CONSTRUCTION REPORT

BONITA RESERVOIR DAM
OUTLET WORKS REHABILITATION
DECEMBER, 2016

Prepared for:

Elmer Ferganchick
21609 Noel Road
`Eckert, CO 81418-8112

Prepared by:

Western Engineers, Inc.
2150 Highway 6 and 50
Grand Junction, CO 81505

TABLE OF CONTENTS

CONSTRUCTION REPORT

BACKGROUND AND RELATED DOCUMENTS:

General:

The existing Bonita Reservoir dam is located approximately 12 air miles northeast of Cedaredge, Colorado. The dam is located roughly in the middle of Section 36, Township 11 South, Range 94 West, 6th Principal Meridian, (Latitude 39° 03" 10" North, Longitude 107° 50' 49" West) with a dam crest elevation of approximately 10,030 feet. The existing structure is a homogeneous earth embankment (with a downstream rockfill zone) approximately 20 feet in maximum embankment height and possessing a total spillway freeboard of 3.5 feet. The upstream and downstream embankment slopes are approximately 2.6 Horizontal to 1 Vertical and 2.3H:1V respectively. The surface slope of the rockfill zone is about 1.2H:1V. The dam is owned by Elmer Ferganchick. It is our understanding that the dam was originally constructed in the early 1900's.

The outlet works consist of an upstream intake structure with a specially fabricated slide gate and frame. The bottom slide surface consists of an 18" square flange which is attached by rivets to the upstream end of a welded steel elbow (elbow deflection is approximately 69 degrees). The original cover plate (or gate leaf) was a 3/8" x 13 5/8" x 18" mild carbon steel plate. The frame consists of angle iron guide rails on the sides which assure generally linear movement of the cover plate. These guide rails are bolted to the flange. The flange includes integrally cast spacers between the flange slide surface and the horizontal leg of the guide rail angles which maintain the space needed for movement of the cover plate. The vertical leg of the original guide rail angles were partially embedded in a concrete base. The concrete base encases most, or all of the outlet pipe elbow and its surface dimensions are about 37" x 51". The upstream travel stop (for cover plate travel in the upstream direction) and seal surface for the gate cover plate is provided by a lip formed in the surface of the concrete base. A 1 ½" diameter steel operator stem rod was originally attached to the cover plate with a single bolt. The stem runs the length of the upstream slope to a rising-stem handwheel operator mounted in a concrete base on the dam crest. There is no stem casing and the stem is directly supported and attached to buried concrete blocks spaced at unknown intervals. The stem is buried for at least half of its length. There is no intake trashrack. The total maximum travel length for the cover plate is 10 ½" which

means that, at maximum possible opening, 8" of the 12" diameter entrance (71% opening by area) is exposed, acting as the entrance orifice. There is no intake air vent. The outlet pipe consists of a 12" diameter riveted steel (or possibly wrought iron) pipe with 35 lengths of pipe, each approximately 3 feet long. The overall pipe slope is very flat (0.2%). The outlet works release to Bonita Creek, a small tributary to Surface Creek (which is, in turn, tributary to the Gunnison River).

The outlet works details are shown on the drawings included as part of the design package.

The spillway is located at the far left abutment and consists of an earth channel. The reservoir's drainage basin area is approximately 0.26 square miles.

Repair and Maintenance Issues:

In 1994, the Colorado State Engineer's Office (SEO) noted deteriorating conditions of the outlet based on an internal inspection of the outlet conduit and began to advise the owner that, while the outlet condition did not rise to the level of an imminent safety issue, at some future time the state of deterioration would reach that point. In 1997, the owner hired an engineer to develop plans for rehabilitation of the outlet pipe by means of slip-lining. Those plans were approved by the SEO. However, economic conditions prevented implementation of those plans and the safety status of the outlet pipe continued to remain a concern but not an imminent danger. The applicant tried unsuccessfully to obtain a loan for the work. The cost to upgrade the access road to accommodate construction vehicle traffic was a significant part of the overall project cost. In 2003, access road improvements had been made as part of rehabilitation efforts for Cedar Mesa reservoir and the slip-lining plans were re-submitted to the SEO office for re-approval. The owner began making arrangements with contractors to complete the slip-lining project. The work was scheduled for late fall of 2005 but early snow prevented execution. In 2006, the owner's father (and business partner) became seriously ill requiring extensive care and later died in 2008. Estate legal claims and probate processes continued through 2012 and attorney's costs consumed nearly all of the estate's value including critical water rights which had been used for the family farming business but had to be liquidated to pay legal costs. In the intervening time since 2006, the owner purchased or traded for

construction equipment and hired a skilled and experienced operator in anticipation of performing open-cut outlet replacement with his own resources if needed. Throughout this entire time since the problem was first noted, the applicant has been building cash reserves specifically designated for outlet rehabilitation. In the summer of 2012, the SEO made another internal inspection of the outlet pipe and discovered a water infiltration leak at the connection between the intake elbow and the horizontal portion of the pipe. This raised safety concerns and the SEO placed a zero storage restriction on the reservoir until the pipe concerns were adequately mitigated. The recently completed project was intended to restore the outlet to a safe operating condition so that the restriction can be lifted. The work generally consists of three parts.

1. The first part was to mitigate the potential for migration of soil along the exterior of the pipe by installation of a filter ("diaphragm) drain at the downstream end of the pipe. This included excavation a small distance into the existing embankment along the outlet pipe from the downstream end, removal of a deteriorated portion of the downstream part of the outlet pipe, replacement and extension of the removed pipe with PVC pipe attached to the existing pipe using a repair coupling, placement of a sand filter around the pipes and backfilling with a combination of compacted borrow material and rockfill.

2. The second part of the work was placement of an internal liner inside the outlet pipe by use of the Cured-in-Place Pipe (CIPP) method.

3. The third part was be maintenance of the intake structure gate and frame.

<u>Documents Associated With The Remedial Work:</u>

1. A letter from Western Engineers to Jason Ward, Colorado Division of Water Resources Dam Safety Engineer, dated March 11, 2013 requesting access to files and information possessed by the Colorado Division of Water Resources (CDWR) related to Bonita dam and reservoir.

2. Application to the Colorado Water Conservation Board (CWCB), Gunnison River Roundtable for a grant from the Water Supply Reserve Account (WSRA) on May 1, 2013.

3. An Operation and Maintenance Plan signed by the Forest Service Ranger on August 2, 2013.

4. A CWCB-WRSA grant purchase order dated, November 14, 2013.

5. Application to the Colorado Division of Water Resources (CDWR), Dam Safety on August 12, 2014, for review of the plans and specifications.

6. Design review response by the CDWR with comments dated November 12, 2014.

7. Re-submittal of plans, specifications and design documents (dated August 23, 2015) with transmittal letter in which comments and questions by the CDWR were addressed and modifications to the previously submitted plans were itemized.

8. Design review response by the CDWR with comments dated October 21, 2015.

9. Re-submittal of plans, specifications and design documents (dated July 11, 2016) with transmittal letter in which comments and questions by the CDWR were addressed and modifications to the previously submitted plans were itemized.

10. Approval of final plans and specifications in a letter from CDWR, Dam Safety dated August 29, 2016.

11. As-constructed drawings dated December 30, 2016.

CONSTRUCTION:

In general, the mitigation plan involved the following:

1. Excavating the downstream embankment toe area around the outlet discharge sufficiently to remove approximately 4 feet of deteriorated original outlet pipe. Excavation continued to about one foot below the final outlet pipe alignment. A pipe extension consisting 14.6 feet of 12" dia SDR 35 PVC was connected to the cut-off end of the original outlet pipe with a steel pipe coupling. The sand and gravel diaphragm drain, including a perforated drain pipe, was installed and consolidated around the outlet pipe extension. The excavation was backfilled with a combination of compacted earth borrow material and rockfill imported from the borrow area located within the reservoir basin in the upstream left groin area. The completed downstream embankment slope around the outlet was significantly flatter than the original slope. During this work, control and diversion of stream water was accomplished with a combination of a 4" diameter siphon pipe, upstream coffer dam and pumping. The siphon functioned satisfactorily for the initial work, but, after a few days developed air leaks at its crest and would only operate for 15 to 20 minutes before the siphon vacuum would break.

2. Cleaning of the pipe and installation of the CIPP pipe liner. This work included video camera inspection of the pipe both prior to and after the lining.

3. Installation of the gate appurtenances including the new cover plate, guides and partial stem replacement.

The chronology of construction activities was as follows:

- Aug 3 2016: A preconstruction meeting was held with the Owner/Contractor.
- Aug 9, 2016: A preconstruction meeting was held with the lining contractor.
- Aug 15, 2016: A site visit was made with Precision Hydrovac and Jetter Services to determine the requirements to get their truck into the site to clean the outlet pipe.
- Aug 16, 2016: A preconstruction meeting was held with Jon Hare of the U.S. Forest Service.
- Aug 18, 2016: A site meeting was held with two representatives of the Forest Service to determine the permit requirements to access the site with a Hydrovac truck.

- Sept 9 - Sept 14, 2016: Commenced mobilization of equipment, set up of water diversion materials and equipment and hauled in construction materials. Started the siphon running on Sept 9.
- Sept 15 - Sept 19, 2016: Performed the work associated with the downstream outlet extension.
- Sept 21, 2016: Performed outlet lining.
- Oct 31 - Nov 1, 2016: Performed work associated with the intake gate maintenance.

In general, the construction was performed by the contractors in a very careful and diligent manner with reasonable efforts to satisfy the specified project requirements and respond to quality assurance concerns.

CONSTRUCTION DEVIATIONS FROM AND REVISIONS TO PLANS AND OTHER OBSERVATIONS:

Following is a list of variations from the plans and specifications made during construction, changes made to the drawings to provide as-constructed plans (and other changes to the drawings requested by the Forest Service and CDWR) and other significant observations made regarding site conditions:

1. The surface geometry of the downstream diaphragm drain was modified to conform to the final excavation characteristics and to minimize drain material volume requirements while still meeting the dimensional requirements of the design.

2. The design was based on the assumption that the original steel pipe satisfied the "Briggs Standards" common at the time that the outlet was constructed with a wall thickness of about 0.41". However, the pipe wall thickness (new condition) was found to be about 0.13". But the pipe was found to be asphalt coated inside and out with the remaining (non-removed) pipe and coating in near-new condition.

3. The specifications called for cleaning the pipe prior to lining using a high pressure hydro-jet method. However, permit limitations prevented mobilizing a hydrovac truck to the site. The lining contractor had proposed using a "porcupine" type of pig but he showed up at the site without the proposed cleaning pig and only had a low pressure fire hose type of jetting nozzle. This method

was used for several runs in and out of the pipe and the amount of debris that was being generated did not seem to decrease using this method. It was decided that the degree of cleaning which was accomplished was sufficient for adequate liner installation.

4. The new stainless steel gate stem was lengthened by 9.5" due to a mistake in the fabrication drawings.

5. The upstream surface of the outlet intake flange was assumed to be completely flat in the design. It turned out that the guide angle spacers were cast integral with the flange. This required that the original integral spacers be used, that the guide angle be changed so that the vertical leg of the angle pointed upward (rather than downward as in the design); required that the guide angles be moved outward, reducing the overlap of the guide angle transverse leg over the cover plate; prevented widening the new cover plate; and prevented adjusting the orientation of the spacer plates to align the gate cover plate slide direction better with the gate stem.

6. The underside of the intake flange was not re-grouted in order to allow future access to the attachment bolt nuts on the underneath side of the flange.

7. The material removed from the downstream outlet excavation was too wet to be suitable for re-use as backfill. Therefore, backfill material was imported from a borrow area located in the upstream left groin area located as shown on the As-Constructed drawings. Originally, the plan was to use a borrow area located above the reservoir basin in order to assure dry material would be available. Shallow test holes were excavated in that area with a hand auger and shovel and It was found that the borrow material was moderately dry well below the optimum moisture of 21.4% determined in the lab (see the laboratory compaction curve in the Appendix) . However, because of permitting considerations, it was necessary to move the borrow area to a location below the level of the normal storage water level, which made obtaining drier material more difficlult. The moisture content in the final borrow material used for backfill of the downstream excavation, made to uncover the downstream pipe, varied from about 1.5 percent below to 6.4 percent above optimum, averaging 2.1 percent above optimum. The contractor made significant efforts to selectively obtain the driest material available, but the entire borrow source was fairly wet. A summary of the compaction test results is presented in the Appendix. Approximately 35 cubic yards of embankment material were placed in the downstream excavation. A total of 14 compaction tests were performed for that backfill using nuclear methods (ASTM D2922). For density, all the compaction tests satisfied the specified requirements. The final overall average moisture of the entire replacement embankment was 2.1 percent above optimum, within the specified upper limit of

3 percent above optimum. Besides facilitating compaction to specified density values, the primary purpose of placing an upper limit on the moisture content of embankment material is to prevent the build-up of high pore pressures within the embankment resulting from compactive pressures. Such high pressures can weaken the embankment and contribute to slope instability. In this case, however, slope instability due to high construction pore pressures would be limited to the replacement embankment and would not be expected to approach the dam crest. Additionally, any excess pore pressures which developed in such a small mass would be expected to dissipate relatively rapidly, and the stability of this portion of the embankment can be expected to increase over time. Therefore, the six tests with moisture contents above the upper specified limit are not a concern for dam safety.

8. One moisture-density compaction test was performed for every 2.5 cubic yards of replacement material placed and compacted in the downstream excavation zone.

9. Each lift was bonded with the existing embankment at the edges of the excavation by running the compactor beyond the edges of the newly placed lift.

10. In general, the construction was performed in a very careful and diligent manner with reasonable efforts to satisfy the specified project requirements and respond to quality assurance concerns.

ADDITIONAL CONSIDERATIONS:

1. During construction, the Owner was represented by Elmer Ferganchick, the Colorado Division of Water Resources was represented by Jason Ward, P.E., and full-time construction inspection/quality assurance was performed by Bruce Marvin, P.E. of Western Engineers, Inc.

2. The discharge from the downstream drain outfall and gate leakage with the gate fully closed should be measured at least once a year (with the reservoir level at maximum stage for the year just prior to drawdown) and preferably more frequently.

Submitted by:

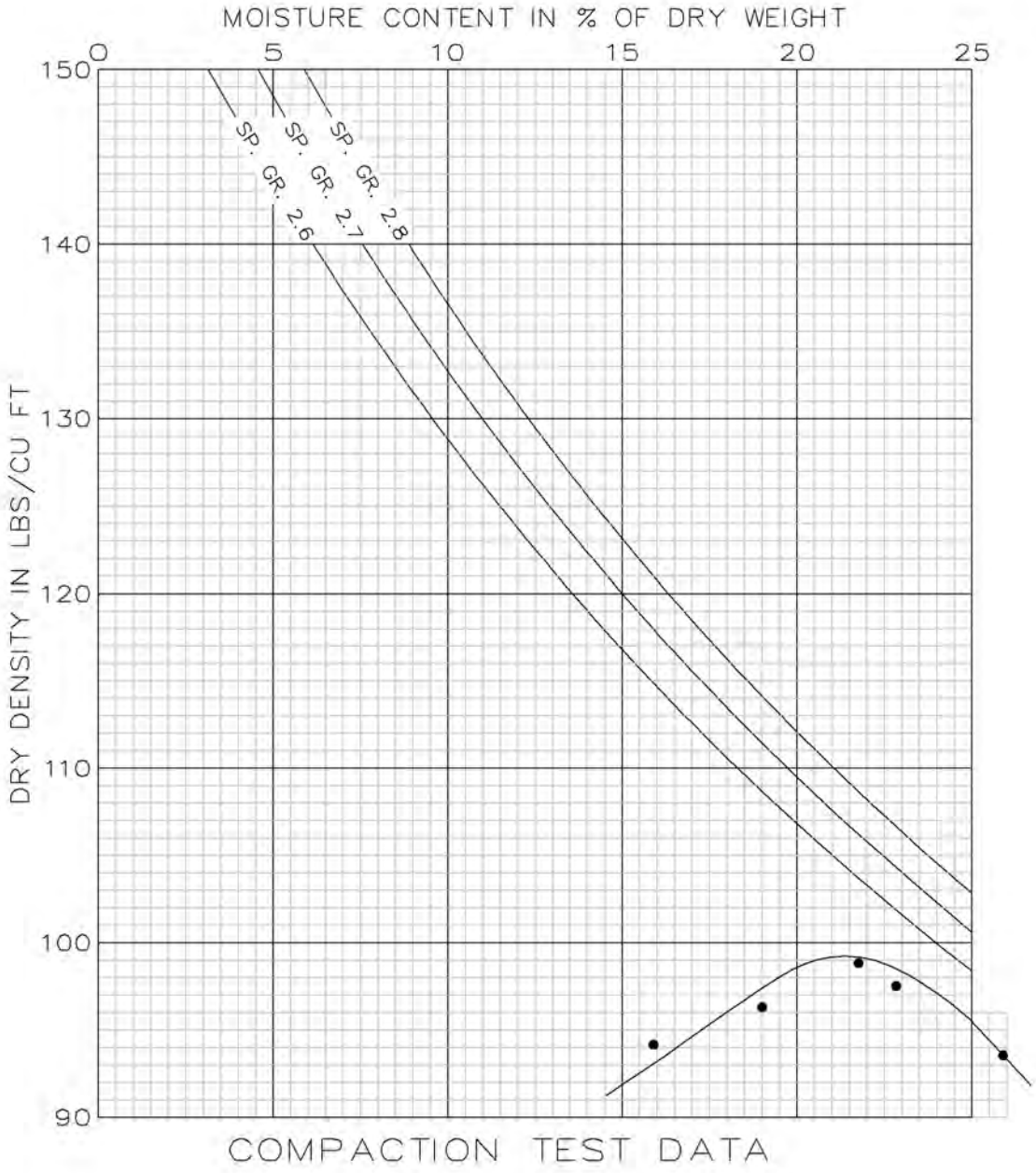
WESTERN ENGINEERS, INC.

Bruce D. Marvin P.E.

APPENDIX

MOISTURE-DENSITY CURVE
COMPACTION TEST SUMMARY
PHOTOS

CLIENT ELMER FERGANCHICK W.O.# 4099
SOIL BONITA DAM BORROW AREA BAG 2 DATE 10/21/15
LOCATION BONITA DAM OUTLET REHABILITATION
OPTIMUM MOISTURE CONTENT 21.4%
MAXIMUM DRY DENSITY 99.2 LBS/CU FT
METHOD OF COMPACTION ASTM D-698B



COMPACTION TEST DATA

WESTERN ENGINEERS, INC.

WESTERN ENGINEERS, INC. / CONSULTING ENGINEERS / LAND SURVEYORS
2150 Hwy 6 & 50 / Grand Junction, CO (970)242-8201

W.O. NO. 4099
DATE: 12/15/16
SHEET 1 OF 1

SUBJECT: FILL OBSERVATION AT BONITA RESERVOIR OUTLET REHABILITATION

TEST NO.	DATE	STATION (FT)	OFFSET (FT)	ELEV. (FT)	MAX. DRY DENS. (PCF)	OPT. MOIST. (%)	FIELD MOIST. (%)	DRY DENS. (PCF)	ESTIMATED COMPACTION (%)	REQUIRED COMPACTION (%)	COMMENTS
1	9/16/16	10.24	1' L	10010.18	99.2	21.4%	22.6%	97.0	97.8%	95%	4" DT
2	9/16/16	14.24	1' L	10009.07	99.2	21.4%	25.6%	100.8	101.6%	95%	4" DT
3	9/16/16	8.24	2' R	10010.91	99.2	21.4%	26.0%	99.5	100.3%	95%	4" DT
4	9/16/16	8.24	1.5' R	10010.74	99.2	21.4%	25.6%	99.5	100.3%	95%	4" DT
5	9/16/16	10.24	2' L	10010.18	99.2	21.4%	27.8%	97.0	97.8%	95%	4" DT
6	9/16/16	7.24	1.5' R	10011.37	99.2	21.4%	25.7%	101.0	101.8%	95%	4" DT
7	9/16/16	2.24	3' L	10012.68	99.2	21.4%	23.1%	102.8	103.6%	95%	4" DT
8	9/16/16	6.24	2' R	10012.17	99.2	21.4%	25.5%	100.0	100.8%	95%	4" DT
9	9/19/16	5.24	2' R	10012.78	99.2	21.4%	20.5%	105.0	105.8%	95%	4" DT
10	9/19/16	8.24	3' L	10012.28	99.2	21.4%	21.6%	104.2	105.0%	95%	4" DT
11	9/19/16	5.74	CL	10013.48	99.2	21.4%	22.7%	104.8	105.6%	95%	6" DT
12	9/19/16	2.24	2' L	10014.78	99.2	21.4%	20.2%	107.8	108.7%	95%	4" DT
13	9/19/16	2.24	1.5' R	10015.11	99.2	21.4%	22.3%	104.3	105.1%	95%	4" DT
14	9/19/16	2.24	CL	10015.45	99.2	21.4%	19.9%	105.5	106.4%	95%	4" DT

