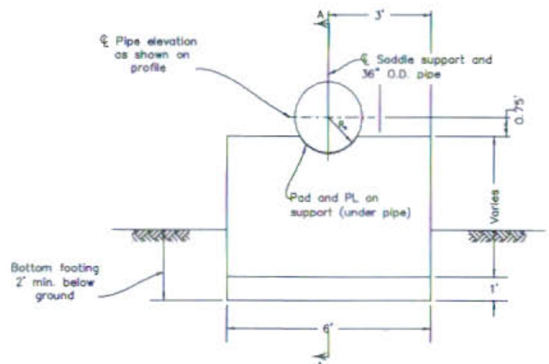
Navajo Nation
Dept. of Water Resources
Technical, Construction and Operations Branch

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

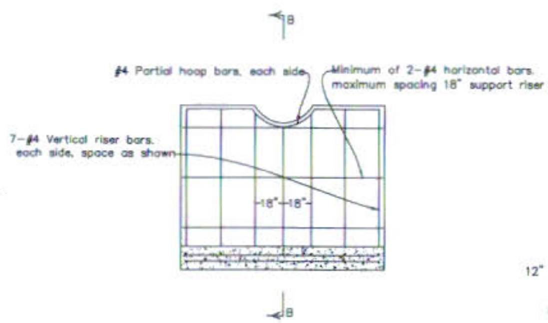
Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Air Valve & Blow off Details

CO12418
Date 11/24/17
Sheet 10 of
DRAWING NO. D111

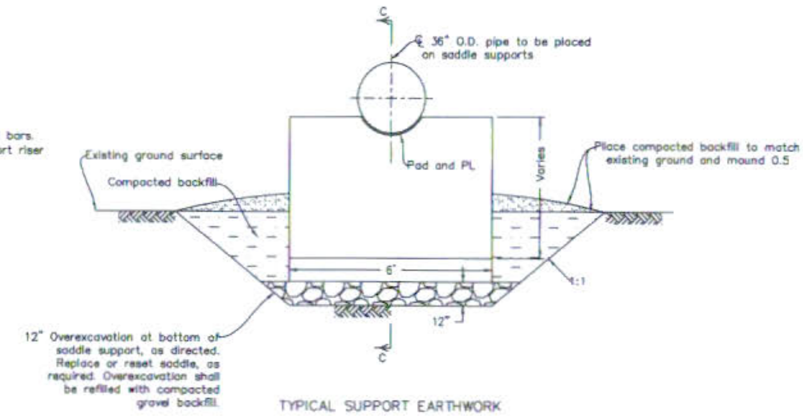
Saddle Supports



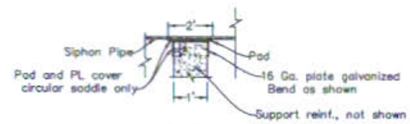
TYPICAL SIPHON SADDLE SUPPORT
(R_s denotes radius for forming concrete in saddle support)
R_s = 18" + pad thickness + plate thickness



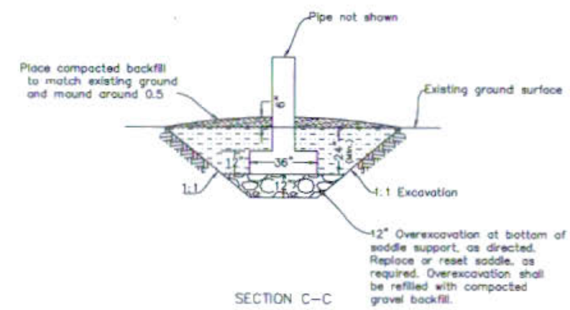
SADDLE SUPPORT REINFORCEMENT



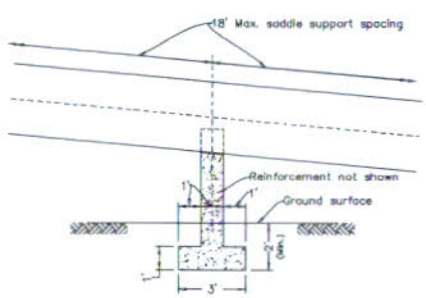
TYPICAL SUPPORT EARTHWORK



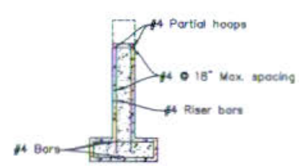
PAD DETAIL



SECTION C–C



SECTION A–A



SECTION B–B

Notes:
1. 4000 psi concrete
2. Reinforcement 60,000 psi yield strength
3. Gravel backfill pit run, reasonably well graded.
4. Field fit each saddle height to final pipe elevation.
5. Compacted gravel backfill shall be 3" minus crushed gravel.

#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	

Coordinate System: State Plane - New Mexico West
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File Name:

Navajo Nation Dept. of Water Resources Technical, Construction and Operations Branch

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Saddle Supports

CO12418
Date 11/24/1
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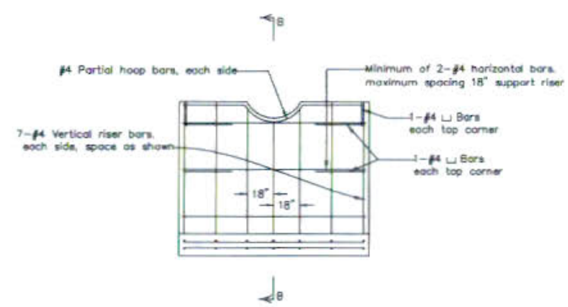
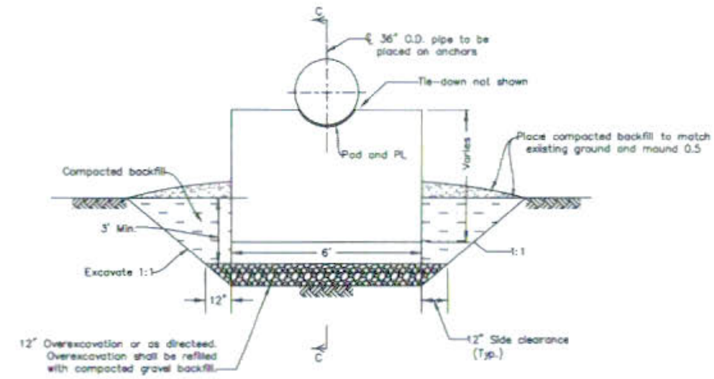
DRAWING NO
D112

Tie-Down Anchor Supports

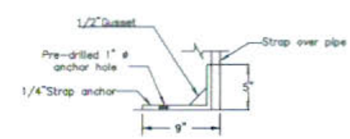


ANCHOR BLOCK REINFORCEMENT REINFORCEMENT

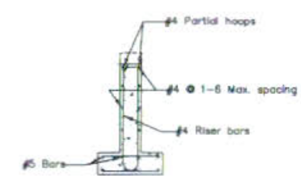


TYPICAL ANCHOR EARTHWORK

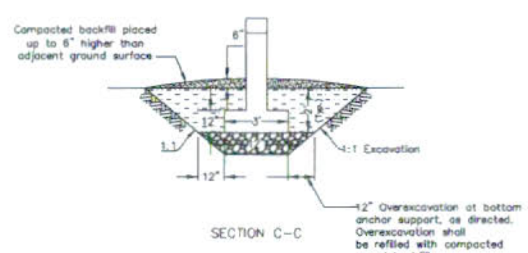
TYPE-2 ANCHOR STRAP DETAILS



DETAIL A
NOT TO SCALE



SECTION B-B
(TYPE 2 ANCHOR SHOWN, TYPE 1 REINFORCEMENT SIMILAR)



SECTION C-C

Notes
1. For type 2 anchor strap: Drill, embed, and grout the anchor bolts after installing strap on the pipe and anchor block.
2. Field weld gusset to steel strap.

SCALE OF FEET

#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	

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Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Tie-Down Anchor Supports

CO12418
Date 11/24/1
Sheet12 of
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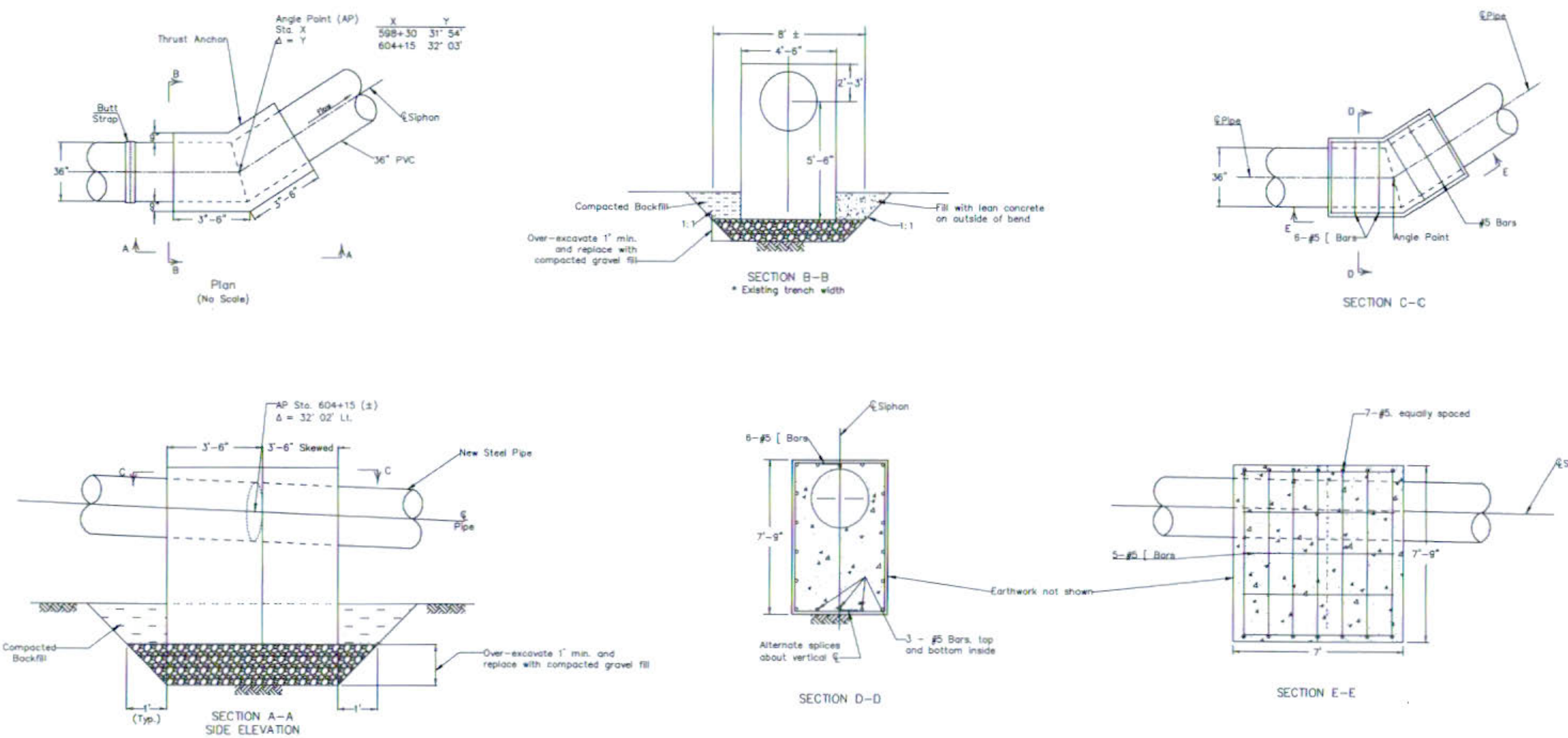
D113

Thrust Anchor



Notes:
1. Remove existing thrust anchor at station 604+16 and replace as shown.

This drawing & the ideas & designs incorporated herein are specific to this project & as an instrument of professional service are the property of KB-Walkoma, LLC. They may not be used, in whole or in part, for any purpose without the written authorization of KB-Walkoma, LLC & the project owner.

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707 N. Dustin Ave
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Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Thrust Anchor

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Date 11/24/1
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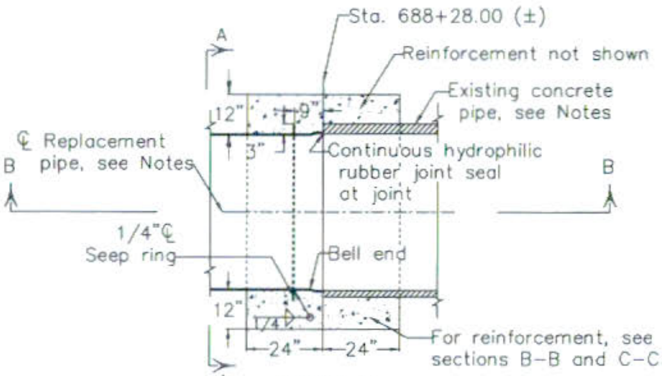
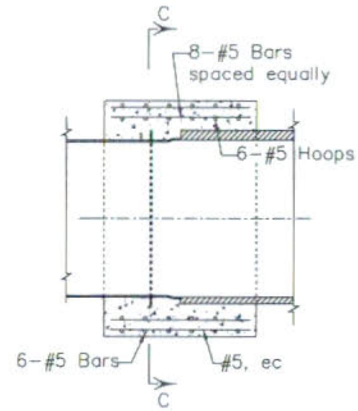
DRAWING NO.
D114

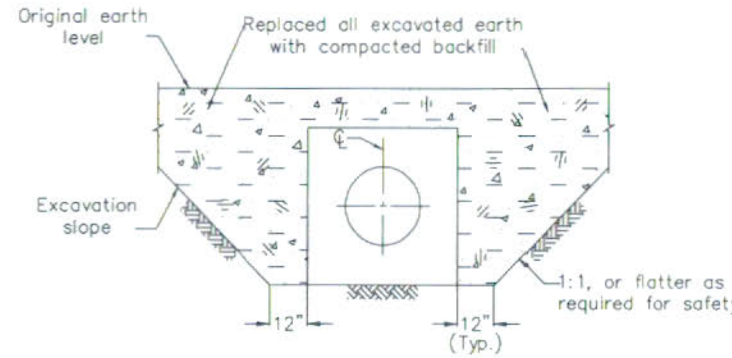
Phase 3 Outlet Details



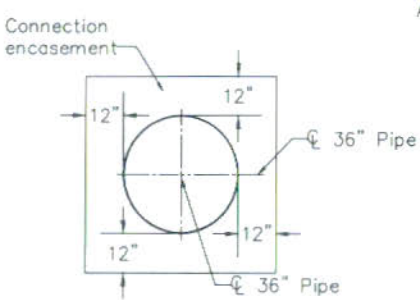
PROFILE
(At Vertical ℄)
(No Scale)



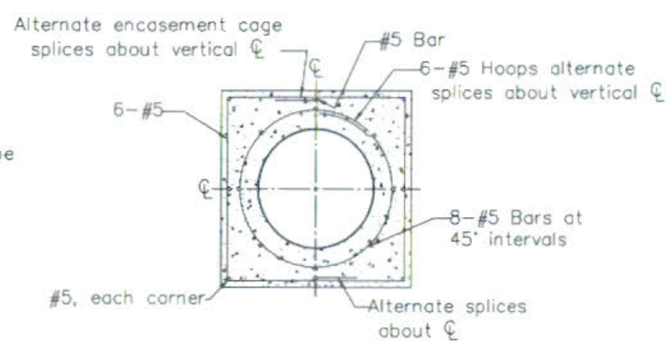
SECTION B-B



EARTHWORK DETAIL



SECTION A-A



SECTION C-C

Notes:
1. Carefully excavate about station 688+28 and expose existing concrete to steel pipe connection.
2. Remove existing pipe at steel to concrete pipe joint.
3. Butt replacement steel pipe to concrete pipe and encase as shown.
4. Place hydrophilic rubber seal at joint interface gap between steel and concrete.
5. Dimensions shown are in inches unless notified

#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	

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KB-Walkoma, LLC 707 N. Dustin Ave Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Phase 3 Outlet Details

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Date: 11/24/17
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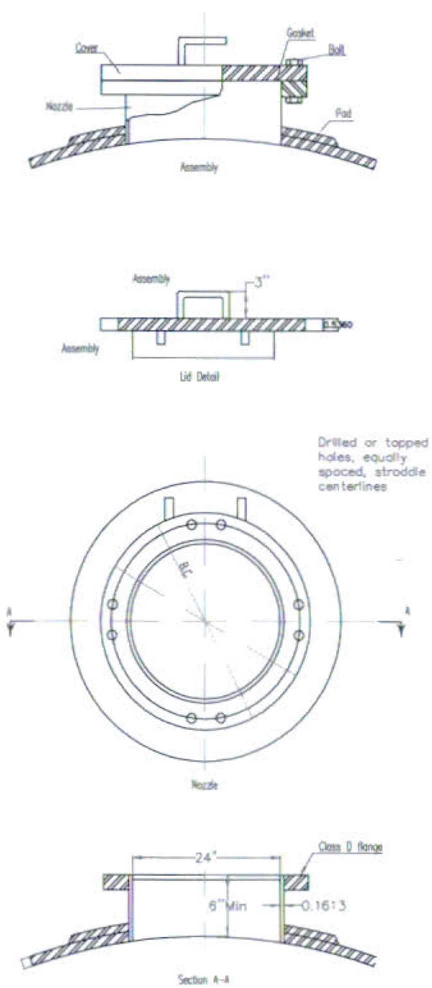
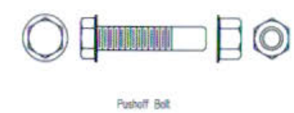
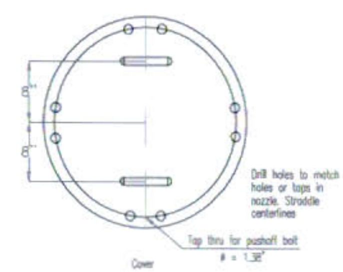
Manhole Details







1. Nozzle shall be shaped to fit the specified pipe or vessel diameter.
2. Bolt holes shall be drilled and tapped as required for bolts or studs furnished.
3. Class D flanges conform to AWWA Standard C207.
4. Gaskets shall be both inserted rubber. See specifications drawing for orientation of Hinges.
5. Pushoff Bolt to be 1-$\frac{1}{4}$".

#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	

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Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Manhole Details

CO12418
Date 11/24/17
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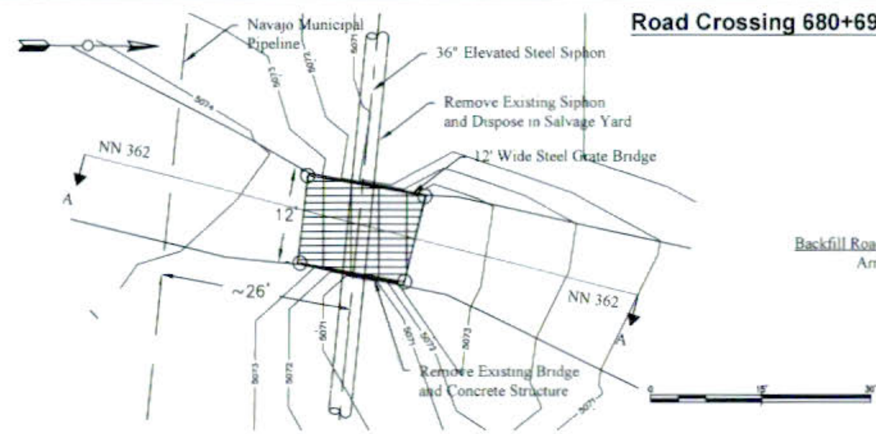
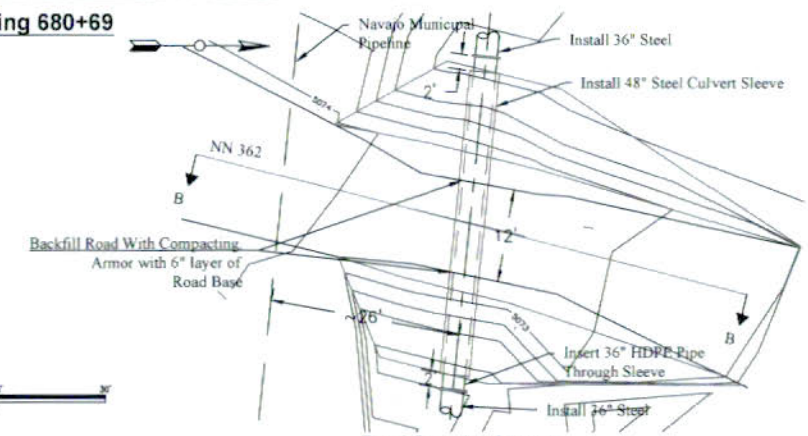
D116

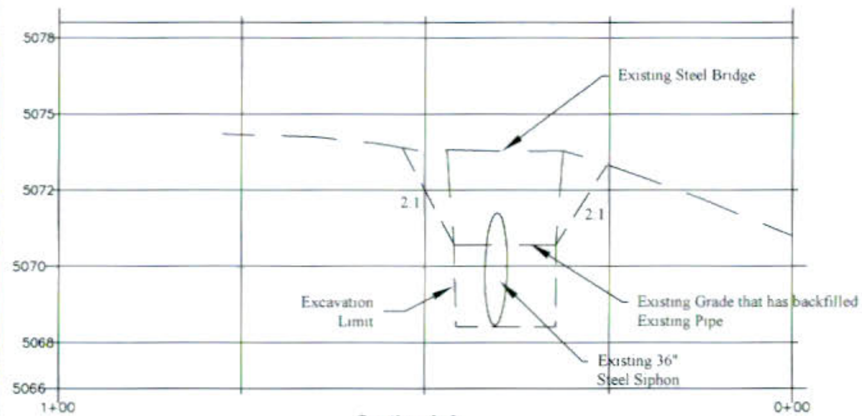
Road Crossing 680+69



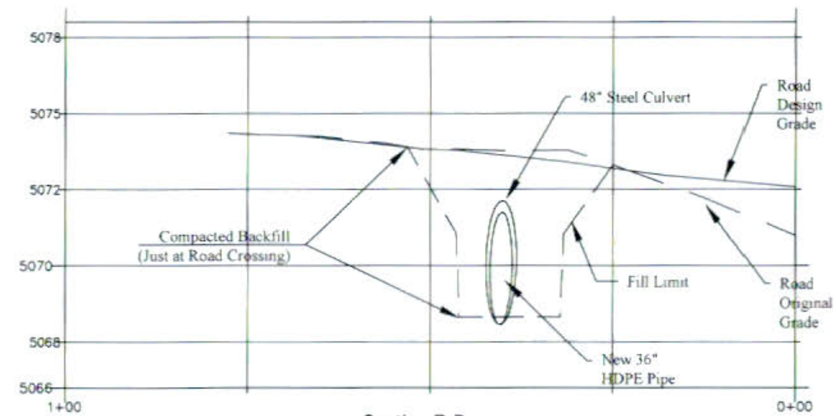
Existing Conditions and Demolition Requirements



Road Crossing Layout



Section A-A



Section B-B

Demolition Notes

1. Steel Bridge shall be disposed of at Shiprock Irrigation yard in Shiprock, NM.
2. Concrete shall be either disposed of at landfill or recycled.
3. Vegetation on centerline shall be removed and disposed of prior to new pipe installation.

Traffic Safety Plan

1. See YMS-L02t for sign details.
2. Limit road closure to 5 calendar days
3. Signs to comply with Manual on Uniform Traffic Control Devices.
4. Detour through traffic to south on NN365 (road against south bluff)

Installation Notes

1. HDPE pipe is DR26
2. 150# flanges to join steel pipe and HDPE
3. Culvert is 48"Ø 12 gage Gal (2 oz) 1" deep corrugated steel pipe. Use manufacturer bands to join pipe
4. Backfill 48" Culvert and compact in 6" lifts to AASHTO T 180
5. Armor road with 6" layer sub-base conforming with FP 14 Table 703-2, Grading Designation A.

#	Version/Revisions	Date	Design	Draw	Check	Approved
0		11/24/17	MI	HD	GJ	
1	Revised to comply with permit	3/5/2018	MI	MI	MI	

Coordinate System: State Plane New Mexico West
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File Name:

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Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Road Crossing 680+69

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Date: 11/24/17
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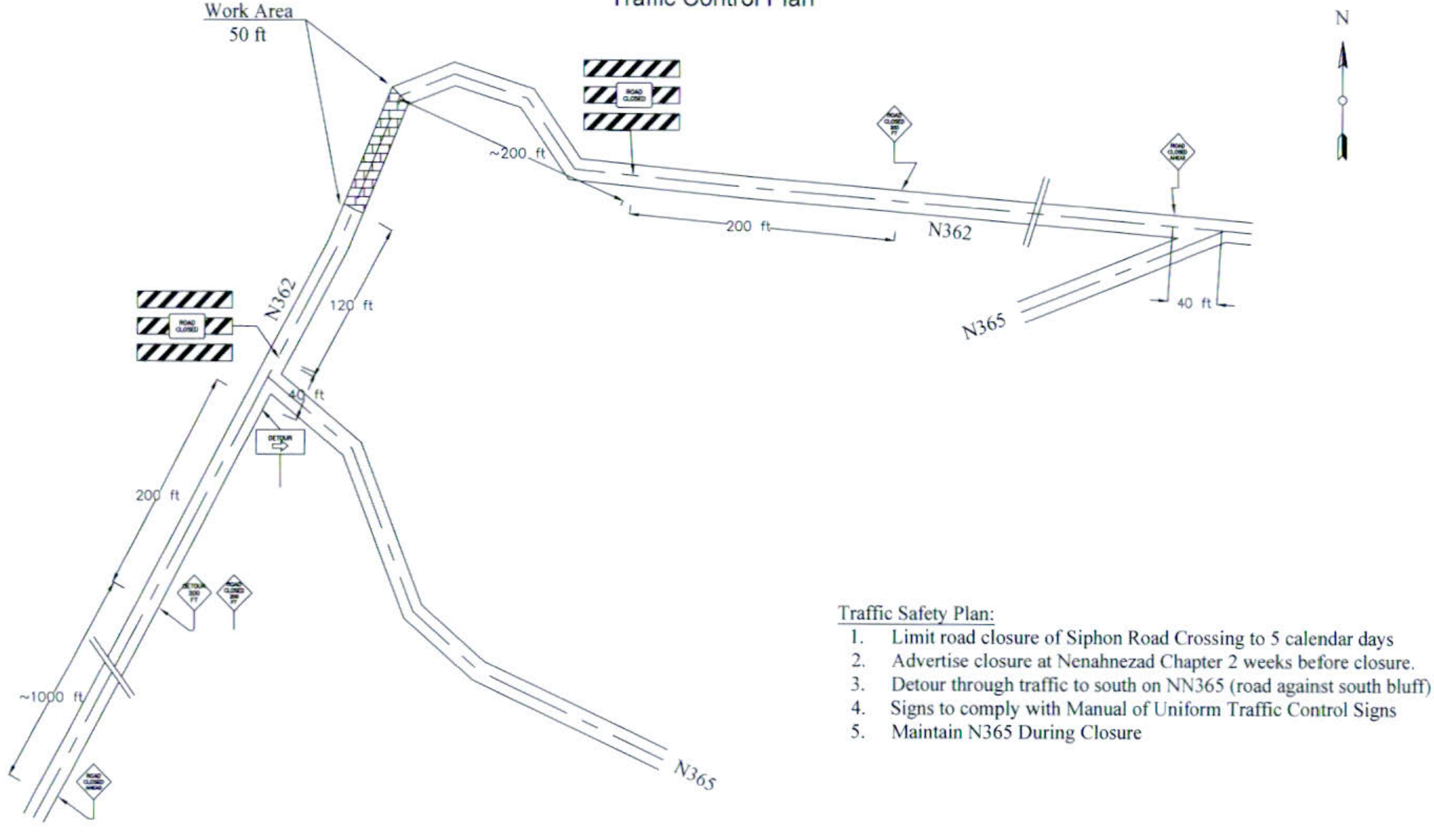
DRAWING NO.: YMS-D117
REV: 1

Traffic Control Plan



Traffic Safety Plan:

1. Limit road closure of Siphon Road Crossing to 5 calendar days
2. Advertise closure at Nenahnezad Chapter 2 weeks before closure.
3. Detour through traffic to south on NN365 (road against south bluff)
4. Signs to comply with Manual of Uniform Traffic Control Signs
5. Maintain N365 During Closure

#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	
1	Reformatted Traffic Plan	3/6/18	MI	HD	RVB	
2	Added Road Closed Ahead Signs	4/18/18	MI	MI	RVB	

Coordinate System: State Plane - New Mexico West
Datum: NAD 83/ GEOID12A
Survey Data Source: KB-Walkoma, LLC & JMAS
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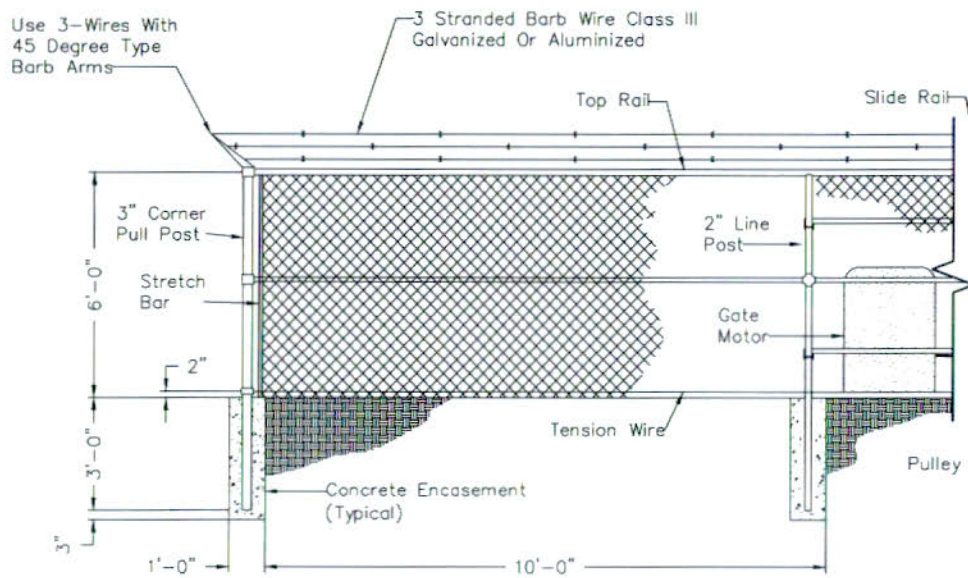
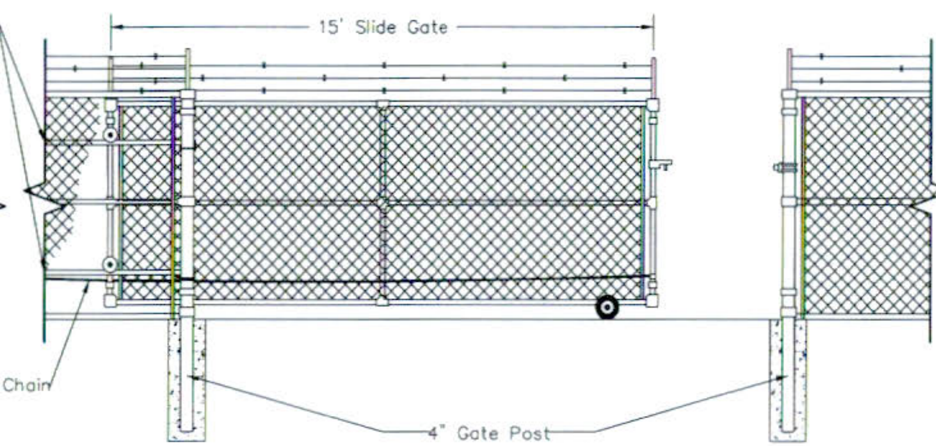
Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Traffic Control Plan

CO12418
Date: 11/24/17
Sheet 17 of
DRAWING NO: YMS-L02t
REV: 2

Chain Link Fence & Gate



FENCE DETAIL



FENCE DETAIL

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#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HO	GJ	
1	Widened the road to 12 ft (Guardrail-Guardrail)	4/18/2018	MI	MI	MI	

Coordinate System: State Plane - New Mexico West
Datum: NAD 83 GEOID12A
Survey Data Source: KB-Walkoma, LLC & JMAS
File Name:

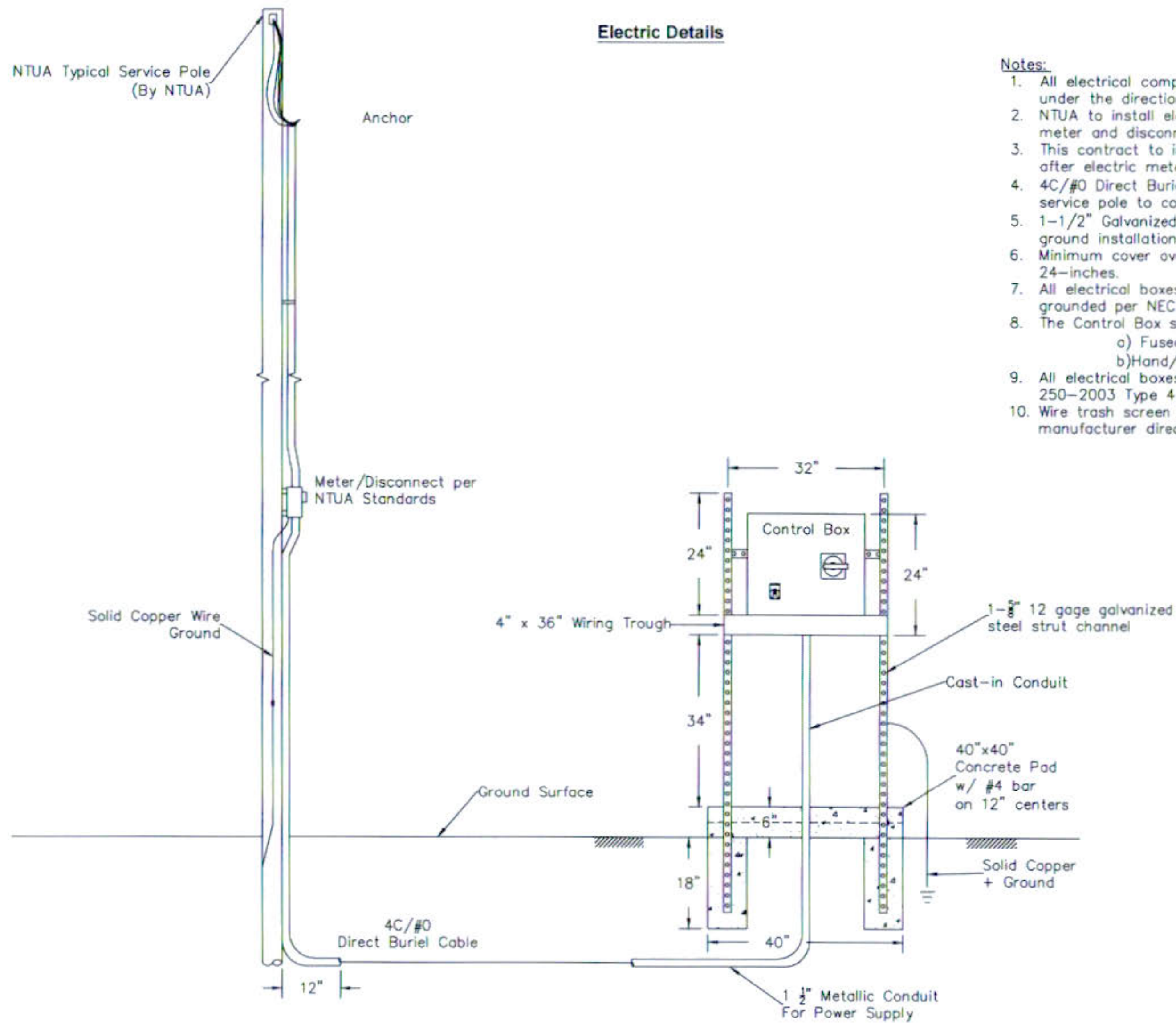
Navajo Nation
Dept. of Water Resources
Technical, Construction and Operations Branch

KB-Walkoma, LLC
707 N. Dustin Ave
Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Chain Link Fence & Gate

CO12418
Date: 11/24/17
Sheet 18 of
DRAWING NO.
D118

Electric Details



Notes:

1. All electrical components shall be installed under the direction of a licensed electrician.
2. NTUA to install electrical service to electric meter and disconnect.
3. This contract to install all electrical service after electric meter and disconnect.
4. 4C/#0 Direct Burial Cable installed from service pole to control box.
5. 1-1/2" Galvanized Steel Conduit for above ground installation.
6. Minimum cover over direct burial cable is 24-inches.
7. All electrical boxes shall be shall be grounded per NEC 250-84.
8. The Control Box shall include
   a) Fused Disconnect
   b)Hand/OFF/Auto Switch
9. All electrical boxes shall be NEMA 600V 250-2003 Type 4 Enclosures.
10. Wire trash screen and pump following manufacturer directions.

#	Version/Revisions	Date	Design	Draw	Check	Approved
		11/24/17	MI	HD	GJ	
1	Widened the road to 12 ft (Guardrail-Guardrail)	4/18/2018	MI	MI	MI	

Coordinate System: State Plane - New Mexico West
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Farmington, NM 87401

Navajo Nation Department of Water Resources
Fruitland-Cambridge Irrigation Project
Yellowman Siphon
Electric Details

CO12418
Date 11/24/1
Sheet 19 of
DRAWING NO
D119

EXHIBIT
D

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
Navajo Regional Office
P.O. Box 1060
Gallup, New Mexico 87301

IN REPLY REFER TO:
465: Branch of Environmental Quality Act Compliance and Review

FEB 01 2018

Ms. Kate Wright
NEPA Specialist
Ecosystem Management, Inc.
3737 Princeton Drive NE, Suite 150
Albuquerque, NM 87107

Dear Ms. Wright:

The Environmental Assessment (EA), **EA-17-18537**, received June 19, 2017, for the Proposed San Juan River Navajo Irrigation Project, was reviewed in the Branch of Environmental Quality Act Compliance and Review, Navajo Regional Office.

The Navajo Nation Department of Water Resources (NNDWR) proposed to rehabilitate and improve two existing irrigation systems; the Fruitland-Cambridge Unit (22 miles long with 120 miles of laterals) and the Hogback-Cudei Unit (26 miles long with 135 miles of laterals). In addition to the proposed irrigation system rehabilitation and improvement, restoration of a secondary channel of the San Juan River is proposed. The proposed project has been named the San Juan Navajo Irrigation project. The rehabilitation and improvements to the SJRNIP are funded through a federal $23.7 million Bureau of Indian Affairs (BIA) 638 contract. The restoration of the secondary channel is funded through a federal grant program administered by the Bureau of Reclamation called the Colorado River Salinity Program. The SJRNIP is located within the Navajo Nation on Tribal Trust lands, near the cities of Farmington and Shiprock, in San Juan County, New Mexico.

In accordance with Section 102 (2) (c) of the National Environmental Policy Act (NEPA) of 1969, as amended, and the Council of Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations (CFR) Parts 1500-1508), the Bureau of Indian Affairs, Navajo Regional Office, finds that the Proposed Action is not a major federal action that will significantly impact the quality of the human environment. Therefore, an Environmental Impact Statement is not required for implementing the Proposed Action. This Finding of No Significant Impact (FONSI) is supported by the Environmental Assessment (EA) and the supporting appendices and documents.

If you have questions, you may contact Ms. Harrilene Yazzie, Supervisory Environmental Protection Specialist at (505) 863-8287.

Sincerely,

Regional Director, Navajo

Enclosure:
Final_Biological Opinion for the San Juan River Navajo Irrigation Rehabilitation and Improvement Project – Fruitland-Cambridge and Hogback-Cuedi Irrigation Units – and Colorado River Salnity Program Habitat Replacement Consultation No. 02ENNM00-2016-F-0131

FINDING OF NO SIGNIFICANT IMPACT
ENVIRONMENTAL ASSESSMENT EA-17-18537
PROPOSED SAN JUAN RIVER NAVAJO IRRIGATION PROJECT

NAVAJO NATION DEPARTMENT OF WATER RESOURCES

Location: Chimney Rock, Waterflow, Fruitland, Kirtland, Hogback North, Sallies Spring, Canal Creek, Skinney Rock, Rattesnake, Shiprock, NM Quadrangle USGS 7.5 Minute Series Map

Section 18, T29N, R13W
Sections 13, 14, 15, 19, 20, 21, and 22, T29N, R14W, NMPM
Sections 7, 8, 9, 14, 15, 16, 23 and 24, T29N, R15W, NMPM
Sections 1, 2, 5, 6-9, 10, 11, 12 and 17, T29N, R16W, NMPM
Sections 1, 2, 3, and 12, T29N, R17W, NMPM
Section 31, T30N, R16W, NMPM
Sections 27-32, 34, 35, and 36, T30N, 17W, NMPM
Sections 2, 3, 4, 5, 9-16, 21-28, 24-36, T30N, R18W, NMPM
Sections 18-21, 28-34, T31N, R18W, NMPM
Sections 4, 8, 9, 10, 11, 13-15, 17-19, 21-23, 25, and 36, T31N, R19W, NMPM
Sections 12, 13, and 14, T31N, R20W, NMPM

San Juan County, New Mexico

The Navajo Nation Department of Water Resources (NNDWR) proposed to rehabilitate and improve two existing irrigation systems; the Fruitland-Cambridge Unit (22 miles long with 120 miles of laterals) and the Hogback-Cudei Unit (26 miles long with 135 miles of laterals). In addition to the proposed irrigation system rehabilitation and improvement, restoration of a secondary channel of the San Juan River is proposed. The proposed project has been named the San Juan Navajo Irrigation project. The rehabilitation and improvements to the SJRNIP are funded through a federal $23.7 million Bureau of Indian Affairs (BIA) 638 contract. The restoration of the secondary channel is funded through a federal grant program administered by the Bureau of Reclamation called the Colorado River Salinity Program. The SJRNIP is located within the Navajo Nation on Tribal Trust lands, near the cities of Farmington and Shiprock, in San Juan County, New Mexico.