CONSTRUCTION PHOTOS

Cutting Downstream End of Original Outlet Pipe

Compacting Downstream Outlet Excavation Subgrade

Downstream Pipe Extension

Diaphragm Filter Drain Slotted Pipe

Wetting Diaphragm Filter Sand

Completed Downstream Diaphragm Filter

Placing and Compacting Downstream Embankment

Completed Downstream Soil Embankment

Completed Downstream Dam Embankment and Armoring Rip Rap

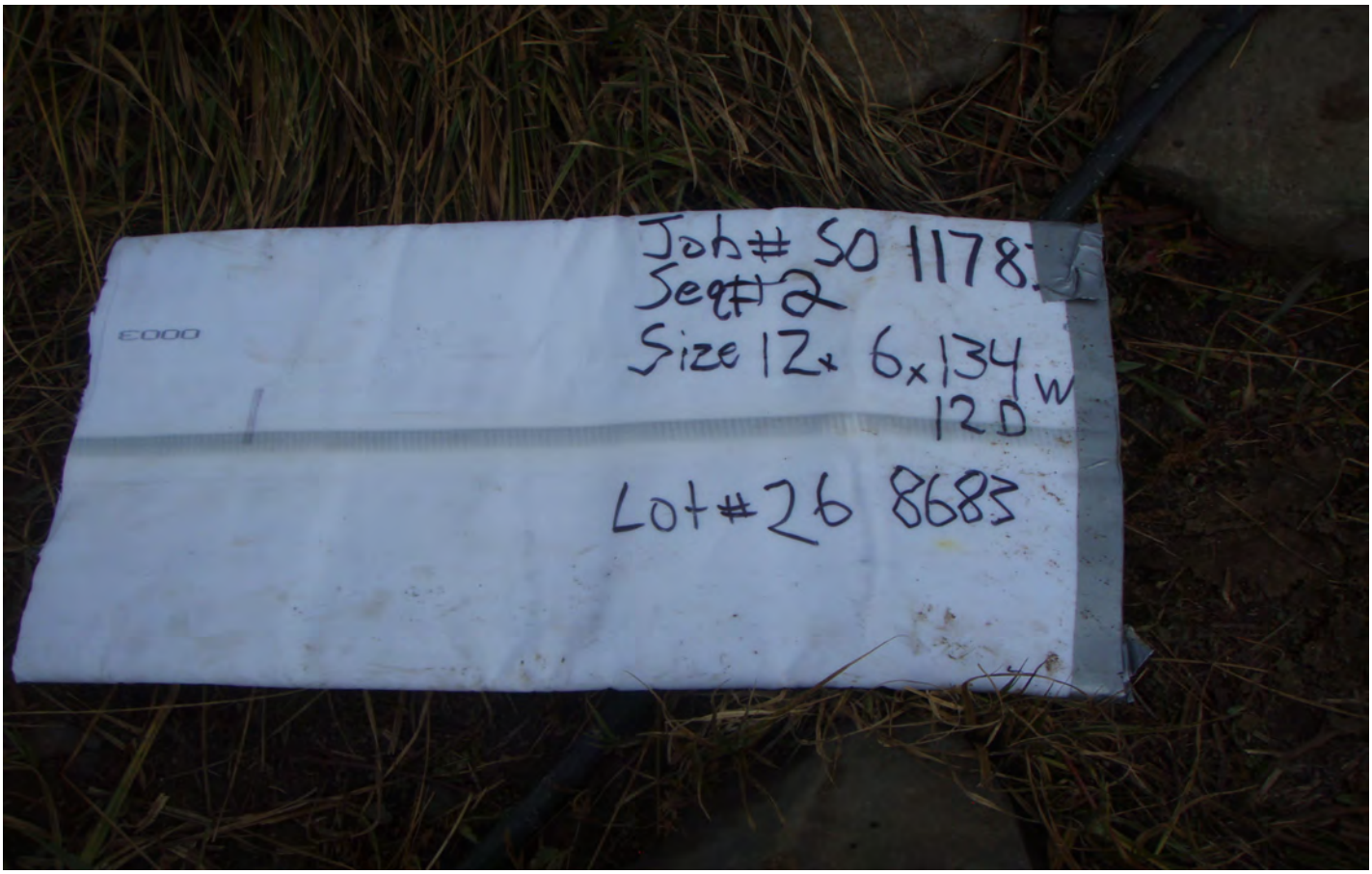
Pre-Lining Video Inspection

Pipe Cleaning Jetting Nozzle

Reservoir Water Filter

Cleaning Outlet Pipe Prior to Lining

Liner Connected to Shooter



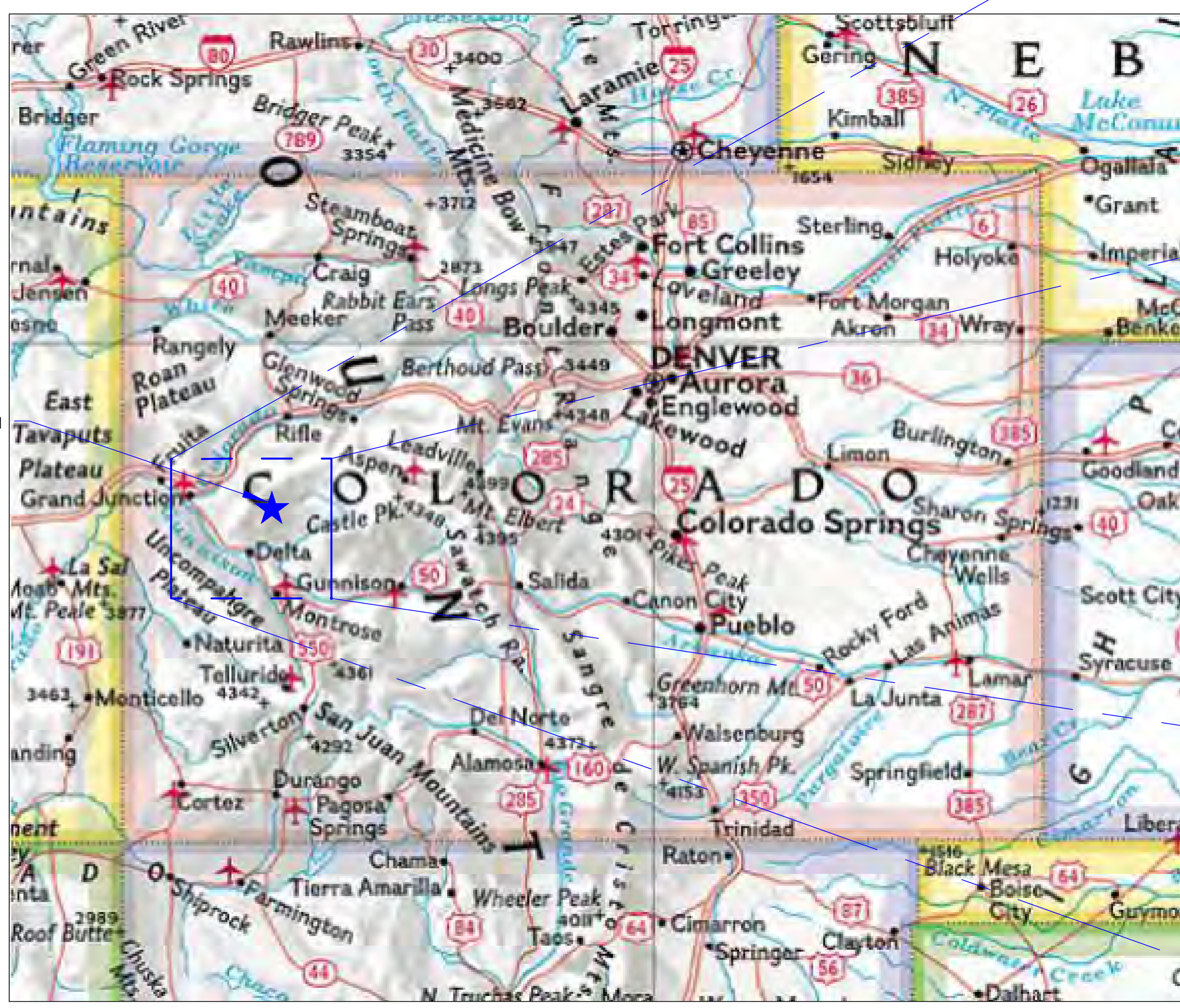
Liner Manufacturer's Identification

Liner Shooter Connected to Outlet Pipe

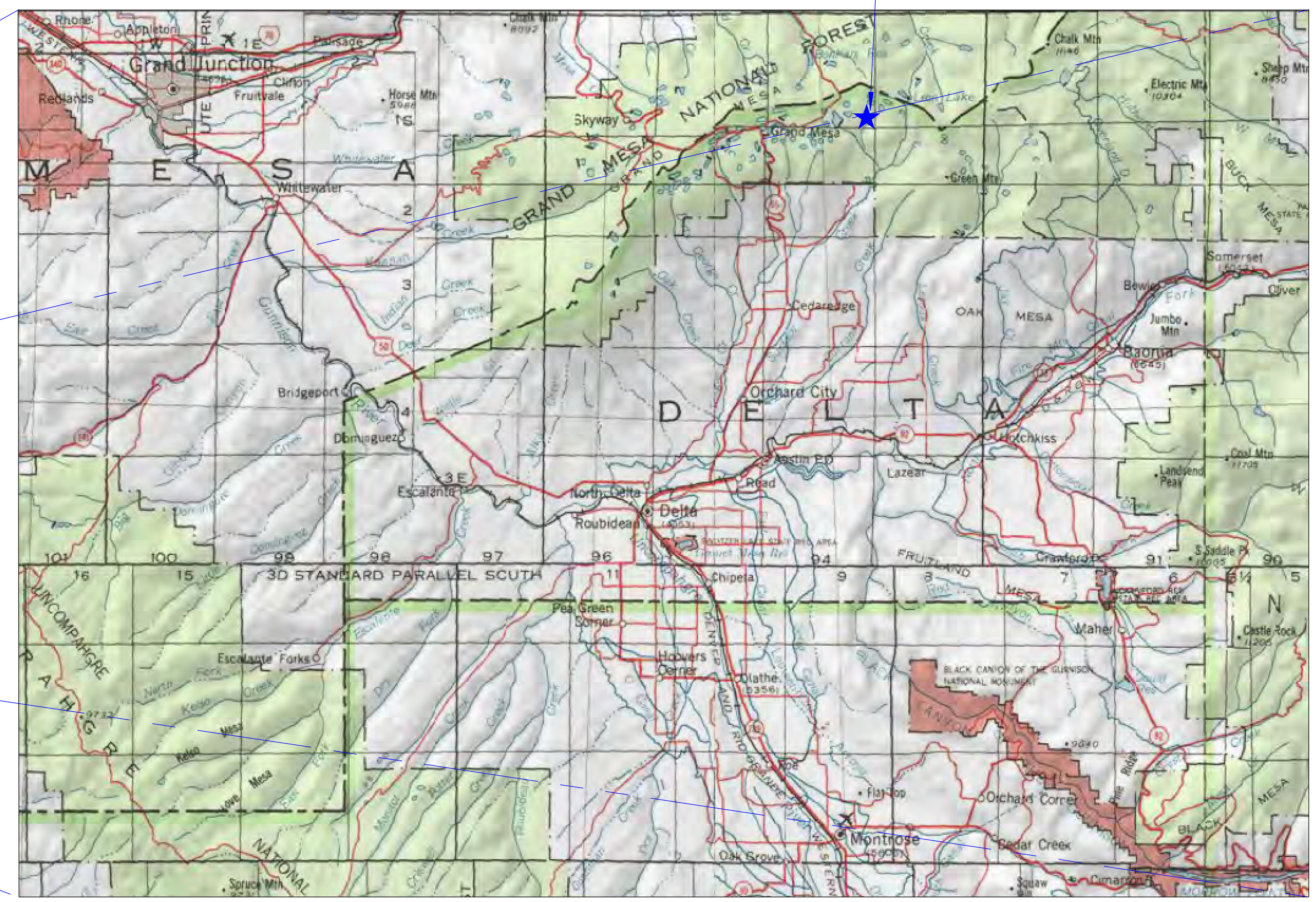
Steam Generators Operating

PLANS FOR
BONITA RESERVOIR DAM OUTLET REHABILITATION
DAMID 400122
PREPARED FOR
ELMER FERGANCHICK

DELTA COUNTY, COLORADO
WATER DIVISION 4
TOWNSHIP 11S, RANGE 94W, 6TH PM
PREPARED BY
WESTERN ENGINEERS, INC.
GRAND JUNCTION, COLORADO



COLORADO MAP



VICINITY MAP

BRUCE D MARVIN, COLORADO P.E. NO. 14856

Approved on the ____________day of ______________2016

State Engineer

By:
William T McCormick, III, Chief, Dam Safety Branch, CO PE 29217

And,

These plans represent the AS-CONSTRUCTED conditons of Bonita Reservoir Dam Outlet Works Rehabilitation to the best of our knowledge and judgement as of the 30 th day of December, 2016

BRUCE D MARVIN, COLORADO P.E. NO. 14856

SEE SHEET 2 FOR LIST OF DRAWINGS

C-2035

SHEET 1 OF 4

AS-CONSTRUCTED 12/30/16
REVISED 6/29/16
REVISED 8/8/16

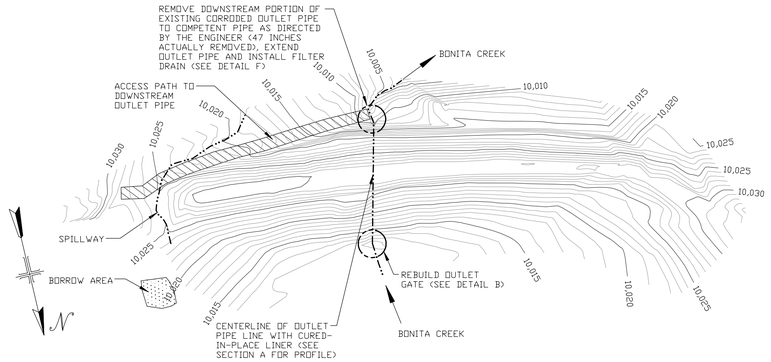
WESTERN ENGINEERS, INC.

COVER SHEET
BONITA RESERVOIR DAM
OUTLET WORKS REHABILITATION
DAM ID 400122
LOCATED IN SECTION 36, T11S, R94W, 6TH PM
WATER DIVISION 4
WATER DISTRICT 40
DELTA COUNTY, COLORADO

DESIGNED BDM	DRAWN BDM	CHECKED BDM
DATE: 8/17/2015	WORK ORDER NUMBER 4099	

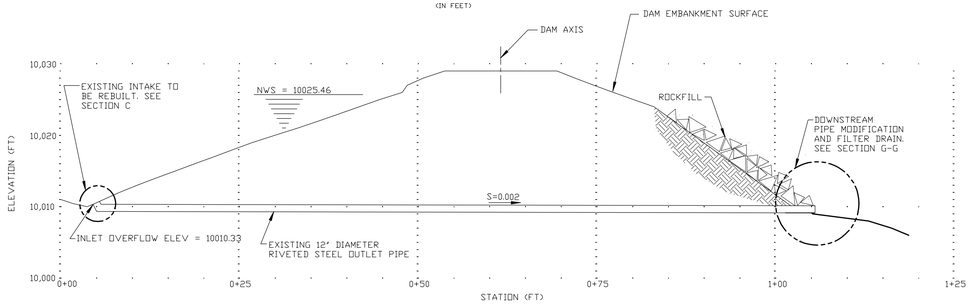
LIST OF DRAWINGS:

DESCRIPTION	SHEET NUMBER
COVER SHEET	1
PLAN, SECTIONS AND DETAILS	2
SECTIONS AND DETAILS	3
SECTIONS AND DETAILS	4



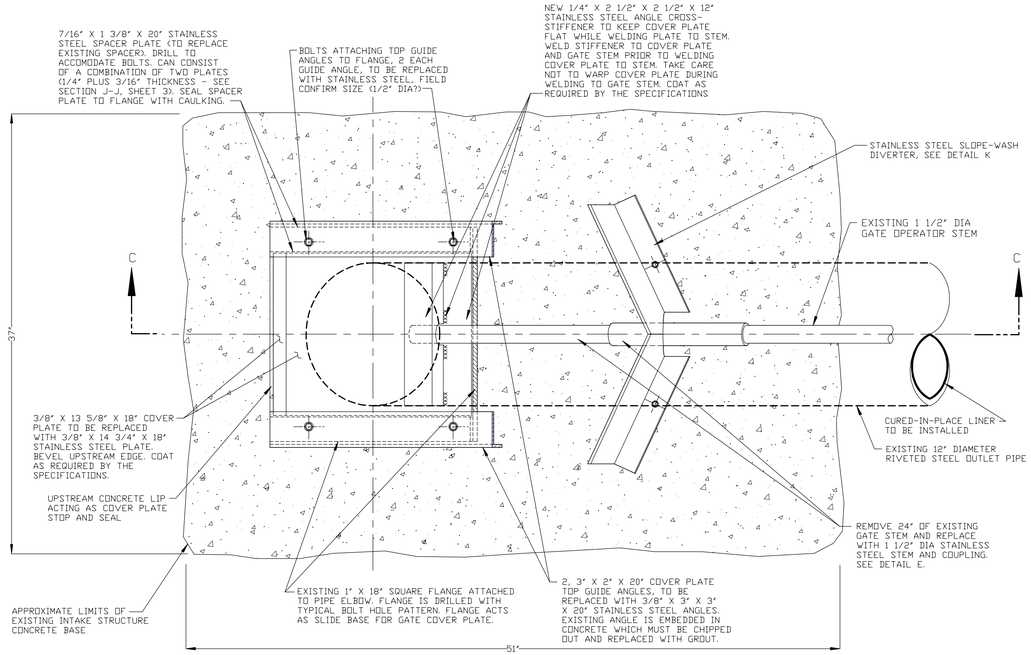
PLAN VIEW

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)



SECTION A
DAM SECTION THROUGH OUTLET

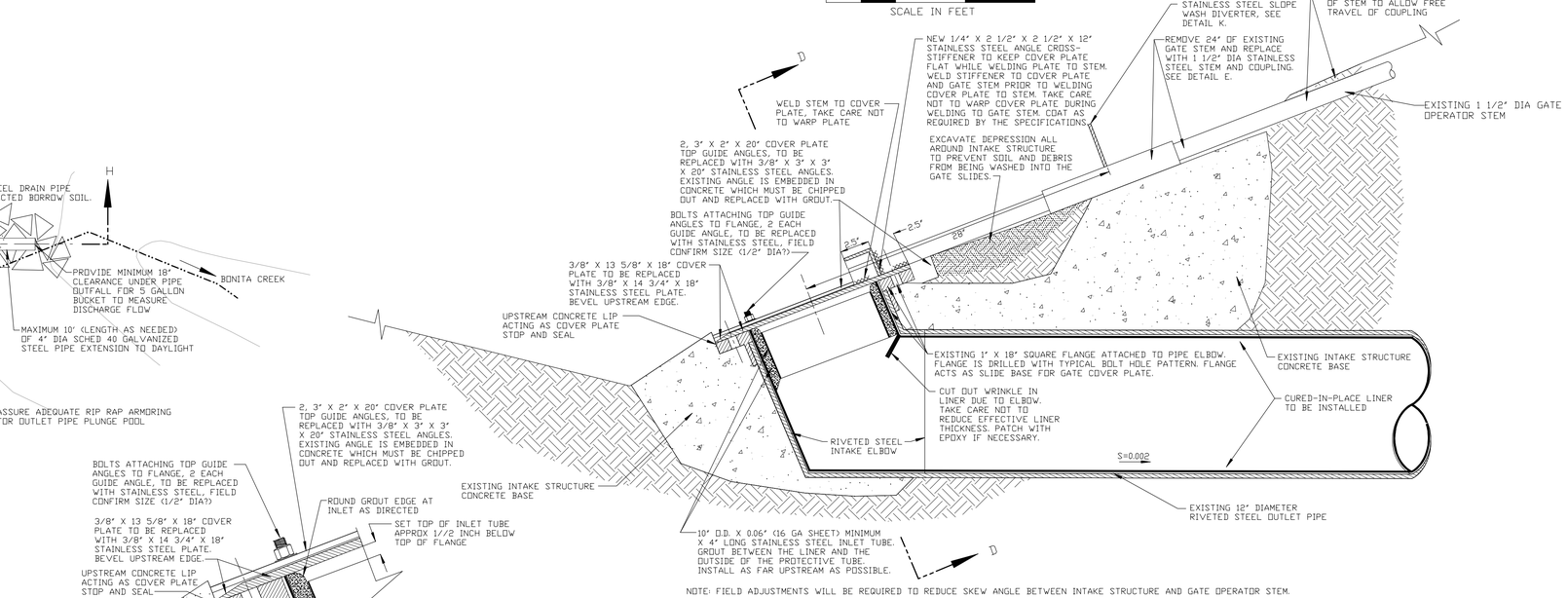
10 0 10 20
SCALE IN FEET



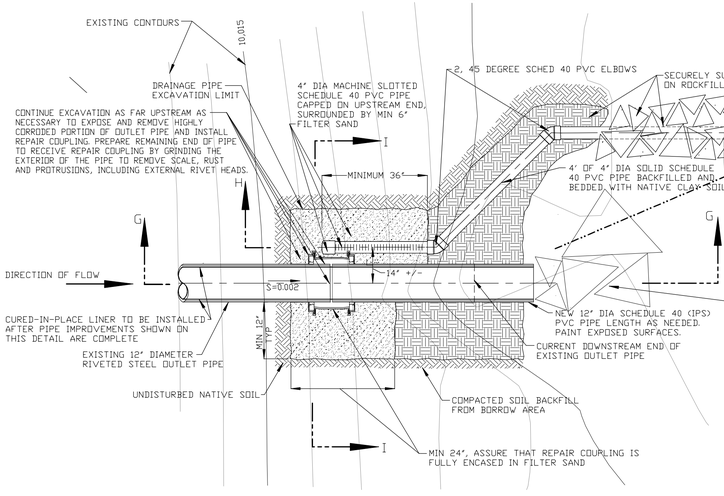
NOTE: FIELD ADJUSTMENTS WILL BE REQUIRED TO REDUCE SKEW ANGLE BETWEEN INTAKE STRUCTURE AND GATE OPERATOR STEM.

DETAIL B
INTAKE STRUCTURE PLAN VIEW

0.5 0 0.5 1.0
SCALE IN FEET

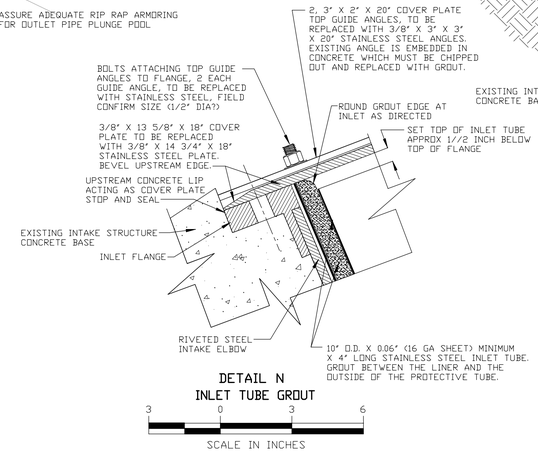


NOTE: FIELD ADJUSTMENTS WILL BE REQUIRED TO REDUCE SKEW ANGLE BETWEEN INTAKE STRUCTURE AND GATE OPERATOR STEM.



DETAIL F
DOWNSTREAM PIPE MODIFICATION PLAN

2 0 2 4
SCALE IN FEET



DETAIL N
INLET TUBE GROUT

3 0 3 6
SCALE IN INCHES

SECTION C-C
INTAKE STRUCTURE MODIFICATIONS

0.5 0 0.5 1.0
SCALE IN FEET

COLORADO LICENSED
BRUCE D MARVIN
14856
PROFESSIONAL ENGINEER

BRUCE D MARVIN, COLORADO P.E. NO. 14856

AS-CONSTRUCTED 12/30/2016
REVISED 6/29/16

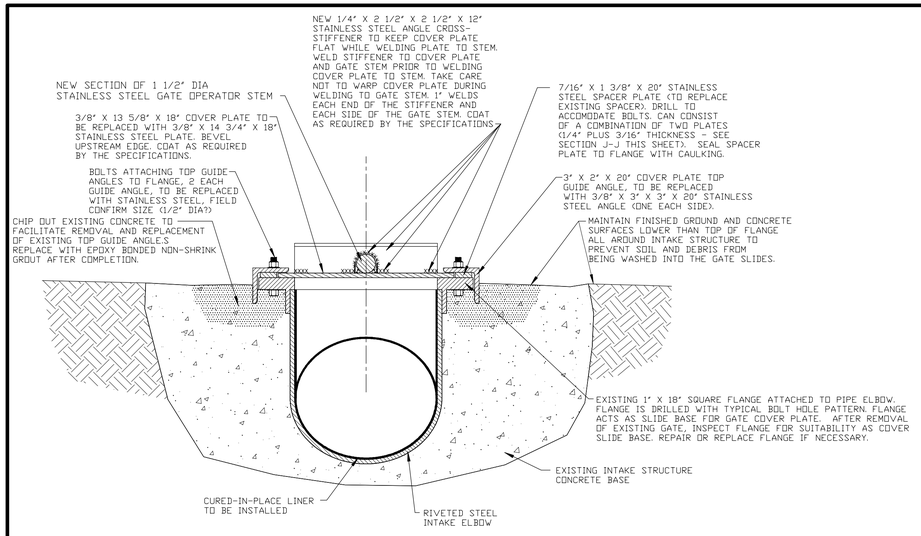
SHEET 2 OF 4

C-2035

WESTERN ENGINEERS, INC.

PLAN, SECTIONS AND DETAILS
BONITA RESERVOIR DAM
OUTLET WORKS REHABILITATION
DAM ID 400122
LOCATED IN SECTION 36, T11S, R94W, 6TH PM
WATER DIVISION 4
WATER DISTRICT 40
DELTA COUNTY, COLORADO

DESIGNED BDM	DRAWN BDM	CHECKED BDM
DATE: 7/31/2014	WORK ORDER NUMBER 4099	



NOTE: FIELD ADJUSTMENTS WILL BE REQUIRED TO REDUCE SKEW ANGLE BETWEEN INTAKE STRUCTURE AND GATE OPERATOR STEM

SECTION D-D
GATE SECTION – MODIFICATIONS

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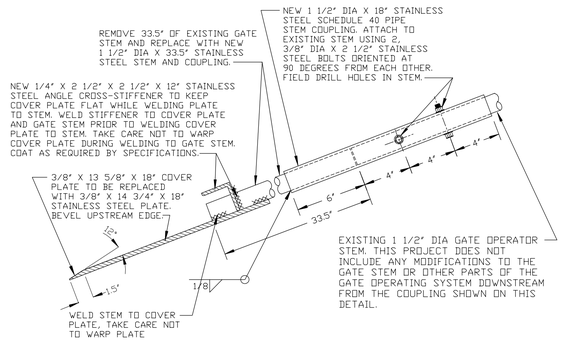
SCALE IN FEET

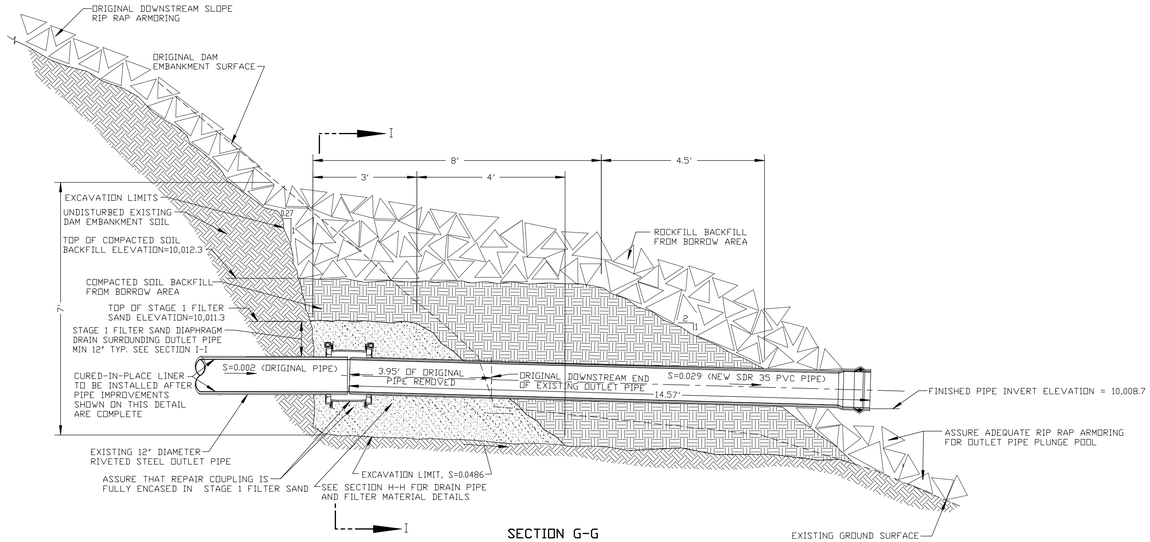


NOTE: FIELD ADJUSTMENTS WERE REQUIRED TO ACCOMMODATE SKEW ANGLE BETWEEN INTAKE STRUCTURE AND GATE OPERATOR STEM.

DETAIL E
STEM COUPLING

0.5 0 0.5 1.0

SCALE IN FEET

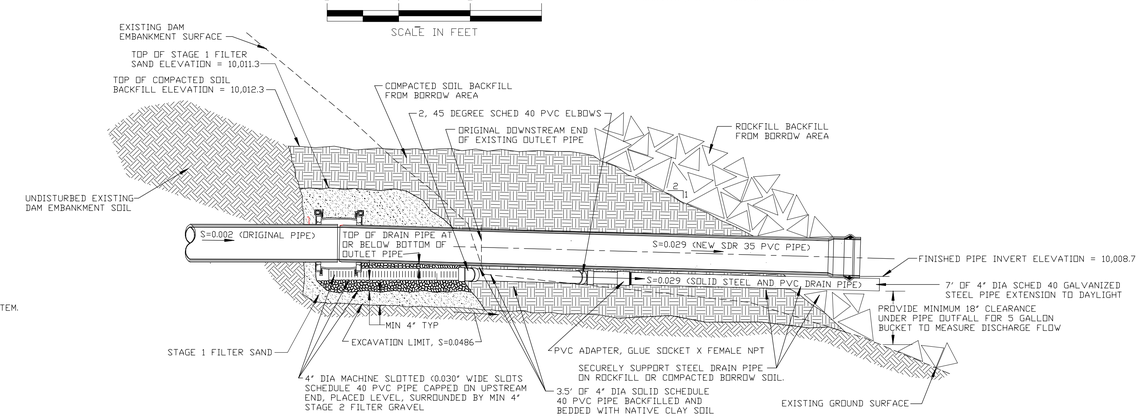


NOTE: ENGINEER SHALL CLOSELY MONITOR EXCAVATED SLOPE DURING CONSTRUCTION

SECTION G-G
DOWNSTREAM PIPE MODIFICATION

2 0 2 4

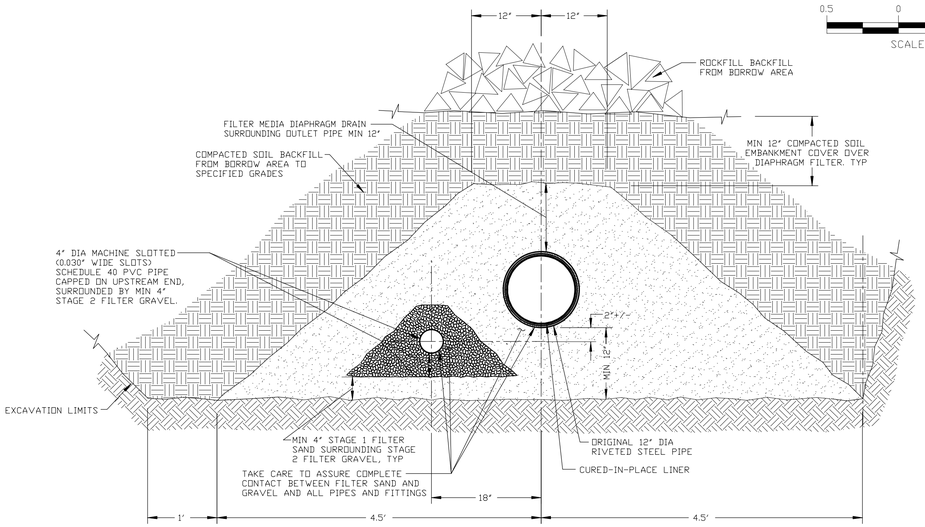
SCALE IN FEET



SECTION H-H (SEE DETAIL F, SHEET 2)
DOWNSTREAM PIPE MODIFICATION
DRAIN PIPE DETAILS

2 0 2 4

SCALE IN FEET

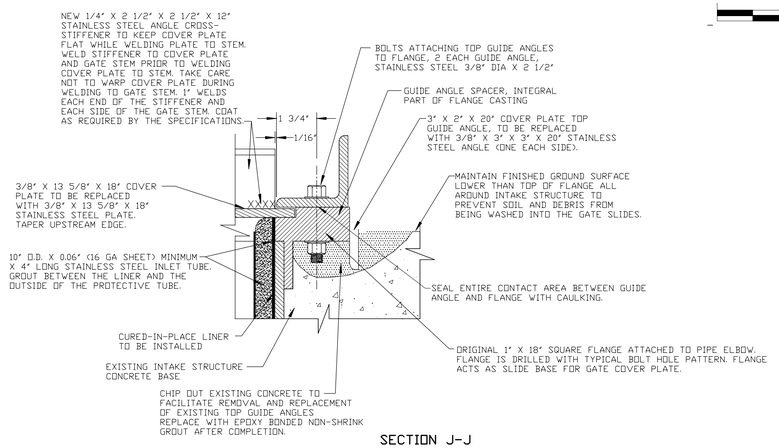


NOTE: SEE SECTION G-G SHEET 2 AND SECTION H-H SHEET 3, FOR EXCAVATION AND SAND PLACEMENT LIMITS.

SECTION I-I
FILTER SAND DIAPHRAGM DRAIN

1 0 1 2

SCALE IN FEET



SECTION J-J
GATE SLIDE DETAIL

3 0 3 6

SCALE IN INCHES

BRUCE D MARVIN, COLORADO P.E. NO. 14856

AS-CONSTRUCTED 12/30/2016
REVISED 6/29/16

SHEET 3 OF 4

C-2035

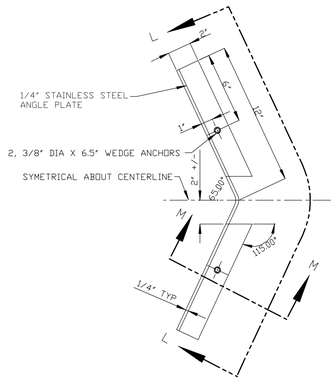
WESTERN ENGINEERS, INC.

SECTIONS AND DETAILS

BONITA RESERVOIR DAM OUTLET WORKS REHABILITATION

DAM ID 40122
LOCATED IN SECTION 36, T11S, R94W, 6TH PM
WATER DIVISION 4
WATER DISTRICT 40
DELTA COUNTY, COLORADO

DESIGNED BDM	DRAWN BDM	CHECKED BDM
DATE: 8/17/15	WORK ORDER NUMBER 4099	



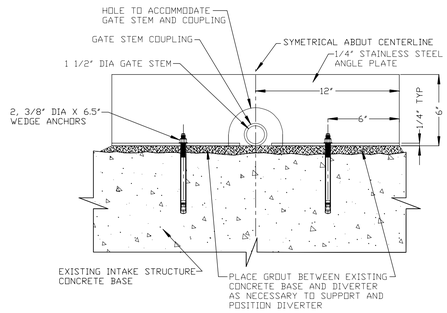
DETAIL K

SLOPE-WASH DIVERTER - PLAN

STAINLESS STEEL

0.5 0 0.5 1.0

SCALE IN FEET



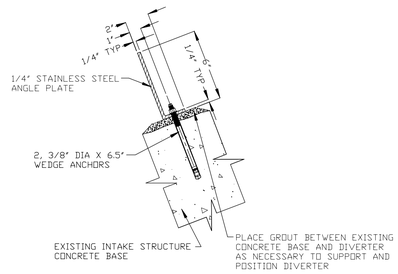
SECTION L-L

SLOPE-WASH DIVERTER

STAINLESS STEEL

0.5 0 0.5 1.0

SCALE IN FEET



SECTION M-M

SLOPE-WASH DIVERTER

STAINLESS STEEL

0.5 0 0.5 1.0

SCALE IN FEET

COLORADO LICENSED BRUCE D MARVIN 14856 PROFESSIONAL ENGINEER

BRUCE D MARVIN, COLORADO P.E. NO. 14856

SHEET 4 OF 4

C-2035

WESTERN ENGINEERS, INC.

NOTES

BONITA RESERVOIR DAM
OUTLET WORKS REHABILITATION

DAM ID 40022

LOCATED IN SECTION 36, T11S, R94W, 6TH PM

WATER DIVISION 4

WATER DISTRICT 40

DELTA COUNTY, COLORADO

AS-CONSTRUCTED

REVISED

DESIGNED BDM	DRAWN BDM	CHECKED BDM
DATE: 8/17/2015	WORK ORDER NUMBER 4099	

TECHNICAL SPECIFICATIONS
BONITA DAM
OUTLET REHABILITATION
PREPARED FOR
ELMER FERGANCHICK
DELTA COUNTY, COLORADO
WATER DIVISION 4
WATER DISTRICT 40
DAMID 400122
CONSTRUCTION FILE NUMBER C-2035
August 24, 2015
Revised June 29, 2016
Revised August 17, 2016

BONITA DAM, OUTLET REHABILITATION

PREPARED FOR ELMER FERGANCHICK

DELTA COUNTY, COLORADO

WATER DIVISION 4

WATER DISTRICT 40

DAMID 400122

CONSTRUCTION FILE NUMBER C-2035

I hereby certify that these specifications for the construction of the Bonita Dam Outlet Rehabilitation and Appurtenant Features were prepared under my supervision for the owners thereof.

_____

Bruce D. Marvin, Colorado P.E. No. 14856

STATE OF COLORADO
DIVISION OF WATER RESOURCES

Approved on the 30th day of August, 2016

Dick Wolfe

State Engineer

By:_____

William T. McCormick, III, Chief, Dam Safety Branch, CO PE 29127

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SECTION 010000

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 CONTRACT DOCUMENTS

A. The plans and specifications cannot be changed without the prior written approval of the State Engineer in accordance with Rule 9.1.8 of the Colorado Rules and Regulations for Dam Safety and Dam Construction. The ENGINEER is obligated to advise the Colorado Division of Water Resources, Dam Safety Department of any substantive deviations from the approved Contract Documents for their review and approval. No work can proceed on any such change until the approval has been received. The ENGINEER's approval must be obtained for any deviations from the Contract Documents. Any unauthorized modifications are the responsibility of the person and/or organization making the modification. Such unauthorized modifications may require that the modified item be uncovered, removed and replaced or otherwise confirmed that the modification receives the required approvals and observations.

B. For any condition of conflict in the Contract Documents, the more stringent condition shall prevail.

C. Drawing details apply to any location which has conditions similar to the conditions where the detail is cut.

1.02 OTHER REQUIREMENTS

A. Design, fabrication and construction of all elements of the WORK are subject to the provisions and requirements of the Colorado Division of Water Resources, Dam Safety Department "Rules and Regulations for Dam Safety and Dam Construction"

B. The work shall conform to all applicable federal, state, and county regulations. The project lands and surrounding areas are under the jurisdiction and control of the U.S. Forest Service. The CONTRACTOR is responsible to perform all WORK in accordance with the applicable land use requirements and regulations and to obtain all applicable permits, unless otherwise stated in the Contract Documents. The CONTRACTOR shall familiarize himself with permits included with the Contract Documents and shall fully comply with all requirements and stipulations therein.

C. All WORK shall be performed in accordance with the Forest Service "Operation and Maintenance Plan, Bonita Reservoir" included in this Section as Attachment A.

D. Access to the site and the location of the approved staging areas are shown on the maps include as part of the Forest Service "Operation and Maintenance Plan, Bonita Reservoir" (Attachment A). The Surface Creek graveled road (NFSR 125) extending to near Park Reservoir is maintained. From that point to Bonita Dam, the access consists of about 1.4 miles of 4-wheel-drive trails plus about 0.25 mile of mainly ATV trail (NFSR 132). This final 0.25 mile of trail may be used by the CONTRACTOR as long as public access is continuously restricted in the same manner as prior to initiation of the work. It will be the responsibility of the CONTRACTOR to determine the appropriate equipment to use for accessing the site, mobilizing equipment and hauling materials to the work site. During construction, the CONTRACTOR shall maintain barriers to limit general public use of the ATV trails to ATV traffic.

E. Staging areas shall be selected by the CONTRACTOR subject to the approval of the ENGINEER. The purpose of staging areas is for construction equipment loading and unloading, vehicle parking and temporary storage of construction materials. Use of the staging area shall be limited to as small an area as possible, to previously disturbed areas as much as possible, and to areas that are dry and firm enough to support the anticipated vehicle and other loads. After completion of the WORK, the CONTRACTOR shall restore the trails to the general character and width prior to commencement of the WORK. At least 10 days prior to start of construction, the contractor shall provide the ENGINEER with a staging area plan. The plan shall be approved by the ENGINEER prior to the CONTRACTOR commencing the WORK.

F. The CONTRACTOR shall limit disturbance due to equipment traffic and construction work to established roads and trails, approved staging areas, the access path to the downstream areas shown on the Drawings, the dam crest, the borrow area, and the upstream and downstream slopes of the dam embankment in the vicinity of the designated WORK.

G. Construction shall not be considered complete until the State Engineer has accepted the construction in writing.

1.03 OWNER'S QUALITY ASSURANCE AND CONSTRUCTION OBSERVATIONS

A. The OWNER's ENGINEER will monitor the quality of construction in accordance with Rule 9 of the Colorado Rules and Regulations for Dam Safety and Dam Construction. The ENGINEER monitoring the construction for the owner is responsible for the quality of construction, compliance with the approved design and specifications, preparation of the necessary documentation for the State Engineer's review and approval of all construction change orders and, and preparation of the project completion documents required in Rule 10 of the Colorado Rules and Regulations for Dam Safety and Dam Construction. Unless otherwise specified,

observation of all construction activities as defined by these specifications will be provided by the OWNER and/or the OWNER's designated ENGINEER. Said observations are for the benefit of the OWNER in determining that the WORK is performed in strict accordance with the Contract Documents, to satisfy the requirements of the Colorado Division of water Resources, to document all construction activities and to document any deviations from approved Contract Documents. The Engineer shall at all times have access to the work whenever it is in preparation or progress. The Contractor shall give the Engineer ample notice of the readiness of the WORK for observation, and the Engineer will perform said observation in such a manner as not to unnecessarily delay the work. All WORK shall be conducted in the presence of the ENGINEER unless otherwise authorized in advance by the ENGINEER. At the ENGINEER's discretion, any WORK performed without the ENGINEER present shall, at the CONTRACTOR's expense, be uncovered, tested, or its condition otherwise verified, to show, to the ENGINEER's satisfaction, whether the requirement of the Contract Documents were satisfied. Whenever, in the opinion of the ENGINEER, workmanship or materials do not meet the requirements or intent of the Contract Documents, the CONTRACTOR, upon notification, shall promptly remove, replace or rework the items in question so that such requirements are met.

B. The ENGINEER shall not, without cause, interfere with or impede the CONTRACTOR's prosecution of the work, and shall, to the extent possible, schedule field surveys, observations, and tests to minimize delays to the CONTRACTOR. However, the CONTRACTOR must anticipate that there will be some work delays due to surveying, observations testing, and other reasonable activities by the OWNER and ENGINEER.

C. The OWNER's and ENGINEER's observations and approvals shall not relieve the CONTRACTOR of responsibility for the adequacy and acceptability of the finished WORK or portions thereof.

D. All WORK performed by the CONTRACTOR shall be subject to final approval by the OWNER and ENGINEER, but, unless otherwise indicated in the Contract Documents, the detailed manner and method of performing the WORK shall be the responsibility of, and under the control of the CONTRACTOR.

1.04 SURVEYS, LAYOUT AND BENCH MARKS

A. The ENGINEER will establish all local reference points needed for the WORK.

B. The ENGINEER will mark all bench marks and reference points. The contractor shall make every effort to preserve all bench marks and reverence points

C. All elevations are referenced to an elevation established for two previously existing bench marks located on the handwheel block and marked “BM 20.40” and “BM 20.98”.

1.05 WORK PERFORMED BY THE OWNER

A. All work performed by the OWNER will be subject to all technical and performance requirements of the Contract Documents and all directives from the ENGINEER as is the CONTRACTOR.

1.06 SAFETY

A. The CONTRACTOR shall be solely and completely responsible for work conditions at the jobsite, including safety of all persons (including employees) and protecting property during performance of the WORK.

1.07 CONSTRUCTION SCHEDULE

A. The Contractor shall begin construction within 7 days after notice to proceed is given. It is the intent to complete all work in 2015.

B. The sequence of construction shall include (in this order):

1. Completing the downstream outlet pipe modifications.
2. Installing the cured-in-place liner
3. Completing the intake structure and gate modifications

1.08 COMPLETED CONSTRUCTION

A. The construction shall not be considered complete until the Colorado State Engineer has accepted the WORK in writing.

1.09 DEFINITIONS

A. Where used in the Contract Documents, the following words and terms shall have the meanings indicated. The meanings shall be applicable to the singular, plural, masculine, and feminine of the words and terms.

ASTM. American Society for Testing and Materials

Acceptance. Formal action of Owner in determining that Contractor's work has been completed in accordance with the Contract Documents and in notifying Contractor in writing of the acceptability of the Work.

Act of God. A cataclysmic phenomenon of nature, such as an earthquake, flood, or cyclone. Rain, wind, high water, or other natural phenomena which might reasonably have been anticipated from historical records of the general locality of the Work shall not be construed as Acts of God.

Agreement. The written Agreement between Owner and Contractor covering the Work to be performed; other Contract Documents which are attached to the Agreement and made a part thereof are included.

Addenda. Written or graphic documents issued prior to the opening of Bids which clarify, correct, or change the bidding documents or the Contract Documents.

Bid. The offer of a Bidder submitted on the prescribed bid form setting forth prices of the Work to be performed.

Bidder. Any person, firm, partnership, corporation, or a combination thereof, including joint ventures, submitting a bid to perform the Work.

Bonds. Bid, performance and payment bonds and other instruments of security.

Change Order. A written order to the CONTRACTOR from the OWNER authorizing an addition, deletion or revision in the work, or an adjustment in the Contract Price or the Contract Time.

Contract Documents. All of the writings and drawings embodying the legally binding obligations between OWNER and CONTRACTOR for the completion of the WORK. Where items in the following list refer to blank forms included in the bid solicitation package, the Contract Documents include both the blank forms and the fully executed forms which are part of the Agreement for the WORK. The Contract Documents include:

- Invitation to bid
- Instructions to Bidders
- Addenda (Not included in Bid Documents)
- Bid Form
- Bid Bond
- Performance and Payment Bonds (as required)
- Documents related to Equal Opportunity, Clean Air and Water Requirements and Certifications, Civil Rights Compliance, Certification of Nonsegregated Facilities, Pre-award Equal Opportunity Check.
- General Conditions
- Supplementary Conditions
- Technical Specifications

- Drawings prepared and issued by Western Engineers, Inc., Dated ????
- Notice of Award
- Notice to Proceed
- Agreement
- All written modifications to the Contract issued to, and accepted by, the CONTRACTOR (Not include in Bid Documents).
- Change Orders

Contract Price. The total monies payable to the CONTRACTOR under the Contract Documents.

Contract Time. The number of days stated in the Contract Documents for the completion of work.

Contractor. Party contracting directly with the OWNER to furnish and perform all work and services in accordance with the Contract Documents.

Day. Calendar day of twenty-four (24) hours.

Defective. An adjective which, when modifying the word WORK refers to WORK that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents or does not meet the requirements of any observation, test or approval referred to in the Contract Documents, or has been damaged prior to the ENGINEER's recommendation for final payment.

Direction. Action of OWNER by which CONTRACTOR is ordered to perform or refrain from performing work under the Contract.

Directive. Written documentation of the actions of OWNER in directing CONTRACTOR.

Drawings. The drawings which show the character and scope of the WORK to be performed and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents.

Effective Date of the Agreement. The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the latter of the two parties to sign and deliver.

Engineer. A qualified licensed engineer appointed and authorized by the OWNER or OWNER's representative to perform construction observation and OWNER's quality assurance services. For the WORK described herein, Western Engineers, Inc., acting directly or through authorized representatives.

Field Order. A written order issued by the Engineer as the OWNER's field representative which clarifies or interprets the Contract Documents, provides clarification

or interpretations, or orders minor changes in the work which will not affect contract price.

Gender and Number. References are made as if masculine in gender and singular in number unless neuter gender is appropriate in the context; however, the use of any gender shall be applicable to all genders and the use of singular number shall include the plural and conversely, the plural shall include the singular.

Good Repair. Good repair shall be construed to mean that any defect, functional or structural deterioration, except that from ordinary and reasonable use, which appreciably reduces the effectiveness or efficiency of the Work or improvement for the purpose intended, or any serious departure from the standards of original construction described in the Contract Documents.

Furnish. To deliver to the job site or other specified location any item, equipment, or material.

Herein. Refers to information presented in the Contract Documents.

Holidays. Legal holidays designated by the State or by labor agreements.

Inspector. Engineering or technical inspectors duly appointed and authorized by ENGINEER, limited to the particular duties entrusted to him or them.

Install. Placing, erecting, or constructing complete in place any item, equipment, or material.

May. Refers to permissive actions.

Notice to Proceed. A written notice given by ENGINEER or OWNER to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

Owner. A public or quasi-public body or authority, corporation, association, firm, partnership or individual for whom the WORK is to be performed and with whom CONTRACTOR has entered into the Agreement. For the WORK described herein, the Owner is Elmer L Ferganchick, individual.

Partial Utilization. Placing a portion of the WORK in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the WORK.

Person. Individual firm, company, corporation, partnership, or joint ventures, as well as individuals.

Project. The undertaking to be performed under the provisions of the Contract Documents.

Provide. Furnish and install complete in place any item, equipment, or material.

Punch List. List of incomplete items of WORK and of items of WORK which are not in conformance with the Contract Documents. The list will be prepared by ENGINEER when CONTRACTOR (1) notifies ENGINEER in writing that the WORK has been completed in accordance with the Contract Documents, and (2) requests in writing that OWNER accept the WORK.

Request for Information (RFI). Written request from CONTRACTOR requesting clarification of Contract Documents or of Work to be performed.

Resident Project Representative. The authorized representative of OWNER or ENGINEER who is assigned to the project site or any part thereof to monitor the construction work and aid ENGINEER in carrying out its duties at the site.

Shall. Mandatory.

Shop Drawings. All drawings, diagrams, illustrations, schedules and other data which specifically prepared by or for CONTRACTOR to illustrate some portion of the WORK and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a supplier and submitted by CONTRACTOR to illustrate material or equipment for some portion of the WORK.

Specifications. That part of the Contract Documents consisting of written descriptions of the technical features of materials, equipment, construction systems, standards, and workmanship.

Specify. Refers to information described, shown, noted, or presented in any manner in the Specifications.

Subcontractor. Party supplying labor and material or only labor or material for work at the site of the project for, and under separate contract or agreement with, the CONTRACTOR. Nothing contained in the Contract Documents shall create any contractual relationship between the OWNER and any Subcontractor.

Substantial Completion. Sufficient completion of the project or the portion thereof to permit effective utilization of the project, or portion thereof for its intended purpose. Substantial completion requires not only that the WORK be sufficiently completed to permit utilization, but that OWNER can effectively utilize the substantially completed WORK. Determination of substantial completion is solely at the discretion of OWNER. Substantial completion does not mean complete in accordance with the Contract Documents nor shall substantial completion of all or any part of the project entitle CONTRACTOR to acceptance under the Contract Documents.

Substantial Completion Date. Date when OWNER puts into service the project, or that portion of the project that has been determined to be substantially complete.

Supplementary Conditions. The part of the Contract Documents which amends or supplements these General Conditions.

Supplier. A manufacturer, fabricator, supplier, distributor, materialman or vendor other than a Subcontractor.

Time. Whenever “time” or “Contract time’ is referenced in the Contract Documents, it shall refer to calendar days.

Underground Facilities. All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

Work. All materials, supplies and equipment incorporated or to be incorporated into the construction and all labor, operations and services necessary to produce the construction, including in part all obligations, duties and responsibilities necessary to the successful completion of the project.

Work Directive. A written order from the OWNER which clarifies the plans or specifications.

Written Amendment. A written modification of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

ATTACHMENT A – OPERATION AND MAINTENANCE PLAN

OPERATION AND MAINTENANCE PLAN

Water Facilities: Bonita Reservoir

Easement Holder: Elmer Ferganchick

This Operation and Maintenance Plan (O&M Plan) and any attachments thereto is hereby incorporated into the easements granted under the Act of March 3, 1891, for Bonita Reservoir. The Holder agrees to operate and maintain the authorized facilities and use the occupied National Forest System (NFS) lands in accordance with the following stipulations:

1. **Equipment/vehicles**: Holder agrees to use only approved equipment listed below (please add any additional equipment to list):
   - A. Tractor and low-boy trailer (graveled roads only).
   - B. Rubber tired backhoe.
   - C. Skid Steer Loader.
   - D. ATV.
   - E. Pickup truck with trailer.
   - F. Walk-behind compactor.