The BIA's deliberation as to whether a Finding of No Significant Impact (FONSI) is appropriate, or, whether an Environmental Impact Statement (EIS) should be prepared, took into consideration, the following issues, which are addressed in the environmental assessment (EA).

1. **Beneficial and adverse environmental impacts:** The EA demonstrates that there will be no significant adverse or beneficial impacts on the quality of the human environment, including: land resources, water resources, air quality, living resources, cultural resources, socioeconomics, environmental justice, resource use patterns, and other values.

2. **Public health and safety:** Primary activities that could pose a risk to public health and safety

from implementing the proposed action are related to construction traffic and the operation of heavy equipment near public roadways. Direct and indirect effects to public health and safety would be minor and short term with adherence to Occupation Safety and Health Administration regulations and implementing best management practices (EA Section 4.8.3 Public Health and Safety – Proposed Action).

3. **Clean Water Act (CWA) Compliance: When a project spans, crosses or results in work in a river bed, stream bed or wetland, permits from the U.S. Army Corps of Engineers (ACOE) and/or the Navajo Nation Environmental Protection Agency, Water Quality Program may be required, including: Section 401, Water Quality Certification; Section 402(p), Storm Water Pollution Prevention Plan, if the project activity will disturb surfaces of ½ acre or more; and Section 404, Permit for Discharge of Dredge or Fill Material into Waters of the US. The applicant shall submit and obtain approval for all required applications prior to construction. The applicant shall adhere to all mitigation measures and strategies developed with the U.S. Army Corps of Engineers and the Navajo Nation Environmental Protection Agency:** Based on the EA, this project will cross or span any waters of the U.S. A Clean Water Act Section 402 National Pollutant Discharge Elimination System General Construction Permit Storm Water Pollution Prevention Plan would be acquired to assure that impacts to water quality during construction are minimized. A hazardous spill plan would be prepared and implemented (EA Section 4.2 Water Resources – Proposed Action).

4. **Unique characteristics of the geographic area:** The project area is not unique within its geographical setting and is similar to other areas in the region. There are no prime farmlands, wild and scenic rivers, wilderness areas, refuges, park lands, unique ecological areas, or other unique or rare characteristics of the land and aquatic environs that will be significantly affected.

5. **Degree to which the effects on the quality of the human environment are likely to be highly controversial:** There are no known scientific controversies over the effects of the proposed project on the human environment.

6. **Degree to which the effects are highly uncertain or involve unique or unknown risks:** There are no known effects on the human environment that are highly uncertain or involve unique or unknown risks.

7. **Degree to which this action will establish a precedent for future actions with significant effects:** This project will not set a precedent for similar projects that may be implemented by the BIA or other agencies.

8. **Relationship to other actions with cumulatively significant impacts:** There are no known incremental effects of the action that become significant when added to other past, present, or reasonably foreseeable future actions that have affected, or will affect, the project area.

9. **Degree to which the action may affect districts, sites, objects, or structures listed on, or eligible for, the National Register of Historic Places, or may cause loss of significant**

cultural resources: The Navajo Nation Historic Preservation Department (NNHPD) issued two Cultural Resources Compliance Forms (CRCFs) for the proposed action. Please see tables below.

CRCF NNHPD No.	Date Issue.d	Conditions?
HPD-16-485	November 22, 2016	Yes

Effect/Conditions of Compliance: No historic properties affected with the following conditions:

Sites NM-H-21-237, NM-H-2-15, NM-H-14-72, NM-H-21-236:

1. Site boundaries will be flagged by a qualified archaeologist prior to ground disturbing activities.
2. Sites will be avoided by a minimum of 50-feet from the site boundaries.

Sites NM-H-14-70, NM-H-14-71

1. Site boundaries will be flagged by a qualified archaeologist prior to ground disturbing activities.
2. Sites will be avoided by a minimum of 50-feet from the site boundaries.
3. Sites were unevaluated, however, if sites cannot be avoided, a testing program will be implemented with consultation with NNHPD.

Jischaa:
Will be avoided by all ground disturbing activities by a minimum of 100-feet.

CRCF NNHPD No.	Date Issued	Conditions?
HPD-16-981	April 19, 2017	No

In the event of a discovery of a previously unidentified or incorrectly identified cultural resource(s), all operations in the immediate vicinity of the discovery must cease, and the NNHPD must be notified.

10. **Degree to which the action may affect threatened, endangered, or sensitive species or their habitat:** Three Biological Resources Compliance Forms (BRCFs) were issued by the Navajo Nation Department of Fish and Wildlife (NNDFW). Please see the tables below:

NNDFW Review No.	Date Issued	Conditions?	Avoidance/Mitigation Measures?
15em105fc	October 5, 2016	No	Yes

Avoidance/Mitigation Measures: Mitigation measures outlined in Section 9.0 will be implemented to avoid impacts on species and habitat.

NNDFW Review No.	Date Issued	Conditions?	Avoidance/Mitigation Measures?
15em105hc	October 5, 2016	Yes	Yes

Avoidance/Mitigation Measures: Mitigation measures outlined in Section 9.0 will be implemented to avoid impacts on species and habitat.

Conditions of Compliance: A biological monitor shall be onsite during construction where Mesa Verde Cactus and habitat was identified in the project area (see Table 5 in Biological Assessment submitted). The biological monitor shall ensure that the construction crew avoids damage to cacti and undisturbed cactus habitat.

NNDFW Review No.	Date Issued	Conditions?	Avoidance/Mitigation Measures?
16doe1107	March 24, 2017	Yes	Yes

Avoidance/Mitigation Measures: The NNDFW concurs with the mitigation recommendations outlined in Section 8. The breeding season for the Burrowing Owl is 01 MAR – 15 AUG.

Conditions of Compliance: SJRDWU will ensure that project construction and vegetation removal will be scheduled outside the Migratory Bird breeding season of 01 MAR – AUG. If the breeding season cannot be avoided, surveys will precede construction activity. The NNDFW recommends a survey buffer of 165 feet for non-endangered migratory birds. Removal or disturbance of nesting habitat (i.e. trees and shrubs) shall not be allowed within 50 meters of an active nest during incubation to fledging.

Formal Section 7 Consultation with United States Fish and Wildlife Services: Final_Biological Opinion for the San Juan River Navajo Irrigation Rehabilitation and Improvement Project – Fruitland-Cambridge and Hogback-Cuedi Irrigation Units – and Colorado River Salnity Program Habitat Replacement Consultation No. 02ENNM00-2016-F-0131 (attached).

Section 7 Consultation was initiated with the United States Fish and Wildlife Services (The Service) on the San Juan River Navajo Irrigation Project. A Biological Opinion (BO) was issued on January 2, 2018 from USFWS. In the Biological Assessment that was submitted to the Service, BIA determined the Proposed Action may affect and is likely to adversely affect the endangered Colorado Pikeminnow (Ptychocheilus Lucius) and Razorback Sucker (Xyrauchen texanus) and designated critical habitat for both species. BIA also determined the Proposed Action is not likely to adversely affect proposed critical habitat for the yellow-billed cuckoo (Coccyzus americanus) (cuckoo) and threatened Mesa Verde cactus (Sclerocactus mesae-verdae). The service agreed with the may affect, not likely to adversely affect determination for proposed cuckoo critical habitat based on the fact that the Primary Constituent Elements (Service 2014) are not present within the action area. Specifically, riparian woodlands greater than 100 meters (325 feet) in width and 81 hectacres (200 acres) in extent have one or more groves with above average canopy closure (greater than 70 percent) with a cooler and more humid environment that the surrounding riparian and upland habitats are not present within the action area. Instead, habitat within the action area consists of sparse invasive species that lacks the height to accommodate cuckoo nesting activity.

The Service agrees with the determination that the proposed action may affect but is not likely to adversely affect the Mesa Verde Cactus (provided in the BA) based on the conservation measures stated below:

1) Where the canal construction areas cross the "Biological Preserve", any Mesa Verde cactus individuals detected during construction activities would be marked with a Global Positioning System (GPS), flagged and avoided. A monitor would be assigned and these areas would be avoided and/or fenced off with a minimum buffer of 60.9 meters (m) (200 feet [ft] from construction activities to avoid direct impacts.
2) Where the canal construction areas cross the "Biological Preserve" any staging or equipment areas must be located within the existing Right of Way (ROW) and not within the "Biological Preserve". However, in the rare vase where construction may impeded on the 200 foot buffer for the Mesa Verde cactus, the buffer may be reduced to 100 feet to accommodate construction activities (100 feet on each side of the cactus).

Ultimately, the Service found that the proposed action will not jeopardize the continued existence of the Colorado Pikeminnow and Razorback Sucker. In addition, the proposed action is not likely to adversely modify or destroy critical habitat for both species.

Working with BIA, Reclamation and others, the Service developed conservation measures within the proposed action, Reasonable and Prudent Measures (RPM) and Terms and Conditions that can be implemented in a manner consistent with the intended purpose of the proposed action, and that can be implemented consistent with the scope of the Federal agencies' legal authorities and jurisdiction. The RPMs are economically and technologically feasible and the Service believes implementing them would minimize the effect of incidental take of Colorado Pikeminnow and Razorback Sucker as a result of the Proposed Action. This project will adhere to all of the Reasonable and Prudent Measures and Terms and Conditions that are outlined in the BO. Please see the attached Biological Opinion titled: Final_Biological Opinion for the San Juan River Navajo Irrigation Rehabilitation and Improvement Project – Fruitland-Cambridge and Hogback-Cuedi Irrigation Units – and Colorado River Salnity Program Habitat Replacement Consultation No. 02ENNM00-2016-F-0131 for all Reasonable and Prudent Measures and Terms and Conditions.

As required by 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may impact listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; 4) a new species is listed or critical habitat designated that may be affected by the action; or 5) if the SJRRIP ceases to exist or if funding levels are reduced so that critical deadlines for specified recovery actions are not met.

11. **Whether the action violates Federal or local laws or requirements imposed for the protection of the environment:** The proposed project will not violate any Federal or Tribal environmental laws or requirements.

12. **Indian Trust Assets:** The proposed project area does not contain any Indian Trust Assets in the form of perennial water resources, fisheries, saleable timber, paleontology resources or agricultural resources. The proposed project area is not part of any right-of-way avoidance and exclusion areas, wilderness area, special management area, area of critical environmental concern, or other protected area.

13. **Climate Change, its effects on the proposed action and its environmental impacts:** No impacts to climate change would be expected from the implementation of the proposed action. A relatively small amount of greenhouse gases (GHG) would be produced when considered on a global scale. The anticipated increase in GHG emissions would not produce climate change impacts that differ from the no action. This is because climate change is a global process that is impacted by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to the global GHGs from the proposed alternatives cannot be translated into effects on climate change globally or locally. It is currently not feasible to predict with certainty the net impacts from the proposed alternatives on global or regional climate (EA Section 4.8.4 Climate Change – Proposed Action).

CONCLUSION

The proposed action is the Preferred Alternative. It does not constitute a major federal action, which normally requires preparation of an environmental impact statement (EIS).
Based on the foregoing, it has been determined that an EIS is not required for this project and thus will not be prepared.

Regional NEPA Coordinator

1/31/18
Date

COPY 2/8/18

THE NAVAJO NATION
HERITAGE & HISTORIC PRESERVATION DEPARTMENT
PO Box 4950, Window Rock, Arizona 86515
TEL: (928) 871-7198 FAX: (928) 871-7886

CULTURAL RESOURCES COMPLIANCE FORM

ROUTE COPIES TO:	NNHPD NO.: HPD-16-485 - *REVISED*
☑ LSD	OTHER PROJECT NO.: LSD 155312

PROJECT TITLE: A Cultural Resource Survey of 129 mi of the Fruitland-Cambridge and Hogback-Cudei Irrigation Projects on Navajo Nation Land Near Farmington, New Mexico

LEAD AGENCY: BIA/NR

SPONSOR: Mike Isaacson, Keller-Bliesner Engineering LLC. 78 East Center, Logan, Utah 84321

PROJECT DESCRIPTION: The proposed undertaking will involve rehabilitation projects along 47 miles of Fruitland-Cambridge and 112.3 miles of Hogback-Cudei Irrigation Projects. The work will involve rehabilitating irrigation main canals, lateral ditches, drains and siphons. The area of effect is 771.49-acres. 68.59- acres was not surveyed because of overgrown marshland, submerged in water, and/or deep arroyos. Ground disturbing activities will be intensive and extensive with the use of heavy equipment.

LAND STATUS:	Navajo Tribal Trust
CHAPTERS:	Beclabito, Gadii'ahi, Shiprock, Tse Daa K'aan, Nenahnezad, San Juan
LOCATION:	Sallies Spring, Canal Creek, Rattlesnake, Skinney Rock, Shiprock, Chimney Rock, Sulphur Spring, The Hogback North, Fruitland, Kirtland Waterflow Quadrangles, San Juan County, New Mexico NMPM

Fruitland – Cambridge Unit								
T.	29	*N.,*	*R.*	17	*W-*	*Sec.*	2, 3, 12
T.	29	*N.,*	*R.*	16	*W-*	*Sec.*	1, 2, 7, 8, 9, 10, 11, 12, 17
T.	29	*N.,*	*R.*	15	*W-*	*Sec.*	7, 8, 9, 14, 15, 16, 23, 24
T.	29	*N.,*	*R.*	14	*W-*	*Sec.*	13, 14, 15, 19, 20, 21, 22
T.	29	*N.,*	*R.*	13	*W-*	*Sec.*	18
Hogback - Cudei Unit							
T.	31	*N.,*	*R.*	20	*W-*	*Sec.*	12, 13, 14
T.	31	*N.,*	*R.*	19	*W-*	*Sec.*	4, 8, 9, 10, 11, 13, 14, 15, 17, 18, 19, 21, 22, 23, 25, 36
T.	31	*N.,*	*R.*	18	*W-*	*Sec.*	18, 19, 20, 21, 28, 29, 30, 31, 32, 33, 34
T.	30	*N.,*	*R.*	18	*W-*	*Sec.*	2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 34, 35, 36
T.	30	*N.,*	*R.*	17	*W-*	*Sec.*	27, 28, 29, 30, 31, 32, 34, 35, 36
T.	29	*N.,*	*R.*	17	*W-*	*Sec.*	1, 2
T.	30	*N.,*	*R.*	16	*W-*	*Sec.*	31
T.	29	*N.,*	*R.*	16	*W-*	*Sec.*	5, 6, 7, 8, 9

PROJECT ARCHAEOLOGIST:	Travis Cureton & Theodore P. Tsouras
NAVAJO ANTIQUITIES PERMIT NO.:	B16078
DATE INSPECTED:	02/10/16 – 03/02/16
DATE OF REPORT:	8/18/16
TOTAL ACREAGE INSPECTED:	702.9-ac
METHOD OF INVESTIGATION:	Class III pedestrian inventory with transects spaced 15 m apart.
LIST OF CULTURAL RESOURCES FOUND within APE:	**R(6) Sites (NM-H-14-70, NM-H-21-237, NM-H-2-15, NM-H-14-71, NM-H-14-72, NM-H-21-236)** **(9) Isolated Occurrences (IO)** **(260) In-Use Sites (IUS)** **(1) Jischaa**
LIST OF ELIGIBLE PROPERTIES:	**(4) Sites (NM-H-21-237, NM-H-2-15, NM-H-14-72, NM-H-21-236)**

LIST OF PROPERTIES UNEVALUATED/UNDETERMINED:	**(2) Sites (NM-H-14-70, NM-H-14-71)**
LIST OF NON-ELIGIBLE PROPERTIES:	**(9) IO** **(260) IUS** **(1) Jischaa**
LIST OF ARCHAEOLOGICAL RESOURCES:	**(6) Sites (NM-H-14-70, NM-H-21-237, NM-H-2-15, NM-H-14-71, NM-H-14-72, NM-H-21-236)**

EFFECT/CONDITIONS OF COMPLIANCE: No historic properties affected with the following conditions:

Sites NM-H-21-237, NM-H-2-15, NM-H-14-72, NM-H-21-236:
1. Site boundaries will be flagged by a qualified archaeologist prior to ground disturbing activities.
2. Sites will be avoided by a minimum of 50-ft from the site boundaries.

Sites NM-H-14-70, NM-H-14-71:
1. Site boundaries will be flagged by a qualified archaeologist prior to ground disturbing activities.
2. Sites will be avoided by a minimum of 50-ft from the site boundaries.
3. Sites were unevaluated, however, if sites cannot be avoided a testing program will be implemented with consultation with NNHPD.

Jischaa:
Will be avoided by all ground disturbing activities by a minimum of 100-ft.

No effect to known TCPs.

In the event of a discovery [*"discovery"* means any previously unidentified or incorrectly identified cultural resources including but not limited to archaeological deposits, human remains, or locations reportedly associated with Native American religious/traditional beliefs or practices], all operations in the immediate vicinity of the discovery must cease, and the Navajo Nation Historic Preservation Department must be notified at (928) 871-7198.

FORM PREPARED BY: **Tamara Billie**
FINALIZED: November 15, 2016

Notification to Proceed Recommended — ☑ Yes ☐ No
Conditions: — ☑ Yes ☐ No

Tamara Billie 11/15/16
The Navajo Nation Historic Preservation Office — Date

Navajo Region Approval — ✓ Yes ☐ No

11/22/16
BIA – Navajo Regional Office — Date

Navajo Nation Environmental Protection Agency
P. O. Box 339, Window Rock, AZ 86515
Phone: 928-871-7690 • Fax: 928-871-7996

Russell Begaye,
President

Jonathan Nez,
Vice-President

July 27, 2015

Michael Isaacson, P.E.
Keller-Bliesner Engineering, LLC
78 East Center
Logan, UT 84321

Re: Three Existing Steel Irrigation Siphons that Require Replacement, Bitsui Siphon, Yellowman Siphon and Salt Creek Siphon, New Mexico

Dear Mr. Isaacson,

Navajo Nation Environmental Protection Agency (NNEPA) Water Quality has reviewed your document requesting consultation for Clean Water Act (CWA) § 401 for the above mentioned siphons. According to the Topo Maps and photographs submitted of the project area it has been determined, that a CWA § 401 Certification application **will not be** required for Bitsui Siphon and the Yellowman Siphon based on the information submitted to our Water Quality Office.

I will need coordinates for the Salt Creek Siphon or a more distinct topo map submitted to our office, due to the broad topo that was submitted for that particular area, a determination was not made just yet for that particular siphon. Please submit to our office and another determination will be made for this specific area. Thank you.

Please be aware of the Storm Water Construction General Permit required for construction activities that result in land disturbance of equal to or greater than once acre. In addition, all Navajo Nation environmental Laws and regulations should be adhere to.

Thank you for contacting our office with your project. Should you have any questions please contact me at (928) 871-7700.

Sincerely,

LeeAnna M. Silversmith

Lee Anna Martinez- Silversmith
401 Coordinator/Sr. Environmental Specialist
Water Quality Program
Navajo Nation Environmental Protection Agency

Cc: Chris Wrbas, USACOE
File

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113
Telephone 505-346-2525 Fax 505-346-2542
www.fws.gov/southwest/es/newmexico/

January 2, 2018

Consultation No. 02ENNM00-2016-F-0131

To: Regional Director, Bureau of Indian Affairs, Navajo, Gallup, New Mexico and Area Manager, Bureau of Reclamation, Western Colorado Office, Grand Junction, Colorado

From: Supervisor, Fish and Wildlife Service, New Mexico Ecological Services, Albuquerque, New Mexico Susan S Millsap

Subject: Final Biological Opinion for San Juan River Navajo Irrigation Rehabilitation and Improvement Project –Fruitland-Cambridge and Hogback-Cudei Irrigation Units – and Colorado River Salinity Program Habitat Replacement

This transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) regarding effects of actions associated with the U. S. Bureau of Indian Affairs (BIA) and U.S. Bureau of Reclamation's (Reclamation) proposal for rehabilitation and improvements of two Navajo Nation irrigation units (Proposed Action), on federally listed species and their critical habitat in accordance with section 7(b) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) and implementing regulations (50 CFR 402). In general, the Proposed Action includes conversion of earthen ditches to pressurized pipelines as well as providing mitigation habitat to offset losses anticipated as a result of salinity control measures. BIA determined the Proposed Action may affect and is likely to adversely affect the endangered Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen texanus*) and designated critical habitat for both species.

BIA determined the Proposed Action is not likely to adversely affect proposed critical habitat for the yellow-billed cuckoo (*Coccyzus americanus*) (cuckoo), and threatened Mesa Verde cactus (*Sclerocactus mesae-verdae*). The Service based our concurrence on the rationales provided in the BA and on subsequent Service review and analysis. We concur with the may affect, not likely to adversely affect determination for proposed cuckoo critical habitat based on the fact that the Primary Constituent Elements (Service 2014) are not present within the action area. Specifically, riparian woodlands greater than 100 meters (325 feet) in width and 81 hectares (200 acres) in extent that have one or more groves with above average canopy closure (greater than 70 percent) with a cooler and more humid environment than the surrounding riparian and upland habitats are not present within the action area. Instead, habitat within the action area consists of sparse invasive species that lacks the height to accommodate cuckoo nesting activity.

We concur with the determination that the proposed action may affect but is not likely to adversely affect the Mesa Verde Cactus (provided in the BA) (NNDWR 2017a) based on conservation measures stated below:

1) Where the canal construction areas cross the "Biological Preserve", any Mesa Verde cactus individuals detected during construction activities would be marked with a Global Positioning System (GPS), flagged and avoided. A monitor would be assigned and these areas would be avoided and/or fenced off with a minimum buffer of 60.9 meters (m) (200 feet [ft]) from construction activities to avoid direct impacts.

2) Where the canal construction areas cross the "Biological Preserve" any staging or equipment areas must be located within the existing Right of Way (ROW) and not within the "Biological Preserve". However, in the rare case where construction may impede on the 200 foot buffer for the Mesa Verde cactus, the buffer may be reduced to 100 feet to accommodate construction activities (100' on each side of the cactus).

Attached is the BO associated with impacts from the Proposed Action on Colorado Pikeminnow and Razorback Sucker and designated critical habitat for both species. This biological opinion relies on the revised regulatory definition of "destruction or adverse modification" of designated or proposed critical habitat from 50 Code of Federal Regulations (CFR) 402.02. As of February 11, 2016, the definition of "destruction or adverse modification" has been revised to align it with the conservation purposes of the Endangered Species Act of 1976, as amended (Act), and the Act's definition of "critical habitat" (81 FR 7214). Specifically, the rule states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." The revised definition continues to focus on the role that critical habitat plays for the conservation of listed species and acknowledges that the development of physical and biological features may be necessary to enable the critical habitat to support the species recovery.

Ultimately, we found that the proposed action will not jeopardize the continued existence of the Colorado Pikeminnow and Razorback Sucker. In addition, the proposed action is not likely to adversely modify or destroy critical habitat for both species. Working with BIA, Reclamation and others, we developed conservation measures within the proposed action, Reasonable and Prudent Measures (RPM), and Terms and Conditions that can be implemented in a manner consistent with the intended purpose of the proposed action, and that can be implemented consistent with the scope of the Federal agencies' legal authorities and jurisdiction. The RPMs are economically and technologically feasible and we believe implementing them would minimize the effect of incidental take of Colorado Pikeminnow and Razorback Sucker as a result of the Proposed Action.
In accordance with section 7 of the ESA and its implementing regulations, this BO represents the best scientific and commercial information available on the effects of the proposed action to

federally listed species, including depletion, entrainment, fish passage, water quality and selenium accumulation in listed species in the San Juan River Basin. A complete administrative record of this consultation is on file at the Service's New Mexico Ecological Services Field Office, in Albuquerque, New Mexico. Please contact the Service if the Proposed Action is changed and new information reveals effects of the Proposed Action to these species or critical habitat to an extent not addressed in the BA or this attached BO. If you have questions regarding this consultation, please contact Melissa Mata at (505) 761-4708.

Attachment

cc: (w/attach)

Regional Director, BIA, Navajo Region, Gallup, New Mexico
(sharon.pinto@bia.gov)
Deputy Regional Director, BIA, Navajo Region, Gallup, New Mexico
(john.halliday@bia.gov)
Area Manager, Reclamation, Western Colorado Office, Grand Junction, Colorado
(lwarner@usbr.gov)
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
(chuck.hayes@state.nm.us)
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico (beth.wojahn@state.nm.us)

Endangered Species Act – Section 7 Consultation
Final Biological Opinion

San Juan River Navajo Irrigation Rehabilitation and Improvement Project – Fruitland-Cambridge and Hogback-Cudei Units – and Colorado River Salinity Program Habitat Replacement

Agency:	U.S. Bureau of Indian Affairs U.S. Bureau of Reclamation
Consultation Conducted By:	U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office
Date Issued:	January 2, 2018
Approved by:	Susan S. Millsap Susan S. Millsap Field Supervisor
Biological Opinion Number:	02ENNM00-2016-F-0131

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INTRODUCTION

This is the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) regarding effects of actions associated with the U. S. Bureau of Indian Affairs (BIA) proposal to fund rehabilitation and improvement of two irrigation units within the San Juan River Navajo Irrigation Project and the U.S. Bureau of Reclamation's (Reclamation) execution of a grant authorized through the Colorado River Salinity Control Program on federally listed species and their critical habitats in accordance with section 7(b) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) and implementing regulations (50 CFR 402). Species affected by the proposed action are: endangered Colorado Pikeminnow (*Ptychocheilus lucius*) and its critical habitat, endangered Razorback Sucker (*Xyrauchen texanus*) and its critical habitat.

This BO is based on information provided in the biological assessment (BA), electronic mail and telephone conversations between our staffs, data in our files, literature review, and other sources of information. A complete administrative record of this consultation is on file at the New Mexico Ecological Services Field Office, Albuquerque, New Mexico. We received all the information necessary for formal consultation on August 23, 2017.

BACKGROUND AND CONSULTATION HISTORY

The BIA and Reclamation are proposing to rehabilitate and improve two irrigation units that divert the San Juan River within the Navajo Nation: 1) Fruitland-Cambridge and 2) Hogback-Cudei. On July 26, 2016, the Service received two BAs from the Navajo Nation Department of Water Resources (NNDWR) through the BIA. One was for actions within the Fruitland-Cambridge irrigation unit and one was for actions within Hogback-Cudei irrigation unit. Letters conveying each BA requested independent initiation of formal section 7 consultation under the ESA. Each BA determined the proposed actions were "likely to adversely affect" listed species and their critical habitat in the San Juan River Basin.

After receiving these BAs, a conference call occurred on September 29, 2016 between BIA, Reclamation, NNDWR, and Keller-Bliesner Engineering (Navajo Nation contractor) to discuss the addition of a new project component, the Lateral Conversion Project, as it related to the two BAs. The Lateral Conversion Project is to be funded by Reclamation through the Colorado River Salinity Control Program, which had not been addressed in either of the BAs submitted to the Service on July 26, 2016. However, the laterals are located in both the Fruitland-Cambridge and Hogback-Cudei irrigation units and identified in both of the BAs submitted to the Service. The Service recommended the BAs be combined given their connected nature and requested an updated determination for listed species within the project area. Additional information with regards to the Lateral Conversion Project was provided on October 6, 2016 and the Service provided initial comments on the two original BAs for NNDWR through BIA to incorporate in their combined BA for later submission.

On May 30, 2017, the Service received one BA from NNDWR through BIA and a letter requesting initiation of formal section 7 consultation under the ESA. The Lateral Conversion Project funded through the Colorado River Salinity Control Program implements the Colorado River Basin Salinity Control Act of 1974. This legislation requires habitat replacement when incidental fish and wildlife values are lost as a result of the salinity control measures. During granting of funds for the Lateral Conversion Project, the Reclamation determined habitat replacement was necessary. Thus the habitat replacement is included as one of the aspects of the overall proposed action and was included in the BA submitted on May 30, 2017.

On June 30, 2017, the Service provided comments on the BA and requested additional information before formal consultation could be initiated. An in-person meeting was held on July 31, 2017 to obtain further information and clarification on the proposed action. On August 4, 2017, the Service submitted a written request to NNDWR through BIA for additional information as a result of the July 31, 2017 meeting. On August 23, 2017, the Service received all information necessary to begin formal consultation. A complete administrative record of this consultation is on file at the Service's New Mexico Ecological Services Field Office, Albuquerque, NM.

DESCRIPTION OF THE PROPOSED ACTION

ACTION AREA

The proposed action area includes the San Juan River from Navajo Reservoir Dam downstream to its confluence with Lake Powell reservoir (river mile [RM] 250 to 0; Figure 1). Proposed construction in the San Juan River would occur at the diversion dam for the Fruitland-Cambridge irrigation unit, the Helium siphon where it crosses the San Juan River and at the Lateral Conversion Project habitat replacement site. Construction would also occur at the Fruitland-Cambridge inlet and throughout the delivery infrastructure for both Fruitland-Cambridge and Hogback-Cudei irrigation units (Figure 2 and Figure 3). Both irrigation units provide water from the San Juan River to Navajo Nation communities on both sides of the San Juan River just west of Farmington, New Mexico to about 27 kilometers (km) (17 miles [mi]) northwest of Shiprock near the Four Corners in San Juan County, New Mexico.

The San Juan River originates in the San Juan Mountains of southwestern Colorado. It flows approximately 50 km (31 mi) south to the Colorado/New Mexico border, 306 km (190 mi) westward to the New Mexico/Arizona border, and 219 km (136 mi) into Lake Powell reservoir, at the western edge of the action area (Figure 1). The San Juan River has few perennial tributaries (the Animas River is the largest) and numerous ephemeral drainages that receive substantial seasonal summer flows. In 1962, Reclamation constructed Navajo Dam in the mainstem of the San Jan River just south of the Colorado border in New Mexico to store flows from the San Juan, Los Pinos, and Piedra rivers (Reclamation 2000) (Figure 1).

Diversion of the San Juan River into the Fruitland-Cambridge unit is approximately 3 km (2 mi) west of Farmington, New Mexico (Figure 4) on property owned by the City of Farmington and a private landowner. The remaining Fruitland-Cambridge infrastructure is located in San Juan, Nenahnezad and Upper Fruitland Chapters, Navajo Nation, San Juan County, New Mexico. These are in Chimney Rock, Waterflow, Fruitland, Kirtland and Hogback North U.S. Geological Survey 24k quadrangles (Figure 2). The Hogback-Cudei irrigation unit is located in the Gadii'ahi, Beclabito, Shiprock, and Hogback Chapters, Navajo Nation, San Juan County, New Mexico. These are in Sallies Spring, Canal Creek, Skinney Rock, Rattlesnake, Shiprock, Chimney Rock, and Hogback North U.S. Geological Survey 24k quadrangles (Figure 3).

Figure 1. Proposed action area, San Juan River Basin to the full pool of Lake Powell reservoir.

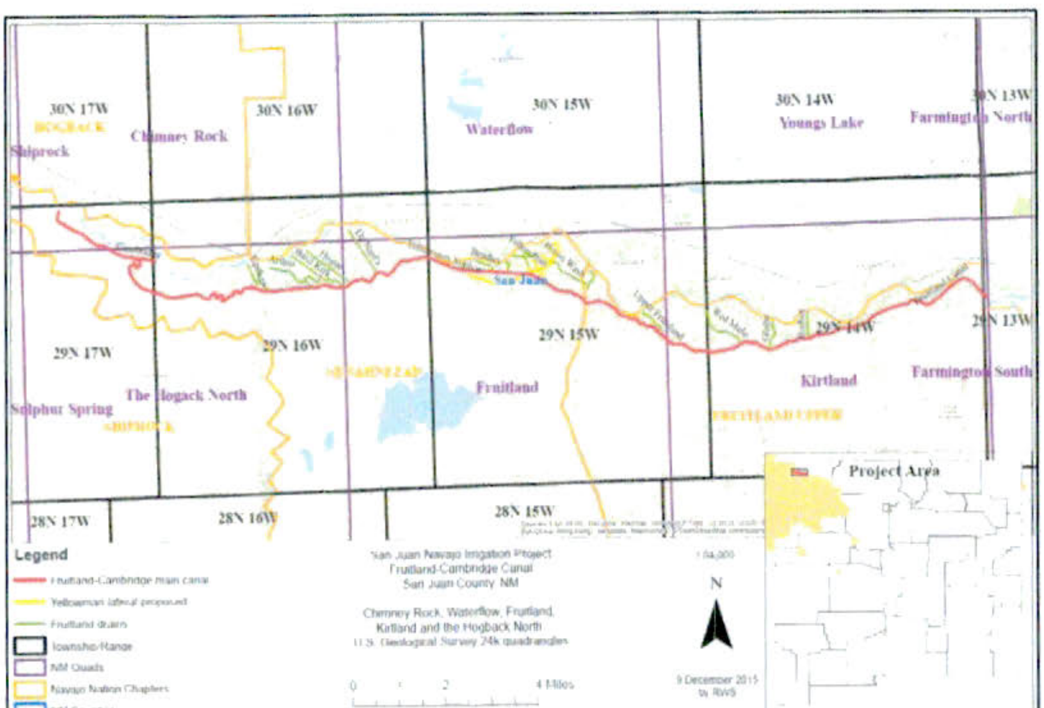


Figure 2. Vicinity map for Fruitland-Cambridge irrigation unit.

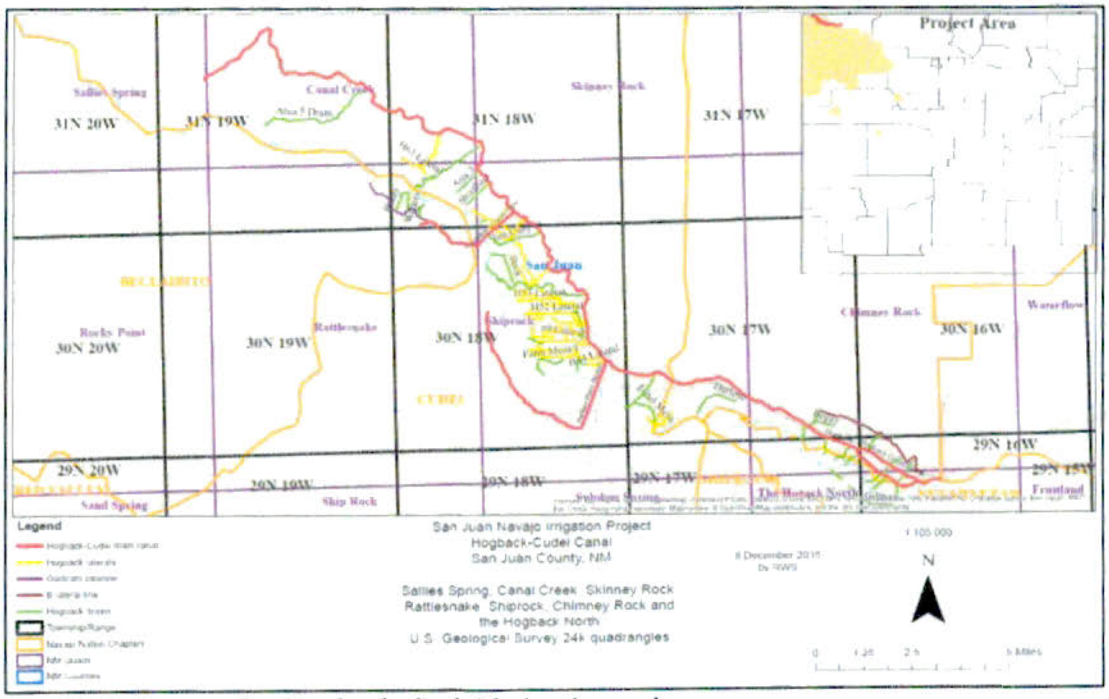


Figure 3. Vicinity map for Hogback-Cudei irrigation unit

PROPOSED ACTION

The proposed action consists of the Lateral Conversion Project (converting earthen ditches to pressurized pipeline), repair and replacement of major system elements, and maintenance activities within the two irrigation units (NNDWR 2017a, Table 1). One purpose of the project is to increase reliability of water to farmers and allow full utilization of water rights. Other purposes are to improve water quality in the San Juan River, determine post construction water quality (selenium loading), provide fish passage at the Fruitland-Cambridge diversion, and reduce fish entrainment at this structure. Additionally, nonnative invasive plant species will be controlled within the irrigation delivery systems to reduce the need for future rehabilitation efforts.

The Lateral Conversion Project is funded through the Colorado River Salinity Control Program, to implement the Colorado River Basin Salinity Control Act of 1974. Conversion of earthen ditches to pressurized pipelines through the Lateral Conversion Project will occur in both the Fruitland-Cambridge and Hogback-Cudei irrigation units (Figure 2 and Figure 3). The Fruitland-Cambridge irrigation unit is located in Nenahnezad Navajo Nation Chapter east of the Hogback monocline. The Fruitland-Cambridge irrigation unit diverts water from the San Juan River at Fruitland Diversion, approximately 16.1 km (10 mi) west of Farmington, NM and serves 1,350 hectares (ha) (3,335 acres [ac]). In this irrigation unit, the Lateral Conversion Project will convert Yellowman Lateral from an earthen ditch into an underground pressurized pipeline network. Yellowman Lateral serves about 35 farmers on 156 ha (386 ac). The length of new pipeline is approximately 8,129 meters (m) (6,671 feet [ft]). The rest of the Lateral Conversion Project will occur within the Hogback- Cudei irrigation unit which diverts water from the San Juan River at the Hogback Diversion and serves 3,573 ha (8,830 ac). This aspect of the Lateral

Conversion Project will convert 14 ditches into underground pressurized pipeline serving approximately 240 farmers on 841 ha (2,077 ac). The length of new pipeline is 47,623 m (156,246 ft).

The Lateral Conversion Project is funded through Reclamation's Colorado River Salinity Control Program. Section 202(a)(6) of this legislation requires replacement of incidental fish and wildlife habitat lost as a result of measures to reduce salinity. In the description of the proposed action for each irrigation unit the Lateral Conversion Project component is identified and a separate section is provided for Lateral Conversion Project habitat replacement.

Water depletions from the San Juan River by the Fruitland-Cambridge irrigation unit are 7,898 acre-feet/year (AFY) and 13,000 AFY for Hogback-Cudei (Service 2009). The Fruitland-Cambridge canal has a maximum diversion capacity of 160 cfs with a limit of 100 cfs into the portion of the canal below the second sluiceway (also identified as the fish return or flow return channel). Both the Fruitland-Cambridge and Hogback-Cudei diversions are considered historical depletions (those in existence prior to 1992) and part of the historical baseline for section 7 consultation purposes (Service 2000). Formal consultation of Hogback-Cudei water depletions was conducted in 2011 (Service 2011) but formal consultation has been not been conducted for Fruitland-Cambridge water depletions. Approximately 50% of water diverted by both irrigation units is returned to the river either by surface runoff or subsurface flow from deep percolation of agriculture fields or through return channels (labeled as drains in Figure 2 and Figure 3).

With the exception of the Lateral Conversion Project habitat replacement component, all project activities are within general footprints of the two irrigation units. Some slight re-alignment of canals may occur during construction (NNDWR 2017c). Obtaining legal easements, or rights-of-way on 35.4 kilometers (km) (22 miles [mi]) of main canal 17.1 km (11 mi) of secondary laterals, and (20.9 km) 13 miles of drains will not require construction or land disturbance. This will include obtaining a legal easement for Fruitland- Cambridge diversion dam, inlet, and outlet works from the City of Farmington and the private landowner.

An operation and maintenance agreement is in place for Hogback-Cudei but may need to be modified when the 5-year term is extended (NNDWR 2017b). An operating agreement will be developed for Fruitland-Cambridge (NNDWR 2017b). All operation and maintenance is intended to be completed within the project's proposed rights-of-way.

The proposed action recommends general operation and maintenance activities for Fruitland-Cambridge and Hogback-Cudei including:

1. Annual diversion and flow measurement of water from the San Juan River to farmer fields
2. Flushing and filling of canals
3. Annual cleaning of canals
4. Annual vegetation control of canals, ditches, and drains
5. Regular program of drain cleaning and maintenance on a rotating basis
6. Occasional replacement of concrete lining, culverts, turnout gates, and pipes
7. Draining and winterizing canals, ditches, and pipelines
8. Maintenance of canal roads
9. Control of canal rights-of-way

Table 1. Project components of San Juan River Navajo Irrigation Project included in the proposed action: Fruitland-Cambridge and Hogback-Cudei irrigation units (with Lateral Conversion Project habitat replacement)

Fruitland-Cambridge	Hogback-Cudei
Diversion dam and headworks replacement	Hogback pump station replacement
Main canal fish barrier weir installation	Helium lateral flume and siphon repair
Main canal slope and lining repair	Main canal lining repair
Lateral Conversion Project (Yellowman)	Lateral Conversion Project
Siphon repair: Yellowman and Bitsui	Siphon repair: Salt Creek, Eagle Nest, Baker Wash, Jim Canyon, Malpai, Area 5, and Buried
Drain cleaning	Drain cleaning
Draft Storm Water Management Plan	Storm water infrastructure cleaning and repair
	Road and bridge maintenance

The proposed action also includes post construction actions to increase water quality and gain a better understanding of effects from irrigation drain runoff on listed species. A stormwater management plan is proposed for the Fruitland-Cambridge irrigation system. Also proposed is a study to quantify the amount of selenium that is contributed by both irrigation projects to the San Juan River.

Fruitland-Cambridge irrigation unit

Fruitland-Cambridge diversion dam and headworks replacement – A conceptual design which includes the diversion dam, headworks, and fish barrier weir wall within the canal to protect from fish entrainment, is provided by NNDWR (2016) and incorporated herein. Repair of the inlet structures will include new concrete headworks, safety rails, automated control gates, trash rack and power trash rake, a log boom (large trash control and safety), moving the concrete sluiceway downstream, and construction of a storage garage and control building (Figure 4 and Figure 5). Replacement of the diversion dam will consist of constructing two grouted boulder weirs spanning the full width of the river (Figure 5). To minimize fish passage blockage, a fish passage will be integrated into the dam, similar to the one constructed at Hogback-Cudei diversion (BIA 2000, Service 1999), along with a boat passage (NNDWR 2017a). Overall, the fish passage is designed as a channel in each of the two river-wide boulder weirs (NNDWR 2016; Figure 6). Each channel will be 5.5 meter (m; 18 feet [ft]) wide made of five rows of boulders with 1 m (3 ft) between rows and 0.3 m (1 ft) of space between each boulder, with each row offset from the adjacent row. The drop in elevation between the upstream and downstream portion of each fish passage is designed to be 0.46 m (1.5 ft). Engineering designs for the diversion dam and inlet works include provisions for installation of passive integrated transponder (PIT) tag antennas to detect the use of the facility by PIT tagged endangered fishes (Figure 5). Engineering designs are not finalized (NNDWR 2016, NNDWR 2017b).

Construction is planned to take place during the non-irrigation season (October – February) with an anticipated construction period of 4 to 5 months. The construction of the Fruitland Diversion Dam would disturb approximately 4.55 ha (11.25 acres). Inlet works will be dewatered by placing non-erosive barriers (inflatable dams, concrete barriers, or other commercial water barriers) upstream and downstream of the structure. The existing structure will be removed to a disposal location and replaced with a new structure, trash rack, sluice gates and canal control gates. When completed construction will begin on the diversion dam. Water will be diverted through the canal and sluiceway adjacent to the canal inlet by placing non-erosive barriers across the river upstream and downstream of the construction zone. The river will be partially dewatered by gravity flow before placing the downstream barrier. Any water remaining in the river will be pumped from the construction zone, with pumps screened to prevent fish entrainment. A qualified fisheries biologist will remove any remaining fish from the construction site during the final stage of dewatering and place them outside of the construction area. The diversion dam site will be graded, sheet pile placed, and boulders grouted in place. Excess excavated material will be removed from the construction site prior to removing dewatering barriers.

The Navajo Nation will conduct maintenance of the Fruitland diversion dam will include periodic removal of trash from the boat and fish passage using an excavator or rubber-tired backhoe, which will be required once per year for the fish passage and two to three times per year for the boat passage. The water level will be lowered and work will be accomplished from a platform next to the passage with no equipment placed in the water. Other routine maintenance will include monthly removal of trash piles that accumulate from the automated trash rake and maintenance of automated equipment, which will occur out of the active river. Trash will be removed to disposal area.

<u>Fruitland-Cambridge main canal fish barrier weir</u> – To reduce entrainment of native and endangered fish species in the Fruitland-Cambridge irrigation canal, a long-crested fish barrier weir with fish return channel (flow return), similar to the Hogback-Cudei fish barrier weir wall diversion facility (Service 2011), is planned for installation at the second canal sluiceway (Figure 4 and Figure 7). The inlet and headworks facility is designed to have a maximum flow depth over the weir of 11.4 centimeter (cm) (4.5 in) or less, representing 8% of the total water column at a capacity of 100 cfs over the weir wall into the Fruitland-Cambridge canal. If operated correctly, automated controls on the canal inlet gates and the vertical leaf gate will maintain the desired flow in the canal while passing a minimum of 25 cfs down the fish return channel. During the non-irrigation season, canal inlet headgates will be closed and water drained through the fish return channel to the river. Provisions for installation of PIT antennae to detect PIT tagged fish will be included (Figure 5). Engineering designs are not finalized (NNDWR 2016, NNDWR 2017b).

Figure 4. Location of Fruitland-Cambridge irrigation unit inlet works, first sluiceway, fish barrier weir, and fish return (flow return), San Juan River river mile (RM) 178.5 Farmington, NM. Insert of current diversion dam and inlet works.

Additional construction may occur in the fish return channel (flow return to river). This channel may be regraded to remove any existing brush or rock checks that formed and would be detrimental to fish passage. If necessary, the channel will be armored in locations where erosion is occurring (NNDWR 2017b). The channel slope and cross-section will be designed to provide at least 0.3 m (1 ft) of depth at the minimum design flow of 25 cfs (NNDWR 2017b). There are no plans to modify the first sluiceway (Figure 4) or its headgates (NNDWR 2017b).

Construction will take place during the non-irrigation season at the same time the Fruitland-Cambridge diversion dam is constructed. All construction will be completed in the dry channel. A stormwater management plan will be developed by the Navajo Nation to assure sediment does not enter San Juan River during construction.

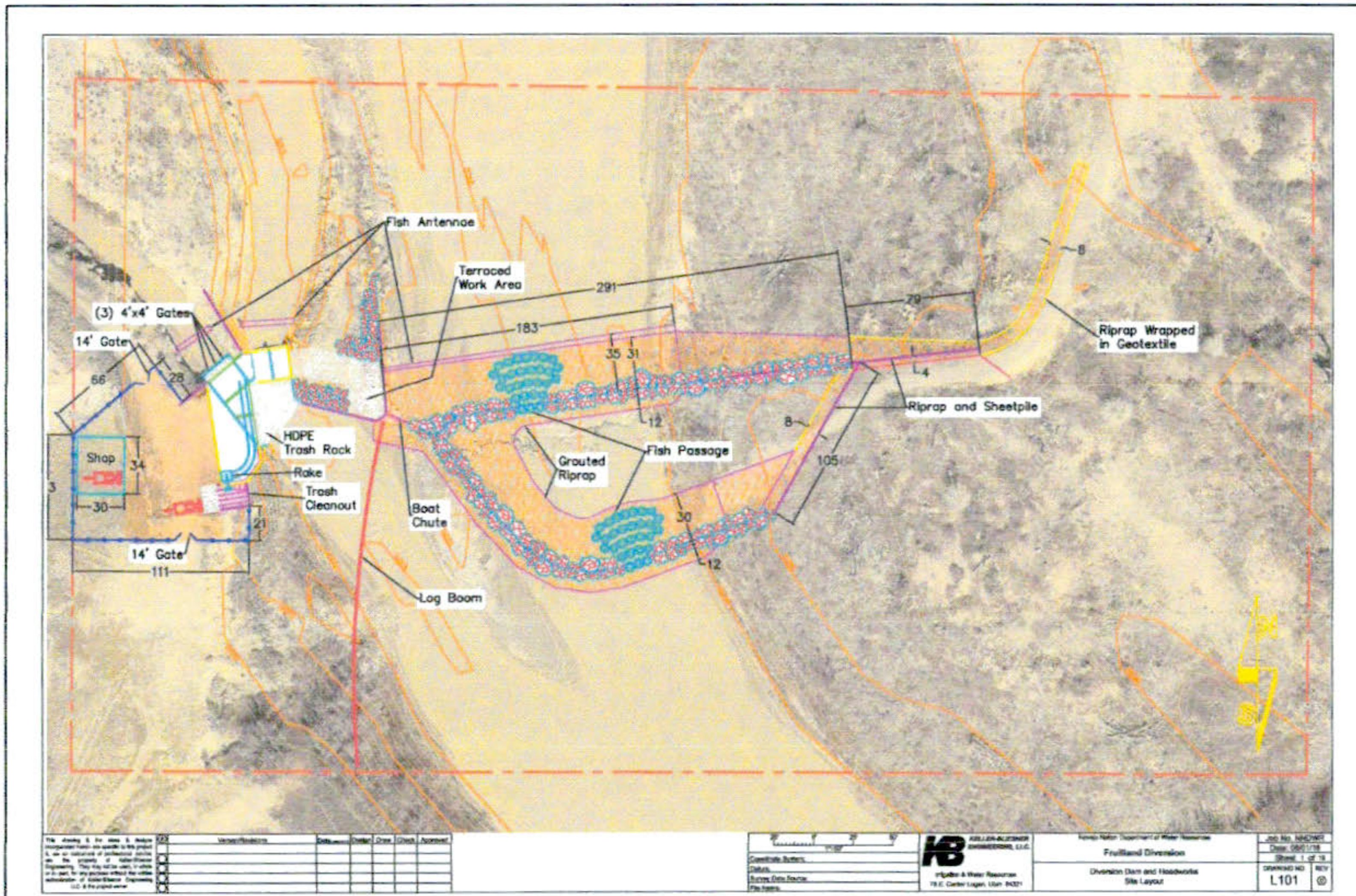


Figure 5. Proposed two-step diversion dam, fish and boat passage, and headworks (NNDWR 2016).

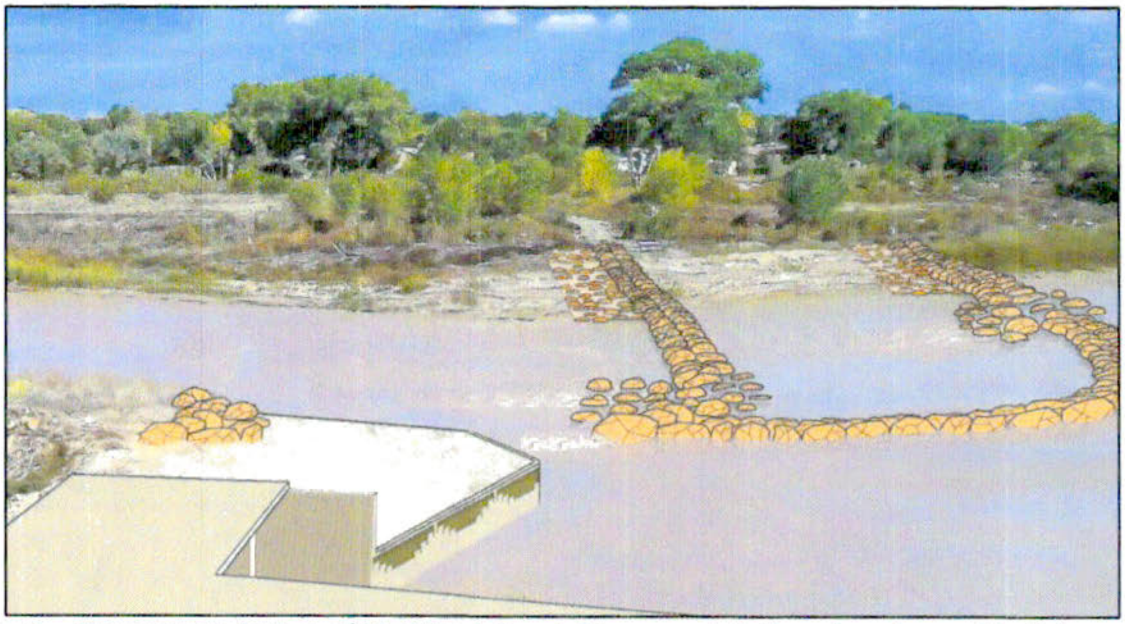


Figure 6. Conceptual design of Fruitland-Cambridge grouted diversion dam with fish passage integrated into each of the two-step boulder fields (NNDWR 2016).

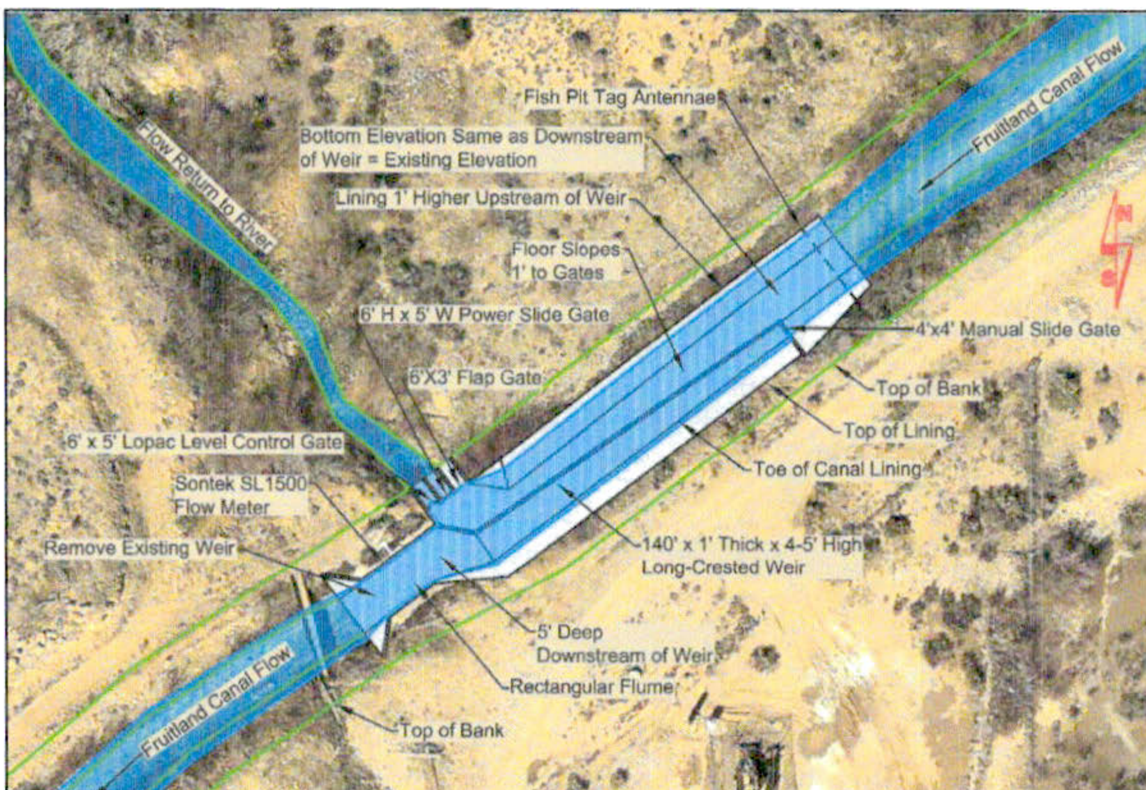


Figure 7. Fruitland-Cambridge fish barrier weir.

Fruitland-Cambridge main canal slope and lining repair – Slope erosion adjacent to the San Juan River has destabilized the canal embankment. The repair in this area (upstream of Nenahnezad Chapter: NW 1/4 Section 14, 29N, 15W) will consist of replacing the failed material with gravel from a commercial yard. This will allow any upslope water seepage to move through the fill without causing failure. Excavated material will be removed from the site and fill will be placed within the area that has failed. No additional riparian area along the river will be disturbed. Silt fences will be placed between the fill area and the river to prevent erosion into the river during construction. Canal lining in this reach will also be repaired.

Fruitland-Cambridge Lateral Conversion Project (Yellowman lateral) –Yellowman lateral is an earthen canal that branches off from the Fruitland-Cambridge main canal (Figure 2). A total of 8,129 m (26,671 ft) of earthen canal will be replaced with underground pressurized pipeline. Fruitland-Cambridge serves 1,350 ha (3,335 ac) and the Yellowman lateral specifically serves 386 of those acres; converting 11.5% of the overall system to pressurized pipelines (SJRDWR 2015). Construction will take place during the non-irrigation season (November – March). Construction activity will be confined to the canal and access road corridor on previously disturbed land.

Fruitland-Cambridge canal siphon repair (Yellowman and Bitsui) – Yellowman (31.5 m [2,400 ft]) and Bitsui (crosses Bitsui wash) siphons are above-ground steel pipes that are leaking and risk bursting (Figure 2). Yellowman siphon steel pipe will be removed and replaced on existing supports. Bitsui siphon will be replaced and buried along the existing corridor using 233.2 m of 106.7 cm (765 ft of 42-inch [in]) high-density polyethylene (HDPE) pipe. During construction silt fences will be placed downstream of the construction zone to prevent sediment entering Bitsui Wash during construction. For both siphons, inlet structures will be replaced and automated trash racks installed. Construction will occur during the non-irrigation season (November – March) and removed pipe will be sent to a recycle center or approved disposal site.

Fruitland-Cambridge canal drain cleaning – Open drains carry stormwater, irrigation runoff, and deep percolation from adjacent irrigation to the San Juan River. These have been filled with soil and are choked with vegetation, primarily Russian olive (*Elaeagnus angustifolia*). Drains will be cleaned in locations where they are restricting drainage and impacting crop production. Drain cleaning (approximately 22.5 km [14 miles]) will be performed during the non-irrigation season. Excavated material will either be placed adjacent to the drains or removed to disposal location. Silt barriers will be placed near the lower ends of the reaches being cleaned to prevent sediment from reaching the San Juan River. A routine drain cleaning schedule will be established so drains will be better maintained in the future. This project and the future cleaning schedule will control nonnative vegetation along the drain corridors. In areas where avian breeding may occur, drain cleaning will not occur during the breeding season (March 1 – September 1).

Fruitland-Cambridge canal Storm Water Management Plan – Stormwater can enter Fruitland-Cambridge canal at many points. A draft storm water management plan to guide future operation and maintenance activities will be developed to address the risks and solutions associated with this run-off. The plan will guide the construction will then replace aged infrastructure or add new infrastructure to safeguard the canal from storm related wash-outs which result in highly-erosive flows with large sediment loads returning back to the river. Construction will be completed during the non-irrigation season (November – March).

Hogback-Cudei irrigation unit

Hogback-Cudei pump station replacement – The entire pump station will be reconfigured to provide the necessary pressure to serve 346.4 hectares (856 acres) and proposed installation of pressurized pipes (1,402 m [46,000 ft]). The design will allow pumps to operate to match the irrigation demand, with no spill from the end of the pipelines which will assist in water conservation. Variable frequency drive (VFD) pump motor controls will be utilized that will automatically maintain a constant downstream pressure. The farmers determine when to irrigate based on crop demand for water and pumps will automatically adjust to account for the change in flow.

The new pump station will contain three centrifugal pumps (two serving lateral B and one serving lateral A). The pumps will be placed in an enclosed pump house and be controlled by the new VFDs with shielding to remediate the current interference with the PIT antenna system that is present monitoring entrainment of endangered fishes. A new sediment removal pond will be constructed east of the pump station to remove sediment upstream of the pumps and reduce wear on them. The project will be constructed during the non-irrigation season (November – March). Existing pipelines that will not be used in the new system will be left in place and the new pipelines installed in parallel. Excess excavated material at the pump station and sediment removal pond will be spread locally on previously disturbed land or used as fill material for pipe cover, if needed.

Hogback-Cudei Helium lateral flume and siphon replacement – The Helium lateral crosses Rattlesnake Wash downstream of the Helium siphon (Figure 8). The flume will be repaired by installing a new 91.44 cm (36-in) steel pipe. A new trash rack will be installed. Inlet protective structures consisting of a spillway and sluiceway gate that will discharge excess flow into Rattlesnake Wash will be constructed. Since there is no water delivery in the Helium lateral, construction can occur at any time. The existing pipe will be removed and transported to a recycling center or disposal site. All construction will be completed within the canal and access road corridor.

The Helium siphon steel pipeline, which crosses the San Juan River and connects to the Helium lateral, will be replaced with buried HDPE or PVC pipe. It will parallel the existing alignment for approximately 144.3 m (5,680 ft), crossing the Bluff Road and the San Juan River (Figure 8). After crossing the floodplain, the alignment diverts from the existing siphon to avoid new municipal and housing development. It will continue along the edge of the development until it ties into the existing Helium lateral (295.9 m [11,650 ft]). At the inlet, a new trash rack, log boom, and safety rope will be installed. At the tie-in to the Helium lateral a new outlet structure will be installed.

The preferred river crossing for the Helium siphon will utilize the existing pipe as a sleeve for the new pipe. A pit will be opened on each side of the river about 2.54 m (100 ft) from each bank. A directional boring machine will be used to enlarge the pipe and place a 32-inch diameter

HDPE pipe inside the existing steel line. If successful, the new pipeline would be connected to each end of this crossing. This would avoid any disturbance of the San Juan River.

If the pipeline has collapsed under the San Juan River, it may not be possible to open it sufficiently to get the pipeline through. If that is the case, then the crossing will be made by open cut as follows:

- Non-erodible structures will be placed in the river, containing about 2/3 of the width of the channel at the indicated crossing point (Figure 8).
- The water will be pumped from inside the barrier and the pipe extended about 60% across the river. If fish are present, they will be netted and moved to the river outside the barrier.
- An additional barrier will be placed across the contained area behind the end of the installed pipe and barriers removed on about 1/3 of the river previously crossed. Once the water is diverted around the portion where the pipe has been installed, barriers will be placed on the remaining portion of the river, the area dewatered, and the remaining pipe installed past the river bank. All barriers will then be removed.

Siphon construction will take place during October 1 – March 1 when flow in the San Juan River is at its lowest. The construction period for the siphon may be as long as 3 months, but the river crossing portion will take approximately two weeks. The total impacted area will be about 6.1 ha (15 ac) with a stream crossing of 55 m (180 ft).

<u>Hogback-Cudei main canal lining repair</u> – There are 17.7 km (11 mi) of canal lining on the Hogback Canal. Most of the concrete lining has minor concrete cracking that needs to be sealed. Approximately 4.8 to 6.4 km (3 to 4 mi) of canal requires partial or full replacement of canal lining. The most problematic areas are in the section of the Hogback Canal just upstream of Shiprock. These will be addressed first. The proposed project will complete design and replacement of these sections of broken lining. The design will consider all alternatives such as concrete, geo-membrane, and piping. The removed lining will be disposed of in a designated landfill.

<u>Hogback-Cudei Lateral Conversion Project</u> – Twelve secondary earthen ditches (laterals) will be converted into underground pressurized pipelines. This project will convert approximately 27% (47,623 m [156,246 ft]) of existing ditches to pressure pipelines. Conversion involves cleaning existing ditches of vegetation, demolishing the existing ditch, and installing new pipeline in the general alignment as the existing ditch (NNDWR 2017c). New valves will be placed wherever a current turnout exists unless the farmer requests the valve be placed in a more convenient location. Construction will take place during the non-irrigation season (November – March) within the existing ditch and access road corridor.

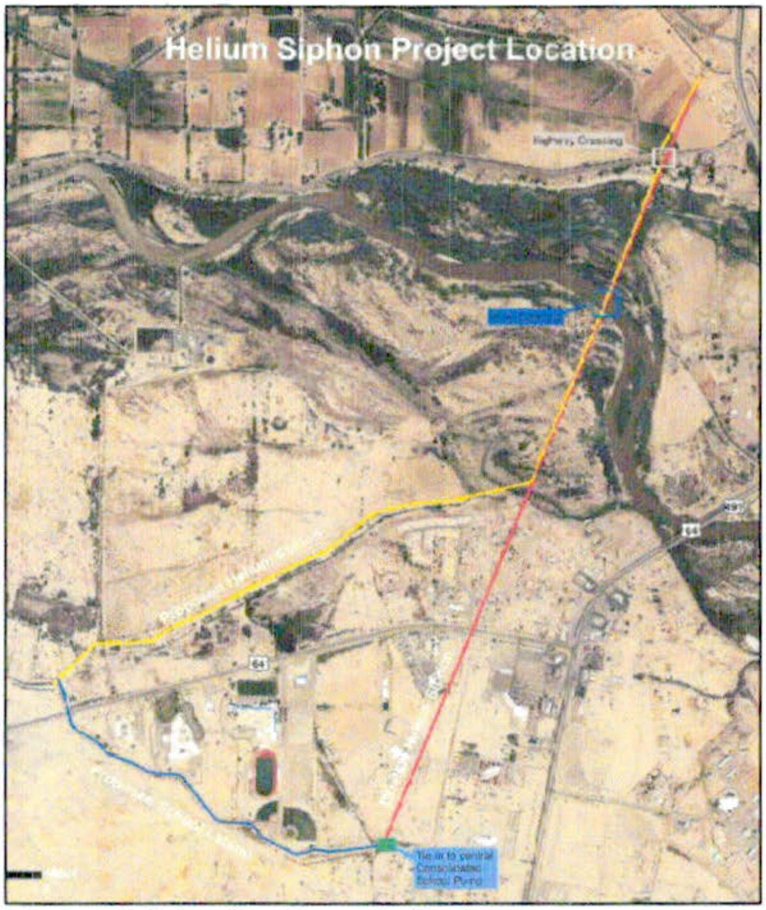


Figure 8. Helium lateral and siphon location and site plan.

Hogback-Cudei drain cleaning – There are 41.8 km (26 mi) of main canal, 217 km (135 mi) of lateral canals, and 53.1 km (33 mi) of drainage canals, which total 312 km (194 mi) of main surface drainage channels in the Hogback-Cudei canal area. All of these canals, ditches, and drains have problems with invasive species such as Russian olives, Chinese elms (*Ulmus parvifolia*), and tamarisks (*Tamarix spp.*). The project will remove all woody vegetation from the canals, ditches, and drains and then establish an annual vegetation control program. Engineers and technicians from NNDWR will perform topographical surveys and provide final grade excavation designs. Spoils piles will be placed next to the drain. Silt barriers will be used at the bottom of the drains to prevent sediment, associated with cleaning, from entering the San Juan River; cleaning will be performed during low or no-flow periods. Drain cleaning and vegetation control will be an ongoing activity with some cleaning of drains on a 5-year cycle. In areas where avian breeding may occur, drain and canal cleaning will not occur during the breeding season (March – September).

Hogback-Cudei siphon repair (Salt Creek, Eagle Nest, Baker Wash, Jim Canyon, Malpais, Area 5, and Buried) – Similar construction and repair activities will occur for each of these siphons (Table 2). These actions will occur within the existing pipeline, canal, and access road corridors. Work will be completed during the non-irrigation season and require minimal disturbance to the area.

Table 2. Hogback siphon repair actions

Construction activity	Salt Creek	Eagle Nest	Baker Wash	Jim Canyon	Malpais	Area 5	Buried
Replacement (remove and dispose existing pipe, repair concrete supports, install new steel mortar lined pipe)	X			X	X	X	
Clean siphon of accumulated sediment		X	X				
Install trash rack, log boom and safety rope	X	X	X	X	X	X	X
Replace buried pipeline with new PVC, HDPE or concrete pipe with existing pipeline being abandoned in place							X

<u>Hogback-Cudei storm water infrastructure cleaning and repair</u> – The Hogback-Cudei canal traverses desert lands that are intersected by many large and small washes that can have high flow rates and sediment loads during storm events. The large sediment-laden flows can damage canals and laterals in the Hogback system when control features have not been adequately maintained. This project will clean 48, replace 20, and install two new culverts. It will also clean a canal in-flow, and install six over-the-canal flumes. These projects are all adjacent to, across, or under the Hogback-Cudei canal. Construction will be confined to the canal right-of-way. The Navajo Nation will be responsible for on-going maintenance of these facilities will be required as part of the canal routine maintenance program after these deficiencies are corrected.

<u>Hogback-Cudei roads and bridge maintenance</u> – There are approximately 141.6 km (88 mi) of canal roads within the boundary of Shiprock Irrigation. Focus will be on restoring the stream and wash crossings for access roads. Five bridges will be replaced and two upgraded with safety features.

Lateral Conversion Project habitat replacement

The proposed habitat replacement, mitigation for the Lateral Conversion Project funded through the Colorado River Salinity Program and approved by Reclamation, is for the loss of fish and wildlife habitat through the conversion of earthen ditches to pressurized pipelines. This mitigation is required by the Colorado River Basin Salinity Control Act of 1974, which maintains that wetlands and riparian areas supported by irrigation canal seepage must be replaced, when salinity control measures result in a loss of this type of habitat. Recipients of funds distributed through the Salinity Control Act of 1974 are responsible for development, implementation, operation and maintenance, monitoring, and a typical project life of 50 years (McWhirter 2017). Habitat replacement is determined by the recipient through Reclamation's "Procedures for Habitat Replacement" (McWhirter 2017). Monitoring is required for the life of the project with annual site visits by Reclamation for the first five years, including yearly reports.

After five years, monitoring and reporting frequency may be adjusted to every three to five years for the remaining life of the project (McWhirter 2017).

The proposed habitat replacement is designed to restore perennial connection and flow of an historical San Juan River secondary channel. The project area encompasses approximately 4.17 ha (10.3 acres). The abandoned channel is located directly downstream of the Shiprock bridge (Figure 8 and Figure 9). When connected to the mainstem of the river, there is potential for a large backwater at the bottom of the channel to form where it rejoins the San Juan River. The perennial nature of the secondary and potential large backwater may provide nursey habitat for fishes that require low velocity water.

The habitat replacement project will consist of excavating an inlet to connect the mainstem river to the historical secondary channel. The location of this new channel mouth is preferred because of its suitable inlet hydraulic conditions and a relatively short route to the historical channel (Figure 9). Construction will involve clearing the area of invasive vegetation such as Russian olive trees, excavating the new channel, placing excavated spoils along the new channel to contain high flows, vegetating the new channel with native plants, including cottonwood (*Populus spp.*) and willow (*Salix spp.*), and building a walking trail along the channel. The new channel would be excavated first before excavating the inlet in order to complete the work in the dry channel.

To control and maintain flow in the new channel, a grouted riprap v-channel section will be constructed at the inlet to control flows to a level that can be contained by the channel without destroying revegetated areas. The channel will be excavated to allow a base flow of about 5 cfs when the river flow is at 600 cfs and will continue to flow when the river is as low as 300 cfs. When the river is bank full (about 11,000 cfs in this location), the predicted flow in the secondary channel will be about 250 cfs.

Fish habitat will be created in two ways. The new channel begins narrow with a higher gradient, then widens and flattens in slope in the downstream direction. At the point of widening, the bottom width of the constructed channel remains the same. However, floodplain shelves will be constructed 1 ft above the bottom of the channel providing a confined, but broader floodplain. This will allow meanders to develop within the confines of the constructed floodplain area. At flows above 100 cfs (5,500 cfs in the river), there will be sufficient flow to scour sediment from the bottom end of the channel where it connects with the San Juan River, where a large low velocity area (backwater) is expected to form.

The project location allows the inclusion of nature trails along the newly restored riparian corridor. There will be a pedestrian foot bridge across the channel at the control section on the upstream end and footpaths on either side of the channel (Figure 9). The floodplain will be contained by natural grade or excavated material upon which the trails will be constructed. Two vehicle bridges are included for access by safety equipment and to maintain existing access across the restored secondary channel while keeping vehicles out of the active channel.

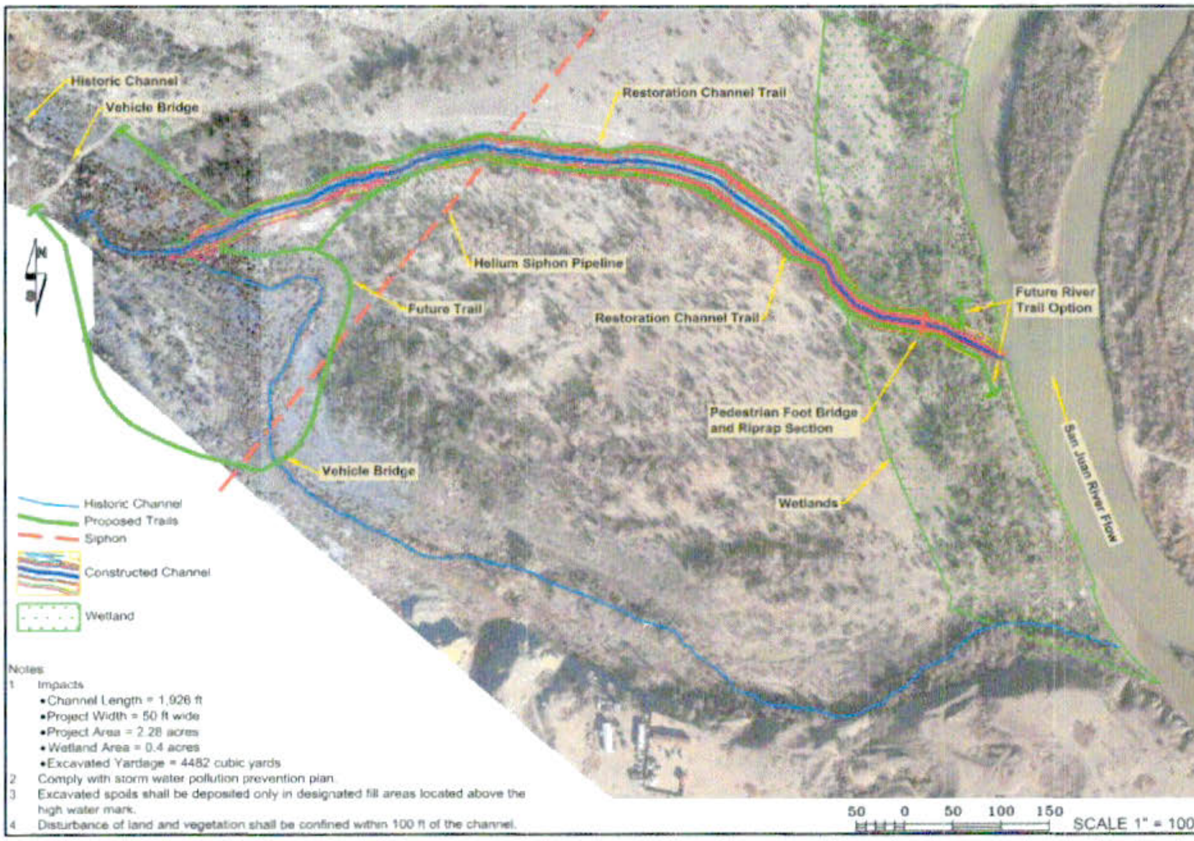


Figure 9. Proposed habitat replacement project restoring flow to historical secondary channels.

Proposed action project components - post construction

Fruitland-Cambridge canal Storm Water Management Plan – Stormwater can enter Fruitland-Cambridge canal at many points. A draft storm water management plan will be developed to address the risks and solutions associated with this run-off and to guide future operation and maintenance activities. Aged infrastructure will be repaired or new infrastructure added to safeguard the canal from storm related wash-outs which result in highly-erosive flows with large sediment loads returning back to the river.

Selenium contribution to San Juan River water quality from irrigation drains – The BIA reports the Navajo Indian Irrigation Project (NIIP) selenium load (lbs of Se per year) to the San Juan River annually as part of their commitments in the 1999 Biological Assessment for NIIP. It is proposed that a study be developed that will compute the total annual selenium load to the San Juan River for the Hogback-Cudei and Fruitland-Cambridge irrigation systems as measured at Four Corners, New Mexico (Figure 1). A selenium study plan will be provided to the Service for agency review/approval within one year of project completion. It is anticipated that a baseline value will be included in the plan using at least 5-years of data to compute an average load and that the computation be repeated at 5-year intervals using available San Juan River water quality data.

STATUS OF THE SPECIES AND CRITICAL HABITAT

COLORADO PIKEMINNOW

The Colorado Pikeminnow is the largest cyprinid (member of the minnow family, Cyprinidae) native to North America and evolved as the top predator in the Colorado River system. It is an elongated pike-like fish that once grew as large as 1.8 m (6 ft) in length and weighed nearly 45 kilogram (kg) (100 pounds [lbs]) (Behnke and Benson 1983); such fish were estimated to be 45-55 years old (Osmundson et al. 1997). Today, Colorado Pikeminnow rarely exceeds 1 m (approximately 3 ft) in length or weighs more than 8 kg (18 lbs). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. Subadult and adults greater than 200 millimeter (mm) total length (TL) tend to occur in turbid, deep, and strongly flowing water (Sublette et al. 1990).

Colorado Pikeminnow is predatory but there is some discrepancy as to the onset and extent of piscivory. Stomach samples collected from Colorado Pikeminnow >80 to 100 mm (3 to 4 in.) captured in the Green River consisted almost entirely of other fishes (Vanicek and Kramer 1969). In the San Juan River, a recent stable isotope study indicated the trophic position of this sized Colorado Pikeminnow was lower than predicted, signifying they were not entirely reliant on fish as prey (Franssen et al. 2014). It is unknown if this is a historical representation of the species' diet, a result of the species' current conditions in the San Juan River, or linked to the hatchery origination of most age-0 fishes (Franssen et al. 2014). Roundtail Chub Gila cypha, a potential prey item, used to be abundant in the San Juan River but is mostly extirpated from the system (Carman 2006).

Colorado Pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the upper Colorado River, the Green River, and the San Juan River including each river's major tributaries, and the Gila River system in Arizona (Seethaler 1978, Platania 1990, Houston et al. 2010). Colorado Pikeminnow was not documented in colder, headwater areas. The species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s (Seethaler 1978). By the 1970s, they were extirpated from the entire lower basin (downstream of Glen Canyon Dam) and from portions of the upper basin as a result of major alterations to the riverine environment. Having lost approximately 75-80 percent of its former range, the Colorado Pikeminnow was federally listed as an endangered species in 1967 (Service 1967, Miller 1961, Moyle 1976, Tyus 1991, Osmundson and Burnham 1998).

Colorado Pikeminnow critical habitat

Critical habitat was designated for the Colorado Pikeminnow in 1994 within the 100-year floodplain of the species' historical range in the following areas of the San Juan River Basin (Service 1994): San Juan County, New Mexico, and San Juan County, Utah, including the San Juan River from the New Mexico State Route 371 Bridge in Township 29 North, Range 13 West, section 17 (of the New Mexico Principal Meridian), to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell reservoir in Township 41 South, Range 11 East, in section 26 (vicinity maps: Figure 10 and Figure 11), approximately 365 km (227 mi). The primary constituent elements (PCEs) of critical habitat, the same for both Colorado Pikeminnow and Razorback Sucker, are listed below.

1. Water: a quantity of water of sufficient quality (i.e., temperature, dissolved oxygen, lack of contaminants, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for the species;

2. Physical habitat: areas of the Colorado River system that are inhabited or potentially habitable for spawning, feeding, rearing, as a nursery, or corridors between these areas, including oxbows, backwaters, and other areas in the 100-year floodplain which when inundated provide access to spawning, nursery, feeding, and rearing habitats; and,

3. Biological environment: adequate food supply and ecologically appropriate levels of predation and competition.

Colorado Pikeminnow life history

Life history phases that appear to be most limiting for Colorado Pikeminnow populations include spawning, egg hatching, development of larvae, and first year survival. These phases of development are closely tied to specific habitat requirements. Natural spawning of Colorado Pikeminnow is initiated on the descending limb of the annual hydrograph as water temperatures approach the range of 16 –20 degrees Celsius (˚C) (60.8–68 degrees Fahrenheit [˚F]) (Vanicek and Kramer 1969, Hamman 1981, Haynes et al. 1984, Tyus 1990, McAda and Kaeding 1991). However, the temperatures when spawning is initiated can vary: 20-23 ˚C (68-73 ˚F) in the Green River; 16-23 ˚C (61-68 ˚F) in the Yampa River (Bestgen et al. 1998); 18-22 ˚C (64-72 ˚F) in the Colorado River (McAda and Kaeding 1991); and 16-22 ˚C (61-72 ˚F) in the San Juan River (Farrington et al. 2015). Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month period between late June and late August. However, sustained high flows during wet years may suppress river temperatures and extend spawning into September (McAda and Kaeding 1991). Conversely, during low flow years, when the water warms earlier, spawning may commence in mid-June. On the San Juan River, based on the collection of larval fish from 1993 to 2015, spawning occurred between mid-May through mid-July (Farrington et al. 2017).

Temperature also has an effect on egg development and hatching success. In the laboratory, egg development and hatching success was found to be highest at 20 ˚C (68 ˚F) and lower at 25 ˚C (77 ˚F). Mortality was 100% at 5, 10, 15, and 30˚C (41, 50, 59, and 86 ˚F). In addition, larval abnormalities were twice as high at 25 ˚C (77 ˚F) than at 20 ˚C (68 ˚F) (Marsh 1985). Experimental tests of temperature preference of age-0 and adult Colorado Pikeminnow indicated that 25 ˚C (77 ˚F) was the most preferred temperature for both life phases and optimal for age-0 fish (Bulkley et al. 1981, Black and Bulkley 1985).

Males become sexually mature earlier and at a smaller size than do females with all fish mature by age 7 and 500 mm (20 in) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981). Hatchery-reared males became sexually mature at four years of age and females at five years. For Age 7 through Age 10 female Colorado Pikeminnow the average number of eggs was 62,133/female and can be estimated based on body weight (y = 39907.24 + 11.4117 * Female Body Weight (g), Valdez 2014). In other studies, ranges of fecundity (11,977-113,341) have been estimated for nine and ten-year-old females with an estimated average fecundity based on body weight ranging from 45,451–55,533 eggs/kg (Hamman 1986).