2. **Access Routes:** Forest Service Road 125 from its southern end near Cedaredge to Forest Service Road 132 to Bonita Reservoir.

3. ***Holder will notify the Forest Officer at least 24 hours prior to using heavy equipment (i.e., dozers, etc.), on the access routes described above***.
   - Use of these routes is approved for water facility operation and maintenance needs only.
   - Holder must ensure maintenance is done by an individual who understands and will apply the specifications of this O&M Plan. They must be familiar with terms in the ditch easement applicable to the maintenance. The holder will make a copy of this plan available for reference and review upon request by the Forest Service.
   - Holder is subject to federal and state laws regulating travel on State, County, and Federal lands. These include Code of Federal Regulations (CFR) 261.13 prohibiting travel in a manner which damages or unreasonably disturbs the land, wildlife and vegetative resources. Violation of the terms and conditions contained herein is punishable by a fine of not more than $5,000 or imprisonment for not more than 6 months or both (Title 16 U.S.C. 551).
   - Operations that involve traveling the above-mentioned roadways, trails or other access to the project shall cease when travel causes rutting 3" or more in depth.
   - Holder shall replace any large rocks currently in place on roads or trails that are not designated as "open" to the public if those rocks are moved in order to allow access by full-sized vehicles or heavy equipment. This requirement does not apply to ATV access.
   - Holder shall cut and pull back any downed trees blocking the access routes and shall not leave the trail in order to go around the trees.

4. **Routine Maintenance:** includes, but is not limited to: regulating channel flows so that a freeboard is maintained above the water line, spillway maintenance, operating valves, weed and brush control, dam crest maintenance, replacing riprap on dams, rodent control and work on outlets (does not include breaching dam and replacing outlet). Repair work on dams done with heavy equipment is generally done from June to November. However, access by ATV, snowmobile, and pickups for operation and maintenance could occur year-round. Removal of dead and downed trees and brush that interfere with proper working condition of ditch, removal of beaver dams, maintaining diversion, headgate and other ditch structures in good functioning condition and clear of sediment and other debris, addition of ditch bank material to maintain freeboard above the water line.

5. **Non-routine Maintenance:** The Holder will contact the Authorized Officer for approval before proceeding with work that is other than routine operations, as this work could require additional authorization from the Forest Service. Some of these situations are:
    a. Bringing in and using heavy equipment other than that approved in 1., above.
    b. Using other than approved maintenance routes for access.
    c. Removal of significant amounts of vegetation and soil and deposition of the same, if on National Forest System lands.
    d. Burning slash, application of seed mixtures (weed-free seed required), or other means of vegetation control measures.
    e. Reconstruction or re-routing of a portion of the ditch (the latter would also entail a new authorization).
    f. Breaching a dam and/or replacement of outlet works.
    g. Raising spillway height in order to enlarge a reservoir.
    h. Excavation of riprap or borrow material from other than inside the reservoir basin. This will generally require a temporary special use permit.

6. The Holder shall be responsible for prevention and control of soil erosion and gullying on land because of any extraordinary events covered by the easement and the land adjacent thereto resulting from operations and maintenance of granted use (i.e., breach of dam, ditch blowout, etc.); maintain channel to prevent downcutting and bank failure; remove all obstructions from the channel; revegetate, tamp down disturbed soil, or otherwise stabilize all ground where the soil has been exposed (i.e., during ditch cleaning, and the spoils removed from the ditch shall not be left in piles but will be compacted on the ditchbank).

7. Holder is responsible for control of and spread of noxious weeds (as identified by the USDA Forest Service and the local county weed list) on dams, ditchbanks, and ditchbank trails as directed by the Authorized Officer. Holder may use non-restricted chemical herbicides for weed control along access route and water facility within the confines of the easement. Label instructions will be strictly followed in the application of pesticides and the disposal of excess materials and containers. Please use the attached form to report weed treatment activities each year.

8. The Holder shall inspect the facility prior to use each year and make necessary repairs. Work that is considered other than routine maintenance and/or minor repairs shall be discussed in advance with the Forest Officer. All repairs shall be acceptable to and completed by the date agreed to by the Holder and the Forest Officer.

9. If any items or archaeological, paleontological, or historic value, including but not limited to historic or prehistoric artifacts, structures, monuments, human remains and funerary objects (grave goods) are discovered, the Holder shall immediately cease all activities which may disturb such items and notify the Forest Service. The Holder shall not resume

activities until written approval is given by the authorized officer. Failure to comply with this stipulation may result in civil or criminal penalties under the Archaeological Resources Protection Act of 1979.

10. This O&M Plan will be reviewed annually by the Holder and the Forest Service and may be amended by mutual agreement signed and dated by the Holder and the District Ranger.

11. Use of mineral materials (borrow material) from within the reservoir basin is authorized for such things as replacement of riprap and reestablishment of freeboard; however:

a) a mineral material permit might be required (determined on a case-by-case basis);
b) all mineral material must come from the permitted reservoir boundary itself;
b) no mineral material shall be hauled to another site or off-forest and is only to be used for the permitted activity, and
c) production records shall be maintained and submitted to the Grand Valley Ranger District Office upon completion of the work.

_____ _____
Holder Date

_____ _____
District Ranger Date

SECTION 015723

TEMPORARY STORM WATER AND POLLUTION CONTROL

DESCRIPTION PAGE

SECTION 015723

TEMPORARY STORM WATER AND POLLUTION CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to complete the WORK of the noted Sections of this Division described herein and on the drawings.

1.02 WORK INCLUDED

A. The work shall include, but is not necessarily limited to, local stormwater management to prevent stormwater runoff from damaging existing or new WORK or otherwise interfering with the WORK, erosion control, disposal of water resulting from dewatering operations as specified; water used in preparing and processing construction materials; spill containment and cleanup of petroleum products; storage and management of chemicals used in the WORK and minimization of air, water and noise pollution. Applicable areas include the areas disturbed by excavation, fill, haul and access roads, staging areas, etc. All WORK shall be performed in accordance with the applicable stipulations of the Forest Service Permits (see Section 010000 General Requirements). See section 357313.20 for stream diversion requirements.

1.03 SUBMITTALS

A. At least 15 days prior to start of the WORK, the CONTRACTOR shall provide a plan for installing measures and performing work to control erosion, dispose of water from dewatering operations, use of water in preparing and processing construction materials, and minimizing the production of sediment and other pollutants to water and air from construction activities. WORK shall not be started until the erosion and pollution control plan has been approved by the ENGINEER. The plan shall include, but not be limited to the following:

1. A description, including the locations, of planned features such as swales, berms, dikes, dams, sedimentation basins, slope drains, brush dams, water bars, seeded and mulched areas, chemical and petroleum containment provisions, etc.

2. A description of all related materials and equipment which will be used in the WORK including, but not limited to geotextiles, silt fences, water booms, straw bale filters, erosion minimization chemicals, wattles, seed mixtures, mulches,

fiber mats, netting, gravel, drain pipes, dust palliatives and other pollution control chemicals, etc. A copy of the product data sheet, including the manufacturer's recommended mixing and application procedures and MSDS shall be submitted. The WORK shall not commence until this plan has been approved by the ENGINEER.

3. A schedule for accomplishing temporary and permanent erosion control work. The schedule for the proposed method of erosion control shall include all construction activities within and adjacent to the project, haul roads, borrow areas, storage and plant sites, and the plan for disposal of waste material.

1.04 REGULATORY REQUIREMENTS

A. The CONTRACTOR shall comply with all applicable local, state and federal pollution control regulations and requirements including the "Colorado Water Quality Control Act," Title 25, Article 8, CRS "Protection of Fishing Streams", Title 33, Article 5, CRS; "Clean Water Act", 33 USC 1344; regulations promulgated; certifications issued; etc.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mulches may be hay, straw, fiber mats, netting, wood cellulose, corn stalks (shredded or chopped), corn cobs (shredded or chopped), bark, wood chips, or other suitable material, and shall be certified clean and free of noxious weeds and deleterious materials.

B. Slope drains may be constructed of pipe, fiber mats, rubble, portland cement concrete, bituminous concrete, plastic sheeting, or other acceptable materials.

C. Grass seed for temporarily seeded areas shall be a quick growing species (such as rye grass, or cereal grasses) suitable to the area, which will provide temporary cover and will not later compete with the grasses sown for permanent cover.

D. Fertilizer and soil conditioners shall be acceptable standard commercial grade.

PART 3 - EXECUTION

2.01 GENERAL

A. The excavation and moving of soil materials shall be scheduled to minimize the size of areas disturbed and unprotected from erosion for the shortest feasible time.

B. The Contractor shall provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams, lakes, ponds, or other watercourses or water impoundments areas.

C. The CONTRACTOR shall incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the erosion and pollution control plan. Erosion and pollution control features shall be maintained by the CONTRACTOR until notice of final acceptance of the project has been issued by the OWNER unless otherwise approved by the ENGINEER.

D. All reasonable steps shall be taken to insure that the CONTRACTOR's provisions for the control of erosion, sedimentation and pollution and the protection of water quality comply with applicable standards, permit conditions, and regulations of appropriate agencies.

E. In the event of conflict between these requirements and water quality control laws, rules, or regulations of other Federal, State or local agencies, the more restrictive laws, rules, or regulations shall apply.

F. Requests for clarification of any permit or certification provisions shall be directed to the ENGINEER.

2.02 EROSION AND POLLUTION CONTROL

A. The water quality control work shall consist of temporary measures needed to control water pollution. These temporary measures shall include the installation of berms, dikes, dams, sediment basins, swales, water bars, fiber mats, netting, brush dams, silt fences, water booms, straw bale filters, wattles, erosion minimization chemicals, gravel, seeding, mulches, grasses, slope drains, and other erosion control devices or methods, at the locations necessary to control erosion and water pollution.

B. Temporary pollution controls shall be coordinated with the permanent erosion control features as shown on the drawings to assure economical, effective, and continuous control throughout the construction phase.

C. Permanent erosion and sediment control measures shall be installed at the earliest practicable time. One of the first construction activities shall be the placement of permanent and temporary erosion and sediment control measures around the perimeter of the project or the initial work areas.

D. Erosion and sediment control measures shall be continuously maintained to perform their intended function throughout construction of the project. Sediment filters shall be adequately anchored and supported to prevent erosion under or around them.

E. Construction operations in rivers, streams, lakes, or other bodies of water shall be restricted to:

1. Modification areas designated on the plans.

2. Areas designated on the plans which must be entered to construct structures or erosion and sediment control measures.

F. Areas designated on the plans shall be seeded or revegetated at the earliest practicable time to prevent soil erosion.

G. The work below the ordinary high water level of any water course or impoundment shall be planned and executed so that, whenever possible, work shall be done from the bank.

H. The practices listed below shall be followed to minimize the pollution of wetlands, watercourses, and impoundments:

1. Discharge of dredged or fill material into water bodies or wetlands shall not be allowed unless specifically included in permits. Such discharges shall be performed in strict conformance with the permit stipulations and requirements.

2. Discharges into spawning areas during spawning seasons shall not be allowed unless specifically included in permits.

3. Adverse impacts on the aquatic system caused by the accelerated passage of water or the restriction of its flow shall be minimized.

4. Heavy equipment working in wetlands shall be on mats to prevent undue disturbance and damage to the wetlands area.

5. Discharge into breeding areas of migratory waterfowl shall not be allowed unless specifically included in permits.

6. All temporary fills, excavations, sediment basins, sediment filters, bridges, culverts and other temporary features shall be removed and the area shall be restored in their entirety after no longer needed. Unless otherwise shown on the drawings or directed by the ENGINEER, the areas impacted by temporary

stormwater and pollution control features shall be restored to their original conditions, as much as feasible, when they are no longer required and permanent measures are completed.

7. Heavy equipment use in or around water bodies or wetlands shall be of such type that will not produce environmental damage

End of Section

SECTION 055013

MISCELLANEOUS METAL FABRICATIONS

DESCRIPTION PAGE

SECTION 055013

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. This Section includes furnishing and installing miscellaneous metal work as shown on the Drawings and specified in this Section.

1.02 WORK INCLUDED

A. The WORK shall include, but is not necessarily limited to, furnishing and installing all intake structure and gate replacement parts as shown on the drawings including the following:

1. Stainless steel spacer plates.
2. Stainless steel cover plate.
3. Stainless steel cover plate angle cross stiffener.
4. Stainless steel top guide angles.
5. Stainless steel gate stem replacement segment.
6. Stainless steel gate stem coupling.
7. Stainless steel inlet liner protective sleeve.
8. Stainless steel slopewash diverter plate.
9. All appurtenant bolts, nuts, washers, fasteners and other miscellaneous hardware.

1.03 REFERENCES

A. ALUMINUM ASSOCIATION (AA)

DAF45 Designation System for Aluminum Finishes

B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 Code of Standard Practice for Steel Buildings and Bridges

C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B1.1 Unified Inch Screw Threads, UN and UNR Thread Form

B18.2.1 Square and Hex Bolts and Screws (Inch Series)

B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

B18.21.1 Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

B18.21.2M Lock Washers (Metric Series)

B18.22M Metric Plain Washers

B18.6.2 Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: (Inch Series)

B18.6.3 Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A36/A36M Standard Specification for Carbon Structural Steel

A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A143/A143M Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A193/A193M Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and other Special Purpose Applications

A194/A194M Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts and Bolts for High Pressure or High Temperature Service or Both

A209/A209M Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes

A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A276 Standard Specification for Stainless Steel Bars and Plates

A283/A283M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

A312/A312M Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A380/A380M Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems

A384/A384M Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies

A479/479M Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

A554 Standard Specification for Welded Stainless Steel Mechanical Tubing

A563 Standard Specification for Carbon and Alloy Steel Nuts

A564/A564M Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A780/A780M Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

B209/B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

B221/B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

C1513 Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

D1187/D1187M Asphalt-Base Emulsions for Use as Protective Coatings for Metal

D7091 Standard Practice for Nondestructive measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, nonconductive Coatings Applied to Non-Ferrous Metals

E488/E488M Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

F436 Standard Specification for Hardened Steel Washers

F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

F594 Standard Specification for Stainless Steel Nuts

E. AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS A5.2/A5.2M Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding

AWS A5.4/A5.4M Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding

AWS A5.5/A5.5M Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding

AWS A5.9/A5.9M Specification for Bare Stainless Steel Electrodes and Rods

AWS A5.10/A5.10M Welding Consumables – Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum Alloys - Classification

AWS A5.17/A5.17M Specification for Carbon Steel Electrodes for Submerged Arc Welding

AWS B2.1/B2.1M Specifications for Welding Procedure and Performance Qualification

AWS D1.1/D1.1M Structural Welding Code – Steel

AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing

AWS D10.12/D10.12M Guide for Welding Mild Steel Pipe

AWS QC7 Standard for AWS Certified Welders

F. MASTER PAINTERS INSTITUTE (MPI)

MPI 79 Alkyd Anti-Corrosive Metal Primers

G. SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SP 3 Power Tool Cleaning

SP 5/NACE No.1 White Metal Blast Cleaning

SP 6/NACE No.3 Commercial Blast Cleaning

H. The publications and standards referenced herein form a part of the Contract Documents.

I. When a date is given for reference standards, that edition shall be used. Where no date is given for the reference standards, the latest edition shall be used.

1.04 SUBMITTALS

A. Test Reports and Certification documents shall be submitted as follows:

1. Welding Performance Qualification for welders and welding operators to be employed on the WORK. Welders shall be certified in accordance with the applicable provision of AWS D1.1 and AWS QC7

2. Manufacturer's certification verifying conformance to these Specifications and that all products in contact with potable water are NSF-approved.

B. Manufacturer’s descriptive literature, MSDS, and recommended methods of storage, application, safety, cleanup and disposal for stainless steel pickling and passivating pastes and solutions.

C. Manufacturer’s descriptive literature, MSDS, and recommended methods of storage, surface preparation, application, safety, cleanup and disposal for coatings intended for use on non stainless steel fabricated and not fabricated surfaces. This includes coal tar epoxy, rust preventative coatings, etc.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The CONTRACTOR shall take reasonable care in the proper handling and storage of articles or materials during erection and installation operations to avoid accumulation of dirt and foreign matter. The CONTRACTOR shall remove from the articles or materials dust, dirt, or other foreign matter that accumulates during construction. Coated surfaces shall be protected from abrasion or other damage during handling, storing, installation and erecting.

B. Materials taken from stock by the CONTRACTOR shall be of a quality at least equal to that required by the ASTM specifications applicable to the classification covering the intended use and shall be supported by test reports prepared at the mill where the material was manufactured, or at a testing laboratory approved by the ENGINEER.

C. All hazardous materials shall be delivered, stored and handled in a manner consistent with the manufacturer’s recommendations and with all applicable local, state and federal regulations.

PART 2 - PRODUCTS

2.01 STEEL, ALUMINUM AND RELATED PRODUCTS

A. Carbon Steel

1. Structural steel rolled shapes and plates shall be in accordance with ASTM A36.

2. Bars and shapes shall be in accordance with ASTM A36 or ASTM A108 Grade

1018.

3. Plate 2 inches and less in thickness shall be in accordance with ASTM A36 or ASTM A283 Grade C or Grade D.

B. Stainless Steel

1. Unless otherwise shown on the Drawings, materials in contact with soil or water, intermittently or continuously, or in a wet or moist environment shall be stainless steel meeting the requirements of ASTM A240 Type 304 or 304L.

2. Stainless steel bars and shapes shall be in accordance with ASTM A276 Type 304 or Type 304L, unless otherwise specified or shown on the Drawings.

3. Stainless steel plate, sheet, and strip shall be in accordance with ASTM A240 Type 304 or Type 304L, unless otherwise specified or shown on the Drawings.

4. Rolled stainless steel shapes shall be in accordance with the requirements of ASTM A479, Type 304, or 304L, heat treatment waived, unless otherwise specified or shown.

5. Stainless steel pipe shall be in accordance with ASTM A312 Type 304L.

6. Stainless steel tubing shall be in accordance with ASTM A554 Type 304.

C. Aluminum plate and sheet shall be in accordance with ASTM B209, Alloy No. 5052 H32.

D. Fasteners

1. Threads for bolts and nuts shall be in accordance with ANSI B 1.1.

   a. Threads for bolts 1-inch and less in diameter shall be coarse-thread series and threads for bolts 1 1/8-inch and greater in diameter shall be the 8-pitch thread series.

   b. All holes to accommodate bolts shall be drilled (not torch-cut) with bits sized according to ASME standards for free-fit connections for the applicable bolt size. The fit shall be Class 2 free fit; except that Class 3 medium fit shall be provided in holes tapped for studs.

2. Unless otherwise shown on the Drawings, bolts shall have heavy hexagon heads and heavy hexagon nuts.

3. The lengths of studs and bolts, excluding anchor bolts, shall provide a projection of not less than 1/4-inch nor more than 1/2-inch through the nut when

it is drawn tight; however, in exposed locations the projection shall be not more than 1/4 inch.

4. Carbon Steel Nuts and Bolts

    a. Carbon steel bolts, anchor bolts, and U-bolts, in above ground applications and not in contact with soil or water shall be in accordance with ASTM A325, Type 1 in type N connections.

    b. Carbon steel nuts in above grade applications and not in contact with water shall be in accordance with ASTM A563, Grade B.

    c. Carbon steel bolts, nuts, washers and other fasteners which will be exposed to soil, or immersed in water, intermittently or continuously, or in moist-environment installations, shall be coated with a bituminous paint-on (non-aerosol) coating such as Por-15 rust preventive coating or approved equivalent, combined with wrapping the associated fittings with polyethylene sheeting (minimum 10 mil thickness).

    d. Steel washers shall be in accordance with ASTM F436.

    e. Carbon steel bolts greater than 1-inch in diameter shall be the 8-pitch thread series and shall be ferritic steel in accordance with ASTM A193, Grade B7. Accompanying nuts shall be in accordance with ASTM A194, Grade 2H.

5. Stainless Steel Fasteners

    a. Except as otherwise specified or shown on the Drawings, stainless steel fasteners shall be used when buried or where the material will be immersed in water, intermittently or continuously, or in moist-environment installations.

    b. Type 304 or 304N stainless steel fasteners shall be Type N connections in accordance with ASTM F593 and F594.

    c. Stainless steel washers shall conform to ASTM F436 except that they shall be punched from steel conforming to ASTM A240 Type 304 or machined from bar stock conforming to ASTM A276 Type 304.

    d. Stainless steel studs, bolts, nuts, and washers shall be stamped indicating the type of stainless steel.

E. Welding Rods

1. Welding rods for welding carbon steel shall be E6010(5P), in accordance with AWS A5.1 or A5.17 for welding carbon steel.

2. Electrodes for welding stainless steel shall be Type E308/308L-16 in accordance with AWS A5.4 or AWS A5.9

3. Electrodes for welding stainless steel to carbon steel shall be Classification Number E309L or E312 in accordance with AWS A5.4 or A5.9.

4. Electrodes for welding aluminum shall be filler alloy 5356 in accordance with AWS A5.10.

F. Anti-Galling Compound

1. The anti-galling compound to be used on threads of stainless steel fastener assemblies shall be a copper-based compound certified by ANSI/NSF or EPA, for use in potable water systems.

2.02 GROUT AND CAULKING

A. In locations where it is desirable, necessary or specified to repair concrete or fill depressions, voids, spaces, gaps, cracks, etc. with high strength rigid grout, the grout shall consist of one of the following as specified, shown on the drawings or directed by the ENGINEER:

1. Epoxy grout shall be high modulus, moisture tolerant and specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics:

a. Minimum 14 day tensile strength (ASTM D638): 2,000 psi

b. Minimum 14 day tensile modulus of elasticity (ASTM D638): $3x10^5$ psi

b. Maximum elongation at break (ASTM D638): 7%

c. Minimum 2 day bond strength (ASTM C882): 1,000 psi

d. Minimum 28 day compressive strength (ASTM D695): 4,000 psi

e. Where low viscosity is required or specified to flow into narrow or limited access passages, the mixed viscosity shall be less than 500 cps.

f. For vertical and overhead applications the grout shall have a non-sag, paste consistency.

g. For wide, easily accessible areas greater than 1/2" in depth, approved mineral aggregate may be mixed with the epoxy grout (if allowed by the manufacturer) in proportions, and using methods, recommended by the manufacturer, subject to the approval of the ENGINEER.

2. Mortar grout shall be high strength, non-shrink grout meeting the requirements of ASTM C1107 specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics:

a. Minimum 28 day bond strength (ASTM C882): 1,000 psi

b. Minimum 28 day compressive strength (ASTM D1107): 6,000 psi

c. Where fluid consistency is required or specified to flow into narrow or limited access passages, a grout specifically formulated for fluid consistency shall be used.

d. For vertical and overhead applications the grout shall have a non-sag paste consistency. Grout specifically formulated for fluid consistency shall not be used for these applications

3. Epoxy adhesives for bonding, sealing or caulking shall be high modulus, moisture tolerant and specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics:

a. Minimum 14 day tensile strength (ASTM D638): 2,000 psi

b. Minimum 14 day tensile modulus of elasticity (ASTM D638): $3x10^5$ psi

b. Maximum elongation at break (ASTM D638): 7%

c. Minimum 2 day bond strength (ASTM C882): 1,000 psi

d. Minimum 28 day compressive strength (ASTM D695): 4,000 psi

e. Where low viscosity is specified the mixed viscosity shall be less than 500 cps.

B. As required for an insulator to prevent galvanic corrosion from occurring where dissimilar metals are in contact and other locations indicated on the drawings, caulking shall be applied as specified or as directed by the ENGINEER.

1. Caulking shall be rated by the manufacturer for the depth of application, shall be moisture tolerant and specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics. Unless otherwise specified or indicated on the drawings, caulking material for depths greater than 1/2 inch shall be two components:

a. Minimum 21 day tensile strength (ASTM D412): 80 psi

b. Maximum 21 day tensile modulus of elasticity at 100 percent elongation (ASTM D412): 100 psi

b. Minimum elongation at break (ASTM D412): 400%

c. Minimum adhesion in peel applied to concrete substrate (ASTM C974): 20 lb

PART 3 - EXECUTION

3.01 FABRICATION OF MISCELLANEOUS METALWORK

A. General

1. The CONTRACTOR shall take all necessary precautions to prevent warpage and distortion of all welded parts. Any warpage or distortion shall be repaired or replaced at the expense of the CONTRACTOR.

2. The CONTRACTOR shall take the necessary precautions as described in ASTM A143 and ASTM A384 during fabrication of articles to be galvanized, to properly fabricate and prepare the material to prevent embrittlement, warpage, and distortion.

3. Violation of the provisions of this section will be sufficient cause for rejection of the WORK.

4. All edges, corners, and welds shall be struck and deburred.

5. As required as an insulator to prevent galvanic corrosion from occurring where dissimilar metals are in contact and other locations indicated on the drawings, caulking shall be applied as specified or as directed by the ENGINEER. Where caulking is used as an insulator between dissimilar metals, it shall be applied in a manner to fully coat both mating surfaces immediately prior to assembly of the mating surfaces.