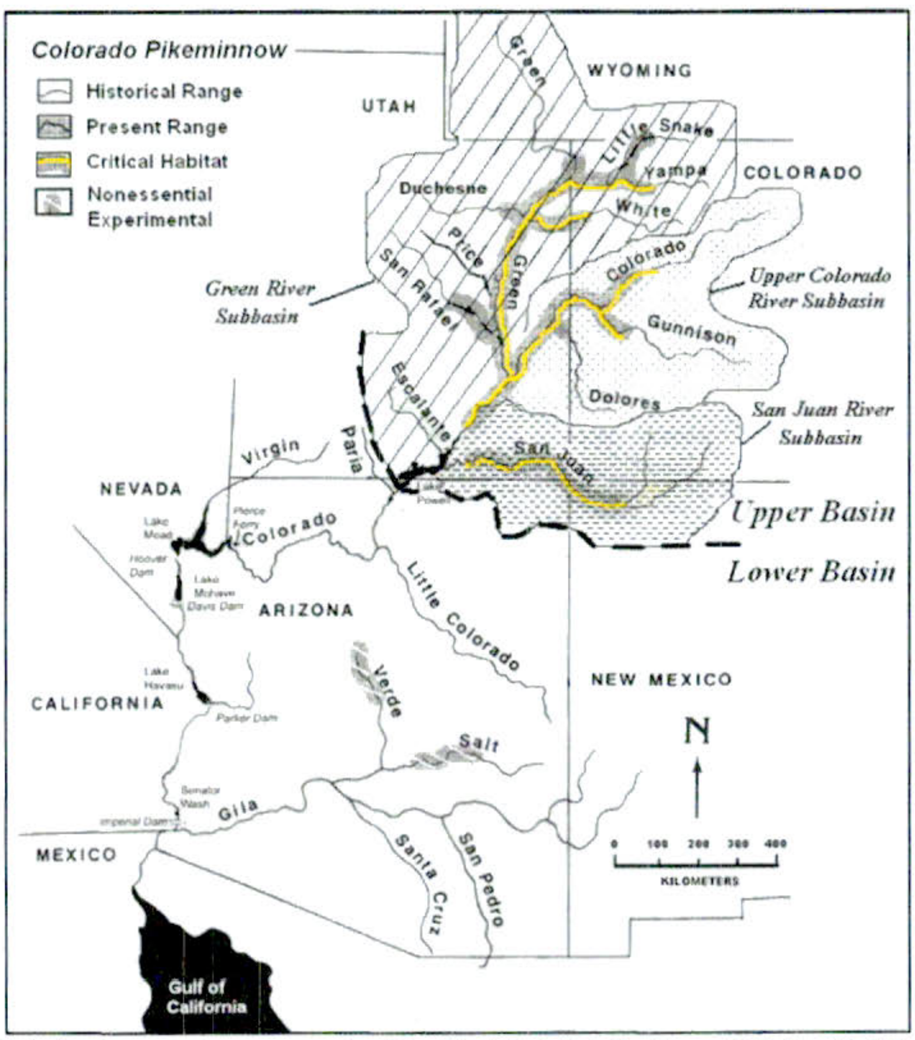


Figure 10. Historical, current range, and critical habitat distribution of Colorado Pikeminnow.

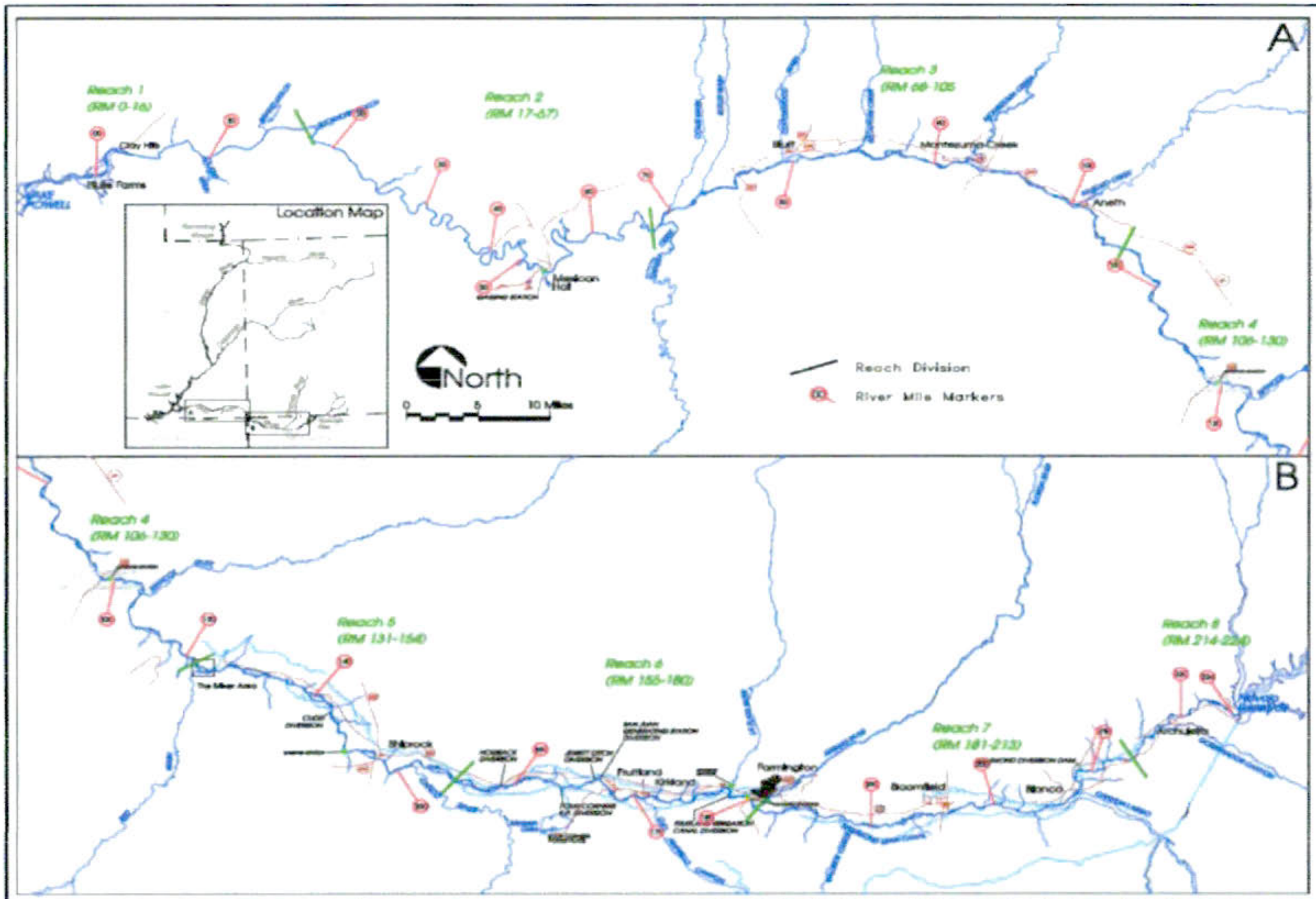


Figure 11. San Juan River location map indicating River Miles (RM) and River Reaches (1-8).

Collections of Colorado Pikeminnow larvae and age-0 fish downstream of known spawning sites in the Green, Yampa, and San Juan Rivers demonstrate that downstream drift of larval Colorado Pikeminnow occurs following hatching (Haynes et al. 1984, Nesler et al. 1988, Tyus 1990, Tyus and Haines 1991, Platania 1990, Ryden 2003a). Studies on the Green and Colorado rivers found that age-0 fish used backwaters almost exclusively (Holden 2000). During their first year of life, Colorado Pikeminnow prefer warm, turbid, relatively deep (averaging 0.4 m [1.3 ft]) backwater areas of zero velocity (Tyus and Haines 1991). After about one year, young are rarely captured in such habitats, although juveniles and subadults are often located in large deep backwaters during spring runoff (Osmundson and Burnham 1998).

Colorado Pikeminnow often migrate considerable distances to spawn. Spawning migrations have been documented in the Green, Yampa, and San Juan rivers (Miller et al. 1982, Archer et al. 1986, Tyus and McAda 1984, Tyus 1985, Tyus 1990). One round-trip event recorded as 463 river miles (Bestgen et al. 2005). In the San Juan River a fish was documented as moving 80 river miles upstream (Platania 1990). In another instance, a Colorado Pikeminnow captured made a 80.5 to 96.5 km (50 to 60 miles) migration during the spawning season, before returning to within (0.64 km [0.4 miles]) of its original capture location (Ryden and Ahlm 1996). Some fish may be more sedentary, as a couple of San Juan River studies documented adults residing near the area in which they spawned (Ryden and Ahlm 1996, Miller and Ptacek 2000). Movements of juvenile Colorado Pikeminnow in the San Juan River show a general upstream migration from spring to summer and downstream over winter (Durst and Franssen 2014). These movements may be associated with maximizing growth along longitudinal and seasonal temperature regimes (Durst and Franssen 2014).

On the Green River, tributaries are an important habitat for Colorado Pikeminnow (Holden 2000). Both the Yampa River and White River were heavily used by Colorado Pikeminnow subadults and adults, apparently as foraging areas (Tyus 1991). The tributaries were the primary area of residence to which adults returned after spawning. Nearly all tributaries to the San Juan River no longer provide habitat for adults because they are dewatered or access is restricted (Holden 2000).

The tributaries in which access is available but restricted include the Animas and Mancos rivers, and McElmo Creek. Historically (late 1800s), Colorado Pikeminnow utilized the Animas River and other perennial portions of tributaries which provide suitable habitat (Zimmerman 2005, Fresques et al. 2013). Five stocked Colorado Pikeminnow were documented in the lower reaches of the Animas River in 2004 (Zimmerman. 2005). Colorado Pikeminnow aggregated at the mouth of the Mancos River prior to spawning in the early 1990s (Ryden and Ahlm 1996, Miller and Ptacek 2000). One individual was found almost 0.8 km (0.5 miles) upstream in the Mancos River on two separate occasions (Ryden and Ahlm 1996). Colorado Pikeminnow was detected in Yellow Jacket Canyon (a tributary of McElmo Creek) each year from 2007 to 2010 (Fresques et al. 2013). All 11 Colorado Pikeminnow (168-425 mm [6.6-16.7 in] TL) detected in Yellow Jacket Canyon were thought to have originated from juvenile fish stocked in the mainstem San Juan River but only one was captured with a previously implanted PIT tag to confirm their origin (Fresques et al. 2013).

Little information is available on the influence of turbidity on the endangered Colorado Pikeminnow within the Colorado River. Osmundson and Kaeding (1989) found that turbidity allows use of relatively shallow habitats, ostensibly by providing adults with cover; this allows foraging and resting in areas otherwise exposed to avian or terrestrial predators. Tyus and Haines (1991) found that young Colorado Pikeminnow in the Green River preferred backwaters that were also turbid. In a laboratory setting, turbidity provided some protection to larval Colorado Pikeminnow from predation by Red Shiner, (*Cyprinella lutrensis*) (Bestgen et al. 2006). Clear water conditions in shallow backwaters might expose larval and juvenile fish to predation from wading birds or nonnative, sight-feeding, piscivorous fish. Currently, it is assumed that endemic fishes evolved under conditions of frequently elevated turbidity, particularly in association with high spring runoff.

Colorado Pikeminnow population dynamics

During five years during the mid-1990s, 19 (17 adult and 2 juvenile) wild Colorado Pikeminnow were collected in the San Juan River by electrofishing between RM 142 (the former Cudei Diversion) and Four Corners at RM 119 (Ryden 2000a, Ryden and Ahlm 1996). The multi-threaded channel, habitat complexity, and mixture of substrate types in this area of the river appear to provide a diversity of habitats favorable to Colorado Pikeminnow on a year-round basis (Holden and Masslich 1997). Estimates made during seven years of research in the 1990s suggested that there were fewer than 50 adult Colorado Pikeminnow (Ryden 2000a).

Starting in 2002, the San Juan River Colorado Pikeminnow population has been augmented by stocking hatchery produced fish. Annual fall monitoring for wild adults and survivors from stockings has occurred every year on the San Juan River since 1998. In 2015, 123 Colorado Pikeminnow were collected during monitoring from RM 180-77, the tenth consecutive year that more than 100 Colorado Pikeminnow were caught in this reach (Schleicher 2016). However, only 9 of these fish were considered adults (i.e. ≥ 450 mm (18 in)). However, in other 2015 efforts to remove nonnative fish, 41 Colorado Pikeminnow ≥450 mm were collected (Duran et al. 2016). Colorado Pikeminnow abundance estimates exhibit substantial annual variation, due to the effects of short-term retention from recent stocking events; no clear population trends are evident in the San Juan River Basin (Figure 12, SJRRIP 2017a).

Successful Colorado Pikeminnow reproduction was documented in the San Juan River in 12 of the last 24 years (Farrington et al. 2017). From 1993 to 2013, a total of 82 larval Colorado Pikeminnow were collected but in 2014 and 2016 annual collections significantly increased to 312 and 548, respectively (Farrington et al. 2017). Larval Colorado Pikeminnow collections occur throughout the San Juan River from Reach 4 downstream to Reach 1 (Farrington et al. 2017, Figure 11). The most upstream capture of larval Colorado Pikeminnow occurred in 2016 within the Hogback diversion facility (RM 159). The capture at this location indicates adults spawned upstream (Farrington et al. 2017). The most upstream capture of adult Colorado Pikeminnow occurred in 2015 at RM 180 about 20 river miles upstream of Hogback diversion (Schleicher 2016).

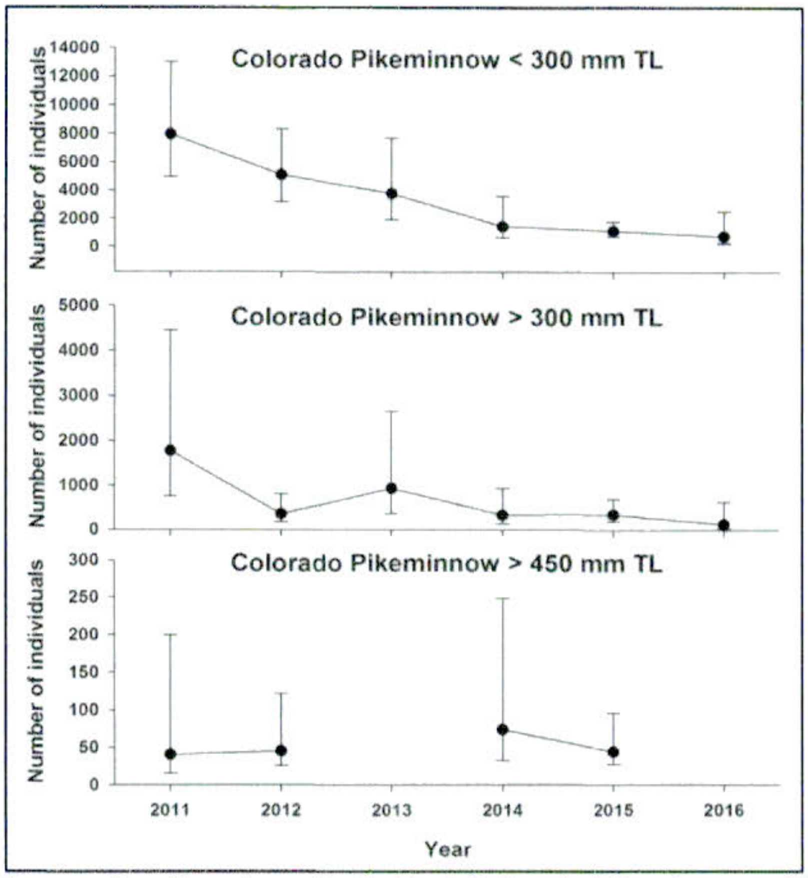


Figure 12. Modeling results of number of individual Colorado Pikeminnow < 300, >300, and >450 mm total length with 95% confidence intervals, between river miles 148-78 (2011-2015) and 148-53 (2016) (SJRRIP 2017a).

Since 1998 small-bodied fish monitoring has been conducted each fall to document recruitment from the larval to juvenile stage. Although Colorado Pikeminnow was collected during small-bodied monitoring every year except 2001-2003, based on length, these fish were likely age-1 hatchery-reared fish, stocked the prior fall (Gilbert 2014). However, in 2015 and 2016 small-bodied fish monitoring resulted in the collection of age-0 fish indicating larval fish recruitment occurred in those years (Zeigler and Ruhl 2016). This reproduction and recruitment could be the result of naturalized flow regimes, which includes high peak flows, as they may favor native fish reproduction and support recruitment from the larval through to age-1+ life-stages (Franssen et al. 2007).

As part of a basin-wide analysis of endangered fish genetics, tissue samples from Colorado Pikeminnow caught during research conducted under by the San Juan River Recovery Implementation Program (SJRRIP) have been analyzed. The results of that analysis indicate that the San Juan River fish exhibit less genetic variability than the Green River and Colorado River populations, likely due to the small population size. However, they were very similar to Colorado Pikeminnow from the Green, Colorado, and Yampa rivers (Morizot 1996). This data suggest that the San Juan population is probably not a separate stock (Holden and Masslich 1997, Houston et al. 2010).

Competition with and predation of Colorado Pikeminnow by nonnative fishes

Nearly 70 nonnative fish species have been introduced into the Colorado River Basin and at least 20 nonnative fish species live with endangered fishes in the San Juan River (Sublette et al. 1990, Maddux et al. 1993, Service 2002a, b, Propst and Gido 2004). These nonnative fish are predators, competitors, and vectors for parasites and diseases (Hawkins and Nessler 1991, Maddux et al. 1993, Bestgen 1997, Brandenburg and Gido 1999, Brooks et al. 2000, Tyus and Saunders 2000, Drake and Bossenbroek 2004, Mueller 2005, Martinez 2012, Pigneur et al. 2014, Service 2002a, b, Service 2014a). Because of the extreme and persistent threat posed by nonnative species, their eradication and management is a priority in the endangered fishes' recovery plans (Service 2002a, b, Service 2014a).

Small-bodied, nonnative fishes are widespread, invasive, and are predatory of larval native fish in nursery backwaters, and low-velocity habitats, where they can affect survival and recruitment of Colorado Pikeminnow (Haines and Tyus 1990, Muth and Nesler 1993, Bestgen 1997, McAda and Ryel 1999, Valdez et al. 1999). Adult Red Shiners are predators of larval native fish in backwaters of the upper basin (Ruppert et al. 1993). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that nonnative Red Shiner, Fathead Minnow (*Pimephales promelas*), and Green Sunfish (*Lepomis cyanellus*) shared activity schedules and space with young Colorado Pikeminnow and exhibited antagonistic behaviors to smaller Colorado Pikeminnow. Young Colorado Pikeminnow exhibit high spatial overlap in habitat use with Red Shiner and Fathead Minnow. Thus, Colorado Pikeminnow may be at a competitive disadvantage in an environment that is resource limited.

Nonnative Channel Catfish (*Ictalurus puncatus*) has been identified as a threat to juvenile, subadult, and adult Colorado Pikeminnow in the San Juan River. They were first introduced in the upper Colorado River Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the upper Colorado River Basin (Tyus et al. 1982, Hawkins and Nessler 1991, Nelson et al. 1995, Duran et al. 2016, Gerig and Hines 2013). Adult Channel Catfish predation of stocked juvenile Colorado Pikeminnow has been documented in the San Juan River (Jackson 2005). There is a risk that stocked juvenile and adult Colorado Pikeminnow which prey on Channel Catfish can die from choking on Channel Catfish pectoral spines (McAda 1983, Pimental et al. 1985, Quarterone 1995, Ryden and Smith 2002).

Although mechanical removal (electrofishing, seining) of Channel Catfish began in 1995, intensive efforts covering limited portions of the San Juan River (10 trips/year) did not begin until 2001 (Davis 2003). Intensive removal efforts expanded to include nearly all critical habitats in the San Juan River starting in 2006. Mechanical removal has not yet led to a positive population response in Colorado Pikeminnow, but attributing a population response to nonnative fish removal is extremely difficult (Davis 2003, SWCA 2010).

Colorado Pikeminnow status and distribution

Colorado Pikeminnow was designated as endangered prior to enactment of the ESA. Construction and operation of main channel dams, nonnative fish, and local eradication of native minnows and suckers in the early 1960s were recognized as early threats (Miller 1961, Holden 1991). The Colorado Pikeminnow Recovery Plan (Service 2002a, 2014a) summarizes threats to this species as follows: stream regulation, habitat modification, competition with and predation by nonnative fish, and pesticides and pollutants.

Major declines in Colorado Pikeminnow populations occurred in the lower Colorado River Basin during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the main channel fragmented the river ecosystem into a series of disjunctive segments, blocked native fish migrations, reduced water temperatures downstream of dams, created lake habitat, and provided conditions that allow competitive and predatory nonnative fishes to thrive both within impounded reservoirs and in modified river segments that connect them. The highly modified flow regime in the lower basin coupled with the introduction of nonnative fishes decimated populations of native fish and led to the listing of the majority of (7 of 10) native, mainstem fishes as endangered (Mueller 2005). Historical, current range and critical habitat is provided in Figure 10.

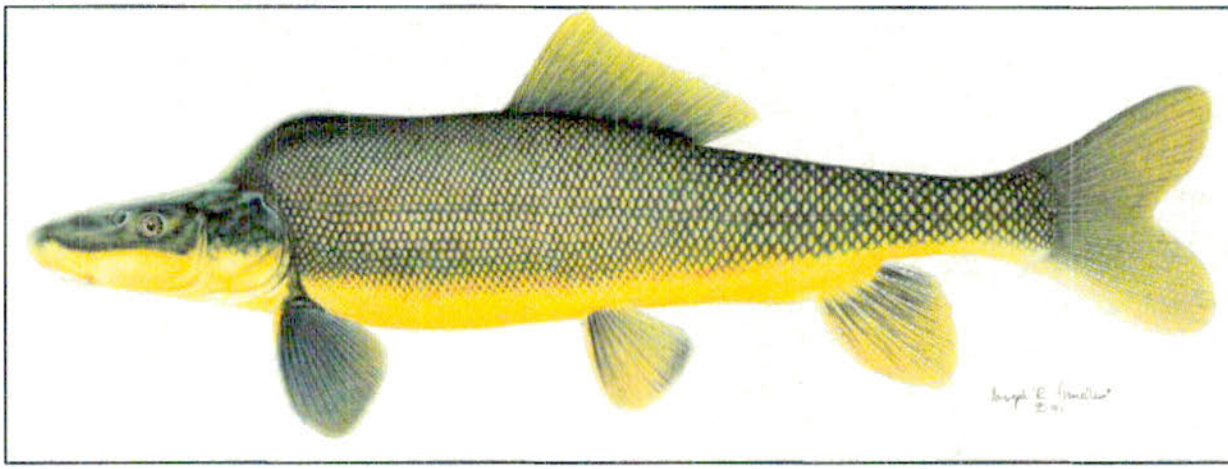
The Colorado Pikeminnow population in the San Juan River is augmented by stocking hatchery-reared fish to reestablish a sustainable population. Approximately 4.8 million Colorado Pikeminnow was stocked from 2002–2015 (Furr 2016). The greatest number of Colorado Pikeminnow (433) was caught during large-bodied fish monitoring in 2010 (Ryden 2012). However, in 2015 the oldest fish were captured, two fish >6 years of age (Schleicher 2016). The capture of adult fish demonstrates that some stocked fish are surviving. Between annual large-bodied fish monitoring and the more intensive (multi-trip) nonnative fish removal, 44 individual adults (≥450 mm total length) were captured in 2016, which substantially exceeds the total of 26 adults captured between 1992 and 2000 (Durst 2017).

Annual population estimates (2011-2016) for Colorado Pikeminnow were generated using five within year sampling efforts from the middle reach of the San Juan River (Figure 12, SJRRIP 2017a). Among all years, point estimates for Colorado Pikeminnow ≥300 mm TL, within the reaches sampled, ranged between 127.8 and 1,778.7 with a 2016 point estimate of 127.8 fish (95% Confidence Interval [CI]:38.9-636.2). However in 2015, when more of the river was sampled the point estimate was 351.4 (95% CI: 196.5-701.9). The limited number of recaptures precluded estimates for fish ≥450 mm TL (i.e. adults). However 16 fish ≥400 mm TL were collected in 2013 and five in 2016.

In 2011, efforts to characterize the fish community in the San Juan River arm of Lake Powell reservoir were undertaken. A total of 24 Colorado Pikeminnow were collected in 2011 and four were of adult size (Francis et al. 2017). Colorado Pikeminnow detected in Lake Powell reservoir was likely the result of fish stocked upstream of Lake Powell reservoir high in the San Juan River (Francis et al. 2017). When the Lake Powell reservoir pool is at a low elevation, a waterfall forms on the San Juan River about 30 river miles upstream from Neskahai Canyon (most downstream location of critical habitat) and precludes connection between the fishes in San Juan River mainstem populations and the San Juan River arm of Lake Powell reservoir (Durst and Francis 2016).

Although augmentation could be resulting in an increase in the numbers of subadult and adult Colorado Pikeminnow, the population is not self-sustaining. Larval Colorado Pikeminnow collected over the last several years (in low numbers) and the most recent detection of survival of these larvae into the juvenile state, indicates some reproduction and survivorship of young in the wild but not at levels to sufficiently support recruitment (SJRRIP 2017a). In spite of the positive trends in numbers of stocked fish retaining in the system, the species' long-term viability remains uncertain because of, reduced habitat suitability, barriers to movement, competition and predation from nonnative fishes, degraded water quality, and the physical changes associated with climate change that will continue to impact the San Juan River Basin. Without active recovery efforts, the Colorado Pikeminnow population (as modeled) would be extirpated from the San Juan River Basin within 20-30 years (Miller 2014).

RAZORBACK SUCKER



Like all suckers (family Catastomidae, meaning "down mouth"), the Razorback Sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The Razorback Sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish white (Sublette et al. 1990). Adults often exceed 3 kg (6 lbs) in weight and 600 mm (2 ft) in length. Like Colorado Pikeminnow, Razorback Suckers may live to be greater than 40 years.

Historically, Razorback Suckers were found in the main channel of the Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1983; Service 2002b) (Figure 13). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and that a commercially marketable quantity was caught in Arizona as recently as 1949. In the upper Colorado River Basin, Razorback Suckers were reported to be very abundant in the Green River near Green River, Utah, in the late 1800s (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand Razorback Suckers during spring runoff in the 1930s and early 1940s. Platania (1990) documented occurrence of wild Razorback Sucker in the main channel of the San Juan River in 1988. Two wild adult Razorback Suckers were also collected from an irrigation pond attached to the San Juan River by a canal in 1976 (Platania 1990). Razorback Sucker likely occurred in the main channel as far upstream as Rosa, New Mexico (now inundated by Navajo Reservoir) (Ryden 1997).

The Razorback Sucker was designated as endangered under the ESA in 1991 (Service 1991), due to little evidence of natural recruitment and declining numbers of adult fish. Threats identified at the time included diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams. Recruitment of larval Razorback Suckers to juveniles and adults continues to be a problem.

Razorback Sucker critical habitat

Critical habitat was designated in 1994 within the 100-year flood plain of the Razorback Sucker historical range in the following areas of the San Juan River Basin (Service 1994): San Juan County, New Mexico, and San Juan County, Utah, including the San Juan River from the Hogback Diversion in Township 29 North, Range 16 West, in section 9 to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell reservoir in Township 41 South, Range 11 East, in section 26, approximately 331 km (206 mi) (Figure 11 and Figure 13). The primary constituent elements of critical habitat are the same as those described earlier for Colorado Pikeminnow.

Razorback Sucker life history

McAda and Wydoski (1980) reported springtime aggregations of Razorback Suckers in off-channel habitats and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the main channel river and that Razorback Suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle.

While Razorback Suckers have never been directly observed spawning in turbid riverine environments within the upper Colorado River Basin, ripe males and females have been captured in the Yampa, Green, Colorado, and San Juan rivers (McAda and Wydoski 1980, Tyus 1985, Osmundson and Kaeding 1989, Tyus and Karp 1989, Tyus and Karp 1990, Osmundson and Kaeding 1991, Platania 1990, Ryden 2000b, Jackson 2003, Ryden 2005). Razorback Sucker likely spawn in low velocity, turbid, main channel habitats. Sexually mature Razorback Suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates. Both sexes mature as early as age-4 (McAda and Wydoski 1980). Fecundity, based on ovarian egg counts, ranged from highs of 75,000-144,000 eggs (Minckley 1983) while McAda and Wydoski (1980) reported an average fecundity (N=10) of 46,740 eggs/fish (27,614–76,576). During spawning, several males (often 3) attend each female and no nest is built. The adhesive eggs briefly drift and hatch at the bottom of the substrate (Sublette et al. 1990). In laboratory experiments, the percentage of egg hatch was greatest at 20 ˚C (68 ˚F) and all embryos died at incubation temperatures of 5, 10, and 30 ˚C (41, 50, and 86 ˚F) (Marsh 1985). Bestgen (2008) found that growth of early life stages was positively related to water temperature and that fastest growth occurred at 25.5˚C (79.9˚F). Average weight of Razorback Suckers reared in 25.5˚C (79.9˚F) water was about four times that of those in 16.5˚C (61.7˚F) (Bestgen 2008).

Larval or juvenile Razorback Suckers habitat requirements are assumed to be low-velocity backwaters and side channels, as it is to the early life stages of most riverine fish. Prior to construction of large dams on the main channel and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the upper Colorado River Basin (Tyus and Karp 1989, Osmundson and Kaeding 1991).

Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel habitats and floodplain habitats. The absence of these seasonally flooded riparian habitats is believed to be a limiting factor in the successful recruitment of Razorback Suckers in other upper Colorado River tributaries (Tyus and Karp 1989, Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified loss of floodplain habitats that provide adequate zooplankton densities for larval food as one of the most important factors limiting Razorback Sucker recruitment; low zooplankton densities in the main channel result in starvation of larval Razorback Suckers. Thus, maintaining low velocity habitats is important for the survival of larval Razorback Suckers.

Outside of the spawning season, adult Razorback Suckers occupy a variety of shoreline and main channel habitats including slow runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1985, Tyus and Karp 1989, Osmundson and Kaeding 1989, Osmundson and Kaeding 1991, Tyus and Karp 1990). Their diet consists primarily of algae, plant debris, and aquatic insect larvae (Sublette et al. 1990). McAda and Wydowski (1980) and Bestgen (1990) suggest that the diet of Razorback Sucker was composed primarily of "ooze," (i.e., plant detritus with associated bacteria, fungus and zooplankton) as well as insect larvae. Papoulias and Minckley (1992) found that Razorback Sucker larvae exhibited prey-size selection, based on body width. Marsh and Langhorst (1988) examined the stomachs of 34 adult specimens from Lake Mohave and found contents dominated by planktonic crustaceans, diatoms, filamentous algae, and detritus. Jonez and Sumner (1954) reported midge larvae as the dominant food item in their stomach analysis of Razorback Suckers in Lake Mohave. They also reported algae as the most common food item found in Razorback Sucker stomachs from Lake Mead, followed by plankton, insects, and decaying organic matter. Vanicek (1967) examined eight adult Razorback Sucker stomachs from the Green River and found them packed with mud or clay containing chironomid larvae, plant stems, and leaves.

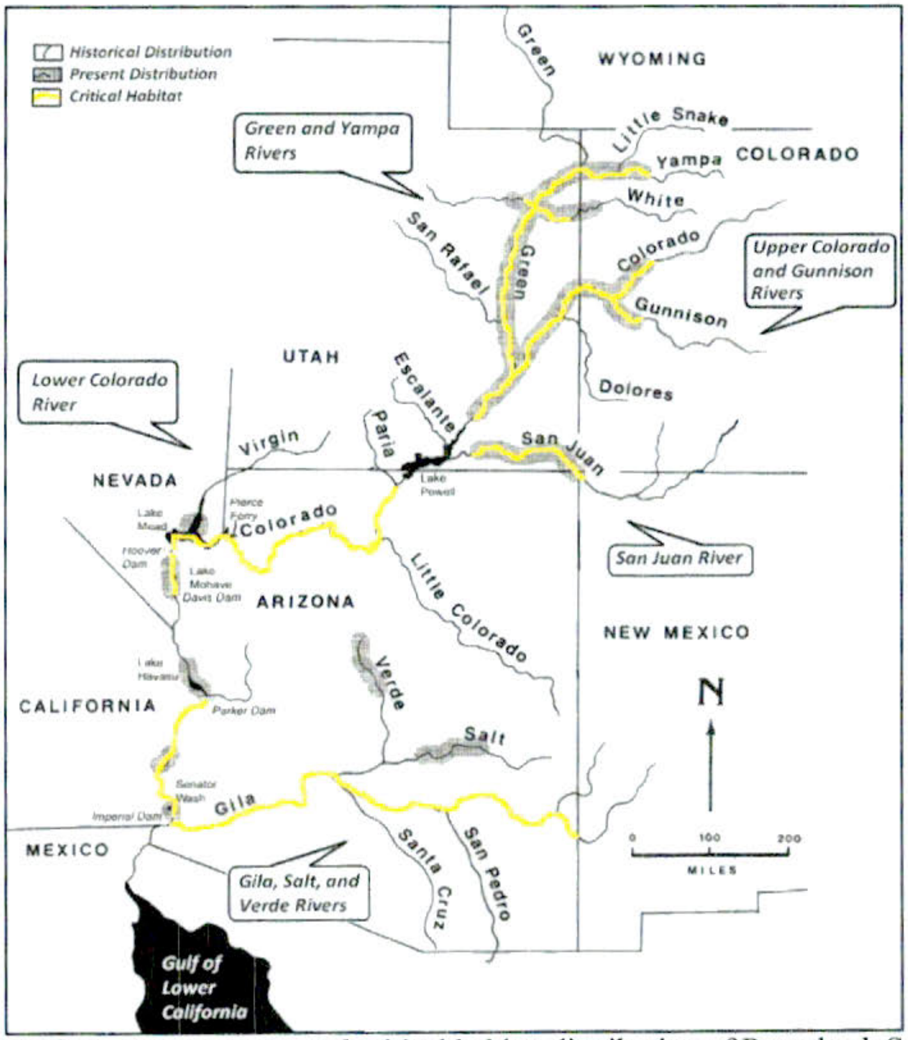


Figure 13. Historical, current range, and critical habitat distribution of Razorback Sucker.

Razorback Sucker population dynamics

Because wild Razorback Sucker, a long-lived fish, is rare throughout its historical range, it is difficult to determine natural fluctuations in their population. In the Colorado River Basin, including the San Juan River, there is limited evidence indicating natural recruitment to any population of Razorback Sucker (Bestgen 1990, Platania 1990, Platania et al. 1991, McCarthy and Minckley 1987, Osmundson and Kaeding 1989, Modde et al. 1996).

In the San Juan River, over 143,672 hatchery-reared Razorback Sucker have been stocked into the San Juan River since the mid-1990s (Furr 2016) and some have survived and are producing larval fish (Farrington et al. 2017). Larval Razorback Suckers have been collected every year since 1998 (Farrington et al. 2017). Age-0 Razorback Suckers in the juvenile ontogenetic stage are regularly captured during larval fish monitoring (Farrington et al. 2017). During annual fall small-bodied fish monitoring, recruitment of those juvenile fish has only been documented once by a single individual captured in 2016 (Zeigler and Ruhl 2017). An additional effort to document wild produced Razorback Sucker was conducted through elemental and isotopic micro-chemical analysis (Clark Barkalow and Platania 2017). Scales from five adult Razorback Sucker captured in Lake Powell reservoir downstream of the San Juan River waterfall were identified through this method as spawned in the San Juan River (Clark Barkalow and Platania 2017). This low level of recruitment is not enough to sustain a population in the San Juan River (SJRRIP 2017a).

Competition with and predation of Razorback Suckers by nonnative fishes

Many species of nonnative fishes are predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982, Lentsch et al. 1996, Pacey and Marsh 1999). Some researchers believe that nonnative species are a major cause for the lack of recruitment and that nonnative fish are the most important biological threat to the Razorback Sucker (e.g., McAda and Wydoski 1980, Minckley 1983, Service 1991, 1998, 2002b, Muth et al. 2000). There are reports of predation of Razorback Sucker eggs and larvae by Common Carp (*Cyprinus carpio*), Channel Catfish, Smallmouth Bass (*Micropterus dolomieu*), Largemouth Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), Green Sunfish, and Red-ear Sunfish (*Lepomis microlophus*) (Jonez and Sumner 1954, Marsh and Langhorst 1988).

Marsh and Langhorst (1988) found higher growth rates in larval Razorback Sucker in the absence of predators in Lake Mohave, and Marsh and Brooks (1989) reported that Channel Catfish and Flathead Catfish (*Pylodictis olivaris)* were major predators of stocked Razorback Sucker in the Gila River. Juvenile Razorback Sucker (average total length [TL] 171 mm [6.7 in.]) stocked in isolated coves along the Colorado River in California, suffered extensive predation by Channel Catfish and Largemouth Bass (Langhorst 1988).

Carpenter and Mueller (2008) tested nine nonnative species of fish that co-occur with Razorback Sucker and found that seven species consumed significant numbers of larval Razorback Suckers. The seven species consumed an average of 54 – 99 percent of the Razorback Sucker larvae even though alternative food was available (Carpenter and Mueller 2008). Lentsch et al. (1996) identified six species of nonnative fishes in the upper Colorado River Basin as threats to Razorback Sucker: Red Shiner, Common Carp, Sand Shiner, Fathead Minnow, Channel Catfish, and Green Sunfish. Smaller fish, such as adult Red Shiner, are known predators of larval native fish (Ruppert et al. 1993). Large predators, such as Walleye, Northern Pike (*Esox lucius*), and Striped Bass, also pose a threat to subadult and adult Razorback Sucker (Tyus and Beard 1990).

Razorback Sucker status and distribution

A marked decline in populations of Razorback Suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, and removal of large quantities of water from the Colorado River Basin (Service 1991, 1994). Dams on the main channel of the Colorado River and its major tributaries have fragmented populations and blocked migration routes. Dams also have drastically altered flows, water temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding, sheltering, or nursery areas. Major changes in species composition have occurred due to the introduction of nonnative fishes, many of which have thrived due to human-induced changes to the natural riverine system. Habitat has been significantly degraded to a point where it impairs the essential life history functions of Razorback Sucker, such as reproduction and recruitment into the adult population.

Currently, the largest numbers of wild adult Razorback Sucker remaining in the Colorado River Basin is in Lake Mohave. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 in 1991, 25,000 in 1993 to fewer than 3,000 in 2001 (Marsh et al. 2003). A repatriation program began in Lake Mohave in 1991, and repatriated fish have apparently begun to contribute to larval cohorts (Turner et al. 2007). Until recently, efforts to introduce young Razorback Sucker into Lake Mohave have failed because of predation by nonnative species (Minckley et al. 1991, Clarkson et al. 1993, Burke 1994, Marsh et al. 2003). Lake Mead is another reservoir where Razorback Suckers may be reproducing and recruiting but elsewhere in the Colorado River Basin have not maintained a secure, self-sustaining wild population or have been extirpated (Marsh et al. 2003, Albrecht et al. 2010).

In the upper Colorado River Basin, above Glen Canyon Dam, Razorback Suckers are found in limited numbers in both lentic (lake-like) and riverine environments. Lanigan and Tyus (1989) estimated a population of 948 adults (95% CI: 758-1,138) in the upper Green River. Eight years later, the population was estimated at 524 adults (95% CI: 351-696) and the population was characterized as stable or declining slowly with some evidence of recruitment (Modde et al. 1996). They attributed this recruitment to unusually high spring flows during 1983-1986 that inundated portions of the floodplain used as nurseries by young. In the Colorado River, most Razorback Suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) reported that the number of Razorback Sucker captures in the Grand Junction area has declined dramatically since 1974. Between 1984 and 1990, intensive collecting effort captured only 12 individuals in the Grand Valley (Osmundson and Kaeding 1991). The wild population of Razorback Sucker is considered extirpated from the Gunnison River (Burdick and Bonar 1997).

Scientifically documented records of wild Razorback Sucker adults in the San Juan River are limited to two fish captured in a riverside pond near Bluff, Utah in 1976, one fish captured in the river in 1988, also near Bluff (Platania 1990), and the five fish captured in the San Juan River arm of Lake Powell reservoir (Clark Barkalow and Platania 2017). In 1976, large numbers of Razorback Suckers were anecdotally reported from a drained pond near Bluff, Utah, but no specimens were preserved to verify species. During the 7-year research period (1991-1997) of the SJRRIP, no wild Razorback Suckers were observed (Holden 1999). Hatchery-reared Razorback Suckers, especially those > 350 mm (13.8 in.), introduced into the San Juan River in the 1990s have survived and are reproducing, as evidenced by recapture data and collection of larval fish (Farrington et al. 2017, Schleicher 2016).

San Juan River river-wide Razorback Sucker population estimates have not grown over time (Figure 14). Although adult Razorback Sucker (i.e., > 400 mm TL) per river mile is generally higher compared to the number of individuals < 400 mm, this is likely due to the size fish are stocked (~300 mm Tl) and limited natural recruitment. The 2016 mean estimate for adult Razorback Sucker was 654.8 (95% CI: 473.2-953.8). While the role of Lake Powell reservoir in the recovery of Razorback Sucker is unclear, 75 individuals were detected in the San Juan arm of Lake Powell reservoir in 2011 (Francis et al. 2017). Upstream of those collections, at the San Juan River waterfall, a significant number of PIT tagged Razorback Suckers are present.

Between 2015 and 2016, 716 unique Razorback Sucker were detected (Cathcart et al. 2017). These fish cannot pass upstream of the waterfall unless Lake Powell reservoir is full (Durst and Francis 2016).