B. Fabrication - Welding Of Carbon Steel

1. Except for the modifications set forth in the Contract Document, the welding of structures or articles fabricated from carbon steel shall be in accordance with the AISC Manual of Steel Construction and AWS D1.1 as referenced therein.

2. Electroslag and electrogas welding procedures will not be permitted.

3. Joints to be welded by automatic machines shall be abrasive-blasted to white metal in accordance with SSPC-SP5.

4. Electrodes for shielded metal arc welding (SMAW) shall not be larger than 1/4-inch for shop welding and not larger than 3/16-inch for field welding.

5. The depth of each pass shall not exceed 1/8-inch for manual welding, and the

weld puddle width shall not exceed three times the electrode diameter or 3/8-inch, whichever is less.

6. Welding of pipe or tubing shall be in accordance with the recommendations of AWS D10.12.

7. Runoff tabs shall be removed by hand flame-cutting or other means as close to the edge or the finished member as practical, followed by grinding to a smooth surface contiguous with the adjacent metal.

C. Fabrication - Welding Of Stainless Steel

1. Welding on austenitic stainless steel shall be performed by the shielded metal arc process using direct current.

2. Electrodes for welding austenitic stainless steels shall be in accordance with AWS A5.4 Classification Number E308L. Electrodes for welding stainless steel to carbon steel shall be Classification Number E309L or E312 electrodes.

3. Weld procedures shall be qualified in accordance with AWS B2.1.

4. Welding of stainless pipe or tubing shall be in accordance with the recommended practices of AWS D10.4.

5. Stainless steel to carbon steel welds performed in the field will not require stress-relieving heat treatment provided the interpass temperature does not exceed 350°F.

6. Stainless steel welds shall be deburred, ground smooth and cleaned. The following precautions shall be taken during fabrication of stainless steel components to minimize contamination of the steel:

   a. Grinding wheels shall be made of aluminum oxide. Carborundum or other carbon bearing wheels are not acceptable for use on stainless steel surfaces.

   b. Grinding wheels, sanding materials or wire brushes made of iron, iron oxide, steel, zinc or other undesirable materials which may cause cross-contamination of the stainless-steel surface shall not be used. Wire brushes shall be made of stainless steel.

   c. Grinding wheels, sanding materials and wire brushes that have previously used on other metals shall not be used on stainless steel.

   d. Blasting abrasives shall consist of clean, unused, glass beads, iron-free silica sand or iron-free alumina sand or an approved equal. Steel shot, grit or previously used abrasives shall not be used.

e. Thoroughly clean all components prior to any thermal processing (i.e. stress relieving, annealing, drawing or other hot-forming processes).

7. After shop fabrication stainless steel shall be cleaned, descaled, pickled and passivated in accordance with ASTM A380. The CONTRACTOR shall use Avesta, or equal, pickling paste and passivating solution, for fieldwork.

3.02 SHOP FINISHES

A. Galvanizing

1. Galvanizing shall have an average weight per square foot of 2.0 ounces with localized areas not less than 1.8 ounces per square foot.

2. Except where otherwise specified, galvanizing shall be performed after fabrication, including cutting, punching, welding, and drilling, etc. has been completed.

3. Prior to galvanizing, items shall be cleaned by abrasive blasting to white metal in accordance with SSPC-SP5.

4. Weld flux residue, weld splatter, and minor weld defects not removed by the abrasive blasting shall be removed by mechanical means.

5. After abrasive blasting and mechanical cleaning, items shall be fluxed and immediately hot dipped.

6. Galvanizing shall be done in the largest possible subassemblies consistent with the appearance of the completed item and with the prevention of warpage of the product.

7. Damage to galvanizing shall be repaired in accordance with one of the methods specified in this Section.

B. Carbon Steel, Low Alloy Steel and High Strength Low Alloy Steel

1. All non-stainless steel fabricated items shall be coated with two coats of coal tar epoxy to a final minimum thickness of 18 mils. Coating shall be performed in accordance with all recommendations of the manufacturer including steel surface preparation, mixing, coating application, curing, etc. The gate cover plate and cross-stiffener angle require coating.

2. All non-stainless steel non-fabricated items shall be coated with two coats of Por-15 or approved equivalent rust preventive coating. Coating shall be

performed in accordance with all recommendations of the manufacturer including steel surface preparation, mixing, coating application, curing, etc.

3.03 INSTALLATION

A. Fabrication, installation and erection shall be in accordance with the latest editions of AISC specifications and codes of standard practice.

B. The existing guide rail angles, intake pipe flange, and cover plate for the intake structure gate are somewhat skewed from the upstream alignment of the gate operating stem. Based on approximate field measurements and photos, the amount of skew was estimated to be between 2.5 and 3 degrees. Therefore, prior to fabrication of new intake structure components (cutting the cover plate to its final size, welding the new stem segment to the new cover plate, drilling holes, attaching new components to existing ones, etc.), the amount of skew must be measured in the field and adjustments must be made to substantially reduce or eliminate the amount of skew in the final intake configuration. These adjustments might include re-sizing the cover plate, filling the existing guide angle mounting holes in the flange with weldment and re-drilling them, installing shims, etc.

C. Installation and anchoring details for miscellaneous metal items shall be as shown on the Drawings. Details not shown shall be developed by the CONTRACTOR and indicated on the submittal shop drawings.

D. All bolts and nuts shall be torqued in the order of priority indicated in the Contract Documents or as directed by the ENGINEER. Unless otherwise indicated in the Contract Documents or recommended by the manufacturer, all bolts shall be torqued to 50% of their yield strength.

E. Unless otherwise specified, anti-galling compound shall be used each time stainless steel fasteners are assembled, removed or reassembled and shall be applied in the fastener threads in accordance with the manufacturer's recommendations.

F. Modification of the intake structure will involve removal (by chipping) of a portion of the existing concrete base, and replacement with epoxy grout or epoxy bonded non-shrink mortar grout. Where the replacement thickness is less than ½ inch, epoxy grout will be used. Epoxy bonding agents shall meet the requirements in the Products paragraph for epoxy adhesives. All grout and bonding agents shall be placed in accordance with the manufacturers' recommendations. Mortar grout shall be placed on the epoxy bonding agent while the bonding agent is still tacky. The substrate for grout materials shall be free of all standing water, laitance, dust, grease, loose particles, foreign particles and other contaminants or debris. Mortar grout shall be tamped to remove air bubbles and to consolidate the grout. Grout with visible voids or air pockets shall be removed and replaced at the expense of the CONTRACTOR. Ambient and substrate temperatures for placement and curing of

grout materials shall be maintained within the range recommended by the manufacturer for the minimum recommended time period. All grout shall be cured for the first 24 hours after placement in an ambient temperature between 50 and 90 degrees Fahrenheit and shall be protected from freezing for the initial 48 hours.

3.04 REPAIR OF GALVANIZED SURFACES

A. Areas of galvanizing damaged during fabrication, shipping, installation, erection, or any other time prior to acceptance of the WORK shall be prepared and recoated by one of the following methods:

1. Parts damaged in the shop shall be removed from the site, stripped of existing coating, cleaned, and re-galvanized in accordance with ASTM A123 or A153 as applicable.

2. Field or shop repair areas shall be cleaned and recoated with a 2.0 mil coating of zinc alloy using meltable zinc-based alloy bars (hot bar process).

    a. The damaged area shall be thoroughly cleaned using a wire brush, a light grinding action or mild abrasive blasting. The cleaning shall extend beyond the damaged area to lap the undamaged galvanized coating at least 1/2-inch.

    b. Weld flux residue, and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling or other mechanical means.

    c. The cleaned area shall be preheated to at least 600°F but not more than 750°F. The surrounding galvanized area shall not be burned. The area to be repaired shall be wire brushed during this preheat.

    d. The cleaned preheated area shall be rubbed with the repair alloy stick to deposit an evenly distributed layer of the zinc alloy.

    e. The repaired area shall be wiped with a damp cloth to remove flux residue.

    f. Dry –film thickness shall be verified using a magnetic or electromagnetic-type gauge, in accordance with ASTM D7091.

3. Shop or field-damaged areas shall be cleaned and recoated with a 4.0 mil minimum coating of zinc, using sprayed zinc (metalizing process).

    a. The surface to be repaired shall be blast cleaned to white metal in accordance with SSPC-SP5. The area to be blast cleaned shall extend at least 1/2-inch onto the surrounding sound coating area.

    b. Weld flux residue and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling, or other mechanical means.

    c. Zinc wire used in repair shall contain not less than 99.98% zinc.

d. Sprayed coating shall be applied within 2 hours after surface preparation has been completed and before any visible deterioration (flash-rust) has occurred.

e. The coating shall be applied to the clean and dry surface by metal spraying pistols fed with zinc wire or zinc powder.

f. The surface of the sprayed zinc shall be of uniform texture, free of lumps, coarse areas, and loosely adhered particles.

g. Dry film thickness shall be verified using a magnetic or electromagnetic-type, gauge, in accordance with ASTM D7091.

4. In the field, for areas where the hot bar or metalizing process methods cannot be used, and with the permission of the ENGINEER, the damaged areas shall be repaired with multiple coats of an approved coating such as Rustoleum Zinc Rich Cold Galvanizing Aerosol; CRC Zinc-It; Spray-on #740 zinc-rich; Sherwin Williams #140 Zinc-Rich; OAE.

   a. The damaged area shall be cleaned and recoated with an organic zinc-rich paint to a minimum dry film thickness (DFT) of 6.0-mils applied in two coats.

   b. The surface to be repaired shall be blast cleaned to white metal in accordance with SSPC-SP5. The area to be blast cleaned shall extend at least 1/2-inch onto the surrounding sound coating area.

   c. Weld flux residue and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling or other mechanical means.

   d. In areas where abrasive blasting cannot be used or cannot effectively clean the required area, power disk sanding or other cleaning methods shall be used, subject to the approval of the ENGINEER.

   e. Apply paint containing zinc dust to the prepared area as recommended by the paint manufacturer.

   f. Dry film thickness shall be verified using a magnetic or electromagnetic-type gauge, in accordance with ASTM D118.

End of Section

SECTION 312219

FINISH GRADING AND SOIL PREPARATION

DESCRIPTION PAGE

SECTION 312219

FINISH GRADING AND SOIL PREPARATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to complete the WORK of the noted Sections of this Division described herein and on the drawings.

1.02 WORK INCLUDED

A. The WORK shall include, but is not necessarily limited to, finish grading and soil preparation for seeding. Applicable areas include the areas disturbed by excavation, fill, haul and access roads, staging areas, etc.

1.03 OWNER'S QUALITY ASSURANCE

A. Prior to placement of topsoil, soil preparation and seeding the ENGINEER will inspect the areas to be seeded to verify that rough grading is within acceptable tolerances of grades specified.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Use existing on-site stripping material from temporary stockpiles for areas to be seeded.

PART 3 - EXECUTION

3.01 ROUGH GRADING

A. Prior to placement of topsoil, soil preparation and seeding, the grades in the areas to be seeded will be within acceptable tolerances of grades specified as determined by the ENGINEER.

B. Prior to placement of topsoil, soil preparation and seeding in designated areas, any soil which has been rendered unfit to receive seeding or planting due to concrete water, mortar, lime water or any other contaminants, shall be

removed and replaced with clean earth from a source approved by the ENGINEER.

3.02 GENERAL

A. Do not perform WORK when existing site conditions will not provide satisfactory results.

3.03 FINISH GRADING

A. Furnish equipment and labor necessary to control the flow, drainage, and accumulation of water as is intended by the specified grades.

B. Complete all fine grading prior to seeding.

3.04 SOIL PREPARATION

A. Soil preparation is required in all areas designated for seeding. See Specification Section 329219, "Seeding and Mulching".

B. All noxious weeds or parts thereof shall be removed from the surface grade prior to seeding.

C. Compaction of the surface grade prior to seeding shall be "firm", but not hard (approximately 80 percent of Standard Proctor - ASTM D698, within 2 percent of optimum moisture).

D. Prior to seeding, rake the prepared surface to a smooth, even surface free of debris, clods, rocks, and vegetable matter greater than 1".

End of Section

SECTION 312300

EXCAVATION AND FILL

DESCRIPTION PAGE

SECTION 312300

EXCAVATION AND FILL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to complete the work of the noted Sections of this Division described herein and on the drawings.

1.02 WORK INCLUDED

A. The work shall include, but is not necessarily limited to, earthwork which shall include stripping, excavating, filling, compacting, grading and related items.

B. Specific work covered by this section includes, but is not limited to the following items:

1. Stripping of all areas affected by construction operations including borrow areas where significant vegetation exists and the downstream face of the existing dam embankment in the vicinity of the outlet pipe.

2. Development and excavation of borrow area.

3. Excavation around the downstream portion of the outlet pipe to the limits indicated on the drawing or described herein.

4. Placement and compaction of filter drain materials around the drain pipe and outlet pipe.

5. Placement and compaction of replacement embankment fill in the portions of the embankment which are excavated as part of the WORK.

6. Placement of replacement rockfill embankment on the outer portions of the embankment which are excavated as part of the WORK.

7. Special hand compaction as may be necessary to install filter drains, drain pipe, and backfill the outlet pipe.

C. Excavate and fill to elevations and dimensions indicated on the drawing and/or as required by field conditions on the site or as directed by the ENGINEER.

1.03 SUBMITTALS

A. At least 15 days prior to start of placement of filter drain materials, the CONTRACTOR shall submit either a certified gradation of the material proposed for use or a sample of the material proposed for use in each filter drain zone.

B. At least 15 days prior to start of placement of embankment material, the CONTRACTOR shall provide information regarding make, model, dimensions, weight, and compactive energy of the compactors proposed for use on the project.

1.04 OWNER'S QUALITY ASSURANCE

A. Field and Laboratory quality assurance (QA) testing and inspection will be performed by the ENGINEEER. The CONTRACTOR shall provide access to the work and any assistance necessary to the ENGINEER for the purpose of obtaining samples and tests or performing QA inspections.

B. QA testing and minimum test frequency will be performed as follows:

1. Classification of Soils: ASTM D 2487 and ASTM D 2488. Soil classification will be determined for each type or classification of material incorporated in the work, and/or for every 5,000-cubic yards of material placed.

2. Moisture-Density Relations of Soils Maximum Dry Density as determined by ASTM D 698 or AASHTO T 99 (Standard Proctor). Moisture-Density relations will be determined for each type or classification of material incorporated in the work, and/or for every 5,000-cubic yards of material placed.

3. Density for Sands and Gravels. No density testing will be performed for free draining sands and gravels including filter sands and gravels.

4. In-place Density Determination Nuclear Method ASTM D 2922 or Sandcone Method ASTM D 1556. In-place density tests will be performed for every 100 cubic yards of each type or classification of earthfill material placed. One quality assurance density test will be made for every 12 inch thickness or each lift of fill, trench backfill or structure backfill placed as a unit or for every 100 cubic yards whichever results in the maximum number of tests.

1.05 CONTRACTOR QUALITY CONTROL

A. The CONTRACTOR may, at any time and at his own expense, obtain field testing from a different independent testing laboratory which meets with the approval of the OWNER for the purpose of controlling his own work operations.

PART 2 - PRODUCTS

2.01 FILTER DRAIN MATERIALS

A. The material placed in placed in the stage 1 filter zone shall satisfy the following gradation requirements:

Sieve Size	Percent Passing
3/8”	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	24-60
No. 50	10-30
No. 100	2-10
No. 200	<5

B. The material placed in placed in the stage 2 filter zone (drain envelope) shall satisfy the following gradation requirements:

Sieve Size	Percent Passing
2”	100
1 1/2”	90-100
3/4”	60-100
No. 4	15-60
No. 10	0-15
No. 16	0-10
No. 200	<5

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR is advised that the dam embankment slopes and surrounding areas are expected to be wet, soft and slick. Stabilization of these areas may be required for construction access and to provide suitable working areas.

3.02 STRIPPING

A. General: Stripping includes removal of topsoil and organic materials, existing subsurface debris and abandoned construction materials.

B. Stripping and Obstructions:

(1) Remove the materials and obstructions previously described within the designated stripping limits delineated or staked by the ENGINEER to a maximum depth of six (6) inches below the existing natural grade. Any stripping depths in excess of six-inches required to provide a suitable earthfill or excavation surface shall be approved by the ENGINEER prior to removing the questionable material.

2. The stripped topsoil and other organic materials of suitable quality generated at the dam site shall be transported, temporarily stockpiled and subsequently respread on appropriate borrow slopes or toe areas as directed by the ENGINEER. Unsuitable dam site stripping materials shall be removed and disposed of in a responsible manner and in accordance with all State, Local and Federal Regulations.

3.03 EXCAVATION

A. Classification of Excavation:

1. Excavation shall be classified as common unless otherwise specified.

2. Common Excavation. Common excavation consists of grass, sod, humus, peat, earth, clay, sand, silt, gravel, hard and compacted materials, such as hardpan, loosely cemented gravel, soft or disintegrated rock and similar materials that can be removed by hand, heavy ripping equipment such as tractor-drawn rippers, and push tractors or by drag line or excavator equipment. Boulders and loose rock less than 1 cu. yd. are also classified as common excavation.

3. Rockfill Excavation. Rockfill excavation includes material excavated from the area around the downstream end of the outlet pipe which consists primarily of rock 6 inches in size and larger. This material shall be stockpiled nearby the excavation for later placement as replacement rockfill in the outer portions of the embankment fill.

4. Borrow Excavation:

   a. Borrow excavation includes materials obtained for earthfill construction. Borrow material shall meet the fill requirements specified herein.

   b. Excavation in the borrow area shall begin along the bank of the existing road in the location shown on the Drawings and shall proceed in a manner that widens the road bed at approximately the same slope as the existing road bank, as directed by the ENGINEER. Borrow area excavation shall be limited to the road bank.

5. Embankment Excavation:

   a. Excavation for downstream outlet modifications shall be made at slopes no steeper than required to maintain stable banks and safe working conditions. The slopes shown on the Drawings are for illustration purposes only. If the slopes show sighs of movement, formation of tension cracks or other indications of slope instability, the excavation cut shall be laid back to slopes which are sufficiently flat as will remain stable. Excavation slopes are intended to be made as steep as possible while achieving worker safety and slope stability.

   b. Any working pads required for staging excavating equipment shall be constructed entirely of fill material. Unless otherwise approved by the ENGINEER, no excavation into the embankment will be allowed to construct working pads for staging excavating equipment or other purposes. Any

approved excavation made for such purposes shall be filled with compacted backfill.

B. Disposal of Surplus and/or Waste Material:

1. Dispose of surplus and waste material where designated on the Drawings or as directed by the ENGINEER. Surplus and waste material includes excavated embankment soil which is either too wet or otherwise unsuitable for re-use in fills. Waste material, excluding removed trees and grubbed debris, generated at the dam site and determined by the ENGINEER to be suitable clean shall be wasted in the designated borrow area, outside of the roadway traveled surface, as directed by the ENGINEER. The CONTRACTOR shall shape the final surface contours in the designated borrow area to conform to the roadway and bank and surrounding terrain and to provide un-obstructed surface drainage without steep drainage paths or pools. Oversize rock shall be placed either in the rockfill portion of the replacement embankment or on the upstream slope of the dam or in the spillway channel, as directed by the ENGINEER.

2. Grade areas for drainage and a uniform appearance, blending into the surrounding grade.

3.04 EARTHFILL OPERATIONS

A. Compacted Fill

1. Lines and Grades. Construct fills to the lines, grades, and cross sections as shown on the Drawings. Finished surfaces shall be generally smooth and pleasing in appearance. It may be necessary to over-build portions of the embankment fills and subsequently grade them to conform with the lines and grades shown on the drawings.

2. General.

a. Maintain and protect fill in a satisfactory condition until completion of the WORK.

b. Remove and replace fill material rendered or determined by the ENGINEER to be unsuitable after being placed before placing subsequent lifts or additional fill material. Unsuitable material includes but is not limited to material obtained from otherwise approved borrow or common excavations which contain brush, roots, sod, frozen or otherwise deleterious materials or is not suitable for use in embankment fill zones.

c. It is anticipated that soil removed from excavations required for the WORK will be too wet to be re-used as backfill or fill material. Native fill and backfill materials shall be obtained from the designated borrow area.

d. Distribute material to avoid lenses, pockets or layers differing substantially from the surrounding material.

e. Subgrade foundation areas shall be compacted to the same requirements of the overlying embankment fill as much as feasible, in the opinion of the ENGINEER. No material shall be placed on subgrade foundations until the foundation has been inspected and approved by the ENGINEER.

3. Quality Assurance. The minimum frequency of QA testing shall be as specified in Part 1 of this Section. If, in the opinion of the Engineer, the specified in-place density and material moisture content is not being achieved on a consistent basis, the frequency of QA testing will be increased until consistently acceptable results are obtained.

4. Imported Fill. Imported fill material will include filter drain sand and gravel. Notify the ENGINEER when imported material is to be used and indicate where material is to be placed in stockpiles and subsequently placed in the WORK. Imported fill material shall conform to the required material specifications contained herein or to those requirements determined suitable for the intended WORK by the ENGINEER. Do not place imported fill until the ENGINEER has received the required submittals and determined if the proposed imported material is suitable for the intended construction.

   a. Deliver and place filter drain sand and gravel material to achieve a well graded filter.

5. Density

   a. Embankment material (except for granular free-draining material): Place compacted fill in maximum 8-inch loose layers and compact by rolling and tamping to a minimum of ninety-five percent (95%) of maximum dry density as determined by ASTM D 698 or AASHTO T 99 (Standard Proctor). Lift thickness shall be varied as necessary to achieve the specified density results. Refer to Sub-Section 3.03, A, 7, "Moisture Control" below for moisture control requirements.

   b. Granular material (including filter drain sand and gravel): Wet with water to the maximum extent possible and consolidate with one pass of the compactor used. Take care not to over-compact filter drain materials.

6. Soil Characteristics

a. Material shall generally be obtained from approved on-site borrow areas or required excavations. Material shall be free of sod, brush roots, other perishable material, and stones larger than 6 inches. Should any undesirable material be placed in the fill, it shall be removed prior to compaction. No frozen material shall be accepted or used.

b. Impervious Fill. The material shall be clay or silty clay Type CL, CH, CL-CH, MH, ML or SC according to the Unified Soil Classification System. Impervious fill is expected to consist of plastic clay and silt material meeting the following requirements:

1) Gradation:

Sieve Size	Percent Passing
6-inch	100
No. 200	≥ 50 of the Minus No. 4 fraction

Materials meeting the impervious fill requirements are found in designated Borrow Areas. The preferred borrow area as shown on the drawing is designated as the primary source of fill material. Other borrow areas shall be developed only in the event that a sufficient quantity of suitable material cannot be obtained from the preferred borrow area, as determined by the Engineer. The designated borrow areas consist of clays and silts with some rock. It is believed that the material is relatively easily excavatable but that some oversize rock will be encountered. It is the responsibility of the bidders to make their own evaluations of borrow area conditions and expected excavation conditions.

c. The maximum particle size of material allowed for special compaction shall be 3-inches, with no particles larger than 3/4-inch being placed within 6-inches of foundations, concrete structures, pipes or other applicable project features.

7. Moisture Control. During the compaction operations the surface of the fill, and the material being placed shall be maintained within the moisture content range of plus or minus three percent (3)% from the Optimum Moisture Content as determined by ASTM D 698 or AASHTO T 99. As much as practicable, Earthfill materials may be moisture conditioned prior to placement on the intended fill areas. Supplementary water may only be added on the fill area as directed by the ENGINEER. Water for moisture conditioning may be obtained from the reservoir as available. It is recognized that, due to the fine-grained nature of the borrow material, the amount of moisture that can be added to

borrow material may be limited. Any addition of supplementary water shall be thoroughly and uniformly blended with the earthfill material by means of harrowing, disking, chiseling or other blending methods acceptable to the ENGINEER. Earthfill material determined to be overly wet shall be dried by harrowing, disking, chiseling or other scarifying means acceptable to the ENGINEER. Overly wet material which cannot be sufficiently dried to meet the specified limit by the methods described above shall be removed from the fill area. Refer to Sub-Section 3.03, A, 5, "Density" above for density control requirements.