The Razorback Sucker recovery goals identified streamflow regulation, habitat modification, predation by nonnative fish species, and pesticides and pollutants as primary threats to the species (Service 2002b). Within the upper Colorado River Basin, recovery efforts include the capture and removal of Razorback Suckers from all known locations for genetic analyses and development of brood stocks. In the short term, augmentation (stocking) may be the only means to prevent the extirpation of Razorback Sucker in the upper Colorado River Basin. However, in the long term it is expected that natural reproduction and recruitment will occur. Genetics management and augmentation plans have been implemented for Razorback Sucker (Crist and Ryden 2003, Ryden 2003b).

At the time of listing, few Razorback Suckers remained in the San Juan River. Since the initiation of the SJRRIP, Razorback Sucker numbers have increased, due to augmentation. The population has been expanding upstream. The highest upstream capture of an adult Razorback Sucker was at RM 180 (Schleicher 2016). Based on captures of larval fish, adult Razorback Suckers have expanded their spawning range upstream over time with the most upstream capture occurring at Hogback diversion (RM 159) in 2016 (Farrington et al. 2017). The long-term population viability remains uncertain because of the relatively limited or degraded habitat available to Razorback Sucker between Navajo Dam and Lake Powell reservoir, competition and predation from nonnative fishes, degraded water quality, and the uncertainty surrounding the changes that climate change will bring to the San Juan basin.

Endangered Fishes Propagation and Augmentation

Because of the extremely low numbers of wild Colorado Pikeminnow and poor recruitment into the population, a stocking program was initiated to augment fish stocks in the San Juan River. Experimental stocking of 100,000 Age-0 Colorado Pikeminnow upstream of Shiprock, New Mexico was conducted in November 1996 to test habitat suitability and quality for young life stages (Lentsch et al. 1996). Monitoring in late 1996 and 1997 found these fish scattered in suitable habitats from just below the Shiprock site to the inflow of Lake Powell reservoir. During the fall of 1997, the fish stocked in 1996 were caught in relatively high numbers and exhibited good growth and survival rates (Holden and Masslich 1997). In August 1997, an additional 100,000 Colorado Pikeminnow were stocked in the river. In October 1997, the Age-0 fish stocked two months previously were found distributed below stocking sites and in relatively large numbers nearly ten miles above the Shiprock stocking location. On average, the 1997 stocked fish were smaller than those stocked in 1996 and were able to move about the river to find suitable habitats (Holden and Masslich 1997). Because of the initial success of the stocked fish, Colorado Pikeminnow has been stocked every year since 1996. Approximately, 4.7 million Colorado Pikeminnows have been stocked between 2002 and 2015 (Furr 2016).

From 1994-2015, a total of 143,672 hatchery and pond raised Razorback Suckers were stocked into the San Juan River (Furr 2016). From 1994 through 2012, 130,473 Razorback Suckers were stocked with the majority of these fish >300 mm in length (Furr 2016). Between 2009 and 2015, the number released has ranged from 8,316 to 28,419, with an average of 13,678 Razorback Suckers released per year (Furr 2016). Razorback Suckers that have been stocked in the river for six or more overwinter periods have been collected every year since 2001 (Schelicher 2016). Larval Razorback Suckers have been collected each year since 1998, indicating that the stocked fish are successfully spawning in the San Juan River (Farrington et al. 2017).

Stocking locations for both species have varied over the years. In 2016 stocking occurred at several sites in the San Juan River from Montezuma Creek, UT (RM 93) to Verde del Rio Park, Bloomfield, NM (RM 196). Stockings also occurred in the Animas River at Berg Park, Farmington, NM (Animas RM 4) (Furr 2016). The number of and size range of endangered fishes stocked in the San Juan River is reported annually (see http://www.fws.gov/southwest/SJRRIP/).

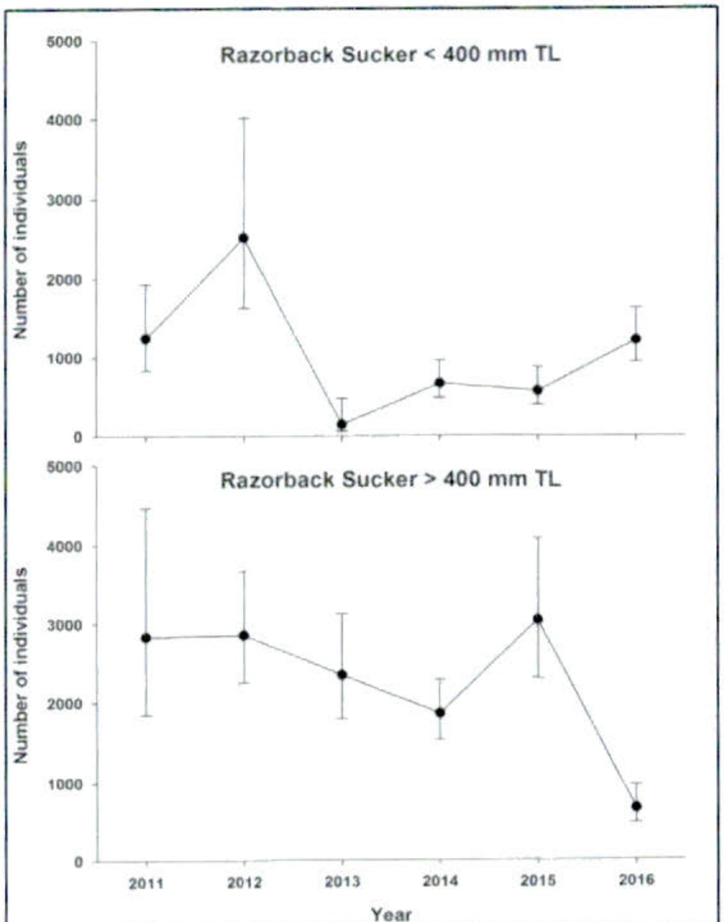


Figure 14. Modeling results of number of individual Razorback Sucker < 400, >400 total length with 95% confidence intervals, between river miles 148-78 (2011-2015) and 148-53 (2016) (SJRRIP 2017a).

ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the ESA, when considering the effects of the action on federally listed species, the Service is required to take into consideration the environmental baseline. Regulations implementing the ESA (50 CFR 402.02) define environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area; the anticipated impacts of all proposed Federal actions in the action area that have already undergone formal or early section 7 consultation; and the impact of State and private actions that are contemporaneous with the consultation in process. All projects previously built or consulted on, and those State, Tribal, or private projects presently being built or considered that deplete water from the San Juan River basin are in the Environmental Baseline for this proposed action. The environmental baseline does not include the effects of the action under review, only actions that have occurred previously.

The Service describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support life stages of the subject species within the action area. When the environmental baseline departs from those biological requirements, the adverse effects of a proposed action on the species or proposed critical habitat are more likely to jeopardize the listed species or result in destruction or adverse modification of designated critical habitat.

FACTORS AFFECTING SPECIES ENVIRONMENT WITHIN THE ACTION AREA

Colorado Pikeminnow and Razorback Sucker

The San Juan River is a tributary to the Colorado River and drains a basin of approximately 65,000 km^2 (25,000 mi^2) located in Colorado, New Mexico, Utah, and Arizona (Reclamation 2003). From its origins in the San Juan Mountains of southwestern Colorado at an elevation exceeding 4,250 m (13,943 ft), the river flows westward through New Mexico, Colorado, and into Lake Powell, Utah. The majority of water that feeds the 570 km (345 mi) of river is from the mountains of Colorado.

From a water resources perspective, the area of influence for the proposed project begins at the inflow areas of Navajo Reservoir, and extends west from Navajo Dam approximately 359 km (224 mi) along the San Juan River to Lake Powell. Navajo Dam is operated and maintained by Reclamation to store water for consumptive uses, provide irrigation, flood control, generate hydroelectric power, and provide recreational and fishery activities (Reclamation 2003). Under these purposes Navajo Dam regulates the majority of the timing and magnitude of San Juan River flows (Reclamation 2003). The major perennial tributaries in the project area are the Los Pinos, Piedra, and Navajo (upstream of Navajo Dam), Animas, La Plata, and Mancos rivers, and McElmo Creek - downstream of Navajo Dam (Figure 1). There are also numerous ephemeral arroyos and washes that contribute little flow to the San Juan River, but large sediment loads.

In the Final Environmental Impact Statement for Navajo Reservoir Operations, Reclamation stated changes in the river ecosystem and biodiversity associated with the historical San Juan River occurred after installation of Navajo Dam (1957-1963). The reservoir physically altered the San Juan River and surrounding terrain and modified the pattern and quality of flows downstream (Holden 1999; Reclamation 2002, 2006; Service 2006). Similar to rivers downstream of other dam operations in the southwestern United States, the San Juan River below the dam became clearer due to sediment retention. Downstream water also became colder, because water is released from the hypoliminal layer deep in the reservoir. All species of plants and animals that existed along the river channel were affected to varying degrees (Reclamation 2006). The disruption of natural patterns of flow caused changes to the vegetation along the riverbanks by altering the previously established conditions under which the plants reproduced and survived. Compounding these changes has been the intentional and non-intentional introduction of nonnative species. These include fish that compete with and prey on native species (Reclamation 2002) and plants that encroach on the river and change channel morphology (Service 2006).

Documentation of historical fish collections in the San Juan River drainage indicate Colorado Pikeminnow once inhabited reaches above what is now Navajo Dam and Reservoir near Rosa, New Mexico which is no longer present as it was inundated by Navajo Reservoir (Platania and Young, 1989). Documentation of Razorback Sucker is lacking but the species likely occurred as far upstream as Rosa, New Mexico (Ryden 1997). The creation of Powell (downstream) and Navajo (upstream) reservoirs resulted in the direct loss of approximately 161 km (100 mi) of San Juan River habitat for the Colorado Pikeminnow and Razorback Sucker (Holden 2000). Since completion of Navajo Dam in 1963, the accompanying fish eradication program, physical changes associated with the dam, and barriers to movement, wild Colorado Pikeminnow and Razorback Sucker have been eliminated from the upper San Juan River upstream of Navajo Dam. In addition to the changes caused to the river by dam operations, there were changes to how nearby lands were used (Reclamation 2002). Irrigation water provided by Navajo Dam contributed to large agricultural developments in this arid region (Abell 1994, Blanchard et al. 1993, Thomas et al. 1998).

Navajo Reservoir stores water for the Navajo Indian Irrigation Project (NIIP), the Hammond Irrigation Project, and various municipal and industrial uses making it possible to nearly double the amount of irrigation in the basin. At present, NIIP is authorized to deplete 280,600 AFY from the reservoir for irrigation south of Farmington (Service 2009) with a current modeled average annual depletion from the San Juan River of 206,500 AFY (SJRRIP 2017b). This project accounts for the largest single diversion in the basin (Service 2009). In the future, the use of San Juan River water is expected to increase (Reclamation 2002). These demands will further affect the river and the native species dependent on the river. This will occur through flow diversions that reduce habitat required by individual life-stages and may result in mortality through entrainment and impede fish passage. Indirectly, effects result from decreased water quality, as a result of the transportation of sediment, trace elements, metals, salts, pesticides, and nutrients from irrigated lands through seepage and return flows (Blanchard et al. 1993; Reclamation 2002; Thomas et al. 2008). In addition to the effects of Navajo Reservoir over the last century, the San Juan River has been diverted downstream of the dam for a variety of uses, resulting in degraded return flows to the river, including variously-treated municipal wastewater, industrial wastewater, and agricultural, urban, and stormwater runoff and seepage (Abell 1994, BIA 1999, Service 2009).

Although there are impacts to the river ecosystem from dam construction itself, dams have many impacts that continue after the structure is complete. Dams affect the physical, chemical, and biological components of a stream ecosystem (Williams and Wolman 1984, Collier et al. 2000, Service 1998, Mueller and Marsh 2002). Some of these effects include, a reduction in lateral channel migration, channel scouring, transformation of riverine habitat into lake habitat, channel narrowing, changes in the riparian community, diminished peak flows, changes in the timing of high and low flows, and a loss of connectivity between the river and its flood plain (e.g., Sherrard and Erskine 1991, Power et al. 1996, Kondolf 1997, Polzin and Rood 2000, Collier et al. 2000, Shields et al. 2000). Of the effects dams have on river ecosystems, transformation of riverine habitat into lake habitat, blockage of fish passage, change in water temperature, changes in the timing and magnitude of high and low flows, water depletions, changes in channel morphology, fish entrainment, and decreases in water quality are discussed in greater detail below. These conditions, plus nonnative species predation and competition adversely affect both endangered fishes and their critical habitat in the San Juan River.

Transformation of Riverine into Lacustrine Habitat

Lake Powell reservoir inundated the lower 87 km (54 mi) of the San Juan River and Navajo Reservoir inundated another 43 km (27 mi) upstream (Figure 11). Thus, the two reservoirs reduced riverine habitat for Colorado Pikeminnow and Razorback Sucker from about 523 km (325 mi) to 362 km (225 mi). At the upstream end, Navajo Reservoir prohibited migration to and inundated potential spawning areas in the upper San Juan River (Holden 2000).

The reduction in the length of riverine habitat likely reduces the contribution of larval fish to overall San Juan River populations for each endangered fish. Larvae of Razorback Sucker and Colorado Pikeminnow drift downstream until suitable nursery habitat is encountered (backwaters or other low velocity areas) (Holden 2000). Because the lower end of the San Juan River has been truncated 87 km (54 mi) there are fewer miles of available nursery habitat for drifting larvae, especially when spawned lower in the San Juan River (Farrington et al. 2017). The distance larvae drift is a consequence of water velocity and channel complexity, with higher complexity resulting in more low velocity habitat (Dudley and Platania 2000, Lamarra and Lamarra 2017). Some wild larval Colorado Pikeminnow in the Green and Colorado River systems have been shown to drift up to 322 km (200 mi) from spawning areas, while others encounter and use nursery areas only a few miles below the spawning areas (Trammell and Chart 1999). In the San Juan River, neutrally buoyant passively drifting particles (beads), which may simulate larval, and hatchery reared larvae were released during ~2,500 cfs river flows (Dudley and Platania 2000). The results of this study indicated larvae hatched at Hogback diversion could drift into Lake Powell reservoir within three days (~255 km [159 mi]). Because of the many predators present in Lake Powell reservoir (Francis et al. 2017) and lack of riverine nursery habitat, larval survivorship may be low in Lake Powell reservoir.

In 2002, with receding pool elevations in Lake Powell reservoir, sediments deposited in the historical San Juan River channel redirected the flow over a bedrock shelf forming a large waterfall (Cathcart et al. 2017; Figure 11 [~RM 0] and Figure 15). The waterfall is impassable to fish (Ryden and Ahlm 1996, Durst and Francis 2016). Thus for those larvae that do drift into and survive in Lake Powell reservoir, movement upstream and contribution to the San Juan

River population is prohibited (Durst and Francis 2016).

Larval native fish that drift into Lake Powell reservoir has a high risk of mortality due to predation by several predatory fish species not native to the San Juan and Colorado River basins. These species include piscivorous fish such as Largemouth Bass, Smallmouth Bass, Striped Bass, Walleye, or Crappie (Francis et al. 2017). Prior to the formation of the waterfall on the San Juan River arm of Lake Powell reservoir, Striped Bass were shown to migrate from Lake Powell reservoir as far upstream as the Public Service Company of New Mexico (PNM) weir (RM 166) (Davis 2003). In 2000, 432 Striped Bass were captured during fish sampling trips in the San Juan River. The contents of 38 stomachs were analyzed and native suckers were found in 41% (Davis 2003). One of the benefits of the waterfall on the San Juan River arm of Lake Powell reservoir is the restriction of upstream movement by these fish. Although the waterfall becomes inundated when the reservoir is >85% full and this last occurred in 2011 for a two week period (Durst and Francis 2016, McKinstry 2017).

Figure 15. Waterfall which developed on the San Juan River (~ RM 0) in 2002

At the upstream end of the San Juan River, the Navajo Reservoir lake habitat and downstream tailwater was converted into a recreational fishery. To reduce and/or eliminate competition and predation between native fish and the nonnative fishery, a rotenone project was completed in 1962. The New Mexico Department of Game and Fish applied rotenone (a chemical poisonous to fish), from the Pine River (24 km [15 mi]), the Navajo River (9.6 km [6 mi]), and the San Juan River (120 km [75 mi]) (Olson 1962). Fourteen species of fish were eliminated in the treated section of river (Olson 1962). Fish were effectively killed from the Colorado state line, near Rosa, New Mexico, down to Fruitland, approximately 64 km (40 mi) below Navajo Dam (Olson 1962). Included in the list of fish eliminated was Colorado Pikeminnow (Olson 1962). The number of fish killed was not recorded because of the large scale of the project. However, the two most abundant species in the river at that time were Flannelmouth Sucker and Roundtail Chub as they were reported as composing nearly one-half of the total number of fish killed

(Olson 1962). Largemouth Bass and Smallmouth Bass, Channel Catfish, Black Crappie, Rainbow Trout, Bluegill, Kokanee Salmon, and Northern Pike are now present in the reservoir for recreational fishing.

The transformation of riverine habitat into lacustrine habitat had the following impacts on Razorback Sucker and Colorado Pikeminnow:

1) Although adult Razorback Sucker appear to be able to use portions of Lake Powell and are able to make transbasin (Colorado River to San Juan River) movements (Platania et al. 1991, Durst and Francis 2016), approximately 130 km (81 mi) of river was inundated and no longer provide suitable habitat for all life stages of both fish.
2) Nursery habitat for both species was reduced to that below Navajo Reservoir and that which had not been inundated when Lake Powell reservoir was filled.
3) The reservoirs support and promote game fish management. Consequently the native fish community, including Razorback Sucker and Colorado Pikeminnow, was treated with a piscicide (Olson 1962, Holden 1991, Quartarone and Young 1995). One of the long-lasting effects was the reduction and eventual extirpation of Roundtail Chub from the San Juan River (Carman 2006). This species is a known prey item of Colorado Pikeminnow (Vanicek and Kramer 1969).
4) Nonnative game fish were stocked in Powell and Navajo reservoirs. Nonnative fish, especially those that are piscivorous as adults, are believed to limit the success of Colorado Pikeminnow and Razorback Sucker recruitment and considered biological threats to the species (McAda and Wydoski 1980, Minckley 1983, Osmundson 1987, Tyus 1985, Ruppert et al. 1993, Bestgen 1997, Bestgen et al. 1997, Service 1998, McAda and Ryel 1999, Muth et al. 2000).

Blockage of Fish Passage
Like other major dams on the Colorado River and its tributaries, Navajo Dam reduced the range of Colorado Pikeminnow and Razorback Sucker by blocking fish passage. Native fish once could move unimpeded from the San Juan River into the Colorado River, its tributaries and return. They are now confined to a relatively short reach of 362 km (~225 mi) of riverine habitat between Navajo Dam and the inflow of the San Juan River with Lake Powell reservoir, a location which varies based on the elevation of Lake Powell reservoir (Durst and Francis 2016, Cathcart et al. 2017). Razorback Sucker and Colorado Pikeminnow that may have been trapped above the Navajo Reservoir have likely all died or were killed during the 1962 piscicide treatment (Olson 1962, Holden 1999). Thus, populations of these fishes are unlikely to be upstream of or in Navajo Reservoir and blocked from downstream movement by the dam. In addition to Navajo Dam, diversion structures constructed for irrigation and municipal uses along the river have impeded or restricted fish passage.

In 1997, five San Juan River instream water diversion structures (weirs) were identified as possible impediments to fish passage. These diversion structures, Cudei, Hogback, San Juan Generating Station [PNM], Arizona Power Station [APS], and Fruitland-Cambridge, are within 60 river km (36.5 river miles) of one another, west of Farmington, NM (Figure 4 and Figure 16) and within critical habitat. Movement analyses indicated native fish could move upstream or downstream over all five weirs at certain river flows (Buntjer and Brooks 1997, Ryden 2000a).

Cudei diversion was identified as the highest threat to Colorado Pikeminnow. When radio telemetry studies were initiated on the San Juan River in 1991, only one radio-tagged Colorado Pikeminnow was recorded moving upstream past one of the diversions. In 1995, an adult Colorado Pikeminnow moved above the Cudei Diversion and then returned back downstream (Miller and Ptacek 2000). In 2001–2002, Cudei diversion (RM142) was removed and connected to the Hogback canal, becoming the Hogback-Cudei canal.

During the same time that Cudei diversion weir was removed, blockage of fish passage at Hogback (RM 150) was reduced. Hogback-Cudei diversion was initially an earth and gravel berm structure. It was replaced with a permanent flat-slope riprap dam made of natural-like boulders to act as a non-selective fish passage at low flows (NNDWR 2017a; Figure 17). Depending on operation of the first set of sluicegates, the fish passage is dry at flows below 1,000 cfs (NNDWR 2107c; Figure 17).

Although fish passage may not always be possible at the Hogback-Cudei diversion due to a dry passage, upstream passage has been documented. All Razorback Sucker stocked into the San Juan River and Colorado Pikeminnow when captured (>150 mm in total length) are implanted with a passive integrated transponder (PIT) tag. Through recaptures of these PIT tagged fish (2010-2016) upstream passage has been detected at Hogback with an annual rate of 35% (95% CI: 0-67) for Colorado Pikeminnow and 23% (95% CI: 2-34) for Razorback Sucker (Gilbert 2017; Figure 18). For both fish species, there was no difference in immigration upstream past Hogback diversion and the San Juan River where no barriers to immigration exists (RM 0-RM 152). The 95% confidence intervals around the mean were larger for Colorado Pikeminnow than for Razorback Sucker indicating more precision in the mean for Razorback Sucker than Colorado Pikeminnow. PIT tag antennas are present in the sluiceway but Hogback's VFD pumps currently interfere with the antenna. Thus, it is not known if fish are using the sluiceway for either downstream of upstream passage.

The PNM diversion (RM 166) is also a barrier to fish passage. Funding and technical assistance provided by the SJRRIP and operation and maintenance contracted to the Navajo Nation by the SJRRIP, resulted in construction and operation of a selective fish ladder at PNM diversion since 2003. Both Colorado Pikeminnow and Razorback Suckers have been collected at the fish ladder and passed upstream. For example, from 2003 – 2007, 65,596 native fish were captured and moved upstream including 27 Colorado Pikeminnow and 21 Razorback Suckers (LaPahie 2007). The efficacy of the use of the fish ladder is currently being studied. In 2014, a PIT tag antenna was installed at the downstream face PNM diversion dam. This provided data on the number of fish detected at the antenna compared to the number of fish which found and accessed the fish ladder. In 2014, 3.5% of Razorback Sucker stocked at least one year prior and 26.9% Colorado Pikeminnow detected at the antenna successfully used the fish ladder (Cheek 2015).

The remaining two diversions on the San Juan River identified as impeding fish passage are within 60 river km (36.5 river miles) of one another and just west of Farmington. Both are currently passable at certain river flows. Although fish can move up past the APS diversion (RM 163.3) it acts as a fish barrier when the structure's control gate is closed (Masslich and Holden 1996, Stamp and Golden 2005). Elimination and reduction of upstream fish passage blockage between diversions currently in place in the upper San Juan River increases the probability that the Animas River, which flows into the San Juan at RM 180, will once again be used by both endangered species, increasing the likelihood of population recovery.

At the downstream end of the San Juan River and as discussed previously, a large waterfall (approximately 9 m [30 ft] in height) formed between Lake Powell and the San Juan River. This created an additional upstream fish passage barrier (Durst and Francis 2016; Cathcart et al. 2017) that is not absolute as the waterfall is occasionally inundated when Lake Powell reservoir pool is >85% full (McKinstry 2017). This has occurred approximately one in ten years, on average, and temporarily allows fish access upstream to the remaining 290 river km (180 river miles) of critical habitat in the San Juan River (Durst and Francis 2016). Except for the rare times when the waterfall has been inundated by Lake Powell Reservoir, Colorado Pikeminnow and Razorback Sucker of any life stage that pass over this waterfall cannot return to the San Juan River to contribute to the population. Early phase larvae in the drift especially susceptible to loss from the San Juan River by transportation over the waterfall (Dudley and Platania 2000). Stocked fish, especially the small Colorado Pikeminnow may be highly susceptible to loss over the waterfall. Recaptures of these fish two years post stocking is low (Durst 2017) and may be the result of loss over the waterfall.

Figure 16. San Juan River diversion structures - river mile location denoted in parenthesis.

Some of the fish transported over the waterfall survive within Lake Powell reservoir but then are disconnected from the main San Juan River population. Surveys conducted in 2011 and 2012 in the San Juan River arm of Lake Powell reservoir documented both Colorado Pikeminnow and Razorback Sucker (Francis et al. 2017). Few Colorado Pikeminnows were captured and appeared to be in poor condition but Razorback Sucker was more abundant and appeared healthy. Surveys directly below the waterfall resulted in the detection of as many as 499 (2015) and 470 (2016) unique Razorback Sucker in the spring of those years (Cathcart et al. 2017). It is possible these fish were attempting to move upstream as part of spawning behavior (Cathcart et al. 2017). Razorback Sucker stocked in the San Juan River have been documented to make transbasin movement and was collected in the upper Colorado River, indicating some exchange of individuals from the San Juan River to the upper Colorado River through Lake Powell can occur (Durst and Francis 2016). However, those fish cannot make the return journey into the San Juan River unless the waterfall is inundated.

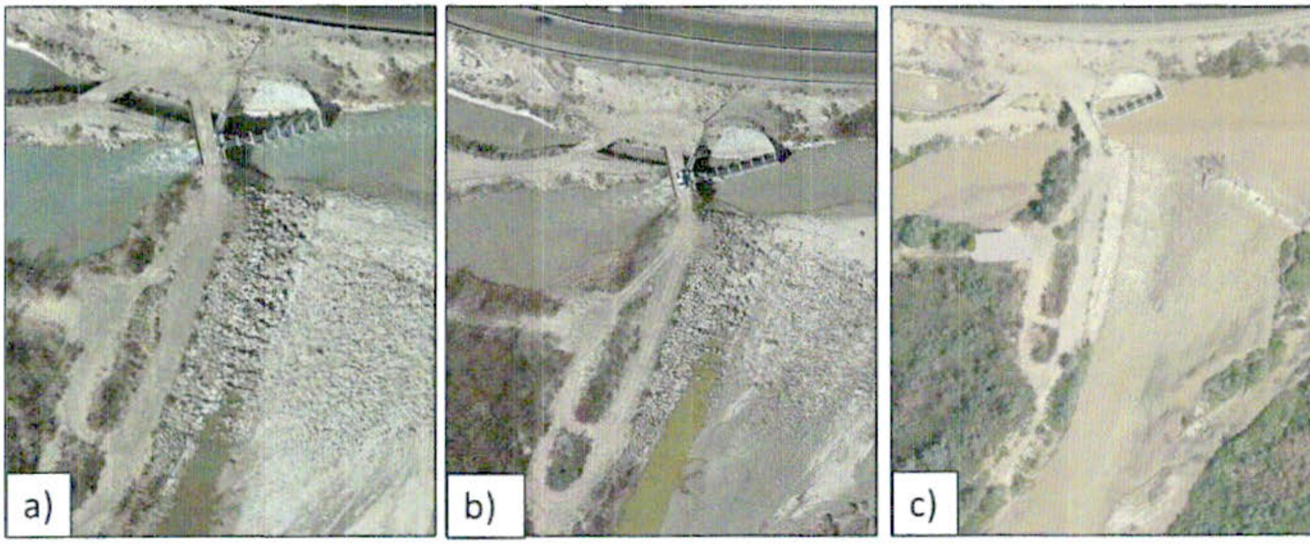


Figure 17. Hogback diversion and fish passage (natural-like boulders). Dry when sluicegates opened and river flow at or below 1,000 cfs; a) 700 cfs, November 2013, b) 1000 cfs, March 2015, c) 730 cfs, August 2016 (sluicegates appear closed).

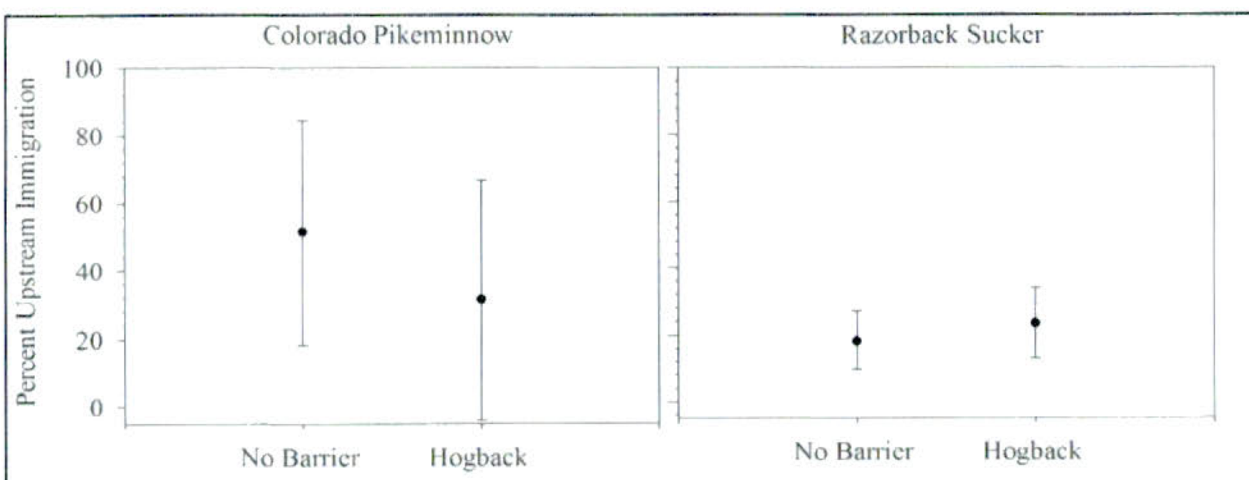


Figure 18. Colorado Pikeminnow and Razorback Sucker upstream immigration rates (2010–2016; mean and 95% CI) for the San Juan River; comparing a section of river where no barrier to immigration is present (RM 0–RM 152) and Hogback diversion (RM 159)

Water Temperature

Below Navajo Dam, summer water temperatures are colder and winter water temperatures are warmer than the pre-dam condition. Lower water temperatures may restrict use of the area by

Colorado Pikeminnow and Razorback Sucker as well as limit spatial and temporal extent of spawning habitat. Colorado Pikeminnow are currently found from near the confluence of the Animas River downstream to Lake Powell, although temperatures in the upper reach of this area may be colder than the species prefers (Durst and Franssen 2014).

The cold water released from Navajo Reservoir limits the potential spawning habitat of the endangered fishes in the San Juan River (Holden 1999, Cutler 2006, Lamarra 2007). Prior to dam construction, water temperatures at Archuleta (approximately 10 km [6.1 mi] below the dam) were warmer from spring through summer and above optimal spawning temperature for Colorado Pikeminnow (20 °C [68 °F]) for approximately two months in the late summer when this species spawns (Holden 1999). Since dam construction, water temperature at Archuleta is rarely over 15 °C (59 °F) likely limits successful spawning by either fish species (Holden 1999, Cutler 2006, Lamarra 2007, Miller 2017). Optimal temperatures for spawning at Shiprock (approximately 125 km [78 mi] below the dam) occur about two weeks later on average than prior to dam construction (Holden 1999, Lamarra 2007). Based on collections of larval Razorback Sucker in the San Juan River and back-calculation spawning dates Razorback Sucker have been able to successfully spawn in the San Juan River at mainstem water temperatures less than 20° C (Farrington et al. 2017). Colorado Pikeminnow spawn later than Razorback Sucker and it is not currently known if certain water temperatures are precluding successful spawning as mainstem temperatures have been approximately 20 °C when successful spawning has been detected (Farrington et al. 2017).

Water temperatures at Shiprock before the construction of Navajo Dam were above 20 °C (68 °F) from approximately mid-June until mid-September (three months) (Holden 1999). Projected temperatures at Shiprock from 1993-1996, during a portion of the 7-year research period, were above 20 °C (68 °F) for more than one month (August) (Holden 1999). Because fish are cold-blooded, their metabolism and growth depend on water temperature. The amount of food eaten, assimilation efficiency, and time to sexual maturity are affected by temperature (Lagler et al. 1977). Cold water typically decreases food consumption, decreases assimilation efficiency, decreases growth rate, and increases the time to sexual maturity (Lagler et al. 1977).

Development time of Colorado Pikeminnow and Razorback Sucker embryos is inversely related to temperature, and survival is reduced at temperatures that depart from 20 °C (68 °F) (Bulkley et al. 1981, Hamman 1982, Bestgen 2008). Marsh (1985) found that for Razorback Suckers, time to peak hatch was nine days at 15 °C (59 °F) and about four days at 25 °C (77 °F) and that the percent of eggs hatched was highest at 20°C (68°F). Bestgen (2008) found that fastest growth of Razorback Sucker occurred at 25.5 °C (77.9 °F). Fast larval growth may be linked to higher survival rates because the faster the larval fish grow, the less time they are highly susceptible to predation.

All Colorado Pikeminnow eggs tested died at incubation temperatures of 15°C (59°F) or lower, and survival and hatching success were maximized near 20 °C (68 °F) (Marsh 1985). Bestgen and Williams (1994) found a relatively wide range of acceptable incubation temperatures above 18 °C (64.4 °F). In addition, Bestgen et al. (2006) found that early hatching Colorado Pikeminnow larvae in the Green River were almost twice the size of late hatching ones because they had more time to grow. Because the combination of a suitable spawning bar (an area of sediment-free cobbles) and suitable temperatures increase longitudinally downstream, there is a greater chance that larvae will be spawned lower in the river and fish will drift into Lake Powell reservoir and be lost from the population. Dudley and Platania (2000) found that drifting larval Colorado Pikeminnow would be transported from the RM 107–130 to Lake Powell reservoir in as little as three days. For those larval fish not carried into Lake Powell reservoir, a delay in spawning (which reduces the amount of time fish have to grow before winter) and overall colder water temperatures (resulting in slower growth) could lead to smaller, less fit juveniles and reduce survival. There is speculation that the large volume of cold water in the upper Green River may be a major reason why larval Colorado Pikeminnow drift so far downstream (Holden 2000). The same pattern may also occur on the San Juan River.

Cold water released from Navajo Dam has affected Razorback Sucker and Colorado Pikeminnow in a number of ways. Water temperatures that were once suitable for spawning for Colorado Pikeminnow near Archuleta are no longer suitable, and, if spawning were to occur near Shiprock, it would be delayed by approximately two weeks compared to pre-dam conditions and thereby desyncing the phenology of their emergence during periods of appropriate food resources. A delay in spawning reduces the amount of time that larval fish have to grow before winter, and colder temperatures reduce growth rate, increasing the amount of time that the larval fish are highly susceptible to predation.

Changes in the Timing and Magnitude of Flows

Natural flow regimes are essential to the ecological integrity of large western rivers (Service 1998) and for the maintenance or restoration of native aquatic communities (Lytle and Poff 2004, Propst and Gido 2004, Propst et al. 2008). The flow regime works in concert with the geomorphology of the basin to establish and maintain the physical, chemical, and biological components of a stream ecosystem (Williams and Wolman 1984, Allan 1995, Collier et al. 2000, Service 1998, Mueller and Marsh 2002). With a natural flow regime streams and rivers retain those ecological attributes with which the native fauna evolved. Some of these ecological attributes and biological components include the native aquatic communities, water temperature, channel formation and migration, the riparian community, connectivity between the river and its flood plain (e.g., Sherrard and Erskine 1991, Allan 1995, Power et al. 1996, Kondolf 1997, Polzin and Rood 2000, Collier et al. 2000, Shields et al. 2000). Equally important is that a natural flow regime is less likely to provide the conditions suitable for the establishment and colonization of systems by nonnative species which evolved under a different set of biotic and abiotic conditions (Propst et al. 2008).

Typical of rivers in the Southwest, the San Juan River was originally characterized by large spring snowmelt peak flows, low summer and winter base flows, and high-magnitude, short-duration summer and fall storm events (Holden 1999). Historically, flows in the San Juan River were highly variable. These ranged from a low of 44 cfs in September 1956, to a high of 19,790 cfs in May 1941 (mean monthly values; USGS gauge Shiprock, NM). For the 49 years of record prior to Navajo Dam a peak spring flow greater than 15,200 cfs occurred 13 times (25% of the time). The highest spring peak flow recorded (daily mean) was 52,000 cfs (June 30, 1927). However, the flows for this period of time do not necessarily represent a "natural" condition because water development began in the basin near the turn of the century and many irrigation projects that diverted and depleted water from the San Juan River were already in place.

The completion of Navajo Dam in 1962 and subsequent dam operations through 1991 substantially altered the natural hydrograph of the San Juan River (Holden 1999; Figure 19) Operations appreciably reduced the magnitude and changed the timing of the annual spring peak. In wet years, dam releases began early to create space in the reservoir to store runoff (Holden 1999). The peak discharge averaged 54% of the spring peak of pre-dam years. The highest mean monthly flow was 9,508 cfs (June 1979), a decrease of more than 10,000 cfs compared to pre-dam years. Base flows were substantially elevated in comparison to pre-dam years. The median monthly flow for the base flow months (August-February) averaged 168% of the pre-dam period (Holden 1999). Minimum flows were elevated and periods of near-zero flow were eliminated with a minimum monthly flow during base-flow periods of 250 cfs compared to 65 cfs for the pre-dam period (Holden 1999). Overall the hydrograph was flatter.

From 1991–1997 the SJRRIP conducted research which included flow manipulation in coordination with Reclamation to determine fish population and habitat responses when Navajo Dam was operated to mimic a natural hydrograph (Holden 1999; Figure 19). Reclamation's flexibility in managing flows and the technical input from the SJRRIP during this period of experimental flow manipulations allowed researchers an opportunity to develop flow recommendations. During this time period, a more natural hydrograph was maintained.

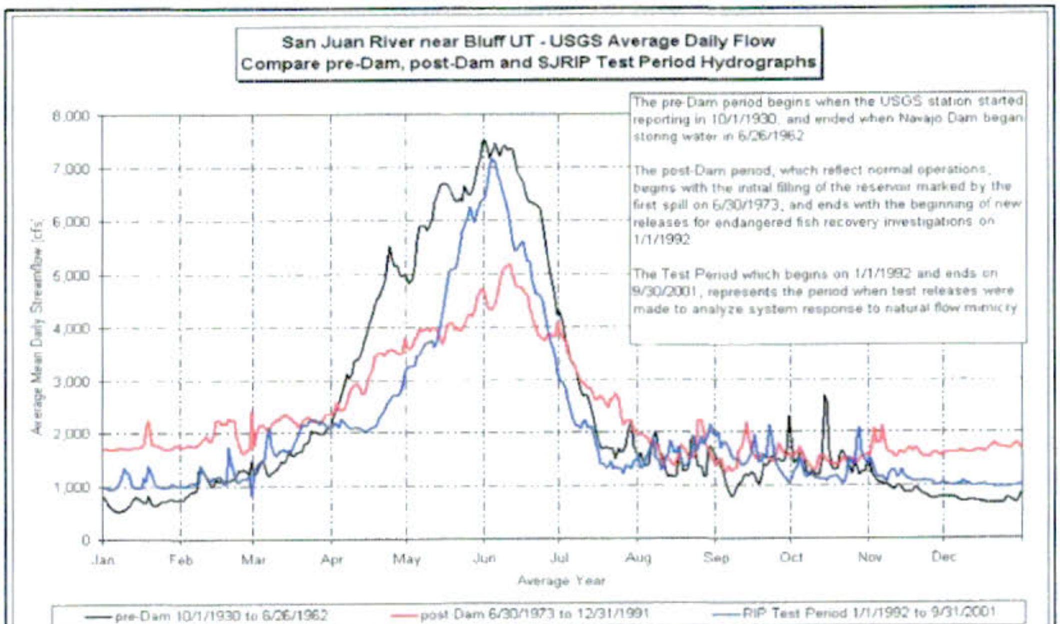


Figure 19. San Juan River flow prior to impoundment, from 1973–1991, and San Juan Recovery Implementation Program (RIP) test period.

Navajo Dam has been operated to meet the Flow Recommendations since their publication in 1999 (Holden 1999; Figure 20). A natural hydrograph has been mimicked but not replicated. Achieving peak magnitudes is no longer possible because of release restrictions at the dam. The more natural hydrograph created by the Flow Recommendations is an improvement over the 1962-1991 hydrograph. With the reoperation of Navajo Dam, native fish may receive proper flow cues at the proper times to trigger spawning and more suitable habitat may be created and maintained for spawning and rearing of young fish.

A second factor which may affect the timing and magnitude of flows in the San Juan River is climate change. In the Colorado River basin, records document an annual mean air surface temperature increase of approximately 1.4 °C (2.5 °F) over the past century with temperatures today at least 0.8 °C (1.5 °F) warmer than during the 1950 drought (Lenart et al. 2007, NRC 2007). Udall (2007) found that multiple independent data sets confirm widespread warming in the West. Both in terms of absolute degrees and in terms of annual standard deviation, the Colorado River Basin has warmed more than any region of the United States (NRC 2007).

Annual Flow Statistics		# OF DAYS MEETING FLOW				YEARS MEETING GOAL			
YEAR	Hydrograph Released	>9,700 cfs	>7,760 cfs	>4,850 cfs	>2,425 cfs	>9,700 cfs	>7,760 cfs	>4,850 cfs	>2,425 cfs
	Minimum Target	*5*	*10*	*21*	*10*	*10*	*6*	*4*	*2*
1998	2-wk	0	4	35	66	1	1	0	0
1999	1-wk	0	1	31	72	2	2	0	0
2000	ns 1-wk	0	0	6	40	3	3	1	0
2001	2-wk	0	4	36	56	4	4	0	0
2002	none	0	0	0	0	5	5	1	1
2003	none	0	0	0	14	6	6	2	0
2004	none	0	0	1	26	7	7	3	0
2005	full+	11	18	52	85	0	0	0	0
2006	1-wk	0	0	8	24	1	1	1	0
2007	2-wk	0	3	21	56	2	2	0	0
2008	3-wk	6	25	62	121	0	0	0	0
2009	1-wk	0	0	20	41	1	1	1	0
2010	none	0	0	0	19	2	2	2	0
2011	1-wk	0	7	12	29	3	3	3	0
2012	1-wk	0	0	6	10	4	4	4	0
2013	none	0	0	0	0	5	5	5	1
2014	none	0	0	0	22	6	6	6	0
2015	none	0	1	16	38	7	7	7	0
2016	30 days	0	8	36	54	8	8	0	0

Figure 20. Flow Recommendations and Navajo Dam operations 1998–2016. Primary flow target specify flow rate (e.g. >9,700cfs) of a minimum duration (e.g. 5 days) and a secondary target of a maximum duration between occurrences (e.g. not to exceed 10 years without reaching target). Table provides the number of days a primary target was met and years between meeting that target (Reclamation 2017).

One expected outcome of increased air temperature is increased evaporation from Navajo Reservoir. An historical and ongoing adverse effect of Navajo Reservoir on the endangered fishes in the San Juan River is the evaporative loss of water. Approximately 27,400 acre-feet (AF) of water are currently lost annually from the reservoir (Reclamation 2003). Water and air temperature are important elements in calculating evaporation rate. Unless humidity increases and wind decreases at Navajo Reservoir, because of climate change, an increase in air temperature will lead to increased evaporation loss from the reservoir impacting the amount of water available for all uses. In addition, the Animas-La Plata project diverts water from the Animas River into Lake Nighthorse with an evaporative loss of approximately 2,700 AFY, although additional increases due to climate change are not included (Service 2009).

In addition to increased depletions due to evaporative losses, Hoerling (2007) projects that in the Southwest, relative to 1990–2005, model simulations indicate that a 25% decline in stream flow will occur by 2030 and a 45% decline will occur from 2035–2060. Broad consensus among climate models indicates the Southwest will get drier in the 21st century and transition to an even more arid climate is already under way (Seager et al. 2007). Only one of 19 models demonstrated a trend toward a wetter climate in the Southwest. These models project a decrease in runoff of 8 to 25% and the Colorado River basinwide snow water equivalent is projected to decline by 13 to 38% from 2025 to 2085 (Christensen and Lettenmaier 2006). Ray et al. (2008) and Udall (2007) summarize several studies which all point to an expected decline in runoff in the Colorado River basin. Although these studies do not model the San Juan River independent of the entire Colorado River basin, it is reasonable to expect that a similar pattern will occur.

The consequence of increased evaporation and decreased runoff is less water available to meet all demands. This could impact the magnitude of flows released for endangered fishes. The Flow Recommendations were developed based on the pre-dam historical hydrograph. Spring flows from 2,500 to 10,000 cfs are scheduled to occur, on average, in intervals from 2 to 10 years, respectively (Holden 1999; Figure 20). Releases from the dam are timed with spring runoff from the Animas River to meet the high target flows as BOR's maximum release from Navajo Dam is 5,000 cfs. It may become more challenging to meet the higher target flows in the future if Navajo Reservoir storage is reduced or runoff from the Animas River decreases or changes in timing. This is particularly important because when high flows are reduced in magnitude or frequency, nonnative vegetation encroaches on the channel causing the channel to simplify (Bliesner et al. 2008). Habitat complexity is the desirable condition for Colorado Pikeminnow and Razorback Sucker. Releasing high spring flows to maintain and create suitable habitat for the endangered fishes will continue to be an important element of the Flow Recommendations in the future.

Climate change is occurring and will continue to increase air temperatures in the Colorado River basin. The most likely consequences of warmer air temperatures are increased evaporation, evapotranspiration, and decreased runoff. An additional effect of climate change is earlier spring runoff. To the extent that climate change reduces the amount of water available in the river, it is anticipated that negative impacts could occur to the endangered fishes because simultaneously there will be an increased demand for water for human uses.

Water Depletions

As discussed previously, natural flow regimes are essential to the ecological integrity of large western rivers (Service 1998) and for the maintenance or restoration of native aquatic communities (Lytle and Poff 2004, Propst and Gido 2004, Propst et al. 2008). The flow regime works in concert with the geomorphology of the basin to establish and maintain the physical, chemical, and biological components of a stream ecosystem (Williams and Wolman 1984, Allan 1995, Collier et al. 2000, Service 1998, Mueller and Marsh 2002). Water development and associated depletions play a major role in limiting the amount of water available for achieving the Flow Recommendations.

Significant depletions and redistribution of flows of the San Juan River have occurred as a result of major water development projects including the Animas-La Plata, NIIP, and the San Juan-

Chama projects. By 1999, the levels of water development had reduced average annual flows at Bluff, Utah by 30% (Holden 1999). By comparison, the Green and Colorado Rivers had been depleted by approximately 20% (at Green River) and 32% (at Cisco), respectively (Holden 1999). These depletions likely contributed to the decline in Colorado Pikeminnow and Razorback Sucker populations (Service 1998). Depletions are expected to increase as full development of water rights and water projects occurs. To the extent that water is exported out of the basin (San Juan-Chama Project) or consumptively used (e.g., evaporation from fields, irrigation canals, reservoir surface) it is not available to maintain flows within the river. Maintenance of instream flows is essential to the ecological integrity of large western rivers (Service 1998).

Water depletion projects that were in existence prior to November 1, 1992, are considered to be historical depletions because they occurred before the initiation of the SJRRIP. These include Fruitland-Cambridge and Hogback-Cudei (Service 2009). Projects that began after this date are considered new projects. On May 21, 1999 the Service issued a BO (R2/ES-TE CL 04-054) determining that new depletions of 100 af or less, up to a cumulative total of 3,000 af, would not: 1) Limit the provision of flows identified for the recovery of the Colorado Pikeminnow and Razorback Sucker; 2) be likely to jeopardize the endangered fish species; or 3) result in the destruction or adverse modification of their critical habitat. Consequently, any new depletions under 100 AF, up to a cumulative total of 3,000 AF, may be incorporated under the May 21, 1999, BO, but would still require consultation.

Consultations contributing to the baseline conditions (depletions) used reoperation of Navajo Reservoir in accordance with the Flow Recommendations as part of their section 7 compliance. This includes Fruitland-Cambridge (identified as Fruitland in Service 2009) historical and baseline depletion of 7,898 AFY. Hogback-Cudei depletions (13,000 AFY) were consulted upon in 2011 (Service 2011). Some water development projects have been completed (e.g., PNM Water Contract with Jicarilla Apache Nation), some are partially complete (e.g., NIIP), and some have not been fully implemented (e.g., Animas-La Plata Project). As these projects are fully implemented, the amount of water available for operational flexibility will decrease.

As discussed under "Changes in the Timing and Magnitude of Flow" it is anticipated that climate change will create additional depletions to the San Juan River. At this time, the magnitude and timing of the depletions cannot be predicted with certainty. However, increased air temperatures will increase evaporation from all water surfaces, increase plant evapotranspiration, and decrease snow water equivalent, reducing the amount of water in the basin. Several studies project a decrease in stream flow from 8 to 45% depending on the model used, the time frame, and the methods (Christensen and Lettenmaier 2006, Hoerling 2007, Seager et al. 2007, Udall 2007, Ray et al. 2008). Although the San Juan River was not modeled independent of the entire Colorado River basin in these studies, based on the projections of the IPCC (2007) for warmer temperatures, an increase in the frequency of hot extremes and heat waves, it is reasonable to expect that there will be a decrease in stream flow in the future.

Changes in Channel Morphology

The timing and magnitude of flows and the amount of sediment input into the system influences channel form and morphology, which creates habitat for fish and other aquatic organisms. The channel of the San Juan River has narrowed considerably since the 1930s because of upland habitat degradation, erosion, and the invasion of nonnative vegetation (Holden 1999). These changes to the active river channel have been exacerbated by the reduction of high spring peak flows following the closure of Navajo Dam (1962). An overall channel narrowing increases water velocity and reduces habitat complexity, ultimately decreasing habitat important to young Colorado Pikeminnow and Razorback Sucker (Service 2006).

It is difficult to know the natural width of the San Juan River. During the 1930's, large amounts of sediment entered the river in response to upland habitat degradation and erosion caused by overgrazing which may have increased channel width (Holden 1999). The 1930's, aerial photography shows a sand-loaded system, and where the channel was not confined; the river was broad during high flows and braided during low flows (Holden 1999). But between 1943 and 1973, the suspended sediment load dropped in half (20 million tons/year) from highs in 1930-1942 of 47 million tons/year. Within that span of time (1930's to 1950's), the channel narrowed by an average of 29% between the present day site of Navajo Dam (RM 224) and RM 67 (Holden 1999).

Channel narrowing before 1962 was most likely due primarily to the reduction in sediment load but in later years corresponds to the modification of flows by Navajo Dam and the introduction and encroachment of nonnative vegetation (Holden 1999). Reduced peak flows after Navajo Dam was completed (1962 to 1991) exacerbated the growth of exotic riparian vegetation (primarily salt cedar and Russian olive). These nonnative trees armor the channel banks and contributed to the creation of a narrower channel because of their resistance to erosion (Bliesner and Lamarra 1995). Reduced flows and nonnative vegetation led to more stabilized channel banks, a deeper, narrower main channel, and fewer active secondary channels (Holden 1999), again increasing water velocity and reducing habitat complexity.

Since Flow Recommendations were implemented (1992), a more natural hydrograph has been mimicked with peak flows higher than those released after Navajo Dam closure. However, backwater habitat, an important nursery area for fish, has not always been maintained. This habitat type reached a low in 2003 at about 20% of the peak value (Bliesner et al. 2008). Trends reversed in 2004 and in 2005 but remained low in 2006, a dry year with a small release from the reservoir (Bliesner et al. 2008). When Navajo Dam operations and Animas River runoff resulted in a combined flow of eight days at 8,000 cfs (at Four Corners) in 2016, a 240% increase in backwaters occurred from the prior year (Lamarra and Lamarra 2017).

Channel complexity, an important component of Razorback Sucker and Colorado Pikeminnow habitat, can be measured as the number and area of islands present. Between 1950 and 1960 there was a decrease in island area (Bliesner and Lamarra 2004). This was due to vegetation encroachment on the channel and long secondary channels cut off as the floodplain stabilized. The increase in vegetation along the river during this period coincided with a long-term drought, which contributed to channel simplification (Bliesner and Lamarra 2004). Between 1960 and 1988, island area increased to the levels that were present in 1934 (Bliesner 2004). The 10 years prior to 1988 were the wettest on record, so although salt cedar and Russian olive continued to increase in the floodplain, the large flows opened secondary channels, creating large islands. From 1992-2007, there was a cumulative reduction in island count of about 25% (Bliesner and

Lamarra 2007). Over that time period, island count showed a significant ($p=<0.01$) downward trend with time, indicating channel simplification. The greatest loss of islands occurred in Reach 5 where channel simplification is of particular concern because this reach includes known spawning habitat for Colorado Pikeminnow. After the large peak flows in 2015, a net gain of islands (55) occurred with the highest count in Reach 5 (Lamarra and Lamarra 2017), indicating that flows at or above 8,000 cfs can continue to maintain necessary fish habitat.

Total wetted area, another measure of habitat complexity, shows a 10% decreasing trend overtime (Bliesner and Lamarra 2007). Again, this channel simplification has been attributed to extended drought and encroachment of Russian olive and salt cedar. Once vegetation is established it becomes an effective trap for fine sediments by creating increased channel roughness and low boundary velocities. Once vegetation is established on main channel margins and within secondary channels it is more difficult for those channels to be flushed and for new ones to be created during high flow years (Bliesner and Lamarra 2007). Yet, high peak flows like those in 2016 caused a change in river morphology and resulted in an increase in total wetted of 4%, reversing the prior trend of a 1% annual decrease (Lamarra and Lamarra 2017).

At current population levels, it is unknown if habitat is a limiting factor for either the Razorback Sucker or Colorado Pikeminnow adults or larvae. The trend in habitat has been towards channel simplification and narrowing, reduced wetted area, and a loss of islands (Bliesner et al. 2008). Yet, 2016 confirmed that flow manipulation can still affect geomorphic process and to a certain extent restore habitats valuable to endangered fishes (Lamarra and Lamarra 2017).

Diversion Structures

There are numerous points of water diversion on the San Juan River for irrigation and energy production. In addition to acting as fish passage impediments, most of these structures do not have screens or other devices to prevent fish from entering (Holden 2000; Lyons et al. 2016; Table 3). In more recent years, efforts have been put forth to reduce entrainment by some diversions in the system.

Entrainment of fish by Hogback canal has been reduced with the construction of a fish barrier weir wall in 2013. Prior to the weir installation, sampling in the canal in 2005 resulted in collection of 140 Colorado Pikeminnow, composing three size classes (Renfro et al. 2006). Most of the individuals (92%) were between 33-65 mm standard lengths (1.3-2.5 in) that had been stocked the October (2004) prior to sampling. About 7% of fish entrained and captured, were older fish between 130-187 mm in length (5.1-7.4 in) and 4% were 210-264 mm (8.3-10.4 in). Colorado Pikeminnow was caught from 0.5 to 17.8 canal miles from the diversion structure (Renfro et al. 2006). After the Hogback-Cudei fish barrier weir wall was installed, tests assessing the reduction in entrainment were conducted using two ages of larval Razorback Sucker, subadult hatchery Colorado Pikeminnow and Razorback Sucker, and wild subadult and adult Flannelmouth Sucker and Bluehead Sucker (McKinstry et al. 2016, Brandenburg et al. 2017). The results indicated that when water operations were conducted as engineered, the fish barrier weir wall prevented entrainment of some fishes at certain life-stages. Younger Razorback Sucker larvae (78.3%) were entrained more often than older larvae (46.6%). There may have been behavioral differences between hatchery and wild subadult and adult fish as no wild suckers were entrained but 31.9% of stocked Colorado Pikeminnow (Brandenburg et al. 2017) was captured in the irrigation canal and a smaller portion of stocked Razorback Sucker (McKinstry et al. 2016).

Table 3. Water diversion, fish entrainment prevention, and density data for Colorado Pikeminnow and Razorback Sucker on the San Juan River (adapted from Lyons et al. 2016).

Location (river mile)	Stocking locations within movement distance*	Fish entrainment prevention	Diversion operation	Colorado Pikeminnow density**	Razorback Sucker density***
Bloomfield Irrigation District (217.8)	0/0	Unknown – not visited	All months	0.49 (0.00)	No data
Turley-Manzanares (214.4)	0/0	Yes, debris screen 100x 100 mm	All months	1.19 (0.01)	No data
Hammond Conservancy District (209.3)	0/0	Unknown – not visited	April-October	2.39 (0.04)	No data
Bloomfield Municipal Diversion (197.9)	0/1	Unknown	Will be relocated	2.65 (0.14)	0.34
Western Refining (196.3	0/1	Yes,10x10 mm openings	Not in service	2.79 (0.17)	0.50
Williams Field Services Kutz Plant (195.6)	1/1	Unknown – not visited	January - August	3.18 (0.18)	0.50
Farmers Mutual ditch (179.6)	2/4	Unknown – not visited	Unknown	---	---
Fruitland-Cambridge canal (178.4)	2/4	None	April-November	4.75 (0.41)	1.48
PNM (166.7)	2/6	Yes, 106x152 mm screen	Unknown	5.24 (0.49)	4.32
Jewett Valley ditch (166.3)	3/6	Unknown – not visited	April-November	5.25 (0.49)	4.32
APS (163.7)	4/5	Yes, 10x10 mm screen	All months	5.32 (0.49)	7.72
Utah Pipe diversions 3, 2,1 (82.3, 81, 80.7)	Unknown	Milk crate at RM 80.7, otherwise unknown	Unknown	----	----

*Movement distance is function of species, whether the fish has been recently stocked into the river, and upstream or downstream direction of movement. See Lyons et al. 2016 for details. (Colorado Pikeminnow/Razorback Sucker)

** Density is fish collected per hour of electrofishing with fish per 100 m^2 in parenthesis

*** Density is fish collected per hour of electrofishing

Entrainment and the presence of fish prevention devices have been assessed for other diversions (Renfro et al. 2006; Lyons et al. 2016). In 2005, fish were found to be entrained in the Fruitland-

Cambridge canal, with 19 of 479 fish identified as Colorado Pikeminnow (Renfro et al. 2006). Fish were also captured in Farmer's Mutual (n=39) and Jewett (n=166) canals although none of the fish entrained was Colorado Pikeminnow or Razorback Sucker. Lyons et al. (2016) investigated which diversion structures on the San Juan River had fish entrainment prevention structures, the months in which water diversion occurred, and density of Colorado Pikeminnow and Razorback Sucker within the vicinity of each diversion (Table 3). Of the 14 diversions identified in the San Juan River, five had some type of structure that would reduce fish entrainment, with one of those five structures being a milk crate attached to a pipe. Fish that enter a diversion face an uncertain fate as some systems return water in a manner that fish can survive and some system do not (Lyons et al. 2016). The Lyons et al. (2016) study did not include Hogback-Cudei fish barrier weir but did identify the future construction of a fish barrier weir at the Fruitland-Cambridge canal, part of the Proposed Action.

Entrainment is often a function of the proportion of water taken by a diversion. Trammell (2000) reported that after stocking 500,000 larval Colorado Pikeminnow below Hogback Diversion structure, 63 larvae were collected from the Cudei Diversion canal. This number represented 0.013% of the total stocked and the catch rate was 4.39 Colorado Pikeminnow/100 m3 of water sampled. The fish barrier weir wall at Hogback-Cudei canal greatly reduces fish entrainment yet, rates of entrainment are still associated with the proportion of water diverted (Brandenburg et al. 2017). As an example of the proportion of the river diverted, Hogback-Cudei, Fruitland-Cambridge, Hammond Conservancy District, and Bloomfield Irrigation District each divert 10-20% of river flow annually with the greatest river annual diversion of 57% at one structure (Lyons et al. 2016).

For those diversion structures that do have mechanism to reduce entrainment, impingement of fish on these structures can be a concern. The likelihood of impingement is determined by a couple of factors. One factor is the size of the fish. Smaller fish may be able to fit through entrainment reduction mechanisms such as trash racks, while larger fish are more likely to become impinged. However, another factor related to impingement is a fish's swimming abilities and the velocity of water entering a diversion. For juvenile and adult Colorado Pikeminnow and Razorback Sucker, sustained swimming ability and burst speed estimates are 1.6–3.8 ft/sec and 13.1–23.0 ft/sec, respectively (Stamp and Golden 2005, NNDWR 2016).

Water of Sufficient Quality

Water quality is of concern in the San Juan River Basin with many water bodies, including the San Juan River, being impaired for one or more factors, including metals, sediment, salinity, temperature, fecal matter, and dissolved oxygen (Service 2006). Land uses within the basin contribute metals, salts, fossil fuel residuals (e.g., polycyclic aromatic hydrocarbons (PAHs)), and pesticides to the San Juan River and its tributaries. The EPA (1979), Abell (1994), Reclamation (2002), and Thomas et al. (1997, 1998) conducted comprehensive contaminants reviews of the San Juan River Basin water quality and identified irrigation and mineral extraction, processing, and utilization as major sources of pollution.

As early as 1994, surface and groundwater quality in the San Jun River and its tributaries became a significant concern (Abell 1994). Increased loadings with heavy metals; elemental contaminants such as selenium (Se), salts, PAHs, and pesticides have degraded water quality of the San Juan River in critical habitat (Abell 1994, Wilson et al. 1995, Simpson and Lusk 1999). The San Juan River Basin has been considered as impaired for one or more factors, including metals, sediment, salinity, temperature, fecal matter, and dissolved oxygen (Service 2006). Thomas et al. (1998) found that concentrations of most potentially toxic elements analyzed from the San Juan River drainage in their study, other than selenium, were generally not high enough to be of concern to fish, wildlife, or humans. Yet, in 2012, a fish consumption advisory for mercury (Hg) was issued for Navajo Reservoir and other smaller reservoirs in the basin (NMED 2012). Although there has been a decrease in water quality over time, The Nature Conservancy (2013) reported that aquatic integrity of the San Juan River Basin was generally fair (Figure 21).

Land uses within the basin contribute metals, salts, fossil fuel residuals (e.g. PAHs), and pesticides to the San Juan River and its tributaries. Some of these chemical changes have occurred as a result of widespread irrigation and drain water disposal (Finger et al. 1995, Thomas et al. 1998, Engberg et al. 1998). In two San Juan River tributaries, changes in water quality and contamination of associated biota are known to result from irrigation projects where return flows from irrigation make up a portion of the tributaries' flow to the San Juan River (Sylvester et al. 1998). The NIIP and other irrigated agricultural projects contribute to estimations of selenium concentrations in the San Juan River. NIIP irrigation return flows were shown to result in increased selenium concentrations in the San Juan River (Blanchard et al. 1993; Thomas et al. 1998).

The Service's (Service 2011, 2012) reviews of threats to endangered fishes identify potential contaminants, including pesticides and other pollutants as potentially affecting Colorado Pikeminnow and Razorback Sucker critical habitat. Pesticide concentrations generally were low and varied seasonally and across land use (Blanchard et al. 1993; Thomas et al. 1998).

Of contaminants, PAHs may reach aquatic environments in domestic and industrial sewage effluents, in surface runoff from land, from deposition of airborne particulates, and particularly from spillage of petroleum and petroleum products into water bodies (Eisler 1989). Concentrations of PAHs were elevated in the Animas River and the San Juan River below Montezuma Creek (Wilson et al. 1995). Seasonal increases in PAH concentrations were detected in San Juan River Reach 5 (Figure 11), an area of the river that is a potential spawning site for Colorado Pikeminnow. PAH levels in the bile of Common Carp and Channel Catfish were high in one species and moderate in several other fish from the San Juan River. The presence of PAH metabolites in bile of every fish sampled suggested some level of exposure to hydrocarbons (Wilson et al. 1995). Service analyses of PAH contamination of aquatic biota of the San Juan River, and liver tissue examinations of fish in the river, raised concerns regarding the exposure of these organisms to contaminants introduced into the basin. However, PAHs did not appear to be a system-wide stressor to native fishes in the San Juan at the time of the study (Holden 2000).

Figure 21. San Juan River Basin aquatic integrity ranking by the Nature Conservancy (2013).

Selenium and mercury have been identified as moderately elevated contaminants of concern in biota and fish tissues collected from the San Juan River Basin (Thomas et al. 1998, Simpson and Lusk 1999, Hinck et al. 2006, Osmundson and Lusk 2011, AECOM 2013, EPRI 2014, Service 2015). Concentrations of selenium and mercury in animal tissues is the most relevant to the understanding of effects to endangered fishes or birds (EPA 2014) and concentrations in different type of tissues (e.g., muscle, whole body, eggs) are relevant to different types and magnitudes of physiological effects. However, selenium and mercury in water are discussed as they are part of the PCEs of critical habitat ("water of sufficient quality). A more thorough assessment of the quantity in water and fish tissues of both selenium and mercury and in the San Juan River Basin is provided in Service (2015).

Selenium

Selenium, a trace element, is a natural component of coal and soils in the San Juan River Basin and can be released to the environment by the irrigation of selenium-rich soils and the burning of coal in power plants with subsequent emissions to air and deposition to land and surface water (EPRI 2014). Sources of selenium, both anthropogenic and natural, in the San Juan River have been reported by O'Brien (1987), Abell (1994), Blanchard et al. (1993), and Thomas et al. (1997, 1998). Selenium, although required in the diet of fish at very low concentrations (<0.5 µg/g on a dry weight [DW] basis), is toxic at higher levels (>3 µg/g) and may be adversely affecting endangered fish in the upper Colorado River basin (Maier et al. 1987, Hamilton 1999, Hamilton et al. 2005a-c). It is considered one of the most toxic elements to fish and can occur at dietary concentrations only 7 to 30 times greater than those considered essential for proper nutrition (i.e., > 3 mg Se/kg DW, Hilton et al. 1980, Hodson and Hilton 1983, Sorenson 1991). At toxic levels selenium can elicit a wide range of adverse effects in fish including mortality, reproductive impairment, effects on growth, and developmental deformities (Hamilton 2004, Holm et al. 2005). These effects occur at the biochemical, cellular, organ, and tissue levels (Sorensen 1991).

Toxicity varies with fish species, temperature, life stage, exposure concentration, chemical form, the presence of pathogens, and other factors (Sorenson 1991).

Selenium Effects to Fish Ovaries and Eggs

Excess dietary selenium causes elevated concentrations to be deposited into developing eggs, particularly the yolk (Buhl and Hamilton 2000, Lemly 2002). If concentrations in the egg are sufficiently high, developing proteins and enzymes become dysfunctional or result in oxidative stress, conditions that may lead to embryo mortality or a higher risk of mortality (Lemly 2002).

One of the outward manifestations of selenium toxicities in fish is teratogenic deformity (Lemly 1998). Teratogenic deformities are permanent congenital malformations attributed to excessive selenium in eggs (Lemly 1998). Excess dietary selenium of the female is deposited into the developing egg, particularly in the yolk (Lemly 1993b, 1998). When eggs hatch, larval fish use the selenium-contaminated yolk, both as an energy supply and as a source of protein for building new body tissues. At this life stage excessive selenium can then lead to permanent developmental deformities (e.g., spinal curvatures, missing or deformed fins, and craniofacial deformities) and other effects such as edema (Hodson and Hilton 1983, Lemly 1993a, Maier and Knight 1994, Hamilton 2003). Although there is variable information on the impacts to egg hatch success (Lemly 1996, Lusk 2015), the incidence of teratogenic deformities increases when selenium concentrations in eggs exceed 10 μg/g DW and lower concentrations may still result in rates >50% for morality, deformity, and failure to hatch (Lusk 2015; Figure 22).

Opercular deformities in San Juan River Razorback Sucker larvae have been quantified (Barkstedt et al. 2014). Annually (1998-2012) 23.6% of larvae captured during regular monitoring events exhibited as shortened or curled portion of the distal gill cover resulting in exposed gill filaments and impairment of the buccal pump system. This deformity results in increased susceptibility of fishes to gill parasites, reduced respiration and mobility and increased mortality. Because this rate of deformity was much more than that observed in hatchery produced larvae (2.1%), selenium was identified as a potential environmental contaminate that could be the cause of opercula deformities observed in wild spawned fish, with low spring runoff concentrating the toxin further (Barkstedt et al. 2014).

Dietary Selenium Toxicity to Fish

Studies have shown that diet is the primary route of exposure that controls chronic toxicity to fish (Coyle et al. 1993, Hamilton et al. 1990, Hermanutz et al. 1996, EPA 1998, 2004, 2014). Threshold and concern levels encompass a range of dietary selenium (2–10 μg/g DW) with adverse effects a certainty as the upper limit is exceeded (Presser and Luoma 2006, Skorupa 1998). Selenium concentrations in diets greater than 10 μg/g DW have been consistently implicated in adverse effects on reproduction in a variety of avian, fish, and mammalian predators (Hodson and Hilton 1983, Woock et al. 1987, Heinz et al. 1989, Doroshov et al. 1992, Coyle et al. 1993, Lemly 1996, 1997, Hamilton et al. 1990, 2005b, Heinz 1996, Hamilton 2003, 2004). Reproductive failure in adults has been associated with dietary concentration of 30–35 μg/g DW (Skorupa 1998, Woock et al. 1987, Coyle et al. 1993). Feeding excessive selenium to larvae, juveniles, or adults does not directly cause malformations in the recipient, but survival of larvae fed elevated selenium can be severely compromised (Lemly 1998; Hamilton et al. 1990, 2001a, 2001b). Dietary toxicity to larval survival can occur at the same time that adult fish appear healthy.

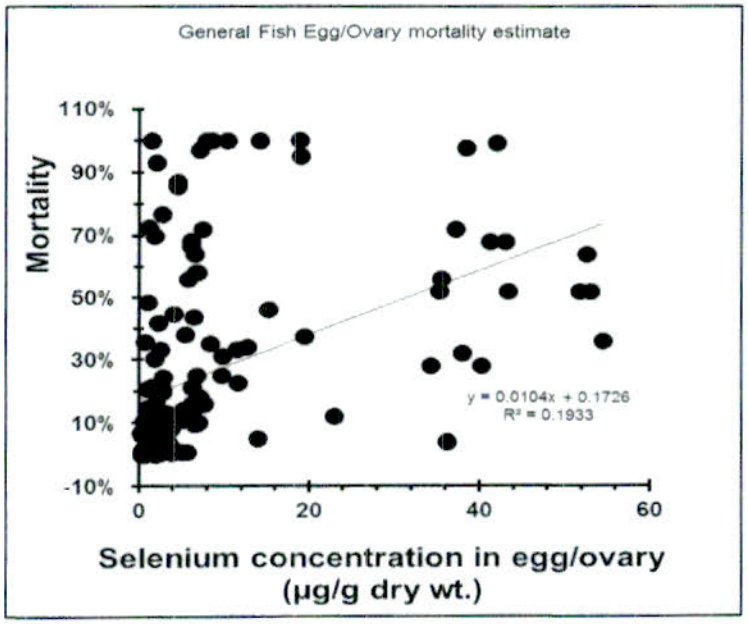


Figure 22. Selenium concentration in fish eggs and relationship to mortality, deformity, or failure to hatch, data aggregated from a variety of studies (Lusk 2015).

Selenium in water

Selenium concentrations can be elevated in areas where irrigation occurs on soils derived from or overlie Upper Cretaceous marine sediments. Percolation of irrigation water through these soils and sediments leaches selenium into receiving waters. Water samples from irrigation-drainage sites developed on Cretaceous soils contained a mean selenium concentration about 10 times greater than those in samples from sites developed on non-Cretaceous soils (Thomas et al. 1998). In the San Juan River, return flows from irrigation projects that are present on Cretaceous soils, especially NIIP and Hogback (prior to its connection with Cudei) have been shown to increase selenium concentrations, whereas Fruitland-Cambridge and the then separate Cudei irrigation system showed minimal selenium concentrations (Blanchard et al. 1993, Thomas et al. 1998, Table 4).

To determine NIIP's contribution of selenium to the San Juan River assessments of return flow and flow rates have been measured over time (BIA 2011). From 2005-2010, NIIP contributed 439 lbs/year of dissolved selenium per year. This is slightly less than the 1999 maximum estimated annual contribution of 476 lbs/year (BIA 1999), which would be 14% of the annual selenium load in the San Juan River at Mexican Hat Utah (BIA 1999; Figure 23). In 2010, a total of 25,831 ha (63,832 acres) of land was farmed with 196,369 AF of water used (BIA 2011).

Other sources of selenium likely include power plant fly ash and oil refineries in the basin (Abell 1994) and the introduction of groundwater to the mainstem of the river along its course (BIA 1999). Water depletions, by reducing dilution effects, can increase the concentrations of selenium and other contaminants in water, sediments, and biota (Osmundson et al. 2000).

Although high selenium levels in tributaries are diluted by the San Juan River, the net effect is a gradual accumulation of the element in the river as it travels downstream (Figure 23). Concentrations from individual sample sights can vary substantially as maximum recorded values ranged from <1–4 µg/L and in general increased from Archuleta, New Mexico, downstream to Bluff, Utah (Wilson et al. 1995). The safe level of selenium concentrations in water for protection of fish and wildlife is considered to be <2 µg/L and chronically toxic levels in water are considered to be >2.7 µg/L (Lemly 1993, Maier and Knight 1994; Wilson et al. 1995). However, dietary selenium is the primary source for selenium in fish (Lemly 1993, EPA 1998). Thus, sediment and biotic analyses are necessary to further elucidate the risk of selenium in water to fish and wildlife.

Table 4. Summary statistics for Years (1991-1995) dissolved selenium concentration in water samples for irrigation projects on the San Juan River, New Mexico (Thomas et al. 1998). Concentrations are µg/L for water and µg/g (dry weight) for plants, invertebrates, and whole body fish.

Irrigation Project	Sample Type	Number of Samples	Mean	Minimum-maximum
Hammond	Water	27	2.5	<1-6
Navajo Indian Irrigation Project	Water	198	14	<1-37
Fruitland	Water	4	0.5	<1-<1
Fruitland	Plants	6	0.4	<0.2-1
Fruitland	Invertebrates	4	2.00	1.6-2.8
Fruitland	Whole Fish	7	2.07	1.4-3.5
Hogback	Water	15	11	7-16
Hogback	Plants	5	5.23	0.9-20.0
Hogback	Invertebrates	4	14.57	11-16
Hogback	Whole Fish	5	20.76	16.0-24.0
Cudei	Water	39	0.5	<1-<1
Cudei	Plants	3	0.25	<0.1-1.0
Cudei	Invertebrates	1	3.20	---
Cudei	Whole Fish	2	3.11	2.3-4.2

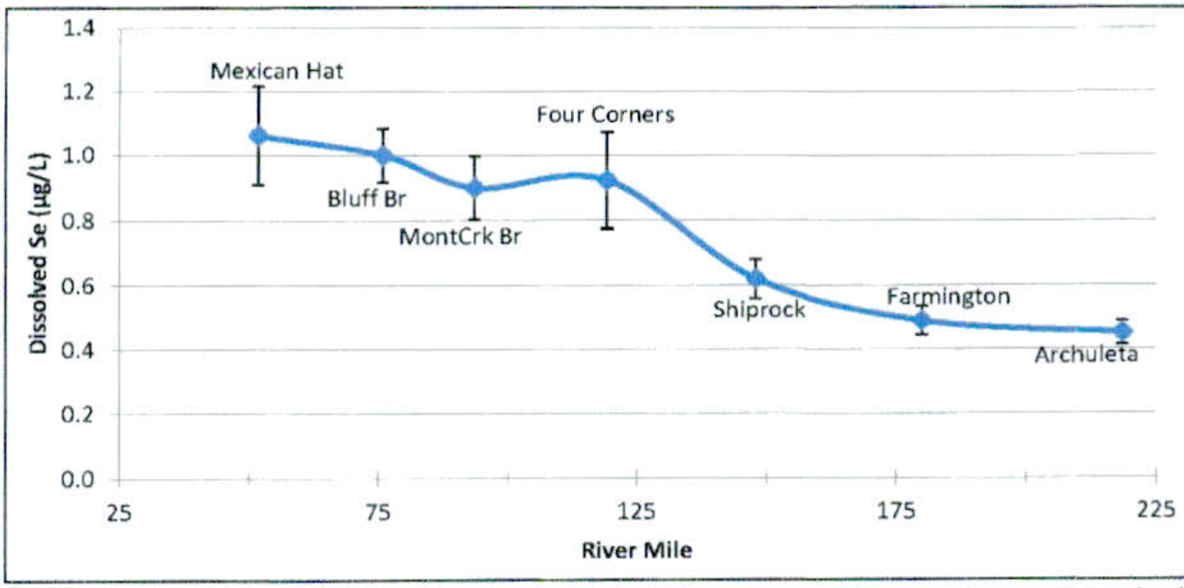


Figure 23. Longitudinal 2010-2011 average dissolved selenium concentrations (SE ±1) in the San Juan River (Stout 2012).

Selenium in Invertebrates

Selenium concentrations differ based on a sample's proximity to habitats underlain by Cretaceous soils and to the mainstem San Juan River. In aquatic habitats underlain by Cretaceous soils selenium concentrations in algae, odonates (dragonflies and damselflies), and Western Mosquitofish were significantly greater than in those collected from similar habitats underlain by non-Cretaceous soils (Thomas et al. 1998). Median selenium concentrations were < 2 µg/g DW for plant samples, < 7 µg/g DW for invertebrate samples, and < 6 µg/g DW for whole-fish samples collected from aquatic habitats underlain by non-Cretaceous soils. Similar samples collected from aquatic habitats underlain by Cretaceous soils contained median selenium concentrations two to five times greater. Concentrations of selenium in biota from aquatic habitats away from the river mainstem - including biota collected from irrigation drains and ponds - had much higher concentrations of selenium in plants (20 µg/g DW), invertebrates (32.5 µg/g DW), and whole fish (41.7 µg/g DW) than those found in the mainstem (Blanchard et al. 1993, Thomas et al. 1997).

Selenium in Fish

Simpson and Lusk (1999) and Osmundson and Lusk (2011; Table 5) reported on the concentrations of selenium in muscle tissues collected from Colorado Pikeminnow and Razorback Suckers from the San Juan River mainstem. Converting to dry weight, selenium concentrations in Razorback Sucker ranged from 1.1 – 5.4 µg/g (mean = 3.5 µg/g) with concentrations in Colorado Pikeminnow similar and ranging from 1.6 – 4.6 µg/g (mean = 3.0 µg/g). An assessment of spatial variation indicated no significant differences.

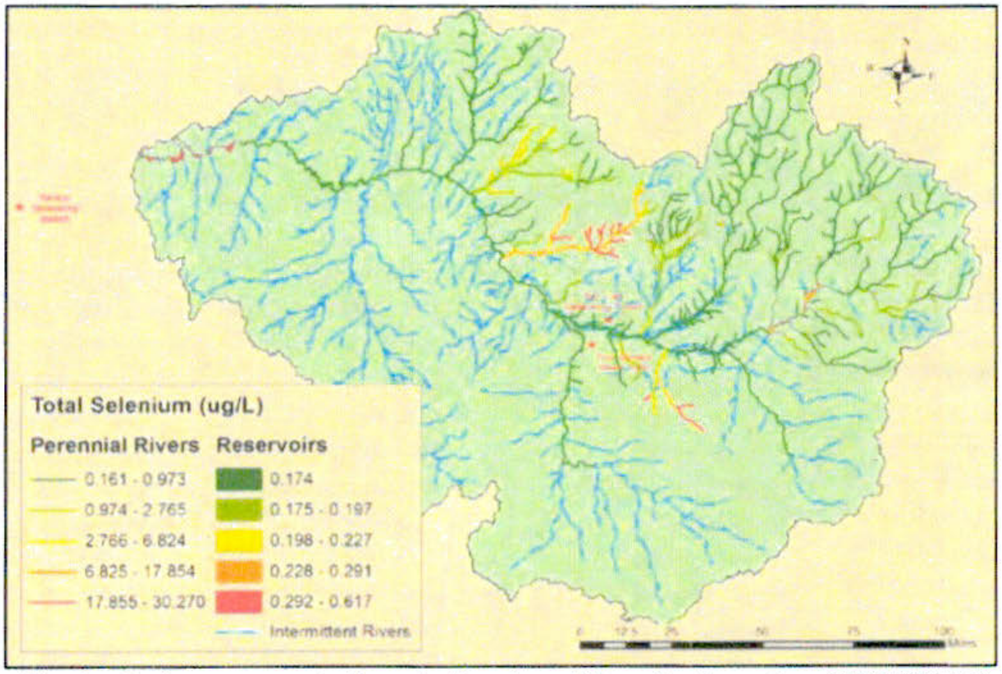


Figure 24. Total selenium concentrations in San Juan River Basin waters (EPRI 2014).

Table 5. Average and range of mercury (μg/g wet weight) and selenium (μg/g wet weight) in Colorado Pikeminnow and Razorback Sucker muscle tissues from San Juan River 2008-2009 (Osmundson and Lusk 2011).

River Basin and Species	Average Hg in Muscle Tissue (min - max)	Average Se in Muscle Tissue (min - max)
San Juan River Colorado Pikeminnow > 400 mm TL	0.37 (0.31 - 0.43)	0.8 (0.6 – 0.9)
San Juan River Razorback Sucker > 400 mm TL	0.12 (0.04 – 0.24)	0.8 (0.4 – 1.4)

Using selenium concentrations reported in both plants (25%) and invertebrates (75%) dietary concentrations in larval Razorback Sucker and Colorado Pikeminnow were estimated (Simpson and Lusk 1999; AECOM 2014). Using this ratio the average environmental baseline condition for selenium concentrations in larval fish diets would be expected range from 2.7–2.9 μg/g DW. For Razorback Sucker, the range of dietary concern is approximately 2–5 μg/g DW because of studies involving sensitive species, life stages, and endpoints (Beyers and Sodergren 1999, Hamilton et al. 2001a, 2001b, 2002a, 2002b, 2005b;). At these levels larval Razorback Sucker survival (12 to 45 days) decreases (Lusk 2015; Service 2015; Figure 25). Because of a lack of data for Colorado Pikeminnow larvae the effect is currently unknown.

Population Impacts of Selenium in the Environmental Baseline

Quartarone and Young (1995) suggested that irrigation and pollution were contributing factors to Razorback Sucker and Colorado Pikeminnow population declines. Hamilton (1999) hypothesized that historic selenium contamination of the upper and lower Colorado River basins contributed to the decline of these endangered fish by affecting their overall reproductive success, including loss of eggs and larvae. Both species can live over 40 years (Behnke and

Benson 1983) increasing their frequency of exposure to both dietary and waterborne selenium. In addition, they often stage at tributary mouths such as the Mancos River before spawning, increasing their exposure to elevated levels of dietary selenium (Wilson et al. 1995; Figure 22 and Figure 24).