8. Placement

   a. Maintain the foundation and/or earthfill surface free of water or unacceptable materials. A positive drainage grade shall be maintained on fill surfaces to prevent the ponding of water and to facilitate precipitation runoff. Prevent surface water from running into filter drain material after before and after placement by maintaining interceptor berms and drainage swales.

   b. The distribution of material throughout the fill shall be such that there will be no lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material in the fill. After placement, spread the fill materials by approved equipment in layers before compaction of not more than 8 inches.

   c. Material placed by dumping in piles or windrows shall be moved and spread by blading or other approved methods.

   d. Earthfill material shall not be placed upon frozen surfaces or coverings of snow and/or ice.

   e. Compacted fill shall not be placed against a slope steeper than one horizontal to one vertical unless otherwise shown on the plans or approved by the ENGINEER. Do not place fill upon frozen surfaces or coverings of snow and/or ice.

   f. Sloping contact surfaces between existing embankment and new embankment or between excavated slope surfaces and replacement embankment shall be thoroughly bonded together. Bonding shall be accomplished by scarifying the existing material or slope surface a minimum of one-foot with each lift or layer of new material placed or by benching into the slope as directed by the ENGINEER. Benching shall consist of creating stair-steps in the excavation slope. The height of each step shall be equal to the lift thickness. The existing material shall be moisture conditioned and blended with the new material being placed to form a homogeneous mixture of the two which is at or near optimum moisture content. Compaction equipment shall be operated as close as is practicable to and/or run onto the existing embankment or slope

so that compactive effort is uniformly applied to both the new and existing surfaces, creating a sound bond. All contacts between each lift or layer and all sloping bonding surfaces will be treated in such a manner.

g. It is very important that the construction be performed in such a way that soil, rock or debris be prevented from rolling down the slope toward the outlet plunge pool and possibly damaging the exposed end of the outlet pipe. Therefore, the CONTRACTOR shall take all necessary measures to protect the exposed portions of the outlet pipe.

h. All oversize rock shall, as much as practicable, be removed at the site of the borrow source. Any remaining oversize material shall be removed during placement on the embankment prior to compaction. Oversize material shall be placed at the toe of the embankment, on the upstream slope of the dam or in the spillway channel as directed by the ENGINEER.

i. In areas where filter sand or gravel is to be placed underneath pipes, fittings, valves and other irregular surfaces, the pipe or other component shall be temporarily supported so that there is an underlying space of at least 3 inches. The filter sand or gravel shall be fully saturated (or as much so as feasible) prior to, and during, placement. Initially, the sand or gravel shall be mounded on one side of the pipe or other item only. The sand or gravel shall then be mobilized by light vibration, mechanical rodding or other adequate means such that it migrates under the pipe so that there is complete and uniform contact between the pipe or other item and the sand, from the bottom of the pipe to at least 1/4 of the diameter of the pipe on the side that the sand or gravel was originally mounded on. Subsequently, the same process shall be used to place sand or gravel under the pipe from the opposite side. The purpose of this method is to assure that the sand or gravel is placed in a manner that assures full uniform contact with the entire external surface of the pipe or other item such that there are no voids in the sand/gravel or gaps in the sand/gravel-pipe contact surface. Care shall be taken not to over-consolidate the sand or gravel and to prevent segregation of filter materials during placement. This WORK shall be performed only under the full and continuous direction of the ENGINEER. Only the minimum amount of vibration, rodding or other effort shall be applied to accomplish the final results. Placement of sand or gravel around other portions of pipes and irregular or abrupt surfaces shall follow a similar procedure to assure full uniform contact without voids or gaps. Pipe and other items shall be restrained against movement during placement and consolidation of the sand.

9. Compaction

a. General Embankment. After each layer of material has been placed, spread, and the required moisture content obtained, compact by passing compaction equipment over the entire layer until the specified density is achieved. If, in the opinion of the ENGINEER the surface of the prepared foundation or the compacted surface of any layer of earthfill is too dry or smooth to bond properly with the layer of material to be placed thereon, it shall be moistened and/or worked with harrow, disc, chisel, or other suitable scarifying equipment, in an approved manner to a sufficient depth to provide a satisfactory bonding surface before the next succeeding layer of earthfill material is placed. Additionally, if, in the opinion of the ENGINEER, the compacted surface of any layer of earthfill material in place is too wet for the proper compaction of the layer of earthfill to be placed thereon, it shall be removed and allowed to dry; or be worked with harrow, disc, chisel, or other suitable scarifying equipment to reduce the moisture content to the required amount. Following the drying or scarifying period, the material shall be recompacted before the next succeeding layer of earthfill material is placed.

b. Compaction Equipment. The specific type of equipment used for compaction of general earthfill embankment material is left to the discretion of the CONTRACTOR, subject to the prior approval of the ENGINEER. Prior to starting work, the CONTRACTOR shall provide information regarding dimensions, weight, and compactive energy of the compactors proposed for use on the project. It is the responsibility of the CONTRACTOR to assure that the proposed compactors are suitable for the work and will provide the specified results.

c. During compaction, the compaction equipment passes shall be staggered to ensure that all the material has received the required compactive effort such that the density is essentially uniform throughout the layer. At no time shall the compaction equipment travel back and forth over the same tracks on consecutive passes unless directed by the ENGINEER.

d. Special Compaction

    1) General. Special compaction methods shall be incorporated in areas shown on the Drawings or as directed by the ENGINEER. In general special compaction shall be provided when placing the initial layers of earthfill materials over project features which require complete bonding between the fill and the surface of the feature, to protect project features from possible damage resulting from the operation of conventional compaction equipment and to provide a method of compaction in confined or limited access spaces.

2) All materials specially compacted shall meet the previously specified material requirements, as modified herein and shall be free from all rubbish, large stones, clods and frozen particles and shall be suitably moisture conditioned prior to placement and compaction. Special compaction will be required to install the filter drain pipe, extend the outlet pipe, cover the drain filter material, and backfill the excavation. Special compaction shall extend at least 2 feet from pipes, structures, etc. or as shown on the drawings.

3) Execution. The maximum particle size of material allowed for special compaction shall be 3-inches, with no particles larger than 1-inch being placed within 6-inches of foundations, concrete structures, pipes or other applicable project features. The moisture content of specially compacted backfill, prior to and during compaction shall be distributed uniformly throughout each layer of the material. The material shall be brought to the specified moisture content prior to placement. Supplementary water, if required, shall be added to the material by sprinkling and shall be mixed uniformly throughout the layer prior to compaction. Properly moisture conditioned material shall be placed in 4-inch loose layers and compacted to the specified density with the use of mechanical hand tampers, walk behind rollers or other approved methods. Specially compacted material shall be placed and compacted equally on both sides of conduits or other project features so as to prevent any displacement in the alignment of structures. Features around which specially compacted backfill is being placed shall be adequately braced to prevent changes in alignment, displacement or other disturbance to the applicable feature.

B. Finish Grading:

1. Perform finish grading for smooth transition between lines. Grades shall be free of abrupt or irregular changes.

2. Blading and Shaping. Blading and shaping of all areas including exhausted borrow areas shall consist of grading along existing contours by filling low areas and removing high spots. Finished surfaces shall be graded to drain, free of abrupt or irregular surface changes, be generally smooth and pleasing in appearance with minimum 2 percent slopes and erosion protection placed in areas as required to provide protection from surface erosion during runoff. In general the sloped surfaces of exhausted borrow areas shall be shaped on a maximum 2.5:1.

C. Disposal of Waste Material: Waste material, excluding removed trees and grubbed debris, generated at the dam site and determined by the ENGINEER to be suitable clean shall be wasted in the designated borrow area, outside of the roadway traveled

surface, as directed by the ENGINEER. The CONTRACTOR shall shape the final surface contours in the designated borrow area to conform to the roadway and bank and surrounding terrain and to provide un-obstructed surface drainage without steep drainage paths or pools. Waste material determined to be unsuitable shall be removed and disposed of as directed by the ENGINEER in a responsible manner and in accordance with all State, Local and Federal Regulations and requirements. All waste sites and borrow areas shall be graded to provide drainage as well as a pleasing final appearance, as determined by the ENGINEER. Suitable stripping waste material shall be re-spread over the surface of the completed borrow slopes, to a minimum depth of 6-inches, to facilitate seeding of these areas.

End of Section

SECTION 329219

SEEDING AND MULCHING

DESCRIPTION PAGE

SECTION 329219

SEEDING AND MULCHING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to complete the WORK of the noted Sections of this Division described herein and on the drawings.

1.02 WORK INCLUDED

A. The WORK shall include, but is not necessarily limited to, preparation, fertilizing, seeding and mulching.

B. Specific areas covered by this Section include, but are not limited to the areas disturbed by borrow and embankment excavation, fill, haul and access roads, staging areas, etc.

D. All WORK shall be performed in accordance with the applicable stipulations of the Forest Service Permits (see Section 010000 General Requirements)

1.03 SUBMITTALS

A. All submittals shall be submitted to the ENGINEER at least 10 days prior to initiation of the portion of the WORK in which the items are to be used. The items shall not be installed, applied or otherwise used in the WORK until the ENGINEER has so approved.

B. Submit seed certification tags showing:

1. Name of seed species/variety for all seeds in the mixture.
2. Lot number.
3. Net Weight.
4. Percentage of purity and of germination (in case of legumes, percentage of germination to include hard seed).
5. Percentage of maximum weed seed content.
6. Noxious weed free.

C. Manufacturer's data sheet, descriptive literature, MSDS, and recommended methods of application for the fertilizer to be used.

D. Manufacturer's data sheet; descriptive literature; quality and testing certifications (as applicable) including overall weed content, noxious weed free certification and chemical composition for the proposed mulch to be used.

PART 2 - PRODUCTS

2.01 FERTILIZER

A. Fertilizer shall be of a standard commercial grade. Fertilizer shall be furnished in new, clean, and sealed containers with the name, weight, and guaranteed analysis of contents clearly marked. Fertilizer failing to meet the specified analysis may be used, subject to the approval of the ENGINEER, providing sufficient materials are applied to supply the specified nutrients without additional cost to the OWNER.

B. A liquid form of fertilizer containing the minimum percentage of available nutrients may be used.

C. The fertilizer shall have the following percentages of nutrients:

Chemical	Percentage
Nitrogen	20%
Phosphoric Acid (from Ammoniated phosphate)	46%
Potash (Potassium)	5%

D. The application rate shall be 50 pounds per acre.

2.02 SEED

A. Seed shall meet the requirements of Federal Specification-JJJ-S-181 and shall be certified and blue tagged.

B. Legume seed shall be inoculated with approved cultures in accordance with the instructions of the manufacturer.

C. Seed shall be furnished separately or in mixture in standard containers identified with:

1. Name of seed species/variety for all seeds in the mixture.
2. Percentage of each species/variety for all seeds in the mixture.
3. Lot number.
4. Net Weight.

5. Percentage of purity and of germination (in case of legumes, percentage of germination to include hard seed).

6. Percentage of maximum weed seed content.

7. Certified noxious weed free.

D. The seed shall be applied at a rate of 20 pounds of PLS (pure live seed) per acre and have the following mix:

Species/Variety	Percentage
Slender Wheatgrass (Agropyron trachycaulum)	21%
Mountain Brome (Bromus carinatus)	43%
Canby Bluegrass (Poa canbyi)	21%
Cicer milkvetch (Astragulus cicer)	15%

2.03 MULCH

A. Wood Chips shall be obtained from green hardwood. They shall be 1/8 inch nominal thickness with 50 percent having an area of not less than 1 square inch, and not more than 6 square inches. All wood chip mulch shall be free of leaves, twigs, shavings, bark, or materials injurious to plant growth. Wood chips from elm trees will not be used when State or Federal regulation prohibits such use, or when the source trees were diseased.

B. Straw for mulching shall be from grain crops that are free from noxious weeds, mold, or other objectionable material. Straw mulch shall be in an air-dry condition and suitable for placing with mulch blower equipment. Straw shall be certified free from noxious weeds.

C. Grass hay shall be of approved herbaceous mowings, free of noxious weeds, mold, or other objectionable material. Grass hay shall be in an air-dry condition and suitable for placing with mulch blower equipment. Grass hay shall be certified free from noxious weeds.

D. Natural wood cellulose fiber mulch shall be produced from clean, whole-wood chips and have the property of dispersing readily in water. The material shall readily blend with water, grass seed, fertilizer, and other additives to form a homogeneous slurry or mixture capable of application with power spray equipment. A colored dye that is noninjurious to plant growth and that fades rapidly with exposure to light may be used. Wood cellulose fiber shall be packaged in new, labeled containers in an air-dry condition. The material shall contain no weed seed and shall be heat-processed to eliminate factors that inhibit growth and germination. Natural wood cellulose fiber shall be certified free from weeds. The material

shall have no toxic effect when combined with seed or other materials and shall have the following physical and chemical properties:

Moisture Content	7-13%
Organic Matter (oven-dried basis)	99.1% maximum
Ash Content	0.9% maximum
pH @ 3% Concentration	4.7 to 7.0
Water-Holding Capacity	200% by weight on oven dry basis

E. Sawdust shall be obtained from wood that has not been subjected to conditions that would cause the sawdust to lose its value or usefulness as a mulch. Sawdust shall not contain any toxic substances and shall be aged.

F. Peat moss shall be a granulated sphagnum peat moss nearly free of woody substances consisting of at least 75 percent of partially decomposed stems and leaves of sphagnum and essentially brown in color. The texture may vary from porous fibrous to spongy fibrous and shall be free of stones, and mineral matter. Peat moss shall be in an air-dry condition, show an acid reaction of 3.5 pH to 5.5 pH, and meet State and Federal regulations.

G. Peat humus shall be natural peat or peat humus from fresh water-saturated areas, consisting of sedge, sphagnum, or reed peat and be of a physical condition that will pass through a 1/2-inch mesh screen. The humus shall be free of sticks, stones, roots, and other objectionable materials. Freshly excavated peat, if saturated with water, shall be stored for a sufficient length of time to condition it for workability. Samples taken at the source of supplies shall have the following characteristics when analyzed:

Acidity Range	4.0 to 7.5 pH
Minimum Water Absorbing Ability	200% by weight on oven-dry basis
Minimum Organic Content	60% when dried at 105°C

H. Natural or cooked straw (grass processed to remove seed) cellulose fiber shall have the property of dispersing readily in water and shall have no toxic effect when combined with seed or other materials. The processed fiber shall contain no growth inhibiting factors or weed seed. Straw cellulose fiber shall be certified free from weeds. The homogeneous slurry or mixture shall be capable of application with power spray equipment. A green colored dye that is noninjurious to plant growth may be used. The fiber shall be packaged in new, labeled containers, shall be of uniform weight (plus or minus 5 percent) in an air-dry condition, and shall bear the name of the manufacturer and the air-dry weight content. The fiber shall meet the following characteristics when tested:

Acidity Range	6.5 - 7.5 pH
Moisture Content (Packaged Fiber)	8 - 12%
Organic Matter	90.0 - 100.0%
Ash Content	0.0 - 10.0%

2.04 WATER

A. Water used in the planting or care of vegetation shall be free of oils, acids, alkalis, salts, or any substances injurious to plant life. Water sources shall be approved by the ENGINEER.

PART 3 - EXECUTION

3.01 GENERAL

A. Ground preparation and topsoil application shall be in accordance with Section 312219, "Finish Grading and Soil Preparation"

B. Seeding materials shall not be applied during windy weather or when the ground is excessively wet or frozen. Work shall be performed during each specified seeding season.

C. The CONTRACTOR shall be responsible for protecting and caring for seeded areas until final acceptance of the entirety of the project WORK. The CONTRACTOR shall repair all damage to seeded areas caused by his construction operations without additional compensation.

3.02 SEED

A. Hydraulic Method

1. The seed or seed and fertilizer shall be mixed with water in the amounts and mixtures specified to produce a slurry and then applied under pressure at the rates specified. When wood cellulose or grass straw cellulose mulch materials are to be incorporated as an integral part of the slurry mix, they shall be added after all other materials have been thoroughly mixed in the tank.

2. Legume seed shall be inoculated with approved cultures in accordance with instructions of the manufacturer. The inoculum used for hydraulic seeding shall be four times that recommended for dry seeding.

B. Dry Method

1. Mechanical seeders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other approved mechanical seeding equipment shall be used to apply the seed or seed and fertilizer.

2. Fertilizer in dry form shall be incorporated in one operation to the required depth on those areas requiring seeding.

3. Hand-operated seeding devices may be used when seed, fertilizer, and ground limestone are applied in dry form.

3.03 MULCH

A. Hydraulic Method

1. Wood cellulose or grass straw cellulose fiber mulch and fertilizer may be applied in one operation by means of hydraulic equipment that uses water as the carrying agent. A continuous agitation action that keeps the materials in uniform suspension must be maintained throughout the distribution cycle. The discharge line shall provide an even distribution of the solution to the seedbed. Mulching shall not be done in the presence of free surface water. Application shall start at the top of the slopes and work downward. If necessary, the use of extension hoses may be required to reach the extremities of slopes. The rate of application shall be at 1,000-pounds per acre.

B. Dry Method

1. Mulch shall be applied after seeding and fertilizing are completed, unless otherwise specified. The mulch shall be applied uniformly at a rate of 4,500-pounds per acre.

2. When a binder is to be used for mulch, the material shall be applied at a rate of 350-pounds per acre. It shall be immediately distributed evenly over the mulch. The CONTRACTOR shall prevent asphalt adhesive materials from marking or defacing structures, appurtenances, pavements, utilities, or plant growth.

End of Section

SECTION 330130.16

CAMERA INSPECTION OF PIPELINES

DESCRIPTION PAGE

SECTION 330130.16

CAMERA INSPECTION OF PIPELINES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the camera/video inspection of pipelines. A video inspection shall be performed after cleaning the pipe but prior to lining. A second video inspection shall be performed after the pipe liner has fully cured. A video shall also be performed of the drain pipe after completion.

1.02 SUBMITTALS

A. At least 10 days prior to starting the work the CONTRACTOR shall provide the following:

1. A detailed description of the equipment which will be used and the procedure which will be followed (including any proposed deviations from the project documents). The equipment description shall include the make and model of the camera, the lens field of view, the vertical and horizontal articulating range of the camera lens, the size and intensity of the lighting system, the means to record time and location, the type of camera undercarriage, the means to center the camera in the pipe, the type of camera propulsion, etc.

2. The inspection log form to be used.

B. Within 48 hours of performing the WORK the CONTRACTOR shall provide one copy of the digital image file, digital logs and printed logs (as applicable) to the ENGINEER. Unless otherwise approved video images which include audio shall be MPEG-4 format. Still images shall be JPEG format. Stand-alone audio files shall be MP3 format. Text files shall be .txt format.

1.03 EQUIPMENT

A. Unless otherwise approved, cameras shall include the following capabilities.

1. The camera shall include a two axis articulated lens capable of swiveling a minimum of 180 degrees (90 degrees in both directions from the pipe axis) about the horizontal and vertical axes. Focal distance shall be adjustable through a range of one (1) inch to infinity. The camera shall be color format and specifically designed and constructed for operation in connection with pipeline

inspection, and for operation in 100% humidity as well as temporarily submerged conditions. Lighting and camera quality shall produce a clear, in-focus picture of the entire periphery of the pipe for a minimum distance of six feet. The camera system shall include all required accessory equipment including undercarriage, centralizers, monitor, cables, power sources, lights, and other equipment necessary to complete the WORK.

2. The camera, including supporting undercarriage, shall be of sufficient size to be capable of travelling the entire length of the pipe without interference from the interior circumference of the pipe. The camera undercarriage shall include a means to adjust the height of the camera such that the camera lens will be approximately in the center of the pipe. The camera transport mechanism shall be capable of transporting the camera through at least 3 inches depth of mud, gravel or other debris and able to traverse the entire length of the pipe from one end.

3. Capable of recording both video and still images. The camera shall have sufficient on-board digital storage to record a minimum of three times the expected time required to perform the inspection.

4. Audio recording capability at the camera.

5. A remote monitor on which the real-time camera image can be viewed and shall have audio recording capability at the monitor which shall over-ride the camera audio.

6. A means of determining the camera location based on distance from the camera insertion end of the pipe. The distance measurement means shall be accurate to 0.10 foot. Unless otherwise approved, this distance shall be automatically recorded on the image.

7. A means of determining the time (in hours, minutes and seconds) since camera insertion into the pipe. Unless otherwise approved, this time shall be automatically recorded on the image.

PART 2 – MATERIALS (Not Used)

PART 3 – EXECUTION

3.01 GENERAL

A. Prior to camera inspection, all flowing water in the pipeline shall be stopped either by tightly closing and sealing an upstream valve or by diverting water around the pipe in accordance with Section 357313.20 "Diversion and Care of the Stream". Where required by the ENGINER, standing water due to obstructions or sags in the pipeline shall be removed prior to initiating the inspection such that the depth of flow does not exceed 20 percent of the inside pipe diameter.

B. The WORK shall be only be performed in the presence of the ENGINEER.

3.02 CAMERA INSPECTION

A. The camera shall be moved through the pipeline in both directions at a uniform rate, stopping when necessary to ensure proper documentation of the pipe condition. In no case shall the camera be pulled or propelled at a speed greater than thirty (30) feet per minute. The camera height shall be adjusted such that the camera lens is always approximately centered in the pipe being inspected. Unless otherwise approved by the ENGINEER, footage measurements shall begin at the camera insertion end of the pipe. The digital video file, audio file and other documentation shall be identified (digitally as part of the digital video or audio file) with the job identification, pipe diameter, pipe length, camera technician name and company, and date of inspection.

B. If the recordings are of such poor quality due to inadequate camera and inspection procedures (blurry, out of focus, lack of detail, etc.) that the ENGINEER is unable to adequately evaluate the condition of the pipe, or verify cleaning, the CONTRACTOR shall re-inspect the pipeline and provide a new recording of good quality at no additional cost to the OWNER. No payment will be made for recordings that do not meet the requirements of these specifications.

C. Video inspection logs furnished by the CONTRACTOR shall be typewritten on a log format that has been pre-approved by the ENGINEER.

End of Section

SECTION 330130.41

CLEANING OF PIPELINES

DESCRIPTION PAGE

SECTION 330130.41

CLEANING OF PIPELINES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the cleaning of pipelines. Cleaning in this section is defined as the removal of all accumulations including sludge, dirt, sand, rocks, grease, roots, loose mineral and oxidation scale and other solid or semisolid material in the pipe and on the pipe interior down to the parent material. In the case of partially deteriorated pipe, care shall be taken not to increase the amount of damage to the existing pipe due to cleaning efforts.

1.02 SUBMITTALS

A. At least 10 days prior to starting the WORK the CONTRACTOR shall provide a cleaning plan which includes a detailed description of how the existing pipe will be cleaned, prepared and flushed. Include the tools to be used; equipment capabilities (hose length, trailer or truck mounting, water tank, pump model and ratings, etc.), available nozzle styles, water pressures to be applied; the proposed jetter pump staging location; procedures to be used; precautions which will be taken to prevent damage to the pipe (including damage to existing rivets and other fasteners or joining devices, enlarging existing holes, etc.); efforts to assure that the pipe will be thoroughly cleaned of debris, soil, loose scale, and other loose material; etc. No WORK shall be performed prior to the ENGINEER'S approval of the cleaning plan.

1.03 EQUIPMENT AND MATERIALS

A. If appropriate, consideration shall be given to use of a cleaning tool (e.g. brush, porcupine, scraper, etc.) prior to flushing or jetting. The type of cleaning tool shall be selected based on the type of pipe, pipe wall thickness, extent of deterioration, fasteners or protrusions into the pipe, etc.

B. The equipment shall have a sufficient length of high pressure hose to reach from the jetter pump staging area to the end of the pipe and completely through the full length of the pipe. A selection of two or more high velocity nozzles shall be available on-site. Nozzles shall be capable of producing a scouring action from 15 degrees to 45 degrees in the project pipe sizes. All controls shall be located so that the equipment can be operated above ground and preferably so that the equipment

can be operated remotely from the insertion end of the pipe. Equipment shall include a high-velocity gun for washing and scouring discharge areas and external portions of exposed pipe. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall include a water tank.

C. Unless otherwise authorized or directed by the contract document or by the ENGINEER, no corrosive, caustic, sanitizing or other chemicals shall be used in the jetting water.

PART 2 – MATERIALS (Not Used)

PART 3 – EXECUTION

3.01 GENERAL

A. The WORK shall be only be performed in the presence of the ENGINEER.

B. Care shall be taken not to increase the amount of damage to the existing pipe due to cleaning efforts. Appropriate tools, water pressures, etc will be used to avoid damaging existing rivets and other fasteners or joining devices, enlarging existing holes, or otherwise increase the amount of pipe deterioration.

3.02 PIPELINE CLEANING

A. Cleaning tools shall be pulled or pushed through the full length of the pipeline in both directions as specified in the approved cleaning plan.

B. After application of the cleaning tool (if any), debris remaining in pipeline shall be cleaned and flushed using a high velocity jetting cleaner run in both directions (entering and exiting) of the pipeline.

C. If, in the opinion of the ENGINEER, the post-cleaning camera inspection indicates that additional cleaning is required, all, or part of the cleaning WORK shall be repeated.

End of Section

SECTION 357313.09

PIPE, VALVES AND FITTINGS

DESCRIPTION PAGE

SECTION 357313.09

PIPE, VALVES AND FITTINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to complete the WORK of the noted Sections of this Division described herein and on the drawings.

1.02 WORK INCLUDED

A. Specific Work covered by this section includes, but is not limited to the following items:

1. Furnishing and installation of the combination PVC/galvanized steel drain at the bottom of the diaphragm drain including threaded slotted PVC pipe, solid PVC pipe, solid galvanized steel pipe and all appurtenant elbows, fittings, connecting hardware and all other items required to provide a completed installation.

2. Furnishing materials for and construction of the PVC outlet pipe extension including the repair coupling.

1.03 SUBMITTALS

A. All submittals shall be submitted to the ENGINEER at least 10 days prior to initiation of the portion of the WORK in which the items are to be used. The items shall not be installed, applied or otherwise used in the WORK until the ENGINEER has so approved.

B. Manufacturer's descriptive literature and recommended methods of installation for the slotted PVC pipe.

C. Manufacturer's data sheet, descriptive literature and recommended methods of installation for the repair coupling.

D. Manufacturer's data sheet, descriptive literature, MSDS, and recommended methods of application for the primer and paint to be used on exterior surfaces of PVC pipe.

1.04 OWNER'S QUALITY ASSURANCE

A. All pipe and filter drain installations will be inspected by the ENGINEER. The CONTRACTOR shall advise the ENGINEER at least 5 days prior to when pipe laying operations are to be performed. No pipe shall be installed without the ENGINEER's approval of foundation or bedding preparations. Likewise no pipe shall receive final backfill without the ENGINEER's approval of the pipe installation.

PART 2 - PRODUCTS

2.01 PVC PIPE

A. Pipe and fittings shall be made from Class 12454-A or 12454-B virgin compounds in accordance with ASTM D 1784.

B. Joints:

1. No pipe joints shall be allowed for the outlet pipe extension.

2. Bell and Spigot: Pipe joints, complying with ASTM D 3139, shall be made using an integral bell with an elastomeric gasketted push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint. Rubber ring gaskets shall conform to ASTM F 477. Adequate gasket lubricant shall be furnished for all of the pipe and fitting connections.

3. Solvent Weld: The joints shall meet the requirements of ASTM D 2672.

C. Schedule PVC Pipe: Schedule pipe requirements shall meet ASTM D 1785 using PVC 1120, 1220 or 2120. Schedule 40 pipe shall be provided for the outlet pipe extension and the filter drain. Socket type fittings for solvent welded joints shall conform to ASTM D 2467 for Schedule 80, ASTM D 2466 for Schedule 40 and ASTM D 2464 for the threaded type. The solvent cement shall comply with ASTM D 2564.

D. Perforated (Slotted) PVC Pipe: Slotted perforations shall be uniformly spaced and clean cut and the pipe shall be slotted over its entire length as shown on the drawings. The fittings for perforated pipe shall not be perforated. Perforations shall consist of at least three rows of slots .010-inch to .090-inch wide by at least 1.5-inches long on a maximum of 0.25-inch centers, the rows shall be parallel to the axis of the pipe and 120° apart for three rows or 90º for four rows. The slotted pipe shall be slotted for its

full length with a minimum slot open area of 8 square inches per foot of length. Slotted pipe shall be machine slotted.

2.02 PROTECTIVE PVC PAINT

A. All PVC pipe which will be permanently exposed to sunlight shall be painted with two coats of UV resistant paint designed for use on exterior PVC. Paint selection, shall be in accordance with "PVC Painting Guide, a Formufit Field Manual" (www.formufit.com/html-how-to-paint-PVC-pipe/). PVC paint shall be approved by the ENGINEER prior to use.

2.03 GALVANIZED STEEL PIPE

A. Galvanized Steel Pipe shall be schedule 40 or heavier conforming to ASTM A53/A53M-99b, thoroughly zinc coated (galvanized) inside and out. Unless otherwise indicated on the drawings, the pipe shall be threaded. Couplings, flanges and other fittings shall be rated for 125 psi or greater.

2.04 REPAIR COUPLING

A. The repair coupling which is used to join the new PVC outlet pipe extension to the existing riveted steel pipe shall meet the requirements of AWWA C219 and shall be compatible with both the existing pipe and the new extension pipe. The sealing (gasketted) inside diameter shall be large enough to freely slip over the outside diameter of both mating pipes and shall have a tightening range of at least 0.5". The rated working pressure shall be at least 125 psi. The body shall be epoxy coated inside and out. Tightening bolts shall be stainless steel.

2.05 BEDDING AND BACKFILL

A. Pipe bedding and backfill in contact with the pipe shall be free from all rock larger than 3/4".

PART 3 - EXECUTION

3.01 HANDLING

A. Haul and handle the pipe in a manner that will avoid damage. Remove any damaged pipe from the project site and replace. Pipe shall not be repaired for installation unless otherwise approved by the ENGINEER.

3.02 ALIGNMENT

A. Alignment of the pipe shall be maintained to the specified lines and grades established by the ENGINEER during construction or as otherwise shown on the Drawings.

3.03 PLACEMENT

A. Lay pipe with spigot ends directed down-grade unless otherwise directed. Lay pipe, fittings and accessories with proper equipment and in a manner to prevent damage.

B. Any defective pipe materials found during inspections shall be replaced prior to placing within the trench or work area.

C. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position. Pipe shall be kept clean during and after completion of laying.

D. Clean the sealing surfaces of the pipe immediately before assembly, and assembly shall be made as recommended by the manufacturer. Check the completed piping to assure joints are intact.

E. All fittings and valves which will be exposed to soil or groundwater shall be encased in polyethylene sheeting in accordance with ANSI/AWWA C105/A21.5. Sheeting shall be minimum 10 mil thickness. These items shall include the repair coupling used to extend the outlet pipe.

F. The highly corroded downstream end of the existing pipe shall be removed by saw-cutting in such a manner that the remaining pipe end is as smooth and square to the axis of the pipe as possible. The length of pipe to be removed will be determined on-site as the pipe is uncovered.

G. The cut end of the existing outlet pipe shall be prepared to receive the repair coupling by exposing a sufficient length of the end of the pipe and removing all rust, scale, encrustations, protrusions, deposits, mud, surface roughness, rivet heads, etc. by grinding, wire brushing and/or other means to provide a surface which is as smooth and uniform as possible to assure a positive gasket seal between the repair coupling and the pipe.

H. The repair coupling shall be installed in accordance with the manufacturer's recommendations. Particular attention shall be paid to bolt lubricating and tightening recommendations to prevent galling of stainless steel bolts. Unless anti-galling bolts are used, the bolts shall be lubricated with an approved anti-seize/anti-galling copper compound prior to assembly.

I. All PVC pipe which will be permanently exposed to sunlight shall be painted with two coats of UV resistant paint designed for use on exterior PVC. Pipe preparation, substrate treatment, priming and application shall be in accordance with "PVC Painting Guide, a Formufit Field Manual" (www.formufit.com/html-how-to-paint-PVC-pipe/). The paint shall also be applied as recommended by the manufacturer including surface preparation, priming, application, and curing.

End of Section

SECTION 357313.10

OUTLET PIPE LINING

DESCRIPTION PAGE

SECTION 357313.10

OUTLET PIPE LINING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes rehabilitation of pipe lines by methods using access to one or both ends.

1. Utilize trenchless methods.
2. Excavations are not allowed except for shallow point repairs.
3. Reline finished, rehabilitated line with continuous tight-fitting, watertight liner extending over entire length specified.

B. Related Sections: Refer to the following sections for related work:

1. Division 31, “Earthwork”.
2. Section 330130.16, “Camera Inspection of Pipelines.”
3. Section 330130.41 "Pipe Cleaning"
4. Section 357313.20 "Diversion and Care of the Stream"

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM)

D543 Resistance of Plastics to Chemical Reagents

D578 Standard Specification Glass Fiber Strands

D638 Tensile Properties of Plastic

D790 Flexural Properties of Unreinforced and Reinforced Plastic and Insulating Materials

D1693 Environmental Stress Cracking of Ethylene Plastics

D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D2122 Standard 1 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D2444 Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D2990 Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

D3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D3350 Polyethylene Plastics Pipe and Fittings Materials

D3567 Standard Practice for Determining Dimensions of ‘‘Fiberglass’’ (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

D5813 Cured-In-Place Thermosetting Resin Sewer Pipe

F1216 Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe

F2019 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP)

1.03 DEFINITIONS

A. Deformed Polyethylene Liner: Polyethylene pipe manufactured in a deformed shape that reduces cross-sectional area for insertion and rehabilitation of nonpressure pipelines, conduits, and ducts.

B. Folded Poly (Vinyl Chloride) (PVC) Pipe: Pipe that has been manufactured in folded shape for use in existing conduit rehabilitation.

C. Cured-in-Place Pipe (CIPP): Hollow cylinder containing non-woven or woven material, or combination of non-woven and woven material impregnated with cured thermosetting resin. Plastic coatings may be included. This pipe is formed within the existing pipe, and takes the shape of and fits tightly to existing pipe.

D. Inversion: Process of turning resin-impregnated tube inside out by use of water steam or air pressure for CIPP.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements

1. Proposed liner material shall be inert to attack by the water carried by the pipe and suitable for use in underground environments.

2. Liner material shall be manufactured in such manner as to result in tight-fitting liner after installation. There shall be no measurable continuous annular space between outside diameter of new liner and existing host pipe.

1.05 SUBMITTALS

A. Shop Drawings: Submit shop drawings that identify locations and method of liner insertion, liner size, thickness, etc.

1. Submit for review by the ENGINEER at least 10 working days prior to start of WORK.

2. Submit water bypass plans and locations with sufficient detail to assure that WORK can be accomplished without water interference in accordance with Section 357313.20 "Diversion and Care of the Stream"

B. Product Data: Provide manufacturer's data for lining materials, preliners, sliding films, resins, sealing and caulking materials, grout, etc., including the following:

1. Manufacturer's certification that materials are in compliance with specifications, codes, and standards referenced herein.

2. Installation instructions and details of component materials and construction details, including complete manufacturer's recommendations for storage procedures and temperature control, handling and inserting liner, curing details, and trimming and finishing.

3. Manufacturer's certification, and pipe-sizing calculations which demonstrate that liner has been properly sized to avoid creation of wrinkles or folds.

4. Preliner or sliding film description, manufacturer, manufacturer splicing guidelines, etc.

5. Description and manufacturer's information of proposed inversion lubricant or other lubricants proposed for use including its compatibility with the liner materials, resins, water which will be carried, etc.

6. Resin manufacturer's heating requirements.

7. If the liner tube is wet out at a remote off-site facility, a certification shall be submitted by the wet out contractor (attached to the impregnated liner) including the following:

a. Date of wet out.

b. The wet out process used and the standards complied with.

c. Type and manufacturer of liner.

d. Type, manufacturer, trade name and lot number of resin.

e. Resin volume calculation and actual volume of resin used.

C. Samples: If requested by the ENGINEER, the CONTRACTOR shall submit at least 20 days prior to start of the WORK samples of the following items:

1. Pre-liner or sliding film: Provide sample and material test data, if pre-liner or sliding film is used.

2. Dry tube and/or inflation hose.

3. A minimum of 32 liquid ounces of unreacted liquid resin along with sufficient catalyst, resin enhancers and other co-reactants to mix and fully cure the liquid resin sample to the same component mixture as will be used in the WORK.

4. A rectangular cuboid sample of fully cured resin with a minimum volume of 1 cubic inch.

5. A rectangular sample (minimum 4 sq inches) of liner material (with the proposed thickness for the WORK) which has been saturated with the proposed resin (including enhancers and additives) and fully cured using the saturation and curing methods which will be employed in the WORK.

D. Measuring and Recording Instruments: Calibration certificates shall be provided for all equipment used to measure pressure, temperature or other process parameters. These certificates shall be within the last 12 months and shall be traceable to the National Institute of Standards and Technology.

E. Quality Control

1. Certificates: Certificates of compliance with design and test reports in accordance with applicable ASTM test methods.

2. Submit evidence acceptable to the ENGINEER, such as certified copy of license or agreement, that CONTRACTOR has authority from patent Owner to use and/or install patented equipment, materials or methods.

F. Lining Plan: Submit a lining plan which provides a detailed description of the materials to be used; equipment to be employed; the process to be used; anticipated schedule; contingency plans for possible problems; CONTRACTOR licensing, certification, experience with similar projects (list at least 3 projects with reference contact information), resume for field superintendent, crew size; and other pertinent information regarding the anticipated installation procedure and CONTRACTOR qualifications. The lining plan shall be approved by the ENGINEER and Colorado State Engineer, Dam Safety prior to starting any related work. As a minimum, the plan shall include the following information:

1. Identification of the resin manufacturer, proposed resin mix formulation, (including the resin and catalyst - if applicable) and resin trade name. Identify any proposed resin enhancers (such as bond enhancers, viscosity control agents, fire retarding agents, air release agents, pot life extenders, photo-initiators, etc.). For thermoset resins include data showing gel time (working time); pot life; cure-time versus ambient temperature which covers the proposed wet out, transportation, insertion and cure temperature ranges; and the expected maximum exothermic temperature. Specify the proposed cure temperature range. Specify the anticipated range of time required to achieve full cure within the range of possible cure temperatures (including at least 25 percent above and below the proposed cure temperature range), the proposed cool-down time period, the maximum allowable rate of curing medium temperature drop during the cool-down period, and the cool-down cutoff temperature. Identify the equipment and procedures which will be used to monitor the curing medium temperature and the exothermic temperature. Specify the desired resin/catalyst mixture ratio and acceptable mixture range. Specify the mix ratio range for any resin enhancers.

2. Identification of the liner manufacturer and the liner material. Provide the manufacturer's description, specifications and certifications for the liner material and liner fabrication process. Identify the minimum liner thickness both prior to and after cure. Identify any lubricants which will be used. Identify types, thicknesses, laminates, reinforcements, etc., of impermeable membranes and their relative juxtaposition such as inner layer, outer layer or both. Specify the strength of the saturated liner system for pulled-in-place installation systems.

3. Include a detailed description of how the existing pipe will be cleaned, prepared and flushed prior to liner insertion. Include the tools to be used; water pressures to be applied; procedures to be used; precautions which will be taken to prevent damage to the pipe (including damage to existing rivets and other fasteners or joining devices, enlarging existing holes, etc.); efforts to assure that the pipe will be thoroughly cleaned of debris, soil, loose scale, and other loose material prior to liner insertion; etc.

4. Describe the equipment and procedure which will be used to provide camera inspections prior to and after lining.

5. Provide a detailed description of the liner wet out process, the location where it will occur (if wet out is to occur on-site, identify the site area where it will occur and how much area will be required), how the liner will be transported to the site, temperature limitations during wet out and transportation, transportation time limitations, etc. Identify any equipment and procedures which will be used to monitor the liner temperature after wet out, during transportation and prior to curing. Provide a list of the equipment to be used in the wet out process. If wet out is to occur at the site; describe the equipment used and how the requirements of ASTM F1216 will be met; the proposed areas which will be used to layout the liner prior to, during and after liner saturation; measures which will be used to protect the liner from contamination, how the liner will be moved from the wet out area to the installation/inversion point, etc.

6. Identify any pipe preheating measures which will be used, the methods employed, the heating temperatures and the preheating time interval.

7. Provide a detailed description of the liner insertion method and equipment including whether a preliner or sliding film will be used, a description of the preliner or sliding film, whether the preliner or sliding film will be removed prior to curing, the pressurizing medium, expected temperature range of the pressurizing medium during insertion, the specific equipment to be used (e.g. shooters, inverters, winches, etc.), pulling force limitations and/or pressure limitations (minimum and maximum pressures), means which will be taken to protect the liner from damage during insertion, range of acceptable rates for liner insertion, etc.

8. Provide a detailed description of how the curing medium will be applied, a diagram of the medium circulation circuit, devices (such as packers) and methods which will be used to seal the ends of the liner during curing, the means used to monitor and adjust the curing medium pressure and temperature (in the case of thermoset resins), the range of pressures to be applied, the expected range of time required to achieve full cure under the allowed range of cure temperatures, etc. For thermoset resins, include calculations of the amount of heat necessary to add in order to maintain the curing medium within the desired temperature range during the curing period. Include in these

calculations the assumed pipe and soil heat sink temperatures. In the case of UV cure, include the required full-cure UV light exposure (e.g. milli-Joule/sq cm) for the proposed liner thickness, the required light source frequency and wave length to achieve resin curing, a description of the number, size, frequency, wave length and power of the UV lamps in the curing source (such as a light train); the calculated UV light intensity (e.g. milli-Watt/sq cm) which will be applied to the liner for the project pipe size; the required rate of travel for the UV light train (or other UV light source) to achieve full resin cure; measures which will be used to assure that the liner for both legs of the inlet elbow will be fully cured; etc.

9. List the anticipated final cured liner characteristics including (as a minimum) initial and long-term flexural modulus and flexural yield strength, initial and long-term tensile modulus and yield strength, and stiffness.

10. Describe methods and products which will be used to seal the ends of the liner to the pipe.

11. Quality Control and Quality Assurance measures which will be taken by the CONTRACTOR.

12. Any anticipated deviations from the requirements of the contract documents.

13. The CONTRACTOR is encouraged to include photos, diagrams, illustrations, etc. which will clarify aspects of the process, equipment and materials.

14. Identify measures which will be taken to overcome difficult access conditions to the site.

15. Provide a description of prior experience with similar work including at least 3 similar projects (similar in pipe size, length, site access, elevation, etc). This list of projects must include a contact reference person along with their contact information. Include a resume for the project field superintendent including work on similar projects and estimated number of feet of liner installed using similar processes, materials and liner sizes. Provide copies of manufacturer's training and certifications and licenses to perform the WORK described.

G. Material safety data sheets for all hazardous chemicals that will be used on the job site including resin, catalyst, resin enhancers, cleaners, repair agents, grouts, etc. Identify the proposed use for each hazardous chemical and where it will be stored and used in the WORK.

1.06 QUALITY ASSURANCE

A. Comply with these specifications and specific product manufacturer’s recommendations. Conflict between product manufacturer’s recommendations and any portion of Contract documents shall be resolved to the satisfaction of the ENGINEER prior to proceeding with WORK.

B. Manufacturer Qualifications: Products used in WORK shall be produced by manufacturers regularly engaged in manufacture of similar items, and with history of successful production acceptable to the ENGINEER.

C. Installer Qualifications: Licensed by lining system manufacturer, and have the following qualifications:

1. Thoroughly trained and experienced in necessary crafts. The job superintendent shall have experience with installation of at least 10,000 feet of liner using similar materials, processes and liner sizes to the WORK.

D. Field Samples: Field sampling procedures shall be in accordance with ASTM F2019 and D5813

1.07 DELIVERY, STORAGE, AND HANDLING

A. Exercise adequate care during transportation, handling, and installation to ensure liner material is not torn, cut, exposed to direct sunlight, environmental temperatures or other conditions that would cause unintended gelling or initiate curing of the resin, or otherwise damaged.

B. If any part or parts of liner material becomes torn, cut, or otherwise damaged before or during insertion, repair or replace at CONTRACTOR'S expense before proceeding further.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Liner Material: Provide light-colored or white liner to facilitate camera inspection. Finished liner shall be a single piece, continuous over entire length of pipe being lined without joints, overlaps or seams (except those resulting from the non-impregnated liner manufacturing process), homogeneous and free from visual defects such as cracks, holes, tears, blisters, foreign inclusions, pinholes, and delamination. The liner tube shall be capable of withstanding installation pressures and have sufficient strength to bridge missing pipe segments while meeting or exceeding the design wall thickness at all locations under installation conditions and pressures. Overlapping layers of liner material in longitudinal or transverse seams will not be allowed. Manufactured liner seams shall be at least as strong as the non-seamed material.

1. Cured-In-Place Liner: Comply with ASTM D5813 and F1216.

a. Resin-impregnated tube liner material shall consist of one or more layers of flexible needled felt, or equivalent woven or non-woven material with a minimum final cured thickness of 3 mm. Liner material shall be free from tears, holes, cuts, foreign materials and other surface defects. Fiberglass liners shall be non-corrosion (E-CR Glass) material. Glass fibers must extend in a longitudinal direction to insure no longitudinal stretching will occur during insertion.

b. Liner shall be capable of carrying resin, and withstanding installation pressures and curing temperatures.

c. Liner shall be able to stretch to fit irregular pipe sections and negotiate bends.

d. Liner shall have staggered longitudinal and circumferential joints between multiple layers of fabric so as not to coincide.

e. Liner shall be fabricated to a size so that when installed it fits tightly in the internal circumference and length of the pipe.

f. Resins shall be polyester or vinyl ester resin and catalyst system, or epoxy resin and hardener (if applicable) system that is compatible with the installation and curing process and with the liner material. The resin must be capable of curing in the presence and absence of water.

g. Liner shall have an impermeable plastic inner liner or outer liner film, or both for resin control. Inner/outer liners shall compatible with the resin system used and resistant to degradation by contact with resin components. Inner/outer liners which will remain a permanent part of the final cured system shall be an integral part of the fabric tube by bonding or fusing to the fabric tube. Interior liners shall consist of material which will not interfere with visual inspection. For UV cured resins, the outer liner or coating shall be impermeable to all wave lengths of light required for curing.

B. Liners fabricated from PVC, PE, or resin-impregnated tubes shall meet the following physical requirements:

Property	Test Method	Minimum Values			
		Fiberglass Liner With UV Cured Resin	Thermoplastic Systems	Polyester Resin Systems	Epoxy and Vinylester Resins
Corrosion Resistance	-	-	-	ASTM F1216 Section X2	Green Book Sec. 210-2.3.3
Flexural Modulus (Initial)	ASTM D790	725,000 psi (5,000 MPa)	136,000 psi (940 MPa)	250,000 psi (1720 MPa)	300,000 psi (2070 MPa)
Flexural Modulus (Long Term)	ASTM 2990	-	-	125,000 psi (860 MPa)	150,000 psi (1030 MPa)
Flexural Strength	ASTM D790	6,500 psi (45 MPa)	-	4500 psi (31 MPa)	5000 psi (34 MPa)
Tensile Strength (Yield)	ASTM D638	20,000 psi (140MPa)	3200 psi (22 MPa)	3000 psi (21 MPa)	4000 psi (28 MPa)
Tensile Modulus (Initial)	ASTM D638	1,100,000 psi 7,580 psi	-	300,000 psi (2070 MPa)	250,000 psi (1720 MPa)
Tensile Modulus (Long Term)	ASTM D638	-	-	150,000 psi (1030 MPa)	125,000 psi (860 MPa)
Impact Resistance	ASTM D2444[(1)]	-	210 ft-lb (29 m-kg)	-	-
Pipe Flattening	ASTM D3034[(2)]	-	60% deflection	-	-
Pipe Stiffness	ASTM D2412	-	15 psi (103 kPa)	-	-
Environmental Stress-Crack Resistance	ASTM D1693 Condition C	-	2000 hours	-	-

(1) Impact testing performed with 20 lb (9.1 kg) Tup A and flat plat holder B.

(2) Without cracking, breaking, or splitting.

C. Pre-Liner or Sliding Film Material: If used, the pre-liner or sliding film shall be manufactured from material capable of withstanding temperatures and pressures encountered during installation.

D. Lubricants: Lubricants used for inversion or other purposes shall be non-toxic, compatible with the liner and resin, shall not support the growth of bacteria and shall not adversely impact or react with the water being carried by the pipe.

E. Sealing and Caulking Materials:

1. The liner shall be sealed to the pipe at the ends of the pipe using one of the following sealing/caulking materials. Treated silicates (designed for crystal growth within concrete pores and passageways) which require activation reaction with concrete by-products are not permitted for sealing between the liner and pipe at pipe ends. These products which are not allowed include, but are not limited to, Aquafin, Ipanex, Kryton, Penetron and Xypex. Except as otherwise specified, hydraulic cements and quick-set cementitious products are not acceptable:

   a. The epoxy resin used for impregnating the liner.

   b. Epoxy adhesives.

   c. One or two part caulking sealants.

2. Epoxy adhesives for sealing or caulking shall be high modulus, moisture tolerant and specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics:

   a. Minimum 14 day tensile strength (ASTM D638): 2,000 psi

   b. Minimum 14 day tensile modulus of elasticity (ASTM D638): $3x10^5$ psi

   c. Maximum elongation at break (ASTM D638): 7%

   d. Minimum 2 day bond strength (ASTM C882): 1,000 psi

   e. Minimum 28 day compressive strength (ASTM D695): 4,000 psi

   f. Where low viscosity is specified the mixed viscosity shall be less than 500 cps.