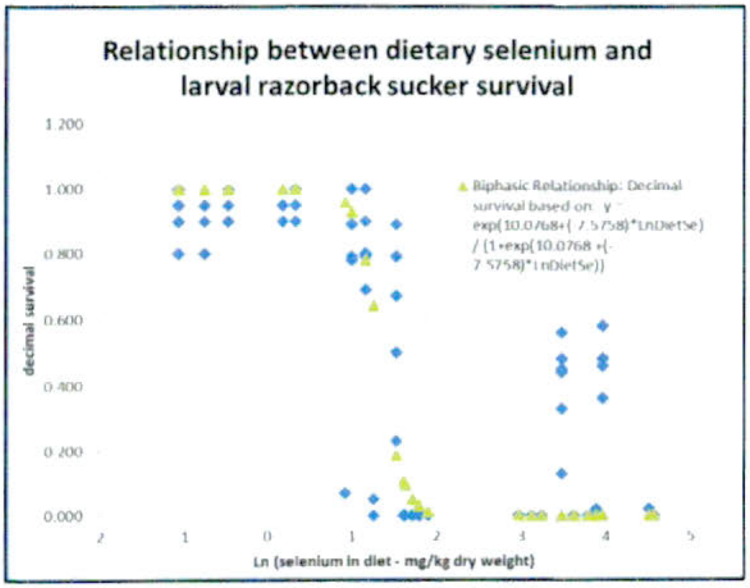


Figure 25. Relationship between dietary selenium in fish diets (in mg/kg which is equal to µg/g DW) and larval survival based on studies involving Razorback Sucker (Lusk 2015).

Mercury

The biological uptake of mercury is complex (EPA 1997, Lorey 2001, Wiener et al. 2007, EPRI 2014), but in general a converted form (methylmercury) enters an aquatic food chain through plants, zooplankton and benthos, to herbivorous fish, and then carnivorous fish (Potter et al. 1975, Grieb et al. 1990, EPA 1997, UNEP 2002). In particular, methylmercury bioaccumulates in aquatic food chains with the greatest impacts to top predatory fishes like Colorado Pikeminnow (Osmundson and Lusk 2011).

Atmospheric mercury deposition, and subsequent overland transport, is the predominant pathway delivering mercury to aquatic systems and into fish tissues (Downs et al. 1998, Cocca 2001, Bullock 2005, EPA 2005, Engstrom 2007, Harris et al. 2007). Modeled deposition of mercury into the San Juan River Basin currently ranges from 13.9–16.5 ug/m^2 throughout the basin with sources including global and local sources (EPRI 2014; Service 2015). The EPRI (2014) model predicts gradually rising mercury concentrations in water and fish tissue because the San Juan River Basin has not yet reached equilibrium with the rate of atmospheric mercury deposition the basin will continue to receive in the foreseeable future. Modeled reductions in mercury emissions never exceed a 0.2 percent reduction in adult Colorado Pikeminnow tissue burdens within the 85-year model simulation period (EPRI 2014). As piscivorous fish, Colorado Pikeminnow accumulates mercury more readily than Razorback Sucker (Table 5). For Colorado Pikeminnow, size is strongly related to mercury levels (Hope 2003; Peterson et al. 2007; Service 2015) and adult Razorback Sucker whole body concentrations may be more similar to juvenile Colorado Pikeminnow (fish <400 mm; Service 2015).

The accumulation of mercury from water occurs via the gill membranes as well as through ingestion (Beckvar et al. 1996; EPA 1997). Methylmercury is eventually transferred from the gills to muscle and other tissues where it is retained for long periods of time (Julshamn et al. 1982, Riisgård and Hansen 1990). Probably less than 10 percent of the mercury in fish tissue residues is obtained by direct (gill) uptake from water (Francesconi and Lenanton 1992, Spry and Wiener 1991). Mercury taken up with food initially accumulates in the tissues of the posterior intestine of fish (Boudou et al. 1991) with mercury ingested in food transferred from the intestine to other organs including muscle tissues (Boudou et al. 1991). Methylmercury has been reported to constitute from 70 to 95% of the total mercury in skeletal muscle in fish (Huckabee et al. 1979, EPA 1985, Riisgård and Famme 1988, Greib et al. 1990, Spry and Wiener 1991) and accounted for almost all of the mercury in muscle tissue in a wide variety of both freshwater and saltwater fish (Bloom 1992).

Mercury bioaccumulation acts as potent neurotoxin that affects endangered fish in the San Juan River through their fitness and reproductive health (Crump and Trudeau 2009). Once mercury enters the body, it poses the highest threats of toxicity because it can be absorbed into living tissues and blood. Once in the blood it crosses into the brain and accumulates with no known process of expulsion from the brain (Gonzalez et al. 2005). The toxicity of mercury to aquatic organisms is affected by both abiotic and biotic factors including the form (inorganic versus organic), environmental conditions (e.g., temperature, salinity, and pH), the sensitivity of individual species and life history stages, and the tolerance of individual organisms. In addition to neurological damage, mercury can impair reproduction, inhibit growth, produce developmental abnormalities, cause mortality, and alter behavior (Beckvar et al.1996, Beckvar et al. 2005, Dillon et al. 2010, ERM 2010a, b). Wiener and Spry (1996) concluded that neurotoxicity seems to be the most probable chronic response of wild adult fishes, based on observed effects such as incoordination, inability to feed, diminished responsiveness, abnormal movements, lethargy, and brain lesions. In laboratory studies, reproduction is generally more sensitive than growth or survival, with embryos and the early developmental stages being the most sensitive (Hansen 1989).

Mercury in fish tissues can be transferred to ovary and eggs (Beckvar et al.1996, Wiener and Spry 1996, McKim et al. 1976). Exposure of the parent population to concentrations of 0.03 to 2.93 ug/L in the laboratory resulted in mercury concentrations as high as 2 μg/g in their embryos (McKim et al. 1976). Other studies reported a maternal burden transfer to eggs ranging from 0.2–36% (Hammerschmidt et al. 1999, Hammerschmidt and Sandheinrich 2005, Alvarez et al. 2006, Nye et al. 2007). Hatching success and embryonic survival in fish is inversely correlated with mercury concentrations in the egg (Whitney 1991, Dillon et al. 2010, ERM 2014b). For Colorado Pikeminnow adverse effects from mercury occurs at 0.7 μg/g (wet weight), which is related to a greater than 8% reproductive injury and above 1.5% adult mortality (AECOM 2013, Miller 2014, ERM 2014 a, b, Service 2015). This correlates to mercury concentrations in water of 0.002 μg/L methylmercury or 0.2 μg/L of mercury (Service 2015).

Interactions of selenium and other elements

Many different compounds interact with selenium. Selenium does not aid the excretion of mercury; instead, it increases the accumulation of an inert form, including mercury-selenide (Himeno and Imura 2002), although conflicting studies exist; Huckabee and Griffith (1974) reported selenium increased the toxicity of mercury. Interactions between selenium and mercury are known to be concentration-dependent (Kim et al. 1977). Interactions between selenium can be synergistic at low mercury concentrations (<0.07 ppm) and antagonistic at high concentrations (>0.10 ppm) in water (Kim et al. 1977). Selenium protected Cyprinid species against mercury toxicity as a molar ratio of 2.5:1 mercury: selenium (Cuvin and Furness 1988). However, a 1.3:1 molar ratio caused increased mortality compared with 0.3 ppm mercury only. These studies of demonstrate that antagonistic and synergistic toxic interactions between selenium and mercury are possible and are a function of the concentrations of the two elements and the molar ratio of one to the other (Sorensen 1991). The underlying mechanisms regarding the interactions, the compounds that are formed in tissues and the conditions that are responsible for antagonism remain unclear (Kahn and Wang 2009).

Numerous pollutants are often released into the environment and result in a mixture of elements that is unique to each aquatic system. Categorization of various elemental mixtures in the environment or in the fish as synergistic or antagonistic can depend on the concentrations, their bioavailability, water temperature, the molar ratios of selenium and mercury, the fish species, and other factors (Sorensen 1991). Available data does not show whether the various inorganic and organic compounds and oxidation states of selenium are equally effective sources of selenium as a trace nutrient, or as reducing the toxic effects of various pollutants (EPA 2004). As some of the accumulations of selenium and mercury will result in irreversible injury, and the optimal antagonistic molar ratios for selenium and mercury in the environment (along with other elements and environmental stressors) have not been determined for the Colorado Pikeminnow, Razorback Sucker, or their prey sufficiently to address the antagonistic interactions between selenium and mercury.

<u>Nonnative Fish</u>
Nearly 70 nonnative fish species (identified early in the document) have been introduced into the Colorado River system over the last 100 years (Service 1998). For more than 50 of those years, researchers have been concerned that nonnative fishes have contributed to the decline of native fishes in the Colorado River Basin (Service 1998). These species are potential predators, competitors, and vectors for parasites and disease (Tyus et al. 1982, Lentsch et al. 1996, Pacey and Marsh 1999). Channel Catfish was first introduced in the upper Colorado River Basin in 1892 (Tyus and Nikirk 1990). This species is the most abundant nonnative fish in the San Juan River (Franssen et al. 2014). It is thought to impact endangered fishes through predation on juveniles and resource overlap with subadults and adults (Hawkins and Nesler 1991, Lentsch et al. 1996, Tyus and Saunders 1996). Adult and juvenile Colorado Pikeminnows that have preyed on Channel Catfish are at risk of dying from choking on the pectoral spines (McAda 1983, Pimental et al. 1985, Quartarone and Young 1995, Ryden and Smith 2002). Common Carp may also have a negative impact on endangered fishes in the San Juan River (Service 1998). Because nonnative fish are considered to be an important biological threat to Colorado Pikeminnow and Razorback Sucker, control through removal is part of SJRRIP management actions, with mechanical removal (seining and electrofishing) from the San Juan River began in 1995 (Brooks et al. 2000).

A large number of Channel Catfish and Common Carp have been removed from the system (Franssen et al. 2014). From 1994-2012 a total of 144,870 Channel Catfish have been removed from the San Juan River and 26,956 Common Carp. Over time, catch rates for Common Carp significantly decreased. On the other hand, the impact of removal on Channel Catfish populations has been ambiguous, with densities decreasing in some river reaches but not others and a reduction in the size of fish showing a marginal decrease (Franssen et al. 2014). Channel Catfish are thought to become piscivorous at a length of 450 mm (17.7 in) and fecundity is much greater in larger fish (Davis 2005). Theoretically, a decrease in the size structure of Channel Catfish could lead to a positive response by endangered fishes. The danger in reducing the size structure is a commensurate increase in the number of smaller fish, leading to an increase in competition with native fish (Davis 2005). Mechanical removal, while continuing, has not yet led to a measurable positive population response in native San Juan River fishes (Franssen et al. 2014).

Climate Change

Climate change has and will occur and affect endangered species and their habitat over the duration of the Proposed Action and beyond, whether or not the Proposed Action occurs. The potential impacts of climate change are deviations in precipitation patterns, including the timing, intensity, and type of precipitation received; runoff patterns based on the amount of precipitation falling as snow and when snowmelt occurs; and atmospheric temperatures, which exhibit a strong influence on water temperatures. These changes over the coming decades and centuries have the potential to affect Razorback Sucker and Colorado Pikeminnow, and their associated Critical Habitat.

According to the NRC (2007), air temperature has increased by 1.4°C in the last century. The Colorado River Basin has warmed more than any other part of the U.S. Warmer air temperatures will lead to increased evaporation from Navajo Reservoir. This increase is expected to reduce water availability, operational flexibility, and the quality and quantity of fish habitat, which are important elements to native fish in the river downstream.

Native fish in the San Juan River cannot move upstream in response to climate change because their migration is blocked by Navajo Dam, which precludes migration to more favorable upstream areas as a behavioral adaptation to changing climatic conditions. However, Navajo Dam currently releases water that is colder than what would naturally be present during the summer and fall months (Service 2006). Thus, the temperature effect of climate change might be offset by operation of the Navajo Dam, but the impact is unknown.

Climate change models agree that the southwest will get drier in the next century, with runoff decreasing 8 to 25 percent (Seager et al. 2007), resulting in decreased water availability. This reduction in precipitation will make it increasingly challenging to meet the Flow Recommendations for the San Juan River, established to protect listed fish and other native fish species, especially the high-flow requirements that provide for channel maintenance and create or renew habitat for listed fish. Under current climate conditions, Reclamation has not been able to provide the required number of days of flow over 10,000 cfs since 2008 (Reclamation 2017). Reduced flow levels may also exacerbate contaminant issues, as less dilution of contaminants in the river would occur.

EFFECTS OF THE ACTION

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, the Service will evaluate the net combined effects of the proposed action and the offsite measures as interrelated actions.

'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 CFR 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this BO.

The proposed action, including the specific activities for the Lateral Conversion Project, mitigation for this project, and rehabilitation of the Fruitland-Cambridge and Hogback-Cudei canal irrigation systems are described above, in the BA, and additional communications (NNDWR 2016, 2017a, 2017b, 2017c). Overall the proposed action is expected to improve conditions for the listed species. Although most effects of the project are beneficial or have been minimized, direct effects to the endangered fish species may still occur. Project activities whose analysis indicated an adverse effect could occur are categorized and explained below. These are grouped by activity, combines both irrigation units when possible (Fruitland-Cambridge and Hogback-Cudei), and extent of effects are summarized in Table 6.

Fruitland-Cambridge irrigation unit

Effects of depletions on habitat quantity and quality
The depletion of the San Juan River for irrigation results in the reduction of river flows and a potential decrease in the quantity and quality of spawning, nursery, and foraging habitat for Colorado Pikeminnow and Razorback Sucker. Operation of the Fruitland-Cambridge irrigation project results in an average annual depletion of 7,898 AFY from the San Juan River. The SJRRIP was formed to minimize any adverse effects on the Colorado Pikeminnow and Razorback Sucker from continued San Juan River water depletions. The annual Fruitland-Cambridge irrigation unit depletion of 7,898 AFY is included in the hydrologic baseline for the San Juan River (Service 2000). Hydrologic modeling indicates this continued level of depletion does not impact the ability of the SJRRIP to implement SJRRIP Flow Recommendations (Service 2006). Thus, it is expected that key habitats for the endangered fish will continue to be created and maintained at this level. Any net depletion above 7,898 AFY from this project would result in incidental take. Depletions by Hogback-Cudei canal were assessed in a similar manner in a previous consultation (Service 2011).

Effects of diversion dam replacement on blockage to fish passage
Modeling results for the Fruitland-Cambridge diversion dam suggest that the rock dam structure currently in place does not significantly hinder fish passage, except perhaps at very high discharges (8,000 cubic feet per second [cfs] and greater) (Stamp and Golden 2005). For the past ten years the structure may have been of little hindrance to fish passage as the dam was

continually pushed down by high river flows (NNDWR 2017a). The boulders, which compose the current diversion dam (Figure 26), shift and roll downstream during high river flows requiring periodic repositioning. Fish passage at the current structure was assessed in 2004, two years after any maintenance had been performed, with intervening years having low springtime flows and thus no significant shifting of boulders prior fish passage assessment (Stamp and Golden 2005). The 2004 assessment concluded the diversion dam did not negatively affect fish passage and indicated fish passage conditions would improve as individual rocks shifted or tumbled downstream during high river flow events. The boulder dam was last reconstructed and fully diverting water 10 years ago (NNDWR 2017b). The proposed action will replace the diversion's loose boulders with a permanent two-step river-wide grouted-boulder dam and change the current boulder configuration (NNDWR 2017a).

Figure 26. Fruitland-Cambridge diversion dam as functioning in 2004 (Stamp and Golden, 2005)

The SJRRIP monitors fish populations in the San Juan River above the Fruitland-Cambridge diversion dam. An assessment of these data (1995-2016) indicate that a single Colorado Pikeminnow (2015) and a single Razorback Sucker (2016) captured below the Fruitland-Cambridge diversion dam was subsequently captured above, indicating that fish can currently pass upstream (Gilbert 2017). The limited number of fish recaptured above the diversion may be due to the limited amount of sampling above the dam. However, sampling has increased from one to 15 river miles upstream from the Fruitland-Cambridge diversion dam in recent years and may provide data indicating the presence of a greater number of fish (Schleicher 2016).

To minimize the effects of a permanent diversion dam, the proposed action incorporates a fish passage to reduce fish passage blockage (NNDWR 2017a). The fish passage was designed to provide water velocity and depth that would allow for fish passage. Maximum water velocities was determined using two-dimensional HEC-RAS modeling and indicates the maximum velocity between boulders in the fish passage would be 8 ft/sec with some areas below 6 ft/sec with ~2 ft/sec between dams (Figure 27). Based on sustained swimming ability (1.6–3.8 ft/sec) and burst speed estimates (13.1–23.0 ft/sec), these velocities are not likely to preclude upstream movement of juvenile or adult Colorado Pikeminnow and Razorback Sucker (Stamp and Golden 2005, NNDWR 2016).

The flow and depth of water in the fish passage will be dependent on river flows and diversion rates. At low San Juan River flows (475cfs), a maximum of 145 cfs can be diverted into Fruitland-Cambridge canal (NNDWR 2017b). When operated correctly, at this river and diversion flows, with 100 cfs passing through the radial gates adjacent to the canal's inlet, modeling indicates 100 cfs should flow through the fish passage. At these flows, water depth in the fish passage is modeled to be 0.4-0.46 m (1.2-1.5 ft) (Figure 28). At similar river and diversion flows, it is estimated that more flow (130 cfs) will pass down the boat passage (NNDWR 2016). If these depths and flows are maintained upstream movement of juvenile or adult Colorado Pikeminnow and Razorback Sucker is not likely to be precluded.

However, the fish passage design and operation criteria are similar to that at the Hogback-Cudei fish passage (NNDWR 2017a). Similar to the Hogback-Cudei fish passage, if the radial gates adjacent to the canal inlet are fully open and the river is below 1,000 cfs, the fish passage may go dry, or operate at lower flow rates than designed, and thus preclude fish passage (NNDWR 2017c). From January 1, 2007 to December 31, 2016 (3,654 days), flows in the San Juan River, above Fruitland-Cambridge diversion at the Farmington USGS gage were below 1,000 cfs for 2,330 days. Given the scenario that the radial gates adjacent to the Fruitland-Cambridge fish passage are opened to such an extent that they cause the fish passage to go dry when flows are <1,000 cfs, upstream fish passage could potentially be impeded 63.8% of time (2,330/3,654 days).

Upstream fish passage blockage, when the diversion dam is not operated as engineered, can be estimated from the numbers of Colorado Pikeminnow and Razorback Sucker downstream of Fruitland-Cambridge canal (SJRRIP 2017a). Among all years, the point estimate for subadult to adult Colorado Pikeminnow (≥ 300 mm total length) ranged from 128–1,779 fish and for Razorback Sucker (≥ 400 mm total length) 149–3,032. If these fish pass upstream of Hogback diversion at the same average rate as they have since 2010 (Colorado Pikeminnow at 31.5% and Razorback Sucker 23.3%) then between 40–560 Colorado Pikeminnow and 35–706 Razorback Sucker may encounter the Fruitland-Cambridge diversion dam attempting to move upstream. Numbers of fish encountering the Fruitland-Cambridge diversion dam will change over time as the population of both species and upstream passage rates vary.

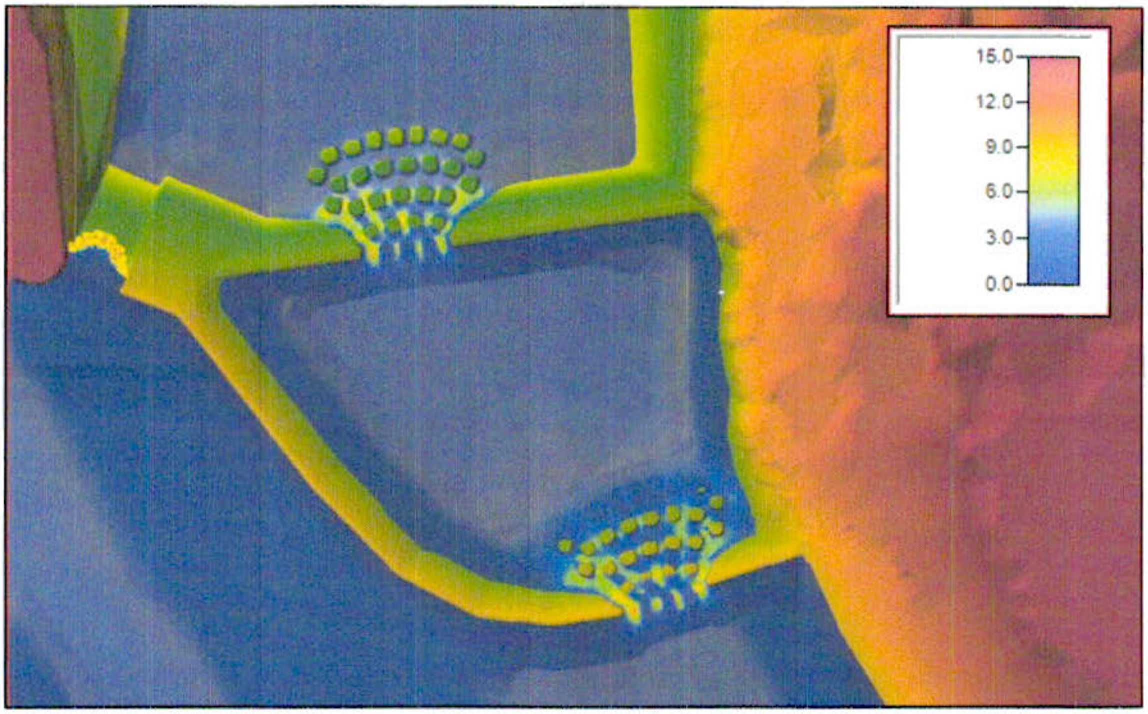


Figure 27. Water velocity distribution (ft/sec) at river flows of 475 cfs, Fruitland-Cambridge diversion of 145 cfs, and 100 cfs through radial gates adjacent to canal inlet.

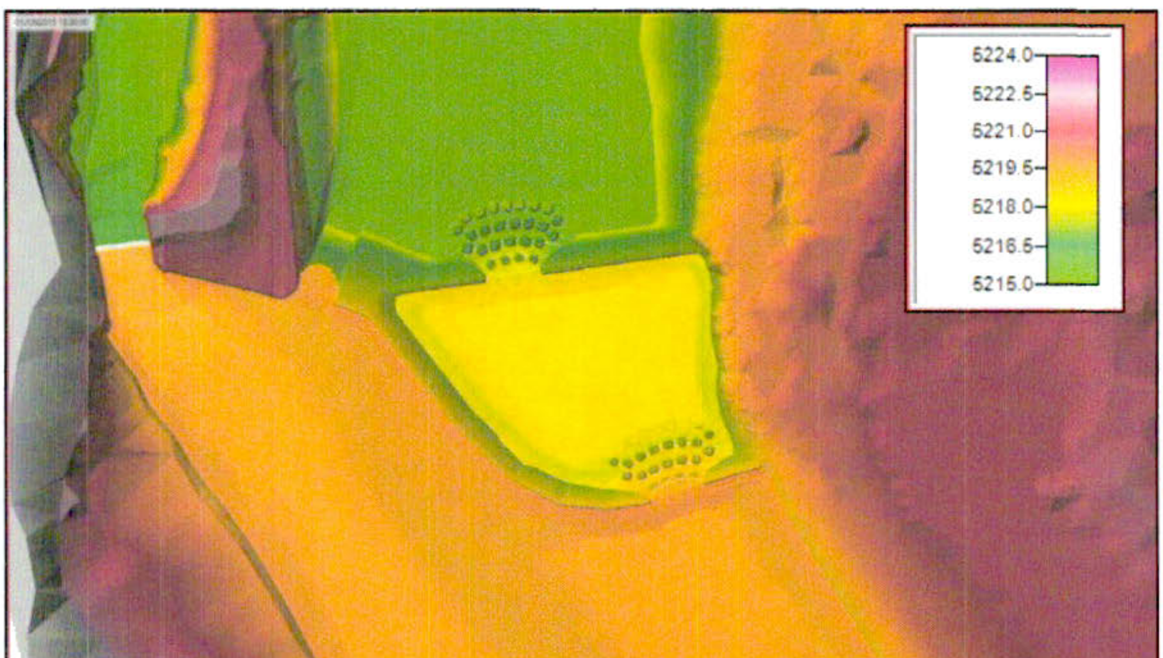


Figure 28. Water surface elevation at river flows of 475 cfs, Fruitland-Cambridge diversion of 145 cfs, and 100 cfs through radial gates adjacent to canal inlet.

Effects of headworks replacement on fish impingement

During the irrigation season debris and trash entering the Fruitland-Cambridge canal will be primarily controlled by a log boom upstream of the canal inlet but also by a trash rack (vertical bar screen with 4-inch bar spacing) at the canal headworks. Debris from the trash rack is removed by a rail-mounted trash rake. Although it is unlikely, any fish that is too large to be entrained through the 4-inch bar spacing has the potential to be impinged on the trash rack and removed from the river while debris is being removed.

Comparison of river approach velocities and fish burst speeds, which would allow a fish to counter an approach velocity, can help determine whether such large fish are likely to become impinged on the trash rack. Data on river approach velocities are not available for the Fruitland-Cambridge inlet but approach velocities at San Juan Generating Station intakes where the volume of water entering is 47 cfs were estimated to be 1.7 ft/sec (EPRI 2015). Using that approach velocity, at 145 cfs which is the maximum intake of the Fruitland-Cambridge canal, approach velocities may be three times as much (5.8 ft/sec). This approach velocity is less than speed bursts that are likely to be exhibited by adult Colorado Pikeminnow and Razorback Sucker (Stamp and Golden 2005). Thus, it would be expected that adults of both species if impinged on the trash rack, would only be impinged temporarily. However, data do exist which indicate the debris racks used on the upstream end of a fish passage associated with the PNM diversion (Figure 16) has resulted in impingement and mortality of fish when debris is removed (Yazzie 2017). The approach velocities at this debris rack are unknown. Therefore, although it is unlikely fish would be impinged on the trash rack and subsequently removed by the trash rake, the potential exists for individual mortality. When considering the area of the Fruitland-Cambridge screen (37.75 ft) and submerged depth (6ft) during normal operations, the resulting approach velocity could be reduced to as little as 0.65 ft/s at 145 cfs.

Effects of water diversion into main canal and fish entrainment

The current Fruitland-Cambridge diversion intake structure had the potential to entrain all life-stages of Colorado Pikeminnow and Razorback Sucker which may have resulted in injury or death. Since the new headworks and inlet structures will be repaired and rebuilt to allow for closure of the headworks during non-irrigation season (October-February) there will be an overall reduction in annual entrainment of fishes by 33%. During the remaining 66% of the time, larvae and juveniles and subadults of both species (Colorado Pikeminnow <450 mm TL and Razorback Sucker <400 mm TL) may become entrained into the main canal through the 4-inch trash rack bars of the canals headworks.

The first place in the main canal where fish may be adversely affected is the first sluiceway (Figure 4). This sluiceway has a steep drop, when sluicing operations are underway. Injury or morality to fish could occur from the steep drop or if the sluiceway is drained in such a manner that fish become stranded. Under the proposed action, the need to use this sluiceway will be reduced to times when sediment must be removed from the upper reach of the canal. It is anticipated that the gate to this sluiceway will be opened in the fall at the end of the irrigation season to drain the canal and flush accumulated sediment to the river. It may be necessary to perform up to two additional sluicing operations for sediment removal during the season. The duration of each sluicing operation is expected to be eight hours or less.

Smaller bodied fish have the most likelihood of being entrained during sluicing operations given most adults will be prohibited from entering the canal because of the vertical bar spacing. Based on the amount of habitat available upstream of the Fruitland-Cambridge diversion (1.5 of 180 river miles) approximately 0.01% of the juveniles and subadults of the population of each species of could be upstream and entrained through the diversion headworks and into the first sluiceway during operations. Entrainment into the first sluiceway would likely result in mortality for any fish entrained during operations

During normal operations of the Fruitland-Cambridge irrigation unit, when sluicing is not occurring, the proposed fish barrier weir is expected to significantly reduce entrainment of both Colorado Pikeminnow and Razorback Sucker into the irrigation system. With the exception of larval fish, the weir is designed to return most life-stages of fish that enter the Fruitland-Cambridge canal to the San Juan River unharmed. Although the weir has been designed to minimize entrainment, direct take may still occur as testing of a similar weir at Hogback-Cudei canal demonstrated entrainment of hatchery produced and stocked subadult and adult Colorado Pikeminnow and Razorback Sucker (McKinstry et al. 2016, Brandenburg et al. 2017). Direct take of Razorback Sucker is less likely as tests at the Hogback-Cudei weir, using other species of wild juvenile and adult sucker, did not result in entrainment of these fish (Brandenburg et al. 2017). The bottom dwelling behavior of these wild suckers was presumed to be the reason why these fish were not entrained over the top of the weir.

Testing of hatchery produced and stocked juvenile and subadult Colorado Pikeminnow and Razorback Sucker entrainment over the fish barrier weir at Hogback-Cudei indicated the amount of entrainment is proportional to the amount of water diverted into the canal (McKinstry et al. 2016, Brandenburg et al. 2017). Over the past 10 years (2007–2016) and 1.5 river miles upstream of the Fruitland-Cambridge diversion dam, the average annual volume of water in the San Juan River during irrigation season (April–October) was 708,588AF (USGS gage 09365000). The annual volume of water allocated for Fruitland-Cambridge is 7,898 AF – 1.0% of the total volume in the river during irrigation season. Based on results from tests at Hogback-Cudei fish barrier weir, it is possible that 5.3 – 31.9% of juvenile to subadult fish could move over the fish weir wall and become entrained into the main canal, entering the irrigation system (McKinstry et al, 2016, Brandenburg et al. 2017). Thus, of the fishes present in habitat upstream of the diversion (1.5 of the 180 river miles), using the highest rate of potential entrainment, 0.32% would be expected to be entrained. As the number of fish in the Colorado Pikeminnow and Razorback Sucker population changes with time, so would the number of fish entrained (Figure 12).

Because take of larval fish cannot be readily quantified using standard monitoring, we used the method described below to estimate the amount of take of larval fishes. This is a similar method as applied to larval take for the Hogback-Cudei weir (Service 2011) and incorporates results from testing the entrainment of larvae over the weir wall (Brandenburg et al. 2017). The calculation of larval entrainment is a product of the proportion of the spawning habitat upstream of the diversion dam, the proportion of water diverted, and the likelihood of entrainment.

Although there is no known Colorado Pikeminnow or Razorback Sucker spawning sites upstream of the Fruitland-Cambridge diversion dam, the quality of gravel bars between the diversion dam and the Animas River confluence with the San Juan River indicates that spawning could occur in this area (Bliesner and Lamarra 2004). Both species could spawn as far upstream as RM 180. Assuming potential spawning bars are evenly distributed from RM 128–180 (52 river miles) for Colorado Pikeminnow and RM 100–180 (80 river miles) for Razorback Sucker, approximately 1.5 river miles of spawning and therefore, larval drift would occur upstream of the Fruitland-Cambridge diversion dam at RM 178.5 (180-178.5=1.5 river miles; Figure 4). Thus, 2.8% of Colorado Pikeminnow spawning habitat and 1.9% for Razorback Sucker spawning habitat is above the Fruitland-Cambridge diversion dam.

The Fruitland-Cambridge diversion dam can divert a maximum of 160 cfs from the San Juan River during both species' spawning season. In May, during the Razorback Sucker peak spawning period, flows on the San Juan River average 2,837 cfs (USGS gage 0936500, 2007–2016). In August, during the Colorado Pikeminnow spawning peak, flows average 948 cfs. During periods of extreme drought on the San Juan River, flows during both time periods could average as low as 725 cfs (Service 2011). Thus, the Fruitland-Cambridge diversion dam would divert as much as 5.6% of San Juan River flow during Razorback Sucker and 16.8% during Colorado Pikeminnow peak spawning periods. Under conditions of extreme drought the Fruitland-Cambridge diversion dam would divert 22.1% of the San Juan River.

As stated above, the proportion of Colorado Pikeminnow and Razorback Sucker larvae that would be expected to enter the Fruitland-Cambridge canal would be the product of the proportion of spawning occurring upstream of the diversion, the proportion of flow entering the diversion at time of spawning, and larval entrainment rates as measured by Brandenburg et al. (2017). Assuming larvae of both species behave similarly, 78.3% of the youngest phase would be entrained and 46.6% of the older phases (Brandenburg et al. 2017). Thus, the calculation of larval entrainment for Colorado Pikeminnow (0.22–0.37%) and Razorback Sucker (0.05–0.20%) under normal and drought flows for different ages of larvae results in entrainment rates less than 1% of the total larvae spawned in potential spawning habitat (RM 128–180 for Colorado Pikeminnow and RM 100–180 for Razorback Sucker).

As recent as 2016, the most upstream collection of larvae of both species occurred during the Hogback-Cudei weir wall entrainment testing. This is 19.5 river miles downstream of the Fruitland-Cambridge irrigation diversion (Figure 16) and indicates that spawning is occurring upstream of Hogback-Cudei. Sampling of larval fish occurred upstream of Fruitland-Cambridge canal in 2017 but results have not been processed (Farrington 2017). If larvae of either species are present upstream of the Fruitland-Cambridge diversion it is reasonable to assume larvae of both species will be entrained into the irrigation system and result in mortality.

Fruitland-Cambridge and Hogback-Cudei irrigation units

Effects of construction activities in the San Juan River on fish entrainment
Replacement of the Fruitland-Cambridge diversion dam and the inlet headworks as well as the repair of the Helium lateral flume and siphon will require construction activities in the San Juan River. It is possible there will be no in river work for repair of the Helium lateral flume as the preferred method of repair will be to utilize the existing pipe that crosses the river rather than in river construction. However, if this pipe has collapsed a river crossing will be cut. During any in river construction the proposed action includes provisions to construct barriers to de-water the

construction area which should reduce fish entrainment. Any fish still remaining within the barriers will be netted and moved outside of the barrier. Timing of construction for each construction action is proposed to occur between October 1 and March 1, outside spawning periods for both species. Each construction action is expected to take approximately two to four weeks. Approximately 10.9 ha (27 acres) of designated critical habitat for both species will be temporarily disturbed during construction activities in the river, which is less than 1% of designated critical habitat in the San Juan River for both species. However, a small portion of that habitat, approximately 0.6 ha (1.5 acres), will be permanently modified for replacement of the diversion dam consisting of two grouted boulder weirs spanning the full width of the river (Figure 5). To minimize fish passage blockage and functionality of the habitat, a fish passage will be integrated into the dam, similar to the one constructed at Hogback-Cudei diversion (BIA 2000, Service 1999), along with a boat passage.

Annual fish monitoring within one river mile of the Fruitland-Cambridge diversion dam and the Helium lateral flume indicates one to five individual juvenile to adult Colorado Pikeminnow and Razorback Sucker could be captured in these areas (data from Schleicher 2016). Project proponents plan on using a qualified fisheries biologist to capture and move any fish in the area prior to any in-water work occurring. The construction area would then be blocked with seines before dewatering the river. As a result, there may be temporary harassment of juvenile to adult Colorado Pikeminnow and Razorback Sucker in the form of capture and release but no mortality is expected to occur.

Effects of Lateral Conversion Project on water quality
Conversion from earthen ditch to pressurized pipelines will reduce the adverse effects of the irrigation projects' selenium load on the Colorado Pikeminnow and Razorback Sucker. Although the reduction in selenium loading is not currently known, the salinity load will be reduced by 4,371 tons/year (25%) combining both the Hogback-Cudei and Fruitland-Cambridge irrigation units (SJRDWR 2015, NNDWR 2017d). It is possible the reduction in selenium would be in a similar proportion to the reduction in salinity. Determining the San Juan River's selenium loading resulting from both irrigation units is part of the proposed action and will provide for a realistic analysis of effects on listed species and their habitat.

Using other sets of available data and best available science to calculate an effect of selenium on listed fishes requires assumptions that cannot be substantiated. Using Hogback, Fruitland, and Cudei canal selenium concentration in water, plant, invertebrate, and whole body fish selenium concentrations from Thomas et al. (1998) could be used to determine the effects on fish. However, this requires an assumption that fish are residents in the canals or populations of fishes in the river are resident at the canal drains. Rather, listed fishes are found within the mainstem river where selenium and its effects on fish are diluted. Also, both listed species are migratory so are unlikely to be resident at the drain outlets to the river for any length of time.

In the San Juan River, selenium concentration accumulates in a downstream direction. A small portion of this will be due to the selenium loading present in Hogback-Cudei irrigation system and to a much less extent, the Fruitland-Cambridge irrigation system (Thomas et al. 1998). The downstream effect of NIIP has been calculated at Mexican Hat but was based on selenium concentrations and flow rates at those drains. A proportional calculation of Hogback-Cudei and Fruitland-Cambridge acreage farmed (12,165 ac), water diverted (20,898 AFY), and volume of water returned (~50%, NNDWR 2017c) in relation to NIIP (2010: 25,831 ha [63,832 acres] farmed and 196,369 af of water diverted, and 7.8% return to the San Juan River (BIA 2011) could be calculated and applied to the annual selenium loading in the San Juan River at Mexican Hat. This would assume similar concentrations of selenium in soil, soil saturation values, canal spills, and discharge from groundwater, are the same which is unlikely. Selenium concentration in water from the proportion of the irrigation units consisting of Cudei and Fruitland-Cambridge are significantly less than that of Hogback (Thomas et al. 1998) and data on how to take this into account are not currently available. Therefore, we can only assume there will be a reduction of selenium of some unknown quantity given the improved infrastructure from earthen canals to pressurized pipelines - improving critical habitat PCEs of water quality for both Colorado Pikeminnow and Razorback Sucker.

Effects of Lateral Conversion Project habitat replacement
The Lateral Conversion Project habitat replacement project was not analyzed because it is not likely to have an adverse effect on endangered species. However, we can analyze the effect on critical habitat, which will cause temporary disturbance in critical habitat but ultimately will likely increase the amount of low velocity habitat endangered fishes need for rearing young in the San Juan River. The PCEs for both Colorado Pikeminnow and Razorback emphasize the needs to increase the amount of physical habitat likely to be inhabited or potentially used for spawning, feeding, or nursery. The Lateral Conversion Project habitat replacement component of this proposed action will restore a historical channel of the San Juan River. In doing so, approximately 4.17 ha (10.3 acres) of designated critical habitat for both species will be disturbed. However, most of this disturbance will be due to excavating the historical channel in the dry and establish a slope to allow flow into the channel. Although, given the nature of the San Juan River, it is anticipated that this channel may not be connected every year, but for the years that this secondary channel is available to it all for more physical habitat for spawning, nursery, and foraging habitat. The outcome of conservation measures incorporated into the proposed actions should result in minimal effects on the endangered fishes in the San Juan River.

Summary of Direct Impacts

Direct effects of the proposed action include reduction in habitat and quality by water depletions, potential blockage of fish passage, impingement in irrigation inlet headworks, entrainment into sluiceways or into the main irrigation system, and draining of selenium laden irrigation water (Table 6). However, actions have already been put in place to minimize some of these effects or the proposed project incorporates actions to minimize effects like the construction of a fish passage in the Fruitland-Cambridge diversion dam, the construction of a fish barrier weir within the main canal, and the likely reduction in selenium loading or returned irrigation water. Approximately, 10.9 ha (27 acres) of designated critical habitat for both species will be temporary disturbed by in river construction, and approximately 0.6 ha (1.5 acres) will be permanently modified. However, approximately 4.17 ha (10.3 acres) of secondary channel within designated critical habitat will become available for habitat for Colorado Pikeminnow and Razorback Sucker.

Table 6. Summary of project actions which may result in adverse effects on Colorado Pikeminnow and Razorback Sucker

Irrigation unit	Actions	Type of effect	Life-stage	Effect extent
Fruitland-Cambridge	Water depletions	Habitat quantity and quality	All	Minimized*
	Diversion dam	Fish passage blockage	All	Minimized – extent unknown
	Headworks	Impingement	Adult	Unlikely
	Main canal water diversion	Entrainment	Larvae Juvenile to Subadult	Minimized and minimal
Fruitland-Cambridge and Hogback-Cudei	In river construction	Entrainment	Juvenile to adult	Minimal
	Lateral conversion	Water quality	All	Impacts reduced by 25% – remaining effects unknown

*San Juan River Recovery Implementation Program serves as an offsetting measure for this water depletion

INDIRECT EFFECTS

Indirect effects are those that are caused by, or result from, the proposed action, and are later in time, but are reasonably certain to occur. The continued operation of the Fruitland-Cambridge and Hogback-Cudei Irrigation projects may lead to land use changes within the action area that could result in changes to air and water quality. Increased return flow from irrigated lands within the action area may lead to increased sediment, pesticide, nutrient, and selenium loading in the San Juan River. Increases in the population of the area around Shiprock, New Mexico could likely coincide with these land use changes. The quantities associated with these land use changes cannot currently be calculated with any amount of certainty and therefore, the severity of impacts to Colorado Pikeminnow and Razorback Suckers is unknown.