3. Caulking shall be rated by the manufacturer for the depth of application, shall be moisture tolerant and specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics. Unless otherwise specified or indicated on the drawings, caulking material for depths greater than 1/2 inch shall be two components:

   a. Minimum 21 day tensile strength (ASTM D412): 80 psi

   b. Maximum 21 day tensile modulus of elasticity at 100 percent elongation (ASTM D412): 100 psi

c. Minimum elongation at break (ASTM D412): 400%

d. Minimum adhesion in peel applied to concrete substrate (ASTM C974): 20 lb

F. Grout: In locations where it is desirable, necessary or specified to fill depressions, voids, spaces, gaps, cracks, etc. with high strength rigid grout, the grout shall consist of one of the following as specified, shown on the drawings or directed by the ENGINEER:

1. Epoxy grout shall be high modulus, moisture tolerant and specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics:

   a. Minimum 14 day tensile strength (ASTM D638): 2,000 psi

   b. Minimum 14 day tensile modulus of elasticity (ASTM D638): $3x10^5$ psi

   c. Maximum elongation at break (ASTM D638): 7%

   d. Minimum 2 day bond strength (ASTM C882): 1,000 psi

   e. Minimum 28 day compressive strength (ASTM D695): 4,000 psi

   f. Where low viscosity is required or specified to flow into narrow or limited access passages, the mixed viscosity shall be less than 500 cps.

   g. For vertical and overhead applications the grout shall have a non-sag, paste consistency.

   h. For wide, easily accessible areas greater than 1/2" in depth approved mineral aggregate may be mixed with the epoxy grout (if allowed by the manufacturer) in proportions, and using methods, recommended by the manufacturer, subject to the approval of the ENGINEER.

2. Mortar grout shall be high strength, non-shrink grout meeting the requirements of ASTM C1107 specifically approved by the manufacturer for use in submerged and flowing water conditions, with the following characteristics:

   a. Minimum 28 day bond strength (ASTM C882): 1,000 psi

   b. Minimum 28 day compressive strength (ASTM D1107): 6,000 psi

   c. Where fluid consistency is required or specified to flow into narrow or limited access passages, a grout specifically formulated for fluid consistency shall be used.

   d. For vertical and overhead applications the grout shall have a non-sag paste consistency. Grout specifically formulated for fluid consistency shall not be used for these applications

PART 3 - EXECUTION

3.01 GENERAL

A. All WORK shall be performed in accordance with the approved lining plan.

3.02 EXAMINATION

A. Take field measurements of pipe inside diameter of pipes to be rehabilitated.

B. Based on measurements and the results of camera inspection of the pipe, determine the correct liner diameter and wall thickness to ensure tight fit with existing pipe to be restored.

C. Confirm lengths of liner to be installed.

3.03 PREPARATION

A. Successfully complete the following items before installation of WORK.

1. Control stream flow so that the lining WORK will be performed in the dry. See Section 357313.20 "Diversion and Care of the Stream"

2. Prior to liner insertion, the inside surface of the pipe shall be thoroughly cleaned of all debris, soil, loose scale, and other loose material.

   Care shall be taken not to increase the amount of damage to the existing pipe due to cleaning efforts. Appropriate tools, water pressures, etc. will be used to avoid damaging existing rivets and other fasteners or joining devices, enlarging existing holes, or otherwise increase the amount of pipe deterioration.

3. Perform camera inspection of pipe in accordance with Section 330130.16, “Camera Inspection of Pipelines.”

B. In locations where it is desirable, necessary or specified to fill depressions, voids, spaces, gaps, cracks, etc. in portions of existing structures or completed WORK with high strength rigid grout, use grout materials specified herein. The substrate for grouted areas shall be damp, free of all standing water, laitance, dust, grease, loose particles, foreign particles and other contaminants or debris. Ambient and substrate temperatures for placement and curing of grout materials shall be maintained within the range recommended by the manufacturer for the minimum recommended time period. Unless otherwise specified, grout shall be placed in accordance with the manufacturer's recommendations.

C. Inspect for cracks, holes, tears, blisters, foreign inclusions, pinholes, and delamination, pinholes and tears in the liner material, plastic film, preliner and/or sliding film. Repair these defects. If the defective areas cannot be repaired, promptly replace the liner, impermeable plastic film, sliding film or preliner prior to proceeding with liner installation.

D. Before installing the liner, place a continuous impermeable plastic sheet extending from the ends of the pipe at least 20 feet upstream from the upstream end (or as space allows) and 20 feet downstream from the downstream end to capture any spillage of resin during installation. If a pulled-in-place installation method is used, place protective devices over sharp and rough edges of the ends of the pipe to prevent tearing the liner.

E. Take precautions to protect new liner, and existing pipe from damage that might result during insertion process.

F. If required by the lining plan, preheat the pipe prior to liner insertion using air, hot water or steam for the required time period.

3.04 SEQUENCE OF WORK

Perform WORK in the following sequence:

A. Divert stream flow to comply with requirements of Section 1357313.20, “Diversion and Care of the Stream.” and remove standing water that might adversely impact liner installation.

B. Clean pipe and perform pre-insertion camera inspection to comply with requirements of Sections 330130.41, “Pipe Cleaning” and 330130.16, “Camera Inspection of Pipelines.” Complete cleaning and inspection minimum of 24 hours, and maximum of 10 days prior to rehabilitation lining for CIPP.

C. Perform point repairs.

D. Install liner. Notify the ENGINEER at least 10 days prior to start of liner impregnation with resin.

E. If required, leak-test liner to comply with requirements of Section 331100, “Water Utility Distribution Piping.”

F. Perform post-insertion camera inspection to comply with Section 330130.16, “Camera Inspection of Pipelines.”

3.05 PIPELINE POINT REPAIR

A. Repair pipeline where point repairs are identified in Contract documents.

B. Pipe and repair materials shall be the same as host pipeline, unless otherwise indicated.

C. Trenching and excavation shall conform to Division 31, “Earthwork”.

D. Bypassing and Dewatering: When required by the process, bypass water flow around WORK area, in conformance with Section 1357313.20, “Diversion and Care of the Stream.”

E. Notify the ENGINEER minimum of 48 hours in advance of planned time to begin pipeline point repair work at particular locations.

F. Installation and Field Inspection: Installation of replacement pipe and/or repair work shall conform to Section 357313.10, "Outlet Pipe". All pipeline point repairs shall be inspected by the ENGINEER prior to back filling and compaction.

3.06 LINER INSTALLATION – GENERAL

A. Perform operations in strict accordance with OSHA and manufacturers' safety requirements. Particular attention is drawn to safety requirements involving entering confined spaces, work on elevated platforms, and working with pressurized equipment.

B. To ensure proper heat distribution of lining systems using heat exchange methods, and to prevent creation of flat bottoms in liner profile, take steps to isolate new liner system from inflow, infiltration, or standing water.

C. For cured-in-place pipe (CIPP) processes, designate location and notify the ENGINEER where resin impregnation of the liner fabric will take place. Unless otherwise allowed, use a vacuum impregnation process with roller system designed to uniformly distribute resin throughout tube.

D. If the drawings do not include end treatment details for one or both ends of the lined pipe, the end(s) not detailed shall be sealed with an approved epoxy, resin or caulking mixture compatible with the liner/resin system, providing a watertight seal. Liner/pipe end sealing will be in accordance with the lining plan. The liner shall be sealed to the pipe at the ends of the pipe using approved sealing/caulking materials. Unless otherwise specified or shown on the drawings, the preferred method for sealing the liner to the pipe at the ends of the pipe is to apply the sealing or caulking material between the liner and the pipe at the ends of the pipe. This sealing or caulking shall be applied immediately prior to curing the liner such that it is still flexible and uncured at the time that liner curing is initiated. Epoxy or other 2-part sealing/caulking materials shall be applied such that liner curing is commenced while the material is still within the manufacturer's stated pot life time interval (after mixing and application) when liner curing is initiated. The substrate for sealing/caulking materials shall be free of all standing water, laitance, dust, grease, loose particles, foreign particles and other contaminants or debris. Ambient and substrate temperatures for placement and curing of sealing/caulking materials shall be maintained within the range recommended by the manufacturer for the minimum recommended time period.

E. Equipment used to supply heat and pressure shall be capable of providing necessary heat and pressure required for installation condition. Heat sources shall be fitted with suitable monitors to gage temperatures and pressures.

F. Cut and trim new liner at each end to conform to ends of pipe.

G. Trim any wrinkles that form in the liner on the inside of the intake elbow. Trim each wrinkle such that it protrudes from the interior surface of the liner no more than ½". Fill any voids where the each sides of the wrinkled material have not bonded to each other with epoxy grout.

3.07 LINER INSTALLATION – CIPP

A. Install preliner tubes or sliding films prior to liner insertion only in the presence of the ENGINEER. Install liner for cured-in-place pipe in accordance with ASTM F1216.

B. Resin Impregnation: Designate the location where uncured resin in original containers will be stored and unimpregnated liner tube will be impregnated prior to installation.

1. Impregnate liner tube in accordance with ASTM F1216 by vacuum and pinch roller method unless otherwise approved by the ENGINEER. The resin impregnation equipment and process shall contain devices and procedures to assure a uniform distribution of the resin within the liner material. Liner wet-out may be performed at the site if so identified in the lining plan and conditioned on satisfying all other liner tube impregnation requirements herein.

2. The ENGINEER may inspect materials and “wet out” procedure.

3. Use resin and catalyst system compatible with requirements of this method.

C. Liner Insertion: Ensure that the installation and curing pressure in the liner exceeds both pressure due to groundwater head in areas subject to infiltration and the pressure to hold the liner tight to the host pipe interior wall.

1. Transport the impregnated liner from the wet-out facility or site to the insertion end of the pipe in a manner that will protect it from contamination and damage. Contamination or damage of the liner during any part of the process may be cause for rejection of the liner.

2. Insert impregnated tube by means of the designated installation process, and application of hydrostatic head, compressed air, steam pressure, winching force or other means sufficient to fully extend it beyond both ends of the pipe.

   a. Inflate the liner so that it is firmly in contact with the pipe interior wall.

   b. Unless otherwise indicated in the lining plan, Install liner at rate greater than three feet (1 m) per minute and less than 10 feet (3 m) per minute.

3. Mark the exterior of the manufactured tube along its entire length at regular intervals not to exceed five feet (1.5 m) as a gage to measure elongation during installation.

   a. During insertion of the resin impregnated tube into the pipeline, maximum allowable longitudinal elongation or stretch of material shall be 5 percent.

   b. Longitudinal stretch of tube shall be gauged by comparing markers on fully inserted tube to actual length of pipe being rehabilitated.

4. Insertion by Inversion: Insert wet out liner through one end of the pipe by means of the inversion process, and application of hydrostatic head, air pressure or steam pressure sufficient to fully extend it past the other end of the pipe.

    a. At insertion end of the pipe turn liner inside out and attach to standpipe, inverter or shooter so that a leakproof seal is created.

    b. Adjust inversion head or pressure to be of sufficient magnitude to cause the impregnated liner to invert the full length of the pipe and hold the tube tight to the pipe wall. The pressure during inversion shall be maintained between the minimum and maximum values recommended by the manufacturer and/or specified in the liner plan. If and any time during the insertion process, the pressures fall outside of these values, the liner must be removed.

    c. Use lubricant if required.

5. Insertion by Winching (Pulled-in-Place): Winched-in applications are acceptable provided that the liner tube and resin conform to materials and curing requirements of ASTM F1216 and this specification.

    a. Insert the wet out liner through the insertion end of the pipe, and pull through the section with a power winch and steel cable attached to the end of the liner with appropriate pulling force.

    b. Provide a monitoring device on cable to measure the pulling force. Should the pulling force exceed manufacturer recommendations and/or limits established in the lining plan, the tube shall be rejected and replaced.

    c. Install rollers at upstream and downstream ends of pipe to guide the liner into and out of the host pipe, and to guard against chafing of crowns at the entry and exit from the winch cable.

    d. Install the liner within rate limits recommended by the manufacturer and/or specified in the liner plan.

    e. Cover the pipe invert throughout section to be lined, with polyethylene foil or other suitable preliner or sliding film material to facilitate threading of the liner and reduce risk of damage to liner material.

    f. If required or specified in the lining plan, use flexible and impermeable calibration hose to inflate the tube. Unless otherwise allowed by the ENGINEER, calibration hose must be removed after the installation is completed.

        1) Dry tube or inflation hose material that enters the existing pipe that has not been previously vacuum-impregnated with resin under controlled conditions cannot be included in the structural wall of the CIPP. Nominal thickness of this material shall be deducted from any field sample thickness measured in order to verify that minimum specified wall thickness is achieved.

        2) Hose material remaining in the completed installation shall be compatible with the resin system used, bond permanently with the tube, and be translucent to facilitate post-installation inspection.

3) Hose material to be removed after curing shall be non-bondable material.

g. Introduce water, air and/or steam into liner and increase its pressure to within the specified limits. The pressure shall be sufficient to inflate and press the liner material in a tight fit against inner walls of the host pipe, producing flared ends at the upstream and downstream ends of the pipe.

D. Curing:

1. Thermal curing: After insertion of the tube is completed, provide a suitable heat source and distribution system to distribute and recirculate (if needed) hot water, air, and/or stream throughout pipe as recommended by the manufacturer and/or as described in the lining plan.

a. Equipment shall capable of continuously delivering sufficient hot water, air, and/or stream throughout lined section by means of pre-strung hose to uniformly raise the liner temperature to the maximum end of the temperature range required to effect cure of resin.

b. The temperature range shall be determined based on cure-time versus temperature data and other characteristics for the resin/catalyst system employed.

c. Fit the heat source and exhaust or return piping with suitable continuous monitoring thermocouples to gage temperature of the incoming and outgoing curing medium.

d. The temperature of the curing medium shall meet established curing requirements of the resin system as measured at the heat source inflow and outflow return lines to and from the liner.

e. Place additional continuous monitoring thermocouples between the impregnated liner material tube and the pipe invert at pipe ends.

f. The curing medium temperature as measured at the heat source and exhaust or return lines (where they connect to the liner) during cure period shall be within the established temperature range specified by the manufacturer and/or the approved lining plan.

g. The temperature and pressure of all monitoring instruments shall be continuously recorded or recorded at minimum intervals of no more than 5 minutes. The monitoring records shall be submitted to the ENGINEER no more than 48 hours after completion of the liner curing process.

h. Take care during the elevated curing temperature period so as not to over stress liner materials.

i. Initial cure shall be deemed to be complete when inspection of exposed portions of liner indicate that they appear to be hard and sound and the curing temperature has been achieved and held for the time required to achieve full-cure exothermic reaction as defined by the resin manufacturer

and established based on resin cure-time versus temperature data, specified in the lining plan.

1) The cure temperature shall be held for the initial full cure period during which time distribution and control of the curing medium shall continue.

2) Curing requirements of the CIPP resin/liner system shall consider host pipe material, resin/catalyst system, ambient temperature, moisture level, and thermal conductivity of the pipe and soil.

j. Cool-Down: Cool hardened liner to a temperature below 100 degrees F (38 degrees C) before relieving pressure in the pipe. Follow the cool-down procedures (cool-down time period, maximum rate of curing medium temperature drop, etc.) recommended by the manufacturer and/or specified in the lining plan.

1) Cool-down may be accomplished by controlled and limited introduction of cooler water or air into lined pipe to replace water or steam and water being drained.

2) Slowly drain water from a small hole made in downstream end of liner.

3) Take care in release of static water head or air pressure to prevent development of sub-atmospheric pipe pressures that could damage the pipe or newly installed lining.

4) Complete the cool-down period prior to opening the downstream plug and returning normal flow back into the lined pipe.

2. Ultraviolet Light Curing:

a. The light source or light train shall be equipped with a camera on one, or both, ends. The CONTRACTOR shall make a video recording of the liner prior to commencement of, and during, the curing process.

b. UV cured CIPP shall be cured in accordance with applicable requirements of ASTM F2019, Sections 6.6 and 6.7, subject to the following modifications:

1) The UV curing lamps shall provide light within the frequency and wave length and of sufficient intensity required for full resin curing for the proposed liner thickness and size.

2.) Measures shall be taken to assure that the liner for both legs of the inlet elbow will be fully cured.

3) The internal temperature and pressure shall be continuously recorded or recorded at minimum intervals of no more than 5 minutes. The beginning and ending time of the curing process shall be recorded along with the rate of travel for the UV light assembly and any periods during which the light assembly is stationary. The monitoring records, including the pre-curing and curing video shall be submitted to the ENGINEER no more than 48 hours after completion of the liner curing process.

E. Both ends of the cured liner shall be cut flush at the inlet and outlet ends of the pipe and sealed as shown on the drawings and/or specified herein.

3.08 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. Inspection: After completion of the liner insertion, and finish work, pipe shall be camera inspected in color and digitally stored in a common format, as specified in Section 330130.16, "Camera Inspection of Pipelines." Provide a digital copy of the file to the ENGINEER.

1. Except in locations specifically identified in the contract documents where wrinkles are expected, (e.g. around bends or other offsets), wrinkles in finished liner pipe which cause backwater of one inch (25 mm) or more, or reduce the hydraulic capacity of the pipe (wrinkles which exceed 5 percent of pipe diameter), or, in the opinion of the ENGINEER, reduce the structural capability of the liner and/or pipe are unacceptable.

    a. Remove and repair at no additional cost.

3.09 CLEAN-UP

A. Keep premises free from accumulations of waste materials, rubbish and other debris resulting from the WORK.

B. Remove waste materials, rubbish, and debris from and about the premises.

C. Remove tools, construction equipment and machinery, and surplus materials.

D. Restore to the original condition portions of site not designated for alterations by the Contract documents.

End of Section

SECTION 357313.20

DIVERSION AND CARE OF THE STREAM DURING CONSTRUCTION AND REMOVAL OF WATER

DESCRIPTION PAGE

SECTION 357313.20

DIVERSION AND CARE OF THE STREAM DURING CONSTRUCTION AND REMOVAL OF WATER

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all materials and equipment for, and construct and maintain all necessary coffer dams, channels, flumes, pumps, drains, sumps, and/or other temporary diversion and protective works necessary for diversion and care of the stream during construction.

1.02 WORK INCLUDED

A. Specific Work covered by this section includes, but is not limited to diverting the stream during intake structure and gate repair, outlet pipe extension, outlet diaphragm drain construction and outlet pipe lining such that these items of the WORK can be performed in the dry. The entire work area shall be maintained free from standing or flowing water, non-stop, for any period of time during which there is risk of adversely affecting any portion of the existing dam, previously placed backfill, other previously completed portions of the WORK, or any on-going work efforts.

1.03 SUBMITTALS

A. The ENGINEER'S plan for Diversion and Care of the Stream is presented in paragraph 1.05 of this section. A written plan shall be provided by the CONTRACTOR for diversion and care of the stream during construction which shall include the specific methods, equipment materials, etc which will be used during the diversion efforts. It shall be the sole responsibility of the CONTRACTOR to adopt a safe and orderly method of diverting the stream during construction, in accordance with the Engineer's Diversion and Care of the Stream Plan, subject to the approval of the ENGINEER. At least 10 days prior to initiation of any portion of the WORK which requires diversion of the stream, the CONTRACTOR shall submit to the ENGINEER, for approval, a water control plan showing the proposed method for the diversion and care of the stream during construction. This plan shall include pump specifications; number of pumps; location and length of discharge lines; pump discharge locations; size, location and anticipated period of use for coffer dams. No work requiring or involved with stream diversion shall be initiated prior to the ENGINEER's approval. The plan may be placed in operation upon approval, but nothing in this paragraph shall relieve the CONTRACTOR from full responsibility for the adequacy of the diversion and protective works.

1.05 ENGINEER'S DIVERSION AND CARE OF THE STREAM PLAN AND RELATED INFORMATION

A. Stream Flow Estimates: There are no existing stream flow records available for Bonita Creek. The flow in Bonita Creek at the dam can vary widely on a seasonal basis. During late summer and fall the base flow is typically between 0.25 and 0.50 cubic feet/second but the flow is highly dependent on recent and current climatic conditions at the time as well as the amount of water diverted from the drainage basin by the Town of Cedaredge. The CONTRACTOR's water control plan shall include provisions for the possibility of a significant increase in stream flow due to precipitation events and provide adequate protective facilities accordingly.

B. Engineer's Diversion and Control of the Stream Plan:

1. There will be three periods during which the stream flow will need to be diverted around the outlet works:

a. As part of the rehabilitation of the downstream portion of the outlet conduit, a portion of the existing outlet pipe will be removed and a new pipe extension will be installed. The removal of the existing pipe and installation of the extension will be planned such that the WORK can be performed in a single day. Prior to commencing the WORK, all equipment, materials, pipe, couplings, pipe supports, etc, will be on site and staged in a manner to provide for the quickest possible execution of the WORK. This WORK will be commenced as early in the day as feasible and will be completed during that same day. Stream diversion will continue uninterrupted until the pipe extension is fully connected to the existing pipe, is adequately supported and flow through the outlet will not adversely impact downstream work areas. As directed or approved by the ENGINEER, the outlet pipe extension may be longer than shown on the drawings (in order to provide temporary protection of the work areas) and later be cut shorter in accordance with the requirements of the drawings.

b. Installation of the outlet liner. The outlet lining will be planned such that the WORK can be performed in a single day, including initial cleaning and video inspection. Prior to commencing the WORK, all equipment, materials, liners, resin, liner saturating equipment, etc, will be on site and staged in a manner to provide for the quickest possible execution of the WORK. This WORK will be commenced as early in the day as feasible and will be completed during that same day. Stream diversion will continue uninterrupted until the liner is installed and fully cured and flow through the outlet will not adversely impact the liner or any other portion of the WORK.

c. Repair and maintenance of the intake gate. This WORK includes modifications to the intake structure, installation of the protective sleeve for the outlet liner and installation of new gate and gate frame parts. This work will be planned such that the WORK can be performed in a single day. Prior to commencing the WORK, all equipment, materials, gate and frame parts, etc, will be on site and staged in a manner to provide for the quickest possible execution of the WORK. This WORK will be commenced as early in the day as feasible and will be completed during that same day. Stream diversion will continue uninterrupted until the intake structure and gate modifications are fully complete.

2. During each of these periods, the stream flow will be diverted around the WORK area by pumping. Each day's WORK will be performed to coincide with weather forecasts. No work will be performed during periods when the weather forecast indicates a significant chance of significant precipitation during the day, as determined by the ENGINEER.

3. Pumps will be sized to be capable of passing at least 0.5 cubic feet per second over the dam or 1.25 times the maximum daily stream flow at the time, subject to the approval of the ENGINEER. A back-up pump shall be immediately available.

4. A cofferdam will be required to prevent flow into the outlet pipe and provide a basin for pumps to draw from. The cofferdams will be constructed such that its top will extend to at approximately 1 foot above the top of the pipe at the intake structure. Since the cofferdam may be needed at 3 separate times, it shall be constructed such as to facilitate breaching and re-establishing.

5. Reservoir Levels During Construction: The reservoir shall not store water above the outlet pipe during any portion of the WORK.

6. The CONTRACTOR'S water control plan shall include contingency plans in the event of failure of the diversion plan or un-anticipated stream flow amounts which exceed the capacity of the diversion works.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall be responsible for and shall repair at his expense any damage to the embankment, structures, or any other part of the facilities caused failure of any part of the diversion and protective works.

B. Except as otherwise provided herein, the CONTRACTOR shall at all times pass the flow of the stream and shall not interrupt nor interfere with the natural flow of the stream through the dam site for any purpose without written approval of the ENGINEER and the OWNER.

C. The CONTRACTOR shall be solely responsible for providing water for construction purposes. The CONTRACTOR may use any inflow to the reservoir basin belonging to the OWNER subject to his water rights.

3.02 DIVERSION AND DEWATERING METHODS

A. For the purpose of stream diversion, the CONTRACTOR will be permitted to use any method, as approved by the ENGINEER, which may include coffer dams, pumps, etc. Intakes for diversion works will be limited to the immediate location of the outlet intake structure unless prior written authorization otherwise is obtained from the Forest Service and the ENGINEER.

B. The CONTRACTOR shall keep the outlet works free of debris at all times. The water control plan must take into account the requirements and considerations for stream diversion through the outlet works.

3.03 CLOSURE OF THE OUTLET WORKS

A. Prior to termination of diversion efforts and use of the outlet works for stream flow releases all work on the intake structure, upstream gate, outlet pipe extension, diaphragm drain, backfilling and outlet pipe lining shall be complete.

3.04 DECOMMISSIONING AND REMOVAL OF TEMPORARY FEATURES

A. After having served their purpose, all coffer dams, diversion channels, sumps and other temporary diversion and protective works shall be removed from the stream channel, or leveled to give a sightly appearance, so as not to interfere in any way with the operation or usefulness of the reservoir, and in a manner approved by the ENGINEER. All coffer dams, diversion channels and other temporary diversion and protective works constructed upstream from the dam, and not a part of the permanent dam embankment shall be removed or leveled and graded to the extent required to prevent obstruction in any degree whatsoever of the flow of water to the outlet works. Clean waste material from removal of temporary features shall be disposed of in the designated borrow area outside of the roadway traveled surface, as directed by the ENGINEER. The CONTRACTOR shall shape the final surface contours in the designated borrow area to conform to the roadway and bank and surrounding terrain and to provide un-obstructed surface drainage without steep drainage paths or pools.as directed by the ENGINEER.

B. After having served their purpose, all material furnished by the CONTRACTOR and placed for temporary diversion and protection shall remain the property of the CONTRACTOR and shall be removed from the site.

End of Section