INTERRELATED AND INTERDEPENDENT EFFECTS

The Animas La-Plata Project is interrelated to the Fruitland-Cambridge and Hogback-Cudei irrigation projects because implementation of the Flow Recommendations was a condition of the reasonable and prudent alternative for the Animas La-Plata Project consultation, through the operation of Navajo Dam. Implementation of the Flow Recommendations was also part of the proposed action for Navajo Indian Irrigation Project and therefore it is also an interrelated effect of the proposed action. In addition, the Fruitland-Cambridge and Hogback-Cudei irrigation projects could not operate without the presence of Navajo Dam, which is another reason why it is interrelated with this proposed action. Because the effects of these projects (Animas La-Plata, Navajo Dam, Navajo-Gallup Water Supply, and NIIP) were already considered in previous consultations, they are part of the environmental baseline of this consultation.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions on endangered or threatened species or critical habitat that are reasonably certain to occur in the foreseeable future in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Cumulative effects analysis as stated here applies to section 7 of the ESA and should not be confused with the broader use of this term in the National Environmental Policy Act or other environmental laws.

Coalbed methane development

The San Juan basin in southwestern Colorado and northwestern New Mexico is rich in coalbed methane, and development of this resource has increased rapidly in the last ten years. There are currently more than 3,000 coalbed methane wells in the San Juan basin in the Fruitland Coal Formation. Historically, one well per 139 ha (320 acres) was allowed in this area; however, the Colorado Oil and Gas Commission approved an increase of the well spacing to one well per 64 ha (160 acres). Potentially more than 700 additional wells may be drilled and approximately 250 of these could occur on private or State land. Coalbed methane development requires the extraction of groundwater to induce gas flow. It was estimated that the wells would be drilled by 2013, but because of slow groundwater movement water depletion effects would not be incurred until at least 2025.

A study was initiated in 1998 to determine the effects of groundwater extraction from the Fruitland Formation. The study is called the 3M Project (mapping, modeling, and monitoring) and was being conducted by the Colorado Oil and Gas Conservation Commission in cooperation with the Southern Ute Indian Tribe, BLM, the Forest Service, and the industry. The mapping and modeling studies were completed in 2000. A follow-up project was funded by the Ground Water Protection Research Foundation (GWPRF).

The Fruitland Formation and the underlying Pictured Cliffs Sandstone were shown to be an aquifer system. In general terms, the groundwater produced from near-outcrop coalbed methane wells is recent recharge water that would, under predevelopment conditions, discharge to the Animas, Pine, Florida and Piedra Rivers. These rivers provide flow to the San Juan River. Coalbed methane wells occur on Federal, State, Tribal and private lands. Future section 7 consultations are not expected for coalbed methane development on private or State lands; therefore, these water depletions are considered a cumulative effect that is reasonably certain to occur within the action area.

The GWPRF used a groundwater model and a reservoir model to determine water budgets and depletions associated with coalbed methane development. Three areas around the Animas, Pine, and Florida Rivers were modeled using three-dimensional multi-layer models to account for aquifer-river interactions and the effects of coalbed methane development. Baseline conditions were simulated with a single-phase ground water flow model (MODFLOW), and predictive runs were made using two-phase flow models (EXODUS and COALGAS). The predictive model run results are summarized in The RiverWare Model, which is used to evaluate hydrologic conditions in the San Juan River and its tributaries, requires a defined project to determine project compatibility with the San Juan River Flow Recommendations (Holden 2000). Because future coalbed methane development on State and private land is not a defined project and the depletions associated with it are relatively small and not specifically quantified, the RiverWare Model is not an appropriate tool to assess these effects.

The model results show that prior to coalbed methane development, the Fruitland Formation discharged approximately 205 AFY to the San Juan River. Modeling shows approximately 74 AFY is currently being depleted with existing wells and predicts the maximum depletions to be approximately 200 AFY.

The RiverWare Model, which is used to evaluate hydrologic conditions in the San Juan River and its tributaries, requires a defined project to determine project compatibility with the San Juan River Flow Recommendations (Holden 2000). Because future coalbed methane development on State and private land is not a defined project and the depletions associated with it are relatively small and not specifically quantified, the RiverWare Model is not an appropriate tool to assess these effects.

Table 7. Surface water modeled depletions as a result of coalbed methane development

River	Pre-CBM Discharge (AFY)	Current Depletion (AFY)	Maximum Depletion (AFY)	Year when Max Depletions Begin
Animas	66	41	66	2045
Pine	61	31	61	2025
Florida	17.5	2	12.5	2050
Piedra*	60	0	60	**
Total	204.5	74	199.5	

*Piedra River depletions are estimated based on discharges simulated from the 3M Project and the depletions modeled in the GWPRF at other rivers.
**Maximum depletions at the Piedra River will depend on the rate of coalbed methane development in the northeastern portion of the San Juan basin.

Other depletions and diversions from the San Juan River basin

The Service believes most San Juan River basin depletions are accounted for in the environmental baseline depletions. Irrigation ditches and canals below Navajo Dam could entrain Colorado Pikeminnow and Razorback Sucker, including Citizens, Hammond, Fruitland, San Juan Generating Station, Jewett Ditch, and Hogback. Increased urban and suburban use of water, including municipal and private uses, will increase demands for water. Further use of surface water from the San Juan River will reduce river flow and decrease available habitat for the Razorback Sucker and Colorado Pikeminnow. Livestock grazing may adversely impact Razorback Sucker and Colorado Pikeminnow by reducing base flows from removal of water for drinking and reduction in soil water holding capacity in the floodplain.

Increase in development and urbanization in the historical floodplain result in reduced peak flows because of flooding threats. Development in the floodplain makes it more difficult to transport large quantities of water that would overbank and create low velocity habitats that the Razorback Sucker and Colorado Pikeminnow need for their various life history stages.

Nonnative fish species in Lake Powell and Navajo reservoirs
The presence of Striped Bass, Walleye and Channel Catfish in Lake Powell reservoir constitutes a future threat to Colorado Pikeminnow and Razorback Sucker in the San Juan River. When the water elevation of Lake Powell reservoir is high enough to inundate a barrier created by a waterfall, Striped Bass, Walleye, Channel Catfish, and other nonnative fish species can enter the San Juan River. Boating, fishing, ORV use, and camping in the San Juan River basin is expected to increase as the human population increases. Potential impacts include angling pressure, non-point source pollution, increased fire threat, the introduction of additional nonnative species, and the potential for harassment of native fishes.

CONCLUSION

After reviewing the current status of the Colorado Pikeminnow and Razorback Sucker, the Environmental Baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action, as described, is not likely to jeopardize the continued existence of the Colorado Pikeminnow and Razorback Sucker. This determination was reached because the proposed action will result in reduction of current effects of irrigation activities on endangered fish species in the San Juan River and the remaining effects are minimal enough to not result in jeopardy to either species (Table 6). As pertains to water diversion at the Fruitland-Cambridge irrigation unit, water depletions effects are minimized by the SJRRIP. Although the diversion dam will be replaced with a permanent structure a fish passage similar to that at Hogback-Cudei diversion has been engineered into the Fruitland-Cambridge design. The fish passage rates at Hogback-Cudei diversion do not appear to jeopardize species or preclude species recovery. Thus, should the Fruitland-Cambridge fish passage result in similar passage rates, jeopardy to the species or their recovery should not occur. Currently, water is diverted into the Fruitland-Cambridge irrigation system year-round with no barriers to entrainment. Refurbishing the headworks will allow water to remain in the San Juan River during non-irrigation times, reducing the likelihood of entrainment by 33% and providing more wetted habitat in the San Juan River. Refurbishing the headworks will include installation of a trash rack which will likely prohibit adult fish from entering the diversion. Although debris removal using this trash rack could result in mortality to impinged fish placed on the bank, it is expected that such instances will be rare. There may be entrainment and mortality of juvenile to subadult fish of both species, entrained through the 4-inch trash rack, during sluicing operations. However, those operations will occur infrequently for 8-hour periods. At those times, mortality of 0.01% of population of juvenile to subadults of both species could occur. During a significant portion of the irrigation season the first sluiceway will be closed and fish will pass down the main canal to the fish barrier weir. Entrainment over the fish barrier weir of juvenile to subadult Colorado Pikeminnow and Razorback Sucker is possible and could consist of <0.5% of the population. However, due to the bottom dwelling nature of Razorback Sucker, it is more likely any juvenile or subadult Razorback Sucker entrained into the main canal will be shunted to the river because of the installation of the fish barrier weir. It is expected that larval fish of both species will be entrained through the trash rack and over the fish barrier weir in proportion to the amount of water diverted. This could result in entrainment of <0.5% larvae produced each year. In river construction associated with both irrigation units may occur, but provisions have been made to limit construction to a time period when larvae are not in the system and limit the amount of time construction is occurring in the river. This will result in few fish entrained in construction areas and limits take to harassment in the form of capture and release. Although there are a number of effects that could cause mortality or harassment, they will be limited in duration or overall population effect and thus not result in jeopardizing the persistence of Colorado Pikeminnow or Razorback Sucker.

The direct effect of selenium on endangered fishes and point source contribution is difficult to identify. The proposed action includes an analysis of the contribution of selenium to the San Juan River from both irrigation units. Also, a study is currently in place and being funded by BIA, which will quantify relationship between waterborne selenium and its contribution to selenium in Razorback Sucker diet and thus the fish's body burden (Buhl and Cleveland 2015). Once this study is completed and the contribution of selenium from Hogback-Cudei and Fruitland-Cambridge irrigation drains is quantified, the effects on listed fishes can be assessed. Until that time, the impact of the proposed project on the listed fishes and their critical habitat as it pertains to selenium is not provided by this BO.

In addition, the proposed action is not likely to adversely modify or destroy designated critical habitat for either species because the proposed action is estimated to impact 10.9 ha (27 acres) temporarily during in river construction and 0.6 ha (1.5 acres) will be permanently modified. However, approximately 4.17 ha (10.3 acres) of a restored secondary channel within designated critical habitat will become available for habitat for Colorado Pikeminnow and Razorback Sucker. Designated critical habitat that is temporarily disturbed and permanently modified is less than 1% of designated critical habitat within the San Juan River. This small percentage of impacted designated critical habitat does not rise to the level of an adverse modification because the PCEs for both Colorado Pikeminnow and Razorback Sucker are still available in the vast majority of critical habitat areas and provide for life-history processes that are essential to the conservation of both species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such take is in compliance with the terms and conditions of an incidental take statement.

The Reasonable and Prudent Measures described below are non-discretionary, and must be undertaken by BIA and Reclamation, as appropriate so that they become binding conditions of any grant or permit issued to any applicants, as appropriate, for the exemption in section 7(o)(2) to apply. BIA and Reclamation have a continuing duty to regulate the activity covered by this incidental take statement. If BIA or Reclamation (1) fails to assume and implement the terms and conditions, or (2) fails to require applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, BIA and Reclamation, as appropriate, must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

Fish passage blockage

As a result of replacing the current diversion dam upstream fish passage may be reduced. Take estimates due to blockage of fish passage and modification of the depth and velocity of habitat are indeterminate at this time. However, rates of fish passage as calculated at the Hogback-Cudei fish passage, on which the Fruitland-Cambridge fish passage was designed, provide and surrogates estimate of take. For juvenile to adult Colorado Pikeminnow the passage rates are 31.5% for Colorado Pikeminnow and for these same life-stages of Razorback Sucker 23.3% (Figure 17). Rates of passage below these values would exceed the amount of take provided.

Impingement

As a result of operating the Fruitland-Cambridge irrigation unit trash rack removal of debris direct take of impinged adult Colorado Pikeminnow and Razorback Sucker may occur. However, the necessity of debris removal is unknown and adult fish are unlikely to be impinged on the trash rack. The amount or extent of take cannot be quantified, given the unknown timing of debris removal and rarity of a fish becoming impinged. Take of an unknown amount may be occurring and is not quantified for this project.

Entrainment

As a result of water diversion into the Fruitland-Cambridge irrigation unit main canal fish will be entrained. During sluicing operations, juvenile and subadult Colorado Pikeminnow and Razorback Sucker entrained through the headworks structures could be further entrained into the sluicing canals. Approximately 0.01% of the juvenile and subadult population of Colorado Pikeminnow and Razorback Sucker could be entrained through the trash rack and during each sluicing operation harm or mortality could occur to all individuals entrained into the first sluiceway. As the number of fish for both species' population changes with time, so would the number of fish entrained (Figure 12 and Figure 14).

Further down the irrigation canal entrainment of larvae through subadult Colorado Pikeminnow and Razorback Sucker could occur. Entrainment of <0.5% of the population of Colorado Pikeminnow and Razorback Sucker larvae is anticipated to occur over the weir wall during spawning season from the operation of Fruitland-Cambridge water diversions. For Colorado Pikeminnow and Razorback Sucker juvenile to subadult life-stage 0.32% of their populations are expected to be entrained over the weir wall. As the number of fish in the Colorado Pikeminnow and Razorback Sucker populations changes with time, so would the number of fish entrained (Figure 12).

During construction of the Fruitland-Cambridge diversion dam, headworks replacement, and Hogback-Cudei Helium lateral siphon entrainment of endangered fishes may occur. Take of these individuals would be in the form of harassment. Given conservation measures taken by project proponents to slowly dewater and block off construction areas, entrainment of juvenile to adult fish of both species will be minimal but may extend to five fish per species.

EFFECT OF THE TAKE

In this BO, the Service determined that the level of anticipated take is not likely to result in jeopardy to the Colorado Pikeminnow and Razorback Sucker or result in the destruction or adverse modification of their critical habitat. The proposed action is likely to have adverse effects on individuals but those effects are not anticipated to result in any long-term consequences on the population. Incidental take of both Colorado Pikeminnow and Razorback Sucker will result from harassment during in-river construction, impingement and entrainment during water diversion operation.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of both Colorado Pikeminnow and Razorback Sucker due to activities associated with the proposed action.

1. BIA through NNDWR will include the Service (SJRRIP Program Office) and a Service designated Reclamation representative in the review and comment process of the construction design at 30%, 60%, and 90% completion, prior to design completion. Reclamation will be included in the review and approval process of the fish barrier weir wall design and structures needed for installation of PIT Tag antennas.
2. BIA through NNDWR will provide a copy of the Fruitland Diversion operation and maintenance plan once drafted for Service (SJRRIP Program Office) review and comment. Recommendations made by the Service that are intended to minimize for take, will be incorporated into the final agreement.
3. If funded by BIA, BIA through NNDWR will provide a copy of the Fruitland-Cambridge canal draft storm water management plan once it is completed for Service (SJRRIP Program Office) review and comment.
4. When the Hogback-Cudei operations and maintenance plan expires, Reclamation through NNDWR will include the Service (SJRRIP Program Office) in the renegotiation.

TERMS AND CONDITIONS

Compliance with the following terms and conditions must be achieved in order to be exempted from the prohibitions of section 9 of the ESA. The terms and conditions implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. The terms and conditions are non-discretionary.

The following term and condition is established to implement Reasonable and Prudent Measure Number 1:

i. For the Fruitland-Cambridge diversion dam, headworks replacement and repair, and fish barrier weir wall installation, BIA through NNDWR will provide the Service (SJRRIP Program Office) and a Service designated Reclamation representative, the name and contact information for both design and engineering companies, the construction timeline, including estimates of 30, 60, and 90% construction design completion schedule, construction start date, and general construction schedule.
ii. At a minimum, Reclamation through SJRRIP in collaboration with NNDWR will install a PIT tag antenna within the Fruitland-Cambridge irrigation canal on the downstream side of the weir wall to monitor entrainment of PIT tagged Colorado Pikeminnow and Razorback Sucker.
iii. Reclamation, through the SJRRIP will be responsible for the operation, maintenance, and data collection of the remote PIT tag antennas, and will be included in the SJRRIP Annual Work Plan. PIT tag data will be submitted to the Service annually.
iv. Reclamation through SJRRIP in collaboration with NNDWR will determine the feasibility of installation of a log boom with skirt on the upper surface of the weir wall to further deflect and reduce entrainment of Colorado Pikeminnow and Razorback Sucker larvae and juveniles and subadult Colorado Pikeminnow. If feasible, the log boom and skirt will be installed.

The following term and condition is established to implement Reasonable and Prudent Measure Number 2:

i. The operations and maintenance plan at the minimum should require the sluiceway adjacent to the canal inlet to be:
   a. Operated to maximize water flow in the fish passage, while providing for adequate water operation for the irrigation system. This will be addressed in the development of the Fruitland Diversion operation and maintenance plan.
   b. Operated to maintain at least 100 cfs through the fish passage (i.e. refrain from keeping the sluiceway open more than necessary when mainstem river flows are less than 1,000 cfs).
ii. BIA through NNDWR will submit an annual report to the Service for approval for the first three years to determine adequate reporting. At a minimum, the report should include: a summary of operation and maintenance, the percentage of time the fish passage may have been dry, and the estimated water surface elevations or water depths within the fish passage. The report should also describe maintenance conducted at the Fruitland Diversion Structure. After the three year approval period, annual reports submitted, do not require approval.

The following term and condition is established to implement Reasonable and Prudent Measure Number 3:

i. Any reports submitted to other agencies in regards to monitoring should also be submitted to the Service.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's section 7(a)(1) responsibility for these species. In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species and their habitat, we request notification of the implementation of the conservation recommendations. We suggest the following conservation recommendations be implemented:

In order to determine if the weir wall design and installation of the log boom further reduces entrainment from that found at the Hogback-Cudei canal test of larval, juvenile, and subadult Colorado Pikeminnow and Razorback Sucker entrainment should be conducted. In anticipation of such experiments, initial construction should include a walkway over the canal downstream of the weir wall and a walkway across the fish return canal. Both walkways should include structures to install fish sampling equipment.

REPORTING REQUIREMENTS

Documentation and reporting on the implementation of the conservation measures and terms and conditions will occur within six months after completion of the proposed action and annually thereafter for a period of five years. The nearest Service Law Enforcement Office must be notified within 24 hours in writing should any listed species be found dead, injured, or sick. Notification must include the date, time, and location of the carcass, cause of injury or death (if known), and any pertinent information. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. If necessary, the Service will provide a protocol for the handling of dead or injured listed animals. In the event BIA or Reclamation suspects that a species has been taken in violation of Federal, State, or local law, all relevant information should be reported in writing within 24 hours to the Service's New Mexico Law Enforcement Office (505/883-7814) or the New Mexico Ecological Services Field Office (505/346-2525).

REINITIATION NOTICE

This concludes formal consultation on the proposed San Juan River Navajo Irrigation Rehabilitation Project – Fruitland-Cambridge and Hogback-Cudei Irrigation Units – and Colorado River Salinity Program Habitat Replacement that are in the Gadii'ahi, Beclabito, Shiprock, Hogback, Nenahnezad, and Upper Fruitland Navajo Nation Chapters. As required by 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded. See section on Amount or Extent of Take; 2) new information reveals effects of the agency action that may impact listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; 4) a new species is listed or critical habitat designated that may be affected by the action; or 5) if the SJRRIP ceases to exist or if funding levels are reduced so that critical deadlines for specified recovery actions are not met.

In future communications regarding this project please refer to consultation number 02ENNM00-2016-F-0131. If you have any questions or would like to discuss any part of this BO, please contact Melissa Mata of my staff at (505) 761-4708.

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June 26, 2015

Mr. Christopher R. Wrbas
U.S. Army Corps of Army Engineers
Durango Regulatory Office
1970 East 3rd Avenue, Suite 109
Durango, CO 81301

Dear Chris:

There are three existing steel irrigation siphons that require replacement due to age. Two of these siphons are on the Fruitland-Cambridge Irrigation Project and are named Bitsui Siphon and Yellowman Siphon. The third siphon, Salt Creek Siphon, is located on the Hogback-Cudei Irrigation Project.

Bitsui Siphon is a 775 foot long,40-inch steel pipe located on Fruitland Canal which is on the south side of the San Juan River approximately one mile southwest of Fruitland. It has failed several times and may not make it through the 2015 irrigation season. It will be replaced with 42-inch buried HDPE pipe. Figure 1 shows the location of the Bitsui Siphon. The current siphon acts as a weir on the existing arroyo. The new buried design will enable the arroyo to naturally flow. Figure 2 shows a picture of the existing siphon.

Yellowman Siphon, is a 9000 foot long 36-inch steel pipe located on Fruitland Canal located along the south side of the San Juan River. The inlet is approximately 1.7 miles west of Fruitland. Ten years ago, the Navajo Nation Department of Water Resources replaced half of the pipe with new pipe but were unable to complete total replacement. As with the Bitsui Siphon, the old portion of the Yellowman Siphon has failed several times and may not make it through the 2015 irrigation season. NNDWR plans to replace the remaining portions of Yellowman Siphon. Figure 1 shows the location of the Yellowman Siphon.

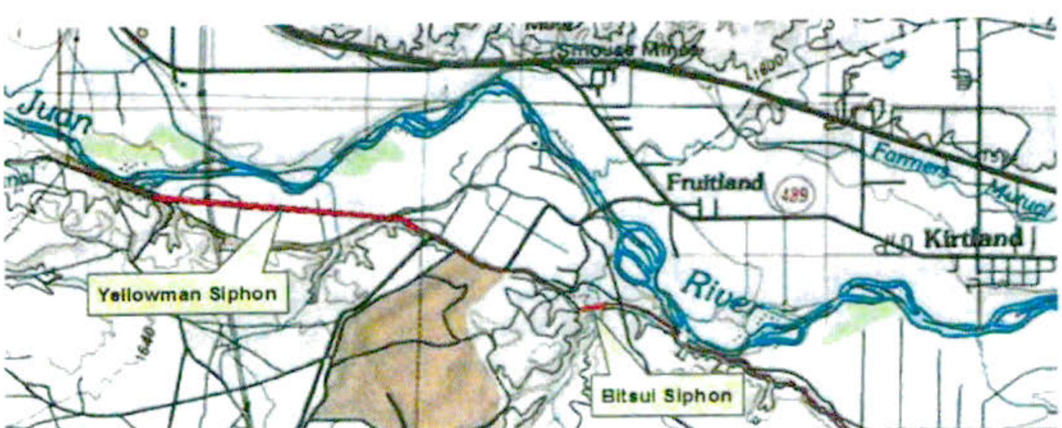

Figure 1. Location of Yellowman Siphon and Bitsui Siphon

Figure 4. Recent failure of Salt Creek Siphon.

The Navajo Nation Department of Water Resources Shiprock Irrigation respectfully requests that the U.S. Corps of Army Engineers provides an exemption to the Section 404 permit of the Clean Water Act for these three locations for the following reasons:

1. Existing irrigation structure replacement qualifies for an exemption under implementing regulation 33 CFS 323.4(a).
2. The work intended is part of the regular maintenance of both Hogback and Fruitland Canal.

We appreciate your consideration of these exemption requests. Please let me know if you have any questions or require additional information

Sincerely,

Michael Isaacson

Michael Isaacson, PE

Cc: Marlin Saggboy, Shiprock Irrigation
David Tallman, NNDWR
Rudy Keedah, BIA-Navajo Region

EXHIBIT
E

Norman C. Begaye
President

Lucinda Yellowman-Bennalley
Vice President

LoJan Watson
Secretary/Treasurer

Harold Dodge
Grazing Committee Member

Tracy Raymond
Farm Board Member

DIBE' NI' TSAA

NENAHNEZAD CHAPTER

P.O. BOX 438
FRUITLAND, NEW MEXICO 87416
Ph 505/960-9702 Fax 505/960-6657
www.nenahnezad@navajochapters.org

Lorenzo Bates
Council Delegate

NZC-47-2018

SUPPORTING THE NAVAJO NATION WATER RESOURCES' PLAN TO REPLACE THE YELLOWMAN SIPHON PIPE AND INSTALL AN AUTOMATCH TRASH SCREEN ON THE INLET OF YELLOWMAN SIPHON

WHEREAS:

1. Pursuant to 26 N.N.C. §3 (A), the Nenahnezad Chapter was certified on November 10, 1955 as a chapter of the Navajo Nation and is listed under 11 N.N.C., Part 1, §(B), the Nenahnezad Chapter is delegated the governmental authority to make decisions over local matters consistent with Navajo Laws including custom, tradition, and fiscal matters; and
2. The Nenahnezad Chapter membership has been informed that the Navajo Nation Water Resources has slowly been replacing the 40-inch steel pipe on the Yellowman Siphon with new pipe. Approximately 2,300 ft. of steel pipe remains on the downstream end of Yellowman Siphon. Another 1,114 ft. on the upstream end requires replacement; and
3. The NNDWR will replace 1,414 ft. of Yellowman Siphon with new steel pipe and install an automated trash screen on the inlet of the siphon; and
4. Similar to Bitsui Siphon, during state up earlier this month, the siphon piping failed in several places. Closure inspection revealed that the siphons walls are "paper" thin and probably will not last another year. NNDWR was able to patch together the leaky places but is uncertain how it will maintain over the irrigation season. It is critical that the remaining portion of the siphon that hasn't been replaced, be replaced by next year; and
5. The Reclamation has completed a design for this project. NNDWR contractor, KB, will use this design to create contract documents for placing the siphon. All final documents will then be reviewed by BIA. The siphon pipe replacement should be eligible for categorical exclusion so construction can happen later in 2018; and
6. NNDWR will use Subpart J funding to complete a design for the trash rack. The automated trash rack will require electrical power. NNDWR will have to work with the local utility, NTUA, to bring electrical power service to the site. Full NEPA compliance will be required for the trash rack;
7. That the siphon failed in early 2015 and is now an emergency project.
8. That the project is in the best interest of the community membership.

NOW THEREFORE BE IT RESOLVED THAT:

1. The Nenahnezad Chapter supports Navajo Nation Water Resources Dept.to replace the Yellowman Siphon Pipe and to install an automated trash rack on the inlet.
2. The Nenahnezad Chapter directs the Community Services Coordinator, Chapter Officers, and Council Delegate to carry out the intent of this resolution.

CERTIFICATION

We hereby certify that the foregoing resolution was duly considered by the Nenahnezad Chapter at a duly called meeting at Nenahnezad, (New Mexico) Navajo Nation. A motion was made by Larry Lowe and seconded by Summer Begay and the same was passed by a vote of 25 in favor, 00 opposed and 01 abstained, this 9th day of July 2018.

Norman C. Begaye

Norman C. Begaye, President

Lucinda Y. Bennalley

Lucinda Y. Bennalley, Vice President

CONCURRED:

LoJan Watson

LoJan Watson, Secretary/Treasurer

LoRenzo Bates, Council Delegate

EXHIBIT

tabbies

F

Document No. 010773

Date Issued: 07/24/2018

EXECUTIVE OFFICIAL REVIEW

Title of Document: TCE-YELLOWMAN SIPHON

Contact Name: YAZZIE, ELERINA B

Program/Division: DIVISION OF NATURAL RESOURCES

Email: elerina_yazzie@frontier.com

Phone Number: 928-871-6447

☐ **Business Site Lease**

			Sufficient	Insufficient
1. Division:		Date:	☐	☐
2. Office of the Controller:		Date:	☐	☐
(only if Procurement Clearance is not issued within 30 days of the initiation of the E.O. review)				
3. Office of the Attorney General:		Date:	☐	☐

☐ **Business and Industrial Development Financing, Veteran Loans, (i.e. Loan, Loan Guarantee and Investment) or Delegation of Approving and/or Management Authority of Leasing transactions**

1. Division:		Date:	☐	☐
2. Office of the Attorney General:		Date:	☐	☐

☐ **Fund Management Plan, Expenditure Plans, Carry Over Requests, Budget Modifications**

1. Office of Management and Budget:		Date:	☐	☐
2. Office of the Controller:		Date:	☐	☐
3. Office of the Attorney General:		Date:	☐	☐

☐ **Navajo Housing Authority Request for Release of Funds**

1. NNEPA:		Date:	☐	☐
2. Office of the Attorney General:		Date:	☐	☐

☐ **Lease Purchase Agreements**

1. Office of the Controller: (recommendation only)		Date:	☐	☐
2. Office of the Attorney General:		Date:	☐	☐

☐ **Grant Applications**

1. Office of Management and Budget:		Date:	☐	☐
2. Office of the Controller:		Date:	☐	☐
3. Office of the Attorney General:		Date:	☐	☐

☐ **Five Management Plan of the Local Governance Act, Delegation of an Approving Authority from a Standing Committee, Local Ordinances (Local Government Units), or Plans of Operation/Division Policies Requiring Committee Approval**

1. Division:		Date:	☐	☐
2. Office of the Attorney General:		Date:	☐	☐

☐ **Relinquishment of Navajo Membership**

1. Land Department:		Date:	☐	☐
2. Elections:		Date:	☐	☐
3. Office of the Attorney General:		Date:	☐	☐

EOR # 010773

☐ **Land Withdrawal or Relinquishment for Commercial Purposes**

				Sufficient	Insufficient
1. Division:		Date:		☐	☐
2. Office of the Attorney General:		Date:		☐	☐

☐ **Land Withdrawals for Non-Commercial Purposes, General Land Leases and Resource Leases**

1. NLD		Date:		☐	☐
2. F&W		Date:		☐	☐
3. HPD		Date:		☐	☐
4. Minerals		Date:		☐	☐
5. NNEPA		Date:		☐	☐
6. DNR		Date:		☐	☐
7. DOJ		Date:		☐	☐

☐ **Rights of Way**

1. NLD		Date:		☐	☐
2. F&W		Date:		☐	☐
3. HPD		Date:		☐	☐
4. Minerals		Date:		☐	☐
5. NNEPA		Date:		☐	☐
6. Office of the Attorney General:		Date:		☐	☐
7. OPVP		Date:		☐	☐

☐ **Oil and Gas Prospecting Permits, Drilling and Exploration Permits, Mining Permit, Mining Lease**

1. Minerals		Date:		☐	☐
2. OPVP		Date:		☐	☐
3. NLD		Date:		☐	☐

☐ **Assignment of Mineral Lease**

1. Minerals		Date:		☐	☐
2. DNR		Date:		☐	☐
3. DOJ		Date:		☐	☐

☒ **ROW (where there has been no delegation of authority to the Navajo Land Department to grant the Nation's consent to a ROW)**

1. NLD		Date:		☐	☐
2. F&W		Date:		☐	☐
3. HPD		Date:		☐	☐
4. Minerals		Date:		☐	☐
5. NNEPA		Date:		☐	☐
6. DNR		Date:		☐	☐
7. NNDWR	[signature]	Date:	12/3/18	☑	☐
8. DOJ -(ic)	[signature]	Date:	12/4/18	☒	☐
9. OPVP	[signature]	DATE:	12/7/18	☒	☐

☐ **OTHER:**

1.		Date:		☐	☐
2.		Date:		☐	☐
3.		Date:		☐	☐
4.		Date:		☐	☐
5.		Date:		☐	☐

NAVAJO NATION DEPARTMENT OF JUSTICE

☐ RESUBMITTAL

DOCUMENT REVIEW REQUEST FORM

RECEIVED
NOV - 8 2018
DEPARTMENT OF JUSTICE
RECEPTIONIST DESK

DOJ
11/8/18 @ 219p
DATE / TIME
☐ 7 Day Deadline
DOC #: 010773
SAS #:
UNIT: Nru

*** FOR NNDOJ USE ONLY - DO NOT CHANGE OR REVISE FORM. VARIATIONS OF THIS FORM WILL NOT BE ACCEPTED. ***

CLIENT TO COMPLETE			
DATE OF REQUEST:	11/8/2018	DIVISION:	Division Natural Resources
CONTACT NAME:	Michelle Hoskie or Stevie Hudson	DEPARTMENT:	General Land Development Department
PHONE NUMBER:	871-6447 or 871-6423	E-MAIL:	michellehoskie@frontier.com
TITLE OF DOCUMENT:	TCE YELLOWMAN SIPHON, NANAHNAZAD, SAN JUAN COUNTY, NEW MEXICO, EOR NO. 010773		

DOJ SECRETARY TO COMPLETE			
DATE/TIME IN UNIT:	11.8.18 3pm	REVIEWING ATTORNEY/ADVOCATE:	Irvin Chee 11/20/18
DATE TIME OUT OF UNIT:	12/4/18, 340 PM		

DOJ ATTORNEY / ADVOCATE COMMENTS

- Document is legally sufficient. TCE T&C is attached

REVIEWED BY: (Print)	Date / Time	SURNAMED BY: (Print)	Date / Time
Irvin Chee	12/3/18	V Blackhat	12/4/18 9:05AM

DOJ Secretary ~~Called~~ emailed: Michelle H. for Document Pick Up on 12/4/18 at 336PM By: MM

PICKED UP BY: (Print) DATE / TIME:

NNDOJ/DRRF-July 2013

Tier 1 Document Voting Results							
User Name (Facility)	Job Title	Department	Vote Cast	Comments	Replies	Vote Date	Signature
Eugenia Quintana EPA (Navajo Land Title Data System - Windowrock AZ)	Air and Toxics - Reviewer	Navajo Nation Environmental Protection Agency	Approved	1. Adequate documentation for the temporary easement.	1. *No Reply*	27-Sep-2018	[illegible]
Lee Anna Martinez EPA (Navajo Land Title Data System - Windowrock AZ)	Water Quality - Reviewer	Navajo Nation Environmental Protection Agency	Approved	1. If proposal require crossing Waters of the US or Waters of the NN contact US COE and Patrick Antonio at (928)871-7185 for a 401 Cert.	1. *No Reply*	20-Aug-2018	[illegible]
Najamh Tariq (Navajo Land Title Data System - Windowrock AZ)	Approver	Department of Water Resources	Approved	*no comments*	*No Reply*	20-Aug-2018	Najam H. Tariq
Pam Kyselka F&W (Navajo Land Title Data System - Windowrock AZ)	Technical Review	Fish and Wildlife	Approved	1. 02ENNM00-2016-F-0131	1. *No Reply*	24-Aug-2018	[illegible]
Patrick Antonio EPA (Navajo Land Title Data System - Windowrock AZ)	Water Quality - Supervisor	Navajo Nation Environmental Protection Agency	Approved	1. Total land surface disturbance greater than 1.0 acre requires coverage under USEPA's Construction General Permit for storm water discharges from construction sites. The project EA-17-18537 indicates storm water permit coverage will be obtained.	1. *No Reply*	17-Aug-2018	[illegible]

Robert Allan DNR (Navajo Land Title Data System - Windowrock AZ)	Deputy Director DNR	DNR Administration	Approved	*no comments*	*No Reply*	07-Sep-2018	Robert O. Allan
Tamara Billie NNHP (Navajo Land Title Data System - Windowrock AZ)	HPD Reviewer	Historic Preservation Department	Approved	1. HPD-16-485 - Follow stipulations for sites as outlined in CRCF. HPD-16-981	1. *No Reply*	27-Aug-2018	[illegible]
Warren Roan - EPA (Navajo Land Title Data System - Windowrock AZ)	Storage Tanks Program - Reviewer	Navajo Nation Environmental Protection Agency	Approved	1. No concerns regarding storage tanks and/or leaking storage tanks.	1. *No Reply*	20-Aug-2018	Warren J Roan
Yolanda Barney EPA (Navajo Land Title Data System - Windowrock AZ)	Public Water System Supervision Program	Navajo Nation Environmental Protection Agency	Approved	*no comments*	*No Reply*	18-Aug-2018	[illegible]

Tier 2 Document Voting Results							
User Name (Facility)	**Job Title**	**Department**	**Vote Cast**	**Comments**	**Replies**	**Vote Date**	**Signature**
Bidtah N. Becker (FBFA)	FBFA Users	FBFA Action Team	Approved	*no comments*	*No Reply*	08-Nov-2018	BNBecker
Richard Begay NNHP (Navajo Land Title Data System - Windowrock AZ)	Navajo Nation Historic Preservation Officer	Historic Preservation Department	Approved	1. CRCF fro this project has been uploaded here. Please note conditions of clearance.	1. *No Reply*	15-Oct-2018	[illegible]
Ronnie Ben EPA (Navajo Land Title Data System - Windowrock AZ)	Underground Injection Control - Reviewer	Navajo Nation Environmental Protection Agency	Approved	1. Conditional Approval granted and contingent on any changes that may trigger review under the NNEPA and USEPA environmental laws.	1. *No Reply*	28-Sep-2018	[illegible]
Sam Diswood (Navajo Land Title Data System - Windowrock AZ)	Technical Review	Fish and Wildlife	Approved	*no comments*	*No Reply*	27-Sep-2018	Samuel F. Diswood
Steven Prince MIN (Navajo Land Title Data System - Windowrock AZ)	Technical Reviewer	Navajo Nation Minerals Management	Approved	1. This vote contingent on permanent inclusion in the approval package of the uploaded Terms & Conditions document. slp	1. *No Reply*	27-Sep-2018	Steven L Prince
W. Mike Halona (NLTDS - Everytt)	DCD Division Director	Navajo Nation	Approved	*no comments*	*No Reply*	27-Sep-2018	[illegible]

OLC SERVICE REQUEST FORM

DATE: 12-11-18 OLC# ____________

I. REQUESTOR:
☑ DELEGATE Lorenzo Bates PHONE: [redacted]
Co-Sponsor ____________ PHONE: ____________

II. AGENT(S): Elerina Yazzie PHONE: [redacted]
____________ PHONE: ____________
☐ Legislative Branch Employee/Official: ____________

III. SERVICE: ☑ LEGISLATION ☐ CORRESPONDENCE ☐ LEGAL ADVICE
(Check One) ☐ SUBPOENA ☐ OTHER: ____________

IV. DESCRIBE REQUEST:

Approving A temporary construction easement for Yellowman Siphon

V.
☑ Executive Branch Review Complete
☐ Financial Review Documents Attached

VI.
☐ Confidential Information Included
☐ Department of Justice Memo Regarding Confidential Information

OPENED BY: ____________
ASSIGNED TO: MK
OLC NOTES (IF ANY):

DATE COMPLETED: completed for
INITIAL OF DRAFTER: 24th NNC on 6.28.19
UPLOADED TO SHARED FILE ☐ by M. Kahn

Signature of Requestor
RELEASED TO: ____________ DATE RELEASED: ____________
Rev. 08/17

Office of Legislative Counsel
Telephone: (928) 871-7166
Fax # (928) 871-7576

Honorable Seth Damon
Speaker
24th Navajo Nation Council

MEMORANDUM

TO: Honorable Eugenia Charles-Newton
Shiprock Chapter

FROM: Mariana Kahn
Mariana Kahn, Attorney
Office of Legislative Counsel

DATE: June 28, 2019

SUBJECT: PROPOSED STANDING COMMITTEE RESOLUTION; AN ACTION RELATING TO RESOURCES AND DEVELOPMENT COMMITTEE; APPROVING A TEMPORARY CONSTRUCTION EASEMENT FOR THE TERM OF ONE YEAR TO THE NAVAJO NATION WATER RESOURCES DEPARTMENT FOR THE PURPOSE OF REPLACING THE YELLOWMAN SIPHON LOCATED WITHIN THE NENAHNEZAD CHAPTER VICINITY (SAN JUAN COUNTY, NEW MEXICO)

I have prepared the above-referenced proposed resolution and associated legislative summary sheet pursuant to your request for legislative drafting.

Please ensure that his particular resolution request is precisely what you want. You are encouraged to review the proposed resolution to ensure that it is drafted to your satisfaction.

Based on existing law and review of documents submitted, the resolution as drafted is legally sufficient. As with any action of government however, it can be subject to review by the courts in the event of proper challenge. The Office of Legislative Counsel confirms the appropriate standing committee(s) based on the standing committees powers outlined in 2 N.N.C. §§301, 401, 501, 601 and 701. Nevertheless, "the Speaker of the Navajo Nation Council shall introduce [the proposed resolution] into the legislative process by assigning it to the respective oversight committee(s) of the Navajo Nation Council having authority over the matters for proper consideration." 2 N.N.C. §164(A)(5).

THE NAVAJO NATION
LEGISLATIVE BRANCH
INTERNET PUBLIC REVIEW PUBLICATION

LEGISLATION NO: 0183-19 **SPONSOR: Eugenia Charles-Newton**

TITLE: An Action Relating To Resources And Development Committee; Approving A Temporary Construction Easement For The Term Of One Year To The Navajo Nation Water Resources Department For The Purpose Of Replacing The Yellowman Siphon Located Within The Nenahnezad Chapter Vicinity (San Juan County, New Mexico)

***Date posted*: July 2, 2019 at 3:15 PM**

Digital comments may be e-mailed to comments@navajo-nsn.gov

Written comments may be mailed to:

Executive Director
Office of Legislative Services
P.O. Box 3390
Window Rock, AZ 86515
(928) 871-7586

Comments may be made in the form of chapter resolutions, letters, position papers, etc. Please include your name, position title, address for written comments; a valid e-mail address is required. Anonymous comments will not be included in the Legislation packet.

Please note: This digital copy is being provided for the benefit of the Navajo Nation chapters and public use. Any political use is prohibited. All written comments received become the property of the Navajo Nation and will be forwarded to the assigned Navajo Nation Council standing committee(s) and/or the Navajo Nation Council for review. Any tampering with public records are punishable by Navajo Nation law pursuant to 17 N.N.C. *§374 et. seq.*

THE NAVAJO NATION
LEGISLATIVE BRANCH
INTERNET PUBLIC REVIEW SUMMARY

LEGISLATION NO.: 0183-19

SPONSOR: Honorable Eugenia Charles-Newton

TITLE: An Action Relating To Resources And Development Committee; Approving A Temporary Construction Easement For The Term Of One Year To The Navajo Nation Water Resources Department For The Purpose Of Replacing The Yellowman Siphon Located Within The Nenahnezad Vicinity (San Juan County, New Mexico)

Posted: July 2, 2019 at 3:15 PM

5 DAY Comment Period Ended: July 07, 2019

Digital Comments received:

Comments Supporting	*None*
Comments Opposing	*None*
Inconclusive Comments	*None*

Legislative Tracking Secretary
Office of Legislative Services

7/8/19
Date/Time